Q. (Reference Application, 4.2 Mobile Hydro Plant Refurbishment, page 18)

It is stated "*Deferring the proposed refurbishment to a future year would increase the risk of failure of a major Plant component.*"

a) What is the probability of failure in 2023, 2024 and 2025 if the project is deferred? How does this compare to the probability of failure in past years; i.e., in 2021 or 2010?

b) If the probability of failure in 2023 were less than 10%, would it be economic to defer the project to a future year?

a) A condition assessment of the Mobile Hydro Plant identified numerous deficiencies within the plant that could jeopardize its safe and reliable operation going forward. This includes obsolete protection and control systems and antiquated switchgear. The generator is the oldest original single generator plant remaining in service in the Company's fleet of plants.[1]

Section 4.0 Risk Assessment of report *4.2 Mobile Hydro Plant Refurbishment* provides information from a statistical analysis of the lifetime of stator windings published by the Institute of Electrical and Electronics Engineers.[2] The analysis is based on industry experience. It shows that the average age of shellac-based windings is approximately 45 years, the leading causes of failure are aging and contamination of the windings, and the probability of generator failure increases with age.

Table 1 approximates the failure probabilities based on the age of the Mobile Hydro Plant generator for the requested scenarios using the statistical analysis described above.

Table 1
Failure Probability Based on Age of Mobile Generating Plant Shellac Stator Windings Over Equipment Lifetime

Year	Age (years)	Failure Probability[3]
2010	59	80%
2021-2025	70-74	88%-92%

1 See the *2023 Capital Budget Application,* report *4.2 Mobile Hydro Plant Refurbishment, Section 3.0 Condition Assessment.*

2 See C. Sumereder, *Statistical Lifetime of Hydro Generators and Failure Analysis*, *IEEE Transactions on Dielectrics and Electrical Insulation*, Vol. 15, No. 3, June 2008.

3 Failure probability is based on the age of the unit, not the specified year. For example, after 59 years, only 20% of the windings studied by C. Sumereder, 2008, would have neither failed nor have been replaced. Similarly, after 74 years, only 8% of windings studied would have neither failed nor have been replaced.

Based on the plant's age, condition and operating experience, Newfoundland Power has assessed the probability of failure to be likely if the *Mobile Hydro Plant Refurbishment* project were to be deferred.[4]

b) As per the statistical analysis described above, a probability of failure of less than 10% is consistent with stator windings having a lifetime of less than approximately 12 years old.[5] If a plant were to have a failure probability of 10%, it would likely be uneconomical to pursue a generator refurbishment as the unit would be expected to have many years of useful life remaining.

[4] See the *2023 Capital Budget Application, Schedule B,* page 117.
[5] See C. Sumereder, *Statistical Lifetime of Hydro Generators and Failure Analysis*, *IEEE Transactions on Dielectrics and Electrical Insulation*, *Vol. 15, No. 3*, *June 2008*.