Wayne H. Jens
Vice President
Nuclear Operations

Detroit Edison

Fermi-2
6400 North Dixie Highway
Newport, Michigan 48166
(313) 586-4150

Nuclear Operations

April 22, 1985
NE-85-0463

Director of Nuclear Reactor Regulation
Attention: Mr. B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Youngblood:

Reference: Fermi 2
NRC Docket No. 50-341

Subject: Testing of Control Center
Emergency Filtration System

This letter documents information provided to the NRC (Mr. W. Gammill) in previous telecons and responds to specific NRC questions concerning recent testing of the Control Center Emergency Filtration System. The dialogue on this subject was initiated by Detroit Edison due to some recent preoperational test results deviating from ANSI N510-1980, specifically the airflow capacity and uniform distribution criteria.

The results of the DOP test for the HEPA filters, the refrigerant gas and methyl iodide tests for the charcoal beds and the pressurization test for the Control Center were successful. In addition, there is substantial flow-capacity margin for the makeup filter unit and reserve charcoal bed depth (4" vs. 2") for the recirculation filter unit. Based on review of the HEPA filters and charcoal bed configurations within the housing units, the airflow distribution and airflow anomalies are understood. The acceptable test results and the system design margins assure the Control Center Emergency Filtration System can perform its safety function.

The enclosure and its attachments provide:

- A brief description of the system.
- Applicable equipment layout drawings.

Aperture Card Dist
Drawings To:
Reg File - 1 Set
ORB #1 BC - 7 Sets
Region 3 - 1 Set
ACRS - 1 Set

A001
1/10

- A discussion of the deviating results and technical justification for their acceptance.
- A discussion of the method used to measure the airflow velocity.
- A discussion of hardware-modification alternatives to influence the airflow distribution for the charcoal beds and their need/desirability.

Please direct any questions to Mr. O. K. Earle at (313) 586-4211.

Sincerely,

Daniel H. Jens

Attachments

cc: Mr. P. M. Byron
Mr. W. Gammill
Mr. M. D. Lynch
USNRC Document Control Desk
Washington, D.C. 20555

bcc: (* with attachment)
Approval Control
F. E. Agosti
L. P. Bregni
W. F. Colbert *
O. K. Earle *
W. J. Fahrner
W. R. Holland
W. H. Jens
R. J. Letkiewicz *
R. S. Lenart
A. K. Lim *
P. A. Marquardt
A. Papadopoulos
T. D. Phillips
L. J. Simpkin
M. D. Stout
G. M. Trahey
A. E. Wegele

O. K. Earle (Bethesda Office)
Secretary's Office (2412 WCB)
NRR Chron File *
NOC Satellite Service Center *

Enclosure to NE-85-0463

CONTROL CENTER EMERGENCY FILTRATION SYSTEM TESTING

Introduction

During testing of the Control Center Emergency Filtration System, some test results did not meet the acceptance criteria in ANSI N510-1980. The deviating test results were:

- Airflow distribution for the makeup filter unit (T4100D011) and the recirculation filter unit (T4100D016) HEPA filter banks.
- Airflow distribution for the makeup and recirculation filter units charcoal beds.
- Airflow capacity at 1.25 times the design dirty-filter pressure drop rating.

Description of Filter Units

The emergency makeup and recirculation filter units were manufactured by CTI Nuclear. The filter housings have side access and a serpentine airflow path as the air travels from the inlet to the discharge of the unit. Attachments 1 and 2 provide the layout of internal components for the makeup and recirculation filter units respectively.

The upstream and downstream HEPA filter banks in each of the filter units contain two HEPA filter elements rated at 1500 cfm each. The HEPA filters have a minimum efficiency of 99.97%.

The charcoal beds in the makeup and recirculation filter units are of the vertical gasketless design. The makeup unit has a 2-inch charcoal bed and the recirculation unit has a 4-inch charcoal bed. Credit has been taken for a 95% decontamination efficiency for each charcoal bed.

Airflow Distribution - HEPA Filter Banks

In accordance with Article 8.3.2.1 of ANSI N510-1980, a minimum of 10 velocity measurements were taken on the downstream side of each HEPA filter bank. The readings were taken approximately one to two inches from the downstream face of the filters with a direct reading 4-inch diameter rotating vane anemometer. The 10 velocity readings include one in the center of each filter and one in each corner of each filter as shown on Attachment 3. The air distribution results for each bank are also provided in Attachment 3.

The HEPA filter airflow distribution test results, which did not meet the ANSI N510-1980 acceptance criteria (+/-20% deviation from average velocity measured), are technically acceptable for the following reasons:

- The main purpose of this test, as discussed in ERDA 76-21 (Article 8.2.4), is to identify variable distribution across a HEPA filter bank that may result in underutilization of some of the individual filters and produce variable performance. This test and concern is addressed more towards variation in distribution between filter elements, rather than variation across the face of individual filters, and is reflected by the ANSI N510-1980 requirements for velocity readings in the center of each filter on banks containing more than 10 filters. Along this thinking, the results for the average of the five readings for each HEPA filter when compared to the average of all 10 readings, does not vary from the average by more than 6.6%.

- The results of the in-place DOP penetration tests (Attachment 4) are within the acceptance criteria limits of 0.05% and substantially within the Technical Specification limits of 1.0%. Even though the in-place DOP penetration test utilizes a polydisperse DOP challenge aerosol instead of the monodisperse challenge aerosol required for efficiency certification of each filter, the large margin between the actual test results and the requirements ensures that the airflow distribution variations for the individual HEPA filters do not have a negative impact on the HEPA filter bank performance.

- The airflow distribution across the face of the filter elements will become more uniform as the filter units are operated. This is due to accelerated particulate loading in the higher velocity areas. While this is not expected to occur rapidly when the units are operated for only 10 hours/month and for surveillance testing, the airflow equalization will take place if the units are required to operate for extended periods of time.

Airflow Distribution - Charcoal Beds

In accordance with Article 8.3.2(2) of ANSI N510-1980, velocity readings were taken 12-inches apart, vertically at each air slot on the downstream side of the charcoal beds. The readings were taken with a direct reading 4-inch diameter rotating vane anemometer approximately one to two inches from the face of the air slot as shown on Attachment 5. A rotating vane anemometer was used instead of the hot-wire anemometer or pitot tube because it is able to provide relatively stable readings when compared to these instruments in turbulent airflow.

The results of the airflow distribution tests for the makeup filter unit are provided in Attachment 6 and for the recirculation unit in Attachment 7.

The charcoal bed airflow distribution test results, which did not meet the ANSI N510-1980 acceptance criteria (+/-20% deviation from average velocity measured), are technically acceptable for the following reasons:

- The velocity readings that were beyond the acceptance criteria (i.e., +36% to +57% for T4100D011 and +49.6% and -24.6% for T4100D016) are principally at the downstream air slots adjacent to the housing wall. Not all of the higher-reading portion above 20% can be solely attributed to the serpentine airflow pattern within the unit; the velocities at this air slot are influenced by the lack of opposing airflow within the slot and by reflection from the housing wall.

- The higher velocities for the makeup filter unit do not result in charcoal residence times less than 0.25 second per 2-inch depth of charcoal as required by Regulatory Guide 1.52, Rev. 2. The unit was designed for 3000 cfm, but operates at 1800 cfm. To exceed the residence time requirements, the velocity measured at slot 1 would need to be 66% higher than the average measured at the other slots. This is without considering that the higher readings at slot 1 are influenced by other than the serpentine airflow pattern as discussed above.

- The results of the airflow distribution for the recirculation filter unit 4-inch charcoal bed show that one reading at slot 4 results in a residence time lower than 0.25 seconds per 2-inch bed depth. The unit is operated at 3000 cfm and was designed for 3000 cfm (i.e., 40 ft./min. charcoal face velocity). However, the one high velocity reading at slot 4 does not result in methyl iodide penetration through the 4-inch bed exceeding the 3% maximum penetration for new charcoal (at 30°C and 95% RH) established by ANSI N509-1980 (Table 5-1).

- The one high velocity measured through one section of the charcoal bed at slot 4, when the slot area, charcoal face area and actual airflow through the unit are taken into account, results in a charcoal face velocity of 58 ft./min.

- At 60 ft./min., it has been demonstrated that methyl iodide penetration increases by 200% to 300% above the penetration at 40 ft./min.[1] The charcoal batch test results (Attachment 8) indicate that the installed charcoal has a 0.92% penetration of methyl iodide when tested at 30°C and 95% RH. The methyl iodide projected conservative penetration through the one section of slot 4 is therefore 2.76%. When this increase is taken into account in a weighted manner, the overall methyl iodide penetration increases from 0.92% to 0.994%, which is still far below the 3% maximum penetration established by ANSI N509-1980 (Table 5-1) for new charcoal.

[1] An Experimental Investigation of the Relationship Between Bed Packing and Flow Distribution by H.C. Parish, et al, 14th ERDA Air Cleaning Conference.

- Air channeling has not occurred in the charcoal beds. If air channeling was present, it would be identified by high penetration of the challenge gas (R-11) during the in-place leak test. The 0.065% penetration for the makeup filter unit and no measurable penetration for the recirculation filter unit confirm that air channeling has not occurred. The in-place leak test results are significantly below the Technical Specification limit of 1% maximum penetration.

Considerations for Installation of Charcoal Bed Baffles

The installation of seismically supported baffles for the makeup and recirculation filter units to reduce the flow through the end slot of the charcoal beds is not believed to be warranted. The bases for this conclusion are:

- Evaluation of the charcoal bed airflow distribution for the makeup filter unit shows that the higher flow through the end slot does not result in a residence time of less than 0.25 seconds for the 2-inch bed. Therefore, the performance of the makeup filter unit charcoal bed meets the design requirements for methyl iodide removal efficiency.

- Evaluation of the charcoal bed airflow distribution for the recirculation filter unit shows that the higher flow through the end slot does not result in methyl iodide penetration above that allowed by ANSI N509-1980 for new charcoal. Therefore, the performance of the 4-inch charcoal bed meets the design requirements for methyl iodide removal efficiency.

- The installation of seismically supported baffles on the downstream side of the charcoal bed would be difficult to physically implement due to the arrangement of the filters. Welding of the baffle would be required and could result in warpage of the stainless steel charcoal bed housing and thereby potentially increase the bypass around the charcoal bed. In addition, the ANSI N510 testing accomplished would have been invalidated and would have to be repeated. This retesting would take approximately 3 to 4 weeks to accomplish. In Detroit Edison's opinion, due to the work and retesting involved, the uncertainty in whether the fix will actually work and the fact that the bed performance meets the design requirements, installation of baffles is not considered practical or advisable.

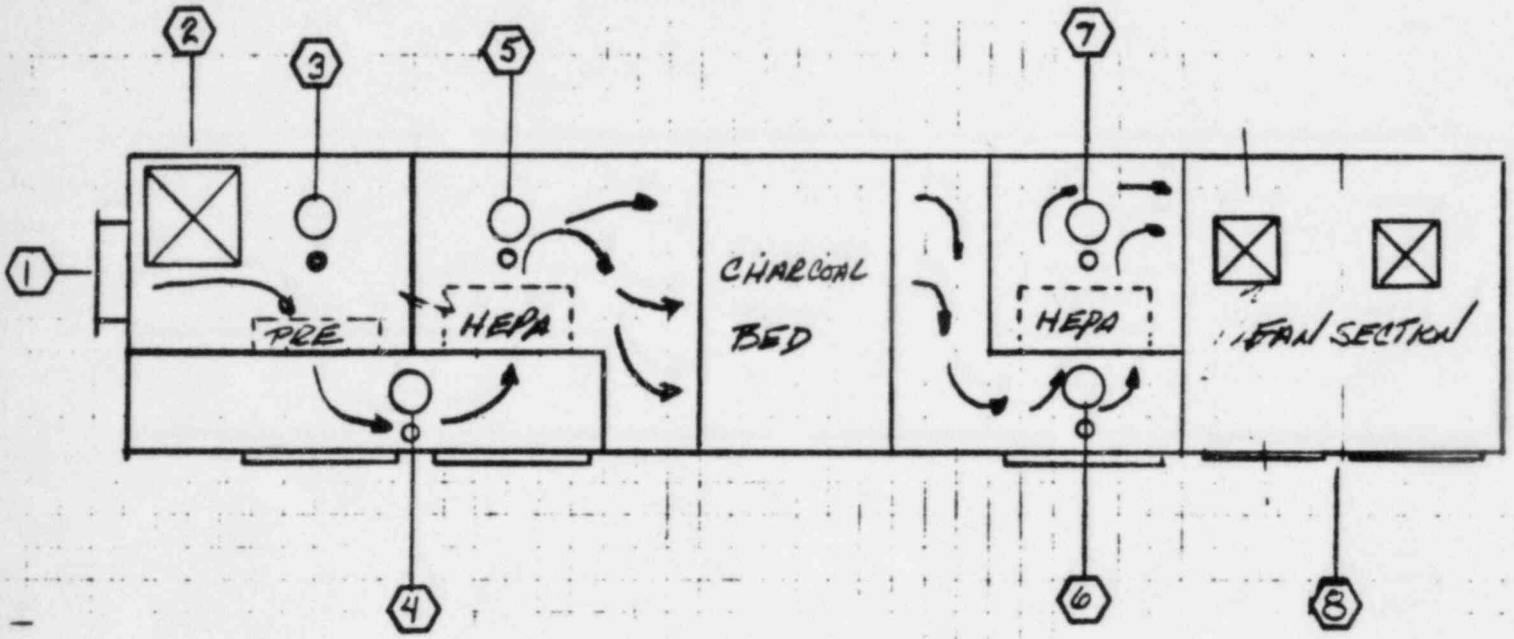
Airflow Capacity

ANSI N510-1980 airflow capacity tests were performed for recirculation fans T4100C047 (Division I) and T4100C048 (Division II) at clean, 1.25 times design dirty, and 1/2 (clean plus 1.25 times design dirty) filter conditions. The results of the tests at 1.25 times design dirty filter

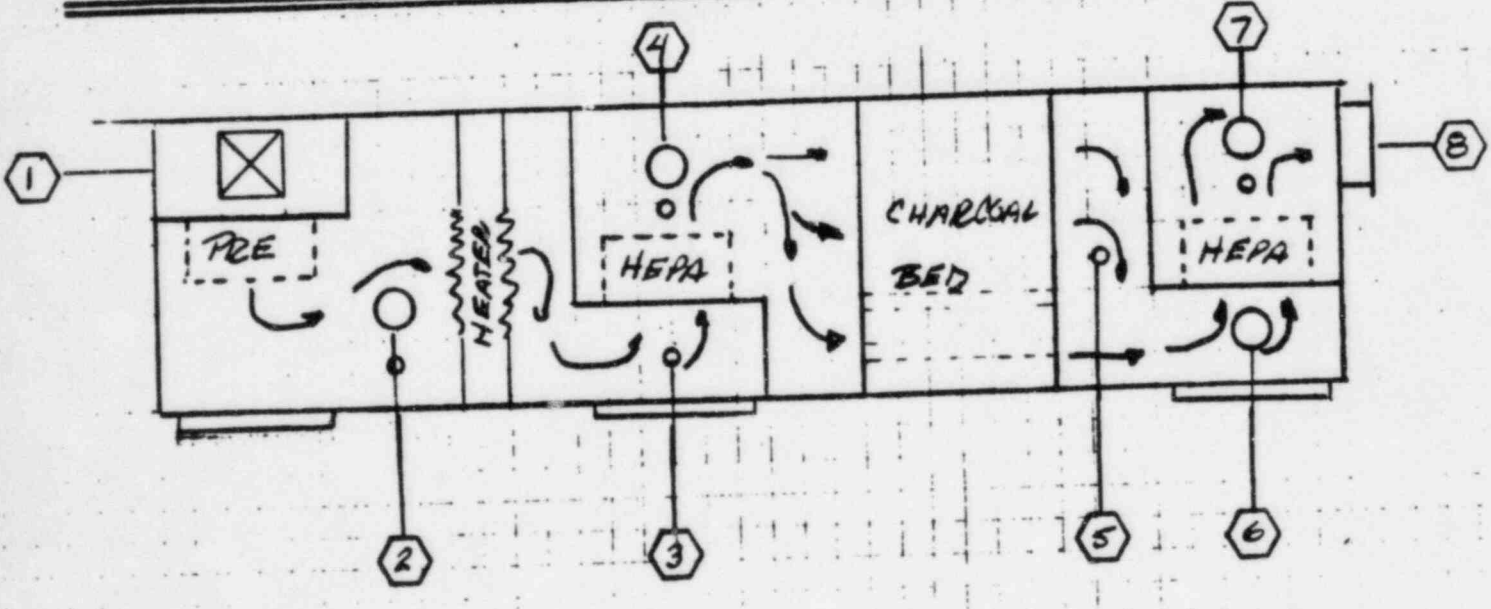
conditions were 15% below the design airflow and therefore did not meet the ANSI N510-1980 acceptance criteria of +/-10% deviation from design conditions. Additional tests were performed at design dirty filter conditions. The results of these tests met the acceptance criteria. Attachment 9 summarizes the results at each of the test conditions.

Based on the system's ability to meet the design requirements for Control Center pressurization (at least 0.125 inch water gauge) at 1.25 times design dirty filter conditions, the results are considered technically acceptable. The control room operator dose calculation is based on 1800 cfm of outside air mixing with 1200 cfm of recirculated air at the inlet to the recirculation filter unit. To achieve the desired iodine protection factor, the ratio of recirculated air to outside air must be greater than or equal to 0.67 (i.e., 1200/1800). As shown on Attachment 9, the ratio of recirculated to outside air was above 0.67 for each of the test conditions.

CONTROL CENTER - RECIRCULATION FILTER UNIT (T4100D06)

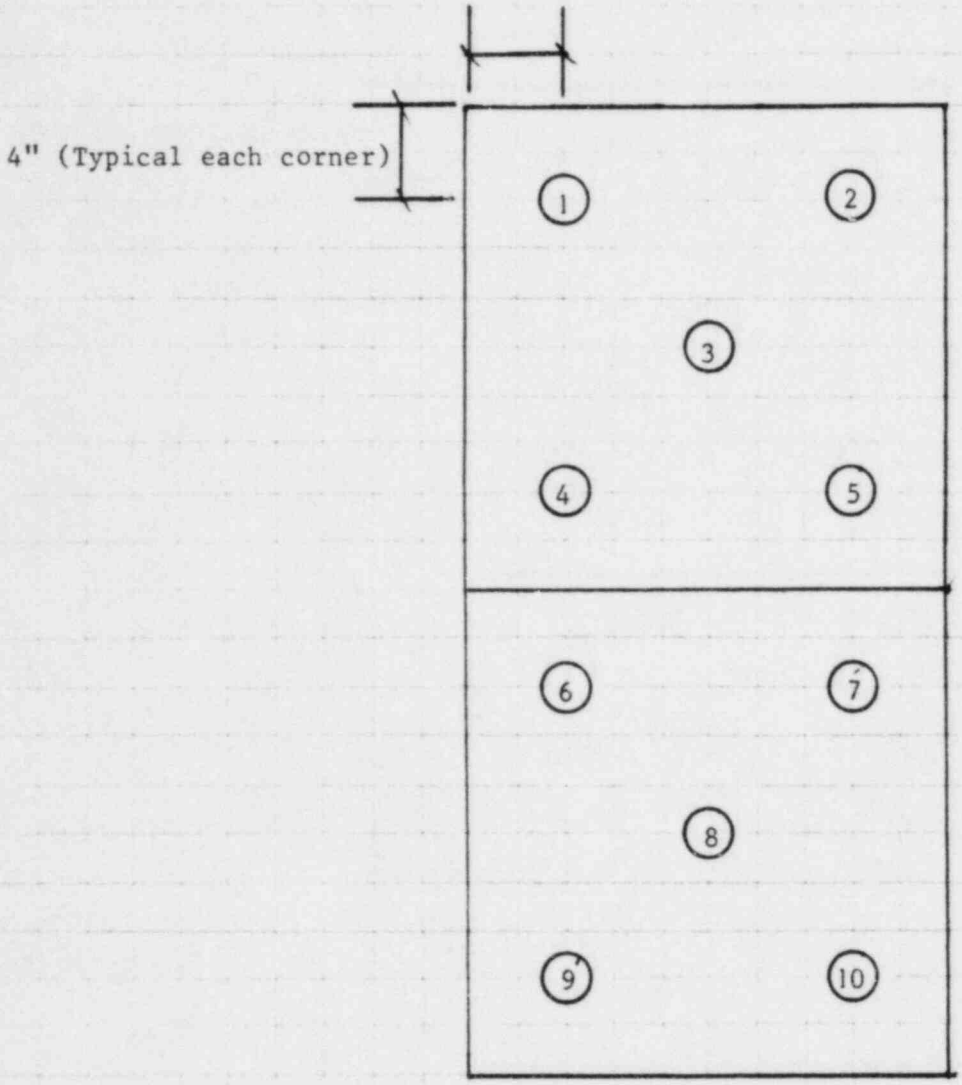


CONTROL CENTER - EMERGENCY MAKE UP FILTER UNIT (T4100D011)



	DRAWING	
1)	30151, Rev. E Sheets 1 and 2	Gasketless Adsorber Assy. 3000 CFM Emergency Makeup Air Filter
2)	30127, Rev. E Sheets 1 and 2	We dment Assembly 300 CFM Emergency Make-up Air Fi ter
3)	30025, Rev. D Sheets 1 and 2	Gask tless Adsorb r Assembly 3000 CFM Recirculation Air Filter
4)	30025, Rev. D Sheets 1 and 2	Weldment Assembly 3000 CFM Recirculation Air Filter

(Above drawings (5 sets) delivered separately)



View of downstream face of HEPA filters showing measurement locations.

FILTER UNIT HEPA FILTER BANK AIR DISTRIBUTION TEST RESULTS

LOCATION NO.	MAKEUP FILTER UNIT				RECIRCULATION FILTER UNIT			
	UPSTREAM		DOWNSTREAM		UPSTREAM		DOWNSTREAM	
	READING	(1) %	READING	(1) %	READING	(1) %	READING	(1) %
1	250	-19.6%	300	-8.7%	550	+0.7%	480	-7.1%
2	280	-9.9%	300	-8.7%	550	+0.7%	530	+2.5%
3	300	-3.5%	300	-8.7%	490	-10.3%	570	+10.3%
4	410	+31.8%	400	+22.7%	530	-2.9%	440	-14.9%
5	390	+25.4%	370	+13.5%	430	-21.2%	410	-20.7%
6	260	-16.4%	230	-29.4%	640	+17.2%	580	+12.2%
7	320	+2.9%	290	-11.0%	600	+9.9%	570	+10.3%
8	280	-10%	310	-4.9%	590	+8%	470	-9.1%
9	330	+6.1%	350	+7.36%	490	-10.3%	490	-5.2%
10	290	-6.7%	410	+25.8%	590	+8%	630	+21.9%
Avg. of All	311		326		546		517	
Avg. (1-5)	326	+4.8%	334	+2.5%	510	-6.6%	486	-6%
Avg. (6-10)	296	-4.8%	318	-2.5%	582	+6.6%	548	+6%

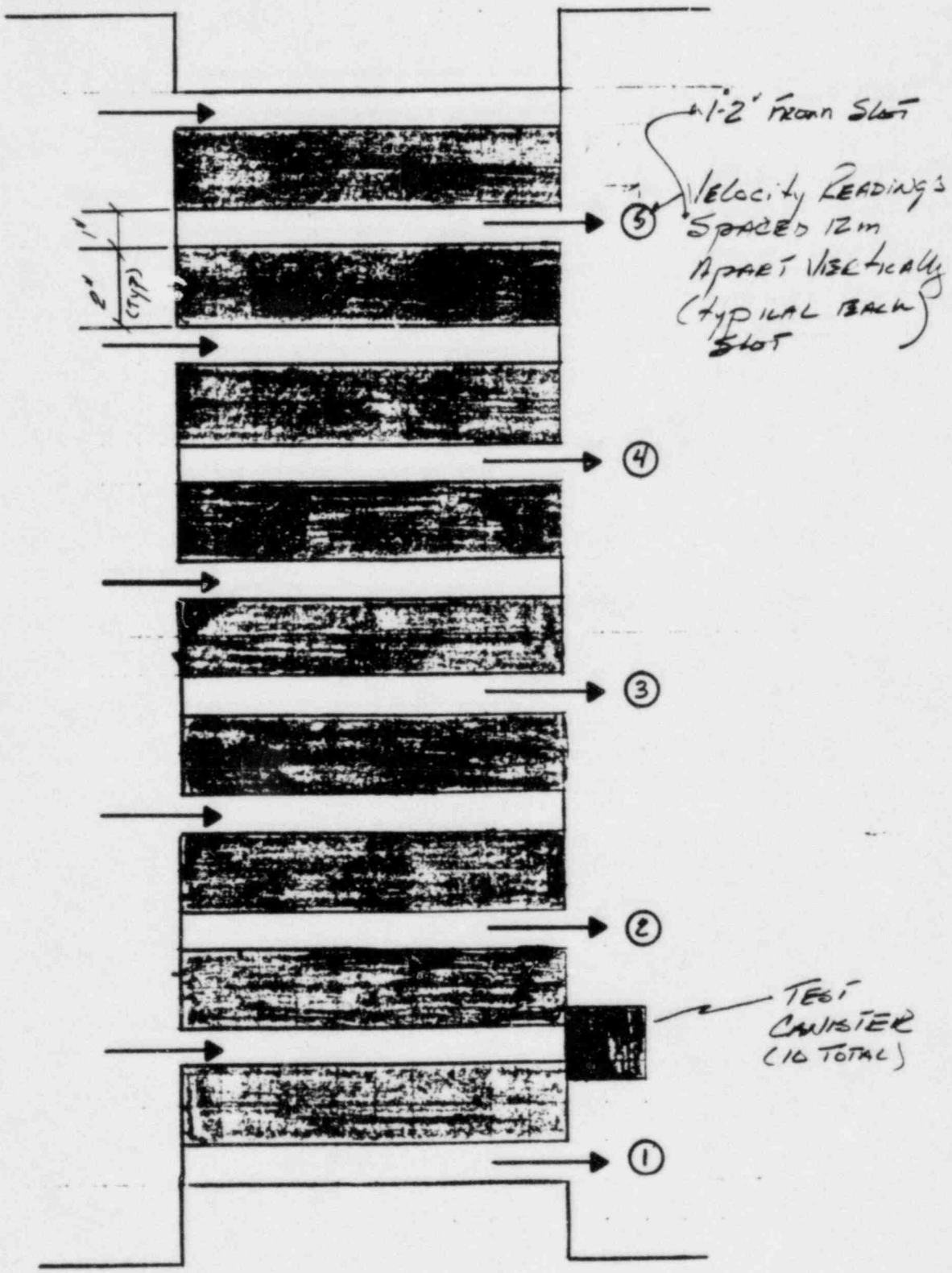
(1) Deviation From Average Of 10 Readings.

HEPA FILTER DOP PENETRATION TEST RESULTS SUMMARY

FILTER/FILTER BANK	DOP PENETRATION (%)
1. Make-up Filter Unit (T4100D011)	
A. Upstream Filter Bank In-Place Test	0.014
B. Downstream Filter Bank In-Place Test	0.006
2. Recirculation Filter Unit (T4100D016)	
A. Upstream Filter Bank In-Place Test	0.020
B. Downstream Filter Bank In-Place Test	0.028

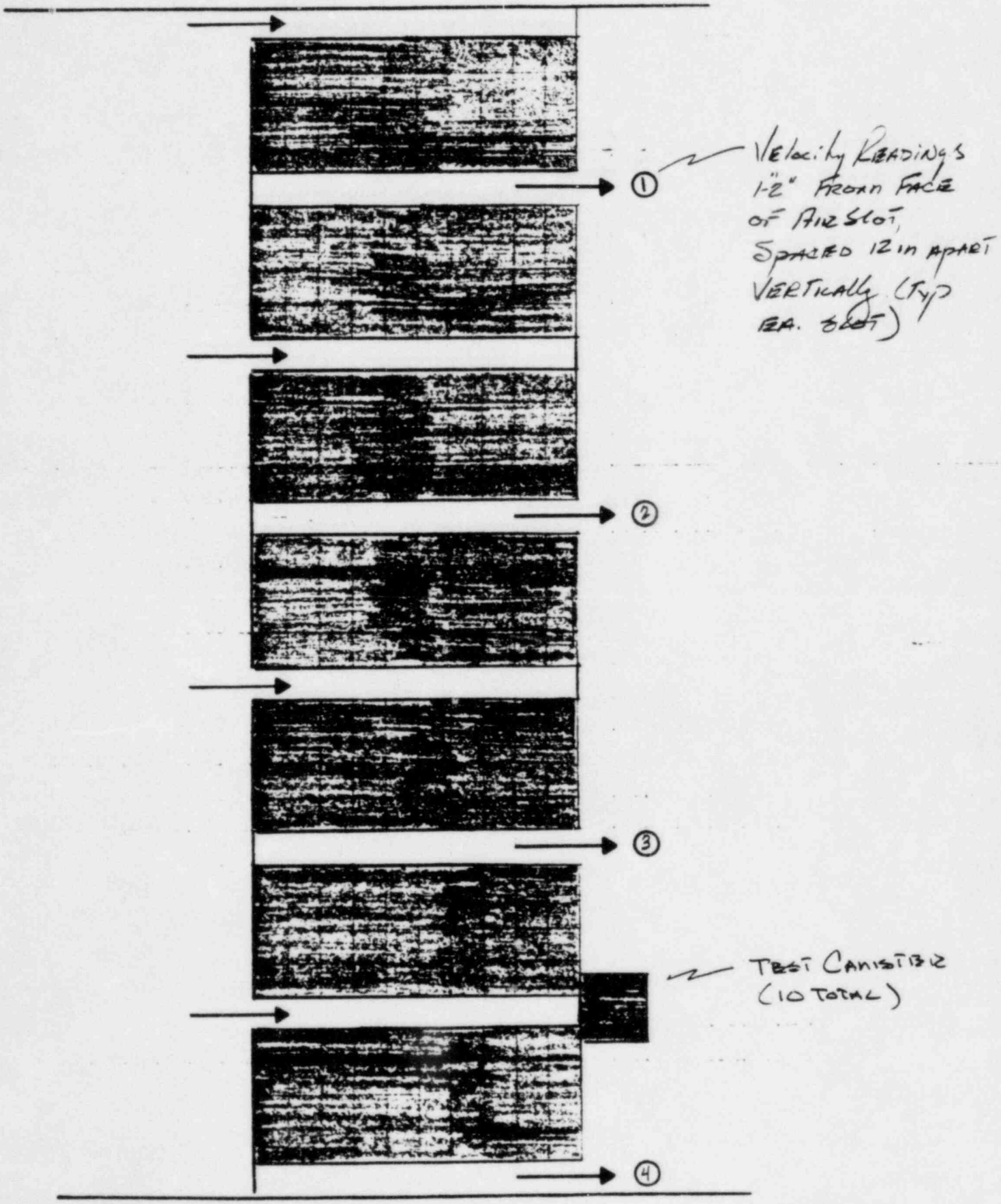
Makeup Filter Unit

ATTACHMENT 5
1 of 2



RECIRC FILTRATION

ATTACHMENT 5
2 of 2



MAKEUP FILTER UNIT (T4100D011)
CHARCOAL BED AIR DISTRIBUTION RESULTS

SLOT 1		SLOT 2		SLOT 3		SLOT 4		SLOT 5	
Measured	(2)	Measured	(2)	Measured	(2)	Measured	(2)	Measured	(2)
520	+57.3%	670	+1.3%	730	+10.4%	550	-16.8%	670	+1.3%
500	+51.2%	620	-6.2%	710	+7.4%	730	+10.4%	660	+0%
450	+36.1%	590	-10.8%	580	-12.3%	740	+11.9%	550	-16.8%
450	+36.1%	710	+7.4%	600	-9.3%	730	+10.4%	740	+11.9%
Avg. = 480	+45%	Avg.=647.5	-2.1%	Avg. =655	-0.9%	Avg.=687.5	+4%	Avg.=655	-0.9%
NOTE (1)		Avg. slots 2 to 5 = 661.3 fpm ∴Max. = 793.5 Min. = 528.8							

Note (1) Average at Slot 1 should be 1/2 of that measured at Slots 2 to 5 due to configuration of charcoal bed.
∴Slot 1 Acceptance Criteria Average = 330.65

Note (2) Deviation of reading from average.

Note (3) Airflow during test = 1761 acfm.

Note (4) Open area of each air slot = (1" x 52")/(144"/ft^2) = 0.36 ft^2.

Note (5) Face area of each charcoal bed = 8.23 ft^2.

Note (6) Readings taken 2/1/85.

RECIRCULATION FILTER UNIT (T4100D016)
CHARCOAL BED AIR DISTRIBUTION RESULTS

SLOT 1		SLOT 2		SLOT 3		SLOT 4	
Measured	(2)	Measured	(2)	Measured	(2)	Measured	(2)
1450	-5.7%	1775	+15.4%	1650	+7.3%	830	+8%
1250	-18.7%	1400	-8.9%	1500	-2.4%	580	-24.6%
1600	+4.1%	1750	+13.8%	1575	+2.4%	1150	+49.6%
1500	-2.4%	1500	-2.4%	1500	-2.4%	880	+14.5%
Slot Avg.=1450	-5.7%	Slot Avg.=1606	+4.5%	Slot Avg.=1556	+1.2%	Slot Avg.=860	+11.9%
Average of Slots 1, 2, and 3 = 18,450/12 = 1537.5						NOTE (1)	

NOTE (1) Average at Slot 4 should be 1/2 of that measured at Slots 1 to 3 or 1537.5/2 = 768.75 fpm.
∴Max. = 922.5 Min. = 615

NOTE (2) Deviation of reading from average.

NOTE (3) Airflow during test = 3186 Acfm.

NOTE (4) Open area of each air slot = $\frac{1" \times 49"}{144"/ft^2} = 0.34\ ft^2$.

NOTE (5) Face area of each charcoal bed = 11.6 ft^2

NOTE (6) Readings taken 2/1/85.

SUTCLIFFE, SPEAKMAN & Co. Ltd.

To: American Air Filters

Serial No. 1437

ANALYTICAL REPORT.

Date 7 February 19 81

Date Rec'd 19

Copies to: Mr. D. Wycherley, File (2)

Dept. Ref. No.

Sample of

Marked

208C 8-16 U.S. Imp. KI_3

A.A.P. Order No. 78575-08H
S.S. Inc. Order No. ST.0216/C.
S.S. Carbons Limited, Order No. C.0200
Item 1 Lot 1 Batch 1 AAF LOT # 0166
Weight 10,000 lbs.

Analytical Results

TEST	RESULTS	METHOD
CTC % (Base)	63.5	ASTM D.3467
Hardness No.	97.5	ASTM D.3802
Ash %	2.64	ASTM D.2866
Ignition Temp.°C	372	ASTM D.3466
Moisture %	3.0	ASTM D.2867
Density gm/ml	0.51	ASTM D.2854
pH (water extract)	8.6	ASTM D.3838
Granular Size		ASTM D.2862
on 6 ASTM #11 (%)	NIL	
6 - 8 "	1.0	
8 - 12 "	47.0	
12 - 16 "	50.4	
- 16 "	1.6	
- 18 "	0.1	

ACCEPTED 8 7 EDISON

Remarks

Signed ..... Chief Analyst Inspector

Signed ..... Chief Chemist

Form No L (m)

72

TEST SPECIFICATION REFERENCES : ANSI N509 1980
MANUFACTURER: SUTCLIFFE SPEAKMAN & CO CO200
SUTCLIFFE SPEAKMAN , INC ST0246/C
BATCH : NC 517 AAF LOT # 0166
TYPE : 208C
CUSTOMER : AMERICAN AIR FIL
P.O. NUMBER: 78-57508
PRIOR USE : NEW
DATE TESTED : 09-FEB-83
SAI TEST NUMBER : 1592

EST CONDITIONS :

TEMPERATURE : 30.0 DEGREES CENTIGRADE
RELATIVE HUMIDITY : 95.0 PERCENT
BED DIAMETER : 51 MM
BED DEPTH : 51 MM
FACE VELOCITY : 12 METERS/MIN
PRESSURE : 101. KPA
FEED CONCENTRATION: 1.750 MG/M-3 CH3I (WITH 131-I TRACER)
EQUILIBRATION PERIOD : 0. MIN
FEED PEDIOD : 120. MIN
ELUTION PERIOD : 240. MIN

EST RESULTS:

TEST BED: 2.11E-01 +,- 1.01E-03 UCI
BACKUP A: 1.08E-03 +,- 6.54E-05 UCI
BACKUP B: 4.87E-04 +,- 4.02E-05 UCI

RETENTION EFFICIENCY (%): 99.08 +,- 0.19

ACCEPTED 8 (7) EDISON

Kathy A. Soraya 16-FEB-83
SCIENCE APPLICATIONS , INC.

ATTACHMENT 9

AIRFLOW CAPACITY TEST RESULTS SUMMARY

DIVISION I FAN T4100C047

Parameter	Acceptance Criteria		Results							
			Clean		1.25* Dirty		(2)		Dirty	
AIRFLOWS (ACFM)										
Fan Total (@ D016)	2700 to 3300		3075		2534		3002		2886	
Outside Air (@ D011) (1)	1500* to 1980		1673		1409		1751		1661	
Recirc. Air (3)	1200		1402		1125		1251		1225	
Recirc/Outside Air	.67		.84		.80		.71		.74	
MOTOR AMPS	26 amps		18,18.5,18		16.5,17.5, 17.5		18.2,19.2, 18.5		17.8,18,18.6	
CONTROL ROOM ΔP	+.25 iwg +/-1/8		+0.40 iwg.		+0.20 iwg.		+0.32 iwg.		+0.35 iwg.	
FILTER ΔP (iwg.)	D011	D016	D011	D016	D011	D016	D011	D016	D011	D016
Clean	1.6	4.7	1.9	4.3	N/A	N/A	N/A	N/A	N/A	N/A
1.25* Dirty	7.25	10.25	N/A	N/A	7.45	10.20	N/A	N/A	N/A	N/A
1/2(Clean & 1.25* Dirty)	4.4	7.5	N/A	N/A	N/A	N/A	4.7	7.5	N/A	N/A
Dirty	5.9	8.2	N/A	N/A	N/A	N/A	N/A	N/A	5.9	8.4

DIVISION II FAN T4100C048

Parameter	Acceptance Criteria		Results							
			Clean		1.25* Dirty		(2)		Dirty	
AIRFLOWS (ACFM)										
Fan Total (@ D016)	2700 to 3300		3143		2544		3038		2865	
Outside Air (@ D011) (1)	1500 to 1980		1679		1454		1754		1637	
Recirc. Air (3)	1200		1464		1090		1284		1228	
Recirc/Outside Air	.67		.87		.75		.73		.75	
MOTOR AMPS	26 Amps		17.5,18,18.5		16,16.5,16.8		18,19.2,18		19,17.5,19	
CONTROL ROOM ΔP	.25 iwg +/-1/8		+0.40 iwg.		+0.22 iwg.		+0.40 iwg.		+0.40 iwg.	
FILTER ΔP	D011	D016	D011	D016	D011	D016	D011	D016	D011	D016
Clean	1.6	4.7	1.9	4.3						
1.25* Dirty	7.25	10.25			7.4	10.25				
1/2(Clean & 1.25* Dirty)	4.4	7.5					4.6	7.35		
Dirty	5.9	8.2							5.8	8.4

Notes:

(1) A minimum of 1500 cfm of outside air is needed to maintain Control Center pressurization. As Control Center differential pressure in a governing condition 1500 cfm is used as a min. value instead of 1620 cfm (ie. 1800-10%).

(2) 1/2 (Clean + 1.25* Dirty).

(3) Recirculation airflow is calculated by (fan total measured-outside air measured).