



DRAFT REGULATORY GUIDE

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DRAFT REGULATORY GUIDE DG-1274

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DESIGN, INSPECTION, AND TESTING CRITERIA FOR AIR FILTRATION AND ADSORPTION UNITS OF POSTACCIDENT ENGINEERED-SAFETY-FEATURE ATMOSPHERE CLEANUP SYSTEMS IN LIGHT-WATER-COOLED NUCLEAR POWER PLANTS

A. INTRODUCTION

This guide provides a method that the U.S. Nuclear Regulatory Commission (NRC) considers acceptable to implement Title 10, of the *Code of Federal Regulations*, Part 50, "Domestic Licensing of Production and Utilization Facilities" (10 CFR Part 50) (Ref 1), Appendix A, "General Design Criteria for Nuclear Power Plants," as it applies to the design, inspection, and testing of air filtration and iodine adsorption units of engineered-safety-feature (ESF) atmosphere cleanup systems in light-water-cooled nuclear power plants. For the purposes of this guide, ESF atmosphere cleanup systems are those systems that are credited in the licensee's current design-basis accident (DBA) analysis, as described in the safety analysis report (SAR). This guide addresses ESF atmosphere cleanup systems, including the various components and ductwork, in the postulated DBA environment.

In Appendix A to 10 CFR Part 50, General Design Criterion (GDC) 41, "Containment Atmosphere Cleanup," GDC 42, "Inspection of Containment Atmosphere Cleanup Systems," and GDC 43, "Testing of Containment Atmosphere Cleanup Systems," require that containment atmosphere cleanup systems be provided as necessary to reduce the amount of radioactive material released to the environment following a postulated DBA. These GDC also require that these systems be designed to permit appropriate periodic inspection and testing to ensure their integrity, capability, and operability.

GDC 61, "Fuel Storage and Handling and Radioactivity Control," requires that fuel storage and handling systems, radioactive waste systems, and other systems that may contain radioactivity be designed to ensure adequate safety under normal and postulated accident conditions and that they be designed with appropriate containment, confinement, and filtering systems. GDC 19, "Control Room," requires that adequate radiation protection be provided to permit access to and occupancy of the control

This regulatory guide is being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. It has not received final staff review or approval and does not represent an official NRC final staff position. Public comments are being solicited on this draft guide (including any implementation schedule) and its associated regulatory analysis or value/impact statement. Comments should be accompanied by appropriate supporting data. Written comments may be submitted to the Rules, Announcements, and Directives Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; submitted through the NRC's interactive rulemaking Web page at <http://www.nrc.gov>; or faxed to (301) 492-3446. Copies of comments received may be examined at the NRC's Public Document Room, 11555 Rockville Pike, Rockville, MD. Comments will be most helpful if received by February 25, 2012.

Electronic copies of this draft regulatory guide are available through the NRC's interactive rulemaking Web page (see above); the NRC's public Web site under Draft Regulatory Guides in the Regulatory Guides document collection of the NRC Library at <http://www.nrc.gov/reading-rm/doc-collections/>; and the NRC's Agencywide Documents Access and Management System (ADAMS) at <http://www.nrc.gov/reading-rm/adams.html>, under Accession No. ML11244A045. The regulatory analysis may be found in ADAMS under Accession No. ML11244A050.

room under accident conditions and for the duration of the accident without personnel radiation exposures in excess of 5 rem to the whole body, or its equivalent to any part of the body, or 5 rem total effective dose equivalent (TEDE) for licensees that implement an alternative source term pursuant to 10 CFR 50.67 or applicants or licensees under 10 CFR Part 50 or 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants” (Ref 2.) who apply after January 10, 1997.

In 10 CFR Part 100, “Reactor Site Criteria,” (Ref 3) the NRC requires nuclear power plants to be sited so that radiological doses from normal and postulated accidents are kept acceptably low. A footnote to 10 CFR 100.11, “Determination of Exclusion Area, Low Population Zone, and Population Center Distance,” states that the fission product release assumed in the plant design should be based on a major accident involving substantial core damage with subsequent release of appreciable quantities of fission products. For applicants after January 10, 1997, the siting criteria in 10 CFR 100.21 refer to dose values in §50.34(a)(1), which are also included in the technical information requirements for applications for early site permits, combined licenses, standard design certifications, standard design approvals, and manufacturing licenses in 10 CFR Part 52; all of which have similarly worded footnotes on the fission product release assumptions. According to 10 CFR 50.67, “Accident Source Term,” an application to revise a licensee’s current accident source term must contain an evaluation of the consequences of applicable DBAs previously analyzed in the SAR.

This guide does not apply to atmosphere cleanup systems designed to collect airborne radioactive materials during normal plant operation, including anticipated operational occurrences. Regulatory Guide 1.140, “Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants,” provides guidance for these systems (Ref. 4).

The NRC issues regulatory guides to describe to the public methods that the staff considers acceptable for use in implementing specific parts of the agency’s regulations, to explain techniques that the staff uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations and compliance with them is not required.

This regulatory guide contains information collection requirements covered by 10 CFR Part 50 that the Office of Management and Budget (OMB) approved under OMB control number 3150-0011. The NRC may neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number. This regulatory guide is a rule as designated in the Congressional Review Act (5 U.S.C. 801–808). However, the NRC has determined that this regulatory guide is not a major rule as designated by the Congressional Review Act and has verified this determination with the OMB.

B. DISCUSSION

The design of light-water-cooled nuclear power plants includes atmosphere cleanup systems as ESFs to mitigate the radiological consequences of postulated accidents. The mitigating action of ESF atmosphere cleanup systems is limited to the removal of radioactive iodine (both elemental iodine and organic iodides) and particulate matter (aerosols) that may be released into the building or containment during and after the accident; the removal of fission product noble gases by ESF atmosphere cleanup systems is negligible. ESF atmosphere cleanup systems should be designed to operate under the environmental conditions that would be generated during and after DBAs.

For the purpose of this guide, ESF atmosphere cleanup systems that must operate under postulated DBA conditions inside the primary containment are designated as “primary systems.” ESF systems required to operate outside the primary containment under postulated DBA conditions are designated as “secondary systems.” Secondary systems include such systems as the standby gas treatment system and the atmosphere cleanup systems for the spent fuel handling building, control room, shield or annulus building, and secondary containment, as well as the emergency core cooling system pump leakage. Figures 1 and 2 depict example ESF atmosphere cleanup systems.

For most currently licensed plants, the characteristics of the fission product release from the core into the containment were set forth using the guidance in Regulatory Guide 1.3, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors” (Ref. 5), and Regulatory Guide 1.4, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors” (Ref. 6), and were derived from Technical Information Document (TID) 14844, “Calculation of Distance Factors for Power and Test Reactor Sites,” issued 1962 (Ref. 7). Since the publication of TID-14844 in 1962, significant advances have been made in understanding the timing, magnitude, and chemical form of fission product releases from severe nuclear power plant accidents. In February 1995, the NRC published NUREG-1465, “Accident Source Terms for Light-Water Nuclear Power Plants” (Ref. 8), which provides estimates of an alternative accident source term based on insights from severe accident research. The NRC promulgated 10 CFR 50.67 to provide a means for operating reactors to change their design-basis source terms. The NRC staff issued Regulatory Guide 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors” (Ref. 9), to provide guidance to licensees of operating power reactors on acceptable applications of alternative source terms (ASTs). Regulatory Guide 1.183 establishes an acceptable AST and identifies the significant attributes of other ASTs that the NRC staff may find acceptable. Regulatory Guide 1.183 also identifies acceptable radiological analysis assumptions for use in conjunction with the accepted AST. The NRC staff expects that future plant applications will use the alternative accident source term, as appropriate, in support of safety analyses performed in accordance with 10 CFR 50.34, “Contents of Applications; Technical Information,” 10 CFR 52.47, “Contents of Applications; Technical Information” [Standard Design Certifications], 10 CFR 52.79, “Contents of Applications; Technical Information in Final Safety Analysis Report” [Combined Licenses], 10 CFR 52.137, “Contents of Applications; Technical Information” [Standard Design Approvals], 10 CFR 52.157, “Contents of Applications; Technical Information in Final Safety Analysis Report” [Manufacturing Licenses], and 10 CFR 50.90, “Application for Amendment of License, Construction Permit, or Early Site Permit.”

The DBA environmental design conditions for a given ESF system (primary and secondary systems) should be determined for each plant. DBA radiological design conditions for typical primary and secondary systems should be based on the radiation source term specified in Regulatory Guides 1.3 (Ref. 5), 1.4 (Ref. 6), 1.25 (Ref. 10), or 1.183 (Ref. 9), as applicable. The ESF system should also consider DBA environmental design conditions such as temperature, relative humidity, and pressure. In

addition, ESF primary systems should be designed to withstand the radiation dose from water and plateout sources in the containment and the corrosive effects of chemical sprays (if such sprays are included in the plant design).

An ESF atmosphere cleanup system consists of housing, dampers, fans, and associated ductwork, motors, valves, and instrumentation. Typical components within the housing are moisture separators, heaters, prefilters, high-efficiency particulate air (HEPA) filters, medium-efficiency postfilters, and iodine adsorption units.

The housing is the portion of an ESF atmosphere cleanup system that encloses air-cleaning components and provides connections to adjacent ductwork. Each of these components may be used for moving, cleaning, heating, cooling, humidifying, or dehumidifying the air stream.

The principal purpose of dampers in an ESF atmosphere cleanup system is to shut off or seal the system components from air flowing in a designated flow path. A typical unit has dampers both upstream and downstream from the “train” of components (i.e., upstream from the moisture separator and downstream from the last HEPA filter or iodine adsorber or postfilter). The dampers prevent or isolate unwanted flow or circulation of the normal air stream through the system components in order to preserve or extend the useful service life of the filtration and iodine adsorption media. ESF system dampers may also serve secondary functions such as flow control, pressure control, balancing, pressure relief, or backflow prevention. This guide does not address the fire prevention aspect of dampers in ESF atmosphere cleanup systems.

The principal purpose of a moisture separator is to remove entrained water droplets from the inlet air stream, thereby protecting prefilters, HEPA filters, and iodine adsorbers from water damage and plugging. Moisture separators may also function as prefilters in some system designs.

Heaters normally follow the moisture separators in the cleanup train. They are designed to heat the incoming air stream to reduce the stream’s relative humidity upstream from the HEPA filters and iodine adsorbers during system operation to minimize adsorption of water vapor from the air by the iodine adsorbers and to reduce the detrimental effects of high humidity on the HEPA filters. As an added measure, some designs use heaters (or some other mechanism) to prevent condensation within the isolated components of the cleanup unit while the cleanup units are not in service.

Prefilters and HEPA filters are installed to remove particulate matter from the air stream. Prefilters remove the larger airborne particles from the air stream and prevent excessive loading of the HEPA filters. The HEPA filters remove the fine discrete particulate matter from the air stream. A HEPA filter or a medium-efficiency postfilter downstream from the adsorption units collects carbon fines and provides additional protection against particulate matter release in case of failure of the upstream HEPA filter bank. It is not necessary to perform in-place leak testing on postfilters or HEPA filters downstream from the carbon adsorbers. The preferred design of the housing and the injection and measurement ports should provide for testing HEPA filters without the need to remove any other component (e.g., adsorbers or downstream filters). If required, removing the filters downstream from the carbon adsorbers will permit sampling downstream from the fan. The fan will provide the necessary mixing for an accurate test, and the absence of the postfilters or HEPA filters downstream from the carbon adsorbers will prevent the challenge aerosol from being removed from the air stream.

The iodine adsorption units typically consist of impregnated activated carbon and are installed to remove gaseous radioactive elemental and organic forms of iodine from the air stream during DBAs.

The location of the fan, with respect to the overall system design and the individual ESF atmosphere cleanup unit, is important because of the imposed positive and negative pressure gradients that the fan creates during operation. The ESF system design should consider the impact of the ESF atmosphere cleanup unit's operating pressure with respect to surrounding areas. For example, when the ESF atmosphere cleanup system is located in a radioactively contaminated area, supplying air to a radioactively clean area or exhausting to the environment, it is advantageous to locate the fan upstream from the ESF atmosphere cleanup unit. This minimizes the potential for unfiltered in-leakage into the radioactively clean area or an inadvertent release of radioactive materials to the environment. When the ESF atmosphere cleanup system is located in a radioactively clean area, it is advantageous to locate the fan downstream from the ESF atmosphere cleanup unit. This minimizes the potential for outward leakage of radioactive materials into the radioactively clean area.

The environmental operating conditions preceding a postulated DBA may affect the performance of ESF atmosphere cleanup systems during and after a DBA. Industrial contaminants, pollutants, high temperature, and high relative humidity contribute to the aging and weathering of filters and adsorbers and may reduce their effective capability to perform their intended design functions. Therefore, the design, operation and maintenance of the ESF atmosphere cleanup systems should consider aging and weathering, both of which will vary according to site-specific conditions. The ESF atmosphere cleanup system design should also address the potential for condensation of moisture inside ESF atmosphere cleanup system components when in a shutdown or standby mode of operation, (e.g., by including provisions for space heaters). The effects of these environmental factors on the performance of the ESF atmosphere cleanup system should be determined by scheduled periodic inspection and testing during operation.

All ESF atmosphere cleanup system components should be designed for reliable performance under accident conditions. Qualification and initial testing, periodic inspection and testing, and proper maintenance are primary factors in ensuring the reliability of the ESF atmosphere cleanup system. Careful attention to problems of ESF system maintenance during the design phase can contribute significantly to the reliability of the system by increasing the ease of such maintenance. A layout that provides accessibility and sufficient working space to safely and efficiently perform the required maintenance functions is of particular importance in the design. Periodic inspection and testing during operation of the components is another important means of ensuring reliability. It is important to perform periodic inspections and tests of the ESF atmosphere cleanup system in a manner that is consistent with the way the system was intended to operate during an accident. Built-in features that will facilitate convenient access for in-place testing are important in ESF system design.

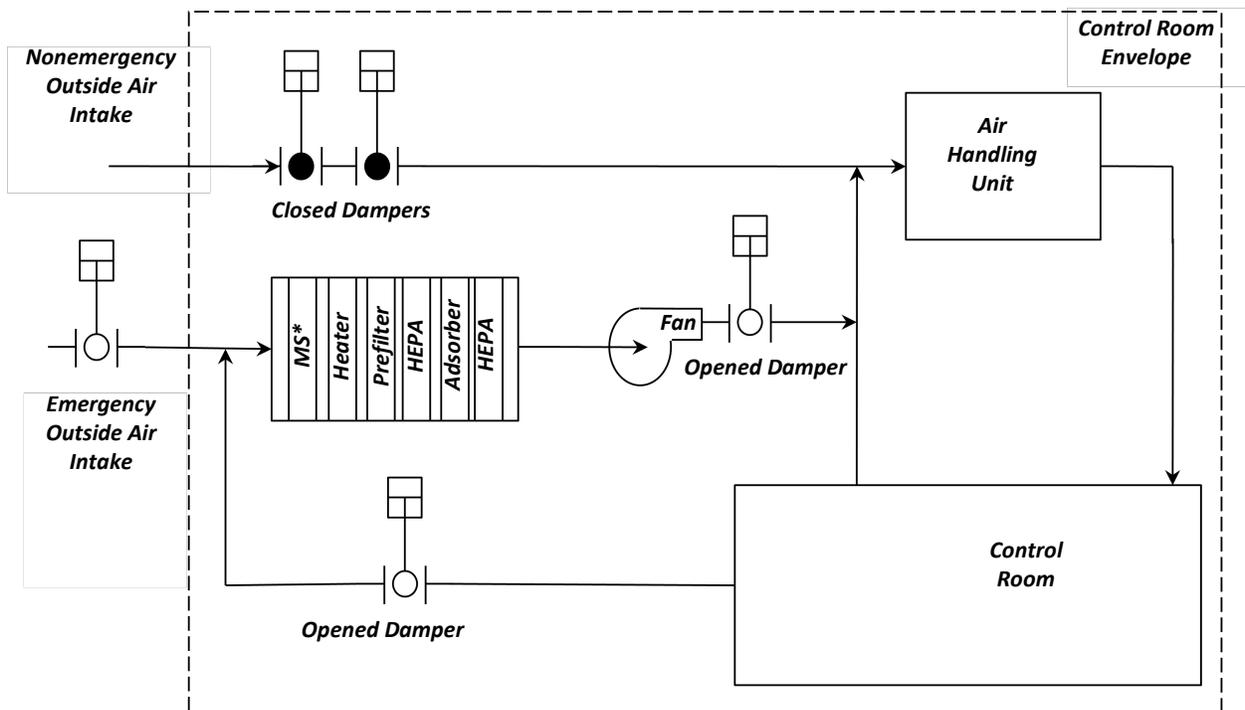
Standards acceptable to the NRC staff for the design and testing of ESF atmosphere cleanup systems include those portions of American Society of Mechanical Engineers (ASME) N509-2002 (reaffirmed 2008), "Nuclear Power Plant Air-Cleaning Units and Components" (Ref. 11); ASME N510-2007, "Testing of Nuclear Air-Treatment Systems" (Ref. 12); ASME AG-1-2009 (with 2010 and 2011 addenda), "Code on Nuclear Air and Gas Treatment" (Ref. 13); and ASME N511-2007, "In-Service Testing of Nuclear Air Treatment, Heating, Ventilating, and Air-Conditioning Systems" (Ref. 14), that are referenced in this guide, and American Society for Testing and Materials (ASTM) D3803-1991 (reapproved 2009), "Standard Test Methods for Nuclear-Grade Activated Carbon" (Ref. 15).

The above standards reference several industry codes and standards. If a referenced standard has been incorporated separately into the NRC's regulations, licensees and applicants must comply with that standard as set forth in the regulation. If the referenced standard has been endorsed in a regulatory guide, the standard constitutes a method acceptable to the NRC staff for meeting a regulatory requirement as described in that regulatory guide. If a referenced standard has been neither incorporated into the NRC's

regulations nor endorsed in a regulatory guide, licensees and applicants may consider and use the information in the referenced standard if appropriately justified, consistent with current regulatory practice.

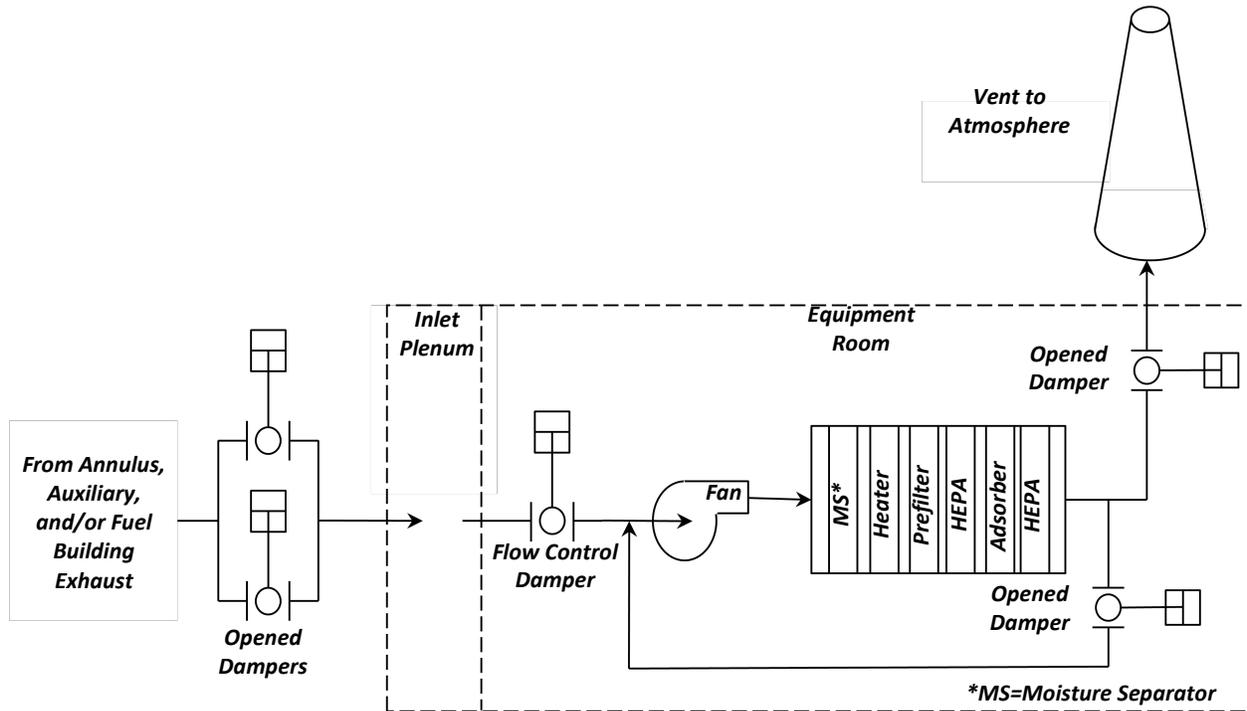
The International Atomic Energy Agency (IAEA) has established a series of safety guides and standards constituting a high level of safety for protecting people and the environment. IAEA safety guides present international good practices and increasingly reflects best practices to help users striving to achieve high levels of safety. Pertinent to this regulatory guide, IAEA Safety Guide NS-G-1.10, “Design of Reactor Containment Systems for Nuclear Power Plants” (Ref. 16), addresses the requirements of management of radionuclides leaking through a containment of Nuclear Power Plants, including a procedure how to control the leakage. The NRC has an interest in facilitating the harmonization of standards used domestically and internationally. This regulatory guide is consistent with the recommendations and guidance in the IAEA Safety Guide NS-G-1.10.

Figure 1. Example of a control room ESF atmosphere cleanup train^a



^a Other acceptable configurations exist; this figure is only provided for conceptual purposes.

Figure 2. Example of a shield, annulus, and/or fuel building ESF atmosphere cleanup train^a



^a Other acceptable configurations exist; this figure is only provided for conceptual purposes.

C. STAFF REGULATORY GUIDANCE

1. General Design and Testing Criteria

ASME AG-1-2009 with addenda (Ref. 13) and ASME N509-2002 (Ref. 11) provide criteria that are acceptable to the NRC staff for the performance, design, construction, acceptance testing, and quality assurance of equipment used as components in nuclear safety-related or ESF air and gas treatment systems in nuclear power plants. ESF atmosphere cleanup systems designed to ASME N509-2002 (or its earlier versions) and tested to ASME N510-2007 (or its earlier versions) (Ref. 12) or ASME N511-2007 (Ref. 14), as applicable, are considered adequate to protect public health and safety.

2. Environmental Design Criteria

All parts and components of the ESF atmosphere cleanup system should be selected and designed to operate under the environmental conditions specified by the following guidelines.

- a. In accordance with Section 4.4 of ASME N509-2002 (Ref. 11), the design of an ESF atmosphere cleanup system should be based on the anticipated range of operating parameters of temperature, pressure, relative humidity, radiation levels, and airborne iodine concentrations that are likely during and following the postulated DBA.
- b. The location and layout of each ESF atmosphere cleanup system should consider the radiation dose to essential services and personnel in the vicinity, integrated over the 30-day period following the postulated DBA. The radiation source term should be consistent with the assumptions found in Regulatory Guides 1.3 (Ref. 5), 1.4 (Ref. 6), 1.25 (Ref. 10), or 1.183

(Ref. 9). Other ESFs, including pertinent components of essential services such as power, air, and control cables, should be adequately shielded from the ESF atmosphere cleanup systems.

- c. The design of each adsorber should be based on the concentration and relative abundance of the iodine species (elemental, particulate, and organic) and should be consistent with the assumptions found in Regulatory Guides 1.3 (Ref. 5), 1.4 (Ref. 6), 1.25 (Ref. 10), or 1.183 (Ref. 9).
- d. The operation of any ESF atmosphere cleanup system should not degrade the operation of other ESFs, such as containment spray systems, nor, conversely, should the operation of other ESFs, such as containment spray systems, degrade the operation of any ESF atmosphere cleanup system.
- e. Components of systems connected to compartments that are unheated during a postulated accident should be designed for the postaccident effects of both the lowest and highest predicted temperatures.
- f. The design of an ESF atmosphere cleanup system should consider any significant contaminants that may occur during a DBA, such as dusts, chemicals, excessive moisture, or other particulate matter, that could degrade the cleanup system's operation.

3. System Design Criteria

ESF atmosphere cleanup systems should be designed in accordance with Section 4 of ASME N509-2002 (Ref. 11) and ASME AG-1-2009 with addenda (Ref. 13), as modified and supplemented by the following:

- a. ESF atmosphere cleanup systems designed and installed for the purpose of mitigating accident doses should have redundant units (trains) to provide assurance that an operable unit will be available during the DBA. A typical unit is composed of the following components: (1) moisture separator, (2) prefilter (a moisture separator may serve this function), (3) heater, (4) HEPA filter before the adsorbers, (5) iodine adsorber (impregnated activated carbon), (6) HEPA filter or medium-efficiency postfilter after the adsorbers, (7) fan, and (8) interspersed ducts, motors, dampers, valves, and related instrumentation.
- b. The redundant ESF atmosphere cleanup units should be physically separated so that damage to one unit does not also cause damage to the other unit. The generation of missiles from high-pressure equipment rupture, rotating machinery failure, or natural phenomena should be considered in the design for separation and protection.
- c. If the ESF atmosphere cleanup system is subject to pressure surges resulting from the postulated accident, the system should be protected from such surges. Each component should be protected with devices such as pressure relief valves¹ so that the overall system will perform its intended function during and after the passage of the pressure surge.
- d. All components of an ESF atmosphere cleanup system whose failure would lead to the release of fission products that would exceed the regulatory limits should be designated as seismic Category I (per Regulatory Guide 1.29, "Seismic Design Classification" (Ref. 17)).

¹ Surge protection devices, such as pressure relief valves, that have the potential to be an effluent discharge path should be monitored in accordance with GDC 64, "Monitoring Radioactive Releases," of Appendix A to 10 CFR Part 50.

- e. In the mechanical design of the ESF system, the high radiation levels that may be associated with buildup of radioactive materials on the ESF system components should be given particular consideration. ESF system construction materials should effectively maintain their intended function under the postulated radiation levels. The effects of radiation should be considered not only for moisture separators, heaters, HEPA filters, adsorbers, motors, and fans, but also for any electrical insulation, controls, joining compounds, dampers, gaskets, and other organic materials that are necessary for operation during and after a postulated DBA. In addition to the consideration of high radiation levels, the mechanical design of the ESF system should be based on consideration of other harsh conditions that may occur during a DBA, such as high humidity, containment rainout, chemical sprays, or high temperatures and pressures.
- f. To ensure reliable in-place testing, the volumetric airflow rate of each cleanup unit should be limited to approximately 30,000 cubic feet per minute in accordance with the recommendations of DOE-HDBK 1169-2003, "Nuclear Air Cleaning Handbook", (Ref. 18), paragraph 4.4.11, "Size of Banks". If a total system air flow in excess of this rate is required, multiple units should be used. For ease of maintenance, a filter layout that is 3 HEPA filters high and 10 wide is preferred. Each ESF atmosphere cleanup system train should be designed such that, at the maximum accident flow rate, the adsorber residence time is not less than the design value (typically 0.25 seconds per 2 inches of activated carbon) as specified in Regulatory Position 4.k of this guide. The residence time should be calculated in accordance with Article I-1000 of Sections FD and FE of ASME AG-1-2009 with addenda (Ref. 13).
- g. The ESF atmosphere cleanup system should be instrumented to signal, alarm, and record pertinent pressure drops and flow rates at the control room in accordance with the recommendations of Section IA of ASME AG-1-2009 with addenda (Ref. 13), and Section 4.9 of ASME N509-2002 (Ref. 11). Instrumentation, readout, recording, and alarm provisions for ESF atmosphere cleanup systems should meet the guidance given in Table 1 of this regulatory guide as a minimum.
- h. The power supply and electrical distribution system for the ESF atmosphere cleanup system should be designed in accordance with Regulatory Guide 1.32, "Criteria for Power Systems for Nuclear Power Plants" (Ref. 19). All instrumentation and equipment controls should be designed to IEEE Standard 603-1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations" (Ref. 20). The ESF system should be qualified and tested under Regulatory Guide 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants" (Ref. 21). To the extent applicable, Regulatory Guides 1.30 (Ref. 22), 1.100 (Ref. 23), 1.118 (Ref. 24) and 1.40 (Ref. 25) should be considered in the design.
- i. Unless the applicable ESF atmosphere cleanup system operates continuously during all times that a DBA can be postulated to occur, the system should be automatically activated upon the occurrence of a DBA by (1) a redundant ESF actuation signal (e.g., temperature, pressure) or (2) a signal from redundant Seismic Category I radiation monitors.
- j. To maintain radiation exposures to operating and maintenance personnel as low as is reasonably achievable (ALARA), ESF atmosphere cleanup systems and components should be designed to control leakage and facilitate maintenance, inspection, and testing in accordance with the guidance of Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable" (Ref. 26). The ESF atmosphere cleanup unit should be totally enclosed. To minimize the potential contamination of the area when maintaining the ESF atmosphere cleanup system, the

system should be designed and installed in a manner that permits replacement of an entire unit or a minimum number of segmented sections without removal of individual components.

- k. Outdoor air intake openings should be equipped with louvers, grills, screens, or similar protective devices to minimize the effects of high winds, rain, snow, ice, trash, and other contaminants on the operation of the system. The outdoor air intake openings should be located to minimize the effects of possible onsite plant contaminants, such as the diesel generator exhaust. If the atmosphere surrounding the plant could contain significant environmental contaminants, such as dusts and residues from smoke cleanup systems from adjacent coal-burning power plants or industry, or is a salty environment near an ocean, the design of the system should consider these contaminants and prevent them from affecting the operation of any ESF atmosphere cleanup system.
- l. ESF atmosphere cleanup system housings and ductwork should be designed to exhibit on test a maximum total leakage rate as defined in Section SA-4500 of ASME AG-1-2009 with addenda (Ref. 13). Duct and housing leak tests should be performed in accordance with Section TA-4300 of ASME AG-1-2009 with addenda.
- m. To minimize contamination of the facility to the extent practicable, ESF atmosphere cleanup systems and components should be designed, maintained, and operated to minimize contamination in accordance with the guidance of Regulatory Guide 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning" (Ref. 27).

4. Component Design Criteria and Qualification Testing

Components of ESF atmosphere cleanup systems should be designed, constructed, and tested in accordance with Division II of ASME AG-1-2009 with addenda (Ref. 13), as modified and supplemented by the following:²

- a. Moisture separators should be designed, constructed, and tested in accordance with Section FA of ASME AG-1-2009 with addenda.
- b. Air heaters should be designed, constructed, and tested in accordance with Section CA of ASME AG-1-2009 with addenda.
- c. Materials used in the prefilters should withstand the radiation levels and environmental conditions prevalent during the postulated DBA. Prefilters should be designed, constructed, and tested in accordance with Section FB or FJ of ASME AG-1-2009 with addenda.
- d. HEPA filters used in ESF atmosphere cleanup systems should be designed, constructed, and tested in accordance with Section FC of ASME AG-1-2009 with addenda. HEPA filters should be compatible with the chemical composition and physical conditions of the air stream. Each HEPA filter should be tested for penetration of a challenge aerosol, such as dioctyl phthalate or 4 centistoke polyalpha olephin (PAO), in accordance with section TA of ASME AG-1-2009 with addenda.

² The pertinent quality assurance requirements of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 apply to all activities affecting the safety-related functions of all components of the ESF atmosphere cleanup system.

Testing and documentation should be in accordance with a quality assurance program consistent with Appendix B to 10 CFR Part 50.

- e. The HEPA filter and Type II adsorber cell mounting frames should be constructed and designed in accordance with Section FG of ASME AG-1-2009 with addenda.
- f. Filter and adsorber banks should be arranged in accordance with the recommendations of Section HA of ASME AG-1-2009 with addenda.
- g. System filter housings, including floors and doors, should be constructed and designed in accordance with Section HA of ASME AG-1-2009 with addenda.
- h. Water drains should be designed in accordance with the recommendations of Section HA of ASME AG-1-2009 with addenda, including Appendix HA-B. Special design features, such as water traps for each drain, should be incorporated into drain systems to prevent contaminated air bypassing filters or adsorbers through the drain system. Procedures should be in place to routinely verify the water level. Drains should be piped to a radioactive waste system.
- i. Adsorption units function most efficiently for the removal of radioiodine, particularly organic iodides, at an input relative humidity of 70 percent or less. If the relative humidity of the air entering the ESF atmosphere cleanup system is expected to exceed 70 percent during accident situations, humidity control should be provided in the system design for controlling the relative humidity of the air entering the system.
Humidity control promotes the long-term retention of radioiodine in the iodine adsorbers (minimizing the potential for early desorption and release) by maintaining the relative humidity at less than or equal to 70 percent. For secondary systems, humidity control may be provided by either safety-related heaters or an analysis that demonstrates that the air entering the adsorbers is maintained at less than or equal to 70 percent relative humidity under all DBA conditions. For primary systems, an electric heater should not be provided because its use inside containment could result in a spark and possible hydrogen explosion in the event of an accident. Systems with humidity control can perform laboratory testing of representative samples of activated carbon at a relative humidity of 70 percent, and systems without humidity control should perform laboratory testing of representative samples of activated carbon at a relative humidity of 95 percent (see Table 2 of this guide).
- j. Adsorbers should be designed, constructed, and tested in accordance with Section FD (for Type II adsorber cells) or Section FE (for Type III adsorber cells) of ASME AG-1-2009 with addenda.

The design of the adsorber section should consider possible iodine desorption and adsorbent auto-ignition that may result from radioactivity-induced heat in the adsorbent and concomitant temperature rise. Acceptable designs include a low-flow air bleed system, cooling coils, water sprays for the adsorber section, or other cooling mechanisms. Any cooling mechanism should satisfy the single-failure criterion. A low-flow air bleed system should satisfy the single-failure criterion for providing low-humidity (less than 70 percent relative humidity) cooling airflow.

When a water-based fire suppression or prevention (cooling) system is installed in the ESF atmosphere cleanup system housing, the fire system should be manually actuated unless there is a reasonable probability that the iodine desorption and adsorbent auto-ignition could occur in the housing, in which case the fire system should have both automatic and manual actuation. The fire system should use open spray nozzles or devices of sufficient size, number, and location to provide complete coverage over the entire surface of the combustible filter media. The fire

system should be hard piped and supplied with a reliable source of water at adequate pressure and volume. The location of the manual release (or valve) for the fire system should be remote from the cleanup system housing and should be consistent with the ALARA guidance in Regulatory Guide 8.8 (Ref. 26). Automatic fire systems should include a reliable means of detection³ to actuate the system. Cross-zoning of detectors is acceptable. Manual fire systems should include a reliable means of internal monitoring for determining when to manually actuate the fire systems. The monitoring indication should be remote from the cleanup system housing in accordance with ALARA practices.

- k. The adsorber section of the ESF atmosphere cleanup system may contain any adsorbent material demonstrated to remove gaseous iodine (elemental iodine and organic iodides) from air at the required efficiency. However, because impregnated activated carbon⁴ is used almost exclusively, only impregnated activated carbon is discussed in this guide.

Each original or replacement batch or lot of impregnated activated carbon used in the adsorber section should meet Section FF-5000 of ASME AG-1-2009 with addenda.^{5,6} A test performed as a “qualification test” should be interpreted to mean a test that establishes the suitability of a manufacturer’s product for a generic application, normally a one-time test establishing the typical performance of the product. Tests not specifically identified as being performed only for qualification purposes should be interpreted as “batch tests.” Batch tests are tests to be made on each production batch of product to establish suitability for a specific application. Test conditions and acceptance criteria for batch tests should be the same as, or more stringent than, those specified in the plant’s technical specifications for the specific application.

If impregnated activated carbon is used as the adsorbent, the adsorber system should be designed for an average atmosphere residence time of 0.25 seconds per 2 inches of adsorbent bed. Sections FD and FE of ASME AG-1-2009 with addenda should be used to determine the residence time. The adsorption unit should be designed for a maximum loading of 2.5 milligrams of total iodine (radioactive plus stable) per gram of activated carbon. No more than 5 percent of impregnant (50 milligrams of impregnant per gram of carbon) should be used. The radiation stability of the type of carbon specified should be demonstrated and certified (see Regulatory Position 2.b of this guide for the design source term).

If an adsorbent other than impregnated activated carbon is proposed, or if the mesh size distribution or other physical properties of the impregnated activated carbon are different from the specifications above, the proposed adsorbent should have the capability to perform as well as

³ Detection can be accomplished by a mechanical or electrical device, including, but not limited to, thermal, carbon monoxide, or smoke detectors.

⁴ Activated carbon is typically impregnated with a chemical compound or compounds to enhance radioiodine retention, particularly under high temperature and humidity conditions. Typical impregnants include iodides such as potassium iodide and triiodide, amines such as triethylenediamine, and combinations thereof.

⁵ A “batch of activated carbon” or a “batch of impregnated activated carbon” is a quantity of adsorbent, not to exceed 10 cubic meters (or 350 cubic feet) in size, of the same grade or type that has been produced under the same manufacturer’s production designation using a consistent manufacturing procedure and equipment, and that has been homogenized to exhibit the same physical properties and performance characteristics throughout the mass. (See Article FF-1130 of ASME AG-1-2009 with addenda.)

⁶ A “lot of activated carbon” or a “lot of impregnated activated carbon” is that quantity of adsorbent consisting of one or more batches of adsorbent that constitute and satisfy a purchase order. (See Article FF-1130 of ASME AG-1-2009 with addenda.)

or better than activated carbon that satisfies the specifications in Article FF of ASME AG-1-2009 with addenda.

If sample canisters are used, they should be designed in accordance with Appendix I to ASME N509-2002 (Ref. 11).

- l. Ducts and filter housings should be laid out with a minimum of ledges, protrusions, and crevices that could collect dust and moisture and that could impede personnel or create a hazard to them in the performance of their work. Turning vanes or other airflow distribution devices should be installed where needed to ensure representative airflow measurement and uniform flow distribution through cleanup components.
- m. Dampers should be designed, constructed, and tested in accordance with Section DA of ASME AG-1-2009 with addenda.
- n. The system fan, its mounting, and the ductwork connections should be designed, constructed, and tested in accordance with Section BA (for blowers) and Section SA (for ducts) of ASME AG-1-2009 with addenda. The fan or blower used on the ESF atmosphere cleanup system should be capable of operating under the environmental conditions postulated, including radiation. Each driver should be qualified in accordance with Class 1E qualification standards in ANSI/IEEE Standard 323, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations." (Ref. 28) Ductwork should be designed, constructed, and tested in accordance with Section SA of ASME AG-1-2009 with addenda.
- o. If used as postfilters, medium-efficiency filters of Minimum Efficiency Reporting Value (MERV) 15 or higher should be used. Postfilters should be designed and constructed in accordance with Section FB of ASME AG-1-2009 with addenda.

5. Maintainability Criteria

Provisions for maintaining ESF atmosphere cleanup systems should be incorporated into the system design in accordance with Section HA of ASME AG-1-2009 with addenda (Ref. 13), as supplemented by the following:

- a. The accessibility of components for maintenance should be considered in the design of ESF atmosphere cleanup systems in accordance with Section HA of ASME AG-1-2009 with addenda. For ease of inspection and maintenance, the system design should provide for a minimum of 3 feet from mounting frame to mounting frame between banks of components. If components are to be replaced, the dimensions to be provided should be the maximum length of the component plus a minimum of 3 feet.
- b. The cleanup components (i.e., HEPA filters, prefilters, and adsorbers) that are used during construction of the ventilation systems should be replaced before the system is declared operable.
- c. Provisions for duct access for maintenance and inspection should be provided in accordance with Section 4.3.4 of National Fire Protection Association (NFPA) 90A, "Standard for the Installation of Air-Conditioning and Ventilation Systems" (Ref. 29). Ductwork should be inspected as needed to ensure continued operability in accordance with the expected design parameters of the system in a postaccident environment. Operating experience, such as that contained in Information Notice 10-27, "Ventilation System Preventative Maintenance and Design Issues," dated December 16, 2010 (Ref. 30), should be considered.

6. In-Place Testing Criteria

Initial in-place acceptance testing of ESF atmosphere cleanup systems and components should be performed in accordance with Section TA of ASME AG-1-2009 with addenda (Ref. 13). Periodic in-place testing of ESF atmosphere cleanup systems and components should be performed in accordance with ASME N511-2007 (Ref. 14), as modified and supplemented by the following:

- a. Each ESF atmosphere cleanup train should be operated continuously for at least 15 minutes each month, with the heaters on (if so equipped), to justify the operability of the system and all of its components.
- b. A visual inspection of the ESF atmosphere cleanup system and all associated components should be performed in accordance with Section 4.1 of ASME N511-2007.
- c. In-place aerosol leak tests for HEPA filters upstream from the carbon adsorbers in ESF atmosphere cleanup systems should be performed in accordance with and at the frequency intervals specified in Sections 5.1 and 5.7 of Appendix III to ASME N511-2007 or (1) after each partial or complete replacement of a HEPA filter bank, (2) following detection of, or evidence of, penetration or intrusion of water or other material into any portion of an ESF atmosphere cleanup system that may have an adverse effect on the functional capability of the filters, and (3) following painting, fire, or chemical release in any ventilation zone communicating with the system that may have an adverse effect on the functional capability of the system.⁷ The leak test should confirm a combined penetration and leakage (or bypass)⁸ of the ESF atmosphere cleanup system of less than 0.05 percent of the challenge aerosol at system rated flow plus or minus 10 percent. To be credited with 99-percent removal efficiency for particulate matter in accident dose evaluations, a HEPA filter bank in an ESF atmosphere cleanup system should demonstrate an aerosol leak test result of less than 0.05 percent of the challenge aerosol at system rated flow plus or minus 10 percent. The test should be documented in accordance with Section TA-6000 of ASME AG-1-2009 with addenda.
- d. HEPA filter sections in ESF atmosphere cleanup systems that fail to satisfy the appropriate leak-test criteria should be examined to determine the location and cause of leaks. Adjustments, such as alignment of filter cases and tightening of filter holddown bolts, may be made; however, patching or caulking materials should not be used in the repair of defective, damaged, or torn filter media in ESF atmosphere cleanup systems: such filters should be replaced and not repaired. HEPA filters that fail to satisfy test criteria should be replaced with filters qualified under Regulatory Position 4.d of this guide. After adjustments or filter replacement, the ESF atmosphere cleanup system should be retested as described above in this regulatory position. The

⁷ Painting, fire, or chemical release is “not communicating” with the HEPA filter or adsorber if the ESF atmosphere cleanup system is not in operation, the isolation dampers for the system are closed, and there is no pressure differential across the filter housing. This provides reasonable assurance that air is not passing through the filters and adsorbers. A program should be developed and consistently applied that defines the terms “painting,” “fire,” and “chemical release” in terms of the potential for degrading the HEPA filters and adsorbers. This program should be based on a well-documented, sound, and conservative technical basis (i.e., the criteria should overestimate the potential damage to the filter and adsorber).

⁸ In Section FD-1130 of ASME AG-1-2009 with addenda, “penetration” is defined as the exit concentration of a given gas from an air-cleaning device, expressed as a percentage of inlet concentration. “Bypass” is defined as a pathway through which contaminated air can escape treatment by the installed HEPA or adsorber banks. Examples are leaks in filters and filter mounting frames, defective or inefficient isolation dampers that result in uncontrolled flow through adjacent plenums, and unsealed penetrations for electrical conduits, pipes, floor drains, and so forth.

above process should be repeated as necessary until combined penetration and leakage (bypass) of the system is less than the acceptance criteria described above in this regulatory position.

- e. The standard challenge aerosol used in the in-place leak testing of HEPA filters is polydisperse droplets of dioctyl phthalate (DOP), also known as di-2-ethylhexyl-phthalate (DEHP). Alternative challenge agents⁹ may be used to perform in-place leak testing of HEPA filters when their selection is based on the following:
 - (1) The challenge aerosol has the approximate light-scattering droplet size specified in Article TA-VI-3000 of ASME AG-1-2009 with addenda.
 - (2) The challenge aerosol meets the characteristics described in Appendix TA-C-1200 to ASME-AG-1-2009 with addenda.
- f. In-place leak testing for adsorbers should be performed in accordance with and at the frequency intervals specified in Sections 5.1 and 5.8 of Appendix IV to ASME N511-2007 or (1) following removal of an adsorber sample for laboratory testing if the integrity of the adsorber section is affected, (2) after each partial or complete replacement of carbon adsorber in an adsorber section, (3) following detection of, or evidence of, penetration or intrusion of water or other material into any portion of an ESF atmosphere cleanup system that may have an adverse effect on the functional capability of the adsorber, and (4) following painting, fire, or chemical release in any ventilation zone communicating with the system that may have an adverse effect on the functional capability of the system.⁷ The leak test should confirm a combined penetration and leakage (or bypass)⁸ of the adsorber section of 0.05 percent or less of the challenge gas at rated flow plus or minus 10 percent. The test should be documented in accordance with Section TA-6000 of ASME AG-1-2009 with addenda.
- g. Adsorber sections that fail to satisfy the appropriate leak-test conditions should be examined to determine the location and cause of leaks. Repairs, such as alignment of adsorber cells, tightening of adsorber cell holddown bolts, or tightening of test canister fixtures, may be made; however, the use of temporary patching material on adsorbers, filters, housings, mounting frames, or ducts should not be allowed. After repairs or adjustments have been made, the adsorber sections should be retested as described above in this regulatory position. The above process should be repeated as necessary until the combined penetration and leakage (bypass) of the adsorber section is less than the acceptance criteria described above in this regulatory position.
- h. The standard challenge gas used in the in-place leak testing of adsorbers is Refrigerant-11 (trichloromonofluoromethane). Alternative challenge gases may be used to perform in-place leak testing of adsorbers when their selection is based on meeting the characteristics specified in Appendix TA-C-1100 to ASME AG-1-2009 with addenda.
- i. If any welding repairs are necessary on, within, or adjacent to the ducts, housing, or mounting frames, the HEPA filters and adsorbers should be removed from the housing (or otherwise protected) before such repairs are performed. The repairs should be completed before reinstallation of filters and adsorbers; the system should then be visually inspected and leak tested as in Regulatory Positions 6.a through 6.h.

⁹ Care should be taken to ensure that the aerosol generator is compatible with the selected alternative challenge agent (see NRC Information Notice 99-34, "Potential Fire Hazards in the Use of Polyalphaolefin in Testing of Air Filters," dated December 28, 1999 (Ref. 31)).

7. Laboratory Testing Criteria for Activated Carbon

Laboratory testing of samples of activated carbon adsorber material from ESF atmosphere cleanup systems should be performed in accordance with ASTM D3803-1991 (R2009) (Ref. 15) and Table 2 of this guide, as supplemented by the following:

- a. If an analysis of unused activated carbon has not been conducted within the past 5 years, representative¹⁰ samples of the unused activated carbon should be collected at the time of installation or replacement of adsorber material and submitted for analysis. The analysis should be performed in accordance with Regulatory Position 4.k or Table 2 of this guide, whichever is more restrictive. Carbon that is stored for future use should be stored in its original unopened and undamaged container and stored in a storage area that meets the specifications provided in Subpart 2.2 of ASME NQA-1-2008, “Quality Assurance Requirements for Nuclear Facility Applications” (Ref. 32). Licensees should not use carbon that does not meet these specifications without performing an analysis demonstrating its current capability.
- b. Sampling and analysis should be performed (1) after each 720 hours of system operation, or at least once each 24 months, whichever comes first, (2) following painting, fire, or chemical release in any ventilation zone communicating with the system that may have an adverse effect on the functional capability of the carbon media,⁷ and (3) following detection of, or evidence of, penetration or intrusion of water or other material into any portion of an ESF atmosphere cleanup system that may have an adverse effect on the functional capability of the carbon media.
- c. For accident dose evaluation purposes, the activated carbon adsorber section of an ESF atmosphere cleanup system should be assigned the appropriate decontamination efficiency given in Table 2 for elemental iodine and organic iodides if the following conditions are met:
 1. The adsorber section meets the leak-test conditions given in Regulatory Position 6.c of this guide
 2. New activated carbon meets the performance and physical property specifications given in Regulatory Position 4.k of this guide and Article FF-5000 of ASME AG-1-2009 with addenda.
 3. Representative samples of new or used activated carbon pass the applicable laboratory tests specified in Table 2 of this guide.

If the activated carbon fails to meet any of the above conditions, it should not be used in adsorbers in ESF atmosphere cleanup systems.

- d. The activated carbon adsorber section should be replaced with new unused activated carbon that meets the performance and physical property specifications of Regulatory Position 4.k of this guide if (1) testing in accordance with Regulatory Positions 7.a and 7.b results in a representative sample that fails to pass the applicable test in Table 2 of this guide or (2) no representative sample is available for testing.

¹⁰ For the definition of “representative sample” and a description of sampling methods, see Appendix I to ASME N509-2002 (Ref. 11).

**Table 1. Instrumentation, Readout, Recording, and Alarm Provisions
for ESF Atmosphere Cleanup Systems**

Sensing location	Local readout/alarm	Continuously manned control panel (main control room or auxiliary control panel if manning is a technical specification requirement)
Unit inlet or outlet	Flow rate (indication)	Flow rate (recorded indication, high alarm and low alarm signals)
Demister	Pressure drop (indication) (optional high alarm signal)	
Electric heater	Status indication	
Space between heater and prefilter	Temperature (indication, high alarm, and low alarm signals)	Temperature (indication, high alarm, low alarm, trip alarm signals)
Prefilter	Pressure drop (indication, high alarm signal)	
First HEPA (pre-HEPA)	Pressure drop (indication, high alarm signal)	Pressure drop (recorded indication)
Space between adsorber and second HEPA (post-HEPA)	Temperature (two-stage high alarm signal)	Temperature (indication, two-stage high alarm signal)
Second HEPA (post-HEPA)	Pressure drop (indication, high alarm signal)	
Fan	(Optional hand switch and status indication)	Hand switch, status indication
Valve/damper operator	(Optional status indication)	Status indication
Deluge valves	Hand switch, status indication	Hand switch, status indication
System inlet to outlet		Summation of pressure drop across total system, high alarm signal

Table 2. Laboratory Tests for Activated Carbon

Activated Carbon^a Total Bed Depth^b	Maximum Assigned Credit for Activated Carbon Decontamination Efficiencies		Methyl Iodide Penetration Acceptance Criterion for Representative Sample
2 inches	Elemental iodine	95%	Penetration $\leq 2.5\%$ when tested in accordance with ASTM D-3803-1991 (R2009) (Ref. 15)
	Organic iodide	95%	
4 inches or greater	Elemental iodine	99%	Penetration $\leq 0.5\%$ when tested in accordance with ASTM D-3803-1991 (R2009) (Ref. 15)
	Organic iodide	99%	

^a The activated carbon, when new, should meet the specifications of Regulatory Position 4.k of this guide.

^b Multiple beds (e.g., two 2-inch beds in series) should be treated as a single bed of aggregate depth. It is advantageous when series beds are located in separate housings and individually in-place leak tested. This aids in mixing the challenge agent and contributes to the accuracy of the test results.

NOTES:

- (1) Credited decontamination efficiencies (a portion of which includes bypass leakage) are based on a 0.25-second residence time per 2-inch bed depth.
- (2) Organic iodide and elemental iodine are the forms of iodine that are expected to be absorbed by activated carbon during a DBA. Organic iodide is more difficult for activated carbon to adsorb than elemental iodine. Therefore, the laboratory test to determine the performance of the activated carbon adsorber is based on organic iodide. Methyl iodide is the organic form of iodine that is used in the laboratory test.
- (3) This table provides acceptable decontamination efficiencies and methyl iodide test penetrations of used activated carbon samples for laboratory testing. Laboratory tests are conducted in accordance with ASTM D3803-1991 (R2009) (Ref. 15). Tests are conducted at a temperature of 30 degrees Celsius and a relative humidity of 95 percent, with the exception that a relative humidity of 70 percent is used when the air entering the carbon adsorber is maintained at less than or equal to 70-percent relative humidity.
- (4) See Appendix I to ASME N509-2002 (Ref. 11) for the definition of a representative sample. Testing should be performed at the frequencies specified in Regulatory Position 7.b of this guide. Testing should be performed in accordance with ASTM D3803-1991 (R2009) (Ref. 15) at a temperature of 30 degrees Celsius and a relative humidity of 95 percent (or 70 percent with humidity control). The allowable penetration as specified in Table 2 is derived using the methyl iodide penetration acceptance criterion for a representative sample with a safety factor of two according to NRC Generic Letter 99-02 (Ref. 33).

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D. IMPLEMENTATION

The purpose of this section is to provide information on how applicants and licensees may use this guide and information regarding the NRC's plans for using this regulatory guide. In addition, it describes how the NRC staff has complied with the Backfit Rule, 10 CFR 50.109, and any applicable finality provisions in 10 CFR Part 52.

Use by Applicants and Licensees

Applicants and licensees may voluntarily use the information in this regulatory guide to develop applications for initial licenses, amendments to licenses, requests for exemptions, or NRC regulatory approval. Licensees may use the information in this regulatory guide for actions that do not require prior NRC review and approval (e.g., changes to a facility design under 10 CFR 50.59 that do not require prior NRC review and approval). Licensees may voluntarily use the information in this regulatory guide or applicable parts to resolve regulatory or inspection issues (e.g., by committing to comply with provisions in the regulatory guide).

Current licensees may continue to use the guidance that was found acceptable for complying with specific portions of the regulations as part of their license approval process, which may be a previous version of this regulatory guide.

A licensee who believes that the NRC staff is inappropriately imposing this regulatory guide as part of a request for a license amendment or request for a change to a previously issued NRC regulatory approval may file a backfitting appeal with the NRC in accordance with applicable procedures.

Use by NRC Staff

The NRC staff does not intend or approve any imposition or backfitting of the guidance in this regulatory guide. The staff does not expect any existing licensee to use or commit to using the guidance in this regulatory guide in the absence of a licensee-initiated change to its licensing basis. The NRC staff does not expect or plan to request licensees to voluntarily adopt this regulatory guide to resolve a generic regulatory issue. The NRC staff does not expect or plan to initiate NRC regulatory action that would require the use of this regulatory guide (e.g., issuance of an order requiring the use of the regulatory guide, requests for information under 10 CFR 50.54(f) as to whether a licensee intends to commit to use of this regulatory guide, generic communication, or promulgation of a rule requiring the use of this regulatory guide) without further backfit consideration.

During inspections of specific facilities, the staff may suggest or recommend that licensees consider various actions consistent with staff positions in this regulatory guide as one acceptable means of meeting the underlying NRC regulatory requirement. Such suggestions and recommendations would not ordinarily be considered backfitting even if prior versions of this regulatory guide are part of the licensing basis of the facility with respect to the subject matter of the inspection. However, the staff may not represent to the licensee that: (1) the licensee's failure to comply with the positions in this regulatory guide constitutes a violation, (2) the licensee may avoid the violation only by agreeing to comply with this regulatory guide, or (3) the only acceptable way for the licensee to address the NRC-identified noncompliance or violation is to commit to this regulatory guide (i.e., including this regulatory guide in the facility's licensing basis).

If an existing licensee seeks an amendment or change in an already approved area of NRC regulatory concern and (1) the NRC staff's consideration of the request involves a regulatory issue

directly relevant to this new or revised regulatory guide and (2) the specific subject matter of this regulatory guide is an essential consideration in the staff's determination of the acceptability of the licensee's request, then, as a prerequisite for NRC approval of the license amendment or change, the staff may require the licensee to either follow the guidance in this regulatory guide or to provide an equivalent alternative method that demonstrates compliance with the underlying NRC regulatory requirements. This is not considered backfitting as defined in 10 CFR 50.109(a)(1) or a violation of any of the issue finality provisions in 10 CFR Part 52.

Conclusion

This regulatory guide is not being imposed upon current licensees and may be voluntarily used by existing licensees. In addition, this regulatory guide is issued in conformance with all applicable internal NRC policies and procedures governing backfitting. Accordingly, the issuance of this regulatory guide by the NRC staff is not considered backfitting, as defined in 10 CFR 50.109(a)(1), nor is it deemed to be in conflict with any of the issue finality provisions in 10 CFR Part 52.

REFERENCES¹¹

1. 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” U.S. Nuclear Regulatory Commission, Washington DC.
2. 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” U.S. Nuclear Regulatory Commission, Washington DC.
3. 10 CFR Part 100, “Reactor Site Criteria,” U.S. Nuclear Regulatory Commission, Washington DC.
4. Regulatory Guide 1.140, “Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light—Water—Cooled Nuclear Power Plants,” U.S. Nuclear Regulatory Commission, Washington, DC
5. Regulatory Guide 1.3, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors,” U.S. Nuclear Regulatory Commission, Washington, DC.
6. Regulatory Guide 1.4, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors,” U.S. Nuclear Regulatory Commission, Washington, DC.
7. TID-14844, “Calculation of Distance Factors for Power and Test Reactor Sites,” U.S. Atomic Energy Commission, Washington, DC, 1962.
8. NUREG-1465, “Accident Source Terms for Light-Water Nuclear Power Plants,” U.S. Nuclear Regulatory Commission, Washington, DC, February 1995.
9. Regulatory Guide 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors,” U.S. Nuclear Regulatory Commission, Washington, DC.
10. Regulatory Guide 1.25, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors,” U.S. Nuclear Regulatory Commission, Washington, DC.
11. ASME N509-2002, American Society of Mechanical Engineers, ASME Standard N509, “Nuclear Power Plant Air-Cleaning Units and Components,” American Society of Mechanical Engineers, New York, NY, 2002, Reaffirmed 2008.¹²

¹¹ Publicly available NRC published documents are available electronically through the NRC Library on the NRC’s public Web site at: <http://www.nrc.gov/reading-rm/doc-collections/>. The documents can also be viewed on-line or printed for a fee in the NRC’s Public Document Room (PDR) at 11555 Rockville Pike, Rockville, MD; the mailing address is USNRC PDR, Washington, DC 20555; telephone 301-415-4737 or (800) 397-4209; fax (301) 415-3548; and e-mail pdr.resource@nrc.gov.

¹² Copies of American Society of Mechanical Engineers (ASME) standards may be purchased from ASME, Three Park Avenue, New York, New York 10016-5990; telephone (800) 843-2763. Purchase information is available through the ASME Web-based store at <http://www.asme.org/Codes/Publications/>.

12. ASME N510-2007, American Society of Mechanical Engineers, ASME Standard N510, "Testing of Nuclear Air-Treatment Systems," American Society of Mechanical Engineers, New York, NY, 2007
13. ASME AG-1-2009, American Society of Mechanical Engineers, ASME Standard AG-1, "Code on Nuclear Air and Gas Treatment," 2009, including the 2010 Addendum 1a and the 2011 Addendum 1b.
14. ASME N511-2007, American Society of Mechanical Engineers Standard N511, "In-Service Testing of Nuclear Air Treatment, Heating, Ventilating, and Air-Conditioning Systems," American Society of Mechanical Engineers, New York, NY, 2007.
15. ASTM D3803-1991, "Standard Test Methods for Nuclear-Grade Activated Carbon," *Annual Book of ASTM Standards*, American Society for Testing and Materials, West Conshohocken, PA, 1991, Reapproved 2009.¹³
16. International Atomic Energy Agency (IAEA) Safety Standard No. NS-G-1.10, "Design of Reactor Containment Systems for Nuclear Power Plants," International Atomic Energy Agency, Vienna, Austria, 2004¹⁴.
17. Regulatory Guide 1.29, "Seismic Design Classification," U.S. Nuclear Regulatory Commission, Washington, DC.
18. DOE-HDBK-1169-2003, "Nuclear Air Cleaning Handbook," U.S. Department of Energy, Washington, DC, November 2003. (See <http://www.hss.doe.gov/nuclearsafety/ns/techstds/>.)
19. Regulatory Guide 1.32, "Criteria for Power Systems for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC.
20. IEEE Std 603-1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers Inc., Piscataway, NJ, June 27, 1991.
21. Regulatory Guide 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC.
22. Regulatory Guide 1.30, "Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment," U.S. Nuclear Regulatory Commission, Washington, DC.
23. Regulatory Guide 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC.

¹³ Copies of American Society for Testing and Materials (ASTM) standards may be purchased from ASTM, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, Pennsylvania 19428-2959; telephone (610) 832-9585. Purchase information is available through the ASTM Web site at <http://www.astm.org>.

¹⁴ Copies of International Atomic Energy Agency (IAEA) documents may be obtained through their Web site: WWW.IAEA.Org/ or by writing to the International Atomic Energy Agency (IAEA) documents may be obtained through their Web site: WWW.IAEA.Org/ or by writing to the International Atomic Energy Agency P.O. Box 100 Wagramer Strasse 5, A-1400 Vienna, Austria. Telephone (+431) 2600-0, Fax (+431) 2600-7, or E-Mail at Official.Mail@IAEA.Org the International Atomic Energy Agency P.O. Box 100 Wagramer Strasse 5, A-1400 Vienna, Austria. Telephone (+431) 2600-0, Fax (+431) 2600-7, or E-Mail at Official.Mail@IAEA.Org

24. Regulatory Guide 1.118, "Periodic Testing of Electric Power and Protection Systems," U.S. Nuclear Regulatory Commission, Washington, DC.
25. Regulatory Guide 1.40, "Qualification of Continuous Duty Safety-Related Motors for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC.
26. Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," U.S. Nuclear Regulatory Commission, Washington, DC.
27. Regulatory Guide 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," U.S. Nuclear Regulatory Commission, Washington, DC.
28. IEEE Std 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers Inc., Piscataway, NJ, 1974.
29. NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilation Systems," National Fire Protection Association (NFPA), National Fire Codes, 2002.¹⁵
30. IN 10-27, "Ventilation System Preventive Maintenance and Design Issues" U.S. Nuclear Regulatory Commission, Washington, DC, December 16, 2010.
31. IN 99-34, "Potential Fire Hazards in the Use of Polyalphaolefin in Testing of Air Filters," U.S. Nuclear Regulatory Commission, Washington, DC, December 28, 1999.
32. ASME NQA-1-2008, American Society of Mechanical Engineers, ASME Standard NQA-1, "Quality Assurance Requirements for Nuclear Facility Applications," American Society of Mechanical Engineers, New York, NY, 2008.
33. GL 99-02, "Laboratory Testing of Nuclear-Grade Activated Charcoal," U.S. Nuclear Regulatory Commission, Washington, DC, June 3, 1999, including GL 99-02 errata dated August 23, 1999.

¹⁵ The listed National Fire Protection Association (NFPA) code names and titles are based on the current editions of the codes. The "code of record" for an existing plant will typically be an earlier edition and/or may be an edition with a different title and/or number that addresses the same subject. The code of record for fire protection system modifications and for new reactors should be in accordance with the "Code of Record" subsection in Section B of this regulatory guide. Copies may be purchased from the NFPA, 1 Batterymarch Park, Quincy, Massachusetts; telephone (800) 344-3555 and fax (800) 593 NFPA (6372). Purchase information is available through the NFPA Web based store at <http://www.nfpa.org/Catalog/>.