PNNL-17964, Rev. 1

Capability Replacement Laboratory

Physical Sciences Facility Air Emission Control Equivalency Evaluation

CRL-TECH-ESH-006, Revision 1

Pacific Northwest
NATIONAL LABORATORY

Approved for release by:

James K. McClusky 10/17/08

James K. McClusky, Project Director Date

Office of Science
U.S. DEPARTMENT OF ENERGY

NNSA
National Nuclear Security Administration

DISCLAIMER

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC05-76RL01830

Printed in the United States of America

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information,
P.O. Box 62, Oak Ridge, TN 37831-0062;
ph: (865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov

Available to the public from the National Technical Information Service,
U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161
ph: (800) 553-6847
fax: (703) 605-6900
email: orders@ntis.fedworld.gov
online ordering: http://www.ntis.gov/ordering.htm


This document was printed on recycled paper.
(9/2003)

Physical Sciences Facility Air Emission Control Equivalency Evaluation
Revision History

Revision Number	Effective Date	Description of Change
0	September 2007	Initial document
1	September 2008	Incorporate WSDOH comments

Contents

Acronyms and Abbreviations iv

1.0 Scope 1

2.0 Purpose 1

3.0 Introduction 1
- 3.1 PSF Process Descriptions 1
- 3.2 Exhaust Systems Description 2
- 3.3 General HVAC System Components 3
- 3.4 BARCT Technology Standards 3

4.0 Conclusion 4

5.0 Analysis 4
- 5.1.1 PSF Radioactive Air Exhaust System Components Evaluation 4
- 5.2 Evaluation of BARCT Technology Standards Other than ASME AG-1 12
  - 5.2.1 ASME N509 12
  - 5.2.2 ASME N510 14
  - 5.2.3 ANSI/ASME NQA-1 14
- 5.3 Economic Impact Summary 14
- 5.4 Economic Impact Analysis 14
  - 5.4.1 Protective Measure 14
  - 5.4.2 Relevant Activity 15
  - 5.4.3 Relevant Time Frame 15
  - 5.4.4 Collective Dose Saved 15
  - 5.4.5 Cost of Protective Measure 15
  - 5.4.6 Activity Cost 15
  - 5.4.7 Cost Effectiveness 15
  - 5.4.8 ALARA Factor Analysis 16

6.0 References 98
- 6.1 References 98
- 6.2 Codes and Standards 98

Figures

1 Typical PSF Radioactive Air Exhaust Systems 2

Tables

1 Unabated and Abated Dose Rates from PSF Emission Units[a,b,c] 17
2 PSF Components for Code and Standard Evaluation 17
3 Section BA, Fans and Blowers Equivalency Evaluation 21
4 Section DA, Dampers Detailed Evaluation 37
5 Section SA, Ductwork Detailed Evaluation 49
6 Section IA, Instrumentation and Control Detailed Evaluation 71
7 Section CA, Conditioning Equipment 86
8 Section FB, Medium Efficiency Filters 94
9 ALARA Factor Analysis 97

Acronyms and Abbreviations

AABC	Associated Air Balance Council
ACGIH	American Conference of Government Industrial Hygienists
AFBMA	Anti-Friction Bearing Manufacturers Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALARA	as low as reasonably achievable
AMBA	American Bearing Manufacturers Association
AMCA	Air Movement and Control Association
ANS	American Nuclear Society
ANSI	American National Standards Institute
ARI	Air Conditioning & Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BARCT	best available radionuclide control technology
DCSMF	Duct Construction Standards, Metal and Flexible (SMACNA Standard)
HADLTM	HVAC Air Duct Leakage Test Manual (SMACNA Standard)
HEPA	high efficiency particulate air
HDSIG	HVAC Duct Systems Inspection Guide (SMACNA Standard)
HSDD	HVAC Systems Duct Design (SMACNA Standard)
HVAC	heating, ventilation and air-conditioning
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
PNNL	Pacific Northwest National Laboratory
PSF	Physical Sciences Facility
R&D	research and development
RIDCS	Round Industrial Duct Construction Standards (SMACNA Standard)
SMACNA	Sheet Metal and Air-Conditioning Contractors National Association
WAC	Washington Administrative Code
WC	water column
WDOH	Washington Department of Health

1.0 Scope

This document presents the adequacy evaluation for the application of technology standards during design, fabrication, installation and testing of radioactive air exhaust systems at the Physical Sciences Facility (PSF), located on the Horn Rapids Triangle north of the Pacific Northwest National Laboratory (PNNL) complex. The analysis specifically covers the exhaust portion of the heating, ventilation and air-conditioning (HVAC) systems associated with emission units EP-3410-01-S, EP-3420-01-S and EP-3430-01-S.

2.0 Purpose

The Washington Administrative Code (WAC) establishes requirements and procedures for the issuance of a radioactive air emissions license and for regulation of those emissions. These requirements ensure compliance with the standards for radioactive emissions established by the Washington Department of Health (WDOH). New emission units must incorporate best available radionuclide control technology (BARCT) as defined in the WAC. This document provides justifications, as required under WAC 246-247-110 (18), for the application of industry standards associated with the design, fabrication, installation and testing of radioactive air exhaust systems in the PSF.

Application of alternative technology standards will be considered if they meet the following criteria.

- They will continue to provide sufficient control of radioactive contamination,
- They will not increase the radiation exposure of site workers, the public or the environment beyond an amount justified by the cost savings, and
- They will provide a significant cost advantage.

3.0 Introduction

3.1 PSF Process Descriptions

The PSF is planned as a modular facility with discrete space for each of the PNNL technical capabilities that will be relocated from the Hanford site 300 Area. The PSF will be constructed in two or more phases over a period of up to 20 years. The initial PSF construction phase will include the following buildings:

- Building 3410 – Materials Science and Technology Laboratory
- Building 3420 – Radiation Detection Laboratory
- Building 3430 – Ultra-Trace Laboratory.

For the purpose of this analysis, the justifications supporting the selection of industrial technology standards are based on the radioactive air exhaust system design associated with the buildings identified above. Additional information may be prepared and submitted for WDOH review and approval for the future buildings in the PSF complex.

Activities and research programs associated with the three capabilities are described below.

Building 3410 – Materials Science and Technology Laboratory

The Materials Science and Technology Laboratory will support research and development (R&D) focused on the performance and life of materials in the aggressive environments frequently encountered in next-generation technologies and applications in energy, construction and transportation.

Building 3420 – Radiation Detection Laboratory

The Radiation Technology Laboratory will support R&D focused on: 1) ultra-low background radiation detection and advanced radiation detection and testing, 2) border and interdiction technology, 3) materials development for radiation detection, 4) instrument systems development and engineering, 5) radiochemistry and quantitative radiation counting and 6) data analysis.

Building 3430 – Ultra-Trace Laboratory

The Ultra-Trace Laboratory will support R&D focused on: 1) preparation of environmental samples for ultra-trace level organic, inorganic and radiological analysis, 2) highly sensitive analytical systems (i.e., highly sensitive ionic, organic and inorganic analysis using unique analytical instrumentation), 3) mass spectrometry for inorganic and radiochemical analysis, and 4) optical and electron microscopy for physical and inorganic analysis

3.2 Exhaust Systems Description

The HVAC systems serving each of the buildings within the PSF complex will be essentially the same with some minor differences in actual quantities of equipment. The basic system features a supply air handling unit that will provide heated/cooled/filtered air to the building, a non-radioactive exhaust system and a radioactive exhaust air system. The supply air and non-radioactive exhaust systems will not be discussed further in this document.

The major components of the radioactive exhaust air system include fume hoods, airflow control dampers, isolation dampers, exhaust fans, connecting ductwork, stack assemblies and a control system.

Figure 1 presents an example of the PSF radioactive exhaust air systems.

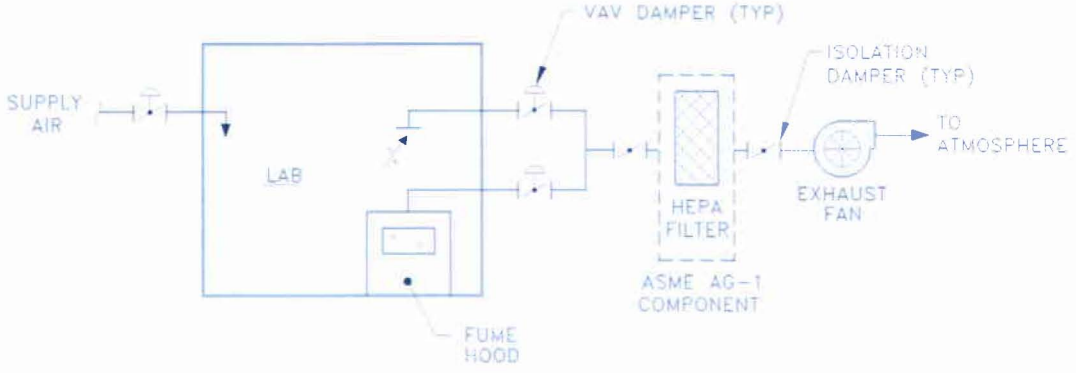

Figure 1. Typical PSF Radioactive Exhaust Air Systems

There will be two confinement zones in the PSF. The fume hood will be the primary confinement zone, and the room where the hood is located will be the secondary confinement zone. All of the exhaust air from these two zones will be discharged via the radioactive exhaust air system.

The variable air volume (VAV) damper connected to the fume hood will maintain a constant inward face velocity of room air into the fume hood regardless of the hood sash position. The VAV dampers on the supply air and general room exhaust air are controlled in conjunction with fume hood VAV damper to maintain the room pressure level lower than the surrounding non-radioactive areas of the building.

3.3 General Radioactive Exhaust Air System Components

The radioactive exhaust air system components as identified in ASME AG-1 are listed below.

- fans
- dampers
- ductwork
- housings
- refrigeration equipment
- conditioning equipment
- moisture separators
- medium efficiency filters
- HEPA filters
- Type II adsorber cells
- Type III adsorber cells
- adsorbent media
- frames
- instrumentation and controls
- field testing

These components are subject to the analysis described in Chapter 5. Some of these components will not be installed in PSF radioactive air exhaust systems, and those will be identified as not applicable when addressed in Chapter 5.

3.4 BARCT Technology Standards

The emission standards promulgated in WAC 246-247 are intended to limit radiation exposure to the public; BARCT is required to ensure compliance with these emissions standards. BARCT is defined as "...technology that will result in a radionuclide emission limitation based on the maximum degree of reduction for radionuclides from any proposed newly constructed or significantly modified emission units that the licensing authority determines is achievable on a case-by-case basis." The BARCT technology standards ensure that selected abatement controls are designed and constructed to accepted nuclear industry standards, such that compliance with emission standards is ensured to the greatest degree practical.

Following are the BARCT technology standards required by WAC 246-247-120 that are subject to evaluation in this document:

- ASME AG-1 – Code on Nuclear-Air and Gas-Treatment
- ASME N509 – Nuclear Power Plant Air-Cleaning Units and Components
- ASME N510 – Testing of Nuclear-Air Treatment Systems
- ASME NQA-1 – Quality Assurance Program Requirements for Nuclear Facilities

4.0 Conclusion

Based on the evaluation and technical justification provided in Chapter 5 of this document, the cost savings realized through the application of industry standards and design specifications (other than the BARCT standards of WAC-246-247-120) are justified for the PSF radioactive air exhaust systems.

5.0 Analysis

The analysis process uses the ASME AG-1 code as a benchmark for the comparison of the proposed standards or specifications identified in Table 2. ASME AG-1 is the highest level standard for nuclear air-treatment systems. It encompasses most requirements from, or requires the implementation of, some of the other BARCT technology standards such as ASME N509, ASME N510 and ASME NQA-1, as well as other industry standards. Also, WAC 246-247-120 requires that in cases where conflicts in BARCT standards arise, the standards in ASME AG-1 will take precedence.

Each HVAC system is divided into components, and each HVAC component classification mirrors the component classification in ASME AG-1. Industry standards or PSF specifications that apply to each component are identified in combination with the component design specifications and, then, are evaluated against ASME AG-1. If a determination is made that ASME AG-1 contains additional and more stringent requirements, a technical justification for implementing the other industry standards or specifications is provided, if feasible. Next, the cost savings that would result from designing, fabricating and installing the components to the other industry standards are determined. Using the guidance in WHC-SA-0484-FP (WHC 1989), compliance with ASME AG-1 is then evaluated to determine the costs versus the benefits. If significant cost savings would be realized by implementing the other industry standards or the PSF specification and this cost savings would be justified based on the WHC-SA-0484-FP evaluation, these standards or specifications would be implemented.

Additional requirements from the other BARCT technology standards, which were not covered in the ASME AG-1 comparison, would then be evaluated using the same methodology, as needed.

5.1.1 PSF Radioactive Exhaust Air System Components Evaluation

Table 1 provides the unabated and abated dose equivalent rates associated with emission units EP-3410-01-S, EP-3420-01-S and EP-3430-01-S. Table 2 identifies the proposed industry standards and specifications that may be applied to the PSF radioactive air exhaust system components. The industry standards and applicable PSF design specifications chosen for evaluation against the BARCT technology standards are also identified.

5.1.1.1 Fans

ASME AG-1, Section BA, *Fans and Blowers*, provides requirements developed to ensure that fan equipment used in nuclear facilities is acceptable in all aspects of performance, design and construction. Evaluation of ASME AG-1, Section BA, is performed by comparing its requirements against the requirements of the PSF design specification for laboratory-grade centrifugal fans as identified in Table 2. Other industry standards cited in ASME AG-1, Section BA, that are required by the design specification are identified in Table 2. Detailed evaluation of Section BA is presented in Table 3, Section BA, *Exhaust Fans, Detailed Evaluation*.

The fans and motors selected for this application will be standard, laboratory-grade equipment of a size, type and arrangement that have an extensive operating history in the industry; this operating history demonstrates the reliability of these fans. Custom fans, motors or arrangements will not be selected. The fan manufacturer's in-house requirements and procedures for materials, design, fabrication and construction of laboratory-grade fans demonstrate acceptable assurance that these fans will provide sustained performance if reasonable maintenance and repair procedures and schedules are followed. Accessibility for maintenance activities will be provided, and contamination levels will be minimal to allow for routine access.

The increased reliability in, and assurance of, fan performance gained through implementation of the requirements of ASME AG-1 is very important to emission units that that must remove high levels of radioactive material, especially if the equipment is not accessible for repair because of radiation exposure. As stated in Table 1, the PSF radioactive exhaust air fans will handle minimal radioactive contamination, and they will be accessible for routine maintenance and monitoring. Therefore, the rigor associated with ASME AG-1 standards is not needed to ensure reliable operation and performance of the design function.

5.1.1.2 Dampers

ASME AG-1, Section DA, *Dampers and Louvers*, provides the requirements for design, manufacture, shop testing and installation of dampers and louvers in nuclear-air and gas-treatment systems. Evaluation of Section DA was performed by comparison with the intended requirements of the PSF design specification for laboratory-grade HVAC dampers, as described in Table 2. Other industry standards called out in Section DA that also are intended to be required by the design specification are identified in Table 2. A detailed evaluation of Section DA is presented in Table 4.

The dampers and the associated actuators and accessories selected for this application will be standard, laboratory-grade equipment with a past operating history in the industry; this operating history demonstrates the reliability of the dampers. Custom dampers or actuators will not be selected. The requirements and procedures for materials, design, fabrication and construction of laboratory-grade dampers adopted by damper manufacturers demonstrate acceptable assurance that these dampers will provide sustained performance if reasonable maintenance and repair procedures and schedules are followed. Accessibility for maintenance activities will be provided, and contamination levels will be minimal or non-existent to allow for routine access.

The increased reliability in and assurance of damper performance gained through implementation of ASME AG-1 is very important to emission units that must remove high levels of radioactive material, especially if the equipment is not accessible because of radiation exposure. The PSF radioactive exhaust

air dampers will be exposed to very little or no radioactive contamination as shown in Table 1, and they will be accessible for routine maintenance and monitoring. Therefore, the rigor associated with ASME AG-1 standards is not needed to ensure reliable operation and performance of the design function.

5.1.1.3 Ductwork

ASME AG-1, Section SA, *Ductwork*, provides requirements for the performance, design, construction, inspection, shop and field fabrication acceptance testing, and quality assurance for ductwork and accessories used in nuclear-air and gas-treatment systems. Evaluation of Section SA is performed by comparison with the requirements of the Sheet Metal and Air-Conditioning Contractors National Association (SMACNA) duct construction and installation standards and the PSF Construction Specification as identified in Table 2. The PSF Construction Specification is applicable to both ASME AG-1 and non-ASME AG-1 ductwork. Table 5 presents a detailed evaluation of Section SA.

The ductwork construction standards for the PSF radioactive exhaust air ductwork systems are based on SMACNA ductwork construction methods. Ductwork materials that meet SMACNA standards (that are acceptable under ASME AG-1) have been incorporated into the project design specifications. Loading and allowable stress criteria identified by SMACNA and the project design specifications are similar to ASME AG-1 requirements and, therefore, provide acceptable assurance that the PSF ductwork systems will perform their function over the life of the plant.

ASME AG-1, Article SA-4000, provides requirements for ductwork and ductwork support. ASME AG-1 specifies design load combinations based on service levels (A, B, C and D), but does not determine the required service level. The ASME AG-1 design load combinations for Service Level A ductwork systems are compared to SMACNA requirements identified below:

ASME AG-1 (Service Level A) Ductwork Load Combination	SMACNA
Dead Weight (DW)	Sections between hangers carry their own load
Normal Operating Delta-P (NODP)	Pressurized test with maximum deflection and leakage
Fluid Momentum Load (FML)	Noise and vibration considerations
External Loads (EL)	All in-line equipment shall be braced independently of the duct in conformance with all applicable building codes.
Live Load (L) – 250 Pound Load	Construction and maintenance loads must be taken into consideration.
Thermal (T)	Temperature extremes, chemical, corrosion. Forces resulting from thermal expansion must be taken into consideration.
Wind (W)	Weather, earthquake

The design loads referenced by ASME AG-1 and SMACNA may differ, but the SMACNA design loads still provide a complete and operable system under all anticipated operating conditions. Furthermore, the project design specifications require that the duct systems be designed for a 40-year life starting when operation commences.

ASME AG-1 spells out the requirements to be followed for sheet metal cutting, forming and bending; SMACNA addresses these details as well. Similar guidelines have been formulated by ASME AG-1 and SMACNA for construction and assembly of ductwork. Both standards allow the same type of longitudinal seams to be used during fabrication. Transverse joint types identified in SMACNA are acceptable per ASME AG-1 guidelines.

Some key similarities between the ASME AG-1 and SMACNA requirements are shown below.

Item	ASME AG-1	SMACNA	Notes
Galvanized Duct Material	ASTM A525	ASTM A525	ASME AG-1 and SMACNA requirements are equal.
Stainless Steel Duct Material	ASTM A167 and A240	ASTM A167 and A240	ASME AG-1 and SMACNA requirements are equal.
Welding	AWS D1.1, 1.3 and 9.1	AWS D1.1, 1.3 and 9.1	ASME AG-1 and SMACNA requirements are equal.
Construction	similar joints	similar joints	ASME AG-1 and SMACNA requirements are equal.
Installation	NFPA 90A	NFPA 90A	ASME AG-1 and SMACNA requirements are equal.
Leak Test	5% flow	Based on duct surface area	ASME AG-1 and SMACNA requirements are equal.

The following ASME AG-1 articles show how SMACNA is an acceptable equivalent to ASME AG-1:

- ASME AG-1, Section AA, Non-Mandatory Appendix AA-D, *Design of Ductwork by Analysis (Suggested Approach), Article D-1000, Introduction*: "Other methods may be used to determine the adequacy of ductwork for design loading. These include the techniques presented in the Sheet Metal and Air-Conditioning Contractor's National Association (SMACNA) Rectangular Industrial Duct Construction Standards."
- ASME AG-1, Section AA, Non-Mandatory Appendix AA-D, *Design of Ductwork by Analysis (Suggested Approach), Article D-2400, Stiffener Design*: "The stiffener may be designed in accordance with the recommendations of SMACNA."
- ASME AG-1, Section AA, Non-Mandatory Appendix AA-D, *Design of Ductwork by Analysis (Suggested Approach), Article D-2410, Stiffener Spacing*: "As an alternative, the spacing recommendation contained in SMACNA may be used as an initial spacing value."
- ASME AG-1, Section AA, Non-Mandatory Appendix AA-D, *Design of Ductwork by Analysis (Suggested Approach), Article D-3200, Rectangular Duct Analysis*: "Tests performed have demonstrated that ducts constructed to SMACNA specifications can adequately withstand specified dynamic loads."
- ASME AG-1, Section AA, Non-Mandatory Appendix AA-D, *Design of Ductwork by Analysis (Suggested Approach), Article D-3520, Stiffener Size and Spacing*: "It is recommended that as a starting point, the stiffener size and spacing given by SMACNA, which are primarily based on operational requirements, be used."
- ASME AG-1, Section SA-5000, *Inspection and Testing, Article SA-5410, Ductwork Pressure Test*: "This test is not required if duct construction specified is equal to or greater than the duct construction allowed in the SMACNA standards listed in Article SA-2000 for the system operational pressure transient (SOFT)."
- ASME AG-1, Section SA, Non-Mandatory Appendix SA-C, *Additional Guidelines for Duct Design and Construction, Article C-1300, Duct Construction Standards*: "Table C-1300-1 lists standards that may be used in the mechanical design of ductwork. All listed standards are SMACNA standards."

Installation of an ASME AG-1 ductwork system is very important for nuclear power plant emission units that must remove high levels of radioactive material, especially if the equipment is not accessible because

of radiation exposure. As stated in Table 1, the PSF radioactive exhaust air ductwork will be exposed to very low levels of radioactive contamination. The PSF radioactive exhaust air ductwork systems will be designed to allow accessibility for routine maintenance and monitoring.

The above similarities between ASME AG-1 and SMACNA requirements (and the fact that ASME AG-1 recognizes SMACNA methods as an acceptable approach for determining the adequacy of ductwork for design loading) suggest that approving the use of SMACNA standards will result in robust PSF radioactive exhaust air ductwork systems that will ensure reliable operation and performance while meeting the intent of ASME AG-1.

5.1.1.4 HEPA Filter Housings

Housings for HEPA filters will be designed and constructed to meet the standards of ASME AG-1 and, therefore, will not be evaluated.

5.1.1.5 Refrigeration Equipment

No refrigeration equipment will be installed in the PSF radioactive air exhaust systems; therefore, they are not subject to this analysis.

5.1.1.6 Conditioning Equipment

Heat recovery coils will be installed in the PSF radioactive exhaust air systems (located between the HEPA filters and the exhaust fans). These coils will be designed, procured and installed in accordance with ARI Standard 410 defined by PSF Construction Specifications, Section 23 8216, *Coils*.

5.1.1.7 Moisture Separators

No moisture separators will be installed in the PSF radioactive exhaust airsystems; therefore, they are not subject to this analysis.

5.1.1.8 HEPA Filters

The PSF Construction Specifications, Section 23 4114, *Filters*, specify that HEPA filters be listed or classified under the UL 586 test standard. Nuclear-grade HEPA filters shall meet ASME AG-1 Section FK requirements. The nuclear-grade HEPA filters will be designed and constructed to meet the standards of ASME AG-1 Article FK; therefore, they will not be evaluated.

5.1.1.9 Type II Adsorber Cells

No Type II Adsorber cells will be installed in the PSF radioactive exhaust air systems; therefore, they are not subject to this analysis.

5.1.1.10 Type III Adsorber Cells

No Type III Adsorber cells will be installed in the PSF radioactive exhaust air systems; therefore, they are not subject to this analysis.

5.1.1.11 Adsorbent Media

No adsorbent media will be installed in the PSF radioactive exhaust air systems; therefore, they are not subject to this analysis.

5.1.1.12 Frames

No HEPA filter frames will be installed in the PSF radioactive exhaust air systems; therefore, they are not subject to this analysis.

5.1.1.13 Instrumentation and Controls

ASME AG-1, Section IA, *Instrumentation and Controls*, establishes requirements for the design, manufacture, installation, testing and documentation for instrumentation, control components and control panels used in nuclear-air and gas-treatment systems. Evaluation of Section IA was performed by comparison with the requirements of the PSF Construction Specifications for control instrumentation as identified in Table 2. Table 6 presents a detailed evaluation of Section IA.

A review of Table 6 reveals that PSF Construction Specifications and procedures are equivalent to Section IA in many cases and, in all cases, address the same areas of concern. Project specifications and procedures ensure that:

- all aspects of environmental and functional requirements are addressed during design
- the requirements are incorporated into procurement and construction documents
- compliance by vendors and the construction forces is achieved and verified
- nonconformance is detected, tracked and corrected.

Written documentation of the entire process is included in project records. An extensive commissioning and testing period is planned to provide final verification of compliance.

The instrumentation and control components selected for this application will be standard laboratory/ industrial-grade equipment that have an extensive operating history in research laboratories and similar environments. This operating history demonstrates the reliability of this equipment. The in-house requirements and procedures for materials, design, fabrication and construction of laboratory/industrial grade instrumentation and control components adopted by the instrumentation manufacturers have demonstrated acceptable assurance that this equipment will provide sustained performance when reasonable maintenance and repair procedures and schedules are followed.

The increased reliability in, and the assurance of, instrument performance gained through implementation of ASME AG-1 is very important to emission units that must remove high levels of radioactive material, especially if the equipment is not accessible because of radiation exposure. The instrumentation and control components for the PSF systems will be exposed to minimal or no radioactive contamination as shown in Table 1, and will be accessible for routine maintenance and monitoring. Therefore, the rigor associated with ASME AG-1 standards is not needed to ensure reliable operation and performance of the design function.

5.1.1.14 Field Testing

ASME AG-1, Section TA, *Field Testing of Air Treatment Systems*, provides requirements for field acceptance testing to verify that nuclear-air treatment HVAC systems are capable of performing their intended function after installation in the facility. Field testing of the PSF radioactive exhaust air systems will be performed according to the applicable standards identified in the detailed component evaluations in this analysis. For example, field testing of ductwork will be conducted in accordance with SMACNA standards. Also, all components must be factory tested to applicable industry standards as described in the detailed evaluation sections of this document.

For the reasons discussed below, field testing of the PSF radioactive exhaust air systems to the detailed field-testing requirements of ASME AG-1 is too restrictive for this application. The leak test procedure of the SMACNA *HVAC Air Duct Leak Test Manual* is similar to the constant-pressure method of Section TA, Mandatory Appendix TA-III. ASME AG-1 has more specific requirements for test personnel qualification, test documentation, and test instrumentation and also requires structural capability testing. SMACNA provides specific acceptance criteria for leakage, while ASME AG-1 provides very specific guidance for the designer to establish leakage criteria.

Duct inspection, in accordance with the SMACNA *HVAC Duct Systems Inspection Guide*, will identify any deficiencies in installation while the duct is accessible during construction and while correction of such deficiencies does not cause unreasonable costs and delay.

The remainder of the PSF radioactive exhaust air system components will be accessible for monitoring and maintenance. Contamination after startup is expected to be minimal. The exhaust fans will be redundant, thus allowing for repair or replacement without interruption of system operation.

The installation of ductwork and in-line components (including dampers) will include a visual inspection of materials and workmanship as well as field testing. For field testing, ASME AG-1, Article TA, offers two procedural tests: the Constant Pressure Test, and the Pressure Decay Test. Both tests yield a flow rate equal to air lost from the ductwork pressure boundary. Acceptance criteria are to be provided by the owner. ASME AG-1, Section SA, indicates a maximum allowable leakage of 5 percent rated flow for non-safety related system and components. The PSF radioactive exhaust air system construction specifications call out allowable leakage rates for ductwork systems. Allowable leakage rate is indicated by percentage (%) of system design air quantity, determined in accordance with Appendix C of SMACNA *HVAC Air Duct Leakage Test Manual*. ASME AG-1 recognizes either the Constant Pressure Test or the Pressure Decay Test as acceptable methods for assessing duct leakage; both methods use the maximum operating pressure to assess leakage. The PSF radioactive exhaust air system construction specification also uses the maximum operating pressure for leak testing requirements, which is consistent with ASME AG-1.

SMACNA standards identify ductwork gauge thickness and corresponding operating pressure. SMACNA fabrication methods are based on laboratory testing in which a maximum allowable deformation value may not be exceeded when pressure tested. SMACNA tables are based on structural-capability test pressures. The tables provide a predetermined gauge thickness based on structural test pressures for various duct sizes. The PSF radioactive exhaust air systems will operate at pressures below 10-inches water column (WC), and the material thickness for the ducts will be selected from SMACNA tables based on maximum operating pressure. The PSF subcontractor will submit shop

drawings and pressure test reports to ensure that design requirements have been met. Because the material thickness is based on a laboratory test performed under prescribed operating parameters to ensure structural integrity, a structural examination test for duct material thickness is not considered necessary upon field installation of the ductwork. The field pressure test results will ensure that duct leakage is within allowable limits.

The PSF radioactive exhaust air systems are designed to perform their intended function during normal plant operations. If any component fails to meet engineering acceptance criteria during construction or pre-operation of the PSF, the component will be considered for replacement or repair, or for use "as is" if proper technical justification can be made. For example, ASME AG-1 requires that the variation in velocity measurement across a HEPA filter bank be +/- 20 percent of the average velocity. If a remote HEPA filter bank with five filters has one HEPA filter that does not meet the ASME AG-1 acceptance criteria, then the options described above may be exercised. The PSF ductwork and in-line components and devices will be designed for in-place removal should contamination accumulation warrant their replacement.

ASME AG-1, Section TA, *Field Testing of Air Treatment Systems*, provides requirements for field acceptance testing to verify that nuclear-air treatment HVAC systems are capable of performing their intended function after installation in the facility.

For the PSF project, field-testing comprises both pre-commissioning and commissioning tests. The pre-commissioning test includes visual inspection and pressure boundary tests. The commissioning test includes system functional tests. As detailed in Table 2, ASME AG-1 is the chosen standard for performing commissioning tests on applicable PSF radioactive exhaust air components.

For centrifugal exhaust fans, the selected sections of ASME AG-1 will ensure that fan power circuits and controls are verified, and that specific functional tests are performed, including flow balance, mechanical run, flow rate, static pressure, electrical, rotational speed, vibration, bearing temperature, fan performance and air-flow capacity.

For dampers, the selected sections of ASME AG-1 will ensure that damper power circuits, control circuits and controls are verified, and that specific functional tests are performed, including position indication, exercise, static timing, flow control, dynamic timing and interlock tests, as applicable.

For HEPA filter banks, the selected sections of ASME AG-1 will ensure that specific functional tests are performed for differential pressure, airflow distribution, air-aerosol mixing and in-place challenge aerosol leakage, and further that the tests for airflow distribution, air-aerosol mixing and in-place challenge aerosol leakage will be performed using prescribed test methodology.

As detailed in Table 2, SMACNA standards and engineering specifications are the chosen standards for performing the field tests on applicable PSF radioactive exhaust air system components.

5.2 Evaluation of BARCT Technology Standards Other than ASME AG-1

The detailed evaluation comparing ASME AG-1 with other industry standards or the design specifications encompasses most of the requirements from the other BARCT technology standards. The remaining requirements from these standards are discussed in this section.

5.2.1 ASME N509

ASME N509 is a system-based standard, but it identifies requirements both at the system level and the component level. The ASME N509 component sections are not evaluated for the PSF radioactive air exhaust systems because ASME AG-1 now includes the requirements for each of those components. The evaluation for ASME AG-1 encompasses the component requirements for ASME N509. Therefore, the discussion in this section will focus only on the system general design requirements of ASME N509, Section 4, *Functional Design*.

ASME N509, Section 4.1, General, includes a list of components to be considered in the system. All these components have been considered, and some of the components are included in the systems. For those components that were not included, a determination was made that they are not needed to perform the design functions of the system or to meet emission guidelines.

ASME N509, Section 4.2, *Design Parameters*, identifies design parameters that must be specified to ensure proper design and operation of the system. Most of these parameters are identified in project design documentation such as facility drawings, specifications, data sheets or the Notice of Construction Applications. The required design parameters that are not specified are maximum and minimum flow rate. Not considering these parameters is acceptable because the fans of these systems are controlled by variable frequency drives, which vary the fan speed to maintain a constant exhaust duct static pressure.

ASME N509, Section 4.3, *Size (Installed Capacity) of Air Cleaning Unit*, requires that the installed capacity of the air cleaning unit be no greater than the capacity of any of the individual components. This requirement will be met, and the system flow rate will not exceed the rated flow capacity of any of the components.

ASME N509, Section 4.4, *Environmental Design Conditions*, requires selection or design of components that will operate under the expected environmental conditions. The evaluation of ASME AG-1 encompasses these requirements.

ASME N509, Section 4.5, *Structural Load Requirements*, requires that systems and all components be shown through testing or analysis to remain functional under specified structural loading. The evaluation of ASME AG-1 encompasses these requirements.

ASME N509, Section 4.6, *Design Pressures*, requires that the system be designed to withstand expected normal and transient pressures. These pressures are defined in this section of ASME N509, and include the operating pressure, leak test pressure, maximum design pressure and structural capability pressure. The procurement specifications and design requirement documents identify the operating pressure of the system, the leak test pressure for each system, the maximum design pressure and the structural capability

pressure. Therefore, this requirement will be met. The evaluation of ASME AG-1 regarding structural loading encompasses these requirements.

ASME N509, Section 4.7, *Nuclear-Air Treatment System Configuration and Location*, provides guidance on the configuration of the system and the location and sequence of components in the system to prevent cross contamination. This guidance has been taken into account during the system design.

ASME N509, Section 4.8, *Maintainability Criteria*, requires that the system be designed for maintenance, testing and inspection activities to be performed while maintaining radiation exposure as low as reasonably possible (ALARA). Some general accessibility guidelines that can be used to accomplish this requirement are identified. The design incorporates this philosophy by ensuring accessibility for maintenance.

ASME N509, Section 4.9, *Monitoring of Operational Variables*, provides guidance for consideration of external effects in the design of instrumentation, identifies the minimum instrumentation required to be included in the system and establishes the qualification requirements for that instrumentation. The design of the PSF radioactive air exhaust systems includes monitoring instrumentation for key parameters such as flow rate, temperature and pressure. This instrumentation exceeds the required instrumentation of ASME N509, except for air inlet temperature indication. Temperature monitoring at the air inlet will not be required because no conditioning equipment that could be affected by inlet temperature will be included in the systems. The design of the instrumentation has considered the applicable external effects. The evaluation of ASME AG-1, Section IA, encompasses the qualification requirements.

ASME N509, Section 4.10, *Adsorbent Cooling*, is not applicable because no adsorbers will be installed.

ASME N509, Section 4.11, *Fire Protection*, establishes requirements for fire protection systems. Specific fire protection systems have been considered, and a determination was made that these requirements are not applicable.

ASME N509, Section 4.12, *Insulation*, establishes requirements for insulation, when installed. This section is not applicable because these systems will be located inside buildings and will not be insulated.

ASME N509, Section 4.13, *Testability*, requires 1) installation of sufficient injection and sampling ports or manifolds to permit accurate testing in accordance with ASME N510 and 2) access for inspection of both sides of system components. Although the systems are not being designed to ASME N509 criteria, the systems will be routinely aerosol tested using the guidance provided in ASME N510. The design includes adequate ports for proper mixing of the aerosol to challenge the filters, as well as determining the leakage after the filter. Field testing will be performed in accordance with ASME AG-1, with any deviations documented in the compliance matrices. Access will be provided for inspection of both sides of the HEPA filter units.

ASME N509, Section 4.14, *Pressure Boundary Leakage*, establishes requirements for determining allowable leakage criteria and leak test parameters. The only applicable portion of this section is the leak testing that will be performed by the manufacturer prior to shipping The PSF construction specification identifies the testing parameters, the test method and the acceptance criteria. The field acceptance testing criteria was discussed above.

5.2.2 ASME N510

ASME N510 defines the technical requirements for testing of nuclear ventilation systems. This standard applies to both factory acceptance testing and routine in-place leak testing.

The HEPA filter units are the only components that fall under the factory testing provision identified in ASME N510, including pressure leak testing, airflow capacity and distribution testing, air-aerosol mixing uniformity testing and in-place leak testing. The filter units are not designed to the requirements of ASME N509; therefore, the testing requirements identified in ASME N510 can only be applied as guidance. The filter units are being designed, constructed and tested to ASME AG-1 requirements. The routine, in-place leak testing of the filter units after installation will be performed in accordance with ASME N510.

5.2.3 ANSI/ASME NQA-1

The evaluation for ASME AG-1 encompasses the requirements of ASME NQA-1.

5.3 Economic Impact Summary

The estimated additional costs needed to meet all the requirements of the BARCT technology standards are itemized below. These estimated costs are averages per emission unit with a total of three emission units associated with PSF and include capital costs only. Acceptance test specifications and procedures have not yet been developed, so operational costs associated with acceptance testing could not be established and are not included. Ductwork costs include both labor and materials for all aspects of purchase and installation. Ductwork support costs are expected to remain the same and are not included.

Fans	$29,000
Dampers	$204,000
Ductwork	$335,000
Instrumentation and Control	$50,000
Field Testing	Not available
Total (per emission unit)	$618,000

5.4 Economic Impact Analysis

The economic impact analysis is performed following guidance outlined in WHC-SA-0484-FP, *A Practical Method of Performing Cost-Benefit Analysis of Occupational and Environmental Protective Measures* (WHC 1989). This method has established decision gates based on person-rem dollar figures. Non-quantitative parameters, such as reliability and risk reduction, are evaluated using an ALARA factor analysis.

5.4.1 Protective Measure

The protective measure for the PSF radioactive air exhaust systems is complies with ASME AG-1 and other BARCT technology standards. The protective measure is further subdivided into applying ASME AG-1 to each of the specific components of the exhaust systems identified in Section 3.3. This approach allows evaluation in terms of ASME AG-1 requirements for the components, both individually

and separately. Detailed descriptions of the protective measures provided by ASME AG-1 and the other BARCT technology standards are provided in Sections 5.1 through 5.5.

5.4.2 Relevant Activity

The relevant activities are design, fabrication, installation and testing of the PSF radioactive air exhaust systems.

5.4.3 Relevant Time Frame

The relevant time frame is the time period required for design, fabrication, installation and testing of the PSF radioactive air exhaust systems. The cost savings will be realized during this time frame; however, the benefits will continue throughout the life of the plant.

5.4.4 Collective Dose Saved

The collective dose saved is indeterminate because implementation of the requirements of ASME AG-1 and the other BARCT technology standards as protective measures results in greater assurance of high standards of manufacture, greater reliability, and, therefore, reduced risk. Quantitative estimation of collective dose saved is not practical so the ALARA factor analysis is used to evaluate the protective measure (WHC 1989).

It is reasonable to expect that the collective dose saved will be zero because the chosen abatement technology (i.e., HEPA filters) will be equivalent and will comply with ASME AG-1 regardless of the standards to which other components of the system are built. Ductwork compliance with ASME AG-1 may result in less leakage because of lower leakage criteria and tighter fabrication tolerances, but the system will operate continuously at a negative pressure, which will provide containment of the minimal contamination expected within the ductwork. Therefore, it is reasonable to expect that no decrease in occupational or environmental exposure would result from ductwork compliance with ASME AG-1.

5.4.5 Cost of Protective Measure

The total additional cost for compliance with ASME AG-1 and the other BARCT technology standards evaluated in this document is expected to be $618,000 per emission unit.

5.4.6 Activity Cost

The total expected cost for all the PSF radioactive air exhaust systems complying with ASME AG-1 is approximately $1,854,000.

5.4.7 Cost Effectiveness

The cost effectiveness was determined by applying the ALARA factor analysis method and assuming the collective dose saved is zero or indeterminate (see Section 5.4.8).

5.4.8 ALARA Factor Analysis

The ALARA factor analysis weighs the intangible or non-quantitative aspects of the protective measure. The answers to the 14 questions shown in Table 9 help determine if the protective measure is reasonable and can be recommended. Analysis for each component resulted in the same answers so the analysis is presented only once in Table 9. The results of the ALARA factor analysis indicate that the protective measure is not recommended for all components identified in Table 2 that are subject to this economic impact analysis.

Table 1. Unabated and Abated Dose Rates from PSF Emission Units[a,b,c]

Emission Units	Unabated Dose (millirem/year)	Abated Dose (millirem/year)
EP-3410-01-S	Gross alpha: 2E-01 Gross beta: 3E+00	Gross alpha: 2E-03 Gross beta: 3E-02
EP-3420-01-S	Gross alpha: 2E-01 Gross beta: 3E+00	Gross alpha: 2E-03 Gross beta: 3E-02
EP-3430-01-S	Gross alpha: 2E-01 Gross beta: 3E+00	Gross alpha: 2E-03 Gross beta: 3E-02

[a] Pacific Northwest National Laboratory, Phase I *Radioactive Air Emissions Notice of Construction (NOC) Application for Material Science and Technology Laboratory (Building 3410).*
[b] Pacific Northwest National Laboratory, Phase I *Radioactive Air Emissions Notice of Construction (NOC) Application for Radiation Detection Laboratory (Building 3420).*
[c] Pacific Northwest National Laboratory, Phase I *Radioactive Air Emissions Notice of Construction (NOC) Application for Ultra-Trace Laboratory (Building 3430).*

Table 2. PSF Components for Code and Standard Evaluation

	Component	Applicable Industry Standards	Chosen Industry Standards and PSF Specifications
1	Fans	AMCA-201, -210, -300, 204-96, 111, -211, -311, 99-401, -301 NEMA MG-1 API-673 SMACNA HVAC Duct Construction Standards, Metal and Flex (DCSMF) IEEE ANSI S2.19 NEC UL ASHRAE 51 ISO 5801 ANSI/AMBA 9, 11 ASME NQA-1 ANSI/AWS D9.1	AMCA-201, -300, -204-96, 111, -211, -311, -301, -203 NEMA MG-1 SMACNA HVAC Duct Construction Standards, Metal and Flex (DCSMF) ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities* and Chapter 14, *Laboratories*, 2003 IEEE ANSI NEC UL ASHRAE 51 ISO 5801 ANSI/AFMBA 9, 11 ASME NQA-1 ANSI/AWS D9.1 PSF Construction Specification, Section 23 3400, *Fans* PSF Construction Specification, Section 20 0513, *Motors* PSF Construction Specification, Section 20 0513, *Variable Frequency Drive (VFD) System*

Table 2. (contd)

	Component	Applicable Industry Standards	Chosen Industry Standards and PSF Specifications
2	Dampers	SMACNA HVAC Duct Construction Standards, Metal and Flex (DCSMF) ASME-B31.1, -B31.3, -B16.34 API-609 AMCA 500 ASME NQA-1 ANSI/AWS D9.1	ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*, 2003 AMCA 500 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 1995 ASME NQA-1 ANSI/AWS D9.1 PSF Construction Specification, Section 23 3314, *Ductwork Specialties* PSF Construction Specification, Section 23 3614, *Laboratory Temperature and Airflow Control System* PSF Construction Specification, Section 01 4000, *Quality Requirements* PSF Construction Specification, Section 20 0000, *General Mechanical Requirements*
3	Ductwork	SMACNA HVAC Duct Construction Standards, Metal and Flex (DCSMF) SMACNA Round Industrial Duct Construction Standards (RIDCS) SMACNA Rectangular Industrial Duct Construction Standards (RTIDCS) SMACNA HVAC Systems Duct Design (HSDD) SMACNA HVAC Air Duct Leakage Test Manual (HADLTM) SMACNA HVAC Duct Systems Inspection Guide (HDSIG) NFPA 90A ANSI/AWS D9.1 ASME NQA-1	SMACNA HVAC Duct Construction Standards, Metal and Flexible, 1995 SMACNA Round Industrial Duct Construction Standards, 1999 SMACNA Rectangular Industrial Duct Construction Standards, 1997 SMACNA HVAC Air Duct Leakage Test Manual ASME NQA-1 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*, 2003 NFPA 90A ANSI/AWS D9.1 PSF Construction Specification, Section 23 3114, *Ductwork* PSF Construction Specification, Section 23 0550, *Vibration Isolation* PSF Construction Specification, Section 23 0595, *Air Systems Test Adjust Balance* PSF Construction Specification, Section 23 3713, *Diffusers, Registers, and Grilles* PSF Construction Specification, Section 01 4000, *Quality Requirements*
4	Housings	ASME AG-1	ASME AG-1 (See Note 1)
5	Refrigeration Equipment	N/A	N/A

Table 2. (contd)

Component		Applicable Industry Standards	Chosen Industry Standards and PSF Specifications
6	Conditioning Equipment	ARI Standard 410 ANSI/ASHRAE Standard 33-2000 ASME NQA-1 ANSI/AWS D9.1	ARI Standard 410 ASME NQA-1 ANSI/ASHRAE Standard 33 ANSI/AWS D9.1 PSF Construction Specification, Section 23 8216, *Coils* PSF Construction Specification, Section 01 4000, *Quality Requirements*
7	Moisture Separators	N/A	N/A
8	Medium Efficiency Filters	N/A	N/A
9	HEPA Filters	ASME AG-1	ASME AG-1 (See Note 1)
10	Type ii Adsorber Cells	N/A	N/A
11	Type iii Adsorber Cells	N/A	N/A
12	Adsorbent Media	N/A	N/A
13	Frames	N/A	N/A
14	Instrumentation and Controls	NFPA 70, National Electric Code NEMA ICS 6, Industrial Control and System Enclosures. ANSI ASME-B31 ASME NQA-1	NEC (NFPA 70) ANSI NEMA ASME NQA-1 ASHRAE HVAC Applications, Chapter 14, Laboratories, and Chapter 26, Nuclear Facilities, 2003 PSF Construction Specification, Section 23 0901, *Control Systems Integration* PSF Construction Specification, Section 23 0903, *Control Instrumentation* PSF Construction Specification, Section 23 3614, *Laboratory Temperature and Airflow Control System* PSF Construction Specification, Section 23 2120, *Piping Specialties* PSF Construction Specification, Section 26 2813, *Fuses* PSF Construction Specification, Section 20 0553, *Mechanical Identification* PSF Construction Specification, Section 01 4000, *Quality Requirements*

Table 2. (contd)

	Component	Applicable Industry Standards	Chosen Industry Standards and PSF Specifications
15	Field Testing	SMACNA HVAC Air Duct Leakage Test Manual (HADLTM). SMACNA HVAC Duct Systems Inspection Guide (HDSIG). ASHRAE 126, Method of Testing Air Ducts.	SMACNA HVAC Air Duct Leakage Test Manual (HADLTM) SMACNA HVAC Duct Systems Inspection Guide (HDSIG) PSF Construction Specification, Section 23 3114, *Ductwork*
16	Field Testing	SMACNA Testing Adjusting and Balancing. NEBB Testing, Adjusting and Balancing. AABC Total System Balance. ACGIH Industrial Ventilation A Manual of Recommended Practice. ASHRAE 87.1, Method of Testing Fan Vibration. ASHRAE 111, Practices for Measurement, Testing, Adjusting and Balancing of HVAC and Refrigeration Systems.	PSF Commissioning Plan PSF Construction Specification, Section 23 0595, *Air Systems Testing, Adjusting and Balancing* HEPA Filter Units: ASME AG-1, Section TA-4630 through TA-4642, Appendix TA-IV, Appendix TA-V, and Appendix TA-VI, with deviations to TA-4632, Appendix TA-IV, and Appendix TA-V as approved in the HVAC compliance matrices.

1 HEPA filters units will be designed and constructed to ASME AG-1, Article FK; therefore, they will not be evaluated. The radial-flow HEPA filters and filter housings are not specifically covered in ASME AG-1.

Table 3. Section BA, Fans and Blowers Equivalency Evaluation

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
BA-1000, *Introduction*			
BA-1000, *Introduction*	BA-1000 assures that fan equipment used in nuclear facilities is acceptable in all aspects of performance, design and construction. **General Design Criteria to be Satisfied**: None	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*.	BA-1000 is an introductory section and does not provide functional system design criteria to be satisfied.
BA-2000, Referenced Documents			
BA-2000, *Referenced Documents*	BA-2000 provides supplemental codes and standards. **General Design Criteria to be Satisfied**: None	Not applicable to this evaluation.	BA-2000 provides additional technical reference information and includes ASHRAE. Reference information only.
BA-3000, Materials			
BA-3100, *General*	BA-3100 defines *allowable* materials and material stress limits, primarily by requiring specific ASTM and ASME designated materials based on chemical and mechanical limits. **General Design Criteria to be Satisfied**: Allowable materials comply with the design intent of Table BA-3100.	The construction specification (PSF Construction Specification, Section 233400, *Fans*) outlines the use of structural steel shapes and plates. It is intended that the design specification will require that materials used be ASTM or ASME designated materials identified in SMACNA *HVAC Duct Construction Standards, Metal and Flexible*, 2nd Edition, 1995.	Design equivalence is predicated on the application of the SMACNA requirement of ASTM or ASME designated materials.
BA-3200, *Special Limitations on Materials*	BA-3200 precludes the use of aluminum or zinc to be used in a corrosive environment and requires that all materials be compatible with operating environmental conditions. **General Design Criteria to be Satisfied**: Material environmental compatibility.	The construction specification (PSF Construction Specification, Section 233400, *Fans*) prohibits certain materials and specifies that all materials shall be compatible with the air stream. PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities* and Chapter 14, *Laboratories*.	The chosen specification is equivalent to or exceeds ASME AG-1. Where corrosive vapors are present designed materials shall be compatible with the operating environment in accordance with the ASHRAE.
BA-3300, *Designation of Materials*	BA-3300 requires identification of ASME or ASTM material numbers and grades for fan components. **General Design Criteria to be Satisfied**: ASME and ASTM identified fan components	The construction specification (PSF Construction Specification, Section 233400, *Fans*) requires identification/certification of compliance with Air Movement and Control Association International (AMCA) which requires ASTM or ASME materials.	The chosen specification satisfies the intent of this ASME AG-1 requirement.

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
BA-3400, *Certification of Materials*	Requires certified test reports and Manufacturer's Certificate of Compliance with ASME or ASTM specifications for certain fan stress components and accessories. **General Design Criteria to be Satisfied**: Material and hardware Certificate of Conformance of chemical and physical properties for stress components to ASME and ASTM specifications.	The construction specification (PSF Construction Specification, Section 233400, *Fans*) requires identification/certification of compliance with Air Movement and Control Association International (AMCA) which requires ASTM or ASME materials	The chosen specification satisfies the intent of this ASME AG-1 requirement.
BA-3500, *Purchased Materials*	Requires purchased materials to meet the requirements of BA-3100, BA-3200, BA-3300, and BA-3400. **General Design Criteria to be Satisfied**: Purchased Materials meet ASME or ASTM requirements and certifications.	Requirements identified in the previous sections apply.	Previously identified requirements satisfy this AG-1 requirement.
BA-3600, *Driver Materials*	Requires driver materials to meet ANSI/IEEE 323, ANSI/IEEE 334, ANSI/IEEE 344, and NEMA MG-1, as required by the design specification. **General Design Criteria to be Satisfied**: ANSI/IEEE 323 – *Qualification Class for 1E Equipment for Nuclear Power Generating Stations* ANSI/IEEE 334 – *IEEE Standard for Qualifying Continuous Duty Class 1E Motors for Nuclear Power Generating Stations* ANSI/IEEE 344 –*Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations* NEMA MG-1 – *Motors and Generators*	The construction specification (PSF Construction Specification, Section 200513, *Motors*) requires identification/certification of compliance with governing IEEE, NEMA, ANSI, NEC, and UL requirements. IEEE-323, IEEE-334, IEEE-344 do not apply as this facility does not have any Safety Related or Safety Significant systems, structures or components as documented in the *Physical Sciences Facility Hazards Analysis Report*, CRL-PROC-ES&H-001.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
BA-4000, Design			
BA-4100, *Design Conditions*	BA-4110, *Performance*, requires fan selection to meet volume and pressure requirements while operating in the stable region of the fan curve. Fan sizing shall consider inlet and discharge conditions and dynamic losses. System characteristics shall be considered using AMCA 201. Fan data to support fan selection is identified. **General Design Criteria to be Satisfied**: Fan operating performance requirements are within the stable region of the fan curve.	The PSF radioactive exhaust air system is designed and modeled in accordance applicable sections of 2003 ASHRAE Handbook, *HVAC Applications, I-P Edition*, Chapter 14, *Laboratories*, and Chapter 26, *Nuclear Facilities*. The construction specification (PSF Construction Specification, Section 233400, *Fans*) requires compliance with AMCA 201 demonstrating system characteristics are considered.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	BA-4120, *Environmental Conditions*, requires continuous operation for at least 30 days under environmental conditions caused by a postulated accident. Identifies environmental aging mechanisms affecting life expectancy that are to be considered. Design qualification shall be specified in accordance with ANSI/IEEE 627. **General Design Criteria to be Satisfied**: Post accident 30 day operation without maintenance. ANSI/IEEE 627- *IEEE standard for design qualification of safety systems equipment used in nuclear power generating stations*	ANSI/IEEE 627 is an archived standard and is not presently active and design requirements contained therein are not applicable to this research laboratory. The PSF radioactive exhaust air systems is designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities* and Chapter 14, *Laboratories*. This facility does not have any Safety Related or Safety Significant systems, structures or components (CRL-PROC-ES&H-001) that require a qualification and testing program demonstrating component qualified life.	This ASME AG-1 requirement does not apply to this facility and component aging for accident conditions is not a concern because of the inherent design of the radioactive exhaust air system located in the interstitial and roof spaces above the laboratories. The 30-day operation criteria are for operation under postulated accident conditions and do not affect continuous emissions or confinement ventilation under normal operation.

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	BA-4130, *Loading*, provides specific and detailed structural loading criteria such as pressure transients, external forces, free end constraint loads, starting loads and missile protection. Also, the reference to AA-4000 includes detailed load, stress and deflection criteria, design verification, and documentation requirements. **General Design Criteria to be Satisfied**: Detailed design loading criteria such as pressure transients, external forces, free end constraint loads, starting loads and missile protection are implemented.	HVAC system is designed and modeled in accordance applicable sections of 2003 ASHRAE Handbook, *HVAC Applications, I-P Edition*, Chapter 14, *Laboratories*, and Chapter 26, *Nuclear Facilities*. The construction specification (PSF Construction Specification, Section 23 3400, *Fans*) requires compliance with AMCA design requirements and demonstrating that system characteristics are considered. AMCA testing requirements require compliance with ANSI/AMCA Standard 210/ASHRAE 51, ISO 5801, or other standards recognized in AMCA Publication 111, Laboratory Accreditation Program.	The chosen specifications and governing construction requirements satisfies the intent of this ASME AG-1 requirement and assures operational safety requirements for radiological laboratories.
	BA-4140, *Leakage*, provides fan-housing and shaft-leakage criteria to be implemented if the direction of leakage would impose a contamination burden on the space housing the fan or the space supplied with air by the fan. **General Design Criteria to be Satisfied**: Fan housing design leakage does not impose a contamination burden.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*) requires compliance with AMCA design requirements and demonstrating that system characteristics are considered. The intended design requirement and the inherent design of PSF radioactive exhaust air systems minimize leakage. Contamination burden could only occur because of a failure of the upstream HEPA filter.	The PSF radioactive air exhaust air system design inherently places exhaust fans downstream of the system HEPA Filter units and exclusive of the boundary required for aerosol testing. Aerosol injection takes place upstream of the filter units. In addition, the exhaust fans are located on the roof. The initiating event of a transient would be attributed to a ruptured contaminated filter resulting from maintenance activities. Therefore a less stringent leakage is acceptable for normal operations.
	BA-4150, *Support Boundary*, requires identification of size and type of anchorage points and anchorage loads. **General Design Criteria to be Satisfied**: Anchorage points and loads specified.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*) requires mounting dimensions and information for the design of supports and foundations to be provided after fan selection as well as requiring manufacturers mounting instructions for radioactive exhaust air system fan units.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	BA-4160, *Vibration*, identifies fan balancing requirements and bearing displacement limits. **General Design Criteria to be Satisfied**: Fans wheels shall be balanced prior to assembly.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*) requires compliance to grade G6.3 per ANSI S2.19 and AMCA 204-96 ensuring vibration levels meet or exceed guidelines in Application Category BV-3.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
BA-4200, *Selection*	BA-4210, Fans		
	BA-4211, *General,* specifies descriptive fan information to be used for fan selection, such as unique identifier, duty, fan location, fan environment, drive arrangement and special limitations. **General Design Criteria to be Satisfied**: Fans shall have a unique equipment identifier and shall be designed for the operating environment.	HVAC system is designed and modeled in accordance applicable sections of 2003 ASHRAE Handbook, *HVAC Applications, I-P Edition,* Chapter 14, *Laboratories*, and Chapter 26, *Nuclear Facilities*. The construction specification (PSF Construction Specification, Section 23 3400, *Fans*) requires compliance with AMCA design requirements and demonstrating that system characteristics are considered. AMCA testing requirements require compliance with ANSI/AMCA Standard 210/ASHRAE 51, ISO 5801, or other standards recognized in AMCA Publication 111, Laboratory Accreditation Program. All PSF radioactive exhaust air system fans will be assigned unique Equipment Identification and shall be controlled in the Master Equipment List.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	BA-4212, *Performance Rating*, identifies minimum information to be used to specify the fan performance rating. **General Design Criteria to be Satisfied**: Identification of fan operating points	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*) requires compliance with AMCA 211 and 311 design requirements and demonstrating that system characteristics are considered.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.
	BA-4213, *Pressure Relationships*, requires fan ratings to use both total and static pressure, as illustrated in AMCA 201. **General Design Criteria to be Satisfied**: Fan pressure relationships comply with AMCA 201.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*) requires compliance with AMCA 201 requirements and demonstrating that system pressure characteristics are considered.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	BA-4214, *Operation at Reduced Flow*, requires evaluation of operation at reduced flow to ensure stable operation over the entire range of expected fan operation. **General Design Criteria to be Satisfied**: Evaluated fan performance over entire range of operation.	The PSF radiological exhaust system is designed and modeled in accordance applicable sections of 2003 ASHRAE Handbook, *HVAC Applications, I-P Edition*, Chapter 14, *Laboratories*, and Chapter 26, *Nuclear Facilities*. The ASHRAE guidelines specifically address minimum flow rates as a design consideration. The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 1.4.D), requires variable air volume applications indicate operating points at 100, 80, 60 and 40 % design capacity.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.
	BA-4215, *Construction Information* identifies specific construction information for fan selection. **General Design Criteria to be Satisfied**: Fan selection shall consider specific construction information. Refers to BA-4300 for more specific requirements depending on fan type.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*) specifically addresses AMCA construction requirements and labeling.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	BA-4216, *Bases for Fan Rating Data*, requires testing to establish fan rating data and tests to establish performance ratings from reduced size fans are required to comply with AMCA 210. **General Design Criteria to be Satisfied**: Fans shall comply with AMCA 210	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*) specifically addresses AMCA 211 requirements which invoke AMCA 210 (ASHRAE 51) in order to obtain AMCA labeling.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	BA-4217, *Bases for Sound Data Rating*, requires testing of the actual fan or calculations from test data from a similar fan in accordance with AMCA 301. **General Design Criteria to be Satisfied**: Fan sound rating shall comply with AMCA 301.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 1.5.J) states "sound power levels shall be based on performance tests in accordance with AMCA Standards 300 and 301."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	BA-4220, Drivers		

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	BA-4221, *Information Required for Driver Selection*, identifies minimum information to be used in driver selection. **General Design Criteria to be Satisfied**: Fan driver shall include specific design considerations	The construction specification (PSF Construction Specification, Section 23 3400, *Fans* and Section 200513, *Motors*) address these requirements.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	BA-4222, *Special Limitations*, limits or does not allow under certain circumstances the use of belt drives, direct drives, drives with gear reducers, and variable pitch diameter sheaves on centrifugal fans. **General Design Criteria to be Satisfied**: Specific limitations on types of fan drives and locations of fans.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 2.1), calls out direct drive, centrifugal type fans for the PSF radioactive exhaust air system. The fans will be located on the roof of the PSF in a readily accessible service area.	The chosen specification and governing construction requirements satisfiesf this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
BA-4300, *Construction*	**BA-4310, Fans**		
	BA-4311.1, *General*, requires compliance with BA-4100 and BA-4200 for housing materials and design. Spark resistant construction, where specified, shall meet AMCA 99-401. **General Design Criteria to be Satisfied**: Fan housing materials shall comply with AMCA 99-401.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 2.1.B) specifically addresses this requirement stating "AMCA Type C spark resistant construction"	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	BA-4311.2, *Bearings*, provides bearing requirements and the bearing rating life criteria are to be established in accordance with ANSI/ AFBMA 9 or 11 (currently ANSI/AMBA 9 or 11). **General Design Criteria to be Satisfied**: Bearing rating shall comply with AMBA 9 or 11 and have a minimum L-10 life of 100,000 hours.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*) specifically states "[bearings] shall be selected for minimum life (ABMA L-10) of not less than 80,000 hrs operation at maximum cataloged operating speed based on ABMA 9 and 11"	The difference of 20,000 hours equates to 2.2 years for a fan running 24 hours per day per year at full loading. The PSF radiological exhaust system has redundant exhaust fans as well reduced loading (due to the variable exhaust flow capability), consequently the fan bearing life will be extended considerably. The fans are located in a readily accessible area and any required bearing replacement will be a straightforward task.
	BA-4320, Drivers and Drives		

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	BA-4322, *Drive Alignment and Adjustment*, requires metal shims for direct drive alignment and adjustable driver base for belt tension adjustments. **General Design Criteria to be Satisfied**: Drives and belts are to be adjustable	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 3.1) requires fans to be installed in accordance with manufacture's recommendations.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.
	BA-4323, *Mechanical Design Requirements for Drivers*, requires specific bearing life-expectancy, sheave arrangement limitations according to NEMA MG-1, and driver conformance with NEMA MG-1. **General Design Criteria to be Satisfied**: Driver bearing design life shall have a minimum L-10 life of 100,000 hours unless limited by driver constraints. Sheave limitations as well as the driver shall comply with NEMA MG-1.	The construction specification (PSF Construction Specification, Section 20 0513, *Motors*, Paragraph 2.2.) requires a minimum L-10 bearing life of 26,280 hours at full load and that all motors are to be in compliance with NEMA MG-1. The PSF radioactive exhaust system fans are direct drive, so the sheave limitations of NEMA MG-1 do not apply.	The L-10 bearing life of 26,280 hours is a NEMA standard for the type of premium efficiency industrial motors to be used in the PSF radiological exhaust air system. The difference of 73,720 hours equates to 8.4 years for a motor running 24 hours per day per year at full loading. The PSF radiological exhaust system has redundant exhaust fans as well reduced loading (due to the variable exhaust flow capability), consequently the motor bearing life will be extended considerably. The fans are located in a readily accessible area and any required motor replacement will be a straightforward task.

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	BA-4324, *Electrical Design Requirements*, requires that drivers be designed for single voltage supply, have solid grounding, and conform to NEMA MG-1. **General Design Criteria to be Satisfied**: Drives design shall comply with NEMA MG-1	The construction specification (PSF Construction Specification, Section 20 0513, *Motors*, Paragraph 2.2) requires all motors to be designed to applicable NEMA standards.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG 1 requirement. The design specifications require single voltage motors on a 460-volt basis. Motors are specified to comply with NEMA MG-1 requirements and to perform at their rated load at a service factor of 1.15.
	BA-4325, *Application*, requires drivers to be designed to operate at maximum-load brake horsepower without encroaching on the driver service factor. **General Design Criteria to be Satisfied**: Drivers designed to operate at maximum brake horsepower without entering service factor.	The construction specification (PSF Construction Specification, Section 20 0513, *Motors*, Paragraph 2.2) requires all motors to be designed to applicable NEMA standards.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG 1 requirement. The design specifications require single voltage motors on a 460-volt basis. Motors are specified to comply with NEMA MG-1 requirements and to perform at their rated load at a service factor of 1.15.
	BA-4330, *Accessories*, identifies requirements and criteria for lifting lugs, inspection panels, direction arrows, gaskets, bearing lubricants, bearing thermocouples, variable inlet vanes, inlet screen guards, vibration isolators, guards, inlet transitions and shaft seals. **General Design Criteria to be Satisfied**: Accessory requirements shall be complied with.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 2.1) specifically addresses applicable requirements by defining inspection/access panels, bearing lubricants, belt and shaft guards, etc.	The chosen specification is equivalent to and meets the intent of ASME AG-1.
BA-4400, *Reports and Calculations*	Establishes requirements for documentation of fan performance rating, sound production and structural verification. **General Design Criteria to be Satisfied**: Identification of fan operating points and fan compliance with AMCA 210. Sound tests shall comply with AMCA 300 or ASHRAE 68.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 1.5.A) requires fan ratings to be tested and certified in accordance with AMCA Standards 211 and 311. Sound power levels shall be based on tests performed in accordance with AMCA 300 and 301.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
BA-5000, Inspections and Testing			
BA-5100, *Fan Inspection and Testing*	AA-5000 and AA-6430, referenced subsections, establish general requirements for calibration of M&TE, visual inspections, and inspections and testing of bolted and brazed connections. **General Design Criteria to be Satisfied**: Fans shall comply with AMCA 210.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 1.5.A) requires fan ratings to be tested and certified in accordance with AMCA Standards 211 and 311.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	BA-5110, *General Testing Requirements*, establishes requirements for fans requiring performance tests and for test facilities. **General Design Criteria to be Satisfied**: Fans shall comply with AMCA 210.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 1.5.A) requires fan ratings to be tested and certified in accordance with AMCA Standards 211 and 311.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	BA-5120, *Performance Acceptance Tests*, requires AMCA 210 for all aspects of performance testing, requires IEEE 112A for driver testing, and identifies specific tests and measurements. **General Design Criteria to be Satisfied**: Performance tests shall comply with AMCA 210. Driver test results in accordance with IEEE 112A.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 1.5.L) requires that drive efficiency be considered in motor selection according to manufacturer's published recommendation, or according to AMCA Publication 203, Appendix L. Requires fan ratings to be tested and certified in accordance with AMCA Standards 211 and 311.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	BA-5130, *Sound Tests*, requires AMCA 300 or ASHRAE 68 for sound power level ratings tests. **General Design Criteria to be Satisfied**: Sound tests shall comply with AMCA 300 or ASHRAE 68.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 1.5.J) requires that sound power levels shall be based on tests performed in accordance with AMCA 300 & 301.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	BA-5140, *Mechanical Tests*, requires and establishes criteria for over-speed tests, leakage tests, fan vibration tests, mechanical running tests and seismic tests, if required. **General Design Criteria to be Satisfied**: Vibration test maximum displacement requirements. Fan wheels shall be dynamically balanced prior to fan assembly.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 1.5.C) requires compliance to grade G6.3 per ANSI S2.19 and AMCA 204-96 ensuring vibration levels meet or exceed guidelines in Application Category BV-3.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	BA-5150, *Test Results and Reports*, requires that all test results be certified and documented. **General Design Criteria to be Satisfied**: Tests results certified and documented	The construction specification (PSF Construction Specification, Section 20 0000, *General Mechanical Requirements*, Paragraph 3.10 Testing and Balancing, E & F), states "This Contractor is responsible for certifying in writing equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria, test medium and pressure used, duration of test and name and title of person signing Test Certification Document. Maintain copies of certified test results, including those for any failed tests, at project site. At completion of Project, include copies of test records and certifications in O&M Manuals."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
BA-5200, *Driver Inspection and Testing*	Requires driver testing according to IEEE 112A and documentation of test data. **General Design Criteria to be Satisfied**: Driver test results in accordance with IEEE 112A.	The construction specification (PSF Construction Specification, Section 20 0513, *Motors*, Paragraph 2.2.I) requires testing of motors in accordance with IEEE Standard 112, Method B.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
BA-6000, Fabrication and Installation of Centrifugal and Axial Fans (References Section AA-6000)			
AA-6100, *General*	Identifies materials requirements by reference to BA-3000 and requires quality control procedures for all fabrication, installation, and repair processes by reference to AA-8000 or AA-6300. **General Design Criteria to be Satisfied:** General requirements for the fabrication, joining, welding, brazing, protective coating and installation of components, parts, and equipment. Component, parts, and equipment shall comply with ASME NQA-1. Materials shall meet ASME or ASTM requirements and certifications.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
AA-6200, *Fabrication Processes*	Establishes specific requirements for cutting, forming, bending, forming tolerances, fitting and aligning for bolting or welding, welded joints and mechanical joints. **General Design Criteria to be Satisfied:** fabrication/assembly requirements	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*) requires fan ratings to be tested and certified in accordance with AMCA Standards 211 and 311. The PSF radioactive exhaust system will utilize laboratory grade fans. These fans will be fabricated/assembled in accordance with the manufacturer's standard procedures. During the submittal process, appropriate reviews will be made to assure that the proposed exhaust fans meet the specification requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
AA-6300, *Welding Requirements*	Establishes very detailed and specific requirements for welding including workmanship, inspection, testing, non-destructive testing, inspector qualifications and repairs. Identifies several ANSI/AWS codes and ASME Code, Section IX to be complied with. **General Design Criteria to be Satisfied:** welding requirements	The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
AA-6400, *Brazing*	Establishes brazing requirements similar to the welding requirements of AA-6300. **General Design Criteria to be Satisfied:** Brazing requirements	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 2.1.C), states that the fume exhaust fans will have heavy gage welded steel housings. No brazing required.	This AG-1 requirement does not apply.
AA-6500, *Cleaning and Coating*	Establishes coating requirements using a graded approach using service levels based on the coating's and the equipment's relation to nuclear safety. **General Design Criteria to be Satisfied:** Coating requirements.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 1.5.P) states "Fans scheduled with baked phenolic coating shall have parts in contact with air stream coated with minimum 5 mils equal to Heresite P-4403(first 3 coats) and L-66L (final 2 coats) with each coat baked separately."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
AA-6600, *Installation Requirements*	Establishes requirements for handling, rigging, field assembly, installation procedures, and temporary field attachments. **General Design Criteria to be Satisfied:** Follow manufacturer's procedures for installation of fans.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 3.1.A), states "Install fans as shown on drawings and according to manufacturer's installation instructions".	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
BA-6100, *Fabrication*	Requires written fabrication procedures to be established and used, and all heat-treating requirements to be indicated on drawings or procedures. **General Design Criteria to be Satisfied:** Manufacturer's shall provide fabrication procedures.	The PSF radioactive exhaust system will utilize laboratory grade fans. These fans will be fabricated/assembled in accordance with the manufacturer's standard procedures. During the submittal process, appropriate reviews will be made to assure that the proposed exhaust fans meet the specification requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
BA-7000, Packaging, Shipping, and Storage (References Section AA-7000)			
AA-7000	Establishes general requirements and responsibilities for packaging, shipping, receiving, storage and handling, primarily by supplementing the provisions of ANSI/ASME NQA-2, Part 2.2. Personnel qualification requirements of ANSI/ASME NQA-1 are required for inspection, examination, and testing. **General Design Criteria to be Satisfied:** Packaging, shipping, receiving, storage and handling shall be in accordance with ANSI/ASME NQA-2, Part 2.2. Personnel qualification requirements of ANSI/ASME NQA-1.	The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
BA-7100, *Fans*	Defines ANSI/ASME NQA-2 protection levels for fans and drivers during shipment and storage. Requires a storage procedure. **General Design Criteria to be Satisfied:** Fans shall be prepared for shipment and stored in accordance with ANSI/ASME NQA-2.	The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
BA-7200, *Drivers Shipped Separately*	Establishes short term and long term storage requirements for drivers shipped separately from the fan. **General Design Criteria to be Satisfied:** Drivers shall be prepared for shipment and stored in accordance with ANSI/ASME NQA-2.	Per the construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 1.5.A) the drivers for the PSF radioactive air exhaust fans will be shipped with the fans (fans will be fully assembled at the manufacturer), therefore this requirement is not applicable.	N/A
BA-8000, Quality Assurance (References Section AA-8000)			
BA-8000, *Quality Assurance*	Establishes general requirements and responsibilities for quality assurance primarily by supplementing the provisions of ANSI/ASME NQA-1. **General Design Criteria to be Satisfied:** Quality assurance in accordance with ANSI/ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
BA-8100, *Required Documentation for Fans*	Requires fan performance curves generated in accordance with AMCA 210 and material certification records. **General Design Criteria to be Satisfied.** Performance tests shall comply with AMCA 210. Manufacturer's Certificate of Compliance shall be provided.	The construction specification (PSF Construction Specification, Section 23 3400, *Fans*, Paragraph 1.5.A) requires fan ratings to be tested and certified in accordance with AMCA Standards 211 and 311.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
BA-8200, *Quality Assurance for Drivers*	Requires driver manufacture under a quality assurance program that conforms to ANSI/ASME NQA-2 and qualification of drivers in accordance with ANSI/IEEE 323 Class 1E standards. **General Design Criteria to be Satisfied.** Driver manufacturer shall have quality assurance program in accordance to ANSI/ASME NQA-1. Each driver shall be qualified in accordance with ANSI/IEEE 323 Class 1E	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1." The construction specification (PSF Construction Specification, Section 20 0513, *Motors*, Paragraph 2.2) requires identification/certification of compliance with governing IEEE, NEMA, ANSI, NEC, and UL requirements.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories. IEEE-323 does not apply as this facility does not have any Safety Related or Safety Significant systems, structures or components as documented in the *Physical Sciences Facility Hazards Analysis Report*, CRL-PROC-ES&H-001.
BA-9000, Nameplates and Operating and Maintenance Manuals			
BA-9100, *Fans*	Establishes nameplate requirements for fans and references AA-9000 for more specific nameplate requirements. Driver nameplates are required to comply with NEMA MG-1. **General Design Criteria to be Satisfied.** Requirements for fan nameplate information. Driver nameplates in accordance with NEMA MG-1.	The construction specification (PSF Construction Specification, Section 20 0553, Mechanical Systems Identification) Paragraph 3.4 "Equipment and Control Panel Identification" lists the requirements for identification of PSF equipment, which includes the exhaust fans serving the radiological exhaust system. The construction specification (PSF Construction Specification, Section 20 0513, *Motors*, Paragraph 2.2) requires identification/certification of compliance with governing IEEE, NEMA, ANSI, NEC, and UL requirements, this includes nameplates in accordance with NEMA MG-1.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
BA-9200, *Accessories*	The manufacturer must be identified on each accessory. **General Design Criteria to be Satisfied.** Each accessory shall be marked to identify the manufacturer.	The exhaust fans serving the PSF radioactive exhaust air systems do not have "accessories" per se, the fans will be completely assembled by the manufacturer and all of the components will be identified on the documentation provided in the O&M manuals described in the next section.	N/A

Table 3. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
BA-9300, *Operating and Maintenance Manuals*	Requires the manufacturer to provide an operation and maintenance manual including recommended spare parts list and recommended maintenance procedure. **General Design Criteria to be Satisfied.** Manufacturer shall provide operating and maintenance manual for equipment furnished.	The construction specification (PSF Construction Specification, Section 20 0000, *General Mechanical Requirement*, Paragraph 1.7.C) defines the requirements for Operation and Maintenance Manuals, the PSF radiological exhaust system is included in this requirement.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 4. Section DA, Dampers Detailed Evaluation

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
DA-1000, Introduction			
DA-1000, *Introduction*	DA-1000 assures that dampers/louvers used in nuclear facilities are acceptable in all aspects of performance, design, and construction. **General Design Criteria to be Satisfied**: Dampers/louvers used meet the requirements of nuclear facilities.	PSF radioactive exhaust air systems are designed and constructed in accordance with applicable sections of 2003 ASHRAE *HVAC Applications*, Chapter 26, *Nuclear Facilities* and SMACNA *HVAC Duct Construction Standards, Metal and Flexible, 1995*.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
DA-2000, Referenced Documents			
DA-2000, *Referenced Documents*	Identifies codes and standards referenced in this section. **General Design Criteria to be Satisfied**: None	Not applicable to this evaluation.	Not applicable to this evaluation.
DA-3000, Materials			
DA-3100, *Allowable Materials*	Defines allowable materials and material stress limits for frames, blades, shafts, and linkages, primarily by requiring specific ASTM and ASME designated materials. Bearing and seal allowable materials are defined by reference to DA-4250 and DA-4260. **General Design Criteria to be Satisfied**: Allowable materials comply with the design intent of Table DA-3110. Materials shall meet ASME or ASTM requirements and certifications.	PSF radioactive exhaust air systems require materials used to be ASTM or ASME designated materials identified in SMACNA *HVAC Duct Construction Standards, Metal and Flexible, 1995*.	Design equivalence is predicated on the application of the SMACNA requirement of ASTM or ASME designated materials.
DA-3200, *Special Limitations on Materials*	Requires consideration of special conditions such as high temperatures, galvanic corrosion, and corrosive vapors. Additional consideration is required when using non-metallic materials. **General Design Criteria to be Satisfied**: Galvanic corrosion between dissimilar metals will be considered.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 1.5.B, Design Criteria) states "Ductwork specialties exposed to airstream, such as dampers…shall be of the same material as duct where the specialties are mounted, unless otherwise noted". The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.1, General) states "Where two different metal ducts meet, install joint in such a manner that metal ducts do not contact each other by using proper gasket seal or compound."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 4. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
DA-3300, *Certification of Materials*	Requires certified test reports for damper stress components, and Manufacturer's Certificate of Compliance with ASME or ASTM specifications for all other components. **General Design Criteria to be Satisfied**: Provide certified test reports for damper components under stress (frame, blades, shafts, etc).	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 1.4, Submittals), specifies that components exposed to the airstream, such as dampers, be constructed of the same material as the ductwork. Per Section 23 3114, *Ductwork*, of the PSF Construction Specification, ductwork will be constructed of materials outlined in various SMACNA Publications, which reference various ASTM standards. Certified test reports of damper materials is not required. Section 01 4000, *Quality Requirements*, of the PSF construction specification requires that the procurement of items and services be controlled to assure conformance with specified requirements.	The AG-1 requirement is more stringent, however, the quality requirements imposed on the contractor (and suppliers) will provide sufficient assurance that the materials specified will be procured and installed.
DA-4000, Design			
DA-4100, *General Design*	DA-4110, *Requirements of Design Specifications*, requires specific design parameters, as applicable, that provide a complete basis for design and manufacture of dampers. **General Design Criteria to be Satisfied**: Requirements of design specifications to provide a complete basis for design and manufacture	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	DA-4120, *Requirements of the Manufacturer*, requires specific documentation, as applicable, to be provided by the manufacturer to the Owner. **General Design Criteria to be Satisfied**: Applicable documentation provided by the Manufacturer to the Owner.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 1.4, Submittals and Section 233614, *Laboratory Temperature and Airflow Control System*, Paragraph 1.5, Submittals), specifies the required documentation that will be provided to the owner.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 4. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	DA-4130, *Performance Requirements,* establishes requirements for seat leakage, frame leakage, pressure drop, fire ratings, fire damper closure, and cycle time. **General Design Criteria to be Satisfied**: Requirements for leakage, pressure drop.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3 and Section 233614, *Laboratory Temperature and Airflow Control System*, Paragraph 2.3.F), outline the requirements for damper seat and frame leakage and cycle time. Pressure drop across open dampers is not addressed. There are no fire dampers in the PSF radioactive exhaust air system.	The chosen specification meets a portion of the AG-1 requirement (damper leakage and cycle time). The other AG-1 requirements contained in DA-4130 are not applicable to the PSF radioactive exhaust air system.
	DA-4210, *Structural*, provides very specific and very detailed structural loading criteria. **General Design Criteria to be Satisfied**: Damper loading criteria requirements.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.1.J) states the requirements for supporting dampers located in the PSF radioactive exhaust air system.	The additional rigorous design analysis required by ASME AG-1 is not necessary for this application. The extensive past operating history of these dampers demonstrates adequate structural design for this application.
	DA-4220, *Thermal Expansion,* requires that the design provide for the relative motions that occur between components due to differential expansion. **General Design Criteria to be Satisfied**: Not applicable	Not applicable	Thermal expansion need not be a consideration because temperature gradients will not be established. The air stream temperature will not deviate significantly from the temperature of the room housing the equipment.
	DA-4230, *Torque*, establishes requirements for determination of the torque required to actuate the blades and for minimum actuator torque. **General Design Criteria to be Satisfied**: Torque requirements will be determined by manufacturer and submitted to owner.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) calls out manual operators for these particular dampers. Torque requirements are not required.	ASME AG-1 has more detailed and specific requirements. See Section 5.1.1.2 for further justification.
	DA-4240, *Linkage,* establishes specific requirements for linkage design. **General Design Criteria to be Satisfied**: Suitable linkage shall be selected.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) calls out manually operated, single-blade type for these particular dampers. Linkages are not required. The construction specification (PSF Construction Specification, Section 23 3614, *Laboratory Temperature and Airflow Control System*, Paragraph 2.3.E) specifies the damper linkage material for these types of dampers.	The chosen specifications meet the intent of the AG-1 requirements.

Table 4. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	DA-4250, *Bearings*, establishes specific requirements for bearing selection including bearing types, bearing design, and bearing loading. **General Design Criteria to be Satisfied**: Bearings shall be adequate for intended usage.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) calls out bearing requirements for these particular dampers. The construction specification (PSF Construction Specification, Section 23 3614, *Laboratory Temperature and Airflow Control System*, Paragraph 2.3.E) does not specifically call out shaft bearings, but does specify shaft bearing surface requirements.	ASME AG-1 has more detailed and specific requirements. See Section 5.1.3.2 for further justification.
	DA-4260, *Seals*, establishes requirements for seal design and materials to limit seat and frame leakage. **General Design Criteria to be Satisfied**: Seal requirements.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) calls out blade seal requirements for these particular dampers. The construction specification (PSF Construction Specification, Section 23 3614, *Laboratory Temperature and Airflow Control System*, Paragraph 2.3.E) does not call out seal requirements as these types of dampers do not require seals.	The chosen specifications meet the intent of ASME AG-1.
	DA-4270, *Frame Construction*, requires stuffing boxes, gasketed cover plates, or other sealing devices to limit frame leakage on dampers where leakage is a consideration. Also, specifies material requirements for gasket and packing materials. **General Design Criteria to be Satisfied**: Frame construction requirements.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) calls out frame requirements for these particular dampers. The construction specification (PSF Construction Specification, Section 23 3614, *Laboratory Temperature and Airflow Control System*, Paragraph 2.3.E) calls out frame requirements for these types of dampers.	The chosen specifications meet the intent of ASME AG-1.

Table 4. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	DA-4280, *Mounting of Actuators and Accessories*, establishes requirements for the mounting structure, accessibility, mounting structure material, attachment, and linkage adjustability for actuators and accessories. **General Design Criteria to be Satisfied**: Allowable materials comply with the design intent of Table DA-3110. Actuator mounting requirements. Linkage adjustability requirements.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) calls out manual operators for these particular dampers. The construction specification (PSF Construction Specification, Section 23 3614, *Laboratory Temperature and Airflow Control System*, Paragraph 2.3.E) calls out the actuator mounting requirements for these types of dampers.	The chosen specifications will be equivalent to ASME AG-1, except for stress limitations. Rigorous stress loading analysis is not necessary for this application. See Section 5.1.3.2 for further justification.
DA-4300, *Actuators*	DA-4310, *Power-Operated Actuators*, establishes requirements for required torque, actuator loading, voltage or pressure rating, and minimum specified design parameters to establish requirements for actuator performance. **General Design Criteria to be Satisfied**: Establish actuator requirements.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) calls out manual operators for these particular dampers. The construction specification (PSF Construction Specification, Section 23 3614, *Laboratory Temperature and Airflow Control System*, Paragraph 2.3.F) calls out the actuator requirements for these types of dampers.	It is acceptable to allow the manufacturer to select power-operated actuators for dampers, given design parameters that ensure acceptable actuator performance.
	DA-4320, *Manual Actuators*, establishes requirements for locking devices, position indicators, torque requirements, actuator loading, and maximum input forces. **General Design Criteria to be Satisfied**: Manufacturer shall select manual actuators for dampers.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) calls out the requirements for manual actuators for these particular dampers.	It is acceptable to allow the manufacturer to select manual actuators for dampers.
	DA-4330, *Self-Contained Actuators*, references DA-4231 for torque requirements for self-contained actuators. **General Design Criteria to be Satisfied**: Torque requirements.	No self-contained actuators are used in the PSF radioactive exhaust air system.	Not applicable.

Table 4. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	DA-4340, *Heat or Temperature Operated Actuators*, requires compliance with NFPA 90A for heat or temperature operated actuators. **General Design Criteria to be Satisfied**: Meet requirements of NFPA 90A.	No heat or temperature operated actuators are used in the PSF radioactive exhaust air system.	Not applicable.
DA-4400, Accessories	Establishes requirements for accessories to be provided, auxiliary energy source, modulating actuators, position indicators, environmental conditions, piping of pneumatic actuators, and electrical wiring, primarily to be identified in the design specification. **General Design Criteria to be Satisfied**: Accessories as required by the design specification.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3 and Section 233614, *Laboratory Temperature and Airflow Control System*, Paragraph 2.3.E &F), outline the requirements for any needed damper accessories to ensure system operation and maintainability.	The chosen specifications meet the intent of ASME AG-1.
DA-5000, Inspections and Testing			
Referenced Sections of AA-5000	Establishes general requirements for calibration of M&TE, visual inspections, inspections and testing of welded connections, inspections of bolted connections, examination of fabrication tolerances, and seismic testing. **General Design Criteria to be Satisfied**: Control calibration shall be in accordance to ASME NQA-1	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	ASME AG-1 has more detailed and specific requirements as described. Reliance on the manufacturer's inspection and testing procedures for fabrication of laboratory grade dampers is acceptable for this application. The level of detail specified in ASME AG-1 is unnecessary for this application. See Section 5.1.3.2 for further justification.

Table 4. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
DA-5100, *Testing*	DA-5110, *Pressure Drop Testing*, requires pressure drop data to be based on tests performed in accordance with AMCA 500. **General Design Criteria to be Satisfied**: Pressure drop testing in accordance with AMCA 500	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) specifically call out an acceptable manufacturer and model of round, butterfly type of damper. This damper has published pressure drop data, which is tested per AMCA 500. The dampers specified in Section 23 3614, *Laboratory Temperature and Airflow Control System*, Paragraph 2.3.E &F), are not tested to AMCA 500 by the manufacturer. These dampers are designed to operate over a large range of duct static pressures and the data obtained by AMCA 500 testing would be of no value. Section 014000, *Quality Requirements*, of the PSF construction specification requires that the procurement of items and services be controlled to assure conformance with specified requirements.	The AG-1 requirement is more stringent, however, the quality requirements imposed on the contractor (and suppliers) will provide sufficient assurance that the materials specified will be procured and installed.
	DA-5120, *Cycle Time and Cycle Repetition*, establishes requirements for valve cycle testing to verify such things as free and smooth operation, proper seating of blades, cycle time, and limit switch operation. **General Design Criteria to be Satisfied**: Manufacturer cycle testing will be sufficient.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) specifically call out an acceptable manufacturer and model of damper.	Reliance on the manufacturer's cycle testing provides adequate assurance of damper operation for this application. The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 4. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	DA-5130, *Frame Leakage Testing for Frame Leakage Classes A and B*, establishes testing requirements for frame leakage on dampers where leakage is a consideration. **General Design Criteria to be Satisfied**: Frame leakage requirement.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) specifically call out an acceptable manufacturer and model of round, butterfly type of damper. This damper has published frame leakage data, which is tested per AMCA 500. The dampers specified in Section 23 3614, *Laboratory Temperature and Airflow Control System*, Paragraph 2.3.E &F), are not tested to AMCA 500 by the manufacturer. These dampers are designed to operate over a large range of duct static pressures and the data obtained by AMCA 500 testing would be of no value. Section 01 4000, *Quality Requirements*, of the PSF construction specification requires that the procurement of items and services be controlled to assure conformance with specified requirements.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	DA-5140, *Seat Leakage Testing*, establishes testing requirements for seat leakage specifically or by requiring AMCA 500 test methods. Fire dampers shall be tested in accordance with AMCA 500. **General Design Criteria to be Satisfied**: Seat Leakage testing in accordance with AMCA 500.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) specifically call out an acceptable manufacturer and model of round, butterfly type of damper. This damper has published seat leakage data, which is tested per AMCA 500. The dampers specified in Section 23 3614, *Laboratory Temperature and Airflow Control System*, Paragraph 2.3.E &F), are not isolation type dampers and thus do not have any "seats". Section 01 4000, *Quality Requirements*, of the PSF construction specification requires that the procurement of items and services be controlled to assure conformance with specified requirements.	The AG-1 requirement is more stringent, however, the quality requirements imposed on the contractor (and suppliers) will provide sufficient assurance that the materials specified will be procured and installed.

Table 4. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
DA-6000, Fabrication, Finishing and Installation (References Section AA-6000)			
AA-6100, *General*	Identifies materials requirements by reference to DA-3000 and requires quality control procedures for all fabrication and installation processes by reference to AA-8000. **General Design Criteria to be Satisfied:** General requirements for the fabrication, joining, welding, brazing, protective coating, and installation of components, parts, and equipment. Component, parts, and equipment shall comply with ASME NQA-1. Materials shall meet ASME or ASTM requirements and certifications.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1." The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*) 1.6 Welding Requirements, in accordance with AWS, Sheet Metal Welding Code ANSI/AWS D9.1.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
AA-6200, *Fabrication Processes*	Establishes requirements for cutting, forming, bending, forming tolerances, fitting and aligning for bolting or welding, welded joints, and mechanical joints. **General Design Criteria to be Satisfied:** Welding requirements	PSF radioactive exhaust air systems are designed in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2005. SMACNA requires welding per AWS D9.1. The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*) 1.6 Welding Requirements, in accordance with AWS, Sheet Metal Welding Code ANSI/AWS D9.1.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
AA-6300, *Welding Requirements*	Establishes very detailed and specific requirements for welding including workmanship, inspection, testing, non-destructive testing, inspector qualifications, and repairs. Identifies several ANSI/AWS codes and ASME Code, Section IX to be complied with. **General Design Criteria to be Satisfied:** Welding procedure specifications shall be in accordance with AWS.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*) 1.6 Welding Requirements, in accordance with AWS, Sheet Metal Welding Code ANSI/AWS D9.1.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
AA-6400, *Brazing*	Establishes similar requirements as AA-6300. **General Design Criteria to be Satisfied:** Braze welding requirements	All of the dampers in the PSF radioactive exhaust air system are constructed of steel or formed aluminum, no brazing is required.	N/A

Table 4. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
AA-6500, *Cleaning and Coating*	Establishes coating requirements using a graded approach using service levels based on the coating's and the equipment's relation to nuclear safety. **General Design Criteria to be Satisfied:** Galvanized steel and stainless steel surfaces do not require additional coating systems. Galvanized steel surfaces from which the coating has been removed during fabrication shall be coated with an appropriate qualified material.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 1.5.B, Design Criteria) states "Ductwork specialties exposed to airstream, such as dampers…shall be of the same material as duct where the specialties are mounted, unless otherwise noted". The construction specification (PSF Construction Specification, Section 23 3614, *Laboratory Temperature and Airflow Control System*, Paragraph 2.3.E) specifies the coating requirements for the internal surfaces of these types of dampers.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
AA-6600, *Installation Requirement*	Establishes requirements for handling, rigging, field assembly, installation procedures and temporary field attachments. **General Design Criteria to be Satisfied:** Manufacturer's procedures shall include the classification of the item to be handled as defined in ANSI/ASME NQA-2. The equipment manufacturer shall provide detailed written procedures for making the proper final assembly.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
DA-7000, Packaging, Shipping, and Storage (References Section AA-7000)			
AA-7000	Establishes general requirements and responsibilities for packaging, shipping, receiving, storage and handling, primarily by supplementing the provisions of ANSI/ASME NQA-2, Part 2.2. Personnel qualification requirements of ANSI/ASME NQA-1 are required for inspection, examination, and testing. **General Design Criteria to be Satisfied:** Packaging, shipping, receiving, storage, handling and personnel shall be in accordance with ANSI/ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 4. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
DA-7000	Identifies ANSI/ASME NQA-2 classification levels for packaging, shipping, storage, and handling of dampers, louvers, actuators, and accessories. **General Design Criteria to be Satisfied:** Packaging, shipping, receiving, storage and handling shall be in accordance with ANSI/ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
DA-8000, Quality Assurance (References Section AA-8000)			
AA-8000, *Quality Assurance*	Establishes general requirements and responsibilities for quality assurance primarily by supplementing the provisions of ANSI/ASME NQA-1. **General Design Criteria to be Satisfied:** Quality assurance shall be in accordance with ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
DA-8100, *Damper and Louver Performance*	Requires documentation to verify that damper and louver performance comply with the testing criteria of DA-5000. **General Design Criteria to be Satisfied:** Documentation of performance will be submitted.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 4. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
DA-9000, Nameplates, Stampings, and Manuals			
AA-9000	Establishes specific nameplate requirements for materials, lettering, attachment, and location. **General Design Criteria to be Satisfied:** None, nameplate requirements will be determine by the manufacturer.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.2 and 2.3) specifically call out an acceptable manufacturer and model of damper.	The chosen specification will be equivalent to ASME AG-1.
DA-9100, *Nameplates and Stampings*	Requires part marking of each part of removable frames and the manufacturer must be identified on each actuator and accessory. **General Design Criteria to be Satisfied:** None, nameplate requirements will be determine by the manufacturer. Manufacturer name, model number, sizes will be submitted for each device.	The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 1.4.A, Submittals) outlines the required information to be provided, this includes manufacturer's name and model number of equipment, capacity, sizes, etc.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
DA-9200, *Manuals*	Requires manuals that shall include a recommended spare parts list and recommended installation, maintenance, and operational procedures. **General Design Criteria to be Satisfied:** Manufacturer shall provide operating and maintenance manual for equipment furnished.	The construction specification (PSF Construction Specification, Section 20 0000, *General Mechanical Requirement*, Paragraph 1.7.C) defines the requirements for Operation and Maintenance Manuals.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. Section SA, Ductwork Detailed Evaluation

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-1000, Introduction			
SA-1000, *Introduction*	SA-1000 assures that ductwork used in nuclear facilities is acceptable in all aspects of performance, design, and construction. **General Design Criteria to be Satisfied:** Acceptability of ductwork in a nuclear facility.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
SA-2000, Referenced Documents			
SA-2000, *Referenced Documents*	BA-2000 provides supplemental codes and standards. **General Design Criteria to be Satisfied:** None	Not applicable to this evaluation.	Not applicable to this evaluation. Reference information only.
SA-3000, Materials			
SA-3100, *General*	Identifies allowable materials and material stress limits, primarily by requiring ASTM and ASME designated materials with certified test reports. **General Design Criteria to be Satisfied:** Allowable materials comply with the design intent of Table SA-3400.	Materials shall be ASTM or ASME designated materials identified in various SMACNA *Duct Construction Standards*. The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 1.6, Design Criteria, subparagraph I), states "Use material weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA Publications: *HVAC Duct Construction Standards, Metal and Flexible*, 2nd Edition, 1995; *Round Industrial Duct Construction Standards*, 2nd printing, 1999; and *Rectangular Industrial Duct Construction Standards*, 8th printing, 1997."	Materials identified in the referenced SMACNA Duct Construction Standards meet the intent of ASME AG-1. The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-3200, *Material Substitution*	Measures shall be established for controlling and identifying material substitutions throughout the manufacturing and installation process. **General Design Criteria to be Satisfied**: Allowable materials comply with the design intent of Table SA-3400.	Materials shall be ASTM or ASME designated materials identified in various SMACNA Duct Construction Standards . The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 1.6, Design Criteria, subparagraph 1), states "Use material weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA Publications: *HVAC Duct Construction Standards, Metal and Flexible*, 2nd Edition, 1995; *Round Industrial Duct Construction Standards*, 2nd printing, 1999; and *Rectangular Industrial Duct Construction Standards*, 8th printing, 1997."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-3300, *Material Testing*	When required by the design specification, material shall be tested in accordance with the applicable material specification. **General Design Criteria to be Satisfied**: Design specifications will define applicable material testing requirements.	PSF radioactive exhaust air systems ductwork construction specifications do not require material testing. The materials shall be ASTM or ASME designated materials and shall meet the functional criteria identified in various SMACNA Duct Construction Standards. This is stated in the construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*) Paragraph 1.6, Design Criteria, subparagraph D, states "Unless otherwise indicated, construct the ductwork to meet functional criteria defined in Chapter VII of SMACNA *HVAC Duct Construction Standards, Metal and Flexible*, 1995 and other SMACNA Duct Construction Standards where applicable."	Material testing is specified as an option in ASME AG-1. The PSF radioactive air exhaust systems ductwork specifications do not require material testing. The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-3400, *Material Specifications*	Material for ductwork and ductwork supports shall be capable of meeting all requirements of Article SA-4000. Materials selected shall be evaluated for suitability with service conditions and compatibility with other materials used in duct construction. **General Design Criteria to be Satisfied**: Materials shall be in conformance with the ASTM materials listed in Table SA-3400 and Article SA-4000.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 1.6, Design Criteria, subparagraph l), states "Use material weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA Publications... *HVAC Duct Construction Standards, Metal and Flexible*, 2nd Edition, 1995; *Round Industrial Duct Construction Standards*, 2nd printing, 1999; and *Rectangular Industrial Duct Construction Standards*, 8th printing, 1997."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.
SA-4000, Design			
SA-4200, *Design Criteria*	SA-4210, *Load Criteria*, identifies the loads and load definitions for duct and duct supports to be considered. **General Design Criteria to be Satisfied**: Round and Rectangular duct and duct support load criteria.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 1.6, Design Criteria, subparagraph l), states "Use material weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA Publications: *HVAC Duct Construction Standards, Metal and Flexible*, 2nd Edition, 1995; *Round Industrial Duct Construction Standards*, 2nd printing, 1999; and *Rectangular Industrial Duct Construction Standards*, 8th printing, 1997."	The referenced SMACNA documents take duct and duct support loads into account when material shape and thicknesses are specified. Based on this, the chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.
	SA-4220, *Stress Criteria* – The ductwork stress shall be based upon the AISI *Specifications for the Design of Cold Formed Steel Structural Members*. The ductwork support stress shall be based upon the AISC, *Specification for the Design, Fabrication, and erection of Structural Steel for Buildings*. **General Design Criteria to be Satisfied:** The ductwork and ductwork support stress will in accordance with SMACNA.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 1.6, Design Criteria, subparagraph l), states "Use material weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA Publications: *HVAC Duct Construction Standards, Metal and Flexible*, 2nd Edition, 1995; *Round Industrial Duct Construction Standards*, 2nd printing, 1999; and *Rectangular Industrial Duct Construction Standards*, 8th printing, 1997."	The referenced SMACNA documents use very conservative safety factors for determining minimum duct thickness for various duct sizes, these safety factors range from 4 for smaller duct sizes to 8 for sizes up to 60 inches in diameter. For duct hangers, the referenced SMACNA standards use a limit of 25% of the failure load for an allowable load for various hanger configurations. Based on this, the chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	SA-4230, Deflection Criteria – The maximum deflection that may be sustained, so that the duct function is not impaired, shall be determined by analysis, testing, or both. The allowable deflections are as defined in AA-4231 for various Service level conditions. **General Design Criteria to be Satisfied:** Maximum allowable deflection shall be determined.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 1.6, Design Criteria, subparagraph I), states "Use material weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA Publications: *HVAC Duct Construction Standards, Metal and Flexible*, 2nd Edition, 1995; *Round Industrial Duct Construction Standards*, 2nd printing, 1999; and *Rectangular Industrial Duct Construction Standards*, 8th printing, 1997." The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.17.B, Fume Exhaust Stacks) states "Construct stacks of sufficient strength so that top of stack will not deflect more than 1/2" under horizontal wind pressure of 40 psf over surface area of stack."	The referenced SMACNA standards take duct deflection into account when the duct material thickness and support spacing requirements are developed. The deflections vary as a function of duct size. Based on this, the chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.
	SA-4240, *Other Criteria*, establishes requirements for vibration isolation, relative movement, and permanent attachments. **General Design Criteria to be Satisfied:** The vibration isolation type and efficiencies, primarily between duct and equipment. Welded attachment requirements.	The construction specification (PSF Construction Specification, Section 23 0550, *Vibration Isolation*, Paragraph 2.16, Performance) states "Select vibration isolation devices to achieve either minimum 95% isolation efficiency or minimum static deflection and mounting requirements." This section provides requirements for ductwork connected to exhaust fan inlets and outlets and ductwork located in mechanical equipment rooms. The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 1.6, Design Criteria, subparagraph I), states "Use material weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA Publications: *HVAC Duct Construction Standards, Metal and Flexible*, 2nd Edition, 1995; *Round Industrial Duct Construction Standards*, 2nd printing, 1999; and *Rectangular Industrial Duct Construction Standards*, 8th printing, 1997."The SMACNA standards define the deflection criteria to be followed.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-4300, *Ductwork Joints and Seams*	SA-4320, *Duct Joints and Seams,* identifies acceptable longitudinal seams (groove weld, lock type, Pittsburgh lock, and fillet weld) and transverse joints (welded flange, companion angle, Vanstone flange, and welded coupling) **General Design Criteria to be Satisfied:** Longitudinal seam and transverse joint requirements.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.15), list the requirements for the PSF radioactive exhaust air duct. Depending on location, ducts will be welded stainless steel, galvanized steel with longitudinal seams and transverse joints or galvanized spiral seam type and transverse joints. For stainless steel ducts, Paragraph 3.15.D.1 states "Use 18 gage or heavier 304 stainless steel sheet with all joints and seams butt-welded airtight unless noted otherwise on drawings." Paragraph 3.15.E.1 lists the requirements for the galvanized duct, which refers to Paragraphs 3.3.A.1 (longitudinal seams) and 3.4.A (transverse joints). Paragraph 3.3.A.1 states "Unless otherwise indicated, use Pittsburgh lock seams for rectangular ductwork except button punch snap lock may be used for ductwork downstream of supply air terminals." For transverse joints Paragraph 3.4.A.1 states "Transverse joints shall be in accordance with SMACNA HVAC Duct Construction Standards." Paragraph 3.15.E.2 lists the requirements for galvanized spiral duct, which refers to Paragraph 2.8.B, which states "Ducts shall be machine formed round duct constructed of G90 galvanized steel. Use spiral lockseam construction unless otherwise indicated. Use fittings as indicated on drawings, as specified, and as required in accordance with manufacturer's published data." Paragraph 2.8.C gives the requirements for connections and states "Connection shall use slip coupling, angle ring or Van Stone connectors in accordance with manufacturer's recommendations." Paragraph 2.8.D lists the required gage thickness and reinforcement requirements for the various duct diameters.	The chosen specifications and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	SA-4324, *Limitations of Ductwork Joints and Seams*, requires that longitudinal seams and transverse joints that are folded or punched metal, shall be pressure tested. Also, requires qualification by testing, analysis, or both for longitudinal seams that use sealants or elastomers to meet the leakage requirements. **General Design Criteria to be Satisfied:** Longitudinal seams and transverse joints shall be pressure tested.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8) states the duct leakage test requirements. Paragraph 3.8.C states "Leakage test shall be in accordance with test method described in Section 5 of SMACNA HVAC Air Duct Leakage Test Manual, except as modified in this Section." Paragraph 3.8.D states "Test pressure shall be equal to duct pressure class. Negative pressure ductwork shall be tested with negative test pressure." Paragraph 3.8.H states "Leakage rate shall not exceed more than 1% of system design air quantity for high pressure ductwork, determined in accordance with Appendix C of SMACNA HVAC Air Duct Leakage Test Manual." Paragraph 3.8.I states "Welded ductwork shall be air and watertight and shall have no air leakage."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	SA-4325, *Bolts and Fasteners*, establishes specific bolt spacing and size requirements for ductwork with a design pressure differential less than 15 in. w.g. and requires calculations or testing for bolted connections for ducts with pressures greater than 15 in. w.g. and for nonbolted, non-welded type fastening devices. **General Design Criteria to be Satisfied:** Bolt and fastener requirements will be in accordance with RIDCS, RTIDCS and DCSMF	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 1.5, Design Criteria I). states "Use material, weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA Publications: *HVAC Duct Construction Standards, Metal and Flexible*, 2nd Edition, 1995; *Round Industrial Duct Construction Standards*, 2nd printing, 1999; and *Rectangular Industrial Duct Construction Standards*, 8th printing, 1997."	ASME AG-1 has more restrictive requirements. The SMACNA allowable bolt spacing exceeds the 4" spacing of ASME AG-1. Standard industrial bolting practices will provide acceptable sealing and load bearing capability for this application. Testing of the duct system as described above will confirm this.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-4400, *Components*	SA-4410, *Flexible Connections*, establishes loading and pressure boundary leakage requirements for flexible connections and requires compliance with NFPA 90A. Also establishes requirements for pressure rating, qualified life, and adhesives. **General Design Criteria to be Satisfied:** Compliance with NFPA 90A.	PSF radioactive exhaust air systems are designed in accordance with SMACNA *HVAC Duct Construction Standards, Metal and Flexible, 2005*. The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8, Leakage Test), requires test be performed in accordance with SMACNA *Air Duct Leakage Test Manual* PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Smoke Management section refers to compliance with NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems. The construction specification (PSF Construction Specification, Section 23 3314, *Ductwork Specialties*, Paragraph 2.8, Duct Flexible Connections), outlines the material requirements for flexible connections. Material is to be glass fabric, fire retardant, waterproof, air tight and comply with UL Standard 214 and NFPA 90A. Material for fume hood exhaust systems shall consist on an inner layer of "Ventel" and an outer layer of "Ventglas".	The flexible connection materials specified are compatible with the service conditions, the flex connections are also subject to the duct leakage tests. Based on this, the flex connection materials satisfy the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	SA-4420, *Gaskets*, establishes requirements for gasket materials, dimensions, and compression criteria. **General Design Criteria to be Satisfied:** Gasket material requirements.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 2.9.B, Gaskets), states gaskets shall be "Butyl, copolymer or neoprene based tape similar to Ductmate 440 Gasket Tape or Neoprene Gasket Tape for flanged joints." Paragraph 2.9.C, Gaskets for fume hood exhaust ductwork shall be "Gasket material shall be Teflon based similar to Gore-Tex Series 300 or Butyl based tape similar to Ductmate 440 Gasket Tape." "Gasket thickness and width shall be as required for flange and surface irregularities to seal joint air tight."	The gasket materials specified are compatible with the service conditions, the gaskets are also subject to the duct leakage tests. Based on this, the gasket materials satisfy this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	SA-4430, *Access Doors and Panels*, establishes requirements for allowable leakage, sealing surfaces, compression, adjustment, and spacing of hinges, latches and bolts for access doors and panels. **General Design Criteria to be Satisfied:** allowable leakage requirements for Access Doors and Panels.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork Specialties*) Paragraph 2.6.C lists the requirements for access doors in exhaust systems, these are to be fabricated and rated to positive and negative pressures to 10 inches water column.	The access doors specified are compatible with the service conditions as well as the pressure requirements of the duct systems. The access doors are also subject to the duct leakage tests. Based on this, the access doors satisfy this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	SA-4440, *Provisions for Testing and Maintenance* – The engineer shall evaluate the design function of the equipment to determine where test ports (including injection and sampling ports) are required. **General Design Criteria to be Satisfied:** Requirement to determine where test ports are required.	The construction specification (PSF Construction Specification, Section 23 0595, *Air Systems Test Adjust Balance*) outlines requirements and procedures for accomplishing needed testing. Paragraph 2.2, Instrument Test Hole Plugs states "Center-pull plugs similar to Alliance Plastics CP Series. Plug material shall be Grade 1 virgin polyethylene." The construction specification (PSF Construction Specification, Section 23 4114, *Filters*, Paragraph 2.6, DOP Test Ports), lists requirements for HEPA filter test port locations and materials.	The Test Hole Plugs and HEPA filter test ports specified are compatible with the service conditions as well as the pressure requirements of the duct systems. The plugs and ports are also subject to the duct leakage tests. Based on this, these items satisfy this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	SA-4451, *Drains* – Consideration shall be given to drains depending on requirements, services, or components within ductwork. Drains are subject to the air leakage requirements established in SA-4500 **General Design Criteria to be Satisfied:** Drain requirements.	There are no permanent drains installed as part of the PSF filtered exhaust systems.	This ASME AG-1 requirement is N/A for the PSF.
	SA-4452, *Insulation*, establishes insulation requirements which includes location and type of insulation, fire hazard classification and insulation attachment requirements. **General Design Criteria to be Satisfied:** Insulation requirements.	The construction specification (PSF Construction Specification, Section 20 0700, *Mechanical Systems Insulation*) establishes the insulation requirements for ductwork.	The chosen specification and governing construction requirements satisfy this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	SA-4453, *Air Distribution Devices* – Design of air distribution devices and their attachments shall comply with SA-4200 and AA-4300. The performance rating of air distribution devices shall be determined by actual tests performed in accordance with the Air Diffusion Council standard listed in SA-2000. **General Design Criteria to be Satisfied:** Testing to determine performance rating of air distribution devices.	The construction specification (PSF Construction Specification, Section 23 3713, *Diffusers, Registers, and Grilles*, Paragraph 1.3.A), states "Performance data shall be based on tests conducted in accordance with ASHRAE Standard 70."	The chosen standard (ASHRAE Standard 70) is functionally equivalent to the ADC 1062 reference listed in SA-2000 of ASME AG-1, therefore this ASME AG-1 requirement is satisfied and ensures operational safety requirements for radiological laboratories.
	SA-4454, *Security Barriers*, establishes requirements for internal and bullet resistant barriers. **General Design Criteria to be Satisfied:** Not applicable.	No security barrier requirements are established.	Security barriers are not applicable to this application.
SA-4500, *Pressure Boundary Leakage*	SA-4510, *General,* identifies considerations for determination of allowable leakage for a system including control of airborne contamination, control of space pressure, control of space temperature, and control of space humidity **General Design Criteria to be Satisfied:** Determination of allowable leakage for ductwork system.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8 Leakage Test), states the allowable leakage rates in subparagraphs 3.8.H (1% of system design air quantitiy) and 3.8.I (air and watertight).	The chosen specification and governing construction requirements satisfy this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	SA-4520, *Applicability* – Pressure boundary leakage shall apply to air cleaning, air cooling, and ventilation systems. Identifies components that make up the systems pressure boundary, as applicable. **General Design Criteria to be Satisfied:** Components to comply with pressure boundary leakage.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8, Leakage Test, subparagraph J), states "Test 100% of HVEF ductwork and 10% of all other ductwork...."	The chosen specification and governing construction requirements satisfy this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	SA-4531, *Responsibility* – The engineer shall evaluate each system to establish the allowable leakage to ensure its design ventilation, temperature, and contamination control function is achievable. **General Design Criteria to be Satisfied:** Responsibility of allowable leakage.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8 Leakage Test), states the allowable leakage rates in subparagraphs 3.8.H (1% of system design air quantitiy) and 3.8.I (air and watertight).	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	SA-4532, *Allowable Leakage Determination*, identifies criteria to be utilized in the determination of allowable leakage. **General Design Criteria to be Satisfied:** Allowable leakage requirements.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8 Leakage Test), states the allowable leakage rates in subparagraphs 3.8.H (1% of system design air quantitiy) and 3.8.I (air and watertight).	Article SA-B-1000 of ASME AG-1 provides guidance for determination of allowable levels of duct leakage. Table SA-B-1310 gives two levels of Leakage Class, Class I has an allowable leak rate of 0.1% of rated flow for duct and Class II is allowed a 1% leak rate of rated flow. Figure SA-B-1410-1 shows examples of single pass air cleaning system configurations, Scheme Number 8 most closely matches the PSF design. This scheme allows a combination of Leakage Class I and II. For PSF, all ductwork upstream of the air cleaning units is required to be air and watertight (welded stainless steel), this exceeds the Leakage Class I and II allowed by Figure SA-B-1410-1. For ductwork downstream of the air cleaning units, Figure SA-B-1410-1 allows Leakage Class II duct (1% leak rate), PSF meets this requirement. Based on this, the chosen specification and governing construction requirements meet or exceed this ASME AG-1 requirement.
	SA-4533, *Exceptions to Leakage Requirements* identifies portions of systems that may not be subject to quantitative measurement of leakage, but will have all audible leaks sealed. **General Design Criteria to be Satisfied:** Exceptions to leakage requirements.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8 Leakage Test, subparagraph J), states "Test 100% of HVEF ductwork and 10% of all other ductwork...."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	SA-4534, *Documentation*, establishes documentation requirements for the evaluation of allowable leakage. **General Design Criteria to be Satisfied:** Allowable leakage documentation	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8 Leakage Test), refers to the Test and Balancing portion of Section 20 0000 for test documentation requirements.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	SA-4540, *Leakage Testing* – When specified for a system, leakage testing shall be performed in accordance with SA-5300 and Section TA of this Code. **General Design Criteria to be Satisfied:** Leakage testing shall be performed.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8 Leakage Test), requires tests be performed in accordance with SMACNA *Air Duct Leakage Test Manual*.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
SA-4600, *Design Specification*	Identifies minimum information to be included in a design specification including loads, environmental conditions, service conditions, design and service limits, allowable leakage, and system safety related function. **General Design Criteria to be Satisfied:** Design specifications shall be prepared and include loads, environmental conditions, service conditions, design and service limits, allowable leakage, and system safety related function.	PSF Construction Specifications is designed and modeled in accordance applicable sections of 2003 ASHRAE HVAC Applications, Chapter 14, *Laboratories,* and Chapter 26, *Nuclear Facilities*. SMACNA *Duct Construction Standards* and the SMACNA *Air Duct Leakage Test Manual*.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
SA-5000, Inspection And Testing			
SA-5120, *Responsibility for Procedures*	Requires written inspection or testing procedures and test personnel qualification in accordance with ASNT SNT-TC-1A as amended by ASME NQA-1 and AA-6433. **General Design Criteria to be Satisfied:** Quality assurance requirements in accordance with ASME NQA-1	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-5200, *Visual Inspection*	Establishes requirements for visual inspections of welded connections, ductwork, joints and seams, stiffeners, and ductwork supports. References AA-5200 and TA-3510 for general visual inspection requirements and AA-5300 and AA-6000 for weld inspection requirements. **General Design Criteria to be Satisfied:** Visual inspection requirements.	The construction specification (PSF Construction Specification, Section 01 7513, *Installation Verification Procedures*) generically outlines procedures and guidelines to be used for verifying installation of various systems. The PSF filtered exhaust duct system is included in the "Exhaust Fans" portion of this specification requirement. The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*) 1.7 Welding Requirements, require that all welding be in accordance with AWS, Sheet Metal Welding Code ANSI/AWS D9.1.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
SA-5300, *Pressure Boundary Leakage Testing*	SA-5310, *General* – The ductwork system shall be tested to demonstrate compliance with the design leakage requirements identified in SA-4500, unless exempted by SA-4533. **General Design Criteria to be Satisfied:** Leakage testing shall be performed.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8 Leakage Test), requires tests be performed in accordance with SMACNA *Air Duct Leakage Test Manual*.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	SA-5320, *Systems Completeness*, requires the system to be complete prior to testing and allows exclusion of terminal-air distribution devices, pressure boundary items not yet installed, and testing in sections. **General Design Criteria to be Satisfied:** Requirements for completeness of sections to perform leakage test.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8 Leakage Test), requires tests be performed in accordance with SMACNA *Air Duct Leakage Test Manual*. Section 3 of the SMACNA *Air Duct Leakage Test Manual* contains general procedures to be followed for conducting leakage tests.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	SA-5330, *Allowances for Testing System Leakage Rates by Sections*, establishes requirements for temporary isolation at a transverse joint. **General Design Criteria to be Satisfied:** Allowance for testing leakage by duct sections.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8 Leakage Test), requires test be performed in accordance with SMACNA *Air Duct Leakage Test Manual*. Section 3 of the SMACNA *Air Duct Leakage Test Manual* allows testing by duct sections.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	SA-5340, *Testing Procedures,* requires test procedures in accordance with TA-3400, requires test equipment to be specified with the proper range and required accuracy, and requires acceptance criteria be determined by SA-4500, SA-5320, and SA-5330. **General Design Criteria to be Satisfied:** Test procedures approval of test equipment and acceptance criteria.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8 Leakage Test), requires testing to be performed in accordance with SMACNA *Air Duct Leakage Test Manual*. Section 5 of the SMACNA *Air Duct Leakage Test Manual* describes required test instrumentation and equipment, including typical ranges and accuracies needed.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	SA-5350, *Documentation,* identifies minimum information to be included in a test report to document the pressure boundary leakage test. **General Design Criteria to be Satisfied:** Test report documentation requirements for leakage test.	The construction specification (PSF Construction Specification, Section 20 0000, *General Mechanical Requirements*, Paragraph 3.10 Testing and Balancing, subparagraphs E & F), state the following: "This Contractor is responsible for certifying in writing equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria, test medium and pressure used, duration of test and name and title of person signing Test Certification Document. Maintain copies of certified test results, including those for any failed tests, at project site. At completion of Project, include copies of test records and certifications in O&M Manuals." The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8, Leakage Test), requires test be performed in accordance with SMACNA *Air Duct Leakage Test Manual*.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	SA-5360, *Acceptance Criteria*, requires that acceptance criteria for quantitative leakage tests comply with SA-4500 and SA-5350(d). For non-quantitative leakage tests allowed by SA-4533, the acceptance criteria shall be that audible leaks have been sealed. **General Design Criteria to be Satisfied:** Acceptance criteria for quantitative and non-quantitative leakage tests.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8), states the duct leakage test requirements. Paragraph 3.8.C states "Leakage test shall be in accordance with test method described in Section 5 of SMACNA HVAC Air Duct Leakage Test Manual, except as modified in this Section." Paragraph 3.8.D states "Test pressure shall be equal to duct pressure class. Negative pressure ductwork shall be tested with negative test pressure." Paragraph 3.8.H states "Leakage rate shall not exceed more than 1% of system design air quantity for high pressure ductwork, determined in accordance with Appendix C of SMACNA *HVAC Air Duct Leakage Test Manual*." Paragraph 3.8.I states "Welded ductwork shall be air and watertight and shall have no air leakage." Paragraph 3.8.J states in part "Test 100% of HVEF ductwork...."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
SA-5400, *Structural Capability Tests*	SA-5410, *Ductwork Pressure Test*, requires that a pressure test be performed at the structural capability pressure per TA-3522, with acceptance criteria of not permanent distortion or breach of integrity. This test is not required if duct construction allowed in the SMACNA standards listed in Article SA-2000 for the system operational pressure transient (SOPT). **General Design Criteria to be Satisfied:** Structural test is not required if duct construction allowed in the SMACNA standards listed in Article SA-2000.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 1.6, Design Criteria, subparagraph l), states "Use material weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA Publications: *HVAC Duct Construction Standards, Metal and Flexible*, 2nd Edition, 1995; *Round Industrial Duct Construction Standards*, 2nd printing, 1999; and *Rectangular Industrial Duct Construction Standards*, 8th printing, 1997."	The PSF ductwork will be constructed in accordance with the listed SMACNA standards, therefore structural testing is not required. This meet the AG-1 standard.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	SA-5420, *Longitudinal Seam Qualification Test,* requires structural capability pressure testing of ductwork utilizing folded or punched metal longitudinal seams to qualify the structural design capability of those seams prior to any of these seams being installed. **General Design Criteria to be Satisfied:** Longitudinal seams utilizing folded or punched metal shall require pressure test before installation into the facility.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.8) states the duct leakage test requirements. These tests will be conducted after installation of the ductwork.	The referenced duct leakage testing requirements provide sufficient assurances that the installed ductwork will meet or exceed the specification thus satisfying the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
SA-6000, Fabrication and Installation			
SA-6120, *Materials*	Establishes requirements for materials selection by reference to SA-3000, material identification on fabrication plans, installation plans, and specifications, and use of materials with defects. **General Design Criteria to be Satisfied:** Requirements for materials used in fabrication and installation.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 1.6, Design Criteria, subparagraph I), states "Use material weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA Publications: *HVAC Duct Construction Standards, Metal and Flexible*, 2nd Edition, 1995; *Round Industrial Duct Construction Standards*, 2nd printing, 1999; and *Rectangular Industrial Duct Construction Standards*, 8th printing, 1997." PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1." The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 1.7.B.1), states in part, "Qualification of welding procedure shall meet or exceed requirements of the latest revision of American Welding Society, Sheet Metal Welding Code ANSI/AWS D9.1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-6130, *Control of Installation and Fabrication Process*	Quality control procedures shall be prepared and maintained current for all fabrication and installation processes in accordance with the requirements of AA-8000. **General Design Criteria to be Satisfied:** Quality control procedure requirements in accordance with ASME NQA-1	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
SA-6140, *Welding*	The welding of ductwork and ductwork supports shall comply with the requirements of AWS D1.1, AWS D1.3, AWS-D9.1, and ASME Code, Section IX, as applicable. Welding and brazing, performed in accordance with this section, shall meet the requirements of AA-6300 and AA-6400. **General Design Criteria to be Satisfied:** Welding of ductwork and ductwork supports shall comply with the requirements of AWS D1.1, AWS D1.3, AWS-D9.1, and ASME Code, Section IX.	For welding of ductwork and ductwork supports, the construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 1.7.B.1), states in part, "Qualification of welding procedure shall meet or exceed requirements of the latest revision of American Welding Society, Sheet Metal Welding Code ANSI/AWS D9.1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-6200, *Fabrication Process*	Establishes requirements for cutting, forming, bending, aligning, and fitting. **General Design Criteria to be Satisfied:** Fabrication and installation methods.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*) Paragraph 3.1.D states "Fabricate and install duct, fittings, joints, seams, reinforcement, supports, sealing, liner, etc., in sizes indicated on drawings and in accordance with manufacturer's published data and SMACNA Standards except as modified in this Section of Specifications." The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.1.Q) states: "When original galvanized finish is altered or damaged, apply field galvanizing paint as follows: Prepare surface with use of power sanders or wire brushes to remove rust, paint, etc. Apply cold galvanizing material equal to ZRC Products, Inc."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
SA-6300, *Mechanical Fastening*	Establishes requirements for nuts, bolts, screws, rivets, pins, and flange faces. References AISC code for bolting requirements and SA-4000 for qualification of screws, rivets, and attachment of pins. **General Design Criteria to be Satisfied:** Mechanical fastening requirements.	PSF duct systems are designed and installed in accordance with SMACNA *HVAC Duct Construction Standards, Metal and Flexible*, 1995 and SMACNA *Round Industrial Duct Construction Standards*, 2nd printing, 1999 and *Rectangular Industrial Duct Construction Standards*, 8th printing, 1997. The construction specification (PSF Construction Specification, Section 20 0529, *Mechanical Supporting Devices*, Paragraph 2.8.A), calls out ASTM A307 bolts, nuts, studs and washers for all mechanical supporting devices.	The use of A307 fasteners coupled with the conservative nature of the SMACNA standards provide assurance that the intent of this ASME AG-1 requirement is met and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-6400, *Fabrication Tolerances*	Establishes specific ductwork fabrication tolerances for rectangular and circular ducts as a method of quality control. These include twist, joint flange squareness, joint connection maximum offset, and flat plate waviness or bulge for rectangular ducts; out-of-round, joint end squareness, and joint connection offset for circular ducts; and hole tolerances for bolted connections. **General Design Criteria to be Satisfied:** Fabrication tolerances for ductwork.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.1.D) states "Fabricate and install duct, fittings, joints, seams, reinforcement, supports, sealing, liner, etc in sizes indicated on drawings and in accordance with manufacturer's published data and SMACNA Standards except as modified in the Section of Specification."	The chosen specification and governing construction requirements meet the criteria to maintain acceptable system performance. Neither the referenced SMACNA Standards nor the PSF radioactive air exhaust system design specifications specifically identify fabrication tolerances and it is unlikely these will impair system function.
SA-6500, Installation Tolerances	Ductwork and their supports shall be installed within the tolerance specified by approved construction documents. These tolerances shall comply with the design requirements of SA-4000. **General Design Criteria to be Satisfied:** Installation tolerance requirements.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.1.D) states "Fabricate and install duct, fittings, joints, seams, reinforcement, supports, sealing, liner, etc in sizes indicated on drawings and in accordance with manufacturer's published data and SMACNA Standards except as modified in the Section of Specification."	The chosen specification and governing construction requirements meet the criteria to maintain acceptable system performance. Neither the referenced SMACNA Standards nor the PSF radioactive air exhaust system design specifications specifically identify installation tolerances and it is unlikely these will impair system function.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-6600, *Cleaning, Finishing, and Coating*	Establishes requirements for repair of galvanized surfaces, preparation and repair of painted surfaces, and requires marking for identification on the exterior of each section. **General Design Criteria to be Satisfied:** Requirements for painting and repair of galvanized surfaces. Marking for identification in accordance with ASME NQA-1.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork,* Paragraph 2.1.B), states "Use G90 Galvaneal or Zincgrip where painting is specified." PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities.* The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1." The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.1.Q) states: "When original galvanized finish is altered or damaged, apply field galvanizing paint as follows: Prepare surface with use of power sanders or wire brushes to remove rust, paint, etc. Apply cold galvanizing material equal to ZRC Products, Inc."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-7000, Packaging, Shipping and Storage			
AA-7000 and SA-7000	Establishes general requirements and responsibilities for packaging, shipping, receiving, storage and handling, primarily by supplementing the provisions of ANSI/ASME NQA-2, Part 2.2 (now contained in ANSI/ASME NQA-1). Duct components are required to meet Level C or Level D of ANSI/ASME NQA-2, Part 2.2. **General Design Criteria to be Satisfied:** Protection requirements in accordance with ANSI/ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE *HVAC Applications*, Chapter 26, Nuclear Facilities. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1." The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork*, Paragraph 3.7, Protection of Ductwork), states "Protect ductwork during construction against entry of foreign matter and construction dirt. Keep ductwork capped when work is complete for the day or when duct is not being worked on or added to. Use of polyvinyl (VISQUEEN) with duct tape wrap is an adequate measure as long as it is secure with no openings or tears in product. Remove dirt and foreign matter from entire duct system and clean diffusers, registers and grilles before operating fans."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
SA-8000, Quality Assurance (References Section AA-8000)			
AA-8000, *Quality Assurance*	Establishes general requirements and responsibilities for quality assurance primarily by supplementing the provisions of ANSI/ASME NQA-1. **General Design Criteria to be Satisfied:** Quality assurance requirements in accordance with ANSI/ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-8200, *Material Identification*	Measures shall be established for controlling and identifying material throughout the manufacturing process and during shipment in accordance with Article AA-8000, Quality Assurance. **General Design Criteria to be Satisfied:** Marking or labeling requirements in accordance with ANSI/ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
SA-8300, *Drawings and Documentation*	Identifies minimum drawings and documentation to be provided to the Owner. **General Design Criteria to be Satisfied:** Drawing and documentation requirements, as a minimum to include: • Design parameters • Material certifications • Maximum operating pressure • Structural capability pressure • Test pressures • Basis and quantity for maximum allowable leakage • System layout drawings • Welding procedures • Visual inspection reports • Test acceptance criteria • Leak test reports • Environmental qualification reports • Ductwork and ductwork support fabrication details	The design documentation provided by the Architect/Engineer of record to the Owner for the PSF radioactive exhaust air system includes the following: • . Design Basis Documentation • Design calculations • Design drawings and a construction specification (includes material requirements, test pressures and leakage criteria) • Test acceptance criteria Prior to, during and following construction completion, the following documentation related to the PSF radioactive exhaust air system will be provided to the Owner by the contractor: • Welding procedures • System layout drawings • Inspection reports • Ductwork and ductwork support fabrication details • Test reports	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
SA-9000, Nameplates and Stamping			

Table 5. (contd)

AG-1 Section	AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
SA-9000, *General*	Establishes nameplate and stamping/marking requirements for ductwork, supports, and air distribution accessories. Also, references AA-8200, AA-9130, and AA-9140 for additional requirements. **General Design Criteria to be Satisfied:** Identification requirements to maintain traceability of materials.	The construction specification (PSF Construction Specification, Section 23 3114, *Ductwork)* does not require labeling of individual duct sections and/or duct supports for the PSF radioactive exhaust air system. Important air distribution devices (such as fume hoods) are labeled per Section 20 0553, *Mechanical Identification*, Paragraph 2.1.C of the PSF construction specification, however other air distribution devices such as grilles are not labeled.	AG-1 requires extensive labeling of ductwork and ductwork supports, the PSF radioactive air exhaust system will have minimal labeling. The chosen specification and governing construction requirements will assure acceptable system performance, and it is unlikely that the lack of labeling will impair system function.

Table 6. Section IA, Instrumentation and Control Detailed Evaluation

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
IA-1000, Introduction			
IA-1000, *Introduction*	IA-1000 assures that instrumentation and control equipment used in nuclear facilities is acceptable in all aspects of performance, design, and construction. **General Design Criteria to be Satisfied**: None	PSF radioactive exhaust air Systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*.	IA-1000 is an introductory section and does not provide functional system design criteria to be satisfied.
IA-2000, Referenced Documents			
IA-2000, *Referenced Documents*	Identifies codes and standards referenced in this section. **General Design Criteria to be Satisfied**: None	Not applicable to this evaluation.	IA-2000 provides additional technical reference information and includes ASHRAE. Reference information only.
IA-3000, Materials			
IA-3100, *Materials of Construction*	Defines allowable materials and material properties and composition requirements, primarily by requiring ASTM and ASME designated materials. Also, references AA-4000 for structural requirements for materials that are part of the pressure boundary. **General Design Criteria to be Satisfied**: Instrumentation and controls shall be constructed to withstand operating environment conditions.	The construction specification (PSF Construction Specification, Section 23 0903, *Control Instrumentation*, Paragraph 2.1 General), states "Pressure and temperature ratings of devices indicated in Part 2 of this Section are minimum required. Devices shall be designed to withstand maximum pressures and temperatures encountered in respective systems."	The chosen specifications allow some materials that are not ASME AG-1 allowable materials and, in some cases, make no specific requirements other than the manufacturer's standard materials. The extensive past operating history of these industrial components essentially provides field design qualification testing for components of similar design and demonstrates the adequacy of the manufactures' design verification processes. It is also acceptable to rely on the equipment manufacturer to provide adequate structural analysis of instrumentation supports and panels for this application.
IA-3200, *Non-permissible Materials*	Does not allow mercury, asbestos, or radiologically unstable fluorinated polymers to be used in the manufacture and installation of instrumentation and controls. **General Design Criteria to be Satisfied:** Materials listed above are non-permissible materials for use in instruments and controls.	The construction specification (PSF Construction Specification, Section 23 0903, *Control Instrumentation*, Paragraph 2.1.B, General), states "No devices containing mercury will be allowed under this Specification." Although not specifically addressed in this Section, no asbestos or radiogically unstable fluorinated polymers are expected to be used.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
IA-3300, *Restricted Materials*	Does not allow aluminum and zinc to be used in a corrosive environment, chlorine producing materials (PVC) or adjoining materials that may cause galvanic corrosion. All materials are required to be compatible with the operating environment. **General Design Criteria to be Satisfied:** Adjoining materials that may cause galvanic corrosion are not allowed.	PSF radioactive exhaust air system design specification does not allow metals in combination that may cause galvanic action and requires the materials to be compatible with the operating environment. The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Section 3.3.B.2. Air Piping), states "Provide tubing clamps with insulated standoffs where metallic tubing may come into contact with other dissimilar metals to prevent galvanic corrosion from occurring."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories. No corrosive vapors are present in the PSF systems and chlorine producing materials are not of concern.
IA-3400, *Certification of Material*	Requires manufacturer's Certificate of Conformance with specified ASTM designations for panel box structural materials and tubing and Certificates of Compliance with the design specification for other materials. **General Design Criteria to be Satisfied:** None	PSF radioactive exhaust air system design specification does not address Certificates of Conformance regarding panel box or tubing materials.	ASME AG-1 has certificate of conformance regarding materials. The PSF radioactive exhaust air system design specification ensures materials will meet the operating environment.
IA-4000, Design Requirements			
IA-4100, *General Design*	IA-4110 establishes design requirements for instrument and control systems and the selection of instrumentation and control components used in nuclear facilities air and gas treatment systems. **General Design Criteria to be Satisfied:** None	PSF radioactive exhaust air system is designed and modeled in accordance applicable sections of 2003 ASHRAE Handbook, *HVAC Applications, I-P Edition*, Chapter 14, *Laboratories*, and Chapter 26, *Nuclear Facilities*.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	IA-4120, *Design Specification*, establishes minimum requirements for the design specification including design function, safety classification, performance requirements, ambient and process operating conditions, and design, fabrication, and selection requirements. **General Design Criteria to be Satisfied:** The design specification shall establish the design function and performance of the instrumentation and control components.	PSF radioactive exhaust air system design specifications establish the design function, performance, and operating conditions for instrumentation and controls.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories. ASME AG-1 has more detailed requirements for electrical power transients and structural loading.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	IA-4130, *Manufacturer's Documentation Requirements,* identifies documentation requirements, when required by the design specification. **General Design Criteria to be Satisfied:** Manufacturer's documentation shall be required when identified in the design specifications.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 1.10, Operation and Maintenance Manuals), states "Operation and Maintenance manuals shall provide descriptions of maintenance on all system components, including sensors and controlled devices."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	IA-4140, *Clarification of Code Applicability,* establishes code precedence for pressure retaining parts between ASME AG-1 and ASME Section III, if implemented. **General Design Criteria to be Satisfied:** Not applicable, ASME Section III is not implemented by PSF radioactive exhaust air system design specifications.	PSF radioactive exhaust air system design specifications do not implement ASME Section III.	Not applicable because ASME Section III is not implemented by the design specifications.
IA-4200, *Single Failure Criteria*	Requires redundant safety related components to meet the single failure requirements of ANSI/IEEE 379. **General Design Criteria to be Satisfied:** Not applicable, redundancy safety channels are not required.	PSF radioactive exhaust air design specifications do not require redundancy safety channels.	Not applicable.
IA-4300, *Separation Criteria*	Establishes separation criteria for nuclear safety-related circuits, devices, and instrument sensing lines. Also provides general requirements to protect instrument circuits and sensing lines. **General Design Criteria to be Satisfied:** Not applicable. Nuclear safety-related circuits do not exist in the PSF radioactive exhaust air system design specifications.	PSF radioactive exhaust air system design specifications do not require nuclear safety-related circuits.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
IA-4400, *Qualification of Equipment*	Establishes requirements for qualification of equipment to defined normal operating conditions, harsh environments, and seismic loading. Requires documentation of qualification. **General Design Criteria to be Satisfied:** All components shall be operable when exposed to the range of operating conditions specified.	The construction specification (PSF Construction Specification, Section 23 0903, *Control Instrumentation*, Paragraph 2.1, General), states "Devices shall be designed to withstand maximum pressures and temperatures encountered in respective systems." The construction specification (PSF, Construction Specification, Section 23 2120, *Piping Specialties*, Paragraph 2.1, Materials), states "Unless otherwise specified, select devices for highest pressures and temperatures existing in respective systems in accordance with ANSI Specifications."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	IA-4410, *Normal Operating Conditions*, requires component specification, manufacture, and qualification to function under normal operating conditions. Establishes minimum information for definition of normal operating conditions. **General Design Criteria to be Satisfied:** All components shall be specified, manufactured, and qualified to ensure operation within performance limits when exposed to their normal operating	The construction specification (PSF Construction Specification, Section 23 0903, *Control Instrumentation*, Section 2.1, General), states "Devices shall be designed to withstand maximum pressures and temperatures encountered in respective systems." The construction specification (PSF, Construction Specification, Section 23 2120, *Piping Specialties*, Section 2.1, Materials), states "Unless otherwise specified, select devices for highest pressures and temperatures existing in respective systems in accordance with ANSI Specifications."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	IA-4420, Environmental Qualification, requires safety related components that are operated in a harsh environment to be qualified in accordance with IEEE 323. **General Design Criteria to be Satisfied:** Not applicable, no safety related components operating in harsh conditions per 10 CFR 50.49	Not applicable.	Not applicable.
	IA-4430, *Seismic Qualification*, requires safety related components and mountings to be seismically qualified in accordance with IEEE 344. **General Design Criteria to be Satisfied:** Not applicable, no safety related components.	Not applicable.	Not applicable.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	IA-4440, *Qualification Documentation*, requires documentation that demonstrates the qualification of components and the acceptance of qualification testing and results. **General Design Criteria to be Satisfied:** The owner shall have documentation showing the qualification of components.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 1.8, Submittals), requires manufacturer documentation and detailed completion checklist. The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, 3.4.A., Adjustment and Completion Checklist), states "After completion of installation, follow checklist procedure defined in checklist submittal to adjust and calibrate thermostats, control valves, control actuators, controllers, sensors, and other equipment provided in this contract. Include signed and dated, completed checklist in Operation and Maintenance Manual."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
IA-4500, *Panels*	IA-4510, *General,* establishes requirements for control panel design to support and protect nuclear safety related instrumentation and controls, and control panel instrumentation arrangement, in accordance with ISA-RP60.3, and control panel temperature limits. **General Design Criteria to be Satisfied:** Panel requirements.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 2.2, Local Control Panels), states "Unless otherwise indicated, local control panels shall be manufacturer's standard panels. Construction for exterior panels shall comply with NEMA 4." The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 3.5.B, Local Control Panels), states "Mount panels on wall with suitable brackets or on self-supporting stand. Mount top of panels no higher than 6 ft above floor. Install panels so front cover door can swing fully open without interference."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	IA-4520, *Structures and Enclosure Materials*, establishes requirements for structural design of panels and supports, supports for incoming cables, wiring, and piping, lifting eyes, and fire safe materials. **General Design Criteria to be Satisfied:** Enclosure requirements.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Section 2.2, Local Control Panels), states "Unless otherwise indicated, local control panels shall be manufacturer's standard panels. Construction for exterior panels shall comply with NEMA 4."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	IA-4530, *Panel Wiring*, establishes requirements for wiring bundles, insulating grommets, cable marking, wire performance characteristics, terminal blocks, and grounding. **General Design Criteria to be Satisfied:** Wiring shall be in accordance with NFPA 70.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 2.1, Control Wiring), states "Control wiring shall be in accordance with National Electric Code and Local electric Codes…Use of wire nuts and crimped connections are not allowed for terminating control wiring unless approved by Engineer." The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 3.2, Control Wiring), states "Provide electrical wiring required for complete functional control systems, including power circuit to control panels, both line and low voltage, in accordance with applicable local codes, and latest version of National Electrical Code and NFPA."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	IA-4540, *Power Supply and Fuses*, requires that power supplies within control panels be provided with branch circuit overload protection and a means to disconnect incoming power. Requirements for fuse location and sizing are also specified. **General Design Criteria to be Satisfied:** Wiring shall be in accordance with NFPA 70	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 3.2, Control Wiring), states "Provide electrical wiring required for complete functional control systems, including power circuit to control panels, both line and low voltage, in accordance with applicable local codes, and latest version of National Electrical Code and NFPA." The construction specification (PSF Construction Specification, Section 26 2813, *Fuses*, Paragraph 1.3.C, Quality Assurance), states "Comply with NFPA 70 for components and installation."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	IA-4550, *Panel Piping, Tubing, Valves, and Fittings*, establishes requirements for protection from vibration (IA-4600), compliance with ANSI/ASME B31.1, tubing bends, maintenance accessibility, isolation valve support, bulkhead fittings, and instrument line identification tags. **General Design Criteria to be Satisfied:** Control piping installation recommendations and vibration protection.	The construction specification (PSF Construction Specification, Section 23 2120, *Piping Specialties*, Paragraph 3.1.A, General) states "Install piping specialties as indicated on plans, details, and according to manufacturer's recommendations."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories. Compliance with ASME B31.1 is excessive for these low pressure systems.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	IA-4560, *Instrument Air-Supply Header Assembly*, establishes requirements for the instrument air system **General Design Criteria to be Satisfied:** Standard industry practice to provide regulated instrument supply air to header.	These requirements are standard industry practice.	These requirements are standard industry practice.
	IA-4570, *Instrument Tags*, requires permanent nameplates on control panels to designate instrument function and tag number in accordance with ISA-RP60.6 or the owner's requirements. **General Design Criteria to be Satisfied:** Permanent nameplates shall be installed on control panels to designate instrument function and tag number. Nameplates shall be in accordance the design specification requirements.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 3.3.C, Local Control Panels), states "Label local control panels with respective unique ID numbers in accordance with Section 200553, *Mechanical Identification*."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
IA-4600, *Mounted Instruments and Sensors*	Instruments shall not be mounted in locations where their performance will be adversely affected by equipment vibration. Instrument chassis and attached capillary tubing shall be supported to meet the seismic requirements for their particular location. **General Design Criteria to be Satisfied:** Instruments shall be mounted in accordance with manufactures recommendations.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Instrumentation*, Paragraph 3.1.A, General), states "Install control equipment, wiring and air piping in neat and workmanlike manner and in accordance with manufactures recommendations."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
IA-4700, *Interconnecting Wiring for Skid Mounted Components*	Interconnecting circuits between components mounted on a skid shall meet the requirements of the National Electric Code (NFPA 70), Sections 250-59 and 250-95, and paragraphs IA-4534 and IA-4535. **General Design Criteria to be Satisfied:** Permanent nameplates shall be installed on control panels to designate instrument function and tag number. Nameplates shall be in accordance the design specification requirements.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*) references the National Electrical Code (NFPA 70) in numerous places.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
IA-4800, *Instrument Sensing Lines and Field-Installed Tubing*	IA-4810, *Pressure Boundary and Mechanical Design Requirements*, Establishes requirements for instrument sensing lines connected to systems designed to ASME Section III. Also, requires sensing lines not connected to ASME Section III systems to meet ANSI/ASME B31.1. Specifies that fittings are to be compatible with tubing and piping. **General Design Criteria to be Satisfied:** Fitting material shall be compatible with the tube or pipe material to avoid galvanic corrosion and provide acceptable soldering or brazing joints.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 3.3.B.2, Air Piping), states "Provide tubing clamps with insulated standoffs where metallic tubing may come into contact with other dissimilar metals to prevent galvanic corrosion from occurring." The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 2.2.A, Air Piping), states "Type L, hard or soft seamless, ASTM B88, with wrought copper soldered fittings, ANSI B16.22, except at connections to apparatus, where brass compression-type fittings shall be used. Solder joints shall be made with ASTM B32, 95-5 tin-antimony solder-joint, Bridgit or Silvabrite." The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 1.3.J), states "Unless otherwise indicated, construct piping for highest pressures and temperatures in respective system in accordance with the latest revision of the applicable sections of ASME Code for pressure piping, ASME B31."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	IA-4820, *Tube Pitch and Condensate Trap* requires condensate or oil traps with valved drain legs to be provided at the low points of tubing, where the potential for condensation or oil migration exists. **General Design Criteria to be Satisfied:** Valve drain legs shall exist where condensation or oil mitigation exists.	PSF radioactive exhaust air design specifications require installation of drain and vent valves, where required.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	IA-4830, *Support System,* establishes requirements for sensing lines and tubing supports, including loading requirements. Safety-related sensing lines are to meet the requirements of Section AA-4000. **General Design Criteria to be Satisfied:** Tubing supports and protection.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 3.3.A, Air Piping), states "Conceal all piping, except for piping in mechanical rooms and other areas where mechanical system is exposed." B. states "Install exposed piping and conduit parallel to or at right angles to building structure and support adequately at uniform intervals." B.3. states "Use of tubing channel designed for mounting metallic or polyethylene tubing shall be allowed."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	IA-4840, *Root Valves and Isolation Valves,* establishes requirements for the location of root valves, isolation valves, and test connections. **General Design Criteria to be Satisfied:** Root and Isolation valve locations in accordance with standard industry practice.	PSF radioactive exhaust air design specifications will require root valve locations and isolation valves in accordance with standard industry practice.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
IA- 4900, *Instrument Setpoints*	Establishes requirements for establishing nuclear-safety related set points using ISA S67.04. **General Design Criteria to be Satisfied:** Requirements for safety related components do not apply. Non-safety related set points are determined by the design team and documented in software functional specifications. Provisions to ensure that systems perform within their design limits.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 1.7.D, Submittals), states "Control loops shall be tuned to maintain controlled process variable at set point through seasonal conditions without operator intervention. Provide multiple sets of tuning parameters if necessary. Controller shall automatically use tuning parameters appropriate to existing ambient conditions. Maintain record on completion checklist, of control loops that require tuning at alternate times of year. Instruct technicians to supply default parameters that can approximate stable control until actual load conditions allow proper tuning of control loops." "Performance tests of analog control loops shall be performed by changing set points and verifying that sequences can come into stable control within reasonable time period appropriate for each sequence. Simulate load changes for pressure and flow control loops." Performance tests of discrete control loops shall be performed by, adjusting set point and verifying sequence action."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
IA-5000, Inspection and Testing			
IA-5100, *General*	Requires inspection and testing of instrumentation and control components to be in accordance with ANSI/IEEE 336 and Article AA-5000. AA-5000 establishes general requirements for calibration of M&TE (measuring and test equipment), visual inspections, inspections and testing of welded and bolted connections, conformance to fabrication tolerances, pressure and leak testing, performance and functional testing, and seismic testing. Also, requires written test procedures in accordance with AA-5120 and TA-3000 and test reports. **General Design Criteria to be Satisfied:** Inspection and testing will be performed.	The PSF radioactive exhaust air system design specification requires inspection and testing. The actual requirements are delineated in the individual specification sections that relate to the instrumentation and controls.	AG-1 references IEEE 336 which specifically addresses Class IE systems. The PSF radiological exhaust air system is not a Class IE system. The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories. See additional applicable sections.
IA-5200, *Visual Inspection*	Establishes requirements for visual inspections, checklists, and procedures, primarily by reference to applicable sections of AA-5000. **General Design Criteria to be Satisfied:** Visual inspection to verify compliance with the specifications	The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
IA-5300, *Calibration and Testing*	Requires that the manufacturer's calibration and test instrumentation comply with Article TA-3000 and be traceable to NIST. Article TA-3000 requires establishment of a calibration program and specifies minimum accuracy for calibration and test instrumentation. **General Design Criteria to be Satisfied:** Manufacturer's calibration and test instrumentation shall be in accordance with NQA-1 and traceable to NIST.	The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1." The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 1.8.D.2, Completion Checklist), states "Instruments and sensors shall be calibrated by comparison to known device, which is traceable to National Institute of Standards and Testing."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	IA-5310, *Panel-Mounted Instruments*, requires test and calibration procedures in accordance with AA-5120 and TA-3000, Megger tests for control power wiring, continuity tests, and functional tests. **General Design Criteria to be Satisfied:** Control and calibration of measuring and test	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 3.4.A, Adjustment and Completion Checklist), states "After completion of installation, follow checklist procedure defined in checklist submittal to adjust and calibrate thermostats, control valves, control actuators, controllers, sensors,	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
	equipment shall be in accordance with ASME NQA-1, and NEC	and other equipment provided in this contract. Include signed and dated, completed checklist in Operation and Maintenance Manual." The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 1.8.D.2, Completion Checklist), states "Instruments and sensors shall be calibrated by comparison to known device, which is traceable to National Institute of Standards and Testing." The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 2.1, Control Wiring), states "Control wiring shall be in accordance with National Electric Code and Local electric Codes."	
	IA-5320, *Local Mounted Instruments*, requires calibration according to the manufacturer's procedures and those procedures developed in accordance with AA-5120 and TA-3000. **General Design Criteria to be Satisfied:** Calibration and testing shall be in accordance with manufacturer's recommendation.	The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1." The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*, Paragraph 3.4.A, Adjustment and Completion Checklist),states "After completion of installation, follow checklist procedure defined in checklist submittal to adjust and calibrate thermostats, control valves, control actuators, controllers, sensors, and other equipment provided in this contract. Include signed and dated, completed checklist in Operation and Maintenance Manual."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
	IA-5330, *Pressure Testing of Tubing and Sensing Lines*, requires pressure testing of sensing lines in accordance with ANSI/ASME B31.1 or ASME Section III, as applicable, and pressure testing of pneumatic control circuits. **General Design Criteria to be Satisfied:** Pressure testing requirements and documentation.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*) Section 3.3, Air Piping, F. states "Test entire piping system by placing it under 20-psig pressure for 24 hrs. Trend log pressure during test and submit test results with Operation and Maintenance submittal."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
IA-6000, Panel Fabrication and Assembly (References Section AA-6000)			
AA-6100, *General*	Identifies materials requirements by reference to IA-3000 and requires quality control procedures for all fabrication, installation and repair processes by reference to AA-8000 or AA-6300. **General Design Criteria to be Satisfied:** Marking or labeling requirements in accordance with ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
AA-6200, *Fabrication Processes*	Establishes requirements for cutting, forming, bending, forming tolerances, fitting and aligning for bolting or welding, welded joints, and mechanical joints. **General Design Criteria to be Satisfied:** Panel fabrication requirements.	PSF radioactive exhaust airsystems design specifications requires panels to be manufacturer's standard panels and NEMA standards as applicable.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
AA-6300, *Welding Requirements*	Establishes very detailed and specific requirements for welding including workmanship, inspection, testing, non-destructive testing, inspector qualifications, and repairs. Identifies several ANSI/AWS codes and ASME Code, Section IX to be complied with. **General Design Criteria to be Satisfied:** Manufacturers welding procedures shall be acceptable.	PSF radioactive exhaust air system design specifications require welding in accordance with manufacturer's procedures.	ASME AG-1 provides much more specific and detailed welding requirements. Typical manufacturer's standards and tolerances for welding processes for control panels are acceptable for this application.
AA-6400, *Brazing*	Establishes similar requirements as AA-6300. **General Design Criteria to be Satisfied:** Braze welding requirements	PSF radioactive exhaust air system design specifications require brazing in accordance with manufacturer's procedures.	ASME AG-1 provides much more specific and detailed brazing requirements. Typical manufacturer's standards and tolerances for brazing processes for control panels are acceptable for this application.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
AA-6500, *Cleaning and Coating*	Establishes coating requirements using a graded approach using service levels based on the coating's and the equipment's relation to nuclear safety. **General Design Criteria to be Satisfied:** Service level III, Coating systems in accordance with manufacturer's procedures.	PSF radioactive exhaust air system design specifications require painting in accordance with manufacturer's procedures.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
AA-6600, *Installation Requirements*	Establishes requirements for handling, rigging, field assembly, installation procedures, and temporary field attachments. **General Design Criteria to be Satisfied:** Handling shall be in accordance with NQA-1	The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
IA-6110, *Materials*	Requires materials to conform to IA-3000 and plate material to meet the design structural requirements of IA-4000 and the design specification. Repair of materials is required to be in accordance with AA-6123. **General Design Criteria to be Satisfied:** None, manufacturers materials used in fabrication of panels will be acceptable.	PSF radioactive exhaust air systems design specifications requires panels to be manufactures standard panels.	Reliance on manufacturer's material selection for commercial grade panels and instrumentation is acceptable for this application.
IA-6200, *Fabrication Process*	Establishes requirements for cutting, forming, bending, thermal cutting, and welding by reference to the applicable sections of AA-6000. Also, establishes additional limits on warping or distortion due to fabrication and panel deflection due to instrument weight. **General Design Criteria to be Satisfied:** None, manufacturers fabrication procedures will be acceptable.	PSF radioactive exhaust air systems design specifications requires panels to be manufactures standard panels.	Reliance on manufacturer's fabrication procedures for commercial grade panels and instrumentation is acceptable for this application.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
Remaining subsections of IA-6000.	Establishes requirements for fitting, aligning, mechanical joints, welding, brazing, cleaning, coating, handling, and rigging by reference to applicable sections of AA-6000. Requires materials identification in accordance with IA-3400. **General Design Criteria to be Satisfied:** Refer to previous sections AA-6000 and IA-3400 for compliance.	Refer to previous sections AA-6000 and IA-3400 for compliance.	See applicable subsections evaluating AA-6000 and IA-3400 of this table.
IA-7000, Packaging, Shipping, Receiving, Storage, and Handling (References Section AA-7000)			
AA-7000 and IA-7000	Establishes general requirements and responsibilities for packaging, shipping, receiving, storage and handling, primarily by supplementing the provisions of ANSI/ASME NQA-2, Part 2.2 (now contained in ANSI/ASME NQA-1). **General Design Criteria to be Satisfied:** Quality assurance requirements in accordance with ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
IA-8000, Quality Assurance Requirements (References Section AA-8000)			
AA-8000, *Quality Assurance*	Establishes general requirements and responsibilities for quality assurance primarily by supplementing the provisions of ANSI/ASME NQA-1. **General Design Criteria to be Satisfied:** Quality assurance requirements in accordance with ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 6. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
IA-8200, *Test Reports and Data*	Identifies test reports and data to be maintained in records, including records and procedures required by ANSI/ASME B31.1 and ASME Section III and documentation identified in IA-4130 and IA-4440. **General Design Criteria to be Satisfied:** Test reports and data shall be maintained in records.	Refer to previous sections IA-4130 and IA-4440 for compliance.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories. Compliance with ANSI/ASME B31.1 and ASME Section III is not applicable.
IA-9000, Nameplates			
IA-9100, *General*	Permanent types of nameplates shall be designed, manufactured, and installed in accordance with the requirements of Article AA-9000. **General Design Criteria to be Satisfied:** Permanent nameplate shall be installed.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*) Section 3.5, Local Control Panels, C. states "Label local control panels with respective unique ID numbers in accordance with Section 200553, *Mechanical Identification*."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
IA-9200, *Requirements*	Each instrument and control device shall be provided with a permanent type of Manufacturer's nameplate. **General Design Criteria to be Satisfied:** Permanent type of Manufacturer's nameplate shall be provided.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*) Section 3.5, Local Control Panels, C. states "Label local control panels with respective unique ID numbers in accordance with Section 200553, *Mechanical Identification*."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
IA-9300, *Nameplates*	Requires nameplates to be made of a non-corrosive material and sized to accommodate all pertinent information. Identifies information to be included on nameplates. **General Design Criteria to be Satisfied:** Nameplate requirement to be made of non-corrosive material and sized accordingly.	The construction specification (PSF Construction Specification, Section 23 0901, *Control Systems Integration*) Section 3.5, Local Control Panels, C. states "Label local control panels with respective unique ID numbers in accordance with Section 200553, *Mechanical Identification*."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 7. Section CA, Conditioning Equipment

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
CA-1000, Introduction			
CA-1000, *Introduction*	DA-1000 assures that conditioning equipment used in nuclear facilities is acceptable in all aspects of performance, design, and construction. **General Design Criteria to be Satisfied**: Conditioning equipment used meet the requirements of nuclear facilities.	Not applicable to this evaluation.	Not applicable to this evaluation.
CA-2000, Referenced Documents			
CA-2000, *Referenced Documents*	Identifies codes and standards referenced in this section. **General Design Criteria to be Satisfied**: None	Not applicable to this evaluation.	Not applicable to this evaluation.
CA-3000, Materials			
CA-3100, *General Requirements*	Gives the general requirements and the material specifications. **General Design Criteria to be Satisfied**: None	Not applicable to this evaluation.	Not applicable to this evaluation.
CA-3200, *Water, Steam, and Volatile Refrigerant Coil Materials*	Identifies pressure retaining materials for water, steam, and volatile refrigerant coils. Also identifies non-pressure retaining materials, load bearing members, and non-load carrying members. **General Design Criteria to be Satisfied**: Identifies pressure retaining materials for water coils.	The construction specification (PSF Construction Specification, Section 23 8216, *Coils*) identifies the material, size, tube wall thickness, and pressure and temperature maximums. These coils utilize seamless copper tubes with aluminum fins, Type 304 stainless steel casings. The coil header material may be cast iron, steel pipe or heavy seamless copper tube.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
CA-3300, *Air Washer and Evaporative Cooler Materials*	The general requirements, or conformances and specifications for the materials for air washers, evaporative coolers and accessories. **General Design Criteria to be Satisfied**: Not applicable, no air washers or evaporative coolers exist.	Not applicable to this evaluation.	Not applicable to this evaluation.

Table 7. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
CA-3400, *Electric Heating Coil Materials*	Electric heating coils and accessories shall meet all requirements of CA-4400. Materials shall also be in conformance with the specifications. **General Design Criteria to be Satisfied**: Not applicable, no electric heating coils exist.	Not applicable to this evaluation.	Not applicable to this evaluation.
CA-3500, *Certification of Materials*	Contains the general requirements for certification of materials along with the applicable specific requirements for stated materials. **General Design Criteria to be Satisfied**: Certification of materials.	The construction specification (PSF Construction Specification, Section 23 8216, *Coils*) does not require certification of materials. Section 014000, *Quality Requirements,* of the PSF construction specification requires that the procurement of items and services be controlled to assure conformance with specified requirements.	The AG-1 requirement is more stringent, however, the quality requirements imposed on the contractor (and suppliers) will provide sufficient assurance that the materials specified will be procured and installed.
CA-4000, Design			
CA-4100, *Design Conditions for Water and Steam Coils*	Identifies the design specifications and gives technical requirements for tubes, return bends, nozzles and header assembly, fins, casing and tube support and design recommendations. Section also identifies the structural requirements for water, steam, and volatile refrigerant coils. **General Design Criteria to be Satisfied**: Coil design and performance requirements.	The construction specification (PSF Construction Specification, Section 23 8216, *Coils*, Paragraph 1.5.B, Design Criteria), states "Coil sizes, capacities, configurations and operating characteristics to be shown on plans and/or as scheduled. Coil performance data shall be certified in accordance with ARI Standard 410."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
CA-4200, *Design Conditions for Volatile Refrigerant Coils*	Gives the design specification and technical requirements for those materials identified as being part of the volatile refrigerant coil. **General Design Criteria to be Satisfied**: Not applicable, PSF does not have any volatile refrigerant coils.	Not applicable to this evaluation.	Not applicable to this evaluation.
CA-4300, *Design Conditions for Air Washers and Evaporative Coolers*	Establishes the design specification, technical requirements, and structural requirements for the air washers and evaporative coolers. **General Design Criteria to be Satisfied**: Not applicable, PSF does not have any air washers and evaporative coolers.	Not applicable to this evaluation.	Not applicable to this evaluation.

Table 7. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
CA-4400, *Design Conditions for Electric Heating Coils*	Establishes the design specification, technical requirements, and structural requirements for electric heating coils. **General Design Criteria to be Satisfied**: Not applicable, PSF does not have any electric heating coils.	Not applicable to this evaluation.	Not applicable to this evaluation.
CA-5000, Inspection and Testing			
CA-5100, *General Requirements*	Introduction, stating that examinations, testing, and inspection shall be accordance with AA-5000. **General Design Criteria to be Satisfied**: Article AA-5000, Establishes general requirements for calibration of M&TE in accordance with NQA-1. Welding inspection in accordance with AA-6000.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
CA-5200, *Testing of Water, Steam, and Volatile Refrigerant Coils*	Establishes the two acceptable methods for coil performance verification along with pressure testing for water and steam coils and for volatile refrigerant coils. Gives non-destructive examination specifications along with visual examination accordance of brazed joints. **General Design Criteria to be Satisfied**: Performance verification testing for water coils.	The construction specification (PSF Construction Specification, Section 23 8216, *Coils*, Paragraph 1.5.B, Design Criteria), states "Coil sizes, capacities, configurations and operating characteristics to be shown on plans and/or as scheduled. Coil performance data shall be certified in accordance with ARI Standard 410." ARI Standard 410 requires testing in accordance with ANSI/ASHRAE Standard 33. Paragraph 2.4.A of the same section requires the tube side of the coils to be tested at 250 PSIG under water.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
CA-5300, *Testing of Air Washers and Evaporative Coolers*	Establishes the general requirements for performance testing and non-destructive examination and inspection of air washers and evaporative coolers. **General Design Criteria to be Satisfied**: Not applicable, PSF does not have any air washers and evaporative coolers.	Not applicable to this evaluation.	Not applicable to this evaluation.

Table 7. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
CA-5400, *Testing of Electric Heating Coils*	Establishes the general requirements for functional tests, dielectric withstand tests, resistance tests, and non-destructive examination of electric heating coils. **General Design Criteria to be Satisfied**: Not applicable, PSF does not have any electric heating coils.	Not applicable to this evaluation.	Not applicable to this evaluation.
CA-5500, *Test Reports*	Sufficient records shall be provided to show documentary evidence of all testing. **General Design Criteria to be Satisfied**: Test report shall be provided documenting all testing.	The construction specification (PSF Construction Specification, Section 23 8216, *Coils*, Section 1.4, Submittals), lists the documents that are required to be submitted. Of these, the capacity/rating information generated by the coil vendor's computer based selection program suffices as test documentation per AG-1 Section CA-5210.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
CA-6000, Fabrication and Installation			
CA-6100, *General Requirements*	Fabrication and installation shall be in accordance with AA-6000 and welding shall be in accordance with AA-6300 and CA-6120. Brazing for pressure retaining components shall be designed and fabricated in accordance with the ASME Code and mechanical joining shall be in accordance with the ASME Code as well. **General Design Criteria to be Satisfied**: Section AA-600 for fabrication and AA-6300 for welding.	See sections AA-6000 for fabrication and installation, and AA-6300 for welding, of this table.	See sections AA-6000 for fabrication and installation, and AA-6300 for welding, of this table.
CA-6200, *Cleaning, Finishing, and Coating*	Establishes cleaning and finishing requirements, finishing and surface preparation, and coating and application applications. **General Design Criteria to be Satisfied**: Coating requirements	The construction specification (PSF Construction Specification, Section 23 8216, *Coils*, Paragraph 1.6, Corrosion Protection Coating), states "Where coils are specified to be corrosion protection coated, protect coils with coating similar to Heresite P-413 baking phenolic with plasticizer....Apply coating by four consecutive total immersions. After each of the first three immersions, coating shall be partially cured in oven. Following the fourth immersion and one spray coat, coating shall be totally cured in oven." Paragraph 2.4.F of the same section requires corrosion protection to be provided on the exhaust air heat recovery coils, refers back to Part 1 of the section.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 7. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
CA-7000, Packaging, Shipping, Storage, and Handling			
CA-7100, *General Requirements*	Packaging, shipping, and storage requirements shall be in accordance with applicable requirements, and different levels of classification are required for different parts of equipment. **General Design Criteria to be Satisfied:** Packaging requirements in accordance with ASME NQA-1	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	Rely on manufacturer's general requirements for packaging, shipping, and storage of the conditioning equipment.
CA-7200, *Packaging*	Establishes equipment requirements of Packaging Level C and Level B of NQA-2, Part 2.2, paragraph 3. **General Design Criteria to be Satisfied:** Packaging requirements in accordance with ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
CA-7300, *Shipping*	Water, steam and volatile refrigerant coils, air washers, and evaporative coolers shall meet requirements of Shipping Level C of NQA-2. Electric heating coils, control panels, and terminal boxes shall meet the requirements of Shipping Level B of NQA-2. **General Design Criteria to be Satisfied:** Shipping requirements in accordance with ASME NQA-1.	PSF radioactive exhaust airSystems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 7. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
CA-7400, *Storage*	Establishes equipment requirements for Storage Level B and C of NQA-2, Part 2.2, paragraph 6. **General Design Criteria to be Satisfied:** Storage requirements in accordance with ASME NQA-1	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
CA-7500, *Handling*	Handling and rigging requirements shall be in accordance with AA-6610 and such handling levels of NQA-2. **General Design Criteria to be Satisfied:** Handling requirements in accordance with ASME NQA-1	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
CA-8000, Quality Assurance			
CA-8100, *General Requirements*	Comprises all those planned and systematic actions required to provide confidence that equipment will perform its required function and that the organizations responsible for a project shall establish documented quality assurance programs in accordance with the requirements of AA-8000. **General Design Criteria to be Satisfied:** Quality assurance in accordance with ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 7. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
CA-9000, Nameplates and Records			
CA-9100, *General Requirements*	Nameplates and stamping requirements shall meet the requirements of AA-9000, except as provided in the article. **General Design Criteria to be Satisfied:** Quality assurance in accordance with ASME NQA-1.	PSF radioactive exhaust air systems are designed in accordance with applicable sections of 2003 ASHRAE HVAC Applications, Chapter 26, *Nuclear Facilities*. The Quality Assurance section refers to compliance with ASME Standard NQA-1 for quality assurance program requirements. The construction specification (PSF Construction Specification, Section 01 4000, *Quality Requirements*, Paragraph 1.4, Quality Assurance), states "Contractor shall have a quality assurance program that meets the requirements of NQA-1."	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
CA-9200, *Coils*	Coils designed and fabricated in accordance with the ASME Code, Section III, shall meet the requirements of NCA-8000 for nameplates, stamping, certification and data reports. **General Design Criteria to be Satisfied:** Coils shall meet requirements for nameplates, stamping, certification, and data reports.	The coils that are part of the PSF radioactive exhaust air system are not designed/fabricated in accordance with Section III of the ASME Code.	N/A
CA-9300, *Information on Nameplates*	Permanent nameplate of non-corrosive material shall be affixed to water, steam, and volatile refrigerant coils. The nameplate shall bear the information stated in this section. **General Design Criteria to be Satisfied:** Nameplate information.	The construction specification (PSF Construction Specification, Section 20 0553, *Mechanical Systems Identification*, Paragraph 3.4, "Equipment and Control Panel Identification", lists the requirements for identification of PSF equipment, which includes the heat reclaim coils serving the radiological exhaust air system. The field label will not necessarily contain all the information required by CA-9300, however, that information will be retained by the owner in the Operation and Maintenance Manuals, which are specified in Section 20000, *General Mechanical Requirements*, of the construction specifications.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 7. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
CA-9400, *Nameplate Location*	Visibility of a nameplate may not be visible without removing a panel or, in some cases, removing of the coil from the housing. In these cases, the visibility requirement of AA-9140 does not apply. **General Design Criteria to be Satisfied:** Nameplate location.	The construction specification (PSF Construction Specification, Section 20 0553, *Mechanical Systems Identification*, Paragraph 3.4, "Equipment and Control Panel Identification"), lists the requirements for identification of PSF equipment, which includes the heat reclaim coils serving the radiological exhaust air system.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.
CA-9500, *Data Reports*	Water and steam coils shall be fabricated in accordance with the ASME Code, Section III shall have an N-1 Code Data Report completed for each coil. For coils not stamped in accordance with the ASME Code, a manufacturer's data report shall be provided in accordance with Mandatory Appendix CA-1, form CA-IA. **General Design Criteria to be Satisfied:** Manufacturer's data report shall be provided.	The coils that are part of the PSF radioactive exhaust air system are not designed/fabricated in accordance with Section III of the ASME Code.	The chosen specification and governing construction requirements satisfies the intent of this ASME AG-1 requirement and ensures operational safety requirements for radiological laboratories.

Table 8. Section FB, Medium Efficiency Filters

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
FB-1000, Introduction			
FB-1100, *Introduction*	FB-1000 assures that filters used in nuclear facilities are acceptable in all aspects of performance, design, and construction. **General Design Criteria to be Satisfied**: None The PSF will not use medium efficiency filters in the radioactive air exhaust system.	N/A	N/A
FB-2000, Referenced Documents			
FB-2000, *Referenced Documents*	FB-2000 provides supplemental codes and standards. **General Design Criteria to be Satisfied**: None	Not applicable to this evaluation.	N/A
FB-3000, Materials			
FB-3100, *Allowable Materials*	Defines allowable materials and material properties and composition requirements. **General Design Criteria to be Satisfied:** None.	N/A	N/A
FB-4000, Design			
FB-4100, *General Design*	Medium efficiency filters shall be replaceable, extended media, dry-type, and certified to UL 900, Class 1. **General Design Criteria to be Satisfied:** None	N/A	N/A
FB-4200, *Design Criteria*	Establishes the parameters for the design criteria for medium efficiency filters. **General Design Criteria to be Satisfied:** None	N/A	N/A

Table 8. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
FB-4300, *Structural Requirements*	States that medium efficiency filters shall be in accordance with AA-4350. **General Design Criteria to be Satisfied:** None	N/A	N/A
FB-5000, Inspection and Testing			
FB-5100, *Inspection Plan*	Establishes that the manufacturer shall have a recognized sampling and inspection plan acceptable to the purchaser. **General Design Criteria to be Satisfied:** None	N/A	N/A
FB-5200, *Qualification Testing*	States that Medium efficiency filters shall be certified to UL-900, Class 1, and that three medium efficiency filters of the design to qualified shall be tested in accordance with ASHRAE 52 to obtain standard ratings. **General Design Criteria to be Satisfied:** None	N/A	N/A
FB-6000, Fabrication			
FB-6100, *General*	Medium efficiency filters shall be assembled from materials that conform to Article FB-3000 and meet design requirements of Article FB-4000. **General Design Criteria to be Satisfied:** None	N/A	N/A
FB-7000, Packaging, Shipping, Receiving, Storage, and Handling (References Section AA-7000)			
FB-7100	All packaging, shipping, receiving, storage, and handling shall meet the requirements of Article AA-7000 and NQA-1. **General Design Criteria to be Satisfied:** None	N/A	N/A

Table 8. (contd)

ASME AG-1 Section	ASME AG-1 Requirement	Chosen Standard or Specification Requirement (See Table 2)	Difference Between ASME AG-1 and the Chosen Standard or Specification
FB-8000, Quality Assurance			
FB-8100, *Documentation*	List of documents that should be available to the purchaser, if requested. **General Design Criteria to be Satisfied**: None	N/A	N/A
FB-9000, Labels and Marking			
FB-9100, *Filter Markings*	Each filter shall have a permanent label, listed is the required information that the label shall provide. **General Design Criteria to be Satisfied**: None	N/A	N/A
FB-9200, *Package Marking*	Provides required information to be provided on the label, as well as states that each label shall be of a size and type so that it can be read from a minimum distance of 3 ft. **General Design Criteria to be Satisfied**: None	N/A	N/A

Table 9. ALARA Factor Analysis

		Negative Factor for Protective Measure?		**Positive Factor for Protective Measure?**	
1	Does the cost of the protective measure exceed the cost of the activity?	Yes		No	X
2	Will individual doses for the activity be maintained below 10 millirem (occupational) or 1 millirem (public) even without the protective measure?	Yes	X	No	
3	Does the protective measure increase the risk of occupational incidents or accidents?	Yes		No	X
4	Does the protective measure decrease the risk of environmental incidents or accidents?	No	X	Yes	
5	Does the protective measure ultimately result in collective dose savings during the post operational phase of operations?	No	X	Yes	
6	Does the protective measure ultimately result in cost savings during the post operational phase of operations?	No	X	Yes	
7	Could the protective measure increase future occupational or public dose (other than via decontamination and decommissioning)?	Yes		No	X
8	Does the protective measure increase the flexibility of personnel or other resources?	No	X	Yes	
9	Does the protective measure optimize the balance between occupational and public exposures?	No	X	Yes	
10	Does the protective measure result in improved relations with outside organizations?	No	X	Yes	
11	Does the protective measure have adverse effects on employees (such as discomfort or strain)?	Yes		No	X
12	Does the protective measure have adverse effects on other activities?	Yes	X	No	
13	Does the protective measure have an extreme adverse effect on the activity schedule?	Yes		No	X
14	Does the protective measure have any favorable environmental impacts other than public dose reduction?	No	X	Yes	
A predominance of checks in the left-hand column indicates the protective measure is not reasonable and not recommended. Conversely, a predominance of checks in the right-hand column indicates that the protective measure is reasonable and recommended.					

6.0 References

6.1 References

Flad & Associates. 2006. *Design Development Document (FCX-113-Vol. 3), PSF Construction Specification.*

Pacific Northwest National Laboratory, Phase I *Radioactive Air Emissions Notice of Construction (NOC) Application for Material Science and Technology Laboratory (Building 3410).*

Pacific Northwest National Laboratory, Phase I *Radioactive Air Emissions Notice of Construction (NOC) Application for Radiation Detection Laboratory (Building 3420).*

Pacific Northwest National Laboratory, Phase I *Radioactive Air Emissions Notice of Construction (NOC) Application for Ultra-Trace Laboratory (Building 3430).*

Westinghouse Hanford Company (WHC). 1989. *A Practical Method of Performing Cost-Benefit Analysis of Occupational and Environmental Protective Measures.* WHC-SA-0484-FP, Richland, Washington,

6.2 Codes and Standards

AABC, *National Standards for Total System Balance*, Associated Air Balance Council, Washington D.C., 2002.

WAC 246-247, Radiation Protection – Air Emissions *Washington Administrative Cod*e, as amended, Washington State Department of Health, Olympia, Washington.

ACGIH, *Industrial Ventilation: A Manual of Recommended Practice*, 24th edition, American Conference of Government Industrial Hygienists, Cincinnati, Ohio, 2001.

AISC, *Specifications for the Design of Cold Formed Steel Structural Members*, American Institute of Steel Construction, Chicago, Illinois, 1986.

AISC, *Specification for Structural Joints Using A325 or A490 Bolts*, American Institute of Steel Construction, Chicago, Illinois, 2000.

AISI, *Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings*, 9th Edition, American Iron and Steel Institute, Washington D.C.

AMCA 99, *Standards Handbook,* Air Movement and Control Association International, Inc., Arlington Heights, Illinois, 1986.

AMCA 201, *Fans and Systems*, Air Movement and Control Association International, Inc., Arlington Heights, Illinois, 1990.

AMCA 210, *Laboratory Methods for Testing Fans for Rating*, Air Movement and Control Association International, Inc., Arlington Heights, Illinois, 1985.

AMCA 300, *Reverberant Room Method for Sound Testing of Fans*, Air Movement and Control Association International, Inc., Arlington Heights, Illinois, 1996.

AMCA 301, *Methods for Calculating Fan Sound Ratings from Laboratory Test Data*, Air Movement and Control Association International, Inc., Arlington Heights, Illinois, 1990.

AMCA 500, *Laboratory Methods for Testing Dampers for Rating*, Air Movement and Control Association International, Inc., Arlington Heights, Illinois, 1998.

ANS 3.1, *Selection, Qualification, and Training of Nuclear Power Plant Personnel*, LaGrange Park, Illinois, 1993.

ANSI/ABMA 9, *Load Rating and Fatigue Life for Ball Bearings*, American Bearing Manufacturers Association, Washington, D.C., 2000.

ANSI/ABMA 11, *Load Rating and Fatigue Life for Roller Bearings*, American Bearing Manufacturers Association, Washington, D.C., 1999.

ANSI/IEEE 323, *Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations*, Institute of Electrical and Electronics Engineers, Inc., New York, New York, 1983.

ANSI/IEEE 334, *Standard for Type Tests of Continuous Duty Class 1E Motors for Nuclear Power Generation Stations*, Institute of Electrical and Electronics Engineers, Inc., New York, New York, 1994.

ANSI/IEEE 336, *IEEE Standard Installation, Inspection, and Testing Requirements for Power, Instrumentation, and Control Equipment at Nuclear Facilities*, Institute of Electrical and Electronics Engineers, Inc., New York, New York, 1985.

ANSI/IEEE 344, *Recommended Practice for Seismic Qualifications of Class 1E Equipment for Nuclear Power Generating Stations*, Institute of Electrical and Electronics Engineers, Inc., New York, New York, 1987.

ANSI/IEEE 379, *IEEE Standard Application of the Single Failure Criterion to Nuclear Power Generating Station Safety Systems*, Institute of Electrical and Electronics Engineers, Inc., New York, New York, 2000.

ANSI/IEEE 627, *Standard for Design Qualification of Safety Related Equipment Used in Nuclear Power Generating Stations*, Institute of Electrical and Electronics Engineers, Inc., New York, New York, 1980.

API-609, *Butterfly Valves: Double Flanged, Lug- and Wafer-Type*, 5th Edition, American Petroleum Institute, Washington, D.C., 1997.

API-673, *Centrifugal Fans for Petroleum, Chemical and Gas Industry Services*, 2nd Edition, American Petroleum Institute, Washington, D.C., 2002.

ARI Standard 410, *Forced-Circulation Air-Cooling and Air-Heating Coil*, Air Conditioning & Refrigeration Institute, Arlington, Virginia, 2001.

ASHRAE 52.1, *Gavimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter,* American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Atlanta, Georgia, 1992.

ASHRAE 52.2, *Method for Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*, American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Atlanta, Georgia, 1999.

ASHRAE 68, *Laboratory Method of Testing to Determine the Sound Power in a Duct*, American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Atlanta, Georgia, 1997.

ASHRAE 87.1, *Method of Testing Fan Vibration – Blade Vibrations and Critical Speeds*, American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Atlanta, Georgia, 1992.

ASHRAE 111, *Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems*, American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Atlanta, Georgia, 1988.

ASHRAE 126, *Method of Testing HVAC Air Ducts*, American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Atlanta, Georgia, 2000.

ASME AG-1, *Code on Nuclear-Air and Gas-Treatment*, American Society of Mechanical Engineers, New York, New York, 2003.

ASME B16.34, *Valves Flanged, Threaded, and Welding End*, American Society of Mechanical Engineers, New York, New York, 1996.

ASME B31.1, *Power Piping*, American Society of Mechanical Engineers, New York, New York, 2001.

ASME B31.3, *Process Piping*, American Society of Mechanical Engineers, New York, New York, 2002.

ASME N509, *Nuclear Power Plant Air Cleaning Units and Components*, American National Standards Institute/American Society of Mechanical Engineers, New York, New York, 1989.

ASME N510, *Testing of Nuclear-Air Treatment Systems*, American Society of Mechanical Engineers, New York, New York, 1989.

ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities*, American Society of Mechanical Engineers, New York, New York, 2004.

ASME Section III, *Boiler and Pressure Vessel Code – Rules of Construction for Nuclear Facility Components*, American Society of Mechanical Engineers, New York, New York, 2001.

ASME Section IX, *Boiler and Pressure Vessel Code – Welding and Brazing Qualifications*, American Society of Mechanical Engineers, New York, New York, 2001.

ASNT SNT-TC-1A, *Recommended Practice No. SNT-TC-1A*, American Society for Nondestructive Testing, Columbus, Ohio, 2001.

AWS D1.1, *Structural Welding Code – Steel*, American Welding Society, Miami, Florida, 2002.

AWS D1.3, *Structural Welding Code – Sheet Steel*, American Welding Society, Miami, Florida, 1998.

AWS D9.1, *Sheet Metal Welding Code*, American Welding Society, Miami, Florida, 2000.

IEEE 112A, *IEEE Standard Test Procedures for Polyphase Induction Motors and Generators*, Institute of Electrical and Electronics Engineers, Inc., New York, New York, 1996.

ISA-RP60.3, *Human Engineering for Control Centers*, Instrument Society of America, Research Triangle Park, North Carolina, 1985.

ISA-RP60.6, *Nameplates, Labels, and Tags for Control Centers*, Instrument Society of America, Research Triangle Park, North Carolina, 1984.

NEMA MG-1, *Motors and Generators*, National Electrical Manufacturers Association, Rosslyn, Virginia, 1998.

NFPA 70, *National Electric Code*, National Fire Protection Association, Quincy, Massachusetts, 1999.

NFPA 90A, *Installation of Air Conditioning and Ventilating Systems*, National Fire Protection Association, Quincy, Massachusetts, 2002.

SMACNA, *HVAC Air Duct Leakage Test Manual*, Sheet Metal and Air-conditioning Contractors National Association, Chantilly, Virginia, 1985.

SMACNA, *HVAC Duct Construction Standards, Metal and Flexible*, Sheet Metal and Air-conditioning Contractors National Association, Chantilly, Virginia, 2005.

SMACNA, *HVAC Duct Systems Inspection Guide*, Sheet Metal and Air-conditioning Contractors National Association, Chantilly, Virginia, 2000.

SMACNA, *HVAC Systems Duct Design*, Sheet Metal and Air-conditioning Contractors National Association, Chantilly, Virginia, 1990.

SMACNA, *HVAC Systems Testing, Adjusting, and Balancing*, Sheet Metal and Air-conditioning Contractors National Association, Chantilly, Virginia, 1993.

SMACNA, *Round Industrial Duct Construction Standards,* Sheet Metal and Air-conditioning Contractors National Association, Chantilly, Virginia, 1999.

Capability Replacement Laboratory Project
Document Concurrence Form

Document No: **CRL-TECH-ESH-006** | Rev No. **1** | Title: **Physical Sciences Facility Air Emission Control Equivalency Evaluation**

Originator: **Dave Brown** | Date: **09/23/2008** | Date Review & Approval Required by: **09/30/2008**

Formatting/Tech. Editing Complete ☐ Yes (Initials) _____ DRR Required: ☐ Yes ☐ No Work Package:

WBS Line Review/Concur (Check required Reviewers / Select Concurrence Order)	CAM/Reviewer	Review – Initial & Date (Check Box if No Comment)	Order of Concurrence	Concur – Initial & Date
PSF Project Integration & Support (WBS 1.1.01) and/or Project Integration & Support (WBS 1.2.01)				
☐ Project Mgmt and Business Mgmt Sys Integration	Angus Bampton	☐		
☐ Environmental Safety & Health	Hans Vogel	☐		
☐ Quality Assurance	Rocky Crisp	Jason Smith for Rocky 10/14/08 Crisp ☒	5	
☐ R&D Liaison	Walt Laity	☐		
☐ Project Controls	Paul Weinman	☐		
PSF Horn Rapids Triangle (HRT) Facilities (WBS 1.1.02)				
☐ PSF HRT Facilities Integration	Jeff Pittman	JPP 10/14/08 ☐	6	
☐ PSF HRT Engineering, Design & Inspection	Dale Flowers	☐		
☐ PSF HRT Facilities - Safety Basis	Hans Vogel	☐	4	
☐ PSF HRT Facility Construction	Bill Steward	☐		
☐ PSF HRT Facilities - Operational Startup	Skip Kerschner	☐		
☐ PSF HRT Facilities - Site Permitting	Dan Edwards	DLE 10/14/08 ☒	3	
Building 325 Life Extension Projects (LEP) (WBS 1.1.03)				
☐ Building 325 LEP - Integration and/or Ops Readiness	Skip Kerschner	☐		
☐ Building 325 LEP - Design/Construction	Julia Cunningham	☐		
☐ Building 325 LEP - Safety Basis	Hans Vogel	HEV 10/14/08 ☐		
300 Area Infrastructure and Upgrades (WBS 1.2.02)				
☐ 300 Area Infrastructure and Upgrades Integration	Skip Kerschner	☐		
☐ 318 Bldg Rehabilitation / 350 Bldg Rehabilitation	Brian Greenaway	☐		
☐ 331 Building Rehabilitation	Raul Carreno	☐		
Privately Financed Facilities (WBS 1.2.03)				
☐ Privately Financed Facilities Integration	Greg Herman	☐		
☐ BSF/CSF	Paul Dotson	☐		
☐ COR Utility Infrastructures	Ray Gerk	☐		
Transition (WBS 1.2.4)				
☐ Capabilities Relocation	Kathy Poston	☐		
Other Reviews/Concurrences				
☐ - PNNL Engineering	Dave Brown	Dave Brown ☐	1	
☐ - PNNL Engineering	Shan Belew	☐	2	
☐ -		☐		
☐ -		☐		

Signature Information (Use the drop-down box to set the order of the Signature/Approval Page)

1 CRL Project Director, J. McClusky	CRL Deputy Project Director, J. Fulton	CRL Integration & Support, A. Bampton
PSF HRT Facilities, J. Pittman	325 Life Extension Project, S. Kerschner	CRL Quality Assurance, R. Crisp
300 Area Infrastruct. & Upgrades, S. Kerschner	Privately Financed Facilities, G. Herman	Transition, C. Mac Donald
Other -	Other -	Other -