James Scarola
Senior Vice President and Chief Nuclear Officer
Progress Energy Carolinas, Inc.

Serial: NPD-NRC-2008-048
October 31, 2008

10CFR52.79

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 REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 017 RELATED TO ACCIDENTAL RELEASES OF RADIOACTIVE LIQUID EFFLUENTS IN GROUND AND SURFACE WATERS

Reference: Letter from Manny Comar (NRC) to James Scarola (PEC), dated September 25, 2008, "Request for Additional Information Letter No. 017 Related to SRP Section 02.04.13 for the Harris 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. The enclosure also identifies changes that will be made in a future revision of the Shearon Harris Nuclear Power Plant Units 2 and 3 application.

If you have any further questions, or need additional information, please contact Bob Kitchen at (919) 546-6992, or Garry Miller at (919) 546-6107.

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

Executed on October 31, 2008.

Sincerely,

James Scarola

Enclosure

cc : U.S. NRC Director, Office of New Reactors/NRLPO
U.S. NRC Office of Nuclear Reactor Regulation/NRLPO
U.S. NRC Region II, Regional Administrator
U.S. NRC Resident Inspector, SHNPP Unit 1
Mr. Manny Comar, U.S. NRC Project Manager

P.O. Box 1551
Raleigh, NC 27602

T> 919.546.4222
F> 919.546.2405

D084
NRO

Shearon Harris Nuclear Power Plant Units 2 and 3 (HAR)
Response to NRC Request for Additional Information Letter No. 017 Related to SRP Section 02.04.13 for the Combined License Application, dated September 25, 2008

NRC RAI #	Progress Energy RAI #	Progress Energy Response
02.04.13-1	H-0094	Response enclosed – see following pages
02.04.13-2	H-0095	Response enclosed – see following pages
02.04.13-3	H-0096	Response enclosed – see following pages

NRC Letter No.: HAR-RAI-LTR-017

NRC Letter Date: September 25, 2008

NRC Review of Final Safety Analysis Report

NRC RAI #: 02.04.13-1

Text of NRC RAI:

The staff requests that the applicant provide a description of the process used to evaluate the conceptual site model of the subsurface environment. The description should include how this process was used as the basis for the calculation of the radionuclide transport in FSAR Section 2.4.13, and how the most conservative conceptual model from the set of plausible conceptual models was applied for the radionuclide transport analysis. Staff also request that the applicant explain how the conservative assumptions employed in the conceptual site model compensate for observed spatial and temporal variability and the resulting uncertainty in describing the sub-surface radionuclide transport analysis.

PGN RAI ID #: H-0094

PGN Response to NRC RAI:

The process for evaluation of the site subsurface hydrologic environment began with a literature review of federal and state hydrologic and geologic information. This information included published regional and local geologic surveys and water resources information. Previous subsurface investigations performed for Harris Nuclear Plant Unit 1 (HNP) were reviewed in preparation for HAR's onsite investigations. The HAR site hydrological investigations further characterized the site's potentiometric surfaces, hydraulic gradients, vertical gradients, and flow. Hydraulic conductivity measurements were made for the surficial and bedrock aquifers. Site borings confirmed the structure of the regolith and bedrock. The subsurface information and investigations presented in FSAR Section 2.4.12 were used as the bases of the conceptual radiological models in FSAR Section 2.4.13.

The development of conceptual models recognized the need to accommodate ranges of parametric values applicable to site conditions. Next, the process accepted that the radiological predictions should be conservative. Conversely, it was considered important to be able to demonstrate a significant margin between the effective concentration limit and the predicted maximum radionuclide concentrations at water user locations. Hence, worst-case assumptions are used. Finally, the models were evaluated routinely to gain understanding of the interaction among parameters, assumptions and pathways.

The process focused on two conceptual models that would bound the dose consequences to the surface water and well users from contamination of groundwater. Thus, releases from the failure of a radwaste tank were postulated to occur consistent with USNRC BTP 11-6 assumptions using the worst-case tank radionuclide sources identified for the AP1000. The location of the releases was at the bottom of the auxiliary building below the surficial and bedrock groundwater potentiometric surfaces. Accordingly, the entire release is assumed to enter the surficial or bedrock aquifer.

The process considered public and private users of surface water or groundwater near the site. Contamination of the main reservoir was recognized as a plausible pathway affecting site and public users of surface waters: (1) HAR and HNP use the main reservoir's Thomas Creek branch as a source of raw water for their potable water systems, and (2) Lillington, NC's water supply uses surface waters downstream of the main reservoir's spillway. Contamination of the bedrock aquifer was also considered a plausible pathway affecting water users since domestic wells near HAR derive their supplies from this aquifer.

Site-specific hydraulic head and potentiometric surface conditions were evaluated and showed that contaminated groundwater in the surficial and bedrock aquifers could reach the main reservoir's Thomas Creek branch. Further evaluation established that flow through the surficial aquifer resulted in the shortest plausible travel time to the branch. This observation was used as a benchmark for evaluating various conceptual pathways where groundwater contaminants could ultimately migrate to surface waters.

The process included consideration of possible surface and subsurface pathways for the transport of radionuclides affecting surface water users:

> Groundwater contaminants released to the surficial aquifer resurface in Thomas Creek branch of the main reservoir. In this scenario groundwater moves a relatively short distance to the east of the HAR units. Little dilution occurs due to the small flow and volume in the Thomas Creek branch.
>
> Groundwater contaminants released to the surficial aquifer resurface in the main reservoir. Groundwater is impounded along the diabase dikes to the east of the HAR units, and moving in the direction of decreasing hydraulic head, eventually flows to the main reservoir. The concentrations are further diluted and held-up in the main reservoir.
>
> A small amount of groundwater contaminants released to the surficial aquifer may resurface in the nearby HNP emergency service water canal. Any contaminated water reaching the canal would be diluted and have increased residence time in the auxiliary reservoir prior to spilling to the main reservoir.
>
> Migration of groundwater contaminants released to the bedrock aquifer is constrained along the diabase dikes. Groundwater could leak from the diabase dikes to the main reservoir if the dikes are in hydraulic contact with the reservoir. The time for groundwater to travel to the southeast to the reservoir was expected to be greater than the time for contaminants to flow in the Thomas Creek branch's surface water to the main reservoir. Therefore, the potential radiological impact on surface water users was considered bounded by the Thomas Creek surficial groundwater scenario described above.

The first scenario of the above with groundwater flow from HAR 3 to the Thomas Creek branch was considered the most conservative conceptual model for evaluation of radiological consequences to surface water users. This scenario results in the largest radionuclide concentration at a potential surface water user (HAR raw water intake). This scenario was also used to determine radiological consequences to surface water users at Lillington, NC. Specifically, the radionuclide flux to the branch is diluted in the main reservoir and then further diluted down stream of the reservoir's spillway by the Cape Fear River prior to reaching Lillington. FSAR Section 2.4.13.1.1 qualitatively describes the model; FSAR Section 2.4.13.1.3 describes the analytical model.

Conceptual subsurface pathways considered for transport of radionuclides impacting well users included:

Groundwater contaminants released to the bedrock aquifer move along the diabase dikes but go to recharge of the fractured bedrock. Migration of groundwater to domestic wells penetrating the bedrock aquifer three miles to the southeast of HAR (see FSAR Table 2.4.12-202 for well users) is a plausible scenario.

Groundwater contaminants released to the bedrock aquifer migrates directly eastward toward domestic wells two miles from HAR (see FSAR Table 2.4.12-202). The scenario assumes groundwater is not held-up at the dikes, nor does it resurface in the nearby Thomas Creek branch. This scenario is unlikely because releases are expected to migrate along the diabase dikes or resurface at the branch.

The second of the two scenarios above is considered for the most conservative conceptual model for the evaluation of radiological consequences to well users because it is the shortest path despite the first well scenario being more likely. This scenario evaluated the nearest domestic wells to HAR in the direction of possible groundwater movement. FSAR Section 2.4.13.1.2 qualitatively describes the model; FSAR Section 2.4.13.1.3 describes the analytical model.

Spatial variability and uncertainty of site conditions included consideration of backfill, pathways, main reservoir elevation, hydraulic head, and site drainage. Conceptual bases and assumptions used to ensure model conservatism included: (1) straight-line groundwater flow is always assumed to maximize predicted concentration; (2) minimum distances to surface water or water user location are used; (3) soil and weathered rock removed for excavation of the units are used for backfill assuring pre- and post-construction soil properties are similar; (4) maximum applicable values of site hydraulic conductivity and hydraulic heads are used to calculate pore velocities; (5) use of pre-construction hydraulic gradients and pore velocities are conservative since the eventual increase in main reservoir level and installation of engineered drainage ditches will decrease the hydraulic gradients.

The conceptual models compensate for seasonal variability in groundwater levels, gradients and surface water flow. Groundwater level variations are unimportant since the releases are always completely below the potentiometric surfaces of both aquifers: no credit is ever given in the models to releases to unsaturated regions. The direction of groundwater flows are consistently in the same directions due to the high potentiometric head to the north and west of the HAR site and the constant water levels in the auxiliary and main reservoirs. Seasonal variation in dilution are accommodated by (1) not crediting the volume of the Thomas Creek branch and use of a flow that is 2/3 the annual average flow in the branch; (2) use of the minimum annual average spillway flow for dilution in the main reservoir.

Associated HAR COL Application Revisions:

No COLA revisions have been identified associated with this response.

Attachments/Enclosures:

None.

NRC Letter No.: HAR-RAI-LTR-017

NRC Letter Date: September 25, 2008

NRC Review of Final Safety Analysis Report

NRC RAI #: 02.04.13-2

Text of NRC RAI:

Values for Kd used in the assessment of the impact of the release of radioactive liquid effluent to the groundwater need to be measured from site-specific sediments and groundwater. Explain why using literature values of Kd is consistent with the requirements for site-specific measurements in 10 CFR 100.20(C)(3).

PGN RAI ID #: H-0095

PGN Response to NRC RAI:

Regulatory Background

10 CFR 100.20(C)(3) states that parameters important to hydrological radionuclide transport must be obtained from on-site measurements.

Regulatory Guide 1.206 does not provide specific guidance but does state that the bases for parameters used in evaluation of accidental releases of effluents in ground and surface waters must be discussed.

Review guidance in NUREG 0800, Section 2.4.13, part III.3, "Characteristics that Affect Transport", states that detailed considerations of site-specific properties are needed unless the uncertainty in a property can be offset by conservatism in the applicant's assessment. Part III.3 advises that site-specific absorption studies may not be needed if any retardation of contaminant migration is negligible.

Rationale for Use of Literature Kd Values

Negligible retardation of radionuclide contaminants by soil or sediment implies no credit for absorption, i.e., a Kd of zero for the contaminant. The HAR groundwater radiological models determined that small values of Kd for Cs and Sr would meet the effective concentration limits (ECLs) of 10 CFR 20, Appendix B.

FSAR Subsection 2.4.13.1.4 describes the determination of the minimum Kd using EPA-402-R99-004. This section identifies minimum values of Kd = 30 ml/g for Cs and 10 ml/g for Sr were determined for the surficial/overburden groundwater path. Similarly, Kd = 10 ml/g and 2 ml/g were determined for the bedrock pathway. The results of the FSAR groundwater radiological analysis, which use these Kd values, are reported in FSAR Subsection 2.4.13.1.5.

Through a sensitivity analysis of the ECLs, reasonable allowances for uncertainties in Kd or site conditions can be demonstrated by changing the Kd to 2 ml/g for Cs and 0 ml/g for Sr. The ECLs are then re-calculated for both pathways and compared to the results reported in FSAR Subsection 2.4.13.1.5:

Groundwater Path Spill to Receptor	ECLs FSAR Subsection 2.4.13.1.5	ECLs Kd = 2 for Cs and Kd = 0 for Sr
Thomas Creek branch	14%	37%
Lillington NC	<0.01%	0.02
Well	0.4%	1%

The tabulation shows that as the ECLs increase they remain, as expected, within 10 CFR 20, Appendix B limits for unrestricted members of the public using groundwater.

EPA-402-R99-004 reported the results of its evaluation of considerable Kd data and regression analyses. The EPA reviewed the correlations and applied expert judgment to identify minimum Kd for Sr and Cs that could be selected based on ranges of soil properties. Representative property ranges for HAR clay content, cation exchange capacity, and pH as required by EPA-402-R99-004's method were used to determine the site-specific Kd values. These values are described in FSAR Subsection 2.4.13.1.4.

To ensure that HAR Kd values obtained from EPA Report 402-R99-004 were conservative minimum values, the Kd values were compared to data in Thibault's compilation referenced in FSAR Subsection 2.4.13.1.4. The EPA-based Kd values used for HAR corresponded to the lower 10th percentile in Thibault's assessed frequency distributions of Kd values for Cs and Sr. This additional assurance combined with the reasonable allowances for uncertainty in Kd values provided a conservative basis for evaluating the accidental releases of a radioactive spill to groundwater at the HAR site.

Commitment to Validate Kd

Progress Energy will perform site-specific Kd testing for site bedrock and surficial soils to validate the conservatism of Kd used in FSAR Subsection 2.4.13. Site-specific testing will include the collection of soil/bedrock and associated groundwater samples from the surficial/overburden and bedrock aquifers at several depths to ensure representative properties. The selection of samples, development of test and QA documentation, and performance of the Kd testing at a national laboratory is expected to be completed in the first quarter of 2009.

FSAR Subsection 2.4.13 will be revised in a future amendment and updated to include the test results.

Associated HAR COL Application Revisions:

1. A tabulation of site-specific Kd values as determined by laboratory tests will be added to FSAR Section 2.4.13.

2. FSAR Section 2.4.13 will be revised to identify that the Kd values used in the postulated spill analysis are conservative as validated by laboratory testing of HAR site samples.

Attachments/Enclosures:

None.

NRC Letter No.: HAR-RAI-LTR-017

NRC Letter Date: September 25, 2008

NRC Review of Final Safety Analysis Report

NRC RAI #: 02.04.13-3

Text of NRC RAI:

Explain how effective porosity values used in the scenarios are representative of the fractured bedrock conditions at the site with implications for contaminant transport. The effective porosity values need to be conservative for the pathline from the tank release location to the receptor location (e.g. surface water body or well location). Spatial variability in effective porosity needs to be considered as the applicant has noted that the fracture density (and therefore effective porosity) could be higher near diabase dikes.

PGN RAI ID #: H-0096

PGN Response to NRC RAI:

To explain how effective porosity values are representative of the fractured bedrock conditions at the site with implications for contaminant transport, an understanding of site specific bedrock conditions is required. Regionally, geologic units associated with the Triassic Basin consist of claystone, shale, siltstone, sandstone, conglomerate, and fanglomerate as detailed in HAR FSAR Subsection 2.4.12.1.1. Site investigations at HAR indicate that bedrock consists predominantly of well-consolidated Triassic siltstones and sandstones interbedded with subordinate shale, claystone, and conglomerate as detailed in HAR FSAR Subsection 2.5.1.2.3. These units have a relatively low primary effective porosity and poorly interconnected pores. Normally, groundwater flows principally along joints, fractures, and bedding planes, which create anisotropic conditions where most water movement is parallel to the strike of the beds. Exceptions to the Triassic Basin lithology are thin, vertically oriented, diabase dikes. These dikes are characterized by very low primary porosity and generally yield little water. However, the strata adjacent to dikes become fragmented by upward intrusion and secondary porosity is created in the form of fractures. In these areas, groundwater movement through geologic units is influenced by secondary porosity significantly more than by primary porosity. Locations of diabase dikes associated with HAR 2 and HAR 3 are shown on HAR FSAR Figure 2.5.1-232. It is important to note that five diabase dikes oriented approximately northwest to southeast are located within 0.6 miles on both the west and east side of each proposed unit.

Literature values were used as a basis for effective porosity that would account for spatial variability near the site. Regionally, primary porosity for the Triassic Basin is typically less than 1 percent as indicated in HAR FSAR Subsection 2.4.12.1.1. This estimate does not account for secondary porosity, which is the dominant property for groundwater transport at the HAR site. Therefore, an effective porosity estimate of 1 percent for the HAR site was not considered plausible.

Additional information pertaining to generic rock unit effective porosities and specific rock type specific yields is published in the *Handbook of Hydrology* by David R. Maidment (1993). Table 16.2.1 presents representative values of effective porosity for generic rock units; porous media such as sandstone has an average effective porosity value of 0.15 or 15 percent. In addition,

effective porosity is strongly dependent on specific yield. Table 6.3.4 in Maidment presents representative values of specific yield for specific rock types; sandstone ranged from 5 to 20 percent and shale ranged from 0.5 to 5 percent.

Using the site specific information from the site investigations at HAR and literature values, an effective porosity of 0.05 (5 percent) was used in the groundwater linear flow velocity calculation as indicated in HAR FSAR Table 2.4.12-209 to represent a combination of geologic units associated with the HAR site. This effective porosity value is considered to be the most plausible and conservative for a pathline from a postulated tank release at HAR 2 or HAR 3 to a receptor location (the Main Reservoir or an offsite well) due to both primary and secondary porosity effects. Spatial variability was considered for this parameter due to the differences of the primary porosity within the site specific geologic units and the increased secondary porosity near diabase dikes.

Associated HAR COL Application Revisions:

No COLA revisions have been identified associated with this response.

Attachments/Enclosures:

None.