Connections Customer Forum

7th November 2017

National Railway Museum

Welcome

Connections Update

Mike Hammond

Head of Connections Services

Connections performance update – Nov 2017

Current Performance

- BMCS (YTD) NPg 4th overall (85.7%), Connections 4th (83.3%)
- 17/18 Reg Year Av time to Quote – LVSSA&B just outside Ofgem reward target
- 17/18 Reg Year Av time to Deliver – LVSSA&B just inside Ofgem min target
- ICE - 2016/17 ICE plan viewed a success by Ofgem & stakeholders - zero penalty
- ICE – 23 actions in 2017/18 plan, nine already delivered, remainder on target
- ICE – 2017/18 mid-year update published with three additional actions

Outputs Delivered

- ✓ Monthly updates of heat map and contracted capacity register data
- ✓ Contract milestones capacity clawback
- ✓ Workshops on emerging connections topics
- ✓ New ways to engage - webinar, social media

Ongoing Initiatives

- Refinement of small works enduring process ongoing
- Medium & Large Works business wide review ongoing
- Commercial changes – ECCR, contract milestones, A&D fees
- Technical innovation - ANM, Storage, DNO to DSO
- Development of our 2018/19 ICE service improvement plan, requiring continued stakeholder engagement and process change

ED1 Environment

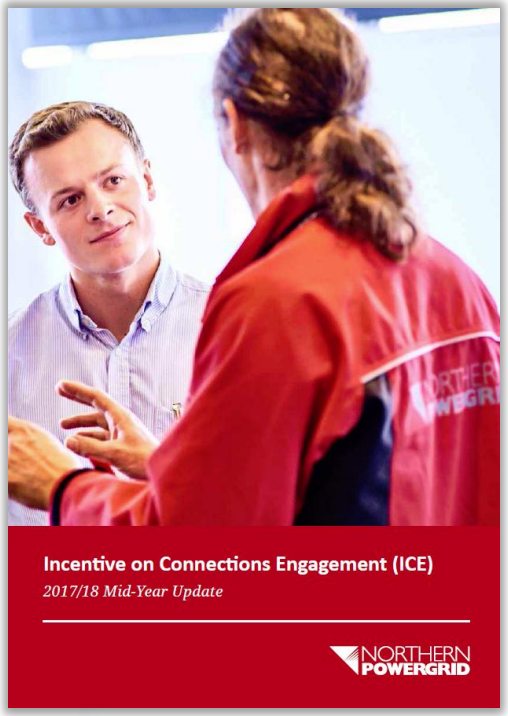
- Minor cons BMCS reward/penalty
- Minor cons TTC/TTQ reward
- Major works ICE incentive – penalty only
- Constrained networks – Flexible connections
- DNO to DSO strategies

Incentive on Connections Engagement

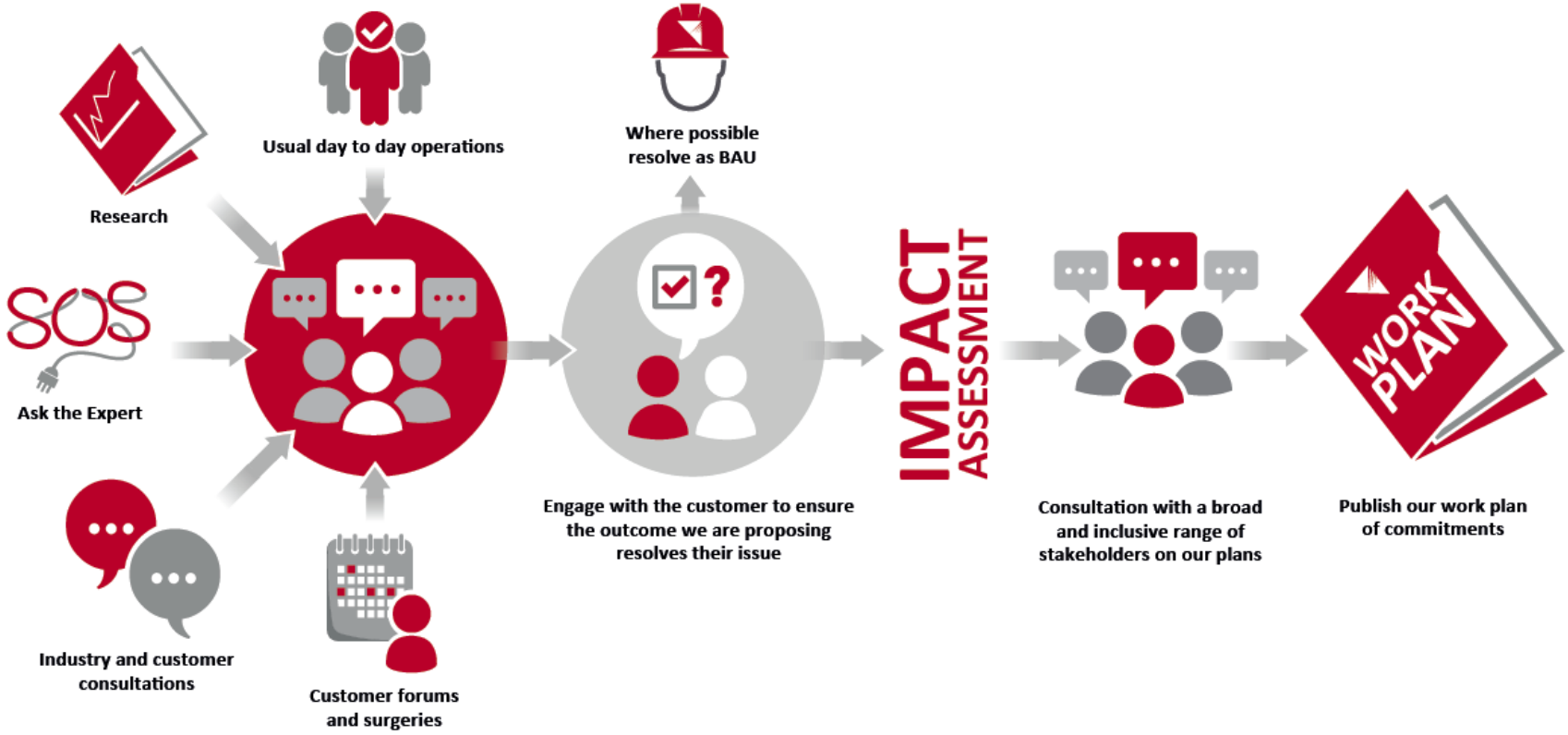
- The Incentive on Connections Engagement (ICE) drives DNOs to continually improve services to major connections customers
- Each year we produce a detailed work plan of service improvement actions
- Our work plans are developed together with our connections stakeholders, all actions are based on their feedback and ideas

Delivering on our ICE commitments

- Original plan contained 23 actions, added 3 additional actions
- Robust stakeholder feedback process, considered 142 individual pieces of feedback
- What we've we done
  - Used social media to extend our reach to customers
  - Contract milestone explanatory guide
  - Workshops on topics of interest – accessing network records
  - Better publicising design optioneering process
  - Further promoting fair and open competition
  - Sharing our vision for the DSO transition

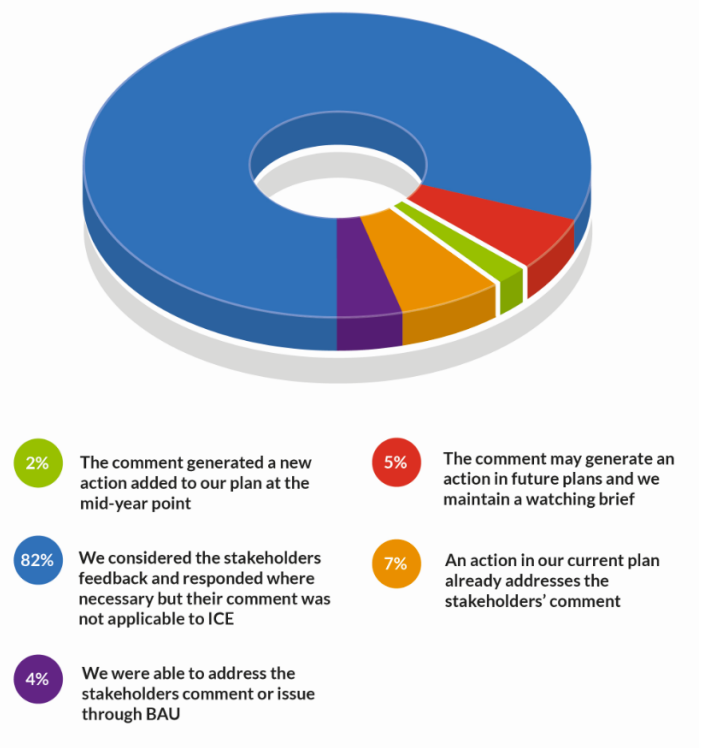


Our review of feedback follows a robust process



Delivering on our ICE commitments

- Our plan for 2017/18 consists of 23 service improvement commitments
- We have currently delivered 9 of the original actions…
- … and added 3 new actions in our mid-year update from our review of 142 pieces of feedback, making our total number of actions 26



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Industry Update

Chris Allanson

Market Strategy Manager

Our world is changing fast

UK sets ambitious new 2030s carbon target

Electric cars will rule the future

Solar panel costs predicted to fall 10% a year

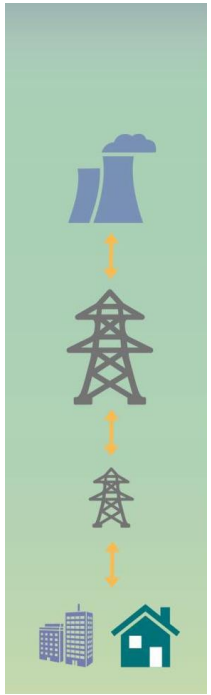
Solar Is Going to Get Ridiculously Cheap

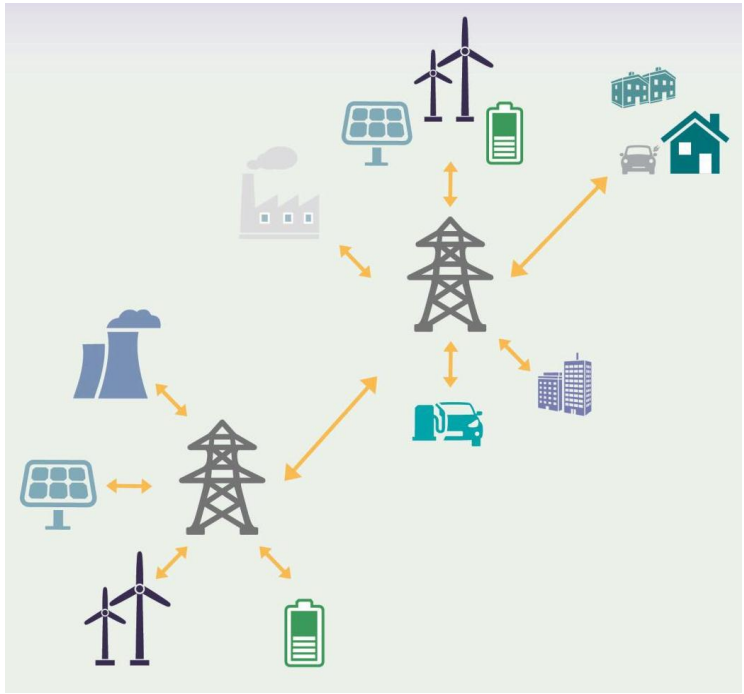
Some 147 Gigawatts of renewable electricity came online in 2015 - the largest annual increase ever and as much as Africa's entire power generating capacity.

Capacity Market success evidence of 'crucial role' battery storage to play in UK grid

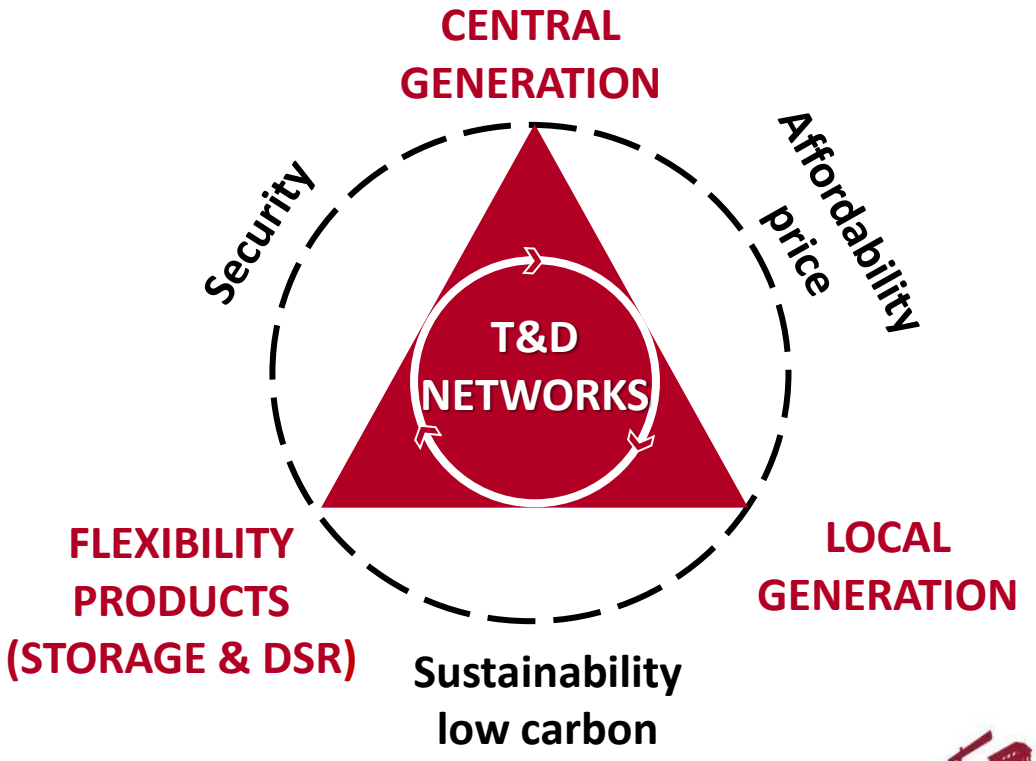
Renewable energy smashes global records in 2015

A changing system: the need for smart, flexible solutions

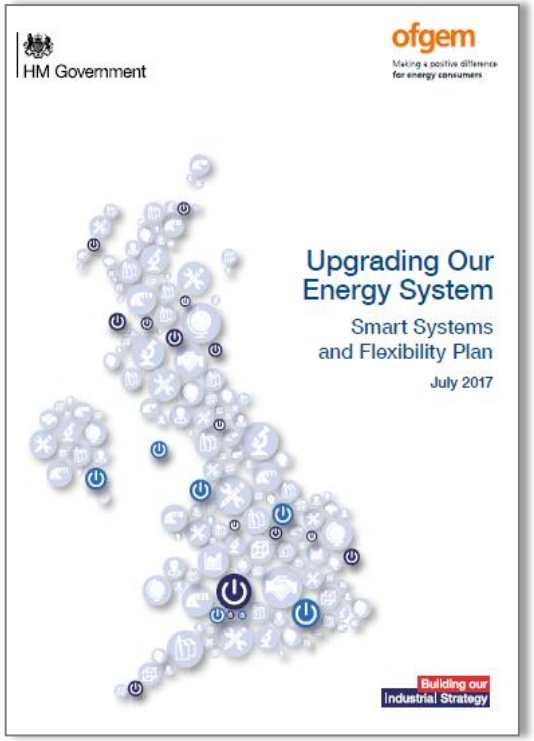


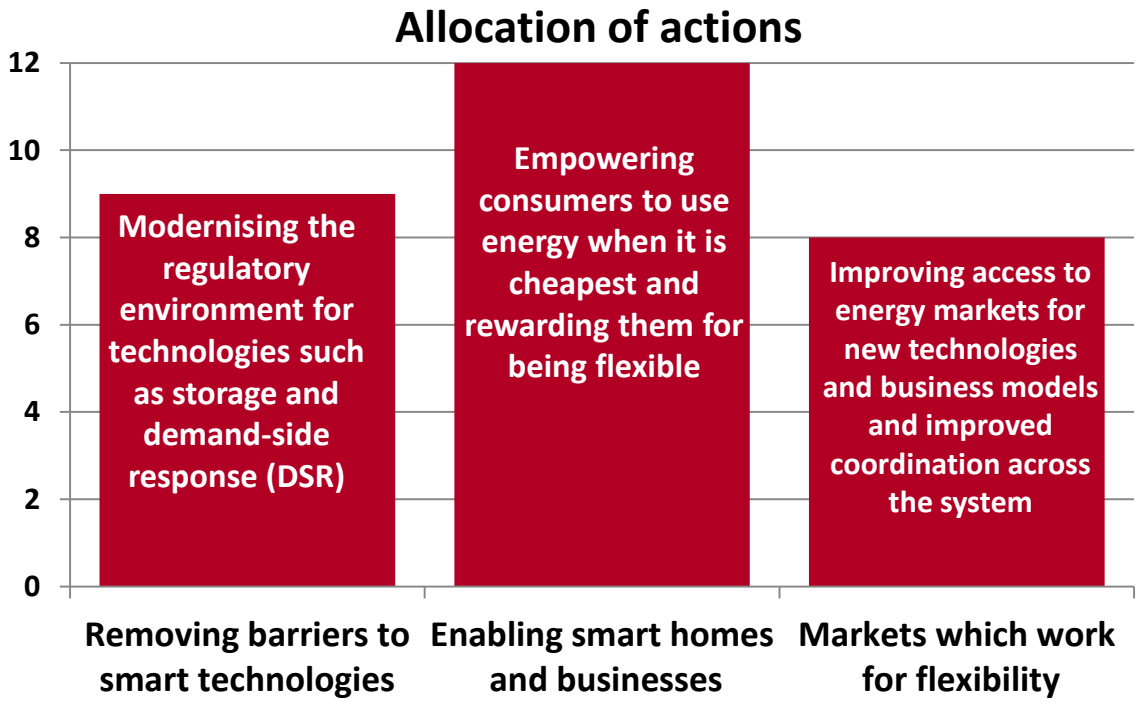


Networks taking centre stage



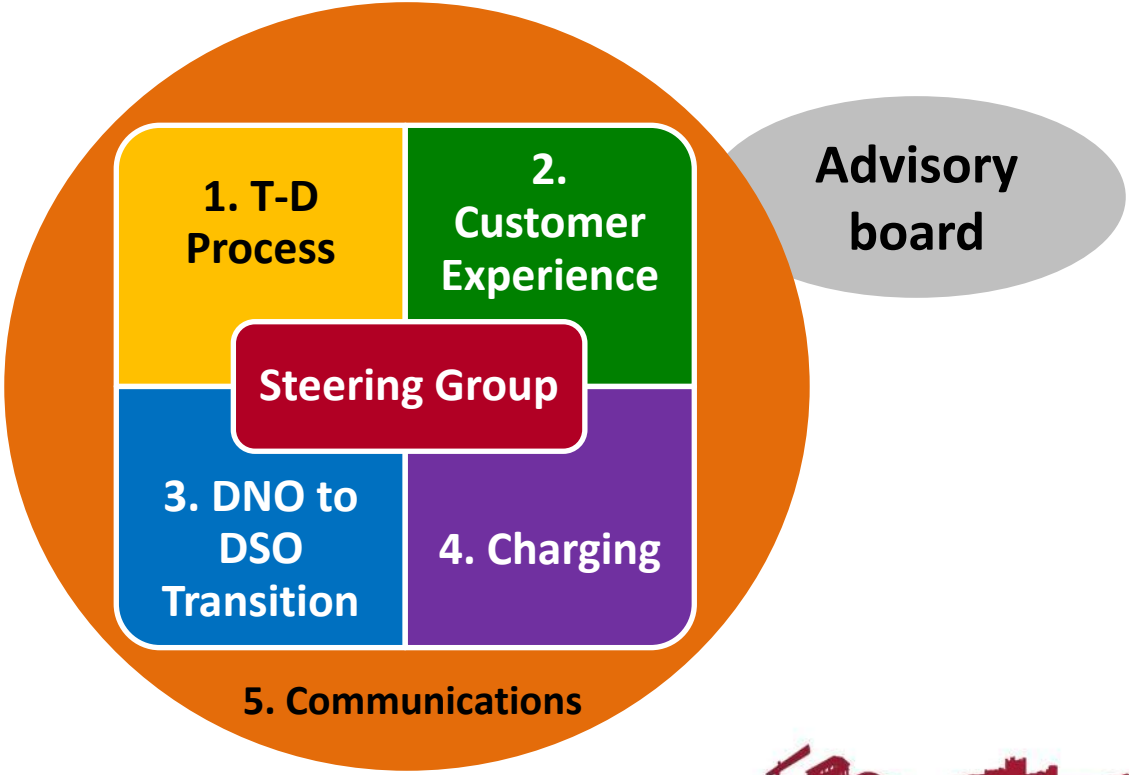
Smart Systems and Flexibility Plan





https://www.ofgem.gov.uk/system/files/docs/2017/07/upgrading_our_energy_system_-_smart_systems_and_flexibility_plan.pdf

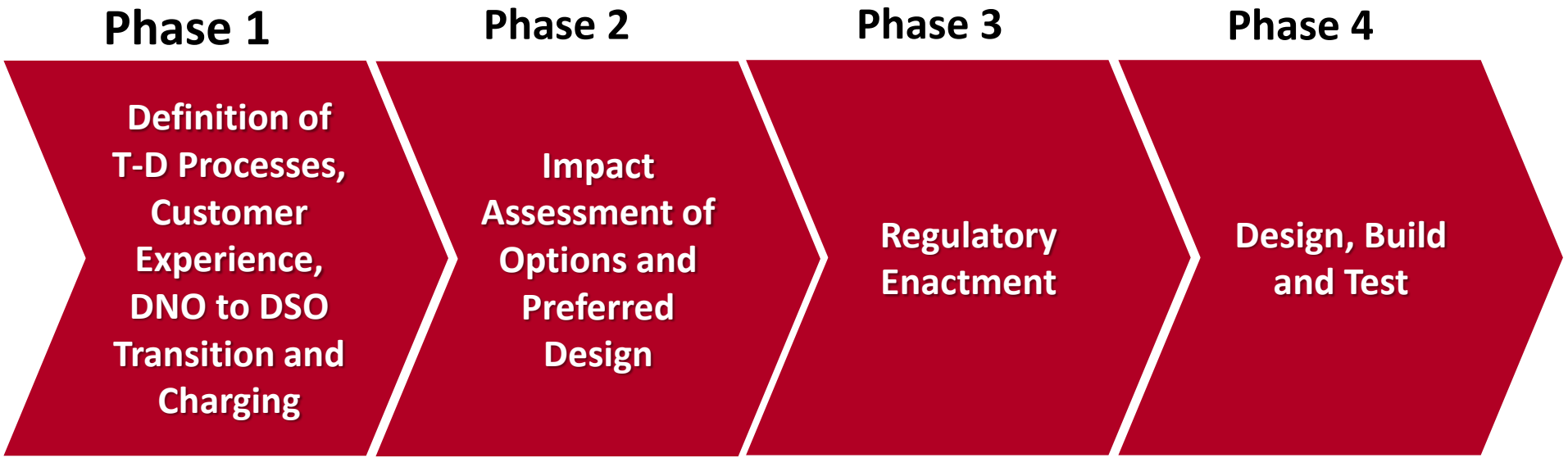
Open Networks: Project collaboration



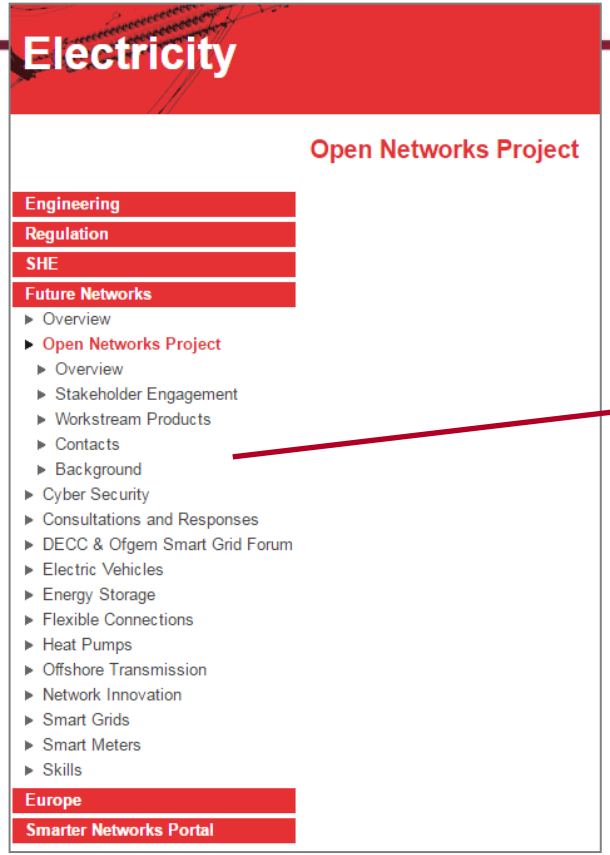
Open Networks: Project objectives

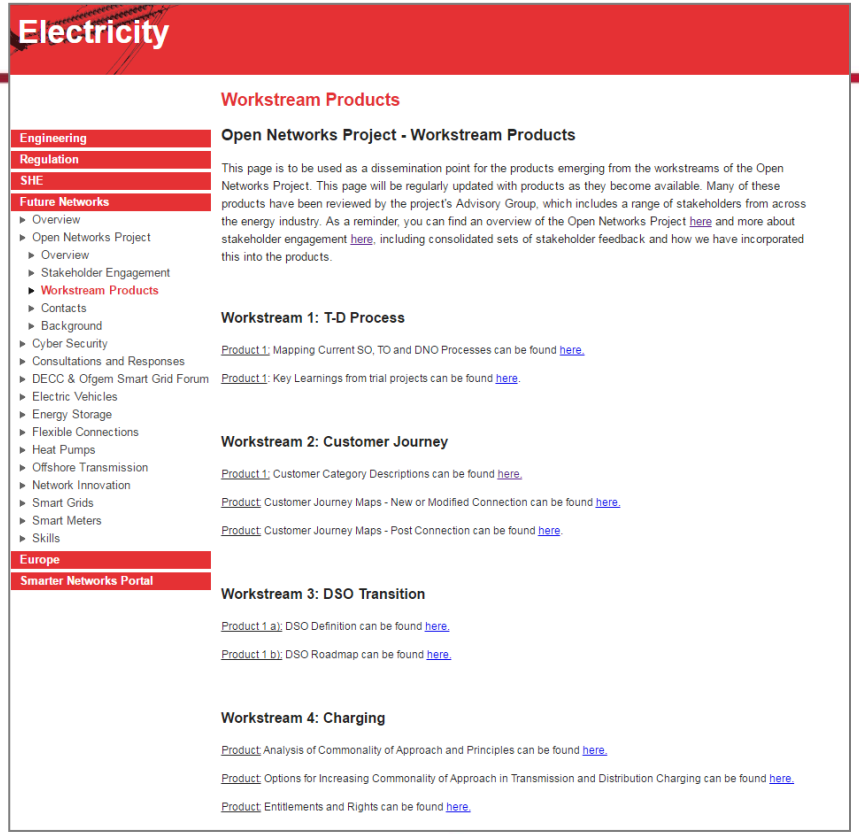
1. T-D Process	Develop improved **T-D processes** around connections, planning, shared TSO/DSO flexibility services and network operation
2. Customer Experience	Assess the gaps in the **experience our customers** and identify any further changes to close the gaps within the context of 'a level playing field' and applying common and consistent principles/approaches for T & D processes
3. DNO to DSO Transition	Develop a more detailed view of the required **transition from DNO to DSO** including the impacts on existing organisation capability
4. Charging	Consider the **charging** requirements of an enduring electricity transmission/ distribution system, whose purpose is to facilitate a market place between producers and consumers. Develop a whole system pricing approach
5. Communications	**Communicate** and engage on Open Networks developments, both between workstreams and with external stakeholders

Open Networks: Project timeline



Open Networks website





http://www.energynetworks.org/electricity/futures/open-networks-project/

Our distribution system operator (DSO) vision

- Transition is required to a ***customer-led*** actively managed (and probably semi-autonomous) network…
- …where we are providing a cost-efficient, non-discriminatory and technology neutral physical trading platform…
- …for third parties in our region to participate in the electricity markets

DSO must provide a compelling value proposition for customers and stakeholders

DSO roles and responsibilities and functions

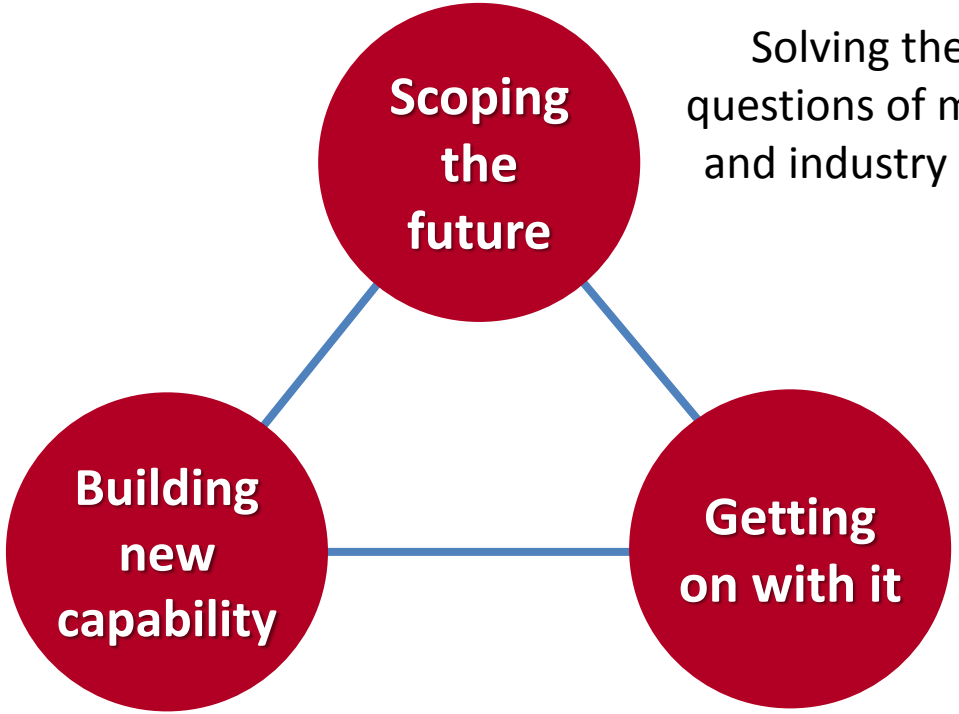
Roles and Responsibilities
1. Maintain distribution network resilience and security.
2. Support whole system stability.
3. Provide fair and cost-effective distribution network access.
4. Provide capacity in an efficient, economic, coordinated and timely manner.
5. Support whole system optimisation.
6. Enable and facilitate competition in energy markets.
7. Provide and maintain systems, processes and data to facilitate markets and services.

Functions

- Investment Planning
- Service Provision
- Connections and Connections Rights
- Balancing / System Coordination
- Network Operation
- Service / Market Facilitation
- System Defence and Restoration
- Charging

http://www.energynetworks.org/electricity/futures/open-networks-project/

Our DSO strategy



Solving the big open questions of market design and industry architecture

Providing new infrastructure and processes

Low regrets steps to demonstrate and learn

Customer-Led Distribution System (CLDS)

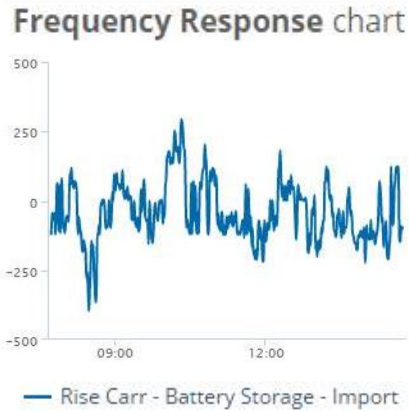
- Examining the future structure of the distribution sector with customer front and central:
  - Accommodating large volumes of distributed energy at least cost
  - Deliver value to customers that thrive in a flexibility market
- A *virtual demonstrator* - using laboratory modelling:
  - Market design - what is traded, and how and where it is traded
  - Industry structure - roles of each party and the relationships between the parties
- Providing quantified evidence base for the changes required

Network services trading: started September 2017

- Storage offers flexibility by smoothing intermittent generation or contributing to more active local balancing by the DSO
- Through aggregator KiWi Power we are providing dynamic firm frequency response to the GB system operator (SO)
- Practical low-regrets innovation through a ‘learning by doing’ approach
- Revenues earned used for innovation

Customer-Led Network Revolution

2.5MW battery at Rise Carr



Break

Systems Design Update – Assessment & Design Fees

Derek Fairbairn
System Design Manager

New regulations on connections offer costs

- BEIS has decided that DNOs can charge to cover offer costs
- BEIS proposed new regulations
- Timing of implementation – likely to be April 2018

Department for Business, Energy & Industrial Strategy

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/646430/AD_Fees_consultation_document_Final.pdf

- Connections offer expenses:
  - Previously referred to as Assessment & Design (A&D) fees
  - The consultation sought views on BEIS' approach and its assessment of the economic impacts (consultation closed 2 November 2017)
  - BEIS also consulted on the proposed *'The Electricity (Connection Offer Expenses) Regulations 2017'*
  - The consultation is about **'how'** the regulations will be implemented not **'if'**

BEIS policy thinking

At the moment, those customers whose connection jobs go ahead fund the cost of design and preparing quotations for those that do not - the proposed regulations aim *to recover expenses from customers more fairly* i.e. to address cross-subsidy

Department for Business, Energy & Industrial Strategy

- BEIS highlight two primary factors that are driving its thinking:
  - To allocate costs more fairly
  - To improve the efficiency of the connections process
- Examples of current quotation acceptance rates for Northern Powergrid:
  - Distributed generation: 9% (down from 14% last year)
  - Storage: 14% of 150 offers (…and we provided 617 budget quotations)

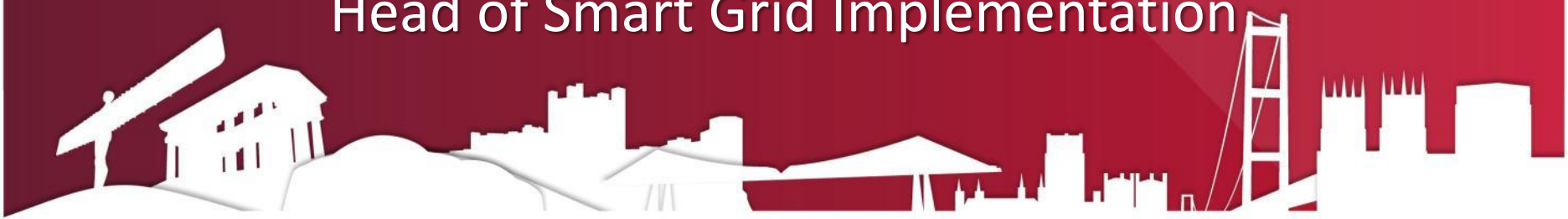
The previous Call for Evidence

- In March 2016, BEIS published its Call for Evidence
  https://www.gov.uk/government/consultations/assessment-and-design-fees-call-for-evidence
- BEIS summarised the stakeholder responses to the Call for Evidence in its September 2017 consultation
- Of the 26 responses there was only one clear objection to introducing fees
- BEIS decided there was enough stakeholder support to seek ministerial approval to go ahead

Department for Business, Energy & Industrial Strategy

Moving towards a Smarter Grid

Mark Nicholson
Head of Smart Grid Implementation



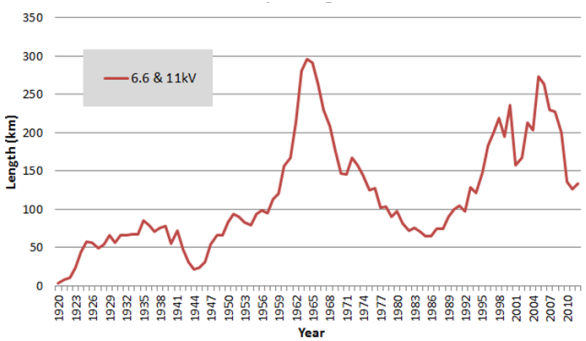
Change is occurring but the pathway to a smarter grid is different for each operator

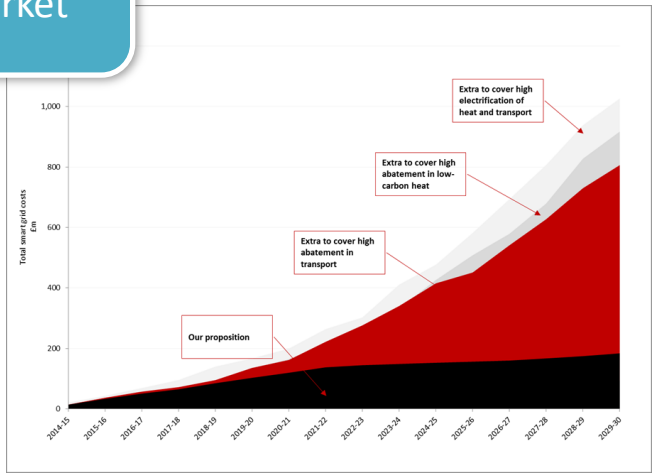
Where are we heading?

Fit 'N Forget

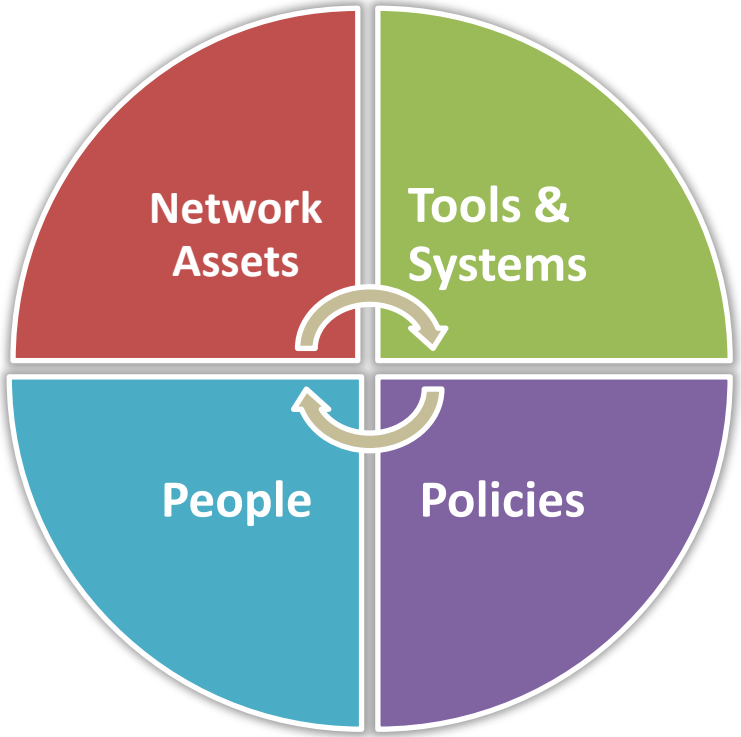
Active Management

Distributed Market





Whatever the final outcome we do know that we need to make “no regrets” changes now



£83m of smart grid enablement to provide:

- Better network visibility
- Ability to communicate
- More complex control

Development of new tools & processes:

- Scenario based forecasting
- Integrated planning and flexible design tools

Smarter solutions using:

- Network flexibility
- Customer flexibility

Development of staff:

- New skills
- Being supportive & changing mentality

Network assets – biggest coordinated technical change since the 1970's

AREA	AS-IS	TO BE
Telecoms (primary)	1200 baud, 8bit & 16bit legacy protocols, limited redundancy	IP based network with additional resilience across 800+sites
Primary substation RTUs	Varying levels of reliability Limited control functionality	Upgrade & replace RTUs across 500+ sites Platform for local control & IP capable
Voltage control and monitoring	Limited control of tap changer Commenced voltage reduction	Functionality for ANM & reactive services Improved visibility & alternative settings
Telecoms (secondary)	Control operations limited Fault location data only	RF mesh operating over 7000+sites
Distribution monitoring	Limited visibility downstream of HV source breaker	Pole mounted recloser Retrofitting of GM distribution subs
Data historians and design tools	Multiple systems that don't interact Increasing volumes of data being generated Excel based tools in use	Build on our new asset management system and smart metering data Multiple voltage level analysis Interfaces that assist the design engineer

Active Network Management update

- ANM provides a cheaper connection cost in return for an actively managed connection
- Non standard systems for single and multiple generators in use
- Developed specification for standardised ANM solution building on CLNR learning and the ENA good practice guide
- Framework awarded and first order placed for implementation at Driffield
- Four customers signed up with total of 25MW actively managed generation which is a mix of biomass and wind
- All customers provided with an indication of likely curtailment based on historical power flows (no guarantees and customers to undertake own due diligence)

Active Network Management update

- Initial front end engineering design study in progress with ZIV Automation
- Detailed design complete Summer 2018 with installation end 2018
- Once solution is proven then we will use it elsewhere from 2019 onwards
- ENA Open Networks project providing a forum for moving ANM forward at the transmission & distribution interface, operational data exchanges, commercial principles

Panel Q&A

Closing Statements

Andy MacLennan
Business Development Director

Lunch

Assessment & Design Fees Workshop

Chris Allanson
Market Strategy Manager

Aims of this workshop session

- This workshop session aims to provide a little more detail on:
  - BEIS policy drivers
  - BEIS approach to drafting the new regulations
  - Implementation timetable
  - Stakeholder feedback to BEIS's 2016 call for evidence

We would welcome your observations and feedback

BEIS policy drivers

- There are two primary factors highlighted in the BEIS consultation that drive the policy thinking:

BEIS approach to the regulations

- This summarises some key features on BEIS approach to drafting the regulations:
  - BEIS have opted light touch regulations which rely on existing primary legislation (the Electricity Act)
  - BEIS are confident that existing legislation only allows DNOs to recover reasonable costs
  - BEIS feel that current legal and regulatory requirements provide Ofgem with sufficient oversight and provide safeguards to customers
  - In principle, all customers should pay offer expenses but it may be inefficient or impractical for smaller connections

Next steps for BEIS – dates unconfirmed

2 NOV	Consultation response closed
NOV/DEC	BEIS considers responses
NOV/DEC	BEIS tweak the draft regulations (if necessary)
DEC	BEIS send into the Government approval process
TBC	BEIS submit to Parliament for approval
Q1 2018	DNOs submit changes to published charges to Ofgem
APR 2018	Go live date planned for 1 April 2018

We plan to update stakeholders via email newsletter - is this ok with you?

BEIS stakeholder feedback

- BEIS captured stakeholder feedback from the call for evidence in its September 2017 consultation:
  - Improving customer service, customers want better conversations with us
  - Transparency of charges is important
  - There is support for standard fees
  - Smaller projects to be exempt from paying upfront A&D fees
  - DNOs need to avoid over recovering costs
  - Larger projects should be charged the actual costs

Do you share these stakeholders' views?

Accessing Network Records Workshop

Ian Foster
Records Applications Manager

Aims of this workshop session

- This workshop session aims to:
  - Explain how to access our existing Safedig systems
  - Give an overview of ICP access
  - Give an insight into what's coming in the future

We welcome your questions, comments and feedback

How to gain access to Safedig mapping applications

The following are the requirements:

- Applicants name
- Company name & address
- Contact telephone number and email address
- Agreement to sign and return
- Completed registration form
- Application to be sent to the following email records.information@northernpowergrid.com

Where to gain access

- Visit our website www.northernpowergrid.com
- Select ‘Our services’
- Then ‘Check before you dig’
- Email: records.information@northernpowergrid.com

Where to gain access

Check before you dig

Moving my electricity supply (Service Alteration)

Temporary protection from overhead lines (shrouding)

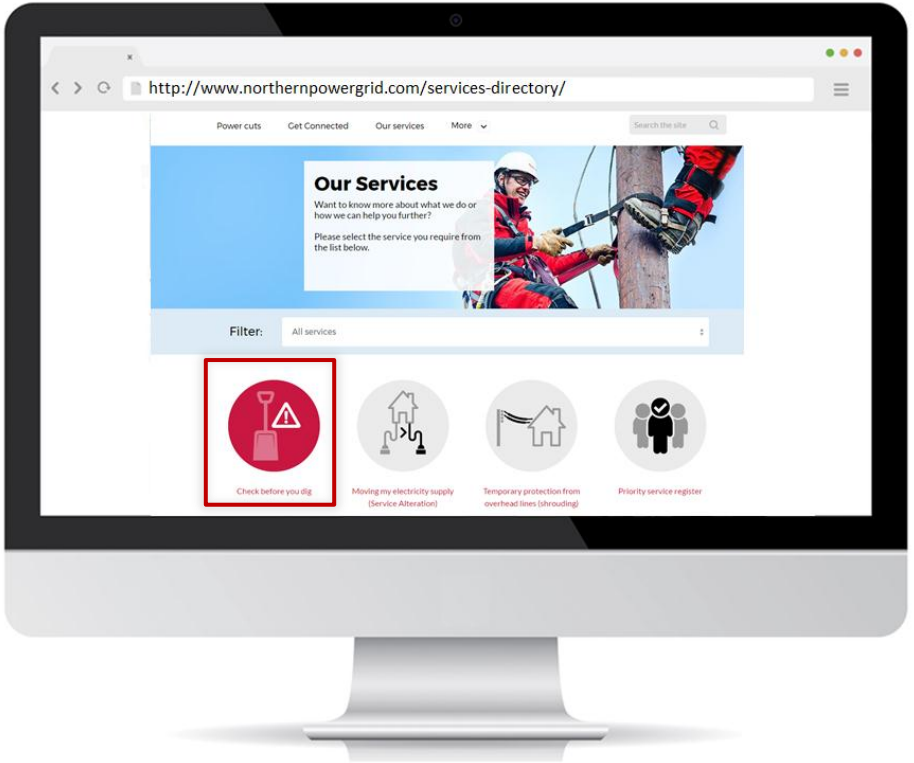
Priority service register

CHECK BEFORE YOU DIG

Planning to do your own digging? If you hit an electricity cable while digging you could endanger your life. Please be safe and find out about the location of our electricity cables first. If you require a single safe digging plan, please email your request including a site location plan and full postal address to safediggingplans@northernpowergrid.com. If you require multiple site locations, please complete our agreement and email it back to us. If you're a customer in the North East, please register online afterwards - log in details will be sent once your account is created. For Yorkshire customers, your registration will be automatic. If you need any further information, email us at records.information@northernpowergrid.com and we'll be happy to help.

COMPLETE OUR AGREEMENT ›

REGISTER (NORTH EAST CUSTOMERS) ›



Agreement for use of data

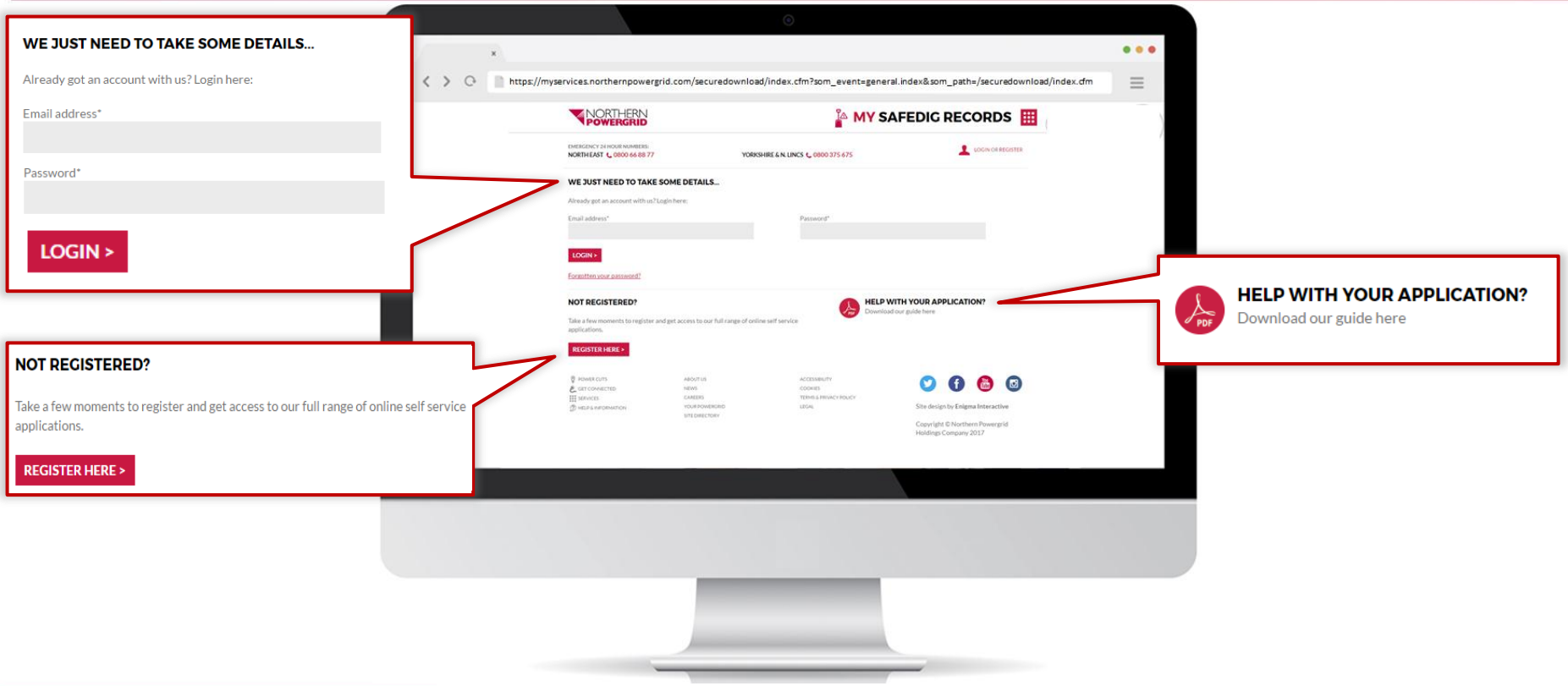
AGREEMENT FOR USE OF NORTHERN POWERGRID ELECTRONIC MAINS RECORDS

This Agreement is entered into on [*insert date, including year*]
between (1) [*Northern Powergrid (Northeast) Limited (company number: 02906593)/Northern Powergrid (Yorkshire) plc (company number: 04112320)*] whose registered office is at Lloyds Court, 78 Grey Street, Newcastle Upon Tyne, NE1 6AF ("Northern Powergrid") and (2) [*enter individual or company name, company number and individual or company address*] (the "User")

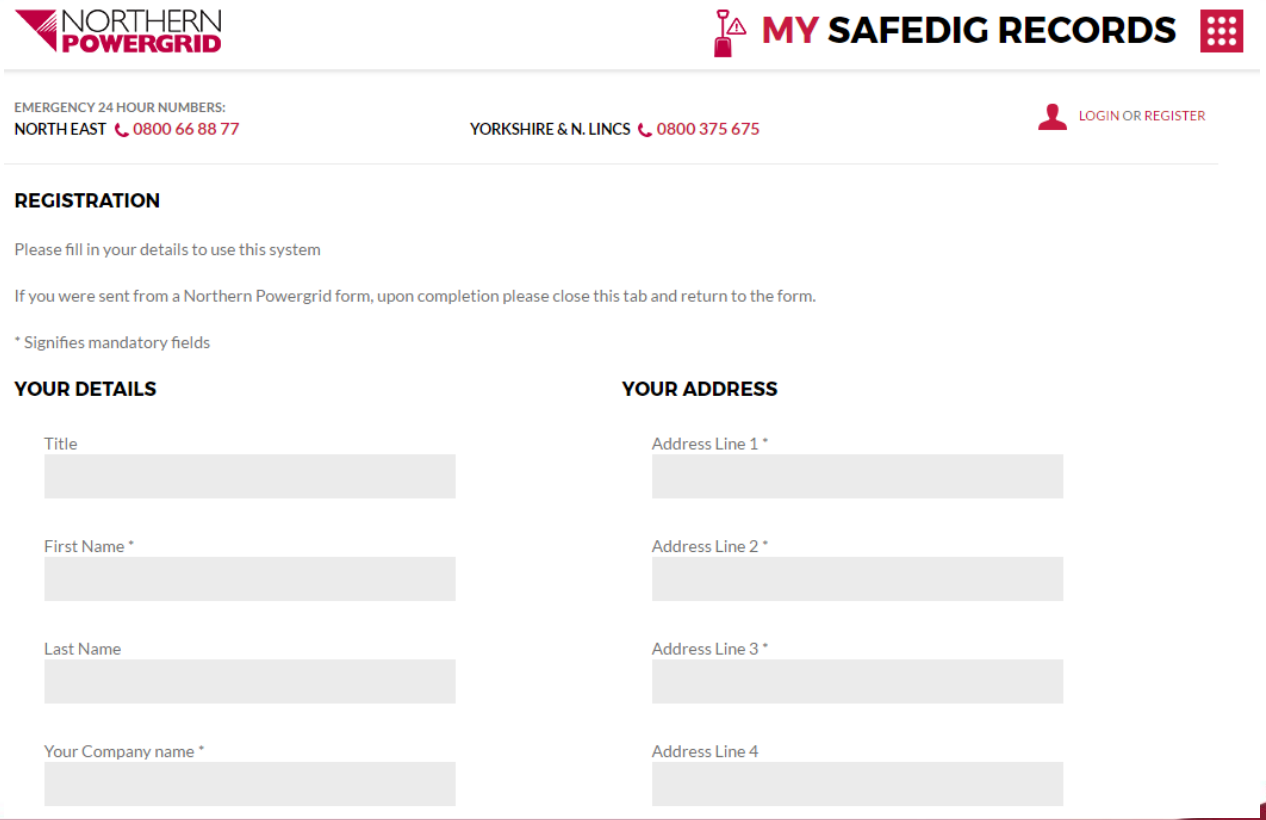
The parties agree as follows:

http://www.northernpowergrid.com/asset/0/document/3671.pdf

Registration form/Login



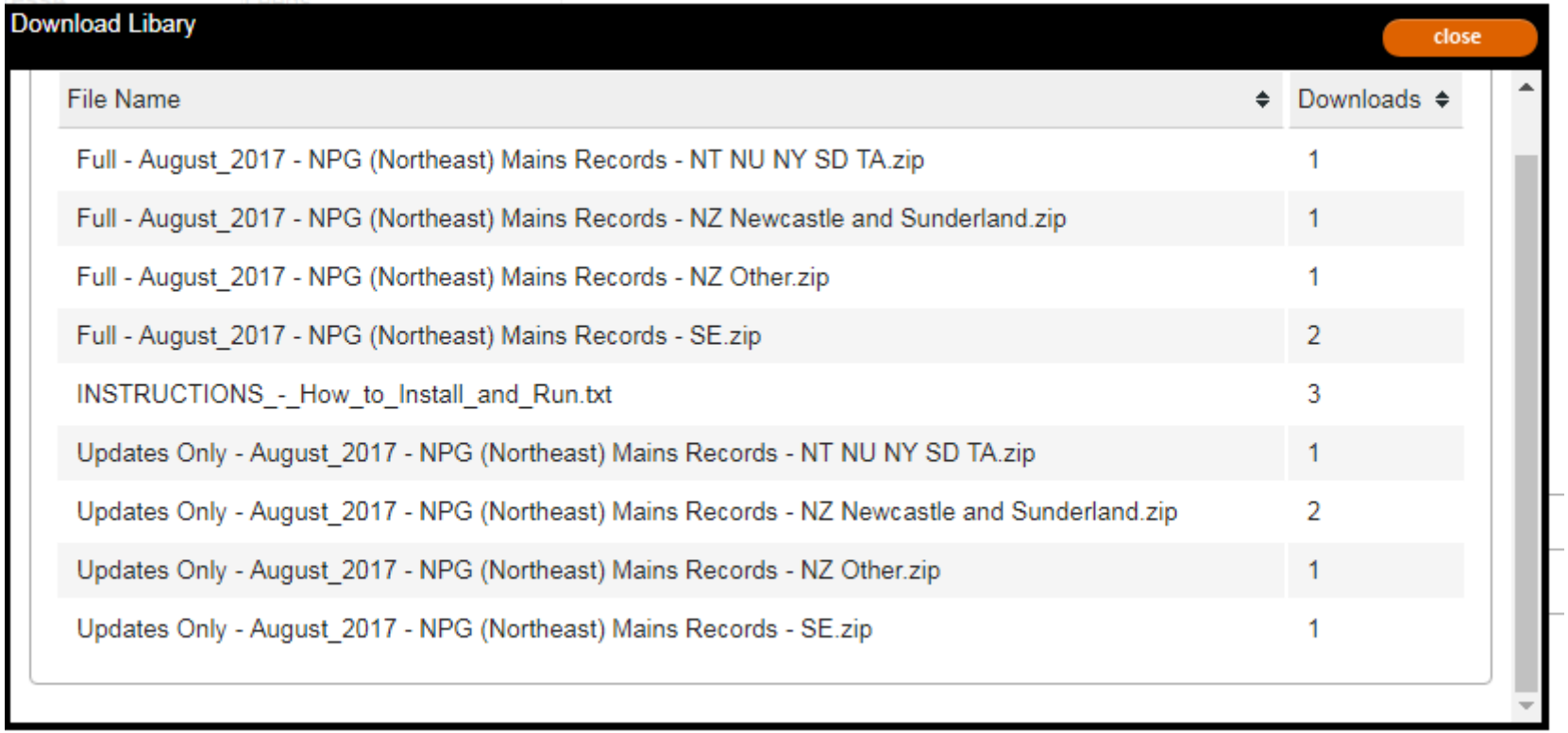
Registration form



What will be provided

- ✓ Access to North East download facility
- ✓ Access to YEDL Safedig web page
- ✓ A full set of instructions on how to use both applications

North East download facility



North East map

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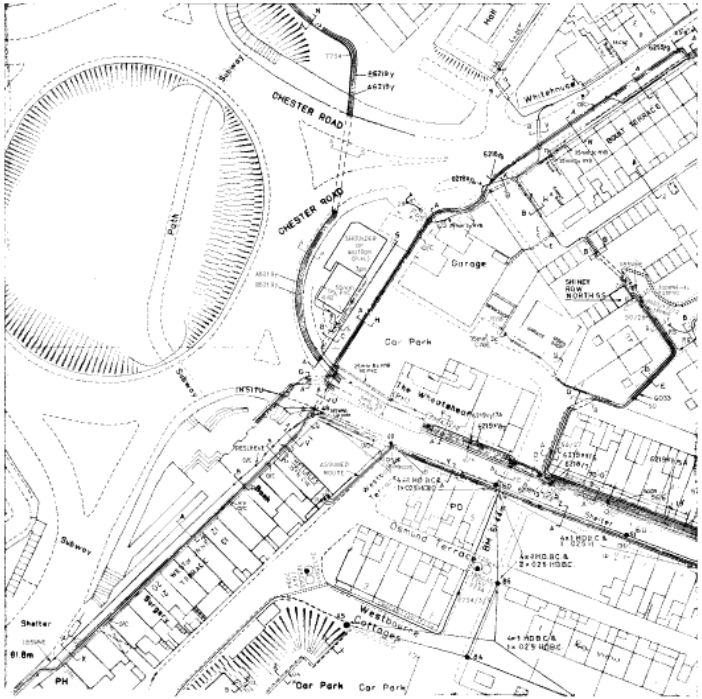

Base Map Data - Copyright Ordnance Survey

North East map detail sheet

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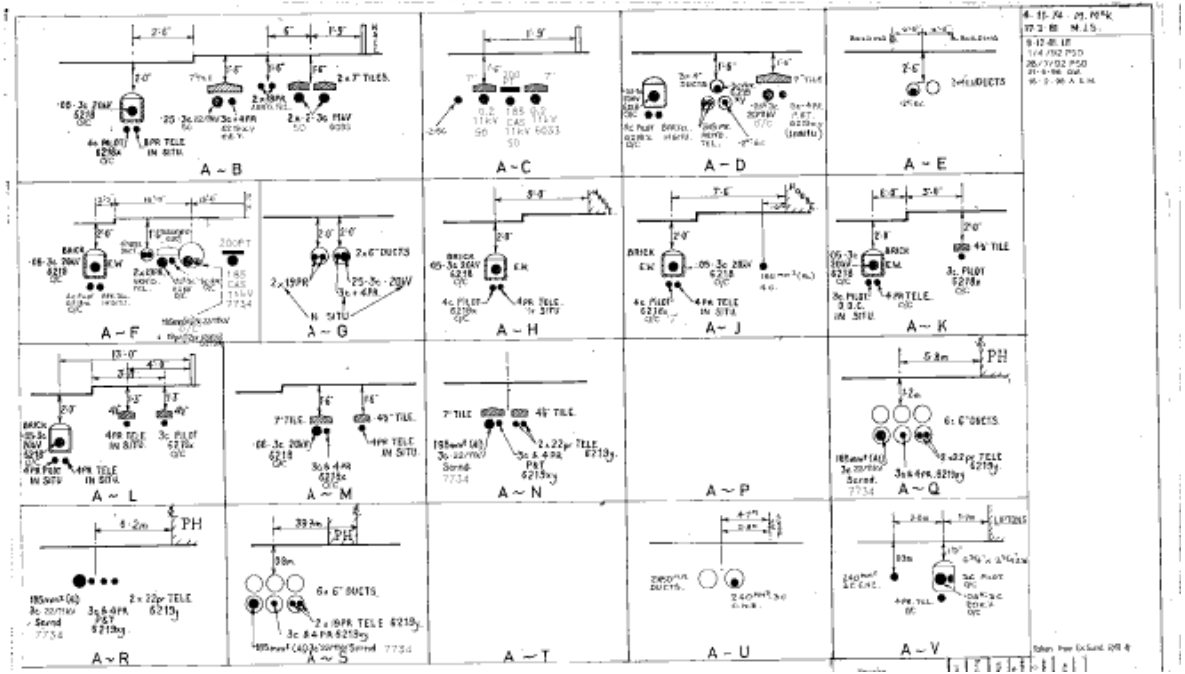
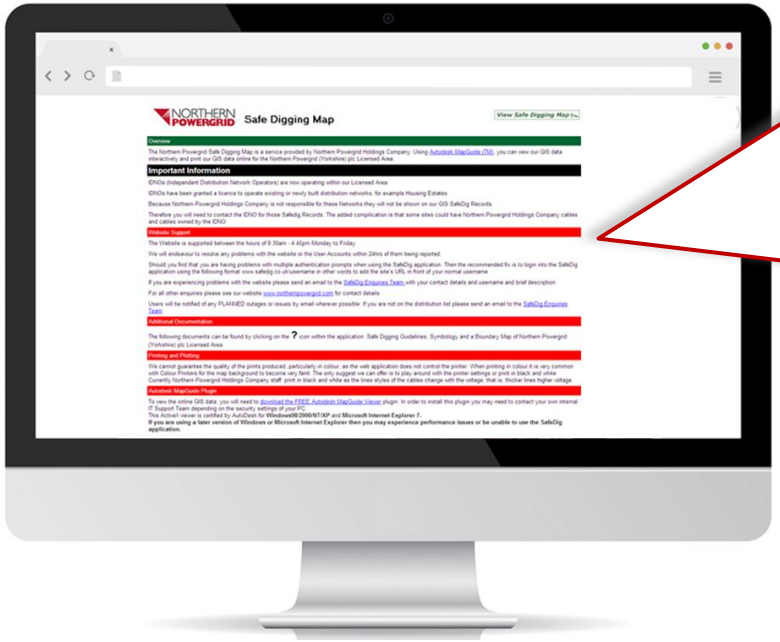


YEDL Safedig webpage

- URL www.safedig.co.uk
- Requirements - Login and Password
- Email sent with Login / Password / Map Guide Application / Instructions

YEDL Safedig webpage

YEDL Safedig webpage



NORTHERN POWERGRID **Safe Digging Map**

View Safe Digging Map

Overview

The Northern Powergrid Safe Digging Map is a service provided by Northern Powergrid Holdings Company. Using Autodesk MapGuide (TM), you can view our GIS data interactively and print our GIS data online for the Northern Powergrid (Yorkshire) plc Licensed Area.

Important Information

IDNOs (Independent Distribution Network Operators) are now operating within our Licensed Area.

IDNOs have been granted a licence to operate existing or newly built distribution networks, for example Housing Estates.

Because Northern Powergrid Holdings Company is not responsible for these Networks they will not be shown on our GIS SafeDig Records.

Therefore you will need to contact the IDNO for those Safedig Records. The added complication is that some sites could have Northern Powergrid Holdings Company cables and cables owned by the IDNO.

Website Support

The Website is supported between the hours of 8.30am - 4.45pm Monday to Friday.

We will endeavour to resolve any problems with the website or the User Accounts within 24hrs of them being reported.

Should you find that you are having problems with multiple authentication prompts when using the SafeDig application. Then the recommended fix is to login into the SafeDig application using the following format: www.safedig.co.uk\username in other words to add the site's URL in front of your normal username.

If you are experiencing problems with the website please send an email to the SafeDig Enquiries Team with your contact details and username and brief description.

For all other enquiries please see our website www.northernpowergrid.com for contact details.

Users will be notified of any PLANNED outages or issues by email wherever possible. If you are not on the distribution list please send an email to the SafeDig Enquiries Team.

Additional Documentation

The following documents can be found by clicking on the ? icon within the application. Safe Digging Guidelines, Symbology and a Boundary Map of Northern Powergrid (Yorkshire) plc Licensed Area.

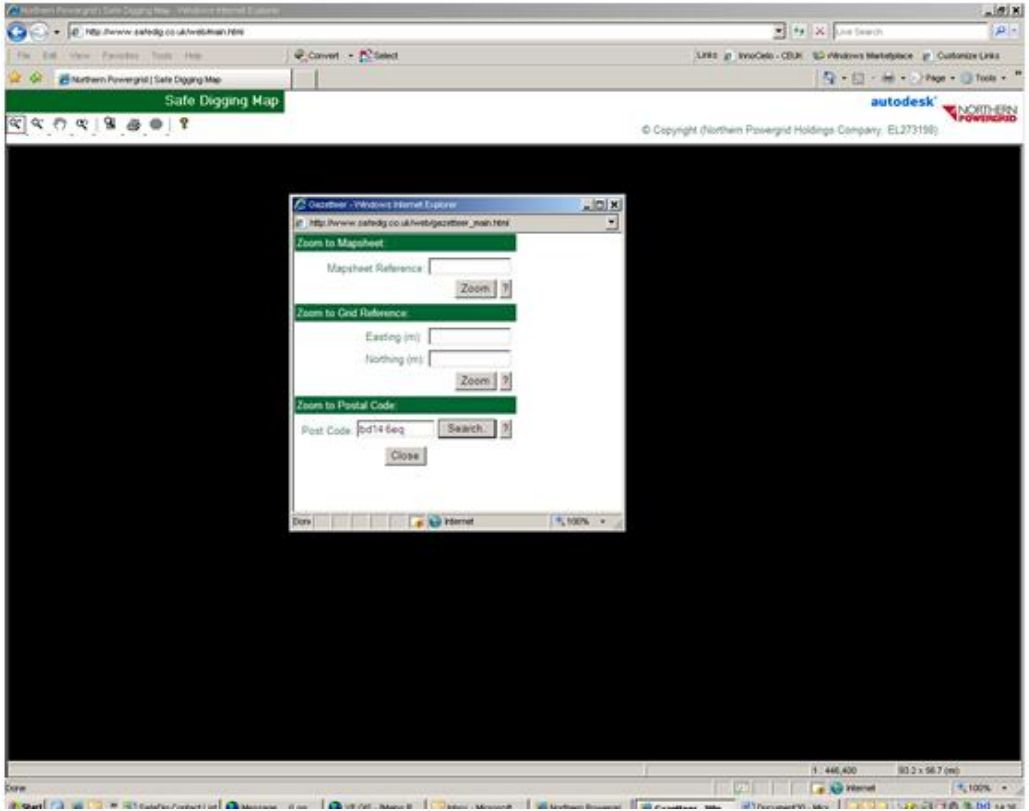
Printing and Plotting

We cannot guarantee the quality of the prints produced, particularly in colour, as the web application does not control the printer. When printing in colour it is very common with Colour Printers for the map background to become very faint. The only suggest we can offer is to play around with the printer settings or print in black and white. Currently Northern Powergrid Holdings Company staff print in black and white as the lines styles of the cables change with the voltage, that is, thicker lines higher voltage.

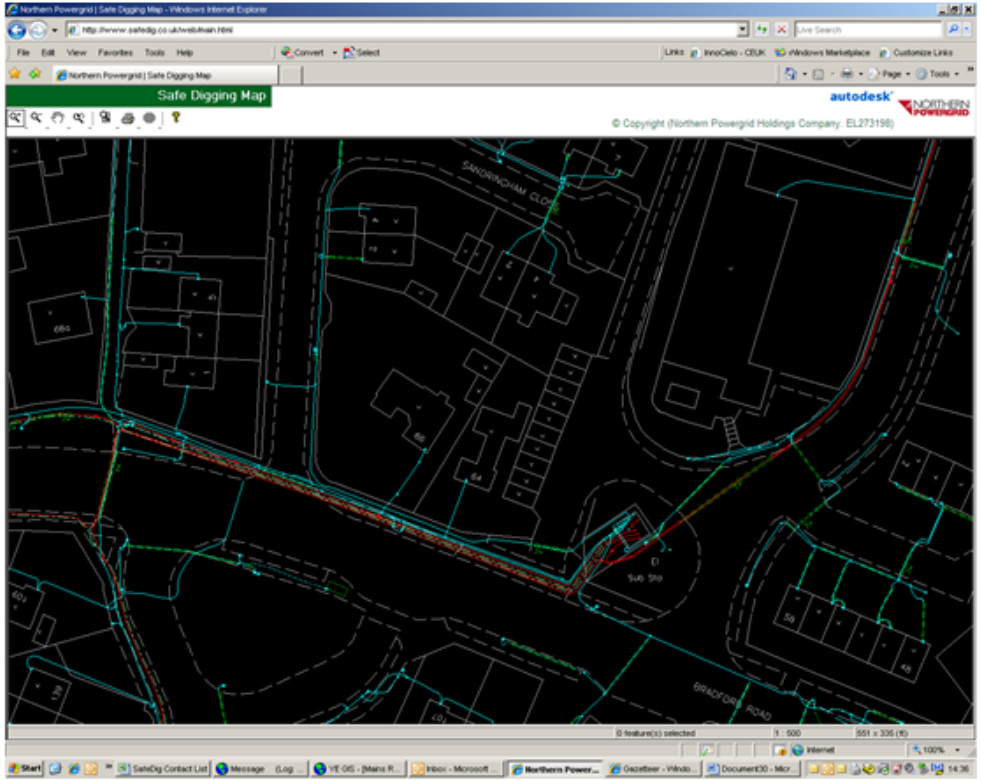
Autodesk MapGuide Plugin

To view the online GIS data, you will need to download the FREE Autodesk MapGuide Viewer plugin. In order to install this plugin you may need to contact your own internal IT Support Team depending on the security settings of your PC.
This ActiveX viewer is certified by AutoDesk for **Windows98/2000/NT/XP** and **Microsoft Internet Explorer 7.**
If you are using a later version of Windows or Microsoft Internet Explorer then you may experience performance issues or be unable to use the SafeDig application.

YEDL Safedig webpage



YEDL Safedig webpage



ICP access - What is required?

- Applicants name
- Company name & address
- Contact telephone number and email address
- Smart phone or Android IMEI number
- Application to be sent to the following email records.information@northernpowergrid.com
- Agreement to be signed and returned

ICP access - What will be provided

- VPN token is provided by an app to your smart phone or android
- Email will be sent to your email address
- Full set of instruction on how to set up access to Northern Powergrid / Access to AD03 / YEDL GIS and RSA VPN Access

ICP access - Access to AMP2View

- **North East Records (Ex NEDL)**
- Access to info can be by the following:
  - Substation name
  - Premise record (Post code / Street name / MPAN / Meter number or Substation)

Site location provides

- ✓ Mains records
- ✓ LV skeleton
- ✓ Substation diagram
- ✓ System diagram

Site network configuration provides

- ✓ Substation diagram
- ✓ System diagram DINIS feeder map
- ✓ HV feeder schedules
- ✓ LV feeders (customer numbers / Priority Services Register (PSR) customers / map of feeders and customers)
- ✓ Also provides protection zone
- ✓ Connected primary substation
- ✓ Switching feeder

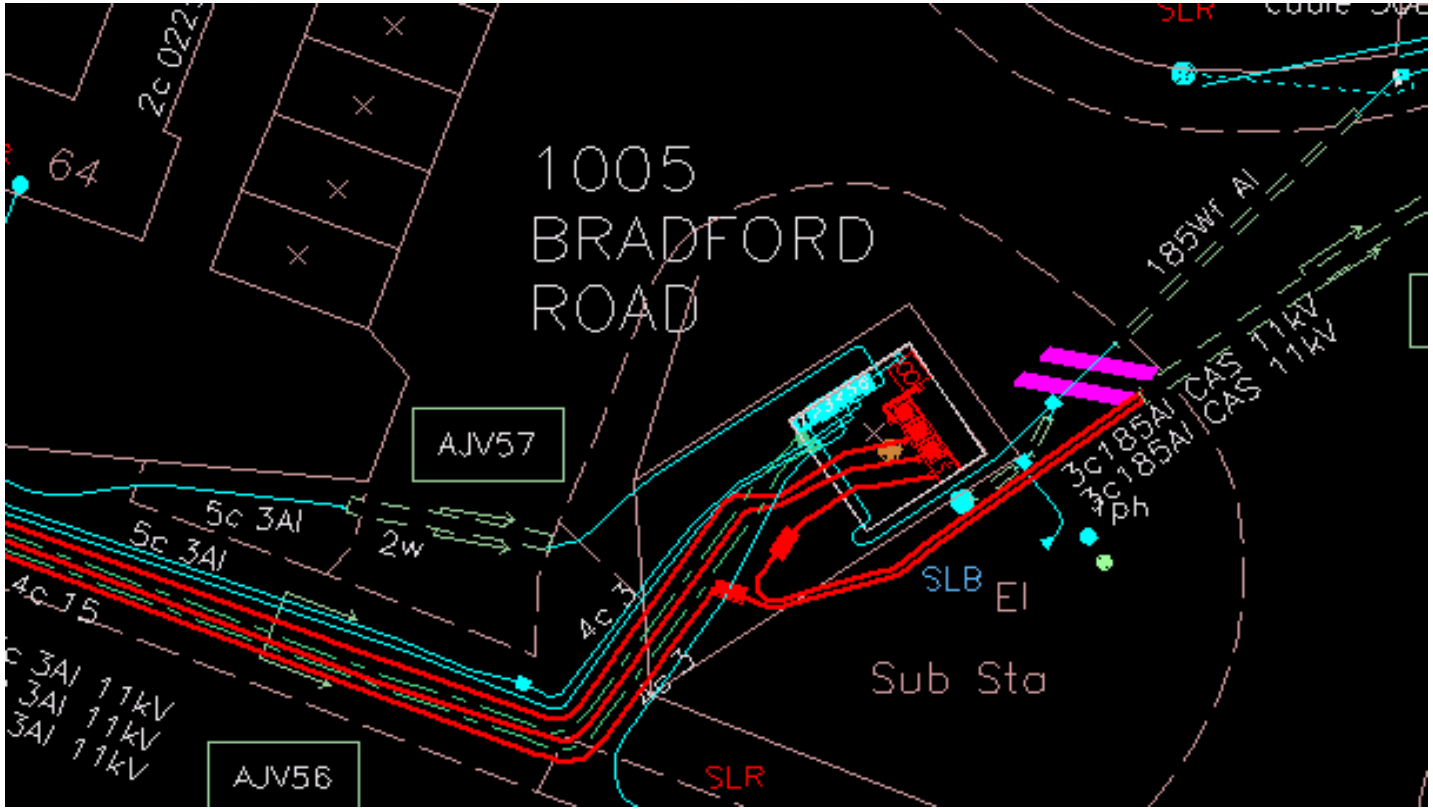
Site and plant data

- List of components at site
- Mains records
- LV Skeleton
- Substation diagram
- Also available:
  - Max demands
  - Via MPAN
  - LV network customer loadings

YEDL GIS

- **Yorkshire Records (Ex YEDL)**
- Access to info can be by the following:
  - Substation name
  - Premise record (Post code / Street name / MPAN / meter number or Substation)

YEDL GIS


1005
BRADFORD
ROAD
AJV57
AJV56
64
2c 022
5c 3Al
5c 3Al
2w
4c 15
3Al 11kV
3Al 11kV
3Al 11kV
4c 3
185Wr Al
3c185Al CAS 11kV
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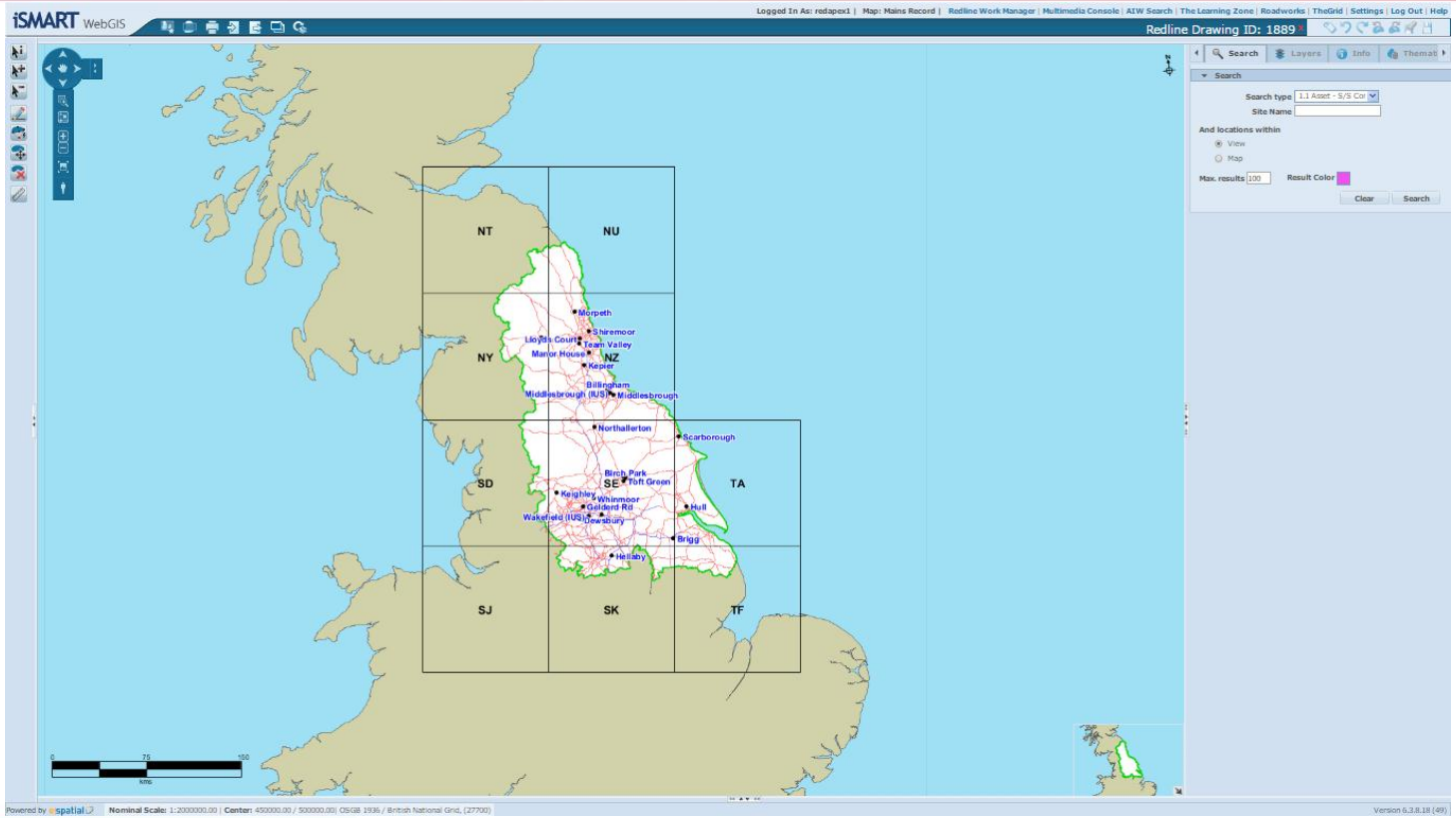
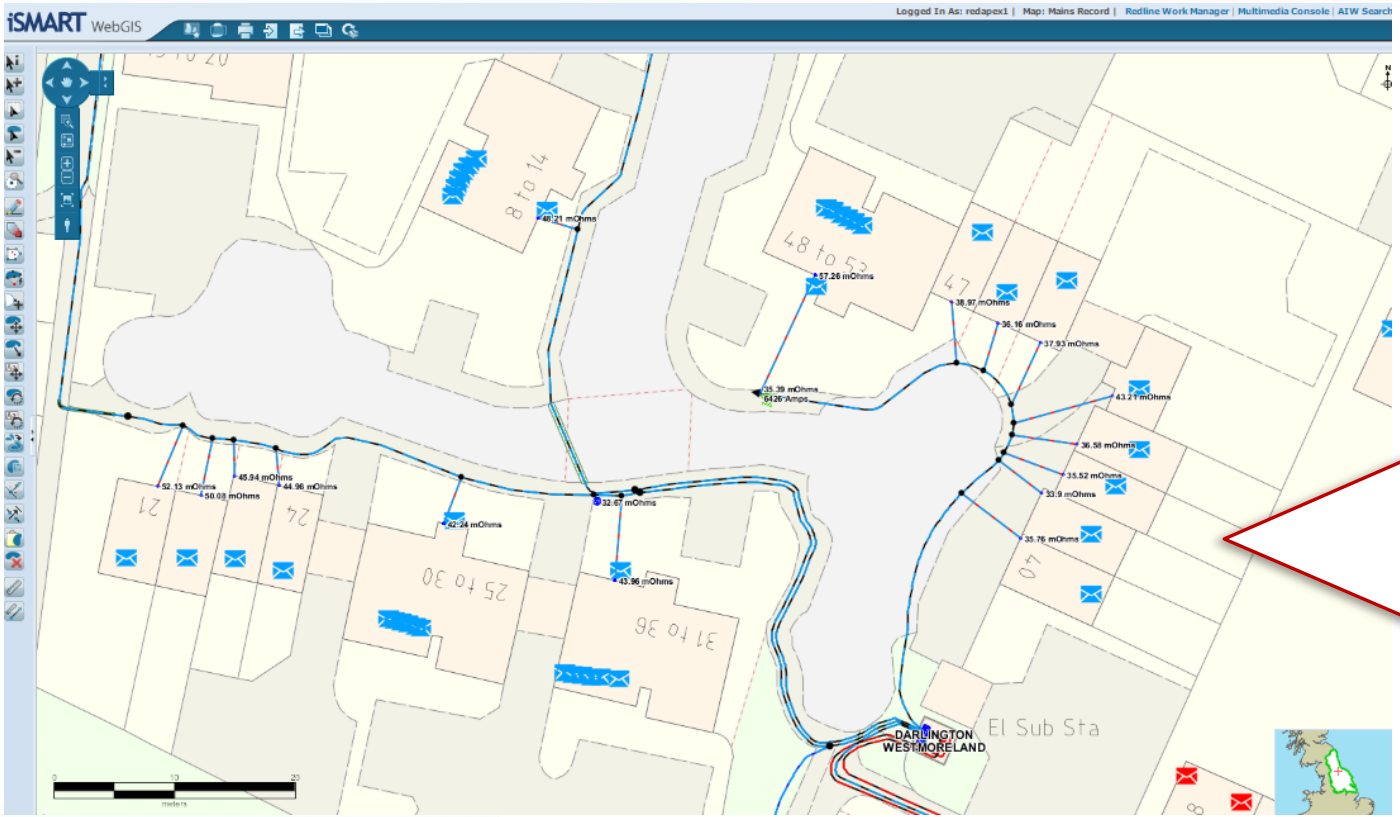
An insight into what's to come

Our network records have had a facelift and their format aligned across North East and Yorkshire

iSmart webGIS homepage

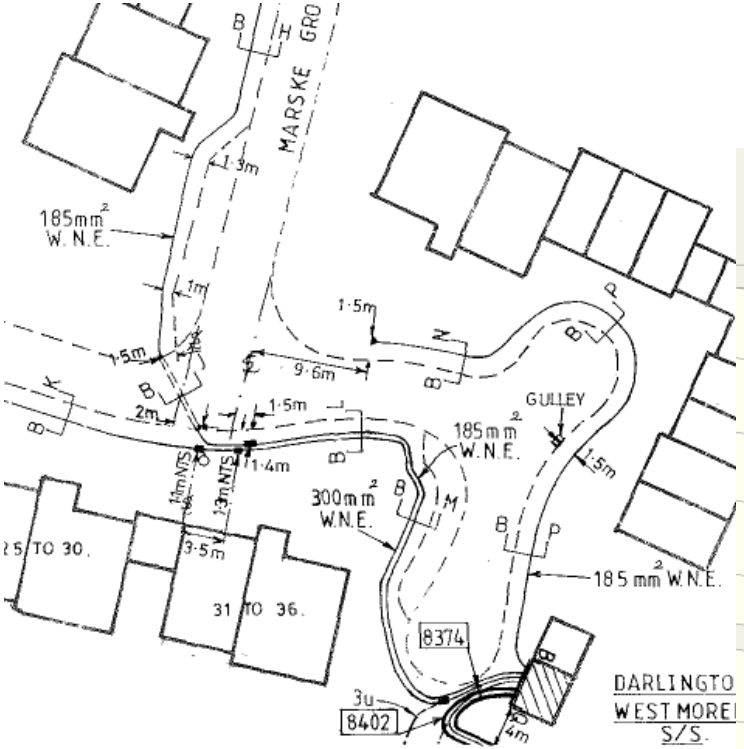


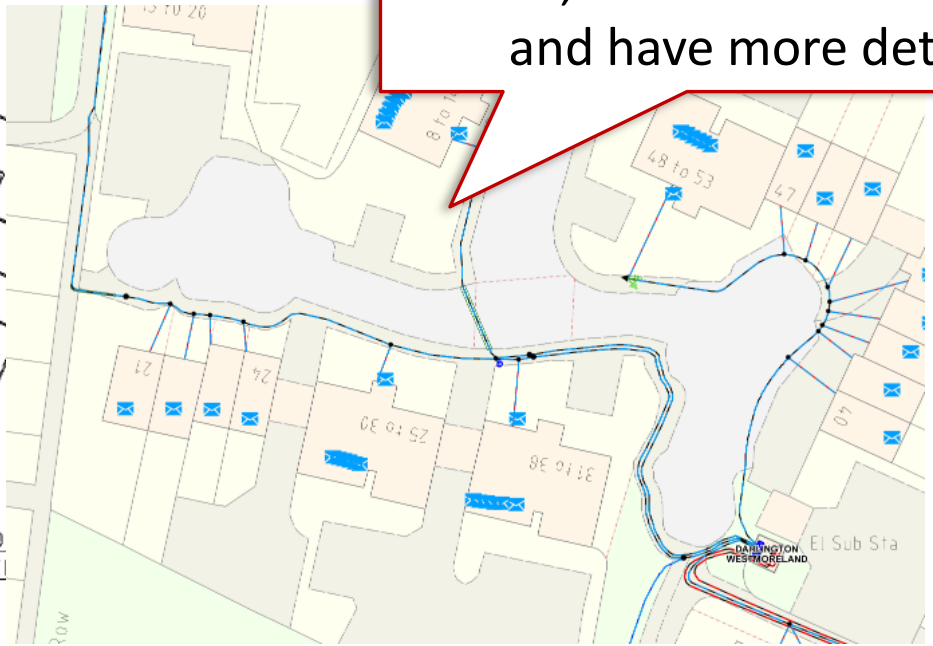
What's coming



GIS and graphical tools will be replaced by iSmart and our asset record positions aligned to Ordnance Survey MasterMap

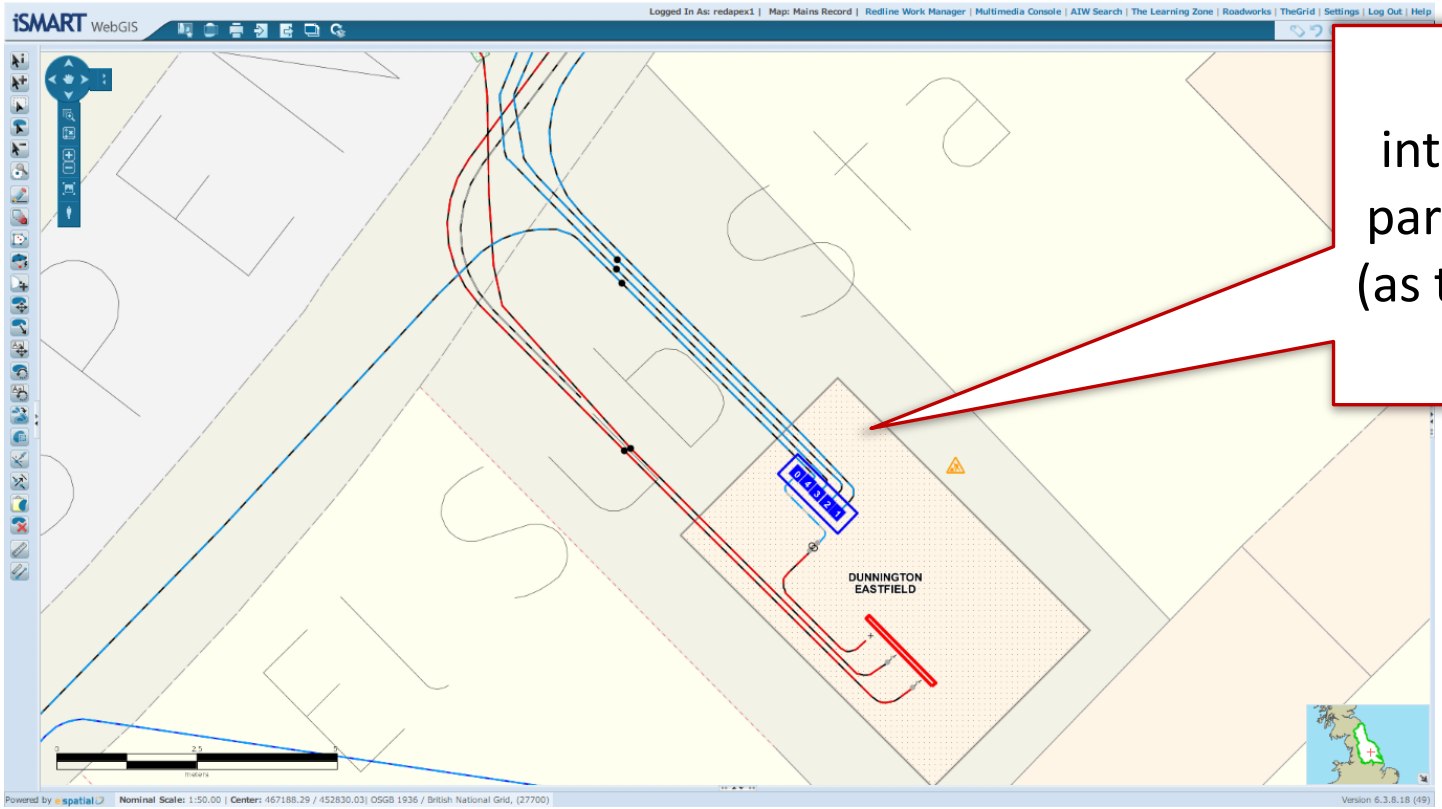
What's coming





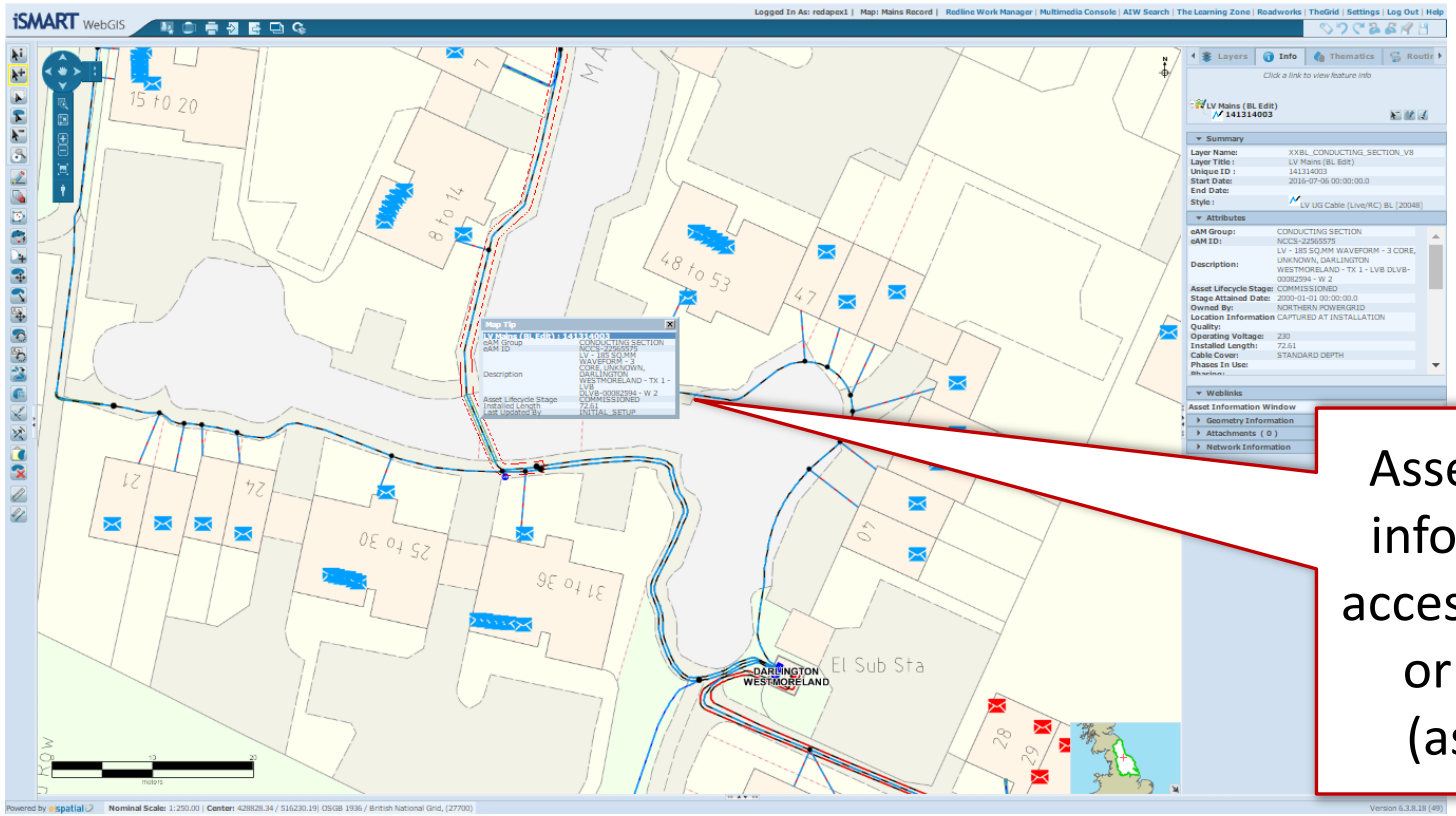
Records, including substation details, are easier to interpret and have more detail

What's coming



Substation internals are now part of the records (as they are already in GIS)

What's coming



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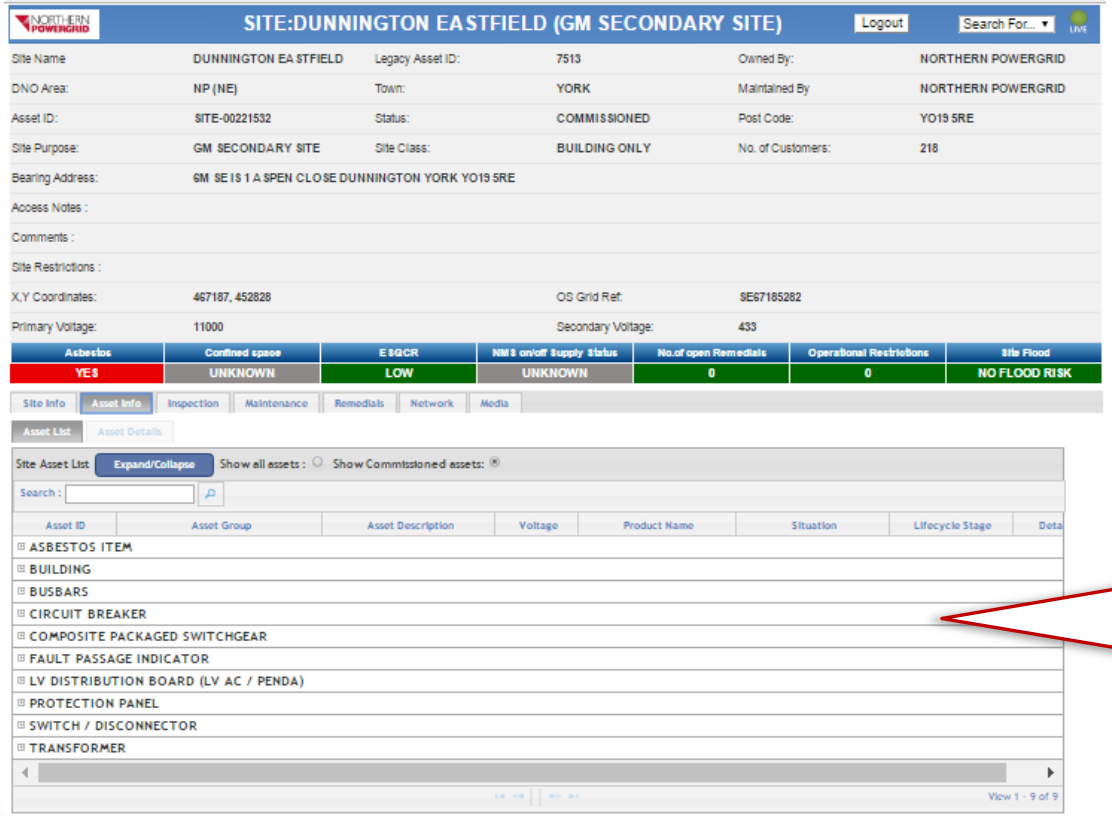
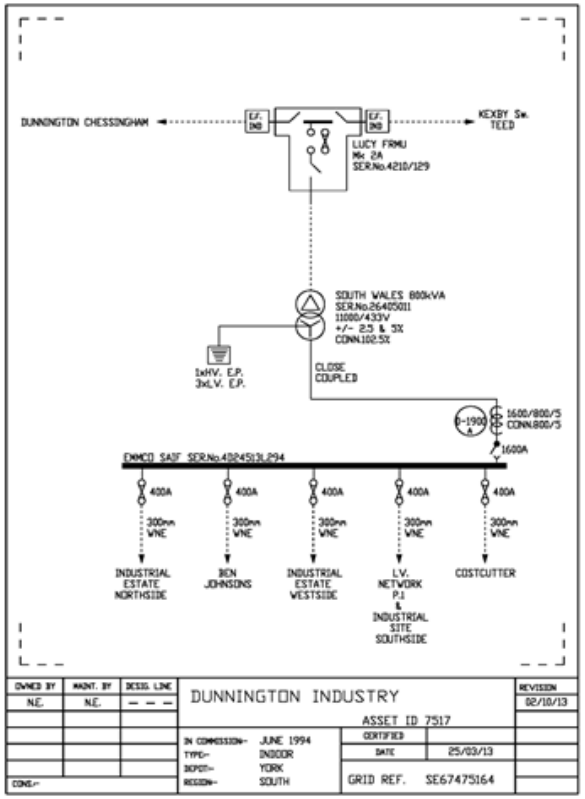
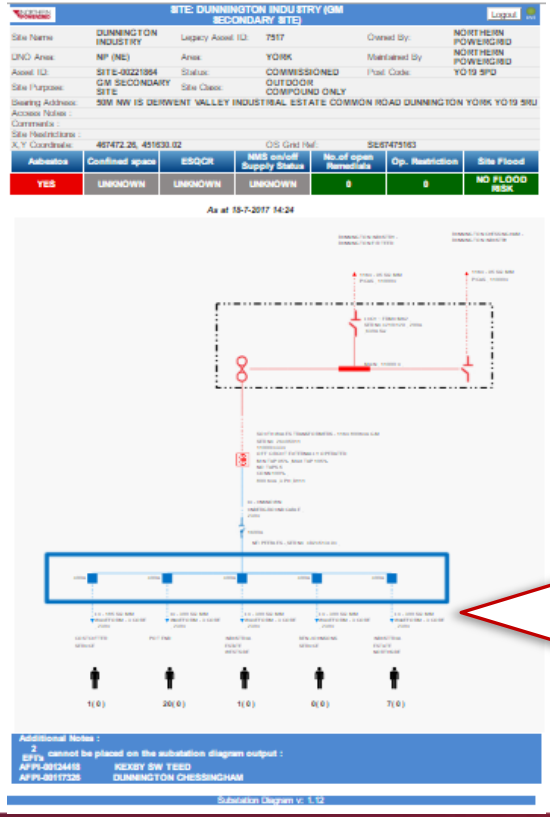


AMP2View and AR&V View will be replaced with the Asset Information Window

What's coming





System generated substation diagrams have been developed to support the new format records

How does it affect you in terms of access to geographical network records showing the location, size and type of assets?

The most obvious changes for you are:

- Same systems across North East and Yorkshire
- Any download format will be the same across North East and Yorkshire although the specific format and refresh frequency are still to be determined
- Remote access solution is been developed but it will no longer be restricted to older operating system it will be accessed through Chrome browser
- Availability will coincide with the internal rollout for design staff
- Current assistance routes will remain available
- Training can be scheduled if required
  - records.information@northernpowergrid.com
  - 0191 229 4271

Connecting Energy Storage Workshop

Rimnesh Shah and
Zweli Ndlovu

Aims of this workshop session

- This workshop session aims to:
  - Share the key technical and financial considerations of energy storage connections
  - Share key considerations of EREC G100: Export Limitation Schemes
  - Introduce the G59-fast track process for domestic energy storage connections

We would welcome your observations and feedback

Connecting Energy Storage

A. Introduction

- Enquiries being received are to connect battery storage systems (BESS) by customers looking to tender mostly for NGET Enhanced Response service (EFR)
- A BESS basically allows for the import and export of power at a controlled rate up to its maximum power rating (ramp rate)
- Technical studies using load flow and fault level software applications are conducted to evaluate whether or not the operation of a BESS device will impact the system parameters of the distribution network

Connecting Energy Storage

B. Technical considerations

1) Voltage consideration

a. Steady state voltage

– Voltage levels at different parts of the distribution network are to remain within pre-defined limits as prescribed in the Electricity Supply, Quality and Continuity Regulations (ESQCR 2002).

b. Steady state voltage

– Voltage step change based on instantaneous power swing from full export @0.95 lagging pf to full import @0.95 lagging pf before transformer automatic voltage control (AVC) has responded

– Voltage power swing shall be limited to 3% in line with Engineering Recommendation P28

Connecting Energy Storage

2) Thermal considerations:

a. Transformers

– Import purposes:

- Overloading of transformers may be permitted based on duration of overload, the overload capacity, transformer cyclic rating and pre-loading conditions of transformer units on site

– Export purposes:

- Some transformers do not have equal forward and reverse power ratings
- Maximum reverse power through a substation shall be limited by the tap changer type

Connecting Energy Storage

b. Overhead circuits

- Continuous seasonal OHL ratings based on 0% excursion ratings for non-firm connections, or 3% excursion for firm connections
- Bespoke cyclic current ratings can be explored in conjunction with the use of real-time thermal rating equipment

c. Underground cable

- Thermal time constant for U/G cables allows for consideration of cyclic ratings as long as they are not fully loaded

d. Switchgear

- Our switchgear normally has an assigned standard rating but a short term enhancement is feasible depending upon the operational arrangement
- Fault level duty (make and /or break) shall not exceed switchgear rating

Connecting Energy Storage

C. Observations

a. Voltage step change limits

Based on past assessments, the following observations have been made on BESS capacity connection levels, of which P28 voltage step change limit is key

Connection voltage	BESS capacity	Approximate cost	Approximate timescales
33kV	Up to 20MW	Bespoke	Up to 18/24 months
66kV	Less than 40MW	Bespoke	Up to 18/24 months
132kV	Over 40MW	Bespoke	Up to 24/32 months

The above values are typical maxima rather than guaranteed

Connecting Energy Storage

b. Connections cost

Connections costs based on solution scheme resulting from the assessment of:

i. Connection capacity required (new connection asset capacity required)

ii. Connection voltage (33kV, 66kV or 132kV)

iii. Fault level headroom availability

iv. Distance from BESS site to point of connection (PoC) – shorter distance invariably means cheaper & more capacity

v. Connection arrangement required (Busbar, or loop-in or tee-connection)

Export limitation schemes

- Solutions for generators
  - Where there is limited export capacity on the DNO network
  - Network reinforcement is unviable in terms of cost and/or time
- Used for customer energy management
  - By letting over-sizing generation
  - Increased flexibility of onsite demand peak

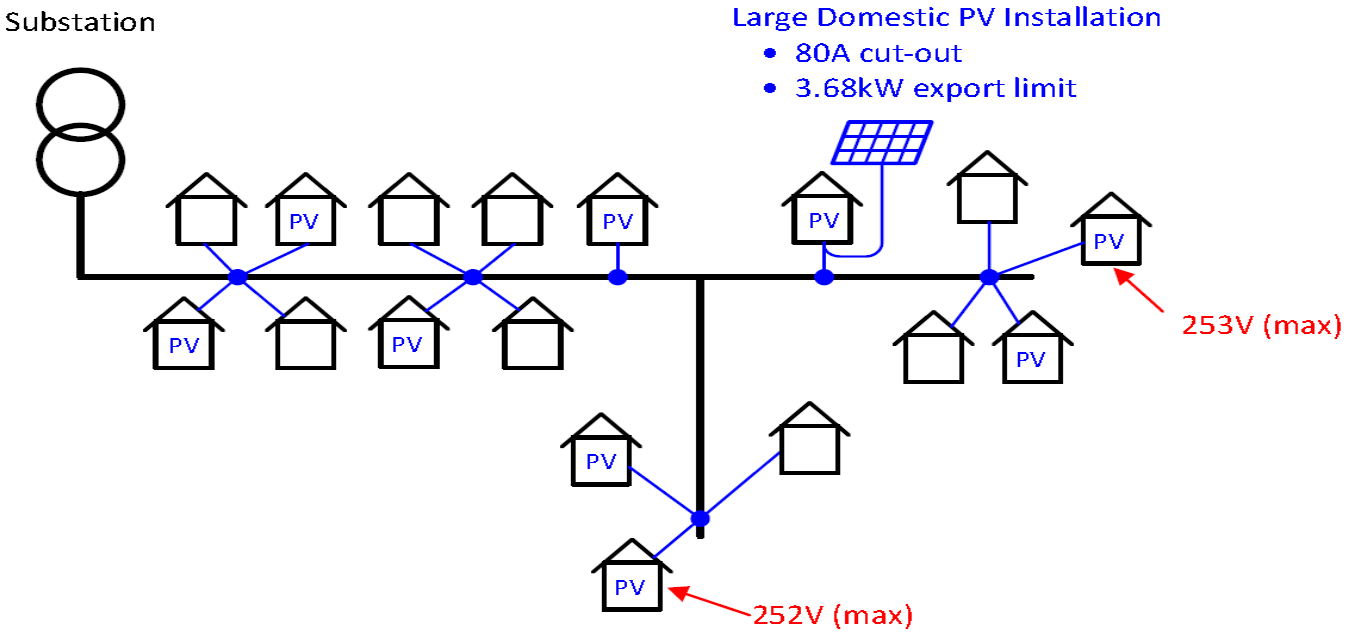
- Customer's controller diverts generated power into a load to avoid or limit export
  - Hot water immersion heater
  - Battery storage system
- Generator reduces output/turns off to ensure export agreement not exceeded
- Can be set for zero export if required

Engineering Recommendation G100

- EREC G100 published in 2016
  - Guidance for customers as well as DNOs for connection of customer ELS operated in parallel to DNO systems
- Contains a functional specification for scheme requirements
- Customer responsible for proof of design and installation
- EREC G100 applies mainly to HV/LV; other voltages at discretion of DNO
- Northern Powergrid COP for ELS: IMP/001/015 mirrors G100
- Maximum power station capacity (DG size) is smallest of the three:
  - Equipment thermal limit: Based on plant and equipment rating (mostly cut-out in domestic scenarios; default is 60A if info not available);
  - Protection assessment: Limits the total generation to 125% of the highest of the import or export agreement;
  - Voltage assessment: Limits the total generation so that highest network voltage to be no greater than "Statutory Voltage + 1%" i.e. 230V+1%=255.3V at LV.

Export limitation scheme example

A domestic **Customer** wishes to install a PV system but the **DNO** has restricted the **Agreed Export Capacity** to 3.68kW due to concerns over voltage rise. The cut-out fuse rating is 80A. An **ELS** is to be installed so that the capacity of the PV installation can be maximised.



Export limitation scheme example

Thermal Assessment:

The continuous rating of the cut-out and service cable are both in excess of 80A (18.4kW) and the 5s rating is substantially higher than this. The DNO determines that the thermal rating of the installation does not, in practice, limit the **Power Station Capacity**.

Protection Assessment:

The protection assessment restricts the **Power Station Capacity** to the higher of:

- 1.25 x **Agreed Import Capacity** = 1.25 x 80A x 230V = 23.0kW
- 1.25 x **Agreed Export Capacity** = 1.25 x 3.68kW = 4.6kW

The higher of the two values is 23kW.

Voltage Assessment:

The highest voltage that can be accepted on the **LV** network (during the 5s period before the **ELS** operates and restricts the export) is the upper **Statutory Voltage Limit** + (1% of the **Nominal Voltage**) = 253V + 1% of 230V = 255.3V.

The **DNO** calculates that when 10kW of generation is connected at the property the voltage at the end of the circuit reaches 255.3V.

Conclusion

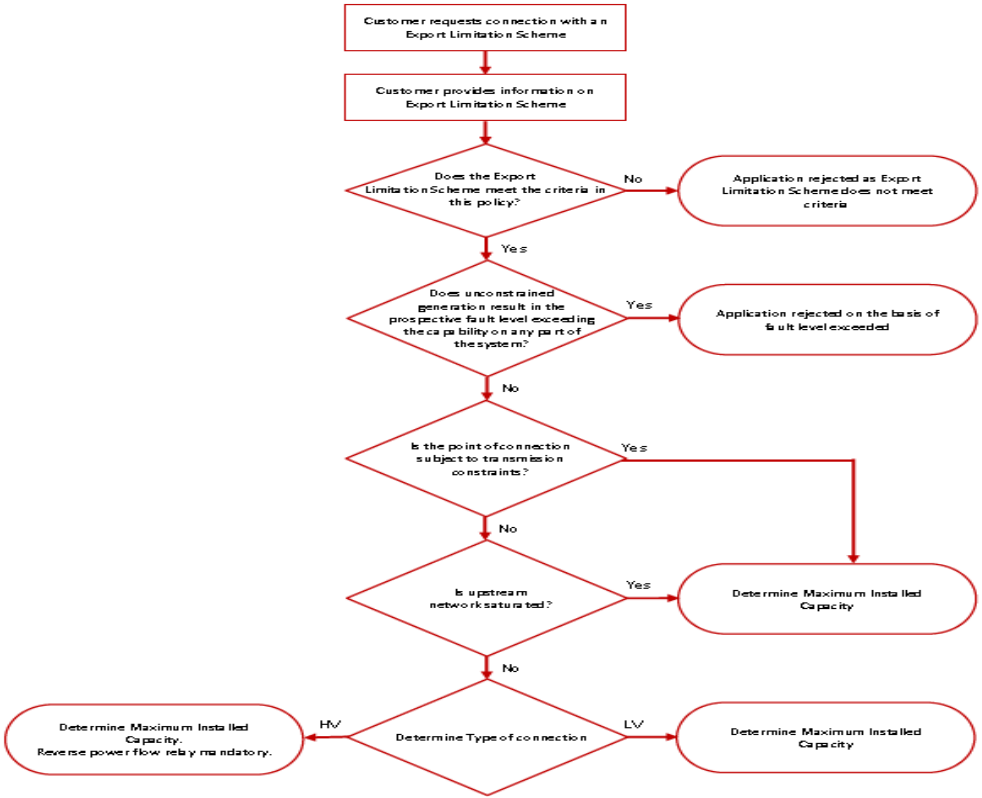
If an ELS is installed that limits the export to 3.68kW the maximum acceptable **Power Station Capacity** is the lower the results from the thermal assessment, protection assessment and voltage assessment. In this case the **Power Station Capacity**, i.e. the aggregate rating of the PV inverters, must be no higher than 10kW.

Export limitation scheme example

- Limitations due to fault level exceedance and any transmission still apply
- Default export capacity for LV connections 16A per phase; greater than that with ELS must be fail safe
- Reverse power protection required at HV metered connections as back up and at LV only if DNO deems the ELS is not fail safe
- Overall ELS accuracy is customers responsibility determined by manufacturer of the ELS
- ELS = within 5 sec operation.
- Back up systems must have +/-3% accuracy and operate within 5 sec

Total generator size	Witnessed testing?
<3.68kW	Not required
3.68-50kW	Discretionary
>50kW	Compulsory*

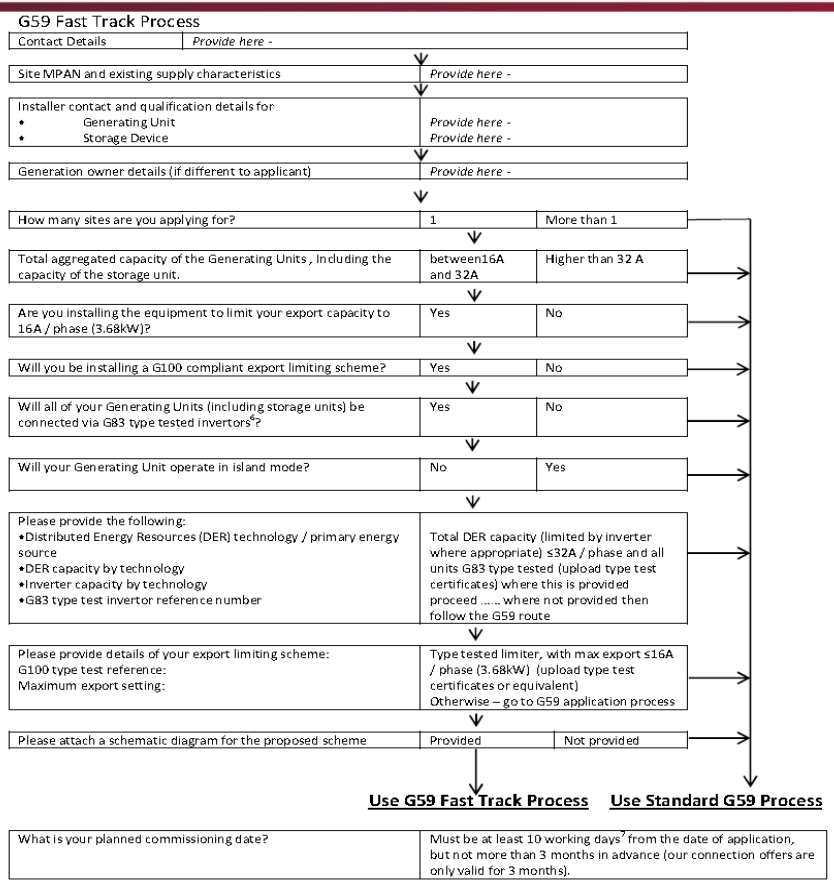
Export limitation scheme application flowchart



EREC G59 fast-track process

- Aims
  - To facilitate and expedite the LV connected small scale energy storage
  - Current 45d GSOP timescales for providing LV generation quote; bit excessive for small scale storage
  - Short term process change; keeping in mind the possible long term solutions
  - Improve customer experience, project viability without sacrificing visibility

G59 fast-track process



- Typically 1ph connections with existing or new G83 DG and G83 storage via separate invertor would be G59: 45d
- Installation complies with requirements of EREC G100 and export limited to 16A/ph
- Upper limit for total generation being 32A/ph (16A for DG & 16A for storage) under fast track process to minimize risks to networks
- Fast track application applies with automated approval within 10 days rather than 45 days
- EREC G100 changes pending

Connection application summary

	Installation Type	Type of Application Required[1]	Network Impact Assessment Required[2]	EREC G59 Witnessing Required	Export Limiting Scheme Designed to EREC G100	EREC G100 Witnessing Required
1	LV installation where total aggregated Energy Sources are ≤ 16A/phase and use Type Tested Inverters	EREC G83 Stage 1	No	No	No	No
2	Multiple LV installations where total aggregated Energy Sources are ≤ 16A/phase and use Type Tested Inverters	EREC G83 Stage 2	Yes	No	No	No
3	LV installation where total aggregated Energy Sources are > 16A/phase but Generation is ≤ 16A/phase and Energy Storage is ≤ 16A/phase and all use Type Tested Inverters[3] but export is limited to a maximum 16A/phase	EREC G59 *Fast Track*	Automated/ Fast-tracked	No	Yes	No
4	Multiple LV installations where total aggregated energy Sources are greater than16A/phase but Generation is ≤ to 16A/phase and Energy Storage is ≤ to16A/phase and all use Type Tested Inverters[3].	EREC G59	Yes	No	Yes if material impact on the network	First Device (if material impact on the network)
5	LV installation where total aggregated Energy Sources are > 16A/phase but ≤ to 50kW/17KW three/single phase and all use Type Tested Inverters and do not meet the requirements of 3 or 4 above[3].	EREC G59	Yes	Not normally, but at the discretion[4] of the DNO[5]	Yes if material impact on the network	Not normally, but at the discretion[4] of the DNO[5]
6	LV installation where total aggregated energy Sources are greater than 50kW/17KW three/single phase and all use Type Tested Inverters[3].	EREC G59	Yes	Yes normally, but at the discretion[4] of the DNO[5]	Yes if material impact on the network	Yes normally, but at the discretion[4] of the DNO[5]
7	HV & EHV Installations of any size.	EREC G59	Yes	Yes[5]	Yes if material impact on the network or managed MECs	Yes[5]

[1] All non-type tested equipment requires a G59 application regardless of size. With the exception of G83 Stage 1 all applications require consent from the DNO before connecting.

[2] All non-type tested equipment requires a network assessment regardless of size.

[3] Under G5-4-1 Customer's LV Equipment having an Aggregate Load or Rated Current greater than 16 A per phase will need to comply with the emission limits of Stages 1 or 2 of IEC Technical Report 61000-3-4 may to allow connection without assessment, subject to the fault level at the point of common coupling being at least equal to the minimum value required in that Technical Report.

[4] The DNO may choose to witness, or waive its right to witness, depending on previous experience with developer, and the overall impact of the scheme on the network.

[5] The DNO shall charge the generator for attendance of staff, for witness testing at its own commercial rates.