ENCLOSURE

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555
April 21, 1987

MEMORANDUM FOR: Jon Hopkins, Project Manager
Project Directorate II-1
Division of Reactor Projects - I/II

FROM: John J. Hayes, Project Engineer
Division of Reactor Projects - I/II

SUBJECT: SURVEY OF V. C. SUMMER CONTROL ROOM

During the period of January 12-16, 1987, a survey was conducted at the V. C. Summer Nuclear Station. The survey was performed by John Driscoll, Malcolm Carnes and Roger Evans of Argonne National Laboratory (ANL) and me. The purpose of the survey was to evaluate: (1) the operation of the control room ventilation system and its ability to maintain the V. C. Summer control room habitable and (2) the adequacy of the plant's technical specifications and procedures to demonstrate system operability and system capability consistent with the assumptions made in the plant's TMI Action Item III.D.3.4, "Control Room Habitability" analysis, FSAR Section 6.4, and the NRC staff's associated safety evaluations.

The survey team usually gathers flow rate data in various portions of the control room ventilation system with the system operating in its normal mode of operation. However, because a toilet and kitchen exhaust fan motor burned out and was not replaced prior to the team's exit, flow data with the system in its normal mode was not obtained. Four sets of data were gathered with the ventilation system operating in its emergency radiological operating mode. The survey team also reviewed, with the licensee, plant specific technical specifications, system operation, system descriptions, system procedures, and the III.D.3.4 analysis. As a result of these discussions and the flow measurements, a number of findings were made by the survey team.

At the exit meeting, the survey team identified the following items as requiring prompt attention.

1. The plant may have been in a Technical Specification Condition 3.0.3 when the toilet and kitchen exhaust fan was removed from the ductwork. Both emergency trains may have been rendered inoperable upon removal because the toilet and kitchen fan is common to both units since ductwork from the fan is connected to the air handling unit of each train. Removal of this fan breaks envelope integrity. The isolation of this ductwork with plastic may have restored the integrity but whether the plastic was an appropriate material needs to be addressed. (Region II)

2. The system is susceptible to single failure. Failure of dampers XDP-22A-AH or XDP-22B-AH to isolate could result in unfiltered flow entering the control room envelope. (NRR)

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3. Operation of the control room ventilation system in the event of a CL_2 gas incident needs to be reevaluated. Section 6.4 of the updated FSAR indicates that the control room ventilation system isolates if a CL_2 gas incident occurs and refers to Section 9.4.1. Review of that section of the updated FSAR and station procedures shows that the control room does not isolate but continues to draw outside makeup air into the envelope. In addition, there is no annunciator response procedure (ARP) for the remote CL_2 detector. An ARP should provide direction as to what actions the operator should take in placing the control room ventilation system in the appropriate operating mode. (Region II)

4. At the exit meeting the survey team also stated that a revised III.D.3.4 analysis needs to be performed to take into account inleakage in the ductwork, air handling units, and the control room envelope and infiltration into the envelope from ingress/egress. Since the exit meeting the survey team has reviewed the flow data in detail and believes that it is appropriate for the licensee to perform similar flow balances as the survey team did. From the survey team's review of the flow data they have concluded that such measurements are warranted to allow the licensee to confirm that the doses to operators in the V. C. Summer control room would still meet GDC 19 limits in the event of an accident involving the release of radioactivity. The survey team's review of the flow data shows:

   (1) unfiltered inleakage into the Train A air handling unit ranges from 360-1250 cfm;

   (2) inleakage into the Train A emergency filter unit between the supply and exhaust ductwork ranged from 315-892 cfm. Whether it is filtered or unfiltered depends upon the location of the inleakage. For Train B, in one case this leakage was 1292 cfm.

   (3) outside makeup air is approximately 25% higher than the technical specification (as well as the III.D.3.4 analysis) value of 1000 cfm.

These conclusions raise concerns as to the capability of the Summer Control Room to meet GDC 19 limits in its present operating condition and a determination with respect to this needs to be made by the licensee immediately.

Enclosure 1 contains additional findings resulting from the survey as viewed by the NRR team representative while Enclosure 2 contains the ANL report of the survey. Of these numerous findings those which seem more important include:

   (1) the need to measure differential pressure between the control room envelope and all adjacent areas outside the envelope when in the pressurization mode (Region II);

   (2) the need for periodic testing of the instrumentation and control ventilation area system to ensure that it is not a source of unfiltered inleakage into the envelope (NRR);

   (3) the presence of dry loop seals in drains within the envelope (Region II);

   (4) the labeling of technical specifications doors within the envelope (NRR);

(5) procedures for ensuring appropriate procedural changes and/or additions are in place concurrent with plant modifications (Region II);

(6) station documents reflecting current design and operation, e.g., updated FSAR, system descriptions, and training documents (NRR & Region II); and

(7) updated technical specifications are needed, including appropriate test conditions and system bypass test (NRR).

Consistent with an August 8, 1985 memorandum from D. R. Muller to Philip Stohr of Region II, we are providing Region II a copy of this memorandum and its enclosures. Previously, a draft was provided to Doug Collins of Region II for the Region's comments. This memorandum identifies the findings NRR and the Region will be responsible for resolving. The resolution of the above findings has been designated according to the usual areas of NRR and Region II responsibility. This designation has been included after each of the above findings. This is the eighth of eleven control room survey reports completed.

A comment needs to be made concerning the measurement of flows at Summer. During the visit, the survey team showed flows through the outside air makeup line of Train A and through both Train A and Train B emergency filter units which were greater than that allowed by plant technical specifications. Flow measurements made by the licensee during the same operating conditions using a pitot tube showed flows consistently lower by 10-32% of the values measured by the survey team. The licensee's measurements showed that they were within their technical specification limits. In an attempt to determine whether a problem existed with the ANL hot-wire anemometer, ANL used their hot-wire anemometer and a pitot tube to measure flows in round and circular ducts at their facility under both high and low flow conditions. Their measurements showed that the pitot tube flow rates were 12 % higher than those determined with the hot-wire. Discussions with North Anna Station personnel indicated that they found ANL flow rates 12-18% lower than what they measured using a pitot tube. In order to resolve this problem, we have asked the licensee to go back and take flow measurements utilizing different pitot tubes to verify that there are no calibration problems with their instrument. If that does not resolve the problem, a third party may need to be called in to measure such flows.

Utility management and personnel were extremely cooperative and our survey personnel said it was a pleasure working with them.

Please forward a copy of this report to the licensee.

John J. Hayes, Project Engineer
Division of Reactor Projects - I/II

Enclosures:
As stated

cc: See attached sheet

cc: P. Stoddart, Rg II
R. Marston, Rg II
D. Prevatte, V. C. Summer RI
F. Cantrell, Rg II
J. Craig
J. Driscoll (ANL)
D. Collins, Rg II
J. Stohr, Rg II

ENCLOSURE 1

NRR FINDINGS V. C. SUMMER CONTROL ROOM

By: Jack Hayes
X27214

NRR FINDINGS V. C. SUMMER CONTROL ROOM

System Design

1. The control room ventilation system design is susceptible to single failure. Failure of either damper XDP-22A or XDP-22B to close would result in the control room emergency filter unit being bypassed. With unfiltered flow entering the control room envelope, control room operator doses could exceed GDC-19 limits. (NRR)

2. Differential pressure measurements need to be made to all adjacent areas to the envelope when the system is being pressurized in the emergency mode of operation. Currently measurements are made only with respect to the turbine building and atmosphere. Measurements need to be made with respect to the cable chase area, the 463' elevation, and the stairwells. (NRR)

3. The air handling unit which supplies the Instrumentation and Control Shop area is located within the control room envelope but supplies air to a room outside the envelope and returns air to the air handling unit from an area outside the envelope. Return and exhaust flow rates for this air handling unit must be measured on a periodic basis to ensure that the return is not greater than the exhaust, thereby resulting in contaminated air entering the envelope as a result of outleakage from the air handling unit. (NRR)

4. Five of nine floor drains in the cable spreading room had loop seals which were dry. At the time of the survey team's visit flow was going out of the room. During other conditions contaminated air may enter the envelope through these drains. (Rg II)

5. There are a number of entrance/exit doors in the control room envelope. Almost too many to maintain closed in the event of an accident. Some are not obvious as being part of the envelope. An example is the health physics office door. All control room envelope boundary doors should be marked as a technical specification door so that the doors are maintained closed during operation. (NRR)

6. The original 1500 cfm capacity HEPA filters in the emergency filter units were replaced by 1000 cfm capacity HEPA filters. A review of the 10 CFR 50.59 evaluation which approved this replacement was conducted by the survey team. The team believes that this replacement is acceptable provided the filter fan can handle the increased operating differential pressure and still maintain design flow.

7. Discussions with the plant staff seemed to indicate that a considerable amount of time had been spent during startup in selecting the appropriate location to measure temperature in the control room. Since additional instrumentation has been added to the control room and since ventilation system operations may have changed, the licensee should perform periodic tests to ensure that the present temperature monitoring location reflects the most critical location resulting from increased heat loads and changing ventilation system conditions for heat sensitive instrumentation and equipment. (Rg II)

8. The toilet and kitchen exhaust, which was filtered through a charcoal adsorber and returned to the control room ventilation system air handling unit (versus an exhaust to the environment), is an excellent design feature.

9. The control room layout was among the best seen. The spacious office for the shift supervisor with a large window for observation of the control room operators and control panels and availability of several adjoining meeting rooms are excellent ideas. However, having the technical support center within the envelope makes the envelope susceptible to a large number of entries and/or exits. It would be better if the technical support center envelope were outside the control room envelope.

10. During the visit the removal of the toilet and kitchen exhaust vane axial fan violated the control room envelope integrity and placed the two emergency filter trains in an inoperable status until the ductwork was

sealed. This demonstrates the potential for common mode failure present in the system design. Flow rate measurements showed that the toilet & kitchen exhaust fan is probably not needed. (NRR)

Plant & System Operation

1. Station operating procedures should include guidance to the operators instructing them to isolate the control room in the event of a CL_2 challenge. (Rg II)

2. In discussion with an operator it was indicated that both control room emergency filter trains were to operate for a period of 30 minutes or greater. Actual design basis accident analysis assumes no longer that 30 minutes. Instructions, i.e., procedures, should be clear as to the appropriate time. (Rg II)

3. Administrative procedures should be reviewed to ensure that, when plant modifications are made, the appropriate operations and maintenance procedural implications are recognized. An example of the breakdown in this area was the change in water treatment from bottled chlorine to sodium hypochlorite, then back to bottled chlorine. After changing back to bottled chlorine the annunicator response procedure for the remote CL_2 monitors was not replaced. (Rg II)

4. Control room conduct was appropriate and control room layout is excellent for facilitation of operations.

5. Access to the filter units and air handling units is excellent.

6. The air handling unit area should be posted for ear protection because the noise level is high with emergency filter units operating.

7. There should be a temperature alarm in the control room to forewarn the operators when the control room temperature is approaching 85°F (technical specification limit). During the visit control room temperature reached 82°F with one of the emergency filter trains operating and the operators were unaware of it. Because 85°F is not uncomfortable, operator discomfort can not be considered as a triggering mechanism for warning the operators that this technical specification limit is being approached. Therefore, the operators need some warning device to alert them that the control room temperature is approaching the technical specification limit.

Procedures, System Descriptions and Updated FSAR

1. The updated FSAR is not current and, in some cases, is inaccurate. All areas of the updated FSAR addressing control room habitability should be revised to reflect actual system design and operation. (NRR)

2. Discussion with plant operating staff indicated that system design descriptions were not utilized by the operating staff. They relied upon station training descriptions. The station engineering staff, on the other hand, seemed to rely upon the system design descriptions. Operations personnel said that the system design descriptions serve no purpose while station engineering said that the descriptions are being updated. There should be one central document that is the focal point for understanding system design and operations. It should be clear as to which plant document fulfills this requirement. If a document has no use, as indicated for the system design description, it should be purged from the files. If it is to be utilized, it should be up-to-date. (Rg II)

3. Procedures should be more specific. Some procedures seem to rely upon the historical knowledge of the individual to ensure that the right steps

are taken. Some of the important criteria are missing. An example is the procedure concerning the laboratory test of charcoal. In this case, the laboratory test conditions are not stated. (Rg II)

4. System descriptions, the updated FSAR, and all other documents describing system design and operation should be very clear as to both the system's design and its intended mode of operation. Based upon reading these documents it was unclear as to whether the system always operated in a pressurization mode or sometimes operated in an isolation and recirculation mode. Flow rates were never specified. System design and operation details should be presented. (NRR & Rg II)

Technical Specification (NRR for all)

1. A system bypass test should be conducted anytime an inplace freon or DOP test is conducted to ensure that during emergency operation outside air intake flow and recirculation flow do not bypass the emergency filter unit via dampers XDP-22A or XDP-22B. Allowable bypass would be based upon control room operator's doses meeting GDC 19. Region II would address whether bypass tests have been conducted by the licensee.

2. Charcoal laboratory test conditions should be specified. The test should specify the ASTM-3803 test method, 70% relative humidity, 30°C, and allowable penetration for methyl radioiodine of 1%.

3. Monthly demonstration of system operability, surveillance requirement 4.7.6.b, should last for 1 hour rather 15 minutes to ensure than units do not trip off.

4. Surveillance requirement 4.7.6.e.2 should be eliminated. Requirement 4.7.6.e.3 is sufficient.

Flow Measurements

Two sets of data were taken with the Train A emergency filter unit operating and two with Train B operating. One set of data for each train was taken to confirm greater than technical specification flow through the filter units and to allow the licensee to verify the survey team's conclusion under the same operating conditions.

Train A (Refer to Figure 1)

With train A operating in its emergency mode the two sets of data showed:

(1) There appears to be a considerable amount of inleakage into the air handling unit. It ranged from 363-1246 cfm. This inleakage is unfiltered.

(2) There appears to be a considerable amount of inleakage between the locations where flows at measurement points 8, 10, and 12 are made and the location where flow at measurement point 14 is made. This inleakage ranged from 1050-1620 cfm.

(3) Only outleakage occurs across the emergency filter train. This outleakage ranges from 740-800 cfm.

(4) The control room exhaust (return air) is greater than control room supply which would seem to indicate that the control room has another source, not measured by the survey team, which is pressurizing the envelope. The source is unknown but the deficiency between the two flows is 785-2550 cfm for the two data sets.

(5) Filter flow is 17-19% greater than the technical specification value.

(6) With the toilet and kitchen fan removed from the ductwork and the ductwork blanked off, the amount of flow supplied to the control room increased by 2.22% while the amount of return flow decreased by 2.78%.

With Train A idle, a flow balance around the idle air handling unit seems to indicate that there is outleakage from the air handling unit. This situation is confirmed by the fact that inleakage occurs when the train is operating. Similar confirmation occurs with respect to the outleakage in the ductwork between measurement point 14 and the locations where measurements 8, 10, and 12 are made.

The flow direction through measurement point location 2 is particularly baffling. During emergency operation, flow through the outside air intake almost equals, the flow through measurement point 12. Differences range from 1.7-9.4%. If the point 12 flow rate is added to the flow rates measured at location 2, 600-700 cfm of flow cannot be accounted for. The flow direction was determined, and it was toward the emergency filter train when the train was operating. If the train was not operating, the flow appeared to be toward the air handling unit and damper XDP-22A-AH. One scenario which may explain the situation, with the train idle, is described as follows. Back pressure from the control room causes flow toward the air handling unit (364 cfm for data set 1). Some of this flow leaks out from the air handling unit. That flow which remains (unknown) is combined with the flow from point 2 to pass through the fan and the emergency filter unit. Approximately 130 cfm leaks out from the emergency filter train. The flow from the emergency filter unit combines with the flow from the control room return duct (point 8). This gives the combined flow at point 12, which is proceeding toward the air handling unit. A portion of the flow, 148 cfm at point 2, is probably directed towards the flanged intake while the remainder is directed towards either the air handling unit or the emergency filter fan.

When the train is operating in its emergency mode of operation, since the outside air intake flow is almost equal to the flow at point 12, which is the makeup flow to the filter unit, one might conclude that the flow at point 2 seems to be recirculated by the emergency filter train back to point 2 where most of the flow is lost. Point 2 almost seems like a black hole. Flow seems to get lost here.

Train B (Refer to Figure 2)

With train B operating in its emergency mode of operation the two sets of data showed:

(1) Outleakage from the air handling unit ranged from 450-680 cfm. This was the opposite of train A where inleakage occurred.

(2) Outleakage occurred across the emergency filter unit. This ranged from 2800-3700 cfm.

(3) As with train A, there was a considerable amount of inleakage in the ductwork between measurement points 22 and 26 and that at point 28. Amounts varied from 3250-4080 cfm.

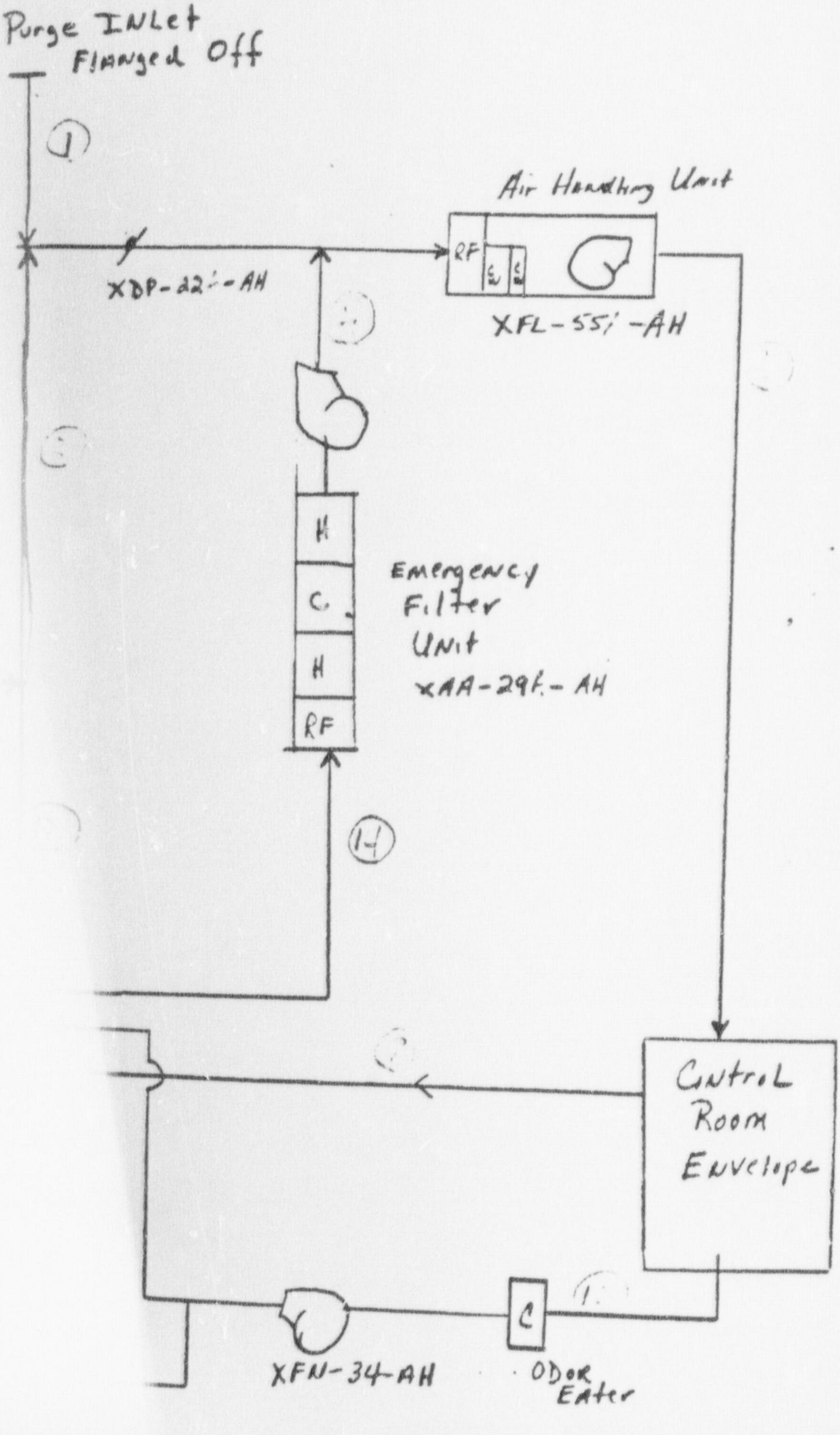
(4) Control room supply flow was greater than control room exhaust (return) flow in one of the two cases. Supply and exhaust flows were almost equal with a difference of only 90-100 cfm in the two cases.

(5) Flow through the emergency filter train was 13-16% greater than the technical specification value.

(6) When the toilet and kitchen exhaust fan was removed from the ductwork, the amount of flow to the envelope decreased and the amount of return air from the envelope increased. With the ductwork blanked off, envelope supply flow was less than envelope return flow.

For train B measurement location 16 was similar to measurement point 2 on train A. As with train A, location 16 provided abnormal flow results when considered with measurement points 15, 18 and 20.

Figure 1 V.C. Summer [illegible]



Train B (Refer to Figure 2)

With train B operating in its emergency mode of operation the two sets of data showed:

(1) Outleakage from the air handling unit ranged from 450-680 cfm. This was the opposite of train A where inleakage occurred.

(2) Outleakage occurred across the emergency filter unit. This ranged from 2800-3700 cfm.

(3) As with train A, there was a considerable amount of inleakage in the ductwork between measurement points 22 and 26 and that at point 28. Amounts varied from 3250-4080 cfm.

(4) Control room supply flow was greater than control room exhaust (return) flow in one of the two cases. Supply and exhaust flows were almost equal with a difference of only 90-100 cfm in the two cases.

(5) Flow through the emergency filter train was 13-16% greater than the technical specification value.

(6) When the toilet and kitchen exhaust fan was removed from the ductwork, the amount of flow to the envelope decreased and the amount of return air from the envelope increased. With the ductwork blanked off, envelope supply flow was less than envelope return flow.

For train B measurement location 16 was similar to measurement point 2 on train A. As with train A, location 16 provided abnormal flow results when considered with measurement points 15, 18 and 20.

Figure 1 V.C. Summer Train A

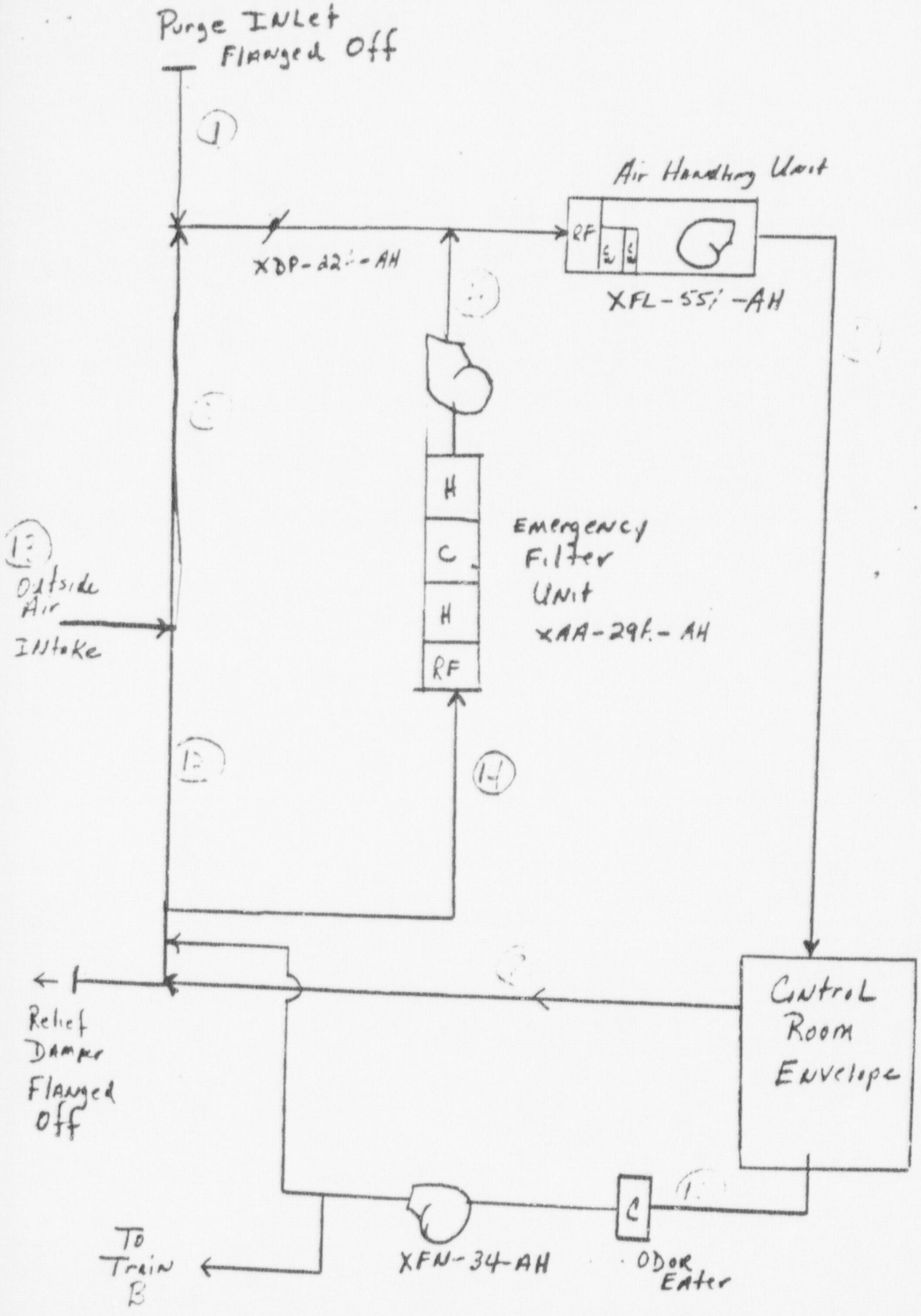
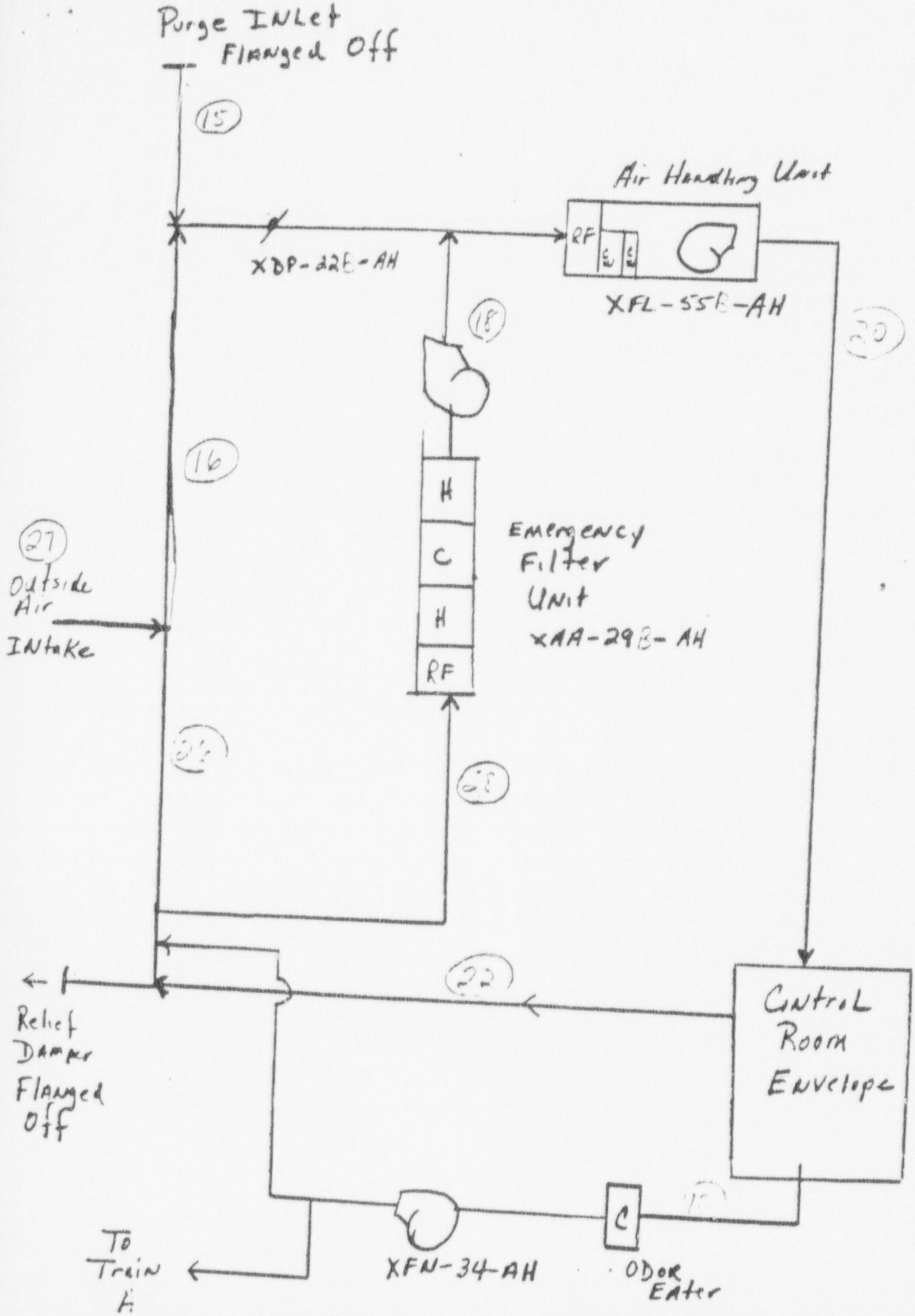


Figure 2 V.C Summer Train B



US Department of Energy

ARGONNE NATIONAL LABORATORY

ARGONNE-WEST P.O. Box 2528, Idaho Falls, Idaho 83403-2528 Telephone 208/526-7657

March 31, 1987

U.S. Nuclear Regulatory Commission
Nuclear Reactor Regulatory DSI/RP
Mail Stop 416
Washington, DC 20555

Attention: J. Hayes

Subject: Generic Studies Related to Generic Issue 83 on Control Room Habitability Fin A-2328

Gentlemen:

Enclosed is the Plant Visit Summary Report for the visit to the V. C. Summer Nuclear Station on January 12-16, 1987. If you have any questions concerning this report, contact me at (FTS 583-7657).

Very truly yours,

John W. Driscoll

John W. Driscoll
Argonne Project Manager

JWD:lm

cc: D. W. Cissel, EBR-II
R. Dalton, DOE-CH
M. J. Lineberry, SSPO
R. N. Smith, EBR-II

PLANT VISIT SUMMARY

1. Plant: V. C. Summer Nuclear Station

2. Utility: South Carolina Electric and Gas

3. Location: Jenkinsville, South Carolina

4. NRC Region: II

5. Visit Date: January 12-16, 1987

6. Participants from Argonne National Laboratory: M. D. Carnes, J. W. Driscoll, R. A. Evans

7. Scope:

   The plant visit was made to gather information on control room habitability - Generic Issue 83. As a part of the review, the Plant Technical Specifications were reviewed and compared to the safety analysis (including III.D.3.4 submittal and the NRC staff safety evaluation) and plant procedures to determine what operational practices are being employed. System air flow measurements were made to determine the unfiltered air inleakage into the control room envelope and system performance.

8. System Description:

   The V. C. Summer Nuclear Station is a single unit station. The control room envelope is located on two levels. The lower level consists of the cable spreading room and a Health Physics Supervisors office. The upper level consists of the control room, Shift

Supervisors Office, Technical Support Center, kitchen, toilets, and several other offices.

The HVAC Equipment Room is located above the control room and is not part of the control room envelope. There are two redundant equipment trains for the Control Room HVAC system. Each train consists of an air handling unit (AHU) and an emergency filter unit. The toilet and kitchen exhaust fan is common to each train.

During normal operation, by design, the control room envelope is maintained at a positive pressure by admitting < 1000 cfm of outside air to the suction of the AHU. When the system operates in the emergency mode the outside air is admitted to the suction of the emergency filter unit. When the emergency filter unit is in service full system design flow of 21270 cfm is circulated through the emergency filter unit and the AHU. The toilet and kitchen exhaust fan circulates air from the control room into the kitchen and toilets then through a charcoal filter (odor eater) and discharges to the AHU. The kitchen and toilet exhaust fan is shutdown during the emergency mode of operation.

As originally designed the system had the capability to purge the control room at full system flow. In order to pressurize the control room envelope to 1/8 in. W.G. the purge valves (both inlet and outlet) were sealed off with blank flanges.

The I&C shop AHU is located inside the control room envelope (Health Physics Supervisors Office) and does not interface with the control room HVAC system. However leakage into or from this unit will affect the integrity of the control room envelope.

9. Findings

9.1 General

9.1.1 The control room general layout is among the best designed that the survey team has seen. The shift supervisors office is arranged such that the shift supervisor can conduct business without interfering with control room operations, yet he can still observe operations in the control room.

9.1.2 The system descriptions says that the kitchen and toilet exhaust fan discharges to the equipment room relief vent. Drawing D-912-140 shows that they discharge to the suction of the air handling units. The system description should be revised to show the actual system configuration. (Region II should address this item)

SCE&G is presently upgrading the system descriptions but has not revised the section on control room HVAC.

9.1.3 There were two high temperature status lights that indicated a high temperature condition on the HVAC status display panel. When operators were asked the significance of these lights they did not know. The next morning the lights had a tag on them that indicated that the lights were out-of-service.

9.2 Procedures

9.2.1 Procedure STP-554.001, "Control Room Emergency Air Cleanup System Cannister Test," step 8.4 should include test conditions and test method for the laboratory analysis. (Region II should address this item.)

9.2.2 Procedure STP-554.001, "Control Room Emergency Air Cleanup System Cannister Test," step 9.2 should include the temperature at which the laboratory test are to be conducted. Attachment III to the procedure should also include the laboratory test temperature. (Region II should address this item.)

9.2.3 Procedure STP-125.011, Integrated Safeguards Test - B Train, step 8.11 should be clear as to whether the control room ventilation system is pressurizing the control room or if the system is in isolation with re-circulation. (Region II should address this item.)

9.2.4 Procedure STP-125.011, Integrated Safeguards Test - B Train, Attachment I should list the positions for dampers XDP-3B and XDP-4B. (Region II should address this item.)

9.2.5 Procedure STP-554.002, "Control Room Emergency Air Cleanup System Performance Test," should require a system bypass test be performed in addition to the inplace test. (Region II should address this item.)

9.2.6 Procedure STP-554.002, "Control Room Emergency Air Cleanup System Performance Test," step 6.1 should include instructions to align the system for testing Train A in accordance with Attachment IIA, or Train B in accordance with Attachment IIB. (Region II should address this item.)

9.2.7 There should be a procedure that requires manual isolation of the control room envelope in the event of a chlorine alarm. Refer to Regulatory Guide 1.95 section C.2. (Region II should address this item.)

9.2.8 The review team believes that in general, plant procedures do not contain enough detail. In some cases if new personnel were required to perform some maintenance functions, it is doubtful that the procedures contain enough detail to do the job. (See items 9.2.1, 9.2.2, 9.2.3, 9.2.4, and 9.2.6 above.) (Region II should address this item.)

9.3 Safety Analysis

9.3.1 The updated FSAR implies that CO_2 is used in the control room envelope as part of the fire protection system. During the plant visit it was determined that CO_2 is not used in any part of the control room envelope.

The FSAR should be revised to remove references to CO_2 systems in the control room envelope.

9.3.2 The equation used by NRC to determine the Iodine Protection Factor (IPF) assumed 10 cfm unfiltered inleakage. It would seem that this number only reflects ingress-egress and does not allow for any unfiltered inleakage due to AHU housing, filter train housing, damper and duct leakage or the control room incorporating several different volumes other than the control room.

The ten cfm unfiltered inleakage value for ingress-egress is for a limited access control room which does not have an extensive volume associated with the control room envelope that is used by support personnel and incorporates the technical support center.

Since there may be additional unfiltered inleakage into the envelope, ducts, AHU housings, and bypass flow from outside air supply directly to the AHU and because additional air leaks in ducts could increase the filtered air flow, the survey team recommends that the dose to control room operators for a DBA be reevaluated taking these conditions into consideration. (Refer to Item 9.6)

9.3.3 FSAR section 6.4.1.2.1 should be revised to clearly define the boundaries of the control room envelope.

9.3.4 FSAR 15.4-13 item 6 says: "The amount of outside air admitted to the control room to maintain a positive control room pressure is limited to a maximum flow of 1000 cfm by positioning one of the isolation valves in each train." FSAR paragraph 2.2.2.1 states both units are started automatically on SI or high radiation.

It seems that with both units running, more than 1000 cfm outside air will be admitted to the control room envelope. The FSAR needs to be revised to eliminate this conflict in information. If it is permissible to operate both trains for a period of time, the amount of filtered and unfiltered air entering the envelope should be included in the dose evaluation (See item 9.3.2).

Plant procedures indicate that the control room operators should shutdown one of the HVAC trains within 30 minutes. At least one operator told the review team that the two trains were required to operate for a minimum of 30 minutes following automatic initiation. (Region II should address this item.)

Procedures governing the operation of the control room HVAC system should be clearly written and operator training should ensure that operators know the correct procedures. (Region II should address this item.)

9.3.5 Although control room instrumentation is rated at 120°F and the technical specification limit for control room temperature is 85°F, there is still a potential for instrumentation to reach its design temperature limit. Control room ambient temperature is measured once every twelve hours using a calibrated thermometer that is located in the center of the control room away from any of the instrument panels. During the survey the temperature had slowly increased to 82°F. This contition was not recognized by any of the operating crew.

The review team believes that the utility should consider installing a temperature instrument that will cause an alarm before the technical specification limit is exceeded. The sensing element should be located so that it will be indicative of temperatures that sensitive instrumentation will see.

9.3.6 FSAR section 6.4.1.5.1 item 4 says that instrumentation annunciates alarms on high or low differential pressure for control room to outside areas. The differential pressure in the control room envelope should be monitored to all adjacent boundaries and not just to the outside atmosphere.

9.3.7 The system description says that the emergency filter trains are designed for 21,000 cfm. The FSAR section 9.4.1.2.1(4) specifies 20,000 cfm. Drawing D-912-140 rev. 22 shows a total flow of 20420 cfm control room return which does not include 1000 cfm outside air makeup. The technical specifications (4.7.6) specifies a flow of 21,270 cfm ±10%.

All of the above listed documents should be revised to be in agreement with the design basis for the plant.

9.3.8 Table 6.4.3 of the FSAR indicates that in an emergency there are $\geq$ 25 people in the technical support center and seven people in the control room giving a total of $\geq$ 32 people in the control room envelope. If the occupancy is indeed this high there should be 48 self contained breathing apparatuses (SCBA's) available for the protection of the control room occupants.

There are presently 14 SCBA's available to personnel in the control room envelope. Table 6.4.3 of the FSAR should be evaluated to ascertain the need for $\geq$ 32 people in the control room envelope during an accident and revise the FSAR or the number of SCBA's as appropriate. The number of people in the control room envelope should be taken into account in determining ingress-egress infilteration values and analyses revised accordingly.

9.3.9 The review team believes that having only one inlet isolation damper to the AHU's results in the system design failing the single failure criterion. If the AHU inlet damper were to fail the majority of the air flow through the emergency filter train could be re-circulated back to the suction of the filter train and the AHU would re-circulate the control room volume, or most of the outside air makeup could be discharged into the control room envelope without first going through the emergency filter train.

The utility should evaluate the duct and isolation damper designs and addresses how it meets the single failure criterion.

9.4 Technical Specifications

9.4.1 Technical specification 4.7.6.a requires monitoring control room temperature every 12 hours to verify temperature is ≤ 85°F. This technical specification does not assure that temperatures inside of control panels will not exceed the design limit of 120°F. The technical specifications should be revised to ensure that temperatures inside instrument cabinets will not exceed design limits (see item 9.3.5).

9.4.2 Technical specification 4.7.6.c.2 and 4.7.6.d should state the allowed penetration and test conditions such as relative humidity, temperature, and test method required to satisfy laboratory testing of charcoal.

9.4.3 The thirty-one day test demonstrating flow through the filter unit should be run for one hour to ensure the units are operable. In some instances the review team has seen HVAC system trip between 15 and 20 minutes of operation. Had the system operated for the minimum time of 15 minutes the overheating problem would not have been seen. Either a longer run time is required or a monitoring system to insure the equipment in the system (i.e. damper motors, fan motors, etc.) has reached stable operating temperatures at a shorter time interval.

9.4.4 Specification 4.7.6.e.2 and 4.7.6.e.3 seem to conflict with one another in that one implies that the control room HVAC filter train is operating in a recirculation mode while the other implies a system which pressurizes the control room utilizing a filter train.

It would appear that specification 4.7.6.e.2 does not apply to the control room HVAC system as it is currently operated, since there is no automatic initiation to the recirculation mode of operation.

9.4.5 Technical specification 4.7.6.e.3 should also specify that system flow be at 21,270 cfm ± 10% when verifying that the control room pressure is maintained at $\geq$1/8 in. W.G. pressure.

9.4.6 A DOP and freon system bypass test and specification should be incorporated into the technical specifications.

9.5 HVAC Flow and Temperature Measurements

During the visit, air flow, dP, and control room temperature data were collected with the control room HVAC system operating in the emergency mode of operation. Data were not collected in the normal mode of operation because the kitchen and toilet exhaust fan was found to be inoperable. Utility personnel removed the fan from the system for repairs. The ends of the duct were sealed using polyethylene sheeting and duct tape.

9.5.1 Temperature Measurements

Air temperature was measured in the control room with the unit operating at full power. The train "B" measurements were made at 0830 and the train "A" measurements were made at 1400 on the same day. The following is a summary of the data collected:

- The overall temperature control seemed to wok better when train "B" was in service. The control room technical specification thermometer showed 75°F with train "B" in service and 82°F with train "A" in service.

- The area inside the main control panel is well ventilated. The average temperature inside the panels was 77.6°F with train "A" in service and 75.7°F with train "B" in service.

- The occupied area of the control room averaged 75.6°F with train "A" in service and 72.9°F with train "B" in service.

- The back side of the control panel is a rather large are compared to other plants surveyed. This area had the lowest temperatures in the control room. Back of panel temperatures averaged 72.8°F with train "A" in service and 68.9°F with train "B" in service.

- Differential temperatures from inside of the main control panel to front of control panels were +2.0°F with train "A" in service and +2.8°F with train "B" in service.

- Differential temperatures from inside of the main control panels to the back of the panels were +2.8°F with train "A" in service and 4.0°F with train "B" in service.

9.5.2 Differential Pressure Measurements

Differential pressure readings were taken across all control room envelope doors using a magnehelic gauge. One of the sensing lines was equipped with a small piece of copper tube which was placed across the door seal and the door closed tight on the copper tube and seal. The differential pressure indicated on the installed meters in the control room was also recorded. Refer to Table 1 for the differential pressure data.

The data taken shows the control room to be positive with respect to all surrounding areas and exceeds the 1/8 in. W.G. requirement except for the cable spreading room East door and the control room door to the West stair well. The seals on these two doors should be repaired.

The cable spreading room is equipped with nine floor drains. The floor drains were tested using a smoke powder and it was determined that five of the nine drains has flow out through the drains.

A periodic inspection of these drains should be made to insure that the loop seals are full and the control room envelope boundary is not degradated.

9.5.3 Air Flow Measurements

Two sets of air flow readings were taken on each train of the control room HVAC system. The second set of data was taken so that utility personnel could take readings at the same time so that comparisons could be made between data taken by the utility and the survey team. Refer to Table 2 for actual flow data and to Table 3 for comparisons of one point to another. The following conclusions have been reached by studying the data in the tables:

- There is excessive flow through the filter trains which lowers the residence time in the charcoal adsorbers.

- The HEPA filters are rated at 1000 cfm and would see about 1500 cfm each by design. Actual flow through the HEPA filters is >1600 cfm.

- The charcoal adsorbers are rated at 2000 cfm and would see about 1900 cfm at design flow conditions. Actual measured flow through the charcoal adsorbers is >2200 cfm.

- During the emergency modes of operation, the train "B" AHU is pressurized by the filter train fan and results in outleakage to the mechanical equipment room.

- Train "A" AHU has inleakage from the mechanical equipment room when it operates in the emergency mode of operation. This is a source of unfiltered air inleakage.

- Based on all data sets, there appears to be an outleakage between the filter train fan and the filter train discharge test points on both filter trains.

- Blanking off the toilet and kitchen exhaust line for repair of the toilet and kitchen exhaust fan results in higher overall inleakage into the control room HVAC system when train "A" is in service. (See magnitude of difference in Table 2 for Data Sets 2 and 4.) With train B in service the flow to the control room envelope decreased and return air flow increased.

The survey team believes that the difference in flow may be attributed to leakage in the kitchen and toilet exhaust isolation dampers and ducts. There may also be some cross flow from one train to the other during the emergency mode of operation. SCE&G should evaluate these findings and determine where inleakage is occurring.

- Because the readings taken by ANL showed that flows in the control room HVAC system are outside the technical specification limits, SCE&G personnel took readings using a pitot tube to have a data base for comparison. Data sets 5 and 6 in Tables 2 and 3 are the readings taken by SCE&G. Because the readings taken by SCE&G with the pitot tube show that the flows are within the technical specifications and the ANL readings taken with a hot wire anemometer are high, the survey team checked the hot wire anemometer against a different pitot tube. The comparisons made by the survey team showed that the hot wire anemometers read about 8% lower than the pitot tube. According to several text books reviewed by survey team members, the pitot tube is more accurate than a hot wire anemometer at high flows, but the pitot tube readings are not as accurate in low velocity areas and the error will show a higher flow condition with the pitot tube than with the hot wire anemometer. In the low flow ducts at V. C. Summer the pitot tube readings taken by SCE&G were lower than the readings obtained with the hot wire anemometer.

- SCE&G should check the air velocity reading in the control room HVAC system using a different pitot tube to verify the accuracy of the instrument used during the survey. Also, SCE&G should examine their calibration procedures and methods to verify that instruments are properly calibrated.

9.6 Outside Air Infiltration

The number of occupants in the control room envelope during an emergency at V. C. Summer nuclear station is considerably larger than that of most plants surveyed due to the technical support center, health physics supervisor's office, and other offices being located inside the envelope. The ten cfm ingress-egress assumed in the safety analysis is based on control room occupancy and does not include the technical support center or personnel in the health physics supervisor's office, etc.

The survey team believes that a more realistic value should be used for ingress-egress based on the total number occupants of the control room envelope.

The III.D.3.4 evaluation does not include any outside air infiltration due to duct, AHU housing, or isolation valve leakage.

The survey team recommends that the III.D.3.4 submittal be re-evaluated using revised values for outside air infiltration due to higher ingress-egress and other system inleakage.

9.7 LER Evaluation

There are no LER's associated with the loss of cooling to the control room envelope. However, during the data collection portion of the survey temperature in the control room reached a value of 82°F as read on the control room technical specification thermometer. See items 9.3.5 and 9.4.1 of this report for further discussion.

TABLE 1

V. C. SUMMER NUCLEAR STATION

DIFFERENTIAL PRESSURE DATA

LOCATION	DATA SET 1	DATA SET 2	DATA SET 3	DATA SET 4
CONTROL ROOM TO OUTSIDE (UPPER dP GAUGE)	+0.16 IN. W.G.	+0.18 IN. W.G.	+0.16 IN. W.G.	+0.20 IN. W.G.
CONTROL ROOM TO OUTSIDE (LOWER dP GAUGE)	+0.16 IN. W.G.	+0.18 IN. W.G.	+0.16 IN. W.G.	+0.20 IN. W.G.
CONTROL ROOM TO CABLE CHASE ROOM (DOOR CB-508)	+0.15 IN. W.G.	+0.19 IN. W.G.	+0.15 IN. W.G.	+0.18 IN. W.G.
CONTROL ROOM TO CABLE CHASE ROOM (DOOR CB-513)	+0.13 IN. W.G.	+0.17 IN. W.G.	+0.14 IN. W.G.	+0.19 IN. W.G.
CONTROL ROOM TO CABLE CHASE ROOM (DOOR CB-514)	+0.155 IN. W.G.	+0.19 IN. W.G.	+0.15 IN. W.G.	+0.19 IN. W.G.
CONTROL ROOM TO ELEVATOR SHAFT (MAIN DOOR)	+0.11 IN. W.G.	+0.14 IN. W.G.	+0.185 IN. W.G.	+0.21 IN. W.G.
CONTROL ROOM TO WEST STAIRS (DOOR CB-517)	+0.08 IN. W.G.	+0.06 IN. W.G.	+0.14 IN. W.G.	+0.18 IN. W.G.
CONTROL ROOM TO CABLE CHASE ROOM (DOOR CB-516)	+0.135 IN. W.G.	+0.145 IN. W.G.	+0.115 IN. W.G.	+0.18 IN. W.G.
CABLE SPREADING ROOM WEST DOOR (DOOR CB-402)	+0.19 IN. W.G.	+0.13 IN. W.G.	+0.125 IN. W.G.	+0.23 IN. W.G.
CABLE SPREADING ROOM EAST DOOR (DOOR CB-401)	+0.065 IN. W.G.	+0.105 IN. W.G.	+0.11 IN. W.G.	+0.19 IN. W.G.

NOTE: Data sets 5 and 6 were taken at the same time as data sets 3 and 4 therefore there are no Dp readings for data sets 5 and 6.

TABLE 2

V. C. SUMMER NUCLEAR STATION

CONTROL ROOM HVAC SYSTEM FLOW DATA

POINT #	LOCATION	DATA SET 1	DATA SET 2	DATA SET 3	DATA SET 4	DATA SET 5	DATA SET 6
1	TRAIN A OUTSIDE AIR FOR PURGE SUPPLY	-148	-176		-192		
2	OUTSIDE AIR MAKEUP TO AHU TRAIN A	460	-706		-594		
4	FILTER TRAIN A DISCHARGE	-241	25294		24865		22058
6	TRAIN A AHU DISCHARGE	-364	24775		25325		21384
8	CONTROL ROOM ENVELOPE RETURN TO TRAIN A	337	23406		22779		21830
10	KITCHEN AND TOILET EXHAUST	28	203	*	*	*	*
12	OUTSIDE AIR MAKEUP TO FILTER TRAIN A	-405	1369		1268		
13	TRAIN A OUTSIDE AIR INTAKE	-15	1252		1243		967
14	FILTER TRAIN A INLET	109	26031		25666		22224
15	TRAIN B OUTSIDE AIR PURGE SUPPLY	0	0	0			
16	OUTSIDE AIR MAKEUP TO TRAIN B AHU	569	0	559			
18	FILTER TRAIN B DISCHARGE	24585	-206	24109		20652	
20	TRAIN B AHU DISCHARGE	23336	-189	23095		21004	
22	CONTROL ROOM ENVELOPE RETURN TO TRAIN B	22515	191	23199		20882	
26	OUTSIDE AIR MAKEUP TO FILTER TRAIN B	778	-212	1302			
27	TRAIN B OUTSIDE AIR INTAKE	1035	0	984		943	
28	FILTER TRAIN B INLET	27375	0	27758		21026	
29	I&C CALIBRATION SHOP SUPPLY	8153	8626				
30	I&C CALIBRATION SHOP RETURN	6655	7307				

* KITCHEN AND TOILET EXHAUST FAN REMOVED AND DUCT BLANKED OFF WITH POLYETHYLENE SHEETING

TABLE 3

V. C. SUMMER NUCLEAR STATION

CONTROL ROOM HVAC SYSTEM FLOW COMPARISONS

DATA SET	TRAIN IN SERV. SERV.	AHU IN. = AHU OUT. (A) 1+2+4=6 (B) 15+16+18=20	C.R. IN = C.R. C.R. OUT 6+20 = 8+10+22	FILTER IN. = FILTER OUT. (A) 14=4 (B) 28=18	C.R. RETURNS + KITCHEN/TOILET RETURNS + OAI = FILTER OUTLET (A) 8 + 10 + 13 = 4 (B) 22 + 10 + 27 = 18
1	B	0 - 569 + 24585 = 23336 24016 = 23336	-364 337 2336 28 22515 22972 = 22880	27375 = 24585	22515 + 28 + 1035 = 24585 23578 = 24585
2	A	-176 -706 +25294 = 24775 24412 = 24775	24775 23406 -189 203 191 24586 23800	26031 = 25294	23406 + 1252 + 203 = 25294 24861 = 25294
3	B	0 - 559 + 24109 = 23095 23550 = 23095	*** 20 = 22 23095 = 23199	27758 = 24109	** 23199 + 984 = 24109 24183 = 24109
4	A	-192 -594 +24865 = 25325 24079 = 25325	*** 6 = 8 25325 = 22779	25666 = 24865	** 22779 + 1243 = 24865 24022 = 24865
5*	B	NOT ENOUGH DATA TAKEN	*** 20 = 22 21004 = 20882	21026 = 20652	** 20882 +943 = 20652 21825 = 20652
6*	A	NOT ENOUGH DATA TAKEN	*** 6 = 8 21384 = 21830	22224 = 22058	** 21830 + 967 = 22058 22797 = 22058

* DATA TAKEN BY SCE&G USING A PITOT TUBE ALL OTHER DATA TAKEN WITH A HOT WIRE ANEMOMETER
** TOILET AND KITCHEN RETURN LINE BLANKED OFF WITH POLYETHYLENE SHEETING
*** CONTROL ROOM INLET AND OUTLET DATA TAKEN ON OPERATING TRAINS ONLY FOR DATA SETS 3 - 6