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TITLE IN-PLACE TESTING SUMMARY (1988)

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IN-PLACE TESTING SUMMARY (1988)

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ENGINEERING SERVICES SECTION
INDUSTRIAL HYGIENE GROUP
OCTOBER 1989

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PREFACE

This report is another in a series about an on-going in-place testing program of high efficiency filtration and chemical adsorber systems at the Los Alamos National Laboratory. This testing is in support of the Laboratory's airborne waste management programs. Periodic in-place testing, along with Health Physics air sampling will determine whether the air cleaning systems are maintaining acceptable air-cleaning levels. These periodic evaluations help ensure that the plant and surrounding environment are free of any significant radioactive particulates, based on current EPA environmental levels and chemical airborne hazards from processing effluents.

The purpose of this report is to provide an overview of system performance and the testing methods and procedures.

1.0 INTRODUCTION

Periodic evaluation of an air-cleaning system is necessary in order to establish a record of its current operating condition. These evaluations along with Health Physics air sampling determine whether air-cleaning integrity is being maintained. The in-place test is conducted in most instances without disrupting plant operations¹ and only if the systems failed the test would it become necessary to shut down. Testing is conducted on single and multi-stage filter systems and other filtration devices using an optical particle counter.² The testing procedure requires that the filter system be challenged with a 0.1 to 3.0 micrometer range heterodisperse test aerosol. This type of testing is not to be confused with tests performed by the Quality Assurance Testing Stations,⁴ whose purpose is directed at filter efficiency.

In-place testing of an adsorber system is required for several reasons: 1) chemical poisoning of the adsorbers by organic vapors; 2) by settling of the charcoal in the bed due to vibration; and 3) by installation defects. There are two methods of in-place testing of

adsorber systems. The first method uses a fluorocarbon (Freon 11 gas), the second method uses a radioactive gas (Iodine or Methyl Iodide). At Los Alamos, we use the Freon 11 method.⁴

This report presents the results of the 1988 tests, including the methods and procedures used in the testing and calibration of the spectrometer and aerosol diluter system. A summary of three years of testing is included.

2.0 TESTING SCHEDULE

Schedules are prepared and sent out to those affected groups 2 weeks in advance, notifying them of the testing dates. The schedules are normally flexible and our policy is to work around operational conflicts.

3.0 DEFINITIONS

3.1 Decontamination Factor (DF). A measure of air cleaning effectiveness, which is 100 times the reciprocal of the per cent penetration.

3.2 Diluter. A device used to reduce high aerosol concentrations to concentrations useable by the single-particle spectrometer. Maximum concentrations are determined by the occurrence of coincidence counting losses when more than one particle occupies the sampling volume of the spectrometer.

3.3 Dilution Ratio (DR). The ratio of the undiluted to diluted aerosol concentrations. Because diluters have inherent particle losses which may vary according to the particle size, the dilution ratio may not be constant for different sizes.

3.4 Single-Particle Spectrometer (SPS). A precision aerosol detector which allows single particle counting and sizing by the amount of light scattered from individual particles by pulse height discrimination. The signals can be grouped into categories corresponding to particle size using pulse height discrimination.

3.5 HEPA. A high efficiency particulate air filter.

3.6 Other. Other terms pertinent to this report are defined in the reference material, more specifically in the Standards, ANSI/ASME N-510, and Nuclear Standard, F341T.

4.0 POLICY FOR IN-PLACE TESTING

4.1 New Installations. All new filter installations handling toxic materials will be tested before initiating any operations.

4.2 Test Frequency. Each filter system, including entry boxes and adsorbers handling toxic or radioactive materials such as asbestos, beryllium, plutonium, and enriched uranium will be tested annually.

4.3 Filters Changes. All systems containing HEPA or Aerosolve 95 filters will be tested within 2 working days of the filter change, except for glove box in-line filters.

4.4 Other Filtration. Testing of filter systems handling moderately toxic materials such as depleted uranium, lead, etc., will be determined on a case-by-case basis.

4.5 Supply Systems. Supply air systems will be tested only at TA-55 and the new Nuclear Storage Facility.

4.6 Glove Box In-Line Filters. No routine tests will be conducted on these filters except for new installations.

5.0 TEST REQUIREMENTS

5.1 Aerosol or Test Gas Injection Ports. Proper location and installation of injection ports are required in order to properly mix the test agents.

5.2 Sampling Ports. Proper location and installation of sampling probes is required to complete the testing.

5.3 Lighting. Adequate lighting is required both inside and outside the filter system.

5.4 Electrical Power. A minimum of 20 amps, at 120 volts is required.

6.0 TEST METHODS

6.1 HEPA Filters Systems. Figure 1 shows the setup for testing a multi-stage filter system as one unit rather than the stage-by-stage photometer method used in conventional testing. A challenge aerosol is generated upstream of the filter system and allowed to mix thoroughly with the airstream. Aerosol samples from the airstream through probes both upstream and downstream of the filter system are analyzed with a SPS. With this method the penetration of the filter system can be calculated as a function of particle size. Because of high particle concentration which is required to evaluate the performance of filter systems, it is necessary to dilute the upstream aerosol sample to avoid coincidence errors. A schematic of the diluter is shown in Figure 2.

The aerosol should be heterodisperse, spanning the diameter range of 0.1 to 3.0 micrometers. The required upstream concentration is 2×10^6 particles per cubic centimeter, or about 30 micrograms per liter (assuming unit density) to properly evaluate a two-stage HEPA filter system. A schematic of the aerosol generator is shown in Figure 3.

The minimum acceptable DF for 1 stage is 2×10^3 , for 2 stages in series, 4×10^6 is required. If the filter system fails the tests, then a series of additional tests is required to identify and correct the problem.

6.2 Adsorbers. Adsorber stages are tested individually to establish remaining adsorption capacity and the presence of leaks that may have developed under service conditions. The test method utilizes a refrigerant gas (Freon 11, Fluorotrichloromethane) as the test agent in accordance with procedures of Sect: 12 ANSI/ASME, N-510. Analysis of the gas both upstream and downstream is accomplished with a gas chromatograph using a detector. The minimum DF for adsorber systems is 1×10^3 .

6.3 Portable Filtered Exhaust. Portable filtered exhaust systems are used primarily for asbestos removal operations. Figure 4 shows a typical unit. The DF for these systems is 2×10^3 .

7.0 TEST PROCEDURE (HEPA)

7.1 Calibration (SPS). Calibration should be performed periodically (2 times per month), or more frequently if the system encounters rough handling. The calibration consists of testing the SPS with two sizes of Poly Styrene Latex Spheres (PSLS), 0.1 and 0.3 micrometers (traceable to NBS). The SPS sizes the PSLS to within ± 0.05 micrometers. If the SPS fails the test, then the instrument must be returned to the manufacturer for repair and calibration.

7.1.2 Aerosol Diluter. Calibration of a diluter is very similar to that of the filter penetration test measurement. However, generation of lower particle concentrations is required for the diluter calibration than for the actual filter test. If more than one diluter stage is used, each must be calibrated independently. The dilution ratio (DR) for each stage can be calculated by the equation in 7.2.3. An example of the diluter is shown in Figure 2.

7.1.3 DR Calculations.

$$DR = (\text{Sum } C_u) (i) / (C_d (i))$$

where C_u and C_d refer to the concentration of particles of the undiluted to the diluted portion of the aerosol in each of the size intervals. Concentrations are determined by dividing the particles counts in the specified interval by the total sample volume of the SPS.

7.2 Background. Because of the expected low concentrations of test particles penetrating two stages of HEPA filters, it is required to measure the concentration of non-test particles in the airstream as a background sample. With no aerosol generation and no sample dilution, samples are collected with the SPS from downstream of two filter stages. The sampling times may vary depending on the accumulated particle counts; a 20-minute sample is usually sufficient.

7.3 Challenge Aerosol. Generate the test aerosol and accumulate samples from the upstream probe through the diluter and establish the challenge concentration. The concentration is calculated by the equation in 7.4. The required concentration to properly evaluate a two-stage filter system is 2×10^6 particles per cubic centimeter, and for one-stage the concentration is 2.5×10^5 .

7.4 Calculations (Challenge Conc.).

$$C_u = (C_d) (i) * (DR) (i)$$

where C_u refers to the undiluted aerosol concentration and DR is the dilution ratio and i refers to the size interval.

7.5 Downstream Sampling. Collect samples of the test aerosol through the downstream probe. Sampling time periods should be selected to yield net particle counts over background of at least 100 of the size interval. At least two samples should be taken to insure representativeness. The difference between counts of two successive samples should not exceed 0.25 of the larger count. With the one-stage system, shorter sampling times

may be used than with two-stages because of higher particle concentrations. If coincidence counting is suspected (above 3000 particles per second), the diluter must be used.

7.6 Calculations (DF).

The DF is calculated by:

$$DF = [\text{Sum } Cu(i) \times DR(i)] / [Cd(i) - Bd(i)] \times 100$$

where $Bd(i)$, $Cd(i)$, and $Cu(i)$ denote the particle concentration in the i th size interval for the background, downstream, and upstream samples respectively. Concentrations are obtained by dividing the accumulated count data by the sample volume through the SPS.

8.0 TEST PROCEDURE (ADSORBERS)

8.1 Challenge Agent. Freon 11 gas is injected into the upstream side of the adsorber system at a rate of 0.50 liters per minute per 1000 CFM of system volume.

8.2 Upstream and Downstream Sampling. Samples are collected in separate mylar bags upstream and at a point downstream where satisfactory mixing of the gas is accomplished.

8.3 Analysis. The content of each bag is determined by gas chromatography in accordance with ANSI/ASME, N-510, Section 12.

9.0 SUMMARY OF TESTS

Listed below is a summary of all filter systems tested in 1988. The summary includes number of systems that passed the tests, how many failed, and how many were retested. Figure 5 shows a 3-year comparison of the test results.

TABLE I

9.1 Main Exhaust and Supply Filter Systems

9.1.1	Passed Test _____	162
9.1.2	Failed Test _____	19
9.1.3	Retested _____	15

9.2 Adsorber Systems

9.2.1	Passed Test _____	2
9.2.2	Failed Test _____	2
9.2.3	Retested _____	1

9.3 Portable Filtered Exhausters

9.3.1	Passed Test _____	6
9.3.2	Failed Test _____	0
9.3.3	Retested _____	0

10.0 IN-PLACE TEST RESULTS

Listed below are the test results of all in-place tests for 1988. The performance of each filter system is expressed as DF values, across one stage and across both stages as one single unit.

TABLE II

<u>HSE NO</u>	<u>ENG NO</u>	<u>LOCATION</u>	<u>FIL CHG DATE</u>	<u>TEST DATE</u>	<u>DF 1ST</u>	<u>DF 1 & 2</u>
140	FE-14	TA-3-29		03/01/88	2.7×10^3	4.6×10^6
150	FE-15	TA-3-29		03/04/88	5.2×10^3	$1.4 \times 10^6*$
150	FE-15	TA-3-29		03/21/88		$1.3 \times 10^6*$
150	FE-15	TA-3-29		03/21/88		$3.5 \times 10^6*$
150	FE-15	TA-3-29	03/10/88	03/24/88		4.8×10^7
180	FE-19	TA-3-92		03/29/88	4.2×10^1	
190	FE-28	TA-3-29		07/25/88	1.6×10^4	6.6×10^6
200	FE-29	TA-3-29	04/08/88	04/11/88	3.2×10^3	3.6×10^7

TABLE II (Continued)

<u>HSE NO</u>	<u>ENG NO</u>	<u>LOCATION</u>	<u>FIL CHG DATE</u>	<u>TEST DATE</u>	<u>DF 1ST</u>	<u>DF 1 & 2</u>
210	FE-30	TA-3-29		09/16/88	6.7×10^3	
220	FE-31	TA-3-29		09/16/88	1.3×10^4	
230	FE-32	TA-3-29		10/03/88	2.3×10^4	3.3×10^7
240	FE-33	TA-3-29	09/29/88	10/03/88	2.1×10^4	2.5×10^9
250	FE-34	TA-3-29		04/18/88	4.7×10^3	
250	FE-34	TA-3-29	05/09/88	05/12/88	1.5×10^4	
260	FE-35	TA-3-29	05/08/88	05/18/88	1.3×10^4	
290	FE-66	TA-3-29		06/08/88	1.1×10^4	
440	FE-43	TA-3-29	04/08/88	04/18/88	4.3×10^3	
690	FE-7	TA-50-1		03/22/88	4.1×10^4	
790	FE-54	TA-48-1		06/20/88	1.8×10^4	4.4×10^6
840	FE-25	TA-50-1		06/14/88	3.0×10^4	
860	FE-3	TA-50-1		03/18/88	4.0×10^3	4.6×10^6
1140	FE-1	TA-50-69		02/09/88	3.3×10^3	
1150	FE-3	TA-50-69	02/09/88	02/09/88	$2.4 \times 10^2*$	$7.8 \times 10^5*$
1150	FE-3	TA-50-69	02/10/88	02/10/88	2.3×10^4	4.7×10^7
1150	FE-3	TA-50-69	07/28/88	07/29/88	4.6×10^4	
1210	FA-801	TA-55-4		10/03/88	2.0×10^3	$2.3 \times 10^6*$
1220	FA-802	TA-55-4		10/03/88	$6.9 \times 10^2*$	4.5×10^6
1220	FA-802	TA-55-4		10/31/88	$1.1 \times 10^3*$	
1220	FA-802	TA-55-4		11/01/88	2.2×10^3	
1230	FA-803	TA-55-4		10/03/88	$1.2 \times 10^3*$	8.2×10^6
1230	FA-803	TA-55-4		10/05/88	3.3×10^3	
1240	FA-804	TA-55-4		10/06/88	$1.5 \times 10^3*$	7.6×10^6
1240	FA-804	TA-55-4		10/11/88	2.6×10^3	
1250	FA-805	TA-55-4		10/06/88	5.9×10^3	1.9×10^7
1260	FA-806	TA-55-4		10/07/88	3.2×10^3	$2.6 \times 10^6*$
1260	FA-806	TA-55-4		10/11/88		4.6×10^6
1270	FA-807	TA-55-4		10/11/88	4.4×10^3	2.1×10^7
1280	FA-808	TA-55-4		10/12/88	4.3×10^3	1.8×10^7
1290	FA-809	TA-55-4		04/27/88	1.2×10^4	
1300	FA-810	TA-55-4		04/27/88	7.7×10^3	
1310	FA-811	TA-55-4		10/28/88	$8.4 \times 10^2*$	4.3×10^6
1310	FA-811	TA-55-4	10/31/88	10/31/88	3.3×10^4	

TABLE II (Continued)

<u>HSE NO</u>	<u>ENG NO</u>	<u>LOCATION</u>	<u>FIL CHG DATE</u>	<u>TEST DATE</u>	<u>DF 1ST</u>	<u>DF 1 & 2</u>
1320	FA-812	TA-55-4		10/22/88	$1.3 \times 10^3*$	4.9×10^6
1320	FA-812	TA-55-4	11/1/88	11/03/88	2.2×10^3	
1330	FA-820	TA-55-4		01/04/88	3.1×10^3	1.1×10^7
1330	FA-820	TA-55-4	09/08/88	09/12/88	2.9×10^3	1.2×10^7
1340	FA-821	TA-55-4	09/08/88	09/12/88	4.2×10^3	2.2×10^7
1350	FA-822	TA-55-4		10/20/88	2.6×10^3	$3.5 \times 10^6*$
1350	FA-822	TA-55-4	10/25/88	10/27/88		3.2×10^7
1360	FA-823	TA-55-4		10/20/88	$4.3 \times 10^2*$	7.7×10^6
1360	FA-823	TA-55-4		10/21/88	2.5×10^3	
1370	FA-828	TA-55-4		10/18/88	6.3×10^3	4.8×10^6
1380	FA-829	TA-55-4		10/18/88	2.7×10^3	4.0×10^6
1390	FA-840	TA-55-4		04/18/88	7.3×10^3	
1400	FA-841	TA-55-4		04/18/88	3.9×10^3	
1410	FA-850	TA-55-4	03/22/88	03/25/88	2.6×10^3	1.7×10^7
1410	FA-850	TA-55-4		03/25/88	$3.3 \times 10^4\#$	$1.0 \times 10^8\%$
1420	FA-851	TA-55-4	02/10/88	02/12/88	2.8×10^3	1.0×10^7
1420	FA-851	TA-55-4		02/12/88	$4.9 \times 10^5\#$	$1.5 \times 10^8\%$
1430	FA-852	TA-55-4	01/29/88	02/01/88	1.6×10^4	3.3×10^7
1430	FA-852	TA-55-4		02/01/88	$3.1 \times 10^3\#$	
1440	FA-853	TA-55-4	02/02/88	02/04/88	5.4×10^3	1.8×10^7
1440	FA-853	TA-55-4		02/04/88	$1.1 \times 10^4\#$	
1450	FA-854	TA-55-4	01/20/88	01/22/88	5.9×10^4	8.9×10^6
1450	FA-854	TA-55-4		01/22/88	$6.5 \times 10^3\#$	
1460	FA-855	TA-55-4		12/19/88	3.3×10^3	1.8×10^8
1460	FA-855	TA-55-4		12/19/88	$1.0 \times 10^4\#$	
1470	FA-856	TA-55-4	02/18/88	02/22/88	4.4×10^3	2.9×10^7
1470	FA-856	TA-55-4		02/18/88	$2.8 \times 10^3\#$	
1470	FA-856	TA-55-4	12/02/88	12/05/88	1.2×10^4	
1470	FA-856	TA-55-4	12/19/88	12/20/88	6.8×10^3	
1480	FA-857	TA-55-4	02/26/88	02/29/88	5.6×10^3	5.8×10^6
1480	FA-857	TA-55-4		02/29/88	$4.3 \times 10^4\#$	
1480	FA-857	TA-55-4	08/24/88	08/26/88	4.6×10^4	4.1×10^7
1570	XB-103	TA-55-4		01/05/88	3.4×10^5	
1580	XB-104	TA-55-4		01/05/88	1.3×10^4	

TABLE II (Continued)

<u>HSE NO</u>	<u>ENG NO</u>	<u>LOCATION</u>	<u>FIL CHG DATE</u>	<u>TEST DATE</u>	<u>DF 1ST</u>	<u>DF 1 & 2</u>
1590	XB-105A	TA-55-4		01/06/88	4.2×10^5	
1600	XB-105B	TA-55-4		01/06/88	5.6×10^5	
1610	XB-106	TA-55-4		01/06/88	3.2×10^4	
1620	XB-107A	TA-55-4		01/06/88	1.3×10^4	
1630	XB-107B	TA-55-4		01/06/88	3.2×10^5	
1640	XB-109	TA-55-4		01/08/88	2.9×10^4	
1650	XB-110	TA-55-4		01/07/88	1.3×10^4	
1660	XB-111A	TA-55-4		01/07/88	1.9×10^4	
1670	XB-111B	TA-55-4		01/07/88	1.7×10^5	
1680	XB-112	TA-55-4		01/05/88	3.8×10^5	
1710	XB-114	TA-55-4		01/08/88	1.2×10^6	
1730	XB-118	TA-55-4		01/08/88	2.6×10^6	
1760	FE-60	TA-48-1	07/26/88	08/03/88	$1.0 \times 10^{2*}$	
1760	FE-60	TA-48-1		08/22/88	$9.8 \times 10^{2*}$	
1760	FE-60	TA-48-1	09/01/88	09/01/88	$3.7 \times 10^{2*}$	
1790	XB-223	TA-55-4	01/09/88	01/09/88	3.7×10^5	
1840	XB-204A	TA-55-4		01/09/88	8.2×10^5	
1850	XB-204B	TA-55-4		01/09/88	2.3×10^5	
1860	XB-206A	TA-55-4		01/19/88	7.3×10^5	
1870	XB-206B	TA-55-4		01/19/88	1.1×10^5	
1880	XB-207	TA-55-4		01/19/88	1.0×10^5	
1890	XB-208	TA-55-4		01/20/88	5.2×10^4	
1900	XB-209A	TA-55-4		01/20/88	3.5×10^5	
1910	XB-209B	TA-55-4		01/21/88	9.1×10^5	
1920	XB-215A	TA-55-4		01/21/88	1.9×10^5	
1930	XB-215B	TA-55-4		01/22/88	6.6×10^5	
1940	XB-216	TA-55-4		01/22/88	3.6×10^3	
1950	XB-217	TA-55-4		01/22/88	2.2×10^5	
1960	XB-218	TA-55-4		01/25/88	2.6×10^5	
1990	XB-220A	TA-55-4		01/25/88	6.0×10^3	
2000	XB-220B	TA-55-4		01/25/88	1.4×10^4	
2010	XB-301	TA-55-4		02/03/88	1.3×10^5	
2020	XB-302	TA-55-4		02/03/88	2.2×10^4	
2030	XB-304	TA-55-4		02/04/88	6.6×10^5	

TABLE II (Continued)

<u>HSE NO</u>	<u>ENG NO</u>	<u>LOCATION</u>	<u>FIL CHG DATE</u>	<u>TEST DATE</u>	<u>DF 1ST</u>	<u>DF 1 & 2</u>
2040	XB-303A	TA-55-4		02/04/88	1.1×10^5	
2050	XB-306A	TA-55-4		02/04/88	6.3×10^5	
2070	XB-303B	TA-55-4		02/05/88	1.6×10^5	
2080	XB-306B	TA-55-4		02/05/88	1.3×10^4	
2090	XB-402	TA-55-4		02/08/88	5.4×10^5	
2100	XB-405	TA-55-4		02/08/88	5.4×10^4	
2110	XB-401	TA-55-4		02/08/88	2.2×10^5	
2120	XB-407	TA-55-4		02/09/88	4.4×10^4	
2140	XB-412	TA-55-4		02/09/88	2.2×10^5	
2150	XB-478	TA-55-4		02/09/88	4.3×10^4	
2220	XB-213	TA-55-4		02/10/88	1.2×10^6	
2850	XB-308	TA-55-4		02/10/88	1.4×10^4	
2990	BE-EXH	TA-35-213		02/12/88	3.9×10^4	
2970	XB-4414	TA-55-4		02/11/88	1.3×10^5	
3980	FE-2	TA-50-69		06/06/88		$1.6 \times 10^{6*}$
3980	FE-2	TA-50-69	06/08/88	06/09/88		1.1×10^7
5870	FA-854SR	TA-55-4	01/20/88	01/21/88	2.4×10^4	1.0×10^8
5870	FA-854SR	TA-55-4		01/21/88	$6.3 \times 10^4\#$	
5880	FA-855SR	TA-55-4		12/19/88		3.3×10^7
6150	FE-1	TA-3-141		10/19/88	2.4×10^3	
6000	XB-390	TA-55-4		02/24/88	1.2×10^5	
6610	GB-166	TA-55-4	03/11/88	03/16/88	1.8×10^4	
6650	GB-385	TA-55-4	03/11/88	03/16/88	2.0×10^5	
6660	GB-1400	TA-55-4	03/01/88	03/03/88	1.1×10^5	
6670	GB-453	TA-55-4	02/15/88	02/16/88	1.5×10^4	
6920	XB-340	TA-55-4	01/28/88	01/29/88	2.7×10^5	
6930	XB-310	TA-55-4	02/10/88	02/16/88	8.1×10^4	
6940	XB-413	TA-55-4	02/10/88	02/16/88	4.3×10^5	
6950	XB-231	TA-55-4	02/10/88	02/16/88	1.1×10^5	
6960	GB-232	TA-55-4	05/26/88	05/26/88	1.6×10^4	
6970	GB-233	TA-55-4	05/26/88	05/26/88	2.6×10^4	

* Systems Failing Test

Measurements Across Filter Stage 3

% Measurements Across Filter Stages 3,4

11.0 IN-PLACE TEST RESULTS (ADSORBERS)

TABLE III

<u>HSE-NO</u>	<u>ENG-NO</u>	<u>LOCATION</u>	<u>ADSORB CHG</u>	<u>TEST DATE</u>	<u>DF</u>
290	FE-66	TA-3-29		01/14/88	$3.9 \times 10^{1*}$
160	FE-3	TA-50-37		07/13/88	1.8×10^3
OMEG-1		TA-2-1	06/06/88	06/10/88	$3.3 \times 10^{2*}$
OMEG-1		TA-2-1		06/15/88	3.3×10^3

12.0 PORTABLE FILTER SYSTEMS

TABLE IV

<u>SYST-NO</u>	<u>ENG-NO</u>	<u>LOCATION</u>	<u>FILTER CHG</u>	<u>TEST DATE</u>	<u>DF(1st)</u>	<u>DF(2nd)</u>
MEC-1		TA-3-39	05/10/88	05/10/88	5.3×10^5	
A-1		TA-15-283	02/25/88	05/25/88		1.2×10^9
A-2		TA-15-283	05/15/88	05/27/88		1.6×10^8
A-3		TA-15-283	05/15/88	05/27/88		1.0×10^9
MST-6		TA-3-141	09/07/88	09/27/88	1.1×10^4	
HSE-7		TA-52-1	09/01/88	09/27/88	4.9×10^3	

13.0 SUMMARY

The test results indicate DFs across one or more filter stages to be higher compared to last year's results. This trend was observed, especially when the test was conducted across two filter stages. During the 1987 testing period there were a number of systems whose filters had been in service for more than 10 years and based on the 1985, 1986, and 1987 test results, these systems were showing a trend of higher particle penetration, and in some cases, they were failing the tests. Prior to the 1988 testing, all of these filters were replaced which resulted in fewer failures.

Particle losses due to coincidence counting in particle counters is a very difficult and complex problem, especially if the challenge particle concentration is high. The particle counters count and size particles efficiently at less than 3000 particles per unit time. If the particle count exceeds that amount, then it becomes necessary to dilute the aerosol. A passive two-stage aerosol diluter was designed and calibrated to accept aerosol in one or two stages and at the same time minimize particle losses in the diluter. The airflow through the diluter was set at a constant 15 liters per minute and the sampling probes at each stage were sized to match the velocity of the diluter to that of the SPS. The dilution ratio for the first stage is 1200-1 and the second stage 850-1. This values can be adjusted up or down by simply increasing or decreasing the pressure drop across the diluter capillary tube.

14.0 CONCLUSIONS

In most cases, the majority of system failures were caused by inadequate sealing of the filters to the filter frame. For instance, the Zone 1 exhaust systems at TA-55 contained an accumulation of acid residues which interfered with proper sealing of filters. Acid residues will continue to pose problems during filter changes and could lead to reduced system integrity if the acid continues to deposit on the filter frame.

Other problems encountered in 1988 were with filter housings that were purchased and installed during that period. These filter housings had problems with filter sealing and difficulties with changing filters. For example, one housing had to be completely replaced and in another case extensive modifications had to be performed to pass the in-place test.

REFERENCES

1. Nuclear Standard F 3-41T, In-place Testing of HEPA Filter Systems by the Single-Particle, Particle Size Spectrometer Method, September 1986.
2. American National Standards Institute/American Society of Mechanical Engineers, N-510, 1988.
3. In-Place Testing of Multiple-Stage Filter Systems Without Disruption of Plant Operations at the Plutonium Facility at Los Alamos, 18th DOE Nuclear Airborne Waste Management and Air Cleaning Conference, 1984.
4. Quality Assurance Inspection and Testing of HEPA Filters, September 1986.

APPENDIX A

Figure 1. In-Place Testing Schematic.

SAMPLE PROBE DETAIL

SCALE: 1/1
4 REQUIRED

CAPILLARY TUBE ASSEMBLY DETAIL

SCALE: 1/1
3 REQUIRED

TUBE	SIZE
A	0.042 O.D. X 0.020 I.D.
B	0.058 O.D. X 0.040 I.D.
C	0.083 O.D. X 0.063 I.D.

Figure 2. Aerosol Diluter.

SCHEMATIC DIAGRAM SHOWING THE AEROSOL GENERATOR

Figure 3. Aerosol Generator.

Figure 4. Typical Asbestos Filter Exhauster.

In-Place Testing Summary

Figure 5. Pass/Fail Ratio for 1986-1988.

**DATE
FILMED**

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END