

1 **Q. (Reference Application, Schedule A, page 2)**  
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3 **It is stated "An independent assessment of the inspection results determined**  
4 **that the abnormal noise and temperature levels were likely caused by**  
5 **deterioration of the core lamination to lamination insulation. This is a rare**  
6 **condition that exposes MUN-T2 to a high probability of failure." (emphasis**  
7 **added)**  
8

9 **a) How "likely" is it that this "rare condition" is the cause of the abnormal**  
10 **noise and temperature levels?**

11 **b) How probable is it that this condition will lead to failure? What experience**  
12 **is there in the industry upon which to base this assumption?**

13 **c) What is the cause of this rare condition; i.e., materials defects,**  
14 **environmental, etc?**

15 **d) Has MUN-T1 been inspected to determine if it also has the rare core**  
16 **deterioration? Please provide inspection dates for the last five years.**  
17

18 **A. a)** Industry experience from Newfoundland Power's transformer consultant, van Kooy  
19 Transformer Consulting Services Inc. ("van Kooy"), identifies that the primary source  
20 of noise within a power transformer is from the core vibrating. With the evidence of  
21 core lamination to lamination insulation deterioration present in the internal  
22 inspection, it is evident that there is a reduced amount of insulation between core  
23 laminations. A decrease of insulation material will lead to additional core vibration  
24 producing increased noise levels.  
25

26 In addition to the abnormal noise level, power transformer MUN-T2 was also  
27 experiencing a higher than normal internal temperature. Heat within power  
28 transformers is typically produced by the core and windings. Low transformer  
29 loading and normal oil sampling results indicate that the windings are not the cause  
30 of excessive heat. Therefore, it can be deduced that the source of the excessive  
31 heat is the transformer core. Industry experience identifies that, as the core  
32 lamination to lamination insulation deteriorates, the heat produced increases.  
33

34 Van Kooy states: "*From this evidence I conclude that the core lamination to*  
35 *lamination insulation (Carlite) is deteriorating. This has led to the core producing*  
36 *more losses which in turn is creating more heat and more noise."*<sup>1</sup>  
37

38 No other potential failure mode has been identified to account for the abnormal  
39 noise and temperature levels.  
40

41 **b)** See part (d) of the response to Request for Information CA-NP-011.  
42

43 **c)** The cause of this rare condition is unknown. In order to determine the cause, the  
44 unit would need to be shipped to a third-party facility outside of the province for an  
45 internal assessment. This would require dismantling, de-tanking, removing the

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<sup>1</sup> See the *Application, Schedule B, Appendix C*, page 3.

1 windings and inspecting all internal components. Given this failure mode is rare and  
2 has not previously affected any of Newfoundland Power’s power transformers, the  
3 Company has not identified a need to commission this assessment.  
4

5 d) No, MUN-T1 has not undergone an inspection to determine if it is also experiencing  
6 core deterioration. Diagnosing core deterioration requires an internal inspection of a  
7 power transformer. This involves deenergizing the unit and partially draining the oil  
8 to inspect internal components. Internal inspections are rare and are typically  
9 completed only in response to suspected failures. This was the case for MUN-T2  
10 when it began exhibiting abnormal noise and temperature levels.  
11

12 The two MUN Substation power transformers are different designs purchased from  
13 different manufacturers at different times. MUN-T1 is not currently exhibiting any  
14 signs of failure that would warrant an internal inspection to examine the possibility  
15 of core deterioration.  
16

17 For information on the inspections completed over the last five years, see the  
18 response to Request for Information CA-NP-006.