electricity north west

Bringing energy to your door

Celsius Cooling Technologies Call for Innovation

28 April 2017

Celsius

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1 INTRODUCTION

Celsius is funded via Ofgem's Network Innovation Competition (NIC) funding mechanism. The project was authorised to commence in December 2015 and is expected to be completed by March 2020.

Celsius explores innovative, cost-effective approaches to managing potentially excessive temperatures within distribution substations and their assets, which could otherwise constrain the connection of low carbon technologies (LCTs).

Celsius will develop an understanding of the operating temperatures of distribution substation assets, including transformers and cables, within a range of substation environments. The project will also investigate and demonstrate alternative, innovative ways to optimise thermal capacity, leading to faster, cheaper responses to the connection of low carbon technologies.

Retrofit cooling techniques for substations and their assets, and in particular, cables and transformers will be evaluated and deployed on 100 trial sites. Celsius will identify and evaluate a range of potential techniques and technologies, which may be used to cool or thermally manage assets. For example, passive techniques such as painting transformers with reflective paint, new backfill material for cables; and active techniques such as fans on transformers.

This invitation for expression of interest seeks potential solutions focussing on **retrofit cooling (passive or active) for secondary substations and their assets**.

2 NEED

Due to changing patterns in demand and the increase in distributed generation, new expectations have been placed on the assets of a distribution network operator. At the local level, the secondary substation, made up of 11kV switchgear, a transformer and low voltage (LV) cabinet, has become a stressed asset in some cases. This stress has arisen due to increased current flowing through the transformer and the LV cabling, and can be exasperated by other environmental effects, for example, other adjacent heat sources and solar gain. The rise in operating temperatures of the equipment can lead to a thermal constraint to the future connection of demand or generation in the area. These thermal constraints are typically resolved by replacing the asset, be it transformer or cabling with higher rated assets, at great cost and disruption.

Celsius is focussed on trialling different cooling methods on heavily loaded assets in the 11kV and LV networks. The cooling methods must be cost effective due to the relatively low value of replacing these assets with larger equivalents, which is approximately £27,500, as a worst case if all the substations assets were replaced.

There are many different methods that can be used to cool electrical assets, be they active or passive. This project will investigate as many of these as possible. Active and passive cooling solutions for substation buildings, transformers and LV cables are sought, but cooling technologies designed for switchgear is not in scope. These substations come in a range of sizes and locations such as: in the open, brick buildings, fibre glass enclosures or in basements. Solutions being offered will need to take into account restrictions associated with the locations they might be installed in.

Oil filled transformers are currently cooled with passive natural air radiators while LV cabling relies upon the thermal characteristics of the soil it is buried in.

3 OUTLINE DESIGN SPECIFICATION

As this invitation is looking at a range of solutions for a range of assets there is no outline specification per se.

This invitation is open to all concepts that are cost effective with respect to the assets they will be applied to. They must also be quick, straightforward and safe to deploy. Ultimately, they must provide adequate cooling of the asset type they are applied to with a life span commensurate with the life expectance of the asset (20-40 years).

In collaboration with other distribution network operators, Electricity North West will select a number of appropriate techniques to be trialled. The selection of cooling interventions will consider the following criteria:

- Safety
- Capacity benefit estimation
- Cost, carbon impact and benefits
- Operational processes
- Substation environment limitations
- Energy consumption
- Ease of installation
- Disposal and waste products
- Maintenance requirements.

In accordance with NIC governance, techniques with a technology readiness level (TRL) lower than four at the time of deployment will not be considered eligible for trial. Please refer to appendix A for a TRL guide.

4 REQUIRED INFORMATION

Electricity North West would like to know the following from interested parties:

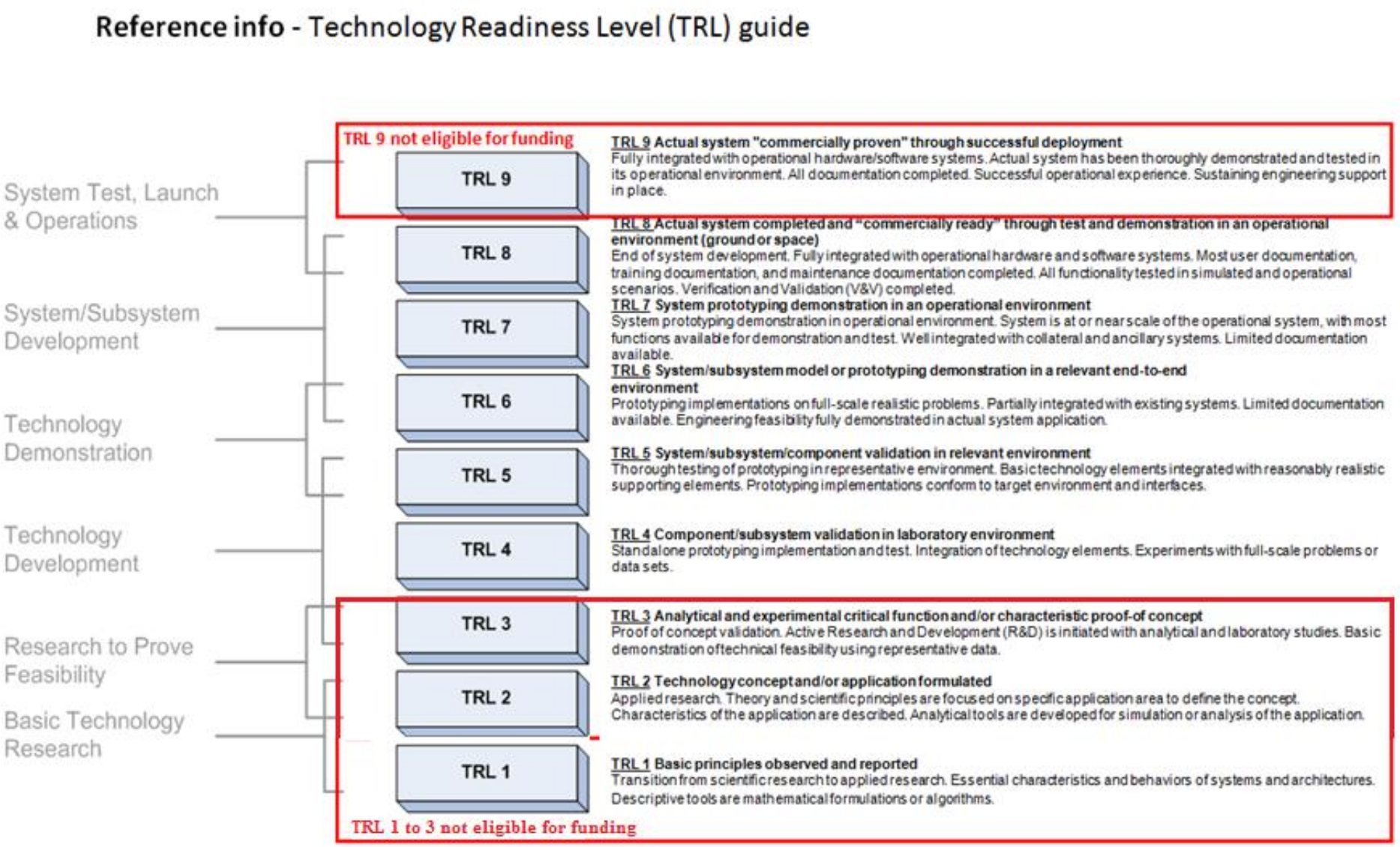
- Purchase costs (estimated if the product is in development)
- Technology readiness level (minimum of TRL 4, if currently in development)
- Technical details for the solution
- Basic installation requirements
- Operation and maintenance ongoing costs
- Carbon impact assessment, including manufacturing and transport carbon, if possible
- Previous deployment case studies
- References from previous installations
- If the technology has not been applied in the power industry, details of where it has been applied and how, and the impact that it had

5 PROCESS FOR REGISTERING INTEREST

Electricity North West is completely open to ideas and approaches to solve this challenge. Solutions can range from one single idea to several innovations that complement each other.

To register initial interest and request an expression of interest form, please contact the Electricity North West innovation team.

APPENDIX A:


Reference info - Technology Readiness Level (TRL) guide
TRL 9 not eligible for funding
System Test, Launch & Operations
TRL 9
TRL 9 Actual system "commercially proven" through successful deployment
Fully integrated with operational hardware/software systems. Actual system has been thoroughly demonstrated and tested in its operational environment. All documentation completed. Successful operational experience. Sustaining engineering support in place.
System/Subsystem Development
TRL 8
TRL 8 Actual system completed and "commercially ready" through test and demonstration in an operational environment (ground or space)
End of system development. Fully integrated with operational hardware and software systems. Most user documentation, training documentation, and maintenance documentation completed. All functionality tested in simulated and operational scenarios. Verification and Validation (V&V) completed.
TRL 7
TRL 7 System prototyping demonstration in an operational environment
System prototyping demonstration in operational environment. System is at or near scale of the operational system, with most functions available for demonstration and test. Well integrated with collateral and ancillary systems. Limited documentation available.
Technology Demonstration
TRL 6
TRL 6 System/subsystem model or prototyping demonstration in a relevant end-to-end environment
Prototyping implementations on full-scale realistic problems. Partially integrated with existing systems. Limited documentation available. Engineering feasibility fully demonstrated in actual system application.
TRL 5
TRL 5 System/subsystem/component validation in relevant environment
Thorough testing of prototyping in representative environment. Basic technology elements integrated with reasonably realistic supporting elements. Prototyping implementations conform to target environment and interfaces.
Technology Development
TRL 4
TRL 4 Component/subsystem validation in laboratory environment
Standalone prototyping implementation and test. Integration of technology elements. Experiments with full-scale problems or data sets.
Research to Prove Feasibility
TRL 3
TRL 3 Analytical and experimental critical function and/or characteristic proof-of concept
Proof of concept validation. Active Research and Development (R&D) is initiated with analytical and laboratory studies. Basic demonstration of technical feasibility using representative data.
Basic Technology Research
TRL 2
TRL 2 Technology concept and/or application formulated
Applied research. Theory and scientific principles are focused on specific application area to define the concept. Characteristics of the application are described. Analytical tools are developed for simulation or analysis of the application.
TRL 1
TRL 1 Basic principles observed and reported
Transition from scientific research to applied research. Essential characteristics and behaviors of systems and architectures. Descriptive tools are mathematical formulations or algorithms.
TRL 1 to 3 not eligible for funding