TECHNICAL EVALUATION REPORT

REVIEW OF THE DESIGN AND OPERATION OF VENTILATION SYSTEMS FOR SEP PLANTS

(SEP, IX-5)

CONSUMERS POWER COMPANY
BIG ROCK POINT PLANT

NRC DOCKET NO. 50-155

NRC TAC NO. 47075

NRC CONTRACT NO. NRC-03-79-118

FRC PROJECT C5257

FRC ASSIGNMENT 15

FRC TASK 414

Prepared by

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Prepared for

Nuclear Regulatory Commission
Washington, D.C. 20555

Lead NRC Engineer: S. Brown

August 13, 1982

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FOREWORD

This Technical Evaluation Report was prepared by the Franklin Research Center under a contract with the U.S. Nuclear Regulatory Commission (Office of Nuclear Reactor Regulation, Division of Operating Reactors) for technical assistance in support of NRC operating reactor licensing actions. The technical evaluation was conducted in accordance with criteria established by the NRC.

1. INTRODUCTION

This review of the design and operation of ventilation systems at the Big Rock Point Plant is part of Topic IX-5 of the Systematic Evaluation Program (SEP) and consists of the technical review and assessment of safety systems in light of changes in design conditions and criteria. The purpose of this review is to ascertain whether the ventilation systems can provide a safe environment for plant personnel under all modes of operation and whether all safety-related equipment can function properly to ensure safe shutdown of the reactor under normal and emergency conditions.

The SEP was established to evaluate the safety of 11 of the older nuclear plants. An important part of the SEP is the evaluation of each plant according to current licensing criteria with regard to 137 selected topics. A wide range of information sources is used, including final safety analysis reports, more recent drawings and system descriptions, and licensee submittals.

Information for this review included the above sources, elements of related SEP topics already reviewed for the Big Rock Point Plant, and a plant visit on June 21, 1982. Special emphasis was placed upon information sources [1, 2, 3] documenting those components and systems necessary for safe shutdown.

2. REVIEW CRITERIA

In accordance with Nuclear Regulatory Commission (NRC) guidance for this evaluation, a ventilation system or portion thereof is considered essential to safety if it services systems or parts of systems that are necessary to ensure:

- o the integrity of the reactor coolant pressure boundary
- o the capability to shut down the reactor and maintain it in a safe condition
- o the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the guidelines of 10CFR100, "Reactor Site Criteria."

The criteria and guidelines used to determine if the ventilation system meet the topic safety objectives are provided in the following sections of the Standard Review Plan:

Section	Subject
9.4.1	Control Room Area Ventilation System
9.4.2	Spent Fuel Pool Area Ventilation System
9.4.3	Auxiliary and Radwaste Area Ventilation System
9.4.4	Turbine Area Ventilation System
9.4.5	Engineered Safety Features Ventilation System

In addition, applicable portions of related safety topic reviews were used where possible.

In accordance with NRC guidance, the following criteria (expressed in the form of questions to be determined) also were used to evaluate those heating, ventilation, and air conditioning (HVAC) systems or portions thereof that are relied upon to ensure the operation of safety-related equipment:

1. Whether a single active failure cannot result in loss of the system functional performance capability.

2. Whether the failure of a non-safety-related portion of a system will affect the performance of the essential portion of the system or will result in an unacceptable release, as was defined during licensing review, of radioactive contaminants.

3. Whether the capability exists to detect the need for isolation and to isolate safety-related portions of the system in the event of failures or malfunctions, and the capability of the isolated system to function under such conditions.

4. Whether the ventilation systems (except for the control room) have the capability to direct ventilation air from areas of low radioactivity to areas of progressively higher radioactivity.

5. Whether both control room and engineered safety feature area ventilation systems have the capability to maintain temperature within the design parameters range for safety-related equipment.

6. Whether the engineered safety feature area ventilation system has the capability to circulate air to prevent accumulation of flammable or explosive fuel vapor mixtures from stored fuel.

3. RELATED SAFETY TOPICS

The scope of review for this topic was limited to avoid duplication of effort, since some aspects of the review are covered under related topics. These related topics are identified below. Each related topic report contains acceptance criteria and review guidance for its subject matter.

SEP Topic	Subject
II-2.A	Severe Weather Phenomena
II-3.3	Flooding Potential
II-4	Geology and Seismology
III-1	Classification of Structures, Components and Systems (Seismic and Quality)
III-2	Wind and Tornado Loadings
III-3	Hydrodynamic Loads
III-4	Missile Generation and Penetration
III-5.A	Pipe Breaks Inside Containment
III-5.B	Pipe Breaks Outside Containment
III-6	Seismic Design Considerations
III-12	Environmental Qualification of Safety-Related Equipment
VI-4	Containment Isolation System
VI-7.C.1	Independence of Onsite Power
VII-3	Systems Required for Safe Shutdown
IX-3	Station Service and Cooling Water
IX-6	Fire Protection
XV-20	Radiological Consequence of Fuel Damaging Accidents (Inside and Outside Containment)
TMI III.D.3.4	Control Room Habitability

4. TECHNICAL EVALUATION

4.1 CONTROL ROOM AREA VENTILATION SYSTEM

The Licensee described the control room ventilation as follows:

"The control room area ventilation system provides a controlled environment for the control room and the control room panel. The system utilizes a mixture of fresh air and recirculated air which is filtered after mixing in the mix plenum. The air will then be heated from the heat coil supplied from the steam boiler heating system or cooled from the cooling coil supplied from the service water pumps feeding from the lake. The air is then humidified and delivered into the control room.

The control room ventilation system will not function following loss of offsite power as it does not have emergency power available. Room temperature increase due to high ambient temperatures and temperature increases from electrical equipment in the area is not likely to cause failure of equipment. This area was not considered hostile in our submittals on Environmental Qualification dated 10/31/80 and 1/30/81. As a nonhostile environment, the area would experience an insignificant rise in temperature due to operating equipment heat loss.

Typically, Big Rock Point equipment is designed to operate in ambient temperatures up to 104°F. Exterior daytime temperatures at the plant normally range from 75°F to 90°F during the months of July and August. Therefore, temperatures would not affect the operation of equipment following a failure of the ventilation system."

Since the control room ventilation system is being reviewed generically under TMI Item III.D.3.4, "Control Room Habitability," further review was not made for this calculation.

4.2 SPENT FUEL POOL VENTILATION SYSTEM

The Licensee provided the following description of the spent fuel pool, which is located in the reactor containment building [1]:

"The function of the spent fuel ventilation system is to maintain ventilation in the spent fuel pool equipment areas, permit personnel access and control airborne radioactivity in this area during normal plant operation.

The spent fuel pool ventilation system, which is part of the reactor containment ventilation system, has an exhaust air vent located at the top edge of the fuel pool. The fuel pool area vents to the stack through the exhaust system which is a draft induced system.... Since the fuel pool is located in the reactor containment building there is no need for the ventilation system to work post-accident.

Ventilation air to the reactor containment building is controlled to maintain a slight negative pressure within the building. The ventilation building is attached to the containment building which contains the inlet for outside air into the containment building, a filtering system, a heating coil supplied by the steam boiler heating system and an air intake line bypassing the heating coil. Two air supply fans are located inside containment. Each air supply fan suction has an open/shut damper positioner with initiation integral to the fan starting circuit and inlet vanes controlled by indoor/outdoor differential pressure to regulate airflow.

A reactor building vacuum relief line with damper control integral to supply air fan motor starting circuits is open to the building when both supply air fans are stopped, insuring a free path for outside air in the event that the building vacuum must be relieved. Two 24" diameter pneumatic cylinder and spring-operated check and butterfly valves, connected in series, are provided for the supply air inlet and for the exhaust air outlet to isolate the reactor building ventilation air. These valves are arranged for spring closing and air opening and are closed either automatically or manually during all scrams."

The requirements concerning safety-related equipment within the reactor containment building are addressed under SEP Topic III-12, Environmental Qualification of Safety-Related Equipment [4], and SEP Topic VI-4, Containment Isolation System. The spent fuel pool is not essential to safe shutdown or to mitigation of conditions following loss-of-coolant accidents; however, it is reviewed under this topic with respect to personnel hazards and the release of radioactivity outside the plant.

As described above by the Licensee, the containment building has the capability for isolation to prevent the spread of radioactive material from the spent fuel pool outside the plant. With respect to personnel hazards, the ventilation air flow over the spent fuel pool is downward toward the pool water surface, where it is collected by a series of exhaust ports along the edge of the pool just above the water surface. Thus, the air flows from working areas to the pool water surface and into the exhaust ducts. The criteria for this review are satisfied.

4.3 TURBINE AND SERVICE BUILDING VENTILATION SYSTEM

The Licensee provided the following description of the turbine building ventilation system [1]:

"The turbine and service building ventilation system is composed of three air supply systems. These include the condensate pump room heating and ventilation system, the shop heating and ventilation system and the equipment room cooling system.

The condensate pump room ventilation system utilizes both outside air and recirculated air to provide ventilation to the condensate pump room. The air passes through a filter and can either pass over a heating coil, which is supplied from the steam boiler system, or can pass by the heating coil. A fan will deliver air into the condensate pump room and will then be distributed to the radwaste area and to the condensate demineralizer room. Equipment is this area is not required to operate in a post-accident condition.

The shop area ventilation system utilizes both outside air and recirculated air to provide ventilation to the shop area room. The air passes through a filter and can either pass over a heating coil, which is supplied from the steam boiler system, or can bypass the heating coil.

A fan will deliver air into several areas including the tool crib, shop, storeroom, condenser area, pipe tunnels and the decontamination washdown areas. An additional outside air intake supplies airflow to the pipe tunnel and the area under the turbine. Equipment in this area is not required to operate in a post-accident condition.

The equipment room area ventilation system provides cooling to the heating and ventilating equipment room and the air compressors and electric equipment room. The system recirculates air within the room through a cooling unit and supplies ventilation to the lube oil storage room and the turbine lube oil tank.

The equipment room contains equipment that will be required to operate post accident. Ventilation will not remove contaminants, therefore, the area will be evacuated in a post-accident situation.

With loss of offsite power, the ventilation system and the station power transformers, which are the primary source of heat, will not operate. Ventilation and temperature control for the equipment room under the above condition may be adequately maintained by opening any one of three doors in this area to the outside environment.

The turbine and service building ventilation systems are forced-draft induced systems with draft induction, the result of two exhaust fans which also push the exhaust air through the exhaust ventilation stack. The turbine building and service building will not require post-accident ventilation for either heat or contamination removal."

As described by the Licensee, the turbine and service building system is made up of three separate air supply and circulation systems, each discharging to the plant vent stack exhaust.

The condensate pump room ventilation subsystem provides filtered, tempered outside air to the condensate pump room with provisions for recirculation (in cold weather, per Drawing 0740G40124). Since no equipment essential to safe shutdown or to the mitigation of accidents is serviced by this ventilation subsystem, the reader is referred to Section 4.4 of this report for further discussion of this system with respect to the radwaste area ventilation.

The shop area ventilation system provides tempered outside and recirculated air to the various shop areas as described by the Licensee, but also provides ventilation for the four reactor depressurization system battery cubicles that have been added to the shop area in recent years. While the shop area ventilation system provides a means of removing the hydrogen produced by the batteries, the Licensee should provide assurance that adequate ventilation is provided by other means during a loss of offsite power during which the shop ventilation system will not function.

Essential equipment in the electrical equipment room includes the main plant batteries, two motor-generator sets, air compressors for instrument air, 480V switchgear, and cable spreading. The ventilation system is mainly a service-water-cooled, recirculating room cooler. The only outside air supplied directly is via the adjacent heating and ventilating room from the service building ventilation system. By this means, 400 cfm of outside air is supplied.

Electrical power to the recirculating room cooler is supplied through motor control center bus 1D for which power is provided from 480V load center bus 2. This electrical power is not supplied by emergency diesel-generated power, and thus would not be available with a loss of offsite power. It was noted on a plant visit that the electrical equipment room is separated from the shop area by a large iron gate instead of doors. In the event of a loss of offsite power and the resultant loss of cooling and outside air to this room, partial ventilation could be achieved through the shop area, where a large overhead door could be opened for access to outside air. This emergency measure could be augmented with the temporary use of portable fans to decrease the rate of heat buildup in the room. The ventilation of this system can be maintained sufficiently to satisfy the acceptance criteria for this review.

4.4 RADWASTE AREA VENTILATION SYSTEM

The Licensee provided the following evaluation [1]:

"The radwaste area ventilation system is vented from the condensate pump room ventilation system, which is part of the turbine and service building ventilation system.

The condensate pump room ventilation system utilizes both outside air and recirculated air to provide ventilation to the radwaste area. The air passes through a filter and can either pass over a heating coil, which is supplied from the steam boiler system, or can bypass the heating coil. A fan will deliver the air into the condensate pump room and into the radwaste area. Additional airflow can be obtained by opening the cover block on the outside air vent and increasing the opening of the exhaust damper. The exhaust is induced by the exhaust fans and is then vented through the stack....

The radwaste system is not designed for post-accident cleanup and will not be required; therefore, additional ventilation will not be required."

The condensate pump room ventilation system is one of the air supply and distribution systems which make up the turbine building ventilation system. Exhaust is provided by the stack vent exhaust system. The stack vent exhaust system handles the exhaust effluent for all ventilation systems servicing the turbine and containment buildings. The fact that neither the air supply from the condensate pump room ventilation system nor the exhaust system is supplied with emergency onsite diesel-generated power is not a problem since the radwaste area is not essential to safe shutdown or mitigation of the consequences of an accident.

Drawing M-124, Service Building and Turbine Building Ventilation P & I diagram, carries a note to the effect that the outside air louvers can be closed for recirculation of the condensate pump room ventilation during cold weather. The same drawing also shows that the recirculation is from the condensate pump room back to the air handling unit. The radwaste area is located between the condensate pump room and the vent stacks exhaust system and is ventilated by the effluent from the condensate pump room; therefore; the Licensee should indicate how the radwaste area is ventilated when the condensate pump room ventilation is in the recirculation mode.

4.5 ENGINEERED SAFETY FEATURES VENTILATION SYSTEMS

This section reviews the ventilation of safety-related systems and components necessary for safe shutdown and post-accident operation that were not reviewed above under the topics of major building ventilation systems.

4.5.1 Post-Incident Cooling System

The diesel and electric fire pumps are major elements of the post-incident cooling system, and are located in the screenhouse. The Licensee provided the following description:

> "The screenhouse contains the fire safety system (diesel and electric fire pumps). The ventilation system consists of ventilation louvers on the outside walls with circulation fans inside the screenhouse. The screenhouse is a separate building located away from the containment and turbine buildings and is not exposed to radioactive contaminates during normal or post-accident conditions of the Plant; therefore, ventilation for the purpose of reduction of contamination is not necessary. Since the heat load from the fire pumps (only major equipment running under post-accident condition with loss of off-site power) is relatively low, and since there are numerous heat sinks in the room, operability should not be impaired by a loss of ventilation. Again, however, doors can be opened to allow passive ventilation of the room."

This review concurs with the Licensee's statement and notes that all acceptance criteria for this review appear to be satisfied. A tour of the screenhouse during the plant visit revealed two exhaust fans and one manually adjusted louvered air entrance. Since the exhaust fans are not powered by onsite emergency diesel-generated power, the exhaust fans will not operate with a loss of onsite power. In this event, a large equipment door and two personnel doors could be opened to increase the passive circulation.

4.5.2 Fire Protection Water System

The fire protection water system uses the electric and diesel fire pumps located in the screenhouse, reviewed in Section 4.5.1 above.

4.5.3 Reactor Depressurization System

The ventilation of the battery cubicles of the reactor depressurization system is reviewed as part of the shop ventilation in Section 4.3 of this report.

4.5.4 Core Spray System

The core spray pump room ventilation was described by the Licensee as follows [1]:

> "The core spray pump room houses the core spray pump and a heat exchanger which supplies emergency cooling water to the reactor vessel and the containment building. This area is not ventilated. The heat rise in the core spray pump room area following an accident due to recirculation of the containment sump water is not expected to raise the room temperature greater than 152°F (reference CPCo submittals to NRC dated 10/31/80 and 1/30/81). This heat load is not detrimental to the operation of the core spray pump. This room is not exposed to radioactive contaminates during normal or accident plant operation; therefore, ventilation for the purpose of reduction of contamination is not necessary. The room also is not habitated during operation of the equipment."

In concurring with the Licensee's assessment, this review notes that the core spray pumps are categorized [4] as "qualified" for the environment of the core spray pump room following an accident. It was noted during a plant visit that the core spray room is equipped with ceiling hatches that could be opened to the loading dock. However, each hatch is held in place by a single-bolted bracket which would have to be removed from inside the core spray room before the hatch could be opened. With consideration of the core spray pump environmental certification documentation provided by Reference 4, all acceptance criteria for this review are satisfied.

4.5.5 Reactor Protection System

Instrumentation for the reactor protection system was observed during a plant visit to be located in the computer room. The computer room is a relatively small room dominated by the computer which was said to be cooled by its own cooling system. Cooling for the room is provided by service-water-cooled air conditioning equipment in an alcove opening off the room. Power to the air conditioning equipment is not supplied by diesel generator essential buses, and the equipment will not function upon a loss of offsite power. Recognizing that this reactor protection instrumentation will not be needed for a long term and that any temperature increase in the room would take place over a longer period of time, the acceptance criteria for this review are satisfied.

4.5.6 Emergency Power System

Two diesel generating systems are used. The main plant diesel generator is located adjacent to the screenhouse and was described by the Licensee as follows:

> "The emergency diesel generator room, located in the screenhouse, has a passive ventilation system. The passive ventilation system consists of ventilation louvers which allow outside air to enter the emergency diesel generator room. Exhaust from the diesel engine is through the roof of the building. This area is not adjacent to either the containment or turbine buildings and is not exposed to radioactive contamination during normal or post-accident conditions; therefore, ventilation for the purpose of reduction of contamination is not necessary. Heat rise from the diesel generator will not impair its operation however, access doors could be opened to ventilate the room."

While the diesel engine is cooled by service water, the radiant heat from the engine will produce a temperature rise in the diesel generator room. The main concern is the ambient temperature requirements of the generator and the electrical equipment panel in the room. The Licensee should address these requirements.

With only a passive ventilation system, the Licensee should indicate that the ventilation is adequate to disperse vapors from the day fuel tank if the tank is not vented externally.

A backup diesel generator is mounted in a trailer van located at the site of domestic water well No. 1. When needed, this backup diesel is connected manually to the emergency electrical power bus. Ventilation of the diesel is provided by opening large doors to expose the diesel engine and generator to the atmosphere on two sides and rear end at the trailer. This means of ventilation for the backup diesel satisfies all acceptance criteria for this technical review.

5. CONCLUSIONS

5.1 CONTROL ROOM VENTILATION SYSTEM

Since the control room ventilation system is being reviewed generically under TMI Item III.D.3.4, Control Room Habitability, further review was not performed.

5.2 SPENT FUEL POOL VENTILATON SYSTEM

Since the spent fuel is located in the reactor containment building, the isolation of the pool with respect to the possible release of radioactive material outside plant is considered under SEP Topic VI-4, Containment Isolation System. With respect to personnel hazards within the plant, the spent fuel pool ventilation system satisfies the acceptance criteria of this review.

5.3 TURBINE AND SERV'CE BUILDING VENTILATION SYSTEM

Within the turbine and service building, the shop ventilation system was determined to ventilate the four essential battery cubicles of the reactor depressurization system. The Licensee should ensure that adequate ventilation is maintained to remove the hydrogen generated by battery charging and heavy discharging during a loss of offsite power which will shut down the shop ventilation system.

An alternate means of ventilation for the electrical equipment room during a loss of offsite power was found to satisfy the acceptance criteria for this review.

No essential equipment or systems are vent[illegible]ed by the condensate pump room ventilation system. Its effect upon the [illegible]aste area is concluded under that topic.

5.4 RADWASTE AREA VENTILATION SYSTEM

To prevent hazards to personnel, the Licensee should indicate how the radwaste area is ventilated when the condensate pump room ventilation system in the turbine building is operating in the recirculation mode as indicated on Drawing M-124.

5.5 ENGINEERED SAFETY FEATURES VENTILATION SYSTEMS

5.5.1 Post-Incident Cooling System

The major components providing ventilation are the diesel and electric fire pumps. The screenhouse ventilation was determined to satisfy the acceptance criteria for this review.

5.5.2 Fire Protection Water Systems

The major elements considered in this review were the diesel and electric fire pumps. Please refer to Section 5.5.1 for conclusions.

5.5.3 Reactor Depressurization Systems

Conclusions regarding the battery cubicles ventilated by the shop ventilation system are shown in Section 5.3.

5.5.4 Core Spray System

Although not ventilated, the core spray pump motors in the core spray pump room were shown to be qualified for that room's environment following an accident. The acceptance criteria for this review are thus satisfied.

5.5.5 Reactor Protection System

Although ventilation of instrumentation for the reactor protection system located in the computer room would be lost upon loss of offsite power, the resulting relatively slow rise in this room's temperature was considered to satisfy the acceptance criteria for this review.

5.5.6 Emergency Power System

With only a passive ventilation system for the main plant diesel generator room, the Licensee should ensure that the radiant heat from the diesel would not result in temperatures too high for the electrical generator and electrical distribution panel in the room.

Since the standby diesel generator is mounted in a van type trailer and exposed to the atmosphere on three sides during operation, the acceptance criteria for this review are satisfied.

6. REFERENCES

1. Safety Assessment Report, SEP Topic IX-5
   Ventilation Systems, Big Rock Point Plant
   Consumers Power Company, June 11, 1982

2. Safe Shutdown Report, Big Rock Point Plant
   U.S. Nuclear Regulatory Commission

3. Technical Evaluation Report
   Systems Needed for Safe Shutdown, Big Rock Point Plant
   Franklin Research Center, May 20, 1981
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4. Techical Evaluation Report
   Equipment Environmental Qualification, Big Rock Point Plant
   Franklin Research Center, May 15, 1981
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