DEPARTMENT OF ELECTRONIC & ELECTRICAL ENGINEERING

University of Strathclyde Engineering

BHA PV scheme analysis

Report produced by University of Strathclyde for the Accelerating Renewables Connection Project

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1 Introduction

Small-scale distributed generation (DG), such as photovoltaic (PV) panels, are normally connected to the Low Voltage (LV) network. Small numbers of DGs does not usually cause any significant negative impact on the local LV network. However, significant network issues are possible when their penetration levels are high. This could result in bi-directional power flows and thermal overloading as well as voltage rise and phase imbalance.

SP Energy Networks (SPEN) manages connections at the LV network level according to either ER G59/3 or ER G83/2[1]. The former covers DG connections above 16A and the latter covers small-scale DG connections (up to 16A per phase).

Applications for single small-scale DG installations, up to the limit of 16A per phase, are covered under G83 Stage 1. In this case, there is no need for network changes and the installer is required to inform the Distribution Network Operator (DNO) within 28 days that the unit is installed and commissioned. The DNO then records the unit location and capacity on their GIS system.

On the other hand, multiple installations, for example multiple applications from a Housing Association, require a consent from the DNO before they can connect. After the developer submits an application under G83/2 Stage 2, a generation assessment by the DNO is required in order to ensure that the cumulative effect of multiple connections will not cause the distribution network to operate outside its design limits. These include: (i) at periods of low demand a distributed generator must not overload the thermal limits of the feeder; and (ii) under all expected operating conditions, voltage limits across the feeder must be maintained within operational limits.

If the assessment identifies issues related to voltage rise, thermal capacity of the existing network, reverse power flow or voltage fluctuation, the developer can either request the network reinforcement or reduce the scale of the proposed generation.

This report details work carried out by the University of Strathclyde (UoS) to help SPEN with mass deployment of domestic PV systems on an already constrained distribution network. These installations were proposed by the Berwickshire Housing Association (BHA) and installed within the period February 2015 – January 2016. The key objective of the report is to provide an overview of the analysis used to investigate which proposed PV systems were able to be installed, and what effects they would have on the network. This report is produced as part of the Accelerating Renewable Connections (ARC) project for SPEN, which investigates alternative methods to allow integration of new DG connections onto a distribution network that previously was believed to be at full capacity.

[1] Distributed Generation Connection Requirements, SPEN, ESDD-01-005, Issue No 1.

2 Berwickshire Housing Association's solar scheme

Berwickshire Housing Association (BHA) is an association serving tenants and communities throughout 1/5th of Berwickshire households. With around 1800 tenancies, BHA provides accommodation to some of the most disadvantaged and vulnerable households in Berwickshire.

In partnership with Oakapple Renewable Energy and Edison Energy, in October 2014, BHA proposed the installation of 749 roof-mounted solar PV systems, ranging from 2kW to 4kW in capacity, with a total capacity of around 2600kW. These capacities were based on roof types and sizes and obtained from an initial desktop exercise. Those PV systems would be installed on social housing, terraced and semi-detached properties located across Berwickshire, including Duns, Eyemouth and Coldstream[2]. As the proposed installations represent multiple installations on constrained network, subjected to connections under G83/2 Stage 2, a generation assessment has been required in order to ensure that the distribution network operates inside its design limits.

The area proposed for BHA PV installations falls within an area of the electrical distribution network that is focus of the ARC project. In Figure 1, the ARC trial area is highlighted in green, and the area proposed for BHA PV installations is within the black circle.

Figure 1: The ARC trial area and an area proposed for BHA PV installations

An initial assessment of locations was carried out, and all proposed properties were plotted geographically onto maps of the distribution network, to identify the areas that may be subject to high penetration of PV installations. Figure 2 shows a number of BHA properties aggregated to Grid Supply Points (GSPs). It can be seen that most properties, 1029, are supplied from Berwick GSP from 6 primary substations, followed by Eccles GSP with 647 properties and 49 properties at Dunbar GSP connected to Torness primary substation.

[2] Berwickshire Housing Association PV scheme: http://www.edisonenergy.co.uk/case-studies/berwickshire-housing-association

Figure 2: Number of PV approved properties aggregated to Grid Supply Points

The BHA properties were categorised at the primary substation level, distinguishing proposed PV approved properties and PV approved and worst performing properties, i.e. all-electric homes with less efficient heating systems. This analysis is presented in Figure 3. Most of the proposed properties were connected to Duns and Eyemouth primary substations, 136 and 272, respectively. Ayton and Chirnside primary substations had a number of proposed properties between 66 and 130. All other primary substations had less than 65 PV proposed properties and they are shown in green.

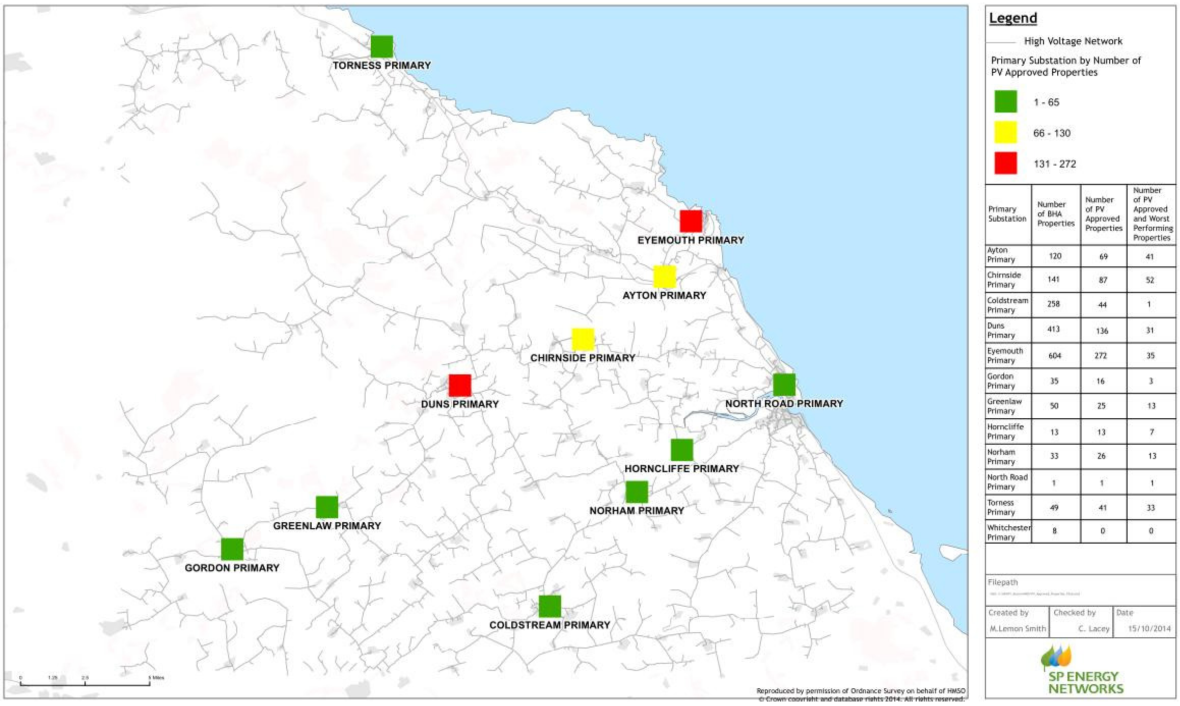

Figure 3: Number of PV approved properties aggregated to primary substations

Further clustering analysis was carried out at the secondary substation level. All PV proposed properties were mapped within SPEN's GIS system based on their addresses in order to identify the particular low voltage circuit and phase that a proposed unit would be connected to. In addition, a survey of each Secondary

Substation (S/S) site was carried out in order to identify the number of existing domestic PV systems, as some of the single installations were not recorded in SPEN's GIS database. It was discovered, in this area, that only 30% of installed PV systems had been reported to SPEN and recorded on internal systems.

Each circuit 'cluster' was then further analysed to determine if potential PV generation would exceed voltage or thermal limits. Based on proposed PV system sizes, number of PVs per S/S, number of PVs per particular feeder and roof direction, all PV approved properties were categorised into three groups: green, amber, and red. Overall, 182 properties were categorised as green, 253 as amber, and 314 into as red. Figure 4 shows an example of PV approved properties clustered at a single S/S by system size. It can be seen that this particular S/S has three 3-phase LV feeders (green, amber and red) based on a number of proposed PV approved properties.

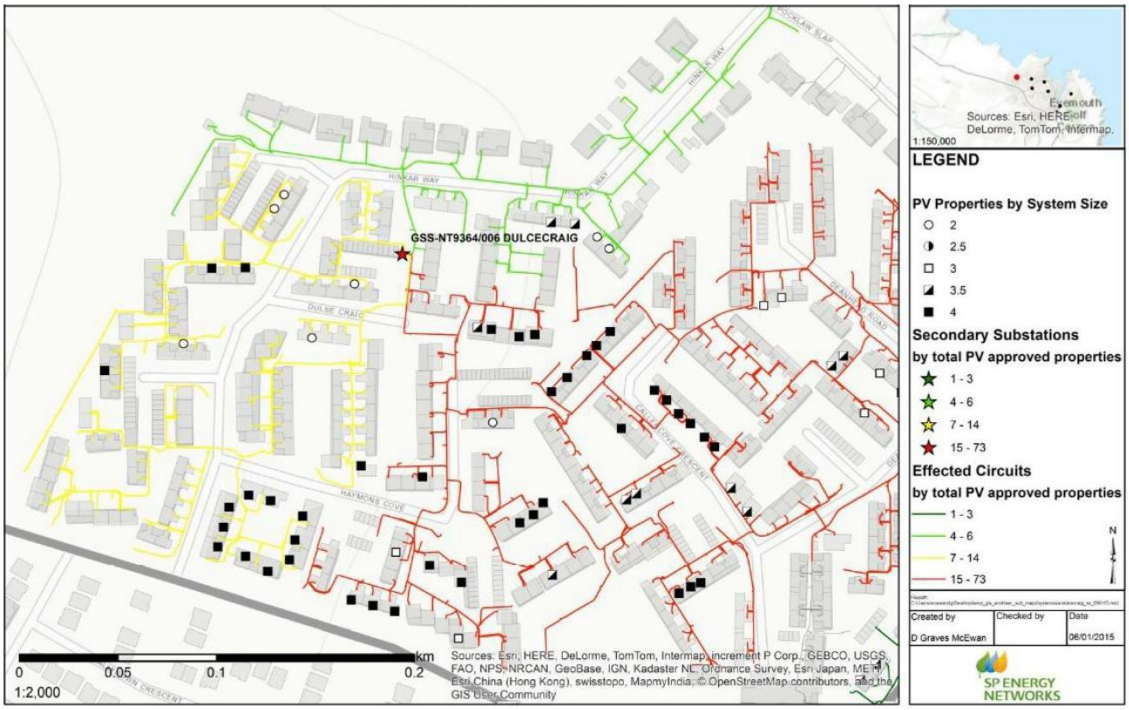

Figure 4: Example of PV approved properties at a single secondary substation

All PVs within the green group of properties were approved for installation immediately by SPEN, as it was deemed that they would not have any significant negative impact on the network. At this stage, an agreed common document containing information and updates on progress was agreed between all parties to ensure one common point of truth. BHA and Edison Energy started their installation in February 2015. An example of installed BHA PV panels is shown in Figure 5.

Figure 5: Installed PV panels

The properties in the amber group required a further level of analysis to be carried out based on cable sizes, proximity to S/S and monitored voltage at a secondary substation. After this additional analysis, these properties were either categorised as green and released or categorised as red for further analysis.

The red category LV circuits and hence substations were deemed most likely to have the greatest impact on the network and as such required a more detailed analysis. In addition to the installation of monitoring equipment at the secondary substations that supplied these properties, this analysis also included detailed modelling of each of the red category S/S, including their LV feeders and 11kV circuit they are connected to; and the load flow analysis based on real and historic data.

The flowchart of the overall analysis explained above is presented in Figure 6.

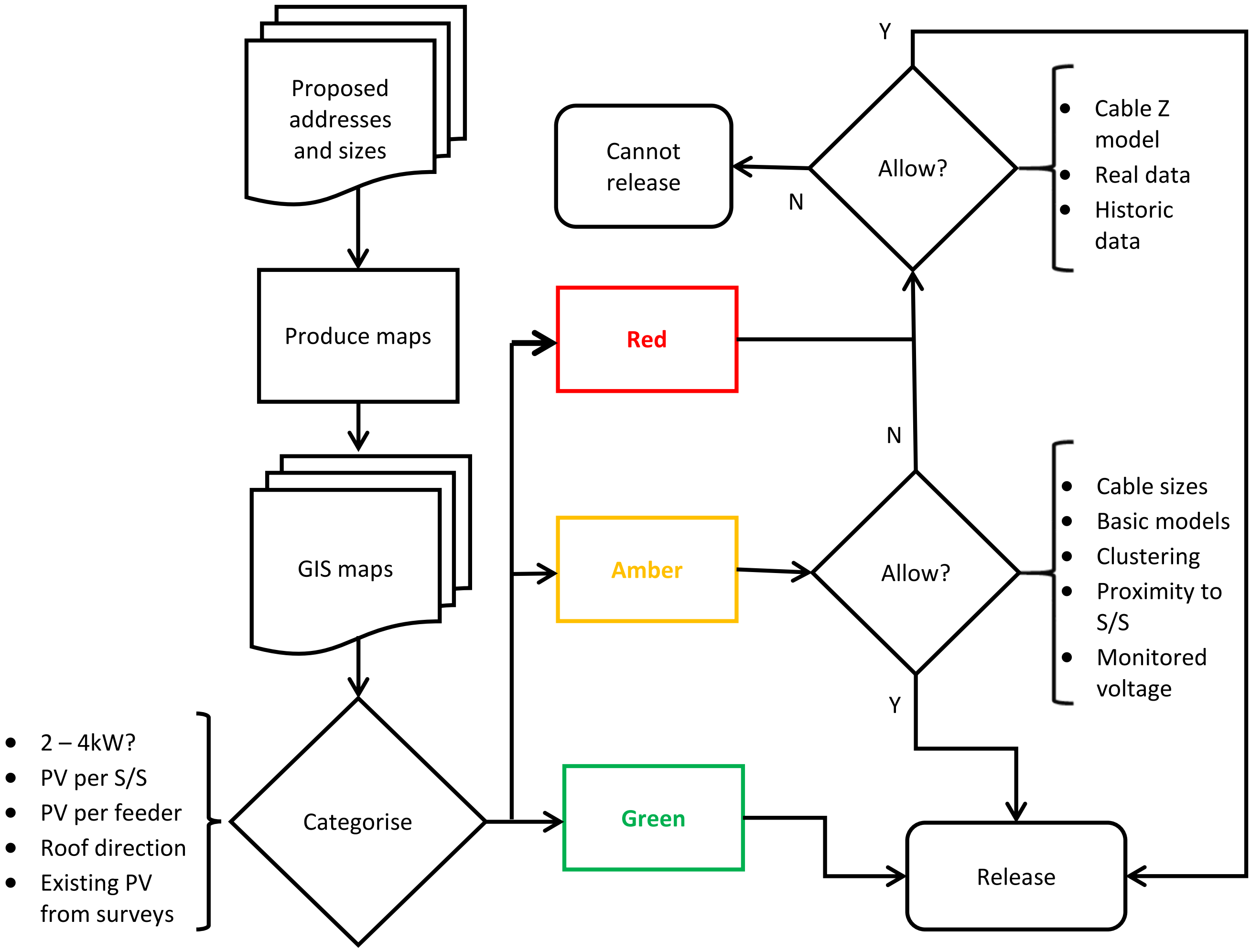

Figure 6: The flowchart of the analysis[3]

[3] A. Park, "Delivering Community Energy" Presented at Low Carbon Networks & Innovation (LCNI) Conference, Liverpool, Nov 2015.

3 Monitoring and modelling

As detailed in section 2, PV approved properties in the amber and red categories had potential to have a significant influence on the network. The greatest impact would be seen on the secondary substation feeders where these PV panels would be connected. This could be due to the number and size of PV connections, the locations of panels, i.e. distance from the S/S or the network design. Therefore, these substations required additional, more detailed analysis that included the installation of monitoring equipment, detailed modelling of their respective 11kV circuits and LV feeders, and associated analysis based on real and historic data.

3.1 Monitoring equipment

As the traditional distribution LV network is passive, with limited monitoring data and no real-time controllability at secondary transformers, several secondary substations with properties within red and amber groups were fitted with advanced LV monitors. Overall, 22 monitors were installed at the locations shown in Figure 7, with four, more detailed regions shown in Figure 8. It is obvious that some of the susbstations are geographically next to each other and hence connected to the same 11kV circuit, especialy in the area 4. This cumulation can cause problems in the network, as the aggreagted generation can cause the distribution network to operate outside of its design limits.

Figure 7: Overview of monitored secondary substations

Figure 8: Monitored secondary substations

The project selected two monitoring solutions, GMC-I METSyS[4] and Gridkey MCU 520[5]. Both monitors are powered via single phase voltage connection and they are totally protected against water and dust ingress (IP65). These monitors can monitor 3-phase voltage and current and up to maximum of 5 LV feeders in case of Gridkey MCU 520 and 6 LV feeders in case of GMC-I METSyS. Voltage connections for both monitors include: fused leads, busbar clamps, crimped lugs, dummy fuse and modified fuse holder. Current connections include Gridhound CTs and Rogowski coils for Gridkey MCU 520 monitor and Rogowski coils for GMC-I METSyS. Both monitors provide GPRS connection to SPEN's iHost server. Figure 9 and Figure 10 show GMC-I METSyS and Gridkey MCU 520, respectively.

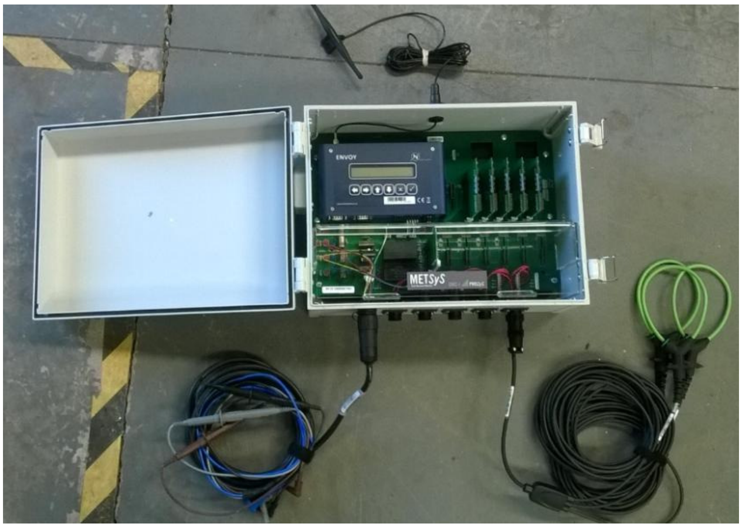

Figure 9: GMC-I METSyS substation monitor

[4] GMC-I METSyS specifications: http://www.i-prosys.com/images/documents/GMC-I%20PORSyS%20(Compressed).pdf
[5] Gridkey MCU 520 specifications: http://gridkey.co.uk/wp-content/uploads/2015/11/Gridkey-System-Product-Brochure-0713.pdf

Figure 10: Gridkey MCU 520 susbstation monitor

3.2 Modelling

Overall, fifteen secondary substations with their respective 11kV circuits and LV feeders were modelled in DIgSILENT PowerFactory software. These are highlited with red circles in Figure 7 and Figure 8, and they are: Ayton Lawfield, Briery Baulk, Buss Craig, Castle Street, Churchill, Deanhead, Dovecote, Dulcecraig, Grantshouse, Gunsgreenhill, Hawthorn Bank duns, Hoprig Road, Leitholm Village, Swinton Duns, and Chirnside West End. These substations differ in network topology, transformer ratings, numbers of customers connected and number of PV systems. They include mostly properties within red and amber groups, and they were likely to produce the greatest learning of the impact of solar panels on the distribution network.

Every modelled S/S has 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.5% and a centre tap position of 0%. Transformer ratings and numbers of LV feeders of each modelled S/S are provided in Table 1.

Substation Name	Transformer rating (MVA)	Number of LV feeders	Number of LV customers	Number of PV systems
Ayton Lawfield	0.5	3	73	24
Briery Baulk	0.3	3	129	17
Buss Craig	0.5	4	125	35
Castle Street	0.5	4	156	21
Churchill	0.5	4	91	20
Deanhead	0.5	4	242	39
Dovecote	0.3	3	127	51
Dulcecraig	0.5	3	180	42
Grantshouse	0.5	2	39	12
Gunsgreenhill	0.3	4	122	46
Hawthorn Bank Duns	0.5	3	111	15
Hoprig Road	0.5	4	99	38
Leitholm Village	0.3	3	94	19
Swinton Duns	0.2	2	54	20
West End Chirnside	0.8	6	162	52

Table 1: Transformer rating, numbers of LV feeders, customers and PVs at each modelled S/S

As it was not possible to automaticaly transfer network data from SPEN’s GIS database (shown in Figure 11) to PowerFactory, all fifteen models were developed manually which made this aspect of the project significantly more labour intensive than was anticipated.

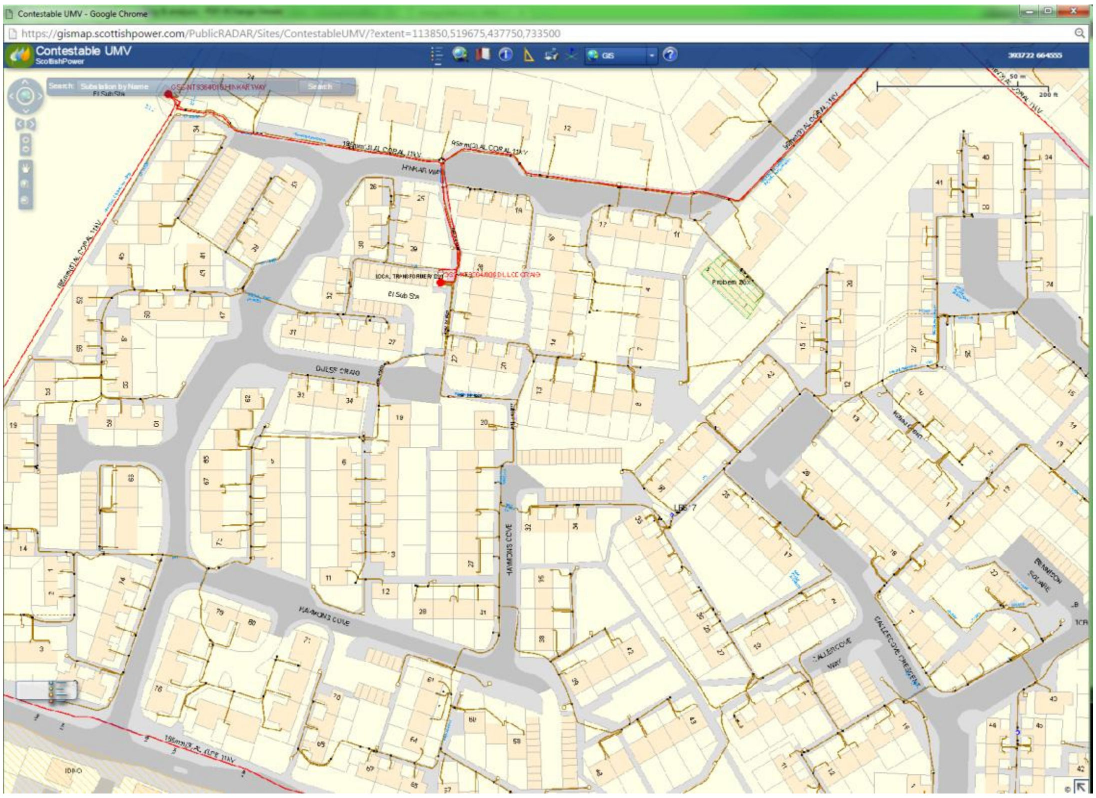

Figure 11: Example of SPEN's GIS system displaying a single substation with LV feeder cables and services

The network topology, cables and overhead lines (OHL), together with the type of conductor and its length are sourced directly from SPEN’s GIS database. SPEN’s LV network consists of a very large number of diverse aluminum and copper cables/OHL whose installation dates vary from 1930s until the present. Besides a large number of different cables/OHL types, there were also some errors in the GIS entries, e.g. in some cases 2 cores were recorded instead of 4 cores or types were unknown or missing. In such cases, and in the cases of very old cables/OHL, impedance and current ratings were not available in the present cable database, so they were assumed to be the same as the surrounding cables. A list with full specifications of all cables/OHL used and assumed in the modelling process is provided in Appendix 1.

Another challenge was to allocate a phase to each customer (load) and PV system, as SPEN’s GIS had no information available in some cases. Therefore, it was necessary to develop a systematic strategy to make assumptions, which included the following:

- If the phase of a customer was known and phase of PV system was unknown, it was assumed that the PV system was (or would be) connected to the same phase as the customer.
- If the phase of a customer was unknown, the customers together with PV systems were allocated a balanced rotation: red, yellow, blue.

Total numbers of PV systems and customers per each model are shown in Table 1, and their full lists, together with their phase allocation, are given in Appendix 3 and Appendix 4.

Overall, approximately 5-10% of all of the information has been assumed per model, including both cables/OHL and load/PV phase allocation. Figure 12 and Figure 13 illustrate how a single secondary substation with its respective 11kV circuits and LV feeders is represented in PowerFactory after the migration process explained above. In Figure 12, the modelled secondary substation is the one with LV transformer and the primary substation is shown at the beginning of the feeder with connected external grid acting as the swing bus. Figure 13 presents the same area of SPEN's network shown in Figure 11 migrated from GIS to PowerFactory. Detailed explanation of each model is provided in Appendix 2.

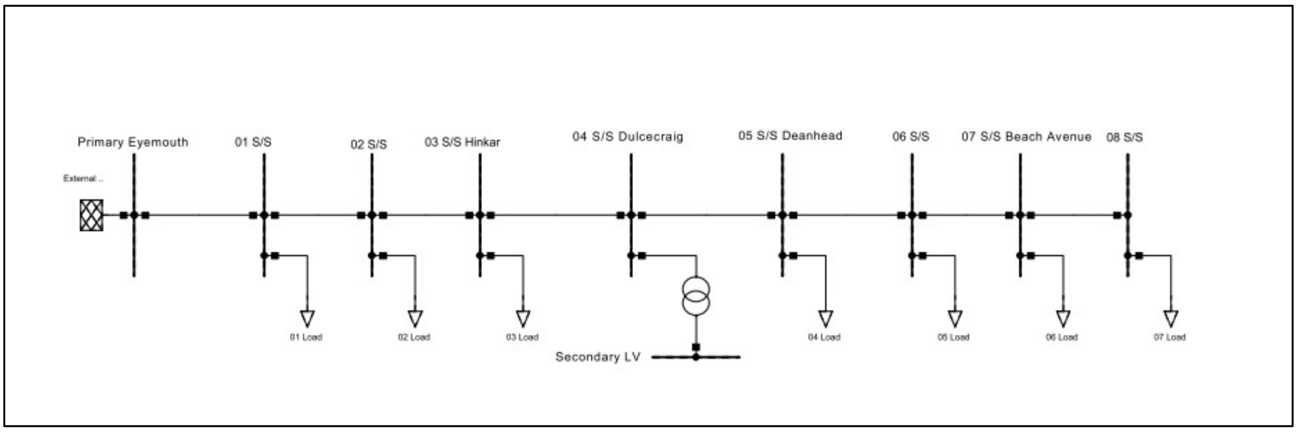

Figure 12: PowerFactory example of a single secondary substation with its respective 11kV circuits

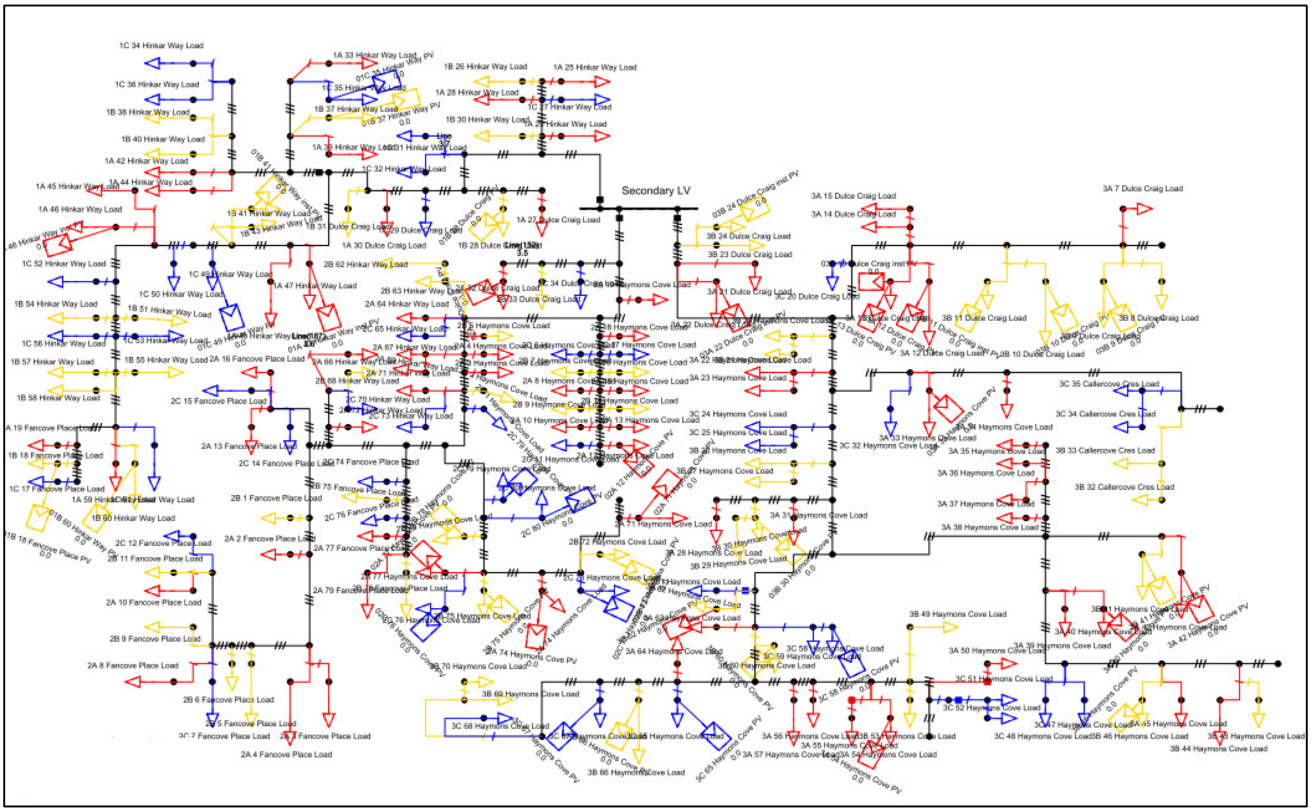

Figure 13: PowerFactory example of a single secondary substation with its respective LV feeders. This is the same area of SPEN's network as shown in Figure 11.

4 Methodology, analysis and results

In order to analyse the impact of high penetration of PV systems installed on properties within the amber and red groups, LV monitoring equipment was installed on associated secondary substations and the University of Strathclyde developed different methodologies to investigate the potential headroom for new PV systems at each secondary substation. These methodologies have been used to develop PowerFactory scripts written in DIgSILENT Programming Language (DPL).

As previously discussed, SPEN has a requirement to ensure that the distribution network operates inside its design limits. The statutory voltage limits are as follows:

- For the 11kV network: 11kV + / - 6% corresponding to 10.34kV – 11.66kV.
- For the LV network: 230V +10% - 6% corresponding to 216.2V – 253V.

However, as limited monitoring equipment is connected at these voltage levels, and no real time control actions are possible, SPEN generally applies more stringent operational limits. When considering the connection of DG to an 11kV feeder, a typical operational voltage regime involves limiting the voltage at the point-of-connection of a generator to the maximum of 11.25kV under worst-case conditions (maximum DG output and minimum demand). The feeder is normally operated with the primary voltage set slightly higher than the nominal value as with low DG penetration, voltages will reduce along the feeder. The SPEN Design Manual[6] suggests using 11.2kV as the primary voltage for DG studies if actual readings are not available. This choice is made using through engineering experience and knowledge of the maximum expected voltage drops across the 11kV and LV networks.

In order to ascertain whether a number of PV installations could be connected to the network, clustering analysis was carried out as explained in Section 2. This analysis started in February 2015 and was reviewed a number of times throughout the year. During this time, fifteen secondary substation sites were modelled and analysed in PowerFactory, by running different load flow studies.

The aim of the PowerFactory analysis was to calculate a number of acceptable proposed PV systems under the worst-case conditions – highest solar irradiance and lowest network demand – whilst ensuring that network limits were maintained. In the case of PV systems, worst-case scenario normally occurs in summer time.

Different methodologies have been developed to analyse each secondary substation site under recorded and predicted conditions. These methodologies depended on the level of monitoring data available from each substation. The sites were only analysed during the daylight, as PV systems do not generate during the night. Every methodology assumed that PV panels should be prioritised based on electrical distance, with closest to the secondary substation first. The secondary LV voltages were simulated as the connected generation increased. The voltage was fixed at the primary substation. Recorded data included the following half-hourly data:

- voltage at the primary substations,
- LV voltage at modelled secondary substations, and
- LV load data at modelled secondary substations – real and reactive power per each phase at each feeder.

After processing the data, three representative simulation time-steps were chosen, which correspond to the cases of minimum load at LV feeders and/or maximum LV voltages. Table 2 summarizes developed methodologies based on their input data.

[6] Distributed Generation Connection Requirements, SPEN, ESDD-01-005, Issue No 1.

Methodology	Voltage at the primary recorded	LV load data (P and Q) at modelled S/S
(i)	Yes	Recorded
(ii)-a	No	Recorded
(ii)-b	No	Predicted

Table 2: Summary of developed methodologies based on their input data

Methodology (i) was developed to investigate the potential headroom for new PV installations at a particular secondary substation under the recorded values of LV load and the voltage at the primary (recorded conditions). It includes the following steps:

1. Set the voltage at the primary to the recorded value.
2. Equally distribute recorded LV load (P and Q) along each of LV feeder at the particular S/S.
3. Set 11kV loads on other 11kV substations included in the model based on available data and assumptions derived from these data.
4. Connect a PV (start from the electrically closest one to S/S).
5. Run an unbalanced load flow.
6. Check voltage and thermal limits at all locations and all phases. Satisfied?
7. If YES: Mark the last PV as acceptable, add the next electrically closest PV, and go to 5.
8. If NO: Go to 9.
9. Set the last PV out of operation, add the next electrically closest PV, and go to 5.
10. Stop when all PVs are checked.

Slightly modified methodology (ii) was developed to investigate a number of acceptable PV installations under the predicted conditions at a particular S/S, which include conditions when the voltage at the primary was not available. Therefore, this methodology calculates the voltage at the primary that allows connections of all proposed PV systems at the particular S/S. The starting point for the voltage at the primary is 11.2kV as suggested by SPEN Design Manual and decrease step size is 0.05kV. In addition, this methodology is further divided into two parts:

- (ii)-a when LV load data at the particular S/S were available (recorded conditions) and
- (ii)-b when LV load data at the particular S/S were not available (predicted conditions).

It consists of the following steps:

1. Start from 11.2kV voltage at the primary.
2. Equally distribute:
   2.1. recorded LV load along LV feeders – (ii)-a
   2.2. predicted LV load along LV feeders – (ii)-b
   along each of LV feeder at the particular S/S.
3. Set 11kV loads on other 11kV substations included in the model based on available data and assumptions derived from these data.
4. Connect a PV (start from the electrically closest one to S/S).
5. Run an unbalanced load flow.
6. Check voltage and thermal limits at all locations and all phases. Satisfied?
7. If YES: Mark the last PV as acceptable, add the next electrically closest PV, and go to 5.
8. If NO: Go to 9.
9. Set the last PV out of operation, add the next electrically closest PV, and go to 5.
10. Check if all PVs are connected?
11. If NO: Decrease primary voltage for 0.05 and go to 2.
12. If YES: Stop.

First set of simulations was carried out in June 2015 for winter period, November 2014 – March 2015, at secondary substations that had monitors installed at that time. These are Dovecote, Dulcecraig, and Gunsgreenhill, connected to Eyemouth primary; Hoprig Road connected to Torness primary; Swinton Duns connected to Norham primary; and Chirnside West End connected to Chirnside primary. These sites were analysed based on the methodology (i) apart from Hoprig Road and Chirnside West End, which were analysed based on the methodology (ii)-a as there were no available voltage data from the primary stations. The simulations were carried out for two different PV output scenarios:

- PV panels export full installed capacity (100%) which is the worst-case scenario.
- PV panels export 85% of their installed capacity.

The overall results suggested that the numbers of acceptable PV systems vary with their output capacity. There were no violations of thermal constraints and some of the PV installations were constrained by LV voltage limits at the connection terminals. These constrained PV systems were normally proposed to be connected at the end of an LV feeder. The results also suggested that the voltage at the secondary substation is dominated by the voltage at the primary, and in the cases of high primary voltage (above 11.1kV) less PV systems could be connected.

As the worst-case scenario (minimum demand and maximum PV generation) is expected to occur in summer time, in addition to the above analysis, it was important to investigate the values of the voltage at the primary that will allow the connection of all proposed PVs during summer time. Since in June 2015, summer data were still not available, second set of simulations for these six sites was carried out for predicted summer LV load data based on the methodology (ii)-b. These data were calculated based on the recorded winter data. The winter LV load was scaled to 50, 60, and 40% in order to investigate different scenarios for summer LV load.

As expected, different levels of primary voltages that allow connections of all proposed PVs were found at different primary stations due to network topology, load level, number of PVs and their output. However, different voltage values were also found at Eyemouth primary for three sites connected to it. While the calculated primary voltage showed low values 10.45-10.7kV for Dulcecraig, it was around 10.95kV for Dovecote and Gunsgreenhill that are connected to same 11kV feeder.

Based on above simulations, SPEN was able to release more PV panels proposed to connect to these six S/S as well as to further re-cluster other red and amber sites. Following this process, nine additional S/S sites were fitted with LV monitors and modelled in PowerFactory. These are Ayton Lawfield and Grantshouse connected to Ayton primary; Briery Baulk, Castle Street, Hawthorn Bank Duns, and Leitholm Village connected to Duns primary; Churchill connected to Greenlaw; and Buss Craig and Deanhead connected to Eyemouth primary.

Finally, third set of simulations for all fifteen modelled S/S was carried out in August 2015, when the recorded summer LV load data, June-July 2015, were available. These simulations were based on the methodologies (i) and (i)-a, for sites with no available primary voltage. They included three different PV output scenarios: 100, 90, and 85%. The third output scenario, 90%, was added based on SPEN's Flexible Networks project[7], which finds 90% of PV output to be the most realistic measured maximum output capacity.

The overall results suggested that the numbers of acceptable PVs vary with their output capacity as it was expected. There were no thermal constraint violations and all not acceptable PVs were voltage constrained. For sites that were analysed for both predicted and recorded summer primary voltage and LV load data, when comparing the values of predicted voltage at the primary that allows connection of all proposed PVs and recorded primary voltage, it can be seen that for the values of recorded voltage higher than predicted ones, not all PVs could be connected.

The following subsections represent individual results for each of fifteen modelled secondary substations. First six S/S are the ones that were analysed for both recorded and predicted winter and summer data, and the others are additional S/S analysed only for recorded summer data.

[7] Flexible Networks project: http://www.spenergynetworks.co.uk/userfiles/file/Ruabon_Case_study.pdf

4.1 Dovecote

Dovecote 3-phase LV network consists of three LV feeders and there are in total 127 loads and 51 proposed and existing PV systems. It is connected to Eyemouth primary at the same feeder as Buss Craig and Gunsgreenhill. Detailed explanation of the 11kV and LV models are provided in Appendix A 2.7.

An LV monitor at Dovecote S/S was installed in November 2014, so the analysis was carried out for both recorded and predicted data in winter and summer time.

At the time of the analysis for winter period, which was based on the methodology (i), there were 50 proposed PV systems. Table 3 shows a number of those PVs allowed to be installed per phase, for three different values of the voltage at the prymary measured at different dates and for two different PV output scenarios. The results suggest that all PVs could be connected at all times.

	Recorded Winter load					
	PV 100%			PV 85%		
Primary V (kV), date	**10.9, 18/3**	**10.964, 28/2**	**10.901, 10/3**	**10.9, 18/3**	**10.964, 28/2**	**10.901, 10/3**
Phase A	19	19	19	19	19	19
Phase B	16	16	16	16	16	16
Phase C	15	15	15	15	15	15
Total	**50**	**50**	**50**	**50**	**50**	**50**

Table 3: Results at Dovecote S/S for winter period in 2015

Table 4 and Table 5 present a number of proposed PVs per each phase and the primary voltage that allows all proposed PV systems to be installed without violating network voltage limits for predicted summer loads and different PV output scenarios. These results are calculated following the methodology (ii)-b and they suggest that the voltage at the primary should be at 10.95kV in all casses.

	Assumed Summer load, PV 100%								
	Winter load scaled to 0.5%			Winter load scaled to 0.6%			Winter load scaled to 0.4%		
Winter load date	**18-Mar**	**28-Dec**	**10-Mar**	**18-Mar**	**28-Dec**	**10-Mar**	**18-Mar**	**28-Dec**	**10-Mar**
Phase A	19	19	19	19	19	19	19	19	19
Phase B	16	16	16	16	16	16	16	16	16
Phase C	15	15	15	15	15	15	15	15	15
Total	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
Primary V (kV)	**10.95**	**10.95**	**10.95**	**10.95**	**10.95**	**10.95**	**10.95**	**10.95**	**10.95**

Table 4: Results at Dovecote S/S for predicted summer loads in 2015 and 100% of PV output

	Assumed Summer load, PV 85%								
	Winter load scaled to 0.5%			Winter load scaled to 0.6%			Winter load scaled to 0.4%		
Winter load date	**18-Mar**	**28-Dec**	**10-Mar**	**18-Mar**	**28-Dec**	**10-Mar**	**18-Mar**	**28-Dec**	**10-Mar**
Phase A	19	19	19	19	19	19	19	19	19
Phase B	16	16	16	16	16	16	16	16	16
Phase C	15	15	15	15	15	15	15	15	15
Total	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**	**50**
Primary V (kV)	**10.95**	**10.95**	**10.95**	**10.95**	**10.95**	**10.95**	**10.95**	**10.95**	**10.95**

Table 5: Results at Dovecote S/S for predicted summer loads in 2015 and 85% of PV output

At the time of the analysis for summer period, which was based on the methodology (i), 3 out of 50 PVs have already been installed and there were still 47 proposed PV installations. Table 6 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for three different PV output scenarios. The results shows that all PVs could be allowed at all times as in the winter period.

	Recorded Summer load								
	PV 100%			PV 90%			PV 85%		
Primary V (kV), date	**10.838, 24/6**	**10.903, 1/6**	**10.675, 24/7**	**10.838, 24/6**	**10.903, 1/6**	**10.675, 24/7**	**10.838, 24/6**	**10.903, 1/6**	**10.675, 24/7**
Phase A	16	16	16	16	16	16	16	16	16
Phase B	16	16	16	16	16	16	16	16	16
Phase C	15	15	15	15	15	15	15	15	15
Total	**47**	**47**	**47**	**47**	**47**	**47**	**47**	**47**	**47**

Table 6: Results at Dovecote S/S for summer period in 2015

4.2 Gunsgreenhill

Gunsgreenhill 3-phase LV network consists of four LV feeders and there are in total 122 loads and 46 proposed and existing PV systems. It is connected to Eyemouth primary at the same feeder as Dovecote and Buss Craig. Detailed explanation of the 11kV and LV models are provided in Appendix A 2.10.

An LV monitor at Gunsgreenhill S/S was installed in November 2014, so the analysis was carried out for both recorded and predicted data in winter and summer time.

At the time of the analysis for winter period, which was based on the methodology (i), there were 38 proposed PV systems. Table 7 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for two different PV output scenarios. As in the case of Dovecote S/S, the results suggest that all PVs could be allowed at all times.

	Recorded Winter load					
	PV 100%			PV 85%		
Primary V (kV), date	**10.982, 1/1**	**11.034, 28/12**	**10.899, 10/3**	**10.982, 1/1**	**11.034, 28/12**	**10.899, 10/3**
Phase A	14	15	15	15	15	15
Phase B	11	11	11	11	11	11
Phase C	11	12	12	12	12	12
Total	**36**	**38**	**38**	**38**	**38**	**38**

Table 7: Results at Gunsgreenhill S/S for winter period in 2015

Table 8 and Table 9 present a number of proposed PVs per each phase and the primary voltage that allows all proposed PV systems to be installed without violating network voltage limits for predicted summer loads and different PV output scenarios. These results are calculated following the methodology (ii)-b and they suggest that the voltage at the primary should be in a range of 10.9-11kV, depending on load level and PV output.

	Assumed Summer load, PV 100%								
	Winter load scaled to 0.5%			Winter load scaled to 0.6%			Winter load scaled to 0.4%		
Winter load date	**01-Jan**	**28-Dec**	**10-Mar**	**01-Jan**	**28-Dec**	**10-Mar**	**01-Jan**	**28-Dec**	**10-Mar**
Phase A	15	15	15	15	15	15	15	15	15
Phase B	11	11	11	11	11	11	11	11	11
Phase C	12	12	12	12	12	12	12	12	12
Total	**38**	**38**	**38**	**38**	**38**	**38**	**38**	**38**	**38**
Primary V (kV)	**10.9**	**10.95**	**10.9**	**10.9**	**10.95**	**10.9**	**10.85**	**10.9**	**10.9**

Table 8: Results at Gunsgreenhill S/S for predicted summer loads in 2015 and 100% of PV output

	Assumed Summer load, PV 85%								
	Winter load scaled to 0.5%			Winter load scaled to 0.6%			Winter load scaled to 0.4%		
Winter load date	**01-Jan**	**28-Dec**	**10-Mar**	**01-Jan**	**28-Dec**	**10-Mar**	**01-Jan**	**28-Dec**	**10-Mar**
Phase A	15	15	15	15	15	15	15	15	15
Phase B	11	11	11	11	11	11	11	11	11
Phase C	12	12	12	12	12	12	12	12	12
Total	**38**	**38**	**38**	**38**	**38**	**38**	**38**	**38**	**38**
Primary V (kV)	**10.95**	**10.95**	**10.95**	**10.95**	**11**	**10.95**	**10.9**	**10.95**	**10.95**

Table 9: Results at Gunsgreenhill S/S for predicted summer loads in 2015 and 85% of PV output

4.3 Dulcecraig

Dulcecraig 3-phase LV network consists of three LV feeders and there are in total 180 loads and 42 proposed and existing PV systems. It is connected to Eyemouth primary at the same feeder as Denahead. Detailed explanation of the 11kV and LV models are provided in Appendix A 2.8.

An LV monitor at Dulcecraig S/S was installed in November 2014, so it was analysed for both recorded and predicted data in winter and summer time.

At the time of the analysis for winter period, which was based on the methodology (i), there were 17 proposed PV systems. Table 10 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for two different PV output scenarios. It can be seen that decreasing PV outputs to 85% on their installed capacity would allow the installations of all of them when the voltage at the primary is lower than 10.9kV.

	Recorded Winter load					
	PV 100%			PV 85%		
Primary V (kV), date	**10.838, 19/3**	**11.033, 8/3**	**11.033, 1/2**	**10.838, 19/3**	**11.033, 8/3**	**11.033, 1/2**
Phase A	0	0	0	7	0	0
Phase B	0	0	0	5	0	0
Phase C	0	0	0	5	0	0
Total	**0**	**0**	**0**	**17**	**0**	**0**

Table 10: Results at Dulcecraig S/S for winter period in 2015

Table 11 and Table 12 present present a number of proposed PVs per each phase and the primary voltage that allows all proposed PV systems to be installed without violating network voltage limits for predicted summer loads and different PV output scenarios. These results are calculated following the methodology (ii)-b and they suggest that the voltage at the primary should be very low, in range of 10.5-10.65kV in order to allow all proposed PVs to connect.

	Assumed Summer load, PV 100%								
	Winter load scaled to 0.5%			Winter load scaled to 0.6%			Winter load scaled to 0.4%		
Winter load date	**19-Mar**	**08-Mar**	**01-Feb**	**19-Mar**	**08-Mar**	**01-Feb**	**19-Mar**	**08-Mar**	**01-Feb**
Phase A	7	7	7	7	7	7	7	7	7
Phase B	5	5	5	5	5	5	5	5	5
Phase C	5	5	5	5	5	5	5	5	5
Total	**17**	**17**	**17**	**17**	**17**	**17**	**17**	**17**	**17**
Primary V (kV)	**10.5**	**10.5**	**10.45**	**10.55**	**10.55**	**10.5**	**10.45**	**10.45**	**10.45**

Table 11: Results at Dulcecraig S/S for predicted summer loads in 2015 and 100% of PV output

	Assumed Summer load, PV 85%								
	Winter load scaled to 0.5%			Winter load scaled to 0.6%			Winter load scaled to 0.4%		
Winter load date	**19-Mar**	**08-Mar**	**01-Feb**	**19-Mar**	**08-Mar**	**01-Feb**	**19-Mar**	**08-Mar**	**01-Feb**
Phase A	7	7	7	7	7	7	7	7	7
Phase B	5	5	5	5	5	5	5	5	5
Phase C	5	5	5	5	5	5	5	5	5
Total	**17**	**17**	**17**	**17**	**17**	**17**	**17**	**17**	**17**
Primary V (kV)	**10.65**	**10.65**	**10.6**	**10.7**	**10.7**	**10.65**	**10.6**	**10.6**	**10.55**

Table 12: Results at Dulcecraig S/S for predicted summer loads in 2015 and 85% of PV output

At the time of the analysis for summer period, which was based on the methodology (i), 1 out of 17 PVs have already been installed and there were still 16 proposed PV installations. Table 13 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for three different PV output scenarios. As the voltages at the primary in all three time-step were above 11kV, some of the proposed PVs would cause voltage rise above the network limits.

	Recorded Summer load								
	PV 100%			PV 90%			PV 85%		
Primary V (kV), date	**11.11, 8/7**	**11.12, 31/7**	**11.02, 16/7**	**11.11, 8/7**	**11.12, 31/7**	**11.02, 16/7**	**11.11, 8/7**	**11.12, 31/7**	**11.02, 16/7**
Phase A	4	4	4	4	4	4	4	4	4
Phase B	4	5	5	4	5	5	5	5	5
Phase C	3	4	4	4	5	5	4	5	5
Total	**11**	**13**	**13**	**12**	**14**	**14**	**13**	**14**	**14**

Table 13: Results at Dulcecraig S/S for summer period in 2015

4.4 Hoprig Road

Hoprig Road 3-phase LV network consists of four LV feeders and there are in total 99 loads and 38 proposed and existing PV systems. It is connected to Torness primary and detailed explanation of the 11kV and LV models are provided in Appendix A 2.12.

An LV monitor at Hoprig Road S/S was installed in November 2014, so the analysis was carried out for both recorded and predicted data in winter and summer time.

At the time of the analysis for winter period there were 23 proposed PV systems. As there are no iHost data from Torness primary, the methodology (i)-a was applied, i.e. there was calculated the voltage at the primary that will allow connections of all proposed PV systems. The number of proposed PVs per each phase and the calculated primary voltage are shown in Table 14.

	Recorded Winter load					
	PV 100%			PV 85%		
Primary V (kV), date	**24-Feb**	**10-Jan**	**10-Mar**	**24-Feb**	**10-Jan**	**10-Mar**
Phase A	6	6	6	6	6	6
Phase B	4	4	4	4	4	4
Phase C	13	13	13	13	13	13
Total	**23**	**23**	**23**	**23**	**23**	**23**
Primary V (kV)	**11.05**	**11.2**	**11.1**	**11.15**	**11.2**	**11.2**

Table 14: Results at Hoprig Road S/S for winter period in 2015

Table 15 and Table 16 present the values of the voltage at the primary that allows all proposed PV systems to be installed without violating network voltage limits for predicted summer loads and different PV output scenarios. These results are calculated following the methodology (ii)-b and they suggest that the voltage at the primary should be in a range of 10.75-11.05kV, depending on load level and PV output.

	Assumed Summer load, PV 100%								
	Winter load scaled to 0.5%			Winter load scaled to 0.6%			Winter load scaled to 0.4%		
Winter load date	**24-Feb**	**10-Jan**	**10-Mar**	**24-Feb**	**10-Jan**	**10-Mar**	**24-Feb**	**10-Jan**	**10-Mar**
Phase A	6	6	6	6	6	6	6	6	6
Phase B	4	4	4	4	4	4	4	4	4
Phase C	13	13	13	13	13	13	13	13	13
Total	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**
Primary V (kV)	**10.8**	**10.9**	**10.8**	**10.85**	**10.95**	**10.9**	**10.75**	**10.8**	**10.75**

Table 15: Results at Hoprig Road S/S for predicted summer loads in 2015 and 100% of PV output

	Assumed Summer load, PV 85%								
	Winter load scaled to 0.5%			Winter load scaled to 0.6%			Winter load scaled to 0.4%		
Winter load date	**24-Feb**	**10-Jan**	**10-Mar**	**24-Feb**	**10-Jan**	**10-Mar**	**24-Feb**	**10-Jan**	**10-Mar**
Phase A	6	6	6	6	6	6	6	6	6
Phase B	4	4	4	4	4	4	4	4	4
Phase C	13	13	13	13	13	13	13	13	13
Total	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**	**23**
Primary V (kV)	**10.9**	**11**	**10.9**	**10.95**	**11.05**	**10.95**	**10.8**	**10.9**	**10.85**

Table 16: Results at Hoprig Road S/S for predicted summer loads in 2015 and 85% of PV output

4.5 Swinton Duns

Swinton Duns 3-phase LV network consists of two LV feeders and there are in total 54 loads and 20 proposed and existing PV systems. It is connected to Norham primary and detailed explanation of the 11kV and LV models are provided in Appendix A 2.14.

An LV monitor at Swinton Duns S/S was installed in November 2014, so the analysis was carried out for both recorded and predicted data in winter and summer time.

At the time of the analysis for winter period, which was based on the methodology (i), there were 19 proposed PV systems. Table 17 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for two different PV output scenarios. While a number of acceptable PVs is not affected by their generation output in the cases of lower primary voltage, it can be seen that this number varies when the voltage at the primary has higher value.

	Recorded Winter load					
	PV 100%			PV 85%		
Primary V (kV), date	**10.972, 19/3**	**11.164, 14/3**	**11.066, 2/3**	**10.972, 19/3**	**11.164, 14/3**	**11.066, 2/3**
Phase A	5	4	5	5	5	5
Phase B	8	5	8	8	8	8
Phase C	6	5	6	6	6	6
Total	**19**	**14**	**19**	**19**	**19**	**19**

Table 17: Results at Swinton Duns S/S for winter period in 2015

Table 18 and Table 19 present a number of proposed PVs per each phase and the primary voltage that allows all proposed PV systems to be installed without violating network voltage limits for predicted summer loads and different PV output scenarios. These results are calculated following the methodology (ii)-b and they suggest that the voltage at the primary should be in a range of 11-11.1kV, depending on load level and PV output.

	Assumed Summer load, PV 100%								
	Winter load scaled to 0.5%			Winter load scaled to 0.6%			Winter load scaled to 0.4%		
Winter load date	**19-Mar**	**14-Mar**	**02-Mar**	**19-Mar**	**14-Mar**	**02-Mar**	**19-Mar**	**14-Mar**	**02-Mar**
Phase A	5	5	5	5	5	5	5	5	5
Phase B	8	8	8	8	8	8	8	8	8
Phase C	6	6	6	6	6	6	6	6	6
Total	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**
Primary V (kV)	**11**	**11.05**	**11**	**11.05**	**11.05**	**11**	**11**	**11**	**11**

Table 18: Results at Swinton Duns S/S for predicted summer loads in 2015 and 100% of PV output

	Assumed Summer load, PV 85%								
	Winter load scaled to 0.5%			Winter load scaled to 0.6%			Winter load scaled to 0.4%		
Winter load date	**19-Mar**	**14-Mar**	**02-Mar**	**19-Mar**	**14-Mar**	**02-Mar**	**19-Mar**	**14-Mar**	**02-Mar**
Phase A	5	5	5	5	5	5	5	5	5
Phase B	8	8	8	8	8	8	8	8	8
Phase C	6	6	6	6	6	6	6	6	6
Total	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**	**19**
Primary V (kV)	**11.05**	**11.05**	**11.05**	**11.05**	**11.1**	**11.05**	**11**	**11.05**	**11**

Table 19: Results at Swinton Duns S/S for predicted summer loads in 2015 and 85% of PV output

At the time of the analysis for summer period, which was based on the methodology (i), 5 out of 19 PVs have already been installed and there were still 14 proposed PV installations. Table 20 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for three different PV output scenarios. The results shows that almost all PVs could be connected at all times.

	Recorded Summer load								
	PV 100%			PV 90%			PV 85%		
Primary V (kV), date	**11.11, 8/7**	**11.12, 31/7**	**11.02, 16/7**	**11.11, 8/7**	**11.12, 31/7**	**11.02, 16/7**	**11.11, 8/7**	**11.12, 31/7**	**11.02, 16/7**
Phase A	4	4	4	4	4	4	4	4	4
Phase B	4	5	5	4	5	5	5	5	5
Phase C	3	4	4	4	5	5	4	5	5
Total	**11**	**13**	**13**	**12**	**14**	**14**	**13**	**14**	**14**

Table 20: Results at Swinton Duns S/S for summer period in 2015

4.6 Chirnside West End

Chirnside West End 3-phase LV network consists of six LV feeders and there are in total 164 loads and 52 proposed and existing PV systems. It is connected to Chirnside primary and detailed explanation of the 11kV and LV models are provided in Appendix A 2.15.

An LV monitor at Hoprig Road S/S was installed in November 2014, so the analysis was carried out for both recorded and predicted data in winter and summer time.

At the time of the analysis for winter period there were 31 proposed PV systems. As there are no iHost data from Chirnside primary, the methodology (i)-a was applied, i.e. there was calculated the voltage at the primary that will allow all proposed PV systems to be installed. The number of proposed PVs per each phase and the calculated primary voltage are shown in Table 21.

	Recorded Winter load					
	PV 100%			PV 85%		
Primary V (kV), date	**19-Mar**	**26-Dec**	**04-Jan**	**19-Mar**	**26-Dec**	**04-Jan**
Phase A	12	12	12	12	12	12
Phase B	13	13	13	13	13	13
Phase C	6	6	6	6	6	6
Total	**31**	**31**	**31**	**31**	**31**	**31**
Primary V (kV)	**10.95**	**11.05**	**10.95**	**11**	**11.05**	**11**

Table 21: Results at Chirnside West End S/S for winter period in 2015

Table 22 and Table 23 present a number of proposed PVs per each phase and the primary voltage that allows all proposed PV systems to be installed without violating network voltage limits for predicted summer loads and different PV output scenarios. These results are calculated following the methodology (ii)-b and they suggest that the voltage at the primary should be in range of 10.9-11.05kV, depending on load level and PV output.

	Assumed Summer load, PV 100%								
	Winter load scaled to 0.5%			Winter load scaled to 0.6%			Winter load scaled to 0.4%		
Winter load date	**19-Mar**	**26-Dec**	**04-Jan**	**19-Mar**	**26-Dec**	**04-Jan**	**19-Mar**	**26-Dec**	**04-Jan**
Phase A	12	12	12	12	12	12	12	12	12
Phase B	13	13	13	13	13	13	13	13	13
Phase C	6	6	6	6	6	6	6	6	6
Total	**31**	**31**	**31**	**31**	**31**	**31**	**31**	**31**	**31**
Primary V (kV)	**10.9**	**11.05**	**10.95**	**10.95**	**11.05**	**10.95**	**10.9**	**11**	**10.9**

Table 22: Results at Chirnside West End S/S for predicted summer loads in 2015 and 100% of PV output

	Assumed Summer load, PV 85%								
	Winter load scaled to 0.5%			Winter load scaled to 0.6%			Winter load scaled to 0.4%		
Winter load date	**19-Mar**	**26-Dec**	**04-Jan**	**19-Mar**	**26-Dec**	**04-Jan**	**19-Mar**	**26-Dec**	**04-Jan**
Phase A	12	12	12	12	12	12	12	12	12
Phase B	13	13	13	13	13	13	13	13	13
Phase C	6	6	6	6	6	6	6	6	6
Total	**31**	**31**	**31**	**31**	**31**	**31**	**31**	**31**	**31**
Primary V (kV)	**10.95**	**11.05**	**10.95**	**10.95**	**11.05**	**10.95**	**10.95**	**11.05**	**10.95**

Table 23: Results at Chirnside West End S/S for predicted summer loads in 2015 and 85% of PV output

At the time of the analysis for summer period, 3 out of 31 PVs have already been installed and there were still 28 proposed PV installations. As there were no iHost data from Chirnside primary, the voltage at the primary that will allow all proposed PV systems to be installed was calculated based on the methodology (i)-a. The results are shown in Table 24.

	Recorded Summer load								
	PV 100%			PV 90%			PV 90%		
Primary V, date	**02-Jul**	**08-Jun**	**15-Jul**	**02-Jul**	**08-Jun**	**15-Jul**	**02-Jul**	**08-Jun**	**15-Jul**
Phase A	10	10	10	10	10	10	10	10	10
Phase B	12	12	12	12	12	12	12	12	12
Phase C	6	6	6	6	6	6	6	6	6
Total	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**
Primary V (kV)	**10.95**	**10.95**	**10.95**	**10.95**	**10.95**	**10.95**	**11**	**11**	**10.95**

Table 24: Results at Chirnside West End S/S for summer period in 2015

4.7 Ayton Lawfield

Ayton Lawfield 3-phase LV network consists of three LV feeders, and there are in total 73 loads and 24 proposed and existing PV systems. It is connected to Ayton primary and detailed explanation of the 11kV and LV models are provided in Appendix A 2.1.

An LV monitor at Ayton Lawfield S/S was installed in May 2015, so only the analysis for recorded summer data based the methodology (i) was carried out. There were six proposed PV installations, and Table 25 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for three different PV output scenarios.

	Recorded Summer load								
	PV 100%			PV 90%			PV 85%		
Primary V (kV), date	**11.06, 21/7**	**11.237, 3/7**	**11.134, 25/7**	**11.06, 21/7**	**11.237, 3/7**	**11.134, 25/7**	**11.06, 21/7**	**11.237, 3/7**	**11.134, 25/7**
Phase A	0	0	0	0	0	0	0	0	0
Phase B	0	0	0	0	0	0	0	0	0
Phase C	0	0	0	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 25: Results at Ayton Lawfield S/S for summer period in 2015

It can be seen that none of the proposed PV installations were allowed to connect under these network conditions. Ayton Lawfield S/S is the first S/S next to the primary and hence its voltage is highly influenced by the primary voltage, which is above 11kV most of the time. All of these PVs are voltage constrained, as they would cause a rise of the voltage at Ayton Lawfield S/S above network limits, 253V.

4.8 Briery Baulk

Briery Baulk 3-phase LV network consists of three LV feeders and there are in total 129 loads and 17 proposed and existing PV systems. It is connected to Duns primary and detailed explanation of the 11kV and LV models are provided in Appendix A 2.2.

An LV monitor at Briery Baulk S/S was installed in May 2015, so only the analysis for recorded summer data based the methodology (i) was carried out. At that time, all 16 proposed PV systems were released by SPEN and this analysis was carried out to investigate if network constraints are satisfied. Table 26 diplays an indication if network constraints were satisfied for three different values of the voltage at the prymary at different dates and for three different PV output scenarios. The results suggests that there are violations of voltage constraints when the voltage at the primary has higher values.

	Recorded Summer load								
	PV 100%			PV 90%			PV 85%		
Primary V (kV), date	**11.021, 31/7**	**11.119, 22/6**	**10.968, 19/7**	**11.021, 31/7**	**11.119, 22/6**	**10.968, 19/7**	**11.021, 31/7**	**11.119, 22/6**	**10.968, 19/7**
Constraints	**Not satisfied**	**Not satisfied**	**Satisfied**	**Not satisfied**	**Not satisfied**	**Satisfied**	**Satisfied**	**Not satisfied**	**Satisfied**

Table 26: Results at Briery Baulk S/S for summer period in 2015

4.9 Buss Craig

Buss Craig 3-phase LV network consists of four LV feeders and there are in total 125 loads and 35 proposed and existing PV systems. It is connected to Eyemouth primary at the same feeder as Dovecote and Gunsgreenhill. Detailed explanation of the 11kV and LV models are provided in Appendix A 2.3

An LV monitor at Buss Craig S/S was installed in March 2015, so only the analysis for summer period based on the methodology (i) was carried out. There were 13 proposed PV installations. Table 27 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for three different PV output scenarios.

	Recorded Summer load								
	PV 100%			PV 90%			PV 85%		
Primary V (kV), date	**10.622, 9/7**	**10.884, 4/6**	**10.666, 24/7**	**10.622, 9/7**	**10.884, 4/6**	**10.666, 24/7**	**10.622, 9/7**	**10.884, 4/6**	**10.666, 24/7**
Phase A	5	0	5	5	1	5	5	1	5
Phase B	5	0	5	5	1	5	5	2	5
Phase C	3	1	3	3	1	3	3	2	3
Total	**13**	**1**	**13**	**13**	**3**	**13**	**13**	**5**	**13**

Table 27: Results at Buss Craig S/S for summer period in 2015

It can be seen that the voltage at the primary is in range of 10.6-10.9kV and PV installations are constrained only in the case of its higher values.

4.10 Castle Street

Castle Street 3-phase LV network consists of four LV feeders and there are in total 156 loads and 21 proposed and existing PV systems. It is connected to Duns primary and detailed explanation of the 11kV and LV models are provided in Appendix A 2.4.

An LV monitor at Castle Street S/S was installed in May 2015, so only the analysis for summer period based on the methodology (i) was carried out. There were eight proposed PV installations. Table 28 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for three different PV output scenarios. As expected, the results suggest that in the cases of higher voltage at the primary not all PVs could be connected.

	Recorded Summer load								
	PV 100%			PV 90%			PV 85%		
Primary V (kV), date	**11.045, 19/7**	**11.119, 22/6**	**11.039, 26/7**	**11.045, 19/7**	**11.119, 22/6**	**11.039, 26/7**	**11.045, 19/7**	**11.119, 22/6**	**11.039, 26/7**
Phase A	2	0	2	2	0	2	1	1	2
Phase B	3	0	3	3	0	4	4	1	4
Phase C	2	0	2	2	1	2	2	1	2
Total	**7**	**0**	**7**	**7**	**1**	**8**	**7**	**3**	**8**

Table 28: Results at Castle Street S/S for summer period in 2015

4.11 Churchill

Churchill 3-phase LV network consists of four LV feeders and there are in total 91 loads and 20 proposed and existing PV systems. It is connected to Greenlaw primary and detailed explanation of the 11kV and LV models are provided in Appendix A 2.5.

An LV monitor at Churchill S/S was installed in March 2015, so only the analysis for summer period based on the methodology (i) was carried out. There were 11 proposed PV installations. Table 29 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for three different PV output scenarios.

	Recorded Summer load								
	PV 100%			PV 90%			PV 85%		
Primary V (kV), date	**11.103, 16/7**	**11.224, 22/7**	**11.018, 30/7**	**11.103, 16/7**	**11.224, 22/7**	**11.018, 30/7**	**11.103, 16/7**	**11.224, 22/7**	**11.018, 30/7**
Phase A	0	0	3	0	0	3	0	0	3
Phase B	0	0	2	0	0	3	0	0	3
Phase C	0	0	4	0	0	4	0	0	4
Total	**0**	**0**	**9**	**0**	**0**	**10**	**0**	**0**	**10**

Table 29: Results at Churchill S/S for summer period in 2015

As the voltage at the primary Greenlaw generally shows values above 11kV and even above 11.2kV, not many PVs could be connected at this substation.

4.12 Deanhead

Deanhead 3-phase LV network consists of four LV feeders and there are in total 242 loads and 39 proposed and existing PV systems. It is connected to Eyemouth primary and detailed explanation of the 11kV and LV models are provided in Appendix A 2.6.

An LV monitor at Deanhead S/S was installed in March 2015, so only the analysis for summer period based on the methodology (i) was carried out. There were 11 proposed PV installations. Table 30 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for three different PV output scenarios.

	Recorded Summer load								
	PV 100%			PV 90%			PV 85%		
Primary V (kV), date	**10.686, 2/6**	**10.92, 13/6**	**10.83, 6/7**	**10.686, 2/6**	**10.92, 13/6**	**10.83, 6/7**	**10.686, 2/6**	**10.92, 13/6**	**10.83, 6/7**
Phase A	4	4	4	4	4	4	4	4	4
Phase B	3	3	3	3	3	3	3	3	3
Phase C	4	4	4	4	4	4	4	4	4
Total	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**

Table 30: Results at Deanhead S/S for summer period in 2015

As the voltage at Eyemouth primary has lower values 10.6-10.9kV, all of the proposed PV installation could be allowed at all time.

4.13 Grantshouse

Grantshouse 3-phase LV network consists of two LV feeders and there are in total 39 loads and 12 proposed and existing PV systems. It is connected to Ayton primary and detailed explanation of the 11kV and LV models are provided in Appendix A 2.8.

An LV monitor at Grantshouse S/S was installed in May 2015, so only the analysis for summer period based on the methodology (i) was carried out. At that time, all 11 proposed PV systems were released by SPEN and this analysis was carried out to investigate if network constraints are satisfied. Table 31 displays an indication if network constraints were satisfied for three different values of the voltage at the primary at different dates and for three different PV output scenarios. The results suggest that there are violations of voltage constraints for all three different PV output scenarios when the voltage at the primary is above 11.1kV.

	Recorded Summer load								
	PV 100%			PV 90%			PV 85%		
Primary V (kV), date	**10.929, 23/7**	**11.154, 31/7**	**11.131, 12/7**	**10.929, 23/7**	**11.154, 31/7**	**11.131, 12/7**	**10.929, 23/7**	**11.154, 31/7**	**11.131, 12/7**
Constraints	**Satisfied**	**Not satisfied**	**Not satisfied**	**Satisfied**	**Not satisfied**	**Not satisfied**	**Satisfied**	**Not satisfied**	**Not satisfied**

Table 31: Results at Grantshouse S/S for summer period in 2015

4.14 Hawthorn Bank Duns

Hawthorn Bank Duns 3-phase LV network consists of three LV feeders and there are in total 111 loads and 15 proposed and existing PV systems. It is connected to Duns primary and detailed explanation of the 11kV and LV models are provided in Appendix A 2.11.

An LV monitor at Hawthorn Bank Duns S/S was installed in July 2015, so only the one-month summer analysis based on the methodology (i) was carried out. There were eight proposed PV installations. Table 32 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for three different PV output scenarios. As the voltage at Duns primary was mostly 11kV at the analysed time, just few PVs were acceptable.

	Recorded Summer load								
	PV 100%			PV 90%			PV 85%		
Primary V (kV), date	**11.028, 29/7**	**11.128, 13/7**	**11.036, 26/7**	**11.028, 29/7**	**11.128, 13/7**	**11.036, 26/7**	**11.028, 29/7**	**11.128, 13/7**	**11.036, 26/7**
Phase A	1	0	1	1	0	1	1	0	1
Phase B	0	0	0	1	0	0	1	0	1
Phase C	2	0	1	2	0	2	2	0	2
Total	**3**	**0**	**2**	**4**	**0**	**3**	**4**	**0**	**4**

Table 32: Results at Hawthorn Bank Duns S/S for summer period in 2015

4.15 Leitholm Village

Leitholm Village 3-phase LV network consists of three LV feeders and there are in total 94 loads and 19 proposed and existing PV systems. It is connected to Duns primary and detailed explanation of the 11kV and LV models are provided in Appendix A 2.13.

An LV monitor at Leitholm Village S/S was installed in May 2015, so only the analysis for summer period based on the methodology (i) was carried out. There were five proposed PV installations. Table 33 shows a number of those PVs allowed to be installed per phase for three different values of the voltage at the prymary at different dates and for three different PV output scenarios. The results suggest that all of the proposed PV installation could be allowed for almost every time-step.

	Recorded Summer load								
	PV 100%			PV 90%			PV 85%		
Primary V (kV), date	**11.051, 17/7**	**11.119, 22/6**	**11.023, 29/7**	**11.051, 17/7**	**11.119, 22/6**	**11.023, 29/7**	**11.051, 17/7**	**11.119, 22/6**	**11.023, 29/7**
Phase A	2	1	2	2	2	2	2	2	2
Phase B	1	0	1	1	1	1	1	1	1
Phase C	2	0	2	2	2	2	2	2	2
Total	**5**	**1**	**5**	**5**	**5**	**5**	**5**	**5**	**5**

Table 33: Results at Leitholm Village S/S for summer period in 2015

5 Conclusions and next steps

The work presented in this report describes the overall process of mass deployment of domestic PV systems on a constrained distribution network. It details the modelling of 11kV and LV networks associated with a number of secondary substations and describes the development of methodologies, PowerFactory modelling and analysis to identify the potential headroom for new PV systems at each of these secondary substations. The work presents results from several months of data obtained by SPEN through measurements in winter and summer 2015.

Based on the presented analysis and results, more than 700 (out of 749) PVs have been released for installation and the overall conclusions are listed below:

- During the modelling process, it was found that there was missing data or errors in SPEN's GIS database, which was approximately 5-10% per each modelled substation.
- The number of acceptable PV systems varies with their output capacity and proximity to the secondary substation.
- There were no thermal constraint violations and all not acceptable PVs were constrained by LV voltage limits at the connection terminals. These constrained PV systems were normally proposed to be connected at the end of an LV feeder.
- The voltage at the secondary substation is dominated by the voltage at the primary and in the cases of high primary voltage (above 11.1kV) less PV systems could be connected. This number also varies with PV output capacity.
- Under the ARC project, a factor of 0.9 has been found to be the maximum output of any PV system. This factor was applied in the analysis.

Ideally, the presented methodologies should be carried out for at least one full year of co-incident network and generation data before drawing firm conclusions. However, there are potentially useful avenues for further work in terms of identifying ways to operate the network with large penetrations of distributed generation under G83/2 rules. These are:

- The PowerFactory models provide an opportunity to investigate the impact to the network load flows and voltages when using different cable types.
- With new PVs and LV monitors installed, there is an opportunity to investigate the impact of static voltage reduction at secondary substations to the additional headroom for new DGs.
- With new PVs and LV monitors installed and at least one full year of data, there is a potential to analyse the applicability of learning from the project LV Templates[8]. This project, carried out by Western Power Distribution, monitored the LV feeders and attempted to classify secondary substations into 'templates' which can then predict important aspects of its operation including daily demand profiles and daily voltage profiles.

[8] LV Templates project: http://www.westernpowerinnovation.co.uk/Projects/Network-Templates.aspx

Appendix 1 Cable types

This appendix contains detailed information about cables and overhead lines (OHL) used during modelling studies. These are aluminium and copper conductors and their parameters were sourced from SPEN's cable database. Every table shows cable/OHL PowerFactory name alongside with their nominal cross section, current and impedance ratings, and temperature. In addition, there is a column showing a model that includes particular cable/OHL. The following indices are used:

a. Swinton Duns
b. Hoprig Road
c. Dulcecraig
d. Dovecote
e. Gunsgreenhill
f. Chirnside west end
g. Ayton Lawfield
h. Grantshouse
i. Churchill
j. Hawthorn Bank Duns
k. Briery Baulk
l. Leitholm Village
m. Buss Craig
n. Castle Street
o. Deanhead

A 1.1 11kV Cables and Overhead Lines

PowerFactory Component Name	Nominal Cross Section	Phase R (ohm/km)	Neutral R (ohm/km)	Phase X (ohm/km)	Neutral X (ohm/km)	Current (summer) ground (kA)	Current (summer) air (kA)	Temperature (°C)	Models
Aluminium									
Cable 11kV Al 0.15in	0.15in	0.3084		0.0842		0.172	0.172	80	f, n, i
Cable 11kV Al 0.25in	0.25in	0.1849		0.0798		0.23	0.23	80	f, g
Cable 11kV Al 185mm Coral	185mm2	0.165		0.08		0.23	0.23	80	b, f, h, j, k, o
Cable 11kV Al 185mm XLPE 3c	185mm2	0.21		0.088		0.236	0.236	80	a, c, k, l, n
Cable 11kV Al 300mm Coral	300mm2	0.1		0.076		0.305	0.305	80	g
Cable 11kV Al 95mm Coral	95mm2	0.321		0.087		0.16	0.16	80	d, e, f, g, k, m, n, i
Cable 11kV Al 95mm XLPE 3c	95mm2	0.408		0.099		0.157	0.157	80	a
Copper									
Cable 11kV Cu 0.06in	0.06in	0.4635		0.0962		0.128	0.128	80	a, n
Cable 11kV Cu 0.15in	0.15in	0.1882		0.0842		0.22	0.22	80	k
Cable 11kV Cu 0.25in	0.25in	0.1128		0.0798		0.294	0.294	80	f
Overhead Lines									
OHL 11kV Cu 0.025in	0.025in	1.08		0.383			0.098	80	h, k
OHL 11kV SCA 0.05in	0.05in	0.544		0.373			0.158	80	b
OHL 11kV SCA 100mm	100mm2	0.275		0.352			0.249	80	a, f, g, h, l
OHL 11kV SCA 150mm	150mm2	0.185		0.304			0.345	80	g
OHL 11kV SCA 50mm	50mm2	0.544		0.373			0.158	80	l

Table 34: 11kV cables and overhead lines

A 1.2 LV Cables and Overhead Lines

PowerFactory Component Name	Nominal Cross Section	Phase R (ohm/km)	Neutral R (ohm/km)	Phase X (ohm/km)	Neutral X (ohm/km)	Current (summer)		Temperature (°C)	Models
						ground (kA)	air (kA)		
Cable LV Cu 0.0225ins CONC 2 core	0.0225ins	1.26	1.257	0.086	0.086	0.1	0.1	80	o
Cable LV Cu 0.0225ins CONC 4 core	0.0225ins	1.26	1.257	0.086	0.086	0.1	0.1	80	e
Cable LV Cu 0.0225ins PILC 2 core	0.0225ins	1.258	1.258	0.086	0.086	0.1	0.1	80	a,b,d,e,f,g,k,l,m,n
Cable LV Cu 0.0225ins PILC 3 core	0.0225ins	1.258	1.258	0.086	0.086	0.1	0.1	80	d,e
Cable LV Cu 0.0225ins PILC 4 core	0.0225ins	1.258	1.258	0.086	0.086	0.1	0.1	80	a,g,h,x,l,n
Cable LV Cu 0.04ins 2 core	0.04ins	0.703	0.703	0.078	0.078	0.14	0.14	80	b,d,g,k,m,n,o
Cable LV Cu 0.04ins LC 4 core	0.04ins	0.703	0.703	0.078	0.078	0.14	0.14	80	n
Cable LV Cu 0.04ins PILC 4 core	0.04ins	0.703	0.703	0.078	0.078	0.14	0.14	80	a,b,d,e,f,k,m,n
Cable LV Cu 0.06ins PILC 2 core	0.06ins	0.464	0.464	0.075	0.075	0.175	0.175	80	h,m,n
Cable LV Cu 0.06ins PILC 4 core	0.06ins	0.464	0.464	0.075	0.075	0.175	0.175	80	a,b,d,e,k,o
Cable LV Cu 0.06ins PILC 5 core	0.06ins	0.464	0.464	0.075	0.075	0.175	0.175	80	m
Cable LV Cu 0.15ins PILC 5 core	0.15ins	0.188	0.188	0.07	0.07	0.29	0.29	80	a,m
Cable LV Cu 0.1ins 6 core	0.1ins	0.276	0.276	0.073	0.073	0.24	0.24	80	a
Cable LV Cu 0.1ins PILC 4 core	0.1ins	0.276	0.276	0.073	0.073	0.24	0.24	80	h,k
Cable LV Cu 0.1ins PILC 5 core	0.1ins	0.276	0.276	0.073	0.073	0.24	0.24	80	a,d,e,g,k,l,n
Cable LV Cu 0.25ins 5 core	0.25ins	0.113	0.113	0.067	0.067	0.395	0.395	80	d,n
Cable LV Cu 0.2ins 4 core	0.2ins	0.142	0.142	0.069	0.069	0.345	0.345	80	e
Cable LV Cu 0.2ins 5 core	0.2ins	0.142	0.142	0.069	0.069	0.345	0.345	80	d,e
Cable LV Cu 16mm2 3 core	16mm2=0.025ins	1.26	1.257	0.086	0.086	0.1	0.1	80	e,f,i,x,l,n
Cable LV Cu 16mm2 CONC 2 core	16mm2=0.025ins	1.258	1.258	0.086	0.086	0.1	0.1	80	o
Cable LV Cu 16mm2 PILC 1 core	16mm2=0.025ins	1.258	1.258	0.086	0.086	0.1	0.1	80	a,b,f,h,i,k,l,m,n
Cable LV Cu 16mm2 PILC 2 core	16mm2=0.025ins	1.258	1.258	0.086	0.086	0.1	0.1	80	l
Cable LV Cu 16mm2 SNE 1 core	16mm2=0.025ins	1.26	1.257	0.086	0.086	0.1	0.1	80	c,d,e,f,g,k,m,o
Cable LV Cu 25mm2 CNE 1 core	25mm2 = 0.04ins	0.703	0.703	0.078	0.078	0.14	0.14	80	e,g,h,i,j,l,n,o
Cable LV Cu 25mm2 CNE 3 core	25mm2 = 0.04ins	0.703	0.703	0.078	0.078	0.14	0.14	80	e,h,i,n
Cable LV Cu 25mm2 CONC 2 core	25mm2 = 0.04ins	0.703	0.703	0.078	0.078	0.14	0.14	80	e,k,l,n,o
Cable LV Cu 25mm2 PILC 3 core	25mm2 = 0.04ins	0.703	0.703	0.078	0.078	0.14	0.14	80	k,l
Cable LV Cu 25mm2 PILC 4 core	25mm2 = 0.04ins	0.703	0.703	0.078	0.078	0.14	0.14	80	a,l
Cable LV Cu 25mm2 SNE 1 core	25mm2 = 0.04ins	0.703	0.703	0.078	0.078	0.14	0.14	80	a,b,d,e,f,g,i,k,l,m,n
Cable LV Cu 25mm2 SNE 3 core	25mm2 = 0.04ins	0.703	0.703	0.078	0.078	0.14	0.14	80	b,d,g,m,o
Cable LV Cu 35mm2 CNE 1 core	35mm2 = 0.05	0.583	0.544	0.076	0.078	0.16	0.16	80	d
Cable LV Cu 35mm2 CNE 3 core	35mm2 = 0.05	0.583	0.544	0.076	0.078	0.16	0.16	80	g,i
Cable LV Cu 35mm2 PILC 3 core	35mm2 = 0.05	0.583	0.544	0.076	0.078	0.16	0.16	80	h
Cable LV Cu 35mm2 XLPE 4 core	35mm2 = 0.05	0.583	0.544	0.076	0.078	0.16	0.16	80	d
OHL LV Al Cored Steel Reinf 95mm 5 core	95mm2	0.32	0.32	0.077	0.077		0.255	75	n
OHL LV Arial Bunched 35mm 2 core	35mm2	0.868	0.868	0.084	0.084		0.125	75	n,h
OHL LV Arial Bunched 35mm 4 core	35mm2	0.868	0.868	0.084	0.084		0.125	75	n
OHL LV Arial Bunched 50mm 3 core (3x50 ABC LV)	50mm2	0.641	0.641	0.084	0.084		0.16	75	h
OHL LV Arial Bunched 95mm 4 core (4x95 ABC LV)	95mm2	0.32	0.32	0.077	0.077		0.255	75	g,h,i,n
OHL LV Cu 0.147ins 2 core	0.147ins	0.183	0.183	0.278	0.278		0.404	75	b
OHL LV Cu 16mm2 1 core	16mm2	1.083	1.083	0.347	0.347		0.152	75	i
OHL LV Cu 1x0.05ins 1 core	0.05ins	0.544	0.544	0.325	0.325		0.206	75	e,g
OHL LV Cu 32mm2 3 core	32mm2	0.541	0.541	0.325	0.325		0.2	75	n
OHL LV Cu 4x0.05ins 4 core	0.05ins	0.544	0.544	0.325	0.325		0.206	75	e

Table 35: LV Copper cables and overhead lines

PowerFactory Component Name	Nominal Cross Section	Phase R (ohm/km)	Neutral R (ohm/km)	Phase X (ohm/km)	Neutral X (ohm/km)	Current (summer) ground (kA)	Current (summer) air (kA)	Temperature (°C)	Models
Cable LV Al 0.04ins CNE 2 core	As Al 0.06ins.								
Cable LV Al 0.06ins CNE 2 core	0.06ins	0.767	0.767	0.075	0.075	0.135	0.135	80	b,d,e,f,g,i,k,o
Cable LV Al 0.06ins CNE 4 core	0.06ins	0.767	0.767	0.075	0.075	0.135	0.135	80	d,f,i,k,l,o
Cable LV Al 0.06ins PILC 4 core	0.06ins	0.767	0.767	0.075	0.075	0.135	0.135	80	i
Cable LV Al 0.15ins CNE 4 core	0.15ins	0.312	0.312	0.07	0.07	0.225	0.225	80	em
Cable LV Al 0.15ins PILC 5 core	0.15ins	0.312	0.312	0.07	0.07	0.225	0.225	80	b,d,e,f,g,k,m
Cable LV Al 0.15ins Wave 3 core	0.15ins	0.312	0.312	0.07	0.07	0.225	0.225	80	k,n
Cable LV Al 0.15ins Wave 5 core	0.15ins	0.312	0.312	0.07	0.07	0.225	0.225	80	k
Cable LV Al 0.1ins 3 core	0.1ins	0.456	0.456	0.073	0.073	0.185	0.185	80	e,n
Cable LV Al 0.1ins Wave 5 core	0.1ins	0.456	0.456	0.073	0.073	0.185	0.185	80	k
Cable LV Al 0.25ins 3 core	0.25ins	0.187	0.187	0.068	0.068	0.31	0.31	80	n
Cable LV Al 0.25ins 5 core	0.25ins	0.187	0.187	0.068	0.068	0.31	0.31	80	o
Cable LV Al 0.2ins 3 core	0.2ins	0.234	0.234	0.069	0.069	0.27	0.27	80	e
Cable LV Al 0.3ins 4 core	0.3ins	0.152	0.152	0.068	0.068	0.35	0.35	80	d
Cable LV Al 0.3ins Wave 3 core	0.3ins	0.152	0.152	0.068	0.068	0.35	0.35	80	b,d,e,f,k,o
Cable LV Al 0.3ins Wave 5 core	0.3ins	0.152	0.152	0.068	0.068	0.35	0.35	80	d,i,k,l,o
Cable LV Al 0.5ins Wave 5 core	0.5ins	0.092	0.152	0.067	0.067	0.45	0.45	80	o
Cable LV Al 185mm2 Districtable 4 core	185mm2	0.164	0.164	0.068	0.068	0.33	0.33	90	n
Cable LV Al 185mm2 Wave 3 core	185mm2	0.164	0.164	0.068	0.068	0.33	0.33	90	b,c,d,f,g,h,i,j,k,l,m,n,o
Cable LV Al 185mm2 Wave 4 core	185mm2	0.164	0.164	0.068	0.068	0.33	0.33	90	a,d,i
Cable LV Al 240mm2 3 core	240mm2	0.125	0.71	0.0675	0.0245	0.486	0.486	80	f
Cable LV Al 25mm2 5 core	25mm2	1.2	1.3	1.45	1.45	0.115	0.115	80	b
Cable LV Al 25mm2 CNE 1 core	25mm2	1.2	1.3	1.45	1.45	0.115	0.115	80	a,b,c,d,e,f,g,h,i,j,k,l,m,n,o
Cable LV Al 25mm2 CNE 3 core	25mm2	1.2	1.3	1.45	1.45	0.115	0.115	80	c,k
Cable LV Al 25mm2 PVC/SNE 1 core	25mm2	1.2	1.3	1.45	1.45	0.115	0.115	80	c,o
Cable LV Al 25mm2 XLPE 1 core	25mm2	1.2	1.3	1.45	1.45	0.115	0.115	80	d
Cable LV Al 25mm2 XLPE 3 core	25mm2	1.2	1.3	1.45	1.45	0.115	0.115	80	f
Cable LV Al 300mm2 CNE 3 core	300mm2	0.1	0.164	0.067	0.067	0.43	0.43	90	b,j
Cable LV Al 300mm2 Wave 3 core	300mm2	0.1	0.164	0.067	0.067	0.43	0.43	90	c,i,k,o
Cable LV Al 300mm2 Wave 4 core	300mm2	0.1	0.164	0.067	0.067	0.43	0.43	90	k,o
Cable LV Al 35mm2 4 core	35mm2	0.868	0.912	0.075	0.033	0.12	0.12	90	c,l,o
Cable LV Al 35mm2 CNE 1 core	35mm2	0.868	0.912	0.075	0.033	0.12	0.12	90	b,c,f,j,l,n,o
Cable LV Al 35mm2 CNE 2 core	35mm2	0.868	0.912	0.075	0.033	0.12	0.12	90	o
Cable LV Al 35mm2 CNE 3 core	35mm2	0.868	0.912	0.075	0.033	0.12	0.12	90	b,c,d,f,g,h,i,j,l,m,n,o
Cable LV Al 35mm2 CNE 5 core	35mm2	0.868	0.912	0.075	0.033	0.12	0.12	90	c
Cable LV Al 25mm2 Hybrid 1 core	As Al 35mm2.	0.868	0.912	0.75	0.033	0.12	0.12	80	n
Cable LV Al 35mm2 SNE 3 core	35mm2	0.868	0.912	0.075	0.033	0.12	0.12	90	i
Cable LV Al 35mm2 PVC 1 core/3core	35mm2	0.868	0.912	0.075	0.033	0.12	0.12	90	n
Cable LV Al 35mm2 PVC 4 core	35mm2	0.868	0.912	0.075	0.033	0.12	0.12	90	c
Cable LV Al 70mm2 4 core	70mm2	0.443	0.386	0.0705	0.0315	0.205	0.205	90	g,l
Cable LV Al 70mm2 Wave 3 core	70mm2	0.443	0.386	0.0705	0.0315	0.205	0.205	90	c,d,k,o
Cable LV Al 95mm2 Districtable 4 core	95mm2	0.32	0.32	0.07	0.07	0.225	0.225	80	n
Cable LV Al 95mm2 PILC 4 core	95mm2	0.32	0.32	0.07	0.07	0.225	0.225	80	g,l
Cable LV Al 95mm2 Wave 3 core	95mm2	0.32	0.32	0.0735	0.0735	0.235	0.235	90	b,c,d,f,g,i,j,m,n,o
Cable LV Al 95mm2 Wave 4 core	95mm2	0.32	0.32	0.0735	0.0735	0.235	0.235	90	a,b,g,h,i,k,l,n,o

Table 36: LV Aluminium cables

Appendix 2 Description of the models

This appendix provides a summary of the secondary substations PowerFactory models developed by the University of Strathclyde during the modelling of BHA PV scheme. Overall, fifteen secondary substations with their respective 11kV circuits and LV feeders were modelled based on SPEN's GIS database.

A 2.1 Ayton Lawfield

A 2.1.1 11kV model

The 11kV PowerFactory model associated with Ayton Lawfield S/S is a simplification of the SPEN's circuit 120/22 that Ayton Lawfield is connected to and it has been matched as closely as possible to the information available on the design of the feeder. The developed model is based on the PowerFactory model, provided by SPEN, of 11kV circuit 120/22 fed from Ayton primary, which is shown in Figure 14.

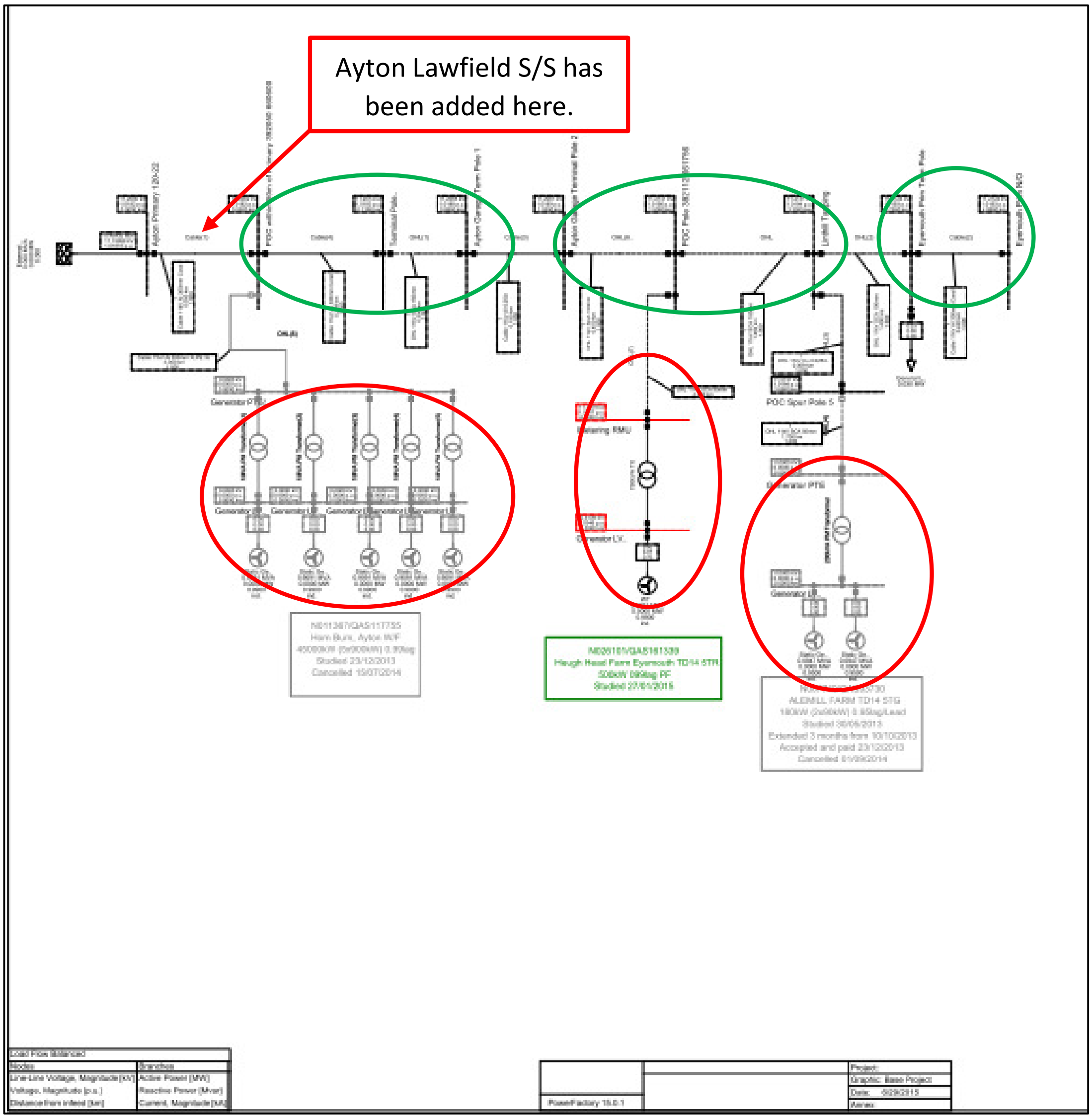

Figure 14: PowerFactory model of 11kV circuit 120/22 provided by SPEN

The SPEN model included the feeder itself, secondary subsations, annual minimum three-phase load for some of the substations taken directly off the 11kV busbars and the external grid acting as the swing bus connected to 11kV primary busbar. The initial model also included a number of distributed generators that were investigated in previous studies carried out by SPEN (dated in 2013 and 2015, as indicated in Figure 14). These were not necessary for the purpose of this work and such they were removed from the model (red circles in Figure 14).

Since Ayton Lawfield was not included in the original PowerFactory model, additional substation representing Ayton Lawfield has been added based on SPEN's GIS data, as shown in Figure 14. For simplification, few secondary substations were aggregated together and modelled as one substation (green circle in Figure 14). Additionaly, for the purpose of modelling and writing scripts, all substations were renamed in the PowerFactory model. Table 37 summarizes substations' name changes with their associated loads.

Number	***Original substation name***	***Power Factory substation name***	***Substation load name***
	Ayton Primary 120-22	Primary Ayton	N/A
1.	N/A	01 S/S Ayton Lawfield	N/A (LV extension)
2.	Ayton Garage Terminal Pole 1	02 S/S Ayton Garage 1	01 Load
3.	Ayton Garage Terminal Pole 2	03 S/S Ayton Garage 2	02 Load
4.	Eyemouth Prim Term Pole	04 S/S Eyemouth Prim Term Pole	03 Load

Table 37: Summary of secondary substations included in 11kV Ayton Lawfield PowerFactory model

Figure 15 shows the final 11kV model of Ayton Lawfield S/S, where Ayton Lawfield is a secondary substation with LV transformer. It is fed from Ayton primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.5MVA.

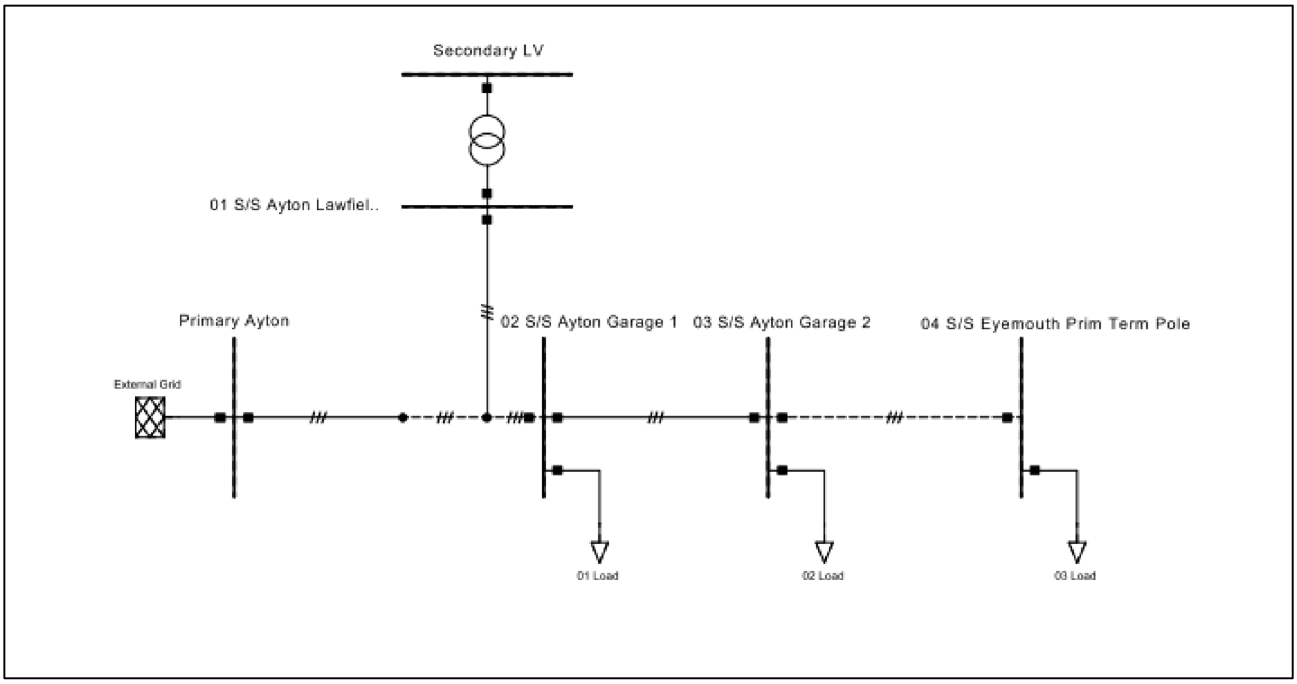

Figure 15: Ayton Lawfield 11kV PowerFactory model

A 2.1.2 LV model

Ayton Lawfield 3-phase LV network consists of four LV feeders shown in Figure 16.

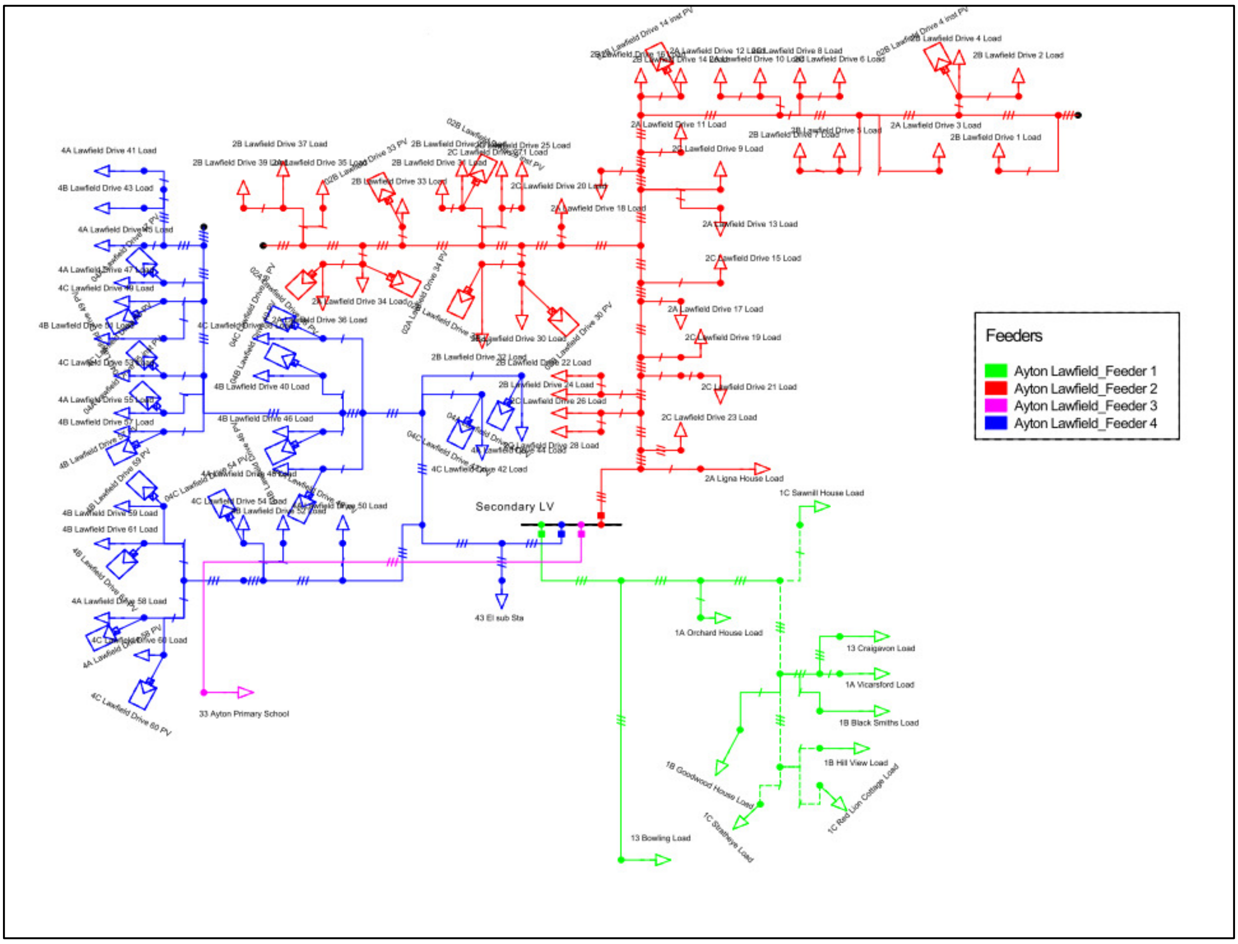

Figure 16: Ayton Lawfield LV PowerFactory model indicating LV feeders

There are in total 73 loads and 24 proposed and existing PV systems. These are summarized in Table 38 and shown in Figure 17.

Load		PV		Load		PV	
Feeder 1				Feeder 3			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	2	Red (A)	0	Red (A)	0	Red (A)	0
Yellow (B)	3	Yellow (B)	0	Yellow (B)	0	Yellow (B)	0
Blue (C)	3	Blue (C)	0	Blue (C)	0	Blue (C)	0
Black (3-phase)	2	Black (3-phase)	0	Black (3-phase)	1	Black (3-phase)	0
Total	**10**	**Total**	**0**	**Total**	**1**	**Total**	**0**
Feeder 2				Feeder 4			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	11	Red (A)	2	Red (A)	8	Red (A)	5
Yellow (B)	16	Yellow (B)	6	Yellow (B)	8	Yellow (B)	5
Blue (C)	12	Blue (C)	0	Blue (C)	6	Blue (C)	6
Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	1	Black (3-phase)	0
Total	**39**	**Total**	**8**	**Total**	**23**	**Total**	**16**

Table 38: Summary of LV loads and PV systems included in Ayton Lawfield LV PowerFactory model

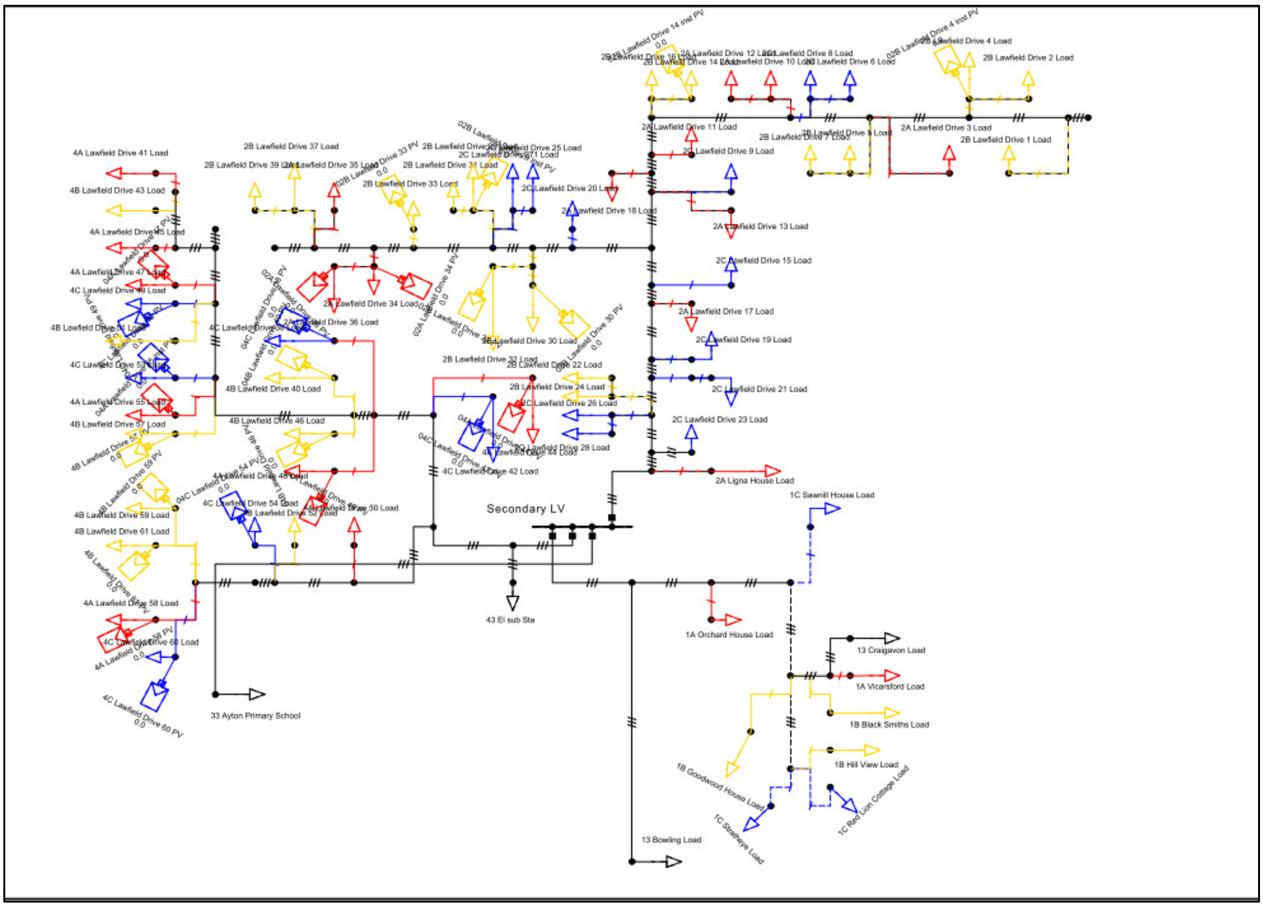

Figure 17: Ayton Lawfield LV PowerFactory model indicating LV phasing

A 2.2 Briery Baulk

A 2.2.1 11kV model

The 11kV PowerFactory model associated with Briery Baulk S/S is a simplification of the SPEN's circuit 114/24 that Briery Baulk is connected to and it has been matched as closely as possible to the information available on the design of the feeder. The developed model is based on the PowerFactory model, provided by SPEN, of 11kV circuit 114/24 fed from Duns primary, which is shown in Figure 18.

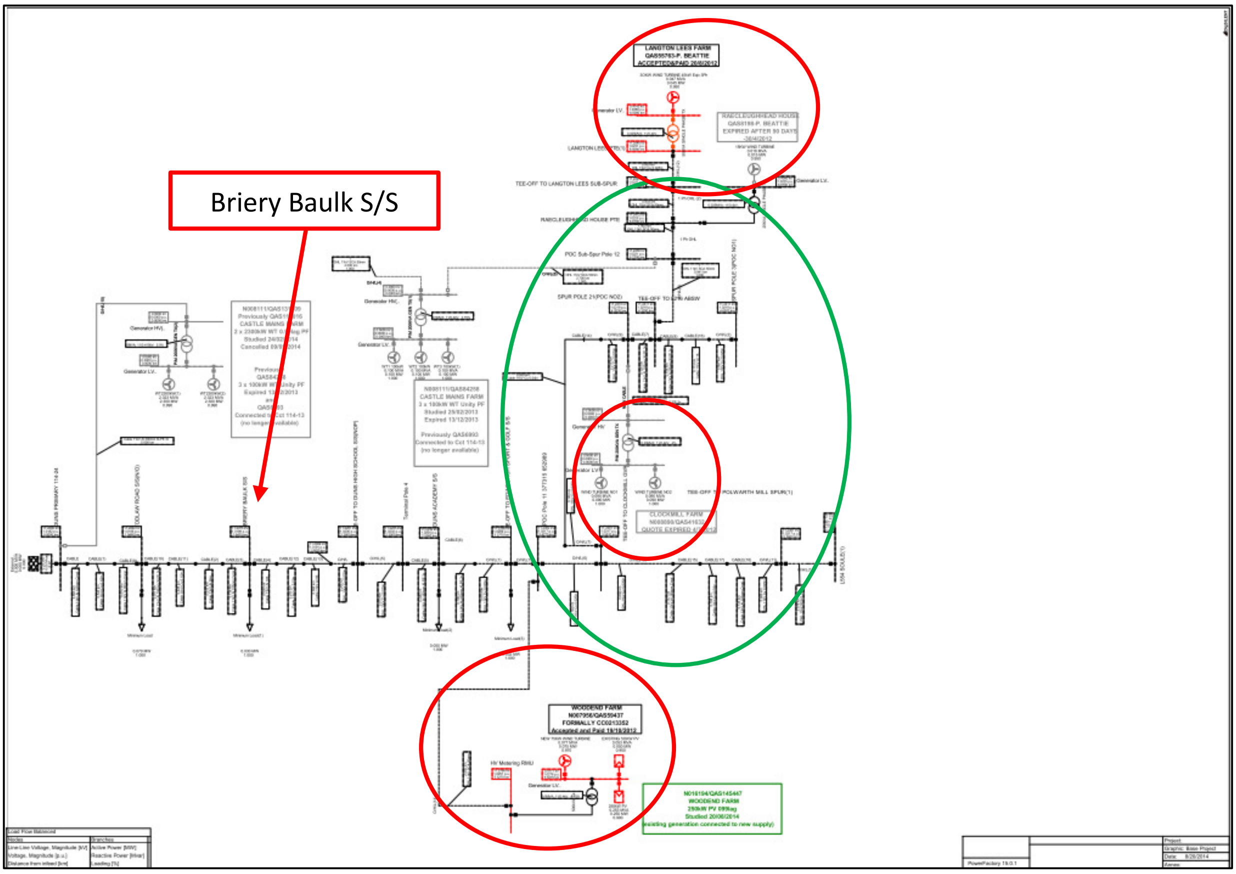

Figure 18: PowerFactory model of 11kV circuit 114/24 provided by SPEN

The SPEN model included the feeder itself, secondary subsations, annual minimum three-phase load for some of the substations taken directly off the 11kV busbars and the external grid acting as the swing bus connected to 11kV primary busbar. The initial model also included a number of distributed generators that were investigated in previous studies carried out by SPEN between 2012 and 2014, as indicated in Figure 18. These were not necessary for the purpose of this work and such they were removed from the model (red circles in Figure 18).

For simplification, few secondary substations were aggregated together and modelled as one substation (green circle in Figure 18). Additionaly, for the purpose of modelling and writing scripts, all substations were renamed in the PowerFactory model. Table 39 summarizes substations' name changes with their associated loads.

Number	***Original substation name***	***Power Factory substation name***	***Substation load name***
	Duns Primary 114-24	Primary Duns	N/A
1.	Todlaw Road S/S (N/O)	01 S/S Todlaw Road	01 Load
2.	Briery Baulk S/S	02 S/S Briery Baulk	N/A (LV extension)
3.	Duns High School S/S (NOP)	03 S/S Duns HS	02 Load
4.	Terminal Pole 4	04 S/S Terminal Pole 4	03 Load
5.	Duns Academy S/S	05 S/S Duns Academy	04 Load
6.	Edinburgh Sport & Golf S/S	06 S/S Edi Sport	05 Load

Table 39: Summary of secondary substations included in 11kV Briery Baulk PowerFactory model

Figure 19 shows the final 11kV model of Briery Baulk S/S, where Briery Baulk is a secondary substation with LV transformer. It is fed from Duns primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.3MVA.

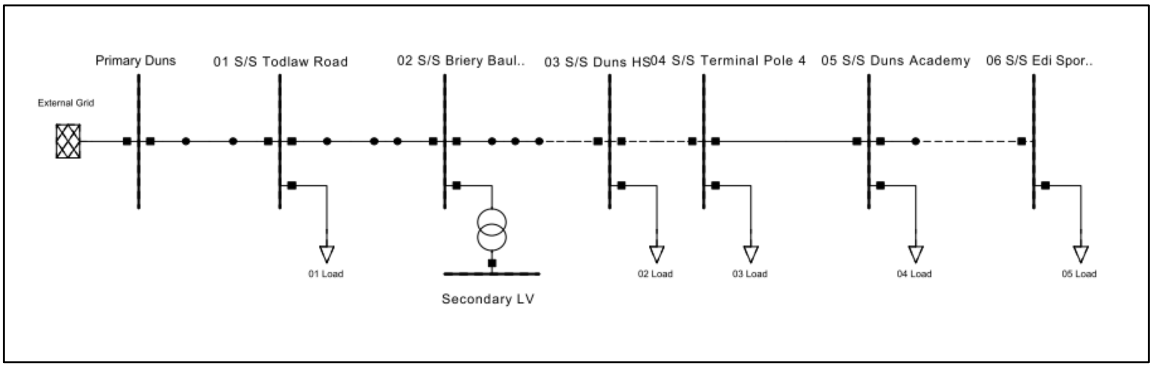

Figure 19: Briery Baulk 11kV PowerFactory model

A 2.2.2 LV model

Briery Baulk 3-phase LV network consists of three LV feeders shown in Figure 20.

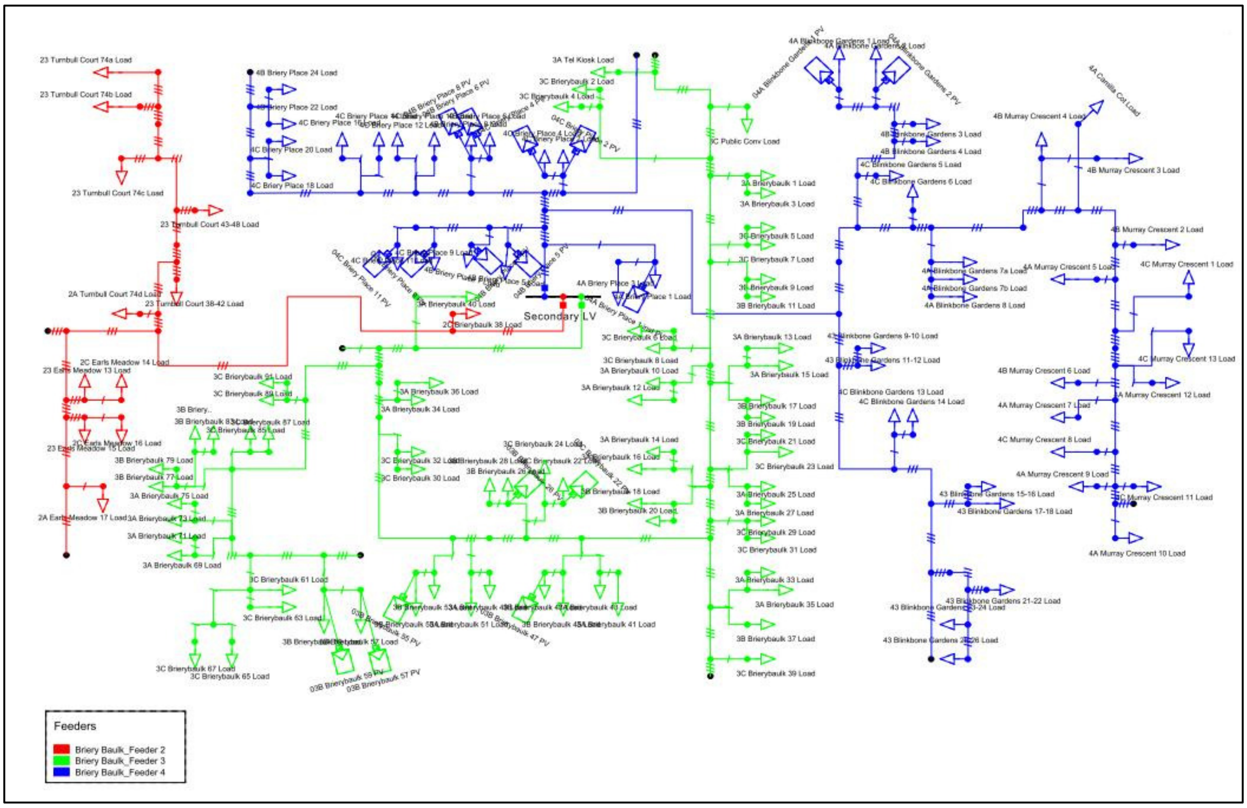

Figure 20: Briery Baulk LV PowerFactory model indicating LV feeders

There are in total 129 loads and 17 proposed and existing PV systems. These are summarized in Table 40 and shown in Figure 21.

Load		PV	
Feeder 2			
Phase	Number	Phase	Number
Red (A)	2	Red (A)	0
Yellow (B)	0	Yellow (B)	0
Blue (C)	3	Blue (C)	0
Black (3-phase)	7	Black (3-phase)	0
Total	**12**	**Total**	**0**
Feeder 3			
Phase	Number	Phase	Number
Red (A)	24	Red (A)	5
Yellow (B)	19	Yellow (B)	1
Blue (C)	24	Blue (C)	0
Black (3-phase)	0	Black (3-phase)	0
Total	**67**	**Total**	**6**
Feeder 4			
Phase	Number	Phase	Number
Red (A)	13	Red (A)	3
Yellow (B)	12	Yellow (B)	4
Blue (C)	18	Blue (C)	4
Black (3-phase)	7	Black (3-phase)	0
Total	**50**	**Total**	**11**

Table 40: Summary of LV loads and PV systems included in Briery Baulk LV PowerFactory model

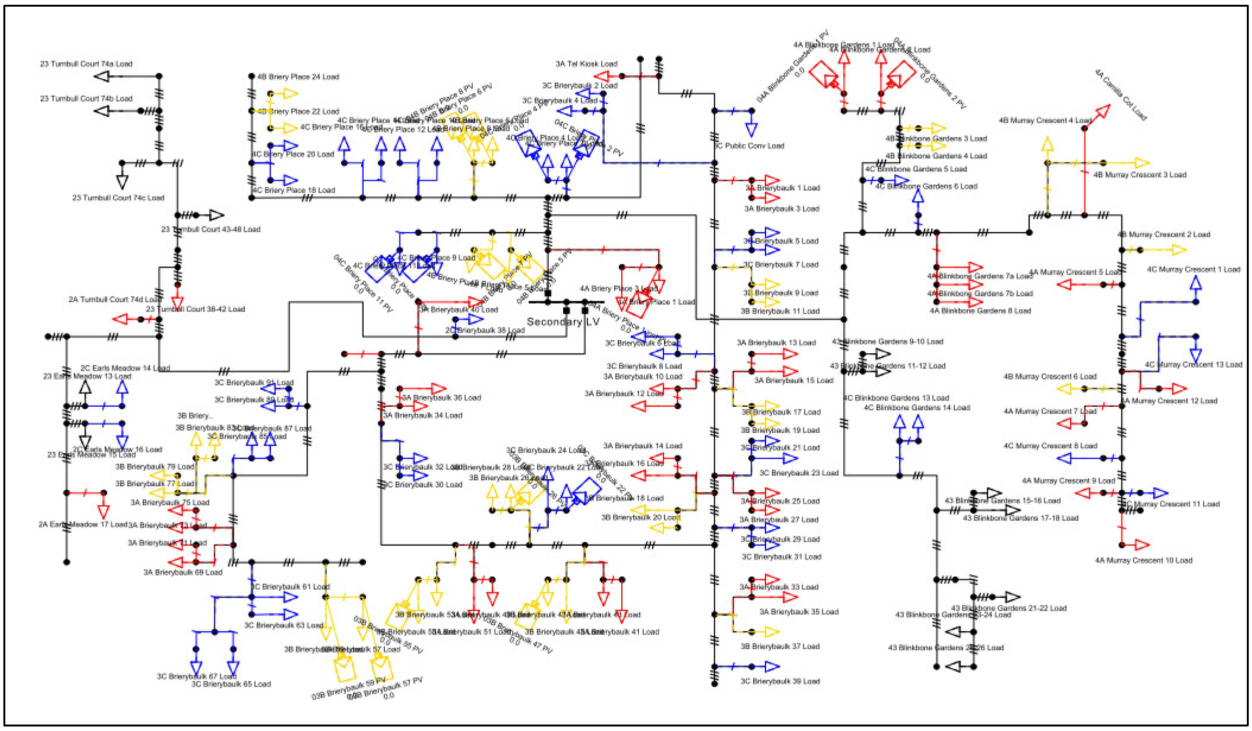

Figure 21: Briery Baulk LV PowerFactory model indicating LV phasing

A 2.3 Buss Craig

A 2.3.1 11kV model

The 11kV PowerFactory model associated with Buss Craig S/S is a simplification of the SPEN's circuit 131/16 that Buss Craig is connected to and it has been matched as closely as possible to the SPEN's GIS information available on the design of the feeder.

Figure 22 shows the developed 11kV model of Buss Craig S/S, where Buss Craig is a secondary substation with LV transformer. It is connected to the same feeder as Dovecote and Gunsgreenhill and fed from Eyemouth primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.5MVA.

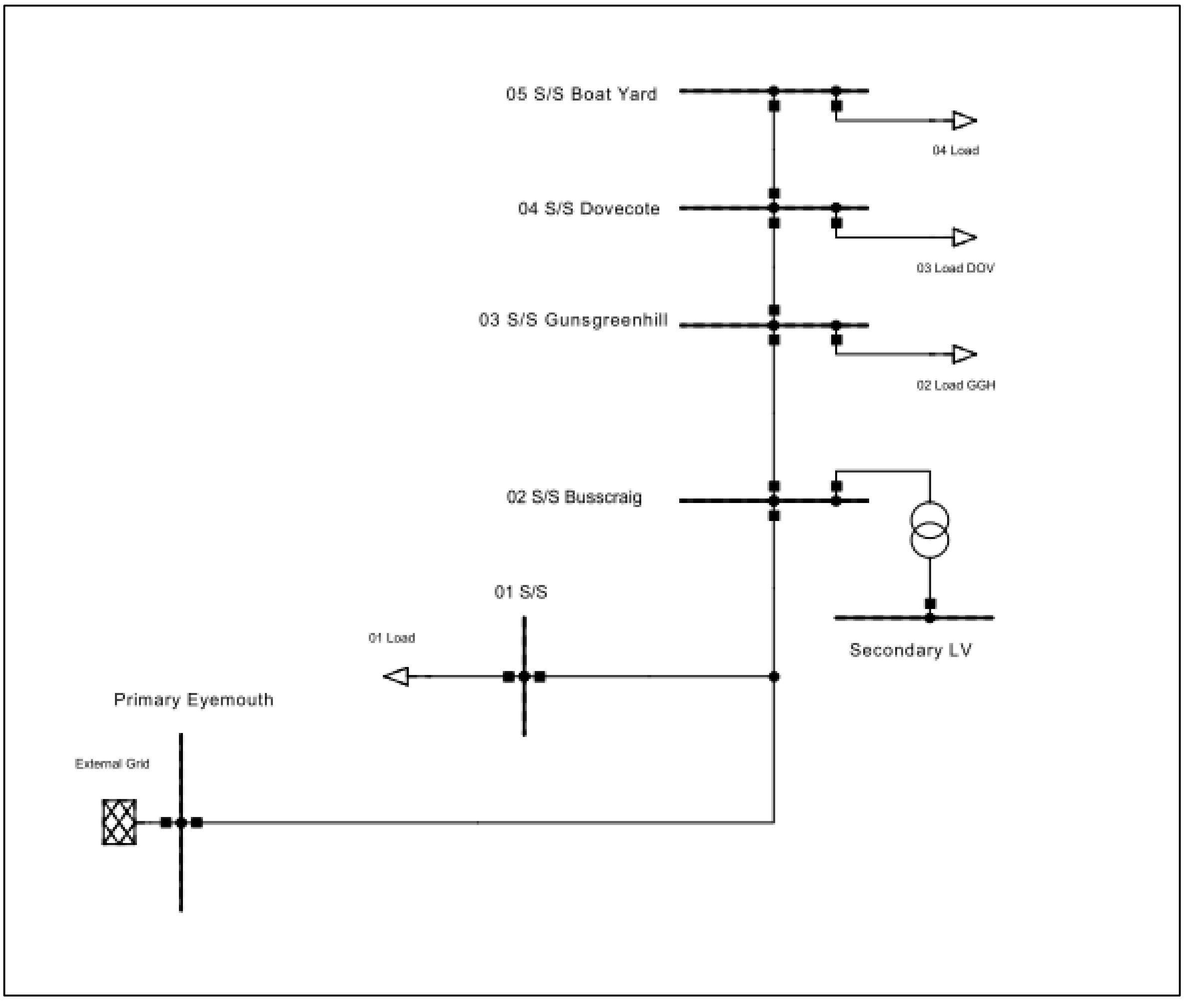

Figure 22: Buss Craig 11kV PowerFactory model

Table 41 summarizes substations included in the model with their associated loads.

Number	***Power Factory substation name***	***Substation load name***
	Primary Eyemouth	N/A
1.	01 S/S	01 Load
2.	02 S/S Buss Craig	N/A (LV extension)
3.	03 S/S Gunsgreenhill	02 Load GGH
4.	04 S/S Dovecote	03 Load DOV
5.	05 S/S Boat Yard	04 Load

Table 41: Summary of secondary substations included in 11kV Buss Craig PowerFactory model

A 2.3.2 LV model

Buss Craig 3-phase LV network consists of four LV feeders shown in Figure 23.

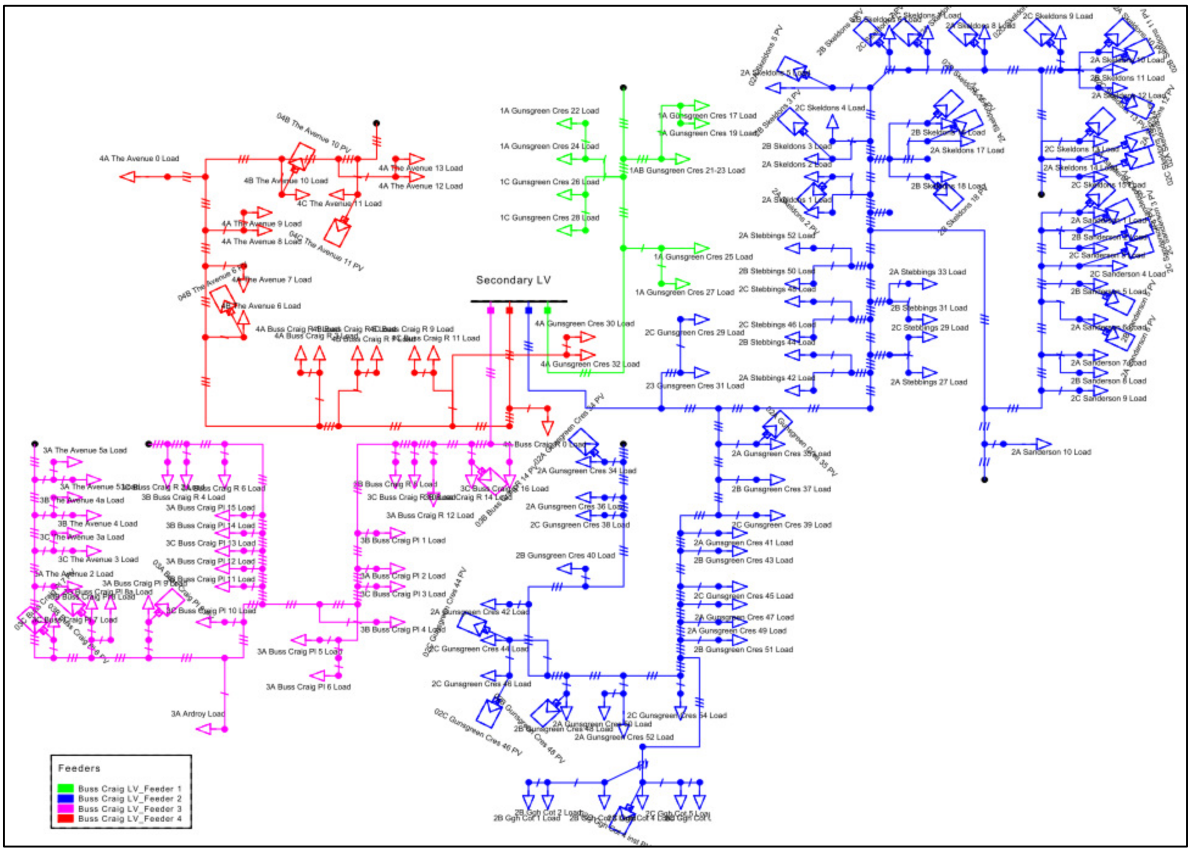

Figure 23: Buss Craig LV PowerFactory model indicating LV feeders

There are in total 125 loads and 35 proposed and existing PV systems. These are summarized in Table 42 and shown in Figure 17.

Load		PV		Load		PV	
Feeder 1				**Feeder 3**			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	7	Red (A)	0	Red (A)	12	Red (A)	1
Yellow (B)	0	Yellow (B)	0	Yellow (B)	11	Yellow (B)	2
Blue (C)	2	Blue (C)	0	Blue (C)	9	Blue (C)	1
Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	0
Total	**9**	**Total**	**0**	**Total**	**32**	**Total**	**4**
Feeder 2				**Feeder 4**			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	25	Red (A)	11	Red (A)	11	Red (A)	0
Yellow (B)	19	Yellow (B)	8	Yellow (B)	4	Yellow (B)	2
Blue (C)	21	Blue (C)	9	Blue (C)	3	Blue (C)	1
Black (3-phase)	1	Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	0
Total	**66**	**Total**	**28**	**Total**	**18**	**Total**	**3**

Table 42: Summary of LV loads and PV systems included in Buss Craig LV PowerFactory model

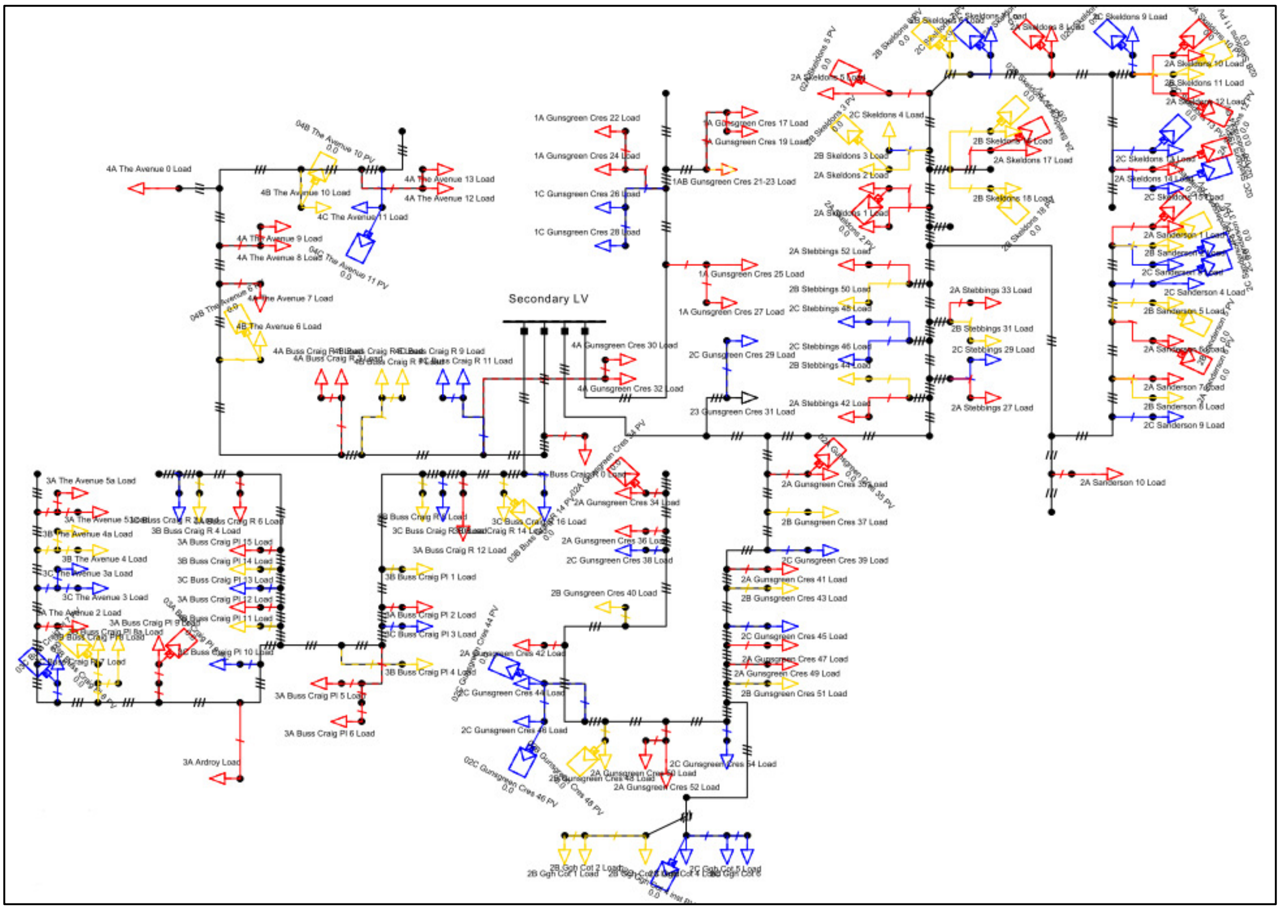

Figure 24: Buss Craig LV PowerFactory model indicating LV phasing

A 2.4 Castle Street

A 2.4.1 11kV model

The 11kV PowerFactory model associated with Castle Street S/S is a simplification of the SPEN's circuit 114/22 that Castle Street is connected to and it has been matched as closely as possible to the information available on the design of the feeder. The developed model is based on the PowerFactory model, provided by SPEN, of 11kV circuit 114/22 fed from Duns primary, which is shown in Figure 25.

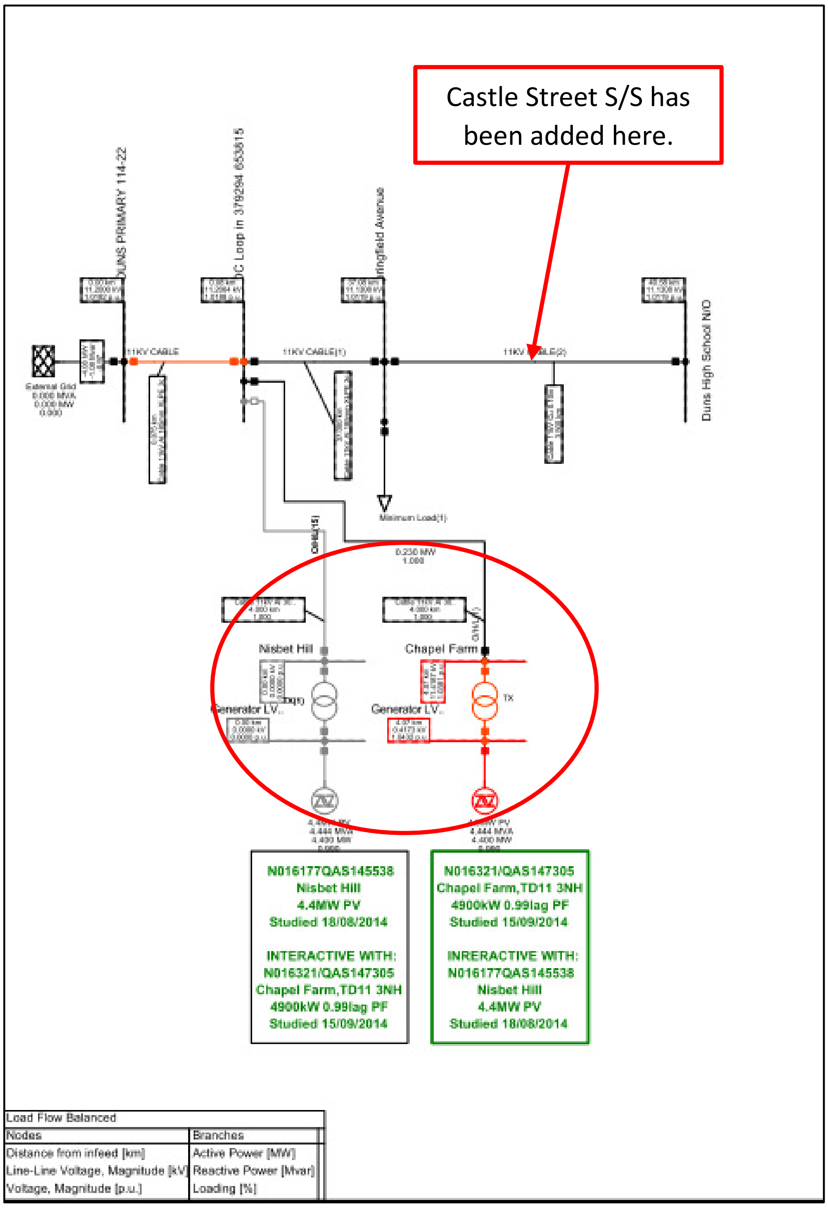

Figure 25: PowerFactory model of 11kV circuit 114/22 provided by SPEN

The SPEN model included the feeder itself, secondary subsations, annual minimum three-phase load for some of the substations taken directly off the 11kV busbars and the external grid acting as the swing bus connected to 11kV primary busbar. The initial model also included a number of distributed generators that were investigated in previous studies carried out by SPEN in 2014, as indicated in Figure 25. These were not necessary for the purpose of this work and such they were removed from the model (red circle in Figure 25).

Since Castle Street and some other substations were not included in the original PowerFactory model, additional substations, including Castle Street, have been added based on SPEN's GIS data, as shown in Figure 25. Additionaly, for the purpose of modelling and writing scripts, all substations were renamed in the PowerFactory model. Table 43 summarizes substations' name changes with their associated loads.

Number	*Original substation name*	*Power Factory substation name*	*Substation load name*
	Duns Primary 114-22	Primary Duns	N/A
1.	Springfield Avenue	01 S/S Springfield Avenue	01 Load
2.	N/A	02 S/S Whitchester Hospital	02 Load
3.	N/A	03 S/S Currie Street	03 Load
4.	N/A	04 S/S Tannage Brae	04 Load
5.	N/A	05 S/S Castle Street	N/A (LV extension)
6.	Duns High School N/O	06 S/S Duns High School	05 Load

Table 43: Summary of secondary substations included in 11kV Castle Street PowerFactory model

Figure 26 shows the final 11kV model of Castle Street S/S, where Castle Street is a secondary substation with LV transformer. It is fed from Duns primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.5MVA.

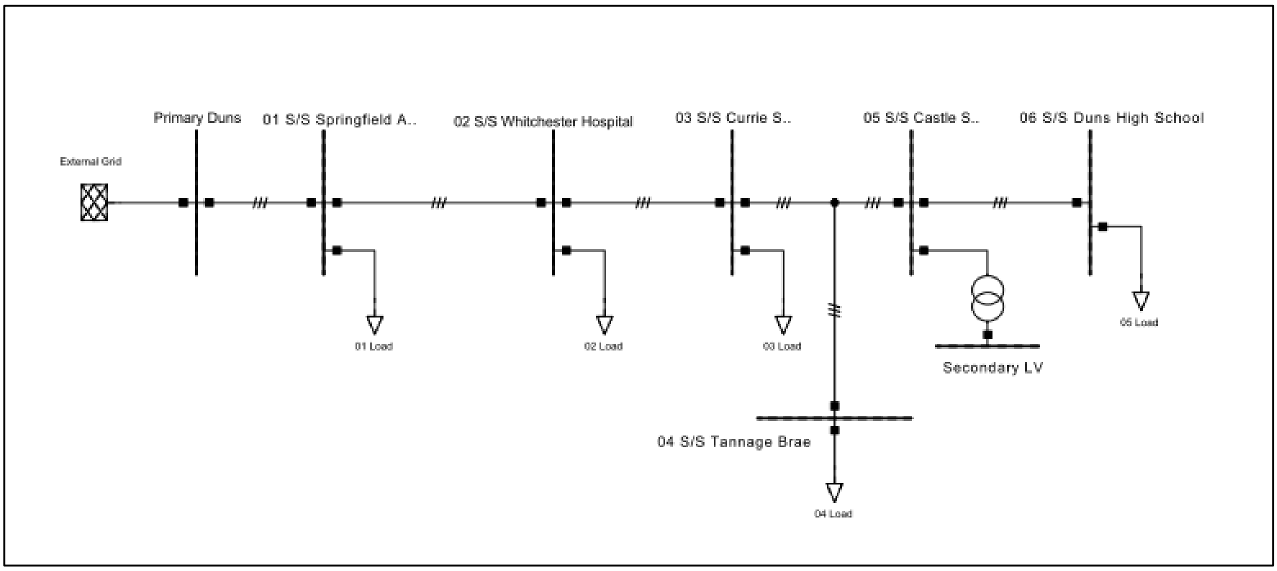

Figure 26: Castle Street 11kV PowerFactory model

A 2.4.2 LV model

Castle Street 3-phase LV network consists of four LV feeders shown in Figure 27.

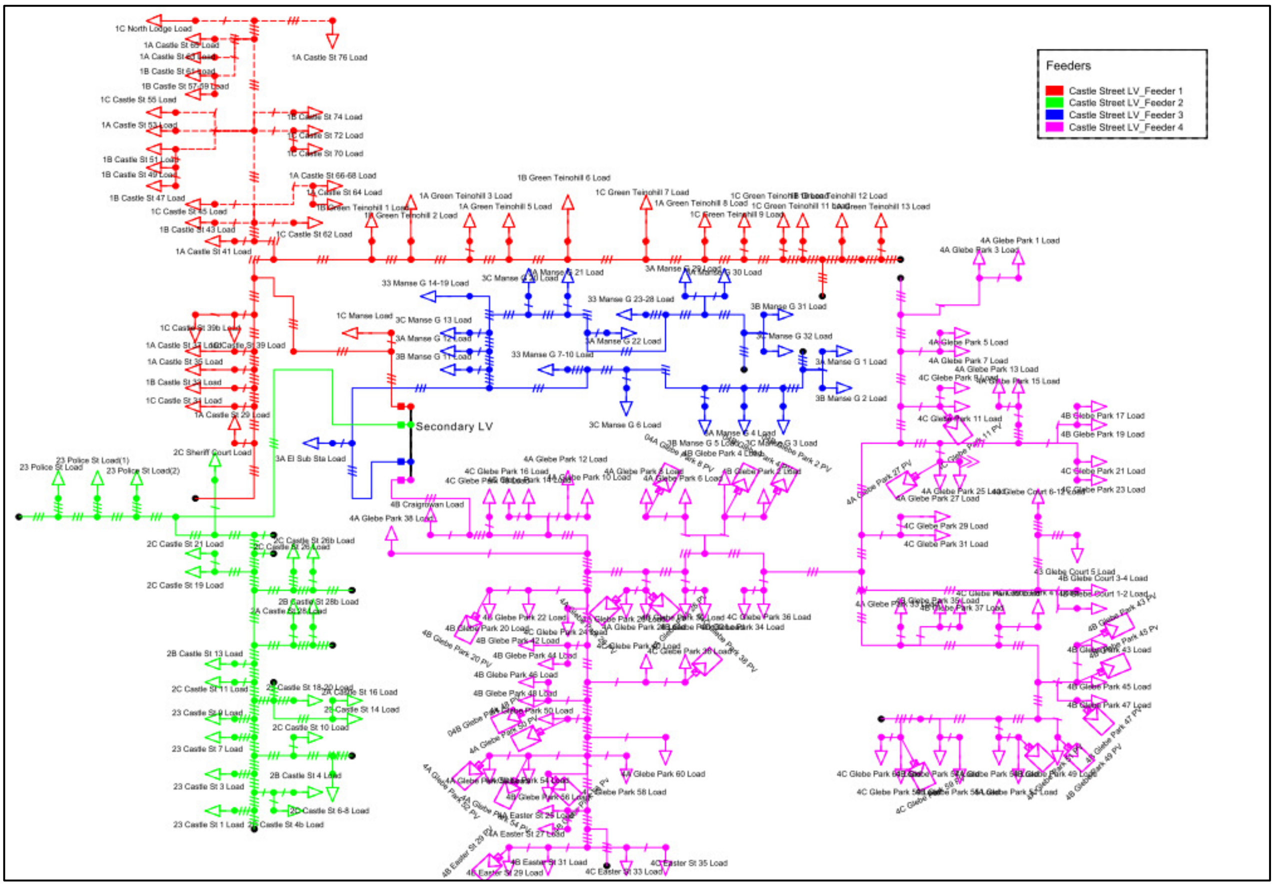

Figure 27: Castle Street LV PowerFactory model indicating LV feeders

There are in total 156 loads and 21 proposed and existing PV systems. These are summarized in Table 44 and shown in Figure 28.

Load		PV		Load		PV	
Feeder 1				**Feeder 3**			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	14	Red (A)	0	Red (A)	8	Red (A)	0
Yellow (B)	12	Yellow (B)	0	Yellow (B)	4	Yellow (B)	0
Blue (C)	14	Blue (C)	0	Blue (C)	5	Blue (C)	0
Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	3	Black (3-phase)	0
Total	**40**	**Total**	**0**	**Total**	**20**	**Total**	**0**
Feeder 2				**Feeder 4**			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	2	Red (A)	0	Red (A)	24	Red (A)	8
Yellow (B)	4	Yellow (B)	0	Yellow (B)	26	Yellow (B)	10
Blue (C)	8	Blue (C)	0	Blue (C)	21	Blue (C)	3
Black (3-phase)	9	Black (3-phase)	0	Black (3-phase)	2	Black (3-phase)	0
Total	**23**	**Total**	**0**	**Total**	**73**	**Total**	**21**

Table 44: Summary of LV loads and PV systems included in Castle Street LV PowerFactory model

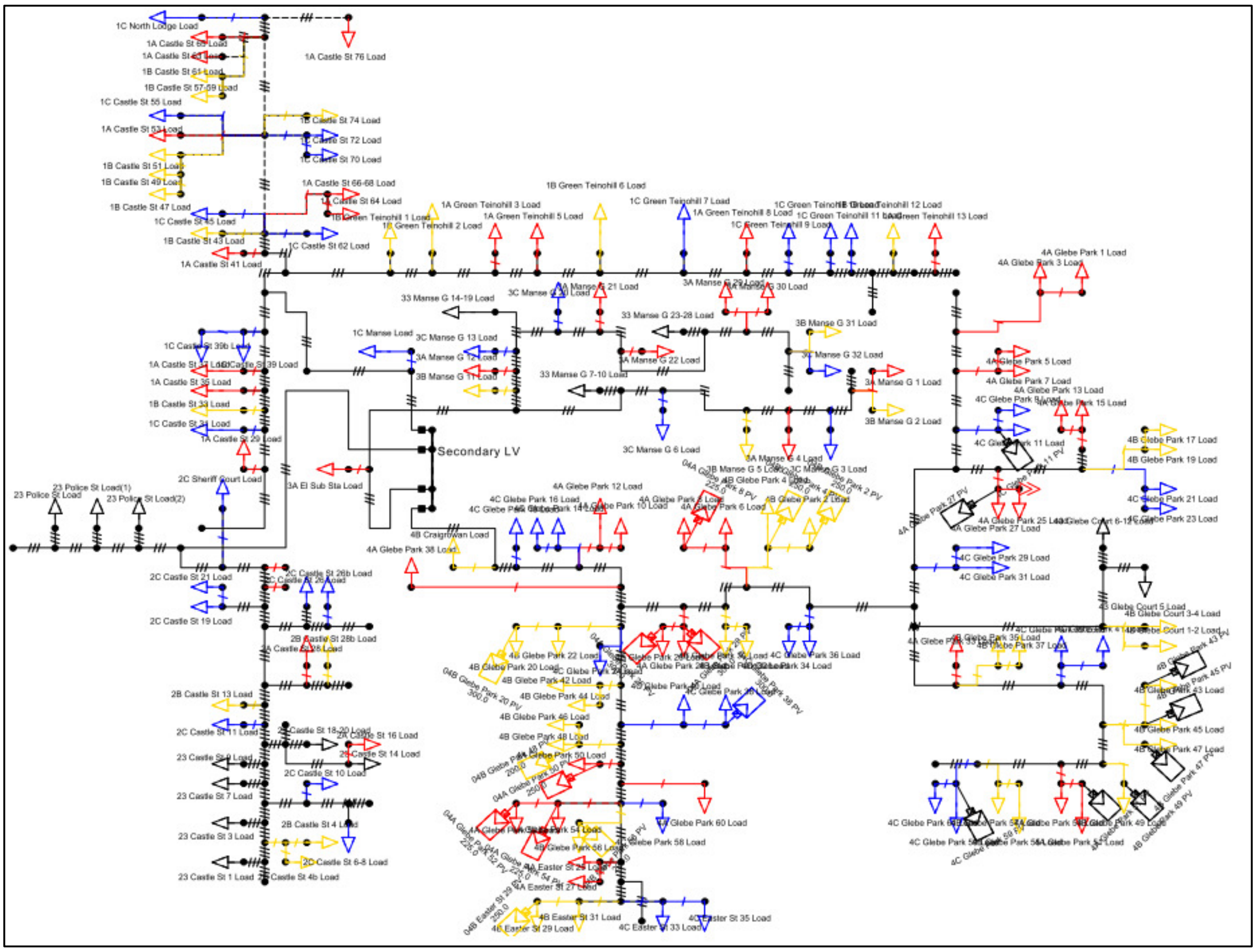

Figure 28: Castle Street LV PowerFactory model indicating LV phasing

A 2.5 Churchill

A 2.5.1 11kV model

The 11kV PowerFactory model associated with Churchill S/S is a simplification of the SPEN's circuit 122/14 that Churchill is connected to and it has been matched as closely as possible to the SPEN's GIS information available on the design of the feeder.

Figure 29 shows the developed 11kV model of Churchill S/S, where Churchill is a secondary substation with LV transformer. It is fed from Greenlaw primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.5MVA.

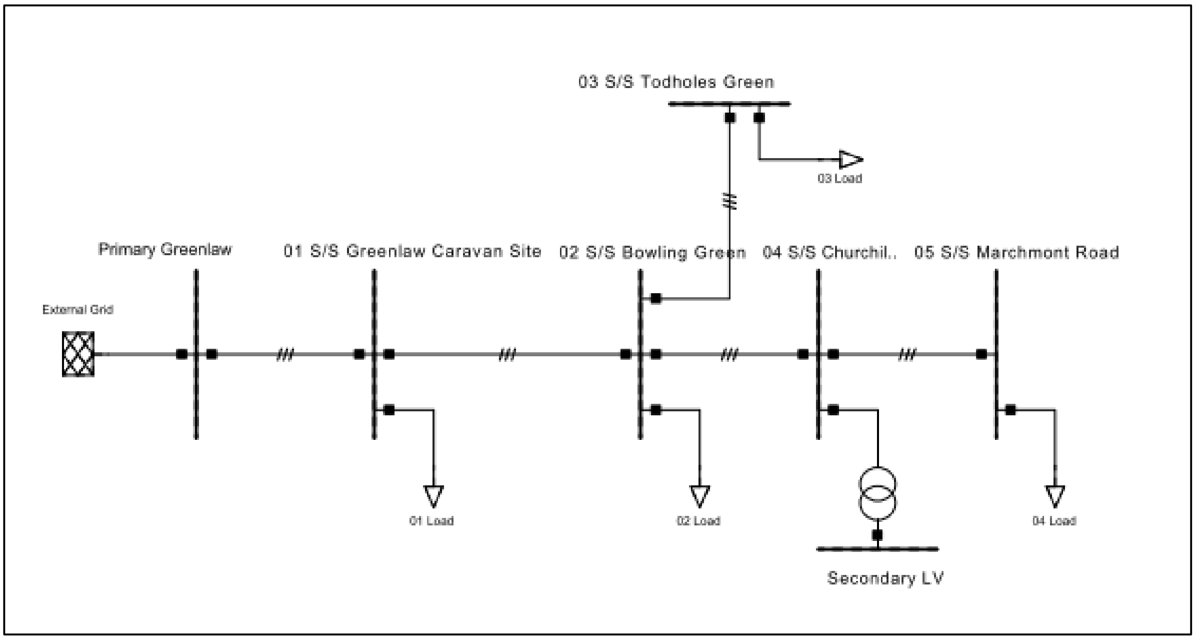

Figure 29: Churchill 11kV PowerFactory model

Table 45 summarizes substations' name changes with their associated loads.

Number	Power Factory substation name	Substation load name
	Primary Greenlaw	N/A
1.	01 S/S Greenlaw Caravan Site	01 Load
2.	02 S/S Bowling Green	02 Load
3.	03 S/S Todholes Green	03 Load
4.	04 S/S Churchill	N/A (LV extension)
5.	05 S/S Marchmont Road	04 Load

Table 45: Summary of secondary substations included in 11kV Churchill PowerFactory model

A 2.5.2 LV model

Churchill 3-phase LV network consists of four LV feeders shown in Figure 30.

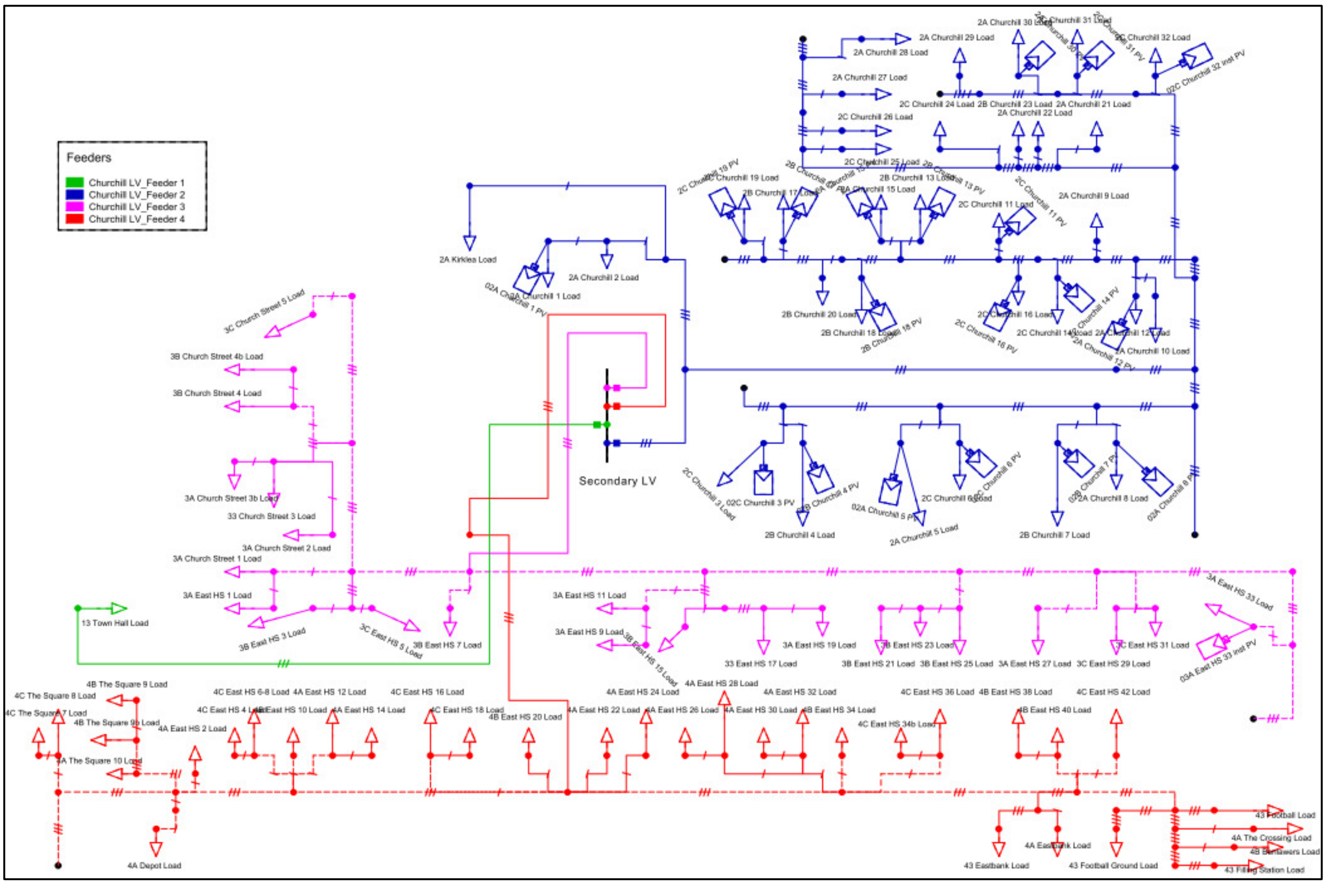

Figure 30: Churchill LV PowerFactory model indicating LV feeders

There are in total 91 loads and 20 proposed and existing PV systems. These are summarized in Table 46 and shown in Figure 31.

Load		PV		Load		PV	
Feeder 1				**Feeder 3**			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	0	Red (A)	0	Red (A)	9	Red (A)	1
Yellow (B)	0	Yellow (B)	0	Yellow (B)	8	Yellow (B)	0
Blue (C)	0	Blue (C)	0	Blue (C)	4	Blue (C)	0
Black (3-phase)	1	Black (3-phase)	0	Black (3-phase)	2	Black (3-phase)	0
Total	**1**	**Total**	**0**	**Total**	**23**	**Total**	**1**
Feeder 2				**Feeder 4**			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	15	Red (A)	6	Red (A)	13	Red (A)	0
Yellow (B)	7	Yellow (B)	5	Yellow (B)	8	Yellow (B)	0
Blue (C)	11	Blue (C)	8	Blue (C)	9	Blue (C)	0
Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	4	Black (3-phase)	0
Total	**33**	**Total**	**19**	**Total**	**34**	**Total**	**0**

Table 46: Summary of LV loads and PV systems included in Churchill LV PowerFactory model

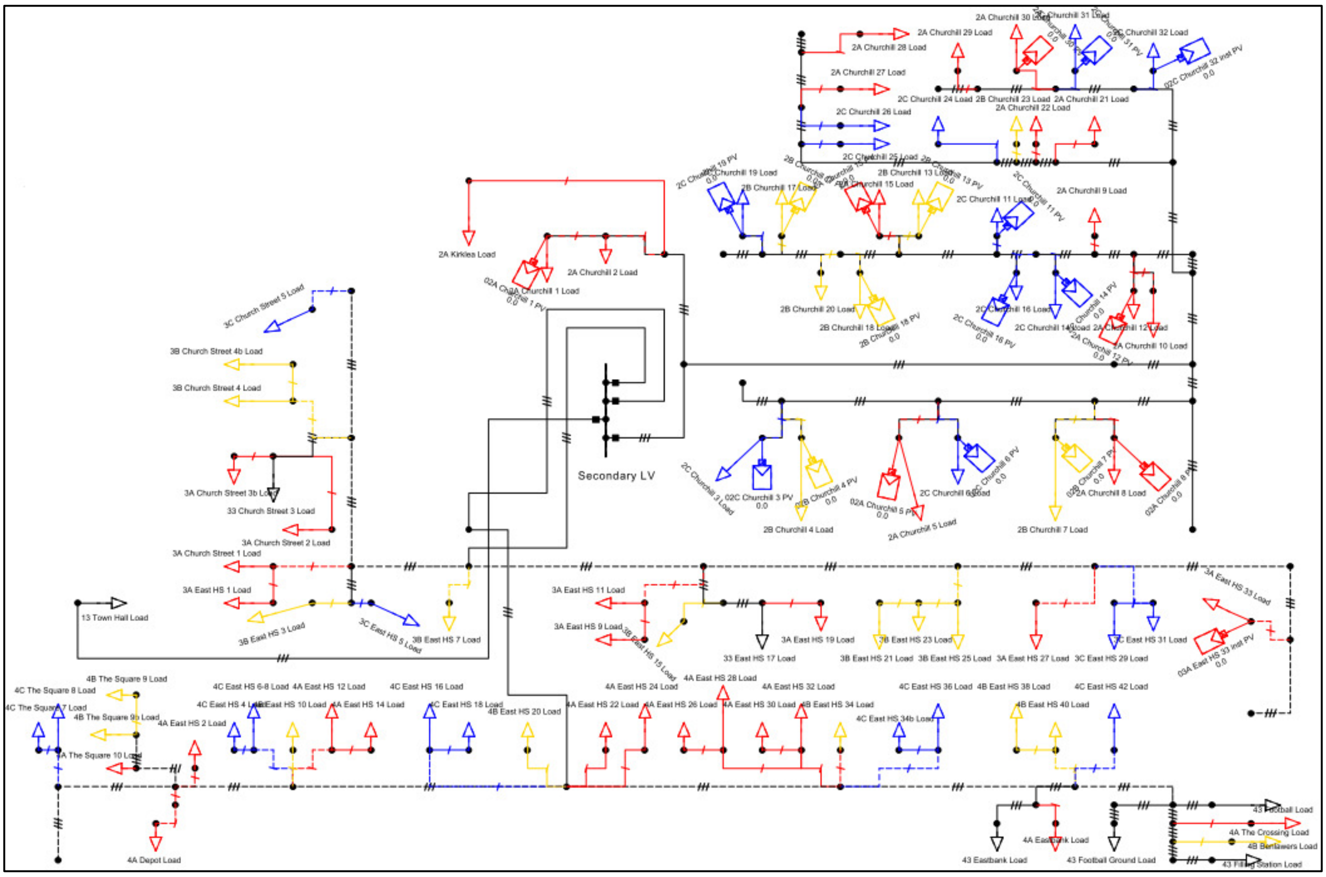

Figure 31: Churchill LV PowerFactory model indicating LV phasing

A 2.6 Deanhead

A 2.6.1 11kV model

The 11kV PowerFactory model associated with Deanhead S/S is a simplification of the SPEN's circuit 131/14 that Deanhead is connected to and it has been matched as closely as possible to the SPEN's GIS information available on the design of the feeder.

Figure 32 shows the developed 11kV model of Deanhead S/S, where Deanhead is a secondary substation with LV transformer. It is connected to the same feeder as Dulcecraig and is fed from Eyemouth primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.5MVA.

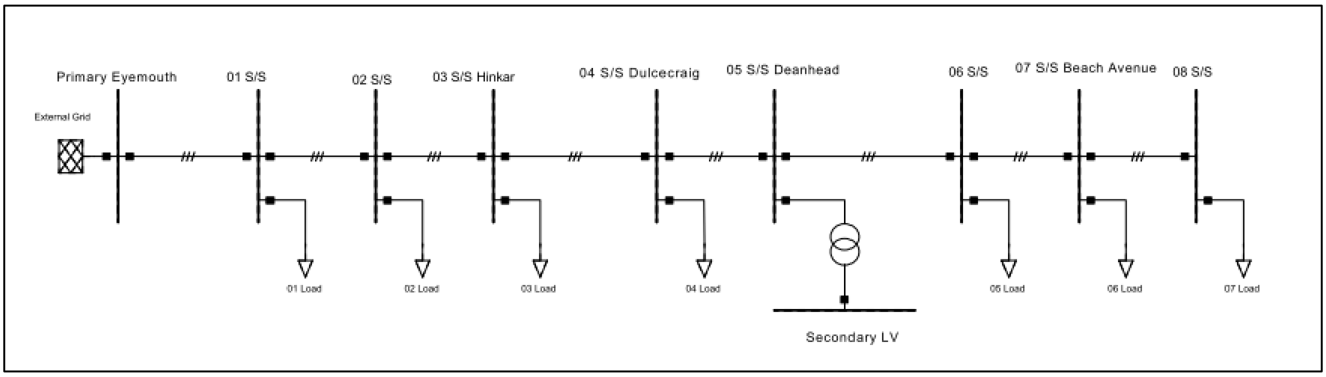

Figure 32: Deanhead 11kV PowerFactory model

Table 47 summarizes substations included in the model with their associated loads.

Number	***Power Factory substation name***	***Substation load name***
	Primary Eyemouth	N/A
1.	01 S/S	01 Load
2.	02 S/S	02 Load
3.	03 S/S Hinkar	03 Load
4.	04 S/S Dulcecraig	04 Load
5.	05 S/S Deanhead	N/A (LV extension)
6.	06 S/S	05 Load
7.	07 S/S Beach Avenue	06 Load
8.	08 S/S	07 Load

Table 47: Summary of secondary substations included in 11kV Deanhead PowerFactory model

A 2.6.2 LV model

Deanhead 3-phase LV network consists of four LV feeders shown in Figure 33.

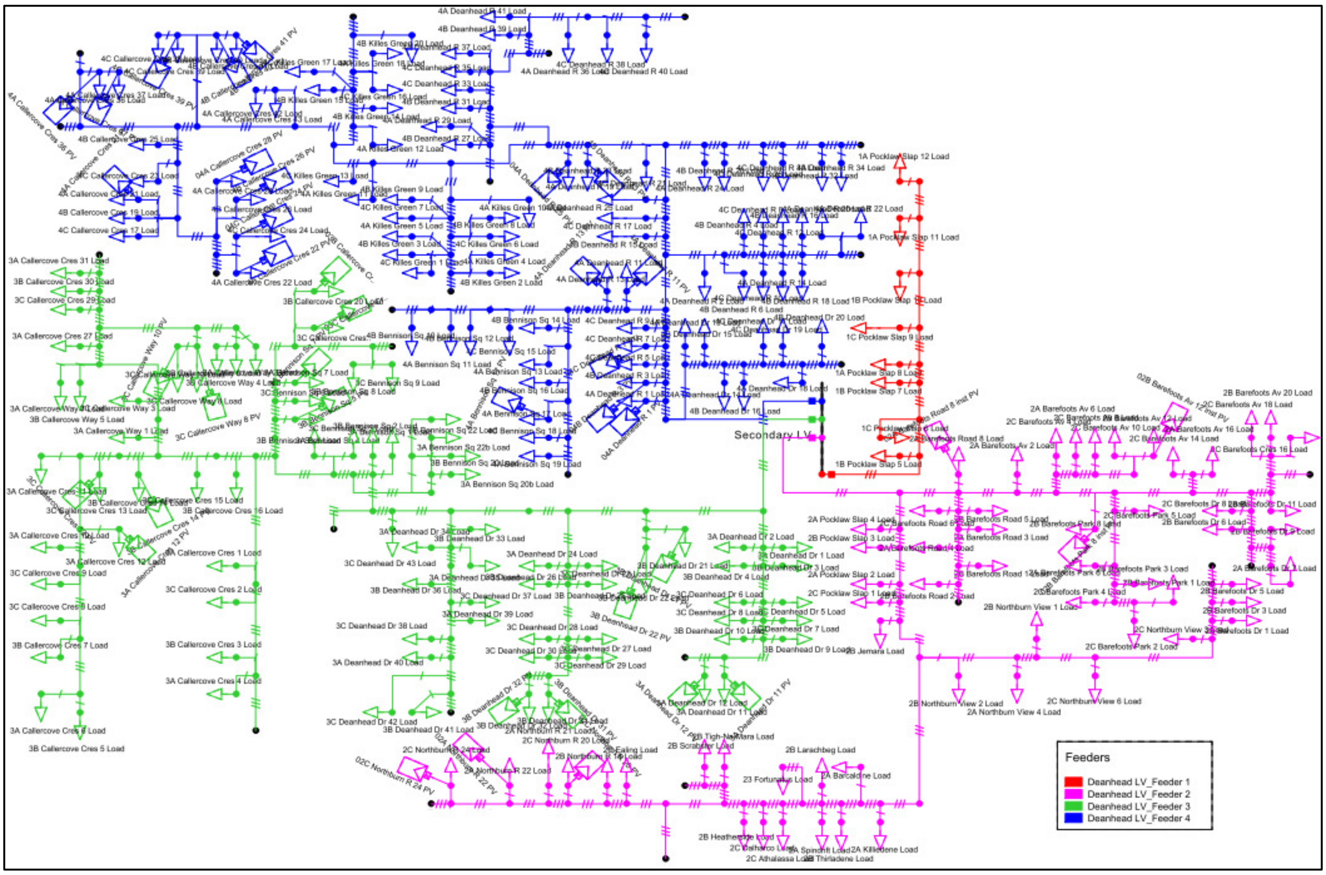

Figure 33: Deanhead LV PowerFactory model indicating LV feeders

There are in total 242 loads and 39 proposed and existing PV systems. These are summarized in Table 48 and shown in Figure 34.

Load		PV		Load		PV	
Feeder 1				Feeder 3			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	3	Red (A)	0	Red (A)	26	Red (A)	4
Yellow (B)	3	Yellow (B)	0	Yellow (B)	28	Yellow (B)	7
Blue (C)	2	Blue (C)	0	Blue (C)	25	Blue (C)	4
Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	0
Total	**8**	**Total**	**0**	**Total**	**79**	**Total**	**15**
Feeder 2				Feeder 4			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	16	Red (A)	2	Red (A)	35	Red (A)	10
Yellow (B)	24	Yellow (B)	2	Yellow (B)	31	Yellow (B)	5
Blue (C)	19	Blue (C)	2	Blue (C)	29	Blue (C)	3
Black (3-phase)	1	Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	0
Total	**60**	**Total**	**6**	**Total**	**95**	**Total**	**18**

Table 48: Summary of LV loads and PV systems included in Deanhead LV PowerFactory model

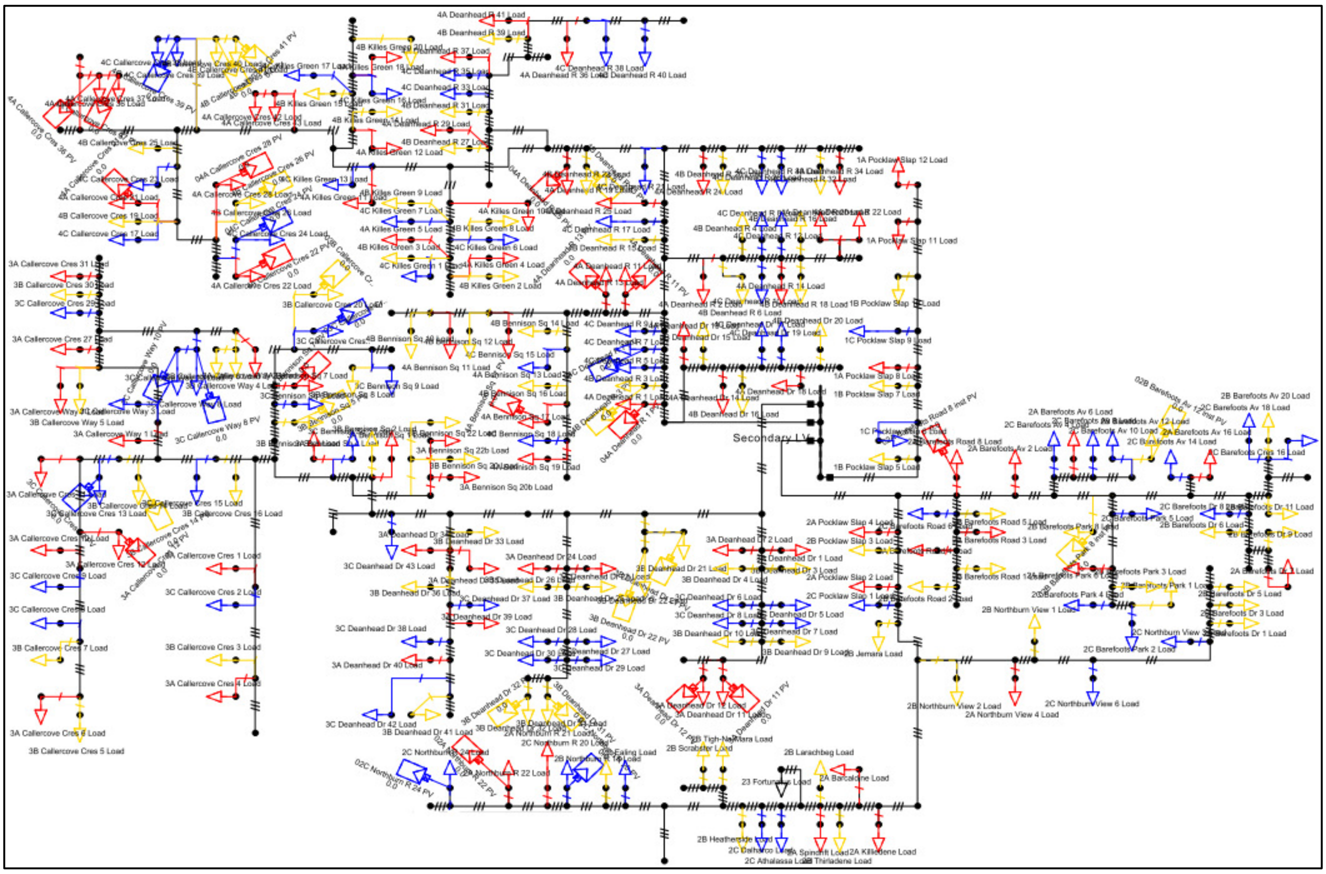

Figure 34: Deanhead LV PowerFactory model indicating LV phasing

A 2.7 Dovecote

A 2.7.1 11kV model

The 11kV PowerFactory model associated with Dovecote S/S is a simplification of the SPEN's circuit 131/16 that Dovecote is connected to and it has been matched as closely as possible to the SPEN's GIS information available on the design of the feeder.

Figure 35 shows the developed 11kV model of Dovecote S/S, where Dovecote is a secondary substation with LV transformer. It is connected to the same feeder as Buss Craig and Gunsgreenhill and fed from Eyemouth primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.3MVA.

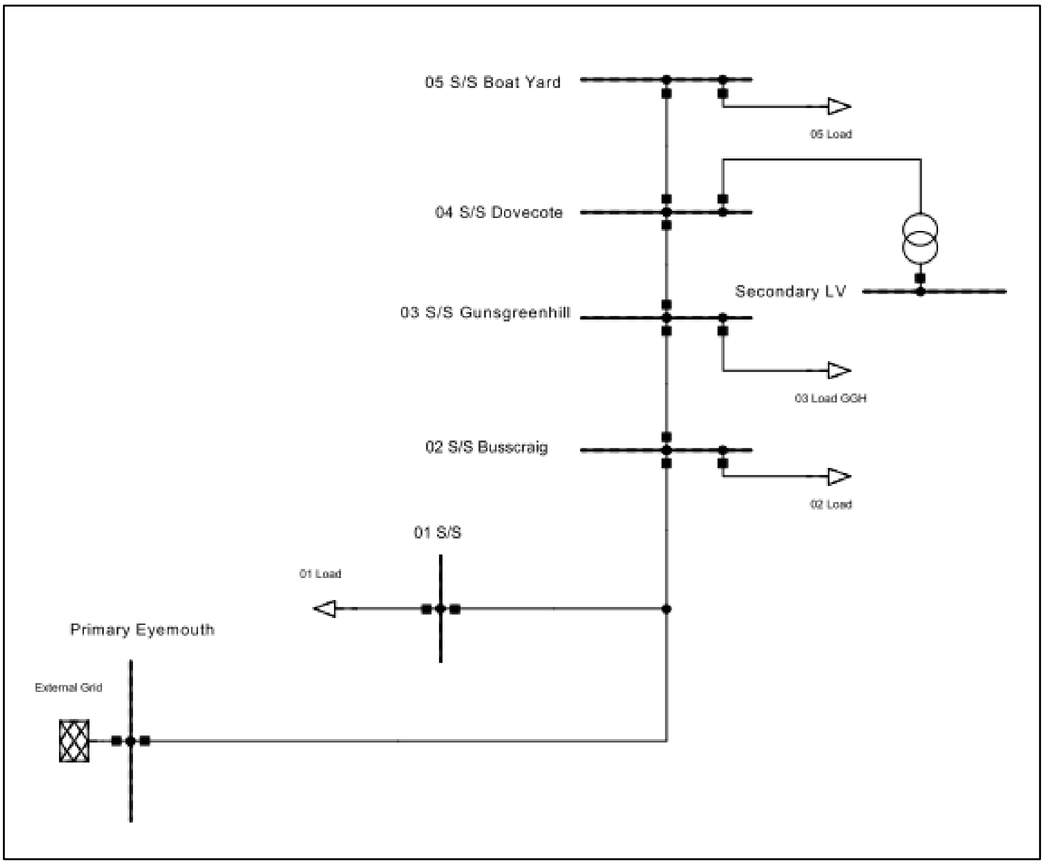

Figure 35: Dovecote 11kV PowerFactory model

Table 49 summarizes substations included in the model with their associated loads.

Number	*Power Factory substation name*	*Substation load name*
	Primary Eyemouth	N/A
1.	01 S/S	01 Load
2.	02 S/S Buss Craig	02 Load
3.	03 S/S Gunsgreenhill	02 Load GGH
4.	04 S/S Dovecote	N/A (LV extension)
5.	05 S/S Boat Yard	05 Load

Table 49: Summary of secondary substations included in 11kV Dovecote PowerFactory model

A 2.7.2 LV model

Dovecote 3-phase LV network consists of three LV feeders shown in Figure 36.

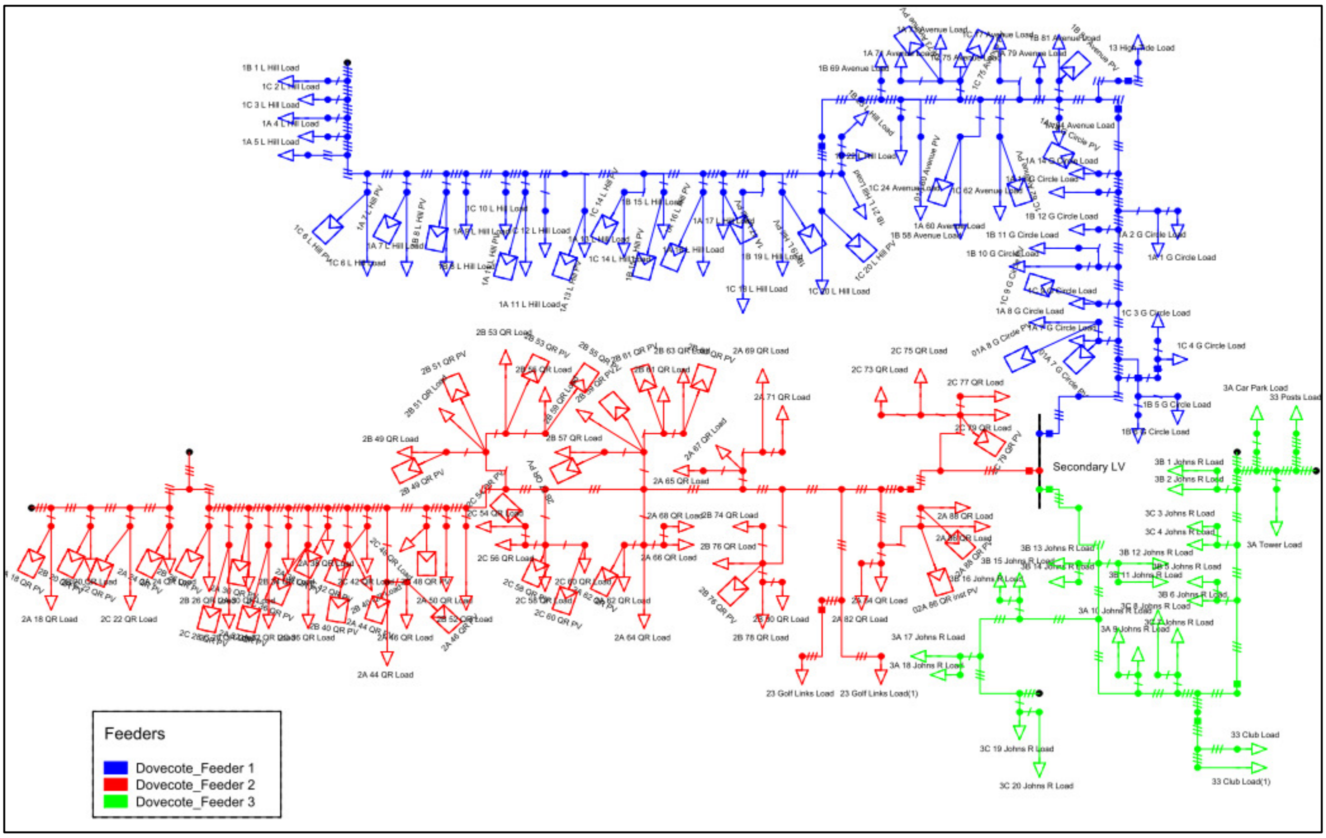

Figure 36: Dovecote LV PowerFactory model indicating LV feeders

There are in total 127 loads and 51 proposed and existing PV systems. These are summarized in Table 50 and shown in Figure 37.

Load		PV	
Feeder 1			
Phase	Number	Phase	Number
Red (A)	19	Red (A)	10
Yellow (B)	15	Yellow (B)	4
Blue (C)	15	Blue (C)	6
Black (3-phase)	1	Black (3-phase)	0
Total	**50**	**Total**	**20**
Feeder 2			
Phase	Number	Phase	Number
Red (A)	20	Red (A)	10
Yellow (B)	17	Yellow (B)	12
Blue (C)	13	Blue (C)	9
Black (3-phase)	2	Black (3-phase)	0
Total	**52**	**Total**	**31**
Feeder 3			
Phase	Number	Phase	Number
Red (A)	6	Red (A)	0
Yellow (B)	10	Yellow (B)	0
Blue (C)	6	Blue (C)	0
Black (3-phase)	3	Black (3-phase)	0
Total	**25**	**Total**	**0**

Table 50: Summary of LV loads and PV systems included in Dovecote LV PowerFactory model

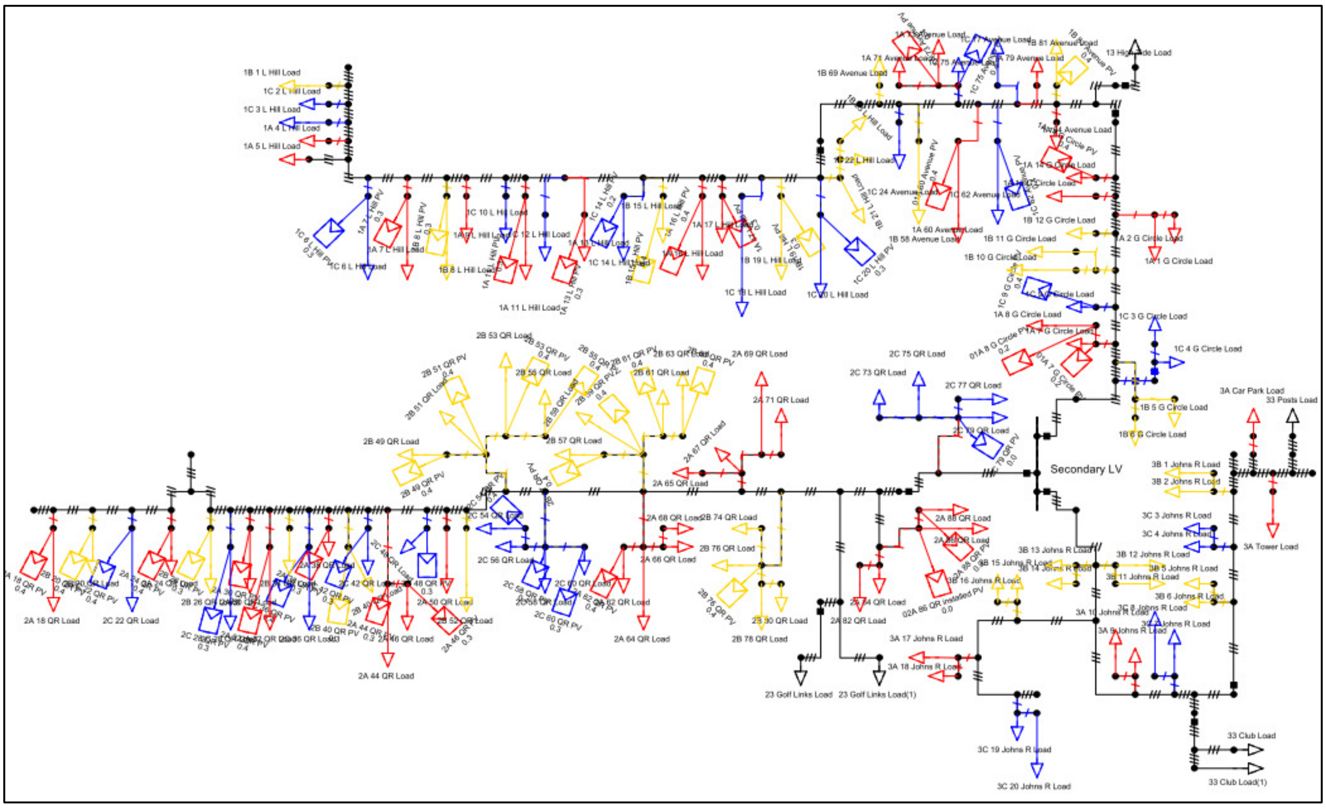

Figure 37: Dovecote LV PowerFactory model indicating LV phasing

A 2.8 Dulcecraig

A 2.8.1 11kV model

The 11kV PowerFactory model associated with Dulcecraig S/S is a simplification of the SPEN's circuit 131/14 that Dulcecraig is connected to and it has been matched as closely as possible to the SPEN's GIS information available on the design of the feeder.

Figure 38 shows the developed 11kV model of Dulcecraig S/S, where Dulcecraig is a secondary substation with LV transformer. It is connected to the same feeder as Deanhead and fed from Eyemouth primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.5MVA.

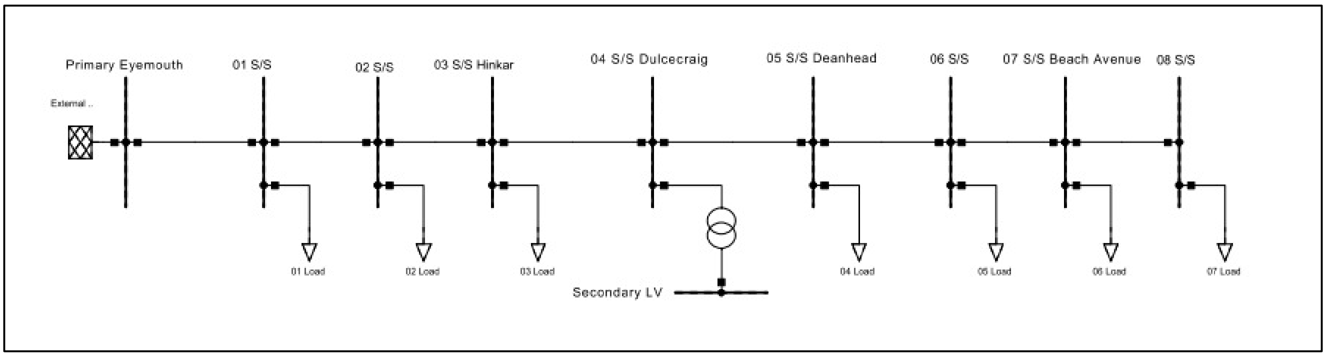

Figure 38: Dulcecraig 11kV PowerFactory model

Table 51 summarizes substations included in the model with their associated loads.

Number	Power Factory substation name	Substation load name
	Primary Eyemouth	N/A
1.	01 S/S	01 Load
2.	02 S/S	02 Load
3.	03 S/S Hinkar	03 Load
4.	04 S/S Dulcecraig	N/A (LV extension)
5.	05 S/S Deanhead	04 Load
6.	06 S/S	05 Load
7.	07 S/S Beach Avenue	06 Load
8.	08 S/S	07 Load

Table 51: Summary of secondary substations included in 11kV Dulcecraig PowerFactory model

A 2.8.2 LV model

Dulcecraig 3-phase LV network consists of three LV feeders shown in Figure 39.

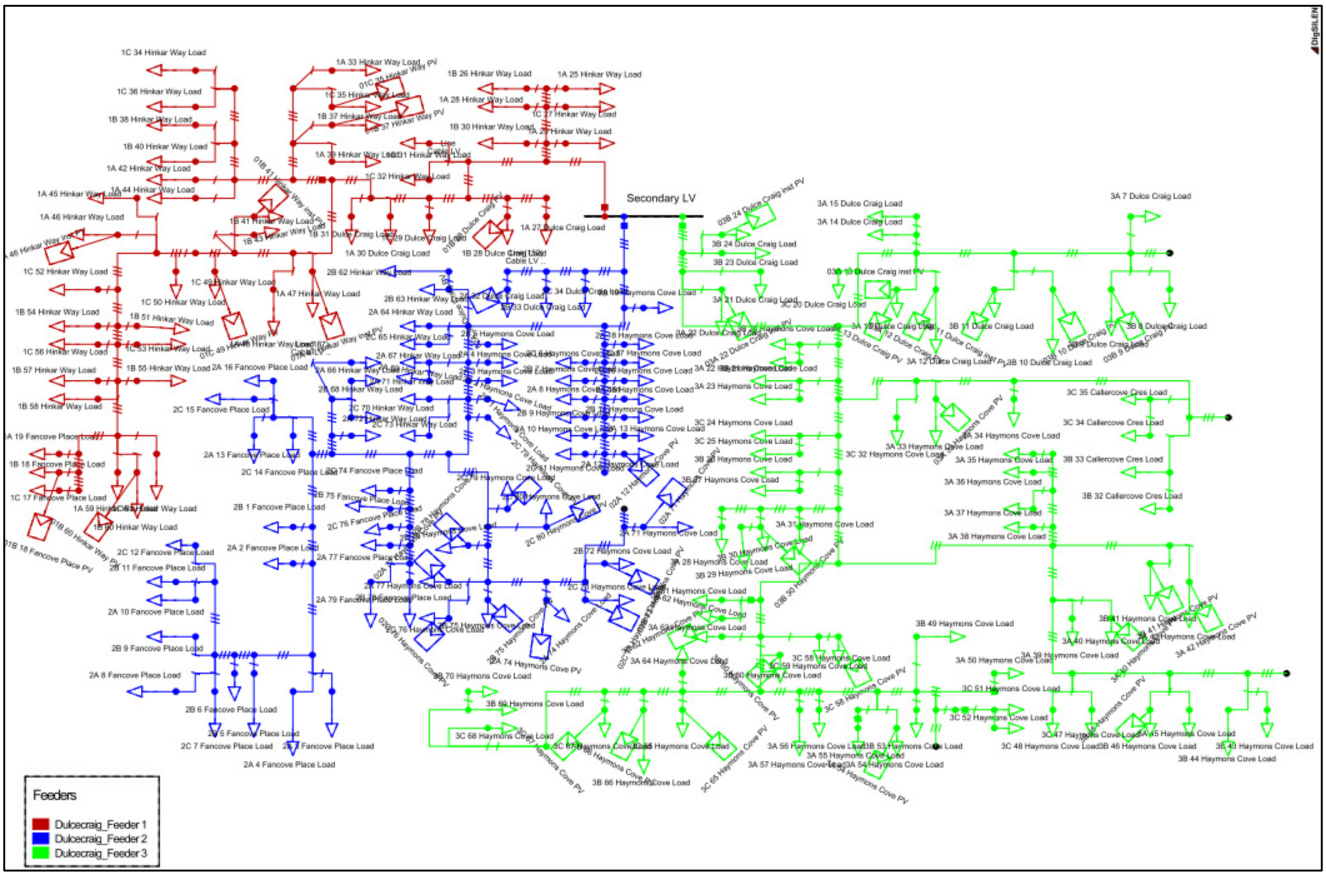

Figure 39: Dulcecraig LV PowerFactory model indicating LV feeders

There are in total 180 loads and 42 proposed and existing PV systems. These are summarized in Table 52 and shown in Figure 40.

Load		PV	
Feeder 1			
Phase	Number	Phase	Number
Red (A)	15	Red (A)	2
Yellow (B)	16	Yellow (B)	5
Blue (C)	14	Blue (C)	2
Black (3-phase)	0	Black (3-phase)	0
Total	**45**	**Total**	**9**
Feeder 2			
Phase	Number	Phase	Number
Red (A)	28	Red (A)	5
Yellow (B)	20	Yellow (B)	3
Blue (C)	18	Blue (C)	4
Black (3-phase)	0	Black (3-phase)	0
Total	**66**	**Total**	**12**
Feeder 3			
Phase	Number	Phase	Number
Red (A)	28	Red (A)	8
Yellow (B)	25	Yellow (B)	10
Blue (C)	16	Blue (C)	3
Black (3-phase)	0	Black (3-phase)	0
Total	**69**	**Total**	**21**

Table 52: Summary of LV loads and PV systems included in Dulcecraig LV PowerFactory model

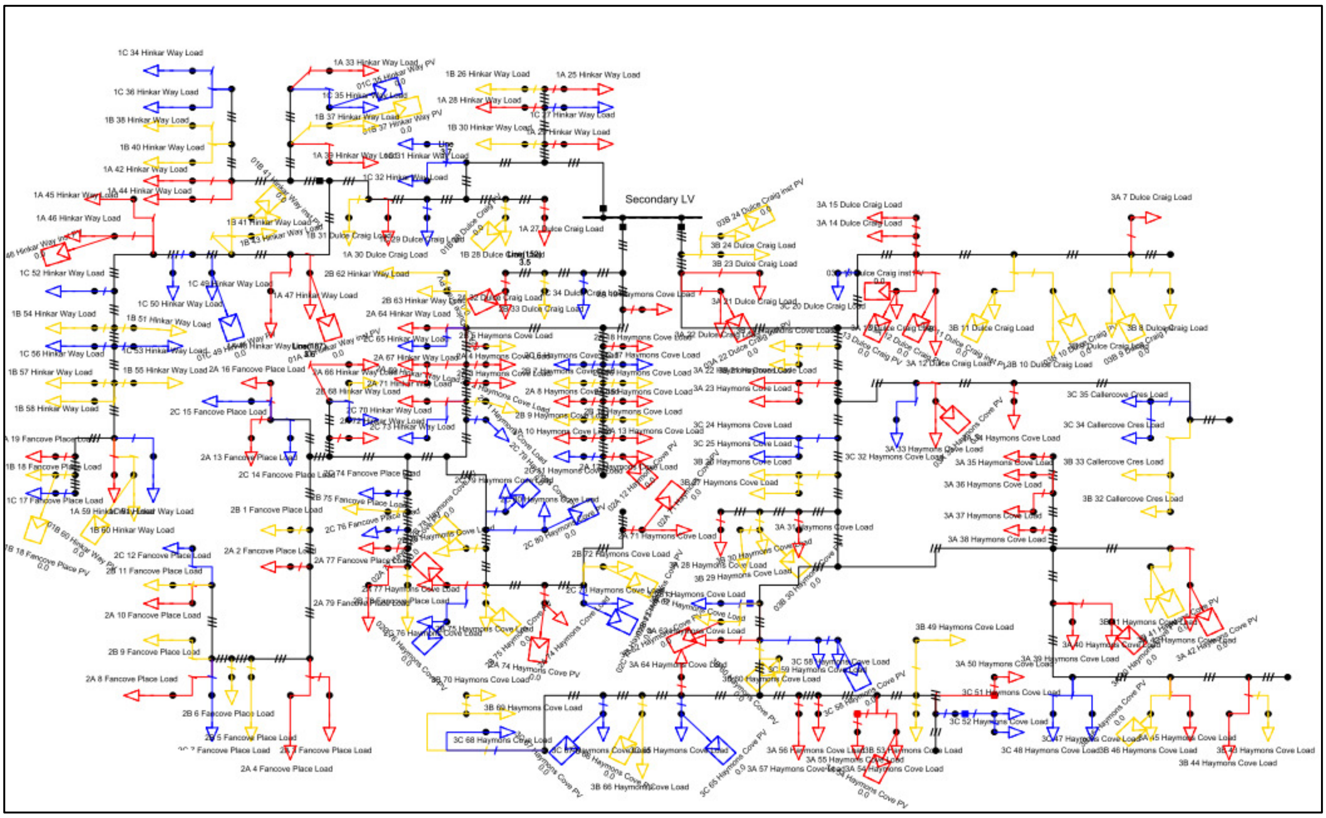

Figure 40: Dulcecraig LV PowerFactory model indicating LV phasing

A 2.9 Grantshouse

A 2.9.1 11kV model

The 11kV PowerFactory model associated with Grantshouse S/S is a simplification of the SPEN's circuit 120/21 that Grantshouse is connected to and it has been matched as closely as possible to the information available on the design of the feeder. The developed model is based on the PowerFactory model, provided by SPEN, of 11kV circuit 120/21 fed from Ayton primary, which is shown in Figure 41.

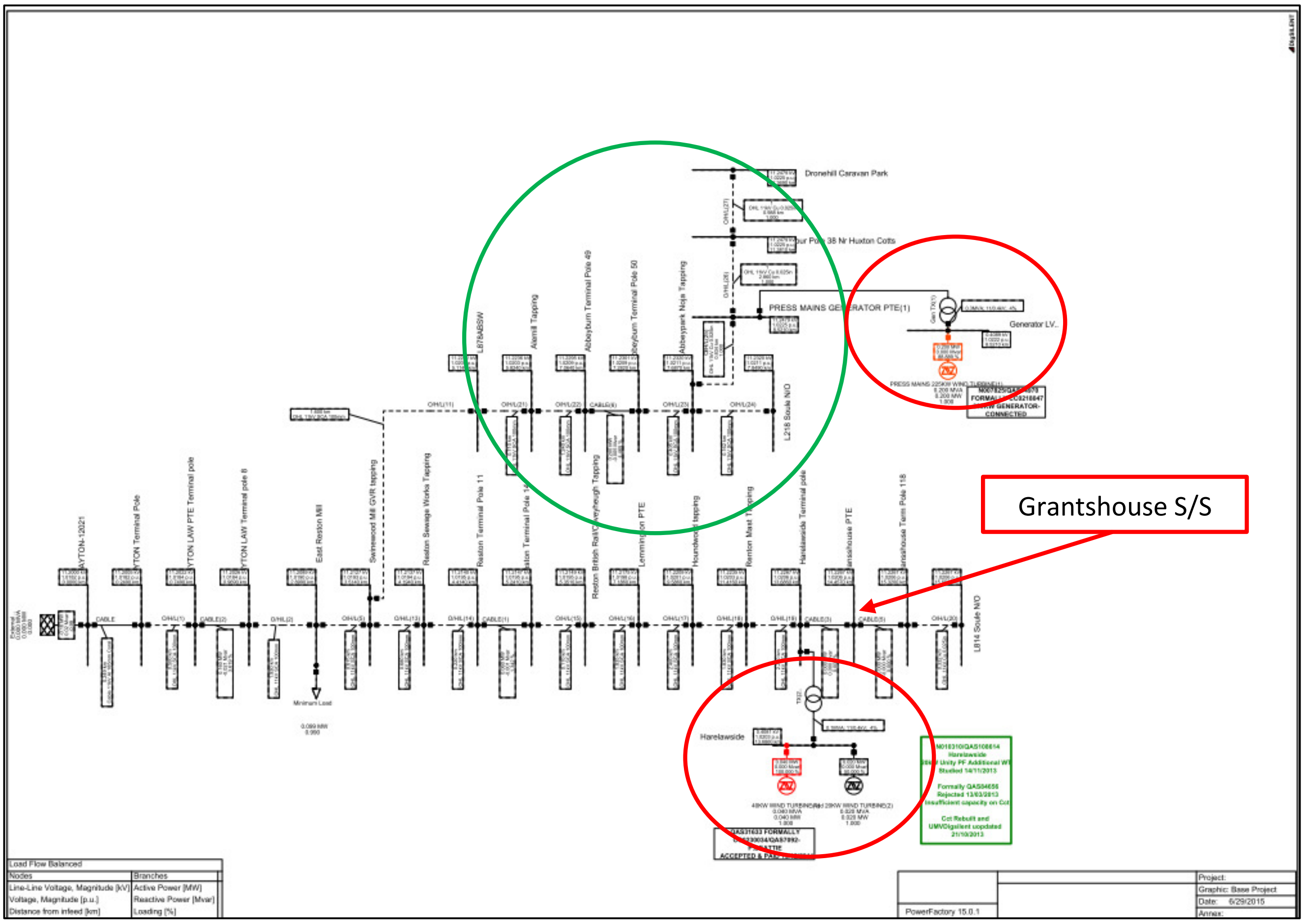

Figure 41: PowerFactory model of 11kV circuit 120/21 provided by SPEN

The SPEN model included the feeder itself, secondary subsations, annual minimum three-phase load for some of the substations taken directly off the 11kV busbars and the external grid acting as the swing bus connected to 11kV primary busbar. The initial model also included a number of distributed generators that were investigated in previous studies carried out by SPEN between 2012 and 2014, as indicated in Figure 41. These were not necessary for the purpose of this work and such they were removed from the model (red circles in Figure 41).

For simplification, few secondary substations were aggregated together and modelled as one substation (green circle in Figure 41). Additionaly, for the purpose of modelling and writing scripts, all substations were renamed in the PowerFactory model. Table 53 summarizes substations' name changes with their associated loads.

Number	Original substation name	Power Factory substation name	Substation load name
	Ayton-12021	Primary Ayton	N/A
1.	Ayton Terminal Pole	01 S/S	01 Load
2.	Ayton Law PTE Terminal pole	02 S/S	02 Load
3.	Ayton Law Terminal pole 8	03 S/S	03 Load
4.	East Reston Mill	04 S/S	04 Load
5.	Swinewood Mill GVR tapping	05 S/S	05 Load
6.	Reston Swage Works Tapping	06 S/S	06 Load
7.	Reston Terminal Pole 11	07 S/S	07 Load
8.	Reston Terminal Pole 14	08 S/S	08 Load
9.	Reston British Rail/Coveyheugh Tapping	09 S/S	09 Load
10.	Lemmington PTE	010 S/S	010 Load
11.	Houndwood tapping	011 S/S	011 Load
12.	Renton Mast tapping	012 S/S	012 Load
13.	Harelawside Terminal pole	013 S/S	013 Load
14.	Grantshouse PTE	014 S/S Grantshouse	N/A (LV extension)
15.	Grantshouse Term Pole 118	015 S/S	015 Load
16.	L814 Soule N/)	016 S/S	016 Load
17.	L878ABSW	017 S/S	017 Load

Table 53: Summary of secondary substations included in 11kV Grantshouse PowerFactory model

Figure 42 shows the final 11kV model of Grantshouse S/S, where Grantshouse is a secondary substation with LV transformer. It is fed from Ayton primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.2MVA.

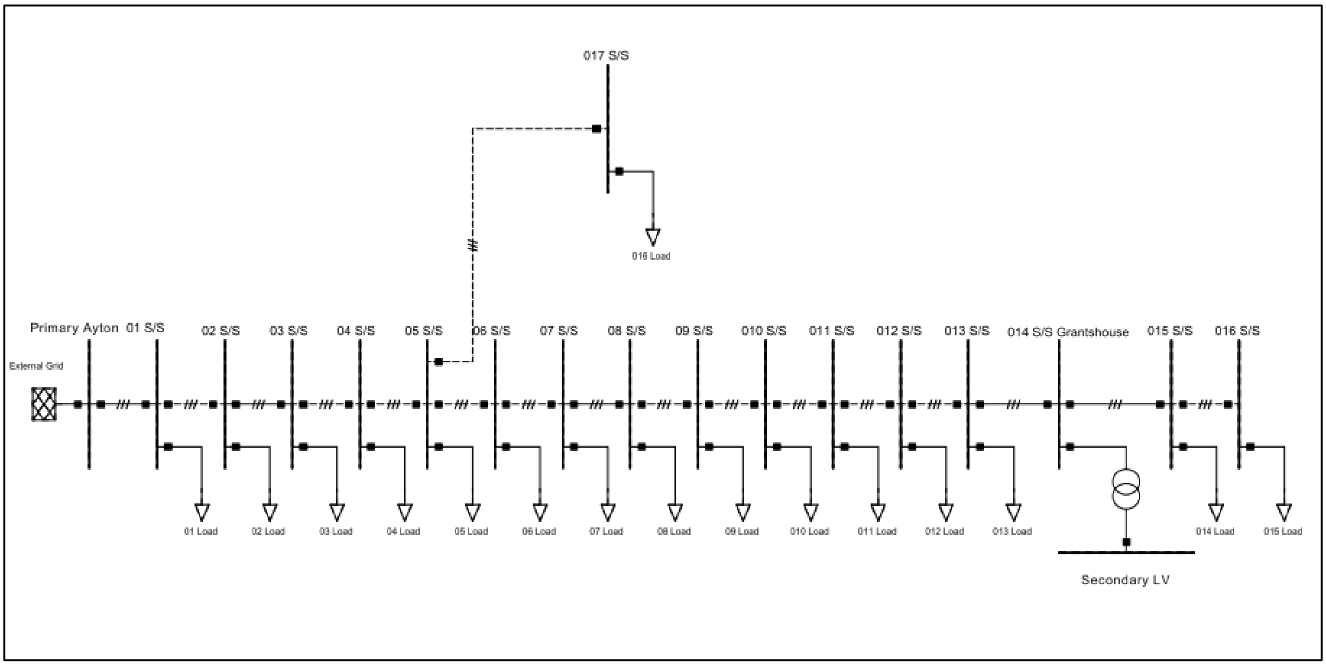

Figure 42: Grantshouse 11kV PowerFactory model

A 2.9.2 LV model

Grantshouse 3-phase LV network consists of two LV feeders shown in Figure 43.

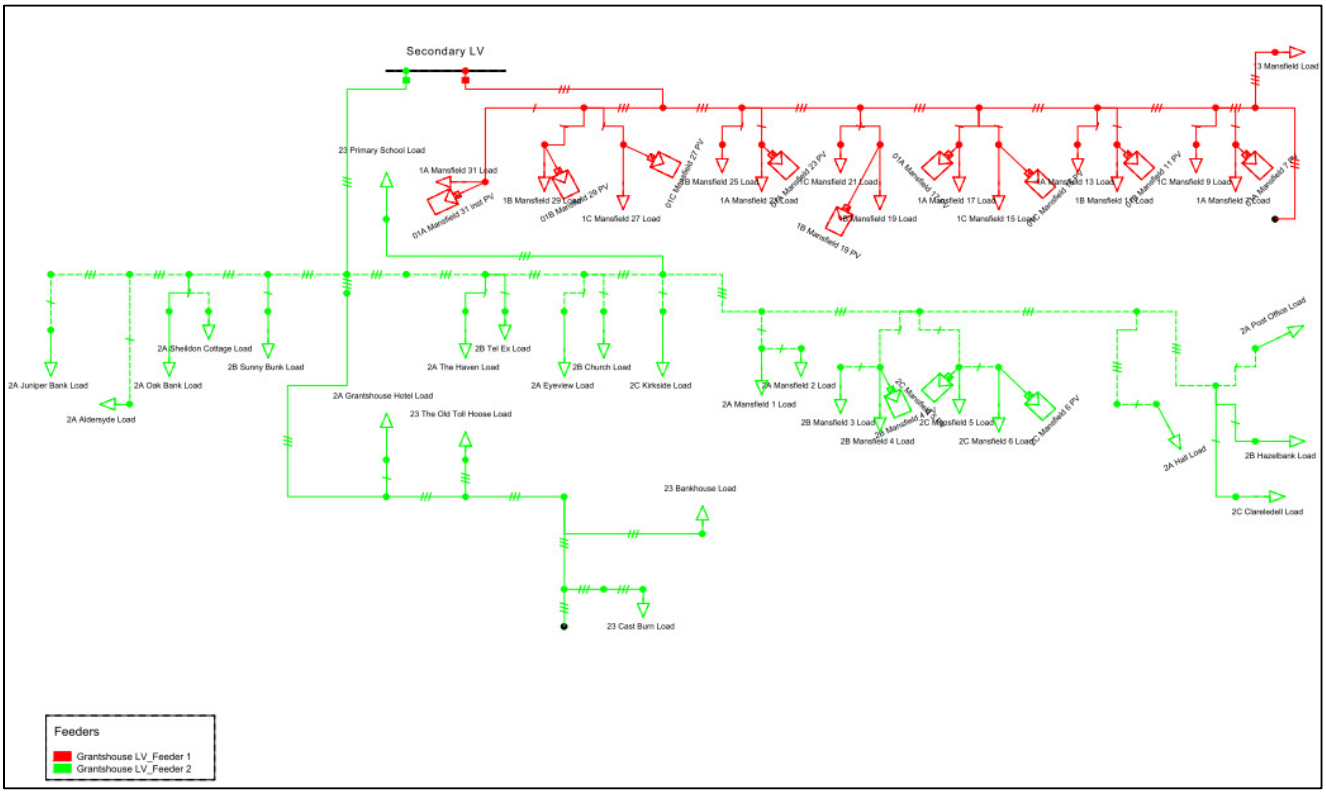

Figure 43: Grantshouse LV PowerFactory model indicating LV feeders

There are in total 39 loads and 12 proposed and existing PV systems. These are summarized in Table 54 and shown in Figure 44.

Load		**PV**	
Feeder 1			
Phase	Number	Phase	Number
Red (A)	5	Red (A)	4
Yellow (B)	4	Yellow (B)	3
Blue (C)	4	Blue (C)	2
Black (3-phase)	1	Black (3-phase)	0
Total	**14**	**Total**	**9**
Feeder 2			
Phase	Number	Phase	Number
Red (A)	11	Red (A)	0
Yellow (B)	6	Yellow (B)	1
Blue (C)	4	Blue (C)	2
Black (3-phase)	4	Black (3-phase)	0
Total	**25**	**Total**	**3**

Table 54: Summary of LV loads and PV systems included in Grantshouse LV PowerFactory model

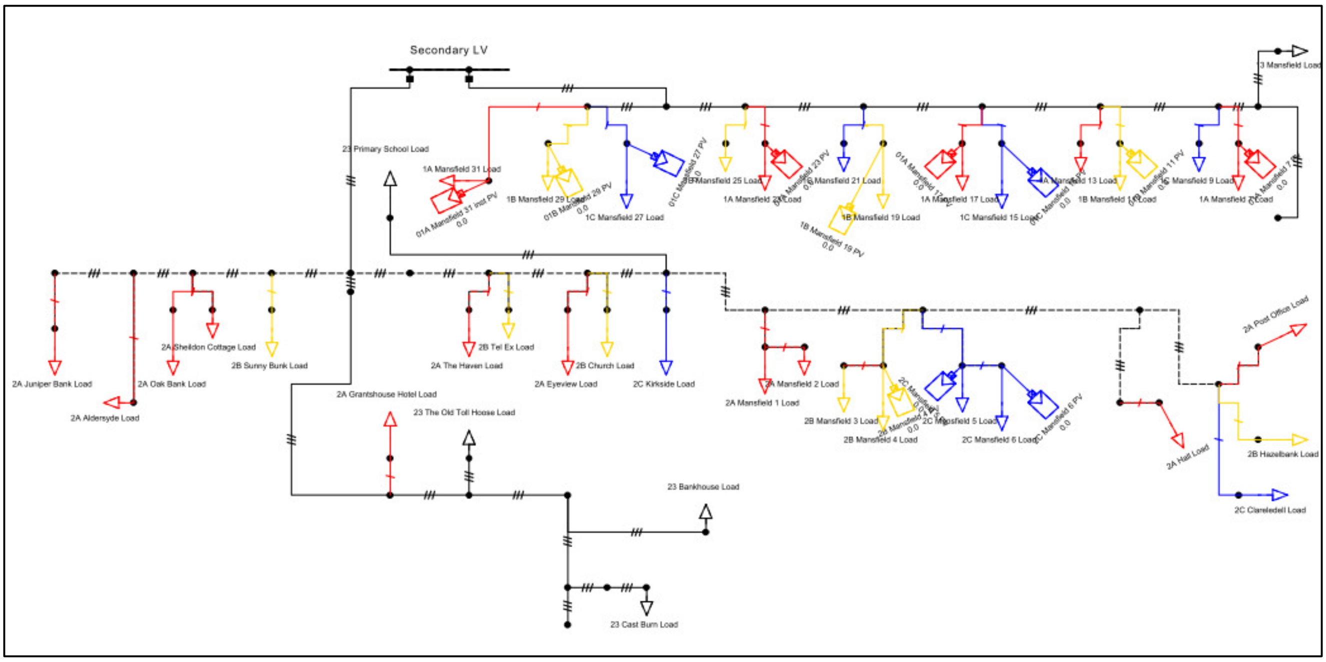

Figure 44: Grantshouse LV PowerFactory model indicating LV phasing

A 2.10 Gunsgreenhill

A 2.10.1 11kV model

The 11kV PowerFactory model associated with Gunsgreenhill S/S is a simplification of the SPEN's circuit 131/16 that Gunsgreenhill is connected to and it has been matched as closely as possible to the SPEN's GIS information available on the design of the feeder.

Figure 45 shows the developed 11kV model of Gunsgreenhill S/S, where Gunsgreenhill is a secondary substation with LV transformer. It is connected to the same feeder as Dovecote and Buss Craig and fed from Eyemouth primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.3MVA.

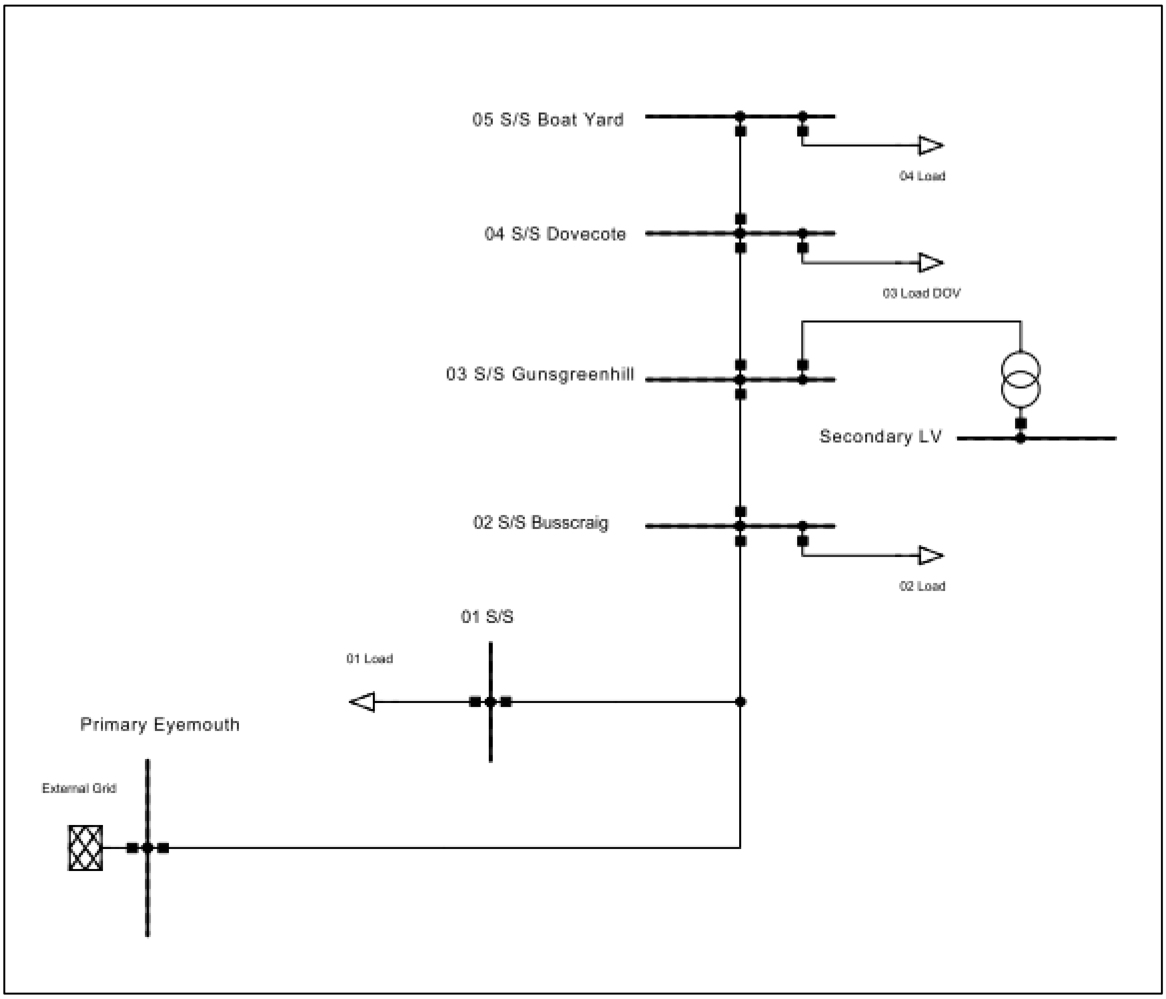

Figure 45: Gunsgreenhill 11kV PowerFactory model

Table 55 summarizes substations included in the model with their associated loads.

Number	Power Factory substation name	Substation load name
	Primary Eyemouth	N/A
1.	01 S/S	01 Load
2.	02 S/S Buss Craig	02 Load
3.	03 S/S Gunsgreenhill	N/A (LV extension)
4.	04 S/S Dovecote	03 Load DOV
5.	05 S/S Boat Yard	05 Load

Table 55: Summary of secondary substations included in 11kV Gunsgreenhill PowerFactory model

A 2.10.2 LV model

Gunsgreenhill 3-phase LV network consists of four LV feeders shown in Figure 46.

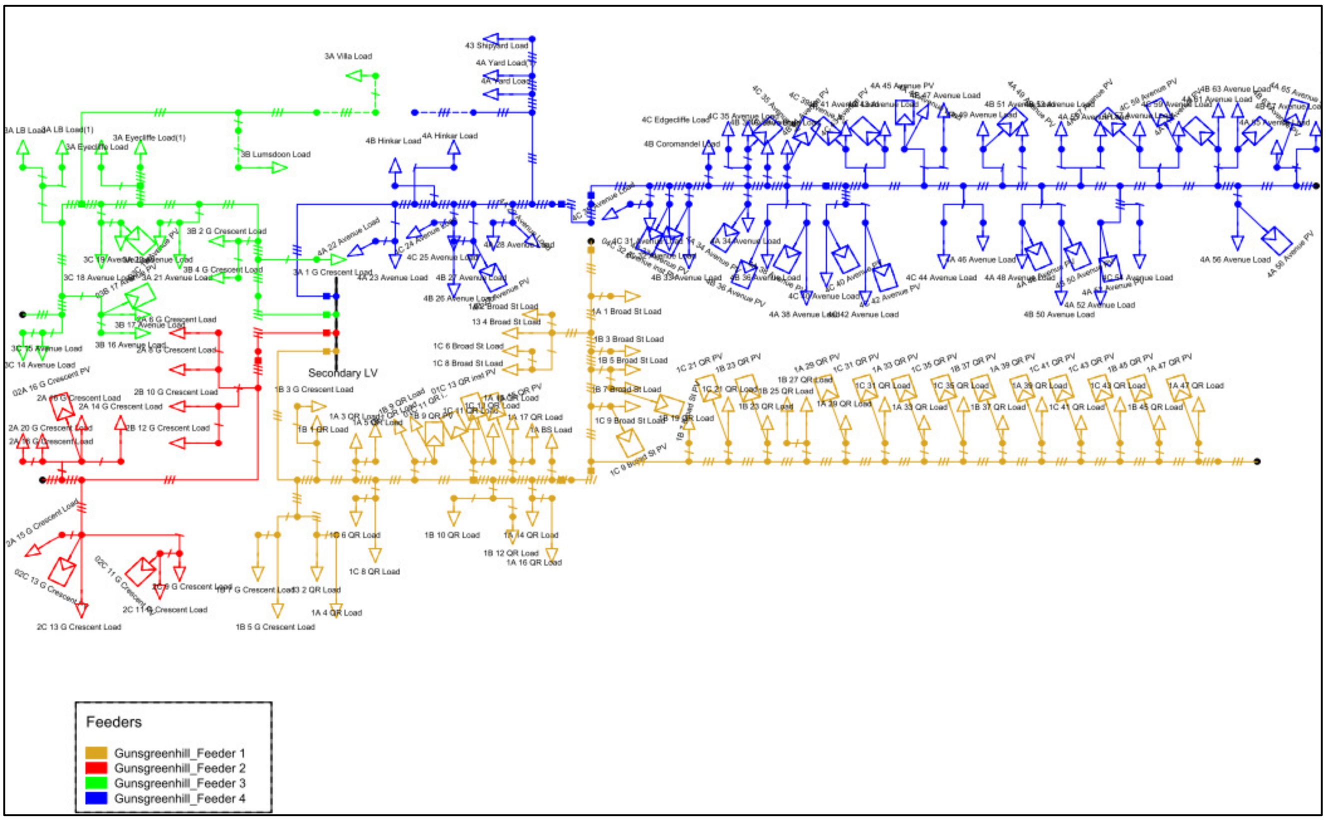

Figure 46: Gunsgreenhill LV PowerFactory model indicating LV feeders

There are in total 121 loads and 46 proposed and existing PV systems. These are summarized in Table 56 and shown in Figure 47.

Load		PV		Load		PV	
Feeder 1				Feeder 3			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	14	Red (A)	5	Red (A)	7	Red (A)	0
Yellow (B)	17	Yellow (B)	5	Yellow (B)	5	Yellow (B)	1
Blue (C)	12	Blue (C)	8	Blue (C)	4	Blue (C)	1
Black (3-phase)	2	Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	0
Total	**45**	**Total**	**18**	**Total**	**16**	**Total**	**2**
Feeder 2				Feeder 4			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	7	Red (A)	1	Red (A)	19	Red (A)	10
Yellow (B)	2	Yellow (B)	0	Yellow (B)	14	Yellow (B)	6
Blue (C)	3	Blue (C)	2	Blue (C)	14	Blue (C)	7
Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	1	Black (3-phase)	0
Total	**12**	**Total**	**3**	**Total**	**48**	**Total**	**23**

Table 56: Summary of LV loads and PV systems included in Gunsgreenhill LV PowerFactory model

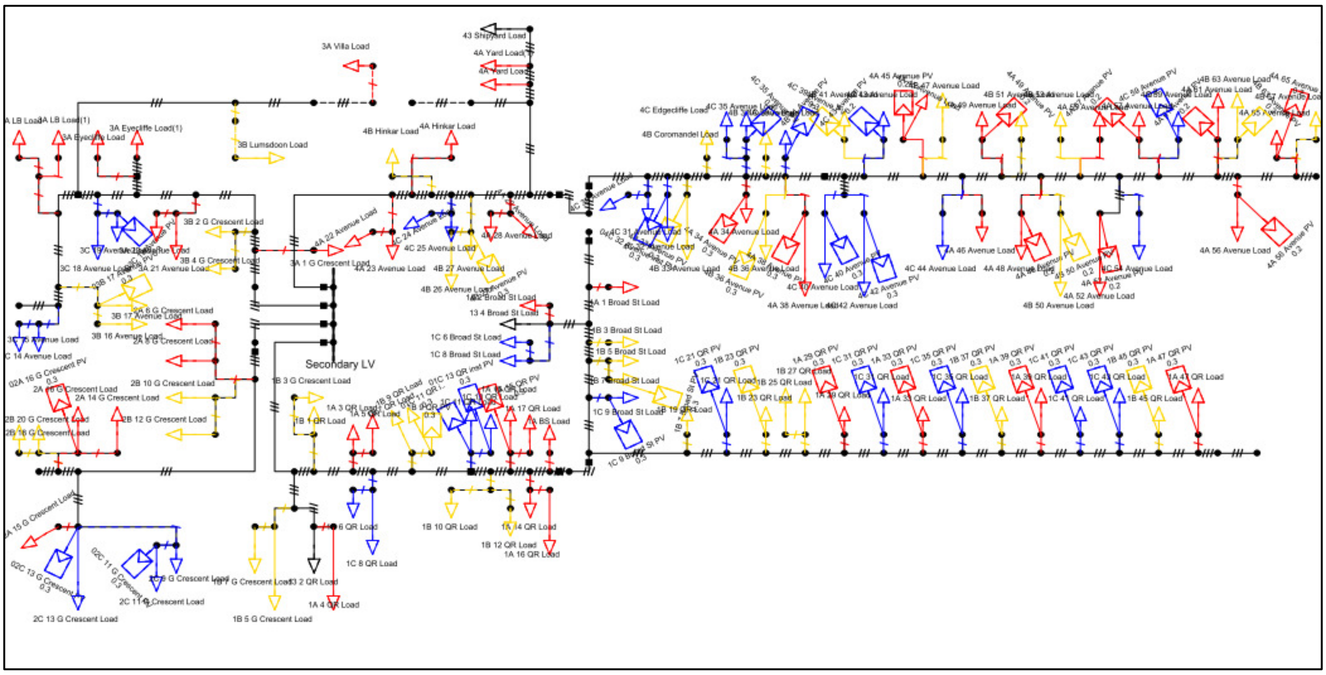

Figure 47: Gunsgreenhill LV PowerFactory model indicating LV phasing

A 2.11 Hawthorn Bank Duns

A 2.11.1 11kV model

The 11kV PowerFactory model associated with Hawthorn Bank Duns S/S is a simplification of the SPEN's circuit 114/12 that Hawthorn Bank Duns is connected to and it has been matched as closely as possible to the SPEN's GIS information available on the design of the feeder.

Figure 48 shows the developed 11kV model of Hawthorn Bank Duns S/S, where Hawthorn Bank Duns is a secondary substation with LV transformer. It is fed from Duns primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.5MVA.

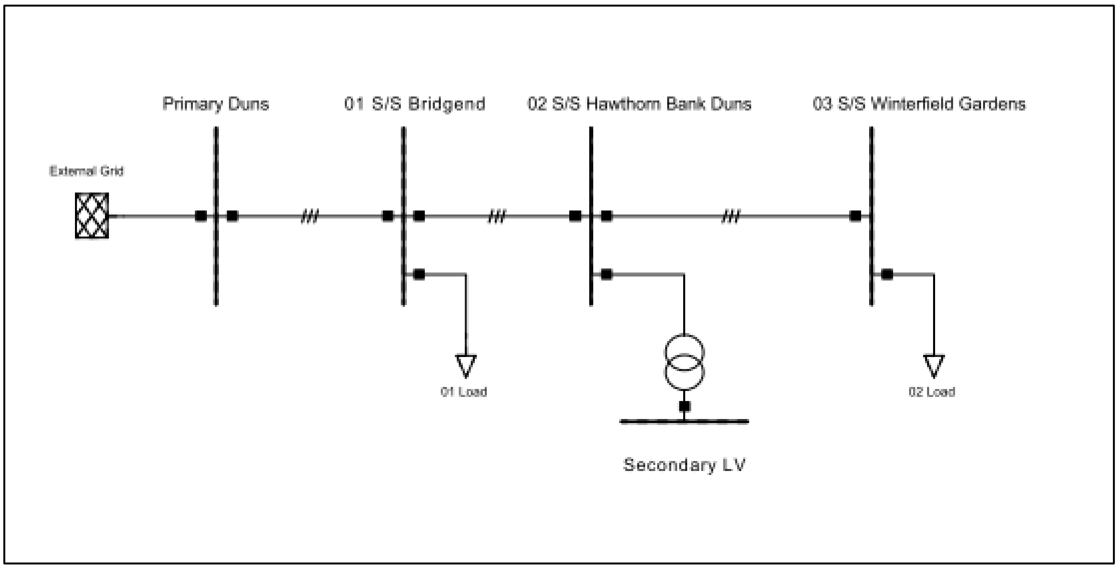

Figure 48: Hawthorn Bank Duns 11kV PowerFactory model

Table 57 summarizes substations included in the model with their associated loads.

Number	Power Factory substation name	Substation load name
	Primary Duns	N/A
1.	01 S/S Bridgend	01 Load
2.	02 S/S Hawthorn Bank Duns	N/A (LV extension)
3.	03 S/S Winterfield Gardens	02 Load

Table 57: Summary of secondary substations included in 11kV Hawthorn Bank Duns PowerFactory model

A 2.11.2 LV model

Hawthorn Bank Duns 3-phase LV network consists of three LV feeders shown in Figure 49.

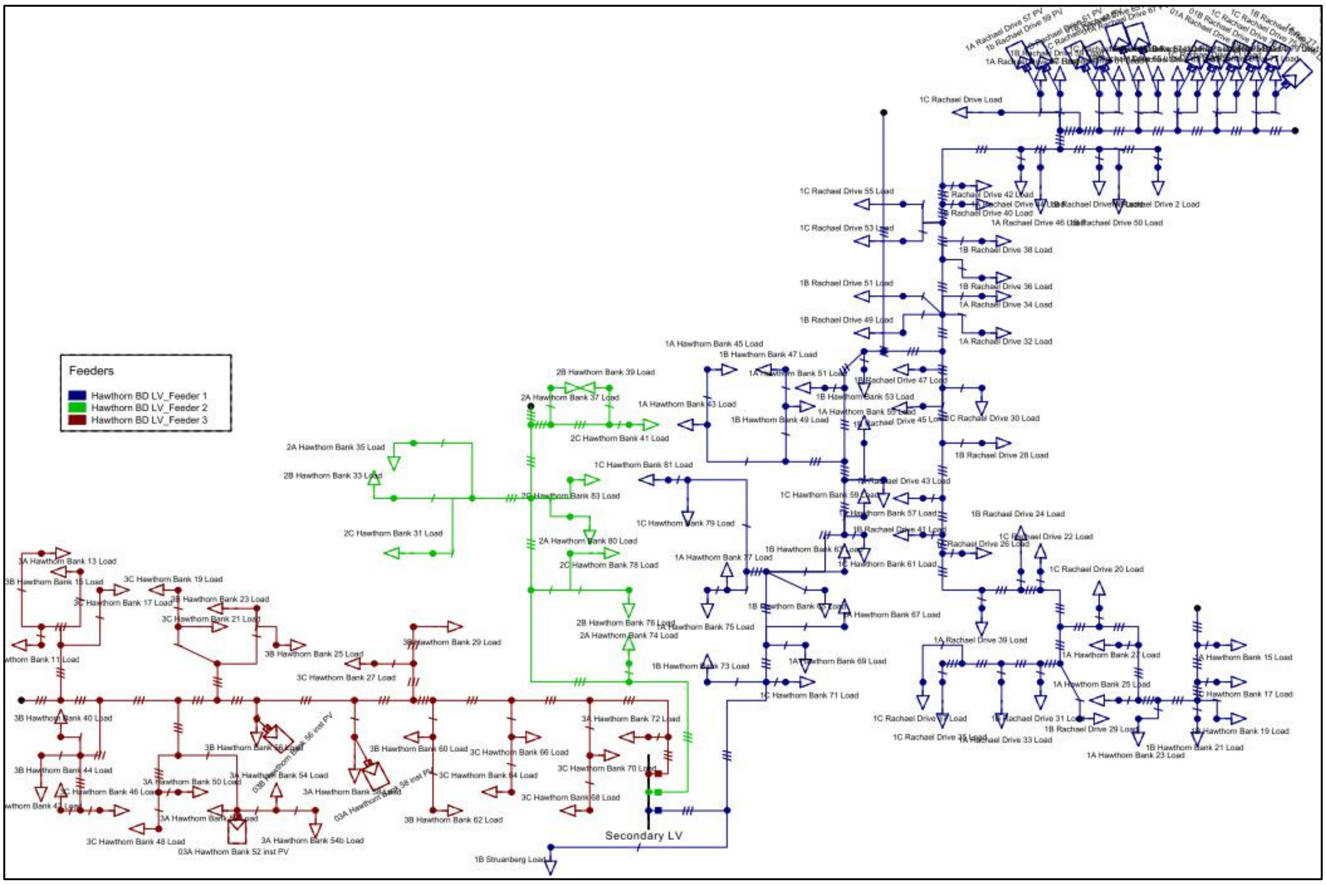

Figure 49: Hawthorn Bank Duns LV PowerFactory model indicating LV feeders

There are in total 111 loads and 15 proposed and existing PV systems. These are summarized in Table 58 and shown in Figure 50.

Load		PV	
Feeder 2			
Phase	Number	Phase	Number
Red (A)	26	Red (A)	4
Yellow (B)	27	Yellow (B)	4
Blue (C)	19	Blue (C)	4
Black (3-phase)	72	Black (3-phase)	0
Total		**Total**	**12**
Feeder 3			
Phase	Number	Phase	Number
Red (A)	4	Red (A)	0
Yellow (B)	3	Yellow (B)	0
Blue (C)	4	Blue (C)	0
Black (3-phase)	0	Black (3-phase)	0
Total	**11**	**Total**	**0**
Feeder 4			
Phase	Number	Phase	Number
Red (A)	7	Red (A)	2
Yellow (B)	9	Yellow (B)	1
Blue (C)	12	Blue (C)	0
Black (3-phase)	0	Black (3-phase)	0
Total	**28**	**Total**	**3**

Table 58: Summary of LV loads and PV systems included in Hawthorn Bank Duns LV PowerFactory model

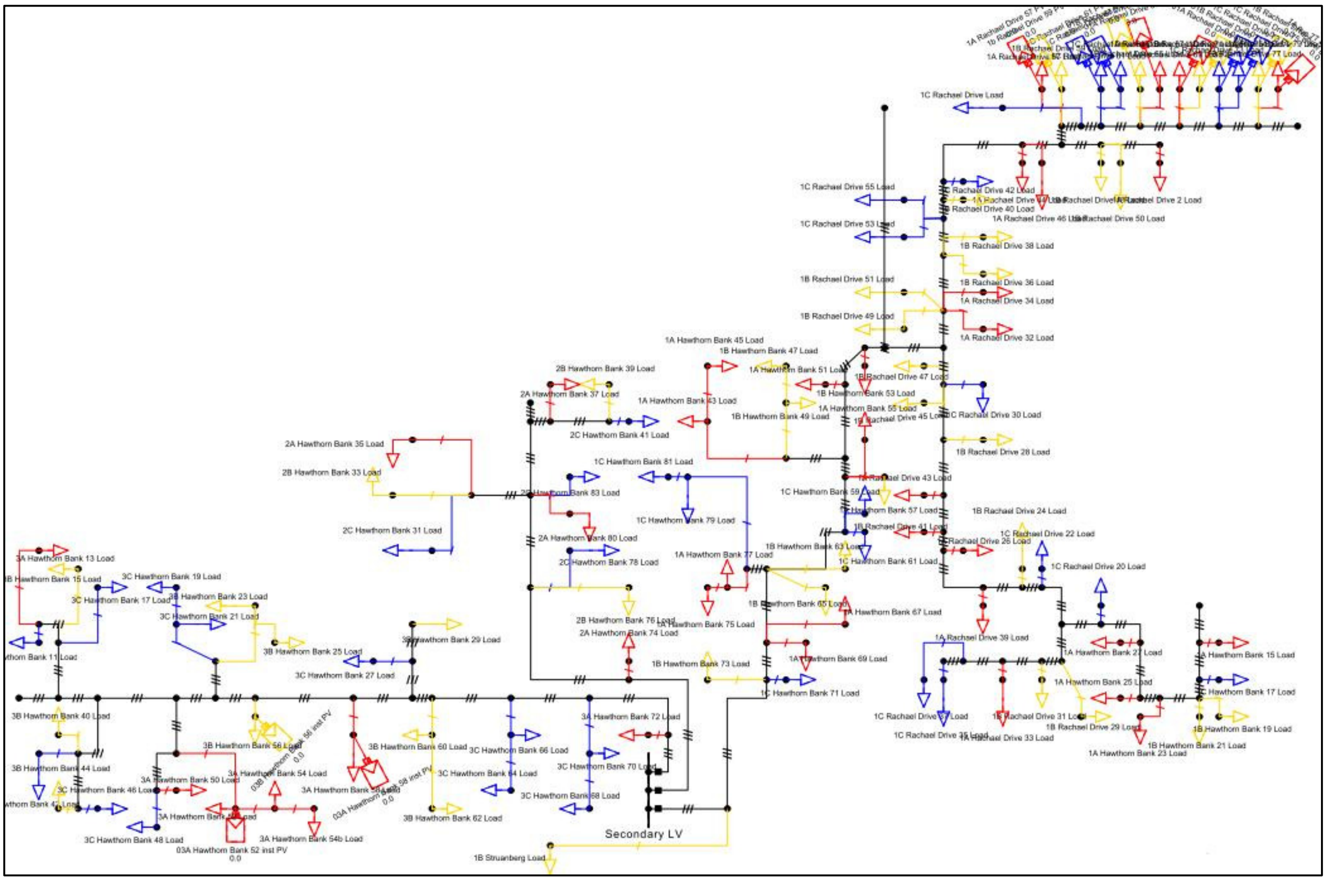

Figure 50: Hawthorn Bank Duns LV PowerFactory model indicating LV phasing

A 2.12 Hoprig Road

A 2.12.1 11kV model

The 11kV PowerFactory model associated with Hoprig Road S/S is a simplification of the SPEN's circuit 344/24 that Hoprig Road is connected to and it has been matched as closely as possible to the information available on the design of the feeder. The developed model is based on the PowerFactory model, provided by SPEN, of 11kV circuit 344/24 fed from Torness primary, which is shown in Figure 51.

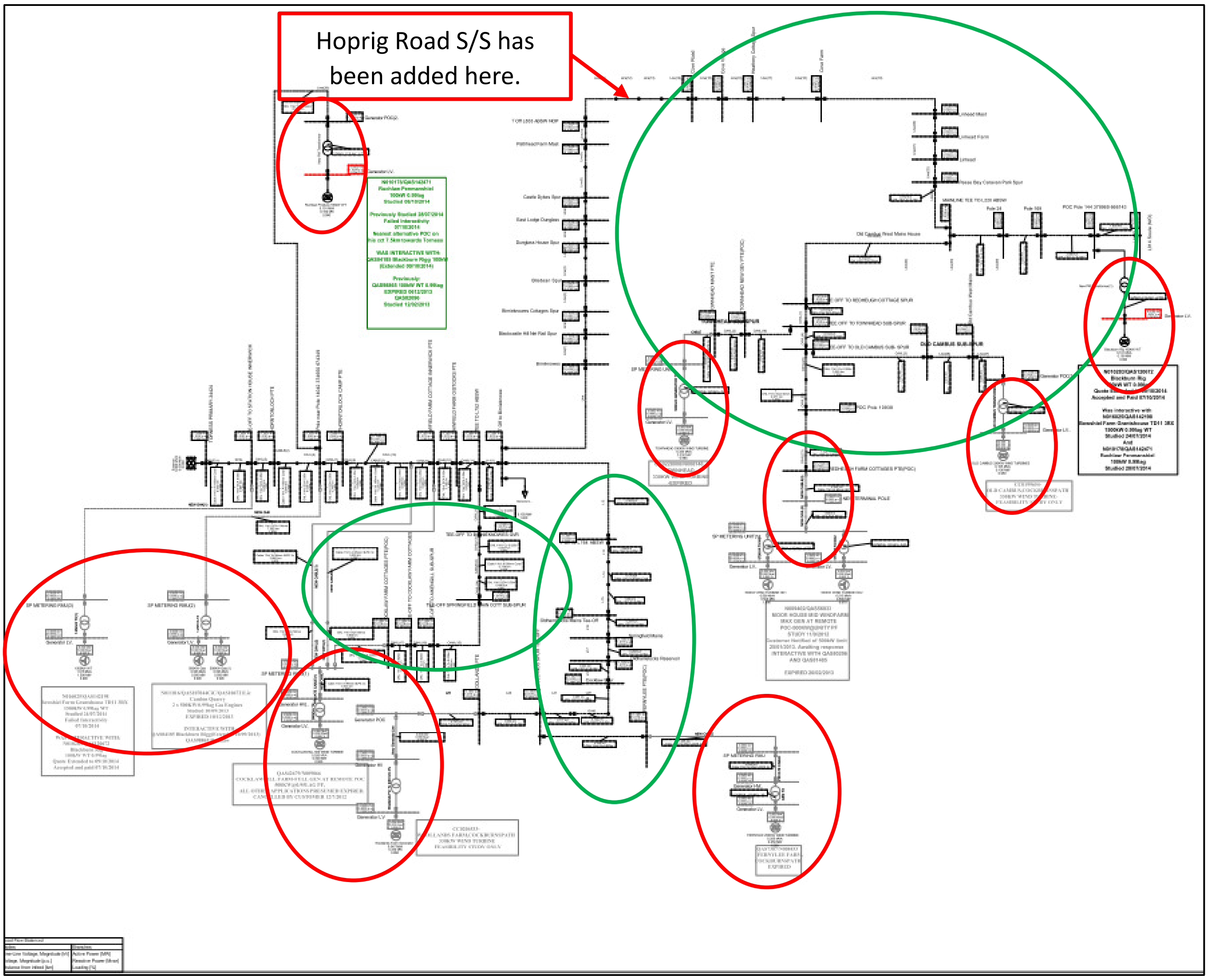

Figure 51: PowerFactory model of 11kV circuit 344/24 provided by SPEN

The SPEN model included the feeder itself, secondary subsations, annual minimum three-phase load for some of the substations taken directly off the 11kV busbars and the external grid acting as the swing bus connected to 11kV primary busbar. The initial model also included a number of distributed generators that were investigated in previous studies carried out by SPEN (dated in 2012 and 2015, as indicated in Figure 51). These were not necessary for the purpose of this work and such they were removed from the model (red circles in Figure 51).

Since Hoprig Road was not included in the original PowerFactory model, additional substation representing Hoprig Road has been added based on SPEN's GIS data, as shown in Figure 51. For simplification, few secondary substations were aggregated together and modelled as one substation (green circles in Figure 51). Additionaly, for the purpose of modelling and writing scripts, all substations were renamed in the PowerFactory model. Table 59 summarizes substations' name changes with their associated loads.

Number	***Original substation name***	***Power Factory substation name***	***Substation load name***
	Torness Primary-34424	Primary Torness	N/A
1.	Off to station House Innerwick	01 S/S	01 Load
2.	Horntonloch PTE	02 S/S	02 Load
3.	Pole near Pole	03 S/S	03 Load
4.	Camp PTE	04 S/S	04 Load
5.	Lawfield Farm Cottage Innerwick PTE	05 S/S	05 Load
6.	Lawfield Farm O/Stocks PTE	06 S/S	06 Load
7.	Tee to L752 ABSW	07 S/S	07 Load
8.	Off to Birnieknowe	08 S/S	08 Load
9.	L764 ABSW	09 S/S	09 Load
10.	Birniknowes	010 S/S	010 Load
11.	Blackcastle Hill Net Rail Spur	011 S/S	011 Load
12.	Birnieknowes Cottages Spur	012 S/S	012 Load
13.	Bilsdean Spur	013 S/S	013 Load
14.	Dunglass House Spur	014 S/S	014 Load
15.	East Lodge Dunglass	015 S/S	015 Load
16.	Castle Dykes SPur	016 S/S	016 Load
17.	Pathhead Farm Mast	017 S/S	017 Load
18.	T Off L833 ABSW NOP	018 S/S	018 Load
19.	N/A	019 S/S Hoprig Road	N/A (LV extension)
20.	Cove Road	020 S/S	019 Load

Table 59: Summary of secondary substations included in 11kV Hoprig Road PowerFactory model

Figure 52 shows the final 11kV model of Hoprig Road S/S, where Hoprig Road is a secondary substation with LV transformer. It is fed from Torness primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.5MVA.

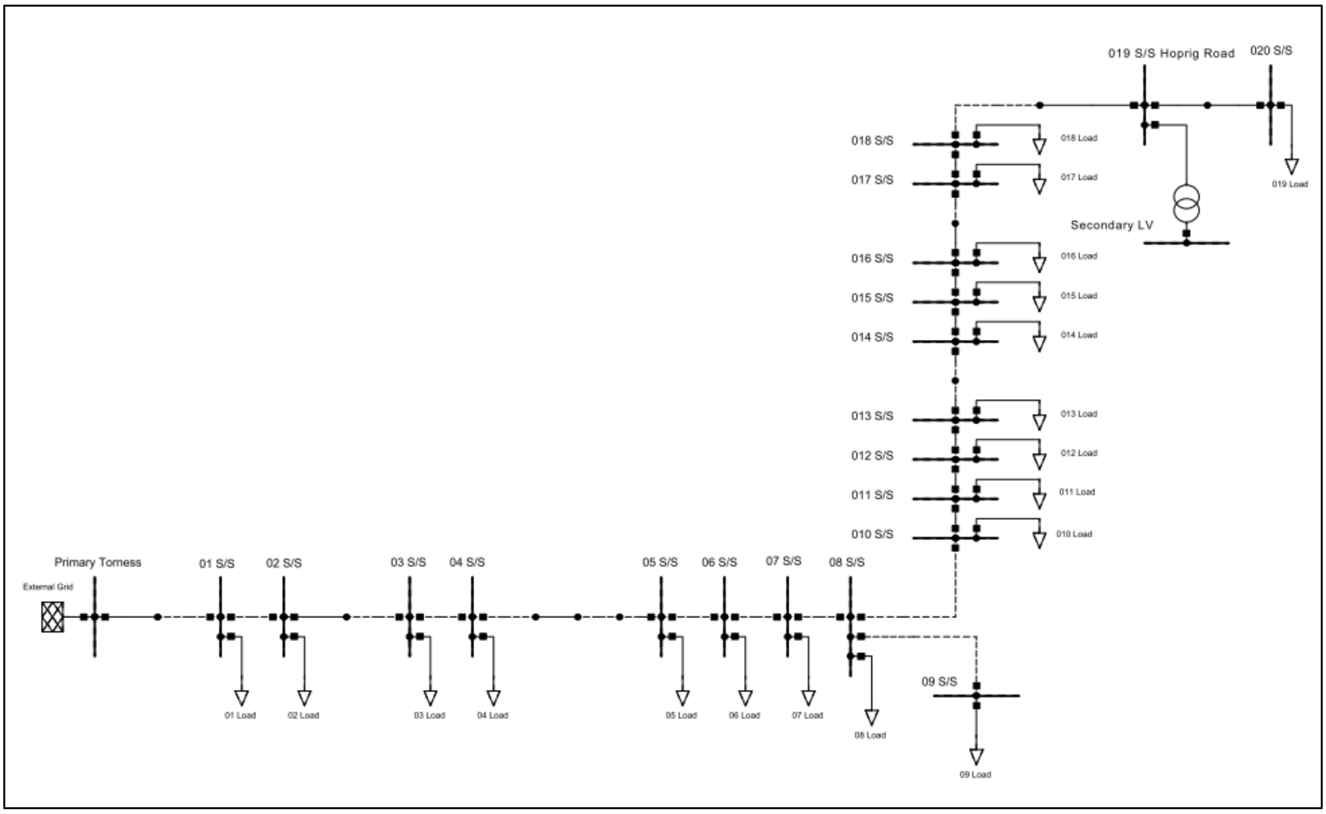

Figure 52: Hoprig Road 11kV PowerFactory model

A 2.12.2 LV model

Hoprig Road 3-phase LV network consists of four LV feeders shown in Figure 53.

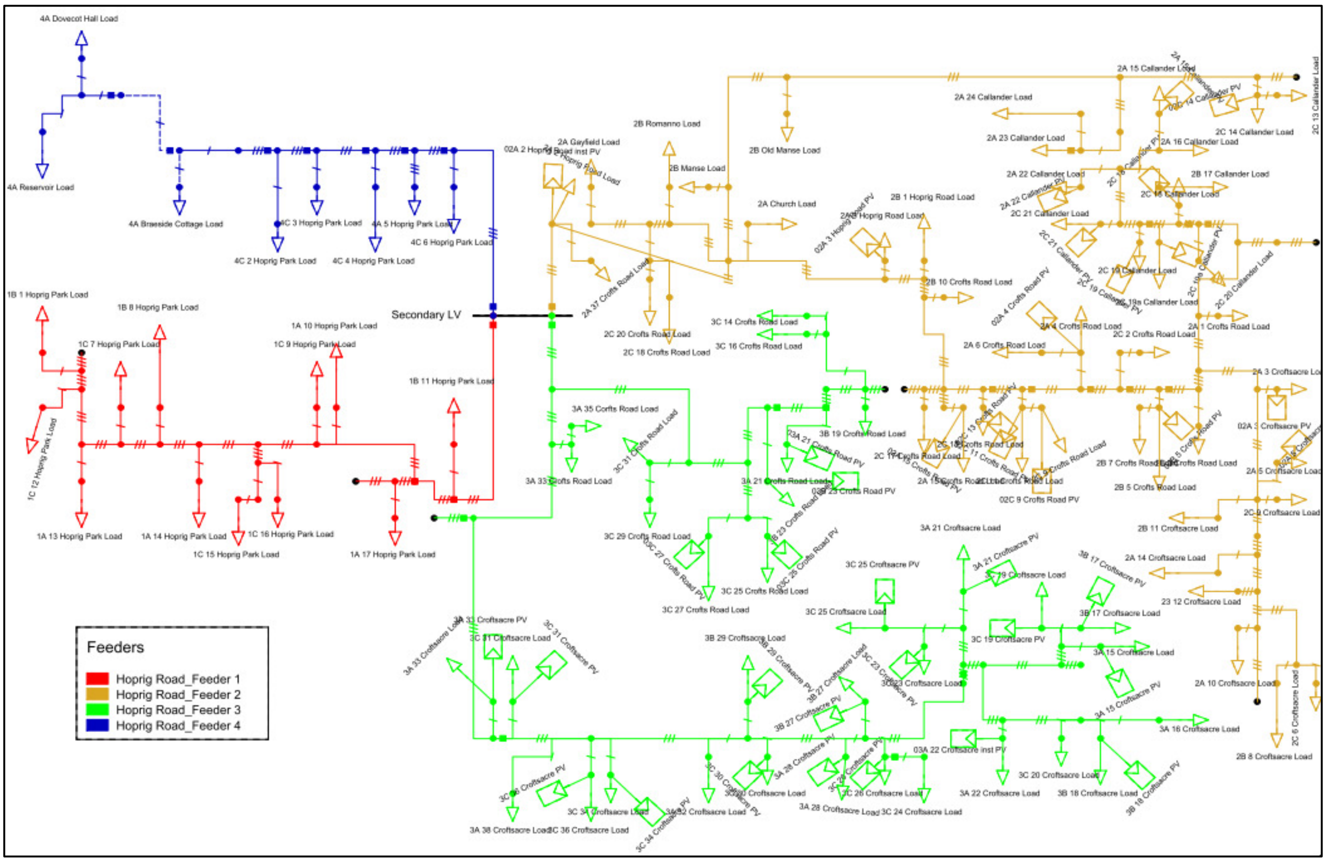

Figure 53: Hoprig Road LV PowerFactory model indicating LV feeders

There are in total 99 loads and 38 proposed and existing PV systems. These are summarized in Table 60 and shown in Figure 54.

Load		PV		Load		PV	
Feeder 1				**Feeder 3**			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	4	Red (A)	0	Red (A)	11	Red (A)	6
Yellow (B)	3	Yellow (B)	0	Yellow (B)	61	Yellow (B)	5
Blue (C)	5	Blue (C)	0	Blue (C)	16	Blue (C)	10
Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	0
Total	**12**	**Total**	**0**	**Total**	**33**	**Total**	**21**
Feeder 2				**Feeder 4**			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	18	Red (A)	8	Red (A)	4	Red (A)	0
Yellow (B)	11	Yellow (B)	1	Yellow (B)	0	Yellow (B)	0
Blue (C)	16	Blue (C)	8	Blue (C)	4	Blue (C)	0
Black (3-phase)	1	Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	0
Total	**46**	**Total**	**17**	**Total**	**8**	**Total**	**0**

Table 60: Summary of LV loads and PV systems included in Hoprig Road LV PowerFactory model

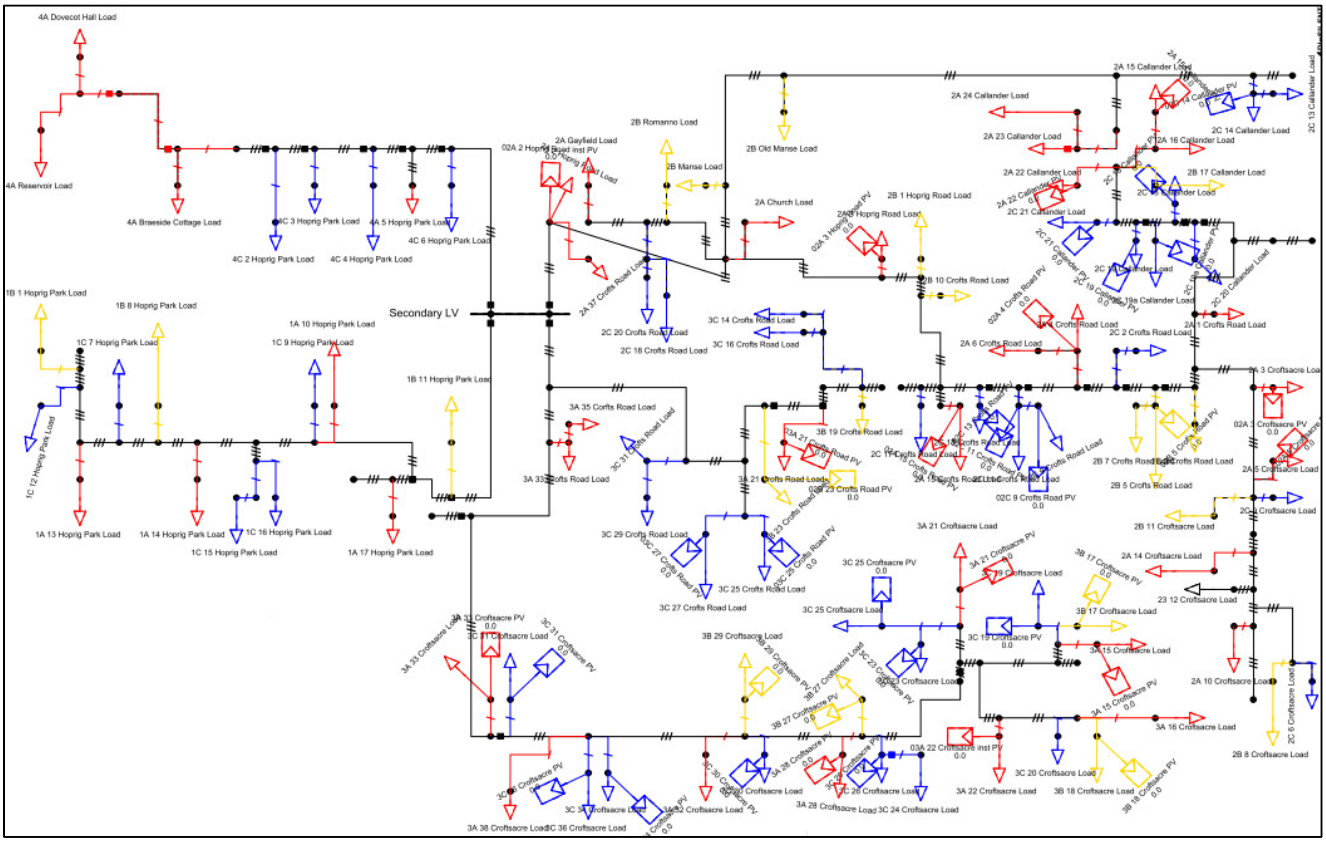

Figure 54: Hoprig Road LV PowerFactory model indicating LV phasing

A 2.13 Leitholm Village

A 2.13.1 11kV model

The 11kV PowerFactory model associated with Leitholm Village S/S is a simplification of the SPEN's circuit 114/23 that Leitholm Village is connected to and it has been matched as closely as possible to the information available on the design of the feeder. The developed model is based on the PowerFactory model, provided by SPEN, of 11kV circuit 114/23 fed from Duns primary, which is shown in Figure 55.

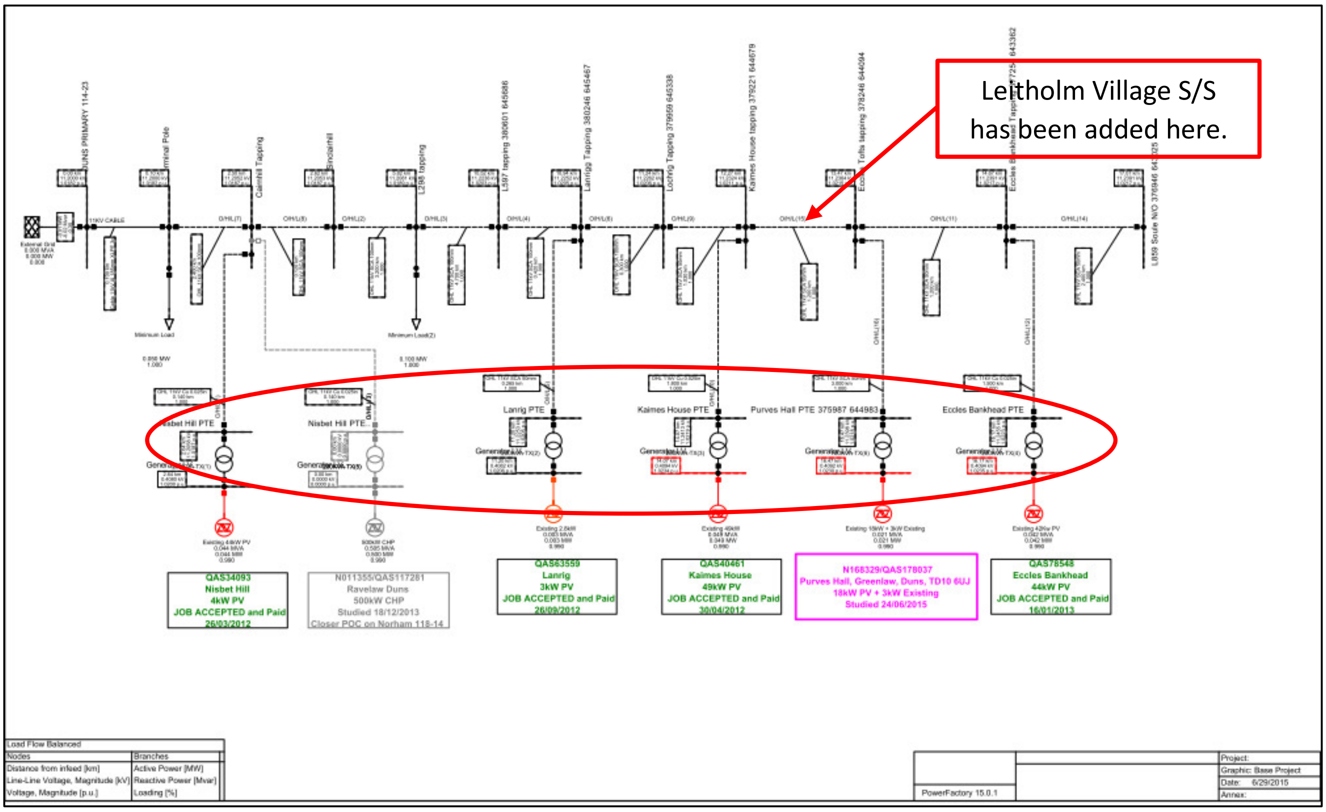

Figure 55: PowerFactory model of 11kV circuit 114/23 provided by SPEN

The SPEN model included the feeder itself, secondary subsations, annual minimum three-phase load for some of the substations taken directly off the 11kV busbars and the external grid acting as the swing bus connected to 11kV primary busbar. The initial model also included a number of distributed generators that were investigated in previous studies carried out by SPEN between 2012 and 2015, as indicated in Figure 55. These were not necessary for the purpose of this work and such they were removed from the model (red circle in Figure 55).

Since Leitholm Village was not included in the original PowerFactory model, additional substation representing Leitholm Village has been added based on SPEN's GIS data, as shown in Figure 55. Additionaly, for the purpose of modelling and writing scripts, all substations were renamed in the PowerFactory model. Table 61 summarizes substations' name changes with their associated loads.

Number	Original substation name	Power Factory substation name	Substation load name
	Duns Primary 114-23	Primary Duns	N/A
1.	Terminal Pole	01 S/S	01 Load
2.	Cairnhill Tapping	02 S/S	02 Load
3.	Sinclairhill	03 S/S	03 Load
4.	L298 tapping	04 S/S	04 Load
5.	L597 tapping 380601	05 S/S	05 Load
6.	Lanrigg Tapping	06 S/S	06 Load
7.	Lochrig Tapping	07 S/S	07 Load
8.	Kairness House tapping	08 S/S	08 Load
9.	N/A	09 S/S Leitholm Village	N/A (LV extension)
10.	Eccles Tofts tapping	010 S/S	09 Load
11.	Eccles Bankhead tapping	011 S/S	010 Load
12.	L859 Soule N/O	012 S/S	011 Load

Table 61: Summary of secondary substations included in 11kV Leitholm Village PowerFactory model

Figure 56 shows the final 11kV model of Leitholm Village S/S, where Leitholm Village is a secondary substation with LV transformer. It is fed from Duns primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.3MVA.

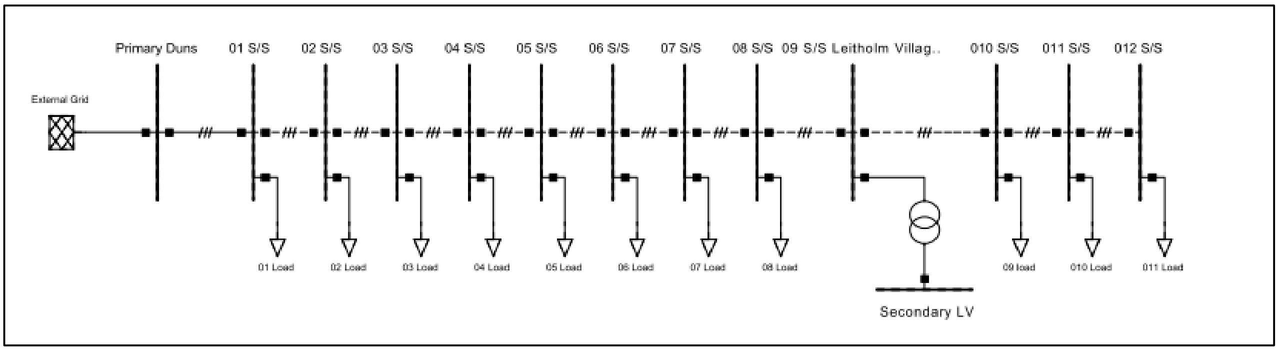

Figure 56: Leitholm Village 11kV PowerFactory model

A 2.13.2 LV model

Leitholm Village 3-phase LV network consists of three LV feeders shown in Figure 57.

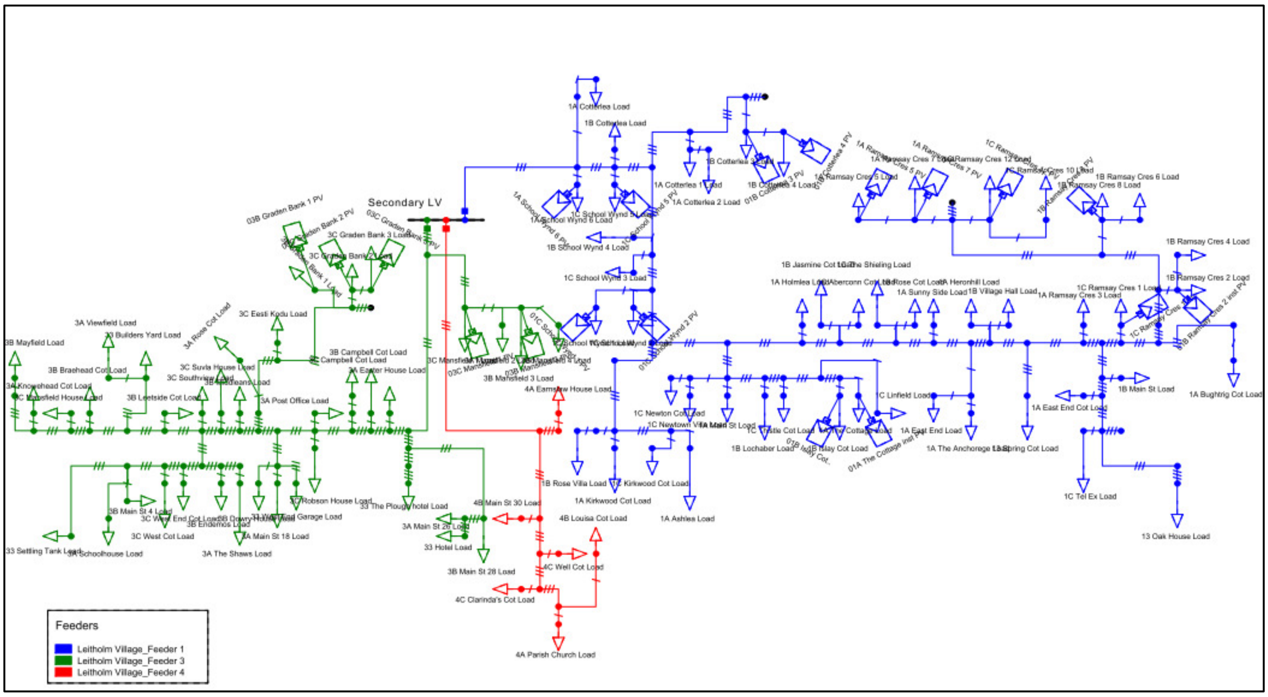

Figure 57: Leitholm Village LV PowerFactory model indicating LV feeders

There are in total 94 loads and 19 proposed and existing PV systems. These are summarized in Table 62 and shown in Figure 58.

Load		PV	
Feeder 1			
Phase	Number	Phase	Number
Red (A)	18	Red (A)	4
Yellow (B)	15	Yellow (B)	5
Blue (C)	15	Blue (C)	5
Black (3-phase)	2	Black (3-phase)	0
Total	**50**	**Total**	**14**
Feeder 3			
Phase	Number	Phase	Number
Red (A)	10	Red (A)	0
Yellow (B)	12	Yellow (B)	2
Blue (C)	11	Blue (C)	3
Black (3-phase)	5	Black (3-phase)	0
Total	**38**	**Total**	**5**
Feeder 4			
Phase	Number	Phase	Number
Red (A)	2	Red (A)	0
Yellow (B)	2	Yellow (B)	0
Blue (C)	2	Blue (C)	0
Black (3-phase)	0	Black (3-phase)	0
Total	**6**	**Total**	**0**

Table 62: Summary of LV loads and PV systems included in Leitholm Village LV PowerFactory model

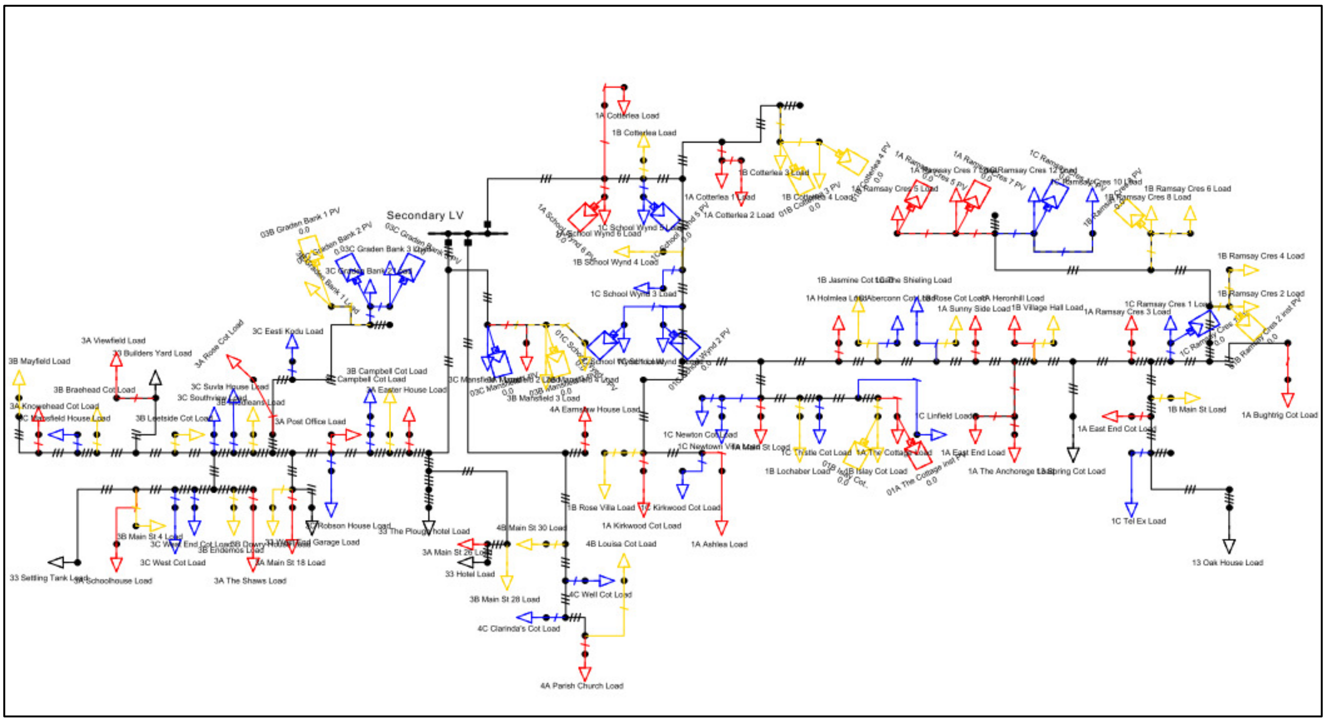

Figure 58: Leitholm Village LV PowerFactory model indicating LV phasing

A 2.14 Swinton Duns

A 2.14.1 11kV model

The 11kV PowerFactory model associated with Swinton Duns S/S is a simplification of the SPEN's circuit 118/14 that Swinton Duns is connected to and it has been matched as closely as possible to the information available on the design of the feeder. The developed model is based on the PowerFactory model, provided by SPEN, of 11kV circuit 118/14 fed from Norham primary, which is shown in Figure 59.

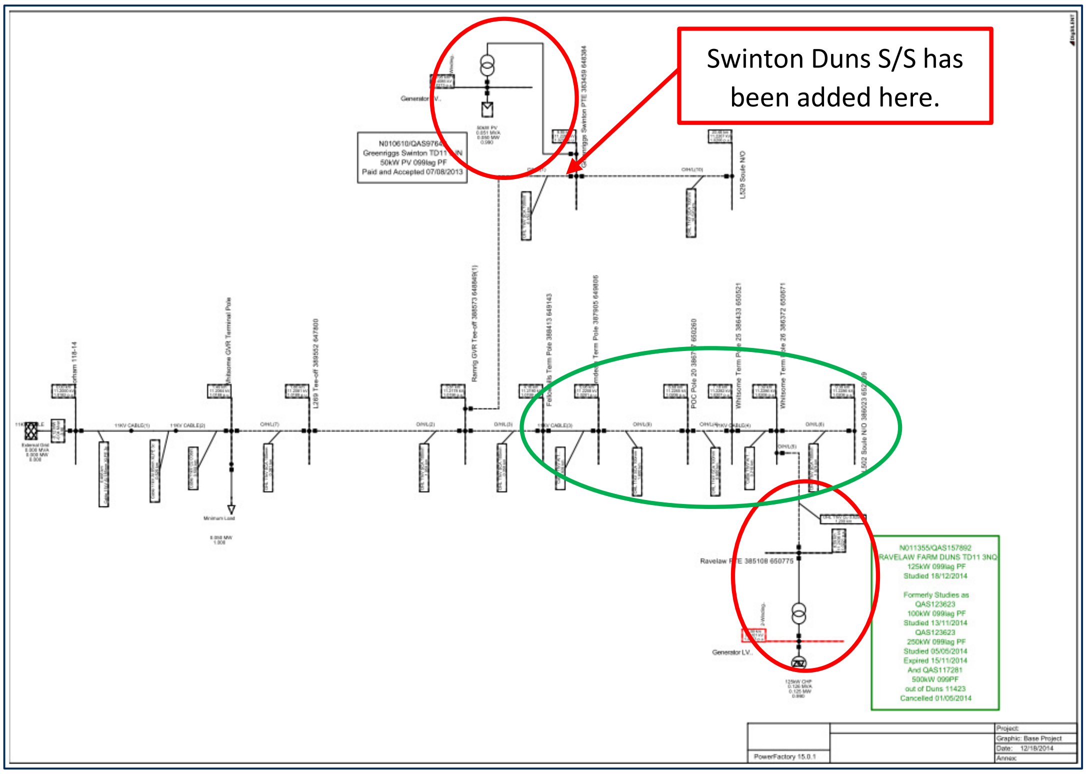

Figure 59: PowerFactory model of 11kV circuit 118/14 provided by SPEN

The SPEN model included the feeder itself, secondary subsations, annual minimum three-phase load for some of the substations taken directly off the 11kV busbars and the external grid acting as the swing bus connected to 11kV primary busbar. The initial model also included a number of distributed generators that were investigated in previous studies carried out by SPEN in 2013 and 2014, as indicated in Figure 59. These were not necessary for the purpose of this work and such they were removed from the model (red circles in Figure 59).

Since Swinton Duns was not included in the original PowerFactory model, additional substation representing Swinton Duns has been added based on SPEN's GIS data, as shown in Figure 59. For simplification, few secondary substations were aggregated together and modelled as one substation (green circle in Figure 59). Additionaly, for the purpose of modelling and writing scripts, all substations were renamed in the PowerFactory model. Table 63 summarizes substations' name changes with their associated loads.

Number	***Original substation name***	***Power Factory substation name***	***Substation load name***
	Norham 118-14	Primary Norham	N/A
1.	Whitesome GVR Terminal Pole	01 S/S Whitesome	01 Load
2.	L269 Tee-off 389552 647800	02 S/S Tee-off	02 Load
3.	Ramrig GVR Tee-off 388573 648849(1)	03 S/S Ramrig	03 Load
4.	N/A	Swinton Duns	N/A (LV extension)
5.	Greenriggs Swinton PTE 383459 648384	04 S/S Greenriggs	04 Load
6.	L529 Soule N/O	05 S/S Soule	05 Load

Table 63: Summary of secondary substations included in 11kV Swinton Duns PowerFactory model

Figure 60 shows the final 11kV model of Swinton Duns S/S, where Swinton Duns is a secondary substation with LV transformer. It is fed from Norham primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.2MVA.

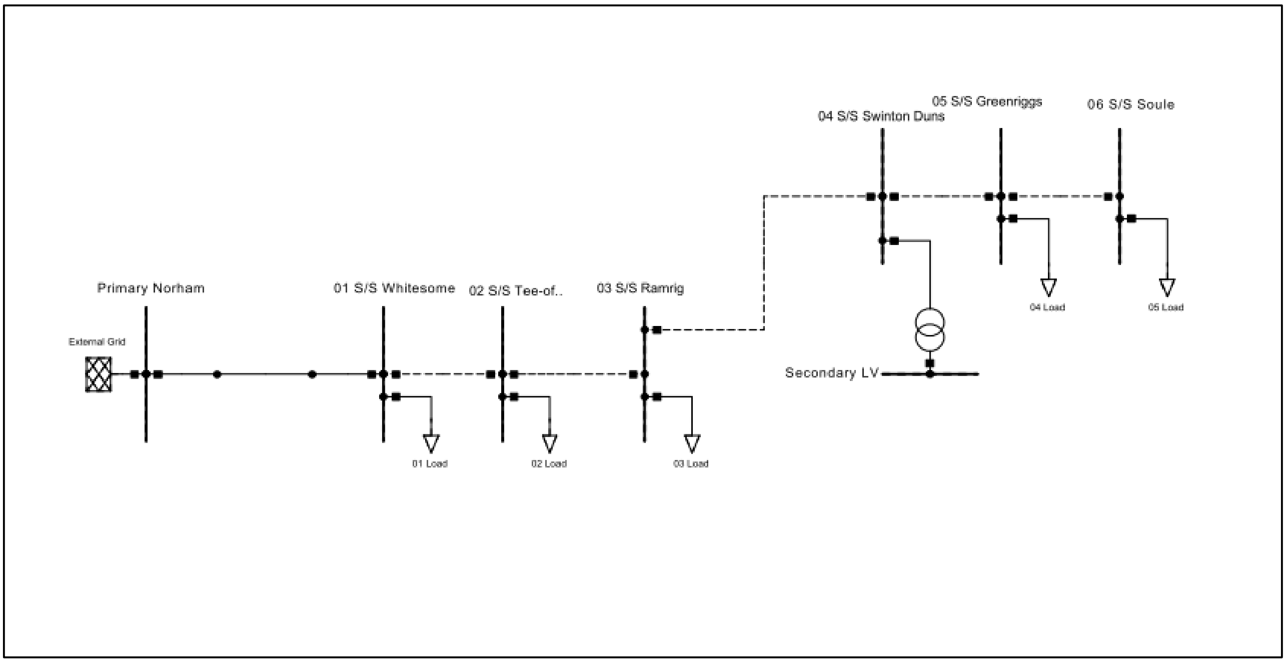

Figure 60: Swinton Duns 11kV PowerFactory model

A 2.14.2 LV model

Swinton Duns 3-phase LV network consists of two LV feeders shown in Figure 61.

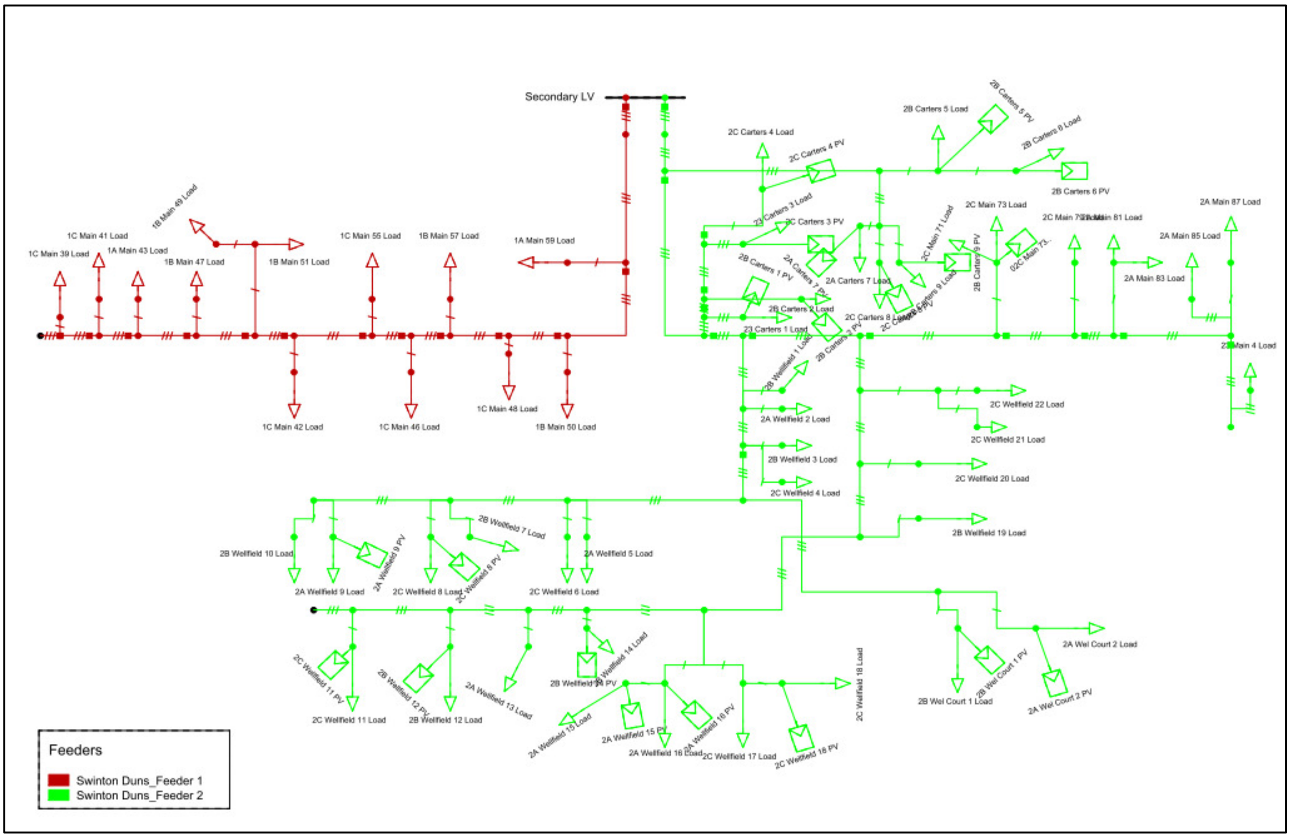

Figure 61: Swinton Duns LV PowerFactory model indicating LV feeders

There are in total 54 loads and 20 proposed and existing PV systems. These are summarized in Table 64 and shown in Figure 62.

Load		PV	
Feeder 1			
Phase	Number	Phase	Number
Red (A)	2	Red (A)	0
Yellow (B)	5	Yellow (B)	0
Blue (C)	6	Blue (C)	0
Black (3-phase)	0	Black (3-phase)	0
Total	**13**	**Total**	**0**
Feeder 2			
Phase	Number	Phase	Number
Red (A)	12	Red (A)	5
Yellow (B)	12	Yellow (B)	8
Blue (C)	14	Blue (C)	7
Black (3-phase)	3	Black (3-phase)	0
Total	**41**	**Total**	**20**

Table 64: Summary of LV loads and PV systems included in Swinton Duns LV PowerFactory model

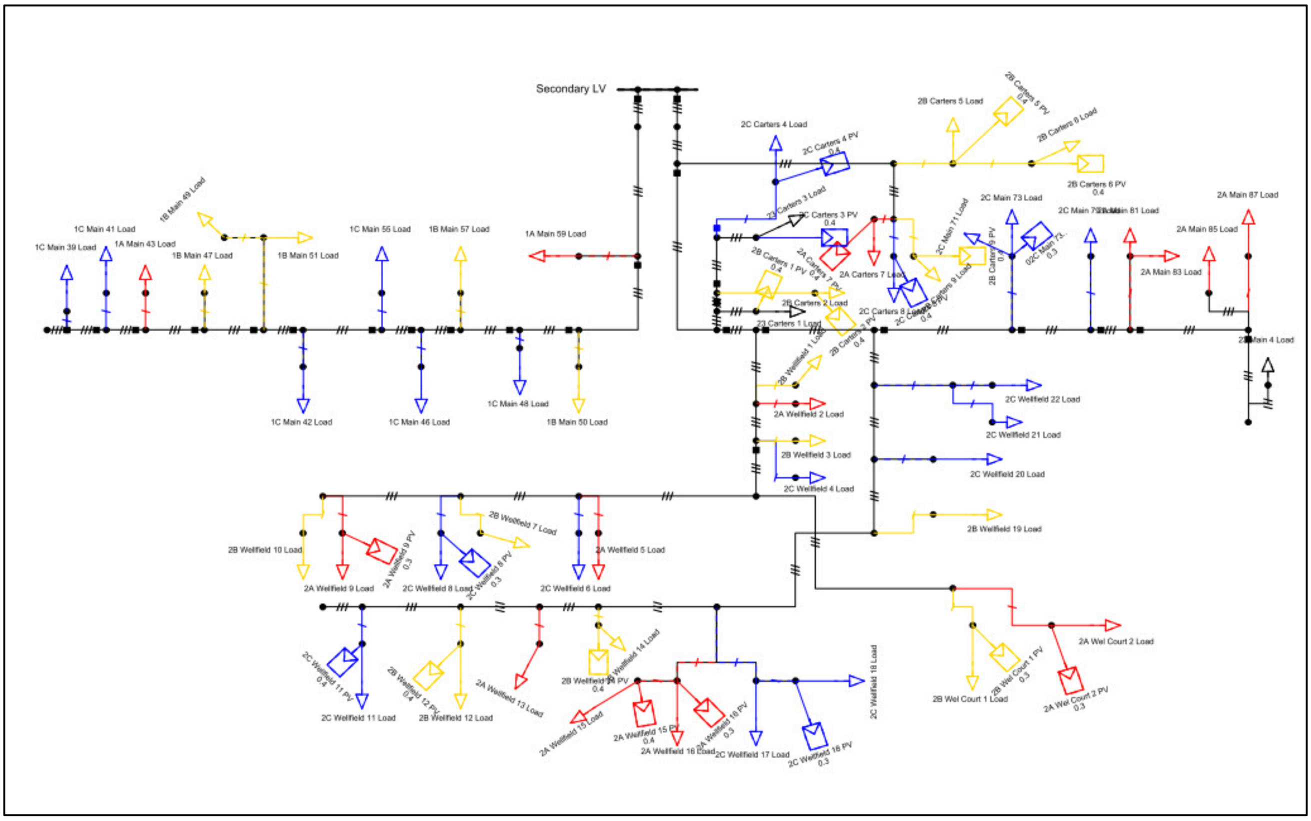

Figure 62: Swinton Duns LV PowerFactory model indicating LV phasing

A 2.15 Chirnside West End

A 2.15.1 11kV model

The 11kV PowerFactory model associated with Chirnside West End S/S is a simplification of the SPEN's circuit 121/22 that Chirnside West End is connected to and it has been matched as closely as possible to the information available on the design of the feeder. The developed model is based on the PowerFactory model, provided by SPEN, of 11kV circuit 121/22 fed from Chirnside primary, which is shown in Figure 63.

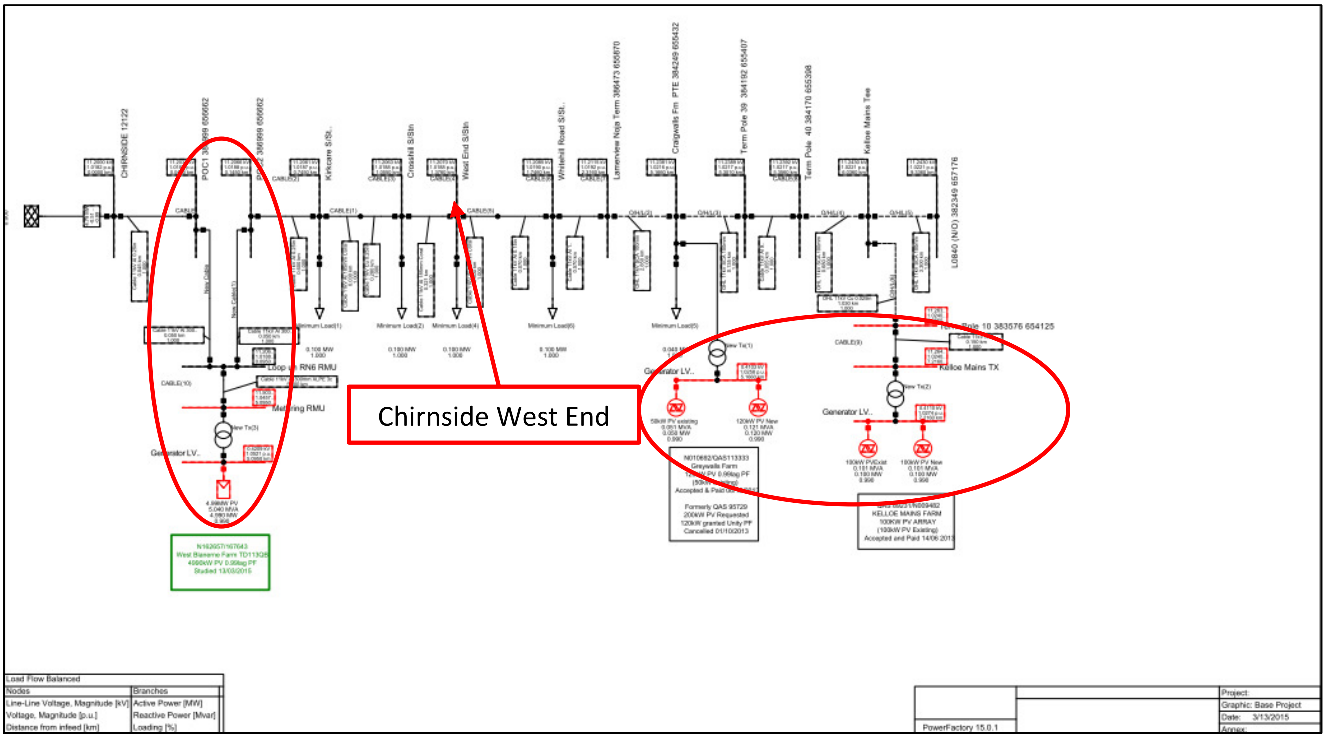

Figure 63: PowerFactory model of 11kV circuit 121/22 provided by SPEN

The SPEN model included the feeder itself, secondary subsations, annual minimum three-phase load for some of the substations taken directly off the 11kV busbars and the external grid acting as the swing bus connected to 11kV primary busbar. The initial model also included a number of distributed generators that were investigated in previous studies carried out by SPEN in 2013 and 2015, as indicated in Figure 63. These were not necessary for the purpose of this work and such they were removed from the model (red circles in Figure 63).

For the purpose of modelling and writing scripts, all substations were renamed in the PowerFactory model. Table 65 summarizes substations' name changes with their associated loads.

Number	Original substation name	Power Factory substation name	Substation load name
	Chirnside 12122	Primary Chirnside	N/A
1.	Kirkcare	01 S/S	01 Load
2.	Croshill	02 S/S	02 Load
3.	West End	03 S/S Chirnside West End	N/A (LV extension)
4.	Whitehill Road	04 S/S	03 Load
5.	Lamerview Noja Term	05 S/S	04 Load
6.	Craigwalls Fm PTE	06 S/S	05 Load
7.	Term Pole 39	07 S/S	06 Load
8.	Term Pole 40	08 S/S	07 Load
9.	Kelloe Mains Tee	09 S/S	08 Load
10.	L0840 (N/O)	010 S/S	09 Load

Table 65: Summary of secondary substations included in 11kV Chirnside West End PowerFactory model

Figure 64 shows the final 11kV model of Leitholm Village S/S, where Chirnside West End is a secondary substation with LV transformer. It is fed from Chirnside primary shown at the beginning of the feeder with connected external grid acting as the swing bus. The LV transformer is 11/0.4k33V 2-winding transformer, with reactance-to-resistance (X/R) ratio of 4.75%, a centre tap position of 0% and rating of 0.8MVA.

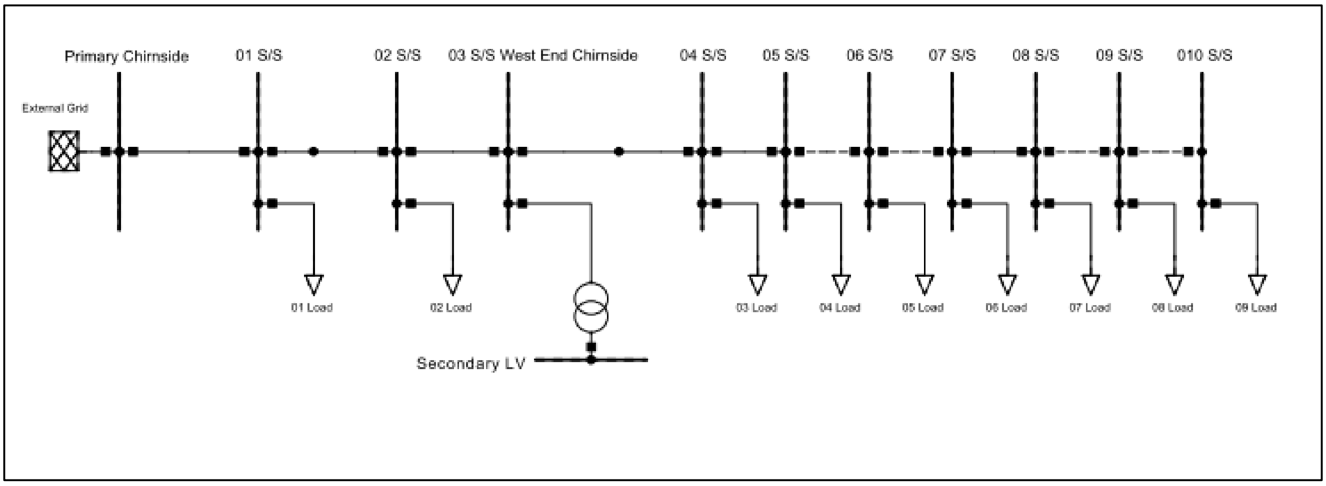

Figure 64: Chirnside West End 11kV PowerFactory model

A 2.15.2 LV model

Chirnside West End 3-phase LV network consists of six LV feeders shown in Figure 65.

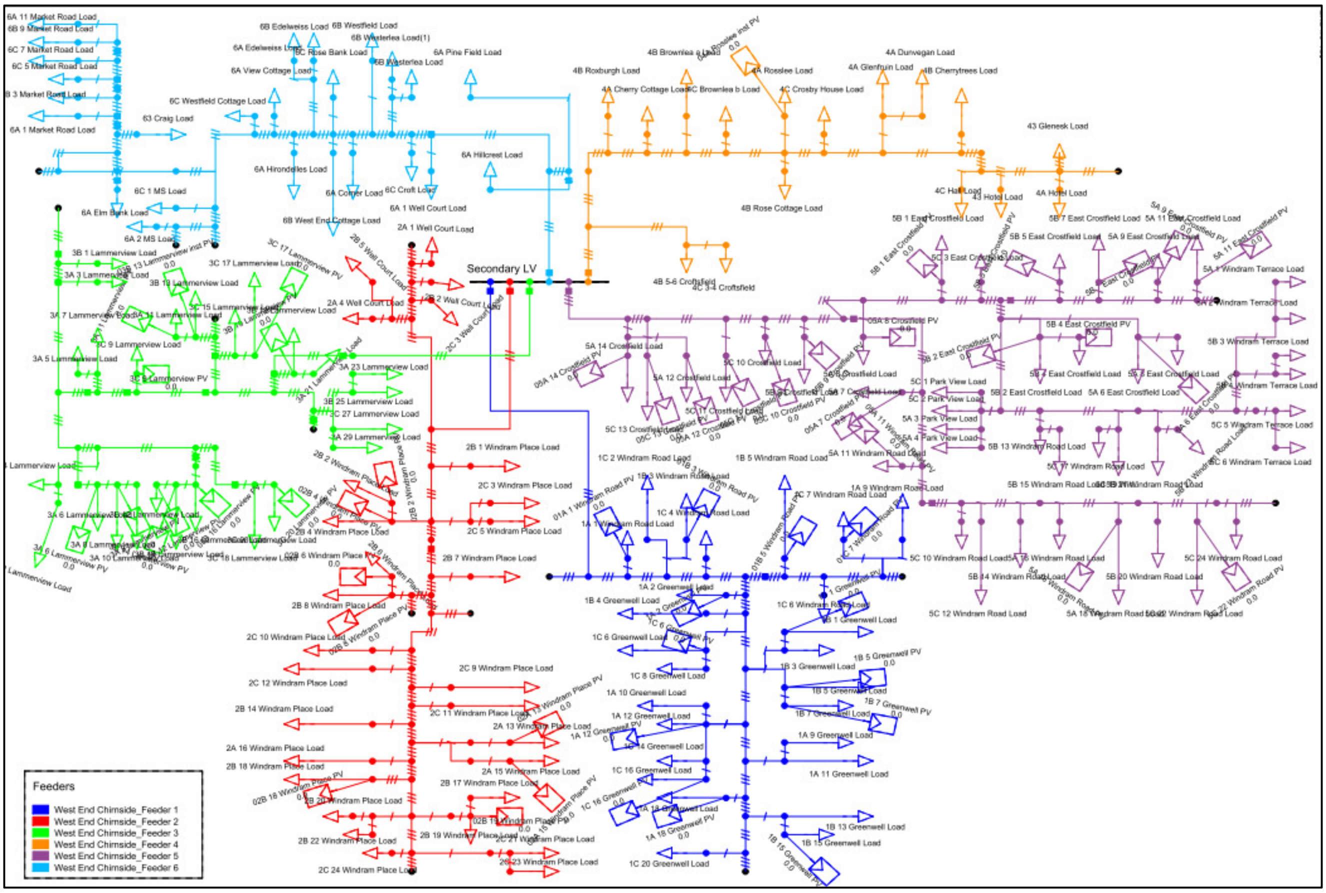

Figure 65: Chirnside West End LV PowerFactory model indicating LV feeders

There are in total 162 loads and 52 proposed and existing PV systems. These are summarized in Table 66 and shown in Figure 66.

Load		PV		Load		PV	
Feeder 1				**Feeder 4**			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	8	Red (A)	4	Red (A)	10	Red (A)	1
Yellow (B)	9	Yellow (B)	6	Yellow (B)	2	Yellow (B)	0
Blue (C)	9	Blue (C)	3	Blue (C)	0	Blue (C)	0
Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	2	Black (3-phase)	0
Total	**26**	**Total**	**13**	**Total**	**14**	**Total**	**1**
Feeder 2				**Feeder 5**			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	8	Red (A)	2	Red (A)	15	Red (A)	9
Yellow (B)	12	Yellow (B)	6	Yellow (B)	14	Yellow (B)	6
Blue (C)	9	Blue (C)	0	Blue (C)	14	Blue (C)	4
Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	0	Black (3-phase)	0
Total	**29**	**Total**	**8**	**Total**	**43**	**Total**	**19**
Feeder 3				**Feeder 6**			
Phase	Number	Phase	Number	Phase	Number	Phase	Number
Red (A)	**12**	Red (A)	**3**	Red (A)	**15**	Red (A)	**0**
Yellow (B)	**7**	Yellow (B)	**5**	Yellow (B)	**5**	Yellow (B)	**0**
Blue (C)	**6**	Blue (C)	**3**	Blue (C)	**4**	Blue (C)	**0**
Black (3-phase)	**0**	Black (3-phase)	**0**	Black (3-phase)	**1**	Black (3-phase)	**0**
Total	**25**	**Total**	**11**	**Total**	**25**	**Total**	**0**

Table 66: Summary of LV loads and PV systems included in Chirnside West End LV PowerFactory model

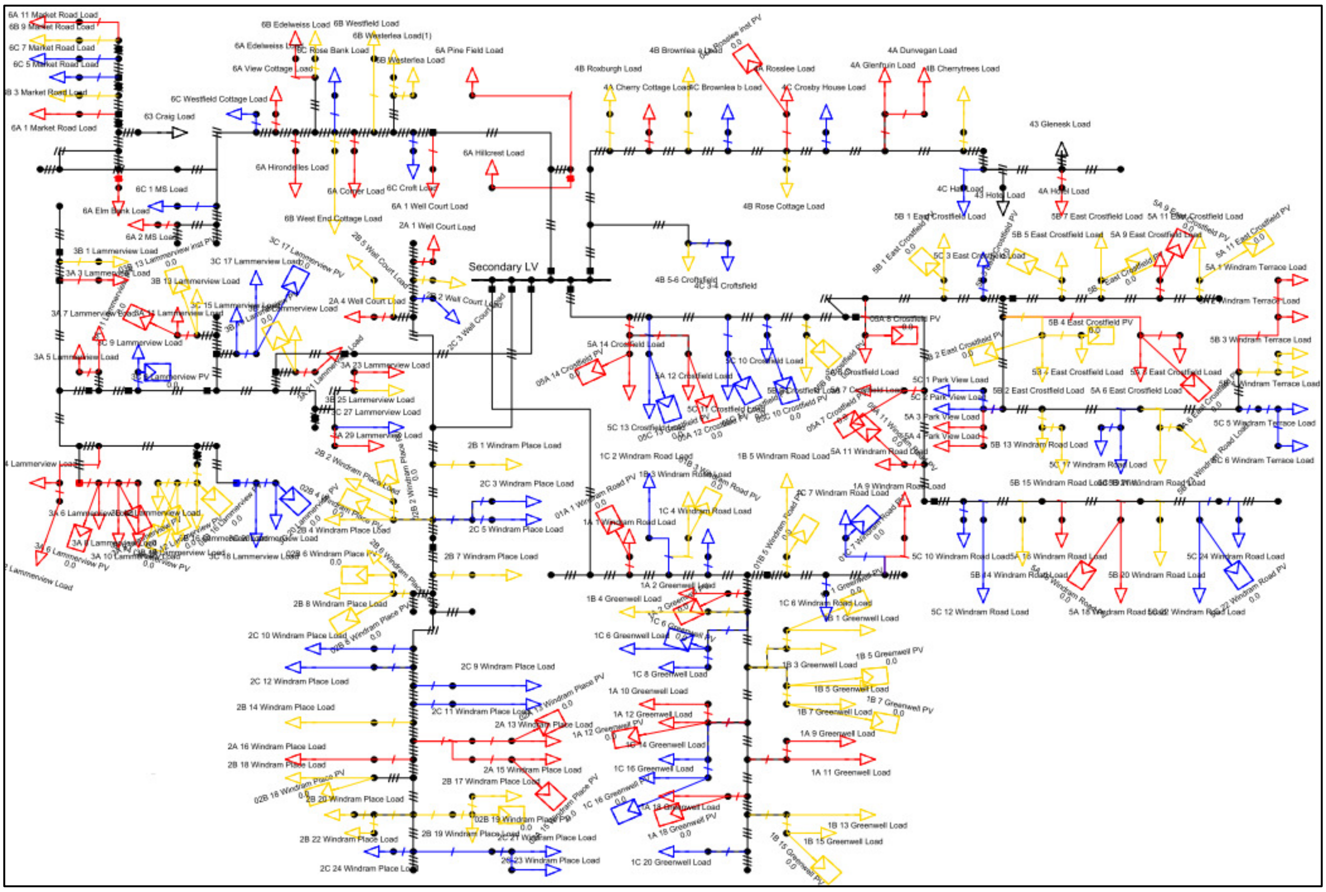

Figure 66: Chirnside West End LV PowerFactory model indicating LV feeders

Appendix 3 PV systems included in the models

This appendix contains information about PV systems included in modelling. There are existing PV systems based on a survey carried out by SPEN, and PV systems proposed by BHA.

Each table shows addresses, sizes, PowerFactory name, and phasing of PV systems per each modelled secondary substation. The following indices were used for different phasing:

- Red phase – A
- Yellow phase – B
- Blue phase – C

Each PowerFactory PV name includes a feeder and phase PV is connected to, and PV address. For example, *2A Lawfield Drive 36 PV* is PV connected to feeder 2, phase A, at address Lawfield Drive 36. In addition, all existing PVs have a prefix zero. For instance, *02B Lawfield Drive 4 inst PV* presents existing PV, connected to feeder 2, phase B at address Lawfield Drive 4.

Every table has also different row colours. Green, amber and red colours represent PV approved properties within green, amber and red groups (explained in Section 2), and black colour represents properties with existing PV system on their roofs.

A 3.1 Ayton Lawfield

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
33 Lawfield Drive, Ayton	TD14 5QU	2.5	2B Lawfield Drive 33 PV	B
36 Lawfield Drive, Ayton	TD14 5QU	3.5	2A Lawfield Drive 36 PV	A
34 Lawfield Drive, Ayton	TD14 5QU	3.5	2A Lawfield Drive 34 PV	A
32 Lawfield Drive, Ayton	TD14 5QU	3.5	2B Lawfield Drive 32 PV	B
30 Lawfield Drive, Ayton	TD14 5QU	3.5	2B Lawfield Drive 30 PV	B
60 Lawfield Drive, Ayton	TD14 5QU	4	4C Lawfield Drive 60 PV	C
61 Lawfield Drive, Ayton	TD14 5QU	4	4B Lawfield Drive 61 PV	B
58 Lawfield Drive, Ayton	TD14 5QU	4	4A Lawfield Drive 58 PV	A
59 Lawfield Drive, Ayton	TD14 5QU	4	4B Lawfield Drive 59 PV	B
53 Lawfield Drive, Ayton	TD14 5QU	4	4C Lawfield Drive 53 PV	C
47 Lawfield Drive, Ayton	TD14 5QU	4	4A Lawfield Drive 47 PV	A
49 Lawfield Drive, Ayton	TD14 5QU	4	4C Lawfield Drive 49 PV	C
57 Lawfield Drive, Ayton	TD14 5QU	4	4B Lawfield Drive 57 PV	B
42 Lawfield Drive, Ayton	TD14 5QU	3.5	4C Lawfield Drive 42 PV	C
44 Lawfield Drive, Ayton	TD14 5QU	3.5	4A Lawfield Drive 44 PV	A
46 Lawfield Drive, Ayton	TD14 5QU	4	4B Lawfield Drive 46 PV	B
48 Lawfield Drive, Ayton	TD14 5QU	4	4A Lawfield Drive 48 PV	A
54 Lawfield Drive, Ayton	TD14 5QU	4	4C Lawfield Drive 54 PV	C
40 Lawfield Drive, Ayton	TD14 5QU	4	4B Lawfield Drive 40 PV	B
38 Lawfield Drive, Ayton	TD14 5QU	4	4C Lawfield Drive 38 PV	C
4 Lawfield Drive, Ayton	TD14 5QU	2	02B Lawfield Drive 4 inst PV	B
14 Lawfield Drive, Ayton	TD14 5QU	1.25	02B Lawfield Drive 14 inst PV	B
29 Lawfield Drive, Ayton	TD14 5QU	2.25	02B Lawfield Drive 29 inst PV	B
55 Lawfield Drive, Ayton	TD14 5QU	1.25	04A Lawfield Drive 55 inst PV	A

Table 67: Proposed PVs at Ayton Lawfield S/S

A 3.2 Briery Baulk

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
22 Brierybaulk, Duns	TD11 3BH	3	3C Brierybaulk 22 PV	C
26 Brierybaulk, Duns	TD11 3BH	3	3B Brierybaulk 26 PV	B
59 Brierybaulk, Duns	TD11 3BQ	4	3B Brierybaulk 59 PV	B
57 Brierybaulk, Duns	TD11 3BQ	4	3B Brierybaulk 57 PV	B
55 Brierybaulk, Duns	TD11 3BQ	3	3B Brierybaulk 55 PV	B
47 Brierybaulk, Duns	TD11 3BQ	2.5	3B Brierybaulk 47 PV	B
2 Briery Place, Duns	TD11 3BJ	4	4C Briery Place 2 PV	C
4 Briery Place, Duns	TD11 3BJ	4	4C Briery Place 4 PV	C
6 Briery Place, Duns	TD11 3BJ	4	4B Briery Place 6 PV	B
8 Briery Place, Duns	TD11 3BJ	4	4B Briery Place 8 PV	B
11 Briery Place, Duns	TD11 3BJ	3	4C Briery Place 11 PV	C
9 Briery Place, Duns	TD11 3BJ	3	4C Briery Place 9 PV	C
7 Briery Place, Duns	TD11 3BJ	4	4B Briery Place 7 PV	B
5 Briery Place, Duns	TD11 3BJ	4	4B Briery Place 5 PV	B
2 Blinkbonnie Gardens, Duns	TD11 3BG	3	4A Blinkbone Gardens 2 PV	A
1 Blinkbonnie Gardens, Duns	TD11 3BG	3	4A Blinkbone Gardens 1 PV	A
1 Briery Place, Duns	TD11 3BJ	2.25	04A Briery Place 1 inst PV	A

Table 68: Proposed PVs at Briery Baulk S/S

A 3.3 Buss Craig

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
35 Gunsgreen Crescent, Eyemouth	TD14 5DW	3.5	2A Gunsgreen Cres 35 PV	A
48 Gunsgreen Crescent, Eyemouth	TD14 5DW	2	2B Gunsgreen Cres 48 PV	B
44 Gunsgreen Crescent, Eyemouth	TD14 5DW	2.5	2C Gunsgreen Cres 44 PV	C
34 Gunsgreen Crescent, Eyemouth	TD14 5DW	3.5	2A Gunsgreen Cres 34 PV	A
46 Gunsgreen Crescent, Eyemouth	TD14 5DW	2.5	2C Gunsgreen Cres 46 PV	C
16 Skeldons Brae, Eyemouth	TD14 5LJ	4	2B Skeldons 16 PV	B
17 Skeldons Brae, Eyemouth	TD14 5LJ	4	2A Skeldons 17 PV	B
18 Skeldons Brae, Eyemouth	TD14 5LJ	4	2B Skeldons 18 PV	B
3 Skeldons Brae, Eyemouth	TD14 5LJ	3.5	2B Skeldons 3 PV	B
6 Skeldons Brae, Eyemouth	TD14 5LJ	4	2B Skeldons 6 PV	B
14 Skeldons Brae, Eyemouth	TD14 5LJ	4	2A Skeldons 14 PV	A
7 Skeldons Brae, Eyemouth	TD14 5LJ	4	2C Skeldons 7 PV	C
10 Skeldons Brae, Eyemouth	TD14 5LJ	4	2A Skeldons 10 PV	A
11 Skeldons Brae, Eyemouth	TD14 5LJ	4	2B Skeldons 11 PV	B
5 Skeldons Brae, Eyemouth	TD14 5LJ	4	2A Skeldons 5 PV	A
9 Skeldons Brae, Eyemouth	TD14 5LJ	4	2C Skeldons 9 PV	C
8 Skeldons Brae, Eyemouth	TD14 5LJ	4	2A Skeldons 8 PV	A
15 Skeldons Brae, Eyemouth	TD14 5LJ	4	2C Skeldons 15 PV	C
12 Skeldons Brae, Eyemouth	TD14 5LJ	4	2A Skeldons 12 PV	A
2 Skeldons Brae, Eyemouth	TD14 5LJ	3.5	2A Skeldons 2 PV	A
13 Skeldons Brae, Eyemouth	TD14 5LJ	4	2C Skeldons 13 PV	C
3 Sanderson Way, Eyemouth	TD14 5LY	4	2C Sanderson 3 PV	C
2 Sanderson Way, Eyemouth	TD14 5LY	4	2B Sanderson 2 PV	B
1 Sanderson Way, Eyemouth	TD14 5LY	4	2A Sanderson 1 PV	A
6 Sanderson Way, Eyemouth	TD14 5LY	4	2A Sanderson 6 PV	A
5 Sanderson Way, Eyemouth	TD14 5LY	4	2B Sanderson 5 PV	B
4 Sanderson Way, Eyemouth	TD14 5LY	4	2C Sanderson 4 PV	C
14 Buss Craig Road, Eyemouth	TD14 5DN	4	3B Buss Craig Pl 14 PV	B
7 Buss Craig Place, Eyemouth	TD14 5DJ	4	3C Buss Craig Pl 7 PV	C
8 Buss Craig Place, Eyemouth	TD14 5DJ	4	3B Buss Craig Pl 8 PV	B
9 Buss Craig Place, Eyemouth	TD14 5DJ	4	3A Buss Craig Pl 9 PV	A
6 The Avenue, Eyemouth	TD14 5DL	4	4B The Avenue 6 PV	B
10 The Avenue, Eyemouth	TD14 5DL	4	4B The Avenue 10 PV	B
11 The Avenue, Eyemouth	TD14 5DL	4	4C The Avenue 11 PV	C
4 Gunsgreenhill	TD14 5SF	3.75	02C Ggh Cot 4 inst PV	C

Table 69: Proposed PVs at Buss Craig S/S

A 3.4 Castle Street

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
52 Glebe Park, Duns	TD11 3EE	2.25	4A Glebe Park 52 PV	A
54 Glebe Park, Duns	TD11 3EE	2.25	4A Glebe Park 54 PV	A
29 Easter Street, Duns	TD11 3DW	2.5	4B Easter St 29 PV	B
56 Glebe Park, Duns	TD11 3EE	2.25	4B Glebe Park 56 PV	B
59 Glebe Park, Duns	TD11 3EE	4	4C Glebe Park 59 PV	C
51 Glebe Park, Duns	TD11 3EE	3	4A Glebe Park 51 PV	A
49 Glebe Park, Duns	TD11 3EE	4	4B Glebe Park 49 PV	B
47 Glebe Park, Duns	TD11 3EE	4	4B Glebe Park 47 PV	B
45 Glebe Park, Duns	TD11 3EE	4	4B Glebe Park 45 PV	B
43 Glebe Park, Duns	TD11 3EE	4	4B Glebe Park 43 PV	B
27 Glebe Park, Duns	TD11 3EE	4	4A Glebe Park 27 PV	A
11 Glebe Park, Duns	TD11 3EE	4	4C Glebe Park 11 PV	C
50 Glebe Park, Duns	TD11 3EE	2.5	4A Glebe Park 50 PV	A
48 Glebe Park, Duns	TD11 3EE	2.5	4B Glebe Park 48 PV	B
38 Glebe Park, Duns	TD11 3EE	4	4C Glebe Park 38 PV	C
28 Glebe Park, Duns	TD11 3EE	3	4A Glebe Park 28 PV	A
26 Glebe Park, Duns	TD11 3EE	3	4A Glebe Park 26 PV	A
20 Glebe Park, Duns	TD11 3EE	3	4B Glebe Park 20 PV	B
2 Glebe Park, Duns	TD11 3EE	4	4B Glebe Park 2 PV	B
4 Glebe Park, Duns	TD11 3EE	4	4B Glebe Park 4 PV	B
8 Glebe Park, Duns	TD11 3EE	4	4A Glebe Park 8 PV	A

Table 70: Proposed PVs at Castle Street S/S

A 3.5 Churchill

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
3 Church Hill, Greenlaw	TD10 6YG	4	2C Churchill 3 PV	C
4 Church Hill, Greenlaw	TD10 6YG	4	2B Churchill 4 PV	B
5 Church Hill, Greenlaw	TD10 6YG	4	2A Churchill 5 PV	A
6 Church Hill, Greenlaw	TD10 6YG	4	2C Churchill 6 PV	C
7 Church Hill, Greenlaw	TD10 6YG	4	2B Churchill 7 PV	B
8 Church Hill, Greenlaw	TD10 6YG	4	2A Churchill 8 PV	A
12 Church Hill, Greenlaw	TD10 6YG	4	2A Churchill 12 PV	A
14 Church Hill, Greenlaw	TD10 6YG	4	2C Churchill 14 PV	C
16 Church Hill, Greenlaw	TD10 6YG	4	2C Churchill 16 PV	C
18 Church Hill, Greenlaw	TD10 6YG	4	2B Churchill 18 PV	B
1 Church Hill, Greenlaw	TD10 6YG	4	2A Churchill 1 PV	A
19 Church Hill, Greenlaw	TD10 6YG	4	2C Churchill 19 PV	C
17 Church Hill, Greenlaw	TD10 6YG	4	2B Churchill 17 PV	B
15 Church Hill, Greenlaw	TD10 6YG	4	2A Churchill 15 PV	A
13 Church Hill, Greenlaw	TD10 6YG	4	2B Churchill 13 PV	B
11 Church Hill, Greenlaw	TD10 6YG	3.5	2C Churchill 11 PV	C
31 Church Hill, Greenlaw	TD10 6YG	4	2C Churchill 31 PV	C
30 Church Hill, Greenlaw	TD10 6YG	4	2A Churchill 30 PV	A
32 Church Hill, Greenlaw	TD10 6YG	3.5	02C Churchill 32 inst PV	C
33 East High Street, Greenlaw	TD10 6YF	1.75	03A East HS 33 inst PV	A

Table 71: Proposed PVs at Churchill S/S

A 3.6 Deanhead

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
32 Deanhead Drive, Eyemouth	TD14 5RZ	3.5	3B Deanhead Dr 32 PV	B
31 Deanhead Drive, Eyemouth	TD14 5RZ	3.5	3B Deanhead Dr 31 PV	B
22 Deanhead Drive, Eyemouth	TD14 5RZ	3.5	3B Deanhead Dr 22 PV	B
21 Deanhead Drive, Eyemouth	TD14 5RZ	3.5	3B Deanhead Dr 21 PV	B
12 Deanhead Drive, Eyemouth	TD14 5RZ	3.5	3A Deanhead Dr 12 PV	A
11 Deanhead Drive, Eyemouth	TD14 5RZ	3.5	3A Deanhead Dr 11 PV	A
8 Callercove Way, Eyemouth	TD14 5BH	3.5	3C Callercove Way 8 PV	C
10 Callercove Way, Eyemouth	TD14 5BH	3.5	3C Callercove Way 10 PV	C
20 Callercove Crescent, Eyemouth	TD14 5BL	4	3B Callercove Cres 20 PV	B
18 Callercove Crescent, Eyemouth	TD14 5BL	4	3C Callercove Cres 18 PV	C
5 Bennison Square, Eyemouth	TD14 5SB	3.5	3B Bennison Sq 5 PV	B
7 Bennison Square, Eyemouth	TD14 5SB	3.5	3A Bennison Sq 7 PV	A
13 Callercove Crescent, Eyemouth	TD14 5BJ	4	3C Callercove Cres 13 PV	C
14 Callercove Crescent, Eyemouth	TD14 5BJ	4	3B Callercove Cres 14 PV	B
12 Callercove Crescent, Eyemouth	TD14 5BJ	4	3A Callercove Cres 12 PV	A
20 Northburn Road, Eyemouth	TD14 5AS	3.5	2C Northburn R 20 PV	C
22 Northburn Road, Eyemouth	TD14 5AS	3.5	2A Northburn R 22 PV	A
24 Northburn Road, Eyemouth	TD14 5AS	3.5	2C Northburn R 24 PV	C
36 Callercove Crescent, Eyemouth	TD14 5BL	4	4A Callercove Cres 36 PV	A
37 Callercove Crescent, Eyemouth	TD14 5BL	4	4A Callercove Cres37 PV	A
39 Callercove Crescent, Eyemouth	TD14 5BL	4	4C Callercove Cres 39 PV	C
40 Callercove Crescent, Eyemouth	TD14 5BL	4	4B Callercove Cres 40 PV	B
41 Callercove Crescent, Eyemouth	TD14 5BL	4	4B Callercove Cres 41 PV	B
21 Callercove Crescent, Eyemouth	TD14 5BL	4	4A Callercove Cres 21 PV	A
28 Callercove Crescent, Eyemouth	TD14 5BL	4	4A Callercove Cres 28 PV	A
26 Callercove Crescent, Eyemouth	TD14 5BL	4	4B Callercove Cres 26 PV	B
24 Callercove Crescent, Eyemouth	TD14 5BL	4	4C Callercove Cres 24 PV	C
22 Callercove Crescent, Eyemouth	TD14 5BL	4	4A Callercove Cres 22 PV	A
17 Bennison Square, Eyemouth	TD14 5SB	3	4A Bennison Sq 17 PV	A
1 Deanhead Road, Eyemouth	TD14 5SA	4	4A Deanhead R 1 PV	A
3 Deanhead Road, Eyemouth	TD14 5SA	4	4B Deanhead R 3 PV	B
7 Deanhead Road, Eyemouth	TD14 5SA	3	4C Deanhead R 7 PV	C
11 Deanhead Road, Eyemouth	TD14 5SA	3.5	4A Deanhead R 11 PV	A
13 Deanhead Road, Eyemouth	TD14 5SA	3.5	4A Deanhead R 13 PV	A
23 Deanhead Road, Eyemouth	TD14 5SA	3	4B Deanhead R 23 PV	B
25 Deanhead Road, Eyemouth	TD14 5SA	3	4A Deanhead R 25 PV	A
12 Barefoots Avenue, Eyemouth	TD14 5JH	3.5	02B Barefoots Av 12 inst PV	B
8 Barefoots Park, Eyemouth	TD14 5BW	3.5	02B Barefoots Park 8 inst PV	B
8 Barefoots Road, Eyemouth	TD14 5EE	3.5	02A Barefoots Road 8 inst PV	A

Table 72: Proposed PVs at Deanhead S/S

A 3.7 Dovecote

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
7 Gunsgreen Circle, Eyemouth	TD14 5DU	2.5	1A 7 G Circle PV	A
8 Gunsgreen Circle, Eyemouth	TD14 5DU	2.5	1A 8 G Circle PV	A
9 Gunsgreen Circle, Eyemouth	TD14 5DU	4	1C 62 Avenue PV	C
14 Gunsgreen Circle, Eyemouth	TD14 5DU	3.5	1A 14 G Circle PV	A
17 Lairds Hill, Eyemouth	TD14 5ED	2.5	1A 17 L Hill PV	A
19 Lairds Hill, Eyemouth	TD14 5ED	2.5	1B 19 L Hill PV	B
20 Lairds Hill, Eyemouth	TD14 5ED	2.5	1C 20 L Hill PV	C
6 Lairds Hill, Eyemouth	TD14 5ED	3	1C 6 L Hill PV	C
7 Lairds Hill, Eyemouth	TD14 5ED	3	1A 7 L Hill PV	A
8 Lairds Hill, Eyemouth	TD14 5ED	3	1B 8 L Hill PV	B
11 Lairds Hill, Eyemouth	TD14 5ED	3	1A 11 L Hill PV	A
13 Lairds Hill, Eyemouth	TD14 5ED	3	1A 13 L Hill PV	A
14 Lairds Hill, Eyemouth	TD14 5ED	2	1C 14 L Hill PV	C
15 Lairds Hill, Eyemouth	TD14 5ED	3.5	1B 15 L Hill PV	B
16 Lairds Hill, Eyemouth	TD14 5ED	3.5	1A 16 L Hill PV	A
81 The Avenue, Eyemouth	TD14 5EA	3.5	1B 81 Avenue PV	B
75 The Avenue, Eyemouth	TD14 5EA	3.5	1C 75 Avenue PV	C
73 The Avenue, Eyemouth	TD14 5EA	3.5	1A 73 Avenue PV	A
62 The Avenue, Eyemouth	TD14 5EA	4	1C 62 Avenue PV	C
60 The Avenue, Eyemouth	TD14 5EA	4	1A 60 Avenue PV	A
46 Queens Road, Eyemouth	TD14 5DS	3	2A 46 QR PV	A
40 Queens Road, Eyemouth	TD14 5DS	3	2B 40 QR PV	B
38 Queens Road, Eyemouth	TD14 5DS	3	2A 38 QR PV	A
36 Queens Road, Eyemouth	TD14 5DS	3.5	2C 36 QR PV	C
32 Queens Road, Eyemouth	TD14 5DS	3.5	2A 32 QR PV	A
30 Queens Road, Eyemouth	TD14 5DS	3	2A 30 QR PV	A
28 Queens Road, Eyemouth	TD14 5DS	3	2C 28 QR PV	C
26 Queens Road, Eyemouth	TD14 5DS	3	2B 26 QR PV	B
22 Queens Road, Eyemouth	TD14 5DS	3.5	2C 22 QR PV	C
20 Queens Road, Eyemouth	TD14 5DS	3.5	2B 20 QR PV	B
18 Queens Road, Eyemouth	TD14 5DS	3.5	2A 18 QR PV	A
42 Queens Road, Eyemouth	TD14 5DS	3	2C 42 QR PV	C
24 Queens Road, Eyemouth	TD14 5DS	3.5	2A 24 QR PV	A
44 Queens Road, Eyemouth	TD14 5DS	3	2A 44 QR PV	A
48 Queens Road, Eyemouth	TD14 5DS	3	2C 48 QR PV	C
62 Queens Road, Eyemouth	TD14 5DS	3.5	2A 62 QR PV	A
88 Queens Road, Eyemouth	TD14 5DS	3.5	2A 88 QR PV	A
79 Queens Road, Eyemouth	TD14 5DR	3.5	2C 79 QR PV	C
63 Queens Road, Eyemouth	TD14 5DR	3.5	2B 63 QR PV	B
61 Queens Road, Eyemouth	TD14 5DR	3.5	2B 61 QR PV	B
59 Queens Road, Eyemouth	TD14 5DR	3.5	2B 59 QR PV	B
57 Queens Road, Eyemouth	TD14 5DR	3.5	2B 57 QR PV	B
55 Queens Road, Eyemouth	TD14 5DR	3.5	2B 55 QR PV	B
51 Queens Road, Eyemouth	TD14 5DR	3.5	2B 51 QR PV	B
49 Queens Road, Eyemouth	TD14 5DR	3.5	2B 49 QR PV	B
53 Queens Road, Eyemouth	TD14 5DR	3.5	2B 53 QR PV	B
76 Queens Road, Eyemouth	TD14 5DS	3.5	2B 76 QR PV	B
58 Queens Road, Eyemouth	TD14 5DS	3.5	2C 58 QR PV	C
60 Queens Road, Eyemouth	TD14 5DS	2.5	2C 60 QR PV	C
54 Queens Road, Eyemouth	TD14 5DS	3.5	2C 54 QR PV	C
86 Queens Road, Eyemouth	TD14 5DS	0.5	02A 86 QR inst PV	A

Table 73: Proposed PVs at Dovecote S/S

A 3.8 Dulcecraig

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
49 Hinkar Way, Eyemouth	TD14 5EH	4	1C 49 Hinkar Way PV	C
35 Hinkar Way, Eyemouth	TD14 5EH	2	1C 35 Hinkar Way PV	C
37 Hinkar Way, Eyemouth	TD14 5EH	2	1B 37 Hinkar Way PV	B
28 Dulse Craig, Eyemouth	TD14 5EJ	2	1B 28 Dulce Craig PV	B
60 Hinkar Way, Eyemouth	TD14 5EH	2	1B 60 Hinkar Way PV	B
18 Fancove Place, Eyemouth	TD14 5JQ	4	1B 18 Fancove Place PV	B
66 Haymons Cove, Eyemouth	TD14 5EG	4	3B 66 Haymons Cove PV	B
62 Haymons Cove, Eyemouth	TD14 5EG	3	3B 62 Haymons Cove PV	B
58 Haymons Cove, Eyemouth	TD14 5EG	4	3C 58 Haymons Cove PV	C
60 Haymons Cove, Eyemouth	TD14 5EG	4	3B 60 Haymons Cove PV	B
54 Haymons Cove, Eyemouth	TD14 5EG	3	3A 54 Haymons Cove PV	A
46 Haymons Cove, Eyemouth	TD14 5EG	3.5	3B 46 Haymons Cove PV	B
40 Haymons Cove, Eyemouth	TD14 5EG	4	3A 40 Haymons Cove PV	A
41 Haymons Cove, Eyemouth	TD14 5EG	4	3B 41 Haymons Cove PV	B
30 Haymons Cove, Eyemouth	TD14 5EG	4	3B 30 Haymons Cove PV	B
13 Dulse Craig, Eyemouth	TD14 5EJ	3.5	3A 13 Dulce Craig PV	A
12 Dulse Craig, Eyemouth	TD14 5EJ	4	3A 12 Dulce Craig PV	A
10 Dulse Craig, Eyemouth	TD14 5EJ	4	3B 10 Dulce Craig PV	B
9 Dulse Craig, Eyemouth	TD14 5EJ	4	3B 9 Dulce Craig PV	B
33 Haymons Cove, Eyemouth	TD14 5EG	2	3A 33 Haymons Cove PV	A
67 Haymons Cove, Eyemouth	TD14 5EG	4	3C 67 Haymons Cove PV	C
65 Haymons Cove, Eyemouth	TD14 5EG	4	3C 65 Haymons Cove PV	C
42 Haymons Cove, Eyemouth	TD14 5EG	4	3A 42 Haymons Cove PV	A
80 Haymons Cove, Eyemouth	TD14 5EG	4	2C 80 Haymons Cove PV	C
79 Haymons Cove, Eyemouth	TD14 5EG	4	2C 79 Haymons Cove PV	C
78 Haymons Cove, Eyemouth	TD14 5EG	4	2B 78 Haymons Cove PV	B
77 Haymons Cove, Eyemouth	TD14 5EG	4	2A 77 Haymons Cove PV	A
76 Haymons Cove, Eyemouth	TD14 5EG	4	2C 76 Haymons Cove PV	C
75 Haymons Cove, Eyemouth	TD14 5EG	4	2B 75 Haymons Cove PV	B
74 Haymons Cove, Eyemouth	TD14 5EG	4	2A 74 Haymons Cove PV	A
73 Haymons Cove, Eyemouth	TD14 5EG	4	2C 73 Haymons Cove PV	C
72 Haymons Cove, Eyemouth	TD14 5EG	4	2B 72 Haymons Cove PV	B
71 Haymons Cove, Eyemouth	TD14 5EG	4	2A 71 Haymons Cove PV	A
32 Dulse Craig, Eyemouth	TD14 5EJ	2	2A 32 Dulce Craig PV	A
12 Haymons Cove, Eyemouth	TD14 5EG	4	2A 12 Haymons Cove PV	A
41 Hinkar Way, Eyemouth	TD14 5EH	4	01B 41 Hinkar Way inst PV	B
46 Hinkar Way, Eyemouth	TD14 5EH	3	01A 46 Hinkar Way inst PV	A
11 Dulse Craig, Eyemouth	TD14 5EJ	3.5	03B 11 Dulce Craig inst PV	B
22 Dulse Craig, Eyemouth	TD14 5EJ	2	03A 22 Dulce Craig inst PV	A
24 Dulse Craig, Eyemouth	TD14 5EJ	2	03B 24 Dulce Craig inst PV	B
13 Dulse Craig, Eyemouth	TD14 5EJ	1.75	03A 13 Dulce Craig inst PV	A
47 Hinkar Way, Eyemouth	TD14 5EH	4	01A 47 Hinkar Way inst PV	A

Table 74: Proposed PVs at Dulcecraig S/S

A 3.9 Grantshouse

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
19 Mansefield, Grantshouse	TD11 3RN	3.5	1B Mansfield 19 PV	B
15 Mansefield, Grantshouse	TD11 3RN	3.5	1C Mansfield 15 PV	C
11 Mansefield, Grantshouse	TD11 3RN	3	1B Mansfield 11 PV	B
23 Mansefield, Grantshouse	TD11 3RN	3.5	1A Mansfield 23 PV	A
27 Mansefield, Grantshouse	TD11 3RN	3	1C Mansfield 27 PV	C
29 Mansefield, Grantshouse	TD11 3RN	3	1B Mansfield 29 PV	B
6 Mansefield, Grantshouse	TD11 3RN	4	1C Mansfield 6 PV	C
5 Mansefield, Grantshouse	TD11 3RN	4	1C Mansfield 5 PV	C
4 Mansefield, Grantshouse	TD11 3RN	4	1B Mansfield 4 PV	B
17 Mansefield, Grantshouse	TD11 3RN	3.5	1A Mansfield 17 PV	A
7 Mansefield, Grantshouse	TD11 3RN	3	1A Mansfield 7 PV	A
31 Mansefield, Grantshouse	TD11 3RN	0.5	01A Mansfield 31 inst PV	A

Table 75: Proposed PVs at Grantshouse S/S

A 3.10 Hawthorn Bank Duns

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
61 Rachel Drive, Duns	TD11 3LP	3.5	1C Rachael Drive 61 PV	C
59 Rachel Drive, Duns	TD11 3LP	3.5	1B Rachael Drive 59 PV	B
57 Rachel Drive, Duns	TD11 3LP	3.5	1A Rachael Drive 57 PV	A
63 Rachel Drive, Duns	TD11 3LP	3.5	1C Rachael Drive 63 PV	C
65 Rachel Drive, Duns	TD11 3LP	3.5	1B Rachael Drive 65 PV	B
67 Rachel Drive, Duns	TD11 3LP	3.5	1A Rachael Drive 67 PV	A
69 Rachel Drive, Duns	TD11 3LP	3.5	1A Rachael Drive 69 PV	A
71 Rachel Drive, Duns	TD11 3LP	3.5	1B Rachael Drive 71 PV	B
75 Rachel Drive, Duns	TD11 3LP	3.5	1C Rachael Drive 75 PV	C
77 Rachel Drive, Duns	TD11 3LP	3.5	1B Rachael Drive 77 PV	B
73 Rachel Drive, Duns	TD11 3LP	3.5	1C Rachael Drive 73 PV	C
79 Rachel Drive, Duns	TD11 3LP	3.5	1A Rachael Drive 79 PV	A
52 Hawthorn Bank, Duns	TD11 3HH	3.43	03A Hawthorn Bank 52 inst PV	A
56 Hawthorn Bank, Duns	TD11 3HH	3.5	03B Hawthorn Bank 56 inst PV	B
58 Hawthorn Bank, Duns	TD11 3HH	3.5	03A Hawthorn Bank 58 inst PV	A

Table 76: Proposed PVs at Hawthorn Bunk Duns S/S

A 3.11 Gunsgreenhill

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
7 Broad Street, Eyemouth	TD14 5DT	4	1B 7 Broad St PV	B
9 Broad Street, Eyemouth	TD14 5DT	4	1C 9 Broad St PV	C
9 Queens Road, Eyemouth	TD14 5DR	3	1B 9 QR PV	B
15 Queens Road, Eyemouth	TD14 5DR	4	1A 15 QR PV	A
21 Queens Road, Eyemouth	TD14 5DR	3	1C 21 QR PV	C
23 Queens Road, Eyemouth	TD14 5DR	3	1B 23 QR PV	B
29 Queens Road, Eyemouth	TD14 5DR	3.5	1A 29 QR PV	A
31 Queens Road, Eyemouth	TD14 5DR	3.5	1C 31 QR PV	C
47 Queens Road, Eyemouth	TD14 5DR	3	1A 47 QR PV	A
45 Queens Road, Eyemouth	TD14 5DR	3.5	1B 45 QR PV	B
43 Queens Road, Eyemouth	TD14 5DR	3.5	1C 43 QR PV	C
41 Queens Road, Eyemouth	TD14 5DR	3.5	1C 41 QR PV	C
39 Queens Road, Eyemouth	TD14 5DR	3	1A 39 QR PV	A
37 Queens Road, Eyemouth	TD14 5DR	3	1B 37 QR PV	B
35 Queens Road, Eyemouth	TD14 5DR	3.5	1C 35 QR PV	C
33 Queens Road, Eyemouth	TD14 5DR	3.5	1A 33 QR PV	A
19 The Avenue, Eyemouth	TD14 5DL	4	3C 19 Avenue PV	C
17 The Avenue, Eyemouth	TD14 5DL	4	3B 17 Avenue PV	B
27 The Avenue, Eyemouth	TD14 5DL	4	4B 27 Avenue PV	B
56 The Avenue, Eyemouth	TD14 5EB	2.5	4A 56 Avenue PV	A
52 The Avenue, Eyemouth	TD14 5EB	2.5	4A 52 Avenue PV	A
50 The Avenue, Eyemouth	TD14 5EB	2.5	4B 50 Avenue PV	B
48 The Avenue, Eyemouth	TD14 5EB	2.5	4A 48 Avenue PV	A
42 The Avenue, Eyemouth	TD14 5EB	4	4C 42 Avenue PV	C
40 The Avenue, Eyemouth	TD14 5EB	4	4C 40 Avenue PV	C
38 The Avenue, Eyemouth	TD14 5EB	4	4A 38 Avenue PV	A
36 The Avenue, Eyemouth	TD14 5EB	4	4B 36 Avenue PV	B
34 The Avenue, Eyemouth	TD14 5EB	4	4A 34 Avenue PV	A
65 The Avenue, Eyemouth	TD14 5EA	2.5	4A 65 Avenue PV	A
63 The Avenue, Eyemouth	TD14 5EA	2.5	4B 63 Avenue PV	B
61 The Avenue, Eyemouth	TD14 5EA	2.5	4A 61 Avenue PV	A
59 The Avenue, Eyemouth	TD14 5EA	2.5	4C 59 Avenue PV	C
57 The Avenue, Eyemouth	TD14 5EA	2.5	4A 57 Avenue PV	A
49 The Avenue, Eyemouth	TD14 5EA	2.5	4A 49 Avenue PV	A
45 The Avenue, Eyemouth	TD14 5EA	2.5	4A 45 Avenue PV	A
43 The Avenue, Eyemouth	TD14 5EA	2.5	4C 43 Avenue PV	C
39 The Avenue, Eyemouth	TD14 5EA	4	4C 39 Avenue PV	C
35 The Avenue, Eyemouth	TD14 5EA	4	4C 35 Avenue PV	C
33 The Avenue, Eyemouth	TD14 5EB	4	4B 33 Avenue PV	B
41 The Avenue, Eyemouth	TD14 5EA	4	4B 41 Avenue PV	B
11 Gunsgreen Crescent, Eyemouth	TD14 5DW	3.5	2C 11 G Crescent PV	C
13 Gunsgreen Crescent, Eyemouth	TD14 5DW	3.5	2C 13 G Crescent PV	C
16 Gunsgreen Crescent, Eyemouth	TD14 5DP	3	2A 16 G Crescent PV	A
13 Queens Road, Eyemouth	TD14 5DR	3	01C 13 QR inst PV	C
11 Queens Road, Eyemouth	TD14 5DR	3	01C 11 QR inst PV	C
32 The Avenue, Eyemouth	TD14 5EB	3	04C 32 Avenue inst PV	C

Table 77: Proposed PVs at Gungreenhill S/S

A 3.12 Hoprig Road

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
27 Crofts Road, Cockburnspath	TD13 5YB	4	3C 27 Crofts Road PV	C
25 Crofts Road, Cockburnspath	TD13 5YB	4	3C 25 Crofts Road PV	C
23 Crofts Road, Cockburnspath	TD13 5YB	4	3B 23 Crofts Road PV	B
21 Crofts Road, Cockburnspath	TD13 5YB	4	3A 21 Crofts Road PV	A
15 Croftsacre, Cockburnspath	TD13 5YD	4	3A 15 Croftsacre PV	A
17 Croftsacre, Cockburnspath	TD13 5YD	4	3B 17 Croftsacre PV	B
19 Croftsacre, Cockburnspath	TD13 5YD	4	3C 19 Croftsacre PV	C
21 Croftsacre, Cockburnspath	TD13 5YD	4	3A 21 Croftsacre PV	A
23 Croftsacre, Cockburnspath	TD13 5YD	4	3C 23 Croftsacre PV	C
25 Croftsacre, Cockburnspath	TD13 5YD	4	3C 25 Croftsacre PV	C
27 Croftsacre, Cockburnspath	TD13 5YD	4	3B 27 Croftsacre PV	B
29 Croftsacre, Cockburnspath	TD13 5YD	4	3B 29 Croftsacre PV	B
31 Croftsacre, Cockburnspath	TD13 5YD	4	3C 31 Croftsacre PV	C
33 Croftsacre, Cockburnspath	TD13 5YD	4	3A 33 Croftsacre PV	A
36 Croftsacre, Cockburnspath	TD13 5YD	3	3C 36 Croftsacre PV	C
34 Croftsacre, Cockburnspath	TD13 5YD	3	3C 34 Croftsacre PV	C
30 Croftsacre, Cockburnspath	TD13 5YD	3	3C 30 Croftsacre PV	C
28 Croftsacre, Cockburnspath	TD13 5YD	3	3A 28 Croftsacre PV	A
26 Croftsacre, Cockburnspath	TD13 5YD	3	3C 26 Croftsacre PV	C
18 Croftsacre, Cockburnspath	TD13 5YD	3	3B 18 Croftsacre PV	B
4 Crofts Road, Cockburnspath	TD13 5YB	4	2A 4 Crofts Road PV	A
3 Hoprig Road, Cockburnspath	TD13 5YA	2.5	2A 3 Hoprig Road PV	A
15 Crofts Road, Cockburnspath	TD13 5YB	2.5	2A 15 Crofts Road PV	A
13 Crofts Road, Cockburnspath	TD13 5YB	2.5	2C 13 Crofts Road PV	C
11 Crofts Road, Cockburnspath	TD13 5YB	2.5	2C 11 Crofts Road PV	C
9 Crofts Road, Cockburnspath	TD13 5YB	2.5	2C 9 Crofts Road PV	C
5 Crofts Road, Cockburnspath	TD13 5YB	2.5	2B 5 Crofts Road PV	B
3 Croftsacre, Cockburnspath	TD13 5YD	2.5	2A 3 Croftsacre PV	A
5 Croftsacre, Cockburnspath	TD13 5YD	2.5	2A 5 Croftsacre PV	A
14 Callander Place, Cockburnspath	TD13 5XY	4	2C 14 Callander PV	C
15 Callander Place, Cockburnspath	TD13 5XY	4	2A 15 Callander PV	A
18 Callander Place, Cockburnspath	TD13 5XY	4	2C 18 Callander PV	C
19A Callander Place, Cockburnspath	TD13 5XY	3	2C 19A Callander PV	C
19 Callander Place, Cockburnspath	TD13 5XY	3	2C 19 Callander PV	C
21 Callander Place, Cockburnspath	TD13 5XY	4	2C 21 Callander PV	C
22 Callander Place, Cockburnspath	TD13 5XY	4	2A 22 Callander PV	A
22 Croftsacre, Cockburnspath	TD13 5YD	3	03A 22 Croftsacre inst PV	A
2 Hoprig Road	TD13 5YA	0.5	02A 2 Hoprig Road inst PV	A

Table 78: Proposed PVs at Hoprig Road S/S

A 3.13 Leitholm Village

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
3 Cotter Lea, Leitholm	TD12 4JY	3	1B Cotterlea 3 PV	B
4 Cotter Lea, Leitholm	TD12 4JY	3	1B Cotterlea 4 PV	B
5 School Wynd, Leitholm	TD12 4JZ	4	1C School Wynd 5 PV	C
2 School Wynd, Leitholm	TD12 4JZ	4	1C School Wynd 2 PV	C
8 Ramsay Crescent, Leitholm	TD12 4JH	4	1B Ramsay Cres 8 PV	B
12 Ramsay Crescent, Leitholm	TD12 4JH	4	1C Ramsay Cres 12 PV	C
5 Ramsay Crescent, Leitholm	TD12 4JH	4	1A Ramsay Cres 5 PV	A
7 Ramsay Crescent, Leitholm	TD12 4JH	4	1A Ramsay Cres 7 PV	A
1 School Wynd, Leitholm	TD12 4JZ	4	1C School Wynd 1 PV	C
6 School Wynd, Leitholm	TD12 4JZ	4	1A School Wynd 6 PV	A
1 Ramsay Crescent, Leitholm	TD12 4JH	3.5	1C Ramsay Cres 1 PV	C
1 Graden Bank, Leitholm	TD12 4JG	4	3B Graden Bank 1 PV	B
2 Graden Bank, Leitholm	TD12 4JG	4	3C Graden Bank 2 PV	C
1 Mansefield, Leitholm	TD12 4JQ	3.5	3C Mansfield 1 PV	C
3 Mansefield, Leitholm	TD12 4JQ	3.5	3B Mansfield 3 PV	B
3 Graden Bank, Leitholm	TD12 4JG	4	3C Graden Bank 3 PV	C
2 Ramsey Crescent, Leitholm	TD12 4JH	4	01B Ramsay Cres 2 inst PV	B
Islay Cottage, Main Street, Leitholm	TD12 4JN	4	01B Islay Cot inst PV	B
The Cottage, Main Street, Leitholm	TD12 4JN	4	01A The Cottage inst PV	A

Table 79: Proposed PVs at Leitholm Village S/S

A 3.14 Swinton Duns

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
6 Carters Wynd, Swinton	TD11 3JG	4	2B Carters 5 PV	B
5 Carters Wynd, Swinton	TD11 3JG	4	2B Carters 6 PV	B
4 Carters Wynd, Swinton	TD11 3JG	4	2C Carters 4 PV	C
3 Carters Wynd, Swinton	TD11 3JG	4	2C Carters 3 PV	C
9 Carters Wynd, Swinton	TD11 3JG	4	2B Carters 9 PV	B
8 Carters Wynd, Swinton	TD11 3JG	4	2C Carters 8 PV	C
7 Carters Wynd, Swinton	TD11 3JG	4	2A Carters 7 PV	A
2 Carters Wynd, Swinton	TD11 3JG	4	2B Carters 2 PV	B
1 Carters Wynd, Swinton	TD11 3JG	4	2B Carters 1 PV	B
2 Wellfield Court, Swinton	TD11 3JR	3.5	2A Wel Court 2 PV	A
1 Wellfield Court, Swinton	TD11 3JR	3.5	2B Wel Court 1 PV	B
8 Wellfield, Swinton	TD11 3JF	3.5	2C Wellfield 8 PV	C
9 Wellfield, Swinton	TD11 3JF	3.5	2A Wellfield 9 PV	A
11 Wellfield, Swinton	TD11 3JF	3.5	2C Wellfield 11 PV	C
12 Wellfield, Swinton	TD11 3JF	3.5	2B Wellfield 12 PV	B
14 Wellfield, Swinton	TD11 3JF	3.5	2B Wellfield 14 PV	B
15 Wellfield, Swinton	TD11 3JF	3.5	2A Wellfield 15 PV	A
16 Wellfield, Swinton	TD11 3JF	3.5	2A Wellfield 16 PV	A
18 Wellfield, Swinton	TD11 3JF	2.5	2C Wellfield 18 PV	C
73 Main Street	TD11 3JF	3	02C Main 73 inst PV	C

Table 80: Proposed PVs at Swinton Duns S/S

A 3.15 Chirnside West End

Address	Postcode	System Size (kW)	PowerFactory PV Name	Phase
13 Croftsfield, Chirnside	TD11 3UX	4	5C 13 Crostfield PV	C
12 Croftsfield, Chirnside	TD11 3UX	4	5A 12 Crostfield PV	A
11 Croftsfield, Chirnside	TD11 3UX	4	5C 11 Crostfield PV	C
10 Croftsfield, Chirnside	TD11 3UX	3	5C 10 Crostfield PV	C
9 Croftsfield, Chirnside	TD11 3UX	3	5B 9 Crostfield PV	B
8 Croftsfield, Chirnside	TD11 3UX	3	5A 8 Crostfield PV	A
7 Croftsfield, Chirnside	TD11 3UX	3	5A 7 Crostfield PV	A
5 East Croftsfield, Chirnside	TD11 3UZ	4	5B 5 East Crostfield PV	B
7 East Croftsfield, Chirnside	TD11 3UZ	4	5B 7 East Crostfield PV	B
9 East Croftsfield, Chirnside	TD11 3UZ	4	5A 9 East Crostfield PV	A
2 East Croftsfield, Chirnside	TD11 3UZ	4	5B 2 East Crostfield PV	B
4 East Croftsfield, Chirnside	TD11 3UZ	4	5B 4 East Crostfield PV	B
6 East Croftsfield, Chirnside	TD11 3UZ	4	5A 6 East Crostfield PV	A
11 East Croftsfield, Chirnside	TD11 3UZ	4	5A 11 East Crostfield PV	B
1 East Croftsfield, Chirnside	TD11 3UZ	4	5B 1 East Crostfield PV	B
11 Windram Road, Chirnside	TD11 3UT	4	5A 11 Windram Road PV	A
18 Windram Road, Chirnside	TD11 3UT	4	5A 18 Windram Road PV	A
22 Windram Road, Chirnside	TD11 3UT	4	5C 22 Windram Road PV	C
9 Lammerview, Chirnside	TD11 3UN	2.5	3C 9 Lammerview PV	C
11 Lammerview, Chirnside	TD11 3UN	2.5	3A 11 Lammerview PV	A
13 Lammerview, Chirnside	TD11 3UN	2.5	3B 13 Lammerview PV	B
17 Lammerview, Chirnside	TD11 3UN	4	3C 17 Lammerview PV	C
19 Lammerview, Chirnside	TD11 3UN	4	3B 19 Lammerview PV	B
6 Lammerview, Chirnside	TD11 3UW	2.5	3A 6 Lammerview PV	A
8 Lammerview, Chirnside	TD11 3UW	2.5	3A 8 Lammerview PV	A
12 Lammerview, Chirnside	TD11 3UW	2.5	3B 12 Lammerview PV	B
14 Lammerview, Chirnside	TD11 3UW	2.5	3B 14 Lammerview PV	B
20 Lammerview, Chirnside	TD11 3UW	4	3C 20 Lammerview PV	C
16 Lammerview, Chirnside	TD11 3UW	2.5	3B 16 Lammerview PV	B
2 Greenwell Avenue, Chirnside	TD11 3UU	3.5	1A 2 Greenwell PV	A
6 Greenwell Avenue, Chirnside	TD11 3UU	3.5	1C 6 Greenwell PV	C
12 Greenwell Avenue, Chirnside	TD11 3UU	3.5	1A 12 Greenwell PV	A
16 Greenwell Avenue, Chirnside	TD11 3UU	3.5	1C 16 Greenwell PV	C
18 Greenwell Avenue, Chirnside	TD11 3UU	3.5	1A 18 Greenwell PV	A
1 Greenwell Avenue, Chirnside	TD11 3UU	3.5	1B 1 Greenwell PV	B
5 Greenwell Avenue, Chirnside	TD11 3UU	3.5	1B 5 Greenwell PV	B
7 Greenwell Avenue, Chirnside	TD11 3UU	3.5	1B 7 Greenwell PV	B
15 Greenwell Avenue, Chirnside	TD11 3UU	3.5	1B 15 Greenwell PV	B
14 Croftsfield, Chirnside	TD11 3UX	4	5A 14 Crostfield PV	A
3 Windram Road, Chirnside	TD11 3UT	4	1B 3 Windram Road PV	B
7 Windram Road, Chirnside	TD11 3UT	4	1C 7 Windram Road PV	C
5 Windram Road, Chirnside	TD11 3UT	4	1B 5 Windram Road PV	B
1 Windram Road, Chirnside	TD11 3UT	4	1A 1 Windram Road PV	A
18 Windram Place, Chirnside	TD11 3UP	3.5	2B 18 Windram Place PV	B
6 Windram Place, Chirnside	TD11 3UP	2.5	2B 6 Windram Place PV	B
4 Windram Place, Chirnside	TD11 3UP	2.5	2B 4 Windram Place PV	B
2 Windram Place, Chirnside	TD11 3UP	2.5	2B 2 Windram Place PV	B
19 Windram Place, Chirnside	TD11 3UR	3.5	2B 19 Windram Place PV	B
15 Windram Place, Chirnside	TD11 3UR	2.5	2A 15 Windram Place PV	A
13 Windram Place, Chirnside	TD11 3UR	2.5	2A 13 Windram Place PV	A
8 Windram Place, Chirnside	TD11 3UP	2.5	2B 8 Windram Place PV	B
Rosslee		4	04A Rosslee inst PV	A

Table 81: Proposed PVs at Chirnside West End S/S

Appendix 4 Loads included in the models

This appendix contains detailed information about loads per each substation. The information was based on SPEN's GIS database (explained in Section 3.2).

Each table shows PowerFactory load name and phasing. The following indices were used for different phasing:

- Single phase
    - Red phase – A
    - Yellow phase – B
    - Blue phase – C
- Three phase – 3

Each load name includes a feeder and phase the load is connected to, and load address. For example, *2A Lawfield Drive 10 Load* is load connected to feeder 2, phase A, at address Lawfield Drive 10, while *23 Earls Meadow 13 Load* is 3-phase load connected to feeder 2, at address Earls Meadow 13.

A 4.1 Ayton Lawfield

PowerFactory Load Name	Phase
13 Bowling Load	3-phase
13 Craigavon Load	3-phase
1A Orchard House Load	A
1A Vicarsford Load	A
1B Black Smiths Load	B
1B Goodwood House Load	B
1B Hill View Load	B
1C Red Lion Cottage Load	C
1C Sawnill House Load	C
1C Stratheye Load	C
2A Lawfield Drive 10 Load	A
2A Lawfield Drive 11 Load	A
2A Lawfield Drive 12 Load	A
2A Lawfield Drive 13 Load	A
2A Lawfield Drive 17 Load	A
2A Lawfield Drive 18 Load	A
2A Lawfield Drive 3 Load	A
2A Lawfield Drive 34 Load	A
2A Lawfield Drive 35 Load	A
2A Lawfield Drive 36 Load	A
2A Ligna House Load	A
2B Lawfield Drive 1 Load	B
2B Lawfield Drive 14 Load	B
2B Lawfield Drive 16 Load	B
2B Lawfield Drive 2 Load	B
2B Lawfield Drive 22 Load	B
2B Lawfield Drive 24 Load	B
2B Lawfield Drive 29 Load	B
2B Lawfield Drive 30 Load	B
2B Lawfield Drive 31 Load	B
2B Lawfield Drive 32 Load	B
2B Lawfield Drive 33 Load	B
2B Lawfield Drive 37 Load	B
2B Lawfield Drive 39 Load	B
2B Lawfield Drive 4 Load	B
2B Lawfield Drive 5 Load	B
2B Lawfield Drive 7 Load	B

PowerFactory Load Name	Phase
2C Lawfield Drive 15 Load	C
2C Lawfield Drive 19 Load	C
2C Lawfield Drive 20 Load	C
2C Lawfield Drive 21 Load	C
2C Lawfield Drive 23 Load	C
2C Lawfield Drive 25 Load	C
2C Lawfield Drive 26 Load	C
2C Lawfield Drive 271 Load	C
2C Lawfield Drive 28 Load	C
2C Lawfield Drive 6 Load	C
2C Lawfield Drive 8 Load	C
2C Lawfield Drive 9 Load	C
33 Ayton Primary School	3-phase
43 El sub Sta	3-phase
4A Lawfield Drive 41 Load	A
4A Lawfield Drive 44 Load	A
4A Lawfield Drive 45 Load	A
4A Lawfield Drive 47 Load	A
4A Lawfield Drive 48 Load	A
4A Lawfield Drive 50 Load	A
4A Lawfield Drive 55 Load	A
4A Lawfield Drive 58 Load	A
4B Lawfield Drive 40 Load	B
4B Lawfield Drive 43 Load	B
4B Lawfield Drive 46 Load	B
4B Lawfield Drive 51 Load	B
4B Lawfield Drive 52 Load	B
4B Lawfield Drive 57 Load	B
4B Lawfield Drive 59 Load	B
4B Lawfield Drive 61 Load	B
4C Lawfield Drive 38 Load	C
4C Lawfield Drive 42 Load	C
4C Lawfield Drive 49 Load	C
4C Lawfield Drive 53 Load	C
4C Lawfield Drive 54 Load	C
4C Lawfield Drive 60 Load	C

Table 82: Loads connected to Ayton Lawfield S/S

A 4.2 Briery Baulk

PowerFactory Load Name	Phase
23 Earls Meadow 13 Load	3-phase
23 Earls Meadow 15 Load	3-phase
23 Turnbull Court 38-42 Load	3-phase
23 Turnbull Court 43-48 Load	3-phase
23 Turnbull Court 74a Load	3-phase
23 Turnbull Court 74b Load	3-phase
23 Turnbull Court 74c Load	3-phase
2A Earls Meadow 17 Load	A
2A Turnbull Court 74d Load	A
2C Brierybaulk 38 Load	C
2C Earls Meadow 14 Load	C
2C Earls Meadow 16 Load	C
3A Brierybaulk 1 Load	A
3A Brierybaulk 10 Load	A
3A Brierybaulk 12 Load	A
3A Brierybaulk 13 Load	A
3A Brierybaulk 14 Load	A
3A Brierybaulk 15 Load	A
3A Brierybaulk 16 Load	A
3A Brierybaulk 25 Load	A
3A Brierybaulk 27 Load	A
3A Brierybaulk 3 Load	A
3A Brierybaulk 33 Load	A
3A Brierybaulk 34 Load	A
3A Brierybaulk 35 Load	A
3A Brierybaulk 36 Load	A
3A Brierybaulk 40 Load	A
3A Brierybaulk 41 Load	A
3A Brierybaulk 43 Load	A
3A Brierybaulk 49 Load	A
3A Brierybaulk 51 Load	A
3A Brierybaulk 69 Load	A
3A Brierybaulk 71 Load	A
3A Brierybaulk 73 Load	A
3A Brierybaulk 75 Load	A
3A Tel Kiosk Load	A
3B Brierybaulk 11 Load	B
3B Brierybaulk 17 Load	B
3B Brierybaulk 18 Load	B
3B Brierybaulk 19 Load	B
3B Brierybaulk 20 Load	B
3B Brierybaulk 26 Load	B
3B Brierybaulk 28 Load	B
3B Brierybaulk 37 Load	B
3B Brierybaulk 45 Load	B
3B Brierybaulk 47 Load	B
3B Brierybaulk 53 Load	B
3B Brierybaulk 55 Load	B
3B Brierybaulk 57 Load	B
3B Brierybaulk 59 Load	B
3B Brierybaulk 77 Load	B
3B Brierybaulk 79 Load	B
3B Brierybaulk 81 Load	B
3B Brierybaulk 83 Load	B
3B Brierybaulk 9 Load	B
3C Brierybaulk 2 Load	C
3C Brierybaulk 21 Load	C
3C Brierybaulk 22 Load	C
3C Brierybaulk 23 Load	C
3C Brierybaulk 24 Load	C
3C Brierybaulk 29 Load	C
3C Brierybaulk 30 Load	C
3C Brierybaulk 31 Load	C
3C Brierybaulk 32 Load	C
3C Brierybaulk 39 Load	C
3C Brierybaulk 4 Load	C
3C Brierybaulk 5 Load	C
3C Brierybaulk 6 Load	C
3C Brierybaulk 61 Load	C
3C Brierybaulk 63 Load	C
3C Brierybaulk 65 Load	C
3C Brierybaulk 67 Load	C
3C Brierybaulk 7 Load	C
3C Brierybaulk 8 Load	C
3C Brierybaulk 85 Load	C
3C Brierybaulk 87 Load	C
3C Brierybaulk 89 Load	C
3C Brierybaulk 91 Load	C
3C Public Conv Load	C
43 Blinkbone Gardens 11-12 Load	3-phase
43 Blinkbone Gardens 15-16 Load	3-phase
43 Blinkbone Gardens 17-18 Load	3-phase
43 Blinkbone Gardens 21-22 Load	3-phase
43 Blinkbone Gardens 23-24 Load	3-phase
43 Blinkbone Gardens 25-26 Load	3-phase
43 Blinkbone Gardens 9-10 Load	3-phase
4A Blinkbone Gardens 1 Load	A
4A Blinkbone Gardens 2 Load	A
4A Blinkbone Gardens 7a Loa	A
4A Blinkbone Gardens 7b Loa	A
4A Blinkbone Gardens 8 Load	A
4A Briery Place 1 Load	A
4A Briery Place 3 Load	A
4A Camilla Cot Load	A
4A Murray Crescent 10 Load	A
4A Murray Crescent 12 Load	A
4A Murray Crescent 5 Load	A
4A Murray Crescent 7 Load	A
4A Murray Crescent 9 Load	A
4B Blinkbone Gardens 3 Load	B
4B Blinkbone Gardens 4 Load	B
4B Briery Place 22 Load	B
4B Briery Place 24 Load	B
4B Briery Place 5 Load	B
4B Briery Place 6 Load	B
4B Briery Place 7 Load	B
4B Briery Place 8 Load	B
4B Murray Crescent 2 Load	B
4B Murray Crescent 3 Load	B
4B Murray Crescent 4 Load	B
4B Murray Crescent 6 Load	B
4C Blinkbone Gardens 13 Loa	C
4C Blinkbone Gardens 14 Loa	C
4C Blinkbone Gardens 5 Load	C
4C Blinkbone Gardens 6 Load	C
4C Briery Place 10 Load	C
4C Briery Place 11 Load	C
4C Briery Place 12 Load	C
4C Briery Place 14 Load	C
4C Briery Place 16 Load	C
4C Briery Place 18 Load	C
4C Briery Place 2 Load	C
4C Briery Place 20 Load	C
4C Briery Place 4 Load	C
4C Briery Place 9 Load	C
4C Murray Crescent 1 Load	C
4C Murray Crescent 11 Load	C
4C Murray Crescent 13 Load	C
4C Murray Crescent 8 Load	C

Table 83: Loads connected to Briery Baulk S/S

A 4.3 Buss Craig

PowerFactory Load Name	Phase
1A Gunsgreen Cres 17 Load	A
1A Gunsgreen Cres 19 Load	A
1A Gunsgreen Cres 21-23 Load	A
1A Gunsgreen Cres 22 Load	A
1A Gunsgreen Cres 24 Load	A
1A Gunsgreen Cres 25 Load	A
1A Gunsgreen Cres 27 Load	A
1C Gunsgreen Cres 26 Load	C
1C Gunsgreen Cres 28 Load	C
23 Gunsgreen Cres 31 Load	3-phase
2A Gunsgreen Cres 34 Load	A
2A Gunsgreen Cres 35 Load	A
2A Gunsgreen Cres 36 Load	A
2A Gunsgreen Cres 41 Load	A
2A Gunsgreen Cres 42 Load	A
2A Gunsgreen Cres 47 Load	A
2A Gunsgreen Cres 49 Load	A
2A Gunsgreen Cres 50 Load	A
2A Gunsgreen Cres 52 Load	A
2A Sanderson 1 Load	A
2A Sanderson 10 Load	A
2A Sanderson 6 Load	A
2A Sanderson 7 Load	A
2A Skeldons 1 Load	A
2A Skeldons 10 Load	A
2A Skeldons 12 Load	A
2A Skeldons 14 Load	A
2A Skeldons 17 Load	A
2A Skeldons 2 Load	A
2A Skeldons 5 Load	A
2A Skeldons 8 Load	A
2A Stebbings 27 Load	A
2A Stebbings 33 Load	A
2A Stebbings 42 Load	A
2A Stebbings 52 Load	A
2B Ggh Cot 1 Load	B
2B Ggh Cot 2 Load	B
2B Ggh Cot 3 Load	B
2B Gunsgreen Cres 37 Load	B
2B Gunsgreen Cres 40 Load	B
2B Gunsgreen Cres 43 Load	B
2B Gunsgreen Cres 48 Load	B

PowerFactory Load Name	Phase
2B Gunsgreen Cres 51 Load	B
2B Sanderson 2 Load	B
2B Sanderson 5 Load	B
2B Sanderson 8 Load	B
2B Skeldons 11 Load	B
2B Skeldons 16 Load	B
2B Skeldons 18 Load	B
2B Skeldons 3 Load	B
2B Skeldons 6 Load	B
2B Stebbings 31 Load	B
2B Stebbings 44 Load	B
2B Stebbings 50 Load	B
2C Ggh Cot 4 Load	C
2C Ggh Cot 5 Load	C
2C Ggh Cot 6 Load	C
2C Gunsgreen Cres 29 Load	C
2C Gunsgreen Cres 38 Load	C
2C Gunsgreen Cres 39 Load	C
2C Gunsgreen Cres 44 Load	C
2C Gunsgreen Cres 45 Load	C
2C Gunsgreen Cres 46 Load	C
2C Gunsgreen Cres 54 Load	C
2C Sanderson 3 Load	C
2C Sanderson 4 Load	C
2C Sanderson 9 Load	C
2C Skeldons 13 Load	C
2C Skeldons 15 Load	C
2C Skeldons 4 Load	C
2C Skeldons 7 Load	C
2C Skeldons 9 Load	C
2C Stebbings 29 Load	C
2C Stebbings 46 Load	C
2C Stebbings 48 Load	C
3A Ardroy Load	A
3A Buss Craig Pl 12 Load	A
3A Buss Craig Pl 15 Load	A
3A Buss Craig Pl 2 Load	A
3A Buss Craig Pl 5 Load	A
3A Buss Craig Pl 6 Load	A
3A Buss Craig Pl 9 Load	A
3A Buss Craig R 12 Load	A
3A Buss Craig R 6 Load	A

PowerFactory Load Name	Phase
3A The Avenue 5 Load	A
3A The Avenue 5a Load	A
3A The Avenue 2 Load	A
3B Buss Craig Pl 1 Load	B
3B Buss Craig Pl 11 Load	B
3B Buss Craig Pl 14 Load	B
3B Buss Craig Pl 4 Load	B
3B Buss Craig Pl 8 Load	B
3B Buss Craig Pl 8a Load	B
3B Buss Craig R 14 Load	B
3B Buss Craig R 4 Load	B
3B Buss Craig R 8 Load	B
3B The Avenue 4 Load	B
3B The Avenue 4a Load	B
3C Buss Craig Pl 10 Load	C
3C Buss Craig Pl 13 Load	C
3C Buss Craig Pl 3 Load	C
3C Buss Craig Pl 7 Load	C
3C Buss Craig R 10 Load	C
3C Buss Craig R 16 Load	C
3C Buss Craig R 2 Load	C
3C The Avenue 3 Load	C
3C The Avenue 3a Load	C
4A Buss Craig R 0 Load	A
4A Buss Craig R 1 Load	A
4A Buss Craig R 3 Load	A
4A Gunsgreen Cres 30 Load	A
4A Gunsgreen Cres 32 Load	A
4A The Avenue 0 Load	A
4A The Avenue 12 Load	A
4A The Avenue 13 Load	A
4A The Avenue 7 Load	A
4A The Avenue 8 Load	A
4A The Avenue 9 Load	A
4B Buss Craig R 5 Load	B
4B Buss Craig R 7 Load	B
4B The Avenue 10 Load	B
4B The Avenue 6 Load	B
4C Buss Craig R 11 Load	C
4C Buss Craig R 9 Load	C
4C The Avenue 11 Load	C

Table 84: Loads connected to Buss Craig S/S

A 4.4 Castle Street

PowerFactory Load Name	Phase	PowerFactory Load Name	Phase	PowerFactory Load Name	Phase
1A Castle St 29 Load	A	2B Castle St 28b Load	B	4A Glebe Park 54 Load	A
1A Castle St 35 Load	A	2B Castle St 4 Load	B	4A Glebe Park 6 Load	A
1A Castle St 37 Load	A	2B Castle St 4b Load	B	4A Glebe Park 60 Load	A
1A Castle St 41 Load	A	2C Castle St 10 Load	C	4A Glebe Park 7 Load	A
1B Castle St 43 Load	B	2C Castle St 11 Load	C	4A Glebe Park 8 Load	A
1A Castle St 53 Load	A	2C Castle St 19 Load	C	4B Craigrowan Load	B
1A Castle St 63 Load	A	2C Castle St 21 Load	C	4B Easter St 29 Load	B
1A Castle St 64 Load	A	2C Castle St 26 Load	C	4B Easter St 31 Load	B
1A Castle St 65 Load	A	2C Castle St 26b Load	C	4B Glebe Court 1-2 Load	B
1A Castle St 66-68 Load	A	2C Castle St 6-8 Load	C	4B Glebe Court 3-4 Load	B
1A Castle St 76 Load	A	2C Sheriff Court Load	C	4B Glebe Park 17 Load	B
1A Green Teinohill 13 Load	A	33 Manse G 14-19 Load	3-phase	4B Glebe Park 19 Load	B
1A Green Teinohill 3 Load	A	33 Manse G 23-28 Load	3-phase	4B Glebe Park 2 Load	B
1A Green Teinohill 5 Load	A	33 Manse G 7-10 Load	3-phase	4B Glebe Park 20 Load	B
1A Green Teinohill 8 Load	A	3A El Sub Sta Load	A	4B Glebe Park 22 Load	B
1C North Lodge Load	C	3A Manse G 1 Load	A	4B Glebe Park 30 Load	B
1B Castle St 33 Load	B	3A Manse G 12 Load	A	4B Glebe Park 32 Load	B
1B Castle St 47 Load	B	3A Manse G 21 Load	A	4B Glebe Park 35 Load	B
1B Castle St 49 Load	B	3A Manse G 22 Load	A	4B Glebe Park 37 Load	B
1B Castle St 51 Load	B	3A Manse G 29 Load	A	4B Glebe Park 4 Load	B
1B Castle St 57-59 Load	B	3A Manse G 30 Load	A	4B Glebe Park 42 Load	B
1B Castle St 61 Load	B	3A Manse G 4 Load	A	4B Glebe Park 43 Load	B
1B Castle St 74 Load	B	3B Manse G 11 Load	B	4B Glebe Park 44 Load	B
1B Green Teinohill 1 Load	B	3B Manse G 2 Load	B	4B Glebe Park 45 Load	B
1B Green Teinohill 12 Load	B	3B Manse G 31 Load	B	4B Glebe Park 46 Load	B
1B Green Teinohill 2 Load	B	3B Manse G 5 Load	B	4B Glebe Park 47 Load	B
1B Green Teinohill 6 Load	B	3C Manse G 13 Load	C	4B Glebe Park 48 Load	B
1C Castle St 31 Load	C	3C Manse G 20 Load	C	4B Glebe Park 49 Load	B
1C Castle St 39 Load	C	3C Manse G 3 Load	C	4B Glebe Park 55 Load	B
1C Castle St 39b Load	C	3C Manse G 32 Load	C	4B Glebe Park 56 Load	B
1C Castle St 45 Load	C	3C Manse G 6 Load	C	4B Glebe Park 57 Load	B
1C Castle St 55 Load	C	43 Glebe Court 5 Load	3-phase	4C Easter St 33 Load	C
1C Castle St 62 Load	C	43 Glebe Court 6-12 Load	3-phase	4C Easter St 35 Load	C
1C Castle St 70 Load	C	4A Easter St 25 Load	A	4C Glebe Park 11 Load	C
1C Castle St 72 Load	C	4A Easter St 27 Load	A	4C Glebe Park 14 Load	C
1C Green Teinohill 10 Load	C	4A Glebe Park 1 Load	A	4C Glebe Park 16 Load	C
1C Green Teinohill 11 Load	C	4A Glebe Park 10 Load	A	4C Glebe Park 18 Load	C
1C Green Teinohill 7 Load	C	4A Glebe Park 12 Load	A	4C Glebe Park 21 Load	C
1C Green Teinohill 9 Load		4A Glebe Park 13 Load	A	4C Glebe Park 23 Load	C
1C Manse Load	C	4A Glebe Park 15 Load	A	4C Glebe Park 24 Load	C
23 Castle St 1 Load	3-phase	4A Glebe Park 25 Load	A	4C Glebe Park 29 Load	C
23 Castle St 14 Load	3-phase	4A Glebe Park 26 Load	A	4C Glebe Park 31 Load	C
23 Castle St 18-20 Load	3-phase	4A Glebe Park 27 Load	A	4C Glebe Park 34 Load	C
23 Castle St 3 Load	3-phase	4A Glebe Park 28 Load	A	4C Glebe Park 36 Load	C
23 Castle St 7 Load	3-phase	4A Glebe Park 3 Load	A	4C Glebe Park 38 Load	C
23 Castle St 9 Load	3-phase	4A Glebe Park 33 Load	A	4C Glebe Park 39 Load	C
23 Police St Load	3-phase	4A Glebe Park 38 Load	A	4C Glebe Park 40 Load	C
23 Police St Load(1)	3-phase	4A Glebe Park 5 Load	A	4C Glebe Park 41 Load	C
23 Police St Load(2)	3-phase	4A Glebe Park 50 Load	A	4C Glebe Park 58 Load	C
2A Castle St 16 Load	A	4A Glebe Park 51 Load	A	4C Glebe Park 59 Load	C
2A Castle St 28 Load	A	4A Glebe Park 52 Load	A	4C Glebe Park 61 Load	C
2B Castle St 13 Load	B	4A Glebe Park 53 Load	A	4C Glebe Park 9 Load	C

Table 85: Loads connected to Castle Street S/S

A 4.5 Churchill

PowerFactory Load Name	Phase
13 Town Hall Load	3-phase
2A Churchill 1 Load	A
2A Churchill 10 Load	A
2A Churchill 12 Load	A
2A Churchill 15 Load	A
2A Churchill 2 Load	A
2A Churchill 21 Load	A
2A Churchill 22 Load	A
2A Churchill 27 Load	A
2A Churchill 28 Load	A
2A Churchill 29 Load	A
2A Churchill 30 Load	A
2A Churchill 5 Load	A
2A Churchill 8 Load	A
2A Churchill 9 Load	A
2A Kirklea Load	A
2B Churchill 13 Load	B
2B Churchill 17 Load	B
2B Churchill 18 Load	B
2B Churchill 20 Load	B
2B Churchill 23 Load	B
2B Churchill 4 Load	B
2B Churchill 7 Load	B
2C Churchill 11 Load	C
2C Churchill 14 Load	C
2C Churchill 16 Load	C
2C Churchill 19 Load	C
2C Churchill 24 Load	C
2C Churchill 25 Load	C
2C Churchill 26 Load	C
2C Churchill 3 Load	C
2C Churchill 31 Load	C
2C Churchill 32 Load	C
2C Churchill 6 Load	C
33 Church Street 3 Load	3-phase
33 East HS 17 Load	3-phase
3A Church Street 1 Load	A
3A Church Street 2 Load	A
3A Church Street 3b Load	A
3A East HS 1 Load	A
3A East HS 11 Load	A
3A East HS 19 Load	A
3A East HS 27 Load	A
3A East HS 33 Load	A
3A East HS 9 Load	A
3B Church Street 4 Load	B
3B Church Street 4b Load	B
3B East HS 15 Load	B
3B East HS 21 Load	B
3B East HS 23 Load	B
3B East HS 25 Load	B
3B East HS 3 Load	B
3B East HS 7 Load	B
3C Church Street 5 Load	C
3C East HS 29 Load	C
3C East HS 31 Load	C
3C East HS 5 Load	C
43 Eastbank Load	3-phase
43 Filling Station Load	3-phase
43 Football Ground Load	3-phase
43 Football Load	3-phase
4A Depot Load	A
4A East HS 12 Load	A
4A East HS 14 Load	A
4A East HS 2 Load	A
4A East HS 22 Load	A
4A East HS 24 Load	A
4A East HS 26 Load	A
4A East HS 28 Load	A
4A East HS 30 Load	A
4A East HS 32 Load	A
4A Eastbank Load	A
4A The Crossing Load	A
4A The Square 10 Load	A
4B Benlawers Load	B
4B East HS 10 Load	B
4B East HS 20 Load	B
4B East HS 34 Load	B
4B East HS 38 Load	B
4B East HS 40 Load	B
4B The Square 9 Load	B
4B The Square 9b Load	B
4C East HS 16 Load	C
4C East HS 18 Load	C
4C East HS 34b Load	C
4C East HS 36 Load	C
4C East HS 4 Load	C
4C East HS 42 Load	C
4C East HS 6-8 Load	C
4C The Square 7 Load	C
4C The Square 8 Load	C

Table 86: Loads connected to Chirchill S/S

A 4.6 Deanhead

PowerFactory Load Name	Phase
1A Pocklaw Slap 11 Load	A
1A Pocklaw Slap 12 Load	A
1A Pocklaw Slap 8 Load	A
1B Pocklaw Slap 10 Load	B
1B Pocklaw Slap 5 Load	B
1B Pocklaw Slap 7 Load	B
1C Pocklaw Slap 6 Load	C
1C Pocklaw Slap 9 Load	C
23 Fortunatus Load	3-phase
2A Barcaldine Load	A
2A Barefoots Av 16 Load	A
2A Barefoots Av 2 Load	A
2A Barefoots Av 6 Load	A
2A Barefoots Dr 7 Load	A
2A Barefoots Park 6 Load	A
2A Barefoots Road 3 Load	A
2A Barefoots Road 4 Load	A
2A Barefoots Road 8 Load	A
2A Killiedene Load	A
2A Northburn R 21 Load	A
2A Northburn R 22 Load	A
2A Northburn View 4 Load	A
2A Pocklaw Slap 2 Load	A
2A Pocklaw Slap 4 Load	A
2A Spindrift Load	A
2B Barefoots Av 12 Load	B
2B Barefoots Av 20 Load	B
2B Barefoots Dr 1 Load	B
2B Barefoots Dr 11 Load	B
2B Barefoots Dr 3 Load	B
2B Barefoots Dr 5 Load	B
2B Barefoots Dr 6 Load	B
2B Barefoots Dr 9 Load	B
2B Barefoots Park 1 Load	B
2B Barefoots Park 3 Load	B
2B Barefoots Park 8 Load	B
2B Barefoots Road 1 Load	B
2B Barefoots Road 2 Load	B
2B Barefoots Road 5 Load	B
2B Heatherside Load	B
2B Jemara Load	B
2B Larachbeg Load	B
2B Northburn R 18 Load	B
2B Northburn View 1 Load	B
2B Northburn View 2 Load	B
2B Pocklaw Slap 3 Load	B
2B Scrabster Load	B
2B Thirladene Load	B
2B Tigh-Na-Mara Load	B
2C Athalassa Load	C
2C Barefoots Av 10 Load	C
2C Barefoots Av 14 Load	C
2C Barefoots Av 18 Load	C
2C Barefoots Av 4 Load	C
2C Barefoots Av 8 Load	C
2C Barefoots Cres 16 Load	C

PowerFactory Load Name	Phase
3A Callercove Way 1 Load	A
3A Callercove Way 2 Load	A
3A Callercove Way 7 Load	A
3A Deanhead Dr 1 Load	A
3A Deanhead Dr 11 Load	A
3A Deanhead Dr 12 Load	A
3A Deanhead Dr 2 Load	A
3A Deanhead Dr 23 Load	A
3A Deanhead Dr 24 Load	A
3A Deanhead Dr 34 Load	A
3A Deanhead Dr 35 Load	A
3A Deanhead Dr 39 Load	A
3A Deanhead Dr 40 Load	A
3B Bennison Sq 2 Load	B
3B Bennison Sq 20 Load	B
3B Bennison Sq 22 Load	B
3B Bennison Sq 5 Load	B
3B Bennison Sq 8 Load	B
3B Callercove Cres 14 Load	B
3B Callercove Cres 16 Load	B
3B Callercove Cres 20 Load	B
3B Callercove Cres 3 Load	B
3B Callercove Cres 30 Load	B
3B Callercove Cres 5 Load	B
3B Callercove Cres 7 Load	B
3B Callercove Way 4 Load	B
3B Callercove Way 5 Load	B
3B Callercove Way 6 Load	B
3B Deanhead Dr 10 Load	B
3B Deanhead Dr 21 Load	B
3B Deanhead Dr 22 Load	B
3B Deanhead Dr 25 Load	B
3B Deanhead Dr 26 Load	B
3B Deanhead Dr 3 Load	B
3B Deanhead Dr 31 Load	B
3B Deanhead Dr 32 Load	B
3B Deanhead Dr 33 Load	B
3B Deanhead Dr 36 Load	B
3B Deanhead Dr 4 Load	B
3B Deanhead Dr 41 Load	B
3B Deanhead Dr 9 Load	B
3C Bennison Sq 3 Load	C
3C Bennison Sq 6 Load	C
3C Bennison Sq 9 Load	C
3C Callercove Cres 13 Load	C
3C Callercove Cres 15 Load	C
3C Callercove Cres 18 Load	C
3C Callercove Cres 2 Load	C
3C Callercove Cres 29 Load	C
3C Callercove Cres 8 Load	C
3C Callercove Cres 9 Load	C
3C Callercove Way 10 Load	C
3C Callercove Way 3 Load	C
3C Callercove Way 8 Load	C
3C Deanhead Dr 27 Load	C
3C Deanhead Dr 28 Load	C

PowerFactory Load Name	Phase
4A Deanhead R 11 Load	A
4A Deanhead R 13 Load	A
4A Deanhead R 14 Load	A
4A Deanhead R 19 Load	A
4A Deanhead R 2 Load	A
4A Deanhead R 20 Load	A
4A Deanhead R 22 Load	A
4A Deanhead R 24 Load	A
4A Deanhead R 25 Load	A
4A Deanhead R 29 Load	A
4A Deanhead R 34 Load	A
4A Deanhead R 36 Load	A
4A Deanhead R 37 Load	A
4A Deanhead R 41 Load	A
4A Killes Green 10 Load	A
4A Killes Green 11 Load	A
4A Killes Green 12 Load	A
4A Killes Green 18 Load	A
4A Killes Green 4 Load	A
4A Killes Green 5 Load	A
4B Bennison Sq 10 Load	B
4B Bennison Sq 12 Load	B
4B Bennison Sq 14 Load	B
4B Bennison Sq 16 Load	B
4B Callercove Cres 19 Load	B
4B Callercove Cres 25 Load	B
4B Callercove Cres 26 Load	B
4B Callercove Cres 40 Load	B
4B Callercove Cres 41 Load	B
4B Deanhead Dr 15 Load	B
4B Deanhead Dr 16 Load	B
4B Deanhead Dr 20 Load	B
4B Deanhead R 15 Load	B
4B Deanhead R 16 Load	B
4B Deanhead R 18 Load	B
4B Deanhead R 23 Load	B
4B Deanhead R 26 Load	B
4B Deanhead R 27 Load	B
4B Deanhead R 3 Load	B
4B Deanhead R 31 Load	B
4B Deanhead R 32 Load	B
4B Deanhead R 39 Load	B
4B Deanhead R 4 Load	B
4B Deanhead R 6 Load	B
4B Killes Green 14 Load	B
4B Killes Green 15 Load	B
4B Killes Green 2 Load	B
4B Killes Green 20 Load	B
4B Killes Green 3 Load	B
4B Killes Green 8 Load	B
4B Killes Green 9 Load	B
4C Bennison Sq 15 Load	C
4C Bennison Sq 18 Load	C
4C Callercove Cres 17 Load	C
4C Callercove Cres 23 Load	C
4C Callercove Cres 24 Load	C

PowerFactory Load Name	Phase	PowerFactory Load Name	Phase	PowerFactory Load Name	Phase
2C Barefoots Dr 8 Load	C	3C Deanhead Dr 29 Load	C	4C Callercove Cres 38 Load	C
2C Barefoots Park 2 Load	C	3C Deanhead Dr 30 Load	C	4C Callercove Cres 39 Load	C
2C Barefoots Park 4 Load	C	3C Deanhead Dr 37 Load	C	4C Deanhead Dr 17 Load	C
2C Barefoots Park 5 Load	C	3C Deanhead Dr 38 Load	C	4C Deanhead Dr 19 Load	C
2C Barefoots Road 6 Load	C	3C Deanhead Dr 42 Load	C	4C Deanhead R 10 Load	C
2C Dalharco Load	C	3C Deanhead Dr 43 Load	C	4C Deanhead R 12 Load	C
2C Ealing Load	C	3C Deanhead Dr 5 Load	C	4C Deanhead R 17 Load	C
2C Northburn R 20 Load	C	3C Deanhead Dr 6 Load	C	4C Deanhead R 21 Load	C
2C Northburn R 24 Load	C	3C Deanhead Dr 7 Load	C	4C Deanhead R 28 Load	C
2C Northburn View 3 Load	C	3C Deanhead Dr 8 Load	C	4C Deanhead R 30 Load	C
2C Northburn View 6 Load	C	4A Bennison Sq 11 Load	A	4C Deanhead R 33 Load	C
2C Pocklaw Slap 1 Load	C	4A Bennison Sq 13 Load	A	4C Deanhead R 35 Load	C
3A Bennison Sq 1 Load	A	4A Bennison Sq 17 Load	A	4C Deanhead R 38 Load	C
3A Bennison Sq 20b Load	A	4A Bennison Sq 19 Load	A	4C Deanhead R 40 Load	C
3A Bennison Sq 22b Load	A	4A Callercove Cres 21 Load	A	4C Deanhead R 5 Load	C
3A Bennison Sq 4 Load	A	4A Callercove Cres 22 Load	A	4C Deanhead R 7 Load	C
3A Bennison Sq 7 Load	A	4A Callercove Cres 28 Load	A	4C Deanhead R 8 Load	C
3A Callercove Cres 1 Load	A	4A Callercove Cres 36 Load	A	4C Deanhead R 9 Load	C
3A Callercove Cres 10 Load	A	4A Callercove Cres 37 Load	A	4C Killes Green 1 Load	C
3A Callercove Cres 11 Load	A	4A Callercove Cres 42 Load	A	4C Killes Green 13 Load	C
3A Callercove Cres 12 Load	A	4A Callercove Cres 43 Load	A	4C Killes Green 16 Load	C
3A Callercove Cres 27 Load	A	4A Deanhead Dr 13 Load	A	4C Killes Green 17 Load	C
3A Callercove Cres 31 Load	A	4A Deanhead Dr 14 Load	A	4C Killes Green 6 Load	C
3A Callercove Cres 4 Load	A	4A Deanhead Dr 18 Load	A	4C Killes Green 7 Load	C
3A Callercove Cres 6 Load	A	4A Deanhead R 1 Load	A		

Table 87: Loads connected to Deanhead S/S

A 4.7 Dovecote

PowerFactory Load Name	Phase
13 High Tide Load	3-phase
1A 1 G Circle Load	A
1A 11 L Hill Load	A
1A 13 G Circle Load	A
1A 13 L Hill Load	A
1A 14 G Circle Load	A
1A 16 L Hill Load	A
1A 17 L Hill Load	A
1A 2 G Circle Load	A
1A 4 L Hill Load	A
1A 5 L Hill Load	A
1A 60 Avenue Load	A
1A 64 Avenue Load	A
1A 7 G Circle Load	A
1A 7 L Hill Load	A
1A 71 Avenue Load	A
1A 73 Avenue Load	A
1A 79 Avenue Load	A
1A 8 G Circle Load	A
1A 9 L Hill Load	A
1B 1 L Hill Load	B
1B 10 G Circle Load	B
1B 11 G Circle Load	B
1B 12 G Circle Load	B
1B 15 L Hill Load	B
1B 19 L Hill Load	B
1B 21 L Hill Load	B
1B 22 L Hill Load	B
1B 23 L Hill Load	B
1B 5 G Circle Load	B
1B 58 Avenue Load	B
1B 6 G Circle Load	B
1B 69 Avenue Load	B
1B 8 L Hill Load	B
1B 81 Avenue Load	B
1C 10 L Hill Load	C
1C 12 L Hill Load	C
1C 14 L Hill Load	C
1C 18 L Hill Load	C
1C 2 L Hill Load	C
1C 20 L Hill Load	C
1C 24 Avenue Load	C
1C 3 G Circle Load	C

PowerFactory Load Name	Phase
1C 3 L Hill Load	C
1C 4 G Circle Load	C
1C 6 L Hill Load	C
1C 62 Avenue Load	C
1C 75 Avenue Load	C
1C 77 Avenue Load	C
1C 9 G Circle Load	C
23 Golf Links Load	3-phase
23 Golf Links Load(1)	3-phase
2A 18 QR Load	A
2A 24 QR Load	A
2A 30 QR Load	A
2A 32 QR Load	A
2A 38 QR Load	A
2A 44 QR Load	A
2A 46 QR Load	A
2A 50 QR Load	A
2A 62 QR Load	A
2A 64 QR Load	A
2A 65 QR Load	A
2A 66 QR Load	A
2A 67 QR Load	A
2A 68 QR Load	A
2A 69 QR Load	A
2A 71 QR Load	A
2A 82 QR Load	A
2A 84 QR Load	A
2A 86 QR Load	A
2A 88 QR Load	A
2B 20 QR Load	B
2B 26 QR Load	B
2B 34 QR Load	B
2B 40 QR Load	B
2B 49 QR Load	B
2B 51 QR Load	B
2B 52 QR Load	B
2B 53 QR Load	B
2B 55 QR Load	B
2B 57 QR Load	B
2B 59 QR Load	B
2B 61 QR Load	B
2B 63 QR Load	B

PowerFactory Load Name	Phase
2B 74 QR Load	B
2B 76 QR Load	B
2B 78 QR Load	B
2B 80 QR Load	B
2C 22 QR Load	C
2C 28 QR Load	C
2C 36 QR Load	C
2C 42 QR Load	C
2C 48 QR Load	C
2C 54 QR Load	C
2C 56 QR Load	C
2C 58 QR Load	C
2C 60 QR Load	C
2C 73 QR Load	C
2C 75 QR Load	C
2C 77 QR Load	C
2C 79 QR Load	C
33 Club Load	3phase
33 Club Load(1)	3phase
33 Posts Load	3-phase
3A 10 Johns R Load	A
3A 17 Johns R Load	A
3A 18 Johns R Load	A
3A 9 Johns R Load	A
3A Car Park Load	A
3A Tower Load	A
3B 1 Johns R Load	B
3B 11 Johns R Load	B
3B 12 Johns R Load	B
3B 13 Johns R Load	B
3B 14 Johns R Load	B
3B 15 Johns R Load	B
3B 16 Johns R Load	B
3B 2 Johns R Load	B
3B 5 Johns R Load	B
3B 6 Johns R Load	B
3C 19 Johns R Load	C
3C 20 Johns R Load	C
3C 3 Johns R Load	C
3C 4 Johns R Load	C
3C 7 Johns R Load	C
3C 8 Johns R Load	C

Table 88: Loads connected to Dovecote S/S

A 4.8 Dulcecraig

PowerFactory Load Name	Phase	PowerFactory Load Name	Phase	PowerFactory Load Name	Phase
1A 19 Fancove Place Load	A	2A 64 Hinkar Way Load	A	3A 31 Haymons Cove Load	A
1A 25 Hinkar Way Load	A	2A 66 Hinkar Way Load	A	3A 33 Haymons Cove Load	A
1A 27 Dulce Craig Load	A	2A 67 Hinkar Way Load	A	3A 34 Haymons Cove Load	A
1A 28 Hinkar Way Load	A	2A 69 Hinkar Way Load	A	3A 35 Haymons Cove Load	A
1A 29 Hinkar Way Load	A	2A 71 Haymons Cove Load	A	3A 36 Haymons Cove Load	A
1A 30 Dulce Craig Load	A	2A 71 Hinkar Way Load	A	3A 37 Haymons Cove Load	A
1A 33 Hinkar Way Load	A	2A 72 Hinkar Way Load	A	3A 38 Haymons Cove Load	A
1A 39 Hinkar Way Load	A	2A 74 Haymons Cove Load	A	3A 39 Haymons Cove Load	A
1A 42 Hinkar Way Load	A	2A 77 Fancove Place Load	A	3A 40 Haymons Cove Load	A
1A 44 Hinkar Way Load	A	2A 77 Haymons Cove Load	A	3A 42 Haymons Cove Load	A
1A 45 Hinkar Way Load	A	2A 79 Fancove Place Load	A	3A 45 Haymons Cove Load	A
1A 46 Hinkar Way Load	A	2A 8 Fancove Place Load	A	3A 50 Haymons Cove Load	A
1A 47 Hinkar Way Load	A	2A 8 Haymons Cove Load	A	3A 54 Haymons Cove Load	A
1A 48 Hinkar Way Load	A	2B 1 Fancove Place Load	B	3A 55 Haymons Cove Load	A
1A 59 Hinkar Way Load	A	2B 11 Fancove Place Load	B	3A 56 Haymons Cove Load	A
1B 18 Fancove Place Load	B	2B 14 Haymons Cove Load	B	3A 57 Haymons Cove Load	A
1B 26 Hinkar Way Load	B	2B 16 Haymons Cove Load	B	3A 63 Haymons Cove Load	A
1B 28 Dulce Craig Load	B	2B 2 Haymons Cove Load	B	3A 64 Haymons Cove Load	A
1B 30 Hinkar Way Load	B	2B 33 Dulce Craig Load	B	3A 7 Dulce Craig Load	A
1B 31 Dulce Craig Load	B	2B 5 Fancove Place Load	B	3B 10 Dulce Craig Load	B
1B 37 Hinkar Way Load	B	2B 5 Haymons Cove Load	B	3B 11 Dulce Craig Load	B
1B 38 Hinkar Way Load	B	2B 6 Fancove Place Load	B	3B 20 Haymons Cove Load	B
1B 40 Hinkar Way Load	B	2B 62 Hinkar Way Load	B	3B 21 Haymons Cove Load	B
1B 41 Hinkar Way Load	B	2B 63 Hinkar Way Load	B	3B 23 Dulce Craig Load	B
1B 43 Hinkar Way Load	B	2B 68 Hinkar Way Load	B	3B 24 Dulce Craig Load	B
1B 51 Hinkar Way Load	B	2B 7 Haymons Cove Load	B	3B 26 Haymons Cove Load	B
1B 54 Hinkar Way Load	B	2B 72 Haymons Cove Load	B	3B 27 Haymons Cove Load	B
1B 55 Hinkar Way Load	B	2B 75 Fancove Place Load	B	3B 29 Haymons Cove Load	B
1B 57 Hinkar Way Load	B	2B 75 Haymons Cove Load	B	3B 30 Haymons Cove Load	B
1B 58 Hinkar Way Load	B	2B 78 Fancove Place Load	B	3B 32 Callercove Cres Load	B
1B 60 Hinkar Way Load	B	2B 78 Haymons Cove Load	B	3B 33 Callercove Cres Load	B
1C 17 Fancove Place Load	C	2B 9 Fancove Place Load	B	3B 41 Haymons Cove Load	B
1C 27 Hinkar Way Load	C	2B 9 Haymons Cove Load	B	3B 43 Haymons Cove Load	B
1C 29 Dulce Craig Load	C	2C 1 Haymons Cove Load	C	3B 44 Haymons Cove Load	A
1C 31 Hinkar Way Load	C	2C 11 Haymons Cove Load	C	3B 46 Haymons Cove Load	B
1C 32 Hinkar Way Load	C	2C 12 Fancove Place Load	C	3B 49 Haymons Cove Load	B
1C 34 Hinkar Way Load	C	2C 14 Fancove Place Load	C	3B 53 Haymons Cove Load	B
1C 35 Hinkar Way Load	C	2C 15 Fancove Place Load	C	3B 60 Haymons Cove Load	B
1C 36 Hinkar Way Load	C	2C 17 Haymons Cove Load	C	3B 62 Haymons Cove Load	B
1C 49 Hinkar Way Load	C	2C 34 Dulce Craig Load	C	3B 66 Haymons Cove Load	B
1C 50 Hinkar Way Load	C	2C 6 Haymons Cove Load	C	3B 69 Haymons Cove Load	B
1C 52 Hinkar Way Load	C	2C 65 Hinkar Way Load	C	3B 70 Haymons Cove Load	B
1C 53 Hinkar Way Load	C	2C 7 Fancove Place Load	C	3B 8 Dulce Craig Load	B
1C 56 Hinkar Way Load	C	2C 70 Hinkar Way Load	C	3B 9 Dulce Craig Load	B
1C 61 Hinkar Way Load	C	2C 73 Haymons Cove Load	C	3C 20 Dulce Craig Load	C
2A 10 Fancove Place Load	A	2C 73 Hinkar Way Load	C	3C 24 Haymons Cove Load	C
2A 10 Haymons Cove Load	A	2C 74 Fancove Place Load	C	3C 25 Haymons Cove Load	C
2A 12 Haymons Cove Load	A	2C 76 Fancove Place Load	C	3C 32 Haymons Cove Load	C
2A 13 Fancove Place Load	A	2C 76 Haymons Cove Load	C	3C 34 Callercove Cres Load	C
2A 13 Haymons Cove Load	A	2C 79 Haymons Cove Load	C	3C 35 Callercove Cres Load	C
2A 15 Haymons Cove Load	A	2C 80 Haymons Cove Load	C	3C 47 Haymons Cove Load	C
2A 16 Fancove Place Load	A	3A 12 Dulce Craig Load	A	3C 48 Haymons Cove Load	C
2A 18 Haymons Cove Load	A	3A 13 Dulce Craig Load	A	3C 51 Haymons Cove Load	C
2A 19 Haymons Cove Load	A	3A 14 Dulce Craig Load	A	3C 52 Haymons Cove Load	C
2A 2 Fancove Place Load	A	3A 15 Dulce Craig Load	A	3C 58 Haymons Cove Load	C
2A 3 Fancove Place Load	A	3A 21 Dulce Craig Load	A	3C 59 Haymons Cove Load	C
2A 3 Haymons Cove Load	A	3A 22 Dulce Craig Load	A	3C 61 Haymons Cove Load	C
2A 32 Dulce Craig Load	A	3A 22 Haymons Cove Load	A	3C 65 Haymons Cove Load	C
2A 4 Fancove Place Load	A	3A 23 Haymons Cove Load	A	3C 67 Haymons Cove Load	C
2A 4 Haymons Cove Load	A	3A 28 Haymons Cove Load	A	3C 68 Haymons Cove Load	C

Table 89: Loads connected to Dulcecraig S/S

A 4.9 Grantshouse

PowerFactory Load Name	Phase
13 Mansfield Load	3-phase
1A Mansfield 13 Load	A
1A Mansfield 17 Load	A
1A Mansfield 23 Load	A
1A Mansfield 31 Load	A
1A Mansfield 7 Load	A
1B Mansfield 11 Load	B
1B Mansfield 19 Load	B
1B Mansfield 25 Load	B
1B Mansfield 29 Load	B
1C Mansfield 15 Load	C
1C Mansfield 21 Load	C
1C Mansfield 27 Load	C
1C Mansfield 9 Load	C
23 Bankhouse Load	3-phase
23 Cast Burn Load	3-phase
23 Primary School Load	3-phase
23 The Old Toll Hoose Load	3-phase
2A Aldersyde Load	A
2A Eyeview Load	A
2A Grantshouse Hotel Load	A
2A Hall Load	A
2A Juniper Bank Load	A
2A Mansfield 1 Load	A
2A Mansfield 2 Load	A
2A Oak Bank Load	A
2A Post Office Load	A
2A Sheildon Cottage Load	A
2A The Haven Load	A
2B Church Load	B
2B Hazelbank Load	B
2B Mansfield 3 Load	B
2B Mansfield 4 Load	B
2B Sunny Bunk Load	B
2B Tel Ex Load	B
2C Clareledell Load	C
2C Kirkside Load	C
2C Mansfield 5 Load	C
2C Mansfield 6 Load	C

Table 90: Loads connected to Grantshouse S/S

A 4.10 Hawthorn Bank Duns

PowerFactory Load Name	Phase	PowerFactory Load Name	Phase	PowerFactory Load Name	Phase
1A Hawthorn Bank 15 Load	A	1B Rachael Drive 31 Load	B	2A Hawthorn Bank 74 Load	A
1A Hawthorn Bank 23 Load	A	1B Rachael Drive 36 Load	B	2A Hawthorn Bank 80 Load	A
1A Hawthorn Bank 25 Load	A	1B Rachael Drive 38 Load	B	2B Hawthorn Bank 33 Load	B
1A Hawthorn Bank 27 Load	A	1B Rachael Drive 40 Load	B	2B Hawthorn Bank 39 Load	B
1A Hawthorn Bank 43 Load	A	1B Rachael Drive 41 Load	B	2B Hawthorn Bank 76 Load	B
1A Hawthorn Bank 45 Load	A	1B Rachael Drive 45 Load	B	2C Hawthorn Bank 31 Load	C
1A Hawthorn Bank 51 Load	A	1B Rachael Drive 47 Load	B	2C Hawthorn Bank 41 Load	C
1A Hawthorn Bank 55 Load	A	1B Rachael Drive 48 Load	B	2C Hawthorn Bank 78 Load	C
1A Hawthorn Bank 57 Load	A	1B Rachael Drive 49 Load	B	2C Hawthorn Bank 83 Load	C
1A Hawthorn Bank 67 Load	A	1B Rachael Drive 50 Load	B	3A Hawthorn Bank 13 Load	A
1A Hawthorn Bank 69 Load	A	1B Rachael Drive 51 Load	B	3A Hawthorn Bank 50 Load	A
1A Hawthorn Bank 75 Load	A	1B Rachael Drive 59 Load	B	3A Hawthorn Bank 52 Load	A
1A Hawthorn Bank 77 Load	A	1B Rachael Drive 65 Load	B	3A Hawthorn Bank 54 Load	A
1A Rachael Drive 2 Load	A	1B Rachael Drive 71 Load	B	3A Hawthorn Bank 54b Load	A
1A Rachael Drive 26 Load	A	1B Rachael Drive 77 Load	B	3A Hawthorn Bank 58 Load	A
1A Rachael Drive 32 Load	A	1B Struanberg Load	B	3A Hawthorn Bank 72 Load	A
1A Rachael Drive 33 Load	A	1C Hawthorn Bank 17 Load	C	3B Hawthorn Bank 15 Load	B
1A Rachael Drive 34 Load	A	1C Hawthorn Bank 59 Load	C	3B Hawthorn Bank 23 Load	B
1A Rachael Drive 39 Load	A	1C Hawthorn Bank 61 Load	C	3B Hawthorn Bank 25 Load	B
1A Rachael Drive 43 Load	A	1C Hawthorn Bank 71 Load	C	3B Hawthorn Bank 29 Load	B
1A Rachael Drive 44 Load	A	1C Hawthorn Bank 79 Load	C	3B Hawthorn Bank 40 Load	B
1A Rachael Drive 46 Load	A	1C Hawthorn Bank 81 Load	C	3B Hawthorn Bank 44 Load	B
1A Rachael Drive 57 Load	A	1C Rachael Drive 20 Load	C	3B Hawthorn Bank 56 Load	B
1A Rachael Drive 67 Load	A	1C Rachael Drive 22 Load	C	3B Hawthorn Bank 60 Load	B
1A Rachael Drive 69 Load	A	1C Rachael Drive 30 Load	C	3B Hawthorn Bank 62 Load	B
1A Rachael Drive 79 Load	A	1C Rachael Drive 35 Load	C	3C Hawthorn Bank 11 Load	C
1B Hawthorn Bank 19 Load	B	1C Rachael Drive 37 Load	C	3C Hawthorn Bank 17 Load	C
1B Hawthorn Bank 21 Load	B	1C Rachael Drive 42 Load	C	3C Hawthorn Bank 19 Load	C
1B Hawthorn Bank 47 Load	B	1C Rachael Drive 53 Load	C	3C Hawthorn Bank 21 Load	C
1B Hawthorn Bank 49 Load	B	1C Rachael Drive 55 Load	C	3C Hawthorn Bank 27 Load	C
1B Hawthorn Bank 53 Load	B	1C Rachael Drive 61 Load	C	3C Hawthorn Bank 42 Load	C
1B Hawthorn Bank 63 Load	B	1C Rachael Drive 63 Load	C	3C Hawthorn Bank 46 Load	C
1B Hawthorn Bank 65 Load	B	1C Rachael Drive 73 Load	C	3C Hawthorn Bank 48 Load	C
1B Hawthorn Bank 73 Load	B	1C Rachael Drive 75 Load	C	3C Hawthorn Bank 64 Load	C
1B Rachael Drive 24 Load	B	1C Rachael Drive Load	C	3C Hawthorn Bank 66 Load	C
1B Rachael Drive 28 Load	B	2A Hawthorn Bank 35 Load	A	3C Hawthorn Bank 68 Load	C
1B Rachael Drive 29 Load	B	2A Hawthorn Bank 37 Load	A	3C Hawthorn Bank 70 Load	C

Table 91: Loads connected to Hawthorn Bank Duns S/S

A 4.11 Gunsgreenhill

PowerFactory Load Name	Phase
13 2 QR Load	3phase
13 4 Broad St Load	3phase
1A 1 Broad St Load	A
1A 14 QR Load	A
1A 15 QR Load	A
1A 16 QR Load	A
1A 17 QR Load	A
1A 2 Broad St Load	A
1A 29 QR Load	A
1A 3 QR Load	A
1A 33 QR Load	A
1A 39 QR Load	A
1A 4 QR Load	A
1A 47 QR Load	A
1A 5 QR Load	A
1A BS Load	A
1B 1 QR Load	B
1B 10 QR Load	B
1B 12 QR Load	B
1B 19 QR Load	B
1B 23 QR Load	B
1B 25 QR Load	B
1B 27 QR Load	B
1B 3 Broad St Load	B
1B 3 G Crescent Load	B
1B 37 QR Load	B
1B 45 QR Load	B
1B 5 Broad St Load	B
1B 5 G Crescent Load	B
1B 7 Broad St Load	B
1B 7 G Crescent Load	B
1B 7 QR Load	B
1B 9 QR Load	B
1C 11 QR Load	C
1C 13 QR Load	C
1C 21 QR Load	C
1C 31 QR Load	C
1C 35 QR Load	C
1C 41 QR Load	C
1C 43 QR Load	C
1C 6 Broad St Load	C

PowerFactory Load Name	Phase
1C 6 QR Load	C
1C 8 Broad St Load	C
1C 8 QR Load	C
1C 9 Broad St Load	C
2A 14 G Crescent Load	A
2A 15 G Crescent Load	A
2A 16 G Crescent Load	A
2A 18 G Crescent Load	A
2A 20 G Crescent Load	A
2A 6 G Crescent Load	A
2A 8 G Crescent Load	A
2B 10 G Crescent Load	B
2B 12 G Crescent Load	B
2C 11 G Crescent Load	C
2C 13 G Crescent Load	C
2C 9 G Crescent Load	C
3A 1 G Crescent Load	A
3A 20 Avenue Load	A
3A 21 Avenue Load	A
3A Eyecliffe Load	A
3A Eyecliffe Load(1)	A
3A LB Load	A
3A LB Load(1)	A
3B 16 Avenue Load	B
3B 17 Avenue Load	B
3B 2 G Crescent Load	B
3B 4 G Crescent Load	B
3B Lumsdoon Load	B
3C 14 Avenue Load	C
3C 15 Avenue Load	C
3C 18 Avenue Load	C
3C 19 Avenue Load	C
43 Shipyard Load	3-phase
4A 22 Avenue Load	A
4A 23 Avenue Load	A
4A 28 Avenue Load	A
4A 29 Avenue Load	A
4A 34 Avenue Load	A
4A 38 Avenue Load	A
4A 45 Avenue Load	A

PowerFactory Load Name	Phase
4A 46 Avenue Load	A
4A 48 Avenue Load	A
4A 49 Avenue Load	A
4A 52 Avenue Load	A
4A 55 Avenue Load	A
4A 56 Avenue Load	A
4A 57 Avenue Load	A
4A 61 Avenue Load	A
4A 65 Avenue Load	A
4A Hinkar Load	A
4A Yard Load	A
4A Yard Load(1)	A
4B 26 Avenue Load	B
4B 27 Avenue Load	B
4B 33 Avenue Load	B
4B 36 Avenue Load	B
4B 37 Avenue Load	B
4B 41 Avenue Load	B
4B 47 Avenue Load	B
4B 50 Avenue Load	B
4B 51 Avenue Load	B
4B 53 Avenue Load	B
4B 63 Avenue Load	B
4B 67 Avenue Load	B
4B Coromandel Load	B
4B Hinkar Load	B
4C 24 Avenue Load	C
4C 25 Avenue Load	C
4C 30 Avenue Load	C
4C 31 Avenue Load	C
4C 32 Avenue Load	C
4C 35 Avenue Load	C
4C 39 Avenue Load	C
4C 40 Avenue Load	C
4C 42 Avenue Load	C
4C 43 Avenue Load	C
4C 44 Avenue Load	C
4C 54 Avenue Load	C
4C 59 Avenue Load	C
4C Edgecliffe Load	C

Table 92: Loads connected to Gunsgreenhill S/S

A 4.12 Hoprig Road

PowerFactory Load Name	Phase	PowerFactory Load Name	Phase
1A 10 Hoprig Park Load	A	2C 2 Crofts Road Load	C
1A 13 Hoprig Park Load	A	2C 20 Callander Load	C
1A 14 Hoprig Park Load	A	2C 20 Crofts Road Load	C
1A 17 Hoprig Park Load	A	2C 21 Callander Load	C
1B 1 Hoprig Park Load	B	2C 6 Croftsacre Load	C
1B 11 Hoprig Park Load	B	2C 9 Crofts Road Load	C
1B 8 Hoprig Park Load	B	2C 9 Croftsacre Load	C
1C 12 Hoprig Park Load	C	3A 15 Croftsacre Load	A
1C 15 Hoprig Park Load	C	3A 16 Croftsacre Load	A
1C 16 Hoprig Park Load	C	3A 21 Crofts Road Load	A
1C 7 Hoprig Park Load	C	3A 21 Croftsacre Load	A
1C 9 Hoprig Park Load	C	3A 22 Croftsacre Load	A
23 12 Croftsacre Load	3-phase	3A 28 Croftsacre Load	A
2A 1 Crofts Road Load	A	3A 32 Croftsacre Load	A
2A 10 Croftsacre Load	A	3A 33 Crofts Road Load	A
2A 14 Croftsacre Load	A	3A 33 Croftsacre Load	A
2A 15 Callander Load	A	3A 35 Corfts Road Load	A
2A 15 Crofts Road Load	A	3A 38 Croftsacre Load	A
2A 16 Callander Load	A	3B 17 Croftsacre Load	B
2A 2 Hoprig Road Load	A	3B 18 Croftsacre Load	B
2A 22 Callander Load	A	3B 19 Crofts Road Load	B
2A 23 Callander Load	A	3B 23 Crofts Road Load	B
2A 24 Callander Load	A	3B 27 Croftsacre Load	B
2A 3 Croftsacre Load	A	3B 29 Croftsacre Load	B
2A 3 Hoprig Road Load	A	3C 14 Crofts Road Load	C
2A 37 Crofts Road Load	A	3C 16 Crofts Road Load	C
2A 4 Crofts Road Load	A	3C 19 Croftsacre Load	C
2A 5 Croftsacre Load	A	3C 20 Croftsacre Load	C
2A 6 Crofts Road Load	A	3C 23 Croftsacre Load	C
2A Church Load	A	3C 24 Croftsacre Load	C
2A Gayfield Load	A	3C 25 Crofts Road Load	C
2B 1 Hoprig Road Load	B	3C 25 Croftsacre Load	C
2B 10 Crofts Road Load	B	3C 26 Croftsacre Load	C
2B 11 Croftsacre Load	B	3C 27 Crofts Road Load	C
2B 17 Callander Load	B	3C 29 Crofts Road Load	C
2B 3 Crofts Road Load	B	3C 30 Croftsacre Load	C
2B 5 Crofts Road Load	B	3C 31 Crofts Road Load	C
2B 7 Crofts Road Load	B	3C 31 Croftsacre Load	C
2B 8 Croftsacre Load	B	3C 34 Croftsacre Load	C
2B Manse Load	B	3C 36 Croftsacre Load	C
2B Old Manse Load	B	4A 5 Hoprig Park Load	A
2B Romanno Load	B	4A Braeside Cottage Load	A
2C 11 Crofts Road Load	C	4A Dovecot Hall Load	A
2C 13 Callander Load	C	4A Reservoir Load	A
2C 13 Crofts Road Load	C	4C 2 Hoprig Park Load	C
2C 14 Callander Load	C	4C 3 Hoprig Park Load	C
2C 17 Crofts Road Load	C	4C 4 Hoprig Park Load	C
2C 18 Callander Load	C	4C 6 Hoprig Park Load	C
2C 18 Crofts Road Load	C	2C 2 Crofts Road Load	C
2C 19 Callander Load	C		

Table 93: Loads connected to Hoprig Road S/S

A 4.13 Leitholm Village

PowerFactory Load Name	Phase
13 Oak House Load	3-phase
13 Spring Cot Load	3-phase
1A Ashlea Load	A
1A Bughtrig Cot Load	A
1A Cotterlea 1 Load	A
1A Cotterlea 2 Load	A
1A Cotterlea Load	A
1A East End Cot Load	A
1A East End Load	A
1A Heronhill Load	A
1A Holmlea Load	A
1A Kirkwood Cot Load	A
1A Main St Load	A
1A Ramsay Cres 3 Load	A
1A Ramsay Cres 5 Load	A
1A Ramsay Cres 7 Load	A
1A School Wynd 6 Load	A
1A Sunny Side Load	A
1A The Anchorege Load	A
1A The Cottage Load	A
1B Cotterlea 3 Load	B
1B Cotterlea 4 Load	B
1B Cotterlea Load	B
1B Islay Cot Load	B
1B Jasmine Cot Load	B
1B Lochaber Load	B
1B Main St Load	B
1B Ramsay Cres 2 Load	B
1B Ramsay Cres 4 Load	B
1B Ramsay Cres 6 Load	B
1B Ramsay Cres 8 Load	B
1B Rose Cot Load	B
1B Rose Villa Load	B
1B School Wynd 4 Load	B
1B Village Hall Load	B
1C Aberconn Cot Load	C
1C Kirkwood Cot Load	C
1C Linfield Load	C
1C Newton Cot Load	C
1C Newtown Villa Load	C
1C Ramsay Cres 1 Load	C
1C Ramsay Cres 10 Load	C
1C Ramsay Cres 12 Load	C
1C School Wynd 1 Load	C
1C School Wynd 2 Load	C
1C School Wynd 3 Load	C
1C School Wynd 5 Load	C

PowerFactory Load Name	Phase
1C Tel Ex Load	C
1C The Shieling Load	C
1C Thistle Cot Load	C
33 Hotel Load	3-phase
33 Settling Tank Load	3-phase
33 The Plough hotel Load	3-phase
33 West End Garage Load	3-phase
33 Builders Yard Load	3-phase
3A Easter House Load	A
3A Knowehead Cot Load	A
3A Main St 18 Load	A
3A Main St 26 Load	A
3A Mansfield 2 Load	A
3A Post Office Load	A
3A Rose Cot Load	A
3A Schoolhouse Load	A
3A The Shaws Load	A
3A Viewfield Load	A
3B Braehead Cot Load	B
3B Campbell Cot Load	B
3B Dowry House Load	B
3B Endemos Load	B
3B Graden Bank 1 Load	B
3B Leetside Cot Load	B
3B Main St 28 Load	B
3B Main St 4 Load	B
3B Mansfield 3 Load	B
3B Mansfield 4 Load	B
3B Mayfield Load	B
3B Middleans Load	B
3C Campbell Cot Load	C
3C Eesti Kodu Load	C
3C Graden Bank 2 Load	C
3C Graden Bank 3 Load	C
3C Mansfield 1 Load	C
3C Mansfield House Load	C
3C Robson House Load	C
3C Southview Load	C
3C Suvla House Load	C
3C West Cot Load	C
3C West End Cot Load	C
4A Earnslaw House Load	A
4A Parish Church Load	A
4B Louisa Cot Load	B
4B Main St 30 Load	B
4C Clarinda's Cot Load	C
4C Well Cot Load	C

Table 94: Loads connected to Leitholm Village S/S

A 4.14 Swinton Duns

PowerFactory Load Name	Phase
1A Main 43 Load	A
1A Main 59 Load	A
1B Main 47 Load	B
1B Main 49 Load	B
1B Main 50 Load	B
1B Main 51 Load	B
1B Main 57 Load	B
1C Main 39 Load	C
1C Main 41 Load	C
1C Main 42 Load	C
1C Main 46 Load	C
1C Main 48 Load	C
1C Main 55 Load	C
23 Carters 1 Load	3-phase
23 Carters 3 Load	3-phase
23 Main 4 Load	3-phase
2A Carters 7 Load	A
2A Main 81 Load	A
2A Main 83 Load	A
2A Main 85 Load	A
2A Main 87 Load	A
2A Wel Court 2 Load	A
2A Wellfield 13 Load	A
2A Wellfield 15 Load	A
2A Wellfield 16 Load	A
2A Wellfield 2 Load	A
2A Wellfield 5 Load	A
2A Wellfield 9 Load	A
2B Carters 2 Load	B
2B Carters 5 Load	B
2B Carters 6 Load	B
2B Carters 9 Load	B
2B Wel Court 1 Load	B
2B Wellfield 10 Load	B
2B Wellfield 12 Load	B
2B Wellfield 14 Load	B
2B Wellfield 19 Load	B
2B Wellfield 3 Load	B
2B Wellfield 7 Load	B
2B Welllfield 1 Load	B
2C Carters 4 Load	C
2C Carters 8 Load	C
2C Main 71 Load	C
2C Main 73 Load	C
2C Main 79 Load	C
2C Wellfield 11 Load	C
2C Wellfield 17 Load	C
2C Wellfield 18 Load	C
2C Wellfield 20 Load	C
2C Wellfield 21 Load	C
2C Wellfield 22 Load	C
2C Wellfield 4 Load	C
2C Wellfield 6 Load	C
2C Wellfield 8 Load	C

Table 95: Loads connected to Swinton Duns S/S

A 4.15 Chirnside West End

PowerFactory Load Name	Phase	PowerFactory Load Name	Phase	PowerFactory Load Name	Phase
1A 1 Windram Road Load	A	2C 9 Windram Place Load	C	5A 9 East Crostfield Load	A
1A 10 Greenwell Load	A	3A 10 Lammerview Load	A	5B 1 East Crostfield Load	B
1A 11 Greenwell Load	A	3A 11 Lammerview Load	A	5B 13 Windram Road Load	B
1A 12 Greenwell Load	A	3A 2 Lammerview Load	A	5B 14 Windram Road Load	B
1A 18 Greenwell Load	A	3A 21 Lammerview Load	A	5B 15 Windram Road Load	B
1A 2 Greenwell Load	A	3A 23 Lammerview Load	A	5B 2 East Crostfield Load	B
1A 9 Greenwell Load	A	3A 29 Lammerview Load	A	5B 20 Windram Road Load	B
1A 9 Windram Road Load	A	3A 3 Lammerview Load	A	5B 21 Windram Road Load	B
1B 1 Greenwell Load	B	3A 4 Lammerview Load	A	5B 23 Windram Road Load	B
1B 13 Greenwell Load	B	3A 5 Lammerview Load	A	5B 3 Windram Terrace Load	B
1B 15 Greenwell Load	B	3A 6 Lammerview Load	A	5B 4 East Crostfield Load	B
1B 3 Greenwell Load	B	3A 7 Lammerview Load	A	5B 4 Windram Terrace Load	B
1B 3 Windram Road Load	B	3A 8 Lammerview Load	A	5B 5 East Crostfield Load	B
1B 4 Greenwell Load	B	3B 1 Lammerview Load	B	5B 7 East Crostfield Load	B
1B 5 Greenwell Load	B	3B 12 Lammerview Load	B	5B 9 Crostfield Load	B
1B 5 Windram Road Load	B	3B 13 Lammerview Load	B	5C 1 Park View Load	C
1B 7 Greenwell Load	B	3B 14 Lammerview Load	B	5C 10 Crostfield Load	C
1C 14 Greenwell Load	C	3B 16 Lammerview Load	B	5C 10 Windram Road Load	C
1C 16 Greenwell Load	C	3B 19 Lammerview Load	B	5C 11 Crostfield Load	C
1C 2 Windram Road Load	C	3B 25 Lammerview Load	B	5C 12 Windram Road Load	C
1C 20 Greenwell Load	C	3C 15 Lammerview Load	C	5C 13 Crostfield Load	C
1C 4 Windram Road Load	C	3C 17 Lammerview Load	C	5C 17 Windram Road Load	C
1C 6 Greenwell Load	C	3C 18 Lammerview Load	C	5C 19 Windram Road Load	C
1C 6 Windram Road Load	C	3C 20 Lammerview Load	C	5C 2 Park View Load	C
1C 7 Windram Road Load	C	3C 27 Lammerview Load	C	5C 22 Windram Road Load	C
1C 8 Greenwell Load	C	3C 9 Lammerview Load	C	5C 24 Windram Road Load	C
2A 1 Well Court Load	A	43 Glenesk Load	3-phase	5C 3 East Crostfield Load	C
2A 13 Windram Place Load	A	43 Hotel Load	3-phase	5C 5 Windram Terrace Load	C
2A 15 Windram Place Load	A	4A Brownlea Load	A	5C 6 Windram Terrace Load	C
2A 16 Windram Place Load	A	4A Cherry Cottage Load	A	63 Craig Load	3-phase
2A 2 Well Court Load	A	4A Cherrytrees Load	A	6A 1 Market Road Load	A
2A 3 Well Court Load	A	4A Crosby House Load	A	6A 1 Well Court Load	A
2A 4 Well Court Load	A	4A Dunvegan Load	A	6A 11 Market Road Load	A
2A 5 Well Court Load	A	4A Glenfruin Load	A	6A 2 MS Load	A
2B 1 Windram Place Load	B	4A Hall Load	A	6A 3 Market Road Load	A
2B 14 Windram Place Load	B	4A Hotel Load	A	6A 5 Market Road Load	A
2B 17 Windram Place Load	B	4A Rose Cottage Load	A	6A 7 Market Road Load	A
2B 18 Windram Place Load	B	4A Rosslee Load	A	6A 9 Market Road Load	A
2B 19 Windram Place Load	B	4B Brownlea Load	B	6A Corner Load	A
2B 2 Windram Place Load	B	4B Roxburgh Load	B	6A Edelweiss Load	A
2B 20 Windram Place Load	B	5A 1 Windram Terrace Load	A	6A Elm Bank Load	A
2B 22 Windram Place Load	B	5A 11 East Crostfield Load	B	6A Hillcrest Load	A
2B 4 Windram Place Load	B	5A 11 Windram Road Load	A	6A Hirondelles Load	A
2B 6 Windram Place Load	B	5A 12 Crostfield Load	A	6A Pine Field Load	A
2B 7 Windram Place Load	B	5A 14 Crostfield Load	A	6A View Cottage Load	A
2B 8 Windram Place Load	B	5A 16 Windram Road Load	A	6B Edelweiss Load	B
2C 10 Windram Place Load	C	5A 18 Windram Road Load	A	6B West End Cottage Load	B
2C 11 Windram Place Load	C	5A 2 Windram Terrace Load	A	6B Westerlea Load	B
2C 12 Windram Place Load	C	5A 3 Park View Load	A	6B Westerlea Load(1)	B
2C 21 Windram Place Load	C	5A 4 Park View Load	A	6B Westfield Load	B
2C 23 Windram Place Load	C	5A 6 East Crostfield Load	A	6C 1 MS Load	C
2C 24 Windram Place Load	C	5A 7 Crostfield Load	A	6C Croft Load	C
2C 3 Windram Place Load	C	5A 8 Crostfield Load	A	6C Rose Bank Load	C
2C 5 Windram Place Load	C	5A 8 East Crostfield Load	A	6C Westfield Cottage Load	C

Table 96: Loads connected to Chirnside West End S/S