DOC-190522-HLR
INNOVATION PROJECT
CLOSE-OUT REPORT

300 KVA POLE MOUNTED TRANSFORMER PROJECT

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1. PROJECT SCOPE AND DESCRIPTION

Introduction & Problem Statement

As customers adopt more low carbon technologies and there is an increase in the electrification of heat and transport, ESB Networks will see increasing loads on the Low Voltage (LV) network. This can lead to constraints on the Network in two forms. The first is where increased loads cause the voltage to fall below the standards set by EN50160, or the second case, where the transformer becomes overloaded. This report deals with a solution to an issue where the current maximum size of pole mounted transformer (200kVA) becomes overloaded.

Traditionally, increased loads would be accommodated by just increasing the transformer size, however, upgrading an existing transformer to a larger size model to accommodate increased loads can be challenging. In situations where the space isn't available, except at significant cost, innovative approaches that leverage new and improved technologies and materials may be needed. It is anticipated that customers will want to be able to use electrified heat and charge their Electric Vehicles (EV) at home, at the forecourt, at the office and many other public places. This project supports the delivery of one of ESB Networks' core objectives, which is to provide necessary infrastructure to support this fundamental shift in energy usage.

Currently the existing largest capacity pole mounted transformer available is a 200 kVA. If an increase in capacity is required from an existing pole mounted 200 kVA transformer, the options are either to divide up the number of customers between the original transformer and a new additional pole mounted transformer or install a ground mounted Substation. Both options pose difficulties, both physically, and financially and can have very long lead times. It is thought that 200 kVA pole mounted transformers are the most at-risk category of transformer of being overloaded, purely given that the options to uprate are very limited and/or expensive/disruptive, and so Design Engineering Officers may be more inclined to push these 200 kVA transformers to their nameplate rating, resulting in little or no headroom available for LCT uptake.

Proposed Solution

The proposed solution is to develop a 300 kVA pole mounted transformer which would have similar dimensions to the existing 200 kVA pole mounted transformer and remain within allowable weight limits for the pole, so that the uprating would now simply require the direct replacement of the 200 kVA unit with one of 300 kVA rating. The new 300 kVA would be required to conform to ESB Networks specification for Pole Mounted Transformers. The specification itself required some very minor alterations to include the 300 kVA option. The alterations to the specification included minor increases in the allowable dimensions of the unit and a marginal increase in the allowable weight limit.

Existing 200 kVA pole mounted transformers are typically cabled by two circuits of 4X 95's Aerial Bundle Conductor (ABC). Each run of 4X 95's ABC can supply circa 175 kVA, so two such circuits (if evenly balanced), are sufficient to cope with an overall load of 350 kVA, which is in excess of the 300 kVA installed. If required, an additional circuit of 4X 95's ABC can be added, to further split the load.

2. MEASURES OF SUCCESS AND EXPECTED BENEFITS

The project's key success metrics are:

- To develop and produce 2 no.300 kVA, which is compliant with the EU ECO tier 2 directive[1], pole mounted transformers and pass type tests. One unit will be type tested to destruction through the internal arc test. The type tests requested are listed in Table 1

Item Number	Quantity & Description
1	2 X 300 kVA transformer
2	Noise Test
3	Internal Arc Test (on one unit)
4	Partial Discharge Test
5	Lightning Test
6	Temperature Rise Test

Table 1

- To carry out a constructability test on the network, using a 300 kVA pole mounted transformer to directly replace the existing 200 kVA unit in situ, within weight, within limits of pole specification and with dimensions that facilitates mounting and connection on existing pole.

[1] The European Commission estimates that 2.9% of all energy generated across EU27 and the UK is wasted through transformer losses. This amounts to 93TWh which is equivalent to the electricity consumed in Denmark over three years.
The regulation applies to all transformers placed in the market or put into service in the UK and the EU. Commission Regulation (EU) No 548/20141 and Amendment (EU) 2019/17832 lay out Tier 2 requirements for transformers with a minimum power rating of 1 kVA used in 50 Hz electricity transmission and distribution networks or for industrial applications.

The EU Eco Design regulation for transformer losses Tier 2 will take effect from 1st July 2021 replacing Tier 1 regulation. Tier 2 specifications for transformer losses aspire to reduce the energy waste by 10% compared to Tier 1 (2015) levels.

3. CHANGES TO PROJECT (SCOPE / TIMELINES / DELIVERABLES / BUDGET / RESOURCES)

The initial scope of this project was to use one manufacturer to supply two 300 kVA Pole Mounted Transformers but at the start of the project it became clear that seeking units from the second supplier would also be possible without causing an unnecessary delay in the project. Therefore, the scope of the project was changed to using two manufacturers with each manufacturer supplying two 300 kVA Pole Mounted Transformers each. The remaining project was implemented in line with original scope.

Figure 1: Photographs of the 300 kVA pole mounted transformers from the two suppliers

The ESB Networks specification for Pole Mounted Transformers was altered to include the new 300 kVA transformer. ESB Networks have ordered a further 5 units each from both manufacturers. In line with procurement rules, both suppliers would then be invited to tender to supply future requirements of the 300 kVA transformer for the remaining duration of the term contract.

4. RESULTS

The first 300 kVA pole mounted transformer was successfully installed as a direct replacement of a 200 kVA pole mounted transformer at St Mary's Park in Carlow. It was installed on an intermediate 263 pole and there were no modifications required to the pole or the connections.

Figure 2: Pictures showing the installation of the 300 kVA pole mounted transformer

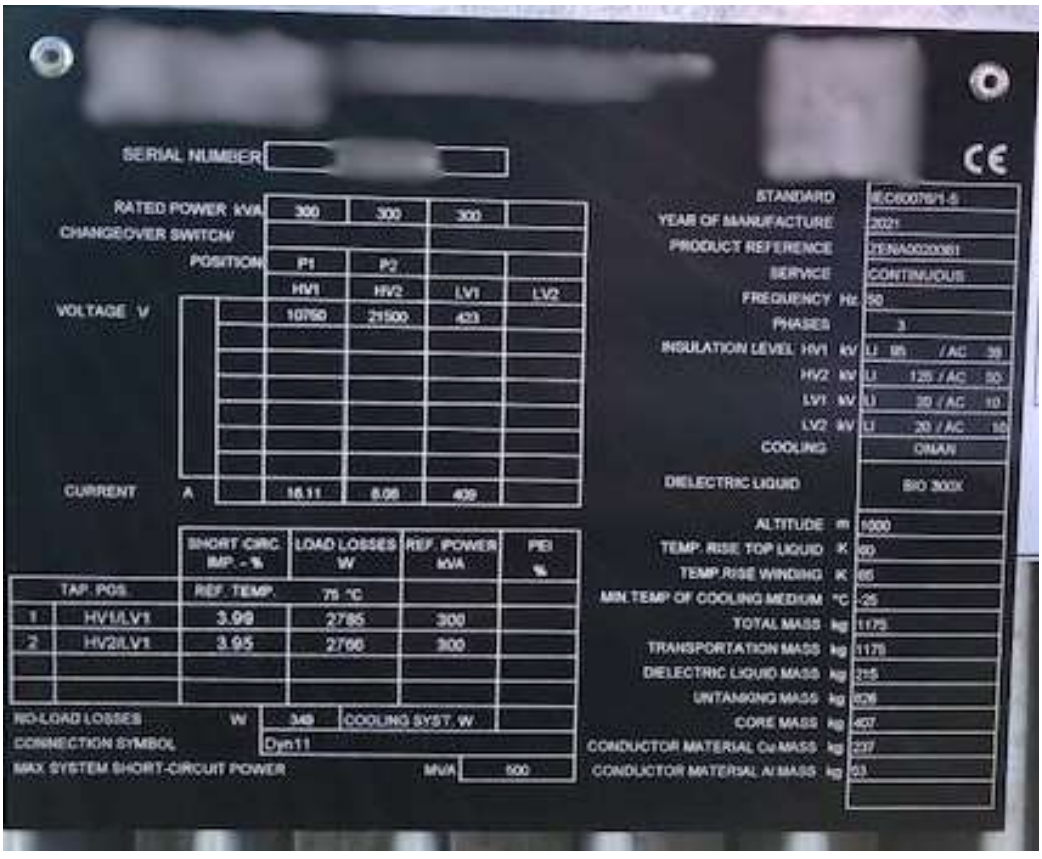

Figure 3: A picture of the nameplate of the installed 300 kVA pole mounted transformer

The unit from supplier B was damaged during transit so has since been returned to supplier B for repair.

5. LEARNINGS AND RECOMMENDATIONS

The first manufactured 300 kVA trial unit, from supplier A, was filled with mineral oil but failed the temperature rise type test. Therefore, to successfully pass the test, the manufacturer stated that the trial unit would have to be de-rated to 275 kVA. This was not acceptable to ESB Networks, so to ensure the trial transformer would be rated to 300 kVA it was then filled with Nytro Bio 300X oil. The temperature rise test was performed again and the transformer passed. To ensure any future units from this supplier would pass the temperature rise test, the current design would be used but the insulation would be changed to have thermal upgraded paper (Nomex 910) on the windings. The temperature rise test will be repeated on the first unit built as part of the term contract if supplier A is successfully chosen from the tender.

Supplier B also has successfully tested their transformer and have submitted the test results. This unit is filled with mineral oil.

6. BENEFITS REALISED

The 300 kVA pole mounted transformer provides a straightforward mechanism for uprating the typical rural village 200 kVA LV group by simply undergoing a direct change-out of the transformer for the 300 kVA pole mounted transformer. This will support ESB Networks to enable electrification of heat and transport and respective increases in loads on the LV Network.

7. FINAL TIMELINES

Purchase Order issued for trial units:	January 2021
Design:	December 2020
Prototype build:	July 2021
Type testing:	February & June 2021
Delivery:	September 2021
Energisation:	February 2022

8. NEXT STEPS – BAU / TRANSFER OF OWNERSHIP

Following the successful completion of this project, a formal handover meeting will be arranged with the business asset owner to transition this new transformer to Business as Usual (BAU).

Following a successful tender process, the process to bring any new item of plant into BAU in ESB Networks, must follow a robust materials introduction process.

A briefing document to alert all relevant stakeholders, that this new item of plant is now available for use will be drafted and circulated. An entry in the library of available options, will allow Design Engineering Officer's to choose this transformer as on option.