TETRA TECH

APPENDIX F

AIR DISPERSION MODELING REPORT

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Introduction

Cabot is proposing to construct a cesium formate pilot plant at Tanco's existing mining/milling operation at Bernic Lake, Manitoba, Canada. This document details the procedures used in modelling the different sources of air emissions at the facility. The pollutants emitted at the facility are carbon monoxide (CO), nitrogen oxides (NOx), hydrogen sulfide (H_2S) and suspended particulate matter (PM). The emissions are minor in nature but are modelled for purposes of comparing maximum predicted ground level concentrations with Maximum Acceptable Level Concentrations (MALC) as specified by Manitoba Environment Ambient Air Quality Guidelines.

Dispersion Model

The latest version of the SCREEN3 model was used to estimate maximum ground level concentrations of each of the pollutants from the different sources. The SCREEN 3 model is an U.S Environmental Protection Agency (EPA) approved air dispersion model that predicts extremely conservative ground level concentrations as compared to the other refined models. SCREEN3 is accepted as an approved screening level model in Manitoba Environment's Draft Protocol for Air Dispersion Modelling.

Meteorology

SCREEN examines a range of stability classes and wind speeds to identify the "worst case" meteorological conditions, i.e., the combination of wind speed and stability that results in the maximum ground level concentrations. The wind speed and stability class combinations used by SCREEN are given in the table below. The 10-meter wind speeds given in the table are adjusted to stack height by SCREEN using the wind profile power law exponents of the US EPA's screening procedures document. For release heights of less than 10 meters, the wind speeds listed in the table are used without adjustment.

Wind Speed and Stability Class Combinations

Stability Class	10-meter Wind Speed (m/s)												
	1	1.5	2	2.5	3	3.5	4	4.5	5	8	10	15	20
A	*	*	*	*	*								
B	*	*	*	*	*	*	*	*	*				
C	*	*	*	*	*	*	*	*	*	*	*		
D	*	*	*	*	*	*	*	*	*	*	*	*	*
E	*	*	*	*	*	*	*	*	*				
F	*	*	*	*	*	*	*						

The "full meteorology" option which examines all six stability classes and their associated wind speeds was used in the modelling analysis.

Downwash

Each of the sources at the facility were evaluated in terms of their proximity to nearby structures. The purpose of this evaluation is to determine if the stack discharge might become caught in the turbulent wake of structures leading to downwash of the plume. The wind blowing around a building or structure creates zones of turbulence that are greater than if the building were absent. This in turns causes greater ground level concentrations at lesser distances from the source than if normal dispersion were to take place.

A structure influences the emissions from a source if the source is located within 5L of it. "L" is defined as the lesser of the height or the maximum projected width of the structure. Stacks located at a distance greater than 5L are not subject to the wake effects of the structure. Based on this approach the cesium plant building was identified as the dominant structure that influences the emissions from all sources.

Modelling Methodology

The following methodology was used to perform modelling:

1. Based on the topography of the area surrounding the plant, rural option for the dispersion mode was chosen in the modelling analysis. It should also be noted that there are no other inhabitants on the lake other than TANCO. The closest cottages to the facility are at least 4 miles away.
2. The shortest distance to the nearest property line was 0.5 miles (800 meters).
3. The worst case meteorology ("full meteorology" option in SCREEN3) was used. An ambient temperature of 2 °C, which is the annual average temperature at Pinawa, was used in the analysis.
4. The terrain around the facility is generally flat with a difference in elevation of about 25 feet with most of the gradient change occurring within the property boundary. Therefore the simple terrain option was chosen in the modelling analysis.
5. The cesium plant building was used as the structure influencing downwash for all sources as can be seen from the attached plot plan. The dimensions of the building used in the modelling were:
   Height - 22 meters
   Minimum Width - 30 meters
   Maximum Width - 45 meters
6. One hour CO concentrations determined by the model were converted to 8-hour concentrations using a factor of 0.7 as per the U.S. EPA's guidance.
7. One hour NOx concentrations determined by the model were converted to 24-hour and annual concentrations using factors of 0.4 and 0.1 respectively, as per the U.S.EPA's guidance.
8. One hour H_2S concentrations determined by the model were converted to 24-hour concentrations using a factor of 0.4 as per the U.S.EPA's guidance.

9. One hour PM concentrations determined by the model were converted to 24-hour and annual concentrations using factors of 0.4 and 0.1 respectively, as per the U.S.EPA's guidance.
10. The maximum concentrations from each of the sources, irrespective of which receptor the maximum occurred at, were added to give an overall maximum that was compared to the standard. This extremely conservative approach was used even though in reality such a situation is not possible.

Model Input Data

The table below lists the input parameters to the SCREEN3 model. Since all of the sources are new, the input parameters are based on the current available manufactures data.

Source	Emission Rate		Height		Diameter		Velocity		Temperature	
Name	(lb/hr)	(gm/s)	(Ft)	(m)	(Ft)	(m)	fps	m/s	F	K
Carbon Monoxide										
Boiler	3.125	0.394	81	24.689	2.00	0.610	34.975	10.660	393	473.71
Water Heater	0.250	0.032	75	22.860	1.33	0.405	--	0.82	374	463.15
Formic Acid Tank*	*Negligible Emissions*									
Nitrogen Dioxide										
Boiler	3.615	0.455	81	24.689	2.00	0.610	34.975	10.660	393	473.71
Water Heater	0.290	0.037	75	22.860	1.33	0.405	--	0.82	374	463.15
Hydrogen Sulfide										
Barium Tank**	0.320	0.040	35	10.698	0.50	0.152	46.70	14.234	104	313.15
Suspended Particulate Matter										
Ore Hopper	0.094	0.012	75	22.860	0.67	0.203	26.00	7.925	36	275.15
Lime Silo***	0.094	0.012	78	23.899	0.67	0.203	26.00	7.925	36	275.15

*Intermittent emission of carbon monoxide occur over 5-minute intervals.
**The maximum emission rate (not the average) of hydrogen sulfide was used in the modelling analysis.
***Lime is in the form of pebbles but is conservatively modelled as particulate matter.

Modelling Results

Results of the modelling are shown in the table below and compared to the Maximum Acceptable Level Concentrations (MALC) listed in the Manitoba regulations. The outputs from the SCREEN3 model are shown in the attachment. The converted concentrations reflect the concentrations obtained by multiplying the modeled 1-hour concentrations with the approved EPA factors which are 0.7 for 8-hour concentrations, 0.4 for 24-hour concentrations, and 0.1 for annual concentrations.

Modelling Scenario	Modelled 1-Hour Concentrations (µg/m3)	Converted Concentrations (µg/m3)	MALC (µg/m3)
Carbon Monoxide			
1-hour concentrations			
Boiler	33.68	33.68	
Water Heater	3.45	3.45	
Total		***37.13****	***35,000***
8-hour concentrations			
Boiler	33.68	23.58	
Water Heater	3.45	2.42	
Total		***26.0****	***15,000***
Nitrogen Dioxide			
1-hour concentrations			
Boiler	38.89	38.89	
Water Heater	3.93	3.93	
Total		***42.82***	***400***
24-hour concentrations			
Boiler	38.89	15.56	
Water Heater	3.93	1.57	
Total		***17.13***	***200***
Annual concentrations			
Boiler	38.89	3.89	
Water Heater	3.93	0.39	
Total		***4.28****	***100***
Hydrogen Sulfide			
1-hour concentrations			
Barium Formate Tank	8.32	***8.32***	***15***
24-hour concentrations			
Barium Formate Tank	8.32	***3.33***	***5***
Suspended Particulate Matter			
24-hour concentrations			
Ore Hopper	1.70	0.68	
Lime Silo	2.15	0.86	
Total		***1.54***	***120***
Annual concentrations			
Ore Hopper	1.70	0.17	
Lime Silo	2.15	0.22	
Total		***0.39****	***70***

*Below Maximum Desirable Level Concentrations.

Summary

As shown in the table above, the modelled results are significantly below the MALC for all pollutants and therefore the construction of the new cesium formate unit is expected to comply with Manitoba Environment Guidelines for Ambient Air Quality.