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ARC Project PV Modelling & Monitoring

Project Summary

- Duration: Oct 2013 / Oct 2016
Funding: £8.4 million LCNF
Partners: CES, SGS, University of Strathclyde
- Key Objectives
 - Accelerate connections of renewable generation to the distribution network.
 - Accelerate the time to connect new generation projects.
- Customer Benefits
 - Assist communities in the development of methods of using locally produced energy, allowing generators to produce more and helping all parties benefit from reduced costs.

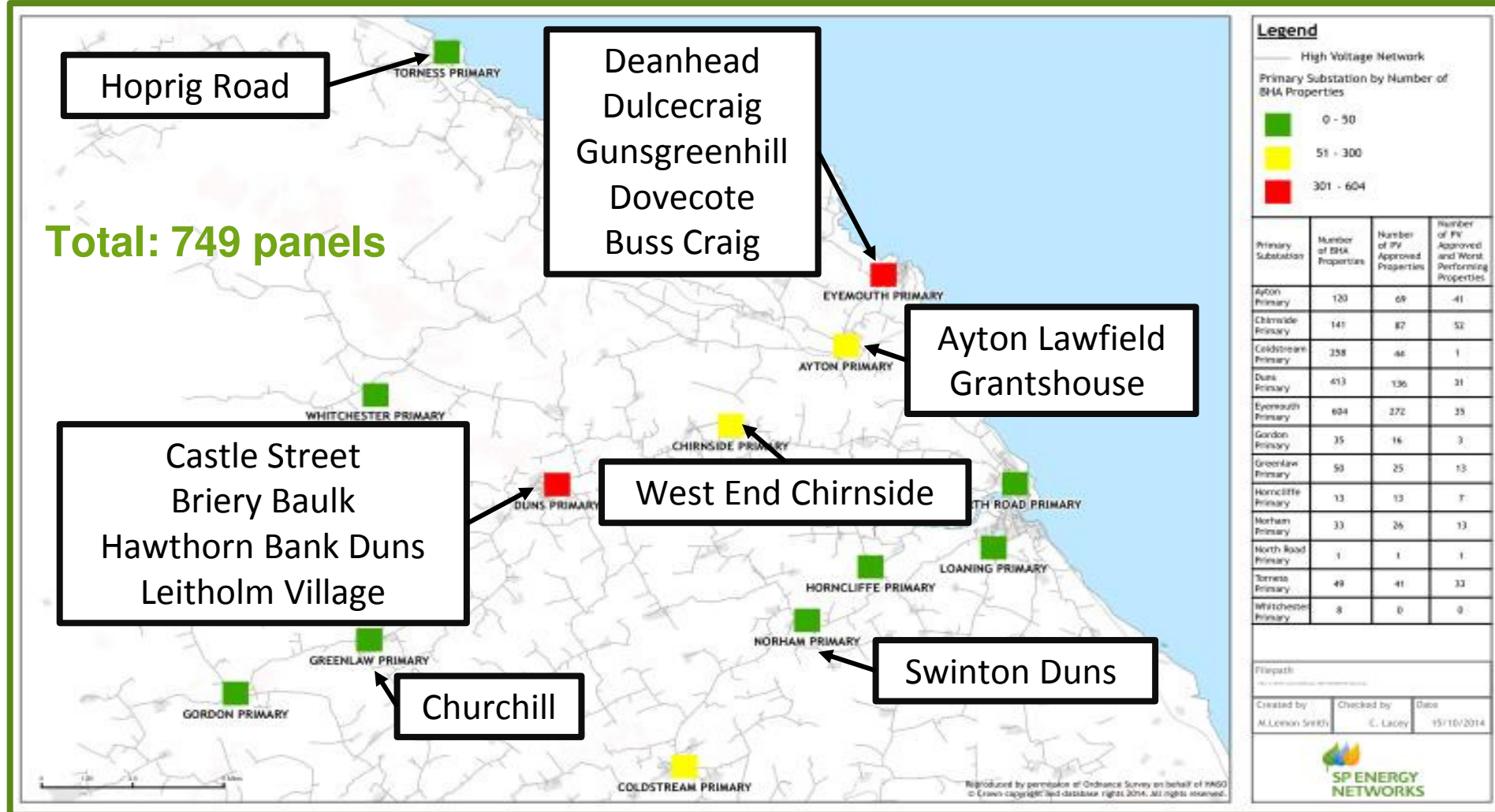
Presentation Focus

The presentation focusses on modelling and monitoring of the Low Voltage (LV) network in order to analyse the impact of the integration of domestic photovoltaics (PVs).

Highlight:

- Modelling of distribution substations and their associated LV feeder circuits.
- Methodology used for the analysis.

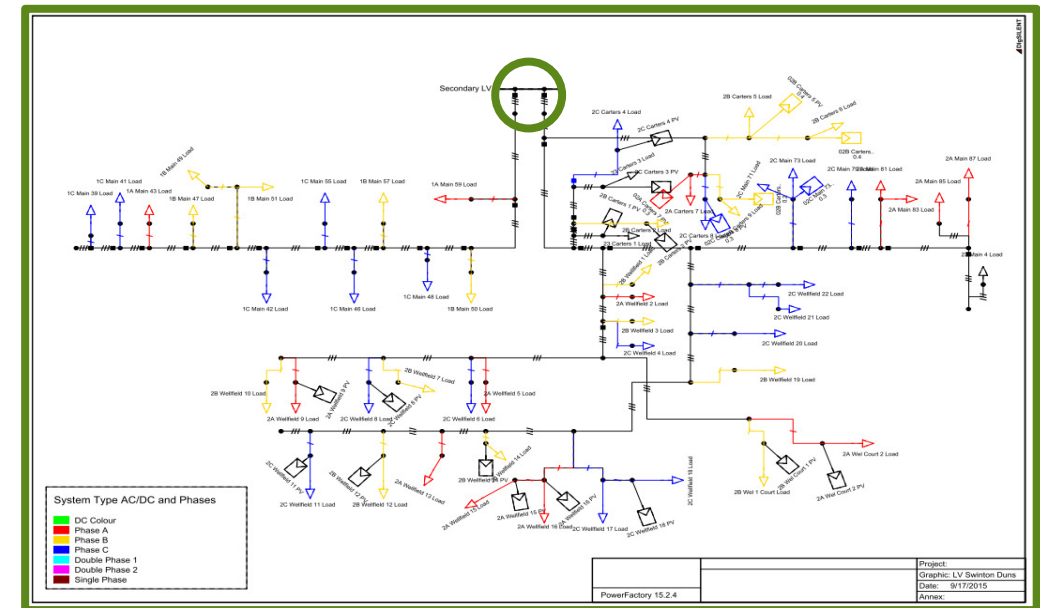
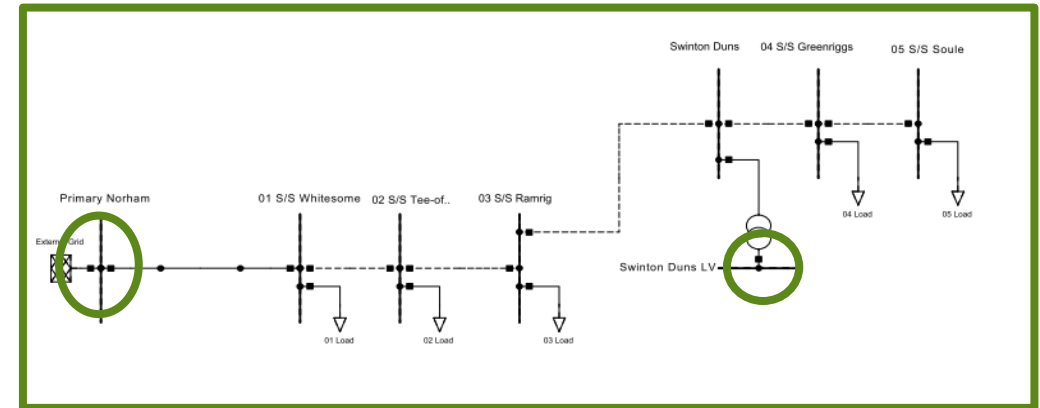
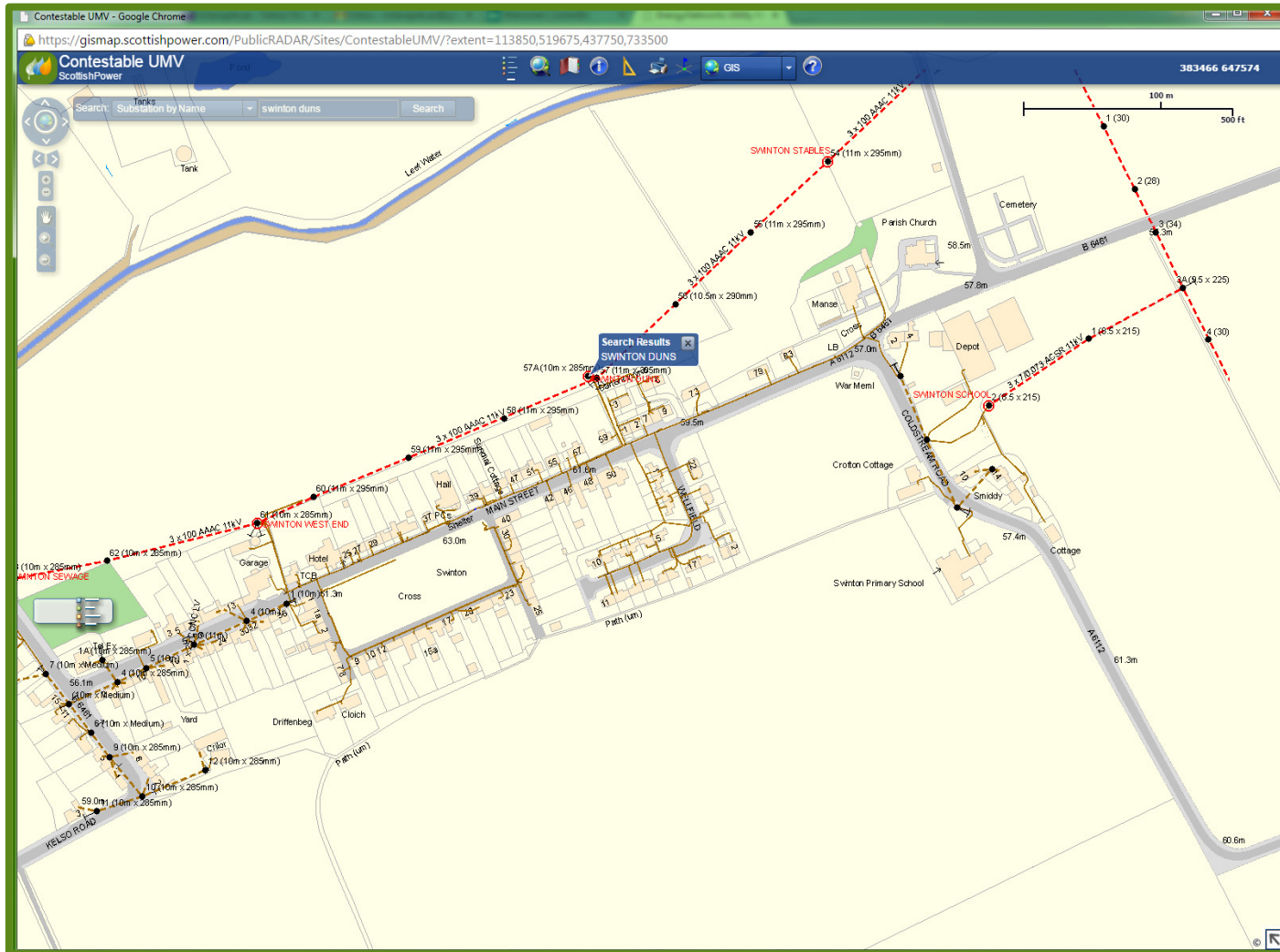
BHA properties with proposed PV installations at Primary level



Swinton Duns



PV Modelling & Monitoring



Methodology for real and assumed data

1. Set the voltage at the Primary to measured data or start from 11.2kV

2. Equally distribute measured / assumed LV load along feeders

3. Set 11kV loads at other Secondary Substations (S/S)

4. Connect a PV (start from the electrically closest one to S/S)

5. Run a load flow

6. Check if voltage and thermal limits at all locations and all phases are satisfied

YES

NO

7. Mark the PV as acceptable, add the next electrically closest PV and go to 4

7. Set the PV out of operation, add the next electrically closest PV and go to 4

8. Stop when all PVs are checked / decrease Primary voltage for 0.05 and go to 2 until all PVs are connected

Swinton Duns Results

	Recorded Winter load (19 proposed PVs)					
	PV 100%			PV 85%		
Primary V, 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 L1	5	4	5	5	5	5
Phase L2	8	5	8	8	8	8
Phase L3	6	5	6	6	6	6
Total*	19	14	19	19	19	19

*Total number of PVs that can be connected for recorded conditions.

Swinton Duns Results

	Assumed Summer load, PV 100% (19 proposed PVs)								
	50% winter load			60% winter load			40% winter load		
	19/3	14/3	2/3	19/3	14/3	2/3	19/3	14/3	2/3
Winter load date	19/3	14/3	2/3	19/3	14/3	2/3	19/3	14/3	2/3
Primary V target*	11	11.05	11	11.05	11.05	11	11	11	11
	Assumed Summer load, PV 85% (19 proposed PVs)								
Primary V target*	11.05	11.05	11.05	11.05	11.1	11.05	11	11.05	11

*The voltage at the Primary that allows the connections of all proposed PVs.

	Recorded Summer load (14 proposed PVs)								
	PV 100%			PV 90%			PV 85%		
	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
Primary V, 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 L1	4	4	4	4	4	4	4	4	4
Phase L2	4	5	5	4	5	5	5	5	5
Phase L3	3	4	4	4	5	5	4	5	6
Total*	11	13	13	12	14	14	13	14	14

*Total number of PVs that can be connected for recorded conditions.

Closing Summary

Summary of Key Points:

- 15 sites have been modelled.
- More PVs can be connected at the beginning of the feeder.
- PV power output is 90% of installed capacity.

Closing Summary

What is happening next / likelihood of Business as usual adoption:

- 749 PVs have been released, following BHA increasing the total number of potential sites to 1200.
- Remodelling with different cable types in order to see how much that will affect power flows and voltages.
- Trialling voltage control options at Primary and Secondary substations.

Closing Summary

Customer Benefits:

- Customers are able to use locally produced energy and benefit from reduced costs.

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