CleanAir

CleanAir Engineering
7936 Conner Road
Powell, TN 37849-3513
800-208-6162
www.cleanair.com

ICT DTE BLUE WATER ENERGY CENTER DRIFT TEST REPORT

DTE Blue Water Energy Center
East China, MI

International Cooling Tower USA, Inc
4460 Highway 225, Suite 180
Deer Park, TX 77536
Client Reference No. 9376-001-3

CleanAir Project No. 14983
Report No. CA23-04D
Revision 0
August 17, 2023

This confidential test report was generated by Clean Air Engineering, a licensed CTI Testing Agency.

Submitted by:

Daniel McBrayer

Daniel McBrayer

Reviewed by:

David Wheeler

David Wheeler, PE

TEST REPORT REVISION HISTORY

Version	Revision	Date	Pages	Comments
Final	0	August 17, 2023	All	Original version of document.

PROJECT CONTACT INFORMATION

Primary Client Contact	Primary CleanAir Contact
Joel Dyck, Project Manager	Shane Tucker
International Cooling Tower USA	Performance Engineer
Phone: (816) 599-1267	7936 Conner Road
jdyck@ictower.com	Powell, TN 37849
	Office: 865-938-7555
	stucker@cleanair.com

TABLE OF CONTENTS

LIST OF TABLES

1. EXECUTIVE SUMMARY

Clean Air Engineering (CleanAir) was contracted by International Cooling Tower USA, Inc (ICT), to generate this test report for the drift emissions acceptance testing of the cooling tower serving the DTE Blue Water Energy Center facility.

The objective of the test effort documented in this report was to accurately quantify the drift emission rates of four cells (cells 5A, 5B, 6A, and 6B) in the 14-cell cooling tower. Three drift test runs were completed on each of the specified cells.

Based on the test data collected from July 7th to July 12th, 2023, the drift emission rates for the selected DTE Blue Water Energy Center cooling tower cells are stated as percentages of the circulating water flow rate. These rates are based on calcium and magnesium as the chosen tracers and are shown below in Table 1-1.

Table 1-1: Drift Emissons Test Results

Cell #	Test ID	Date	Drift Rate Ca	Drift Rate Mg	Drift Rate Average
6A	Test 1	7/7/23	0.00084%	0.00073%	0.00079%
6A	Test 2	7/9/23	0.00087%	0.00068%	0.00077%
6A	Test 3	7/9/23	0.00085%	0.00067%	0.00076%
Cell 6A Average			**0.00077%**		
6B	Test 1	7/7/23	0.00032%	0.00041%	0.00037%
6B	Test 2	7/7/23	0.00078%	0.00065%	0.00071%
6B	Test 3	7/9/23	0.00054%	0.00046%	0.00050%
Cell 6B Average			**0.00053%**		
5A	Test 1	7/10/23	0.00051%	0.00043%	0.00047%
5A	Test 2	7/10/23	0.00058%	0.00050%	0.00054%
5A	Test 3	7/11/23-7/12/23	0.00043%	0.00039%	0.00041%
Cell 5A Average			**0.00047%**		
5B	Test 1	7/10/23	0.00060%	0.00043%	0.00052%
5B	Test 2	7/11/23-7/12/23	0.00062%	0.00041%	0.00052%
5B	Test 3	7/11/23-7/12/23	0.00055%	0.00046%	0.00050%
Cell 5B Average			**0.00051%**		

The average drift rate for cells 6A and 6B was 0.00065% of the circulating water flow rate. The average drift rate for cells 5A and 5B was 0.00049% of the circulating water flow rate. Average results were based on calcium and magnesium as the chosen tracers.

In the event that changes to this report are required, the changes will be documented in the revision log and resubmitted to the appropriate parties.

End of Section

2. TEST OVERVIEW

Scope of Work

CleanAir was retained by ICT to perform drift emissions testing on the cooling tower that serves the cooling needs of the DTE Blue Water Energy Center facility.

The drift emissions testing was conducted in accordance with the site-specific drift test plan written by CleanAir under the guidelines of the CTI ATC-140 (2023), Isokinetic Drift Test Code.

The objective of the test effort was to accurately quantify the drift emission rates of four cells of the 14-cell cooling tower in order to compare the drift emission rates of the four indiviual cells. Three drift test runs were completed on the selected cells.

Cooling Tower Description

The tested cooling tower is an ICT designed and constructed 14-cell induced draft counterflow tower. The cooling tower is designed to cool 203,970 gpm, with each cell cooling 14,569 gpm, from a design hot water temperature of 105.6°F, to a cold-water temperature of 82.0°F, with an inlet wet bulb temperature of 73.0°F. Each cell of the tower is equipped with a single fan driven by a 250 bhp motor. Hot water is delivered to the tower via seven 36-inch diameter supply risers that feed two cells each.

Test Schedule

The testing was executed according to the schedule shown in Table 2-1.

Table 2-1: Test Schedule

Date	List of Activities
July 6, 2023	Deployed drift test equipment on tower. Initial measure of water flow rate for test cells.
July 7, 2023	Final measure of water flow rate for test cells after flow adjustments. Measured fan motor power for cells 6A and 6B. Conducted two tests on cell 6B and one test on cell 6A.
July 8, 2023	Testing delayed due to weather conditions.
July 9, 2023	Conducted two tests on cell 6A and one test on cell 6B.
July 10, 2023	Conducted two tests on cell 5A and one test on cell 5B.
July 11, 2023	Measured fan motor power for cells 5A and 5B. Conducted two partial tests on cell 5B and one partial test on cell 5A due to inclement weather near the end of testing.
July 12, 2023	Finished testing on cells 5A and 5B. Packed up equipment. Demobilized from site.

A list of personnel participating on site during the test is shown in Table 2-2.

Table 2-2: Test Participants

Name	Company	Role
Shane Tucker	CleanAir Engineering	Test Director
Skyler Turner	CleanAir Engineering	Test Engineer
Daniel McBrayer	CleanAir Engineering	Test Engineer
Jake Matherne	CleanAir Engineering	Test Technician
Lisa Clare	International Cooling Tower	Representative Witness
Doug Tackaberry	Commercial Contracting Corp.	Site Operation Support

End of Section

3. METHODOLOGY

Test Execution

Prior to drift testing, CleanAir measured the water flow rate of the two risers that supplied the four test cells. The water flow rate was then adjusted closer to design limits to ensure compliance with test code requirements. During the first test day, the water flow rate of the two risers of interest was measured again for use in the test analysis.

Before each drift test period began, CleanAir inspected the cooling tower to ensure it was ready to test. CleanAir observed little to no water droplets in the exhaust plenums and there was no standing water on the structural beams inside the plenum. There were two rain delays during the project window, but the tower was given sufficient time to dry out on both days. No excessive foam was observed in the cold-water basin.

The CleanAir test crew performed drift emissions testing July 7-12th, 2023.

Test Instruments

The temporary test instrumentation supplied by CleanAir was calibrated at the CleanAir calibration facility in Powell, TN except for the pitot tube, which was calibrated at the TVA Flow Lab in Norris, TN. The instruments were installed by the CleanAir test crew. The CleanAir instruments met the requirements set forth in the CTI ATC-140 test code Section 3: Instruments and Measurements.

The parameters measured during the test and the number of instruments used are shown in Table 3-1.

Table 3-1: Test Instrumentation

Parameter	Number of Instruments
Isokinetic Sampling Trains	3
Ambient Air Sampler	1
Circulating Water Flow Rate	1
Barometric Pressure	1
Wind Speed	1

Water flow rate was measured in the two 36-inch diameter hot water risers supplying water to the four test cells. Each riser was equipped with two pitot taps. A 20-point diameter traverse was performed in each of the four taps.

Fan motor amperage, voltage, and kilowatts were recorded from the available panel readouts in the motor control center. This measurement was used as the basis for verifying that the fan motor power was within the ±15% window prescribed by the ATC-140 Drift Test Code.

Barometric pressure was measured once during each day of testing with a hand-held electronic barometer.

Wind speed was measured on the fan deck, upwind of the tested cells with a RM Young wind speed device.

The concentration of the potential tracer elements (calcium and magnesium) in the ambient air was determined with a high-volume ambient sampler placed approximately 100 ft from the side of the cooling tower. Unfortunately, the ambient sampler filter backing was left attached to the filter on the first day of testing. This caused no airflow to pass through the filter, nullifying the ambient tracer elements analysis for test 1 on cell 6A and tests 1 and 2 on cell 6B.

Sample Locations

The sampling locations were based on the net stack area and located at the centroids of equal area of the annular sample zones based on 4 radii and 6 points per radius. The position of the sampling locations is calculated by:

$$X_i = \frac{D_s}{2} - \sqrt{\left[\left(\frac{2N-2i+1}{8N}\right)(D_s^2 - D_h^2)\right] + \left(\frac{D_h}{2}\right)^2} \quad \text{(Eq. 1)}$$

Where:

X_i	=	sample location i, distance from wall
D_s	=	stack diameter at the sampling plane
D_h	=	effective hub diameter
N	=	number of sampling points on a single radius
i	=	sampling point number

CleanAir measured the diameter of the fan stack and the effective hub diameter at the exit plane while deploying the test equipment.

Six locations on each of four radii were sampled for each test run. Table 3-2 contains the radial sampling stations at the stack exit plane for all tested cells. The sampling positions varied slightly as a result from the effective hub diameter measurements.

Table 3-2: Radial Sampling Positions

Sampling Position	Cell 6A (inches)	Cell 6B (inches)	Cell 5A (inches)	Cell 5B (inches)
1	7.8	7.7	7.8	7.7
2	24.2	24.1	24.2	24.0
3	42.1	41.9	42.1	41.7
4	61.9	61.6	61.9	61.2
5	84.4	83.9	84.4	83.3
6	111.1	110.3	111.1	109.5

Drift Emission Measurements

During the execution of the drift tests, the airflow speed and direction were measured at each of the sampling stations in order to set the "target" sampling velocity at the inlet to the glass bead pack. The air speed and direction measurements were made with an S-type "double" pitot consisting of two pitots positioned at 90 degrees to each other and mounted on the end of the sampling boom near the sampling nozzle. The differential pressure of the angle sensing pitot was measured locally with a Magnahelic gauge. The velocity pressure of the flow measuring pitot was measured with an inclined manometer. The angle of rotation of the sample train was directly measured with a protractor after the sample train was aligned with the flow.

The flow rate through the sampling train was measured with a certified orifice in a dimensional flow section. Differential pressure across the orifice was also measured with an inclined manometer. Barometric pressure, inlet temperature (stack temperature) and flow section temperature were measured to correct for the density difference between the air at the sampling probe inlet and the air flowing through the orifice. After assembly in the field, the sampling train was leak checked under a strong vacuum to ensure the integrity of the sampling train.

The primary collection media for the HGBIK test is a Teflon cylinder containing tightly packed Pyrex beads. Exhaust air from the cooling tower containing the mineral bearing drift droplets is drawn through the bead pack and backup filter by a large vacuum pump. The outside of the cylinder is heated so that when drift droplets impact the heated beads, moisture is driven off and the non-volatile solids present in the drift (metallic salts) are deposited on the beads. The backup filter captures any mineral mass which escapes the bead pack. The drift rate is a function of the collected mineral mass as explained below. One glass bead cylinder and one backup filter are used per test.

The ambient concentration of the potential tracer elements was determined by deploying a high-volume sampler near the air inlets of the tested cells, approximately 100ft away from the tower. One filter was exposed for each test day, with the exception of the first test day in which the filter backing was left attached to the filter. The objective of this sampling was to provide guidance as to the selection of tracer elements and to note any excursions in the ambient concentrations which could have impacted the test results.

Test and Operating Conditions

The surface tension of the circulating water was measured each test day to ensure the surface tension of the water was above the 63 dynes/cm limit specified in the test plan. The results of the surface tension measurements are provided in Table 3-3.

Table 3-3: Surface Tension Measurements

Date	Dynes/cm
7/7/23	68.74
7/9/23	70.48
7/10/23	67.93
7/11/23 - 7/12/23	67.87

The circulating water chemistry stability during the tests was determined by review of the water chemistry analyses to evaluate compliance with the test plan specification. The circulating water chemistry stability measurements, which were compliant with the test code specifications, are summarized in Table 3-4. The variation in circulating water chemistry is defined as the greater of the maximum minus the average or the average minus the minimum, divided by the average value.

Table 3-4: Circulating Water Analysis

Date	Ca Sample 1 mg/L	Ca Sample 2 mg/L	Ca Sample 3 mg/L	Variation <10%	Mg Sample 1 mg/L	Mg Sample 2 mg/L	Mg Sample 3 mg/L	Variation <10%
July 7	201	186	216	7%	65.9	68.1	71.4	4%
July 9	203	212	202	3%	68.6	72.4	70.1	3%
July 10	205	209	216	3%	72.8	70.4	73.2	2%
July 11/12	188	204	192	5%	64.5	62.6	60.0	4%

A summary of the selection criteria and target values for the candidate tracers are presented in Tables 3-5 to 3-8. The values of the stack to ambient concentration ratios are listed in Tables 3-9 to 3-12, the values that are shown were calculated using the analysis of the filter from the ambient sampler. The target values were assigned by CleanAir in the initial drift emissions test plan.

Table 3-5: Elemental Tracer Selection Criteria Cell 6A

July 7 - Cell 6A Test Run 1	Target	Ca	Mg
Ratio of bead pack concentration to RDL	>5	13.60	4.06
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	NA	NA
July 9 - Cell 6A Test Run 2	**Target**	**Ca**	**Mg**
Ratio of bead pack concentration to RDL	>5	14.00	3.76
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	24.19	NA
July 9 - Cell 6A Test Run 3	**Target**	**Ca**	**Mg**
Ratio of bead pack concentration to RDL	>5	14.40	3.89
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	23.10	NA

Table 3-6: Elemental Tracer Selection Criteria Cell 6B

July 7 - Cell 6B Test Run 1	Target	Ca	Mg
Ratio of bead pack concentration to RDL	>5	4.72	1.18
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	NA	NA
July 7 - Cell 6B Test Run 2	**Target**	**Ca**	**Mg**
Ratio of bead pack concentration to RDL	>5	13.00	3.69
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	NA	NA
July 9 - Cell 6B Test Run 3	**Target**	**Ca**	**Mg**
Ratio of bead pack concentration to RDL	>5	8.22	2.44
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	17.21	NA

Table 3-7: Elemental Tracer Selection Criteria Cell 5A

July 10 - Cell 5A Test Run 1	Target	Ca	Mg
Ratio of bead pack concentration to RDL	>5	8.49	2.42
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	1.80	1.52
July 10 - Cell 5A Test Run 2	**Target**	**Ca**	**Mg**
Ratio of bead pack concentration to RDL	>5	9.61	2.86
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	1.97	1.74
July 11/12 - Cell 5A Test Run 3	**Target**	**Ca**	**Mg**
Ratio of bead pack concentration to RDL	>5	6.49	1.89
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	0.71	0.97

Table 3-8: Elemental Tracer Selection Criteria Cell 5B

July 10 - Cell 5B Test Run 1	Target	Ca	Mg
Ratio of bead pack concentration to RDL	>5	8.58	2.31
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	2.27	1.65
July 11/12 - Cell 5B Test Run 2	**Target**	**Ca**	**Mg**
Ratio of bead pack concentration to RDL	>5	10.10	2.10
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	1.05	1.02
July 11/12 - Cell 5B Test Run 3	**Target**	**Ca**	**Mg**
Ratio of bead pack concentration to RDL	>5	8.05	2.19
Ratio of bead pack concentration to procedural blank	>5	NA	NA
Ratio of stack concentration to ambient concentration	>5	0.98	1.25

The results listed as "NA" indicate that analyses of the procedural blank returned a non-detect for the tracer element. Non-detect means the concentration was below the detection limit of the analysis technique. In this case, "NA" indicates that these criteria are acceptable.

There was no detectable concentration of either calcium or magnesium for the procedural blank. The ratio of the bead pack concentration to the detection limit was greater than the target value of 5 for calcium for all the tests. For magnesium, the ratio of the bead pack concentration to the detection limit was less than the target value of 5. This is less than ideal because values near the detection limit can contribute to scatter in the test results. However, for these tests, the magnesium test results were repeatable and in line with those for calcium.
The test plan specified that ratio of tracer stack concentraton to tracer ambient concentration be at least five. This concentration ratio is a quality assurance check intended to support selection of a tracer element for which the drift rate is not influenced by the ambient concentration of the tracer element, as elevated ambient concentrations could introduce a positive bias on the reported drift rate. The ratio of stack concentraion to ambient concetration for both calcium and magnesium was greater than five for the tests of cell 6A and 6B. Because of high ambient concentration of both calcium and magnesium on July 10 and 11, the ratio of the stack concentration to the ambient concentration for both calcium and magnesium was much less than the target value of 5. Both calcium and magnesium were used as tracers for the analysis described in this report.

CTI ATC-140 (2023) dictates that an ambient air sample be collected during each drift test run to evaluate the amount of the tracer element in the air in the vicinity of the tower. Substantial amounts of the tracer in the ambient air may lead to a reported drift rate that is artificially high. This positive bias occurs when mineral bearing ambient air enters the tower and the minerals are not scrubbed by the falling water within the tower, but the minerals are captured by the drift sampling equipment. Since the scrubbing effect of individual cooling towers is unknown, as indicated in ATC-140, a correction for the ambient concentration cannot be applied.

The primary drift emissions data was in compliance with all the operating condition requirements of the test plan and ATC-140. The tower operating conditions are shown in Tables 3-9 to 3-12.

Table 3-9: Operating Conditions Cell 6A

Description	Units	Test Plan Requirement	Design	Test	Test Value (cell)	Ambient Wind Speed (avg)	Deviation
Circulating Water Flow Rate (per cell)	gpm	± 10%	14,569	1-3	14,866	NA	2.0%
Fan Motor Power (corrected for air density)	bhp	± 15%	250.0	1-3	233.2	NA	-6.7%
Wind Speed	mph	<75% average exit velocity	NA	7/7	17.6 (max)	7.6	43% of max
				7/9	17.7 (max)	6.6	37% of max
				7/9	18.2 (max)	6.6	36% of max

Table 3-10: Operating Conditions Cell 6B

Description	Units	Test Plan Requirement	Design	Test	Test Value (cell)	Ambient Wind Speed (avg)	Deviation
Circulating Water Flow Rate (per cell)	gpm	± 10%	14,569	1-3	14,866	NA	2.0%
Fan Motor Power (corrected for air density)	bhp	± 15%	250.0	1-3	237.7	NA	-4.9%
Wind Speed	mph	<75% average exit velocity	NA	7/7	15.5 (max)	7.6	49% of max
				7/7	17.4 (max)	7.6	44% of max
				7/9	15.5 (max)	6.6	43% of max

Table 3-11: Operating Conditions Cell 5A

Description	Units	Test Plan Requirement	Design	Test	Test Value (cell)	Ambient Wind Speed (avg)	Deviation
Circulating Water Flow Rate (per cell)	gpm	± 10%	14,569	1-3	14,825	NA	1.8%
Fan Motor Power (corrected for air density)	bhp	± 15%	250.0	1-3	251.9	NA	0.8%
Wind Speed	mph	<75% average exit velocity	NA	7/10	16.9 (max)	9.3	55% of max
				7/10	17.3 (max)	9.3	54% of max
				7/11-12	16.5 (max)	5.4	33% of max

Table 3-12: Operating Conditions Cell 5B

Description	Units	Test Plan Requirement	Design	Test	Test Value (cell)	Ambient Wind Speed (avg)	Deviation
Circulating Water Flow Rate (per cell)	gpm	± 10%	14,569	1-3	14,825	NA	1.8%
Fan Motor Power (corrected for air density)	bhp	± 15%	250.0	1-3	247.3	NA	-1.1%
Wind Speed	mph	<75% average exit velocity	NA	7/10	15.8 (max)	9.3	59% of max
				7/11-12	16.6 (max)	5.4	33% of max
				7/11-12	15.5 (max)	5.4	35% of max

ATC-140 and the CleanAir generated test plan state that the average allowable wind velocity shall not exceed 75% of the average air exit velocity, based on the gross diameter of the fan stack being tested. The average wind speeds for all tests were code compliant as the wind speed averages were well below the required limitations.

End of Section

4. CALCULATIONS

Air Velocity Calculations

Air Velocity with Flow Sensing Portion of Double "S-type" Pitot

$$V_{stack} = 1097 * C_{pitot} * \sqrt{\frac{\Delta P_{pitot}}{\rho_{stack}}} \quad \text{(Eq. 2)}$$

Where:

V_{stack}	=	stack air velocity at measurement point, ft/min
C_{pitot}	=	coefficient for S-type pitot tube, dimensionless
ΔP_{pitot}	=	manometer deflection for pitot tube, inwg
ρ_{stack}	=	density of saturated air at stack temperature and pressure, lbm/ft^3

The density is a function of the barometric pressure, the stack temperature and stack gas composition. The composition of the stack gas is assumed to be saturated air.

The velocity of the air entering the sampling nozzle is adjusted by valve manipulation to match, as closely as possible, the air velocity at each of the sampling stations.

Mass Air Flow Rate through Metering Section

$$\dot{m}_{air} = C_D * \sqrt{\rho_{meter} * \Delta P_{orifice}} \quad \text{(Eq. 3)}$$

Where:

$\dot{m}_{air}$	=	mass air flow rate through sampling train, lbm/min
C_D	=	discharge coefficient for metering section, $(lbm/min)/(inwg\text{-}lbm/ft^3)^{.5}$
$\Delta P_{orifice}$	=	differential pressure measurement for metering orifice, inwg
ρ_{meter}	=	density of saturated air at orifice temperature and pressure, lbm/ft^3

Air Velocity at HGBIK Tube Inlet

$$V_{tube} = \frac{\dot{m}_{air}}{\rho_{stack} * A_{tube}} \quad \text{(Eq. 4)}$$

Where:

V_{tube}	=	velocity of the air entering the HGBIK tube inlet, ft/min
A_{tube}	=	area of HGBIK tube inlet, ft^2

Drift Emissions Calculations

Exiting Tracer Mass

The test apparatus is used to collect an integrated sample of the exiting tracer mass from across the stack.

$$W_T = (M_{GB} - M_{GBB}) + (M_F - M_{FB}) \quad \text{(Eq. 5)}$$

Where:

W_T = the net mass recovered from the glass bead pack and the back-up filter for the selected tracer element (e.g. µg magnesium)

M_{GB} = mass recovered from the glass bead pack for the selected tracer element (e.g. µg magnesium)

M_{GBB} = mass recovered from the glass bead field blank for the selected tracer element (e.g. µg magnesium)

M_F = mass recovered from the back-up filter for the selected tracer element (e.g. µg magnesium)

M_{FB} = mass recovered from the back-up filter field blank for the selected tracer element (e.g. µg magnesium)

Total Circulating Water Emitted as Drift

$$\%Drift = 100 * K_1 * \frac{A_{SP}}{A_N} * \frac{W_T}{Q_{WT} * t_s * C_{TC}} \quad \text{(Eq. 6)}$$

Where:

A_N = nozzle area, m^2

A_{SP} = sample plane area, m^2

C_{TC} = circulating water tracer concentration, mg/L

K_1 = 0.001 mg/µg for SI units

Q_{WT} = water flow rate during test, L/s

t_s = total sample time, s

Although the equations listed above are for one element, when available in enough concentration, multiple elements are analyzed and used in parallel as a quality assurance step. This is beneficial since an unexpectedly high concentration in a blank or ambient sample for one element may not be present for other elements. A sample calculation is included in Appendix C.

The flow rate for each pair of cells (6A/6B, 5A/5B) was measured. The measured flow for each pair of cells was divided by two to obtain the flow for each cell.

The test samples were brought to CleanAir for chemical recovery. The glass bead packs were rinsed with ultrapure hydrochloric acid and water solutions. The chemical mass on the filters were recovered by digestion in an acid solution. The samples were sent to a laboratory for chemical analyses by Inductively Coupled Plasma (ICP) which provides a highly accurate analysis of a relatively small sample.

End of Section

5. DRIFT EMISSONS SUMMARY

Performance Evaluation

Table 5-1 summarizes the results of the tests conducted at the DTE Blue Water Energy Center cooling tower from July 7th to July 12th, 2023.

Table 5-1: Drift Emissons Test Results

Cell #	Test ID	Date	Drift Rate Ca	Drift Rate Mg	Drift Rate Average
6A	Test 1	7/7/23	0.00084%	0.00073%	0.00079%
6A	Test 2	7/9/23	0.00087%	0.00068%	0.00077%
6A	Test 3	7/9/23	0.00085%	0.00067%	0.00076%
Cell 6A Average			**0.00077%**		
6B	Test 1	7/7/23	0.00032%	0.00041%	0.00037%
6B	Test 2	7/7/23	0.00078%	0.00065%	0.00071%
6B	Test 3	7/9/23	0.00054%	0.00046%	0.00050%
Cell 6B Average			**0.00053%**		
5A	Test 1	7/10/23	0.00051%	0.00043%	0.00047%
5A	Test 2	7/10/23	0.00058%	0.00050%	0.00054%
5A	Test 3	7/11/23-7/12/23	0.00043%	0.00039%	0.00041%
Cell 5A Average			**0.00047%**		
5B	Test 1	7/10/23	0.00060%	0.00043%	0.00052%
5B	Test 2	7/11/23-7/12/23	0.00062%	0.00041%	0.00052%
5B	Test 3	7/11/23-7/12/23	0.00055%	0.00046%	0.00050%
Cell 5B Average			**0.00051%**		

On test 1 of cell 6A, the tracer analysis of the backup filter yielded unrealistically high levels of calcium which ultimately led to the decision to omit the data and replace it with the mineral levels detected in the backup filter from test 2 of cell 6A. The original data from page D-8 was replaced with that found on page D-9. Comparatively, the calcium level derived from test 1 of cell 6A was at least an order of magnitude higher than any of the other backup filter calcium levels, providing the basis for the assumption that the backup filter data for test 1 should be omitted.

The average drift rate for cells 6A and 6B was 0.00065% of the circulating water flow rate. The average drift rate for cells 5A and 5B was 0.00049% of the circulating water flow rate. The four cells are uniform in construction except cells 5A and 5B contain two layers of drift eliminators while cells 6A and 6B contain one layer of drift eliminators.

Average results were based on calcium and magnesium as the chosen tracers.

Laboratory analyses are included in Appendix D. Drift test data and calculations are included in Appendix B.

End of Section

APPENDIX A: MANUAL DATA