CHAPTER 12

RADIATION PROTECTION

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CHAPTER 12 RADIATION PROTECTION

12.1 ASSURING THAT OCCUPATIONAL RADIATION EXPOSURES ARE AS-LOW-AS-REASONABLY ACHIEVABLE (ALARA)

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

STD COL 12.1-1

This section incorporates by reference NEI 07-08, Generic FSAR Template Guidance for Ensuring That Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA), Revision 2, which is currently under review by the NRC staff. See Table 1.6-201. ALARA practices are developed in a phased milestone approach as part of the procedures necessary to support the Radiation Protection Program. Table 13.4-201 describes the major milestones for ALARA procedures development and implementation.

Add the following information at the end of DCD Subsection 12.1.2.4.2:

12.1.2.4.3 Equipment Layout

STD SUP 12.1-1

A video record of the equipment layout in areas where radiation fields are expected to be high following operations may be used to assist in ALARA planning and to facilitate decommissioning.

12.1.3 COMBINED LICENSE INFORMATION

STD COL 12.1-1

This COL item is addressed in NEI 07-08 and Appendix 12AA.

12.2 RADIATION SOURCES

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

12.2.1.1.10 Miscellaneous Sources

Add the following information at the end of DCD Subsection 12.2.1.1.10:

STD COL 12.2-1 Licensed sources containing byproduct, source, and special nuclear material that warrant shielding design consideration meet the applicable requirements of 10 CFR Parts 20, 30, 31, 32, 33, 34, 40, 50, and 70.

There are byproduct and source materials with known isotopes and activity manufactured for the purpose of measuring, checking, calibrating, or controlling processes quantitatively or qualitatively.

These sources include but are not limited to:

- Sources in field monitoring equipment.
- Sources in radiation monitors to maintain a threshold sensitivity.
- Sources used for radiographic operations.
- Depleted uranium slabs used to determine beta response and correction factors for portable monitoring instrumentation.
- Sources used to calibrate and response check field monitoring equipment (portable and fixed).
- Liquid standards and liquids or gases used to calibrate and verify calibration of laboratory counting and analyzing equipment.
- Radioactive waste generated by the use of radioactive sources.

Specific details of these sources are maintained in a database on-site following procurement. This database, at a minimum, contains the following information:

- Isotopic composition
- Location in the plant
- Source strength
- Source geometry

Written procedures are established and implemented that address procurement, receipt, inventory, labeling, leak testing, surveillance, control, transfer, disposal, storage, issuance and use of these radioactive sources. These procedures are developed in accordance with the radiation protection program to comply with 10 CFR Parts 19 and 20. A supplementary warning symbol is used in the presence of large sources of ionizing radiation consistent with the guidance in Regulatory Issue Summary (RIS) 2007-03.

Sources maintained on-site for instrument calibration purposes are shielded while in storage to keep personnel exposure ALARA. Sources used to service or calibrate plant instrumentation are also routinely brought on-site by contractors. Radiography is performed by the licensed utility group or licensed contractors. These sources are maintained and used in accordance with the provisions of the utility group's or contractor's license. Additional requirements and restrictions may apply depending on the type of source, use, and intended location of use. If the utility group or contractor source must be stored on-site, designated plant personnel must approve the storage location, and identify appropriate measures for maintaining security and personnel protection.

12.2.3 COMBINED LICENSE INFORMATION

STD COL 12.2-1 This COL item is addressed in Subsection 12.2.1.1.10.

12.3 RADIATION PROTECTION DESIGN FEATURES

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

12.3.4 AREA RADIATION AND AIRBORNE RADIOACTIVITY MONITORING INSTRUMENTATION

Add the following text to the end of DCD Subsection 12.3.4.

STD COL 12.3-2 Procedures detail the criteria and methods for obtaining representative measurement of radiological conditions, including in-plant airborne radioactivity concentrations in accordance with applicable portions of 10 CFR Part 20 and consistent with the guidance in Regulatory Guides 1.21-Appendix A, 8.2, 8.8, and 8.10. Additional discussion of radiological surveillance practices is included in the radiation protection program description provided in Appendix 12AA.

Surveillance requirements are determined by the functional manager in charge of radiation protection based on actual or potential radiological conditions encountered by personnel and the need to identify and control radiation, contamination, and airborne radioactivity. These requirements are consistent with the operational philosophy in Regulatory Guide 8.10. Frequency of scheduled surveillance may be altered by permission of the functional manager in charge of radiation protection or their designee. Radiation Protection periodically provides cognizant personnel with survey data that identifies radiation exposure gradients in an area resulting from identified components. This data includes recent reports, with survey data, location and component information.

The following are typical criteria for frequencies and types of surveys:

<u>Job Coverage Surveys</u>

- Radiation, contamination, and/or airborne surveys are performed and documented to support job coverage.
- Radiation surveys are sufficient in detail for Radiation Protection to assess the radiological hazards associated with the work area and the intended/specified work scope.
- Surveys are performed commensurate with radiological hazard, nature and location of work being conducted.
- Job coverage activities may require surveys to be conducted on a daily basis where conditions are likely to change.

Radiation Surveys

- Radiation surveys are performed at least monthly in any radiological controlled area (RCA) where personnel may frequently work or enter. Survey frequencies may be modified by the functional manager in charge of radiation protection as previously noted.

- Radiation surveys are performed prior to or during entry into known or suspected high radiation areas for which up to date survey data does not exist.

- Radiation surveys are performed prior to work involving highly contaminated or activated materials or equipment.

- Radiation surveys are performed at least semiannually in areas outside the RCA. Areas to be considered include shops, offices, and storage areas.

- Radiation surveys are performed to support movement of highly radioactive material.

- Neutron radiation surveys are performed when personnel may be exposed to neutron emitting sources.

Contamination Surveys

- Contamination surveys are performed at least monthly in any RCA where personnel may frequently work or enter. Survey frequencies may be modified by the functional manager in charge of radiation protection as previously noted.

- Contamination surveys are performed during initial entry into known or suspected contamination area(s) for which up to date survey data does not exist.

- Contamination surveys are performed at least daily at access points, change areas, and high traffic walkways in RCAs that contain contaminated areas. Area access points to a High Radiation Area or Very High Radiation Area are surveyed prior to or upon access by plant personnel or if access has occurred.

- Contamination surveys are performed at least semiannually in areas outside the RCA. Areas to be considered include shops, offices, and storage areas.

- A routine surveillance is conducted in areas designated by the functional manager in charge of radiation protection or their designee likely to

indicate alpha radioactivity. If alpha contamination is identified, frequency and scope of the routine surveillance is increased.

Airborne Radioactivity Surveys

- Airborne radioactivity surveys are performed during any work or operation in the RCA known or suspected to cause airborne radioactivity (e.g., grinding, welding, burning, cutting, hydrolazing, vacuuming, sweeping, use of compressed air, using volatiles on contaminated material, waste processing, or insulation).

- Airborne radioactivity surveys are performed during a breach of a radioactive system, which contains or is suspected of containing significant levels of contamination.

- Airborne radioactivity surveys are performed during initial entry (and periodically thereafter) into any known or suspected airborne radioactivity area.

- Airborne radioactivity surveys are performed immediately following the discovery of a significant radioactive spill or spread of radioactive contamination, as determined by the functional manager in charge of radiation protection.

- Airborne radioactivity surveys are performed daily in occupied radiological controlled areas where the potential for airborne radioactivity exists, including containment.

- Airborne radioactivity surveys are performed any time respiratory protection devices, alternative tracking methods such as derived air concentration-hour (DAC-hr), and/or engineering controls are used to control internal exposure.

- Airborne radioactivity surveys are performed using continuous air monitors (CAMs) for situations in which airborne radioactivity levels can fluctuate and early detection of airborne radioactivity could prevent or minimize inhalations of radioactivity by workers. Determination of air flow patterns are considered for locating air samplers.

- Airborne radioactivity surveys are performed prior to use and monthly during use on plant service air systems used to supply air for respiratory protection to verify the air is free of radioactivity.

- Tritium sampling is performed near the spent fuel pit when irradiated fuel is in the pit and other areas of the plant where primary system leaks occur and tritium is suspected.

Appropriate counting equipment is used based on the sample type and the suspected identity of the radionuclides for which the sample is being done. Survey results are documented, retrievable, and processed per site document control and records requirements consistent with Regulatory Guide 8.2. Completion of survey documentation includes the update of room/area posting maps and revising area or room postings and barricades as needed.

Air samples indicating activity levels greater than a procedure specified percentage of DAC are forwarded to the radiochemistry laboratory for isotopic analysis. Samples which cannot be analyzed on-site are forwarded to an off-site laboratory or a contractor for analysis; or, the DAC percentage may be hand calculated using appropriate values from 10 CFR Part 20, Appendix B.

The responsible radiation protection personnel review survey documentation to evaluate if surveys are appropriate and obtained when required, records are complete and accurate, and adverse trends are identified and addressed.

An in-plant radiation monitoring program maintains the capability to accurately determine the airborne iodine concentration in areas within the facility where personnel may be present under accident conditions. This program includes the training of personnel, procedures for monitoring, and provisions for maintenance of sampling and analysis equipment consistent with Regulatory Guides 1.21 (Appendix A) and 8.8. Training and personnel qualifications are discussed in Appendix 12AA.

A portable monitor system meeting the requirements of NUREG-0737, Item III.D.3.3, is available. The system uses a silver zeolite or charcoal iodine sample cartridge and a single-channel analyzer. The use of this portable monitor is incorporated in the emergency plan implementing procedures. The portable monitor is part of the in-plant radiation monitoring program. It is used to determine the airborne iodine concentration in areas where plant personnel may be present during an accident. Accident monitoring instrumentation complies with applicable parts of 10 CFR Part 50, Appendix A.

Sampling cartridges can be removed to a low background area for further analysis. These cartridge samples can be purged of any entrapped noble gases, when necessary, prior to being analyzed.

12.3.5.1 Administrative Controls for Radiological Protection

STD COL 12.3-1 This COL Item is addressed in Appendix 12AA.

12.3.5.2 Criteria and Methods for Radiological Protection

STD COL 12.3-2

This COL Item is addressed in Subsection 12.3.4.

12.3.5.3 Groundwater Monitoring Program

STD COL 12.3-3

This COL Item is addressed in Appendix 12AA.

12.3.5.4 Record of Operational Events of Interest for Decommissioning

STD COL 12.3-4

This COL Item is addressed in Appendix 12AA.

12.4 DOSE ASSESSMENT

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

HAR SUP 12.4-1

Add the following new subsection after DCD Subsection 12.4.1.8:

12.4.1.9 Dose to Construction Workers

This section assesses the potential radiological dose impacts to those who will construct the proposed Shearon Harris Nuclear Power Plant Units 2 and 3 (HAR) and be exposed to the existing Shearon Harris Nuclear Power Plant, Unit 1 (HNP) and HAR 2 during construction of HAR 3.

12.4.1.9.1 Site Layout

Figure 2.1.1-203 indicates the locations of HAR 2 and 3 relative to the layout of various HNP facilities. The major activities during the construction of HAR 2 and 3 are expected to take place outside the HNP protected area boundary, but inside the restricted area boundary.

12.4.1.9.2 Radiation Sources

PEC proposes to construct HAR 2 first. Thus, HAR 2 construction workers could be exposed to any elevated background levels and gaseous effluent discharges from current HNP reactor operations. 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. Scatter dose and gaseous effluent release pathway dose contributions from HNP are minor. However, active HAR 2 operations would then be the major contributor to any external doses received, if any, from active operations. 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.

12.4.1.9.3 Construction Worker Dose Estimates

Annual potential radiological dose impacts to construction workers have been conservatively estimated based on the following factors:

- 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.

- The estimated radiological exposure to a construction worker from the operation of the HNP via the gaseous effluent release pathway was less

than 2.38 E-01 mrem/yr (Reference 201). Even if doubled for two operating units (HNP and HAR 2) the doses would be negligible contributors.

- 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.

- 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 11.1 µrem/hr .

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

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.

Table 12.4-201 compares the estimated doses to a HAR construction worker with the public dose criteria of 10 CFR 20.1301. This comparison demonstrates compliance with 10 CFR 20.1301 criteria and supports the conclusion that those who will construct the HAR facility would not need to be classified as radiation workers nor would they require monitoring.

12.4.4 REFERENCES

HAR SUP 12.4-1

201. Progress Energy Carolinas, Inc. (PEC), “Shearon Harris Nuclear Power Plant Annual Radioactive Effluent Release Report: January 1, 2004 to December 31, 2004,” 2004.

HAR SUP 12.4-1

Table 12.4-201
Comparison of HAR Construction Worker Estimated Radiation Doses Compared to 10 CFR 20.1301 Public Dose Criteria

Type of Radiation Dose	Public Dose Limits 10 CFR 20.1301	Estimated HAR Construction Worker Dose
Total effective dose equivalent (TEDE)	100 mrem/yr	Approximately 24 mrem/yr
Maximum dose in any one hour	2 mrem	Less than 1 mrem

12.5 HEALTH PHYSICS FACILITY DESIGN

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

12.5.5 COMBINED LICENSE INFORMATION

STD COL 12.5-1 This COL Item is addressed in Appendix 12AA.

Add the following Appendix after Section 12.5 of the DCD.

APPENDIX 12AA RADIATION PROTECTION PROGRAM DESCRIPTION

STD COL 12.1-1
STD COL 12.3-1
STD COL 12.5-1

This appendix incorporates by reference NEI 07-03, Generic FSAR Template Guidance for Radiation Protection Program Description, Revision 3, which is currently under review by the NRC staff. See Table 1.6-201. The numbering of NEI 07-03 is revised from 12.5# to 12AA.5# through the document, with the following revisions and additions as indicated by strikethroughs and underlines. Table 13.4-201 provides milestones for radiation protection program implementation.

Revise the first paragraph of NEI 07-03 Subsection 12.5.2 as follows:

Qualification and training criteria for site personnel are consistent with the guidance in Regulatory Guide 1.8 and are described in FSAR Chapter 13. Specific radiation protection responsibilities for key positions within the plant organization are described in Section 13.1. ~~below.~~

Subsections 12.5.2.1 through 12.5.2.5 of NEI 07-03 are not incorporated into Appendix 12AA.

Subsections 12.5.3 and 12.5.3.1 of NEI 07-03 are not incorporated into Appendix 12AA. Facilities, instrumentation and equipment are described in DCD Subsection 12.5.2.

Add the following text after the first paragraph of NEI 07-03 Subsection 12.5.3.3.

If circumstances arise in which NIOSH tested and certified respiratory equipment is not used, compliance with 10 CFR 20.1703(b) and 20.1705 is maintained.

The following headings and associated material are described in DCD Subsection 12.5.3, and are therefore not incorporated into Appendix 12AA:

- Radwaste Handling
- Spent Fuel Handling
- Normal Operation
- Sampling

Add the following text to the end of the discussion on normal operation in NEI 07-03 Subsection 12.5.4.2.

STD COL 12.3-1 A closed circuit television system may be installed in high radiation areas to allow remote monitoring of individuals entering high radiation areas by personnel qualified in radiation protection procedures.

Add the following text after the second paragraph of NEI 07-03 Subsection 12.5.4.4.

In addition to the access control requirements for high radiation areas, the following control measures are implemented to control access to very high radiation areas in which radiation levels could be encountered at 500 rads or more in one hour at one meter from a radiation source or any surface through which the radiation penetrates:

- Sign(s) conspicuously posted stating GRAVE DANGER, VERY HIGH RADIATION AREA.
- Area is locked. Each lock shall have a unique core. The keys shall be administratively controlled by the functional manager in charge of radiation protection as described in Section 13.1.
- Plant Manager's (or designee) approval required for entry.
- Radiation Protection personnel shall accompany person(s) making the entry. Radiation Protection personnel shall assess the radiation exposure conditions at the time of the entry.

The locations and radiological controls of the radiation zones on plant diagrams are located in DCD Section 12.3.

Revise the third paragraph of NEI 07-03 Subsection 12.5.4.7 as follows.

STD COL 12.1-1
STD COL 12.3-1
STD COL 12.5-1

As described in Sections 12.1, ~~12.5.1~~Appendix 12AA and ~~12.5.2~~ 13.1, management policy is established, and organizational responsibilities and authorities are assigned to implement an effective program for maintaining occupational radiation exposures ALARA. Procedures are established and implemented that are in accordance with 10 CFR 20.1101 and consistent with the guidance in Regulatory Guides 8.8 and 8.10. Examples of such procedures include the following:

Revise the second bullet of NEI 07-03 Subsection 12.5.4.7 as follows.

II. Radiation Protection will assure that procedures and methods for operation, maintenance, repair, surveillance, refueling, and other activities that may involve significant exposures are reviewed prior to initial use and periodically thereafter to assure measures are considered to minimize occupational and public radiation exposures. <u>Significant exposures are defined by the functional manager in charge of radiation protection in procedures.</u>

Add the following text after the last bullet of NEI 07-03 Subsection 12.5.4.8.

STD COL 12.5-1

This subsection adopts NEI 08-08 (Reference 201), which is currently under review by the NRC staff, for discussion of compliance with 10 CFR 20.1406.

Add the following Subsection to the information incorporated from NEI 07-03.

STD COL 12.3-3

12AA.5.4.14 Groundwater Monitoring Program

A groundwater monitoring program beyond the normal radioactive effluent monitoring program is developed. If necessary to support this groundwater monitoring program, design features will be installed during the plant construction process. Areas of the site to be specifically considered in this groundwater monitoring program are (all directions based on plant standard):

- West of the auxiliary building in the area of the fuel transfer canal.
- West and south of the radwaste building.
- East of the auxiliary building rail bay and the radwaste building truck doors

This subsection adopts NEI 08-08 (Reference 201), which is currently under review by the NRC staff, for the Groundwater Monitoring Program description.

Add the following Subsection to the information incorporated from NEI 07-03.

STD COL 12.3-4

12AA.5.4.15 Record of Operational Events of Interest for Decommissioning

This subsection adopts NEI 08-08 (Reference 201), which is currently under review by the NRC staff, for discussion of recordkeeping practices important to decommissioning.

Add the following reference to the NEI 07-03 REFERENCES.

201. NEI 08-08, Generic FSAR Template Guidance for Life Cycle Minimization of Contamination, Revision 0.