WESTERN POWER DISTRIBUTION

LOW CARBON HUB

CONNECTING RENEWABLE ENERGY IN LINCOLNSHIRE

Lincolnshire Low Carbon Hub
Close Down Dissemination Event
Tuesday 2nd June 2015

LCN Fund
Low Carbon Networks

WESTERN POWER DISTRIBUTION
LOW CARBON HUB

Close Down Dissemination Event Agenda

	Timescales
Welcomes and Introduction to WPD and the Low Carbon Hub	10:00 – 10:20
Ring Network	10:20 – 10:40
Dynamic Voltage Control	10.40 – 11:05
Coffee Break	11:05 – 11:30
Network Enhancements	11:30 – 11:50
FACTs Device	11:50 – 12:20
Summary	12:20 – 12:30
Q&A	12:30 – 13:00
Lunch	13:00 – 13:45
Dynamic Line Ratings	13:45 – 14:00
New Commercial Arrangements	14:00 – 14:30
Summary	14:30 – 14:35
Q&A	14:35 – 14:50
Roll Out Plans	14:50 – 15:00

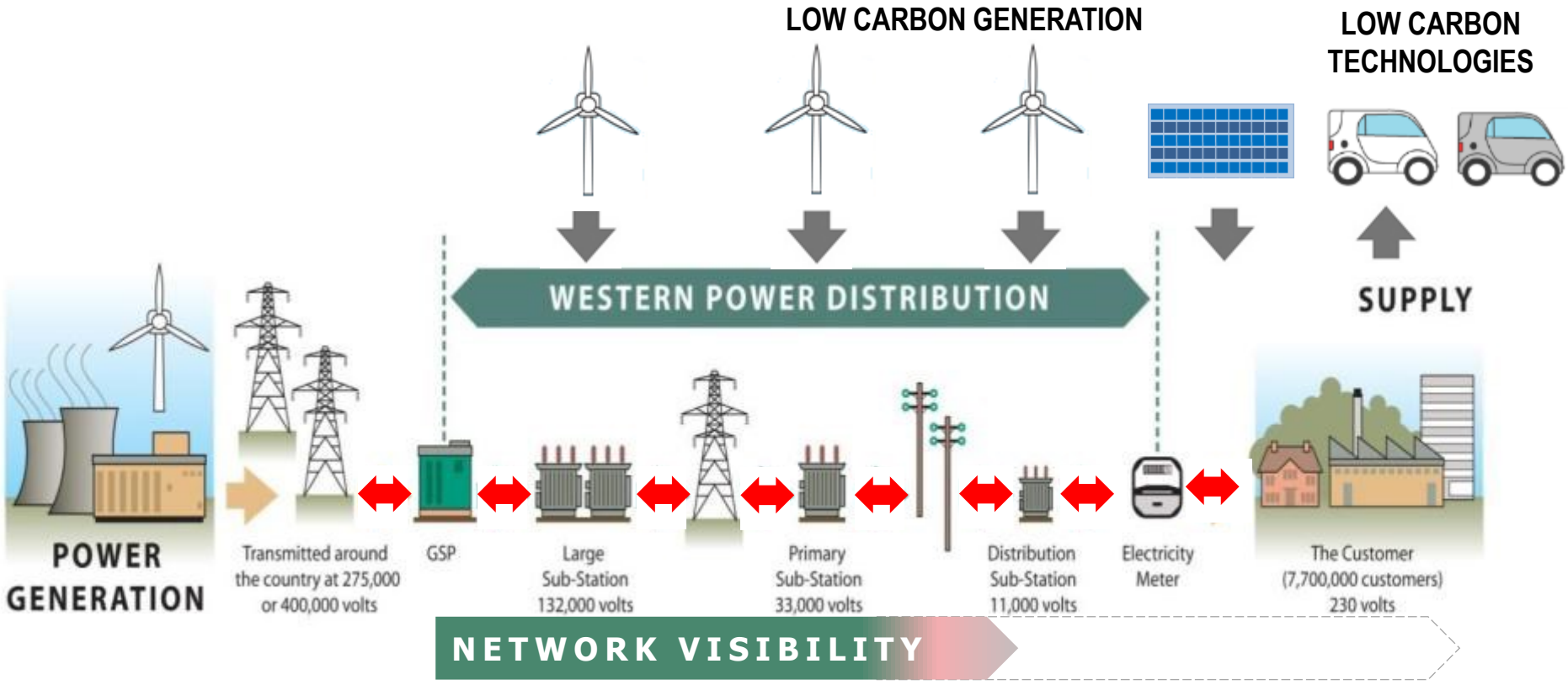
WESTERN POWER DISTRIBUTION

KEY FACTS:

- Wholly owned by Pennsylvania Power & Light
  (PPL - NYSE listed)
- 4 UK Distribution Licences
- 7.7 million customers
- 55,000 sq km area
- Largest length UK network
  216,000 kms of overhead lines and underground cables, and 184,000 substations

WESTERN POWER DISTRIBUTION
LOW CARBON HUB

The Evolving Electricity Network



- Limited capacity
- Passive design / operation
- Centralised Generation
- Limited Visibility
- One-way power flow
- Load centric design

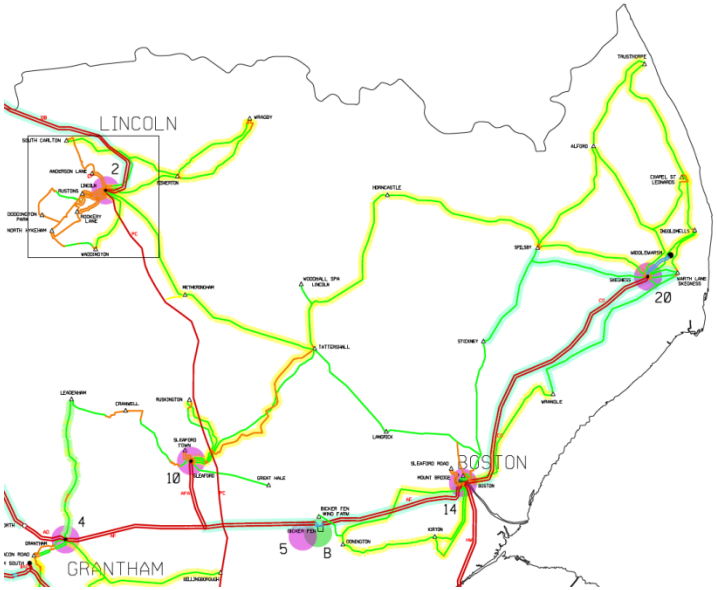
- Reduced headroom
- Increased Intelligence / Active Management
- Distributed Generation
- Need for increased visibility
- Two-way power flows
- Utilisation centric design

Lincolnshire Low Carbon Hub

Generation Connections – East Lincolnshire

East Lincolnshire is rich in renewable energy, however generation connections large and small can be prohibitively expensive as this triggers traditional network reinforcement.

All additional generation now triggers 132kV (thermal) network reinforcement and often 33kV reinforcement (voltage rise).



Lincolnshire Low Carbon Hub location

Solution

Using innovative techniques we are demonstrating how we can unlock network capacity, allowing more generation connections without excessive traditional network reinforcement (often new overhead lines or underground cables).

WESTERN POWER DISTRIBUTION
LOW CARBON HUB

Innovation Strategy

Networks

Demonstrating alternative investment strategies to facilitate the UK's Low Carbon Transition

Customers

Testing innovative solutions to make it simple for customers to connect Low Carbon Technologies

Performance

Developing new solutions to improve network and business performance

Stakeholder Engagement and Knowledge Management

WESTERN POWER DISTRIBUTION NETWORK TEMPLATES

WESTERN POWER DISTRIBUTION LOW CARBON HUB

WESTERN POWER DISTRIBUTION SOLA BRISTOL

WESTERN POWER DISTRIBUTION FALCON

WESTERN POWER DISTRIBUTION FLEXDGRID

WESTERN POWER DISTRIBUTION NETWORK EQUILIRIUM

WESTERN POWER DISTRIBUTION CLEAN ENERGY BALANCING

WESTERN POWER DISTRIBUTION TELECOMS TEMPLATES

WESTERN POWER DISTRIBUTION POWER & HEAT

WESTERN POWER DISTRIBUTION ISENTROPIC

WESTERN POWER DISTRIBUTION LV PLUS Innovate UK

WESTERN POWER DISTRIBUTION WIRELESS HIGHWAYS Innovate UK

WESTERN POWER DISTRIBUTION ECHO

WESTERN POWER DISTRIBUTION COMMUNITY ENERGY ACTION

WESTERN POWER DISTRIBUTION LOSS MITIGATION

WESTERN POWER DISTRIBUTION SOLAR STORAGE

WESTERN POWER DISTRIBUTION STATISTICAL RATINGS

WESTERN POWER DISTRIBUTION D-SVC INTEGRATION

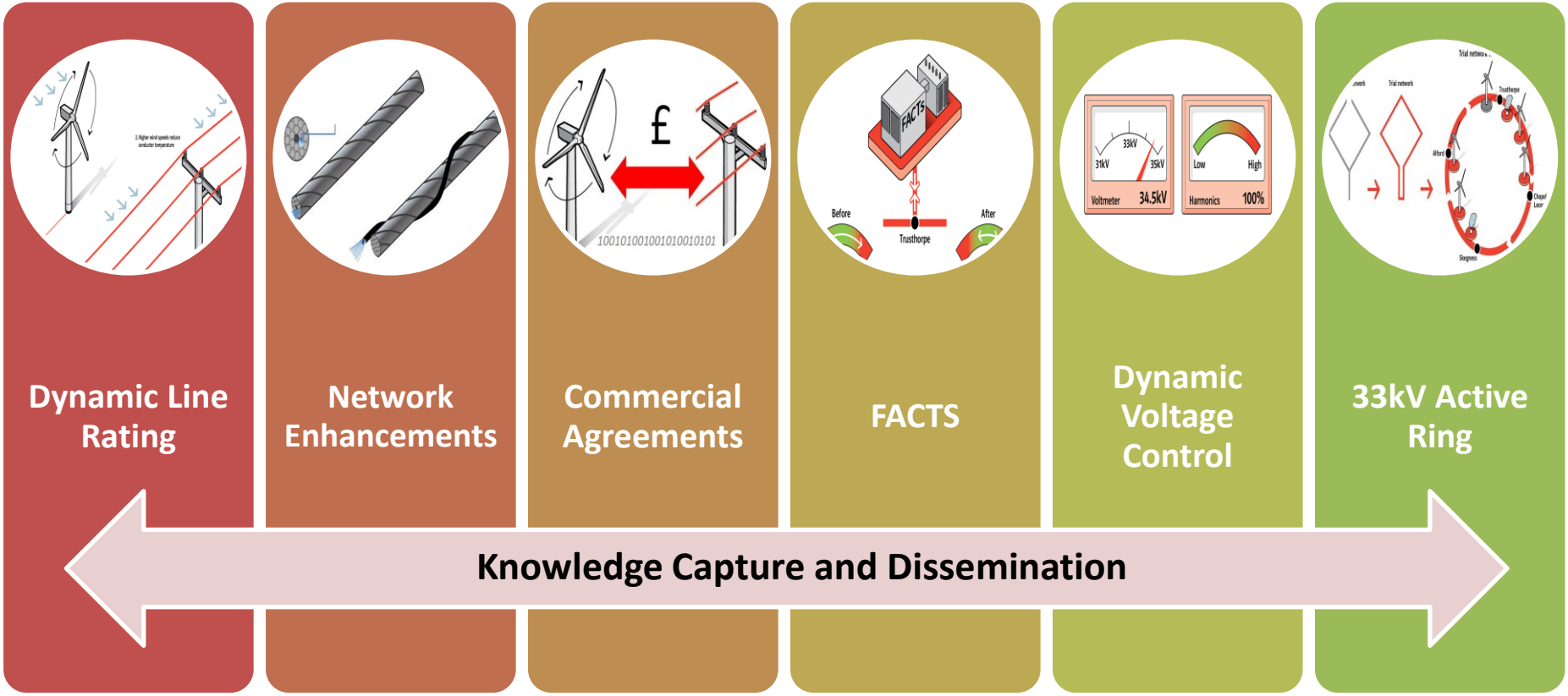
WESTERN POWER DISTRIBUTION ELECTRIC BOULEVARDS

WESTERN POWER DISTRIBUTION CARBON TRACING

WESTERN POWER DISTRIBUTION SUNSHINE TARIFF

WESTERN POWER DISTRIBUTION AERIAL INSPECTION

Low Carbon Hub Techniques



Further information – Project close down report

http://www.westernpowerinnovation.co.uk/Document-library/2015/CNT2002-LLCH-Close-Down-Report_v1-0-Final.aspx

Ring Network

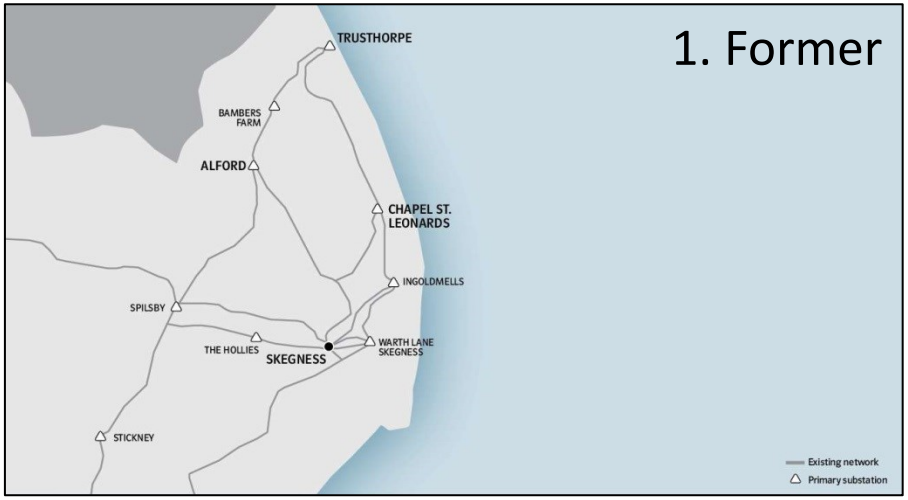
Presentation Overview

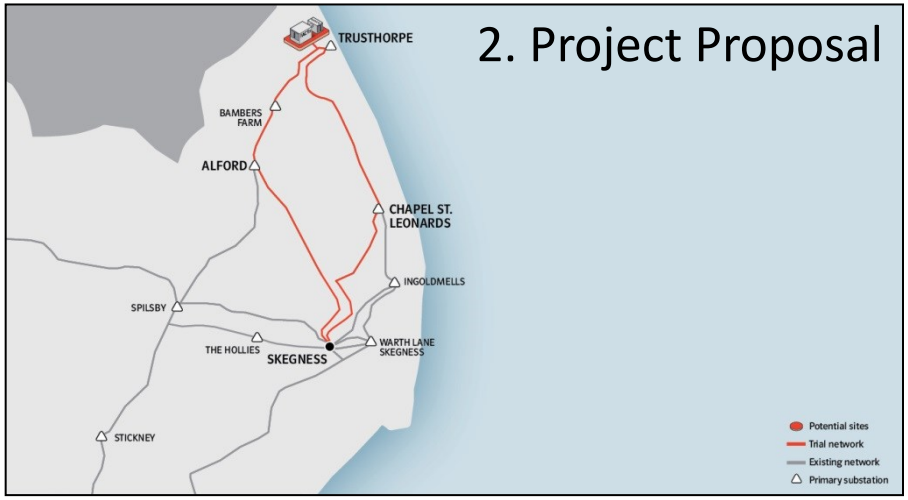
- Background to the Ring Network
- Details of the work carried out
- Method outcomes & Lessons Learnt

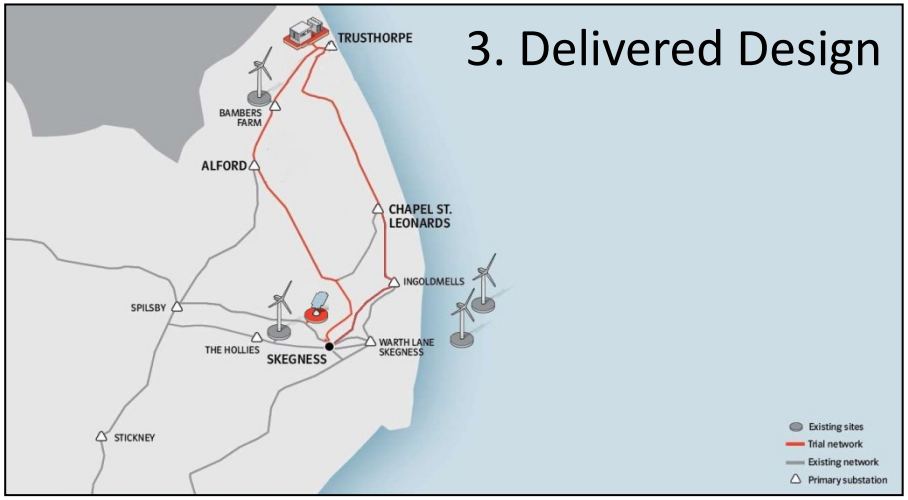
Working with Murphy, NMC and GTDS

Design

1. The former radial network,
2. Proposed build,
3. Delivered design.







Ring Network

Change Request

BBC NEWS LINCOLNSHIRE

Lincolnshire County Council approves wind farm restrictions

A Conservative-led council has approved new restrictions against the building of wind farms in Lincolnshire.

It voted unanimously and issued a statement advising district councils not to grant permission if wind farms failed to meet strict criteria.

The authority's leader said on Monday he did not want the county to be covered by a "forest" of wind turbines.

The council does not want new wind farms to be built within six miles of villages

Skegness Standard

Furious residents hit out at Triton Knoll plan

Skegness Standard

Orby planning inquiry to resume

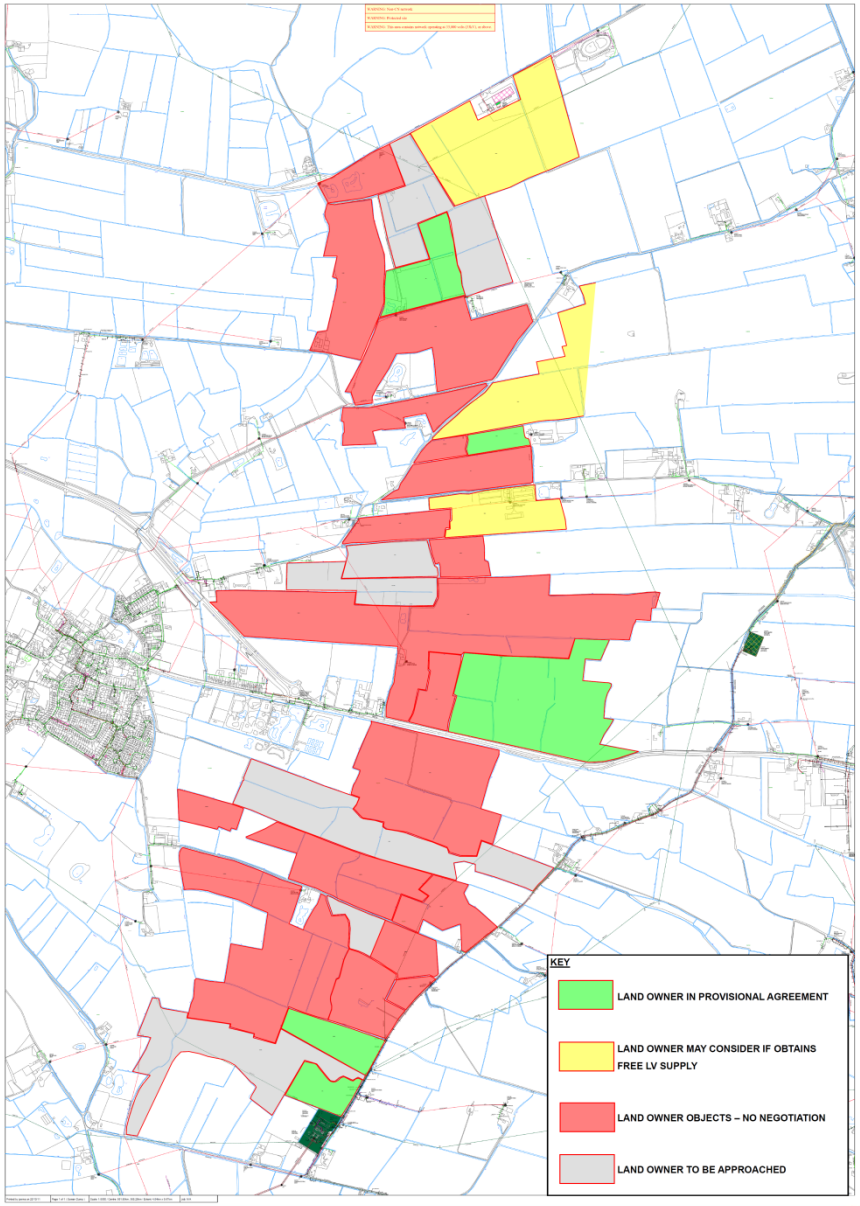
BBC NEWS LINCOLNSHIRE

29 September 2011 Last updated at 17:05

Anderby wind farm plan rejected by government

this is Lincolnshire

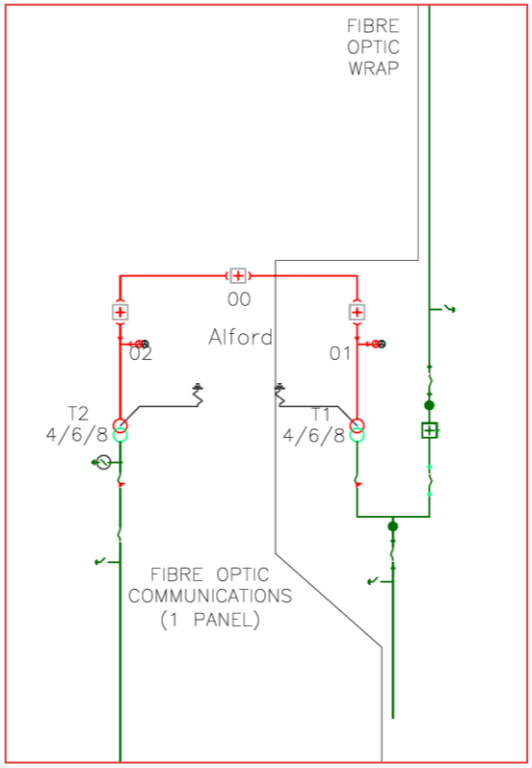
Doubts over public inquiry into refusal of plans for nine wind turbines in Lincolnshire

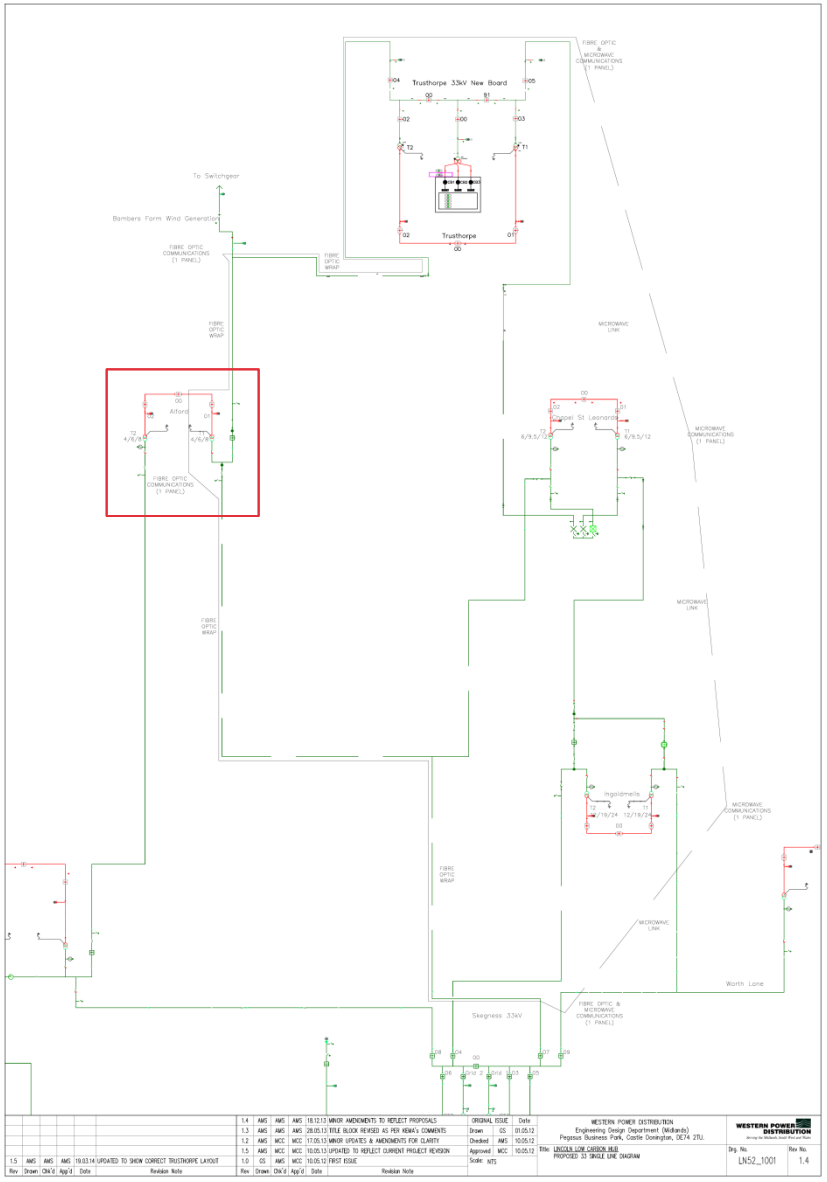


Ring Network

Alford

- New CTs and VTs were provided
- Equipment was changed in order to obtain appropriate auxiliary contacts,
- New protection systems were provided.

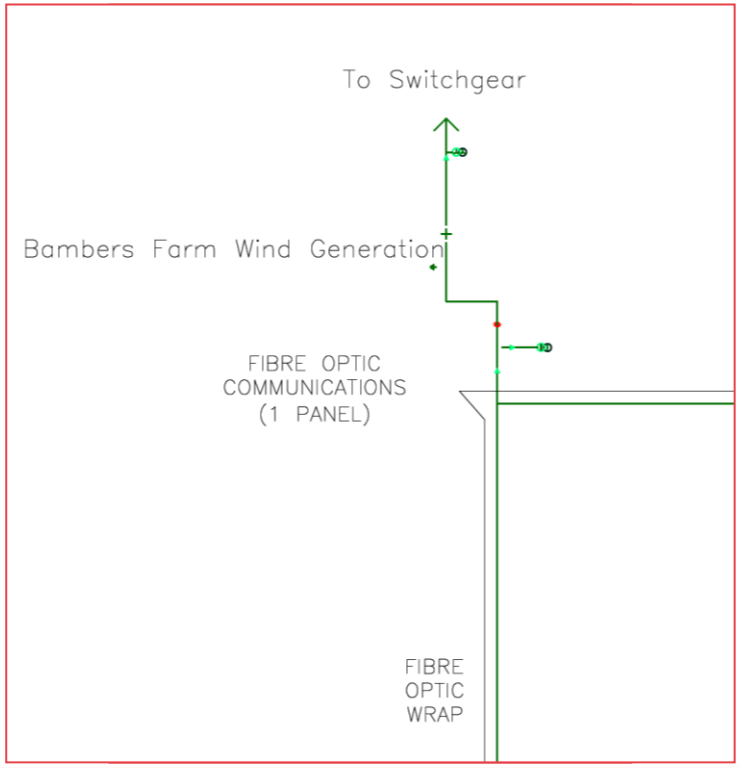


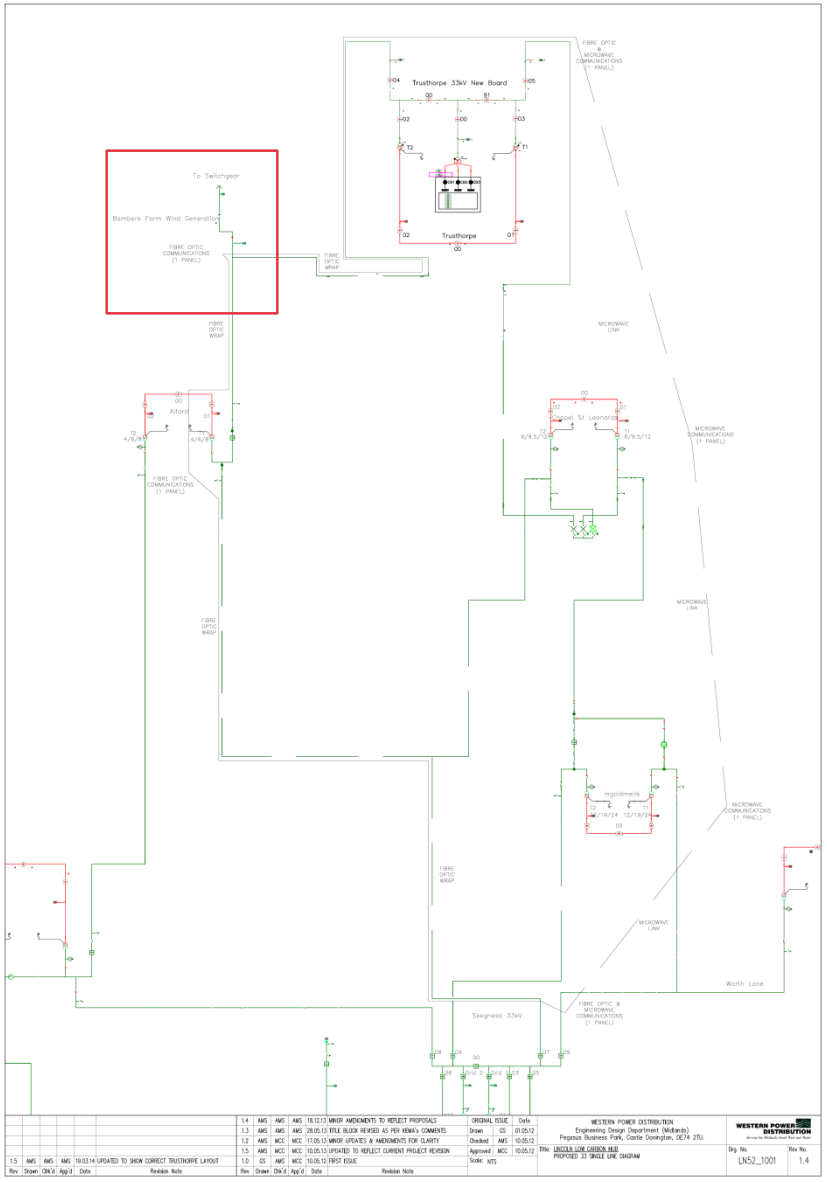


Ring Network

Bambers Wind Farm

- Instrument transformers and protection was added at this site.

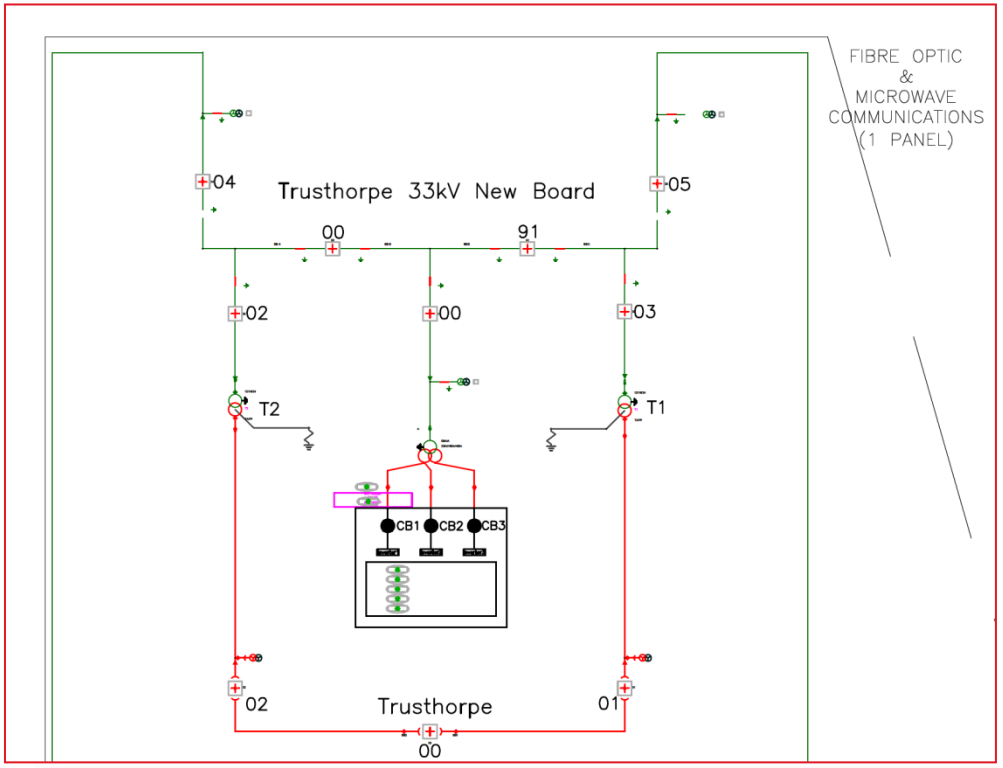


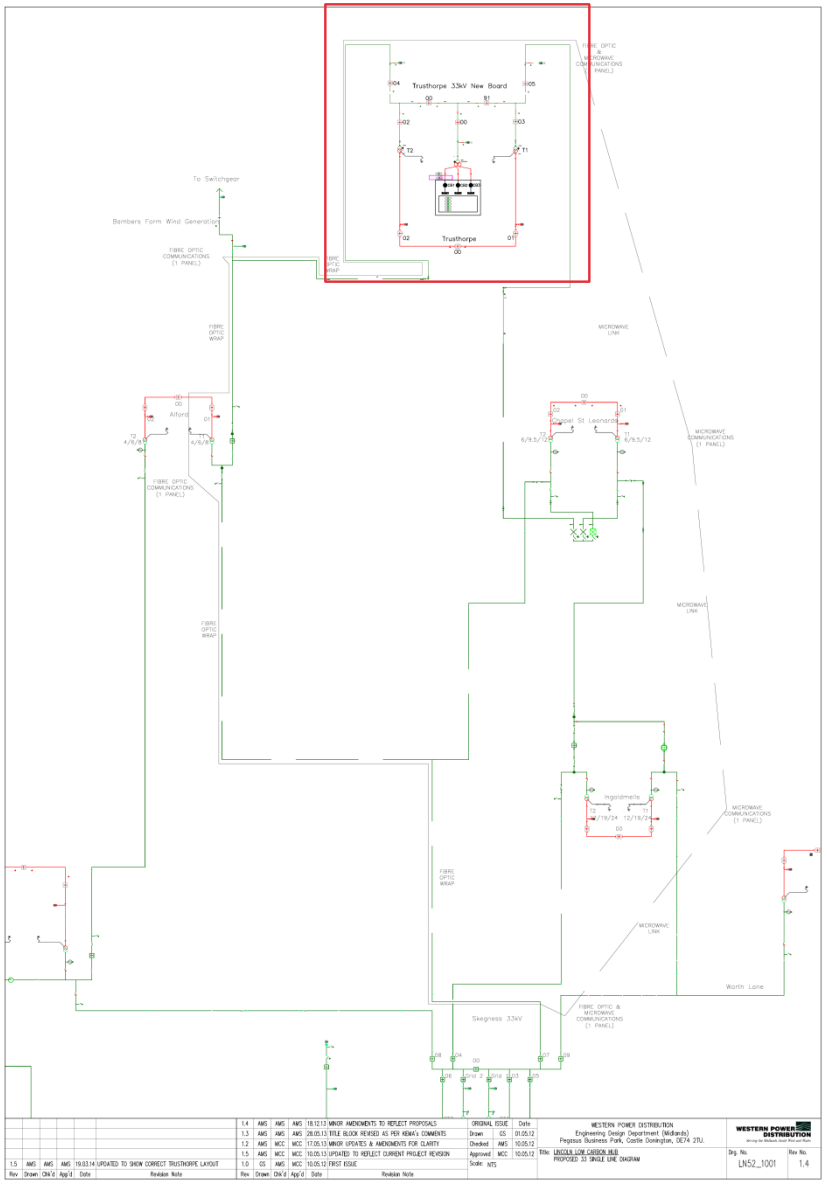


Ring Network

Trusthorpe

- A new 33kV 7 panel switchboard and new protection, was added at this site.

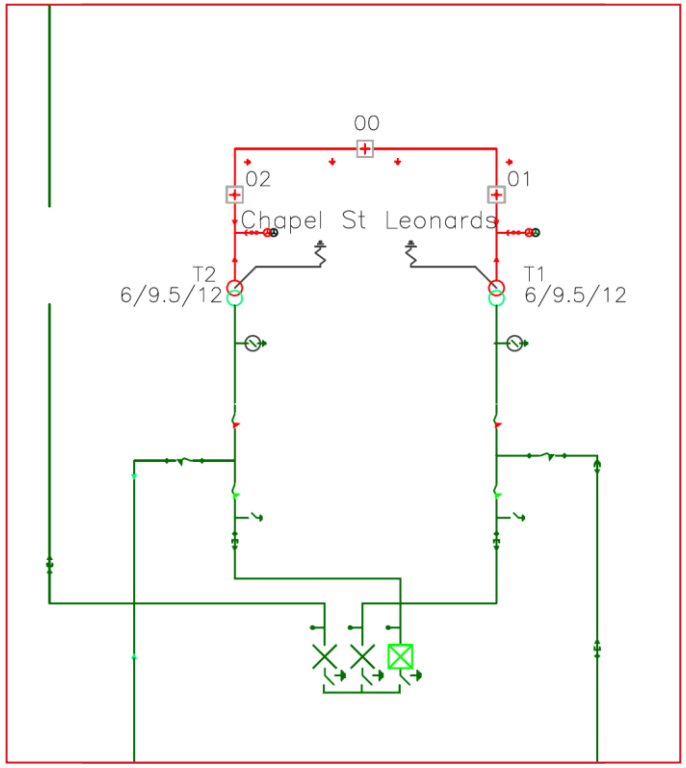


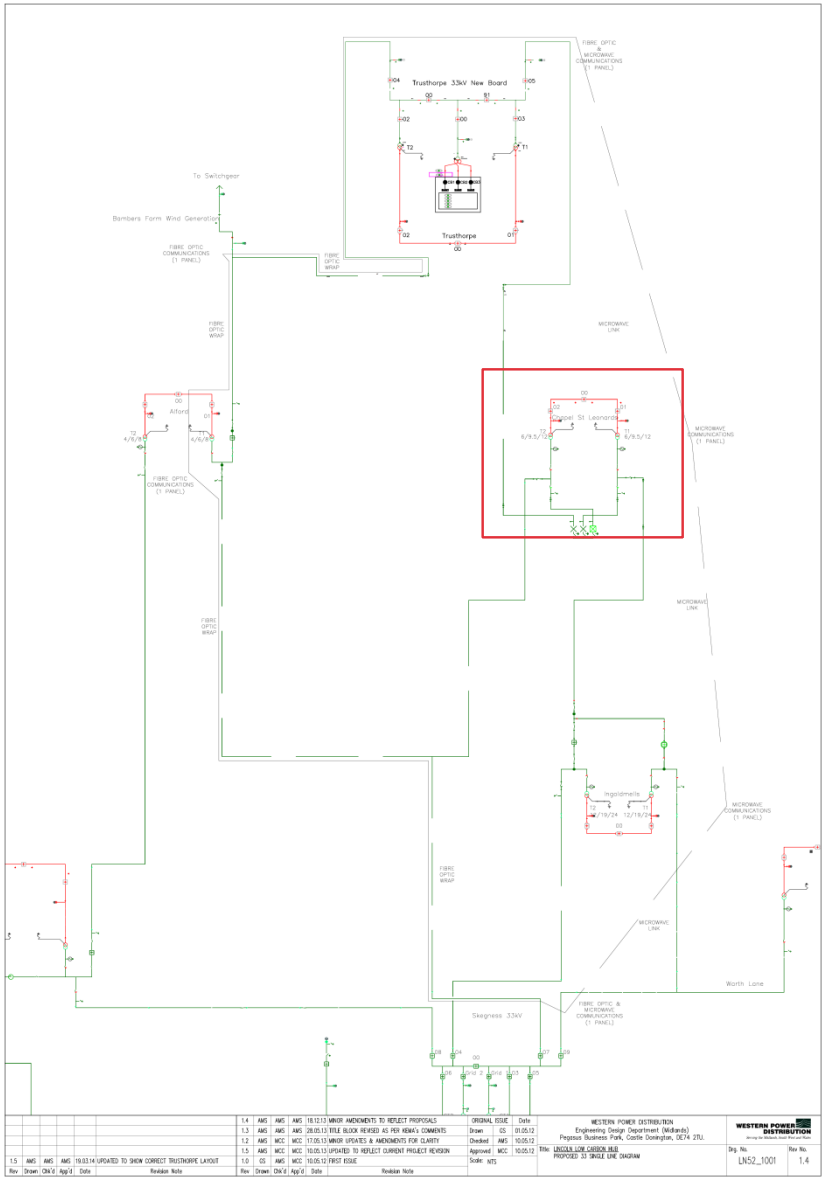


Ring Network

Chapel St Leonards

- A new 33kV 3 panel switchboard, VTs, and new protection was added at this site.

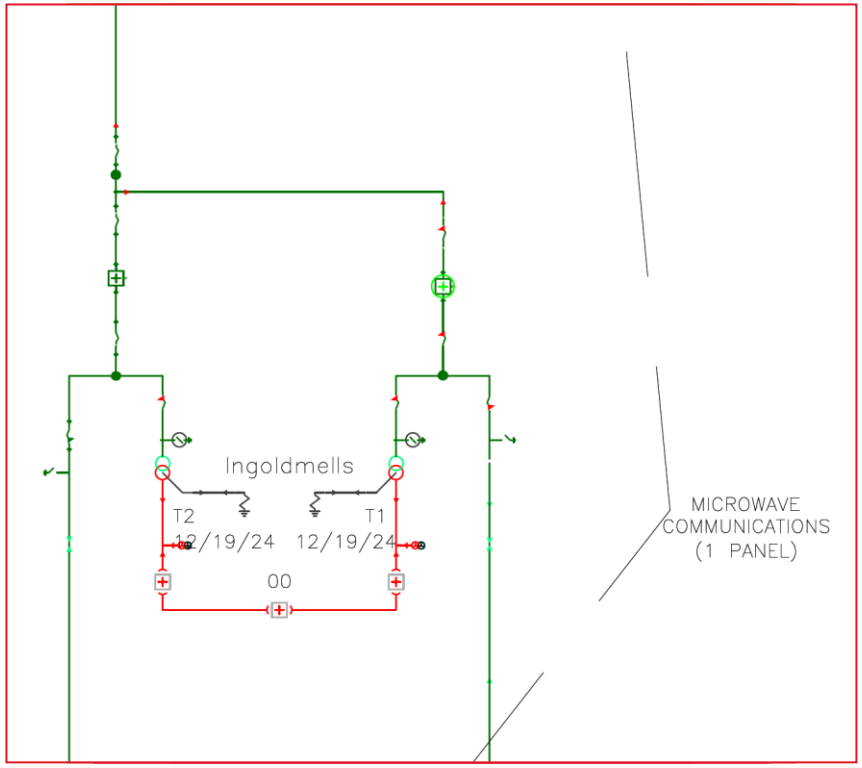


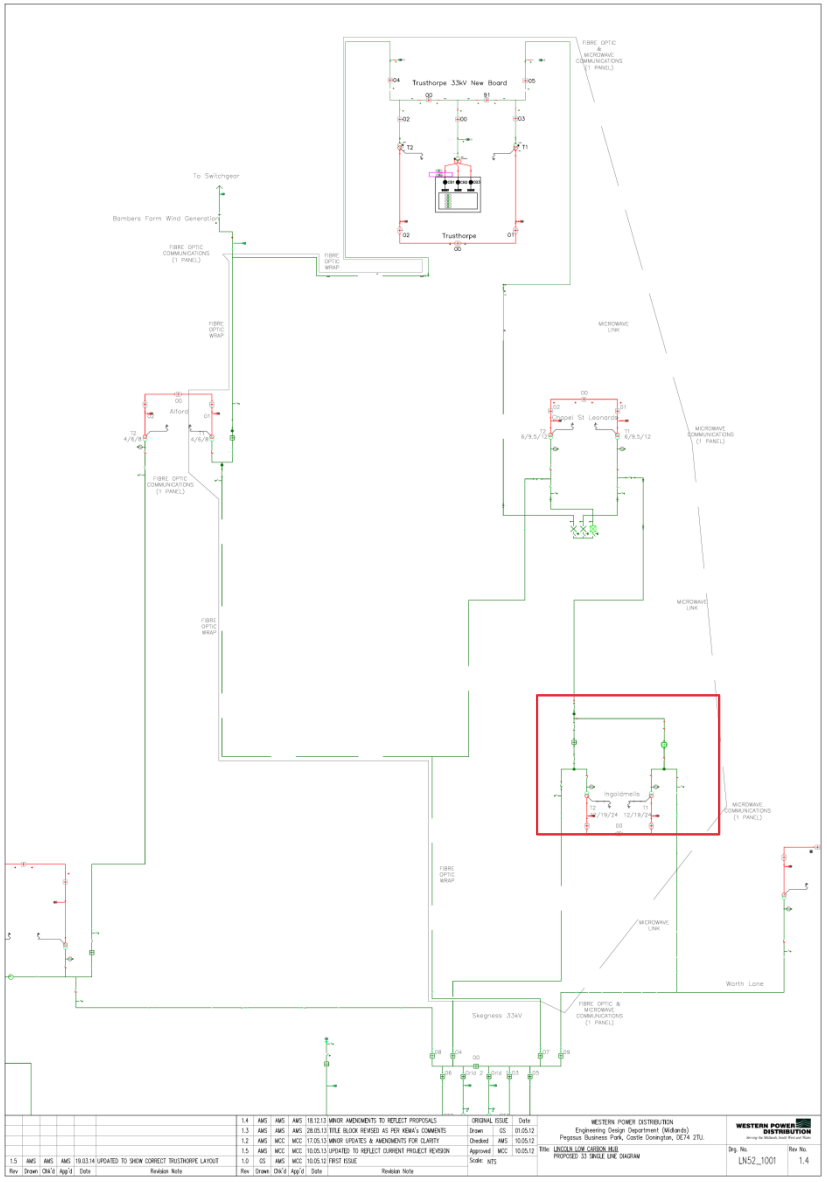


Ring Network

Ingoldmells

- New bay to with additional circuit breakers installed;
- Up-grades included a new circuit breaker and new line disconnectors,
- VTs and new protection were also added.

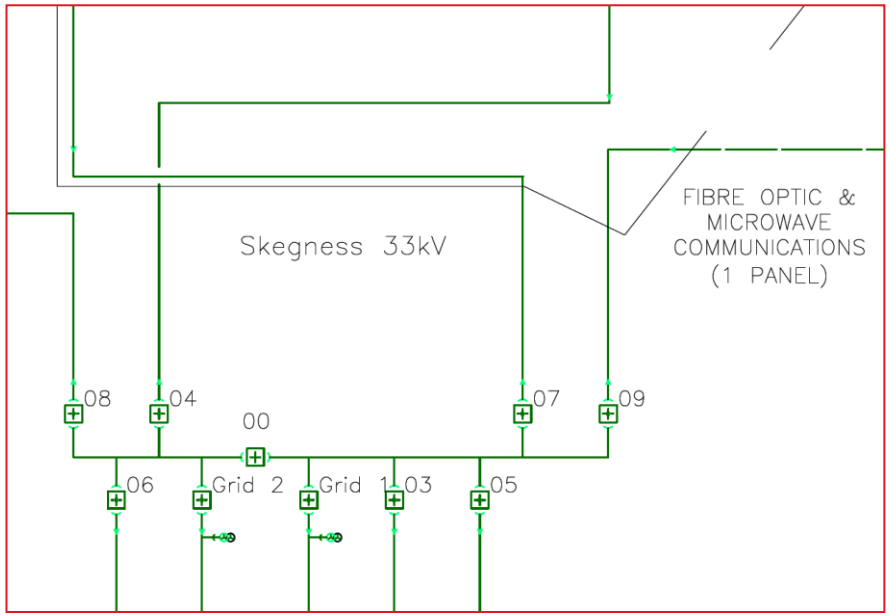


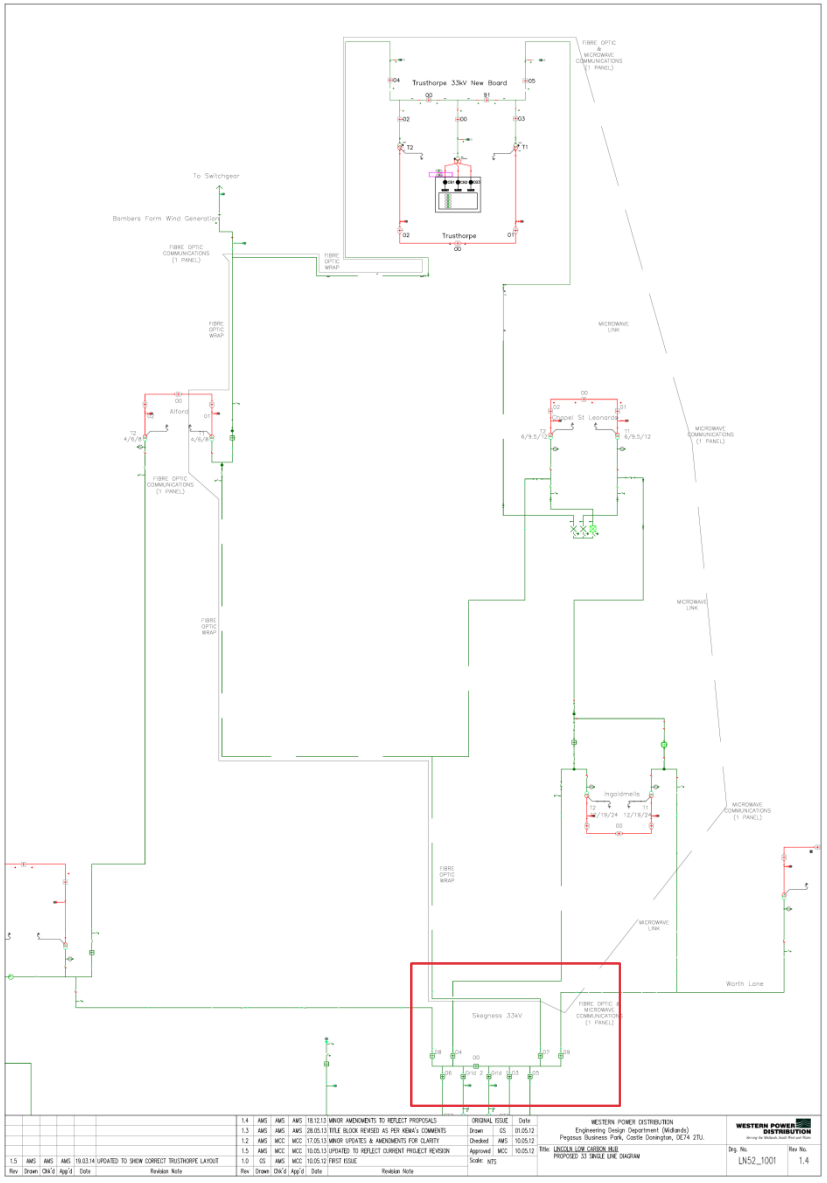


Ring Network

Skegness

- System security improved, and power flows balanced (through 33kV circuit transposition),
- Several new back-up protection systems provided,
- 110V batteries and charger capability increased.

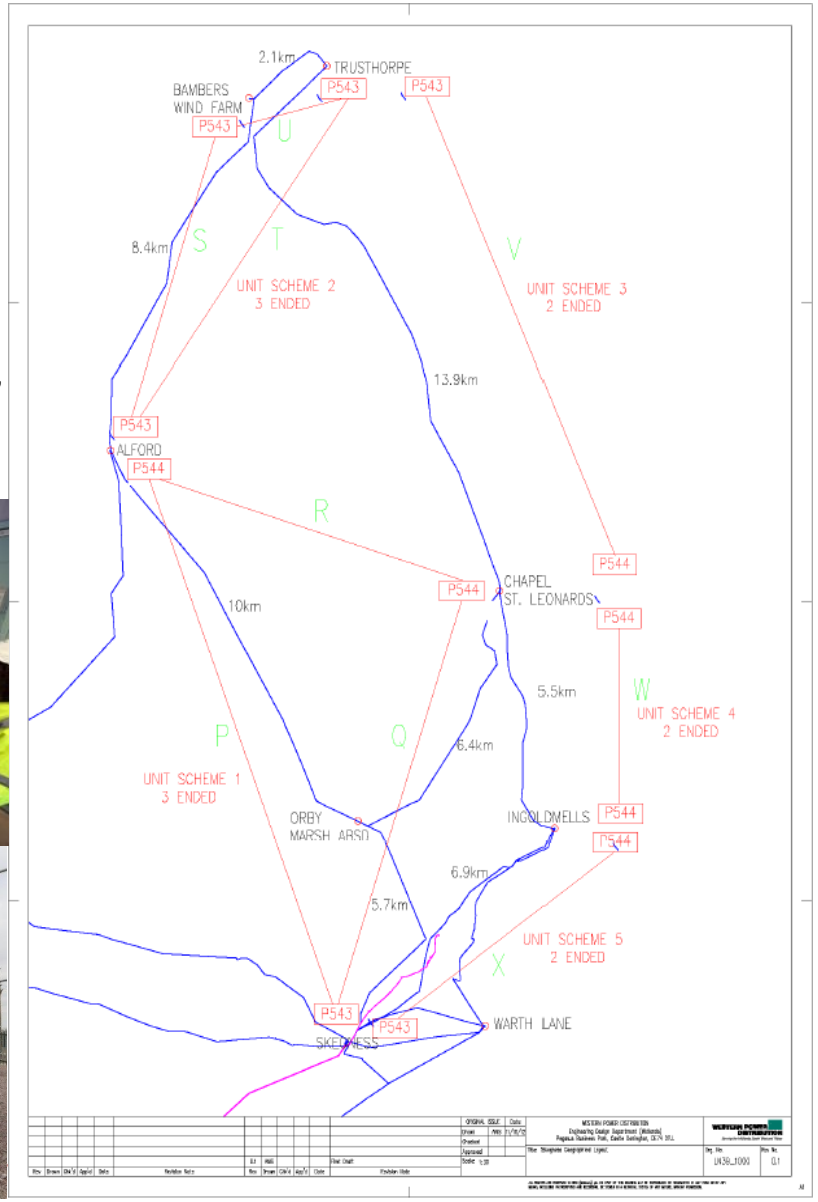




Ring Network

33kV Active Ring

- Skegness – Protection upgrades,
- Alford – Site and protection upgrades,
- Bambers Wind Farm - Protection upgrades,
- Trusthorpe - Site and protection upgrades,
- Chapel St Leonards- Site and protection upgrades,
- Ingoldmells - Site and protection upgrades.



Outcomes and Lessons learnt

- Timescales for repeating the method,
- Capacity released by the ring method and other associated benefits,
- Considerations when Modifying a network vs Rebuilding a network,
- Locating of suitable Current and Voltage Transformers,
- Operational space and permissions associated with each site,
- Protection settings with very low fault levels,
- Managing complexity.

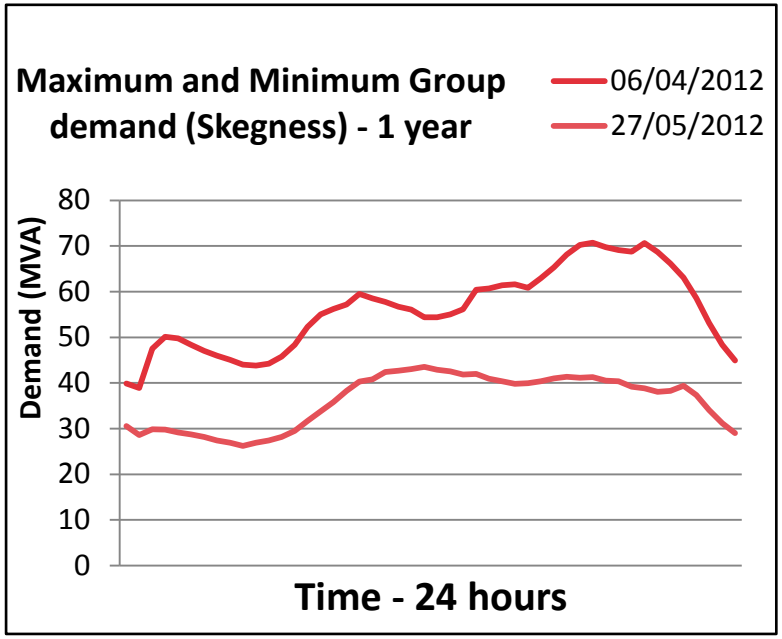
Dynamic Voltage Control

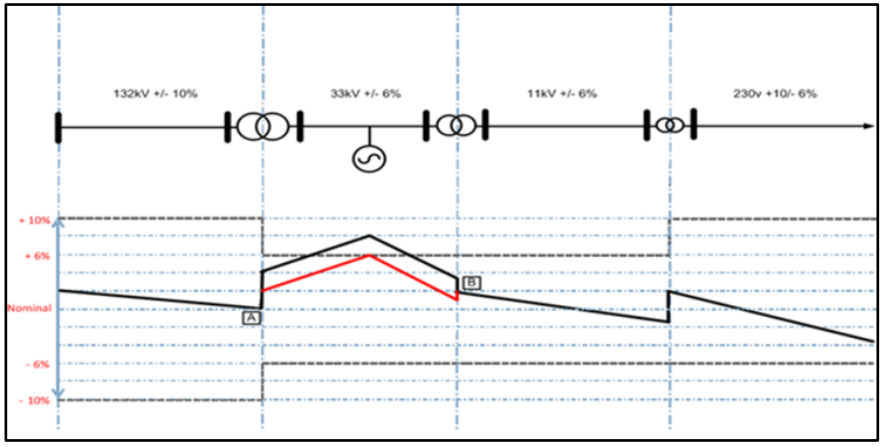
Presentation Overview

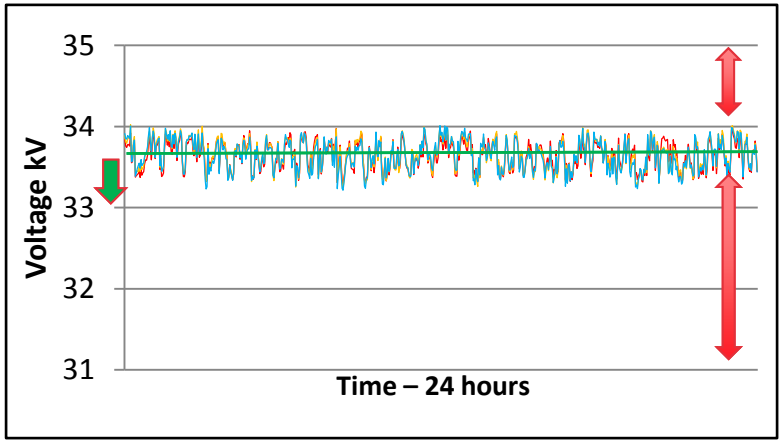
- Background to Voltage Control
- Details of the work carried out
- Method outcomes & Lessons Learnt

Dynamic Voltage Control

- Voltage at Grid and Primary Substations
  - On Load Tap Changer (OLTC), and
  - Automatic Voltage Control (AVC) relay,
- Fixed target voltage settings are applied,
- Both localised and centralised Dynamic Voltage Control (DVC) control schemes.

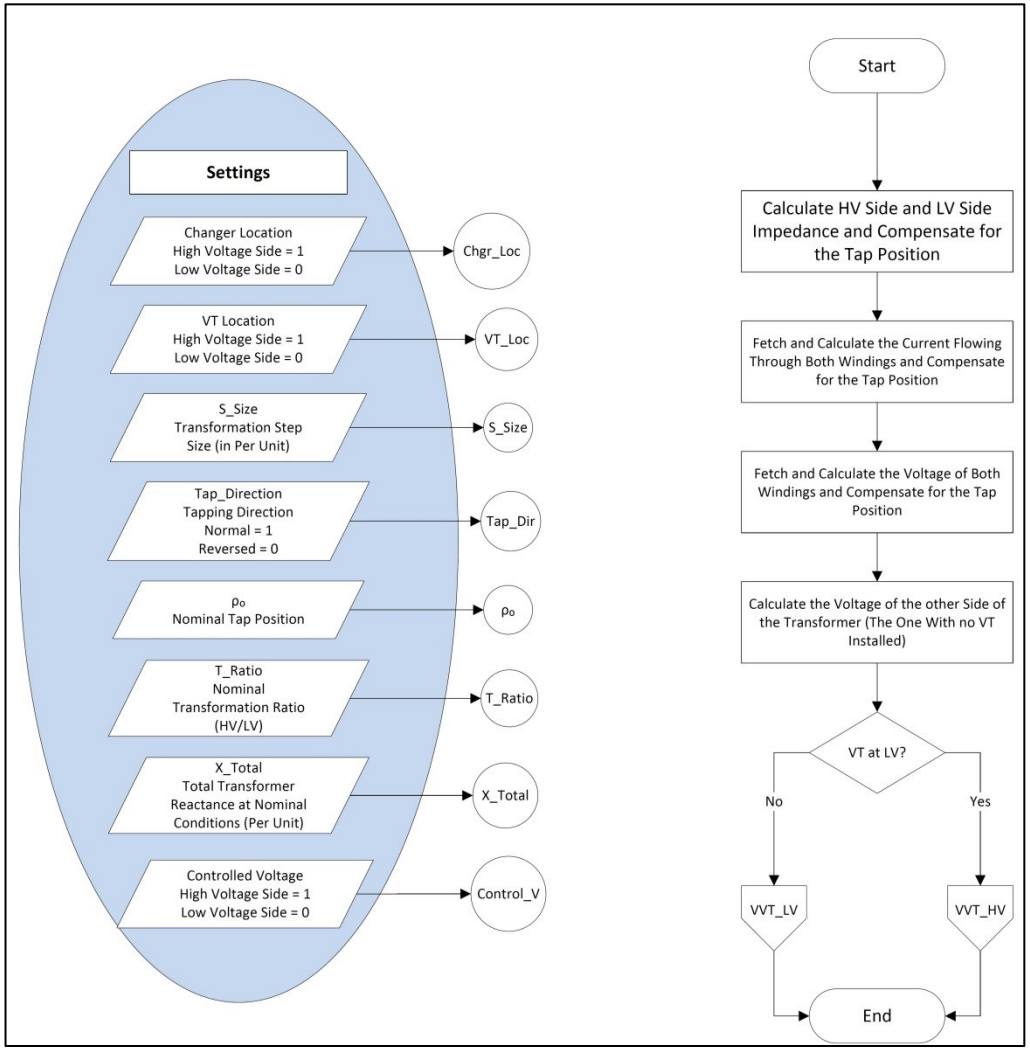






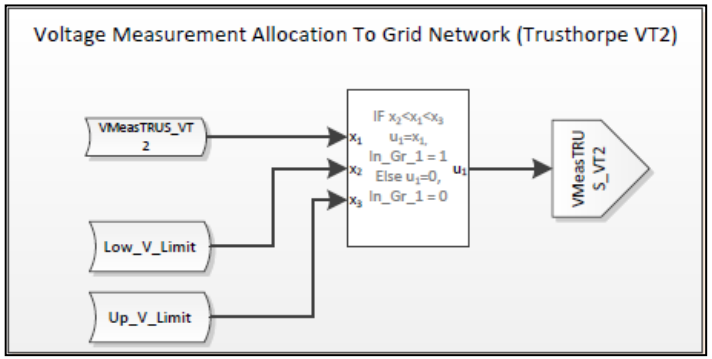
Dynamic Voltage Control
Virtual VT

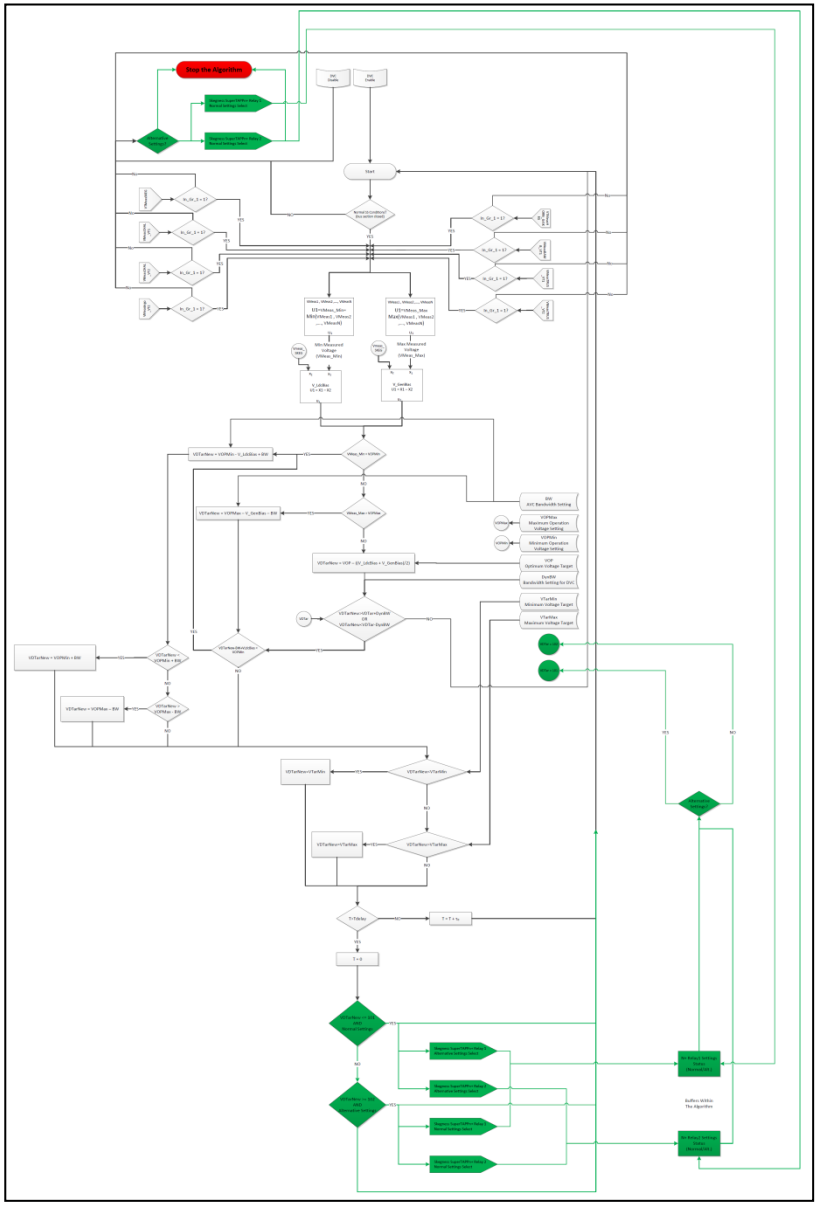
- Typical locations of 33kV Voltage Transducers,
- Importance of knowing the voltage at remote locations,
- Estimating voltage profiles at remote substations,
- Cost effective alternative to traditional Voltage Transformer.



Dynamic Voltage Control Algorithm

- Written in shell script within WPD's DMS PowerON,
- Checks key assets to determining network connectivity,
- Evaluates key voltages, ensuring they are within limits,
- Determines if alternative target voltage settings can be applied.





Dynamic Voltage Control

- Configuring AVC's to receive remote target voltages,
- Hardwired and DNP3 control schemes,
- Maintaining all other functionality,
- Complexity and risk,
- Importance of testing, and
- Installation at Skegness Grid Substation.

Outcomes and Lessons learnt

- Use of VVT to calculate 33kV network voltages,
- Importance of understanding network configuration,
- Transferring AVC schemes away from Hardwired control schemes,
- A DVC algorithm needs to be flexible enough for changes in network connections and robust enough to operate without regular intervention of a control engineer,
- Use of Dynamic Voltage Control to unlock new network capacity.

Coffee Break

Network Enhancements

Presentation Overview

- Background to Network Enhancements
- Details of the work carried out
- Method outcomes & Lessons learnt

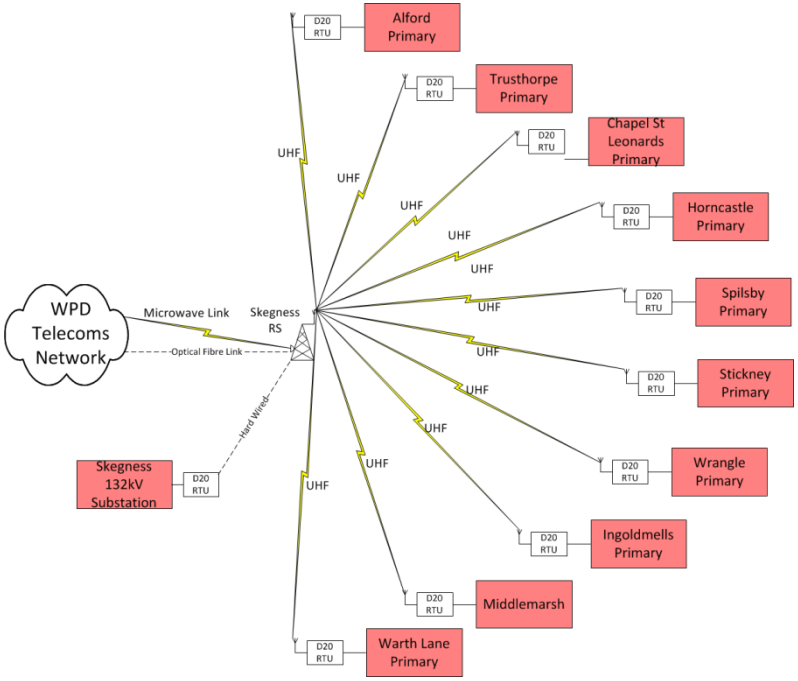
Network Enhancements

33kV Overhead Line design standards for rural networks

Typically 0.1Steel Cored Aluminium (SCA) or 150mm^2 Aluminium Core Steel Reinforced (ACSR).

Telecommunications in rural networks

Typically UHF radio SCADA using a hub and spoke arrangement.

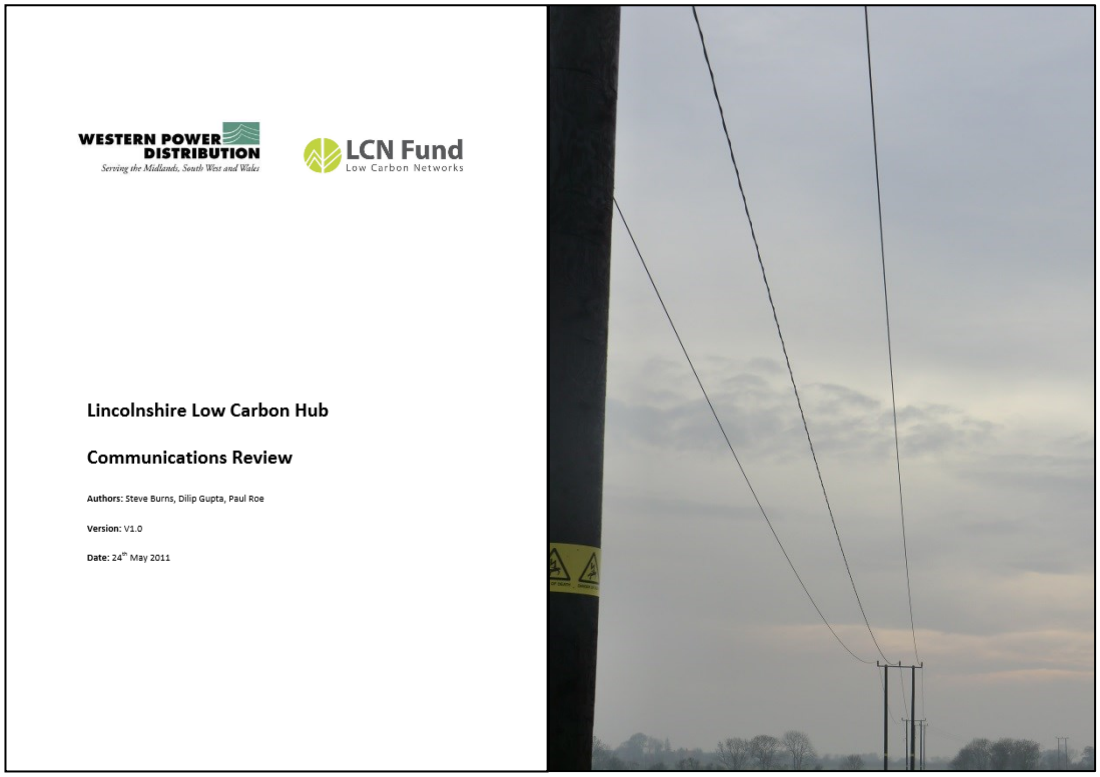


Details of the works carried out

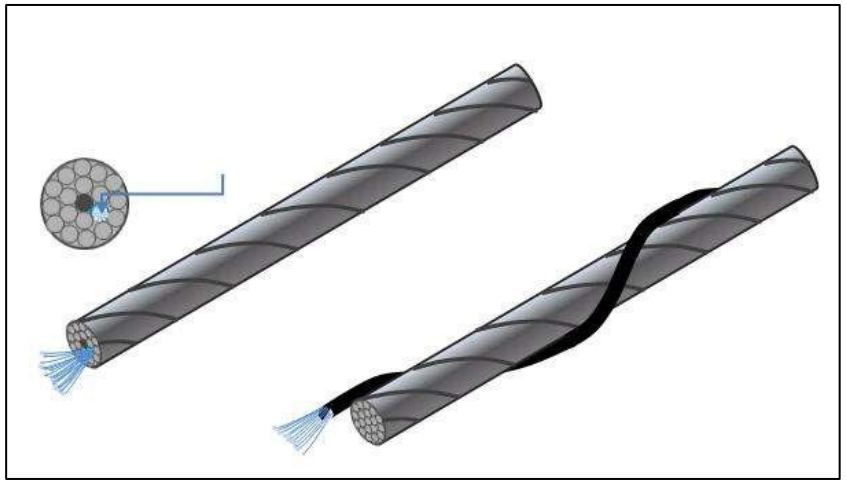
- 10.2 km of key overhead lines in the trial area rebuild to the LCH Standard

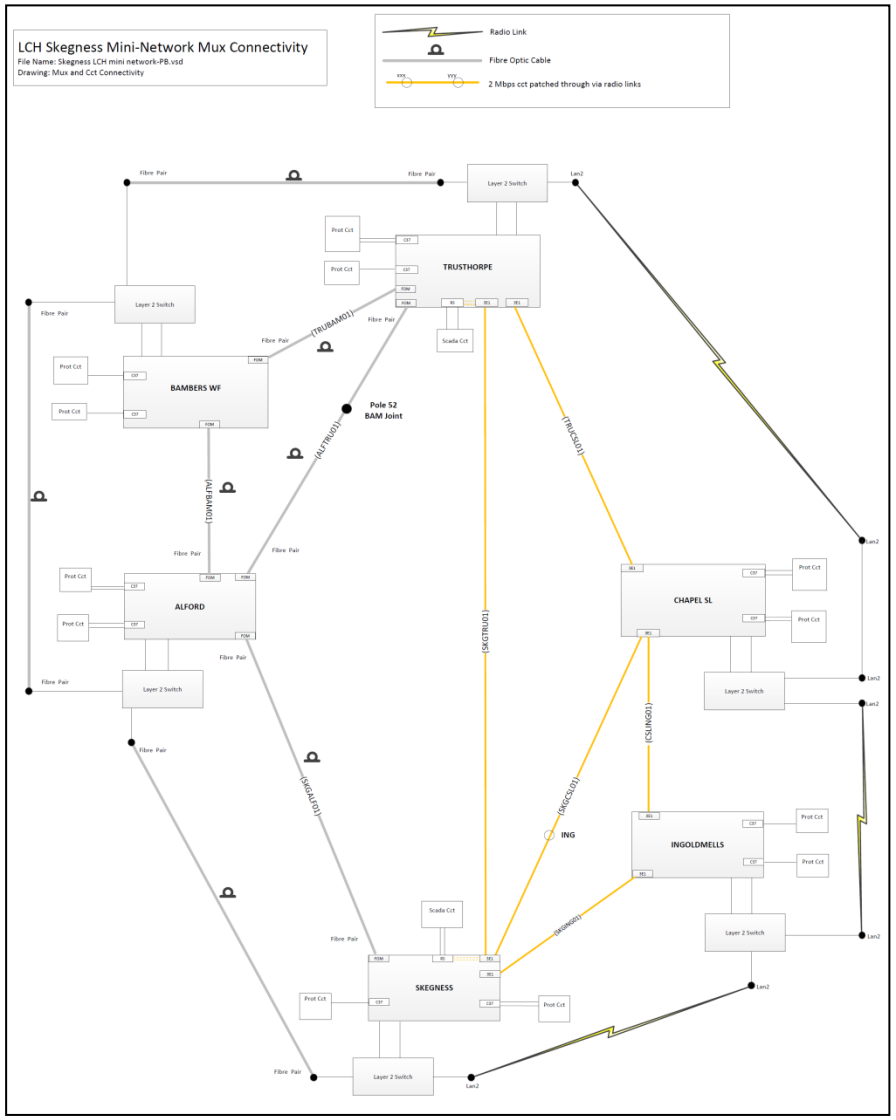
Communications Review

- Optical Phase Conductor (OPPC),
- All-Dielectric Self Supporting cable (ADDS),
- Optical Fibre Wrap (SkyWrap),
- Microwave Radio,
- MiMo Max UHF Radio,
- IP Based Microwave Radio.



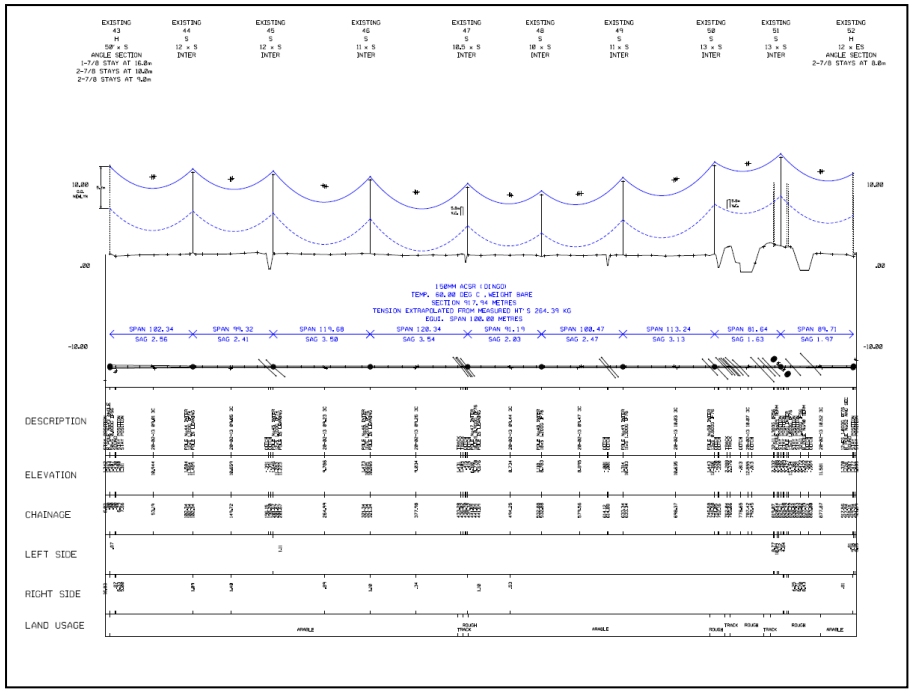
Communications Network





Outcomes and Lessons learnt

- OHL rebuilds,
- Fibre Wrap,
- Microwave circuits,
- Associated telecommunications equipment.



Flexible AC Transmission systems (FACTs)

Presentation Overview

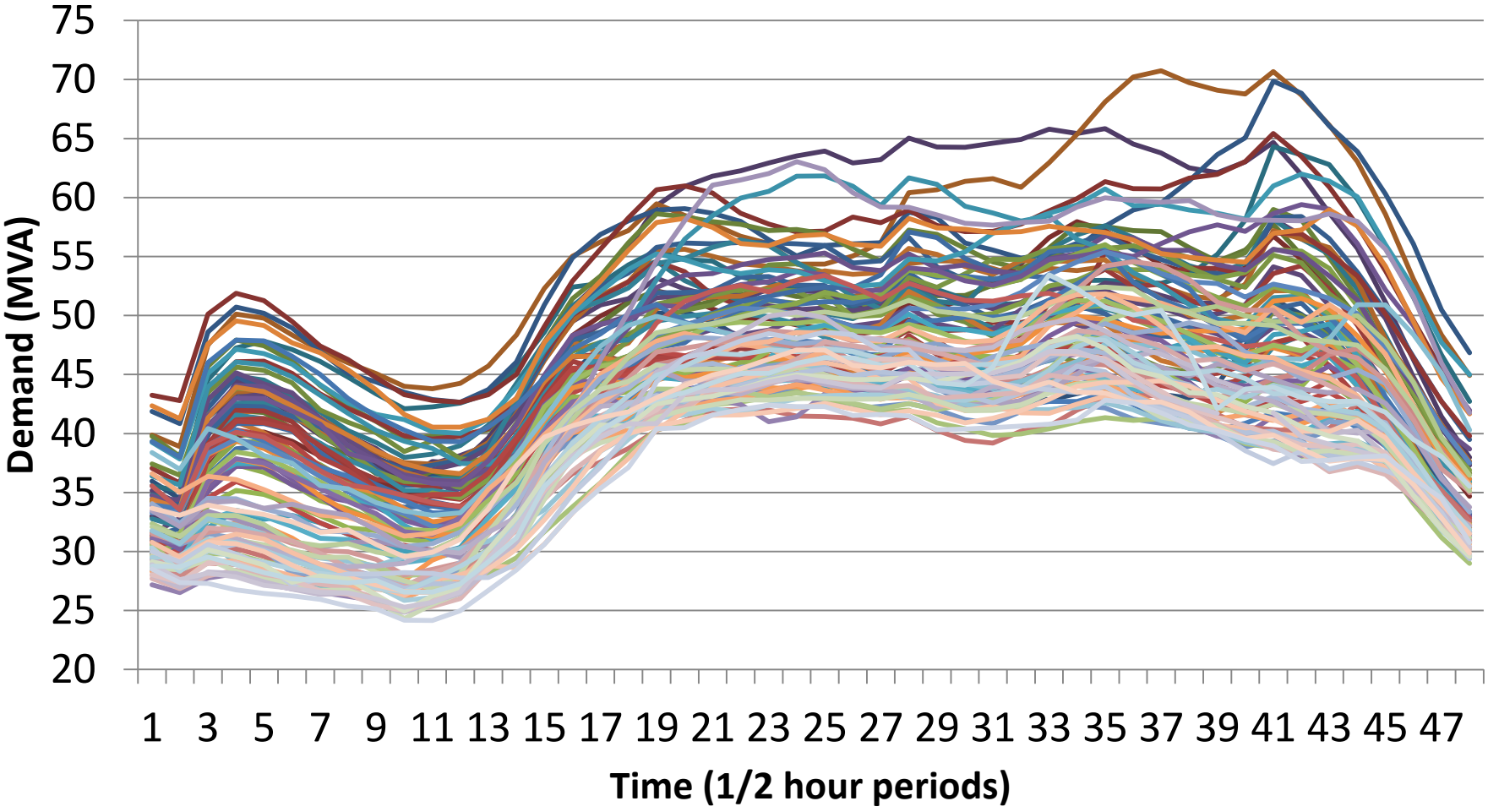
- Background to FACTs
- Details of the work carried out
- Method outcomes & Lessons Learnt

Working with S&C Electric

What is FACTS Technology

	Conventional (Switched)		FACTS-Device (Fast, Static)	
	R, L, C, Transformer		Thyristorvalve	Voltage Source Converter (VSC)
Shunt - Devices	Switched Shunt-Compensation (L, C)		Static Var Compensator (SVC)	Static Synchronous Compensator (STATCOM)
Series - Devices	(Switched) Series-Compensation (L,C)		Thyristor Controlled Series Compensator (TCSC)	Static Synchronous Series Compensator (SSSC)
Shunt & Series- Devices	Phase Shifting Transformer		Dynamic Flow Controller (DFC)	Unified /Interline Power Flow Controller (UPFC/ IPFC)
Shunt & Series- Devices			HVDC Back to Back (HVDC B2B)	HVDC VSC Back to Back (HVDC VSC B2B)

Skegness demand data April - June



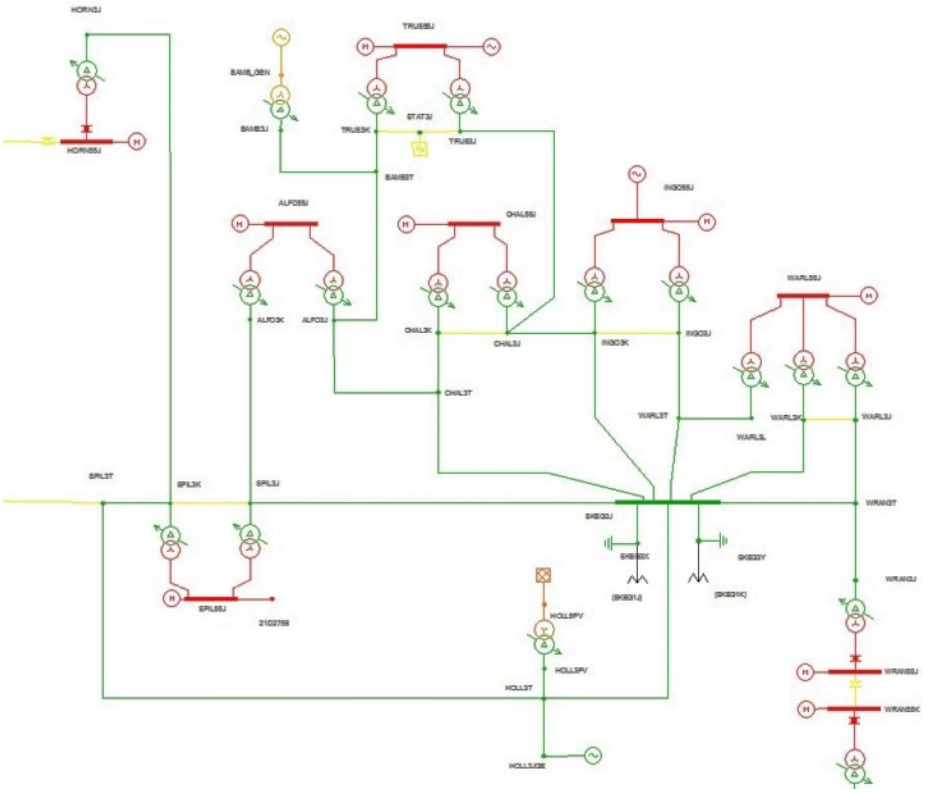
Pre procurement Studies

Internal studies

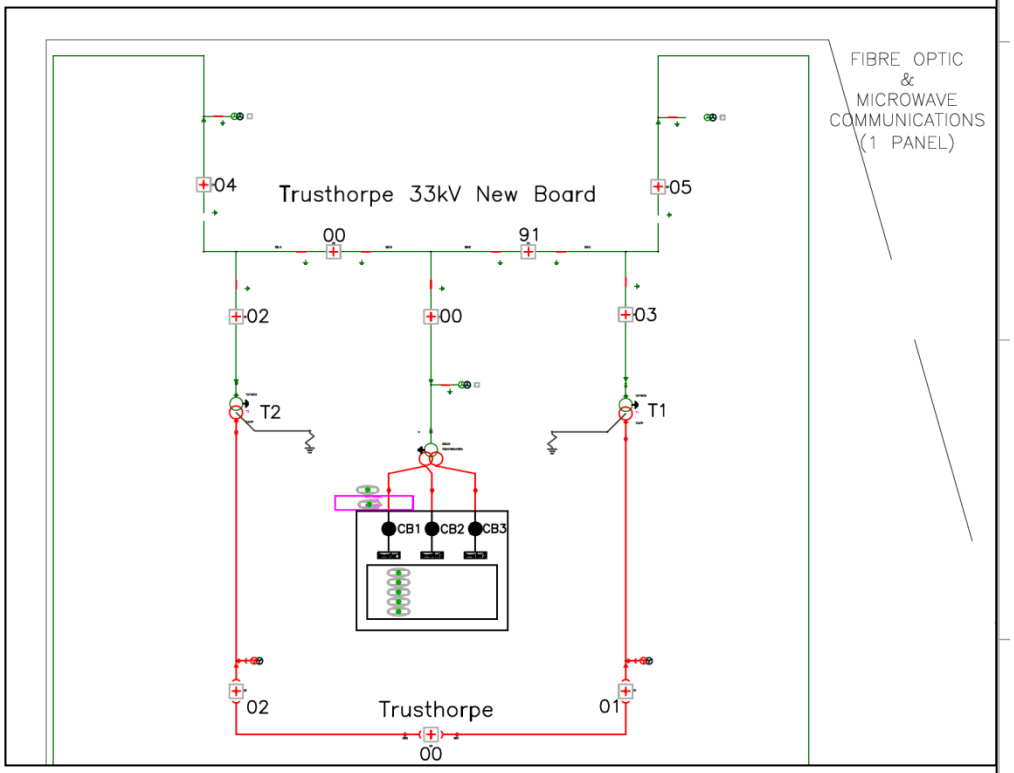
- Load flow analysis,
- DStatcom sizing,
- IPSA v1.6 fault current studies.

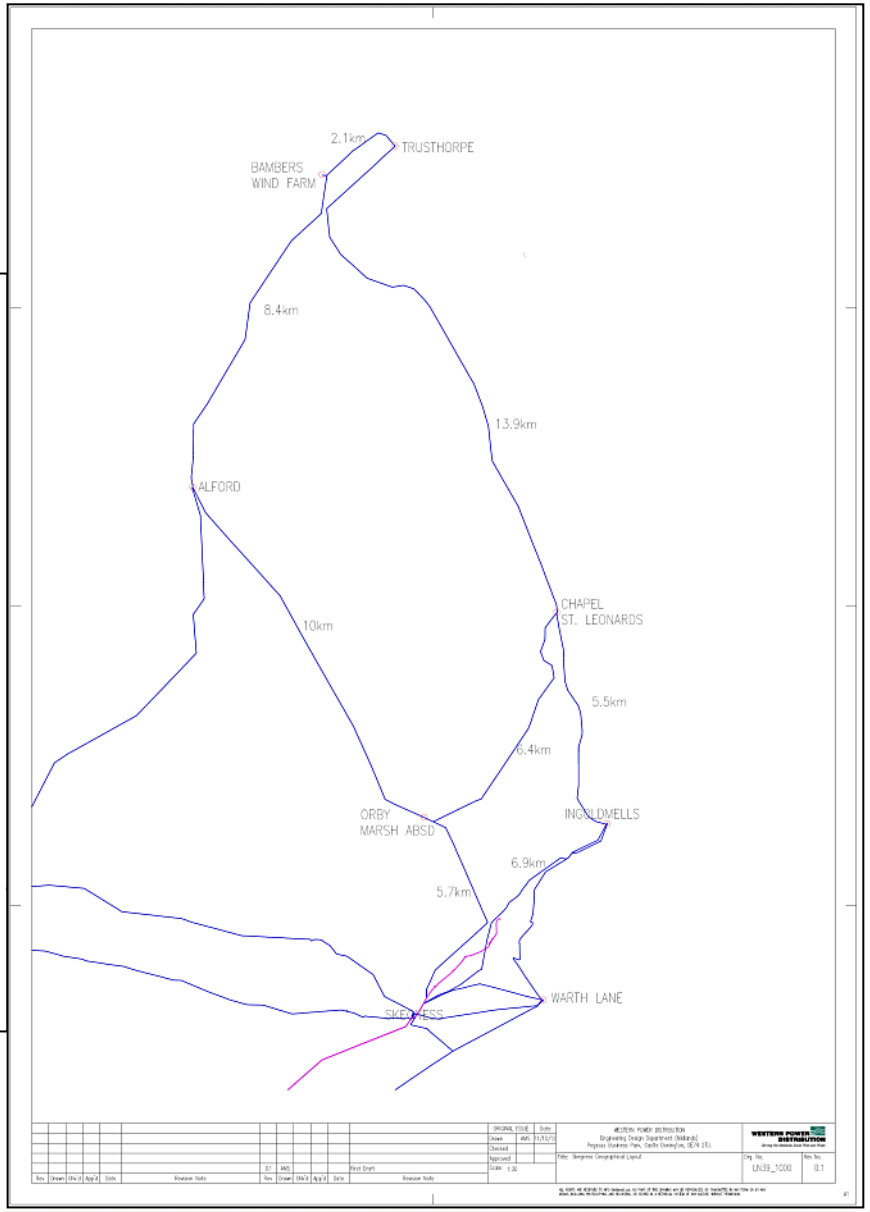
External studies – conducted by TNEI

- Steady State – various demand, generation and contingency studies,
- Protection review,
- DStatcom sizing,
- TRV studies.



Where it is located





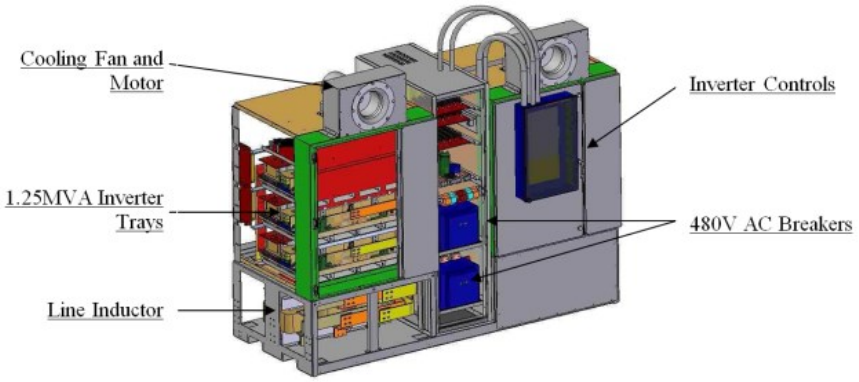
Order, build, Installation & Commissioning

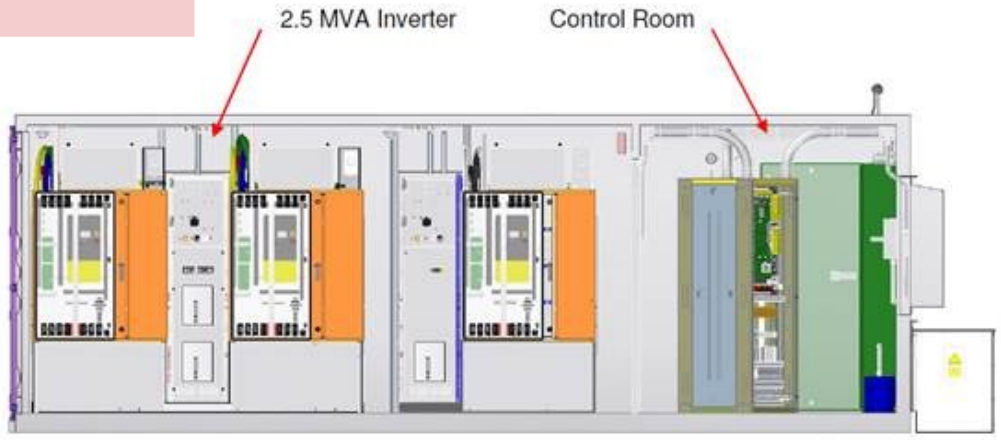
- Tender competitive tender
  Completed 10th January 2013
- Post tender discussion
  January & February 2013
- Equipment Ordered
  7th March 2013
- Transformer Factory Acceptance Testing
  July 2013
- Statcom Factory Acceptance Testing
  12th August 2013
- Delivery Date
  23rd September 2013
- Installation at Trusthorpe
  October – November 2013
- Commissioned
  2nd Week January 2014

FACTs

DStatcom Specification

Equipment	
Transformer Weight, Length, Width, Height	5MVA – 33,000/480/480 14,750kg, 3.5m x 2.81m x 3.1m
DStatcom steady state rating DStatcom transient rating Weight, Length, Width, Height	3 x 1.25 MVAr 9.9MVAr (2 seconds) 14,062kg, 8.23m x 2.44m x 2.9m
Measured steady state sustained performance	±3.84MVAr
Impact on network voltage	+ 3.75MVAr = 3% voltage rise -3.75MVAr = 5% voltage drop
Speed of response	3-6mS





Policies

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Company Directive

STANDARD TECHNIQUE : OC31A

Operation and Control of DStatcom Equipment at Trusthorpe 33kV Substation

Policy Summary

This Standard Technique sets out the procedures for enabling and disabling the DStatcom at Trusthorpe

Author: P Bale
Innovation and Low Carbon Networks Engineer

Implementation Date: May 2014

Approved by Phil Davies
Network Services Manager (South Wales)

Date: May 2014.

ST:OC31A May 2014 - 1 of 26 -

1) Engineering Specification – 36kV Static Synchronous Compensator for the LLCH

2) Policy for the DStatcom installed at Trusthorpe

3) Standard Technique - operational safety procedures of the DStatcom

4) Standard Technique - maintaining and working on the DStatcom

5) Standard Technique - operation and control of the DStatcom

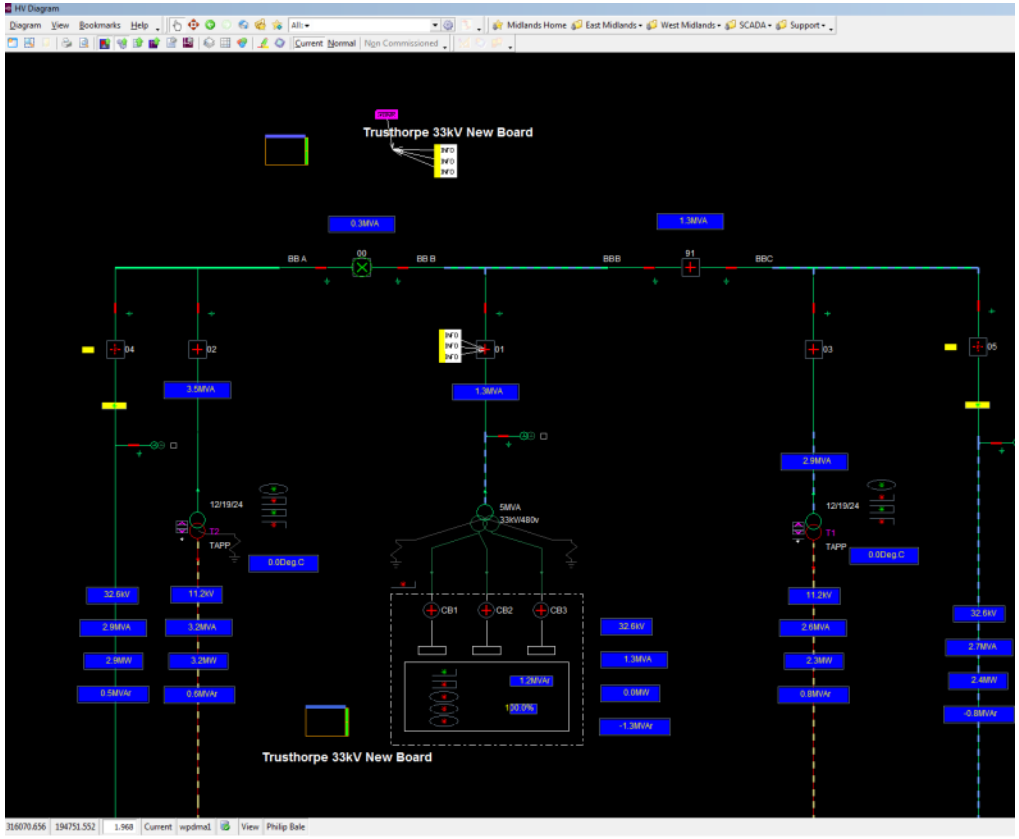
Integration & control

Fully Integrated into PowerON

- Start / Stop
- VAR / Volt mode
- Target VAR's setting
- Slope setting
- Target Volts setting
- Warning
- Inhibit
- Trip Alarm

Local HMI for detailed diagnostics

- DStatcom control restricted
- Interrogation of performance and alarms
- Resetting alarms
- Records 10 second snapshots

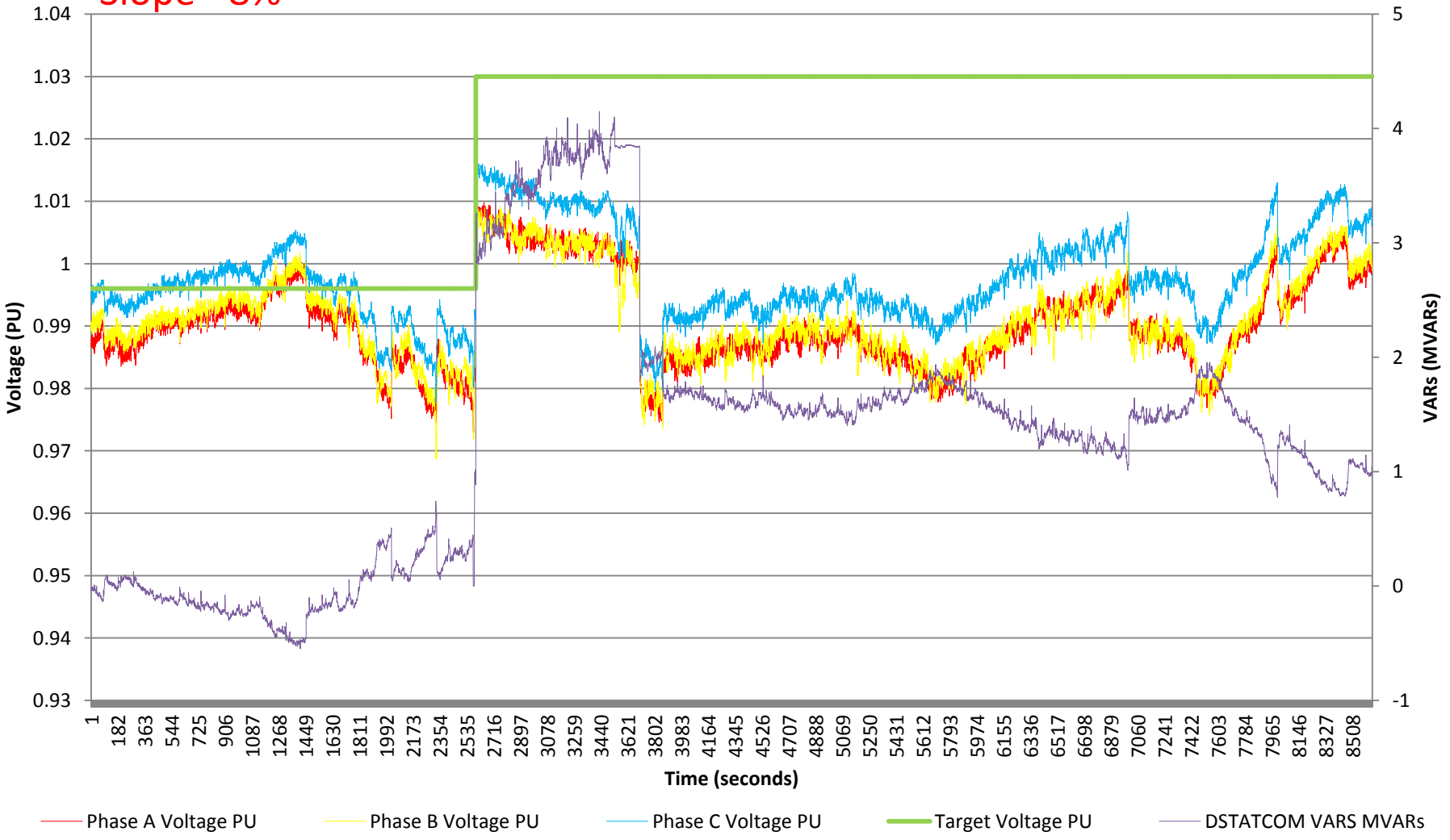


FACTs

Target Voltage - 0.996
Slope - 8%

25th June 2014

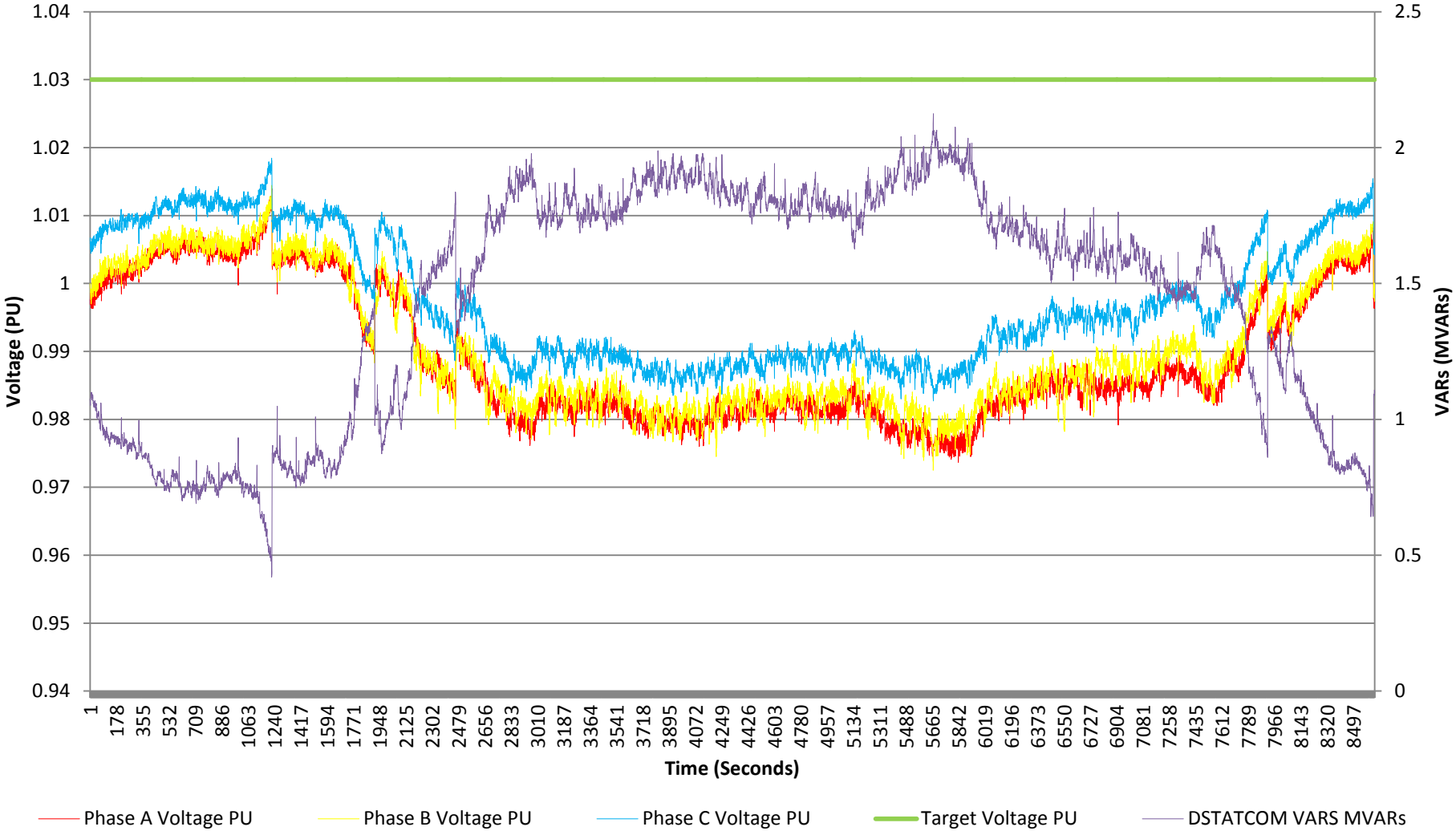
Target Voltage – 1.03
Slope - 8%



FACTs

26th June 2014

Target Voltage – 1.03
Slope - 8%



Outcomes and Lessons learnt

- How a DStatcom can be used by a DNO,
- Limiting factors for future use,
- Key knowledge for future projects,
- Integration into main business and timescales for future adoption,
- Reliability, Faults and modifications required.

Summary Slide

- Ring Network
- Dynamic Voltage Control
- Network Enhancements
- FACTs

Q&A Session

Lunch

Returning at 13:15

Dynamic Line Rating

Presentation Overview

- Background to Overhead Line Ratings
- Details of the work carried out
- Method outcomes & Lessons Learnt

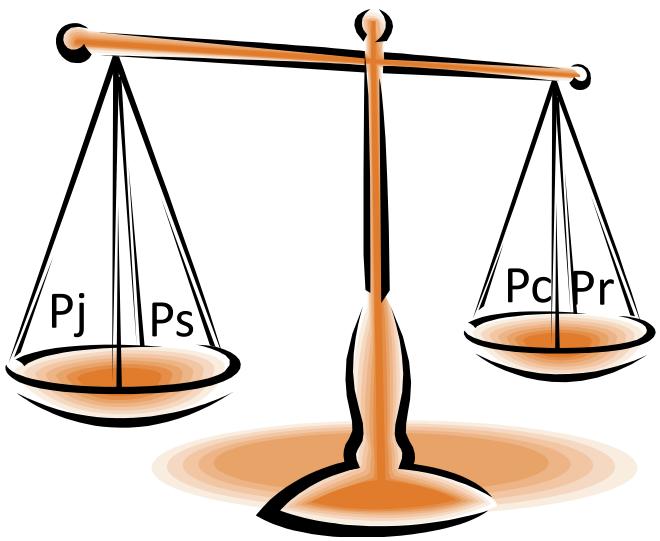
Overhead Line Ratings

- OHL ratings based on ENA ER P27 – Current rating guide for High Voltage OHL operating in the UK,

Season	Wind Speed	Ambient Temperature	Solar Gain
Winter	0.5 m/s	2˚C	nil
Spring/ Autumn	0.5 m/s	9˚C	nil
Summer	0.5 m/s	20˚C	nil

- Assumes there is no correlation between power flows and the weather conditions,
- However, conditions aren't always static. If measured, the capacity of circuits could be increased to take into account the surrounding conditions. There are several factors which affect the current capability of an overhead conductor.

Steady State Heat Balance Equation



- Pj = Joule Heating of Conductor (I^2R)
- Ps = Solar Heating
- Pc = Forced Convective Cooling
- Pr = Radiative Cooling

Dynamic Line Ratings

- Demonstrated the use of generator output as a proxy for wind speed as a lower capital cost and more reliable alternative to installing weather stations or purchasing weather data from the Met office,

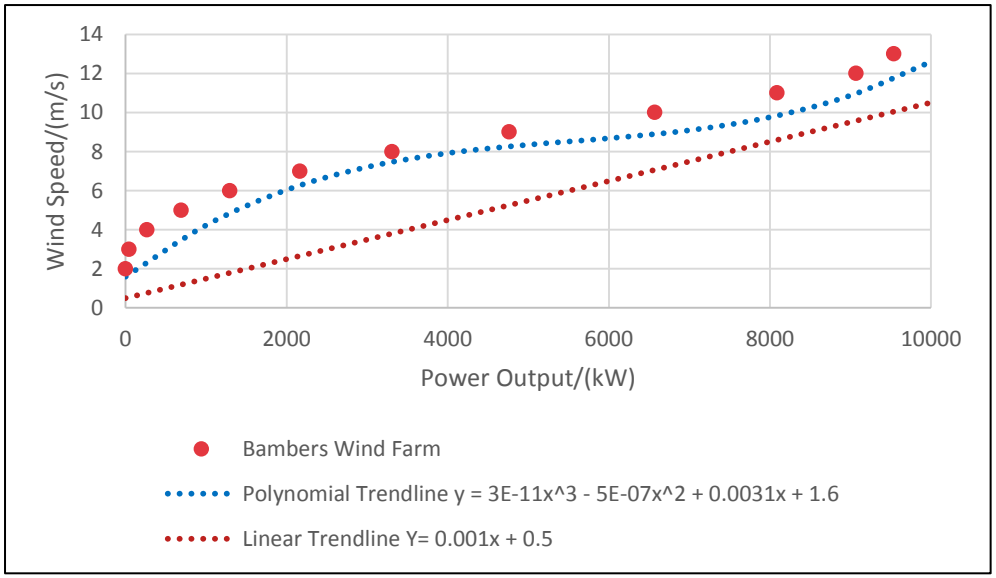
- Wind speed and ambient air temperature data enables ENMAC to calculate a real-time line rating based on the CIGRE 207 methodology,

- Predominate Wind Direction varies - But turbulence effects around the conductor mean that an angle of 20 degrees is used in the calculations.

Work carried out by the project

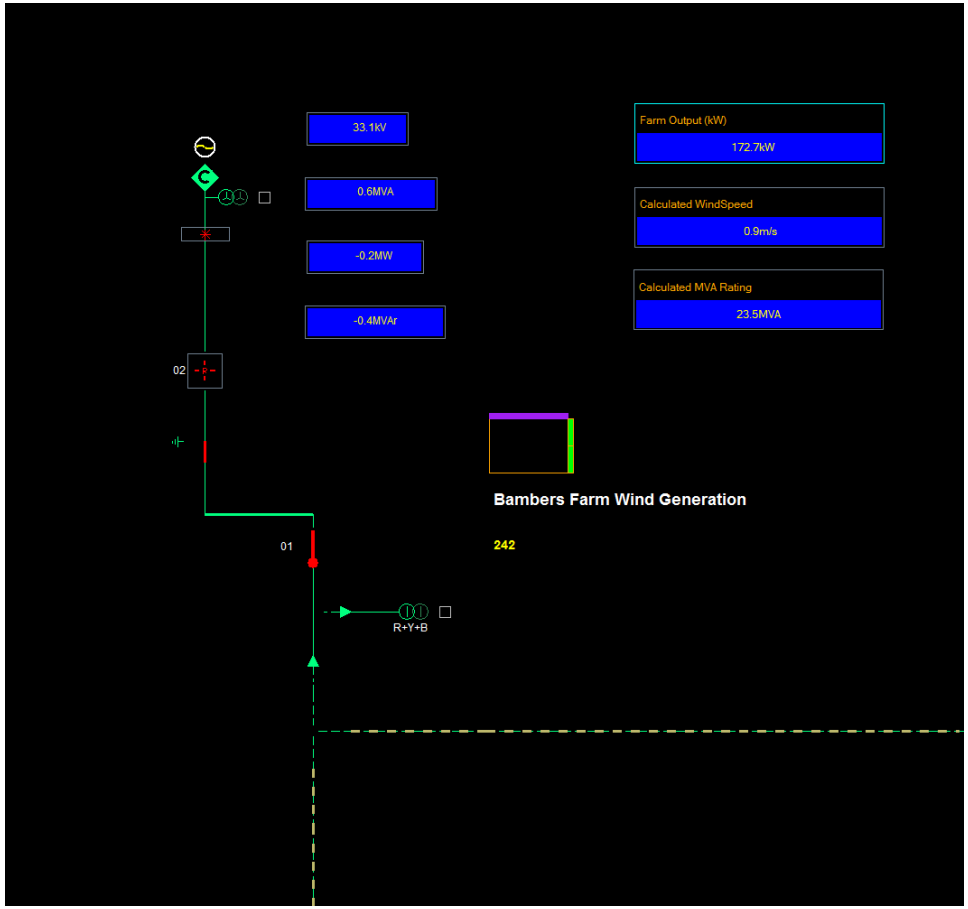
- Key Wind Farms selected,
- Polynomial and Linear Trend lines created for each location,
- Wind speed estimated at OHL height.

=



Work carried out by the project

- All components assessed to determine the maximum Dynamic Line Rating,
- Impact of distance on wind speed estimates taken into account,
- The linear equations were scripted into PowerOn using Shell script,
- All Overhead lines were patrolled to assess their suitability for Dynamic Line Ratings.



Outcomes and Lessons learnt

- Using Dynamic Line Rating to increase capacity,
- Using electrical wind farm outputs as a proxy for wind speed,
- Key risks that need to be assessed,
- How the Low Carbon Hub method could be applied.

New Commercial Arrangement

Presentation Overview

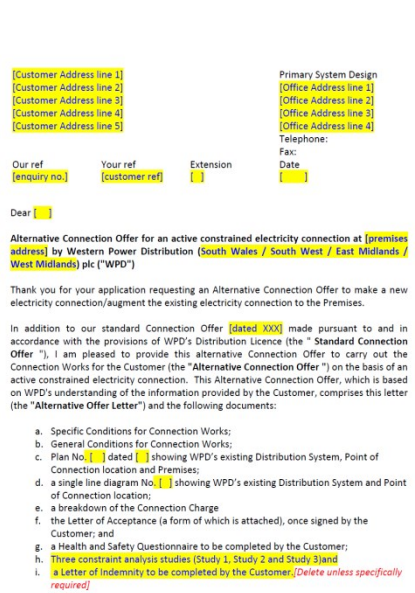
- Background to Commercial Arrangements
- Details of the work carried out
- Method outcomes & Lessons Learnt

Working with Engage Consulting, Smarter Grid Solutions & TNEI

New Commercial Arrangement

Commercial Arrangements

- Alternative Connection offer,
- Alternative Connection agreement,
- SGS ANM – Procured and installed,
- Constraints analysis tool – built,
- 23 connection offers,
- 130.13 MW offers made,
- 49.25MW accepted.



[Customer Address line 1]
[Customer Address line 2]
[Customer Address line 3]
[Customer Address line 4]
[Customer Address line 5]

Primary System Design
[Office Address line 1]
[Office Address line 2]
[Office Address line 3]
[Office Address line 4]
Telephone:
Fax:

Our ref [enquiry no.] | Your ref [customer ref] | Extension [ ] | Date [ ]

Dear [ ]

Alternative Connection Offer for an active constrained electricity connection at [premises address] by Western Power Distribution (South Wales / South West / East Midlands / West Midlands) plc ("WPD")

Thank you for your application requesting an Alternative Connection Offer to make a new electricity connection/augment the existing electricity connection to the Premises.

In addition to our standard Connection Offer [dated XXX] made pursuant to and in accordance with the provisions of WPD's Distribution Licence (the " **Standard Connection Offer** "), I am pleased to provide this alternative Connection Offer to carry out the Connection Works for the Customer (the "**Alternative Connection Offer** ") on the basis of an active constrained electricity connection. This Alternative Connection Offer, which is based on WPD's understanding of the information provided by the Customer, comprises this letter (the "**Alternative Offer Letter**") and the following documents:

a. Specific Conditions for Connection Works;
b. General Conditions for Connection Works;
c. Plan No. [ ] dated [ ] showing WPD's existing Distribution System, Point of Connection location and Premises;
d. a single line diagram No. [ ] showing WPD's existing Distribution System and Point of Connection location;
e. a breakdown of the Connection Charge
f. the Letter of Acceptance (a form of which is attached), once signed by the Customer; and
g. a Health and Safety Questionnaire to be completed by the Customer;
h. Three constraint analysis studies (Study 1, Study 2 and Study 3)and
i. a Letter of Indemnity to be completed by the Customer.*[Delete unless specifically required]*

WESTERN POWER DISTRIBUTION

ALTERNATIVE CONNECTION AGREEMENT

THIS AGREEMENT is made the 123 day of Month 2013

Between: **Western Power Distribution (East Midlands) plc**
Registered in England and Wales No. 2366923
Whose **REGISTERED OFFICE** is at
Avonbank
Feeder Road
Bristol
BS2 0TB
("the "Company")

And Any Company Ltd
Registered in England & Wales No 123456
Any Street
Any Town
Any County
Any Postcode

Concerning the Customer's Premises known as Any Company Ltd
Registered in England & Wales No 123456
Any Street
Any Town
Any County
Any Postcode

Address for Notices: Any Company Ltd
Registered in England & Wales No 123456
Any Street
Any Town
Any County
Any Postcode

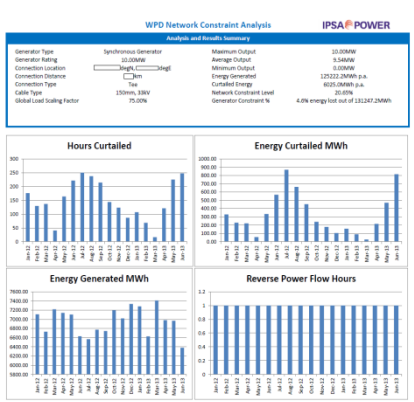
Western Power Distribution (East Midlands) plc
Avonbank
Feeder Road
Bristol
BS2 0TB

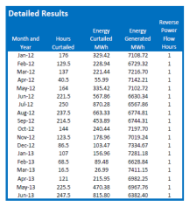
The Company and the Customer shall together be referred to as the "Parties," and each a "Party".

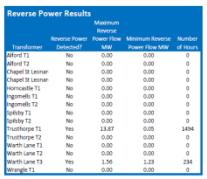
This agreement (excluding the schedules to this agreement) shall be referred to as the "Agreement", the schedules to the Agreement shall be referred to as the "Schedules", and Schedule 3 of the national terms of connection shall be referred to as the "National Terms of Connection". The Agreement, the Schedules, and the National Terms of Connection shall together be referred to as the "Connection Agreement".

The National Terms of Connection are available to view on the website: www.connectionterms.co.uk. Alternatively the Customer may request a copy of the National Terms of Connection from the Company by written request to the address for notices given above. The Customer confirms that they have read, fully understand and accept the terms of the National Terms of Connection.

Subject to the express provisions of this Agreement:
(a) the National Terms of Connection will apply as if set out in this Agreement;
(b) references in the National Terms of Connection to "this agreement" or to "this Agreement" shall be interpreted as if references to this Connection Agreement; and
(c) expressions used in this Agreement and the Schedules shall have the same meanings as if given to them in the National Terms of Connection.







Innovative commercial arrangements

Connections Agreements

- Connection agreements govern the long-term relationship between the user and WPD, setting out the terms upon which an end user will be, and remain connected to, WPD's distribution system. They are governed by the National Terms of Connection (NTCs).
- For larger connections (HV and above) these agreements contain:
  - Connection characteristics,
  - Site specific generation, operational and technical details,
  - Site Responsibility schedule.

Innovative commercial arrangements

Alternative Connection Offer

- Alternative offer will provide terms for Active Constrained Connections
  - Will detail the type and method of curtailment,
  - Clearly explain the specific conditions of the active constraints and the responsibilities of both parties.
- We will still provide a standard Offer to enable effective choice and cost / benefit analysis. This will also ensure we meet our regulatory obligations.

– **Connection Agreement**

- Will clearly set out terms of the ANM scheme and the constraints
  - Introduces new terms to the ‘standard’ agreement to cater for the ANM scheme’s requirements.

Innovative commercial arrangements

Connection Agreement: key new terms

Adjusted Export Capacity:

- the Company shall be entitled to issue an Instruction to:(a) specify a level of import and export capacity which shall not be less than the level of the Protected Import & Export Capacity and / or;
- Specify a particular Power Factor, or a particular range of Power Factors, for any flow of electricity from / to the Distribution System to the Customer's Installation.

Protected Export and Import Capacity:

» The Import / Export capacity the user is entitled to subject to NTCs which will not be intentionally interrupted for ANM purposes

Innovative commercial arrangements

Connection Agreement: key new terms

Curtail / Curtailment means:

- to limit from time to time the maximum amount of electricity that may flow to / from the Distribution System through the Connection Point; or
- in respect of the flow of electricity to / from the Company's Distribution System to the Customer's Installation to require this to be at a particular Power Factor or to be within a particular range of Power Factors.

Innovative commercial arrangements

Connection Agreement: Enduring Terms

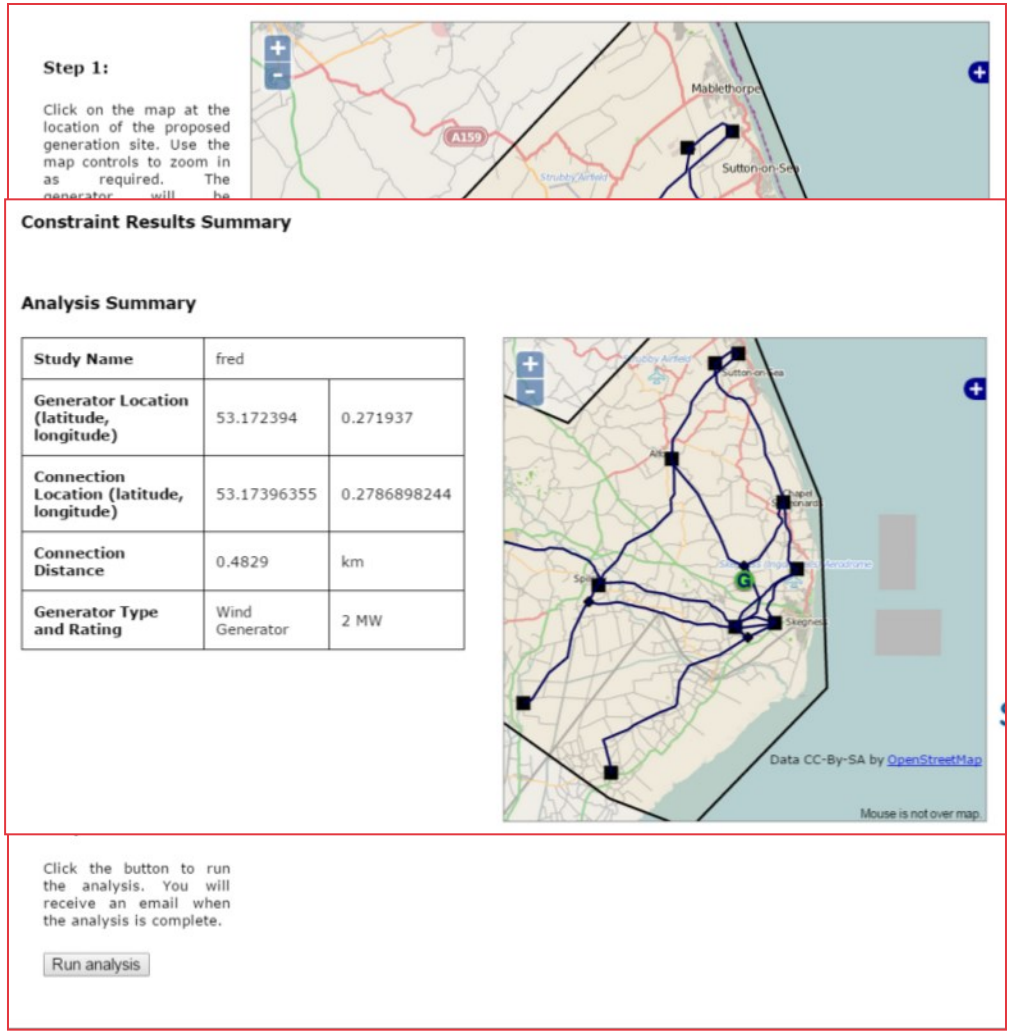
WPD will need to ensure that the ANM scheme and agreed curtailment remain in place where there is a transfer of ownership whilst a new or varied agreement is put in place:

New term introduced for this: **Subsequent Owners**

The Customer covenants that it shall not dispose of any interest in the Premises, the Customer's Installation or the Customer's Generating Equipment unless the Customer has obtained from the proposed transferee of such interest a deed of covenant in a form acceptable to the Company in its sole discretion binding the proposed transferee to this Connection Agreement and provided such deed to the Company.

Constraint Analysis Tools – Web tool

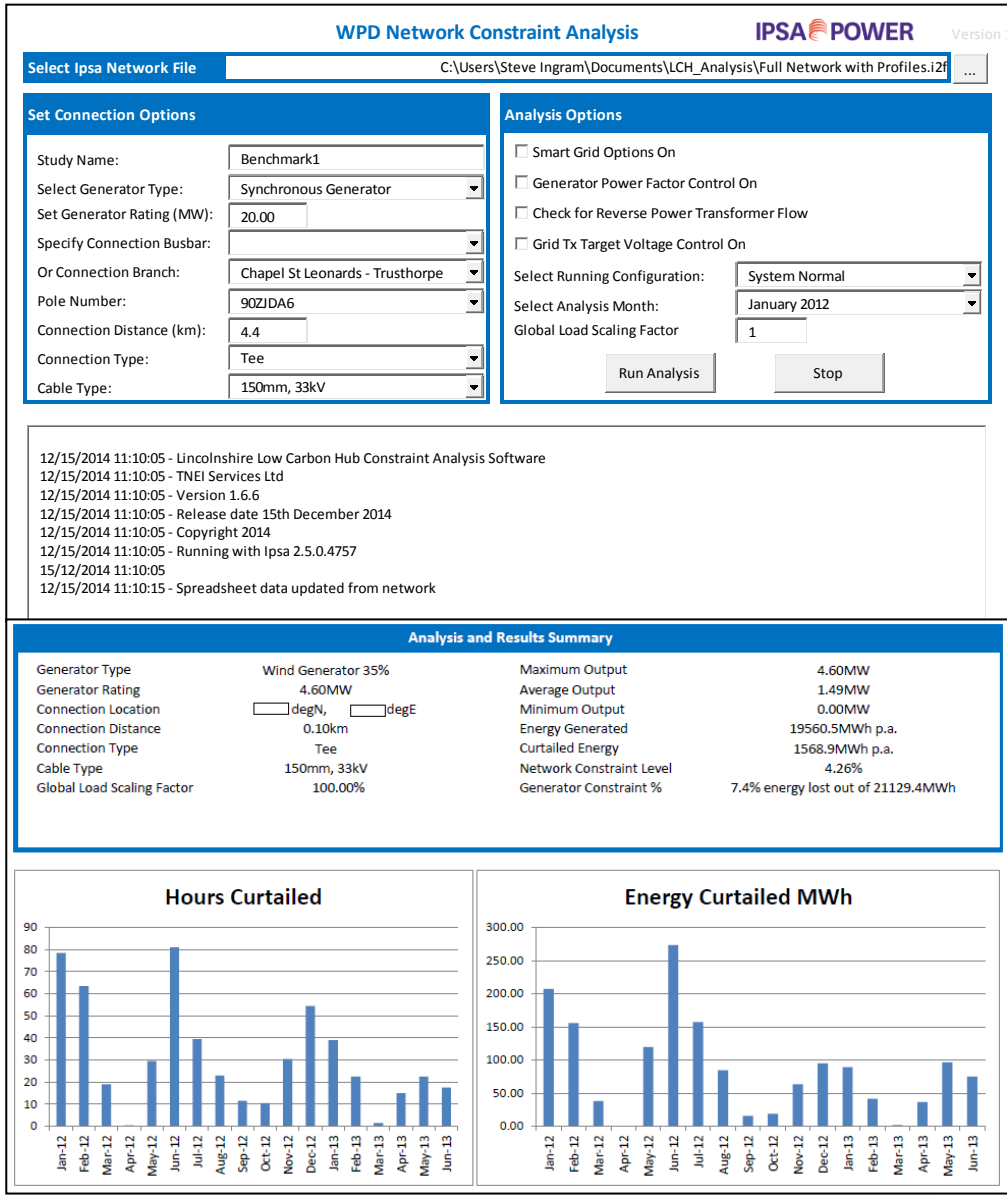
- Accessible through a dedicated website,
- Provide a geographic map view of the analysis area,
- Connect a generator at any location inside the analysis area,
- Perform the required constraint analysis for the requested generator location,
- Present the constraint results to the developer,
- Allows the results to be saved for future use.



New Commercial Arrangement

Constraint Analysis Tools – Desktop tool

- Controlling LIFO stack,
- Identifying Point of Connection,
- Assessing constraints under a number of different scenarios,
- Providing DG developers an understanding of risk,
- Understanding how a network will operate with ANM.



What Influences Curtailment?

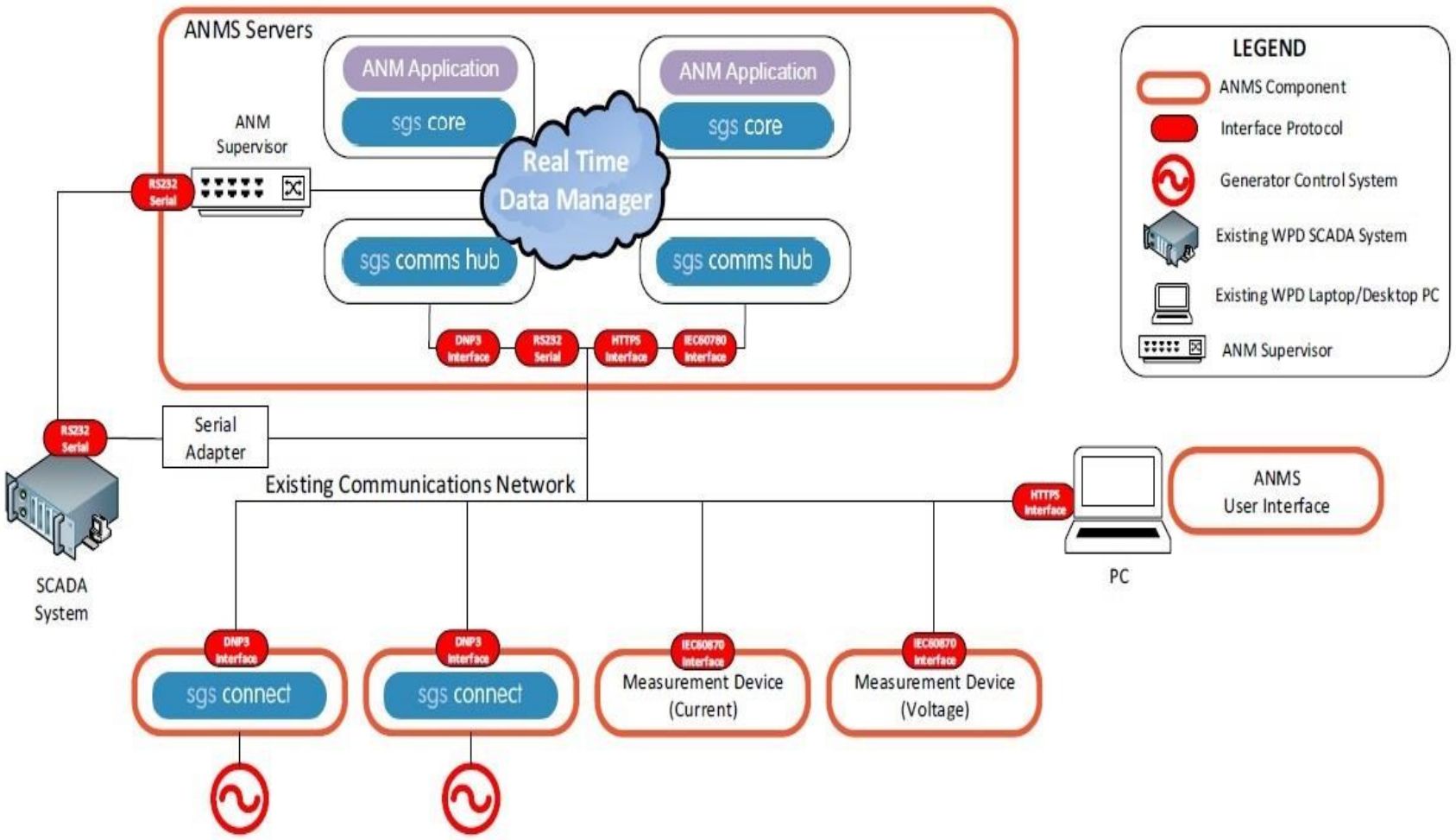
Increase

- Outages for maintenance
- Unplanned Faults
- Load loss
- Net demand transfers out
- Net generation transfers in
- Small scale generation
- Communications loss

Decrease

- New load connections
- Load increases
- Net demand transfers in
- Net generation transfers out
- Generation outages
- Reinforcement
- Accepted generation not materialising

Active Network Management



Outcomes and Lessons learnt

- How ANM can be used to unlock additional network capacity,
- The requirements of constraint analysis tools to understand how ANM zones will operate,
- Requirement for a Good Practice Guide,
- Key knowledge for future replication,
- Integration into main business and timescales for future adoption.

Summary Slide

- Dynamic Line Ratings

- New Commercial Arrangement

Discussion Session

Roll out plans – Low Carbon Hub Methods

Dynamic Line Ratings	Network Enhancements
Commercial Arrangements	FACTs
Dynamic Voltage Control	33kV Active Ring

Concluding Points

1. Active Network Management will be replicated and rolled out in areas where distribution network voltage and thermal constraints limit the connection of future Distributed Generation.

2. A constraint analysis software package that is suitable for rolling out and adoption by planning teams need to be developed, taking the lessons learnt already learnt from the LCH demonstration. The Low Carbon Hub tool has proven the concept and that any future constraint analysis software will have a trade-off between the accuracy of the results and performance.

Further information – Project close down report
http://www.westernpowerinnovation.co.uk/Document-library/2015/CNT2002-LLCH-Close-Down-Report_v1-0-Final.aspx

Concluding Points

3. The project has shown the 33kV active ring method is less appropriate for roll-out due to the high costs and effort associated with delivery. It is expected that in simple meshing scenarios could be achieved by adapting the existing network and for more complex meshing scenarios, an offline rebuild would be most appropriate solution. Further work is required to understand when it is appropriate to mesh simple 33kV sections.

4. Certain assets, such as 33kV OHLs in ANM areas, should be enhanced ahead of need where there is a clear indication the functionality will be utilised in the future.

Further information – Project close down report
http://www.westernpowerinnovation.co.uk/Document-library/2015/CNT2002-LLCH-Close-Down-Report_v1-0-Final.aspx

Concluding Points

5. Dynamic line ratings are less suitable for 33kV and 11kV networks due to the lower height of the conductors and the risks associated with sheltering,
6. Dynamic Voltage Control requires future work before it will be ready for wider area deployment without Active Network Management. The Low Carbon Hub has proven the concept and how it could be incorporated into an ANM enabled area,
7. Statcoms will increasingly be used in key distribution locations to improve voltage control and to facilitate further generation connections, and
8. A range of suitable communication solutions continues to be a barrier to wide scale rollout of innovation projects.

Further information – Project close down report
http://www.westernpowerinnovation.co.uk/Document-library/2015/CNT2002-LLCH-Close-Down-Report_v1-0-Final.aspx

WESTERN POWER DISTRIBUTION

LOW CARBON HUB

CONNECTING RENEWABLE ENERGY IN LINCOLNSHIRE

Lincolnshire Low Carbon Hub
Close Down Dissemination Event
Tuesday 2nd June 2015

LCN Fund
Low Carbon Networks