Celsius ENA P15/P17 Workshop

Damien Coyle
Innovation Project Manager

ENA Buildings
Monday 28th November 2016
Agenda

Celsius Project Overview

P15 & P17 Review

Damien Coyle
Innovation Project Manager

Dr. Stelios Cristou
Analyst Consultant
Agenda

Introduction

Project overview

Progress and next steps

Questions & answers
Our smart grid development

Leading work on developing smart solutions

Deliver value from existing assets

Customer choice

Five flagship products (second tier/NIC) £42 million

C2C

SMART STREET

CLASS

RESPOND

Celsius

LCN Fund
Low Carbon Networks
Up to £583m investment across GB by 2050

- **Awarded:** 9th December 2015
- **Go live:** Monitoring installation Mar 2017
- **Monitoring trial:** Mar 2018
- **Thermal ratings tool stage 1:** Oct 2018
- **Retrofit cooling installation:** Jun 2018
- **Cooling trial:** Jun 2019
- **Thermal ratings tool stage 2:** Jan 2020
- **Closedown:** Mar 2020

**Investment:** £5.5 million

**Financial benefits:** Up to £583m across GB by 2050
### Partners and roles on project

<table>
<thead>
<tr>
<th>ASH</th>
<th>Ricardo-AEA</th>
<th>UK Power Networks</th>
<th>Impact Research</th>
<th>University of Southampton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply complete retrofit monitoring solution</td>
<td>Analyse trial data Develop methodologies to understand relationship between asset temperature, load characteristics and surrounding environment Determine impact of cooling technologies Develop tool and spec for low cost temperature sensor Recommendations for BAU rollout</td>
<td>Work with ASH, Ricardo-AEA and Electricity North West to develop retrofit thermal monitoring solution Participate in evaluation and selection of retrofit cooling techniques</td>
<td>Facilitate customer focus groups Develop customer communication materials Lead the customer survey engagement</td>
<td>Peer review of the analysis methodology of the retrofit temperature sensor part of the project An investigative study on the impact of Celsius on the lifetime health of network assets</td>
</tr>
</tbody>
</table>
The problem

Objective is to maximise power through transformer

Assets have nominal thermal rating
Ratings = °C
Ratings K amps

Diverse range of environments
Small changes in environmental factors can result in very different actual ratings

Assumed thermal ratings can lead to capacity being under-utilised or unnecessary risk
Celsius as part of the smart future

Smart meter data → Thermal Ratings Tool

- Celsius monitoring
- Retrofit cooling
- Reinforce

→ Extra capacity

→ Lower bills for customers
Step 1: Fit thermal monitoring

Asset

- Internal temperature
- External temperature
- Environmental factors

Learning

- Thermal coefficient

Deliverable

- Thermal Ratings Tool

Benefit

- More capacity
Step 2: Retrofit cooling

<table>
<thead>
<tr>
<th>Asset</th>
<th>Internal temperature</th>
<th>External temperature</th>
<th>Environmental factors</th>
<th>Retrofit cooling</th>
</tr>
</thead>
</table>

**Learning**
- Retrofit cooling specifications, installation methodologies and buy order

**Deliverable**
- Enhanced Thermal Ratings Tool

**Benefit**
- Full capacity
Celsius studies

**Thermal analysis (step 1)**

\[ q_{\text{core}} = \frac{\text{Internal asset temperature}}{\text{Thermal coefficient}} \times \text{External asset temperature} \]

- Research into heat and air flows for optimal substation design

**Thermal flow study (steps 1 & 2)**

- Examines effects of increased load and cooling techniques on assets

**Asset health study (steps 1 & 2)**
### Monitoring site selection and timescales

<table>
<thead>
<tr>
<th>520 substations</th>
<th>100 cooling technique sites</th>
<th>Four year project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enough substations to represent 80% of GB substation population</td>
<td>Subset of 520 substations – enough sites to adequately trial all techniques</td>
<td>To enable trials to take place during all seasons and to trial all cooling techniques</td>
</tr>
</tbody>
</table>
Site selection map
Site selection – rural and urban
Site selection

- Number of substations in total population (Left Axis)
- Number of substations in trial population (Right Axis)
### CELSIUS: Site List

<table>
<thead>
<tr>
<th>Location</th>
<th>ID</th>
<th>Type</th>
<th>Component</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>DENE RD</td>
<td>171526</td>
<td>Single Temperature Sensor</td>
<td>Transformer</td>
<td>Top Oil Temperature - Face 1</td>
</tr>
<tr>
<td>Ash Wireless</td>
<td>1</td>
<td>Single Temperature Sensor</td>
<td>Transformer</td>
<td>Bottom Oil Temperature - Face 1</td>
</tr>
<tr>
<td>TOWNEND FM M6</td>
<td>660360</td>
<td>Hex voltage flying lead</td>
<td>LV Board</td>
<td>Voltage Phase 1</td>
</tr>
</tbody>
</table>
Celsius technology

Hub

Wireless sensor
Celsius technology – trial fit

LV board with three sensors
Celsius technology – trial fit

Transformer singles
Celsius technology – trial fit

Ventilation

25.2°C
Celsius technology – trial fit

Transformer

40.0°C
Trial site data

Magda Rd 750kVA Transformer Load and Temperatures

- Temperature (°C)
- Real Power (kW per Phase)

- P1 kW
- P2 kW
- P3 kW
- Top Oil (°C)
- Inlet (°C)
- Outlet (°C)
- Bottom Oil (°C)
<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>Celsius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Traditional replacement of ground-mounted transformer is expensive</td>
<td>Low cost options to release capacity as and when required</td>
</tr>
<tr>
<td>Complexity</td>
<td>Complex and time-consuming</td>
<td>Simple and quick to deploy</td>
</tr>
<tr>
<td>Disruption</td>
<td>Highly disruptive</td>
<td>Minimal or no disruption to customers</td>
</tr>
</tbody>
</table>
Customer engagement

Customers in the Celsius trial areas will find the implementation of innovative retrofit cooling techniques as acceptable as traditional reinforcement.

Customers who are educated as to the need for and benefits of Celsius are significantly more likely to find it acceptable.
Progress and next steps

January – June 2016
- Project mobilised
- Partner contracts awarded
- Customer engagement plan
- Data privacy statement

July - December 2016
- Monitoring site selection
- Commissioning tool
- Monitoring installation
- ENA ER P15 & P17 workshop

January – June 2017
- Data capture
- Thermal flow study
- ENA cooling workshop
- Customer focus groups

July – December 2017
- Monitoring installation report
- Cooling installation plan
- Thermal flow study report

Knowledge sharing and dissemination
CL.3.1 ENA Workshops with DNO’s held by November 2016 (to agree areas of changes to Engineering Recommendations P15 and P17)

CL.3.2 Publish any areas for change identified at the ENA workshop and publish change proposal options to ER P15 and ER P17 on Celsius website by February 2017

CL.3.3 Incorporate relevant Celsius outputs into change proposal options for ER P15 and ER P17 and hold workshop with DNO’s by January 2020

CL.3.4 Submit proposals for changing ER P15 and ER P17 to ENFG by March 2020
For more information

<table>
<thead>
<tr>
<th></th>
<th><a href="http://www.enwl.co.uk/thefuture">www.enwl.co.uk/thefuture</a></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><a href="mailto:futurenetworks@enwl.co.uk">futurenetworks@enwl.co.uk</a></td>
</tr>
<tr>
<td></td>
<td>0800 195 4141</td>
</tr>
<tr>
<td></td>
<td>@ElecNW_News</td>
</tr>
<tr>
<td></td>
<td>linkedin.com/company/electricity-north-west</td>
</tr>
<tr>
<td></td>
<td>facebook.com/ElectricityNorthWest</td>
</tr>
<tr>
<td></td>
<td>youtube.com/ElectricityNorthWest</td>
</tr>
</tbody>
</table>

Please contact us if you have any questions or would like to arrange a one-to-one briefing about our innovation projects