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SUBJECT: Forwards response to NRC RAI re reactor pressure vessel integrity dtd 980414.Assessment results of impact of OG data on reactor vessel parameters re GL 92-01,rev 1,suppl 1, "Reactor Vessel Structural Integrity," included w/response.

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Carolina Power & Light Company
Robinson Nuclear Plant
3581 West Entrance Road
Hartsville SC 29550

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United States Nuclear Regulatory Commission
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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
REGARDING REACTOR PRESSURE VESSEL INTEGRITY

Sir or Madam:

This letter provides Carolina Power & Light (CP&L) Company's response to the NRC Request for Additional Information (RAI) regarding reactor pressure vessel integrity at the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, dated April 14, 1998. The RAI response is provided as an attachment to this letter.

By letter dated December 17, 1996, the NRC closed CP&L's response to Generic Letter (GL) 92-01, Revision 1, Supplement 1, "Reactor Vessel Structural Integrity," and requested that CP&L provide the results of ongoing Owners' Group (OG) reactor vessel integrity programs relative to HBRSEP, Unit No. 2 when the OG activities are completed. By letter dated September 11, 1997, CP&L stated that it will assess the impact of OG data on reactor vessel parameters and provide the NRC with the results of the assessment by May 1, 1998. In accordance with discussions held with the NRC, the results of this CP&L assessment are included as part of the response to the NRC RAI dated April 14, 1998.

As Manager of Regulatory Affairs, I verify that the information in this submittal is accurate and that the previously submitted chemistry factor evaluations documented in CP&L letter dated November 20, 1995, which is restated in this submittal and supplemented by additional information regarding Weld Heat W5214, is valid.

A028

If you have any questions concerning this matter, you may contact me or Mr. H. K. Chernoff of my staff.

Very truly yours,

for TMW

T. M. Wilkerson

ALG/alg
Attachment

c: Mr. L. A. Reyes, USNRC, Region II
Mr. J. W. Shea, USNRC
USNRC Resident Inspector, HBRSEP

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

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
REGARDING REACTOR PRESSURE VESSEL INTEGRITY

Background

On May 19, 1995, the NRC issued Generic Letter (GL) 92-01, Revision 1, Supplement 1, "Reactor Vessel Structural Integrity." In GL 92-01, Revision 1, Supplement 1, the NRC requested that nuclear licensees perform a review of their reactor pressure vessel (RPV) structural integrity assessments in order "to identify, collect, and report any new data pertinent to [the] analysis of [the] structural integrity of their reactor pressure vessels (RPVs) and to assess the impact of that data on their RPV integrity analyses. . ." Carolina Power & Light (CP&L) provided the required responses for the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2, by letters dated August 17, 1995, and November 20, 1995. The November 20, 1995 response provided revised RPV data to the NRC and stated that the revised data does not impact the Low Temperature Overpressure Protection (LTOP) and Pressure-Temperature (P-T) analyses, and that the previously submitted information remained conservative.

By letter dated December 17, 1996, the NRC closed CP&L's response to Generic Letter (GL) 92-01, Revision 1, Supplement 1, "Reactor Vessel Structural Integrity," and requested that CP&L provide the results of ongoing Owners' Group RPV integrity programs relative to HBRSEP, Unit No. 2.

By letter dated April 14, 1998, the NRC issued a Request for Additional Information (RAI) to CP&L regarding RPV integrity. The RAI was based upon information provided to the NRC in July 1997 by the Combustion Engineering Owners Group (CEOG)[1] which contained additional RPV weld chemistry data for RPVs fabricated by Combustion Engineering (CE).

Section 1.0, Assessment of Best-Estimate Chemistry

"Based on this information [i.e., provided in CEOG report CE-NPSD-1039], in accordance with the provisions of Generic Letter (GL) 92-01, Revision 1, Supplement 1, the NRC requests the following:"

1. "An evaluation of the information in the reference above and an assessment of its applicability to the determination of the best estimate chemistry for all of

[1] CE-NPSD-1039, Revision 2, "Best Estimate Copper and Nickel Values in CE Fabricated Reactor Vessel Welds," Combustion Engineering Owners Group, June 1997.

your RPV beltline welds. Based upon this evaluation, supply the information necessary to completely fill out the data requested in Table 1 for each RPV beltline weld material. Also provide a discussion for the copper and nickel values chosen for each weld wire heat noting what heat-specific data were included and excluded from the analysis and the analysis method chosen for determining the best estimate. If the limiting material for your vessel's pressurized thermal shock/pressure-temperature (PTS/PT) limits evaluation is not a weld, include the information requested in Table 1 for the limiting material also. Furthermore, you should consider the information provided in Section 2.0 of this RAI on the use of surveillance data when responding."

Response:

The chemistry analysis values for the HBRSEP, Unit No. 2 RPV beltline welds have been established using manufacturer's Certified Material Test Reports and data obtained by cooperative sharing activities with other utilities whose vessels or surveillance capsules contain the weld heats found in the HBRSEP, Unit No. 2 RPV.

Table 1, "Information Requested On RPV Weld And/Or Limiting Materials," provides the requested information for the weld heats. The beltline welds in the HBRSEP, Unit No. 2 RPV are represented by three heats of weld metal, and each has had additional data reported since CP&L responded to GL 92-01, Revision 1, Supplement 1, by letter dated November 20, 1995. The results of the chemistry factor determination and the adjusted reference temperature or RT_{PTS} at End of Life (EOL) for heats 86054B and 34B009 did not change.

The results for heat W5214 have changed compared to the values reported by letter dated November 20, 1995, primarily due to the use of CVGRAPH[2] as noted in the Table 1 discussion. The surveillance capsule data summary for the W5214 heat is included in Tables 2 and 3 as requested in Section 2 of the RAI. The W5214 heat material remains limiting for the HBRSEP, Unit No. 2 RPV.

[2] CVGRAPH, "Hyperbolic Tangent Curve Fitting Program," Version 4.0, ATI Consulting, March 1995.

Section 2.0: Evaluation and Use of Surveillance Data

"Based on this information, and consistent with the provisions of GL 92-01, Revision 1, Supplement 1, the NRC requests the following:"

2. "that (1) the information listed in Table 2, Table 3, and the chemistry factor from the surveillance data be provided for each heat of material for which surveillance weld data are available and a revision in the RPV integrity analysis (i.e., current licensing basis) is needed or (2) a certification that previously submitted evaluations remain valid. Separate tables should be used for each heat of material addressed, If the limiting material for your vessel's PTS/PT limits evaluation is not a weld, include the information requested in the tables for the limiting material (if surveillance data are available for this material)."

Response:

Only the chemistry factor results for heat W5214 have changed compared to the chemistry factors reported by CP&L letter dated November 20, 1995, as noted in the Table 1 discussion. The changes to the chemistry factor for heat W5214 have been evaluated and no revision in the RPV integrity analysis is required. Surveillance capsule data for weld heat W5214 is used in the RPV integrity analysis for HBRSEP, Unit No. 2. The summary of the surveillance capsule data is provided in Tables 2, "Heat W5214 Data," and 3, "Heat W5214 Results." The data are considered credible based on the differences between the predicted ΔRT_{NDT}'s and the measured ΔRT_{NDT}'s remaining within 28°F for welds in accordance with 10 CFR 50.61.

There is sufficient evidence that the chemistry of the surveillance weld differs from the "best estimate" chemistry of the RPV; and therefore, the ratio method is used in accordance with Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials," Revision 2. The surveillance data used are from HBRSEP, Unit No. 2 capsules and the irradiation temperature of the capsule, located on the Outside Diameter (OD) of the thermal shield, is evaluated to be within 25°F of the RPV operating temperature.

Table 1 provides the revised value for the heat W5214 chemistry factor as a result of the use of CVGRAPH to replot past surveillance capsule data. The increase in the chemistry factor from 225°F to 230°F and the revised Charpy curves resulted in the requirement for an evaluation of the RPV integrity analyses provided below.

The EOL RT_{PTS} for the heat W5214 increases from 249°F to 255°F which is below the screening criteria of 300°F for a circumferential RPV weld. The fluence value,

chemistry factor, initial RT_{NDT}, and margin term for this change are shown in Table 1. The change is a result of the use of plant specific surveillance capsule data as an input to CVGRAPH, which has improved the accuracy and consistency in plotting the Charpy data. The RT_{PTS} for HBRSEP, Unit No. 2 remains below the screening criteria in accordance with 10 CFR 50.61.

The decrease in upper shelf energy (USE), as determined from the surveillance capsule data plotted with CVGRAPH, results in an insignificant difference for EOL considerations (i.e., projected EOL USE of 66.6 foot-pounds (ft-lbs) compared to a USE of 65 ft-lbs reported by letter dated November 20, 1995). The projected fluences for the ¼ T location at EOL, provided by letter dated November 20, 1995, remain valid for the RPV, and the EOL values for USE reported by letter dated November 20, 1995, remain conservative.

The chemistry factor for the W5214 weld heat has made the upper circumferential weld the limiting beltline material for operating limit considerations. The current ¼ T and ¾T Adjusted Reference Temperatures (ART), incorporated into Technical Specifications (TSs) Section 3.4.3, "RCS Pressure and Temperature (P/T) Limits," were developed for the lower circumferential weld and are valid through 24 effective full power years (EFPY) using conservative margin and fluence terms (i.e., conservative relative to the margin and fluence terms projected for the upper circumferential weld). Because of these conservatisms, the current TSs P-T operating limits and LTOP setpoints remain conservative and no revision to the RPV integrity analyses are required.

Evaluations for weld heats 34B009 and 86054B previously submitted by letter dated November 20, 1995, remain valid.

Section 3.0; PTS/PT Limit Evaluation

3. "If the limiting material for your plant changes or if the adjusted reference temperature for the limiting material increases as a result of the above evaluations, provide the revised RT_{PTS} value for the limiting material in accordance with 10 CFR 50.61. In addition, if the adjusted RT_{NDT} value increased, provide a schedule for revising the PT and LTOP limits. The schedule should ensure that compliance with 10 CFR 50 Appendix G is maintained."

Response:

The limiting material for the HBRSEP, Unit No. 2 RPV RT_{PTS} did not change as a result of using the CVGRAPH to replot surveillance capsule data. However, the chemistry factor and corresponding RT_{PTS} values for the limiting weld increased. This change is reflected in Table 1 and an evaluation of the change is included in the above Section 2.0 response.

Due to the use of conservative values in determining the TSs P-T operating limits and LTOP setpoints in accordance with 10 CFR 50, Appendix G, the RT_{NDT} values as reported by CP&L letter dated November 20, 1995, remain conservative and are in accordance with 10 CFR 50, Appendix G.

Summary Assessment

Table 4, "Comparison Of Reactor Vessel Integrity Data 'Best Estimate' Chemistries," summarizes the evaluation of the weld heat "best estimate" chemistries for the HBRSEP, Unit No. 2 RPV and includes the Pressurized Thermal Shock (PTS) limiting material, heat W5214. Table 4 also includes a comparison of "best estimate" chemistry values for HBRSEP, Unit No. 2 and CEOG data.

The "best estimate" chemistry factors for HBRSEP, Unit No. 2 weld heats have not changed as a result of CE-NPSD-1039. The chemistry factor for the limiting weld has been changed as a result of using CVGRAPH to replot surveillance capsule data for weld heat W5214. Evaluations for weld heats 34B009 and 86054B previously submitted by CP&L letter dated November 20, 1995, remain valid. The effect of the change in chemistry factor for weld heat W5214 has been evaluated. The increase in chemistry factor for weld heat W5214 is within conservative margins used to develop the existing TSs P-T operating limits and LTOP setpoints in accordance with 10 CFR 50, Appendix G. Therefore, no revision to the TSs P-T operating limits and LTOP setpoints is required.

Facility: H. B. Robinson Steam Electric Plant, Unit No. 2
Vessel Manufacturer: Combustion Engineering

TABLE 1
INFORMATION REQUESTED ON RPV WELD AND/OR LIMITING MATERIALS

RPV Weld Wire Heat[1]	"Best Estimate" Copper	"Best Estimate" Nickel	End Of Life (EOL) Inside Dimension (ID) Fluence ($\times 10^{19}$)	Assigned Material Chemistry Factor (CF)	Method of Determining CF[2]	Initial RT_{NDT} ($RT_{NDT(U)}$)	σ_U	σ_Δ	Margin	ART or RT_{PTS} at EOL
W5214	0.208	1.01	1.80	230	Surveillance /Ratio	-56	17	14	44	255
86054B	0.22	0.054	3.93	101	Table	-56	17	28	65.5	146.2
34B009	0.19	0.98	2.00	217	Table	-77	0	28	56	237

Table Notes:
(1) Or the material identification of the limiting material as requested in Section 1.0.
(2) Determined from tables or from surveillance data.

Facility: H. B. Robinson Steam Electric Plant, Unit No. 2
Vessel Manufacturer: Combustion Engineering

TABLE 1
INFORMATION REQUESTED ON RPV WELD AND/OR LIMITING MATERIALS

Discussion of the Analysis Method and Data Used for Each Weld Wire Heat.

Weld Wire Heat	Discussion
86054B	The upper, intermediate, and lower shell axial welds (i.e., weld IDs 1-273 A, B, & C; 2-273 A, B, & C; and 3-273 A, B, & C) were produced using wire heat number 86054B. The wire was a copper coated wire; however, the welding process did not include the cold nickel wire feed. As noted in CP&L response to GL 92-01, Revision 1, dated November 29, 1993, the chemistry values for this heat were adopted from the Connecticut Yankee surveillance weld that was produced from the same wire heat without the cold nickel addition. A chemistry of 0.22% Cu and 0.054% Ni was provided in the November 29, 1993, response. The RPV surveillance capsule data is insufficient to calculate a chemistry factor. Therefore, Table 1, "Chemistry Factor for Welds, °F," of Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials," Revision 2, was used to determine a chemistry factor of 101°F for this heat. The "best estimate" copper and nickel values reported in CE-NPSD-1039 for heat 86054B contain chemistry points from material other than vessel or surveillance welds. The report does not clarify the base material used for these welds nor does it provide sufficient backup documentation to demonstrate how the results can be considered applicable to RPV welds. For example, the use of "wire/flux qualification" chemistry samples are referenced in some cases; however, sufficient information is not provided within the report to allow independent validation that the quality control and welding variables used in the qualification activity should be considered applicable to RPV welds. Since the HBRSEP, Unit No. 2 "best estimate" chemistry for wire heat 86054B is conservative, with respect to the reported values in CE-NPSD-1039, the HBRSEP, Unit No. 2 "best estimate" chemistry was not changed.

Facility: H. B. Robinson Steam Electric Plant, Unit No. 2
Vessel Manufacturer: Combustion Engineering

TABLE 1
INFORMATION REQUESTED ON RPV WELD AND/OR LIMITING MATERIALS

Discussion of the Analysis Method and Data Used for Each Weld Wire Heat.

Weld Wire Heat	Discussion
34B009	The 34B009 wire heat is contained in the Northeast Utilities' Millstone Nuclear Power Station (NPS), Unit No. 1 surveillance weld and RPV, the Consumers Power Company's Palisades Nuclear Plant (NPP) RPV and retired steam generators, the HBRSEP Unit No. 2 torus-dome weld and RPV, the Consolidated Edison Company's Indian Point, Unit No. 2 (IP2) RPV, the New York Power Authority's Indian Point Nuclear Generating Unit No. 3 (IP3) RPV, and the Public Service Electric & Gas Company's Salem Nuclear Generating Station (NGS), Unit No. 1 RPV. A cooperative data sharing effort among eight utilities in 1995, including the five with RPVs containing this weld heat, determined the "best estimate" chemistries for the 34B009 weld heat. The November 20, 1995, response to GL 92-01 Revision 1, Supplement 1 reported the results of the data sharing effort. The "best estimate" chemistry of 0.19% copper and 0.98% nickel was determined from over 300 individual chemistry measurements. The copper content was established using a coil weighted approach and the nickel content was determined using an average of the nickel values from each weld. The copper values reported in CE-NPSD-1039 agree with the currently reported copper for HBRSEP, Unit No. 2. The nickel values of the simple and weighted means are lower than the currently reported HBRSEP, Unit No. 2 values and therefore, the reported nickel values for HBRSEP, Unit No. 2 are conservative. Report CE-NPSD-1039 reported generic "best estimate" for nickel in nickel addition welds of 1.038% Ni was not adopted for the HBRSEP, Unit No. 2 "best estimate" chemistry. Report CE-NPSD-1039 used nickel

Facility: H. B. Robinson Steam Electric Plant, Unit No. 2
Vessel Manufacturer: Combustion Engineering

TABLE 1
INFORMATION REQUESTED ON RPV WELD AND/OR LIMITING MATERIALS

Discussion of the Analysis Method and Data Used for Each Weld Wire Heat.

Weld Wire Heat	Discussion
	measurements from different heats of nickel addition welds, determined a "generic" value, and used the Chauvenet's criterion for evaluating outliers. Report CE-NPSD-1039 recommends the "generic" nickel value ". . . when heat-specific measurements are inadequate." The HBRSEP, Unit No. 2 "best estimate" chemistry was determined from a larger number of individual measurements. Only measurements from 34B009 wire heats were used in the determination of the HBRSEP, Unit No. 2 "best estimate" nickel content. Therefore, the CE-NPSD-1039 reported generic nickel value of 1.038% was not adopted in the determination of the HBRSEP, Unit No. 2 "best estimate" chemistry. The HBRSEP Unit No. 2 nickel values for 34B009 are based on adequate data and are conservative when compared to the simple and weighted means reported in CE-NPSD-1039 for this same weld heat. Therefore, the "best estimate" chemistry for wire heat 34B009 remains valid and has not changed.

Facility: H. B. Robinson Steam Electric Plant, Unit No. 2
Vessel Manufacturer: Combustion Engineering

TABLE 1
INFORMATION REQUESTED ON RPV WELD AND/OR LIMITING MATERIALS

Discussion of the Analysis Method and Data Used for Each Weld Wire Heat.

Weld Wire Heat	Discussion
W5214	Weld heat W5214 is contained in the IP2 RPV and surveillance weld, the IP3 surveillance weld, the Millstone NPS, Unit No. 1 RPV, the Palisades NPP RPV and retired steam generators, the Salem NGS, Unit No. 1 RPV, the HBRSEP Unit No. 2 RPV and surveillance weld, the Niagara Mohawk Power Corporation's Nine Mile Point Nuclear Station, Unit No. 1 (NMP1) surveillance welds, and General Public Utilities Nuclear Corporation's Oyster Creek Nuclear Power Plant surveillance welds. Heat W5214 was also included in the data sharing effort described above for wire heat 34B009. Both the copper and nickel values were determined from over 300 individual measurements resulting in a coil weighted content of 0.208 % copper and an average nickel value of 1.01%. The copper content determined for heat W5214, during the data sharing effort in 1995, used a considerable number of individual measurements and contains measurements from vessel production and surveillance weld preparation using the nickel addition process. Also, the "best estimate" coil weighted mean of CEOG report CE-NPSD-1039 is essentially the same as the HBRSEP, Unit No. 2 value. Therefore, the currently reported copper "best estimate" value as reported by letter dated November 20, 1995, is not changed as a result of CEOG report CE-NPSD-1039. The simple and weighted means for nickel reported specifically for heat W5214 by CE-NPSD-1039 are non-conservative when compared to the HBRSEP, Unit No. 2 "best estimate" nickel values, were determined by including chemistries from welds with no cold addition nickel, and provided insufficient documentation to

Facility: H. B. Robinson Steam Electric Plant, Unit No. 2
Vessel Manufacturer: Combustion Engineering

TABLE 1
INFORMATION REQUESTED ON RPV WELD AND/OR LIMITING MATERIALS

Discussion of the Analysis Method and Data Used for Each Weld Wire Heat.

Weld Wire Heat	Discussion
	consider the quality control and welding variables used in the "wire/flux qualifications" activities applicable to RPV welds. Therefore, CE-NPSD-1039 "best estimate" nickel was not adopted for the HBRSEP, Unit No. 2 heat W5214. The HBRSEP, Unit No. 2 "best estimate" nickel for heat W5214 was based on adequate data and was not changed as a result of CE-NPSD-1039. The results for heat W5214 have changed compared to the values reported by letter dated November 20, 1995, primarily due to the use of CVGRAPH to reevaluate the Charpy V-notch data from past capsule testing. CP&L Letter dated November 20, 1995, noted ". . . discrepancies between the data reported for Capsules S and V and the data for these same Capsules contained in earlier surveillance reports . . . ," and also used the surveillance capsule data to determine the most conservative chemistry factor in accordance with Position 2 of Regulatory Guide 1.99 Revision 2. In some cases capsule reports of past capsule surveillance data appeared to use hand drawn curves. To resolve the noted discrepancies, the past capsule surveillance data was replotted using CVGRAPH for consistency. The CVGRAPH replotted curves result in slight curve changes and a change in the chemistry factor for weld heat W5214 from 225°F to 230°F.

TABLE 2
Heat W5214 Data

Capsule ID (HBRSEP Unit NO. 2)	Cu	Ni	Irradiation Temperature (°F)	Fluence (x1019n/cm2)	Measured ΔRT_{NDT} (°F)	Data Used in Assessing Vessel (Y or N)
V	0.34	0.66	548	0.601	209	Y
T	0.34	0.66	548	0.442	288	Y

TABLE 3
Heat W5214 Results

Capsule ID (HBRSEP Unit NO. 2)	Cu	Ni	Irradiation Temperature (°F)	Fluence Factor	Measured ΔRT_{NDT} (°F)	Predicted ΔRT_{NDT} from best fit line (°F)	(Measured - Predicted) ΔRT_{NDT} (°F)
V	0.34	0.66	548	.857	209	187.6	21.4
T	0.34	0.66	548	1.377	288	301.3	-13.3

TABLE 4

COMPARISON OF REACTOR VESSEL INTEGRITY DATA "BEST ESTIMATE" CHEMISTRIES

Weld Heat Number	November 20, 1995 Response to Generic Letter 92-01, Revision 1, Supplement 1		CE NPSD-1039[1] Simple Mean		CE NPSD-1039[1] Weighted Mean		CE NPSD-1039[1] "Best Estimate"		Current HBRSEP, Unit No. 2 "Best Estimate"	
	% Cu	% Ni	% Cu	% Ni	% Cu	% Ni	% Cu	% Ni	% Cu	% Ni
86054B	0.22	0.054	0.214	0.0463	0.214	0.0463	0.214	0.046	0.22	0.054
34B009	0.19	0.98	0.1887	0.9633	0.1924	0.8884	0.192	1.038 [2]	0.19	0.98
W5214	0.208	1.01	0.255	0.934	0.225	0.799	0.213[3]	1.038 [2]	0.208	1.01

Table Notes:

(1) CE NPSD-1039, Revision 2, "Best Estimate Copper and Nickel Values in CE Fabricated Reactor Vessel Welds," Combustion Engineering Owners Group, June 1997.

(2) The "best estimate" nickel values, of the CEOG report CE-NPSD-1039 using the cold nickel addition process, were determined over a wide range of heats, and documented as "generic values."

(3) Coil weighted mean.