TECHNICAL REVIEW AND EVALUATION
FOR THE GENERAL AIR QUALITY PERMIT FOR SOIL VAPOR EXTRACTION UNITS (SVEU)

I. INTRODUCTION

This General Air Quality Control Permit is intended for sources which operate Soil Vapor Extraction Unit which utilize thermal oxidation, catalytic oxidation, or carbon adsorption as the method for controlling emissions of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs). This general permit is intended only for SVEUs remediating motor fuel contaminated sites with the exception of carbon canisters which may be used to remediate locations with concentrations of halogenated compounds. This general permit is intended for statewide use with additional restrictions for operations in Maricopa County, Pima County, and Pinal County.

II. PROCESS DESCRIPTION

The process of remediating a site which has been contaminated with a motor fuel spill consists of extracting the gases from the contaminated soil or ground water and directing it into a thermal oxidizer, catalytic oxidizer or carbon adsorption unit. The thermal oxidizer destroys emissions by burning them at a high temperature (1400 degrees Fahrenheit). Likewise, the catalytic oxidizer destroys emissions by using a special catalyst, and can operate at a lower temperature and produce similar results as the thermal oxidizer. A carbon adsorption unit can be used to adsorb contaminates, but only at lower inlet concentrations.

Most SVEU systems include a soil vapor extraction blower and an air pollution control device (APCD). These systems are most often truck mounted devices for easy portability.

III. EMISSIONS

Emissions from SVEU systems typically consist of VOCs, benzene, and other organic pollutants. The limiting pollutant for which permit restrictions have been based is benzene. Setting limits on benzene safeguard impacts from other pollutants since benzene has the potential to exceed the modeling guideline before any other pollutant. Facilities operating under this general permit must maintain emission rates less than what is listed in Table 1 below:

Table 1 – Emission Limits

Pollutant	Pounds per Hour	Pounds per Day*	Pounds per Year	Tons per Year
VOC	N/A	135	N/A	75 22.5*
Benzene	0.55	N/A	67	N/A

*Only applicable for facilities operating within Maricopa County.

IV. APPLICABLE REGULATIONS

The following table summarizes the findings of the Department with respect to the regulations that are applicable to SVEU facilities.

Table 2: Applicable Regulations

Unit	Control Device	Rule	Verification
SVEU	Thermal Oxidizer, Catalytic Oxidizer, and Carbon Adsorption	A.A.C. R18-2-702(B)	40% opacity limit in PM_{10} attainment areas until April 23, 2006. 20% opacity limit currently effective in PM_{10} non attainment and maintenance areas and effective in PM_{10} attainment areas after April 23, 2006.
		A.A.C. R18-2-702(C)	If the presence of uncombined water is the only reason for an exceedance of any visible emissions requirement in this Article, the exceedance shall not constitute a violation
		A.A.C. R18-2-730(A)(1)(a) A.A.C. R18-2-730(A)(3) A.A.C. R18-2-730(A)(2)	Particulate matter emission limit Nitrogen Oxide emission limit Sulfur Oxide emission limit
		A.A.C. R18-2-730(D)	Limits on emissions of gaseous or odorous materials
		A.A.C. R18-2-730(G)	Requirement for the installation of stack abatement equipment
		Maricopa County Rule 300§301	To limit the emission of air contaminants into the ambient air by establishing standards for visible emissions and opacity.
		Maricopa County Rule 320§300	To limit the emissions of odors and other gaseous air contaminants into the atmosphere.
		Maricopa County Rule 330§	To limit emissions of volatile organic compounds into the atmosphere that may result from the use and storage of organic solvents or processes that emit volatile organic compounds.
		Pima County Code 17.16.030	To limit the emissions of odors and other gaseous air contaminants into the atmosphere.

Unit	Control Device	Rule	Verification
		Pima County Code 17.16.040	To limit the emission of air contaminants into the ambient air by establishing standards for visible emissions and opacity.

V. MONITORING REQUIREMENTS

A. Volatile Organic Compounds (VOCs)

1. At each location at which the SVEU is operated, the Permittee must take representative grab samples of the gases entering and exiting the SVEU.

2. Representative grab samples must be taken upon startup at each new location, and then once every two weeks for the first six weeks, then monthly for the following six months, and then quarterly thereafter. The process temperature of the thermal oxidizer or catalytic oxidizer will be monitored continuously.

3. The process flow rate of the SVEU system will be monitored continuously.

4. For operations taking place in Maricopa County the Permittee shall maintain a log detailing the daily average VOC emissions emanating from the SVEu stack.

B. Benzene

The Permittee is required to calculate a rolling 12-month total of benzene emissions by the close of business within 5 days after the last day of each month.

Emissions must be calculated using the representative gas samples exiting the SVEU, using the first sampling results for the first month to calculate emission until the second sampling date. Likewise, the second sampling results will be used to calculate the emissions until the third sampling date and so forth. The following example below details the required calculation:

Example 1: Calculate total Benzene emissions over a 14 month period

Assumptions:

- Initial Benzene sample prior to startup = 0.01 $\left({}^{lb}/_{hr}\right)$
- First Benzene sample after initial sample = 0.009 $\left({}^{lb}/_{hr}\right)$
- Second Benzene sample after initial sample = 0.007 $\left({}^{lb}/_{hr}\right)$
- Sample Period = 30 days for this example
- 24 hours per day operation
- Unit Conversion $\left({}^{minute}/_{hr \bullet feet^3}\right)$ = 1.56e-7 = 0.000000156

Step1: Convert ppmv to Pounds:

$$(1.56e-7)\times(\text{FlowRate})\times(\text{Concentration})\times(\text{MW}) = \text{Emission Rate in Pounds per Hour}\left({}^{lb}/_{hr}\right)$$

Where: MW = molecular weight = 78.17 for Benzene and 100 for VOC\

Flow Rate is in Units of $\left(\text{feet}^3/\text{minute}\right)$

Step 1: Calculate Benzene emissions for first month

$$\text{Benzene Total Pounds for first month } (\text{BTP1}) = \left(0.01 \tfrac{\text{lb}}{\text{hour}}\right) \times (30 \text{ days}) \times \left(24 \tfrac{\text{hours}}{\text{day}}\right) = 7.2 \text{ Pounds Benzene}$$

Step 2: Calculate total Benzene Emission after second month:

$$\text{Benzene Total Pounds for first month } (\text{BTP2}) = \left(0.009 \tfrac{\text{lb}}{\text{hour}}\right) \times (30 \text{ days}) \times \left(24 \tfrac{\text{hours}}{\text{day}}\right) = 6.48 \text{ Pounds Benzene}$$

$$\text{Total Benzene Emissions After Two Months } (\text{Total2}) = \text{BTP1} + \text{BTP2} = 7.2 + 6.48 = 13.68 \text{ Pounds Benzene}$$

Step 3: Calculate total Benzene Emission after third month:

$$\text{Benzene Total Pounds for first month } (\text{BTP3}) = \left(0.007 \tfrac{\text{lb}}{\text{hour}}\right) \times (30 \text{ days}) \times \left(24 \tfrac{\text{hours}}{\text{day}}\right) = 5.04 \text{ Pounds Benzene}$$

$$\text{Total Benzene Emissions After Three Months } (\text{Total3}) = \text{BTP1} + \text{BTP2} + \text{BTP3} = 7.2 + 6.48 + 5.04 = 18.72 \text{ Pounds Benzene}$$

Step 5: Continue calculating emission for months 4 through 14 following the steps above.

$$\text{Total Benzene After 12 Months } (\text{Total12}) = \text{BTP1} + \text{BTP2} + \text{BTP3} + \text{BTP} \ldots + \text{BTP11} + \text{BTP12}$$
$$\text{Total Benzene After 13 Months } (\text{Total13}) = \text{BTP2} + \text{BTP3} + \text{BTP} \ldots + \text{BTP12} + \text{BTP13}$$
$$\text{Total Benzene After 14 Months } (\text{Total14}) = \text{BTP3} + \text{BTP} \ldots + \text{BTP13} + \text{BTP14}$$

Once the initial 12 months is reached the Total Benzene **must not exceed** 67 Pounds per Year.

C. Opacity

Because the SVEU is powered by natural gas or propane, compliance with the applicable opacity standard is presumed under all operating conditions. Therefore, no monitoring is required.

VI. IMPACTS TO AMBIENT AIR QUALITY

A. Introduction

As part of the development of the SVEU general permit, ADEQ has performed an in-house air quality impact analysis (i.e. modeling analysis, SCREEN3). The air quality impact analysis considered a worst case scenario of a SVEU system. Based on the configurations allowed the worst case configuration would be based on a catalytic oxidizer since this system has the lowest process temperature which would negatively affect air dispersion. The Department also conducted an air dispersion modeling for a carbon adsorption system. The results of that analysis can be seen in Table 5.

The purpose of the modeling analysis is to determine whether air quality impacts from criteria pollutants and Hazardous Air Pollutant emissions will cause or contribute to a violation of any air quality standard, or worsen an existing air quality problem. Applicable guidelines and standards include the Arizona Ambient Air Quality Guidelines (AAAQG) and the National Ambient Air Quality Standards (NAAQS).

B. Modeling Analysis Overview

1. Source Release Parameters

Table 3 displays the sources release parameters used in the modeling analysis. Modeled emissions for the catalytic oxidizer are based on 8,760 hour per year and 24 hour per day operations.

Table 3. Modeled Source Parameters

Equipment	Equipment Type	Stack Ht. (m)	Stack Dia. (m)	Exit Temp. (deg K)	Exit Vel. (m/s)
SVEU	Catalytic Oxidizer	3.96	0.41	588	2.3
SVEU	Carbon Adsorption Unit	3.96	0.41	293	0.7

2. AAAQG Analysis

Table 2 indicates AAAQG Analysis performed for the HAPs of concern to determine if the proposed general permit configuration would exceed ADEQ's guideline concentrations. Modeling was performed at a flow rate of 810 actual cubic feet per minute (ACFM). Table 4 below shows the modeling results at an operating flow rate of 810 SCFM and 588 degrees Kelvin.

Table 4. AAAQG Modeling Analysis Results for Catalytic Oxidizer at 810 ACFM

Pollutant	Emissions (lb/hr)	Averaging Time	Max. Conc. (ug/m3)	AAAQG (ug/m3)	Pass/Fail?
Benzene	2.7 lb/hour*	1-Hr	124	630	Pass
	13.2 lb/hour or 0.55 lb/24 hours*	24-Hrs	49	51	Pass
	67 lb/year*	Annual	1.39E-01	0.14	Pass
Ethylbenzene	.0161 lb/hour	1-Hr	3.96	4500	Pass
		24-Hrs	1.46	3500	Pass
		Annual		na	
Toluene	.116 lb/hour	1-Hr	2.62E-01	4700	Pass
		24-Hrs	1.05E-01	3000	Pass
		Annual		na	
Xylene	.0844 lb/hour	1-Hr	19.1	5500	Pass
		24-Hrs	7.63	3500	Pass
		Annual		na	

*Numbers are based on permit limits

Table 5. AAAQG Modeling Analysis Results for Carbon Adsorption at 200 ACFM

Pollutant	Emissions (lb/hr)	Averaging Time	Max. Conc. (ug/m3)	AAAQG (ug/m3)	Pass/Fail?
Benzene	.0168 lb/hour	1-Hr	1.46	630	Pass
		24-Hrs	5.84E-01	51	Pass
		Annual	1.17E-01	0.14	Pass
Ethylbenzene	.0161 lb/hour	1-Hr	3.45E-01	4500	Pass
		24-Hrs	1.38E-01	3500	Pass
		Annual		na	
Toluene	.116 lb/hour	1-Hr	2.5	4700	Pass
		24-Hrs	9.98E-01	3000	Pass
		Annual		na	
Xylene	.0844 lb/hour	1-Hr	1.81	5500	Pass
		24-Hrs	7.23E-01	3500	Pass
		Annual		na	

3. NAAQS Analysis

Table 6 below shows the results of the NAAQS analysis for carbon monoxide and nitrogen monoxide. Both pollutants are within the standards set by the NAAQS.

Table 6 NAAQS Modeling Analysis Results

Pollutant	Emissions (lb/hr)	Averaging Time	Max. Conc. (ug/m3)	NAAQS (ug/m3)	Pass/Fail?
Carbon Monoxide	0.20	1-Hr	4540.2	10000	Pass
	.14	8-Hr	1746.24	40000	Pass
Nitrogen Monoxide	.12	Annual	34.52	100	Pass

VII. LIST OF ABBREVIATIONS

AAAQG ..... Arizona Ambient Air Quality Guideline
A.A.C. ..... Arizona Administrative Code
ACFM. ..... Actual Cubic Feet per Minute
APCD. ..... Air Pollution Control Device
CO ..... Carbon Monoxide
HAP ..... Hazardous Air Pollutant
GRO ..... Gasoline Range Organics
Lb/hr ..... Pound per Hour
NAAQS. ..... National Ambient Air Quality Standards
NO_x ..... Nitrogen Oxide
ppmv ..... Parts per Million by Volume
SCFM. ..... Standard Cubic Feet per Minute
SVEU ..... Soil Vapor Extraction Unit
TPY ..... Tons per Year
$\mu g/m^3$ ..... Microgram per Cubic Meter
VOC ..... Volatile Organic Compound