DTE

EMISSIONS TEST REPORT

for

40 CFR Part 63, Subpart YYYY
FORMALDEHYDE (CH_2O)

EUCTGHRSG1 and EUCTGHRSG2
MI-PTI-19-18

DTE Electric Company – Blue Water Energy Center
China, Michigan

September 11-12, 2024

Prepared By
Environmental Management & Safety
Ecology, Monitoring, and Remediation
DTE Corporate Services, LLC
7940 Livernois G4-S
Detroit, MI 48210

DTE

CONTENTS

Section			Page
EXECUTIVE SUMMARY			IV
1. 0	INTRODUCTION		1
2.0	SOURCE DESCRIPTION		1
3.0	SAMPLING AND ANALYTICAL PROCEDURES		2
	3.1	OXYGEN (USEPA METHOD 3A)	2
		3.1.1 Sampling Method	2
		3.1.2 Sampling Train	2
		3.1.3 Sampling Train Calibration	3
		3.1.4 Sampling Duration & Frequency	3
		3.1.5 Quality Control and Assurance	3
		3.1.6 Data Reduction	3
	3.2	FORMALDEHYDE (CH_2O) (USEPA METHOD 320)	3
		3.2.1 Sampling Method	3
		3.2.2 Sampling Train Calibration	4
		3.2.3 Quality Control and Assurance	5
		3.2.4 Data Reduction	5
4.0	OPERATING PARAMETERS		6
5.0	RESULTS		6
6.0	CERTIFICATION STATEMENT		7

DTE

RESULTS TABLES

Table No. 1.....EUCTGHRSG1 CH_2O Test Results
Table No. 2.....EUCTGHRSG2 CH_2O Test Results

FIGURES

1 EUCTGHRSG1-2 Stack Drawing & Sampling Location
2 USEPA Method 3A/320 Sampling Train

APPENDICES

A EGLE Test Plan and Acceptance Letter
B Raw Analyzer Data
C Equipment and Analyzer Calibration Data
D Example Calculations
E Operational Data
F FTIR Data Validation Report

DTE

EXECUTIVE SUMMARY

DTE Energy's Environmental Management and Safety (EM&S) Field Services Group performed emissions testing at the DTE Electric Company – Blue Water Energy Center, located in China, Michigan. The fieldwork, performed September 11-12, 2024, was conducted to satisfy requirements of the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Permit to Install No. 19-18B and 40 CFR Part 63 Subpart YYYY. Emissions tests were performed on General Electric turbines Unit 11-1 (EUCTGHRSG1) and Unit 12-1 (EUCTGHRSG2) for formaldehyde (CH_2O).

The results of the emissions testing are highlighted below:

Emissions Test Results
Blue Water Energy Center
EUCTGHRSG1-2
September 11-12, 2024

Emission Unit	O_2 (%)	CH_2O (ppbvd @ 15% O2)
EUCTGHRSG1	12.2	17.1
EUCTGHRSG2	12.0	8.7
Permit Limit		***91***

ND = Non Detect

DTE

1. 0 INTRODUCTION

DTE Energy's Environmental Management and Safety (EM&S) Field Services Group performed emissions testing at the DTE Electric Company – Blue Water Energy Center, located in China, Michigan. The fieldwork, performed September 11-12, 2024, was conducted to satisfy requirements of the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Permit to Install No. 19-18B and 40 CFR Part 63 Subpart YYYY. Emissions tests were performed on General Electric turbines Unit 11-1 (EUCTGHRSG1) and Unit 12-1 (EUCTGHRSG2) for formaldehyde (CH_2O) at greater than 90% load as required by permit conditions.

The fieldwork was performed in accordance with EPA Reference Methods and EM&S's Intent to Test[1], submitted December 11, 2023, which was approved in a letter by Mr. Andrew Riley from the Michigan Department of Environment, Great Lakes, and Energy (EGLE), dated June 25, 2024[2]. The following DTE personnel participated in the testing program: Mr. Thomas Snyder, Principal Environmental Specialist, and Mr. Mark Grigereit, Principal Engineer. Mr. Brian McDiarmid, Supervisor – Engineering at the plant coordinated process operations for the testing program.

2.0 SOURCE DESCRIPTION

The Blue Water Energy Center located at 4400 River Rd, East China, MI 48054 consists of two combustion turbines in a combined cycle configuration. A combined cycle electric generating unit consisting of two (2) General Electric ("GE") "H"-class combustion turbines each with maximum fuel type-based heat input of 3,658 million British Thermal Units per hour (MMBtu/hr) (natural gas) coupled with a heat recovery steam generator (HRSG). Each HRSG is equipped with a natural gas-fired duct burner rated at 800 MMBTU/hr to provide heat for additional steam production. The HRSG is not capable of operating independently from the CTG on each unit. The CTG/HRSG is equipped with a combined oxidation catalyst for the control of CO and VOCs, and selective catalytic reduction (SCR) with dry low NOx burners for the control of nitrogen oxides. Exhaust emissions from each HRSG are controlled by an oxidation catalyst and selective catalytic reduction (SCR).

Figure 1 presents a schematic of the sampling location for both turbines.

---

[1] EGLE, Test Plan, Submitted December 11, 2023 (Attached-Appendix A)

[2] EGLE, Approval Letter, June 25, 2024 (Attached-Appendix A)

DTE

3.0 SAMPLING AND ANALYTICAL PROCEDURES

DTE Energy obtained emissions measurements in accordance with procedures specified in the USEPA *Standards of Performance for New Stationary Sources*. The sampling and analytical methods used in the testing program are indicated in the table below:

Sampling Method	Parameter	Analysis
USEPA Method 3A	Oxygen	Instrumental Analyzer Method
USEPA Method 320	Formaldehyde	Instrumental Analyzer Method

3.1 OXYGEN (USEPA METHOD 3A)

3.1.1 Sampling Method

Exhaust Oxygen (O_2) content was measured using USEPA Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)". The O_2 analyzer utilizes a paramagnetic sensor. Triplicate 60-minute tests were performed on each turbine's exhaust. Testing was performed simultaneously with the gaseous emissions testing.

For Unit 11-1, stratification testing was performed the day prior to the formaldehyde testing on 9-10-24. For Unit 12-1, stratification testing was performed during the first run on 9-12-24. The exhausts were not stratified as the diluent gas (O_2) did not vary more than 5% on either unit.

Samples were measured on a dry basis (i.e. sample was conditioned prior to introduction into the diluent analyzers).

3.1.2 Sampling Train

The EPA Methods 3A sampling system consisted of the following components:

(1) Heated Teflon™ sampling line, drawing sample from FTIR exhaust.
(2) Universal® gas conditioner with particulate filter.
(3) Flexible unheated Teflon™ sampling line.
(4) Servomex 4900 O_2 gas analyzer.
(5) Appropriate USEPA Protocol 1 calibration gasses.
(6) Data Acquisition System.

Refer to Figure 2 for a schematic of the sampling train.

3.1.3 Sampling Train Calibration

The O_2 analyzer was calibrated according to procedures outlined in USEPA Methods 3A and 7E. Zero, span, and mid-range calibration gases were introduced directly into the analyzer to determine the instruments linearity. Then a zero and mid-range span gas was introduced through the entire sampling system to determine sampling system bias. System calibrations were performed prior to, and at the conclusion of, each test period.

3.1.4 Sampling Duration & Frequency

Oxygen (O_2) sampling was performed during all CH_2O sampling. Concentration averages were logged at 10-second intervals.

3.1.5 Quality Control and Assurance

All sampling and analytical equipment was calibrated according to the guidelines referenced in Methods 3A and 7E. Calibration gases were EPA Protocol 1 gases. Calibration gas concentrations were within the acceptable ranges specified in Method 7E.

Field calibration data sheets and gas certification sheets are in Appendix C.

3.1.6 Data Reduction

The O_2 (%) readings were logged at 10-second intervals and recorded in 1-minute increments. CH_2O emissions are reported in parts per billion, dry, corrected to 15% O_2 (ppb @ 15% O_2) for comparison to the emission limit.

Raw CEM data is presented in Appendix B.

3.2 FORMALDEHYDE (CH_2O) (USEPA METHOD 320)

3.2.1 Sampling Method

Formaldehyde (CH_2O) emissions were evaluated using USEPA Method 320, "Measurement of Vapor Phase Organic Emissions by Extractive Fourier Transform Infrared (FTIR)". Triplicate 60-minute test runs were performed.

The Method 320 sampling system (Figure 2) consisted of the following:

(1) Single-point sampling probe
(2) Flexible heated PTFE sampling line
(3) Air Dimensions Heated Head Diaphragm Pump
(4) ThermoFisher™ MAX-iR with Starboost™ FTIR spectrometer
(5) ThermoFisher™ Thermal Oxidizer Module
(6) Appropriate calibration gases

(7) Data Acquisition System

The FTIR was equipped with a temperature controlled, 10 meter, high throughput, multipass gas cell maintained at 191°C. Gas flows and sampling system pressures were monitored using a rotometer and pressure transducer. All data was collected at 1 cm^{-1} resolution.

3.2.2 Sampling Train Calibration

The FTIR was calibrated per procedures outlined in Method 320. Direct measurements of formaldehyde (CH_2O) gas standards were made at the test location to confirm concentrations.

A calibration transfer standard (CTS) was analyzed before and after testing at each location. The concentration determined for all CTS runs were within ±5% of the certified value of the standard. Ethylene was passed through the entire system to determine the sampling system response time and to ensure that the entire sampling system was leak-free.

Nitrogen was purged through the sampling system at each test location to confirm the system was free of contaminants. Formaldehyde (CH_2O) gas standards were passed through the sampling system at each test location to determine the response time and confirm recovery.

Formaldehyde (CH_2O) spiking with Thermal Oxidizer Module in bypass mode was performed to verify the ability of the sampling system to quantitatively deliver a sample containing CH_2O from the base of the probe to the FTIR. Analyte spiking assures the ability of the FTIR to quantify CH_2O in the presence of effluent gas.

Formaldehyde (CH_2O) spiking with Thermal Oxidizer Module activated was performed to verify target analyte removal, and to demonstrate the efficiency of the Thermal Oxidizer Module.

As part of the spiking procedure, samples from each engine were measured to determine CH_2O concentrations to be used in the spike recovery calculations. The determined nitrous oxide (N_2O) concentration in the spiked and unspiked samples was used to calculate the dilution factor of the spike and thus used to calculate the concentration of the spiked CH_2O. The following equation illustrates the percent recovery calculation.

$$DF = \frac{N2O(spike)}{N2O(direct)} \qquad \text{(Sec. 9.2.3 (3) Method 320)}$$

$$CS = DF * Spike_{dir} + Unspike\ (1 - DF) \quad \text{(Sec. 9.2.3 (4) Method 320)}$$

DF = Dilution factor of the spike gas
$N_2O_{(direct)}$ = N_2O concentration measured directly in undiluted spike gas
$N_2O_{(spike)}$ = Diluted N_2O concentration measured in a spiked sample
$Spike_{dir}$ = Concentration of the analyte in the spike standard measured by the FTIR directly
CS = Expected concentration of the spiked samples
Unspike = Native concentration of analytes in unspiked samples

All analyte spikes were introduced using an instrument grade stainless steel rotometer. The spike target dilution ratio was 1:10 or less. All CH_2O spike recoveries were within the EPA Method 320 allowance of ±30%.

3.2.3 Quality Control and Assurance

The method validation procedure in Method 320 Section 13 was completed prior to collection of test data, validation data and statistical treatment/analysis included in the report, and emissions data corrected for %R, if applicable. The validation source was a combustion gas turbine fired with natural gas equipped with like-kind emission controls as the unit to be tested. Each validation spiked sample was preceded and followed by an unspiked sample. The results of the validation procedure are located in Appendix F.

As part of the data validation procedure, reference spectra are manually fit to that of the sample spectra and a concentration is determined. The reference spectra are scaled to match the peak amplitude of the sample, thus providing a scale factor. The scale factor multiplied by the reference spectra concentration is used to determine the concentration value for the sample spectra. Sample pressure and temperature corrections are then applied to compute the final sample concentration. The manually calculated results are then compared with the software-generated results. The data is then validated if the two concentrations are within ± 5% agreement. If there is a difference greater than ± 5%, the spectra are reviewed for possible spectral interferences or any other possible causes that might lead to inaccurately quantified data. PRISM Analytical Technologies, Inc. validated the FTIR data. The data validation reports are in Appendix E.

3.2.4 Data Reduction

Each spectrum was derived from the coaddition of 55 scans, with a new data point generated approximately every minute. The CH_2O emissions were recorded in parts per million (ppb) wet volume basis. The O_2 emissions were recorded in percent (%) dry volume basis.

DTE

The O_2 (%) and CH_2O (ppbvd) readings were logged at 10-second intervals and recorded in 1-minute increments. CH_2O emissions are reported in parts per billion dry, corrected to 15% O_2 (ppb @ 15% O_2) for comparison to the emission limit.

4.0 OPERATING PARAMETERS

The test program included the collection of turbine operating data during each test run. Parameters recorded included % Load (reported as horsepower), gross dry BTU, fuel feed rate, compressor exhaust pressure, and compressor exhaust temperature.

Operational data can be found in Appendix D.

5.0 RESULTS

Testing was performed while the turbine was operated in LoNOx mode while operating within 10% of 100% load. The results of the formaldehyde (CH_2O) emissions testing conducted on EUCTGHRSG1-2 are presented in Results Table Nos. 1 and 2.

EUCTGHRSG1-2 demonstrated compliance with 40 CFR Part 63, Subpart YYYY formaldehyde (CH_2O) emission limit of 91 ppb @ 15% O_2.

DTE

6.0 CERTIFICATION STATEMENT

"I certify that I believe the information provided in this document is true, accurate, and complete. Results of testing are based on the good faith application of sound professional judgment, using techniques, factors, or standards approved by the Local, State, or Federal Governing body, or generally accepted in the trade."

Mr. Thomas Snyder, QSTI

This report prepared by: _____

Mr. Thomas Snyder, QSTI
Principal Environmental Specialist,
Field Services Group
Environmental Management & Safety
DTE Energy Corporate Services, LLC

This report reviewed by: Mark Grigereit

Mr. Mark Grigereit, QSTI
Principal Engineer,
Field Services Group
Environmental Management & Safety
DTE Energy Corporate Services, LLC

DTE

RESULTS TABLES

DTE

TABLE NO. 1
FORMALDEHYDE EMISSIONS TEST RESULTS
DTE Gas -Blue Water Energy Center
EUCTGHRSG1 (Unit 11-1)
September 11, 2024

Test	Test Time	Unit Load (MW)	O_2 Concentration (%, dry)[1]	CH_2O Concentration (ppbvd)	CH_2O Concentration (ppbvd @ 15% O_2)
Run 1	12:10-13:10	364	12.2	21.3	15.9
Run 2	13:27-14:27	364	12.2	34.0	25.4
Run 3	14:46-15:46	364	12.1	13.6	10.1
				Ave:	***17.1***
				Permit Limit:	***91***

[1]corrected for analyzer drift as per USEPA Method 7E

ND = Non Detect

DTE

TABLE NO. 2
FORMALDEHYDE EMISSIONS TEST RESULTS
DTE Gas -Blue Water Energy Center
EUCTGHRSG2 (Unit 12-1)
September 12, 2024

Test	Test Time	Unit Load (MW)	O_2 Concentration (%, dry)[1]	CH_2O Concentration (ppbvd)	CH_2O Concentration (ppbvd @ 15% O_2)
Run 1	9:02-10:24	370	12.0	5.2	3.8
Run 2	10:54-11:54	366	12.0	22.9	16.8
Run 3	12:19-13:19	368	12.0	7.5	5.5
				Ave:	***8.7***
				Permit Limit:	***91***

[1]corrected for analyzer drift as per USEPA Method 7E

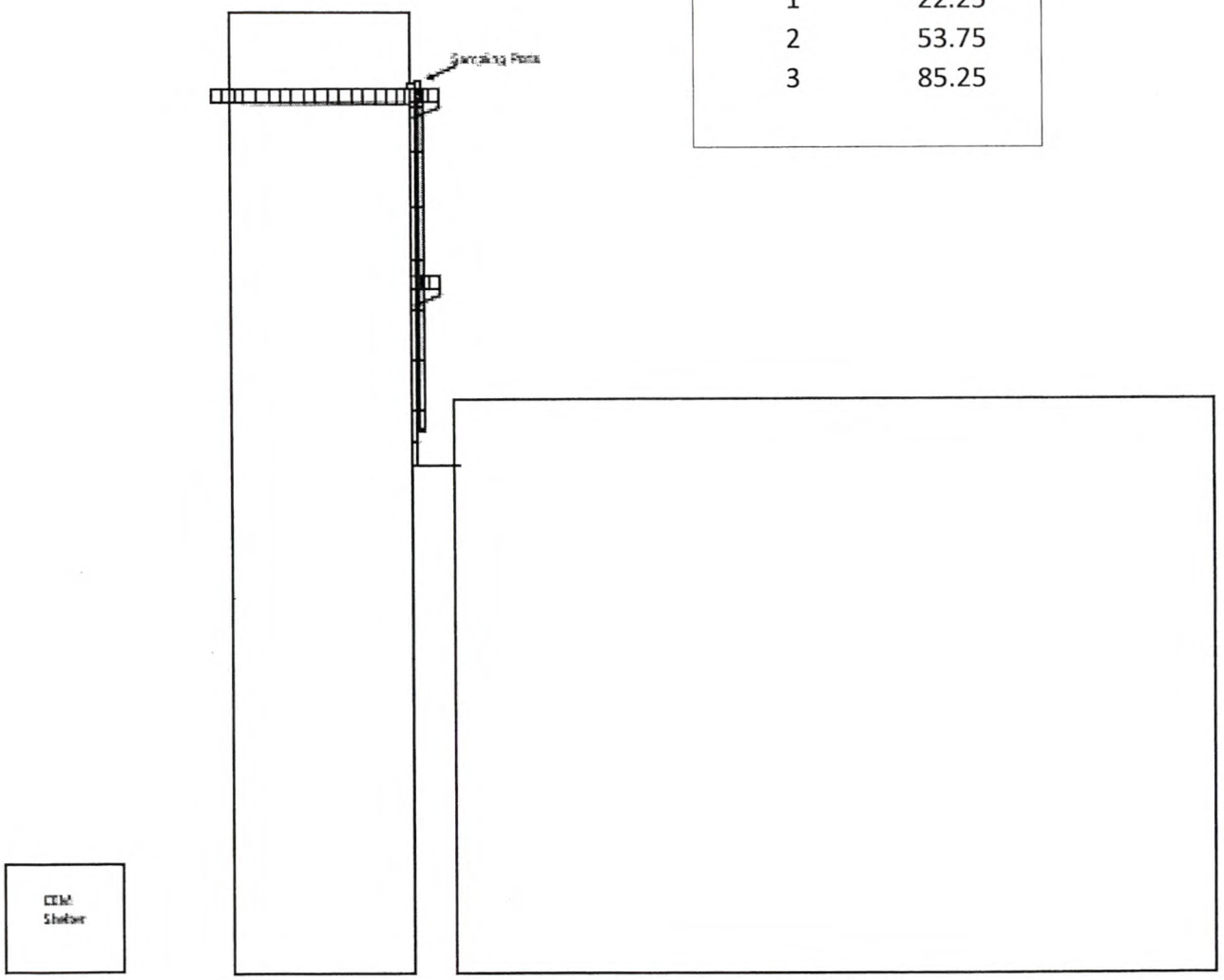
ND = Non Detect

DTE

FIGURES

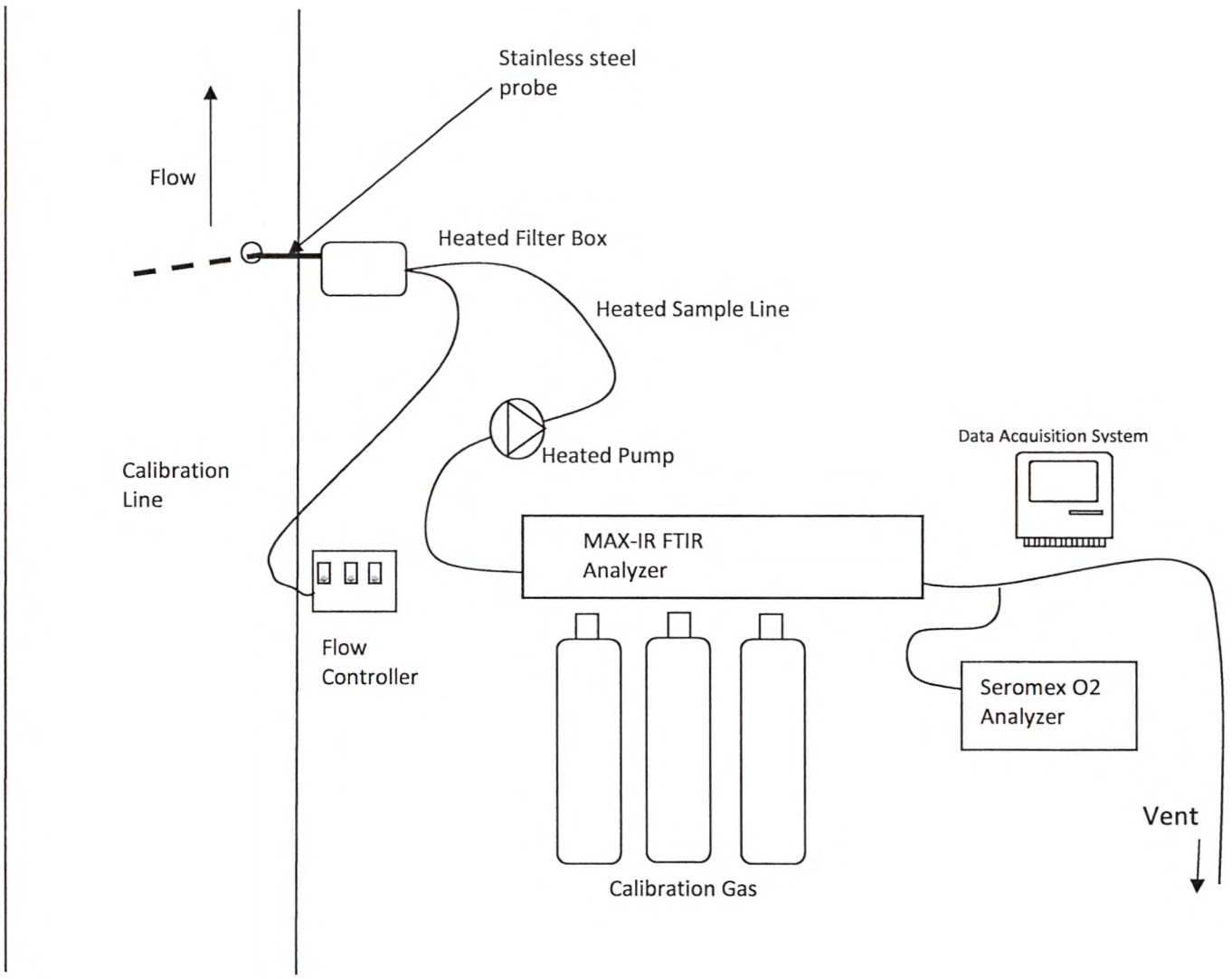
Figure 1 – Stack Drawing & Sampling Location
EUCTGHRSG1 & EUCTGHRSG2
Bluewater Energy Center

Point	Inches
1	22.25
2	53.75
3	85.25



DTE

Figure 2 – Method 3A/320
EUCTGHRSG1 & EUCTGHRSG2
Bluewater Energy Center



DTE