UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 52 TO FACILITY OPERATING LICENSE NO. DPR-40

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION, UNIT NO. 1

DOCKET NO. 50-285

Introduction

By letter dated March 14, 1978, Omaha Public Power District (OPPD) submitted an application to amend the Fort Calhoun Station, Unit No. 1 Technical Specifications in the area of charcoal ventilation system flow rates for the spent fuel pool area and the safety injection (SI) pump rooms. Following staff review of this application, questions were asked of OPPD which resulted in further analyses and a revision to the application being submitted by letter dated March 6, 1979.

In early 1980, the staff became aware that there was some misunderstanding regarding the use of the term "operable" as it applies to single failure criterion for safety systems in power reactors Technical Specifications. In an effort to remove this misunderstanding and to clarify NRC requirements, the staff sent a letter (dated April 10, 1980) to all Power Reactor Licensees informing them of our requirements and requesting that they speci y and clarify these requirements in their Technical Specifications. OPPD responded to this request by letter dated August 5, 1980.

Discussion and Evaluation

I. VENTILATION SYSTEM FLOW RATES

Section 9.10 of the Fort Calhoun Unit No. 1 FSAR discussed the design function of the charcoal filters which are installed in the controlled access area ventilation system:

> "Charcoal filters are installed in normally bypassed ducts at the exhaust of the three compartments where the safety injection and spray pumps and suction piping are situated. These filters could be remote-manually brought on to line in the event of an accidental release of activity in these rooms during a plant emergency in particular during the recirculation period following a DBA (see Section 6.2)."

> "A charcoal filter is also installed in a normally bypassed section of the return ductwork drawing air from the spent fuel storage pool area. During spent fuel handling, the filter will be brought on the line to absorb gaseous iodines in the unlikely event of a fuel handling incident resulting in the release of large quantities of radioactivity (Section 14.18)."

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By letters dated March 14 and April 28, 1978, and March 6, 1979, the Omaha Public Power District (the licensee) requested that Table 3-5 of Section 3.2 (Equipment and Sampling Tests) of the Technical Specifications for Fort Calhoun Station Unit 1 (Ft. Calhoun) be amended to reduce the air flow rate surveillance requirements for the spent fuel pool area ventilation (SFPAV) and the safety injection pump room ventilation (SIPRV). The licensee requested that Specifications 10.b.3.b and 10.c.3.b of Table 3-5 be changed to reduce the magnitude of the volume flow rate required to be passing through the charcoal filters in the two ventilation systems. The volume flow rates now required to be passing through the SFPAV and SIPRV are the design flow rates (±10%) for the systems.

The following information was given in the letter dated March 14, 1978, from the licensee. The design flow rates for the charcoal filters in the SFPAV and SIPRV are 12,800 cfm and 5,500 cfm, respectively. The number of standard charcoal filter cells in the SFPAV and SIPRV are 12 and 6, respectively, and each standard charcoal filter cell is rated at 1,000 cfm. These ventilation systems have been adjusted for optimum performance; but the design rates given in the station Technical Specifications have not been achieved. The maximum volume flow rates obtainable without extensive modifications of these ventilation systems are 4,400 cfm for the SIPRV and 10,400 cfm for the SFPAV.

The charcoal filters are installed in these ventilation systems to reduce the amount of radioiodine released from the station to the environment during accident conditions. Reducing the flow rate through the charcoal filters will increase the efficiency of the charcoal to remove airborne radioiodine. However, the volume air flow must be sufficient to collect all the radioiodine released during the accident. The licensee stated that both ventilation systems have been balanced to ensure negative pressures in the areas serviced by these ventilation systems. He states that testing has verified that the proposed volume flow rates maintain the safety injection/spray pump rooms and the spent fuel storage pool area at negative pressures relative to the surroundings. He further states that the proposed range of volume flow rates for the SFPAV and SIPRV allow some variation in performance of the ventilation system while not allowing such low volume rates that the negative pressures would be eliminated.

The licensee has reported the low measured flow rates in the SFPAV and SIPRV in Licensee Event Reports (LERs) 78-041 (1/2/79) and 78-041 (1/30/79). In LER 78-041, the licensee stated that the volume flow rates were chosen prior to the selection of the charcoal filter units for the SFPAV and SIPRV.

We have reviewed and evaluated the proposed changes to Specifications 10.b.3.b and 10.c.3.b of Table 3-5 of the Technical Specifications for Fort Calhoun Station. These specifications are for the charcoal filters in the spent fuel pool area ventilation system (SFPAV) and the safety injection pump room ventilation system (SIPRV), respectively.

The two ventilation systems were designed to collect radioactivity released during accidents and pass this radioactivity through charcoal filters. The SFPAV would collect radioactivity released from the spent fuel pool during a fuel handling or cask drop accident. The SIPRV would collect radioactivity released into the safety injection pump rooms during a LOCA. This radioactivity would come from ECCS leakage outside containment from safety injection and containment spray pumps pumping water from the containment sump during the recirculation mode.

The licensee has run tests measuring air flow to determine that the two ventilation systems at the proposed air flow rates will collect the radioactivity released during accidents as they were designed to do. Each safety injection pump room is an enclosed area with a single opening, a door (which would be closed during a LOCA) and a supply air duct. Air is supplied to and exhausted from the room to cool the high and low pressure safety injection pumps and the containment spray pump in the room. The ventilation system has been balanced to have the safety injection pump room at a negative pressure. The door is a fire barrier and plant procedures require it to be shut or there be a person present to shut the door in case of a fire or an accident. The licensee has run tests measuring air flow into the rooms when the doors are partially open to verify that the proposed volume flow rates for the SIRPV would maintain the room at negative pressures relative to the surroundings. The doors were partially opened to have measurable flow rates into each room. Based on this, we conclude that the SIRPV should collect the radioactivity released into the room.

The spent fuel pool is located in the Auxiliary Building. The ventilation supply ducts for the area are located below the operating floor level and the exhaust ducts are located at floor level around the pool. The licensee has run tests measuring the air flow in the building. The air flow is toward the exhaust ducts arranged around the pool. Based on this, we conclude that the SFPAV should collect the radioactivity released from the pool.

The potential consequences of a postulated Loss-of-Coolant Accident (LOCA) and Fuel Handling Accident are given in Table 1. The assumptions to calculate the potential consequences for these accidents are given in Tables 2 and 3. The potential consequences for the postulated ECCS leakage outside containment and the Fuel Handling Accident are given with and without charcoal filtration. The potential consequences of the postulated accidents are well within the exposure guidelines of 10 CFR Part 100 and are, therefore, acceptable.

The licensee does not measure the negative pressure in the Fuel Handling Building and in the safety injection pump room when its respective ventilation system is operating. The licensee has measured that the air flow in each area when its ventilation system is operating is such that the radioactivity released to each area should be collected and filtered. Because of this and because the potential consequences of the postulated accidents without charcoal filtration of the radioactivity released from the spent fuel pool and to the safety injection pump room are well within the exposure guidelines of 10 CFR Part 100, we conclude that these air flow tests are adequate to show that the ventilation systems will maintain a negative pressure in the appropriate areas and that the radioactivity will be collected and filtered. No additional tests are needed. Based on this, we conclude that the proposed Technical Specification changes are acceptable as written.

The licensee does not have a technical specification which limits the leakage from the high and low pressure safety injection pumps and the containment spray pumps outside containment. For long term cooling of the core and the containment, a continuous source of borated water is provided by recirculating containment sump water. Recirculation is automatically initiated by low water level in the safety injection and refueling water tank. In the recirculation mode, the high-pressure safety injection pumps and the containment spray pumps take suction directly from the containment sump and pump the water back into containment. The low-pressure safety injection pumps may also be used to inject cooled water when the system pressure permits. Leakage from these pumps drains to the pump room sump. From there it is pumped to the radioactive liquid waste disposal system for processing. This leakage during a LOCA will contribute to the potential consequences of the accident. The potential consequences given in Table 1 are for 10 gph leakage from these systems outside containment.

By letter dated June 25, 1980, the licensee presented the results of leak rate tests performed as required by NUREG-0578, Item 2.1.6.a, "Integrity of Systems Outside Containment Likely to Contain Radioactive Materials". These tests showed a maximum total leak rate of 489 cc/hr for all systems of consideration. Since this leak rate is well below the 10 gph assumed in the staff's analyses and since the staff, as part of the continuing review of the TMI accident, is considering the necessity of either Technical Specification limits or license condition requirements to ensure acceptably low leakage rates from these systems, we find the present procedures to be acceptable pending a generic resolution.

One of the primary functions of the safety injection pump room ventilation system is to provide adequate cooling for the safety injection/containment spray pump motors.

Design flow rates for the two safety injection/spray pump room filters and for the spent fuel storage pool area filter are 5500 cfm per filter and 12,800 cfm, respectively. Accordingly, the plant's Technical Specifications require that these design flow rates be periodically verified. However, although the ventilation system at Fort Calhoun Station has been adjusted for optimum performance, the design flow rates have not been achieved. The maximum flow rates obtainable without extensive modification of the ventilation system are 4400 cfm for each safety injection/spray pump room filter and 10,400 cfm for the spent fuel storage pool area filter. (See References 3 and 4.)

The Omaha Public Power District submitted an application for Amendment of Facility Operating License, dated March 13, 1978 (Reference 1), requesting the NRC to revise Technical Specifications for the Fort Calhoun Station to permit use of reduced air flow rates in the spent fuel pool area and the safety injection pump room.

The temperature of the safety injection pump room must be limited in order to assure the safe operation of the pumps. The bearings for the safety injection/containment spray pump motors are the limiting factors in determining the maximum allowable room temperature. The manufacturer has recommended that the motors not be operated with room ambient temperatures greater than 122°F (Reference 2).

The licensee has performed two separate analyses to predict the maximum temperature in the safety injection pump room. Both analyses assume all four ECCS pumps operating in each of the pump rooms for the first 30 minutes following a LOCA. One spray and one HPSI pump operate from 30-50 minutes and one HPSI pump operates indefinitely after 50 minutes (Reference 6).

The first analysis performed by the licensee was a transient analysis using Combustion Engineering's CONTRANS computer code. CONTRANS has been reviewed by the NRC staff and has been found acceptable for calculating containment pressure/temperature responses. This analysis predicted the long term sump water temperature. The CONTRANS analysis assumed that the ECCS pumps and the recirculation piping that carried the hot sump water were the only heat sources in the safety injection pump room. The heat sinks were the concrete floors and walls. Without taking credit for the ventilation system and assuming natural convective heat transfer, the CONTRANS analysis predicted a maximum temperature of 117°F during the first 27 hours. By this time, the shutdown cooling system is put into operation, which cools the sump water and in turn lowers the safety injection pump room temperature.

The second analysis performed by the licensee was a steady state calculation which assumed that the sump water temperature did not drop below 165°F (this was the temperature predicted by CONTRANS 27 hours after the LOCA). The steady state calculation predicted that if a minimum ventilation flow rate of 1500 cfm exists, the safety injection pump room temperature will remain below the maximum allowable 122°F. Since the proposed Technical Specifications will require a minimum ventilation flow rate of 3000 cfm for the safety injection pump room, the analysis appears conservative.

The analyses performed by the licensee to calculate the maximum safety injection pump room temperature appears to be conservative. No credit was taken for either the shutdown cooling heat exchangers or the containment building air cooling and filtration system. Both of these systems would remove energy from the containment system and would tend to lower the sump water temperature thus reducing the pump room temperature. The steady state calculation which took credit for the ventilation flow rate made the conservative assumption that the temperature of the ventilation flow was 95°F.

There were two assumptions in the licensee's analyses that the staff questioned. In the transient analysis performed with the CONTRANS computer code, the instantaneous mixing partition model was used. While this flashing model maximizes the peak calculated containment pressure, it tends to minimize the sump water temperature thus lowering the heat load in the safety injection pump room. In addition, while the licensee assumed a natural convective heat transfer coefficient of 2.0 BTU/hr-ft^2-°F to the pump room's heat sinks, a lower convective heat transfer coefficient of 1.7 BT /hr-ft^2-°F was assumed from the recirculation piping (heat source). In a confirmatory analysis, the staff performed the steady state calculation assuming a constant sump water temperature of 200°F and a uniform convective heat transfer coefficient of 2.0 BTU/hr-ft^2-°F. Our calculations verified that the minimum proposed ventilation flow rate of 3000 cfm will be sufficient to cool the pump's motor bearings.

To further ensure the integrity of the ECCS pumps, the licensee is in the process of installing temperature detectors, with readout and alarms, in the control room to monitor the safety injection pump room temperature. In the event that additional cooling is needed for the pump rooms, two actions can be taken. If activity levels are low enough, portable fans and blowers can be brought into the area. Otherwise, operator action can be taken from the control room to rebalance the ventilation system (i.e., clearing off ventilation flow to non-essential areas) in order to provide increased cooling.

Based on our review of the licensee's submittals, we conclude that the safety injection pump room temperature has been adequately addressed and that the proposed Technical Specifications are acceptable.

Table 1

POTENTIAL CONSEQUENCES OF POSTULATED ACCIDENTS

	Potential Consequences in Rem			
	Exclusion Area Boundary (910m)		Low Population Zone (4800m)	
	Thyroid	Whole Body	Thyroid	Whole Body
Loss-of-Coolant				
Leakage Through Containment	39	1.5	5	0.5
Leakage Outside Containment				
With charcoal filtration	4	0.5	28	0.2
Without charcoal filtration	30	0.6	28	0.3
Purging	(*)	(*)	(*)	(*)
Fuel Handling In Spent Fuel Pit				
With charcoal filtration	15	.4	2	.4
Without charcoal filtration	100	.4	13	.4

* Negligible - less than 0.1 rem

Table 2

LOSS-OF-COOLANT ACCIDENT - ASSUMPTIONS

Core Power Level	1500 MWt
Operating Time	3.0 years
Containment Leak Rate (0-24 hours)	0.10%
(24 hours)	0.05%
Fraction of Core Inventory Available for Leakage	
Iodine	25%
Noble Gases	100%
Iodine Composition - Elemental	91%
- Particulate	5%
- Organic	4%
Minimum Site Boundary Distance	910m
Low Population Zone Distance	4800m
X/Q Values (sec/m^3)	
0-2 hr. at 910 meters	5.0×10^{-4}
0-8 hr. at 4800 meters	6.3×10^{-5}
8-24 hr. at 4800 meters	1.3×10^{-5}
24-96 hr. at 4800 meters	4.3×10^{-6}
96-120 hr. at 4800 meters	9.3×10^{-7}
Building Effective Cross Sectional Area	760m^2
Containment Parameters	
Containment Volume	1.05×10^6ft^3
Containment Charcoal Filters (one unit)	0 to 30 days
Elemental Iodine Removal Coefficient	5.14/hr
Particulate Iodine Removal Coefficient	5.14/hr
Organic Iodine Removal Coefficient	1.70/hr
Flow Rate	100,000 cfm
Removal Efficiency elemental iodine	90%
particulate iodine	90%
methyl iodine	30%

Containment Parameters

Containment Purge (Hydrogen Purge)		23 to 30 days
Flow rate		250 cfm
Removal Efficiency	elemental iodine	90%
	particulate iodine	90%
	methyl iodine	70%

ECCS Leakage Outside Containment	55 min. to 30 days
Leakage	20 gal/hr
Volume in Sump	350,000 gal.
Iodine in Sump	50% of core inventory
Fraction of leakage which Flashes	10%

Removal Efficiency

Elemental iodine	90%
Methyl iodine	0%
Particulate iodine	90%

Table 3

FUEL HANDLING ACCIDENTS - ASSUMPTIONS

Power Level	1500 MWt
Operating Time	3 years
Peaking Factor	1.65
Number of Fuel Assemblies Damaged	1
Number of Fuel Assemblies in Core	133
Shutdown Time Before Start of Refueling	72 hours
Activity Release From Pool	Regulatory Guide 1.25
Charcoal Filtration of Radioiodine	85%
x/Q Values (sec/m^3)	
0-2 hr. at 910	5.0×10^{-4}
0-8 hr. at 4800 meters	6.3×10^{-5}
8-24 hr. at 4800 meters	1.3×10^{-5}
24-96 hr. at 4800 meters	4.3×10^{-6}
96-720 hr. at 4800 meters	9.3×10^{-7}
Building Effective Cross Sectional Area	$670 m^2$

II. CLARIFICATION OF OPERABLE

By letter dated April 10, 1980, the NRC requested all Power Reactor Licensees to upgrade their Technical Specifications to clarify the term operable as it applies to the single failure criterion for safety systems. OPPD submitted a license amendment request by letter dated August 5, 1980, to provide this clarification in the Fort Calhoun Station's Technical Specifications.

The proposed specifications differ from the guidance provided in the allowable time for placing the reactor in the hot shutdown condition (subcritical at operating temperature and pressure). OPPD proposed a six hour time limitation whereas the guidance specified a one hour limit. is proposed difference would allow adequate time for the licensee to conduct a controlled and orderly shutdown through a boration method, which is the normal method employed at the Fort Calhoun Station. The boration method results in a maximum rampdown rate of approximately 20 percent per hour.

Since the staff's requirement is based on an orderly shutdown and since it is not the intent to require extraordinary actions which could possibly have adverse effects, the staff agrees that the proposed time limitation is acceptable.

Since this proposal was submitted in response to the staff's request and is in conformance with that request, except for the agreed to deviation noted above, we find the proposed additional requirements to be acceptable.

Environmental Consideration

We have determined that the amendment does not authorize a change in effluent types or total amounts nor an increase in power level and will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment involves an action which is insignificant from the standpoint of environmental impact and, pursuant to 10 CFR §51.5(d)(4), that an environmental impact statement or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of the amendment.

Conclusion

We have concluded, based on the considerations discussed above, that: (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Date: October 14, 1980

References

1. Letter from Omaha Public Power District to U.S.N.R.C., dated March 13, 1978.

2. Letter from Omaha Public Power District (T.E. Short) to U.S.N.R.C. (Director, NRR), dated March 6, 1979.

3. Ft. Calhoun LER #77-033 submitted February 15, 1978.

4. Ft. Calhoun LER #78-041, Revision 1, submitted January 30, 1979.

5. Letter from Omaha Public Power District (W.C. Jones) to U.S.N.R.C. (Director, NRR), dated September 6, 1979.

6. Letter from Omaha Public Power District (T.E. Short) to U.S.N.R.C. (Director, NRR), dated May 24, 1979.