Progress Energy

Serial: NPD-NRC-2011-020
March 28, 2011

10 CFR 52.79

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. 078 RELATED TO RADIATION PROTECTION DESIGN FEATURES - CONSTRUCTION WORKER DOSE

Reference: Letter from Donald Habib (NRC) to John Elnitsky (PEC), dated February 15, 2011, "Request for Additional Information Letter No. 078 Related to SRP Section 12.3-12.4, Radiation Protection Design Features, for the Shearon 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 me at (727) 820-4481.

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

Executed on March 28, 2011.

Sincerely,

John Elnitsky
Vice President
New Generation Programs & Projects

Enclosure/Attachment

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

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NRO

Shearon Harris Nuclear Power Plant Units 2 and 3
Response to NRC Request for Additional Information Letter No. 078 Related to SRP Section 12.3-12.4 for the Combined License Application, dated February 15, 2011

NRC RAI #	Progress Energy RAI #	Progress Energy Response
12.03-12.04-3	H-0662	Response enclosed – see following pages
12.03-12.04-4	H-0663	Response enclosed – see following pages

NRC Letter No.: HAR-RAI-LTR-078

NRC Letter Date: February 15, 2011

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 12.03-12.04-3

Text of NRC RAI:

Harris COL FSAR Section 12.4.1.9 provides a description of the potential sources of exposure to construction workers. The dose limits to the workers are reviewed by the staff to ensure compliance with 10 CFR 20.1301. 10 CFR 20.1301(a)(1) states, in part, that each licensee shall conduct operations so that the total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year.

The supplemental information item HAR SUP 12.4-1 provides information regarding dose to construction workers in the new FSAR Subsection 12.4.1.9 (Subsection 12.4.1.9.1 through 12.4.1.9.3). The information provided in FSAR Section 12.4.1.9.1 through 12.4.1.9.3 is not sufficient for the staff to validate or independently verify the estimated doses for HAR 2 and HAR 3 construction workers. NRC staff is unable to make a determination that the applicant meets the acceptance criteria in SRP 12.3-4 and complies with the dose limits to a member of the public, as stated in 10 CFR 20.1301 and 1302. Harris COL FSAR Subsection 12.4.1.9.2 identifies the specific sources of radiation that may be encountered by the HAR 2 and HAR 3 construction workers. The NRC staff requests additional information on the following aspects of this subsection:

i. Subsection 12.4.1.9.2 states, "Once HAR 2 is operational, workers involved with the construction of HAR 3 would be shielded by HAR 2; and thus, the direct dose contribution from HNP operations would not contribute appreciably to their total external dose." Please provide a justification for this conclusion, addressing the general lay-out of the HAR 3 construction site, relative location of construction workers, and the physical structures of (and shielding provided by) HAR 2.

ii. Subsection 12.4.1.9.2 states, "it is assumed that doses calculated to HAR 2 construction workers from active HNP operations would be similar to those received by HAR 3 construction workers from active HAR 2 operations." Please provide a more detailed basis for this conclusion. As an alternative, provide an assessment of the dose contribution to HNP 3 construction workers from HAR 2 effluent releases based on design basis source term and direction and distance from HAR 2 release points to HNP 3 construction worker locations.

iii. Subsection 12.4.1.9.2 provides no mention of exposures to construction workers from liquid effluents from either HNP or HAR 2.

    a. Provide a basis for why the drinking water exposure pathway is not identified, considering that the lake is the source of drinking water for the site.
    b. Identify any exposures to construction activities resulting from working on shared radioactive systems, such as the liquid waste discharge line.

c. As determined applicable, provide an assessment of the construction worker dose from any additional pathways in FSAR Subsection 12.4.1.9.3.

iv. While controlling exposures to construction workers during radiography is the responsibility of the licensed radiographer, this activity represents a potential construction worker dose. As such, identify measures to control potential construction worker doses from radiography operations, as well as any measures or controls that will be taken for ensuring the total dose to construction workers does not exceed the regulatory limit.

PGN RAI ID #: H-0662

PGN Response to NRC RAI:

i. HAR 2 is located approximately 1300 feet north and west of the HNP containment. HAR 3 is located approximately 950 feet north and west of HAR 2. As can be seen in FSAR Figures 1.1-201 and 2.1.1-203, HAR 2 is located between HNP and HAR 3 and thus shields the HAR 3 construction site from HNP. The construction of HAR 3 will lag the construction of HAR 2 by 18 months. During the initial stages of construction on HAR Units 2 and 3, construction will be mainly focused in the nuclear and turbine island areas of each unit. Once HAR 2 has completed significant nuclear and turbine island construction, workers involved with the construction of HAR 3 would be shielded by HAR 2; and thus, the direct dose contribution from HNP operations would not contribute appreciably to their total external dose. Scatter dose and gaseous effluent release pathway dose contributions from HNP are minor. Once HAR 2 is operational, the remaining construction on HAR 3 will occur primarily in the power block for HAR 3. Therefore, active HAR 2 operations would then be the major contributor to any external doses received.

ii. DCD Subsection 12.4.1 states, "the AP1000 design incorporates features to reduce occupational radiation exposure that go beyond the designs provided for plants currently in operation," such as HNP. AP1000 DCD Subsection 12.3.2.2.1 states, "During reactor operation, the shield building protects personnel occupying adjacent plant structures and yard areas from radiation originating in the reactor vessel and primary loop components. The concrete shield building wall and the reactor vessel and steam generator compartment shield walls reduce radiation levels outside the shield building to less than 0.25 mrem/hr from sources inside containment. The shield building completely surrounds the reactor coolant system components." With a dose rate directly outside the HAR 2 shield building of less than 0.25 mrem/hr, the dose at the fence around the HAR 2 protected area would be negligible. Thus, the contribution to HAR 3 construction workers from the HAR 2 containment and other buildings would be negligible.

Additionally, a new subsection will be inserted in between Subsections 12.4.1.9.2 and 12.4.1.9.3. This subsection will include an assessment of the dose contribution to HAR 3 workers from HAR 2 and HNP effluent releases and direct radiation exposure.

iii.

a. The drinking water has now been identified as an exposure pathway to construction workers. Dose to construction workers from the drinking water pathway from HNP is estimated to be equal to 1.24 E-01 mrem (Reference 203). The estimated maximum construction worker on-site dose due to the drinking water pathway from HAR 2 liquid

effluent releases to Harris Lake is 0.7 mrem/yr. Thus, the total estimated construction worker dose due to the drinking water exposure pathway for liquid effluents from both HNP and HAR 2 is approximately 0.8 mrem/yr.

b. HAR 2 and 3 will use a separate discharge structure and blowdown piping from HNP. Since the discharge structure and blowdown piping for HAR 2 and 3 will be completed during HAR 2 construction, there will be no exposure to HAR 3 construction workers for the tie to HAR 3. There are no other shared radioactive systems.

c. No additional exposure pathways to construction workers have been identified beyond the drinking water exposure pathway discussed in the response to Item a above.

iv. Control of exposure due to radiography is addressed in FSAR Subsection 12.2.1.1.10.

Associated HAR COL Application Revisions:

The following changes will be made to the HAR FSAR in a future amendment:

1. Revise the first bullet in Subsection 12.4.1.9.3 (to be renumbered Subsection 12.4.1.9.4 per Item 8 below) from:

   The estimated maximum individual off-site dose due to radioactivity released in the HNP's liquid effluent release pathway was 1.86 E-02 mrem per year (mrem/yr), total body; and 2.63 E-02 mrem/yr, GI-LLI (Reference 201). Even if doubled for two operating units (HNP and HAR 2) the doses would be negligible contributors.

   To read:

   Dose to construction workers from the drinking water pathway from HNP is estimated to be equal to 1.24 E-01 mrem (Reference 203). The estimated maximum construction worker on-site dose due to the drinking water pathway from HAR 2 liquid effluent releases to Harris Lake is 0.7 mrem/yr. Thus, the total estimated construction worker dose due to the drinking water exposure pathway for liquid effluents from both HNP and HAR 2 is approximately 0.8 mrem/yr.

2. Figure 12.4-202 will be revised to indicate the quarterly dose at Protected Area Fence TLD # 7 (see attachment).

3. Add the following paragraphs to the end of Subsection 12.4.1.9.2:

   In accordance with plant procedures, small amounts of liquid radioactive effluents (below regulatory limits) will be mixed with the cooling water and discharged to Harris Reservoir. Construction workers are assumed to use Harris Lake as a drinking water source. PEC maintains USEPA drinking water standards for water taken from Harris Lake for use as drinking water at the Harris Site. PEC will continue to maintain drinking water standards for use at the site.

   Exposure of HAR 3 workers to radioactive liquid effluents due to shared systems was not evaluated because the discharge structure and blowdown piping will be completed during HAR 2 construction.

4. Delete everything after the first sentence in the third bullet of Subsection 12.4.1.9.3 (to be renumbered Subsection 12.4.1.9.4 per Item 8 below) and revise the first sentence from:

   The direct radiation exposure was based on a 2,080-hour work year and an exposure rate of 11.1 µrem/hr or 24 mrem/yr.

   To read:

   The direct radiation exposure was based on a 2,080-hour work year and an exposure rate of 14.8 µrem/hr or 31 mrem/yr.

5. Revise the fourth bullet in Subsection 12.4.1.9.3 (to be renumbered Subsection 12.4.1.9.4 per Item 8 below) from:

   The annual collective dose to the construction workforce is estimated to be 72.8 person-rem (that is, the maximum individual dose multiplied by the number of people exposed). This estimate assumes 3,150 persons based on 2,080 working hours per year at an exposure rate of 11.1µrem/hr.

   To read:

   The annual collective dose to the construction workforce is estimated to be 100.2 person-rem (that is, the maximum individual dose multiplied by the number of people exposed). This estimate assumes 3,150 persons based on a construction worker dose of 31.8 mrem/yr.

6. Revise the second to last paragraph (the paragraph which immediately follows the bullets) in Subsection 12.4.1.9.3 (to be renumbered Subsection 12.4.1.9.4 per Item 8 below) from:

   The largest contributor to the (total effective dose equivalent) TEDE would be the external dose assumed from active HNP operations (24 mrem/yr). Doses from the liquid and gaseous pathways are considered negligible contributors (well below those specified in 10 CFR Part 50 Appendix I). It is concluded that annual construction worker doses attributable to HNP operations for the proposed construction areas for HAR 2 and 3 are a small fraction of those limits specified in 10 CFR Part 20 and 10 CFR Part 50 Appendix I.

   To read:

   The largest contributor to the (total effective dose equivalent) TEDE would be the external dose assumed from the active HNP operations (31 mrem/yr). Doses contributed by liquid effluents from HNP and HAR 2 provide an additional 0.8 mrem/yr. Doses contributed by gaseous effluents are negligible. It is concluded that annual construction worker doses attributable to HNP operations for the proposed construction areas for HAR 2 and 3 are a small fraction of those limits specified in 10 CFR Part 20 and 10 CFR Part 50 Appendix I.

7. Revise the text in Table 12.4-201, under the column heading "Estimated HAR Construction Worker Dose," for total effective dose equivalent from:

   "Approximately 24 mrem/yr"

   To read:

   "Approximately 31.8 mrem/yr"

8. Insert the following subsection in between Subsections 12.4.1.9.2 and 12.4.1.9.3 (Subsection 12.4.1.9.3 will be renumbered as Subsection 12.4.1.9.4 and the following subsections will be renumbering accordingly):

12.4.1.9.3 Measured Radiation Dose Rates and Liquid/Airborne Concentrations

During construction of the HAR 2 facility, construction workers may be exposed to direct radiation and to the radioactive effluents emanating from the routine operation of the HNP. During construction of the HAR 3 facility, construction workers may be exposed to direct radiation from HAR 2 and to the radioactive effluents emanating from the routine operation of the HNP and HAR 2.

12.4.1.9.3.1 Liquid Effluent Doses

12.4.1.9.3.1.1 HNP Liquid Effluent Doses

Radioactive liquids are routinely released as batches from the waste evaporator condensate tank and the treated laundry and hot shower tank. Batch releases may also originate from the secondary waste sample tank and the waste monitor tank at the HNP. Based on analysis of the tank contents, the tank release rate is adjusted, based on the cooling tower blowdown line flow rate, to dilute the tank activities to 50 percent of the allowable concentrations at the release point to Harris Reservoir (Reference 202). The liquid effluent release point is at the point of discharge from the cooling tower blowdown line into Harris Reservoir. The cooling tower blowdown line provides liquid effluent dilution prior to release to Harris Reservoir. Per procedure, concurrent batch releases do not occur at the HNP. The secondary waste sample tank and the normal service water system have a low potential for radioactive effluent releases. Effluent monitors on the secondary waste sample tank and the normal service water lines check these releases (Reference 202).

During the period of January 1, 2004 through December 31, 2004, the estimated maximum individual off-site dose due to radioactivity released in liquid effluents was 1.86E-02 millirem (mrem), whole body, as compared to a limit of 3.0 mrem, whole body. The estimated maximum individual off-site dose was 2.63E-02 mrem, Gastrointestinal tract (lower large intestine wall) (GI-LLI), as compared to a limit of 10.0 mrem, GI-LLI (Reference 201). Doses were calculated using the methodology presented in ER Subsection 2.2.1 of the HNP ODCM (Reference 202).

During the period of January 1, 2008 through December 31, 2008, the tritium dose from drinking water obtained from Harris Lake to the worker at the Wake County Fire Training Center was equal to 1.24 E-01 mrem. Construction workers are assumed to use Harris Lake as a drinking water source. The exposure to construction workers due to liquid effluents discharged by HNP into Harris Lake is considered to be equivalent to the exposure of the worker at the Wake County Fire Training Center in 2008 because the drinking water source for the Wake County Fire Training Center is Harris Lake. PEC maintains USEPA drinking water standards for water taken from Harris Lake for use as drinking water at the Harris Site. PEC will continue to maintain drinking water standards for use at the site.

12.4.1.9.3.1.2 HAR 2 Liquid Effluent Doses

In accordance with plant procedures, small amounts of liquid radioactive effluents (below regulatory limits) will be mixed with the cooling water and discharged to Harris Reservoir. Construction workers are assumed to use Harris Lake as a drinking water source. The LADTAP II computer program was used to calculate the construction worker doses from the liquid pathway via the ingestion of drinking water from Harris Lake. Calculations resulted in a whole body dose of 0.7 mrem per year (mrem/yr). PEC maintains USEPA drinking water standards for water taken from Harris Lake for use as drinking water at the Harris Site. PEC will continue to maintain drinking water standards for use at the site.

12.4.1.9.3.2 Gaseous Effluent Releases

12.4.1.9.3.2.1 HNP Gaseous Effluent Releases

At the HNP, four gaseous effluent discharge points exist: Plant Vent Stack 1, Turbine Building Vent Stack 3A, and the Waste Processing Building Vent Stacks 5 and 5A. During refueling outages, when the equipment hatch is removed, there is the potential for airborne particulate releases. All gaseous effluent releases at the plant are considered ground releases (Reference 202).

If the reactor has been shut down for greater than 30 days, the condenser vacuum pump discharge during initial hogging operations at plant start-up and prior to turbine operation may be routed as dual exhaust to (1) the Turbine Building Vent Stack 3A and (2) the atmosphere directly (Reference 202).

The stack effluent monitor setpoints ensure that the dose rates from noble gases at the HAR site boundary do not exceed the applicable regulatory limits established for releases to unrestricted areas (Reference 202). During the period of January 1, 2004, through December 31, 2004, the estimated maximum individual off-site dose due to radioactivity released in gaseous effluents for the following items were (Reference 201):

- **Noble gases**. 1.1E-04 millirad (mrad) Beta as compared to a limit of 20.0 mrad and 4.84E-05 mrad Gamma as compared to a limit of 10.0 mrad.

- **Tritium (H-3), iodine-131 (I-131), iodine-133 (I-133), particulates with greater than an 8-day half life**. 2.38E-01 mrem/year (critical organ is the lung) as compared to a limit of 15.0 mrem/year.

- **Doses from gaseous emissions**. Doses resulting from gaseous emissions were calculated using the methodology presented in Subsection 3.3.1 of the HNP ODCM (Reference 202).

12.4.1.9.3.2.2 HAR 2 Gaseous Effluent Releases

AP1000 DCD Subsection 12.4.1 states, "there is no separate determination of doses due to airborne activity. Past experience demonstrates that the dose from airborne activity is not a significant contributor to the total doses." To be conservative, the airborne dose due to

gaseous effluents for HAR 2 is assumed to be equivalent to the dose from gaseous effluents from HNP.

12.4.1.9.3.3 Direct Radiation Measurements

12.4.1.9.3.3.1 Direct Radiation Exposure from HNP

Direct radiation exposure input was determined from HNP protected area fence line Thermo Luminescent Dosimeter (TLD) readings that have been compiled over approximately 7 years, from the 1st quarter of 1999 through the 3rd quarter of 2006 (Reference 204). There are 16 TLD locations along the HNP protected area fence line as shown on Figure 12.4-201.

Selecting the individual TLD dose data for the TLDs that are closest to the HAR 2 construction boundary (TLDs 6, 7 and 8 per Figure 12.4-201), identifies the highest peak dose to be approximately 32 mrem for any 90-day period (from TLD # 7) (Reference 204). TLDs 15 and 24 have peak dose rates higher than TLD # 7; however, TLD # 15 is located on the opposite end of HNP with respect to the HAR 2 construction site and TLD # 24 is located on the 4th floor of K Building. Neither TLD # 15 nor TLD # 24 would provide dose measurements representative of construction worker doses.

The maximum dose of gamma radiation over any 90-day period for TLD # 7 was approximately 32 mrem (without background correction) as shown on Figure 12.4-202. Using the 32 mrem per 90-day period value for TLD # 7 for estimating the doses to construction workers is considered both reasonable and conservative because:

- The HAR facilities will be located outside the HNP protected area fence line and will be away from any HNP radiation sources. The HNP TLD locations that are the closest to HAR 2 are TLD # 6, 7, and 8. These TLDs are over 300 feet from the closest HAR 2 structures.

- TLD # 7 has the highest peak dose over any 90-day period of the TLDs located closest to the construction workers.

- The majority of the construction workers will be located in the nuclear and turbine island area which is further from the HNP operating radiation sources than the distances reflected in the protected area fence line TLD locations.

- No credit for the reduction in potential dose is given for the distance from the HNP protected area fence line TLD locations to the HAR facility construction areas.

The direct radiation exposure for construction worker was based on a 2,080-hour work year and an exposure rate of 14.8 μrem/hr or 31 mrem/yr.

12.4.1.9.3.3.2 Direct Radiation Exposure from HAR 2

The dose calculated for HAR 2 construction workers does not take credit for the reduction in potential dose rate due to the separation distance of the plants. Additionally, the AP1000 design incorporates features to reduce the occupation radiation exposure that go beyond

the designs of plants that are currently operating, such as HNP. AP1000 DCD Subsection 12.3.2.2.1 states, "During reactor operation, the shield building protects personnel occupying adjacent plant structures and yard areas from radiation originating in the reactor vessel and primary loop components. The concrete shield building wall and the reactor vessel and steam generator compartment shield walls reduce radiation levels outside the shield building to less than 0.25 mrem/hr from sources inside containment. The shield building completely surrounds the reactor coolant system components." With a dose rate directly outside the HAR 2 shield building of less than 0.25 mrem/hr, the dose at the fence around the HAR 2 protected area would be negligible. Thus, the contribution to construction workers from the HAR 2 containment and other buildings would be negligible. Therefore, the doses to HAR 3 construction workers from active HAR 2 operations would be negligible.

9. Add new References 202 through 204 to Subsection 12.4.4:

202. Progress Energy Carolinas, Inc., "Shearon Harris Nuclear Power Plant Off-Site Dose Calculation Manual (ODCM)," Revision 17, Docket No. STN-50-400, Progress Energy Carolinas," November 30, 2004.

203. Progress Energy Carolinas, Inc. (PEC), "Shearon Harris Nuclear Power Plant Annual Radioactive Effluent Release Report: January 1, 2008 through December 31, 2008," 2008.

204. Nuclear Generation Group, "Area Thermoluminescent Dosimeter (TLD) Monitoring," DOS-NGGC-0010, Revision 7, 2006, Nuclear Generation Group Standard Procedure Volume 99 Book/Part 99, information obtained from the HNP TLD monitoring group via a request for information.

Attachments/Enclosures:

Revised Figure 12.4-202 (Revision 4 Draft) – Quarterly Dose at Protected Area Fence TLD # 7

NRC Letter No.: HAR-RAI-LTR-078

NRC Letter Date: February 15, 2011

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 12.03-12.04-4

Text of NRC RAI:

Harris COL FSAR Section 12.4.1.9 provides a description of the potential sources of exposure to construction workers. The dose limits to the workers are reviewed by the staff to ensure compliance with 10 CFR 20.1301. 10 CFR 20.1301(a)(1) states, in part, that each licensee shall conduct operations so that the total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year.

Review of related Harris SCOL documents to support an independent assessment of compliance with the regulations requires the staff to request additional information to make a determination of reasonable assurance. HAR SUP 12.4-1 provides information regarding dose to construction workers in the new FSAR Subsection 12.4.1.9 (Subsection 12.4.1.9.1 through 12.4.1.9.3). The information provided in FSAR Section 12.4.1.9.1 through 12.4.1.9.3 is not sufficient for the staff to validate and verify the estimated doses for HAR 2 and HAR 3 construction workers. NRC staff is unable to make a determination that the applicant meets the acceptance criteria in SRP 12.3-4 and complies with the dose limits to a member of the public, as stated in 10 CFR 20.1301 and 1302.

Harris COL FSAR Subsection 12.4.1.9.3 provides the assumptions and calculations used to determine the construction worker dose estimates. The NRC staff requests additional information on the following aspects of this subsection:

i. Subsection 12.4.1.9.3 states that the maximum individual off-site dose due to radioactivity released in HNP's liquid effluent, based on the 2004 Annual Radioactive Effluent Release Report, is negligible and would remain so, even if doubled for two operating units (HNP and HAR 2). Please provide additional bases for this statement, including evaluations that show that:
   a. The maximum individual off-site dose is representative of the on-site construction worker exposure, recognizing that the maximum offsite individual is assumed to receive drinking water from a downstream supply, whereas the construction worker's drinking water may come directly from the lake.
   b. The liquid effluent exposures from HAR 2 would be equal to those from HNP, given the differences between the two units.
   c. The exposures calculated in 2004 are representative of the average annual exposures that will be received by construction workers.

   As an alternative, an assessment of construction worker dose from liquid effluents could be made considering current lake tritium levels, potential annual releases from HNP to the lake, and the design basis release rate from HAR 2 to the lake.

iii. Subsection 12.4.1.9.3 states that the estimated radiological exposure to a construction worker from the operation of HNP via the gaseous effluent release pathway, based on the

2004 Annual Radioactive Effluent Release Report, is negligible and would remain so, even if doubled for two operating units (HNP and HAR 2). Please provide the basis for this statement, including evaluations that show that:

a. The gaseous effluent exposures from HAR 2 would be equal to those from HNP, given the differences between the two units.
b. The exposures calculated in 2004 are representative of the annual exposures that will be received by construction workers.

iii. Subsection 12.4.1.9.3 states that the direct radiation component of construction worker exposure is 24 mrem per year. The derivation of this exposure value was included in the Progress Energy response to RAI 12.03-12.04-1, dated March 27, 2009. This response stated that the maximum gamma dose (without background correction) of 16 protected area (HNP) fence line TLD locations was approximately 24 mrem, referencing Environmental Report Figure 4.5-2. However, examining the information and data of Figures 12.4-201 and 12.4-202 seems to indicate that the 24 mrem gamma dose level is not the maximum TLD measurement as referenced but is the maximum of the average for the 16 TLD locations. A more representative value for the direct radiation component of construction worker exposure would be based on the maximum TLD values of the protected area TLD(s) located closest to the expected location of the construction workers for HNP2. Provide the maximum measured TLD values for the TLD(s) located closest to the HNP2 construction workers and modify Subsection 12.4.1.9.3 of the FSAR to reflect that the direct radiation exposure for construction workers is based on these TLD values. Modify your estimate of the annual collective dose to the construction work force based on the revised estimate of the direct radiation component of the construction worker exposure.

iv. Table 12.4-201 compares the estimated HAR construction worker dose of approximately 24 mrem/yr with the 10 CFR 20.1301 public dose limit of 100 mrem/yr. This table does not provide a breakdown of the different dose contributions to the estimated construction worker dose of approximately 24 mrem/yr. In order to clarify the basis for this number, add a footnote to this table to list the individual contributions to this dose from direct dose and liquid and gaseous effluents.

v. Subsection 12.4.1.9.3 states that the annual collective dose to the construction workforce is estimated to be 72.8 person-rem, based on 3,150 persons working 2,080 working hours per year at a dose rate of 24 mrem/yr. On the basis of your responses to items i thru iii above, specify whether this dose estimate is for the construction workforce working on HNP2 or on HNP3 (or if this dose estimate is the same for both construction workforces).

vi. The calculations for construction worker exposures are based on an assumption that workers spend 2080 hours per year on site. Please provide a rationale for this assumption, given that projects of this nature can involve construction workers spending significant amounts of overtime at the construction site.

PGN RAI ID #: H-0663

PGN Response to NRC RAI:

i. An assessment of construction worker dose from liquid effluents was conducted considering current lake tritium levels, potential annual releases from HNP to the lake, and the design basis release rate from HAR 2 to the lake. The applicable results are noted below:

   a. The liquid effluent exposure due to HNP has been provided in the response to RAI 12.03-12.04-3, Item ii as revised FSAR Sections 12.4.1.9.3.1.1 and 12.4.1.9.3.1.2. The assessment identifies that the maximum individual off-site dose is 1.86 E-02 millirem whole body considering the downstream water supply versus the construction worker dose of approximately 0.8 millirem whole body considering the Harris Lake drinking water supply. A revision to the FSAR to incorporate the dose from drinking water has been included with the response to RAI 12.03-12.04-3.

   b. The liquid effluent exposure due to HNP and HAR 2 has been provided in the response to RAI 12.03-12.04-3, Item ii as revised FSAR Sections 12.4.1.9.3.1.1 and 12.4.1.9.3.1.2. The assessment identified that the liquid effluent exposure to construction workers from HNP would be 1.42 E-01 millirem (1.86 E-02 maximum individual off-site dose + 1.24 E-01 millirem Harris Lake drinking water supply) versus the HAR 2 calculated exposure of 7.0 E-01 millirem.

   c. The liquid release effluents from HNP and HAR 2 are provided with the response to RAI 12.03-12.04-3, Item ii. The assessment identified that the maximum individual off-site dose is 1.86 E-02 millirem whole body versus the liquid effluent exposure to construction workers from HNP and HAR 2 would be approximately 0.8 mrem per year.

ii. The gaseous effluent exposure due to HNP and HAR 2 has been provided in the response to RAI 12.03-12.04-3, Item ii. A revision to the FSAR to address the dose from airborne activity has been included with the response to RAI 12.03-12.04-3.

iii. The derivation of the direct radiation component of construction worker exposure due to HNP and HAR 2 has been modified and a new value has been determined in the response to RAI 12.03-12.04-3, Item ii. A revision to the FSAR to incorporate the new derivation and the dose from direct exposure has been included with the response to RAI 12.03-12.04-3.

   The direct radiation exposure for construction worker was based on a 2,080-hour work year and an exposure rate of 14.8 μrem/hr or 31 mrem/yr. The annual collective dose of 100.2 person-rem (as based on 3,150 persons and a construction worker dose of 31.8 mrem/yr) is conservatively applicable to both the construction workforce for HAR 2 and HAR 3 during the initial construction stages of HAR 2 and 3. Once significant construction of the HAR 2 nuclear and turbine islands is completed, the HAR 3 construction workers will be shielded from the direct radiation of HNP and future direct radiation exposure will be from HAR 2 once operational.

iv. The largest contribution to the TEDE is from the external dose assumed from active HNP operations (31 mrem/yr). Doses contributed by liquid effluents from HNP and HAR 2 provide an additional 0.8 mrem/yr. Doses contributed by gaseous effluents are negligible. A footnote will be added to Table 12.4-201.

v. The annual collective dose of 100.2 person-rem (as based on 3,150 persons working 2,080 working hours per year at a dose of 31.8 mrem/yr) is applicable to both the construction workforce for HAR 2 and HAR 3 during the initial construction stages of HAR 2 and 3. Once significant construction of the HAR 2 nuclear and turbine islands is completed, the HAR 3 construction workers will be shielded from the direct radiation of HNP and future direct radiation exposure will be from HAR 2 once operational. HAR 2 and 3 construction workers will be exposed to HNP liquid and gaseous releases during construction of HAR 2. Construction workers will be exposed to liquid and gaseous releases from HNP and HAR 2 once HAR 2 is operational.

vi. In FSAR Subsection 12.4.1.9.3, it has been assumed a construction worker exposure time is 2080 hours (40 hours per week for 52 weeks). If it is assumed that a construction worker exposure time is 60 hours per week (assuming 20 hours per week overtime) for 52 weeks, the annual dose to a construction worker would increase by 50% (47.7 mrem). With an increase in the annual dose to a construction worker of 50%, the annual dose would remain below the 10 CFR 20.1301 limits of 100 mrem/yr.

Associated HAR COL Application Revisions:

The following changes will be made to the HAR FSAR in a future amendment:

1. Table 12.4-201 will be revised to include a footnote.

   The text under the column heading "Estimated HAR Construction Worker Dose" for total effective dose equivalent will now read as:

   "Approximately 31.8 mrem/yr[(a)]"

   The footnote will read as:

   a) The largest contribution to the TEDE is from the external dose assumed from active HNP operations (31 mrem/yr). Doses contributed by liquid effluents from HNP and HAR 2 provide an additional 0.8 mrem/yr. Doses contributed by gaseous effluents are negligible.

2. Add the following paragraph to the end of Subsection 12.4.1.9.3:

   It has been assumed that a construction worker exposure time is 40 hours per for 52 weeks. Since construction projects can involve significant overtime for construction workers the annual dose to a construction worker could be higher. The dose would be higher in proportion to the amount of time over 40 hours per week. If the construction worker worked 60 hours per week for 52 weeks the dose presented in Table 12.4-201 would increase by 50%. However, when compared to the dose limits presented in Table 12.4-201, the dose to the construction worker is still be well below the 10 CFR 20.1301 public dose limit. This would be the case for including the most limiting case of 72 or 84 hours.

Attachments/Enclosures:

None.

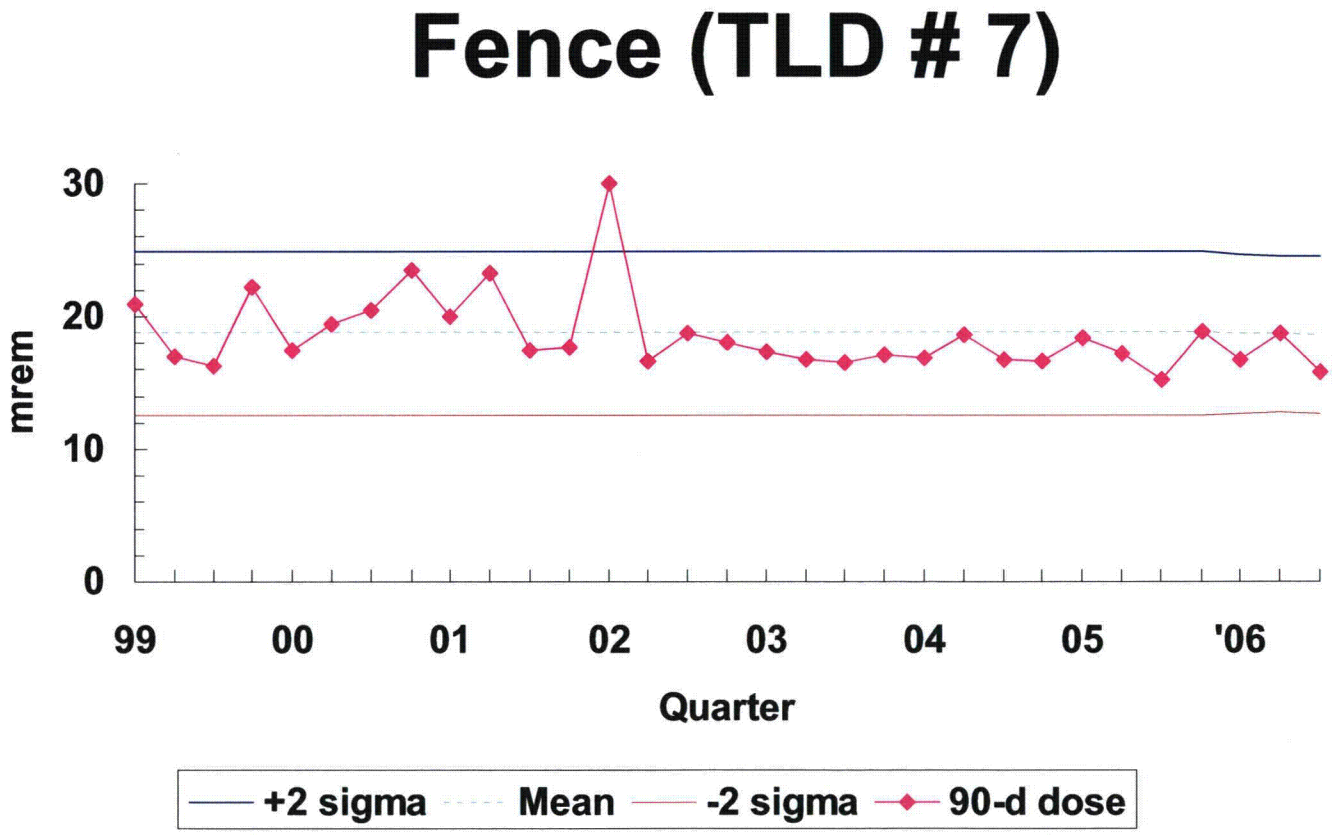
Attachment to

NRC RAI NUMBER: 12.03-12.04-3 [PGN RAI ID #: H-0662]

Revised Figure 12.4-202 (Revision 4 Draft)

Quarterly Dose at Protected Area Fence TLD # 7

[1 page attached following this cover page]



SOURCE: Nuclear Generation Group (NGG), 2006

Progress Energy Florida

Shearon Harris Nuclear Plant
Units 2 and 3
Part 2, Final Safety Analysis Report

Quarterly Dose at Protected Area
Fence TLD #7

FIGURE 12.4-202

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