



UNITED STATES
 NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO NRC BULLETIN 93-02

DUKE POWER COMPANY

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-413 AND 50-414

1.0 INTRODUCTION

NRC Bulletin 93-02, "Debris Plugging of Emergency Core Cooling Suction Strainers," requested licensees to remove fibrous air filters and other temporary sources of fibrous material not designed to withstand a loss-of-coolant accident (LOCA) from the containment and to take actions which would assure the functional capability of the emergency core cooling systems (ECCS). The Bulletin scope included both installed material and material that is stored in the containment. The intent of the Bulletin was to prevent fibrous air filters or other temporary sources of fibrous material in the containment from becoming dislodged during a LOCA and being transported to the ECCS sump strainers and clogging them.

By letter dated June 10, 1993, Duke Power Company (DPC, the licensee) submitted a response to NRC Bulletin 93-02. This response included the licensee's plant specific analysis which concluded that fibrous air filters used in the containment ventilation systems did not pose a clogging threat to the ECCS sump strainers for Catawba Nuclear Station, Units 1 and 2. After discussions with the staff regarding the licensee's analysis, DPC submitted a supplemental response to Bulletin 93-02 by letter dated September 16, 1993. The supplemental response described plans for the Catawba Nuclear Station, Units 1 and 2, to remove the pre-filter and high efficiency particulate adsorber (HEPA) from the containment air charcoal filter units (CACFUs) during each unit's next shutdown. The licensee stated that they would perform a visual inspection to determine if the potential for interaction between a high energy pipe break and the ventilation filters exists. By letter dated December 15, 1993, the licensee submitted a revised supplemental response to Bulletin 93-02. The revised supplement requested that the NRC approve Catawba's plan to reinstall the HEPA filters in the CACFUs based on a plant specific analysis which concludes that the filters are not susceptible to impingement by high energy line breaks or containment sprays and are, therefore, unlikely to be transported to the containment sump strainers. The December 15, 1993, submittal also provided the licensee's analysis for leaving the pre-filters for the upper containment ventilation units (UCVUs) and the incore instrumentation room ventilation units (IIRVUs) installed. After an initial review of the licensee's analysis, the staff sent a request for additional information (RAI) to the licensee on May 2, 1994. By letter dated May 9, 1994, the licensee submitted additional information in response to the staff's May 2, 1994, RAI. The letter provided additional details regarding

the construction of the containment ventilation filters. In response to questions raised during a phone conference with the staff, the licensee provided additional information in a letter dated June 2, 1994.

2.0 DISCUSSION

Catawba Nuclear Station (CNS) has 3 ventilation systems per unit which are located in containment and have fibrous filter material in the system. The 3 systems are the UCVUs (4 trains) the IIRVUs (2 trains), and the CACFUs (2 trains). The UCVUs and the IIRVUs are cooling units providing cooling to the upper containment and the incore instrumentation rooms respectively. These units contain standard commercial grade 2-inch thick ventilation pre-filters in the air inlet to the system. The air inlet is open ended exposing the pre-filters. The inlets are covered with a wire mesh. The CACFU systems, on the other hand, function to reduce radioactivity in the containment by circulating the air through carbon cleanup filters. The CACFU systems are normally operated prior to entry into the containment to reduce personnel exposure. The CACFUs have inlet filter plenums consisting of pre-filters, HEPA filters and charcoal filters in series. The plenums are constructed of 11 gage, type 304 stainless steel and are open-ended to the containment exposing the pre-filters. The HEPA filters are located immediately behind the pre-filters. The plenum design pressure is ± 15 inches water gauge (in. w.g.) or approximately 0.5 psi. The CACFU systems do not have a wire mesh covering the air inlet to the system.

The pre-filter construction for all 3 ventilation systems is the same consisting of normal commercial grade ventilation filters with cardboard framing stapled to a media retainer. The filter media is fiber glass. The pre-filters are not designed for a harsh environment such as would be found in a containment following a LOCA.

The HEPA filter (used in the CACFUs only) construction is more durable than the pre-filters. The filter has a stainless steel frame and the filter media (fiberglass mesh) is bonded to the frame. A 4 x 4 steel wire mesh is located on either side of the filter media and is also bonded to the filter frame. The adhesive for bonding the fiberglass mesh and the wire mesh to the filter frame is a water-proof neoprene adhesive. The filter meets the requirements of military specification MIL-F-51068. In accordance with the requirements of MIL-F-51068, the filter design has been tested by the manufacturer in a 700° F air environment for 5 minutes. In addition, the manufacturer has successfully tested the filters for continuous operation in a 261° F air environment for 24 hours and in a 261° F steam environment for 4 hours with no significant degradation. This temperature is above the final safety analysis report (FSAR) value of 245° F for the postulated peak temperature in the containment following a LOCA. It should be noted, however, that HEPA filters designed to meet the requirements of MIL-F-51068 are only required to withstand a pressure differential of 10.0 ± 0.2 inches of water (or a pressure differential of approximately 0.4 psi) for 1 hour.

The licensee has performed a plant specific analysis for each system to determine if the ventilation filters have the potential to clog the ECCS strainers. The licensee has concluded that, with the exception of the pre-

filters for the CACFUs, none of the filters could be dislodged and transported to the sump strainers; and therefore, could not clog the strainers. The licensee proposed to leave the pre-filters in for the UCVUs and the IIRVUs and requests the staff to allow reinstallation of the HEPA filters only for the CACFUs. The licensee's analysis for each system is as follows:

The licensee concludes that the filters installed in the UCVUs are not a sump blockage concern based on the following key points:

1. The UCVU is located in the upper containment above any postulated flooding levels.
2. The UCVU is located in an area where there are "no credible high energy pipe breaks." The licensee has stated that there are no high energy pipes, as defined in the licensee's FSAR, in the upper containment. Therefore, there is no possibility of direct impingement of jet impingement from a high energy pipe break dislodging the filters.
3. The UCVU is located in such a manner that it cannot receive direct impingement from the containment sprays on its filters.
4. Given a dislodgement of the filter media, there is "no reasonable mechanism to get the filter media into the ECCS sump screens."
5. Additional protection against dislodgement is provided by wire mesh screens which cover both the ventilation system inlet and discharge openings.

The licensee concludes that the filters installed in the IIRVUs are not a sump blockage concern based on the following key points:

1. The IIRVU is located above any postulated flooding levels.
2. The unit is located in a separate instrumentation room in the lower containment which is completely isolated from postulated pipe breaks, sprays or any other sources of water which could dislodge filter media.
3. There are no high energy pipes passing through the instrumentation room and the ventilation system does not penetrate the room walls.
4. Additional protection is provided by a stainless steel screen which covers the filter media.

The licensee concludes that the HEPA filters installed in the CACFUs are not a sump blockage concern based on the following key points:

1. Although the CACFUs are located in an area in lower containment where they would be susceptible to postulated flooding conditions, the construction of the HEPA filters is durable enough to prevent dislodging of the fibrous material. Flooding, therefore, only affects the pre-filters.

2. The location of the CACFUs makes it difficult to transport fibrous debris to the ECCS sump strainers because the CACFU is located in the lower containment inside the polar crane wall. The ECCS sump strainers are located in the pipe tunnel outside the polar crane wall. The main flow path from the CACFU to the ECCS strainer would be through 78-inch diameter pipe sleeves that are above the floor level. The path for transport to the ECCS strainers would, therefore, be difficult.
3. A visual inspection by the licensee showed that there is an extensive amount of piping, structural and framing steel, between potential break locations and the filter units screening the unit from adverse pipe break interactions.
4. There is a very low probability of dislodgement of the filters by a backpressure in the system. Steam flow would have to be directly into the system ductwork and not into containment or else pressure would equalize on both sides of the filter. The licensee's analysis concluded that there are no breaks that would pressurize the ductwork. If the ductwork were pressurized in such a manner, the ductwork would likely be blown apart and would not, therefore, create a backpressure situation.

Note: The licensee concludes that pre-filters cannot be installed in the CACFUs due to the threat of dislodgement from a postulated flood. The staff agrees with this conclusion.

3.0 EVALUATION

The staff has reviewed the licensee's analysis for each system and has addressed them individually as follows:

UCVU- The staff has reviewed the licensee's analysis for this system and finds it inadequate for justifying the installation of the ventilation system pre-filters. The staff concludes this because it is not clear as to whether the pre-filter construction is substantial enough to withstand the harsh environment following a LOCA. The staff has concluded that immediately following a LOCA, the turbulent environment in the containment may be sufficient to dislodge the pre-filters. In addition, the containment sprays may then further degrade the filters and transport them via the refueling cavity drains to the lower containment.

IIRVU-The staff has reviewed the licensee's analysis supporting leaving the pre-filters installed in the IIRVU and finds them acceptable. The basis for the staff's decision is that by being located in a separate concrete room, the IIRVU is physically separated from any means of dislodging or transporting filter media to the sumps. Since there are no high energy pipes or sprays in the room, there is not a credible means of dislodging the filter media. The room itself provides a physical barrier to transport of the filter media to the ECCS sump should it become dislodged.

CACFU-Since the licensee's visual inspection showed that there is an extensive amount of piping, structural and framing steel between potential break locations and the filter units screening the unit from adverse pipe break interactions, the staff concludes that there is little likelihood of a high energy pipe break impinging directly on the HEPA filters and cause them to be dislodged. In addition, the licensee has stated that the filters are positioned in such a manner that direct impingement on the filters by containment sprays cannot occur. The staff, therefore, concludes that the filters are not likely to be dislodged by direct impingement by a high pressure jet or containment spray during a LOCA. The licensee has shown that the filters are tested under a variety of high temperature and high-humidity environments per MIL-F-51068 with no significant degradation of the filter. The epoxy used to join the wire mesh and the filter media to the filter housing is water proof and has passed through the rigid tests of MIL-F-51068 with no significant degradation, so the staff concludes that it is unlikely that the filters would be significantly degraded by flooding during a LOCA. The licensee has also stated that there were no dampers or louvers in the system which could prevent equalization of pressure on both sides of the filters. The staff, therefore, concludes that there is little likelihood of dislodgement of the HEPA filters due to a high differential pressure developing across the filters during a LOCA, and that the overall probability of dislodgement of the HEPA filters in this system during a LOCA is very low. The licensee has stated that reinstallation of the HEPA filters is sufficient to meet the station's needs in reducing the risk to personnel by allowing the filter systems to be run to reduce the radioactivity level in the lower containment prior to personnel entry. The staff concludes that the safety enhancement of removing these filters is low and is outweighed by the personnel safety gain of allowing the filters to be reinstalled.

Therefore, the staff finds the licensee's analysis acceptable for reinstallation of the HEPA filters for this unit.

4.0 CONCLUSION

Based on the staff's evaluation of the licensee's submittals, the staff concludes that the pre-filters can remain installed in the IIRVUs, and that the HEPA filters can be reinstalled in the CACFUs. However, the licensee should remove the pre-filters from the UCVUs.

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Date: June 10, 1994