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REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 1.52

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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

A. INTRODUCTION

This regulatory guide (RG) provides a method that the U.S. Nuclear Regulatory Commission (NRC) considers acceptable to implement Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities" (Ref. 1), 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 assure 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 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 for licensees that implement an alternative source term pursuant to 10 CFR 50.67, "Accident Source Term," or applicants or licensees that apply on or after January 10, 1997 under 10 CFR Part 50 or 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants" (Ref. 2).

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 on or after January 10, 1997, the siting criteria in 10 CFR 100.21, "Non-Seismic Siting Criteria," refer to dose values in 10 CFR 50.34(a)(1), which also are 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. These sections in 10 CFR Part 52 also all have footnotes on the fission product release assumptions similar to the footnote in 10 CFR 100.11. According to 10 CFR 50.67, 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. RG 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).

This RG 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 RG is a rule as designated in the Congressional Review Act (5 U.S.C. 801-808). However, the NRC has determined that this RG is not a major rule as designated by the Congressional Review Act.

B. DISCUSSION

The NRC published Revision 3 of RG 1.52 in June 2001 to provide licensees and applicants with agency-approved guidance for complying with 10 CFR Part 50, Appendix A with regard to the design, inspection, and testing of air filtration and iodine adsorption units of engineered-safety-feature atmosphere cleanup systems in light-water-cooled nuclear power plants. Since the publication of Revision 3, the American Society of Mechanical Engineers (ASME) Committee on Nuclear Air and Gas Treatment (CONAGT) has expanded the scope of equipment covered by ASME-AG-1, "Code on Nuclear Air and Gas Treatment." The staff had previously endorsed earlier revisions of ASME-AG-1 in RG 1.52. The revision to ASME-AG-1 consolidated select requirements from ASME-N509, "Nuclear Power Plant Air-Cleaning Units and Components," ASME-N510, "Testing of Nuclear Air-Treatment Systems," and other documents previously endorsed by the staff in RG 1.52. In addition, CONAGT has developed and published a new standard, ASME-N511-2007, "Inservice Testing of Nuclear Air Treatment, Heating Ventilation and Air Conditioning Systems." This new standard provides comprehensive test and inspection requirements and is written to complement the expanded ASME-AG-1. Revision 4 of this RG is necessary to address these changes to the referenced industry standards.

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 examples of ESF atmosphere cleanup systems.

Initially the characteristics of the fission product release from the core into the containment were set forth for most plants using the guidance in RG 1.3, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors” (Ref. 5), and RG 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 in 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 RG 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). RG 1.183 establishes an acceptable AST and identifies the significant attributes of other ASTs that the NRC staff finds acceptable. RG 1.183 also identifies acceptable radiological analysis assumptions for use in conjunction with the accepted AST. Most currently licensed plants use the alternative accident source term, as appropriate, in support of safety analyses performed in accordance with the following:

- 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)

- 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 appropriate radiation source term specified in RGs 1.3 (Ref. 5), 1.4 (Ref. 6), 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" (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 to preserve or extend the useful service life of the filtration and iodine adsorption media. ESF system dampers also may 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 also may 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 iodine adsorbers. The preferred design of the housing and the injection and measurement ports should provide for testing HEPA filters without the need for removal of any other component (e.g., adsorbers or downstream filters).

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 also should 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.

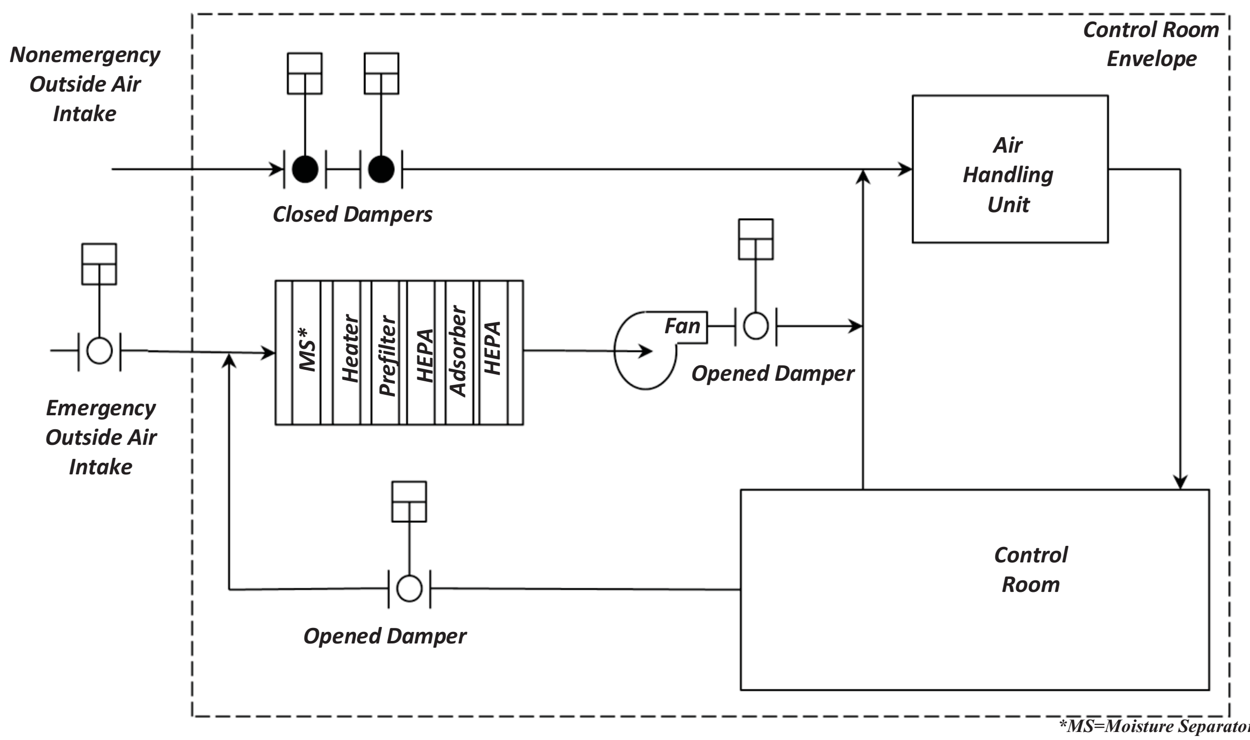
All ESF atmosphere cleanup system components should be designed for reliable performance under accident conditions. Qualification and initial testing, periodic inspection and testing, and proper maintenance are primary factors in ensuring the reliability of the ESF atmosphere cleanup system. Careful 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 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).

This regulatory guide endorses the use of one or more voluntary consensus codes or standards developed by external organizations. These codes or standards may contain references to other codes or standards. These references should be considered individually. If a referenced standard has been incorporated separately into NRC 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 the specific regulatory guide. If a referenced standard has been neither incorporated into NRC regulations nor endorsed in a regulatory guide, licensees and applicants may consider and use the information in the referenced standard, if appropriately justified and consistent with current regulatory practice.

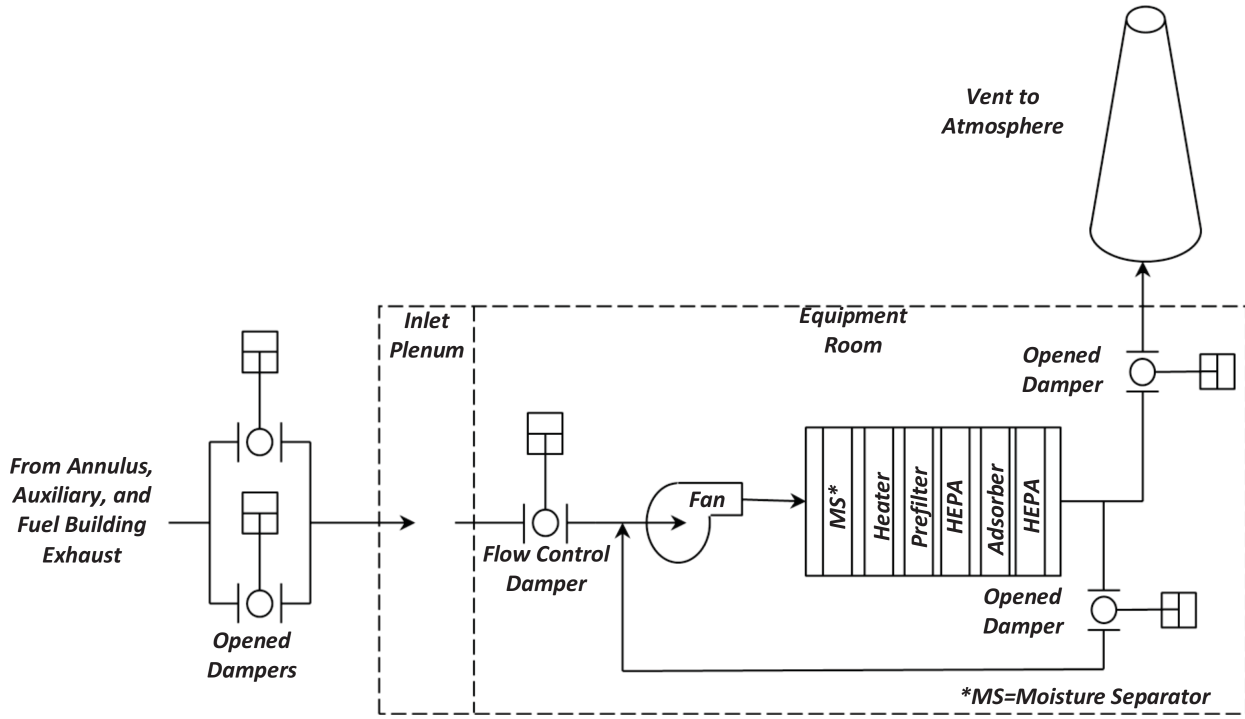
The International Atomic Energy Agency (IAEA) has established a series of safety guides and standards constituting a high level of safety for protecting people and the environment. IAEA safety guides present international good practices and increasingly reflect best practices to help users achieve high levels of safety. Pertinent to this RG, 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 on 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 for Installed HEPA filters and charcoal iodine adsorbers in IAEA Safety Guide NS-G-1.10 Paragraphs 4.139 through 4.143.

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 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 RG 1.3 (Ref. 5), RG 1.4 (Ref. 6), RG 1.25 (Ref. 10), or RG 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 RGs 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 post-accident 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 dust, 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 valves[1] 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 RG 1.29, "Seismic Design Classification" (Ref. 17)).

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. 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). Instrumentation, readout, recording, and alarm provisions for ESF atmosphere cleanup systems should meet the guidance given in Table 1 of this RG as a minimum.

h. The power supply and electrical distribution system for the ESF atmosphere cleanup system should be designed in accordance with RG 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 RG 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants" (Ref. 21). To the extent applicable, RG 1.30, "Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment" (Ref. 22), RG 1.100, "Seismic Qualification of Electric and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants" (Ref. 23), RG 1.118, "Periodic Testing

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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 Radioactivity Releases," of Appendix A to 10 CFR Part 50.

of Electric Power and Protection Systems" (Ref. 24), and RG 1.40, "Qualification of Continuous Duty Safety-related Motors for Nuclear Power Plants" (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 RG 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.

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 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 HA-4500 and section SA-4500, respectively, 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 RG 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]

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[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.

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, in accordance with section TA of ASME AG-1-2009 with addenda.

   Testing and documentation should be in accordance with a quality assurance program consistent with Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," 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 RG 8.8 (Ref. 26). Automatic fire systems should include a reliable means of detection[3] 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 carbon[4] is used almost exclusively, only impregnated activated carbon is discussed in this guide.

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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.

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 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 section 4.13(b) and 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

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).

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 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 0.9 meters (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 0.9 meters (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 post-accident environment. Operating experience, such as that contained in Information Notice 10-27, "Ventilation System Preventive 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 iodine 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 and 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 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.

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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.

e. The standard challenge aerosol used in the in-place leak testing of HEPA filters is polydisperse droplets of dioctyl phthalate, also known as di-2-ethylhexyl-phthalate. Alternative challenge agents[9] 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 and 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 charcoal 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.

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[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, representative[10] 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 iodine 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.f 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 adsorbent 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

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

representative sample that fails to pass the applicable test in Table 2 of this guide or (2) no representative sample is available for testing.

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

Sensing location	**Local readout or 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 and 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 Organic iodide	95% 95%	Penetration ≤2.5% when tested in accordance with ASTM D-3803-1991 (R2009) (Ref. 15)
4 inches or greater	Elemental iodine Organic iodide	99% 99%	Penetration ≤0.5% when tested in accordance with ASTM D-3803-1991 (R2009) (Ref. 15)

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

b Multiple beds (e.g., two 0.6-meter (2-inch) beds in series) should be treated as a single bed of aggregate depth. When two or more beds are used in a series, it may be advantageous to locate these beds in separate housings. This may aid in the mixing of the challenge agent and contribute to the overall accuracy of the test. This does not preclude the use of test manifolds. Each bank shall be individually in-place leak tested.

NOTES:

(1) Credited decontamination efficiencies (a portion of which includes bypass leakage) are based on a 0.25-second residence time per 0.6 meter (2-inch) bed depth.

(2) The iodine forms organic iodide and elemental iodine are expected to be adsorbed 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 iodine 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 iodine 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).

D. IMPLEMENTATION

The purpose of this section is to provide information on how applicants and licensees[11] may use this RG and information on the NRC's plans for using this RG. In addition, it describes how the NRC staff has complied with the Backfit Rule, 10 CFR 50.109, "Backfit," and any applicable finality provisions in 10 CFR Part 52.

Use by Applicants and Licensees

Applicants and licensees may voluntarily[12] use the guidance in this RG to demonstrate compliance with the underlying NRC regulations. Methods or solutions that differ from those described in this regulatory guide may be deemed acceptable if they provide sufficient basis and information for the NRC staff to verify that the proposed alternative demonstrates compliance with the appropriate NRC regulations.

Current licensees may continue to use the guidance the NRC found acceptable for complying with the identified regulations as long as their current licensing basis remains unchanged. The acceptable guidance may be a previous version of this regulatory guide.

Licensees may use the information in this regulatory guide for actions which do not require NRC review and approval such as changes to a facility design under 10 CFR 50.59. Licensees may use the information in this regulatory guide or applicable parts to resolve regulatory or inspection issues. This regulatory guide is not being imposed upon current licensees and may be voluntarily used by existing licensees.

Use by NRC Staff

The NRC staff does not intend or approve any imposition or backfitting of the guidance in this RG. The staff does not expect any existing licensee to use or commit to using the guidance in this RG 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 RG 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 RG (e.g., issuance of an order requiring the use of the RG, requests for information under 10 CFR 50.54(f) as to whether a licensee intends to commit to use of this RG, generic communication, or promulgation of a rule requiring the use of this RG without further backfit consideration).

During regulatory discussions on plant specific operational issues, the staff may discuss with licensees various actions consistent with staff positions in this RG as one acceptable means of meeting the underlying NRC regulatory requirement. Such discussions would not ordinarily be considered backfitting even if prior versions of this RG are part of the licensing basis of the facility. However, unless this regulatory guide is part of the licensing basis for a facility, the staff may not represent to the licensee that the licensee's failure to comply with the positions in this RG constitutes a violation.

If an existing licensee voluntarily seeks a license 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

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11 In this section, "licensees" refers to licensees of nuclear power plants under 10 CFR Parts 50 and 52; and the term "applicants," refers to applicants for licenses and permits for (or relating to) nuclear power plants under 10 CFR Parts 50 and 52, and applicants for standard design approvals and standard design certifications under 10 CFR Part 52.

12 In this section, "voluntary" and "voluntarily" means that the licensee is seeking the action of its own accord, without the force of a legally binding requirement or an NRC representation of further licensing or enforcement action.

directly relevant to this new or revised RG, and (2) the specific subject matter of this RG 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 that the licensee either follow the guidance in this RG or provide an equivalent alternative process 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.

Additionally, an existing applicant may be required to adhere to new rules, orders, or guidance if 10 CFR 50.109(a)(3) applies.

If a licensee believes that the NRC is either using this regulatory guide or requesting or requiring the licensee to implement the methods or processes in this regulatory guide in a manner inconsistent with the discussion in this Implementation section, then the licensee may file a backfit appeal with the NRC in accordance with the guidance in NUREG-1409 and NRC Management Directive 8.4.

REFERENCES[13]

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. RG 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. RG 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. RG 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. (ML021750625)

8. NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC, February 1995. (ML041040063)

9. RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," U.S. Nuclear Regulatory Commission, Washington, DC.

10. RG 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.[14]

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[13] 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 also can be viewed online 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.

[14] Copies of American Society of Mechanical Engineers (ASME) standards may be purchased from ASME, Three Park Avenue, New York, NY 10016-5990; telephone 800-843-2763. Purchase information is available through the ASME online 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," American Society of Mechanical Engineers, New York, NY, 2009, including the 2010 Addendum 1a and the 2011 Addendum 1b.

14. ASME N511-2007, American Society of Mechanical Engineers, ASME 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.[15]

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, 2004.[16]

17. RG 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. RG 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.[17]

21. RG 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC.

22. RG 1.30, "Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment," U.S. Nuclear Regulatory Commission, Washington, DC.

23. RG 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC.

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[15] 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, PA 19428-2959; telephone 610-832-9585. Purchase information is available through the ASTM Web site at http://www.astm.org.

[16] Copies of International Atomic Energy Agency (IAEA) documents may be obtained through the organization's Web site: http://www.IAEA.org/ or by writing to IAEA at 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.

[17] Copies of Institute of Electrical and Electronics Engineers (IEEE) documents may be purchased from the Institute of Electrical and Electronics Engineers Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855 or through the IEEE's public Web site at http://www.ieee.org/publications_standards/index.html.

24. RG 1.118, "Periodic Testing of Electric Power and Protection Systems," U.S. Nuclear Regulatory Commission, Washington, DC.

25. RG 1.40, "Qualification of Continuous Duty Safety-Related Motors for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC.

26. RG 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. RG 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.[18]

30. IN 10-27, "Ventilation System Preventive Maintenance and Design Issues" U.S. Nuclear Regulatory Commission, Washington, DC, December 16, 2010. (ML102450114)

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. (ML993550113)

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. (ML082350935 and ML031110094)

[18] Copies may be purchased from the NFPA, 1 Batterymarch Park, Quincy, MA 02269; 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/.