Sampling and Analysis Plan
for the
Pueblo Chemical Agent-Destruction Pilot Plant
Explosive Destruction System Emissions Test

Revision 5
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Table of Contents

ACRONYMS, ABBREVIATIONS, AND SYMBOLS viii

1.0 INTRODUCTION 1

2.0 PROJECT/TASK ORGANIZATION 3

3.0 DATA QUALITY OBJECTIVE OUTLINE 6

4.0 PROJECT/TASK DESCRIPTION 9
- 4.1 Field Sampling 9
- 4.2 Modification of Sampling Procedures 11
- 4.3 Laboratory Analyses 12
- 4.4 List of Analytes 12
  - 4.4.1 Metals. 13
  - 4.4.2 Semivolatile Organic Compounds (SVOCs 13
  - 4.4.3 Volatile Organic Compounds (VOCs). 13
  - 4.4.4 Dioxins and Furans 13
  - 4.4.5 Miscellaneous Analytes 13
- 4.6 Data Validation 13
- 4.7 Data Reduction 14
- 4.8 Report Preparation 14

5.0 QUALITY ASSURANCE AND QUALITY CONTROL OBJECTIVES 20
- 5.1 Precision 20
- 5.2 Accuracy 22
- 5.3 Representativeness 22
- 5.4 Completeness 23
- 5.5 Comparability 23

6.0 Training Requirements/Certifications 30

7.0 Documentation and Records 32
- 7.1 Document Control 32
- 7.2 Instructions, Procedures, and Drawings 32
- 7.3 Records 33

8.0 Sampling Process Design 35
- 8.1 Schedule 35
- 8.2 Rationale for Experimental Design 36
- 8.3 Design Assumptions 36
- 8.4 Procedures for Locating and Selecting Environmental Samples 36
- 8.5 Classification of Measurements as Critical or Noncritical 36
- 8.6 Background Sampling and Analysis 36

9.0 Sampling Methods Requirements 40
- 9.1 Field Program Description 40
- 9.2 Presampling Activities 40
  - 9.2.1 Equipment Calibration 40
  - 9.2.2 Glassware Preparation 41
  - 9.2.3 Sample Media Preparation 41
  - 9.2.4 Other Presampling Activities 41
- 9.3 Sampling Locations 42
  - 9.3.1 AFS Inlet Gas Sampling Locations 42
  - 9.3.2 AFS Outlet Exhaust Gas Sampling Locations (Stack) 42

9.4 Sampling Methods ... 43
9.4.1 EPA Methods 1 and 2 for Velocity Measurements and Cyclonic Flow ... 43
9.4.2 EPA Method 3A for Oxygen and Carbon Dioxide ... 44
9.4.3 EPA Method 6C for Sulfur Dioxide ... 44
9.4.4 EPA Method 7E for Nitrogen Oxides Emissions ... 45
9.4.5 TO-10A/Method 23 for Dioxins/Furans ... 45
9.4.6 TO-10A/Method 0010 for Semivolatile Organic Compounds ... 46
9.4.7 TO-15 for Volatile Organic Compounds, CH_4 and C_2H_6 ... 47
9.4.8 Conditional Test Method 027 (CTM-027) for NH3 ... 47
9.4.9 Modified EPA Method 29 for Metals ... 48
9.4.10 Method 30B for Total Gas Phase Mercury ... 49
9.4.11 EPA OTM-29 for HCN ... 50
9.4.12 OSHA PV2111 for MEA ... 51
9.4.13 Sample Holding Times ... 52

10.0 Sample Chain-of-Custody ... 57
10.1 Sample Labeling ... 57
10.2 Integrity Seals ... 58
10.3 Field Logbook ... 58
10.4 Chain-of-Custody Forms ... 59
10.4.1 Chain-of-Custody Procedures ... 59
10.5 Shipping and Packing of Samples ... 61
10.6 Laboratory Operations ... 62

11.0 Analytical Methods Requirements ... 65
11.1 Analytical Laboratory ... 65
11.2 Analytical Procedures ... 65
11.3 Target Analyte List ... 65

12.0 Quality Control Requirements ... 71
12.1 Data Collection and Sampling Quality Control Procedures ... 71
12.1.1 Sampling Equipment Quality Control Checks and Frequency ... 71
12.1.2 Sample Collection Quality Control Checks ... 72
12.2 Analytical Quality Control Procedures for Samples to be Analyzed in the Laboratory ... 72
12.2.1 Quality Control Samples and Blanks ... 72
12.2.2 Quality Control of Sorbents ... 73

13.0 Instrument Calibration and Frequency ... 75
13.1 General Equipment and Instrument Requirements ... 75
13.1.1 Calibration Records ... 75
13.1.2 Balances, Thermometers ... 75
13.1.3 General Requirement for Standards ... 76
13.1.4 Calibration of Laboratory Measurement Systems ... 76
13.1.5 Instrument/Equipment Maintenance ... 77
13.2 Specific TRC Equipment and Instrument Requirements ... 78
13.2.1 Process Monitoring Equipment ... 78
13.2.2 Exhaust Duct Sampling Equipment ... 78
13.2.3 General Temporary Reference Method CEMS ... 79
13.2.4 Temporary Reference Method CEMS for Nitrogen Oxides, Sulfur Dioxide, Carbon Monoxide, Oxygen, and Carbon Dioxide ... 79

14.0 Procurement of Items and Services ... 86

15.0 Data Management ... 87

16.0 Corrective Actions and Assessment ... 88
16.1 Audit Procedures ... 88
16.2 Corrective Action for Minor System Events ... 88
16.3 Corrective Action for Major System Events ... 88
16.4 Corrective Action for Laboratory Nonconformance ... 90
16.5 Corrective Action Arising from Review of Test, Quality Control, or Audit Sample Data ... 90
16.6 Quality Assurance Reporting ... 91

17.0 Reports to Management ... 93

18.0 Data Reduction, Reporting, Verification, and Validation ... 94
18.1 Data Reporting ... 94
18.1.1 Analytical Data Packages ... 94
18.1.2 Certificates of Analysis ... 95
18.1.3 Analytical Data Results ... 95
18.1.4 Report Preparation ... 96
18.2 Data Review ... 96
18.3 Field Data Reduction ... 97
18.3.1 Analytical Data Summary ... 97
18.3.2 Quality Control Data Summary ... 98
18.4 Data Validation ... 98

19.0 Software and Database Control ... 103

20.0 Reporting ... 104
20.1 Mass Emission Rate Determination - EDS Emissions Sampling and Analysis Report ... 104
20.1.1 Volatile Organics (Example Calculation) ... 105
20.1.2 Semivolatile Organics (Example Calculation) ... 106
20.1.3 Trace Metals (Example Calculation) ... 106
20.1.4 Ammonia (Example Calculation) ... 107
20.1.5 Hydrogen Cyanide (Example Calculation) ... 107
20.1.6 MEA (Example Calculation) ... 107
20.1.7 Oxides of Nitrogen (Example Calculation) ... 108
20.2 Program Reports ... 108
20.2.1 Reporting of Non-Detects ... 109
20.2.2 EDS Sampling and Analysis Reports ... 109
20.2.3 Final Report ... 110

List of Tables

Table 1-1. Crosswalk Between this SAP and EPA/R-5 2
Table 4-1. Sample and Analytical Summary for EDS Emissions Sampling and Analysis 15
Table 4-2. Metals for the PCAPP EDS Emissions Analyte List 16
Table 4-3. SVOCs for the PCAPP EDS Emissions Analyte List 17
Table 4-4. VOCs for the PCAPP EDS Emissions Analyte List 18
Table 5-1. Summary of Target Data Quality Objectives for Precision, Accuracy, and Frequency[a] 25
Table 5-3. Semivolatile Surrogate Compounds with Target Recovery Criteria for SW-846 Method 8270C 26
Table 5-4. Semivolatile LCS/D Compounds with Target Recovery Criteria for SW-846 Method 8270C 27
Table 5-5. Semivolatile and Dioxin/Furan Sampling Surrogate Spike Compounds with Target Recoveries for SW-846 Mod. Methods 0010 and 0023A 27
Table 5-6. Volatile Surrogate Compounds with Target Recovery Criteria 27
Table 5-7. Volatile LCS/D Compounds with Target Recovery Criteria for TO-15 28
Table 5-8. Dioxin/Furan Isotope Dilution Internal Standard Spike Compounds with Target Recoveries for SW-846 Method 8290 29
Table 5-9. Dioxin/Furan LCS/D Compounds with Target Recoveries for SW-846 Method 8290 29
Table 8-1. Anticipated Test Schedule for the PCAPP EDS Emissions Sampling and Analysis Program 39
Table 8-2. Anticipated Daily Sampling Activity Schedule [a] 39
Table 9-1. Presentation of Port Placement Measurements 53
Table 9-2. AFS Gas Stream Analyses, Locations, and Frequency 53
Table 9-3. Requirements for Containers, Preservation, and Holding Times 54
Table 11-1. Summary of Exhaust Gas Analytical Methods and Procedures 67
Table 11-2. PCAPP EDS Emissions Sampling and Analysis Project Target Analyte List, ... 68
Table 11-2. PCAPP EDS Emissions Sampling and Analysis Project Target Analyte List, ... 69
Table 11-2. PCAPP EDS Emissions Sampling and Analysis Project Target Analyte List, ... 70
Table 12-1. Summary of the Field Quality Control Requirements for the PCAPP EDS Emission Sampling and Analysis Project 74
Table 13-1. Calibration Procedures for Analytical Methods 84
Table 13-2. Activity Matrix for Calibration of Sampling Equipment 85
Table 18-1. Offsite Laboratory Report Constituents 100
Table 18-2. Data Validation Criteria[a] 101
Table 20-1. Estimated Reporting Limit-Based Emission Values 113
Table 20-2. Determination of EDS Emission Rates 116

List of Figures

Figure 2-1. PCAPP EDS Emissions Sampling and Analysis Project Organization..... 5
Figure 9-1. Schematic of Air Filtration Systems with Inlet and Outlet Sampling Locations 55
Figure 9-2. Schematic of Air Filtration System A Showing Inlet and Outlet Sampling Locations..... 56
Figure 10-1. Example Sample Label 63
Figure 10-2. Example Custody Seal 63
Figure 10-3. Example Chain-of-Custody Form..... 64
Figure 16-1. Example Nonconformance Report..... 92
Figure 20-1. Example Dioxins and Furans Emissions Summary 111
Figure 20-2. Example Metals Emissions Summary 112

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

%	Percent
±	Plus/Minus
<	Less Than
≤	Less Than Or Equal To
>	Greater Than
≥	Greater Than Or Equal To
®	Registered Trademark
°C	Degrees Celsius
°F	Degrees Fahrenheit
AAS	Atomic Absorption Spectroscopy
AFS	Air Filtration System
Ag	Silver
Al	Aluminum
As	Arsenic
Ba	Barium
Be	Beryllium
B	Boron
CCV	Continuing Calibration Verification
Cd	Cadmium
CEMs	Continuous Emissions Monitoring System
CH_4	Methane
C_2H_2	Acetylene
C_2H_6	Ethane
CO	Carbon Monoxide
Co	Cobalt
CO_2	Carbon Dioxide
COC	Chain-Of-Custody
COPC	Chemical of Potential Concern
Cr	Chromium
CTM	Conditional Test Method
Cu	Copper
EDS	Explosive Destruction System
EPA	U.S. Environmental Protection Agency
FID	Flame Ionizing Detector
GC	Gas Chromatograph
GC/MS	Gas Chromatography/Mass Spectrometry
HCN	Hydrogen Cyanide
HEPA	High Efficiency Particulate Air
Hg	Mercury
HNO_3	Nitric Acid
H_2O_2	Hydrogen Peroxide
IC	Ion Chromatography
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
NaOH	Sodium Hydroxide
LPM	Liters per Minute
M	Molar
MDL	Method Detection Limit

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

MEA	Monoethanolamine
mLs	Milliliters
MM	Modified Method
Mn	Manganese
N	Normal
Ni	Nickel
NH_3	Ammonia
NITC	1-Naphthylisothiocyanate
NIST	National Institute of Standards and Technology
NO_x	Oxides of Nitrogen
O_2	Oxygen
OSHA	Occupational Safety and Health Administration
OTM	Other Test Method
P	Phosphorus
Pb	Lead
PCAPP	Pueblo Chemical Agent-Destruction Pilot Plant
PCBs	Polychlorinated Biphenyls
PCD	Pueblo Chemical Depot
PCDD/PCDF	Polychlorinated Dibenzo-p-Dioxins/Polychlorinated Dibenzofurans
PICS	Products of Incomplete Combustion
ppm	Parts per Million
PUF/XAD	Polyurethane Foam/Amberlite XAD-2 Polymeric Resin
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
S	Sulfur
Sb	Antimony
Se	Selenium
Sn	Tin
SO_2	Sulfur Dioxide
Sr	Strontium
SVOCs	Semivolatile Organic Compounds
TCD	Thermal Conductivity Detector
TCEMS	Transportable Continuous Emissions Monitoring System
TEF	Toxicity equivalency factor
TEQ	Toxicity equivalency quantity
TIC	Tentatively identified compounds
Tl	Thallium
µg/dscm	Micrograms per Dry Standard Cubic Meter
V	Vanadium
VOCs	Volatile Organic Compounds
WB/DB	Wet Bulb/Dry Bulb
WTS	Waste Transfer Subsystem
Zinc	Zinc

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1.0 INTRODUCTION

The objective of Pueblo Chemical Agent-Destruction Pilot Plant (PCAPP) Explosive Destruction System (EDS) emissions sampling and analysis project is to collect emission samples that can be used to assess acute and chronic health risks via a Multiple Pathway Health Risk Assessment (MPHRA). This PCAPP EDS Emissions Sampling and Analysis Plan (SAP) describes the sampling and analytical design as well as the quality assurance (QA)/quality control (QC) requirements necessary for the precision, accuracy, representativeness, completeness, and comparability (PARCC) of a data set, and assures that the resulting data will be of sufficient quality for management decisions. The SAP describes the plan for emission sampling and analysis to include sampling locations, sampling and analytical methods, number of samples to be collected, analytes of interest, and how the resulting data will be reported. The SAP also describes the rationale behind the design of the sampling and analysis plan.

This SAP is written in a 20-point format. Tables and Figures referenced in a section are located at the end of each section. **Table 1-1** provides a crosswalk between this format and the requirements presented in EPA QA/R-5. **Section 3.0**, Data Quality Objective Outline, provides an outline of the EPA 7-step data quality objective (DQO) process summarizing information that is provided in greater detail in the various sections of the SAP.

Table 1-1. Crosswalk Between this SAP and EPA/R-5

SAP Outline		EPA/R-5 Section [a]	
	Title Page	A1	Title and Approval Sheet
	Table of Contents	A2	Table of Contents
1.0	Introduction	A5 A6	Problem Definition/Background Project/Task Description
2.0	Project/Task Organization	A4	Project/Task Organization
3.0	Data Quality Objective Outline	A5 A7	Problem Definition/Background Quality Objectives and Criteria for Measurement Data
4.0	Project/Task Description	A6	Project/Task Description
5.0	Quality Assurance and Quality Control Objectives	A7	Quality Objectives and Criteria for Measurement Data
6.0	Training Requirements/Certifications	A8	Special Training/ Certification
7.0	Documentation and Records	A9	Documents and Records
8.0	Sampling Process Design (Experimental Design)	B1	Sampling Process Design (Experimental Design)
9.0	Sampling Method Requirements	B2	Sampling Methods
10.0	Sample Handling and Custody	B3	Sample Handling and Custody
11.0	Analytical Methods Requirements	B4	Analytical Methods
12.0	Quality Control Requirements	B5	Quality Control
13.0	Instrument Calibration and Frequency	B6 B7	Instrument/Equipment Testing, Inspection, and Maintenance Instrument/Equipment Calibration and Frequency
14.0	Procurement of Items and Services	B8	Inspection/Acceptance of Supplies and Consumables
15.0	Data Management	B10	Data Management
16.0	Corrective Actions and Assessment	C1	Assessments and Response Actions
17.0	Reports to Management	C2	Reports to Management
18.0	Data Reduction, Reporting, Verification, and Validation	D1 D2 D3	Data Review, Verification, and Validation Verification and Validation Methods Reconciliation with User Requirements
19.0	Software and Database Control	B10	Data Management
20.0	Reporting	B10	Data Management

Note:

[a] Element A3 (Distribution List) is addressed by facility procedures concerning the distribution of permit controlled documents, and Element B9 (Non Direct Measurements) is not applicable to this testing program.

2.0 PROJECT/TASK ORGANIZATION

Figure 1-1 illustrates the project organization. The PCAPP EDS is a Recovered Chemical Material Directorate (RCMD) project in support of the Joint Project Manager for Elimination (JPM-E) and the PCAPP Site Project Manager.

PCD – As owner of the Hazardous Waste Permit, PCD is responsible for ensuring and maintaining safe and environmentally compliant operations. PCD is responsible for coordinating with the Colorado Department of Public Health and Environment (CDPHE) Hazardous Materials and Waste Management Division.

PCAPP - PCAPP is a subordinate organization of Program Executive Officer (PEO) ACWA and is responsible for managing the destruction of the chemical stockpile at Pueblo Chemical Depot (PCD) including the items that will be destroyed in the PCAPP EDS. The PCAPP Site Project Manager manages the PCAPP EDS project. The PCAPP Site Project Manager also provides coordination with PCD and with Colorado Department of Public Health and Environment (CDPHE).

JPM-E - JPM-E, through an Interservice Support Agreement with PEO ACWA has been delegated responsibility for planning, executing, and completing PCAPP EDS operations. JPM-E is also a signatory to the PCAPP EDS section of the PCD Resource Conservation and Recovery Act (RCRA) permit issued by CDPHE. JPM-E provides oversight of the PCAPP EDS operations and interface with PEO ACWA.

RCMD - RCMD a subordinate organization of the Chemical Materials Agency (CMA) and through a Memorandum of Agreement with JPM-E is responsible for execution of the PCAPP EDS operation. The RCMD Site Manager manages daily operations at the PCAPP EDS site. The RCMD Site Manager is responsible for approving the SAP and will maintain a copy of the SAP as well as reports generated under the SAP at the PCAPP EDS Command Post. The RCMD Site Manager will establish coordination between the PCAPP EDS Command Post and the TRC Project Manager to ensure that the sampling team is able to turn sample trains on and off as needed to capture emissions from the neutralent, rinsate, or purge gases.

Edgewood Chemical and Biological Center (ECBC) - ECBC operates the EDS. The ECBC Operations Manager will coordinate with RCMD and other agencies to ensure that on the days when emissions measurements are being performed, EDS operations are performed in concert with the needs of the emissions sampling team.

Leidos - Leidos is the integration contractor for RCMD has assisted in planning the emissions sampling and analysis project and preparation of the SAP. Leidos will receive interim reports from TRC and will prepare the final EDS emissions sampling and analysis report. Leidos provides direction and guidance to TRC and coordinates between TRC and the other agencies during planning stages for the emissions monitoring effort.

Science and Technology Corporation (STC) – As a subcontractor with Leidos, STC provides technical expertise in support of and at the direction of Leidos.

TRC Environmental Corporation (TRC) - TRC, as a subcontractor to Leidos participated in planning for the emissions monitoring program and development the SAP. TRC will perform emissions sampling, coordinate with contract laboratories for analysis of samples, receive laboratory results, and prepare interim reports for each of the sampling events. The TRC Project QA Manager is responsible for ensuring that the performance of sampling and analysis of the PCAPP EDS emissions meets the requirements of this SAP.

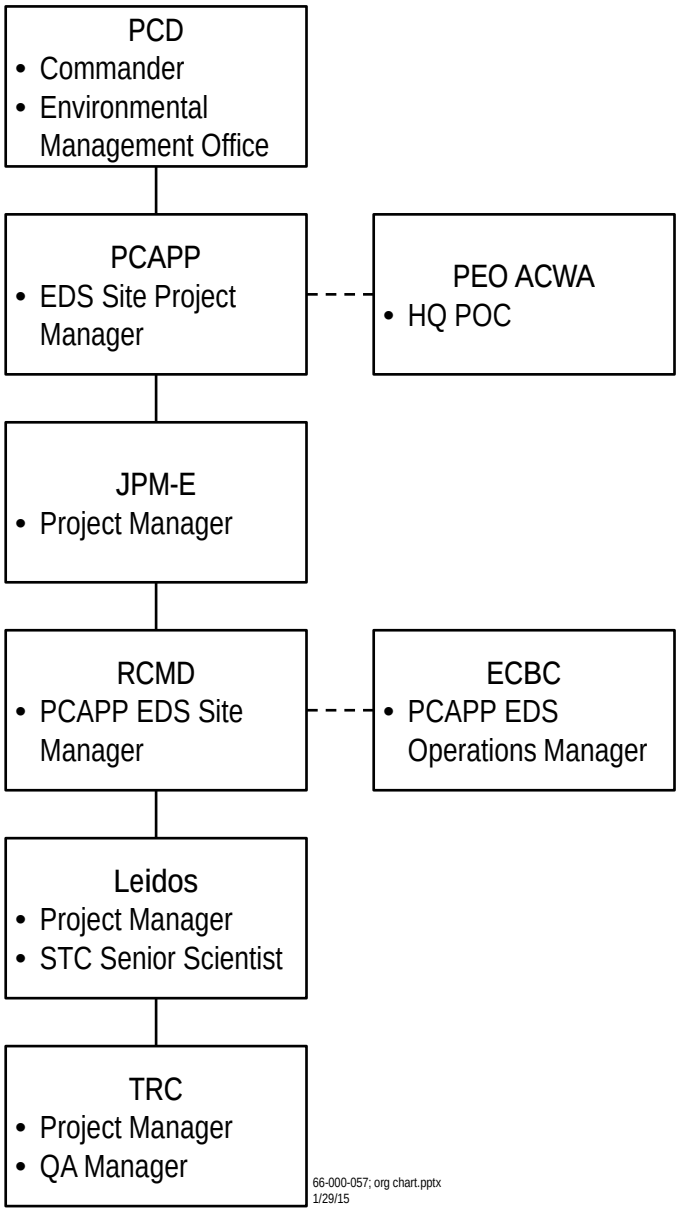

Figure 2-1. PCAPP EDS Emissions Sampling and Analysis Project Organization

3.0 DATA QUALITY OBJECTIVE OUTLINE

The following outline is based on the DQO process as described in the Environmental Protection Agency (EPA), Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4, EPA/240/B-06/001, 2006.

EPA Step 1. State the Problem (see Section 1.0):

i. Primary goal of this study is to collect post-carbon emissions from the EDS to assess acute and chronic exposure.

ii. The secondary goal is to collect pre-carbon emissions from the EDS to assess acute and chronic exposure independent of engineering controls. This information will be used to evaluate future operating conditions.

EPA Step 2. Identify the Decision:

i. Are the data repre sentative of maximum EDS emissions? Maximum emissions were selected versus average emissions as the EDS emissions are intermittent (4 emission events) and of short duration (total of approximately 40 minutes per day).

ii. Are the data comparable to previously provided EDS emission data so that the MPHRA decision maker will be able to determine if the MPHRA needs to be rerun based solely on a changed in EDS emission input values? Previous MPHRA determinations indicated that EDS emissions did not pose any risks that exceeded state/federal guidelines. Therefore, by selecting the same sampling and analytical methods previously used the MPHRA decision maker will have comparable data with which to make an informed decision.

EPA Step 3. Identify the Inputs to the Decision:

i. A sampling strategy that obtains representative COPC concentrations from the EDS emissions, post-carbon.

ii. A sampling strategy that obtains representative COPC concentrations from the EDS emissions, pre-carbon.

EPA Step 4. Define the Study Boundaries:

i. Spatial boundaries for this sampling effort include EDS emissions, pre- and post-carbon. Analytes are identified in **Section 4.4.5** and **Tables 4-2, 4-3, 4-4, and 4-5**.

ii. Temporal boundaries for this sampling effort are limited to real-time emissions from four EDS shots at future date(s) to be determined.

1. 1 DOT 3A container filled with various lots of HD
2. 1 DOT 3A container filled with various lots of HT
3. 6 pack of HD filled 155mm projectiles
4. 6 pack of 4.2 inch HD filled mortars contaminated with mercury

i. The rational for using these 4 shots is provided in **Section 4.1**, Field Sampling.

EPA Step 5. Develop a Decision Rule:

i. Each class of analytes (VOC, SVOC, etc.) has laboratory reporting limits (RLs) that are specific to the analytical method. **Section 20.1** describes the application of RLs and MDLs to this SAP and **Table 20-1** shows the MDLs and RLs for each method. The RLs used are the same as those used for previous EDS emissions testing and MPHRA calculations. Because the previous emission testing results were determined to be acceptable by the MPHRA (calculated risks met state/federal guidelines) these values were selected for PCAPP EDS to ensure comparability to the previously used levels.

ii. If data validation indicates that results are within the bounds of the DQOs identified in **Section 5**, Quality Assurance and Quality Control Objectives, of the SAP then the data will be judged to be acceptable for the intended use.

EPA Step 6. Specify Tolerable Limits on Decision Error:

i. Potential sources of error are managed by employing trained/certified sampling personnel; following standard sampling methods (with modifications designed to meet the goals of the project); and using certified laboratories that follow standard analytical procedures. The modified methods used are those used in previous EDS emission sampling. The rational for the modifications to sampling methods is described in **Section 4.1** Field Sampling, and **Section 4.2**, Modification of Sampling Procedures; details of how the modification may apply to specific methods are described in **Section 8**, Sampling Process Design, and **Section 9**, Sampling Methods Requirements. The modifications used are those used previously to provide data for MPHRA use thus ensuring comparability of data.

ii. Tolerance limits for data validation are described in SAP **Tables 5-1 through 5-8**.

iii. Probability limits for false positive and false negative decision errors are not applicable to this study due to the type of decision to be made.

EPA Step 7. Optimize the Design:

i. The number of sampling events (four) was selected to provide a representative picture of EDS emissions for all the various fills and explosives that will be treated in the EDS. **Section 4.1** details the sampling events and why they were selected.

ii. Sampling design employs standard stack testing methods that have been modified in the manner described in **Section 8**, Sampling Process Design, and **Section 9**, Sampling Methods Requirements, of the SAP. The modifications introduced in **Section 4.2**, Modification of Sampling Procedures, are designed to obtain data representative of a maximum EDS emission without undo dilution by ambient air. The modifications are the same as those used in the previous EDS emission sampling with the addition of a new class of analytes, dioxins and furans. Sampling methods for dioxins and furans were selected and modified as needed so that the dioxin and furan data would be compatible with the goals of the project.

iii. Analytical design employs standard stack test analytical methods specified for emissions performance testing (See **Table 4-1** for list of methods). The laboratory methods selected are standard methods used for analyzing stack samples and other environmental samples and are designed to provide data suitable for use in a risk assessment. The methods used are the same as previously used to ensure comparability of data. **Section 11**, Analytical Methods Requirements, describes analytical requirements for this project.

iv. Data validation will determine if results are useable for the intended purpose of comparing to previous MPHRA inputs. (See **Table 18-2**, Data Validation Checklist, for a summary of data validation criteria.)

v. Data reduction and reporting methods are the same as previously used and are designed to provide data usable in an MPHRA. **Section 18**, Data Reduction, Verification, and Validation, describes how the data will be handled and **Section 20**, Reporting, describes how the data will be reported.

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4.0 PROJECT/TASK DESCRIPTION

4.1 Field Sampling

The EDS treatment process is a batch process that takes place inside a sealed reaction vessel. A single batch is often referred to as a "shot" therefore the words batch and shot will be used interchangeably when referring to the EDS process. There are two types of mustard agent to be treated at PCAPP; HT (mustard-T) which was made by the British process and HD (distilled mustard) made by distillation of sulfur mustard (HS) that had been made by the American process. The principle component of both mustard agents is bis (2 chloroethyl) sulfide, however there are differences in the minor components of the two fill materials. The mustard-filled munitions at PCD are of three sizes, 4.2-inch mortars, 105mm projectiles, and 155mm projectiles. Additionally, there are a number of DOT 3A containers filled with chemical agent (HT or HD). Aside from the chemical agent, many of the munitions contain bursters containing the explosives tetryl or tetrytol. The final consideration is that some of the HD used to fill the 4.2-inch mortars was contaminated with mercury.

In order to sample EDS emissions covering both types of chemical agent, both types of explosives, and mercury-contaminated HD, the sampling approach will be conducted during four (4) shots:

a) 1 DOT 3A container filled with various lots of HD
b) 1 DOT 3A container filled with various lots of HT
c) 6-pack of HD-filled 155mm projectiles
d) 6-pack of 4.2-inch HD-filled mortars contaminated with mercury.

The DOT 3A container filled with HD contains HD from several munitions. Therefore, it was selected to be representative of the HD fill materiel. Likewise, the DOT 3A container filled with HT contains HT from several munitions and was selected as a representative of the HT fill materiel. The third shot represents the maximum amount of HD and the maximum amount of tetrytol that will be treated in a single EDS batch. The fourth shot represents mustard agent that has been contaminated with mercury and also represents the maximum amount of tetryl that will be treated in a single EDS batch.

It is believed that the four planned sampling events will provide results that are more representative of maximum potential emissions than if samples were collected from four shots of the maximum EDS load (a 6-pack of 155mm projectiles which would only contain one type of fill and one type of explosive). The two DOT 3A containers were selected because each container is filled with mustard agent from a number of munition lots and thus represent variability that would be seen in the two types of agent, HD and HT.

The third shot represents the maximum amount of fill that will be treated by the PCAPP EDS in a single batch and also represents the maximum amount of tetrytol that will be treated in a single batch. The fourth shot was selected to represent HD that contains mercury contamination and also represents the maximum amount of tetryl that will be treated in a single batch.

Exhaust gas samples will be collected during each of four (4) treatment batches producing four (4) sample sets for analysis. A background sample set will also be collected for historical purposes and to help interpret the actual emission samples. **Table 4-1** presents a summary of the exhaust gas samples that will be collected during the emissions test. Included in the table is the listing of the sampling and analytical methods to be utilized during the program, the analytical approach, the numbers of samples to be collected at each location, as well as the blanks collected for QC purposes. The upper table lists the samples for the background and first shot sampling. The lower table lists the samples to be collected for each of the second, third, and fourth shots. Further detail on the sampling and analytical methods is presented in subsequent sections.

Collecting samples to represent the maximum hourly emission rate will provide conservative data for evaluating acute risk. Given the intermittent nature of EDS emissions this means modifying the sampling methods to focus on the brief periods when the EDS is actually producing emissions. The same is true for evaluating chronic risk because there are no routine operations performed in the EDS during EDS processing enclosure that involve release of chemicals. For example, all equipment inside the enclosure are either electric, pneumatic, or hydraulic powered; there are no internal combustion engines. Therefore, no emission sources other than the EDS vessel.

During the mobilization phase, trained and experienced engineers, scientists, and technicians will prepare, calibrate, and perform QC checks on the sampling equipment. Calibrations will be documented and kept in the project file on site. Calibration documents will be available during the course of the field sampling program. Evidence of field sampling equipment calibrations and QC checks will be available for inspection onsite during each of the 4 sampling events.

The field sampling subcontractor (TRC) will inspect, wash, and rinse all sample train glassware (**Section 9.2.2** Glassware Preparation) and inspect all pre-cleaned sample containers (**Section 10.4.1.1**, Presampling Procedures). The equipment will be packed in specially designed shipping containers for transport to the site (**Section 10.4.1.4**, Sample Shipment, and **Section 10.5**, Shipping and Packing of Samples).

4.2 Modification of Sampling Procedures

EDS emissions are produced on an intermittent basis and for only brief periods of time. Out of the entire 12-hour workday, there is only about 40 minutes when emissions are being released from the EDS vessel. Based on modeling and previous sampling and analysis data it is expected that PCAPP EDS emissions will be very small. It is the philosophy of the EDS program that when estimating risk a worst case scenario is preferable to a routine scenario. If the worst case scenario has acceptable risk, then it is not necessary to pursue risk calculations from a variety of routine (less than worst case) scenarios. Based on that philosophy and the fact that any one EDS emission event is no more than 15 minutes in duration, it means that in order to create a worst case scenario, the sampling methods would need to be modified to fit the EDS emission sequence. Therefore, in order to provide conservative results, it was decided that a maximum hourly emission rate that assumes all EDS emissions occur within a single 60-minute period would be developed. In reality, the EDS emissions occur over approximately a 3-hour period; therefore the maximum hourly emission rate represents a worst case scenario that is 4.5 times greater than would be expected given routine EDS operating conditions.

During a treatment process, the EDS releases emissions via the Waste Transfer Sub-system (WTS) on an intermittent basis; when liquid neutralent or rinsate is drained from the vessel and when the vessel is purged with inert gas. When the EDS is not being drained or purged, the valves that would allow gases to exit the EDS vessel are shut. Therefore, a systematic bias sampling methodology which includes integrated sampling for some classes of analytes was developed to produce samples that are maximally representative of EDS emissions during the times when the EDS is actually producing emissions. As stated in **Section 4.1**, Field Sampling, there are four events during the EDS treatment process when emissions are released from the EDS vessel. These four events are, for sampling purposes, divided into three time periods, a, b, and c in the following list.

a) Neutralent drain
b) Hot Rinsate drain
c) Cold Rinse drain and Inert Gas purge.

Draining of the neutralent and rinsate takes 10 to 15 minutes each. The inert gas purge takes about 10 minutes. Therefore, during a 1-day batch operation there is only about 40 minutes of emissions from the EDS. Gases from the WTS enter the inlet to the Air Filtration System (AFS) units at the same point as the building air. Therefore, there is dilution of the EDS emissions. In order to obtain the maximum possible emissions results, sampling methods have been modified to only sample during the brief periods when gases and vapors are actually exiting the WTS. Modifying the sampling methods in this way minimizes the amount of dilution of EDS emissions by ambient air which is constantly being drawn

through the AFS. The modified sampling procedure involves turning sample trains on just before the neutralent drain event begins and turning them off again when the neutralent drain is complete. Then, just before the hot rinsate is drained, the sample trains will be turned on again. After the hot rinsate is drained the trains are turned off until the cold rinsate is drained. At that time the sample trains are turned on for a third time. The inert gas purge follows immediately after the cold rinse drain therefore the sample trains will be left on from the start of the cold rinse train until the inert gas purge is complete. After the gas purge is complete, the sample trains will be turned off for the final time and the sample containers collected and prepared for shipment to the laboratory.

4.3 Laboratory Analyses

PCAPP EDS monitoring and laboratory personnel are responsible for chemical agent monitoring using MINICAMS® and Depot Area Air Monitoring Systems (DAAMS). Operation of the facility Agent Monitoring Systems and associated QA/QC are described in facility procedures and plans and are not addressed by this SAP.

TRC is responsible for operation of the Continuous Emissions Monitoring Systems (CEMS) and collection of all other emissions samples. Analyses of samples collected by TRC will be performed by TRC and the off-site non-agent laboratories.

4.4 List of Analytes

The list of analytes to be used in the current emission sampling and analysis project is based on chemicals detected in the 2012/2013 emissions sampling test with the addition of selected chemicals detected in the analysis of HD neutralent and rinsate samples.

Aside from helium and nitrogen gases which are used in the EDS process and gaseous products of the donor charge detonation, EDS emissions are derived from volatilization of compounds from the EDS neutralent and rinsate wastes. Therefore, compounds identified in the liquid neutralent and rinsate are considered as potential analytes. Some of these chemicals of potential concern (COPCs) have such a low vapor pressure at EDS operating temperatures they would not be measurable in vapor phase.

The lists of chemicals of potential concern for the PCAPP facility as identified in 2012 EDT MPHRA and in the 2014 *Laboratory Sampling and Analysis Plan (LSAP) for Pilot Test Phase Operations* (2014 LSAP) were reviewed for additional analytes.

The U.S. Environmental Protection Agency list of hazardous constituents in 40 Code of Federal Regulation (CFR) 261 Appendix VIII was reviewed to identify any chemicals not already selected for the

PCAPP EDS analyte list that were appropriate to include in the list. No chemicals in the Appendix VIII list were identified for inclusion in the PCAPP EDS emission analyte list that were not already identified by one or another of the previously mentioned sources.

4.4.1 Metals. Table 4-2 lists the metals identified in the various sources consulted and the final PCAPP EDS analyte list. The metals contained in the analyte list include the 7 metals detected in the 2012/2013 emissions test plus 7 additional metals detected in liquid neutralent or rinsate samples.

4.4.2 Semivolatile Organic Compounds (SVOCs*).* The 2012/2013 emissions test did not detect any SVOC emissions. Therefore, the source of analytes for the PCAPP EDS analyte list is the results of liquid neutralent and rinsate analyses. Many of the compounds considered in the SVOC list are solids dissolved or suspended in the MEA/water matrix or are liquids with very low vapor pressure. In either case these chemicals have a strong tendency to remain in the neutralent or rinsate and not volatilize. **Table 4-3** lists the SVOCs that are included in the PCAPP EDS analyte list.

4.4.3 Volatile Organic Compounds (VOCs). Previous EDS emission sampling and analysis detected 7 VOCs, all of which are included in the PCAPP EDS analyte list. Seventeen additional VOCs have been detected in EDS liquid waste and are included in the PCAPP EDS analyte list. **Table 4-4** lists VOCs on the PCAPP EDS emissions analyte list.

4.4.4 Dioxins and Furans. Although dioxins and furans would not be produced based on EDS operating conditions and treatment chemistry, sampling and analysis for dioxin and furan emissions are included at the request of CDPHE. The seventeen dioxin and furan compounds identified in the PCAPP LSAP were selected for inclusion in the PCAPP EDS analyte list. **Table 4-5** lists the dioxins and furans that will be analyzed.

4.4.5 Miscellaneous Analytes. A few compounds are included in the PCAPP EDS analyte list that do not fit into the previous categories: MEA, NH_3, HCN, SO_2, NO_x, and CO. These are compounds that are included in the PCAPP EDS analyte list because they are either identified in previous EDS emission sampling and analysis or as in the case of MEA are of special interest even though they were not previously detected in EDS emissions.

4.6 Data Validation

Leidos will validate each laboratory report. Data validation procedures are described in **Section 18.0**, Data Reduction, Reporting, Verification, and Validation, of this SAP.

4.7 Data Reduction

The data will be reduced within standardized spreadsheets and summarized in tables for presentation in a form that is usable as input to a MPHRA. **Figures 20-1** and **20-2** show what these tables will be look like with data examples from previous emission testing.

4.8 Report Preparation

Because it is envisioned that emission monitoring may require four separate deployments to the EDS site (one per sampling event), a interim report containing analytical results is planned for each deployment. Each interim report will contain the raw data from that sampling event along with data reduction calculations, summary tables and data validation information (see **Section 20.0**, Reporting, for details). At the conclusion of the four sampling events, a final report will be prepared and will incorporate results from all of the sampling events, provide the operating details and outline the goals, methods, and results for the emissions sampling.

The final report will include interpretation of the results as they pertain to the purpose of the sampling project. The report will undergo technical review by Leidos designated personnel and any deviations from this SAP will be highlighted. Any deviations will be documented and will include an evaluation of the perceived impact of the deviation on the emissions data. The Final report will contain any/all deviations (see **Section 20.0**, Reporting).

Table 4-1. Sample and Analytical Summary for EDS Emissions Sampling and Analysis

BACKGROUND AND INITIAL EDS SHOT

AFS Inlet & Outlet Sampling Parameters	Sampling Method(s)	Analytical Method	Analytical Procedure	Field Samples		Blank	Background	Total
				Inlets (2)	Outlets (2)			
Inlet/Outlet Gas --								
Volatile Organics	TO-15	TO-15	GC/MS	2	2	0	1	5
Semivolatile Organics	TO-10A/M0010	M 8270	GC/MS	2	2	1	1	6
PCDD/PCDFs	TO-10A/M23	M 8290	HRGC/HRMS	2	2	1	1	6
MEA	OSHA PV2111	OSHA PV2111	HPLC	2	2	1	1	6
CH4, C2H6	TO-15	Mod. ASTM D-1945	GC/TCD/FID	2	2	0	1	5
NH3	CTM-027	CTM-027	IC	2	2	1	1	6
HCN	OTM-29	OTM-29	IC	2	2	1	1	6
Trace Metals [1]	M 29	M 6020	ICP-MS	2	2	1	1	6
Hg	M 30B	M 30B	AAS	4	4	2	2	12
SO2, CO, NOx,	M 7E, 6C, 10	M 7E. 6C. 10. 3A	CEMS	-	Continuous		Continuous	
	MEA Sorbent tubes							10
	Preparation of 6L SUMMA Canister:							10
	Preparation of SUMMA Canister Flow Controller:							6
	Preparation of PUF for SVOCs:							8
	Preparation of PUF for PCDD/PCDF:							8
	Method 30B Sorbent Tubes (spiked)							8
	Method 30B Sorbent Tubes (unspiked)							10

[1] - *Trace Metals: Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, Ag, Sr, Tl, Zn*

SECOND, THIRD AND FOURTH EDS SHOTS (EACH)

AFS Inlet & Outlet Sampling Parameters	Sampling Method(s)	Analytical Method	Analytical Procedure	Field Samples		Blank		Total
				Inlets (2)	Outlets (2)			
Inlet/Outlet Gas --								
Volatile Organics	TO-15	TO-15	GC/MS	2	2	0		4
Semivolatile Organics	TO-10A/M0010	M 8270	GC/MS	2	2	1		5
PCDD/PCDFs	TO-10A/M23	M 8290	HRGC/HRMS	2	2	1		5
MEA	OSHA PV2111	OSHA PV2111	HPLC	2	2	1		5
CH4, C2H6	TO-15	Mod. ASTM D-1945	GC/TCD/FID	2	2	0		4
NH3	CTM-027	CTM-027	IC	2	2	1		5
HCN	OTM-29	OTM-29	IC	2	2	1		5
Trace Metals [1]	M-29	M 6020	ICP-MS	2	2	1		5
Hg	M-30B	M 30B	AAS	4	4	2		10
SO2, CO, NOx,	M 7E, 6C, 10	M 7E. 6C. 10. 3A	CEMS	-	Continuous			
	MEA Sorbent tubes							8
	Preparation of 6L SUMMA Canister:							8
	Preparation of SUMMA Canister Flow Controller:							6
	Preparation of PUF for SVOCs:							7
	Preparation of PUF for PCDD/PCDF:							7
	Method 30B Sorbent Tubes (spiked)							7
	Method 30B Sorbent Tubes (unspiked)							8

[1] - *Trace Metals: Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, Ag, Sr, Tl, Zn*

Table 4-2. Metals for the PCAPP EDS Emissions Analyte List

Metals Potentially Present in Vent Gas from EDS Waste Transfer Sub-system	Detected in EDS Liquid Waste	Previously Detected EDS Emission	PCAPP EDS Emission Analyte List
Aluminum (Al)		X	X
Antimony (Sb)	X		X
Arsenic (As)	X	X	X
Barium (Ba)	X		X
Beryllium (Be)			X
Cadmium (Cd)	X	X	X
Chromium (Cr)	X	X	X
Cobalt (Co)			X
Copper (Cu)	X	X	X
Lead (Pb)	X	X	X
Manganese (Mn)			X
Mercury (Hg)	X		X
Nickel (Ni)	X		X
Selenium (Se)	X		X
Silver (Ag)	X	X	X
Strontium (Sr)	X		X
Thallium (Tl)			X
Zinc (Zn)	X		X

Table 4-3. SVOCs for the PCAPP EDS Emissions Analyte List

SVOCs Potentially Present in Vent Gas from EDS Waste Transfer Sub-system	Detected in EDS Liquid Waste	Previously Detected EDS Emission	PCAPP EDS Emission Analyte List
Acenaphthylene	X		X
Anthracene	X		X
Bis(2-chloroisopropyl)ether	X		X
4-Chloroaniline	X		X
2-Chloronaphthalene	X		X
1,4-Dichlorobenzene	X		X
3,3'-Dichlorobenzidine	X		X
2,4-Dichlorophenol	X		X
Di-n-butylphthalate	X		X
2,4-Dinitrotoluene	[a]		X
1,4-Dithiane	X		X
Fluoranthene	X		X
Fluorene	X		X
Hexachloroethane	[a]		X
MEA	X		X
2-Methylnaphthalene	X		X
2-Methylphenol (o-cresol)	X		X
3&4-Methylphenol (m- and p-cresol)	X		X
N-nitrosodiphenylamine	X		X
Naphthalene	X		X
Nitrobenzene	X		X
Phenanthrene	X		X
Phenol	X		X
Pyrene	X		X
2,2-Thiodiglycol	X		X
1,4-Thioxane	X		X

Note:

[a] These compounds are included because they are of interest to PCAPP.

Table 4-4. VOCs for the PCAPP EDS Emissions Analyte List

VOCs Potentially Present in Vent Gas from EDS Waste Transfer Sub-system	Detected in EDS Liquid Waste	Previously Detected EDS Emission	PCAPP EDS Emission Analyte List
Acetone	X	X	X
Benzene	X		X
Carbon disulfide		X	X
Chlorobenzene	X		X
Chloroform	X		X
1,2-Dichlorobenzene	X		X
1,3-Dichlorobenzene	X		X
Dichlorodifluoromethane	X		X
1,2-Dichloroethane	X		X
cis-1,2-Dichloroethene	X		X
trans-1,2-Dichloroethene	X		X
1,1-Dichloroethene	X		X
Ethanol		X	X
Ethylbenzene	X		X
Methane		X	X
Methylene chloride (dichloromethane)		X	X
Methyl ethyl ketone (2-butanone)	X		X
Styrene	X		X
Tetrachloroethene	X		X
Toluene	X	X	X
1,2,4-Trichlorobenzene	X		X
Trichloroethene	X		X
Xylenes	X		X
Vinyl chloride	X	X	X

Table 4-5. PCDDs and PCDFs for the PCAPP EDS Emissions Analyte List

PCDD and PCDF Potentially Present in Vent Gas from EDS Waste Transfer Sub-system	PCAPP EDS Emission Analyte List
2,3,7,8-TCDD	X
1,2,3,7,8-PeCDD	X
1,2,3,4,7,8-HxCDD	X
1,2,3,6,7,8-HxCDD	X
1,2,3,7,8,9-HxCDD	X
1,2,3,4,6,7,8-HpCDD	X
OCDD	X
2,3,7,8-TCDF	X
1,2,3,7,8-PeCDF	X
2,3,4,7,8-PeCDF	X
1,2,3,4,7,8-HxCDF	X
1,2,3,6,7,8-HxCDF	X
1,2,3,7,8,9-HxCDF	X
2,3,4,6,7,8-HxCDF	X
1,2,3,4,6,7,8-HpCDF	X
1,2,3,4,7,8,9-HpCDF	X
OCDF	X

5.0 QUALITY ASSURANCE AND QUALITY CONTROL OBJECTIVES

The EPA has defined QA objectives for each of its reference sampling methodologies. These objectives are extensively detailed in the *Quality Assurance Handbook for Air Pollution Measurement System, Volume III, Stationary Source Specific Methods*, EPA 600/4-77-027b. These criteria generally establish calibration procedures and equipment acceptance criteria. Additionally, there are specific QA objectives for accuracy and precision of the sample preparation and analysis procedures (see **Section 11.0**, Analytical Methods Requirements, of this SAP) that will be used in the laboratories.

Laboratory QC samples will be used to check the precision and accuracy of the measurement system in the laboratory. Laboratory QC samples will include calibration blanks, matrix blanks, method (or reagent) blanks, laboratory duplicates, QC check samples, and surrogates, as applicable. Laboratory QC samples are described further in **Section 12.0**, Quality Control Requirements, of this SAP. **Table 5-1** displays the target accuracy and precision objectives that have been defined for the analyses to be performed during the PCAPP EDS emission sampling and analysis project.

If the data validation process determines that any of the DQO limits are exceeded an assessment will be made of the effect the deviation has on the usability of the data along with any recommended action that may be appropriate. This information will all be contained in the interim and final reports (**Section 20.0** Reporting).

5.1 Precision

In general, there are no EPA-approved procedures that allow an isolated determination of exhaust gas sampling precision to be made for the methods to be employed. The following characteristics of sampling design contribute to precision

a. Methods selected are standard methods used for analyzing stack samples specific for the target analytes. Required Reporting Limits (RLs) are standard, current RLs provided by the laboratories for the specific methods.
b. **Section 4.4** explains how the list of analytes was developed using input from previous sampling and analysis as well as consultation of standardized lists of potential analytes.
c. **Sections 8 through 20** describe the gathering, handling, processing of samples and results to ensure that usable data are obtained.
d. The 4 shots selected for sampling represent the spectrum of chemical fills and burster explosives present in the PCD munitions. Rather than measurements for 4 shots of a

single presumed worst case condition (e.g. maximum sized batch of the largest munition), measurement swere made for each class of muntion that will be processed. Results from the 4 shots will be examined to determine a maximum value is obtained.

Duplicate exhaust gas samples will not be collected for most trains. However in EPA Method 30B for mercury, which is being conducted at each of the four sampling locations, paired sorbent tubes are utilized to determine measurement precision and verify acceptability of the measured emissions data. The relative deviation (RD) of the tube pair results will be used to assess precision in the following equation:

$$RD = \left| \frac{Value\ 1 - Value\ 2}{Value\ 1 + Value\ 2} \right| x\ 100$$

Analytical precision for a single analyte is expressed as the relative percent difference (RPD) as percentage, which is calculated as follows:

$$RPD = \left| \frac{Value\ 1 - Value\ 2}{Arithmetic\ Mean\ of\ Values\ 1\ and\ 2} \right| x\ 100$$

Precision will be determined through the use of duplicates, laboratory control samples, laboratory control sample duplicates, matrix spikes, and matrix spike duplicates, as applicable, for the analytical work performed as shown in **Table 5-1** of this SAP.

Tables 5-3, 5-6, 5-7, and **5-8** show the spiking compounds and recovery limits that will be employed for analysis by SW-846 Methods 8270C, 8260B, and 8290, respectively. The target precision estimates presented in **Table 5-1** display acceptable target variability levels for replicate measurements of the same parameters and are expressed in terms of RPD for duplicate samples. Precision data will be calculated and presented in the interim and final reports.

If the data validation process determines that any of the DQO limits are exceeded an assessment will be made of the effect the deviation has on the usability of the data along with any recommended action that may be appropriate. This information will all be contained in the interim and final reports (**Section 20.0** Reporting).

5.2 Accuracy

Field instruments and equipment will be calibrated, as needed, to ensure accuracy of the measurement of field parameters. Field and reagent blanks will be used to verify the sample collection and handling process has not affected the quality of the samples. Reagents to be used during the emissions testing will meet or exceed quality specifications presented in the reference method. Reagent blanks will be used to measure the cleanliness of the reagents used in each sampling train and during recovery operations. Reagent blanks will be prepared by collecting aliquots of the reagents used in the field into appropriate containers. Blanks that exhibit contamination in excess of the standard reporting limits (RL) may result in corrective action. The nature of the corrective action will be assessed on an individual basis. Trip blanks (see **Table 4-1**) will be used to identify contamination present in the sample media/glassware.

Accuracy values presented in **Table 5-1** represent components of both random error and bias, which are expressed as percent recovery of a "known" concentration of analyte spike, internal standard spike, standard reference material analysis, or audit sample analysis. Where direct analyses of a known standard material can be evaluated, accuracy may be assessed by analysis of a sample of the reference standard. In cases in which the matrix or sample preparation is to be evaluated for effects on accuracy, matrix spikes will be evaluated in the samples. In some cases, a combination of these accuracy evaluation procedures will be used. The accuracy of organic determinations by gas chromatography/mass spectrometry (GC/MS) analysis will include spiking each sample with surrogate compounds and laboratory spiking compounds. **Tables 5-2 through 5-8** show the surrogate and spiking compounds and recovery limits that will be employed for analysis by SW-846 Methods 8270C, 8260B, and 8290. Accuracy data will be presented in each interim and final report. Percent recovery is calculated as follows:

$$Percent\ Recovery = \frac{Spiked\ Sample\ Result - Unspiked\ Sample\ Result}{True\ Value_{spike}}\ x\ 100$$

If the data validation process determines that any of the DQO limits are exceeded an assessment will be made of the effect the deviation has on the usability of the data along with any recommended action that may be appropriate. This information will all be contained in the interim and final reports (**Section 20.0** Reporting).

5.3 Representativeness

Representativeness is a qualitative objective achieved through sampling program design. **Section 4.1**, Field Sampling, and **Section 4.2**, Modification of Sampling Procedures, describes how sampling design is

believed to provide for representative samples. By ensuring the sampling locations are selected properly and that standard protocols are used, the resulting data will represent the chemical conditions existing at the site at the time of sample collection.

5.4 Completeness

The completeness objective for this SAP will be to obtain acceptable results for all parameters, as described in this plan, for each shot. Samples resulting from test runs that are judged to be invalid on the basis of aborted test runs will not be analyzed. With regard to the objective of obtaining valid test runs, the impact of any sample losses will be assessed in each interim and final report.

Completeness of the data will be calculated by dividing the number of valid measurements obtained by the number of measurements planned. The data quality objective for completeness is 90 percent, i.e., to obtain acceptable results for each test run. Samples resulting from test runs that are judged to be invalid based on field indicators (aborted test runs) will not be submitted to the laboratory for analysis and are not considered to be a part of the laboratory completeness objective. The impact of any occurrence of sample loss will be assessed against the objective of obtaining valid test runs and will be discussed in each interim and final report. Completeness is calculated as follows:

$$C = 100 \, x \, \frac{V}{T}$$

where:

C = percent completeness

V = number of measurements judged valid

T = total number of measurements

If the data validation process determines that any of the DQO limits are exceeded an assessment will be made of the effect the deviation has on the usability of the data along with any recommended action that may be appropriate. This information will all be contained in the final report (**Section 20.0** Reporting).

5.5 Comparability

Comparability will be obtained by the use of standardized methodology (e.g., approved EPA sample collection procedures) to collect samples and the generation of data in common units. Comparability of the data set will be achieved by using the standard techniques described in this SAP to collect and analyze representative samples and by reporting analytical results in appropriate units (see **Section 4**, Project/Task

Description plus **Sections 8 through 20** for details). If sampling and analysis is performed in accordance with this SAP then the samples will be deemed comparable. Any deviations from the SAP will be evaluated to assess the effect on comparability and that discussion will be presented in the final report..

Table 5-1. Summary of Target Data Quality Objectives for Precision, Accuracy, and Frequency[a]

Parameter	QC Type	Precision	Accuracy (% Recovery)	Frequency
Exhaust Gas Samples				
HCN	LCS		80 – 120%	1 per analytical batch
	Laboratory Duplicate	≤ 20% RPD		1 per analytical batch
	Initial Calibration Verification Check		90 – 110%	1 per analytical sequence
Dioxins/furans	LCS/D	≤ 35% RPD	See Tables 5-8 and 5-9	1 per analytical batch
	Internal standard	N/A	See Table 5-7	Every sample
	Sampling surrogate spike	N/A	See Table 5-4	Every resin trap
Metals except Hg	LCS/D	≤ 25% RPD, as applicable	75% to 125%	1 per analytical batch
	MS/MSD	≤ 25% RPD	75% to 125%	1 per analytical batch
Semivolatile organics	LCS/D	≤ 35% RPD	See Table 5-3	1 per analytical batch
	Internal standard	N/A	See Table 5-2	Every sample
	Sampling surrogate spike	N/A	See Table 5-2	Every resin trap
Ammonia	LCS		80 – 120%	1 per analytical batch
	Laboratory Duplicate	≤ 20% RPD		1 per analytical batch
	Initial Calibration Verification Check		90 – 110%	1 per analytical sequence
MEA	LCS		75 – 125%	1 per analytical batch
	Initial Calibration Verification Check		90 – 110%	1 per analytical sequence
Volatile organics	LCS/D	≤ 25% RPD	See Table 5-6	1 per analytical batch
	Surrogate spike	N/A	See Table 5-5	Every sample
Methane, Ethane	LCS/D	≤ 25% RPD		1 per analytical batch
	Lab duplicate	≤ 25% RPD		1 per analytical batch

Table 5-2. Summary of Target Data Quality Objectives for Precision, Accuracy, and Frequency[a] (Continued)

Parameter	QC Type	Precision	Accuracy (% Recovery)	Frequency
Hg	Field recovery spike		85 – 115%	1 tube per location per run
	Paired tube agreement	≤ 20% RD, or ≤0.2 µg/dscm absolute difference for HG concentrations ≥1 µg/dscm		Per location per run
	Initial Calibration Verification Check		90 – 110%	1 per analytical sequence
	Breakthrough	≤ 50% of section 1 mass for Hg conc. ≤0.5 ug/dscm >0.1ug/dscm, no criteria for concentration ≤0.1 ug/dscm		

Note:

[a] If precision, accuracy, or frequency objectives are not met then an evaluation of the impact that has on the data will be described in the final report along with any recommendations that might be appropriate.

Table 5-3. Semivolatile Surrogate Compounds with Target Recovery Criteria for SW-846 Method 8270C

Compound	Target Air-Train Surrogate Standard Spike Recoveries (percent)
Nitrobenzene-d_5	46 to 118
2-Fluorobiphenyl	58 to 105
Terphenyl-d_{14}	69 to 110
Phenol-d_5	43 to 122
2-Fluorophenol	41 to 105
2,4,6-Tribromophenol	61 to 118
1,2-Dichlorobenzene-d_4 [a]	57 to 106

Note:

[a] As this surrogate is field spiked, there is no corrective action required by the laboratory.

Table 5-4. Semivolatile LCS/D Compounds with Target Recovery Criteria for SW-846 Method 8270C

Compound	Air-Train Blank Spike Recoveries (percent)
Acenaphthylene	66 to 106
Anthracene	66 to 106
bis (2-chloroisopropyl) ether	48 to 116
2-Chloronaphthalene	65 to 105
Di-n-butyl phthalate	66 to 115
1,4-Dichlorobenzene	57 to 102
2,4-Dichlorophenol	65 to 107
Fluoranthene	67 to 111
Fluorene	66 to 107
2-Methylnaphthalene	63 to 103
2-Methylphenol	60 to 105
3-Methylphenol & 4-Methylphenol	10 to 230
Naphthalene	59 to 99
Nitrobenzene	62 to 103
N-Nitrosodiphenylamine	66 to 107
Phenanthrene	69 to 109
Phenol	42 to 125
Pyrene	71 to 111

Table 5-5. Semivolatile and Dioxin/Furan Sampling Surrogate Spike Compounds with Target Recoveries for SW-846 Mod. Methods 0010 and 0023A

Compound	Target Recovery (percent)
Semivolatile Sampling Surrogate Compound	
1,2-Dichlorobenzene-d_4	57 to 106
Dioxin/Furan Sampling Surrogate Compounds	
$^{37}Cl_4$-2,3,7,8-Tetrachlorodibenzodioxin	70 to 130
$^{13}C_{12}$-1,2,3,4,7,8-Hexachlorodibenzodioxin	70 to 130
$^{13}C_{12}$-2,3,4,7,8-Pentachlorodibenzofuran	70 to 130
$^{13}C_{12}$-1,2,3,4,7,8-Hexachlorodibenzofuran	70 to 130
$^{13}C_{12}$-1,2,3,4,7,8,9-Heptachlorodibenzofuran	70 to 130

Table 5-6. Volatile Surrogate Compounds with Target Recovery Criteria for TO-15

Compound	Recoveries (percent)
Toluene-d_8	70 to 130
4-Bromofluorobenzene	70 to 130
1,2-Dichloroethane-d_4	70 to 130

Table 5-7. Volatile LCS/D Compounds with Target Recovery Criteria for TO-15

Compound	Recoveries (percent)
1,1-Dichloroethene	70 to 130
1,1,2,2-Tetrachloroethane	70 to 130
1,1-Dichloroethane	70 to 130
1,1-Dichloroethene	70 to 130
1,2,4-Trichlorobenzene	70 to 130
1,2,4-Trimethylbenzene	70 to 130
1,2-Dichlorobenzene	70 to 130
1,3-Dichlorobenzene	70 to 130
Benzene	70 to 130
Chlorobenzene	70 to 130
Chloroform	70 to 130
cis-1,2-Dichloroethene	70 to 130
Dichloromethane (Methylene Chloride)	70 to 130
Ethylbenzene	70 to 130
Freon 12 (Dichlorodifluoromethane)	70 to 130
m,p-Xylene	70 to 130
o-Xylene	70 to 130
Styrene	70 to 130
Tetrachloroethene	70 to 130
Toluene	70 to 130
Trichloroethene	70 to 130
Vinyl Chloride	70 to 130
2-Butanone (Methyl Ethyl Ketone)	70 to 130
Acetone	70 to 130
Carbon Disulfide	70 to 130
Ethanol	70 to 130
Methyl t-Butyl Ether (MTBE)	70 to 130
trans-1,2-Dichloroethene	70 to 130

Table 5-8. Dioxin/Furan Isotope Dilution Internal Standard Spike Compounds with Target Recoveries for SW-846 Method 8290

Compound	Target Recoveries (percent)
Dioxin/Furan Internal Standards	
$^{13}C_{12}$-2,3,7,8-Tetrachlorodibenzodioxin	40 to 130
$^{13}C_{12}$-2,3,7,8-Tetrachlorodibenzofuran	40 to 130
$^{13}C_{12}$-1,2,3,7,8-Pentachlorodibenzodioxin	40 to 130
$^{13}C_{12}$-1,2,3,7,8-Pentachlorodibenzofuran	40 to 130
$^{13}C_{12}$-1,2,3,6,7,8-Hexachlorodibenzodioxin	40 to 130
$^{13}C_{12}$-1,2,3,6,7,8-Hexachlorodibenzofuran	40 to 130
$^{13}C_{12}$-1,2,3,4,6,7,8-Heptachlorodibenzodioxin	25 to 130
$^{13}C_{12}$-1,2,3,4,6,7,8-Heptachlorodibenzofuran	25 to 130
$^{13}C_{12}$-Octachlorodibenzodioxin	25 to 130

Table 5-9. Dioxin/Furan LCS/D Compounds with Target Recoveries for SW-846 Method 8290

Compound	Target Recovery (percent)
2,3,7,8-Tetrachlorodibenzodioxin	68 to 129
1,2,3,7,8-Pentachlorodibenzodioxin	78 to 123
1,2,3,4,7,8-Hexachlorodibenzodioxin	77 to 130
1,2,3,6,7,8-Hexachlorodibenzodioxin	83 to 132
1,2,3,7,8,9-Hexachlorodibenzodioxin	83 to 146
1,2,3,4,6,7,8-Heptachlorodibenzodioxin	72 to 129
Octachlorodibenzodioxin	63 to 135
2,3,7,8-Tetrachlorodibenzofuran	80 to 127
1,2,3,7,8-Pentachlorodibenzofuran	84 to 124
2,3,4,7,8-Pentachlorodibenzofuran	75 to 120
1,2,3,4,7,8-Hexachlorodibenzofuran	80 to 129
1,2,3,6,7,8-Hexachlorodibenzofuran	87 to 134
2,3,4,6,7,8-Hexachlorodibenzofuran	67 to 165
1,2,3,7,8,9-Hexachlorodibenzofuran	64 to 167
1,2,3,4,6,7,8-Heptachlorodibenzofuran	75 to 129
1,2,3,4,7,8,9-Heptachlorodibenzofuran	71 to 130
Octachlorodibenzofuran	59 to 137

Notes:

LCS/D laboratory control sample duplicate

6.0 Training Requirements/Certifications

Work performed at the PCAPP will require site-specific training per the policies of PCAPP and Leidos. This will include training on issues of security and evacuation routes.

Field sampling personnel performing exhaust gas sample collections must be familiar with the equipment and methods being employed. TRC Environmental Corporation is an Air Emission Testing Body as defined by ASTM D-7036. For each field test program, qualified individuals (QI, as defined in ASTM D7036-12) will be onsite during the test program to oversee and supervise the implementation of the test methods for which the individual is qualified. The following is exerpted from TRC's Standard Operating Procedure AM-ADM-003.

Qualified Individual

Position requirements include:

- Have participated in at least 10 tests that employ the method for which they are qualified or have completed at least 1 year of general air testing experience including (where applicable):
    1. Instrument calibration.
    2. Equipment prep.
    3. Field set-up.
    4. Equipment operation and data recording.
    5. Sample recovery, handling and custody.
    6. Sample analysis.
    7. Data reduction and relevant calculations.
    8. Quality control.
    9. Reporting.
- Have completed a qualification exam, either internal or external, that meets the requirements of ASTM D7036-1.

Field Team Leader

Position requirements include:

- Classification as a Category 5 or higher.
- Two years of experience filling similar project roles.
- Two years experience functioning as a Field Scientist/Engineer/Analyst.

- Knowledge of standard word processing and spreadsheet software packages.

Field Scientist/Engineer/Analyst

Position requirements include:

- Classification as a Category 8 or higher.
- Scientist/Analyst: Minimum of a high school diploma (or equivalent) and a minimum of one year experience participating in air and emission field test programs. BS in Science or Engineering (or 4 years of equivalent education in a related field) is preferred.
- Engineer: BS in Engineering.
- Working knowledge of EPA's 450 Course content for stack sampling or EPA's 460 Course content for ambient monitoring.

Field Assistant / Technician

Position requirements include:

- Classification as a Category 10 or higher.
- Minimum of a high school diploma, or equivalent.
- Self study of stack sampling and monitoring manuals during first month of employment.
- Calibration and equipment set up/operation demonstration during first two months of employment.

Field sampling personnel performing exhaust gas sample collections must be familiar with the equipment and methods being employed.

Data validators are responsible for performing data validation and associated reporting. Data validators must have a minimum of a bachelor's degree in any physical or life science, plus six months experience performing data review and validation.

Report writers will have a bachelor's degree or an equivalent combination of education, training, and experience.

7.0 Documentation and Records

Leidos, TRC, and each laboratory will establish and implement a system for timely preparation, review, approval, issuance, use, control, revision, and maintenance of documents that prescribe work activities and specify requirements. Additionally, a system will be documented and implemented for identifying, preparing, approving, transmitting, correcting, distributing, retaining, retrieving, and disposing of records. These systems are generally documented in procedures developed by the responsible organization and are not specific to the PCAPP EDS Emissions Test program. The organization developing the system is responsible for documenting, reviewing, and approving of the system, as applicable (e.g., TRC is responsible for developing, documenting, reviewing, and approving only those procedures for which it is responsible). Systems and procedures of sub-tier organizations are subject to audit and review by higher-tier organizations (e.g., Leidos may audit and review a laboratory facility and procedures at any time).

7.1 Document Control

Document control will include measures by which documentation can be controlled, tracked, and updated in a timely manner to ensure applicability and correctness. Control measures will be used to ensure documents are reviewed for adequacy, approved for release by authorized personnel, and distributed to Leidos, the PCAPP Field Office, and the regulatory authorities. For this PCAPP EDS Emissions Test, the final report (see **Section 20.0**, Reporting) will be the means by which the relevant documentation will be transmitted to the regulatory authorities.

Revised documents will be reviewed and approved by the appropriate organizations that participated in the original review and approval, unless designated otherwise. The nature of the change(s) will be identified within the document or in appropriate attachments.

Obsolete or superseded documents will be identified and measures taken to promptly remove or otherwise control these documents to prevent their inadvertent use.

7.2 Instructions, Procedures, and Drawings

Activities will be described by documented instructions, procedures, or drawings that include quantitative or qualitative acceptance criteria, as appropriate, that can be used to determine whether activities are satisfactorily accomplished.

Instructions, procedures, and drawings will be reviewed and approved by appropriately qualified individuals. Revisions to instructions, procedures, and drawings that affect the process or are technical

will receive the same level of review and approval as the original document. Editorial changes may be made to these documents without review and approval.

Procedures should address the following activities, as applicable:

- Environmental, health, and safety
- Sampling
- Assessment
- Sample shipping and receipt
- Sample chain-of-custody
- Sample storage
- Sample preparation
- Sample analysis
- Standard preparation and handling
- Post-analysis sample handling
- Data security and confidentiality
- Control of reagents and water quality
- Cleaning laboratory glassware
- Waste disposition
- Decontamination of field sampling equipment
- Control and transfer of electronic data
- Records management.

Such procedures should be identified in applicable QA documents for each project participant. As such, procedures for the aforementioned items, as applicable, are not detailed in this SAP.

7.3 Records

All documents generated during this PCAPP EDS emissions sampling and analysis project will be placed in the operating record. Corrections to these documents will be made by drawing one line through an error, initialing and dating the correction, and justifying the correction (if not self-explanatory). Changes to computerized data records will be identified so the original and corrected entries are retrievable, and the individual initiating the changes can be identified. For the PCAPP EDS Emissions Test, documents designated to become records include calibration documentation, field sampling documentation, chain-of-custody documentation, and analytical laboratory reports of analysis, all of which will be included in the final reports. The final reports are designated to become records and will be controlled by Leidos.

Sufficient records will be prepared and maintained in order to readily reconstruct technical and quality affecting activities. Leidos' document control procedures are not detailed in this SAP. Each laboratory's document control procedures should be identified in the respective laboratory QA manual.

8.0 Sampling Process Design

The experimental design for the PCAPP EDS emissions sampling and analysis program is based on applicable program requirements and EPA guidance for collecting emission samples. This section discusses a schedule, rationale for the experimental design, sampling design assumptions, procedures for locating and selecting environmental samples, and classification of measurements as critical or noncritical.

8.1 Schedule

The program schedule is presented in **Table 8-1** showing the anticipated schedule for each shot. The actual dates have not been established at the time of preparation of this SAP. The schedule for the conduct of the sampling and analysis for the PCAPP EDS Emissions Sampling and Analysis project is divided into three phases:

- Preparation Phase
  - Preparation and approval of the test plans
  - Procurement of sampling equipment and supplies
  - Equipment cleaning and calibration
  - Mobilization of equipment and supplies to the PCAPP EDS site
  - Mobilization of personnel to the site
  - Preparation of the equipment for sampling

- On-Site Sampling and Data Acquisition Phase
  - Collect samples and data from a minimum of one valid test run per shot
- Post-Test Phase
  - Final preparation of the samples
  - Demobilization of the equipment
  - Transport and receipt of the samples by the off-site laboratories
  - Analytical program management of the samples through the off-site laboratories
  - Data reporting, review, and reduction
  - Compilation of the final report.

Table 8-2 shows the anticipated daily schedule for PCAPP EDS Emissions Test sampling activities. This table includes the relative start and stop times for the sampling trains, the duration of the expected sampling periods. The daily schedule indicates only one run is to be conducted each day.

8.2 Rationale for Experimental Design

The conduct of the PCAPP EDS emission sampling and analysis project is to be in accordance with applicable regulatory requirements using standard sampling methods modified to ensure collection of representative samples. Exhaust gas samples will be collected from permanently installed ports as described in this SAP. **Section 4.2**, Modification of Sampling Procedures, **Section 8.3**, Design Assumptions, and **Section 8.4**, Procedures for Locating and Selecting Environmental Samples, provide further explanation.

8.3 Design Assumptions

Previous EDS liquid waste and emissions sampling and analysis have identified a list of chemical compounds that may pose a potential risk to the human and ecological populations associated with the PCAPP. To evaluate the applicability of the current list of compounds in the MPHRA, samples that allow for the determination of the applicable chemical compounds of concern will be collected during each of the four demonstration shots. Based on the approved protocol, risk will be evaluated from the detected concentration of a given compound in the stack gas.

Analytical methods were chosen to achieve the required RLs to meet the performance standards or would otherwise provide the lowest practical RL in cases where the performance standard was lower than the attainable RL. The test methods selected are indicated in **Section 11.0**, Analytical Methods Requirements, of this SAP.

8.4 Procedures for Locating and Selecting Environmental Samples

The frequency of sampling and the sampling locations are detailed in the **Section 9.0**, Sampling Methods Requirements, of this SAP. The sampling locations were selected (**Figures 9-1** and **9-2**) considering the test objectives defined in **Section 3.0**, Data Quality Objective Outline, EPA method requirements, and operational conditions.

8.5 Classification of Measurements as Critical or Noncritical

All samples indicated in this SAP should be collected during the PCAPP EDS Emissions Test.

8.6 Background Sampling and Analysis

Background sampling and analysis will be performed using the same sampling and analytical methods described in **Section 4,** Project/Task Description, **Table 4-1**. The background values will determine Air Filtration System (AFS) inlet concentrations present in the ambient air and will be used to help interpret

results from PCAPP EDS emissions sampling and analysis. Background values will not be used to adjust PCAPP EDS emission values nor will they enter into calculations regarding PCAPP EDS emissions. Background sampling will take place during the first field deployment on the day before the first PCAPP EDS emissions sampling event takes place (see **Table 8-1**). The following information provides a detailed description of background sampling and data reduction.

As shown in the **Table 4-1**, the same sampling methods will be used for background sampling as for the PCAPP EDS emissions sampling. However, whereas PCAPP EDS emissions sampling will be tailored to the time periods when PCAPP EDS emissions are being released, background sampling will take place in a single continuous 60-minute period when there are no operations occurring inside the Environmental Enclosure. As described in **Section 4.2**, Modification of Sampling Procedures, and **Table 8-2** of this document, PCAPP EDS emissions occur on an intermittent basis during the batch process. PCAPP EDS emissions sampling will be spread out over three time intervals to capture the four emission events that occur during a PCAPP EDS treatment cycle (**Section 4.2**, Modification of Sampling Procedures). Background sampling is being performed to measure ambient air concentrations which flow continuously through the AFS. Therefore, there is no need to divide background sampling into intervals. Hence, the background sampling will be performed in one continuous sampling period of 60 minutes duration. PCAPP EDS emission samples will be collected from both inlet ducts. However, for expediency, the background samples will be collected from one of the inlet ducts as the ambient air in both ducts is from the same source.

Analytical methods used for the background samples will be the same as those used for EDS emission samples. Data reduction for background sampling will use the same equations as will be used for PCAPP EDS emission data but will only be used to calculate concentrations and flow rates needed to help interpret PCAPP EDS emission values (see example calculations in **Section 20.1**, Mass Emission Rate Determination).

Background data will be reported in the same interim report as the PCAPP EDS emissions data for the first shot. Background data will also be summarized in the final report that integrates data from all four of the PCAPP EDS emission sampling events. Any compounds identified in background sampling and analysis will be discussed in relation to interpretation of the PCAPP EDS emission data. If a compound is detected in the background sample and in one or more of the PCAPP EDS emission samples, then a qualitative comparison will be made that could include statements such as the following:

- Background value is approximately the same as the PCAPP EDS emission value, therefore this compound is probably not generated by PCAPP EDS operations. (This result will not affect further reporting of the PCAPP EDS values for that compound. The compound will be reported with other PCAPP EDS emissions along with a calculated value that would be suitable for use in the MPHRA.)

- Background value is noticeably lower than the PCAPP EDS emission value therefore the compound, although it is present in the background is also likely generated by PCAPP EDS treatment. (Again, no adjustment will be made to the PCAPP EDS emission value.)

- Background value is noticeably higher than the PCAPP EDS emission value therefore the compound was probably an anomaly that happened to be present in the ambient air at the time the background sample was collected and is apparently not associated with the PCAPP EDS treatment process. This result will not affect further reporting of the PCAPP EDS values for that compound. The compound will be reported at the measured PCAPP EDS emission value, and a value generated that will be suitable for use in the MPHRA.)

- If a compound is not detected in the background sample but is detected in one or more of the PCAPP EDS emissions samples, then it will be assumed that the presence of the compound in the PCAPP EDS emissions is related to PCAPP EDS operations.

- If a compound is detected in the background but is not detected in any of the PCAPP EDS emission samples, then it will be assumed that the compound was an anomaly present in the ambient air during the time period when the background sample was collected.

Regardless of how the comparison of the background data to the PCAPP EDS emissions data turns out, the comparison will not affect the reporting or handling of the PCAPP EDS emissions data. PCAPP EDS emissions data will not be adjusted for background.

Table 8-1. Anticipated Test Schedule for the PCAPP EDS Emissions Sampling and Analysis Program

Days Onsite	Site Activity
Background/Shot 1 - Day 1	Travel to Site; In-process
Day 2	Set Up Equipment; Conduct Background Test
Day 3	Emissions Testing First Shot
Day 4	Demobilization of Equipment; Return Travel
Shot 2 - Day 1	Travel to Site; Set Up Equipment
Day 2	Emissions Testing on Second Shot
Day 3	Demobilization of Equipment; Return Travel
Shot 3 - Day 1	Travel to Site; Set Up Equipment
Day 2	Emissions Testing on Third Shot
Day 3	Demobilization of Equipment; Return Travel
Shot 4 - Day 1	Travel to Site; Set Up Equipment
Day 2	Emissions Testing on Fourth Shot
Day 3	Demobilization of Equipment; Return Travel

Table 8-2. Anticipated Daily Sampling Activity Schedule [a]

Activity	Approximate Time
Meet on site and conduct tailgate safety meeting and status review meeting with all members of the sampling team, key PCAPP personnel, and regulatory authorities.	06:45 – 07:00
Prepare Sampling Equipment and Sampling Locations.	07:00 – 07:45
Conduct Initial Train Leak Checks and Preliminary CEMS Calibrations.	07:45 – 09:00
Test Team Vacate EDS and AFS Area for Commencement of Site Operations.	09:00 – 11:00
Return to AFS Area, Conduct Final Sampling Train Positioning and Initial CEMS Calibrations.	11:00 – 11:45
Commence Sampling During the Neutralent Drain (10 to 15 Minutes).	11:40 – 11:53
Commence Sampling During the Hot Rinsate Drain (10 to 15 Minutes).	13:41 – 13:53
Commence Sampling During the Cold Rinsate Drain (10 Minutes) and Allow to Sample Through the Inert Gas Purge (5 Minutes); End All Sampling.	14:21 – 14:35
Conduct All Sampling Train Leak Checks and Recover all Samples. Conduct Final CEMS Calibrations. Pack Samples and Begin Site Breakdown Activities.	14:35 – 17:00
Demobilize From Site.	17:00

Note:

a. The schedule, times, and durations shown herein are for example purposes only and are subject to change based on actual field events and conditions encountered prior to, during, and after each PCAPP EDS Emissions Test shot.

9.0 Sampling Methods Requirements

Sampling methods requirements include instructions on the sampling methods, equipment, sample containers, sample preservation, and holding times. Throughout the overall program, TRC will utilize EPA-approved sampling methods as identified and described in this SAP. As described in **Section 4.2**, Modification of Sampling Procedures, some of the sampling methods have been modified to accommodate the intermittent nature of EDS emissions. Any deviations from the specified sampling methods will be fully documented in each PCAPP EDS Emissions Test interim and final report, as necessary.

9.1 Field Program Description

The current schedule is detailed in **Tables 8-1** and **8-2** of this SAP. This SAP provides a specific summary of the sampling and analytical parameters required for each test run and details the field samples that will be collected for each test run.

9.2 Presampling Activities

Presampling activities include equipment calibration, sample media preparation, precleaning of the sample train glassware, and other miscellaneous tasks. Each of these activities is described or referenced in the following subsections. Other presampling activities include such details as team meetings, equipment packing and shipping, equipment setup, and finalization of all details leading up to the start of the sampling program.

9.2.1 Equipment Calibration

An important aspect of presampling preparation is the inspection and calibration of the equipment. Equipment is inspected for proper operation and durability before calibration. Calibration of sampling equipment will be conducted in accordance with the procedures outlined in the EPA document entitled *Quality Assurance Handbook for Air Pollution Measurement Systems; Volume III -- Stationary Source Specific Methods*, (EPA-600/4-77-027b and 600/R-94-038c), 40 CFR 60, and the specific equipment calibration requirements detailed in the applicable EPA sampling method source document. **Table 13-2** summarizes the calibration requirements for the field sampling equipment. Calibrations will be performed prior to and at the conclusion of the PCAPP EDS emission sampling event, as required. Documentation of pretest calibrations will be kept on site during PCAPP EDS emission sampling.

9.2.2 Glassware Preparation

Before use in the field, sample train glassware and sample containers will require specialized precleaning to avoid contamination of the sample from the collection container or devices. All bottle caps will be fitted with Teflon® liners which will be cleaned in the same manner as the bottles themselves. Cleaning and storage procedures for sample train glassware, as applicable, are summarized below.

- CTM Method 027 (NH_3) and OTM 29 (HCN): Soap and water wash, DI water rinse three times, acetone rinse three times, and air dried. Open ends sealed with Parafilm® or equivalent.
- Method 29 (metals): Soap and water wash, tap water rinse three times, DI water rinse three times, 10 percent nitric acid soak for 4 hours minimum, DI water rinse three times, final acetone rinse, and air dried. Open ends sealed with Parafilm® or equivalent.

9.2.3 Sample Media Preparation

Analysis-grade solvents and reagents with a certificate of analysis from the vendor will be used during the PCAPP EDS Emissions Test. Verification of each lot is documented by retaining the certificate of analysis provided by the manufacturer, as applicable.

Resin used in the TO-10A/Method 23 and TO-10A/Method 0010 sampling trains will be packed in specially designed sorbent traps provided by the subcontract laboratory. The resin will be purchased precleaned or prepared by the laboratory to meet or exceed all QC requirements specified in EPA Method 23 or SW-846 Method 0010, as applicable. The date a batch of resin was cleaned will not be used to determine the usability of the resin. In all instances, resin will be used that has been cleaned and batch certified to be sufficiently clean for the applicable target analytes by the laboratory supplying the resin. The batch certification will be documented using copies of the actual analytical results used to batch certify the resin. A media request form will also accompany the resin traps that shows the batch identification of the resin used to prepare the traps and any spiking of the resin that was conducted.

9.2.4 Other Presampling Activities

CDPHE will be notified at least 72 hours prior to start of sample collecting activities for each of the 4 shots. Sample team meetings will be held to designate responsibilities to each team member. Assignments will be based on individual experience and relative importance of the assigned task. Equipment will then be transported to the sampling location.

Site setup is the final presampling activity. This task involves moving the equipment to the vicinity of the sample collection areas. The Background Sampling may be run during the first mobilization after the site setup is complete (regulatory observers will be provided with sufficient notification).

Preliminary tests will be conducted at the exhaust duct locations to determine inlet and outlet gas moisture using wet bulb/dry bulb (WB/DB) measurements and velocity in accordance with the applicable EPA reference method (i.e., EPA Methods 1 through 4).

9.3 Sampling Locations

Table 9-1 presents a summary of the distance measurements for the ports for the inlet and outlet sampling locations on both AFS units. The following presents a description of the inlet and outlet locations.

9.3.1 AFS Inlet Gas Sampling Locations

Sampling of the inlet gas streams to each AFS unit will be conducted in the horizontal ducts between where the WTS gas releases into the enclosure opening and the AFS unit. The positioning of the WTS flexible hose in the enclosure opening will ensure adequate mixing prior to splitting into the separate inlet ducts. **Figures 9-1** and **9-2** show the relative positions of the inlet ports to the enclosure and the AFS units. During the PCAPP EDS Emissions Test, the inlet sampling ports, as shown in the figures, will be used for sampling of the inlet gas streams to determine the parameters specific to this plan. The ports meet the accepted standards for distance from flow disturbances for non-isokinetic sampling. EPA Method 1 will be used to establish the required traverse for sampling points. Cyclonic flow checks will be made within the inlet ducts prior to commencement of sampling.

9.3.2 AFS Outlet Exhaust Gas Sampling Locations (Stack)

Sampling of the outlet gas streams from each AFS unit will be conducted in the vertical stack atop each AFS induced draft fan. **Figures 9-1** and **9-2** show the relative positions of the outlet ports to each AFS fan and final exit point. During the PCAPP EDS Emissions Test, the outlet sampling ports, as shown in the figures, will be used for sampling of the outlet gas streams to determine the parameters specific to this plan. The ports meet the accepted standards for distance from flow disturbances for non-isokinetic sampling. EPA Method 1 will be used to establish the required traverse for sampling points. Cyclonic flow checks will be made within each AFS outlet (stack) prior to commencement of sampling.

9.4 Sampling Methods

On-site sampling activities will include the equipment staging in the field, sampling operations, data logging (except where noted below), and sample recovery. TRC will use standardized field sampling data sheets that have been reviewed by the Project QA manager prior to use in the field.

The PCAPP EDS emission sampling and analysis will consist of one test run per shot. Approximately 40 minutes of sampling time will be required to collect each exhaust gas sample. The planned samples and collection frequency are presented in **Table 9-2**.

The sampling methods that will be utilized during the PCAPP EDS Emissions Test are as follows (**Table 9-2** indicates the specific sampling trains required):

- EPA Method 1 and 2 - Velocity profile and volumetric flow rate
- EPA Method 3A – O_2 and CO_2
- EPA Method 4 – Moisture content
- EPA Method 6C – SO_2
- EPA Method 7E – NO_x
- EPA Method 10 – CO
- TO-10A/Method 0010 – Semivolatile organic compounds
- TO-10A/Method 23 – PCDD/PCDF
- TO-15 - Volatile organic compounds
- Modified EPA Conditional Test Method 027 – Ammonia
- Modified EPA Other Test Method 29 – Hydrogen Cyanide
- Modified EPA Method 29 - Metals
- EPA Method 30B - Mercury
- OSHA Method PV2111 - MEA

Section 4.2, Modification of Sampling Procedures, gives a general description of why and how sampling methods were modified. The modifications are further described in the following sections as applicable.

9.4.1 EPA Methods 1 and 2 for Velocity Measurements and Cyclonic Flow

Velocity traverses will be conducted at each sampling location with an S-type pitot assembly in accordance with EPA Method 1, “Sample Velocity Traverse for Stationary Sources,” and EPA Method 2,

"Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S pitot tube)," 40 CFR 60, Appendix A. An S-type pitot tube with an attached inclined manometer will be used to measure the gas velocities. An attached Type-K thermocouple with remote digital display will be used to determine the exhaust gas temperature. During the test program, velocity measurements will be conducted prior to each test run at the sampling location. The required number of velocity measurement points for each sampling location will be determined following EPA Method 1 delineated for particulate sampling (i.e., isokinetic trains) (40 CFR 60, Appendix A).

Cyclonic flow checks will be conducted at each sampling location in accordance with Section 11.4 of EPA Method 1, 40 CFR 60, Appendix A. This procedure is referred to as the nulling technique. An S-type pitot tube connected to an inclined manometer will be used in this method. The pitot tube will be positioned at each traverse point so the face openings of the pitot tube are perpendicular to the stack cross-sectional plane. This position is called the "0° reference." The velocity pressure (delta P) measurement will be noted. If the delta P reading is zero, the cyclonic angle is recorded as 0°. If the delta P reading is not zero, the pitot tube is rotated clockwise or counterclockwise until the delta P reading becomes zero. This angle is then measured with a leveled protractor, or equivalent, and reported to the nearest degree. After this nulling technique is applied at each traverse point, the average of the absolute cyclonic angles is calculated. If this average is less than 20°, no yaw adjustments need to be made to the velocity measurements.

9.4.2 EPA Method 3A for Oxygen and Carbon Dioxide

Oxygen and carbon dioxide emissions will be determined using a temporary reference CEMS. The temporary reference CEMS will be operated in accordance with 40 CFR 60, Appendix A, EPA Method 3A. A continuous sample of the flue gas will be delivered to an analyzer through a heated sample line. A single-opening stainless steel probe will be used to collect the sample. The probe will be located in the 10 percent central area of the duct.

9.4.3 EPA Method 6C for Sulfur Dioxide

Sulfur dioxide emissions will be determined using a temporary reference CEMS. The temporary reference CEMS will be operated in accordance with 40 CFR 60, Appendix A, EPA Method 6C. A continuous sample of the flue gas will be delivered to an analyzer through a heated sample line. A single-opening stainless steel probe will be used to collect the sample. The probe will be located in the 10 percent central area of the duct.

9.4.4 EPA Method 7E for Nitrogen Oxides Emissions

Nitrogen oxides emissions will be determined using a temporary reference CEMS. The temporary reference CEMS will be operated in accordance with 40 CFR 60, Appendix A, EPA Method 7E. A continuous sample of the flue gas will be delivered to an analyzer through a heated sample line. A single-opening stainless steel probe will be used to collect the sample. The probe will be located in the 10 percent central area of the duct.

9.4.5 TO-10A/Method 23 for Dioxins/Furans

A modified method 23/TO-10A sampling system will be used to determine the concentrations of Dioxins/Furans (PCDD/PCDF) in the inlet and outlet exhaust gas (see Appendix A). The sampling system will be a non-isokinetic sampling train and sampling rates will be approximately 5 LPM. The use of this sampling approach was chosen for following reasons:

- The length of the batch treatment does not support use of an isokinetic sampling approach (typically 3-4 hours per test run);
- The exhaust gas will be primarily ambient air with very low pollutant concentrations, ambient level moisture content, ambient temperatures, and a very well-mixed gas stream.

A leak check will be conducted at the trap opening at the beginning of each test run. Gaseous samples will be drawn from the outlet stack through the PUF/XAD sorbent trap. The sampled gas will be a dilute, dry (ambient moisture) gas stream and the XAD trap will be followed by connecting tubing, adjustable regulating valve and a vacuum pump.

Recovery of the sample train will be performed as described below for PCDD/PCDF:

- The PUF/XAD sorbent tube will be sealed and stored at approximately 4°C for shipment to the laboratory.

Following the initial leak check a calibrated BIOS dry cell will be connected to the inlet to the sample train. The flow rate through the sample train will be adjusted to approximately 5 LPM by adjusting and then locking down the regulating valve located prior to the vacuum pump. The flow rate indicated by the dry cell will be recorded as the initial flow rate. Following the final leak check the dry cell will again be connected to the inlet to the sampling train and the vacuum pump will be turned on and the flow rate indicated by the dry cell will be recorded as the final flow rate. The sample train will then be recovered

as described as above. The initial and final indicated flow rates will be averaged to determine the sample train flow rate. This flow rate will be multiplied by the sampling duration to calculate the sample volume. It should be noted that during the flow rate determinations the sample train will be pulling ambient air.

9.4.6 TO-10A/Method 0010 for Semivolatile Organic Compounds

A modified TO-10A sampling system will be used to determine the concentrations of semivolatile organic compounds (SVOC) in the inlet and outlet exhaust gas (see **Table 11-2**). The sampling system will be a non-isokinetic sampling train and sampling rates will be approximately 5 LPM. The use of this sampling approach was chosen for following reasons:

- The length of the batch treatment does not support use of an isokinetic sampling approach (typically 3-4 hours per test run);
- The exhaust gas will be primarily ambient air with very low pollutant concentrations, ambient level moisture content, ambient temperatures, and a very well-mixed gas stream.

A leak check will be conducted at the trap opening at the beginning of each test run. Gaseous samples will be drawn from the outlet stack through the PUF/XAD sorbent trap. The sampled gas will be a dilute, dry (ambient moisture) gas stream and the XAD trap will be followed by connecting tubing, adjustable regulating valve and a vacuum pump.

Recovery of the sample train will be performed as described below for semivolatiles:

- The PUF/XAD sorbent tube will be sealed and stored at approximately 4°C for shipment to the laboratory.

Following the initial leak check, a calibrated BIOS dry cell will be connected to the inlet to the sample train. The flow rate through the sample train will be adjusted to approximately 5 LPM by adjusting and then locking down the regulating valve located prior to the vacuum pump. The flow rate indicated by the dry cell will be recorded as the initial flow rate. Following the final leak check the dry cell will again be connected to the inlet to the sampling train and the vacuum pump will be turned on and the flow rate indicated by the dry cell will be recorded as the final flow rate. The sample train will then be recovered as described above. The initial and final indicated flow rates will be averaged to determine the sample train flow rate. This flow rate will be multiplied by the sampling duration to calculate the sample volume. It should be noted that during the flow rate determinations the sample train will be pulling ambient air.

9.4.7 TO-15 for Volatile Organic Compounds, CH_4 and C_2H_6

Sampling for volatile organic compounds (VOCs), methane, and ethane will be conducted in accordance with procedures presented in Compendium Method TO-15, "Determination of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS).

The sampling train will be connected to a Teflon® sample line and consists of a calibrated orifice flow controller and evacuated SUMMA canister. The sample gas passes through the sample line into the canister using the vacuum from the evacuated canister. Both initial and final vacuum readings will be recorded to ensure sample collection. A single SUMMA canister equipped with a flow controller will be used to collect a sample at each location. The flow controller will be opened and closed for each gas release, resulting in an integrated air sample for the entire shot process. Each SUMMA canister represents a whole air sample and is representative of the air within the duct during each shot. Each sample will be analyzed for the target VOCs, CH_4, and C_2H_6.

9.4.8 Conditional Test Method 027 (CTM-027) for NH3

The concentration of NH_3 in the exhaust gas will be determined in accordance with EPA CTM-027 modified for this source. It is anticipated that any NH_3 will be at extremely low concentrations due to the dilution air and, if present, will only be in the gaseous phase. Sampling will be conducted nonisokinetically encompassing each of the gas releases (approximately 10-15 minutes each). Sampling at the rate of approximately 2 Lpm for a total of 40 minutes will yield a sample volume of 80 liters.

The sample train will consist of a Teflon probe, four impingers, connecting tubing, adjustable regulating valve and a vacuum pump. An ice bath containing four impingers will be attached to the back end of the probe. The first and second impingers each contain 15 ml of 0.1 N sulfuric acid (H_2SO_4). The third impinger will be empty, and the fourth impinger contains silica gel to remove any remaining moisture. The sampling train will be leak checked from the probe tip at the beginning and end of each test run. At the conclusion of sampling, the impinger contents will be deposited into a sample container and the probe, impingers and connecting glassware will be rinsed with deionized water and this rinse will be deposited in the same container as the impinger contents.

For each test run, the CTM-027 sampling train produces the following sample:

- Impinger contents and probe/impinger rinses for NH_3 analysis.

Following the initial leak check a calibrated BIOS dry cell will be connected to the inlet to the sample train. The flow rate through the sample train will be adjusted to approximately 2 LPM by adjusting and then locking down the regulating valve located prior to the vacuum pump. The flow rate indicated by the dry cell will be recorded as the initial flow rate. Following the final leak check the dry cell will again be connected to the inlet to the sampling train and the vacuum pump will be turned on and the flow rate indicated by the dry cell will be recorded as the final flow rate. The sample train will then be recovered as described as above. The initial and final indicated flow rates will be averaged to determine the sample train flow rate. This flow rate will be multiplied by the sampling duration to calculate the sample volume. It should be noted that during the flow rate determinations the sample train will be pulling ambient air.

9.4.9 Modified EPA Method 29 for Metals

A modified Method 29 (MM29) sampling train will be used to measure and determine the concentrations of trace metals in the outlet exhaust gas. A modified method is used as the use of a standard isokinetic Method 29 train is not supported by the short duration of the HD Treatment gas releases. As described above, the exhaust gas is expected to be diluted to almost ambient concentrations. The gas stream will be primarily ambient air, with very little moisture (no entrained droplets) and no particulate matter. The sampling approach will be modified for use of a single point, non-isokinetic sampling train with midget impingers.

The sampling rates will be approximately 2 Lpm. Gaseous samples will be drawn through a 1/4-inch Teflon line and into the first impinger. Because the sample gas is at ambient conditions and speciation of particulate bound metal versus total metal emissions is not a concern, a filter will not be necessary prior to the first impinger. The first and second impingers will each contain 15 mLs of a 5% HNO_3/10% H_2O_2 solution. The third impinger will be empty. The fourth impinger will contain a preweighed amount of silica gel. The impingers will be followed by connecting tubing, adjustable regulating valve and a vacuum pump.

TRC will conduct a single MM29 sampling run for each shot test. Leak checks will be conducted from the probe tip at the beginning and end of each test run. Following the completion of each test run, the MM29 train will be transported to the recovery area. The metals train will produce the following sample:

- 5% HNO_3/H_2O_2 Impinger Catch and 0.1M HNO_3 rinse of impingers, connecting glassware and Teflon line.

- The HNO_3/H_2O_2 impinger catches (Impingers 1 and 2) will be combined with the Impinger 3 catch and the rinses of the train components, then analyzed for the target elements.

Following the initial leak check a calibrated BIOS dry cell will be connected to the inlet to the sample train. The flow rate through the sample train will be adjusted to approximately 2 LPM by adjusting and then locking down the regulating valve located prior to the vacuum pump. The flow rate indicated by the dry cell will be recorded as the initial flow rate. Following the final leak check the dry cell will again be connected to the inlet to the sampling train and the vacuum pump will be turned on and the flow rate indicated by the dry cell will be recorded as the final flow rate. The sample train will then be recovered as described as above. The initial and final indicated flow rates will be averaged to determine the sample train flow rate. This flow rate will be multiplied by the sampling duration to calculate the sample volume. It should be noted that during the flow rate determinations the sample train will be pulling ambient air.

9.4.10 Method 30B for Total Gas Phase Mercury

The emissions of mercury (Hg) will be determined according to "Determination of Total Vapor Phase Mercury Emissions from Coal-Fired Combustion Sources Using Carbon Sorbent Traps" (40 CFR Part 60 Appendix A). Sampling will be conducted during each gas release (approximately 10-15 minutes each). At the end of each gas release, sampling will be halted and will recommence at the start of the next release. Method 30B utilizes in-stack sorbent media coupled with analysis of the integrated samples. Known volumes of flue gas are extracted from a stack through paired, in-stack, sorbent media traps at an appropriate nominal flow rate. Collection of Hg on the sorbent media in the stack mitigates potential loss of Hg during transport through a probe/sample line. The use of paired train sampling is utilized to determine measurement precision and verify acceptability of the measured emissions data.

The Method 30B sampling train consists of a probe, the paired sorbent traps, an umbilical line, moisture removal components, an airtight sample pump, and a dry gas meter. The sampling system samples the inlet and exhaust gases at constant flow rates. Using the sample volume measured by the dry gas meter and the results of the analyses of the sorbent traps, the average mercury concentration in the gas streams for the sampling period is determined in units of micrograms per dry standard cubic meter (µg/dscm).

The following is a general outline of the sample collection procedure:

- Perform an initial leak check with the sorbent traps in place. Draw a vacuum in each sample train. Adjust the vacuum in the sample train to 15" Hg. Using the dry gas meter, determine leak

rate. The leakage rate must not exceed 4 percent of the target sampling rate. Once the leak check passes this criterion, carefully release the vacuum in the sample train then seal the sorbent trap inlet until the probe is ready for insertion into the stack or duct.

- Prior to placement of the probe into the duct, remove the plug from the end of each sorbent trap and store each plug in a clean sorbent trap storage container. Remove the stack or duct port cap and insert the probe(s). Secure the probe(s) and ensure that no leakage occurs between the duct and environment.
- Record initial data including the sorbent trap ID, start time, starting dry gas meter readings, initial temperatures, set-points, and any other appropriate information.
- When sampling is completed, turn off the sample pump, remove the probe/sorbent trap from the port and carefully re-plug the end of each sorbent trap. Perform a leak check with the sorbent traps in place, at the maximum vacuum reached during the sampling period. Use the same general approach described for the initial leak check. Record the leakage rate and vacuum. The leakage rate must not exceed 4 percent of the average sampling rate for the data collection period. Following the leak check, carefully release the vacuum in the sample train.
- Recover each sampled sorbent trap by removing it from the probe, sealing both ends. Wipe any deposited material from the outside of the sorbent trap. Place the sorbent trap into an appropriate sample storage container and store/preserve in appropriate manner.

9.4.11 EPA OTM-29 for HCN

Determination of hydrogen cyanide emissions will be done in accordance with a modified EPA OTM-29 sampling train. A non-isokinetic train will be used to determine the concentrations of HCN in the duct gases as the standard isokinetic OTM-29 train is not supported by the short duration of the HD treatment gas releases. The OTM-29 method was designed to capture HCN emissions in combustion stack gases with high moisture and acidic conditions. In the case of the PCAPP EDS, the duct gases are expected to be diluted to near ambient conditions. The gas stream will be primarily ambient air, with very little moisture (no entrained droplets) and no particulate matter. The OTM-29 sampling approach will be modified for use of a single point, non-isokinetic sampling train with midget impingers.

The approach uses a single point, non-isokinetic sampling train with midget impingers. The sampling rate will be approximately 2 Lpm. Prior to and at the conclusion of sampling, the sampling train will be leak checked from the probe tip. Gaseous samples will be drawn through a 1/4-inch Teflon line and into the impinger train. The first impinger will contain 15 mLs of 0.1N NaOH. Again, due to the high dilution air, concentrated 6N NaOH will not be necessary and the use of the lower normality solution will

reduce matrix interferences and possible contamination. The second impinger will be empty and will be used to control splashover. The third impinger will contain a small amount of silica gel.

TRC will conduct a single sampling run for each treatment run encompassing three gas releases. The sampling train will be stopped at the end of each release and restarted at the beginning of the next release. Following the completion of each treatment run, the sampling train will be transported to the recovery area. The HCN train will produce the following samples:

- NaOH Impinger Solution with Rinse.

Following the initial leak check a calibrated BIOS dry cell will be connected to the inlet to the sample train. The flow rate through the sample train will be adjusted to approximately 2 LPM by adjusting and then locking down the regulating valve located prior to the vacuum pump. The flow rate indicated by the dry cell will be recorded as the initial flow rate. Following the final leak check the dry cell will again be connected to the inlet to the sampling train and the vacuum pump will be turned on and the flow rate indicated by the dry cell will be recorded as the final flow rate. The sample train will then be recovered as described as above. The initial and final indicated flow rates will be averaged to determine the sample train flow rate. This flow rate will be multiplied by the sampling duration to calculate the sample volume. It should be noted that during the flow rate determinations the sample train will be pulling ambient air.

9.4.12 OSHA PV2111 for MEA

OSHA Method PV2111 will be used to determine Monoethanolamine (MEA) emissions from the outlet exhaust gas. This method utilizes a sampling tube containing XAD-2 treated with 10% 1-naphthylisothiocyanate (NITC). It is anticipated that any MEA will be at extremely low concentrations due to the dilution air and, if present, will only be in the gaseous phase. The sampling sorbent tube will be placed directly in the exhaust flow. The sorbent tube outlet will be connected to a sample pump which will be set at an approximate rate of 0.1 Lpm. A leak check of the pump will be conducted prior to sampling.

TRC will conduct a single sampling run for each treatment shot encompassing three gas releases. The sample pump will be stopped at the end of each release and restarted at the beginning of the next release. Following the completion of each test run, the sorbent tube sampling assembly will be transported to the recovery area. For each treatment run, the OSHA PV2111 produces the following sample:

- Coated XAD-2 sorbent tube for MEA analysis.

The flow rate through the sorbent tube will be adjusted to approximately 0.1 LPM by connecting a calibrated BIOS dry cell to the inlet of the sorbent tube and adjusting and then locking down the regulating valve located prior to the vacuum pump. The flow rate indicated by the dry cell will be recorded as the initial flow rate. Following the sampling event the dry cell will again be connected to the inlet of the sorbent tube and the vacuum pump will be turned on and the flow rate indicated by the dry cell will be recorded as the final flow rate. The sorbent tube will then be recovered as described as above. The initial and final indicated flow rates will be averaged to determine the sample flow rate. This flow rate will be multiplied by the sampling duration to calculate the sample volume. It should be noted that during the flow rate determinations the sample train will be pulling ambient air.

9.4.13 Sample Holding Times

Table 9-3 of this SAP provides general requirements for containers, preservation, and holding times for exhaust gas samples.

Table 9-1. Presentation of Port Placement Measurements

Sample Ports	Duct Diameter	Nearest Upstream Flow Disturbance (Duct Diameters)	Nearest Downstream Flow Disturbance (Duct Diameters)	Satisfies EPA Method 1
AFS Inlet A (see Figure 9-1)				
A/B	22”	163” (7.41)	24” (1.09)	Yes
AFS Outlet A (see Figure 9-2)				
A/B	17.75”	50” (2.82)	18” (1.01)	Yes
AFS Inlet B (see Figure 9-1)				
A/B	22”	108” (4.91)	24” (1.09)	Yes
AFS Outlet B (see Figure 9-2)				
A/B	17.75”	50” (2.82)	18” (1.01)	Yes

Table 9-2. AFS Gas Stream Analyses, Locations, and Frequency

Analyte Group	Sampling Method	Duct Location	Sampling Procedure	Sampling Frequency	Sampling Rate and/or Volume
Oxygen, Carbon Dioxide, Sulfur Dioxide, Nitrogen Oxides, Carbon Monoxide	EPA Methods 3A, 6C, 7E, 10	Outlet	Nonisokinetic	Continuous	N/A
PCDD/PCDF	TO-10A/Method 23	Inlet and Outlet	Single point	One 40-minute sample per run	5 liters per minute
Semivolatile Organics	TO-10A/ Method 0010	Inlet and Outlet	Single point	One 40-minute sample per run	5 liters per minute
HCN	OTM 29	Inlet and Outlet	Single point	One 40-minute sample per run	2 liters per minute
NH_3	CTM 027	Inlet and Outlet	Single point	One 40-minute train per run	2 liters per minute
Volatile Organics	TO-15	Inlet and Outlet	Single point	One 40-minute sample per run	4-5 liters
Metals	EPA Method 29	Inlet and Outlet	Single point	One 40-minute sample per run	2 liters per minute
Hg	EPA Method 30B	Inlet and Outlet	Single point	One 40-minute sample per run	4 liters per minute
MEA	OSHA PV2111	Inlet and Outlet	Single point	One 40-minute sample per run	0.1 liters per minute

Table 9-3. Requirements for Containers, Preservation, and Holding Times

Measurement	Sampling Method	Matrix	Container [a]	Preservative [b]	Holding Time
Inlet/Outlet Gas Streams					
PCDD/PCDF	TO-10A/Method 23	PUF/XAD®-2 Resin	Resin Tube	Cool, 4°C	30 days to extraction 45 days to analysis
Metals	EPA Method 29	Impinger Solution	G	None	6 months
Semivolatile Organics	TO-10A/Method 0010	PUF/XAD®-2 Resin	Resin Tube	Cool, 4°C	14 days to extraction 40 days to analysis
Hg	Method 30B	Charcoal Tubes	Tubes	None	28 Days
HCN	OTM 29	Impinger Solution	P	Cool, 4°C, pH> 12	30 Days
NH_3	CTM 027	Impinger Solution	P	Cool, 4°C	14 days
Volatile Organics	TO-15	Whole Air	SUMMA Canister	none	14 days
MEA	OSHA PV2111	Treated XAD-2 Tube	Tube	Cool, 4°C	14 days

Notes:

[a] Polyethylene (P) or amber glass (G); both with Teflon®-lined cap.
[b] Samples requiring preservation of "Cool, 4°C" will be maintained within the temperature range of 0 to 6°C.

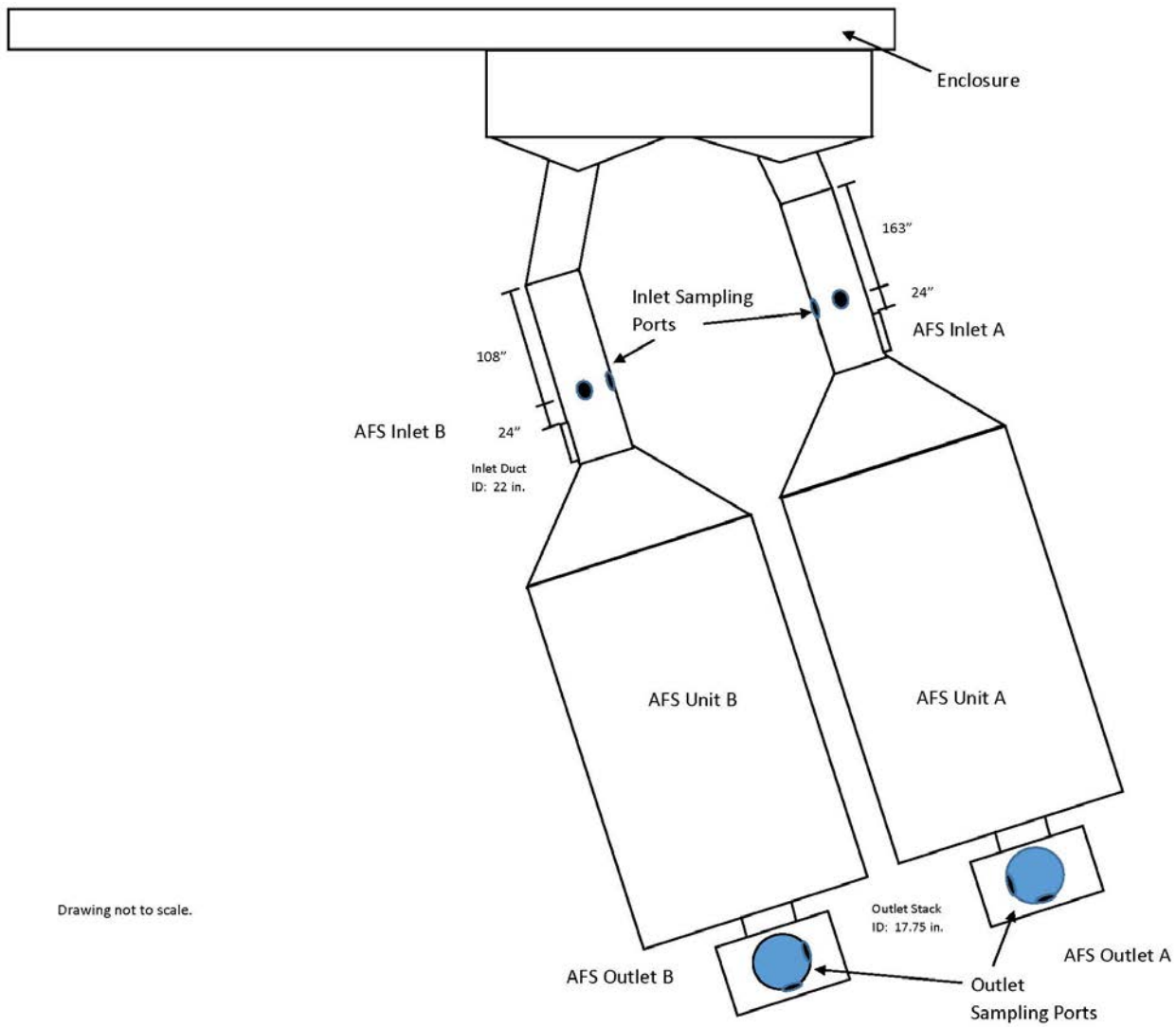

Figure 9-1. Schematic of Air Filtration Systems with Inlet and Outlet Sampling Locations

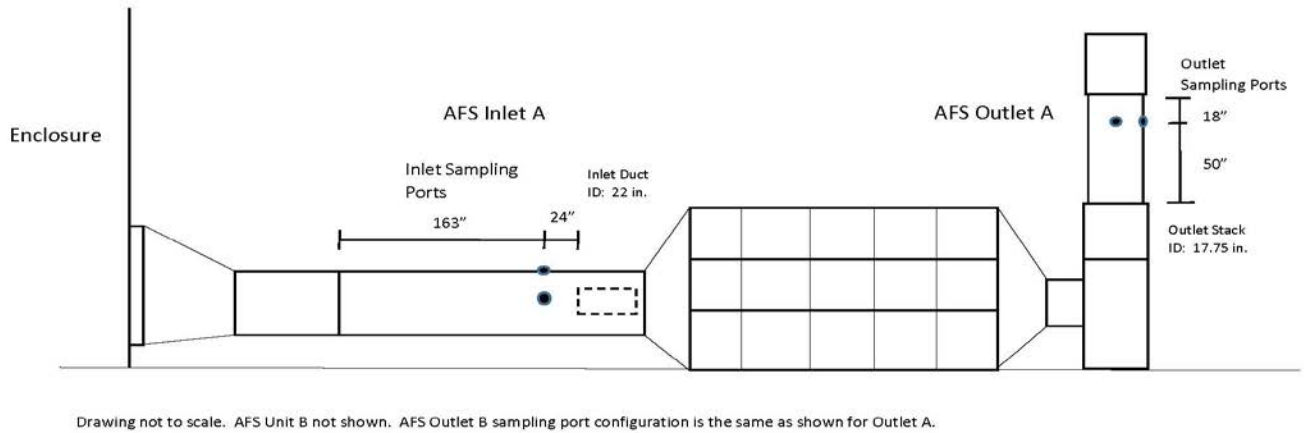

Figure 9-2. Schematic of Air Filtration System A Showing Inlet and Outlet Sampling Locations

10.0 Sample Chain-of-Custody

Sample custody will be the responsibility of the TRC project manager from the time of sample collection until delivery of the samples to the analytical laboratories. Thereafter, custody will be maintained by the laboratory performing the analysis. Samples will be kept on ice or equivalent, as required, (at a temperature between 0°C and 6°C) and shipped to the analytical laboratories in secured containers. Sample custody procedures will comply with the general elements outlined for PCAPP EDS Emissions Test sample custody found in the following EPA reference document:

> *Handbook, QA/QC (QA/QC) Procedures for Hazardous Waste Incineration.* U.S. Environmental Protection Agency. U.S. Government Printing Office: Washington, D.C. January 1990. EPA-625/6-89-023.

Custody of samples will begin with the sampling team and be transferred to the analytical laboratories with sample shipment. The custody procedures will include the following activities:

- Labeling of all samples with a unique sample number
- Individual preparation and maintenance of a sample collection sheet with complete sampling data for each sample
- Maintenance of a list of all samples collected using a sample logbook that will serve as a master sample checklist
- Shipment of the samples to the analytical laboratories performing sample analysis accompanied by chain-of-custody forms that will be inclusive of all samples in various containers for that shipment.

The intent of these procedures is to document the samples' traceability, while providing a chain-of-custody record for all samples collected. Possession and custody of the samples will be maintained in a competent fashion, and samples will be handled and stored responsibly at all times.

10.1 Sample Labeling

Samples will be collected in containers labeled appropriately to give each sample a unique identification. The sample labels will be completed with sample type, date, test run number, and sample number and placed on all sample containers before or at the time of sample collection or recovery, as applicable. To identify and track each sample and its corresponding analytical results, a unique alphanumeric sample number will be affixed to each sample container. The unique alphanumeric numbering system for the

exhaust gas samples will consist of a three-part identifier as shown in **Figure 10-1**. The first portion is an acronym for the sampling train (e.g., "M23" identifies the TO-10A/Method 23 sampling train), the second portion is an acronym for the system (e.g., "EDS"), and the third portion identifies the run number (e.g., "2" identifies the second run), with each portion separated by a hyphen (i.e., "-"). The same sample number will be annotated in the field logbook in numerical order along with all pertinent sample description information. Alternate sample identification schemes may be used provided they yield unique sample identifiers and are reviewed by the RCMD Site Project Manager prior to use in the field. The final report for the PCAPP EDS Emissions Test will include a correlation table for the sample numbers assigned in the field and the sample descriptions. An example sample label showing the written information that identifies each sample is shown in **Figure 10-1**. After all containers have been labeled, each will be staged in a sample cooler at its appropriate sampling location.

10.2 Integrity Seals

Integrity (custody) seals will be placed over the top of the sample containers to detect unauthorized sample handling. At a minimum, these seals will include the date the seal was affixed and the initials of the person affixing the seal. An example custody seal is shown in **Figure 10-2**.

10.3 Field Logbook

A permanently bound field logbook will be maintained by the TRC team leader. Information pertinent to the sampling will be recorded in a sampling log. All entries will be made in indelible ink and all corrections will follow error correction protocol of one line through the error, the initials of the person performing the correction, and the date of the correction. Sampling personnel will also record all information on the appropriate sampling forms. The following information will typically be included:

General Entries	Specific Entries per Test Run
Test sampling	Date of run
Installation	Sampling start and stop times
Facility	Sampling upsets
Project number	Process upsets
Project manager	Delay times
Person receiving sample	

10.4 Chain-of-Custody Forms

To establish the documentation necessary to trace sample possession from the time of collection, a chain-of-custody form must be filled out and must accompany every sample or group of individually identified samples. This form will also include the necessary information to detail the required analyses for each sample listed and serve as the request for analysis. Each person who has custody must sign the chain-of-custody form that will contain the following information:

- Sample identification number
- Date of sample collection
- Signature or initials of sample collector (must be legible)
- Matrix type
- Container type
- Size of container
- Requested analysis
- Signature of persons with custody
- Date and time of each custody change.

An example chain-of-custody form is shown in **Figure 10-3**. All chain-of-custody forms will be retained by TRC and reported in the final report.

10.4.1 Chain-of-Custody Procedures

10.4.1.1 Presampling Procedures

TRC will purchase precleaned sample bottles and containers for items such as probe washes, resin, and filters, and additional sample bottles for QA/QC samples and blanks.

The TO-10A/Method 0010 and TO-10A/Method 23 resin will be cleaned in a manner consistent with that described in the reference methods. The resin will be placed in numbered modules and sealed. The sample numbers for the resin modules and filter containers and the lot numbers for the various solvents will be recorded in the laboratory notebook. The laboratory technician will prepare and pack glass fiber filters for the sampling.

Impingers and other glassware will be cleaned and packed for shipment. After cleaning, the above items will be stored in a controlled access laboratory in the custody of an assigned individual until the shipment to the test site.

Shipment of equipment and materials may be accomplished by means appropriate for the task. Traceability of reagents and media prepared by TRC or the analytical laboratories will be established by recording all such media and reagents and the associated lot number or identifier on a chain-of-custody form(s) or equivalent document before shipment to the TRC office or site location. All custody changes will be recorded on this form(s) through receipt at the site. Reagents and media purchased directly from a commercial vendor will be inspected upon receipt to ensure the original packing is intact. Once on site, all equipment and sample containers will be stored in a secure area.

10.4.1.2 On-Site Sample Train Preparation

Preparation of sampling trains is a responsibility of TRC. TRC will prepare the following for each sampling train as required:

- Impingers, each appropriately labeled
- Resin module(s) labeled.

TRC personnel will document the train preparation and components on a standardized form. Custody of the sampling train will be maintained by keeping the train components in a designated area prior to transport to the sampling area. The TRC sampling train operators take custody of the sampling train upon transport to the sampling area for assembly. Once the sampling trains are assembled, TRC personnel may leave the sampling trains unattended for brief periods in response to plant upset conditions, severe weather activity, or at the direction of the RCMD Site Project Manager, or designee.

If during a test run, any components are broken, plugged, or otherwise require replacement, the train preparation document will be updated to reflect whether or not the component was removed and replaced with a new component.

10.4.1.3 Sample Recovery

The following sample recovery procedures are applicable:

- When sample trains are returned from the sampling site, the TRC personnel receiving the train will take custody of the sampling train.
- The sampling trains are then broken down and the various samples recovered. TRC personnel will maintain a separate data sheet for the samples that they recover. As each sample is recovered, the samples will be labeled and sealed.

- TRC personnel will consolidate the samples in a designated storage area at the test site. For designated "cold" storage areas, a temperature log will be maintained by the TRC to document the temperature at which the samples were stored. The samples will either be in their view, in the view of other authorized test team members, or be under lock and key until these samples are shipped to TRC's analytical laboratory. The samples will be shipped to the subcontractor laboratories in an expeditious manner.

10.4.1.4 Sample Shipment

Samples will be shipped to the appropriate laboratory via overnight courier. Before shipment, TRC personnel will prepare a chain-of-custody form for each shipping container. In the event that a courier service is employed to deliver the samples, receipt of the samples will be acknowledged by the shipping agent via the waybill(s) and the laboratory sample custodian on the chain-of-custody upon opening the sealed shipping container. The chain-of-custody and, preferably, the waybill(s) should be multipart forms. At least one copy must be included with the shipping container, and one copy must be retained by TRC personnel on site. Upon arrival at each laboratory, the samples will be delivered to the laboratory project manager or designated agent for further distribution and analysis. The chain-of-custody form will reflect all changes in custody through sample receipt at the laboratory and note sample condition and temperature upon receipt.

10.5 Shipping and Packing of Samples

All samples will be shipped under chain-of-custody to the laboratories in an expeditious manner. All samples will be shipped in a manner that will maintain the integrity of the samples as dictated by the preservation requirements identified in **Table 9-3**. Glass sample bottles will be wrapped in bubble wrap before being placed in containers containing ice, or equivalent, as applicable. A signed chain-of-custody form listing all samples in the cooler will be placed in the cooler and the cooler sealed with custody tape.

Shipping considerations include the following:

- Separate packages will be used for each International Air Transport Association and/or U.S. Department of Transportation class of samples. All packing and labeling will conform to applicable International Air Transport Association and/or Department of Transportation regulations for shipment.
- Samples requiring preservation at 0°C–6°C will be shipped chilled and packed with ice, or equivalent, to maintain the temperature of the samples in the range of 0° to 6°C.

- All samples will be preserved per **Table 9-3**.
- A laboratory representative will be present to take custody of samples at the time of delivery by the commercial delivery service.

10.6 Laboratory Operations

All samples submitted to the laboratories will be brought to a sample custodian, who will continue the traceability documentation logging the samples into a central log book or database and assigning laboratory sample numbers. These laboratory sample numbers will serve as a means of tracking samples through the laboratory analysis. These tasks may be accomplished electronically (i.e., laboratory information management system). The sample number must be unique and nonrecurring.
Each laboratory maintains a secure laboratory facility. Access to laboratory operations and sample storage is possible only to employees having the proper access mechanism (e.g., combination, key, key card).

All materials such as field and laboratory notebooks and logbooks, field and laboratory data records, correspondence, reports, sample tags, traceability records, and instrument printouts will be clearly labeled with the project number and become a permanent part of the laboratory project file.

Project samples and extracts will be disposed of in an appropriate manner no less than 60 days after acceptance and approval of the final analytical report(s) by the RCMD Site Project Manager.

When samples are received at each laboratory, they will be brought to a sample custodian who will unpack them and immediately reconcile the sample counts with the chain-of-custody documentation. Discrepancies will be immediately reported to the laboratory manager, or designee, who will contact the TRC project manager, or designee, in the most expeditious manner possible. Until discrepancies are resolved, the laboratory will retain all packing materials for that sample shipment.

Figure 10-1. Example Sample Label

PCAPP EDS Emissions Test			
Code:	M23-EDS-2		
Matrix:	PUF/XAD	**Date:**	1/01/15
Analysis:	PCDD/PCDF	**Lab:**	ABC
Initials:	BDW	**Contract:**	XYZ
TO-10A/M23, Run 2			

Figure 10-2. Example Custody Seal

Person Collecting Sample _____ Sample No. _____
(signature)

Date Collected _____ Time Collected _____

Figure 10-3. Example Chain-of-Custody Form

CHAIN OF CUSTODY RECORD

Project Name: _____
Project No.: _____
Sampling Date(s): _____
Laboratory: _____
Laboratory P.O.: _____
Shipping Date(s): _____
Shipper's Name: _____

Sample Code	Sampled Date	Container Size	Container G/P	MATRIX: Aqueous	Organic Solvent	Ash/Soil/Sediment (Solid)	Acidic	Basic	Other	Source Description	ANALYSIS: Trace Metals*	Mercury	HCl	Cl2	Particulate Matter	PCDD/PCDF	Semivolatile Organics	Voaltile Organics	Physical Parameters*					Comments

Relinquished by:	**Date/Time:**	**Relinquished by:**	**Date/Time:**
Received by:	**Date/Time:**	**Received by:**	**Date/Time:**

Remarks (*):

11.0 Analytical Methods Requirements

The analytical objective for the PCAPP EDS emission sampling and analysis project is to provide a database that most accurately reflects the composition of the samples being analyzed. This objective will be met by successful implementation of the analytical methodologies and procedures selected for the analysis of samples collected during each test run. The process of selecting the analytical methods and procedures considers the sample matrix, composition, volume, and analytes of interest.

11.1 Analytical Laboratory

All analyses will be performed by a laboratory experienced in the appropriate categories of sample analysis. The following section summarizes the methods of analysis that will be used to analyze samples collected during PCAPP EDS emission sampling.

11.2 Analytical Procedures

Standard analytical reference methods, procedures, and techniques described in this plan will be followed during analysis of all samples collected and associated with the PCAPP EDS emission sampling and analysis project. The methods and procedures are discussed in detail in the following documents:

- *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*. Second Edition, Center of Environmental Research and Development U.S. Environmental Protection Agency, Cincinnati, OH, January 1999.
- *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods*. SW-846 Third Edition, December 1996. EPA, Office of Solid Waste and Emergency Response (OSWER). Washington, D.C. 20460.
- 40 CFR 60, Appendix A, Methods.
- *Occupational Safety and Health Administration*

The type of analysis, sample matrices, procedure descriptions, and associated reference methods (preparation and analysis) are summarized in **Table 11-1**. Minimum calibration requirements are summarized in **Tables 13-1** and **13-2**.

11.3 Target Analyte List

A target analyte list has been developed for the PCAPP EDS emission sampling and analysis project to provide the data necessary to demonstrate the test objectives. Each laboratory will report their actual DLs or RLs, which will be less than or equal to the limits shown on **Table 11-2**. Each laboratory will also

report their method detection limit (MDL) for each analyte, as applicable. Example equations showing how emission rates will be calculated from the laboratory reported values are shown in **Section 20.0**, Reporting.

Table 11-1. Summary of Exhaust Gas Analytical Methods and Procedures

Parameter	Matrix	Procedure Description	Preparation Method	Analysis Method
Dioxins and furans	Exhaust gas (PUF/XAD®-2)	Soxhlet extraction, high-resolution GC/MS	Methods 23 and 8290	Methods 23 and 8290
Metals	Exhaust gas (filter, rinsate, impinger solutions)	Acid digestion, ICP, ICP/MS	EPA Method 29, SW-846 Method 3010A/ 3050B	SW-846 Method 6010B/6020
Semivolatile organic compounds (SVOC)	Exhaust gas (PUF/XAD®-2)	Solvent extraction, GC/MS	SW-846 Methods 3542, 3510C, and 3540C	SW-846 Method 8270C
Volatile organic compounds (VOC)	SUMMA Canister	Purge and trap or thermal desorption, GC/MS	TO-15, ASTM D1945	TO-15, ASTM D1945
NH_3	Exhaust gas (impinger solutions)	Ion chromatography	EPA CTM 027	EPA CTM 027
Hg	Exhaust gas (charcoal tube)	Thermal desorption AA	Method 30B	Method 30B
MEA	Exhaust Gas (treated XAD-2)	HPLC	OSHA PV2111	OSHA PV2111
HCN	Exhaust gas (impinger solutions)	Ion chromatography	EPA OTM 29	EPA OTM 29

Table 11-2. PCAPP EDS Emissions Sampling and Analysis Project Target Analyte List, Analytical Methods, and Typical Reporting Limits

Analyte	Sampling Method	Analysis Method	Typical Reporting Limit
Volatile Organic Compounds			
1,1-Dichloroethene	TO-15	TO-15	0.5 ppbv
1,2,4-Trichlorobenzene	TO-15	TO-15	2.0 ppbv
1,2-Dichlorobenzene	TO-15	TO-15	0.5 ppbv
1,3-Dichlorobenzene	TO-15	TO-15	0.5 ppbv
Benzene	TO-15	TO-15	0.5 ppbv
Chlorobenzene	TO-15	TO-15	0.5 ppbv
Chloroform	TO-15	TO-15	0.5 ppbv
cis-1,2-Dichloroethene	TO-15	TO-15	0.5 ppbv
Dichloromethane (Methylene Chloride)	TO-15	TO-15	5.0 ppbv
Ethylbenzene	TO-15	TO-15	2.0 ppbv
Freon 12 (Dichlorodifluoromethane)	TO-15	TO-15	0.5 ppbv
m,p-Xylene	TO-15	TO-15	0.5 ppbv
o-Xylene	TO-15	TO-15	0.5 ppbv
Styrene	TO-15	TO-15	0.5 ppbv
Tetrachloroethene	TO-15	TO-15	0.5 ppbv
Toluene	TO-15	TO-15	0.5 ppbv
Trichloroethene	TO-15	TO-15	0.5 ppbv
Vinyl Chloride	TO-15	TO-15	0.5 ppbv
2-Butanone (Methyl Ethyl Ketone)	TO-15	TO-15	2.0 ppbv
Acetone	TO-15	TO-15	5.0 ppbv
Carbon Disulfide	TO-15	TO-15	2.0 ppbv
Ethanol	TO-15	TO-15	0.5 ppbv
trans-1,2-Dichloroethene	TO-15	TO-15	0.5 ppbv
1,1-Dichloroethene	TO-15	TO-15	0.5 ppbv
1,2-Dichloroethane	TO-15	TO-15	0.5 ppbv
Methane	TO-15	ASTM D1945	0.0001%
Ethane	TO-15	ASTM D1945	0.001%
Semivolatile Organic Compounds [a]			
Acenaphthylene	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
Anthracene	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
bis (2-chloroisopropyl) ether	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
4-Chloroaniline	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
2-Chloronaphthalene	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
Di-n-butyl phthalate	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
1,4-Dichlorobenzene	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
2,4-Dichlorophenol	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
2,4-Dinitrotoluene	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
Fluoranthene	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
Fluorene	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
Hexachloroethane	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
2-Methylnaphthalene	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
2-Methylphenol	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms

Table 11-2. PCAPP EDS Emissions Sampling and Analysis Project Target Analyte List, Analytical Methods, and Typical Reporting Limits (Continued)

Analyte	Sampling Method	Analysis Method	Typical Reporting Limit
3-Methylphenol & 4-Methylphenol	TO-10A/Method 0010	SW-846 Method 8270C	50 micrograms
Naphthalene	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
Nitrobenzene	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
N-Nitrosodiphenylamine	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
Phenanthrene	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
Phenol	TO-10A/Method 0010	SW-846 Method 8270C	50 micrograms
Pyrene	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
3,3'-Dichlorobenzidine	TO-10A/Method 0010	SW-846 Method 8270C	10 micrograms
1,4-Dithiane	TO-10A/Method 0010	SW-846 Method 8270C	Not applicable
2,2'-Thiodiglycol	TO-10A/Method 0010	SW-846 Method 8270C	Not applicable
1,4-Thioxane	TO-10A/Method 0010	SW-846 Method 8270C	Not applicable
Dioxins/Furans [a]			
2,3,7,8-Tetrachlorodibenzo-p-dioxin	TO-10A/Method 23	SW-846 Method 8290	20 picograms
Total Tetrachlorodibenzo-p-dioxins	TO-10A/Method 23	SW-846 Method 8290	20 picograms
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	TO-10A/Method 23	SW-846 Method 8290	100 picograms
Total Pentachlorodibenzo-p-dioxins	TO-10A/Method 23	SW-846 Method 8290	100 picograms
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	TO-10A/Method 23	SW-846 Method 8290	100 picograms
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	TO-10A/Method 23	SW-846 Method 8290	100 picograms
1,2,3,7,8,9-Hexachlorodibenzo-p_dioxin	TO-10A/Method 23	SW-846 Method 8290	100 picograms
Total Hexachlorodibenzo-p-dioxins	TO-10A/Method 23	SW-846 Method 8290	100 picograms
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	TO-10A/Method 23	SW-846 Method 8290	100 picograms
Total Heptachlorodibenzo-p-dioxins	TO-10A/Method 23	SW-846 Method 8290	100 picograms
Total Octachlorodibenzo-p-dioxins	TO-10A/Method 23	SW-846 Method 8290	200 picograms
2,3,7,8-Tetrachlorodibenzofuran	TO-10A/Method 23	SW-846 Method 8290	20 picograms
Total Tetrachlorodibenzofurans	TO-10A/Method 23	SW-846 Method 8290	20 picograms
1,2,3,7,8-Pentachlorodibenzofuran	TO-10A/Method 23	SW-846 Method 8290	100 picograms
2,3,4,7,8-Pentachlorodibenzofuran	TO-10A/Method 23	SW-846 Method 8290	100 picograms
Total Pentachlorodibenzofurans	TO-10A/Method 23	SW-846 Method 8290	100 picograms
1,2,3,4,7,8-Hexachlorodibenzofuran	TO-10A/Method 23	SW-846 Method 8290	100 picograms
1,2,3,6,7,8-Hexachlorodibenzofuran	TO-10A/Method 23	SW-846 Method 8290	100 picograms
1,2,3,7,8,9-Hexachlorodibenzofuran	TO-10A/Method 23	SW-846 Method 8290	100 picograms
2,3,4,6,7,8-Hexachlorodibenzofuran	TO-10A/Method 23	SW-846 Method 8290	100 picograms
Total Hexachlorodibenzofurans	TO-10A/Method 23	SW-846 Method 8290	100 picograms
1,2,3,4,6,7,8-Heptachlorodibenzofuran	TO-10A/Method 23	SW-846 Method 8290	100 picograms
1,2,3,4,7,8,9-Heptachlorodibenzofuran	TO-10A/Method 23	SW-846 Method 8290	100 picograms
Total Heptachlorodibenzofurans	TO-10A/Method 23	SW-846 Method 8290	100 picograms
Total Octachlorodibenzofurans	TO-10A/Method 23	SW-846 Method 8290	200 picograms

Table 11-2. PCAPP EDS Emissions Sampling and Analysis Project Target Analyte List, Analytical Methods, and Typical Reporting Limits (Continued)

Analyte	Sampling Method	Analysis Method	Typical Reporting Limit
Metals [a]			
Aluminum	EPA Method 29	SW-846 Method 6020	7.5 micrograms
Antimony	EPA Method 29	SW-846 Method 6020	0.3 micrograms
Arsenic	EPA Method 29	SW-846 Method 6020	0.3 micrograms
Barium	EPA Method 29	SW-846 Method 6020	0.15 micrograms
Beryllium	EPA Method 29	SW-846 Method 6020	0.15 micrograms
Cadmium	EPA Method 29	SW-846 Method 6020	0.15 micrograms
Chromium	EPA Method 29	SW-846 Method 6020	0.3 micrograms
Cobalt	EPA Method 29	SW-846 Method 6020	0.15 micrograms
Copper	EPA Method 29	SW-846 Method 6020	0.3 micrograms
Lead	EPA Method 29	SW-846 Method 6020	0.15 micrograms
Nickel	EPA Method 29	SW-846 Method 6020	0.3 micrograms
Selenium	EPA Method 29	SW-846 Method 6020	0.3 micrograms
Silver	EPA Method 29	SW-846 Method 6020	0.15 micrograms
Strontium	EPA Method 29	SW-846 Method 6020	0.75 micrograms
Thallium	EPA Method 29	SW-846 Method 6020	0.15 micrograms
Zinc	EPA Method 29	SW-846 Method 6020	0.75 micrograms
Hg	EPA Method 30B	EPA Method 30B	10 nanograms
Other [a]			
Hydrogen Cyanide	EPA OTM 29	EPA OTM 29	4.0 micrograms
Ammonia	EPA CTM 027	EPA CTM 027	4.0 micrograms
MEA	OSHA PV2111	OSHA PV2111	0.5 micrograms

Note:

[a] Results shown in units of mass represent mass per sample train fraction. Those mass values are then converted to concentration values based on the sample volume and to rate values based on the AFS flow rate. (See example calculations in **Section 20.0**, Reporting.)

12.0 Quality Control Requirements

Quality control checks will be performed to ensure the collection of representative samples and the generation of valid analytical results on these samples. These checks will be performed by project participants through the program under the guidance of the Leidos quality assurance manager, RCMD project manager or designee, the TRC quality assurance manager, or TRC team leader.

12.1 Data Collection and Sampling Quality Control Procedures

The following standardized procedures will be utilized to adhere to quality control while performing sampling and analyses:

- Use of standardized data sheets, checklists, and field notebooks to ensure completeness, traceability, and comparability of the process information and samples collected
- Field checking of standardized forms by the TRC team leader and a second person to ensure accuracy and completeness
- Strict adherence to the sample traceability procedures outlined in **Section 10.0**, Sample Chain-of-Custody, of this plan
- Submission of reagent blanks and field blanks (blank trains)
- Leak checks of sample trains before and after sample collection and during the test, when appropriate.

12.1.1 Sampling Equipment Quality Control Checks and Frequency

Calibration of field sampling equipment will be performed before and at the conclusion of the field sampling effort (**Section 9.2.1**, Equipment Calibration). Copies of the calibration sheets will be submitted to the TRC team leader to take on site for reference and to the project file. Calibrations will be performed as described in the EPA publication *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods*. Calibration requirements are specifically addressed in **Section 13.0**, Instrument Calibration and Frequency.

Leak checks of the sample trains will be conducted in accordance with the protocol specified by each method. Leak checks will be conducted before the initiation of sample collection, between each port change, at the end of sample collection and during the test run, when appropriate (i.e., following equipment replacement).

12.1.2 Sample Collection Quality Control Checks

To provide a quality control check on sample handling, field, trip, and reagent blanks will be collected.

For the PCAPP EDS emission sampling and analysis project, sample collection quality control checks and frequency for samples to be analyzed in the laboratory are listed in **Table 12-1** of this SAP. QC requirements for the facility monitoring systems are provided in facility plans and procedures.

12.2 Analytical Quality Control Procedures for Samples to be Analyzed in the Laboratory

This section describes quality control procedures that will be followed by each laboratory during the analysis of the samples from the PCAPP EDS emission sampling and analysis project. Each laboratory will be required to monitor the precision and accuracy of their sample analyses. The laboratories will use the following high-purity, commercially available materials for their quality control procedures: standard reference materials, calibration standards, internal standards, and surrogate compounds. Using these materials, data precision and accuracy will be assessed by evaluating the results from an analysis of method blanks, laboratory blanks, and reagent blanks; calibration standards; laboratory control samples; and surrogate spikes and internal standard spikes. **Tables 5-1 through 5-8** provide the target data quality objectives for precision, accuracy, and frequency. **Table 12-1** provides the specific quality control sample requirements for each sampling train. The QC checks and requirements are described in greater detail in the appropriate analytical reference method.

12.2.1 Quality Control Samples and Blanks

Method Blanks – Method blanks contain all the reagents used in the preparation and analysis of samples and are processed through the entire analytical scheme to assess spurious contamination arising from reagents, glassware, and other materials used in the analysis.

Field Blanks – Field blanks are used to verify the sample collection and handling process has not affected the quality of the samples. Field blanks are also used to measure the cleanliness of sampling equipment.

Trip Blanks – Trip blanks are used to indicate potential contamination due to migration of chemicals from the air at the sampling location or in sample storage or shipping containers into the sample. For the TO-10A/Method 0010 and TO-10A/Method 23 sampling trains, a trip blank consists of resin trap that is shipped to the site from the laboratory, held onsite for the duration of the PCAPP EDS Emissions Test, and shipped back to the laboratory with the field samples. It is not opened and uncapped until it is analyzed in the laboratory with the actual site samples.

Calibration Check Samples – One of the working calibration standards used to periodically check the validity of the initial calibration.

Laboratory Control Samples/Laboratory Control Sample Duplicates – These samples are generated from spikes prepared independently from the calibration concentrates. Laboratory control samples are used to establish that an instrument or procedure is in control. A laboratory control sample is normally carried through the entire sample preparation and analysis procedure. A laboratory control sample duplicate is prepared at the same time as the laboratory control sample. Precision and accuracy data can be determined from the analysis of laboratory control sample and laboratory control sample duplicate pairs.

Field Spike – These samples are used to verify the sample collection and handling process has not affected the quality of the samples and the analytical procedures used to prepare and analyze the field samples are in control.

Internal Standard and Surrogate Spikes – Internal standards and surrogates will be added to each sample analyzed by mass spectrometry in accordance with method requirements. The percentage recovery of each internal standard and surrogate will be calculated where required by the analytical method to determine if quality control requirements have been met.

Reagents used in the laboratory will be of analytical reagent grade or higher purity; each lot of reagent used will be checked for acceptability before laboratory use. All reagents are to be labeled with the date received and date opened. The quality of the laboratory DI water will be routinely checked.
All glassware used in the sampling and analysis procedures will be precleaned according to the method requirements. Standard laboratory practices for laboratory cleanliness, personnel training, and other general procedures will be employed. The results of these QC procedures, in part or in whole, will be included in the final report, as applicable.

12.2.2 Quality Control of Sorbents

Resins will be prepacked or packed in traps provided by TRC or the laboratories. The resins are purchased precleaned or cleaned at the laboratory then quality checked by the laboratory before shipment to the field. The laboratory will spike the resins used for the SW-846 Method 0010 and EPA Method 23 sampling trains with the appropriate surrogates prior to shipping.

Table 12-1. Summary of the Field Quality Control Requirements for the PCAPP EDS Emission Sampling and Analysis Project

Sample	Quality Control Sample Type	Frequency
TO-10A/Method 23	Trip blanks	One per sample shipment
TO-10A/Method 0010 (Semivolatile organic compounds and PICs)	Trip blanks	One per sample shipment
EPA Method 29	Reagent blanks	One each per PCAPP EDS Emissions Test Trip: • 0.1N nitric acid probe rinse solution • 5% nitric acid and 10% hydrogen peroxide impinger solution
	Blank train (field blank)	One complete blank train per PCAPP EDS Emissions Test Trip: • 5% nitric acid and 10% hydrogen peroxide impinger solution • 0.1N nitric acid rinse
OTM 29	Field Spike	One spike per PCAPP EDS Emissions Test Trip: • 0.1N NaOH impinger solution
	Reagent blanks	One blank each per PCAPP EDS Emissions Trip: • 0.1N NaOH impinger solution
	Blank train (field blank)	One blank train per PCAPP EDS Emissions Trip: • 0.1N NaOH impinger solution and rinse
CTM-027	Reagent blanks	One blank each per PCAPP EDS Emissions Trip: 0.1N H_2SO_4 impinger solution
	Blank train (field blank)	One blank train per PCAPP EDS Emissions Trip: • 0.1N H_2SO_4 impinger solution and rinse
OSHA PV2111	Field blank	One tube per trip
EPA Method 30B	Field blank	One tube set per test
	Field Spike	One tube per location per test
TO-15	Trip blank	One SUMMA canister per trip

13.0 Instrument Calibration and Frequency

This section addresses the tools, gauges, instruments, and other sampling, measuring, and test equipment used for data collection and analysis that must be controlled and, at specified periods, calibrated to maintain performance within specified limits.

13.1 General Equipment and Instrument Requirements

Chemical measurements are made using a system that includes sample preparation and measurement processes. All aspects of the measurement process should be calibrated. Temperature, pressure, humidity, volumetric capacity, mass, and flow rate data may be needed as well, requiring accurately calibrated instrumentation for their measurement. Accordingly, any of the instruments, standards, and methods used for these purposes will be calibrated to assure that their accuracy is within acceptable limits.

13.1.1 Calibration Records

Each laboratory will keep a record of raw calibration data for all methods. Calibration records (initial calibration, initial calibration verification, and continuing calibration verification) will include the raw calibration data, associated reports, date of analysis, and name of analyst or initials, at a minimum. Calibration data will be traceable to the standards used. All samples analyzed will be traceable to the calibration under which the results were produced. Sample analysis can only proceed when measurement systems are accurately calibrated. Records will be maintained according to **Section 7.0**, Documentation and Records.

13.1.2 Balances, Thermometers

Calibration records of measurement devices such as balances and thermometers for critical mass and temperature measurement will be maintained. Analytical balances will be calibrated annually, at a minimum, by an approved metrology organization. An approved metrology organization is one that has been evaluated and selected on the basis of specified criteria consistent with industry standards for the calibration of balances (see **Section 14.0**, Procurement of Items and Services). These records will contain the date of calibration, identity of the person performing the calibration, the identity of the device or serial number, and the date the calibration expires. This information will be affixed on or near the balance. Acceptable balance calibration will be verified using a certified reference material and documented daily when in use. The accuracy of thermometers and thermocouples used for critical temperature measurements (e.g., refrigerator temperature for sample storage) will be verified annually by comparing readings of such devices with readings of a National Institute of Standards and Technology-traceable,

factory-certified thermometer. Acceptance criteria will be established in accordance with the applicable standard and/or the organizations' QA program requirements. A device that does not meet the acceptance criteria will be replaced with a factory-certified device or removed from service until corrective action is completed and the device meets acceptance criteria.

13.1.3 General Requirement for Standards

Standards used for calibration of measurement systems will be traceable to a nationally or internationally recognized standard agency source or measurement system, if available. A program for verifying and documenting the accuracy and traceability of all working standards against appropriate primary grade standards or the highest quality standards available will be routinely followed.

Standards used for calibration will be accompanied by a certificate or record that includes the vendor, lot number, purity, date of preparation and/or expiration, and concentration of the standard material. At a minimum, the following information will be maintained on standard preparations and, if possible, placed on the label:

- Name of preparer
- Date prepared
- Standard identification
- Dilution performed
- Final concentration
- Expiration date or shelf life.

When recognized standard material is not available or its purchase is impractical, the laboratory will attempt to purchase standard material from a reliable source. The laboratory will have procedures in place to determine the acceptability of such materials.

13.1.4 Calibration of Laboratory Measurement Systems

The calibration process correlates instrument response to an established concentration. Calibration procedures will be established by the laboratory and will consider the manufacturer's recommendations and comply with the specific requirements of the analytical methods (see **Table 13-1** of this SAP).

The initial calibration verification checks the accuracy of the calibration and the standards used for that purpose. A level of independence will exist between materials used for calibration and for initial

calibration verification when such materials are available. When an independent source is not available, the laboratory will attempt to purchase an alternate lot of the same material.

The continuing calibration verification checks the stability of the original calibration over time. This standard may be from the same source as that used for either calibration or initial calibration verification.

The minimum requirements of calibration, frequency, and acceptance criteria for laboratory measurement systems are identified in each analytical method. **Table 13-1** provides a summary of the minimum requirements for each method.

The laboratory is required to take corrective action when measurement systems fail calibration QC criteria. Sample analysis will not proceed until the calibration QC criteria have been met.

13.1.5 Instrument/Equipment Maintenance

Critical equipment necessary to maintain PCAPP operating conditions are identified in facility plans and procedures as are the required calibration and maintenance activities.

TRC and each laboratory will establish a periodic preventative and corrective maintenance program for instrumentation and equipment used to collect the samples for the PCAPP EDS Emissions Test. This assures the availability and satisfactory performance of the instrumentation and equipment. Equipment and/or instrumentation requiring periodic maintenance will be identified. All instrumentation/equipment subject to maintenance or repair will be recalibrated, as necessary, before use.

The following items will be considered for inclusion in the program:

- Routine inspections (e.g., daily, weekly, or as needed) will be based on the manufacturer's recommendations, performed by the responsible staff, and followed by corrective actions, if necessary. Anomalies will be noted in a logbook, record sheet, or electronic record system, which will be kept close to the instrument/equipment.
- Significant corrective action(s) for the instrument/equipment will be documented in a logbook, record sheet, or electronic record system. The notation shall include a description of the corrective action, the date performed, and the identity of the person who performed the corrective action.

- Instrument/equipment maintenance will be performed by appropriate personnel. This could include services provided through an external maintenance contract.
- Instrument/equipment maintenance and repairs shall be documented, including the date and signatures of personnel who performed the maintenance, in a logbook, record sheet, or electronic records system. This documentation will be reviewed annually or in accordance with method and/or laboratory requirements.
- Critical spare parts list and an inventory will be maintained. If applicable, a written contingency plan specifying backup equipment will be established.

13.2 Specific TRC Equipment and Instrument Requirements

13.2.1 Process Monitoring Equipment

The TRC process monitoring equipment includes flow meters, weigh scales, thermocouples, pressure-sensing devices, and temporary reference method CEMS, as required. All calibration data for each instrument shall be documented and shall include the calibration procedures implemented, if different from the manufacturers' recommended procedures and/or published method (e.g., American Society for Testing and Materials), as well as the following:

- Device being calibrated
- Identification number (serial number or tag number)
- Calibration method reference or procedure
- Acceptance criteria
- Reference device
- Date of reference device's last calibration
- Identification of reference device (i.e., serial number or lot number)
- Date of calibration
- Name of primary technician performing calibration.

13.2.2 Exhaust Duct Sampling Equipment

All sampling trains will be calibrated as indicated in the EPA *Quality Assurance Handbook for Air Pollution Measurement Systems* (EPA/600/4-77-027b). Calibration of the EDS exhaust gas sampling equipment (see **Table 13-2**) will be performed before use during the PCAPP EDS Emissions Sampling and Analysis project. **Table 13-2** summarizes the calibration requirements for the field sampling equipment.

13.2.3 General Temporary Reference Method CEMS

The following temporary reference method CEMS (TCEMS) calibration procedures will be used by TRC:

- Calibration before and after each test run
- Performance check of TCEMS.

Calibration procedures will be in accordance with the manufacturer's requirements and demonstrated in accordance with the applicable EPA performance specification. These requirements are as follows:

- Calibration of instrument
- Interference response check, as necessary
- Analyzer error and sampling system bias
- Equipment inspections.

If the temporary reference method CEMS fails any portion of the calibration check, corrective action will be taken, and the failed portion will be repeated. Sampling will not be initiated until the temporary reference method CEMS passes applicable requirements. Failure of any post-run requirement may necessitate conduct of an additional run. The PCAPP will consult with the onsite regulatory observer(s) and seek concurrence before making any such determination.

Documentation of all calibrations and calibration checks made in association with PCAPP EDS Emissions Sampling and Analysis will be maintained for further review and included in the final report as applicable. These calibration records will include the following information:

- Calibration values on the data logger
- Recorder strip charts
- Calibration standards (e.g., cylinder gas certificate of analysis)
- Documentation of values obtained during calibration checks
- Calibration logbook (including a record of the date and time of any adjustments).

13.2.4 Temporary Reference Method CEMS for Nitrogen Oxides, Sulfur Dioxide, Carbon Monoxide, Oxygen, and Carbon Dioxide

TRC will conduct emissions monitoring for nitrogen oxides, sulfur dioxide, and carbon monoxide at each exhaust duct during PCAPP EDS Emissions Sampling and Analysis using TCEMS.

Determination of these gaseous parameters will be done using TRC's transportable continuous emissions monitoring system (CEMS). Gas samples will be extracted from each outlet exhaust stack through a heated probe and sample line and routed to the analyzers for determination of O_2, CO_2, SO_2, NO_x, and CO in accordance with Methods 3A (O_2 and CO_2), 6C (SO_2), 7E (NO_x), and 10 (CO). These instruments will be operated concurrently with the exhaust gas sampling for the other parameters. TRC will follow procedures outlined in the EPA Publication 340/1-83-016 regarding setup and operation of its Transportable Continuous Emissions Monitoring System (TCEMS). Calibrations of the CEMS will done prior to, and at the conclusion of each test run. System bias checks will be performed, as well.
The TCEMS consists of three subsystems: sample acquisition/conditioning, sample analysis, and a data acquisition system. The sample acquisition/conditioning is designed to deliver a representative sample of the stack gas stream to the sample analysis subsystem. Since the gas stream must be dry for each of these analyzers, a noncontact moisture condenser will be used for moisture removal. The sample line will be heat-traced to eliminate in-line condensation prior to the condenser. It is fully anticipated that the moisture content of the gas stream will be extremely low, as it is primarily made up of ambient dilution air.

The data acquisition subsystem consists of a Strata digital data logger designed to receive and log instrument signals (raw voltages) at user-defined intervals. The resulting values are instantaneously accessible. Once the system is set up, the CEMS will be connected to a power source and brought online. Prior to hookup of the sample line to the heated manifold and sample conditioning system, the sample/acquisition system will be leak-checked by the following procedure:

1. Plug probe;
2. Observe that flow in rotameter reaches zero Lpm;
3. Observe vacuum; and
4. Confirm that sample vacuum during sampling does not exceed vacuum attained during leak check.

The initial phase of instrumental analysis methods requires calibration of all involved monitors. At the beginning of each day, direct instrument calibrations for zero and upscale gases will be performed prior to initiation of testing by direct calibration gas injection. System calibrations will be performed both prior to and following each run using zero and one upscale gas concentration. This will be accomplished by directing calibration gas through the sample line and conditioning system to assess system bias. Following completion of the required runs, final system calibrations will be performed. These procedures allow for determination of initial and final system bias, as well as system drift. Calibration gas values and instrument range settings are listed below:

Analyzer	Range	Conc.	High	Mid	Zero
O_2	0 – 25	%	22	10	nitrogen
CO_2	0 – 20	%	18	10	nitrogen
SO_2	0 – 5	ppm	5	2.7	nitrogen
NO_x	0 – 5	ppm	5	2.6	nitrogen
CO	0 – 100	ppm	89	42	nitrogen
CO	0 – 1,000	ppm	918	417	nitrogen

Calibration gases used will be certified and traceable to the National Institute of Standards and Technology (NIST). The measurement system performance specifications as stated in 40 CFR 60 Appendix A, for Methods 3A, 6C, 7E, and 10 are listed below and are the performance criteria for this program.

Procedure	Performance Criteria				
	O_2 M3A	**CO_2 M3A**	**SO_2 M6C**	**NO_x M7E**	**CO M10**
Zero Drift, % of range	< ± 3	< ± 3	< ± 3	< ± 3	< ± 3
Calibration Drift, % of range	< ± 3	< ± 3	< ± 3	< ± 3	< ± 3
Interference Response, % of range	< ± 2	< ± 2	< ± 2	< ± 2	< ± 2
NO_2 to NO Converter, % efficiency	NA	NA	NA	> 90	NA
Calibration Error, % of cal gas	< ± 2	< ± 2	< ± 2	< ± 2	< ± 2

Bias Checks

The following is the sequence of operations to be conducted to determine the basis of the sampling system for the specific source and setup configuration. This activity is conducted subsequent to the system calibration.

- Mark on the DAS printout the start and end of the bias check procedure. Introduce to the sampling system a zero gas. Allow the analyzer to reach a stable output. Record the time to reach a stable output on the DAS printout.
- Introduce to the sampling system an upscale calibration gas (i.e., the high-range calibration gas). Allow the analyzer to obtain a stable reading. Record the analyzer response on the DAS printout for the upscale calibration gas.
- Repeat the procedures for each analyzer. Note that zero gas may be appropriate as a zero for multiple analyzers and it is not necessary to repeat the procedure as long as the measurement was made for each analyzer.
- Calculate the TCEMS bias for each analyzer. The system bias for each analyzer must be within 5 percent of the span value.
- Calculate the TCEMS system drift by comparing the system response to the zero and upscale calibration gas with the system response during the previous bias check. Zero and calibration drift must be within 3 percent of the analyzer span value.

Response Time Determination

The following is the sequence of operations to be conducted to determine the response time of the system. This activity precedes the system calibration and bias check and or other measurements made through the TCEMS.

- Introduce a zero gas to the sampling system, set the zero, and mark the DAS printout accordingly.
- Introduce to the sampling system a high concentration calibration gas. Mark on the DAS printout at the start of the response time test. Allow the analyzer to reach 95 percent of the calibration gas value. Mark the end on the DAS printout. Record the number of seconds for the 95 percent response as the “upscale” response time.
- Introduce zero gas. Allow the analyzer to reach 5 percent of zero. Mark the time and record the number of seconds for the 5 percent response as the “downscale” response time.

- The longer of the two response times (i.e., upscale and downscale) will be used as the response time for the analyzer.
- Repeat procedures for each analyzer.
- The longest response time of any analyzer will be used as the system response time.

Table 13-1. Calibration Procedures for Analytical Methods

Method	Calibration Curve	Calibration Checks	Target Criteria
EP Method 30B	Blank and four standards, validated mid-range with an independent source.	Verified every 10 samples and at the end of a sample run	Correlation coefficient of >0.995, 90-110% of known value
SW-846 Method 6020	Blank and one standard checked with an independent blank and standard	Verified every 10 samples and at the end of a sample run	± 10% of known value
SW-846 Method 8260B	Five-point calibration checked with an independent standard	Verified every 12-hour tune period	Variability of average RRF of 30% RSD
SW-846 Method 8270C	Five-point calibration checked with an independent standard	Verified every 12-hour tune period	Variability of average RRF of 30% RSD
SW-846 Method 8290	Five-point calibration checked with an independent standard	Verified every 12-hour tune period	Variability of average RRF: • Labeled Standard RSD ≤ 30% • Unlabeled Standard RSD ≤ 20%
ASTM D1945	A 5-point calibration using average Response Factor.	Verified prior to analysis	The acceptance criterion is RSD ≤15%. All target analytes must be within the linear range of calibration (with the exception of oxygen, nitrogen, and C6+ hydrocarbons.
EPA OTM 29	Four point calibration checked with an independent standard	Verified every 10 samples and at the end of a sample run	90-110% of theoretical concentration
EPA CTM 027	Four point calibration checked with an independent standard	Verified every 10 samples and at the end of a sample run	90-110% of theoretical concentration
PV2111	Four point calibration checked with an independent standard	Verified every 10 samples and at the end of a sample run	90-110% of theoretical concentration

Table 13-2. Activity Matrix for Calibration of Sampling Equipment

Equipment	Acceptance Limits	Frequency and Method of Measurements	Method Reference	Action if Requirements are Not Met
Dry gas meter (All control boxes)	$Y_i = Y \pm 0.02\ Y$	Calibration versus wet test meter, reference dry gas meter, or critical orifice set: Initially and when post-check exceeds $Y \pm 0.05$	EPA Method 5	Repair or replace, and then calibrate
Thermocouples	Thermocouple and reference agree within ± 2º F.	Verification before and after test against an ASTM mercury-in-glass reference thermometer or equivalent	EPA Alt. Method 011	Adjust, determine a constant correction factor, or reject
Barometer, aneroid	± 2.5 mm (0.1 in.) mercury of mercury-in-glass barometer	Calibration initially versus mercury-in-glass barometer: checks before field test	EPA Method 5	Adjust to agree with a certified barometer
Type-S pitot tube or probe assembly or both	All dimension specifications met.	Calibration before test and visual inspection after each field test	EPA Method 2	Use pitot tubes that meet face opening specifications, repair or replace, as required
Bios Dry cell Defender flow calibrator	Vendor calibrated	Annual	N/A	Recalibration.

14.0 Procurement of Items and Services

A process will be established and implemented to control purchased items and services (e.g., equipment, analytical services, certified sample bottles, standards, and reagents). Procured items and services will meet established requirements and perform as specified. Prospective suppliers will be evaluated and selected on the basis of specified criteria. Processes to ensure approved suppliers continue to provide acceptable items and services will be established and implemented.

The procurement process will describe provisions for the following:

- Defining applicable technical and administrative requirements for subcontracted services and items including acceptance criteria
- Selecting qualified subcontractors
- Verifying that qualified subcontractors can continue to provide acceptable products and/or services
- Accepting purchased items and/or services
- Receiving and maintaining procurement records including evidence of conformance
- Documenting nonconforming items and services.

Qualified suppliers and, as necessary, sub-tier suppliers will be monitored periodically to ensure acceptable items and services continue to be supplied.

Procurement documents will contain information clearly describing the item or service needed and associated technical and quality requirements. Procurement documents will specify the quality system requirements within this plan for which the supplier is responsible. Procurement documents will be reviewed for accuracy and completeness by qualified personnel before release. Changes to procurement documents will receive the same level of review and approval as the original documents.

15.0 Data Management

Data management consists of five areas where data is collected, analyzed, and reported: field sampling data, laboratory analyses, interim reports, data validation, and final reports. As much as possible, data will be transferred electronically through the data management areas to avoid transcription errors.

The laboratories will prepare and submit analytical data packages as described in **Section 18.0**, Data Reduction, Reporting, Verification, and Validation, of this SAP. These packages will be delivered to designated project personnel. After verification that all required results have been reported, Leidos and TRC will designate individuals to validate the data. The laboratories will report results in a format that will allow for full validation of the data. **Section 18.0**, Data Reduction, Reporting, Verification, and Validation, and **Section 20.0**, Reporting, of this SAP provide additional information about the reports.

All raw data and data packages associated with the analysis of PCAPP EDS emission samples will be archived for a minimum of five years after completion of the testing. This includes field notebooks, data notebooks, hard copies of data packages from laboratories and data validators, and any associated workbooks and calculations. Each laboratory will provide notification to their parent contractor before the disposal of any archived materials.

16.0 Corrective Actions and Assessment

16.1 Audit Procedures

TRC will accomplish sampling performance audits through observation of the sampling operations. Adherence to procedures may be maintained by the use of checklists for each sampling train configuration. When used, these checklists will aid in documenting that the steps of the procedure were followed in the correct order. Combined with the field data sheets, these data will constitute a complete record of the sampling activity. TRC will assume full responsibility for review of the sampling data.

Analytical performance audits will consist of the replicate analysis and spiked sample procedures outlined in **Section 5.0**, Quality Assurance and Quality Control Objectives, and **Section 12.0**, Quality Control Requirements, of this SAP. These audits will be performed for each of the 4 EDS shots.

16.2 Corrective Action for Minor System Events

Corrective action is required whenever a circumstance arises that adversely affects the quality of the data output. In order for corrective action to be initiated, awareness of a discrepancy must exist. In most instances, the personnel conducting the fieldwork and the laboratory analysis are in the best position to recognize events that will affect data quality. Keen awareness on their part can frequently detect minor instrument changes, drifts, or malfunctions, which can then be corrected, thus preventing a major breakdown of the system.

In the event TRC observes a condition that may adversely affect the quality of the data, he/she must first decide if he/she can fix the discrepancy before a serious effect occurs. An example would be any circumstance where instrumental conditions have to be changed to maintain sampling rates within the flow rate window. If this kind of circumstance occurs, TRC will correct the discrepancy immediately, and then note the discrepancy and the corrective action on the run sheet. A nonconformance report is not required to document minor system events.

16.3 Corrective Action for Major System Events

If major sampling events arise, such as a failed leak check, TRC's technicians are in the best position to observe a need for corrective action and initiate a response immediately, thus minimizing data loss. Therefore, the field sampling personnel will have a prime responsibility for recognizing nonconforming conditions. TRC must notify the RCMD Site Manager immediately when serious situations arise. The RCMD Site Manager may authorize a temporary suspension of sampling while corrective action is defined and/or performed. If the event is deemed to be minor, the RCMD Site Manager will then enter

the event in his/her records and instruct the appropriate personnel that the test run will continue. It is the responsibility of the RCMD Site Manager to promptly notify the appropriate regulatory authorities of all such occurrences.

If testing is suspended, the corrective action must follow a more formal path. The Leidos project manager and TRC will obtain input from the appropriate personnel and initiate a closed-loop response. The steps to a closed-loop response to the nonconformance are as follows:

- Define the event
- Assign responsibility for investigating the event
- Investigate and determine the root cause of the event
- Determine corrective action course to eliminate the root cause of the event
- Assign responsibility for implementing the corrective action
- Determine the effectiveness of the corrective action and implement the correction
- Verify the corrective action has eliminated the root cause of the event
- If the discrepancy is not completely eliminated, loop back to first step
- Notify appropriate regulatory authorities and PCAPP oversight personnel
- Obtain approval to restart the test run if feasible
- Restart the test run if feasible.
- Document the event as a nonconformance, and note the event in the appropriate logs and reports.

If the event cannot easily be contained, then alternative actions must be considered and communicated to oversight personnel. Decisions on whether to take corrective action and what action(s) to take will be made by the Leidos project manager or TRC. When a corrective action is taken by any of the sampling technicians, they will be responsible for notifying TRC, if deemed necessary, QA surveillance of the affected sampling or analysis system can be intensified. The personnel identifying the event shall initiate nonconformance reports. Each nonconformance and corrective action report will become part of the final report or the supporting data files. The primary method of documenting nonconformance and corrective action will be the TRC nonconformance report, an example of which is shown in **Figure 16-1**. Documentation shall include:

- Identification of the individual(s) identifying or originating the nonconformance
- Description of the nonconformance
- Any required approval signatures

- Method(s) for correcting the nonconformance (corrective action) or description of the variance granted
- Schedule for completing corrective action.

Documentation in the form of a nonconformance report shall be made available to the Leidos project manager, as well as TRC. It is the responsibility of TRC to notify appropriate project personnel of the nonconformance. It is the responsibility of Leidos to promptly notify the appropriate regulatory authorities of the nonconformance. Samples affected will be listed on the TRC nonconformance report.

16.4 Corrective Action for Laboratory Nonconformance

Laboratory personnel will have a prime responsibility for recognizing the need for a nonconformance. The person originating it shall document each nonconformance. More significant events require the initiation of a nonconformance report. Minor events will be recorded in the analysis run log.
The primary method of documenting nonconformance and corrective action in the laboratories will be a nonconformance memo (not shown). Documentation shall include:

- Identification of the individual(s) identifying or originating the nonconformance
- Description of the nonconformance
- Any required approval signatures
- Method(s) for correcting the nonconformance (corrective action) or description of the variance granted
- Schedule for completing corrective action.

Documentation in the form of a nonconformance report shall be made available to the RCMD Site Project Manager. It is the responsibility of TRC to notify their appropriate project personnel of the nonconformance. Samples affected will be listed on the nonconformance report.

16.5 Corrective Action Arising from Review of Test, Quality Control, or Audit Sample Data

Another recognition level of the need for corrective action will be from the results of the audits described in the SAP and from review of the QA data generated during the PCAPP EDS Emissions Test. TRC will be responsible for initiating corrective action during sample analysis. The appropriate management will then be responsible for instituting corrective action and verifying that the corrective actions produce the desired results. For example, if matrix spike results are outside quality control limits and sufficient sample remains to re-prepare and reanalyze the sample, the decision may be made to repeat the analysis. Optionally, modified preparation techniques may be used if the analyst's observations indicate that the

standard preparation is inadequate. If results cannot be obtained that meet the target criteria, then qualification may result. The entire situation will be reported on a nonconformance memo and discussed in the case narrative of the analytical report and in the final report, as appropriate. Ultimately, the personnel performing and checking the sampling and analysis procedures and results must participate in decisions to take corrective actions. To reach the proper decision, each individual must understand the program objectives and data quality required to meet these objectives. Data quality objectives for PCAPP EDS Emissions Sampling and Analysis are presented in this SAP. Personnel involved in the PCAPP EDS Emissions Sampling and Analysis project will receive or have available to them an approved copy of this SAP and will be informed of these objectives. Each individual will have a responsibility to notify the respective field sampling or laboratory operations supervisor whenever a measurement system is not yielding data within these objectives.

16.6 Quality Assurance Reporting

TRC will review this SAP before initiation of the PCAPP EDS emission sampling and analysis project. TRC will immediately notify the Leidos project manager of any event or occurrence that could have a significant effect on the validity of the PCAPP EDS Emissions Sampling and Analysis results. Notification will be verbal, followed by a written memorandum, which includes the proposed corrective action. Major events will be reported using the TRC nonconformance report. QA reports will be submitted with the final report.

It will be the responsibility of Leidos to promptly notify the appropriate regulatory authorities of any event or occurrence that could have a significant effect on the validity of the PCAPP EDS Emissions Sampling and Analysis results.

Figure 16-1. Example Nonconformance Report

Date:	**NCR-**
Project/Activity:	
Requirement:	
NCR Identified by:	**NCR Identified:**
Description of Nonconformance:	
☐ **Use-as-is** ☐ **Rework**	☐ **Reject and Replace** ☐ **Retrain**
Recommended Resolution:	
QC Supervisor	**Project Manager**
Signature/Date	**Signature/Date**
Evaluation of Disposition:	
NCR Closeout: **Verification of Resolution by:** _____ **Signature and Date**	

17.0 Reports to Management

A formal mechanism for reporting the status of the program to Leidos will be established and implemented by TRC. At a minimum, reports will be issued before field mobilization, at the conclusion of the field program, and following submission of the final report. The reporting system will identify the following:

- Frequency schedule for QA, tasks, and subcontractor reports
- Report recipient(s)
- Report preparer(s).

QA reports will include a summary of the results of the following:

- Performance evaluation assessments
- Technical system assessments
- Management system assessments
- External audits and surveillance activities
- Data quality and validation assessments
- Regulatory compliance issues
- Corrective actions and status
- Supplier/subcontractor performance.

18.0 Data Reduction, Reporting, Verification, and Validation

This section of the SAP describes the approach used to report, review, and reduce the field and laboratory data into an appropriate presentation format in the final report. The results will be presented in a manner that demonstrates compliance with the PCAPP EDS Emissions Sampling and Analysis project objectives. The raw data will be generated as field sampling documentation, sample traceability documentation, laboratory processing documentation, and raw data from analytical instruments. The most significant aspect of data reporting will be the compilation of the analytical results from each laboratory. Analytical results will be compiled into analytical data packages. Following delivery of the analytical results to the designated personnel, a data verification effort will be undertaken to review the content of these deliverables for compliance with the PCAPP EDS Emissions SAP requirements. The reported data also will be evaluated for compliance with the data quality objectives. If the data are determined to have met the analytical requirements, they will then be used to demonstrate the project objectives.

18.1 Data Reporting

Data reporting is considered to be the compilation of the results from the laboratories. The laboratory deliverables that constitute this compilation are the hard copy analytical data packages. The style and format of the deliverables and the process for completing their compilation is discussed in this section.

18.1.1 Analytical Data Packages

Analytical data packages are formatted and organized in a manner to allow independent verification of the reported results. These data packages are stand-alone deliverables that include the instrument raw data, parameter-specific quality control documentation, calibration and calibration check performance, and instrumentation performance information. These data are included so an independent verification of the final analytical results can be conducted. In addition to the raw data, all analytical data packages will contain a narrative that identifies project-specific information and any pertinent information from the performing laboratory concerning data quality. The narrative also summarizes the quality control data and any difficulties or analytical anomalies encountered during laboratory processing that are considered pertinent to achieving data quality objectives or project-specific objectives. Each laboratory report will also include all chain-of-custody records as well as a cross-reference for the field sample and laboratory sample identities.

The remaining analytical data package sections are specific to each type of analysis performed (the associated reference methods are summarized in **Table 11-1**). Each validatable data package will summarize the raw data on standard forms. The summary forms are included to tabulate information that

is relevant to the analysis in a more accessible fashion. Specific information that will be provided for each analysis type is summarized in **Table 18-1**.

18.1.2 Certificates of Analysis

Certificates of analysis, or results pages, will be presented in a format that includes both sample collection information (i.e., date of collection) and analytical data. The results pages will summarize the analytical results and may provide a summary of the internal standard and surrogate recoveries, as applicable.

18.1.3 Analytical Data Results

Reporting of analytical results is dependent upon the analytical procedure employed. For this analytical program, DL, RL, and MDLs may be reported.

The laboratory reports a DL when the analytical method (e.g., SW-846 Method 8290) specifies a minimum level at which results will be reported. The DL is calculated in accordance with the method requirements and values below the DL are not reported. It is isotope dilution methods that typically report to a DL given the quantitation technique. For these methods, each sample is spiked with an isotopically labeled surrogate or internal standard for each target compound. On a sample-by-sample basis, the recovery of each surrogate or internal standard is determined; then, the analytical result is normalized to the recovery of the corresponding surrogate compound. In this manner, the DL for each sample and each compound can vary as the surrogate recovery varies.

The MDL is defined as the minimum concentration of a substance that can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero. It is a statistical limit that is matrix independent. The MDL, however, is an absolute measurement and, as such, does not factor in the accuracy of the quantitation. The laboratory-generated MDLs are evaluated to ensure their suitability. One evaluation criteria that is often employed is the comparison of the mean concentration of the replicate analyses from the study versus the statistically-derived MDL. Based on such evaluations, the limit of reliable detection may be established at a value that is greater than the statistically-derived value (e.g., the MDL may be based on the analysis of a low-level DL verification sample). The MDL is used, in general, with analyses that employ external or internal standard quantitation.

The RL is a laboratory-specific minimum concentration at which results are typically reported (i.e., values less than the RL are generally not reported). For this program, results that are less than the RL, but greater than the MDL, will be reported. There is no specific requirement that establishes how an RL must

be established. SW-846 guidance suggests that values below the lowest calibration standard should not be reported. In the absence of a specific requirement, RLs are established based on the lowest concentration in the calibration curve, one-half of the lowest concentration in the calibration curve, or a multiplier of the MDL. The RL may not be established at a value that is less than the MDL. Changes to extraction protocol, amount of sample used in preparation, or dilution applied to the sample can raise or lower the RL.

The results of sample analyses will be reported in concentration units. Sample results will be reported for all samples and parameters required for the PCAPP EDS Emissions Test. Exhaust gas sample results will be reported as a total mass at the DL or RL. In all instances, results will be calculated following method requirements or standard reporting conventions. Based on guidelines found in the analytical method, data validation guidelines, or in this SAP, each laboratory will assign qualifiers to the results, when appropriate. Qualifiers appearing on a results page will be defined on that results page or in the case narrative.

18.1.4 Report Preparation

Each laboratory will follow a standard operating procedure for the steps taken in the reporting process for the analytical data packages. Laboratory personnel will review the calculations to confirm the analytical results are correct. An analysis-specific data review checklist will be used to ensure all preparation and analysis documentation for the test run and the quality control samples is included in the data package. Laboratory personnel will also check the accuracy and completeness of the summarization forms. The data package will also be subject to peer review by the group leader, section head, or designated laboratory personnel. The laboratory manager, or designee, will perform the final review of the deliverables to check for completeness and to determine that the client's requirements for data quality were met.

18.2 Data Review

The data review process will be initiated when the designated personnel receives the analytical data packages from the laboratory and verifies each sample was analyzed correctly for the parameter requested on the chain-of-custody forms. This review of the deliverables will confirm all required laboratory quality control was performed and the results were reported. After this initial review, data reported on the results pages and raw data are compared to verify no transcription errors occurred during reporting. Next, the data for each analytical parameter will be reviewed thoroughly for each individual sample to

ensure all the pertinent information is included in the analytical data package. This review will confirm the data are usable for an assessment of the PCAPP EDS emissions.

If, during the review process, any errors or deficiencies are found in the analytical data packages, they will be noted by the reviewer and the laboratory will be notified so corrected pages can be issued for inclusion into the final report. The corrected pages are then reviewed upon submittal for accuracy before incorporation into the data package.

18.3 Field Data Reduction

When the data review process is complete, the results will be summarized in tables for presentation in the final report and reduced into a form that is usable demonstrating the project objectives. **Section 20.0**, Reporting, presents additional information as to how the sampling and analytical data will be reduced to calculate the mass emissions rates and presents example calculations as well as two example tables.

18.3.1 Analytical Data Summary

Analytical data summary tables will be included in each final report and will be categorized primarily by analytical parameter. Typically, these tables will summarize the analytical results and the results of the individual sampling trains, as applicable.

In the summary tables, the data for exhaust gas samples will be summarized for all test runs and/or on a run-by-run basis and presented. The data for exhaust gas samples will be presented on a per-fraction basis. Results for each fraction are, in general, reported from the laboratory in terms of total mass. Combining the results from each fraction produces a total to be used in calculating mass emission.
In instances where the analyte concentration in a sample is reported as a nondetect (ND), the RL and a "less than" symbol (i.e., <) will be the reported value in the table for the result, and the value will be used for any emission calculations. Any estimated quantitation reported from the laboratory or as indicated by the data validation effort will be discussed in the final report.

The results will be evaluated by designated personnel to determine if the project objectives have been met. If anomalous results are obtained, every effort will be made to identify the reason for the anomaly in the sample collection, sample preparation, or analysis. If any anomalies have occurred, the final report will include the results of the affected sample data, a thorough discussion of occurrence, and any perceived impact on overall data usability.

18.3.2 Quality Control Data Summary

The quality control data summary tables will be provided in the QA/QC report appendix of each final report and will be organized by parameter. General types of quality control data summary tables that may be provided include internal standard and surrogate recovery results and laboratory control sample/laboratory control sample duplicate recovery results. The results will be checked against the target acceptance limits. Any data that fall outside of the target acceptance limits will be flagged or footnoted on the quality control data summary tables. The data from the field-generated blanks will be sorted into categories such as field blanks, trip blanks, reagent blanks, and blank trains. The data from the field blanks and trip blanks will be interpreted in the QA/QC report to show that the samples could be handled in the field and transported to the laboratory without contamination problems. The reagent blank and blank train results will be interpreted to represent the amount of contamination from reagents or handling that will be present in a train before sampling has begun.

18.4 Data Validation

The data reporting, review, and reduction activities described in **Sections 18.1, 18.2, 18.3**, and elsewhere in this SAP include actions that will allow designated personnel to verify data produced in the field and by the laboratory and assess that these data meet the criteria established in this SAP. Generally, only the end user of the data can make a final assessment of the usability of the data with respect to making regulatory decisions based on PCAPP EDS Emissions Sampling and Analysis results.

In accordance with the requirements of this SAP, TRC will require each non-agent laboratory to supply analytical data packages intended to support data validation by a third party. Each laboratory will be required to submit data packages that are supported by quality control test results and raw data.

Leidos designated personnel will validate each laboratory report. The results of this validation will be provided to the regulatory authorities as an appendix to each final report. The validation protocols used to validate the data will be based on published EPA data validation guidelines, including the following:

- *USEPA Analytical Operations/Data Quality Center (AOC) National Functional Guidelines for Chlorinated Dioxin/Furan Data Review*, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C., August 2002
- *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C., July 2002

- *USEPA Analytical Operations/Data Quality Center (AOC) National Functional Guidelines for Chlorinated Dioxin/Furan Data Review*, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C., August 2002.

There are three validation levels established for the PCAPP EDS Emissions Sampling and Analysis program. The three levels and a description of the level of activity associated with each level are identified below.

- Level A: This level of data validation includes:
  - Verification of required deliverables
  - Requested versus reported analyses
  - Evaluation and qualification of results based on holding times
  - Qualification of results based on method blank results.
- Level B: This level of data validation includes all items identified in Level A plus evaluation and qualification of results based on the following:
  - Matrix spike/matrix spike duplicate (MS/MSD) analysis
  - Laboratory control sample/laboratory control sample duplicate (LCS/LCSD) analysis
  - Surrogate recoveries
  - Internal standards performance (HRGC/HRMS only).
- Level C: This level of data validation includes all items identified in Levels A and B plus evaluation and qualification of results based on the following:
  - Initial and continuing instrument calibrations (standards and blanks)
  - Laboratory control samples
  - Instrument tuning
  - Analytical sequence
  - Internal standards performance (GC/MS and ICP/MS only).

All non-agent exhaust gas reports provided by the non-agent laboratories will be prepared to allow validation to any level. The non-agent exhaust gas results will be validated to Level B. **Table 18-2** is a list of data validation criteria that will be used as a guide for performance of data validation.

Table 18-1. Offsite Laboratory Report Constituents

Report Constituent [a]	Volatile Organics by GC/MS	Semivolatile Organics by GC/MS	MEA by HPLC	Dioxins/Furans by HRGC/HRMS	Polychlorinated Biphenyls by HRGC/HRMS	Metals by ICP/MS	Mercury by CVAAS	Ammonia by IC	HCN by IC
Case Narrative	X	X	X	X	X	X	X	X	X
Sample Results Summary	X	X	X	X	X	X	X	X	X
Instrument Tuning and Instrument Performance Check	X	X		X	X	X			
Initial Calibration	X	X	X	X	X	X	X	X	X
Continuing Calibration	X	X	X	X	X	X	X	X	X
Method Blank	X	X	X	X	X	X	X	X	X
Surrogate Recovery	X	X		X	X				
MS/MSD, as applicable	X	X	X	X	X	X	X	X	X
LCS/LCSD, as applicable	X	X	X	X	X	X	X	X	X
Internal Standards	X	X		X	X	X			
Tentatively Identified Compounds	X	X							
Interference Check Sample Results						X			
Serial Dilution Results						X			
Raw Data	X	X	X	X	X	X	X	X	X

Note:

[a] Report constituents will reflect the actual method requirements and/or quality control analyses performed as required by the analytical method and this SAP. For example, not all exhaust gas sample reports will include MS/MSD as LCS/LCSD is typically performed in lieu of MS/MSD (see **Section 5.0**, Quality Assurance and Quality Control Objectives).

Table 18-2. Data Validation Criteria[a]

Components of the Laboratory Report (See SAP Table 18-1 for which criteria apply to which reports)			
Item	Criteria (Evaluate for each laboratory data package)	Present/Absent/Not Applicable	Comment
1	Case narrative present		
2	Sample results summary present		
3	Instrument tuning and instrument performance check results reported		
4	Initial calibration results reported		
5	Blank results reported (method/field/reagent/trip as appropriate)		
6	Surrogate recovery data present		
7	MS/MSD results present		
8	LCS/LCSD results present		
9	Internal standards results given		
10	TICS reported along with estimated values		
11	Interference check sample results present		
12	Serial dilution results provided		
13	Raw data provided		
General Components of the TRC Report			
	Criteria	Present/Absent/Not Applicable	Comments
14	Reason is given for all flagged/qualified data		
15	RL is given for all nondetects		
16	Do reported results match requested results (they performed the analyses that were requested)		
Validation of Data versus DQO Parameters (See SAP **Tables 5-1 through 5-8** for the various values)			
	Criterion	Pass/Fail	Comment
17	Precision, accuracy, and frequency values are within guidelines set in **Table 5-1** (evaluate separately for each COPC grouping)		
18	Percent recoveries are within the guidelines identified in **Tables 5-2 through 5-8** (evaluate each class of analyte separately)		
Validation of Calculations (See SAP **Sections 5.0 and 20.0** for equations and example calculations)			
	Criterion	Pass/Fail	Comment
19	Review calculations to ensure correct equations were used and arithmetic is correct (Minimum 10% review of each type of calculation for each laboratory and class of analyte). Equations for precision, accuracy, and completeness are in **Section 5.0** while equations for data reduction are in **Section 20.0**.		

Table 18-2. Data Validation Criteria[a] (Continued)

Note:

[a] This checklist is intended to be a guide in the validation process and will be applied to each data set received. Any deviations identified will be described in text along with an assessment of the impact the deviation has on the usability of the overall data set.

19.0 Software and Database Control

Software systems can be separated by application into two categories: administrative and technical. Administrative software systems are used to manage the workflow or to monitor performance against administrative requirements. Examples of administrative software systems are those that control sample tracking, procedural control, training, and reporting. Technical software systems are used to control laboratory systems and to accumulate and reduce data. Examples of technical software systems are those that provide instrument interface, calculations, calibration control, and control charts. Databases may be included in administrative or technical software.

For laboratory-developed software, a copy of the original program code will be maintained, acceptance tested, and all changes will include a description of the change, authorization for the change, and test data that validates the change.

Requirements will be established and implemented for the backing up of software and electronic data at regular intervals. The frequency of the backups will be based on the quantity of data and the impact of data or software loss.

Software user manuals will be available to personnel using the software.

20.0 Reporting

Generally, data to be generated during this program will be the result of the sampling effort and the analysis of the collected samples. The sampling trains will be both for groups of compounds (speciated metals, PCDD/PCDF, volatile and semivolatile organics) and for specific compounds (Hg, NH_3, HCN, and MEA). The CEMS instruments will determine individually SO_2, NO_x, and CO. Flow rates will be measured prior to the start of the sampling and used to calculate the mass emission rates.

In addition to reporting data for the analytes of interest, the laboratories will also provide data on tentatively identified compounds (TICs) for speciated volatiles and semivolatiles. The TRC chemist, in coordination with Leidos and the analytical laboratories, will assess each TIC to determine what significance, if any, that compound has for EDS emissions. All TICs and TIC interpretations will be included in the interim and final PCAPP EDS emission reports. Potential TIC interpretations include but are not limited to:

- TIC is a likely EDS-related emission and will be considered for inclusion as an analyte of interest in future sampling events if feasible;
- TIC is a common laboratory contaminant and may not be an EDS emission;
- TIC is a chemical used in the collection or processing (solvents, for example) of the PCAPP EDS emission samples and therefore not an EDS emission;
- TIC is a reaction product from chemicals (surrogates for example) used in the collection or processing of the emissions samples and therefore not an EDS-related compound.

20.1 Mass Emission Rate Determination - EDS Emissions Sampling and Analysis Report

The field sampling will primarily yield the actual samples for analysis, the duct gas flow rates, and the individual sampled gas volumes. The analytical effort will yield results for each target analyte expressed as mass (e.g.- µg) or concentration (e.g.- ppm). Either one is converted to a usable mass concentration and combined with the flow rate to determine the mass emission rates. The following presents example calculations for the different sample types. Note that, if a compound was not detected above the analytical reporting limit (RL), then the RL is presented, preceded by a “less than” (<) sign. Subsequent data reduction of that compound will carry the “<” throughout.

The RL is a laboratory specific minimum concentration at which results are typically reported. Values less than the RL are generally not reported. For this program, results that are less than the RL, but greater than the MDL, will be reported and will be flagged as J-coded (estimated) values. There is no specific

requirement for how an RL must be established and in fact different rules may be used for different analytical methods. SW-846 guidance suggests that values below the lowest calibration standard should not be reported. In the absence of a specific requirement, RLs are established based on the lowest concentration in the calibration curve, one half of the lowest concentration in the calibration curve, or a multiplier of the MDL. The RL may not be established at a value that is less than the MDL. Changes to the extraction protocol, amount of sample used in preparation, or dilution applied to the sample can raise or lower the RL.

The results of sample analyses will be reported in mass and/or concentration units. Sample results will be reported for all samples and parameters required for the PCAPP EDS Emissions Sampling and Analysis project. Exhaust gas sample results (all but volatile organics) will be reported as a total mass at the DL or RL. Volatile organics will be reported as concentrations at the respective RLs. In all instances, results will be calculated following method requirements or standard reporting conventions. Based on guidelines found in the analytical method, data validation guidelines, or in this SAP, each laboratory will assign qualifiers to the results when appropriate. Qualifiers appearing on a results page will be defined on that results page or in the case narrative (SAP **Section 18.1.3**, Analytical Data Results).

The labs will report analytical results relative to the respective minimum RL for each compound. These compound-specific RLs are presented in SAP **Table 11-2**. A non-detected compound will be reported as a "less than" value which will then be used to calculate the subsequent concentrations and emission rates preceded by a "<". The table below contains MDLs and RLs for the various analytes and also presents a summary of the emission rates that would be reported for compounds identified as non-detected by the laboratories. The results shown in the table are based on assuming a total sampling time of 40 minutes, a stack flow rate of 5,500 dscfm, and sampling rates applicable to the various sampling methods. The equations in this section were used to calculate the emission rates (lb/hr and g/s). This table is presented as **Table 20-1**.

Note that the example calculations given below are based on a prior EDS shot test where the measured flow rate was 4,920.4 dry standard cubic feet per minute (dscfm).

20.1.1 Volatile Organics (Example Calculation)

The volatile organics were collected using Method TO-15 and yielded a whole air sample with analytical results expressed as both ppm and $\mu g/m^3$. The methane and ethane concentrations from the samples were expressed as % which were converted to ppm and then $\mu g/m^3$.

The example given for vinyl chloride is:

Vinyl chloride, lb/hr = 4,920.4 dscfm × <2.8 µg/m^3 vinyl chloride ÷ 35.31 m^3/dscf ÷ 453,600,000 µg/lb × 60 min/hr
= <5.16 E^{-5} lb/hr

Vinyl chloride, g/s = <5.16 E^{-5} lb/hr × 453.6 g/lb ÷ 3,600 s/hr
= <6.50 E^{-6} g/s

20.1.2 Semivolatile Organics (Example Calculation)

The semivolatile organics were collected using Method TO-10A in 175.88 dry standard liters (dsL) collected over the 33-minute sampling period. The analytical results are expressed as µg.

The example of acenaphthene is:

Acenaphthene, lb/hr = 4,920.4 dscfm × <10 µg acenaphthene ÷ 175.88 L × 28.32 L/dscf ÷ 453,600,000 µg/lb × 60 min/hr
= <1.05 E^{-3} lb/hr

Acenaphthene, g/s = <1.05 E^{-3} lb/hr × 453.6 g/lb ÷ 3,600 s/hr
= <1.32 E^{-4} g/s

Note that PCDD/PCDF emissions will be determined in the same manner for the individual congeners.

20.1.3 Trace Metals (Example Calculation)

The metals were collected using a modified Method 29 in 2.34 dry standard cubic feet (dscf) collected over a 34-minute sampling period. The analytical results are expressed as µg.

The example of chromium is:

Chromium, lb/hr = 4,920.4 dscfm × <0.35 µg chromium ÷ 2.34 dscf ÷ 453,600,000 µg/lb × 60 min/hr
= <9.73 E^{-5} lb/hr

Chromium, g/s $= <9.73\ E^{-5}$ lb/hr $\times$ 453.6 g/lb $\div$ 3,600 s/hr

$= <1.23\ E^{-5}$ g/s

20.1.4 Ammonia (Example Calculation)

Ammonia was collected using Method CTM-027 in 2.38 dry standard cubic feet (dscf) collected over a 34-minute sampling period. The analytical results are expressed as µg.

The example of ammonia is:

Ammonia, lb/hr $=$ 4,920.4 dscfm $\times$ <24 µg NH_3 $\div$ 2.38 dscf $\div$

453,600,000 µg/lb $\times$ 60 min/hr

$= <6.56\ E^{-3}$ lb/hr

Ammonia, g/s $= <6.56\ E^{-3}$ lb/hr $\times$ 453.6 g/lb $\div$ 3,600 s/hr

$= <8.27\ E^{-4}$ g/s

20.1.5 Hydrogen Cyanide (Example Calculation)

Hydrogen Cyanide was collected using Method OTM-29 in 26.75 dry standard liters (dsL) collected over the 34-minute sampling period. The analytical results are expressed as µg.

The example of hydrogen cyanide is:

Hydrogen Cyanide, lb/hr $=$ 4,920.4 dscfm $\times$ <2.6 µg HCN $\div$ 26.75 L $\times$ 28.32 L/dscf $\div$

453,600,000 µg/lb $\times$ 60 min/hr

$= <1.79\ E^{-3}$ lb/hr

Hydrogen Cyanide, g/s $= <1.79\ E^{-3}$ lb/hr $\times$ 453.6 g/lb $\div$ 3,600 s/hr

$= <2.26\ E^{-4}$ g/s

20.1.6 MEA (Example Calculation)

MEA was collected using OSHA Method PV2111 in 3.42 dry standard liters (dsL) collected over the 34-minute sampling period. The analytical results are expressed as µg.

The example of MEA is:

MEA, lb/hr = 4,920.4 dscfm × <0.3 µg MEA ÷ 3.42 L × 28.32 L/dscf ÷ 453,600,000 µg/lb × 60 min/hr
= <1.62 E^{-3} lb/hr

MEA, g/s = <1.62 E^{-3} lb/hr × 453.6 g/lb ÷ 3,600 s/hr
= <2.04 E^{-4} g/s

20.1.7 Oxides of Nitrogen (Example Calculation)

As with the sulfur dioxide and carbon monoxide concentrations, the oxides of nitrogen concentrations within the outlet ducts will be monitored using the CEMS in accordance with their respective methods. The concentrations are expressed as ppm (by volume, dry basis, ppmvd).

The example of oxides of nitrogen is:

The NO_x mass emission rate at each sampling location was calculated as follows:

NO_x, lbs/hr = 4,920.4 dscfm × 0.11 ppmvd NO_x × 46 MW × 60 min/hr ÷ 385.3E6
= 3.83 E^{-3} lb/hr

NO_x, g/s = 3.83 E^{-3} lb/hr × 453.6 g/lb ÷ 3,600 s/hr
= 4.83 E^{-4} g/s

20.2 Program Reports

The primary objective of PCAPP EDS emissions sampling and analysis is to determine if measured emission levels warrant reevaluation of the MPHRA. Those decisions are outside the scope of the PCAPP EDS emission sampling and analysis project. However, it is important that the values obtained from sampling and analysis be converted to units that are compatible with MPHRA input requirements. Upon receipt of the emission values from TRC, Leidos will make necessary adjustments in units and organize the data into tables so that persons working with the MPHRA can determine if there is a need to rerun the MPHRA using the new values. The results of that comparison will be reported in each of the interim reports and the final report for the PCAPP EDS emissions project.

20.2.1 Reporting of Non-Detects

As noted above, if a compound is not detected in an analysis, that result will be presented in the EDS sampling and analysis reports' emissions tables. However, for the MPHRA, non-detect values will not be used. In that case, the maximum detected value of each analyte (even if it is an estimated value) is the value that will be used in subsequent calculations. The plan is to collect emission samples from 4 EDS shots. Because of the small number of samples, maximum detected values will be used rather than average or median values. Therefore, non-detects will not be used. The only reason a maximum value would not be used is if the value is rejected during QA evaluation due to a sampling or analytical issue. If analytical results from all 4 EDS shots are non-detects then that analyte will be excluded from further calculations.

20.2.2 EDS Sampling and Analysis Reports

Because emissions sampling and analysis will be performed in 4 separate sampling events likely requiring 4 separate deployments to the PCAPP EDS site, TRC will produce an interim report after each sampling event which will be submitted within 90 days following the event. If two sampling events occur within 30 days of each other TRC may, at its discretion, produce a single interim report covering the two events. The TRC report will be forwarded to Leidos for review and preparation of a cover document that interprets the results based on the need to produce data of sufficient quality that it can be used for comparison to previously estimated and measured emission values. Leidos will submit the TRC report along with the Leidos interpretation to RCMD within 135 days of completion of the sampling event. The interim reports will function to inform RCMD and other participating agencies, as well as CDPHE and the public, of the results of the emissions sampling and analysis effort.

The TRC report will include all emissions sample data collected including raw data (field and laboratory) necessary to allow for an independent audit to be performed. The report will summarize field activities, laboratory results, and any changes to the SAP. The TRC report containing the raw analytical data wil be included in the Leidos Report.

Data reports will be formatted in an appropriate manner. Program data will be presented in tables modeled on those used in the chemical agent demilitarization trial burn programs and in previous EDS emissions test programs. **Figures 20-1** and **20-2** are examples of the tables that will be used to present the exhaust gas data for dioxins/furans and metals. Similar tables will be used to report the results from the analyses not shown in the examples.

Upon receipt of a TRC interim report, Leidos will review the report to ensure it contains the required information and that the report has been prepared in accordance with this SAP. Any issues will be resolved between TRC and Leidos after which, Leidos will prepare a cover report summarizing the results along with a determination of whether the data contained in the report is responsive to the purpose of the PCAPP EDS emission sampling program.

Upon receipt of the TRC report for the final emissions sampling event, Leidos will prepare a final report that summarizes results from all four (4) sampling events and how that data compares to previous emission estimates/measurements. It is anticipated that the maximum value from the 4 sampling events will be the value used in the final report summary. However, if, TRC's or Leidos' data quality review determines that the maximum value does not meet quality requirements and should not be used, an alternative value will be selected. The alternative value will most likely be the highest remaining value that meets data quality requirements. However, the actual value used may be different based on circumstances. In any case, a rationale will be presented for how the selected value was determined. Leidos will have 60 days after receipt of the last TRC interim report to prepare the draft of the final report.

20.2.3 Final Report

Upon receipt of the fourth TRC report, Leidos will prepare a summary report built around a table that summarizes the results from the four sampling events and identifies the emission values that will be used for comparison to emission estimates/measurements previously used as inputs to the MPHRA. The values from the current emission sampling and analysis will also be used to calculate EDS emissions for the various EDS campaigns. **Table 20-2** shows the calculations that will be performed.

Figure 20-1. Example Dioxins and Furans Emissions Summary

Parameter	Units	Run 1						Run 2						RCRA Permit Limits
Sampling Location	—	Exhaust Duct						Exhaust Duct						—
Date	—	01/01/01						01/01/01						—
Start Time	—	0800						0800						—
Stop Time	—	1400						1400						—
Net Sampling Time	minutes	240						240						—
Sample Volume	dscf	171.576						172.323						—
Exhaust Gas Flow Rate	dscfm	5,477.2						5,565.5						—
O_2 Concentration (PS4B)	%	11.95						11.96						—
Congeners	**TEF[1]**	**Quantity Detected**			**Weighted TEQ**			**Quantity Detected**			**Weighted TEQ**			—
2,3,7,8 TetraCDD	1	<	6.1	ND	<	6	ND	<	6.0	ND	<	6.0	ND	—
Total TetraCDD	0	<	8.3	ND	<	0	ND	<	7.5	ND	<	0	ND	—
1,2,3,7,8 PentaCDD	1	<	17.3	ND	<	17	ND	<	18.0	ND	<	18	ND	—
Total PentaCDD	0	<	17.3	ND	<	0.0	ND	<	18.0	ND	<	0	ND	—
1,2,3,4,7,8 HexaCDD	0.1	<	10.0	ND	<	1.0	ND	<	9.4	ND	<	0.9	ND	—
1,2,3,6,7,8 HexaCDD	0.1	<	9.2	ND	<	0.9	ND	<	8.6	ND	<	0.9	ND	—
1,2,3,7,8,9 HexaCDD	0.1	<	11.9	ND	<	1.2	ND	<	14.6	ND	<	1.5	ND	—
Total HexaCDD	0	<	22.2	ND	<	0.0	ND	<	23.9	ND	<	0	ND	—
1,2,3,4,6,7,8 HeptaCDD	0.01	<	14.0	ND	<	0.14	ND	<	15.9	ND	<	0.16	ND	—
Total HeptaCDD	0	<	14.0	ND	<	0.0	ND	<	15.9	ND	<	0	ND	—
Total OctaCDD	0.0001	<	36	ND	<	0.0036	ND	<	72	ND	<	0.0072	ND	—
Sum	pg	<	97.8	ND	<	26.7	ND	<	137.3	ND	<	27.4	ND	—
Concentration	ng/dscm at 7% O_2		0.0313			0.0085			0.0437			0.0087		—
Emission Rate	g/s		5.20E-11			1.42E-11			7.39E-11			1.47E-11		—
2,3,7,8 TetraCDF	0.1	<	6.6	ND	<	0.7	ND	<	13.0	ND	<	1.3	ND	—
Total TetraCDF	0	<	6.6	ND	<	0	ND	<	13.0	ND	<	0	ND	—
1,2,3,7,8 PentaCDF	0.05	<	8.0	ND	<	0.40	ND	<	7.8	ND	<	0.39	ND	—
2,3,4,7,8 PentaCDF	0.5	<	7.7	ND	<	4	ND	<	7.6	ND	<	3.8	ND	—
Total PentaCDF	0	<	8.0	ND	<	0	ND	<	9.6	ND	<	0	ND	—
1,2,3,4,7,8 HexaCDF	0.1	<	8.6	ND	<	0.9	ND	<	8.4	ND	<	0.8	ND	—
1,2,3,6,7,8 HexaCDF	0.1	<	7.9	ND	<	0.8	ND	<	7.7	ND	<	0.8	ND	—
2,3,4,6,7,8 HexaCDF	0.1	<	8.6	ND	<	0.9	ND	<	8.4	ND	<	0.8	ND	—
1,2,3,7,8,9 HexaCDF	0.1	<	8.9	ND	<	0.9	ND	<	8.7	ND	<	0.9	ND	—
Total HexaCDF	0	<	9.2	ND	<	0	ND	<	11.1	ND	<	0	ND	—
1,2,3,4,6,7,8 HeptaCDF	0.01	<	17.4	ND	<	0.17	ND	<	14.6	ND	<	0.15	ND	—
1,2,3,4,7,8,9 HeptaCDF	0.01	<	14.7	ND	<	0.15	ND	<	11.1	ND	<	0.11	ND	—
Total HeptaCDF	0	<	18.3	ND	<	0	ND	<	15.2	ND	<	0	ND	—
Total OctaCDF	0.0001	<	27	ND	<	0.0027	ND	<	31	ND	<	0.0031	ND	—
Sum	pg	<	69.1	ND	<	8.6	ND	<	79.5	ND	<	9.1	ND	—
Concentration	ng/dscm at 7% O_2	<	0.0221		<	0.0028		<	0.0253		<	0.0029		—
Emission Rate	g/s	<	3.68E-11		<	4.59E-12		<	4.28E-11		<	4.88E-12		—
Total PCDD/PCDF	ng/dscm at 7% O_2	<	0.0533	ND	<	0.0113	ND	<	0.0691	ND	<	0.0116	ND	—
	g/s	<	8.88E-11	ND	<	1.88E-11	ND	<	1.17E-10	ND	<	1.96E-11	ND	#.##E-10

Figure 20-2. Example Metals Emissions Summary

Table 3-5. Metals Emissions Summary

Parameter		Units	Baseline	Run 1	Run 2	Run 3	Run 1-3 Average
Sampling Location				EDS AFS Exhaust Blower Duct			
Date			18-Jun-12	19-Jun-12	26-Jun-12	10-Jul-12	
Start Time			1500	1419	1412	1440	
Stop Time			1600	1523	1503	1546	
Net Sampling Time		minutes	60	34	27	30	
Sample Volume (MM29 Train)		dscf	4.35	2.34	1.90	2.10	
Stack Gas Flow Rate		dscfm	5,463.8	4,920.4	4,595.6	4,632.3	4,716.1
Aluminum	Total Catch	µg	**4.0**	**3.0**	**3.7**	**4.6**	3.8
	Concentration	µg/dscm	32.4	45.3	68.8	77.2	63.8
	Emission Rate	lbs/hr	6.64E-04	8.35E-04	1.18E-03	1.34E-03	1.12E-03
	Emission Rate	g/s	8.37E-05	1.05E-04	1.49E-04	1.69E-04	1.41E-04
Arsenic	Total Catch	µg	**0.12**	**0.094**	**0.076**	**0.13**	0.10
	Concentration	µg/dscm	0.973	1.42	1.41	2.18	1.67
	Emission Rate	lbs/hr	1.99E-05	2.62E-05	2.43E-05	3.78E-05	2.94E-05
	Emission Rate	g/s	2.51E-06	3.30E-06	3.07E-06	4.77E-06	3.71E-06
Cadmium	Total Catch	µg	**0.19**	**0.12**	< 0.15	**0.037**	< 0.10
	Concentration	µg/dscm	1.54	1.81	< 2.79	0.621	< 1.74
	Emission Rate	lbs/hr	3.15E-05	3.34E-05	< 4.80E-05	1.08E-05	< 3.07E-05
	Emission Rate	g/s	3.97E-06	4.21E-06	< 6.05E-06	1.36E-06	< 3.87E-06
Chromium	Total Catch	µg	< 0.30	< 0.35	< 0.30	< 0.30	< 0.32
	Concentration	µg/dscm	< 2.43	< 5.28	< 5.58	< 5.03	< 5.30
	Emission Rate	lbs/hr	< 4.98E-05	< 9.74E-05	< 9.61E-05	< 8.73E-05	< 9.36E-05
	Emission Rate	g/s	< 6.28E-06	< 1.23E-05	< 1.21E-05	< 1.10E-05	< 1.18E-05
Copper	Total Catch	µg	**0.16**	**0.25**	**0.47**	**0.24**	0.32
	Concentration	µg/dscm	1.30	3.77	8.74	4.03	5.51
	Emission Rate	lbs/hr	2.66E-05	6.96E-05	1.51E-04	6.99E-05	9.67E-05
	Emission Rate	g/s	3.35E-06	8.77E-06	1.90E-05	8.80E-06	1.22E-05
Lead	Total Catch	µg	< 2.1 (1,2)	< 1.1 (1,2)	< 1.00 (1,2)	**0.30**	< 0.80
	Concentration	µg/dscm	< 17.0	< 16.6	< 18.6	5.03	< 13.4
	Emission Rate	lbs/hr	< 3.49E-04	< 3.06E-04	< 3.20E-04	8.73E-05	< 2.38E-04
	Emission Rate	g/s	< 4.39E-05	< 3.86E-05	< 4.03E-05	1.10E-05	< 3.00E-05
Mercury (3)	Total Catch	µg	(4)	(4)	(4)	(4)	(4)
	Concentration	µg/dscm	< 0.01	< 0.02	< 0.03	< 0.02	< 0.02
	Emission Rate	lbs/hr	< 2.05E-07	< 3.69E-07	< 5.16E-07	< 3.47E-07	< 4.11E-07
	Emission Rate	g/s	< 2.58E-08	< 4.64E-08	< 6.51E-08	< 4.37E-08	< 5.18E-08
Selenium	Total Catch	µg	< 0.30	< 0.35	< 0.30	< 0.45	< 0.37
	Concentration	µg/dscm	< 2.43	< 5.28	< 5.58	< 7.55	< 6.14
	Emission Rate	lbs/hr	< 4.98E-05	< 9.74E-05	< 9.61E-05	< 1.31E-04	< 1.08E-04
	Emission Rate	g/s	< 6.28E-06	< 1.23E-05	< 1.21E-05	< 1.65E-05	< 1.36E-05
Silver	Total Catch	µg	< 0.15	< 0.18	< 0.15	**0.0061**	< 0.112
	Concentration	µg/dscm	< 1.22	< 2.72	< 2.79	0.102	< 1.87
	Emission Rate	lbs/hr	< 2.49E-05	< 5.01E-05	< 4.80E-05	1.78E-06	< 3.33E-05
	Emission Rate	g/s	< 3.14E-06	< 6.31E-06	< 6.05E-06	2.24E-07	< 4.20E-06

Blank corrections have not been made to these data with the exception of Lead (Pb). If undetected in the analysis, the detection limit is reported. In accordance with Method 29, for Pb, the Field (Reagent) Blank value was greater than 1µg and therefore, the method allows for 1µg to be deducted from the sample result. Further, due to the high Method Blank value and suspected field blank and sample contamination in the Background and Run 1 samples, EPA validation guidance states that the sample values should be considered non-detect at the method blank value As the field blank correction was deducted from the sample value, reducing it to less than the method blank value, a '<' was placed in front of the blank-corrected values.

A "<" indicates that the compound was not detected in the sample.
Detected compounds and their detected quantities are in bold.

(1) - Field Blank corrections made to these runs in accordance with EPA Method 29 criteria
(2) - Suspected Method Blank contamination in lab - these samples reported as non-detect
(3) - Mercury sampling and analysis was conducted using Method 30B
(4) - Mercury results from both Method 30B tubes were averaged to yield the average concentration in µg/dscm for each test run

Table 20-1. Estimated Reporting Limit-Based Emission Values

Parameter	MDL[1]	RL[2]	Estimated Sample Volume[3] (L)	Concentration (µg/m^3)	Emission Rate[4] (lb/hr)	Emission Rate[4] (g/s)
Volatile Organic Compounds						
Reported Units	***ppbv***	***ppbv***	***6L***	***µg/m^3***	***lb/hr***	***g/s***
1,2-Dichloroethane	0.5	0.5		2.06	4.24E-05	5.34E-06
1,1-Dichloroethene	0.5	0.5		2.02	4.15E-05	5.23E-06
1,2,4-Trichlorobenzene	0.5	2.0		15.09	3.11E-04	3.92E-05
1,2-Dichlorobenzene	0.5	0.5		3.06	6.30E-05	7.94E-06
1,3-Dichlorobenzene	0.5	0.5		3.06	6.30E-05	7.94E-06
2-Butanone (Methyl Ethyl Ketone)	0.5	2.0		6.00	1.24E-04	1.56E-05
Acetone	0.5	5.0		12.08	2.49E-04	3.14E-05
Benzene	0.5	0.5		1.62	3.35E-05	4.22E-06
Carbon Disulfide	0.5	2.0		6.33	1.30E-04	1.64E-05
Chlorobenzene	0.5	0.5		2.34	4.82E-05	6.08E-06
Chloroform	0.5	0.5		2.48	5.11E-05	6.44E-06
cis-1,2-Dichloroethene	0.5	0.5		2.02	4.15E-05	5.23E-06
Dichloromethane (Methylene Chloride)	0.5	5.0		17.66	3.64E-04	4.58E-05
Ethanol	0.5	0.5		0.96	1.97E-05	2.49E-06
Ethylbenzene	0.5	2.0		8.83	1.82E-04	2.29E-05
Freon 12 (Dichlorodifluoromethane)	0.5	0.5		2.51	5.18E-05	6.53E-06
m,p-Xylene	0.5	0.5		2.21	4.55E-05	5.73E-06
o-Xylene	0.5	0.5		2.21	4.55E-05	5.73E-06
Styrene	0.5	0.5		2.17	4.46E-05	5.62E-06
Tetrachloroethene	0.5	0.5		3.45	7.10E-05	8.95E-06
Toluene	0.5	0.5		1.92	3.95E-05	4.97E-06
trans-1,2-Dichloroethene	0.5	0.5		2.02	4.15E-05	5.23E-06
Trichloroethene	0.5	0.5		2.73	5.63E-05	7.09E-06
Vinyl Chloride	0.5	0.5		1.30	2.68E-05	3.37E-06
Reported Units	***%***	***%***	***6L***	***mg/m^3***	***lb/hr***	***g/s***
Methane	0.0001%	0.0001%		0.667	1.37E-02	1.73E-03
Ethane	0.001%	0.001%		12.50	2.58E-01	3.25E-02
Semivolatile Organic Compounds						
Reported Units	***µg***	***µg***	***200L***	***µg/m^3***	***lb/hr***	***g/s***
Acenaphthylene	5.0	10		50	1.03E-03	1.30E-04
Anthracene	5.0	10		50	1.03E-03	1.30E-04
bis (2-chloroisopropyl) ether	1.61	10		50	1.03E-03	1.30E-04
4-Chloroaniline	5.0	10		50	1.03E-03	1.30E-04
2-Chloronaphthalene	1.11	10		50	1.03E-03	1.30E-04
Di-n-butyl phthalate	2.74	10		50	1.03E-03	1.30E-04
1,4-Dichlorobenzene	2.0	10		50	1.03E-03	1.30E-04
2,4-Dichlorophenol	2.98	10		50	1.03E-03	1.30E-04
2,4-Dinitrotoluene	5.0	10		50	1.03E-03	1.30E-04
Fluoranthene	1.45	10		50	1.03E-03	1.30E-04
Fluorene	5.0	10		50	1.03E-03	1.30E-04
Hexachloroethane	1.9	10		50	1.03E-03	1.30E-04
2-Methylnaphthalene	1.75	10		50	1.03E-03	1.30E-04
2-Methylphenol	6.24	10		50	1.03E-03	1.30E-04
3-Methylphenol & 4-Methylphenol	25	50		250	5.15E-03	6.49E-04
Naphthalene	1.65	10		50	1.03E-03	1.30E-04
Nitrobenzene	1.84	10		50	1.03E-03	1.30E-04
N-Nitrosodiphenylamine	1.68	10		50	1.03E-03	1.30E-04
Phenanthrene	5.0	10		50	1.03E-03	1.30E-04
Phenol	10	50		250	5.15E-03	6.49E-04
Pyrene	2.31	10		50	1.03E-03	1.30E-04
3,3'-Dichlorobenzidine	5.0	10		50	1.03E-03	1.30E-04

Table 20-1. Estimated Reporting Limit-Based Emission Values (cont'd)

Parameter	MDL[1]	RL[2]	Estimated Sample Volume[3] (L)	Concentration (µg/m^3)	Emission Rate[4] (lb/hr)	Emission Rate[4] (g/s)
1,4-Dithiane	TIC	TIC		NA	NA	NA
2,2'-Thiodiglycol	TIC	TIC		NA	NA	NA
1,4-Thioxane	TIC	TIC		NA	NA	NA
Dioxins/Furans						
Reported Units	***pg***	***pg***	***200L***	***µg/m^3***	***lb/hr***	***g/s***
2,3,7,8-Tetrachlorodibenzo-p-dioxin	20	20		0.0001	2.06E-09	2.60E-10
Total Tetrachlorodibenzo-p-dioxins	20	20		0.0001	2.06E-09	2.60E-10
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	100	100		0.0005	1.03E-08	1.30E-09
Total Pentachlorodibenzo-p-dioxins	100	100		0.0005	1.03E-08	1.30E-09
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	100	100		0.0005	1.03E-08	1.30E-09
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	100	100		0.0005	1.03E-08	1.30E-09
1,2,3,7,8,9-Hexachlorodibenzo-p_dioxin	100	100		0.0005	1.03E-08	1.30E-09
Total Hexachlorodibenzo-p-dioxins	100	100		0.0005	1.03E-08	1.30E-09
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	100	100		0.0005	1.03E-08	1.30E-09
Total Heptachlorodibenzo-p-dioxins	100	100		0.0005	1.03E-08	1.30E-09
Total Octachlorodibenzo-p-dioxins	200	200		0.0010	2.06E-08	2.60E-09
2,3,7,8-Tetrachlorodibenzofuran	20	20		0.0001	2.06E-09	2.60E-10
Total Tetrachlorodibenzofurans	20	20		0.0001	2.06E-09	2.60E-10
1,2,3,7,8-Pentachlorodibenzofuran	100	100		0.0005	1.03E-08	1.30E-09
2,3,4,7,8-Pentachlorodibenzofuran	100	100		0.0005	1.03E-08	1.30E-09
Total Pentachlorodibenzofurans	100	100		0.0005	1.03E-08	1.30E-09
1,2,3,4,7,8-Hexachlorodibenzofuran	100	100		0.0005	1.03E-08	1.30E-09
1,2,3,6,7,8-Hexachlorodibenzofuran	100	100		0.0005	1.03E-08	1.30E-09
1,2,3,7,8,9-Hexachlorodibenzofuran	100	100		0.0005	1.03E-08	1.30E-09
2,3,4,6,7,8-Hexachlorodibenzofuran	100	100		0.0005	1.03E-08	1.30E-09
Total Hexachlorodibenzofurans	100	100		0.0005	1.03E-08	1.30E-09
1,2,3,4,6,7,8-Heptachlorodibenzofuran	100	100		0.0005	1.03E-08	1.30E-09
1,2,3,4,7,8,9-Heptachlorodibenzofuran	100	100		0.0005	1.03E-08	1.30E-09
Total Heptachlorodibenzofurans	100	100		0.0005	1.03E-08	1.30E-09
Total Octachlorodibenzofurans	200	200		0.0010	2.06E-08	2.60E-09
Metals						
Reported Units	***µg***	***µg***	***80L***	***µg/m^3***	***lb/hr***	***g/s***
Aluminum	0.32	7.5		93.8	1.93E-03	2.43E-04
Antimony	0.0054	0.3		3.8	7.73E-05	9.74E-06
Arsenic	0.075	0.3		3.8	7.73E-05	9.74E-06
Barium	0.14	0.15		1.9	3.86E-05	4.87E-06
Beryllium	0.018	0.15		1.9	3.86E-05	4.87E-06
Cadmium	0.011	0.15		1.9	3.86E-05	4.87E-06
Chromium	0.14	0.3		3.8	7.73E-05	9.74E-06
Cobalt	0.0086	0.15		1.9	3.86E-05	4.87E-06
Copper	0.0084	0.3		3.8	7.73E-05	9.74E-06
Lead	0.0099	0.15		1.9	3.86E-05	4.87E-06
Manganese	0.013	0.3		3.8	7.73E-05	9.74E-06
Nickel	0.015	0.3		3.8	7.73E-05	9.74E-06
Selenium	0.26	0.3		3.8	7.73E-05	9.74E-06
Silver	0.0045	0.15		1.9	3.86E-05	4.87E-06
Strontium	0.042	0.75		9.4	1.93E-04	2.43E-05
Thallium	0.052	0.15		1.9	3.86E-05	4.87E-06
Zinc	0.75	0.75		9.4	1.93E-04	2.43E-05
Reported Units	***ng***	***ng***	***160L***	***µg/m^3***	***lb/hr***	***g/s***
Hg	5.0	10.0		0.063	1.29E-06	1.62E-07

Table 20-1. Estimated Reporting Limit-Based Emission Values (cont'd)

Parameter	MDL[1]	RL[2]	Estimated Sample Volume[3] (L)	Concentration (µg/m^3)	Emission Rate[4] (lb/hr)	Emission Rate[4] (g/s)
Other Target Compounds						
Reported Units	***µg***	***µg***	***80L***	***µg/m^3***	***lb/hr***	***g/s***
Hydrogen Cyanide	4.0	4.0		50	1.03E-03	1.30E-04
Ammonia	4.0	4.0		50	1.03E-03	1.30E-04
Reported Units	***µg***	***µg***	***4L***	***µg/m^3***	***lb/hr***	***g/s***
MEA	0.3	0.5		125	2.58E-03	3.25E-04

[1] - Laboratories' Method Detection Limits (MDLs) are provided for information only.

[2] - Laboratories' Reporting Limits (RLs) used in all subsequent calculations.

[3] - Based on individual sampling rates and the assumption that the total available sampling time will be 40 minutes.

[4] - Based on assumption that the volumetric flow rate is 5,500 dscfm (similar to 2012 HD Treatment flow data).

Table 20-2. Determination of EDS Emission Rates

Chemical	Sample Value (g/s)	Sample Duration (s)	Sample Mass (g)	Max 1-hr Emission (lb/hr)	12-hr Average Value (g/s)	12-hr Average Value (lb/hr)
	A	B	C	D	E	F
(Name)	0.001	2400	2.4	0.005286	5.56E-05	0.000441
	Given	Given	Given, or = AxB	= C/454	= C/43,200	= C/454/12

Batches per Campaign				Mass per Campaign						
Leaker Campaign	155mm Campaign	105mm Campaign	4.2-in Campaign	Leaker Campaign (g)	155mm Campaign (g)	105mm Campaign (g)	4.2-in Campaign (g)	Total Mass (g)	Long-term (5-yr) Emissions (g/hr)	Long-term (5-yr) Emissions (lb/hr)
G	H	I	J	K	L	M	N	O	P	Q
103	102	128	11	247.2	244.8	307.2	26.4	825.6	0.0441	9.71E-05
Given	Given	Given	Given	= CxG	= CxH	= CxI	= CxJ	= Sum(K to N)	= O/5/3,744	= P/454

Notes:

A, B, and C	=	values obtained from the analytical results
D	=	454 g/lb conversion factor
E	=	43,200 seconds based on assumed 12-hour day
F	=	12 hours based on assumed 12-hour day
G, H, I, and J	=	known or estimated numbers of batches
P	=	based on assumption of 5 years and 3,744 hours per year.