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T. Giant/File

OCT . 5 1978

October 4, 1978

Air Pollution Control Directorate
Environmental Protection Service
Place Vincent Massey
HULL, Quebec
K1A 1C8

Attention: Mr. W.A. Lemmon
Gold Roasting Task Force Chairman

Re: SOCIO-ECONOMIC IMPACT ASSESSMENT
GOLD ROASTING ARSENIC EMISSION
PROPOSED REGULATIONS

Dear Sir:

Attached is the submission of Giant Yellowknife Mines Limited toward this assessment. It must be emphasized that for the existing gold roasters, and especially for any future installations, the regulations must contain provision for exceeding the limits for short periods of up to about one week. Annual verification of compliance has been discussed and should be the initial regulation. However, the history of similar situations, in many jurisdictions, indicate that the frequency of requested tests increases with time and tends to approach continuous monitoring as quickly as suitable instruments become available.

As discussed many times at the Task Force meetings the locations of Gold Roasters in remote areas adds considerably to the practical difficulties of meeting a tight emission regulation such as the proposed 17 mg/m^3. It would appear at this time that Giant Yellowknife Mines Limited has a reasonable hope of living with this regulation. The mines must be given fair and understanding treatment by all levels of the regulation process, if this very tight emission limit is to be a realistic operating constraint.

Yours truly,

FALCONBRIDGE NICKEL MINES LIMITED

L.S. Price, P. Eng.,
Manager - Environmental Control

LSP/ft
attach.

cc: W.A. Moore, D.J. Emery, S. Reid, J.E. Finlay

Socio-Economic Impact Assessment
Gold Roasting Arsenic Regulation

INTRODUCTION

Giant and the Community

The History of Yellowknife until the mid-1960's and the History of gold mining on Yellowknife Bay of Great Slave Lake are virtually one and the same.

There was no community on Yellowknife Bay until gold was discovered. By 1951 the original tent camp had grown to a village of 2,500 people. The total work force was 1,438 of which 813 were employed by the mines. Many of the remaining 625 were employed in providing services directly to the mining companies so that virtually the entire population depended on the mines. This situation continued through the 1950's and early 1960's.

The transportation, communication and utility facilities in that area were all established by, or for, the mines. This comprehensive base of services allowed the very rapid, over 80% expansion of the population in the late 1960's when Yellowknife was developed as a major government center.

Not only did the gold mines establish (or were the reason for establishing) most of the facilities and services in Yellowknife but also many mine people took a very active part in the development of the community.

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In its history, Giant Yellowknife Mines Limited has seen employees, or spouses become, Mayor (twice), deputy - Mayor, council members, Presidents of the School Board, Library Board, Hospital Board and Chamber of Commerce, Member of N.W.T. Labour Board, Territorial Hospital Insurance Board and N.W.T. Heritage Council, leaders in sporting, scouting and cadet activities, members and executive members of many service and social clubs.

In December 1972 the "Regional Planning and Manpower Sector, Economic Staff Group, Northern Economic Development Branch, Department of Indian Affairs and Northern Development" published a report - "The Socio-Economic Implications of Gold Mine Closure in the Yellowknife Region" by Marcel St Pierre. This report is a comprehensive outline of the economic development of Yellowknife and the major part played by the gold mines in this development.

Some of the tables in this 1972 Report have been modified and updated, for Giant Yellowknife Mines Limited only, to show some of this mine's contribution to the Yellowknife economy from 1961 to date. (See Tables 1,2 &_3)

Giant and Canada

Since the product from Giant Yellowknife is gold, all production has been a direct or potential source of foreign exchange income for Canada. From the enclosed annual statement, it can be seen that this has exceeded $260 million dollars over the thirty years the mine has operated.

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NUMBER OF EMPLOYEES, WAGES AND SALARIES PAID BY GIANT YELLOWKNIFE MINES LIMITED

Table 1

Year	Average Number of Employees	Wages and Salaries	Numbers of persons directly dependent on mine (Employees + Dependents + (Contractors Employees + Dependents)	
1977	333	5,615,000	906	
1976	345	5,613,000	930	
1975	357	5,311,000	974	
1974	326	4,317,000	880	*
1973	359	4,053,000	900	*
1972	380	3,953,000	868	
1971	388	3,700,000		
1970	411	3,740,000		
1969	415	3,492,000		
1968	388	3,016,219		
1967	361	2,576,338		

* Estimate

Table 2 - VARIOUS TAX PAYMENTS BY GIANT YELLOWKNIFE TO THE MUNICIPALITY OF YELLOWKNIFE

Year	Real Property Tax	Business Tax	School Tax	Water Payment	Other	Total	% of Total Municipal Revenue
1977	92,124	-	34,524	-	-	126,648	3.5
76	116,181	-	45,599	-	-	161,780	6.2
75	102,943	36,577	38,880			178,400	7.2
74	119,410	41,975	57,031			218,416	
73	72,763	37,927	54,891			165,581	
72	74,624	35,000	56,490	50	2,703	168,867	
71	54,557	40,193	67,146	934	2,480	165,310	11.1
70	53,394	39,196	65,804	465	2,480	161,339	
69	48,113	33,662	59,391	465	2,480	144,111	
66	25,040	33,243	33,243	194	1,720	80,117	13.1
61	18,372	16,145	32,795	185	1,640	69,137	13.6

Table 3 - LOCAL PURCHASES BY GIANT YELLOWKNIFE MINES IN YELLOWKNIFE AREA

	Average 1970-71	1975	1976	1977
Electricity	341,028	478,450	675,094	858,354
Fuel, Gasoline etc.	135,604	509,855	489,488	565,266
Lumber	68,314	80,800	54,456	42,964
Transport-Trucking	47,871	522,681	206,188	229,098
Mining Services	394,890	2,606,230	1,002,005	855,124
Office Supplies	16,798	36,354	13,066	22,621
TOTAL	1,089,620	4,231,370	2,440,297	2,603,427

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A large portion of the operating expenses not spent directly in Yellowknife were used to buy goods and services from locations all over Canada.

HISTORY AND TECHNICAL ASPECTS OF As_2O_3 CONTROL

The major developments in arsenic emission control technology in the roasting of gold ore took place in the 1950's. Many of the significant advances in technology were pioneered at Giant Yellowknife Mines Limited.

A cold electrostatic precipitator as a combined particulate and arsenic control device was started at Giant, in 1951. A hot electrostatic precipitator was installed ahead of the original cold unit in February 1955, giving the combination of a hot then a cold precipitator in series. This concept proved unsatisfactory.

In November 1958, the present baghouse for collecting arsenic was installed to replace the cold precipitator, resulting in greatly improved arsenic collection efficiency. In 1962, the original cold precipitator was converted to hot operation to reduce the load on the system and allow more time for maintenance on precipitators.

The only technology that could conceivably be substituted for baghouse filtration of gases would be high energy scrubbing with water. This technology was used at the Con Mine in Yellowknife, but involves major difficulties and expense in protecting the environment from arsenic that can escape the slurry disposal site, through the action of both water and wind.

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Currently, the newest gold roasting arsenic collection system is at Campbell Red Lake. This is the Giant concept, using much newer equipment. The hot precipitator, cool baghouse system is the only current practical technology for controlling arsenic emissions from gold ore roasting, but it is not a simple or easily operated technolgy. A wide variety of technical, mechanical, and operation control factors impact on both efficiency of recovery, and operating costs. Recent changes to the shaker control equipment and operating methods at Giant Yellowknife have reduced emissions to a level which should meet the proposed regulation of 17 mg/m^3 most of the time.

There are two major operating factors which make this process difficult to control:

(a) The composition of the roaster feed changes from time-to-time. This change in feed composition can cause major changes in the roaster off-gas, especially moisture content, sulphur dioxide/ trioxide concentrations and ratios, and the presence of semi-volatile oxides of metals such as antimony and lead which can range from traces to significant quantities.

(b) The vapour pressure of arsenic trioxide rises very rapidly at temperatures above 100°C. The need to maintain the temperature in the baghouse above the dew-point of acid to prevent blockage and/or corrosion and the need for the lowest possible vapour arsenic content in off-gases, restricts operation to a very narrow compromise temperature range of 104°C minimum to 110°C maximum.

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At 104°C, during periods of combined high moisture and high SO_3 in the gas there is a real possibility of acid mist condensation. At 110°C, the arsenic vapour content of the gas is over 10 mg/m^3, leaving very little safety factor for temperature sensing instrument error, controller cycling, or for fine dust escape through the bags.

High temperatures in the baghouse can be caused by a number of factors the most important of these being:

(a) Instrument error - the sensing element for baghouse temperature control can become inaccurate with age or lose sensitivity due to coating by arsenic or other oxides.

(b) Either high roaster off-gas heat content, or warm ambient air, can increase the volume of tempering air required beyond the capabilities of the exhaust system.

(c) Infrequent intervals of high acid dew-point gas can require the use of a higher control temperature to prevent system blockage.

Other factors that can result in higher arsenic emissions from the stack for short periods include:

(a) Deterioration of the general quality of the bags, without visible or obvious failure.

(b) Changes in gas volume and velocity which result in deposition and then reentrainment of arsenic dust in the "clean" side of baghouse and the flues to the stack.

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The above factors make it mandatory that the proposed arsenic emission regulations have a clause that allows short term excursions of emissions above 17 mg/m^3. It would be impossible for any operation to guarantee less than 17 mg/m^3, at all times under all conditions.

CAPITAL COSTS

Giant Yellowknife has had all of the basic equipment required to maintain less than 17 mg/m^3 emission limit installed for 20 years. No attempt has been made to accurately cost a new system, but quick factoring from the information given in the August 1978 issue of the "Journal of the Air Pollution Control Association" and other sources indicates a present cost of $\$5 \times 10^6$ minimum.

Giant has made the following Capital Expenditures over the past two years to improve the performance of the existing baghouse, protect the personnel who must maintain both the baghouse and precipitator, and provide suitable facilities to both continuously monitor, and properly and safely sample emissions from the stack.

1.	Pressure switch control system for baghouse. Opacity Indicating-Recorder for flue after baghouse. Stack testing equipment to meet EPS Standard Method.	$ 20,000
2.	Rebuild and extend sampling station on stack.	$ 7,770
3.	Six - total enclosure dust suits for personnel entering equipment.	$ 3,000
	TOTAL 1977 and 1978 EXPENDITURES	$ 30,770

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Experience may prove that the probe for the above new stack sampling system should be at least two feet longer. If this becomes fact, a new probe plus new monorail carriage systems at the two sampling ports will be required at a probable cost of about $10,000.00.

OPERATING COSTS

Attached is a tabulation of Environmental Control expenditures for the entire life of the mine. This table was originally prepared in 1976 for the N.W.T. Water Board, and has since been updated to July 1978 for the air arsenic emission control cost items only.

The item "Special Testing Projects (Environmental Control)" is a combination of monitoring and improvement research costs for both air and water emissions.

The annual cost shown for Arsenic Disposal before 1975 was the actual expenditure each year. Since 1975, the cost of preparation of storage vaults has been placed in a special suspense account and charged out on the basis of tons stored. There are no remaining suitable mined out areas therefore, since 1975, it has been necessary to mine storage vaults specifically for arsenic. The current cost of storage on this basis is roughly $33 per ton of arsenic dust.

One area of cost that is not shown in this table is the cost of supervisory staff time spent on the roaster off-gas system, and environmental matters in general. The cost accounting system at Giant does not usually distribute the supervisors time between the various sections of the plant. All personnel involved confirm that a much

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larger portion of their time has been spent in checking and supervising both operating and maintenance of this system during the past two years, and they anticipate this percentage will continue to increase. If this increase in Supervisor involvement in the gas handling system continues, it may prove necessary to employ more staff or risk deterioration of safety and efficiency in the main revenue producing portion of the plant. In a location such as Yellowknife, competent, conscientious supervisors are difficult to find and retain (see page 9 of attached Annual Report re Personnel turnover rate).

Not all operating and trades personnel are willing to operate or maintain the gas handling system. Some object to the personal protection equipment necessary. They find it hot and/or clumsy. Others are afraid of what they believe to be hazardous work, even when using the best available protective equipment. This factor has resulted in the establishment of several special pay categories. The three main ones are:

1. Routine operation - SENIOR OPERATOR RATE PLUS 63%

2. Repair, cleaning, inspecting all equipment and parts after removal from roaster, precipitator, baghouse train. Manually handling contaminated solids (roaster bed material, dust from cleaning parts etc.) } EMPLOYEES NORMAL RATE PLUS 50%

3. All work inside the roaster, precipitator, baghouse, flue system. } EMPLOYEES NORMAL RATE PLUS 150%

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GIANT YELLOWKNIFE MINES LIMITED

Environmental Control Expenditures - 1949-1976

TABLE 4 - Page 1.

	1949-51	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Tons Milled	362,914	165,846	245,559	275,985	286,742	297,582	309,673	289,220	321,002	544,597	366,515	375,820	388,190
EXPENDITURES: (Dollars)													
Tailings Disposal	6,259	3,083	4,504	4,199	5,290	4,980	15,399	13,380	21,361	23,459	11,599	10,813	15,618
Treatment Mill Waste	-	-	-	-	-	-	-	-	-	-	-	-	-
Special Testing Projects * (Environmental Control)	20,415	14,933	41,745	36,958	49,728	37,054	111,457	31,372	69,921	66,024	27,294	28,772	22,360
Cottrell Plant	-	10,020	18,016	20,629	32,966	30,739	22,612	27,981	21,484	24,292	26,443	34,451	39,074
Baghouse, Stack & Stack Fan	-	-	-	-	-	-	-	-	12,423	15,579	14,182	29,573	23,925
Arsenic Disposal	975	45,844	51,044	60,649	42,551	64,559	80,165	49,061	73,773	200,869	119,404	71,699	52,871
Land Reclamation	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Conservation	-	-	-	-	-	-	-	-	-	-	-	-	-
Effluent Clean-up	-	-	-	-	-	-	-	-	-	-	-	-	-
Total:	27,649	73,880	115,309	122,435	130,535	137,332	229,633	121,794	198,962	330,223	198,922	175,308	153,848

* Re-named Environmental Control in 1975

GIANT YELLOWKNIFE MINES LIMITED

Environmental Control Expenditures - 1949-1976

Table 4 (cont'd) - Page 2

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	6 mos. 1978
Tons Milled	400,606	395,001	384,271	319,876	374,717	399,647	424,774	403,819	401,272	389,460	328,039	391,969	428,154	446,192	
EXPENDITURES: (Dollars)															
Tailings Disposal	16,024	11,850	7,685	9,552	6,846	3,998	16,136	31,284	17,686	35,311	184,086	324,054	190,000		
Treatment Mill Waste	-	-	-	19,104	41,826	48,061	38,106	43,555	51,555	47,476	51,525	57,925	69,000		
Special Testing Projects * (Environmental Control)	20,710	15,414	11,947	11,983	4,897	4,933	2,621	3,747	8,467	6,727	21,007	25,436	16,380	50,611	45,115
Cottrell Plant	20,030	59,250	42,270	47,761	41,148	28,143	31,883	37,325	51,250	59,488	55,349	64,184	47,762	77,910	87,797
Baghouse, Stack & Stack Fan	32,050	23,700	42,270	47,761	26,842	30,278	27,309	35,475	35,039	27,159	23,478	39,435	32,331	37,846	24,689
Arsenic Disposal	36,055	35,550	35,427	19,104	15,855	24,062	24,435	8,971	11,063	40,149	13,154	102,242	191,342	115,586	54,600
Land Reclamation	-	-	-	-	-	2,314	4,188	-	20,434	10,003	9,188	2,325	20,000		
Water Conservation	-	-	-	-	-	-	-	-	-	-	96,106	7,005	2,500		
Effluent Clean-up	-	-	-	-	-	-	-	-	-	-	59,968	-	-		
DPAT Program	-	-	-	-	-	-	-	-	-	-	-	-	40,000		
														Air Only	Air Only
Total:	124,869	145,764	142,599	155,265	137,414	141,789	144,678	160,357	195,494	226,313	513,861	622,606	591,315	281,953	212,201

* Re-named Environmental Control in 1975

Compiled by D.J. Emery Feb. 24, 1975
Updated by D.J. Emery Oct. 29, 1976
Updated by L.S. Price Aug. 8, 1978

Even this large financial incentive at times is not enough to encourage the types of personnel (especially trades) required to inspect and maintain the precipitator and baghouse.

OTHER PENDING ENVIRONMENTAL COSTS

The tailings waste waters from Giant Yellowknife do not meet proposed and/or established quality criteria, especially for arsenic and cyanide. The mine must make improvements in this condition within a maximum of 2 1/2 years.

One treatment concept that has been investigated in a pilot plant has an indicated cost of roughly $250,000.00 capital and $700,000.00 additional annual operating cost. It is doubtful that the mine could continue with this additional burden. Several promising alternatives to this concept are being investigated.

MARKET POTENTIAL FOR As_2O_3 AS CAPTURED

Until very recently, the only market for As_2O_3 in North America has been for very pure material. The price has always been below the cost of freight from Yellowknife to areas of use.

During the last year, at least one user of As_2O_3 has developed the capacity to process slightly lower quality material, and the market price has risen with combined rising demand and falling supply. Giant Yellowknife is presently exploring the possibility of disposing of current As_2O_3 production on a near "Zero Net Value" basis. It is much too soon to state what chance this study will have of developing as an alternate method of disposal.

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ENVIRONMENTAL BENEFITS

The Canadian Public Health Association "Task Force on Arsenic" stated that in the Yellowknife district "Arsenic in Air and Suspended Particles are at Acceptable Levels". They go on to say "They (people of Yellowknife) evidently have about the same arsenic intake as people in other industrial towns in Canada".

Recent improvements made to the emissions from Giant Yellowknife Mines are difficult to relate to historical records, since the method of stack sampling has been changed. If one accepts the results of stack sampling by Environment Canada in 1975, as indicative of emissions before any change, the new emissions are 1/4 of previous levels. If one uses the mine's results for tests in 1975 and 1976 the new emissions are roughly 1/10th of previous levels.

Regardless of which set of results one uses as reference, the reduction is a substantial safety factor below a condition that could not be shown to be hazardous. Therefore this proposed regulation would seem to be adequate and any more restrictive emission limit would only improve this safety factor at tremendous cost to the industry.

CORPORATE FINANCIAL POSITION

Attached is the 1977 Annual Report of Giant Yellowknife Mines Limited. This is the latest "Audited" financial statement. Pages 14 and 15 of this report gives a very clear picture of the entire 30 year life of this mine.

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As shown on page 3, the proven ore reserves at the beginning of 1978 are slightly more than requirements for two years of operation. This low ore reserve picture means that exploration efforts and expenditures must be intensified to ensure that all economic grade ore is found and mined before final closure of this operation. As the available ore reserves of a mine dwindle, it becomes very difficult to maintain sufficient work places to produce at a rate that will fully utilize the mill. Any discovery of new ore zones will require rapid expenditure of substantial amounts of Capital to develop the new ore before the existing ore is depleted.

IMPACT OF PROPOSED REGULATION ON NEW MINES

The fact that a strict emission regulation for arsenic exists will be a major obstacle, added to the economic and technical ones already in the path of the development of any new arsenic containing gold orebodies.

Unless the potential profitability is very large, few companies or individuals will consider any undertaking where they believe that obtaining the necessary approvals to proceed could involve, long time delays, preparation of voluminous complex reports, and harassment from both the public and regulatory agencies.

This tendency to avoid complex or troublesome projects that are not obviously highly attractive on the part of both financial and operating people, coupled with the probable minimum 10% additional capital and operating cost, will prevent serious consideration of developing medium or lower grade arsenic containing ores.

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In the event that a new facility for roasting arsenical gold ore is ever built, there will be an absolute need for an upset emission excursion clause in the regulations. During start-up and for many months after, the probability is very great that any criteria, especially the proposed 17 mg/m^3, will be exceeded for several substantial periods. Since each ore is different, time is required to find the optimum operating conditions and to train the operators in the practices and techniques necessary to maintain these conditions.

If the regulations do not contain any upset allowance even a carefully designed new facility would be wise to budget a substantial amount during the first year of operation to cover, extensive stack sampling programs, public relations compaign, legal fees and a number of large fines.

L.S. Price

LSP/ft
2/10/78