

Worked Examples Illustrating the Application of the Connection Charging

Methodology

The following Examples are to illustrate the application of the Connection Charging Methodology and are not intended to provide an accurate estimate of the charges which a person would become liable in respect of the provision of a connection. The Examples do not necessarily represent the Minimum Scheme for a specific connection application.





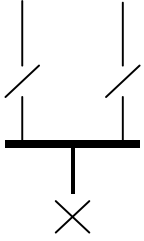






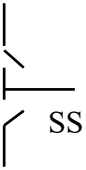
The figures quoted in the Examples are illustrative. Section [7] of this statement provides our charges and indicative costs to undertake various activities.

The Examples illustrate where we undertake both the Contestable and Non-Contestable Work. These costs will include the determination of the POC and assessment and design costs, though these may not be explicitly identified in the Examples.

Where Contestable Work is undertaken by an ICP, we will apply CIC Charges for services associated with the Contestable Works which would cover activities including design approval, inspection and monitoring. The CIC Charges shown in the Examples are for illustration only. For the avoidance of doubt, in each Example, where an ICP undertakes the Contestable Work, our Connection Charge will include the cost of the Non-Contestable Work and the CIC Charges but exclude the cost of Contestable Work.

The Examples are generic and standard for all LDNOs, but they do not represent the network analysis and subsequent design solutions that would be completed for an actual connection scheme. The actual designs are subject to our design policies.

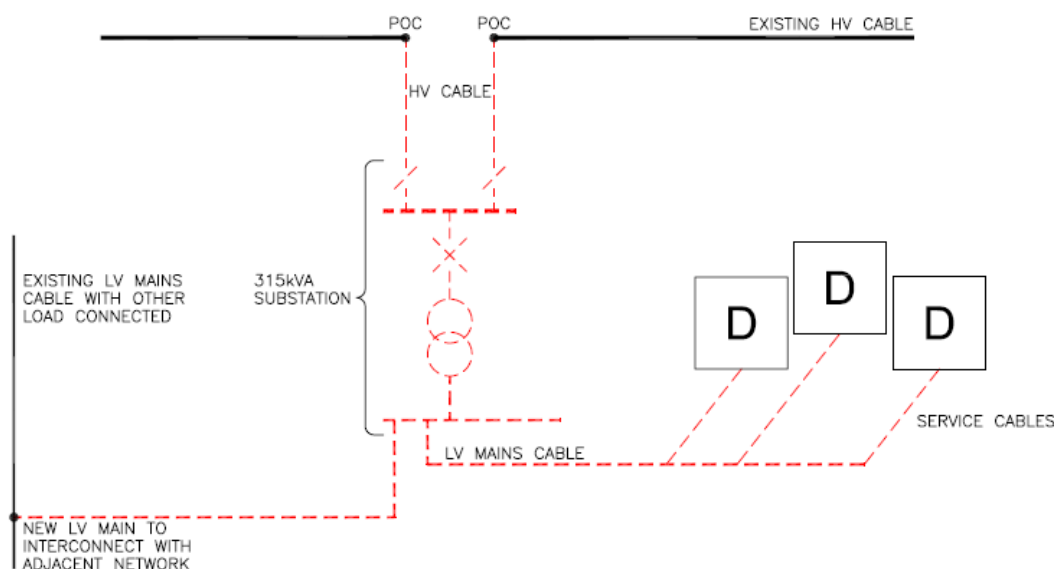
Key to Illustrations

	Circuit Breaker (any voltage)
	Switch
	Transformer
	Joint on cable
	High voltage ring main unit
	Existing cable
	Proposed cable
	Normal Open Point (NOP)
	Generator Customer
	Demand Customer
	Point of Connection (POC)
	Sub Station

Example 2B: New connections on a domestic housing development with interconnection.

This Example demonstrates the application of two of the exceptions to the apportionment rules, Exception 1 (paragraph 1.17) and Exception 2 (paragraph 1.18).

As in Example 2A, a housing developer requests connections for 200 domestic Premises. The Required Capacity to supply the 200 homes is 250kVA. A new distribution substation will be established to provide the Required Capacity of the site. The Minimum Scheme requires the substation to be looped into the existing HV network. However, in this Example there is an option to provide an additional LV cable to interconnect the distribution substation with the existing LV network. This option is over and above the Minimum Scheme.



Interconnecting into the existing LV network will increase the capacity of the existing Distribution System. Therefore, the assets that connect the HV and LV network would normally be considered to be Reinforcement. These assets (as shown on the diagram above) include the HV cable, the 315kVA substation and the interconnecting LV main. They exclude the LV mains and service cables from the 315kVA substation to the Customer's development. However, whether these assets are to be considered Reinforcement or Extension Assets depends upon who requested the LV interconnection and whether any capacity created is likely to be used. One of three scenarios will apply –

a) The LV interconnection is requested by the Customer (Exception 2).

In this case the Reinforcement is over and above the Minimum Scheme and requested by the Customer. Therefore, Exception 2 applies and all assets (including the interconnecting LV

cable) will be treated as Extension Assets and their costs will be borne in full by the Customer. As the interconnecting LV main and associated LV joint are over and above the Minimum Scheme, a charge for their future operation and maintenance will be made.

The Connection Charge for this Scheme is calculated as follows:

Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Works			
Provision and installation 100m 11kV cable (from existing HV network to substation)	£11,000	n/a	£11,000
315kVA substation	£24,000	n/a	£24,000
LV mains, service cables and terminations (from substation to the Customer's development)	£170,000	n/a	£170,000
Interconnecting LV Cable (from substation to existing LV network)	£10,000	n/a	£10,000
Non-Contestable Works			
Two HV cable joints	£2,000	n/a	£2,000
LV cable joint	£1000	n/a	£1,000
Difference between Minimum and the actual Scheme is £11,000. Operation & Maintenance @20%* of £11,000		n/a	£2,200
Total Extension Asset Cost	£218,000		£220,200
CIC Charges			£1,500

Total Connection Charge = £220,200

*Note, the 20% Operation and Maintenance figure is illustrative.

- b) The LV interconnection is requested by us in order to create additional network capacity (No exception).

In this case, the assets connecting the existing HV and LV network add capacity to the existing network and none of the exceptions described in paragraphs 1.17-1.21 apply. Therefore they will be treated as Reinforcement. The costs of the Reinforcement assets that form part of the Minimum Scheme (the HV cable and associated HV joints; the 315kVA substation) will be apportioned. The interconnecting LV cable and associated LV joint are considered to be Reinforcement but, as they are over and above the Minimum Scheme and requested by us, the costs will be borne in full by us.

Reinforcement:

The RSN is that part or parts of the Distribution System that can be used to supply the Customer in both normal and abnormal running arrangements which, in this case, is the distribution substation and the HV Cables.

Security CAF calculation: the numerator in the CAF calculation is based upon the Required Capacity of the Customer, which is 250kVA. The denominator is based on the New Network Capacity following Reinforcement, which is 315kVA, i.e. the secure capacity of the distribution substation and HV cables.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non-Contestable Work			
Provision and installation 100m 11kV cable (from existing HV network to substation)	£11,000	250/315 =79.4%	£8,730
315 kVA substation	£24,000	as above	£19,048
Two HV cable joints	£2,000	as above	£1,587
Interconnecting LV Cable (from substation to existing LV network)	£10,000	In excess of Minimum Scheme	£0
LV Cable Joint	£1,000	In excess of Minimum Scheme	£0
Total Reinforcement Cost	£48,000		£29,365

Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Work			
LV mains, service cables and terminations (from the substation to the Customer's development)	£170,000	n/a	£170,000
Total Extension Asset Cost	£170,000		£170,000
CIC Charges			£1,500

Total Connection Charge = £29,365 + £170,000 = £199,365

- c) The LV interconnection is requested by us but there is little prospect of the capacity created being used (Exception 1).

In this case all the requirements of Exception 1 (paragraph 1.17) are met so the assets that connect the existing HV and LV Distribution System will be treated as Extension Assets and their costs will not be apportioned. The Customer will pay the costs associated with the Minimum Scheme in full. The interconnecting LV cable and associated LV joint as they are over and above the Minimum Scheme and requested by us, therefore the costs will be borne in full by us

The Connection Charge for this Scheme is calculated as follows:

Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Works			
Provision and installation 100m 11kV cable (from existing HV network to substation)	£11,000	n/a	£11,000
315 kVA substation	£24,000	n/a	£24,000
LV mains, service cables and terminations (from substation to the Customer's development)	£170,000	n/a	£170,000
Non-Contestable Works			
Two HV cable joints	£2,000	n/a	£2,000
Interconnecting LV Cable (from substation to existing LV network)	£10,000	In excess of Minimum Scheme	£0
LV Cable Joint	£1000	In excess of Minimum Scheme	£0
Total Extension Asset Cost	£218,000		£207,000
CIC Charges			£1,500

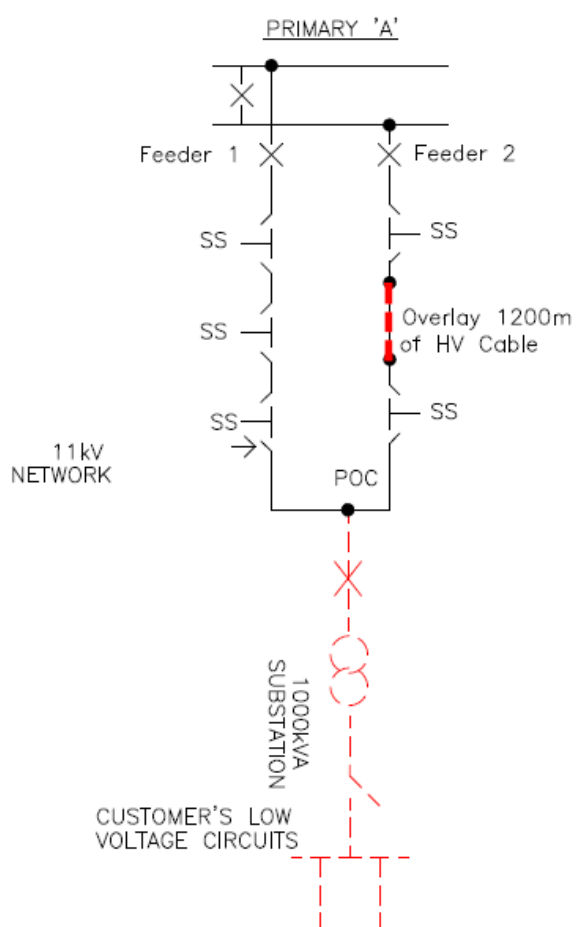
Total Connection Charge = £207,000

Example 4: Additional load application for commercial Premises (requiring a new connection from the HV network)

A Customer requests to increase the Maximum Capacity of their existing LV connection from 200kVA to 850kVA; an increase of 650kVA (the Required Capacity).

As the Customer's existing LV connection is unable to deliver the Required Capacity a new connection will be required from the local HV network. This will be a non-secure connection to a secure network. The Minimum Scheme is to overlay part of the nearest HV circuit (Feeder 2) which only has spare capacity of 200kVA. The Reinforcement to make the capacity available requires 1200m of existing HV cable to be overlaid with a larger capacity cable.

Following the Reinforcement the New Network Capacity will be 8000kVA. (i.e. after Reinforcement, in this particular case, the section of cable with the lowest rating in the ring represented by Feeder 1 and Feeder 2 is rated at 8000kVA).



Reinforcement:

The RSN is the two feeder ring comprising Feeder 1 and Feeder 2.

Security CAF calculation: As this request is from an existing customer the numerator in the CAF calculation is based upon the increment of capacity requested, i.e. 650kVA (850kVA – 200kVA). The denominator is based upon the New Network Capacity following the Reinforcement.

Fault Level CAF calculation: This Scheme does not have any significant Fault Level contribution to the existing shared use distribution network and the Fault Level CAF is therefore not applicable here.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Work			
Overlay 1200m of HV cable	£120,000	$650 / 8000 \times 100\% = 8.1\%$	£9,750
HV Jointing	£4,800	As above	£390
Total Reinforcement Cost	£124,800		£10,140

Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Work			
Provision and installation HV cable	£29,000	n/a	£29,000
1000kVA substation	£20,000	n/a	£20,000
Termination of Customer's LV cables	£1,400	n/a	£1,400
LV Metering panel	£800	n/a	£800
Non-Contestable Work			
HV Jointing	£1,600	n/a	£1,600
Total Extension Asset Cost	£52,800		£52,800
CIC Charges			£1,100

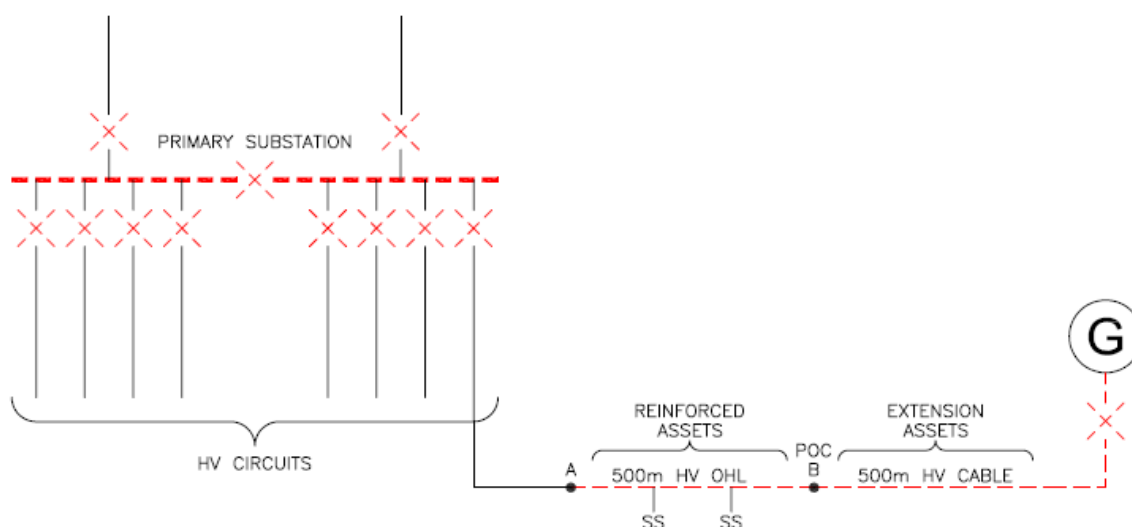
Total Connection Charge = £10,140 + £52,800 = £62,940

Example 5: Connection of a new embedded generator that requires Reinforcement involving Security and Fault Level CAFs.

A Customer requests a connection to a generator with a Required Capacity for export purposes of 3MVA. The Fault Level contribution at the primary substation from the generation connection is 10MVA.

The POC is to the existing HV network at point B and it is proposed to install 500m of HV underground cable from the POC to the Customer's installation. This is a non-secure connection that requires reinforcement of a non-secure network.

The connection requires the Reinforcement of 500m of HV overhead line between points A and B for a thermal capacity requirement and replacement of the existing 11 panel HV switchboard at the primary substation in order to increase its fault level rating from 150MVA to 350MVA. However, the new fault level will be limited by the fault level rating of the local network of 250MVA.



Reinforcement:

The RSN is the HV network from the primary substation to Point B.

Security CAF calculation: the numerator in the CAF calculation is based upon the Required Capacity of the Customer, i.e. 3MVA. The denominator is based on the New Network Capacity following Reinforcement, which is 7.6MVA, i.e. after Reinforcement, in this particular case, the section of cable with the lowest rating.

The RSN is the 11kV switchboard at the primary substation.

Fault Level CAF calculation: The numerator in the CAF calculation is based upon the Fault Level contribution from the Customer's new generator connection, in this Example 10MVA. The denominator is based upon the New Fault Level Capacity, which is the lower of the Fault Level capacity of the new HV switchboard, 350MVA or of the local system, 250MVA in this Example.

The Connection Charge for this Scheme is calculated as follows:

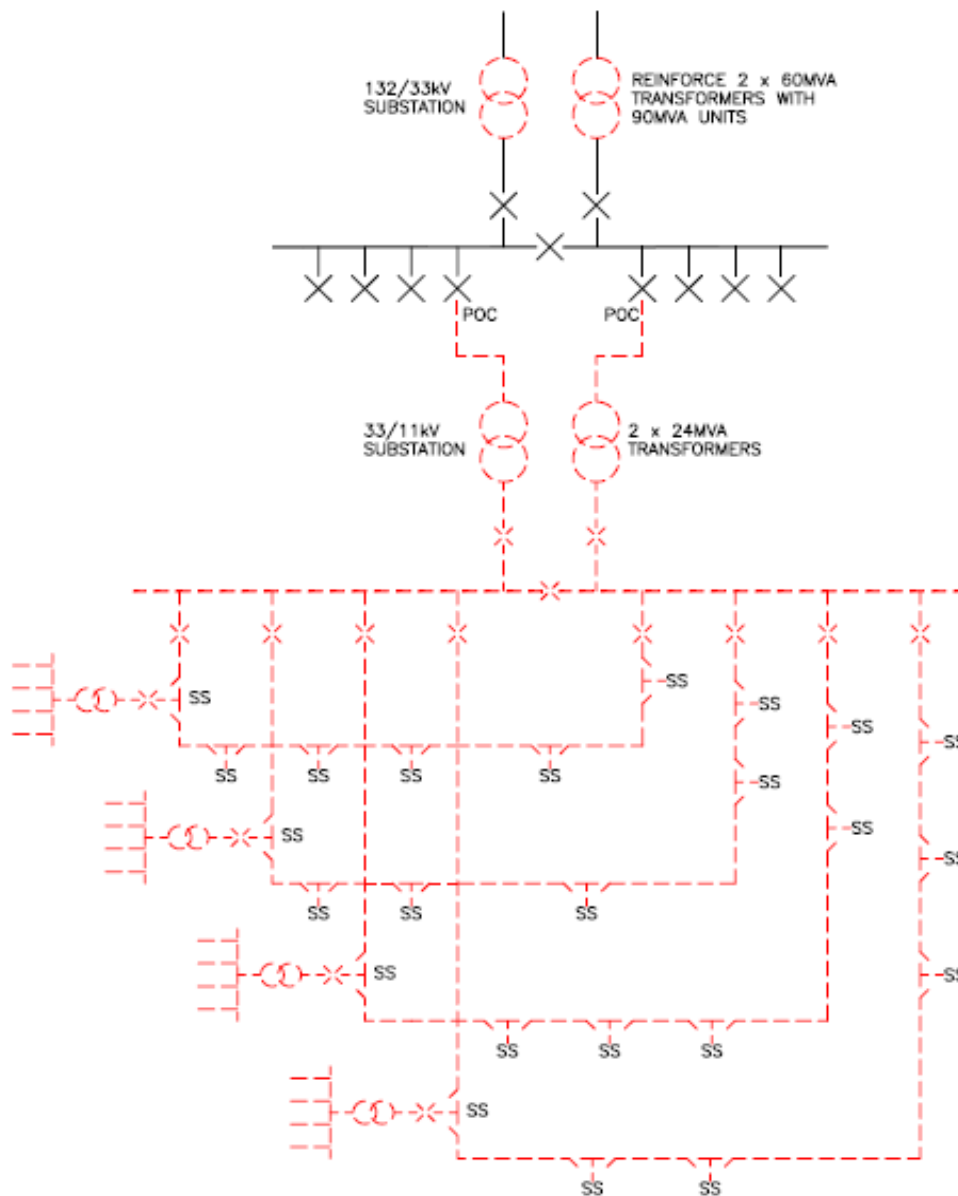
Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Work			
Re-conductor of 500m of HV overhead line	£49,000	$3/7.6 \times 100\% = 39.5\%$ Security CAF	£19,342
Replacement of existing 11 panel 11kV switchgear	£540,000	$3 \times (10/250) \times 100\% = 12.0\%$ Fault Level CAF	£64,800
Total Reinforcement Cost	£589,000		£84,142

Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Work			
Installation of 500m HV cable	£47,000	n/a	£47,000
HV circuit breaker at Customer's substation	£10,000	n/a	£10,000
Non-Contestable Work			
HV pole top termination	£1,400	n/a	£1,400
Total Extension Asset Cost	£58,400		£58,400
CIC Charges			£1,100

Total Connection Charge = £84,142 + £58,400 = £142,542

Example 6: Connection of Mixed Housing and Commercial Development

The Customer requests 18MVA for a new mixed housing & commercial development site which comprises of 7,000 plots and a mixture of small commercial Premises. The POC on the network will be at the two existing 33kV circuit breakers located at the 132/33kV substation approximately 600m from the site boundary. In order to accommodate the Required Capacity it will be necessary to reinforce the two 60MVA, 132/33kV, transformers with 90MVA transformers. It will then be necessary to extend the network and establish a 2 by 24MVA transformer 33/11kV substation on site with an extendable HV board in this new substation. The HV board will comprise of 2 incomer, 1 bus section and 8 outgoing circuit breakers. From this substation there will be 3km of HV cable required to supply 24 substations. From each of these 24 substations there will be associated LV cable and services as required.

Reinforcement:

The RSN for the Reinforcement is the transformers at the existing 132/33kV substation

Security CAF calculation: the numerator in the CAF calculation is based upon the Required Capacity of the Customer, i.e. 18MVA. The denominator is based on the secure New Network Capacity following Reinforcement, i.e. 90MVA.

Fault Level CAF calculation: This Scheme does not have any significant Fault Level contribution to the existing shared use distribution network and Fault Level CAF is therefore not applicable here.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Work			
Replace two 60MVA, 132/33kV transformers with two 90MVA transformers.	£1,500,000	$18/90 \times 100\% = 20.0\%$	£300,000
Total Reinforcement Cost			£300,000

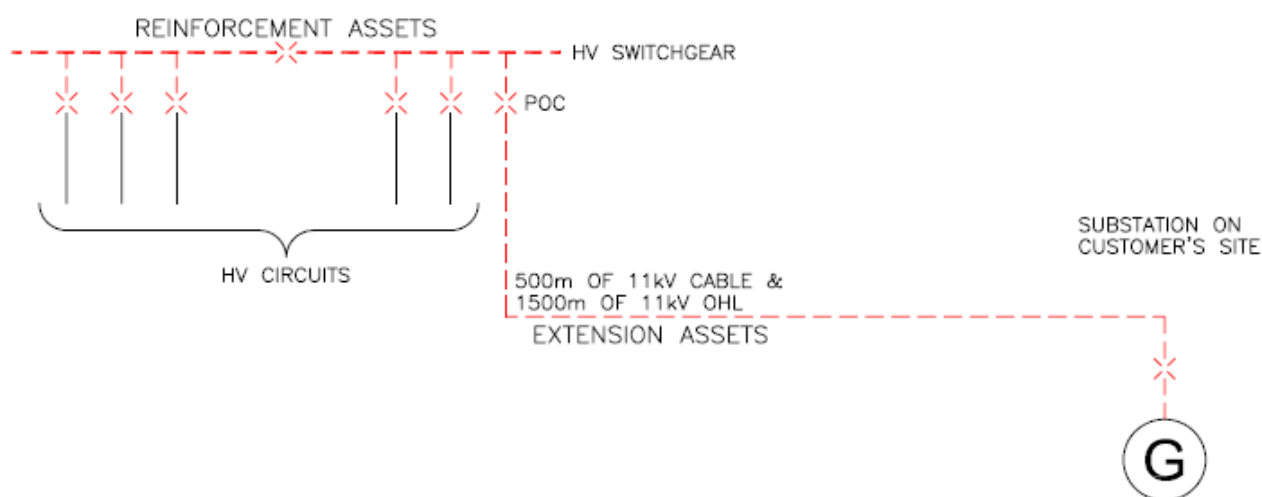
Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Work			
600m of 2 by 33kV cable	£180,000	n/a	£180,000
3000m of HV circuits, 24 HV/LV substations, LV cable and services	£7,000,000	n/a	£7,000,000
2 by 24MVA transformer substation	£2,000,000	n/a	£2,000,000
Non-Contestable Work			
Terminate two 33kV cables on to two existing 33kV circuit breakers.	£25,000	n/a	£25,000
Total Extension Asset Cost	£9,205,000		£9,205,000
CIC Charges			£15,000

Total Connection Charge = £9,205,000 + £300,000 = £9,505,000

Example 7A: New 3MVA Generation Connection, Fault Level Triggered Reinforcement

A Customer wishes to connect a new generator with a Required Capacity for export purposes of 3MVA. The connection of the generator requires the installation of 500m of 11kV cable and 1500m of overhead line between a new circuit breaker, added to the 11kV extensible switchgear panel at an existing primary substation and a new substation at the Customer's Premises. The 24MVA Fault Level contribution from the generator necessitates Reinforcement works to replace the 11kV switchgear at the existing primary substation with switchgear of a higher fault level rating.



Reinforcement:

Fault Level CAF calculation: The numerator in the CAF calculation is based upon the Fault Level contribution from the Customer's new generator connection, in this Example 24MVA. The denominator is based upon the New Fault Level Capacity, in this Example the Fault Level capacity of the new 11kV switchboard, 315MVA.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Work			
Replacement HV switchboard (excluding Customer's sole use circuit breaker)	£450,000	3x(24/315) x 100% = 22.9%	£102,857
Total Reinforcement Cost	£450,000		£102,857

Extension Assets:

	Cost	Apportionment	Customer Contribution
Non-Contestable Work			
HV circuit breaker at primary substation	£25,000	n/a	£25,000
Contestable Work			
Installation of a 500m HV cable	£40,000	n/a	£40,000
Installation of a 1500m HV overhead line	£35,000	n/a	£35,000
HV circuit breaker at Customer substation	£25,000	n/a	£25,000
Total Extension Asset Cost	£125,000		£125,000
CIC Charges			£1,100

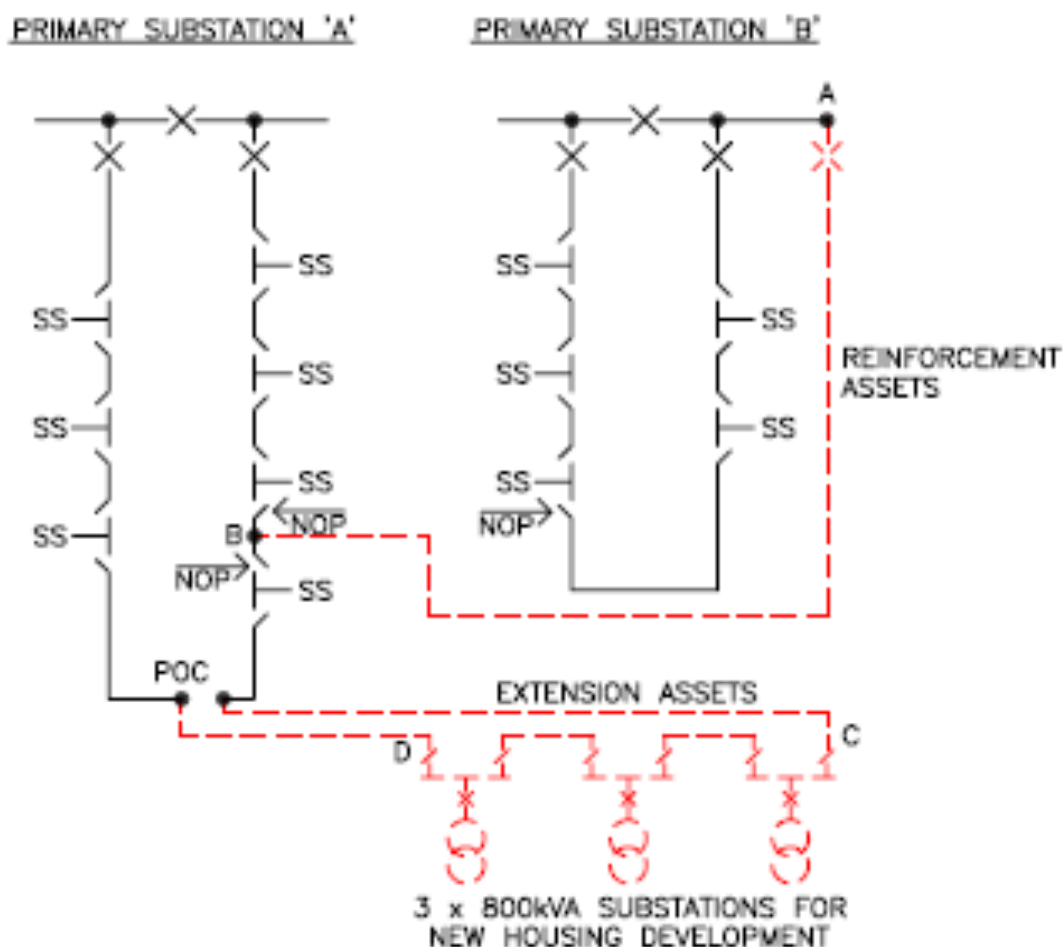
Total Connection Charge = £102,857 + £125,000 = £227,857

Example 8A: Connection of housing development with network Reinforcement

A new housing development has a Required Capacity of 2MVA to serve 900 plots. The local 11kV feeder has a network capacity of 7.7MVA based upon the limitation of the existing 400 Amp circuit breakers at Primary Substation A. The existing load on the circuit is 7.6MVA. It is therefore not possible to connect the new load to this circuit without Reinforcement works. To reinforce the circuit it is proposed to install a new circuit breaker at Primary Substation B and install a new 11kV feeder (also rated at 7.7MVA) to the local 11kV circuit. The new 11kV feeder is used to split the existing circuit from a secure two to a secure three feeder network. The new 11kV feeder is used to split the existing circuit from a secure two to a secure three feeder network. The newly installed cable between point A and B is 1300m long. The newly installed cable to connect the development from the POC is 1200m.

This Reinforcement will allow a POC to be taken from the local 11kV circuit to supply the new development. Three 800kVA distribution substations are established onsite. The above work represents the Minimum Scheme to provide services to the new site.

The figure below shows the proposed Reinforcement and POC to the 11kV network:



Reinforcement:The RSN for the Reinforcement

For the Reinforcement CAF the RSN is considered to be the secure three feeder 11kV network comprising the two feeders from Primary Substation A and the new feeder from Primary Substation B as this new feeder is capable of feeding either of the existing circuits. The numerator in the CAF calculation is based upon the Required Capacity of the new development, i.e. 2MVA. In this case, the New Network Capacity (under secure N -1 conditions) following the Reinforcement works is equal to $(3 - 1) \times 7.7\text{MVA} = 15.4\text{MVA}$

Fault Level CAF calculation: This Scheme does not have any significant Fault Level contribution to the existing shared use distribution network and Fault Level CAF is therefore not applicable here.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Work			
1300m of 11kV Cable	£130,000	$2/15.4 \times 100\% = 13.0\%$	£16,883
11kV Circuit Breaker at Primary Substation B	£45,000	As above	£5,844
11kV jointing at Point B	£3,000	As above	£390
Total Reinforcement Cost	£178,000		£23,117

Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Work			
1200m of 11kV Cable	£120,000	n/a	£120,000
3 by 800kVA distribution substations	£150,000	n/a	£150,000
On site LV mains and services	£330,000	n/a	£330,000
Non-Contestable Work			
2 by 11kV closing joints	£5,000	n/a	£5,000
Total Extension Asset Cost	£605,000		£605,000
CIC Charges			£3,500

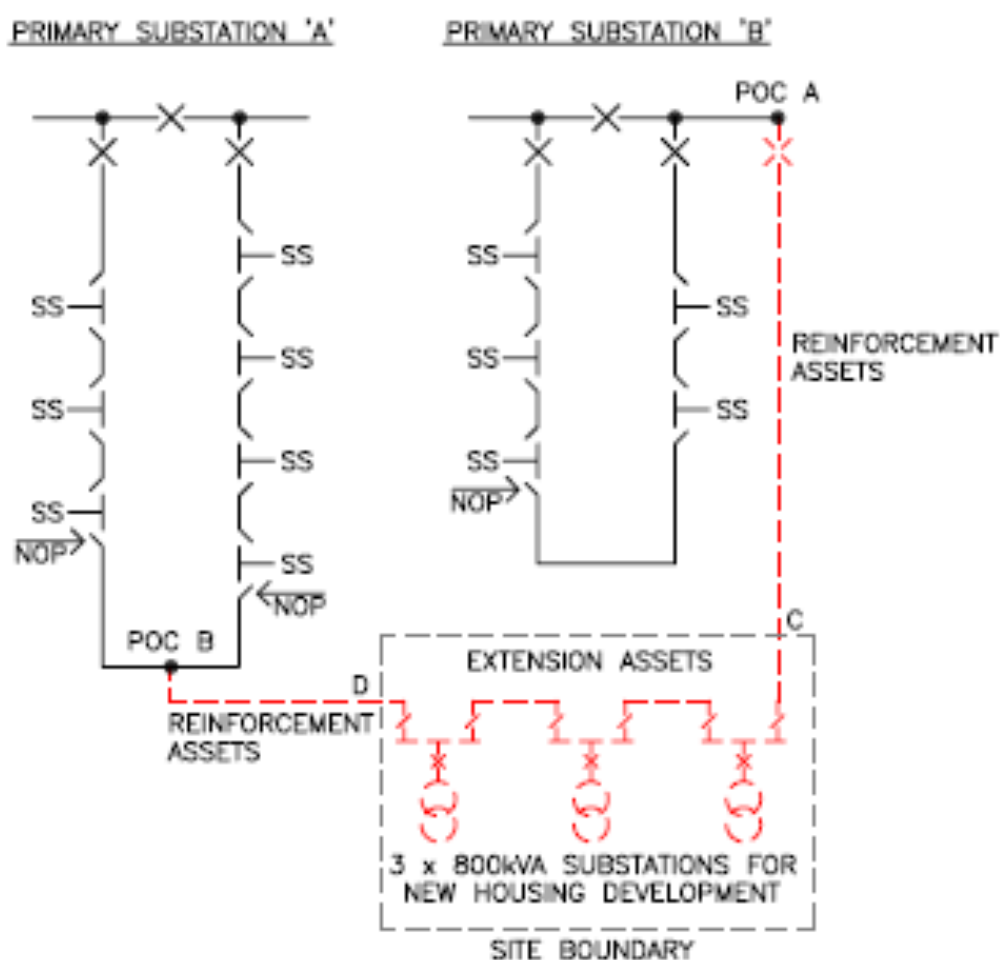
Total Connection Charge = £23,117 + £605, 000 = £628,117

Example 8B: Connection of housing development

This example demonstrates the application of Exception 5 (paragraph 1.21)

In this variation of the previous Example the site is closer to Primary Substation B and the Minimum Scheme is to connect the new load to the new 11kV feeder from Primary Substation B and provide interconnection to an existing secure 11kV feeder from Primary Substation A. In this Example 600m of 11kV cable on site (between Points C and D) is required to provide connectivity within the development and is considered to be Extension Assets.

The figure below shows the proposed network.



The assets connecting POC A and POC B add capacity to the existing network, so would normally be treated as Reinforcement. These comprise –

- the assets between the Customer's site and POC A (POC A to point C);
- the assets between the Customer's site and POC B (POC B to point D); and
- the 600m of 11kV cable on site.

The three 800kVA substations are not considered to provide connection between POC A and POC B. The 600m of 11kV cable on site is additional network length to provide connectivity between multiple exit points on the Customer's site. Therefore, Exception 5 applies and the 600m of 11kV cable on site will be treated as Extension Assets and its costs will be charged in full to the customer. No exceptions apply to the assets between POC A and point C and POC B and point D. Therefore, these will be treated as Reinforcement and their costs will be apportioned.

Reinforcement:

The RSN for the Reinforcement

The RSN is considered to be the secure three feeder 11kV network comprising the two feeders from Primary Substation A and the new feeder from Primary Substation B. As in the above example the numerator in the CAF calculation is based upon the Required Capacity of the new development, i.e. 2MVA. In this case, however the work to provide the connection will increase the capacity of the existing shared use Distribution System from 7.7MVA to 15.4MVA. The New Network Capacity (under secure N -1 conditions) following the Reinforcement works is equal to $(3 - 1) \times 7.7\text{MVA} = 15.4\text{MVA}$

Fault Level CAF calculation: This Scheme does not have any significant Fault Level contribution to the existing shared use Distribution System and Fault Level CAF is therefore not applicable here.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Works			
1 new 11kV Circuit Breaker tailed out from primary substation B	£45,000	2/15.4 x 100% = 13.0%	£5,844
2 by 11kV closing joints	£5,000	As above	£649
700m of 11kV cable from primary B to site	£70,000	As above	£9,091
600m of 11kV cable from POC B to site	£60,000	As above	£7,792
Total Reinforcement Cost	£180,000		£23,376

Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Works			
600m of 11kV cable on site	£60,000	n/a	£60,000
3 by 800KVA unit Substation	£150,000	n/a	£150,000
On site LV mains and services	£330,000	n/a	£330,000
Non-Contestable Work			
2 by 11kV cable box terminations	£2,000	n/a	£2,000
Total Extension Asset Cost	£542,000		£542,000
CIC Charges			£3,500

Total Connection Charge = £23,376 + £542, 000 = £565,376

Example 8C: Connection of housing development with remote network Reinforcement

This further variation shows the arrangements that will apply where it is necessary to reinforce a different part of the Distribution System so that existing demand may be transferred in order to release capacity for the new connection.

A new housing development has a Required Capacity of 2MVA to serve 900 plots. The local 11kV feeder has a network capacity of 7.7MVA based upon the limitation of the existing 400 Amp circuit breakers at Primary Substation A. The existing load on the circuit is 7.6MVA. It is therefore not possible to connect the new load to this circuit without Reinforcement works.

It is proposed to reinforce an adjacent network so that two existing substations may be transferred on to it, in order to release capacity so that the new connections can be made. Primary Substation B has sufficient spare capacity to accommodate the two existing substations. A new circuit breaker is to be installed at Primary Substation B and a new 11kV feeder (also rated at 7.7MVA) is to be installed between points A – B and between points E – F for connection to the local 11kV circuit at point F. The existing circuit will be cut at point BE so that the new joints can be made. This will convert the Primary Substation B network from a two-feeder to a three-feeder network. The total new cable length between points A – B and points E - F is 500m. The network will be reconfigured by the installation of two short straps C – D and G - H in order to maintain connectivity.

This Reinforcement will allow a POC to be taken from the local 11kV circuit to supply the new development. The newly installed cable to connect the development from the POC is 1200m long. Three 800kVA distribution substations are to be established onsite. The above work represents the Minimum Scheme to provide connections to the new site.

Reinforcement:The RSN for the Reinforcement

For the Reinforcement CAF the RSN is the three-feeder network from Primary Substation B which supplies the loads on the existing two feeders from Primary Substation B as well as the loads at points C and D transferred from the network from the Primary Substation A. The Relevant Section of Network does not supply the new development in this case. The numerator in the CAF calculation is based upon the Required Capacity of the new development, i.e. 2MVA. In this case, the New Network Capacity (under N-1 conditions) following the Reinforcement works is equal to $(3 - 1) \times 7.7\text{MVA} = 15.4\text{MVA}$.

Fault Level CAF calculation: This Scheme does not have any significant Fault Level contribution to the existing shared use distribution network and Fault Level CAF is therefore not applicable here.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Work			
500m of 11kV cable: A-B, C-D, E-F	£50,000	$2/15.4 \times 100\% = 13\%$	£6,500
11kV Circuit Breaker at Primary Substation B	£45,000	As above	£5,844
11kV jointing at Points A,B,C,D,E,F	£10,000	As above	£1,300
Total reinforcement cost	£105,000		£13,644

Extension Assets:

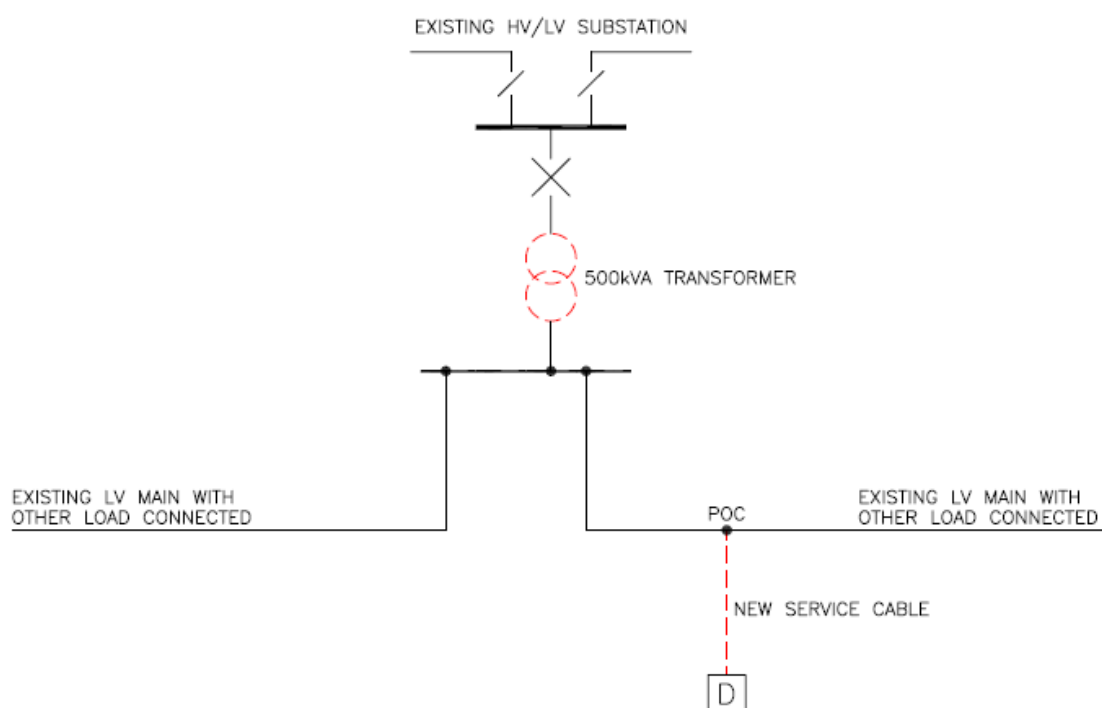
	Cost	Apportionment	Customer Contribution
Contestable Work			
1200m of 11kV cable inc. strap at G - H	£120,000	n/a	£120,000
3 by 800kVA distribution substations	£150,000	n/a	£150,000
On site LV mains and services	£330,000	n/a	£330,000
Non Contestable Work			
4 by 11kV closing joints at POC and at points G,H	£10,000	n/a	£10,000
Total extension asset cost	£610,000		£610,000
CiC charges			£3,500

Total Connection Charge = £13,644 + £610,000 = £623,644

Example 9: Minimum Scheme

A Customer requests a new 100kVA connection. There is sufficient spare capacity on the adjacent LV main but the existing 300kVA transformer at the local 11kV/LV substation is fully loaded.

- (a) The Minimum Scheme is to provide a new service cable and to replace the 300kVA transformer at the local substation with a 500kVA transformer.



Reinforcement:

The RSN for the Reinforcement is the HV/LV transformer

Security CAF calculation: the numerator in the CAF calculation is based upon the Required Capacity of the Customer, i.e. 100kVA. The denominator is based on the New Network Capacity following Reinforcement, i.e. 500kVA.

Fault Level CAF calculation: This scheme does not have any significant Fault Level contribution to the existing shared use distribution network and Fault Level CAF is therefore not applicable here.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

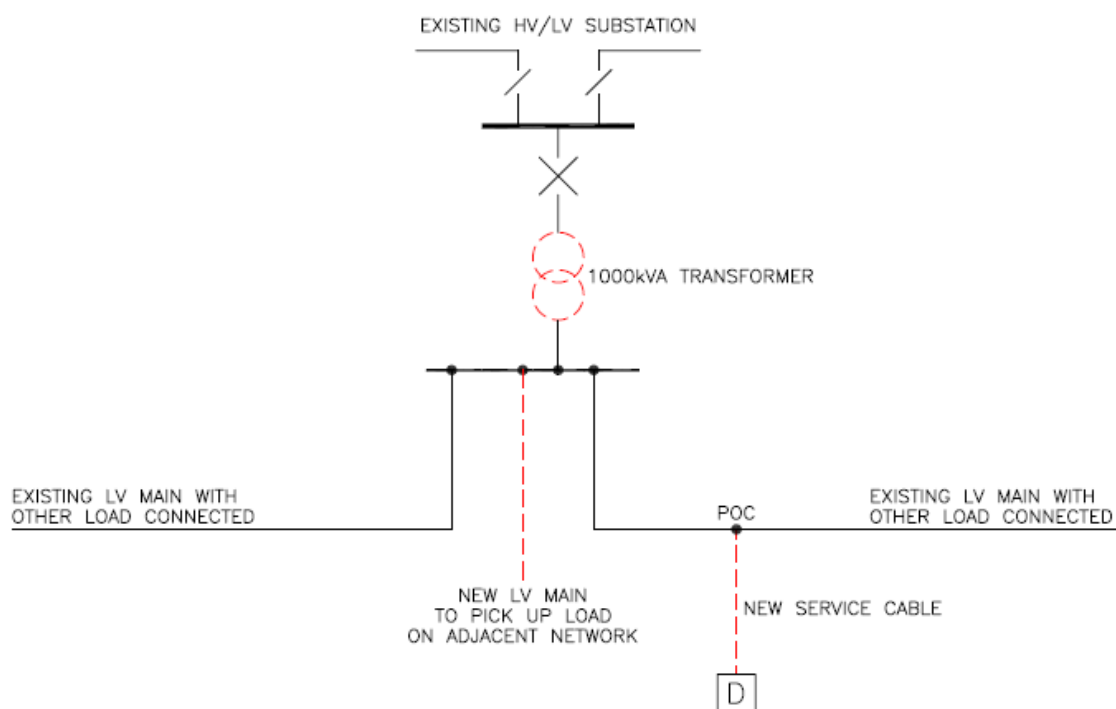
	Cost	Apportionment	Customer Contribution
Non Contestable Work			
Replacement 500kVA transformer	£10,000	$100/500 \times 100\% = 20.0\%$	£2,000
Total Reinforcement Cost	£10,000		£2,000

Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Work			
Provision and installation of LV service cable	£1,500	n/a	£1,500
Non-Contestable Work			
LV joints to network	£500	n/a	£500
Total Extension Asset Cost	£2,000		£2,000
CIC Charges			£200

Total Connection Charge = £2,000 + £2,000 = £4,000

- (b) However the DNO wishes to carry out an Enhanced Scheme to install a 1000kVA transformer at the local substation and install a new LV main that will connect to and pick up load from an adjacent LV network.



The RSN for the Reinforcement is the HV/LV transformer

Security CAF calculation: the numerator in the CAF calculation is based upon the Required Capacity of the Customer, i.e. 100kVA. The denominator is based on the New Network Capacity following Reinforcement, i.e. 1000kVA.

Fault Level CAF calculation: This scheme does not have any significant Fault Level contribution to the existing shared use distribution network and Fault Level CAF is therefore not applicable here.

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Work			
Replacement 1000kVA transformer	£15,000	100/1000 x 100% = 10.0%	£1,500
Total Reinforcement Cost	£15,000		£1,500

Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Work			
Provision and installation of LV service cable	£1,500	n/a	£1,500
Non-Contestable Work			
LV joints to network	£500	n/a	£500
Total Extension Asset Cost	£2,000		£2,000
CIC Charges			£200

Total Connection Charge = £1,500 + £2,000 = £3,500

The cost of the new LV mains will be met by us and does not form part of the Connection Charge.

In this instance the Connection Charge resulting from the Enhanced Scheme is lower than that resulting from the Minimum Scheme and the Customer would benefit from the lower Connection Charge and pay £3,500 (paragraph 1.5 refers).

- (c) If, however under the proposed DNO Scheme the transformer cost was £25,000 then the resultant Connection Charge would be considered as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Work			
Replacement 1000kVA transformer	£25,000	$100/1000 \times 100\% = 10.0\%$	£2,500
Total Reinforcement Cost	£25,000		£2,500

Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Work			
Provision and installation of LV service cable	£1,500	n/a	£1,500
Non-Contestable Work			
LV joints to network	£500	n/a	£500
Total Extension Asset Cost	£2,000		£2,000
CIC Charges			£200

Total Connection Charge = £2,500 + £2,000 = £4,500 but in this instance the Customer contribution will be capped at the contribution that would have been due under the Minimum Scheme, i.e. £4,000 (paragraph 1.5 refers).

Reinforcement:

Security CAF calculation: In this example there are two different security CAFs applied. This is because the RSN is different when considering the new network capacity in respect of different elements of the Reinforcement works.

The RSN for the Reinforcement comprising the 11kV Cable Works:

For the 11kV cable assets the RSN is considered to be the secure three feeder 11kV network from Primary A (Feeder 2), Primary C (Feeder 2) and Primary E (Feeder 1). In this case the New Network Capacity (under secure N -1 conditions) following the Reinforcement works is equal to

$$(3 - 1) \times 7.7\text{MVA} = 15.4\text{MVA}$$

This is due to the fact that following the Reinforcement work both of the existing circuits; Primary A, Feeder 2 and Primary C, Feeder 2 can be loaded to their full capacity and will have the newly installed clean feeder from Primary E to act as a back feed to meet the requirements of P2/6.

The security CAF for these assets will therefore be $4/15.4 \times 100\% = 26.0\%$

The RSN for the Reinforcement comprising the Primary substation assets:

In this instance the RSN comprises Primary A, C and E within the group that can be used to supply the customer. The New Network Capacity of this RSN (under secure N -1 conditions) following the Reinforcement works is equal to 17.7MVA. (10MVA from either Primary A or Primary C and 7.7MVA from Primary E which is limited by the single 11kV cable connected to it.

The security CAF for these assets will therefore be $4/17.7 \times 100\% = 22.6\%$

Fault Level CAF calculation: This Scheme does not have any significant Fault Level contribution to the existing shared use distribution network and Fault Level CAF is therefore not applicable here.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Works			
500m 11kV cable from new primary substation E	£50,000	4/15.4 X 100% = 26.0%	£12,987
1 by 11kV closing joints	£4,000	As above	£1,039
11kV switchgear at new Primary E	£80,000	4/17.7 X 100% = 22.6%	£18,079
Primary transformer	£600,000	As above	£135,593
2.5km of 33kV cable installation	£500,000	As above	£112,994
33kV Circuit Breaker	£70,000	As above	£15,819
33kV Terminations	£10,000	As above	£2,260
Total Reinforcement Cost	£1,314,000		£298,771

Extension Assets:

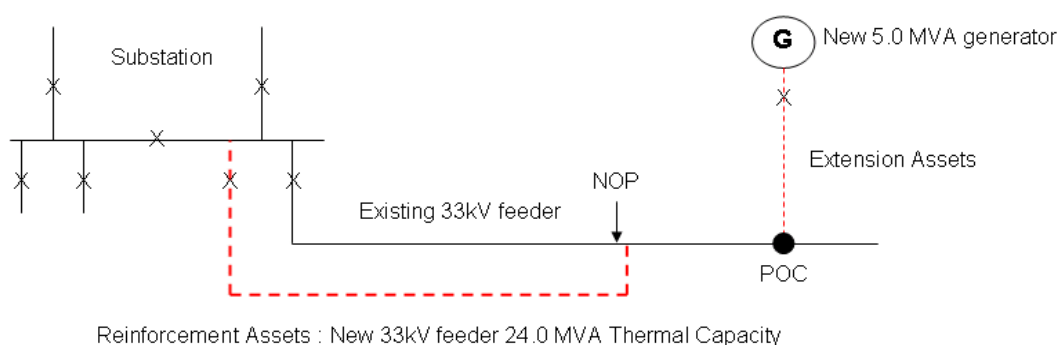
	Cost	Apportionment	Customer Contribution
Contestable Work			
HV ring main unit	£20,000	n/a	£20,000
HV metering unit	£10,000	n/a	£10,000
500m of 11kV cable	£100,000	n/a	£100,000
Non-Contestable Work			
2 by 11kV closing joints	£5,000	n/a	£5,000
Total Extension Asset Cost	£135,000		£135,000
CIC Charges			£3,500

Total Customer Contribution = £298,771 + £135,000 = £433,771

Example 11: Non-Secure Connection With Non-Secure Reinforcement

A Customer wishes to connect a new generator with a Required Capacity for export purposes of 5 MVA. The connection of the generator requires the installation of 1,000m of 33kV cable and a 33kV metering circuit breaker, these being Extension Assets. An existing spare circuit breaker at the substation is utilised which, in this case, is not chargeable to the Customer.

As there is insufficient capacity in the existing 24.0 MVA thermal capacity rated 33kV feeder for the new generation due to the presence of existing generation, the connection also requires the installation of a new 33kV feeder, which also has a thermal capacity of 24.0 MVA, as Reinforcement. This is the Minimum Scheme as it is cheaper to do this, to the extent as shown in the diagram below, rather than upgrade the existing 33kV feeder to the same point along it.



Reinforcement:

The numerator in the CAF calculation is the Required Capacity of the new generator, which is 5.0 MVA.

The Relevant Section of Network in this case is the existing 33kV feeder and the new 33kV feeder. The New Network Capacity is calculated using the non-secure capacity and is therefore the sum of the thermal capacities of the two feeders, which is 48.0 MVA. This is the denominator in the CAF calculation.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Contestable Work			
Installation of new 33kV feeder	£ 500,000	$5.0 / 48.0 \times 100\% = 10.4\%$	£ 52,000
Total Reinforcement Cost	£ 500,000		£ 52,000

Extension Assets:

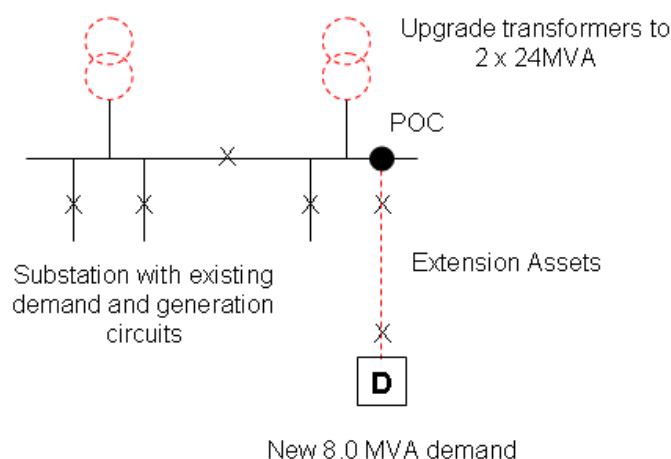
	Cost	Apportionment	Customer Contribution
Contestable Work			
Installation of 1,000m 33kV cable	£ 200,000	n/a	£ 200,000
Installation of 33kV metering circuit breaker	£ 70,000	n/a	£ 70,000
Non-Contestable Work			
Joints to 33kV network	£ 10,000	n/a	£ 10,000
Total Extension Asset Cost	£ 280,000		£ 280,000
CIC Charges			£ 3,500

Total Connection Charge = £ 52,000 + £ 280,000 = £ 332,000

Example 12: Non-Secure Connection With Secure Reinforcement

A Customer requests a new connection to industrial premises requiring an 8 MVA metered demand connection. In this case, the Customer has exercised their option to request non-secure Extension Assets in the provision of the connection.

The existing network comprises a substation which has 2 x 15 MVA transformers. The Minimum Scheme to provide the connection is to install 750m of 11 kV cable from the substation to the industrial premises, as Extension Assets. As there is insufficient capacity available from the existing 2 x 15 MVA transformers to provide the new connection, it will be necessary to upgrade the transformers to 2 x 24 MVA units. Both transformers at the substation must be upgraded to ensure the 11kV network load can be maintained during planned or unplanned outages of one of the transformers. Although the Customer wishes to accept a non-secure connection, the substation must provide secure capacity to its Group Demand (which includes the Customer) to comply with the requirements of Engineering Recommendation P2/6. As the Extension Assets will be provided solely for the Customer, these can be provided on the basis of a single circuit to provide a non-secure connection, at the Customer's request.



Reinforcement:

The numerator in the CAF calculation is the Required Capacity of the new demand, which is 8.0 MVA.

The Relevant Section of Network in this case is the transformers at the substation. The New Network Capacity is the secure capacity of the transformers, which is 24 MVA. This is the denominator in the CAF calculation.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non-Contestable Work			
Installation of 2 x 24 MVA 33/11 kV transformers	£ 1,500,000	$8.0 / 24.0 \times 100\% = 33.3\%$	£ 500,000
Total Reinforcement Cost	£ 1,500,000		£ 500,000

Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Work			
Installation of 750m 11kV cable	£ 75,000	n/a	£ 75,000
Installation of 11kV metering circuit breaker	£ 50,000	n/a	£ 50,000
Non-Contestable Work			
Joints to 11kV network	£ 5,000	n/a	£ 5,000
Total Extension Asset Cost	£ 130,000		£ 130,000
CIC Charges			£ 1,100

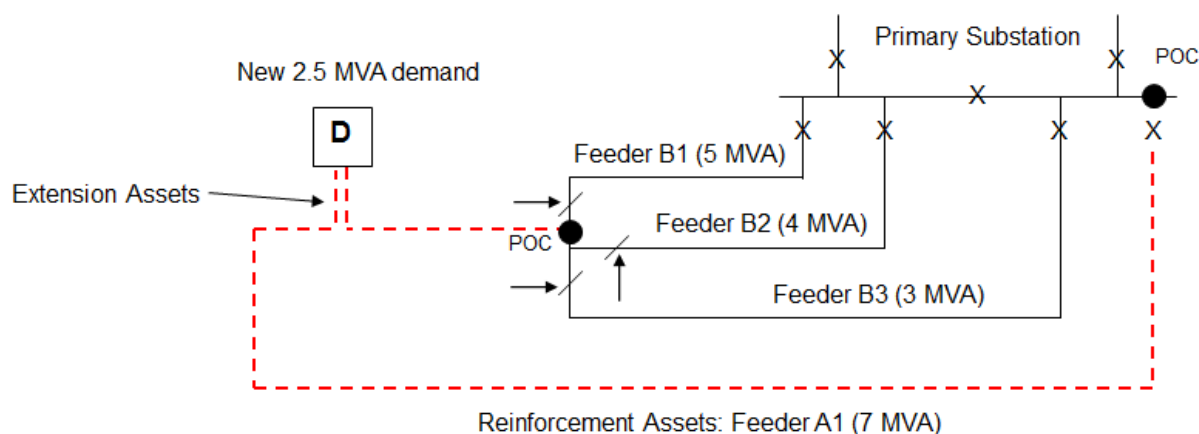
Total Connection Charge = £ 500,000 + £ 130,000 = £ 630,000

Example 13: Secure Connection With Secure Reinforcement

A Customer requests a new connection to commercial premises which has a Required Capacity of 2.5 MVA. The connection is to be provided on a secure basis and the Minimum Scheme is as shown.

On the existing network, only Feeder B1 has sufficient thermal capacity available to accommodate the additional demand. To comply with demand security requirements, it is necessary to install a new feeder (Feeder A1) with a thermal capacity of 7 MVA, as a Reinforcement of the network.

The Extension Assets in this case are two 11 kV cable circuits of 25m each.



Reinforcement:

If sufficient capacity had been available in the existing network, only two of the existing feeders would have been required to provide the required security. To determine which two feeders are relevant, the feeders with the closest ratings to the new feeder are considered.

In this case, Feeders B1 (5 MVA) and B2 (4 MVA) have the closest ratings to the new Feeder A1 (7 MVA). Therefore, the Relevant Section of Network is (B1 and B2) and A1. Note that the RSN will at most be limited to a three-feeder ring.

The New Network Capacity is determined by applying $(N - 1)$ security to the three-feeder RSN. This gives a secure NNC of $(5 \text{ MVA} + 4 \text{ MVA}) = 9 \text{ MVA}$. This recognises the possible loss of feeder A1 and supply through Feeder B1.

Therefore, the numerator in the CAF calculation is the Required Capacity of 2.5 MVA and the denominator is the New Network Capacity of 9.0 MVA.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Contestable Work			
Installation of new 11kV feeder	£ 250,000	$2.5 / 9.0 \times 100\% = 27.8\%$	£ 69,500
Total Reinforcement Cost	£ 250,000		£ 69,500

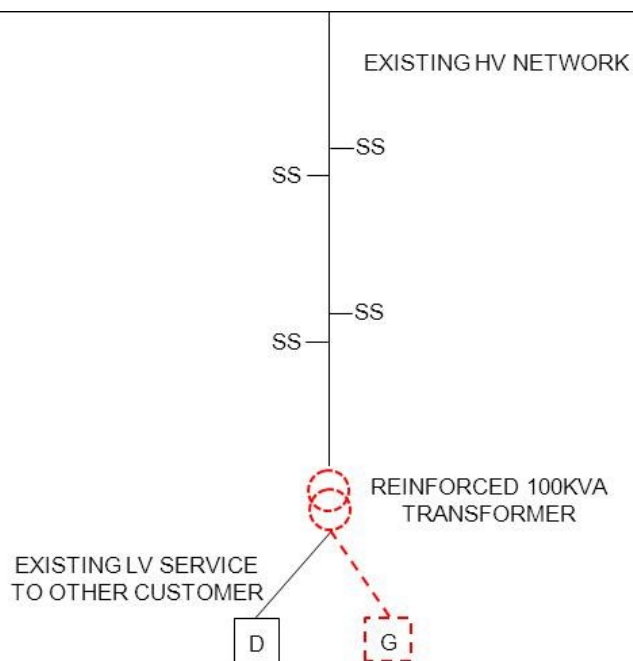
Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Work			
Installation of 2 x 25m 11kV cable	£ 10,000	n/a	£ 10,000
Installation of 2 x 11kV metering circuit breakers	£ 100,000	n/a	£ 100,000
Non-Contestable Work			
Joints to 11kV network	£ 5,000	n/a	£ 5,000
Total Extension Asset Cost	£115,000		£115,000
CIC Charges			£ 1,100

Total Connection Charge = £ 69,500 + £ 115,000 = £ 184,500

Example 14: New 25kVA Generation Connection, Voltage Rise Triggered Reinforcement

An existing Customer wishes to connect a new generator with a Required Capacity for export of 25kVA. The Minimum Scheme for connection of the generator requires the local 25kVA pole mounted transformer to be reinforced with a 100kVA split phase transformer in order to keep voltage rise within acceptable limits. A new 95mm² service cable is to be installed to the premises.



Reinforcement:

The RSN for the Reinforcement is the HV/LV transformer.

Security CAF calculation: the numerator in the CAF calculation is the Required Capacity of the Customer, i.e. 25kVA. The denominator is the New Network Capacity following Reinforcement, this being the maximum generation output that could be connected whilst keeping the voltage rise within acceptable limits, i.e. 40kVA in this case.

Fault Level CAF calculation: this scheme does not have any significant Fault Level contribution to the existing shared use distribution network and Fault Level CAF is therefore not applicable here.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Work			
Replacement 100kVA transformer	£15,000	25/40 x 100% = 62.5%	£9,375
Total Reinforcement Cost	£15,000		£9,375

Extension Assets:

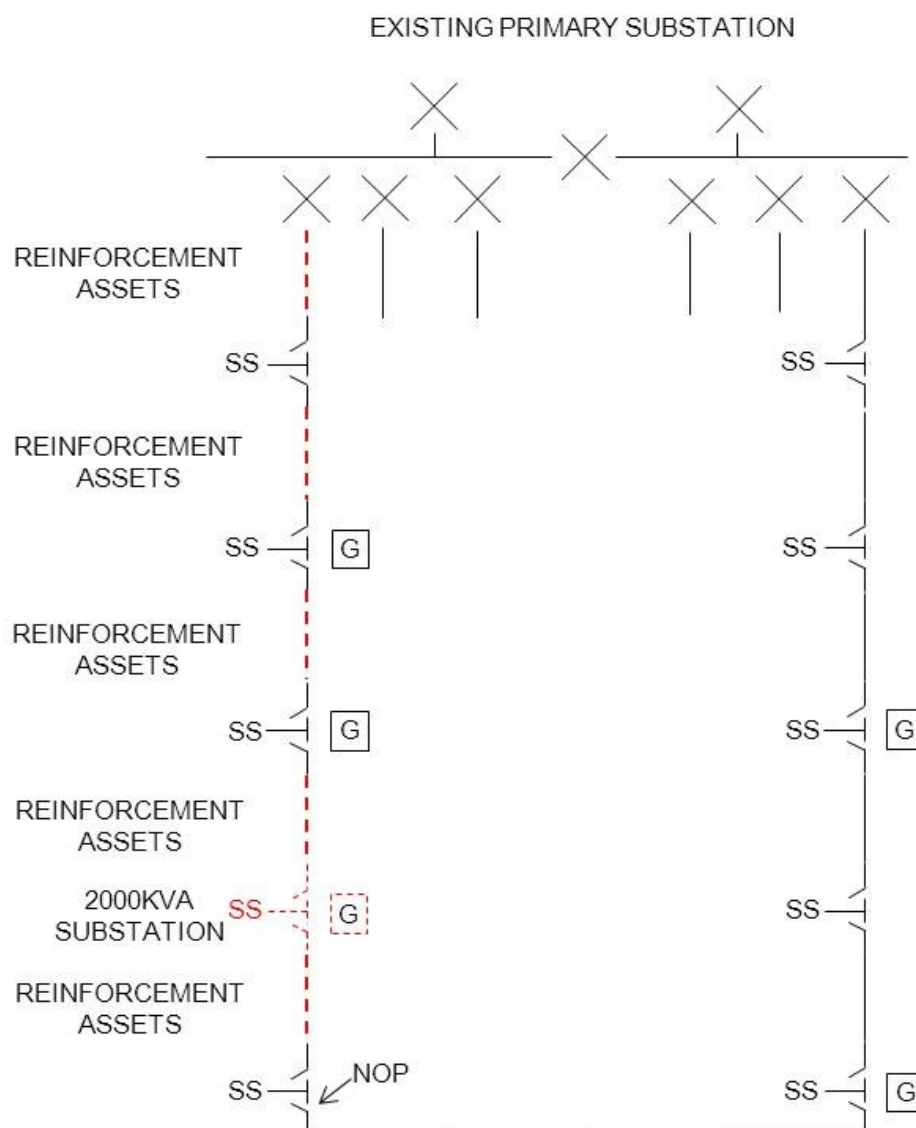
	Cost	Apportionment	Customer Contribution
Contestable Work			
Provision and installation of LV service cable	£1,500	n/a	£1,500
Non-Contestable Work			
LV joints to network	£500	n/a	£500
Total Extension Asset Cost	£2,000		£2,000
CIC Charges			£200

Total Connection Charge = £9,375 + £2,000 = £11,375

(Note – for simplicity, the high-cost generation project threshold of £200/kW has been ignored in this example, but would apply in respect of the costs illustrated. Refer to paragraph 1.15.)

Example 15: New 2MVA Generation Connection, Voltage Rise Triggered Reinforcement

A Customer wishes to connect a new generator with a Required Capacity for export purposes of 2MVA. The local 11kV feeder has a large amount of generation already connected and will need to be reinforced in order to keep voltage rise within acceptable limits. The Minimum Scheme requires Reinforcement of the existing 185mm² 11kV underground cable with 300mm² underground cable and installation of a new substation for connection of the 2MVA export capacity. The total length of the reinforced cable is 2km. The thermal rating of the 300mm² underground cable is 8MVA. The 11kV underground cable on the other side of the normal open point is already 300mm² and does not require to be reinforced.



Reinforcement:

The RSN for the Reinforcement is the 11kV feeder.

Security CAF calculation: the numerator in the CAF calculation is the Required Capacity of the Customer, i.e. 2MVA. The denominator is the New Network Capacity following Reinforcement, this being the maximum generation that could be connected whilst keeping the voltage rise within acceptable limits, i.e. 6MVA in this case.

Fault Level CAF calculation: this scheme does not have any significant Fault Level contribution to the existing shared use distribution network and Fault Level CAF is therefore not applicable here.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Work			
2km 300mm 11kV cable	£200,000	2/6 x 100% = 33.3%	£66,666
Total Reinforcement Cost	£200,000		£66,666

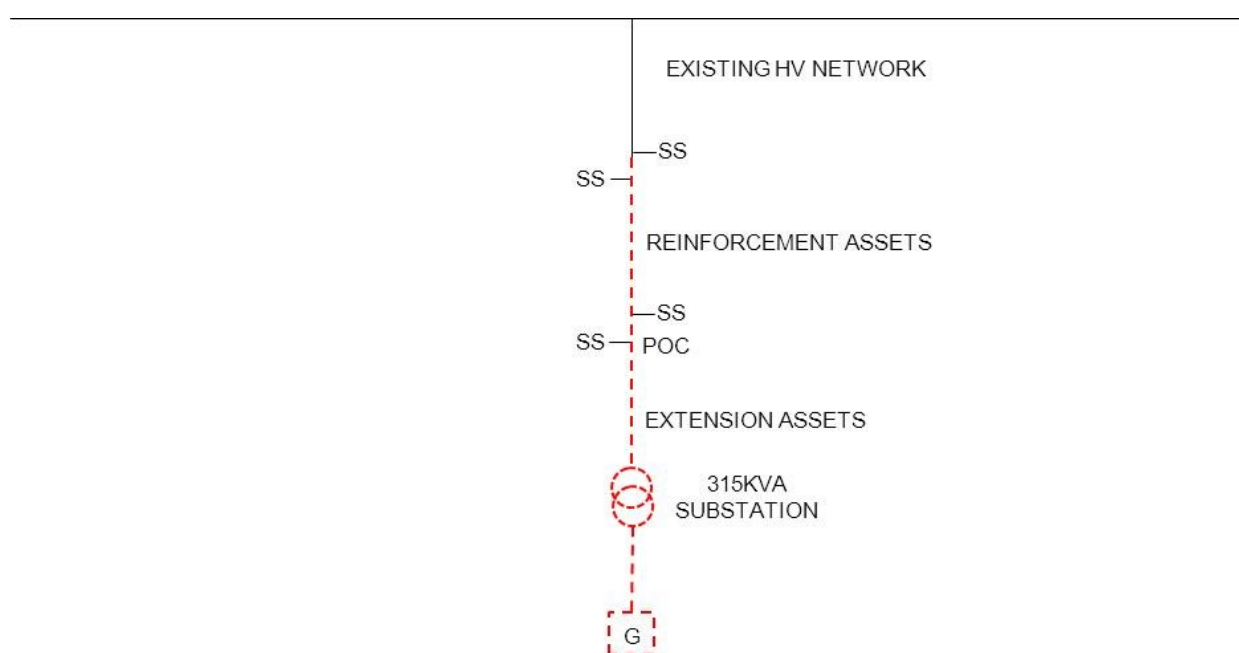
Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Work			
2MVA 11kV substation	£40,000	n/a	£40,000
Non-Contestable Work			
2 by 11kV closing joints	£5,000	n/a	£5,000
Total Extension Asset Cost	£45,000		£45,000
CIC Charges			£200

Total Connection Charge = £66,666 + £45,000 = £111,666

Example 16: New 250kVA Generation Connection, Voltage Rise Triggered Reinforcement

A Customer wishes to connect a new generator with a Required Capacity for export of 250kVA. The Minimum Scheme for connection of the generator requires the local 11kV overhead line to be reinforced with 100mm² conductor over part of its length in order to keep voltage rise within acceptable limits. The thermal capacity of the 100mm² overhead line is 5MVA. The thermal capacity of the original 50mm² overhead line is 3MVA. A new 315kVA ground mounted substation requires to be installed at the premises. The overhead line is 1km in length but only 500m is required to be reinforced in order to keep voltage rise within acceptable limits.



Reinforcement:

The RSN for the Reinforcement is the 11kV overhead line.

Security CAF calculation: the numerator in the CAF calculation is the Required Capacity of the Customer, i.e. 250kVA. The denominator is the New Network Capacity following Reinforcement, this being the maximum generation that could be connected whilst keeping the voltage rise within acceptable limits. As the length of overhead line to be reinforced has been determined to accommodate the 250kVA requirement only, then this is also 250kVA in this case.

Fault Level CAF calculation: this scheme does not have any significant Fault Level contribution to the existing shared use distribution network and Fault Level CAF is therefore not applicable here.

The Connection Charge for this Scheme is calculated as follows:

Reinforcement:

	Cost	Apportionment	Customer Contribution
Non Contestable Work			
Replacement 11kV overhead line conductor	£25,000	250/250 x 100% = 100%	£25,000
Total Reinforcement Cost	£25,000		£25,000

Extension Assets:

	Cost	Apportionment	Customer Contribution
Contestable Work			
Provision and installation of 315kVA substation	£50,000	n/a	£50,000
Non-Contestable Work			
11kV joint to network	£1,000	n/a	£1,000
Total Extension Asset Cost	£51,000		£51,000
CIC Charges			£200

Total Connection Charge = £25,000 + £51,000 = £76,000