WESTERN POWER DISTRIBUTION

*Serving the Midlands, South West and Wales*

# Company Directive

## STANDARD TECHNIQUE: SD4E

## Relating to High Voltage Connections with Minimal Network Analysis


**Author:** Seth Treasure


**Implementation Date:** May 2018

**Approved by**

**Policy Manager**

**Date:** 9 May 2018

## IMPLEMENTATION PLAN

### Introduction

This document specifies the requirements for using matrix type 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 matrix type 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** |
| May 2018 | This is a new document | Seth Treasure / Andy Hood |
| | | |

## 1.0 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 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).

1.2 Independent connection providers (ICP's) that wish to follow the procedures detailed within this document shall be signatory to the WPD 'Framework Agreement Relating to Network Access and Adoption of Electricity Connections and Distribution Equipment' (FNA&AA) and also the 'Extension of Contestability for the Self Determination of a Point of Connection' (EOC).

1.3 Where the pre-conditions specified within 3.2 are not satisfied more detailed analysis shall be carried out using either the procedure detailed within Standard Technique: SD4D or utilising 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 This document specifies the requirements to determine the Point of Connection (POC) for the connection of demand with a capacity up to 500kW (26A).

2.3 ICPs may only self determine the point of connection of a new load where the criteria specified within ST:SD1F and the 'EOC' 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 matrix 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) There are no upstream constraints e.g. overloaded Primary Transformer

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

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

(e) The 11kV network does not include circuits operating in parallel or 'clean' interconnectors between primary substations.

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

(g) The aggregate Installed generation 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 (3.68kW) per phase or below is ignored when making this assessment.

(h) 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.

(i) 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.

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

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

(l) 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

(m) 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 D

## 3.3 **Matrix requirements**

Once the analysis of the high voltage network has been undertaken, the following conditions shall be satisfied

(a) Before the proposed demand is included, during the normal running arrangement the maximum current flow through each section of main route conductor is $\leq$ 25% the appropriate seasonal sustained rating of the cable.

(b) Before the proposed demand is included, during the abnormal running arrangement the maximum current flow through each section of main route conductor is ≤ 50% the appropriate seasonal sustained rating of the cable.

(c) During the abnormal running arrangement, the aggregate Agreed Import Capacity of all connections rated above 69kVA plus the capacity of the proposed connection is ≤ 66% the rating of the lowest rated conductor within the circuit.

Note, 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.

## 4.0 COMPLIANCE

4.1 If all of the pre-conditions listed in 3.2 and the matrix requirements listed in 3.3 are satisfied a connection with a balanced demand of up to 500kVA and an installed transformer capacity of up to 500KVA is permitted.

This process is described below and shown in Figure 1 and 2. A detailed example is included in Appendix A.

4.2 Any non-compliance with one or more of the criteria detailed within this policy will require more in depth analysis of the network in accordance with ST:SD4A or ST:SD4D. The analysis can be undertaken by WPD or an Independent Connection Provider where permitted by the Standard Technique: SD1F (Code of Practice).

## 5.0 DATA REQUIREMENTS

5.1 The following data shall be collated to undertake a study in accordance with this document;

(a) The previous two years magnitude of current flow through the source circuit breakers for the normal and abnormal feeding arrangement.

(b) The previous two years measured voltage at the primary substation/s

(c) The rating of the lowest rated main route conductor in each circuit (spurs are discounted) as per Standard Technique: SD8B part 2.

(d) The existing aggregate Agreed Import capacity connected to each circuit ignoring capacities rated ≤ 69kVA.

(e) The existing aggregate Installed generation capacity connected to each circuit ignoring capacities rated ≤ 3.68kVA.

Guidance for the provision of current and voltage data is found via the following **Link.**

5.2 An ICP can submit a request to WPD for the information required in (a), (b), (d) and (e) above – the request shall be submitted by completing Appendix B and forwarding to the relevant network services team.

## 6.0 ANALYSIS METHOD

6.1 A 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 1 and 2. Note, for each outage (e.g. circuit breaker 1 switched out) only one back-feed option needs to satisfy the matrix requirements detailed within 3.3.

### 6.2 Normal running arrangement

The apparent power measured at the circuit breaker shall be ≤ 25% the rating of the lowest rated conductor within each circuit of relevance.

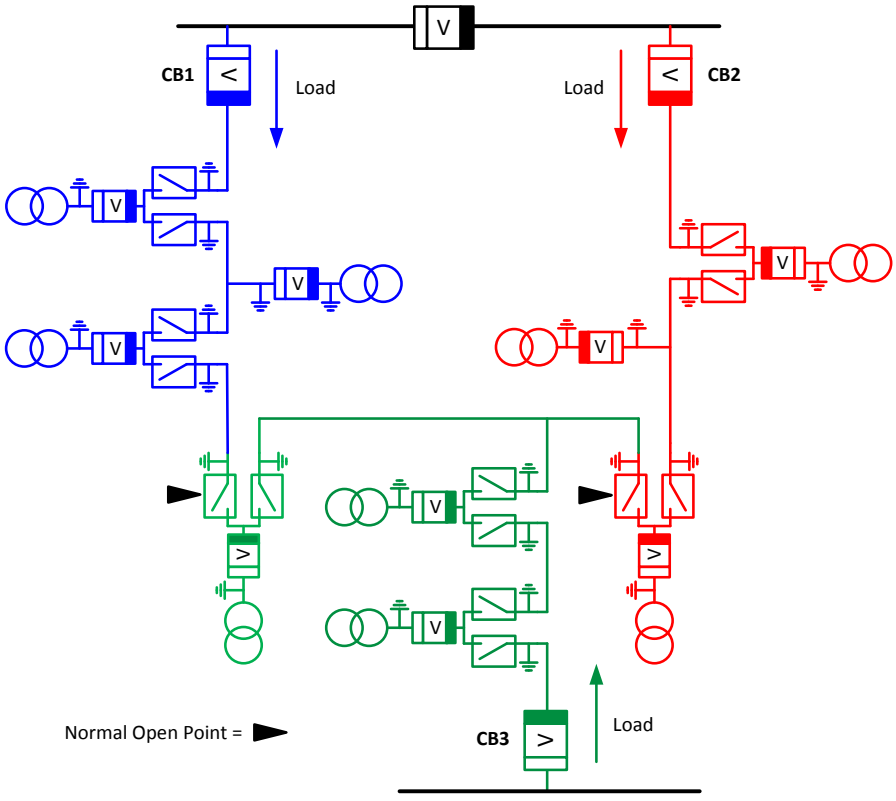


**Figure 1 Normal Feeding Arrangement**

## 6.3 Abnormal running arrangement

The apparent power measured at each circuit breaker shall be combined with the apparent power measured at the alternative source circuit breaker for the various combinations of feeding arrangements.

The calculated demand (KVA) for each iteration shall be ≤ 50% the rating of the lowest rated cable within any of the relevant circuits.

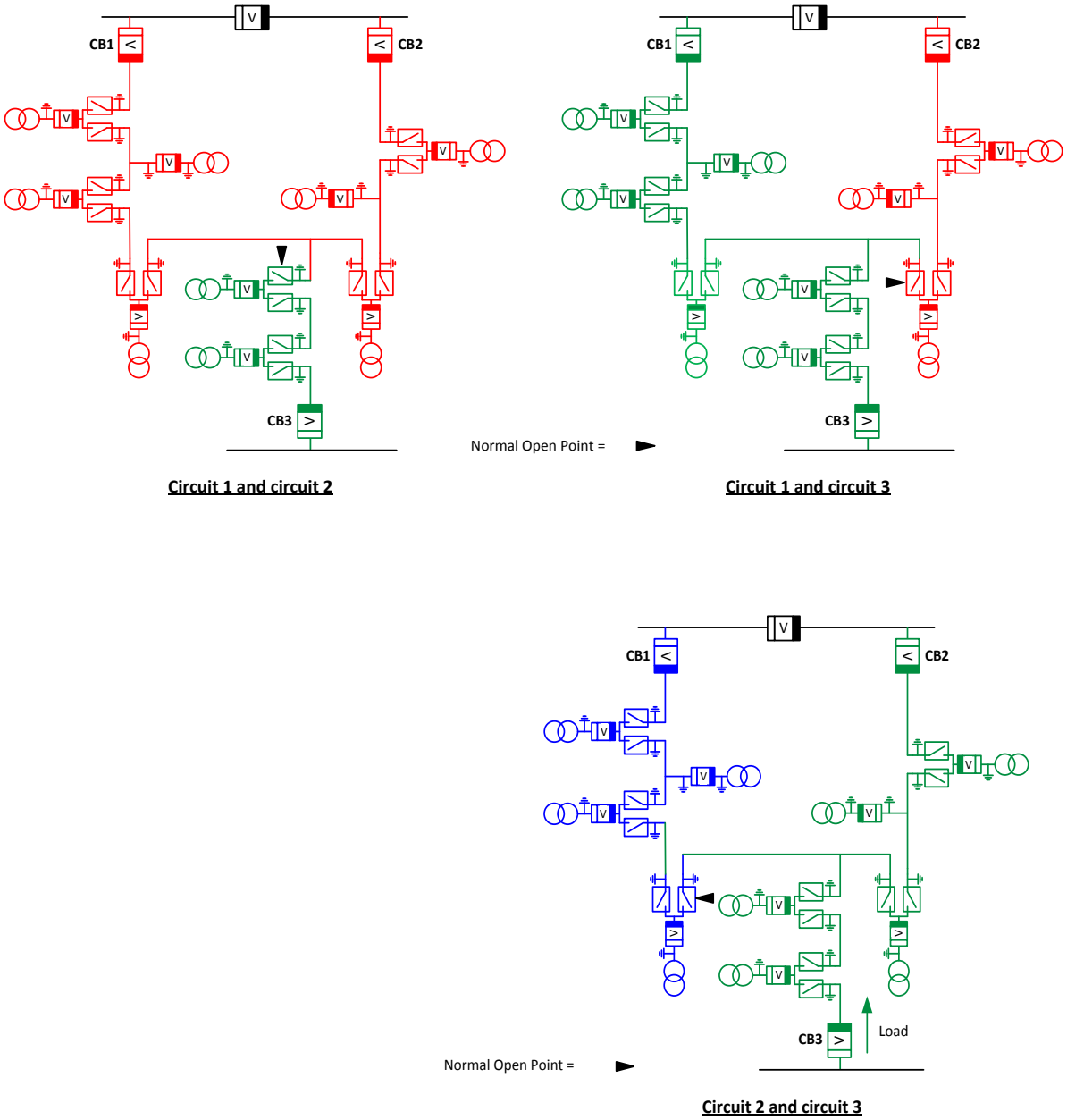


**Figure 2 Abnormal Running Arrangements**

## 7.0 ICP CONNECTION PROCEDURE

7.1 The electrical designer will assess the proposed electrical installation for compliance with clauses 3.2 and 4.1 of this document (demand and transformer capacity ≤ 500kVA). Only installations compliant with these requirements may be processed via the High Voltage design 'matrix'.

7.2 Where possible the competent electrical designer will assess the WPD record maps to evaluate the pre conditions stated with clause 3.2.

Access to WPD's linear asset records will be made available via our online map view package.

7.3 Circuits that are identified with a warning 'hand' symbol which detail 'AOC' (Apportionment of costs) are outside of the scope of this document and the determination of the point of connection shall be undertaken by WPD.

7.4 Once the electrical designer has established compliance with the above clauses, they shall raise an enquiry '**CIC Demand HV – ICP Works Only Notification'** via CIRT or EMAIL to the WPD Records Team (providing the minimum information).

7.5 WPD (Network Services) will assess the initial connection enquiry from the ICP with the requirements of this document. If the installation is acceptable with the requirements of this document, WPD shall issue an acceptance notice (Appendix B).

7.6 Following a design submission to WPD, if the installation or high voltage system is deemed to be non-compliant with the requirements of this Standard Technique (e.g. upstream constraint or interactive quotation). The design submission will be rejected by WPD and a traditional CIC enquiry shall be raised by the ICP.

7.7 Following a design submission to WPD, if a circuit is subject to the ECC Regulations (Potential Refund) the applicable installation will be rejected by WPD and the ICP will be required to raise a traditional CIC enquiry so that the appropriate costs can be refunded to the initial party.

An ICP may resubmit a new design not including the circuits subject to the ECC Regulations.

## 8.0 DESIGN ASSESSMENT

8.1 Once the load flow studies have been successfully completed the results shall be documented using the 'Design Submission' form (Appendix C) or via the 'Design Submission' spreadsheet found from the following **Link.**

8.2 The design assessment (undertaken by WPD or and ICP) shall be audited in accordance with Standard Technique: NC2M (The Inspection and monitoring regime) however WPD shall review (no cost) all design assessments.

8.3 Once the design assessment has been audited / reviewed, WPD will issue an ICP with a 'Confirmation of Acceptance' or 'Rejection' notice (Appendix B).

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 MATRIX LOAD FLOW EXAMPLE

### A1.1 Scenario

A developer intends to install a new housing estate with an expected demand of 400kVA. It is proposed to install a new 500kVA substation onto circuit 1 from primary substation A. The associated HV circuit is designed to be back fed from circuit 2 from primary substation A and circuit 3 from primary substation B. The proposed arrangement is shown in Figure A1, below.

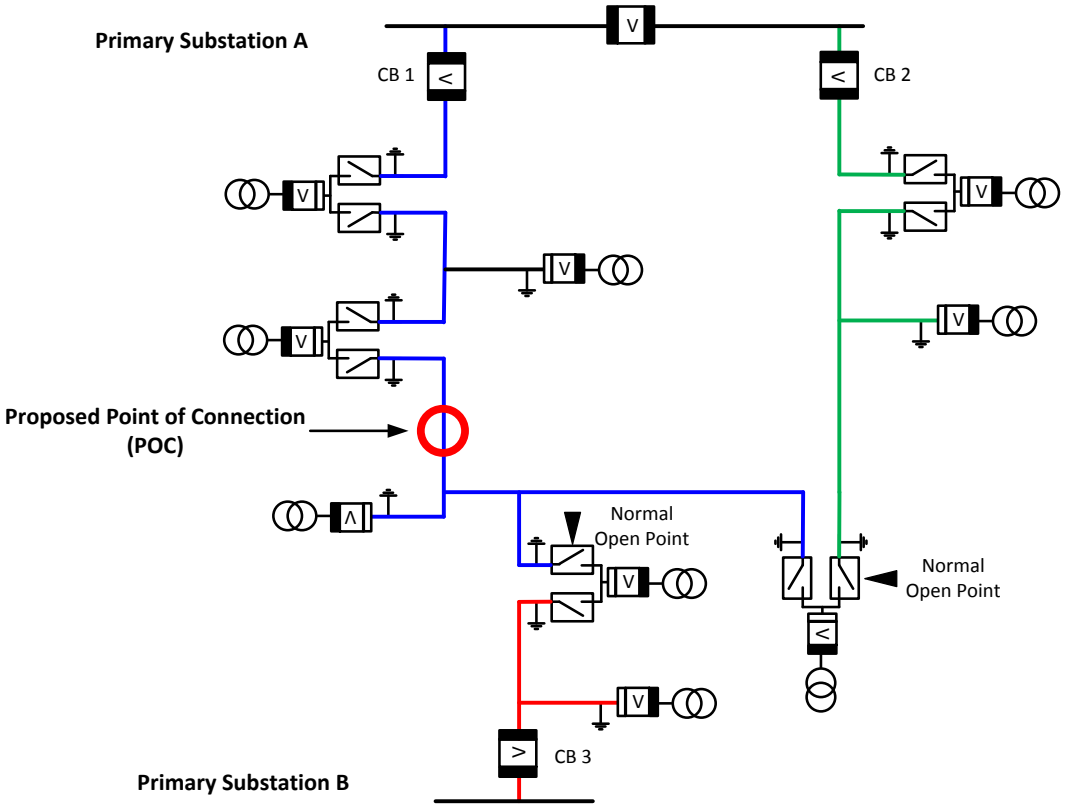


**Figure A1 Example Network**

### A1.2 Checking Pre-conditions

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

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

(b) There are no upstream constraints.

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

(d) The network does not employ arc suppression coil earthing (ASC).

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

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

(g) 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.

(h) 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.

(i) 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.

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

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

(l) 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

(m) 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.

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

## A1.3 Data Collation

| Circuit 1 from Primary Substation A | |
|---|---|
| Demand | *1380 kVA (72.43A)* |
| Lowest Rated Cable | *185 Al EPR* |
| Cable Rating (sustained) | *345 A (in ground)* |
| Season | *Summer* |
| Aggregate Installed Generation Capacity | *800 kVA (41.99A)* |
| Aggregate Agreed Import Capacity | *1500kVA (78.73A)* |

| Circuit 2 from Primary Substation A | |
|---|---|
| Demand | *1545 kVA (81.09A)* |
| Lowest Rated Cable | *185 Al XLPE* |
| Cable Rating (sustained) | *338 A (in ground)* |
| Season | *Summer* |
| Aggregate Installed Generation Capacity | *Nil* |
| Aggregate Agreed Import Capacity | *2000kVA (104.97A)* |

| Circuit 3 from Primary Substation B | |
|---|---|
| Demand | *700 kVA (36.74A)* |
| Lowest Rated Cable | *0.3 Al PILC* |
| Cable Rating (sustained) | *246 A (in duct)* |
| Season | *Summer* |
| Aggregate Installed Generation Capacity | *200 kVA (10.5A)* |
| Aggregate Agreed Import Capacity | *Nil* |

## A1.4 Matrix Assessment

The designer assesses compliance with the requirements of clause 3.3. (a) – demand less than 25% of the lowest rated cable

| **Circuit 1 from Primary Substation A** | |
|---|---|
| **Utilisation Factor** | *21% (72.43A)* |

| **Circuit 2 from Primary Substation A** | |
|---|---|
| **Utilisation Factor** | *24% (81.09A)* |

| **Circuit 3 from Primary Substation B** | |
|---|---|
| **Utilisation Factor** | *15% (36.74A)* |

The designer assesses compliance with the requirements of clause 3.3. (b) – demand less than 50% of the lowest rated cable.

| **Abnormal Running Arrangements** | **Utilisation Factor** |
|---|---|
| **Circuit 1 and Circuit 2** | *45 % (21+ 24)* |
| **Circuit 1 and Circuit 3** | *36 % (21 + 15)* |
| **Circuit 2 and Circuit 3** | *39 % (24 + 15)* |

The designer assesses compliance with the requirements of clause 3.3. (c) – aggregate Agreed Import Capacity connected to circuit is less than 66% of the lowest rated cable.

| **Abnormal Running Arrangements (ASC)** | | **Lowest Rated Cable** | **Utilisation factor** |
|---|---|---|---|
| **Circuit 1 and Circuit 2** | *183.7A (78.73+ 104.97)* | *185 Al XLPE (338A)* | *54%* |
| **Circuit 1 and Circuit 3** | *78.73A (78.73+ 0)* | *0.3 Al PILC (246 A)* | *32%* |
| **Circuit 2 and Circuit 3** | *104.97A (104.97 + 0)* | *0.3 Al PILC (246 A)* | *43%* |

Once the load flow studies have been completed the designer shall document and complete the design submission form (Appendix C or Spreadsheet). An example of a completed form (based on the example load flow study) is provided.

## A1.5 DATA SUBMISSION EXAMPLE

**Section A - Your Details:**

ICP reference: 112233 WPD Reference: 12345

Site address: 12 Acacia Avenue, Wells, BA5 0TB

WPD Responsible Team: Mendip Construction

**Section B – Connection Details:**

Requested Capacity (kVA): 400kVA Rating of Transformer (kVA): 500kVA

Connection Security (Ringed or Teed): Ringed

List of Installed Equipment: Ringmaster RN2D, 500kVA transformer, 5 way (Type IX) LV cabinet

Protection Details: Time Limit Fuses

**Section C – Design Analysis:**

**Normal Feeding Arrangement:**

Source Circuit Breaker Number: 16/0375/0001

Existing Maximum Circuit Demand (kVA): 1380kVA

Cable with lowest rating:

Cable Type: $185^2$ Al EPR Installation type: Bare in ground Rating (A): 345A
Location: Between substation 16/1457 and 16/5478
Date & Time of Maximum Circuit Demand (e.g. 16:30, 19/05/2017): 17:30 29/08/2017

During the normal running arrangement the maximum current flow through each section of main route conductor is $\leq$ 25% the appropriate seasonal sustained rating of the cable.

_____YES (21%) _____

Additional Comments: _____

_____

**Back Feed Condition 1**

Source Circuit Breaker Number: 16/0375/0002

Existing Maximum Circuit Demand (kVA): 1545kVA

Cable with lowest rating:

Cable Type: 185² Al XLPE Installation type: Bare in ground Rating (A): 338A

Location: Between substation 16/1066 and 16/1233

Date & Time of Maximum Circuit Demand (e.g. 16:30, 19/05/2017): 16:30 14/07/2017

Description of Arrangement (including location of open points): Normal circuit back fed via Normal Open Point (NOP) at main switch 16/1066/2 Southover Wells.

During the normal running arrangement the maximum current flow through each section of main route conductor is ≤ 25% the appropriate seasonal sustained rating of the cable.

_____YES (24%) _____

Combined Maximum Demand (kVA): 2925kVA

During the abnormal running arrangement the maximum current flow through each section of main route conductor is ≤ 50% the appropriate seasonal sustained rating of the cable.

_____YES (45%) _____

Additional Comments: _____

Following the inclusion of the proposed load, during the abnormal running arrangement the aggregate Agreed Supply Capacity of the network is ≤ 66% of the lowest rated conductor within the circuit (main route).

_____ YES (54%) _____

Additional Comments: _____

**Back Feed Condition 2**

Source Circuit Breaker Number: 16/0410/0003

Existing Maximum Circuit Demand (kVA): 700kVA

Cable with lowest rating:

Cable Type: 0.3 in² PILC Installation type: In Duct Rating (A): 246A

Location: Between substation 16/3402 and 16/0136

Date & Time of Maximum Circuit Demand (e.g. 16:30, 19/05/2017): 17:00 16/08/2016

Description of Arrangement (including location of open points): Normal circuit back fed via Normal Open Point (NOP) at main switch 16/2040/2 Clares Rd Wells.

During the normal running arrangement the maximum current flow through each section of main route conductor is ≤ 25% the appropriate seasonal sustained rating of the cable.

_____YES (15%) _____

Combined Maximum Demand (kVA): 2080kVA

During the abnormal running arrangement the maximum current flow through each section of main route conductor is ≤ 50% the appropriate seasonal sustained rating of the cable.

_____YES (36%) _____

Additional Comments: _____

Following the inclusion of the proposed load, during the abnormal running arrangement the aggregate Agreed Supply Capacity of the network is ≤ 66% of the lowest rated conductor within the circuit (main route).

_____ YES (32%) _____

Additional Comments: _____

**Back Feed Condition 3 (System security)**

Source Circuit Breaker Number: 16/0410/0003 & 16/0375/0002

Combined Maximum Circuit Demand (kVA): 2245kVA

Cable with lowest rating:

Cable Type: 0.3 in² PILC Installation type: In Duct Rating (A): 246A

Location: Between substation 16/3402 and 16/0136

Description of Arrangement (including location of open points): Normal Open Point (NOP) at main switch 16/1066/2 Southover Wells, Normal Open Point (NOP) at main switch 16/2040/2 Clares Rd Wells, Open Point inserted at Main Switch 16/0144/1.

During the abnormal running arrangement the maximum current flow through each section of main route conductor is ≤ 50% the appropriate seasonal sustained rating of the cable.

_____YES (39%) _____

Additional Comments: _____

Following the inclusion of the proposed load, during the abnormal running arrangement the aggregate Agreed Supply Capacity of the network is ≤ 66% of the lowest rated conductor within the circuit (main route).

_____ YES (43%) _____

Additional Comments: _____

**Section D – Design Summary**

Each circuit individually ≤ 2.5km? (Yes / ~~No~~)

Back feeding arrangement ≤ 5km? (Yes / ~~No~~)

Current in circuit is ≤ 25% of its lowest rating when fed normally? (Yes / ~~No~~)

Current in circuit is ≤ 50% of its lowest rating during back feed conditions? (Yes / ~~No~~)

Agreed supply capacity is ≤ 66% of the lowest rating cable 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 Acceptance / Rejection Notice:**

| | | | |
|---|---|---|---|
| **Accepted / Rejected Comments?** | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| **Signed (WPD)** | | **Designation** | |
| **Print name**<br>**Date** | | | |

**APPENDIX B**

**DATA COLLATION FORM**

**Section A - Your Details:**

ICP Name: _____ ICP reference: _____

WPD Reference:_____

Site address:_____

Location Plan:_____

WPD Responsible Team:_____

**Section B – Connection Details:**

Requested Capacity (kVA): _____ Rating of Transformer (kVA):_____

Connection Security (Ringed or Teed): _____

**Section C – Design Analysis:**

**Normal Feeding Arrangement:**

Source Circuit Breaker Number:

**Abnormal Feeding Arrangement/s:**

Source Circuit Breaker Number:

Source Circuit Breaker Number:

Source Circuit Breaker Number:

Source Circuit Breaker Number:

**Planner's Details / Signature:**

| | | | |
|---|---|---|---|
| **Signed** | | **Date** | |
| **Print name** | | **Designation** | |

**DATA RESPONSE FORM**

**Measured Current flow and Voltage**

**Normal Feeding Arrangement:**

Source Circuit Breaker Number: _____ File no:_____

**Abnormal Feeding Arrangement/s:**

Source Circuit Breaker Number: _____ File no:_____

Source Circuit Breaker Number: _____ File no:_____

Source Circuit Breaker Number: _____ File no:_____

Source Circuit Breaker Number: _____ File no:_____

Note, WPD to attach Excel file of measured current flow and voltage

**Aggregate Agreed Supply Capacities**

Source Circuit Breaker Number: Import _____ Installed DG_____

**Abnormal Feeding Arrangement/s:**

Source Circuit Breaker Number:_____

Import_____Installed DG_____

Source Circuit Breaker Number:_____

Import_____Installed DG_____

Source Circuit Breaker Number:_____

Import_____Installed DG_____

Source Circuit Breaker Number:_____

Import_____Installed DG_____

**Planner's Details / Signature:**

| | | | |
|---|---|---|---|
| **Objection?** **Provide reasons** | | | |
| **Signed** | | **Date** | |
| **Print name** | | **Designation** | |

**APPENDIX C**

**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):

Cable with lowest rating:

Cable Type: Installation type: Rating (A):

Location:

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

During the normal running arrangement the maximum current flow through each section of main route conductor is $\leq$ 25% the appropriate seasonal sustained rating of the cable.

_____

Additional Comments: _____

_____

**Back Feed Condition 1**

Source Circuit Breaker Number:

Existing Maximum Circuit Demand (kVA):

Cable with lowest rating:

Cable Type: Installation type: Rating (A): Location:
Date & Time of Maximum Circuit Demand (e.g. 16:30, 19/05/2017):

Description of Arrangement (including location of open points):

During the normal running arrangement the maximum current flow through each section of main route conductor is ≤ 25% the appropriate seasonal sustained rating of the cable.

_____

Combined Maximum Demand (kVA):

During the abnormal running arrangement the maximum current flow through each section of main route conductor is ≤ 50% the appropriate seasonal sustained rating of the cable.

_____

Additional Comments: _____

Following the inclusion of the proposed load, during the abnormal running arrangement the aggregate Agreed Supply Capacity of the network is ≤ 66% of the lowest rated conductor within the circuit (main route).

_____

Additional Comments: _____

**Back Feed Condition 2**

Source Circuit Breaker Number:

Existing Maximum Circuit Demand (kVA):

Cable with lowest rating:

Cable Type: Installation type: Rating (A): Location:

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

Description of Arrangement (including location of open points):

During the normal running arrangement the maximum current flow through each section of main route conductor is ≤ 25% the appropriate seasonal sustained rating of the cable.

_____

Combined Maximum Demand (kVA):

During the abnormal running arrangement the maximum current flow through each section of main route conductor is ≤ 50% the appropriate seasonal sustained rating of the cable.

_____

Additional Comments: _____

Following the inclusion of the proposed load, during the abnormal running arrangement the aggregate Agreed Supply Capacity of the network is ≤ 66% of the lowest rated conductor within the circuit (main route).

_____

Additional Comments: _____

**Back Feed Condition 3**

Source Circuit Breaker Number:

Existing Maximum Circuit Demand (kVA):

Cable with lowest rating:

Cable Type: Installation type: Rating (A): Location:

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

Description of Arrangement (including location of open points):

During the normal running arrangement the maximum current flow through each section of main route conductor is ≤ 25% the appropriate seasonal sustained rating of the cable.

_____

Combined Maximum Demand (kVA):

During the abnormal running arrangement the maximum current flow through each section of main route conductor is ≤ 50% the appropriate seasonal sustained rating of the cable.

_____

Additional Comments: _____

Following the inclusion of the proposed load, during the abnormal running arrangement the aggregate Agreed Supply Capacity of the network is ≤ 66% of the lowest rated conductor within the circuit (main route).

_____

Additional Comments: _____

**Back Feed Condition 4 (System security)**

Source Circuit Breaker Numbers:

Combined Maximum Circuit Demand (kVA):

Cable with lowest rating:

Cable Type: Installation type: Rating (A): Location:
Description of Arrangement (including location of open points):

During the abnormal running arrangement the maximum current flow through each section of main route conductor is ≤ 50% the appropriate seasonal sustained rating of the cable.

_____

Additional Comments: _____

**Back Feed Condition 5 (System security)**

Source Circuit Breaker Numbers:

Combined Maximum Circuit Demand (kVA):

Cable with lowest rating:

Cable Type: Installation type: Rating (A): Location:
Description of Arrangement (including location of open points):

During the abnormal running arrangement the maximum current flow through each section of main route conductor is ≤ 50% the appropriate seasonal sustained rating of the cable.

_____

Additional Comments: _____

Following the inclusion of the proposed load, during the abnormal running arrangement the aggregate Agreed Supply Capacity of the network is ≤ 66% of the lowest rated conductor within the circuit (main route).

_____

Additional Comments: _____

**Section D – Design Summary**

Each circuit individually ≤ 2.5km? (Yes / No)

Back feeding arrangement ≤ 5km? (Yes / No)

Current in circuit is ≤ 25% of its lowest rating when fed normally? (Yes / No)

Current in circuit is ≤ 50% of its lowest rating during back feed conditions? (Yes / No)

Agreed supply capacity is ≤ 66% of the lowest rating cable 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 Acceptance / Rejection notice:**

| | | | |
|---|---|---|---|
| **Accepted / Rejected Comments?** | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| **Signed (WPD)** | | **Designation** | |
| **Print name**<br>**Date** | | | |

**APPENDIX D**

**CHECK LIST FOR COMPLIANCE WITH ST: SD4E**

| **Circuit requirements** | **Y/N** |
|---|---|
| Network voltage is 11kV & 3 phase | |
| All relevant Primary substations have 2 or more Tx's | |
| The HV circuits are not normally run in parallel | |
| The proposed connection has an export capacity ≤ 50kW | |
| The aggregate circuit export capacity is ≤ 1MVA | |
| The additional load will not significantly increase fault levels | |
| The demand complies with Power Qualitity standards (BSEN 61000-3-2 or -3-3 or 3-11 or 3-12) | |
| Installed motors have a rating ≤ 50kW | |
| The circuits of interest comprise of underground cable | |
| The circuit length from the CB to any open point is ≤ 2.5km | |
| | |
| **Load flow analysis** | |
| During normal running arrangements, the current flow is ≤ 25% of the relevant seasonal sustained rating for each circuit | |
| During abnormal running arrangements, the current flow is ≤ 50% of the relevant seasonal sustained rating for each circuit | |
| Following the inclusion of the proposed load, during the abnormal running arrangement the aggregate Agreed Supply Capacity of the network is less than 66% of the lowest rated conductor within the circuit (main route). | |

**APPENDIX E**

**SUPERSEDED DOCUMENTS**

None

**APPENDIX F**

**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 G**

**KEY WORDS**

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