Progress Energy

Serial: NPD-NRC-2010-073
September 15, 2010

10 CFR 52.80

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 CONCERNING HYDROLOGY CALCULATIONS IN SUPPORT OF A TRITIUM ANALYSIS

Reference: Letter from Donald Palmrose (NRC) to John Elnitsky (PEC), dated August 20, 2010, "Supplemental Request for Additional Information Concerning Hydrology Calculations in Support of a Tritium Analysis for the Shearon Harris Nuclear Power Plant, Units 2 and 3, Combined License Application"

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 each NRC request is addressed in the enclosure. In support of this response, the CE-QUAL-W2 model executable and input files and the requested native spreadsheet file are provided on the attached Native Files CD. A list of files on the attached CD for CE-QUAL-W2 is provided as Attachment 5.4-1A.

The supplemental information contained in the files on the attached CD is provided to support the NRC's review of the HAR COL application but does not comply with the requirements for electronic submission. The NRC staff requested the files be submitted in their native formats, required for utilization in the software employed to support the COL application development. PEC understands that converting the information to PDF output files would not serve the underlying purpose of the submittal; i.e., to provide the raw, unprocessed data to enable reviewers to evaluate software used in the HAR application.

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 September 15, 2010.

Sincerely,

John Elnitsky
Vice President
New Generation Programs & Projects

Progress Energy Carolinas, Inc.
P.O. Box 1551
Raleigh, NC 27602

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NRO

Enclosure/Attachments

cc : U.S. NRC Region II, Regional Administrator (without attached CD)
U.S. NRC Resident Inspector, SHNPP Unit 1 (without attached CD)
Mr. Brian Hughes, U.S. NRC Project Manager (without attached CD)
Dr. Donald Palmrose, U.S. NRC Environmental Project Manager (w/3 copies of attached CD)

**Shearon Harris Nuclear Power Plant Units 2 and 3
Response to NRC Supplemental Request for Additional Information Concerning Hydrology Calculations in Support of a Tritium Analysis for the Combined License Application, dated August 20, 2010**

NRC RAI #	Progress Energy RAI #	Progress Energy Response
5.2.2-4	H-0627	Response enclosed – see following pages
5.2.2-5	H-0628	Response enclosed – see following pages
5.4-1	H-0629	Response enclosed – see following pages

NRC Letter No.: ER-SUPL-Tritium

NRC Letter Date: August 20, 2010

NRC Review of Environmental Report

NRC RAI #: 5.2.2-4 (ESRP 5.2.2, 10 CFR 51.7(d))

Text of NRC RAI:

Provide the native spreadsheet file used to calculate the monthly water balance for Harris Reservoir and the elevation area storage capacity curves used in the water level calculation (ranging from 215 ft to 260 ft).

The calculation package HAG-XK01-GER-004, Rev 0 "Lake Level Variation due to Variable Makeup Pumping Rates from Cape Fear River" presents calculations from a spreadsheet of the monthly water balance for Harris Reservoir. The lake level analysis is important in determining the feasibility of maintaining the level of Harris Reservoir. The lake level is determined by several factors including the elevation-storage relation for Harris Reservoir as well as the conditions under which makeup water are available from the Cape Fear River.

PGN RAI ID #: H-0627

PGN Response to NRC RAI:

The monthly water balance spreadsheet for Harris Reservoir used in the calculation package HAG-XK01-GER-004, Rev 0 "*Lake Level Variation due to Variable Makeup Pumping Rates from Cape Fear River*" is included as Attachment 5.2.2-4A.xlsx to this request for additional information (RAI). This spreadsheet quantifies the inflows and outflows to Harris Reservoir and is a useful tool in evaluating the potential changes in reservoir level caused by modifications of either inflows or outflows.

This approach was not used, however, for the lake level analysis described in Technical Memorandum (TMEM)-107, Revision 3 "*Determination of Future Harris Reservoir Storage Requirements*," or the tritium analysis documented in the Response to RAI 5.2.2-5. TMEM-107, Rev 3 uses the Cape Fear River Basin hydrological model, but the Response to RAI 5.2.2-5 relies on the water balances as calculated by the CE-QUAL-W2 model. More information regarding the assumptions used for the CE-QUAL-W2 model of Harris Reservoir is provided in the response to NRC RAI # 5.2.2-5.

Associated HAR COL Application Revisions:

No COLA changes have been identified associated with this response.

Attachments/Enclosures:

Attachment 5.2.2-4A.xlsx included as requested native file spreadsheet on attached Native Files CD.

NRC Letter No.: ER-SUPL-Tritium

NRC Letter Date: August 20, 2010

NRC Review of Environmental Report

NRC RAI #: 5.2.2-5 (ESRP 5.2.2, 10 CFR 51.7(d))

Text of NRC RAI:

Provide the native files for the model CE-QUAL-W2 for the water quality analysis of Harris Reservoir, as referenced in the calculation package HAR-338884-TMEM-122 and table of input parameters and their values which were used for conducting water quality analysis using the model CE-QUAL-W2.

The report titled "Development and Calibration of a CE QUAL W2 Model for Harris Lake including 2008 Update," is referenced in the calculation package HAR-338884-TMEM-122 titled "Modeling of Long Term Tritium Level in Harris Lake," submitted by Progress Energy. The native files for the water quality model were not provided with the calculation package. Input parameters that govern the transport and fate of water quality constituents were not provided with the calculation package.

PGN RAI ID #: H-0628

PGN Response to NRC RAI:

The CE-QUAL-W2 model executable and input files are provided on the attached Native Files CD. As described below, the evaluation used an existing CE-QUAL-W2 model based on the CE-QUAL-W2 version 3.2 executable. To run the model, the user should follow the instructions provided for CE-QUAL-W2 version 3.2 on the developer's website at: http://www.ce.pdx.edu/w2/.

The Dynamic Array Viewer must be installed to run this version of the model. Instructions for downloading the Dynamic Array Viewer software is provided on the developer's website after the user has registered for download of the model. Once the Dynamic Array Viewer software is installed, the user can run the CE-QUAL-W2 model using the executable included on the Native Files CD. The CE-QUAL-W2 User's Manual is also available on the developer's website and provides detailed information on the technical basis of the model.

The model was originally constructed and applied to provide initial insight into potential effects of the Western Wake Regional Water Reclamation Facility (WRF) discharge to Harris Lake. The Western Wake Project Partners worked in cooperation with Progress Energy and the North Carolina Division of Water Quality (NCDWQ) to consider a discharge to Harris Lake as an alternative to a discharge to the Cape Fear River. At the time, a key issue for this discharge option was whether the WRF would cause unacceptable nutrient impacts to the lake under current and proposed future operating conditions. Increases in algal populations were of primary interest, as measured by chlorophyll a concentrations, and subsequent depletion of dissolved oxygen (DO). To evaluate these issues, NCDWQ required the development of a calibrated nutrient response model. Subsequent efforts using more detailed monitoring data collected in 2008 were used to refine and validate the model. This process is described in *Development and Calibration of a CE-QUAL-W2 Model for Harris Lake including 2008 Update* (Reference RAI 5.2.2-5 01). The model calibration was approved by NCDWQ on May 22, 2009

(Reference RAI 5.2.2-5 02). The model was requested from NCDWQ and was provided to Progress Energy on November 11, 2009.

While the model was originally developed to evaluate nutrient concentrations and algal response, the modeling efforts began with hydrologic and thermal calibration. The hydrologic calibration demonstrates that the model is capturing the water balance of the system. The thermal calibration demonstrates that the model is predicting the thermal stratification and turn over that occurs in the reservoir. Since these components were calibrated, the model was considered to be acceptable for use in predicting long-term tritium concentrations.

Only minor modifications were made to perform the tritium evaluation. The modifications include the following:

- Raise lake level to 240 feet National Geodetic Vertical Datum of 1929 (NGVD29)
- Increase consumptive use because two Westinghouse Electric Company, LLC, AP1000 Reactor (AP1000) units were added
- Increase blowdown because two AP1000 units were added
- Include inflow timeseries from Cape Fear River to represent pumping during non-drought conditions
- Use tracer component in blowdown constituent file to represent tritium contribution from the existing and proposed units
- Set inflow from WRF to 0.0.

The CE-QUAL-W2 model dynamically simulates the hydrodynamics, thermodynamics, and transport within a reservoir system on a sub-hourly timestep. Physical factors such as inflows, air temperature, and wind have the largest effect on the prediction of tritium concentrations. These inputs are specified in the model input files included in the attached Native Files CD with listing provided in response to RAI 5.4-1 as Attachment 5.4-1A.

The fate of tritium within the system is controlled by the decay rate with a half-life of 12.3 years and a 30 percent reduction factor based on calibration of the model to observed data. The results of the calibration are provided in HAR-338884-TMEM-122 (Reference RAI 5.2.2-5 03). This information along with the other input parameters related to the loading, fate, and transport of tritium, as specified in the model input and control files, are described in Table 1.

Table 1
CE-QUAL-W2 Parameter Values Used in Tritium Evaluation

Parameter	Value	Default	Source
Lake Level	240 feet NGVD29	NA	Reference RAI 5.2.2-5 04
Maximum pumping rate	134 cfs	NA	Reference RAI 5.2.2-5 04
Inflow	Variable	NA	Reference RAI 5.2.2-5 01
Outflow	20 cfs	NA	Specified
Cape Fear Threshold for Pumping	600 cfs	NA	Specified
Blowdown Rate	35.6 cfs	NA	Reference RAI 5.2.2-5 05

Table 1
CE-QUAL-W2 Parameter Values Used in Tritium Evaluation

Parameter	Value	Default	Source
HNP Tritium Load	465 Ci/yr	NA	Reference RAI 5.2.2-5 06
HAR Tritium Load	1,010 Ci/yr per unit	NA	Reference RAI 5.2.2-5 06
Tritium Half-life	12.3 years	NA	Reference RAI 5.2.2-5 06
Tritium Loss	30 percent	NA	Reference RAI 5.2.2-5 03
Initial Tritium Concentration	10,000 pCi/L	NA	Reference RAI 5.2.2-5 03
Number of Segments	33	NA	Reference RAI 5.2.2-5 01
Number of Layers	25	NA	Reference RAI 5.2.2-5 01
Number of Branches	5	NA	Reference RAI 5.2.2-5 01
Minimum Timestep	1 second	1 second	Reference RAI 5.2.2-5 07
Vertical Eddy Viscosity Limit on Timestep	On	On	Reference RAI 5.2.2-5 07
Internal Gravity Wave Limit on Timestep	On	On	Reference RAI 5.2.2-5 07
Transport Scheme	ULTIMATE	ULTIMATE	Reference RAI 5.2.2-5 07
Theta	0.55	0.55	Reference RAI 5.2.2-5 07
Longitudinal Eddy Viscosity	1.0	1.0	Reference RAI 5.2.2-5 07
Longitudinal Eddy Diffusivity	1.0	1.0	Reference RAI 5.2.2-5 07
Interfacial Friction Factor	0.0	0.01	Reference RAI 5.2.2-5 07
Bottom Friction Solution	CHEZY	CHEZY	Reference RAI 5.2.2-5 07
Vertical Turbulence Closure Algorithm	W2	W2	Reference RAI 5.2.2-5 07
Vertical Eddy Viscosity Treatment	Explicit	Explicit	Reference RAI 5.2.2-5 07
Maximum Vertical Eddy Viscosity	1.0E-4	1.0E-4	Reference RAI 5.2.2-5 07

cfs = cubic feet per second
Ci/yr = curies per year
NA = not applicable
NGVD29 = National Geodetic Vertical Datum of 1929
pCi/L = picocuries per liter

References

Reference RAI 5.2.2-5 01

CH2M HILL, *Development and Calibration of a CE-QUAL-W2 Model for Harris Lake including 2008 Update*, 2009.

Reference RAI 5.2.2-5 02

Behm, Pamela/North Carolina Division of Water Quality. Personal communication with Klaus Albertin/CH2M HILL, May 22, 2009.

Reference RAI 5.2.2-5 03

Progress Energy Carolinas, Inc. (PEC), HAR-338884-TMEM-122 R1, *Modeling of Long-term Tritium Levels in Harris Lake*, 2009.

Reference RAI 5.2.2-5 04

Progress Energy Carolinas, Inc. (PEC), HAR-338884-TMEM-107 R1, *Determination of Future Harris Reservoir Storage Requirements,* 2009.

Reference RAI 5.2.2-5 05

Sargent &Lundy, HAG-XK01-GER-001, *Evaluation of Lake Level-Normal Pool Level and Makeup Flow Requirements for Two Additional AP 1000 Units*, 2007.

Reference RAI 5.2.2-5 06

Worley Parsons, HAG-0000-N5C-003, *Final Tritium Analysis – Harris (RAD-4),* 2006.

Reference RAI 5.2.2-5 07

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.

Associated HAR COL Application Revisions:

No COLA revisions have been identified associated with this response.

Attachments/Enclosures:

Attachment 5.4-1A: CE-QUAL-W2 Native Files file list.

CE-QUAL-W2 native files included on attached Native Files CD.

NRC Letter No.: ER-SUPL-Tritium

NRC Letter Date: August 20, 2010

NRC Review of Environmental Report

NRC RAI #: 5.4-1 (ESRP 5.4, 10 CFR 51.7(d))

Text of NRC RAI:

Provide the native files for the model CE-QUAL-W2 for the tritium analysis of Harris Reservoir as discussed in the calculation package HAR-338884- TMEM-122, a table of input parameters and their values which were used for conducting the tritium analysis using the model CE-QUAL-W2, and the model segment and layer numbers from which the results were extracted.

The calculation package HAR-338884-TMEM-122 titled "Modeling of Long Term Tritium Level in Harris Lake," was submitted by Progress Energy. The native files for the tritium model were not provided with the calculation package. Input parameters that govern the transport and fate of tritium were not provided with the calculation package.

PGN RAI ID #: H-0629

PGN Response to NRC RAI:

The CE-QUAL-W2 model executable and input files are provided on the attached Native Files CD. A table of input parameters and their values used for conducting the tritium analysis is provided as part of response to NRC RAI # 5.2.2-5.

The results shown in HAR-338884-TMEM-122 are from the 1-meter surface layer closest to the Main Dam (Segment 13). Review of the evaluations performed in support of the Western Wake WRF study and the tritium modeling results indicated that this segment had the highest concentration of water quality constituents because of flow patterns and stratification of the reservoir in the summer. When the reservoir has stratified, tritium concentrations become fairly uniformly distributed in the volume above and the volume below the thermocline.

Tritium concentrations can build up below the thermocline during the summer resulting in concentrations that are higher than in the surface layer (See Figure 1, *Depth Profile of Tritium Concentrations)*, however, the thermocline varies from approximately 5 to 10 meters below the surface. For this reason, the concentrations in the water volume above the thermocline are most relevant to primary contact concerns. Drinking water withdrawals are also above the thermocline and in one of the tributary arms of the reservoir, distant from the main dam. Reservoir turnover occurs each fall, distributing the accumulated tritium load throughout the entire water column.

On average, the tritium concentrations below the thermocline are 20 percent higher than above the thermocline. Review of the model predictions show that concentrations reach their highest level in the elevation range of 180 to 195 feet NGVD29. Table 2 presents the annual average and total average tritium concentrations for the simulation period (2001 to 2008) in the surface layer and at 187 feet NGVD29.

The allowable total body dose calculation of 4 millirems per year (mrem/yr) is based on an annual average concentration of 20,000 picocuries per liter (pCi/L). As shown in Table 2, the annual averages below the thermocline remain below 20,000 pCi/L even during drought periods, such as 2007 to 2008, when reservoir inflows were limited. These annual averages support the conclusion that tritium levels are within acceptable levels at all locations within the reservoir.

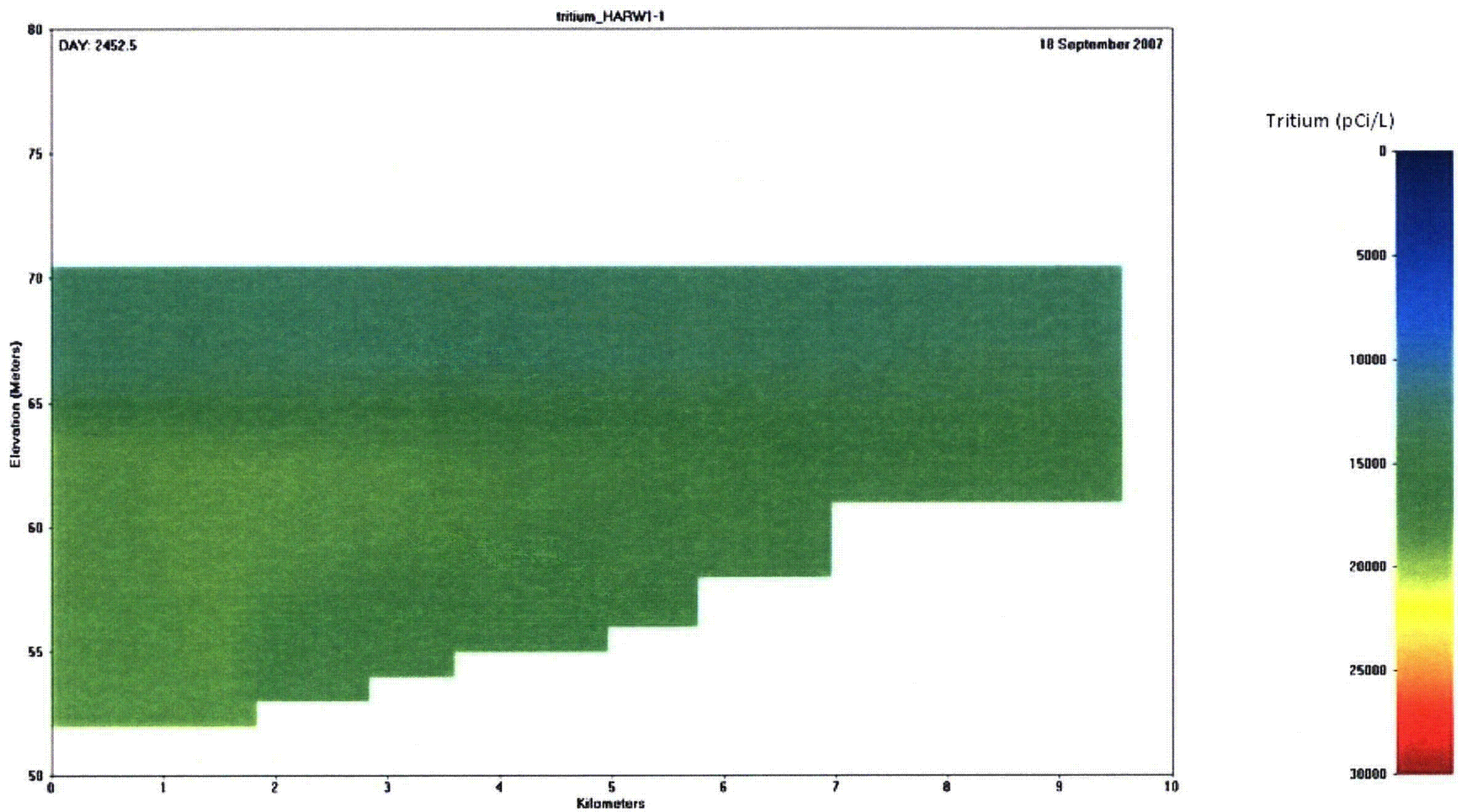

Figure 1
Depth Profile of Tritium Concentrations

Table 2
Average and Single Data Tritium Concentrations

Year	Surface Layer Tritium Concentration (pCi/L)	Deep Layer (187 feet NGVD29) Tritium Concentration (pCi/L)
2001 Average	10,591	12,751
2002 Average	13,931	16,151
2003 Average	9,645	12,153
2004 Average	9,477	11,721
2005 Average	10,184	12,545
2006 Average	12,560	14,294
2007 Average	12,602	15,533
2008 Average	15,507	18,035
Overall Average	11,811	14,147

NGVD29 = National Geodetic Vertical Datum of 1929
pCi/L = picocuries per liter

Associated HAR COL Application Revisions:

No COLA revisions have been identified associated with this response.

Attachments/Enclosures:

Attachment 5.4-1A: CE-QUAL-W2 Native Files file list.

CE-QUAL-W2 Native Files included on attached Native Files CD.

Attachment 5.4-1A

File List for CE-QUAL-W2 Tritium Test

Filename	Purpose
agpm.npt	Control file for post processor
ctr_bd.npt	Blowdown water quality constituent file
ctr_CF.npt	Cape Fear water quality constituent file
ctr_PE.npt	Progress Energy WWTP water quality constituent file
ctr_WRF01.npt	Western Wake Regional Water Reclamation Facility water quality constituent file (not used in tritium test)
E_Br1.npt	Watershed water quality constituent file for Branch 1
E_Br2.npt	Watershed water quality constituent file for Branch 2
E_Br3.npt	Watershed water quality constituent file for Branch 3
E_Br4.npt	Watershed water quality constituent file for Branch 4
E_Br5.npt	Watershed water quality constituent file for Branch 5
E_Trib1.npt	Watershed water quality constituent file for Tributary 1
graph.npt	Output descriptor file
Har_bth.npt	Bathymetry file
harmetcl.npt	Hourly meteorology file
makeup.npt	Withdrawal file
Qin_Br1.npt	Watershed flow file for Branch 1
Qin_Br2.npt	Watershed flow file for Branch 2
Qin_Br3.npt	Watershed flow file for Branch 3
Qin_Br4.npt	Watershed flow for Branch 4
Qin_Br5.npt	Watershed flow for Branch 5
Qot_Br1.npt	Reservoir outflow file
Qtr_bd.npt	Blowdown flow file
Qtr_CF.npt	Cape Fear flow file
Qtr_PE.npt	Progress Energy WWTP flow file
Qtr_tr1.npt	Watershed flow file for Tributary 1
Qtr_WRF0.npt	Western Wake Regional Water Reclamation Facility flow file (not used in tritium test)
shd.npt	Shade coefficient file
Tin_br1.npt	Watershed temperature file for Branch 1
Tin_br2.npt	Watershed temperature file for Branch 2
Tin_br3.npt	Watershed temperature file for Branch 3
Tin_br4.npt	Watershed temperature for Branch 4
Tin_br5.npt	Watershed temperature for Branch 5
Ttr_bd.npt	Blowdown temperature file
Ttr_CF.npt	Cape Fear temperature file
Ttr_PE.npt	Progress Energy WWTP temperature file
ttr_tr1.npt	Watershed temperature file for Tributary 1
Ttr_WRF.npt	Western Wake Regional Water Reclamation Facility temperature file (not used in tritium test)
w2.exe	CE-QUAL-W2 executable
w2_con.npt	CE-QUAL-W2 control file
wsc.npt	Wind sheltering coefficient file