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VOLUME I

FINAL REPORT

ENVIRONMENTAL RISK ASSESSMENT SURVEY OF NEWMONT MINING CORPORATION

Versar Job No. 879

Prepared by:

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10.3.5 Cambridge, Ohio

The Cambridge, Ohio, facility is involved in the production and manufacturing of various vanadium alloys, baron/titanium ferroalloys, and vanadium chemicals. The plant is sited on 130 acres of land and employs 102 people.

The specific products manufactured at the site include:

Product	Quantity (tons est. 1985)
Ferrovanadium 70/80	398.0
Ferovan 42	2086.6
Low nitrogen ferovan	1444.8
Grainal 79	2046.3
Grainal 100	130.6
Vanadium pentoxide purified	0
Vanadium pentoxide C.P.	5.0
Ammonium metavanadate tech.	7.7
Ammonium metavandate C.P.	7.5
Sodium metavanadate tech.	9.9
Vanadium oxytrichloride	43.5
Briquettes of Crium Cove	676.6
Vanadyl sulphate	0
Vanadyl chloride	0

Of the products listed above, two are listed hazardous wastes: vanadium pentoxide (Hazardous Waste No. P120) and ammonium vanadate (Hazadous Waste No. P119). In the production of vanadium alloys (i.e., ferrovanadium 70/80, ferovan 42, and low nitrogen ferovan), various vanadium bearing raw materials (including boiler residues, vanadium

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pentoxide-fused flake and a vanadium bearing slag obtained from Highveld Steel Corporation), reducers (such as aluminum can scrap, aluminum dross, and silicon metal) and fluxes such as lime are received primarily in bulk and stored in bulk lots on site. Prior to processing, materials are loaded into a centrally located multicompartment silo. Various raw material formulations are weighed, mixed, and loaded into intermediate tanks. The mix formulations are fed at controlled rates into two open-arch electric smelting furnaces.

The Ferrovanadium 70/80 process consists of an electroalumino reduction of vanadium pentoxide (as fused flake) into ferrovanadium and slag phases. This reduction takes place in No. 1 furnace only. The slag is poured through a water spray system and after cooling is either landfilled on site or sold as a construction material. The alloy is poured into flat cast iron molds to cool. After cooling, the alloy is crushed and sized according to customer requirements. The material is packaged in bags, cans, drums, and bulk for shipping.

The Ferovan 42 and Low Nitrogen Ferovan processes are two step. The first step consists of lowering the iron content of the Highveld slag by melting in No. 1 furnace combined with a partial reduction of the iron oxides using silicon. The metallic iron is cast and sold as by-product. The molten, vanadium, and iron bearing slag is transferred to the No. 2 furnace where it is combined with other vanadium bearing materials. The vanadium oxides are reduced using aluminum in the form of metallic can scrap (low nitrogen) or in the form of aluminum can scrap and aluminum dross (Ferovan 42). After the reduction, the alloy and the slag are processed as described above.

In the production of the grainol alloys (i.e., grainol 79 and 100), raw materials consisting of borax, titanium oxides, titanium scrap metal, aluminum can scrap, zirconium oxide, and fluxes proceed through the silo storage, weighing and mixing stations, and are introduced into the No. 1

furnace at a controlled rate. The boron, zirconium, and titanium oxides are reduced by the aluminum leaving alloy and slag phases. The molten slag and alloy are processed as described above.

Sodium metavanadate is produced by concentration and evaporation of an aqueous sodium vanadate solution containing a mixture of vanadium pentoxide, sodium carbonate, sodium peroxide, and water. The resulting salt is crushed and packaged. The product is packaged in plastic bags in drums.

Ammonium metavanadate (Technical Grade) is produced by an interaction of aqueous solutions of sodium vanadate, ammonium chloride, and ammonium sulphate. The resulting precipitate is isolated by filtration, washed with water, and dried. The material is shipped in plastic bags in fibre drums.

Ammonium metavanadate (C.P. Grade) is produced in a similar manner to Ammonium Metavanadate Technical Grade except that the starting material is Ammonium Metavanadate (Technical Grade) and the precipitating agent is ammonium chloride. The material is shipped in plastic bags in fibre drums.

Vanadium oxytrichloride is produced by chlorination of vanadium pentoxide in the presence of carbon reducer. Fluidized bed technique is used. Purification is by distillation. Material is shipped in liquid form in special 200 gallon containers and via tank truck. Material cannot be exposed to air and is normally moved via nitrogen displacement.

Vanadium pentoxide (Purified Grade) is produced by thermal oxidation (calcining) of Ammonium Metavanadate, Technical Grade. Material is shipped in plastic bags in fibre drums. Vanadium Pentoxide (C.P. Grade) is produced by thermal oxidation of Ammonium Metavanadate (C.P. Grade). Material is shipped in plastic bags in fibre drums.

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Vanadyl sulphate is produced by the reaction of sulphuric acid, vanadium pentoxide, methyl alcohol, and water. The product is filtered, dried, and packed in plastic bags and small fibre containers. Vanadyl chloride is produced similarly to vanadyl sulphate except hydrochloric and is used in the reaction.

The raw materials and their quantities used in the production of these products are presented in Table 10.3-2. Atmospheric emissions fromn the Cambridge facility originate from numerous sources. A complete inventory of all emission sources is presented in Table 10.3-3.

Wastewater emissions sources are also numerous. In general, these wastes are collected, pH adjusted, and discharged to the county sewer system. A complete inventory of all wastewater sources is presented in Table 10.3-4.

The volumes and chemical analyses of discard slags and baghouse dusts which are generated at the plant are summarized in Table 10.3.5. Some of the slag and all of the baghouse dusts are landfilled on site in a nonregulated landfill. In recent years, the quantity of slag that has been landfilled has been reduced due to sales of this material for construction purposes.

"Garbage" is generated in small quantities and is removed to a sanitary landfill by a local contractor. Some materials such as bags, broken pallets, wood, etc. are landfilled on site or burned and landfilled.

As a processor, smelter, and refiner of ores and minerals, the Cambridge facility is exempt from waste handling and management regulations under Subtitle C of RCRA. However, the exemption does not mitigate the hazardous characteristics of the waste streams or eliminate the potential for third party claims resulting from the release of these

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Table 10.3-2. Raw Materials Inventory

Raw Material	Quantity (tons est. 1985)
Vanadium pentoxide fused flake (lbs. V205)	851.9
Highveld slag (lbs. V205)	1786.1
Vanadium bearing residues (lbs. V205)	800.7
Aluminum dross (lbs.)	1194.0
Aluminum scrap (lbs.)	2982
Silicon metal remelt (90%) (lbs.)	259.3
Magnesium ferrosilicon fines (lbs.)	405.4
Pebble lime (lbs.)	4498.3
Graphite electrodes 10" (lbs.)	59.9
Graphite electrodes 12" (lbs.)	83.9
Syndolag (CaO,MgO) (lbs.)	54.4
Refractories (lbs.)	2530.6
Fluorspar (lbs.)	110.6
Mill scale (lbs.)	31.7
Steel punchings (lbs.)	769.6
Quebec ilmenite	262.3
Quilon ilmenite	583.0
Sorel slag	262.3
Titanium scrap	218.6
Manganese ore	437.2
Zircon sand	320.6
Borax	117.4

Table 10.3-3. Cambridge, Ohio, Air Emissions Inventory

Source	Control	Pollutant	Quantity (lbs/yr)
Heating boiler (natural gas)	-	Hydrocarbons	ND
Process boiler (gas/#2 fuel oil)	-	Hydrocarbons	ND
Tertiary alloy crusher and Screen	Fabric	Metallex alloy	180
Raw material handling storage area	Cyclone/fabric	Particulates	1,800
Vanadium oxytri-chloride plant	Wet scrubber	Chlorine	ND
Shipping, alloy, grinding/screening	Fabric	Metallic alloy slag dust	100
Shotblast equipment/shipping	Fabric	Metallic alloy slag dust	140
Vanadium pentoxide grinding/screening	Fabric	Vanadium pentoxide dust	20
Alloy crushing/screening	Fabric	Metallic alloy slag dust	3,000
Alloy screening bagging machines	Fabric	Metallic alloy	200
Rotary kiln dryer	Fabric	Particulates	400
No. 2 Smelting furnace	Fabric	Furnace fume	16,000
No. 1 Smelting furnace	Fabric	Furnace fume	6,000
Crushing/pulverizing	2 Fabric collectors	Metallic alloy slag dusts	60
Briquetting equipment	Fabric	Cerium oxide	10
Residue crushing	-	Vanadium pentoxide	500
Slag dispersing/quenching system	-	Hydrogen sulfide	Trace
Miscellaneous/fugitive sources	-	Particulates	ND

ND = No data.

Table 10.3-4. Cambridge, Ohio, Wastewater Emission Inventory

Source	Quantity	Disposal
Sanitary sewage	8,000 gpd	County sewer system
Laboratory chemicals	ND	Neutralized/county sewer system
Vanadium oxytrichloride scrubber solution	1,400 gpd	County sewer system
Boiler water blowdown	20 gpd	County sewer system
Ammonium metavonadate decant solution	300 gpd	County sewer system
Vanadate filter backwash	500 gal/week	County sewer system
Recirculator water blowdown	150 gpd	Drainage ditch

Table 10.3-5. Cambridge, Ohio, Solid Waste Inventory

Source	Volume	Composition	
Ferovan 42 (slag)	16,000	V_2O_5	0.3%
		SiO_2	4.0%
		Al_2O_3	48.0%
		TiO_2	2.0%
		Cr_2O_3	Trace
		MnO	0.2%
		FeO	0.29%
		CaC	28.0%
		MgO	13.0%
Grainal 79+100 (slag)	3,700	V_2O_5	<0.1%
		SiO_2	1.0%
		Al_2O_3	49.0%
		TiO_2	6.0%
		MnO	0.5%
		CaO	27.0%
		MgO	11.0%
		Fe_2O_3	0.6%
		B_2O_3	0.9%
		ZrO_2	4.0%
Ferrovanadium 70/80 (slag)	1,100	V_2O_5	0.3%
		SiO_2	0.2%
		Al_2O_3	56.0%
		FeO	0.43%
		CaO	30.0%
		MgO	12.0%
Ferovan 42 (baghouse dust)	1,115	V	1.6%
		SiO_2	10.04%
		Al_2O_3	5.72%
		CaO	5.82%
		MgO	36.39%
		Fe	1.11%
		Ti	0.24%
		Cr	0.16%
		Mn	2.41%
Grainal 79 & 100 (baghouse dust)	225	V	1.12%
		SiO_2	5.50%
		Al_2O_3	7.2%
		CaO	24.86%
		MgO	26.38%
		Fe	2.68%
		Ti	0.76%
		Cr	0.21%
		Mn	2.98%

materials to the environment. Therefore, concern is expressed over the disposal practices employed by the Cambridge facility relating to the landfilling of solid wastes containing vanadium pentoxide and ammonium vanadate fractions. Specifically, approximately 75 tons per year of waste vanadium pentoxide are disposed of in an unsecured landfill. Groundwater contamination from this source, therefore, is probable.

The plant also has a number of PCB containing transformers, circuit breakers, and capacitors. An inventory of these is presented below:

Transformers:
(1) 975 gallons (in storage); space for an in-service unit
(2) 85 gallons (in storage); no function
(3) 75 gallons (in service); contaminated only: 759 PPM
(4) 800 gallons (in storage); spare for an in-service unit contaminated only; 85 PPM

Oil circuit breakers:
(1) 3 mineral oil filled tanks contaminated at levels between 70 PPM-118PPM (in service)
(2) 1 mineral oil filled tank contaminated at 26,327 PPM

Capacitors:
(1) 82 large power capacitors, 33 of which are in-service and the remainder of which are stored on site.

Information regarding the security and protection of these systems (i.e., diking, fencing) was not provided.

Air emissions, primarily because of relatively low emission levels (approximately 75 pounds per day), do not appear to be a major concern.

It was indicated in the information provided by the Cambridge facility that a certain process wastewater stream was routed to an intermediate holding tank for pH adjustment prior to discharge to the county sewer system. Specific information regarding this collection system was not provided for review; but may be beneficial in evaluating the facility's wastewater collection and disposal practices.

Based on the review of available information, this site is considered to represent a potential for adverse environmental impact that is high (above average). This is based on an examination of the quantities and characteristics of the chemicals used at the site (primarily from the on-site disposal of vanadium pentoxide) in comparison to risk ratings of other paper audit sites. On site review would provide a more precise evaluation of the conditions at the site and better determine the overall site rating.

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