2018 AB2588 AIR TOXICS EMISSION INVENTORY REPORT

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1.0 GENERAL INFORMATION

The California Air Toxic "Hot Spots" Information and Assessment Act of 1987, Assembly Bill 2588 (AB2588), requires that facilities emitting more than 10 tons per year of criteria pollutants submit emissions inventory information to the local Air Pollution Control District (APCD). The APCD assigns priorities to the facilities based on their emissions. Facilities in the "high and intermediate priority" categories must conduct risk assessments and then may be required to report potential risk to the public.

Vandenberg Space Force Base (SFB)[1], a California facility emitting more than 10 tons per year of a criteria pollutant, must comply with AB2588. To demonstrate compliance, Vandenberg SFB has submitted Air Toxics Emission Inventory Plans (ATEIP) and Air Toxics Emission Inventory Reports (ATEIR) since 1989, as required. On 29 March 2019, Vandenberg SFB received a notification from the Santa Barbara County Air Pollution Control District (SBCAPCD or District) requesting an updated ATEIP and ATEIR for the 2018 inventory year.

In December 2019, a draft ATEIP was submitted to the SBCAPCD. Comments were received from the SBCAPCD in March 2020 and Vandenberg SFB submitted a revised ATEIP in July 2020 along with responses to District comments. In December 2020, SBCAPCD sent a conditional approval letter that contained various issues for Vandenberg SFB to address in order to gain approval of the ATEIP. The letter also requested the submittal of a final ATEIP, response letter, and ATEIR by 15 June 2021. Final ATEIP, responses to conditional approval items, and ATEIR were submitted to the District on 11 June 2021. SBCAPCD issued a final approval of the ATEIP on 3 February 2022. On 29 March 2022 Vandenberg SFB received a conditional approval letter for the ATEIR. The letter contained items for Vandenberg SFB to address in order to gain approval of the ATEIR. The letter also requested the submittal of a final ATEIR, response letter, and health risk assessment (HRA) by 1 October 2022. Submittal was extended to 16 January 2023 through email exchange with SBCAPCD.

1.1 OBJECTIVE

The objective of this ATEIR is to present the emissions inventory as compiled according to the approved ATEIP.

1.2 DOCUMENT ORGANIZATION

The ATEIR is organized into the following sections:

Section 1.0: Provides a brief introduction to this report.

Section 2.0: Lists emissions sources that existed at Vandenberg SFB in 2018.

Section 3.0: Describes the processes and calculations for 2018 activities.

Section 4.0: Discusses the facility diagram.

Section 5.0 Provides a list of acronyms and abbreviations.

[1] On 14 May 2021, Vandenberg Air Force Base (AFB) was renamed Vandenberg Space Force Base (SFB).

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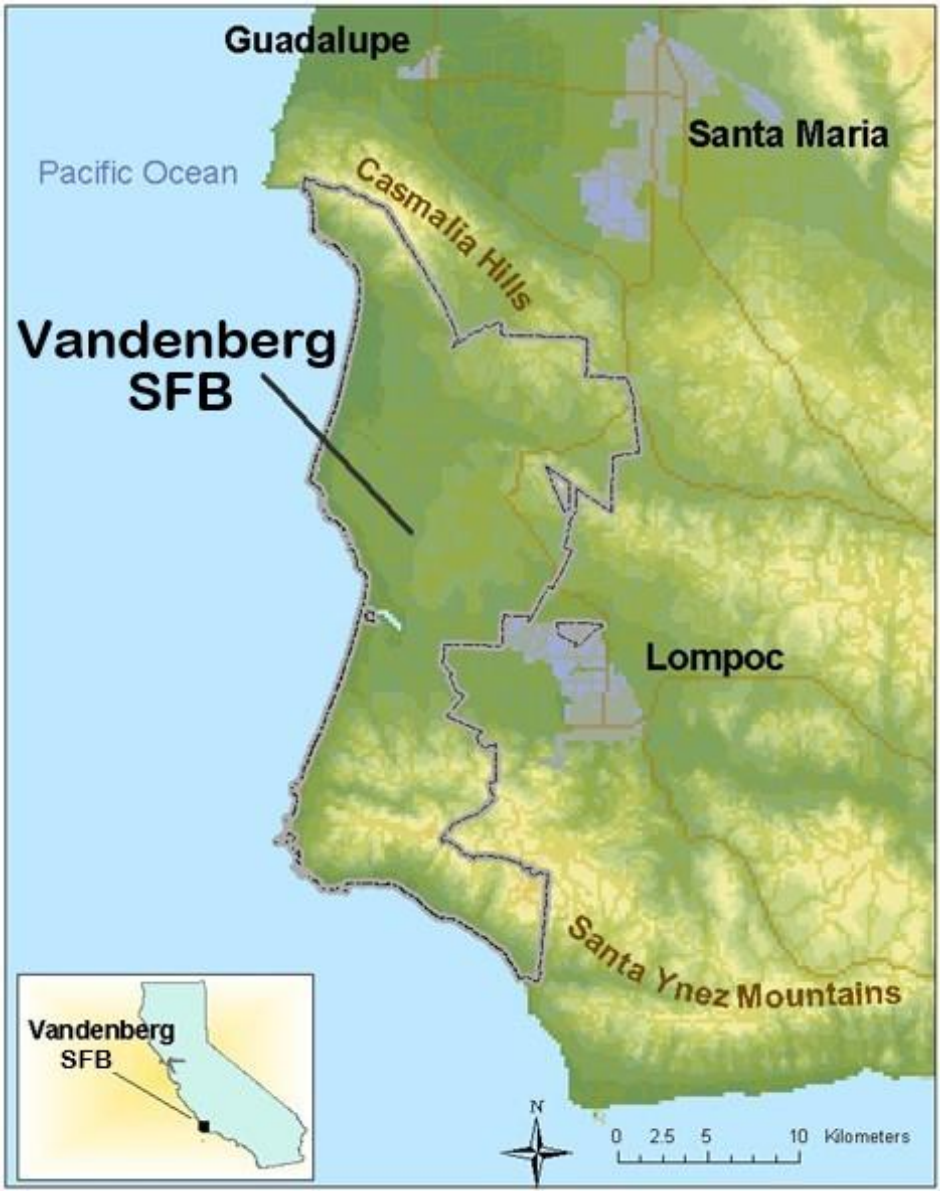
2.0 FACILITY DESCRIPTION

Vandenberg SFB occupies 99,604 acres along the central coast of California and is the third largest Air Force installation in the continental United States. Vandenberg SFB is located in Santa Barbara County within 10 miles of Lompoc and approximately 50 miles north of Santa Barbara. State Highway 246 divides Vandenberg SFB into North Base and South Base with the main cantonment area sited on North Base. The location of the base is shown in Figure 2.0-1.

Figure 2.0-1
Vandenberg SFB Site Location Map



Vandenberg SFB covers more than 154 square miles and includes approximately 612 buildings, 999 privatized housing units, 520 miles of roads, 80 miles of natural gas pipelines, 17 miles of railroad track, and a 15,000-foot concrete runway.

2.1 SOURCE TYPES

Vandenberg SFB has numerous sources that emitted air toxics in 2018. Appendix A includes a complete list of the AB2588 air toxic sources that emitted at Vandenberg SFB during 2018. These devices have been categorized into the following source types for ease of calculation:

- Abrasive Blasting
- Boilers and Heaters
- Food Preparation
- Process Heaters – Paint Booth heater
- Crash Fire Rescue Training
- Explosive Ordnance Disposal
- Internal Combustion Engines (ICE)
- Landfill Gas/Dust
- Motor Vehicle Fueling Facility (MVFF)
- Paint Spray Booths (PSB)
- Propellant Loading
- Solvent and Chemical Usage
- Storage Tanks
- Turbine Engines

Vandenberg SFB has sources of air toxics that are exempt from reporting under AB2588. These exemptions are based on either the definition of facility or on specific inventory guidelines. The following source types were not included in the inventory:

- commercial space entities;
- mobile sources such as motor vehicles, launch vehicles, and small arms range;
- livestock;
- grounds maintenance such as lawn mowers, herbicides, pesticides, and vegetation management burning;
- structural maintenance such as asphalt paving, asphalt roofing, and architectural surface coatings;
- nitrogen tetroxide (N2O4) from the oxidizer vapor scrubbing system—N2O4 is not listed as a toxic substance for which emissions must be quantified;
- use of products for minor maintenance and repair of process and industrial equipment; and
- use of products for the purpose of maintaining motor vehicles.

In addition, the following sources are proposed to be excluded from the inventory on the basis of negligible risk:

- diesel fuel storage tanks; and
- emissions from rocket propellant 1 (RP-1) and jet fuel (Jet-A) loading and storage due to their very low vapor pressure.

3.0 EMISSION QUANTIFICATION METHODS

This section describes how emission rates for each emission category were estimated in the ATEIR. Emission factors were combined with throughput rates for 2018, as previously reported to the SBCAPCD. To simplify the complexity of large number of sources at Vandenberg SFB, source types with common calculation proposals are grouped. Each calculation subsection below discusses a brief source description, assumptions on operational parameters, and emission factor (EF) sources.

3.1 ABRASIVE BLASTING

Abrasive blasting is performed on Vandenberg SFB with various kinds of blasting materials within controlled and uncontrolled environments. Calculating emissions from abrasive blasting was completed using mass balance and control efficiencies.

Emissions calculation for abrasive blasting is provided in Appendix C, Calculation ID 1. Calculation methodology is shown below.

Inputs	Q_A = Quantity of abrasive used (lbs/year) R = Rated throughput (lbs/hour) X_c = Mass fraction of toxic compound in abrasive (%/100) CE = Control efficiency
Outputs	E_Y = Emission of regulated compounds (lbs/year) E_H = Emission of regulated compounds (lbs/hour)
Calculations	$$E_Y = 0.041 \times Q_A \times X_c (1 - CE)$$ $$E_H = 0.041 \times R \times X_c (1 - CE)$$

Notes: lbs – pounds

3.2 BOILERS AND FURNACES

Boilers and furnaces are used for heating of water, generation of steam, or comfort heating. Vandenberg SFB operates both natural gas and liquefied propane gas (LPG) boilers and furnaces. All operating boilers and furnaces are included in the emissions and fuel consumption calculations, even if they were partially operated during 2018.

Emissions for boilers and furnaces are calculated based on fuel usage. The fuel usage for some of the boilers was provided from fuel meter readings. These known usages are subtracted from the total base wide natural gas and LPG usage. The remaining natural gas and LPG totals are allocated to the unmetered boilers and furnaces based upon the ratio between individual boiler/furnace capacity. Further details are listed below in their appropriate sections.

3.2.1 Natural Gas

EFs for natural gas boilers and furnaces are listed in *SBCAPCD-Approved Toxic Air Contaminants (TAC) Emission Factors.xlsx.*

The emissions calculation for natural gas boilers is provided in Appendix C, Calculation ID 2a. Calculation methodology is shown below.

Inputs	BQ = Base Quantity (MMscf/year) BR = Boiler Rating (MMBtu/hr) EF_p = Emission Factor for pollutant p (lbs emitted/MMscf)
Outputs	E_{pY} = Emission for pollutant p (lbs/year) E_{pH} = Emission for pollutant p (lbs/hour)
Calculation	$$E_{pY} = BQ(EF_p)$$ $$E_{pH} = \frac{BR(EF_p)}{1050}$$
Notes	1050 Btu = 1 cubic feet of natural gas

Notes: lbs – pounds
MMBtu – million British thermal units
MMscf – million standard cubic feet

3.2.2 Liquefied Propane Gas

EFs for LPG boilers and furnaces are listed in *SBCAPCD-Approved TAC Emission Factors.xlsx*.

Emissions calculation for LPG boilers is provided in Appendix C, Calculation ID 2b. Calculation methodology is shown below.

Inputs	BQ = Base Quantity (gal/year) BR = Boiler Rating (MMBtu/hour) EF_p = Emission Factor for pollutant p (lbs emitted/1000 gal)
Outputs	E_{pY} = Emission for pollutant p (lbs/year) E_{pH} = Emission for pollutant p (lbs/hour)
Calculations	$$E_{pY} = \frac{BQ(EF_p)}{1000}$$ $$E_{pH} = \frac{BR(EF_p)}{91.5}$$
Notes	91.5 MMBtu = 1000 gallon of propane Emission factors are for LPG fired external combustion sources < 10 MMBtu/hour.

Notes: gal – gallons
lbs – pounds
LPG – liquefied propane gas
MMBtu – million British thermal units

3.3 FOOD PREPARATION

Several restaurants and fast-food establishments operate at Vandenberg SFB. Emissions from cooking of food was calculated based on quantity of food prepared and type of facility (restaurant or fast food). EFs for cooking operations are from *San Joaquin Valley Air Pollution Control District (SJVAPCD) Guidance for Air Dispersion Modeling*.

Emissions calculation for the food preparation are provided in Appendix C, Calculation ID 3. Calculation methodology is shown below.

Inputs	BQ = Base Quantity (tons of food/year) EF_p = Emission Factor for pollutant p (lbs/ton of food)
Outputs	E_{pY} = Emission for pollutant p (lbs/year)
Calculations	$$E_{pY} = BQ(EF_p)$$

Notes: lbs – pounds

3.4 PROCESS HEATERS – PAINT BOOTH HEATER

There are three processes associated with paint booth heaters located at Vandenberg SFB. Emissions are calculated based on natural gas usage. EFs for the natural gas paint booth heaters are listed in *SBCAPCD-Approved TAC Emission Factors.xlsx (Process Heater – Natural Gas)*.

Emissions calculation for the paint booth heaters is provided in Appendix C, Calculation ID 4. Calculation methodology is shown below.

Inputs	BQ = Base Quantity (MMscf/year) BR = Burner Rating (MMBtu/hour) EF_p = Emission Factor for pollutant p (lbs emitted/MMscf)
Outputs	E_{pY} = Emission for pollutant p (lbs/year) E_{pH} = Emission for pollutant p (lbs/hour)
Calculations	$$E_{pY} = BQ(EF_p)$$ $$E_{pH} = \frac{BR(EF_p)}{1050}$$
Notes	1050 Btu = 1 cubic feet of natural gas Emission factors are for Natural Gas fired process heaters < 10 MMBtu/hour.

Notes: lbs – pounds
MMBtu – million British thermal units
MMscf – million standard cubic feet

3.5 CRASH FIRE RESCUE TRAINING

The crash fire rescue training facility is used to train Vandenberg SFB fire fighters and other public agencies in the techniques for extinguishing aircraft fires. Simulated fires are created by igniting LPG in a mock aircraft. An exercise may consist of one or more scenarios. In the worst-case scenario, a maximum of two internal and two ground burners are used. Safety personnel in the safety tower regulate the gas flow when the burners are in operation. The amount of gas is gradually decreased to simulate the fire being extinguished.

Emissions are based on LPG usage. EFs for the crash fire rescue training facility are listed in *SBCAPCD-Approved TAC Emission Factors.xlsx (External Combustion – Propane)*.

Emissions calculation for the crash fire rescue training facility is provided in Appendix C, Calculation ID 5. Calculation methodology is shown below.

Inputs	BQ = Activity Rate or Base Quantity (gal/year) EF_p = Emission Factor for pollutant p (lbs emitted/1000 gal) H = Hours of operation (hour/year)
Outputs	E_{pY} = Emission for pollutant p (lbs/year) E_{pH} = Emission for pollutant p (lbs/hour)
Calculations	$$E_{pY} = \frac{BQ(EF_p)}{1000}$$ $$E_{pH} = \frac{BQ(EF_p)/H}{1000}$$

Notes: gal – gallons
lbs – pounds

3.6 EXPLOSIVE ORDNANCE DISPOSAL

Explosive ordnance disposal is utilized at Vandenberg SFB for the safe elimination of discovered munitions, excess missile or launch vehicle remote destruction components, and ordnance that has exceeded its shelf life. Additionally, a small amount of explosive ordnance is used for training purposes and during emergencies.

Emissions are based on pounds of explosive used during 2018. EFs for explosive ordnance disposal are from the *Air Emissions Guide for Air Force Stationary Sources, August 2018*.

Emissions calculation for explosive ordnance disposal is provided in Appendix C, Calculation ID 6. Calculation methodology is shown below.

Inputs	BQ = Activity Rate or Base Quantity (lbs of explosive/year) EF_p = Emission Factor for pollutant p (lbs/lb of explosive)
Outputs	E_p = Annual Emissions for pollutant p (lbs/year)
Calculations	$$E_p = BQ(EF_p)$$ Hourly Emissions = (E_p) / Operating Days

Notes: lb or lbs – pounds

3.7 INTERNAL COMBUSTION ENGINES

ICEs at Vandenberg SFB are used to power generators, pumps, air compressors, and welders. Vandenberg SFB operates diesel, gasoline, Jet-A, LPG, and natural gas ICEs. Emergency hours were not included in annual emissions. Brake horsepower (bhp) rating was used to calculate hourly emissions.

3.7.1 Diesel

Maximum hourly speciated emissions from diesel engines was calculated by using EFs listed in *SBCAPCD-Approved TAC Emission Factors.xlsx*. Emission calculation for speciated pollutants is provided in Appendix C, Calculation ID 7a. Per SBCAPCD-Approved Emission Factors for TAC, "**Maximum hourly emissions from Tier 3 and Tier 4 engines and Tier 2 engines greater than 750 bhp are not required to be included in the HRA at this time."**

Annual emissions from diesel internal combustion engines are calculated for only diesel particulate matter (PM). Diesel PM emissions was quantified based on the engine-specific diesel PM emission rate, which range from 0.01 to 0.4 grams of diesel PM per bhp-hour, depending on engine size and model year (tier). Diesel PM EFs are from SBCAPCD Emission Factors webpage (https://www.ourair.org/dice/emission-factors) and the California Air Resources Board (CARB) Airborne Toxic Control Measures (ATCM).

Emissions calculation for diesel ICE are provided in Appendix C, Calculation ID 7a and b (annual and hourly emissions are in one spreadsheet). Calculation methodology is shown in the following table for speciated pollutants.

Inputs	EF = Emission Factor (lbs/1000 gal) BHP = Brake Horsepower (bhp)
Outputs	E_{pH} = Emission of pollutant p (lbs/hour)
Calculations	$$E_{pH} = \frac{0.0569(BHP)(EF)}{1000}$$
Notes	0.0569 gal/bhp-hour = (7,800 Btu/bhp-hour)/(137,000 Btu/gal) Only hourly emissions are required for calculating acute risk. Maximum hourly emissions from Tier 3 and Tier 4 engines and Tier 2 engines greater than 750 bhp are not required to be included in the HRA.

Notes: Btu – British thermal unit
gal – gallons
HRA – health risk assessment
lbs – pounds

Calculation methodology is shown below for Diesel PM.

Inputs	BQ = Activity Rate or Base Quantity (hours/year) or (gal/year) EF = Emission Factor for Diesel Particulate Matter (g/bhp-hour) BHP = Brake Horsepower (bhp)
Outputs	E_Y = Emission of Diesel Particulate Matter (lbs/year)
Calculations	$$E_Y = \frac{(BQ)(BHP)(EF)}{453.6}$$

Notes: gal – gallons
lbs – pounds

3.7.2 Gasoline

EFs for gasoline ICEs from *SBCAPCD-Approved TAC Emission Factors.xlsx* were used to calculate TAC emissions.

Emissions calculation for gasoline ICEs is provided in Appendix C, Calculation ID 7c. Calculation methodology is shown below.

Inputs	BQ = Activity Rate or Base Quantity (hrs/year) or (gal/yr) EF = Emission Factor for pollutant p (lbs /1000 gal) BHP = Brake Horsepower (bhp)
Outputs	E_{pY} = Emission for pollutant p (lb/year) E_{pH} = Emission for pollutant p (lb/hour)
Calculations	$$E_{pY} = \frac{0.0808\,(BHP)(BQ)(EF_p)}{1000}$$ $$E_{pH} = \frac{0.0808\,(BHP)(EF_p)}{1000}$$

Notes: gal – gallons
hrs – hours
lbs – pounds

3.7.3 Jet-A

Two units that function as ground support equipment at the flight line use Jet-A fueled turbines. EFs for the Jet-A turbines were obtained from the Air Emissions Guide for Air Force Mobile Sources, August 2018.

Emissions calculation for Jet-A turbines is provided in Appendix C, Calculation ID 7d. Calculation methodology is shown below.

Inputs	BQ = Activity Rate or Base Quantity (gal/year) EF = Emission Factor for pollutant p (lbs /1000 gal) BHP = Brake Horsepower (bhp)
Outputs	E_Y = Annual emission for pollutant p (lb/year) E_H = Hourly emission for pollutant p (lb/hour)
Calculations	$$E_Y = \frac{(BQ)(EF)}{1000}$$ $$E_H = \frac{0.0766\,(BHP)(EF)}{1000}$$

Notes: gal – gallons
lbs – pounds

3.7.4 Liquefied Propane Gas

EFs for LPG ICEs from *SBCAPCD-Approved TAC Emission Factors.xlsx* were used to calculate TAC emissions.

Emissions calculation for LPG ICEs is provided in Appendix C, Calculation ID 7e. Calculation methodology is shown below.

Inputs	BQ = Activity Rate or Base Quantity (hrs/year) or (gal/year) EF = Emission Factor for pollutant p (lbs /1000 gal) BHP = Brake Horsepower (bhp)
Outputs	E_{pY} = Emission for pollutant p (lb/year) E_{pH} = Emission for pollutant p (lb/hour)
Calculations	$$E_{pY} = \frac{0.1148\,(BHP)(BQ)(EF\ )}{1000}$$ **Or** $$E_{pY} = \frac{(BQ)(EF)}{1000}$$ $$E_{pH} = \frac{0.1148\,(BHP)(EF\ )}{1000}$$

Notes: gal – gallons
hrs – hours
lbs – pounds

3.7.5 Natural Gas

EFs for natural gas ICEs from *SBCAPCD-Approved TAC Emission Factors.xlsx* were used to calculate TAC emissions.

Emissions calculation for natural gas ICEs is provided in Appendix C, Calculation ID 7f. Calculation methodology is shown below.

Inputs	BQ = Activity Rate or Base Quantity (hours/year) or (MMscf/year) EF_p = Emission Factor for pollutant p (lbs/MMscf) BHP = Brake Horsepower (bhp)
Outputs	E_{pY} = Emission for pollutant p (lbs/year) E_{pH} = Emission for pollutant p (lbs/hour)
Calculations	$$E_{pY} = \frac{10(BHP)(BQ)(EF_p)}{10^6}$$ **Or** $$E_{pY} = (BQ)(EF)$$ $$E_{pH} = \frac{10(BHP)(EF_p)}{10^6}$$

Notes: lbs – pounds
MMscf – million standard cubic feet

3.8 LANDFILL GAS AND FUGITIVE DUST

Landfill gas contains a small amount of non-methane organic compounds (NMOC). This NMOC fraction may contain various organic hazardous air pollutants and volatile organic compounds (VOCs). Vandenberg SFB used the method described in Part 70/Permit to Operate 13968-R2, the United States Environmental Protection Agency (USEPA) AP-42, and Tajiguas Landfill's test results for LFG to calculate emissions from this source.

Landfill gas emission calculation is included in Appendix C, Calculation ID 8A. Calculation methodology is shown below.

Inputs	8.14E+07 scf Raw LFG/yr (source: *Revised VAFB Landfill _ 2018 Fugitive LFG Emissions for ATEIP.xlsx*) <u>Annual Emissions</u> C = A specific pollutant EmC_{Annual} = Average annual emissions of pollutant C to atmosphere (lb C/yr) LFG_{Annual} = Annual fugitive landfill gas emissions to atmosphere (scf/yr) $Conc_{C\ ppmv}$ = Concentration of pollutant C in ppmv MV = Molar Volume = 379.62 (scf/lb-mol) MW = Molecular Weight of specific pollutant, C (lb/lb-mol) 10^6 = Conversion factor for concentration in ppmv <u>Hourly Emissions</u> C = A specific pollutant $Em_{C\ Max\ Hourly}$ = Maximum hourly emissions of pollutant C (lb C/hr) LFG_{Annual} = Annual fugitive landfill gas emissions to atmosphere (scf/yr) $Conc_{C\ ppmv}$ = Concentration of pollutant C in ppmv MV = Molar Volume = 379.62 (scf/lb-mol) MW = Molecular Weight of specific pollutant, C (lb/lb-mol) 8760 = Number of hours in a year (8760 hr = 1 yr) 10^6 = Conversion factor for concentration in ppmv
Outputs	$Em_{C\ Annual}$ = Average annual emissions of pollutant C (lb C/yr) year $Em_{C\ Max\ Hourly}$ = Maximum hourly emissions of pollutant C (lb C/hr)
Calculations	$Em_{C\ Annual} = LFG_{Annual} * MW * Conc_{C\ ppmv} / (MV * 10^6)$ $Em_{C\ Max\ Hourly} = LFG_{Annual} * MW * Conc_{C\ ppmv} / (8760 * MV * 10^6)$

Notes: hr – hour
lbs – pounds
scf – standard cubic feet
ppmv – parts per million volume
yr – year

Emission calculations for fugitive dust from transport of materials over the landfill paved haul roads is provided in Appendix C, Calculation ID 8B. Calculation methodology is shown below.

Inputs	k = particle size multiplier for particle size range and units of interest (see notes below) sL = road surface silt loading (g/m2) W = average weight (tons) of the vehicles traveling the road VMT = Vehicle Miles Traveled E_{ext} = annual emission factor in the same units as k P = number of hours with at least 0.254 mm (0.01 in) of precipitation during the averaging period N = number of hours in the averaging period (8,760 for annual) VMT for hourly calculation = 15 mph
Outputs	Annual Emissions (lbs/yr) Hourly Emissions (lbs/hr)
Calculations	$Annual\ Emissions\ (lbs/yr) = VMT \times E_{ext}$ $Hourly\ Emissions\ (lbs/hr) = VMT \times E_{ext}$ $E_{ext} = [\ k\ (sL)^{0.91} \times (W)^{1.02}\ ]\ (1 - 1.2P/N)$

Notes: hr – hour
in – inch
g/m2 – grams per square meter
lbs – pounds
mm – millimeter
mph – miles per hour
yr – year

Emission calculations for fugitive dust from unloading of trucks at the landfill is provided in Appendix C, Calculation ID 8C. Calculation methodology is shown below.

Inputs	E = particulate emission factor (lb/ton) k = 0.74 (for TSP, assumed equivalent to PM30) U = mean wind speed (mph) M = material moisture content (14% for load-in). N = number of operating hours (loading/unloading)
Outputs	Annual Emissions (lbs/yr) Hourly Emissions (lbs/hr)
Calculations	*Annual Emissions (lbs/yr) = tons of soil unloaded x E* $E = k * 0.0032 * \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$ *Hourly Emissions (lbs/hr) = Annual Emissions / N*

Notes: hr – hour
lb or lbs – pounds
PM30 – particulate matter less than or equal to 30 micrometers in diameter
TSP – total suspended particulate matter
yr – year

3.9 MOTOR VEHICLE FUELING FACILITIES

This emission source category considers the fugitive losses of fuel that occurs during refueling at motor vehicle fueling facilities (MVFF). Emissions are based on fuel throughput and apply only to gasoline and E-85.

EFs for MVFF are from SBCAPCD permit to operate (PTO) 13968-R2 and South Coast Air Quality Management District (SCAQMD), Supplemental Instructions for Liquid Organic Storage Tanks, Appendix 3, Default TAC Profile for Select Petroleum Products. SBCAPCD Memorandum GDF Emission Factors for Phase I EVR and Phase II EVR and SBCAPCD Form-25T were also used to calculate fugitive emissions.

Emissions calculation for motor vehicle fueling facilities is provided in Appendix C, Calculation ID 9. Calculation methodology is shown below.

Inputs	BQ = Activity Rate or Base Quantity (gal/year) EF_p = Emission Factor for pollutant p (lbs/1000 gal) Z_p = Weight fraction of TAC component PTE_H = Potential to emit (lbs/hour)
Outputs	E_{pY} = Emission for pollutant p (lbs/year) E_{pH} = Emission for pollutant p (lbs/hour)
Calculations	$$E_{pY} = \frac{BQ(EF_p)}{1000}$$ Where: $$EF_p = \frac{Z_p \times EF_{fuel}}{100}$$ Hourly emissions are calculated using methodology in SBCAPCD Form-25T

Notes: gal – gallons
lbs – pounds

3.10 PAINT SPRAY BOOTH

Paint spray booths (PSB) at Vandenberg SFB are equipped with various types of control equipment each having its own control efficiency. Additionally, California Air Pollution Control Officers Association (CAPCOA) *Auto Bodyshop Industrywide Risk Assessment Guidelines* were used to assign capture efficiency for PSB emissions. Maximum hourly emissions from coating and solvent usage are calculated by assuming the maximum monthly usage divided by 21.7 days per month. Safety data sheets (SDSs) for all coatings are provided in Appendix D.

Emissions calculation for PSB is provided in Appendix C, Calculation ID 10. Calculation methodology is shown below.

Inputs	V_p = Volume of product used (gal/year) V_m = Maximum monthly usage (gal/month) D = Density of product (lbs/gal) X_c = Mass fraction of toxic volatile compound in product (%/100) Xs = Mass fraction of solid compound in product (%/100) TE = Transfer efficiency for particulates CE = Control efficiency for particulates CP = Capture efficiency for particulates
Outputs	E_{vY} = Emission of toxic volatile compound (lbs/year) E_{vH} = Emission of toxic volatile compound (lbs/hour) E_{sY} = Emission of solid compounds (lbs/year) E_{sH} = Emission of solid compounds (lbs/hour)
Calculations	$$E_{vY} = V_p \times D \times X_c$$ $$E_{vH} = \frac{V_m \times D \times X_c}{21.7}$$ $$E_{sY} = V_p \times D \times X_s(1 - TE)(1 - CE)CP$$ $$E_{sH} = \frac{V_m \times D \times X_s(1 - TE)(1 - CE)CP}{21.7}$$

Notes: gal – gallons
lbs – pounds

3.11 PROPELLANT LOADING

Two of the four scrubbers operating at Vandenberg SFB emit TAC:

- Fuel vapor scrubbing system (FVSS) for Aerozine-50 (A-50) and hydrazine at Buildings 976/977 are regulated by SBCAPCD Part 70 Permit13968-R2. EFs are based on the Source Test Report for PTO 7987 (July 2001), Table 2.1-1, FVSS Compliance Test Results.
- FVSS for A-50 is located at Space Launch Complex (SLC)-2. EFs are based on the 2018 SBCAPCD Annual Report for Part 70 Permit 13968-R2.

Emissions calculation for the FVSS are provided in Appendix C, Calculation ID 11a and ID 11b. Calculation methodologies are shown below.

Inputs	BQ = Activity Rate or Base Quantity (hours/year) EF_p = Emission Factor for pollutant p (lbs emitted/hour)
Outputs	E_p = Emission for pollutant p (lbs/year)
Calculations	$$E_p = BQ(EF_p)$$ Hourly Emissions are listed below.

Notes: lbs – pounds

Inputs	Activities as reported in the 2018 SBCAPCD Annual Report for Permit 13968. Annual Emission: 1.526 lbs
Outputs	Hydrazine and UDMH Emissions
Calculations	92% of vapor phase is Dimethyl Hydrazine (1,1-) and 8% is Hydrazine. Estimation based on Tables 6.5 – 6.7 of *Determination of Thermodynamic Properties of Aerozine-50* UDMH emissions = 92% * 1.526 = 1.404 lbs/yr and 92% x 0.170 = 0.1564 lbs/hr N2H4 emissions = 8% * 1.526 = 0.122 lbs/yr and 8% x 0.170 = 0.0136 lbs/hr

Notes: hr – hour
lbs – pounds
yr – year
UDMH – Dimethyl Hydrazine (1,1-)
N2H4 – Hydrazine

3.12 SOLVENT AND CHEMICAL USAGE

Minor amounts of individual chemicals are used throughout Vandenberg SFB and include the following source types:

- Adhesives and Sealants
- Concrete Bonding/Curing
- General Surface Coatings
- Miscellaneous Products
- Solvent – Rinse Degreasing

- Solvent Cold Degreaser
- Solvent Wipe Cleaning
- Solvent – Miscellaneous Use

Chemical use is tracked through the Vandenberg SFB hazardous materials pharmacy (HazMart). A barcode is issued for each product to be used at Vandenberg SFB. After a product has been used, HazMart depletes the barcode for that product. At the end of the month, HazMart runs a report of all products depleted during the month. The data contained in the monthly report is used to calculate emissions.

The chemical speciation for the products is obtained from Material SDSs provided in the ATEIP. The chemical speciation (in percent weight) is then multiplied by the weight of product used. All VOCs in products are assumed to be fully emitted. Maximum hourly emissions for chemical usage are calculated by assuming the maximum monthly usage divided by 21.7, the average number of workdays in a month. As a conservative approach, it was assumed that a day's work was done in 1 hour.

In instances where transfer efficiencies are applicable, a factor based on the application method was applied to the calculation. Table 3.12-1 lists the common transfer efficiencies based on historical data.

Table 3.12-1
Chemical Use Transfer Efficiency

Transfer Efficiency	Transfer Efficiency Basis	Factor	Source Type
99%	Hand rolled or brushed	0.99	Adhesives/Sealants
99%	Hand rolled or brushed	0.99	Concrete Bonding/Curing & General Surface Coating

Emissions calculation for solvent and chemical usage is provided in Appendix C, Calculation ID 12.

3.13 STORAGE TANKS

This source category addresses the losses of organic products through the breather vents of organic liquid storage tanks. These losses occur when the pressure of the vapor space above the organic liquid exceeds the pressure settings of the breather vents. Diurnal changes in temperature ("breathing losses") and changes in liquid height from filling and emptying operations ("working losses") contribute to the increases or decreases in vapor pressure. Density and composition of the organic vapor depend upon the vapor pressure of the organic liquid constituents.

Air Program Information Management System (APIMS) was used to calculate TAC emissions from gasoline storage tanks. Emissions calculation for storage tanks is provided in Appendix C, Calculation ID 13.

3.14 TURBINE ENGINES

Vandenberg SFB has five natural-gas turbines used for electric power generation. A continuous emission monitoring system tracks emissions of nitrogen oxides and carbon monoxide. The

turbines use oxidation catalysts to reduce turbine exhaust emissions of carbon monoxide and hydrocarbons. The catalysts do not use ammonia injection.

TAC Emissions are based on fuel usage. EFs for turbine engines are from *SBCAPCD-Approved TAC Emission Factors.xlsx*. Ammonia EF is from Table B-1: Default EF for Natural Gas Combustion (SCAQMD)

Emissions calculation for turbine engines is provided in Appendix C, Calculation ID 14. Calculation methodology is shown below.

Inputs	BQ = Base Quantity (MMscf/year) BR = Turbine Rating (MMBtu/hour) EF_p = Emission Factor for pollutant p (lbs/MMscf)
Outputs	E_{pY} = Emission for pollutant p (lbs/year) E_{pH} = Emission for pollutant p (lbs/hour)
Calculations	$$E_{pY} = BQ(EF_p)$$ $$E_{pH} = \frac{BR(EF_p)}{1020}$$

Notes: lbs – pounds
MMBtu – million British thermal units
MMscf – million standard cubic feet

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4.0 FACILITY DIAGRAM

Map of Vandenberg SFB showing sources and some receptors are provided in Appendix B of the ATEIR.

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5.0 ACRONYMS AND ABBREVIATIONS

A-50	Aerozine 50
AB2588	Assembly Bill 2588
AFB	Air Force Base
APCD	Air Pollution Control District
APIMS	Air Program Information Management System
ATCM	Airborne Toxic Control Measures
ATEIP	Air Toxic Emission Inventory Plan
ATEIR	Air Toxic Emission Inventory Report
bhp	brake horsepower
btu	British thermal units
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resources Board
EF	emission factor
EVR	enhanced vapor recovery
E-85	fuel comprised of 85 percent ethanol and 15 percent gasoline
FVSS	fuel vapor scrubbing system
GDF	gasoline dispensing facilities
HazMart	hazardous materials pharmacy
HRA	health risk assessment
ICE	internal combustion engine
lbs	pounds
LPG	liquefied propane gas
MMBtu	million British thermal units
MMscf	million standard cubic feet
MVFF	Motor Vehicle Fueling Facility
N_2O_4	nitrogen tetroxide
NMOC	non-methane organic compounds
PAHs	polycyclic aromatic hydrocarbons
PM	particulate matter
ppmv	parts per million volume
PSB	paint spray booth
PTO	permit to operate
RP-1	rocket propellant 1
SBCAPCD	Santa Barbara County Air Pollution Control District
SCAQMD	South Coast Air Quality Management District
scf	standard cubic feet

SDS	Safety Data Sheet
SFB	Space Force Base
SJVAPCD	San Joaquin Valley Air Pollution Control District
SLC	space launch complex
TAC	Toxic Air Contaminant
TSP	total suspended particulate matter
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound