U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

6.5.1 ESF ATMOSPHERE CLEANUP SYSTEMS

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of ventilation and air filtration

Secondary - Organization responsible for review of design basis accident radiological consequence analyses

I. AREAS OF REVIEW

This review addresses engineered safety feature (ESF) atmosphere cleanup systems designed for fission product removal in post accident environments. These systems generally include primary systems, such as in-containment recirculation, and secondary systems, such as standby gas treatment systems and emergency or post-accident air-cleaning systems for the fuel-handling building, control room, shield building, and areas containing ESF components.

At the construction permit (CP) stage of review, the organization responsible for ventilation and air filtration reviews the information in the applicant's safety analysis report (SAR) in the areas listed below. At the operating license (OL) stage, the organization responsible for ventilation and air filtration review consists of confirming the design accepted at the CP stage and evaluating the adequacy of the applicant's technical specifications in these areas.

For design certification (DC) reviews or combined license (COL) reviews involving an application that does not reference a DC, the organization responsible for ventilation and air filtration reviews the information in the DCD or SAR, as applicable, in the areas listed below.

For each ESF atmosphere cleanup system, the specific areas of review are as follows:

1. The system design, design objectives, and design criteria. The organization responsible for ventilation and air filtration reviews the methods of operation and the factors that could influence the filtration capabilities of the system, e.g., system interfaces and potential bypass routes. The components included in each atmosphere cleanup system and the seismic design category of each system are reviewed. Redundancy of the atmosphere cleanup systems, the physical separation of the redundant trains, and the volumetric airflow rate of each train are reviewed.

2. The environmental design criteria, the design pressure and pressure differential, relative humidity, maximum and minimum temperature, and radiation source term.

3. The component design criteria, qualification requirements, and qualification testing of heaters, demisters, prefilters, and high-efficiency particulate air (HEPA) filters, design requirements of the filter and adsorber mounting frames, system filter and adsorber housings, and water drains, the adsorbent used for removal of gaseous iodines (in the preliminary safety analysis report (PSAR)), the physical properties of the adsorbent, and the design of the adsorber section of the filter trains (in the final safety analysis report (FSAR)). Provisions to inhibit offdesign temperatures in the adsorber section and the design criteria of the system fans or blowers, ductwork, and housings are also reviewed.

4. Design provisions incorporated in the equipment and features to facilitate operation and maintenance. The design of doors to the filter housings, the spacing of components, alignment and support of filter elements, the spacing of filter elements in the same bank, design of test probes, and provisions for adequate lighting in the filter housing are also reviewed.

5. The design criteria for inplace testing of the airflow distribution to the HEPA filters, dioctyl phthalate (DOP) testing of the HEPA filter sections, and gaseous halogenated hydrocarbon refrigerant bypass leak testing of the activated carbon adsorber section.

6. The laboratory test criteria for the activated carbon adsorbent, qualification and batch tests, provisions for obtaining representative adsorbent samples for laboratory testing in order to estimate the amount of penetration of the system adsorbent throughout its service life (PSAR), and the provisions and conditions for each field and laboratory test (FSAR).

7. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the staff reviews the applicant's proposed ITAAC associated with the structures, systems, and components (SSCs) related to this SRP section in accordance with SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria." The staff recognizes that the review of ITAAC cannot be completed until after the rest of this portion of the application has been reviewed against acceptance criteria contained in this SRP section. Furthermore, the staff reviews the ITAAC to ensure that all SSCs in this area of review are identified and addressed as appropriate in accordance with SRP Section 14.3.

8. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will also address COL action items and requirements and restrictions (e.g., interface requirements and site parameters).

For a COL application referencing a DC, a COL applicant must address COL action items (referred to as COL license information in certain DCs) included in the referenced DC. Additionally, a COL applicant must address requirements and restrictions (e.g., interface requirements and site parameters) included in the referenced DC.

Review Interfaces

Other SRP sections interface with this section as follows:

1. The organization responsible for ventilation and air filtration performs related reviews as part of its primary review responsibility under the SRP sections indicated:

   A. The organization responsible for ventilation and air filtration reviews control room habitability systems as part of its primary review responsibility for SRP Section 6.4.

   B. The organization responsible for ventilation and air filtration reviews the control room area ventilation system as part of its primary responsibility for SRP Section 9.4.1.

   C. The organization responsible for ventilation and air filtration reviews the spent fuel pool area ventilation system as part of its primary review responsibility for SRP Section 9.4.2.

   D. The organization responsible for ventilation and air filtration reviews the auxiliary and radwaste area ventilation system as part of its primary review responsibility for SRP Section 9.4.3.

   E. The organization responsible for ventilation and air filtration reviews the ventilation systems for areas housing engineered safety features as part of its primary review responsibility for SRP Section 9.4.5.

   F. The organization responsible for environmental qualification of safety-related electrical equipment reviews the qualification of essential power or electrical control cables associated with the ESF atmosphere cleanup system as part of its primary responsibility for SRP Section 3.11.

2. The review of the ESF atmosphere cleanup systems also involves reviewing evaluations performed by other organizations. The conclusions from other organizations evaluations are used by the organization responsible for ventilation and air filtration to complete the overall evaluation of the facility. The organization responsible for ventilation and air filtration will coordinate other organization's evaluations that interface with the overall review of the system, as follows:

   A. The organization responsible for containment systems and severe accidents reviews the secondary containment accident mitigation systems as part of its primary review responsibility for SRP Section 6.2.3.

   B. The organization responsible for civil engineering and geosciences determines the acceptability of the design analyses, procedures, and criteria used to establish the ability of seismic Category I structures housing the systems and

supporting systems to withstand the effects of natural phenomena such as the safe shutdown earthquake (SSE), probable maximum flood (PMF), and tornado missiles as part of its primary review responsibility for SRP Sections 3.3.1, 3.3.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5.

C. The organization responsible for mechanical engineering determines the acceptability of the seismic and quality group classifications for system components as part of its primary review responsibility for SRP Sections 3.2.1 and 3.2.2.

D. The review for technical specifications is coordinated and performed by the organization responsible for technical specifications as part of its primary review responsibility for SRP Section 16.0.

E. The review for quality assurance is coordinated and performed by the organization responsible for quality assurance and maintenance as part of its primary review responsibility for SRP Chapter 17.

F. The organization responsible for instrumentation and controls reviews the associated instrumentation as part of its primary review responsibility for SRP Sections 7.3 and 7.5.

G. The organization responsible for electrical engineering reviews the power supply and electrical distribution systems as part of its primary review responsibility for SRP Section 8.2.

H. The organization responsible for review of design basis accident radiological consequence analyses calculates the doses that could result as a consequence of postulated accidents as part of its review responsibility for SRP Sections 6.4, 6.5.2 through 6.5.4 and 15.0.3. Upon request, the organization responsible for review of design basis accident radiological consequence analyses will calculate filter loadings of all the iodine isotopes under accident conditions to enable the organization responsible for ventilation and air filtration to complete its overall evaluation of the ESF atmosphere cleanup systems.

The specific acceptance criteria and review procedures are contained in the reference SRP sections.

II. ACCEPTANCE CRITERIA

Requirements

Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

The installed ESF atmosphere cleanup systems are needed to mitigate the consequences of postulated accidents by removing from the atmosphere radioactive material that may be released in the event of an accident. The organization responsible for review of ventilation and air filtration acceptance criteria for the ESF atmosphere cleanup systems are based on meeting the relevant requirements of the following regulations:

1. General Design Criterion (GDC) 19, as it relates to maintaining the control room in a safe condition under accident conditions, including loss-of-coolant accidents (LOCAs).

2. GDC 41, as it relates to providing systems to control the release of fission products to the environment and to control the concentration of hydrogen, oxygen, and other substances in containment following postulated accidents.

3. GDC 42, as it relates to designing containment ESF atmosphere cleanup systems to permit inspection.

4. GDC 43, as it relates to designing containment ESF atmosphere cleanup systems to permit pressure and functional testing.

5. GDC 61 as it relates to the design of systems for radioactivity control under normal and postulated accident conditions.

6. GDC 64 as it relates to monitoring releases of radioactivity from normal operations , including anticipated operational occurrences, and from postulated accidents.

7. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations.

8. 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the Atomic Energy Act, and the NRC's regulations.

SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are as follows for the review described in this SRP section. The SRP is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with the NRC regulations.

Relevant aspects of the requirements listed above are met by use of the regulatory positions of Regulatory Guide 1.52 as to the design, testing, and maintenance of ESF atmosphere cleanup system air filtration and adsorption units.

Technical Rationale

The technical rationale for application of these acceptance criteria to the areas of review addressed by this SRP section is discussed in the following paragraphs:

1. Compliance with GDC 19 requires radiation protection of the control room to ensure that access and occupancy under accident conditions, including LOCAs, will not result in radiation exposures in excess of the specified limit.

   GDC 19 applies to this section because control room radiation protection under accident conditions may require an ESF atmosphere cleanup system.

   Meeting this criterion provides assurance that personnel needed to monitor and control an accident will be able to perform those functions effectively.

2. Compliance with GDC 41 requires systems to control fission products that may be released into the reactor containment, thereby reducing the concentration of fission products released to the environment after an accident. GDC 41 also includes redundancy and reliability requirements for such systems.

   GDC 41 applies to this section because control of fission products released from the containment after an accident may require an ESF atmosphere cleanup system.

   Meeting this criterion provides assurance that offsite radiation doses resulting from an accident will be within regulatory limits.

3. Compliance with GDC 42 requires that containment atmosphere cleanup systems be designed to accommodate periodic inspection of important components such as filter frames, ducts, and piping.

   GDC 42 applies to this section because the containment atmosphere cleanup system may be an ESF.

   Meeting this criterion provides assurance that the equipment necessary to mitigate the consequences of an accident will maintain its functional capability.

4. Compliance with GDC 43 requires that containment atmosphere cleanup systems be designed to accommodate periodic pressure and functional testing.

   GDC 43 applies to this section because the containment atmosphere cleanup system may be an ESF.

   Meeting this criterion provides assurance that the equipment necessary to mitigate an accident will maintain its functional capability.

5. Compliance with GDC 61 requires that fuel storage and handling, radioactive waste, and other systems that may contain radioactive material be designed to ensure adequate safety under normal and postulated accident conditions. These systems shall be designed with appropriate containment, confinement, and filtering systems.

GDC 61 applies to this section because attainment of the objectives for postulated accident conditions may require an ESF atmosphere cleanup system.

Meeting this criterion provides assurance that offsite doses of radiation resulting from accident conditions will not exceed regulatory limits.

6. Compliance with GDC 64 requires monitoring the reactor containment atmosphere, spaces containing components for recirculation of LOCA fluids, effluent discharge paths, and the plant environs to detect radioactivity that may be released from normal operations (including anticipated operational occurrences) and postulated accidents.

   GDC 64 applies to this section because the ESF atmosphere cleanup systems are used to control releases of radioactivity from postulated accidents. The review ensures that means are provided to monitor releases.

   Meeting this criterion provides assurance that offsite doses of radiation resulting from accident conditions will not exceed regulatory limits and that releases will be adequately documented.

III. REVIEW PROCEDURES

The reviewer will select material from the procedures described below, as may be appropriate for a particular case.

These review procedures are based on the identified SRP acceptance criteria. For deviations from these acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

1. The organization responsible for the review of ventilation and air filtration reviews the plant design to determine where ESF atmosphere cleanup systems are needed. This effort is coordinated with the organization responsible for the review of design basis accident radiological consequence analyses.

2. The organization responsible for the review of ventilation and air filtration review is carried out by making a detailed comparison of atmosphere cleanup system designs with the acceptance criteria of Section II, above.

3. The organization responsible for the review of ventilation and air filtration verifies each ESF atmosphere cleanup system, as follows:

   A. The system is designed so that it can operate after a design basis accident (DBA) and can retain radioactive material after a DBA.

      The capability of a system to remove fission products from the atmosphere after a DBA is reviewed, based on a design loading of 2.5 mg of total iodine (radioactive plus stable) per gram of activated charcoal adsorbent. Designs consistent with General Design Criteria 19, 41, 42, 43, 61, and 64 and the guidelines of Regulatory Guide 1.52 will be assigned the system efficiencies for removal of elemental iodine and organic iodides given in Tables 2 and 1 of Regulatory Guide 1.52 revisions 2 and 3 respectively and a system efficiency of

99% for removal of particulates resulting from a DBA. The assigned efficiencies are for the organization responsible for the review of design basis accident radiological consequence analyses use in accident analyses to calculate offsite doses to the whole body and thyroid.

B. The system has provisions to prefilter air, remove moisture, and meet the guidance of Regulatory Guide 1.52 for charcoal adsorption.

C. The system is redundant, is designed to Seismic Category I requirements, is able to actuate automatically, and is limited to an airflow rate of approximately 15 m^3/s (30,000 cfm).

D. Design of instrumentation for ESF atmosphere cleanup systems conforms to the guidelines of Regulatory Guide 1.52 and to the recommendations of ASME N509-1989. Instrumentation, readout, recording, and alarm provisions for ESF atmosphere cleanup systems meet the minimum guidance given in Table 6.5.1-1 of this SRP section.

E. Environmental design guidelines for acceptability are based on the conditions following a DBA. Radiation source terms are consistent with the guidelines in Regulatory Guides 1.3, 1.4, 1.183[1], 1.7, and 1.25.

F. Fabrication of the charcoal tray and screen involves all-welded construction to preclude potential loss of charcoal from adsorber cells. Further guidance on charcoal loss is found in NRC Bulletin 80-03.

G. Components such as demisters, heaters, prefilters, HEPA filters, mounting frames, filter housings, adsorbent, fans, ductwork, and dampers are designed, constructed, and tested in accordance with ASME N509-1989 design and qualification testing criteria. Water drain design and the accessibility of components and ease of maintenance are in accordance with the recommendations of ERDA 76-21 and ASME N509-1989.

H. Inplace testing includes meeting the requirements of ASME N510-1989. For laboratory testing of activated carbon adsorbent, conformance with ASME N509-1989 will be used as an acceptability criterion.

I. For the post-LOCA ESF atmosphere cleanup system, the organization responsible for the review of ventilation and air filtration will accept the following deviations from the above criteria:

   i. If the calculated dose (sum of the long-term doses from the LOCA and the purge dose at the low population zone outer boundary) is less than

[1]Regulatory Guides 1.3, 1.4, and RG 1.25 provide guidance related to Technical Information Document (TID) 14844, “Calculation of Distance Factors for Power and Test Reactor Sites.” This guidance is applicable to a holder of an operating license issued prior to January 10, 1997 or a holder of a renewed license under 10 CFR Part 54 whose initial operating license was issued prior to January 10, 1997. These license holders may voluntarily revise the accident source term. Regulatory Guide1.183 is applicable to applicants or license holders issued after January 10, 1997.

the criteria of 10 CFR 100.11 or 10 CFR 100.21, as applicable, no filtration system is needed.

ii. If a radioiodine decontamination factor of 10 or less is needed for the calculated dose to be below 10 CFR 100.11 or 10 CFR 100.21, as applicable, an atmosphere cleanup system that meets the design, testing, and maintenance guidelines for HEPA filters and charcoal adsorbers as specified in Regulatory Guide 1.140 are acceptable. If decontamination factors for iodine differ from those specified in Regulatory Guide 1.140 for design purposes, this fact should be supported by test data under operating or simulated conditions (including temperature, pressure, humidity, expected iodine concentrations, and flow rate). The effects of aging and poisoning by airborne contaminants should also be supported by test data.

iii. If a radioiodine decontamination factor of greater than 10 is needed for the calculated dose to be below 10 CFR 100.11 or 10 CFR 100.21, as applicable, the ESF atmosphere cleanup system meeting all of the above acceptance criteria, with the exception of Items 2b and 2c of Part C of Regulatory Guide 1.52, Rev. 2 or Regulatory Positions 3.2 and 3.4 of Regulatory Guide 1.52, Rev. 3, is acceptable.

4. If the applicant proposes to use the standby gas treatment system (SGTS) more than 90 hours per year during normal operation, the reviewer will verify that this level of use does not impair the capability of the SGTS to perform its intended function in the event of a LOCA.

5. The applicant has provided for monitoring all radioactive releases from the ESF atmosphere cleanup systems.

6. For review of a DC application, the reviewer should follow the above procedures to verify that the design, including requirements and restrictions (e.g., interface requirements and site parameters), set forth in the final safety analysis report (FSAR) meets the acceptance criteria. DCs have referred to the FSAR as the design control document (DCD). The reviewer should also consider the appropriateness of identified COL action items. The reviewer may identify additional COL action items; however, to ensure these COL action items are addressed during a COL application, they should be added to the DC FSAR.

   For review of a COL application, the scope of the review is dependent on whether the COL applicant references a DC, an early site permit (ESP) or other NRC approvals (e.g., manufacturing license, site suitability report or topical report).

   For review of both DC and COL applications, SRP Section 14.3 should be followed for the review of ITAAC. The review of ITAAC cannot be completed until after the completion of this section.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following type to be included in the staff's safety evaluation report. The reviewer also states the bases for those conclusions.

> The staff concludes that the design of the ESF atmosphere cleanup systems, including the equipment and instrumentation to control the release of radioactive materials in gaseous effluents following a postulated design basis accident, are acceptable. This conclusion is based on the applicant having met the requirements of General Design Criteria 19, 41, and 61 by providing ESF atmosphere cleanup systems on the control room habitability, containment, and associated systems. The applicant has met the requirements of General Design Criteria 41, 42, 43, and 64 by providing a program for inspecting and testing the ESF atmosphere cleanup systems and monitoring for radioactive materials in effluents from these systems. In meeting these regulations, the applicant has provided an evaluation that demonstrates that the design of the ESF atmosphere cleanup systems meets the guidelines of Regulatory Guide 1.52 and the ASME N509-1989 and ASME N510-1989 industry standards. We have reviewed the applicant's system descriptions and design criteria for the ESF atmosphere cleanup systems. Based on our evaluation, we find the proposed ESF atmosphere cleanup systems are acceptable, and the filter efficiencies given in Tables 2 and 1 of Regulatory Guide 1.52 revisions 2 and 3 respectively are appropriate for use in accident analyses.

For DC and COL reviews, the findings will also summarize the staff’s evaluation of requirements and restrictions (e.g., interface requirements and site parameters) and COL action items relevant to this SRP section.

In addition, to the extent that the review is not discussed in other SER sections, the findings will summarize the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable.

V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of DC applications and license applications submitted by applicants pursuant to 10 CFR Part 50 or 10 CFR Part 52. Except when the applicant proposes an acceptable alternative method for complying with specified portions of the Commission’s regulations, the staff will use the method described herein to evaluate conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications submitted six months or more after the date of issuance of this SRP section, unless superseded by a later revision.

VI. REFERENCES

1. Regulatory Guide 1.3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling Water Reactors."

2. Regulatory Guide 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Pressurized Water Reactors."

3. Regulatory Guide 1.7, "Control of Combustible Gas Concentrations in Containment Following a Loss-of-Coolant Accident."

4. 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."

5. Regulatory Guide 1.52, "Design, Testing, and Maintenance Criteria for Post Accident Engineering-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."

6. Regulatory Guide 1.140, "Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."

7. ASME N509-1989, "Nuclear Power Plant Air Cleaning Units and Components," American Society of Mechanical Engineers, 1989.

8. ASME N510-1989, "Testing of Nuclear Air Cleaning Systems," American Society of Mechanical Engineers, 1989.

9. ERDA 76-21, "Nuclear Air Cleaning Handbook," Oak Ridge National Laboratory, C. A. Burchsted, I. E. Kahn and A. B. Fuller, March 31, 1976.

10. "Building Materials List," Underwriters' Laboratories, Inc.

11. 10 CFR Part 50, Appendix A, General Design Criterion 19, "Control Room."

12. 10 CFR Part 50, Appendix A, General Design Criterion 41, "Containment Atmosphere Cleanup."

13. 10 CFR Part 50, Appendix A, General Design Criterion 42, "Inspection of Containment Atmosphere Cleanup Systems."

14. 10 CFR Part 50, Appendix A, General Design Criterion 43, "Testing of Containment Atmosphere Cleanup Systems."

15. 10 CFR Part 50, Appendix A, General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control."

16. 10 CFR Part 50, Appendix A, General Design Criterion 64, "Monitoring Radioactivity Releases."

17. NRC Generic Letter 80-11, "IE Bulletin No. 80-03, Loss of Charcoal from Standard Type II, 2 Inch, Tray Adsorber Cells," January 30, 1980.

18. NRC Bulletin 80-03, "Loss of Charcoal from Standard Type II, 2 Inch, Tray Adsorber Cells," July 1, 1981.

19. Regulatory Guide 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors.”

20. Regulatory Guide 1.195, “Methods and Assumptions for Evaluating Radiological Consequences of Design Basis Accidents at Light-Water Nuclear Power Reactors.”

Table 6.5.1-1 Minimum instrumentation, readout, recording, and alarm provisions for ESF atmosphere cleanup systems

References: ASME N509-1989 and Regulatory Guide 1.52

Sensing location	Local readout/alarm	Continuously manned control panel (main control room or auxiliary control panel if manning is a tech spec 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