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ASME N510, ASME N511 In-Service Testing Intervals Code Interpretation of Ventilation Structures, Systems, and Components

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Abbreviations and Acronyms

ACGIH®	American Conference of Government Industrial Hygienists
ALARA	as low as reasonably achievable
ALARACT	as low as reasonably achievable control technology
ANSI®	American National Standards Institute, Inc.
ASHRAE®	American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.
ASME®	American Society of Mechanical Engineer
BMP	best management practice
CAM	continuous air monitor
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DST	double-shell tank
FTF	Filter Test Facility
GDC	General Design Criterion
HEPA	high-efficiency particulate air
NRC	U.S. Nuclear Regulatory Commission
PM	preventive maintenance
PMID	Preventive Maintenance Identification
RCW	*Revised Code of Washington*
SSC	structure, system, and component
SST	single-shell tank
TOC	Tank Operations Contractor
TSR	technical safety requirement
WAC	*Washington Administrative Code*
WDOH	Washington State Department of Health

Units

in.	inch
mrem	millirem
w.g.	water gauge

List of Trademarks

ACGIH	Registered trademark of American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.
ANSI	Registered trademark of the American National Standards Institute, Inc., New York, New York.
ASHRAE	Registered trademark of the American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc., Atlanta, Georgia.
ASME	Registered trademark of the American Society of Mechanical Engineers, New York, New York.

1.0 INTRODUCTION

The Tank Operations Contractor (TOC) is in the process of establishing the basis for Preventive Maintenance (PM) requirements for structures, systems, and components (SSCs) including those for high-efficiency particulate air (HEPA) filter aerosol challenge (leak) testing to comply with the applicable codes and standards, governing industry best management and operating practices. These leak tests are currently set to a frequency of annual based on the environmental requirements in RPP-16922, *Environmental Specification Requirements*. There is concern that HEPA filter leak tests are being performed more frequently than required, as the annual frequency is not an identified requirement for all such units in the American Society of Mechanical Engineers (ASME) standards applicable to the TOC facilities.

1.1 SUMMARY

This document provides a clarification of the applicability of ASME N511-2017, *In-Service Testing of Nuclear Air Treatment, Heating, Ventilating, and Air-Conditioning Systems*, for compliance with the requirements stated in RPP-16922 regarding PM intervals for the ventilation SSCs. TOC ventilation systems are associated with nonreactor facilities and therefore developing testing frequencies for the ventilation system SSCs are not required per ASME N510-2007, *Testing of Nuclear Air-Treatment Systems*, Table 1, "Tests and Inspections with Recommended Frequencies," and subsequently in ASME N511-2017. ASME N510-2007 states that such SSC testing intervals may be used for guidance for test frequencies of nonreactor facilities. The TOC facility modes of operation, and operational experiences provide the basis for establishing future in-service frequency per the TOC specifications, test programs, system performance evaluations with respect to the system classification, and functional requirements specification rather than verbatim compliance with ASME N511-2017. Hence, TFC-ENG-STD-07, "Ventilation System Design Standard" will be revised to provide additional guidance for SSCs PM intervals. This basis will be used for assessing the regulatory compliance requirements while minimizing worker's facility entries to perform unnecessary PM.

This document supports that the frequency of in-service leak testing for ventilation system regulated HEPA filters be extended to a biennial (every two years) PM frequency. This revised requirement will apply to powered or active HEPA ventilation systems at TOC facilities on the Hanford Site, as identified in RPP-16922 pending approval of emission units in Washington State Department of Health (WDOH) permit application. Abnormalities (e.g., wetting, filter bypass), observed during monitoring will continue to be addressed and, if necessary, will alert facility operations and engineering to replace and test the filters. The current annual testing requirements will be changed to biennial (every two years) in a revision to the *Tank Operations Contractor High-Efficiency Particulate Air (HEPA) Filter Management Plan* (RPP-RPT-54544).

In addition, in-service aerosol leak test intervals for HEPA filters not identified in RPP-16922 and the WDOH emission units permit application (e.g., best management practice [BMP]), will be changed to task on demand after initial installation and testing in accordance with ASME AG-1, *Code on Nuclear Air and Gas Treatment*, and ASME N511-2017 leak test requirements. Such filters will not be required to comply with the ASME N511-2017 testing

PM intervals and will rely on the monitoring parameters identified in Section 3.5.2 of this document.

1.2 PURPOSE

This document provides ASME N510-2007 and ASME N511-2017 code interpretations for establishing in-service testing intervals of ventilation SSCs particularly HEPA filter aerosol challenge (leak) testing for TOC ventilation systems credited in the permit application and RPP-16922.

1.3 SCOPE

This document provides the ASME N510-2007 and ASME N511-2017 code interpretations and justification for departure from established set testing intervals previously used for TOC facility ventilation systems (e.g., annual HEPA filter aerosol challenge [leak] testing for the powered primary ventilation systems including double-shell tanks [DSTs], single-shell tanks [SSTs], 222-S Laboratories, Effluent Treatment Facility, and 242-A Evaporator Facility, as identified in RPP-16922, Section 2.3.4, "High-Efficiency Particulate Air Filters"), instrumentation, etc.

1.4 IMPLEMENTATION

This document will be used as a basis for revising the ventilation system PM procedures that are in accordance with requirements specified in RPP-16922 (Section 2.3.4) and associated facility specific PMIDs. Initial implementation of this assessment will be phased in over a period of time and after RPP-16922 is revised. Subsequently, implementing preventive maintenance procedures will be revised for future planning and scheduling of the TOC HEPA filter management plan (RPP-RPT-54544).

The TOC Contract, DE-AC27-08RV14800, contains a list of DOE directives, regulations, policies, and standards in Table J.2.8, "Directives, Regulations, Policies, and Standards." In Table J.2.8, DOE O 420.1C, *Facility Safety,* is the applicable document listed for the facility safety. Section 4.b of DOE O 420.1C states:

> *"…All new construction, as a minimum, must comply with national consensus industry standards and the model building codes applicable for the state or region, supplemented in a graded manner with additional safety requirements for the associated hazards in the facility that are not addressed by the codes."*

The TOC complies with the "Washington Clean Air Act" (*Revised Code of Washington* [RCW] 70.94), requirements stated in *Washington Administrative Code* (WAC) 246-247, "Radiation Protection – Air Emissions." The code states that the applicant (operator) will evaluate all available technologies that can reduce levels of radionuclide emissions to the environment. The emission unit design and construction must meet the technology standards if the potential to emit exceeds 0.1-mrem/yr total effective dose to the maximum exposed individual per WAC 246-247-120, "Appendix B–BARCT Compliance Demonstration."

2.0 DEFINITIONS

Age of Filters – The age of the HEPA filters is established from the date of manufacture or the date stamped or marked on the filter. Should the date of manufacture be indeterminate, the date of the original certification at a DOE Filter Test Facility shall be substituted for the date of manufactured.

Asset Monitoring System – An automated system that monitors critical alarms from the various TOC facilities and provides recording and data logging of the instrument reported values and alarm indications. Tank Farm Monitoring and Control System Asset Monitoring Program is described in RPP-PLAN-60864, *Tank Farm Asset Monitoring Program*.

Best Management Practice (BMP) Filters – Filters whose performances are not derived from the regulations, are not identified or categorized in the facility permit applications and are, therefore, included as recommended practices, not as requirements. BMP filters include TOC facilities, but not limited to 222-S Laboratory hood, safety shower, and TOC annulus and primary ventilation system filters.

Ventilation System – Normal operation of a filter is defined as any operating condition or installation where the air relative humidity at the filter is maintained below 70%.

In-Place Test – A test to perform when an item is being placed in the system for the first time.

In-Service Test – A test to determine the operational readiness of a component or system.

In-Service Tests Intervals – In-service tests shall be conducted at intervals not to exceed those specified in ASME N511-2017 (Section 5) or the owner's test program, whichever is most limiting. In-service test intervals are the minimum intervals allowed by the ASME N511-2017 standard for safety-related systems and should not be used as default intervals in the absence of system-specific evaluations. Specific system test intervals should be determined on the basis of system design use as defined by ASME N511-2017 (Section 3.3.4) and RPP-11413, *Ventilation System In-Service Requirements*.

ASME N510 Operating Cycle – A period of time, defined by the owner, not to exceed 24 months (as defined by ASME N510-2007).

Note: Historically based on Reactor refueling cycles.

Operating Mode/Cycle – Tank farm operating mode is being defined for the first time for consistency with the HEPA filter management requirements. The tank farm operating mode depends on the facility mission and operational demands as follows:

- <u>Normal Active Ventilation</u>. Normal operating mode/cycle of a powered ventilation system to support day-to-day safe operations. There is no specific duration for the operating mode associated with maintaining the DST and SST ventilations. This operating mode requires normal monitoring of the HEPA filter pressure and temperature during day-to-day operations.

- Waste Transfer Activities. This operating mode/cycle does not have a defined duration and depends on the volume associated with waste transferred. The HEPA filters (including prefilter and first stage) differential pressure will increase due to the entrained particulates and amount of aerosol removed from the tank headspace(s). This operating mode requires close monitoring of the prefilter and first-stage HEPA filter differential pressure because this affects the operating life, age of filter, by 10 years.

- Mixer Pump Operation. This is a planned future operation mode/cycle for mixing tank waste contents prior to transferring waste to the Waste Treatment Plant. Prefilters and HEPA filters are expected to be replaced more frequently.

Note: Operating requirement technical basis for the ventilation systems (i.e., pressure, temperature, in-place leak test, and monitoring requirements and frequency) are identified in RPP-11413.

Passive Ventilations Systems – Ventilation systems (typically on SSTs) that are non-powered and operate on "passive" only breathing due to changes in pressure gradient (caused by barometric pressure changes) across the filter creating flow.

Shelf Life – The time from when the HEPA filter is manufactured or date stamped by the manufacturer until it is placed into service.

Operating Life – The time from when a HEPA filter is placed in service until it is removed from service. The time count begins as soon as a filter is placed in the filter housing regardless of whether it is operating or in standby operating mode. Factors such as humidity, differential pressure, and radiation dose will affect the operating life.

Service/Total Life – HEPA filter service/total life is defined as the time from the manufacturer date stamped or marked to the time at which the filter is removed from service. The term "service/total life" will only be used during the initial scheduling of HEPA change out. Subsequent HEPA change-out frequencies will use operating life as a basis.

Wet Ventilation System – Potential wet operation of a filter is defined as any filter operating condition or service installation where a filter may be exposed to liquid water or to high air humidity, as specified below:

- Direct spray of nozzle-generated water droplets, at any temperature, and of any time duration.

- Airborne droplets of condensed water (fog) at any temperature, and of any time duration.

- Moist air flow at a relative humidity greater than 70%.

- Gravity-driven surface water in the form of seepage or flood, that originates from any source.

Note: Wetting of HEPA filters is not expected to occur in any of the powered or active TOC ventilation HEPA filtration systems due to installed design features, such as demisters, heaters, and prefilters upstream of the HEPA filter banks.

3.0 HIGH-EFFICIENCY PARTICULATE AIR FILTER TESTING REQUIREMENTS

The following subsections provide an overview of typical TOC HEPA filter systems, a list of codes and standards requirements applicable to these systems, provide the basis and justification for those regulations, industrial codes and standards, and BMPs that apply to ventilation systems.

3.1 OVERVIEW

Typical HEPA filter systems are provided on the subject ventilation exhaust systems to prevent emission of radioactive or hazardous particulate material to the environment. The DST and SST powered ventilation exhaust systems have two stages of HEPA filters installed in series within a filter “train” or housing, thereby providing redundant protection against unfiltered release should there be a single-stage failure. The purpose of multi-stage HEPA filter series is to increase the reliability of the system by providing back-up filtration in the event of damage, deterioration, or failure of a single-filtration stage. A HEPA filter stage may consist of either one single filter or a bank of multiple filters in parallel, depending on the particular system design.

Based on the past ventilation operating parameters, the TOC has defined the HEPA filter operating cycle as periodicity for HEPA filter service life of 10 years or when the monitoring parameters are detected by either the pressure differential transmitters or continuous air monitor (CAM) alarms displayed on the Tank Farm Monitoring and Control System (see Figure 1).

On all DST Ventilation Tank Primary Systems, parallel HEPA filter trains exist, providing the capability to direct the exhaust air stream through either train. These configurations allow for continued operation of the ventilation exhaust system during testing, maintenance, or filter replacement activities.

Continuous Exhaust Stack Radiation Monitoring Systems are configured prior to the emission point to detect filter break through releases. The Exhaust Stack Radiation Monitoring Systems may include both a CAM and a proportional record sampler. The record sampler collects a composite sample to provide emission data for reporting and confirmatory purposes. The CAMs monitor the activity of the particulate matter in the emission air stream by continuously withdrawing a sample through probes mounted in the stack or duct. Interlocks automatically shut down the exhaust fan when radiation is detected at an established alarm setpoint. The Exhaust Stack Radiation Monitoring Systems also have local and remote alarms that communicate failures of monitoring system equipment.

The CAM detects breakthrough of the ventilation system HEPA filters. The CAM and interlock protect against the continued unfiltered release of radiological and hazardous material following a filter breach.

3.2 VENTILATION SYSTEMS STANDARDS

The following standards are considered for design, fabrication, and testing of safety-class (SC) and safety-significant (SS) ventilation systems:

1. Engineering Basis – Code Interpretation

    a. ASME N510-2007. WAC 246-247, "Radiation Protection – Air Emissions," identifies this standard as the basis for the abatement technologies, however, this standard has been incorporated in ASME AG-1, Section TA, "Field Testing of Air Treatment Systems," for testing and ASME N511-2017 for in-service testing requirements. This code standard serves only as a code of record for the majority of systems that were built to ASME/ N509-2002, *Nuclear Power Plant Air Cleaning Units and Components*, requirements.

    b. For post installation testing, operation, and maintenance similar industry codes and standards have been used conservatively over the past two decades. The basis for performing in-service testing and frequency of such SSCs (e.g., HEPA filters, housing, moisture separators) vary due to the facility hazard classifications. For HEPA filter aerosol challenge (leak) testing and calibration requirements for HEPA filter differential pressure indicator and transmitter calibrations, ASME N511-2017 and DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*, guidance has been used annually. However, the basis for in-service testing requirements were not well established in the past, and DOE-HDBK-1169 and ASME N511-2017 were initially relied on for performing annual aerosol challenge test even though the TOC ventilation systems were not credited in the Documented Safety Analysis (DSAs) (HNF-12125, *222-S Laboratory Documented Safety Analysis*; HNF-14755, *242-A Evaporator Documented Safety Analysis;* and RPP-13033, *Tank Farms Documented Safety Analysis*) and do not perform a credited safety function based on the hazard analysis.

    c. The following government, industry codes and standards further support departure from annual HEPA filter leak testing frequency:

        i. ERDA 76-21, *Nuclear Air Cleaning Handbook*, identifies annually and semi-annually periodic frequency testing based on the Reactor post-accident cleanup and engineered safety features (also known for Control Room Habitability) per U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.52, *Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants*, Zone I, II, III, and IV contamination areas. General Design Criterion (GDC) 41 Operating Cycle is defined as a period of time, defined by the Nuclear Facilities Owner, not to exceed 24 months per ASME N510-2007. TOC has not defined the Operating Cycle for the primary ventilation systems as stated in ASME N510-2007, but has adopted conservative annual surveillance requirements for meeting the intent of ASME N510-2007.

ii. DOE-HDBK-1169 specifies periodic test frequencies based on the reactor refueling cycle of 18 to 24 months as guiding principles and, therefore, does not apply to the TOC HEPA filters PMs.

iii. ASME N510-2007 (Table 1) and ASME N511-2017 (Section 5.7.1, Table 8) are based on reactor containment cleanup units and or after complete or partial filter bank replacement and, therefore, does apply to the TOC HEPA filters PMs.

The ASME N510-2007 standard provides a basis for the development of test programs and does not include acceptance criteria, except where the results of one test influences the performance of other tests. Acceptance criteria shall be developed based on the design/function in accordance with ASME N509-2002, *Nuclear Power Plant Air Cleaning Units and Components*.

This standard is arranged so that the user may select those portions (tests) that are relevant to their application. Tests should be performed in the sequence listed in Table 1 of ASME N510-2007. Table 1 also lists the recommended minimum frequency for performing these tests. The user must specify which tests shall be performed, and the acceptance criteria for those tests, in the test program. Nonreactor facilities applying these standards will need to develop other testing frequencies appropriate for their operational requirements.

iv. Title 10 *Code of Federal Regulations* (CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities" (10 CFR 50, Appendix A, GDC 41) is associated with the containment atmospheric clean up system, which is basis for above referenced documents. In fact, DOE-HDBK-1169, third edition, identifies the ORNL/NSIC-65, *Design, Construction, and Testing of High Efficiency Air Filtration Systems for Nuclear Application*, which was issued in January 1970 and for simplification, the title was changed to "Nuclear Air Cleaning Handbook," and the report has been issued under an ERDA number. It further clarifies its usage reflects a consensus of issues and concerns that have been risen by the Division of Reactor at atomic energy facilities throughout the United States and Canada and, therefore, does not apply to the TOC HEPA filters PMs.

v. NRC Generic Letter 91-04, *Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle,* provides the basis for changing the 18-month instrument surveillance requirement to 24-months to accommodate the 24-month fuel cycle technical specification requirements. These surveillance requirements are the basis for the HEPA filter leak test and associated instrumentation. The generic letter identifies the setpoints for Safety-Related Instrumentation per NRC Regulatory Guide 1.105, *Setpoints for Safety-Related Instrumentation*. This standard provides a basis for establishing setpoints for nuclear instrumentation for safety systems and addresses known contributing errors in the channel.

2. Environmental Basis – Regulatory and Code Applicability

   a. The point source emission units are required, at a minimum, to maintain HEPA filter(s) as emissions abatement equipment (RPP-16922). The DOE facilities operated by TOC must comply with RCW 70.94 environment requirements stated in WAC 246-247 in order to be operated safely, to protect the workers, the public, and the environment. WAC 246-247-120, “Appendix B – BARCT Compliance Demonstration” and WAC 246-247-130, “Appendix C – ALARACT Compliance Demonstration” state that the applicant shall evaluate all available control technologies that can reduce the level of radionuclide emissions.

   b. RPP-16922 stipulates requirements for the periodic in-place HEPA leak tests of systems as required in the *Hanford Site Air Operating Permit* (00-05-006) shall be in accordance with the requirements of ASME AG-1. ASME AG-1, Article TA-4000, “Field Acceptance Tests,” states that test results shall be documented and shall be retained as reference values for comparison to periodic in-service tests, but does not identify the required intervals for in-service tests. Additional testing is required for the following conditions:

      i. Prior to startup for new systems;

      ii. Following repair, modification, or upgrade to the ventilation system that could have an effect on HEPA system integrity;

      iii. Following filter replacement(s); or

      iv. Configuration is modified.

   c. The HEPA filters are in-place leak tested to ensure compliance with WAC-246-247 and ASME AG-1, Mandatory Appendix TA-VI, “HEPA Filter Bank In-Place Leak Test Procedural Guidelines,” requirements. In addition, when systems are designed to operate at more than one specified flow rate, the air-aerosol mixing test and subsequent in-place leakage tests shall be performed at each flow rate (+/-10%). It should be noted that ASME AG-1, Division IV, “Testing Procedures,” Section TA, “Field Testing of Air Treatment Systems,” addresses the acceptance test following initial component installation and prior to the system for intended operations. The TOC is responsible for the post-installation in-service leak test and frequencies as defined in the implementing specifications and procedures.

3.3 DESIGN AND OPERATION

Requirements: For Engineering requirements, the nuclear industry codes, standards and guidelines (e.g., ASME AG-1; DOE-HDBK-1169; ASME N509-2002; ACGIH 2106, *Industrial Ventilation: A Manual of Recommended Practice for Operation and Maintenance;* American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) standards, ERDA 76 21) have been used to establish the performance, design, fabrication, installation, inspection, acceptance testing, and quality assurance of SSCs as specified in the specification documents.

Basis: ASME AG-1, Article FC, applies to all aspects of design and operation of HEPA filters. These filters are currently procured as General Service applications (GS) because they do not perform any credited safety function and do not perform any credited safety function at TOC nuclear facilities per the DSAs (RPP 13033, HNF 14755, HNF 12125); the Effluent Treatment Facility; and DOE Correspondence, 15-NSD-0010, "Contract No. DE-AC27-08RV 14800 – Approval of Washington River Protection Solutions LLC Request to Use Existing Hazard Categorization Documentation for the Effluent Treatment Facility and Liquid Effluent Retention Facility that was Previously Approved by the U.S. Department Of Energy Richland Operations Office."

RPP-RPT-54544 was developed to document HEPA filter criteria including: maximum shelf life of 10 years and change out frequency after 10 years of in-service operation life. The HEPA filter service life was established based on the historical documents (e.g., DOE-HDBK-1169, manufacturer recommendations, and more importantly Hanford Site operational experiences for successful operation of the facilities based on successful annual HEPA filter aerosol challenge (leak) testing and monitoring program over the past 15 to 25 years.

Requirements: WAC 246 247 requires that HEPA filters are to be purchased from an evaluated *Quality Assurance Requirements for Nuclear Facility Applications* (ASME NQA-1-2008 with 2009 Addenda) supplier. This is also consistent with the Secretary of Energy, Washington, D.C. letter dated June 4, 2001, "100 Percent Quality Assurance Testing of HEPA Filters at The DOE Test Facility."

Basis: On February 2, 2001, a meeting of Chief Operating Officers (COOs) was held to consider three proposed sets of recommendations (options) drafted by the working group. The working group had unanimously agreed that some level of independent filter quality assurance testing and inspection prior to installation, beyond what the manufacturer provides, is necessary and appropriate for filters used in certain nuclear materials confinement-related applications. However, the working group's review of the existing regime of filter testing, the relatively successful record of HEPA filter procurement and use, and a pragmatic evaluation of the opportunities for system improvement, led to a general consensus that this independent quality assurance approach may be tailored (graded) to the specific needs and situations at each site. This approach would include 100 percent quality assurance testing at the Filter Test Facility (FTF) for HEPA filters used for certain safety applications, while allowing the sites the flexibility of establishing a documented quality assurance testing program that includes sample quality assurance testing at the FTF to achieve a high degree of fitness for service in other filter applications.

Applications where HEPA filters are used in confinement ventilation systems for radioactive airborne particulates, develop, and document an independent, tailored filter quality assurance testing program that achieves a high degree of fitness for service. The program should include the testing of a sample of filters at the FTF. The size of the sample to be tested should be large enough to provide sufficient statistical power and significance to ensure the required level of performance.

A graded HEPA filter testing program, which includes sample quality assurance testing at the FTF for non-critical applications (in-lieu of 100 percent quality assurance testing) may realize cost efficiencies.

3.4 MANUFACTURER IN-PLACE CHALLENGE TEST REQUIREMENT

Requirements: The HEPA filter testing shall be performed by the filter manufacturer prior to delivery to the Hanford Site. The HEPA filters shall exhibit a minimum efficiency of 99.97% when tested with an aerosol of 0.3-µm diameter test aerosol particles. The total test aerosol penetration through the filter media, frame, and gasket shall not be greater than 0.03% of upstream concentration when tested at rated airflow, and at 20% of rated flow when tested in accordance with ASME AG-1, Article FC-5120, “Test Aerosol Particle Penetration.”

In addition to the manufacturer preservice testing, the HEPA filters are sent to a DOE program for quality assurance inspection and performance testing of HEPA filters per DOE-STD-3020, *DOE Technical Standard − Specification for HEPA Filters Used by DOE Contractors*, to be installed in DOE nuclear facilities. Quality assurance inspection and performance testing shall be performed at a DOE-approved Filter Test Facility prior to HEPA filter installation per DOE-STD-3025, *DOE Technical Standard − Quality Assurance Inspection and Testing of HEPA Filters*. This latter standard describes the operational requirements and procedures in performing HEPA filter quality assurance inspection and performance testing.

Basis: The HEPA filter manufacturer and DOE-approved Filter Test Facility shall perform testing per ASME AG-1, Division IV, Section TA. The ASME AG-1, Article TA-4634, “In-Place Leak Test,” requires the challenge aerosol leak rate of each HEPA filter bank be measured in accordance with the ASME AG-1, Mandatory Appendix TA-VI, with the system operating at the HEPA filter manufacturer’s design flow rate. The aerosol penetration shall be determined to be less than 0.03% of upstream concentration.

3.5 IN-SERVICE TESTING

In accordance with ASME AG-1, Article TA-4000, field acceptance tests are performed under conditions readily reproducible during subsequent in-service tests to allow for direct comparison of test results. RPP-16922, Section 2.3.4, provides the technical framework of the various periodic maintenance procedures that are currently used to verify the operability of the ventilation system equipment. These procedures are also used to perform the current “annual” in-service aerosol testing of the regulated TOC installed HEPA filters.

However, due to the successful operational experiences for the past two decades with the installed instruments, periodic in-service, monitoring, and tracking, along with the confirmatory results by the CAM and record samplers, annual HEPA filter leak test frequency should be changed to support facility operational experiences. Increasing in-service filter's leak test frequency based on extended operational experience will provide cost benefits associated with performing such periodic activities, but also minimizes workers' exposure and improves workers' safety.

3.5.1 Environmental Parameters

Requirements: All parts and components of the air-cleaning unit shall be selected or designed to operate under the facility environmental parameters (temperature, relative humidity, pressure, radiation, etc.).

Components shall be selected or treated to limit generation of combustibles and contaminants and, to resist corrosion and degradation that would result in loss of function when exposed to the specified environmental conditions for the design life of the component.

Basis: DOE O 433.1B, *Maintenance Management Program for DOE Nuclear Facilities,* references Federal regulations, DOE directives, and industry best practices using a graded approach regarding implementation of requirements for maintaining DOE-owned government property.

ASME AG-1 only identifies in-place testing requirements at initial HEPA filter installation for establishing the system baseline values for periodic maintenance comparison. Currently, ASME N511-2017 is being cited for annual in-service testing intervals.

WAC 246-247-120, Appendix B, requires that the applicant (operator) should evaluate all available technologies that can reduce the level of radionuclide emissions. The technology requirements are identified in ASME AG-1 and ASME N509-2002 (Section 5.5.1). Procurement specifications for HEPA filtration systems are developed to meet the ASME AG-1, Article FC-4200, "Performance Requirements," based on the environmental service conditions (i.e., temperature, air flow, humidity, chemicals, penetration particle size).

3.5.2 Monitoring Parameters and Limits

Requirements: The TOC ventilation systems shall be monitored for the following parameters/limits as identified in RPP-13033, Table 4.4.10-1, "DST Primary Tank Ventilation Environmental Compliance Related General Service Support Systems." RPP-16922 and RPP-RPT-54544 also establishes such requirements. Examples of possible process monitoring parameters include:

1. Filter aerosol penetration test results;
2. Heater outlet/HEPA prefilter inlet temperature instrumentation readings (as applicable);
3. Differential pressure readings across the heaters (as applicable), prefilters, first-stage HEPA filters, and second-stage HEPA filters;

4. Air stream temperature upstream readings of the first stage of HEPA filters (< 200 °F);

5. Exhaust air temperature at the stack discharge (for temperature correction of the measured air flow rate);

6. Stack exhausts flow rate readings;

7. Exhaust fan speed (as applicable as required in RPP-13033, Table 4.4.10-1);

8. Continuous air monitor sampling readings;

9. Stack record sample system results;

10. Routine visual inspections of HEPA filter housing, exhaust fan, and motor; and

11. Shock pressures (pulse) alarms (> 1.7 psig).

Basis: The TOC monitoring and routine visual inspection comply with the recommended in-service monitoring of emission air flow rates and concentrations per applicable sections of ASME AG-1, ASME N510-2007, and DOE-HDBK-1169. This monitoring ensures the following.

WAC 246-247-120 Appendix B references ASME N510-2007, which requires HEPA filters in-service leak test after each HEPA filter replacement and at least once for each operating cycle. Operating cycles are defined as a period of time, defined by the owner, not to exceed 24 months based on a reactor refueling cycle.

The ASME N510-2007 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 based on the design/function in accordance with ASME N509-2002. ASME N509-2002 is arranged so that the user may select those portions (tests) that are relevant to their application.

ASME N510-2007, Table 1, specifically states that, field testing of motors, valve, and damper actuators, and fire protective systems are not covered by this standard and nonreactor facilities applying this standard will need to develop other testing frequencies appropriate for their operational requirements. However, this standard may be used for guidance for test frequencies of nonreactor facilities.

Therefore, since TOC facilities are classified as nonreactor facilities, the use of this standard for in-service test intervals should be based on operational experiences and not a reactor refueling cycle paradigm.

1. In-service filter aerosol penetration tests are performed per ASME N511-2017, Mandatory Appendix III, "HEPA Filter Bank in-Place Leak Test Procedure," at initial HEPA filter installation. Because TOC filters are classified as General Service and do not perform a credited safety function per the DSAs (HNF-12125, HNF-14755, and RPP-13033), the applied leak testing frequencies identified in ASME N511-2017 are

not required for meeting TSR PMs, but are required by reference for Environmental PMs and compliance with WAC 246/247-120, Appendix B. Therefore, establishing HEPA Filter Bank In-Service Tests intervals after initial installation and major modifications should be developed based on the operational based on the TOC operational experiences, a reliability monitoring program and instrumentation calibrations.

2. Monitoring for tracking of HEPA filter differential pressure, ensuring loading does not exceed 10-in. water gauge (w.g.), as required by ASME AG-1, Section FC, "HEPA Filters" (conservative values are set at 5.9-in. w.g. on the first stage and 4.0-in. w.g. on the second stage).

3. Maintaining the air stream temperature below 225 °F and monitoring routinely to ensure longer operating filter life and more reliable service for the HEPA filters by minimizing heat aging effects.

4. Prefilter and HEPA filter banks and moisture separator pad differential pressures are visually inspected routinely per ASME N511-2017, Mandatory Appendix I.

5. Exhaust stack temperatures are typically monitored by the exhauster process control system.

6. Relative humidity maintained below 70% as required by ASME N509-2002, Section 5.1.1.

7. High pressure alarms of > 6.0-in. w.g., internal or across filter media is monitored by the control process system. Filters are changed if the differential pressure (adjusted for rated flow) exceeds 4.0-in. w.g. Conditions triggering HEPA filter change-out per the TOC HEPA filter management plan (RPP-RPT-54544) and facility specification documentation:

   a. Filter differential pressure exceeds preset limits (5.8-in. w.g. on first stage and 4.0-in. w.g. on second stage filters).

   b. Dose rates reach or exceed ALARA limits for personnel exposure as specified in TFC-ESHQ-RP_RWP-C-03, "ALARA Work Planning."

4.0 CONCLUSIONS

Based on the interpretation of the standards within this document, regulated ventilation systems SSCs PM intervals, such as HEPA filter testing frequency requirements, should be revised pending WDOH approval. The revised testing frequency will also provide opportunities for improvement in minimizing worker hazards associated with the HEPA system facility entry and stresses imposed on workers by wearing protective clothing and respiratory protection. Increasing time in between in-service testing will not change the probability or consequences of exposing workers or public to new hazards. The facilities operations and engineering personnel routinely monitor the HEPA filter instrumentation and the stack emissions and provide confirmatory results via the existing CAM and record sampler testing results.

The proposed new TOC HEPA Filters Management Program Plan will apply to active regulated by WDOH HEPA ventilation SSCs at TOC facilities on the Hanford Site. The initial implementation phase, to be consistent with RPP-RPT-54544 change out and monitoring requirements, will include a plan to perform aerosol testing based on the results obtained during 10-years specified operating life change out requirements. Abnormalities (e.g., wetting, filter bypass), observed during routine monitoring will be addressed and, if necessary, alert facility operations and engineering to replace and in-place test the filters. The current annual testing requirements may be re-introduced as identified in the HEPA Filter Management Program Plan if operational failures render revised frequency in adequate.

Filters currently used in facilities that are not regulated by WDOH are required to comply with the best industrial and engineering practices and operational experiences, and to comply with the requirements of as low as reasonable achievable control technology (ALARACT) controls, as well as industry standards (e.g., from American National Standards Institute, Inc. [ANSI], ASME, ASHRAE, ACGIH). Therefore, filter change out and aerosol leak testing interval requirements should be based on and established by the facility operational requirements and experiences.

The 222-S Laboratory nonregulated BMP ventilation SSCs are to comply with the requirements of ALARACT controls, as well as industry standards. These HEPA filters are not required to have annual nor biennial aerosol leak in-service testing frequency after initial installation as long as they perform their intended function per the facility established requirements.

In conclusion, facilities may establish regulated and nonregulated filter testing intervals basis in accordance with the facility safety classification, risks associated with revised in-service leak test intervals, and operational experiences that justifies use of ALARACT for meeting best management and industry practices without adhering to ASME N511-2017 requirements and this approach will be consistent with the proposed revision of TFC-ENG-STD-07 Section 3.34, “Inspection and Testing” as stated in the recommendations section of this document.

5.0 RECOMMENDATIONS

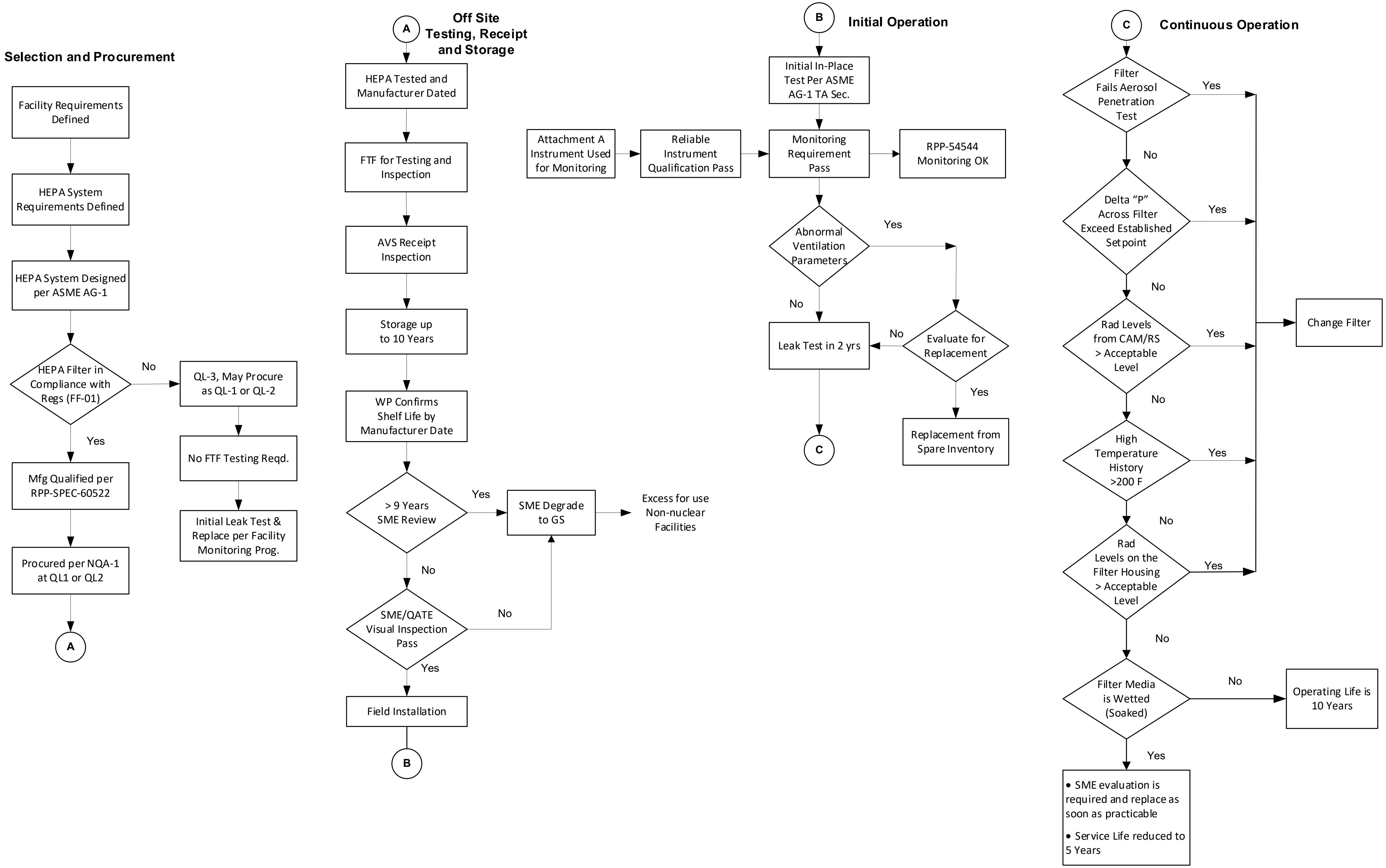
For the revised WDOH regulated HEPA filter in-service leak test, a minimum of biennial (every two years) PM frequency will apply to powered or active HEPA ventilation systems at TOC facilities on the Hanford Site identified in RPP-16922 pending approval of emission units in WDOH permit application. Abnormalities (e.g., wetting, filter bypass) observed during monitoring will continue to be addressed and, if necessary, will alert facility operations and engineering to replace and test the filters. The current annual testing requirements will be changed to biennial as the basis for revising the HEPA Filter Management Program Plan.

In addition, in-service aerosol leak test intervals for HEPA filters not identified in RPP-16922 and the WDOH emission units permit application (e.g., BMP) will be changed to task on demand after initial installation and testing in accordance with ASME AG-1 requirements. Such filters will not be required to comply with the ASME N511-2017 testing intervals. Furthermore, in order to maintain consistency with the equipment and system specifications requirements, TFC-ENG-STD-07 and RPP-11413 will be revised to provide additional guidance for ventilation SSCs PM intervals.

It should be noted that once the HEPA filter testing PM frequency changes have been implemented, remaining ventilation system's SSC PM frequencies will require similar evaluation and assessment for compliance with such requirements.

A depiction on the over-all life cycle of a HEPA filter from facility definition to filter change-out is shown in Figure 1.

Figure 1. High-Efficiency Particulate Air Filter Leak Test/Service Life.



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