# Air Quality: Air Pollutants, SLAC Emissions Sources, and Regulatory Reference

Department: Chemical and General Safety
Program: Air Quality
Owner: Program Manager
Authority: ES&H Manual, Chapter 30, Air Quality[1]

SLAC's air emissions are regulated through a federally mandated site-wide permit as well as through local, regional, and state regulatory requirements, as outlined in Chapter 30, "Air Quality". Air permit regulations are designed to track, record, and control air pollutants belonging to several different categories, some of which are based on public health concerns, and some of which are based on chemical classifications. This reference outlines major categories of air pollutants found at SLAC and associates them with the areas where they are found or produced.

*Note* *For a complete list of emissions sources, locations, and SLAC's umbrella permit conditions, see Air Quality: Permitted and Permit-exempt Emissions Source Requirements.*[2]

## *Air Pollution Classifications*

Air pollution can exist in many different forms, including gas, mist, aerosol, and particulates, and it can consist of many types of chemical constituents, including inorganic gases, hazardous pollutants, and organic compounds. The main regulatory categories of air pollutants at SLAC are *criteria pollutants, organic compounds, hazardous air pollutants (HAPs),* and *air toxics,* and g*reenhouse gases.*

### Criteria Pollutants

The US Environmental Protection Agency (USEPA) regulates *criteria pollutants*, which are considered harmful to public health and the environment, under the National Ambient Air Quality Standards (NAAQS). The six criteria pollutants are[3]

- Carbon monoxide (CO)
- Oxides of nitrogen ($NO_x$)
- Sulfur dioxide ($SO_2$)
- Particulate matter (PM10 and PM2.5)
- Lead (Pb)
- Ozone ($O_3$)

1 *SLAC Environment, Safety, and Health Manual* (SLAC-I-720-0A29Z-001), Chapter 30, "Air Quality", http://www-group.slac.stanford.edu/esh/environment/air_quality/policies.htm

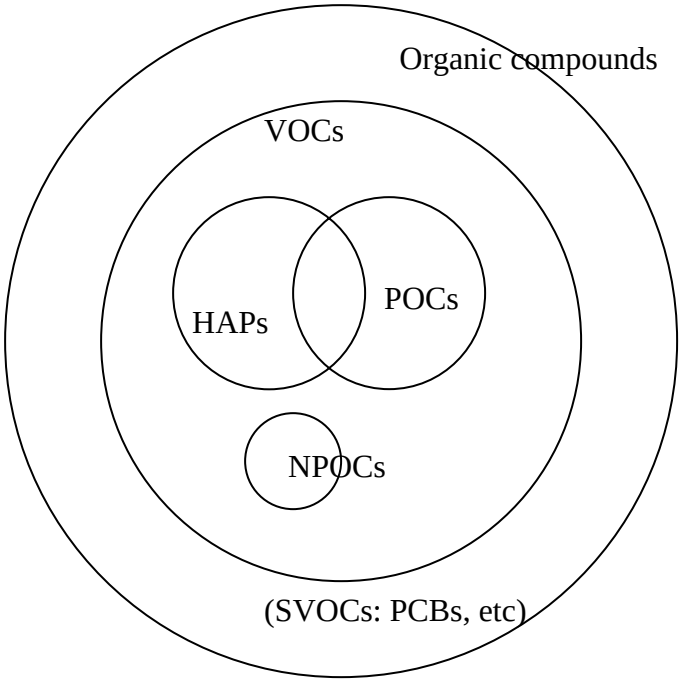
2 Air Quality: Permitted and Permit-exempt Emissions Source Requirements (SLAC-I-730-0A16S-002), http://www-group.slac.stanford.edu/esh/eshmanual/references/airReqSources.pdf

3 "EPA National Ambient Air Quality Standards, NAAQS", http://epa.gov/air/criteria.html

*Note* *Ozone is a pollutant when close to the Earth's surface, but in the upper atmosphere the ozone layer protects the Earth from harmful ultraviolet rays. Stratospheric ozone is depleted by various man-made chemicals (mostly freons) known as* ozone-depleting substances (ODSs).

## Organic Compounds

The Bay Area Air Quality Management District (BAAQMD) has established strict requirements for many processes and products that emit organic – or carbon-containing – compounds. This complex group of compounds comprises multiple interlaced subgroups as illustrated and described below. These compounds are regulated because they contribute to smog, global warming, and/or depletion of the ozone layer.




| ACRONYM | EXPLANATION |
|---|---|
| VOCs | volatile organic compounds |
| SVOCs | semi-volatile organic compounds |
| POCs | precursor organic compounds |
| NPOCs | non-precursor organic compounds |
| HAPs | hazardous air pollutants |
| PCBs | polychlorinated biphenyls |
| ODSs | ozone-depleting substances |

Figure 1 Organic Compounds Classification Overlap

### *Volatile Organic Compounds*

Volatile organic compounds (VOCs) vaporize when used, thus releasing potentially harmful organic compounds into the atmosphere. Examples of liquids that contain VOCs include paints, paint thinner, solvents, petroleum hydrocarbons, and liquid fuel. Although they are not as reactive as VOCs, certain semi-volatile organic compounds (SVOCs) are also regulated – for example, those that persist in the environment and break down very slowly.

### *Precursor Organic Compounds*

Precursor organic compounds (POCs), which react with light to form photochemical tropospheric smog, include gasoline vapors, perchloroethylene (perc), alcohols (such as ethanol or methanol), and ketones (such as acetone).

### *Non-precursor Organic Compounds*

Non-precursor organic compounds (NPOCs) do not contribute to photochemical smog, although they may deplete the ozone layer in the stratosphere. This group includes methylene chloride, methyl chloroform, and chlorofluorocarbons (CFCs), which are commonly referred to as *freons*. At SLAC, NPOCs are used in equipment such as vapor degreasers, cold cleaners, and air-conditioning equipment.

*Note* *Many organic compounds belong to two or more regulated overlapping classifications. Air permits specify the allowable amount for specific sources and also express limits in terms of pollutant type (for instance, HAPs, POCs, and VOCs).*

## Hazardous Air Pollutants

This category comprises the 188 pollutants that are listed in Section 112(b) of the federal Clean Air Act.[4] The USEPA established emissions standards for a wide range of industrial activities that involve use of these chemicals under the National Emission Standards for Hazardous Air Pollutants (NESHAPs) program.

Hazardous air pollutants (HAPs) are used at SLAC in several permitted emissions sources. Most of the halogenated-solvent cleaners used at SLAC and regulated under NESHAPs are located in the Plating Shop Complex. These chemicals are

- Perchloroethylene (PCE) or Perc
- 1,1,1-trichloroethane (TCA)
- Trichloroethylene (TCE)

## Air Toxics or Toxic Air Contaminants

The National Ambient Air Quality Standards (NAAQS) were established in order to identify and address airborne chemicals with potentially significant impacts to human health and the environment. More recently, the state of California has compiled a list of toxic air contaminants (TACs) that expand the scope of air quality management. Specifically, TACs are thought to cause or contribute to irreversible illness,

4 Clean Air Act, Section 112, "Hazardous Air Pollutants", http://www.epa.gov/oar/caa/caa112.txt

incapacitating illness, or death.[5] Selected substances from the list of TACs that may typically be found at SLAC include

- Arsenic, cyanide
- Glycol ethers, methanol
- Asbestos
- Hydrochloric acid (HCl)
- Radionuclides
- Nickel, lead, chromium, cadmium, beryllium, mercury

### Greenhouse Gases

Greenhouse gases (GHGs) comprise a variety of chemicals that trap heat in the lower atmosphere, rather than allowing it to dissipate. Each GHG has a characteristic global warming potential (GWP) that measures its heat-trapping ability relative to carbon dioxide ($CO_2$), which has a GWP of one.

Many freons and other halogenated compounds have substantial GWP values in the hundreds or thousands, but the most powerful GHG known is sulfur hexafluoride ($SF_6$), which has a GWP of 23,900. This gas is used routinely in electrical equipment around the world, and is used at SLAC in both electrical and research applications.

In California, the passage of Assembly Bill 32 in 2006 paves the way for these emissions to be regulated in the near future.[6]

## *SLAC Emissions Sources*

Gasoline fumes and vehicle exhaust probably represent the most typical chemical exposure for most persons, both at SLAC and elsewhere, but specific areas at SLAC present specific hazards. These are noted on signage outside each building and work area and incorporated into area hazard analyses (AHAs).

A simplified overview of the main emissions sources at SLAC is provided below. These sources, listed in alphabetical order, are associated with the type of pollutant, the hazard category, and regulatory responsibilities for emissions source custodians (ESCs). Each of these topics is described in more detail in the exhibits indicated at the bottom of the table.

The recordkeeping efforts outlined under regulatory responsibilities are translated by the air quality program manager into the required reports and deliverables itemized in Air Quality: Reporting Requirements.7 Each of the emissions sources is discussed in more detail in the following section.

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5 New Source Review of Toxic Air Contaminants, http://www.baaqmd.gov/dst/regulations/rg0205.pdf

6 Assembly Bill 32, http://www.arb.ca.gov/cc/docs/ab32text.pdf

7 Air Quality: Reporting Requirements (SLAC-I-730-0A16S-004), http://www-group.slac.stanford.edu/esh/eshmanual/references/airReqReporting.pdf

| Emissions Source[1] (activity and/or equipment) | Permitted (P), Exempt (E), or Not Applicable (n/a) | Pollutant | Hazard Category[2] | Regulatory Responsibilities[3] |
|---|---|---|---|---|
| Abrasive blasting | E | Particulates | Particulates | Periodic inspection to maintain exempt status |
| Asbestos removal; construction | P | Asbestos dust | HAP | BAAQMD advance notification |
| Boilers | P | Nitrous oxides ($NO_x$)<br>Carbon monoxide (CO) | Criteria pollutant | Read flow meter<br>(ccf , hundred cubic feet) |
| Cutting/grinding | E | Particulates | Criteria pollutant | Periodic inspection to maintain exempt status |
| Electroplating | P | Cyanide compounds<br>VOCs / solvents<br>Acids<br>Corrosives | HAP (NESHAPs)<br>Air toxics<br>Organic compounds | Process chemical use<br>Recordkeeping<br>(solvents and alcohols) |
| Epoxies and adhesives | P | Resins<br>Solvents | Air toxics | Recordkeeping |
| Generators<br>(Emergency backup) | P | Hydrocarbons, particulates | Criteria pollutant | Recordkeeping<br>(operating hours) |
| Lead shielding | n/a | Lead oxides | Criteria pollutant | Inventory and reporting for the Toxics Release Inventory (TRI)<br>Integrated Safety and Environmental Management System (ISEMS) |
| Paints and coatings<br>Spray paint booths | P | VOCs | HAP | Recordkeeping<br>of hazardous material use |
| Sludge dryer | P | Particulates | Criteria pollutant | Sludge volume throughput |
| Solvent cleaning operations (facility-wide)<br>Wipe and cold cleaners and hot vapor degreasers | P | VOCs | HAP | Recordkeeping<br>Find substitutes |
| Solvent recyclers | E | VOCs | HAP | Recordkeeping |
| Vehicles | E | Petroleum hydrocarbons, asbestos from brake pads, copper, chromium, other metals | Air toxics<br>Criteria pollutants | Recordkeeping |

[1]For a full list, see Air Quality: Permitted and Permit-exempt Emissions Source Requirements

[2]For a full list of regulatory reports and deliverables, including program details, see Air Quality: Reporting Requirements

[3]For an overview of personnel responsibilities, see Air Quality: Roles, Responsibilities, and Authorities Matrix

## Asbestos

Renovation or demolition projects can cause *regulated asbestos-containing material* ([R]ACM) to contaminate the air unless the renovation or demolition is carried out in accordance with the BAAQMD airborne toxic control measure (ATCM) for asbestos. Such projects must be evaluated by the industrial hygiene program manager, and depending on the project scope, a notification form must be submitted to the BAAQMD. Asbestos work can only be performed by qualified personnel. For details and requirements, see

- Chapter 27, "Asbestos"[8]
- Air Quality: Construction Project Air Permit Requirements[9]
- Air Quality: Asbestos Notification Procedure[10]

## Boilers

SLAC's boilers supply heat that is used for climate control in buildings and for various industrial operations, including plating processes. The two main boilers burn natural gas, but can be switched to diesel in an emergency. Fuel combustion produces the criteria pollutants nitrogen oxides and carbon monoxide. These emissions are minimized by performing regular maintenance and annual tune-ups.

*Note* *SLAC's permit limits the amount of fuel consumed. The site-wide limit for natural gas is 770,000 therms. The boilers must operate within this constraint, as well as an operational limit of 500 hours maximum per year running on diesel.*

## Cutting and Grinding

SLAC shops include wheels used for grinding and various kinds of saws and torches used for cutting. These sources are all permit-exempt due to either to adequate abatement, low-use frequency, or use of non-hazardous materials.

## Electroplating / Plating Shop Complex

The Plating Shop Complex offers complete onsite plating and solvent-cleaning services that necessitates the use of an extensive range of hazardous materials, including cyanides, halogenated solvents, strong acids and bases, and alcohols.

Due to the range and volume of hazardous materials used, the Plating Shop manager is highly proactive regarding worker protection, process safety management, waste minimization, chemical substitution, and alternate plating technologies. Process improvements include the installation of a near-zero emissions (NZE) degreaser, a chromium reduction tank, and the regeneration and re-use of ferric chloride.

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8 *SLAC Environment, Safety, and Health Manual* (SLAC-I-720-0A29Z-001), Chapter 27, "Asbestos", http://www-group.slac.stanford.edu/esh/hazardous_substances/asbestos/policies.htm

9 Air Quality: Construction Project Air Permit Requirements (SLAC-I-730-0A16S-003), http://www-group.slac.stanford.edu/esh/eshmanual/references/airReqConstruction.pdf

10 Air Quality: Asbestos Notification Procedure (SLAC-I-730-0A16C-001), http://www-group.slac.stanford.edu/esh/eshmanual/references/airProcedAsbestosNotify.pdf

The complex encompasses the Plating Shop, the annex, and the cyanide room (all in Building 25), a chemical storage area (Building 36), and a wastewater treatment plant (Building 38). The treatment plant includes a sludge press, sludge dryer (see below), and bag-house. Dedicated air scrubbers provide emissions abatement for this area.

## Epoxies and Adhesives

Epoxies and adhesives generally contain organic solvents that make application easier but when they evaporate they become hazardous air emissions.(See also Paints and Coatings, below.) Proper ventilation is essential, as well as appropriate personal protective equipment (PPE) as specified on the MSDS.

*Note* *Epoxies, adhesives, epoxy/adhesive containers, disposable face masks, and particulate filters must be disposed of as described in Chapter 17, "Hazardous Waste".*[11]

## Generators

Electric power shortages and increasing electricity costs have led to a sharp rise in the purchase and use of fossil fuel-powered generators in California. SLAC generators use Biodiesel 20 exclusively, but increasingly stringent regulations to protect air quality limit the amount of fuel that may be used. SLAC's permit specifies that

- No more than 95,000 gallons of diesel will be purchased or dispensed in any 12-month period, including emergency use
- A monthly log of gallons of diesel used in the previous month with a year summary of gallons used in the previous 12 months must be kept on site
- The log must be submitted at the time of permit renewal

Portable generators are regulated under the statewide portable equipment registration program (PERP).[12] Subcontractors and university technical representatives (UTRs) must provide registration documentation to the program manager before such non-SLAC portable equipment can be brought on site. In addition, use logs must be kept to record hazardous material use, fuel consumption, and equipment operating hours.[13]

## Paints and Coatings

Surface coatings, such as paint, lacquer, varnish, enamel, and sealant, contain regulated organic solvents such as xylenes, glycol ethers, and chlorinated hydrocarbons. While organic solvents make applying a coating easier, they also constitute a regulated hazardous emissions source when they evaporate.

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11 *SLAC Environment, Safety, and Health Manual* (SLAC-I-720-0A29Z-001), Chapter 17, "Hazardous Waste", http://www-group.slac.stanford.edu/esh/environment/hazardous_waste/policies.htm

12 Regulation to Establish a Statewide Portable Equipment Registration Program, http://www.arb.ca.gov/portable/perp/newreg.pdf

13 Air Quality: Monthly Hazardous Material Use, Fuel Consumption, and Equipment Operation Forms (SLAC-I-730-0A16J-001), http://www-group.slac.stanford.edu/esh/forms/

SLAC's central paint shop is equipped with filters to control air emissions during routine painting of equipment and fabricated metal and wood parts. When paint is applied elsewhere, considerations such as limiting VOC emissions must be taken into account. Often, a water-based surface coating may be available, and any suitable surface coating that is below the applicable VOC limit should be the preferred choice.

*Note* *Paints, coatings, paint/coating containers, disposable face masks, and particulate filters must be disposed of as described in Chapter 17, "Hazardous Waste".*[14]

## Abrasive Blasting

Abrasive blasting mechanically cleans equipment parts or prepares surfaces for coating. This method generates fine particulates of dry aluminum oxide or wet abrasives, together with paint chips and other materials, and these emissions are regulated due to their small size. Virtually all abrasive blasting at SLAC is performed within containments to control the release of particulates. SLAC's air permit specifies a cap of 8,000 pounds per year of particulates (PM10).

### *Indoor Abrasive Blasting*

SLAC's abrasive-blasting booths provide a controlled environment where emissions are drawn into a collection reservoir, typically a baghouse.

*Note* *Baghouses function like vacuum cleaners, collecting suspended dusts and solids from exhaust air as it passes through filters. Cyclone baghouses use centrifugal force and gravity to perform the same function. The filtered air is then discharged to the atmosphere.*

### *Outdoor Abrasive Blasting*

Any unconfined dry sandblasting that is to be done outdoors must first be evaluated by the program manager. Examples of outdoor abrasive-blasting activities include preparing a building for repainting or cleaning stationary equipment.

The abrasive blasters used at SLAC are permit-exempt due to low use frequency and use of non-hazardous materials such as glass beads or sand.

## Sludge Dryer

A sludge dryer is associated with the Metal Finishing Pre-Treatment Facility (MFPF), which services the Plating Shop Complex. The sludge is produced in the course of processing the effluent from that area's metal finishing operations and the industrial wastewater treatment facility.

The sludge is dewatered by first passing it through a filter press and then through a dryer, where a packed-tower fume scrubber collects emissions. Water sprayed through the tower absorbs any gas and particulates in the exhaust as it travels upward. The dried sludge is bagged and collected by the Waste Management Group (WM) for offsite disposal.

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14 *SLAC Environment, Safety, and Health Manual* (SLAC-I-720-0A29Z-001), Chapter 17, "Hazardous Waste", http://www-group.slac.stanford.edu/esh/environment/hazardous_waste/policies.htm

### Solvent Recyclers

Solvents are used for cleaning equipment parts, usually by dipping or placing them in vapor-degreasing and cold-cleaning tanks, or by wiping the surface. Cleaning can be performed by automated stationary equipment, or manually anywhere on site.

Vapor degreasing involves heating solvents such as TCA or PCE and using the vapors and spray wands to clean equipment parts. Cold cleaning is done at room temperature, using such solvents as petroleum distillates or isopropyl alcohol. Wipe cleaning involves using a solvent-soaked cloth or paper towel to clean equipment parts.

Halogenated solvent cleaning sources such as TCE, trichloroethane, and methylene chloride are subject to special reporting requirements under the NESHAP program.

*Note* *Place used cloths/paper towels into a covered waste container provided and managed by WM. For additional information, see Hazardous Waste: Rags, Wipes, Swabs, and Other Items Contaminated with Hazardous Material - Guidelines.*[15]

### Vehicles

Passenger cars and trucks, along with forklifts, mobile cranes, and other heavy equipment are exempt from the air permit. However, both personal and government vehicles are subject to the California Air Resources Board's (CARB) smog certification program, which aims to keep vehicles within allowable emissions standards. In addition, vehicles are subject to SLAC's policy to minimize motor idling to reduce emissions.

Fleet Services, which operates under Conventional and Experimental Facilities (CEF), maintains vehicle records for both General Services Administration (GSA) and Department of Energy (DOE) vehicles. SLAC is continuing its efforts to convert its vehicle fleet to newer, cleaner, more efficient electric and alternative-fuel vehicles.

## *Abatement Devices and Strategies*

An abatement device is any equipment or process whose sole purpose is to reduce the amount of one or more pollutants released into the atmosphere. Abatement devices include catalytic converters on cars and particulate filters. Although a given source might never qualify for a permit without emissions abatement, effective abatement can reduce emissions sufficiently to exempt that same source from permitting requirements entirely.

In the course of processing a permit application for a new source, the regulator may determine that the source would be in violation if allowed to operate without abatement. In such cases, the applicant would be directed to prepare a proposal to reduce the emissions from the source in order to get the source approved. In the case of an existing source, its regulated emissions may become unacceptable, due to aging of the equipment and/or more stringent limits over time, and an abatement device is added on under a separate permit.

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15 Hazardous Waste: Guidelines for Rags, Wipes, Swabs, and Other Items Contaminated with Hazardous Material (SLAC-I-750-0A08T-004), http://www-group.slac.stanford.edu/esh/eshmanual/references/hazwasteGuideRag.pdf

Abatement strategies include waste minimization efforts outlined in Chapter 22, "Waste Minimization and Pollution Prevention".[16] Examples of such strategies include finding alternatives to products that reduce air quality, such as choosing water-based paints instead of paints containing a solvent carrier, or replacing equipment that uses ozone-depleting substances (ODSs), such as chillers, with newer models that operate using ODS substitutes.

## Vehicle Emissions Abatement

### *Electric Vehicles*

SLAC's growing fleet of electric vehicles is replacing older, less efficient gasoline and diesel powered vehicles. As of 2007, 50 such vehicles are in use at SLAC.

### *Biodiesel*

Biodiesel is a cleaner-burning diesel fuel containing natural, renewable non-petroleum compounds such as new and used vegetable oils and animal fats. Like petroleum diesel, biodiesel operates in compression-ignition engines. Biodiesel 20, a blend of conventional diesel mixed with 20 percent biologically based compounds, is dispensed exclusively from the SLAC Gasoline Dispensing Facility (GDF). It can be used in temperate climates in nearly all diesel equipment, and is compatible with most storage and distribution equipment. Such low-level blends (20 percent and less) require no engine modifications and can provide the same payload capacity as diesel. In addition, using biodiesel in a conventional diesel engine substantially reduces emissions.

### *Natural Gas*

The two main boilers account for nearly three-quarters of SLAC's total natural gas usage. SLAC's smaller boilers (generating less than 1 million BTU/hour) are permit-exempt if they run solely on natural gas. (A secondary supply line for diesel fuel can be installed for contingency use.)

16 *SLAC Environment, Safety, and Health Manual* (SLAC-I-720-0A29Z-001), Chapter 22, "Waste Minimization and Pollution Prevention", http://www-group.slac.stanford.edu/esh/environment/pollution_prevention/policies.htm