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AIR QUALITY DIV.

Consumers Energy Company

J H Campbell Generating Station
West Olive, Michigan

Unit 3
Particulate Emission Test

Testing Conducted On:
August 5, 2014

Report Submitted: October 2, 2014

Testing Conducted By:
Mr. Gregg Koteskey, Mr. Brian Miska,
Mr. Brian Glendening & Mr. Calvin Mason
Consumers Energy Company Engineering
Services Department
Regulatory Compliance Testing Section

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

RENEWABLE OPERATING PERMIT
REPORT CERTIFICATION

Authorized by 1994 P.A. 451, as amended. Failure to provide this information may result in civil and/or criminal penalties.

Reports submitted pursuant to R 336.1213 (Rule 213), subrules (3)(c) and/or (4)(c), of Michigan's Renewable Operating Permit (ROP) program must be certified by a responsible official. Additional information regarding the reports and documentation listed below must be kept on file for at least 5 years, as specified in Rule 213(3)(b)(ii), and be made available to the Department of Environmental Quality, Air Quality Division upon request.

Source Name Consumers Energy Company, J.H. Campbell Plant County Ottawa

Source Address 17000 Croswell City West Olive

AQD Source ID (SRN) B2835 ROP No. MI-ROP-2835-2013 ROP Section No. 1

Please check the appropriate box(es):

☐ **Annual Compliance Certification (Pursuant to Rule 213(4)(c))**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, this source was in compliance with **ALL** terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference. The method(s) used to determine compliance is/are the method(s) specified in the ROP.

☐ 2. During the entire reporting period this source was in compliance with all terms and conditions contained in the ROP, each term and condition of which is identified and included by this reference, **EXCEPT** for the deviations identified on the enclosed deviation report(s). The method used to determine compliance for each term and condition is the method specified in the ROP, unless otherwise indicated and described on the enclosed deviation report(s).

☐ **Semi-Annual (or More Frequent) Report Certification (Pursuant to Rule 213(3)(c))**

Reporting period (provide inclusive dates): From _____ To _____

☐ 1. During the entire reporting period, **ALL** monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred.

☐ 2. During the entire reporting period, all monitoring and associated recordkeeping requirements in the ROP were met and no deviations from these requirements or any other terms or conditions occurred, **EXCEPT** for the deviations identified on the enclosed deviation report(s).

☒ **Other Report Certification**

Reporting period (provide inclusive dates): From N/A To N/A

Additional monitoring reports or other applicable documents required by the ROP are attached as described:

Unit 3 Particulate Matter Test Report

I certify that, based on information and belief formed after reasonable inquiry, the statements and information in this report and the supporting enclosures are true, accurate and complete

Thomas J. Gesinski	Site Business Manager	(616) 738-3200
Name of Responsible Official (print or type)	Title	Phone Number
Thomas J. Gesinski		10/2/2014
Signature of Responsible Official		Date

* Photocopy this form as needed.

EQP 5736 (Rev 11-04)

INTRODUCTION

This report summarizes the results of the emission testing for particulate matter (PM), conducted on August 5, 2014, on Unit 3 at Consumer Energy Company's J. H. Campbell Generating Plant, located in West Olive, Michigan. The purpose of the emission testing was to demonstrate compliance with the PM emission limit for Boiler 3, as identified in the facility's current Renewable Operating Permit (ROP) No. MI-ROP-B2835-2013. The stack test was conducted in accordance with the ROP and a stack test protocol, dated July 3, 2014. The stack test protocol was approved by Mr. Jeremy Howe of the Michigan DEQ Technical Programs Unit on July 29, 2014. Mr. Howe was present on August 5, 2014 to witness a portion of the stack testing.

Consumers Energy Company's J. H. Campbell Generating Plant Unit 3 is a pulverized coal fired boiler. Unit 3's full load rating is 6,157,000 lbs/hr steam flow at 880 MW gross (835 MW net) load. Unit 3 has two separate ducts (A & B) feeding into a single stack. Particulate matter testing for this unit was performed on Duct A and Duct B simultaneously. Boiler 3 burns 100% Western sub-bituminous coal. On a typical day, Unit 3 will burn approximately 10,000 tons of coal.

The particulate matter sampling procedure, as outlined in Reference Method 17 of 40 CFR 60, Appendix A, was followed throughout the test. In addition, equations contained in Method 5B of Michigan Rule 336.2011 were also utilized to determine the amount of excess air and correct the particulate matter concentration to 50% excess air (Attachment 1).

SOURCE INFORMATION

Consumers Energy Company
J.H. Campbell Plant
17000 Croswell
West Olive, MI 49460

Contact: Mr. Joe Firlit (616) 738-3260

TESTING FIRM INFORMATION

Consumers Energy Company
Regulatory Compliance Testing Section
17010 Croswell
West Olive, MI 49460

Contact: Mr. Brian Glendening (616) 738-3234

SUMMARY OF RESULTS

During the testing period, Unit 3 burned 100% Western coal. On August 5, 2014, Unit 3 burned an average of 438 tons of coal per hour. Testing was conducted as close to full load (880MW gross) as possible, with an average gross unit load of 850 MW.

Testing was conducted on Unit 3 in order to demonstrate compliance with facility's current ROP (No. MI-ROP-B2835-2013) particulate matter emission limits. The particulate matter emission limits for Unit 3 are specified in Conditions I.2 and I.3 of Table EUBOILER3. The permitted limits are summarized below in Table 1.

Table 1. Summary of EUBOILER3 PM Emission Limits

Pollutant	Limit
PM	0.10 pound per million Btu heat input
PM	370 pounds per hour

As shown in Table 2 below, the combined flow-weighted average from each individual run of ducts A and B, was below the Unit 3 PM emission limit of 0.10 pound per million Btu heat input. The sum of the Ducts A and B particulate matter mass emission rates was also below the Unit 3 PM emission limit of 370 pounds per hour. Thus, Unit 3 is in compliance with the ROP particulate matter emission limits.

Table 2. Summary of Unit 3 PM Emission Test Results

Run Number	PM Emission Rates				
	Steam Flow (klb/hr)	Total Gas Volume (acfm)	Particulate Emission Rate (lb/mmBTU)	Particulate Emission Rate (lb/hr)	Stack Opacity (%)
Run 1	5,937	3,545,432	0.0037	34.3	5.0
Run 2	5,921	3,530,599	0.0025	23.0	5.0
Run 3	5,899	3,608,146	0.0025	22.8	5.0
Average	5,919	3,561,392	0.0029	26.7	5.0

SOURCE DESCRIPTION

Consumers Energy Company's J. H. Campbell Generating Plant Unit 3 is a pulverized coal fired boiler. Unit 3's full load rating is 6,157,000 lbs/hr steam flow at 880 MW gross (845 MW net) load. Unit 3 utilizes a two-chamber electrostatic precipitator (ESP) to control particulate emissions. Each boiler exhaust duct is served by one chamber of the precipitator. No significant maintenance will have been performed on the ESP within the last three months on the test date. Low sulfur coal is used for fueling the unit. An SCR is currently used for control of nitrogen oxides (NOx) and was in operation during the test; however it is not a requirement for it to be in operation. Unit 3 blows soot continuously.

Unit 3 has two separate ducts (A & B) feeding into a single stack. Testing for this unit was performed on Duct A and Duct B simultaneously. Boiler 3 burns 100% Western sub-bituminous coal. On a typical day, Unit 3 will burn approximately 10,000 tons of coal. The ESP, supplied by Buell Envirotech , consists of two chambers. Each chamber is four sections wide and 12 fields deep. The design efficiency is 99.58% at a gas volume of 3,400,000 ACFM at 305 degrees F.

SAMPLING AND ANALYTICAL PROCEDURES

Verification of the absence of cyclonic flow (i.e., an average null angle less that 20°) was performed on September 22, 2008 (Attachment 2), as outlined in Reference Method 1 of 40 CFR 60, Appendix A. The procedures in Section 11.4 of Method 1 were used to determine the average null angle, which was calculated as 4° (A-Duct) and 3° (B-Duct). Since the cyclonic flow testing conducted in 2008, the A and B Ducts have not been modified (i.e. no changes in flow disturbances upstream and downstream of the test location). Therefore, the flow conditions at the Unit 3 traverse points were deemed acceptable without additional cyclonic flow testing.

The particulate matter sampling procedure, as outlined in Reference Method 17 of 40 CFR 60, Appendix A, was followed throughout the test. In addition, equations contained in Method 5B of Michigan Rule 336.2011 were also utilized to determine the amount of excess air and correct the particulate matter concentration to 50% excess air (Attachment 1).

Testing was conducted as close to full load (880 MW gross) as possible, with an average gross unit load of 850 MW. Soot blowing and ash removal occurred as normal during testing, with at least one soot blow occurring during one test run.

Plant operating data collected during the test periods included load (in megawatts), steam flow (in 1,000 lbs/hr), and percent stack opacity. This data is presented in Attachment 4.

Three runs were performed on each duct, which constitutes a complete test. Each run included sampling 4 points in each of 6 ports on each duct (Figures 1 and 4), which resulted in 3 minutes per point, for a total of 72 minutes per run. The two ducts were sampled simultaneously, with at least 30 cubic feet of flue gas sampled on each side.

The cross-section at the sampling site was divided into equal areas as per Method 1. The particulate material was collected isokinetically from the gas stream and the weight determined on a dry basis. The isokinetic variation on the tests performed is shown on the summary sheet in the post-test report (Attachment 2). The allowable range according to Method 17 is 100% ± 10%, and all isokinetic variations were well within this range.

A flow diagram of the sampling train is attached with the report (Figure 2). A sample nozzle was connected to the primary filter holder, followed by a secondary filter (Figure 3). This assembly was connected to a probe extension (Figure 5). The gas sample was drawn through the filter assembly and probe, into a moisture trap, and then into the leak-free Method 17 test module.

A type "S" pitot tube was attached to the probe to measure the stack gas velocity (Figure 5). Stack gas temperature measurements were made with a thermocouple wire attached to the pitot tube, and read on a digital indicator.

Moisture was determined using Reference Method 4, 40 CFR Part 60, Appendix A. Analysis of the flue gas was performed by Reference Method 3A, 40 CFR Part 60, Appendix A. A Servomex O_2/CO_2 analyzer was used.

Before sampling was started, a pre-weighed fiberglass filter and backup filter were placed in the filter housing assembly. One hundred milliliters (100ml) of water was put into the first chamber of the moisture trap. The second chamber of the moisture trap was left empty, and the third chamber was partially filled with indicating-type silica gel desiccant. The sample train was then assembled and leak-checked at 15" Hg vacuum. At this time, the pitot tube assembly was also leak checked.

The isokinetic meter rate was calculated at each traverse point by entering the differential pressure and temperature into a computer spreadsheet. Adjustment of the sampling rate was made by using a calibrated orifice at the discharge of the dry gas meter. Field data was recorded on the computer spreadsheet at each sample point.

Extreme care was exercised during the sample recovery period. The collected condensate in the moisture trap was measured. The filter assembly was removed and disassembled in the laboratory. The thimble and back up filter were both dried during the same time period and at the same temperature that they were subjected to before they were used. Then they were weighed to determine the net weight of the particulate matter that was collected. The nozzle was washed with deionized water (in lieu of acetone) into a beaker, and the wash water was evaporated from the beaker. Following the evaporation, the beaker was reweighed. Any weight gain was added to the particulate matter weights of the primary and secondary filters. Calibration data is provided in Attachment 5.

TEST RESULTS AND DISCUSSION

Each of the three test runs, along with the average, were below the particulate matter emission limits for Unit 3. Thus, Unit 3 is in compliance with the ROP particulate matter emission limits. Refer to the following page for a detailed tabulation of results, including process operating conditions and flue gas conditions.

There were no process or control equipment upset conditions which occurred during the testing, and no major maintenance was performed on the ESP during the three month period prior to testing.

Sample calculations for all formulas used in the test report are contained in Attachment 1. All calculation sheets, field data sheets, and calibration sheets are included as Attachments 2, 3, and 5, respectively.

J H CAMPBELL 3

PARTICULATE EMISSION TEST

SUMMARY TABLES

CAMPBELL 3 TOTAL UNIT CONDITIONS

Date	Test #	Gross MW	Steam Flow (klb/hr)	Total Gas Volume (ACFM)	Total Particulate Concentration (lb/hr)	Total Particulate Concentration (lb./mm BTU)	Stack Opacity (%)	Average Gas Temp (°F)	Average Velocity (fps)	Average Flue Excess Air (%)	Average Flue Gas Moisture (%)	Average Isokinetic Variation (%)
8/5/2014	1	853	5,937	3,545,432	34.3	0.0037	5.0	351.2	73.9	32.2	11.4	95.46
8/5/2014	2	849	5,921	3,530,599	23.0	0.0025	5.0	353.3	73.6	32.4	12.1	96.67
8/5/2014	3	847	5,899	3,608,146	22.8	0.0025	5.0	354.2	75.2	32.9	12.3	98.65
Average		849.67	5,919	3,561,392	26.7	0.0029	5.0	352.9	74.2	32.5	11.9	96.9

CAMPBELL 3 "A" DUCT (SOUTH) CONDITIONS

Date	Test #	Gas Volume (ACFM)	Outlet Grain Loading (Gr/dscf)	Particulate Concentration (lb./hr.)	Particulate Concentration (lb./mm BTU)	Average Gas Temp (°F)	Average Velocity (fps)	Average Flue Excess Air (%)	Average Flue Gas Moisture (%)	Average Isokinetic Variation (%)
8/5/2014	1	1,759,017	0.0012	10.5	0.0022	348.29	73.29	29.09	11.47	97.63
8/5/2014	2	1,726,361	0.0008	7.0	0.0015	350.29	71.93	28.80	12.23	98.20
8/5/2014	3	1,758,811	0.0007	6.3	0.0013	351.50	73.28	29.50	11.94	102.30
Average		1,748,063	0.0009	8.0	0.0017	350.03	72.84	29.13	11.88	99.38

CAMPBELL 3 "B" DUCT (SOUTH) CONDITIONS

Date	Test #	Gas Volume (ACFM)	Outlet Grain Loading (Gr/dscf)	Particulate Concentration (lb./hr.)	Particulate Concentration (lb./mm BTU)	Average Gas Temp (°F)	Average Velocity (fps)	Average Flue Excess Air (%)	Average Flue Gas Moisture (%)	Average Isokinetic Variation (%)
8/5/2014	1	1,786,414	0.0027	23.7	0.0052	354.17	74.43	35.31	11.32	93.30
8/5/2014	2	1,804,237	0.0018	16.0	0.0036	356.38	75.18	36.00	11.98	95.13
8/5/2014	3	1,849,336	0.0019	16.5	0.0037	356.83	77.06	36.25	12.89	95.01
Average		1,813,329	0.0021	18.7	0.0042	355.79	75.56	35.85	12.00	94.48

Notes:

1. The particulate emission limits are 0.10 lb/million Btu and 370 lbs/hour.
2. Oxygen and carbon dioxide are measured at the point of particulate sampling.
3. Flue gas moisture is determined by the condensate method.
4. Flue gas temperature is the average temperature at the point of particulate sampling.

Figures

Figure 1
Precipitator Outlet Breeching and Test Port Location

J. H. CAMPBELL PLANT UNIT 3
PRECIPITATOR OUTLET BREECHING AND TEST PORT LOCATION DETAIL

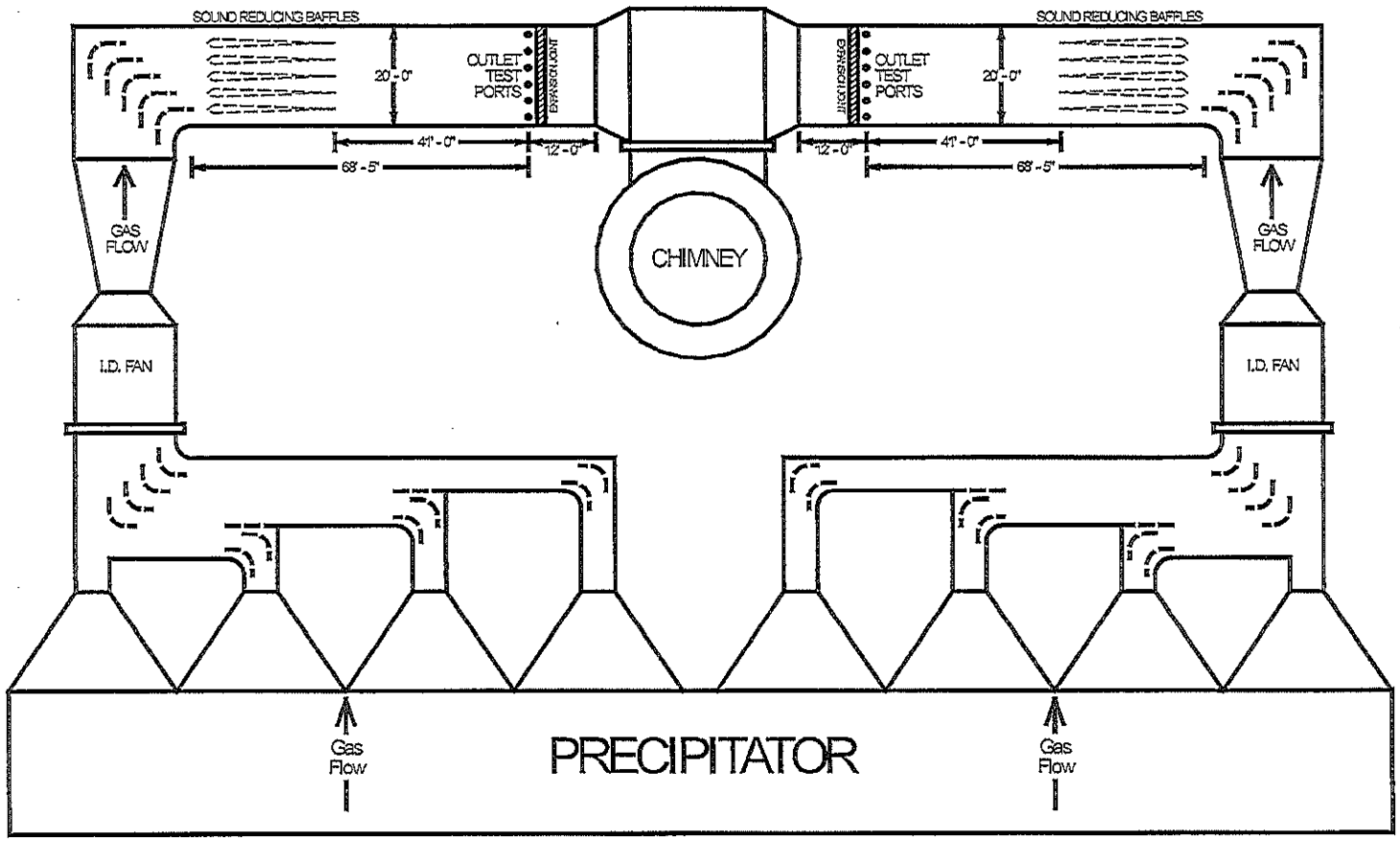

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Figure 2
Sampling Train Flow Diagram

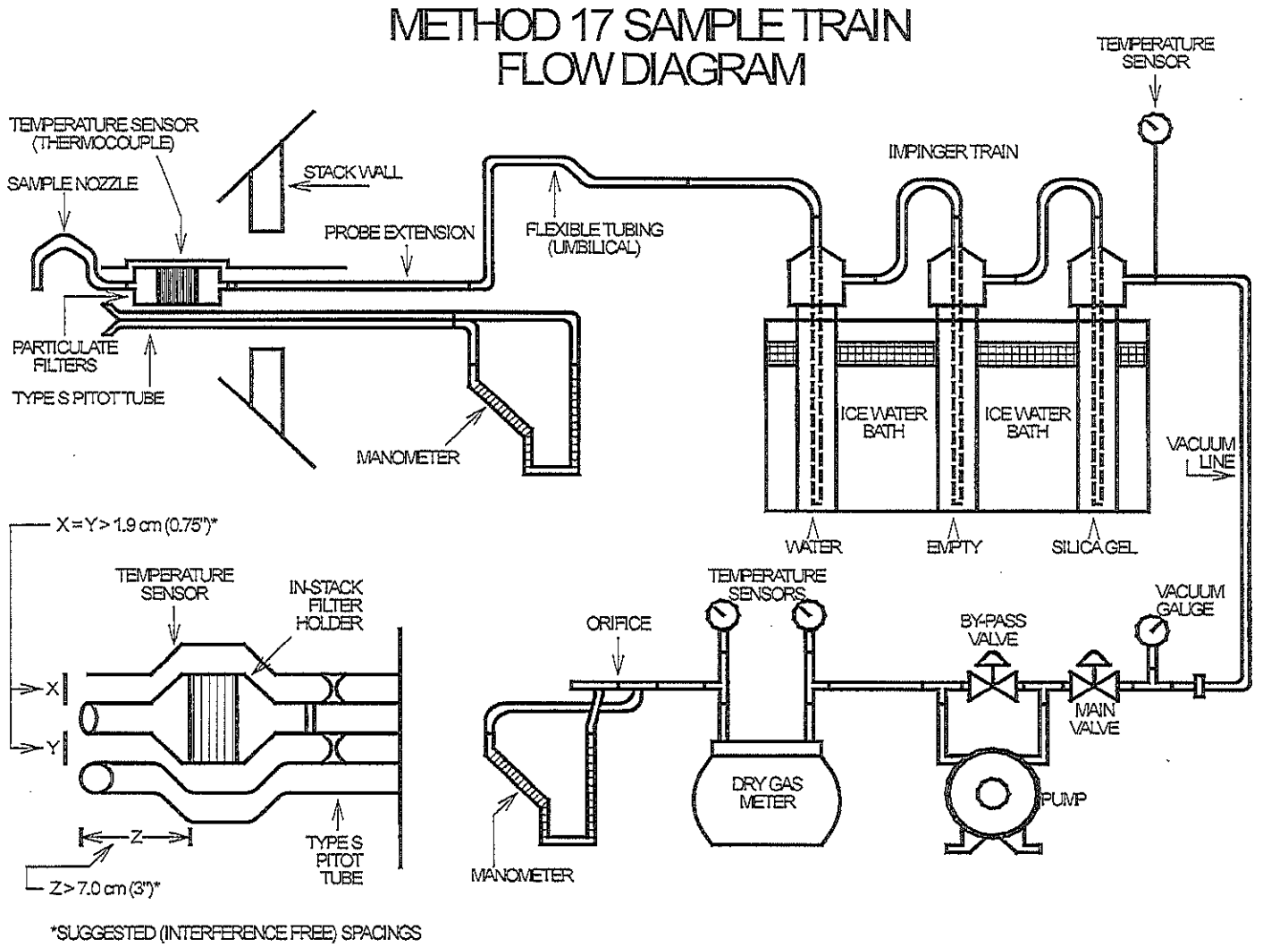
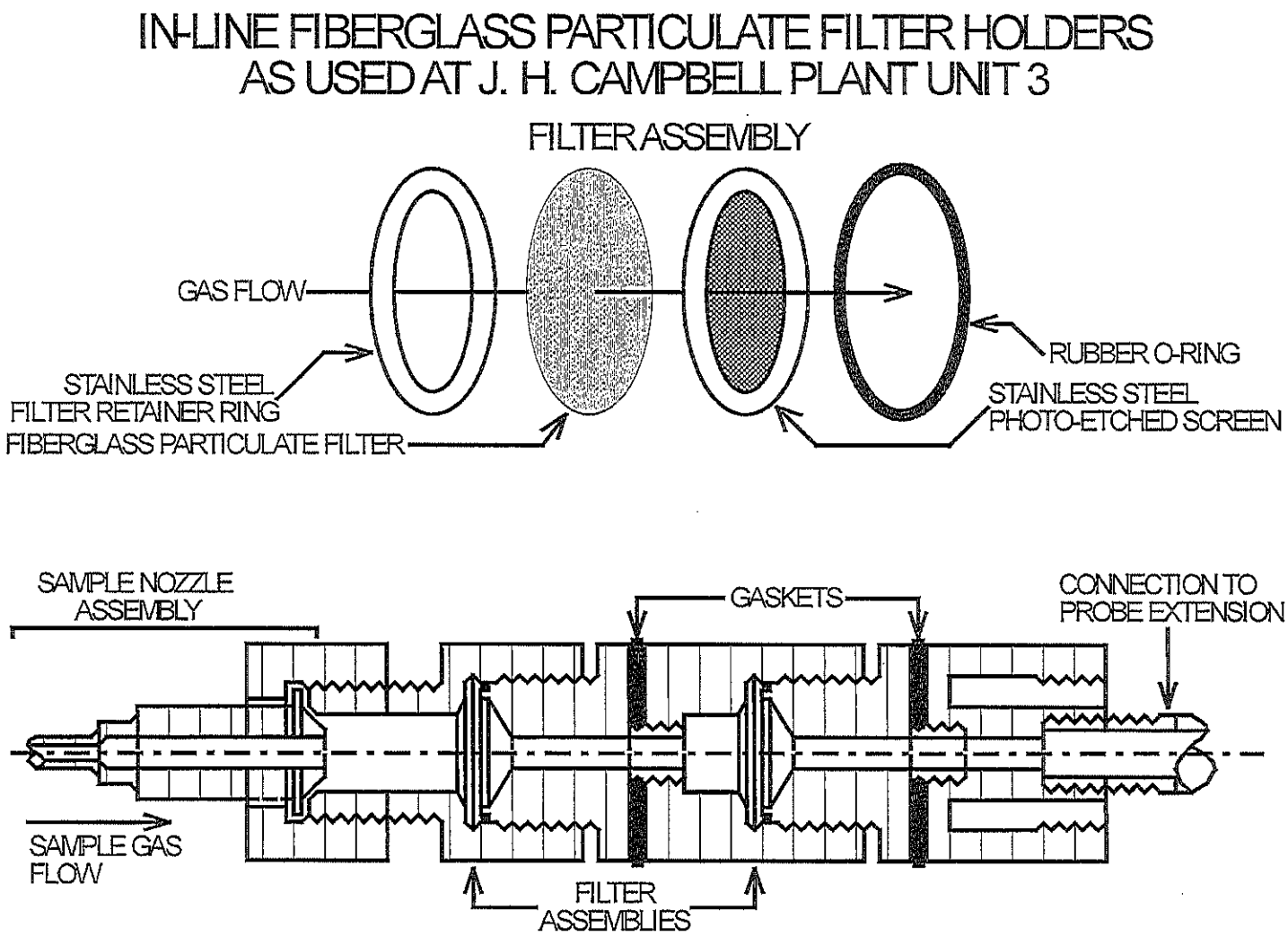


Figure 3 Probe Assembly



Diagram

Figure 4
Unit 3 Outlet Duct and Test Port Traverse Detail

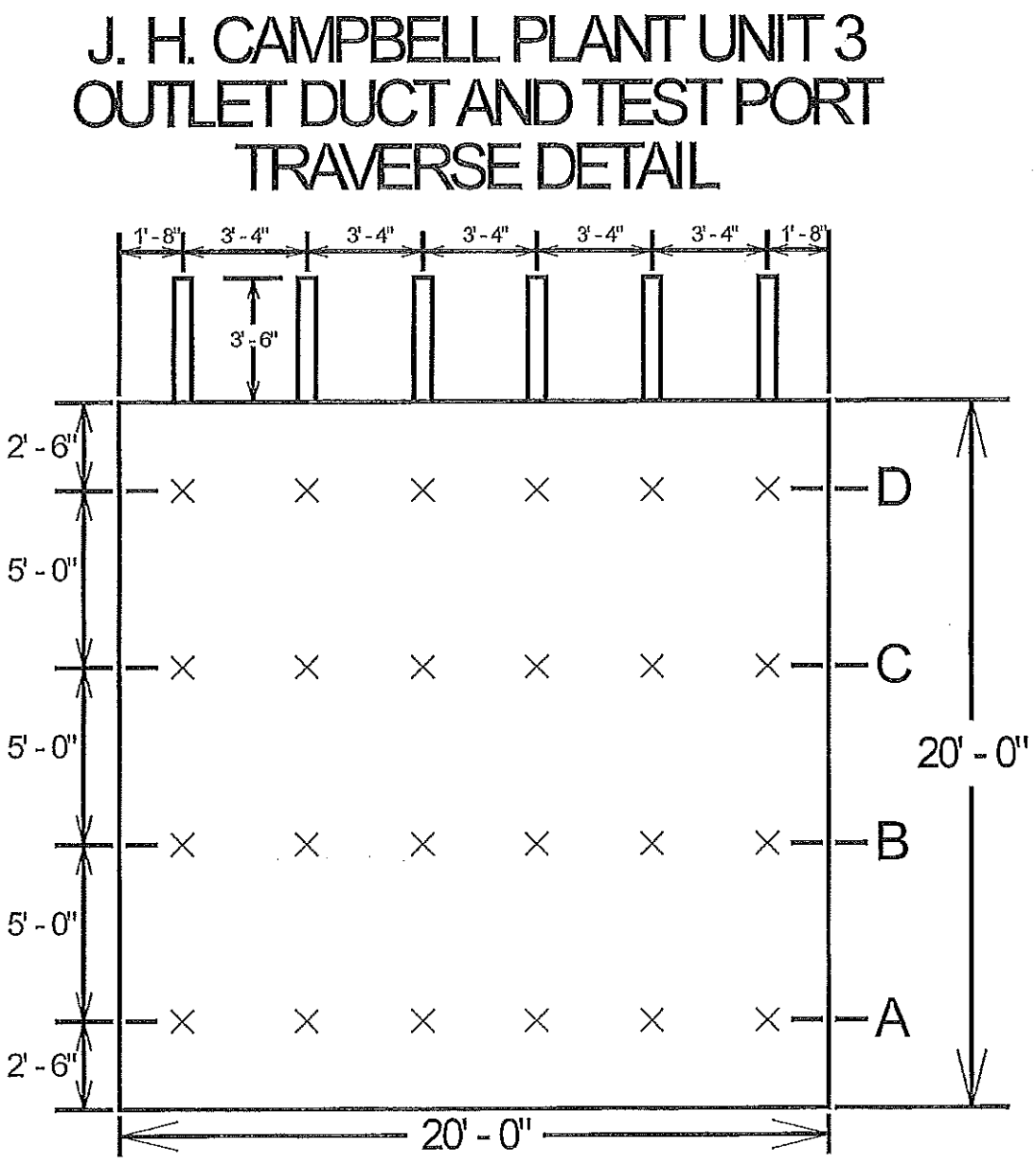


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Figure 5
Probe Assembly