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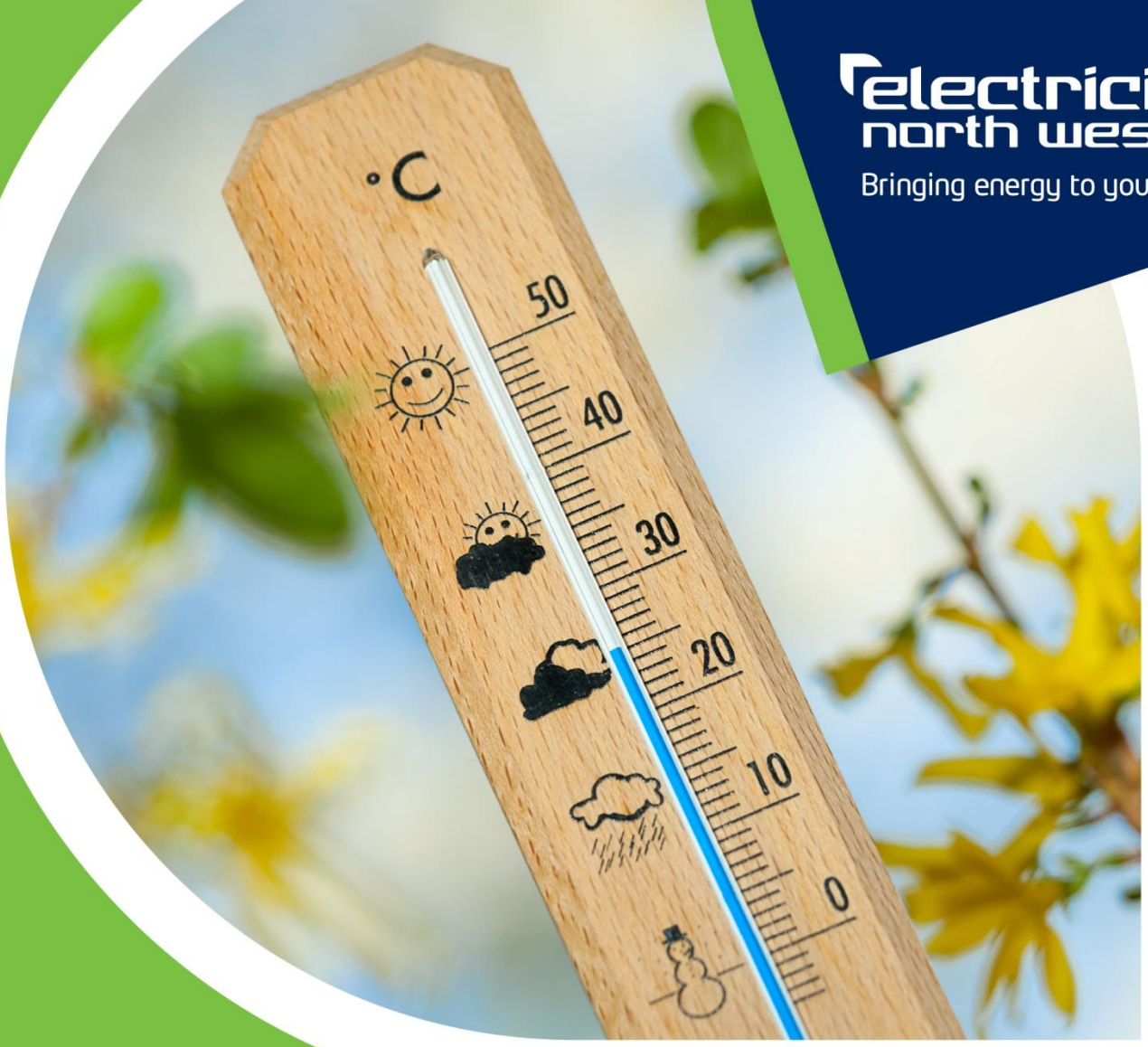

Celsius

Cooling Technology Selection

27 July 2017

CONTENTS

1 INTRODUCTION

Celsius is funded via Ofgem's Network Innovation Competition (NIC). 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.

2 PROCESS

A number of potential cooling technologies have been identified in the Celsius NIC full submission bid. Further market research was conducted to identify further cooling technologies or interventions.

As part of this process to identify existing and new technologies an expression of interest was released via the ENA innovation portal, a copy of the expression of interest can be found on the Celsius website key documents.

A summary of all previously identified and new technologies were presented at the Celsius cooling technology workshop held on the 31 May 2017, which included participation from other distribution network operators. A review of technologies took place, these were refined and a scoring mechanism agreed. It was also agreed further research was to take place prior to final selection for inclusion in the trial.

3 SELECTION SCORING

Following the refined list of technologies from the cooling technology workshop, each cooling intervention was scored on the following parameters:

- Safety
- Purchase cost
- Technology readiness level
- Installation
- Environmental Impact
- Operational
- Maintenance
- Energy use
- Customer impact

In order to be consistent and fair in selection of cooling technologies the Celsius team set out a common scoring mechanism. Each intervention/technology was scored 1, 2 or 3.

1. Unknown or does not meet requirements
2. Meets requirements
3. Exceeds requirements.

Due to intellectual property rights, only the scoring and title of the solution will be shared at this stage of the project. The final scoring and selection is contained in Appendix A.

APPENDIX A: FINAL SELECTION

Asset	Solution	Safety	Purchase Cost	TRL	Installation	Operational	Energy use	Environmental	Maintenance	Customer impact	Total	Acceptable
PMT	Black Paint	2	3	3	2	3	3	2	2	2	**22**	YES
PMT	White Paint	2	3	3	2	3	3	2	2	2	**22**	YES
PMT	PMT shade	2	3	3	2	3	3	3	3	2	**24**	YES
GMT	Black Paint	2	3	3	3	3	3	2	2	3	**24**	YES
GMT	White Paint	2	3	3	3	3	3	2	2	2	**23**	YES
GMT	Shade	2	3	3	3	3	3	3	3	2	**25**	YES
GMT	PV shade	1	1	3	2	2	3	3	2	2	**19**	YES
GMT	Cooling Plates	2	2	2	2	2	2	2	2	3	**19**	YES
GMT	Phase change material	1	1	2	2	2	2	2	2	3	**17**	YES
GMT	Flexible water cooled tubes	2	2	2	2	2	2	2	2	3	**19**	YES
GMT	Forced ventilation	2	2	2	2	2	2	3	2	3	**20**	YES
GMT	Improved ventilation chimney	2	3	2	2	3	3	3	2	2	**22**	YES
GMT	Improved ventilation	2	3	3	3	3	3	3	2	3	**25**	YES
GMT	Internal oil pump	1	2	1	1	2	2	2	1	3	**15**	More detail required
GMT	External oil heat sink	1	2	2	1	2	2	1	1	2	**14**	More detail required
Cables	Backfill 1 type solution	2	3	3	3	3	3	3	3	3	**26**	YES
Cables	Backfill 2 type solution	2	3	2	3	3	3	2	3	3	**24**	YES