Electricity Distribution

nationalgrid

Company Directive

STANDARD TECHNIQUE: SD4D

The use of Simplified Load Flow Techniques for 11kV Network Design

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Implementation Date: October 2017

Approved by

Policy Manager

Date: 26 October 2017

All references to Western Power Distribution or WPD must be read as National Grid Electricity Distribution or NGED

IMPLEMENTATION PLAN

Introduction

This document specifies the requirements for using simplified load flow analysis techniques. These simplified techniques may be used by WPD Planners and by ICPs where the relevant criteria are met.

Main Changes

This is a new document

Impact of Changes

This document provides a simplified load flow assessment method for 11kV network design. The document is relevant to all WPD staff and contractors and to ICPs involved with the design of WPDs 11kV Network.

Implementation Actions

Managers shall ensure that all staff and contractors involved in the design of WPD HV networks are aware of and follow the requirements of this Standard Technique.

Implementation Timetable

This document is implemented with immediate effect.

REVISION HISTORY

Document Revision & Review Table		
Date	**Comments**	**Author**
October 2017	• This is a new document	Andy Hood / Seth Treasure

INTRODUCTION

1.1 This document specifies a simplified load flow technique that may be used for analysing WPDs 11kV network when certain criteria are satisfied. The document shall be read in conjunction with the ST: SD4A (Design of Western Power Distribution's 11kV and 6.6kV networks) and ST: SD1F Competition in Connections Code of Practice – Procedure for Network analysis by Independent Connection Providers).

1.4 Where the pre-conditions specified within 3.2 are not satisfied detailed analysis shall be carried out using appropriate A.C. load flow software (e.g. DINIS or equivalent) instead.

2.0 SCOPE

2.1 This document applies to the assessment of new 11kV connections only. Further restrictions are listed in Section 3.0.

2.2 ICPs may only self determine the point of connection of a new load where the criteria specified in ST:SD1F are satisfied.

3.0 REQUIREMENTS

3.1 The detailed requirements for the design of 11kV and 6.6kV networks are specified in ST: SD4A.

3.2 **Pre-conditions**

The detailed A.C. load flow analysis specified in ST: SD4A may be replaced by the simplified load flow analysis techniques where all the following pre-conditions are satisfied:

(a) The network voltage is 11kV (nominal) and 3 phases are provided

(b) The primary substation feeding the 11kV network has more than one primary transformer

(c) The network shall not employ arc suppression coil earthing (ASC).

(d) The 11kV network does not include circuits operating in parallel.

(e) The new / augmented connection or Point of Connection (POC) that is being considered has an export capacity of 50kW or less.

(f) The aggregate export capacity of all the individual connections on each 11kV circuit being considered (including those connections made at LV) is no greater than 1MVA when fed normally. Note, LV generation rated at 16A per phase or below is ignored when making this assessment.

(g) The new / additional load is not expected to increase fault levels significantly. Note, restricting the maximum motor rating (pre-condition (e)) and restricting the export capacity at the new / augmented connection to 50kW (pre-condition (b)) helps to limit the fault level contribution.

(h) The new / additional load must not have an adverse impact on power quality. ST: SD6F includes a list of equipment that is considered to be potentially disturbing. Where such equipment complies with BSEN 61000-3-2 or BSEN 61000-3-12 (Harmonics) and BSEN 61000-3-3 or BSEN 61000-3-11 (Flicker) then the simplified load flow analysis may be applied. Where these standards are not satisfied then detailed analysis is required.

(i) The largest motor being connected is rated at 50kW or less.

(j) The circuit that feeds the new connection and all of the credible back feeds to that circuit comprise entirely of underground cable.

(k) All cable sections have a summer sustained rigiduct rating of 150A or greater. Note, WPD cable ratings are defined in ST: SD8A Part 2. For example, the following cables satisfy this criteria:

- 95mm² Aluminium
- 0.1in² Copper
- 0.15in² Aluminium

(l) The length of each circuit, from the source primary substation circuit breaker to the most remote node (e.g. substation or switch) and most remote Normally Open Point (NOP) does not exceed 2.5km. Note, this requirement must be satisfied after the new / augmented load has been connected to the network.

The above pre-conditions are included in a standard checklist, provided in Appendix C.

3.3 Simplified Load Flow Process

If all of the pre-conditions listed in 3.2 are satisfied then a simplified load flow analysis (that ignores voltage drop / voltage rise) may be carried out. This process is described below and shown in Figure 1. A detailed example is included in Appendix A.

3.3.1 <u>Load Allocation</u>

The first stage is to allocate demand to each substation / HV connection. The same principles are used when a full AC Load Flow Study is carried out. A detailed example is provided in Appendix A.

(a) All the half hour load data (kVA)* for the previous two year period is obtained for the HV circuits concerned. In addition, the half hour export data (kVA) for ≥50kW generator connections, for the previous two year period is also obtained. For each circuit, the associated generator export data is added to the circuit data to provide the maximum demand for each half hour on the circuit (excluding the impact of ≥50kW generation). The data is analysed and any half hour values that appear to be abnormally high (e.g. due to abnormal feeding arrangements) are discarded. The highest credible half hour demand is determined and its time and date noted.
*Separate voltage and current data is provided

(b) All the half hour import data (kVA) for the HV metered connections are obtained and the values that occur at the same date and time as the maximum circuit demand are determined and noted.

(c) For each circuit, the half hour values for the relevant HV metered connections determined in (b) are subtracted from the highest credible half hour demand determined in (a). The resultant for each circuit is the maximum demand that must be allocated to the conventional distribution substations (i.e. excluding HV connections).

(d) The maximum demand determined in (c) is allocated to each substation supplying LV metered connections in proportion to the transformer capacity. If, for example the maximum demand on the circuit is 3000kVA and the aggregate transformer capacity is 9000kVA each substation will be allocated a demand (after diversity maximum demand) of 33.3% of its rating. Note, substations that are only used to supply LV generation (i.e. that have very little connected demand) are excluded from this allocation process.

(e) The existing HV metered connections are then allocated a demand (kVA) based on their Agreed Import Capacity. Where a circuit normally has 2 or less HV metered connections then no diversity is applied. If the circuit has more than 2 HV metered connections then some diversity may be allowed where this is supported by the half hour data obtained in (c).

(f) Where a new / augmented substation feeding LV metered connections (WPD or IDNO LV customers) is being studied a demand equal to the rating of the transformer shall be allocated to the substation (even if the expected demand is lower than the transformer rating). This is because additional load could be added to the transformer (e.g. using the minimal design process defined in ST: SD5B) without re-analysing the HV network. For new or augmented HV metered connections the Agreed Import Capacity is allocated instead.

(g) The allocated kVA demands are converted to amperes (A) using the nominal 11kV voltage. An allocated demand of 200kVA would, for example, be converted to 10.5A.

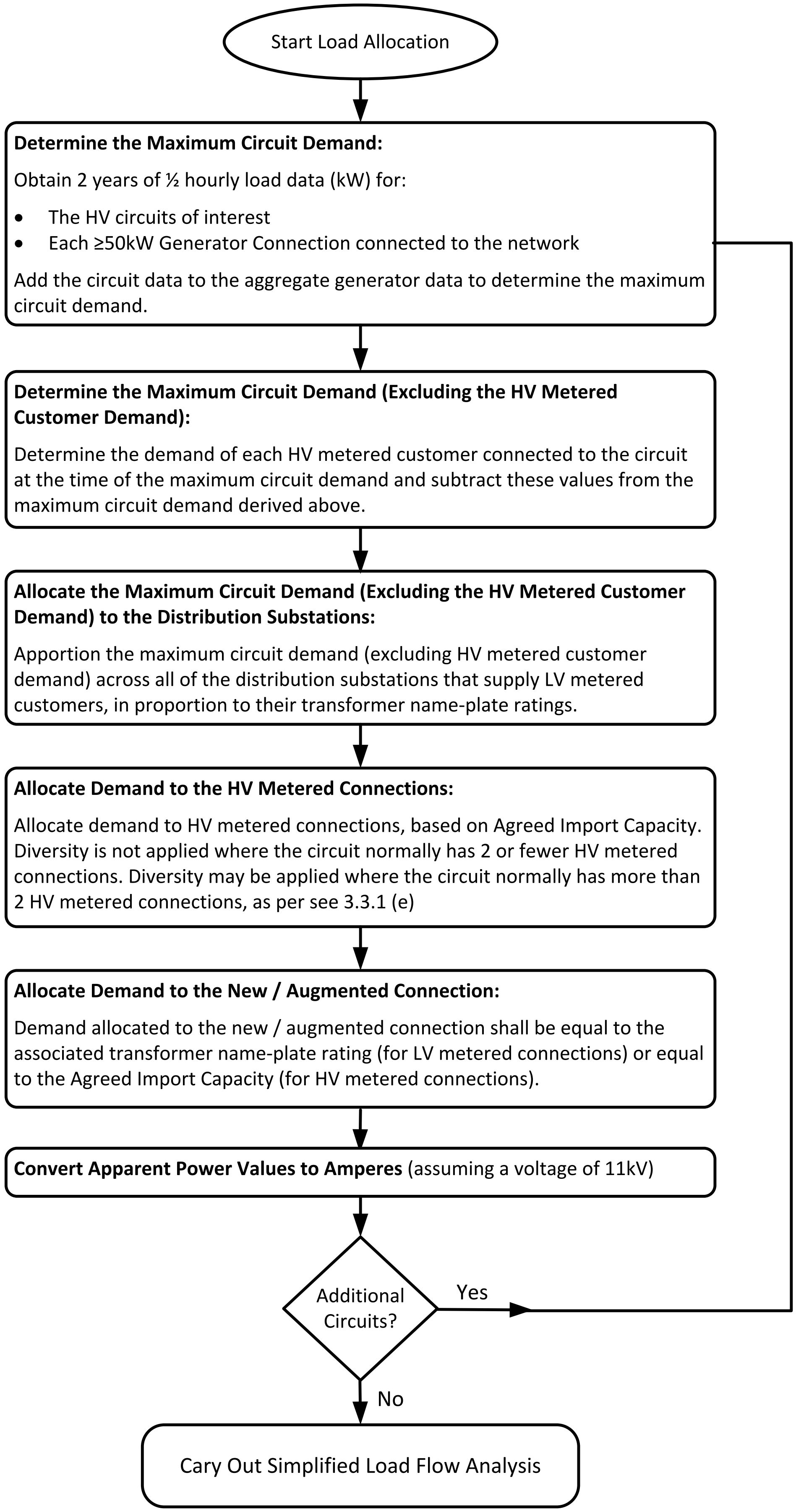

Figure 1 Load Allocation Process

3.3.2 Load Flow

Once the loads (in amperes) have been allocated to each substation / HV connection these values are added together using Kirchhoff's current law, starting at the furthest positions from the source circuit breaker.

Using this process the current flowing through each section and through each cable can be determined, as shown in Figure 2.

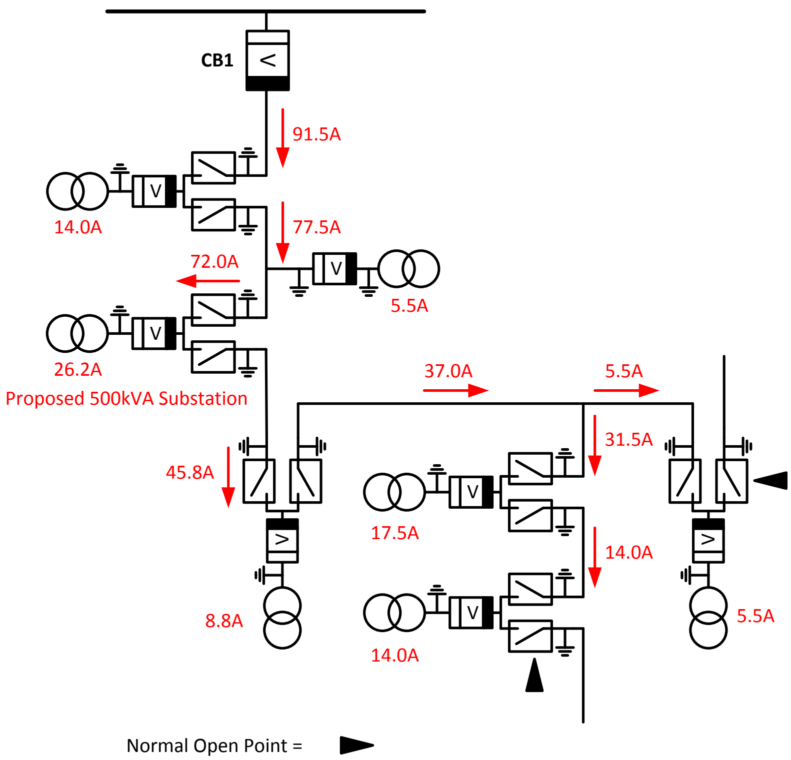

Figure 2 Simplified Load Flow Analysis

A simplified load flow analysis is carried out for the normal feeding arrangement and for any credible back feeds arrangements, including back feeds to adjacent circuits. Typically the most onerous back feed conditions occur when source circuit breakers are opened. Examples of normal and abnormal (back feed) arrangements are given in Figure 3, 4, 5 and 6. Note, for each outage (e.g. circuit breaker 1 switched out) only one back-feed option needs to satisfy the thermal requirements specified in 3.3.3.

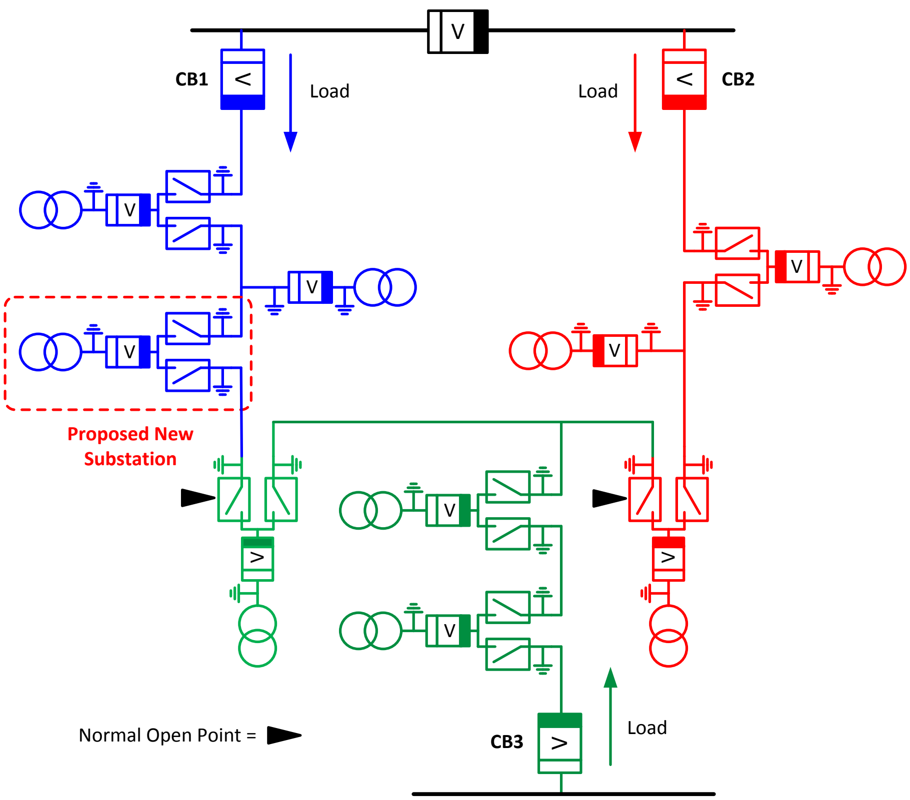

Figure 3 Normal Feeding Arrangement

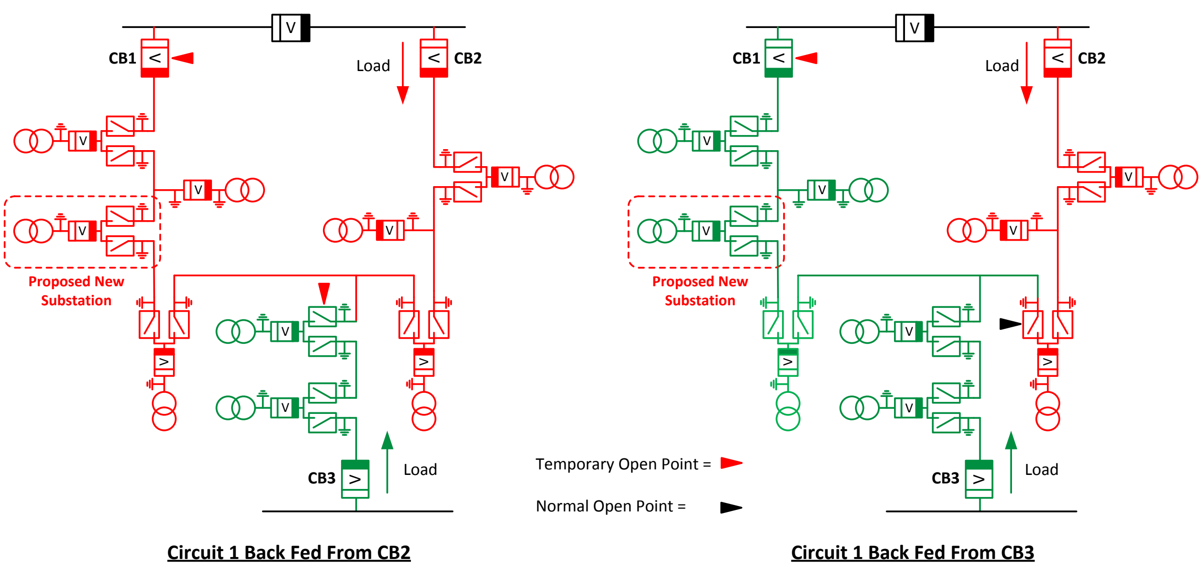

Figure 4 Abnormal Arrangement (Circuit Breaker 1 Open)

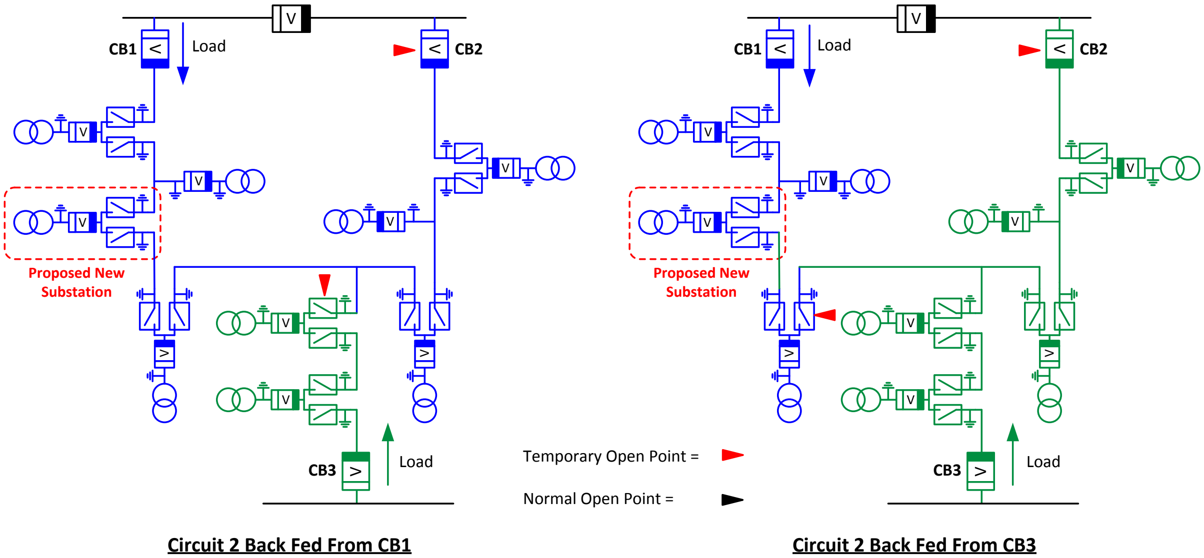

Figure 5 Abnormal Arrangement (Circuit Breaker 2 Open)

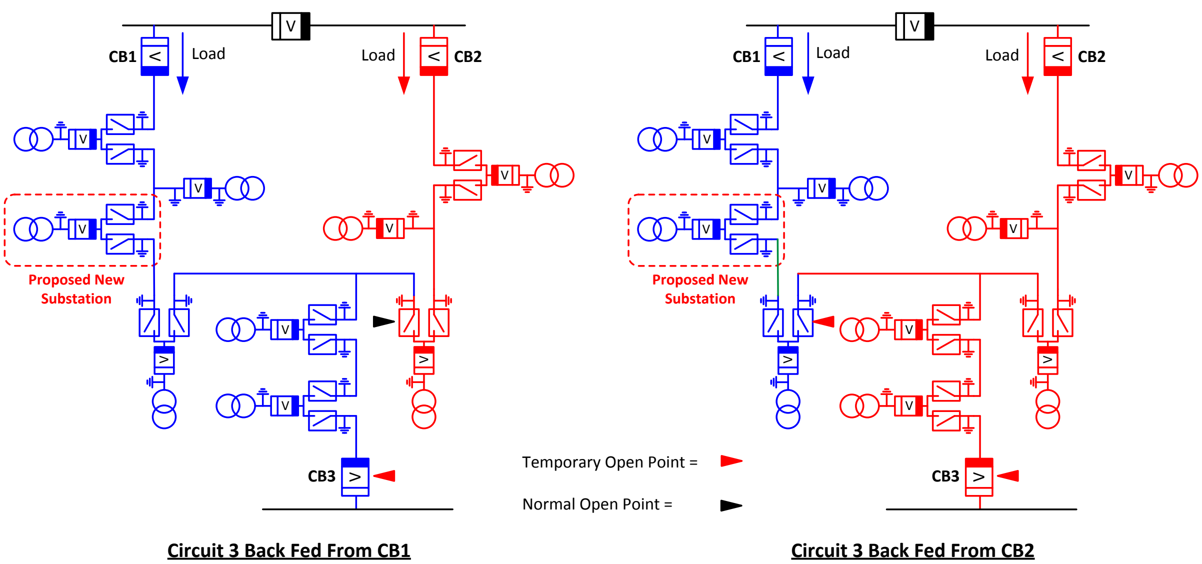

Figure 6 Abnormal Arrangement (Circuit Breaker 3 Open)

3.3.3 Analysis of Results

The proposal is deemed to be acceptable if current flowing through each section of cable is no higher than 66% of its seasonal sustained rigiduct rating when fed normally and no higher than 90% of its seasonal sustained rigiduct rating when fed abnormally. The season selected should align with the period of the maximum demand. Where the circuit maximum demand does not vary significantly between seasons, summer sustained cable ratings shall be used.

If the simplified load flow is not successful, i.e. the thermal limits described in (d) are not satisfied, than a more accurate load flow study using appropriate AC load flow software (e.g. DINIS or equivalent) may be carried out instead (in accordance with ST:SD4A) to determine if the cable ratings and / or voltage limits are exceeded.

3.4 Design Submission

Once the load flow studies have been successfully completed the results shall be documented using a Design Submission Form and held within the design folder / file.

An example of a completed Design Submission Form is given in Appendix A. An un-completed Design Submission form is provided in Appendix B.

A1 SIMPLIFIED LOAD FLOW EXAMPLE

A1.1 Scenario

A developer intends to install a new housing estate with an expected demand of 300kVA. It is proposed to install a new 500kVA substation close to primary substation A. The associated HV circuit is designed to be back fed from primary substation B. The proposed arrangement is shown in Figure A1, below.

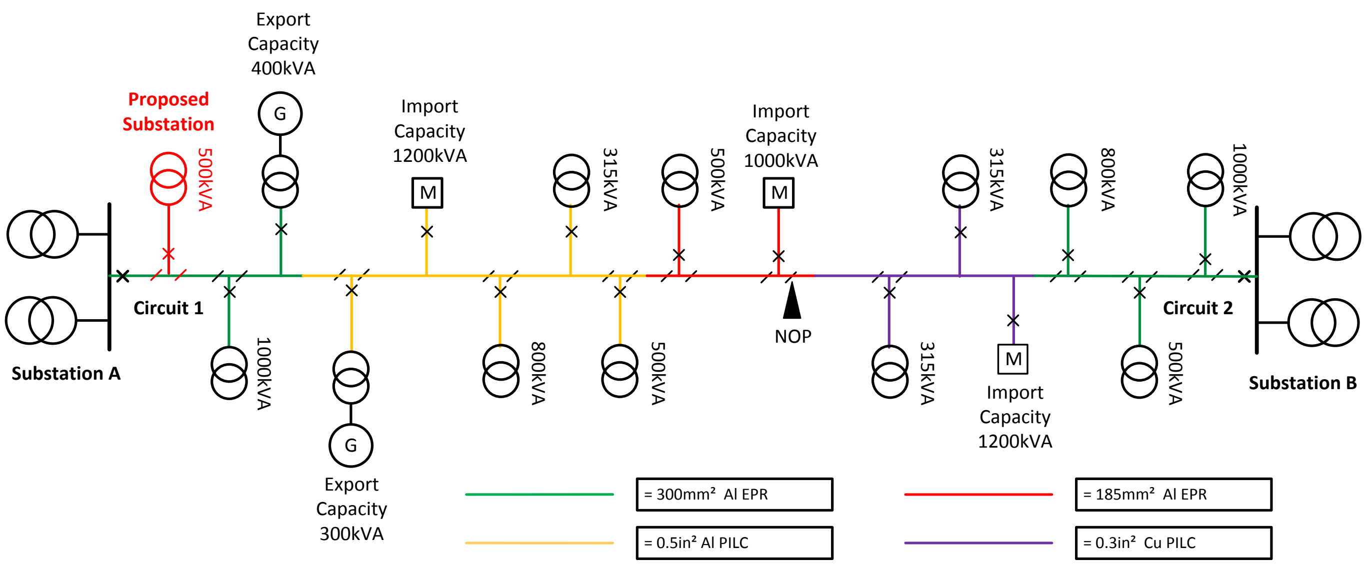

Figure A1 Example Network

A1.2 Checking Pre-conditions

Initially the planner checks to see if the pre-conditions listed in 3.2 are satisfied:

(a) The nominal voltage is 11kV and 3 phases are available.

(b) The primary substations both have more than one primary transformer.

(c) The 11kV circuits do not operate in parallel

(d) The new connection (i.e. the new substation) is not expected to export (i.e. it will have an export capacity ≤50kW)

(e) The aggregate export capacity of the individual connections to Circuit 1 is 500KVA (i.e. less than 1000kVA). The back feed, i.e. Circuit 2 has no connections with an export capacity at all.

(f) The new connections are domestic houses and a few commercial shops etc. The associated load is not expected to increase fault levels significantly.

(g) Some of the new properties may include some small scale embedded generators, heat pumps, electric vehicle changing points etc. however these are expected to comply with BSEN 61000-3-3 or BSEN 61000-3-11 and BS 61000-3-2 or BS61000-3-12. No other disturbing loads are expected.

(h) No motors in excess of 50kW (3phase) are expected to be connected.

(i) Both circuits comprise entirely of underground cable.

(j) The cable with the lowest summer sustained rigiduct rating is the 185mm^2 Aluminium EPR cable (with a rating of 288A). This is significantly higher than the 150A limit.

(k) The length of each separate circuit, from the source primary substation circuit breaker to the most remote node is within the 2.5km limit.

Each of the pre-conditions has been satisfied and therefore the simplified load flow technique may be used.

A1.3 Load Allocation

A1.3.1 Determine Maximum Demand on Each Circuit

Half hourly load data (i.e. apparent power data in kVA) for each of the circuits is obtained for the previous 2 years. Often the apparent power (kVA) data is derived from separate voltage and current measurements.

Export half hourly apparent power data is also obtained for each ≥50kW generator connection and added to the associated circuit data.

WPD planners should carry this out using standard data logger spreadsheets.

Once this has been completed the half hour with the highest demand is then found and its value (in kVA) and the associated date and time are recorded. Data associated with abnormal running arrangement should be discarded, where this can be identified.

For circuit 1, the apparent power measured at the source circuit breaker (over one half hour period) is 2000kVA. During this period the generation connected to the circuit is exporting a total of 500kVA.

The total demand connected to the circuit during this period is therefore 2000kVA + 500kVA = 2500kVA.

This process is repeated for every half hour over the 2 year period and the highest circuit demand is recorded.

For the purpose of this example, the highest maximum demand on circuit 1 is deemed to be 2500kVA as shown in Figure A2.

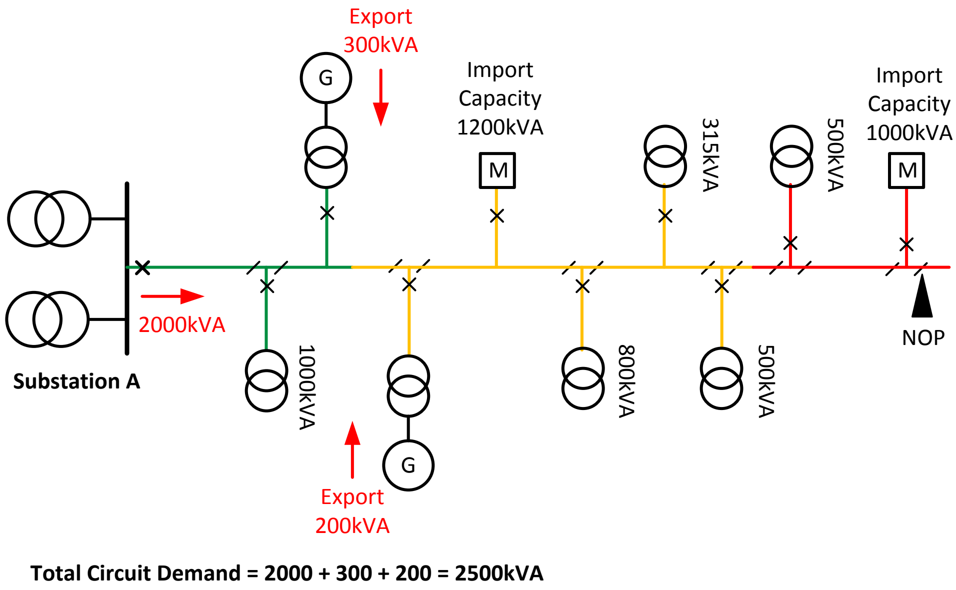

Figure A2 Determining Existing Maximum Demand (Circuit 1)

A1.3.2 <u>Determine HV Metered Demands at the time of the Circuit Maximum Demand</u>

The <u>Import</u> apparent power for HV metered customer at the date and time of the Circuit Maximum Demand is determined.

For the purposes of this example the maximum demand (excluding generation) of 2500kVA occurred at 18:00 on 23rd January 2015 and at this time the two HV metered customers were importing 1.05MVA and 0.75MVA respectively, as shown in Figure A3.

As the maximum demand occurs in January winter sustained rigiduct cable ratings are used.

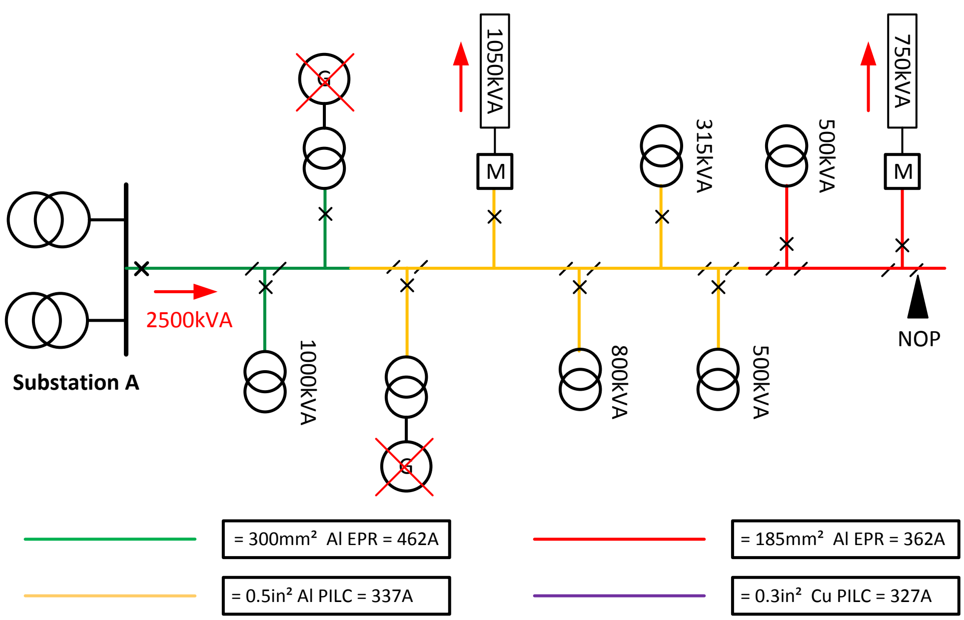

Figure A3 HV Demands at Time of Circuit Maximum Demand (Circuit 1)

A1.3.3 Apportionment of Demand to Distribution Transformers

The circuit maximum demand minus the demand associated with HV metered connections is apportioned to the transformers in proportion to their transformer capacities.

In this example the maximum circuit demand minus the HV metered connection demand is 2500kVA – 900kVA – 500kVA = 1100kVA.

The aggregate capacity of the distribution transformers connected to the circuit is 1000kVA + 800kVA + 315kVA + 500kVA + 500kVA = 3115kVA.

The demand allocated to each transformer is (1100/3115) x 100 = 35.3% of the transformer's capacity.

In this case the following demands are allocated:

- 1000kVA transformer = 353kVA
- 800kVA transformer = 282kVA
- 500kVA transformer = 177kVA
- 315kVA transformer = 111kVA

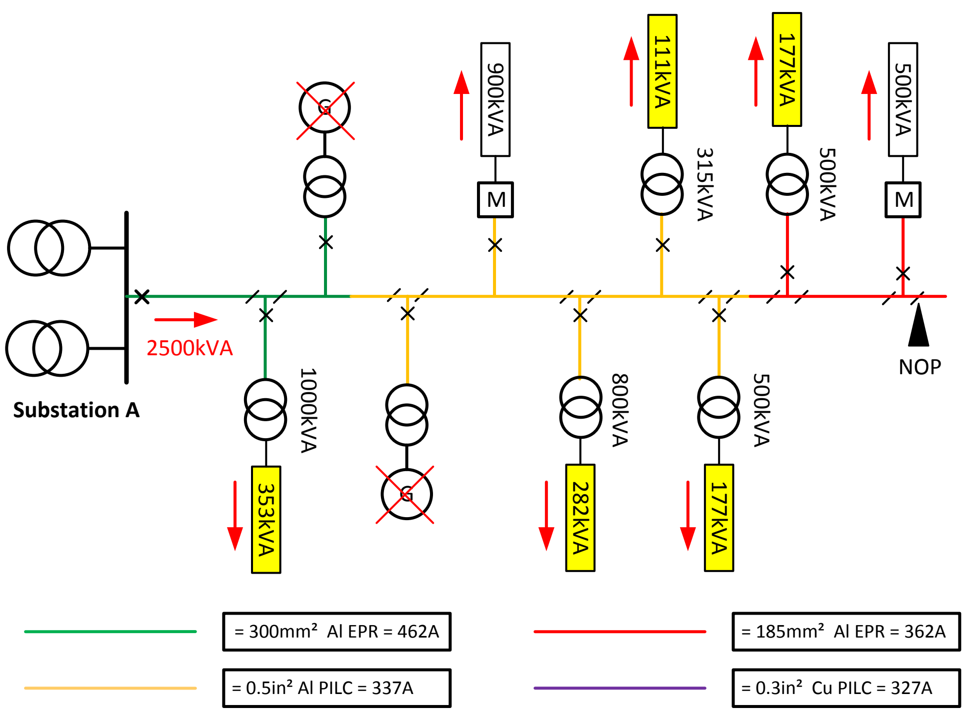

Figure A4 Allocation of Demands to Transformers (Circuit 1)

A1.3.4 Allocation of Maximum Demands to HV Metered Connections and Adjustment of Circuit Maximum Demand

Often the circuit maximum demand determined in A1.3.1 does not coincide with the time of the maximum demand of the individual HV metered customers. If this is the case there is a risk that future circuit demands could be underestimated. In order to account for this the demand allocated to the HV metered customers is increased (which in turn increases the maximum circuit demand).

Where the circuit has 2 or fewer HV metered connections their demands are increased to their Agreed Import Capacities. Where there are more than 2 HV metered connections some diversity may be applied to the Agreed Import Capacities where this is supported by the half hourly data.

In this example, the 2 HV metered connections have agreed import capacities of 1200kVA and 900kVA, respectively. These values are allocated to the HV metered connections which increases the maximum circuit demand to 3200kVA as shown on Figure A5.

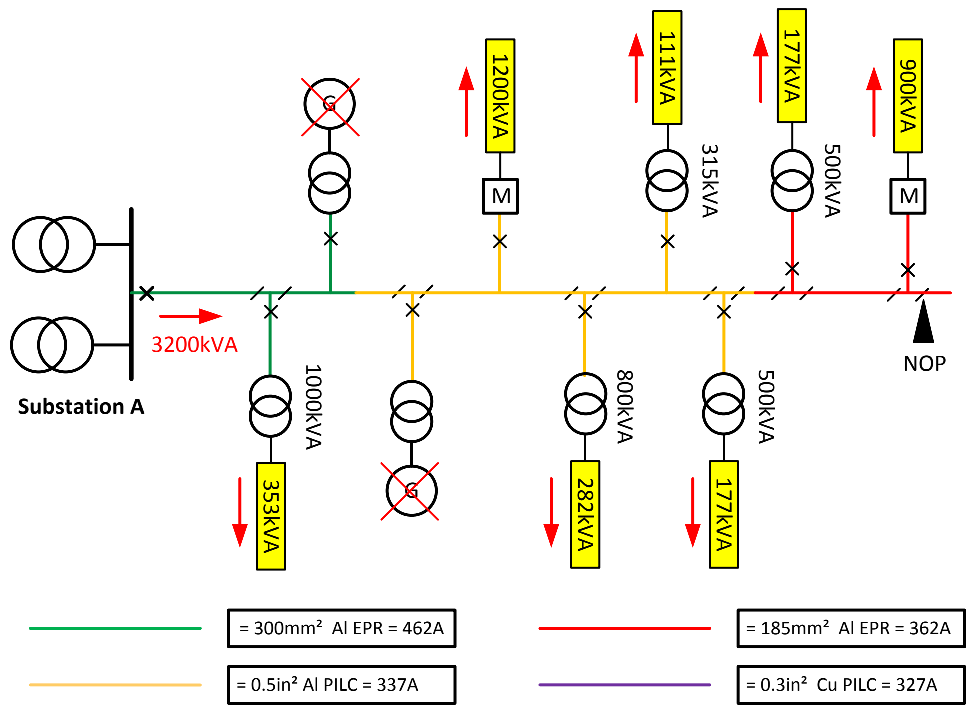

Figure A5 Existing Demand Load Allocation (Circuit 1)

A1.3.5 <u>Addition of New Substation / Connection</u>

The proposed new substation is added to the diagram. If this is ringed into the existing network this increases the length of the cable circuit. If the cable circuit exceeds 2.5km then the simplified load flow technique is no longer appropriate and full load flow study is required instead.

The additional demand is allocated in accordance with 3.3.1 (f). In this case the full transformer rating is allocated (i.e. 500kVA) as shown in Figure A6.

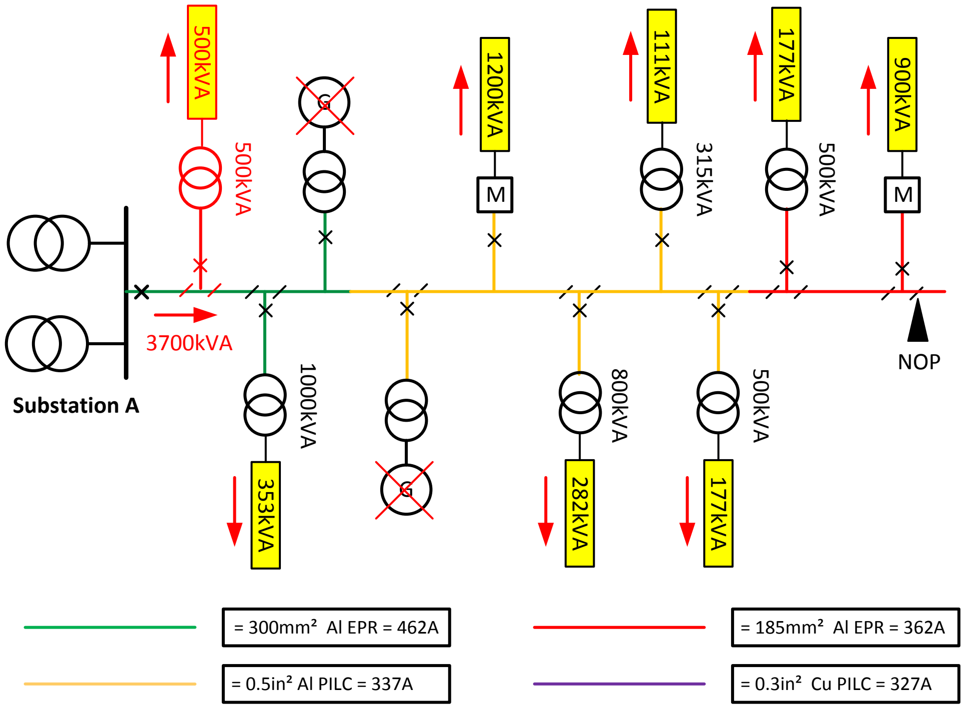

Figure A6 Addition of New Substation (Circuit 1)

A1.3.6 <u>Conversion of Apparent Power to Amperes</u>

The next step is to convert the allocated apparent power to amperes using the nominal voltage (11kV). The following equation should be used:

$$I = S / (\sqrt{3} \times 11000)$$

Where I = current (A) and S = apparent power (kVA)

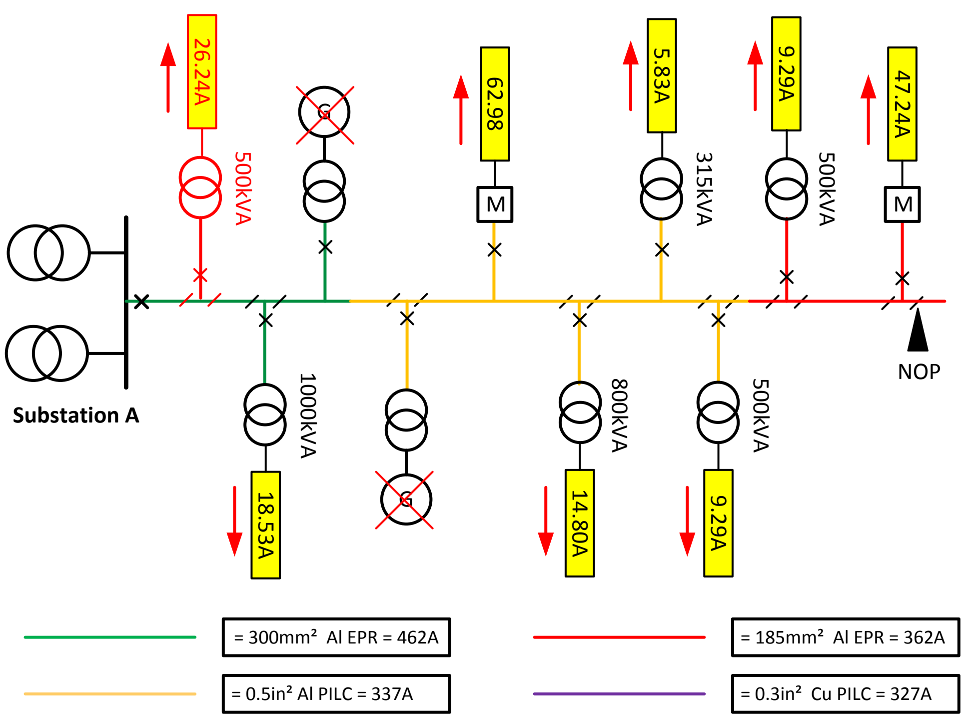

Figure A7 Final Current Allocation (Circuit 1)

A1.3.7 Complete Load Allocation for other relevant circuits

The above steps (A1.3.1 to A1.3.6) are repeated for all of the circuits that provide a back feed to the circuit being modified and also for circuits that are back fed by that circuit (as detailed in Figure 3 to 6).

In this example, only one additional circuit, circuit 2, needs to be considered.

The circuit maximum demand is found to be 1900kVA (at 17:00 on 15th January 2015) and on that time and date the HV metered connection is operating at 1000kVA.

The remaining demand, i.e. 1900 – 1000 = 900kVA is allocated to the transformers (aggregate transformer capacity = 2930kVA) as follows:

% of transformer capacity allocated = (900/2930) x 100 = 30.7%

Demand allocated to individual transformers:

- 1000kVA transformer = 307kVA
- 800kVA transformer = 246kVA
- 500kVA transformer = 154kVA
- 315kVA transformer = 97kVA

The demand allocated to the HV metered connection is increased to its Agreed Import Capacity (1200kVA) which increases the circuit demand to 2200kVA.

These values are shown in Figure A8

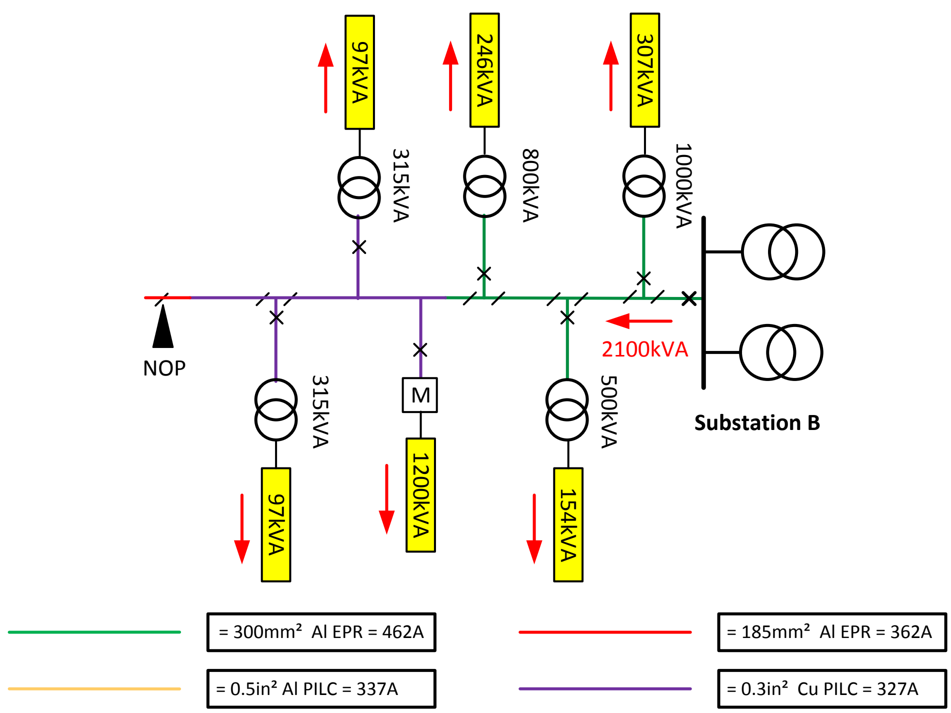

Figure A8 Final Demand Allocation (Circuit 2)

The apparent power values are then converted to amperes as shown in Figure A9

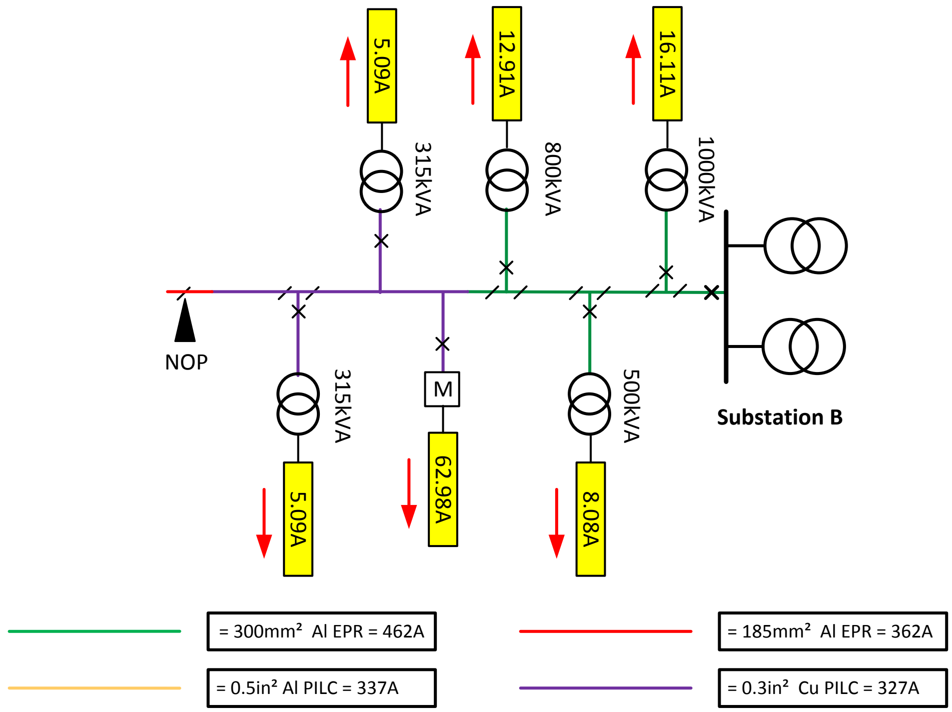

Figure A9 Final Current Allocation (Circuit 2)

A1.4 Load Flow and Analysis

A1.4.1 <u>Normal Feeding Arrangement</u>

The current is added together using Kirchhoff's current law to determine the current flow through the network for the normal feeding arrangement. The results are given in Figure A10.

The cable ratings are then checked to ensure that the current flow is no greater than 66% of the seasonal sustained rigiduct ratings. In this example, winter ratings are used. The % utilisation (i.e. the % of the cable rating that is used) has been included in Figure A11.

In this case the highest cable utilisation on Circuit 1 is 44% and on Circuit 2 is 24%, well within the required 66%.

A1.4.1 <u>Abnormal Feeding Arrangements</u>

Simplified load flow studies are repeated for all the abnormal feeding arrangements, as shown in Figure A11 and A12. The current is added together using Kirchhoff's current law to determine the current flow through the network for the abnormal feeding arrangements. The results are given in Figure A12 and A13.

When circuit 1 is back fed by circuit 2 the highest cable utilisation is 82% and when circuit 2 is back fed by circuit 1 the highest utilisation is 77%. Both of these values are within the required 90% for back feed conditions.

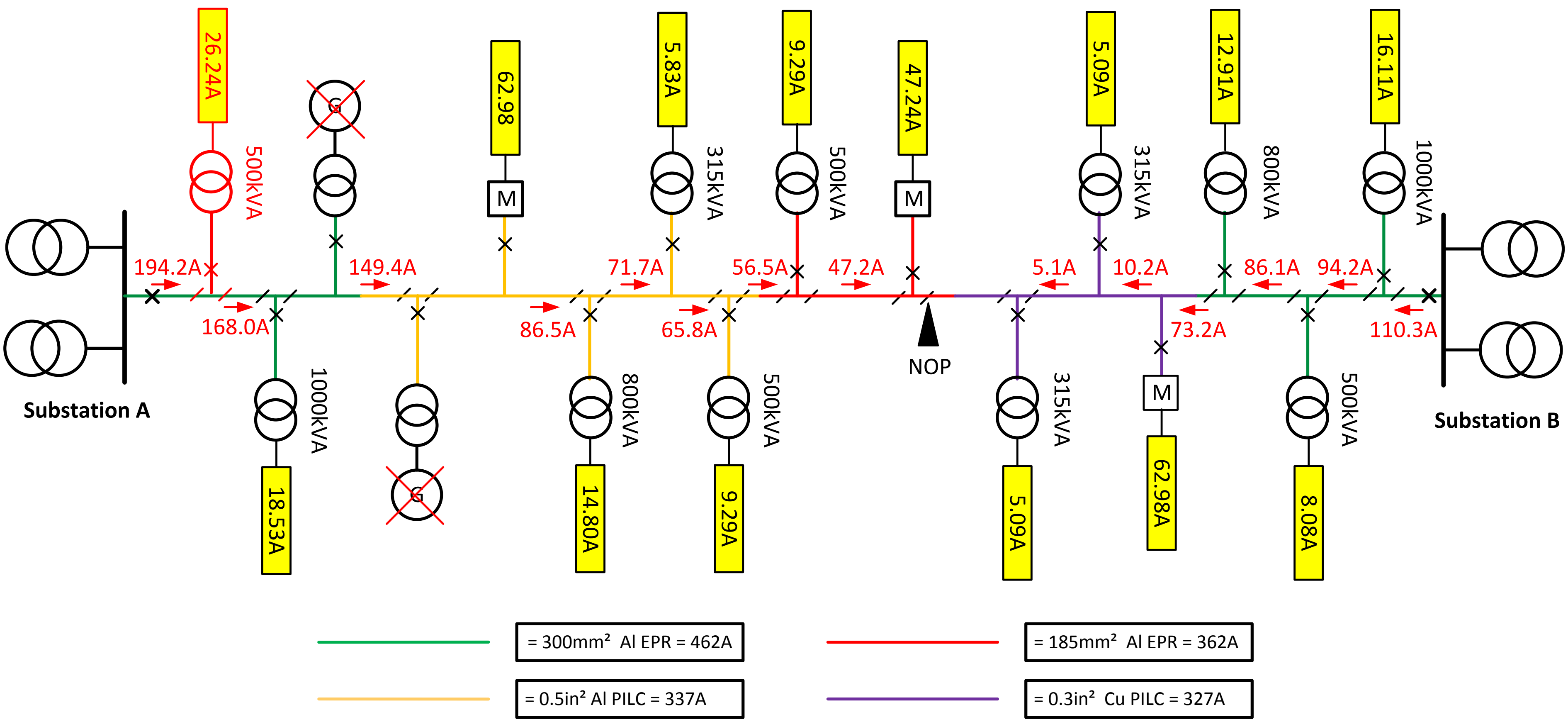

Figure A10 Load Flow (Normal Feeding Arrangement)

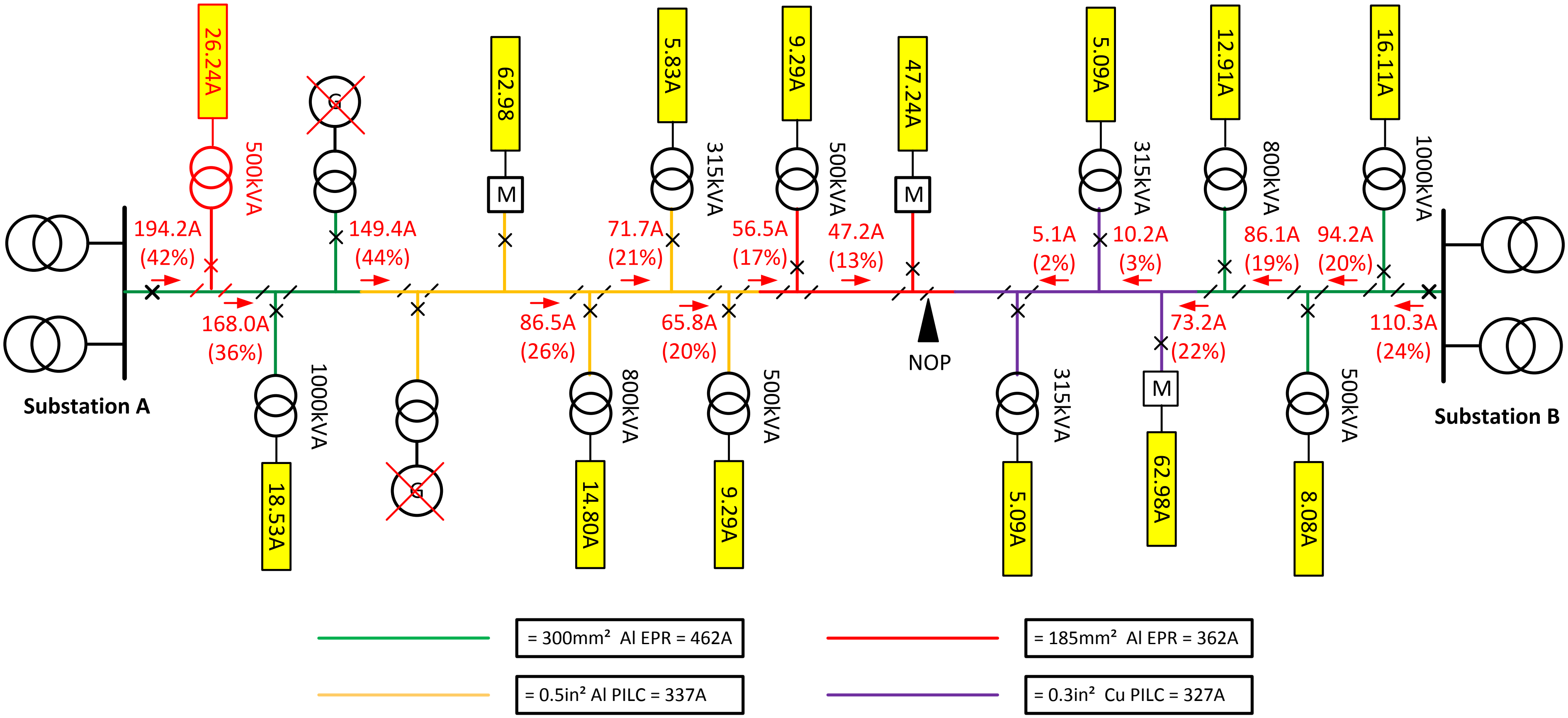

Figure A11 Load Flow with % Utilisation of Cable (Normal Feeding Arrangement)

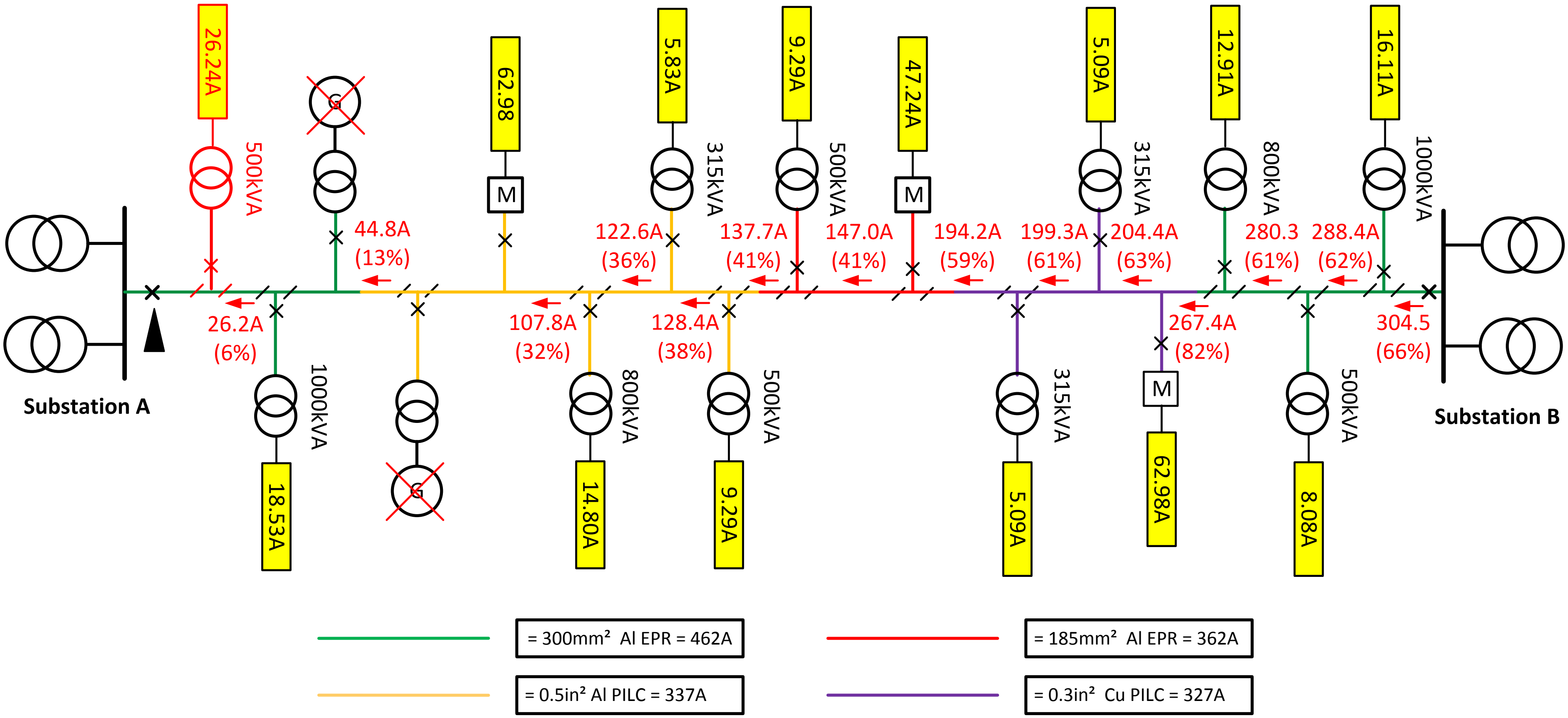

Figure A12 Load Flow with % Utilisation of Cable (Circuit 1 Back-fed from Circuit 2)

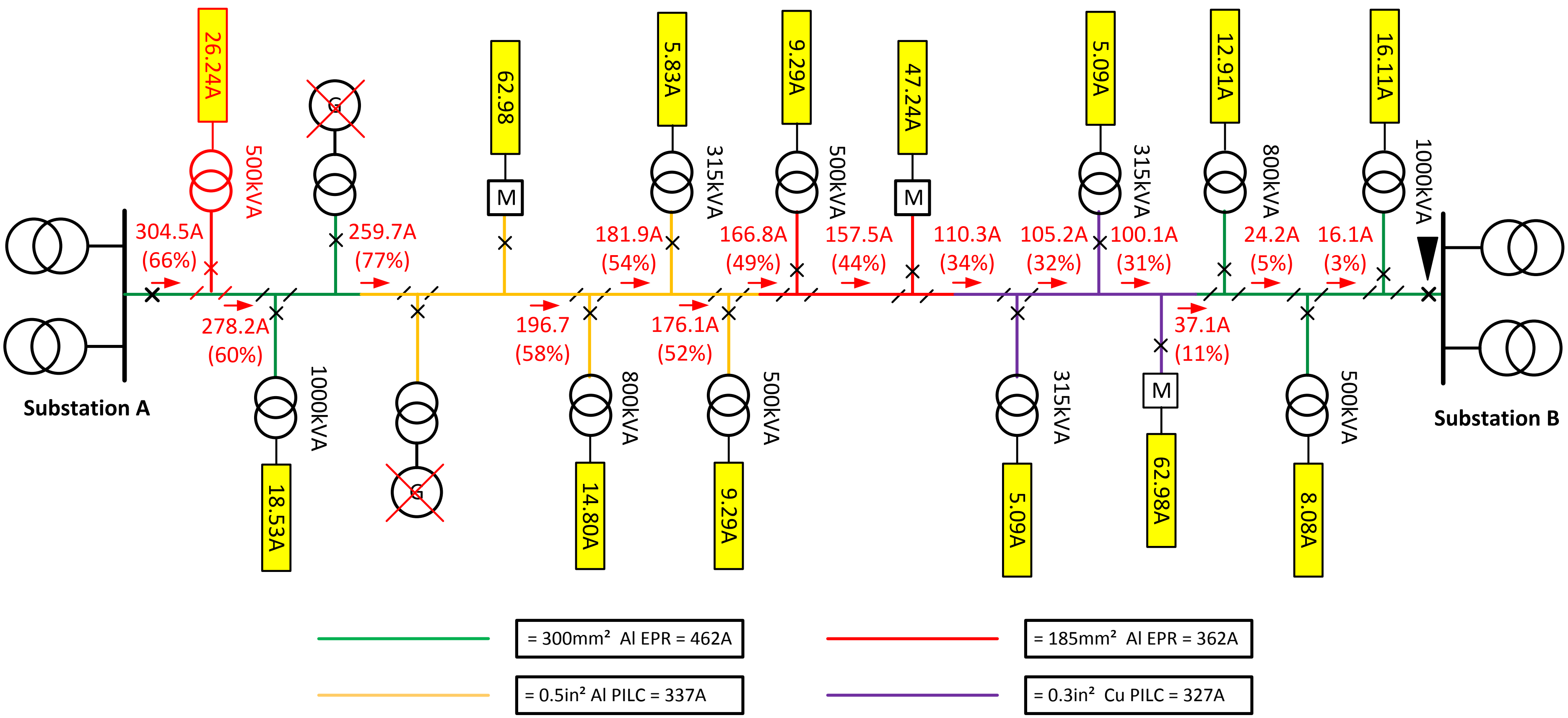

Figure A13 Load Flow with % Utilisation of Cable (Circuit 2 Back-fed from Circuit 1)

A1.5 Design Submission

Once the load flow studies have been completed the Planner should document to fill in the design submission form. An example of a completed form (based on the example load flow study) previous is provided overleaf.

DESIGN SUMBISSION FORM - EXAMPLE

Section A - Your Details:

ICP reference: N/A WPD Reference: 12345

Site address: 12 Acacia Avenue, Bristol, BS2 0TB

WPD Responsible Team: Bristol Construction

Section B – Connection Details:

Requested Capacity (kVA): 300kVA Rating of Transformer (kVA): 500kVA

Connection Security (Ringed or Teed): Ringed

List of Installed Equipment: Ringmaster RN2C, 500kVA transformer, 5 way LV cabinet

Protection Details: Time Limit Fuses

Section C – Design Analysis:

Normal Feeding Arrangement:

Source Circuit Breaker Number: 11/0375/0001

Existing Maximum Circuit Demand (kVA): 3200kVA

Date & Time of Maximum Circuit Demand (e.g. 16:30, 19/05/2017): 18:00 23/01/2015

Proposed Maximum Circuit Demand (kVA): 3700kVA

Current in each section of cable ≤66% of its summer sustained rigiduct rating? YES

Additional Comments: ____

____

Back Feed Condition 1

Source Circuit Breaker Number: 11/0382/0003

Description of Arrangement (including location of open points): Normal circuit back fed from Bedminster Primary Substation. CB 11/0375/001 open and normally open ring switch 11/1345/0001 closed.

Proposed Maximum Demand (kVA): 4800kVA

Current in each cable is no greater that 90% of its summer sustained rigiduct rating: Yes/~~No~~

Cable with lowest rating:

Cable Type: 0.3in² Cu PILC Rating (A): 327A Location: Between substation 11/1457 and 11/5478

Cable with highest utilisation (i.e. where the load is closest to its rating):

Cable Type: 0.3in² Cu PILC % utilisation: 82% Location: Between substation 11/1457 and 11/5478

Additional Comments: ____

____

Back Feed Condition 2

Source Circuit Breaker Number: 11/0375/0001

Description of Arrangement (including location of open points): Bedminster circuit 11/0375/0003 back fed from Feeder Road. CB 11/0382/003 open, normally open ring switch 11/1345/0001 closed

Proposed Maximum Demand (kVA): 4800kVA

Current in each cable is no greater that 90% of its summer sustained rigiduct rating: Yes/~~No~~

Cable with lowest rating:

Cable Type: 0.3in² Cu PILC Rating (A): 327A Location: Between substation 11/1457 and 11/5478

Cable with highest utilisation (i.e. where the load is closest to its rating):

Cable Type: 0.5in² Al PILC % utilisation: 77% Location: Between substation 11/4359 and 11/3462

Additional Comments: ____

____

Back Feed Condition 3

Source Circuit Breaker Number: N/A

Description of Arrangement (including location of open points): ________________________

____

Proposed Maximum Demand (kVA): ____

Load Profile (Sustained or Cyclic):____

Current in each cable is no greater that 90% of its summer sustained rigiduct rating: Yes/No

<u>Cable with lowest rating</u>:

Cable Type: ____________ Rating (A): _________ Location: ___________________________

<u>Cable with highest utilisation (i.e. where the load is closest to its rating):</u>

Cable Type: ____________ % utilisation: _________ Location: _________________________

Additional Comments: ____

____

Back Feed Condition 4

Source Circuit Breaker Number: N/A

Description of Arrangement (including location of open points): ________________________

____

Proposed Maximum Demand (kVA): ____

Load Profile (Sustained or Cyclic):____

Current in each cable is no greater that 90% of its summer sustained rigiduct rating: Yes/No

<u>Cable with lowest rating</u>:

Cable Type: ____________ Rating (A): _________ Location: ___________________________

<u>Cable with highest utilisation (i.e. where the load is closest to its rating):</u>

Cable Type: ____________ % utilisation: _________ Location: _________________________

Additional Comments: ____

____

Back Feed Condition 5

Source Circuit Breaker Number: N/A

Description of Arrangement (including location of open points): ________________________

____

Proposed Maximum Demand (kVA): ____

Load Profile (Sustained or Cyclic):____

Current in each cable is no greater that 90% of its summer sustained rigiduct rating: Yes/No

<u>Cable with lowest rating</u>:

Cable Type: ____________ Rating (A): _________ Location: ___________________________

<u>Cable with highest utilisation (i.e. where the load is closest to its rating):</u>

Cable Type: ____________ % utilisation: _________ Location: _________________________

Additional Comments: ____

____

Back Feed Condition 6

Source Circuit Breaker Number: N/A

Description of Arrangement (including location of open points): ________________________

____

Proposed Maximum Demand (kVA): ____

Load Profile (Sustained or Cyclic):____

Current in each cable is no greater that 90% of its summer sustained rigiduct rating: Yes/No

<u>Cable with lowest rating</u>:

Cable Type: ____________ Rating (A): _________ Location: ___________________________

<u>Cable with highest utilisation (i.e. where the load is closest to its rating):</u>

Cable Type: ____________ % utilisation: _________ Location: _________________________

Additional Comments: ____

____

Section D – Design Summary

Each circuit individually $\leq$ 2.5km?	(Yes / ~~No~~)
Back feeding arrangement $\leq$ 5km?	(Yes / ~~No~~)
Current in each cable is $\leq$ 66% of its rating when fed normally?	(Yes / ~~No~~)
Current in each cable is $\leq$ 90% of its rating during back feed conditions?	(Yes / ~~No~~)
Design & security of overall network complies with ST:SD4A?	(Yes / ~~No~~)
Design & security of new / augmented connection complies with ST:SD4A?	(Yes / No)

Planner's Details / Signature:

Signed	*A.N. Other*	**Date**	03/08/2017
Print Name	A.N OTHER	**Designation**	11kV Planner

WPD's Review:

Accepted / Rejected Comments?			
Signed (WPD)		**Designation**	
Print name			

APPENDIX B

DESIGN SUBMISSION

Section A - Your Details:

ICP reference: __________________________WPD Reference:__________________________

Site address:____

WPD Responsible Team:____

Section B – Connection Details:

Requested Capacity (kVA): ______________ Rating of Transformer (kVA):_______________

Connection Security (Ringed or Teed): ____

List of Installed Equipment:____

____

Protection Details: ____

Section C – Design Analysis:

Normal Feeding Arrangement:

Source Circuit Breaker Number: ____

Existing Maximum Circuit Demand (kVA): ____

Date & Time of Maximum Circuit Demand (e.g. 16:30, 19/05/2017): ___________________

Proposed Maximum Circuit Demand (kVA): ____

Current in each section of cable ≤66% of its summer sustained rigiduct rating? YES/NO

Additional Comments: ____

____

Back Feed Condition 1

Source Circuit Breaker Number: ____

Description of Arrangement (including location of open points): _______________________

____

Proposed Maximum Demand (kVA): ____

Current in each cable is no greater that 90% of its summer sustained rigiduct rating: YES/NO

Cable with lowest rating:

Cable Type: ____________ Rating (A): _________ Location: __________________________

Cable with highest utilisation (i.e. where the load is closest to its rating):

Cable Type: ____________ % utilisation: _________ Location: ________________________

Additional Comments: ____

____

Back Feed Condition 2

Source Circuit Breaker Number: ____

Description of Arrangement (including location of open points): _______________________

____

Proposed Maximum Demand (kVA): ____

Current in each cable is no greater that 90% of its summer sustained rigiduct rating: YES/NO

Cable with lowest rating:

Cable Type: ____________ Rating (A): _________ Location: __________________________

Cable with highest utilisation (i.e. where the load is closest to its rating):

Cable Type: ____________ % utilisation: _________ Location: ________________________

Additional Comments: ____

____

Back Feed Condition 3

Source Circuit Breaker Number: ____

Description of Arrangement (including location of open points): ______________________

____

Proposed Maximum Demand (kVA): ____

Current in each cable is no greater that 90% of its summer sustained rigiduct rating: YES/NO

Cable with lowest rating:

Cable Type: ____________ Rating (A): _________ Location: __________________________

Cable with highest utilisation (i.e. where the load is closest to its rating):

Cable Type: ____________ % utilisation: _________ Location: ________________________

Additional Comments: ____

____

Back Feed Condition 4

Source Circuit Breaker Number: ____

Description of Arrangement (including location of open points): ______________________

____

Proposed Maximum Demand (kVA): ____

Current in each cable is no greater that 90% of its summer sustained rigiduct rating: YES/NO

Cable with lowest rating:

Cable Type: ____________ Rating (A): _________ Location: __________________________

Cable with highest utilisation (i.e. where the load is closest to its rating):

Cable Type: ____________ % utilisation: _________ Location: ________________________

Additional Comments: ____

____

Back Feed Condition 5

Source Circuit Breaker Number: ____

Description of Arrangement (including location of open points): ________________________

____

Proposed Maximum Demand (kVA): ____

Current in each cable is no greater that 90% of its summer sustained rigiduct rating: YES/NO

<u>Cable with lowest rating</u>:

Cable Type: _____________ Rating (A): _________ Location: ___________________________

<u>Cable with highest utilisation (i.e. where the load is closest to its rating):</u>

Cable Type: _____________ % utilisation: _________ Location: _________________________

Additional Comments: ____

____

Back Feed Condition 6

Source Circuit Breaker Number: ____

Description of Arrangement (including location of open points): ________________________

____

Proposed Maximum Demand (kVA): ____

Current in each cable is no greater that 90% of its summer sustained rigiduct rating: YES/NO

<u>Cable with lowest rating</u>:

Cable Type: _____________ Rating (A): _________ Location: ___________________________

<u>Cable with highest utilisation (i.e. where the load is closest to its rating):</u>

Cable Type: _____________ % utilisation: _________ Location: _________________________

Additional Comments: ____

____

Section D – Design Summary

Each circuit individually < 2.5km?	(Yes / No)
Back feeding arrangement < 5km?	(Yes / No)
Current in each cable is < 66% of its rating when fed normally?	(Yes / No)
Current in each cable is < 90% of its rating during back feed conditions?	(Yes / No)
Design & security of overall network complies with ST:SD4A?	(Yes / No)
Design & security of new / augmented connection complies with ST:SD4A?	(Yes / No)

Planner's Details / Signature:

Signed		**Date**	
Print name		**Designation**	

WPD's Review:

Accepted / Rejected Comments?			
Signed (WPD)		**Designation**	
Print name			

APPENDIX C

SUPERSEDED DOCUMENTS

None

APPENDIX D

ASSOCIATED DOCUMENTATION

- Electricity Act 1989
- Electricity, Safety, Quantity and Continuity Regulations 2002
- ST:SD1F, Competition in Connections Code of Practice Procedure for Network Analysis by ICPs
- ST:SD4A, Design of WPDs High Voltage 11kV and 6.6kV Networks
- ST:SD4O, Standard HV Connection Arrangements
- ST:SD8B, Relating to Cable Ratings
- ST:TP21D, 11kV, 6.6kV and LV earthing
- WPD G81 Appendices (all parts)
- ENA Competition in Connections Code of Practice
- ENA ER G5, Planning Levels for Voltage Harmonic Distortion and the Connection of Non-linear Equipment to Transmission Systems and Distribution Systems in the UK
- ENA ER P2, Security of Supply
- ENA ER P28, Planning Limits for Voltage Fluctuations Caused by Industrial, Commercial and Domestic Equipment in the UK

APPENDIX E

KEY WORDS

11kV Design, HV Design, Point of Connection, Independent Connection provider, ICP, Load Flow, Connections Code of Practice