TECHNICAL MEMORANDUM

DATE April 20, 2015   **REFERENCE No.** 1416711-009-TM-Rev0

TO Nathan Gloag
Woodfibre LNG Limited

CC Sarah Bowie

FROM Dennis Chang, Frank Wimberley   **EMAIL** dennis_chang@golder.com;
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WOODFIBRE LNG - RESPONSE TO FOLLOW-UP REQUESTS FOR INFORMATION REQUEST #53A AND #53B

1.0   INTRODUCTION

This memorandum provides the additional information requested within Information Request #53a and #53b from the BC Ministry of Environment (BCMOE). A memo (Reference No. 1416711-002-TM-Rev1) containing the proponent's response to Information Request #53A and #53B was submitted to the Hemmera Envirochem Inc. (Hemmera) on April 9, 2015. Based on the responses provided in that memo, BCMOE submitted the following additional requests:

"*In the attachment memo Response to Comment 53a, did they apply the 55% radiant heat loss to the parameter THR (as specified in Section 11.1.1.1)? I have asked for them to supply a list of modelling files, and to date I have not received them. Could you ask the proponent when I might receive them?*"

The responses to these additional requests from BCMOE are provided in the following sections.

2.0   FLARE PSEUDO STACK PARAMETERS AND 55% RADIANT HEAT LOSS

As stated in the memo dated April 9, 2015, the pseudo stack parameters for the flares at the project were calculated using the methods outlined in Section 11.1.1.2 of the *Guidelines for Air Quality Dispersion Modelling in British Columbia* (British Columbia Ministry of Environment, March 2008) [BC Modelling Guideline]. The equations specifically used for determining flare pseudo stack height and diameter are:

$Effective\ flare\ height\ [m] = HSTK + 0.00456 \times THR^{0.478}$ (Equation 1)

$Pseudo\ Flare\ Diameter\ [m] = 0.000663\sqrt{THR}$ (Equation 2)

Where:

HSTK = Physical Stack Height in metres [m]

THR = Total Heat Release [cal/s]

Section 11.1.1.1 of the BC Modelling Guideline, states that the USEPA SCREEN3 dispersion model assumes that 55% of the total heat release from a flare flame is lost as radiant heat loss and only 45% of the total heat release is available for plume rise. This is based on a study by Leahcy and Davies (1984). In order to demonstrate that Equations 1 and 2 above also incorporate the same sensible heat assumption adopted in the SCREEN3 model, we looked into the effective diameter calculation for flares in the SCREEN3 model, which is represented by Equation 3 (US EPA 1995) below.

$$d_s = 9.88 \times 10^{-4}\sqrt{Q_H} \quad \text{(Equation 3)}$$

Where:

d_s = effective or pseudo stack diameter [m]

Q_H = sensible heat [cal/s]

Applying the assumption that 45% of the total heat release is sensible heat and substituting Q_H with Q_H = 0.45THR, where THR is the total heat release, Equation 3 becomes:

$$d_s = 9.88 \times 10^{-4}\sqrt{0.45THR} \text{ or } d_s = 9.88 \times 10^{-4} \times \sqrt{0.45} \times \sqrt{THR} \text{ (Equation 4)}$$

By solving the calculations preceding $\sqrt{THR}$, Equation 4 becomes:

$$d_s = 0.000663\sqrt{THR} \text{ (Equation 5)}$$

Equation 5 is identical to the pseudo stack diameter equation (Equation 2) provided in Section 11.1.1.2 of the BC Modelling Guideline. The above calculations demonstrate that the factor representing 55% radiant heat loss is already incorporated into the pseudo stack diameter calculation from the BC Modelling Guideline. Since Equation 1 and Equation 2 need to be used together to obtain corresponding pseudo stack height and diameter based on the total heat release (THR), it can be assumed that Equation 1 also includes the assumption of 55% of total heat release is radiant heat loss. Therefore, an additional 55% factors does not need to be applied to total heat release (THR) when using Equations 1 or 2 in the pseudo stack parameter calculations. The pseudo stack parameter calculations for Project's flares in the Environmental Assessment are thus correct.

3.0 DISPERSION MODELLING

The requested model input and output files will be provided to BC MOE in a portable hard drive. The files to be provided are based on the Environmental Assessment as well as the test run for the winter geophysical parameters described for the April 9, 2015 memorandum. Please see the readme.docx on the hard drive for a list and the folder structure of all files provided.
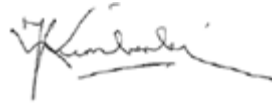
4.0   CLOSURE

We trust the above information provides that requested from Environment Canada in Information Request 53a and 53b and that no further action is required at this time.

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