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**COMPREHENSIVE PERFORMANCE TEST PLAN**  
**BOILER NUMBERS 1, 2, AND 3**  
**LYONDELL CHEMICAL COMPANY**  
**EPA I.D. NO. TXD 083472266**

PREPARED FOR:



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- C. Naphthalene DRE Analysis

### List of Acronyms

|                  |   |
|------------------|---|
| AMA              | alternative monitoring application                            |
| APC              | air pollution control   |
| ASTM             | American Society for Testing and Materials                    |
| AWFCO            | automatic waste feed cutoff                                   |
| BDO              | 1,4-butanediol  |
| BIF              | Boiler and Industrial Furnace Rule (40 CFR 266, Subpart H)    |
| Btu              | British thermal unit  |
| Cd               | cadmium   |
| CEM              | continuous emissions monitoring/monitor                       |
| CEMS             | continuous emissions monitoring system                        |
| CFR              | Code of Federal Regulations                                   |
| Cl <sup>-</sup>  | chloride ion  |
| Cl <sub>2</sub>  | molecular chlorine  |
| CMS              | continuous monitoring system                                  |
| CMSPETP          | continuous monitoring system performance evaluation test plan |
| CO               | carbon monoxide   |
| CPT              | comprehensive performance test                                |
| Cr               | chromium  |
| CVAA<br>or CVAAS | cold vapor atomic absorption spectrometry                     |
| DCS              | distributed control system                                    |
| D/F              | dioxins/furans  |
| DRE              | destruction and removal efficiency                            |
| DQO              | data quality objective  |
| dscf             | dry standard cubic foot                                       |
| dscm             | dry standard cubic meter                                      |
| EPA              | U.S. Environmental Protection Agency                          |
| FAP              | feedstream analysis plan                                      |
| ft               | foot  |
| g                | gram  |
| gpm              | gallons per minute  |
| gr               | grain   |
| HC or THC        | total hydrocarbons  |
| HCl              | hydrogen chloride (gas) or hydrochloric acid (aqueous)        |
| Hg               | mercury   |
| hr               | hour  |
| HWC              | hazardous waste combustor                                     |
| I&E              | instrumentation and electrical                                |
| ICP or ICAP      | inductively coupled argon plasma                              |
| inwc             | inches water column   |
| kg               | kilogram  |
| l or L           | liter   |
| Lb or lb         | pound   |
| LFB              | liquid fuel-fired boilers                                     |
| LVM              | low volatility metals   |
| MACT             | Maximum Achievable Control Technology                         |
| mg               | milligram   |
| MHWTC            | Maximum Hazardous Waste Thermal Concentration                 |
| ml               | milliliter  |
| MMBtu/hr         | million British thermal units per hour                        |
| MTEC             | Maximum Theoretical Emission Concentration                    |
| NDIR             | non-dispersive infrared                                       |
| NOC              | Notification of Compliance                                    |
| O <sub>2</sub>   | oxygen  |

|           |   |
|-----------|---|
| OPL       | operating parameter limit                 |
| PAH       | polynuclear aromatic hydrocarbon          |
| Pb        | lead                                      |
| PCB       | polychlorinated biphenyl                  |
| PCDD      | polychlorinated dibenzo-p-dioxin          |
| PCDF      | polychlorinated dibenzofuran              |
| PEP       | performance evaluation plan               |
| PETP      | performance evaluation test plan          |
| PIC       | product of incomplete combustion          |
| POHC      | principal organic hazardous constituent   |
| ppm       | parts per million                         |
| ppmdv     | parts per million dry volume              |
| ppmv      | parts per million by volume               |
| PM        | particulate matter                        |
| psid      | pounds per square inch, differential      |
| psig      | pounds per square inch, gauge             |
| QA        | quality assurance                         |
| QAPP      | quality assurance project plan            |
| QC        | quality control                           |
| RCRA      | Resource Conservation and Recovery Act    |
| scfh      | standard cubic feet per hour              |
| scfm      | standard cubic feet per minute            |
| SOP       | standard operating procedure              |
| SSMP      | startup, shutdown and malfunction plan    |
| SVM       | semi volatile metals                      |
| TAC       | Texas Administrative Code                 |
| TCEQ      | Texas Commission on Environmental Quality |
| TEQ       | toxicity equivalents                      |
| THC or HC | total hydrocarbons                        |
| vol%      | volume percent                            |
| WFE       | wiped film evaporator                     |
| wt%       | weight percent                            |
| µg or ug  | microgram                                 |
| ng or ng  | nanogram                                  |



## 1.0 TEST PROGRAM SUMMARY

### 1.1 Facility and Test Plan Background

This comprehensive performance test (CPT) plan describes the protocol for testing of the Lyondell Chemical Company's (Lyondell) three hazardous waste boilers located at the Channelview, Texas site. The three boilers are Boiler Nos. 1, 2, and 3. Treatment of hazardous wastes in these boilers is regulated under the Hazardous Waste Combustor (HWC) Maximum Achievable Control Technology (MACT) final rule promulgated on October 12, 2005. The HWC MACT rules at 40 CFR 63 Subpart EEE are incorporated by reference into the State of Texas regulations at 30 TAC 113.620. The initial CPT of these units was performed in September 2010. This test plan is for the second periodic CPT required to be performed 61 months from the commencement of the previous CPT [40 CFR 63.1207(d)(1)]. The previous CPT was conducted December 2015 making the next periodic test required by January 2021.

### 1.2 Test Performance and Emissions Objectives [40 CFR 63.1217]

The Lyondell HWC Boilers are classified as liquid-fuel-fired boilers (LFBs) under the HWC MACT rule. The as-fired or aggregate as-fired heating value of the waste treated exceeds 10,000 Btu/lb. The CPT program will demonstrate compliance of the Lyondell HWC Boilers with the following applicable HWC MACT performance and emissions standards:

- Demonstrate the feed rate of mercury (Hg) is less than 4.2E-05 pounds per million Btu (lb/MMBtu) of waste fired for wastes with heating values of 10,000 Btu/lb or greater based on Maximum Hazardous Waste Thermal Concentration (MHWTC) (no system removal approach) [40 CFR 63.1217(a)(2)(ii), 63.1207(m)(2), & 63.1209(l)(1)(ii)];
- Demonstrate the emissions of the semivolatile metals (SVM) [the combined emissions of lead (Pb) and cadmium (Cd)] are less than 8.2E-05 lb/MMBtu of waste fired for wastes with heating values of 10,000 Btu/lb or greater based on MHWTC [40 CFR 63.1217(a)(3)(ii), 63.1207(m)(2), & 63.1209(n)(2)(v)(A)];
- Demonstrate the emissions of chromium (Cr) [low volatility metal (LVM)] are less than 1.3E-04 lb/MMBtu of waste fired for wastes with heating values of 10,000 Btu/lb or greater based on MHWTC [40 CFR 63.1217(a)(4)(ii), 63.1207(m)(2), & 63.1209(n)(2)(v)(B)];
- Demonstrate the stack gas carbon monoxide (CO) hourly rolling average concentration is less than or equal to 100 parts per million, dry volume (ppmdv), corrected to 7% oxygen [40 CFR 63.1217(a)(5)(i)];
- Demonstrate the stack gas total hydrocarbons (HC or THC) hourly rolling average concentration is less than or equal to 10 ppmdv as propane, corrected to 7% oxygen [40 CFR 63.1217(a)(5)(ii)];
- Demonstrate the combined feed rates of chloride and chlorine or emissions of HCl and Cl<sub>2</sub> are less than 5.1E-02 lb/MMBtu of waste fired for wastes with heating values of 10,000 Btu/lb or greater expressed as chloride (Cl<sup>-</sup>) equivalents [40 CFR 63.1217(a)(6)(ii) & 63.1209(o)(1)(ii)];
- Demonstrate the stack gas particulate matter (PM) concentration is less than or equal to 80 milligrams per dry standard cubic meter (mg/dscm) [0.036 grains per dry standard cubic foot (gr/dscf)] corrected to 7% oxygen [40 CFR 63.1217(a)(7)];

- Demonstrate the organic destruction removal efficiency (DRE) of 99.99% for the selected principle organic hazardous constituent (POHC) [40 CFR 63.1217(c)(1)].

Provisions at 40 CFR 63.1206(b)(7) and 63.1207(c)(2)(iv) do not require re-demonstrating organic destruction and removal efficiency (DRE) performance. DRE testing was not repeated during the 2015 CPT. The DRE-related operating parameter limits (OPLs) of maximum waste feed rate, minimum combustion temperature, and maximum combustion gas velocity established via the 2010 CPT were retained. However, Lyondell desires to increase the maximum hazardous waste and atomizing gas differential pressure limit. This CPT plan includes re-demonstrating DRE waste at a higher maximum hazardous waste and atomizing gas differential pressure limit. Concurrently, the CPT will re-establish minimum combustion temperature, the maximum waste feed rate, and maximum combustion gas velocity indicator limits.

There is no specific numerical performance standard for polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/PCDFs) emissions from liquid fuel-fired boilers not equipped with dry air pollution control (APC) systems. PCDD/PCDF emissions were measured during the initial (2010) CPT as required by 63.1207(b)(3). Measurement of PCDD/PCDF emissions will be repeated during this CPT as required by 40 CFR 63.1207(b)(3)(v).

### 1.3 Test Operating Objectives

Target unit operating conditions are presented in Section 4.0 of this CPT plan. The HWC MACT operating parameter limits (OPLs) from 40 CFR 63.1209(j)-(p) applicable to the Lyondell HWC Boilers are summarized in Table 1-1. Values for some operating limits will be demonstrated during the CPT, while others will be set independently of the CPT demonstrated values or results.

The Lyondell HWC Boilers have no air pollution control equipment. Lyondell has examined the potential emissions from treatment of the liquid waste streams in the boilers and has determined compliance with the HWC MACT HCl/Cl<sub>2</sub> and metals emission limits is possible via MHWTC. The MHWTC compliance analyses presented in Section 3.0 show the combustion of wastes in Boiler Nos. 1, 2, and 3 complies with the HWC MACT thermal-input based emission limits with no control. MHWTC compliance is based on the feed rate of the respective HWC MACT constituents (Cl, Hg, LVM, and SVM) divided by the heat input from waste in accordance with the performance test waiver provisions of 40 CFR 63.1207(m)(2).

Details on how the CPT results and operating data will be translated into established limits are presented in Section 7.0 of this CPT plan. The CPT process operating data will be used to establish the maximum ash feed rate [40 CFR 63.1209(m)(3)] and the following DRE-related OPLs.

- Maximum hazardous waste feed rate [40 CFR 63.1209(j)(3), (k)(4)]
- Minimum combustion temperature [40 CFR 63.1209(j)(1), (k)(2)]
- Maximum combustion gas flow rate [40 CFR 63.1209(j)(2), (k)(3)]

- Maximum hazardous waste and atomizing gas differential pressure [40 CFR 63.1209(j)(4)].

Commensurate with the original CPT plan submittal, Lyondell submitted an Alternative Monitoring Application (AMA) in accordance with 40 CFR 63.1209(g) and 63.8(f) [MACT *General Provisions*]. In the AMA, Lyondell proposed alternative CMS operating limits that provided equivalent or better assurance of compliance with specific HWC MACT performance standards. This version of the CPT reflects the resolution of the AMA items between Lyondell, the Texas Commission on Environmental Quality (TCEQ), and U.S. Environmental Protection Agency (EPA) Region 6.

#### **1.4 Test Protocol [40 CFR 63.1207(f)]**

The CPT will include testing of one boiler to demonstrate compliance of the three HWC Boilers at the Lyondell site. Boiler Nos. 1, 2, and 3 are identical and share a common feed tank and stack. Boiler No. 1 or Boiler No. 3 will be tested with the emissions and performance results used as data-in-lieu for the two untested units. Stack sampling of the tested boiler's emissions will be performed in the duct from the boiler, upstream from point of its connection to the common stack.

The test program will be composed of two test conditions with three replicate sampling runs conducted at each set of operating conditions:

- Test 1 is the minimum combustion temperature DRE test. The test condition will demonstrate DRE performance, establish a new combustion temperature limit and demonstrate carbon monoxide and total hydrocarbon emissions compliance.
- Test 2 is the maximum waste feed rate and maximum combustion air flow rate DRE test. The test condition will demonstrate DRE performance establish new maximum waste feed rate and maximum combustion air flow limits, demonstrate carbon monoxide and total hydrocarbon emissions compliance, , and establish the maximum ash feed rate limit. Compliance with the metals and HCl/Cl<sub>2</sub> emissions standards will be demonstrated via MHWTC.

The sampling protocols for the CPT are provided in Section 5.0 of this CPT plan and summarized in Table 1-2. An ash surrogate will be spiked (metered to the waste feed) during Test 2 to demonstrate the desired ash feed rate limit. Additionally, the selected POHC naphthalene will be metered to the waste feed to demonstrate DRE during both test conditions. Detailed information on ash and naphthalene spiking is provided in Section 4.0 of this CPT plan. The previous CPT programs included collection of additional metals data for demonstrating emissions compliance with the Resource Conservation and Recovery Act (RCRA) Boiler and Industrial Furnace (BIF) emission standards. Lyondell's RCRA permit modification request in accordance with 40 CFR 270.22 to remove certain hazardous waste permit provisions including the RCRA BIF monitoring and testing requirements was approved by TCEQ. Therefore, concurrent collection of additional RCRA BIF compliance data is removed from this test plan.

## 1.5 CPT Plan Organization

The CPT plan is organized into eight sections as follows:

- Section 1.0 – Test Program Summary;
- Section 2.0 - Feed Stream Description;
- Section 3.0 - Engineering Description;
- Section 4.0 - Test Design and Protocol;
- Section 5.0 - Sampling, Analysis, and Monitoring Procedures;
- Section 6.0 - Test Schedule;
- Section 7.0 - Operating Permit Objectives; and
- Section 8.0 - Test Report.

The Quality Assurance Project Plan (QAPP) is included as Appendix A. The Continuous Monitoring System Performance Evaluation Test Plan (CMS PETP) is provided in Appendix B.

Any modification to this plan or any appendix will be submitted to the TCEQ for approval.

## 1.6 Reference Documents

Reference documents that have been used in developing the plan include the following:

- Title 30 Texas Administrative Code Chapter 335 (30 TAC 335) Industrial Solid Waste and Municipal Hazardous Waste.
- National Emission Standards for Hazardous Air Pollutants from Hazardous Waste Combustors, 40 CFR 63 Subpart EEE, September 30, 1999, as amended through February 14, 2002, and Phase II changes effective October 12, 2005.
- American Society for Testing and Materials, "Annual Book of ASTM Standards," latest annual edition.
- EPA, "New Source Performance Standards, Test Methods and Procedures," Appendix A, 40 CFR 60.
- EPA, "Test Methods for Evaluating Solid Wastes Physical/Chemical Methods (SW-846)," Third Edition, 1986 and updates.
- Quality Assurance/Quality Control (QA/QC) Procedures for Hazardous Waste Incineration, EPA/625/6-89/023, January 1990.
- EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5 EPA/240/B-01/003), March 2001.
- Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (QAMS-005/80).

Table 1-1. HWC MACT Operating Limits Applicable to the Lyondell Boiler Nos. 1, 2, and 3

| LIMIT  | REGULATORY CITATION                              | HOW ESTABLISHED   | AVERAGING TIME              | ASSOCIATED STANDARD  |        |    |     |     |    |
|--|--|---|-----------------------------|--|--------|----|-----|-----|----|
|  |  |   |                             | DRE  | D/Fs   | Hg | SVM | LVM | PM |
| <b>LIMITS ASSOCIATED WITH THE COMBUSTION ZONE</b>    |  |   |                             |  |        |    |     |     |    |
| Minimum combustion temperature                       | 63.1209(j)(1), (k)(2)                            | Average of test run averages                                      | Hourly rolling average      | Note 1   | Note 2 |    |     |     |    |
| Maximum combustion chamber pressure                  | 63.1206(c)(5), 63.1209(p)                        | Sealed unit or lower than ambient pressure                        | Instantaneous; no averaging | For control of fugitive emissions - no quantified limits established by the HWC MACT rule. |        |    |     |     |    |
| Maximum flue gas flow rate or production rate        | 63.1209(j)(2), (k)(3)                            | Average of the maximum hourly rolling averages                    | Hourly rolling average      | Note 1   | Note 2 |    |     | X   |    |
| Operation of waste firing system                     | 63.1209(j)(4)                                    | Operator to specify parameters and limits                         | Parameter specific          | Note 1   |        |    |     |     |    |
| <b>LIMITS ASSOCIATED WITH THE WASTE FEED STREAMS</b> |  |   |                             |  |        |    |     |     |    |
| Maximum hazardous waste feed rate                    | 63.1209(j)(3), (k)(4)                            | Maximum total as the average of the maximum rolling hour averages | Hourly rolling average      | Note 1   | Note 2 |    |     |     |    |
| Maximum feed rate of mercury                         | 63.1209(l)(1)(ii); 63.1217(a)(2)                 | Maximum total feed/emissions rate                                 | Annual average              |  |        | X  |     |     |    |
| Maximum ash feed rate                                | 63.1209(m)(3); 63.1217(a)(7)                     | Average of the test run average feed rates                        | 12-hour rolling average     |  |        |    |     | X   |    |
| Maximum feed rate of SVM (Cd+Pb)                     | 63.1209(n)(2)(i)(A), (n)(2)(v)(A); 63.1217(a)(3) | Maximum total feed/emissions rate                                 | Annual average              |  |        |    | X   |     |    |
| Maximum feed rate of LVM (Cr Only)                   | 63.1209(n)(2)(i)(B), (n)(2)(v)(B); 63.1217(a)(4) | Maximum total feed/emissions rate                                 | 12-hour rolling average     |  |        |    |     | X   |    |
| Maximum feed rate of total chlorine and chloride     | 63.1209(o)(1)(ii); 63.1217(a)(6)                 | Maximum total feed/emissions rate                                 | 12-hour rolling average     |  |        |    | X   | X   | X  |

**Table 1-1-1. HWC MACT Operating Limits Applicable to the Lyondell Boiler Nos. 1, 2, and 3(continued)**

Notes:

<sup>1</sup> Organic destruction and removal efficiency (DRE) compliance will be demonstrated during using the Class 1 principal organic hazardous constituent (POHC), naphthalene. The Test 1 operating data will be used to establish a new minimum combustion temperature limit. The Test 2 operating data will be used to establish new maximum waste feed rate and maximum combustion gas velocity indication limits.

<sup>2</sup> There is no specific numerical performance standard for polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/PCDFs) emissions from liquid fuel-fired boilers. PCDD/PCDF emissions were measured during the initial (2010) CPT as required by 63.1207(b)(3). Measurement of PCDD/PCDF emissions is being repeated during this CPT as required by 40 CFR 63.1207(b)(3)(v).

Table 1-2. Sampling and Analysis Data Collection and Use

| Sample         | Sampling Method | Analytical Method                                   | Target Analytes                          | Collected During: |                |
|----------------|-----------------|---|--|-------------------|----------------|
|                |                 |   |  | Test 1            | Test 2         |
| Waste Feeds    | ASTM E-300-03   | ASTM D-240  | Heating Value                            | X                 | X              |
|                |                 | ASTM D-445  | Viscosity                                | X                 | X              |
|                |                 | ASTM D-1475   | Density                                  | X                 | X              |
|                |                 | ASTM D-482  | Ash Content                              | X                 | X              |
|                |                 | ASTM D-4017   | Moisture                                 | X                 | X              |
|                |                 | SW-846 5050/9056A                                   | Total Chlorine                           | X                 | X              |
| Ash Spike      | ASTM E-300-03   | ICP (SW-846 Method 3050B & 6010C)                   | Metals: Cd, total Cr, Pb                 |                   | X              |
|                |                 | CVAA (SW-846 7471A)                                 | Hg                                       |                   | X              |
| POHC Spike     | ASTM E-300-03   | ASTM D-482  | Ash Content                              |                   | X              |
|                |                 | SW-846 8015   | Naphthalene Content                      | X                 | X              |
| Stack Gas      | EPA Method 5    | EPA Method 5  | Particulate (Filterable and Condensable) |                   | X              |
|                |                 | SW-846 Method 0023A                                 | PCDD/PCDFs                               | X                 | X              |
|                |                 | Carbon Monoxide Installed CEMS                      | Naphthalene                              | X                 | X              |
|                |                 | Oxygen Installed CEMS                               | Carbon Monoxide                          | X                 | X              |
| Temporary CEMS | Temporary CEMS  | 40 CFR 60, Appendix B, Performance Specification 4B | Oxygen                                   | X <sup>1</sup>    | X <sup>1</sup> |
|                |                 | 40 CFR 60, Appendix A, Method 25A                   | Hydrocarbons                             | X                 | X              |

Notes:

<sup>1</sup> Oxygen Correction Only.

## **2.0 FEED STREAM DESCRIPTION [40 CFR 63.1207(f)(1)(i), (ii), (xi)]**

### **2.1 Feed Stream Characteristics [40 CFR 63.1207(f)(1)(i), (ii), (xi)]**

Lyondell has included the liquid waste streams that may be treated in Boiler Nos. 1, 2, and 3 in the RCRA Part A application. The Lyondell Channelview HWC Boilers are captive systems that treat only wastes generated by manufacturing processes owned and operated by Lyondell. The liquid waste treated are fed from storage tanks (Refer to Figures 2-1). The as-fired characteristics of the liquid wastes treated in the HWC Boilers are summarized in Table 2-1. Potential waste feed organic constituents are presented in Table 2-2.

### **2.2 HWC MACT Chloride and Metals Emissions Compliance [40 CFR 63.1217(a)(2)-(4) & (6); 63.1209(l)(1)(ii), (n)(2)(v), (o)(1)(ii)]**

Table 2-3 compares the potential chloride and metals emissions from Boiler Nos. 1, 2, and 3 to the HWC MACT emissions limits for LFBs. The HWC MACT emission standards are technology-based standards applicable to each unit and are independent of any other HWC units operating at any given time. The analyses presented in Table 2-3 shows that no pollution control is required for Boiler Nos. 1, 2, and 3. Boiler Nos. 1, 2, and 3 comply with the HWC MACT chloride and metals emissions standards via a MHWTC approach [40 CFR 63.1207(m)(2); 63.1209(l)(1)(ii)(B), (n)(2)(v), (o)(1)(ii)].

The waste streams treated in Boiler Nos. 1, 2, and 3 are consolidated and fed from Tank D-6804. The as-fired heating value of the D-6804 waste stream is consistently greater than 10,000 Btu/lb. For waste streams with heating values equal to or greater than 10,000 Btu/lb, the HWC MACT chloride and metals emissions limits are normalized to the heating value (thermal concentration) of the waste expressed in lb/MMBtu of waste fired. Therefore, the potential-to-emit compliance analysis for any individual waste stream is independent of the combustion system configuration, especially for units with no APC equipment. Lyondell treats the waste streams as they are generated and are accumulated in Tank D-6804. Periodic sampling and analysis of the Tank D-6804 waste stream is conducted to demonstrate continued compliance with the HWC MACT metals and chloride emission standards.

### **2.3 HWC MACT Particulate Matter Emissions Compliance [40 CFR 63.1209(m)(3)]**

The CPT program will establish the maximum ash feed rate limit for the HWC Boilers based on the test average ash feed rates and corresponding demonstrated compliance with the HWC MACT particulate matter emissions standard. The periodic waste sampling and analysis will include analysis for ash content to demonstrate continued compliance with the ash feed rate limits for the HWC Boilers.

### **2.4 Auxiliary Fuel [40 CFR 63.1207(f)(1)(xi)]**

Fuel gas, which is a mixture of natural gas and by-product generated propane, is used to bring the combustion temperature to the minimum temperature to start hazardous waste feed. Natural gas is used



to atomize the liquid waste feed. Typical characteristics of the natural gas are summarized in Table 2-4. The potential contribution of HWC MACT constituents from natural gas are summarized in Table 2-5.

The liquid waste is fired through the burner assemblies once the waste feed permissive temperature is reached. When liquid waste is not being burned and/or the boilers are operating in a standby mode, or when liquid waste feed rates are low, fuel gas can be used as a supplemental or auxiliary fuel to maintain minimum combustion temperature.

Certain Lyondell manufacturing operations generate gaseous by-product streams. Propane by-product streams may be combined with natural gas to form "fuel gas" that is fed to Boiler Nos. 1, 2, and 3. Additionally, hydrogen by-product streams are fed separately to Boiler Nos. 2 and 3. Combustion of these gaseous streams offsets natural gas that would otherwise be fired in the boilers.

The natural gas, by-product gas streams, and vapor streams used as auxiliary fuel in the HWC Boilers are not expected to contain ash, chloride, or HWC MACT regulated metals. Samples of the natural gas, or the by-product and vapor streams, will not be collected during testing. In accordance with 40 CFR 63.1207(f)(1)(xi), natural gas characterization information from the Gas Research Institute is provided in Table 2-4. Based on process knowledge, the by-product gas and vapor streams do not contain ash, chloride, or HWC MACT regulated metals. The propane and hydrogen by-product streams are composed respectively of propane and hydrogen with some air or inerting nitrogen.

## **2.5 Other Feed Streams [40 CFR 63.1207(f)(1)(xi)]**

Other feed streams to the HWC Boilers include combustion air and vapor vent streams. These feed streams are not expected to contain ash or HWC MACT regulated metals. Because Lyondell does not produce or handle chlorinated organics, the vapor vent streams do not contain chloride. These streams will not be sampled during testing.

## **2.6 Feed Stream Management**

### **2.6.1 Liquid Waste**

The liquid wastes treated in the HWC Boilers are mixes of waste streams from various Lyondell production processes as noted in Figure 2-1. These production processes exhibit little variation over time. Therefore, the wastes generated correspondingly do not vary appreciably. The liquid wastes are pumped directly from the Tank D-6804 to the HWC Boilers.

Lyondell does not specifically blend or premix hazardous liquid waste streams for purposes of achieving or controlling specific waste characteristics prior to their thermal treatment in the HWC Boilers. Therefore 40 CFR 63.1207(f)(1)(ii)(C) does not apply.

Liquid waste feeds are continuously accumulated in and fed from Tank D-6804 to the respective boilers as portrayed in the schematic flow diagram. The contributing waste stream identifications/sources noted

in the flow diagram are provided for information purposes only. The waste feed compliance analysis point is the combined/mixed feed from Tank D-6804 to the boiler units. The analysis results presented in the CPT plan are of the “as-fired” properties of the combined/mixed waste stream. For characterization purposes, Lyondell has on occasion sampled and separately analyzed many of the intermediate contributing waste streams for identification of their respective regulated constituent contributions. However, the continuing compliance analysis point under HWC MACT is proposed as the combined/mixed waste feeds from Tank D-6804.

### **2.6.2 Vapor Vent System**

As noted in Figure 2-1, Boiler Nos. 1, 2, and 3 manage three vapor streams, the 1,4-butanediol (BDO) Hydrogen, PO/SM I Propane Purge, and PO/SM II Propane Purge. The organic fraction of the BDO stream is primarily hydrogen and natural gas. The organic fraction of the PO/SM I and PO/SM II streams is primarily propane. The balance of these streams is air or inerting nitrogen. The two propane streams are combined with natural gas to form “fuel gas” which is fired through the boiler burner assemblies of Boiler Nos. 1, 2, and 3. The BDO stream is fed separately and fired through the boiler burner assemblies of Boiler Nos. 2 and 3.

Styrene vapors are also directed to the operating boiler(s) for emissions control.

The vapor vent and gaseous streams contain sufficient combustible organic constituents to support combustion. Because the vent vapor streams are not compressed, ignitable gases, they are not hazardous wastes per 40 CFR 261.21(a)(3).

### **2.6.3 Feedstream Analysis Plan [40 CFR 63.1209(c)(2)]**

Lyondell has developed and implemented a Feedstream Analysis Plan (FAP) as required by 40 CFR 63.1209(c)(2). The FAP addresses the HWC MACT compliance of the HWC Boilers with the feed limits for ash, chloride, and metals.

**Table 2-1. Waste Feed Characterization**

| <b>Parameter</b> | <b>Units</b> | <b>Stat.</b> | <b>Stream D-6804</b> |
|------------------|--------------|--------------|----------------------|
| Cadmium (Cd)     | mg/kg        | Average      | 0.026                |
|                  |              | Maximum      | 0.100                |
|                  |              | Minimum      | 0.008                |
|                  |              | St. Dev.     | 0.027                |
| Chromium (Cr)    | mg/kg        | Average      | 0.112                |
|                  |              | Maximum      | 0.341                |
|                  |              | Minimum      | 0.008                |
|                  |              | St. Dev.     | 0.073                |
| Lead (Pb)        | mg/kg        | Average      | 0.008                |
|                  |              | Maximum      | 0.050                |
|                  |              | Minimum      | 0.001                |
|                  |              | St. Dev.     | 0.010                |
| Mercury (Hg)     | mg/kg        | Average      | 0.009                |
|                  |              | Maximum      | 0.100                |
|                  |              | Minimum      | 0.002                |
|                  |              | St. Dev.     | 0.022                |
| Chloride         | mg/kg        | Average      | 7.5                  |
|                  |              | Maximum      | 35                   |
|                  |              | Minimum      | 2.5                  |
|                  |              | St. Dev.     | 7.6                  |
| Ash              | wt%          | Average      | 0.015                |
|                  |              | Maximum      | 0.093                |
|                  |              | Minimum      | 0.001                |
|                  |              | St. Dev.     | 0.020                |
| Heating Value    | Btu/lb       | Average      | 10,578               |
|                  |              | Maximum      | 15,029               |
|                  |              | Minimum      | 9,666                |
|                  |              | St. Dev.     | 1,045                |

**Table 2-2. Waste Feed Organic Constituents**

| Constituent                 | Stream D-6804 |                |
|-----------------------------|---------------|----------------|
|                             | CAS No        | Normalized Wt% |
| 1,2 Propylene Oxide         | 75-56-9       | 1.25           |
| 1,3-Butadiene               | 106-99-0      | 0.14           |
| Sec-Butanol                 | 78-92-2       | 0.74           |
| Sec-Butyl Acetate           | 105-46-4      | 0.37           |
| Sec-Butyl Methyl Ether      | 6795-87-5     | 0.06           |
| t-Butanol                   | 76-65-0       | 4.1            |
| 1-Methoxy-2-Propanol        | 107-98-2      | 16.34          |
| 1-Phenyl-2-Propanol         | 698-87-3      | 0.25           |
| 1-t-Butoxy-2-Propanol       | 57018-52-7    | 1.86           |
| 2-Methoxy-1-Propanol        | 001589-47-5   | 1.67           |
| 2-Phenyl-2-Propanol         | 617-94-7      | 0.02           |
| 2-t-Butoxy-2-Propanol       | 5131-66-8     | 0.93           |
| Acetic Acid                 | 64-19-7       | 2.41           |
| Acetone                     | 67-64-1       | 11.28          |
| Acetophenone                | 98-86-2       | 3.28           |
| Benzaldehyde                | 100-52-7      | 6.23           |
| Benzene                     | 71-43-2       | 0.08           |
| Benzyl Alcohol              | 100-51-6      | 0.01           |
| C4s - C8s                   | NA            | 1.67           |
| C9s                         | NA            | 0.03           |
| Cumene (n-Propyl Benzene)   | 103-65-1      | 0.79           |
| Diethylbenzene              | 25340-17-4    | 0.07           |
| Di-t-butyl peroxide         | 110-05-4      | 0.002          |
| Ethyl Benzene               | 100-41-4      | 3.37           |
| I-Butyl Oxide               | NA            | 0.99           |
| Isobutanol                  | 78-83-1       | 3.12           |
| Isobutyl Acetate            | 110-19-0      | 0.93           |
| Isobutyl Formate            | 542-55-2      | 0.56           |
| Isobutylaldehyde            | 8-84-2        | 0.04           |
| Isobutylene                 | 115-11-7      | 0.87           |
| Isobutylene Glycol          | 558-43-0      | 0.37           |
| Isobutylene Oxide           | 558-30-5      | 1.34           |
| Isobutyric Acid             | 79-31-2       | 1.49           |
| Isopropanol                 | 67-63-0       | 9.15           |
| Methanol                    | 67-56-1       | 6.56           |
| Methyl Benzyl Alcohol (MBA) | (o-) 89-95-2  | 0.67           |
| Methyl Ethyl Ketone         | 78-93-3       | 0.92           |
| Monopropylene Glycol        | 57-55-6       | 0.90           |
| n-Propanol                  | 71-23-8       | 0.80           |
| Phenyl Ethyl Alcohol (PEA)  | NA            | 0.76           |
| Propionaldehyde             | 123-38-6      | 0.46           |
| Propionic Acid              | 79-09-4       | 0.37           |
| Propylene Glycol            | 57-55-6       | 1.67           |

**Table 2-2. Waste Feed Organic Constituents**

| Constituent                  | Stream D-6804 |                |
|------------------------------|---------------|----------------|
|                              | CAS No        | Normalized Wt% |
| Propylene Glycol Monoacetate | 1331-12-0     | 0.37           |
| Propylene Oxide (PO)         | 75-56-9       | 2.01           |
| Styrene                      | 100-42-5      | 0.27           |
| Toluene                      | 108-88-3      | 0.29           |
| Water                        | 7732-18-5     | 8.15           |
| <b>TOTAL</b>                 |               | 100.0          |

**Table 2-3. HWC MACT Metals and Chloride Compliance Analysis-Boiler Nos. 1, 2 and 3**

| <b>Constituent</b>               | <b>D-6804</b> |
|----------------------------------|---------------|
| Chromium (LVM) Std., lb/MMBtu    | 1.3E-04       |
| Avg. Conc., mg/kg                | 0.112         |
| lb/MMBtu @ Avg. Conc.            | 1.1E-05       |
| Meets HWC MACT LVM Std.          | Yes           |
| Total SVM (Cd+Pb) Std., lb/MMBtu | 8.2E-05       |
| Avg. Conc., mg/kg                | 0.034         |
| lb/MMBtu @ Avg. Conc.            | 3.2E-06       |
| Meets HWC MACT SVM Std.          | Yes           |
| Mercury Std., lb/MMBtu           | 4.2E-05       |
| Avg. Conc., mg/kg                | 0.009         |
| lb/MMBtu @ Avg. Conc.            | 8.3E-7        |
| Meets HWC MACT Hg Std.           | Yes           |
| Chlorine Std., lb/MMBtu          | 5.1E-02       |
| Avg. Conc., mg/kg                | 7.5           |
| lb/MMBtu @ Avg. Conc.            | 7.1E-4        |
| Meets HWC MACT Cl Std.           | Yes           |
| Average Heating Value (Btu/lb)   | 10,578        |
| Feed Rate (gpm)                  | 90            |
| Feed Rate (lb/hr)                | 39,960        |

**Table 2-4. Typical Characteristics of Natural Gas**

| Constituent/Property                 | Units             | Value   |               |
|--------------------------------------|-------------------|---------|---------------|
|                                      |                   | Typical | Range         |
| <b>Major Organic Constituents</b>    |                   |         |               |
| Methane                              | vol%              | 93.7    | 93.4 - 93.9   |
| Ethane                               | vol%              | 3.3     | 2.8 - 3.6     |
| Propane                              | vol%              | 0.5     | 0.5           |
| i-Butane                             | vol%              | 0.07    | 0.06 - 0.1    |
| n-Butane                             | vol%              | 0.09    | 0.08 - 0.1    |
| i-Pentane                            | vol%              | 0.03    | 0.02 - 0.05   |
| n-Pentane                            | vol%              | 0.02    | 0.02 - 0.03   |
| Hexane                               | vol%              | 0.05    | 0.04 - 0.06   |
| <b>Inorganic Constituents</b>        |                   |         |               |
| Water                                | vol%              | ~0      | ~0            |
| Carbon dioxide                       | vol%              | 0.9     | 0.7 - 1.0     |
| Nitrogen                             | vol%              | 1.4     | 1.4 - 1.5     |
| Oxygen/Argon                         | vol%              | 0.03    | 0.03 - 0.04   |
| Ash                                  | vol%              | ~0      | ~0            |
| <b>HWC MACT Metals</b>               |                   |         |               |
| Chromium                             | ug/m <sup>3</sup> | <0.01   | <0.01         |
| Cadmium                              | ug/m <sup>3</sup> | <0.01   | <0.01         |
| Lead                                 | ug/m <sup>3</sup> | <0.05   | <0.05         |
| Mercury                              | ug/m <sup>3</sup> | <0.01   | <0.01         |
| <b>Physical/Chemical Properties</b>  |                   |         |               |
| Heating Value                        | Btu/scf           | 1,030   | 1,028 - 1,033 |
| Vapor Specific Gravity               | NA                | 0.594   | 0.593 - 0.595 |
| <b>Typical Elemental Composition</b> |                   |         |               |
| Carbon                               | wt%               | 74.8    |               |
| Hydrogen                             | wt%               | 24      |               |
| Oxygen                               | wt%               | 0       |               |
| Nitrogen                             | wt%               | 1.2     |               |
| Sulfur                               | wt%               | 0       |               |
| Chlorine/Chloride                    | ug/m <sup>3</sup> | <1.6    |               |
| Bromine/Bromide                      | ug/m <sup>3</sup> | ~0      |               |
| Fluorine/Fluoride                    | ug/m <sup>3</sup> | ~0      |               |
| Iodine/Iodide                        | ug/m <sup>3</sup> | ~0      |               |

Source: "Analysis of Trace Level Compounds in Natural Gas" Gas Research Institute, Document Number GRI-99/0111, February, 2000

**Table 2-5. Potential HWC MACT Constituent Feed Rates from Natural Gas**

| Constituent/Property | Typical Value | Units             | Feed Rate per MMBtu Fired | Units    |
|----------------------|---------------|-------------------|---------------------------|----------|
| Chromium             | < 0.01        | ug/m <sup>3</sup> | < 6.1E-10                 | lb/MMBtu |
| Cadmium              | < 0.01        | ug/m <sup>3</sup> | < 6.1E-10                 | lb/MMBtu |
| Lead                 | < 0.05        | ug/m <sup>3</sup> | < 3.9E-09                 | lb/MMBtu |
| Mercury              | < 0.01        | ug/m <sup>3</sup> | < 6.1E-10                 | lb/MMBtu |
| Chlorine/chloride    | < 1.6         | ug/m <sup>3</sup> | < 9.7E-08                 | lb/MMBtu |

| Heating Value | Range         | Typical |         |
|---------------|---------------|---------|---------|
|               | 1,028 - 1,033 | 1,030   | Btu/scf |



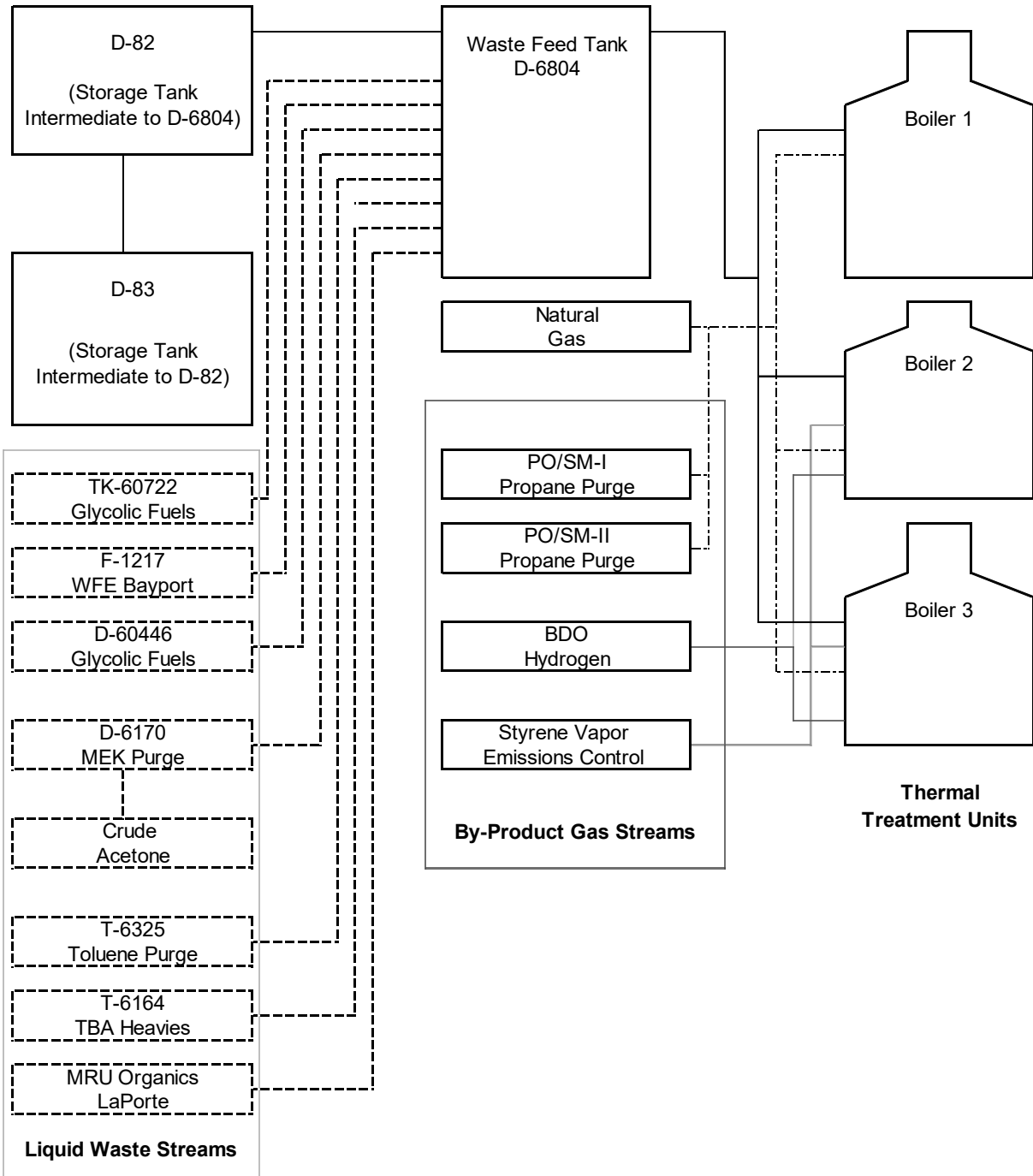


Figure 2-1. Boiler Nos. 1, 2, and 3 Feed Streams

### **3.0 ENGINEERING DESCRIPTION [40 CFR 63.1207(f)(iii)]**

#### **3.1 General**

Lyondell operates three HWC Boilers, Boiler Nos. 1, 2, and 3, at its facility located in Channelview, Texas. These units treat liquid hazardous waste, co-products and certain process vapors produced by the Lyondell manufacturing operations. Boiler Nos. 1, 2, and 3 supply steam for use in the manufacturing processes. Fuel gas, a mixture of natural gas and by-product propane, is used to bring the units to waste feed permissive operating temperatures, to maintain minimum combustion temperature when not treating liquid wastes, and/or to meet the minimum combustion rating of the boilers. Natural gas is used to atomize the liquid waste feed. Engineering design information for the boilers is summarized in Table 3-1.

#### **3.2 Manufacturer's Name and Model Number [40 CFR 63.1207(f)(1)(iii)(A)]**

The boilers were custom built for Lyondell. The manufacturer names and model numbers are noted in Table 3-1.

#### **3.3 Combustor Type [40 CFR 1207(f)(1)(iii)(B)]**

Boiler Nos. 1, 2, and 3 are units similar in design and operation. Maintenance and upgrades are managed to maintain this similarity. The three units vent to a common stack; there are no APC devices. The boilers are forced draft units with combustion air blowers on the burners.

#### **3.4 Maximum Capacity [40 CFR 1207(f)(1)(iii)(C)]**

The designed maximum thermal capacity for the HWC Boilers is noted in Table 3-1.

#### **3.5 Feed System Description [40 CFR 1207(f)(1)(iii)(D)]**

##### **3.5.1 Burner Assembly Description**

The type of burner feed system is noted in Table 3-1. Boiler Nos. 1, 2 and 3 are each equipped with six (6) liquid and vapor fuel burners that fire natural gas or natural gas/by-product gas mixture, and liquid waste. All liquid feed to the boilers' burners is pumped from tank D-6804, including Glycolic Fuels transferred from tank TK-60722 or TK-60644, the WFE Bayport stream, Mixed Alcohols, and MRU organics from LaPorte. The maximum liquid waste hydraulic feed capacity of each burner is nominally 15 gallons per minute (gpm). Natural gas is used as the atomizing media for the liquid waste. Each boiler is nominally rated at 759 MMBtu/hr including burner pilots. The flow of natural gas and/or natural gas/by-product gas mixture and waste is varied to control the boiler to the steam flow or pressure set point. The by-product propane purge streams are combined with natural gas to form "fuel gas" at the boiler burners of each of the three boilers. The by-product hydrogen stream is combined with fuel gas at the boiler

burners at Boiler No. 2 and/or Boiler No. 3. The fuel value of these by-product gas streams is used to offset natural gas use.

### **3.5.2 Combustion Air**

Blowers provide combustion air to Boiler Nos. 1, 2, and 3. The boilers' shared stack also provides natural induced draft to the boiler combustion zones.

### **3.5.3 Vapor Vent Feed System**

The vapor vent feed streams are co-fired with natural gas/fuel gas through the burners.

### **3.5.4 Auxiliary Fuel System**

Fuel gas is used as fuel gas for the pilot and as auxiliary fuel to raise the operating temperature to acceptable levels before liquid wastes are introduced, and to maintain combustion temperature when operating at low waste feed rates. Natural gas is used to atomize liquid waste feed. The supply of auxiliary fuel is provided from a plant supply line. Feed pressure to the burners is regulated using pressure control valves. An additional pressure control valve provides control of the pilot fuel gas supply pressure.

### **3.6 Feed System Capacity [40 CFR 1207(f)(1)(iii)(E)]**

The designed maximum waste feed rate for the boilers is noted in Table 3-1.

### **3.7 Continuous Monitoring System (CMS) and AWFCO System [40 CFR 1207(f)(1)(iii)(F)]**

Table 3-2 lists the major process instrumentation for the boilers. Waste feed is rapidly stopped either due to a regulatory automatic waste feed cutoff (AWFCO) or a safety shutoff. An AWFCO will occur following any of the below conditions:

- When an emission-related parameter set point is reached or exceeded
- When a span value of any parameter CMS is met or exceeded
- When a CMS or CEMS malfunctions.

When any of the above occurs, waste feed is rapidly stopped by either automatic waste feed control valves or the cessation of the waste feed transfer pump or a combination of the two.

Integral to each boiler's control system and AWFCO system is a continuous monitoring system (CMS). The CMS maintains an electronic record of the system's operation. The CMS's electronic records include three types of data: 1) one-minute average values for each continuously monitored regulatory parameter, including carbon monoxide and oxygen, 2) data registers for calculating and recording rolling average values for rolling average limited regulatory parameters (These will be hourly rolling averages for carbon monoxide and oxygen.), and 3) an alarm and AWFCO history log. The CMS's electronic data records are

periodically transferred from the CMS data storage to electronic storage media for long-term record storage.

### **3.8 Design, Operation and Maintenance of APC Systems [40 CFR 63.1207(f)(1)(iii)(G)]**

None of the Lyondell HWC Boilers are equipped with APC systems. Therefore, this section is not applicable. However, general unit operations and maintenance are discussed in the following sections.

#### **3.8.1 System Operation**

Boiler Nos. 1, 2, and 3 are operated and maintained in accordance with Lyondell's Operation and Maintenance Plan (O&M Plan). A summary of the associated operating and maintenance procedures is provided in this section of the CPT plan.

The procedures for operating Boiler Nos. 1, 2, and 3 during startup and shutdown are delineated in detailed standard operating procedures (SOPs). The latest approved versions of the SOPs are maintained within Lyondell's in-house computer network, which can be accessed by all HWC unit operators. This online system is configured to support easy access during operation as well as informal reviews of specific information by individual operators. On-line access to SOPs is available in the Boiler Nos. 1, 2, and 3 control room, the Boiler Nos. 1, 2, and 3 supervisor's office, and other facility locations.

The SOPs are designed to ensure that Boiler Nos. 1, 2, and 3 are operated safely with procedures to minimize hazards and emissions. Each unit's control system provides the unit operators with two types of alarms; advisory and critical. Advisory alarms are intended to be used for operator information by warning of unexpected operation. The critical alarm is intended to be used for operator warning of imminent dangerous or improper operation that in some cases might result in excess or non-compliant emissions.

#### **3.8.2 Maintenance**

Lyondell maintains an extensive array of maintenance inspections, calibration, and/or preventive maintenance schedules and procedures. Some of these maintenance schedules and procedures are listed below:

- Regular inspection
- Cleaning, repair, or replacement
- Re-calibration of CEM/CMS systems/components
- Routine repair of malfunctioning equipment
- Preventive maintenance of HWC unit equipment
- Predictive maintenance on critical rotating equipment based on periodic vibration testing and analysis.

These inspection maintenance schedules/procedures are routinely used on a plant-wide basis and include the HWC units.

### **3.9 Design, Operation and Maintenance of the CEMS and CMS [40 CFR 63.1207(f)(1)(iii)(H)]**

The continuous emissions monitoring system (CEMS) on each HWC boiler is the primary emission monitoring system. The CEMS on each unit continuously monitors stack gas for carbon monoxide (CO) and oxygen (O<sub>2</sub>).

All CMS equipment that measure the flows of auxiliary fuel, waste feed rate, combustion air, temperature, etc, is maintained and operated according to procedures associated with Lyondell's CMS Performance Evaluation Plan (PEP). Each CMS in the HWC boiler units has an appropriate calibration and maintenance procedure and schedule. These procedures utilize either regulatory-specified procedures or equipment manufacture's recommendations and require regular inspection, calibration, cleaning, servicing, and maintenance.

### **3.10 CMS Performance Evaluation Test Plan [40 CFR 63.8(e)]**

Included with this CPT plan is a CMS Performance Evaluation Test Plan (PETP). This plan outlines the performance evaluation testing of the parameter CMS' (flow, temperature, pressure, etc.), and the CEMS. This test plan is submitted for agency review. The testing of the CMS and CEMS will be completed in accordance with the plan commensurate with the CPT schedule.

### **3.11 CMS Performance Evaluation Plan [40 CFR 63.8(d), 63.1207(f)(1)(iii)(H)]**

Lyondell has developed and maintains a CMS PEP that includes the detailed procedures and frequencies for calibration and maintenance of the parameter CMS' (flow, temperature, pressure, etc.), and CO and O<sub>2</sub> CEMS. See Section 3.9 for additional discussion of the CMS PEP.

### **3.12 Determination of Hazardous Waste Residence Time [40 CFR 63.1207(f)(1)(ix)]**

Table 3-3 presents the determination of hazardous waste residence time for Boiler No. 3 from data obtained during the 2010 CPT.

### **3.13 Startup, Shutdown, and Malfunction Procedures [40 CFR 63.1206(c)(2)]**

Lyondell has organized its SOPs as components of the startup, shutdown and malfunction plan (SSMP). These SOPs include procedures for rapidly stopping the hazardous waste feed in the event of an equipment malfunction. In most cases, the AWFCO system and safety interlocks will shut off waste feed immediately in the event of an equipment malfunction. When such an event occurs, an alarm sounds to notify the operator there is a problem. Whether the waste feed is stopped by the operator or the AWFCO/safety interlocks, the HWC burner(s) will usually continue to operate on auxiliary fuel until the HWC system is returned to safe and permissible operating conditions. The SOPs for rapidly stopping the hazardous waste feed ensure that emissions are controlled in the event of an equipment malfunction.

**Table 3-1. Engineering Data - Boiler Nos. 1, 2, and 3**

| <b>Parameter</b>                      | <b>Boiler No. 1</b>                                       | <b>Boiler No. 2</b>                                       | <b>Boiler No. 3</b>                                       |
|---------------------------------------|---|---|---|
| Manufacturer:                         | Babcock & Wilcox  | Babcock & Wilcox  | Babcock & Wilcox  |
| Model No.:                            | PFT-3178  | PFT-3178  | PFT-3178  |
| Type:                                 | Water Tube  | Water Tube  | Water Tube  |
| Date of Mfr.:                         | 1976  | 1976  | 1976  |
| No. of Burners:                       | Six (6)   | Six (6)   | Six (6)   |
| Burner Type:                          | Natural gas atomized liquid burners                       | Natural gas atomized liquid burners                       | Natural gas atomized liquid burners                       |
| Maximum Liquid Feed per Burner        | 15 gal/min  | 15 gal/min  | 15 gal/min  |
| Maximum Steam Conditions:             | 750 psig, 580°F   | 750 psig, 580°F   | 750 psig, 580°F   |
| Maximum Steam Production:             | 660,000 lbs/hr  | 660,000 lbs/hr  | 660,000 lbs/hr  |
| Minimum Steam Production              | 75,000 lb/hr  | 75,000 lb/hr  | 75,000 lb/hr  |
| Maximum Heat Release:                 | 759 MM Btu/hr   | 759 MM Btu/hr   | 759 MM Btu/hr   |
| CO CEMS Manufacturer/Type             | ABB URAS-11<br>Non-dispersive Infrared (NDIR)<br>Analyzer | ABB URAS-11<br>Non-dispersive Infrared (NDIR)<br>Analyzer | ABB URAS-11<br>Non-dispersive Infrared (NDIR)<br>Analyzer |
| O <sub>2</sub> CEMS Manufacturer/Type | ABB MAGNOS 106<br>Paramagnetic Analyzer                   | ABB MAGNOS 106<br>Paramagnetic Analyzer                   | ABB MAGNOS 106<br>Paramagnetic Analyzer                   |

**Table 3-2. Major Instrumentation – Boiler Nos. 1, 2, and 3**

| Parameter                           | Instrument Location <sup>2</sup> | Boiler No. 1 Instrument No.         | Boiler No. 2 Instrument No.         | Boiler No. 3 Instrument No.         | Instrument Type                         | Units     | Instrument Scale                         | Accuracy (% Full Scale) | Typical Value |
|-------------------------------------|----------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---|-----------|--|-------------------------|---------------|
| Waste Feed Rate (D-6804)            | F1                               | FT-68120                            | FT-68220                            | FT-68320                            | Orifice plate & Dp Transmitter          | gpm       | 0 - 99 (FT-120)<br>0 - 85.5 (FT-220/320) | 3%                      | 30-50         |
| Atomizing Natural Gas Pressure      | P1, P2, P3                       | PT118A<br>PT119B<br>PT120C          | PT218A<br>PT219B<br>PT220C          | PT318A<br>PT319B<br>PT320C          | Transmitter on each firing deck         | psig      | 0 - 200 (A, B)<br>0 - 150 (C)            | 0.25%                   | 10 - 30       |
| Combustion Temperature <sup>1</sup> | T1                               | TI-46132A<br>TI-46132B<br>TI-46132C | TI-46232A<br>TI-46232B<br>TI-46232C | TI-46332A<br>TI-46332B<br>TI-46332C | Type B Thermocouple & Transmitter       | °F        | 212 - 2,700                              | 0.025%                  | 1,600-1,900   |
| Combustion Air Flow Rate            | F2                               | FT-106                              | FT-206                              | FT-306                              | dP Transmitter                          | M lb/hr   | 0 - 850                                  | 3%                      | 400 - 600     |
| Stack Gas CO                        | A1                               | AT-68108 & AT-68109                 | AT-68208 & AT-68209                 | AT-68308 & AT-68309                 | Non-Dispersive Infrared (NDIR) analyzer | ppmv, dry | 0 - 200 (Low)<br>0 - 10,000 (High)       | 3%                      | 0 - 10        |
| Stack Gas O <sub>2</sub>            | A2                               | AT-6846173 & AT-68111               | ATI-6846175 & AT-68211              | AT-6846177 & AT-68311               | Paramagnetic analyzer                   | %vol, dry | 0 - 25%                                  | 0.5% vol.               | 5 - 10        |

**Notes:**

<sup>1</sup>Combustion temperature is measured in the firebox.

<sup>2</sup> Refer to the Figure 3-1 process schematic for the generalized locations of the monitoring instruments.

**Table 3-3. Boiler No. 3 Combustion Gas Residence Times-2010 CPT**

**Minimum Combustion Temperature Boiler Operating Conditions**

|   |                                      |               |
|---|--------------------------------------|---------------|
| Liquid Fuel Flow                                | 77.1 gpm                             |               |
| Stack Gas Temperature                           | 304 deg F                            |               |
| Total Stack Gas Flow                            | 18,202,702 ft <sup>3</sup> /hr       |               |
| Total Stack Gas Flow                            | 921,881 lb/hr                        |               |
| Barometric Pressure                             | 29.97 in Hg                          |               |
| Static Pressure                                 | -1.4 in H <sub>2</sub> O             |               |
| Absolute Pressure                               | 29.87 in Hg                          |               |
| Stack Gas Oxygen                                | 11.3 % dry volume                    | 10.0 % volume |
| Stack Gas Carbon Dioxide                        | 6.7 % dry volume                     | 5.9 % volume  |
| Stack Gas Nitrogen                              | 82.0 % dry volume                    | 72.8 % volume |
| Stack Gas Moisture                              | 11.20 % volume                       |               |
| Stack Gas Wet Mol Wt                            | 28.23                                |               |
| Total Stack Gas Flow                            | 32,652 lbmol/hr                      |               |
| Dry Stack Gas                                   | 28,995 lbmol/hr                      |               |
| Dry Stack Gas                                   | 856,054 lb/hr                        |               |
| Firebox Temperature                             | 1,404 deg F                          |               |
| Firebox Pressure                                | 13.6 in H <sub>2</sub> O             |               |
| Total Flue Gas Volume Flow @ Firebox Conditions | 46,090,254 ft <sup>3</sup> /hr       |               |
| Gas Constant                                    | 21.9 ft <sup>3</sup> in Hg / R lbmol |               |
| Utility Boiler Furnace Volume                   | 23,085 ft <sup>3</sup>               |               |

|  |                    |
|--|--------------------|
| <b>Utility Boiler Combustion Zone Residence Time =</b> | <b>1.8 seconds</b> |
|--|--------------------|

**Maximum Firing Rate Utility Boiler Operating Conditions**

|   |                                      |               |
|---|--------------------------------------|---------------|
| Liquid Fuel Flow                                | 90.0 gpm                             |               |
| Stack Gas Temperature                           | 304 deg F                            |               |
| Total Stack Gas Flow                            | 18,128,687 ft <sup>3</sup> /hr       |               |
| Total Stack Gas Flow                            | 917,695 lb/hr                        |               |
| Barometric Pressure                             | 29.97 in Hg                          |               |
| Static Pressure                                 | -1.1 in H <sub>2</sub> O             |               |
| Absolute Pressure                               | 29.89 in Hg                          |               |
| Stack Gas Oxygen                                | 10.2 % dry volume                    | 8.9 % volume  |
| Stack Gas Carbon Dioxide                        | 8.2 % dry volume                     | 7.2 % volume  |
| Stack Gas Nitrogen                              | 81.6 % dry volume                    | 71.2 % volume |
| Stack Gas Moisture                              | 12.8 % volume                        |               |
| Stack Gas Wet Mol Wt                            | 28.22                                |               |
| Total Stack Gas Flow                            | 32,519 lbmol/hr                      |               |
| Dry Stack Gas                                   | 28,357 lbmol/hr                      |               |
| Dry Stack Gas                                   | 842,770 lb/hr                        |               |
| Firebox Temperature                             | 1,563 deg F                          |               |
| Firebox Pressure                                | 14.1 in H <sub>2</sub> O             |               |
| Total Flue Gas Volume Flow @ Firebox Conditions | 49,881,807 ft <sup>3</sup> /hr       |               |
| Gas Constant                                    | 21.9 ft <sup>3</sup> in Hg / R lbmol |               |
| Utility Boiler Furnace Volume                   | 23,085 ft <sup>3</sup>               |               |

|  |                    |
|--|--------------------|
| <b>Utility Boiler Combustion Zone Residence Time =</b> | <b>1.7 seconds</b> |
|--|--------------------|



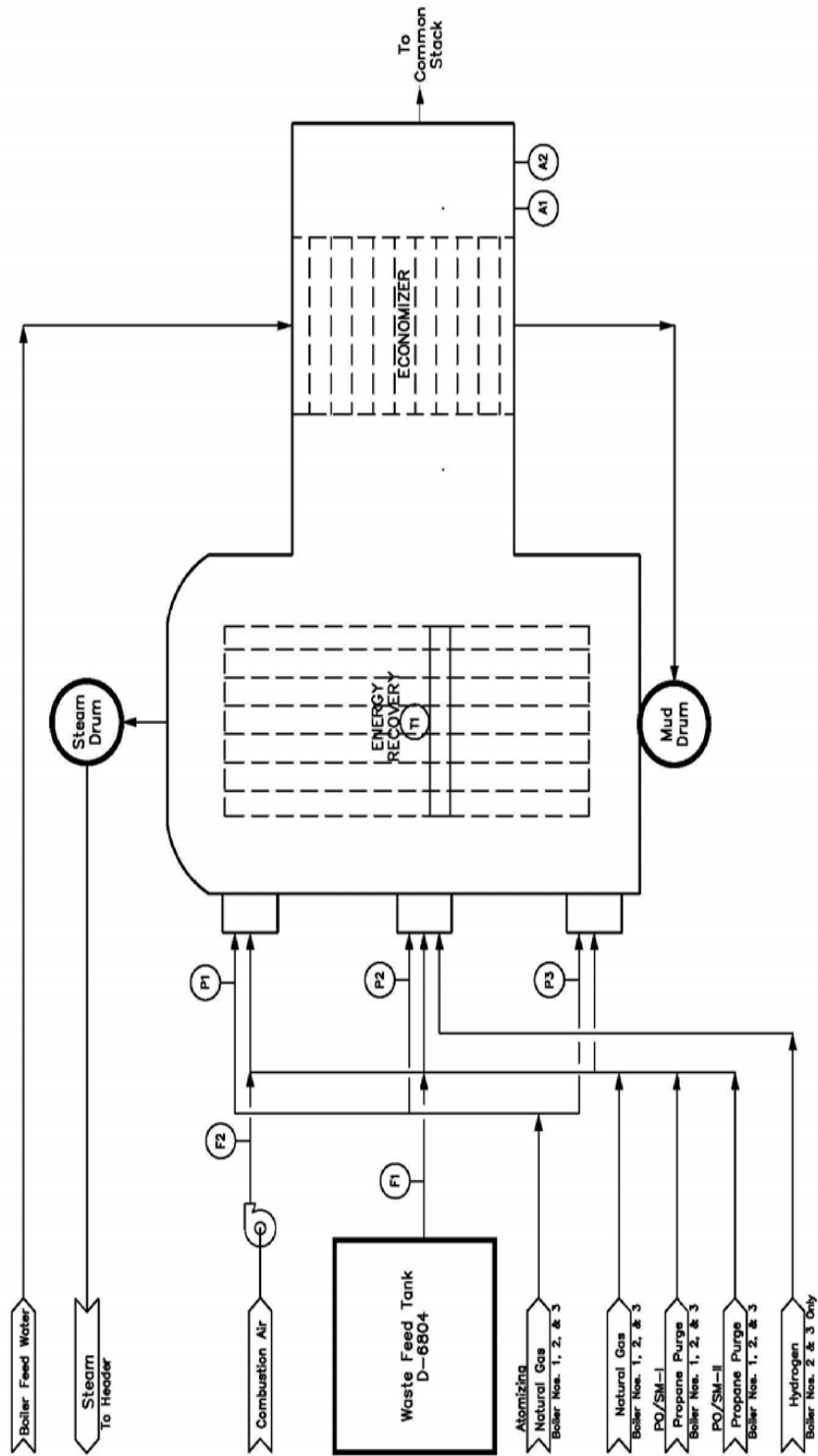


Figure 3-1. Boiler Nos. 1, 2, or 3 Process Monitoring Instrument Locations

## 4.0 TEST DESIGN AND PROTOCOL

### 4.1 GENERAL

This section describes the CPT performance targets and test protocol that will be used to obtain the data necessary to demonstrate compliance of Boiler Nos. 1, 2, and 3, with the HWC MACT regulations. Boiler Nos. 1, 2, and 3 are similar in design and operation, and share a common feed tank and stack. Boiler No. 1 or Boiler No. 3 will be tested with the emissions and performance results used as data-in-lieu for the two untested units [40 CFR 63.1207(c)(2)]. Written documentation of which boiler will be used during testing will be provided to TCEQ prior to the pre-test meeting. Boiler emissions sampling will be performed in the boiler duct upstream of the point where the duct discharges to the common stack. EPA Region 6 made determinations of the similarity of the boilers previously in 1992 and 2010.

The test program will be composed of two test conditions with three replicate sampling runs conducted at each set of operating conditions. One test condition will be performed to establish the minimum combustion temperature for organic DRE. The second test condition will be performed to establish the maximum waste feed rate and maximum combustion air flow limits.

### 4.2 Performance and Emissions Standards

The applicable HWC MACT performance and emissions standards for existing liquid-fired boilers are delineated in Section 1.2 of this CPT plan.

### 4.3 CPT Operating Objectives

This CPT is designed to demonstrate compliance with the performance requirements and operating standards for HWC MACT. HWC MACT requires demonstrating compliance with DRE at conditions of minimum combustion temperature, maximum waste feed rate, and maximum combustion gas velocity. The configuration of the boilers does not allow for simultaneous demonstration of these three operating parameters. Therefore, the 2010 CPT program included testing at two test conditions with measurement performance and emissions during both tests. Test 1 was designed to demonstrate the minimum combustion temperature limit for organic DRE. Test 2 was designed to demonstrate the maximum waste feed rate and maximum combustion air flow limits.

Unit operating and emissions data collected during the 2010 CPT was used to demonstrate compliance with the HWC MACT performance standards noted above. The 2010 CPT process operating data were used to establish the following DRE-related permissible operating limits under the HWC MACT regulations:

- Maximum hazardous waste feed rate [40 CFR 63.1209(j)(3), (k)(4)]
- Minimum combustion temperature [40 CFR 63.1209(j)(1), (k)(2)]
- Maximum combustion gas flow rate [40 CFR 63.1209(j)(2), (k)(3)].

Post-2010 CPT, EPA established a maximum hazardous waste and natural gas differential pressure limit under the auspices of 40 CFR 63.1209(j)(4). DRE testing is being repeated during the CPT conducted under this test plan to establish a new higher maximum hazardous waste and natural gas differential pressure limit. New limits will be concurrently established for the other three DRE-related limits noted above. The CPT conducted under this test plan will be used to establish the maximum ash feed rate [40 CFR 63.1209(m)(3)]. Compliance with the HWC MACT waste feed thermal-input based metals and chlorine feed rate limits will be demonstrated via waste feed analyses and waste feed rate data.

Table 4-1 summarizes the target operating conditions for each test condition. How the target operating conditions relate to the expected final established operating limits is presented in Section 7.0 of this CPT plan.

#### **4.4 Test Protocol [40 CFR 63.1207(f)(1)(vi)]**

The boiler being tested will be subjected to two test conditions, similar to the 2010 and 2015 CPT programs, with three replicate sampling runs conducted at each set of operating conditions.

- Test 1 is the minimum combustion temperature DRE test. The test condition will demonstrate DRE performance, establish a new combustion temperature limit, and demonstrate carbon monoxide and total hydrocarbon emissions.
- Test 2 is the maximum waste feed rate and maximum combustion air flow rate DRE test. The test condition will demonstrate DRE performance, establish new maximum waste feed rate and maximum combustion air flow limits, demonstrate carbon monoxide and total hydrocarbon emissions compliance, and establish the maximum ash feed rate limit. Compliance with the metals and HCl/Cl<sub>2</sub> emissions standards will be demonstrated via MHWTC.

The sampling protocols for the CPT are provided in Section 5.0 of this CPT plan.

#### **4.5 Waste Feed Characteristics [40 CFR 63.1207(f)(1)(vi)]**

Lyondell generated liquid waste will be treated in the boiler during the CPT at the rate noted in Table 4-1. Characterization data on the waste stream are provided in Section 2.0. The waste fed during Test 2 of the CPT will be spiked with ash for demonstrating particulate matter emissions compliance performance at maximum ash feed rate. The waste fed during Test 1 and Test 2 of the CPT will also be spiked with naphthalene for demonstrating organic DRE performance.

##### **4.5.1 Spiking Procedures**

Lyondell will utilize the services of a spiking contractor to provide the waste feed spiking. Ash surrogate (titanium dioxide in a mineral oil dispersion) and naphthalene dissolved in toluene will be metered to the waste feed line. The spiking systems will consist of variable speed, positive displacement pumps, which

will transfer the materials from containers directly into the waste feed line. The injection point will be downstream of the point where waste feed samples are collected. The contractor's certification of composition of the spiking materials and the spiking logs (differential weights or equivalent) will be used to determine the amount of material metered to the waste feed line. Samples of the spiking materials will be collected during testing for confirmation analysis.

#### **4.5.2 POHC Selection Rationale [40 CFR 63.1217(c)(3)(ii)]**

To evaluate the ability of combustion systems to destroy organic compounds, EPA developed the POHC Thermal Stability Index (circa 1989). The Thermal Stability Index is based on laboratory studies of the destruction of organic compounds under low oxygen conditions in a non-flame environment. The EPA's Thermal Stability Index divides specific organic compounds into seven thermal stability classes, with Class 1 compounds being the most stable, and Class 7 compounds being the least thermally stable. The EPA Thermal Stability Index is structured on the principle that if a combustion system is successful in destroying compounds in a particular class, it is appropriate to assume that other compounds within the same and lower classes will be destroyed at efficiencies equal to or greater than the destruction efficiencies demonstrated.

Since the HWC MACT regulations do not mention any specific incinerability hierarchy, Lyondell used naphthalene as the POHC for demonstrating the DRE during the 2010 CPT. Naphthalene is a Class 1 compound (most thermally stable) on EPA's Thermal Stability Index. Naphthalene is chemically compatible with the organics treated in HWC Boilers. Because naphthalene is chemically distinguishable from, and generally more thermally stable than, the organic constituents routinely present in the Lyondell waste streams, naphthalene provided an excellent indicator of DRE performance.

After reviewing the 37 Class 1 compounds on the Thermal Stability Index, Lyondell selected naphthalene as the CPT POHC. Many of the Class 1 compounds have undesirable aspects or properties:

- Analytical properties (e.g., water soluble or hydrolyze [acetonitrile or acrylonitrile]);
- Gases [sulfur hexafluoride];
- Toxicity, gases and/or ozone depleters (e.g., hydrogen cyanide, cyanogen, cyanogen chloride, cyanogen bromide, methyl chloride, methyl bromide, and Freon 13);
- Common products of incomplete combustion (PICs) (e.g., benzene); or
- Exotic or difficult to obtain mass quantities of pure compounds (e.g., the many polynuclear aromatic hydrocarbon compounds [PAHs] and the two dioxin/furan compounds).

As a result, the list of potential and viable POHCs from Class 1 narrows to naphthalene, chloronaphthalene, and the multiple chlorinated benzene compounds.

For the reasons noted above, the two compounds most commonly selected from Class 1 for use as POHCs are monochlorobenzene and naphthalene. Both compounds have well-established records as

DRE POHCs. Lyondell originally considered using monochlorobenzene as the target POHC. However, when the expected DRE, sampling method, and analytical detection limits were examined, the amount of monochlorobenzene necessary to demonstrate 99.99% DRE would exceed the applicable HWC MACT chlorine feed rate limits for the HWC Boilers. Additionally, chlorinated organics generate HCl when burned leading to unnecessary corrosion to boiler components not designed for such service. The choice of POHC from Class 1 then defaulted to naphthalene since naphthalene is the only non-chlorinated compound on the short list of possible of Class 1 POHC compounds. Lyondell believes that the choice of naphthalene as a POHC provided a significant challenge to the thermal destruction capabilities of the HWC Boilers.

During 2010 CPT Test 1 and Test 2 DRE testing, Lyondell metered naphthalene to the waste feed line and measured naphthalene emissions to assess DRE performance. The naphthalene was dissolved in toluene for metering to the liquid waste feed. Liquid waste feed analyses were performed to determine the native feed rate of naphthalene; no detectable naphthalene was found in any of the waste feed samples. The total naphthalene feed rate utilized in determining DRE was solely from the amount metered to the waste feed. The emission rate of naphthalene was determined via split analysis of the SW-846 Method 0023A sampling train also used to concurrently measure PCDD/PCDF emissions during both test conditions. Summary DRE performance and PCDD/PCDF emissions results from the 2010 CPT are presented in Table 4-2.

During Test 1 and Test 2 of the CPT conducted under this test plan, Lyondell will meter naphthalene to the boiler liquid waste feed and measure the resulting emissions using SW-846 Method 0023A. Provided that 99.99% DRE of naphthalene is demonstrated during Test 1, the new minimum combustion temperature limit should be based on the values demonstrated during Test 1. Provided that 99.99% DRE of naphthalene is demonstrated during Test 2, the new maximum waste feed rate and maximum combustion velocity indicator limits should be based on the values demonstrated during Test 2. Measurement of PCDD/PCDF emissions will be repeated during this CPT as required by 40 CFR 63.1207(b)(3)(v).

Since naphthalene ranks among the most difficult to destroy on the Thermal Stability Index, successful demonstration of 99.99% DRE allows Lyondell to burn all wastes represented by the waste codes in the facility's most current RCRA Part A permit application.

#### **4.5.3 Ash Content [40 CFR 63.1209(m)(3)]**

During Test 2, Lyondell will feed actual liquid wastes at maximum rates. Test 2 will include measurement of particulate emissions. To provide a greater margin of operational flexibility in the ash content of the wastes treated in the HWC Boilers, Lyondell will meter an ash surrogate, titanium dioxide, to the liquid waste used during Test 2. Samples of the waste feeds will be analyzed for native ash content. The ash surrogate will be metered to the liquid waste feed line by the spiking contractor. Samples of the ash

spiking material will be collected for confirmation ash analysis. The waste feed ash analyses and the total waste feed rate will be used to determine the native ash feed rate. Provided that the particulate matter emissions results during Test 2 are in compliance with the particulate matter emissions standard, the permit limit for ash feed rate will be proposed as the total ash feed rate, native plus spiked, demonstrated during Test 2.

#### **4.5.4 Chloride Content [40 CFR 63.1209(o)(1)(ii)]**

Data presented in Section 2.0 include the typical chloride contents for the waste streams treated by Lyondell. Analysis presented in this CPT plan show that the potential HCl/Cl<sub>2</sub> emissions from the HWC Boilers comply with the HWC MACT chloride emissions limit via MHWTC. Therefore, there will be no spiking of chloride during the CPT. Waste feed analyses and waste feed rates will be used to assess compliance with the HWC MACT chloride emissions limit via MHWTC.

#### **4.5.5 Metals Content [40 CFR 63.1209(l)(1)(ii), (n)(2)(v)]**

Data presented in Section 2.0 include the typical metals content for the waste streams treated by Lyondell. Analysis presented in this CPT plan show that the potential metals emissions from the HWC Boilers comply with the HWC MACT emissions limits via MHWTC. Therefore, there will be no spiking of metals during the CPT. Waste feed analyses and waste feed rates will be used to assess compliance with HWC MACT mercury, SVM, and LVM limits via MHWTC.

#### **4.5.6 Expected Constituent Levels in Auxiliary Fuel and Other Feed Streams [40 CFR 63.1207(f)(1)(i)(A), (xi)]**

The HWC MACT rule requires that all feed streams be assessed [40 CFR 63.1207(f)(1)(i)(A), (xi)]. The ash, chloride, and metals contents of natural gas, fuel gas, and combustion air are such that their quantification would be meaningless to the facility operating records. Based on process knowledge, the vapor vent streams treated in Boiler Nos. 1, 2, and 3 do not contain measurable ash or metals, nor do these streams contain measurable chloride as Lyondell does not produce or handle chlorinated organic chemicals at this site. Therefore, these streams will not be sampled or analyzed during the test.

#### **4.6 Process Operating Conditions [40 CFR 63.1207(f)(1)(vii)]**

Table 4-1 summarize the planned operating conditions (temperatures, flow rates, etc.) for the two CPT conditions. Actual CPT results will be used to establish some operating specifications and to compute feed and emission rates. Some of Lyondell's current AWFCO set points will be modified so that the CPT target operating limit can be demonstrated. The modified AWFCO set points to be in effect during the CPT are presented in Table 4-1.

Steady-state operating conditions will be achieved when the liquid waste feed rate and combustion temperature have stabilized at the target operating conditions, at which time CPT sampling may commence.

#### **4.7 CMS Performance Evaluation Test Plan [40 CFR 63.8(e), 63.1209(e)]**

To satisfy HWC MACT requirements at 40 CFR 63.8(e) and 63.1209(e), the CMS instrumentation will be calibrated in accordance with Lyondell's instrumentation and electrical (I&E) maintenance department's SOPs. Calibrations will be verified before the commencement of the CPT. Copies of the calibration records will be included in the CPT report.

Lyondell will perform daily calibrations of the CO and O<sub>2</sub> CEMS in accordance with its normal operating procedures. Lyondell will include a copy of the most recent annual RATA report with the CPT report.

As allowed by HWC MACT at 40 CFR 63.1206(b)(6), a temporary CEMS operated in accordance with 40 CFR 60 Appendix A, Method 25A will be used to sample for hydrocarbons during the test to demonstrate compliance with the hydrocarbon standard of 40 CFR 63.1217(a)(5)(ii).

**Table 4-1. Comprehensive Performance Test Targets –Boiler Nos. 1, 2, and 3**

| Parameter  | Units                                | Test 1    | Test 2 | AWFCO Set Point <sup>1</sup> | AWFCO Set Point Basis        |
|--|--------------------------------------|-----------|--------|------------------------------|------------------------------|
| Waste Feed Rate (D-6804)   | gpm                                  | As Needed | 90     | 99                           | Maximum Target +10%          |
|  | lb/hr                                | As Needed | 40,000 | 44,000                       |                              |
| Ash Feed Rate  | g/hr                                 | N/A       | 13,000 | N/A                          | N/A                          |
|  | lb/hr                                | N/A       | 28.7   | N/A                          | NA                           |
| Liquid waste/natural gas differential pressure for waste atomization | psid                                 | 60        | N/A    | 75                           | Proposed Limit +15 psid      |
| Combustion Temperature <sup>2</sup>                                  | °F                                   | 1,404     | N/A    | 1,204                        | Current Minimum Limit –200°F |
| Combustion Air Flow Rate (Combustion Gas Velocity Indicator)         | Mlb/hr                               | As Needed | 750    | 850                          | Current Instrument Limit     |
| Stack Gas CO   | ppmdv,<br>HRA @ 7%<br>O <sub>2</sub> | < 100     | < 100  | 100                          | Regulation                   |

<sup>1</sup> Automatic waste feed cutoff (AWFCO) set point during operational shakedown and testing periods.

<sup>2</sup> Combustion temperature as measured in the firebox.

N/A-Not applicable



**Table 4-2. Summary Boiler No. 3 DRE Test Results-2010 Comprehensive Performance Test**

| Parameter              | Units                             | HWC<br>MACT<br>Standard | Test 1, Minimum Combustion Temperature |         |         |         |
|------------------------|-----------------------------------|-------------------------|--|---------|---------|---------|
|                        |                                   |                         | Run 1                                  | Run 2   | Run 3   | Average |
| Waste Feed Rate        | Maximum gpm, HRA                  | N/A                     | 79.0                                   | 79.0    | 78.7    | 78.9    |
| Combustion Temperature | °F average                        | N/A                     | 1,400                                  | 1,409   | 1,405   | 1,404   |
| Combustion Air Flow    | Maximum Mlb/hr HRA                | N/A                     | 710                                    | 714     | 708     | 711     |
| Naphthalene DRE        | %                                 | 99.99                   | 99.9971                                | 99.9975 | 99.9975 | 99.9974 |
| Stack Gas PCDD/PCDF    | ng TEQ/dscm @ 7% O <sub>2</sub>   | NA                      | 0.015                                  | 0.014   | 0.0060  | 0.012   |
| Stack Gas CO           | ppmv, dry @ 7% O <sub>2</sub> HRA | 100                     | -3.2                                   | -3.6    | -3.4    | -3.4    |
| Stack Gas THC          | ppmv, dry @7% O <sub>2</sub>      | 10                      | <0.2                                   | <0.2    | <0.2    | <0.2    |

| Parameter              | Units                             | HWC<br>MACT<br>Standard | Test 2, Maximum Waste Feed Rate |         |         |         |
|------------------------|-----------------------------------|-------------------------|---------------------------------|---------|---------|---------|
|                        |                                   |                         | Run 4/4A                        | Run 5   | Run 6   | Average |
| Waste Feed Rate        | Maximum gpm, HRA                  | N/A                     | 90.3                            | 90.3    | 90.2    | 90.3    |
| Combustion Temperature | °F average                        | N/A                     | 1,589                           | 1,549   | 1,551   | 1,563   |
| Combustion Air Flow    | Maximum Mlb/hr HRA                | N/A                     | 714                             | 707     | 716     | 712     |
| Naphthalene DRE        | %                                 | 99.99                   | 99.9964                         | 99.9988 | 99.9938 | 99.9963 |
| Stack Gas PCDD/PCDF    | ng TEQ/dscm @ 7% O <sub>2</sub>   | NA                      | 0.0037                          | 0.0065  | 0.0095  | 0.0066  |
| Stack Gas CO           | ppmv, dry @ 7% O <sub>2</sub> HRA | 100                     | -3.0                            | -3.1    | -3.1    | -3.0    |
| Stack Gas THC          | ppmv, dry @7% O <sub>2</sub>      | 10                      | <0.2                            | <0.2    | <0.2    | <0.2    |

## **5.0 SAMPLING, ANALYSIS, AND MONITORING PROCEDURES [40 CFR 63.1207(f)(1)(iv)]**

### **5.1 General**

This section of the CPT plan describes the sampling procedures at each sample location, the associated analytical procedures, and process monitoring procedures pertinent to the collection of CPT data.

Sampling, analytical, and monitoring protocols for the tests are summarized below. It should be noted that the reference to SW-846 sampling and analysis methods within this test plan may be presented without suffix letter designations. When a new method is published in SW-846 its method number does not include a suffix letter. However, each time the method is revised and promulgated as part of an SW-846 update, it receives a new letter suffix (e.g., a suffix of "A" indicates revision one of that method, a suffix of "B" indicates revision two, etc.). Specific method numbers and suffix designations used in the implementation of the project will be documented in the final project report.

### **5.2 CPT Sampling and Analysis Protocol**

The CPT involves sampling and analysis protocols for wastes, and HWC MACT particulate matter, HCl/Cl<sub>2</sub>, and metals emissions standards. As noted in the preceding section, sampling will be performed on one of the three boilers at the facility. The selected boiler will be tested at two operating modes. The sampling and analytical protocols for Tests 1 and 2 are summarized in Tables 5-1 and 5-2, respectively. The CPT data use is summarized in Table 1-2. The sampling and analysis are discussed in more detail in the following sections.

#### **5.2.1 Process Sampling Locations and Procedures**

The sampling procedure methods to be used during the test are summarized in Table 5-1 and 5-2.

##### **5.2.1.1 Waste Feed Sampling**

Grab samples of the liquid waste feed will be taken at regular intervals during the course of each test run and will be used to build a run composite sample of the waste feed. The composite sample will be maintained on ice in coolers between each sampling interval. At the end of the test run, discrete aliquots will be collected from the homogenized composite sample for the various analyses as noted in Tables 5-1 and 5-2. After collection from the run composite samples, the samples for analysis will be maintained on ice in coolers.

The waste feed samples will be analyzed for non-mercury metals using SW-846 Methods 6010C, SW-846 Method 7471A for mercury, and physical parameters (ash content, total chloride, heating value, density, and viscosity) using SW-846 and/or ASTM methods.

### 5.2.1.2 Spiking Solutions

The preparer's certified composition for the ash surrogate and naphthalene spiking materials will be provided by the spiking contractor and will be used for determining the ash and naphthalene spike rates. Grab samples of the spiking material will be collected during testing for confirmation analysis.

## 5.2.2 Stack Gas Sampling Procedures

Sampling of the stack gas will be performed from the ports located in the duct prior to the common stack for the unit to be tested for Boiler Nos. 1, 2, and 3. Stack sampling location schematics are shown on Figure 5-1. Each stack sampling method is briefly described below.

### 5.2.2.1 Stack Gas Method 5 (Filterable and Condensable Particulate)

The HWC MACT particulate emissions standard is a performance based standard established using filterable particulate matter data only, and excludes soot-blow corrected data. However, the TCEQ Air Rules require consideration of both filterable (front-half) and condensable (back-half) particulate matter. Therefore, Lyondell will operate and recover the Method 5 sampling train to include measurement and reporting of filterable and condensable particulate matter emissions (TCEQ Method 23). Samples of the system exhaust will be collected iso-kinetically for particulate according to EPA Method 5 during Test 2. Filterable (front-half) particulate matter emissions will be determined via EPA Method 5 analysis of the filter and sampling probe rinses. Condensable (back-half) particulate matter emissions will be determined via TCEQ Method 23 analysis of the impinger water.

### 5.2.2.2 Stack Gas Method 0023A (PCDD/PCDF and Naphthalene)

A single SW-846 Method 0023A sampling train will be used during Test 1 and Test 2 to concurrently determine the emissions of the semivolatile POHC, naphthalene, for DRE determination, and the emissions of PCDD/PCDFs. The extracts from the Method 0023A sampling train will be split two ways for analysis.

- One portion will be analyzed for PCDD/PCDFs via Method 8290A [high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS)].
- The second portion will be analyzed for naphthalene via Method 8270C [gas chromatography/mass spectrometry (GC/MS) with selected ion monitoring (SIM) and isotope dilution internal standard (IDIS) quantification. (Refer to Section 7.5.5 of Method 8270D.)

The SIM/IDIS approach is comparable to the HRGC/HRMS methodology used for PCDD/PCDFs. Analysis of the Method 0010 samples for naphthalene via GC/MS with SIM/IDIS results in substantially lower detection limits. The GC/MS with SIM/IDIS approach will result in a detection limits for the XAD-2 resin fraction of approximately 100 nanograms (ng), and the front half/probe rinse and condensate fractions of approximately 10 ng each. The resulting sampling train total naphthalene detection limit is

approximately 120 ng total. Comparatively, the routine naphthalene reporting limit for Method 8270C (GC/MS) is typically 10 micrograms (ug) per semivolatile sampling train fraction, resulting in a sampling train total of 30 ug for the three distinct fractions that comprise the sampling train analysis.

The naphthalene spiking rates to demonstrate DRE in this CPT program are based a naphthalene sampling train detection limit of 120 ng. This approach is possible because naphthalene does not present any particular analysis difficulties and is highly distinguishable as a target analyte. Naphthalene can be exhibited as an artifact of the XAD-2 resin manufacturing process. The GC/MS with SIM/IDIS detection limit includes consideration of the normal background naphthalene concentrations on the resin.

### **5.2.2.3 Continuous Emissions Monitoring**

During the CPT, the stack gas will be continuously monitored by installed CEMS using the following procedures:

- Stack gas carbon monoxide by non-dispersive infrared (NDIR) analyzer according to the protocols of 40 CFR 60, Appendix B, Performance Specification 4B; and
- Stack gas oxygen by paramagnetic analyzer according to the protocols of 40 CFR 60, Appendix B, Performance Specification 4B.

The carbon monoxide and oxygen stack gas monitors will be checked daily during the test for calibration stability in accordance with standard operating procedures.

In addition, during the test, the stack gas will be continuously monitored for HCs to demonstrate compliance with the HWC MACT performance standard [40 CFR 63.1217(a)(5)(ii)]. As allowed by 40 CFR 63.1206(b)(6), HC monitoring will be performed using a temporary CEMS. The temporary HC CEMS will be calibrated and operated in accordance with the procedures in 40 CFR 60 Appendix A, Method 25A. HC concentration will be reported as propane, corrected to 7% oxygen dry basis.

### **5.2.3 Analytical Procedures**

Analytical methods planned for the test are summarized in Tables 5-1 and 5-2. The anticipated detection limits presented in the QAPP are reporting limits (RLs) and method detection limits (MDLs) based on other similar testing.

### **5.3 Quality Assurance and Quality Control Procedures**

Appendix A contains the QAPP that has been prepared according to EPA Guidance.

### **5.4 Monitoring Procedures**

Continuous monitoring of emissions and process operating variables is conducted as described in Section 3.0 of the CPT plan. Pertinent process parameters listed in Table 3-2 will be monitored during

the CPT to provide information necessary to set operational limits and to allow calculations necessary to demonstrate compliance with performance criteria.

**Table 5-1. Planned Sampling and Analysis-Test 1**

| Sample Name                  | Sampling Location/ Access | Sampling Equipment   | Sampling Reference Method <sup>1</sup>            | Sample Size/Frequency-   | Analytical Parameters  | Analytical Reference Method <sup>1</sup>   |
|------------------------------|---------------------------|--|---|--|--|--|
| Liquid Waste Feed            | Tap on line               | 250 mL bottle for grab sampling; 4 L glass jug; 250 mL glass bottles | ASTM E-300-03                                     | Collect a 250 mL grab sample at each 30-minute interval during each test run. The grab sample of will be used to build a composite sample in a 4L jug. At the end of the test run, collect one-250 mL sample bottle for properties analysis from the homogenized composite sample. | Heating Value<br>Viscosity<br>Density<br>Ash Content<br>Total Chloride<br>Moisture | ASTM D-240<br>ASTM D-445<br>ASTM D-1475<br>ASTM D-482<br>SW846 5050/9056A<br>ASTM D-4017 |
| Naphthalene Spiking Material | Tap on line               | 100 mL sample bottle   | ASTM E-300-03                                     | Collect one 100 mL sample bottle of solution once during test  | Naphthalene  | SW846 Method 8015  |
| Stack Gas                    | Isokinetic Port           | Method 0023A   | SW846 Method 0023A                                | Minimum of 180 minutes to sample a minimum of 3.0 dscm (Boiler Duct: 18 points @ 10 minutes per point) <sup>2,3</sup>  | PCDD/PCDF<br>Naphthalene   | SW846 Method 8290A<br>SW846 Method 8270C with SIM/IDIS                                   |
| Stack Gas                    | CEMS Port                 | Installed CO and O <sub>2</sub> CEMS                                 | 40 CFR 60 Appendix B Performance Specification 4B | Continuous   | CO and O <sub>2</sub>  | 40 CFR 60, Appendix B, Performance Specification 4B                                      |
| Stack Gas                    | CEMS Port                 | Temporary HC CEMS  | 40 CFR 60 Appendix A Method 25A                   | Continuous   | HC   | 40 CFR 60 Appendix A Method 25A  |

**Table 5-1. Planned Sampling and Analysis-Test 1**

Notes:

<sup>1</sup> Reference Method Sources:

"ASTM" refers to American Society for Testing Materials, Annual Book of ASTM Standards, Annual Series

"SW846" refers to Test Methods for Evaluating Solid Waste, Third Edition, November 1986, and Updates.

"EPA Method" refers to New Source Performance Standards, Test Methods and Procedures, Appendix A, 40 CFR 60.

<sup>2</sup> The exact volume of gas sampled will depend on the isokinetic sampling rate.

<sup>3</sup> Isokinetic sampling trains include:

- Collecting one set of bag samples (or using CEM) for oxygen and carbon dioxide to determine stack gas molecular weight (EPA Method 3A).
- Performing stack gas velocity, pressure and temperature profile measurement for each sampling location (EPA Method 2)
- Determining the moisture content of the stack gas for each sampling train sample (EPA Method 4).

**Table 5-2. Planned Sampling and Analysis-Test 2**

| Sample Name                  | Sampling Location/ Access | Sampling Equipment   | Sampling Reference Method <sup>1</sup>            | Sample Size/Frequency  | Analytical Parameters  | Analytical Reference Method <sup>1</sup>   |
|------------------------------|---------------------------|--|---|--|--|--|
| Liquid Waste Feed            | Tap on line               | 250 mL bottle for grab sampling; 4 L glass jug; 250 and 250 mL glass bottles | ASTM E-300-03                                     | Collect a 250 mL grab sample at each 30-minute interval during each test run. The grab sample will be used to build a composite sample in a 4L jug. At the end of the test run, collect one-250 mL sample bottle for properties analysis and one-250 mL sample bottle for metals analysis from the homogenized composite sample. | Heating Value<br>Viscosity<br>Density<br>Ash Content<br>Total Chloride<br><br>Moisture<br><br>HWC MACT<br>Metals: Cd, Cr, Pb, & Hg | ASTM D-240<br>ASTM D-445<br>ASTM D-1475<br>ASTM D-482<br>SW846 5050/9056A<br>ASTM D-4017<br><br>ICAP (SW846 3050/6010C<br><br>Hg: CVAAS (Method 7471A) |
| Ash Spiking Material         | Tap on line               | 100 mL sample bottle   | ASTM E-300-03                                     | Collect one 100 mL sample bottle of solution once during test  | Ash  | ASTM D-482   |
| Naphthalene Spiking Material | Tap on line               | 100 mL sample bottle   | ASTM E-300-03                                     | Collect one 100 mL sample bottle of solution once during test  | Naphthalene  | SW846 Method 8015  |
| Stack Gas                    | Isokinetic Port           | Method 0023A   | SW846 Method 0023A                                | Minimum of 180 minutes to sample a minimum of 3.0 dscm (Boiler Duct: 18 points @ 10 minutes per point) <sup>2,3</sup>  | PCDD/PCDF<br>Naphthalene   | SW846 Method 8290A<br>SW846 Method 8270C with SIM/IDIS   |
| Stack Gas                    | Isokinetic Port           | Method 5   | 40 CFR 60; App A, Method 5                        | 108 minutes (Boiler Duct: 18 points @ 6 minutes per point) <sup>2,3</sup>  | Filterable and Condensable Particulate   | EPA Method 5 (Filterable Particulate)<br>TCEQ Method 23 (Condensable Particulate)  |
| Stack Gas                    | CEMS Port                 | Installed CO and O <sub>2</sub> CEMS   | 40 CFR 60 Appendix B Performance Specification 4B | Continuous   | CO and O <sub>2</sub>  | 40 CFR 60, Appendix B, Performance Specification 4B  |
| Stack Gas                    | CEMS Port                 | Temporary HC CEMS  | 40 CFR 60 Appendix A Method 25A                   | Continuous   | HC   | 40 CFR 60 Appendix A Method 25A  |



**Table 5-2. Planned Sampling and Analysis-Test 2**

Notes:

<sup>1</sup> Reference Method Sources:

"ASTM" refers to American Society for Testing Materials, Annual Book of ASTM Standards, Annual Series

"SW846" refers to Test Methods for Evaluating Solid Waste, Third Edition, November 1986, and Updates.

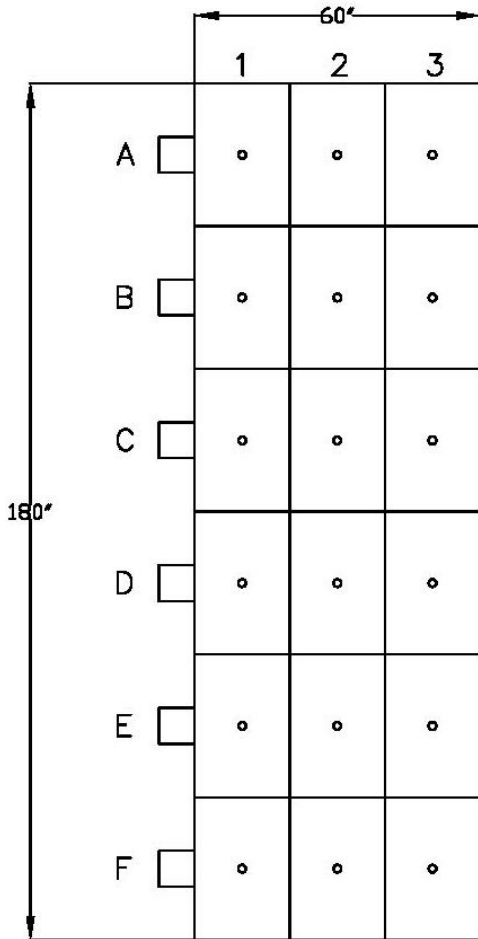
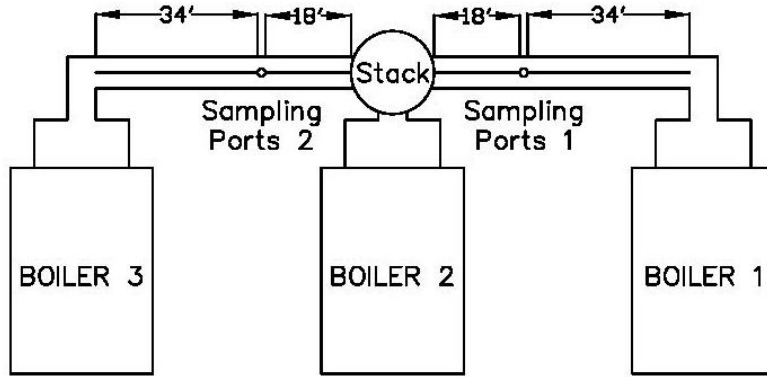
"EPA Method" refers to New Source Performance Standards, Test Methods and Procedures, Appendix A, 40 CFR 60.

"TCEQ Method 23" refers to Texas Commission on Environmental Quality, Method 23 Determination of Particulate Matter in Stack Gases.

<sup>2</sup> The exact volume of gas sampled will depend on the isokinetic sampling rate.

<sup>3</sup> Isokinetic sampling trains include:

- Collecting one set of bag samples (or using CEM) for oxygen and carbon dioxide to determine stack gas molecular weight (EPA Method 3A).
- Performing stack gas velocity, pressure and temperature profile measurement for each sampling location (EPA Method 2)
- Determining the moisture content of the stack gas for each sampling train sample (EPA Method 4).



DISTANCE FROM PORT (INCHES)

- 1. 10"
- 2. 30"
- 3. 50"

DISTANCE FROM TOP (INCHES)

- A. 15"
- B. 45"
- C. 75"
- D. 105"
- E. 135"
- F. 165"

**Figure 5-1. Stack Sampling Ports - Boiler Nos. 1, 2, and 3**

## 6.0 TEST SCHEDULE [40 CFR 63.1207(f)(1)(v)]

### 6.1 General Test Schedule

The CPT of the HWC Boilers is expected to occur during a one-week period. Prior to the CPT, process instruments will be calibrated, testing of the CEMS will be performed, and the AWFCOs will be tested. The planned daily activities for the test are as follows:

- Test Day 1 – The sampling team will mobilize to the test site and set-up equipment at the unit to be tested. A coordination meeting will be conducted. Test levels for AWFCOs will be confirmed.
- Day 2 – The boiler will be brought to the desired steady-state operating conditions for Test 1. Naphthalene spiking will be initiated at least 15 minutes before sampling is started. When all sampling team preparations are complete, Test 1, Runs 1 and 2 will be conducted.
- Day 3 – The boiler will be brought to the desired steady-state operating conditions for Test 1. Naphthalene spiking will be initiated at least 15 minutes before sampling is started. When all sampling team preparations are complete, Test 1, Run 3 will be conducted. [Note: If two test runs are not completed on Day 2 as noted above, Day 3 will consist of two test runs to complete Test 1.] Once Test 1 is completed, time allowing, additional testing may be performed by ramping up operation of the boiler to the maximum waste feed rate target operating conditions (Test 2). Alternatively, Test 2 will begin the following day.
- Day 4 – The boiler will be brought to the desired steady-state operating conditions for Test 2. Naphthalene and ash surrogate spiking will be initiated at least 15 minutes before sampling is started. Once the unit is at the desired steady-state operating conditions for Test 2 and when all sampling team preparations are complete, Test 2, Runs 1 and 2 will be performed.
- Day 5 – The boiler will be brought to the desired steady-state operating conditions for Test 2. Naphthalene and ash surrogate spiking will be initiated at least 15 minutes before sampling is started. When all sampling team preparations are complete, Test 2, Run 3 will be performed. [Note: If two test runs are not completed on Day 4 as noted above, Day 5 will consist of two test runs to complete Test 2.] Once Test 2 is completed, the sampling team will recover testing equipment and prepare to de-mobilize from the test site.
- Day 6 – Testing contingency day if there are testing delays.

The above proposed schedule of testing is a general schedule. Preparation of the CPT report will begin following completion of the on-site testing. The final CPT report will be submitted within 90 days after completion of the CPT.

### 6.2 Duration of Each Test Condition

The anticipated sampling time during each run is four (4) hours. The sequencing of stack sampling trains is noted in Figures 6-1 and 6-2. Installed CEMS measurements will be made throughout each sampling run. Process conditions will remain at the same target conditions throughout the sampling run. Prior to each sampling run, the boiler being tested will be operated at target operating conditions for approximately one (1) hour to establish hourly rolling average values. Minimal change from the target

operating values for the rolling averages will indicate steady-state operation. Target operating parameter values are noted in Table 4-1 of this CPT plan.

In order to establish operating conditions proposed in this test plan, periods of operation will be necessary prior to and during the test that will require temporary operating limits proposed in this test plan to be in place rather than current AWFCO limits. These temporary limits are listed in Table 4-1.

### **6.3 Planned Test Start Date**

The test will be tentatively scheduled for within 180 days of test plan approval by TCEQ and EPA, but no later than January 31, 2021. Lyondell may conduct pre-CPT shakedown testing in this 180-day period. Lyondell will notify TCEQ at least 30 days before the planned date for starting of the test. The test start date will be confirmed the Friday before the planned start of the testing.

### **6.4 Quantity of Waste to be Burned During Testing**

The estimated hours of operation to complete testing are summarized in Table 6-1. The amount of liquid waste feed and spiking material are also summarized in Table 6-1. Any excess spiking material may be fed to the tested unit, returned to the vendor, or disposed of off-site. Amounts are based on four (4) hours per test run plus one contingency run (16 hours total) of testing, and one (1) hour of ramp up time per test run (20 hours total).

### **6.5 Pre-test Shakedown Operation and Testing**

The primary objective of the CPT is to establish limits for the Lyondell HWC Boilers' operating parameters that ensure compliance with the emission standards during subsequent, less rigorous operations. In accordance with the HWC MACT regulations at 40 CFR 63.1207(h)(2), Lyondell requests up to 720 hours of shakedown operation. The specific language from 40 CFR 63.1207(h)(2) is:

*“Current operating parameter limits are also waived during pre-testing prescribed in the approved test plan prior to comprehensive performance testing for an aggregate time not to exceed 720 hours of operation.”*

This shakedown operational period will be at the proposed CPT operating limit targets, which may exceed the operating limits in the current Notification of Compliance (NOC). The purpose of the shakedown operation is to verify the operational readiness for the formal CPT. This testing may include emissions measurements to assess the potential compliance of the unit at the proposed operating targets. Demonstrating the proposed target operating limits will require modifying AWFCO interlock set points as noted in Table 4-1.

## 6.6 Test Interruptions

In the event of an AWFCO or similar test interruption, all emissions sampling will be suspended immediately. Emissions sampling pumps will be switched off, but probes may remain in the sampling ports. The waste feed sampling will continue pending a determination and assessment of the expected stoppage or test delay time by the test manager.

Should the situation be resolved shortly (15 minutes or less), and waste feed instantaneous rates are resumed at or above 90% of the rates prior to the test stoppage event, and other target conditions are comparable to before the test interruption, emissions sampling may be resumed at the discretion of the test manager and after consultation with the unit operations staff. Optionally, the test manager may elect to hold off the re-start of sampling until hourly rolling averages have re-established at or closer to test target values.

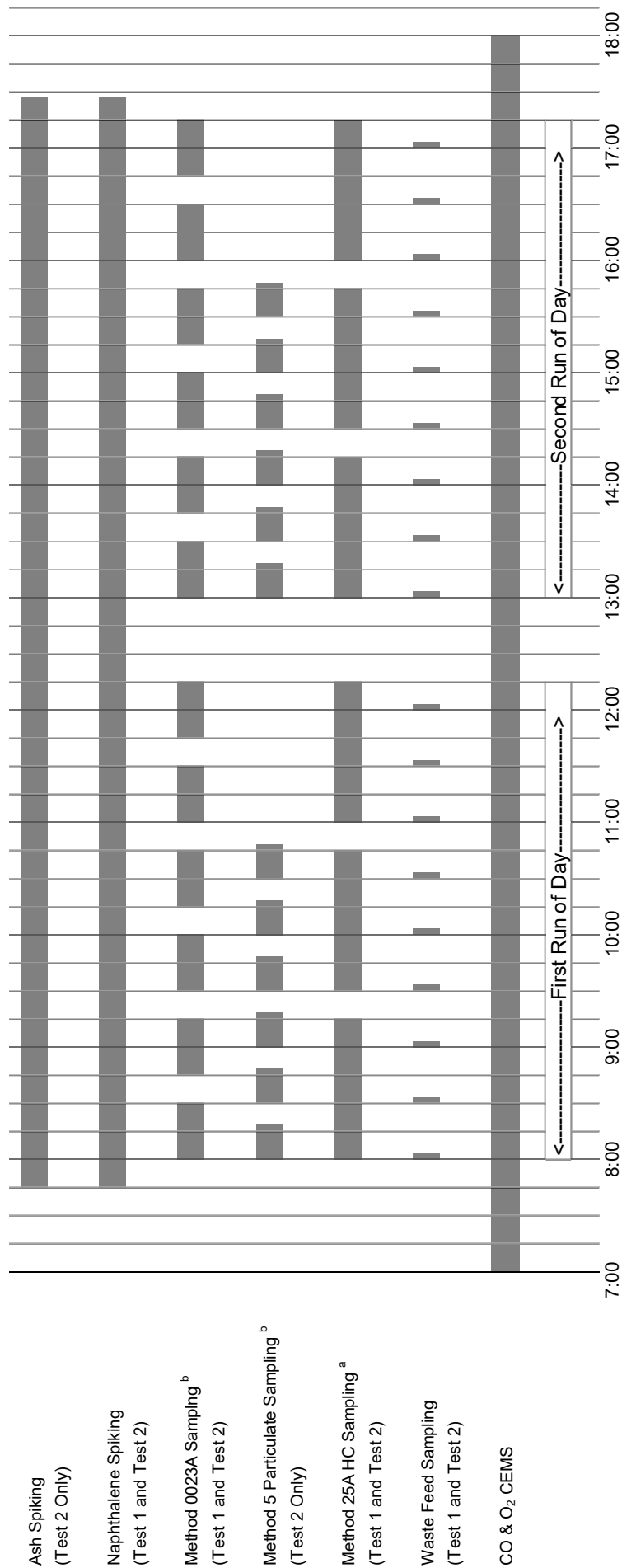
Should the situation take longer to be resolved (more than 15 minutes), all sampling will be suspended until the hourly rolling averages have re-established at or close to test target values. The emissions sampling probes will be removed from the sampling ports and the nozzles sealed with Teflon tape. Emissions sampling equipment will be maintained on hot standby pending a test re-start decision. Once the situation is corrected, waste feed has resumed, and the hourly rolling averages are re-established, testing will resume at the direction of the test manager.

Should the situation become evident that testing cannot be resumed in 1-2 hours, or will take even longer to resolve, the test manager may suspend testing for the day. The test manager will assess whether any emissions sampling trains that have been completed should be retained or discarded. Most incomplete sampling trains may be held for up to 24 hours and then resumed. Waste feed samples may be held over as well. If testing can be resumed the following day, the incomplete stack gas sampling trains, the process sampling equipment, and completed sampling train samples will be secured for the night in such manner as to properly preserve the samples. Sampling will resume the following day where testing the previous day ended once the unit is back at the target test conditions. Optionally, the test run may be scrubbed altogether with all samples to that point being discarded, and all emissions and waste feed sampling started anew when testing can be resumed. No incomplete sampling train or waste feed samples will be held over for more than 24 hours.

All test start/stop/suspension/scrub decisions will be communicated to the regulatory observers present at the time of testing. Such decisions may include consultations between the test manager, the unit operations staff, and the regulatory observers present.

**Table 6-1. Quantity of Feed Materials for Testing**

| Parameter                      | Test | Feed Rate | Units | Hours | Total lbs       |
|--------------------------------|------|-----------|-------|-------|-----------------|
| <b>Boiler Nos. 1, 2, and 3</b> |      |           |       |       |                 |
| Waste                          | 1    | 32,500    | lb/hr | 20    | 650,000 lbs     |
|                                |      | 73        | gpm   |       | 88,000 gallons  |
|                                | 2    | 40,000    | lb/hr | 20    | 800,000 lbs     |
|                                |      | 90        | gpm   |       | 108,000 gallons |
| Ash Surrogate                  | 2    | 13,000    | g/hr  | 20    | 260 kg          |
|                                |      | 28.7      | lb/hr |       | 574 lbs         |
| Naphthalene                    | 1    | 10        | lb/hr | 20    | 200 lbs         |
|                                | 2    | 10        | lb/hr | 20    | 200 lbs         |

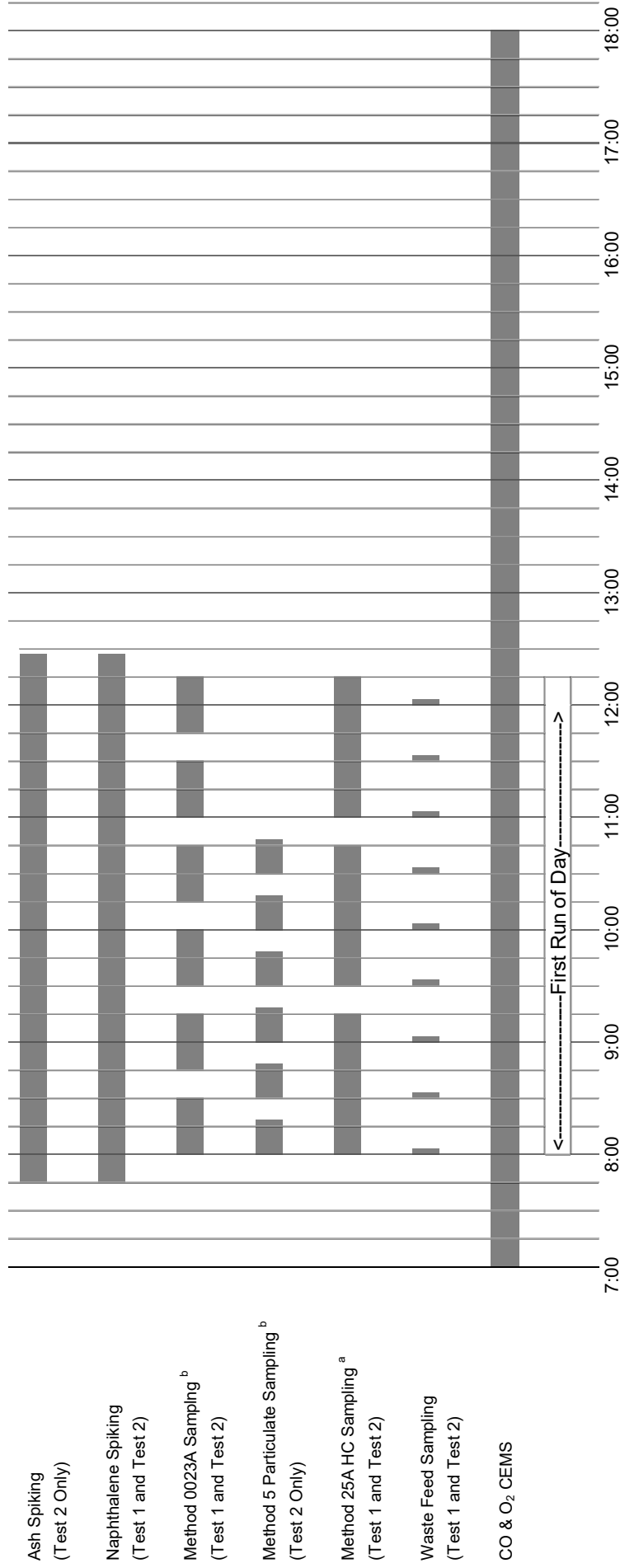


Notes:

<sup>a</sup> Non-isokinetic sampling port.

<sup>b</sup> Six (6) isokinetic sampling ports in the boiler duct with three (3) traverse points for each port.

Figure 6-1. Stack Gas and Waste Feed Sampling - Boiler Nos. 1, 2, and 3, Two Test Runs per Day



Notes:

<sup>a</sup> Non-isokinetic sampling port.

<sup>b</sup> Six (6) isokinetic sampling ports in the boiler duct with three (3) traverse points for each port.

**Figure 6-2. Stack Gas and Waste Feed Sampling - Boiler Nos. 1, 2, and 3, One Run per Test Day**



## 7.0 OPERATING PERMIT OBJECTIVES

### 7.1 Control Parameters

Based on the results of the testing, Lyondell will propose operating limits for the HWC Boilers in the CPT report. Some parameters will be established directly from the operating conditions demonstrated during the CPT; however, other limits will be based on established regulatory guidance, manufacturer's recommendations, good operating practice, or past operating experience. The operating parameters discussed in this section that will have permit limits associated with them will provide equivalent or better assurance of compliance with the applicable emissions performance standards. Should the required objectives from testing be achieved, Lyondell requests that the HWC Boilers be allowed to operate under the conditions proposed in this section.

Table 7-1 summarizes the expected HWC MACT operating limits. In order to achieve the desired operating conditions and demonstrate unit operations at the proposed limits, the AWFCO set points for certain operating parameters must be set higher or lower (as applicable) during testing periods. The recommended AWFCO interlock set points during testing periods are presented in Table 4-1. The following sections present a discussion of each parameter. To facilitate review, the control parameters are grouped into the following categories:

- Group 1 parameter limits are established from test operating data, and are used to ensure that HWC system operating conditions are not significantly less rigorous than those demonstrated during the test. Most Group 1 parameters are continuously monitored and recorded, and are interlocked with the AWFCO system. During the test periods (pre-test shakedown and formal test), continuously monitored and interlocked Group 1 parameters will be operational, but will be set at values, which will allow the desired operating limits to be demonstrated.
- Group 2 parameter limits are regulatory specified limits, and are not based on the test operating conditions (e.g., the maximum stack CO concentration). Some Group 2 parameters are continuously monitored and recorded, and are interlocked with the AWFCO system. Interlocks for continuously monitored Group 2 parameters will be operational during the test periods, without modification to the interlock set points.
- Group 3 parameter limits are based on manufacturer's recommendations, operational safety, and historical operating practice considerations rather than on the test operating conditions. Group 3 parameter limits may be regulatory specified limits. Some Group 3 parameters may be continuously monitored and recorded, and may be interlocked with the AWFCO system. Interlocks for continuously monitored Group 3 parameters will be operational during the test periods.

### 7.2 Development of Permit Limits

The following sections describe how each control parameter limit will be established. In addition to establishing specific operating limits, Lyondell anticipates having limits on the types of waste that can be burned in the HWC Boilers. Since Lyondell demonstrated and will demonstrate 99.99% DRE using naphthalene, a Class 1 (most thermally stable) compound, it is expected that Lyondell will be permitted to

burn all of the wastes represented by the waste codes in the facility's most recent RCRA Part A permit application. Specific prohibitions are expected for wastes containing greater than 50 mg/kg of polychlorinated biphenyls (PCBs) and those wastes listed with the waste codes F020, F021, F022, F023, F026, or F027.

### **7.2.1 Parameters Demonstrated During the Test (Group 1 Limits)**

Group 1 parameter limits are based on the results of the testing. The following parameters are proposed as Group 1 parameters for the HWC boiler systems.

#### **7.2.1.1 Maximum Hazardous Waste Feed Rates [40 CFR 63.1209(j)(3), (k)(4)]**

The maximum waste feed rate operating limit is established for maintaining compliance with the organic DRE performance under HWC MACT. During the 2010 CPT, Test 2 was conducted to demonstrate the maximum feed rates of liquid wastes for HWC Boilers. The liquid waste feed rates were monitored on a continuous basis. Based on successful demonstration of the DRE performance standard during the maximum waste feed rate test, the maximum allowable liquid waste feed rate for the boilers was established as hourly rolling average limit from the averages of the maximum hourly rolling average feed rates demonstrated during the three runs of the 2010 maximum waste feed rate test.

During Test 2 of the CPT conducted under this test plan, Lyondell intends to establish a new waste feed rate limit. Based on successful demonstration of the DRE performance standard during the CPT conducted under this test plan, the maximum allowable liquid waste feed rate limit for the HWC Boilers will be established as hourly rolling average limit from the averages of the maximum hourly rolling average waste feed rates demonstrated during the three runs of the maximum waste feed rate test.

#### **7.2.1.2 Minimum Combustion Temperatures [40 CFR 63.1209(j)(1), (k)(2)]**

The minimum combustion temperature operating limit is established for maintaining compliance with the organic DRE performance under HWC MACT. During the 2010 CPT, Test 1 was conducted in order to demonstrate the minimum combustion temperature for the HWC Boilers for DRE. Combustion gas temperature was monitored on a continuous basis. Based on successful demonstration of the DRE performance standard during the minimum combustion temperature test, the minimum combustion temperature limit for boilers was established as an hourly rolling average equal to the average of the 2010 minimum temperature DRE test run average values.

During Test 1 of the CPT conducted under this test plan, Lyondell intends to demonstrate a new minimum combustion temperature limit. Based on successful demonstration of the DRE performance standard during the CPT conducted under this test plan, the minimum combustion temperature limit for the HWC Boilers will be established as hourly rolling average limit from the average of the average combustion temperatures demonstrated during the three runs of the minimum combustion temperature test.

### **7.2.1.3 Maximum Combustion Gas Velocity [40 CFR 63.1209(j)(2), (k)(3)]**

The maximum combustion gas velocity flow rate operating limit is established for maintaining compliance with the organic DRE performance under HWC MACT. During the 2010 CPT, the combustion gas velocity was maximized during Test 2. Measurement of DRE performance during Test 2 demonstrated that DRE is being met at conditions of maximum waste feed rate and maximum combustion gas velocity. The combustion gas flow rate was measured indirectly by the combined combustion air flow rate. The maximum combustion gas velocity for Boiler Nos. 1, 2, and 3 was established from the average of the maximum hourly rolling average total combustion air flows demonstrated during the three runs of the 2010 CPT Test 2.

During Test 2 of the CPT conducted under this test plan, Lyondell intends to demonstrate a new combustion air flow rate limit for the HWC Boilers. Based on successful demonstration of the DRE performance standard during the CPT conducted under this test plan, the maximum combustion air flow rate limit for the HWC Boilers will be established as an hourly rolling average limit from the averages of the maximum combustion air flow rates demonstrated during the three runs of the maximum waste feed rate test.

### **7.2.1.4 Maximum Ash Feed Rates [40 CFR 63.1209(m)(3)]**

To provide some operational flexibility should the ash content of the wastes vary, Lyondell will augment the native ash content of the waste during Test 2 via spiking of an ash surrogate during the maximum waste feed rate test. Provided that the particulate emissions measured during the maximum waste feed rate test is in compliance with the particulate matter emissions standard, the final total ash feed rate limit should be the test demonstrated feed rate. The total ash feed rate limit should be expressed as a rolling average, equal to the average of the average ash feed rate during the three runs of the maximum feed rate test. For HWC MACT compliance, the ash feed rate limit is expressed in terms of 12-hour rolling average. Records of waste feed analyses, and the electronic waste feed operational data, will be maintained to demonstrate compliance with the ash feed rate limit.

## **7.2.2 Parameters Established by Regulatory Requirements (Group 2 Limits)**

Group 2 parameter limits are based on regulatory requirements.

### **7.2.2.1 Maximum Chloride and Metals Feed Rates [40 CFR 63.1209(l)(1)(ii), (o)(1)(ii), (n)(2)(v); 63.1207(m)(2)]**

Lyondell will feed waste normally treated during the testing. Waste feed analyses will be performed to measure the total chloride and metals contents of the waste feed. These analyses and the system operating feed rate will be used to demonstrate compliance with the applicable HWC MACT hazardous waste thermal input based or stack gas mass concentration emissions limits for metals and chloride. As stated previously in this CPT plan, Lyondell will comply with the HCl/Cl<sub>2</sub> and metals emissions standards

via MHWTC. The applicable chloride and metals emissions limit for Boiler Nos. 1, 2, and 3, is based on the thermal (heat) input from hazardous waste only expressed in lb/MMBtu of hazardous waste. Compliance with the chloride and metals emissions limits are continuously calculated from the total constituent feed rate in the hazardous waste feed (lb/hr) divided by the total hazardous waste thermal feed rate (MM Btu/hr). Compliance with the chromium and HCl/Cl<sub>2</sub> standards for these units will be via a 12-hour rolling average basis. Compliance with the mercury and SVM emission standards for these units must be demonstrated on a not-to-exceed annual average basis. Per agreement with EPA Region 6, the chloride feed rate limit is set at 80% of the HWC MACT emissions standard. The SVM, chromium, and mercury feed rate limits are set at 100% of the HWC MACT emissions standards.

Records of waste feed analyses, and the electronic waste feed operational data, will be maintained to demonstrate compliance of the Lyondell HWC Boilers with the chloride and metals feed rate limits.

#### **7.2.2.2 Maximum Stack CO Concentration [40 CFR 63.1217(a)(5)(i)]**

Lyondell expects a permit limit specifying a maximum allowable stack gas carbon monoxide concentration of 100 ppmv hourly rolling average corrected to 7% oxygen, dry basis.

#### **7.2.2.3 Fugitive Emissions [40 CFR 63.1206(c)(5)(i)(A), (B)]**

The HWC MACT regulations require controlling combustion system leaks. Boiler Nos. 1, 2, and 3 are sealed combustion systems with induced drafts provided by natural draft from the respective unit stacks. Boiler Nos. 1, 2, and 3 therefore comply with 40 CFR 63.1206(c)(5)(i)(A); no combustion chamber pressure limits are proposed for these units.

### **7.2.3 Parameters Established by Manufacturer's Recommendations, Operational Safety and Good Operating Practice (Group 3 Limits)**

Group 3 parameter limits are based on manufacturer's recommendations, operational safety, and good operating practice considerations. The only Group 3 parameter proposed is waste feed atomization pressure. Limits for waste feed atomization are proposed on the operation of the waste firing systems for maintaining compliance with the DRE standard [40 CFR 63.1209(j)(4)].

The HWC MACT rule at 40 CFR 63.1209(j)(4) requires that the operator "...specify operating parameters and limits to ensure that good operation of each hazardous waste firing system is maintained". The rule is not specific as to parameters or monitoring frequency. Generally for liquid waste feed systems, this rule requirement has resulted in minimum atomization media pressure limits.

Fuel gas is always concurrently fired with liquid waste. Separately, only natural gas is used as the waste feed atomization media for Boiler Nos. 1, 2, and 3. During normal operations, a boiler is typically operated firing waste on two of the three decks (four burners) instead of all three decks (six burners). In this normal operating configuration, typically only two decks are feeding liquid waste with atomizing

natural gas. On occasions when steam demand requires such, all three decks may be firing waste with atomizing natural gas.

The distributed control system (DCS), separately measures the liquid waste feed pressure and the atomizing natural gas pressure to each of the three burner decks. The Safety Interlock System is configured to individually shut off liquid waste flow and atomizing natural gas to the impacted deck if there is a loss of atomizing natural gas pressure to a single deck. Immediately shutting all liquid waste to the boiler due to loss of atomizing natural gas pressure on a single deck will result in an immediate and substantial decrease in fuel input to the boiler. The rapid swing in fuel input causes corresponding swings in combustion zone temperature that can damage refractory and heat exchange components leading to a failure of the boiler. Such rapid changes also result in significant carbon monoxide emissions spikes. Stable operation of the boilers is beneficial to the longevity of the boiler components and more desirable from an environmental emissions perspective.

In the original Alternative Monitoring Application submitted concurrently with the 2010 CPT plan, Lyondell had proposed a minimum atomizing natural gas pressure limit of five (5) psig for waste atomization. This minimum atomizing natural gas pressure value had been the operating limit for many years under RCRA BIF operation. However, based on post-CPT discussions with EPA Region 6 relative to Lyondell's original Alternative Monitoring Application and 2010 CPT results, a different compliance approach for triggering an AWFCO in the event of a loss of atomizing natural gas pressure was agreed upon. A maximum value of 35 psid for liquid waste/atomizing natural gas differential pressure was established based on data from the 2010 CPT. In this CPT plan, Lyondell proposes to establish a new maximum differential pressure value based on the differential pressures demonstrated during the testing conducted under this test plan.

During Test 1 (minimum combustion temperature demonstration) of the CPT conducted under this test plan, Lyondell will target demonstrating carbon monoxide and hydrocarbon emissions compliance while operating at a liquid waste/atomizing natural gas differential pressure substantially greater than 35 psid. Based on successful demonstration of the DRE performance standard during the CPT conducted under this test plan, the maximum liquid waste/atomizing natural gas differential pressure limit for the HWC Boilers will be established as an hourly rolling average limit from the averages of the maximum liquid waste/atomizing natural gas differential pressure values demonstrated during the three runs of the minimum combustion temperature DRE test.

The same maximum liquid waste feed/atomizing natural gas pressure differential pressure limit is proposed for each of the three firing decks so that waste and natural gas firing loads can be directed and shifted between the decks to optimize operation of the boiler and allow for on-stream maintenance. The differential pressure is calculated by taking the average of the three individual deck differential pressures which are calculated by taking the difference between the average liquid feed pressure and the atomizing

natural gas pressure for each respective deck. If the average liquid waste feed/atomizing natural gas pressure exceeds the maximum proposed value on an hourly rolling average basis, then liquid waste feed is cutoff. For HWC MACT compliance, the atomizing natural gas pressure AWFCO limit is configured as described here.

**Table 7-1. Summary of Established HWC MACT Operating Limits-Boiler Nos. 1, 2, and 3**

| Operational Parameter  | Units                     | Limit    | AWFCO | Averaging Period               | Method of Setting Limit  |
|--|---------------------------|----------|-------|--------------------------------|--|
| <b>Group 1 Parameters</b>  |                           |          |       |                                |  |
| Maximum liquid waste feed rate   | gpm                       | TBD      | Yes   | Hourly Rolling Average         | Average of the maximum rolling average feed rate during the three runs of the maximum waste feed DRE rate test. [40 CFR 63.1209(j)(3), (k)(4)]   |
| Maximum ash feed rate  | g/hr                      | TBD      | Yes   | 12-Hour Rolling Average        | Mass ash feed rate limit based on the average of the average feed rate during the three maximum waste feed rate test runs. [40 CFR 63.1209(m)(3)]  |
| Minimum combustion temperature   | °F                        | TBD      | Yes   | Hourly Rolling Average         | Average of the average combustion temperature during the three test runs of the minimum combustion temperature DRE test. [40 CFR 63.1209(j)(1), (k)(2)]                                  |
| Maximum combustion air flow  | M lb/hr                   | TBD      | Yes   | Hourly Rolling Average         | Average of the maximum rolling average flow rate during the three runs of the maximum waste feed rate DRE test. [40 CFR 63.1209(j)(2), (k)(3)]   |
| <b>Group 2 Parameters</b>  |                           |          |       |                                |  |
| Maximum total chloride feed rate   | lb/MMBtu                  | 4.1 E-02 | Yes   | 12-Hour Rolling Average        | Set at 80% of the HWC MACT standard. Continuously calculated by the control system based on waste feed rate and analyses. [40 CFR 63.1217(a)(6)(ii), 63.1209(o)(1)(ii), & 63.1207(m)(2)] |
| Maximum mercury (Hg) feed rate   | lb/MMBtu                  | 4.2 E-05 | Yes   | Annual Average (not to exceed) | Continuously calculated by the control system based on waste feed rate and analyses. [40 CFR 63.1217(a)(2)(ii), 63.1209(l)(1)(ii), & 63.1207(m)(2)]                                      |
| Maximum total semivolatile metals (SVM) [cadmium (Cd) + lead (Pb)] feed rate | lb/MMBtu                  | 8.2 E-05 | Yes   | Annual Average (not to exceed) | Continuously calculated by the boiler control system based on waste feed rate and analyses. [40 CFR 63.1217(a)(3)(ii), 63.1209(n)(2)(v), & 63.1207(m)(2)]                                |
| Maximum total low volatility metals (LVM) [chromium Cr only] feed rate       | lb/MMBtu                  | 1.3 E-04 | Yes   | 12-Hour Rolling Average        | Continuously calculated by the control system based on waste feed rate and analyses. [40 CFR 63.1217(a)(4)(ii), 63.1209(n)(2)(v), & 63.1207(m)(2)]                                       |
| Maximum stack gas CO concentration   | ppmvd @ 7% O <sub>2</sub> | 100      | Yes   | Hourly Rolling Average         | HWC MACT Rule [40 CFR 63.1217(a)(1)(ii) and (a)(5)(i)]   |
| <b>Group 3 Parameters</b>  |                           |          |       |                                |  |
| Maximum liquid waste/natural gas differential pressure for waste atomization | psid                      | TBD      | Yes   | Hourly Rolling Average         | Average of the maximum rolling average differential pressure during the three runs of the minimum temperature DRE test. [40 CFR 63.1209(j)(4)]   |

AWFCO - Automatic waste feed cutoff

## 8.0 TEST REPORT

The final test report will be postmarked before the close of business on the 90<sup>th</sup> day after completion of the test unless a time extension is requested. The final test report will be a comprehensive test report that contains a discussion of the test objectives; sampling, analysis, and QA/QC activities performed; summaries of process operating conditions; the results of the test determinations; and proposed permit conditions. The planned outline of the test report is shown in Table 8-1 and is as prescribed by the Industrial and Hazardous Waste Permits Division of TCEQ.



**Table 8-1. Example Test Report Outline**

- NOTIFICATION OF COMPLIANCE (ENCLOSED)
- 1.0 SUMMARY OF TEST RESULTS
  - 1.1 HWC MACT CPT RESULTS
    - 1.1.1 EMISSIONS RESULTS
    - 1.1.2 OPERATING PARAMETER LIMIT RESULTS
      - 1.1.2.1 GROUP 1 LIMITS
        - 1.1.2.1.1 MAXIMUM HAZARDOUS WASTE FEED RATE
        - 1.1.2.1.2 MINIMUM COMBUSTION TEMPERATURE
        - 1.1.2.1.3 MAXIMUM COMBUSTION GAS FLOW RATE
        - 1.1.2.1.4 MAXIMUM ASH FEED RATE
      - 1.1.2.2 GROUP 2 LIMITS
        - 1.1.2.2.1 MAXIMUM CHLORINE FEED RATE
        - 1.1.2.2.2 MAXIMUM MERCURY FEED RATE
        - 1.1.2.2.3 MAXIMUM SVM FEED RATE
        - 1.1.2.2.4 MAXIMUM LVM FEED RATE
        - 1.1.2.2.5 MAXIMUM STACK GAS CO CONCENTRATION
      - 1.1.2.3 GROUP 3 LIMITS
        - 1.1.2.3.1 MINIMUM ATOMIZING MEDIA DIFFERENTIAL PRESSURE
  - 1.2 DEVIATIONS FROM THE APPROVED CPT PLAN AND THEIR IMPACTS
    - 1.2.1 ACTUAL VERSUS PLAN OPERATIONS
    - 1.2.2 DATA QUALITY OBJECTIVES (DQOS)
    - 1.2.3 SAMPLING AND SAMPLE HANDLING
  - 1.3 PERFORMANCE EVALUATION (AUDIT) RESULTS SUMMARY
- 2.0 INTRODUCTION/PROCESS DESCRIPTION
  - 2.1 BRIEF UNIT DESCRIPTION
  - 2.2 TEST OBJECTIVES OVERVIEW
    - 2.2.1 APPLICABLE EMISSIONS STANDARDS
    - 2.2.2 TEST OPERATING OBJECTIVES
    - 2.2.3 PLANNED TEST PROTOCOL
  - 2.3 TEST RESPONSIBLE PARTIES
  - 2.4 TEST CHRONOLOGY
  - 2.5 CONTINUOUS MONITORING SYSTEMS
  - 2.6 PROCESS FLOW DIAGRAM
- 3.0 OPERATING PARAMETER DATA SUMMARY
  - 3.1 FEED RATE DATA
    - 3.1.1 HAZARDOUS AND NONHAZARDOUS WASTE
    - 3.1.2 OTHER FEEDSTREAMS
      - 3.1.2.1 COMBUSTION AIR
      - 3.1.2.2 AUXILIARY FUEL
      - 3.1.2.3 VAPOR RECOVERY (VENT STREAM) FEEDSTREAM
  - 3.2 COMBUSTION AIR
  - 3.3 HAZARDOUS WASTE FEEDSTREAM ATOMIZING PARAMETERS
  - 3.4 STACK GAS FLOW RATE, PRODUCTION RATE, OR SURROGATE PARAMETER
  - 3.5 CONTINUOUS EMISSION MONITORING PARAMETERS
  - 3.6 FUGITIVE EMISSION CONTROL PARAMETERS
  - 3.7 AIR POLLUTION CONTROL (APC) DEVICE PARAMETERS
  - 3.8 OTHER MONITORING METHODS FOR DETERMINING CONTINUING COMPLIANCE
  - 3.9 DATA-IN LIEU-OF TESTING PARAMETER SUMMARY

**Table 8-1. Example Test Report Outline (cont'd)**

- 4.0 FEEDSTREAM SAMPLING AND ANALYSIS
  - 4.1 SAMPLING LOCATIONS
  - 4.2 SAMPLING AND ANALYTICAL METHODS
  - 4.3 CHARACTERIZATIONS
    - 4.3.1 WASTE FEEDS
    - 4.3.2 OTHER FEEDSTREAMS
  - 4.4 HWC MACT CONSTITUENT FEED RATES
    - 4.4.1 MERCURY
    - 4.4.2 SEMIVOLATILE METALS (SVM)
    - 4.4.3 LOW VOLATILITY METALS (LVM)
    - 4.4.4 TOTAL CHLORINE AND CHLORIDES
    - 4.4.5 ASH
    - 4.4.6 PRINCIPAL ORGANIC HAZARDOUS CONSTITUENTS (POHCs)
- 5.0 HWC MACT COMPLIANCE RESULTS
  - 5.1 APPLICABLE EMISSION STANDARDS
  - 5.2 DIOXINS AND FURANS
    - 5.2.1 SAMPLING AND ANALYTICAL METHODS
    - 5.2.2 DIOXINS AND FURANS EMISSION RESULTS
    - 5.2.3 TOXICITY EQUIVALENCY RESULTS (TEQ)
  - 5.3 METALS
    - 5.3.1 SAMPLING AND ANALYTICAL METHODS
    - 5.3.2 MERCURY EMISSION RESULTS
    - 5.3.3 SEMIVOLATILE METAL (SVM) EMISSION RESULTS
    - 5.3.4 LOW VOLATILITY METAL (LVM) EMISSION RESULTS
  - 5.4 HYDROGEN CHLORIDE AND CHLORINE
    - 5.4.1 SAMPLING AND ANALYTICAL METHODS
    - 5.4.2 HYDROGEN CHLORIDE AND CHLORINE EMISSION RESULTS
  - 5.5 PARTICULATE MATTER
    - 5.5.1 SAMPLING AND ANALYTICAL METHODS
    - 5.5.2 PARTICULATE MATTER (PM) EMISSION RESULTS
  - 5.6 DESTRUCTION AND REMOVAL EFFICIENCY (DRE)
    - 5.6.1 SAMPLING AND ANALYTICAL METHODS
    - 5.6.2 POHC EMISSION RESULTS
    - 5.6.3 DRE CALCULATIONS
  - 5.7 CONTINUOUS EMISSIONS MONITORING SYSTEMS
  - 5.8 METALS EXTRAPOLATION
  - 5.9 CONTINUOUS MONITORING SYSTEM (CMS) PERFORMANCE EVALUATION
- TEST SUMMARY
- 6.0 HAZARDOUS WASTE PERMIT-BASED RESULTS

**Table 8-1. Example Test Report Outline (cont'd)**

- 7.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) DOCUMENTATION
  - 7.1 SUMMARY OF QA/QC DATA QUALITY ASSESSMENT
    - 7.1.1 QA/QC ACTIVITIES AND IMPLEMENTATION
      - 7.1.1.1 QA SURVEILLANCE
      - 7.1.1.2 SAMPLE COLLECTION
      - 7.1.1.3 SAMPLE ANALYSIS
      - 7.1.1.4 PROCESS INSTRUMENTATION
      - 7.1.1.5 STACK SAMPLING EQUIPMENT
    - 7.1.2 AUDITS
    - 7.1.3 DATA VALIDATION
      - 7.1.3.1 DETECTION AND REPORTING LIMIT DETERMINATION
      - 7.1.3.2 EVALUATION OF COMPLETENESS
      - 7.1.3.3 ANALYTICAL PROCEDURES AND INTERNAL QC CHECK RESULTS
      - 7.1.3.4 QAPP DEVIATIONS AND CORRECTIVE ACTIONS
    - 7.1.4 CALCULATIONS
  - 7.2 SUMMARY OF DEVIATIONS FROM THE APPROVED QAPP
  - 7.3 LABORATORY ACCREDITATIONS
  - 7.4 RESUMES

LIST OF APPENDICES

- APPENDIX A STACK SAMPLING REPORT
- APPENDIX B FEEDSTREAM SAMPLING REPORT
- APPENDIX C SPIKING REPORT
- APPENDIX D ANALYTICAL DATA
- APPENDIX E-1 CEMS PERFORMANCE EVALUATION REPORT
- APPENDIX E-2 CMS PERFORMANCE EVALUATION REPORT
- APPENDIX F EXAMPLE CALCULATIONS
- APPENDIX G PROCESS OPERATING DATA
- APPENDIX H FIELD LOGS
- APPENDIX I ALTERNATIVE MONITORING, METHOD MODIFICATIONS, AND WAIVER APPROVALS