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Department of Energy

National Nuclear Security Administration
Washington, DC 20585

October 10, 2002

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DNF SAFETY BOARD

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, N.W.
Suite 700
Washington, D.C. 20004

Dear Mr. Chairman:

Consistent with the Department of Energy's Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2000-2, Configuration Management, Vital Safety Systems, I am forwarding an initial Phase II assessment report from the Office of Kirtland Site Operations, Annular Core Research Reactor Ventilation System Assessment at the Sandia National Laboratories. This report represents the final initial Phase II report from the National Nuclear Security Administration.

If you have any questions, please contact me at (202) 586-2179 or have your staff contact Mr. Jeff Kimball at (301) 903-6413.

Sincerely,

Everet H. Beckner
Deputy Administrator
for Defense Programs

Enclosure

cc w/o enclosure:
B. Cook, EH-1
D. Crandall, NA-11
M. Zamorski, OKSO

cc w/enclosure:
E. Blackwood, EH-24
M. Whitaker, S-3.1

02-2071

Report on
Annular Core Research Reactor Ventilation System Assessment at the Sandia National Laboratories (SNL)

September 2002

Team Members Approval

I, by signature here, acknowledge that I concur with the contents and conclusions of this report.

J. R. Baca NNSA/AL	Signature not obtained - Deceased	June, 2002
R. S. Clement NNSA/OKSO	Signature on file	September 17 2002
M. C. Garcia NNSA/AL	Signature on file	September 17, 2002
M. W. Hamilton NNSA/OKSO	Signature on file	September 17, 2002
N. F. Schwers Team Lead SNL	Signature on file	September 17, 2002
J. W. Scott SNL	Signature on file	September 17, 2002

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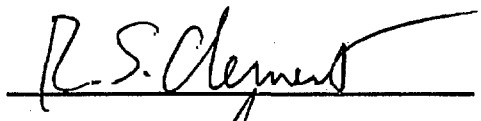
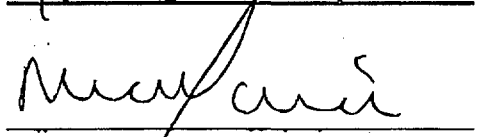
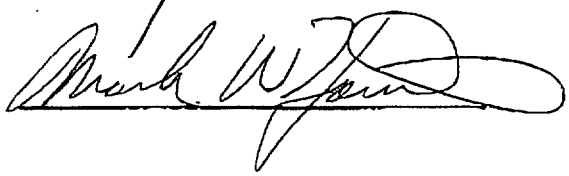
R. S. Clement NNSA/OKSO		September 17 2002
M. C. Garcia NNSA/AL		September 17, 2002
M. W. Hamilton NNSA/OKSO		September 17, 2002
N. F. Schwers Team Lead SNL		September 17, 2002
J. W. Scott SNL		September 17, 2002

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ACRONYMS

ACRR	Annular Core Research Reactor
AL	Albuquerque Area Office of DOE
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
BDBA	beyond design basis accident
BOP	Balance of Plant
CAM	continuous air monitor
CFM	cubic feet per minute
CFR	Code of Federal Regulations
CM	corrective maintenance
CPS	Cavity Purge System
CRAD	Criteria Review and Approach Document
CVS	containment ventilation systems
DBA	design basis accidents
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DP	differential pressure
ES&H	Environment, Safety and Health
ERDA	Energy Research and Development Administration
FBMT	Facilities Building Management Team
FMOC	Facilities Management and Operations Center
FREC	Fuel Ringed External Cavity
GIF	Gamma Irradiation Facility
HBVES	High Bay Ventilation System
HV	heating and ventilating
HEPA	high efficiency particulate air
I&C	instrumentation & control
ILA	Internal Lease Agreement
LCO	limiting conditions for operation
MEL	master equipment list
MIP	Master Implementation Plan
MW	Mega-watt
NEBB	National Environmental Balancing Bureau
NFWCQ	Nuclear Facilities Work Control Questionnaire
NNSA	National Nuclear Security Administration
OKSO	Office of Kirtland Site Operations
OFI	Opportunity for Improvement
PAAA	Price-Anderson Amendments Act
PM	periodic maintenance
PM	preventive maintenance
QA	quality assurance
RAM	radiation area monitor
SAR	Safety Analysis Report
SNL	Sandia National Laboratories

SSCs	structures, systems and components
SSSSC	safety significant structures, systems and components
TA-V	Technical Area Five
TSR	technical safety requirement
USQ	unreviewed safety question
USQD	unreviewed safety question determination
VSS	Vital Safety System
WG	water gauge

EXECUTIVE SUMMARY

This document summarizes the assessment team's conclusions regarding the status of the current operability and reliability of the Sandia National Laboratories (SNL) Annular Core Research Reactor (ACRR) ventilation system. In addition, consideration was directed to a review of the level of confidence in the continued operability and reliability of the ACRR ventilation system over the expected service life. The Assessment Results section of this report is a summary of the overall results based on the Model Assessment Criteria and Guidelines. Appendix A contains the specific analysis conducted by the assigned assessment team member.

The ventilation systems used for normal ACRR operations are fully operable and capable of performing their intended design function. Moreover, the team has concluded that the ACRR ventilation system will meet design requirements related to long-term operability and reliability over the expected service lifetime. Specific issues and opportunities for improvement, identified during the course of the review, are documented in the Appendix A and the Assessment Results section of the report. An issue involving the ventilation systems high efficiency particulate air (HEPA) filter in-place leak test procedure was identified during the assessment. Specifically, at issue was the required system test result compatibility with the designated reference standard (ASME N510). Upon identification of the concern, action was taken by the operations staff to make necessary minor system modifications (i.e., installation of additional test ports) and development of new test procedures to allow a subsequent re-test of the system. The subsequent retest of the system confirmed the operability of the system consistent with the design specifications.

INTRODUCTION

In Recommendation 2000-02, "Configuration Management of Vital Safety Systems," the Defense Nuclear Facilities Safety Board (DNFSB) concluded that degradation of confinement ventilation system (CVS) reliability and operability may be approaching unacceptable levels. Their conclusion was based on a review of U.S. Department of Energy (DOE) Occurrence Reports. The DNFSB's recommendation and the associated DOE Implementation Plan discuss the need to survey operational records and assess the current condition of CVSs important to safety at defense nuclear facilities. The ACRR facility design does not require containment due to the low fission product inventory and the high bay is not constructed as a leak tight barrier.

This Sandia National Laboratories (SNL) Vital Safety System (VSS) Phase II assessment meets the assessment requirements of DNFSB 2000-2 Commitment 11. There was not a Phase I assessment performed on the ACRR ventilation system; therefore, this is the first review against the Model Assessment Criteria and Guidelines for Performing Phase II Assessments at Defense Nuclear Facilities. Using this document, the team further developed an assessment Criteria Review and Approach Document (CRAD). The system chosen was the ACRR ventilation system, which consists of three systems. The High Bay Ventilation System (HBVES) is the primary exhaust system for the ACRR reactor room. The Cavity Purge System (CPS) is used to evacuate experimentation cavities in and around the reactor. The third ventilation component is the former Gamma Irradiation Facility (GIF) Ventilation System that is collocated in the ACRR high bay. There are no safety class or safety significant structures systems and components for the ventilation system in the ACRR. The ventilation system provides an airflow path through high efficiency particulate air (HEPA) filtration to reduce environmental contamination in the event of a large source of contamination in the ACRR high bay or in one of the experiment cavities.

The assessment team included representatives from both DOE and SNL. None of the team members were in the direct operational line. Based on the review, the ACRR ventilation systems meet the applicable requirements. There were no issues in the ventilation systems that would suggest that the reliability or operability of the system is approaching unacceptable levels. There were items that can improve the system overall reliability and these have been documented as Opportunities for Improvement (OFIs). The collective operation of the ACRR ventilation systems meets or exceeds established requirements. Ongoing maintenance of the ventilation systems will be necessary to ensure continued operability throughout the facility lifetime.

SCOPE OF ASSESSMENT

This VSS Phase II assessment was completed using the "Model Assessment Criteria and Guidelines for Performing Phase II Assessments of Vital Safety Systems at Defense Nuclear Facilities." The three primary ACRR ventilation systems include the High Bay Ventilation System (HBVES), the Cavity Purge System (CPS), and the former GIF Ventilation System. The team was comprised of two SNL contractor personnel and four DOE employees. Assessment team members reviewed the model CRAD and determined that it would provide the foundation for the assessment. Functional assignments were made the assignee developed the assessment approach required to validate the criteria. In accordance with the CRAD, the assessment includes review of the facility safety basis document, operational procedures, maintenance practice guides, prints, and work packages. In addition, interviews were conducted with maintenance personnel, the system engineer, and operations personnel.

The physical condition of the evaluated systems for the HBVES included the ventilation supply, exhaust equipment, HEPA filter housing, and the ventilation fan. The CPS physical condition with the exception of piping in the ACRR pool was evaluated. The cavity purge piping from the top of the ACRR, the HEPA filter housings, charcoal filter housings, and associated piping were evaluated for visually identifiable defects. Annual maintenance was performed on the CPS and the HBVES during the period that the team conducted its fieldwork. The completion of the routine maintenance tasks provided the team an opportunity to observe the activities of both the maintenance and operating staff.

Individual team assessment reports are in Appendix A. The team member reports describe methods used for validating the criteria. As part of the final presentation of the assessment report, the DOE Site Office and the ACRR operating staff conducted a review for technical accuracy.

BACKGROUND

Sandia National Laboratories

SNL began in 1945 on Sandia Base in Albuquerque, New Mexico. Sandia came into being as an ordnance design, testing, and assembly facility, and was located on Sandia Base to be close to an airfield and work closely with the military. The SNL's original mission, providing engineering design for all non-nuclear components of the nation's nuclear weapons continues today. Now it also performs a wide variety of national security research and development work. Nuclear facilities at SNL are used in advanced research, which address diverse problems in national security, energy, and the environment. SNL's nuclear engineering and science base provides a broad capability for development, application, and testing of nuclear systems.

Technical Area V (TA-V)

TA-V is located approximately 3.4 miles south of the main SNL facilities. TA-V facilities include research reactors, hot cell facilities, light laboratories, and offices. Capabilities include the ability to analyze and model nuclear systems and experiments and to predict and measure their performance.

Annular Core Research Reactor

The ACRR is used to perform in-pile experiments for radiation effects, reactor development and safety experiments. The irradiation of materials is performed in the central cavity, the Fueled Ring External Cavity (FREC), or the neutron radiography facility. The ACRR is a pool-type research reactor capable of operating in pulse or steady-state modes. The steady state power level is approximately 2.4 MW and the pulse peak power is approximately 30,000 MW. The pool is approximately 10 ft diameter and 27 ft deep.

ACRR Ventilation System

The VSS under review includes the HBVES, CPS, and the former GIF Ventilation System. The HBVES maintains negative pressure in the reactor room compared to adjacent offices and to the outside atmosphere. The airflow through this system may pass through a HEPA filter or it may by-pass the filter depending on the console selection or an interlock from a continuous air monitor (CAM). All of the air passing through the central cavity, the FREC, and the neutron radiography facility passes through a series of filters. The air that exits the high bay through the former GIF is passed through a HEPA filter.

HBVES

This system provides negative pressure ventilation for the ACRR high bay (2,330 m^3 volume). Air purged from the high bay normally bypasses the HEPA filters but may be switched manually by an operator or automatically by a CAM. The CAM that monitors the high bay will, upon receiving a high alarm, shift a set of louvers at the HEPA ventilation filter bank. There is a radiation area monitor (RAM) that monitors the stack to provide operations personnel additional information but it does not cause an automatic shift of the ventilation system. The operators can shift the HBVES to filtered mode at the ACRR control panel. All of the fresh air supplied to the HBVES is filtered to remove dust. Figure 1 illustrates the air flow and flow rates of the HVBES including the air supply and exhaust paths.

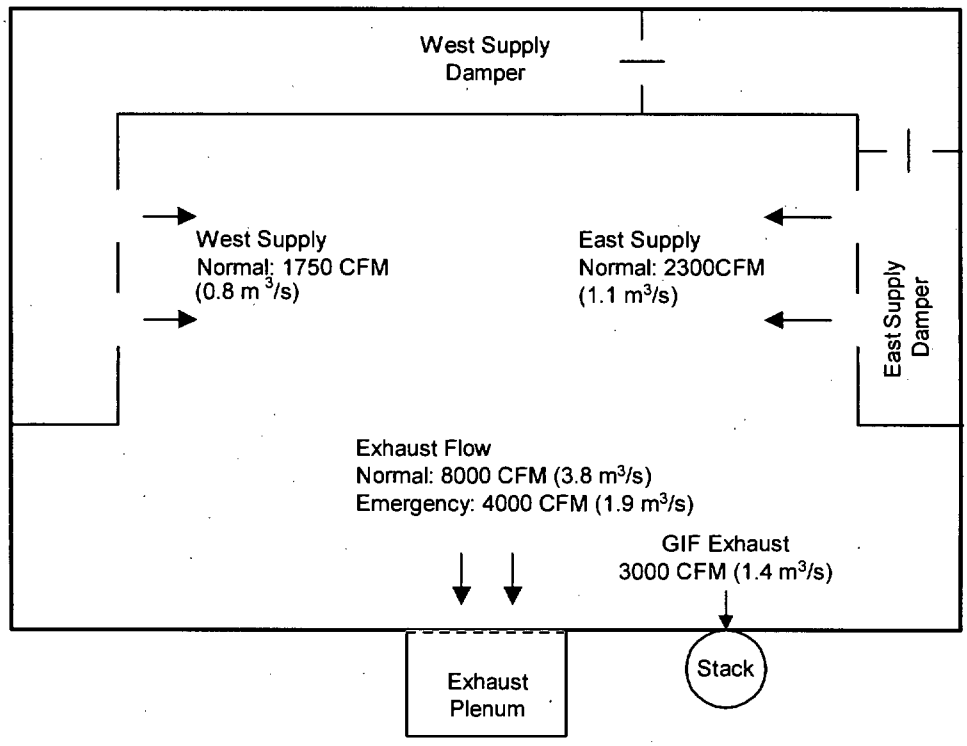

Figure 1: HBVES and GIF Ventilation System Nominal Flow Rates

GIF Ventilation System

The former GIF ventilation system is collocated with the ACRR in the high bay. The ventilation system was intended to purge the cells of ozone generated from air in the presence of intense gamma irradiation. There is outside air supplied to the former GIF cells and there is in-leakage into these cells from the ACRR high bay. The air leaving this system is HEPA filtered prior to entering a small stack and being released to the atmosphere. Figure 1 shows the GIF ventilation exhaust flow rate. Although radiation

sources used in the former GIF sources have been moved to a new building within TA-V, the ventilation system is active and it takes suction from within the former GIF cells.

Cavity Purge System

The CPS takes suction from a variety of reactor locations including the central cavity, the FREC, the neutron radiography system, and possibly from experiment fixtures. The primary purpose of the CPS is to prevent radioactive air and gasses, such as argon-41, that may be present in the experimentation facilities from diffusing into the high bay. The cavity purge is the primary ventilation system for experiments since it is taking suction from the point of release for experiments. The CPS provides a slight vacuum in comparison to the ACRR high bay. All of the cavity purge air is routed through a pre-filter, a HEPA filter, two charcoal filters, and a second HEPA filter. There are two installed purge fans. The fans are alternatively run on a monthly basis to provide approximately even wear. It is possible to operate both fans simultaneously. The operators control this system from the Balance of Plant (BOP) panel at the ACRR console. Figure 2 illustrates the layout of the ACRR CPS.

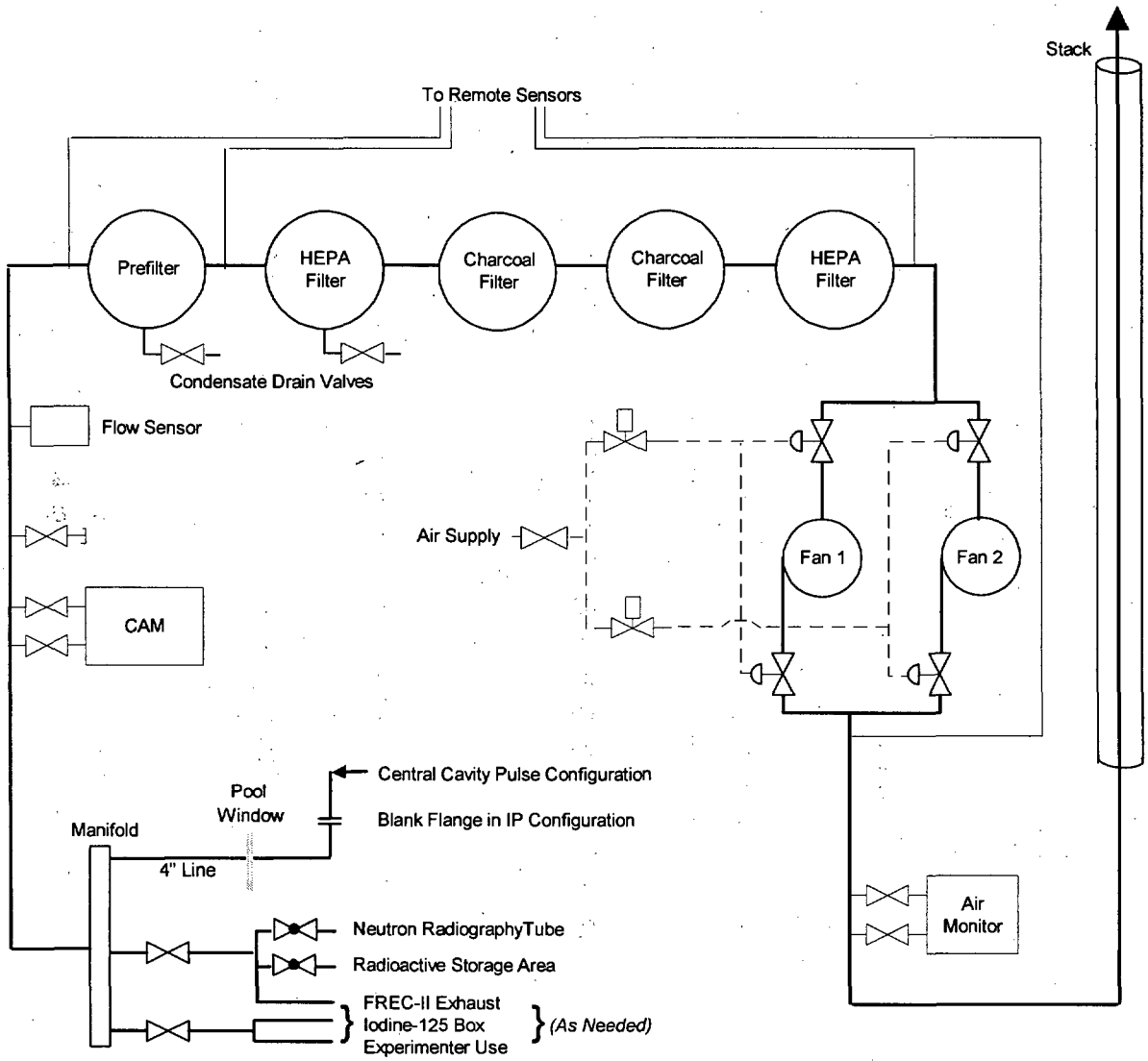

Figure 2: ACRR Cavity Purge System

ASSESSMENT RESULTS

The summaries of the functional areas identified in the CRAD are listed below. The details of the criteria analyses are included as Appendix A. There were 27 OFIs identified during the review. System Maintenance and System Surveillance and Testing were the main areas identified as needing improvement. The system is operational and no major degradation was noted. The work control processes ensure that configuration control is maintained. There is a maintenance management program that routinely evaluates the systems. The system is verified operational prior to reactor operation as part of the pre-operational checkout.

SAFETY BASIS

Based on the current accident analysis section of the Safety Analysis Report (SAR), there is no justification for the HBVES or CPS being listed as SSSSCs. The SAR consistently states that the ventilation system filters (i.e., HEPA and charcoal) are not required during normal or accident conditions. The dose levels to the public and to the environment do not require mitigation to stay within the safety bases criteria. The Technical Safety Requirements (TSR) Limiting Conditions for Operation (LCO) requires that the HBVES and CPS are operational. The systems are capable of meeting the safety bases requirements for the life of the facility. The requirement to have ventilation system TSR LCO for non-SSSSC necessitates subsequent analysis by DOE and SNL. That analysis is outside of the scope of this assessment.

CONFIGURATION MANAGEMENT

Configuration management practices meet the requirements. A documented configuration management process for the ACRR facility has been implemented consistent with the SNL operating requirements and the guidance from DOE Standard 1073-93 "Guide for Operational Configuration Management Program." Minor instances of system degradation were noted; one of the HBVES supply dampers failed to fully close, the cavity purge support bracket wooden base plate needs to be replaced, and a filter housing used as a platform to obtain instrument readings caused some leakage past the HEPA filter. The filter housing was repaired during the assessment.

Configuration management was incorporated in the ACRR as evidenced by the physical systems being consistent with the design bases documentation and the system drawings. Operations personnel implemented a formal system change process through the TA-V Work Control Instruction. The personnel interviewed had an understanding of the change control process and were committed to appropriately manage changes affecting design and safety basis in a formal, disciplined, and auditable manner.

The unreviewed safety question (USQ) process is used effectively to ensure changes were within the DOE-approved safety envelope for the facility, and that DOE review and approval were obtained when required. Minor inconsistencies were identified in the USQ process. The USQ process has been modified and training is scheduled. The guidance documents in place at the

facility are adequate to ensure changes to safety basis-related requirements, documents, and installed components are controlled.

There is an Internal Lease Agreement (ILA) between the maintenance organizations and the operating organization. The ILA identifies requirements for the system engineer involvement in the change control. The TA-V Work Control Instruction needs to implement the system engineer into the change control process. All personnel interviewed were knowledgeable of software configuration management, documentation, and testing. Software configuration management implementation was reviewed and meets the documented requirements.

SYSTEM MAINTENANCE

Maintenance systems for the ACRR ventilation system were evaluated to ensure system integrity, reliability, and operability. Maintenance processes were in place that identify equipment and categorize it according to maintenance standards. An issue concerning predictive maintenance was identified on the ACRR ventilation system. There is a program within SNL that routinely analyzes fan system operations using vibration readings to detect progressive degeneration. This quarterly predictive maintenance had not been applied to the ACRR fans but was added during the assessment.

Self assessments are required by ACRR instructions. The completed assessments were reviewed and found to be adequate. Component failure rates were adequately reviewed to determine their impact on maintenance or system improvement efforts. System review including vibrational analysis had not been done on a timely basis but was added to the maintenance requirements.

A comprehensive program has been developed and implemented to identify potential maintenance concerns and effect necessary action to correct operational concerns. OFIs included documenting the provisions of the standard (ASME N510) used by the ventilation system subcontractor in the operations surveillance procedure. In addition, instituting a tracking and trending program that could improve predictive maintenance. The TA-V Material History Instruction requires entries for maintenance activities on Critical/Safety-Related SSCs as categorized on the facility Master Equipment List (MEL). The procedure that documents the development of the MEL does not use the same terminology. Therefore, the terminology between the Material History Instruction and the MEL should be standardized.

SURVEILLANCE AND TESTING

The ACRR ventilation system TSR LCO is verified through the ACRR operating procedures and through the subcontractor maintenance procedures. The ACRR Safety Analysis Report infers that HEPA filter efficiency (in-place leakage) tests are performed by using provisions of ASME N510. The specificity of ASME N510 could not be invoked in its entirety because the ventilation systems were not designed according to ASME N509 construction specifications. As a result, the exact HEPA filter efficiency (in-place leakage) requirements discussed in ASME N510, requiring both upstream and downstream measurements, could not be implemented for sampling purposes. Paragraph 1.2 of ASME N510, titled "Limitations of the Standard" specifically acknowledges "the standard is only applicable in its entirety to systems designed and

built to ASME N509 specifications." Furthermore, ASME N510 states, "Sections of the standard may be used for technical guidance for testing air treatment systems designed according to other criteria." Filter testing in accordance with the industry standards and system flow rates had been identified as an OFI in a 2000 DOE Facility Representative report.

According to the aforementioned criteria, the ventilation system subcontractor hired by SNL to perform HEPA filter efficiency checks used both Laskin nozzle calculation methods and actual in-place measurements during the conduct of the surveillance. Subsequent investigation during the conduct of this study has shown that alterations to the ventilation system and in the subcontractor's testing methods could be made to permit HEPA efficiency (in-place leakage) testing to more closely match the criteria suggested in ASME N510. A minor modification to the former GIF Ventilation System was made to meet these testing methods. Testing methods were changed for the HBVES and CPS to verify in-place leakage testing.

The airflow through the HVBES exceeded the airflow limits by as high as 25%. However, the BOP computer did not show that the airflow exceeded the expected value. The increased airflow challenges the allowable flow rate for the installed HEPA filter. The differential pressure across the HEPA filters was approximately 50% on the BOP of the measured differential pressure. The in-place leak tests for the charcoal adsorber beds in the CPS are not performed and their justification for omission is not documented. Periodic replacement of the adsorbers is being performed.

There are ten procedures that have ventilation system parameters evaluated or verified. There is some inconsistency in the documentation for out of specification readings and subsequent supervisory notification. The majority of the procedures meet all of the specified criteria. There are a few criteria that are not applicable. There are specified criteria that could not be evaluated due to the procedures not being performed during the period of the review. The information is consistent between the operations procedures (Steady State, Pulse, Double Pulse, TRW, and multimode.)

APPENDIX A: DETAILED DISCUSSION OF RESULTS SAFETY FUNCTION DEFINITION

This Appendix presents detailed discussion of the assessment and results for each objective.

Safety Function Criterion 1

Objective:

Safety basis-related technical, functional, and performance requirements for the VSS are identified/defined in appropriate safety documents.

Criteria:

Safety/authorization basis documents identify and describe: 1) the VSS safety functions and the safety functions of any essential supporting systems; and 2) the system requirements and performance criteria that the VSS must meet to accomplish its safety functions.

Approach:

Review the appropriate safety/authorization basis documents, such as safety analysis reports, basis for interim operations, technical safety requirements, safety evaluation reports, and hazards and accident analyses, to determine if the definition/description of the VSS safety functions includes:

- The specific role of the system in detecting, preventing, or mitigating analyzed events.

Is the Criteria Met?

Yes

Review Process

Facility Safety Documentation

- SAND99-3031 – Safety Analysis Report for the Annular Core Research Reactor Facility (ACRRF) – November 17, 1999
- SAND98-0051 – Technical Safety Requirements for the Annular Core Research Reactor Facility (ACRRF) – September 2000

Discussion of Results

Review of ACRR SAR chapter14A – Consequence for the accidents is clearly evaluated as unmitigated by active system such as ventilation filters. Item 4 on page 14A-30, the Beyond Design Basis Accident (BDBA) stated that the ventilation system is a design feature based on defense in depth. The section provides additional description of the function of the cavity purge and the ventilation systems.

Page 14A-35 defines the reasoning behind not designating the ventilation systems as a SSSSC. The external events list the ventilation system as one of the features that could be damaged. Two events EX-FR-4 and EX-CP-2 refer to the CPS as being a preventative design feature.

Chapter 14B is consistent with 14A in that none of the accidents require the ventilation system for mitigation. The difference between the accident analyses chapters is based on the core configuration.

Review of Chapters 14A and 14B and the corresponding appendices – the HBVES is described in the preliminary hazard analysis primarily as a mitigative feature. The mitigative feature is "High bay ventilation system maintains a negative pressure differential, minimizing building contamination potential."

One accident in both isotope configuration and pulse mode configuration, Loss of Effluent Confinement, lists the failure of the cavity purge or the cavity purge turned off as an entry condition for the accident. This is identified with a negligible consequence.

Functional requirements:

LCO 3.2.7 The ACRR High Bay Ventilation System shall be a. Operating and b. Able to shift to the filtered mode.

LCO 3.2.13 The Cavity Purge SHALL be OPERATING whenever required for Experiments as determined by the experiment review process.

Conclusion/Opportunity for Improvement

The current DOE-approved SAR does not justify having the HBVES or CPS as a SSSSC. The HBVES does not meet any of the requirements as listed in DOE Order 5480.22/10 CFR 830 for LCOs. The order states "Maintaining the LCOs at the minimum number necessary will emphasize the importance of the LCOs and better ensure the compliance with them." The DOE guide 423.1-1 Implementation Guide for Use in Developing Technical Safety Requirements states: "The scope and content of TSRs should be limited to include only the most important nuclear safety areas in order to make TSR documents more operationally useful for controlling facility safety." This guide is used to support compliance with 10 CFR 830.205. ACRR operations personnel should review the requirement for the TSR LCOs and make it consistent with the SAR. [OFI-VSS-ACRR-1]

Safety Function Criterion 2

Objective:

Safety basis-related technical, functional, and performance requirements for the VSS are identified/defined in appropriate safety documents.

Criteria:

Safety/authorization basis documents identify and describe: 1) the VSS safety functions and the safety functions of any essential supporting systems; and 2) the system requirements and performance criteria that the VSS must meet to accomplish its safety functions.

Approach:

Review the appropriate safety/authorization basis documents, such as safety analysis reports, basis for interim operations, technical safety requirements, safety evaluation reports, and hazards and accident analyses, to determine if the definition/description of the VSS safety functions includes:

- The associated conditions and assumptions concerning system performance.

Is the Criteria Met?

Yes

Review Process

Facility Safety Documentation

- SAND99-3031 – Safety Analysis Report for the Annular Core Research Reactor Facility (ACRRF), November 17, 1999
- SAND98-0051 – Technical Safety Requirements for the Annular Core Research Reactor Facility (ACRRF), September 2000

Discussion of Results

Chapter 6 of the ACRR SAR documents the nominal flow rates for normal and bypass modes. The flow rates are current in the SAR using USQD (ACRR #192). The SAR page changes with USQD ACRR-192 were recently submitted to DOE/NNSA/OKSO in an annual update.

Safety function:

The HBVES has the capability to exhaust the air in the building several times per hour.

Radioactive gases created in the irradiation space are prevented from diffusing into the reactor room by the CPS. These lines evacuate the irradiation space and the loading tube. The flow out

of the loading tube into the purge lines prevents the accumulation of heavier-than-air radioactive gases (principally argon-41) at the bottom of the irradiation space.

Functional requirements:

There is no statement in the SAR to specify the number of air changes per hour. The HBVES is required to be operating and capable of switching to the filtered mode.

Conclusion/Opportunity for Improvement

The system engineer or industrial hygienist should evaluate the number of room changes per hour in light of the modification that reduced the system flow rate. [OFI-VSS-ACRR-2]

Safety Function Criterion 3

Objective:

Safety basis-related technical, functional, and performance requirements for the VSS are identified/defined in appropriate safety documents.

Criteria:

Safety/authorization basis documents identify and describe: 1) the VSS safety functions and the safety functions of any essential supporting systems; and 2) the system requirements and performance criteria that the VSS must meet to accomplish its safety functions.

Approach:

Review the appropriate safety/authorization basis documents, such as safety analysis reports, basis for interim operations, technical safety requirements, safety evaluation reports, and hazards and accident analyses, to determine if the definition/description of the VSS safety functions includes:

- Requirements and performance criteria for the system and its active components, including essential supporting systems, for normal, abnormal, and accident conditions relied upon in the hazard or accident analysis.

Is the Criteria Met?

Yes

Review Process

Facility Safety Documentation

- SAND99-3031 – Safety Analysis Report for the Annular Core Research Reactor Facility (ACRRF), November 17, 1999
- SAND98-0051 – Technical Safety Requirements for the Annular Core Research Reactor Facility (ACRRF), September 2000

Discussion of Results

Safety function:

ACRR SAR page 14A-31 states that the ventilation system is not required to operate following an electrical outage.

The former GIF Ventilation System section in the SAR describe basic functionality and a requirement to maintain a negative pressure differential with respect to the ACRR high bay.

There are no specifications for the flow rate. The CPS flow rate is listed as 950 cfm and the alarm on the BOP is 788 cfm.

Functional requirements:

The GIF Ventilation System and the CPS exhaust air through the filters in all modes. The flow rates do not change during abnormal operation. There are no requirements or capabilities for these systems to operate during a power outage.

The HBVES normal flow rate bypasses the system filters. The HBVES switches to filtered mode automatically by a CAM or manually by an operator at the console.

The CPS has charcoal filters but the accident analysis does not specify a reduction requirement for halogens in its dose rate assumptions.

Conclusion

The current DOE-approved SAR consistently states that the ventilation system filters (HEPA and charcoal) are not required during normal or accident conditions. Radiation dose levels to the members of the public and to the environment do not require mitigation to stay within the safety bases criteria. The systems are used as they are designed.

CONFIGURATION MANAGEMENT

Configuration Management Criterion 1-1

Objective:

Changes to safety basis-related requirements, documents, and installed components are controlled.

Criteria:

1. Changes to VSS safety basis requirements, documents, and installed components are designed, reviewed, approved, implemented, tested, and documented in accordance with controlled procedures. Consistency is maintained among system requirements and performance criteria, installed system equipment and components, and associated documents as changes are made.
2. Limited technical walk down of selected system components verifies that the actual physical configuration of these components conforms to documented design and safety basis documents for the system.
3. Changes to system safety basis requirements, documents, and installed components conform to the approved safety/authorization basis (safety envelope) for the facility, and the appropriate change approval authority is determined using the Unreviewed Safety Question (USQ) process.
4. Facility procedures ensure that changes to the system safety basis requirements, documents, and installed components are adequately integrated and coordinated with those organizations affected by the change.
5. Software used in VSS I&C components that perform functions important to safety is subject to a software quality process consistent with 10 CFR 830.120.

Approach:

On a sample basis, review and evaluate the change control process and procedures and associated design change packages and work packages to determine whether the change control process and procedures are adequate and effectively implemented. Determine whether:

- SSCs and documents affected by the change are identified
- Changes are accurately described, reviewed and approved as appropriate
- Installation instructions, post-modification testing instructions and acceptance criteria for turnover to facility operations are specified, and
- Important documents affected by the change (e.g., operating and test procedures, MEL, etc.) are revised in a timely manner.

Is the Criteria Met?

Yes

Review Process

Several ACRR documents were reviewed to include Department Instructions, Master Equipment Lists, SNL guidance document, representative Work Packages, and a SNL-DOE memorandum.

Facility Safety Documentation

- Department 6431/6432 Instruction, Work Control, 6431/6432-MMP.II-04, Issue G, dated 1/31/02
- Department 6431/6432 Instruction, Determination of Systems, Structures and Components, 6431/6432-MMP.II-01, Issue B, dated 2/14/98
- ACRR Facility Master Equipment List, dated 2/11/02
- GIF Master Equipment List, dated 6/16/98
- Internal Lease Agreement For Technical Area V, Rev. 3, dated 4/02
- GN470080 – Implementing the Unreviewed Safety Question (USQ) Process for Nuclear Facilities, dated 10/22/99
- ACRR Work Package 2000-006, "Highbay Ventilation Exhaust," dated 1/20/00
- ACRR Work Package 2000-084, "Cavity Purge," dated 12/15/00
- SNL-DOE memorandum from Bryson to Mullen, "Annual Update of the ACRRF Safety Analysis Report (SAR)," dated 3/6/02

Interviews Conducted

The Facility Supervisor, a Reactor Supervisor and two Reactor Operators were interviewed on 8/1/02.

Discussion of Results

SSCs and documents affected by the change are identified:

The Department 6431/6432 Work Control Instruction identifies that work performed at TA-V nuclear facilities should be controlled using a Work Package (WP) consisting of at least a Facility Work Request (FWR). Work involving modifications requires an additional form in the WP called a Facility Modification Request (FMR). The Instruction states that the FMR is the primary document for tracking and documenting changes to SSCs designated as Configuration Items in the Facility Master Equipment List (MEL).

The FWR has a section where the System and Component and the classification of each are to be identified. The classification is determined by using Department 6431/6432 Instruction Determination of Systems, Structures and Components. The classification ranges from "A" for safety class SSCs to "D" for the lowest level. Based on a review of the MEL, there were no components classified as safety class SSCs as consistent with the SAR. The FMR has a section to identify the documents affected by the change (drawings, operating procedures, vendor manuals, etc.).

Changes are accurately described, reviewed and approved as appropriate:

The FWR includes a section for "Description of Work" and the FMR has a section for "Detailed Description of Modification." The FWR includes the Nuclear Facilities Work Control Questionnaire. This questionnaire is a tool for personnel to identify hazards that must be controlled. This questionnaire also states that if a modification is being performed, then a USQD is required. The Facility Supervisor authorizes work by reviewing and signing the FWR (and FMR for modifications). Additionally, for a modification, an independent review of the FMR is required. The Instruction states that the independent reviewer should be familiar with the design criteria for the SSC being modified. A review with respect to applicable DOE Orders and mandatory standards is also required. The instruction states that the safety committee charters are to be reviewed to determine if the facility safety committee and/or NFSC must review the proposed modification. The Instruction goes on to say that the appropriate safety committee review, and DOE approval is required for all modifications involving:

An unreviewed safety question,
Installation of critical assemblies,
Plant protection systems,
Reactor control systems, and
Engineered safety features.

The Department Manager approves the proposed modification. The Facility Supervisor authorizes the modification work to commence.

Installation instructions, post-modification testing instructions and acceptance criteria for turnover to facility operations are specified:

The FWR includes sections for "Description of Work" and "Post Work Test/Inspection." The FMR includes a section for "Detailed Description of Modification."

The Internal Lease Agreement between Nuclear Facility Operations Department, Organization 6430, and Facilities Management and Operations Center, Organization 10800, identifies roles and responsibilities for maintenance and modifications to Real and specific Programmatic property. A building manager functions as a liaison between the two groups to facilitate planning, performance and documentation of maintenance and modification activities on real property. All work performed inside TA-V will be formally evaluated to determine whether the work might impact the nuclear facility. All work that is identified as having a potential to impact a nuclear facility will interface with the TA-V Nuclear Facility Work Control process.

Important documents affected by the change (e.g., operating and test procedures, Master Equipment List, etc.) are revised in a timely manner:

The FMR has a section to record that the documents have been updated and a date. The Instruction states that a member of the operations staff shall ensure all drawings and documents are updated and will sign the FMR after all changes associated with this modification have been incorporated. It also states that "red-lined" drawings are sufficient to sign off this item. The

Task leader signs the FMR when it is complete then the Department Manager signs that the modification is complete.

The USQ procedure (GN470080) states "Facility managers shall be responsible for ensuring that any changes to the Safety Analysis Report (SAR) resulting from an approved safety evaluation are incorporated in the SAR at the next available opportunity or during the annual SAR update, whichever occurs first."

ACRR FWRs 2000-006 (completed 4/5/01) and 2000-084 (completed 9/7/01) were reviewed. These involved modification work to two of the systems of concern. The SSCs and documents affected by the change were identified; the changes were described, reviewed and approved; the installation instructions, post work testing instruction, and acceptance criteria were noted; and important documents affected by the change were identified. The memorandum from Bryson to Mullen, "Annual Update of the ACRRF Safety Analysis Report (SAR)" dated March 6, 2002, communicates SAR changes that were identified in the FWRs. The revision of the SAR by the annual update is judged to be timely.

Conclusion

The guidance documents in place at the facility are adequate to ensure changes to safety basis-related requirements, documents, and installed components are controlled.

Configuration Management Criterion 1-2

Objective:

Changes to safety basis-related requirements, documents, and installed components are controlled.

Criteria:

1. Changes to VSS safety basis requirements, documents, and installed components are designed, reviewed, approved, implemented, tested, and documented in accordance with controlled procedures. Consistency is maintained among system requirements and performance criteria, installed system equipment and components, and associated documents as changes are made.
2. Limited technical walk down of selected system components verifies that the actual physical configuration of these components conforms to documented design and safety basis documents for the system.
3. Changes to system safety basis requirements, documents, and installed components conform to the approved safety/authorization basis (safety envelope) for the facility, and the appropriate change approval authority is determined using the Unreviewed Safety Question (USQ) process.
4. Facility procedures ensure that changes to the system safety basis requirements, documents, and installed components are adequately integrated and coordinated with those organizations affected by the change.
5. Software used in VSS I&C components that perform functions important to safety is subject to a software quality process consistent with 10 CFR 830.120.

Approach:

- Interview a sample of cognizant line, engineering, QA managers and other personnel to verify their understanding of the change control process and commitment to manage changes affecting design and safety basis in a formal, disciplined and auditable manner.

Is the Criteria Met?

Yes

Review Process

Interviews were conducted with cognizant ACRR personnel that took place in two parts. The first interview took place on 2/10/02, and the second on 8/1/02.

Facility Safety Documentation

- Department 6431/6432 Instruction, Work Control, 6431/6432-MMP.II-04, Issue G, dated 1/13/02

- Department 6431/6432 Instruction, Determination of Systems, Structures and Components, 6431/6432-MMP.II-01, Issue B, dated 2/14/98
- ACRR Facility Master Equipment List, dated 2/11/02

Interviews Conducted

The Facility Supervisor, a Reactor Supervisor and two Reactor Operators were interviewed.

Discussion of Results

All personnel interviewed were familiar with the Work Control process, particularly regarding modifications to systems identified in the SAR.

Conclusion

The personnel interviewed have an understanding of the change control process and are committed to manage changes affecting design and safety basis in a formal, disciplined, and auditable manner.

Configuration Management Criterion 2-1
Objective:

Changes to the safety basis-related requirements, documents, and installed components are controlled.

Criteria:

1. Changes to VSS safety basis requirements, documents, and installed components are designed, reviewed, approved, implemented, tested and documented in accordance with controlled procedures. Consistency is maintained among systems requirements and performance criteria, installed system equipment and components, and associated documents as changes are made.
2. Limited technical walk down of selected system components verifies that the actual physical configuration of these components conforms to documented design and safety basis documents for the system.
3. Changes to system basis requirements, documents and installed components conform to the approved safety/authorization basis (safety envelope) for the facility, and the appropriate change authority is determined using the Unreviewed Safety Question (USQ) process.
4. Facility procedures ensure that changes to the safety basis requirements, documents, and installed components are adequately integrated and coordinated with those organizations affected by the change.
5. Software used in VSS I&C components that perform functions important to safety is subject to a software quality process consistent with 10 CFR 830.120.

Approach:

- Walk down selected VSS components and compare the actual configuration of these components to system documents such as design basis and safety/authorization basis documents, system design descriptions, and system drawings such as piping and instrumentation diagrams, and
- Identify any temporary changes, or configuration discrepancies that call into question: (1) the operability or reliability of the system; or (2) the adequacy of the change control or document control processes, including drawing revision, applied to the system.

Is the Criteria Met?

Yes

Review Process

Interviews were conducted with representatives from the ACRR operations staff, program management, and SNL engineering and maintenance support staff members. The completed walk through inspection included the essential elements of the interior and exterior exhaust and supply systems for the ACRR, former GIF and high bay. As a part of the inspection process, operations staff provided detailed information on the operation and maintenance of the

ventilation systems, exhaust ducts, HEPA filters, cavity purge charcoal filters and performance and testing procedures for the systems.

Engineering drawings of the ventilations systems for the ACRR and high bay were reviewed as part of the inspection process. The drawings included the mechanical elements for the ACRR Modifications to Building 6588.

The completion of the Test and Balance (T&B) of the ACRR ventilation system by SNL's subcontractor was observed as part of the review process. Results of the T&B and actions taken to address findings were the subject of subsequent discussions with the ACRR operations and maintenance staff.

Facility Safety Documentation

- ACRRF SAR
- Safety Evaluation Report, SAND99-3031 – Safety Analysis Report for the ACRRR and Associated Technical Safety Requirements
- 2001 USQD Update of the ACRRF SAR
- Preventive Maintenance & Surveillance Guide
- Ventilation & Cavity Purge Flow Rates & Filter Efficiencies
- Laminar Flow, Preventive Maintenance and Certification Test Form from SNL subcontractor, dated February 2, 2002

Interviews Conducted

- Facility Maintenance Manager
- Reactor Operator
- Systems Engineer
- Facility Manager
- Configuration Management Subject Matter Expert

Discussion of Results

Walk down selected VSS components and compare the actual physical configuration of these components to system documents such as design basis and safety/authorization basis documents, system design descriptions, and system drawings such as piping and instrumentation diagrams.

A documented configuration management process for the ACRR has been implemented consistent with the SNL operating requirements and the guidance contained in the DOE Standard, DOE STD 1073-93, "Guide for Operational Configuration Management Program". The ACRR SAR provides necessary documentation of the safety basis and operational requirements for the facility.

During the walk down of the HBVES and former GIF Ventilation System, no discrepancies were noted between the physical configuration and the system drawings. Moreover, the operational configuration of the ventilation system was determined to be consistent with the design basis

documentation. A formal process has been implemented to document necessary system changes consistent with the recommended USQ guidelines and procedures.

Conclusion

The observed configuration of the ventilation systems is consistent with the drawings and operational design criteria.

Opportunity for Improvement

A systematic approach should be developed to monitor the implementation of the ongoing ACRRF Configuration Management Program. Specifically, a Configuration Management database should be developed to consolidate documentation and allow for a systematic review of the ventilation systems on scheduled basis. [OFI-VSS-ACRR-3]

Configuration Management Criterion 3-1

Objective:

Changes to safety basis-related requirements, documents, and installed components are controlled.

Criteria:

1. Changes to VSS safety basis requirements, documents, and installed components are designed, reviewed, approved, implemented, tested, and documented in accordance with controlled procedures. Consistency is maintained among system requirements and performance criteria, installed system equipment and components, and associated documents as changes are made.
2. Limited technical walk down of selected system components verifies that the actual physical configuration of these components conforms to documented design and safety basis documents for the system.
3. Changes to system safety basis requirements, documents, and installed components conform to the approved safety/authorization basis (safety envelope) for the facility, and the appropriate change approval authority is determined using the Unreviewed Safety Question (USQ) process.
4. Facility procedures ensure that changes to the system safety basis requirements, documents, and installed components are adequately integrated and coordinated with those organizations affected by the change.
5. Software used in VSS I&C components that perform functions important to safety is subject to a software quality process consistent with 10 CFR 830.120.

Approach:

Review documentation, such as change travelers and changes packages, and interview individuals responsible for processing selected changes made to the system requirements, installed equipment, and associated documents. Determine whether:

- Changes to the system are reviewed to ensure that system requirements and performance criteria are not affected in a manner that adversely impacts the ability of the system to perform its safety functions, and
- The USQ process (i.e., USQ screens and USQ safety evaluations/determinations) is being appropriately used.

Is the Criteria Met?

Yes

Review Process

Several ACRR documents were reviewed to include Department Instructions, MELs, SNL guidance document, representative Work Packages, and a SNL-DOE memorandum.

Facility Safety Documentation

- SNL-DOE memorandum from Bryson to Mullen, "Annual Update of the ACRRF Safety Analysis Report (SAR)," dated 3/6/02
- USQD Number ACRR-192, "ACRR HEPA Filter Flow Adjustment to 4000 cfm," dated 9/14/00
- USQD Number ACRR-230, "Cavity Purge Sensing Line Maintenance Modification," dated 12/15/00
- USQD Number ACRR-185, "Neutron Radiography Tube; Flood and Purge Component Removal," dated 2/28/00
- ACRR Work Package 2000-006, "High Bay Ventilation Exhaust," dated 1/20/00
- ACRR Work Package 2000-084, "Cavity Purge," dated 12/15/00
- GN470080 – Implementing the Unreviewed Safety Question (USQ) Process for Nuclear Facilities, dated 10/22/99

Interviews Conducted

The ACRR Facility Supervisor, a Reactor Supervisor, and two Reactor Operator were interviewed.

Discussion of Results

The Department 6431/6432 Work Control Instruction provides guidance on the preparation of Facility Work Requests (FWRs). The FWR includes a Nuclear Facilities Work Control Questionnaire (NFWCQ) that points to the USQ Process if the action is a modification.

Three USQDs were reviewed as examples of the use of the process to review modifications to the systems of concern.

With regard to USQD ACRR-192, a separate Safety Evaluation was attached, not in the format of the form. In accordance with the USQ procedure GN470080, originators shall use the USQ worksheet.

USQD ACRR-230 was generated as part of the modification of removing local differential pressure sensing lines in the Cavity Purge System. The form was accurately filled out.

USQD ACRR-185 was generated to remove components from the Neutron Radiography Tube. The form was accurately filled out.

These USQDs resulted in the generation of page changes to the ACRR SAR in order to update the document based on the modifications. These page changes were transmitted in an SNL-DOE memorandum from Bryson to Mullen, "Annual Update of the ACRR Safety Analysis Report (SAR)," dated March 6, 2002.

Two FWRs associated with two of the previous USQDs were also evaluated. ACRR FMR 2000-006, "High Bay Ventilation Exhaust," and FMR 2000-084, "Cavity Purge," adequately documented the modifications and ensured that the performance of each system was not adversely impacted.

Conclusion

Facility personnel are able to document and review changes to systems to ensure the function of safety systems are not adversely impacted. There were minor inconsistencies noted with the USQDs that were reviewed. Ongoing training on that subject should be sufficient to strengthen that minor weakness. The USQD procedure has been updated in accordance with DOE Guide 424.1-1 and has been submitted to DOE for approval. SNL personnel who perform USQDs have training scheduled for September 2002 that will cover the new procedure.

Changes to safety basis-related requirements, documents, and installed components are controlled.

Configuration Management Criterion 4-1

Objective:

Changes to safety basis-related requirements, documents, and installed components are controlled.

Criteria:

Facility procedures ensure that changes to the system safety basis requirements, documents, and installed components are adequately integrated and coordinated with those organizations affected by the change.

Approach:

- Determine whether engineering (including the design authority and technical disciplines for process control, electrical, mechanical, chemical, HVAC, nuclear, criticality, structural, etc.), operations, and maintenance organizations are made aware of VSS changes that affect them, and are appropriately involved in the change process, and
- Verify integration and coordination with other organizations that could logically be affected by the change such as facility training, document control, construction, radiological control, occupational safety (OHSA), industrial hygiene, occupational medicine, hazard analysis/safety basis, safeguards and security, and fire protection.

Is the Criterion Met?

Yes

Review Process

Facility Safety Documentation

- Work Control Document for conduct of work by department 6431/6432 personnel or by support organizations outside department 6431/6432 at the nuclear facilities in TA-V, Issue G
- Internal Lease Agreement (ILA) for TA-V, Rev. 3, April 2002
- Facilities Business Unit Job-Site Hazard Evaluation Process Document, April 1998
- Sandia National Laboratories Standard Specification for Mechanical Systems Demonstration, Section15994, January 1991
- Building Equipment Identification, Labeling and PM Assignment guideline Administrative Procedure, Procedure No. AP-018, 2000
- Customer Funded Process – Fixed Price, Rev. 14, May 2002
- Customer Funded Process – T&M, Rev. 4, March 2002
- Facilities Express Process – Rev. 9, February 2001

Interviews Conducted

- Building Manager for 6588
- Project Manager for Facilities Express Projects
- Manager Facilities Engineering: Maintenance Work Control, Project Management ORR,SDD,HAD,NQA-1 Auditing, Risk Assessment
- Planner/Analyst for Facilities Planning Services Team
- ES&H Customer Support, Safety

Discussion of Results

The Discussion of Results section under Configuration Management Criterion 1 describes the change control procedures utilized for the HBVES, CPS, and former GIF Ventilation System.

The Internal Lease Agreement (ILA) sets forth the boundaries and responsibilities between Landlord (Facilities Management and Operations Center, FMOC) and Tenant (TA-V personnel) and defines the services to be provided to the Tenant by the Landlord. This Agreement identifies roles and responsibilities, working relationships, services, negotiated operational constraints, and interfaces with process controls for maintenance and restoration activities. The ILA states, in section 3.2 Tenant Responsibilities that "The Tenant has the responsibility of using a facility within its design basis and of seeking changes to that design basis through established FMOC and corporate business processes." If changes are to be made to the design basis the System Engineer in the FMOC must be involved as the design authority and drawings, in custody of the FMOC, must be as-built to reflect final work conditions. The Work Control Document does not clearly specify the required integration and coordination with the design authority in the FMOC for work activities performed by the personnel in departments 6431/6432.

Work assigned to be performed by personnel outside of 6431/6432 is well documented through a Work Package process that includes a Facility Work Request (FWR). This process defines the hazards and assures integration and coordination with all appropriate organizations. The design authority, operations, and maintenance organizations are aware of changes that affect them and participate in the change process.

Conclusion

No issues, concerns, or findings were identified.

Opportunities for Improvement

Specifically state in the TA-V Work Control Document that the FMOC must be notified and involved as necessary in a change process involving modifications to TA-V facilities. All documents affected by that change shall be as built to reflect final conditions and new equipment shall be entered in the MEL and Maximo database. [OFI-VSS-ACRR-4]

Configuration Management 5-1

Objective:

Changes to safety basis-related requirements, documents, and installed components are controlled.

Criteria:

Software used in VSS I&C components that perform functions important to safety is subject to a software quality process consistent with 10 CFR 830.120.

Approach:

For software used by VSS I&C components, request the facility staff to identify:

- The applicable software quality assurance requirements,
- The software quality assurance standards/controls applied to software development, procurement, acceptance, and testing, and
- The basis for acceptance of these standards/controls as providing adequate assurance that the software is acceptable for performing its associated safety functions.

Is the Criteria Met?

Yes

Review Process

Facility Safety Documentation

- TA-V QA procedure 3-2 Computer Software Control

Interviews Conducted

ACRR Facility Supervisor, Technical Support Engineer, Reactor Supervisor, and QA Coordinator.

An interview plan was developed to evaluate knowledge of the software used in ACRR ventilation system interface, QA requirements, administrative control, change control, acceptance test requirements, and individual implementation responsibility.

Discussion of Results

All personnel were familiar with the requirements for software configuration management and acceptance testing. They were all familiar with the process for maintaining a controlled version of the software. An additional copy of the controlled software is maintained by the TA-V CQA

Coordinator. All personnel were familiar with the Software Modification Request (SMR) process.

Conclusion

No issues, concerns, or findings were identified.

Configuration Management 5-2

Objective:

Changes to safety basis-related requirements, documents, and installed components are controlled.

Criteria:

Software used in VSS I&C components that perform functions important to safety is subject to a software quality process consistent with 10 CFR 830.120.

Approach:

Review software quality assurance requirements, procedures, and records. Determine whether:

- Software quality assurance documentation exists for software in use
- Configuration management procedures exist for updates, changes, and version control of software and related documentation such as software design documents and a list of software configuration items installed on computer-based components
- An appropriate degree of independence exists between those responsible for software development and quality assurance functions, and
- A process is in place and used to identify, evaluate, and resolve operational problems that are attributable to software.

Is the Criteria Met?

Yes

Review Process

Facility Safety Documentation

- ACRR operations pertaining to software configuration control
- Software Modification Report #32, FMR 2001-14 and its associated Control Software Acceptance Test Procedure
- USQD ACRR–240 supporting the FMR for software modification
- TA-V QA procedure 3-2 Computer Software Control

Discussion of Results

All discs were clearly labeled as controlled copies on software. Previous version of the software was marked "inactive". The software used for the HBVES and CPS is part of the ACRR BOP software. The software is not control software but is indication only. There is no software that interfaces with the GIF Ventilation System.

The current version (dated 5/9/01) of the software is documented as version 3.0b. Current versions were located at the console and the controlled backup copies were verified current at the ACRR document control files and in the QA Coordinator files. Independence is evident throughout this process. Each of the documents listed above have at least two people involved.

Conclusion

No issues, concerns, or findings were identified.

Configuration Management 5-3

Objective:

Changes to safety basis-related requirements, documents, and installed components are controlled.

Criteria:

Software used in VSS I&C components that perform functions important to safety is subject to a software quality process consistent with 10 CFR 830.120.

Approach:

Interview facility engineering and operations staff to determine their awareness of software QA requirements for system software under their cognizance.

Is the Criteria Met?

Yes

Review Process

Facility Safety Documentation

- ACRR operations pertaining to software configuration control
- Software Modification Report #32, FMR 2001-14 and associated Control Software Acceptance Test Procedure
- USQD ACRR–240 supporting the FMR for software modification
- TA-V QA procedure 3-2 Computer Software Control

Interviews Conducted

ACRR Facility Supervisor, ACRR Reactor Supervisor, Engineer responsible for the software, and the TA-V Quality Coordinator

Discussion of Results

All of the documents USQD, SMR, Control Software ATP, FWR, and FMR were properly filled out, reviewed, and approved.

Conclusion

No issues, concerns, or findings were identified.

SYSTEM MAINTENANCE

System Maintenance Criterion 1-1

Objective:

The system is maintained in a condition that ensures its integrity, operability, and reliability.

Criteria:

Maintenance processes consistent with the VSS safety classification are in place for prescribed corrective, preventive, and predictive maintenance, and to manage the maintenance backlog.

Approach:

- Verify that maintenance for the VSS satisfies system requirements and performance criteria in safety basis documents or other maintenance requirements.

Is the Criterion Met?

Yes

Review Process

Facility Safety Documentation

- Building Equipment Identification, Labeling and PM Assignment guideline Administrative Procedure, Procedure No. AP-018, 2000
- Safety Analysis Report for the Annual Core Research Reactor (ACRR) Facility, SAND99-3031, 1999
- Maintenance Implementation Plan for Nuclear Facilities
- Site Maintenance Management Program
- Building Equipment Identification, Labeling and PM Assignment Guideline Administrative Procedure, No. AP-018

Interviews Conducted

- Building Manager for 6588
- Project Manager for Facilities Express Projects
- Manager Facilities Engineering
- Planner/Analyst for Facilities Planning Services Team
- ES&H Customer Support, Safety

Discussion of Results

The maintenance-management program is based upon DOE Order 4330.4B, Maintenance Management Program. The program is described in the Nuclear Facility Maintenance Implementation Plan (MIP) and the Site Maintenance Plan.

The HBVES, CPS, and former GIF Ventilation System are programmatic equipment that is defined as SNL property, systems, and equipment used for or supporting specific experiments, research, or programmatic missions. This property is owned and controlled by the Tenants and/or Residents. Corrective, preventive, and predictive maintenance is performed by the Facilities Management and Operations Center (FMOC). Maintenance on equipment items is scheduled and performed according to a work order priority table in the MEL (MAXIMO) database. The priority level assigned to a given item is determined by the criticality of that item to life safety, building and asset protection, and mission accomplishment, and as may be negotiated between the FMOC and the Tenant. The priority level is based upon a graded approach to response times.

Corrective maintenance:

The FMOC Maintenance will support maintenance of programmatic equipment as requested. Each main facility in TA-V will submit an annual Service Order for these activities.

All work performed inside TA-V will be formally evaluated to determine whether the work might impact the nuclear facility. The FBMT performs this evaluation using a graded approach. All work that is identified as having a potential to impact a nuclear facility will interface with the TA-V Nuclear Facility Work Control process. Quality Levels for such work will be assigned by the Tenant representative. Quality Levels for work which does not have the potential to impact a nuclear facility will be assigned by the Building Manager.

Preventive and predictive maintenance:

Premature failure, wear, or general degradation are designed to be prevented by preventive and predictive maintenance activities. Periodic monitoring and assessment of the condition of the system or component are essential elements of a predictive maintenance program. Annual and quarterly work packages are applied to the fan systems as appropriate. The systems engineer is responsible for final decisions regarding equipment history that provides information regarding the need for an incresed level of preventive maintenance or a change in equipment priority. Work packages, issued on a periodic basis, consist of inspections of fan assemblies, checkout of vibration assemblies, bearings, drive pulleys and shaft, and lubrication.

The Equipment Identification, Labeling and Preventive Maintenance Assignment Guideline provides consistent metholology by which a site wide MEL and associated Preventive/Predictive Maintenance activities and frequencies may be initially assigned, modified, or deleted for designated SNL/NM buildings. Maximo is the maintenance management computer program/database that issues and tracks maintenance related work orders. The identification,

prioritization, and establishment of PM actions in Maximo provides the foundation for the execution of all maintenance.

The Systems Engineers perform equipment condition assessments during the building walk downs. Equipment is currently evaluated as being in good, fair or poor condition. This condition is recorded in the equipment module of Maximo. The Building Managers and System Engineers are responsible for periodically performing building walkdowns and assessment of overall building and equipment conditions and identifying any deficient conditions within their responsible facilities. Any identified deficiencies are documented. The Building Managers are responsible for assessing the overall condition of facilities.

Work deferral and backlog of maintenance and repair is tracked via the Maximo maintenance management database. Periodic (normally monthly) reports are generated from information contained in Maximo and distributed to designated SNL personnel.

System operability issues or concerns:

Predictive maintenance is the analysis of trends of measured physical readings against known engineered limits in order to detect and correct equipment problems prior to failure. Data obtained from monitoring the equipment is used to schedule maintenance on an as-needed basis. A baseline measurement of the equipment is taken and compared against future readings in order to detect progressive problems and identify faults that require corrective action. The vibration technologist has not taken vibration readings since 1997 on the HBVES and CPS. Vibrations readings are the key tools needed to monitor equipment and adjust maintenance schedules to minimize equipment wear. The vibration technologist said that a vibration predictive maintenance schedule will be initiated on a quarterly basis. Three reading shall be taken: displacement, acceleration, and velocity.

Conclusion

No issues, concerns, or findings were identified.

Opportunities for Improvement

Initiate predictive maintenance using vibration analysis on the fan systems. [OFI-VSS-ACRR-5]

System Maintenance Criterion 1-2

Objective:

The system is maintained in a condition that ensures its integrity, operability and reliability.

Criteria:

1. Maintenance processes consistent with the VSS safety classification are in place for prescribed corrective, preventive, and predictive maintenance, and to manage the maintenance backlog.
2. The system is periodically walked down in accordance with maintenance requirements to assess its material condition.

Approach:

Evaluate maintenance of aging VSS equipment and components.

- Determine whether there are criteria in place to accommodate aging-related system degradation that could affect system reliability or performance
- Review the plans and schedules for monitoring, inspecting, replacing, or upgrading system components needed to maintain system integrity, including the technical basis for such plans and schedules

Is the Criterion Met?

Yes

Review Process

Facility Safety Documentation

- Building Equipment Identification, Labeling and PM Assignment guideline Administrative Procedure, Procedure No. AP-018, 2000
- Safety Analysis Report for the Annual Core Research Reactor Facility (ACRRF), SAND99-3031, 1999
- Maintenance Implementation Plan for Nuclear Facilities
- Site Maintenance Management Program

Interviews Conducted

- Building Manager for 6588
- Project Manager for Facilities Express Projects
- Manager Facilities Engineering
- Planner/Analyst for Facilities Planning Services Team
- ES&H Customer Support, Safety

Discussion of Results

System degradation:

Condition assessments are performed during building walk downs. Assessments are used to establish a condition baseline against which all future equipment degradation is measured. An analysis of the type, severity, and frequency of corrective maintenance from the Maximo historical logs for the MEL and costs of repair are used to determine whether system reliability or performance is deteriorating. Assignment of priorities, changes to preventative maintenance or predictive maintenance activities, and frequencies may be changed to compensate for observed system degradation based upon historical failure data.

Plans and schedules:

Each fan system has a Job Plan for annual and quarterly preventative maintenance. The User, Building Operator, and Building Manager are notified prior to equipment shutdown and the appropriate lockout/tag out procedures are followed. A formal outage is scheduled with the Building Manager prior to equipment shutdown. An equipment checkout is preformed prior to maintenance. This consists of equipment observation, noting any usual vibration, noise, or imbalance that would indicate the need for additional investigation during service. The fan and bearings are inspected, the housing is exposed to obtain access to the motor, belt, and bearings; the fan is rotated by hand to check for roughness or looseness. All components are inspected for indications of excessive play and the fan and motor are lubricated as required.

On an annual basis the following additional steps are taken: external surfaces are cleaned, drive belts are replaced, inspection of drive pulleys for proper alignment and mounting, pulley internal running surface is inspected for signs of excessive wear using a wear gauge, and belt tension is checked.

Plans and schedules are developed in a meeting attended by planners, systems engineers, building managers, work leaders, craft personnel, and building operators and users. The following items are considered in determining input to plans and schedules: equipment operations and maintenance manuals, equipment sequence of operation, hours of operation, manufacturers recommendations, equipment life, and materials of construction.

Conclusion

No issues, concerns, or findings were identified.

Opportunities for Improvement

A requirement should be added to the Surveillance and Test Procedures for the reactor operator to evaluate historical test reports against the current report to determine if any abnormal trends exist in the airflow, differential pressure, or filter leakage rate that may indicate age-related equipment degradation. [OFI-VSS-ACRR-6]

Establish guidelines for the storage plus in-service life for HEPAs. Failing a leak test or exceeding a pressure-drop limit does not by itself account for a possible age-related decrease in filter strength. A test under normal service conditions does nothing to verify the integrity under design conditions of elevated temperatures and high static pressure drop due to moisture entrainment. Guidelines such as this will help counter age-related system degradation. [OFI-VSS-ACRR-7]

System Maintenance Criterion 1-3

Objective:

The system is maintained in a condition that ensures its integrity, operability, and reliability.

Criteria:

Maintenance processes consistent wit the VSS safety classification are in place for prescribed corrective, preventative, and predictive maintenance, and to manage the maintenance backlog.

Approach:

- Determine whether maintenance source documents such as vendor manuals, industry standards, DOE Orders, and other requirements are used as technical bases for development of system maintenance work packages.

Is the Criterion Met?

Yes

Review Process

Facility Safety Documentation

- Building Equipment Identification, Labeling and PM Assignment guideline Administrative Procedure, Procedure No. AP-018, 2000
- Safety Analysis Report for the Annual Core Research Reactor (ACRR) Facility, SAND99-3031, 1999
- Site Maintenance Management Program
- Maintenance Implementation Plan for Nuclear Facilities
- TA-V Work Control Instruction, Issue G

Interviews Conducted

- Building Manager for 6588
- Project Manager for Facilities Express Projects
- Manager Facilities Engineering
- Planner/Analyst for Facilities Planning Services Team
- ES&H Customer Support, Safety

Discussion of Results

Corrective or Preventive Maintenance work packages are prepared using input from work permits, job site hazard evaluations, ES&H personnel, and systems engineers. All sources provide guidance conforming to the industry standards and DOE Orders. In addition, all

maintenance activities are performed according to Manufacturer's Operation and Maintenance manuals and vendor's manuals, which are prepared in conformance with industry standards. The Systems Engineers are notified automatically via an electronic notification system regarding any maintenance activity in their buildings.

Contracts with just-in-time suppliers require monitoring for suspect parts and notification to Sandia National Laboratories of any known suspect/counterfeit parts. This will provide assurance that installed equipment meets the appropriate industry standards.

Conclusion

No issues, concerns, or findings were identified.

System Maintenance Criteria 2-1 and 2-2

Objective:

The system is maintained in a condition that ensures its integrity, operability and reliability.

Criteria:

1. Maintenance processes consistent with the VSS safety classification are in place for prescribed corrective, preventive, and predictive maintenance, and to manage the maintenance backlog.
2. The system is periodically walked down in accordance with the maintenance requirements.

Approach:

- Verify that the system is inspected periodically according to the maintenance requirements
- On a sample basis, perform a walk-down inspection of the system with emphasis on the material condition of installed equipment, components, and operating conditions
- Identify and document any observed conditions that could challenge the ability of the VSS to perform its safety function (e.g., leaks, cracks, deterioration, or other degraded or abnormal), and
- Determine whether observed deficiencies have been identified and addressed in a facility condition assessment or deficiency tracking system.

Is the Criteria Met?

Yes

Review Process

Interviews were conducted with representatives from the ACRR operations staff, program management, and SNL engineering and maintenance support staff members. The completed walk-through inspection included the essential elements of the interior and exterior exhaust and supply systems for the ACRR, former GIF, and high bay. As a part of the inspection process, operations staff provided detailed information on the operation and maintenance of the ventilation systems, exhaust ducts, HEPA filters, cavity purge charcoal filters and performance and testing procedures for the systems.

Facility Safety Documentation

- Internal Lease Agreement for TA-V
- GIF Material History, dated March 27, 2002
- ACRR Material History, dated March 27, 2002
- ACRR Cavity Purge Ventilation System Valve Lineup, dated April 20, 2000
- High Bay Ventilation Exhaust System, Ventilation Exhaust Drawing, dated May 4, 2000
- All Cleared ESL Entries, dated January 1, 1998 to March 15, 2002

- Maintenance Planning Procedure, Procedure No. OP-013, date July 11, 2000
- Building Equipment Identification, Labeling and PM Assignment Guideline, Administrative Procedure, Procedure No. AP-018, dated December 6, 2001
- Job Plan, 6588 Exhaust Fan GIF Quarterly PM, dated January 29, 2002
- Job Plan, 6588 Exhaust Fan High Bay PM, dated December 29, 2001
- Completed PM's Area V, date of Report April 15, 2002
- Completed CMs Area V, date of Report April 15, 2002
- Ventilation Cavity Purge Flow Rates Filter Efficiencies, Issue date March 21, 2001
- Preventive Maintenance Surveillance Guide, Issue date, October 1, 2001.
- Facility Shutdown Checklist, Issue date May 01, 2002
- Facility Startup List, Issue date, May 01, 2002
- Instruction: Work Control (6431/6432)/Issue G, date January 31, 2002

Interviews Conducted

- Reactor Operator(s)
- Facility Manager
- Systems Engineer
- Facility Maintenance Manager
- Ventilation System Mechanic
- Predictive Maintenance Program Manager
- Ventilation Contractor Coordinator
- Ventilation Assessment Support Contractor

Discussion of Results

A documented process has been implemented to evaluate the maintenance status of ACRR ventilation systems and material conditions on a scheduled time frame. The internal control systems are subject to walk downs by the operations management staff on a daily, monthly and annual basis. In addition, the operating conditions of the facility are evaluated and maintained by staff assigned to the Facility Maintenance Organization. Routine repairs are made based on scheduled Preventative Maintenance criteria for the facility and reported discrepancies noted by the operating staff.

Conclusion

A comprehensive program has been developed and implemented to identify potential maintenance concerns and effect necessary action to correct potential operational concerns.

Opportunities for Improvement

A documented review and verification of the SNL subcontractor's practices and procedures, consistent with specified systems Guidelines and Standards, should be referenced as part of the internal surveillance and assessment program for the ACRR. Specific procedures should be included as part of the contract requirements applicable to the operating guidelines specified for

the subcontractor. Qualification documentation for the designated subcontractor employees should be included as part of the annual certification record for the ventilation systems. [OFI-VSS-ACRR-8]

The PM program, as outlined in "Preventive Maintenance Surveillance Guide", ACRR should reference applicable sections of the following Standards and Guidelines [OFI-VSS-ACRR-9]:

- ANSI N509-1996, Nuclear Power Plant Air-Cleaning Units and Components (ref. section 5.6, Filter Housing)
- ASME N510-1995, Testing of Nuclear Air-Cleaning Systems, (ref. section 10, HEPA Filter Bank In-Place Test, 1989)
- ASME AG-1 Code On Nuclear Air and Gas Treatment-1997 (with Addenda issued in 2000; section TA is for acceptance testing of new systems)
- Heating, Ventilating, and Air-Conditioning Design Guide for Department of Energy Nuclear Facilities. ASHRAE, 1993 (This ASHRAE publication will be incorporated into the 2003 issue of the ASHRAE Handbook- Applications-Chapter 25)
- ERDA 76-21, Nuclear Air Cleaning Handbook (ref. Chapter 8 Testing) Note: This Handbook is currently under revision and update with a final version expected by the years end
- DOE-STD-3020-97, Specification for HEPA Filters Used by DOE Contractors
- DOE Radiological Control Manual, Chapter 4

A "Tracking and Trending" program with goals and performance measures should be implemented for the internal (i.e., ACRR Operating Management) and external (i.e. Facilities) maintenance operations for the ACRR. The documented performance measures should consolidated into a document subject to annual review and update. [OFI-VSS-ACRR-10]

Operating procedures for the ACRR ventilation system should be consolidated into a single document. The consolidated document should include the assignment of specific responsibilities and delineation of required actions necessary to meet the operational requirements for the facility. In addition, consideration should be given to re-writing the documents with the necessary detail and specificity to ensure consistency for all designated operators. Finally, a comprehensive "Compliance Self-Assessment Form (or Checklist)" should be developed and implemented as necessary for the review of the HEPA filter systems. [OFI-VSS-ACRR-11]

A Predictive Maintenance Program should be implemented for the ACRR ventilation system consistent with the ongoing SNL Program. [OFI-VSS-ACRR-12]

System Maintenance Criterion 2-3

Objective:

The system is maintained in a condition that ensures its integrity, operability and reliability.

Criteria:

1. Maintenance processes consistent with the VSS safety classification are in place for prescribed corrective, preventive, and predictive maintenance, and to manage the maintenance backlog.
2. The system is periodically walked down in accordance with maintenance requirements to assess its material condition.

Approach:

Review system or component history files for selected system components for the past three years.

- Identify whether excessive component failure rates were identified, and
- Determine how failure rates were used in establishing priorities and schedules for maintenance or system improvement proposals.

Is the Criteria Met?

Yes

Review Process

Several ACRR documents were reviewed to include Department Instructions and a Master Equipment List.

Facility Safety Documentation

- Department 6521 Instruction, Material History 6521-MMP.II-02, Issue A, dated 6/15/95
- Department 6431/6432 Instruction, Determination of Systems, Structures and Components, 6431/6432-MMP.II-01, Issue B, dated 2/14/98
- Department 6521 Instruction, Facility Maintenance and Surveillance Schedule Development, 6521-MMP.II-03, Issue A, dated 7/3/95
- ACRR Facility Master Equipment List, dated 2/11/02

Interviews Conducted

The Facility Supervisor, a Reactor Supervisor and two Reactor Operators were interviewed.

Discussion of Results

The Material History Instruction requires entries for maintenance activities on Critical/Safety-Related SSCs as categorized on the facility Master Equipment List (MEL).

The Determination of Systems, Structures and Components Instruction address the preparation of the facility MEL. The terminology "Critical/Safety-Related" is not specifically used in this instruction. Therefore, it is not clear what equipment should be monitored in the Material History document.

The Material History Instruction does identify that an annual review is to be performed of the database for trending purposes. The Facility Supervisor stated he performs this review with the assistance of some of the reactor operators. There are no criteria established to identify when a maintenance schedule needs to be modified. The Facility supervisor uses his best judgment, taking into consideration the critical nature of the system and the magnitude of failures.

Conclusion

Component failure rates are adequately reviewed to determine their impact on maintenance or system improvement efforts.

Opportunity for Improvement

There is a minor inconsistency between the Material History Instruction and the Determination of Systems, Structures and Components Instruction. The terminology "Critical/Safety-Related" is used in the Material History Instruction but not in the Determination of Systems, Structures and Components Instruction. The terminology used for implementation of Instructions should be consistent in the facility documentation. [OFI-VSS-ACRR-13]

System Maintenance Criterion 2-4

Objective:

The system is maintained in a condition that ensures its integrity, operability and reliability.

Criteria:

1. Maintenance processes consistent with the VSS safety classification are in place for prescribed corrective, preventive, and predictive maintenance, and to manage the maintenance backlog.
2. The system is periodically walked down in accordance with maintenance requirements to assess its material condition.

Approach:

Review the procedure and process for performing walk downs of the system. Verify through manager and worker interviews that personnel performing walk downs understand operational features, safety requirements and performance criteria for the system.

Is the Criteria Met?

Yes

Review Process

Several ACRR documents were reviewed to include a facility guide, operation checklists, checkouts, and audit forms.

Facility Safety Documentation

- Preventive Maintenance and Surveillance Guide, dated 10/1/01
- Facility Startup Checklist, dated 5/1/02
- Facility Shutdown Checklist, dated 5/1/02
- Pulse Configuration and Pre Operation Checkout, dated 9/25/00
- Post Operation Checkout, dated 9/18/00
- Self Assessment Audit Forms (6521-COO.I-02) dated 4/24/00, 8/31/00, 4/20/01, and 8/23/01

Interviews Conducted

The Facility Supervisor, a Reactor Supervisor and two Reactor Operators were interviewed.

Discussion of Results

According to the Preventive Maintenance and Surveillance Guide, the high bay is to be inspected during the month of April and the Outside (including roofs) is to be inspected in the month of

August. The guide also states, "Pay particular attention to the condition of safety class and safety significant systems, structures and components." These inspections are documented on the Department 6521 Instruction Operations and Maintenance Self Assessment Audit Forms. Four examples of these audit forms were reviewed. The inspections were conducted by qualified reactor operators knowledgeable of the safety significance of each system. The forms were found to be satisfactory.

In accordance with the Internal Lease Agreement, one function of the Facilities Management & Operations Center System Engineers is to conduct building system condition assessments.

The following procedures involve checking the functionality of the ventilation systems but they do not explicitly call for an assessment of material condition.

Facility Startup Checklist, dated 5/1/02
Facility Shutdown Checklist, dated 5/1/02
Pulse Configuration and Pre Operation Checkout, dated 9/25/00
Post Operation Checkout, dated 9/18/00

Conclusion

There are sufficient reviews of the functionality of the safety systems and periodic condition inspections by knowledgeable personnel to ensure the systems are in an acceptable material condition.

SYSTEM SURVEILLANCE AND TESTING

System Surveillance and Testing Criterion 1-1

Objective:

Surveillance and testing of the VSS demonstrates that the system is capable of accomplishing its safety functions and continues to meet applicable system requirements and performance criteria.

Criteria:

1. Requirements for surveillance and testing are adequate for demonstrating overall system reliability and operability, and are linked to the technical safety basis.
2. Surveillance and test procedures confirm that key operating parameters for the overall system and its major components are maintained within operating limits.

Approach:

- Identify the acceptance criteria from the surveillance test procedures used to verify that the VSS is capable of performing its safety functions
- Compare the acceptance criteria with the safety functions, functional requirements, performance criteria, assumptions and operating characteristics discussed in safety documents, and
- Verify that there is a clear linkage between the test acceptance criteria and the safety documentation, and that the acceptance criteria are capable of confirming that safety/operability requirements are satisfied.

Is the Criteria Met?

Yes

Facility Safety Documentation

- ACRR Pulse Configuration Pre-Operational, Pulse, and Balance of Plant procedures
- Material History Log, Maintenance records for cavity purge back to 1996, and
- Facility Startup Instruction

REQUIREMENT	FREQUENCY
SR 4.2.7.1 Verify the OPERABILITY of the High Bay Ventilation System	STARTUP
SR 4.2.7.2 Verify High Bay Ventilation System flow rates and filter differential pressures	ANNUALLY
SR 4.2.7.3 Perform filter efficiency tests on all HEPA filters in the High Bay Ventilation System	ANNUALLY

REQUIREMENT	FREQUENCY
SR 4.2.13.1 Verify the OPERABILITY of the Cavity Purge System	STARTUP on days when the Cavity Purge is required
SR 4.2.13.2 Verify the Cavity Purge is OPERATING for required EXPERIMENTS	Prior to the operation of the EXPERIMENT
SR 4.2.13.3 Verify Cavity Purge System flow rates and filter differential pressures	ANNUALLY
SR 4.2.13.4 Perform filter efficiency tests on all HEPA filters in the Cavity Purge System	ANNUALLY
SR 4.2.13.5 Replace the Cavity Purge charcoal filters	5 years (interval not to exceed 6 years)

Discussion of Results

The procedures listed above implement the LCO requiring the HBVES and CPS to be operational.

The BOP procedure is used in combination with a maintenance procedure from an outside contractor using a prime standard to verify the flow rate. The calibration for the BOP is based on a single point airflow measurement (Nominal airflow in the Normal condition). The HEPA filters are rated at 4,000 cfm. The BOP computer showed approximately 4,000 cfm, but the maintenance check showed the airflow was actually >5,000 cfm. There are a few factors that affect this. The first is that the calibration of the instrument does not verify the BOP flow rate in the emergency mode. It is possible that the instrument or its sensor is not linear over its entire range. The BOP uses a single Pitot tube. The annual calibration makes several measurements over the entire duct.

A second issue may be that the calibration of the BOP instrument is not conducted at the same time as the prime standard measurements are performed. Since this is an annual measurement there is not requirement for these to be made in a contiguous period. The GIF Ventilation System is verified operational daily in the facility startup checklist.

During observation of the semi-annual maintenance, the flow rate was determined to be significantly higher than anticipated (5,300 cfm versus 4,000 cfm) when switched to emergency mode. This exceeds the flow rating for the HEPA filters. During the period of the assessment, the damper position was adjusted to the required airflow.

Conclusion

The LCO surveillance requirements (SRs) are met for operation of the HBVES and CPS.

Opportunity for Improvement

The operation procedure for charcoal replacement involves the replacement of one filter and the transition of the other filter. The bases for the transfer is if it has been in place for greater than three years. If the period is greater than three years for two consecutive replacements, then it will likely exceed 6 years total and violate the TSR LCO SR in the process. The procedure should be updated to replace the filters after thirty months to avoid exceeding 5 years for both changes. [OFI-VSS-ACRR-14]

The material history log is not clear if the LCO is met for the charcoal replacement periodicity. Continued review of historical records showed that one of the filters was changed in 6/13/96. Both filters were changed 3/18/2002. Therefore the LCO SR was met. The material history log should be updated. [OFI-VSS-ACRR-15]

The procedure for the HBVES should not be 5,000 cfm but should be <4,000 cfm. [OFI-VSS-ACRR-16]

System Surveillance and Testing Criterion 2-1 Operations Procedures

Objective:

Surveillance and testing of the VSS demonstrates that the system is capable of accomplishing its safety functions and continues to meet applicable system requirements and performance criteria.

Criteria:

1. Requirements for surveillance and testing are adequate for demonstrating overall system reliability and operability, and are linked to the technical safety basis.
2. Surveillance and test procedures confirm that key operating parameters for the overall system and its major components are maintained within operating limits.

Approach:

Review surveillance and testing procedures for the system's major components. Review a sample of the test results. Perform a walkthrough of the surveillance test procedure with appropriate facility personnel and verify:

- Validity of test results
- System performance meets system requirements
- Performance criteria are appropriate for current facility mission life-cycle
- Parameters that demonstrate compliance with the safety requirements can be measured
- Test personnel are knowledgeable and able to satisfactorily perform the test
- The procedure cites applicable Technical Safety Requirements/Limiting Conditions for Operation
- Limits, precautions, system and test prerequisite conditions, data required, and acceptance criteria are included
- Appropriate data recording provisions are included or referenced and are used to record results
- The procedure includes provisions for listing discrepancies
- The procedure requires timely notification of facility management about any failure or discrepancy that could impact operability, and
- Appropriate personnel reviewed the test results and took appropriate action.

Is the Criteria Met?

Yes

Review Process

Facility Safety Documentation

- Ventilation & cavity purge flow rates & Filter Efficiencies.WPD
- Event Response Operation.wpd
- Preventative Maintenance & Surveillance.wpd
- Balance of Plant.wpd
- Pulse Configuration Pre-Operation Checkout.wpd
- Pulse Operation.wpd
- Steady State Operation.wpd
- Double Pulse Operation.wpd
- TRW Operation.wpd
- Multimode.wpd

Discussion of Results

This is a review of the operations procedures only. See the table below that summarizes the results. Some topics are not applicable for all procedures. The validation of knowledgeable personnel is based on an interview with a reactor operator simulating the required tasks at the ACRR console. Not all procedures were performed during the period of evaluation and are marked accordingly in the table.

Conclusion

The majority of the procedures meet all of the specified criteria. There are a few criteria that are not applicable and there are a few criteria that cannot be evaluated due to the procedures not being performed during the period of the review. The information is consistent between the operations procedures (Steady State, Pulse, Double Pulse, TRW, and multimode.) Due to the similarity between the operation procedures, and the successful completion of the procedures for certain operational modes, it is the opinion of the assessor, that successful operation would occur if the other procedures were performed.

There was some inconsistency in the documentation (i.e., some procedures clearly require the operator to document out of specification results and to notify the reactor supervisor while other procedures are silent on these matters). The requirement to notify the supervisor is documented in the TA-V Conduct of Operations Manual Chapter 2 and in DOE Order 5480.19, but it is not required by the DOE order to be in each procedure. Therefore, this is an issue only from the standpoint of consistency. A similar issue is the method to identify discrepancies.

Table SST-1 Operations Procedures Compared to Criteria 2-1

Procedures Criteria	Ventilation & cavity purge flow rates & Filter Efficiencies.WPD	Event Response Operation.wpd	Preventative Maintenance & Surveillance.wpd	Balance of Plant.wpd	Pulse Configuration Pre-Operation Checkout.wpd	Pulse Operation.wpd	Steady State Operation.wpd	Double Pulse Operation.wpd	TRW Operation.wpd	Multimode.wpd
Validity of test results	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
System performance meets requirements	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Criteria appropriate for facility life-cycle	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Parameters demonstrate compliance measurable	✔	NA	✔	✔	✔	✔	✔	✔	✔	✔
Test personnel are knowledgeable and able to perform test	Not Evaluated	✔	✔	✔	✔	✔	✔	✔	✔	✔
The procedure cites TSRs/LCO	✔	NA	NA	✔	✔	✔	✔	✔	✔	✔
Limits, precautions, system and test prerequisite conditions, data required, and acceptance criteria are included	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

Procedures Criteria	Ventilation & cavity purge flow rates & Filter Efficiencies.WPD	Event Response Operation.wpd	Preventative Maintenance & Surveillance.wpd	Balance of Plant.wpd	Pulse Configuration Pre-Operation Checkout.wpd	Pulse Operation.wpd	Steady State Operation.wpd	Double Pulse Operation.wpd	TRW Operation.wpd	Multimode.wpd
Appropriate data recording provisions are included or referenced and are used to record results	✔	Points to narrative or ops. log	✔	✔	✔	✔	✔	✔	✔	✔
The procedure includes provisions for listing discrepancies	Not Specific	Not Specific	✔	No	✔	✔	✔	✔	✔	✔
The procedure requires timely notification of facility management about any failure or discrepancy that could impact operability	✔ But not necessarily timely	✔	No	✔ But not necessarily timely	✔	✔	✔	✔	✔	✔
Appropriate personnel reviewed the test results and took appropriate action	Not Evaluated	Simulated	✔	Not Evaluated	✔	✔	✔	None performed	✔	None Performed

System Surveillance and Testing Criterion 2-1 Maintenance Procedures

Objective:

Surveillance and testing of the VSS demonstrates that the system is capable of accomplishing its safety functions and continues to meet applicable system requirements and performance criteria.

Criteria:

Surveillance and test procedures confirm that key operating parameters for the overall system and its major components are maintained within operating limits.

Approach:

- Review surveillance and testing procedures for the ventilation system's major components
- Review a sample of the test results, and
- Perform a walkthrough of the surveillance test procedure with appropriate facility personnel.

Is the Criterion Met?

No. The SAR states that the filter systems are periodically tested in accordance with the provisions of ASME N510. Confirmation that the HEPA filter leakage operating parameters for the ventilation systems are maintained within the operating limits defined in the Surveillance and Testing Requirements could not be confirmed because physical limitations of the systems prevented applying ASME N510 in its entirety. The systems were not tested according to the exact letter of the industry standard, ASME N510, because they were not constructed in accordance with ASME N509 and testing procedures using the guidance of ASME N510 had not been developed. ASME N510 can only be applied in its entirety to nuclear air treatment systems designed and built to ASME N509 specifications. The Surveillance and Test Procedures were implemented using the technical guidance contained in ASME N510-1989 and a Laskin-nozzle calculation method. It is possible that the filter in-place leakage parameters met requirements but this could not be confirmed because an upstream measurement of the challenge aerosol was not taken. The following are noteworthy facts and practices:

- The airflow rate and differential pressure tests confirm that these operating parameters meet requirements.
- A sample of the test results showed the HEPA filter bank in-place (leakage or penetration) tests were at least a factor of ten better than the requirement. This adds credibility to the results even though the Laskin nozzle calculation procedure is not referenced in ASME N510.
- During the conduct of this assessment, new procedures were developed that more closely follow the guidance of ASME N510. Minor modifications were made to the fan systems and the new procedures were implemented and retesting of the systems was performed. Measurements of aerosol concentration were taken upstream and downstream of the HEPA filters in accordance with the guidance of ASME N510. The HEPA filter bank in-place leak test results demonstrated that the penetration was within operating limits.

- According to the SAR accident analysis, the filters are not required. Changes have been proposed to the SAR, Technical Safety Requirements, and Surveillance and Testing Procedures to appropriately require the filter tests to conform to the guidance in ASME N510.
- The guidance in ASME N510 was not used to determine the tests required monitoring the condition of the adsorbers nor does the SAR require it.
- Neither the surveillance test procedures nor the test report specify the HEPA filter bank in-place (penetration) test methodology.

Review Process

Surveillance and test procedures for the ACRR HBVES, CPS, and GIF Ventilation System were reviewed. A portion of the tests that were used to determine flow rates, filter leakage, and filter differential pressures were observed as they were conducted by the Testing Certification Technician and the documentation of those test results were reviewed. A review of the surveillance test procedure was performed with the Testing Certification Technician. The technician is a subcontractor to SNL.

Facility Safety Documentation

- Technical Safety Requirements for the Annular Core Research Reactor Facility (TSR)
- Safety Analysis Report for the Annular core Research Reactor Facility (SAR), October 1999
- Ventilation & Cavity Purge Flow Rates & Filter Efficiencies Calibration Procedure (Surveillance and Test Ventilation Procedure) dated 3/21/01
- DOE-STD-3020-97, Specification for HEPA Filters Used by DOE Contractors
- ASME N510-1989, "Testing of Nuclear Air Treatment Systems," American Society of Mechanical Engineers
- ASME N509-1989, "Nuclear Power Plant Air-Cleaning Units and Components." American Society of Mechanical Engineers
- Proceedings of the 25th DOE/NRC Nuclear Air Cleaning and Treatment Conference, August 1998, "ASME N510 Testing of Non-N509 Systems," Jack Jacox
- NSF/ANSI 49-2002, "Class II (laminar flow) biosafety cabinetry"
- "Procedural Standards for Certified Testing of Cleanrooms," Second Edition –1996, NEBB, National Environmental Balancing Bureau
- IES-RP-CC006.2 "Testing Cleanrooms," Institute of Environmental Sciences, April 1995
- IEST-RP-CC034.1 "HEPA and ULPA Filter Leak Tests," Institute of Environmental Sciences and Technology," 1999
- ERDA 76-21, "Nuclear Air Cleaning Handbook," Energy Research and Development Administration
- ASHRAE Design Guide for Department of Energy Nuclear Facilities, 1993
- Sandia National Laboratories Standard Specification 15901, System Component Checkout and Balance
- UCRL-AR-134141, "Maximum HEPA-filter Life," June 1999
- UCRL-AR-133354Rev1, "HEPA Filter and In-place Leak Testing Standard," June 1999

- Assessment of the Potential Vulnerability Due to Degraded High-Efficiency Particulate Air (HEPA) Filters in SNL Nuclear Facilities, May 2000
- ACRR Maintenance Guideline (PrevMaintSurv.doc), dated 10/1/01
- Quality Assurance Program Plan dated 1/11/2002

Interviews Conducted

- Building Manager for 6588
- Reactor Supervisor
- Project Manager for Facilities Express Projects
- Manager Facilities Engineering
- Planner/Analyst for Facilities Planning Services Team
- ES&H Customer Support, Safety
- Testing Certification Technician
- Testing Agency Subcontractor (President)

Discussion of Results

Section "6.2.5 Tests and Inspections" of the SAR states: "Filter systems are periodically tested in accordance with the provisions of ANSI/ASME Standard N510. Testing procedures for the HEPA filters follow the industry standard test." Referencing provisions of ASME N510 for testing HEPA filter systems often results in auditing confusion and problems in demonstrating compliance with requirements. ASME N510 is designed to apply in its entirety to systems designed and built to ASME N509 specifications. It cannot be verified that any of the three HEPA systems conform to ASME N509, therefore by definition, ASME N510 only applies as guidance and as a basis for the development of system specific test programs. Reference to ASME N510 should be clarified to require that the procedures for testing air treatment systems may be developed using this document as guidance.

The ASME N510-1989 test describes in section "10 HEPA Filter Bank In-Place Test," a procedure that requires the injection of a challenge aerosol into the air stream upstream of the HEPA filter bank. Concentrations of the aerosol are determined upstream and downstream of the filter bank and the penetration is calculated from a ratio of the downstream concentration to upstream concentration. The test procedure used by the SNL subcontractor (Certified Testing Technician) did not include a measurement of upstream concentration at a sample port. Instead, an upstream concentration was calculated from the aerosol injection rate and measured airflow. Upstream sampling ports were not available for the former GIF Ventilation System until modifications were made during the course of this assessment. Upstream sampling ports were available in the HBVES and CPS. All systems were successfully retested using new procedures to conform to the guidance in ASME N510.

In the case of the CPS, the Certified Testing Technician indicated the physical configuration of the HEPA housings prevented uniform mixing of the test aerosol in the air stream approaching the HEPA filters. Each HEPA housing has a manifold that collects tubes from the injection port, upstream sampling port, and downstream sampling port. The Certified Testing Technician said that the injection port is so close to the upstream sampling port that a uniform distribution over

the HEPA filter face cannot be obtained. The testing agency subcontractor stated that tests have shown that the aerosol can vary as much as 50% at the upstream sampling port and uniformity is not possible with the physical configuration. The testing agency subcontractor stated that the calculation (instead of measurement) of upstream concentration of test aerosol was the most accurate method to set the 100% baseline on the photometer. However, the guidance in ASME N510 was not strictly followed because the systems were not ASME N509 compliant. It was determined that the manufacturer supplied injection/sample ports could not be field verified to meet the guidance in ASME N510. Using ASME N510 as guidance a new procedure was developed, documented, and implemented. The new procedure used the guidance in ASME N510 by taking measurements of upstream challenge aerosol concentration at sample ports. The upstream HEPA was tested by temporarily removing the mist eliminator and the downstream HEPA was tested by temporarily removing the downstream adsorber. These new test procedures should be included in the ACRR Surveillance and Test Procedure.

The former GIF Ventilation System and HBVES test procedure used by the Certified Testing Technician did not include a measurement of upstream concentration at a sample port. Instead, a concentration was calculated from the aerosol injection rate and measured airflow. The Certified Testing Technician stated that the physical configuration of the HBVES and former GIF Ventilation System would not have prevented execution of the correct tests procedures. The technician said he would implement the Standard N510 procedures in the future, and did so in subsequent tests. New test procedures, using ASME N510 as guidance, were developed and, modifications were made to the GIF system.

One of the key operating parameters associated with the HBVES is the flow rate through the HEPA filters in the emergency mode. This flow rate must be no greater than a nominal 4,000 cfm in order to conform to the HEPA filter manufacturer's certified flow limits and DOE-STD-3020. The performance requirement specification, listed in the Surveillance and Test Ventilation Procedure, for the HBVES in filtered mode is listed as less than or equal to 5,000 cfm. This is equivalent to 1,250 cfm per filter, which is greater than the certified/rated flow of 1,000 cfm. The maximum airflow through the HEPA filter must not exceed its maximum rated flow. The 5,000 cfm upper limit should be changed to 4,000 cfm plus 10% or 4400 cfm. This conforms to the Air Capacity Test acceptance criteria in ASME N510. The flow volume is considered acceptable if the final balancing is within 10% of the nominal design value.

The flow rate through the former GIF Ventilation System must be no greater than a nominal 2,000 cfm in order to conform to the HEPA filter manufacturer's certified flow limits and DOE-STD-3020. The performance requirement specification, listed in the Surveillance and Test Ventilation Procedure, for the GIF system is listed as less than or equal to 2,500 cfm. This is equivalent to 1,250 cfm per filter, which is greater than the certified/rated flow of 1,000 cfm. The maximum airflow through the HEPA filter must not exceed its maximum rated flow. The 2,500 cfm upper limit should be changed to 2000 cfm plus 10% or 2,200 cfm. This conforms to the Air Capacity Test acceptance criteria in ASME N510. The flow volume is considered acceptable if the final balancing is within 10% of the nominal design value.

During observation of the surveillance tests on the HBVES, the center electric damper actuator, which controls two dampers at the face of the HEPA filters, was "binding" upon opening. This

is one of two actuators that divert air through the HEPA filters in the emergency mode. This actuator has since been replaced.

The pressure drop specification for performance criteria in the Surveillance and Test Ventilation Procedure for the HEPA filters in the HBVES and former GIF Ventilation System is set for less than or less than or equal to 1.0 inch wg. Typically pressure drops up to 4 inches of water are allowed before filters are replaced. This allows the filter to run its full economic life. The Testing Certification Technician can compensate for the lower flow rates that may occur due to increased filter drop by adjusting balancing dampers to reduce fan resistance or adjusting fan sheaves to increase the fan rpm to the limit of the motor horsepower. A reasonable upper limit for the pressure drop may be 3 inch wg.

A comparison was made between an earlier surveillance and test report dated January 2001, and the most current report dated March 2002, to determine if any abnormal trends could be discovered in the data that may indicate age-related equipment degradation. In the filtered (emergency mode) the air supply or make-up airflow into the high bay is closed. This isolates the reactor room from the adjoining spaces and enables the high bay to develop the greatest pressure differential with respect to the adjacent areas. The supply dampers are leaking in the closed position and the trend shows an increase in the leakage flow. This is substantiated by a corresponding decrease in the pressure of the high bay relative to the adjacent hallway. However, the high bay is still maintaining a negative pressure with respect to the adjoining spaces and the atmosphere. The surveillance test date confirms that the performance specification for negative pressure is met. Building 6588 staff are aware of this issue and a maintenance work request will be issued to repair/replace the supply dampers to reduce the leakage.

The Surveillance and Test Ventilation Procedure indicates that the cavity purge absorbers (charcoal filters) are to be replaced every 5 years (interval not to exceed 6 years) and differential pressure and airflow measurements are to be obtained annually. ASME N510 provides guidance for developing surveillance tests which monitor the condition of the system. These tests are specified in ASME N510-1989 Table 1, "Tests and Inspections with Recommended Frequencies." The tests are to be conducted periodically at intervals defined by the owner, not to exceed 18 months. The owner must specify which tests shall be employed. If appropriate for reactor operation characteristics, tests equivalent to the guidance in ASME N510 should be considered and included in the Surveillance and Test Procedures.

The Quality Assurance Program Plan (QAPP) addresses the quality assurance program requirements of DOE O414.1A and 10 CFR 830. The Inspection and Acceptance Testing requirement stipulates that the project leader/experimenter specify the inspection methods to be employed. The Surveillance and Test Ventilation Procedure does not specify the test procedure for determining the HEPA filter bank in-place test.

The Project/Experiment Quality Plan (PEQP) for routine work conducted at or for ACRR Facility Operations requires trained and qualified personnel to perform tasks required to meet the quality assurance requirements and safety basis requirements of the facility. An outside contractor is under contract with Sandia National Laboratories to perform filter testing. This

contract does not require periodic review of training and calibration records. The contract should include a quality plan, which requires specific training, periodic review, and specific report format.

A walk through of the surveillance test procedure, conducted on March 2002 was performed with the following results:

Validity of test results:

The filter surveillance leak tests were not performed in accordance with test procedures conforming to the guidance of ASME N510 because the systems were not ASME N509 compliant. The concentration of the upstream challenge aerosol was calculated from a known Laskin nozzle generator output and a measurement of airflow. The guidance in ASME N510-1989, ASME AG-1-1997, and the Nuclear Air Cleaning Handbook ERDA 76-21 2002 Draft, require a measurement of upstream concentration.

System performance meets system requirements:

Initial penetration tests showed a penetration of 0.17% on the upstream HEPA filter in the CPS which failed to meet the 0.02% criteria. The fluid seal was repaired and subsequent tests met specifications. The former GIF Ventilation System initial penetration test showed 0.086%. Specifications were met after gasket repair. The initial airflow measurement of the HBVES indicated a flow 5.4% greater than the maximum allowed. Subsequent adjustment of a balancing damper reduced the airflow to within the specifications. The final test results show conformance with the test specifications, however, since the penetration test procedure did not follow the intent of the required test standard, the penetration performance is questionable. The pressure differentials and flows are within specification limits. Adsorber bank in-place leak tests were not performed so performance cannot be verified.

Performance criteria are appropriate for the current facility mission life cycle:

No. The performance criteria are too stringent for the in-place HEPA tests and the filter differential pressures. The criteria for HEPA filter penetration is 0.02% which is more stringent than the industry standard 0.03%. The criteria for differential pressures across the HEPA filters is generally less than 1 inch wg. This low pressure will not allow the filters to develop their full economic life. The maximum allowable flow rates for the HBVES and former GIF Ventilation System are too high.

Parameters that demonstrate compliance with the safety requirements can be measured:

The Certified Testing Technician stated that the physical configuration of the cavity purge filter housings prevented accurate measurement of the penetration of the HEPA filters. Each HEPA filter is provided with an injection port and upstream and downstream sampling ports. The technician stated that the injection port was too close to the upstream sampling port so that a uniform distribution of challenge aerosol across the HEPA could not be attained. Subsequent testing verified the accuracy of this statement. To compensate, the Technician utilized a

procedure to determine upstream concentration by calculation using the Laskin nozzle calculation method instead of measurement. It is possible to develop a procedure that follows the guidance in ASME N510, which allows measurement of penetration for the upstream HEPA by temporarily removing the mist eliminator and by removing the downstream adsorber to test the downstream HEPA. The downstream adsorber penetration can be measured if the upstream adsorber is temporarily removed while the downstream adsorber is tested, or if modifications are made to the ductwork to assure proper uniform challenge gas flow across the adsorber. Possible modifications are described in the Nuclear Air Cleaning Handbook, ERDA 76-21 section 8.3 Surveillance Testing. The manufacturer, Flanders/CSC stated that the Filter housing ports are certified and capable of satisfying the leak test requirements. However, this could not be demonstrated in the field. Procedures using the guidance in ASME N510 can be developed for the HBVES, CPS and former GIF Ventilation System. Procedures to demonstrate testability should be developed. It is a noteworthy practice that, during this assessment, procedures were being developed in accordance with the guidance in ASME N510.

Test personnel are knowledgeable and able to satisfactorily perform the test:

The Certified Testing Technician has 18 years experience doing tests at SNL in TA-V. He has taken numerous National Environmental Balancing Bureau (NEBB) courses and has formal training in Testing HEPA Filters in Cleanrooms. His company is certified through the NEBB, which places emphasis on cleanroom testing. ASME N510 requires that HEPA and adsorber test personnel demonstrate the competence to satisfactorily perform the specific tests in question by experience and training. The contract with the test agency should be amended to include a quality plan which provides that training be provided to assure job proficiency. The training should be equivalent to the Harvard University School of Public Health In-Place Filter Testing Workshop which is required in DOE-STD-3025-99, "Quality Assurance Inspection and Testing of HEPA Filters," section 9.3 Training.

The procedure cites applicable Technical Safety Requirements/Limiting Conditions for Operation:

Yes

Limits, precautions, system and test prerequisite conditions, data required, and acceptance criteria are included:

Yes

Appropriate data recording provisions are included, or referenced and are used to record results:

Yes

The procedure includes provisions for listing discrepancies:

Yes. There is a Job Comments section in the report that lists any discrepancies and associated remedies.

The procedure requires timely notification of facility management about any failure or discrepancy that could impact operability:

Failures and discrepancies are conveyed verbally at end of test to operators. There is no current written requirement to convey this information in a timely fashion.

Appropriate personnel reviewed the test results and took appropriate action:

Discrepancies were either remedied by the Certified Testing Technician during the test or conveyed to the operations staff in written form under recommendations. Reactor operators are required to review the report and ensure that the report satisfies all requirements of the surveillance procedure.

Conclusion

ASME N510-1989 may be used for technical guidance in developing testing procedures for air treatment systems. This standard provides a basis for the development of test programs. HEPA filter leak test procedures should be developed following the guidance of ASME N510 for non-N509 compliant systems. The owner must specify which tests shall be employed, any required system modifications, and the acceptance criteria for those tests. The filter leak tests did not include an upstream measurement of challenge aerosol, contrary to the guidance of N510. A measurement must be done in order to assess the operability or capability of the filtration system to perform its specified function. Modifications and changes to the testing procedures for the ventilation systems during the course of this assessment permitted testing to more closely follow ASME N510.

If required by the SAR, periodic testing procedures should be developed for the adsorbers in the CPS.

The surveillance test procedures did not specify the filter leak test procedures employed by the Certified Testing Technician.

The contract with the testing agency did not contain a quality plan that specifies training and periodic review of qualifications and procedures used by the Certified Testing Technician.

Opportunities for Improvement

Change the title of the testing procedure document from "Ventilation & Cavity Purge Flow Rates & Filter Efficiencies Calibration Procedure" to "Surveillance and Test Ventilation Procedure" or similar title that more appropriately reflects the intent of the document. The current title does not

reflect all of the systems covered under the test procedures or all of the criteria to be tested. [OFI-VSS-ACRR-17]

Establish guidelines for the storage plus in service life for HEPA filters. Data from HEPA filter Aging Studies (UCRL-AR-134141) indicate that decreases in the tensile strength of dry filter media occur with age and with water exposure. Most DOE nuclear facilities leave HEPA filters in place until they fail a leak test or exceed the pressure-drop limit. This criterion alone will not account for the age-related decrease in filter strength. A test under normal service conditions does nothing to verify the integrity under design conditions of elevated temperatures and high static pressure drop due to moisture entrainment. There are no established standards for replacing HEPA filters based solely on filter age. A SNL study of the potential vulnerabilities due to degradation of HEPA filters concluded that there were no current vulnerabilities. However, a guideline for shelf life and in-service life in years should be developed and published in the Surveillance and Test Ventilation Procedure document along with the date HEPA filters were placed in-service. A conservative approach would indicate that a maximum storage and in-service life for HEPA filters should be 10 years from the date of manufacture of the filters for dry systems and 5 years if the filter could be subject to moisture entrainment. If the manufacturing date is not available the original certification date at the DOE filter test facility may be used. [OFI-VSS-ACRR-18]

Recommend that the BOP control display, indicating flow rates and differential pressures associated with the HBVES and CPS be calibrated with the micro-manometer used by the testing certification technician during the annual testing. The micro-manometer is an extremely accurate instrument that can be used to calibrate other instruments. The readings obtained from the BOP console and locally installed gauges at the fan systems differed from each other and from the micro-manometer readings. A magnehelic at the HBVES measured 0.6 in wg drop across the HEPA filters but the BOP console showed 0.3 inch wg. Consistent instrument readings will allow the timely notification of upset or out of limit conditions, which could affect system performance. [OFI-VSS-ACRR-19]

HEPA filters should be tagged with the date they were installed. It is noteworthy that the operations staff has already added tags to accomplish this. [OFI-VSS-ACRR-20]

Add a statement to the Responsibilities section of the Surveillance and Test Ventilation Procedure document requiring a review of prior reports to identify any trends in the data that may indicate gradual degradation of equipment. Increased static pressure across the filters, decrease in static pressure differential between the reactor room and surroundings, or lower airflow rates may indicate the need for rebalancing of the system or filter replacement. [OFI-VSS-ACRR-21]

Change all references to "HEPA filter efficiency test" to "HEPA filter bank in-place test." The efficiency test refers to a monodisperse aerosol test by manufacturers. The in-place test performed in the field is a polydispersed test, which uses an aerosol with a mean droplet size distribution. [OFI-VSS-ACRR-22]

Update the Surveillance and Test Ventilation Procedure document references as follows: Change NE-F-3-42 to DOE-STD-3022-98; change NE-F-3-43 to DOE-STD-3025-99; change ASME AG-1-1994 to ASME AG-1-1997. [OFI-VSS-ACRR-23]

Local differential pressure instrumentation for the demister in the CPS and HEPA filters in the Cavity Purge and former GIF Ventilation System are required in accordance with ASME N509-1989, Table 4-2. The CPS had such instrumentation in the past so test ports and mounting hardware already exist. The former GIF Ventilation System filters never had instrumentation. [OFI-VSS-ACRR-24]

The 16-inch round exhaust stack for the former GIF Ventilation System had a double cone cap with bird screen. This exhaust cap is not recommended by the Industrial Ventilation Guide, 24th edition, American Conference of Governmental Industrial Hygienists, Figure 5-33. This design deflects air downward, prevents adequate dilution, and reduces effective stack height. A stack head with rain protection characteristics should be installed on the former GIF stack. [OFI-VSS-ACRR-25]

Verify that the flow rates in the ACRR Surveillance and Test Procedure do not exceed the certified flow limits of the HEPA filters. See paragraphs 3 and 4 under Discussion of Results. [OFI-VSS-ACRR-26]

System Surveillance and Testing Criterion 3-1

Criteria:

Instrumentation and measurement and test equipment for the VSS system are calibrated and maintained.

Approach:

For the surveillance and test procedures and records reviewed, determine whether the test equipment used for testing was calibrated.

Is the Criterion Met?

Yes

Review Process

The Surveillance and Test Ventilation Procedure section 6.2 Test Equipment, was reviewed for current calibration records.

Facility Safety Documentation

- Ventilation & Cavity Purge Flow Rates & Filter Efficiencies Calibration Procedure (Surveillance and Test Ventilation Procedure) Issue Date 3/21/01
- ASME N510-1989, "Testing of Nuclear Air Treatment Systems," American Society of Mechanical Engineers
- ERDA 76-21, "Nuclear Air Cleaning Handbook," Energy Research and Development Administration
- ACRR Maintenance Guideline (PrevMaintSurv.doc), Issue date 10/1/01
- Quality Assurance Program Plan dated 1/11/2002

Interviews Conducted

- Testing Certification Technician
- Testing Agency Subcontractor (President)
- Reactor Supervisor

Discussion of Results

The "Surveillance and Test Ventilation Procedure" contains a section, 6.2 Test Equipment, that lists the test equipment by type, manufacturer, model, serial number, and calibration due date. The Photometer and Micro Manometer were listed with calibration due dates. The Procedure was reviewed from a report dated March 2002. All equipment was calibrated. The Laskin nozzle aerosol generator that was used to inject a challenge aerosol upstream of the HEPA filters, for the purpose of testing for penetration, was not listed in the ACRR Surveillance and Test

procedure. A retest, done in September 2002 of the HEPA filter in-place tests, pressure differentials, and flow rates for the exhaust systems used calibrated equipment.

The Quality Assurance Program Plan for the Sandia Research Reactor and Experimental Programs, dated 1/11/2002, states in section "iv. Inspection and Acceptance Testing" the requirement that the program shall "Calibrate and maintain equipment used for inspections and tests." The Laskin nozzle generator does not require annual calibration.

Conclusion

No issues, concerns, or findings were identified.

Opportunities for Improvement

List the Laskin nozzle generator under the Test Equipment in the ACRR Surveillance and Test procedure. [OFI-VSS-ACRR-27]

Additional Resources Reviewed in Support of This Report But Specific to a Given Criteria

- Report on Confinement Ventilation System Assessment at the Idaho National Engineering and Environmental Laboratory (INEEL) New Waste Calcining Facility (NWCF), January 2002
- SNL External Website
- SNL Website: Nuclear Technologies, Radiation Effects, and Radioisotopes
- SNL Radiation Facilities brochure SAND-89-1399, December 1989

APPENDIX B: LESSONS LEARNED FROM ASSESSMENT

The Lessons Learned from the assessment is categorized and itemized as follows:

1. Assessment Team Selection

   The team consisted primarily of DOE and SNL staff. The team selected was comprehensive in the knowledge of the facility and/or assessment processes. The assessment is not the primary task for any of the assessors, which extended the time frame for the assessment. Major resource conflicts with normal duties occurred.

2. Provided Assessments and CRAD

   The information provided on the DNFSB web site and provided by DOE was helpful in defining the report format and expectations.

3. Resource Issues

   The small operations and support staff for TA-V does not lend itself well to having independence. The use of knowledgeable personnel required using the TA-V Facility Representative and the ventilation system engineer as team members in the assessment. Thus, issues raised by the assessment required resolution by assessors.

4. Issue Resolution

   The issue with the ventilation system standard had been raised in CY1998 but not fully drawn to a conclusion. Had the issue been evaluated, the result would have shown that the HEPA filters could not be tested to the standard inferred in the SAR because the system was not built to the applicable standard.

APPENDIX C: BIOGRAPHIES OF TEAM MEMBERS

Norm Schwers – Nuclear Engineer, Facility Engineering and Support Department, Sandia National Laboratories – Assessment Team Lead

Mr. Schwers has 18 years experience in nuclear facility operations, operations management, and training. He is currently a nuclear engineer supporting the SNL TA-V nuclear facilities. He was the former manager of the TA-V nuclear facilities, the reactor manager for the Category B nuclear facilities at the Idaho National Engineering Laboratory (INEL) Test Reactor Area (TRA), and was a certified Shift Manager at the Advance Test Reactor at the INEL. Mr. Schwers is a member of the TA-V facility safety committees. His responsibilities at Sandia include maintaining the Authorization Basis for the Gamma Irradiation Facility, and updating the Authorization Bases for the ACRR Rod Control / Reactor Console Upgrade project. Mr. Schwers has a Master's Degree in Nuclear Engineering. He is the TA-V lead for the several of the responses to DNFSB 2000-2 commitments.

Ray Baca – DOE Albuquerque (Deceased – June 6, 2002)

Ray Baca has a Bachelor of Science degree in Chemical Engineering, a Master of Science degree in Nuclear Engineering, and a Master of Arts degree in History. He has been licensed since 1976 in California as a Registered Professional Engineer in Nuclear Engineering. Mr. Baca was most recently assigned to the AL Environment, Safety, and Health Division. During the past five years, he worked on the Contractor Performance Assessment Program and on authorization basis/safety basis reviews. He also has seven years experience as a Safety Engineer and a Radiological Control Manager with the Office of Transportation Safeguards. Mr. Baca provided guidance in developing and implementing all safety programs for the transportation of hazardous materials. He managed a committee in the impact, thermal, and cargo testing of Safe-Secure Trailer scale models and in preparing a Highway Transportation Safety Analysis Report. Mr. Baca served as an Air Force officer for twenty-one years in missile and nuclear weapon operations, nuclear engineering, radio-environmental programs, and nuclear missile systems acquisition, this included five years experience in monitoring worldwide radio-environmental programs and in managing the associated radiochemical analyses.

Mike Garcia – Health Protection Team Leader, Environment Safety and Health Division, DOE Albuquerque.

Mr. Garcia has a Bachelor of Science Degree in Biology and a Masters of Science Degree in Industrial Hygiene. He has over 25 years of experience in the areas of Industrial Hygiene and Environment, Safety and Health (ES&H) Program management including the design, implementation, management, and oversight of ES&H programs. This experience was acquired from work in both the private and public sectors e.g. General Electric Company, University of California (LANL), U.S. Public Health Service, U.S. Navy and the Department of Energy. A major part of the work experience has been directly related to the development and implementation of health protection programs

including: Occupational Medicine, Industrial Hygiene, Occupational Safety and Health Physics.

While working for the Department of Energy, Mr. Garcia has conducted Health and Safety appraisals and employee concern investigations at the different AL contractor and federal employee work sites. In addition, Mr. Garcia has served as a Readiness Assessment Team Leader for the LANL, Beryllium Technology Facility in October 2000 and Readiness Assessment Team Member on several reviews including readiness reviews at LANL (Tritium Facility) and at WIPP.

Mr. Garcia is a trained Emergency Occurrence Responder for the AL Operations Center. As a Responder Mr. Garcia has provided health related support during reported incidents and has participated in numerous training exercises. Also, as a member of the AL Accident Response Group, Mr. Garcia has participated in training and drills necessary to respond to potential incidents.

Rich Clement – Facility Representative, Office of Kirtland Site Operations, National Nuclear Security Administration

Dr. Richard Clement is currently assigned as the DOE Facility Representative at SNL TA-V Nuclear Facilities – Annular Core Research Reactor (ACRR) Facility, New Gamma Irradiation Facility, and Hot Cell Facility. He received advanced degrees in Health Physics and Industrial Hygiene from the University of Lowell where he was appointed as a national DOE fellow for graduate studies. He is currently enrolled in the Ph.D. Nuclear Engineering program at the University of New Mexico. Dr. Clement has 13 years experience in several areas to include radiation shielding analysis, design, and transport methods; reactor operations; operational health physics; radiological instrument design, testing, calibration and evaluation; safety authorization basis; and neutron and gamma field characterization of radiation assemblies. He has operated three NRC-licensed research reactors with various experimental facilities and was licensed by NRC as a Reactor Operator. Dr. Clement recently participated as a member on the DOE Headquarters review team for the ACRR Documented Safety Analysis. Prior to DOE, he held staff and technical positions at the Massachusetts Institute of Technology, Los Alamos National Laboratory, Rhode Island Atomic Energy Commission/Nuclear Science Center, and the NRC Headquarters where he received NRC's Special Act Award for his significant contribution to the work and mission of the NRC.

Mark Hamilton – Nuclear Facilities Operations Engineer, Office of Kirtland Site Operations, National Nuclear Security Administration

Mr. Hamilton has 15 years of operations management experience, 5 years of which have been with nuclear facility operations. He is currently the Nuclear Facilities Operations Engineer for the Office of Kirtland Site Operations, National Nuclear Security Administration. His current responsibilities include oversight of the nuclear criticality safety and training programs and long term planning at the SNL TA-V Nuclear Facilities. He has also completed Nuclear Power Training with the U.S. Navy, and Phase II Facility

Representative Qualification on two of SNL's TA-V Nuclear Facilities (Sandia Pulsed Reactor, and Gamma Irradiation Facility). He has a Bachelors of Science degree in Nuclear Engineering and is pursuing a Masters Degree in Manufacturing Engineering.

John W. Scott – Systems Engineer, Mechanical Systems, Sandia National Laboratories

Mr. Scott has 26 years experience in mechanical design of building systems including HVAC and exhaust systems. He is a registered professional engineer in the mechanical discipline in four states. Mr. Scott holds a Master of Science degree in mechanical engineering from University of New Mexico and is currently a systems engineer with Sandia National Laboratories. Current responsibilities include providing technical direction for planning efforts and comprehensive site planning issues, project validation, design criteria preparation and project review, providing technical direction to the A/E community and Project Managers, and providing technical expertise and design for projects. Mr. Scott has recently served as the lead mechanical engineer on numerous projects at Sandia National Laboratories, including most recently, the Gamma Irradiation Facility, Auxiliary Hot Cell Facility, Model Validation Building, Moly 99 Hot Cell Facility, and The Sandia Underground Reactor Facility. Prior to joining Sandia National Laboratories he worked in the Architect/Engineering community with Black & Veatch Consulting Engineers in Kansas City and L. Robert Kimbel Consulting Engineering in Pennsylvania in mechanical design for office and institutional facilities.