nationalgrid

CONSULTATION DOCUMENT

GB-ECM 09

For the charging arrangements associated with SQSS design variations based on customer requests

November

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1. Executive Summary

This consultation document sets out National Grid's proposals for modifying the Transmission Network Use of System (TNUoS) charging methodology to provide a mechanism by which the capital savings associated with SQSS connection design variations arising from customer requests are passed through to customers.

The document has been published on the National Grid charging website at the following address:

www.nationalgrid.com/uk/electricity/charges

2. Introduction

As the transmission licensee authorised to co-ordinate and direct the flow of electricity onto and over the transmission system within Great Britain, National Grid has duties under the Electricity Act to develop and maintain an efficient, co-ordinated and economical transmission system and to facilitate competition in generation and supply.

Along with these high level duties, National Grid is obliged under its transmission licence:

(i) to keep the Use of System Charging Methodology at all times under review;

(ii) to make such modifications of the Use of System Charging Methodology as may be requisite for the purpose of better achieving the relevant objectives, which are:

a) to facilitate effective competition in generation and supply;

b) to reflect, as far as reasonably practicable, the costs incurred by transmission licensees in their transmission businesses;

c) in so far as is consistent with a) and b) above, as far as reasonably practicable, take account of the developments in transmission licensees' transmission businesses.

In addition to the relevant objectives above, the transmission licence also prohibits National Grid from discriminating against any user or class of users unless such different treatment reasonably reflects differences in the costs of providing a service.

Before making a modification to the Use of System Charging Methodology, National Grid is also required by the transmission licence to consult with CUSC Users on the proposed modification and allow them a period of not less than 28 days within which to make written representations.

The purpose of this document is to set out for consultation National Grid's formal proposal to modify the Use of System Charging Methodology to allow the capital savings associated with connection design variations arising from customer requests to be passed through to customers.

3. Background

The GB Security and Quality of Supply Standard (SQSS) includes criteria for variations to connection designs. The criteria allow generators or demand customers to choose a standard of connection which is higher or lower than the specified standard (e.g. a single circuit connection rather than a double circuit connection), provided this does not, either immediately or in the foreseeable future:

(i) reduce the security of the main interconnected transmission system (MITS) below the minimum planning criteria specified in the standard;

(ii) result in additional investment or operational costs to any particular customer or overall, or a reduction in the security and quality of supply of the affected customers' connections to below the planning criteria in the standard, unless specific agreements are reached with affected customers; or

(iii) compromise the Transmission Licensees' (TL) ability to meet other statutory or licence obligations.

For the example of a single circuit connection to a generator, in order to comply with the SQSS the generator would have to accept uncompensated access restrictions in the event that the single circuit is unavailable as a result of a fault outage or maintenance outage in order to meet these conditions. Without these arrangements, other customers would be exposed to additional operational (CAP 48 compensation) costs as a result of the single circuit connection and condition (ii) above would not be met.

The criteria for variations to connection designs also state that should system conditions subsequently change, for example due to the proposed connection of a new customer, such that either immediately or in the foreseeable future, the conditions described above are no longer satisfied, then alternative arrangements and/or agreements must be put in place such that the standard continues to be satisfied.

This represents a significant risk to customers that choose single circuit design variation connections, since the connection may be modified to a double circuit connection in the future for reasons completely beyond their control.

Prior to the implementation of the plugs 'shallow' connection charging methodology on 1 April 2004, many of the assets associated with generation connection were classified as 'connection'. Consequently, a customer choosing a lower standard of connection design had the capital savings directly reflected in its connection charges. The customer was able to compare the savings with the loss of revenue caused by the associated access restrictions and choose the most efficient connection design.

Following the implementation of the plugs methodology, some assets for connecting generation have been reclassified as 'infrastructure' and since infrastructure assets are funded from use of system rather than connection charges, the savings are no longer passed through directly to the generator.

4. GB ECM06 – The previous Charging Amendment

In November 2006 National Grid submitted a Charging Modification to address this issue following two stages of industry consultation with the publication of a Pre-consultation and a Consultation document[1]. The final proposal required a modification to the Use of System Charging Methodology to provide a dual TNUoS discount mechanism to reflect the capital savings associated with single circuit design variation connection designs. The vast industry consensus supported the principle of this approach, rejecting both a change to the SQSS or a return to a deeper connection charging boundary.

The proposal consisted of a substation discount and circuit discount for users with single circuit design variation connections.

The substation discount intended to reflect the savings associated with the reduced substation asset requirements with a £/kW discount to the TNUoS zonal tariff. The discounts were derived from generic cost analysis that was performed using data submitted by the three Transmission Licensees to compare the substation costs associated with single and double circuit designs. Three tiered discount levels, determined by connection voltage, were proposed so as to provide a generic mechanism that closely represented capital savings. The £/kW tariff discount approach would prevent the possibility of inappropriate negative generation charges from small generators in positive TNUoS zones.

The circuit discount was a nodal specific £/kW tariff reduction which intended to reflect the cost savings of a single overhead line or cable as compared to a double. The discount was derived from the calculation of the Locational Security Factor and was therefore consistent with the Charging Methodology. The circuit discount was derived from the Expansion Constant and Expansion Factors which are calculated from data provided by the three Transmission Licensees. The discount reflected the full cost savings associated with the second circuit to the User.

Several respondents stated that the discounts may not be wholly consistent with the Charging Methodology and did not agree that the principle of providing the full cost savings was sufficient justification for this inconsistency.

Several other respondents stated that the discounts were not sufficiently high to influence generator decisions.

As consistent with the SQSS, it was reiterated that a User choosing a design variation connection accepts that risk that in the future, another party could make an application to connect to the same node with a compliant connection design. Consequently, the original User would also have to accept the same level of security and upon construction of the second circuit would no longer be eligible for the single circuit discount.

5. The Authority's Veto Decision

In January 2007, the Authority vetoed the proposals made within GB ECM06. It was stated that the principle of applying a TNUoS tariff discount for Users requesting a less secure single circuit connection was sound but significant issues remained concerning the cost reflectivity of the proposed discount levels, in particular relating

[1] www.nationalgrid.com/uk/Electricity/Charges/modifications/uscmc/

to the circuit discount. This consultation aims to address those issues with an alternative charging modification.

Summary of specific issues raised by the Authority
Although it was identified that the proposed discount calculation was attempting to introduce clarity and standardisation to the area, a risk was expressed that a proportion of generators may not receive the full cost saving to which they would be eligible, with a site specific discount. Consequently, it was suggested that a standardised discount will not promote competition to the same extent as one calculated by the actual savings for each connection.

It was stated that the discount must be sufficiently large as to affect the generators' behaviours without providing a perverse incentive. The Authority was concerned that the original proposals did not sufficiently reflect the capital costs saved and would consequently not provide the correct signals to the generators. This would not facilitate effective competition. There were several concerns on how both the discounts were calculated.

It was recognised that there was industry opinion to both extremes as to whether the proposed discount was sufficiently cost reflective. For example one respondent compared the discount to an example from the recent Transmission Price Control Review and found the discount to be significantly conservative against the actual costs in this particular instance. The Authority were of the view that this may lead to over investment in the transmission network. National Grid was asked to address the representations of respondents to the Impact Assessment.

Specific industry issues raised from the Impact Assessment
A respondent stated that the original proposals failed to take into account the full cost savings associated with several common connection configurations. The first example is single circuit teed connections, which make up the majority of a sample of 30 connections in the respondent's area, the implications of which were not fully considered. The other type, which consisted of a third of the sample, were described as 'partially firm' connections. These connections have multiple (rather than single) circuit connections, but the aggregate capacity of these circuits is limited such that the generator is not able to export up to its Transmission Entry Capacity (TEC) following the loss of a single circuit.

The same respondent stated that the discount was too small as it did not reflect the actual capital data of projects. It was suggested that a more appropriate approach would be to calculate case-by-case single circuit cost savings and use these as a basis for a site specific discount.

Two respondents expressed that the discount was too large. Firstly because the entire cost of a second circuit was discounted although the use of an average GB locational security factor means that the base charge for a compliant, double circuit connection is based upon 1.8 (rather than 2) circuits.

A respondent stated that the original substation discount was inconsistent with the charging methodology. The non-locational residual charge was apportioned on a flat £/kW basis across generation and demand to the ratio 27:73, and therefore this approach would introduce a cross subsidy. In addition the proposed discount varied with connection voltage whereas the residual does not. Another respondent said that all substation cost savings are site specific and unique and so a generic discount should not be used.

6. Proposed modification/ solution

6.1. Description of proposed modification

National Grid is proposing to modify Chapter 2: Derivation of the Transmission Network Use of System Tariff, of the Statement of the Use of System Charging Methodology to include a mechanism by which charges can be adjusted by application of a discount to TNUoS tariffs to reflect the capital efficiencies associated with single circuit design variation connections. The discount is associated with savings in circuit assets. The proposed Statement of Use of System Charging Methodology drafting for this modification is included in Appendix 1.

Design variation circuit discount
The circuit discount is a nodal specific £/kW tariff reduction from the relevant zonal TNUoS charge. The discount reflects the capital efficiencies from constructing a single overhead line or cable as compared to a double. The circuit discount can be expressed as:

Circuit discount (£/kW) = applicable circuit length x expansion factor x expansion constant x 0.001 x 0.8

All SQSS single circuit design variation connections, which are not charged as Connection Assets, that have arisen from a customer request will be eligible for the discount.

Applicable circuit lengths
A **spur circuit** is a radial circuit that has a single connection to the remainder of the MITS. For the purposes of this definition, a substation which is compliant with the deterministic criteria of the SQSS is considered to represent the MITS. For such circuits the applicable circuit length is the route length directly to the first compliant substation.

A tee circuit can be radial or interconnected. A **radial tee** is connected to the remainder of the MITS via a single compliant substation. The applicable circuit length for a radial tee is the route length directly to the compliant substation and will typically consist of two legs of the tee circuit.

An **interconnected tee** has two transmission paths onto the MITS via compliant substations. The applicable circuit length for a tee is the total circuit length of the entire tee between the generation connection substation and the two compliant substations.

A number of illustrative examples for applicable circuit lengths for single circuit design variations are shown within Appendix 2 for clarification.

Circuit 'partial redundancy' connection discount
A circuit partial redundancy connection has a multiple circuit connection, whose circuit export capacity is not sufficient to allow full export during a single circuit outage. For such connections a discount is available according to:

= [locational security factor - (route transmission capacity/ TEC)] applicable circuit length x expansion factor x expansion constant x 0.001

A negative discount that would result in an increase to tariffs will not be applied. All SQSS design variation connections that have arisen from a customer request and that have a restriction upon export capacity following the outage of one of its connection circuits, which are not be charged as Connection Assets, will be eligible for the discount.

Design Variation substation discount
There is no substation / non locational discount within this proposal.

Offshore connections
National Grid believes that connections which are compliant with the offshore SQSS are similar to onshore design variation connections and therefore offshore connections should be subject to both the single circuit and circuit partial redundancy discounts proposed.

6.2. Justification for proposed modification

National Grid believes that the cost savings associated with design variation connections should be reflected as a discount to users' charges, but that this must not undermine the use of system charging methodology as a whole or provide perverse locational signals.

Users that choose generation connection design variations lead the Transmission Owners to construct fewer circuit and substation assets, and these two categories of asset are considered below.

When deciding whether or not to choose a design variation connection, users will want to compare the use of system charge discount with the lost opportunity associated with the access restrictions that this will cause. An accurate reflection of the cost savings in the associated discount should lead the user to reach the economic and efficient decision, although it is important that the signal should not inappropriately effect such decisions as determining the location of a power station site.

Substation asset discount
The costs associated with substation assets are recovered from the residual element of the use of system charge, which is a flat £/kW charge calculated to ensure that 27% of revenue is recovered from generation users, and 73% from demand users. The residual element is applied to all regardless of the extent and cost of the substation assets required to connect them.

National Grid has considered the following options for the reflection of the substation asset savings associated with generation design variation connections in users' charges:

1. **Project specific discount**
   This would involve the use of a project specific discount from the residual tariff. The discount would be calculated with a project specific analysis of the difference between the capital cost of the design variation connection and the capital cost of a connection design that would meet the requirements of the deterministic generation connection criteria contained in the SQSS.
   This capital cost would then be converted into an annual charge discount with the use of the annuity and overhead factors contained in the use of system charging methodology.

2. **Generic discount**

This would involve the use of generic (£/kW) discounts from the residual generation tariff for each connection voltage level. The generic discounts have been determined from analysis of the costs of single and double circuit connections performed by each of the Transmission Licensees, and are shown in the table below.

Connection Voltage (kV)	**Discount (£/kW)**
33	3.12
132	1.05
275 or 400	0.49

To provide transparency for users, the discounts would be published in the use of system charging statement. In order to rationalise the number of discounts calculated and published, this option would limit the substation asset discount to single circuit design variation connections only. There is a significant number of potential design variations and if a generic discount was to be developed for each, it would tend towards a specific approach.

The discounts would be reviewed each price control and subject to an annual RPI increase.

3. **No discount**
   This would involve no discount for the substation asset savings associated with design variation connections being reflected in users' charges.

A project specific discount would provide an economic signal that precisely reflects the cost savings associated with all design variation generation connections, which should lead users to reach the economic and efficient decision.

A generic discount would also provide an economic signal, but this would be based on single circuit connections only, and on average rather than specific costs. Limiting the discount to single circuit connections may mean that other types of connection (e.g. limited substation switching arrangements), that would otherwise represent the economic and efficient substation design, are not pursued by users. The average nature of the discount may also mean that the efficient and economic transmission design is not achieved in all cases (e.g. when substation cost savings are above average).

The project specific discount would be calculated by the relevant Transmission Licensee and therefore would not be available to users in advance, but instead is something that would be determined as part of the connection offer process. This lack of predictability regarding the level of discount available may lead users to choose a compliant connection, which may not be the most economic and efficient design.

The generic discount would be published in the use of system charging statement and therefore would provide predictability and certainty to all users in advance, subject to an understanding of the route length required.

Due to the 27%/73% split, a project specific or generic discount is likely to lead to a substation discount which is not consistent with the substation charge within the residual. This has the potential to raise two issues:

- A user choosing a single circuit connection will cause fewer assets to be installed, but this cost reduction will not be shared with other users whose charges will increase to fund the use of system discount instead of the assets.
  National Grid does not believe that this issue should prevent the implementation of a project specific or generic discount. The user that chooses a design variation connection (rather than other users) has to deal with the full consequences of this decision with access restrictions and therefore it appears appropriate that they (rather than other users) should receive the associated cost savings.

- The project specific or generic discount may interact with the use of system locational signal, leading to an uneconomic level of transmission investment overall.

  National Grid is concerned that the implementation of a project specific or generic discount for substation assets may interact with a user's decision regarding the siting of a power station. The inconsistency between charge and discount may lead users to choose to site power stations with design variation connections further from demand centres which would provide a lower charge but would cause increased investment in the transmission system.

  This point is demonstrated by considering the size of the substation discounts against the unadjusted locational element of the use of system charge. For example, a £3.12/kW generic discount for a single circuit connection at 33kV is equivalent to the charge associated with a single circuit 132kV overhead line 113km further from the demand centre. A single circuit connection 113km away from the demand centre would clearly trigger more investment overall than a double circuit connection close to the demand centre but the implementation of the generic discount would mean that both users would be liable to pay the same charge.

National Grid has considered the options and arguments presented above, and concluded that **no substation asset discount** should be made available to users.

This decision is based on concerns about the interaction between the signal provided to consider design variation connections and the signal provided regarding power station location. National Grid believes that if these two decisions are considered in isolation, a fully cost reflective signal to consider design variation connections would be appropriate, however, National Grid is concerned that users will consider both signals and that overall this may lead to a decision which causes an increase in the level of transmission investment required.

Circuit asset discount
The use of system charging methodology provides an economic signal with respect to the cost of circuit assets, the locational element. This signal is derived from the transport model, which establishes the marginal cost of transmission reinforcement at each node in the network in MWkms.

In order to convert these costs into £/kW figures, an expansion constant (in £/MWkm) based on 400kV overhead lines and expansion factors for different technologies and voltage levels (e.g. 400kV cables; 132kV overhead lines, etc.) are required. The expansion constant and expansion factors are based on an average from a range of overhead line and cable types, weighted by recent use.

For cables and overhead lines at 132kV, the expansion factor applied currently takes into account the expected proportion of the overhead line and cable that is to be uprated to 275kV or 400kV. This is achieved by calculating a weighted average of the cost of transmission at both voltages.

The use of system charging methodology assumes that a reinforcement to accommodate an additional MWkm (the circuit assets required to transport 1MW over 1km) is feasible, when in reality this is not possible due to the "lumpy" nature of transmission reinforcements. This means that users are charged based on their utilisation of transmission capacity and not what is installed. For example, if a new double circuit 400kV overhead line with a capacity of 5400MW is constructed to connect a new power station of 1320MW to the remainder of the main interconnected transmission system, the power station will pay a charge based on 1320MW and not 5400MW.

The locational element of the use of system charge also includes a locational security factor which is used to reflect the cost of providing secure connections which meet the SQSS requirements. The locational security factor is calculated using a secure loadflow (Seculf) program. The seculf program uses the same nodal and circuit data as the transport model, and calculates the marginal cost of transmission reinforcement to provide a secure connection at each node in the network in MWkms when the contingencies specified in the SQSS are taken into account. The ratio of secured MWkm (from seculf) and intact MWkm (from the transport model) is established for each node, and a GB average figure is established using a "least squares fit" methodology. The GB average for 2007/08 is 1.8.

National Grid has considered the following options for the reflection of the circuit asset savings associated with generation design variation connections in users' charges:

1. **Project specific discount**
   This would involve the use of a project specific discount from the locational tariff. The discount would be calculated with a project specific analysis of the difference between the capital cost of the design variation connection and the capital cost of a connection design that would meet the requirements of the deterministic generation connection criteria contained in the SQSS.

   This capital cost would then be converted into an annual tariff discount with the use of the annuity and overhead factors contained in the use of system charging methodology.

2. **Nodal specific security factor for design variation connections**
   This would involve the calculation of the nodal security factor for those users that choose a design variation connection, and the use of that security factor to establish a discount from the use of system charge.
   National Grid has considered a number of sub-options which would achieve this:

   - Use of the seculf model
     As described above, the seculf model is used to calculate the charge for secure connections and therefore is capable of calculating discounts associated with design variation connections that are consistent with the methodology.

     Since the GB locational security factor is an average, approximately half of the nodes on the transmission system would actually have a higher security factor than the average, and therefore when the nodal specific security factor is calculated it may still be higher than the average of 1.8. In order to overcome this problem, the seculf program would have to be run for the single circuit design variation connection and run again for a connection which meets the requirements of the SQSS, with the difference between the two results being used to establish a discount.

- Use of a generic formula
  This would involve developing a generic formula that would allow users to calculate the applicable discount without running the seculf model. A comparison of the results from the generic formula and the seculf model for an interconnected tee connection is provided in Appendix 3. The seculf calculation has been illustrated for a very simple network in the interests of clarity.

As with the project specific substation discount, a project specific circuit discount would provide an economic signal that precisely reflects the cost savings associated with all design variation generation connections, which should lead users (in isolation) to reach the economic and efficient decision.

The project specific discount would be calculated by the relevant Transmission Licensee and therefore would not be available to users in advance, but instead is something that would be determined as part of the connection offer process. This lack of predictability and transparency regarding the level of discount available may lead users to choose a compliant connection, which may not be the most economic and efficient design.

The nodal specific security factor calculated using seculf would require National Grid to model the design variation connection and the alternative SQSS compliant connection in the seculf program. As with the project specific discount, this lack of predictability regarding the level of discount available may lead users to choose a compliant connection, which may not be the most economic and efficient design.

An external version of the seculf model could be developed to allow users to calculate the nodal specific security factor associated with various connection designs however, this is likely to involve significant costs.

The nodal specific security factor calculated using a generic formula allows users to calculate the discount associated with design variation connections and therefore would provide predictability and certainty to all users in advance.

The project specific discount is unlikely to be consistent with the locational charge for two main reasons:

- As described above, the use of system charge is based on the utilisation of capacity whereas a project specific discount would be calculated based on the assets installed (or in this case avoided). For example, if a 100MW generator was connected with a standard 162MW single circuit 132kV overhead line, instead of a standard 324MW double circuit 132kV overhead line, their charge would be based on 100MW, whereas their project specific discount would be based on (324MW – 162MW =) 162MW.
- Again as described above, the use of system charge is based on an expansion constant and expansion factors that are themselves based on a weighted average of the different line types at that voltage level. If the overhead line used

to connect the user with the design variation connection is higher than the average, the project specific discount will be higher than the charge.
In addition, the expansion factors take future circuit uprating plans into account and are calculated as a weighted average. This means that a charge based on the average expansion factor will not be consistent with a cost calculated explicitly.

This means that the nodal specific security factor is unlikely to reflect the full cost difference between a single circuit design variation connection and an SQSS compliant connection through to users. Without this, users may choose an SQSS compliant connection where a single circuit design variation connection would have been the most economic and efficient solution.

As with the substation asset discount, National Grid is concerned with a project specific discount which is not consistent with the charge. This concern is illustrated in Appendix 4, which demonstrates the effect of a discount which is higher than the charge on the overall signal that users are exposed to. This shows that a higher discount than charge incentivises users that choose a single circuit design variation connection to connect as far from the main interconnected transmission system as possible, causing increased investment costs for the Transmission Licensees.

National Grid has considered the options and arguments presented above, and concluded that a TNUoS discount derived from a **nodal specific security factor calculated using a generic formula** should be made available to users.

Appendix 3 shows the derivation of the applicable circuit length for “tee” connections, used within the generic formula approach.

This decision is based on providing a balance between the need to give a cost reflective signal to users to consider single circuit design variation connections and concerns about the interaction between this signal and the signal currently provided regarding power station location. As with the substation discount, National Grid believes that if these two decisions are considered in isolation, a fully cost reflective signal to consider design variation connections would be appropriate, however, National Grid is concerned that users will consider both signals and that overall this may lead to a decision which causes an increase in the level of transmission investment required.

The decision to implement a nodal security factor based on a transparent and generic formula is based on the provision of a reasonably accurate methodology which allows users to easily reproduce the applicable design variation discount.

Appendix 5 shows the impact of each of the options presented on typical single circuit connections.

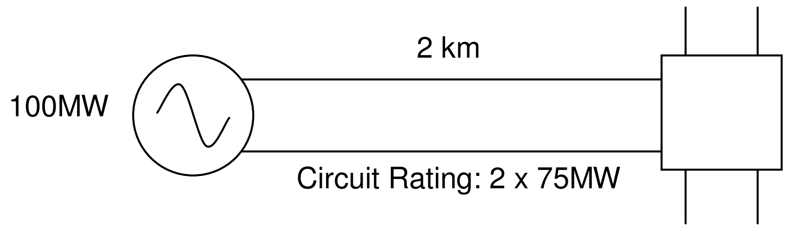
Other Issues
There are a number of other areas that require attention if a nodal specific security factor is to be used as the basis of use of system charge discounts for design variation connections. These issues are addressed in turn below. It should be noted that the use of project specific substation and circuit discounts would mean these changes are not necessary.

<u>Circuit Partial Redundancy Connections</u>
A subset of generation design variation connections have multiple circuit connections whose circuit export capacity is not sufficient to allow full export during a single circuit

outage. Such connections will have commercial arrangements such that their output during such outages will not exceed the physical limit of the remaining circuit or circuits. Similar to single circuit connections, such arrangements have led to avoidance of additional transmission assets and therefore a discount from use of system charges is also applicable. National Grid has considered two options for reflecting the savings associated with partial redundancy connections to users:

1. **A project specific design variation discount**
   A project specific design variation discount would also be able to provide a signal to all types of partial redundancy connections, as previously described for single circuit discounts above. All types of connections that have access restrictions during outage conditions would have the capital cost savings reflected as an annual discount using the annuity and overhead factors contained in the use of system charging methodology.

2. **A generic formula**
   As described above, the seculf model is used to calculate the appropriate cost of providing secure connections. The seculf program calculates the marginal cost of transmission reinforcement required to provide a secure connection. The program ignores the capacity of existing circuits and therefore cannot be used to reflect savings associated with partial redundancy connections. However, the seculf principle can be extended to cover partial redundancy connections with a simple formula.
   The formula is best illustrated with an example as shown in the diagram below:



If we consider the example of a 100MW generator connected to the remainder of the MITS with two circuits of length 2km with a rating of 75MW each.
The unadjusted tariff for this connection is based upon a marginal cost of 360MWkms (2km*100MW*Locational Security Factor). This does not take into account for the export limit of 75MW that would be applied to the generator if either connection circuit were unavailable. The actual marginal cost in such a case is 300MWkm (2km*75MW+2km*75MW) if capacity is taken into account. In other words this connection has a nodal security factor of 1.5 rather than the Locational Security Factor average of 1.8. The differential between these values can be used to calculate a partial redundancy discount to reflect the cost saving. The discount in marginal km terms can be expressed as:
Locational Security Factor – [Route capacity/ Total Generators TEC] * applicable circuit length * Expansion Factor
A User's TNUoS charge is a function of the Locational Security Factor (currently 1.8), that infers the 'average' connection has an additional 80% redundancy to achieve post fault security. This formula would only provide a discount to partially firm connections with capacities below this level.
For multiple generator connections, export constraints are pro-rataed therefore the discount is calculated by adding all TEC and modelling as a single unit.

A project specific design variation discount would provide an economic signal that precisely reflects the cost savings associated with all design variation generation connections, which should lead users to reach the economic and efficient decision.

The project specific discount would be calculated by the relevant Transmission Licensee and therefore would not be available to users in advance or transparent to them, but instead is something that would be determined as part of the connection offer process. This lack of predictability regarding the level of discount available may lead users to choose a compliant connection, which may not be the most economic and efficient design.

The generic formula allows users to calculate the discount associated with partial redundancy design variation connections and therefore would provide predictability and certainty to all users in advance.

As described for the circuit asset discount above, the project specific discount is unlikely to be consistent with the charge because the charge is based on utilisation whereas the discount is based on assets, and the charge is based on an average rather than specific expansion constant and expansion factors.

This means that the discount calculated with the generic formula is unlikely to reflect the full cost difference between a partial redundancy design variation connection and an SQSS compliant connection through to users. Without this, users may choose an SQSS compliant connection where a partial redundancy design variation connection would have been the most economic and efficient solution.

The generic formula exposes all partial redundancy design variation users to both the cost and benefit of the additional redundancy, up to the maximum level represented by the Locational Security Factor. That withstanding the wider decision on the economic level of strategic redundancy lies with the TO.

As with the substation and circuit asset discounts, National Grid is concerned with a project specific discount which is not consistent with the charge because this will interact with the locational signal and may lead to increased investment costs overall.

National Grid has considered the options and arguments presented above, and concluded that a **circuit partial redundancy connection discount based on a generic formula** should be made available to users. For the same reasons presented for not applying a single circuit substation discount, National Grid believes that a discount for substation asset partial redundancy should not be made available.

This decision is based on providing a balance between the need to give a cost reflective signal to users to consider partial redundancy design variation connections and concerns about the interaction between this signal and the signal currently provided regarding power station location.

<u>132kV Uprating factor</u>
Within the Charging Methodology the 132kV overhead line and cable Expansion Factors have been adjusted to take account of the uprating plan. This effect is averaged across all 132kV circuits in each TO region by a single 132kV Expansion Factor, as described below. At the start of the Price Control period each TO submits the forecast number of 132kV circuit kilometres that are planned to be uprated to 275kV or 400kV. A similar approach is also taken for circuits operating at 275kV.

For each region, the future uprated kilometres are assigned the 400kV Expansion Factor and the remaining kilometres assigned the unadjusted 132kV value and a weighted average calculated. This is performed for both cables and overhead lines. Effectively this approach averages the 'uprating benefit' across all 132kV circuits in each TO region eliminating the requirement to track the specific circuits.

If the generic approach was applied to derive nodal specific discounts, the existing method of handling 132kV uprating may have the detrimental effect of reducing the accuracy of the discount produced, by effectively underestimating the single circuit cost saving for connections onto the enduring 132kV network.

National Grid have investigated an alternative approach whereby each TO would submit a specific list of actual circuits that are to be uprated to 275kV or 400kV to allow charge setting at the start of each Price Control period. These 132kV circuits would be modelled as having the same Expansion Factor as 400kV. Therefore the 132kV Expansion Factors would no longer be adjusted for uprating.

Whilst National Grid believes that this alternative approach may improve the cost reflectivity of the design variation discount, National Grid is also concerned about the wider impact of this change on the stability of GB generation and demand charges. Since Expansion Factors are fixed for a Price Control period in the charging methodology, National Grid is not proposing to make any changes the to the derivation of Expansion Factors at this time.

Offshore transmission users
The framework for offshore transmission is currently being developed. The Offshore SQSS drafting describes how an offshore connection would not have the same requirement for redundancy as that of an onshore SQSS compliant connection. National Grid believes in the principle that such offshore connections are similar to onshore single circuit or partial redundancy design variation connections and therefore have proposed that offshore connections should be subject to the same discount mechanism, subject to the final offshore commercial arrangements and association revisions to the Charging Methodology.

It can be anticipated that the successful Offshore Connection tender bid may contain route capacity above the total requested generators' TEC and that required by the Offshore SQSS. The users will benefit from the additional security this provides and will be liable to a TNUoS tariff including the proposed design variation circuit partial redundancy discount.

6.3. Implementation date

The implementation date for the proposed change will be 28 days after furnishing the conclusions report to the Authority, subject to non-veto. National Grid will be seeking to publish two sets of indicative 2008/9 TNUoS charges in December 2007 to reflect charges with or without the implementation of the modification proposals. If the proposal is not vetoed, the design variation discounts will be applied from 1 April 2008.

Assuming the implementation of the proposed amendment, in the order of 30 existing connected generators would qualify for either of the single circuit or partial redundancy design variation discounts. From the 2006/7 generation background, the discounts would total £800k, with an average rate of £0.54/kW.

6.4. Impact on other industry documentations

It is not anticipated that the proposed amendment will require modifications to any other industry documents, although National Grid welcome the views of the industry on this.

7. Responses to this consultation

Comments and views are invited on all of the issues and options raised in this consultation document. To ensure that your comments and views are considered as part of National Grid's Conclusions Report to the Authority, responses must be received by close of business on Friday 30th November 2007.

If you wish to provide comments on this consultation document, responses are welcome via email to: Thomas.Ireland@uk.ngrid.com

Alternatively, users can send their comments in writing, addressed to:

Tom Ireland
Electricity Charging & Access Development
National Grid Electricity Transmission plc
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

If you have any further queries, please do not hesitate to contact Tom on 01926 656152.

Appendix 1: Proposed drafting of the Statement of the Use of System Charging Methodology

Chapter 2: Derivation of the Transmission Network Use of System Tariff

To be inserted after existing paragraph 2.41

Deriving tariff discounts for customer choice design variations

2.42 Generators that have elected to be connected by a single circuit, which is not charged as Connection Assets, under a SQSS design variation, qualify for application of a single circuit discount. The discounts reflect the reduced asset requirements of a single circuit.

2.43 The single circuit discount can be calculated by:

$$\text{Single circuit discount (£ /kW)} = \frac{L_{SC} \times EC \times EF \times 0.8}{1000}$$

Where

L_{SC}	=	Applicable circuit length of single circuit (km)
EC	=	Expansion Constant (£/MWkm)
EF	=	Expansion Factor

2.44 For the avoidance of doubt, applicable circuit length means the length of OHL or cable that requires a reduced asset investment as a result of the design variation, and shall be calculated as per the following:

- A **spur circuit** is a radial circuit that has a single connection to the remainder of the MITS. For the purposes of this definition, a substation which is compliant with the deterministic criteria of the SQSS is considered to represent the MITS. For such circuits the applicable circuit length is the route length directly to the first compliant substation.

- A tee circuit can be radial or interconnected. A **radial tee** is connected to the remainder of the MITS via a single compliant substation. The applicable circuit length for a radial tee is the route length directly to the compliant substation and will typically consist of two legs of the tee circuit.

- An **interconnected tee** has two transmission paths onto the MITS via compliant substations. The applicable circuit length for a tee is the total circuit length of the entire tee between the generation connection substation and the two compliant substations.

For clarity, illustrative examples of the definition of applicable circuit length are shown in Appendix TN-9.

2.45 Generators that have elected to be connected by a partial redundancy circuit connection, which is not charged as Connection Assets, under a SQSS design variation qualify for application of a partial redundancy circuit discount. Circuit export capacity is not sufficient to allow full export during a single circuit outage. The discounts reflect the reduced asset requirements of a partial redundancy connection.

2.46 The partial redundancy circuit discount can be calculated by:

Partial redundancy discount (£ /kW) = $\frac{PRF \times L_{SC} \times EF \times EC}{1000}$

Where

PRF	=	Partial Redundancy Factor
L_{SC}	=	Applicable circuit length of single circuit (km)
EF	=	Expansion Factor
EC	=	Expansion Constant (£/MWkm)

And the Partial Redundancy Factor can be calculated by:

Partial Redundancy Factor = LSF – $\frac{RTC}{\Sigma TEC}$

Where

LSF = Locational Security Factor
RTC = Route Transmission Capacity (MW) of the Partial Redundancy Connection
ΣTEC = Sum of Transmission Entry Capacity (MW) for all generation at the connection node

And LSF > $\frac{RTC}{TEC}$

2.47 The single circuit discount and partial redundancy circuit discount are applied to all customer choice SQSS design variation single circuit or customer choice SQSS design variation partial redundancy generator connections that are not charged as Connection Assets.

2.48 The discounts, in £/kW, is applied to the final tariff for the zone in which the node is situated as under existing zoning criteria. The discount per node will be published in the **Statement of Use of System Charges.** For the avoidance of doubt, the design variation discounts do not affect the allocation of nodes to Generation Zones.

Existing paragraphs 2.42 – 2.59 to be renumbered to 2.49- 2.66

The Residual Tariff

2.39 The total revenue to be recovered through TNUoS charges is determined each year with reference to the Transmission Licensees' Price Control formulas less the costs expected to be recovered through Pre-Vesting connection charges. Hence in any given year t, a target revenue figure for TNUoS charges (TRRt) is set after adjusting for design variation discounts and any under or over recovery for and including, the small generators discount is as follows:

$$TRR_t = R_t + D_{DV} - PVC_t - SG_{t-1}$$

Where

TRR_t	=	TNUoS Revenue Recovery target for year t
R_t	=	Forecast Revenue allowed under National Grid's RPI-X Price Control Formula for year t (this term includes a number of adjustments, including for over/under recovery from the previous year). For further information, refer to Special Condition AA5A of National Grid's Transmission Licence.
D_{DV}	=	The total GB discount for Design Variation in year t

PVC_t	=	Forecast Revenue from Pre-Vesting connection charges for year t
SG_{t-1}	=	The proportion of the under/over recovery included within R_t which relates to the operation of statement C13 of the National Grid Transmission Licence. Should the operation of statement C13 result in an under recovery in year t – 1, the SG figure will be positive and vice versa for an over recovery.

Replaces existing 5.3

5.3 The value of generation to be multiplied by the relevant generation tariff, for the calculation of generation charges, is set out below. For the avoidance of doubt, the intention of the charging rules is to charge the same physical entity only once. Generators with SQSS design variation connections may be eligible for a single circuit discount and a circuit partial redundancy discount from the relevant generation tariff.

Appendix TN-9: Applicable Circuit Marginal Length for Design Variation Discounts

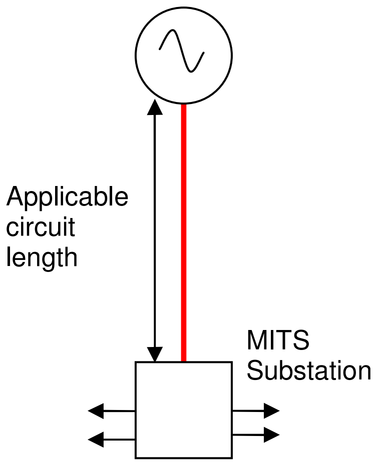
(AS SHOWN IN APPENDIX 2 OF THIS CONSULTATION)

To be inserted into the Glossary Section

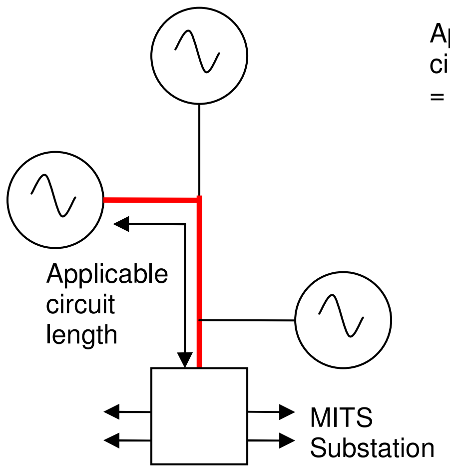
SQSS Design Variation	Defined in Section 2.15 of the SQSS as: "Variations, arising from a generation customer's request, to the generation connection design necessary to meet the requirements of paragraph 2.5 to 2.13 shall also satisfy the requirements of this Standard provided that the varied design satisfies the conditions set out in paragraphs 2.16.1 to 2.16.3."

Appendix 2: Applicable Circuit Marginal Length

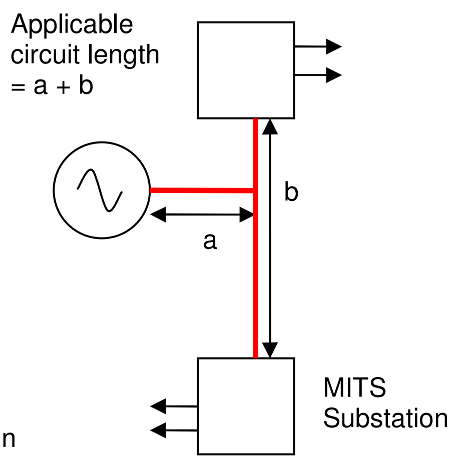
The illustrative examples below show the applicable circuit length for the design variation discount for a range of network and connection configurations.



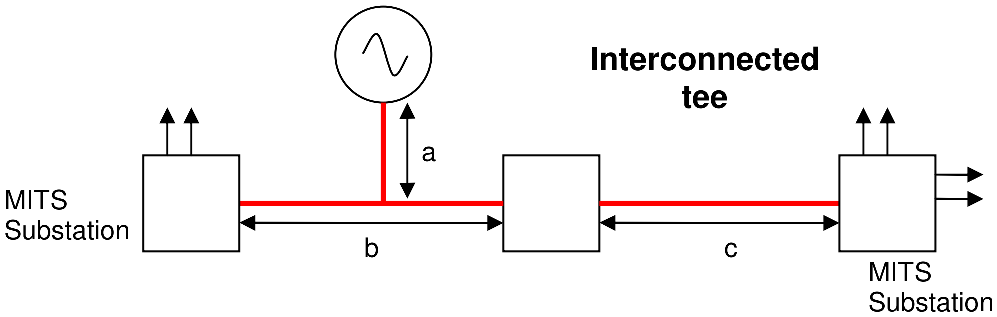
Spur



Radial tee



Interconnected tee

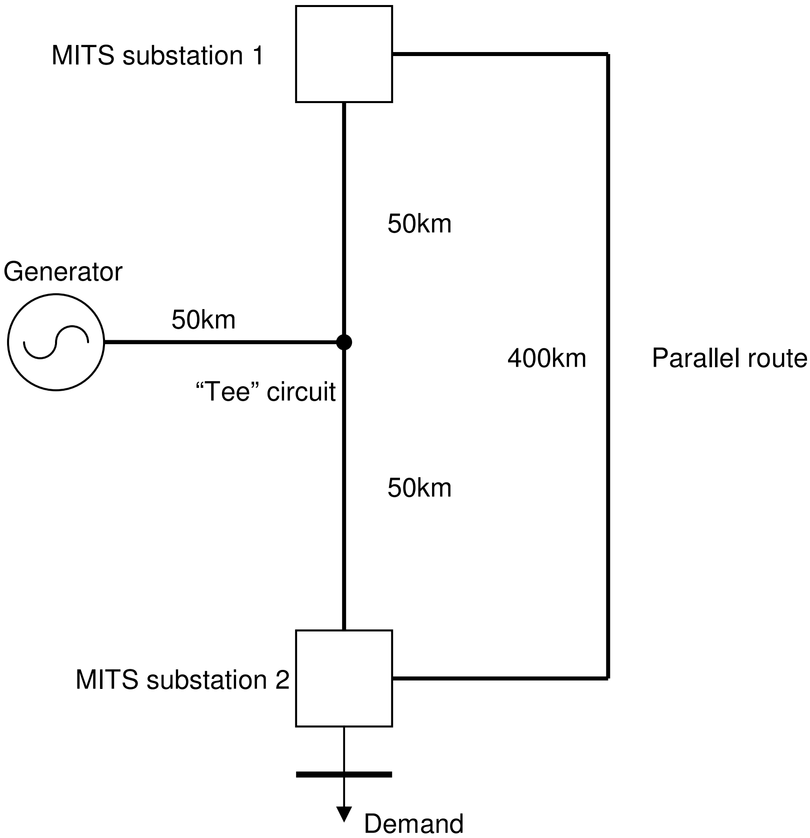


Applicable circuit length = a + b + c

Appendix 3: Determination of the appropriate applicable circuit length for interconnected tee connections

In order to illustrate the calculations performed by the seculf model for “tee” connected generators and compare these with a generic formula, a simple network which includes two main interconnected transmission system substations, a “tee” connected generator and a demand supply point has been constructed.

The network is shown in the diagram below.



The intact marginal cost for this generator is first established. This calculation is performed by the transport model, although it is repeated by the seculf program. An additional MW of generation is added at the generator node and an additional MW of demand is added at the slack node (in this case MITS substation 2). This causes the additional powerflows shown as “intact” in the diagram below.

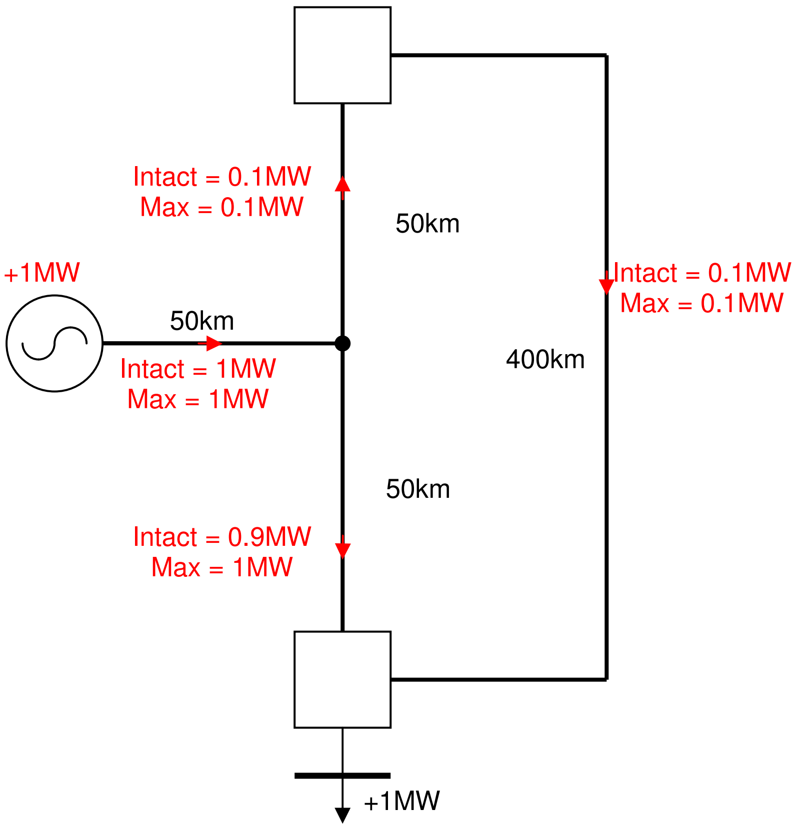
The associated intact marginal km can now be calculated:
= (1MW×50km)+(0.1MW×50km)+(0.9MW×50km)+(0.1MW×400km)
= 140MWkm

This value would be multiplied by the expansion constant and the locational security factor to give the unadjusted nodal tariff.

The seculf model then calculates marginal cost associated with the provision of security to the generator. The marginal km calculation is repeated for all SQSS contingencies, and the maximum flow in each circuit recorded. This maximum flow is used in the calculation of the secured marginal km.

In this case, the outage of the “tee” circuit will not increase the flow in the parallel circuit because the generator will be disconnected, but the outage of the parallel circuit will increase the flow in the leg of the tee circuit between the tee point and MITS substation 2. The maximum additional powerflows are shown as “max” in the diagram below.

The associated secured marginal km can now be calculated:
= (1MW×50km)+(0.1MW×50km)+(1MW×50km)+(0.1MW×400km)
= 145MWkm



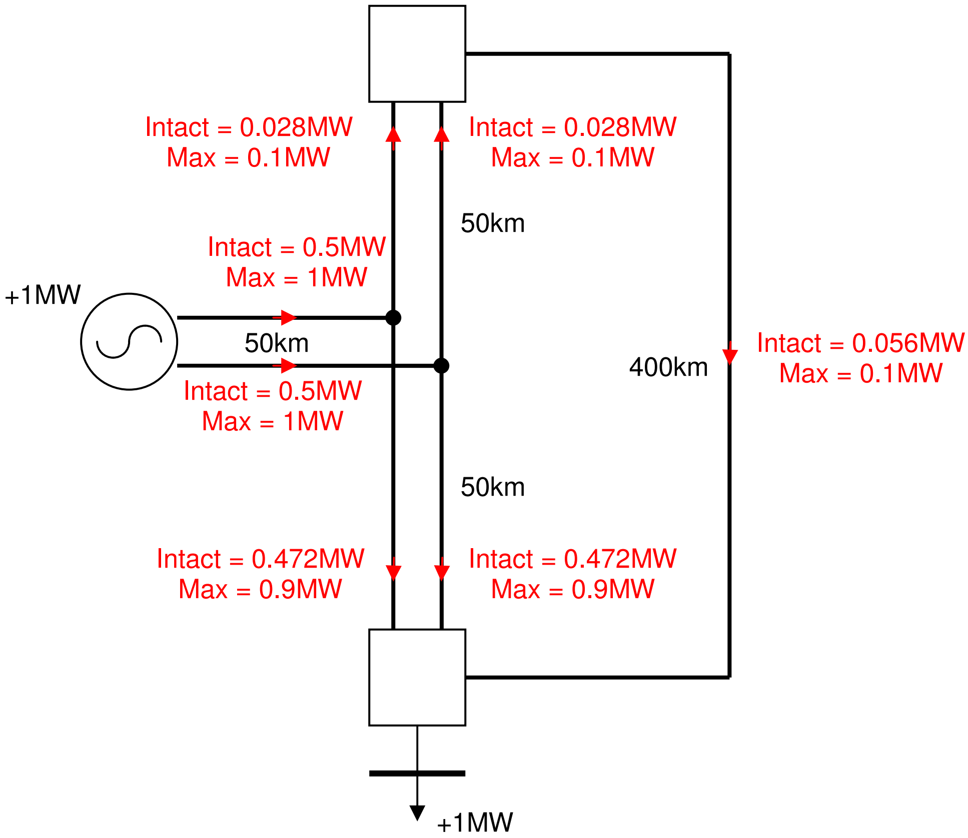
In order to determine the appropriate discount associated with connections of this type, the various connection designs that would be compliant with the deterministic generation connection criteria contained in the SQSS need to be considered. Some of these designs are shown below, together with the calculation of the associated intact and secured marginal km.

Compliant connection designs

(i) Double tee connection

Intact marginal km
= (0.5×50)+(0.5×50)+(0.028×50)+(0.028×50)+(0.472×50)+(0.472×50)+(0.056×400)
= 122.4MWkm

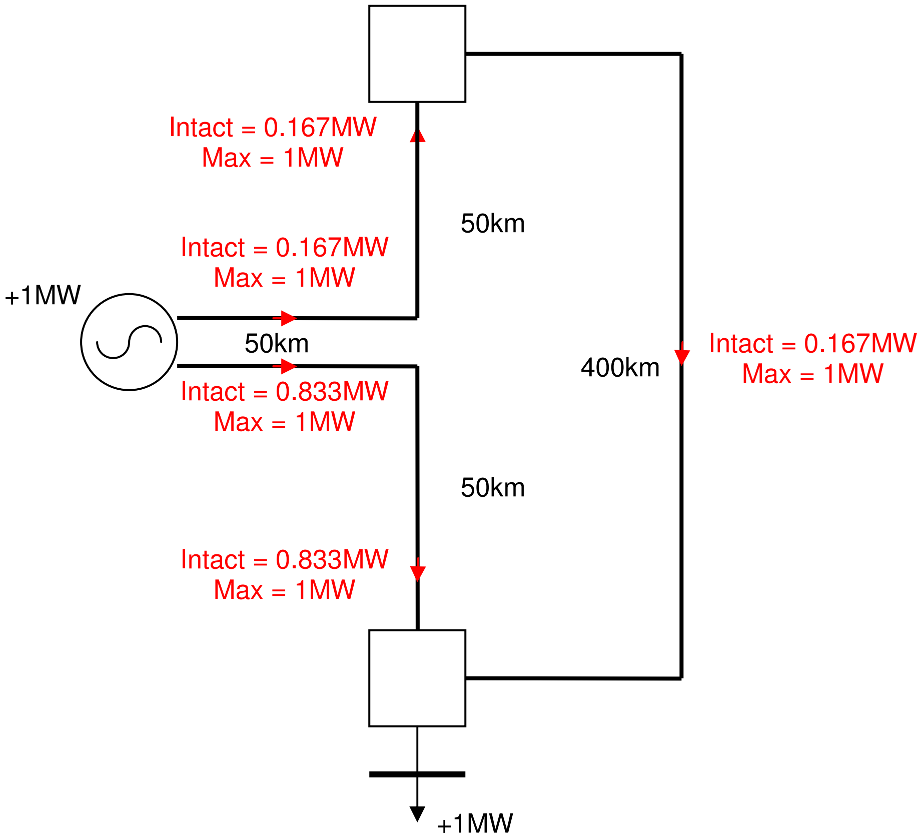
Secured marginal km
= (1×50)+(1×50)+(0.1×50)+(0.1×50)+(0.9×50)+(0.9×50)+(0.1×50)
= 240MWkm



(ii) Turn-in connection

Intact marginal km
= (0.167×50)+(0.833×50)+(0.167×50)+(0.833×50)+(0.167×400)
= 166.8MWkm

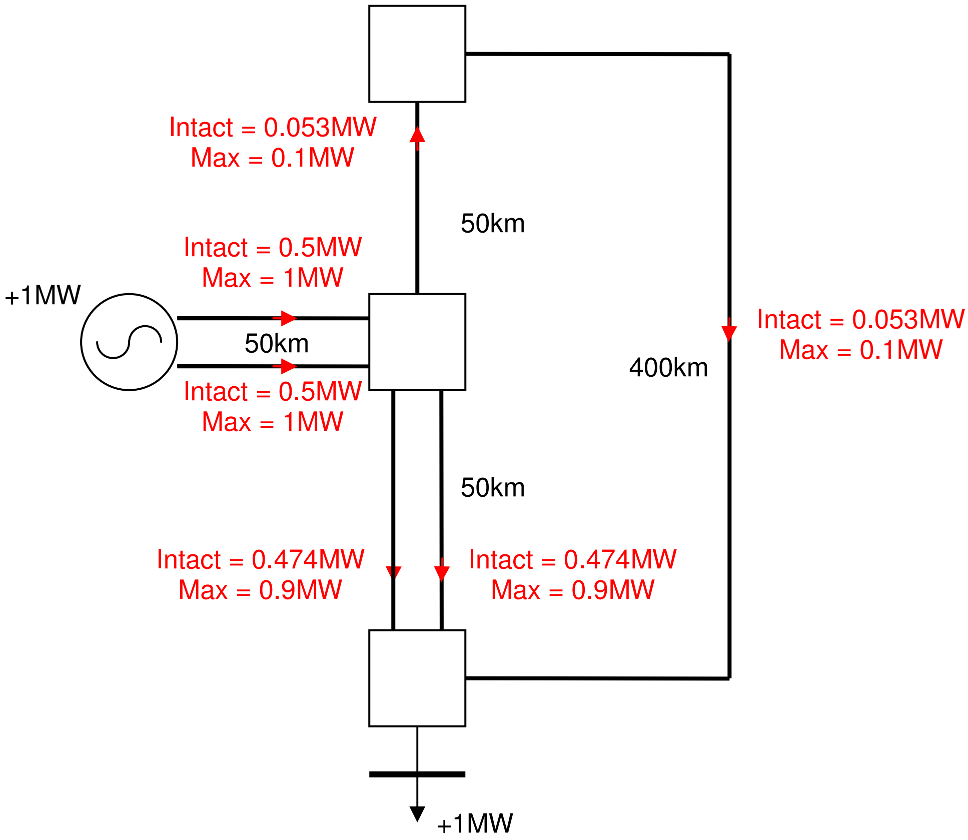
Secured marginal km
= (1×50)+(1×50)+(1×50)+(1×50)+(1×400)
= 600MWkm



(iii) Tee point substation connection

Intact marginal km
= (0.5×50)+(0.5×50)+(0.053×50)+(0.474×50)+ (0.474×50)+(0.053×400)
= 121.25MWkm

Secured marginal km
= (1×50)+(1×50)+(0.1×50)+(0.9×50)+(0.9×50)+(0.1×400)
= 235MWkm



The results of this analysis are summarized in the table below.

Connection design	**Secured marginal cost (MWkm)**	**Appropriate single circuit saving (MWkm)**
Single tee	145	-
Double tee	240	95
Turn in	600	455
Tee point substation	235	90

The analysis shows that the appropriate savings associated with an interconnected tee connection depend on the connection design that would have otherwise been used to provide a connection that is compliant with the deterministic generation connection criteria contained in the SQSS.

It should be noted that in more complex examples, the appropriate savings would also be influenced by a number of other factors, including the location of other generation, the impedance and length of each of the tee circuit legs and the impedance of parallel circuits.

Given that the actual discount is difficult to establish for both existing and new connections, National Grid believe that a standard applicable circuit length is required for all interconnected tee generation connections in order to provide certainty and predictability to users.

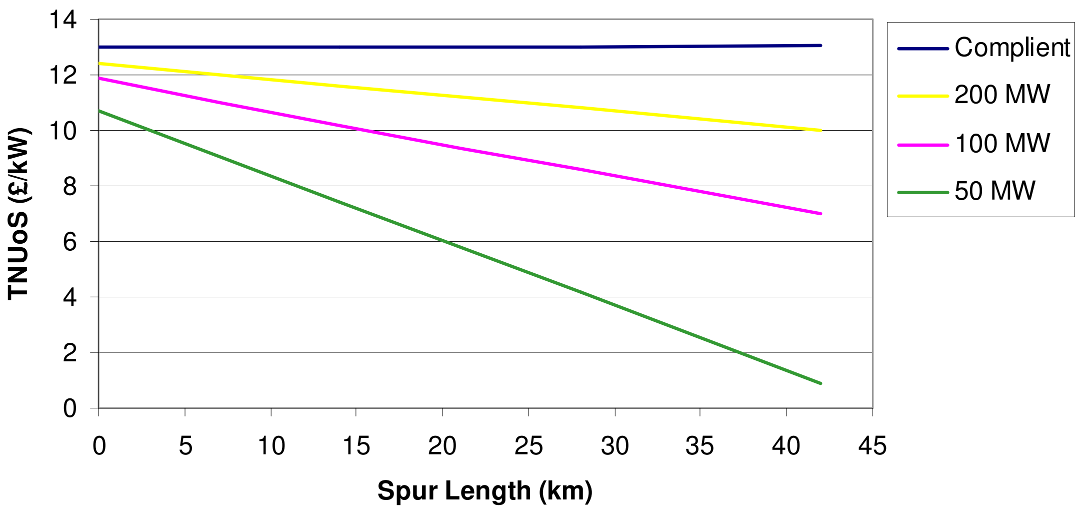
Given the range of appropriate single circuit savings above, National Grid believe that the full length of the interconnected tee circuit should be used as the applicable circuit length.

In this case, this would give a discount in MWkm of:
= 0.8 × 150
= 120MWkm

Appendix 4: The Effect of a Site Specific Circuit and Substation Discount

A transport and tariff model was run in order to illustrate the effect upon TNUoS tariffs of a project specific single circuit discount. The full cost savings from substation and circuit assets were discounted from the generator's TNUoS charge. The following assumptions were made:

- The generator was connecting at 132kV within the TNUoS Zone "South Scotland"
- The generator was modelled with a TEC of 50, 100 and 200MW
- For clarity all single circuit tariffs have been assumed to require an independent zone
- Substation and Circuit cost savings determined from generic design costs from TOs
- Discount annuitised over 40 years
- Cost Saving Values taken from KEMA PCR[2] report:
    - Total Substation Savings £1.4m
    - Total OHL cost savings £1.96m / 14km



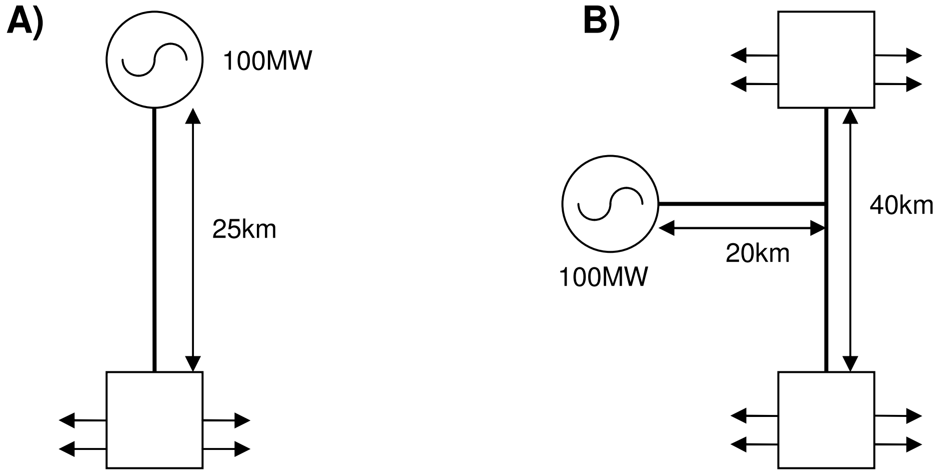
The diagram shows that for any discount that increases faster than the locational signal will undermine the Charging Methodology. As the User locates further from the transmission network and therefore requires a greater number of assets to be built, its TNUoS charge actually decreases.

[2] Review of the Electricity Transmission Asset Management Policies and Processes of Scottish Power Limited Ltd – Draft Final Report – 6 July 2006 KEEMA Limited

Appendix 5: Impact of Substation and Circuit Discount

In order to quantitatively compare the various options examined within this consultation for the calculation of a substation and circuit single circuit design variation discount, illustrative examples have been produced.

This analysis has been performed for a single circuit spur connection (A) and an interconnected tee connection (B):



Assumptions and data sources:

- The connection voltage is assumed to be 132kV
- The connections are assumed to be in TNUoS Zone 7, South Scotland (£13.02/kW in 2007/08)
- The overhead line is assumed to have a 175mm^2, ACSR conductor with a capacity of 162MW.
- L4 steel towers have been used for both single and double circuit designs.
- The specific overhead line and tower capital costs have been taken from a paper by KEMA[3]

A) Single circuit spur

The discounts produced by the three options considered for **substation** discount are:

1. **Project Specific Discount**. The discount is calculated from the actual capital cost savings derived from analysis between the single circuit and the likely compliant connection. To represent this in this example, the generator is 100MW as compared to the 110MW assumed generator size used to calculate the generic discount. If it is assumed the same substation costs would be incurred for both size connection, the Project Specific Discount could be calculated as below:

   Generic 132kV discount x <u>Assumed Size of Generator in Generic Example</u>
   Actual Generator Size

[3] Review of the Electricity Transmission Asset Management Policies and Processes of Scottish Power Limited Ltd – Draft Final Report – 6 July 2006 KEMA Limited

$$= 1.05 \times \frac{110}{100}$$

= £1.16/kW

2. **Generic Discount.** Cost analysis is performed with data submitted from all TOs to produce tiered generic discounts dependant upon connection voltage. The generic discount is applied to all single circuit connections. **£1.05/kW**

3. **No Discount** - **£0/kW**

The discounts derived from the three options considered for a **circuit** discount are:

1. **Project Specific Discount**. The actual estimated cost for a double and circuit site specific circuit are compared and the differential is directly reflected upon the user to determine the discount.

   Cost of a 25km steel tower **single** circuit overhead line = £18.125m
   Cost of a 25km steel tower **double** circuit overhead line = £21.625m

   Total connection capital cost saving = £3.5m

   Annuity factor 6.6%
   Maintenance factor 1.8%

   Total annual cost saving = £294k
   Final annual cost saving discount = **£2.94/kW**

2. **Nodal Specific Security Factor – Seculf Model.** For the example of a spur circuit, the marginal cost savings associated with a single circuit as compared to a single circuit discount is equal to the cost of the second circuit:

$$= \frac{\text{Spur Length} \times \text{Expansion Factor} \times \text{Expansion Constant} \times 0.8}{1000}$$

$$= \frac{25 \times 2.80 \times 9.8 \times 0.8}{1000}$$

= **£0.55/kW**

3. **Nodal Specific Security Factor – Generic**

$$\text{Single circuit discount (£ /kW)} = \frac{L_{SC} \times EC \times EF \times 0.8}{1000}$$

Where

L_{SC}	=	Applicable circuit length of single circuit (km)
EC	=	Expansion Constant (£/MWkm)
EF	=	Expansion Factor

$$= \frac{25 \times 9.8 \times 2.80 \times 0.8}{1000}$$

= **£0.55/kW**

B) Single circuit interconnected tee

The discounts produced by the three options considered for substation discount are the same as for the single circuit example above, namely:

1. **Project Specific Discount. £1.16/kW**
2. **Generic Discount £1.05/kW**
3. **No Discount - £0/kW**

The discounts derived from the three options considered for a **circuit** discount are:

1. **Project Specific Discount.** It has been assumed that the efficient reinforcement is a second tee circuit, to achieve a compliant connection and that the overhead line is 175mm^2 ACSR, 162MW and that L4 steel towers are used.

   Cost of a 60km steel tower single circuit OHL = £43.5m
   Cost of 60km steel tower double circuit OHL = £51.9m

   Total connection capital cost = £8.4m
   Annuity factor 6.6%
   Maintenance factor 1.8%

   Total annual cost saving = £705.6k
   Final annual cost saving = **£7.06/kW**

2. **Nodal Specific Security Factor – Seculf Model.** The seculf model is run for the single circuit connection and the secured marginal km is 58MWkm, which represents the post fault 'cost'. The secured marginal km for a double tee connection is 96MWkm. This differential is used to calculate the saving to the generator:

   Marginal flow differential = 96 – 58 = 38MWkm

   $$\text{Generator discount (£/kW)} = \text{Marginal flow} \times EC \times EF \times 0.8$$

   $$= \frac{38 \times 9.8 \times 2.8 \times 0.8}{1000}$$

   $$= \mathbf{£0.83/kW}$$

3. **Nodal Specific Security Factor – Generic.** The second example is an interconnected tee and therefore the entire length of all legs of the tee is used to calculate the discount.

   $$\text{Single circuit discount (£ /kW)} = \frac{L_{SC} \times EC \times EF \times 0.8}{1000}$$

   $$= \frac{60 \times 9.8 \times 2.80 \times 0.8}{1000}$$

   $$= \mathbf{£1.32/kW}$$

The derived single circuit substation and circuit discounts, in £/kW, are summarised below for the spur circuit and interconnected tee circuit examples shown above:

		Spur (£/kW)	Interconnected Tee (£/kW)
Project Specific	Substation	1.16	1.16
	Circuit	2.94	7.06
	Final tariff	**8.92**	**4.80**
Generic (Seculf)	Substation (generic)	1.05	1.05
	Circuit (seculf)	0.55	0.83
	Final tariff	**11.42**	**11.14**
Generic	Substation (none)	0	0
	Circuit (generic formula)	0.55	1.32
	Final tariff	**12.47**	**11.70**
Unadjusted Zonal TNUoS Tariff		**13.02**	**13.02**