Code of Practice 619

Issue 1 **November 2013**

Procedures for Future Networks Assets

Contents

Approved for issue by the Technical Policy Panel

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Issue and Amendment Summary

Amendment No. Date	Brief Description and Amending Action
0 01/11/13	Issue 1 First Issue Prepared by: G Bryson Approved by the Technical Policy Panel and signed on its behalf by Paul Whittaker:

PROCEDURES FOR FUTURE NETWORKS ASSETS

1. INTRODUCTION

As the UK economy moves towards a low carbon future the effects on the distribution networks will be varied. It is expected that demand for electricity will rise as transportation is decarbonised by electric vehicles. Further demand will result from the electrification of heating in the form of heat pumps, which are expected to replace increasingly expensive oil-fuelled and gas-fuelled heating systems. At the same time, rising retail prices and energy efficient behaviour and appliances, eg LED lighting, may mitigate some of the demand increase. In addition to changes in demand, government incentives such as the feed-in-tariff will drive high penetration of various forms of generation on LV networks. These combined changes in the requirements of connected customers will introduce significant challenges for network operators.

In anticipation of these challenges the Electricity North West Limited, hereinafter referred to as Electricity North West, Future Networks team have been investigating the benefits of new technologies. As part of this investigation various assets have been installed on the Network to gain the practical experience required to inform future policy developments.

2. SCOPE

This code of practice describes the installation, operation and maintenance procedures associated with the technologies installed by the Future Networks team on the electricity distribution network (Network) owned by Electricity North West Limited, as Distribution Licensee.

3. PROCEDURES

The following illustrated Future Network Asset Procedures (FNAPs) have been produced and can be viewed in the electronic library under “Future Network Operating Procedures” in CP619. In some cases the operational procedures are site specific due to network configurations.

FNAP No.	Asset Type	Title
1	ABB Filter	ABB Filter - Howard Street (166559)
2	ABB Filter	ABB Filter - Dunton Green (330127)
3	Power Perfector	Power Perfector - Edge Green Ln (216438)
4	Power Perfector	Power Perfector - Greenside Ln (171747)
5	Distribution Transformer with On-Load Tapchanger	OLTC - Landgate (211951)
6	Distribution Transformer with On-Load Tapchanger	OLTC - Leicester Ave (212726)
7	LV Capacitors	LV Capacitors

4. DOCUMENTS REFERENCED

FNAPs - Electronic library “Future Networks Asset Procedures” in CP619.

5. KEYWORDS

Asset; Operation.

FUTURE NETWORKS ASSET PROCEDURE 1

ABB FILTER - HOWARD STREET (166559)

1. INTRODUCTION

At this site an ABB active filter has been installed, directly off the LV board, as part of a trial under the Low Carbon Networks project on Voltage Management.

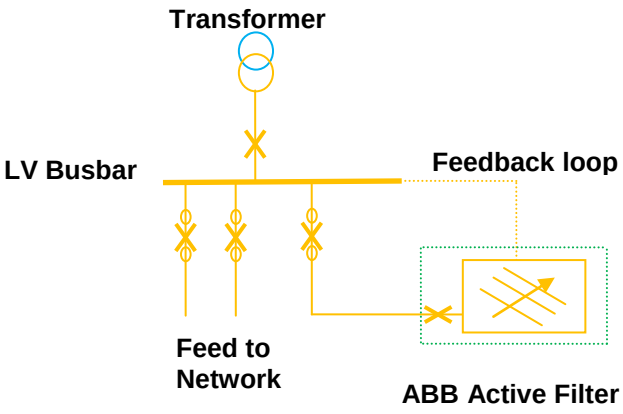
The active filter has been installed to reduce harmonic interference which may be introduced by the connection of generation devices, such as Solar PV panels, onto the network.

The active filter assesses the harmonics on the network using a feedback loop and then injects a complementary waveform onto the LV busbars to reduce the harmonic levels. The feedback loop is provided via a 2.5sqmm cable connected from the filter to a set of 5VA CTs fitted to the LV Busbars.

The unit at Howard Street is located outdoors in a Green GRP housing. The GRP housing shall be locked with standard Electricity North West operational keys.

The schematic below shows the connection arrangement for this unit.

1.1 Schematic



1.2 Fusing Details for the ABB Active Filters

Location	Fuse Size	Location
Howard Street	160A	Within LV cabinet Way 3

2. STARTING AND STOPPING THE FILTER.

It is anticipated that the filter may need to be started and stopped during outage conditions, for example during a network fault.

The filter control panel is located within the GRP housing and it is this control panel which shall be accessed to start and stop the filter.

2.1 To Stop the Filter

a) Press the highlighted Esc button on the front panel until the 'Welcome' screen is displayed.

b) Highlight the filter Start/Stop menu ('PQF' item in the list). In this menu the STOP indication should be visible.

c) Press OK. The filter will ask for confirmation and then it will stop and the main contactor will open.

d) The 'STOP' indication in the start /stop menu changes to a 'START' indication once the filter is stopped.

e) Once filter has stopped remove feeding fuses and post Caution Notice if filter is to be worked on.

f) Before starting any work on the filter the auxiliaries shall be isolated via the internal switch.

Note: The filter contains large Capacitors which can take up to 30min to discharge, ensure this period has elapsed before opening any covers.

2.2 To Start the Filter

a) Ensure power is supplied to the filter, by inserting the 160A fuses.

b) Ensure the filter auxiliaries are switched on via the internal switch.

c) Press the highlighted Esc button on the front panel until the 'Welcome' screen is displayed.

d) Highlight the filter Start/Stop menu ('PQF' item in the list). In this menu the 'START' indication should be visible.

e) Press OK. The filter will ask for confirmation and then it will start and the main contactor should close within 30 seconds. One second after the main contactor has closed the IGBTs will start and the filter will work under no load conditions.

f) The 'START' indication in the start /stop menu changes to a 'STOP' indication once the filter is started.

3. FILTER MALFUNCTION

If the filter malfunctions in any way, isolate it and notify Geraldine Bryson or Dan Randles as soon as possible.

FUTURE NETWORKS ASSET PROCEDURE 2

ABB FILTER - DUNTON GREEN (330127)

1. INTRODUCTION

At this site an ABB active filter has been installed, directly off the LV board, as part of a trial under the Low Carbon Networks project on Voltage Management.

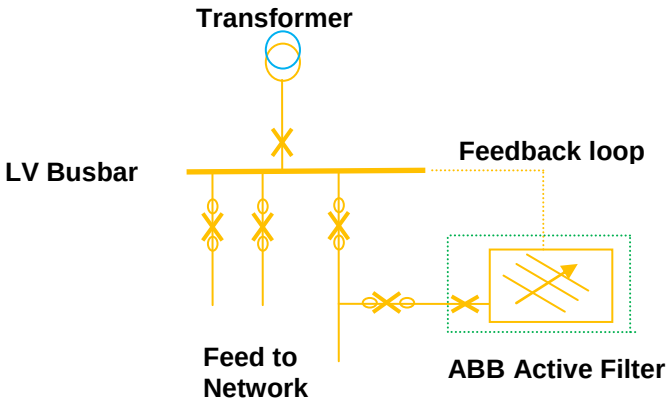
The active filter has been installed to reduce harmonic interference which may be introduced by the connection of generation devices, such as Solar PV panels, onto the network.

The active filter assesses the harmonics on the network using a feedback loop and then injects a complementary waveform onto the LV busbars to reduce the harmonic levels. The feedback loop is provided via a 2.5sqmm cable connected from the filter to a set of 5VA CTs fitted to the LV Busbars.

The unit at Dunton Green is located indoors in a metal cubicle. The metal cubicle shall be locked with standard Electricity North West operational keys.

The schematic below shows the connection arrangement for this unit.

1.1 Schematic



1.2 Fusing Details for the ABB Active Filters

Location	Fuse Size	Location
Dunton Green	160A	3 phase Cut Out situated to LHS of cabinet

2. STARTING AND STOPPING THE FILTER.

It is anticipated that the filter may need to be started and stopped during outage conditions, for example during a network fault.

The filter control panel is located within the metal cubicle and it is this control panel which shall be accessed to start and stop the filter.

2.1 To Stop the Filter

g) Press the highlighted Esc button on the front panel until the 'Welcome' screen is displayed.

h) Highlight the filter Start/Stop menu ('PQF' item in the list). In this menu the STOP indication should be visible.

i) Press OK. The filter will ask for confirmation and then it will stop and the main contactor will open.

j) The 'STOP' indication in the start /stop menu changes to a 'START' indication once the filter is stopped.

k) Once filter has stopped remove feeding fuses and post Caution Notice if filter is to be worked on.

l) Before starting any work on the filter the auxiliaries shall be isolated via the internal switch.

Note: The filter contains large Capacitors which can take up to 30min to discharge, ensure this period has elapsed before opening any covers.

2.2 To Start the Filter

g) Ensure power is supplied to the filter, by inserting the 160A fuses.

h) Ensure the filter auxiliaries are switched on via the internal switch.

i) Press the highlighted Esc button on the front panel until the 'Welcome' screen is displayed.

j) Highlight the filter Start/Stop menu ('PQF' item in the list). In this menu the 'START' indication should be visible.

k) Press OK. The filter will ask for confirmation and then it will start and the main contactor should close within 30 seconds. One second after the main contactor has closed the IGBTs will start and the filter will work under no load conditions.

l) The 'START' indication in the start /stop menu changes to a 'STOP' indication once the filter is started.

3. FILTER MALFUNCTION

If the filter malfunctions in any way, isolate it and notify Geraldine Bryson or Dan Randles as soon as possible.

FUTURE NETWORKS ASSET PROCEDURE

POWER PERFECTOR - EDGE GREEN LN (216438)

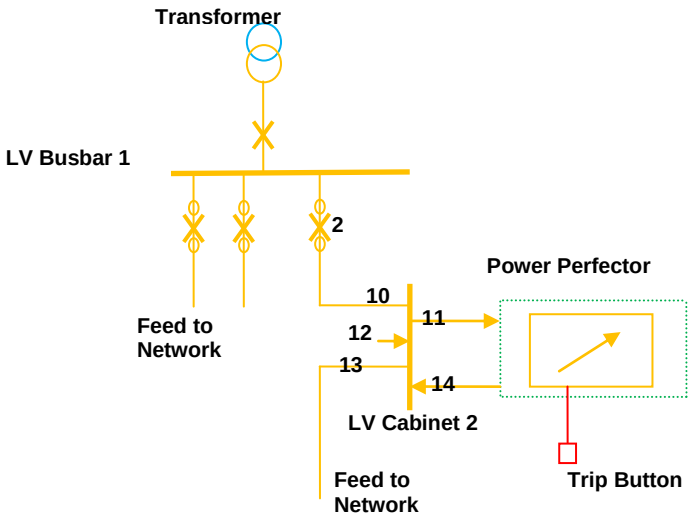
1. INTRODUCTION

At this site a Power Perfector has been installed as part of a trial under the Low Carbon Networks project on Voltage Management.

Power Perfectors are set up to remove any possible voltage fluctuations which may be introduced by the connection of generation devices, such as Solar PV panels, onto the network. A voltage is preset within the unit and the Power Perfector will automatically adjust its output to maintain this voltage level on the individual LV way to which it is connected in series.

The schematic below shows the connection arrangement for these units.

1.1 Schematic



For the above schematic the way numbers are as follows:

LV Busbar 1

Way 2 - Outgoing Feeder (630A Fuseway)

LV Cabinet 2

Way 10 - Incoming Feed (800A Disconnector)

Way 11 - Outgoing Feed to Power Perfector Unit (630A Link)

Way 12 - LV Bus Section Disconnector (800A Disconnector) - Normally open

Way 13 - Outgoing Feed to LV Network (630A Link)

Way 14 - Incoming Feed from Power Perfector Unit (630A Link)

2. OPERATIONAL PROCEDURE

Any blown fuse shall be replaced as per normal operational procedure.

Before any work is carried out on Way 2 fed from LV busbar 1 the Power Perfector shall be set to 0% optimisation ie this means that the input and output voltage are identical. This can simply be achieved by operating the Trip Button located adjacent to the Power Perfector Unit

Note: This does NOT trip the unit and it will remain LIVE until isolated at LV cabinet 2 as described below.

2.1 To Isolate the Power Perfector from the Network using LV Cabinet 2

a) Push the Trip Button to set the Power Perfector to 0% optimisation

b) Close the Bus Section Disconnector (Way 12) to create an LV parallel. (Note: This step only needs to be carried out if supplies are to be maintained).

c) Remove the links in Way 14 to break the LV parallel

d) Remove the links in Way 11 to isolate the Power Perfector.

e) Ways 11 and 14 shall be locked off with Caution Notices applied as per standard operational procedure.

2.2 To Re-connect the Power Perfector to the Network using LV Cabinet 2.

a) Close Bus Section Disconnector (Way 12) to restore supplies if not already closed above.

b) As per standard operational procedure remove any locking or caution notices applied.

c) Insert the links in Way 11 to energise the Power Perfector.

d) Insert the links in Way 14 this will connect the Power Perfector into the circuit at 0% optimisation and create an LV parallel.

e) Open the Bus Section Disconnector (Way 12) to break the LV parallel.

f) Re-set the Trip Button so the Power Perfector unit starts re-optimising the voltage dynamically as appropriate.

3. POWER PERFECTOR MALFUNCTION

If the Power Perfector malfunctions in any way, isolate it and notify Geraldine Bryson or Dan Randles as soon as possible.

FUTURE NETWORKS ASSET PROCEDURE

POWER PERFECTOR - GREENSIDE LANE (171747)

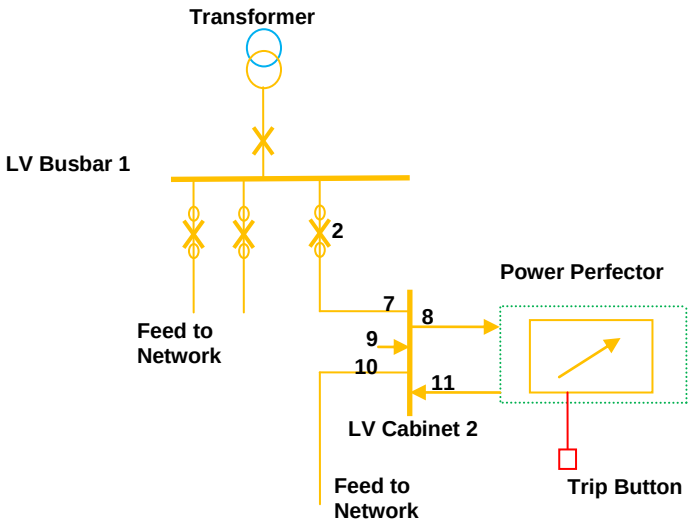
1. INTRODUCTION

At this site a Power Perfector has been installed as part of a trial under the Low Carbon Networks project on Voltage Management.

Power Perfectors are set up to remove any possible voltage fluctuations which may be introduced by the connection of generation devices, such as Solar PV panels, onto the network. A voltage is preset within the unit and the Power Perfector will automatically adjust its output to maintain this voltage level on the individual LV way to which it is connected in series.

The schematic below shows the connection arrangement for this unit.

1.1 Schematic



For the above schematic the way numbers are as follows:

LV Busbar 1

Way 2 - Outgoing Feeder (630A Fuseway)

LV Cabinet 2

Way 7 - Incoming Feed (800A Disconnector)

Way 8 - Outgoing Feed to Power Perfector Unit (630A Link)

Way 9 - LV Bus Section Disconnector (800A Disconnector) – Normally open

Way 10 - Outgoing Feed to LV Network (630A Link)

Way 11 - Incoming Feed from Power Perfector Unit (630A Link)

2. OPERATIONAL PROCEDURE

Any blown fuse shall be replaced as per normal operational procedure.

Before any work is carried out on Way 2 fed from LV busbar 1 the Power Perfector shall be set to 0% optimisation, ie this means that the input and output voltage are identical. This can simply be achieved by operating the Trip Button located adjacent to the Power Perfector Unit

Note: This does NOT trip the unit and it will remain LIVE until isolated at LV cabinet 2 as described below.

2.1 To Isolate the Power Perfector from the Network using LV Cabinet 2

a) Push the Trip Button to set the Power Perfector to 0% optimisation

b) Close the Bus Section Disconnector (Way 9) to create an LV parallel. (Note: This step only needs to be carried out if supplies are to be maintained).

c) Remove the links in Way 11 to break the LV parallel

d) Remove the links in Way 8 to isolate the Power Perfector.

e) Ways 8 and 11 shall be locked off with Caution Notices applied as per standard operational procedure.

2.2 To Re-connect the Power Perfector to the Network using LV Cabinet 2.

a) Close Bus Section Disconnector (Way 9) to restore supplies if not already closed above.

b) As per standard operational procedure remove any locking or caution notices applied.

c) Insert the links in Way 8 to energise the Power Perfector.

d) Insert the links in Way 11 this will connect the Power Perfector into the circuit at 0% optimisation and create an LV parallel.

e) Open the Bus Section Disconnector (Way 9) to break the LV parallel.

f) Re-set the Trip Button so the Power Perfector unit starts re-optimising the voltage dynamically as appropriate.

3. POWER PERFECTOR MALFUNCTION

If the Power Perfector malfunctions in any way, isolate it and notify Geraldine Bryson or Dan Randles as soon as possible.

FUTURE NETWORKS ASSET PROCEDURE

OLTC - LANDGATE (211951)

1. INTRODUCTION

At this site a distribution transformer with a type MR on-load tapchanger has been installed, as part of a trial under the Low Carbon Networks project on Voltage Management.

The transformer has been installed to investigate LV voltage regulation. Voltages may vary significantly due to the connection of generation devices, such as Solar PV panels, onto the network.

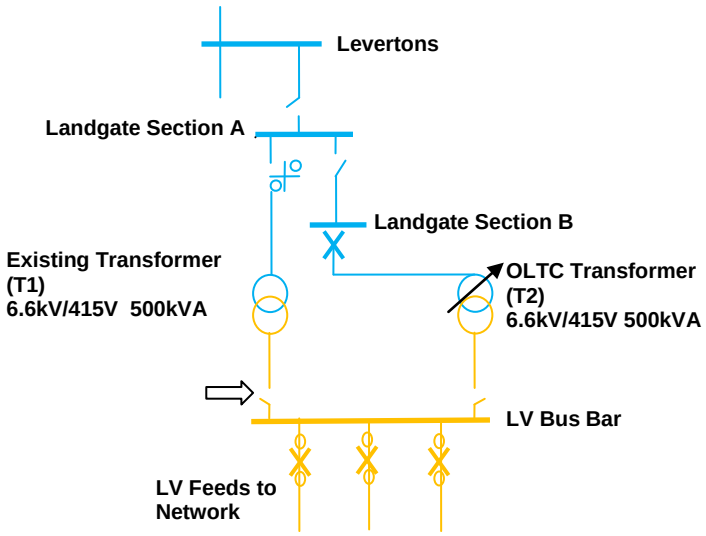
The tapchanger is controlled using a MR Tapcon 230 relay contained in a cabinet alongside the transformer. The relay is preset and should not require any intervention.

The transformer, tapchanger and AVC cabinet at Landgate are located within a separate GRP housing. The GRP housing shall be locked with a standard Electricity North West substation lock.

The existing distribution transformer shall remain energised from the HV side throughout this trial.

The schematic below shows the connection arrangement for this unit.

1.1 Schematic



2. OPERATIONAL PROCEDURE

Any blown fuse shall be replaced as per normal operational procedure.

2.1 To Isolate the OLTC Transformer from the Network

Measure the volts across the open T1 LV isolators.

2.1.1 Procedure to be followed if volts measured is less than or equal to 20V

a) Close T1 LV isolators to create an LV parallel. (Note: This step only needs to be carried out if supplies are to be maintained).

b) Open T2 LV isolators to isolate the LV side of the OLTC Transformer and break the LV parallel.

c) Open T2 CB to isolate the HV side of the OLTC transformer.

d) Remove the fuse from the cut-out to disconnect the LV supplies to the tapchanger. The cut-out is located adjacent to the AVC panel.

2.1.2 Procedure to be followed if volts measured is more than 20V

a) Open T2 CB. This will make the LV busbars dead.

b) Open T2 LV isolators to isolate the OLTC transformer from the system.

c) Open Levertons 6.6kV O/S at Landgate Section A. This will make the substation dead.

d) Close T1 LV isolators (dead operation).

e) Close Levertons 6.6kV O/S at Landgate Section A to restore supplies.

f) Remove the fuse from the cut-out to disconnect the LV supplies to the tapchanger. The cut-out is located adjacent to the AVC panel.

2.2 To re-connect the OLTC Transformer to the Network

2.2.1 Re-insert the fuse in the cut-out to restore the LV supplies to the tapchanger.

2.2.2 Close T2 CB to energise the OLTC transformer.

2.2.3 Measure the volts across the open T2 LV isolators.

2.2.4 Procedure to be followed if volts measured is less than or equal to 20V:

a) Close T2 LV isolators to create an LV parallel. (Note: This step only needs to be carried out if supplies are to be maintained).

b) Open T1 LV isolators to isolate the LV side of T1 and break the LV parallel.

2.2.5 Procedure to be followed if volts measured is more than 20V:

a) Open Levertons 6.6kV O/S at Landgate Section A. This will make the substation dead.

b) Open T1 LV isolators (dead operation).

c) Close T2 LV isolators (dead operation).

d) Close Levertons 6.6kV O/S at Landgate Section A to restore supplies.

3. OLTC TRANSFORMER MALFUNCTION

If the OLTC Transformer malfunctions in any way, isolate it in accordance with 2.1 and notify Geraldine Bryson or Dan Randles as soon as possible.

FUTURE NETWORKS ASSET PROCEDURE

OLTC - LEICESTER AVE (212726)

1. INTRODUCTION

At this site a distribution transformer with a type MR on-load tapchanger has been installed, as part of a trial under the Low Carbon Networks project on Voltage Management.

The transformer has been installed to investigate LV voltage regulation. Voltages may vary significantly due to the connection of generation devices, such as Solar PV panels, onto the network.

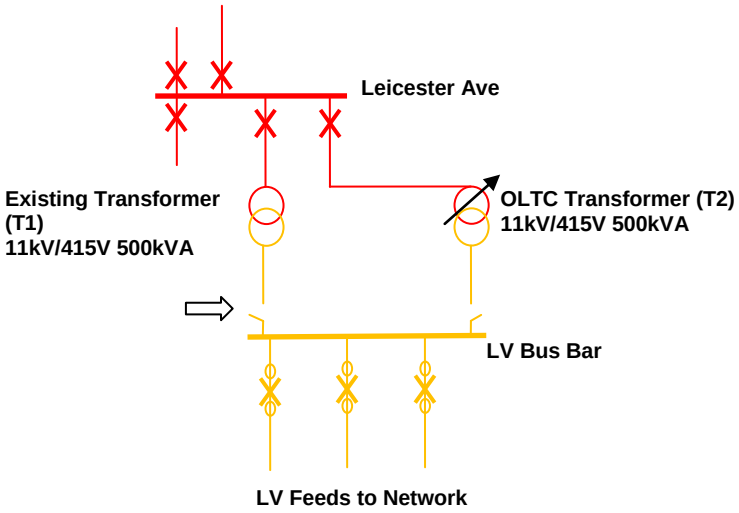
The tapchanger is controlled using a MR Tapcon 230 relay contained in a cabinet alongside the transformer. The relay is preset and should not require any intervention.

The transformer, tapchanger and AVC cabinet at Leicester Ave are located within a separate GRP housing. The GRP housing shall be locked with a standard Electricity North West substation lock.

The existing distribution transformer shall remain energised from the HV side throughout this trial.

The schematic below shows the connection arrangement for this unit.

1.1 Schematic



2. OPERATIONAL PROCEDURE

Any blown fuse shall be replaced as per normal operational procedure.

2.1 To isolate the OLTC Transformer from the Network

Measure the volts across the open T1 LV isolators.

2.1.1 Procedure to be followed if volts measured is less than or equal to 20V

a) Close T1 LV isolators to create an LV parallel. (Note: This step only needs to be carried out if supplies are to be maintained).

b) Open T2 LV isolators to isolate the LV side of the OLTC Transformer and break the LV parallel.

c) Open T2 CB to isolate the HV side of the OLTC transformer.

d) Remove the fuse from the cut-out to disconnect the LV supplies to the tapchanger. The cut-out is located adjacent to the AVC panel.

2.1.2 Procedure to be followed if volts measured more than 20V

a) Open T2 CB. This will make the LV busbars dead.

b) Open T2 LV isolators to isolate the OLTC transformer from the system.

c) Open T1 CB. This will make T1 dead.

d) Close T1 LV isolators (dead operation).

e) Close T1 CB to restore supplies.

f) Remove the fuse from the cut-out to disconnect the LV supplies to the tapchanger. The cut-out is located adjacent to the AVC panel.

2.2 To re-connect the OLTC Transformer to the Network

2.2.1 Re-insert the fuse in the cut-out to restore the LV supplies to the tapchanger.

2.2.2 Close T2 CB to energise the OLTC transformer

2.2.3 Measure the volts across the open T2 LV isolators.

2.2.4 Procedure to be followed if volts measured is less than or equal to 20V:

a) Close T2 LV isolators to create an LV parallel. (Note: This step only needs to be carried out if supplies are to be maintained).

b) Open T1 LV isolators to isolate the LV side of T1 and break the LV parallel.

2.2.5 Procedure to be followed if volts measured is more than 20V:

a) Open T2 CB.

b) Open T1 CB. This will make the substation dead.

c) Open T1 LV isolators (dead operation).

d) Close T2 LV isolators (dead operation).

e) Close T2 CB to energise the OLTC transformer to restore supplies.

3. OLTC TRANSFORMER MALFUNCTION

If the OLTC Transformer malfunctions in any way, isolate it in accordance with 2.1 and notify Geraldine Bryson or Dan Randles as soon as possible.

FUTURE NETWORKS ASSET PROCEDURE 7

LV CAPACITORS

1. INTRODUCTION

Due to the connection of Low Carbon Technologies (LCTs) such Solar PV panels, electric vehicles and heat pumps the management of voltage on the LV network will become increasingly more complex. Situations may arise where it will become impossible to set a voltage at the distribution transformer which will be adequate for all the outgoing LV feeders. Therefore it has become necessary to seek alternative forms of voltage control which can be applied at LV feeder level. One form of this voltage control is the addition of LV capacitors part way along feeders.

This procedure details the installation, operation and maintenance requirements for LV capacitors.

2. INSTALLATION REQUIREMENTS

The capacitor shall be mounted on a foundation and connected to the LV network via a standard 3 phase breech joint.

In order to maintain to IP33 rating the lifting eyes must NOT be removed. If the lifting eyes are removed then 4 off M8 dome headed bolts and washers must be fitted to cover the lifting eye holes.

Before energising the capacitor bank, an electrical insulation test of 1kV between earth and short-circuited phases shall be carried out. Any damage resulting from this test shall be notified immediately. Note: end this test by removing the short-circuit from the phases.

2.1 Commissioning

2.1.1 With the equipment isolated from the supply:

a) check the tightness of all connections,

b) check the earth bonding is adequate,

c) check fuses are inserted in the fuse switch disconnector,

d) check that the contactor moves freely,

e) ensure the enclosure is free of all debris and tools.

2.1.2 Check the network voltage is in accordance with the specification.

2.1.3 Check the requirements for the cable rating and the protection / isolating device.

2.1.4 Check terminal capacitance of each stage with a suitable meter.

2.1.5 Ensure the fuses are tight and secure in the fuse switch disconnectors.

2.1.6 Close the fuse switch disconnectors.

2.1.7 To energise the capacitor close MCCB to “ON” and lock.

2.1.8 Check capacitor current with a clip-on ammeter on the supply cables to determine output kVAr = √3.I.U (I = capacitor line current in amps; U = line to line voltage in Volts). If the output differs from the nameplate rating, it may be due to deterioration of the capacitor. Appropriate action should be taken to replace the capacitor if required.

2.1.9 Set the relay for automatic control.

3. MAINTENANCE REQUIREMENTS

3.1 Check capacitor current with a clip-on ammeter on the supply cables to determine output kVAr = √3.I.U (I = capacitor line current in amps; U = line to line voltage in Volts). If the output differs from the nameplate rating, it may be due to deterioration of the capacitor. Appropriate action should be taken to replace the capacitor if required.

3.2 Isolate capacitor as per section 4.1 of this procedure

3.3 Carry out maintenance. Annual maintenance should include the following:

a) Remove dust deposits, clean all parts, and paint metalwork as required.

b) Check ventilation panels are not obstructed.

c) Check main and control fuse and condition.

d) Check tightness of all electrical connections including the fuses.

e) Check condition of discharge resistors.

f) Check contactor condition and operation and replace as necessary.

g) Check MCCB connections and operation.

3.4 Re-energise the capacitor as per section 4.2 of this procedure

3.5 Re-commission, and check capacitor current with a clip-on ammeter on the supply cables as per item 3.1 above.

4. CAPACITOR OPERATION PROCEDURE

4.1 To Isolate the Capacitor from the Network

Disconnect the capacitor bank from the supply using the MCCB fitted within the cubicle and lock it in the “OFF” position.

Wait for 5 minutes for the capacitors to discharge.

Open the fuse switch disconnectors and remove the fuse carriages. Note: there is one fuse switch disconnector per capacitor bank ensure that all are open and removed.

4.2 To Re-connect the Capacitor to the Network

Carry out an electrical insulation test of 1.0kV between earth and short-circuited phases. After the test remove the short circuit of the phases. Any damage resulting from this test should be immediately notified.

Re-insert the fuse carriages and close the fuse switch disconnectors,

Turn the MCCB to “ON” position and lock it.

5. LV CAPACITOR MALFUNCTION

If the LV Capacitor malfunctions in any way, isolate it in accordance with section 4.1 and notify Geraldine Bryson or Dan Randles as soon as possible.