AIR MANAGEMENT REGULATION XIV: CONTROL OF PERCHLOROETHYLENE FROM DRY CLEANING FACILITIES

BACKGROUND DOCUMENT

City of Philadelphia
Department of Public Health
Air Management Services

Executive Summary

The Philadelphia Department of Public Health's Air Management Services (AMS) is responsible for the prevention, abatement, and control of air pollution in Philadelphia. AMS programs are conducted under authority provided by the Philadelphia Air Management Code, the Pennsylvania Air Pollution Control Act, and the Federal Clean Air Act. These programs include activities directed to the prevention and control of air pollution and air pollution nuisances, as required to achieve and maintain national ambient air quality standards, reduce air toxics, and to provide healthy air quality citywide.

Tetrachloroethylene, also known as perchloroethylene or Perc, is a solvent used in dry cleaning. There are approximately 132 dry cleaning facilities in Philadelphia. Of these, there are 125 dry cleaning facilities identified by AMS as using Perc and 7 dry cleaners using exempt solvents in Philadelphia. Most of these facilities share a partition, designated as co-located, with either a commercial entity (co-commercial) or a residential entity (co-residential). There are 67 co-commercial and 45 co-residential dry cleaning facilities in the City of Philadelphia. The remaining thirteen dry cleaners are stand-alone facilities.

Studies performed by AMS and others show that the use of Perc may result in unacceptable health risks to people who reside or work next to dry cleaners. Also, AMS is concerned that other Perc replacement solvents, namely n-Propyl-Bromide, are as toxic, if not more so, than Perc.

AMS has proposed a new regulation, entitled "Air Management Regulation XIV – Control of Perchloroethylene from Dry Cleaning Facilities," to protect people who live or work next to dry cleaning facilities by eliminating the use of Perc at co-residential dry cleaning facilities and requiring additional testing and control measures at co-commercial dry cleaning facilities. The regulation also bans the use of n-Propyl-Bromide as a solvent used in the dry cleaning process. The proposed regulation requires Perc dry cleaning facilities located in residential buildings (co-residential facilities) or co-sensitive facilities to neither use nor emit Perc after December 31, 2013. In addition, co-located dry cleaning facilities will be required within twelve months of the effective date of the regulation to install a vapor barrier or professionally designed exhaust system that includes a 25 foot buffer zone.

Background

The process of "dry cleaning," which is the process of cleaning fabrics with nonaqueous liquids, is believed to have begun in France in 1825. According to the International Agency for Research on Cancer (IARC):

> Turpentine, benzene, benzene soap, naphtha and gasoline were used. Stoddard solvent (mineral spirits or white spirits) was introduced to the United States in order to minimize the fire hazards associated with use of the more volatile hydrocarbon-based solvents. Carbon tetrachloride was used and eliminated over the years due to toxicity and corrosiveness. Perc was introduced in the 1930s.

Use of Perc began to increase in the 1940s, and by the late 1950s it had virtually replaced carbon tetrachloride and trichloroethylene in commercial dry cleaning.

Health and Environmental Effects of Tetrachloroethylene (Perc)

According to the USEPA's Science Advisory Board, Perc is classified as a possible to probable human carcinogen. Exposure to Perc has been linked to the development of liver tumors in mice. Exposure to Perc also is associated with chronic, non-cancer health effects, including liver and kidney damage in rodents, and neurological effects in humans. Acute exposures can result in loss of coordination; eye, nose and throat irritation; and headache (USEPA, Basic Information, 2006). The major effects from chronic inhalation exposure to Perc in humans are neurological effects, including sensory symptoms such as headaches, impairments in cognitive and motor neurobehavioral functioning and color vision decrements. Other effects noted in humans include cardiac arrhythmia, liver damage, and possible kidney effects.

ATSDR (Agency for Toxic Substances and Disease Registry) has calculated a chronic-duration inhalation minimal risk level (MRL) of 0.04 parts per million (ppm) (or 40 parts per billion, ppb) and 0.2 ppm (200 ppb) for acute-duration for Perc based on neurological effects in humans. The MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure. Acute-duration is defined as 1 – 14 days while chronic-duration is defined as 365 days or longer.

Epidemiological studies of dry cleaning workers exposed to Perc and other solvents suggest an increased risk for a variety of cancers (esophagus, kidney, bladder, lung, pancreas, and cervix). These studies are complicated by potential exposure to other chemicals and personal lifestyle factors such as alcohol consumption and smoking were not taken into account. (USEPA, TTN, Fact Sheet)

IARC, too, has classified Perc as a Group 2A carcinogen, that is, probably carcinogenic to humans (IARC, 1995, Vol. 63). The full report on this cancer classification can be found at the IARC website (www.iarc.fr).

Air toxics, also known as hazardous air pollutants (HAPs), are substances that are known or suspected to cause cancer or other serious health effects, such as birth defects, or adverse environmental and ecological effects. HAPs in the air are more localized than criteria pollutants and are usually found at highest levels close to their sources. The Federal Clean Air Act Amendments (CAAA) of 1990 list 187 pollutants or chemical groups as HAPs. Examples of air toxics include heavy metals (such as beryllium), organic chemicals (such as formaldehyde), polycyclic organic matter (POM, which are formed primarily by combustion), benzene, which is found in gasoline, and pesticides, fine mineral fibers, and asbestos. HAPs are emitted from thousands of sources such as stationary sources (large industrial facilities) and area sources (dry cleaners and household uses), as well as mobile sources (trucks and buses).

There is less information known about the health impact from HAPS than there are for criteria pollutants, and no national standards exist for them. It is not possible to compare the measured ambient air concentrations to Federal standards. However, a number of these pollutants are known or suspected to be carcinogenic, and there is no known "safe concentration." The danger level of toxics is often referred to in terms of risk. Risk is defined as the likelihood of a negative outcome from a certain level of a specific chemical, or the measure of a chance that you will experience health problems. For example, many toxics cause cancer, while others cause respiratory problems, birth defects, neurological problems, immune system problems, and other health problems. Toxics have varying degrees of danger, and some will cause harm in very small amounts, while others require large doses to result in a negative effect. Risk is often related as the additional number of deaths that would occur over 70 years (a lifetime) than would have occurred without that ambient concentration of that pollutant. For example, one in a million implies that one person out of every million people would live a little longer without that amount of that pollutant in the air.

The state of California includes Perc on its list of "Chemicals Known to the State to Cause Cancer". The full list is available at https://oehha.ca.gov/media/downloads/proposition-65/p65chemicalslist.pdf California has developed a Unit Risk Estimate (URE) of 5.9 x 10^{-6} per $\mu g/m^3$ for evaluating cancer risk from inhalation of Perc (CEPA, May 2005). Other cancer UREs for Perc include: New York at $1.3x10^{-6}$ per $\mu g/m^3$,Massachusetts at $55.2x10^{-6}$ per $\mu g/m^3$, and the EPA at $2x10^{-6}$ to $20x10^{-6}$ per $\mu g/m^3$ (draft).
At present the EPA has defined acceptable risks for carcinogens as within the range of 10^{-4} (100 in a million) to 10^{-6} (1 in a million) excess lifetime cancer risk.

The URE or Unit Risk Factor (URF) is the measure of the probability of developing cancer from exposure over a lifetime to a specified concentration of a given chemical. A primary source for cancer risk factors came from the following website: http://www.epa.gov/iris/. The Integrated Risk Information System (IRIS) is a database of human health effects that may result from exposure to various substances found in the environment.

The URE is derived by assuming an adult weighing 70 kilograms (154 pounds) will breathe 20 m^3 (706 ft^3) of air each day for 365 days a year, over a 70-year lifetime of exposure. The excess lifetime cancer risk is calculated for each chemical by multiplying its URE by the average concentration of all valid air samples collected during the year at that site.

A study was performed by the New York State Department of Environmental Conservation (NYSDEC) involving dry cleaning facilities using Perc. Where the facilities were co-located with residential property, such as an apartment house with a dry cleaner on the ground floor, some of the residential areas showed high levels of Perc. Data collected during this period indicated that resident exposures ranged from a geometric mean of 33 $\mu g/m^3$ to a maximum of 5,000 $\mu g/m^3$ which was equated by the USEPA to an estimated incremental lifetime cancer risk of between 4,000 in a million and 30,000 in a million, about 140 times higher than the maximum typical area source risk, and a non-cancer hazard as high as 20 in a million (70 Fed. Reg. 75884) The NYSDEC study cited extensive research that the Hudson County Health Department conducted of Perc sources in Hudson County, New Jersey.

The USEPA referenced the NYSDEC study in its proposal of rules relating to dry cleaners. USEPA stated that in apartments in buildings that are located very close to dry cleaners, residents' exposures and their estimated cancer risks can be much higher than they are for typical area sources. According to the USEPA, Co-residential facilities pose a unique exposure scenario. Because apartments in these buildings are located very close to these dry cleaners, residents' exposures and their estimated cancer risks can be much higher than for typical area sources. Based on the data evaluated for this proposal, estimated maximum cancer risks for people living in some of these buildings might be in excess of 100 in 1 million (USEPA, Dry Cleaner Fact Sheet, 2006).

From September 2008 to January 2009, AMS collected and analyzed Perc samples from 17 businesses located adjacent to dry cleaning establishments. In most cases, three samples were collected from each location over a 24 hour period. The samples were analyzed by AMS' Laboratory using the EPA TO-14 method. Individual concentrations varied from 3 $\mu g/m^3$ (0.42 ppb) to 5860 $\mu g/m^3$ (864 ppb). The average Perc concentration at the businesses was 684 $\mu g/m^3$ (101 ppb), with a minimum of 6.1 $\mu g/m^3$ (0.91 ppb) and a maximum of 3044 $\mu g/m^3$ (449 ppb). Using California's Cancer URE to calculate a cancer risk yields numbers that are in excess of EPA's upper acceptable level of 100 in a million (or 1 in 10,000) risk of cancer.

In addition to air-based environmental impacts, Perc has caused numerous problems with ground and ground water contamination. Such contamination is a result of poor housekeeping, spills, and improper disposal of Perc-containing waste by dry cleaning facilities.

The State Coalition for Remediation of Drycleaners (SCRD), with 13 states currently listed as members, maintains a list of over 120 locations involved in cleanup of contaminated dry cleaning sites where a remedial system has operated for at least one year (see https://www.epa.gov/remedytech/state-coalition-remediation-drycleaners-scrd-10-year-accomplishments-report). It gives particular attention to those dry cleaning sites where innovative technologies have been applied to the cleanup. The SCRD list demonstrates that Perc ground and ground water contamination from dry cleaning operations is a national issue, and not a problem limited to Philadelphia.

To further evaluate Perc and other Perc solvent replacements, its risk, and the relation to Philadelphia's proposed Dry Cleaning Regulation, AMS hired Dr. Alan Finkel. Dr. Finkel's background includes 25 years of developing and improving methods of quantitative risk assessment as well as serving as OSHA's Director of Health Standards Programs from 1995 – 2000. In his report, "*Evaluation of Perchloroethylene Risks and the Philadelphia Dry Cleaning Proposal"* (see Appendix I), Dr. Finkel addressed the following issues:

1. The possible cancer risks from perchloroethylene (Perc)—including the weight of evidence that Perc is a human carcinogen, and data leading to quantitative estimates of its cancer potency and corresponding estimates of cancer risk at various exposure levels;

2. Selected non-cancer risks from Perc, and an appraisal of the "safety" of the two most prominent non-cancer benchmark exposure levels – the "Reference

Concentration" (RfC) of 2.4 parts per billion (ppb) set by the U.S. Environmental Protection Agency (EPA) and the "Minimal Risk Level" (MRL) of 40 ppb set by the Agency for Toxic Substances and Disease Registry (ATSDR);

3. Evidence from various interventions by state and local agencies that bear on whether a given concentration can be readily achieved in residences and workplaces co-located with dry cleaners;
4. Concerns about new risks that might arise from the act of regulating current uses of Perc in dry cleaning (namely the use of more toxic solvent replacements such as n-Propyl-Bromide); and
5. Information about alternative regulatory designs that might reduce risks in more cost-effective and flexible ways.

AMS specifically asked that the quantitative risk analysis focus on the appropriateness of using 40 ppb as a level of regulatory concern in co-located residences and establishments. In his conclusion, Dr. Finkel summarized the 40 ppb benchmark proposed by AMS is not a "safe" level for continuous exposure, but a reasonable science policy that is achievable and will greatly reduce current risks to the citizens of Philadelphia that work or reside next to Perc dry cleaning facilities. To address item #4, Dr. Finkel recommended that the use of any solvent containing n-Propyl-Bromide be banned as it was deemed to be more toxic than Perc (see Appendix II, report *"INCREASED TOXICITY and CARCINOGENICITY OF n-PROPYL BROMIDE (1-BROMOPROPANE) RELATIVE TO PERCHLOROETHYLENE"*).

Federal Regulation

In response to its evaluation of the toxicity of Perc and the risk to the public, the USEPA proposed a rule on December 9, 2005, to limit the use of Perc in dry cleaning facilities. This proposal was published in the Federal Register at 70 Fed. Reg. 75884 (December 21, 2005). The final rule adoption was published in the Federal Register at 71 Fed. Reg. 42724 (July 27, 2006).

USEPA based its proposal on a recent review of dry-cleaning technology, as well as recent analyses of the health risks that remained after the implementation of the USEPA's 1993 air toxics regulation for Perc dry cleaners.

The final USEPA rule requires all new dry cleaning systems to meet fourth generation standards; completely bans all transfer machines; and requires enhanced leak detection and repair (LDAR) to detect and repair Perc leaks, as well as some additional monitoring and record keeping requirements. The Federal rule requires all dry cleaning equipment located in the same building as residences, such as in an apartment building (called co-residential dry cleaning equipment), installed on or after July 27, 2006, to use non-Perc dry cleaning technology. Co-residential Perc equipment installed between December 21, 2005 and July 27, 2006 must include a vapor barrier

to prevent Perc emissions from escaping within the building. All co-residential dry cleaners must cease using Perc by December 21, 2020 (See 40 CFR 63.322(o) 5.).

The State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials (STAPPA/ALAPCO), now known as the National Association of Clean Air Agencies (NACAA), submitted comments on the USEPA dry cleaner proposal. In its comments NACAA said, "We strongly believe the final rule should be more stringent, especially for the mixed-use facilities, because of the high risks associated with dry cleaning facilities. Even after the implementation of the NYSDEC regulations on dry cleaners, there remain troubling risk levels in mixed-use buildings." NACAA also stated that EPA estimates that cancer risk ranges will be reduced from 30 to 220 in one million to 20 to 175 in one million. Again, this level of remaining risk is not protective enough. We recommend that for freestanding area sources, EPA call for fourth generation equipment, which includes closed-loop systems with refrigerated condensers and carbon adsorbers, along with weekly leak inspections, annual third-party inspections and certification by an approved training program. Also, according to NACAA, EPA should consider calling for the elimination of Perc in dry cleaning, and encouraging substitution with less toxic, safer alternatives. This would go a long way toward reducing the risks to individuals exposed to dry cleaning operations and emissions. (STAPPA/ALAPCO, December 21, 2005)

In April 2009, EPA announced that it will reconsider the dry cleaner regulation. The Sierra Club sued EPA on the basis that the rule did not go far enough. The Sierra Club wanted the phase-out of Perc to be applied to all 32,000 dry cleaning establishments in the United States and not just those in apartment buildings (less than 10 percent of the total).

Other State Regulations

Some states or regions have adopted or proposed rules limiting the use of Perc in dry cleaning facilities.

On January 2007, the California Air Resources Board (CARB) adopted a rule in which all Perc will be phased out by January 1, 2023. Also, no newly manufactured Perc dry cleaning systems may be installed or operated after January 1, 2008, no Perc will be allowed at co-residential after July 1, 2010, and beginning July 1, 2010, any Perc dry cleaning system over 15 years old must be removed from service (CARB, 2006).

The New York State Department of Environmental Conservation (NYSDEC) and the New York City Department of Environmental Protection (NYCDEP) adopted dry cleaner regulations in 1997 and 1998 respectively that were intended to reduce and contain fugitive Perc emissions. This regulatory action specifically addressed dry cleaners in residential buildings (co-residential dry cleaners). NYCDEP has required all co-residential facilities to use only fourth generation dry cleaning systems, and to install a vapor barrier enclosure to reduce the amount of Perc that enters the residential areas of the building.

The State of New Jersey Department of Environmental Protection (NJDEP) has a proposed

regulation (draft January 1, 2010) which bans Perc at co-residential drycleaners after December 31, 2010. Co-located commercial Perc dry cleaning systems are required to comply with MACT Subpart M, as amended or supplemented by January 1, 2014; be 4th generation or above; be equipped with a separate air ventilation system (separate from building general ventilation system) that is vertically exhausted at or above the ceiling of the dry cleaning area and out to the outdoors, away from any air intakes and that is designed to provide a minimum of 1 air exchange every 5 minutes (minimum of 12 air exchanges every hour) and operate under a negative pressure. For co-located commercial Perc dry cleaning systems within 50 feet of a licensed day care center, Perc dry cleaning equipment must be contained within an impermeable barrier that is separately ventilated to the outdoors and that will prevent the migration of any Perc vapors from entering adjoining areas. For a standalone Perc facility, only 4th generation or above will be allowed after January 1, 2014.

Proposed Philadelphia Regulation

The proposed regulation requires all existing co-residential Perc dry cleaning facilities to eliminate the use of Perc after December 31, 2013. Co-commercial facilities must petition AMS by July 1, 2013, if they wish to continue using Perc beyond the December 31, 2013 phase out date. The use of n-Propyl-Bromide as a dry cleaning solvent is banned as of the effective date of the regulation.

Within two years of the effective date, the proposed regulation will require facilities to replace Perc systems classified as third generation dry cleaning systems with fourth generation dry cleaning systems. A third generation dry cleaning system is a closed loop dry cleaning machine with a refrigerated condenser to control Perc emissions. A fourth generation dry cleaning system is a closed loop dry cleaning machine with a refrigerated condenser and an integral secondary control system utilizing a regenerative carbon adsorber which is designed to reduce Perc concentrations in the dry cleaning system to less than 300 ppm and, therefore, reduce Perc emissions beyond the ability of third generation system.

The proposed regulation requires construction permits and operating licenses for installing and operating dry cleaning equipment using Perc as a cleaning solvent. Dry cleaning machines are prohibited in facilities that are adjacent to residential or sensitive population locations after December 31, 2013. Co-located facilities also need to install a vapor barrier or professionally designed exhaust system within twelve months of the effective date of the regulation.

One year after the effective date, Co-commercial dry cleaning facilities must collect at least one 24-hour air sample from an adjoining business/site each quarter. If the Perc concentration of the air sample exceeds 200 ppb, the owner/operator shall cease all Perc operations immediately. If the Perc concentration exceeds 40 ppb but below 200 ppb, the owner/operator has 30 days to reduce and maintain the concentration of the adjoining space to 40 ppb or below.

AMS may collect and analyze an ambient air sample for Perc concentration during the operation of dry cleaning equipment at an occupied space that is co-located with the facility. When the

Perc level is measured and found to be greater than 40 ppb, the facility has 30 days to take corrective action, if the level exceeds 200 ppb the facility must shut down until it can demonstrate that the Perc concentration at an occupied space beyond its property below 40 ppb. The owner/operator shall reimburse AMS for the cost of collecting and analyzing the samples whenever the Perc concentration exceeds 40 ppb.

Alternative Technologies

AMS anticipates that as a result of the proposed regulation, some of the smaller dry cleaners will become drop shops, which are facilities that accept garments from their customers and forward the garments to a larger centralized factory-type facility to be dry cleaned. Other facilities will switch to a non-Perc technology.

There are acceptable, cost effective, non-toxic alternatives to Perc in dry cleaning. These alternatives are discussed below, and in the SCAQMD proposal. (SCAQMD, December 6, 2002).

Hydrocarbon Solvent Cleaning

One alternative is the use of hydrocarbon solvents (also called petroleum solvents). All hydrocarbon solvents used in dry cleaning consist of aliphatic hydrocarbons. Hydrocarbon solvents are flammable, volatile, and toxic, and they have an odor. Moreover, all of the hydrocarbon solvents are volatile organic compounds (VOCs). None is classified in the Federal Clean Air Act as a hazardous air pollutant. In addition the USEPA has recently decided not to regulate the use of hydrocarbon solvents used in dry cleaning. (See 71 Fed. Reg. 28320 (May 16, 2006).)

The dry cleaning machines predominantly used for petroleum solvents are closed-loop machines equipped with primary control, which is similar to the refrigerated condenser in a Perc dry cleaning machine, to reduce hydrocarbon emissions. The following hydrocarbon solvents are used:

1. **DF-2000 Fluid**

DF-2000™ Fluid is a major advancement in hydrocarbon solvent dry cleaning, which is the best available alternative hydrocarbon solvent to Perc solvent. DF-2000 Fluid is designed for use with High Flash Point Solvent Dry-to-Dry machinery. It can also be used to advantage in transfer systems, with or without solvent recovery tumblers. When used in conjunction with well-designed cleaning processes and properly formulated cleaning additives, it is a highly effective dry cleaning solvent.

DF-2000 Fluid (DF-2000) was introduced in 1994 by ExxonMobil as an alternative solvent to Stoddard and Perc. Currently, it is the most popular alternative to Perc. Consisting of C11 to C13 aliphatic hydrocarbons, it is a synthetic mix of isoparaffins and cycloparaffins (naphthenes) that

boils between 185 and 211 degrees Centigrade (OEHHA, 2003). Machines designed for DF-2000 and other hydrocarbon solvents offer closed-loop, dry-to-dry operation. Most include a primary control device (refrigerated condenser) and offer computerized control.

2. PureDry

PureDry (PureDry) was developed as a replacement for Perc. It is a blend of isoparaffinic hydrocarbon and a chemical additive produced by the 3M Corporation. The mixture contains about 95 percent odorless mineral spirits. The odorless mineral spirits are a mixture of aliphatic hydrocarbons (C9 to C12). Mineral spirits can cause neurotoxicity, and eye and respiratory irritation at high concentrations. It also contains HFE-7200 (a mixture of ethyl perfluoroisobutyl ether and ethyl perfluorobutyl ether), FC-43 (perfluoro compounds of primarily 12 carbons), PF-5070 (perfluoro compounds of primary seven carbons), and PF-5060 (perfluoro compounds of primarily six carbons) (OEHHA, 2003). The flash point of PureDry is 350° F with a boiling point temperature of 298°F. The flash point of a solvent is the temperature at which vapor given off will ignite when an external flame is applied under specified test conditions. A flash point is defined to minimize fire risk during normal storage and handling. Flash points for all dry cleaning solvents range from 110°F to 350°F.

3. EcoSolv

Chevron Phillips Chemical Company LP manufactures EcoSolv (EcoSolv). This dry cleaning fluid is 100 percent isoparaffin with carbon numbers ranging from C9 through C13. The manufacturer formulated this product by adding butylated hydroxytoluene at 10 parts per million (ppm) to act as an oxygen stabilizer. This solvent is a high purity aliphatic mixture with minimal aromatics. The isoparaffin is a branched hydrocarbon that is also used for food processing, cosmetic and personal care formulations, and as a solvent for a number of industrial products. EcoSolv has a flash point between140°F and 200°F, and is classified as Class IIIA solvent (ARB, 2004e).

4. Shell Sol 140 HT

Shell Sol 140 HT (Shell 140) is a high flash point hydrocarbon solvent. Shell 140's flash point is 145°F. This solvent works well in closed-loop machines.

5. Stoddard Solvent

Stoddard Solvent (Stoddard), a class of petroleum solvents, consists of a blend of C8 to C12 hydrocarbons and is similar to kerosene. Its flash point is 110°F. Stoddard contains small amounts of chemicals known to be carcinogenic but are not classified as toxic. Stoddard also contains benzene, which has been identified as a toxic air contaminant. It also gives off an irritating odor.

Volatile Methyl Siloxane Cleaning

Another alternative to Perc is decamethylcyclopentasiloxane (D5) or volatile methyl siloxane, which is an odorless, colorless liquid that has consumer and industrial applications. D5 is used as an ingredient in personal health and beauty products, including deodorants, antiperspirants, cosmetics, shampoos, and body lotions. It is also used as a dry cleaning solvent, and is not a toxic or hazardous air pollutant. While not considered a VOC, it is flammable and is treated essentially the same as hydrocarbon dry cleaning.

Carbon Dioxide (CO_2) Cleaning

Carbon dioxide cleaning (CO_2) is a process that has been developed for use by commercial and retail dry cleaners. CO_2 is a non-flammable, non-toxic, colorless, tasteless, odorless naturally-occurring gas that, when subjected to pressure, becomes a liquid solvent. CO_2 is naturally occurring and is also used in other applications, such as carbonating soft drinks.

The liquid CO_2 cleaning machines have a configuration that is similar to a solvent or Perc machine. The system is closed-loop and comes equipped with a cleaning chamber, storage unit, filtration, distillation unit, and lint trap. Washing, vapor recovery, and drying are all performed in the cleaning chamber. The CO_2 used in this process is an industrial by-product from other existing operations. There is no net increase in the amount of CO_2 emitted; therefore, this process does not contribute to global warming. There are three manufacturers of CO_2 dry cleaning equipment in the United States.

Professional Wet Cleaning

Professional wet cleaning (wet cleaning), first introduced in 1991 as an alternative to dry cleaning, is different than commercial laundering in several aspects, although both use water and detergent. Wet cleaning uses computer-controlled washers and dryers to minimize agitation and heat, which can damage garments. Wet cleaning systems use non-toxic, biodegradable detergents, which are approved for disposal into the sewer system. The detergents are designed to be pH neutral and incorporate agents that prevent the interlocking of fibers. Many stains, such as salts, sugars, and foods and drinks, are readily removed by the wet cleaning process. Wet cleaning can also clean oil-based stains with the use of pre-spotting chemicals that are specifically designed for water-based cleaning. Wet cleaning has the least impact on the environment and is the preferred method for cleaning for operations where wet cleaning is an acceptable alternative to Perc dry cleaning.

Social Impact

The proposed Regulation is anticipated to have a positive social impact. As discussed above, exposure to Perc (or any other solvent just as toxic, namely n-Propyl-Bromide) from dry cleaning operations results in a significant risk of cancer. The environment should be improved for the residents of Philadelphia as a result of reduced health risks from the reductions of Perc and n-Propyl-Bromide emissions from dry cleaning operations in Philadelphia.

In order to achieve the reduction in health risks, residents may experience some differences in their garment cleaning. Although the alternatives to Perc dry cleaning are effective in most dry cleaning situations, there are some situations where the alternatives are not as effective. In these cases, additional care must be used either in preparing the garments prior to cleaning, such as additional spot cleaning, or in handling the garments after cleaning, such as additional pressing. Customers may have to pay slightly higher prices for the possible additional services resulting from non-Perc alternatives, as discussed in the Economic Impact, below.

Economic Impact

The proposed regulation affects approximately 95 percent of the dry cleaning industry in Philadelphia. Seven out of the 132 total dry cleaning facilities already utilize non-Perc technology and will not be affected by the proposed regulation. Only two of the 13 free standing facilities will need to upgrade their equipment to fourth generation. Forty-six co-residential and co-sensitive facilities will discontinue Perc usage by 12/31/2013. The remaining 66 co-commercial dry cleaning facilities will be allowed to use Perc if they petition AMS by July 1, 2013. All co-located facilities will be required to install a vapor barrier or a professionally designed exhaust ventilation system.

Attached is a table showing the cost associated with complying with the proposed Philadelphia drycleaner regulations, separated into categories and their available options:

Category	Cost Per Facility
CO-RESIDENTIALS (for facilities using 4th generation machines or greater)	
Alternative 1	
• Changing to alternative solvent to comply	$50,000 per machine
• Cost of vapor barrier or professionally designed exhaust system	No greater than $10,000
• Cost of sprinkler system	No greater than $5,000
Alternative 2	
• Changing to “Freestanding” to comply	$1,975 + cost of moving
Alternative 3	
• Changing to “Drop Store” to comply	30% decrease in profits
CO-COMMERCIALS (for facilities using 4th generation machines or greater)	
• Changing to alternate solvent to comply * The Regulation allows Co-Commercial facilities to use Perc machines if they petition AMS.	$0*
• Cost of vapor barrier or professionally designed exhaust system	No greater than $10,000
• Cost of sprinkler system ** Most (if not all) co-commercial dry cleaning locations require a sprinkler system.	$0**
• Cost of quarterly sampling ** If AMS random sampling shows concentrations > 40 ppb, the owner/operator shall reimburse AMS for the cost and analysis of sampling.	$ 700 per sample using independent lab**

FREESTANDING	
3rd generation machines upgrading to 4th generation and continue using Perc	$6,975
USING EXEMPT SOLVENTS	
Using exempt solvent, any generation machine	$0

The greatest economic impact of this proposal on any individual dry cleaning facility will be the phase-out by December 31, 2013 of Perc dry cleaning systems that are co-residential or co-sensitive. All such existing Perc dry cleaning facilities will have to change their operations in less than three years, in order to ensure that they neither use nor emit Perc. In California, more than 400 cleaners are using hydrocarbon solvent in place of Perc and no fire hazard has been reported. The National Fire Protection Association (NFPA) classifies the hydrocarbon as a Class IIIA liquid (with a flash point at or greater than 140º F and below 200º F) and the equipment must be designed accordingly. Equipment sold for use this hydrocarbon solvent contains a vacuum or nitrogen, which can be used to suppress the flammability in the machine in the event of ignition (Cal/EPA 2005). The current Philadelphia Building Code requires a sprinkler system in a dry cleaning facility that exceeds 12,000 square feet in the first floor area. The current Philadelphia Fire Code permits the storage and use in a dry cleaning machine of up to 330 gallons of a Class III combustible liquid (a liquid with a flash point above 140 degrees Fahrenheit). Sprinklers may already be installed in many commercial strip malls depending on the size, construction type and date of construction of these buildings. The cost to install the sprinkler system should not exceed $5,000 for a typical 1,000 square foot dry cleaner. The Fire department was consulted and stated that it believes that it can handle the fire potential from the conversion of Perc dry cleaning facilities to hydrocarbon systems. Several synthetic solvent dry cleaners have been operating in Philadelphia for a number of years without significant problems.

The regulation does not require co-commercial facilities to replace their Perc dry cleaning machines as long as a petition is filed with AMS by July 1, 2013. A vapor barrier system or professionally designed ventilation is required at a cost not exceeding $10,000. Also quarterly air sampling is required at a cost of $700 per sample. Additional costs (sampling and analysis) maybe incurred by the owner/operator of the dry cleaning facility if random sampling performed by AMS shows Perc concentrations greater than 40 ppb at adjoining business/commercial sites.

Freestanding dry cleaning facilities currently using third generation dry cleaning systems would be given more than two years to either replace or upgrade their dry cleaning systems. There are approximately two third generation Perc dry cleaning systems, which will both be required to be upgraded to fourth generation dry cleaning systems or non-Perc technologies within two years after the effective date. Most third generation dry cleaning systems manufactured since 2002, and some manufactured prior to 2002, were designed as fourth generation dry cleaning systems without the integral secondary control systems. Therefore, an upgrade of that system to fourth generation would be appropriate. An upgrade for the system would cost approximately $5,000 to $7,000 per system.

A cost of a typical Perc dry cleaning system versus several of the non-Perc technologies is set forth in the table below. Although the figures were calculated based upon costs in California, AMS anticipates that the cost to Philadelphia dry cleaning facilities would be comparable (SCAQMD, 12/6/2002).

Table 1. Cost

Solvent Type[1]	Machine Type	Rated Capacity (lbs)	Cycle Time (minutes)	List Price ($)[2]
Water (wet) cleaning	Washer mount	15 - 85	12 35	8,700 - 30,400
Water (wet) cleaning	Dryer	15 - 135	12 – 30	2,100 – 12,900
Water (green) Jet	Dry-to-Dry	45	32	30,000
Perc	Secondary Control	35 – 90	45 – 55	38,000 – 83,000
Hydrocarbon	Dry-to-Dry	30 – 90	50 – 60	36,000 – 98,000
Green Earth[3]	Dry-to-Dry	35 – 90	45 – 60	43,000 – 98,000
CO_2	Dry-to-Dry	60	35 - 40	140,000

1. From Machine Manufacturers Survey (CARB, 2004), unless otherwise noted.
2. This reflects manufacture‘s list price; machines can cost less. Also, this does not include installation costs.
3. GreenEarth is the only siloxane technology currently available. This does not include the annual GreenEarth —Affiliation Fee “for the use of the GreenEarth technology.

Based on a study performed by the California Air Resources Board, titled “California Dry Cleaning Industry Technical Assessment Report,” dated October 2005, the annual operating cost for the first five years of operation for a typical Perc dry cleaner in California is $27,376. The study shows that the annual total operating cost for a typical dry cleaner using hydrocarbon technology was comparable to the total annual cost of a Perc dry cleaning system, ranging from $27,755 to $28,535. Several other non-Perc technologies were also comparable to the total annual cost of a Perc dry cleaning system, ranging from $20,929 for professional wet cleaning to $32,718 for a Green Earth dry cleaning system. Dry cleaning systems using carbon dioxide were significantly more expensive to operate.

Assuming a current annual cost for a Perc dry cleaning system to be $27,376, and the highest annual cost for hydrocarbon technology of $28,535, the approximate annual increased cost would be $1,159 or less to switch to non-Perc technology.

In addition to the cost of purchasing and operating a non-Perc dry cleaning system, another factor to be considered in the cost is the cleaning cycle time. The typical cycle time for a Perc dry cleaning system is approximately 35 minutes, while the cycle time for a non-Perc dry cleaning system is typically approximately 45 minutes. Therefore, assuming the dry cleaning systems have similar capacities, a non-Perc dry cleaning facility could process fewer clothes in a work day. Accordingly, some dry cleaning facilities may need to purchase a larger capacity dry

cleaning system to achieve the same throughput of clothes as is currently handled by their Perc dry cleaning system.

The annual cost to operate a dry cleaning facility is summarized in the table below, copied verbatim, including footnotes from the California report (SCAQMD, Table VII-5, December 16, 2002). AMS anticipates that annual costs in Philadelphia would be similar to the annual costs in California. Minor variations, such as energy costs, would have a negligible effect on the annual costs expected for similar dry cleaning systems in Philadelphia.

Table VII-5. Annual Cost Comparison for the First Five Years of a Typical Size Dry Cleaning Facilities[1]

Technology	Solvent	Average Cost Detergent/Spotting Agent	Electricity Cost	Gas Cost[2]	Average Maitenance[3]	Affiliation Fee	Filters[4]	Costs to replace Gaskets	Machine Cost[5]	Waste Disposal ($/gal)[6]	Total Annual Cost[7]
Perc	$1,159[8]	$1,500	$850	$7,800	$375	N/A	$320	$500	$12,372	$2,500	$27,376
Hydrocarbon											
DF-200	$546	$1,500	$850	$3,580	$250	N/A	$371	$500	$17,674	$2,640	$27,911
PureDry	$1,170	$1,500	$850	$3,580	$250	N/A	$371	$500	$17,674	$2,640	$28,535
Shell 140	$390	$1,500	$850	$3,580	$250	N/A	$371	$500	$17,674	$2,640	$27,755
EcoSolv	$507	$1,500	$850	$3,580	$250	N/A	$371	$500	$17,674	$2,640	$27,872
Stoddard	$283	$1,500	$1,160[9]	$3,580	$600	N/A	$371	$500	$17,674	$2,640	$28,308
GreenEarth	$1,715	$1,100[10]	$850	$4,370	$850	$2,500	$371	$500	$18,202	$2260[11]	$32,718
Rynex 3	$1,000	$100 (spotting)	$850	$3,580	$625	$N/A	$371	$500	$17,674	$120[12]	$26,220
CO_2	$552	$1,500	$940	$2,290	$2,250	N/A	$238[13]	$500	$50,121	$490	$$58,881
Professional wet cleaning	$0-$48[14]	$2,355[15] (detergent only)	$660 (washer/dryer)	$5,700	$320[16]	N/A	N/A	$500	$11,343	N/A	$20,926
Green Jet	$1,152	$1,500	$600	Unknown	$400	N/A	$124[16]	N/A	$8,573	N/A	>$12349[17]

1. Where applicable costs are normalized to about 46,600 lbs of clothes dry cleaned per year
2. Therms usage is taken from PERC.2004a report using current PG&E gas rates
3. Information taken from ARB's Machine Manufacture Survey.
4. Cost for standard filter of $32 each is used
5. Out of pocket costs assuming a five year loan and 10% interest rate
6. Waste disposal costs from $6.75-$10 per gallon (ARB,2005a)
7. Costs are given with the assumption that there is no waste treatment unit
8. Includes the current $4 assembly bill fee
9. This includes electricity cost for transfer machine and dryer/claimer
10. Source: ARB.2005a
11. Required only in some local districts
12. Source: ARB.2005a
13. Filter cost for CO2 machine are $26 each and lint filter cost are $9 each
14. PPERC, 2002
15. PPERC, 2002
16. Cost includes $4 for eight felts; $100 for lint bag; and $20 for foam filter
17. Total cost increase because gas costs are unknown

The Perc dry cleaning process generates wastewater containing small amounts of Perc. This waste is generated from water separators, steam presses, and desorption of carbon adsorbers. Some facilities may currently mist or spray water generated in the dry cleaning process into the open air to eliminate the wastewater. This wastewater is contaminated by Perc and is, therefore, classified as a hazardous waste. Disposal of the waste by spraying into the open air is damaging to the environment. The proposed regulation will prohibit this practice. Because spraying and misting of contaminated wastewater is already not allowed by hazardous waste treatment, storage, and disposal regulations, there should be no additional cost to the dry cleaning industry from the proposed regulation limiting the practice.

The proposed regulation will require dry cleaning facilities to dispose of the Perc wastewater as hazardous waste, or to treat the wastewater on site by filtering the water with carbon filters and then either evaporate or, if allowed by the local publicly owned treatment works, discharge the treated wastewater. These disposal options are currently used in the Perc dry cleaning industry and should not result in any change in the current operating costs for dry cleaning facilities.

A California staff presentation for CARB's rule proposal includes a preliminary cost analysis, which compares the financial impacts of operating non-Perc dry cleaning technology versus Perc dry cleaning technology. California estimates the total statewide cost of CARB's proposed rule would be about $39 million, which would be about $2.90 per pound of reduced Perc emissions (CARB, 2006). The cost in Philadelphia per pound of reduced Perc emissions is estimated to be approximately the same as for California. The additional cost to the public for dry cleaning as a result of this proposal should be minimal, amounting to less than $0.05 per garment, and possibly as low as $0.02 per garment. At a current cost of at least $1.00 per garment, and typically $2.50 to $5.00 per garment, an average increase of less than $0.05 per garment would be small to the dry cleaning facility and insignificant to the customers if all of the additional costs are passed to the customer.

As a result of this proposal, it is expected that most dry cleaning facilities will have a less than $1,000 increase in annual operating costs; few if any would see increases of $5,000 per year, and some dry cleaning facilities may see a reduction in annual operating costs primarily due to lower waste disposal costs. The average facility should incur a cost of less than $1,500 per year.

As discussed below, the benefit to the environment from the reduction in emissions of Perc, the reduction in the generation of hazardous waste containing Perc, and the reduction in future ground and ground water contamination from the elimination of the use of Perc more than justifies any additional expense from the use of non-Perc technologies.

Environmental Impact

AMS anticipates that the proposed regulation will have a positive impact on the environment of the City and nearby counties. There are approximately 132 dry cleaning facilities in Philadelphia. There are 125 dry cleaning facilities identified by AMS as using Perc and 7 dry cleaners using exempt solvents in Philadelphia. Most of these facilities share a partition, designated as "Co-located"

with either a commercial entity "Co-commercial" (67) or a residential entity "Co-residential" (45). The remaining thirteen dry cleaners are "Stand-alone Facilities." AMS anticipates that the regulation will result in an increase in non-Perc technology dry cleaning systems, as the number of Perc dry cleaning systems decrease.

AMS estimates that there are 448 adults and 162 children who live, work or are being cared for in locations next to 45 co-residential and 67 co-commercial dry cleaners in Philadelphia. These estimates are based on the average family size of 3.14 from the US Census, 2 adult occupancies per business, and 2 resident housings or businesses per dry cleaner. The proposed regulation would alleviate the Perc exposure impacted from the co-located dry cleaners.

The consumption of Perc per dry cleaning facility varies from less than 90 gallons per year to more than 800 gallons for a large multi-systems operation. The percent of Perc losses, or emissions, varies from system to system. In most cases, the average amount of Perc that a dry cleaning facility can use in a third generation dry cleaning system is limited by permit requirements to 90 gallons per year. The average amount of Perc that a typical dry cleaning facility uses in a fourth generation dry cleaning system is 120 gallons per year (with a permit limit of 150 gallons per year in most cases). The amount of Perc that a well-operated and maintained third generation dry cleaning system emits into the environment is approximately 50 percent of the annual Perc usage. The Perc that is not emitted remains in the dry cleaning system, continually recycled, and eventually shipped off-site as waste. A well-operated and maintained fourth generation dry cleaning system typically emits approximately 25 percent of the Perc that the system uses. Accordingly, an optimal third generation dry cleaning system will emit 45 gallons of Perc per year, and an optimal fourth generation dry cleaning system will emit between 30 and 35 gallons per year.

Unfortunately, however, not all dry cleaning systems are well-operated and maintained, meaning that the actual emissions are likely to be higher. This indicates that there are frequent operational and maintenance issues that are likely to result in higher Perc emissions. Since not all dry cleaning systems are well operated and maintained continuously, actual emissions are likely to be higher.

The study performed by the California Air Resources Board, titled "California Dry Cleaning Industry Technical Assessment Report," dated, October 2005, includes estimates of actual emissions from dry cleaning facilities in California. (CARB, Oct. 2005) This study shows that for the 4,670 Perc dry cleaning systems in California, there are 222,000 gallons of Perc emitted per year. This equates to approximately 642 pounds per year per Perc dry cleaning system.

The proposed regulation will result in the reduction of the emissions of Perc from dry cleaning systems into the environment. AMS anticipates that the proposed regulation will reduce emissions of Perc from dry cleaning operations by approximately 40 percent within approximately three years.

The proposed regulation will result not only in a substantial decrease in Perc emissions, but also a small increase in the emission of volatile organic compounds (VOCs). Based on CARB's "California Dry Cleaning Industry Technical Assessment Report," dated, October 2005, "if the

entire Perc dry cleaning industry in California were to switch to a hydrocarbon dry cleaning process, the statewide increase in VOC emissions in California would be approximately 1.7 tons per day. (CARB, Oct. 2005) Since California has 4670 Perc dry cleaning systems compared to Philadelphia's 136 Perc dry cleaning systems, it is estimated that if all Perc dry cleaning systems in Philadelphia were changed to hydrocarbon technology, Philadelphia would have an increase in VOC emissions of less than 0.05 tons per day, or a total of 18.25 tons per year/365 days in Philadelphia. Based on dry cleaning facilities that have already chosen non-Perc technologies, it is expected that some dry cleaning facilities will choose to install technologies other than the hydrocarbon technologies, such as siloxane or wet cleaning. Therefore the actual increase in VOC emission would be less than 0.05 tons per day. This impact is negligible and will be more than offset by the reduction in health risks due to the reduced emissions of Perc.

There are other environmental concerns involving the use of Perc in dry cleaning systems, in addition to air pollution related issues. As discussed above, the Perc that is not emitted into the environment from a dry cleaning machine is recycled, and eventually disposed of as hazardous waste. Because most dry cleaners are exempt small generators, "they are not required to monitor, record, and prepare manifests for their Perc containing waste streams. Consequently, there is the possibility that some dry cleaning facilities are improperly disposing of Perc. This can result in Perc waste being improperly mixed with municipal waste, resulting in Perc emissions from solid waste handling systems, including landfills.

Perc waste may also be discharged to publicly owned treatment works (POTW), resulting in air emissions of Perc from the wastewater treatment process. Perc is found in wastewater processed by POTW, some of which is emitted into the air. Perc may also be discharged to groundwater or surface water as a result of accidental spills or illegal dumping, in order to avoid hazardous waste disposal costs. Eliminating the use of Perc in dry cleaning systems will likely have a comparable reduction in the generation of Perc containing hazardous waste, and a reduction in the improper handling and disposal of Perc containing waste.

Nationwide there are numerous site remediation projects dealing with Perc contamination from dry cleaning systems. Several states have joined a coalition to share data concerning such remediation projects. Currently there are over 120 projects listed on the State Coalition for Remediation of Drycleaners website at https://clu-in.org/products/drycleanerprofiles/. The existenceof this coalition shows that Perc contamination from dry cleaning systems is a national problem.

Discharges of Perc affect not only air and groundwater, but the areas surrounding co-located dry cleaning facilities. Studies done by NJ Department of Health and Senior Services (NJDHSS) show that Perc concentrations in co-located dry cleaning facilities can also result in unacceptable health risks to adjacent occupied areas. The health risk for young children exposed to a high level of Perc is much higher than for a healthy adult. NJDHSS are aware of several incidents in the past year in which a Perc dry cleaning facility adjacent to a child care facility resulted in unacceptable levels of Perc within the child care facility. As a result of incidents involving dry cleaning facilities and other sources of contamination effecting child care facilities, legislation was adopted, with input from the NJDHSS, limiting the siting of child care centers near dry

cleaners and other sources of unacceptable health risk for the attending children, and requiring

child care facilities to certify they are not being impacted by such contamination (52:27D-130.4 and 5, P.L. 2007, c.1).

Among the 17 commercial facilities AMS has tested to date, one merits special mention—a day care center which measured at levels in excess of the 200 ppb threshold on several occasions, suggesting potential health risks to children. AMS provided the results collected at the day care center to the Agency for Toxic Substances and Disease Registry, a Unit of the Center for Disease Control. As a result of their review and recommendation, AMS ordered the dry cleaner adjacent to the day care center to stop its Perc dry cleaning operation on February 13, 2009 due to unacceptable levels of Perc. Exposure to Perc may result in both cancer and non-cancer health effects for all human beings, but children are particularly susceptible to harm. According to CARB's Initial Statement of Reasons for Proposed Rulemaking, for Perc dry cleaning operations in California "the average population weighted cancer risk from exposure to ambient levels of Perc is estimated between 1 and 2 chances per million. After full implementation of the proposed Perc [Airborne Toxic Control Measure] and with other Perc measures in place, the average potential statewide cancer risk from exposure to ambient Perc levels is expected to drop below 1 chance per million." In California's urban areas, the cancer risk for residents living near Perc dry cleaning operations "is estimated to range between approximately 75 chances per million at 20 meters and 3 chances per million at 100 meters." For the state wide average Perc concentration in California "the residential receptor potential cancer risk is estimated to range between approximately 42 chances per million at 20 meters and 2 chances per million at 100 meters" (CARB, 2006).

Due to the higher population density in Philadelphia, the health effects are likely to be greater. Perc samples at businesses adjacent to dry cleaners, the concentrations vary from 3 mg/m^3 (0.42 ppb) to 5860 mg/m^3 (864 ppb). In California, measurements of Perc have averaged below approximately 100 mg/m^3 since 2001. Therefore, the cancer risk, as well as the non-cancer heath risks, may be significantly higher for Philadelphia residents than for California residents. Based on the above, the average potential Citywide cancer risk from exposure to ambient Perc levels is expected to drop from near two chances per million to less than one chance per million, resulting in a potential reduction of seven to 14 fewer cancer cases per year from Perc dry cleaning operations.

Federal Standards Analysis

AMS compared the proposed regulation to analogous Federal regulations, namely 40 CFR Part 63 Subpart M, "Standards for Hazardous Air Pollutants (NESHAP) for Perchloroethylene Dry Cleaning Facilities," including the USEPA adopted amendments to address the residual risk related to Perc dry cleaning facilities, adopted July 27, 2006 at 71 Fed. Reg. 42724 July 27, 2006. The current Federal requirements for Perc Dry Cleaning Facilities include 40 CFR Parts 63.320 through 324. Proposed Regulation XIV, Section II (c) specifically requires facilities to comply with the Federal rules regarding Perc dry cleaning facilities.

AMS' proposed regulation exceeds the Federal requirements in several respects. Perc dry cleaning facilities located in a residential building (co-residential facilities) and facilities next to sensitive receptors (co-sensitive facilities) have to phase out all Perc after December 31, 2013. The proposed regulation also requires co-commercial dry cleaning facilities to switch to alternative technologies that use cleaning agents other than Perc after December 31, 2013 unless they petition AMS on or before July 1, 2013 to continue using Perc beyond December 31, 2013, by demonstrating that the airborne concentration of Perc in adjoining commercial or industrial sites is at or below 40 ppb. Dry Cleaning Facilities must obtain a 24-hour air sample from any co-located commercial site once every three months. If the Perc concentration in the sample is greater than 40 ppb, but below 200 ppb, corrective action must be taken within 30 days. If the concentration is above 200 ppb, all Perc dry cleaning operations must cease immediately. AMS' proposed regulation requires all existing third generation dry cleaning systems at stand alone facilities to be upgraded to fourth generation dry cleaning systems two years after the effective date (fifth generation if the Perc Dry Cleaning Facility is a major source) and co-located facilities have to implement a minimum 25-foot buffer between Process Ventilation Emission points and all Openings in nearby occupancies (AMS may require this distance to be more than 25 feet, based on computer modeling) and install a vapor barrier enclosure or professional designed exhaust ventilation system within one year after the effective date. The Federal rules require all new Perc dry cleaning facilities to utilize fourth generation dry cleaning systems, but would not require the upgrade or replacement of existing third generation dry cleaning systems.

The proposed regulation bans new Perc dry cleaning facilities from being installed in a building with a residence, which is a provision similar to the Federal rule. AMS proposes to prohibit all co-located dry cleaning facilities from using or emitting Perc as of the effective date; whereas the Federal rules require only existing co-residential dry cleaning facilities to cease using Perc as of December 21, 2020, unless they petition AMS on or before July 1, 2013 to continue using Perc beyond December 31, 2013, by demonstrating that the airborne concentration of Perc in adjoining commercial or industrial sites is at or below 40 ppb. The Federal rules require vapor barrier enclosures to be installed on co-residential dry cleaning facilities that were put in place between December 21, 2005 and July 27, 2006. AMS proposes co-located dry cleaning facilities be required to install a vapor barrier or professionally designed exhaust system that includes a 25 foot buffer zone within one year of the effective date. In addition, the use of any dry cleaning solvent containing n-propyl bromide is banned. The Federal rules do not include such a prohibition. The Federal rules effective prior to December 21, 2005, have been incorporated into all permits issued by the City for Perc dry cleaning facilities. Proposed AMS Regulation XIV specifically requires facilities to comply with the Federal rules regarding Perc dry cleaning facilities.

Other differences to the Federal Regulation include: AMS proposes to shut down leaking Perc dry cleaning equipment that has not been repaired 15 working days after the leak was detected, replace door gaskets every two years, keep all steam and condensing coils free of lint, maintain aisle space, keep supply parts available, ensure that Perc releases do not migrate to sewer systems or groundwater, inspect the dry cleaning system weekly (the Federal Regulation is monthly) keep records of number of loads processed between regenerations, cleaning and replacement of lint filters, carbon adsorber per-filters, the amount of activated carbon in the

carbon adsorbers, the date and volume of any Perc-contaminated hazardous waste shipments and within 30 days of the effective date of the regulation, facilities must be equipped with spill control equipment and vapor proof containers.

Jobs Impact

AMS anticipates that the proposed regulation will have no major impact on employment in the City. There should be little or no change to the number of dry cleaning facilities that provide dry cleaning services to their customers in Philadelphia as a result of the proposed regulation. Since the number of dry cleaning facilities is consumer-driven, the 45 co-residential dry cleaners will either convert to a "drop shop" or use a non-Perc alternative. Most dry cleaning facilities employ six or fewer employees, and often two or fewer (usually the owner and spouse or other family member) (USEPA, Basic Information, 2006). Operating as a drop shop will likely result in a reduction of approximately 30 percent in profit from a facility that formerly operated Perc dry cleaning equipment as well as a reduction in the number of employees. There is no effect on the number of employees for dry cleaning facilities that convert to a non-Perc alternative.

As a result of this proposal, it is expected that most dry cleaning facilities will have a less than $1,000 increase in annual operating costs, few if any would see increases of $5,000 per year, and some dry cleaning facilities may see a reduction in annual operating costs, primarily due to lower waste disposal costs.

The proposed regulation could result in some additional costs to operate a dry cleaning facility in Philadelphia; however, AMS does not anticipate that the proposed regulation will impact overall employment.

Conclusion

As indicated by the documents referenced above and actions taken by USEPA, Philadelphia, and other states, emissions of Perc from dry cleaning operations result in unacceptable health risks to much of the population of Philadelphia. Also as indicated above, and in the impact statements below, there are acceptable, cost effective alternatives to the use of Perc in dry cleaning. AMS anticipates that the proposed regulation will reduce emissions of Perc from dry cleaning operations by approximately 36 percent within approximately four years, and by 90 percent by January 1, 2024, resulting in significantly reduced health risks to the public.

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State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO) letter to USEPA dated March 23, 2006, signed by Robert Colby and Vinson Hellwig, to comment on the USEPA dry cleaner proposal dated December 21, 2005

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The following words and terms, when used in this document, have the following meanings:

(1) *Alternative Cleaning Technology.* A textile cleaning technology which may include, but is not limited to: water-based wet cleaning, carbon dioxide (CO_2) cleaning, decamethylcyclopentasiloxane or volatile methyl siloxane, or petroleum hydrocarbon solvents.

(2) *Ancillary Equipment.* The equipment used with a dry cleaning machine in a dry cleaning system including, but not limited to, emission control devices, pumps, filters, muck cookers, stills, solvent tanks, solvent containers, water separators, exhaust dampers, diverter valves, interconnecting piping, hoses and ducts.

(3) *Articles.* Clothing, garments, textiles, fabrics, leather goods, and other items that are dry cleaned.

(4) *Carbon Adsorber.* An air cleaning device that consists of an inlet for exhaust gases from a dry cleaning machine; activated carbon in the form of a fixed bed, cartridge, or canister, as an adsorbent; an outlet for exhaust gases; and a system to regenerate, or reclaim saturated adsorbent.

(5) *Cartridge Filter.* A replaceable cartridge filter that contains one of the following as the filter medium: paper, activated carbon, or paper and activated carbon. A cartridge filter contains no diatomaceous earth or activated clay. Cartridge filters include, but are not limited to: standard filters, split filters, "jumbo" filters, and all carbon polishing filters.

(6) *Closed-loop Machine.* Dry cleaning equipment in which washing, extraction, and drying are all performed in the same single unit (also known as a dry-to-dry unit) and which re-circulates Perc-laden vapor through a primary control system (e.g. refrigerated condenser) with no exhaust to the atmosphere during the drying cycle. A closed-loop machine may allow for venting to the ambient air through a local exhaust ventilation system, such as a door fan, after the drying cycle is complete and only while the machine door is open.

(7) *Co-commercial.* A facility sharing a common wall, floor or ceiling with another commercial or industrial business/site.

(8) *Co-located.* A facility sharing a common wall, floor or ceiling with a residence/residential site, commercial or industrial business/site. .

(9) *Co-residential*. A facility sharing a common wall, floor, or ceiling with a residence/residential site.

(10) *Co-sensitive.* A facility sharing a common wall, floor, or ceiling with a sensitive facility.

(11) *Colorimetric Detector Tube.* A glass tube (sealed prior to use), containing material impregnated with a chemical that is sensitive to Perc and is designed to measure the concentration of Perc in air.

(12) *Condenser*. An air cleaning device that removes condensable vapors by a reduction in the temperature of the exhaust gases or, in the case of a surface condenser, by contact of the exhaust gases with structures that are cooled by a circulating cooling fluid.

(13) *Cool-down*. The portion of the drying cycle that begins when the heating mechanism deactivates and the refrigerated condenser continues to reduce the temperature of the air recirculating through the drum to reduce the concentration of Perc in the drum.

(14) *Department*. The City of Philadelphia Department of Public Health.

(15) *Desorption.* Regeneration or stripping of an activated carbon bed, or any other type of

vapor adsorber by removal of the adsorbed solvent using hot air, steam, or other means.

(16) *Diverter Valve.* A flow control device that prevents room air from passing through a refrigerated condenser when the door of a dry cleaning machine is open.

(17) *Drum.* The rotating cylinder or wheel of the dry cleaning machine that holds the articles being cleaned.

(18) *Dry Cleaning Control System.* Equipment (e.g., carbon adsorber, refrigerated condenser, azeotropic unit, etc.) or an air cleaning device used to reduce the amount of air pollutant(s) in an air stream prior to discharge to the atmosphere.

(19) *Dry Cleaning Equipment.* Any machine, device, or apparatus used to dry clean articles.

(20) *Dry Cleaning Facility.* An establishment with one or more dry cleaning systems.

(21) *Dry Cleaning System*. All of the following equipment, devices, and apparatuses associated with the Perc dry cleaning operations,: dry cleaning equipment; filter or purification systems; waste holding, treatment, or disposal systems; Perc supply systems; dip tanks; pumps; gaskets; piping, ducting, fittings, valves, or flanges; and dry cleaning control systems.

(22) *Drying Cycle.* The operation used to actively remove the Perc remaining in the materials after washing and extraction. For closed-loop machines, the heated portion of the cycle is followed by cool-down and may be extended beyond cool-down by the activation of a control system. The drying cycle begins when heating coils are activated and ends when the machine ceases rotation of the drum.

(23) *Drying Sensor.* A device that senses when articles being cleaned are relatively dry and automatically controls the drying cycle. Drying sensors include but are not limited to: infrared analyzers, float switches, and resistance probes. The device detects the concentration of synthetic solvents in the drying air or that the liquid solvent recovery rate is at a minimal rate. The drying sensor extends the drying cycle for a minimum time beyond the activation point to ensure dry articles.

(24) *Dry-to-dry Machine.* A one-machine dry cleaning operation in which drying and washing are performed in the same machine.

(25) *Equivalent Closed-loop Vapor Recovery System.* A device or combination of devices that achieves, in practice, a Perc recovery performance equal to or exceeding that of refrigerated condensers.

(26) *Facility.* All emission sources located at one or more adjacent or contiguous properties owned or operated by the same person or persons under common control.

(27) *Fifth (5th) Generation Equipment*. A dry cleaning machine with all the features of fourth generation equipment, and also with a monitor inside the machine drum and an interlocking system to ensure that the concentration is below approximately 300 ppm before the loading door can be opened.

(28) *Filter Muck.* The residue from a filter using loose diatomaceous earth, which must be replaced periodically.

(29) *Fourth (4th) Generation Equipment.* A primary closed-loop refrigerated dry cleaning machine that has a "secondary control system" (e.g., closed-loop refrigerated condenser with a drying sensor and an integral carbon adsorber).

(30) *Fugitive Emissions.* Emissions of air contaminants which could not reasonably pass through a stack, vent, chimney, or other functionally equivalent opening.

(31) *General Exhaust Ventilation system.* A mechanical exhaust ventilation system consisting

of fresh air makeup inlets and one or more exhaust fans in a dry cleaning facility. This type of system would commonly be used to exhaust a dry cleaning workroom or a room enclosure.

(32) *Halogenated-hydrocarbon Detector*. A portable device capable of detecting vapor concentrations of Perc and indicating an increasing concentration by emitting an audible signal or visual indicator that varies as the concentration changes.

(33) *Hazard*. An event which may result in any Perc release, Perc spill, fire or explosion.

(34) *Liquid Leak.* A Perc emission which is in a liquid state at the point(s) of discharge into the atmosphere.

(35) *Major Source.* A dry cleaning facility that emits or has the potential to emit more than 9.1 megagrams per year (10 tons per year) of Perc to the atmosphere. In lieu of measuring a facility's potential to emit Perc or determining a facility's potential to emit Perc, a dry cleaning facility is a major source if it includes only dry-to-dry machine(s) and has a total yearly Perc consumption greater than 8,000 liters (2,100 gallons).

(36) *Muck Cooker.* A device for heating filter muck to drive off Perc vapors for reclaiming.

(37) *Openings.* Any window, door or air intake.

(38) *Leak.* Any Perc vapor or liquid leaks that are obvious from the odor of Perc, pools or droplets of Perc or the detection of gas flow by passing a finger over the surface of the equipment, or as detected by an appropriate portable monitoring instrument.

(39) *Perc.* A colorless volatile chlorinated hydrocarbon. Perc is also known as Perchloroethylene, tetrachloroethylene, tetrachloroethene, and PCE. The chemical formula for Perc is $Cl_2C:CCl_2$. The CAS registry number for Perc is 00127-18-4.

(40) *Portable Gas Analyzer.* A portable device capable of detecting Perc vapor concentrations of 25 ppm by volume.

(41) *ppb*. Parts per billion by volume in air or by weight in water.

(42) *ppm*. Parts per million by volume in air or by weight in water.

(43) *Primary Control System.* A refrigerated condenser or equivalent closed-loop vapor recovery system approved by the Department.

(44) *Process Ventilation Emission.* The emission from any dry cleaning machine that occurs when the machine door is open.

(45) *Refrigerated Condenser.* A closed-loop vapor recovery system into which Perc vapors are condensed by cooling below the dew point of the Perc using a mechanical refrigerated system.

(46) *Residence.* Any dwelling or housing which is occupied or intended to be occupied by the same person for a period of 180 days or more.

(47) *Secondary Control System.* A device or apparatus that reduces the concentration of Perc in the recirculating air at the end of the drying cycle beyond the level achievable with a refrigerated condenser alone. For example, an integral carbon adsorber used in fourth generation equipment constitutes a secondary control system. An *"integral"* secondary control system is designed and offered as an integral part of a production package with a single make and model of dry cleaning machine and primary control system.

(48) *Self-service Dry Cleaning Machine.* A Perc dry cleaning machine that is loaded, activated, or unloaded by the customer.

(49) *Sensitive Facility*. Any educational facility for minors including, but not limited to, schools for kindergarten through twelfth (K-12) grade or preschools or other early childhood

education facilities; and health and community care facilities including, but not limited to, hospitals, long-term or child care centers, and family day care homes.

(50) *Stand-alone Facility.* A facility that is not co-located.

(51) *Still*. Distillation equipment used to volatilize and recover Perc from contaminated solvent removed from the cleaned articles.

(52) *Trained Operator*. A person who can effectively administer the requirements of the 'Work Practice Standards' and 'Leak Detection and Repair' sections of this regulation, and is conversant with the applicable devices and methods listed under Section IV (a)(1) of this regulation.

(53) *Transfer Machine*. Perc dry cleaning equipment in which washing and extraction are performed in one unit and drying is performed in a separate unit. (First generation equipment)

(54) *Vapor Adsorber.* A bed of activated carbon or other adsorbent into which vapors are introduced and trapped for subsequent desorption.

(55) *Vapor Barrier.* A material surface or coating that is impermeable to Perc.

(56) *Vapor Leak.* A fugitive emission of Perc vapor from unintended openings in the dry cleaning system. A vapor leak can be indicated by a rapid audible signal or visual signal from a halogenated-hydrocarbon detector or other approved instrument.

(57) *Water Separator.* A vessel that uses gravity to physically separate liquid Perc from liquid water.

APPENDIX I

Dr. Finkel report: "Evaluation of Perchloroethylene Risks and the Philadelphia Dry Cleaning Proposal" available at:
https://hero.epa.gov/hero/index.cfm/reference/download/reference_id/787781

APPENDIX II

Dr. Finkel report: "INCREASED TOXICITY and CARCINOGENICITY OF n-PROPYL BROMIDE (1-BROMOPROPANE) RELATIVE TO PERCHLOROETHYLENE" available at: https://downloads.regulations.gov/EPA-HQ-OAR-2014-0471-0036/content.pdf

ADDITIONAL LINKS AND DOCUMENTATION

From the January 20, 2010 Air Pollution Control Board Meeting

Perc Risks Report: https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-management-perchloroethylene-pce

Perc Presentation and Comments:
http://www.phila.gov/health/pdfs/air/Comment_Response.pdf

From the June 24, 2010 Air Pollution Control Board Meeting

Proposed Regulation XIV Presentation:
https://downloads.regulations.gov/EPA-R09-OAR-2022-0623-0006/content.pdf

Perc vs. n-Propyl Bromide Presentation:
http://www.phila.gov/health/pdfs/airmanagement/Finkel%20Perc%20nPB.pdf

From the November 17, 2010 Air Pollution Control Board Meeting

Proposed Regulation XIV Presentation:
http://www.phila.gov/health/pdfs/11-17-10%20AMR%20XIV%20Presentation.pdf

Regulation XIV Comment/Response Report:
http://www.phila.gov/health/pdfs/air/AMR%20XIV%20Report%20-%2011-23-10.pdf

Performance Standards for n-Propyl Bromide Memo – 11-4-10:
https://www.epa.gov/sites/default/files/2020-08/documents/risk_evaluation_for_1-bromopropane_n-propyl_bromide.pdf

Perspectives on n-Propyl Bromide Report – 11-12-10:
http://www.phila.gov/health/pdfs/nPB%20Perspectives.pdf