COVER SHEET - FACSIMILE TRANSMISSION

Northwest Territories

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DATE: 10 May 1995

TO: **David Anthony, P.Eng.**
Manager, Environmental Services
Royal Oak Mines, Inc.
NWT Division
(403) 873-2980

FROM: Jim Sparling
Air Quality Specialist
Environmental Protection Division
Department of Renewable Resources
Government of the Northwest Territories
600, 5102 - 50 Avenue
Yellowknife, NT X1A 3S8

Telephone - (403) 920-6396
FAX - (403) 873-0221

MESSAGE:

Dave,

Attached are HUM's proposed revisions. Please let me know if this version is acceptable. I will be FAXing comments back as soon as possible.

Please confirm receipt of this FAX.

HUM SCIENTIFIC
ENERGY•ENVIRONMENTAL SCIENCE•ENGINEERING

TO:	GNWT Renewable Resources	**FAX NO.:**	(403) 873 - 0221
ATTN:	Jim Sparling	**DATE:**	10 MAY 1995
FROM:	Ron Hilburn	**TIME:**	0800, 1400
PROJECT:	Royal Oaks Air Modelling	**PAGES TO FOLLOW:**	4

HUM Scientific
RR 5, Site 4, Box 74
Armdale, Nova Scotia
B3L 4J5

Phone: (902) 868-2022
Fax: (902) 868-2022

MESSAGE: Jim,

Corrections to the final report are provided here as per our earlier telephone conversation.

Ron H

Maximum 24 hr. average total arsenic concentrations were estimated at a location near the Yellowknife City Hall for each month of 1993 and compared to ambient monitoring results reported at that location. These data are presented in Table 3-3. Both maximum daily and mean annual total Arsenic values predicted by the ISCST2 model were similar in magnitude but slightly lower than corresponding monitoring data values.

TABLE 3-3 TOTAL ARSENIC CONCENTRATIONS NEAR YELLOWKNIFE CITY HALL

Concentration	ISCST2 Modelling Results for 1993	Ambient Air Monitoring Results for 1993
Maximum 24 hr. Average Arsenic Concentration (ug/m^3)	0.140	0.251
Annual Geometric Mean Arsenic Concentration (ug/m^3)	.009[1]	0.015

1. Arithmetic average, numerous zero values precluded geometric mean calculation.

Maximum 24 hr. average sulfur dioxide concentrations were estimated at the Yellowknife City Hall for each month of 1993 and compared to ambient monitoring results. These data are presented in Table 3-4. Maximum daily and annual mean SO_2 values predicted by the ISCST2 model were also similar in magnitude but slightly lower than corresponding monitoring data values.

Neither model predicted total arsenic nor sulfur dioxide concentrations exceeded the territorial guideline for sulfur dioxide or the Ontario arsenic 24 hr. guideline for the downtown Yellowknife area. For arsenic, an area extending 3 km to the north and south of the roaster stack and 2.5 km to the east and west contained all 24 hr maximum values that exceeded the 0.3 ug/m^3 Ontario guideline value. The corresponding area for SO_2 guideline exceedences is circular in shape, centered on the stack, with a 5 km. radius. Both of these areas are shown in Figure 3-1.

4.2 COMPARISON OF MODELING AND MONITORING RESULTS

Robust highest concentrations (RHC) for 14 months of ambient SO_2 monitoring data (Yellowknife City Hall Monitoring Station) are compared in Table 4-1 with corresponding model simulated values. These model predictions , computed with a sulfur dioxide mass emission rate of 30 X 10 kg/day, were found to have a fractional bias less than the maximum permissable value of 0.67 for 12 of the 14 months tested. The fractional bias, a measure of deviation from complete model accuracy, was found to be zero for three of the 14 months. These three monthly meteorological data sets were then used to make predictions of compliance with territorial air quality guidelines.

Table 4-1 Model Performance Evaluation Based on Observed and Predicted 1 hr. Avorage SO_2 Concentrations (ug/m3)

Meteorological Data Set	Robust Highest Concentration (OBS.)	Robust Highest Concentration (PRED.)	Fractional Bias
August 1992	342	579	-0.51
[illegible]	[illegible]	[illegible]	0.17
October 1992	500	443	0.12
November 1992	1307	1301	0.004
March 1993	717	811	-0.12
April 1993	592	1028	-0.54
May 1993	421	716	-0.52
June 1993	530	874	-0.40
July 1993	844	848	-0.004
August 1993	1000	994	0.006
September 1993	348	815	-0.80
October 1993	478	1137	-0.82
November 1993	926	1441	-0.44
December 1993	685	1203	-0.55

6.0 CONCLUSIONS

ISCST2 modeling results compared relatively well with fourteen months of ambient SO_2 monitoring data provided. Three months of meteorological data produced effectively zero bias model results, and were therefore used to conduct the sensitivity analysis. The anticipated effects of shoreline fumigation, which would cause the ISCST2 to underpredict ground level concentrations, were not experienced perhaps due to the location of the City Hall monitoring station. During onshore flows, this monitoring station is upwind of the stack, so that even if fumigation were occuring downwind of the stack, it would not be detected at the monitoring station.

Baseline model runs for SO_2 showed that territorial 1 hr. and 24 hr. average ambient SO_2 guideline values were regularly exceeded and that the areal extent of these exceedences could be approximated as a circle, centered at the roaster stack, with a 5 km. radius.

Baseline model runs for total Arsenic emissions showed that the Ontario provincial 24 hr. average ambient guideline value was regularly exceeded in an area, shaped like an ellipse, that extends approximately 3 km. to the north and south of the roaster stack and 2.5 km. to the east and west.

As the mass emission rate of SO_2 is a very important parameter in the control of ground level SO_2 concentrations, it is recommended that the mass emission rate of sulfur dioxide be checked regularly through installation of instack continuous monitoring devices or by mass balance computations. Mass inputs to the roaster (from the sulfide concentrate feed and perhaps the spray water used in the second stage) minus the sum of mass lost via the main roaster discharge, removal by ESPs, and removal by the Baghouse should equal the mass emitted to the atmosphere. These mass balance computations could serve as a check on stack test results, particularly if samples were taken during the time of the stack tests.

An analysis of the sensitivity of ambient ground level SO_2 concentrations to variations in mass emission rate and atmospheric dispersion showed that even significant increases in stack discharge parameter (stack height, exit gas temperature, and exit gas velocity) values did not reduce ambient SO_2 concentrations to levels below territorial 1 hr. and 24 hr. average guideline values at either of the mass emission rates tested. While all exceedences were not eliminated until the mass emission rate of SO_2 was reduced by 90 to 95 percent from its maximum value, several monthly 1 hr. averages were reduced to levels below the acceptable federal level at the 35 X 10 kg/day mass emission rate when stack discharge parameters were optimized.

Although it is not likely that all exceedences of the territorial standard will be eliminated by optimizing stack discharge parameter values operating at a mass emission rate of 35 X 10 kg/day, this combination of efforts may produce results that

are reasonably close. It is therefore recommended that additional model runs be made using adjusted stack height, exit gas temperature, and sulfur dioxide mass emission rate values determined by Royal Oak to be possible to acheive. Ambient maxima produced by these model runs will be representative of actually achievable maximum ambient SO values.