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memo

Date: April 1, 2016

To: Joel Kanvik

From: Len Leblanc

Re: Line 5 Straits – Response on the Impact of Mussels

Joel,

Below is a summary of the e-mail correspondence I had with Cynthia Hansen, VP Operations regarding Pipeline Integrity's September 2015 assessment of the subject threat:

Cynthia, from our line 5 reputation meetings I owed you answers on the weight of the mussels and their impact on the integrity of the crossing. Let me know if further detail is required.

1. *Does the weight of the mussels have any impact on the safe operations of the pipeline or is the weight insignificant with the current safety margins?*

   Based on this it may be evaluated that by conservatively assuming that the pipeline is completely surrounded by mussels and they are 10mm diameter each, the weight of the mussels on the pipelines is approximately 24kg/m. By comparison the weight of the Straits pipeline including product is 420kg/m. Thus in consideration of the large safety margins when determining the allowable span length of 75' at the Straits, this mussel loading is evaluated to be negligible. To qualify for a 75' span the pipeline stresses are 39% 41% and 37% 39% of the ASME allowable longitudinal stress limit, with and without consideration of the mussel weight respectively. Furthermore assuming that the mussels exhibit a thickness of 10mm each, 20 layers of mussels would be required for the pipeline stresses to reach the ASME allowable longitudinal stress limit. The thickness of this 20 layers of mussels would be approximately 200mm. These calculations also demonstrate that the pipeline would be able to safely accommodate numerous layers of mussels if required.

2. *Does having mussels on the coating of the pipeline impair our ability to assess the impact of the mussels – cannot see that they are doing damage/ cannot see the condition of the coating – how can we assess the condition of the external coating?*

   The Line 5 Straits of Mackinac crossing pipelines are coated with a fiberglass reinforced asphalt enamel coating. This coating has performed very well to date as demonstrated by the low density of metal loss features in the line identified by ILI, and the minimal coating repairs evaluated as required following the bi-annual underwater inspections. Correspondingly direct assessment of the effects of mussels on the coating is not considered to be required because there is no indication that the mussels have caused notable damage to the coating or pipelines to date.

3. *Do the mussels damage the pipeline coating*

   Enbridge recently collected a sample of coating with mussels attached to it from the Straits of Mackinac pipelines. This coating sample was studied with the aid of a microscope. It was observed that the mussels were not penetrating or adversely impacting the pipeline coating

Regards,

Len Leblanc, Director Pipeline Integrity Systems