Stantec

Memo

To:	Marilyn Carpenter Prince Rupert Gas Transmission Ltd.	From:	Reid Person and Pam Hayward Stantec Consulting Ltd.
File:	123220064	Date:	July 7, 2017

Reference: Construction Camp Waste Incineration Emissions for the Prince Rupert Gas Transmission Project

BACKGROUND

On January 26, 2017, Prince Rupert Gas Transmission Ltd. submitted a Request for Amendment to EAC #E14-06 – Schedule A to the BC Environmental Assessment Office (EAO. This amendment was for the addition of two main spread construction camps and the addition of a standby compressor unit at each compressor station. During review of this amendment, PRGT received an information request from the Environmental Assessment Office (EAO) and the Ministry of Environment (MOE) regarding waste disposal at the camps (i.e., waste incineration). Confirmation was requested regarding the quantity of waste expected at a camp (after removal of recyclables etc.) as well as details on the typical incineration technology that may be used, what corresponding emission rates would be expected compared to a compressor station. This memorandum summarizes the requested construction phase waste incineration information for a single camp.

PRGT PROJECT INCINERATION DETAILS

In the Application for an Environmental Assessment Certificate (the Application), a typical PRGT Project construction camp was estimated to have a peak population of 1,100 and generate a maximum of 46 tonnes of waste per month.

Incineration is recognized as an effective and environmentally sound disposal method of construction camp waste and is routinely used at construction camps across Canada. Construction camps of 100 or more persons planning to incinerate waste require an Authorization under the BC *Environmental Management Act* to authorize air emissions from the incinerator. A construction camp that proposes to combust more than 400 kg of waste per hour is required to meet the Emission Limits for Municipal Solid Waste Combustion Facilities in British Columbia.

The two new camps proposed in the Amendment noted above, may use an incinerator to burn refuse associated with operation of the construction camps. The manufacturer and specific model of the incinerator has not yet been determined; however, the incinerator will have a capacity of less than 400 kg/hr of waste. The following information is based on a typical batch type waste incinerator similar to the Ketek CY-100 incinerator. Batch waste incinerators are those that operate in a non-continuous manner. They are loaded (charged) with waste prior to the starting combustion and the door remains closed until completion of the burn cycle. The proposed incinerator will meet the requirements in the Environment Canada and Climate Change Technical Document for Batch Waste Incineration (Environment Canada 2000).

The Ketek CY100 incinerator has a maximum waste incineration capacity 75 kg/hr. The incinerator is designed with two chambers: the primary loading and combustion chamber and a secondary residence chamber. The incinerator will use diesel or natural gas as a supplemental fuel.

The incinerator includes numerous safety systems to prevent unsafe or inappropriate operation of the equipment including mechanical limit switches to prevent overloading, door locks, and high temperature shutdown.

The waste will be weighed and loaded into the incinerator consistent with manufacturer recommendations. The operator will observe the initial burn period to ensure the volatility of the waste is not creating too much gas in the primary combustion chamber for the secondary chambers to handle. The combustion rate of the waste will be controlled to achieve correct combustion temperature and residence time in the incinerator to completely burn the waste consistent with the manufacturer operating instructions. After the incinerator has completed the burn cycle and cooled down, the operator will remove and dispose of ash before reloading the incinerator for the next burn cycle.

INCINERATOR EMISSIONS

Emissions of air contaminants from batch waste incinerators are a function of the design and operation of the equipment, and the nature of the waste materials being incinerated. The incineration of waste is a rapid oxidation process that generates heat and converts the waste to the gaseous products of combustion which are carbon dioxide and water vapour. Incombustible materials in the waste result in the formation of ash. The primary contaminants emitted by a camp waste incinerator are criteria air contaminants: particulate matter (PM), nitrogen oxides (NO_X), carbon monoxide (CO) and volatile organic compounds (VOC). Emissions of sulphur dioxide (SO_2) are also present and depend upon the sulphur content of the waste material. PM emissions from incineration are all in the $PM_{2.5}$ size category.

Waste incinerators are designed to ensure adequate mixing of combustion gases and air and to ensure sufficient residence time through the primary and secondary chambers to minimize potential formation of products of incomplete combustion such as CO, VOC, or compounds such as polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (commonly known as dioxins/furans). Dioxins and furans can be generated by poorly designed or poorly operated incinerators; however, when combustion and exhaust gas temperatures are maintained above 600°C, dioxin and furans will be destroyed.

Consistent with Environment Canada's Technical Document for Batch Waste Incineration, the incinerator selected for the PRGT Project will be designed to release stack gases directly to the atmosphere at temperatures greater than 700°C to ensure that dioxin and furan emissions are negligible. Stack sampling for the Ketek CY-100 incinerator indicates an exhaust temperature of more than 1,000°C. Stack sampling completed for the Ketek CY-100 incinerator while burning typical worker camp waste consisting of food and paper waste is summarized in Table 1. Measured dioxin/furan and mercury concentrations in the exhaust gases are less than the Canada-Wide Standards for dioxins/furans and mercury for waste incineration.

In a batch incinerator such as the Ketek CY-100, the waste material is loaded onto a solid surface referred to as the hearth. The initial heat required to ignite the waste is supplied by a burner using diesel or natural gas. The incinerator control system controls the rate at which fuel and air are input to maintain ideal combustion temperatures.

Reference: Construction Camp Waste Incineration Emissions for the Prince Rupert Gas Transmission Project

Table 1 Typical Emission Factors Camp Waste Incinerators

Contaminant	Units	Emission Rate[a]
$PM_{2.5}$	mg/sm^3 [b]	27
CO	mg/sm^3 [b]	37
NO_X	mg/sm^3 [b]	66
SO_2	mg/sm^3 [b]	21
Hg [d]	$\mu g/sm^3$ [b]	1.16
HCl	mg/sm^3 [b]	1.2
PCDD and PCDF TEQ [c]	ng/sm^3 [b]	0.029
O_2	%	8
CO_2	%	12
H_2O	%	10

NOTES:

[a] Based upon information from Ketek for combustion of typical mixed waste for Model CY-100 and CY-20150 incinerators.

[b] Emission factors corrected to 11% O_2, 25 °C, and 1 atmosphere

[c] Emissions of dioxin/furans less than the CWS of 0.080 ng I-TEQ/Rm^3

[d] Emissions of mercury less than the CWS of 20 µg/Rm^3

EMISSION RATES

Emission rates from the incinerator were estimated based upon the manufacturer estimated emission rates and quantity of waste produced by the PRGT camp based upon the Ketek CY-100 incinerator. For purpose of the emission calculations, it is assumed that waste is continuously incinerated at the maximum rated capacity of the waste incinerator of 75 kg/hr. The 75 kg/hr assumption is equivalent to incinerating 54 tonnes/month and is therefore a conservative estimate of emissions from the camp, based on the assumptions from the Application. The pollutant emission rates are summarized in Table 2.

Reference: Construction Camp Waste Incineration Emissions for the Prince Rupert Gas Transmission Project

Table 2 Emission Parameters Associated with Camp Incineration

Parameter	Units	Values
Waste Combustion Rate	kg/hr	75
Exhaust Parameters		
Exhaust Flow Rate [a]	sm^3/min	55
Exhaust Temperature	°C	1045
Emission Rates [b]		
$PM_{2.5}$	kg/hr	0.12
CO	kg/hr	0.17
NO_X	kg/hr	0.30
SO_2	kg/hr	0.095
Hg	kg/hr	5.3E-06
HCl	kg/hr	0.0054
PCDD and PCDF TEQ	kg/hr	1.3E-10

NOTES:

[a] Exhaust flow rate obtained from stack test for Ketek CY-100 incinerator burning 27 kg/hr of waste. Scaled to 75 kg/hr.

[b] Emission rates calculated using emission factors in Table 1.

The camp waste incinerator is estimated to emit 0.12, 0.17, 0.30 and 0.095 kg/hr of $PM_{2.5}$, CO, NO_X and SO_2 respectively. Annual emission rates associated with camp waste incineration are calculated assuming the incinerator operates continuously at a maximum capacity of 75 kg/hr. A camp may be in operation over a period of three to four years during construction, however would likely be operating a peak capacity for only one year. Emissions from waste incineration are compared to the Operations Phase emissions of a compressor station (which operates for 40 years) for the PRGT Project in Table 3.

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Table 3 Emission Rate Comparison

Contaminants	Unit	Camp Waste Incinerator	PRGT Project Emissions from a Single Compressor Station	Percent Incinerator Emissions Compared to Project
CO	t/y	1.5	159	1%
NO_X	t/y	2.6	119	2%
SO_2	t/y	0.83	5.1	16%
$PM_{2.5}$	t/y	1.1	0.6	183%

NOTE:
[a] Operation phase emissions from Table E3-6, Section E.3, Appendix E-3, Detailed Emission Inventory.

The estimated waste incinerator emissions for a construction camp are estimated to be 1%, 2%, 16.0% and 183% of estimated emissions from a typical compressor station during operations of CO, NO_X, SO_2, and $PM_{2.5}$ respectively. It should be noted that the particulate emissions ($PM_{2.5}$) from incineration is higher than that from a compressor station because compressor station emission sources burn natural gas resulting in very low Project particulate emissions.

CONCLUSIONS

The estimated emissions for the Project have been very conservatively estimated, as emissions were estimated based on the maximum throughput of the incinerator which is 8,000 tonnes/month higher than required for an 1,100 person camp, actual camp size will vary from 225 to 1,100 workers. Emissions of CACs associated with incineration have been quantified and compared to emissions associated with the Operations phase of the PRGT Project. The maximum estimated emission rates associated with a typical waste incinerator at a construction camp are overall much less than emissions associated with a compressor station during the Operational Phase of the Project.

The proposed incinerator will meet the requirements in the Environment Canada and Climate Change Technical Document for Batch Waste Incineration and comply with the Canada Wide Standard emission limit for dioxin/furans and mercury. In addition there is a permitting process in place pursuant to the BC *Environmental Management Act* and *Oil and Gas Activities Act*. PRGT will consult with the BC Ministry of Environment on the requirements for air emissions permitting prior to operating a camp incinerator.

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