U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report Nos. 50-456/94008(DRP); 50-457/94008(DRP)

Docket Nos. 50-456; 50-457 License Nos. NPF-72; NPF-77

Licensee: Commonwealth Edison Company
Opus West III
1400 Opus Place
Downers Grove, IL 60515

Facility Name: Braidwood Station, Units 1 and 2

Inspection At: Braidwood Site, Braceville, Illinois

Inspection Conducted: March 7 through April 5, 1994

Inspectors: S. G. Du Pont
E. R. Duncan

Approved By: B. L. Jorgensen, Chief
Reactor Projects Section 1A

4/19/94
Date

Inspection Summary

Inspection from March 7 through April 5, 1994 (Report Nos. 50-456/94008(DRP); 50-457/94008(DRP))
Areas Inspected: Special, reactive safety inspection to review the circumstances surrounding the inoperability of both trains of Control Room Ventilation.
Results: The condition of having both trains of Control Room Ventilation (VC) inoperable is an apparent violation of Braidwood Technical Specification 3.7.6.

- Several opportunities were missed to self-identify that the VC system was inoperable.
- The VC system was inoperable since before 1992.
- Ineffective usage of design basis information was a significant contributor.

DETAILS

1. Purpose (IP 93702)

This inspection was conducted to review the circumstances surrounding the inoperability of both trains of Control Room Ventilation discovered on February 18, 1994.

2. Description of Event

On February 17, 1994, the Braidwood NRC Resident Inspector notified the site System Engineering Supervisor that the South Texas Plant had recently experienced problems with the backup batteries for the actuators in their Control Room Ventilation (VC) system. An investigation was immediately begun to see if a similar situation existed at Braidwood. System Engineering determined that similar damper actuators were only in the main VC system. There are four dampers in each of two trains, with two dampers in each train having two actuators, for a total of ten actuators. System Engineering initially determined that two actuators on Train B were affected. Each actuator has a battery test card which applies a half amp load on the actuator battery for five seconds every day. When the voltage at the end of the test drops below 69 volts, a "battery bad" light stays lit. This light, like others on the card, are under the actuator's cover. Since the lights and batteries are not easy to reach, some requiring scaffolding for examination, System Engineers did not immediately check other actuators.

System Engineering also began reviewing the design basis of the system to determine the safety function of the batteries. The vendor manual contained some information for operability. The manual stated that the "battery bad" light illuminates at 69 volts, but the battery was acceptable to 60 volts. The vendor had also informed the station that these batteries had a 10-year life. The licensee determined that an actual operability determination would require a manual voltage test of all batteries by Electrical Maintenance (EMD).

On the morning of February 18, 1994, System Engineering collected battery voltages to determine operability. The results indicated four failed batteries on train B. Later, collected data indicated that all of the batteries in train A were also failed.

At 1:05 p.m., on February 18, station management met to review the data. Based on Site Engineering evaluation and System Engineering data, the station declared both trains of VC inoperable. Technical Specification (TS) 3.0.3 was entered and the station requested a Notice of Enforcement Discretion (NOED), at 3:15 p.m., on February 18. The NRC granted the NOED at 4:00 p.m., allowing 72 hours to block the dampers shut and satisfy the technical specifications. The station completed the requirements of the NOED and exited TS 3.0.3 at 8:27 p.m. on February 20, 1994.

3. System Description

The Control Room HVAC System (VC) provides the proper environmental conditions conducive to habitability in the Control Room Envelope under normal and abnormal station conditions.

The VC is comprised of two 100 percent capacity, redundant equipment trains, each located in separate HVAC equipment rooms. One train is normally in operation with the other train in standby.

During normal operation, the VC System flowpath consists of air being drawn in through the missile protected outside air intake. The incoming (makeup) air maintains the Control room envelope pressure +.125 in. H_2O above atmospheric pressure. This positive pressure precludes infiltration of potentially contaminated air from adjacent areas.

Under normal conditions, air is recirculated through the system with only a small amount of air needed for makeup. The normal ventilation flowpath will be automatically shifted under a high ionization detection (smoke detection), high radiation detection or a Safety Injection actuation (Attachments 1 and 2).

The makeup air mixes with the return air at the return fan suction. The combined air is discharged to the mixed air plenum via the return fan. The air then passes through the supply filter and will be bypassed around the recirculation charcoal adsorber to the suction of the supply fan. The air is then distributed throughout the Control Room Envelope.

Air is exhausted out of the combined Control Rooms and sent to the return air header. Air from the return header mixes with makeup air in the return fan suction lines as previously described.

If high radiation is detected in the outside air during normal operation, the Makeup Air Fan automatically starts, the inlet and discharge dampers (OVC025Y for Train A: OVC009Y and OVC008Y for Train B) automatically open to provide makeup air to the return fan suction to mix with the return air. The remainder of the system flowpath is identical to the normal flowpath with the exceptions that the supply air to the Control Room Envelope automatically passes through the charcoal adsorber.

Purging of the Control Room Envelope would occur after a fire to remove the smoke. During purging operations of the Control room Envelope, air is taken in through a normally closed purge intake line (OVC020Y for Train A; OVC004Y for Train B) off of the missile protected outside air intake. The air passes through the mixed air plenum and is delivered to the Control Room Envelope in a normal manner. However, the exhausted air from the Control Room Envelope (return air) is discharged to the turbine building through the normally closed purge outlet damper (OVC018Y for Train A; OVC002Y for Train B).

At Braidwood, eight dampers (OVC02Y, OVC04Y, OVC16Y, OVC18Y, OVC20Y, OVC281Y, OVC312Y, AND OVC313Y) are of a bubble tight configuration to provide a leak seal in the event of a high radiation condition or a chlorine accident.

The dampers are two-position, opening and closing by the signaled action of the Borg-Warner electro-hydraulic actuators. When closed, the dampers are to seal "bubble tight" as defined by ANSI N510-1980. In the signaled power mode, the actuators open (or close) the damper blades in between 7 and 20 seconds. In the "failed" mode, with power to the actuators interrupted, emergency batteries located within the actuator are designed to close the damper blades in less than five seconds.

Per the technical manual, there are two safeguards to prevent inadvertent drainage of the battery pack power within the actuator; a fuse to disconnect the battery from the pump motor, and a "battery safeguard strip" between relay K1 contacts.

To prevent battery damage or drainage, the battery fuse must be removed before removing AC power and the fuse must not be reinstalled until after 120 VAC has been applied.

4. Chronology of Events

January 6, 1987

Damper OVC313Y (Attachment 2) did not close on loss of normal power supply during initial installation testing. The Operational Analysis Department (OAD) replaced the battery associated with damper OVC313Y and completed a satisfactory retest prior to turning the system over to System Engineering for pre-operational testing.

October 1, 1987

Damper OVC04Y (Attachment 2) would not open. EMD found motor grounded and dead battery pack. Both the motor and battery pack, as well as other failed components, were replaced and operationally checked by cycling the damper and the damper was returned to service.

June 24, 1988

Damper OVC16Y (Attachment 2) did not open when the VC supply fan was started. EMD found the motor grounded and the backup battery bad. Both the motor and battery pack, as well as other failed components, were replaced and the damper was returned to service.

August 15, 1989

Damper OVC018Y (Attachment 1) failed to open. EMD found motor grounded and dead battery pack. Both the motor and battery pack, as well as other failed components were replaced and operationally checked by cycling the damper and the damper was returned to service.

September 3, 1991

Damper OVCO2Y (Attachment 2) did not actuate when a purge signal was manually generated. EMD replaced both actuators (which included the motor and battery pack) and observed the damper stroke with proper indication prior to returning the damper to service.

March 18, 1992

The licensee conducted a technical review of the technical manual for the Control Room Ventilation system as directed by Generic Letter 90-03, "Vendor Interface for Safety-Related Components."

July 28, 1992

System Engineering discussed the need for a damper battery surveillance with EMD. EMD agreed to perform preventive maintenance and write a surveillance test for the batteries. This action item was not entered into the Commitment Tracking System nor was it accomplished.

August 7, 1992

System Engineering discussed with the operations department the need to pull damper battery fuses prior to the future Station Auxiliary Transformer (SAT) outage, which would deenergize the normal damper actuation power supply. Also discussed was the need for a note in the outage editor concerning bubble tight dampers.

February 18, 1994

Both trains of Control Room Ventilation (Attachments 1 and 2) were declared inoperable following discovery that both A and B train Control Room Ventilation batteries were inoperable. Technical Specification 3.0.3 was entered and the licensee requested and received a Notice of Enforcement Discretion (NOED) giving the station 72 hours to block the dampers shut.

February 20, 1994

The licensee exited TS 3.0.3 at 10:27 a.m., after successfully blocking the VC bubble tight dampers shut.

5. Determination of Root Causes, Duration, and Management Involvement

The inspectors reviewed the event and various processes to determine the root causes and contributing factors. These processes included the vendor manual verification (VTIP), surveillance and maintenance procedures, and component failure records. This review revealed that on several occasions, opportunities existed for the licensee to self-identify and correct the problem. However, in all cases, it was determined that the opportunities were missed.

A chronology of these opportunities are listed in Paragraph 4 of this report. The following issues were reviewed:

- Applicable technical specification requirements.
- Root causes of the event.
- Failure to adequately transfer preoperational information to operational surveillances.
- Inadequate VTIP reviews.
- Lack of analytical evaluation of equipment failures.
- Ineffective usage of design basis.
- Duration of inoperability.
- Management involvement.

Technical Specification (TS) 3.7.6 requires two independent trains of control room ventilation (VC) systems to be operable in all modes of operation. Operability as defined by TS is a system being capable of performing its specified functions and all necessary support components being capable of performing their related support functions. A system description is contained in Paragraph 5 of this report and Attachments 1 and 2 provide a simplified drawing.

The support function of the VC damper actuator batteries is to ensure the actuators are capable to perform their fail safe function during a loss of normal power. The dampers are required to protect the control room from toxic and hazardous environments. The batteries are designed to ensure that the dampers remain closed despite loss of normal electrical power.

A review of surveillance testing revealed that this design support function had not been verified since licensing both Units 1 and 2. Additionally, on February 18, these batteries were found to be inoperable.

The root cause of this condition was the lack of establishing surveillance activities to verify operability. Major contributors were ineffective usage of design basis information and the lack of analytical evaluations during several failures of the batteries. These opportunities should have alerted Braidwood of the potential and actual inoperability of the VC system. The first opportunity to capture the design basis functions of the backup batteries within the damper actuators occurred prior to licensing of both Units 1 and 2 in late 1987.

Preoperational testing of the VC system verified the support functions of the backup batteries. Additionally, during testing, a failure of the battery for damper OVC313Y (Attachment 2) occurred on January 6, 1987. Documentation verified that the battery was replaced and returned to operable. The vendor manual contained information for installing the batteries. These instructions were followed.

The vendor manual's instructions contained steps that were vital in protecting the batteries from inadvertently discharging during installation. These instructions were also supported by a memorandum, dated February 6, 1986. The memorandum was written by Borg-Warner (manufacturer) with a carbon copy to Sargent & Lundy (architect engineer). The memorandum also established that the batteries could inadvertently discharge whenever the normal electrical power to the actuators was removed. This condition required similar protection measures as instructed by the manual during installation.

Other opportunities to establish the need of surveillances to determine operability occurred during two vendor manual verifications (VTIP). In late 1986 and on March 18, 1992, VTIP reviews were conducted. The purposes of these reviews included a verification that the needed surveillance activities establishing TS operability were being implemented.

The initial review in 1986 failed to recognize or use the design basis of the actuator backup batteries. Although the vendor manual does not prescribe or recommend surveillance activities to maintain or verify operability of the batteries, usage and understanding of the design basis should have been sufficient to implement adequate surveillance and preventive maintenance activities. It is also apparent that the Borg-Warner memorandum of February 1986 was not included in the initial VTIP review.

Subsequent to the initial VTIP review, the Borg-Warner memorandum was discovered and included in the second VTIP review. This review of March 18, 1992, also failed to recognize the need for surveillance and preventive maintenance activities to establish and maintain the fail-safe feature of the actuators.

Additional opportunities were routinely missed because of the lack of an analytical approach to repeated failures of the batteries. As listed in Paragraph 4 of this report, several battery failures occurred between 1988 and 1991. In each case, the batteries were replaced without questioning the need for preventive maintenance or surveillances to verify operability.

Additionally, in all cases, root cause determinations were not performed. Prior to 1992, Braidwood's root cause determinations were evaluated by the NRC as being a weakness. Since 1992, Braidwood's corrective actions pertaining to root cause determinations have become effective and are currently a strength. Another contributor was the failure to use design basis information. Although this information was

readily available from Site Engineering, their assistance was not requested during this period. Since the problem of repeated failures was not known by Site Engineering these opportunities were also missed.

Since the design basis information was available and Site Engineering assistance was not requested until the system was found inoperable, the lack of usage of design information appeared to be a significant contributor. The failure to recognize and use the design information appears to be a common contributor to each failed opportunity. In addition to the opportunities during the VTIP reviews and battery failures, another opportunity was missed on August 7, 1992.

System Engineering recognized in mid-1992 that protective measures were needed for the September 1992 Station Auxiliary Transformer (SAT) outage. System Engineering also recognized that the backup batteries were vulnerable to discharging during the extended period that the normal power source were deenergized for the SAT outage. Finally, System Engineering recognized that routine preventive maintenance and operability surveillances were not established and implemented.

System Engineering ensured that adequate protective measures were included in the out-of-service instructions for the SAT outage. Additionally, System Engineering and Electrical Maintenance discussed the need for and recommended the implementation of a formal preventive maintenance procedure. However, neither department implemented the recommendation and procedures were not established. Additionally, neither department recognized the need to establish surveillance procedures to routinely verify operability to meet the technical specification requirements.

The inspectors reviewed the chronology of these events to determine the duration of inoperability of the VC system. However, without documentation of operability verifications, an exact duration is indeterminable.

It is, however, also indeterminable to prove operability. Since protective measures to prevent discharging of the batteries were only established for the September 1992 SAT outage, any bus or SAT outage would have rendered the batteries inoperable, either before or after the 1992 outage. Additionally, the batteries were not verified to be operable after the completion of the 1992 SAT outage. Because of the lack of operability surveillance, it is not possible to establish that the batteries were operable either before or after the outage. Based on these considerations, the licensee determined that the VC system was inoperable prior to September 1992, but the exact date of inoperability could not be determined.

The inspectors also reviewed management's involvement during the events described in Paragraph 4 of this report. Although senior station management was not routinely involved with many of the events, management and corporate management missed an opportunity after February 11, 1994.

The South Texas Nuclear Facility made several requests to purchase spare batteries from Braidwood between February 1 and 11, 1994. Braidwood personnel were not informed about the conditions at South Texas that warranted the purchase of all five spares onsite. Unknown to Braidwood, South Texas had found that their batteries were inoperable and that spares were not available from the manufacturer.

On or about February 11, 1994, South Texas made a direct request of Braidwood's corporate management. This eventually resulted in all of the Braidwood spares being shipped to South Texas. Neither station nor corporate senior management checked to ensure that the Braidwood VC system was operable before releasing all spares. This is also considered to be a missed opportunity.

6. Licensee Corrective Actions

Upon discovery that both trains of Main Control Room Ventilation were inoperable, the licensee immediately entered TS 3.0.3 and requested and received from the NRC a Notice of Enforcement Discretion (NOED) giving the station 72 hours to block the dampers shut.

On February 20, 1994, at 10:27 a.m., the bubble tight dampers associated with VC were blocked shut, providing damper leak-tightness, and TS 3.0.3 was exited.

The licensee's long-term corrective actions included:

a. Establishing a preventive maintenance program for the bubble tight damper actuators. This is being tracked to completion by action item 456-180-94-00201.

b. Establishing a surveillance requirement to check the condition of the VC damper batteries. This is being tracked to completion by action item 456-180-94-00202.

c. Procedure revisions associated with de-energizing electrical buses feeding these actuators to include pulling actuator fuses to minimize battery drainage.

The inspectors reviewed the licensee's procedure revisions and noted that these revisions were incomplete. Although the licensee properly revised their outage procedures to pull fuses associated with dampers on VC train A, the fuses for the dampers associated with train B were inadvertently omitted. When pointed out to the licensee, a procedure revision request was submitted to complete the procedure revisions.

7. Persons Contacted

K. Kaup, Site Vice President
*A. Haeger, Executive Assistant
*K. L. Kofron, Station Manager
R. Stols, Support Services Director
*K. Bartes, Regulatory Assurance Supervisor
R. Kerr, Engineering and Construction Manager
*D. E. Cooper, Operations Manager
G. E. Groth, Maintenance Superintendent
R. Byers, Work Control Superintendent
D. Miller, Technical Services Superintendent
A. D'Antonio, Quality Verification Superintendent
*D. Skoza, Engineering Supervisor
S. Roth, Security Supervisor
*G. E. Kinsella, Fire Marshall
*A. R. Checca, System Engineering Supervisor
*J. Gosnell, System Engineer
*S. Butler, QV Inspector
J. Lewand, Regulatory Assurance

*Denotes those attending the exit interview conducted on April 5, 1994.

The inspectors also interviewed several other licensee employees.

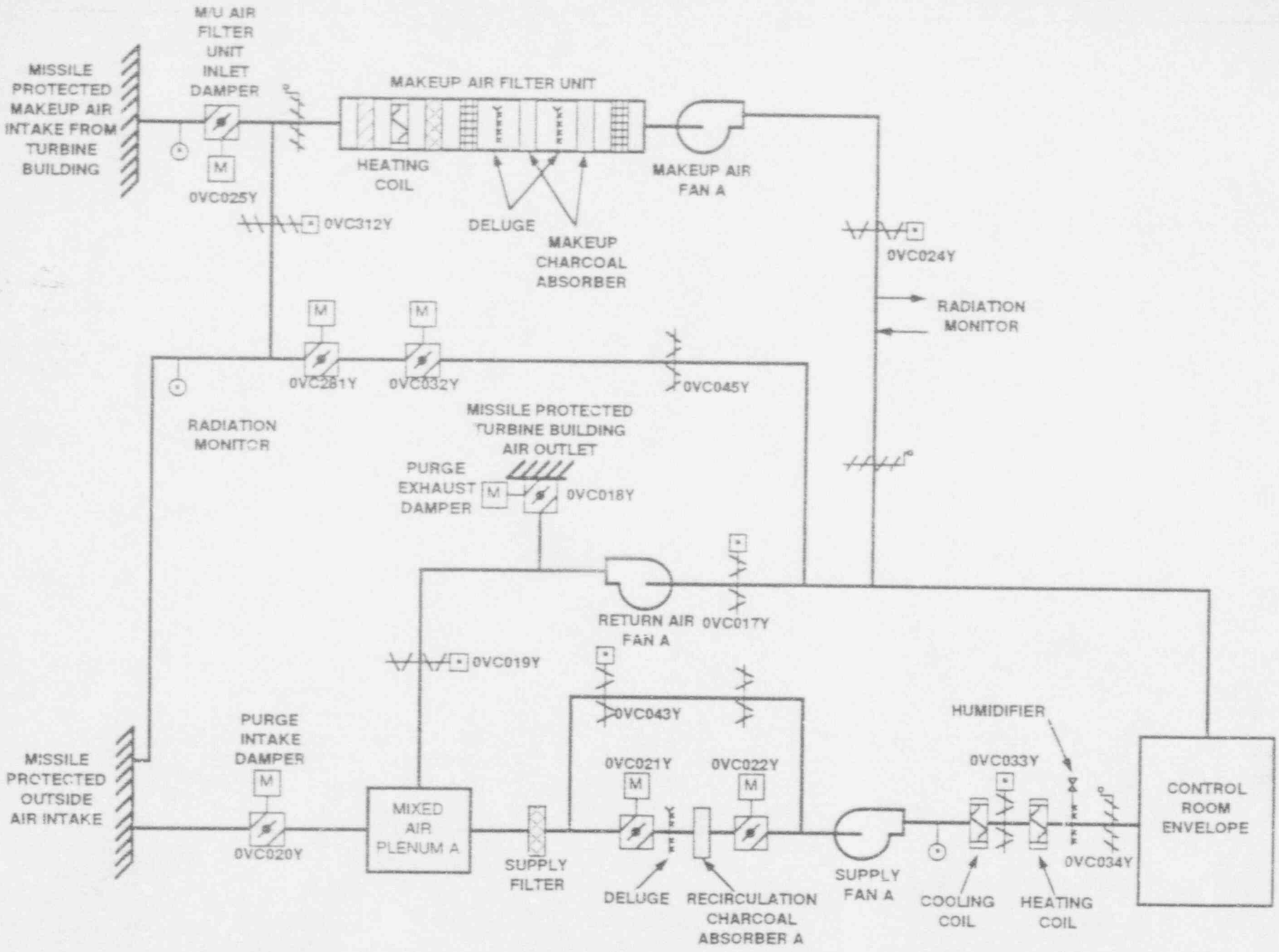

FIGURE 1 CONTROL ROOM HVAC SUPPLY TRAIN A

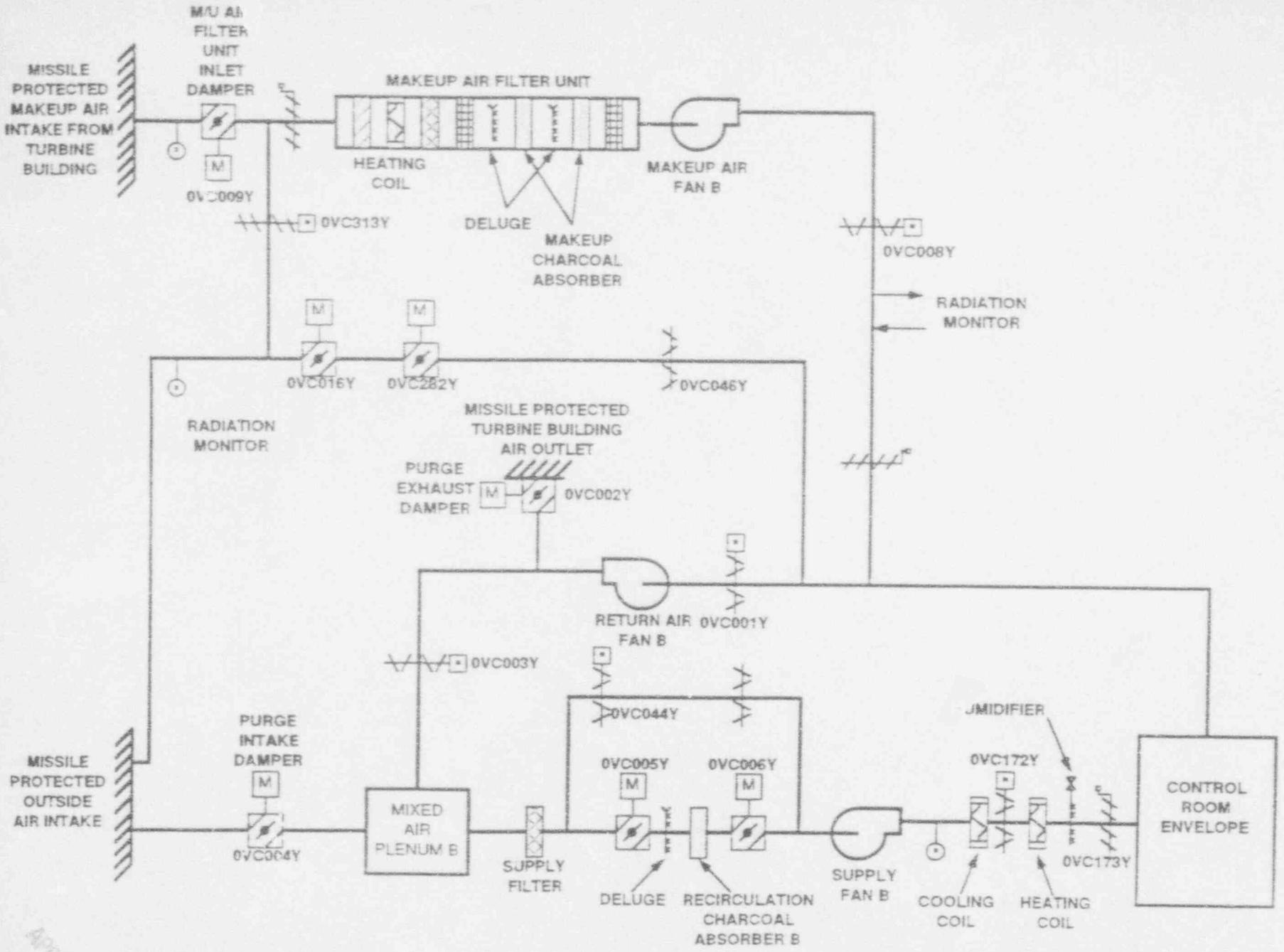

FIGURE 2 CONTROL ROOM HVAC SUPPLY TRAIN B