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10 CFR 50.54(f)

Date: May 19, 2022
Serial: RA-22-0144

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/RENEWED LICENSE NO. DPR-23

Subject: **Response to NRC Request for Additional Information Regarding Supplemental Response to Generic Letter 2004-02 (EPID L-2017-LRC-0000)**

Ladies and Gentlemen:

By letter dated April 22, 2022, the NRC requested that Duke Energy, LLC (Duke Energy) respond to a request for additional information (RAI) regarding its Supplemental Response to Generic Letter 2004-02 (ADAMS No. ML22112A148 and ML21273A365, respectively).

The requested responses have been provided in the enclosure to this letter.

There are no regulatory commitments made in this submittal. If you have any questions regarding this submittal, please contact Mr. David Hall, Manager of Nuclear Support Services, at (843) 951-1358.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 19th day of May 2022.

Sincerely,

Nicole Flippin

Nicole Flippin
Site Vice President

Enclosure: RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION ON THE FINAL SUPPLEMENTAL RESPONSE TO NRC GENERIC LETTER 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS"

c: L. Dudes, NRC Regional Administrator, Region II
T. Hood, NRC Project Manager, NRR
NRC Resident Inspector, HBRSEP Unit No. 2

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION ON THE FINAL SUPPLEMENTAL RESPONSE TO NRC GENERIC LETTER 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS"

H.B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION ON THE FINAL SUPPLEMENTAL RESPONSE TO NRC GENERIC LETTER 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS"

By letter dated April 22, 2022, a request for additional information (RAI) regarding the H.B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, response to NRC Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," was provided by the NRC. The following information is provided in response to this RAI.

NRC Request 1:

Basis for using the fibrous debris amounts from the RCP "B" Bay break instead of the RCP "C" bay break

Response:

The bypass testing performed by ENERCON for HBRSEP, Unit No. 2 used the fibrous debris amounts from an RCP "B" Bay break (Ref. 3). The testing was based on the assertion that a break in the "B" Reactor Coolant Pump (RCP) Bay was the most limiting as it generated the highest particulate-based insulation load. In developing this response, the historical basis for selecting the "B" RCP bay as limiting could not be determined. In the absence of a definitive basis, HBRSEP has elected to perform additional review and analysis of the original bypass test results. These results concluded that while testing was based on the "B" RCP Bay break fiber load, the fiber debris concentration was within the expected range that would occur in the sump following a break in either pump bay. Further, the bypass test results show that the fiber fines debris concentration had no significant effect on the measured fiber bypass rate. Based on this, the existing test data can be used for evaluation of in-vessel downstream effects analysis for the RCP "C" Bay break. A revision to the In-Vessel Downstream Effects calculation (Ref. 10) has been issued and concludes that the total in-vessel fiber load remains bounded by the required WCAP-17788 limit when considering the initial sump fiber debris load from the RCP "C" Bay break.

This calculation update with inclusion of the "C" RCP Bay break revises the September 30, 2021 [ADAMS Accession No. 21272A365] response items 3.n.9 and 3.n.16 parameter tables. The revised tables are shown below with impacted sections identified by revision bars.

Table 3-1 Key Parameter Values for Chemical Precipitation Timing

Parameter	**HBRSEP Unit 2 Values (Ref. 4.3)[(4)]**	**Test Group 45 Value[(1)]**
Buffer	NaOH	NaOH
pH	9.415	9.3
Minimum Sump Volume (ft^3)	23,765	22,691
Max Sump Pool Temperature (°F)	263.93	264.6
CalSil (g) (Notes 1, 2 & 3)	48.8	45.243
E-glass (g)	**25.1**	28.8601
Silica (g)	0	0
Mineral Wool (g)	0	0
Al Silicate (g)	1.83	2.06
Concrete (g)	0.0075	0.0083
Interam (g)	0	0
Al (ft^2)	0.083	0.167
Galvanized Steel (ft^2)	0.689	0.760

Notes:

1. Test Group 45 data comes from Tables F-1 and F-4 in WCAP-17788-P, Volume 5, in the Group 45 column, with the exception of the minimum sump volume, which was taken from the "Total Recirculation Water Volume – Minimum" value from Robinson's response to WOG-05-429.

2. The scaled debris quantity of Cal-Sil is 122 grams. It is determined that 40% minimizes silicate inhibition and maximizes chemical product formation in the WCAP-16785 model (Ref. RNP-M/MECH-1800). Based on this, use 48.8 grams.

3. Silicate inhibition of aluminum corrosion was credited in the determination of chemical precipitate quantities as described in WCAP-16785-NP. The limiting debris quantity was determined to be approximately 40% of the design basis Cal-Sil debris load (Ref. RNP-RA/08-0026).

4. **Values shown are for most limiting RCP Bay Break.**

Table 3 Key Parameter Values for In-Vessel Debris Effects

Parameter	WCAP-17788 Value	HBRSEP, Unit No. 2 Value	Evaluation
Maximum Total In-Vessel Fiber Load (g/FA)	WCAP-17788-P, Rev. 1, Volume1, Section 6.5	**20.37**	Maximum in-vessel fiber load is less than WCAP-17788 limit
Maximum Core Inlet Fiber Load (g/FA)	Table 6-5 for Framatome (Areva fuel) of WCAP-17788-P, Rev. 1, Volume 1	**20.06**	Maximum core inlet fiber load is less than WCAP-17788 threshold
Minimum Sump Switchover Time (min)	20	41	Later switchover time results in a lower decay heat at the time of debris arrival, reducing the potential for debris induced core uncovery and heat up.
Minimum Chemical Precipitate Time (hr)	(4.33 hrs) (t_{block})	24	Potential for complete core inlet blockage due to chemical product generation would occur much later than assumed.
Maximum Hot Leg Switchover Time (hr)	24 (t_{chem})	11	Latest hot leg switchover occurs well before the earliest potential chemical product generation
Related Thermal Power (MWt)	2,951	2,339	Lower rated thermal power results in lower decay heat.
Maximum AFP Resistance	Table 6-2 of WCAP-17788-P Volume 4, Rev. 1	Table RAI-4.2-24 of WCAP-17788-P, Volume 4, Rev. 1	AFP resistance is less than the analyzed value, which increases the effectiveness of the AFP.
Minimum ECCS Recirculation Flow (gpm/FA)	8	24.65	Maximum debris bed resistance at the core inlet occurs at lower flow rates (Note 1).

Notes:

1. It should be noted that the flow rate used to compute the in-vessel fiber limit is 3,870 gpm and is greater than the flow rate used to compute the scaled down approach velocity in the bypass tests which was 3,820 gpm. This was done for conservatism since a greater flow rate will cause more fiber to enter the core sooner.

NRC Request 2:

Provide the methodology for calculating the transport fractions provided in the debris table in Section 3.n.1.4 of the final supplemental response.

Response:

It is assumed that ten percent of the large pieces are eroded and deposit on the screens as fines (Ref. 5).

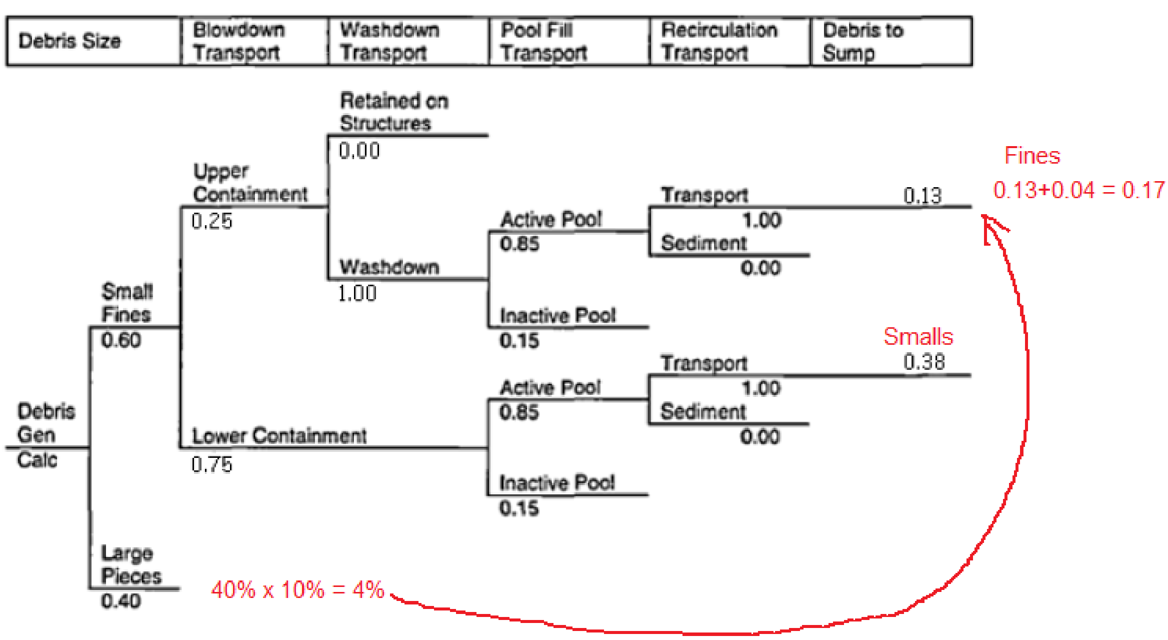
The logic tree for Nukon® and Temp-Mat™ fibrous insulation debris incorporates the fiber debris size distribution of 60% small debris and 40% large debris, which is from the NEI 04-07 Baseline Methodology and endorsed by the NRC. The 60% fraction for fines includes consideration for fibrous erosion. The overall transport fraction for the small fines is determined by summing the proportions for each of the paths from the zone-of-influence (ZOI) to the ECCS sump. The total Nukon® and TempMat™ fibrous insulation small fines transport fraction is 51%. An additional 10% of large pieces (40% of total) are assumed to deposit on the screens as fines (Ref. 5).

The overall transport fraction for Nukon and Temp-Mat small fines is determined by summing the proportions of each of the paths from the ZOI to the ECCS sump. The total Nukon and Temp-Mat fibrous insulation small fines transport fraction is 51%. An additional 10% of large pieces (40% total) are assumed to deposit on the screens as fines, or 4%, for a total of 55% (Ref. 5, Figure 5.1-3). Per Appendix II, Section II.3.1.1 of the NEI 04-07 Safety Evaluation Report, 75% of fibrous debris designated as "small fines" are assumed to be fibrous "small pieces" or "smalls", and 25% of the "small fines" are assumed to be "individual fibers" or "fines".

Based on this, the specific transport fractions of Nukon and Temp-Mat small fines for the penetration test are calculated as follows:

$$Percent\ \text{"smalls"} = (0.75\ x\ 0.51)\ x\ 100 = 38\%$$
$$Percent\ \text{"fines"} = (0.25\ x\ 0.51 + 0.04)\ x\ 100 = 17\%$$

Figure 5.1-3 - Nukon® and Temp-Mat™ Fibrous Insulation Debris Transport Logic Tree

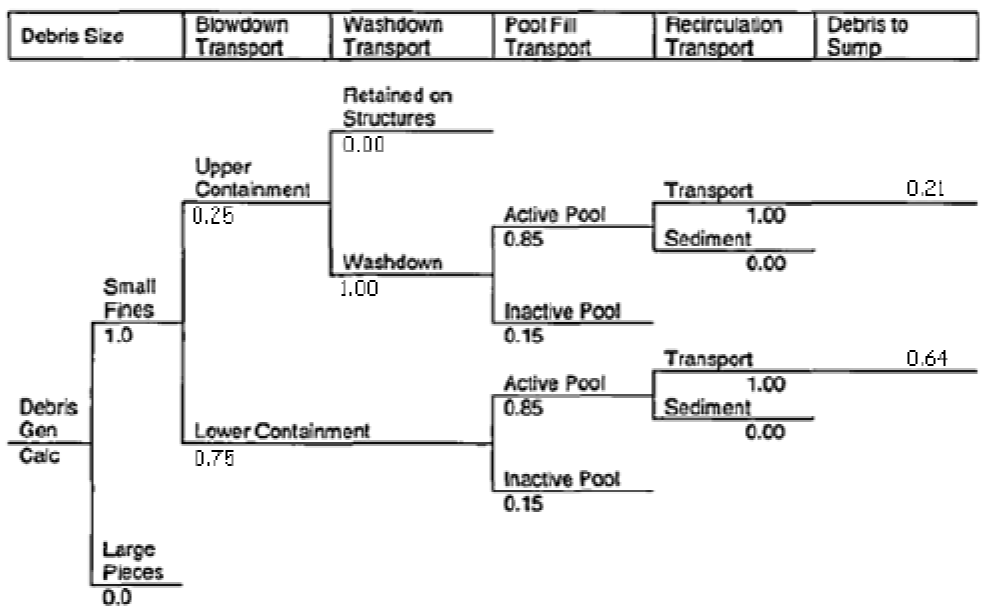


The transport fraction for Kaowool, Unibestos and Fiberglass small fines is 85% (Ref 5, Figure 5.1-5). Per Appendix II, Section II.3.1.1 of the NEI 04-07 Safety Evaluation Report, 75% of fibrous debris designated as “small fines” are assumed to be fibrous “small pieces” or “smalls”, and 25% of the “small fines” are assumed to be “individual fibers” or “fines”.

Based on this, the specific transport fractions Kaowool, Unibestos and Fiberglass small fines for the penetration test are calculated as follows:

$Percent$ "smalls" $= (0.75\ x\ 0.85)\ x\ 100 = 64\%$
$Percent$ "fines" $= (0.25\ x\ 0.85)\ x\ 100 = 21\%$

Figure 5.1-5 - Unibestos, Kaowool and Fiberglass Fibrous Insulation Debris Transport Logic Tree



Note: The percent “fines” is conservatively rounded up to 22% in the In-Vessel Downstream Effects calculation (Ref. 10).

(References 4, 5, 6, 7, & 10)

NRC Request 3:

Method used to account for fiber eroded from larger pieces in the penetration testing.

Response:

By letter dated March 30, 2010, HBRSEP [ADAMS Accession No. ML100920053] agreed to perform additional head loss testing using revised debris transport quantities that included erosion of larger pieces into fines. The transport of large pieces would be addressed by assuming erosion of the large pieces and including the erosion fines in the head loss test debris mix. Ten percent of the large pieces would be assumed to erode and deposit on the screens as fines. This was considered reasonable and conservative because the fines in the debris bed are expected to

add more to the head loss than large pieces. A summary of the results is included in letter dated October 8, 2010 [ADAMS Accession No. ML102860138].

- Fiber eroded from larger pieces is accounted for in the Recirculation Sump-Screen Head Loss Testing (Ref. 8).
- Fiber eroded from larger pieces is accounted for in the Downstream Effects Evaluation (Ref. 1).
- Fiber eroded from larger pieces is accounted for in the Bypass Testing (Ref. 3) and in the In Vessel Downstream Effects (IVDE) Calculation (Ref. 10).

References:

1. RNP-M/MECH-1784, Rev. 5, Post-LOCA Sump Downstream Effects Evaluation
2. Enercon Report, PER003-PR-001, Revision 2, “Robinson Unit 2 Sump Strainer Fibrous Debris Bypass Summary Report” dated April 18, 2007
3. ALION Test Report, ALION-REP-ENGR-8707-04, Revision 0, “Robinson Nuclear Plant: Bypass Fiber Quantity Test Report” dated July 8, 2013
4. RNP-M/MECH-1761, Rev. 7, RNP Containment Vessel GSI-191 Debris Generation Calculation
5. RNP-M/MECH-1762, Rev. 2, RNP Containment Vessel GSI 191 Debris Transport Calculation
6. Design Input Letter (PER-021-LTR-001, Revision 3)
7. NEI 04-07, “Pressurized Water Reactor Sump Performance Evaluation Methodology,” Revision 0, Volume 2 Safety Evaluation by the Office of Nuclear Reactor Regulation Related to NRC Generic Letter 2004-02, Revision 0, December 6, 2004
8. RNP-M/MECH-1764, Revision 3, RNP containment Vessel GSI-191 Recirculation Sump-Screen Debris-Bed Head Loss Calculation.
9. RNP-RA/10-0007, Response to Request for Additional Information Pertaining to NRC Generic Letter 2004-02, “Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors” [ML100920053]
10. RNP-M/MECH-1941, Rev. 2, In-Vessel Downstream Effects (IVDE) Calculation