TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

FLARE TASK FORCE

DRAFT REPORT

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EXECUTIVE SUMMARY

Flares are control devices used to safely combust unwanted process waste gas streams; flares are essential for safe plant operation and have historically been authorized for the abatement of routine emissions. Recent concerns about the proper operation of flares and the reliability of assumed flare efficiency estimates prompted the creation of the Flare Task Force to evaluate the adequacy of existing flare regulations.

The Flare Task Force is recommending the Executive Director's consideration of the following options for improving Texas air quality.

- ***Monitoring*** **-** Requiring additional monitoring of flare operational parameters will help ensure proper flare operation and allow for a more accurate accounting of flare emissions in the state's emissions inventory and permit authorizations by providing reliable data for emission calculations.
- ***Flare Minimization Plans*** **-** Requiring the development of flare minimization plans will reduce emissions from routine flaring events through the implementation of appropriate control strategies.
- ***Agency Process Changes*** **-** Requiring additional evaluation during agency permitting processes will help ensure proper flare operation, especially for those flares that routinely operate at a low percent of their maximum design capacity.
- ***Public Outreach*** **-** Continuing to promote stakeholder involvement in agency flare issues will help improve our collective understanding of how flares factor into Texas air quality issues.

INTRODUCTION

BACKGROUND

Flares are imperative for safe plant operations and must be continuously available, highly reliable, and capable of the stable combustion of unwanted gas streams over the entire range of operating conditions including:

- emergency releases from site-wide general power failure;
- episodic releases during maintenance, startup, and shutdown operations; and
- continuous releases associated with routine process venting.

Flares are highly visible emission sources and their impact on air quality traditionally receives considerable attention. Recently, concerns have been raised regarding proper flare operation and the reliability of assumed flare efficiency estimates and there has been an increased focus on reducing the flaring of routine process waste gas streams.

In the October 2000 *Enforcement Alert Newsletter*, the United States Environmental Protection Agency (EPA) noted that routine flaring does not constitute good air pollution practice and may be a violation of the Federal Clean Air Act. Excessive hydrocarbon flaring is also one of the specific Federal Clean Air Act compliance issues targeted during the EPA's *National Petroleum Refinery Initiative*. As a result of this initiative, the nation's major petroleum refiners entered into multi-issue settlement agreements with the EPA that include provisions for implementing measures to reduce hydrocarbon flaring. This federal initiative is especially relevant since the Nation Petroleum Refiners Association concluded that in 2008 almost 18 percent of the nation's operating petroleum refineries were located in Texas. Additional information about these recent federal actions can be found in Appendix A.

Results from the 2006 Texas Air Quality Study (TexAQS II) indicate that volatile organic compound (VOC) concentrations in the Houston-Galveston-Brazoria ozone nonattainment area (HGB area) are consistent with higher VOC emissions than reported in the state point source emissions inventory. While the factors contributing to the excess VOC emissions observed during TexAQS II are not known at this time, the results from other agency research projects

support the possibility that flares may be one potential source of under-reported VOC emissions in Texas by raising concerns about proper flare operation and flare efficiency.

- Using GasFindIR™ infrared camera technology and direct downwind VOC measurements, TCEQ staff have identified flare plumes with un-combusted or partially combusted hydrocarbon emissions.
- Research indicates that flares emit almost 61 percent of all point source highly reactive volatile organic compound (HRVOC) emissions in the HGB area and almost 85 percent of the HRVOC flares surveyed routinely operate at less than 25 percent of their maximum design capacity.
- Preliminary results from a field research study using Differential Absorption Lidar to evaluate flare emissions indicate that the reliability of flare efficiency estimates warrants further evaluation for flares operating at a low percent of their maximum design capacity.

Additional information about TCEQ flare research projects can be found in Appendix B.

FLARE TASK FORCE

The Flare Task Force was created to assess the adequacy of existing flare regulations and to provide the Executive Director with recommendations for improving Texas air quality. To help ensure these recommendations reflect the perspectives of all affected stakeholders, participation in the Flare Task Force was open to all interested external stakeholders and included staff from all agency air programs. The Flare Task Force evaluated applicable technical documents to identify the most relevant issues for understanding how flares factor into state air quality issues. Open participation meetings were held in March, April, and September to solicit stakeholder input on these flare issues and upon request, individual meeting were held for more detailed discussion on specific flare issues. Additional information about the Flare Task Force is provided in Appendix C.

EVALUATION

The objective of the Flare Task Force evaluation was to assess the adequacy of existing flare regulations by examining the impact of flare emissions on Texas air quality and examining the available options to reduce flare emissions. To evaluate the contribution of flares to state air quality issues it is imperative to understand the quantity and specific content of flare emissions and to understand how flare emissions are accounted for in the state's emissions inventory and permit authorizations. Evaluating the available options to reduce flare emissions requires identifying technologically and economically feasible control strategies and developing the most appropriate methods for implementing those strategies in Texas.

UNDERSTANDING FLARE EMISSIONS

Unlike an enclosed combustion system such as a thermal oxidizer, a flare is open flame combustion device that relies on the uncontrolled ambient air around the flame to provide the necessary combustion air. Flares do not have air control damping system to control the air/fuel mixture and typically lack an enclosed combustion chamber. For complete combustion of the waste gas stream to occur, the flare system must be designed and operated to provide sufficient heat and combustion air to ensure that the hydrocarbons in the waste gas stream will rapidly react with the oxygen molecules in the combustion air. The design of each flare system is dictated by site-specific requirements.

Emission Measurement

Although emissions from full-size industrial flares can be directly measured (by attaching test probes to the stack or a crane for example), the open flame design of flares makes it inherently difficult to use traditional direct measurement techniques to determine the actual emissions. Some of the specific difficulties with using traditional direct measurement techniques to measure flare emissions include: the effects of high temperatures and radiant heat on test equipment; the effects of wind and intrinsic turbulence on the flare flame; the undefined dilution of flare emission plumes with ambient air; and a lack of suitable sampling locations on the flare. Emissions from full-size flares can also be measured using remote sensing technologies like open-path Fourier transform infrared or Differential Absorption Lidar. Alternatively, flare

emissions can be measured using scale-model flares under a hood or in a wind tunnel where all combustion products can be captured; however, the resulting data must be adjusted with scaling factors before it can be applied to full-size flares.

Destruction and Removal Efficiency

Since the direct measurement of flare emissions is difficult, flare destruction and removal efficiency (DRE) estimates have historically been used to determine emissions. Generally, flare DRE is assumed to be at least 98 percent when specific operating conditions in 40 Code of Federal Regulations (CFR) §60.18 or §63.11 are met. The flare operating conditions prescribed in the federal regulations in 40 CFR §60.18 and §63.11 include: limiting visible emissions; ensuring a flame is present at all times; maintaining an exit velocity less than the specified maximum flare tip exit velocity; and maintaining a minimum net heating value content. The existing federal and state flare regulations can be found in Appendix D.

The existing flare DRE estimates were derived from EPA research conducted in the 1980s that evaluated flare performance during a subset of potential operating scenarios; these EPA flare research studies are included in Appendix E. However, flare performance may also be impacted by operating parameters that were not specifically evaluated during these studies including: meteorological conditions; variable waste gas stream flow rate and composition; flare physical design characteristics and general maintenance; and flare steam or air assist operation. The existing flare DRE estimates may not be reliable across the full range of potential operating scenarios because these estimates are based on research that only examined some of these parameters. Additional research may be necessary to examine if various operational parameters impact the reliability of the assumed 98 percent flare DRE estimates. Specifically, it may be beneficial to consider additional research on the following topics.

- The TCEQ is planning to conduct a flare research study at a test facility in early 2010 that will examine the impact of various operational conditions on flare combustion efficiency and DRE in a controlled environment. Direct measurement techniques and remote sensing measurement techniques will be used to quantify flare emissions under varying waste gas flow rates, assist gas flow rates, and waste gas stream heat content.

- Conduct field research at an operating industrial facility to further evaluate flare combustion efficiency and DRE for different flare designs, operational parameters, and waste gas stream compositions.
- Conduct research to evaluate the reliability of existing NOx emission factors for flares. Conduct research to evaluate whether or not implementing measures to reduce VOC emissions from flaring may potentially increase the emissions of other criteria pollutants and evaluate the overall impact on air quality. Conduct research to evaluate the impact of potential future flare emission control strategies to help ensure that no significant emission increases would occur for other pollutants.
- Conduct research to evaluate design or operational requirements for a minimum flow rate for flares to help ensure an appropriate assist gas to waste gas stream ratio is maintained.

Monitoring

Flare emissions are often determined using engineering calculations that rely on assumed DRE and production data to estimate the quantity and composition of the flared waste gas streams. While calculating daily emissions based on annual averages is consistent with standard emission inventory practices, on any given day, actual flare emissions can vary significantly. Monitoring flare operational parameters will help ensure the flare is continuously complying with the operating criteria necessary to achieve the assumed 98 percent DRE. Monitoring flare operational parameters will also provide more reliable data for emission calculations and allow for a more accurate accounting of flare emissions in the state's emissions inventory and permit authorizations. Monitoring some or all of the following flare operational parameters may help improve our understanding of flare emissions.

- ***Waste Gas Stream Flow Rate*** **-** Monitoring the flare waste gas flow rate will provide more reliable estimates of the amount of material being sent to the flare, help ensure that the flare exit velocity is below the exit velocity limit in 40 CFR §60.18, and help determine the assist gas to waste gas ratio for assisted flares.
- ***Waste Gas Stream Net Heating Value*** **-** Monitoring the flare waste gas stream net heating value helps ensure that the minimum net heating value is being maintained for proper operation of the flare.

- ***Waste Gas Stream Composition*** **-** Monitoring the flare waste gas stream composition provides more reliable data on the compounds sent to the flare. In addition to providing more accurate estimates of flare emissions, composition data can be used to improve operational performance of the flare.
- ***Air Assist or Steam Assist Flow Rate*** **-** Monitoring the flare air assist or steam assist flow rate will help determine the assist gas to waste gas ratio for assisted flares. This will help ensure better flare performance by allowing operators to better maintain appropriate assist gas to waste gas ratio and minimize periods where the assist gas is detrimental to the performance of the flare (e.g., over-steaming).
- ***Flame Presence*** **-** Continuous monitoring to verify the presence of the flare flame will help ensure that the flare is lit at all times; this may include monitoring the flare pilot flame and the net heating value of the process waste gas stream being sent to the flare. Although 40 CFR §60.18 requires the pilot to be lit at all times and requires monitoring of the flare pilot flame, it may also be necessary to monitor the net heating value of the waste gas stream to help ensure there is sufficient Btu to support combustion.

REDUCING FLARE EMISSIONS

As previously discussed, concerns have been raised regarding proper flare operation and the reliability of the assumed 98 percent DRE estimates for flares operating at a low percent of their maximum design capacity. Minimizing the frequency and duration of routine flaring events will help reduce emissions. The Flare Task Force evaluation focused on identifying technologically and economically feasible strategies to reduce flare emissions and identifying implementation options that provide facilities with the flexibility to address their unique flare systems without compromising the safety of workers and the general public or production.

Post-combustion control approaches like catalyst systems or scrubbers are not an option for reducing emissions from open combustion sources like flares. Therefore, flare emission reductions can only be achieved by improving flare DRE or by using pre-combustion controls. Because flare DRE is generally assumed to be 98 percent, improving flare DRE requires implementing measures that increase the reliability of achieving this assumed efficiency such as setting operational limits or monitoring operational parameters to ensure proper flare

performance. Pre-combustion controls reduce the amount of waste gas sent to the flare and may involve physical changes to the flare system or pollution prevention strategies.

The following examples of pre-combustion control strategies may require the installation of new equipment or other physical changes to the flare system to reduce emissions.

- ***Use of alternative control devices*** - Some of the routine process waste gas streams typically combusted in a flare can be directed to an alternative control device, such as a vapor combustor.
- ***Diverting or eliminating streams vented to the flares*** - Certain streams that are routinely directed to the flare may be rerouted and treated for use as fuel gas or recycled back in the process using flare gas/hydrocarbon recovery systems.
- ***Use of redundant equipment to increase reliability*** - Installing redundant equipment can help avoid flaring during a process upset since the spare equipment can be put online if the primary equipment breaks down.
- ***Leak source monitoring*** - Installing flow monitors on process unit flare headers can help identify the origin of increased flare flows and allow for immediate corrective actions to prevent or reduce the duration of a flaring event. Conducting periodic acoustic or thermal surveys of the pressure relief devices connected to the flare can allow help identify leak-gas inadvertently being sent to the flare.

The following examples of pre-combustion controls use pollution prevention strategies designed to reduce emissions through operational changes as opposed to controlling the emissions with add-on equipment.

- ***Conducting root cause analysis of significant flaring events*** - The analysis will identify the cause of significant flaring events and help determine the appropriate corrective measures, like equipment and/or operational changes, necessary to prevent future reoccurrences of similar flaring events.
- ***Developing startup and shutdown procedures that minimize or eliminate flaring*** - For certain units, it is possible to develop procedures to minimize or eliminate flaring during planned startup and shutdown activities; these procedures may include using reduced loads, recycling feeds, and better decontamination procedures.

- ***Optimization of turnaround schedules*** - Coordinating turnaround schedules for different units can reduce flaring activity and minimize emissions associated with these periodic maintenance activities.
- ***Better engineering and equipment design*** - Evaluate existing process flow and equipment to identify potential changes in operating parameters like temperature and pressure settings that may result in reduced volumes of vent gas being generated.
- ***Operator training*** - Facility training programs can increase awareness about the environmental impacts of excessive flaring and teach procedures to minimize the frequency and duration of flaring events.

RECOMMENDATIONS

The Flare Task Force is recommending the Executive Director's consideration of the following options for improving Texas air quality. The recommendations are intended to improve our understanding of the quantity and content of flare emissions in Texas, help ensure that flare emissions are accurately accounted for in the state's emissions inventory and permit authorizations, and reduce emissions from routine flaring through the implementation of technologically and economically feasible control strategies.

MONITORING FLARE OPERATIONAL PARAMETERS

The Flare Task Force recommends additional monitoring requirements be added to 30 TAC Chapter 115 for flares located in ozone nonattainment areas, areas that directly impact the air quality of ozone nonattainment areas, and Air Pollutant Watch List areas. The Flare Task Force also recommends additional monitoring requirements be added to the New Source Review Permit boiler plate conditions for flares state-wide and that the adequacy of site specific flare monitoring requirements be evaluated during the permit renewal process.

The Flare Task Force is recommending additional monitoring requirements to provide more reliable data for emission calculations and allow for a more accurate accounting of flare emissions in the state's emissions inventory and permit authorizations. Additional monitoring requirements may also facilitate compliance and enforcement of existing state regulations by helping to ensure the flare is continuously complying with the operating criteria necessary to achieve the assumed 98 percent DRE. The Flare Task Force is not recommending setting operational limits in conjunction with the recommended monitoring requirements. Operational limits for minimum net heating value and maximum exit velocity are already established in 40 CFR §60.18; additional research is needed before establishing an operational limit for the assist gas to waste gas ratio.

The recommended monitoring requirements are stand alone recommendations so any combination could be selected for implementation; in addition, not all of the following recommended monitoring requirements may be necessary for each individual flare. Additional

stakeholder input would be solicited during any formal rule making process to implement these recommendations; specifically, additional stakeholder input would be requested on the appropriate trigger for these monitoring requirements. The costs associated with implementing any of the recommended monitoring requirements will depend on site-specific variables; as an example, the cost estimates for similar rules implemented in other states are provided in Appendix F.

Implementation Options

- Require continuous flow monitoring for flares that receive routine process waste gas streams. These requirements could be applied to flares based on: industry sector, maximum design capacity, emissions exceeding a given threshold, emissions of pollutants on the Air Pollutant Watch List, toxic emissions, or hazardous air pollutants.
- Require continuous physical seal monitoring for emergency-only flares as an alternative option to installing a continuous flow meter. These requirements could be applied to flares based on: industry sector, maximum design capacity, emissions exceeding a given threshold, emissions of pollutants on the Air Pollutant Watch List, toxic emissions, or hazardous air pollutants.
- Require continuous waste gas stream composition monitoring on flares that receive routine process waste gas streams. Composition monitoring could be for: total VOC, speciated VOC, compounds vented in excess of a given percent of total emissions, emissions of pollutants on the Air Pollutant Watch List, toxic compounds, or hazardous air pollutants.
- Require continuous air/steam assist rate flow monitoring for flares that receive routine process waste gas streams. These requirements could be applied to flares based on: industry sector, maximum design capacity, emissions exceeding a given threshold, emissions of pollutants on the Air Pollutant Watch List, toxic emissions, or hazardous air pollutants.
- Require continuous monitoring of the operational parameters necessary to determine the net heating value of the waste gas stream to ensure that the flare is complying with the minimum net heating value requirements in 40 CFR §60.18 requirements and provide greater confidence in flare performance. Net heating value can be monitored using an

on-line calorimeter, composition monitoring to calculate the net heating value, or maintaining sufficient assist fuel gas to maintain the required minimum net heating value.

- Require continuous monitoring to verify the presence of the flare flame and help ensure the flare is lit at all times. Although 40 CFR §60.18 requires the pilot to be lit at all times and requires monitoring of the flare pilot flame, it may also be necessary to monitor the net heating value of the waste gas stream to help ensure there is sufficient Btu to support combustion. Additional monitoring requirements may be necessary for flares that are not currently subject to the requirements in 40 CFR §60.18 to ensure the flare is lit at all times.

FLARE MINIMIZATION PLANS

The Flare Task Force recommends flare minimization plan requirements be added to 30 TAC Chapter 115 or to agreed orders when appropriate.

Site-specific conditions dictate the appropriate mechanism to reduce the quantity and duration of flaring events. Requiring the development of a flare minimization plan provides affected facilities with the flexibility to implement strategies that maximize emission reductions for their unique process designs and maintain the emission reductions achieved from the practices already instituted. Many petroleum refineries have already implemented flare minimization strategies as part of the EPA settlement agreements previously discussed; in addition, informal stakeholder comments provided to the Flare Task Force indicate that many petrochemical companies already have flare minimization plans in place as a best management practice. Regardless of how the plans are reviewed by the agency, requiring the development of flare minimization plans will initiate an in-depth review of all flaring events that will likely benefit plant operations and the subsequent implementation of strategies to reduce flaring may even result in cost savings to the company.

Implementing the recommendation for flare minimization plans would require establishing a new agency program and allocating resources to evaluate and enforce the plans including highly specialized staff with backgrounds in engineering, plant operations and regulatory development. The necessary staff resources would depend on the scope of the subsequent flare minimization

plan rule, including the number and size of facilities affected by the plan requirements; as an example, the estimated staff resources to implement similar rules in other states are provided in Appendix F. Additional stakeholder input would be solicited during any formal rule making process to implement these recommendations; specifically, additional stakeholder input would be requested on the appropriate trigger for review of the flare minimization plans and the specific plan requirements.

Implementation Options

- Flare minimization plan requirements could be applied to flares based on: nonattainment area, Air Pollutant Watch List area, industry sector, maximum design capacity, emissions exceeding a given threshold, toxic emissions, or hazardous air pollutants. The plan requirements could also be phased in over time starting with sites in nonattainment areas or in specific industry sectors.
- The flare minimization plans would only be reviewed upon site inspection, emission events evaluation, new authorization of flares, permit renewals, or some other pre-established trigger.
- The flare minimization plans could be reviewed by: TCEQ staff, an independent contractor hired by the TCEQ, or an independent third party contractor hired by the affected facility.
- Specific flare minimization plan content requirements would be modeled after similar requirements implemented in other states; examples of such rules are provided in Appendix F.

Special Considerations

- If the additional monitoring requirements recommended by the Flare Task Force are not implemented, it may be necessary to require enhanced operational parameter monitoring in conjunction with the flare minimization plan requirements to facilitate compliance and enforcement of the plan commitments.
- It may be appropriate to provide incentives to encourage the voluntary implementation of best management practices for flares.

- It may be necessary to revise the 30 TAC Chapter 117 nitrogen oxide emission specifications and/or mass emissions cap and trade program exemption criteria for incinerators to include smaller units that may be installed as alternative control devices.

AGENCY PROCESS CHANGES

The Flare Task Force recommends implementing process changes to agency permitting programs to require additional evaluation of emergency-sized flares used for the abatement of routine process waste gas streams. Since the agency does not have the authority to require facilities to revise their permit conditions, the implementation options described would only apply to new or modified sources. Similarly, unless they are modified, flares that are already authorized by the 30 TAC Chapter 106 Permits by Rule or 30 TAC Chapter 116 Standard Permits would not be required to comply with any additional requirements added in the future. It is important to note that revisions to existing flare permits can be required during agency enforcement processes if the root cause analysis of the flaring event identifies violations. It is also possible to issue an Agreed Order as part of an enforcement settlement that includes additional requirements beyond the conditions included in an existing permit or requires flares authorized by Permits by Rule or Standard Permits to be included in an existing permit along with the attendant best available control technology (BACT) review, impacts review, and, if need, additional monitoring requirements.

Implementation Options

- Establish procedures to determine a maximum allowable turndown ratio as part of the BACT review for flares used for both emergency and routine process waste gas streams.
- Add additional monitoring requirements for flares that qualify for authorization through the 30 TAC Chapter 106 Permits by Rule and the 30 TAC Chapter 116 Standard Permits. These requirements could include monitoring the flow rate, net heating value, and/or composition of the waste gas stream.

CONTINUED PUBLIC OUTREACH

The Flare Task Force recommends implementing measures to promote public awareness and maintain public involvement in agency flare issues.

Implementation Options

- Maintain the Flare Task Force Stakeholder Group to promote open communication and information sharing among affected stakeholders.
- Begin a public awareness campaign to educate the general public about flare issues. This may include maintaining a web page that provides general information about flares in Texas and links to additional information about flares.
- Conduct outreach to educate business owners and operators about best management practices for flares.

RESEARCH

As previously mentioned, the TCEQ is planning to conduct a flare research study at a test facility in early 2010 that will examine the impact of various operational conditions on flare combustion efficiency and DRE in a controlled environment. Direct measurement techniques and remote sensing measurement techniques will be used to quantify flare emissions under varying waste gas flow rates, assist gas flow rates, and waste gas stream heat content.

Although additional research may be necessary to examine the impact of various operational parameters on the reliability of assumed flare DRE estimates, the Flare Task Force recommends waiting until this planned flare research project is complete to evaluate if additional research is warranted.

APPENDICES

APPENDIX A: RECENT FEDERAL ACTIONS

A-1: EPA Enforcement Alert: Frequent, Routine Flaring may Cause Excessive Uncontrolled Sulfur Dioxide Releases, October 2000

A-2: EPA Enforcement: National Petroleum Refinery Initiative, 2006

A-3: National Petroleum Refiners Association, United States Refining and Storage Capacity Report, 2008

APPENDIX B: TEXAS COMMISSION ON ENVIRONMENTAL QUALITY RESEARCH PROJECTS

B-1: Final Rapid Science Synthesis Report: Findings from the Second Texas Air Quality Study (TexAQS II), 2007

B-2: Measurements of VOC Emissions from Petrochemical Industry Sites in the Houston Area using Differential Absorption Lidar (DIAL) during Summer 2007, Draft Test Report, 2008

B-3: Cost Analysis of HRVOC Controls on Polymer Plants and Flares, 2008

B-4: Cost Analysis of HRVOC Controls on Refineries and Chemical Plants and Control of HRVOC Emissions in Flares at Low Flow Conditions, 2009

B-5: Flare Waste Gas Flow Rate and Composition Measurement Methodologies Evaluation

APPENDIX C: FLARE TASK FORCE

C-1: Flare Task Force Stakeholder Group Members

C-2: Flare Task Force Stakeholder Group Meeting Presentations

C-3: Flare Task Force Stakeholder Group Informal Comments

- C-3A: Buell Consulting Services
- C-3B: ConocoPhillips
- C-3C: Don Weaver
- C-3D: Environmental Integrity Project
- C-3E: Industry Professionals for Clean Air
- C-3F: Sierra Club

C-3G: Texas Chemical Council and Texas Oil and Gas Association

C-3H: Texas Oil and Gas Association

C-3I: Total Petrochemicals

C-3J: Waste Management

C-3K: Western Refining

APPENDIX D: FLARE REGULATIONS AND ASSOCIATED GUIDANCE DOCUMENTS

Federal Flare Regulations and Guidance Documents

D-1: Title 40 Code of Federal Regulations §60.18: Standards of Performance for New Stationary Sources, General Provisions, General Control Device and Work Practice Requirements

D-2: Title 40 Code of Federal Regulations §63.11: National Emission Standards for Hazardous Air Pollutants for Source Categories, General Provisions, Control Device and Work Practice Requirements

D-3: EPA Basis and Purpose Document on Specifications for Hydrogen-Fueled Flares, 1998

Texas Flare Regulations and Guidance Documents

D-4: Title 30 Texas Administrative Code Chapter 106: Permits by Rule, Subchapter V: Thermal Control Devices

D-5: Title 30 Texas Administrative Code Chapter 111: Control of Air Pollution from Visible emissions and Particulate Matter, Subchapter A: Visible Emissions and Particulate Matter

D-6: Title 30 Texas Administrative Code Chapter 115: Control of Air Pollution from Volatile Organic Compounds, Subchapter B: General Volatile Organic Compound Sources, Division 2: Vent Gas Control

D-7: Title 30 Texas Administrative Code Chapter 115: Control of Air Pollution from Volatile Organic Compounds, Subchapter H: Highly Reactive Volatile Organic Compounds, Division 1: Vent Gas Control

D-8: Title 30 Texas Administrative Code Chapter 116: Control of Air Pollution by Permits for New Construction or Modification, Subchapter F: Standard Permits

D-9: Air Permit Technical Guidance for Chemical Sources: Flares and Oxidizers, 2000

D-10: New Source Review Permits Boiler Plate Conditions for Flares

D-11: Emissions Inventory Guidance, 2008

D-12: Houston-Galveston-Brazoria Ozone Nonattainment Area Attainment Demonstration State Implementation Plan Revision, 2004, Appendix L: Justification for 99 Percent Destruction Efficiency

APPENDIX E: EPA FLARE RESEARCH

E-1: Evaluation of the Efficiency of Industrial Flares: Flare Head Design and Gas Composition (EPA-600-2-85-106)

E-2: Evaluation of the Efficiency of Industrial Flares: Test Results (EPA-600-2-84-095)

E-3: Evaluation of the Efficiency of Industrial Flares: H_2S Gas Mixtures and Pilot Assisted Flares (EPA-600-2-86-080)

E-4: Flare Efficiency Study (EPA-600-2-83-052)

E-5: A Report on a Flare Efficiency Study for the Chemical Manufacturers Association

APPENDIX F: CALIFORNIA FLARE MONITORING AND MINIMIZATION PLAN REGULATIONS

F-1: South Coast Air Quality Management District Rule 1118: Control of Emissions from Refinery Flares

F-2: South Coast Air Quality Management District Rule 1118 Staff Report

F-3: Bay Area Air Quality Management District Rule 12-11: Misc. Standards of Performance-Flares Monitoring at Petroleum Refineries

F-4: Bay Area Air Quality Management District Rule 12-11 Staff Report

F-5: Bay Area Air Quality Management District Rule 12-12: Misc. Standards of Performance-Flares at Petroleum Refineries

F-6: Bay Area Air Quality Management District Rule 12-12 Staff Report

F-7: San Joaquin Valley Unified Air pollution Control District Rule 4311: Flares

F-8: San Joaquin Valley Unified Air pollution Control District Rule 4311 Staff Report