APPENDIX F

Air Pollutant Dispersion Modeling Analysis

Modeling Report

Toxic Air Pollutant and Criteria
Refined Air Dispersion Modeling Report

AVX Corporation
Myrtle Beach, South Carolina

September 2010

RESOLUTE ENVIRONMENTAL LLC

REPORT

Refined Air Dispersion Modeling Report

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ENVIRONMENTAL LLC

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Executive Summary

AVX Corporation (AVX) operates a ceramic capacitor manufacturing facility in Myrtle Beach, South Carolina. This refined air dispersion modeling analysis accompanies the facility's June 2010 federal Title V operating permit renewal application. Air dispersion modeling was used to estimate ambient concentrations from facility process emissions of regulated criteria and toxic air pollutants (TAP). This analysis uses the U.S. EPA AERMOD dispersion modeling system to determine receptor grid concentrations and at discrete sensitive receptors. Potential emission rates were modeled and all estimated concentrations were well below the South Carolina Air Pollution Control Regulation 62.5, Standard No. 8 Maximum Allowable Ambient Concentrations and Standard No. 2 National Ambient Air Quality Standards.

1. Introduction

AVX Corporation (AVX) operates a ceramic capacitor manufacturing facility in Myrtle Beach, South Carolina. The facility is renewing their federal Tile V operating permit, and therefore submitting a comprehensive, refined air dispersion modeling analysis for emissions of regulated compounds.

This report documents the technical approach for conducting a refined air dispersion modeling analysis using the USEPA's AERMOD modeling system. The analysis follows the modeling methodologies contained in the South Carolina Department of Health and Environmental Control July 2001 *Air Quality Modeling Guidelines* and provides a summary of the dispersion model input variables and modeling output.

2. Background

2.1. Site Location and Description

The location of the AVX site is shown in Figure 1. The site is located west of 17th Ave South, east of the Myrtle Beach International Airport and within the City of Myrtle Beach, South Carolina. The facility site plan, including building heights and stack locations, is shown in Figures 2 and 3. The facility is comprised of many buildings for administration and various process and other support equipment necessary for the manufacturing of ceramic capacitors and resistors. The source parameters for the emission sources that are to be included in the modeling analysis are summarized in Tables 1 and 2. All of the sources in this analysis, except for fugitive sources, will be modeled as point sources (Table 1). Fugitive emission sources were modeled as a volume point source (Table 2).

2.2 Emissions

Tables 3 is a summary of emission rate modeling input for this analysis. AVX's criteria and TAP emissions result from:

1. Cleaning solutions used in the CMAP, Slip, and Metallization departments
2. Constituents of solvents used to manufacture electronic ink and ceramic slip
3. Dry dicing in the Metallization department,
4. Electroplating,
5. Remediation stripping tower, and
6. Fuel combustion
7. Soldering, and
8. Dry material handling.

Details on the emission rate calculations can be found in the 2010 Title V renewal application.

Cleaning

Typical of the electronics industry, denatured ethyl alcohol (DEA) and 100% xylene are used to clean process components. DEA contains small amounts of methanol and MIBK and is used in the slip, termination, and chip build-up processes. Xylene is used for cleaning in the CMAP and in Metallization departments, however, the use of this solvent for cleaning is being phased out.

Process

Process emissions of organic TAPs and particulate matter result from solvent usage, dry dicing, and dry material handling. The RMM department prepares ceramic materials prior to entering the Slip Department. Some particulate matter emissions result, but are controlled by three fabric filters. Dry dicing is the removal of chips from plates following the build-up process. Most dicing occurs in a wet environment, however, a smaller percentage are removed dry resulting in some particulate matter emissions. Dry dicing is also controlled by a fabric filter.

Plating

Nickel (TAP) and lead (criteria) are emitted from the SBE and Autoline plating operations. Although AVX is consolidating manufacturing (formerly known as MB2) into the new manufacturing building, plating will remain in its present location. This relocation includes the back-end support processes such as plating. The Autoline plating process will soon be decommissioned and not included in the move. In the near future, all plating will be completed using the SBE (active) or FCT (passive) processes. All plating emissions were modeled from their current location in MB1.

Miscellaneous Support - Remediation

AVX operates a groundwater remediation system, located near the Slip Manufacturing building. This is a new (like-for-like) replacement of an older stripping system. Arcadis designed the system and provided the emission rates for multiple organic TAP compounds potentially emitted from the groundwater. It should be noted that a smaller stripping system near MB1 has been decommissioned.

Miscellaneous Support - Soldering

AVX utilizes small soldering pots and a wave solder machine for product QA/QC. Although most solder pots do not have exhausts, a few solder pots and the wave solder machine do have exhausts primarily to evacuate solder flux. A small amount of lead emissions may be emitted from the facility from these units. These stations will also be consolidated to the new manufacturing building. However, similar to the SBE plating stacks, their locations and heights are not currently known. Therefore, all soldering emissions were assumed emitted and modeled from a conservative stack location on the building closest point to the property boundary (SE corner). A height of only 15 feet was modeled.

3. Modeling Methodology

A refined level modeling analysis was performed in accordance with SC DHEC modeling guidance, as specified in the *Air Quality Modeling Guidelines*, and the United States Environmental Protection Agency (USEPA) *Guidelines on Air Quality Models* (USEPA, 2005).

3.1. Model Selection and Use

The current version of the AERMOD (Version 09292) dispersion model was used to predict maximum concentrations. The AERMOD model was selected primarily for the following reasons:

- USEPA and SC DHEC have approved the general use of the model for air quality dispersion analysis as a result of the model assumptions and methods being consistent with those referenced in the Guideline on Air Quality Models.

- The AERMOD model is capable of predicting the impacts from point (stack) and volume sources in rural areas that comprise simple terrain.

- The AERMOD model can predict 24-hr averaging period impacts at each receptor.
- The AERMOD model has several options and features that enable it to be adapted to a wide range of specific applications. A complete listing of model option "switches" to be used for this exercise is included as Table 4.

3.2. Surrounding Terrain

Terrain surrounding the facility is simple, however, there is terrain above stack base. Therefore, AERMOD was run with the receptor specific elevations, i.e., the non-default FLAT option was not utilized.

3.3. Urban/Rural Classification

A land use review was performed to evaluate whether rural or urban dispersion parameters should be used in the analysis. This procedure involved evaluating the presence of various industrial, commercial, residential and agricultural/natural areas within a three-kilometer radius centered on the proposed site (Auer Scheme). If more than fifty percent of the area within this circle were designated industrial, commercial and compact residential, urban dispersion parameters would be used; otherwise, the modeling would use rural dispersion parameters.

A review of the topographic map and aerial photos of the area surrounding the site revealed that the area within three kilometers of the site is predominately rural. Thus, based on this analysis, rural dispersion curves will be used in the AERMOD model.

3.4. Good Engineering Practice Stack Height Analysis

The USEPA provides specific guidance for calculating Good Engineering Practice (GEP) stack height and for evaluating whether building downwash will occur (USEPA, 1985). GEP stack height is defined as the height of the structure plus 1.5 times the lesser of the structure height or projected width. If the stack height for a source is less than the height identified using GEP guidelines, based on the dimensions of nearby buildings, then the potential for building downwash to occur exists and is to be considered in the modeling analysis.

Since all of the stacks in this analysis are less than GEP, BPIP-PRIME was used to obtain the building dimensions required for AERMOD to calculate downwash. Figure 2 depicts the structures that were included in the BPIP analysis.

It should be noted that the PDG building (SEBUILDING in previous modeling) has been decommissioned. The original Tower #2 stripping tower was located next to the PDG building. With the building decommissioning, the stripping tower has been moved slightly west next to the Slip building.

3.5. Meteorological Data

The air quality modeling analysis used National Weather Service (NWS) surface meteorological data from Wilmington, North Carolina and concurrent twice-daily upper air soundings from Charleston, South Carolina for the years 1987-1991. The AERMET processed hourly meteorological data files for each year of record to be used in the analysis were obtained from the SC DHEC website.

3.6. Receptor Locations

A Cartesian grid of receptors was used with a spacing of 100 meters extending to a distance of 1.5 kilometers from the property line. Property line receptors were placed at a spacing of 50 meters. In addition, discrete receptors were placed as locations specified by SC DHEC (See Table 6).

Each receptor was processed through AERMAP (Version 09040), the terrain preprocessor for the AERMOD model. Thirty meter resolution Digital Elevation Models (DEMs) from the USGS were utilized in AERMAP for this analysis.

3.7. Cavity Impacts

Because the stack heights are less than GEP, the potential for impacts in near-building cavity regions must be evaluated. Since the AERMOD model calculates impacts within the cavity, an additional cavity analysis was not performed.

3.8. Coordinate System

The locations for the buildings, stacks, receptors and DEMs for this analysis are in the UTM coordinate system, zone 17, NAD27.

4. Modeling Results

Tables 7 and 8 summarize the results of the modeling for each criteria and TAP compound identified in the AVX processes, respectively. Predicted maximum concentrations are well below all applicable NAAQS and MAACs.

Electronic copies of the BEEST, AERMOD, BPIP-PRIME and DEM files are on the enclosed CD.

5. References

Auer, A.H. 1978. *Correlation of Land Use and Cover with Meteorological Anomalies*. Journal of Applied Meteorology, 17:636-643.

SC DHEC, 2001. South Carolina Department of Health & Environmental Control, *Air Quality Modeling Guidelines,* Columbia, SC.

USEPA, 1985. *Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document of the Stack Height Regulations) (Revised)*. U.S. Environmental Protection Agency. EPA-450/4-80/023R. Washington, DC: USEPA.

USEPA, 2004. *User's Guide for the AMS/EPA Regulatory Model AERMOD*. EPA-454-B-03-001. Research Triangle Park, NC: EPA, Office of Air Quality Planning and Standards.

USEPA, 2005. *Guideline on Air Quality Models*, Appendix W to 40 CFR Part 51.

TABLES

Table 1

AVX Corporation
Myrtle Beach, South Carolina

Summary of Stack Parameters - Point Sources

Source	Description	Stack ID	UTM Easting (m)[A]	UTM Northing (m)[A]	Base Elevation (ft)	Stack Height (ft)	Temperature (F)	Velocity (fps)	Diameter (ft)
RMM	Grinding, mixing, milling, and prilling	15A-1	693764	3728334	23	33	70	14.4	1.3
		15B-1	693770	3728334	23	35	70	49.5	2.5
		15C-1	693758	3728335	23	35	70	47.7	2.9
Metals Mfg.	Metals Mill & Mixing	MD1C-1	693700	3728106	23	37	70	57.0	1.67
	Metals Mill	MD2C-1	693716	3728101	23	22	70	NA[B]	0.67
	Metals Mill	MD3C-1	693720	3728101	23	25	70	26.5	1.00
CMAP Support	Dry dicing	NMFS-S1	693330	3727951	23	6	70	NA[B]	0.08
Metallization	Autoline Plater & SBE	7C-2A	693773	3728208	23	32	70	1.0	3.43
	Autoline Plater & SBE	7C-2B	693773	3728206	23	32	70	1.0	3.43
Thin Film Process	Thin Film Process	MB2-TFS	693300	3727880	23	35	70	54.0	2.50
Miscellaneous Sup.	Soldering	Solder1[C]	693305	3727844	23	15	70	0.03	0.25
	Boiler	MB2-B1	693322	3727939	23	35.5	600	15.3	0.83
	Stripping Tower	TOWER	693890	3728065	23	20	70	NA[B]	2.25

Notes:

A. UTM, Zone 17, NAD27.

B. MB2-F2, NMFS-S1, and the stripping Tower have rain caps, so the velocity was set at 0.01 m/s, per the SC DHEC *Air Quality Modeling Guidelines* .

C. The new soldering stack IDs and locations have yet to be determined. For conservatism, a stack was located at the nearest point to property boundary on builing with a 15 foot height with no exit velocity assumed.

Table 2

AVX Corporation
Myrtle Beach, South Carolina

Summary of Stack Parameters - Volume Sources

Source	Description	Stack ID	UTM Easting (m)[A]	UTM Northing (m)[A]	Base Elevation (ft)	Release Height (ft)	Horizontal Dimension (ft)	Vertical Dimension (ft)
Slip Manufacturing	Ceramic Slip	SLIP	693869	3728057	23	15.0	38.1	14.7
Manufacturing	Department cleaning	MFG	693344	3727899	23	12.0	53.5	11.3

Notes:
A. UTM, Zone 17, NAD27.

Table 3

AVX Corporation
Myrtle Beach, South Carolina

Standards No. 8 and No. 2 Modeled Emission Rates

Department	Emission Unit ID	Constituent	CAS	Material/Process	Potential Emissions[A] (lb/yr)	(g/s)
RMM	14	PM/PM-10/PM-2.5	N/A	Grinding, mixing, milling, prilling	0.30	4.28E-06
Slip Mfg.	15	Methanol	67-56-1	Denatured alcohol - Cleaning	15.40	2.22E-04
	15	MIBK	108-10-1	Denatured alcohol - Cleaning	8.12	1.17E-04
	15	Bis (2-ethylehexyl) phthalate	117-81-7	DiOctylPhthalate process solvent	260.0	3.74E-03
Metals Mfg.	16	PM/PM-10/PM-2.5	N/A	Mixing and milling	2340.00	3.37E-02
	16	Xylene	1330-20-7	Process solvent and contained in Mineral Spirits Type 66	100.00	1.44E-03
	16	Toluene	108-88-3	Mineral Spirits Type 66	1.15	1.66E-05
	16	Bis (2-ethylehexyl) phthalate	117-81-7	DiOctylPhthalate process solvent	9.76	1.40E-04
	16	Ethylbenzene	100-41-4	Mineral Spirits Type 66	0.58	8.28E-06
	16	Methanol	67-56-1	Denatured alcohol - Cleaning	2.84	4.08E-05
Manufacturing	17	Methanol	67-56-1	Denatured alcohol - Cleaning	48.0	6.90E-04
(CMAP & Metallization	17	MIBK	108-10-1	Denatured alcohol - Cleaning	24.0	3.45E-04
cleaning)	17	Bis (2-ethylehexyl) phthalate	117-81-7	DiOctylPhthalate process solvent	60.0	8.63E-04
	17	Ethylbenzene	100-41-4	Mineral Spirits Type 66	60.0	8.63E-04
	17	Toluene	108-88-3	Mineral Spirits Type 66	60.0	8.63E-04
	17	Xylene	1330-20-7	Process solvent and contained in Mineral Spirits Type 66	60.0	8.63E-04
	19	Methanol	67-56-1	Denatured alcohol	140	2.01E-03
	19	MIBK	108-10-1	Denatured alcohol	80.00	1.15E-03
CMAP Support	18	PM/PM-10/PM-2.5	N/A	Dry dicing	460	6.62E-03
Metallization	19	PM/PM-10/PM-2.5	N/A	Electroplating - Autoline & SBE	4.86	6.99E-05
	19	Lead	N/A	Electroplating - Autoline & SBE	0.11	1.56E-06
	19	Nickel	N/A	Electroplating - Autoline & SBE	3.90	5.61E-05
Thin Film Process	20	PM/PM-10/PM-2.5	N/A	Process	20.00	2.88E-04
	20	Lead	N/A	Process	0.59	8.46E-06
	20	Sulfuric acid	7664-93-9	Process	6.32	9.09E-05
	20	Nitric acid	7697-37-2	Process	34.00	4.89E-04
	20	2-ethanolamine	141-43-5	Process	454.00	6.53E-03
	20	Hydrochloric acid	7647-01-0	Process	8.04	1.16E-04
	20	Phosphoric acid	7664-38-2	Process	14.0	2.01E-04
Miscellaneous Support	21	PM/PM-10/PM-2.5	N/A	Soldering	20	2.88E-04
	21	PM/PM-10/PM-2.5	N/A	Boiler	880	1.27E-02
	21	SO_2	N/A	Boiler	69	9.93E-04
	21	NOx	N/A	Boiler	11508	1.66E-01
	21	CO	N/A	Boiler	9667	1.39E-01
	21	Lead	N/A	Boiler	6.E-02	8.28E-07
	21	Lead	N/A	Soldering	0.1864	2.68E-06
	21	1,1,1-trichloroethane	71-55-6	Stripping tower	2631.6	3.79E-02
	21	1,1-dichloroethane	75-34-3	Stripping tower	963.6	1.39E-02
	21	Benzene	71-43-2	Boiler	0.2	3.48E-06
	21	Chriomium (assumed +6)	N/A	Soldering	1.5E-02	2.15E-07
	21	Formaldehyde	50-00-0	Boiler	8.5	1.22E-04
	21	Hexane	110-54-3	Boiler	208.0	2.99E-03
	21	Manganese	N/A	Soldering	0.97	1.40E-05
	21	Naphthalene	91-20-3	Boiler	0.1	1.01E-06
	21	Toluene	108-88-3	Boiler	0.4	5.64E-06
	21	Vinyl chloride	75-01-4	Stripping tower	789.5	1.14E-02

Notes
A. Refer to the 2010 Title V renewal application for emission rate calculations.

Table 4

AVX Corporation
Myrtle Beach, South Carolina

Summary of AERMOD Model Options

Option	Selected Parameter
Calculations	Refined Analysis, 24-hr Averages
Receptor Orientation	Cartesian - 100 meter Spacing to 1.5 km Downwind
Dispersion Coefficients	Rural
Stack Tip Downwash	Yes, as Appropriate
Building Downwash Effect	Yes
Direction Dependant Building Dimensions	Yes
Meteorology	2002-2006 Unkown Surface 2002-2006 Charleston, South Carolina (Upper-Air)
Calm Hours	Omitted from Calculations (Regulatory Default)

Table 5

AVX Corporation
Myrtle Beach, South Carolina

Summary of SC DHEC Specified Receptors

Location[A]	UTM Easting (m)[B]	UTM Northing (m)[B]
Pinner Place	693913	3729018
610 13th Avenue South	694402	3728316
1036 Pinnacle Lane	693635	3729141
1210E Benna Drive	694108	3728608
717 11th Avenue South	694427	3728514

Notes:

A. All locations are in Myrtle Beach, South Carolina.

B. UTM, Zone 17, NAD27.

Table 6

AVX Corporation
Myrtle Beach, South Carolina

Summary of AERMOD Modeling Results - Standard No. 2

Contaminant	*Ave. Period*	*Predicted Maximum Ambient Concentration* ($\mu g/m^3$)	*Background Conc.* ($\mu g/m^3$)	*Total Impact* ($\mu g/m^3$)	*NAAQS* ($\mu g/m^3$)	*Percent of NAAQS* (%)
TSP	Annual	0.81	30.4	31	75	41.6%
PM-10	24-Hr	4.1	34	38	150	25.4%
	Annual	0.81	17.9	19	50	37.4%
PM-2.5	24-Hr	4.1	21	25	35	71.8%
	Annual	0.81	10.5	11	15	75.4%
SO_2	3-Hr	0.2	110	110	1,300	8.5%
	24-Hr	0.12	22.7	23	365	6.3%
	Annual	0.01	3.7	4	80	4.6%
NOx	Annual	2.4	3.8	6	100	6.2%
CO	1-Hr	43.1	878	921	40,000	2.3%
	8-Hr	24.6	458	483	10,000	4.8%
Lead	3-Month (Rolling)[A]	0.00049	0.005	0.005	0.15	3.7%

Notes:
A. Modeled lead concentration based on maximum monthly averaging period.

Table 7

AVX Corporation
Myrtle Beach, South Carolina

Summary of AERMOD Modeling Results - Standard No. 8

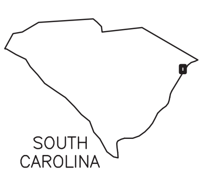
Contaminant	***CAS Number***	***Predicted Maximum Ambient Concentration[a] (ug/m^3)***	***MAAC[A] (ug/m^3)***	***Percent of MAAC (%)***
1,1,1-Trichloroethane	71-55-6	88.8	9550	<1
2-Ethanolamine	141-43-5	0.5	200	<1
Benzene	71-43-2	4.7	150	3
Bis (2-ethylehexyl) phthalate	117-81-7	6.4	25	26
Chriomium (assumed +6)	Chrome	0.00006	2.5	<1
Ethyl Benzene	100-41-4	0.1	4,350	<1
Formaldehyde	50-00-0	0.015	15	<1
Hexane	110-54-3	0.37	900	<1
Hydrochloric acid	7647-01-0	0.008	175	<1
Manganese	Mang	0.004	25	<1
Methanol	67-56-1	1.6	1,310	<1
Methyl Isobutyl Ketone	108-10-1	0.9	2,050	<1
Naphthalene	91-20-3	2.8	1,250	<1
Nickel	7440-02-0	0.036	0.500	7
Nitric Acid	7697-37-2	0.03	125	<1
Phosphoric Acid	7664-38-2	0.01	25	<1
Sulfuric Acid	7664-93-9	0.007	10	<1
Toluene	108-88-3	0.5	2,000	<1
Vinylidene Chloride	75-35-4	35.6	99.0	36
Xylene	1330-20-7	1.6	4,350	<1

Notes:
A. Based on a 24-hour averaging period.

FIGURES

FIGURE 1

ADAPTED FROM: MYRTLE BEACH QUADRANGLE, SC U.S.G.S. 7.5 MIN. QUAD



QUADRANGLE LOCATION

AVX CORPORATION

MYRTLE BEACH, SC

SITE LOCATION MAP

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

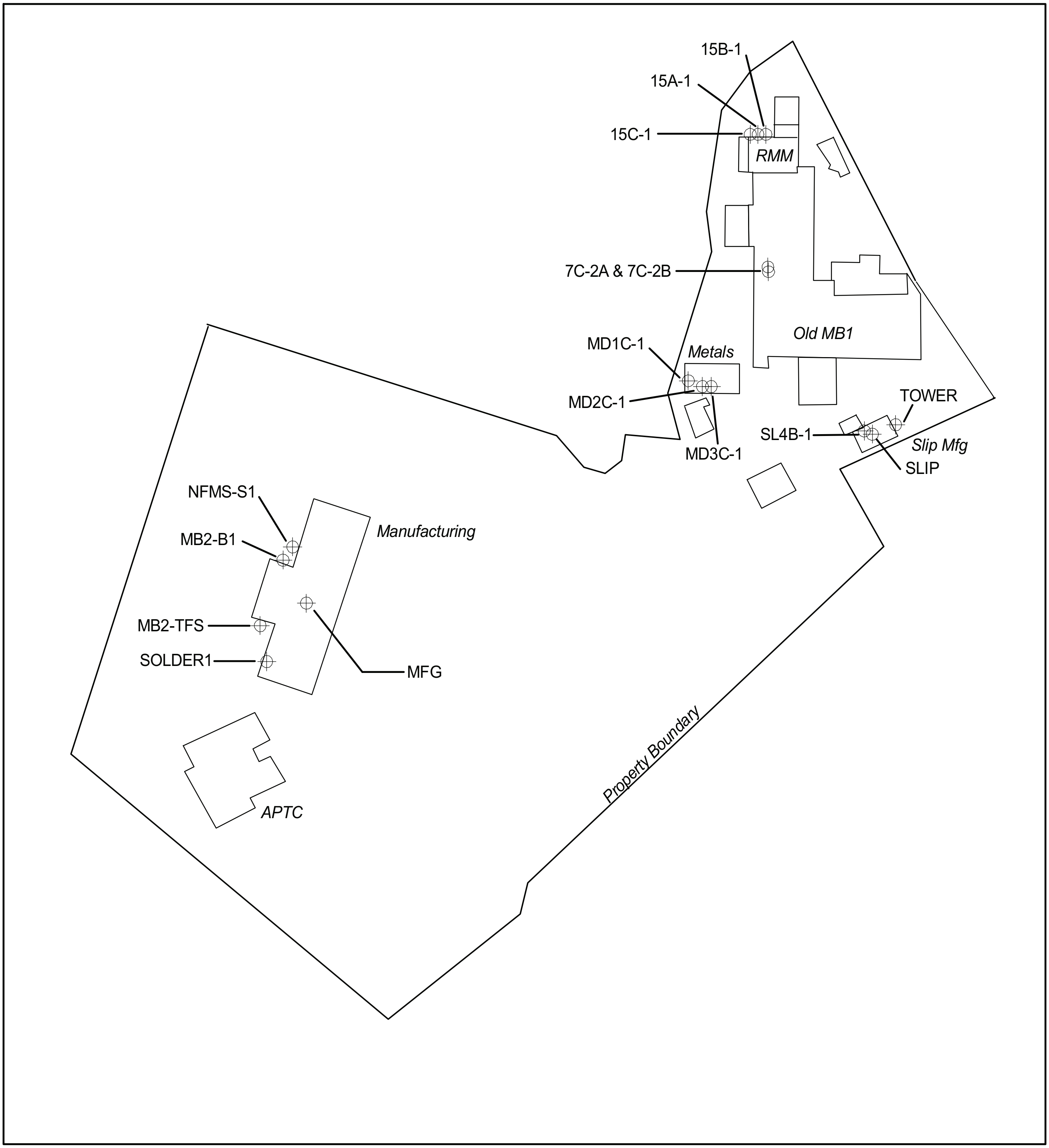
1 5 0 1 KILOMETER

SCALE: 1:24000

FILE NO. 42369-001.001
JULY 2008

O'BRIEN & GERE ENGINEERS INC.

FIGURE 2



AVX CORPORATION
MYRTLE BEACH, SC

FACILITY PLOT PLAN