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FACIL:50-261 H. B. Robinson Plant, Unit 2, Carolina Power and Ligh 05000261
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ZIMMERMAN,S.R. Carolina Power & Light Co.
RECIP.NAME RECIPIENT AFFILIATION
VARGA,S.A. Operating Reactors Branch 1

SUBJECT: Forwards addl info re plant specific homogeneous number densities for matls & fluid in reactor vessel core region, per 820917 request for info re pressurized thermal shock.

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EXTERNAL:	ACRS	10	6	6	LPDR	03	1	1
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CP&L
Carolina Power & Light Company

OCT 07 1982

Office of Nuclear Reactor Regulation
ATTN: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
United States Nuclear Regulatory Commission
Washington, D.C. 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261
LICENSE NO. DPR-23
PRESSURIZED THERMAL SHOCK (PTS) - HOMOGENEOUS NUMBER DENSITY CALCULATIONS

Dear Mr. Varga:

In a conference call on September 17, 1982 between representatives of your staff and members of the Carolina Power & Light Company (CP&L) staff a member of your staff requested additional information regarding plant specific homogeneous number densities for the materials and fluid in the reactor vessel core region at H. B. Robinson Unit 2 (HBR).

These number densities have been calculated as requested and are presented in attachments 1 through 3. All number densities are in units of atoms/barn-cm.

The number densities provided in "Number Densities of Core Region Structurals", Attachment 1, were calculated from actual steel chemistries supplied by Lukens, G. O. Carlsen, and U. S. Steel.

The number densities provided in "Number Densities for Reactor Downcomer Water Region", Attachment 2, were calculated for nominal cold leg temperatures using a cycle average boron concentration.

The number densities provided in "Assembly Average Number Densities vs. Exposure for Fuel Region", Attachment 3, include water gap and are for an Exxon Nuclear Company (ENC) 2.90 w/o bundle which is typical of peripheral assemblies used in all cycles at HBR. The number densities are from a

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depletion in an asymptotic spectrum with XPOSE, the ENC revised LEOPARD. Fission products are represented for power density equal to 86.6 watts/cm^3. Soluble boron concentration is the same as shown in Attachment 2.

If you have any further questions regarding this matter please contact a member of my staff.

Yours very truly,

S. R. Zimmerman
Manager
Licensing & Permits

DCW/ce (5164C2T1)

cc: Mr. J. P. O'Reilly (NRC-RII)
Mr. G. Requa (NRC)
Mr. Steve Weise (NRC-HBR)

H. B. Robinson Unit No. 2
Number Densities of Core Region Structurals

	Fe	Cr	Ni	Mn
Baffle:				
Weight Percent	68.92	18.65	9.60	1.54
Number Density	5.90×10^{-2}	1.71×10^{-2}	7.82×10^{-3}	1.34×10^{-3}
Core Barrel:				
Weight Percent	69.03	18.66	9.68	1.55
Number Density	5.91×10^{-2}	1.71×10^{-2}	7.89×10^{-3}	1.35×10^{-3}
Thermal Shield:				
Weight Percent	69.36	18.41	9.42	1.56
Number Density	5.94×10^{-2}	1.69×10^{-2}	7.68×10^{-3}	1.36×10^{-3}
Reactor Vessel:	Fe	Mn	Mo	Si
Weight Percent	97.	1.32	.477	.23
Number Density	8.22×10^{-2}	1.2×10^{-3}	3×10^{-4}	1×10^{-4}

H. B. Robinson Unit No. 2
Number Densities for Reactor Downcomer Water Region

Density = 0.757 g/cc
Boron = 500 ppm
Temp = 546.8°F
Press = 2,280 psia

Hydrogen = 5.06 E-2 #/barn cm
Oxygen = 2.53 E-2 #/barn cm
Natural Boron = 2.11 E-5 #/barn cm
Boron 10 = 4.17 E-6 #/barn cm

H. B. Robinson Unit No. 2
Assembly Averaged Number Densities vs. Exposure for Fuel Region

	100.0 MWD/TONNE	4,000 MWD/TONNE	6,000 MWD/TONNE
Hydrogen	2.82 E-02	2.82 E-02	2.82 E-02
Oxygen	2.69 E-02	2.69 E-02	2.69 E-02
Zirconium	5.07 E-03	5.07 E-03	5.07 E-03
Iron	1.55 E-05	1.55 E-05	1.55 E-05
Nickel	1.56 E-05	1.56 E-05	1.56 E-05
Aluminum	2.10 E-07	2.10 E-07	2.10 E-07
Chromium	8.25 E-06	8.25 E-06	8.25 E-06
Manganese	3.29 E-07	3.29 E-07	3.29 E-07
Uranium-235	1.87 E-04	1.59 E-04	1.47 E-04
Uranium-236	1.43 E-07	5.22 E-06	7.49 E-06
Uranium-238	6.20 E-03	6.19 E-03	6.18 E-03
Plutonium-239	3.61 E-07	1.17 E-05	1.59 E-05
Plutonium-240	8.23 E-10	9.59 E-07	1.82 E-06
Plutonium-241	3.58 E-12	1.85 E-07	4.97 E-07
Samarium-149	2.42 E-09	1.72 E-08	1.73 E-08
Xenon-135	1.99 E-09	2.05 E-09	2.05 E-09
Fission Prd.	6.66 E-07	2.65 E-05	3.96 E-05
Boron-10	2.32 E-06	2.32 E-06	2.32 E-06
Neptunium-237	3.80 E-11	5.93 E-08	1.26 E-07
Plutonium-238	3.58 E-14	2.33 E-09	7.53 E-09
Americium-241	7.63 E-16	9.07 E-10	3.47 E-09
Americium-243	8.67 E-19	1.01 E-10	6.60 E-10
Curium-244	NEGLIGIBLE	2.31 E-12	2.35 E-11
Plutonium-242	2.76 E-15	6.03 E-09	2.52 E-08
Promethium-149	5.06 E-09	8.23 E-09	8.25 E-09
Iodine-135	5.65 E-09	5.68 E-09	5.68 E-09

H. B. Robinson Unit No. 2 (Continued)
Assembly Averaged Number Densities vs. Exposure for Fuel Region

	8,000 MWD/TONNE	10,000 MWD/TONNE	12,000 MWD/TONNE
Hydrogen	2.82 E-02	2.82 E-02	2.82 E-02
Oxygen	2.69 E-02	2.69 E-02	2.69 E-02
Zirconium	5.07 E-03	5.07 E-03	5.07 E-03
Iron	1.55 E-05	1.55 E-05	1.55 E-05
Nickel	1.56 E-05	1.56 E-05	1.56 E-05
Aluminum	2.10 E-07	2.10 E-07	2.10 E-07
Chromium	8.25 E-06	8.25 E-06	8.25 E-06
Manganese	3.29 E-07	3.29 E-07	3.29 E-07
Uranium-235	1.35 E-04	1.25 E-04	1.15 E-04
Uranium-236	9.57 E-06	1.15 E-05	1.32 E-05
Uranium-238	6.17 E-03	6.16 E-03	6.15 E-03
Plutonium-239	1.92 E-05	2.20 E-05	2.42 E-05
Plutonium-240	2.79 E-06	3.81 E-06	4.86 E-06
Plutonium-241	9.44 E-07	1.49 E-06	2.10 E-06
Samarium-149	1.72 E-08	1.71 E-08	1.69 E-08
Xenon-135	2.04 E-09	2.03 E-09	2.01 E-09
Fission Prd.	5.27 E-05	6.57 E-05	7.87 E-05
Boron-10	2.32 E-06	2.32 E-06	2.32 E-06
Neptunium-237	2.13 E-07	3.16 E-07	4.34 E-07
Plutonium-238	1.71 E-08	3.21 E-08	5.33 E-08
Americium-241	8.67 E-09	1.70 E-08	2.87 E-08
Americium-243	2.39 E-09	6.31 E-09	1.36 E-08
Curium-244	1.18 E-10	4.02 E-10	1.07 E-09
Plutonium-242	6.61 E-08	1.35 E-07	2.36 E-07
Promethiumum-149	8.27 E-09	8.29 E-09	8.31 E-09
Iodine-135	5.68 E-09	5.68 E-09	5.68 E-09

H. B. Robinson Unit No. 2 (Continued)
Assembly Averaged Number Densities vs. Exposure for Fuel Region

	20,000 MWD/TONNE	30,000 MWD/TONNE	40,000 MWD/TONNE
Hydrogen	2.82 E-02	2.82 E-02	2.82 E-02
Oxygen	2.69 E-02	2.69 E-02	2.69 E-02
Zirconium	5.07 E-03	5.07 E-03	5.07 E-03
Iron	1.55 E-05	1.55 E-05	1.55 E-05
Nickel	1.56 E-05	1.56 E-05	1.56 E-05
Aluminum	2.10 E-07	2.10 E-07	2.10 E-07
Chromium	8.25 E-06	8.25 E-06	8.25 E-06
Manganese	3.29 E-07	3.29 E-07	3.29 E-07
Uranium-235	8.08 E-05	4.99 E-05	2.90 E-05
Uranium-236	1.89 E-05	2.35 E-05	2.58 E-05
Uranium-238	6.12 E-03	6.07 E-03	6.01 E-03
Plutonium-239	2.96 E-05	3.17 E-05	3.16 E-05
Plutonium-240	8.94 E-06	1.32 E-05	1.62 E-05
Plutonium-241	4.70 E-06	7.42 E-06	9.15 E-06
Samarium-149	1.58 E-08	1.41 E-08	1.25 E-08
Xenon-135	1.89 E-09	1.71 E-09	1.54 E-09
Fission Prd.	1.30 E-04	1.93 E-04	2.56 E-04
Boron-10	2.32 E-06	2.32 E-06	2.32 E-06
Neptunium-237	9.97 E-07	1.78 E-06	2.51 E-06
Plutonium-238	2.11 E-07	5.84 E-07	1.12 E-06
Americium-241	1.03 E-07	2.20 E-07	3.12 E-07
Americium-243	1.02 E-07	4.28 E-07	1.04 E-06
Curium-244	1.51 E-08	1.07 E-07	3.86 E-07
Plutonium-242	9.98 E-07	2.71 E-06	5.02 E-06
Promethium-149	8.36 E-09	8.40 E-09	8.44 E-09
Iodine-135	5.67 E-09	5.65 E-09	5.63 E-09