APPENDIX ONE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

JUN 21 1985

MEMORANDUM

SUBJECT: Use of Flares at Bulk Gasoline Terminals

FROM: Richard S. Colyer Rick
Standards Development Branch, ESED (MD-13)

TO: Brian Beals
Air, Pesticides, & Toxics Management Division, Region IV

This memorandum is in response to the May 17, 1985, attached letter to me from Victor San Agustin of the Hillsborough County Environmental Protection Commission of Tampa, Florida, requesting information on the testing of flares used to control emissions from bulk gasoline terminals. As you are aware, the NSPS limit for volatile organic compound (VOC) emissions for truck loading at bulk terminals is 35 mg VOC/liter of gasoline loaded (49 FR 37578, August 18, 1983), based on the use of thermal incinerators or carbon adsorbers, which we described as best demonstrated technology for these sources. During the time we developed the bulk terminal NSPS, we had no information or data on the use of flares at bulk terminals, and thus it was not addressed. Since that time, however, we have learned that some flares are being marketed for use at bulk terminals. The NSPS allows any type of control device as long as it meets the limit, flares being no exception.

Unlike other control devices used at bulk terminals, we have not developed a test method for measuring emissions from flares, and even if we did, high testing costs would discourage us from requiring emission tests routinely. Instead, in other standards that allow flaring of emissions, we have specified certain operating conditions that we believe would cause a flare to achieve at least 98 percent reduction. These conditions are contained in Attachment A, and were developed from actual testing performed on industrial-type flares over the past several years. We have no reason to believe that a flare used to control bulk terminal loading emissions would differ substantially from those tested.

To determine whether or not to allow flares to control VOC emissions from bulk terminals without testing specific flares, we have compiled results from all control system test data used in establishing the NSPS limit. We have identified all tests with emission reductions of 98 percent or greater and the associated outlet mass concentration in mg/l (units

of the NSPS). In all cases, the test results in outlet mg/l were well below the 35 mg/l NSPS limit, the highest being 14 mg/l. Attached is a summary of the test results and the basis for our findings marked in yellow.

Based on these determinations, we would not disagree with a State decision to waive the emission test, provided that the flare is operated according to the specified conditions. The State should clearly inform the source owner or operator that (1) the waiver is contingent upon continued operation according to the specifications and (2) the monitoring requirements in Attachment A are necessary and will be reviewed by the State. Although flare tests are costly, failure of the source owner or operator to comply with the conditions on which the waiver of testing are based is not a routine matter and we would require compliance testing at that time.

We confirm in this memo information given to Mr. San Agustin, by telephone, by Leslie Evans of this office on May 31, 1985; June 3, 1985; and June 4, 1985. The numbered responses below correspond to the numbered questions submitted by Mr. San Agustin in the attached letter.

(1) The subject flare should conform to the velocity and heat content required for air assisted flares in attached "Attachment A, Flare-Related Requirements." The maximum velocity, V_{max}, and the minimum heat content, H_T, are related by the following equation:

$$V_{max} = 8,706 + 0.7084\ (H_T)$$

V_{max} = velocity in m/sec at the holes in the sparger

H_T = net heating value as determined as shown (or calculated) in MJ/scm

We believe that a flare meeting these requirements has a volatile organic compound emission reduction efficiency of 98 percent or better, and would meet the emission limits set in the bulk gasoline terminal new source performance standard.

(2) If the flare meets the conditions in (1) then it does not matter whether the plant uses a vapor holder or not. A vapor holder does permit more gasoline vapor to be recycled and reduces the need for fuel gas (propane) to maintain the off-gas to the flare above the upper explosive limit (or above the heat content required for complete combustion).

(3) We do not recommend the testing of open or partially enclosed flares because it is very difficult, expensive, and unnecessary if the requirements in (1) are met. We are not familiar enough with totally enclosed flares at this time to make a judgement.

(4) We recommend that the flare be fitted with a pilot and a device that senses if the flare goes out.

(5) We have sent Mr. San Agustin copies of three EPA reports on research into flare efficiency.

(6) Research on flares is proceeding at the present time and as new information is developed the relationship between velocity and heat content for air assisted flares may change. If this happens, the new relationship would likely be less conservative. That is, all flares meeting the relationship given in (1) are expected to meet the new relationship also.

(7) See response (4)

(8) I have discussed this with Sharon Varnado of your office.

If you have further questions, please call me at FTS 629-5578.

cc: Rich Biondi, SSCD (EN-341)
Leslie Evans, CPB (MD-13)
Joe Italiano, SSCD (EN-341)
Steve Shedd, CPB (MD-13)
Gil Wood, SDB (MD-13)

Attachment A

Flare-Related Requirements

I. Standards

(a)*(1) Flares shall be designed for and operated with no visible emissions as determined by the methods specified in § 60.???(g), except for periods not to exceed a total of 5 minutes during any 2 consecutive hours.

(2) Flares shall be operated with a flame present at all times, as determined by the methods specified in § 60.???(g).

(3) Flares shall be used only with the net heating value of the gas being combusted being 11.2 MJ/scm (300 Btu/scf) or greater if the flare is steam-assisted or air-assisted; or with the net heating value of the gas being combusted being 7.45 MJ/scm or greater if the flare is nonassisted. The net heating value of the gas being combusted shall be determined by the methods specified in § 60.???(g).

(4)(i) Steam-assisted and nonassisted flares shall be designed for and operated with an exit velocity, as determined by the methods specified in § 60.???(g)(4), less than 18.3 m/sec (60 ft/sec), except as provided in paragraph (a)(4)(ii) and (iii).

(ii) Steam-assisted and nonassisted flares designed for and operated with an exit velocity, as determined by the methods specified in § 60.???(g)(4), equal to or greater than 18.3 m/sec but less than 122 m/sec are allowed if the net heating value of the gas being combusted is greater than 37.3 MJ/scm (1000 Btu/scf).

* Specific section and paragragh numbers are not required but the format would be. Please do not define "flare" in your standards.

(iii) Steam-assisted and nonassisted flares designed for and operated with an exit velocity, as determined by the methods specified in § 60.???(g)(4), less than the velocity, V_{max}, as determined by the method specified in §60.???(g)(5), and less than 122 m/sec are allowed.

(5) Air-assisted flares shall be designed and operated with an exit velocity less than the Velocity, V_{max}, as determined by the method specified in § 60.???(g)(6).

(6) Flares used to comply with this subpart shall be steam-assisted, air-assisted, or nonassisted.

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( )[f] Owners or operators of control devices used to comply with the provisions of this subpart shall monitor these control devices to ensure that they are operated and maintained in conformance with their designs.

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( )[f] Closed vent systems and control devices used to comply with provisions of this subpart shall be operated at all times when emissions may be vented to them.

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II. Test Methods and Procedures

(g)(1) Reference Method 22 shall be used to determine the compliance of flares with the visible emission provisions of this subpart. The observation period is 2 hours and shall be used according to Method 22.

(2) The presence of a flare pilot flame shall be monitored using a thermocouple or any other equivalent device to detect the presence of a flame.

[f] The ideas in these provisions are needed in the standards.

(3) The net heating value of the gas being combusted in a flare shall be calculated using the following equation:

$$H_T = K \sum_{i=1}^{n} C_i H_i$$

Where:

H_T = Net heating value of the sample, MJ/scm; where the net enthalpy per mole of offgas is based on combustion at 25°C and 760 mm Hg but the standard temperature for determining the volume corresponding to one mole is 20°C;

K = Constant, 1.740×10^{-7} $\left(\frac{1}{ppm}\right)\left(\frac{g\ mole}{scm}\right)\left(\frac{MJ}{kcal}\right)$

where the standard temperature for $\left(\frac{g\ mole}{scm}\right)$ is 20°C;

C_i = Concentration of sample component i in ppm on a wet basis, as measured for organics by Reference Method 18 and measured for hydrogen and carbon monoxide by ASTM D1946-67 (reapproved 1972) (incorporated by reference as specified in §60.17)$; and

H_i = Net heat of combustion of sample component i, kcal/g mole at 25°C and 760 mm Hg. The heats of combustion may be determined using ASTM D2382-76 (incorporated by reference as specified in §60.17)$ if published values are not available or cannot be calculated.

(4) The actual exit velocity of a flare shall be determined by dividing the volumetric flowrate (in units of standard temperature and pressure), as determined by Reference Method 2, 2A, 2C, or 2D as appropriate; by the unobstructed (free) cross sectional area of the flare tip.

$ Each project needs to incorporate these ASTM methods in final package.

(5) The maximun permitted velocity, V_{max}, for flares complying with §60.???(a)(4)(iii) shall be determined by the following equation:

$Log10(V_{max}) = (H_T + 28.8)/31.7$

V_{max} = Maximum permitted velocity, m/sec.
28.8 = Constant.
31.7 = Constant.
H_T = The net heating value as determined in paragraph (g)(3).

(6) The maximum permitted velocity, V_{max}, for air-assisted flares shall be determined by the following equation:

$V_{max} = 8.706 + 0.7084(H_T)$.

Eng. Units ⇒ $V_{max} = 28.75 + 0.0867[HC]$ (fps) $\left(\frac{BTU}{scf}\right)$

V_{max} = Maximum permitted velocity, m/sec.
8.706 = Constant.
0.7084 = Constant.
H_T = The net heating value as determined in paragraph (g)(3).