WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

FlexDGrid

Advanced Fault Level Management in Birmingham

Workshop programme

02.05.2013

Jonathan Berry (WPD)

Samuel Jupe (PB)

Introductions, aims and objectives

- Health and safety briefing

- Introductions
  - Who are you and what is your role?
  - Why are you here?
  - What do you hope to gain from today?

- Aims and objectives
  - Raise awareness of the FlexDGrid project
  - Develop networks
  - Share learning and collaborate

Comments will be treated with anonymity

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Programme for the day

10:00 – 10:30	Arrival and pre-workshop refreshments
10:30 – 11:30	Introduction to FlexDGrid and the project aims / objectives Summary of initial survey results on fault level modelling
11:30 – 12:45	Session 1 – Topic focus: Sharing best practice in modelling fault level
12:45 – 13:30	Lunch
13:30 – 14:45	Session 2 – Topic focus: Exploration of processes to enhance DNOs' knowledge of fault level
14:45 – 15:00	Break
15:00 – 15:30	Summary of workshop results and closure

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

FlexDGrid: Project Overview

Jonathan Berry

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

FlexDGrid

Advanced Fault Level Management in Birmingham

EFLA DNO Workshop
02.05.2013

Jonathan Berry
Innovation and Low Carbon Networks Engineer
FlexDGrid Project Manager

FlexDGrid – What and Why

What are we doing?

Understanding, Managing and Reducing the Fault Level on an electricity network

Why are we doing it?

Facilitating the early and cost effective integration of Low Carbon generation

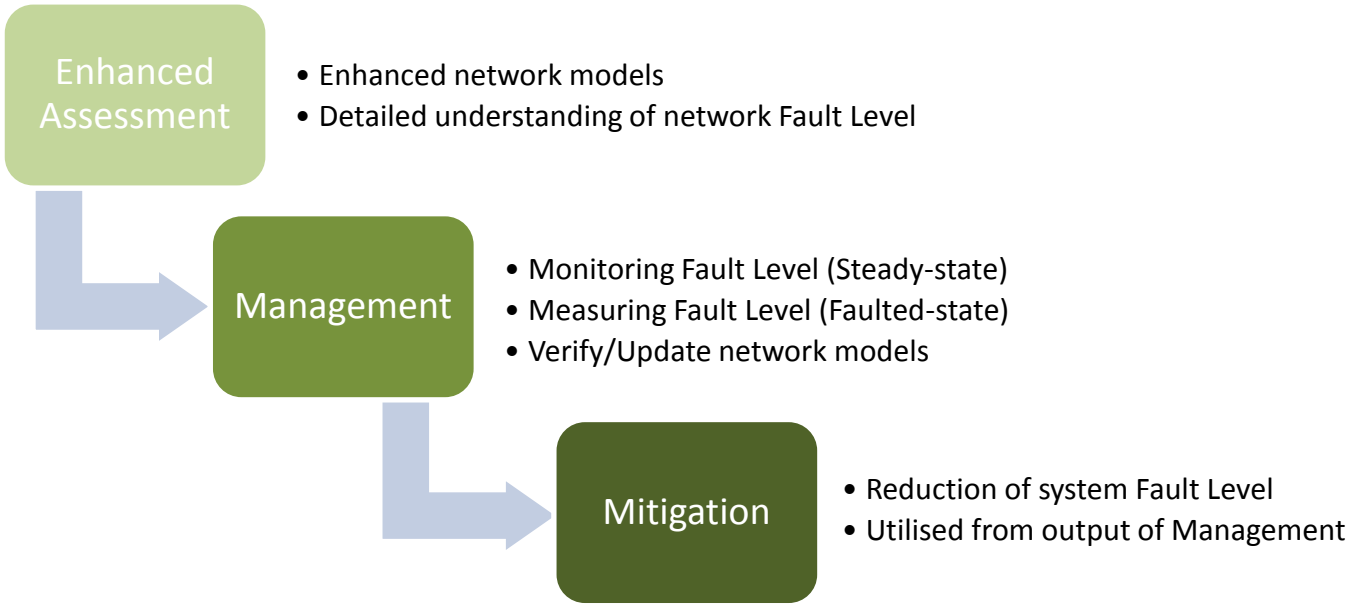
Why are we doing it now?

Supporting the Carbon Plan – Connection of generation to the grid and development of heat networks – reducing carbon emissions

Scenario	Total annual heat generation (TWh(h)/yr)	Total annual electricity generation (TWh(e)/yr)	Total electricity generation capacity (MW)	Number of homes connected to district heating	Annual carbon emission saving compared to the UK generation mix and gas boilers (kt)
Scenario 1: 10% of homes in Birmingham	0.6	0.4	71.2	41,000	60
Scenario 2: Trial Fault Level Mitigation Technology substations	1.95	1.22	214.5	123,379	180
Scenario 3: 50% of homes in Birmingham	3.3	2.0	356.4	205,000	300
Scenario 4: 50% of homes in the UK	210	131	23,051	13,258,500	19370
Scenario 5: 140 substations in the UK with Fault Level Mitigation Technologies	54.7	34.2	6,006	3,454,601	5050

FlexDGrid - Overview

Three integrated Methods leading to quicker and cost effective customer connections through a timely step change in the enhanced understanding, management and mitigation of distribution network Fault Level

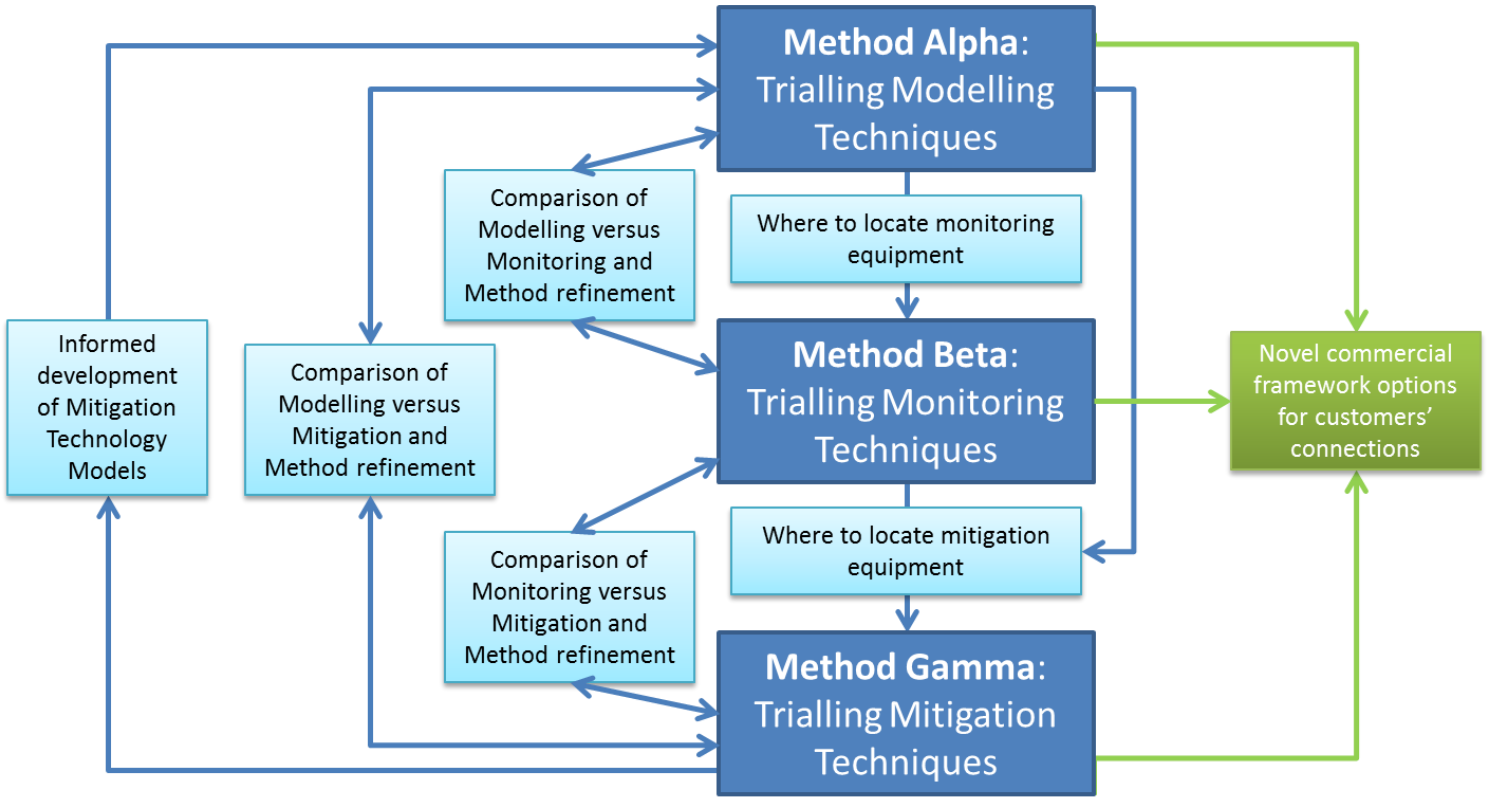


Each Method can be applied on its own whilst the integration of the three Methods combined will provide a system level solution to facilitate the connection of additional generation

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

FlexDGrid Integrated Method Approach



Key: Output benefit of trialling all three Methods in one project (Technical)

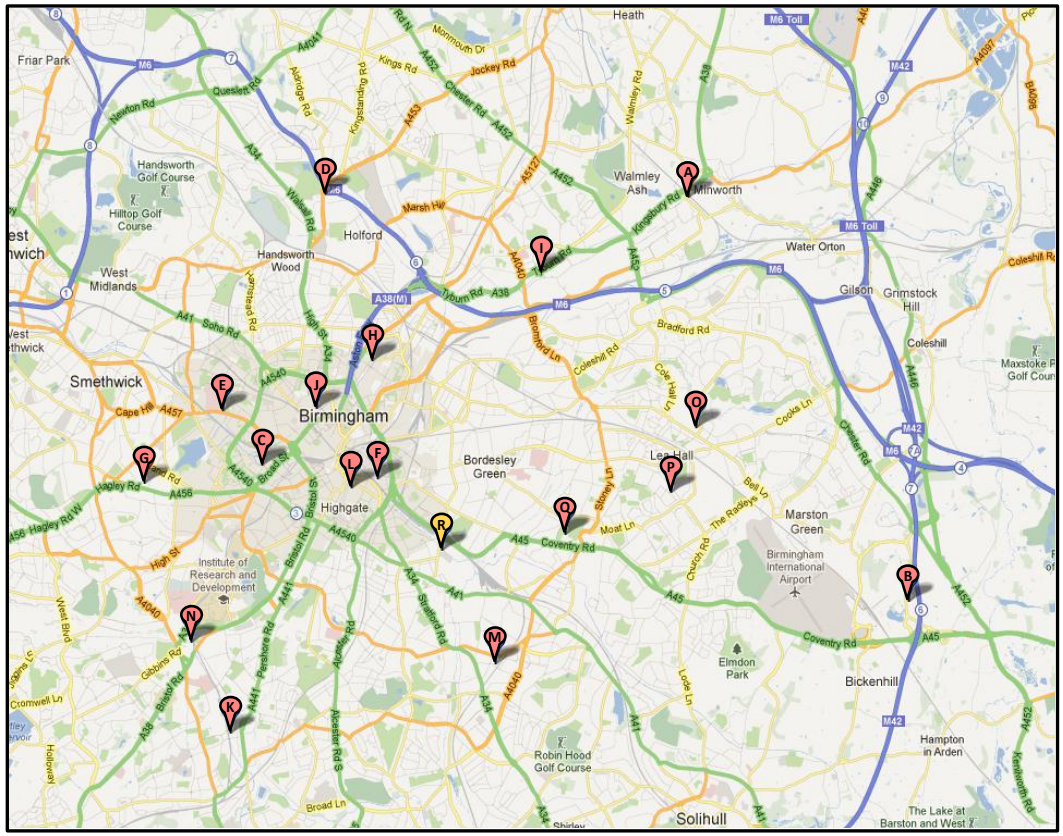
Output benefit of trialling all three Methods in one project (Commercial)

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

FlexDGrid – Where

Potential Primary Substations to be used in the Trials



map data © 2012 Google

Methods

Alpha – Develop enhanced network model for all of Birmingham

Beta – Install FL Monitoring and Measurement in 10 Substations

Gamma – Install FL Mitigation Technologies in 5 of the 10 (in Beta) Substations

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

QUESTIONS

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

FlexDGrid: Initial survey results

Samuel Jupe

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Initial survey results on fault level modelling

- Survey sent out to each GB DNO
  - Responses received representing 6 DNO licence areas

- All respondents agree that there is merit in G74 review
  - G74 is over 20 years old
  - Generator technologies have changed (DFIGs, generators with fully-rated converters)
  - A common methodology for modelling new generation types would be useful
  - Fault level is a growing concern, in-house approaches are being developed to incorporate embedded generation within G74 / IEC60909 calculations
  - Consistent approach will help demand and generation customers
  - It will be beneficial to assess results and application processes from other DNOs

Initial survey results on fault level modelling

- Development of a simple but comprehensive test network
  - Work has already been done in ASG / OSG X/R group of ENA
  - May not be widely known about

- Potential limitations of G74
  - Method options to calculate fault level can give very different results (e.g. X/R ratio)
  - Provides a general consistent approach for voltage levels at 33kV and above, but difficult to apply at HV levels
  - Elements may need updating / expanding

Initial survey results on fault level modelling

- Both IEC60909 (hand calculations) and G74 standards (computer simulations) are used
  - DINIS
  - IPSA
  - PSS/E

- Extent of HV network model
  - 33kV, 11kV and 6.6kV networks modelled in detail with 132kV (slack busbar) connections
  - Separate model for EHV network to HV primary busbars and HV primary substation busbars to corresponding HV distribution networks
  - From National Grid SGTs to 11kV / 6.6kV busbars

Initial survey results on fault level modelling

- Issues encountered with application of G74
  - Some software does not facilitate variable time constants for transient / sub-transient components
  - Limited guidance on the modelling of power electronics (DFIGs, PV, STATCOM)
  - A.C. decrement of fault level and modelling plant with very short A.C. time constants

- DG modelling assumptions
  - Inverter-connected generation modelled as equivalent synchronous model
  - 33kV: DG modelled
  - 11kV: DG modelled , DG modelled as an equivalent in EHV model
  - 0.4kV: DG modelled as an equivalent in EHV or mixture or not at all

Initial survey results on fault level modelling

- Load fault contribution modelling assumptions:
  - Different approaches taken by DNOs
- Is the load fault contribution of sufficient accuracy?
  - Yes
  - Unsure
  - No - it's unclear whether the values are still representative of today's loads
  - At what point should we move from HV to LV load modelling
- Safety margins between calculated fault levels and switchgear ratings vary from 0% - 5%

Initial survey results on fault level modelling

- Short-term paralleling allowed to exceed ratings by some DNOs
- Some DNOs have issues with data for generation connection studies
  - Difficult to obtain detailed technical data from customers
  - Due to the need for an equivalent synchronous in-feed
- Fault level is currently or expected to be a constraint on the connection of generation in some urban areas
- Number of uneconomic connections (due to fault level) unknown – DNO does not find out why customers do not proceed with developing projects

Programme for the morning

- 10:30 – 11:30

  Introduction to FlexDGrid and the project aims / objectives

  Summary of initial survey results on fault level modelling

- 11:30 – 12:45

  Session 1 – Topic focus: Sharing best practice in modelling fault level

- 12:45 – 13:30

  Lunch

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Topic Focus 1:
Sharing best practice in fault level modelling

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Topic Focus: Sharing best practice with modelling fault level in HV networks

- What modifications are needed to G74 to address fault level modelling issues?
- How should these modifications be made?
- How should these modifications be tested?

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Topic Focus: Sharing best practice with modelling fault level in HV networks

- How are staff trained to conduct fault level studies?
- What are the benefits, issues and challenges arising from enhancements to fault level calculations from the following perspectives:
  - Political
  - Economic
  - Social
  - Technological
  - Legislative
  - Environmental

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

FlexDGrid: Lunch break

Food for thought:
Should we move towards probabilistic fault level assessments?

Programme for the afternoon

- 13:30 – 14:45

  Session 2 – Topic focus: Exploration of processes to enhance DNOs' knowledge of fault level

- 14:45 – 15:00

  Break

- 15:00 – 15:30

  Summary of workshop results and closure

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Topic Focus 2
Processes to enhance DNOs' knowledge of fault level

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Topic Focus: Exploration of processes to enhance DNOs' knowledge of fault level

1. Base-line current approaches (covered this morning)
2. Explore assumptions and their impact on fault level calculations
3. Increasing the granularity of fault level assessments
4. Monitoring / measuring fault level
5. Mitigation of fault level
6. Novel commercial frameworks to offer connection options to customers

- What are the benefits and challenges with utilising probabilistic fault level assessments?

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Topic Focus 2:
Processes to enhance DNOs' knowledge of fault level

1. Base-lining

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Topic Focus 2: Processes to enhance DNOs' knowledge of fault level

2. Exploration of assumptions and sensitivity analysis

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Topic Focus 2:
Processes to enhance DNOs' knowledge of fault level

3. Increasing the granularity of fault level assessments

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Topic Focus 2: Processes to enhance DNOs' knowledge of fault level

4. Measuring and monitoring fault level

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Topic Focus 2:
Processes to enhance DNOs' knowledge of fault level

5. Mitigating fault level issues

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Topic Focus 2:
Processes to enhance DNOs' knowledge of fault level

6. Novel commercial contracts

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Topic Focus 2: Processes to enhance DNOs' knowledge of fault level

Voting on priorities

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

FlexDGrid:
Summary of today's outcomes and recommendations

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

FlexDGrid: Closing comments

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

FlexDGrid: Workshop closure

Thank you for your time

Please complete the feedback form

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales