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Subject: Response to Portion of NRC Request for Additional Information Letter No. 215, Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.4-53

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission Request for Additional Information (RAI) sent by NRC Letter 215, dated June 23, 2008 (Reference 1). The GEH response to RAI Number 9.4-53 is addressed in Enclosure 1.

Should you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

Lee F. Dougherty for

Richard E. Kingston
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 08-550, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 215 Related to ESBWR Design Certification Application,* June 23, 2008.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 215 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.4-53

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Enclosure 1

MFN 08-791

Response to Portion of NRC Request for

Additional Information Letter No. 215

Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Number 9.4-53

NRC RAI 9.4-53

NRC Summary:
Operation of the CONAVS post 72 hours

NRC Full Text:

In Item B of the GEH response to RAI 14.3-221, statements are made about the operation of the CONAVS post 72 hours to clean up the contamination in the contaminated area of the building and release it through filters to the stack which is monitored. This is an unanalyzed condition since the release path through the non-safety related CONAVS and filters to the stack have not been considered in the design basis analysis. The impact would be a clean up of the reactor building contaminated area but may increase dose to the CR operators to the point at which it exceeds the GDC 19 Control Room Habitability limit.

A. The CONAVS filter system as stated in the DCD is a 10,170 cfm system. Is this the total flow that would be released to the stack? How does GEH intend to assure that the non-safety nominally 99% efficient filters have not been depleted by normal operation prior to being used in the accident exhaust mode? If the filters are depleted by 10%, approximately 1000 cfm unfiltered flow would be released to the stack. This is over three times the release from the reactor building contaminated area assumed in the design basis analysis. At this flow rate, the contaminated air in the contaminated area would be rapidly exhausted with very little hold up. Please specify the conditions under which the CONAVS would be operation prior to the end of the 30 day post accident period and provide an analysis that would show that limits for the control room, EAB and LPZ would not be adversely impacted or exceeded.

B. The CONAVS filters are stated to be located in the RB. Are they located in the contaminated portion of the RB and has appropriate shielding or isolation been provided to protect personnel in the event these filters become radiologically hot?

C. In the DCD Revision 5, Section 9.4.6 under detailed system description, 2nd paragraph, the CONAVS is described as "once through ventilation system." Later in the same paragraph it is stated that the "Reactor Building HVAC Purge Exhaust Filter Unit (the redundant one is in standby) can be energized to partially recirculate and partially exhaust the space air in the CONAVS area." Please clarify the different modes of operation for the CONAVS. If pneumatic dampers are used to adjust flow rates, is the instrument air system RTNSS qualified. Is the CONAVS system RTNSS qualified?

D. In the response to RAI 6.2-140 S01, in reference to making a cross tie between RWCU and FAPCS suctions and discharges, credit is taken for operating the CONAVS to clean up the contaminated portion of the RB atmosphere and specific efficiency requirements for the RB Purge/Exhaust Recirculation filter units. Please provide your basis for claiming that the filters are still performing at their design efficiency rate (99%) at the time the cross tie is being made (post seven days) and show by analysis that the CR operator doses do not exceed GDC 19 limit for the 30 days following a LOCA. This analysis should include any leakage to the RB from operating the RWCU/FAPCS crosstie flow path in addition to leakages from the primary through the containment penetrations and the concentrated contaminants in the contaminated area due to leakage prior to the crosstie being made. Is the CONAVS RTNSS qualified including fans and filters? RTNSS qualification is necessary since the system is being used as an atmospheric clean up system and is necessary to support the design basis accident analysis for the 30 days following a LOCA. How much time and what actions are required to make the crosstie connections? What dose are the operators who make this cross tie expected to receive?

<u>**GEH Response**</u>

A. The CONAVS filter system as stated in the DCD is a 10,170 cfm system. Is this the total flow that would be released to the stack?

How does GEH intend to assure that the non-safety nominally 99% efficient filters have not been depleted by normal operation prior to being used in the accident exhaust mode? If the filters are depleted by 10%, approximately 1000 cfm unfiltered flow would be released to the stack. This is over three times the release from the reactor building contaminated area assumed in the design basis analysis. At this flow rate, the contaminated air in the contaminated area would be rapidly exhausted with very little hold up. Please specify the conditions under which the CONAVS would be operation prior to the end of the 30 day post accident period and provide an analysis that would show that limits for the control room, EAB and LPZ would not be adversely impacted or exceeded.

Response A:
The total Reactor Building (RB) Purge Exhaust Filter flow provided in DCD Tier 2 Table 9.4-11, RB Purge Exhaust Filter Unit, of 10,170 cfm, would not be released to the stack during a LOCA. During normal (online) operation, the filter unit could be aligned to discharge 10,170 cfm to the stack.The configuration of the RB Purge Exhaust Filter Units will be revised (as shown on attached markups) to address both accident and online filtration functions. Each of the RB Purge Exhaust Filter Units will be split into two separate assemblies. The Reactor Building HVAC Accident Exhaust Filter Unit will be one assembly rated at a nominal 1,000 cfm, as this accident filter assembly will be used exclusively for

accident exhaust / negative pressure control (exhausting air from the reactor building). The other assembly, identified as the Reactor Building (RB) HVAC Online Purge Exhaust Filter Unit, is rated at the nominal 10,170 cfm. The Reactor Building (RB) HVAC Online Purge Exhaust Filter Unit will be used for all other filter design functions (online cleanup, purge operation filter assembly). During an accident, with the RB isolated, the Reactor Building Accident Exhaust Filter Unit will be operated post 7 days when electrical power is credited to be restored. This filter train (nominal 1,000 cfm with variable speed drive) will be used to draw a minimum negative pressure of 62 Pa (-1/4 inch W.G.) from the CONAVS portion of the reactor building exhausting to the stack. Although the Reactor Building Accident Exhaust Filter Unit draws from only the filter train area, the interconnecting ductwork throughout the CONAVS area ensures that this vacuum can be maintained in all the areas served by CONAVS. While the Reactor Building Accident Exhaust Filter Unit will be operated through the 30 day period, it will be placed in service when the FAPCS & RWCU/SDC crosstie is placed in service. Manually placing the FAPCS & RWCU/SDC crosstie into service is required to bring the plant to a cold shutdown following a LOCA as described in RAI 6.2-140S01 (MFN 08-332). Only at this time will the additional radiation source term be present which would require operation of the Reactor Building Accident Exhaust Filter Unit. The Reactor Building HVAC Online Purge Exhaust Filter Unit is not credited for any accident scenario. It will have a recirculation cleanup capability, which could be employed post accident, but is not credited.

To ensure that the designated Reactor Building HVAC Accident Exhaust Filter Units are not excessively depleted prior to being used in the accident mode, run time / hour meters are employed. Run time tracking with periodic testing ensures that the accident filter assembly has adequate margin so minimum capture efficiency is assured. This design feature is identical to that used for existing operating BWR Standby Gas Treatment System monitoring / control to ensure that limits for the Control Room, EAB and LPZ meet the charcoal efficiency assumptions used in the dose analysis. Design, inspection and testing of the Purge Exhaust Filter assemblies (both accident and online cleanup) will be performed per RG 1.140. The design for the Reactor Building HVAC ("Accident" and "Online Purge") Exhaust Filter Units will be detailed in DCD Section 9.4.6, Rev. 6 as per the attached DCD markup.

A dose analysis was performed using the same methodology applied in the LOCA dose analysis (DCD Tier 2, Section 15.4.4). The dose analysis considered leakage to the RB from operating the FAPCS & RWCU/SDC crosstie flow path, leakage from the primary containment through the containment penetrations as well as the concentrated contaminants in the contaminated area due to leakage prior to bringing the FAPCS & RWCU/SDC crosstie into service. The analysis evaluated RWCU crosstie operations beginning at 72 and 168 hours after the event with an assumed RWCU leak rate of 1 gpm and credited the RB filter units as functioning when the cross-tie operations start. The analysis assumed a 95% charcoal efficiency and a 99% HEPA efficiency. The analysis demonstrated that doses from the crosstie operation crediting the RB filter units and an assumed RWCU leakage rate of 1 gpm did not exceed the CR and offsite doses listed in DCD Revision 5, Tier 2 Table 15.4-9.

B. The CONAVS filters are stated to be located in the RB. Are they located in the contaminated portion of the RB and has appropriate shielding or isolation been provided to protect personnel in the event these filters become radiologically hot?

Response B:
The Reactor Building HVAC Exhaust Filter ("Accident" and "Online Purge") Units are located in the CONAVS (contaminated) area of the RB (Room 1600) on the 13570 el. The specific location of the filter units has been provided in the response to RAI 12.4-23 S01 (MFN #08-429). This RAI response also states that no maintenance is expected on these filters for the duration of the accident. Other information regarding these filter units in terms of radiation protection is provided in DCD Revision 5, Tier 2, Subsection 12.3.3.3.

C. In the DCD Revision 5, Section 9.4.6 under detailed system description, 2nd paragraph, the CONAVS is described as "once through ventilation system." Later in the same paragraph it is stated that the "Reactor Building HVAC Purge Exhaust Filter Unit (the redundant one is in standby) can be energized to partially recirculate and partially exhaust the space air in the CONAVS area." Please clarify the different modes of operation for the CONAVS. If pneumatic dampers are used to adjust flow rates, is the instrument air system RTNSS qualified. Is the CONAVS system RTNSS qualified?

Response C:
The Reactor Building HVAC Exhaust Filter Units associated with CONAVS support several different modes of operation. The Reactor Building HVAC Exhaust Filter Units consist of an "Online Purge" and an "Accident" filter assembly (as described above) with two (2) trains provided.
The Reactor Building HVAC Accident Filter Units are designed for:

- ✓ Accident Negative Pressure Control

The Reactor Building HVAC On-Line Purge Filter Units are designed for:

- ✓ Drywell Purge Operation
- ✓ On-line clean-up of a specific CONAVS or REPAVS floor area during periods of high radioactivity
- ✓ Cleanup recirculation

There are NO pneumatic dampers associated with either the "accident" or "online purge" RB HVAC Exhaust Filter Units. The exhaust filter unit's discharge and recirculation dampers are to be supplied with motorized dampers. The entire CONAVS subsystem is not RTNSS. As shown, The Reactor Building HVAC Accident Exhaust Filter Units servicing CONAVS areas are RTNSS "E" as indicated on the attached markups of DCD Tier 2, Chapter 19, 19A.8.4.11 and Table 19A.

D. In the response to RAI 6.2-140 S01, in reference to making a cross tie between RWCU and FAPCS suctions and discharges, credit is taken for operating the CONAVS to clean up the contaminated portion of the RB atmosphere and specific efficiency requirements for the RB Purge/Exhaust Recirculation filter units. Please provide your basis for claiming that the filters are still performing at their design efficiency rate (99%) at the time the cross tie is being made (post seven days).

As stated in Response A above, to ensure that the Reactor Building HVAC Accident Filter Exhaust Unit filters are not depleted prior to being used in the accident mode, run time / hour meters for these units are employed. This will ensure that the filters are performing at the design efficiency at the time the cross tie is being made (post seven days). Run time tracking with periodic testing ensures that the filter trains have adequate margin so minimum capture efficiency is assured. This design feature is identical to that used for existing operating BWR Standby Gas Train control to ensure that the ESBWR dose analysis for the Control Room, EAB and LPZ are within limits. Periodic testing of the RB Purge/Exhaust Recirculation Filter Units will be performed to meet the guidance and requirements of RG 1.140 and ASME AG-1 for HEPA and carbon filter efficiency. RG 1.140 does not include a charcoal filter laboratory test interval so a limit of 1440 hours between tests will be established and included in the Availability Control Manual (See DCD markup of Chapter 19, ACM 3.7.5 and DCD markup of Section 9.4.6.4). This limit is 2 times the time frame specified in RG 1.52 for laboratory testing (RG 1.52 S7.2) and is deemed a reasonable test interval for this application. As stated above, the efficiency of the charcoal will be credited at 95% (HEPA efficiency 99%) as assumed in the dose analysis. DCD Revision 6 will reflect the above discussion. Additionally, the periodic testing of these Reactor Building HVAC Accident Exhaust Filter Units will be performed monthly by running them for 15 minutes, as is recommended in RG 1.52 Rev. 3.

Show by analysis that the CR operator doses do not exceed GDC 19 limit for the 30 days following a LOCA. This analysis should include any leakage to the RB from operating the RWCU/FAPCS crosstie flow path in addition to leakages from the primary through the containment penetrations and the concentrated contaminants in the contaminated area due to leakage prior to the crosstie being made.

A dose analysis was performed using the same methodology applied in the LOCA dose analysis (DCD Tier 2, Section 15.4.4). The analysis considered leakage to the RB from operating the FAPCS & RWCU/SDC crosstie flow path, leakage from the primary containment through the containment penetrations as well as the concentrated contaminants in the contaminated area due to leakage prior to bringing the FAPCS & RWCU/SDC crosstie into service. The analysis evaluated RWCU crosstie operations beginning at 72 and 168 hours after the event with an assumed RWCU leak rate of 1 gpm and credited the RB filter units as functioning when the cross-tie operations start. The analysis assumed a 95% charcoal efficiency and a 99% HEPA efficiency. The analysis demonstrated that doses from the crosstie operation crediting the RB filter units and an assumed RWCU leakage rate of 1 gpm did not exceed the CR and offsite doses listed in DCD Revision 5, Tier 2 Table 15.4-9.

Is the CONAVS RTNSS qualified including fans and filters? RTNSS qualification is necessary since the system is being used as an atmospheric clean up system and is necessary to support the design basis accident analysis for the 30 days following a LOCA.

The Reactor Building HVAC Accident Exhaust Filter Unit operation of the CONAVS subsystem is RTNSS "E" as stated in DCD, Revision 5, Tier 2, Appendix 19A8.4.11. These Reactor Building HVAC Accident Exhaust Filter Unit filters must maintain the required filtering efficiency to ensure that control room doses are not exceeded for certain beyond design basis LOCAs. Failure to provide adequate filtration is considered to be an adverse system interaction. These RTNSS components are subject to regulatory oversight as outlined in the Availability Controls Manual. The required surveillances will assure that the RB HVAC Accident Exhaust Filter Units are capable of performing their RTNSS function. These surveillances include the fans, filters, and dampers associated with the filter trains. The RB HVAC Online Purge Exhaust Filter Units are not classified as RTNSS.

How much time and what actions are required to make the crosstie connections? What dose are the operators who make this cross tie expected to receive?

DCD Tier 2, Revision 5, Subsection 12.3.6 addresses the above questions: "The RWCU valve room may be accessed to rotate flange cross-tie from RWCU to the FAPCS suction and discharge lines to the suppression pool as described in Subsection 5.4.8. Exposures have been evaluated without credit for filtered ventilation, and a 30 minute mission time is feasible after 12 days. If the CONAVS system is operated, as described in Section 9.4, the 30-minute mission could be achieved earlier than 12 days." The dose criterion of 0.5 Sv (5 rem) provided in GDC 19 was used.

DCD Impact

DCD 19A8.4.11 and Table 19A-2 is being updated under Revision 6 to clarify that the Reactor Building HVAC Accident Exhaust Filter Units will be classified RTNSS versus the Online Purge Exhaust Filter Units, which are not classified RTNSS.

DCD Section 9.4.6 is being updated under Revision 6, as attached, to describe the Reactor Building HVAC "Accident" and "Online Purge" Exhaust Filter Unit information.

DCD Figure 9.4-10 is being updated under Revision 6 to include the Reactor Building HVAC "Accident" and "Online Purge" Exhaust Filter Unit information.

DCD Table 9.4-11 is being updated under Revision 6 with Reactor Building HVAC "Accident" and "Online Purge" Exhaust Filter Unit information.

DCD Chapter 19, ACM 3.7.5 are being updated under Revision 6, as attached, to include details on testing and operation of the Reactor Building HVAC Accident Exhaust Filter Units.

DCD Tier 1, subsection 2.16.2.1, Table 2.16.2-2, and Figure 2.16.2-2 are being updated under Revision 6 to include the write-up, tests, and figure addressing the addition of the Reactor Building HVAC Accident Exhaust Filter Units.

(11) The Reactor Building HVAC Online Purge Exhaust Filters are tested to meet RG 1.140 and ASME AG-1 requirements for HEPA and carbon filter efficiency.

(12) The Reactor Building HVAC Accident Exhaust Filters maintains the CONAVS served areas of the reactor building at a minimum negative pressure of 62 Pa (-1/4 inch W.G.) relative to surrounding clean areas when operating. The Reactor Building HVAC Accident Exhaust Filters are tested to meet RG 1.140 and ASME AG-1 requirements for HEPA and carbon filter efficiency.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.16.2-2 provides the design commitments, inspections, tests, analyses and acceptance criteria for the RBVS system.

2.16.2.2 Control Building HVAC System

Design Description

The Control Building HVAC consists of two independent subsystems. The Control Room Habitability Area HVAC Subsystem (CRHAVS) serves the MCR and associated areas bounded by the Control Room Habitability Area (CRHA) envelope. The Control Building General Area HVAC Subsystem (CBGAVS) serves the areas inside the Control Building but outside the CRHA. Table 2.16.2-3 lists the major Control Building HVAC system safety-related components.

Both of these subsystems are nonsafety-related except for that portion of the CRHAVS that forms the CRHA boundary envelope, and the CRHAVS Emergency Filter Units (EFU) and associated components, which are safety-related. This safety-related CRHA boundary envelope consists of the CRHA structure, doors, penetrations, redundant boundary isolation dampers, valves, and that portion of transition ductwork, piping, or tubing that is located between the CRHA boundary structure and the redundant CRHA isolation dampers or valves. The CRHA isolation dampers are the major components discussed in this Subsection. Additional systems, structures, and components (such as EFUs) that are necessary for habitability are discussed in other subsections.

The mechanical cooling of the Control Building General Areas and the CRHA is not provided as a safety-related function during a CRHA boundary isolation. Passive means of limiting CRHA and general area temperature rise to acceptable levels have been provided by the ESBWR design for the first 72-hours.

The CRHAVS serves the MCR and associated support areas during normal plant operations, plant start-up and plant shutdown and is shown in Figure 2.16.2-4. The CBGAVS serves the areas outside the CRHA and is shown in Figures 2.16.2-5a and 2.16.2-5b.

(1) The functional arrangement of the CRHAVS is as described in the Design Description of this Subsection 2.16.2.2 and is as shown in Figure 2.16.2-4.

(2) The CRHA isolation dampers automatically close upon receipt of any of the following signals:

a. high radiation in the CRHAVS intake;

Table 2.16.2-2

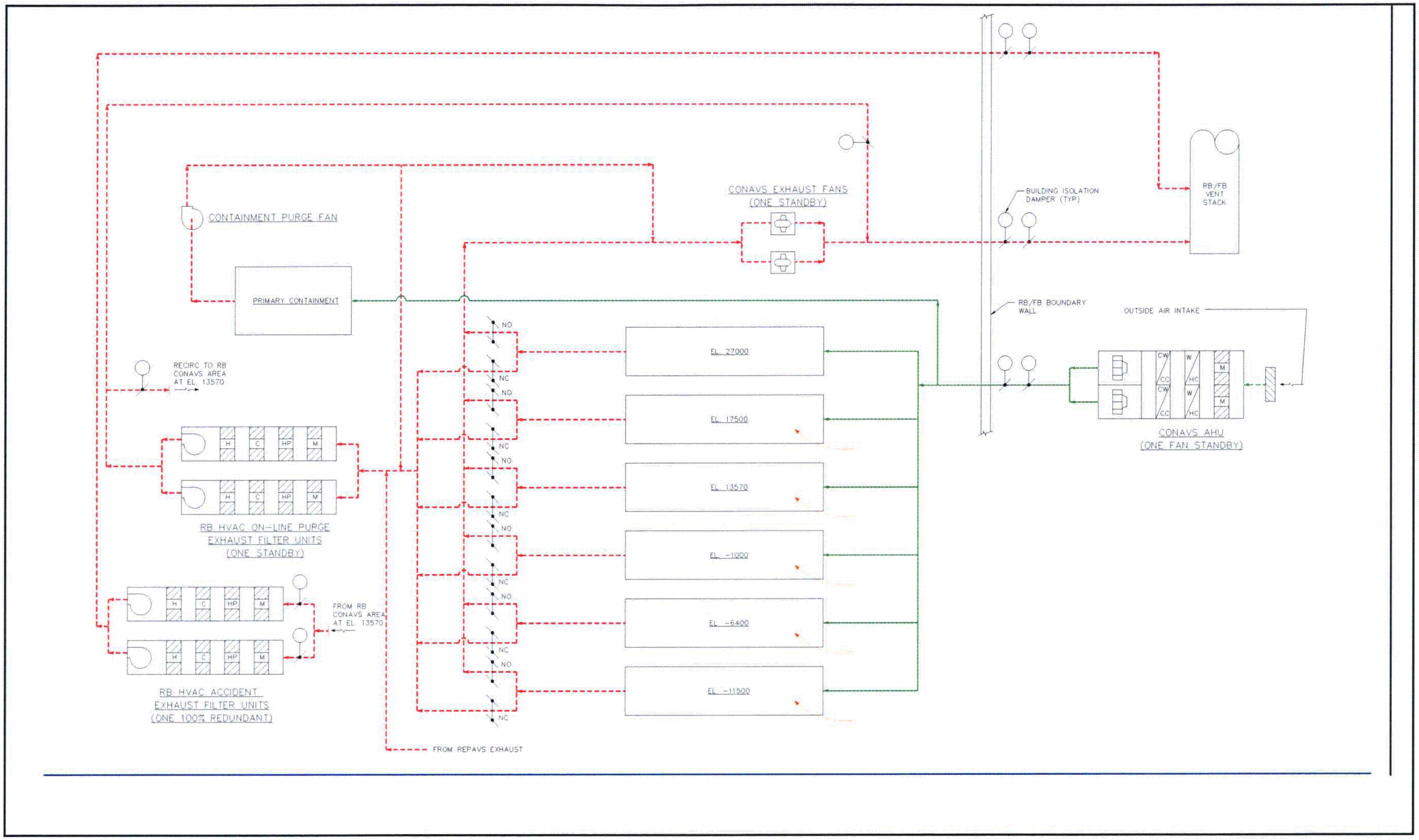
ITAAC For The Reactor Building HVAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. Independence is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment.	a) Tests will be performed on the RBVS dampers by providing a test signal in only one safety-related division at a time. b) Inspection of the as-built safety-related divisions in the system will be performed.	a) Test reports ~~document~~ <u>conclude</u> that the test signal exists only in the safety-related division under test in the as-built RBVS damper. b) Inspection reports ~~document~~ <u>conclude</u> that physical separation or electrical isolation exists between as-built RBVS dampers. Physical separation or electrical isolation exists between safety-related divisions and nonsafety-related equipment.
10. RBVS software that controls the safety-related RBVS components is developed in accordance with the software development program described in Section 3.2.	See Section 3.2.	See Section 3.2.
11. The Reactor Building <u>HVAC Online</u> Purge Exhaust Filters meet RG 1.140 and ASME AG-1 requirements for HEPA and carbon filter efficiency	Each charcoal adsorber will be tested in accordance with RG 1.140. HEPA filters will be tested in accordance with ASME AG-1, Section FC.	Test report(s) ~~document~~ <u>exist and conclude</u> that the as-built R<u>eactor</u> B<u>uilding</u> <u>HVAC Online</u> Purge Exhaust filter efficiency meet the acceptance criteria for in place testing in accordance with RG 1.140 and ASME AG-1.

Table 2.16.2-2

ITAAC For The Reactor Building HVAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
12a. The Reactor Building HVAC Accident Exhaust Filters maintains the CONAVS served areas of the reactor building at a minimum negative pressure of 62 Pa (-1/4 inch W.G.) relative to surrounding clean areas when operating.	a. Testing will be performed to confirm that the Reactor Building HVAC Accident Exhaust Filters maintain the CONAVS area at a minimum negative pressure of 62 Pa (-1/4 inch W.G.) relative to surrounding clean areas when operating each filter train.	a. Test report(s) exist and conclude that the time average pressure differential in the as-built CONAVS served areas of the reactor building as measured by pressure differential indicators is minimum negative pressure of 62 Pa (-1/4 inch W.G.).
12b. The Reactor Building HVAC Accident Exhaust Filters meet RG 1.140 and ASME AG-1 requirements for HEPA and carbon filter efficiency.	b. The Reactor Building HVAC Accident Exhaust Filters meet RG 1.140 and ASME AG-1 requirements for HEPA and carbon filter efficiency.	b. Test report(s) exist and conclude that the as-built RB HVAC Accident Exhaust filter efficiencies meet the acceptance criteria for in place testing in accordance with RG 1.140 and ASME AG-1


CONTAINMENT PURGE FAN
CONAVS EXHAUST FANS (ONE STANDBY)
BUILDING ISOLATION DAMPER (TYP)
RB/FB VENT STACK
PRIMARY CONTAINMENT
RB/FB BOUNDARY WALL
OUTSIDE AIR INTAKE
RECIRC TO RB CONAVS AREA AT EL. 13570
EL. 27000
EL. 17500
EL. 13570
EL. -1000
EL. -6400
EL. -11500
NO
NC
CONAVS AHU (ONE FAN STANDBY)
RB HVAC ON-LINE PURGE EXHAUST FILTER UNITS (ONE STANDBY)
FROM RB CONAVS AREA AT EL. 13570
RB HVAC ACCIDENT EXHAUST FILTER UNITS (ONE 100% REDUNDANT)
FROM REPAVS EXHAUST

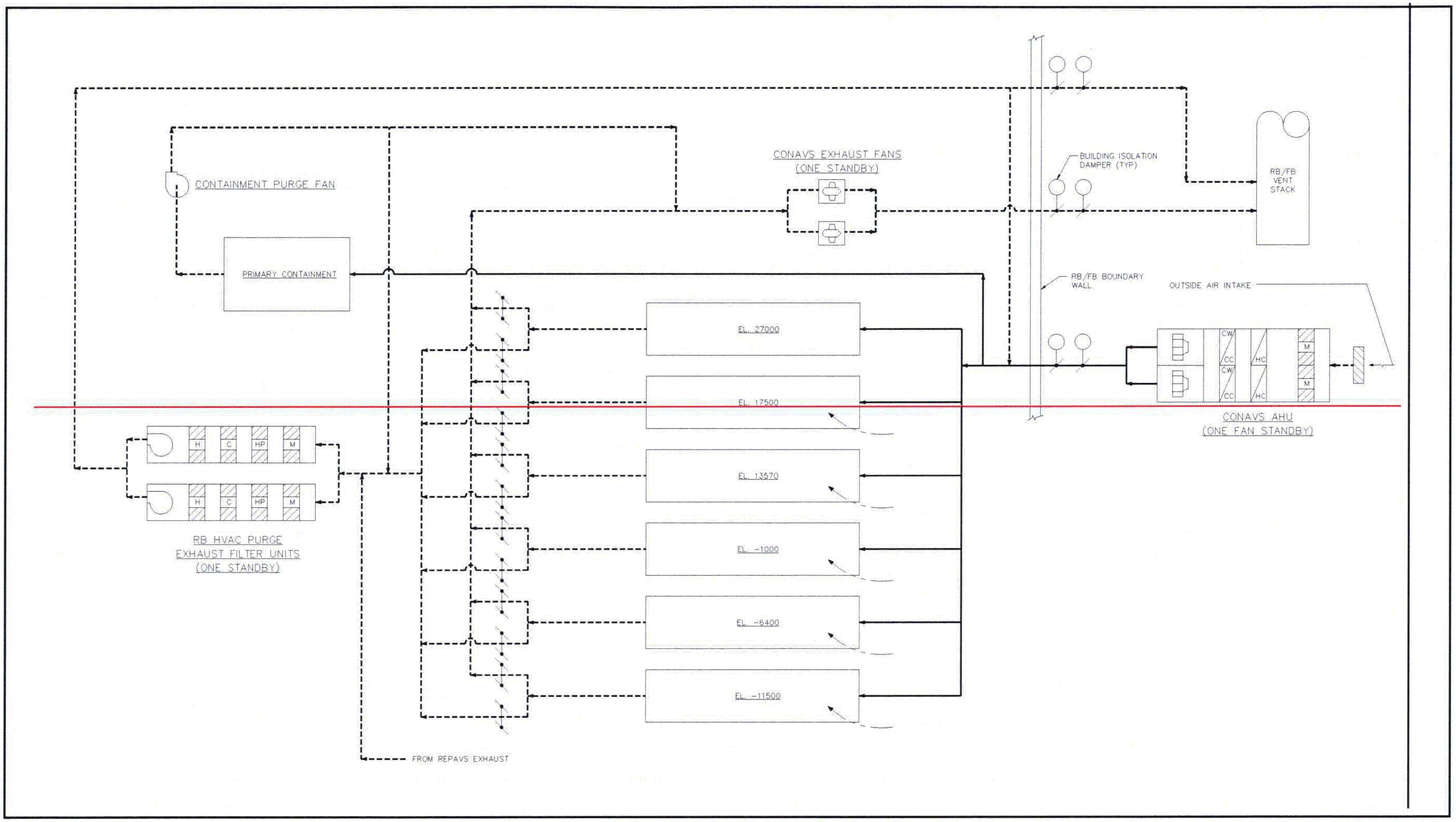


Figure 2.16.2-2. CONAVS Functional Arrangement Diagram

19ACM AVAILABILITY CONTROLS MANUAL

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ACM 3.7 PLANT SYSTEMS

AC 3.7.5 Reactor Building HVAC ~~Purge~~ Accident Exhaust Filtration

ACLCO 3.7.5 Two Reactor Building HVAC ~~purge~~ Accident ~~e~~Exhaust ~~f~~Filtration trains shall be AVAILABLE.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One Reactor Building HVAC ~~purge~~ Accident ~~e~~Exhaust ~~f~~Filtration train unavailable.	A.1 Restore Reactor Building HVAC ~~purge~~ Accident ~~e~~Exhaust ~~f~~Filtration train to AVAILABLE status.	14 days
B. Two Reactor Building HVAC ~~purge~~ Accident ~~e~~Exhaust ~~f~~Filtration trains unavailable.	B.1 Restore one Reactor Building HVAC ~~purge~~ Accident ~~e~~Exhaust ~~f~~Filtration train to AVAILABLE status.	24 hours
B. Required Action and associated Completion Time not met.	B.1 Enter ACLCO 3.0.3.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
ACSR 3.7.5.1	Operate each Reactor Building HVAC purge Accident eExhaust fFiltration train for ≥ 10 15 continuous hoursminutes.	31 days
ACSR 3.7.5.2	Perform Reactor Building HVAC Accident Exhaust fFiltration unit testing in accordance with Section 9.4.6.4.	In accordance with Section 9.4.6.4

ACM B 3.7 PLANT SYSTEMS

AC B 3.7.5 Reactor Building HVAC Purge Accident Exhaust Filtration

BASES

Contaminated Area HVAC subsystem (CONAVS) includes redundant Reactor Building HVAC Accident and Online pPurge eExhaust Filtrationfilter units and exhaust fans (i.e., trains). During radiological events, exhaust air from contaminated areas may be manually diverted through the Reactor Building HVAC Accident or Online Purge Exhaust Filter Filtration Uunits. The Reactor Building Accident and Online pPurge eExhaust Filtrationfilter units are equipped with pre-filters, HEPA filters, high efficiency filters and carbon filters for mitigating and controlling gaseous effluents from the Reactor Building. After LOCA, one Reactor Building HVAC Purge Accident Exhaust FiltrationFilter Unit (the redundant one is in standby) can be energized to partial re-circulate and partial exhaust the space air in the CONAVS area.

This accident function is a nonsafety-related function that provides building negative pressure control and exhaust filtering efficiency to ensure that theoretical control room doses are not exceeded for certain beyond design basis LOCAs. Failure to provide adequate filtration is considered to be an adverse system interaction, and therefore satisfies the criteria for Regulatory Treatment of Non-Safety Systems, and therefore enhanced regulatory oversight is provided. The short-term availability controls for this function, which are specified as Completion Times, are acceptable to ensure that the availability of this function is consistent with the functional unavailability in the ESBWR PRA. The surveillance requirements also provide an adequate level of support to ensure that component performance is consistent with the functional reliability in the ESBWR PRA.

evaluations of the supported systems. The Availability Controls Manual addresses degraded or lost support systems in the context of the supported functions. No explicit availability controls are supplied for these support systems. In addition, performance monitoring of RTNSS components is required by the Maintenance Rule.

19A.8.4.10 *Long-Term Containment Integrity*

Long-term containment pressure control is accomplished by a combination of passive auto-catalytic recombiners (PARs) in the containment airspaces and PCCS Vent Fans, which are operated to redistribute the non-condensable gases from the wetwell to the drywell so that overall containment pressure is reduced.

PARs are independently mounted components which are capable of recombining a stochiometric mix of hydrogen and oxygen into water vapor. This recombination is facilitated through the use of a selective metal catalyst, and requires no external power or controls. A Passive Containment Cooling vent fan is teed off of each PCCS vent line and exhausts to the GDCS pool. The fan aids in the long-term removal of non-condensable gas from the PCCS for continued condenser efficiency. The fans are operated by operator action and are powered by a reliable power source which has a diesel generator backed up by an ancillary diesel if necessary without the need to enter the primary containment.

These functions maintain containment pressure below the design pressure by counteracting a slight increase in noncondensable gases over time. They are not risk-significant and the proposed regulatory oversight is in the Availability Controls Manual.

19A.8.4.11 Reactor Building HVAC ~~Purge~~ Accident Exhaust Filters

The reactor building contaminated area ventilation system filters (Reactor Building HVAC Accident Exhaust Filters only) must maintain the required filtering efficiency to ensure that theoretical control room doses are not exceeded for certain beyond design basis LOCAs. Failure to provide adequate filtration is considered to be an adverse system interaction. They have regulatory oversight in the Availability Controls Manual to provide assurance that they are capable of performing their function.

19A.8.4.12 *Lower Drywell Hatches*

An equipment hatch for removal of equipment during maintenance and an air lock for entry of personnel are provided in the lower drywell. These access openings are sealed under normal plant operation but may be opened when the plant is shut down. Closure of both hatches is required for the shutdown Loss-of-Coolant Accident (LOCA) below top of active fuel (TAF) initiators during MODES 5 and 6. Due to the low frequency of occurrence, this function is not risk-significant and the proposed regulatory oversight is in the Availability Controls Manual.

19A.8.5 COL Information

None

19A.8.6 References

None

Table 19A-2
RTNSS Functions

RTNSS Function	Description	Availability Controls
GDCS Deluge Valves	D – Containment Performance	ACLCO 3.5.1
Reactor Building HVAC ~~Purge~~ Accident Exhaust Filters	E – Adverse System Interactions	ACLCO 3.7.5
Lower Drywell Hatches	E – Adverse System Interactions	ACLCO 3.6.1
FPS Water Tank	B - Supports core cooling for refill of pools	B – ACLCO 3.7.1
FPS Diesel Fuel Oil Tank	B - Supports Diesel Driven FPS pump	B – ACLCO 3.7.1
Ancillary Diesel Generators	B - Supports FPS Motor Driven Pump, PCCS Vent Fans, CRHAVS AHUs, Emergency Lighting, Q-DCIS	ACLCO 3.8.3
Ancillary AC Power Buses	B - AC power distribution from Ancillary Diesel Generators to plant loads.	Maintenance Rule
Ancillary DG Fuel Oil Tank	B - Supports Ancillary Diesel Generators	Maintenance Rule
Ancillary DG Fuel Oil Transfer Pump	B - Supports Ancillary Diesel Generators	Maintenance Rule
N-DCIS	C - The portions that support DPS, FAPCS and supporting equipment	Maintenance Rule
Standby Diesel Generators	C - Supports FAPCS operation	ACLCO 3.8.1, ACLCO 3.8.2
6.9 kV PIP Buses	C - AC power distribution from Standby Diesel Generators to plant loads associated with FAPCS	Maintenance Rule
Standby DG Auxiliaries	C - Supports Standby DG	Maintenance Rule
RCCWS	C - Supports Standby Diesel Generators and NICWS	Maintenance Rule
Nuclear Island Chilled Water	C – Building HVAC	Maintenance Rule
PSWS	C - Supports RCCWS	Maintenance Rule
Electrical Building HVAC Area Cooling	C - Supports PIP Buses, N-DCIS for FAPCS	Maintenance Rule
Fuel Building HVAC Local Cooling	C - Supports FAPCS, N-DCIS for FAPCS	Maintenance Rule
Reactor Building HVAC Local Cooling	C - Supports N-DCIS for FAPCS	Maintenance Rule

Relative to the RBVS, this subsection addresses applicable requirements of General Design Criteria (GDC) 2, 5 and 60. These GDCs are discussed in Standard Review Plan (SRP) 9.4.3. The ESBWR:

- Meets GDC 2 via compliance to the guidance of Regulatory Guide 1.29, Position C.2 for nonsafety-related portions. The RBVS is nonsafety-related except for the building isolation dampers. The RBVS components are designed as Seismic Category II except for the safety-related building isolation dampers and associated controls that are Seismic Category I. The RB is a Seismic Category I structure. The Fuel Building penthouse that houses the RBVS equipment is Seismic Category II.
- Meets GDC 5 for shared systems and components important to safety for the Reactor Building isolation dampers. The RBVS is not shared among other operating units.
- Meets GDC 60 by suitably controlling the release of gaseous radioactive effluents to the environment. The system may direct its exhaust air to the Reactor Building HVAC Online Purge Exhaust Filter Unit during periods of high radioactivity. The Reactor Building HVAC Online Purge Exhaust Filter Unit is designed, tested and maintained in accordance with Regulatory Guide 1.140. The RBVS (CONAVS and REPAVS) exhaust subsystems are equipped with control systems to automatically isolate the effluent on indication of a high radiation level. The RB boundary isolation dampers (CONAVS and REPAVS) close on receipt of a high radiation signal, or on a loss of AC power.

9.4.6.1 Design Bases

Safety (10 CFR 50.2) Design Bases

With the following exception, the RBVS is nonsafety-related. The isolation dampers and ducting penetrating the Reactor Building boundary and associated controls that provide the isolation signal are safety-related. The RBVS performs no safety-related function except for automatic isolation of the Reactor Building boundary (CONAVS and REPAVS subsystems) during accidents. The RBVS has nonsafety-related Reactor Building HVAC Online Purge Exhaust Filter Units for mitigating and controlling gaseous effluents from the Reactor Building. The RBVS has nonsafety-related Reactor Building HVAC Accident Exhaust Filter Units for use post accident (>7 days) to create a negative pressure in the RB contaminated areas and exhausting the filtered air to the RB stack. The filtering efficiency ensures that control room doses are not exceeded for certain beyond design basis LOCAs.

The RBVS has RTNSS functions as described in Appendix 19A, which provides the level of oversight and additional requirements to meet the RTNSS functions. Performance of RTNSS functions is assured by applying the defense-in-depth principles of redundancy and physical separation to ensure adequate reliability and availability. In addition, augmented design standards are applied as described in Subsection 19A.8.3.

Power Generation Design Bases

The RBVS:

- Provides a controlled environment for personnel comfort and safety, and for proper operation and integrity of equipment. See Table 9.4-8 for area temperatures maintained.

- Maintains potentially contaminated areas at a negative pressure to minimize exfiltration of potentially contaminated air. See Table 9.4-8 for area pressurization;
- Maintains clean areas of the building, except for the battery rooms, at a positive pressure to minimize infiltration of outside air. See Table 9.4-8 for area pressurization.
- Maintains airflow from areas of lower potential for contamination to areas of greater potential for contamination. The pressure in these areas hereafter called "Slightly Negative Pressure" is a range from less than zero to −124 Pa (-0.50"w.g.).
- Is provided with redundant active components to increase the reliability, availability, and maintainability of the systems.
- Is capable of exhausting smoke, heat and gaseous combustion products in the event of a fire.
- Prevents smoke and hot gases from migrating into other fire areas by automatically closing smoke dampers upon detection of smoke.
- Smoke control and removal functions are in accordance with NFPA guidelines in Section 9.5 Fire Protection, Subsection 9.5.1.11, Building Ventilation.
- Shuts down during radiological events and isolates the Reactor Building boundary (CONAVS and REPAVS subsystems) to prevent uncontrolled releases to the outside atmosphere.
- Provides the ability to draw a negative pressure and exhaust the contaminated ventilation served areas of the Reactor Building through the Reactor Building HVAC Accident Exhaust Filter Units.
- Provides the capability to manually divert exhaust air for processing through the Reactor Building HVAC On-line Purge Exhaust Filter Units.
- ~~After a LOCA, a~~ Reactor Building HVAC Purge Exhaust Filter Unit can be energized to ~~partially~~ re-circulate ~~and partially exhaust~~ the CONAVS area air space.
- Provides pool sweep ventilation air over the refueling area pool surface.
- Maintains its structural integrity after a safe shutdown earthquake.
- Is designed such that failure of the system does not compromise or otherwise damage safety-related equipment.
- Is provided with shutoff dampers on the inlet and outlet of fans and AHUs to allow for maintenance as required.
- Is provided with shutoff valves at the inlet and outlet of cooling coils to allow for maintenance as required.
- Is provided with access doors for AHUs, fans, filter sections, and duct mounted dampers to allow for maintenance as required.
- Is provided with capability for manual control of system fans to facilitate testing and maintenance.

exhaust air being monitored for radiological contamination. If contaminated, temporary portable filters may be used to exhaust the contaminated air. The building isolation dampers close and the supply and exhaust fans stop due to high radiation in the exhaust ducts. CONAVS also includes redundant Reactor Building HVAC ~~Purge~~ Exhaust Filter Units ("Accident" and "Online Purge" Filter Assemblies) and exhaust fans. During radiological events, exhaust air from contaminated areas may be manually diverted through the Reactor Building HVAC Online Purge Exhaust Filter Units. The Reactor Building ~~purge e~~Exhaust Filter Units are equipped with pre-filters, HEPA filters, high efficiency filters and carbon filters for mitigating and controlling gaseous effluents from the Reactor Building. The Reactor Building HVAC Online Purge Exhaust Filter Units can be used to re-circulate the CONAVS area air and thereby clean up the contaminated environments in the RB.

After a LOCA, one Reactor Building HVAC ~~Purge~~Accident Exhaust Filter Unit (the redundant one is in standby) can be energized to create a negative pressure by ~~partially re-circulate and partially~~ exhausting the ~~space~~ air in the CONAVS area.

The supply AHU and normal exhaust fan ~~is~~ may be shut down during filtered purge exhaust. Recirculation AHUs provide supplementary cooling for selected rooms. Cooling is provided for CRD and RWCU pump motor coolers from RCCW, and electrical/instrument panels are provided with either Chilled Water or Direct Expansion Units designed to limit the room/equipment to within its temperature environmental qualification when the building is isolated. Electric unit heaters provide supplementary heating.

The CONAVS AHU is located in the Fuel Building HVAC Equipment Area. The CONAVS exhaust fans are located in the Reactor Building. The Reactor Building HVAC ~~Purge~~ Exhaust Filter Units and exhaust fans are located in the Reactor Building.

The refueling machine control room recirculating AHU is located in the Reactor Building. Electric unit heaters are located in or near the areas they serve.

REPAVS

Figure 9.4-11 shows a simplified system diagram for the REPAVS. Table 9.4-10 shows the major equipment for the REPAVS.

The REPAVS is a once-through ventilation system and consists of the AHU, redundant exhaust fans and building isolation dampers. The AHU includes filters, heating and cooling coils and redundant supply fans. Outside air is filtered and heated or cooled prior to distribution by the AHU in service. The conditioned air is distributed to the refueling area and across the pool surface. Exhaust air is ducted to the exhaust fans and exhausted to the outside atmosphere through the RB/FB vent stack. During a radiological event, exhaust air from the refueling area may be manually diverted through the Reactor Building HVAC Online Purge Exhaust Filter Units. The chilled water system provides cooling water for the REPAVS AHU. The instrument air system provides instrument air for the pneumatic actuators. In the event of a fire, fire dampers close to isolate the fire area. In the event smoke is detected in the air duct, the system is shut down. After the fire is completely extinguished, the exhaust fans are then used for smoke removal with the exhaust air being monitored for radiological contamination. If contaminated, temporary portable filters are used to exhaust the contaminated air. The building isolation dampers close and the supply and exhaust fans stop due to high radiation in the exhaust ducts.

automatically closed. During inerting operation, the CONAVS exhausts air from containment while the Containment Inerting System supplies nitrogen to the containment.

REPAVS

During normal operation, the REPAVS operates with the AHU and one exhaust fan in service. The exhaust fan starts first to establish negative pressure in the areas served. Then the AHU supply fan starts. Failure of an operating supply or exhaust fan automatically energizes the standby fan and de-energizes the failed fan. The REPAVS AHU supply fan is de-energized due to a loss in room negative pressure. The AHU supply fan is re-energized upon reestablishment of room negative pressure.

CLAVS

During normal operation, the CLAVS operates with the AHU and one return/exhaust fan in service. When outside air conditions are suitable, the CLAVS incorporates an economizer cycle to reduce operating hours for mechanical cooling equipment. Failure of an operating supply or return/exhaust fan automatically energizes the standby fan and de-energizes the failed fan. The return/exhaust fan is de-energized due to a loss in room pressurization. The return/exhaust fan is re-energized upon reestablishment of room positive pressure.

Following a fire recovery, return/exhaust fans are used to remove smoke from the area by exhausting to the outdoors.

9.4.6.3 Safety Evaluation

The RBVS is nonsafety-related, except for the building isolation dampers. The safety-related isolation dampers fail closed upon a loss of control signal, power, or instrument air.

The RBVS components are designed as Seismic Category II, except for the safety-related building isolation dampers and associated controls. The building isolation dampers and associated controls are designed as Seismic Category I.

The RBVS does not perform any safety-related functions, except for the CONAVS and REPAVS subsystem boundary isolation dampers closing in the event of radiological events. The CLAVS subsystems is also provided with safety-related building isolation dampers, which close upon Loss of Power or Loss of Instrument Air. Redundant dampers and controls are provided so the Reactor Building can be isolated even if one of the dampers or controls fail.

Rooms containing safety-related equipment have passive cooling features designed to limit the room temperature to the equipment's environmental qualification temperature.

RBVS maintains SLC accumulator room environmental conditions within temperature limits.

The Non-safety Related, Reactor Building HVAC Accident Exhaust Filter Units provide the ability to draw a negative pressure on the contaminated ventilation served areas of the Reactor Building post accident (>7 days). These accident units are RTNSS.

The Non-safety Related, Reactor Building HVAC Online Purge Exhaust Filter Units provide online cleanup of contaminated areas within the CONAVS or REPAVS subsystems. These online units are not RTNSS.

9.4.6.4 Testing and Inspection Requirements

Routine testing of the RBVS is conducted in accordance with normal power plant requirements for demonstrating system and component operability. Periodic surveillance testing of safety-related building isolation dampers is carried out per IEEE-338.

The Reactor Building HVAC ("Accident" and "Online" Purge) Exhaust Filter components are periodically tested in accordance with Regulatory Guide 1.140, Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants with the additional requirement that charcoal laboratory testing will be performed on the Reactor Building HVAC Accident Exhaust Filter Unit after each 1440 hours of operation, since RG 1.140 does not specify a time based charcoal testing frequency. The Reactor Building HVAC Online Purge Exhaust Filter Units will be tested on a 4-year frequency. The RTNSS Reactor Building HVAC Accident Exhaust Filter Units will additionally be operationally tested each month by running for 15 minutes as is recommended in RG 1.52 Rev. 3.

9.4.6.5 Instrumentation Requirements

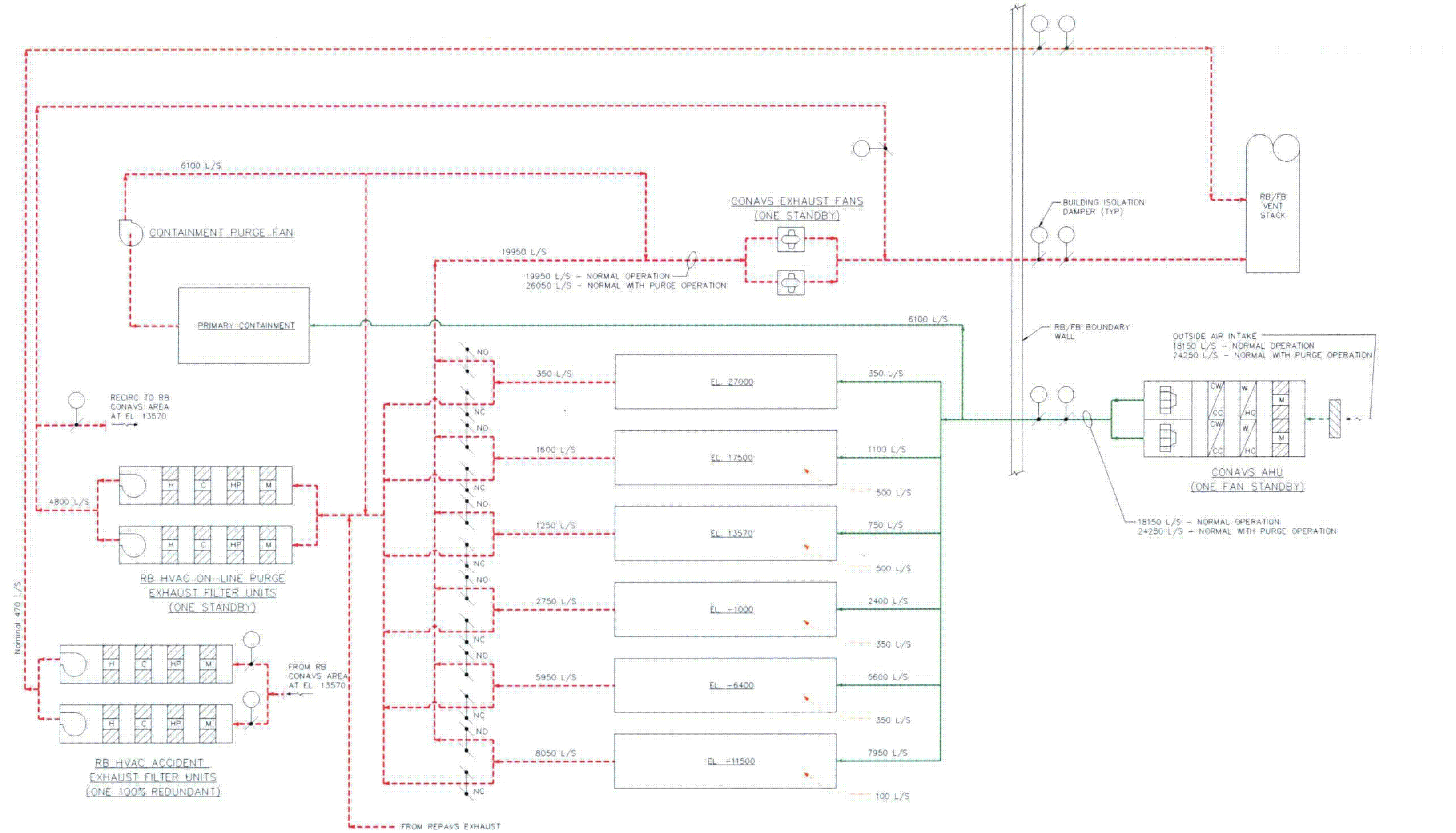
The RBVS is operated from the MCR. A local run/stop control switch is provided for each fan for maintenance and testing purposes. The RBVS is manually controlled, except for certain automatic operations described below:

- Reactor Building boundary isolation dampers for the CONAVS and REPAVS subsystems close on receipt a high radiation signal or on a loss of AC power. There is no automatic high radiation isolation signal for the CLAVS subsystem. As stated in Section 11.5, radiation monitors of the PRMS which initiate automatic building isolation are:
  - Reactor Building HVAC Exhaust (CONAVS)
  - Refuel Handling Area (HVAC) Exhaust (REPAVS)
- For systems with redundant fans, the lead fan is selected manually. The standby fan automatically starts upon indication of low flow in the associated discharge duct;
- Fan operation is allowed only when the corresponding fan shutoff dampers are open;
- The CLAVS return/exhaust fan auto starts after the supply fan starts and the ventilated spaces are at a positive pressure;
- Differential pressures between the ventilated spaces and the outside are transmitted to a pressure controller. The controller adjusts the CLAVS return/exhaust fan speed that modulates airflow to maintain the ventilated spaces at a positive pressure.
- A temperature controller modulates the CLAVS outside, return and exhaust air dampers when outside air temperatures are below design supply air temperatures. Damper modulation provides a mixture of outside and return air at or below design supply air temperatures to the ventilated spaces.
- The CONAVS supply fan auto starts after the exhaust fan starts and a negative pressure has been established in the ventilated spaces;

Table 9.4-11

Major Equipment for CONAVS (Continued)

~~AHU Supply Fan~~Deleted	~~Quantity:~~	~~1 - 100% capacity~~
	~~Capacity:~~	~~Flow - 9,000 l/s (19,070 cfm) per unit~~
	~~Type:~~	~~Centrifugal or Axial with Variable Frequency Drive, approximately 11.2 kW (15 hp)~~
Refueling Machine Control Room Recirculation AHU	Quantity:	1- 100% capacity (used when cooling is necessary)
	Capacity:	Flow - 850 l/s (1800 cfm) per unit
		Filtration – low efficiency
		Cooling - approximately 10,550 watts (36,000 Btu/hr; nominal 3 tons)
	Type:	Centrifugal or Axial, approximately 0.75 kW (1hp)
Reactor Building HVAC Online Purge Exhaust Filter Unit	Quantity:	2 - 100% capacity
	Capacity:	Flow – 4,800 l/s (10,170 cfm)
	Type:	Medium efficiency filter, HEPA filter (99% credited), Carbon filter (~~99~~95%), and post-filter (95% DOP minimum)
	Fan:	Centrifugal or Axial with Variable Frequency Drive or with inlet vanes, approximately 22.4 kW (30 hp)
Reactor Building HVAC Accident Exhaust Filter Unit ~~exhaust fans~~	Quantity:	2 - 100% capacity
	Capacity:	Flow ~~–~~ nominal ~~4,800~~470 l/s (~~10,170~~1,000 cfm) ~~per fan~~
	Type:	Medium efficiency filter, HEPA filter (99% credited), Carbon filter (95%), and post-filter (95% DOP minimum.~~Centrifugal or Axial with Variable Frequency Drive or with inlet vanes, approximately 22.4 kW (30 hp)~~
	Fan:	Centrifugal or Axial with Variable Frequency Drive


6100 L/S
CONTAINMENT PURGE FAN
19950 L/S
19950 L/S – NORMAL OPERATION
26050 L/S – NORMAL WITH PURGE OPERATION
CONAVS EXHAUST FANS
(ONE STANDBY)
BUILDING ISOLATION
DAMPER (TYP)
RB/FB
VENT
STACK
PRIMARY CONTAINMENT
6100 L/S
RB/FB BOUNDARY
WALL
OUTSIDE AIR INTAKE
18150 L/S – NORMAL OPERATION
24250 L/S – NORMAL WITH PURGE OPERATION
RECIRC TO RB
CONAVS AREA
AT EL 13570
NO
NC
350 L/S
EL 27000
350 L/S
1600 L/S
EL 17500
1100 L/S
500 L/S
1250 L/S
EL 13570
750 L/S
500 L/S
2750 L/S
EL -1000
2400 L/S
350 L/S
5950 L/S
EL -6400
5600 L/S
350 L/S
8050 L/S
EL -11500
7950 L/S
100 L/S
4800 L/S
H
C
HP
M
RB HVAC ON-LINE PURGE
EXHAUST FILTER UNITS
(ONE STANDBY)
Nominal 470 L/S
FROM RB
CONAVS AREA
AT EL 13570
RB HVAC ACCIDENT
EXHAUST FILTER UNITS
(ONE 100% REDUNDANT)
FROM REPAVS EXHAUST
CW
CC
W
HC
CONAVS AHU
(ONE FAN STANDBY)
18150 L/S – NORMAL OPERATION
24250 L/S – NORMAL WITH PURGE OPERATION

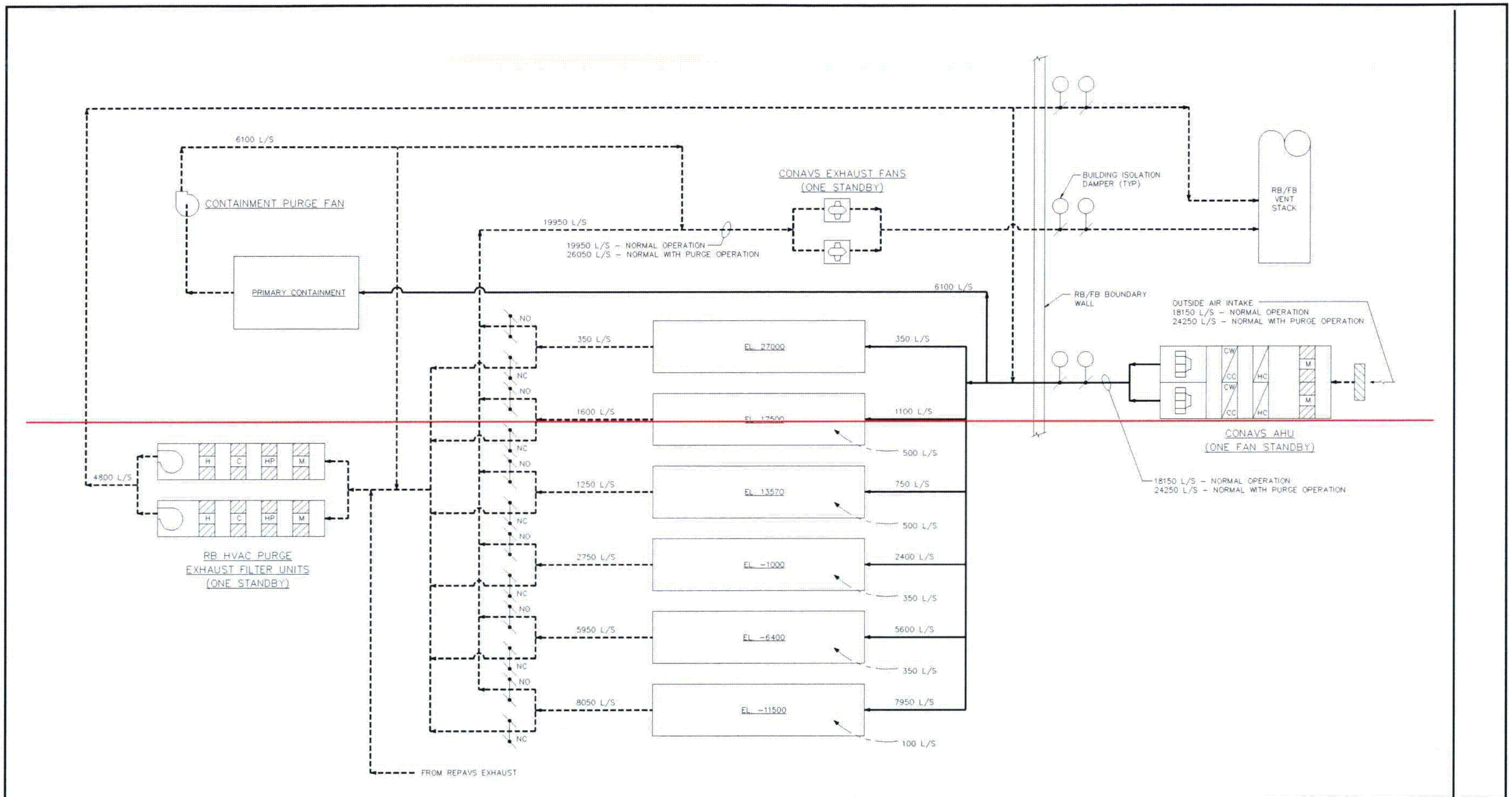


Figure 9.4-10. CONAVS Simplified System Diagram