

QUEST Detailed Site Design Report

Project Name: ENWL QUEST Project

Project Job Number: F12649

Revision No. 1.0

Contents

Abbreviations	2
1 Introduction	3
2 Overview.....	3
3 AVC upgrade works to be completed as part of QUEST	5
4 Feeder Monitoring sites to be completed as part of QUEST.....	37
5 Final Summary and Conclusions.....	38

Abbreviations

ANM	Active Network Management
AVC	Automatic Voltage Control
BSP	Bulk Supply Point
BAU	Business as Usual
CAT6	Category 6 cable
CB	Circuit Breaker
CLASS	Customer Load Active System Services
CT	Current Transformer
DG	Distributed Generation
DM	Drive Mechanism
DNP3	Distributed Network Protocol 3
ENWL	Electricity North West Limited
GSP	Grid Supply Point
kV	kilo Volts
LCT	Low Carbon Technology
MW	Mega Watts
N/A	Not Applicable
NIC	Network Innovation Competition
PSP	Primary Supply Point (Primary Substation)
PVC	Polyvinyl chloride
RTU	Remote Terminal Unit
SCADA	Supervisory control and data acquisition
SWA	Steel Wire Armoured (cable)
TBC	To be confirmed

1 Introduction

The Electricity Network Innovation Competition (NIC) is an annual opportunity for electricity network companies to compete for funding for the development and demonstration of new technologies, operating and commercial arrangements.

The QUEST project by Electricity North West Limited (ENWL) aims to develop and demonstrate a holistic voltage control methodology to co-ordinate and optimise the operation of network innovations such as Active Network Management (ANM) system which manages the connection of demand and generation on constrained networks, and customer voltage optimisation solutions such as Customer Load Active System Services (CLASS) and Smart Street.

QUEST will seek to overcome limitations in network management brought upon by an increase in the uptake of Low Carbon Technologies (LCTs) such as Heat Pumps (HP), Electric Vehicles (EV) and renewable energy sources.

Fundamentals will work in partnership with ENWL, Schneider Electric and Smarter Grid Solutions to integrate discrete voltage control techniques into one overarching, co-ordinated and optimised system.

2 Overview

As part of QUEST, a total of 9 sites have been selected to have their Automatic Voltage Control (AVC) upgraded to the latest technology voltage control relay, SuperTAPP SG.

SuperTAPP SG is approved as ENWL's standard voltage control relay and has been installed as BaU on any AVC upgrades completed on their network.

The 9 sites selected for upgrade with QUEST involve a mixture of BSP and PSP sites all fed out of Whitegate GSP. This means that all voltage control connected downstream of Whitegate GSP will be regulated by SuperTAPP SG equipment.

Fundamentals will also develop bespoke software algorithms to enable QUEST functionality on all SuperTAPP SG relays.

Fundamentals have conducted site surveys at each of the 9 sites and have used their knowledge and expertise to make recommendations on the AVC upgrade works required for each site.

The 9 sites requiring AVC upgrades as part of this project are as follows:

- Ancoats North 100601 (T11/T12/T14)
- Greenhill Primary (T11/T12/T13)
- Chadderton BSP 301101 (GT1/GT2)
- Cannon Street 100607 (T11/T12/T13)
- Werneth 303300 (DNP3) (T11/T12)
- Greenhill BSP 300024 (GT2/GT3)
- Newton Heath 100624 (T11)
- Royton BSP 300009 (GT1/GT2)
- Redbank BSP 100503 (GT2/GT3)

This gives a total of 20 AVC schemes to be upgraded/installed.

Summaries of each of the site's surveys and reports can be found in the following sections of this report.

Fundamentals scope of works for the AVC upgrade at each of the QUEST site are as follows:

- Completion of detailed Site Surveys/composing of Reports
- AVC scheme Design
- AVC Wall Box build and Supply
- AVC Installation (also including upgrade of Marshalling Kiosk and Tapchange Drive Mechanism control gear at selected sites).
- AVC settings Design/Application
- AVC/QUEST Functionality Commissioning

3 AVC upgrade works to be completed as part of QUEST

Ancoats North Primary QUEST AVC Upgrade Design Report Details

Supporting documents:

- *Ancoats North Primary 100601 (T11/T12/T14) Site survey*
- *Ancoats North Primary 100601 DPOWRA*
- *Ancoats North Primary 100601 Drawing Register (with highlighted requested drawing)*
- *Site Survey Photographs*

Site Specifics and proposed Design/Interface details on this site are as follows;

Transformer Suffixes	T11, T12 & T14
Site Voltage	33/6.6kV
Tapchanger Drive Mechanism Details	2 x AEI 3S21 A4XT (T11/T12) 1 x ATL AT317.44/300L (with TAPCOM2 unit) (T14)
Location of existing AVC?	Currently MicroTAPP AVC relays located within single system wall mounted AVC wall boxes within relay room building. Existing AVC wall boxes also include transformer alarm wiring/marshalling terminals (but not Tx trips).
Proposed Alterations for AVC	<p>New CLASS ready AVC wall boxes (x3) to be installed within the relay room in place of the existing AVC wall boxes. The majority of existing AVC SWA multicores will be re used.</p> <p>A new SWA multicore will be installed for the 110Vdc supply to the AVC wall boxes from the 110Vdc battery charger.</p> <p>New CAT6 cables (with Green outer sheath) will be installed from each AVC wall box back to the site RTU to enable AVC relay DNP3 comms connections. All CAT6 cables will be ran/installed within a black 25mm PVC flexible conduit ran in the substation cable trenches.</p> <p>All existing AVC control gear and wiring within T11 and T12 drive mechanism will be removed. New custom-built control gear plates will then be fitted/wired within the DMs. New PVC trunking and terminal rails will also be installed.</p> <p>The TPI resistor chain within each DM will be replaced for new.</p> <p>All TPI and limit switch contacts will be cleaned and checked for correct operation.</p> <p>Note; T11 and T12 have a 'Tapchanger Thermostat Trip' wired within each tapchange DM. This trip is to be rewired as part of the DM upgrade meaning we will require ENW to re-commission this trip functionality once upgrades are completed.</p> <p>Existing Transformer Alarm circuitry/SWAs are to be removed from AVC wall boxes and rerouted into new adaptable terminal boxes as 'Tx Marshalling Circuitry ONLY' (as per CLASS project).</p> <p>The existing AVC related alarms listed and connected within the Annunciator Alarms Panel will become redundant. All relevant labels will be blanked and alarm badges marked as not in use.</p> <p>230Vac Cooler Control Circuits are present for T11 & T12 so CSMR to be added on each AVC scheme. T14 Cooler Control circuit supply is 110Vac meaning no CSMR required.</p>

	<p>T14 is modern type tap changer from 2002 which requires no refurbishment/upgrade works. Minimal connection and re-ferruling works will be required enable correct interface to the new SuperTAPP SG AVC scheme.</p> <p>New AVC design drawings will be provided for the site as per the 'Drawings List' contents sheet at the start of the Design Pack.</p>
<p>Feeder Monitoring to be completed via new AVC schemes?</p>	<p>We propose to monitor the following 6.6kV feeders via the new SuperTAPP SG AVC schemes;</p> <ul style="list-style-type: none"> • 'F826 Silk Street Section B' • 'F134 Royal Mail MLSO' <p>We will require outages on the above feeders to enable us to introduce AVC interposer CTs into the CBs protection CT wiring. A standard arrangement of interposer and shorting link rail can be seen on the design drawings of how we propose to add into each CB.</p> <p>We believe there are enough spare cores on the existing SWA SCADA multicores installed from each of the above CBs back to the site RTU. These spare cores will then be utilised (2 per CB) to enable wiring of the AVC interposer CTs secondary mA signal back to the relevant SuperTAPP SG relays to provide the required DG measurements.</p> <p>Ahead of final AVC commissioning (final week of install works) we will require the following information to be provided by ENWL on the DG affected CBs in order for us to create/design the new SuperTAPP SG AVC settings;</p> <ul style="list-style-type: none"> o DG type(s) connected o DG Size(s) in MW o Average load of affected feeder(s) excluding DG o Average load of Ancoats North Primary substation.
<p>Excavations/Long Cable Tray runs Required?</p>	<p>No</p>
<p>Asbestos Concerns?</p>	<p>No- Register was checked on site. No Asbestos concerns relating to future install works.</p>
<p>Blanking Plates Required?</p>	<p>Yes- Existing Control and Metering panel to have old equipment removed and be blanked.</p> <p>All control panel blanking will be completed using Grey 3mm thick PVC sheeting which will be measured, cut to size and fitted on site.</p>
<p>Pre-Install Works Duration (Estimated)</p>	<p>N/A- Due to existing AVC wall box types and location, we are unable to complete any pre works at this site.</p>
<p>Tx Outage Duration (Estimated)</p>	<ul style="list-style-type: none"> • With the decided final AVC upgrade scope taken into account, Fundamentals will need to request the following timescales to complete the AVC works on each transformer: T11- 1.5 weeks (No weekend working) T12- 1.5 weeks (No weekend working) T14- 1 week (No weekend working) This gives an estimated total of 4 working weeks for completion of this installation. Note; The above proposal involves Primary transformers being left switched out over weekend periods.

Existing AVC arrangement at Ancoats North Primary-



Existing T11/T12 Tapchange Drive Mechanism Condition at Ancoats North Primary-



Cannon Street Primary QUEST AVC Upgrade Design Report Details

Supporting documents:

- *Cannon Street Primary 100607 (T11/T12/T13) Site survey*
- *Cannon Street Primary 100607 DPOWRA*
- *Cannon Street Primary 100607 Drawing Register (with highlighted requested drawing)*
- *Site Survey Photographs*

Site Specifics and proposed Design/Interface details on this site are as follows;

Transformer Suffixes	T11, T12 & T13
Site Voltage	33/6.6kV
Tapchanger Drive Mechanism Details	3 x Ferranti DS2 with 110Vac Motor
Location of existing AVC?	Currently SuperTAPP RVM4 AVC relays located within single system freestanding AVC panels within relay room building.
Proposed Alterations for AVC	<p>New CLASS ready AVC wall boxes (x3) to be installed within corridor of substation building to the right of the door into the 6.6kV control room. (Picture provided as part of the submitted site survey report)</p> <p>All new SWA multicore will be installed as per the Multicore Cable Schedules included as part of the design pack.</p> <p>New CAT6 cables (with Green outer sheath) will be installed from each AVC wall box back to the site RTU to enable AVC relay DNP3 comms connections. All CAT6 cables will be ran/installed within a black 25mm PVC flexible conduit ran in the substation cable trenches.</p> <p>The existing single system freestanding AVC panels are to have all existing/redundant AVC equipment and wiring removed making each of these panels new marshalling points to the new AVC wall boxes. New header labels will be fitted to the panels to indicate that they are new AVC marshalling panels.</p> <p>All holes left by removed equipment will be blanked by Grey 3mm thick PVC sheeting which will be measured, cut to size and fitted on site.</p> <p>As per the instruction of ENWL, ONLY minimal outdoor MK upgrade works will be completed on this site.</p> <p>No inspection or re wiring works will be completed within the Ferranti DS2 DMs at this site.</p> <p>Minimal rewiring/re-ferruling works will be required within each DM external terminal box to enable correct interface of the new SuperTAPP SG schemes.</p> <p>The existing AVC control gear and wiring within T11, T12 and T13 Mks ONLY will be removed and replaced for new via custom-built control gear plates (as per Minimal works option quoted in Q12982).</p> <p>230Vac Cooler Control Circuits are present for T11, T12 and T13 so CSMR to be added within each MK.</p> <p>New AVC design drawings will be provided for the site as per the 'Drawings List' contents sheet at the start of the Design Pack.</p>
Feeder Monitoring to be completed via new AVC schemes?	<p>We propose to monitor the following 6.6kV feeder via the new SuperTAPP SG AVC schemes;</p> <ul style="list-style-type: none"> • 'F845 Marks & Spencer Manchester'

	<p>We will require an outage on the above feeder to enable us to introduce AVC interposer CTs into the CBs protection CT wiring. A standard arrangement of interposer and shorting link rail can be seen on the design drawings of how we propose to add into the CB.</p> <p>We believe there are enough spare cores on the existing SWA SCADA multicores installed from the above CB back to the site RTU. These spare cores will then be utilised (2 per CB) to enable wiring of the AVC interposer CTs secondary mA signal back to the relevant SuperTAPP SG relays to provide the required DG measurements.</p> <p>Ahead of final AVC commissioning (final week of install works) we will require the following information to be provided by ENWL on the DG affected CB in order for us to create/design the new SuperTAPP SG AVC settings;</p> <ul style="list-style-type: none"> o DG type(s) connected o DG Size(s) in MW o Average load of affected feeder(s) excluding DG o Average load of Cannon Street Primary substation.
Excavations/Long Cable Tray runs?	No
Asbestos Concerns?	No- Register was checked on site. No Asbestos concerns relating to future install works.
Blanking Plates Required?	<p>Yes- Existing AVC panels and Control and Metering panel to have old equipment removed and be blanked.</p> <p>All control panel blanking will be completed using Grey 3mm thick PVC sheeting which will be measured, cut to size and fitted on site.</p>
Pre-Install Works Duration (Estimated)	The following dates have been proposed to complete pre-install works at this site; 27/06/22 - 01/07/22 (1 week total)
Tx Outage Duration (Estimated)	<ul style="list-style-type: none"> • With the decided final AVC upgrade scope taken into account, Fundamentals will need to request the following timescales to complete the AVC works on each transformer: T11- 1 week (No weekend working) T12- 1 week (No weekend working) T13- 1 week (No weekend working) <p>This gives an estimated total of 3 working weeks for completion of this installation.</p>

Existing AVC arrangement at Cannon Street Primary-



Proposed new AVC wall box positioning at Cannon Street Primary-



New traywork to be installed from duct in wall to new AVC SG Wallboxes. Duct in wall allows access into trench within control room to enable bottom entry access to existing AVC panels.

Chadderton BSP QUEST AVC Upgrade Design Report Details

Supporting documents:

- *Chadderton BSP 301101 (GT1/GT2) Site survey*
- *Chadderton BSP 301101 DPOWRA*
- *Chadderton BSP 301101 Drawing Register (with highlighted requested drawing)*
- *Site Survey Photographs*

Site Specifics and proposed Design/Interface details on this site are as follows;

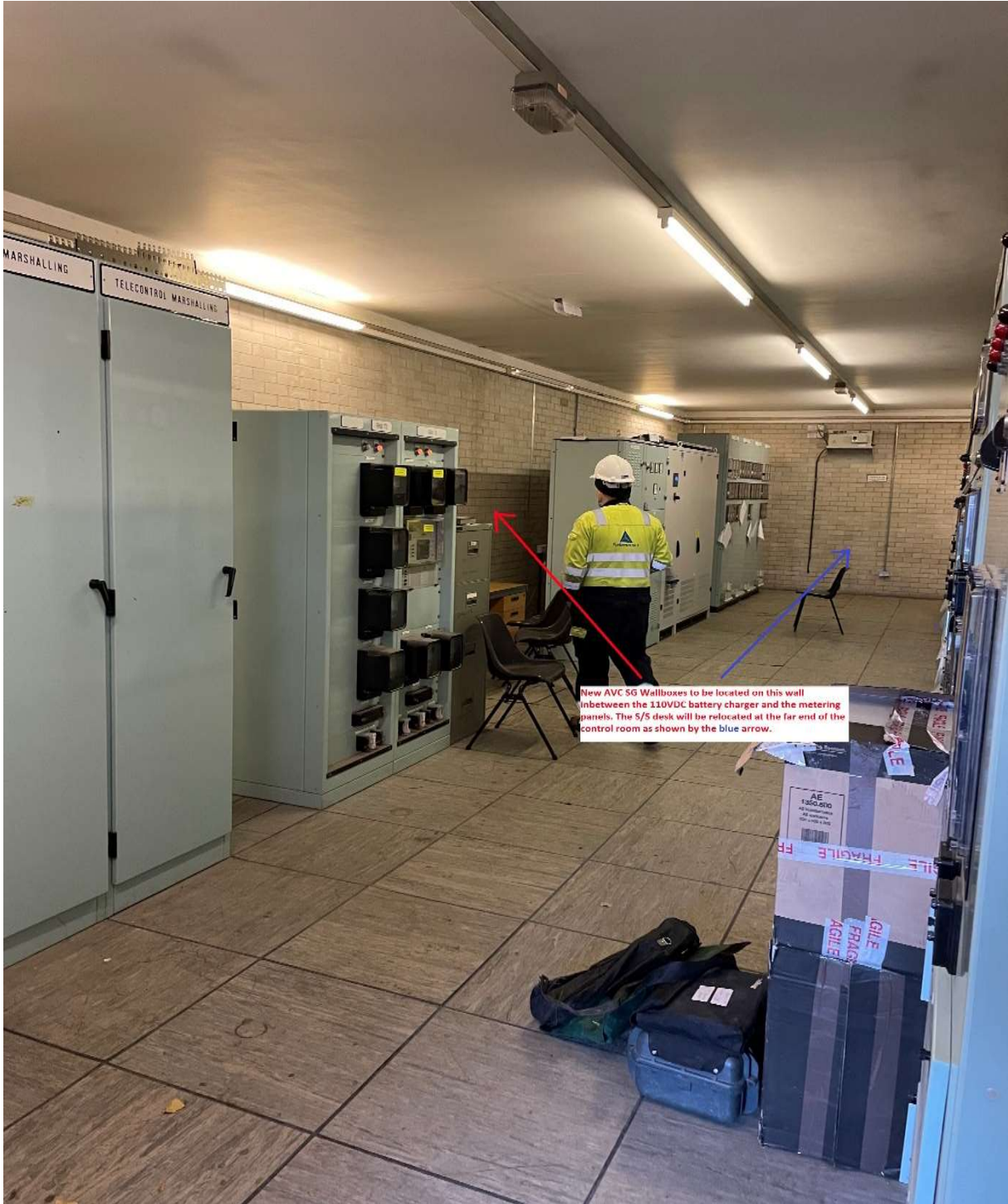
Transformer Suffixes	GT1/GT2
Site Voltage	132/33kV
Tapchanger Drive Mechanism Details	2 x ATL ASD 319.44/500G5RR3 (GT1/GT2)
Location of existing AVC?	Currently MVGC01 AVC relays located within single system freestanding AVC panels within 132kV building relay room. Existing AVC panels also include transformer alarm flag relays/wiring (not trips).
Proposed Alterations for AVC	<p>New CLASS ready AVC wall boxes (x2) to be installed within the relay room in free wall space where the substation desk currently resides. (Picture provided as part of the submitted site survey report)</p> <p>All new SWA multicore will be installed as per the Multicore Cable Schedules included as part of the design pack.</p> <p>New CAT6 cables (with Green outer sheath) will be installed from each AVC wall box back to the site RTU to enable AVC relay DNP3 comms connections. All CAT6 cables will be ran/installed within a black 25mm PVC flexible conduit ran in the substation cable trenches. Please see note 1 within the 'Outstanding Site Related Questions' section with regards to the installation of CAT6 cables.</p> <p>The existing AVC related alarms connected within the existing combined AVC/Tx Protection Panel will become redundant. All relevant redundant AVC flag relay labels will be blanked and marked as not in use.</p> <p>230Vac Cooler Control Circuits are present for GT1 & GT2 so CSMR to be added on each AVC scheme.</p> <p>As per the instruction of ENWL, NO outdoor MK/DM upgrade works will be completed on this site. GT1/GT2 existing MPR shunt trip coils will be used for AVC lockout/runaway prevention.</p> <p>Minimal rewiring/re-ferruling works will be required within each outdoor MK to enable correct interface of the new SuperTAPP SG schemes.</p> <p>No TC Motor Current Monitoring is to be installed as part of these AVC upgrade works.</p> <p>New AVC design drawings will be provided for the site as per the 'Drawings List' contents sheet at the start of the Design Pack.</p>
Feeder Monitoring to be completed via new AVC schemes?	<p>We propose to monitor the following 33kV feeders via the new SuperTAPP SG AVC schemes;</p> <ul style="list-style-type: none"> • 'B194 New Moston No.2/Broadgate Chadderton Generation' • Stock Lane STOR <p>We will require outages on the above feeders to enable us to introduce AVC interposer CTs into the relevant feeders associated relay panels protection CT wiring. A standard arrangement of interposer and shorting link rail can be seen on the design drawings of how we propose to add into each relay panel.</p>

	<p>New 4 core SWAs will be installed from each relevant feeder relay panel to enable wiring of the new AVC interposer CTs secondary mA signal back to the relevant AVC wall boxes to provide the required DG measurements.</p> <p>Ahead of final AVC commissioning (final week of install works) we will require the following information to be provided by ENWL on the DG affected CBs in order for us to create/design the new SuperTAPP SG AVC settings;</p> <ul style="list-style-type: none"> o DG type(s) connected o DG Size(s) in MW o Average load of affected feeder(s) excluding DG o Average load of Chadderton BSP Primary substation.
Excavations/Long Cable Tray runs Required?	No
Asbestos Concerns?	No- Register was checked on site. No Asbestos concerns relating to future install works.
Blanking Plates Required?	Yes- Existing AVC panels to have old equipment removed and be blanked. All control panel blanking will be completed using Grey 3mm thick PVC sheeting which will be measured, cut to size and fitted on site.
Pre-Install Works Duration (Estimated)	The following dates have been proposed to complete pre-install works at this site; 13/06/22 - 17/06/22 (1 week total)
Tx Outage Duration (Estimated)	<ul style="list-style-type: none"> • With the decided final AVC upgrade scope taken into account, Fundamentals will need to request the following timescales to complete the AVC works on each transformer under outage: GT1- 1 week (No weekend working) GT2- 1 week (No weekend working) This gives an estimated total of 2 working weeks for completion of this installation under transformer outages.

Existing AVC arrangement at Chadderton BSP-



Proposed new AVC wall box positioning at Chadderton BSP-



Greenhill BSP QUEST AVC Upgrade Design Report Details

Supporting documents:

- *Greenhill BSP 300024 (GT2/GT3) Site survey*
- *Greenhill BSP 300024 DPOWRA*
- *Greenhill BSP 300024 Drawing Register (with highlighted requested drawing)*
- *Site Survey Photographs*

Site Specifics and proposed Design/Interface details on this site are as follows;

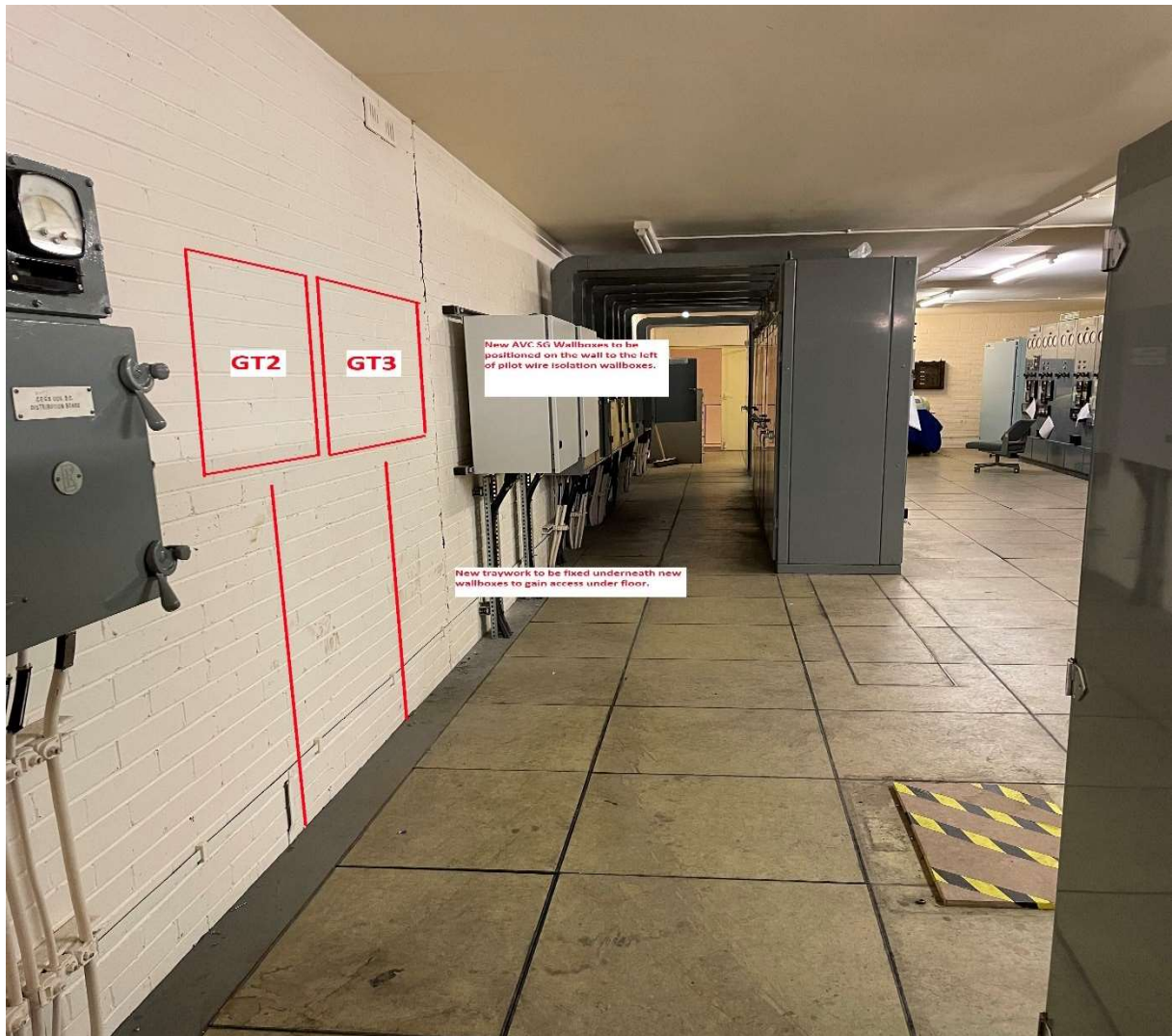
Transformer Suffixes	GT2/GT3
Site Voltage	132/33kV
Tapchanger Drive Mechanism Details	2 x Fuller HS319-33/600 DNRR1 (GT2/GT3)
Location of existing AVC?	Currently SuperTAPP RVM5/RTMU1m AVC relays located within single system freestanding AVC panels on top floor of 132kV building. Existing AVC panels also include transformer alarm flag relays/wiring (not trips).
Proposed Alterations for AVC	<p>New CLASS ready AVC wall boxes (x2) to be installed in free wall space within 132kV relay room. (Picture provided as part of the submitted site survey report)</p> <p>Existing AVC panels to have all AVC equipment and wiring removed to become Transformer Alarm and AVC Marshalling panels.</p> <p>All new SWA multicore will be installed as per the Multicore Cable Schedules included as part of the design pack.</p> <p>New CAT6 cables (with Green outer sheath) will be installed from each AVC wall box back to the site RTU to enable AVC relay DNP3 comms connections. All CAT6 cables will be ran/installed within a black 25mm PVC flexible conduit ran in the substation cable trenches.</p> <p>The existing AVC related alarms connected within the existing combined AVC/Tx Protection Panel will become redundant. All relevant redundant AVC flag relay labels will be blanked and marked as not in use.</p> <p>230Vac Cooler Control Circuits are present for GT2 & GT3 so CSMR to be added on each AVC scheme within the outdoor MKs.</p> <p>As per the instruction of ENWL, NO outdoor MK/DM upgrade works will be completed on this site. GT2/GT3 existing Motor MCBs to be replaced/rewired new MPRs fitted with shunt trip coils for AVC lockout/runaway prevention.</p> <p>Minimal rewiring/re-ferruling works will be required within each outdoor MK to enable correct interface of the new SuperTAPP SG schemes.</p> <p>No TC Motor Current Monitoring is to be installed as part of these AVC upgrade works.</p> <p>New AVC design drawings will be provided for the site as per the 'Drawings List' contents sheet at the start of the Design Pack.</p>
Feeder Monitoring to be completed via new AVC schemes?	No 33kV feeder monitoring to be completed at this site. No substantial size DG connections present.
Excavations/Long Cable Tray runs Required?	No

Asbestos Concerns?	No- Register was checked on site. No Asbestos concerns relating to future install works.
Blanking Plates Required?	Yes- Existing AVC panels to have old equipment removed and be blanked. All control panel blanking will be completed using Grey 3mm thick PVC sheeting which will be measured, cut to size and fitted on site.
Pre-Install Works Duration (Estimated)	The following dates have been proposed to complete pre-install works at this site; 20/06/22 - 24/06/22 (1 week total)
Tx Outage Duration (Estimated)	<ul style="list-style-type: none"> With the decided final AVC upgrade scope taken into account, Fundamentals will need to request the following timescales to complete the AVC works on each transformer under outage: GT2- 1 week (No weekend working) GT3- 1 week (No weekend working) This gives an estimated total of 2 working weeks for completion of this installation under transformer outages.

Existing AVC arrangement at Greenhill BSP-



Proposed new AVC wall box positioning at Greenhill BSP



Greenhill Primary QUEST AVC Upgrade Design Report Details

Supporting documents:

- *Greenhill Primary 300024 (T11/T12/T13) Site survey*
- *Greenhill Primary 300024 DPOWRA*
- *Greenhill Primary 300024 Drawing Register (with highlighted requested drawing)*
- *Site Survey Photographs*

Site Specifics and proposed Design/Interface details on this site are as follows;

Transformer Suffixes	T11, T12 & T13
Site Voltage	33/6.6kV
Tapchanger Drive Mechanism Details	3 x ATL AT317.44/300L (with new Brush replacement units installed)
Location of existing AVC?	Currently MicroTAPP AVC relays located within single system wall mounted AVC wall boxes within relay room building.
Proposed Alterations for AVC	<p>New CLASS ready AVC wall boxes (x3) to be installed within the relay room in place of the existing AVC wall boxes. The majority of existing AVC SWA multicores will be re used.</p> <p>A new SWA multicore will be installed for the 110Vdc supply to the AVC wall boxes from the 110Vdc battery charger.</p> <p>New CAT6 cables (with Green outer sheath) will be installed from each AVC wall box back to the site RTU to enable AVC relay DNP3 comms connections. All CAT6 cables will be ran/installed within a black 25mm PVC flexible conduit ran in the substation cable trenches. Please see note 1 within the ‘Outstanding Site Related Questions’ section with regards to the installation of CAT6 cables.</p> <p>The existing AVC related alarms listed and connected within the ‘Aux Supplies and Alarms’ panel will become redundant. All relevant labels will be blanked and alarm flags marked as not in use.</p> <p>All three drive mechanisms on site require minimal connection and re-ferruling works to enable correct interface to the new SuperTAPP SG AVC scheme.</p> <p>New AVC design drawings will be provided for the site as per the ‘Drawings List’ contents sheet at the start of the Design Pack.</p>
Feeder Monitoring to be completed via new AVC schemes?	No 6.6kV feeder monitoring to be completed at this site. No substantial size DG connections present. Agreed with Steve Stott that DG connection associated with ‘Simon Megson’ 6.6kV feeder is not substantial and does not need to be monitored.
Excavations/Long Cable Tray runs Required?	No
Asbestos Concerns?	No- Register was checked on site. No Asbestos concerns relating to future install works.
Blanking Plates Required?	<p>Yes- Existing Control and Metering panel to have old equipment removed and be blanked.</p> <p>All control panel blanking will be completed using Grey 3mm thick PVC sheeting which will be measured, cut to size and fitted on site.</p>
Pre-Install Works Duration (Estimated)	N/A- Due to existing AVC wall box types and location, we are unable to complete any pre works at this site.

Tx Outage Duration (Estimated)	<ul style="list-style-type: none">With the decided final AVC upgrade scope taken into account, Fundamentals will need to request the following timescales to complete the AVC works on each transformer: T11- 1 week (No weekend working) T12- 1 week (No weekend working) T13- 1 week (No weekend working) This gives an estimated total of 3 working weeks for completion of this installation.
---------------------------------------	--

Existing AVC arrangement at Greenhill Primary-



Royton BSP QUEST AVC Upgrade Design Report Details

Supporting documents:

- Royton BSP 300009 (GT1/GT2) Site survey
- Royton BSP 300009 DPOWRA
- Royton BSP 300009 Drawing Register (with highlighted requested drawing)
- Site Survey Photographs

Site Specifics and proposed Design/Interface details on this site are as follows;

Transformer Suffixes	GT1 & GT2
Site Voltage	132/33kV
Tapchanger Drive Mechanism Details	2 x Ferranti FC6 with 110Vac Motor
Location of existing AVC?	Currently SuperTAPP RVM4 AVC relays located within single system freestanding AVC panels within 132kV building relay room. Existing AVC panels also include transformer alarm flag relays/wiring (not trips).
Proposed Alterations for AVC	<p>New CLASS ready AVC wall boxes (x2) to be installed in free wall space within 132kV relay room. (Picture provided as part of the submitted site survey report). Existing AVC panels to have all AVC equipment and wiring removed to become Transformer Alarm and AVC marshalling panels.</p> <p>All new SWA multicores will be installed as per the Multicore Cable Schedules included as part of the design pack. New CAT6 cables (with Green outer sheath) will be installed from each AVC wall box back to the site RTU to enable AVC relay DNP3 comms connections. All CAT6 cables will be ran/installed within a black 25mm PVC flexible conduit ran in the substation cable trenches.</p> <p>As per the instruction of ENWL, ONLY outdoor MK upgrade works will be completed on this site. No inspection or re wiring works will be completed within the Ferranti FC6 DMs at this site. Minimal rewiring/re-ferruling works will be required within each DM external terminal box to enable correct interface of the new SuperTAPP SG schemes.</p> <p>The existing AVC control gear and wiring within GT1 & GT2 Mks ONLY will be removed and replaced for new via custom-built control gear plates (as per Minimal works option quoted in Q12989).</p> <p>230Vac Cooler Control Circuits are present for GT1 & GT2 so CSMR to be added within each MK.</p> <p>New AVC design drawings will be provided for the site as per the 'Drawings List' contents sheet at the start of the Design Pack.</p>
Feeder Monitoring to be completed via new AVC schemes?	<p>We propose to monitor the following 33kV feeder via the new SuperTAPP SG AVC schemes;</p> <ul style="list-style-type: none"> • 'Stock Lane STOR' <p>We will require an outage on the above feeder to enable us to introduce an AVC interposer CT into the CB/relay panels protection CT wiring. A standard arrangement of interposer and shorting link rail can be seen on the design drawings of how we propose to add into the CB relay panel.</p>

	<p>A new 4 core SWA will be installed from the CB relay panel back to the new AVC wall boxes to enable wiring of the AVC interposer CT secondary mA signal back to the relevant SuperTAPP SG relays to provide the required DG measurements.</p> <p>Ahead of final AVC commissioning (final week of install works) we will require the following information to be provided by ENWL on the DG affected CB in order for us to create/design the new SuperTAPP SG AVC settings;</p> <ul style="list-style-type: none"> o DG type(s) connected o DG Size(s) in MW o Average load of affected feeder(s) excluding DG o Average load of Royton BSP substation.
Excavations/Long Cable Tray runs?	No
Asbestos Concerns?	Yes- No Asbestos Register could be found on site. We will need to request a copy from ENWL.
Blanking Plates Required?	<p>Yes- Existing AVC panels to have old equipment removed and be blanked. Note; 'Common Alarm' lamp will be re drilled and still visible on front of AVC panels after blanking.</p> <p>All control panel blanking will be completed using Grey 3mm thick PVC sheeting which will be measured, cut to size and fitted on site.</p>
Pre-Install Works Duration (Estimated)	The following dates have been proposed to complete pre-install works at this site; 18/07/22 - 22/07/22 (1 week total)
Tx Outage Duration (Estimated)	<ul style="list-style-type: none"> • With the decided final AVC upgrade scope taken into account, Fundamentals will need to request the following timescales to complete the AVC works on each transformer: GT1- 1 week (No weekend working) GT2- 1 week (No weekend working) <p>This gives an estimated total of 2 working weeks for completion of this installation under transformer outages.</p>

Existing AVC arrangement at Royton BSP-



Proposed new AVC wall box positioning at Royton BSP-



Existing GT1/GT2 Outdoor Marshalling Kiosk Condition at Royton BSP-



Werneth Primary QUEST AVC Upgrade (DNP3)

Design Report Details

Supporting documents:

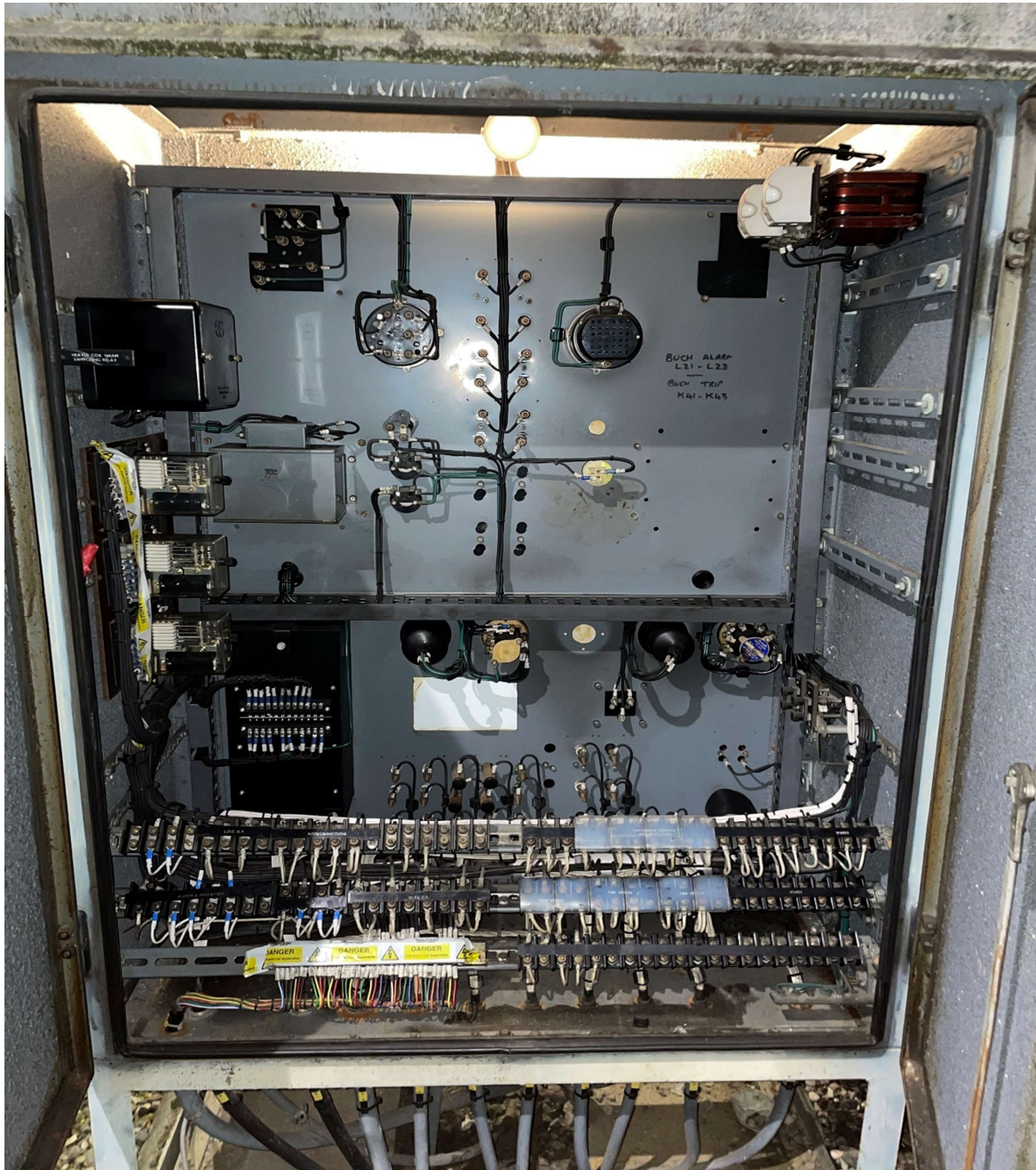
- *Werneth Primary 303300 (T11/T12) Site survey*
- *Werneth Primary 303300 DPOWRA*
- *Werneth Primary 303300 Drawing Register (with highlighted requested drawing)*
- *Site Survey Photographs*

Site Specifics and proposed Design/Interface details on this site are as follows;

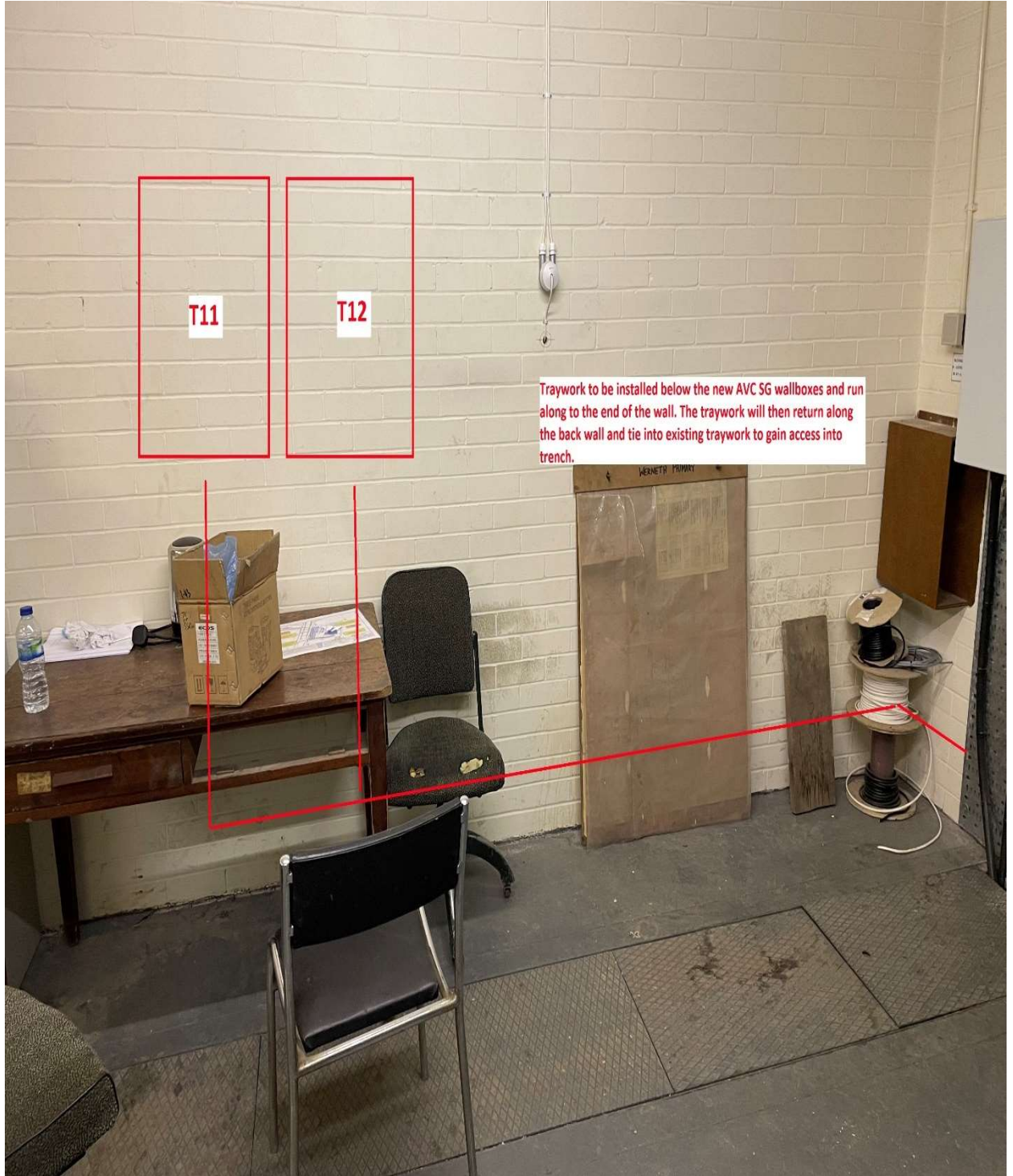
Transformer Suffixes	T11 & T12
Site Voltage	33/6.6kV
Tapchanger Drive Mechanism Details	2 x Ferranti DS2 with 110Vac Motor
Location of existing AVC?	Currently SuperTAPP RVM4 AVC relays located within outdoor MKs adjacent to each 33/6.6kV Transformer.
Proposed Alterations for AVC	<p>New CLASS ready AVC wall boxes (DNP3 variant) (x2) to be installed within relay room of substation building on free wall space available. (Picture provided as part of the submitted site survey report).</p> <p>This site is what is known as having DNP3 protection/comms installed (no hard wired SCADA installed to 6.6kV switch gear). This means a variant type of AVC wall box needs to be installed which is designed/wired differently to all the other QUEST sites.</p> <p>The new 6.6kV Schneider Genie Evo switchgear installed already has all CLASS terminal/handbag links already installed to enable correct CLASS interface.</p> <p>New 19 core SWA multicore cables will need to be installed from each outdoor MK to the new AVC wall box positions within the substation relay room.</p> <p>All new SWA multicores will be installed as per the Multicore Cable Schedules included as part of the design pack.</p> <p>New CAT6 cables (with Green outer sheath) will be installed from each AVC wall box back to the site RTU to enable AVC relay DNP3 comms connections. All CAT6 cables will be ran/installed within a black 25mm PVC flexible conduit ran in the substation cable trenches.</p> <p>As per the instruction of ENWL, ONLY outdoor MK upgrade works will be completed on this site (as above in Red).</p> <p>No inspection or re wiring works will be completed within the Ferranti DS2 DMs at this site.</p> <p>Minimal rewiring/re-ferruling works will be required within each DM external terminal box to enable correct interface of the new SuperTAPP SG schemes.</p> <p>The existing AVC control gear and wiring within T11, T12 and T13 MKs ONLY will be removed and replaced for new via custom-built control gear plates (as per Minimal works option quoted in Q12982).</p> <p>All holes left by removed equipment will be blanked by Grey 3mm thick PVC sheeting which will be measured, cut to size and fitted on site.</p> <p>230Vac Cooler Control Circuits are present for T11 and T12 so CSMR to be added within each MK.</p>

	<p>New AVC design drawings will be provided for the site as per the 'Drawings List' contents sheet at the start of the Design Pack.</p>
<p>Feeder Monitoring to be completed via new AVC schemes?</p>	<p>We propose to monitor the following 6.6kV feeder via the new SuperTAPP SG AVC schemes;</p> <ul style="list-style-type: none"> • '6.6kV CB name currently unknown- Requires confirmation from ENWL' <p>We will require an outage on the above feeder to enable us to introduce AVC interposer CTs into the CBs protection CT wiring. A standard arrangement of interposer and shorting link rail can be seen on the design drawings of how we propose to add into the CB.</p> <p>We believe there are enough spare cores on the existing SWA SCADA multicores installed from the above CB back to the site RTU. These spare cores will then be utilised (2 per CB) to enable wiring of the AVC interposer CTs secondary mA signal back to the relevant SuperTAPP SG relays to provide the required DG measurements.</p> <p>Ahead of final AVC commissioning (final week of install works) we will require the following information to be provided by ENWL on the DG affected CB in order for us to create/design the new SuperTAPP SG AVC settings;</p> <ul style="list-style-type: none"> o DG type(s) connected o DG Size(s) in MW o Average load of affected feeder(s) excluding DG o Average load of Werneth Primary substation.
<p>Excavations/Long Cable Tray runs?</p>	<p>Yes as existing AVC is currently located within outdoor MKs. Additional cable tray installation required at this site to enable 19 core SWA installs from new AVC wall boxes to each outdoor MK.</p> <p>Minor hand dig excavations are also required outside in the transformer compounds adjacent to each MK. All hand digging to be agreed by SAP and completed under his/her personal supervision.</p> <p>Pictures have been provide as part of our site survey report regarding proposed cable tray/dig routes required.</p>
<p>Asbestos Concerns?</p>	<p>No- Register was checked on site. No Asbestos concerns relating to future install works.</p>
<p>Blanking Plates Required?</p>	<p>Yes- Bespoke blanking plates required for each outdoor MK to cover removed AVC equipment.</p> <p>All control panel blanking will be completed using Grey 3mm thick PVC sheeting which will be measured, cut to size and fitted on site.</p>
<p>Pre-Install Works Duration (Estimated)</p>	<p>The following dates have been proposed to complete pre-install works at this site; 04/07/22 - 08/07/22 (1 week total)</p>
<p>Tx Outage Duration (Estimated)</p>	<ul style="list-style-type: none"> • With the decided final AVC upgrade scope taken into account, Fundamentals will need to request the following timescales to complete the AVC works on each transformer: T11- 1.5 week (No weekend working) T12- 1.5 week (No weekend working) This gives an estimated total of 3 working weeks for completion of this installation.

Existing AVC arrangement and Outdoor Marshalling Kiosk condition at Werneth Primary-



Proposed new AVC wall box positioning at Werneth Primary-



Newton Heath Primary QUEST AVC Upgrade

Design Report Details

Supporting documents:

- *Newton Heath Primary 100624 (T11) Site survey*
- *Newton Heath Primary 100624 DPOWRA*
- *Newton Heath Primary 100624 Drawing Register (with highlighted requested drawing)*
- *Site Survey Photographs*

Site Specifics and proposed Design/Interface details on this site are as follows;

Transformer Suffixes	T11
Site Voltage	33/6.6kV
Tapchanger Drive Mechanism Details	1 x Crompton Parkinson Linear Type (T11)
Location of existing AVC?	Currently SuperTAPP RVM4 AVC relay located within single system freestanding AVC panel within relay room building.
Proposed Alterations for AVC	<p>New CLASS ready AVC wall box (x1) to be installed in free wall space within 6.6kV relay room. (Picture provided as part of the submitted site survey report)</p> <p>Existing AVC panel to have all AVC equipment and wiring removed to become T11 AVC Marshalling panel.</p> <p>All new SWA multicore will be installed as per the Multicore Cable Schedule included as part of the design pack.</p> <p>New CAT6 cables (with Green outer sheath) will be installed from T11 AVC wall box back to the site RTU to enable AVC relay DNP3 comms connections. All CAT6 cables will be ran/installed within a black 25mm PVC flexible conduit ran in the substation cable trenches.</p> <p>T11 transformer has no forced cooling installed so no requirement for CSMR to be added.</p> <p>As per the instruction of ENWL, NO outdoor MK/DM upgrade work will be completed on this site. T11 existing Motor thermal overload to be replaced/rewired for new MPR fitted with shunt trip coil for AVC lockout/runaway prevention. Minimal rewiring/re-ferruling works will be required within T11 outdoor MK/DM to enable correct interface of the new SuperTAPP SG scheme.</p> <p>No TC Motor Current Monitoring is to be installed as part of this AVC upgrade work.</p> <p>New AVC design drawings will be provided for the site as per the 'Drawings List' contents sheet at the start of the Design Pack.</p>
Feeder Monitoring to be completed via new AVC schemes?	No 6.6kV feeder monitoring to be completed at this site. No substantial size DG connections present.
Excavations/Long Cable Tray runs Required?	No
Asbestos Concerns?	No- Register was checked on site. No Asbestos concerns relating to future install works.
Blanking Plates Required?	Yes- Existing AVC panel to have old equipment removed and be blanked.

	Control panel blanking will be completed using Grey 3mm thick PVC sheeting which will be measured, cut to size and fitted on site.
Pre-Install Works Duration (Estimated)	The following dates have been proposed to complete pre-install works at this site; 11/07/22 - 15/07/22 (1 week total)
Tx Outage Duration (Estimated)	<ul style="list-style-type: none"> With the decided final AVC upgrade scope taken into account, Fundamentals will need to request the following timescales to complete the AVC works on each transformer under outage: T11- 1 week (No weekend working) This gives an estimated total of 1 working week for completion of this installation under transformer outages.

Existing AVC arrangement at Newton Heath Primary-



Proposed new AVC wall box positioning at Newton Heath Primary-



Redbank BSP QUEST AVC Upgrade Design Report Details

Supporting documents:

- *Redbank BSP 100503 (GT2/GT3) Site survey*
- *Redbank BSP 100503 DPOWRA*
- *Redbank BSP 100503 Drawing Register (with highlighted requested drawing)*
- *Site Survey Photographs*

Site Specifics and proposed Design/Interface details on this site are as follows;

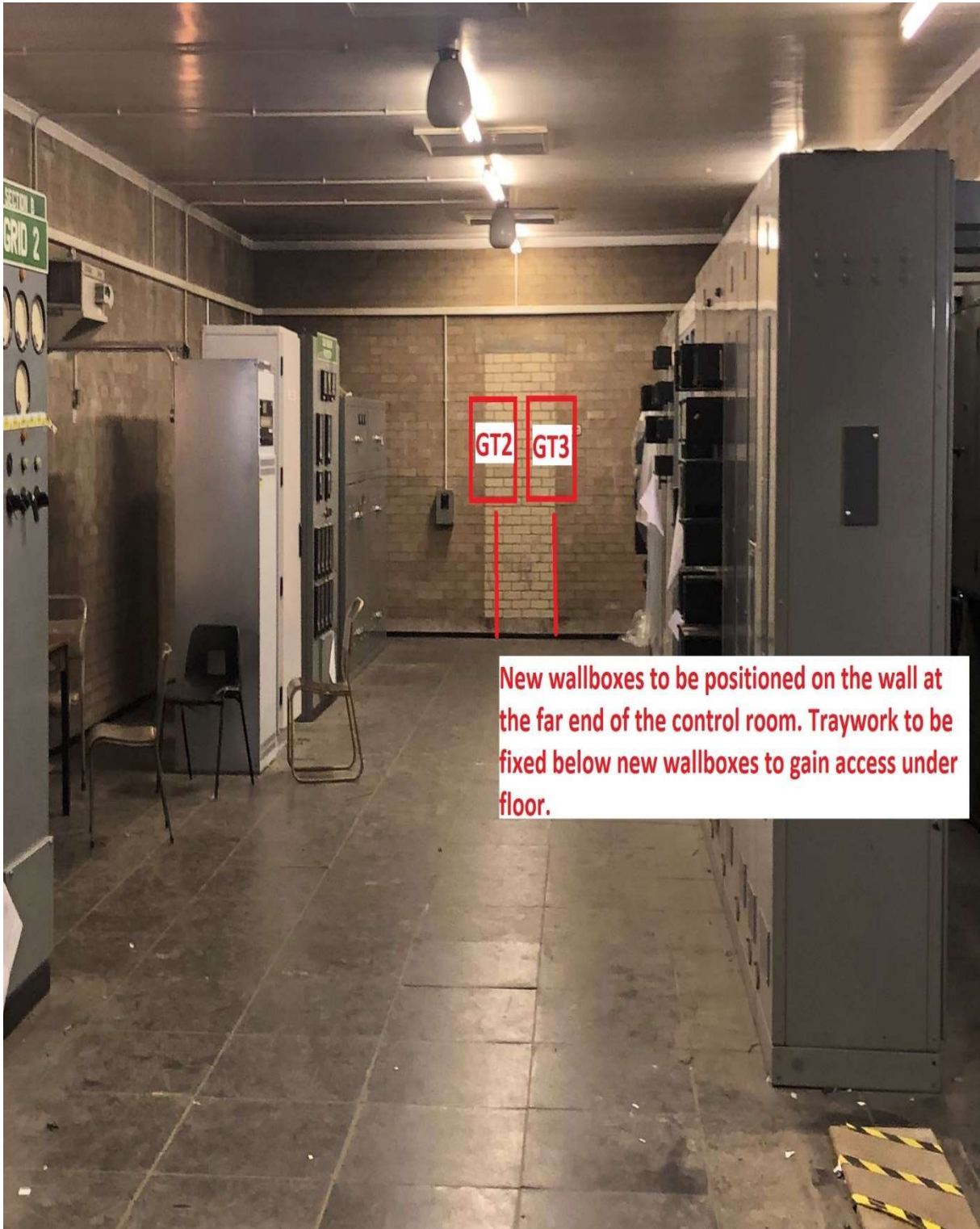
Transformer Suffixes	GT2 & GT3
Site Voltage	132/33kV
Tapchanger Drive Mechanism Details	1 x Fuller HS319-33/600 (GT2) 1 x MR ED100S (GT3)
Location of existing AVC?	Currently SuperTAPP RVM5/RTMU1m AVC relays located within dual system freestanding AVC panel on first floor of 132kV building.
Proposed Alterations for AVC	<p>New CLASS ready AVC wall boxes (x2) to be installed in free wall space within 132kV relay room. (Picture provided as part of the submitted site survey report). Existing AVC panels to have all AVC equipment and wiring removed to become AVC marshalling panels.</p> <p>All new SWA multicores will be installed as per the Multicore Cable Schedules included as part of the design pack.</p> <p>New CAT6 cables (with Green outer sheath) will be installed from each AVC wall box back to the site RTU to enable AVC relay DNP3 comms connections. All CAT6 cables will be ran/installed within a black 25mm PVC flexible conduit ran in the substation cable trenches.</p> <p>The existing AVC control gear and wiring within GT2 MK and DM ONLY will be removed and replaced for new via custom-built control gear plates (as per Minimal works option quoted in Q12987).</p> <p>New PVC trunking and terminal rails will also be installed.</p> <p>The TPI resistor chain within each DM will be replaced for new.</p> <p>All TPI and limit switch contacts will be cleaned and checked for correct operation.</p> <p>GT3 is modern type tap changer from 2008 which requires no refurbishment/upgrade works. Minimal connection and re-ferruling works will be required enable correct interface to the new SuperTAPP SG AVC scheme.</p> <p>230Vac Cooler Control Circuit is present for GT2 ONLY so CSMR to be added within GT2 MK on the new control gear plate..</p> <p>New AVC design drawings will be provided for the site as per the 'Drawings List' contents sheet at the start of the Design Pack.</p>
Feeder Monitoring to be completed via new AVC schemes?	No 33kV feeder monitoring to be completed at this site. No substantial size DG connections present.
Excavations/Long Cable Tray runs?	No
Asbestos Concerns?	Yes- No Asbestos Register could be found on site. We will need to request a copy from ENWL.

Blanking Plates Required?	Yes- Existing AVC panels to have old equipment removed and be blanked. GT2 control panel blanking will be completed using Grey 3mm thick PVC sheeting which will be measured, cut to size and fitted on site. GT3 control panel blanking will be completed using 19" rack blank plates.
Pre-Install Works Duration (Estimated)	The following dates have been proposed to complete pre-install works at this site; 25/07/22 - 29/07/22 (1 week total)
Tx Outage Duration (Estimated)	<ul style="list-style-type: none"> With the decided final AVC upgrade scope taken into account, Fundamentals will need to request the following timescales to complete the AVC works on each transformer: GT2- 1 week (No weekend working) GT3- 1 week (No weekend working) This gives an estimated total of 2 working weeks for completion of this installation under transformer outages.

Existing AVC arrangement at Redbank BSP-



Proposed new AVC wall box positioning at Redbank BSP-



New wallboxes to be positioned on the wall at the far end of the control room. Traywork to be fixed below new wallboxes to gain access under floor.

Existing GT2 Outdoor Marshalling Kiosk Condition at Redbank BSP-



4 Feeder Monitoring sites to be completed as part of QUEST

The following sites form part of the QUEST project trial area but already have SuperTAPP SG AVC installed (upgraded by Fundamentals as part of the ENWL CLASS project during 2017-2019):

- Heyside Primary (QUEST Feeder Monitoring)
- Hollinwood Primary (QUEST Feeder Monitoring)
- Chadderton Primary (QUEST Feeder Monitoring)
- Shaw Primary (QUEST Feeder Monitoring)
- Harpurhey Primary (QUEST Feeder Monitoring)
- Blackley Primary (QUEST Feeder Monitoring)
- Failsworth Primary (QUEST Feeder Monitoring)

These sites only require 'Feeder Monitoring' to be installed on the existing AVC schemes already installed.

On each of the above sites the works require any 6.6kV feeders which are subject to substantial DG connections to be monitored via the existing SuperTAPP SG AVC schemes.

A Fundamentals Interposing ICT arrangement will be installed/modified within the DG affected CB(s). The ICT secondary mA signal will then be wired back to the relevant SuperTAPP SG relay giving it the required DG load measurement.

Site specific settings will then be applied to each SuperTAPP SG relay to compensate for the DG connected to site.

Typically on each of the sites we will utilise 2 existing spare telecontrol cores from the relevant CB to the RTU. Two spare cores from the AVC 10 pair SWA will then be used to complete the wiring back to the SuperTAPP SG wall box.

The SuperTAPP SG relays at these sites will also require the bespoke software algorithm to be uploaded to enable QUEST functionality.

These works are due to be designed and completed after completion of the 9 x sites full AVC upgrades as listed previous.

5 Final Summary and Conclusions

QUEST Site Surveys

The 16 site surveys in total were completed in December 2021 over a 2-week period (9 full AVC upgrade sites and 7 feeder monitoring sites). For the full AVC upgrade sites each survey took approx. 3 hours to complete.

Each site survey was completed by a Fundamentals Project Engineer in accompaniment of an ENWL SAP. Fundamentals bespoke AVC Upgrade Site Survey form was completed for each site and the findings published to ENWL with advisories for AVC upgrade with QUEST functionality.

Each site survey involved detailed recording of information, pictures of the site and equipment, cable run measurements, location of new AVC wall boxes and investigation into AVC drawing availability on site.

Scheme Design

The Fundamentals Design team will use all of the information gathered within the surveys to complete the new QUEST AVC designs. Existing ENWL AVC related drawings required for modification will be requested from the ENWL meridian drawing system.

Full design packs for each site will be sent to ENWL for approval before commencement of installation works. Drawings will be provided in industry standard 'Reds and Greens' format.

Common Issues Highlighted after completion of Site Surveys

Examples of certain issues encountered after completion of site surveys are as follows;

- Age and condition of Tapchange Drive Mechanism control gear and wiring on each site. Our recommendations have been given to ENWL regarding essential Tapchange Drive Mechanism upgrade/refurbishment works also required to ensure reliable operating AVC schemes for QUEST.
- No welfare services available meaning Portaloo and water supply to be arranged for site install works.
- Access issues and concerns (Other building works present, Overgrown shrubbery, Challenging access conditions etc)
- Specific AVC drawings not present on site and also not available on ENWL Meridian system meaning full version AVC drawings needing to be recreated by Fundamentals Design team.
- Lack of available wall space on some sites resulting in the removal/relocation of other equipment within the substation to free up space.
- Typically on combined Grid and Primary sites, the location of the site RTU has posed challenges involving long cable runs or no access to the site RTU from the new AVC equipment. Certain sites were highlighted as requiring to have RTU extension units to be installed at the AVC wall box end allowing easier and efficient install of CAT6 cabling (AVC DNP3 comms).