Q. **Refurbishment of Tank 2.**

With reference to Schedule 2, page 5, lines 11-13, please provide copies of all communications to and from the provincial regulator with respect to the “final extension” to June 2023 for the inspection of Tank 2.

A. For copies of all communications to and from the provincial regulator please refer to the following:

- IC-NLH-014, Attachment 1: Correspondence from TEAM Industrial Services dated February 19, 2021 recommending date of 2023.
- IC-NLH-014, Attachment 2: Correspondence Government of Newfoundland and Labrador dated March 1, 2021.
- IC-NLH-014, Attachment 3: Correspondence from Government of Newfoundland and Labrador dated March 5, 2021.
- IC-NLH-014, Attachment 4: Correspondence from Newfoundland and Labrador Hydro.
- IC-NLH-014, Attachment 5: Correspondence from Government of Newfoundland and Labrador dated March 23, 2021 confirming department acceptance of June 2023 for the next inspection interval.

TEAM® Industrial Services

19 February, 2021

Newfoundland and Labrador Hydro
Holyrood, NL

Attention:- **Ms. Joanne Norman**

Subject: **Tank No. 2 Inspection Interval**

Dear **Ms. Norman,**

We have conducted a review of the API Recommended Practice 575. The review of API RP 575 was recommended in an email response provided by the Department of Environment, Climate Change and Municipalities dated February 12, 2021, regarding the previously requested internal inspection interval for Tank No.2.

In API RP 575 Third Edition, Section 7.2 Condition-based Inspection Scheduling and Minimum Acceptable Thickness, an equation is provided to calculate the remaining life of a tank and its components. Please refer to the equation and defined variables below.

$$\text{remaining life (years)} = \frac{t_{actual} - t_{minimum}}{\text{corrosion rate}} = \text{the remaining life of a tank component in years,}$$

where

t_{actual} is the thickness measured at the time of inspection for a given location or component used to determine the minimum acceptable thickness, in inches (mm),

$t_{minimum}$ is the minimum acceptable thickness for a given location or component, in inches (mm),

$$\text{corrosion rate} = \frac{t_{previous} - t_{actual}}{\text{time (years) between } t_{previous} \text{ and } t_{actual}} = \text{in inches (mm) per year,}$$

where

$t_{previous}$ is the thickness at the same location as t_{actual} measured during a previous inspection, in inches (mm).

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Based on the available data from the Out-of-service inspection completed on Tank No.2 in 2008, we can complete the calculations as shown above to determine the remaining life of the tank floor.

The drawings for the original tank construction indicate that the tank floor was constructed from ASTM A 283 Grade C material. As per ASTM A 283/ ASTM A 6 Standards, the maximum permitted mill tolerance in thickness over nominal thickness for plate specified as 0.25in thick for widths up to 8'0", as utilized in the construction of the tank floor of Tank No.2 is 0.03in. We can use this maximum permissible thickness to calculate the worst-case corrosion rate that could have occurred between construction and the inspection completed in 2008. The MFL scanner used during the 2008 inspection was calibrated based on the nominal plate thickness of 0.25in. All percentage of discontinuities recorded by the MFL scanner were in relation to this nominal thickness used for calibration. Based on all areas with >40% discontinuities being repaired, the minimum remaining thickness following repairs, t_{actual} is as follows.

$$t_{actual} = 0.6 * t_{nominal}$$

$$t_{actual} = 0.6 * 0.25in$$

$$t_{actual} = 0.15in$$

$t_{minimum} = 0.10in$ (As per API 653, Table 4.4 – Bottom Plate Minimum Thickness)

$$t_{previous} = t_{nominal} + Max\ Mill\ Tolerance$$

$$t_{previous} = 0.25in + 0.03in$$

$$t_{previous} = 0.28in$$

$$corossion\ rate = \frac{0.28 - 0.15}{2008 - 1970}$$

$$corossion\ rate = \frac{0.13}{38}$$

$$corossion\ rate = 0.00342in/year$$

$$remaining\ life\ (years) = \frac{0.15 - 0.10}{0.00342}$$

$$remaining\ life\ (years) = 14.6$$

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If we add the remaining life to the date of inspection (November, 2008 = 2008.9) we get the following:

$$2008.9 + 14.6 = 2023.5$$

NLHydro has found a partial payment invoice that includes a line item for the supply and application of 1140 square feet of coating. NLHydro has also found documentation that confirms that 90 patch plates were installed on the floor of Tank No.2. This amount of coating would correlate with the installation of 90 patch plates on the floor, along with any touch ups that would have been required at that time. Confirmation that the floor was coated after the installation of the patch plates establishes a continuity of floor coatings which allows the projection of a linear rate of corrosion.

Based on the confirmation that the coating was applied on the patch plates and the calculation following API RP 575 Section 7.2, it is our recommendation that Tank No.2 remain in service through June, 2023.

Derrick French, P.Eng., IWE

Senior Mechanical Engineer

REGISTERED PROFESSIONAL ENGINEER
PEG Newfoundland and Labrador
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
DERRICK FRENCH
SIGNATURE
22/FEB/2021
DATE
NEWFOUNDLAND & LABRADOR

PROVINCE OF NEWFOUNDLAND AND LABRADOR
pegnl PROFESSIONAL ENGINEERS & GEOSCIENTISTS NEWFOUNDLAND & LABRADOR
PERMIT HOLDER
THIS PERMIT ALLOWS
Custom Fabricators And Machinists Limited (CFM)
To practice Professional Engineering in Newfoundland and Labrador.
Permit No. as issued by PEG 52798
which is valid for the year 2021
by Permit Holder (MIRC No.) 02869

Newfoundland Labrador

Government of Newfoundland and Labrador
Department of Environment, Climate Change and Municipalities
Pollution Prevention Division

March 1, 2021

Ms. Tracy Smith, P.Eng.
Manager - Safety, Health & Environment
Newfoundland and Labrador Hydro
P.O. Box 29, Holyrood, NL
A0A 2R0

Dear Ms. Smith:

RE: Tank No. 2 Inspection Interval

The Department has reviewed the letter from TEAM Industrial Services dated February 19, 2021, regarding the application of the API Recommended Practice 575 to the internal inspection interval for Tank No.2 at the Holyrood Thermal Generating Station. We now offer the following questions and comments.

As a point of clarity, it is important to note that while it has been suggested that consideration might be given the application of API RP 575 as an alternative approach for assessing the next inspection interval, relying solely on this Recommended Practice would not be appropriate. As noted in Section 1 of API RP 575, this Recommended Practice is intended to supplement API 653, which provides minimum requirements for maintaining the integrity of storage tanks after they have been placed in service. The intent of suggesting API RP 575 as an alternative was to suggest that certain aspects of this Recommended Practice may provide alternate interpretation that would complement API 653.

As discussed during the meeting of February 25, 2021 the calculations provided in the letter are from Section 7.2 of the 2014 version of API RP 575. The 2020 version of this Recommended Practice no longer has these calculations. The 2020 version further notes (in Section 7.2.2) that there can be different corrosion rates for the internal and external side (product-side and soil-side for bottoms) of the components, which the MRT calculation in section 4.4.5 of API 653 takes into account. We note that in the event that floor coating is in place, this consideration would be addressed as the MRT calculation would simplify to the same calculation noted in TEAM's letter. It was noted in the letter that NL Hydro has found a partial payment invoice that includes the supply and application of 1140 square feet of coating, and that documentation has been found regarding the 90 patch plates. Can you please forward this documentation to the Department?

As also discussed during our meeting, issues around the annular ring need be addressed. The pressure or stress is greatest at the bottom in this floor shell region. By definition, the portion of the tank bottom or annular plate within 3" of the inside edge of the shell, measured radially inward is considered the critical zone. It is at this point that a catastrophic failure could occur. In section 1.3 (Floor/Shell Region) of the 1998 FGA Canspec report, issues were raised concerning the internal floor shell region. It was indicated that there was considerable pitting in that area. To our knowledge, the MFL scanner does not normally have the ability to measure in that area. Can you please confirm? Could you also indicate whether thickness measurements were taken in the critical zone, and if so please provide the results? If no thickness measurements were obtained in 2008, could you please provide commentary on how the concerns with respect to the annular ring may be addressed?

During the meeting, it was asked whether the MFL equipment used in 2008 had the ability to detect and distinguish between uniform and pitting corrosion. Please confirm. It is also noted in Section 7.2.3 of API RP 575 (2020 version) that cathodic protection would influence the corrosion rate. Could you please indicate whether tank 2 has, or ever had, cathodic protection?

The Department will be in a position to further evaluate the extension request once we have this additional information. Please feel free to contact me should you have any questions or require further clarification on this matter.

Sincerely,

Dexter Pittman Digitally signed by Dexter Pittman
Date: 2021.03.01 18:17:55 -03'30'

Dexter Pittman, P. Eng.
Manager of Environmental Compliance

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Newfoundland Labrador

Government of Newfoundland and Labrador
Department of Environment, Climate Change and Municipalities
Pollution Prevention Division

March 5, 2021

Ms. Tracy Smith, P.Eng.
Manager - Safety, Health & Environment
Newfoundland and Labrador Hydro
P.O. Box 29, Holyrood, NL
A0A 2R0

Dear Ms. Smith:

RE: HTGS Tank No. 2 Inspection Interval

Thank you for your letter and corresponding supporting documentation as provided on March 4, 2021. That information along with yesterday's group discussion has been very helpful to progressing our review of the Tank No. 2 inspection interval. We have since reviewed all information provided and now wish to provide the following.

The Department concurs that there is sufficient supporting documentation to indicate that a bottom coating was applied in 2008. TEAM have previously indicated that the volume of coating applied would correspond to the amount needed for the installation of 90 patch plates. However, during our meeting yesterday it was noted that there appears to be some confusion regarding the applicability of a supporting document to the installation of these plates in Tank No. 2. Could you please clarify? If there was an error in this documentation, could you please provide supporting documentation for how many patch plates were installed?

The information and explanation provided has confirmed that the MFL scanner had the ability to detect both general and pitting corrosion. It was also confirmed that the MFL scanner could scan in the critical zone, with the exception of the 1 inch area closest to the shell. Can you please provide commentary as to whether there are any concerns regarding this 1 inch area?

During the meeting, a discussion took place with respect to calculating a corrosion rate based on the data obtained in 1998 and 2008. Can you please advise why the corrosion rate calculations provided in TEAM's letter of February 19, 2021, were taken over a time interval of 38 years and not 10 years? Would it be feasible and relevant to calculate a corrosion rate based on direct comparison of the data obtained in 1998 and 2008? As noted during the meeting, should a 10-year corrosion rate calculation be feasible and yield a less aggressive corrosion rate, the previously provided corrosion rate should be applied so as to err on the side of caution.

Newfoundland Labrador

Please contact me should you wish to discuss further.

Sincerely,

Dexter Pittman Digitally signed by Dexter Pittman
Date: 2021.03.05 15:04:24 -03'30'

Dexter Pittman, P. Eng.
Manager of Environmental Compliance

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Mr. Dexter Pittman P.Eng
Manager of Environmental Compliance
Pollution Prevention Division
Department of Environment, Climate Change and Municipalities
Government of Newfound and Labrador
PO Box 8700, St. John's NL A1B 4J6

Dear Mr. Pittman

RE: Tank 2 Inspection Interval

We have reviewed the information in your letter dated March 5, 2021 regarding Tank 2 inspection interval. We have summarized your questions with supporting documentation for clarification as follows;

1. **Department of Environment, Climate Change and Municipalities (ECCM):** Supporting documentation to the installation of plates in Tank 2.

   Holyrood Thermal Generating Station (HTGS) Response: Please see Attachment #1: Tank 2 – Patch Plate Installation Confirmation 032021 and Attachment #2: Tank 2 – Vacuum Test Confirmation 032021.

   Note: A Vacuum Test is only conducted after completing of patch plate welding.

2. **ECCM:** It was confirmed that the MFL scanner could scan in the critical zone, with the exception of the 1" area closest to the shell. Please provide commentary as to whether there are any concerns regarding the 1" area.

   TEAM Response: The critical zone is defined as "The portion of the tank bottom or annular plate within 3 inches of the inside edge of the shell, measured radially inward." Thus, 2/3rds of the accessible areas of the critical zone were scanned with only two localized pits being found and repaired. The critical zone was sandblasted and recoated in 1998, and was visibly noted in 2008 that the coating was still in good condition. Stress analysis calculations were completed on the critical zone, and it was determined that if t_{min} of the critical zone went to code minimum of 0.1", it would not be over stressed. See Attachment #3: HTGS Annular Ring Calculation (TEAM) 032021. Based on this there should be no reason to have any concerns in the critical zone for the proposed extension interval.

3. **ECCM:** Can you please advise why the corrosion rate calculation was taken over a time interval of 38 years and not 10 years?

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TEAM/HTGS Response: There has been no replacement of the floor plates or significant repair prior to the 2008 MFL on Tank 2. Since the floor was original, this would justify using a corrosion rate based on 38 years.

If the corrosion rate was to be based on 10 years (1998-2008), the result would be artificially aggressive. It assumes over the 38 years of the tank floor life, all corrosion leading up to 2008 happened in just 10 years. This would not be a standard practice given the data that has been collected from the tank. During the 1998 inspection, there was measurable corrosion but not above the designated threshold to warrant repairs. There was one patch plate installed over an isolated pit. The MFL scan results from 2008 are available, and given the known age of the floor plates during this scan and the original new floor thickness (with maximum mill tolerance applied to assume worst case), it is reasonable to determine a rate of corrosion using the latest readings and over 38 years.

We would like to highlight that the corrosion rate, as calculated under the API 653 code, assumes linear corrosion. Corrosion is more aggressive during the early years when the floor plates were newly installed, and the rate slows down as an oxidizing layer of rust forms. Assuming a linear corrosion pattern over the entire life of the floor produces a more aggressive corrosion rate than the actual rate in later years because of the natural decrease in corrosion over time is not accounted for. In addition significant upgrades to the tank farm drainage system were completed in 2009, which further slowdown the rate of corrosion.

4. **ECCM:** Would it be feasible and relevant to calculate a corrosion rate based on direct comparison of the data obtained in 1998 and 2008?

   TEAM/HTGS Response: No it is not feasible. The exact locations where UT test results were obtained in 1998 cannot be matched with the UT test results from 2008, but we can compare the average results. The average UT results taken from readings on each plate in 2008 showed no material loss when compared to the average UT readings taken in 1998.

   To further clarify, the MFL data collected in 2008 for each floor plate is not loss over the entire plate. Further review of the detailed MFL for an individual plate shows there was only localized loss, with 98% of the plate having negligible corrosion.

We appreciate your time and consideration of our request regarding Tank 2 inspection interval.

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Sincerely

Tracy Smith

Tracy Smith P.Eng
Manager; Safety, Health & Environment
Cc

Jeff Vincent P.Eng., Senior Manager - Thermal Production
Scott Crosbie P.Eng., Director of Operations – NL Hydro

.

Newfoundland Labrador

Government of Newfoundland and Labrador
Department of Environment, Climate Change and Municipalities
Pollution Prevention Division

March 23, 2021

Ms. Tracy Smith, P.Eng.
Manager - Safety, Health & Environment
Newfoundland and Labrador Hydro
P.O. Box 29, Holyrood, NL
A0A 2R0

Dear Ms. Smith:

RE: HTGS Tank No. 2 Inspection Interval

The Department has thoroughly reviewed all information provided to date by NL Hydro and TEAM Industrial Services (TEAM) regarding the next internal inspection date for Tank No. 2 at the Holyrood Thermal Generation Station.

TEAM's recommendation to extend the date of the next API-653 out-of-service inspection of this tank to June 2023 is acceptable to the Department. As previously indicated by NL Hydro, annual in-service inspections of the tank shall be performed in the interim.

We trust this is satisfactory.

Sincerely,

Dexter Pittman Digitally signed by Dexter Pittman
Date: 2021.03.23 16:01:30 -02'30'

Dexter Pittman, P. Eng.
Manager of Environmental Compliance