Q. (Reference Application Schedule B, Lookout Brook Hydro Plant Refurbishment, Table 2, page 92) It is stated "*not proceeding with the Lookout Brook Hydro Plant Refurbishment project would pose a High (20) risk to the delivery of least-cost service to customers*."

a) Is the risk assessment in Table 2 relevant to this point in time, or 2024/25 when the project is completed, or some other time frame?

b) The risk assessment in Table 2 indicates that the consequence of failure is "critical (5)". What is the basis for the "critical" ranking? Has the consequence of failure changed in the past 3 years? Is the consequence of failure likely to change over the next 3 years?

c) The risk assessment in Table 2 indicates that the probability of failure is "likely (4)". Had the assessment been undertaken 3 years ago would the probability of failure have been ranked "likely"? Three years from now would the probability of failure continue to be ranked "likely" if plant maintenance continues and any failures that arise are addressed under programs designed to address in-service failures?

A. a) The risk assessment provided for the *Lookout Brook Hydro Plant Refurbishment* project is relevant for the plant at the current time. The risk assessment was completed following the inspection detailed in report *4.1 Lookout Brook Hydro Plant Refurbishment,* page 13.

b) A generator is a critical component of a hydroelectric plant. Failure of a generator in service would result in an extended period of lost generation while the generator is out of service. The replacement cost of a year's worth of lost generation from Lookout Brook G3 is estimated at $909,000.[1] In addition, an in-service failure of a generator could result in additional damage to other parts of the generator and auxiliary equipment identified as not requiring refurbishment in the condition assessment. For example, a generator failure could result in consequences such as fire or fusing of the laminated stator core. For these reasons, the consequence of failure is considered to be critical.

The consequence of failure for a hydro plant is not generally considered to change appreciably over its service life. The consequence of failure is largely a function of the plant design and environmental conditions, as well as the failure mode experienced.[2] A penstock or dam failure in the first year of life or in the 60th year of life will result in the same consequences.[3]

c) According to industry experience, insulation of the type used in Lookout Brook has an increased risk of failure after 60 years in service. While age is not the sole factor determining the need of refurbishment, extending the service life of these windings

[1] See Newfoundland Power's *2024 Capital Budget Application*, report *4.1 Lookout Brook Hydro Plant Refurbishment*, page 16.

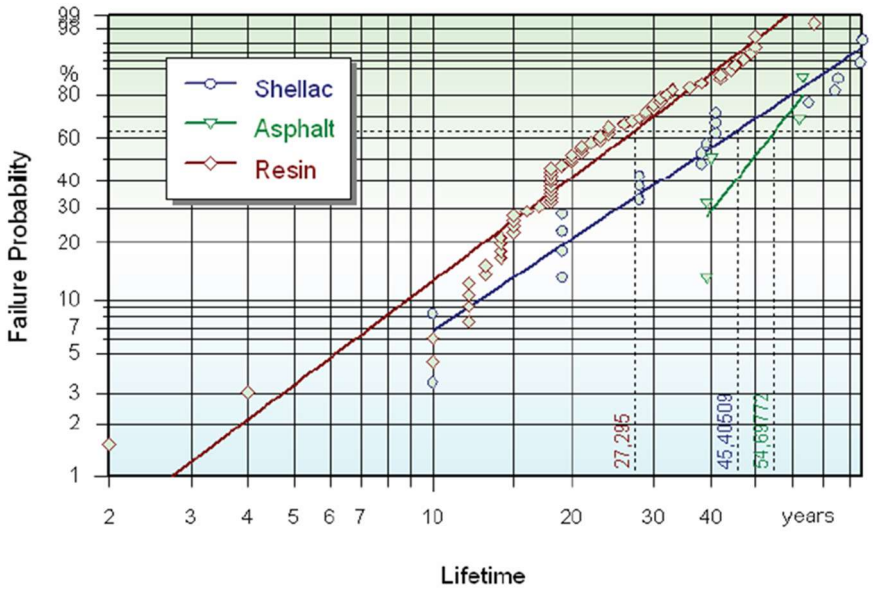
[2] For example, consider a penstock blow-out. A penstock located near a major highway or in close proximity to residential areas may have a higher consequence of failure in comparison to a penstock without those characteristics.

[3] See the response to Request for Information CA-NP-045 for a discussion of how Newfoundland Power performs risk assessments and consequence of failure as it relates to risk assessments.

is not considered good industry practice. Newfoundland Power's condition assessment identified deteriorated insulation, severe carbon contamination, and a high number of start-stop cycles during operation. For these reasons, the probability of failure is considered likely.

Figure 1 identifies the probability of failure for different generator insulation systems as presented in report 4.1.

Figure 1
Statistical Lifetime of Hydro Generators by Insulation System[4]



As the figure shows, all winding types experience a high probability of failure (>80%) in excess of 60 years of age. It is not expected that a significant variation in probability of failure will occur within any three year period. Newfoundland Power classifies probability of failure as likely when it is within a range of 76% to 90%.[5]

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

[5] See the response to Request for Information CA-NP-045 for more details about how Newfoundland Power assesses probability of failure.