Progress Energy

Serial: NPD-NRC-2009-238 10CFR52.79
December 3, 2009

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 2 AND 3
DOCKET NOS. 52-022 AND 52-023
RESPONSE TO SUPPLEMENTAL REQUEST FOR ADDITIONAL INFORMATION REGARDING THE ENVIRONMENTAL REVIEW

Reference: Letter from Donald Palmrose (NRC) to James Scarola (PEC), dated October 30, 2009, "Supplemental Request for Additional Information Regarding the Environmental Review of the Combined Licenses Application for the Shearon Harris Nuclear Power Plant, Units 2 and 3"

Ladies and Gentlemen:

Progress Energy Carolinas, Inc. (PEC) hereby submits our response to the Nuclear Regulatory Commission's (NRC) request for additional information provided in the referenced letter. A response to the NRC request is addressed in the enclosure.

If you have any further questions, or need additional information, please contact Bob Kitchen at (919) 546-6992, or me at (727) 820-4481.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on December 3, 2009.

Sincerely,

John Elnitsky
Vice President
Nuclear Plant Development

Enclosure

cc : U.S. NRC Region II, Regional Administrator
U.S. NRC Resident Inspector, SHNPP Unit 1
Mr. Brian Hughes, U.S. NRC Project Manager
Dr. Donald Palmrose, U.S. NRC Environmental Project Manager

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Shearon Harris Nuclear Power Plant Units 2 and 3
Response to NRC Supplemental Request for Additional Information Regarding the Environmental Review for the Combined License Application, dated October 30, 2009

NRC RAI #	Progress Energy RAI #	Progress Energy Response
5.4.2-2	H-0513	Response enclosed – see following pages

NRC Letter No.: HAR-ER-RAI SUPPLEMENT

NRC Letter Date: October 30, 2009

NRC Review of Environmental Report

NRC RAI #: 5.4.2-2

Text of NRC RAI:

Provide an evaluation of the potential tritium buildup concentration (in pCi/L) in the Harris Reservoir from the addition of liquid effluents containing tritium from the operation of Units 2 and 3.

Additionally, based on the potential tritium buildup concentration in the Harris Reservoir, provide an estimate of dose and impacts to the public due to tritium released by the evaporation of water obtained from the Harris Reservoir from the cooling towers for the proposed Units 2 and 3.

PGN RAI ID #: H-0513

PGN Response to NRC RAI:

PART 1

Progress Energy Carolinas, Inc. (PEC) proposes to co-locate two Westinghouse Electric Company, LLC AP1000 Reactor (AP1000) units with the Shearon Harris Nuclear Power Plant Unit 1 (HNP) in Wake County, North Carolina. The addition of Shearon Harris Nuclear Power Plant Units 2 and 3 (HAR) will result in an increased release of tritium to Harris Lake. A model simulation was performed using the U.S. Army Corps of Engineers' (USACE's) CE-QUAL-W2 model (Reference RAI 5.4.2-2 01) to calculate the change in tritium levels in the lake as a result of the increased release of tritium.

The CE-QUAL-W2 model is a two-dimensional, longitudinal/vertical, hydrodynamic water quality model designed to evaluate water quality in lakes and reservoirs. The model computes water levels, temperature, and numerous other water quality parameters, such as dissolved oxygen, nutrients, pH, the carbonate cycle, general constituents, and dissolved and suspended solids on a sub-daily timestep.

An existing model, used to predict changes in the water quality of Harris Lake, was the basis for the tritium analysis. The Harris Lake CE-QUAL-W2 model was originally set up and calibrated to evaluate the potential changes in water quality resulting from a potential wastewater discharge to Harris Lake (Reference RAI 5.4.2-2 02).

The primary focus of the original model development was response of algae to nutrient inputs. Two of the primary processes relevant to a tritium study, hydrologic balance and stratification, were calibrated in the previous modeling efforts (Reference RAI 5.4.2-2 02). The CE-QUAL-W2 model was modified to predict tritium levels in the lake using historical data for the existing HNP and estimates of tritium discharge for the proposed HAR.

The original CE-QUAL-W2 model development included a scenario that involved the construction of HAR. Under this scenario, a 240-foot lake level was maintained by pumping water from the Cape Fear River. Of specific interest was the change in water quality that might

occur during drought periods when pumping from the Cape Fear River would be restricted due to low-flow levels in the river, dropping lake level below the 240-foot elevation. This scenario was adapted to evaluate the potential tritium levels that would occur with all three units (HNP, HAR 2, and HAR 3) in operation.

The following assumptions were made during the development of the tritium analysis:

- The lake level is maintained at 240 feet using make-up flow from the Cape Fear River when possible.
- Make-up pumping from the Cape Fear River is restricted during drought periods.
- Pumping from the Cape Fear is up to 133.68 cubic feet per second (cfs) during non-drought conditions.
- A minimum release of 20 cfs (12.9 million gallons per day) over the Main Dam is specified.
- The tritium load is 465 curies per year (Ci/yr) from the HNP, which is released uniformly throughout the year.
- The tritium load is 1,010 Ci/yr each from HAR 2 and HAR 3, which is released uniformly throughout the year.
- A 30-percent reduction is applied to the HNP and HAR releases to reflect the losses identified in the model calibration.

The model was run for the time period from 2001 through 2008. This period includes two major droughts: (1) a moderate to extreme drought from October 2001 through October 2002, and (2) a moderate to exceptional drought from June 2007 through April 2008. As described in the assumptions, inflow from the Cape Fear River was restricted. In many instances, only a pass-through lake flow of 20 cfs was specified. During these periods, the lake level was drawn down, causing an increased concentration of tritium in the lake.

The predicted tritium levels in the lake segment downstream of the discharge for the proposed reactor scenario are shown on Figure 1. Tritium levels never exceed a level of 20,000 picocuries per liter (pCi/L).

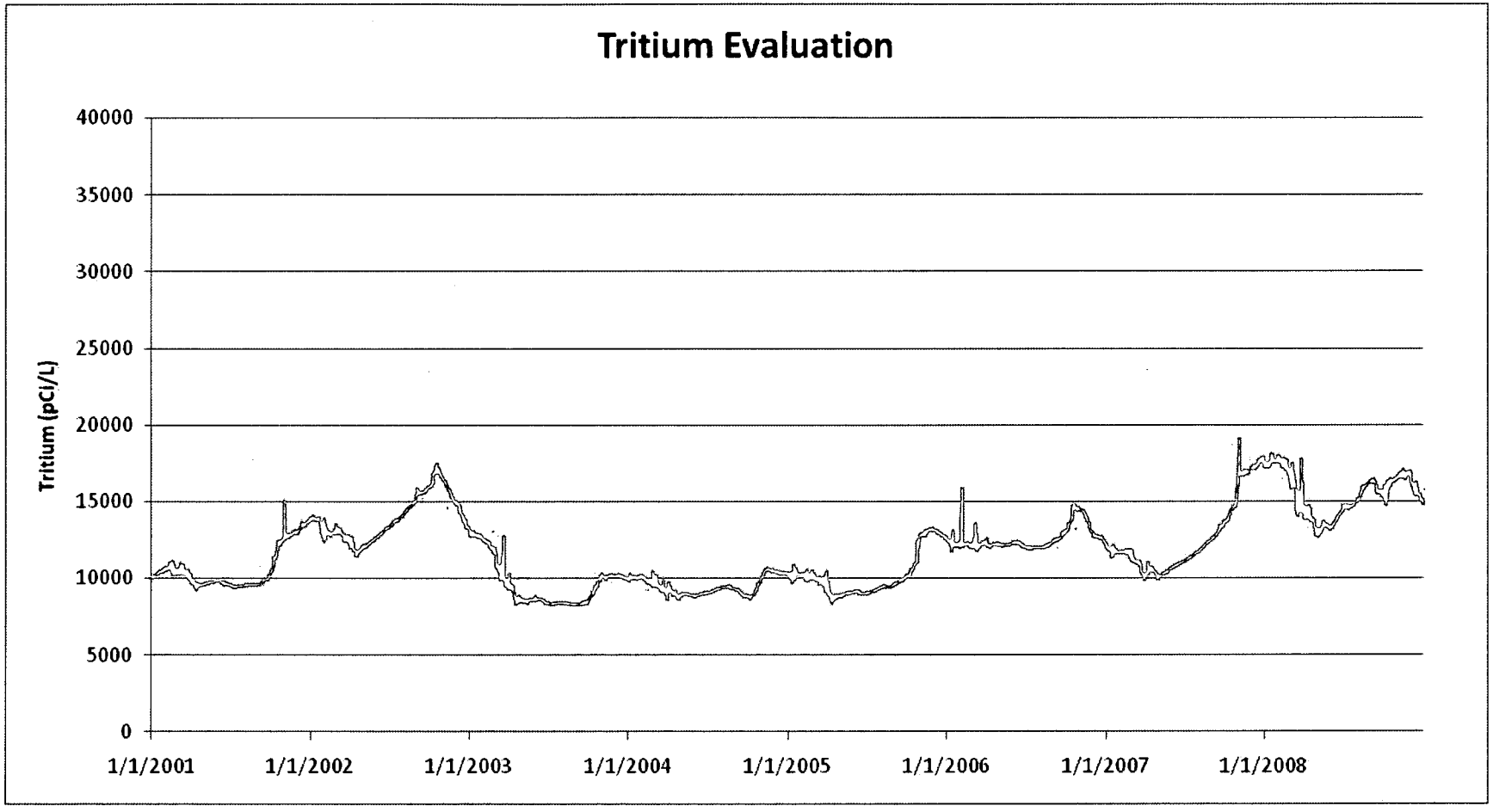

Figure 1
Results of Tritium Evaluation

PART 2

Calculation of the doses to man from routine release of gaseous reactor effluents from HAR was done in accordance with Regulatory Guide 1.109 (Reference RAI 5.4.2-2 03). Regulatory Guide 1.109 characterizes the maximum individual as "maximum" with regard to food consumption, occupancy, and other usage of the region in the vicinity of the plant site, and as such, represents individuals with habits representing reasonable deviations from the average for the population in general. In addition, Regulatory Guide 1.109 identifies exposure pathways for estimating radiation exposure for maximum individuals. Other exposure pathways that may arise due to unique conditions at a specific site should be considered if they are likely to provide a significant contribution to the total dose. As described in Regulatory Guide 1.109, licensees must evaluate any new exposure pathways to members of the public that contribute 10 percent or more of the total effluent dose and include these dose assessments in their demonstration of compliance with Appendix I of Title 10 *Code of Federal Regulations* (CFR) Part 50. Similar discussion is found in *Regulatory Issue Summary* 2008-03 (Reference RAI 5.4.2-2 04).

The methodology contained in the GASPAR II program (Reference RAI 5.4.2-2 05) is used to determine the gaseous pathway doses. This program implements the radiological exposure models described in Regulatory Guide 1.109 (Reference RAI 5.4.2-2 03) for radioactivity releases in gaseous effluent. The code calculates the radiation exposure to man from external exposure to airborne radioactivity, external exposure to deposited activity on the ground, inhalation of airborne activity, and ingestion of contaminated agricultural products. Doses are calculated for both the maximum exposed individual (MEI) and for the 50-mile surrounding population.

The following provides an evaluation of potential dose impact to the public due to tritium discharged back to the environment via the HAR cooling towers by the evaporation of cooling water obtained from the Harris Reservoir.

For the purposes of this evaluation, the maximum equilibrium concentration of tritium in Harris Reservoir is conservatively taken as 20,000 pCi/L. This level is the drinking water standard established by the U.S. Environmental Protection Agency (USEPA). As described earlier in this response, modeling has demonstrated that the concentration of tritium in the lake due to the operation of HNP, HAR 2, and HAR 3 can be maintained at less than 20,000 pCi/L. This is consistent with the discussion in Section 5.4 of the Environmental Report (ER) (Reference RAI 5.4.2-2 06), which states, "PEC will monitor water quality in the reservoir to ensure tritium concentrations are maintained below the USEPA drinking water standard." Section 5.4 also explains that the average annual tritium release to Harris Reservoir from HNP operations is 465 Curies per year (Ci/yr). Tritium releases from the HAR units are conservatively estimated to be 1,010 Ci/yr per unit. The average annual tritium release to Harris Reservoir is the sum of the tritium releases from HNP and HAR or 2,485 Ci/yr. For the HAR, the cooling tower evaporation is given as 13,210 gallons per minute per unit.

Per Appendix I, Section II, B.1 and B.2 of 10 CFR Part 50, compliance with the regulation is satisfied if the specified limits are not exceeded. The limits are specified on a per unit basis.

The percent contribution from each unit at the Harris site to the total lake concentration is given as follows:

HAR 1	HAR 2	HNP	Total
1010 Ci/yr	1010 Ci/yr	465 Ci/yr	2485 Ci/yr
40.6%	40.6%	18.7%	100.0%

The estimated annual release of tritium to the environment per HAR unit via cooling tower evaporation of previously released liquid tritium is given as follows.

(13210 gal/min * 525600 min/yr * 20000 pCi/L * 3.785 l/gal) / (1.0E+12 pCi/Ci * 0.406 / unit)

= 213 Ci/yr/HAR unit

Inputting this release into the HAR GASPAR computer models provides the incremental dose from this pathway. Per HAR ER Table 5.4-7 (a portion of which is reproduced below as Table 1), the MEI dose calculated for the gaseous pathways excluding the cooling tower evaporation was to a child. Table 2 provides the incremental dose to a child from the cooling tower evaporation pathway and the percent the dose would contribute to the total gaseous effluent dose provided in the HAR ER. As seen by the values provided, the contribution from the cooling tower pathway is less than 4.5 percent of the MEI dose.

In addition to evaluating the MEI dose, the 50-mile population dose was evaluated using the 213 Ci/yr tritium source. The results show that the potential contribution to the total 50-mile population dose from the cooling tower evaporation pathway would be 0.679 person rem per year whole body and 0.679 person rem per year thyroid. This compares with the values of 6.52 person rem per year whole body and 12.9 person rem per year thyroid given in ER Table 5.4-11 (Reference RAI 5.4.2-2 06).

A cost-benefit analysis (CBA) was performed for HAR in accordance with Appendix I of 10 CFR 50. The HAR CBA for gaseous effluents is provided in Section 11.3 of the HAR Final Safety Analysis Report (FSAR) (Reference RAI 5.4.2-2 06). The criterion for determining whether a modification was cost effective was $1,000 per person-rem whole body or $1,000 per person-rem thyroid saved. Based on the results provided in the HAR application, the person rem per year whole body dose (equivalent to $6520 available for augments) was negligible compared to the person rem per year thyroid dose (equivalent to $12,900 available for augments). Therefore, the HAR person rem per year thyroid dose provides the limiting case.

The contribution from the cooling tower evaporation pathway is 5.3 percent (100 * 0.679 person rem per year thyroid / 12.9 person rem per year thyroid) of the 50-mile person rem per year thyroid dose. The calculated doses associated with the cooling tower evaporation of Harris lake water do not have the potential for contributing 10 percent or more to the individual MEI dose or the limiting 50-mile population person rem per year thyroid dose. Therefore, this pathway is not considered significant relative to the Appendix I criteria and is not included in the HAR FSAR or ER dose analyses.

Table 1
Annual Dose to Maximum Exposed Individual mrem (mrad)/yr/unit provided in the HAR Environmental Report

		T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin	
		(mrem/yr)	(mrem/yr)	(mrem/yr)	(mrem/yr)	(mrem/yr)	(mrem/yr)	(mrem/yr)	(mrem/yr)	
Plume		3.84E-01	3.84E-01	3.84E-01	3.84E-01	3.84E-01	3.84E-01	4.14E-01	2.14E+00	EAB
Ground		6.25E-02	6.25E-02	6.25E-02	6.25E-02	6.25E-02	6.25E-02	6.25E-02	7.34E-02	EAB
Child Cow Milk		6.25E-02	6.19E-02	2.77E-01	6.40E-02	6.34E-02	2.75E-01	6.20E-02	6.18E-02	Nearest Milk Cow
Child Goat Milk		7.07E-02	6.94E-02	2.83E-01	7.51E-02	7.22E-02	3.55E-01	6.98E-02	6.92E-02	Nearest Goat Milk
Child Vegetable		2.37E-01	2.36E-01	1.08E+00	2.39E-01	2.37E-01	5.78E-01	2.34E-01	2.34E-01	Nearest Garden
Child Inhalation		7.17E-03	7.09E-03	1.58E-03	7.44E-03	7.58E-03	9.54E-02	9.78E-03	6.96E-03	Nearest Residence
Child Meat		2.50E-02	2.51E-02	1.18E-01	2.50E-02	2.50E-02	2.98E-02	2.49E-02	2.49E-02	Nearest Meat Cow
Total		8.49E-01	8.46E-01	2.21E+00	8.57E-01	8.52E-01	1.78E+00	8.77E-01	2.61E+00	

Notes:
EAB = Exclusion Area Boundary
mrad = milliradian
mrem = millirem

Table 2
Annual Dose to Maximum Exposed Individual mrem (mrad)/yr/unit from Cooling Tower Tritium Evaporation

		T.Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin	
		(mrem/yr)	(mrem/yr)	(mrem/yr)	(mrem/yr)	(mrem/yr)	(mrem/yr)	(mrem/yr)	(mrem/yr)	
Plume		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	EAB
Ground		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	EAB
Child Cow Milk		4.34E-03	4.34E-03	0.00E+00	4.34E-03	4.34E-03	4.34E-03	4.34E-03	4.34E-03	Nearest Milk Cow
Child Goat Milk		8.86E-03	8.86E-03	0.00E+00	8.86E-03	8.86E-03	8.86E-03	8.86E-03	8.86E-03	Nearest Goat Milk
Child Vegetable		1.93E-02	1.93E-02	0.00E+00	1.93E-02	1.93E-02	1.93E-02	1.93E-02	1.93E-02	Nearest Garden
Child Inhalation		4.24E-03	4.24E-03	0.00E+00	4.24E-03	4.24E-03	4.24E-03	4.24E-03	4.24E-03	Nearest Residence
Child Meat		8.66E-04	8.66E-04	0.00E+00	8.66E-04	8.66E-04	8.66E-04	8.66E-04	8.66E-04	Nearest Meat Cow
Total		3.76E-02	3.76E-02	0.00E+00	3.76E-02	3.76E-02	3.76E-02	3.76E-02	3.76E-02	
% of MEI		4.4%	4.4%	0.0%	4.4%	4.4%	2.1%	4.3%	1.4%	

Notes:
EAB = Exclusion Area Boundary
mrad = milliradian
mrem = millirem

References

Reference RAI 5.4.2-2 01

Cole and Wells, *CE-QUAL-W2: A Two-Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model, Version 3.2*, U. S. Army Corps of Engineers, Washington, DC, 2002.

Reference RAI 5.4.2-2 02

CH2M HILL, Modeling *of Long-term Tritium Levels in Harris Lake*, 2009.

Reference RAI 5.4.2-2 03

U.S. Nuclear Regulatory Commission, Regulatory Guide 1.109, *Calculation of Annual Does to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I*, Rev. 1, October 1977.

Reference RAI 5.4.2-2 04

U.S. Nuclear Regulatory Commission, RIS 2008-03, *NRC Regulatory Issue Summary 2008-03 Return/Re-use of Previously Discharged Radioactive Effluents*, February 13, 2008.

Reference RAI 5.4.2-2 05

U.S. Nuclear Regulatory Commission, *GASPAR II - Technical Reference and User Guide*, NUREG/CR-4653, PNL-5907, March 1987.

Reference RAI 5.4.2-2 06

Progress Energy Carolinas, Inc. (PEC), *Shearon Harris Nuclear Power Plants Units 2 and 3 Combined License Application*, February 2008.

Associated HAR COL Application Revisions:

No COLA revisions have been identified associated with this response.

Attachments/Enclosures:

None.