ATTACHMENT 3

McGUIRE NUCLEAR STATION

Auxiliary Building Ventilation System

Acceptance Criteria for Supplemental Filter Testing

Document No. MCC-1211.00-00-0096

Prepared: J. K. Richardson 10/23/85

Reviewed: H. A. Smith 10-23-85

Approved: R. R. Weidler 10-23-85

McGuire Nuclear Station
Auxiliary Building Ventilation System
Acceptance Criteria for Supplemental Filter Testing
Document No. MCC-1211.00-00-0096

1.0 PURPOSE

The purpose of this document is to establish acceptance criteria for supplemental test procedures prepared for the auxiliary building ventilation exhaust filter trains at McGuire Nuclear Station.

2.0 SCOPE

Acceptance criteria will be established for supplemental test procedures specifically prepared to determine airflow distribution through the HEPA bank and adsorber bank of the auxiliary building ventilation exhaust filter trains.

3.0 REFERENCES

A. McGuire Nuclear Station Test Procedures
   a) TT/1/A/9100/101A - Unit 1 Pre/HEPA Airflow Distribution Measurements
   b) TT/2/A/9100/101A - Unit 2 Pre/HEPA Airflow Distribtuion Measurements
   c) TT/1/A/9100/101B - Unit 1 Carbon Bed Airflow Distribution Measurements
   d) TT/2/A/9100/101B - Unit 2 Carbon Bed Airflow Distribution Measurements

B. "Elemental Iodine and Methyl Iodide Adsorption on Activated Charcoal at Low Concentrations, R. R. Bellamy, 13th AEC Air Cleaning Conference.

C. "Removal Radioactive Methyl Iodide from Steam-Air Systems", ORNL-4040, Adams, Ackley and Browning.

D. "Supplemental Testing and Analysis of HEPA Filter Elements for ABFU-1 and ABFU-2", Duke Power Document No. MCC-1211.00-00-0055, January 26, 1981.

E. "Verification of Carbon Adsorber Residence Times", Duke Power Document No. MCC-1211.00-00-0066, May 20, 1981.

F. Final Safety Analysis Report, McGuire Nuclear Station, Duke Power Co.

G. Safety Evaluation Report, McGuire Nuclear Station, U.S. Nuclear Regulatory Commission.

4.0 GENERAL DISCUSSION

Preoperational testing conducted on the auxiliary building exhaust filter trains was generally performed in accordance with ANSI N510 - 1975, Testing of Nuclear Air Cleaning Systems. A portion of this testing standard (Attachment 1) addresses three (3) separate evaluations of airflow within the filter system: (1) airflow capacity test, (2) air distribution test across the HEPA filter bank, and (3) adsorber residence time calculation.

Recent analyses of the preoperational test data have precipitated the need to evaluate filter train airflow performance with respect to the 1980 edition of ANSI N510. Comparable sections of this current standard (Attachment 2) address testing of filter system airflow in a different manner than the 1975 version. The 1980 outline procedure for evaluation of airflow includes: (1) airflow capacity test, (2) air distribution test through HEPA filter banks, and (3) air distribution test through adsorber banks.

The basic differences in the two (2) test methods are relatively straightforward. The 1975 edition specifies measurement of HEPA filter airflow distribution to be performed upstream of the filter bank, while the 1980 edition recommends the HEPA measurements be taken downstream of the filters. The 1975 edition requires a verification of adsorber residence time based on calculated average velocity, while the 1980 edition specifies the need to determine the actual airflow distribution through the adsorber bank.

The supplemental test procedures in Reference A have been prepared for the purpose of obtaining additional data required for the 1980 test methods. As set forth in the purpose statement, acceptance criteria for the supplemental testing will be established in the following sections of this document.

5.0 PREOPERATIONAL TESTING RESULTS

An understanding of the preoperational test results and conclusions is relevant in developing acceptance criteria for the supplemental test procedures. A brief review of the essential steps is as follows:

1) Preoperational Airflow Capacity Test - System volumetric flow rate was verified to be within design parameters.
2) Preoperational Air Distribution Test Across HEPA Filter Bank - Velocity measurements were recorded at the upstream face of each prefilter cartridge. The HEPA filters and prefilters are mounted back-to-back on a common frame (see Attachment 3). This arrangement precludes velocity measurement at the upstream HEPA face. Several velocity measurements varied from the average by more than the recommended ±20% tolerance. High and low extreme readings typically were on the order of +100% and -60%, respectively, when compared to the average value. This anomaly was evaluated under laboratory conditions by subjecting identical HEPA filter media to even wider variations in airflow while monitoring DOP removal efficiency. The evaluation of the test data (Reference D) concluded that overall effectiveness of the HEPA filters was not compromised by the observed velocity distribution.
3) Preoperational Adsorber Residence Time Calculation - Verification of the adsorber residence time based on calculated average velocity and effective screen area was documented in Reference E. Resulting values were within the tolerance recommended in the 1975 testing standard.

6.0 ANALYSIS OF SUPPLEMENTAL TESTING

Supplemental testing will be conducted to: (1) verify airflow capacity, (2) determine air distribution through the HEPA bank, and (3) determine air distribution through the adsorber bank.

Acceptance criteria for the airflow capacity test as stated in ANSI N510-1980 is that flow shall be within ±10% of system design flow. This criteria will be utilized in evaluating the supplemental testing.

6.0 ANALYSIS OF SUPPLEMENTAL TESTING (con't)

Acceptance criteria for the HEPA filter bank air distribution test as stated in ANSI N510-1980 is that all velocity readings shall be within ±20% of the average velocity measurement. This criteria will not be utilized in evaluating the supplemental testing. Based on testing and analysis of specific HEPA elements in Reference D, acceptance criteria will be based on limits of observed velocity corresponding to limits established through laboratory testing. These velocity limits are 70 feet per minute minimum and 1135 feet per minute maximum, and will be used to evaluate velocity measurements taken downstream of the HEPA bank. If observations fall within the stated limits, then no corrective action will be necessary relative to the HEPA bank other than documenting the findings in the appropriate FSAR table. Velocity measurements taken upstream of the prefilter are for information only and will not be evaluated against the criteria.

Acceptance criteria for the adsorber bank air distribution test as stated in ANSI N510-1980 is that all velocity readings shall be within ±20% of the average velocity measurement. If the observed airflow distribution is within the ±20% tolerance (either upstream or downstream), then no corrective action will be necessary relative to the adsorber bank.

If the airflow distribution is outside the ±20% tolerance, then the following criteria will be utilized to evaluate the test measurements. In Reference B, a 2 inch bed of impregnated carbon exhibited essentially constant removal efficiency for methyl iodide and elemental iodine throughout a superficial velocity range of 20 feet per minute to 200 feet per minute. This phenomenon is substantiated in Reference C under more severe temperature and humidity but to a lesser velocity variation. Based on the 20-200 fpm range and a nominal superficial average velocity of 40 fpm, the extreme readings could range from a maximum of +400% to a minimum of -50% with no expected loss in efficiency. If airflow distribution through the adsorber bank is outside the ±20% tolerance but within the +400% to -50% range, then the periodic carbon sampling method and/or frequency will be conservatively adjusted to compensate for abnormal weathering rates that may occur in the regions of higher velocity.

6.0 ANALYSIS OF SUPPLEMENTAL TESTING (con't)

The airflow distribution through the adsorber bank is anticipated to be well within the limits established in the preceding paragraph. In the remote event that observations are outside the established criteria, then a comprehensive review of accident analyses will be performed to realistically assess benefit expected from these filters in an emergency situation. Although the NRC credited these filters with 90% elemental iodine removal efficiency in the McGuire SER (Reference G), the FSAR analyses (Reference F) do not assume removal credit. Therefore, a reduction in filter effectiveness will not increase the exposure values presented in the FSAR. Realistically, any level of filter efficiency will reduce potential radiation exposure. However, this aspect of filter performance has no effect on plant operability.

7.0 CONCLUSIONS

Acceptance criteria for airflow capacity test will be ±10% of system design flow. Design flow for Unit 1 is 54,000 cubic feet per minute. Design flow for Unit 2 is 43,000 cubic feet per minute.

Acceptance criteria for HEPA filter bank air distribution test is to verify that velocity measurements are within the range of 70 feet per minute to 1135 feet per minute when measured downstream of the HEPA filters.

Acceptance criteria for the adsorber bank air distribution test will be applied in three (3)succeeding steps as follows:

(1) If velocity readings either upstream or downstream are within ±20% of the average measurement, then no further action is necessary.

(2) If velocity readings are outside the ±20% tolerance but within a range of +400% to -50% of average, then periodic carbon sampling methods and/or frequency will be conservatively adjusted to account for the observed profile.

7.0 CONCLUSIONS (con't)

(3) If velocity readings are outside the +400% to -50% tolerance, then a realistic dose assessment will be performed to evaluate the filter's contribution to radiation exposure reduction.

None of the above acceptance criteria have an effect on plant operability.

6. Final leak rate of mounting frame.
7. Test data.
8. Instrument calibration data.
9. Signature(s) of test personnel.
10. Date of test.
11. Distribution of report.

8. AIRFLOW CAPACITY, DISTRIBUTION, AND RESIDENCE TIME TESTS

8.1 Purpose

These tests are used (1) to verify that the specified volume flowrate of air can be achieved with the fan as furnished, under actual field conditions at maximum and minimum filter pressure drop; (2) to verify that airflow distribution across each filter or adsorber in each stage is reasonably uniform, relative to the average flowrate in the total system; and (3) to verify that the residence time of each adsorber cell, based on actual volume flowrate of the system, is in accordance with specifications. The test is made only during acceptance testing following original installation, modification, or major repair of the air cleaning system.

8.2 Apparatus (See Section 9, ACGIH *Industrial Ventilation*)

1. Standard pitot tube.
2. Inclined manometer.
3. Aneroid type pressure gage.
4. Heated-wire or heated-thermocouple anemometer having calibrated accuracy of at least 3% of full scale reading. Calibration shall be verified before start of test.

8.3 Procedure

8.3.1 Airflow Capacity Test

1. Install all system components.

2. Start system fan.

3. Make a pitot-tube velocity-traverse in accordance with Section 9 of ACGIH *Industrial Ventilation*. The traverse should be made at a point in the duct where airflow velocity is 1000 fpm or more, and, if possible, where velocity measurements can be made at least 7.5 duct diameters downstream of any airflow disturbance. If there is no place where the airflow is greater than 1000 fpm, use one of the other methods as described in Section 9 of the ACGIH *Industrial Ventilation*.

4. Calculate system volume airflow in accordance with Section 9 of ACGIH *Industrial Ventilation*, compare with the value required by project specifications, and adjust system, if possible, to achieve the specified volume flow rate. If the specified value cannot be achieved, stop test and notify Owner. Check for stable fan operation over a period of at least 15 minutes.

5. Upon successful completion of step 4, add artificial resistance to the system by blanking off filters and pressurize space until a pressure drop of at least 1.25 times the design dirty-filter pressure drop for the system (as specified in the test procedure or project specifications) is achieved. Check for stable fan operation over a period of at least 15 minutes. If the required dirty-filter system airflow cannot be achieved, notify Owner.

6. Repeat step 5 using sufficient artificial resistance to produce a pressure drop of about 50% of that of step 5; check fan for stable operation over a period of at least 15 minutes.

8.3.2 Air Distribution Test Across HEPA Filter Bank

1. If total system airflow capacity meets specification requirements (Par. 8.3.1), make an anemometer reading upstream of the face at the center of each HEPA filter. Record all readings.

2. Calculate average velocity .. the housing from the equation:

$$\overline{V} = \frac{\Sigma_1^n V_i}{n} \qquad (4)$$

where $\overline{V}$ = average airflow velocity through the housing;
V_i = individual anemometer readings;
n = number of anemometer readings.

3. All readings shall be within ± 20% of the average velocity calculated from equation (4). If the velocity at any filter varies from the average by more than 20% notify the Owner.

8.3.3 Adsorber Residence Time Calculation.

Calculate residence time of the adsorber stage from the equation:

$$T = \frac{nNt\,(A - b)}{28.8Qs} \qquad (5)$$

where T = residence time, seconds;
n = number of cells in system;
N = number of adsorbent beds per cell (see Fig. 2, CS-8);
t = thickness of adsorbent beds, inches;
A = gross area of all adsorbent-bed screens (in.^{2}) of one cell;
b = area of baffle, margin, and blank area of all adsorbent-bed screens (in.^{2}) of one cell;
Q = volumetric flow rate of system, from Par. 8.3.1 step 4 (cfm);
s = number of screens of one cell.

Actual residence time shall be within ± 20% of the design value.

8.4 Report

A written report shall be furnished to all persons specified in the test procedure. The report shall include as a minimum:

1. Title or identification of test series.
2. Job number or Purchase Order.
3. Test apparatus.
4. Actual airflow rate through system and unit.
5. Actual airflow velocity at each test point, average system airflow velocity, and maximum plus-and-minus deviations from average airflow velocity (Par. 8.3.2).
6. Calculated average system residence time (Par. 8.3.3).
7. Nonconformances discovered during test and name of parties to whom reported.
8. Conclusions and recommendations.
9. Instrument calibration data.
10. Signature(s) of test personnel.
11. Date of test.
12. Distribution of report.

9. AIR-AEROSOL MIXING UNIFORMITY TEST

9.1 Purpose

This test is a prerequisite to the tests of Sections 10 and 12, in-place leak tests of HEPA filter and adsorber banks, respectively. The purpose of the test is to verify that tracer (DOP or refrigerant gas) injection and sample ports are located so as to provide proper mixing of the tracer in the air approaching the component stage (HEPA filter bank or adsorber stage) to be tested, or the sample plane. The test is made only upon completion of initial system installation, modification, or major repair, and is not required each time an in-place test of the filters or adsorbers is made. A valid in-place test is not possible without a uniform tracer-air mixture.

9.2 Summary of Method

DOP aerosol is introduced into the air stream at a previously selected injection point. Aerosol concentration readings are taken across a plane parallel to, and a short distance upstream of the HEPA filter bank; the uniformity of these readings establishes the acceptability of the injection port location.

NOTES: 1. If the system has more than one HEPA filter bank or more than one adsorber stage, a separate tracer-injection port is required for each bank and therefore a separate air-aerosol mixing test is required for each injection port and filter bank. If air-aerosol mixing is adequate for the first bank of HEPA filters, it can be assumed to be adequate for the first adsorber stage downstream. If the system contains a second bank of HEPA filters, the DOP must be injected at a point between the two HEPA banks in order to introduce sufficient aerosol to the second bank for a valid test.

2. In some systems it may be necessary to inject DOP upstream of a bank of adsorbers in order to challenge the HEPA filters downstream, or to inject a refrigerant (fluorocarbon) gas upstream of a bank of HEPA filters in order to test a bank of adsorbers. It has been shown that DOP has no adverse affect on activated carbon, and that refrigerant gases have no adverse affect on HEPA filters.

9.3 Apparatus

1. DOP generator (See Par. 10.4.1);
2. Penetrometer (See Par. 10.4.2);
3. System fan or auxiliary blower capable of producing the airflow and suction pressure specified in the test procedure.

9.4 Procedure

1. Connect DOP generator to injection port, start system fan or auxiliary blower.

2. Connect penetrometer to upstream sample port. Calibrate instrument against its built-in standard in accordance with the instrument-manufacturer's instructions.

3. Start DOP injection, adjust generator to provide a concentration at the upstream sample point of approximately 4 times the background dust concentration.

4. Make concentration readings in a sample plane parallel to and approximately one foot upstream of the filters. Allow instrument to stabilize before taking readings. Record readings. For systems of less than 10,000 cfm installed capacity, divide the sample plane into ten equal areas and take one reading at the center of each area.

For systems of 10,000 cfm installed capacity and larger, take one reading opposite the center of each filter.

5. Calculate average concentration from the equation:

$$\overline{C} = \frac{\Sigma_1^n C_i}{n} \qquad (6)$$

where $\overline{C}$ = average concentration reading;
C_i = individual concentration readings;
n = number of readings taken.

6. Repeat steps 4 and 5 in a plane perpendicular to the duct, passing through the downstream sample point.

7. If the maximum and minimum readings at the

furnished, under actual field conditions at maximum and minimum filter pressure drop, and (2) to verify that airflow distribution across each filter or adsorber in each stage is reasonably uniform at the designed volumetric flowrates.

8.2 Apparatus (See Section 9, ACGIH Industrial Ventilation)

1. Standard pitot tube

2. 1:10 inclined manometer

3. Rotating vane, heated-wire, or heated-thermocouple anemometer having calibrated accuracy of at least 3% of full scale reading. Calibration shall be verified before start of test.

8.3 Procedure

8.3.1 Airflow Capacity Test

1. Install all system components.

2. Start system fan.

3. The preferred procedure is to traverse in accordance with Section 9 of *Industrial Ventilation.* The traverse should be made at a point in the duct where airflow is steady, velocity is 100 fpm or more, and, if possible, where velocity measurement can be made at least 7.5 duct diameters downstream of any airflow disturbance. Calculate system volume airflow in accordance with Section 9 of ACGIH *Industrial Ventilation.*

4. When duct or plenum velocity is below the useful range of the pitot tube, one of the other instruments described in Section 9 of ACGIH *Industrial Ventilation* and listed in paragraph 8.2.3 must be employed. An alternate procedure is to divide the cross-section into not less than 16 equal areas and to measure the velocity in the center of each. In all cases, enough readings must be made that the greatest distance between centers does not exceed 12 inches. To determine total system airflow, *calculate* average velocity in the housing from the equation

$$\overline{V} = \frac{\Sigma^n{}_i V_i}{n}$$

where

$\overline{V}$ = average airflow velocity through the housing;

V_i = individual velocity readings;

n = number of velocity readings.

And then calculate volumetric flowrate, Q, from the equation

$$Q = A\overline{V}$$

where A = cross-sectional area where velocity traverse was made.

5. Compare measured volumetric flowrate with the value required by project specifications. If necessary, adjust system to achieve the specified volume flow rate. If the specified value cannot be achieved, stop test and notify Owner. Check for stable fan operation over a period of at least 15 minutes.

6. After successful completion of par. 8.3.1(3.) or 8.3.1(4.), increase system resistance artificially by blanking off portions of the filter bank until a pressure drop of at least 1.25 times the design dirty-filter pressure drop for the system (as specified in the test procedure or project specifications) is achieved. Check for stable fan operation over a period of at least 15 minutes. If the required dirty-filter system airflow cannot be achieved, notify Owner.

7. Repeat par. 8.3.1(6.) using sufficient artificial resistance to produce a pressure drop of about 50% of that of Par 8.3.1(5).

8. Acceptance Criteria. Flow shall be within ± 10% of system design flow.

8.3.2 Air Distribution Test

NOTE

The tests described in the following paragraphs of 8.3.2 shall be performed only as acceptance tests and after major system modification and repair. The tests are made only during acceptance testing following original installation, modification, or major repair of the air cleaning system.

When duct bends are sharp, airflow may separate from the inner wall of the bend to form a dead space in which air tends to circulate in a large eddy, the direction of rotation being forward near the mainstream and backward near the wall. Separation may also occur when the duct diverges too rapidly, or by the shedding of free eddies, or vortices, downstream of obstacles such as damper blades. This pattern of gas separation and later reattachment downstream usually exhibits slow fluctuations which may be visualized as gusts sweeping first through one part of the flow cross section and then another. Under these circumstances, measurement of flow is made difficult by two factors: (1) the presence of reverse flows caused by large scale eddies in some areas of the cross section and (2) the inconstancy of the velocity profile

when making serial measurements. In such cases even the substantial airflow resistance of filters and adsorbers may be inadequate to redistribute airflow across their faces when they are in close proximity to such flow disturbances. Carefully placed flow straightening baffles may be required to meet the flow distribution acceptance criterion of paragraph 8.3.2(4).

1. *Through HEPA Filter Banks.* For filter banks containing ten or more filters, the minimum number of velocity measurements will be one in the center of each filter. For systems containing fewer than 10 HEPA filters in a single bank, the minimum number of velocity measurements will be ten and will include one reading in the center of every filter in the bank. Velocity measurements are preferably made downstream of the filters to take advantage of the flow straightening characteristics of the HEPA filter.

2. *Through Adsorber Banks.* For banks containing pleated bed adsorber cells (Type I), the air distribution test will follow the same procedures specified for HEPA filter banks in paragraph 1. For banks containing adsorber modular trays (Type II) the air distribution test will follow the same procedures specified for filter banks in paragraph 1 except that all velocity measurements will be made precisely in the plane of the face of the air channels and in the center of every open channel. For single unit adsorbers of the deep bed or gasketless design (Type III), velocity measurements for the air distribution test will be made in the centers of equal areas that cover the entire open face and are not in excess of 12 inches on a side.

3. *Through Prefilter and Moisture Separator Banks.* Whenever air distribution tests are required for these air cleaning devices, the test procedures specified for HEPA filter banks will be followed.

4. *Acceptance Criteria.* All readings shall be within ± 20% of the average velocities measured per 8.3.2.

8.4 Report

A written report shall be furnished to all persons specified in the test procedures. The report shall include as a minimum:

1. Title or identification of test series.
2. Job number or Purchase Order.
3. Test instruments employed.
4. Location and cross-sectional dimensions of each duct of plenum where tests were made.
5. Instrument reading at each test point with identification of location, calculated velocity, and calculated average velocity.
6. Total airflow through system.
7. Airflow distributio test results.
8. Nonconformances discovered during test and name of parties to whom reported.
9. Instrument calibration data.
10. Signature(s) of test personnel.
11. Date of test.
12. Distribution of report.

9. AIR-AEROSOL MIXING UNIFORMITY TEST

9.1 Purpose

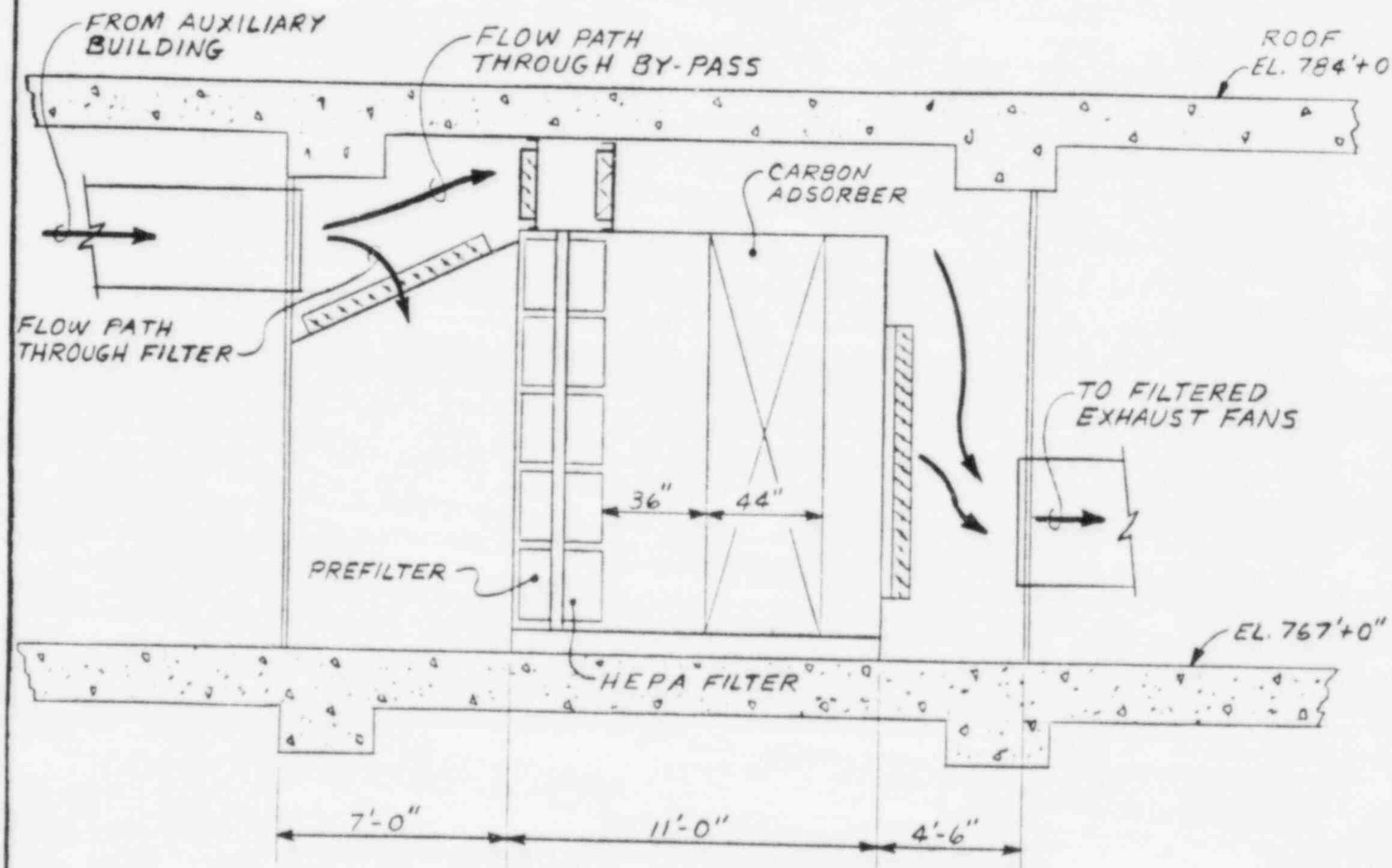
This test is prerequisite to the tests of Sections 10 and 12, in-place leak tests of HEPA filter and adsorber banks, respectively. The purpose of the test is to verify that tracer (DOP or refrigerant gas) injection and sample ports are located so as to provide proper mixing of the tracer in the air approaching the component stage (HEPA filter bank or adsorber stage) to be tested, or the sample plane. The test is made only upon completion of initial system installation, modification, or major repair, and is not required each time an in-place test of the filters or adsorbers is made. A valid in-place test is not possible without a uniform tracer-air mixture.

9.2 Summary of Method

DOP aerosol is introduced into the air stream at a previously selected injection point. Aerosol concentration readings are taken across a plane parallel to, and a short distance upstream of the HEPA filter bank; the uniformity of these readings establishes the acceptability of the injection port location.

NOTE 1

If the system has more than one HEPA filter bank or more than one adsorber stage, a separate tracer-injection port is required for each bank and therefore a separate air-aerosol mixing test is required for each injection port and filter bank. If air-aerosol mixing is adequate for the first bank of HEPA filters, it can be assumed to be adequate for the first adsorber stage downstream. If the system contains a second bank of HEPA filters, the DOP must be injected at a point between the two HEPA banks in order to introduce sufficient aerosol to the second bank for a valid test.



AUXILIARY BUILDING EXHAUST FILTER UNIT

SCALE 3/16" = 1'-0"

MCC-1211.00-00-0096
ATTACHMENT 3

Tabulated Results for Supplemental VA Airflow
Distribution Tests

Unit 1 VA Filtered Exhaust

1. Observed system flow rate: 52,000 cfm
   (54,000 cfm ±10% required by Tech Spec 4.7.7.b1)

2. Flow Distribution at Prefilter Inlet
   a) Average velocity: 273 fpm
   b) Highest: 600 fpm Lowest: 140 fpm
   c) Deviation: +120.13%, -48.63%

3. Flow Distribution at HEPA Exit
   a) Average velocity: 407 fpm
   b) Highest: 500 fpm Lowest: 290 fpm
   c) Deviation: +22.89%, -28.72%

4. Flow Distribution at Carbon Inlet
   a) Average Velocity: 1124 fpm
   b) Highest Point: 1400 fpm* Lowest Point: 950 fpm
   c) Point to Point Deviation: +24.56%*, -15.48%
   d) Highest Slot: 1265 fpm Lowest Slot: 1020 fpm
   e) Slot to Slot Deviation: +12.54%, -9.25%

* Three points taken at an area of increased flow disturbance due to a junction box were 1400, 1350 and 1350 fpm. Discounting these three points, gives an average of 1120 fpm for the remaining 197 measurements, with a high reading of 1300 fpm which equates to a 16.07% deviation.

Unit 2 VA Filtered Exhaust

1. Observed system flow rate: 43,000 cfm
   (43,000 cfm ±10% required by Tech Spec 4.7.7.b1)

2. Flow Distribution at Prefilter Inlet
   a) Average velocity: 289 fpm
   b) Highest: 550 fpm Lowest: 130 fpm
   c) Deviation: +90.22%, -55.04%

3. Flow Distribution at HEPA Exit
   a) Average velocity: 373 fpm
   b) Highest: 450 fpm Lowest: 280 fpm
   c) Deviation: +20.78%, -24.85%

4. Flow Distribution at Carbon Inlet
   a) Average Velocity: 918 fpm
   b) Highest Point: 1100 fpm Lowest Point: 800 fpm
   c) Point to Point Deviation: +19.83%, -12.85%
   d) Highest Slot: 985 fpm Lowest Slot: 825 fpm
   e) Slot to Slot Deviation: +7.26%, -10.16%

COMMENTS: Differing average velocities for prefilter inlet and HEPA exit are indicative of too large a measurement grid to account for turbulence at the upstream face.

Highest point at Unit 1 carbon inlet was seen in an inlet slot nearest the housing wall, at a point just below a junction box mounted on the wall. Once past the obstruction, this flow should further distribute through the blocked, lower flowrate area.

Philip W. Roberson

Philip W. Roberson
Associate Engineer, Performance
McGuire Nuclear Station

McGUIRE NUCLEAR STATION

Auxiliary Building Ventilation System
Engineering Evaluation of Supplemental Filter Testing

Unit 1 VA Filtered Exhaust

1) System flow rate: Acceptable

   Observed value is within ±10% of design value.

2) Flow distribution at prefilter inlet: Acceptable

   Observed values are from +120% to -49% of the average velocity. No criteria are applicable since the prefilter performs no safety function.

3) Flow distribution at HEPA exit: Acceptable

   Observed values are from +23% to -29% of the average velocity, and are sufficiently close to the established ±20% criteria to be considered acceptable. Additionally, laboratory testing performed on HEPA filters indicates no reduction in expected performance at this range of velocity.

4) Flow distribution at carbon inlet: Acceptable

   Observed values are from +25% to -15% of the average velocity, and are sufficiently close to the established ±20% criteria to be considered acceptable. Only three (3) of two hundred (200) data points fell outside the ±20% criteria. With these three points removed from the data set, the variation of observed velocity is +16% to -15% of the average. These three points (1400, 1350, 1350 fpm) were due to small local disturbances upstream of the carbon bed, and are considered to have negligible effect on actual velocity distribution within the carbon bed itself. No reduction in performance is expected. Additionally, the slot to slot deviation was well within the acceptance criteria.

Unit 2 VA Filtered Exhaust

1) System flow rate: Acceptable

   Observed value is within ±10% of design values.

2) Flow distribution at prefilter inlet: Acceptable

   Observed values are from +90% to -55% of the average velocity. No criteria are applicable since the prefilter performs no safety function.

3) Flow distribution at HEPA exit: Acceptable

Observed values are from +21% to -25% of the average velocity, and are sufficiently close to the established ±20% criteria to be considered acceptable. Additionally, laboratory testing performed on HEPA filters indicates no reduction in expected performance at this range of velocity.

4) Flow distribution at carbon inlet: Acceptable

Observed values range from +20% to -13%, and are within the established ±20% criteria. Additionally, the slot to slot deviation is well within the acceptance criteria.