ASME N511-19XX

Standard for Periodic In-Service Testing of Nuclear Air Treatment, Heating, Ventilating and Air Conditioning Systems

For ASME AG-1 Systems

ASME Committee on Nuclear Air and Gas Treatment (CONAGT)

Note: This is a draft document. An approved standard may differ in many respects. This draft version is made available for discussion for discussion purposes only.

Draft Revision
07/09/96

DRAFT
PERIODIC IN-SERVICE TESTING OF NUCLEAR AIR TREATMENT, HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS

TABLES

MANDATORY APPENDICES

NON-MANDATORY APPENDICES

IN-SERVICE TESTING OF NUCLEAR AIR TREATMENT, HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS

1 SCOPE

This Standard covers the requirements for Periodic In-Service testing of nuclear safety-related air treatment, heating, ventilating, and air conditioning systems in nuclear facilities.

1.1 Purpose

The purpose of this Standard is to provide requirements for periodic in-service testing, the results of which are used to verify that nuclear air treatment, heating, ventilating, and air conditioning systems continue to perform their intended function. Such in-service testing is conducted for the purpose of:

(a) Monitoring the performance of the equipment and system(s) to provide assurance that they continue to function within their specified design basis limits;

b) Providing test results which are compared to Acceptance Test Reference Values and to previous in-service test results to establish system performance trends.

1.2 Applicability

This Standard applies to periodic in-service testing of nuclear safety-related air treatment, heating, ventilating, and air conditioning systems which have been designed, built, and acceptance tested in accordance with ASME AG-1. Sections of this Standard may be used for technical guidance for testing air treatment, heating , ventilating, and air conditioning systems designed to other standards. It is the Owner's responsibility to meet each of the applicable requirements in this Standard.

1.3 Use of This Standard

This Standard provides a basis for the development of test programs and does not include acceptance criteria, except where the results of one test influence the performance of other tests. Acceptance criteria shall be developed by the Owner based on the system design and function(s) in accordance with ASME AG-1.

This Standard is arranged so that users may select those portions (tests) which are relevant to their facility. The users must specify which tests shall be employed in their test programs and the acceptance criteria for those tests. The Non-Mandatory Appendices provide additional information and guidance.

1.4 Terms and Definitions

The definitions provided in this section supplement those listed in ASME AG-1 Section AA-1000.

Abnormal Incident -- any event or condition which may adversely affect the function of the nuclear air treatment, heating, ventilating, and air conditioning system.

Acceptance Test -- a test to verify system or component design function following initial field installation, abnormal incident, replacement, repair, or modification, that may affect a test reference value.

Adsorbent -- a solid having the ability to concentrate other substances on its surface.

Adsorber -- a device or vessel containing adsorbent.

Adsorber Bank or *Filter Bank* -- one or more filters or adsorbers secured in a single mounting frame, or one or more side by side panels containing poured or packed air treatment media, confined within the perimeter of a duct, plenum, or vault cross section, sometimes referred to as a stage.

Aerosol -- a stable suspension of particles, solid or liquid, in air

Challenge -- to expose a filter, adsorber, or other air treatment device to an aerosol or gas of known characteristics, under specified conditions, for the purpose of testing.

Challenge Gas -- a gas of known characteristics, under specified conditions, used for the purpose of testing. For in-place testing of adsorbers, the challenge gas is Refrigerant-11, or an acceptable substitute. (Refer to Non-Mandatory Appendix C for alternate challenge gas selection criteria)

Challenge Aerosol -- poly-disperse droplets of dioctyl phthalate, (di(2-ethyl hexyl) phthalate), used as challenge aerosol for testing HEPA filter banks for leaks. The challenge aerosol used for in-place leak testing of installed HEPA filter systems, in accordance with this section, shall be a poly-disperse liquid aerosol having an approximate light scattering droplet size distribution as follows:

99% less than 3.0 micrometer diameter
50% less than 0.7 micrometer diameter
10% less than 0.4 micrometer diameter

NOTE: The poly-disperse aerosol used for in-place leak testing of systems differs in size from the 0.3 micrometer mono-disperse DOP aerosol used for efficiency testing of individual HEPA filters by manufacturers. For potential substitutes for DOP, reference ASME AG-1 paragraph TA-2000. (reference DOE Nuclear Air Cleaning Conference proceedings "Size Distribution of Aerosols Produced From Substitute Materials by Laskin Cold DOP Aerosol Generator")

HEPA Filter -- (High Efficiency Particulate Air) a disposable, extended media, dry type filter enclosed in a rigid casing, that has a minimum efficiency of 99.97% when tested with an essentially mono-disperse 0.3 micrometer test aerosol.

In-Service Test -- a periodic test to verify that a system or component meets its intended design function.

Pressure, Maximum Operating -- The maximum pressure the system components will be subjected to while performing their function. The allowable pressure during abnormal operating conditions which will not physically damage the system (e.g. sudden closure of dampers or registers), shall be considered maximum operating pressure.

Pressure, Operating -- the pressure that corresponds to the normal design operating mode of the system. This pressure is less than or equal to the maximum operating pressure.

Pressure, Structural Capability -- the pressure to which the designer specifies the component or system can be safely operated, including transient conditions, without permanent distortion.

Reference Value -- one or more achieved values or test parameters that are measured, observed, or determined when the equipment or system is known to be operating acceptably within its design basis limits.

System -- An assembly of components, including associated instruments and controls, required to perform the safety-related function of a nuclear air treatment, heating, ventilating, and air conditioning system.

Test Boundary -- the physical limits of the component, system, or device being subjected to a specified test.

Test Canister -- a specially designed sample holder containing adsorbent for laboratory tests which can be removed from an adsorber bank, without disturbing the remainder of the adsorber, to provide representative

DOE Proceedings 16th DOE Nuclear Air Cleaning Conference, page 125, "Size Distribution of Aerosols Produced from Substitute Materials by the Laskin Cold DOP Aerosol Generator", February 1981, NTIS Springfield, VA. (W. Hinds, J. Macher, M. First).

3 GENERAL INSPECTION AND TEST REQUIREMENTS

All inspections and tests shall be conducted in accordance with these requirements and the specific requirements of Sections 6 and 8.

NOTE: Activities in this Section may involve the use of hazardous materials, operations and equipment. This Section does not purport to address all of the safety requirements associated with their use. It is the responsibility of the user of this Section to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.

3.1 TEST INSTRUMENTS

A calibration program shall be established in accordance with the Owner's Quality Assurance Program. All permanent and temporary test instruments used in the conduct of tests required by this Standard shall be in calibration. Instrument accuracy shall meet or exceed the requirements of Table 3-1.

TABLE 3-1
INSTRUMENT ACCURACY REQUIREMENTS

MEASUREMENT	RANGE	ACCURACY
Pressure	>1.0 psig (>7.0 kPa(gage))	+/- 2.0 %
Pressure	from 1.0 in wg to 1.0 psig (0.25 to 7.0 kPa(gage))	+/- 0.1 in wg (+/-0.025 kPa)
Pressure	from 0.1 in wg to 1.0 in wg (25 to 250 Pa(gage))	+/- 0.01 in wg (+/-2.5 Pa)
Temperature	variable	+/- 2.0 °F (+/- 1.0 °C)
Temperature*	variable	+/- 0.5 °F (+/- 0.25 °C)
Vibration	variable	(per para. 3.1.4.1)
Flow	variable	+/- 5.0 %
Velocity (airflow)	variable	+/- 3.0 %
Speed	variable	+/- 2.0 %
Time	variable	+/- 1.0 sec
Electrical voltage	variable	+/- 1.0 %
Electrical resistance	variable	+/- 1.0 %
Challenge aerosol concentration		(per para. 3.1.4.2)
Challenge gas concentration		(per para. 3.1.4.3)

* Required for pressure testing in Mandatory Appendix II.

samples for laboratory testing.

2 Reference Documents

The following documents supplement this Standard and are a part of it to the extent indicated in the text. The issue of the referenced document noted below shall be in effect. If no date is listed, then the issue of the referenced document in effect at the time shall apply.

2.1 AMERICAN CONFERENCE OF GOVERNMENT INDUSTRIAL HYGIENISTS (ACGIH)

INDUSTRIAL VENTILATION: A Manual of Recommended Practice.

2.2 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3803-1989, Standard Test Method for Nuclear Grade Activated Carbon.

2.3 AMERICAN NUCLEAR SOCIETY (ANS)

ANS 3.1 , Selection Qualification and Training of Nuclear Power Plant Personnel. (latest edition)

2.4 American Society of Mechanical Engineers (ASME)

ASME AG-1-1994, Code On Nuclear Air And Gas Treatment

ANSI/ASME NQA-1-1989, Quality Assurance Program Requirements for Nuclear Facilities.

ASME N509-1989, Nuclear Power Plant Air Cleaning Units and Components

ASME N510-1989, Testing of Nuclear Air Treatment Systems

2.5 SHEET METAL AND AIR-CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC (SMACNA)

HVAC Systems Testing, Adjusting, and Balancing 1983.

2.6 ASSOCIATED AIR BALANCE COUNCIL (AABC)

National Standard of Total System Balance 1989.

2.7 NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems 1991.

2.8 DEPARTMENT OF ENERGY,(DOE)

3.1.1 **Range Requirements**

The full scale range of instruments shall be limited as necessary to ensure that the readings are within the accuracy requirements of Table 3-1.

3.1.2 **Instrument Fluctuation**

Symmetrical damping devices or averaging techniques may be used to reduce random signal fluctuations. Hydraulic instruments may be damped by using gauge snubbers or by throttling valves in instrument lines.

3.1.3 **Evaluation Following Test Instrument Loss, Damage or Calibration Failure**

When a test instrument is lost, damaged, or otherwise fails to meet the requirements of Table 3-1 during calibration, all test results obtained using the instrument shall be evaluated, dating back to the time of the previous calibration. If the evaluation does not confirm that the instrument met the acceptance criteria for the test(s) in question, the test(s) shall be repeated with calibrated instruments.

3.1.4 **Specific Instrument Accuracy Requirements**

3.1.4.1 **Vibration Instrument**

Vibration instrument accuracy shall be at least +/- 10%. The minimum frequency response range of the vibration measuring instrument shall be approximately one third of the minimum shaft speed. For rotating components, the maximum frequency response range shall be at least two times the rotational shaft speed of the component being measured. For reciprocating components, the maximum frequency response range shall be at least two times the speed of the crankshaft, times the number of unique planes occupied by a piston throw.

3.1.4.2 **Challenge Aerosol Measuring Instrument**

The Challenge Aerosol Measuring Instrument shall be verified to have a linear range of at least 10^5 times the minimum detectible quantity of the instrument with an accuracy in accordance with the Facility Project Specifications and Owner's Quality Assurance Program.

3.1.4.3 **Challenge Gas Measuring Instrument**

The Challenge Gas Measuring Instrument shall be verified to be capable of distinguishing challenge gas from background and measuring challenge gas over a linear range of at least 10^5 times the minimum detectible quantity of the instrument with an accuracy in accordance with the Facility Project Specifications and Owner's Quality Assurance Program.

4 REFERENCE VALUES

4.1 Establishment of Reference Values

Reference values are determined during acceptance testing (ASME AG-1 Section TA-4000), when the equipment or system is proven to be operating within the acceptable limits of the Owner's Design Specification. Operating tests and inspections specified in ASME AG-1 Section TA-4000 are performed under conditions readily reproducible during subsequent in-service tests to allow for direct comparison of test results. All test results and associated analyses are included in the test procedure documentation.

4.2 Re-establishment of Reference Values Following Component Replacement, Repair, or Modification

Following component replacement, repair, or modification requiring disassembly, an analysis shall be conducted to determine the effect on current reference values. Whenever the analysis indicates any of the reference values have been affected, new reference values shall be established in accordance with paragraph 4.1 or the previous reference values re-verified. Analysis of the new reference values shall verify that the component conforms to acceptance criteria prior to accepting it as fully operational. The analysis to determine the effect on reference values shall be documented.

5 INSPECTIONS AND TEST REQUIREMENTS

Equipment shall be evaluated as separate components and as functioning parts of an integrated system. The Owner shall define system test boundaries and evaluate system performance with respect to system functional requirement in accordance with the Owners Design Specifications. The following categories of tests shall be implemented as applicable and in accordance with this Section.

(a) Periodic in-service tests (Section 8).
(b) Tests following an abnormal incident (Section 9).
(c) Tests following component replacement, repair, modification or maintenance (paragraph 4.2).

Test designations associated with tests required by this Standard are listed in Table 3-2.

TABLE 3-2
TEST DESIGNATIONS

TEST	DESIGNATOR
Differential pressure test	DP
Differential temperature test	DT
Flow rate test	Qf
Functional test*	F
In-place leak test	IP
Laboratory analysis (adsorbent methyl-iodide penetration)	LAB
Electrical performance test	AMP
Leak test	PL
Rotational speed test	N
Bearing temperature test	Tb
Vibration test	Vb
Visual inspection	VT
Flow Distribution Test	Qf

* Functional tests consist of various mechanical actuation and performance verifications and are detailed separately in each test section.

5.1 **Inspection and Test Parameters**

Parameters which need to be observed, calculated and recorded in order to meet the requirements of this Section shall be identified for each system based upon the functional requirements of the Owner's Design Specification.

5.2 **System Operating Conditions**

Operating conditions required for in-service testing shall be determined for each system. These conditions and acceptance criteria shall be based upon the requirements of the Owner's Design Specification.

5.3 **Procedure Requirements**

The Owner shall be responsible for the development and implementation of written test procedures that meet the requirements of this Standard. Each equipment test Section consists of generic (Section 7) and specific (Section 8) test requirements and acceptance criteria which apply to each of the systems in the facility. The Owner shall document which requirements are applicable.

5.4 **In-Service Tests**

In-service tests shall be conducted at intervals not to exceed those specified in Section 8 or the Owners Design Specification, whichever is most limiting. When a test is not practical during facility operation or cannot be conducted due to excessive personnel hazard, the justification for postponement shall be documented and the test shall be completed after entering a condition in which the test can be conducted. When the in-service test interval expires during a period in which the component or system is not required for standby or normal operation, the test shall be conducted prior to returning equipment to normal operation. In-service test intervals are defined in Table 3-3.

TABLE 3-3
IN-SERVICE TEST INTERVALS

INTERVAL	TEST FREQUENCY	SYMBOL
Monthly	Once per 31 days	M
Quarterly	Once per 92 days	Q
Yearly	Once per 366 days	Y

6 GENERIC TESTS

Generic tests as specified in Sections 6.1 through 6.3 shall also be used in Section 8 where applicable.

6.1 Visual Inspection (VT)

Visual inspections shall be conducted in accordance with ASME AG-1 Section AA-5000 and the applicable portions of Mandatory Appendix I. The periodic in-service visual inspections listed in Section 8 shall verify that no unacceptable damage or degradation, which could impair function, has occurred to the equipment or system since the last inspection.

6.2 Pressure Boundary Tests

Pressure boundary tests consist of leak tests for ducts and housings, including fan and damper housings.

6.2.1 Leak tests for duct and housing sections shall be conducted using either the pressure decay method or the constant pressure method to verify that the leak rate for the duct or housing does not exceed the allowable limits established for the system. Testing shall be conducted in accordance with Mandatory Appendix II. Leak testing performed to satisfy ASME AG-1 Section SA may be used to meet these test requirements when the test method is compatible with Mandatory Appendix II.

An optional leak test for HEPA filter and adsorber mounting frames may be conducted, in conjunction with the housing leak test, by blanking off the frame openings and pressurizing the isolated test boundary. This procedure is useful for detecting small leaks in the mounting frame following repair or modification of a mounting frame or mounting frame interface. This test is used to verify that there are no defects in a frame that may cause failure of the in-place leak test. Testing shall be conducted in accordance with Non-Mandatory Appendix A.

6.3 Vibration Test (Vb)

Vibration measurements shall be taken on the accessible motor, fan, compressor and pump bearing housings in at least two different orthogonal planes approximately perpendicular to the line of the rotating shaft. When the bearing housing is not accessible, the frame of the component may be used if it will be representative of bearing housing vibration. When portable vibration instruments are used, reference points shall be clearly identified on the component being measured to permit duplication in both location and plane.

7 ACCEPTANCE CRITERIA

Results of tests described in Section 8 shall be subject to the acceptance criteria in Section 7 and to the applicable operating and design criteria specified by the Owner's Design Specification. Test results are considered acceptable if the component or system is not impaired or degraded to the point that it cannot perform its intended function. Acceptance criteria are specified in Section 8 only when they affect the quality of other tests. When test results do not meet the applicable acceptance criteria, the corrective actions required by Section 10 shall be initiated. In-service test results shall be compared to the acceptance test reference values and previous in-service test results. Comparison shall include a trend analysis designed to predict degradation rates of the components under test. Projected degradation rates that indicate probable loss of intended design function prior to the next scheduled in-service test shall require corrective action prior to the predicted loss of intended design function in accordance with Section 10.

7.1 Visual Inspection

Visual inspections are acceptable when there are no visual indications of improper installation, physical damage, structural distress or degradation that would impair the ability of the equipment or system to perform its intended function.

7.2 Pressure Boundary Tests

Pressure boundary tests are acceptable when there is no permanent structural deformation or leaks in excess of the limits specified in the applicable Sections of ASME AG-1 and the Owner's Design Specification.

7.3 Functional Tests

Functional tests are acceptable when they meet the requirements of the applicable Sections of ASME AG-1 and the Owner's Design Specification.

8 IN-SERVICE TEST REQUIREMENTS

8.1 General

In-service tests shall be conducted at the required time intervals after the completion of the field acceptance tests outlined in ASME AG-1 Article TA-4000. These tests shall be conducted at intervals not to exceed those stated in each Section of this Standard. When the in-service test interval is exceeded, the affected equipment shall be unavailable for service until the required in-service test can be successfully completed. In-service tests are not required to be maintained during periods when the equipment is not required to be available for operation as specified by the Owner's Design Specification. However, these in-service tests are required to be successfully completed prior to returning the equipment to normal or standby service.

8.2 FAN IN-SERVICE TESTS.

This Section provides the in-service test requirements for fans and related accessories. Integrated system testing shall be conducted in accordance with Section 8.10.

8.2.1 In-service Test Requirements

In-service tests listed in Table 8-1 shall be conducted at the specified interval and test results verified to be within the acceptance limits of the Owner's Design Specification and Section 7 and compared to the reference values obtained in acceptance tests in ASME AG-1 Article TA-4100.

TABLE 8-1
FAN IN-SERVICE TESTS

TEST	DESIGNATOR	MEASURE	OBSERVE	INTERVAL
Visual inspection	VT		*	Q
Leak test	PL	*		10Y
Mechanical run test	F		*	Q
Flow rate test	Qf	*		2Y
Static pressure test	DP	*		2Y
Rotational speed test	N	*		2Y
Vibration test	Vb	*		Q

8.2.2 Visual Inspection (VT)

A visual inspection of the fan and associated components shall be conducted in accordance with Section 6.1 and Mandatory Appendix I (I-1100).

8.2.3 Pressure Boundary Test

8.2.3.1 Leak Test (PL)

When a fan housing is part of the system pressure boundary, a pressure boundary leak test shall be conducted to verify the leak tightness of the fan housing, shaft seal and attached interfaces in accordance with paragraph 6.2.1 and Mandatory Appendix II. The fan housing, shaft seal and attached interfaces may be tested concurrent with the duct and housing leak test specified in paragraph 8.4.3.1. However, the shaft seal leak rate shall be evaluated (qualitative) independently of the overall system leak rate.

8.2.4 System Functional Tests

Sections 8.2.4.1 through 8.2.4.5 shall be conducted in the same time frame.

8.2.4.1 Mechanical Run Test (F)

The fan shall be operated at the design flow rate for at least 15 minutes and stable system operation (no surging) verified.

8.2.4.2 Flow Rate Test (Qf)

The fan flow rate shall be measured. Recommended procedures include "ACGIH Industrial Ventilation" or equivalent.

8.2.4.3 Static Pressure Test (DP)

The fan inlet and outlet static pressure and velocity pressure shall be measured and the overall fan static pressure determined.

8.2.4.4 Rotational Speed Test (N)

When a fan does not have a direct drive coupling to the motor, the rotational speed of the fan shaft shall be measured.

8.2.4.5 Vibration Test (Vb)

The vibration of each fan and motor bearing shall be measured in accordance with Section 6.3.

8.3 DAMPER IN-SERVICE TESTS

This Section provides the in-service test requirements for dampers and related accessories. Integrated system testing shall be conducted in accordance with Section 8.10.

8.3.1 In-service Test Requirements

In-service tests listed in Table 8-2 shall be conducted at the specified interval and test results verified to be within the acceptance limits of the Owner's Design Specification and Section 7, and be compared to the reference values obtained in the acceptance tests in ASME AG-1 Article TA-4200.

8.3.2 Visual Inspection (VT)

A visual inspection of the dampers and associated components shall be conducted in accordance with Section 6.1 and Mandatory Appendix I (I-1200).

8.3.3 Pressure Boundary Tests.

8.3.3.1. Leak Test, Damper Seat (PL)

When dampers have seat leak rate limits, a dynamic pressure boundary leak test shall be conducted in the direction the damper is expected to function, in accordance with paragraph 6.2.1 and Mandatory Appendix II. Seat leakage shall be tested by blanking off or otherwise isolating a duct Section upstream of the damper. The leak test shall be performed with the damper cycled closed using its normal closing mechanism (exclusive of any additional assistance).

TABLE 8-2
DAMPER IN-SERVICE TESTS

TEST	DESIGNATOR	MEASURE	OBSERVE	INTERVAL
Visual inspection	VT		*	2Y
Leak test	PL	*		2Y
Position indication test	F		*	2Y
Exercise test	F		*	2Y
Flow Control test	F		*	2Y
Static timing test	F	*		Q
Fire damper test	F		*	2Y
Dynamic time test	F	*		2Y
Interlock test	F		*	2Y

8.3.4 Component Functional Tests

Component functional tests shall verify that the damper is operational prior to conducting the system functional tests specified in Section 8.3.5.

8.3.4.1 Position Indication Test (F)

Dampers having remote position indicators shall be observed during operation to verify that the damper position corresponds to the remote indicator.

8.3.4.2 Exercise Test (F)

Power operated dampers shall be fully cycled using a control switch or other actuating device to verify operation. Manual dampers, which have a shut off function shall be fully cycled to verify operation. Fire dampers shall be tested in accordance with paragraph 8.3.5.2.

8.3.4.3 Static Timing Test (F)

Power operated dampers that are required to operate within a specified time limit shall be tested by measuring the time to fully open or fully close (as required by the Owners Design Specification).

8.3.5 System Functional Tests

8.3.5.1 Flow Control Test (F)

Power operated dampers that control airflow shall be observed under throttled flow conditions to verify freedom of movement and stable operation.

8.3.5.2 Fire Damper Test (F)

Fire dampers shall be tested, using a normal or simulated actuation signal, to verify activation under design flow.

8.3.5.3 Dynamic Timing Test (F)

Isolation dampers having a required actuation response time shall be timed to the fully open or fully closed position (as required by the Owners Design Specification) under design flow rate conditions.

8.3.5.4 Interlock Test (F)

Dampers that have an opening or closing function interlocked with other components, (e.g. fan, other dampers), shall be tested to verify interlock action.

8.4 DUCT AND HOUSING IN-SERVICE TESTS

This Section provides the in-service test requirements for ducts and housings.

8.4.1 In-service Test Requirements

In-service tests listed in Table 8-3 shall be conducted at the specified interval and test results verified to be within the acceptance limits of the Owner's Design Specification and Section 7. Test results shall be compared to the reference values obtained in the acceptance tests in ASME AG-1 Article TA-4300.

TABLE 8-3

DUCT AND HOUSING IN-SERVICE TESTS

TEST	DESIGNATOR	MEASURE	OBSERVE	INTERVAL
Visual inspection	VT		*	2Y*
Leak test	PL	*		10Y

* Loop seal water level in duct or housing drain lines shall be maintained to ensure the integrity of the system pressure boundary at all times. More frequent inspection of the water level in the loop seal may be required, depending on the system design.

8.4.2 Visual Inspection (VT)

A visual inspection of the ducts, housings, and associated attachments shall be conducted in accordance with Section 6.1 and Mandatory Appendix I (I-1300).

8.4.3 Pressure Boundary Tests

8.4.3.1 Leak Test (PL)

A pressure boundary leak test shall be conducted on filter housings in accordance with Section 6.2 and Mandatory Appendix II.

8.5 REFRIGERATION EQUIPMENT IN-SERVICE TESTS

This Section provides the in-service test requirements for refrigeration equipment. Integrated system testing shall be conducted in accordance with Section 8.10.

8.5.1 In-service Test Requirements

In-service tests listed in Table 8-4 shall be conducted at the specified interval and test results verified to be within the acceptance limits of the Owner's Design Specification and Section 7. Test results shall be compared to the reference values obtained in the acceptance tests in ASME AG-1 Article TA-4400.

TABLE 8-4
REFRIGERATION EQUIPMENT IN-SERVICE TESTS

TEST	DESIGNATOR	MEASURE	OBSERVE	INTERVAL
Visual inspection	VT		*	Q
Leak tests	VT	*		Q
Valve position indication test	F		*	2Y
Valve exercise test	F		*	2Y
Valve timing test	F	*		Q
Flow Control valve test	F		*	Q
Mechanical run test	F		*	Q
Performance test	F	*		Q
Vibration test	Vb	*		Q
Rotational Speed test	N	*		2Y

8.5.2 Visual Inspection (VT)

A visual inspection of the refrigeration equipment components shall be conducted in accordance with Section 6.1 and Mandatory Appendix I (I-1400).

8.5.3 Pressure Boundary Tests

8.5.3.1 Leak Test, Refrigerant Piping and Coils (VT)

With the refrigerant system under normal operating pressure, refrigerant fluid levels shall be monitored to verify no unacceptable refrigerant leaks.

8.5.3.2 Leak Test, Hydronic Piping and Coils (VT)

Hydronic piping and coils shall be observed to verify no unacceptable fluid leaks. Testing shall be conducted by inspecting the fluid system, under normal operating pressure, for evidence of leaks.

8.5.4 Component Functional Tests

Fans shall be tested in accordance with Section 8.2.

8.5.4.1 Valve Position Indication Test (F)

Valves with position indicators shall be observed during valve full stroke operation to verify that the valve position corresponds to the remote indication.

8.5.4.2 Valve Exercise Test (F)

Power operated valves shall be fully stroked using their remote control switch or other actuation device to verify operation. Manual valves shall be fully stroked to verify freedom of movement.

8.5.4.3 Valve Timing Test (F)

Power operated valves that are required to operate within a specified time limit shall be tested by measuring the stroke time.

8.5.5 System Functional Tests

8.5.5.1 Flow Control Valve Test (F)

Power operated valves, controlled by flow instrumentation, shall be observed under throttled flow conditions to verify freedom of movement and stable operation.

8.5.5.2 Mechanical Run Test (F)

The refrigeration compressor shall be operated with the system operating in the normal heat load range for at least 15 minutes and stable system operation verified.

8.5.5.3 Performance Test (F)

The refrigeration compressor inlet and outlet pressure and temperature shall be measured with the refrigeration equipment operating at achievable load points.

8.5.5.4 Vibration Test (Vb)

The vibration on each accessible bearing of the compressor and associated motor in the refrigeration system shall be measured in accordance with Section 6.3.

8.5.5.5 Rotational Speed Test (N)

For refrigerant compressors that have variable speed drives, or that do not otherwise have direct drive operations, the rotational speed of the compressor shaft shall be measured (not required for hermetically sealed compressors).

8.6 CONDITIONING EQUIPMENT IN-SERVICE TESTS

This Section provides the in-service test requirements for conditioning equipment. Integrated system testing shall be conducted in accordance with Section 8.10.

8.6.1 In-Service Test Requirements

In-service tests listed in Table 8-5 shall be conducted at the specified interval and test results verified to be within the acceptance limits of the Owner's Design Specification, Section 7 and compared to the reference values obtained in the acceptance tests in ASME AG-1 Article TA-4500.

TABLE 8-5
CONDITIONING EQUIPMENT IN-SERVICE TESTS

TEST	DESIGNATOR	MEASURE	OBSERVE	INTERVAL
Visual inspection	VT		*	Q
Leak test	VT	*		Q
Valve performance tests	F		*	2Y
Mechanical run test	F		*	Q
Performance test	F	*		2Y
Rotational speed test	N	*		2Y
Vibration test	Vb	*		Q
Elect heater performance test	AMP	*		2Y
Hydronic heating and cooling performance test	F	*		2Y

8.6.2 Visual Inspection (VT)

A visual inspection of the conditioning equipment components shall be conducted in accordance with Section 6.1 and Mandatory Appendix (I-1500).

8.6.3 Pressure Boundary Test

8.6.3.1 Leak Test, Hydronic Piping and Coils (VT)

With the conditioning system at normal operating pressure, hydronic piping, coils, and pressure vessels shall be observed to verify no unacceptable fluid leaks.

8.6.4 Component Functional Test

Fans shall be tested in accordance with Section 8.2. Refrigeration components shall be tested in accordance with Section 8.5.

8.6.4.1 Valve Performance Tests (F)

Conditioning system valves shall be tested in accordance with Sections 8.5.4.1, 8.5.4.2 and 8.5.4.3

8.6.5 System Functional Tests

8.6.5.1 Hydronic System Flow Balance Verification Test

A verification of the hydronic system flow balance shall be conducted. Recommended procedures include SMACNA, NEBB, AABC, or equivalent.

8.6.5.2 Flow Control Valve Test (F)

Power operated valves, controlled by flow instrumentation, shall be observed under throttled flow conditions to verify freedom of movement, stable operation, and ability to maintain the required flow rate.

8.6.5.3 Mechanical Run Test (F)

The conditioning system pumps shall be operated, at the reference flow rate, for at least 15 minutes and stable system operation verified.

8.6.5.4 Performance Test (F)

With the conditioning system pump operating at the reference flow rate, pump differential pressure and flow rate shall be measured.

8.6.5.5 Rotational Speed Test (N)

For conditioning system pumps that have variable speed drives, or that do not otherwise have direct drive operations, the rotational speed of the pump shaft shall be measured.

8.6.5.6 Vibration Test (Vb)

The vibration of each bearing on the pump and associated motor in the conditioning system shall be measured in accordance with Section 6.3.

8.6.5.7 Electric Heater Test (AMP)

With design flow rate through the heater bank, the electrical supply voltage, amperage, phase balance, and differential temperature shall be measured.

8.6.5.8 Hydronic Heating and Cooling Performance Test (F)

With the conditioning system operating at design air and hydronic flow rate, at the available heat load conditions, the air side flow, differential pressure and differential temperature, and the hydronic side flow, differential temperature and differential pressure shall be measured.

8.7 MOISTURE SEPARATOR, PREFILTER, HEPA FILTER BANK IN-SERVICE TESTS

This Section provides the in-service test requirements for installed moisture separator, pre-filter, and HEPA filter banks.

8.7.1 In-Service Test Requirements

In-service tests listed in Table 8-6 shall be conducted at the specified interval and test results verified to be within the acceptance limits of the Owner's Design Specification, Section 7 and compared to the reference values obtained in the acceptance tests in ASME AG-1 Article TA-4600.

TABLE 8-6
MOISTURE SEPARATOR, PREFILTER, HEPA FILTER BANK
IN-SERVICE TESTS

TEST	DESIGNATOR	MEASURE	OBSERVE	INTERVAL
Visual inspection	VT		*	2Y
Differential pressure test	DP	*		M
In-place leak test	IP		*	2Y*

*In-place leak tests are not required on systems used for 100% recirculation (e.g. Reactor containment cleanup units).

8.7.2 Visual Inspection (VT)

A visual inspection of the installed moisture separator, prefilter and HEPA filter banks shall be conducted in accordance with Section 6.1 and Mandatory Appendix I (I-1600).

8.7.3 System Functional Tests

8.7.3.1 Differential Pressure Test (DP)

With the system operating at design flow rate (+/- 10%), the differential pressure across each moisture separator, prefilter, and HEPA filter bank shall be measured.

8.7.3.2 In-Place Leak Test (IP)

With the system operating at design flow rate (+/- 10%), the challenge aerosol leak rate of each HEPA filter bank shall be measured in accordance with Mandatory Appendix IV.

8.8 TYPE II and TYPE III ADSORBER BANK IN-SERVICE TESTS

This Section provides the in-service test requirements for installed type II and type III adsorber banks.

8.8.1 In-service Test Requirements

In-service tests listed in Table 8-7 shall be conducted at the specified interval and verified to be within the acceptance limits of the Owner's Design Specification, Section 7, and compared to the reference values obtained in the acceptance tests in ASME AG-1 Article TA-4700.

TABLE 8-7
TYPE II, TYPE III ADSORBER BANK IN-SERVICE TESTS

TEST	DESIGNATOR	MEASURE	OBSERVE	INTERVAL
Visual inspection	VT		*	2Y
Differential pressure test	DP	*		M
In-place leak test*	IP	*		2Y
Electric Heater Performance Test	F	*		2Y

*In-place leak tests are not required on systems used for 100% recirculation (e.g. Reactor containment cleanup units).

8.8.2 Visual Inspection (VT)

A visual inspection of the type II and type III adsorber banks shall be conducted in accordance with Section 6.1 and Mandatory Appendix I (I-1700).

8.8.3 System Functional Tests

8.8.3.1 Differential Pressure Test (DP)

With the system operating at design flow rate (+/- 10%), the differential pressure across each adsorber bank shall be measured.

8.8.3.2 In-Place Leak Test (IP)

With the system operating at design flow rate (+/- 10%), the challenge gas leak rate of each adsorber bank shall be measured in accordance with Mandatory Appendix V.

8.8.3.3 Electric Heater Performance Test

With design air flow (+/- 10%) through each heater bank, the electrical supply voltage, amperage, phase balance of each heater circuit, and differential temperature and air flow across the heater coil shall be measured.

8.9 **ADSORBENT IN-SERVICE TESTS**

This Section provides the in-service laboratory test requirements for radioactive iodine penetration of the adsorbent bed used in carbon adsorber systems.

8.9.1 In-service Test Requirements

In-service laboratory tests shall be conducted, using representative samples of adsorbent, at least every 2 years, or 720* hours of accumulated service time, whichever is sooner. This test measures the penetration of radioiodine through adsorbent. Laboratory test results shall be evaluated to the acceptance limits of the Owner's Design Specification. Sample locations shall be selected to assure samples are representative of the overall condition of the adsorbent in the adsorber bank.

*NOTE: A documented history of adsorbent degradation may be used as a basis for review of the Design Specification or Technical Specification to establish a longer adsorbent sample interval.

8.9.2 Laboratory Analysis (LAB)

A laboratory analysis of the adsorbent shall be conducted in accordance with ASTM D-3803-89, to measure the ability of the adsorbent to remove radioiodine. Test bed depth used in the laboratory test shall be the same as the nominal adsorber depth in the adsorber bank being tested. Samples shall be representative of the oldest adsorbent in the bank and drawn from the bank test canisters, or from the bank itself. An in-place leak test of the bank shall be conducted following sample removal in accordance with Section 8.8, unless it can be demonstrated that the removal of the sample does not create a potential leak path around or through the adsorber bank. Sample adsorbent loaded in replacement test canisters shall be representative of the oldest adsorbent in the bank. If new adsorbent is used to replace the adsorbent removed for sampling, it shall not be used in future samples.

8.10 INTEGRATED SYSTEM TESTS

Each system shall be tested to verify that the functional performance at design operating conditions is achieved. Integrated system tests shall be conducted to challenge all integrated control functions including interlocks, and manual, or automatic actuation circuits, (damper position changes, fan starts and stops, compressor and pump starts or stops, valve position changes, heater energization or de-energization). These actuations can be from a number of different sources including radiation sensors, temperature sensors, chlorine sensors, pressure sensors, manual controls and emergency safeguard signals. Sensor operation shall be verified in addition to control circuitry. Integrated testing shall also include an overall system leak test to verify there are no unacceptable bypasses of the HEPA filter or adsorber banks. Integrated system testing shall verify that the intended design function of the system is achieved in accordance with the Owner's Design Specification. The maximum test interval for integrated system tests shall be 2 years.

8.10.1 Fan Integrated System Test Requirements (F)

Fans designed to respond automatically to a process or emergency actuation signal shall be tested. Sequencing of starts, stops and speed changes shall be conducted utilizing an actual or simulated actuation signal.

8.10.2 Air System Flow Balance Verification Test (Qf)

A verification of the system airflow balance shall be conducted. Recommended procedures include SMACNA, NEBB, ACGIH, AABC, or equivalent.

8.10.3 Damper Integrated System Test Requirements (F)

Dampers designed to respond automatically to a process or emergency actuation signal shall be tested. Sequencing of damper positions shall be conducted utilizing an actual or simulated actuation signal.

8.10.4 Refrigeration and Conditioning Integrated System Test Requirements (F)

Refrigeration and Conditioning equipment designed to respond automatically to a process or emergency actuation signal shall be tested. Sequencing of equipment operation (start, stop, speed change, valve operation or isolation heater operation) shall be conducted utilizing an actual or simulated actuation signal.

8.10.5 HEPA Filter and Adsorber Bank Integrated System Test Requirements (F)

All potential HEPA filter bank and adsorber bank bypass flow paths shall be challenged to verify that leak rates are within the Owner's Design Specification. Bypass flow paths may be challenged during the in-place leak testing, specified in Sections 8.7.3.2 and 8.8.3.2, by ensuring that the challenge aerosol or gas injection and sample ports encompass all potential bypass leak paths (reference Mandatory Appendix IV, step V-1100). If a potential bypass flow path is not challenged during these in-place tests, a separate test shall be performed, using the techniques outlined in Appendix IV or V, to verify that the HEPA or adsorber banks are not being bypassed in excess of the limits specified in the Owner's Design Specification.

9 TESTING FOLLOWING AN ABNORMAL INCIDENT

Following an abnormal incident in which the system has been challenged at or near its design capability, the applicable acceptance tests in ASME AG-1 Article TA-4000 shall be conducted to verify that the system is fully operational. Examples of abnormal incidents include a Design Basis or severe accident exposure of the HEPA filter or adsorber banks to radioactive particles or iodine (that may saturate the HEPA filter or adsorber banks), exposure to smoke, or chemical contaminants, flooding, fire, seismic event or over-pressurization. This requirement shall apply only to those components that may have been affected by the incident. An evaluation shall be conducted and documented to determine the extent of testing required.

Following exposure to smoke, solvent, paints, or other organic fumes or vapors, which could degrade the performance of the adsorbent, the adsorbent shall be replaced or verified functional by a laboratory test in accordance with Section 8.9.2.

10 CORRECTIVE ACTION REQUIREMENTS

Corrective action is required when test results do not meet the acceptance criteria specified. For equipment that is replaced, modified, or repaired, such that the reference values may change, a new set of reference values shall be obtained in accordance with the requirements of Section 4.2 and ASME AG-1 Article TA-4000. Additional guidance for corrective actions is included in Non-Mandatory Appendix B.

11 QUALITY ASSURANCE

11.1 General

Field testing of nuclear air treatment, heating, ventilating, and air conditioning systems shall be conducted in accordance with the quality assurance requirements of ASME AG-1, Article AA-8000, ANSI/ASME NQA-1, and NQA-2.

11.2 Personnel

Tests shall be conducted by personnel who have demonstrated competence to perform the specific tests, as evidenced by documented experience and training. Personnel shall be certified in accordance with ANSI/ASME NQA-1 or ANS 3.1, and in accordance with the Owner's Quality Assurance Program Requirements.

11.3 Documentation

In-service test procedures shall document the test results specified in Section 8 and include a record of test failures with subsequent corrective actions and analysis of test data trends. These records shall be maintained for the life of the facility.

11.3.1 Procedures

Written test procedures shall document the in-service testing performed and the test results obtained in accordance with Section 8 of this Standard.

11.3.2 Reports

A written report shall be provided to document the in-service testing performed in accordance with Section 8 of this Standard. The report shall contain, as a minimum, the following:

(a) The system name, test/inspection procedure(s) used, date of test results and the test performer's signature;
(b) Identification of instruments, equipment, tools and documents to the extent that they, or their equivalent, can be identified for future examinations;
(c) Observations and dimensional checks specified by the respective test data and any reports developed during the inspection and testing;
(d) Conclusions and recommendations by visual examinations and testing personnel;
(e) Reference to previous reports, if this report is for reinspection and testing.

APPENDIX I
MANDATORY
VISUAL INSPECTION CHECKLIST

I-1000 General

A specific inspection checklist for each component in the system shall be included in the in-service test procedures. This Appendix lists typical items for each component to be visually inspected in Section 8 (In-service Tests). The inspection shall be conducted in accordance with Section 6.1. The acceptance criteria for these inspections shall be in accordance with Section 7 and Section 7.1.

I-1100 Fan Inspection Checklist

a. Housing and duct interface
b. Fan belt and shaft guards
c. Interferences with moving parts
d. Fan shaft seal
e. Belt adjustment and condition
f. Lubricant levels
g. Supports and attachments
h. Bolting and fasteners
i. Instrumentation
j. Electrical connections
k. Control system components
l. Pneumatic connections
m. Access for tests and maintenance

I-1200 Damper Inspection Checklist

a. Housing and duct interface
b. Actuator linkage, motor, controller
c. Interferences with moving parts
d. Damper shaft seal
e. Blade edge seals, damper seat
f. Limit switches
g. Supports and attachments
h. Bolting and fasteners
i. Instrumentation
j. Electrical connections
k. Pneumatic connections
l. Access for tests and maintenance

I-1300 Duct, Housing and Mounting Frame Inspection Checklist

a. Housing and duct connections (no caulking)
b. Provision for opening access doors from both inside and outside
c. Access door seals, gaskets
d. Access door latches
e. Housing internal access ladders and platforms

f. Sample and injection ports, location and caps
g. Supports and attachments
h. Bolting and fasteners
i. Instrumentation, connections
j. Electrical connections
k. Housing/duct penetration seals
l. Loop seals (water level), drain connections
m. Lighting conduits, socket housing seals (flush mounted)
n. HEPA/adsorber mounting frame continuous seal welds
o. Mounting frame penetrations seal welded
p. Mounting frame seating surface (weld splatter, flatness, scratches)
q. Sample canister installation
r. Mounting frame clamping devices
s. Access for tests and maintenance
t. Lighting for test and maintenance available

I-1400 Refrigeration Equipment Inspection Checklist

a. Housing or duct interface with refrigeration equipment
b. Fan, pump, compressor belt and coupling guards
c. Interferences with moving parts
d. Belt adjustment and condition
e. Fluid leaks
f. Lubricant levels
g. Supports and attachments
h. Bolting and fasteners
i. Instrumentation
j. Electrical connections
k. Control system components
l. Pneumatic connections and tubing (No crimping)
m. Access for tests and maintenance

I-1500 Conditioning Equipment Inspection Checklist

a. Housing or duct interface with conditioning equipment
b. Belt and coupling guards
c. Interferences with moving parts
d. Belt tightness
e. Fluid leaks
f. Lubricant levels
g. Supports and attachments
h. Bolting and fasteners
i. Instrumentation
j. Electrical connections
k. Control system components
l. Pneumatic connections and tubing (No crimping)
m. Drains and spray nozzles not plugged
n. Access for tests and maintenance

I-1600 Moisture Separator Bank, Prefilter Bank, HEPA Filter Bank Inspection Checklist

a. Moisture separator media, frame, clamps and gaskets
b. Moisture separator water collection system and drains
c. Prefilter media, frame, clamps and gaskets
d. HEPA filter media, frame, clamps and gaskets
e. Sealant or caulking (none allowed)
f. Moisture separator, prefilter, HEPA orientation (vertical)
g. Bolting and fasteners.
h. Access for tests and maintenance

I-1700 Type II, Type III Adsorber Bank Inspection Checklist

a. Type II media, frame, screen, clamps and gaskets
b. Sealant or caulking (none allowed)
c. Type III media, screens, frame
d. Test canisters
e. Bulk loading equipment
f. Fire protection system piping, nozzles, instrumentation
g. Bolting and fasteners
h. Access for tests and maintenance

APPENDIX II
MANDATORY
DUCT AND HOUSING LEAK TEST PROCEDURE

II-1000 General

This procedure is used to test the leak tightness of the ducts and housings including installed fan housings, damper housings and fan and damper shaft seals.

II-1100 Summary of Method

Ducts and housings that form the pressure boundary of the system shall be leak tested, with air, using one of the methods listed in this procedure. Either method may be used and will produce a similar test result. The constant pressure method is useful for testing small volumes and is conducted at the maximum operating pressure for the system. The pressure decay method is useful in testing large volumes and is conducted by pressurizing to 1.25 times the maximum operating pressure, then allowing the pressure to decay for a fixed period of time, or until the pressure decreases to 80% of the maximum operating pressure, whichever occurs first. Fans, dampers, and other components that are part of the pressure boundary shall be installed and tested with the pressure boundary to verify interface connection leak tightness. If the measured leak rate is in excess of the acceptance criteria, the leaks shall be located by one of the methods listed in this procedure. After leaks are repaired, the duct and housing shall be re-tested to verify leak tightness.

NOTE: This test procedure is written as if the operating pressure were positive, but it would be identical for negative pressure systems with appropriate change in signs used in the data collection and calculations.

II-2000 Prerequisites

Construction, modifications and repairs affecting the test boundary shall be complete and the inlet and discharge openings of the duct or housing sealed before the test is started. All electrical, piping, and instrument connections shall be complete and all permanent seals shall be installed before the test is started. For pressure decay testing, the volume of the pressure test boundary must be calculated.

II-3000 Test Equipment

a. Pressurization source (Pneumatic, test fan with flow control, etc.).

b. Covers to seal test boundaries.

c. Clock or timer accurate to +/- 1.0 second.

d. Pressure indicating device accurate to +/- 0.1 in.w.g. (0.025

kPa(gage)).

e. Flowmeter or Totalizing Gas Volume meter accurate to +/-5% (constant pressure method).

f. Temperature indicating device accurate to +/- 0.5 °F (0.25°C).

g. Bubble solution for detecting air leaks (bubble method).

h. Optional portable electronic sound detection equipment (audible leak method).

i. Barometer

II-4000 Procedure

II-4100 Constant Pressure Test

a. Connect the pressurization source to the duct or housing.

b. Connect the flowmeter or totalizing gas volume meter between the pressurization source and the housing (downstream of the throttling valve, if used).

c. Install temperature and pressure indicating devices so that they will indicate representative temperature and pressure inside the duct or housing being tested.

d. Seal test boundaries and close access doors in the normal manner. Do not use temporary sealants, duct tape, or similar temporary materials except for sealing the temporary blank-off panels.

e. Start the pressurization source and operate it until the maximum operating pressure is achieved. Maintain pressure constant with the flow control device until temperature remains constant within +/- 0.5 °F (0.25 °C) for a minimum of 10 minutes. Record the initial stabilized pressure, temperature, and barometric pressure.

f. Measure the flow rate of the air being added to or removed from the duct or housing while maintaining the maximum operating pressure within +/- 0.1 in. w. g. (0.025 kPa(gage)). When using the flow meter, record flow readings once a minute for a 5 minute continuous period and average the readings to calculate the measured leak rate. When using a totalizing gas volume meter, measure the total volume of air for a 10 minute continuous period and divide the measured volume by time (10 minutes) to calculate the measured leak rate. Record final pressure, temperature and barometric pressure.

g. Convert the final calculated leak rate to standard cubic feet per minute (cubic meters per second) in accordance with the method illustrated in "Industrial Ventilation" (ref. Section 2).

II-4200 Pressure Decay Test

a. Connect the pressurization source (with a leak tight shutoff valve) to the duct or housing.

b. Install the temperature and pressure indicating devices where they will indicate the representative temperature and pressure inside the duct or housing being tested.

c. Seal test boundaries and close access doors in the normal manner. Do not use temporary sealants, duct tape, or similar temporary materials except for sealing the temporary blank-off panels.

d. Start the pressurization source and operate until the pressure is 1.25 times the maximum operating pressure (but not to exceed the structural capability pressure). Maintain this pressure constant with a flow control device until temperature remains constant within +/- 0.5 °F (0.25 °C) for a minimum of 10 minutes. Close shutoff valve.

NOTE(1): If the structural capability pressure for the duct or housing is less than 1.25 times the maximum operating pressure, the final test pressure shall be calculated as follows to achieve an average test pressure equal to the maximum operating pressure:

$$Pf = 0.8(OP_{max}) + (1.25(OP_{max}) - SCP)$$

where: Pf = final test pressure
OP_{max} = maximum operating pressure
SCP = structural capability pressure

e. Record the initial time, pressure, temperature, and barometric pressure.

f. Record pressure readings once a minute until pressure decays to 80% of the maximum operating pressure, or for a minimum of 15 minutes (see NOTE(1) in step d above).

h. Record final time, pressure, temperature, and barometric pressure.

i. Calculate leak rate from the following equation in English Units:

$$Q_{ave} = \left(\frac{Pi}{Ti} - \frac{Pf}{Tf} \right) * \frac{V}{R*\Delta t*0.075}$$

Metric Units:

$$Q_{ave} = (1.39 * 10^{-5}) * \left(\frac{Pi}{Ti} - \frac{Pf}{Tf}\right) * \frac{V}{R * \Delta t}$$

where:

Q_{ave}= Average leak rate, scfm (sm^3/s). (air density 0.075 lb/ft3)

V = Volume within test boundary, ft^3 (m^3).

P_i = Initial pressure within test boundary, lb/ft^2 ABS (Pa(absolute)).

P_f = Final pressure within test boundary, lb/ft^2 ABS (Pa(absolute).

T_i = Absolute Temperature at start of test, °R (°K).

T_f = Absolute Temperature at end of test, °R (°K).

Δt = $t_i - t_f$ Time difference (minutes).

t_i = Time at start of test (minutes).

t_f = Time at end of test (minutes).

R = Gas Constant for Air; 53.35 $\frac{ft\text{-}lb}{lb\text{-}°R}$, (0.286 $\frac{kJ}{kg\text{-}°K}$)

II-4300 Acceptance Criteria

If the calculated leak rate exceeds the Owner's acceptance criteria, locate leaks in accordance with one of the techniques outlined in II-4400 or II-4500.

II-4400 Bubble Leak Location Method

a. Pressurize the test boundary to the maximum operating pressure for the system.

b. With the test boundary under continuous pressure, apply bubble solution to areas to be tested. Identify places where bubbles are found and perform corrective actions.

c. Following corrective actions, retest in accordance with II-4100 or II-4200.

II-4500 Audible Leak Location Method

a. Pressurize the test boundary to the maximum operating pressure for the system.

b. With the test boundary continuously pressurized, locate audible leaks (electronic sound detection equipment optional) and perform corrective actions.

c. Following corrective action, retest in accordance with II-4100 or II-4200.

APPENDIX III
MANDATORY
AIRFLOW DISTRIBUTION TEST PROCEDURE

III-1000 General

This procedure is used to measure the air flow distribution across the face of moisture separator, prefilter, HEPA filter, and adsorber banks. Uniform air velocity distribution ensures maximum air treatment efficiency and uniform loading of air treatment components.

III-1100 Summary of Method

The system is operated at design flow rate. Airflow velocity readings are measured downstream of each moisture separator, prefilter, and HEPA filter in the bank. For adsorbers, readings shall be taken in line with the flow slots. Each reading is compared to the average for the bank.

III-2000 Prerequisites

System operating within +/- 10% design flow rate.

III-3000 Test Equipment

Rotating vane, heated wire or heated thermocouple anemometer, pitot tube, or other suitable air velocity measuring device as appropriate for the anticipated velocities.

III-4000 Procedure

a. For each moisture separator, prefilter and HEPA filter, measure the air velocity at the approximate centers of equal areas with at least 1 measurement per each moisture separator, prefilter, and HEPA filter, and a minimum of 9 measurements per bank. Adsorber velocity measurements shall be made in the approximate center of the flow slots. For flow slots greater than 24 inches long (60 cm), measurements shall be nominally every 12 inches (30 cm) along the length of the slot.

b. Calculate the average velocity (V_{ave}) using the following formula:

$$V_{ave}=\frac{\sum_1^n V_i}{n}$$

where:

$\sum_1^n$ = sum of readings from 1 to n

V_i = individual velocity readings
n = number of readings

c. Identify the highest and lowest velocity readings and calculate the percentage they vary from the average calculated above.

APPENDIX IV
MANDATORY
HEPA FILTER BANK IN-PLACE LEAK TEST PROCEDURE

IV-1000 General

This procedure is used to leak test HEPA banks.

IV-1100 Summary of Method

The system is operated at design flow rate. Challenge aerosol is injected upstream of each bank through the injection ports qualified in Acceptance Testing in ANSI/ASME AG-1 Appendix TA-V. The concentration of the challenge aerosol is measured upstream and downstream of the HEPA bank. The ratio of the downstream and upstream concentrations represents the HEPA filter bank leak rate.

IV-2000 Prerequisites

Airflow distribution shall be verified in accordance with Appendix III. The injection port shall be qualified to provide uniform air-aerosol mixing in accordance with ASME AG-1 Appendix TA-V.

IV-3000 Test Equipment

a. Challenge aerosol generator.

b. Challenge aerosol measuring instrument.

c. Flow measuring device.

IV-4000 Procedure

a. Connect challenge aerosol or gas generator to the qualified injection port.

b. Place the challenge aerosol or gas measuring instrument sample probes upstream and downstream of the bank to be tested with adequate hose length to reach all areas of the bank.

c. Start the system and verify stable flow rate within +/- 10% of design flow rate.

d. Measure the upstream and downstream aerosol background concentration. The pre-injection background levels shall be stable to ensure correct instrument response and shall not interfere with the detector's ability to detect leaks in excess of the maximum allowed by the acceptance criteria.

e. Start the challenge aerosol injection.

f. Record the upstream and downstream concentrations. Repeat until at least three of the readings are stable.

g. Stop the injection.

h. Using the final set of readings meeting the stability and tolerance criteria, calculate the bank leak rate using the formula below:

$$L = (100)\,\frac{C_d}{C_u}$$

L = % Leak
C_d = Downstream concentration
C_u = Upstream concentration

APPENDIX V
MANDATORY
ADSORBER BANK IN-PLACE LEAK TEST PROCEDURE

V-1000 General

This procedure is used to leak test adsorber banks.

V-1100 Summary of Method

The system is operated at design flow rate. Challenge gas is injected upstream of each bank through the injection port qualified in ASME AG-1 Appendix TA-V. The concentration of challenge gas is measured upstream and downstream of the bank. The ratio of the downstream and upstream concentrations represents the bank leak rate.

V-2000 Prerequisites

Airflow distribution shall be verified in accordance with Appendix III. The injection port shall be qualified to provide uniform air-aerosol mixing in accordance with ASME AG-1 Appendix TA-V.

V-3000 Test Equipment

a. Challenge gas generator.

b. Challenge gas measuring instrument.

c. Flow measuring device.

V-4000 Procedure

a. Connect challenge gas generator to the qualified injection port.

b. Place the challenge gas measuring instrument sample probes upstream and downstream of the bank to be tested. The sample tubing shall be of equal lengths and bore and as short as possible to minimize the measuring instrument response time. The upstream sample probe shall be located in approximately the center of the bank. The downstream sample probe shall be located in a downstream sample manifold or downstream of a mixing source such as a turbulent fan discharge.

c. Start the system and verify stable flow rate and within +/-10% of design flow rate.

d. Measure the upstream and downstream challenge gas background concentration. The pre-injection background levels shall be stable to ensure correct instrument response and shall not interfere with the detector's ability to detect challenge gas leaks less than the maximum allowed by the acceptance criteria.

e. Start the challenge gas injection.

f. Record the upstream and downstream concentrations, as rapidly as instrument response time allows, until sufficient data has been recorded to allow calculation of adsorber bank leak rate. Care must be taken to obtain sufficient readings quickly after injection.

g. Terminate challenge gas injection.

h. Using the upstream and downstream concentration data, calculate the adsorber bank leak rate using the formula below.

$$L = (100) \frac{C_d}{C_u}$$

L = % Leak
C_d = Downstream concentration
C_u = Upstream concentration

APPENDIX A
NON-MANDATORY
MOUNTING FRAME PRESSURE LEAK TEST PROCEDURE

A-1000 General

This optional test is used to identify leaks through seal welds of the HEPA filter or adsorber mounting frames. The presence of these leaks may be evident when conducting the in-place leak tests on the HEPA filter and adsorber banks. A good visual verification per Appendix I, steps I-1600 and I-1700, is usually adequate. This procedure is provided for use when the frame leaks need to be located.

A-1100 Summary of Method

Temporary blanks, with gaskets, are installed in place of the HEPA filters or adsorbers on the mounting frame in the system. The pressure boundary is then secured by blanking off upstream of the mounting frame in the housing or associated ducts. This modified pressure boundary is then pressurized using the techniques outlined in Appendix II and any leaks in the mounting frame welded interface is detected using the techniques in Appendix II, steps II-4400 or II-4500.

A-2000 Prerequisites

Construction, modifications and repairs affecting the test boundary shall be complete and temporary blanks, with gaskets, installed on the gasket side of the mounting frame. The opening of the duct or housing upstream of the mounting frame shall be blanked off to form a modified pressure boundary.

A-3000 Test Equipment

a. Pressurization source (test fan with flow control).

b. Covers to seal test boundaries.

c. Pressure indicating device accurate to +/- 0.1 in. w.g. (0.025 kPa(gage)).

A-4000 Procedure

a. Connect the pressurization source to the duct or housing pressure boundary.

b. Install pressure indicating device so that it will indicate the pressure inside the duct or housing being tested.

c. Close access doors.

d. Start the fan and operate until the pressure is greater than or equal to the maximum operating differential pressure for the filter bank (not to exceed the structural capability pressure for the duct and housing assembly). Maintain pressure for the duration of the inspection.

e. Inspect the mounting frame welds and attachments for leaks using the methods outlined in Appendix II, steps II-4400 or II-4500.

APPENDIX B
NON-MANDATORY
CORRECTIVE ACTION GUIDANCE

Corrective action may consist of replacement, repair, modification, maintenance, or analysis to demonstrate that the equipment will fulfill its design function. A revised set of reference values, as described in Section 4, shall be established after the corrective action has been taken.

Results of a failed test shall not be resolved simply by a successful repetition of the test. A successful repetition of the test shall be preceded by corrective action.

If the cause of the test failure cannot be determined by inspection or analysis, corrective action may consist of re-calibration of test instruments and subsequent re-testing. If it is determined that the test failure is due to an equipment malfunction, instead of difficulties with the test equipment, or test procedure, the equipment shall be declared unavailable for service until the specific cause has been determined and the condition corrected.

APPENDIX C
NON-MANDATORY
CHALLENGE GAS SUBSTITUTE SELECTION CRITERIA

Alternative test agents (challenge gas) may be used to perform In-place testing of adsorbers, as required in Mandatory Appendix V, when their selection is based upon meeting the following characteristics:

1. The test agent gives the same In-place Leak Test results as one of the following: R-11, R-12, R-112, or R-112a.

2. The test agent has similar retention times on activated carbons, at the same concentration levels, as one of the following: R-11, R-12, R-112, or R-112a.

3. The test agent has similar lower detection limit sensitivity and precision in the concentration range of use as one of the following: R-11, R-12, R-112, or R-112a.

4. The test agent exhibits chemical and radiological stability under the test conditions.

5. The test agent causes no degradation of the carbon and its impregnant(s) or of other Nuclear Air Treatment System components under the test conditions.

6. The test agent is listed in the Environmental Protection Agency "Toxic Substance Control Act" (TSCA) inventory for commercial use.

APPENDIX D
NON-MANDATORY
TEST PROGRAM DEVELOPMENT GUIDANCE

D-1000 OVERVIEW:

The scope of the periodic in-service test program for nuclear safety-related air treatment, heating, ventilating, and air conditioning systems should be developed commensurate with the safety significance of the system performance function(s). The overall depth of the performance monitoring effort should be flexible, with various tests being added, modified, or deleted as results and industry experience warrant. This Appendix will attempt to provide the user with guidance in developing a test program which will meet the requirements of the Standard.

D-2000 DEFINITIONS:

The following definitions are applicable to this Appendix:

Analyzed System Configuration: The alignment and condition (on or off) of various components, handswitches, controls, valves, piping, etc., that have been analyzed as being capable of accomplishing a specific system function.

Analyzed System Performance: The predicted performance as determined in the appropriate analysis (safety, system, or component analysis) or the acceptable limit as defined in the Technical Specification Basis. This value is in the conservative direction when related to the design limit, with the difference between the two defining the analysis margin.

Design Basis: "That information which identifies the specific functions to be performed by a structure, system, or component of a facility, and the specific values or range of values chosen for controlling parameters as reference bounds for the design. These values may be (1) restraints derived from generally accepted "state of the art" practices for achieving functional goals, or (2) requirements derived from analysis (based on calculation and/or experiment) of the effects of a postulated accident for which the structure, system, or component must meet its functional goals". (REF: 10CFR50.2)

Parameters: The variables or measurable qualities of a system or component that define acceptable operation or can be restricted to ensure that performance remains within design limits.

System Performance Function: The goal or task which the system is required to accomplish or support.

Examples of System Performance Functions, which might be applicable to nuclear air treatment, heating, ventilating and air conditioning systems include:

I. Provide a habitable environment (temperature, humidity, filtration, ventilation) for facility personnel.
II. Provide an acceptable environment (temperature, humidity, ventilation) to support equipment operability and Environmental Qualification requirements.

III. Prevent the uncontrolled release of airborne radioactivity and limit offsite dose in accordance with 10CFR50 Appendix I, 10CFR20 and 10CFR100.

D-3000 TEST PROGRAM DEVELOPMENT:

The Owner should perform a detailed review of all design basis documentation applicable to each safety-related system. Subsequent to this review, a Test Basis Document should be prepared for each nuclear safety-related air treatment, heating, ventilating, and air conditioning system in the facility to identify the following:

1. System safety-related performance function(s)

2. Analyzed system configuration for each identified performance function.

3. The critical performance parameters which will define acceptable system operation for each performance function.

4. The Parameter design limits. These are the design or analysis limits which govern the system performance and bound the system.

NOTE: The Nuclear Management and Resources Council, Inc (NUMARC) sponsored document "Design Basis Document Guidelines", NUMARC 90-12, October 1990 and USNRC NUREG-1397, "An Assessment of Design Control Practices and Design Reconstitution Programs in the Nuclear Power Industry", February 1991, can provide further detail on methods for determining the various design basis functions.

D-4000 SAMPLE TEST PROGRAM:

Given a sample Control Room Complex Emergency HVAC System, consisting of a fan, ductwork, dampers, chilled water cooling coils, nuclear air filtration unit (electric preheater,prefilter, HEPA filters, Adsorber), controls, etc., the System Test Basis Document might be structured as follows:

A. System Performance Functions:

1. Provide a habitable environment for control room complex personnel in the event of a design basis accident

2. Maintain the control room complex environment to ensure equipment operability.

3. Limit radiological dose to control room complex personnel in accordance with GDC-19 requirements

B. Analyzed System Configuration:

To achieve Performance Functions A1, A2 and A3:

One Essential Air Filtration unit in service, normal ventilation system isolated and an essential chilled water system in service.

C. **Critical Performance Parameters and Parameter Design Limits:**

Performance Function	Performance Parameters	Parameter Design Limit
A1 and A2	Heat Removal:	850,000 Btuh
	* Total System Airflow	30,000 SCFM (min)
	* Air Temperature at coil outlet	60 °F (Max)
	* Chilled Water Flow to coil	114 GPM (Min)
	* Chilled Water Supply Temperature	45 °F (Max)
	* Control Room Ambient Air Temperature	80 °F (Max)
A3	Radiation Protection:	
	* Outside Airflow (pressurization)	400 SCFM (Min)
	* Outside Airflow	900 SCFM (Max)
	* HEPA Filter Bypass Leakage	1% (Max)
	* Adsorber Bypass Leakage	1% (Max)
	* Adsorbent Methyl Iodide Removal Efficiency	99% (Min)
	* Humidity Control At Adsorber	70% (Max)
	* Control Room Complex Pressure	+0.25 in. wg (relative to all adjacent areas)
	* Isolation Damper Leakage	Bubbletight @ 15 in wg
	* Isolation Damper Closure Time	25 seconds (Max)
	* Filter Unit Total Pressure Drop	8.0 in. wg (Max)

Based upon the identified Critical Performance Parameters for the sample Control Room Complex Emergency HVAC System, the following periodic in-service test program would be appropriate:

Test Section	Test Description	Test Applicable to System?	Test Frequency
8.2	FANS	YES	
8.2.2	Visual Inspection (VT)	YES	Q
8.2.3	Pressure Boundary Test		
8.2.3.1	Leak Test (PL)	YES	10Y
8.2.4.1	Mechanical Run Test (F)	YES	Q

8.2.4.2	Flow Rate Test (Qf)	YES	2Y
8.2.4.3	Static Pressure Test (DP)	YES	2Y
8.2.4.4	Rotational Speed Test (N)	YES	2Y
8.2.4.5	Vibration Test (Vb)	YES	Q
8.3	DAMPERS	YES	
8.3.2	Visual Inspection (VT)	YES	2Y
8.3.3.1	Leak Test Damper Seat (PL)	YES	2Y
8.3.4.1	Position Indication Test (F)	YES	2Y
8.3.4.2	Exercise Test (F)	YES	2Y
8.3.4.3	Static Timing Test(F)	YES	Q
8.3.5.1	Flow Control Test (F)	YES	2Y

Test Section	Test Description	Test Applicable to System?	Test Frequency
8.3.5.2	Fire Damper Test (F)	YES	2Y
8.3.5.3	Dynamic Timing Test (F)	YES	2Y
8.3.5.4	Interlock Test (F)	YES	2Y
8.4	DUCT AND HOUSING	YES	
8.4.2	Visual Inspection (VT)	YES	2Y
8.4.3.1	Leak Test (PL)	YES	10Y
8.5	REFRIGERATION EQUIPMENT	NOTE 1	
8.5.2	Visual Inspection (VT)		
8.5.3.1	Leak Test, Refrigerant Piping and Coil (PL)		
8.5.3.2	Leak Test, Hydronic Piping and Coils (PL)		
8.5.4.1	Valve Position Indication (F)		
8.5.4.2	Valve Exercise Test (F)		
8.5.4.3	Valve Timing Test (F)		
8.5.5.1	Flow Control Valve Test (F)		
8.5.5.2	Mechanical Run Test (F)		
8.5.5.3	Performance Test (F)		
8.5.5.4	Vibration Test (Vb)		
8.5.5.5	Rotational Speed Test (N)		
8.6	CONDITIONING EQUIPMENT	NOTE 2	
8.6.2	Visual Inspection (VT)		
8.6.3.1	Leak Test, Hydronic Piping and Coils (PL)		
8.6.4.1	Valve Performance Tests (F)		
8.6.5.1	Hydronic System Flow Balance Verification (Qf)		
8.6.5.2	Flow Control Valve Test (F)		
8.6.5.3	Mechanical Run Test (F)		

8.6.5.4	Performance Test (F)		
8.6.5.5	Rotational Speed Test (N)		
8.6.5.6	Vibration Test (Vb)		
8.6.5.7	Electric Heater Test (AMP)		
8.6.5.8	Hydronic Heating and Cooling Performance Test (F)	YES	2Y
8.7	MOISTURE SEPARATOR, PREFILTER, HEPA FILTER BANK		
8.7.2	Visual Inspection (VT)	YES	2Y
8.7.3.1	Differential Pressure Test (DP)	YES	M
8.7.3.2	In-Place Leak Test (IP)	YES	2Y
8.8	TYPE II and TYPE III ADSORBER BANK		
8.8.2	Visual Inspection (VT)	YES	2Y

Test Section	Test Description	Test Applicable to System?	Test Frequency
8.8.3.1	Differential Pressure Test (DP)	YES	M
8.8.3.2	In-Place Leak Test (IP)	YES	2Y
8.8.3.3	Electric Heater Performance	YES	2Y
8.9	ADSORBENT		
8.9.2	Laboratory Analysis (LAB)	YES	2Y
8.10	INTEGRATED SYSTEM TESTS	NOTE 3	
8.10.1	Fan Integrated System Tests (F)	YES	2Y
8.10.2	Air System Flow Balance Verification (Qf)	YES	2Y
8.10.2	Damper Integrated System Test (F)	YES	2Y
8.10.3	Refrigeration and Conditioning Integrated System Test (F)	NOTE 1	
8.10.4	HEPA Filter and Adsorber Bank Integrated Test (F)	YES	2Y

NOTES:

1. Refrigeration Equipment is scoped and tested with the Essential Chilled Water System.
2. Conditioning Equipment, with the exception of the Control Room Complex Essential Cooling Coil, is scoped and tested with the Essential Chilled Water System.

3. Measurements for Control Room Complex pressure and ambient room temperature are incorporated into 8.10, Integrated System Testing.

DISCUSSION

PEST: I am a member of the ASME Committee on Nuclear and Gas Treatment and serve as vice-chairman of the Subcommittee on Field Test Procedures, and chairman of the Subgroup of the same name. I am employed at the Palo Verde Nuclear Generating Station, operated by Arizona Public Service Co., the nation's largest electrical power producing site. At this session we will be discussing the proposed AG-1 Code, Section TA, Acceptance Testing, and the proposed Standard N511, Periodic In-Service Testings of Nuclear Air Treatment, Heating, Ventilating and Air Conditioning Systems. I plan to give a brief history of the two documents, why they are needed., and familiarize you with the development process. After a brief review of the contents of the documents, I will ask the panel for comments.

In 1971, a group was organized to develop standards for high reliability air cleaning equipment and a performance test. The result was ANSI/ASME N510, published in 1975 and ANSI/ASME N509, published in 1976. These two standards were updated in 1980, again in 1989, and reaffirmed recently. It appears that they will live on for some time as they are now considered international standards.

The scope was expanded to include ancillary components and systems and the development of an equipment code. The first edition of the code, AG-1, was issued in 1986 and reapproved in 1988 and 1994. Section TA has been in preparation for a number of years. Approximately three years ago, draft Section TA covering acceptance and in-service testing was approved by the CONAGT Main Committee but rejected by the Board of Nuclear Codes and Standards with instructions to make Section TA cover acceptance testing, only. CONAGT resolved to provide a separate standard for in-service testing. Section TA, revision 03-06-96, was sent to the Main Committee for letter ballot but was not approved. It is the subcommittee's intent to prepare responses to negative ballots, and submit a redraft to the Main Committee for approval by August 2, 1996. This means that it could be in print by late 1997.

The proposed in-service testing standard, designated N511-19XX, has just completed the first subcommittee ballot and some changes are needed. The subcommittee intends to prepare responses to all comments, review newly-derived issues, and distribute a new draft for subcommittee ballot by approximately August 15. We believe that the information gained from this session will help us prepare a quality document in a short time. N511 is intended for application to systems built according to provisions of the AG-1 code. This is the same relationship as N510 to N509.

As we review these documents together I am going to read certain paragraphs and tell you what is going to be changed. To TA 2000 we will be adding the latest edition of the references. For TA 3500, the second sentence which reads, "Test results are considered acceptable if the component or system is not impaired or degraded to the point that it cannot perform its intended function" will be deleted. The consensus was that the phrase did not give the correct emphasis. To TA 4010, a note will be added that repairs or maintenance procedures that do not affect test acceptance values will not require a retest. For TA 4436, the first sentence will read, "Correct direction of rotation shall be verified for compressor motors." Because it is not wise to start and stop a compressor motor just to see if it is rotating in the correct direction and because some compressor motors are hidden within the system, verification will have to be performed by electrical means. In the second sentence, we will change restart to start. A caution note will be added to TA 4736 to require monitoring air temperature leaving the heater to avoid challenging the fire protection systems and causing automatic actuations. To TA 4740, acceptance criteria, will be added paragraph 4744, Electrical Heater Performance Test Acceptance Criteria. For TA 4940 after the words "flow path" will be added the words, "housing, by-pass ducts, and associated dampers." In

Appendix TA-1, page 41, a sentence will be changed to read, " provisions for access for performing tests and maintenance." These are all the changes to the balloted Section TA document.

The copy of N511 in your hands is about two revisions old. We have had several word smithing sessions. Appendix A will be deleted. In Section 8.10.2, there will be further work on air balance verification. This was brought up this week in our subcommittee meeting. There was a lot of discussion about what you have to do to certify that the system is balanced. Do you do a traverse at the fan or do you have to go back through the branch ducts and the diffusers? Do you perform temperature surveys? We also need to consider test requirements for medium efficiency filters in N511 and the matter of the test designators that were transferred from Section TA. Through this session, we can smooth out the document before it gets to the Main Committee.

Panel Members are Curt Graves, NUCON, International, Paul Burwinkel, Georgia Power, Vince Kluge, Palo Verde Nuclear Generating Station, and Len Leonard, Leonard Designs. Now, we will open the session for discussion.

SCRIPSICK: I am not certain I have reviewed the entire document. There are sections in N509 that pertain to testing HEPA filter systems. An example is the mandatory appendix for qualification of injection and sampling manifolds. Does that topic appear in either of the two documents, or are there still going to be some provisions in N509 for testing?

PEST: The housing group will try to include some information on locations for sample manifolds.

KLUGE: I think that section TA can only address the sections of AG-1 that have been approved. Manifolds are within the housing group, and that section has not been issued. But when it is, it will be addressed.

SCRIPSICK: It seems to me that considerations for sampling downstream should be an essential part, just as aerosol mixing is included in a mandatory appendix.

PEST: As I see it, N509 would continue to contain acceptance criteria for injection points but the in-service document would describe how you test it.

SCRIPSICK: There is a requirement of ±20% for air flow distribution and air/aerosol mixing on the upstream side but not for sampling downstream, I don't see any reason to treat it differently.

GRAVES: This document is still a work in progress, as other code sections are developed this group will take over the testing portion for them. Until a code section is developed that addresses the component that needs to be tested, this group does not produce anything, although they can anticipate. Did I hear you say sampling manifolds are in the housing section?

KOVACH, L: The basic idea is that the qualification requirements for mixing and test manifolds are in the TA section because if you qualify them on the original system, as it was built, it is not expected that they will change in use. TA requires you redo the qualification procedure if you make changes. Therefore, after you qualify the injection and test locations, N511 gives you the surveillance tests that you need thereafter. It is not expected that it would change as long as you maintain the same flow rate and configuration. But if you change the configuration, you would have to do the TA-type acceptance testing.

This will make N511 less free-standing, because it could be applied to systems that are already qualified according to TA.

SCRIPSICK: My point is that TA does not consider the downstream side, once you qualify the downstream sampling location, you do not have to do it again. That is a major modification. I was not involved and do not know the history, but it seems to me that this is a good point to bring in all the considerations of downstream sampling. I do not understand the reason for treating the two differently.

KOVACH, L: TA covers everything relating to sampling locations that was in N509.

SCRIPSICK: But the qualification criteria for downstream sampling are not in TA.

KOVACH, L: I am not sure, I think it may be in there.

SCRIPSICK: Traditionally, it has been in N509.

KOVACH, L: It is not in N511 because it is expected that it will have already been taken care of.

SCRIPSICK: So it should be in TA, but I do not see it in TA. The concentration profile has to be ±5% to qualify a standard probe and the in-service probe or manifold has to be within ±5% of the standard probe.

KOVACH, L: What you have to understand is that there is segmentation now. Some of the things that you saw in N509 may now be in three or four different AG-1 sections. Now, when you build a housing, you will qualify the various injection ports and sampling locations with the housing. That is how it should be done, not after you build the unit. You do not start drilling holes in the housing like Woody Woodpecker to try to find the best location to test.

SCRIPSICK: I think that same logic should apply to the selection of the injection port.

KOVACH, L: You have be careful because the manufacturer of the housing may not construct the whole system, someone else may put in the HEPA filters, *etc*. Therefore, you must have enough flexibility to allow for commercial practice and make sure that you do not put in any code section specifications that belong to another manufacturing or supply step.

WILHELM: What are the results of the tests done up till now? What is the percentage of reactor filters or systems that really failed? Around twenty years ago, a paper was given that showed 15% of filters failed the test. I do not know the current percentage of failed filters. The in-place test is rather complicated and expensive. Is it really necessary, judging from the results you have today?

GRAVES: The point of the in-place test is to verify that after filter change-out or some other event the system still functions properly and there is no leak. In any case, NRC dictates that tests be performed at nuclear power plants. It is not a test of individual filters, it is a system test to make sure there is no bypass leakage or potential contamination path. It is assumed that the filters left the factory in good shape, and that they looked good when they were installed. After they are installed you want to know that the system does not have bypass leakage. I do not have any idea what percentage of filters failed as a result of the performance of these tests.

HAYES: Can you tell me whether section TA or N511 has any test associated with the integrity of a particular building or area boundary, such as a control room, auxiliary building, shield building, annulus reactor building? If they are included, what are the tests?

KLUGE: That would occur under integrated system testing, but currently, there is nothing specific as far as identifying such items as control room pressure envelope testing, or auxiliary building testing. However, in non-mandatory Appendix C, there is guidance on developing your own in-house program. N511 gives the levels of testing required and then you have to adapt it to your own facility, using your own design basis and the critical functions of your system. We identified pressure envelope testing as one of the things that should be addressed.

WEIDLER: I would like to hear some discussion from the panel regarding the benefits of Section TA and N511 versus the requirements of N509 and N510.

LEONARD: As we see it, TA and N511 will perform the same function for AG-1 systems that N510 performs for N509 systems. You have a design document, AG-1, and an acceptance test, TA, and an in-service test, N511.

BURWINKEL: A benefit of the TA section is that it addresses a large number of components of the overall systems in addition to the filter housing, as N510 tended to do just filter housing. There are sections on refrigerating equipment, there are sections on system performance, not just filtration.

PEST: I may add that when you are using N510 and N509 you are usually testing or building a flange-to-flange component, whereas Section TA, being an in-service testing document, encompasses the ancillary and working parts of the entire system, including any systems that may interact with your air conditioning unit. The advantage of N511 over N510 is that it will help when the NRC maintenance rule takes effect. Some people had thought the maintenance rule only applied to highly important systems, but we are finding out that it is not so. N510 is too restrictive, so we see that we have some room to grow with N511.

FIRST: We have heard a lot through the years about the difficulties of applying the latest versions of N510 and AG-1 to existing power plants that have Technical Specifications based on earlier documents; even in some cases predating the establishment of codes and standards. How are we going to adapt these new versions to the older plants? How are we making them user-friendly so that they can bring their testing procedures into the 1996 era from, say, 1976? This is always a matter of great concern to the users of these documents. Has some thought been given to how they will be made more adaptable than prior documents?

BURWINKEL: For years we have hidden behind the excuse that our Tech. Specs. have out-of-date parameters that conflict with the latest standards and codes. A couple of things ought to be done, first, I think it is the utilitys' responsibility to modify their Tech. Specs. so that they are accurate and current. When that is done, the Tech. Specs. are usually brought up to the latest codes and standards. Second, there is an initiative for utilities to adopt improved tech. specs. that coincide with the latest codes and standards.

GRAVES: I think what Dr. First was asking was, how do you use the new documents with old equipment, and what headaches will you run into there? You will always have those headaches. Some of the older equipment that was not designed to N509 requirements, and certainly not to the AG-1 code, is not easily testable in accordance with the latest versions of these documents. Careful thought is required to meet the intent, but there may be cases where you can not meet the letter of the test requirements. Tech. Spec. fixes might be helpful, but we are sometimes just stuck.

SCRIPSICK: One of the reasons I am interested in downstream sampling is that I see the uncertainty in test results from HEPA filter in-place testing as having several components. One is the air/aerosol mixing test requirement, ±20%. Another is air flow uniformity, a third is an error associated with downstream sampling. Combine all those uncertainties and you come up with an overall uncertainty that is related to the test result, what I call testing geometry effects, poor mixing upstream or downstream and non-representative sampling. Instead of looking independently at specific criteria of ±20% for concentration profile, ±20% for air flow across the bank, and criteria for downstream distribution, why not combine them and come up with an estimate of overall uncertainty? For non-standard systems this has the benefit that should you be out of specification for one or two items, or even three, you may be within your performance acceptance limit, by an increment that is related to the uncertainty because of offsetting effects. Instead of having a test result of 0.05% for non-standard systems that determines that the system performance is acceptable, it might be 0.01 or 0.02%. By having that offset, you account for some of the differences relative to the specifications. That is a plug for my paper tomorrow, but I would appreciate any reaction on that kind of an approach.

BURWINKEL: I do not believe that we can look at the errors in the sampling procedure and the errors in the challenge agent, and balance them off. If you do not have good air/aerosol mixing you may very well not be challenging a part of the bed that is not leak-tight. When I am not challenging part of the bed, I am not getting any test agent downstream. Because of that I do not see a ready relationship to not challenging part of the bed and having fewer errors in the sample. I do not really see a relationship between the two.

GRAVES: It is clear that for the test to mean something you have got to challenge the filtration device in question. If you can't do it correctly, you need to do something about how you are testing it. You need to make corrections there.

SCRIPSICK: I agree. One of the things our analysis has brought out is that ±20% for air/aerosol mixing is an extremely important criterion. On the other hand, ±20% for air flow uniformity distribution over the bank does not seem to make much difference in our analysis. I can understand that from the error propagation analysis that we have done. I also understand it from the context that the tests are performed in. When you have a non-uniform air-flow distribution for your test, the challenge is going to be non-uniform so that contributes to the uncertainty of your test result.

GRAVES: Not necessarily. You may have a non-uniform distribution because of where you are injecting.

SCRIPSICK: No, I am referring to the air flow distribution, not the air/aerosol mixing. It is quite likely that when your test aerosol is not completely mixed you are going to have a difference between the test aerosol distribution over the bank and your air distribution over the bank. That is a serious problem. In the algorithm that we have developed, air/aerosol uniformity comes out to be extremely important. When you do a very good job on that you are going a long way in reducing the uncertainty in your test result measurement. But airflow distribution over the bank does not play as important a role.

KOVACH, L: Please remember that we are dealing not only with particulate filters in these systems, but adsorption systems, also. In adsorption systems, ±20% flow does have a significant effect. Remember that these requirements are based on the MPP system tests that are in MPP-type air cleaning systems, most of which do contain adsorption units that are very strongly affected by airflow velocity and the capacity of the total test. If we are applying the requirement solely for the aerosol filtration test, your comment that the air/aerosol mixing is far more important than the airflow velocity uniformity through the HEPA filters is certainly correct. But when we are dealing with adsorption systems, airflow velocity becomes very important also.

PORCO: From what I understand your code sections address qualification testing of equipment. It also addresses initial installation testing of the equipment and in-service testing. Can we have a discussion on what are the differences and how your code sections address those differences?

KLUGE: The individual sections of AG-1 have their own requirements for factory qualification tests for individual components. What we are addressing in TA is the installed system, and the acceptance tests required to verify that it meets design requirements. N511 covers periodic retesting to verify the system continues to meet design requirements . You will find factory testing in the individual sections of the code, not within TA.

PEST: N511 will have surveillance requirements. When you do your TA acceptance testing you establish your baseline test reference values for acceptability. Requirements for a trending program are in N511 so you will be able to balance new test values against those in the past. When you have a degrading trend, you know that corrective actions have to take place. We looked at all the acceptance tests in TA and tried to include them in N511 for periodic reverification.

FRETTHOLD: Will N511 be any more user-friendly than the N510? We are being asked to comply with N510 but we are saying we use it as a guide.

KLUGE: We hope N511 will be more user-friendly. We are including guidance for development of individual test programs, adapted to facility requirements. Because we are looking at a much larger user group than just the nuclear power plants, we could not mandate a hard and fast test program that everyone must follow. It would not be practical, we would have a document that no one could use. So we addressed the types of tests that should be looked at based on the equipment you have in your own facility. And we have added guidance for developing the necessary level of testing. We are very open for further comments that can be incorporated into the document as it goes through the development stage.

WEIDLER: I would like to get to the bottom line, when these documents are issued, how do they help or change the testing program at McGuire Nuclear Station?

KLUGE: I believe that would depend on whether the individual utility changes its commitment to the new documents. It is not mandatory. I believe it would require a change to Tech. Specs. , if the plant is specifically committed to testing in accordance with N509 and N510. Is that what you are asking?

WEIDLER: That is it. Given the current regulatory climate we still have to do the tests in the Tech. Specs. We would be doing additional tests unless we changed the Tech. Specs., which, as everybody knows, is a fairly lengthy and difficult process.

__KLUGE:__ Under the new improved Tech. Specs., the process is easier because the specific surveillance requirements have been taken out of the body of the Tech. Specs. and put under a filter ventilation test program. This would be like a basis document and it is much easier to make changes in that portion than it was in Tech. Specs. If one adopts improved Tech. Specs., it would be much easier to commit to the new documents with your own level of testing.

__GHOST:__ One of the things that I came across while doing a life extension study was a requirement for housing leak testing every ten years. Most of the plants in the US are over ten years old. 324Does it mean that we have to leak test all the housings?

__BURWINKEL:__ Today, a lot of housings are pressure tested once and never again. We felt this was not adequate to assure that the housings were not leaking. At my site, it has been ten years since we have leak tested housings. We have found a few minor problems, not by testing, but by visual inspections. The subcommittee felt that a pressure test on a filter housing at ten-year intervals was not an unreasonable requirement. It would give us greater confidence that our housings were leak-tight.

__GHOST:__ The older plants are not really set up to do housing leak testing. Is there a basis, besides experience, for ten years? Are we looking at a few plants and saying yes, we did testing on so many plants, and ten years is a realistic basis?

__PEST:__ In other words, is it an arbitrary number that we just selected, or was there some mathematical basis?

__BURWINKEL:__ Ten years was arrived at out of the experience of people on the subcommittee and it seems to have been accepted favorably by the people balloting.

__GHOST:__ Is it possible to make it variable, ten to fifteen years, instead of a finite number? This is a suggestion.

__GRAVES:__ You might prepare expansion of what you are saying and give it to this committee to look at. They will address your comment and get back to you.

__GHOST:__ HEPA filters have a finite life, anywhere from five to fifteen years, by test. Invariably, in-place testing has shown that they are acceptable, but structurally they are weak and they can fail. Have we addressed it by requiring a visual inspection program, to say that even at fifteen years we need to do something prior to testing?

__PEST:__ That would come under the HEPA filter section and filter qualification. If you are performing a visual inspection prior to doing a leak test and notice that the filters have been there for ten years and the glass media appears to be cracking at the base of the units because of high humidity you would want to replace them.

__GHOST:__ That calls for an inspection on a frequency basis?

__PEST:__ Yes, but I do not think we have anything right now that says that after testing a hundred HEPA filters we found that after five years they need to be changed even though the gasket is seal and the media is fine. One of the other committees is looking at HEPA filter aging, and something should coming out about it.

GHOST: Will it be addressed in the TA section?

PEST: It would be addressed in AG-1, I believe.

KOVACH, L: I was involved in coming up with the ten year interval and the way we came up with it was that the proposal was between nine and eleven. So we hired a few statisticians and came up with a reasonable average, that is how we got to ten years. It took several years to resolve and it delayed issuance of the code for some time, but finally we were assured that ten years is reasonable. The reason for retesting housings is not because the structure itself fails, but because of door gaskets and flexible connections deteriorating. Not too long ago I had a chance to walk by a relatively new system. The housing was also used as an air organ, in various places, air was being sucked in at the doors and it was whistling different tunes. The requirement is real. Whether ten years is too long or too short, is certainly subject to question. It relates to how and how often you perform your visual inspections. I have seen systems where the latches float, instead of locking the door; they just hang in the gravity-dictated position rather than in a locked position. It is a question of how to care for the little failures; you do not have to go in for a general repair as often. Certainly 10 years is arbitrary, most requirements are arbitrary, but I believe it is quite reasonable. If anything it may be worthwhile to reduce it. If some old systems do not meet the test requirement, these old systems do not meet their purpose, either. I mean, if they are leaking air, how can we be assured that they are meeting their requirements? Let me comment also on the second question. I do not think that visual inspection alone can tell you that HEPA filters have aged to the point that structurally they may not be able to meet expected pressure, droplet, and thermal challenges. The F sections have to come up with an estimated life for a retest of media strength, etc. I think it is a weak point of the code, at the present time, and it is a weak point of a lot of HEPA filter installations, all over the world, because people assume that as long as the filter passes an in-place test it will perform its intended function in case of an accident challenge.

PORCO: I would like to comment also on the housing leakage issue, and the HEPA filter life issue. AG-1 has a requirement for environmental qualification of safety systems, and that qualification also includes environmental maintenance requirements. For instance, if you are looking at door gaskets when addressing the life of housings, you need to determine the useful environmental life of that component. Using a data base and the Ardenius equation, the gasket life can be predicted. Also, there are requirements on environmental qualification of the HEPA filters that should be addressed. The environmental conditions are going to change for each application. You must address high temperature, you must address all your environmental conditions, address all your materials, and make sure that either the materials last the life of the plant, normal maintenance life, or an environmental maintenance change-out must be established. That is in the standards now. There was environmental qualification on older plants, but possibly the environmental maintenance cycle did not get into the normal plant cycle. I am not sure, but I think that might be where you come up with the ten years. But if you are following your environmental qualification reports, you should be replacing gaskets and other materials before they wear out.

SCRIPSICK: I think the remarks about age are very important. The in-place test, as we perform it, is a snapshot. It tells you what the system is doing that day under normal conditions. It does not provide any information on how the system is going to perform when it is stressed or how it might perform under normal conditions the next day. I see two opportunities to help get some idea of the capability of the components under normal and off-normal conditions. One, is to take some of the filters we have in service now, knowing their exposure histories and their service life histories, and put them back through the qualification test to see how much their performance has degraded compared to the requirements of the design qualification. That is, when you subject them to a heated air test, do they degrade more than three percent or how much is performance changed when you take them up to ten inches of differential pressure. Another opportunity is for careful interpretation of results and, maybe, modification of the tests we are doing. Bergman is going to give a paper tomorrow about the efficiency of filters in-place. I think careful examination of tests like these can provide information about the remaining structural strength of HEPA filter units. As a future development, I think we should look in that direction to garner as much information as we can from the in-place test. One end-point is to try to determine whether the bank we are testing can withstand off-normal conditions.

BATTERSBY: I have a question about retesting existing duct work that has been in service ten years or so. If you do the recommended pressure test would you be in danger of spreading contamination through any leaks that may exist from duct work up stream of the filter bank? Perhaps the retest should be done under negative pressure, rather than positive.

LEONARD: Normally, leak tests are performed on a system in the pressure mode in which they operate, a negative pressure system would be subjected to negative pressure tests. Positive pressure systems (I can't think of any that operate that way) would be the only ones that would be tested under positive pressure. It would require a careful survey by the radiation control people and the whole HVAC engineering group to verify that it would not spread contamination. One thing that the committee looked at, and the basis, I think, for the ten year test interval, was the experience of people on the committee looking at systems in the plants that have been in operation for five, ten, fifteen years. When you look at a system after five years, it does not take a rocket scientist to determine that it is not in the same condition that it was when it was installed and tested.

BERGMAN: I want to add to some comments that Ron Scripsick made about aging. Last conference, John Fretthold, Humphrey Gilbert, and I presented a paper on aging effects of HEPA filters. We searched manufacturers and facilities around the US and attempted to do an aging study. We found that, after ten years, a filter has about half the strength it had initially and it has no water repellency left, things of that nature. We found from some manufacturers basically brand new filters that had strengths that were a fraction of some of the filters that were over ten years old. Through a laboratory analysis we found out there was insufficient binder in the medium to hold the fibers together, and that these filters were practically falling apart. Instead of worrying about setting age limits, let's take a real hard look at the test standards we have. I would like to put in a plug in for Dr. Ricketts' paper, later on this week, about qualification tests. I am not an expert on QA, but to me any QA system that is based on a manufacturer hand picking the best filters to bring them to a qualification test every five years, with no checks in between, is insanity. To expect any reliability under this kind of procedure is nuts. All you have to do is refer to our paper from the last Air Cleaning Conference to see the insanity of the present qualification program.

PEST: The rest of this panel session will be on testing air and gas treatment systems. We have the floor open for questions to the panel on any of the topics of the N511 in-service testing document, and Section TA on acceptance testing, from the AG-1 Code.

How much benefit do you think a utility or a nuclear facility owner would get by moving to AG-1 and N511 as opposed to remaining with N509 and N510? I am trying to learn if there is any benefit as far as clarity goes, because regulatory officials rely on the Regulatory Guide 1.52 that cites ANSI N510-1975 and N509-1976. Since 1976 there have been many changes, yet the Regulatory Guide fails to reflect them. Do you think that moving to N511 will cause the NRC to re-evaluate their position?

__GRAVES:__ For a utility to move to any of these documents from N509 and N510 involves technical, political, and financial considerations. A lot of the N509 built equipment is already difficult to test by N510 methods and it might be that a more particular TA or N511 would cause more problems and people might resist changing. I think TA and N511 will be more particular and more helpful, but there will be less margin, less wiggle room, about what should or shouldn't be done. If the equipment is marginal, these documents are not going to be well received. But they ought to be evaluated as best for equipment. It is going to end up being a political and economic question, I think. We encourage everyone to look at these documents, because they are going to be a lot more helpful and there will be less chance to miss something important in testing and operability of equipment.

__LEONARD:__ I think that they would be better off because they would have a better integrated package than they now have with N509 and N510. I think the package is tied together better. As Curt pointed out, they supplement one another better than N509 and N510 do now.

__PEST:__ Does the panel think that N511 may, in the future, be expanded with an appendix to address the testing of portable filtration systems? I would like to get some guidance because there is not very much available on portable HEPA filters. Do you think some clarification should be made in N511?

__KLUGE:__ N511 is currently set up just to look at permanently installed systems that are designed according to AG-1 requirements. It would be possible to have a non-mandatory appendix that gives guidance on testing such systems. I do not know how much demand there would be for it, or if it would be better to put out some other kind of guidance document specifically addressing those types of systems.

__GRAVES:__ In the absence of a well-designed fabrication document for that equipment, folks could probably use some guidance. Hard and fast testing requirements are not going to help the manufacturers of portables and vacuum cleaners because there is such a variety of equipment out there. Some suggestions might be in order, but hard and fast rules are going to be a problem for them.

__KRANZ:__ I am going to change gears here and start talking about adsorber testing, in-place leak testing. As of January 1, 1997 Freon will not be allowed into our facility. My question to the panel and the audience is, what challenge gases are people using now? What challenge gases are people looking to use? I did not notice in N511 specific challenge gases mentioned. Did I miss it?

__PEST:__ I believe it is in there.

__KLUGE:__ There is an appendix in both TA and N511 which spells out the critical characteristics that have to be met for an alternative challenge agent. But no specific agents are mentioned by name in those documents.

__KRANZ:__ What are people using or looking at using? We are between a rock and a hard place if our facilities are not going to allow us R11 in 1997. The bottom line is, if we use a different challenge gas, will the tests be accepted by the NRC?

GRAVES: Some people are using HCFC123. At the last Air Cleaning Conference, Bela Kovach, of our organization, gave a paper on it. Some are using a compound called 1-Bromo butane. I do not know if it will be widely accepted in the nuclear business, but HCFC123 looks like a good candidate that meets the list of criteria in appendix TA-C. It is always risky to speak for the NRC (there are representatives here who can do that) but my understanding is that when the industry standards people recognize a compound, it is acceptable as far as the NRC is concerned. When N510 is the required, or appropriate, standard, whatever N510 says is okay with the NRC.

LEONARD: The appendix that is in TA and N511 was the basis for a code question response on N510. So it is applicable to N510, also.

HAYES: The guide for any facility is their technical specifications. If you have a problem you need to request a Tech. Spec. change and give the basis for the change. As many of you know, we had a problem with verbatim compliance with the test methods for laboratory testing of charcoal. So it is imperative that we determine what your technical specifications say. If they require you to test a particular way and there is no flexibility, then you need a technical specification change.

FIRST: Further to this same discussion, I am a member of the committee and urged that certain compounds be named as those that have been found acceptable, without indicating that they are the only ones that could be used. Certainly, the criteria that have been published clearly define the characteristics. But few people are able to make this judgement on their own or have the facilities to do so. It seems to me that the standard should provide some guidance in terms of acceptable compounds as examples of what will work. I hope that change can be made, because I, among others, get calls from people wanting to know what is a representative compound that they can use. I do not see why we make a mystery out of it. I want to ask the panel a question. We hear a great deal about international standards and how the international standards organization operates. Having documents approved as international standards is often discussed by code and standard writing committees. Variations of our codes and standards have been adopted by other countries. How can we go about making U.S. standards international standards? And is this highly desirable?

WEIDLER: It is my understanding from ASME that if it can be shown that our standard is being used in countries other than the United States, they are designated international standards. ASME itself is now called ASME International and their boiler code is used in countries other than the US.

PORCO: The code section you have prepared addresses primarily systems for commercial nuclear power plants. Did you take into consideration other systems used at DOE sites and military installations, and can they be easily adapted for those systems?

LEONARD: Insofar as we had input from those sites, we did try to make the document broad enough to cover them. We have representation from DOE on the testing subgroup and subcommittee. We hope we have managed it.

PEST: Yes, we do try to make the code and standard all-inclusive and not be tied down to a specific function.

SCRIPSICK: I have just tracked the history of these standards for my office. The '75, '76 and '80 versions of N509 and N510 were for "nuclear facilities." There was a change in '89, they were now for "nuclear power facilities." This was a change in scope. Now, I am not certain what AG-1 says. It looks like it has been broadened to include all nuclear facilities.

PEST: That is true. There has been some switching around of names, and we try to emphasize that the documents can go across barriers. It might even work out that they can be used in the general commercial area, not just nuclear facilities.

KLUGE: I would like to add that the current scope statement for both Section TA and N511 refers to nuclear facilities, and not specifically to nuclear power facilities.

SCRIPSICK: The speaker was very careful to point out that TA is a code and N511 is a standard. The difference is that one is for acceptance testing, and the other for in-service testing. Why is in-service testing a standard? Is a standard a lesser requirement than a code, or a law? Why was the distinction made?

PEST: When we took all the in-service testing material out of Section TA, and began composing N511, the first thing that we did was to change all the "shall"s that we could, and make them "should"s since a standard is better cast in a more generic overview of what is going on. However, you have to remember that it is the facility's design basis that really dictates what you have to do in the testing. Technical Specifications are spelled out.

KLUGE: The original draft of Section TA addressed both acceptance testing and in-service testing. However when that got up to the level of the BNCS we had to separate acceptance testing from surveillance testing. I do not know what was involved behind it, but that is where the split took place.

GRAVES: Part of the requirement was to make the documents more user-friendly. A document covering both was very confusing. This makes it much simpler.

PEST: I do not know whether I agree. I think Section TA could have handled both rather than make a whole new document. But I am glad that we didn't have to undertake a massive reconstruction of N510.

WEIDLER: One of the driving forces behind the Board's decision to split TA into two documents is that in-service testing is in one section of the code and acceptance testing is in another. In order to follow the format guidelines that ASME has adopted for the overall code, we had to split the TA draft into two different documents.

GHOSH: In the last sentence of section 8.10 in N511 it says that the integrated system test should be once every two years. Under the sub-heading you have air system flow balance verification tests. Is it implied that the flow balance is being tested every two years?

KLUGE: We have had some heated discussions at the committee level on that particular subject. The document will not require a full-blown air balance, such as would be done at start-up. Guidance will be developed that will allow the user to verify system balance by looking at the end functions. For example, if temperature is the critical function, temperature surveys will serve to verify a balanced condition. If pressure is the critical function, non-ducted airflow testing could be utilized. Guidance will be provided, and there will not be a requirement for a full re-balancing of the system.

GHOSH: Will that section be expanded?

KLUGE: That section will be revised, and there will probably be a non-mandatory appendix that will give detailed guidance.

DEVENA: Section 8.6 of N511 covers hydraulics. This is in somewhat the same light as the previous question, are we looking at a complete flow balance of the water systems? To what depth do we go with that? Originally, the whole system was aligned and balanced in the emergency flow mode, quite exhausting and quite extensive. I am not sure that you could come up with the same type of conditions by looking at individual components within the water system. If this is going to be a requirement, I think it goes far beyond just a component that will be looking at water balance. It is like a whole ESW system. You change the flow one place and you might not be able to get it at the other place unless it is lined up like it normally is for the emergency flow condition.

KLUGE: I think we will need additional guidance on the level of hydraulic balance within the document. The bottom line is, can you meet your design basis for heat rejection? If you are never doing any kind of verification of what your flows are, there has to be some kind of test data you can look at to see if you can meet your design basis. Also in Table 8-5, there is a two-year requirement for a cooling coil performance test. I believe the two years came from a recommendation by the maintenance rule that everything seems to go on a twenty-four month cycle. The maintenance rule that became law on the 9th of July will directly affect this type of testing. That is where the twenty-four month recommendation came from.

KRANZ: Did you say N509 and N510 are going to be reissued?

PEST: They have been reaffirmed.

PORCO: ASME N510 has been reaffirmed. When you receive your copy from ASME it will have the reaffirmation sticker. N509 has not been formally issued as reaffirmed, but it will be shortly.

SCRIPSICK: What is the distinction in TA and N511 about test requirements being observed or measured? What is the distinction? Maybe it is defined in sections of AG-1. Why is the acceptance test for HEPA filters a measurement requirement, whereas the in-service test is an observation requirement with a two-year period?

KLUGE: You made a good catch, that is a measured requirement.

SCRIPSICK: So there is a mistake in Table 8-6?

KLUGE: Yes.

SCRIPSICK: What is the distinction between measured and observed? I do not understand how they contrast.

<u>**KLUGE:**</u> The distinction between observed and measured is that a visual inspection is observed whereas anything that has a definite acceptance value would be a measured test.

<u>**GHOST:**</u> Previously, the requirement for personnel qualification was to be certified according to ANSI 45.2. Now you have NQA-1 and ANS standard 93.1. Is there a reason for not including 45.2?

<u>**KLUGE:**</u> The qualification criteria in this section came directly from section AA of the AG-1 code.

<u>**PEST:**</u> ANSI 45.2 is an old document, I am not sure it is still valid.

<u>**KLUGE:**</u> The specific wording is from Section AA 7220 regarding personnel qualifications. It states that all personnel performing on-site inspections and testing of AG-1 equipment shall be qualified in accordance with ANSI-ASME NQA1-1, supplements 2S-1 and 2S-2. So we just brought down the personnel qualification requirements from the code.

<u>**PEST:**</u> Is NQA-1 as stringent as N45.2?

<u>**GRAVES:**</u> I think they are about the same.

<u>**ORZECHOWSKI:**</u> Your scope is changed to include all nuclear facilities. What is your definition of nuclear facilities?

<u>**GRAVES:**</u> I think we mean any place that has fissionable material. We define nuclear facility as any facility that operates under radiological conditions. I imagine that would encompass just about all facilities that are licensed. We mean this for nuclear power plants, plutonium facilities, waste handling facilities, or any facility like that has air cleaning equipment, or the need for air cleaning equipment. We hope the standard will address the kinds of needs they all have. I do not know what guidance BNCS or ASME gave on this, so we may have weasel-worded it a little bit by using the term nuclear facility.

<u>**ORZECHOWSKI:**</u> I am working at the Nordion facility where we produce radio isotopes using an accelerator. Are we a nuclear facility? What do we base this on, how can we define ourselves? Going even further, I can ask whether nuclear medicine departments in hospitals are nuclear facilities. Now you are shifting from a very specific application to power plants to all nuclear facilities. There has to be some definition of what is covered. I do not know that such a definition exists. If you rely on the issuance of a license, hospitals have a license, but are they nuclear facilities? I do not know.

<u>**GRAVES:**</u> That is a good point. You could say, yes, they are, because they are regulated by NRC and follow other requirements. They would be welcome to use this document. It might not do them much good because they may be covered elsewhere. The regulating bodies may dictate to them something that precludes their use of the AG-1 code. But there is no reason why, for any given application, the AG-1 code could not be used. There is nothing to rule it out as applicable to that kind of facility. If there is a chance of airborne contamination, this code would apply, or it could apply.

<u>**PYLE:**</u> What is the intention for the air/aerosol mixing test procedure when you have a small facility where you might have a single HEPA filter as a HEPA filter bank? Would it be applied to a single

GRAVES: I am on the ventilation air cleaning committee, and may disagree with others. I think there should be some evaluation of air/aerosol uniformity, even for a single HEPA filter. That is an opinion that may not reflect what the TA group would say.

LEONARD: In a change from N510, where single HEPA filter systems are exempt, the exemption has been taken away in TA and N511.

PYLE: Therefore, you are saying it would apply?

PEST: You would have to make an air/aerosol mixing uniformity test for a single HEPA filter. Due to system configuration, the distribution may not be uniform and that would necessitate performing the test.

PYLE: Self-contained units would probably fail this test. Is this correct?

LEONARD: Yes, they almost surely will fail.

ANON: There is action in the committees to designate another category for this type of filter. And removing the exemption in N510 makes it necessary to address this issue. I think we are going to let the filter committee see if it warrants bringing out a new classification of filters.

SCRIPSICK: I agree with Curt Graves that there should be testing requirements for acceptance of single-filter systems. Some are being accepted by exemption because the procedures for air/aerosol mixing and for air flow distribution for filter banks at the center of each filter requires a measurement . Therefore, when you have only one filter you just take one measurement, even though that procedure does not apply. If we eliminate the single-filter exemption, we will have to make allowances in the procedure. I propose that we look at it.

BURWINKEL: Currently TA has a requirement for a minimum of nine readings, with the exemption for testing a single filter removed. It would require you to take nine readings in front of a single filter.

LEONARD: That is in mandatory Appendix 4, Section 4-4000.

DEVENA: Prior in-service testing documents contain a distinction between air cleaning equipment totally contained inside a containment, where it does not exhaust to the atmosphere. Does this new document allow the same exemption for filtration systems inside containment?

PEST: You mean, exempt from in-place testing?

DEVENA: Yes.

GRAVES: Are you talking about a Tech. Spec. issue? If your Tech. Spec. does not require it, you do not need to do it. These documents are not intended to supersede your Tech. Specs., just help to test, design, and manufacture equipment. If you are not required in your Tech. Spec. to test them, you could still use this document, but you might use it in a somewhat different way, and you might establish acceptance criteria that would be a little bit different.

DEVENA: Our Tech. Specs. presently reference R.G.1.52, which references the two ANSI standards where you get the exemption on units that are totally enclosed inside the containment. It is not specifically the Tech. Spec. that addresses it, it refers to it by reference. The same exemption is not referenced in the new documents.

BURWINKEL: If your system is entirely inside a containment, is it safety related?

DEVENA: No.

BURWINKEL: These documents refer to safety-related systems. Because we did not find any examples where there was a safety-related system fully contained inside containment, we did not see any reason to carry that provision forward.

KLUGE: In Table 8-7, in the current version of N511, there is the caveat that in-place leak tests are not required for systems used for 100% re-circulation. An example is a reactor containment clean-up system. That is why the exemption is in N511.

GRAVES: N511 is directed to once-through types of equipment.

KLUGE: I would like to encourage everyone to take home the copy of the N511 document, read it over, and provide us with feedback so we can make it an industry-useful document.

GRAVES: Does TA go back to the Main Committee after addressing negatives?

PEST: Yes. Section TA will be ready to go to the Main Committee by August 2. We are looking to October to get the results. If the Main Committee approves, it will go to the BNCS. I do not know how long the BNCS usually takes to make a decision. Last time it was pretty fast.

This Panel Session was an opportunity for our Committee to let you have a look at these documents. We got some very interesting comments and questions which we appreciate. We are looking for your support and contributions to make these documents user-friendly and to provide the help you and your neighbors need.