UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
CAROLINA POWER & LIGHT COMPANY and NORTH CAROLINA EASTERN MUNICIPAL POWER AGENCY	)	Docket Nos. 50-400 OL 50-401 OL
	)	
(Shearon Harris Nuclear Power Plant, Units 1 and 2)	)	

AFFIDAVIT OF DR. WILLIAM H. WILKIE AND RONALD L. SHEARIN
IN SUPPORT OF APPLICANTS' MOTION FOR SUMMARY DISPOSITION
OF JOINT INTERVENORS' CONTENTION VI

County of Wake)
) SS:
State of North Carolina)

William H. Wilkie, being duly sworn according to law, deposes and says:

1. I am employed by Carolina Power & Light Company (CP&L) as Principal Health Physics Specialist. My business address is Shearon Harris Energy & Environmental Center, Route 1, Box 327, New Hill, North Carolina 27562. A statement of my background and qualifications is affixed hereto as Attachment A. I have a Ph.D. degree in nuclear engineering from the Georgia Institute of Technology and extensive professional experience in the area of health physics program development in support of nuclear power operations. Therefore, I have personal knowledge of the matters stated herein and believe them to be true and correct.

8403130164 840309
PDR ADOCK 05000400
G PDR

Ronald L. Shearin, being duly sworn according to law, deposes and says:

2. I am employed by Carolina Power & Light Company as Project Specialist - Environmental for the Radiological & Chemical Support Section of the Operations Training & Technical Support Department. My duties have included the development and establishment of the Shearon Harris Radiological Environmental Monitoring Program including the selection and placement of sampling equipment, the establishment of sampling procedures, and the interpretation of environmental data related to the radiological nature of the environment. My business address is Shearon Harris Energy & Environmental Center, Route 1, Box 327, New Hill, North Carolina 27562. A statement of my background and qualifications is affixed hereto as Attachment B. I have personal knowledge of the matters stated herein and believe them to be true and correct.

3. We make this affidavit in support of Applicants' Motion for Summary Disposition of Joint Intervenors' Contention VI. In this affidavit we will: (1) describe the in-plant area, airborne and effluent monitoring systems, and the environmental monitoring system; (2) show that these systems will provide timely and accurate information necessary to protect the public and plant staff in the event of an emergency; (3) explain the fallacy of Joint Intervenors' contention that

real-time identification and quantification of specific radionuclides is necessary; and (4) explain why the Joint Intervenors are incorrect in asserting that pressurized ionization chambers can provide release rates by specific radionuclide and should be used for monitoring effluents.

4. The Radiation Monitoring System (RMS) for the Shearon Harris Nuclear Power Plant ("SHNPP") consists of:

a. an Area Radiation Monitoring System,

b. an Airborne Radiation Monitoring System, and

c. a Process and Effluent Radiological Monitoring and Sampling System

The RMS is designed to meet all the applicable regulatory requirements of 10 C.F.R. Part 20, 10 C.F.R. Part 50, and General Design Criteria for Nuclear Power Plants Numbers 60 and 64; and, to the extent practicable, is designed in accordance with the applicable recommendations of NRC Regulatory Guides 1.21, 1.45, 1.97, 1.109, 4.15 (with an exception on standards use), 8.2, and 8.8, NUREG-0472 ("Draft Radiological Effluent Technical Specifications for PWRs," March 1979), NUREG-0737 ("Classification of TMI Action Plan Requirements," November 1980), ANSI/ANS-HPSSC-6.8.1-1981 ("Location and Design Criteria for Area Radiation Monitoring Systems for Light Water Nuclear Reactors," 1981), and ANSI N13.10-1974 ("Specification and

Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents," 1974). In addition, the safety-related portion of the system is designed in accordance with specifications in IEEE 279-1971 ("Criteria for Protection Systems for Nuclear Power Generating Stations," 1971), IEEE 308-1974 ("Criteria for Class 1E Power Systems for Nuclear Power Generating Stations," 1974), IEEE 323-1974 ("Qualifying Class 1E Equipment for Nuclear Power Generating Stations," 1974), IEEE 336-1971 ("Installation, Inspection, and Testing Requirements for Class 1E Instrumentation and Electric Equipment at Nuclear Power Generating Stations," 1971), IEEE 344-1975 ("Practices for Seismic Qualifications of Class 1E Equipment for Nuclear Power Generating Stations," 1975), and IEEE 384-1974 ("Criteria for Independence of Class 1E Equipment and Circuits," 1974).

The Area Radiation Monitoring System is described in the SHNPP Final Safety Analysis Report ("FSAR"), Sections 11.5.2.3 and 12.3.4.1. The Airborne Radiation Monitoring System is described in FSAR, Sections 11.5.2.3 and 12.3.4.2. The Process and Effluent Radiological Monitoring and Sampling System is described in FSAR Section 11.5. The above-referenced sections of the FSAR are affixed hereto as Attachment C and are incorporated herein as part of this affidavit.

5. The in-plant health physics program includes surveillance to establish the radiation hazards. The Area Radiation

Monitoring System supports this program using strategically located detectors to monitor trends and sudden changes in gamma radiation fields. The design objectives of the Area Radiation Monitoring System are:

a. to furnish records of radiation exposure rates in specific areas of the plant;

b. to warn of uncontrolled or inadvertent movement of radioactive material in the plant;

c. to provide local and remote indication of ambient gamma radiation and local and remote alarms at key points where a substantial change in radiation fields might be of immediate importance to personnel frequenting the area;

d. to annunciate and warn of possible equipment malfunctions and leaks in specific areas of the plant; and

e. to provide warnings of unacceptable radiation levels.

6. The detectors used in the Area Radiation Monitoring System have the capability of detecting all radionuclides that emit gamma radiation. Gamma radiations deliver all of the significant external whole body radiation doses to personnel in a nuclear power plant. It would not be useful to design area

monitors to have the capability for identifying specific radionuclides or to be sensitive to neutron, alpha, or beta radiation, for the following reasons:

a. A gamma ray is fully characterized by its energy, and the external radiation hazard from a gamma radiation field is determined completely by establishing the exposure rate. Knowledge of the specific nuclides contributing to the gamma radiation in the field is irrelevant for assessing the external radiation hazard.

b. Significant neutron radiation is present only within the containment building whenever the reactor is operating. Hazards to personnel entering containment during reactor operations are determined by surveys at specific locations using portable neutron detectors. This obviates the need for area monitors to detect these neutrons. Neutron fluxes throughout the containment building are directly proportional to reactor power level which is monitored continuously with reactor vessel instrumentation.

c. Alpha radiation poses no external exposure hazard because of its very short range (low-penetrating power). Therefore, area monitors sensitive to alpha radiation would provide no useful information.

d. Beta radiation can pose a hazard in a nuclear plant. However, this hazard exists only from unshielded radioactive materials and occurs primarily at localized sources (water leaks, open systems, disassembled components such as pumps and valves, etc.). It is best evaluated using portable survey instruments and can be minimized with sound work practices and by the use of protective clothing and eye shields. Experience has demonstrated that, when properly controlled, external beta radiation exposures are not a regulatory limitation. It is not reasonable to use area monitors to evaluate beta hazards because of the relatively short range of beta radiation (several meters or less in air) and the localized sources. As with gamma radiation, detailed knowledge of the specific nuclides emitting the beta particles would provide little useful information for identifying or controlling the external beta hazard.

7. The Airborne Radiation Monitoring System is designed to support the in-plant health physics program by:

a. informing operations personnel of airborne particulate, iodine, and gaseous activity trends in the various buildings and structures of the plant;

b. alarming on detection of any abnormal increases in the airborne activity;

c. furnishing records of trends in airborne activity in the various plant areas;

d. alerting personnel to increases in airborne radioactivity concentrations that may indicate a need for changes in respiratory protection requirements;

e. providing information for evaluating the performance of all plant systems that function to minimize the release of airborne radioactivity to accessible areas of the plant and to the environment;

f. providing the capability to alarm and initiate isolation of the normal ventilation systems and actuation of the emergency ventilation systems during postulated accidents and providing operators with information regarding control of the ventilation systems in an emergency;

g. providing information for the purpose of reducing radiation exposure via inhalation of airborne particulates and iodine.

The Airborne Radiation Monitoring System is designed to provide qualitative information for trending and for alarming on detection of sudden increases in concentrations. Detectors in this system will monitor groups of radionuclides--noble gases, particulates, iodines, or all airborne activity depending on the detector design and location. It is neither necessary nor practical for this system to have the capability for monitoring individual nuclides within these groups because the radiation hazard is determined by the net effect of the composite mixture. Should an alarm signal a high concentration that requires investigation, the air is sampled and is analyzed in a laboratory to provide quantitative data for specific nuclides. In emergency situations, however, this laboratory information on specific airborne radionuclides is not needed in order to protect in-plant workers. In fact, if this detailed information were instantly available--as the Joint Intervenors contend that it should be--it would not provide emergency response personnel with data that would cause them to take any actions different from those indicated by presently available data.

8. The Process and Effluent Radiological Monitoring and Sampling System provides the means for monitoring the major liquid and gaseous paths by which radionuclides may be released to the environment, both during normal operating conditions and during emergency conditions. This system provides current and historical information for indicating both the types and rates

of change in radioactivity within process and effluent streams. Quantitative data are generated for gaseous and liquid effluents which track the activity by nuclide for all significant radionuclide releases. It is not reasonable to attempt to detect in real time all nuclides listed in 10 C.F.R. Part 20, Appendix B, Table 2, as the Joint Intervenors contend is necessary, because many of the nuclides listed are not present in effluent streams, and most of the remaining nuclides on the list are insignificant for purposes of radiation protection.

9. The Process and Effluent Radiological Monitoring System detects continuously all gamma emitters in: (1) liquid streams and (2) all noble gases, particulates, and iodines as groups of radionuclides in gaseous streams. Although the Process and Effluent Monitoring and Sampling System provides quantitative data for each significant radionuclide in effluents, this detail is not useful for either in-plant or off-site emergency response personnel. As explained in paragraph 7, initial decisions regarding mitigation of radiological consequences of an accident can be based on knowledge of activity by group; i.e., noble gases, iodines, and particulates rather than on knowledge of detailed data within the groups. Nuclides within these groups have similar properties in plant systems, in the environment, and inside the human body. During the early phases of an emergency it is the plume exposure pathways, i.e. inhalation and external doses from the plume, that are the

controlling factors for emergency management decisions. Knowledge of the total activity of noble gases, iodines, and particulates being (or having the potential of being) released, along with information regarding release path and meteorological conditions is sufficient for emergency personnel to calculate potential doses from plume exposures for most accident scenarios. These calculations are made on the basis of conservative assumptions about the mix of the significant nuclides within each group. Release rates for each individual nuclide are calculated using these pre-defined mixes and measured total activity. When this figure is multiplied by atmospheric dispersion factors and dose factors appropriate for each nuclide-pathway combination and then summed, the result is a determination of dose rates. Sensitivity studies demonstrate that the calculated doses per unit activity released do not vary significantly (more than a factor of two) over a wide range of possible mixes and accident scenarios. If a release is occurring, emergency personnel usually will make field measurements to supplement calculated doses. Again, the accuracy of the field measurements for evaluating both inhalation and external exposure hazards will not be influenced by a knowledge of the precise mix of nuclides being released.

10. A Radiological Environmental Monitoring Program has been established for SHNPP to provide measurements of radiation and radioactive materials in the SHNPP site environs and to

show that in many cases no detectable contamination exists. The Radiological Environmental Monitoring Program will be conducted to verify the effectiveness of in-plant systems used to control the release of radioactive materials and to ensure that unanticipated buildups of radioactivity will not occur in the environment. Secondarily, the environmental monitoring program will identify the effects of releases of radioactivity from all release points whether these are monitored or not and is capable of identifying each radionuclide released. The Radiological Environmental Monitoring Program is discussed in the SHNPP Environmental Report ("ER") at Section 6.1.5 (affixed hereto as Attachment D and incorporated herein) and meets the requirements of NRC Regulatory Guide 4.1, Revision 1, and NUREG-0472.

11. The SHNPP Radiological Environmental Monitoring Program will utilize six continuously operating air samplers (Analytical Process Instruments, Inc., Model NRC-2000, Nuclear Air Samplers), three continuously operating water samplers (two Hydragard Automatic Liquid Samplers and one Brailsford Battery-Operated Liquid Sampler), and 41 thermoluminescent dosimeters. In addition to the continuously operating equipment, periodic samples of environmental media, food crops, and animal products in the SHNPP environs are collected as described in the SHNPP ER in Table 6.1.5-1. <u>See</u> Attachment D affixed hereto. The samples obtained will be analyzed using analytical procedures

and analyses which meet or exceed the sensitivities specified in NUREG 0472.

12. In the event of an abnormal release of radioactivity, SHNPP Emergency Environmental Monitoring Field Teams are equipped with instrumentation adequate to provide an analysis of the radiological impact of any such release. The field teams are provided with radiation monitoring equipment with a full range of detection capability for radiation types and energy levels and with air samplers capable of sampling for airborne particulates (high-volume air samplers), airborne iodines (low-volume air samplers with silver zeolite collection cartridges), as well as portable generators to operate the air samplers. The field teams are also equipped with environmental sampling supplies and equipment to enable them to collect water, soil, vegetation, milk, food, and fodder crops. Each field team has the capability to collect and analyze airborne radionuclides with a sensitivity of at least 5×10^{-8} micro curies per cubic centimeter.

13. The field teams are supported by an environmental laboratory located at the Harris Energy & Environmental Center. This laboratory has the capability to perform detailed analyses on environmental samples for radionuclide content with sensitivities as set forth in the SHNPP FSAR at Section 16.2, Table 3.12-2 affixed hereto as Attachment E and incorporated herein

as part of this affidavit. In addition, the field teams are supported by a mobile laboratory with the same analytical capabilities of the central laboratory. To the extent required, these facilities allow the detection of any specific radionuclide in the environment. However, in general, the capability quickly to identify specific radionuclides in the environment is not used for initial emergency response decisions but rather may be used to provide greater detail should follow-up actions be required. Technical specifications define the operating conditions for the plant, and 40 C.F.R. § 190 specifies radiation dose limits to members of the public from uranium fuel cycle activities during normal operation.

14. The Joint Intervenors have asserted that pressurized ionization chambers ("PICs") can and should be used to identify specific radionuclides and to establish the release rates of each nuclide. In response to Applicants' interrogatories, Joint Intervenors advised: "they need pressurized ionization monitors to do it as those are the only monitors we know that can rapidly detect specific radionuclides," and "pressurized ionization detectors can detect specific radionuclides being passed through them." "Joint Intervenors' Response to Staff Interrogatories," dated August 31, 1983, Response to Interrogatory Nos. 9, 31. These statements demonstrate a lack of knowledge regarding the theory of operation and the applications of these devices. Radionuclides cannot be "passed through"

pressurized ionization chambers, as the Joint Intervenors appear to believe, because these chambers are sealed. PICs are not spectrometers, and it is impossible to use them to identify specific radionuclides. A PIC incorporates a sealed, pressurized chamber within which interactions of gamma radiation with the detection gas occur, producing electrically-charged ions that are collected by an electric field and measured as a current. This current is converted to an equivalent exposure rate for readout. Ion pairs produced by gamma rays from one nuclide are identical to ion pairs produced by gamma rays from any other nuclide.

15. The Joint Intervenors further state that "[T]he contention is that the specific radionuclides and amounts released will not be detected." "Joint Intervenors' Response to Staff Interrogatories," dated August 31, 1983, Response to Interrogatory No. 29. This assertion is incorrect because the RMS and Radiological Environmental Monitoring Program are designed and will be operated in a manner such that all significant radionuclides in both liquid and gaseous effluents will be accounted for, and the activities of each significant radionuclide released and the time of release will be recorded as specified in Regulatory Guide 1.21 and NUREG-0472.

16. In summary, it can be stated that the SHNPP RMS and the Radiological Environmental Monitoring Program are consistent with sound radiation protection procedures, state-of-the-art technology, current industry standard practices, applicable regulations, and recommendations of recognized standards development organizations. In our professional judgment, the programs and systems as designed will meet the objective of providing accurate and timely information regarding radioactivity releases and potential releases during emergency conditions. Even if accurate, real-time identification of specific radionuclides released in the plant or to the environment were feasible, it would not influence the emergency response actions that are dictated by information presently available from the SHNPP RMS.

William H. Wilkie
William H. Wilkie

Ronald L. Shearin
Ronald L. Shearin

Subscribed and sworn to before me
this 8th day of March, 1984.

Betty J. Hicks
Notary Public

My Commission Expires 9/28/85.

BIOGRAPHICAL DATA

DR. WILLIAM H. WILKIE

EDUCATION AND TRAINING

1967-1970 Georgia Institute of Technology, Atlanta, GA
Nuclear Engineering/Biology/Radiological Physics Specialization
Ph.D.

1960-1962 Vanderbilt University, Nashville, TN
Physics/Mathematics/Health Physics Specialization
M.S.

1957-1960 North Carolina State University, Raleigh, NC
Nuclear Engineering/Engineering Mathematics
B.S. (high honors)
Graduate study one semester

1955-1957 Maryville College, Maryville, TN
Mathematics/Physics
(no degree)

1984 Chem-Nuclear Systems, Inc., Columbia, SC
"Regulatory Awareness--Radioactive Waste Packaging, Transportation, and Disposal"

1979 Oak Ridge Associated Universities and Department of Energy, Oak Ridge, TN
"Health Physics in Radiation Accidents"

1976 Institute for Advanced Technology, Washington, DC
"Data Communications Systems"

1967 University of Tennessee, Knoxville, TN
Biology

1962 Oak Ridge Institute of Nuclear Studies, Oak Ridge, TN
"Advanced Radioisotope Technology"

1971-1981 Tennessee Valley Authority, Muscle Shoals, AL
Numerous courses in computer training, management, systems development, etc.

CERTIFICATION

American Board of Health Physics

PROFESSIONAL ORGANIZATIONS

Health Physics Society

International Radiation Protection Association

BIOGRAPHICAL DATA

DR. WILLIAM H. WILKIE

PROFESSIONAL ORGANIZATIONS (cont.)

American Nuclear Society

Sigma Xi

HONORARY SOCIETIES

Phi Kappa Phi

Sigma Pi Sigma

Tau Beta Pi

EXPERIENCE (Active in the field of health physics for 23 years)

1983- Carolina Power & Light Company, Raleigh, NC
Principal Health Physics Specialist

1981-1983 Electricity Supply Commission, Cape Town, South Africa
Regional Senior Health Physicist
Consultant

1971-1981 Tennessee Valley Authority, Muscle Shoals, AL
Staff Health Physicist

1970-1971 University of Pittsburgh, Pittsburgh, PA
Assistant Professor of Health Physics, Graduate School of Public Health
Technical Director, Radiation Medicine Department, Presbyterian-University Hospital

1968-1970 Technical Analysis Corporation, Atlanta, GA
Systems Development Engineer (part time)

1962-1967 Oak Ridge National Laboratory, Oak Ridge, TN
Research Associate

PREVIOUS CONSULTING

Radiological Assessment Systems for Nuclear Power

Technology for Energy Corporation

Oak Ridge National Laboratory

Advanced Research Corporation

BIOGRAPHICAL DATA

DR. WILLIAM H. WILKIE

BOOKS AND PUBLICATIONS

Wilkie, W. H., W. J. Millsap, and J. Walmsley, "Planning Bases for Radiological Emergency Response Near the Koeberg Nuclear Power Station," Escom Report, April 1983

"Operations Manual--Tygerberg Radiation Casualty Facility," Escom/Tygerberg Hospital Report, 1983

"Upgrading Environmental Radiation Data," USEPA Report EPA 520/1-80-012, August 1980

Wilkie, W. H., and M. S. Robinson, "Browns Ferry Nuclear Plant Emergency Dose Assessment Procedures for Atmospheric Releases of Radioactivity," TVA Report OHS-20-80-03, April 1980

Robinson, M. S., and W. H. Wilkie, "Browns Ferry Nuclear Plant Emergency Dose Assessment Procedures for Liquid Releases of Radioactivity," TVA Report OHS-20-80-04, April 1980

Wilkie, W. H., S. M. Nelson, and M. S. Robinson, "Technical Bases for Emergency Dose Assessment Procedures for Liquid Releases of Radioactivity," TVA Report OHS-20-80-06, May 1980

Wilkie, W. H., and M. S. Robinson, "Technical Bases for Emergency Dose Assessment Procedures for Atmospheric Releases of Radioactivity," TVA Report OHS-20-80-05, May 1980

Wilkie, W. H., and M. S. Robinson, "Sequoyah Nuclear Plant Emergency Dose Assessment Procedures for Atmospheric Releases of Radioactivity," TVA Report OHS-20-80-01, April 1980

Robinson, M. S., and W. H. Wilkie, "Sequoyah Nuclear Plant Emergency Dose Assessment Procedures for Liquid Releases of Radioactivity," TVA Report OHS-20-80-02, April 1980

"American National Standard for Internal Dosimetry for Mixed Fission and Activation Products," ANSI N343-1978

"The Tennessee Valley Region Study: Potential Year 2000 Radiological Dose to Population Resulting from Nuclear Facility Operations," DOE/ET-0064/2, June 1978

Garry, S. M., and W. H. Wilkie, "The Use of Environmental Monitoring Data in Determining Background Radiation Doses," Population Exposures, USAEC Report CONF-741018 (1974)

BIOGRAPHICAL DATA

DR. WILLIAM H. WILKIE

BOOKS AND PUBLICATIONS (cont.)

Wilkie, W. H., "The Interdisciplinary Nature of the Radiological Impact of Nuclear Plant Effluents on the Environment," Proceedings of TVA Task Force on Water Resources Research Meeting--The Growing Need for Interdisciplinary Research, 1974

Fish, B. R. and W. H. Wilkie, "The Fluid Dynamics of the Spherical Particle: (1) Tabulation of Settling Velocity, Reynolds Number, Drag Coefficient, Relaxation Time, and Acceleration-Distance in Air and Water," USAEC Report ORNL-TM-4100 (1973)

Wilkie, W. H., "The Spatial and Temporal Capture Distribution for Neutrons in a Coaxial, Two Medium, Liquid Scintillation Detection System," Advanced Research Corporation, Atlanta, GA, February 1970

"Biohazards of Aerospace Nuclear Systems, Final Report," T. G. Clark, B. R. Fish, W. H. Wilkie, J. L. Thompson, R. H. Boyett, and G. W. Royster, Jr., SC-CR-69-3291 (1969)

Wilkie, W. H., and D. S. Harmer, "Theoretical Modulation Transfer Functions and Dosimetry of Fast-Neutron Radiography," Biomedical Sciences Instrumentation-Volume 6, Instrument Society of America, Pittsburgh, PA (1969)

Wilkie, W. H., and B. R. Fish, "Scintillation Extrapolation Dosimetry of Small Beta-Emitting Sources," Solid State and Chemical Radiation Dosimetry in Medicine and Biology, IAEA, Vienna, Austria (1967)

"Environmental Studies: Radiological Significance of Nuclear Rocket Debris," (A series of reports involving classified research) USAEC Reports ORNL-TM-1053 (1965), ORNL-TM-1159 (1966), ORNL-TM-1686 (1966)

Wilkie, W. H., and R. D. Birkhoff, "Measurement of Spectral Distribution of Positron Flux in an Infinite Copper Medium Containing Cu-64," Phys. Rev., 135, A1133 (1964)

More extensive report on the positron research published as USAEC Report ORNL-3469 (1963)

BIOGRAPHICAL DATA

Ronald L. Shearin
Project Specialist - Environmental

Education and Training

B.S. Degree in Physics from the University of North Carolina, Chapel Hill, North Carolina (1955)

M.S.P.H. Degree in Radiological Health from the University of North Carolina, Chapel Hill, North Carolina (1963)

Ph.D. Candidate at the University of Florida (1971) - 1973, no degree)

Certificate in Meteorology from Texas A & M (1956)

Professional Societies

Health Physics (State and National Chapters)

Certified Health Physicist by American Board of Health Physics

Experience

September 1956 to August 1959 - First Lieutenant (Meteorologist), U.S. Air Force.

September 1959 to January 1962 - Health Physicist, E.E. DuPont, Aiken, South Carolina.

June 1963 to January 1966 - Health Physics Instructor, U.S. Public Health Service, Taft Sanitary Engineering Center.

January 1966 to June 1968 - Senior Radiological Health Instructor, Southwestern Radiological Health Laboratory, U.S. Public Health Service.

June 1968 to July 1970 - USAF Eastern Test Range; Kennedy Space Center (Apollo Program), Liaison Officer, U.S. Public Health Service.

July 1970 to August 1971 - Chief - Nuclear Facilities Branch, Eastern Environmental Radiation Facility, Environmental Protection Agency, Montgomery, Alabama.

Experience cont'd.

August 1973 to August 1979 - Health Services Director, Environmental Radiation Studies, Eastern Environmental Radiation Facility, Environmental Protection Agency, Montgomery, Alabama.

August 1979 to January 1980 - Employed as a Senior Generation Specialist - Radiation Control in the Generation Services, Harris Energy & Environmental Center, Section of the Generation Department located at New Hill, North Carolina.

January 1980 to March 1982 - Employed as a Senior Specialist-Environmental in the Environmental & Radiation Control Section of the Nuclear Operations Department, located at the Harris Energy & Environmental Center in New Hill, North Carolina.

March 1982 to Present - Employed as a Project Specialist-Environmental in the Radiological & Chemical Support Section of the Technical Services Department, located at the Harris Energy & Environmental Center in New Hill, North Carolina.

11.5.2.3 Radiation Monitoring System

11.5.2.3.1 System Function and Operation

The description which follows applies to all radiation monitoring equipment discussed in Section 5.2.5, 11.5, and 12.3.4.

The major function of the Radiation Monitoring System (RMS) is to provide plant operations personnel and health physics personnel with both current and historical measurements of radiological conditions in certain areas and plant systems during both normal and design basis conditions. In addition, this system automatically produces alarms to warn plant personnel, and in certain cases exerts control action when unusual radiological conditions or equipment malfunctions occur. All information is presented as efficiently and unambiguously as possible.

The RMS is a comprehensive, plant-wide radiation information gathering and control system encompassing the process and effluent monitors and the area and airborne monitors. The RMS is a digital, distributed microprocessor-based system in which full functional capability resides locally at the microprocessor controlling each monitor. The RMS is divided into a non-safety related portion and a safety related portion, with all equipment in the latter designed in accordance with IEEE 279-1971, 308-1974, 323-1974, 336-1971, 344-1975 and 384-1974.

The non-safety related portion is composed of the local monitors (Section 11.5.4.2.1) and four operator's consoles, one located in each of the two Control Rooms, as well as the Radwaste Control Room, and Health Physics Room.

Each opeator's console consists of a minicomputer, CRT, and hard copy typer. Each monitor is part of a loop, each loop connecting two operator's consoles. The operator's consoles which are so connected are: Unit 1 and Unit 2 Control Room, and WPB Control Room and Health Physics Room.

Communication is in either direction along the loop, thereby assuring redundancy in the event of any single failure. Each microprocessor in a loop is controlled by either of the two operator's console with which it is associated. During the interim period when Unit 1 is operational prior to Unit 2 being operational, the loops shall continue to be routed between the appropriate RMS computers. These computers shall be located in the computer room. During this interim period, no Unit 2 operator's console shall be installed. Readout of all Unit 1 and common monitors shall be via the Unit 1 operator's console. Information from the monitors is displayed at the CRT. Since all four operator's consoles are interconnected, the information is shared among all four operator's consoles and available to all four operator's consoles. Information includes radiation level in the proper engineering units or counts per minute (cpm), effluent flow histories, monitor status and alarm status. Each monitor has two upscale trips for alert and high radiation, and one downscale trip to indicate monitor failure. Monitor failure includes: low flow, torn filter paper, high differential pressure, 3

and detector failure (low count). Controlled functions include monitor setpoints, purging, checksource activation, and monitor testing.

The safety related portion is composed of the local monitors
2 (Section 11.5.4.2.1) and four safety related panels, one for each of two
electrical divisions A and B, for two Control Rooms. Each monitor is remotely
controlled by its own dedicated display and control module located in the
appropriate panel. Information is displayed digitally using LED displays.
Trending of radiation level is accomplished by recording the radiation level
2 on Seismic Category I, Class IE strip charts driven by a resistive buffered
analog output from each display control module.

Additionally, the safety related monitors are grouped into loops, each between two non-safety operator's consoles, similar to those of the non-safety monitors, with the exception that all communication ports between each of the safety related monitors as well as between the safety monitors and non-safety related operator's consoles have properly qualified 1500V, optical isolation buffers, and are used solely for the purpose of transmitting information from the monitor to the operator's consoles: no control can be exercised by the non-safety related portion of the RMS over the safety related monitors. With this technique, information from all the monitors is normally available at the operator's consoles' CRT. Information, control and annunication capabilities of each of the safety related monitors from its display/control module are the same as those capabilities described for the non-safety related monitors.

Furthermore, all information from the Effluent Radiological Monitoring System
regarding radiation levels and effluent flows is passed automatically to the
report processing computer and used in the preparation of Regulatory
Guide 1.21 reports. This is in conjunction with the meteorological and
2 radiological information inputs from the Process Sampling System. A history
of effluent flows is maintained at each microprocessor associated with an
effluent detector.

Meteorological and effluent gross radiation data are collected in real-time modes. The results of isotopic analyses, solid waste data and site specific information (i.e, receptor locations, population data) are collected as they become available.

The meteorological software of the report processing computer performs data acquisition, statistical computations, quality checks and data storage. Each meteorological instrument output from the local analog to digital converter is sampled every 10 seconds. Every 10 minutes, 10-minute averages are calculated for each output. For wind speed and wind direction, the minimum and maximum are retained and the standard deviation calculated. Hourly values of these variables are generated and stored for subsequent processing.

The effluent gross radiation software collects concentration (i.e., Ci/m^3) and process flow data from the operator's consoles, which accumulates hourly averages from each of the monitors in the Effluent Radiological Monitoring System.

The quality checks made by the microprocessors are used by the operator's consoles to generate status codes which are stored in the report processing computer. Each hourly gross radiation data set will have four indices to indicate what isotopic analyses are associated with that hour. The four

indices are associated with isotopic analysis results for noble gases, iodines, particulates and miscellaneous gases.

The results of isotopic analyses of grab samples performed by multi-channel analyzers (MCAs), are entered into the report processing computer as they are available. The type of sample, applicable time period, release point, concentration of each isotope found and other information are stored.

Liquid releases are normally made on a batch basis. The results of isotopic analyses performed prior to a liquid batch release are stored in the report processing computer along with dilution information. Provision is made for continuous liquid release monitor data storage.

Solid waste and irradiated fuel shipment data required by Regulatory Guide 1.21 are entered into the report processing computer by the operator for storage.

The data collected are stored on the report processing computer's disk. The storage capacity is sufficient to allow time for quarterly and semi-annual report generation while new data are being gathered. Certain data files are editable prior to their use in computation. All meteorological and radiological data are checked for reasonableness and edited as needed prior to use in dose computation. Additional files are created during editing to allow the subsequent computations to use edited meteorological and radiological data. This approach preserves the data originally collected yet allows the use of edited data for computations and output. The archiving of data is done on disk.

Computation and data reduction will result in a number of summary reports. These reports are generated upon operator demand.

Offsite doses and pre-release dose estimates are generated upon operator demand. Short-term and accumulated doses are calculated in accordance with Regulatory Guide 1.109, and are available for display at a graphics CRT terminal associated with the report processing computer.

A schematic of the Radiation Monitoring System is shown on Figure 11.5.2-1.

11.5.2.4 RMS Equipment Description

11.5.2.4.1 Monitor (Cabinet/Skid)

Each fluid monitor is a skid mounted self-contained instrument package consisting of the requisite number and type of channels, and sampling pumps, valves, interconnecting piping, fittings, flow and pressure indicators, controls and local annunciators, and process fluid pre-conditioners, as required. All skid mounted monitors obtain for analysis a suitable continuous fluid sample of the process of effluent stream and return the sample to the process or effluent stream in a closed loop. Each skid mounted monitor is located as close as practical to the process or effluent stream, such that sample line losses or transit time is minimized.

TABLE 11.5.2-1

PROCESS RADIATION MONITORS

Description	Tag #	Subsection of 11.5.2.7.1 Described In	Detector Type	Range	Sensitivity	Accuracy (%)	Typical High Alarm Setpoints	Location	Power	Automatic Actuation
Unit 1 Component Cooling Water A	1CC-3501A SA	.1	Liquid (11.5.2.5.7)	$3x10^{-8}$-$1x10^{-3}$ uCi/cc	$1.3x10^{8}$ cpm uCi/cc Cs137	±10	$4x10^{-6}$ uCi/cc	Off Line	†	Closure of the vent valve on the component cooling surge tank
Unit 2 Component Cooling Water A	2CC-3501A SA	.1								
Unit 1 Component Cooling Water B	1CC-3501B SB	.1								
Unit 2 Component Cooling Water B	2CC-3501B SB	.1								
Auxiliary Steam Condensate Tank	21AC-3525A	.2					$6x10^{-6}$ uCi/cc			
Unit 1 Steam Generator Blowdown	1BD-3527	.3					$1x10^{-5}$ uCi/cc			
Unit 2 Steam Generator Blowdown	2BD-3527	.3								

† Safety Related AC Bus

†† Instrumentation AC Bus

TABLE 11.5.2-1
PROCESS RADIATION MONITORS
cont'd

Description	Tag #	Subsection of 11.5.2.2.1 Described In	Detector Type	Range	Sensitivity	Accuracy (%)	Typical High Alarm Setpoints	Location	Power	A[illegible] Actuation
Auxiliary Steam Condensate-Waste Process. Sys. Unit 1 & 2	21AC-3543	.5	Liquid (11.5.2.5.2)	$3x10^{-8}$-$1x10^{3}$ uCi/cc	$1.3 x 10^{8}$ CPM/uCi/cc Cs137	±10	$4 x 10^{-6}$ uCi/cc	Off Line	??	None
Waste Processing Building Cooling Water	*1WG-3544	.6								
Gas Decay Tanks 1 & 2	21WG-3545	.7	Noble Gas (11.5.2.5.5)	$1x10^{-1}$-$1x10^{4}$ uCi/cc	$4.3x10^{7}$ CPM/uCi/cc Xe133	-	500 uCi/cc			
Gas Decay Tanks 3 & 4	43WG-3545	.7								

operating floor to close and the normal exhaust fans to stop, while the emergency exhaust dampers open and emergency exhaust fans start up.

There are a total of four safety related triplet detector systems located on the Fuel Handling Building operating floor. The detectors are located around the appropriate spent fuel pools. The detector locations are shown in Figure 12.3.2-9. The high radiation alarm setpoints are to be placed at 5
100 mr/hr, and an actuation will initiate operation of the emergency ventilation system and terminate normal ventilation system operation. Since monitors are in a zone II area, the detector alert setpoints are to be at 2.7 mr/hr. Personnel in the vicinity of the detectors will be warned of alert levels and high levels of radiation by detector-local indicator units.

Because of a potentially high background, the more sensitive microprocessors are removed from the FHB to the RAB.

12.3.4.1.8.4 Other Area Radiation Monitors

There are two non-safety area monitors located in the North and South fuel 5
pool areas which will also alarm personnel about the presence of unacceptable high radiation levels.

All other area radiation monitors not listed above use the detector types specified in Section 11.5.2.5.1 and provide alarms only and exert no control action. These monitors, as well as the ones discssed in Sections 12.3.4.1.8.1, 12.3.4.1.8.2, and 12,3.4.1.8.3 are shown in Table 12.3.4-1.

12.3.4.2 <u>Airborne Radiation Monitoring System</u>

12.3.4.2.1 Design Objectives

The objectives of the Airborne Radiation Monitoring System during normal operating plant conditions and anticipated operational occurrences are:

a) To inform operations personnel of airborne particulate, iodine and gaseous activity trends in the various buildings and structures of the plant,

b) to alarm any abnormal increases in the airborne activity levels,

c) to furnish records of gross airborne trends in the various plant areas,

d) to help detect identified or unidentified leaks from the reactor coolant pressure boundary (as recommended in Regulatory Guide 1.45, which is discussed in Section 1.8) and other areas of the plant,

e) to assist personnel in deciding whether or not breathing apparatus is necessary when entering a high activity area,

f) to provide information for evaluation of the performance of all plant systems that function to minimize the release of airborne radioactivity to accessible areas of the plant and to the environment,

g) during postulated accidents, to provide the capability to alarm and initiate isolation of the normal ventilation systems and actuation of the emergency ventilation systems, and to provide operators with information regarding control of the ventilation systems in an emergency, and

h) to provide information for the purpose of maintaining low in-plant personnel radiation exposure via inhalation of airborne particulates and iodine, in accordance with 10CFR20 and Regulatory Guide 8.8 (see Section 12.1).

12.3.4.2.2 Criteria for Location of Monitors

Considerations for locating the Airborne Radiation Monitoring System monitors are based on the following:

a) areas where the airborne radioactivity can abruptly increase and where personnel normally have access to the areas,

b) in selected ventilation ducts where the monitors can survey the airborne radioactivity level, and

c) inside the Containment for the purpose of monitoring unidentified leaks.

The radiation monitors associated with the ventilation system are shown on the flow diagrams presented as Figures 9.4.0-2 and following. These monitors are designated by symbols which are defined in Figure 9.4.0-1, Symbols and Abbreviations for HVAC System.

5

An alarm by a ventilation monitor indicates that the airborne contamination is coming from a limited number of enclosures serviced by the monitored ventilation system. Identification of the source enclosure within this group would be made by a systematic program for sampling the air in each enclosure with portable instruments.

12.3.4.2.3 General System Description

The Airborne Radiation Monitoring System provides the means to monitor normal airborne radioactivity levels and to detect and annunciate any abnormal radiation conditions occurring throughout the plant, and as such is an integral part of the Radiation Monitoring System, which is described in detail in Section 11.5.2.3.

The Airborne Radiation Monitoring System consists of skid or duct mounted gaseous monitors. Each monitor is composed of individual channels, with a channel consisting of a sampling chamber (when required, i.e., off-line, skid mounted monitors), check source, and detector. The detector assembly consists of either gamma or beta sensitive scintillation crystal, a photomultiplier tube and a local amplifier. All channels associated with a monitor are served by a local, dedicated microprocessor, and all channel information is processed through this microprocessor, which is then interrogated by the appropriate radiation monitoring system computer for further processing, indication on a cathode ray tube (CRT), storage, remote alarming and hard copy production, if so desired.

The monitors listed in Table 12.3.4-2 of the FSAR comprise the In-Plant Airborne Radiation Monitoring System (IPARMS). The IPARMS will consist of 25 channels containing two detectors per channel for a total of 50 detectors. Each IPARMS channel will consist of a particulate monitor, iodine monitor, and air sampling system.

Each particulate monitor will be a Beta-sensitive plastic scintillation radiation detector coupled to a photomultiplier tube protected by an electromagnetic shield. The sensor shall have a minimum detectable limit of 1.0×10^{-12} µCi/cc concentration for Cesium-137. This is based on sufficient shielding and a sample flow rate of 4 scfm and 4 hour sampling time, in a 1 mr/hr Cs-137 background.

Each iodine monitor shall be a gamma-sensitive NaI scintillation detector at 5
least two (2) inches in diameter by two (2) inches in thickness, coupled to a photomultiplier tube protected by an electromagnetic shield. The sensor shall have a minimum detectable limit of 2.0×10^{-11} µCi/cc concentration for Iodine-131. This is based on sufficient shielding and a sample flow rate of 4 scfm and 4 hour sampling item, in a 1 mr/hr background.

Each IPARMS channel shall be provided with an off-line air sampling system. The particulate sampler is a fixed filter assembly and has at least 99 percent efficiency for particles 0.3 microns and larger. The iodine sampler is also a fixed filter assembly and has at least 99% efficiency for iodine. Each sampling system shall be equipped with a sample probe similar to the isokinetic probe for the Gaseous Effluent Radiation System, except that flow compensation is not required.

12.3.4.2.4 Microprocessor

The microprocessor is described in Section 12.3.4.1.4.

12.3.4.2.5 Local Annunciation

All airborne monitors have local annunciation, consisting of an audible alarm rated at 80 dB at 10 feet, and three alarm lights for high radiation, alert radiation and monitor filure. All airborne monitors have a display at the microprocessor indicating the airborne radioactivity concentration in µ-Ci/cc of the particulate isotope (i.e., Iodine 131) or gross particulate or noble gas activity at the detector.

12.3.4.2.6 Power Supplies

Each channel is provided with an independent power supply, designed such that a failure in that channel does not affect any other channel. Monitors that are identified as safety related are redundant and are supplied power from the station 120V AC safety related buses. The power supplies for these channels are identified in Table 12.3.4-2. Power to the channels that monitor only normal operations is supplied from the station regulated 120V AC instrumentation bus.

12.3.4.2.7 Redundancy, Diversity, and Independence

Monitors designated as safety related are part of the safety related portion of the RMS (Section 11.5.2.3) and are designed for redundancy, diversity, and independence in accordance with IEEE 279-1971, IEEE 308-1974, IEEE 323-1974, IEEE 336-1971, IEEE 344-1975, and IEEE 384-1974. All monitors which are Seismic Category I are also manufactured and rated to the above standards.

12.3.4.2.8 Airborne Radiation Monitors

12.3.4.2.8.1 Containment Atmosphere Leak Detection Monitors

The containment atmosphere leak detection monitors are part of the safety related portion of the RMS (Section 11.5.2.3) and are designed to provide an indication to operations personnel of the particulate and gaseous radioactivity levels inside the Containment. Radioactivity in the containment indicates the presence of fission products due to a reactor coolant pressure boundary leak, and as such these monitors are a part of the Reactor Coolant Pressure Boundary Leakage Detection System required by Regulatory Guide 1.45 (see Section 1.8). A detailed description of the sampling system associated with these monitors, operation and monitoring requirements is found in Section 5.2.5. Each monitor uses the airborne particulate and noble gas detector described in Section 11.5.2.6.5. Each of
5 the two Containments has one monitor. Monitors are powered by the Emergency A Bus. A containment isolation actuation signal will isolate these monitors from the Containment.

These monitors provide a high radiation alarm when concentrations reach preset limits. The receipt of these alarms will alert the operator to the presence of low level leakage so that additional sampling can be effected in order to locate the leakage source.

12.3.4.2.8.2 Control Room Normal Outside Air Intake

Each control room normal outside air intake has two duct mounted beta sensitive monitors, one associated with A Bus, and one with B Bus. These monitors are part of the safety related portion of the RMS (Section 11.5.2.3) and use the ambient gas monitors described in Section 11.5.2.6.1.

These monitors provide a high radiation alarm when concentration levels reach preset limits. Upon receipt of the alarm, the monitor closes the normal outside air intake dampers associated with a given unit, shuts off the exhaust fans, closes the exhaust dampers, starts up the blowers, and opens the required dampers to put the air flow into the recirculatory mode. The receipt of these alarms will also alert the operator to check the radiation levels at both emergency outside air intakes, and to open the intake at which the radiation level is lower (Section 12.3.4.2.8.3).

These normal intake monitors also cause the intake dampers on the electric equipment protection rooms to close, and then open the recirculation dampers, and close the exhaust dampers.

In the interim, prior to Unit 2 being operational, the normal outside air intake monitors for Unit 2 serve as the emergency intake monitors for Unit 1. 10
Section 12.3.4.2.8.3 presents a full discussion of this concept.

12.3.4.2.8.3 Control Rooms Emergency Outside Air Intake

For Units 1 and 2, there are two common emergency outside air intakes. Each intake has four duct-mounted Beta monitors associated with: Unit 1, A Bus; 10
Unit 2, A Bus; Unit 1, B Bus; Unit 2, B Bus. These monitors are part of the safety related portion of the RMS (Section 11.5.2.3), and use the ambient gas monitors described in Section 11.5.2.6.1.

These monitors provide indication to the control room personnel of the radioactivity levels at each emergency air intake, thereby allowing the operator to choose which emergency intake to open (see discussion in Section 12.3.4.2.8.2). These monitors also provide a high radioactivity alarm when concentration levels reach preset limits.

In the interim period, prior to Unit 2 being operational, the normal outside air intake for Unit 2 serves as the emergency outside air intake for Unit 1. During this period, the normal air intake radioactivity monitors for Unit 2 serve as the emergency intake monitors for Unit 1, and consequently the required panel mounted display and control modules controlling these monitors are mounted in Unit 1's safety related panel. Additionally, all software and hardware requirements in communicating with the non-safety related portion of the RMS are completed. 10

12.3.4.2.8.4 Other Airborne Radiation Monitors

A non-safety Particulate and Iodine monitor is located on the fuel handling building operating floor. This monitor takes an ambient air sample from the surrounding air and analyzes it for airborne particulate and iodine concentrations. Alert level alarms are to be set at CS-137 MPC levels for particulate and I-131 MPC levels for Iodine. High level alarms are to be set at 10 MPC levels. Operators will be warned of when respirators are required to permit occupancy.

All other airborne radiation monitors not listed above use the airborne particulate and iodine monitor described in Section 11.5.2.6.3 and provide for alarm only and exert no control action. These monitors, as well as the ones discussed in Sections 12.3.4.2.8.1, 12.3.4.2.8.2, and 12.3.4.2.8.3 are shown in Table 12.3.4-2.

TABLE 12.3.4-1

AREA RADIATION MONITORS

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Setpoints* (mR/hr)	Location	Power
Control Room Area	21RR-3560 SA	.4	GM Tube (11.5.2.5.1)	10^{-1}-10^{5}	10^{2}	±10	2.5	Control Room	Instrumentation AC Safety Bus
CONTAINMENT ISOLATION A									
Unit 1	1CR-3561A SA	.1	Ion chamber (11.5.2.5.3)	10^{1}-10^{7}	1	±15	10^{3}	Around Reactor Cavity	+
Unit 2	2CR-3561A SA	.1	"	"	"	"	"	"	+
CONTAINMENT ISOLATION B									
Unit 1	1CR-3561B SB	.1	"	"	"	"	"	"	+
Unit 2	2CR-3561B SB	.1	"	"	"	"	.	"	+

10

10

+Instrumentation AC Safety Bus

* These typical alarm setpoints represent logical alarm points in the absence of data from the operating conditions encountered in the plant. The actual alarm points will be adjusted to provide useful alarms based on the radiation level within the plant. The operations being conducted and the location of personnel within the plant.

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Setpoints (mR/hr)	Location	Power
									Instrumentation AC Safety Bus
CONTAINMENT ISOLATION C									
Unit 1	1CR-3561C SA	.1	Ion chamber (11.5.2.5.3)	10^1-10^7	1	± 15	10^3	Around Reactor Cavity	+
Unit 2	2CR-3561C SA	.1	"	"	"	"	"	"	+
CONTAINMENT ISOLATION D									
Unit 1	1CR-3561D SB	.1	"	"	"	"	"	"	+
Unit 2	2CR-3561D SB	.1	"	"	"	"		"	+

10

10

+Instrumentation AC Safety Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Set-points (mR/hr)	Location	Power
Post LOCA MONITOR A									
Unit 1	1CR-3563A SA	.2	GM Tube (11.5.2.5.1)	$10^{-1}-10^{5}$	10^{2}	±10	10^{3}	Outside containment shield wall	+
Unit 2	2CR-3563A SA	.2	"	"	"	"	"		+
Post LOCA MONITOR B									
Unit 1	1CR-3563B SB	.2	"	"	"	"	"	"	+
Unit 2	2CR-3563B SB	.2	"	"	"	"		"	+
Fuel Handling Bldg. South	*1FR-3564 SA	.3	GM Tube (11.5.2.5.2)	$10^{-2}-10^{4}$	10^{3}	±10	10^{2}	Around FHB	+
	*1FR-3564 SB	.3		"	"	"	"	"	+
	*1FR-3565 SA	.3	"	"	"	"	"	"	+
	*1FR-3565 SB	.3	"	"	"	"	"	"	+
Fuel Handling Bldg. North	*1FR-3566 SA	.3	"	"	"	"	"	"	+
	*1FR-3566 SB	.3	"	"	"	"	"	"	+
	*1FR-3567 SA	.3	"	"	"	"	"	"	+
	*1FR-3567 SB	.3	"	"	"	"	"	"	+

+Instrumentation AC Safety Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Set-points (mR/hr)	Location	Power
CONTAINMENT SOUTH STAIRWELL, EL. 261									
Unit 1	1CR-3575	.4	GM Tube (11.5.2.5.1)	10^{-2}-10^{5}	10^{2}	± 10	10^{2}	Plant	Instrumentation AC Bus
Unit 2	2CR-3575	.4	"	"	"	"	"	"	*
CONTAINMENT NORTH STAIRWELL, EL. 261									
Unit 1	1CR-3576	.4	"	"	"	"	"	"	*
Unit 2	2CR-3576	.4	"	"	"	"		"	*
CONTAINMENT BLDG. IN-CORE INST. CONTROLS									
Unit 1	1CR-3577	.4	"	"	"	"	"	"	*
Unit 2	2CR-3577	.4	"	"	"	"	"	"	*

*Instrumentation AC Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Setpoints (mR/hr)	Location	Power	
Recycle Monitor Tank										
1A & 2A	21CR-3578A	.4	GM Tube (11.5.2.5.1)	10^{-2}-10^{5}	10^{2}	± 10	10^{2}	Plant	*	
1B & 2B	21CR-3578B	.4	"	"	"	"	"	"	*	10
Boric Acid Filters										
Unit 1	1CR-3579	.4	"	"	"	"	"	"	*	
Unit 2	2CR-3579	.4	"	"	"	"	"	"	*	10
Valve Gallery										
Unit 1	1CR-3580	.4	"	"	"	"	"	"	*	
Unit 2	2CR-3580	.4	"	"	"	"	"	"	*	10
Access Aisle Between Valve Galleries										
Units 1 & 2	21CR-3581A	.4	"	"	"	"	"	"	*	
Units 1 & 2	21CR-3581B	.4	"	"	"	"	"	"	*	10

*Instrumentation AC Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/(mR/hr)	Accuracy (%)	Typical High Alarm Setpoints (mR/hr)	Location	Power	
CONTAINMENT NORTH STAIRWELL, EL. 286			GM Tube							
Unit 1	1CR-3582	.4	(11.5.2.5.1)	$10^{-2}-10^{5}$	10^{2}	±10	10^{2}	Plant	*	
Unit 2	2CR-3582	.4	"	"	"	"		"	*	
										10
CONTAINMENT SOUTH STAIRWELL, EL. 286										
Unit 1	1CR-3583	.4	"	$10^{-1}-10^{5}$	"	"	"	"	*	
Unit 2	2CR-3583	.4	"	"	"	"	"	"	*	
										10
Pressurizer										
Unit 1	1CR-3584	.4	"	"	"	"	"	"	*	
Unit 2	2CR-3584	.4	"	"	"	"		"	*	
										10
SOUTH SECONDARY CONTAINMENT, EL. 236										
Unit 1	1CR-3585	.4	"	"	"	"	"	"	*	
Unit 2	2CR-3585	.4	"	"	"	"	"	"	*	
										10

*Instrumentation AC Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Set-points (mR/hr)	Location	Power	
Primary Cooling Ducts			GM Tube							
Unit 1	1CR-3586	.4	(11.5.2.5.1)	10^{-1}-10^{5}	10^{2}	± 10	10^{2}	Plant	*	
Unit 2	2CR-3586	.4	"	"	"	"	"	"	*	
										10
Reactor Coolant Tank										
Unit 1	1CR-3587	.4	"	"	"	"	"	"	*	
Unit 2	2CR-3587	.4	"	"	"	"	"	"	*	
										10
Personnel Lock & Equip. Removal Area										
Unit 1	1CR-3588	.4	"	"	"	"	"	"	*	
Unit 2	2CR-3588	.4	"	"	"	"	"	"	*	
										10
Volume Control Tank										
Unit 1	1RR-3595	.4	"	"	"	"	"	"	*	
Unit 2	2RR-3595	.4	"	"	"	"	"	"	*	
										10

*Instrumentation AC Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Set-points (mR/hr)	Location	Power	
MS & FW Pipe Tunnel Floor			GM Tube							
Unit 1	1RR-3596	.4	(11.5.2.5.1)	$10^{-1}-10^{5}$	10^{2}	± 10	10^{2}	Plant	*	
Unit 2	2RR-3596	.4	"	"	"	"	"	"	*	
										10
RHR Pump 1B										
Unit 1	1RR-3597	.4	"	"	"	"	"	"	*	
Unit 2	2RR-3597	.4	"	"	"	"	"	"	*	
										10
RHR Pump 1A										
Unit 1	1RR-3598	.4	"	$10^{-1}-10^{5}$	"	"	"	"	*	
Unit 2	2RR-3598	.4	"	"	"	"	"	"	*	
										10
Charging Pump 1A										
Unit 1	1RR-3599A	.4	"	"	"	"	"	"	*	
Charging Pump 2A										
Unit 2	2RR-3599A	.4	"	"	"	"	"	"	*	10

*Instrumentation AC Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Setpoints (mR/hr)	Location	Power
Charging Pump 1B			GM Tube						
Unit 1	1RR-3599B	.4	(11.5.2.5.1)	10^{-1}-10^{5}	10^{2}	± 10	10^{2}	Plant	*
Charging Pump 2B									
Unit 2	2RR-3599B	.4	"	"	"	"	"	"	*
Charging Pump 1C									
Unit 1	1RR-3599C	.4	"	"	"	"	"	"	*
Charging Pump 2C									
Unit 2	2RR-3599C	.4	"	"	"	"	"	"	*
Recycle Evaporator Valve Gallery									
Unit 1	1RR-3600	.4	"	"	"	"	"	"	*
Unit 2	2RR-3600	.4	"	"	"	"	"	"	*

10

10

10

*Instrumentation AC Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Set-points (mR/hr)	Location	Power
Letdown Hx Valve Gallery			GM Tube						
Unit 1	1RR-3601	.4	(11.5.2.5.1)	10^{-1}-10^{5}	10^{2}	±10	2×10^{3}	Plant	*
Unit 2	2RR-3601	.4	"	"	"	"	"	"	*
Moderating Hx Valve Gallery									
Unit 1	1RR-3602	.4	"	"	"	"	"	"	*
Unit 2	2RR-3602	.4	"	"	"	"	"	"	*
Boric Acid Pump Valve Gallery									
Unit 1	1RR-3603	.4	"	"	"	"	"	"	*
Unit 2	2RR-3603	.4	"	"	"	"	"	"	*
Unit 1 and 2 Access Aisle	21RR-3604	.4	"	"	"	"	10^{2}	"	*

10

10

10

10

*Instrumentation AC Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Set-points (mR/hr)	Location	Power
Unit 1 Sample Room 1A	1RR-3605A	.4	GM Tube (11.5.2.5.1)	10^{-1}-10^{5}	10^{2}	± 10	10^{2}	Plant	*
Unit 2 Sample Room 2A	2RR-3605A	.4	"	"	"	"	"	"	*
Unit 1 Sample Room 1B	1RR-3605B	.4	"	"	"	"	"	"	*
Unit 2 Sample Room 2B	2RR-3605B	.4	"	"	"	"	"	"	*
RHR Hx 1A	1RR-3606A	.4	"	"	"	"	"	"	*
RHR Hx 2A	2RR-3606A	.4	"	"	"	"	"	"	*
RHR Hx 1B	1RR-3606B	.4	"	"	"	"	"	"	*
RHR Hx 2B	2RR-3606B	.4	"	"	"	"	"	"	*

*Instrumentation AC Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Set-points (mR/hr)	Location	Power	
Decon Area El. 236			GM Tube							
Unit 1	1RR-3607	.4	(11.5.2.5.1)	10^{-1}-10^{5}	10^{2}	±10	10^{2}	Plant	*	
Unit 2	2RR-3607	.4	"	"	"	"	"	"	*	10
Decon Area El. 261										
Unit 1	1RR-3608	.4	"	"	"	"	"	"	*	
Unit 2	2RR-3608	.4	"	"	"	"	"	"	*	10
Waste Monitor										
TK 1 & 2A	21RR-3609A	.4	"	"	"	"	"	"	*	
Waste Monitor										
TK 1 & 2B	21RR-3609B	.4	"	"	"	"	"	"	*	10
Secondary Waste Sample										
TK 1 & 2	21RR-3610	.4	"	"	"	"	"	"	*	10

*Instrumentation AC Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/(mR/hr)	Accuracy (%)	Typical High Alarm Setpoints (mR/hr)	Location	Power
Recycle Hold-up Tank			GM Tube						
Unit 1	1RR-3611	.4	(11.5.2.5.1)	10^{-1}-10^{5}	10^{2}	±10	10^{2}	Plant	*
Unit 2	2RR-3611	.4	"	"	"	"	"	"	*
Spent Fuel Pool									
South	1FR-3620	.4	"	"	"	"	"	"	*
North	1FR-3621	.4	"	"	"	"	"	"	*
Spent Fuel Shipping Cask	1FR-3622	.4	"	"	"	"	"	"	*
Spent Fuel Pool Hx									
South	1FR-3623A	.4	"	"	"	"	"	"	*
North	1FR-3623B	.4	"	"	"	"	"	"	*
Access Aisle Between Spent Fuel Hx	1FR-3625	.4	"	"	"	"	"	"	*
Purification Pump Filter									
2A & 3A	32FR-3626	.4	"	"	"	"	"	"	*
1A & 4A	41FR-3626	.4	"	"	"	"	"	"	*

*Instrumentation AC Bus

10

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Set-points (mR/hr)	Location	Power
New Fuel Storage Area	1FR-3628	.4	GM Tube (11.5.2.5.1)	10^{-1}-10^{5}	10^{2}	± 10	10^{2}	Plant	*
Filt Backwash Trans. Tank VA Gallery	1WR-3635	.4	"	"	"	"	"	"	*
WPB Filter Part Conc. TK VA Gallery	1WR-3636A	.4	"	"	"	"	"	"	*
WPB Filter Part Conc. TK VA Gallery	WR-3636B	.4	"	"	"	"	"	"	*
Gas Decay Tank Drain Pump 1 & 2	21WR-3637	.4	"	"	"	"	"	"	*
Backwash Storage TK Pump Valve Gallery	1WR-3638A	.4	"	"	"	"	"	"	*
Backwash Storage TK Pump Valve Gallery	1WR-3638B	.4	"	"	"	"	"	"	*

*Instrumentation AC Bus

10

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Set-points (mR/hr)	Location	Power	
Waste Gas Comp. 1A & 2B	21WR-3639A	.4	GM Tube (11.5.2.5.1)	10^{-1}-10^{5}	10^{2}	± 10	10^{2}	Plant	*	
1B & 2B	21WR-3639B	.4	"	"	"	"	"	"	*	10
Waste Evap. Conc. Valve Gallery	21WR-3640	.4	"	"	"	"	"	"	*	10
Waste Evaporator Feed Pump Valve Gallery	21WR-3641	.4	"	"	"	"	"	"	*	10
Waste Evaporator Valve Gallery 1A & 2A	21WR-3642A	.4	"	"	"	"	"	"	*	10

*Instrumentation AC Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/(mR/hr)	Accuracy (%)	Typical High Alarm Setpoints (mR/hr)	Location	Power
Waste Evaporator Valve Gallery 1B & 2B	21WR-3642B	.4	GM Tube (11.5.2.5.1)	10^{-1}-10^{5}	10^{2}	± 10	10^{2}	Plant	*
Waste Evaporator Sample Room 1	1WR-3643	.4	"	"	"	"	"	"	*
Room 2	2WR-3643	.4	"	"	"	"	"	"	*
Spent Resin Pumps 1 - 2A	*1WR-3644A	.4	"	"	"	"	"	"	*
1 - 2B	*1WR-3644B	.4	"	"	"	"	"	"	*
Catalytic Recombiner 1 & 2A	21WR-3645A	.4	"	"	"	"	"	"	*
1 & 2B	21WR-3645B	.4	"	"	"	"	"	"	*
WP Control Room	*1WR-3646	.4	"	"	"	"	2.5	"	*

10

10

10

*Instrumentation AC Bus

TABLE 12.3.4-1 (continued)

Description	Tag #	Subsection of 12.3.4.1.8 Described in	Detector Type	Range (mR/hr)	Sensitivity CPM/ (mR/hr)	Accuracy (%)	Typical High Alarm Set-points (mR/hr)	Location	Power
Gas Decay TK Valve Gallery									
1 & 2	21WR-3647A	.4	GM Tube (11.5.2.5.1)	$10^{-1}-10^{5}$	10^{2}	±10	10^{2}	Plant	*
1 & 2	21WR-3647B	.4	"	"	"	"	"	"	* 10
Reverse Osmosis Module									
East	1WR-3648	.4	"	"	"	"	"	"	*
West	1WR-3649	.4	"	"	"	"	"	"	*
Reverse Osmosis FD Module									
1 & 2	21WR-3650	.4	"	"	"	"	"	"	*
3 & 4	43WR-3650	.4	"	"	"	"	"	"	*
Floor Drain Tank									
1 & 2A	21WR-3651A	.4	"	"	"	"	"	"	*
3 & 4A	43WR-3651A	.4	"	"	"	"	"	"	*
1 & 2B	21WR-3651B	.4	"	"	"	"	"	"	*
3 & 4B	43WR-3651B	.4	"	"	"	"	"	"	*
WPB Men's Locker Room	1WR-3652A	.4	"	"	"	"	2.5	"	*
WPB Men's Locker Room	1WR-3652B	.4	"	"	"	"	2.5	"	*
WPB Women's Locker Room	1WR-3652C	.4	"	"	"	"	2.5	"	*

*Instrumentation AC Bus

TABLE 12.3.4-2

AIRBORNE RADIATION MONITORS

Description	Tag #	Subsection of 12.3.4.2.8 Described In	Detector Type	Range (µCi/cc)	Sensitivity	Accuracy (%)	Typical High Alarm Setpoints	Location	Power
Containment Atmosphere Leak Detection A			Particulate - (11.5.2.5.8) & Noble Gas - (11.5.2.5.6)	3.6×10^{-12} - 3.6×10^{-7} ; 1×10^{-7} - 5×10^{-3}	8.6×10^{4} CPM/µCi Cs-137 ; 4.4×10^{7} CPM/µCi/cc Xe-133	± 10	3×10^{-12} µCi/cc & 2×10^{-7} µCi/cc	Outside Containment	
Unit 1	1LT-3502A SA	.1	"	"	"	"	"	"	+
Unit 2	2LT-3502A SA	.1	"	"	"	"	"	"	+

10

Description	Tag #	Subsection of 12.3.4.2.8 Described In	Detector Type	Range (µCi/cc)	Sensitivity	Accuracy (%)	Typical High Alarm Setpoints	Location	Power
Containment Atmosphere Leak Detection B									
Unit 1	1LT-3502B SB	.1	"	"	"	"	"	"	+
Unit 2	2LT-3502B SB	.1	"	"	"	"	"	"	+

10

Description	Tag #	Subsection of 12.3.4.2.8 Described In	Detector Type	Range (µCi/cc)	Sensitivity	Accuracy (%)	Typical High Alarm Setpoints	Location	Power
Main Control Rooms Normal Outside Air Intake			Beta Sensitive (11.5.2.5.4)	2×10^{-8} - 2×10^{-3}	1.0×10^{8} CPM/ Ci/cc Kr-85	± 10	2.5 mR/hr	Duct	
Unit 1	1CZ-3504A SA	.2	"	"	"	"	"	"	+
Unit 2	2CZ-3504A SA	.2	"	"	"	"	"	"	+

10

+Instrumentation AC Safety Bus

TABLE 12.3.4-2 (continued)

Description	Tag #	Subsection of 12.3.4.2.8 Described in	Detector Type	Range (µCi/cc)	Sensitivity	Accuracy (%)	Typical High Alarm Setpoints	Location	Power
Main Control Rooms Normal Outside Air Intake			Beta Sensitive (11.5.2.5.4)	2×10^{-8} - 2×10^{-3}	1.0×10^{8} CPM/µCi/cc Kr-85	±10	2.5 mR/hr	Duct	
Unit 1	1CZ-3504B SB	.2	"	"	"	"	"	"	+
Unit 2	2CZ-3504B SB	.2	"	"	"	"	"	"	+
Main Control Room Emerg. Outside Air Intake									
Unit 1	1CZ-3505A SA	.3	"	"	"	"	10 mR/hr	"	+
Unit 2	2CZ-3505A SA	.3	"	"	"	"	"	"	+
Main Control Room Emerg. Outside Air Intake B									
Unit 1	1CZ-3505B SB	.3	"	"	"	"	"	"	+
Unit 2	2CZ-3505B SB	.3	"	"	"	"	"	"	+

+Instrumentation AC Safety Bus

10

10

10

TABLE 12.3.4-2 (continued)

Description	Tag #	Subsection of 12.3.4.2.8 Described In	Detector Type	Range (μCi/cc)	Sensitivity	Accuracy (%)	Typical High Alarm Setpoints	Location	Power	
Main Control Room Emerg. Outside Air Intake C			Beta Sensitive (11.5.2.5.4)	2×10^{-8} - 2×10^{-3}	1.0×10^{8} CPM/μCi/cc Kr-85	±10	10 mR/hr	Duct		
Unit 1	1CZ-3505A2 SA	.3	"	"	"	"	"	"	+	10
Unit 2	2CZ-3505A2 SA	.3	"	"	"	"	"	"	+	10
Main Control Room Emerg. Outside Air Intake D										
Unit 1	1CZ-3505B2 SB	.3	"	"	"	"	"	"	+	10
Unit 2	2CZ-3505B2 SB	.3	"	"	"	"	"	"	+	10

+Instrumentation AC Safety Bus

TABLE 12.3.4-2 (continued)

Description	Tag #	Subsection of 12.3.4.2.8 Described in	Detector Type	Range (μCi/cc)	Sensitivity	Accuracy (%)	Typical High Alarm Setpoints	Location	Power
			Particulate - (11.5.2.5.4) & Iodine - (11.5.2.5.9)	$3.6x10^{-12}$- $3.6x10^{-7}$ $6.2x10^{-12}$- $6.5x10^{-5}$	$8.6x10^4$CPM/μCi Cs-137 $1.0x10^5$CPM/μCi I-131	±10	$3x10^{-11}$μCi/cc & $2x10^{-10}$μCi/cc	Outside Containment	
Hot Machine Shop Vent	1AV-3533	.4	"	"	"	"	"	"	*
WPB HP Calibration Room	1WV-3548	.4	"	"	"	"	"	"	*
FHB Operating Floor	1AV-3549	.4	"	"	"	"	"	"	*
WPB Control Room	1AV-3550	.4	"	"	"	"	"	"	*
Volume Reduction System	1WV-3551	.4	"	"	"	"	"	"	*
Solidification System	1WV-3552	.4	"	"	"	"	"	"	*
WPB Personnel Handling Facility	1WV-3553	.4	"	"	"	"	"	"	*
Hot Lab	1WV-3554	.4	"	"	"	"	"	"	*

*Instrumentation AC Bus

REFERENCES: SECTION 12.3

12.3.1-1 Design, Inspection, Operation, and Maintenance Aspects of the W NSSS to Maintain Occupational Radiation Exposures ALARA, WCAP-8872, April 1977.

12.3.2-1 Rockwell, T., "Reactor Shielding Design Manual," USAEC Report 7004, 1956.

12.3.2-2 ISOSHLD, "Kernel Integration Code, General Purpose Isotope Shielding Analysis," CCC-79, Oak Ridge RSIC, 1973.

12.3.2-3 SPAN-4, "A Point Kernel Computer Program for Shielding," WAPD-TM-809(L), O.J. Wallace, October 1973.

12.3.2-4 MORSE-CG, "General Purpose Monte Carlo Multigroup Neutron and Gamma-Ray Transport Code with Combinational Geometry," CCC-203, E.A. Straker; Oak Ridge, 1970.

12.3.2-5 Engle, W. W., Jr., "A Users Manual for ANISN: A One Dimensional Discrete Ordinates Transport Code with Anisotropic Scattering", K-1693 (1967). Contained in CCC-254 from the Radiation Shielding Information Center, Oak Ridge National Laboratory.

12.3.2-6 Courtney, J. C., "A Handbook of Radiation Shielding Data," ANS/SD-76/14, July, 1976.

12.3.2-7 Schaeffer, N. M., "Reactor Shielding for Nuclear Engineers," TID-25951, 1973.

12.3.2-8 DiNunno, Anderson, Bales, and Anderson "Calculation of Distance Factors for Power and Test Reactor Sites," TID-14844, Atomic Energy Commission, March 23, 1962.

12.3.2-9 TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations, NUREG-0578, U.S. Nuclear Regulatory Commission, July, 1979. 3

12.3.2-10 Theodore Rockwell III, "Reactor Shielding Design Manual," U.S. AEC, 1956.

12.3.2-11 R. L. Engle, J. Greenberg, M. M. Hendrickson, "ISOSHLD - A Computer Code for General Purpose Isotope Shielding Analysis", BNWL-236, 1966.

12.3.2-12 Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment, NUREG-0588 U.S. Nuclear Regulatory Commission, August, 1979.

12.3.2-13 Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment, NUREG-0588 Rev. 1 U.S. Nuclear Regulatory Commission, July, 1981.

REFERENCES: SECTION 12.3 (Continued)

3 12.3.2-14 Clarification of TMI Action Plan Requirements. NUREG-0737 U.S. Nuclear Regulatory Commission, November, 1980.

RADIATION ZONES

LEGEND:

RADIATION DOSE RATE LEVELS
D, EXPECTED NORMAL OPERATION

I < 0.25 m rem/hr

II $0.25 \leq D < 2.5$

III $2.5 \leq D < 5.0$

IV $5.0 \leq D < 100$

V ≥ 100

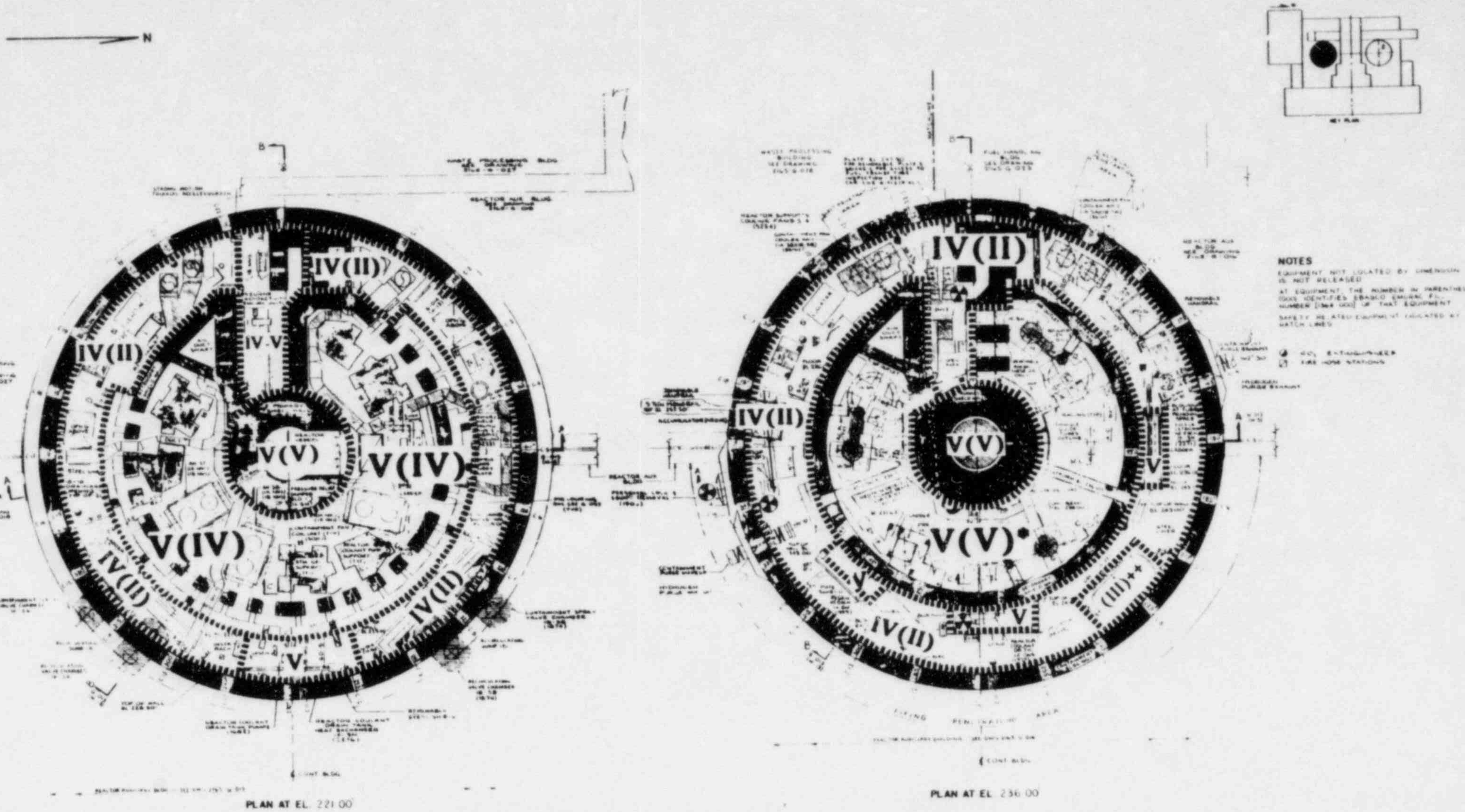
( ) INDICATES AFTER SHUTDOWN

⟷ PATROL ROUTES

☢ AREA RADIATION MONITOR

▪▪▪▪▪▪▪▪▪▪ RADIATION ZONE BOUNDARY

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company FINAL SAFETY ANALYSIS REPORT	RADIATION ZONES LEGEND	FIGURE 12.3.2-1



NOTES:
++ BECOMES V DURING DISCHARGE OF PRESSURIZER SAFETY RELIEF VALVES
( )* LEVEL MAY BE IV AWAY FROM REACTOR COOLANT PIPING

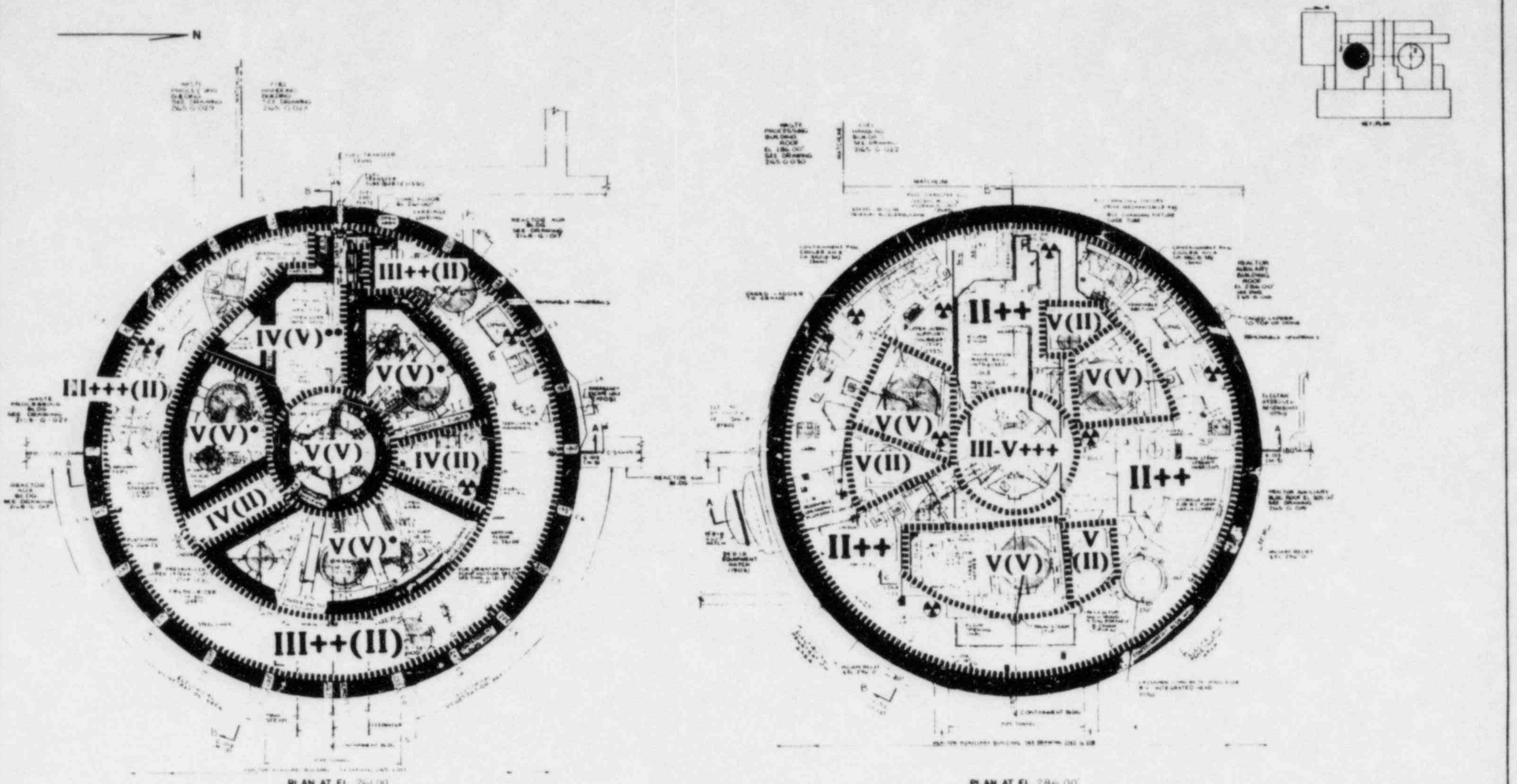
REF DWG: CAR 2165-G-011 (REV 6, OPEN)

Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – CONTAINMENT BLDG
PLAN EL 221.00' AND 236.00'
UNIT 1

FIGURE 12.3.2-2



NOTES:
( )* LEVEL MAY BE IV AWAY FROM REACTOR COOLANT PIPING AFTER SHUTDOWN
( )** DURING REFUELING
++ ASSUME MINIMUM AMOUNT OF AIRBORNE RADIATION. IF EQUIPMENT LEAKAGE OCCURS, SIMULTANEOUSLY WITH FUEL DEFECTS, LEVEL MAY BECOME IV OR V PRIOR TO PURGING. PURGING WILL REDUCE LEVEL TO II
+++ MAY BE III–IV DURING OPERATION, IN LIMITED AREA OVERLOOKING CAVITY CAN BE V

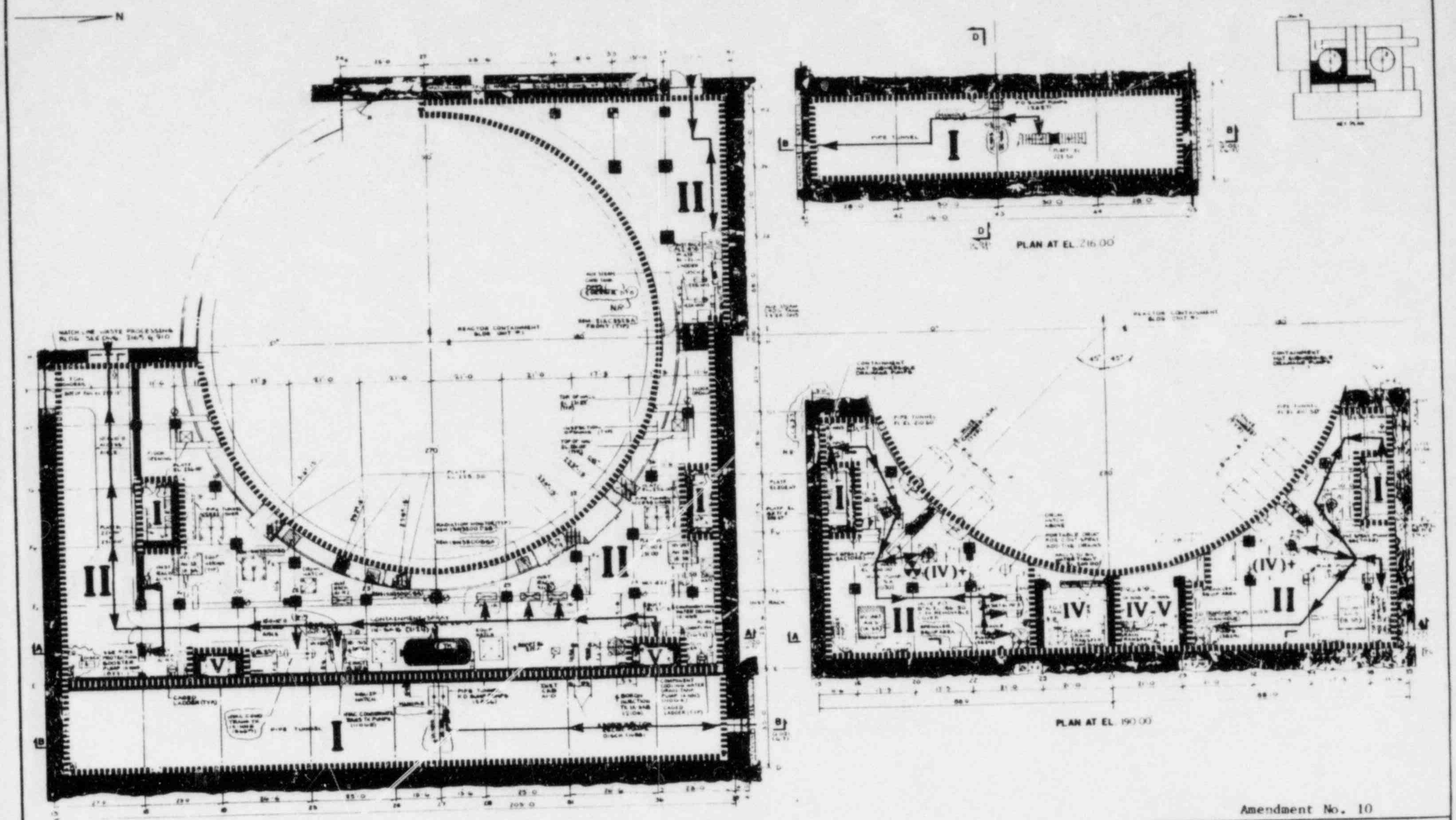
REF DWG: CAR 2165-G-012 (REV 6, OPEN)

Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – CONTAINMENT BLDG
PLAN EL 261.00' AND 286.00'
UNIT 1

FIGURE 12.3.2-3



PLAN AT EL. 216.00'

NOTE:
( )+ MAY BE IV IN PROXIMITY OF RHR PUMPS DURING SHUTDOWN

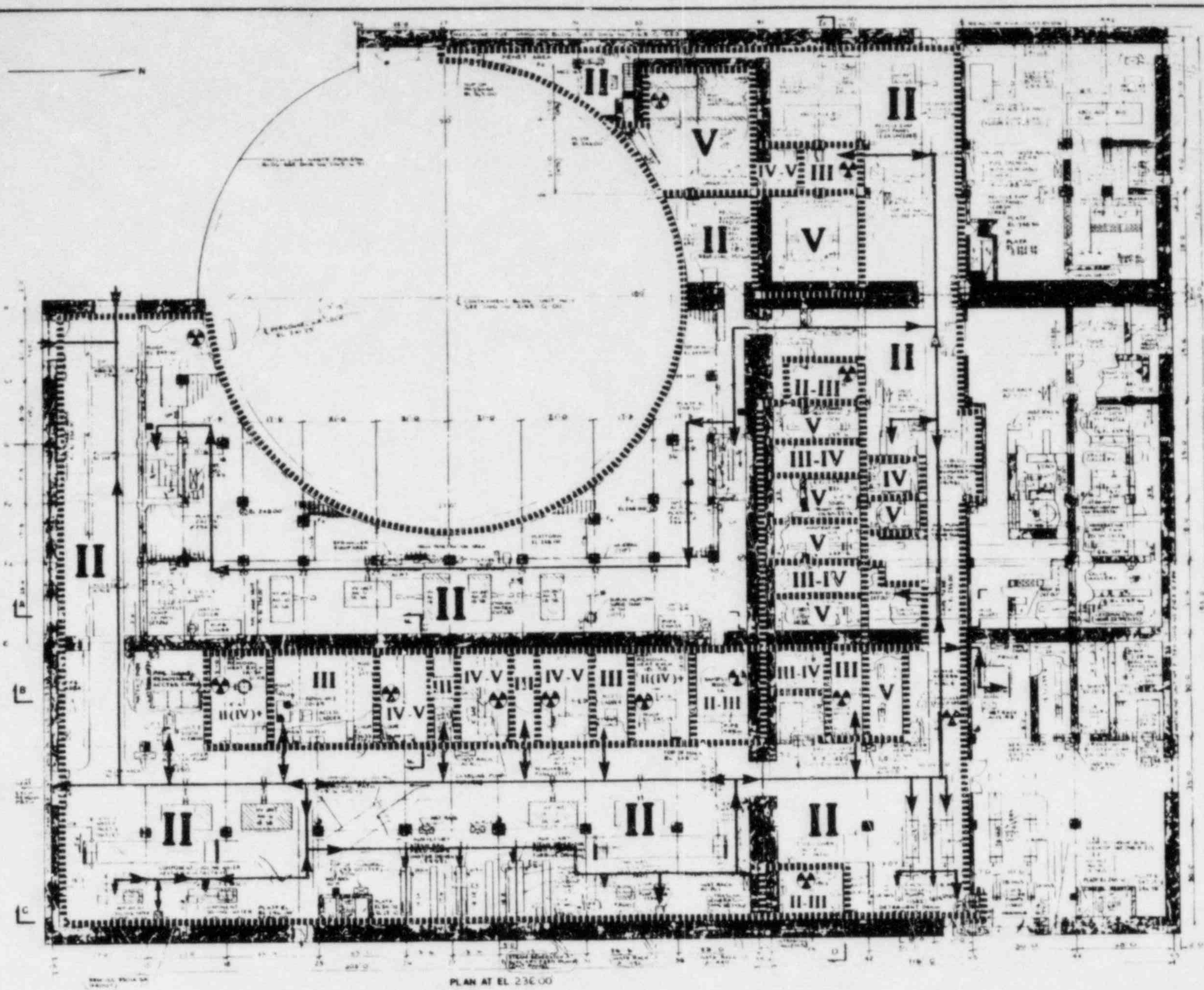
Amendment No. 10

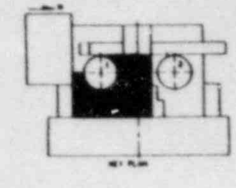
SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – REACTOR AUX BLDG
PLAN EL 190.00' AND 216.00'
UNIT 1

FIGURE 12.3.2-4

REF DWG: CAR 2165-G-015 (REV 8)





NOTES

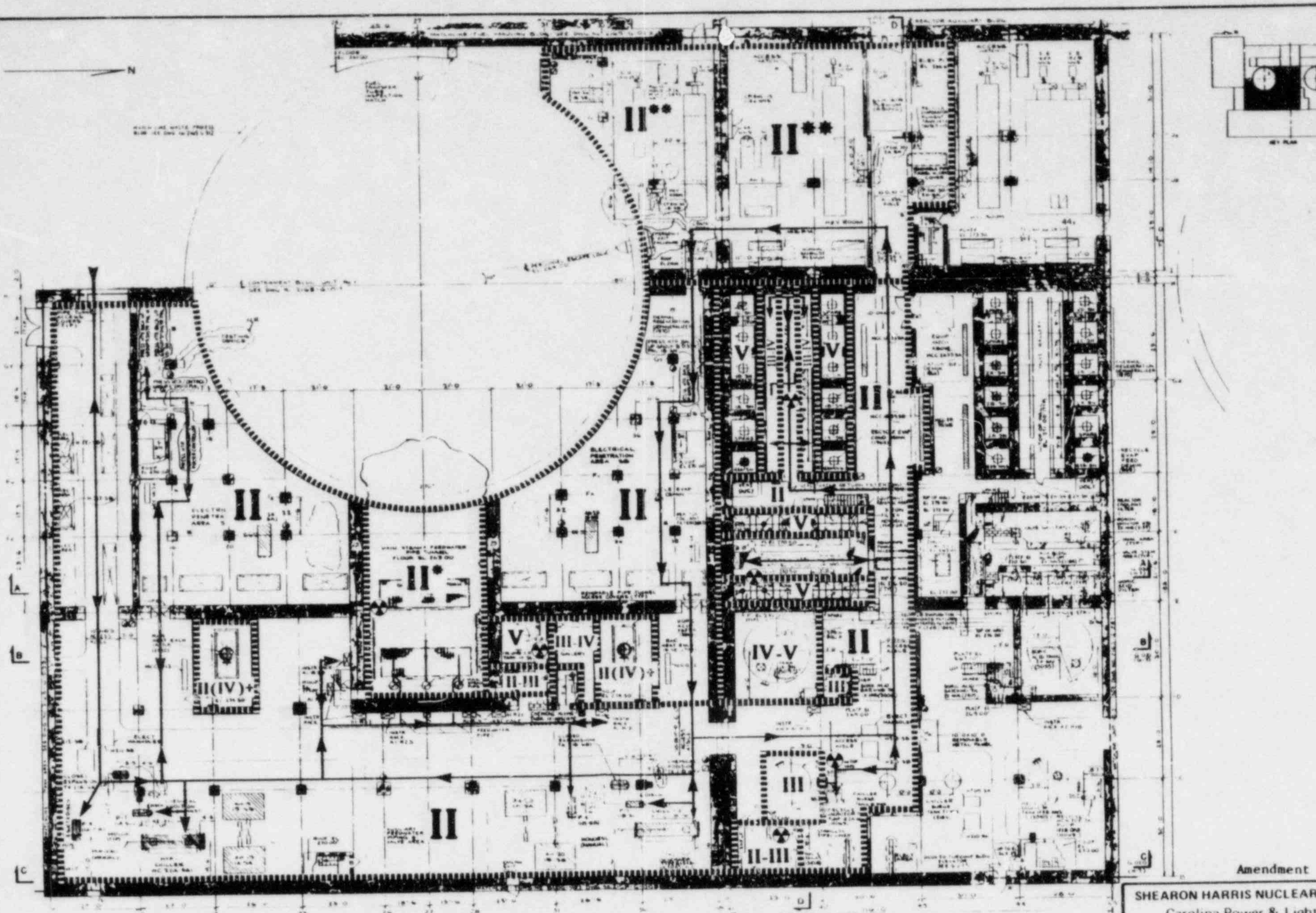
NOTE
( )+ DURING SHUTDOWN

Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – REACTOR AUX BLDG
PLAN EL 236.00' – UNIT 1
FIGURE 12.3.2-5

REF DWG: CAR 2165-G-016 (REV 8)



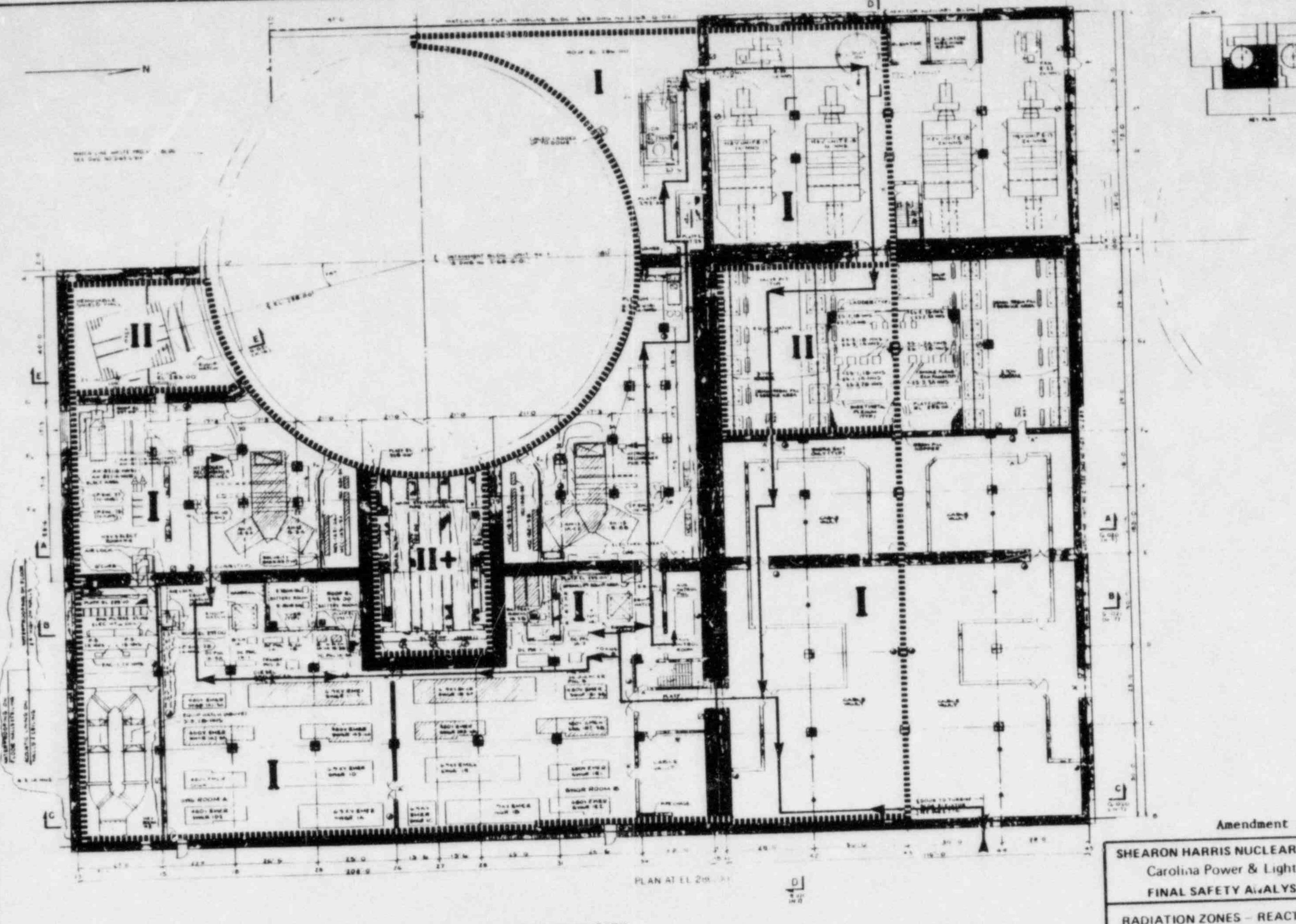
NOTES:
* LEVEL CAN BECOME III OR IV NEAR PIPES IF THERE IS SIGNIFICANT PRIMARY TO SECONDARY LEAKAGE AND FUEL DEFECTS.
** CAN BE III OR IV IN IMMEDIATE VICINITY OF EMERGENCY EXHAUST SYSTEM POST LOCA
( )+ DURING SHUTDOWN

REF DWG: CAR 2165-G 017 (REV 7)

Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – REACTOR AUX BLDG
PLAN EL 261.00' – UNIT 1
FIGURE 12.3.2-6



NOTE:
* LEVEL CAN BECOME III OR IV NEAR PIPES IF THERE IS SIGNIFICANT PRIMARY TO SECONDARY LEAKAGE AND FUEL DEFECTS

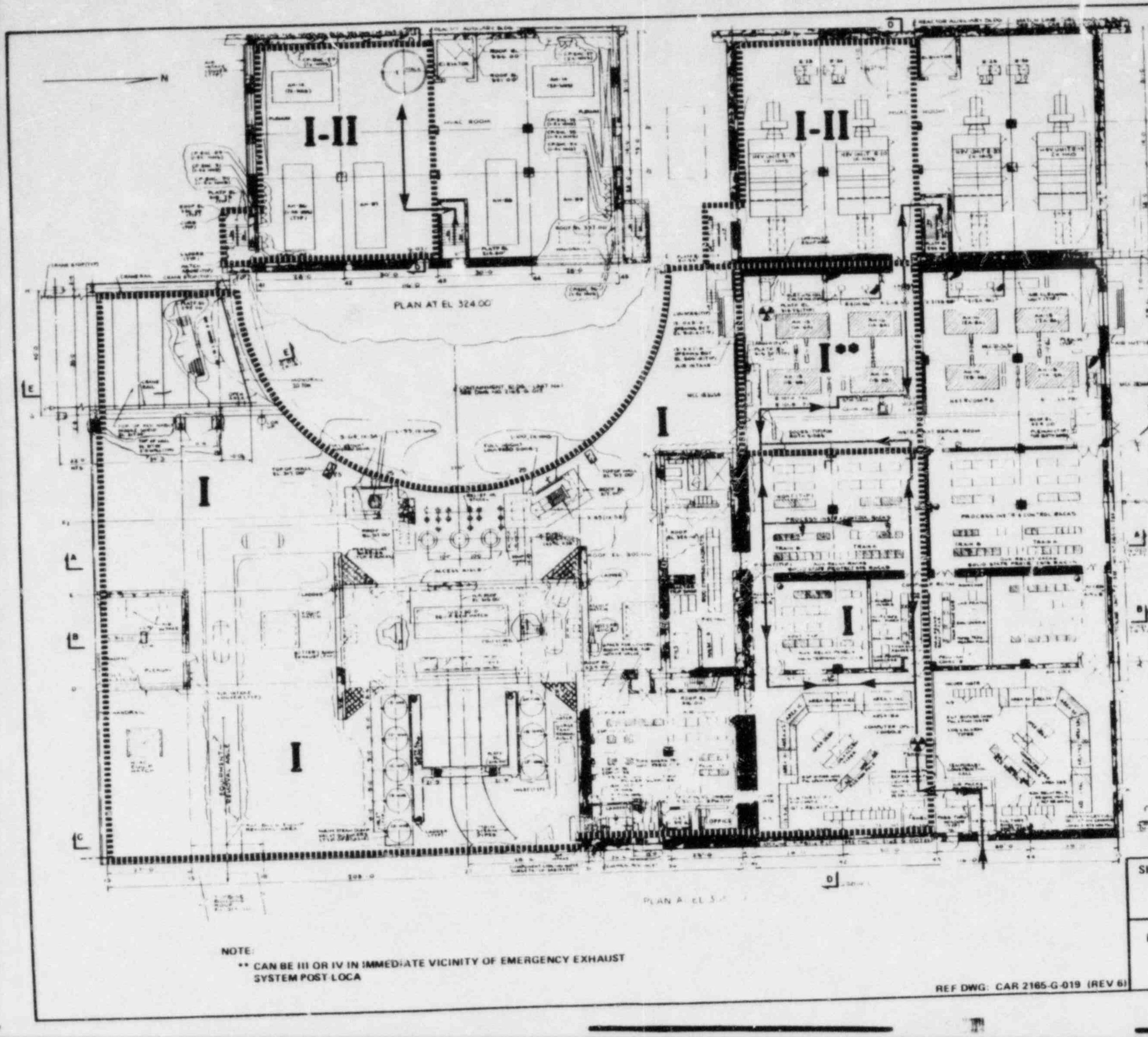
REF DWG: CAR 2165-G-018 (REV 6)

Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – REACTOR AUX BLDG
PLAN EL 286.00' – UNIT 1

FIGURE 12.3.2-7



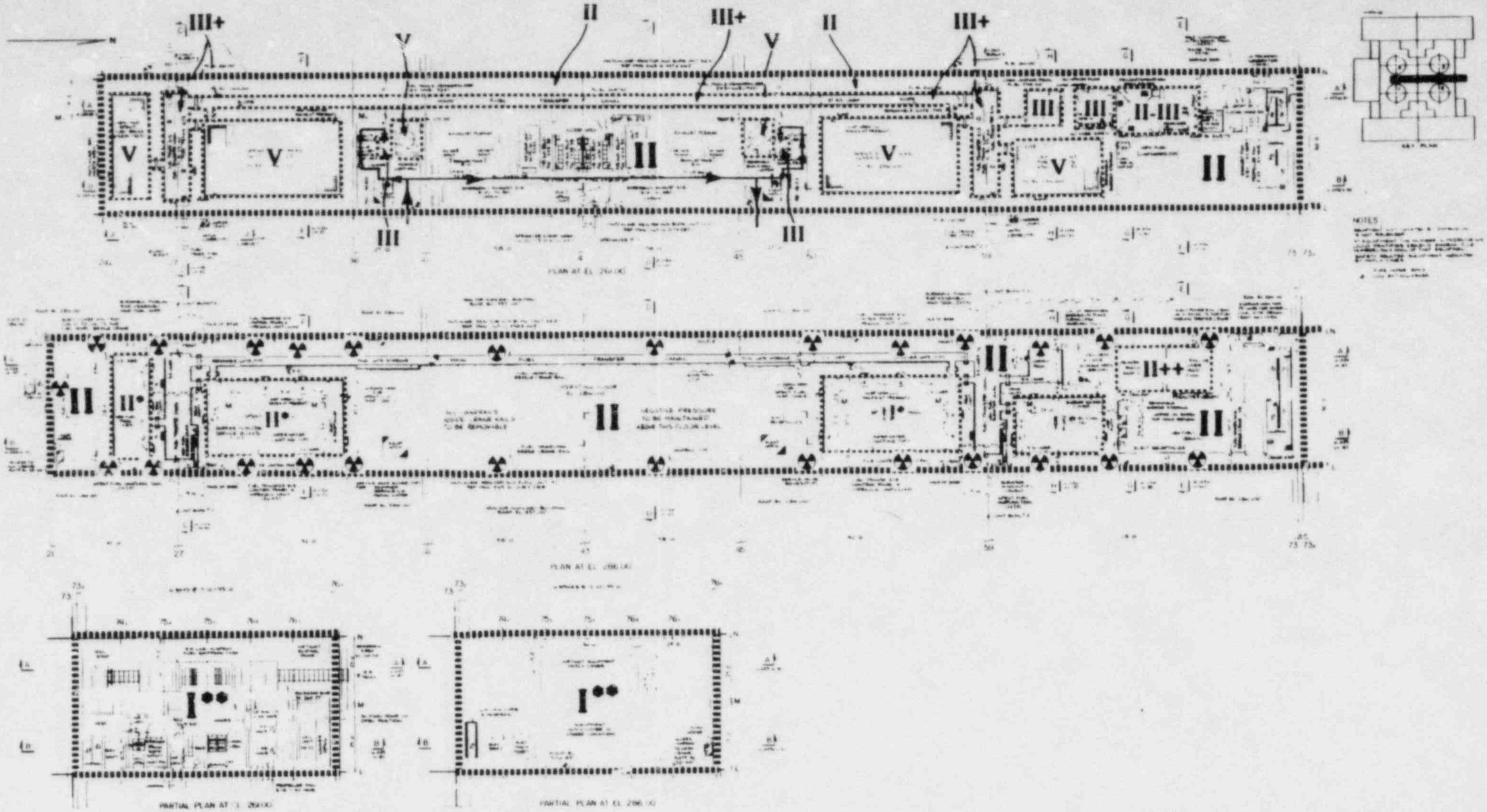
NOTE:
** CAN BE III OR IV IN IMMEDIATE VICINITY OF EMERGENCY EXHAUST SYSTEM POST LOCA

REF DWG: CAR 2165-G-019 (REV 6)

Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – REACTOR AUX BLDG
PLAN EL 305.00' – UNIT 1
FIGURE 12.3.2-8



NOTES:

- \+ WILL BE V DURING FUEL TRANSFER
- ++ MAY BE III IN LIMITED AREAS DURING DECON PROCEDURE
- * MAY BECOME V DURING FUEL HANDLING ACCIDENT
- ** MAY BECOME IV DURING SPENT FUEL SHIPPING CASK TRANSFER IN AND OUT OF RR CAR OR V DURING FUEL HANDLING ACCIDENT

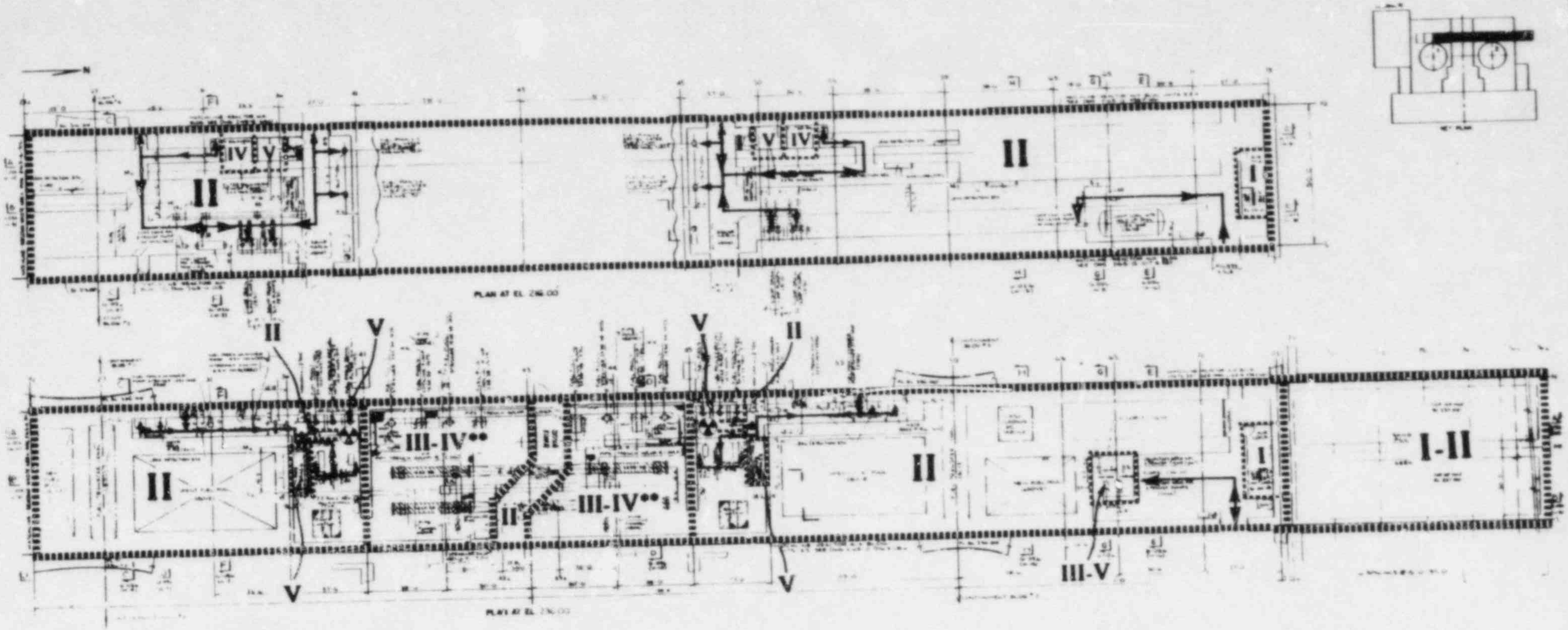
REF DWG: CAR 2165-G-022 (REV 6)

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – FUEL HANDLING BLDG
PLANS – SHEET 1
UNITS 1, 2, 3 AND 4

FIGURE 12.3.2-9



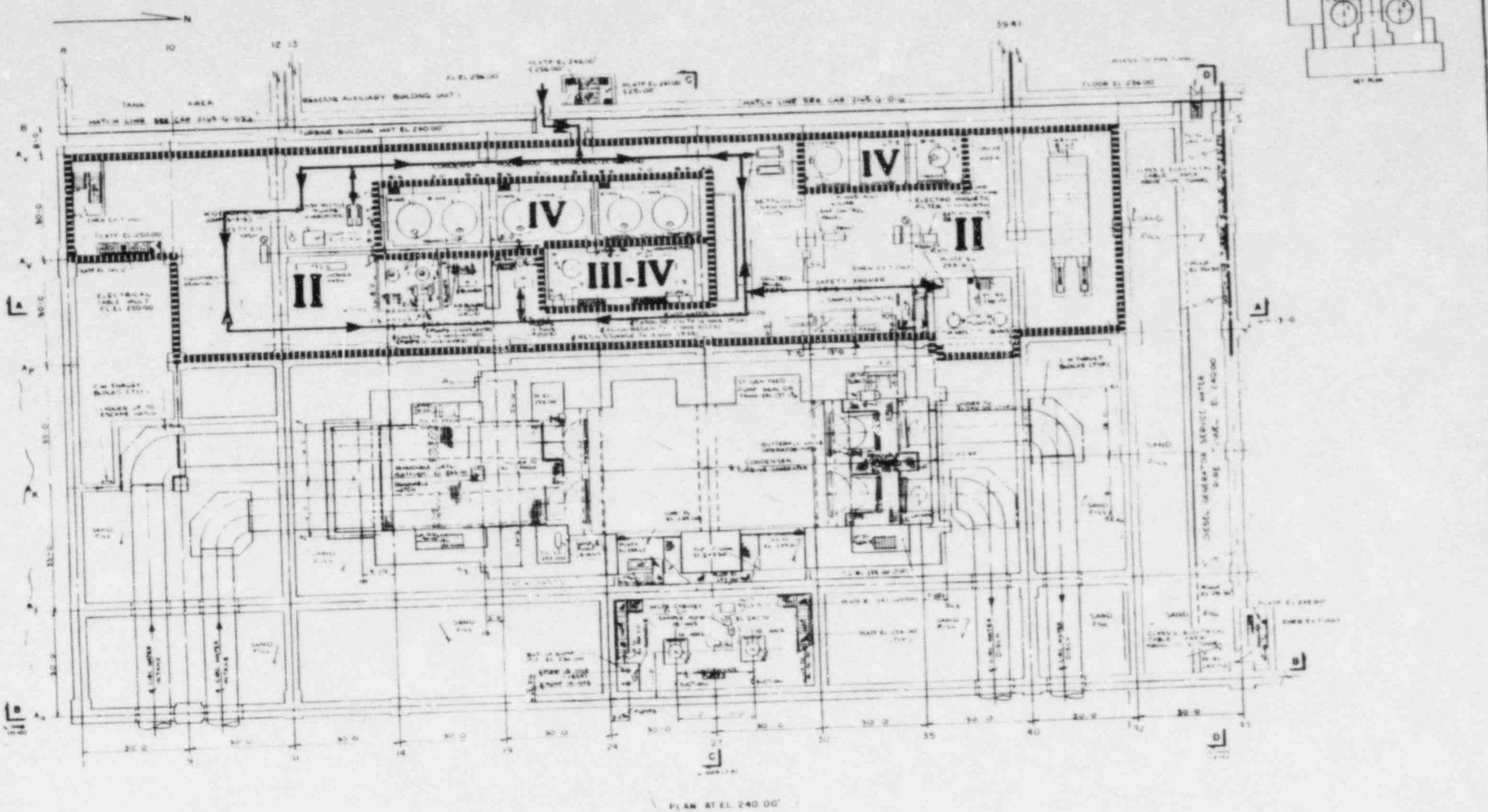
NOTE:
** MAY BECOME V AS CRUD DEPOSITION ACCUMULATES WITH HEAT EXCHANGER AGE

REF DWG: CAR 2165-G-023 (REV 6)

Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – FUEL HANDLING BLDG
PLANS – SHEET 2
UNITS 1 AND 2
FIGURE 12.3.2-10

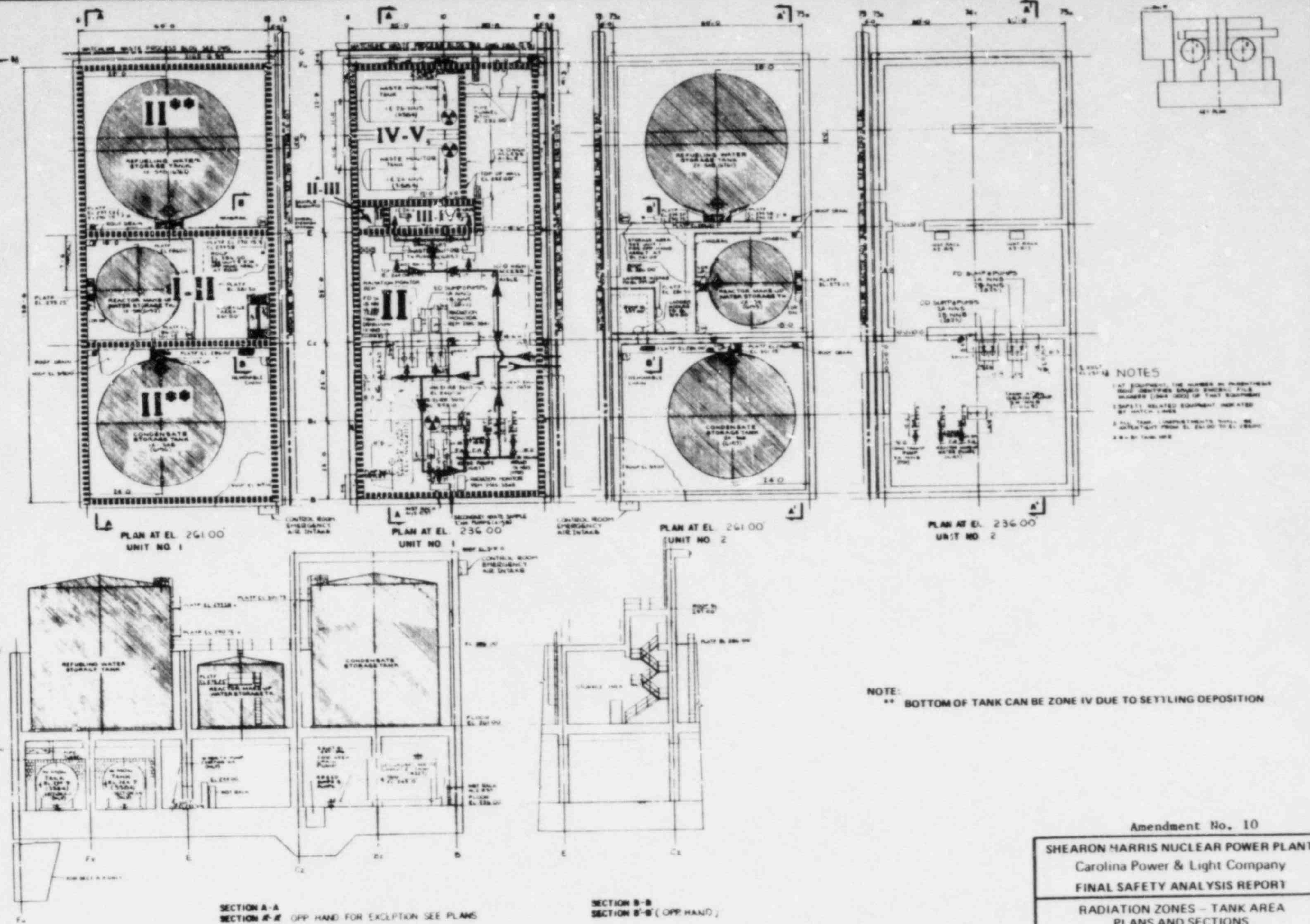


Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – TURBINE BLDG
PLAN AT EL 240.00' – UNIT 1
FIGURE 12.3.2-11

REF DWG: CAR 2165-G-004 (REV 3)



NOTE:
** BOTTOM OF TANK CAN BE ZONE IV DUE TO SETTLING DEPOSITION

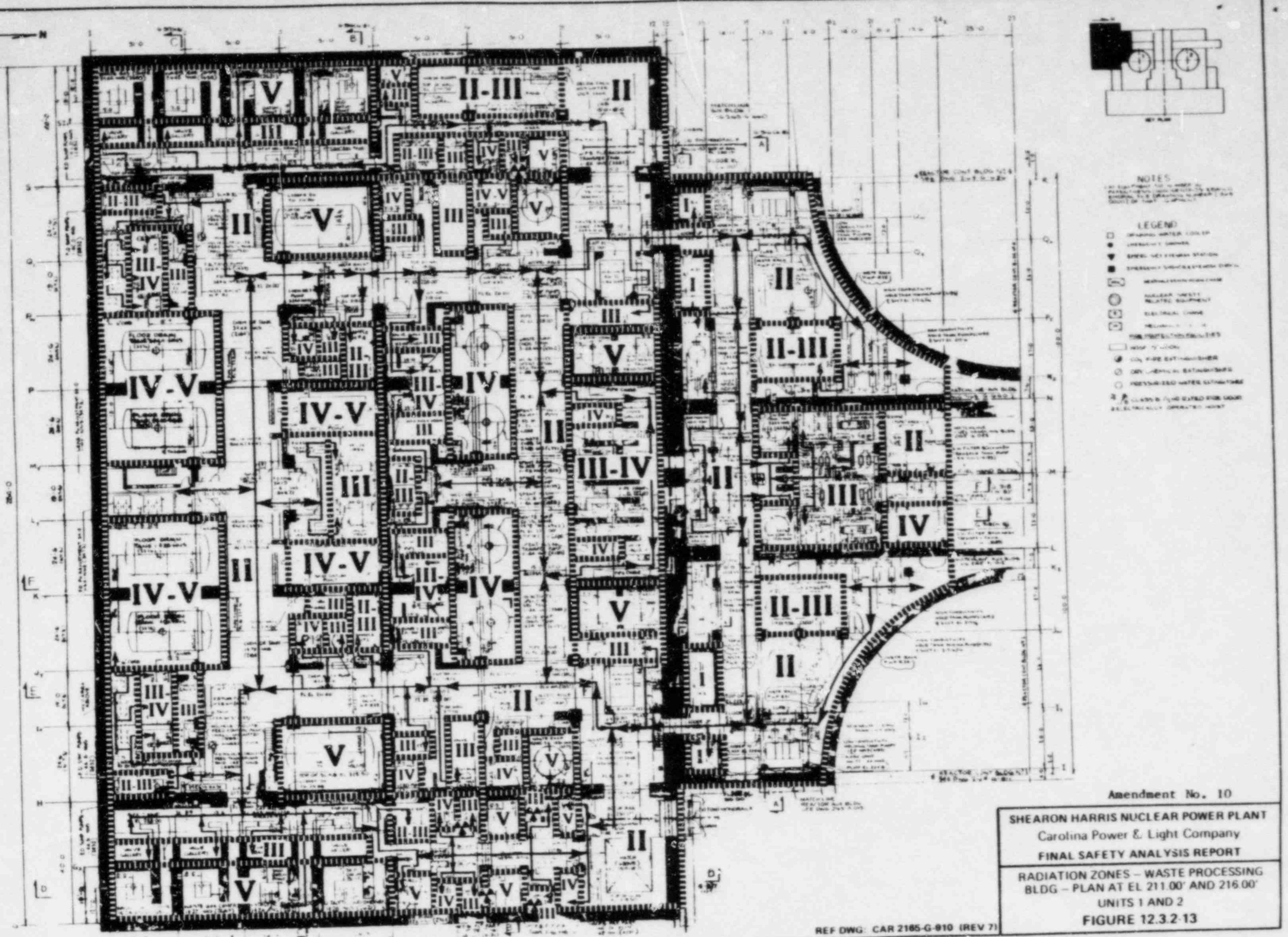
REF DWG: CAR 2165-G-033 (REV 6, OPEN)

Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – TANK AREA
PLANS AND SECTIONS
UNITS 1 AND 2

FIGURE 12.3.2-12

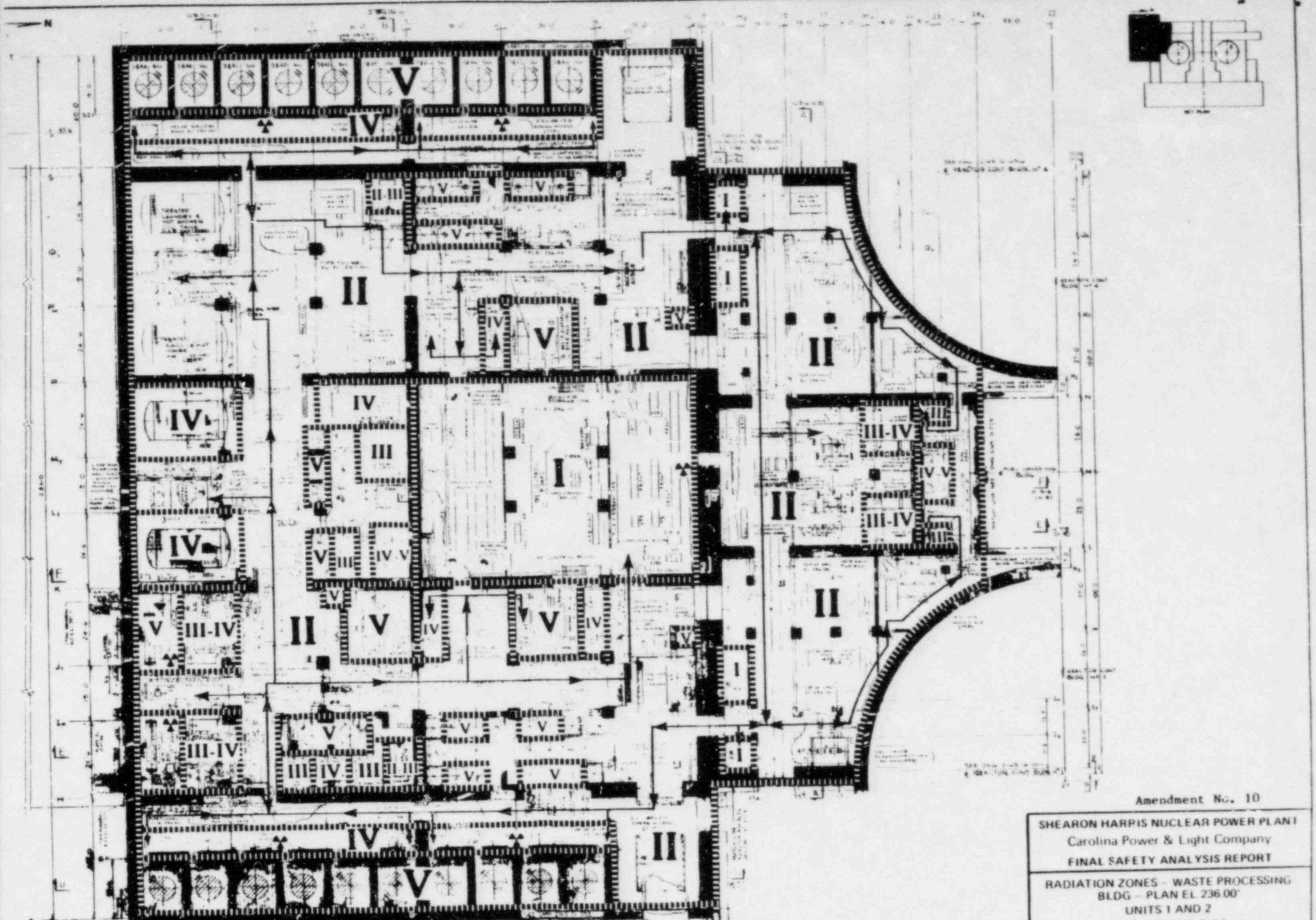


Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – WASTE PROCESSING BLDG – PLAN AT EL 211.00' AND 216.00'
UNITS 1 AND 2

FIGURE 12.3.2-13

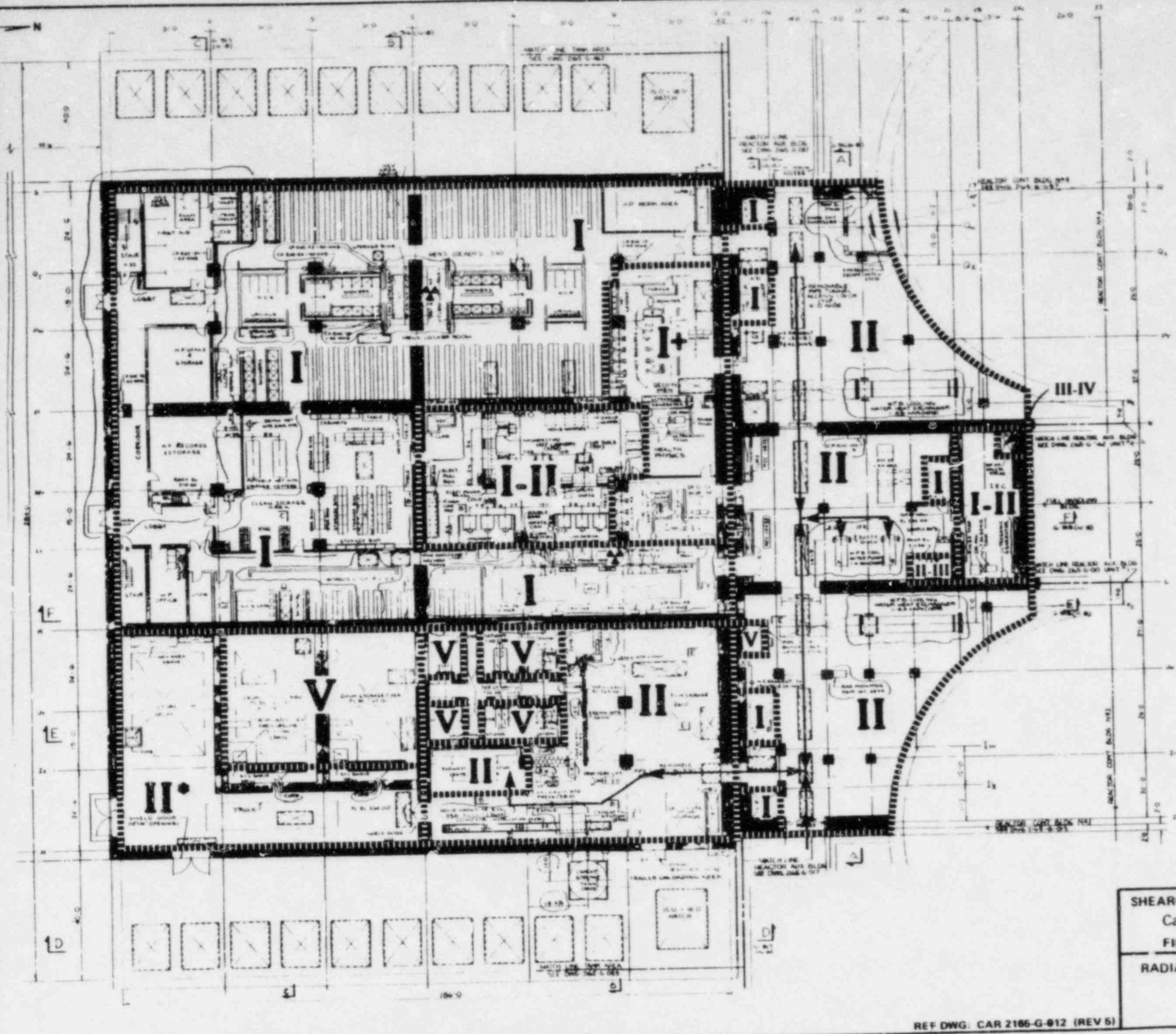


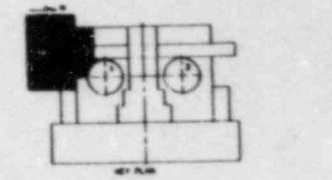
REF DWG CAR 2165-G-911 (REV 7)

Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES - WASTE PROCESSING BLDG - PLAN EL 236.00'
UNITS 1 AND 2
FIGURE 12.3.2-14





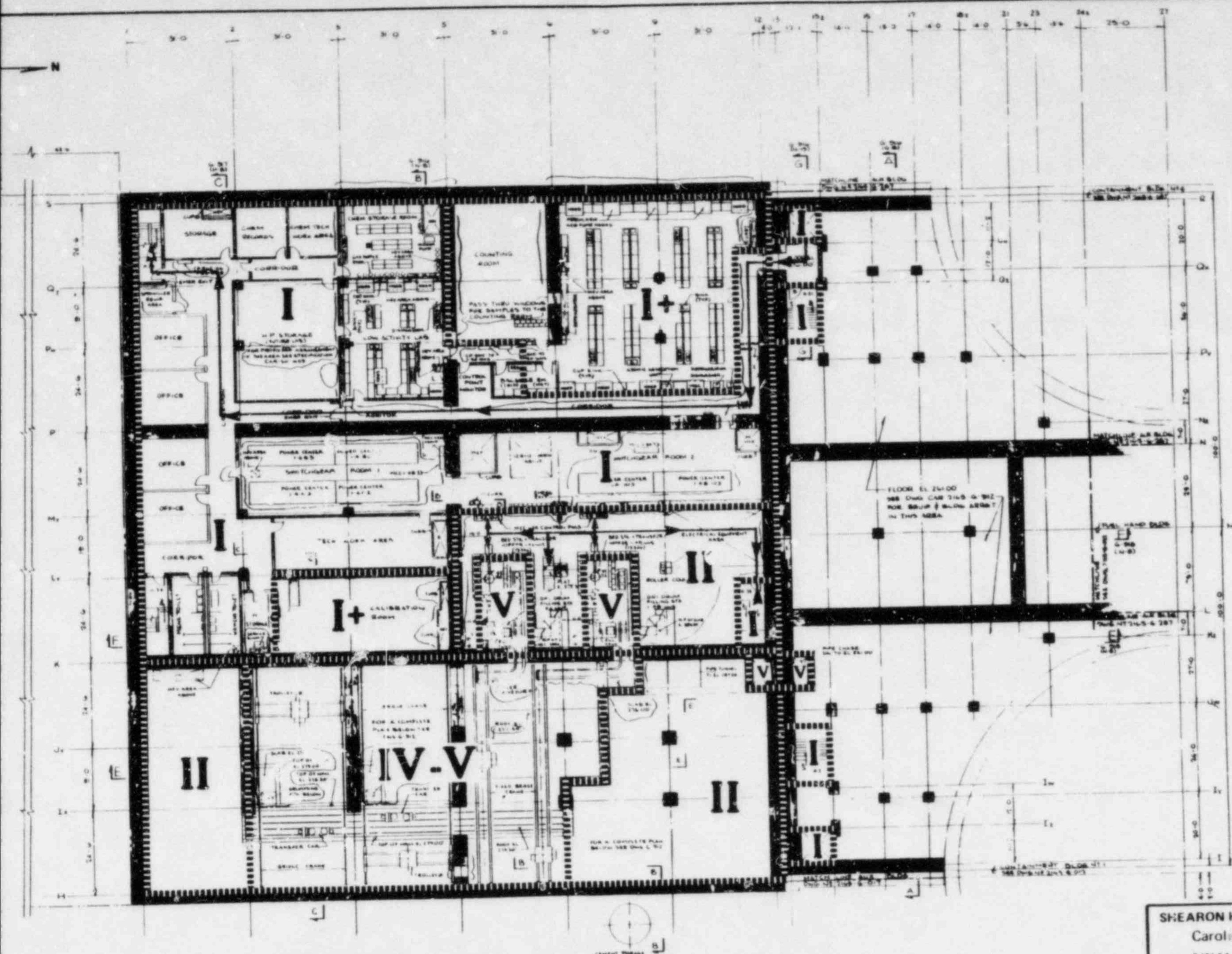
NOTES:
+ MAY BECOME II DURING DECON PROCEDURE
* MAY BECOME IV OR V DURING DRUM TRANSFER

Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – WASTE PROCESSING BLDG – PLAN EL 261.00'
UNITS 1 AND 2
FIGURE 12.3.2-15

REF DWG: CAR 2166-G-012 (REV 5)



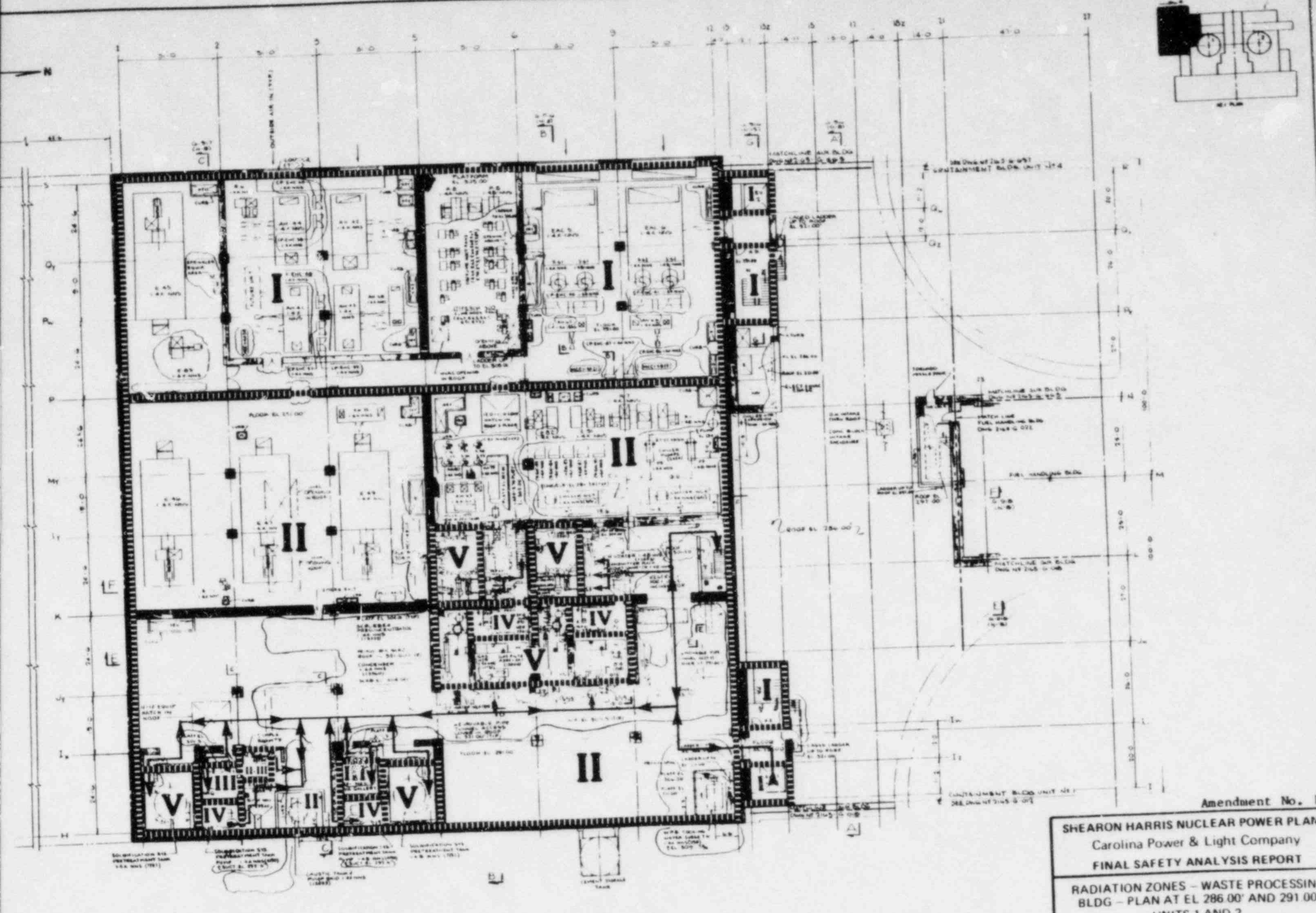
NOTE:
+ CAN BECOME II OR III AT LOCAL SPOTS DUE TO STORAGE OF RADIOACTIVE SAMPLES OR SOURCES

Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – WASTE PROCESSING BLDG – PLAN EL 276.00'
UNITS 1 AND 2
FIGURE 12.3.2-16

REF DWG: CAR 2165-G-913 (REV 5)

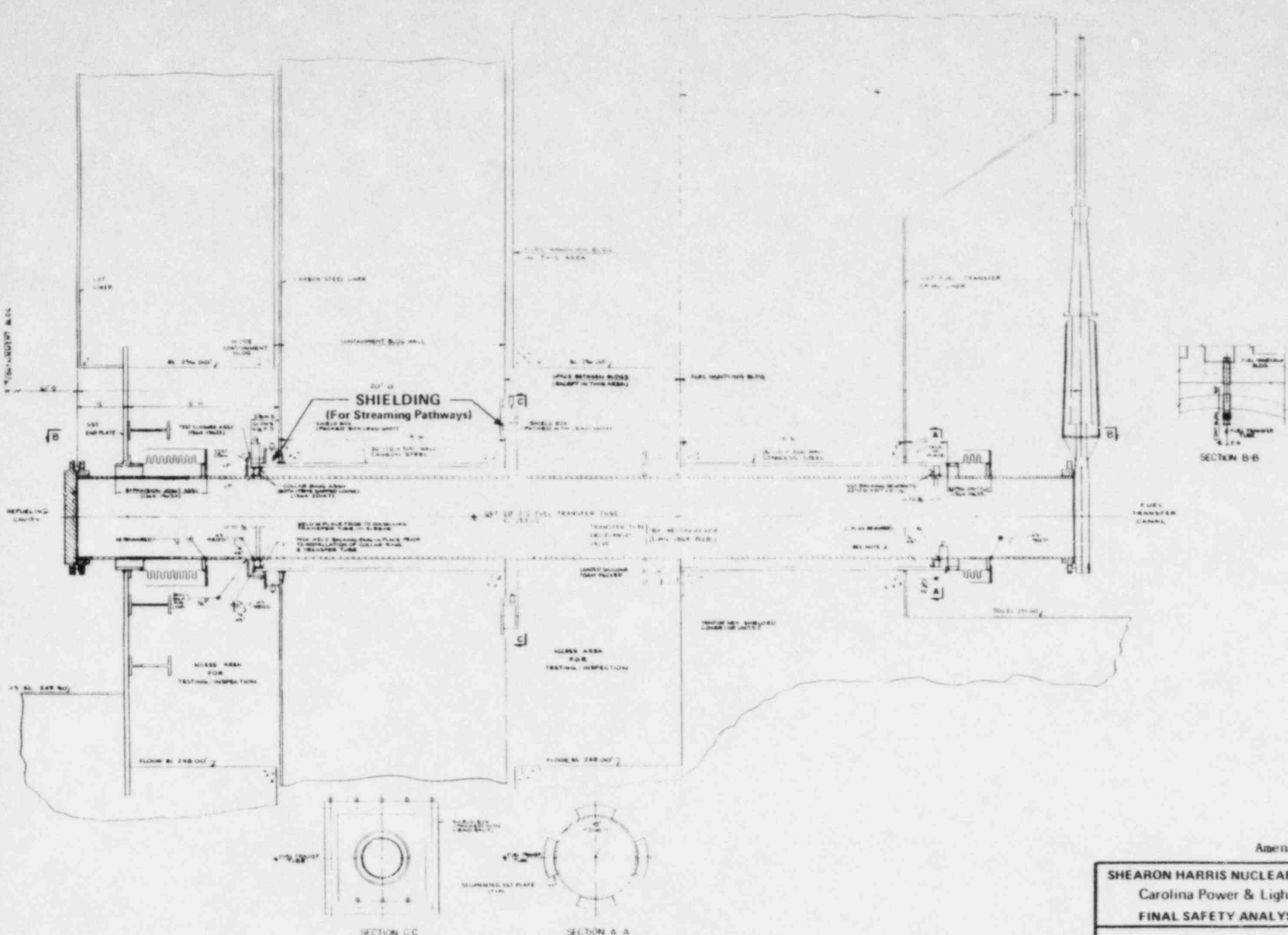


Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

RADIATION ZONES – WASTE PROCESSING BLDG – PLAN AT EL 286.00' AND 291.00'
UNITS 1 AND 2
FIGURE 12.3.2-17

REF DWG: CAR 2165-G-814 (REV 5)



Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT

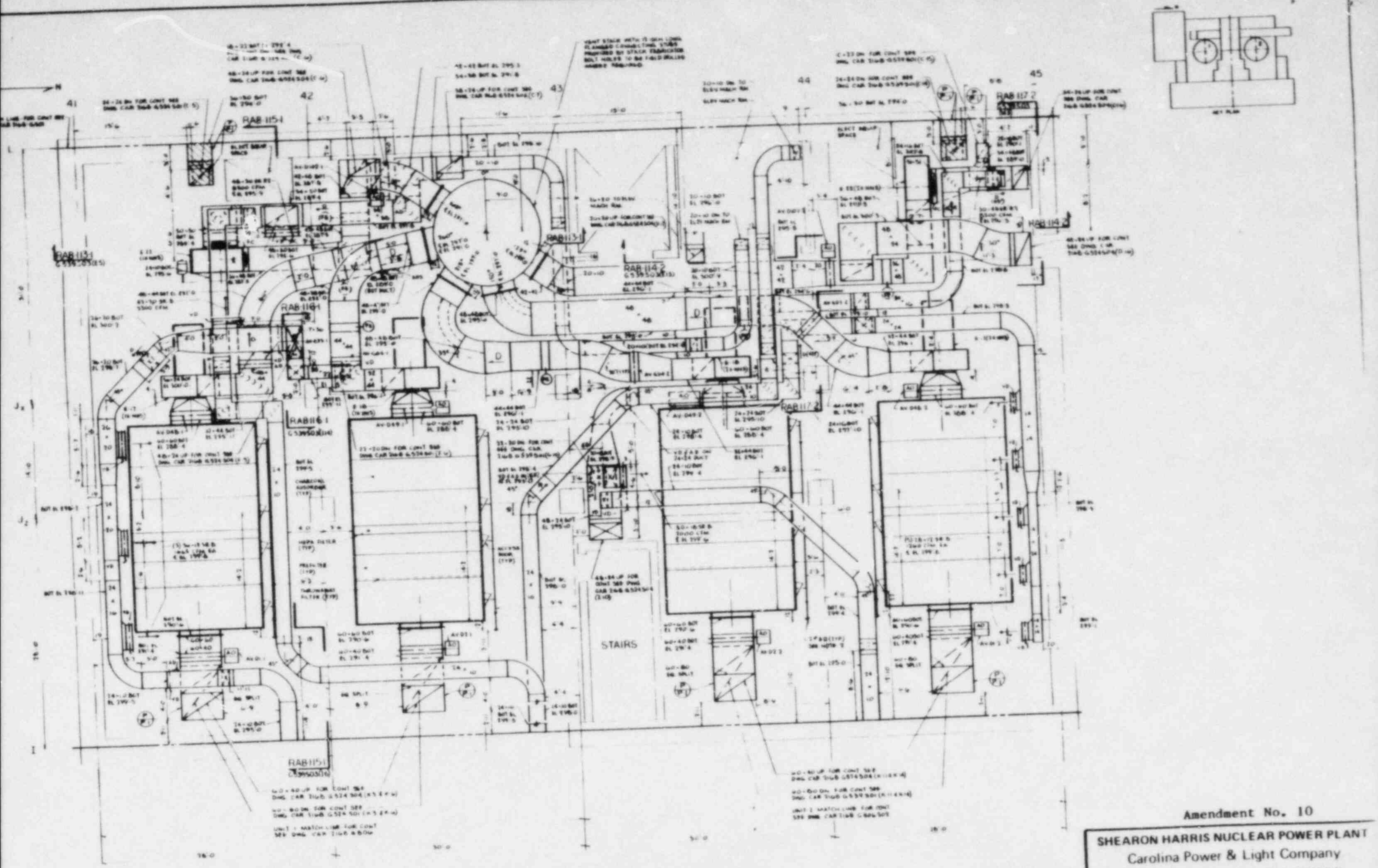
Carolina Power & Light Company

FINAL SAFETY ANALYSIS REPORT

FUEL TRANSFER TUBE
SHIELDING

FIGURE 12.3.2-18

REF DWG: CAR-2165-G-066 (REV. 7)



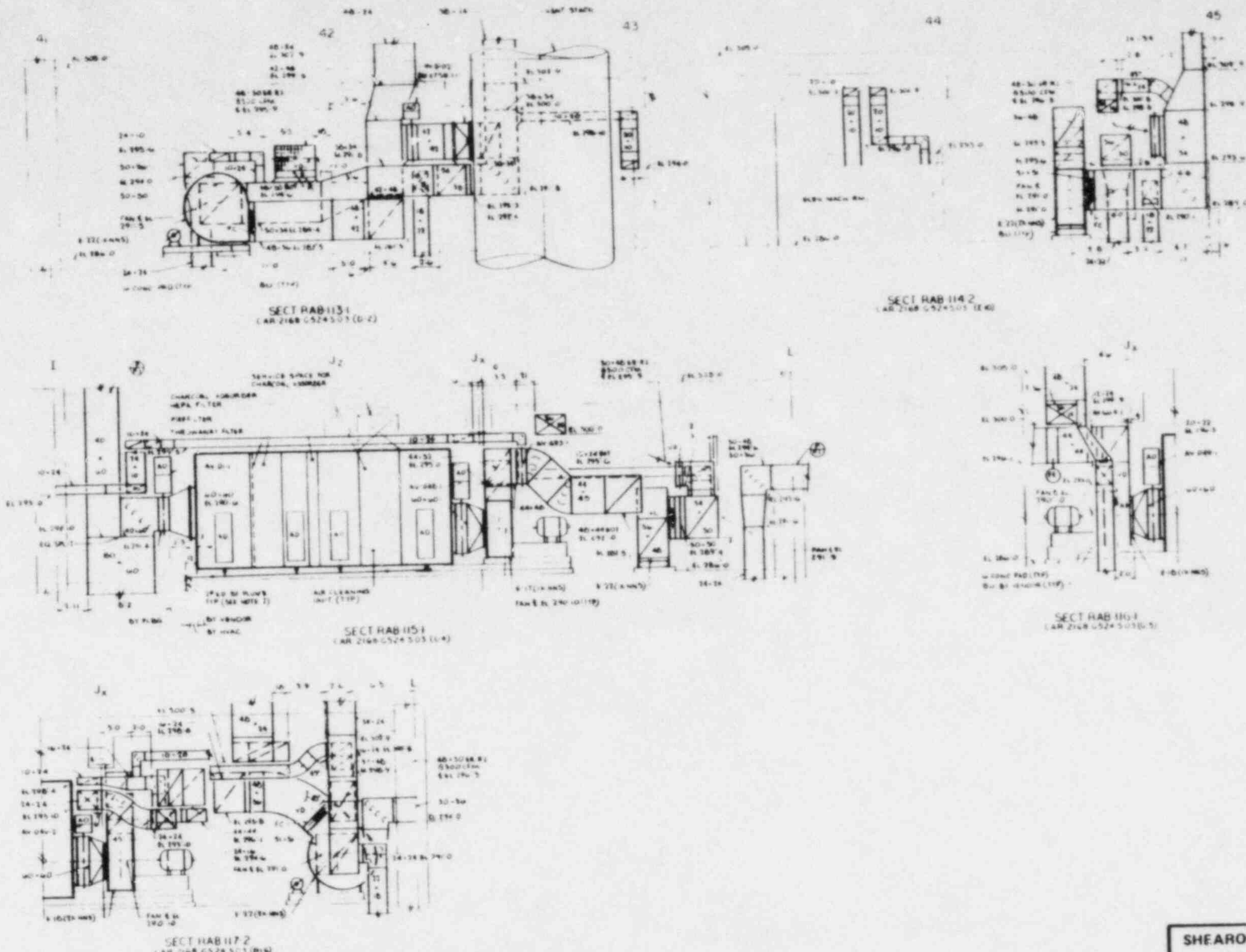
Amendment No. 10

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

HVAC – REACTOR AUXILIARY BUILDING
NORMAL EXHAUST EQUIPMENT ROOM
EL 286.00' – UNITS 1&2

FIGURE 12.3.3-1

REF DWG: CAR 2168-G 524 S03 (REV 1)



REF DWG: CAR 2168-G-539 S03 (REV 1)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

HVAC – REACTOR AUXILIARY BUILDING NORMAL EXHAUST EQUIPMENT ROOM SECTIONS – EL 286.00' – UNITS 1&2

FIGURE 12.3.3-2

DOSE RATE	ACCESSIBILITY	SYMBOL
< 15 MREM/HR	CONTINUOUS ACCESS	- - - - -
15 – 100 MREM/HR	POSSIBLE FREQUENT ACCESS	- - - - - - - - - -
100 MREM/HR – 50 R/HR	POSSIBLE INFREQUENT ACCESS	- - - - - ———
>50 R/HR	NO ACCESS	═══

1 HA ONE HOUR AFTER THE ACCIDENT

1 DA ONE DAY AFTER THE ACCIDENT

1 MA ONE MONTH AFTER THE ACCIDENT

←→ POST-ACCIDENT SAMPLING ANALYSIS ROUTE

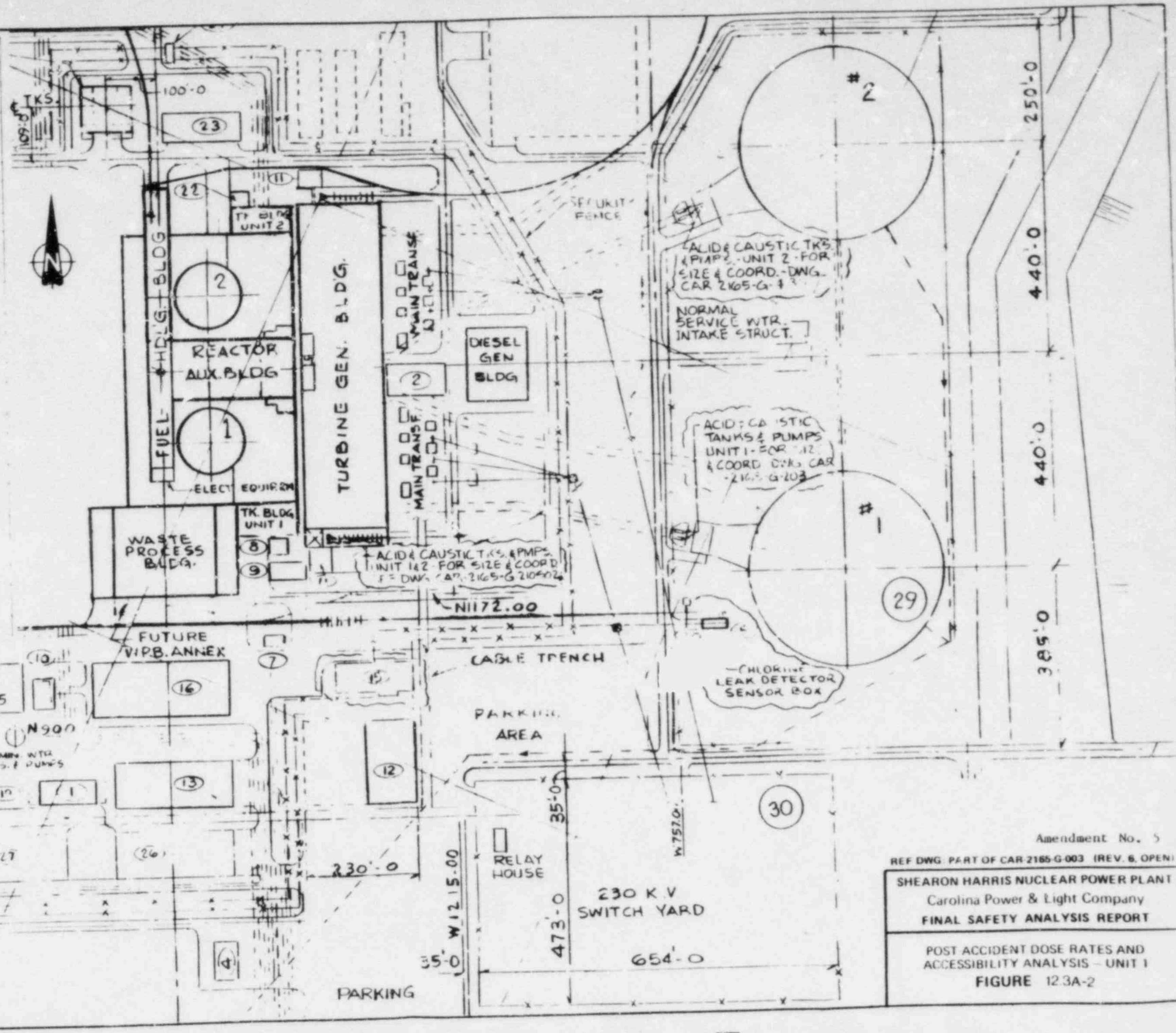
ZONE BOUNDARY

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT Carolina Power & Light Company FINAL SAFETY ANALYSIS REPORT	POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1 LEGEND	FIGURE 12.3A-1

ZONE	DOSE RATE 1 HR	ACCESSIBILITY 1 DA	1 MO
1	20 MREM/HR	8 MREM/HR	0.25 MREM/HR
2	30 MREM/HR	12 MREM/HR	0.25 MREM/HR
7	30 MREM/HR	12 MREM/HR	0.25 MREM/HR
8	50 MREM/HR	20 MREM/HR	0.25 MREM/HR
9	50 MREM/HR	20 MREM/HR	0.25 MREM/HR
12	20 MREM/HR	8 MREM/HR	0.25 MREM/HR
14	20 MREM/HR	8 MREM/HR	0.25 MREM/HR
15	25 MREM/HR	10 MREM/HR	0.25 MREM/HR
16	30 MREM/HR	12 MREM/HR	0.25 MREM/HR
29	10 MREM/HR	4 MREM/HR	0.25 MREM/HR
30	10 MREM/HR	4 MREM/HR	0.25 MREM/HR

NOTE REFER TO LEGEND ON FIGURE 12.3A-1



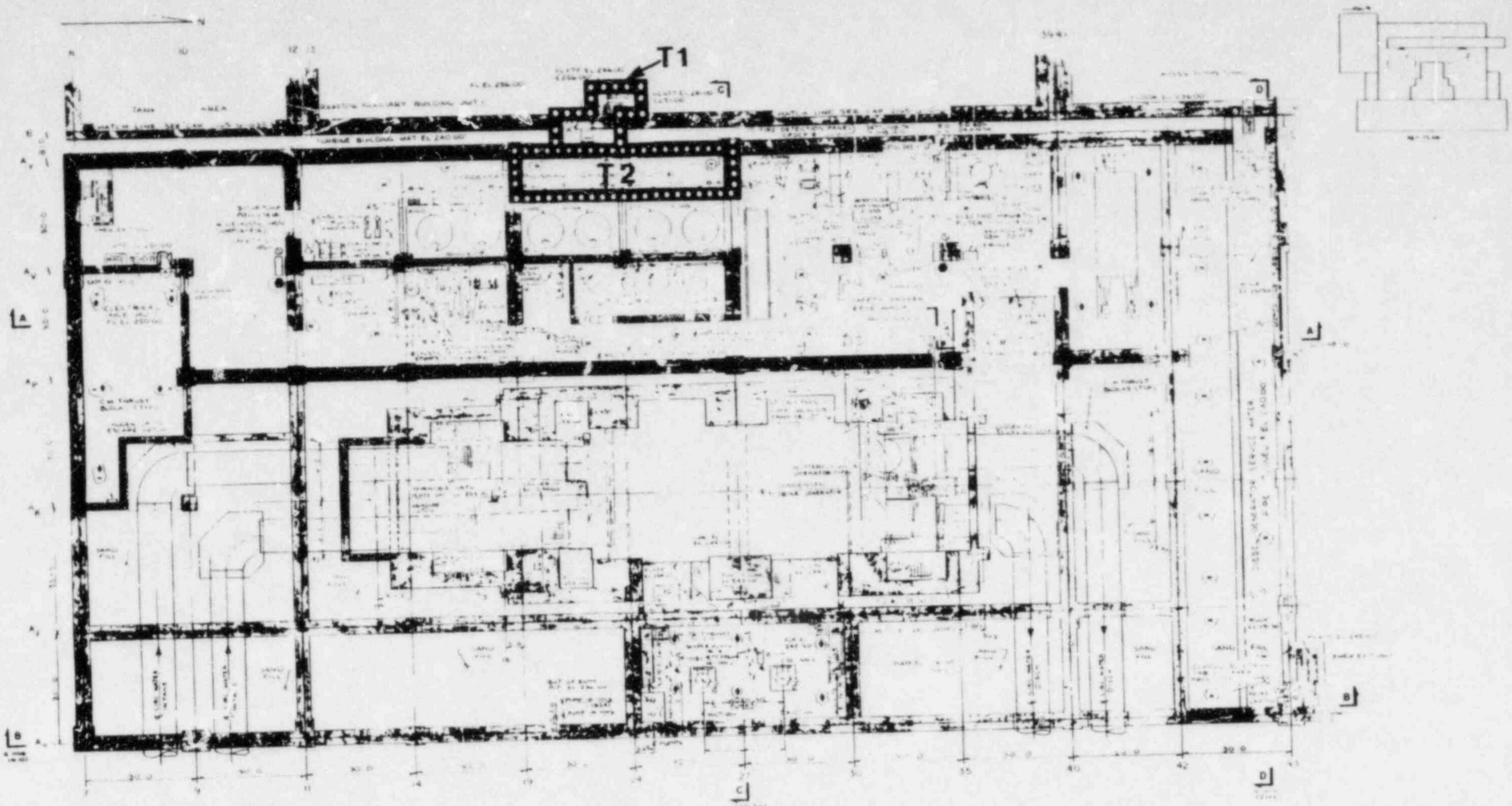
Amendment No. 5

REF DWG PART OF CAR 2165-G-003 (REV. 6, OPEN)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-2



PLAN AT EL 240.00'

TURBINE BUILDING

ZONE	DOSE RATE / ACCESSIBILITY		
	1 HA	1 DA	1 MA
T1	20 – 80 R/HR	200 – 800 MREM/HR	2.5 MREM/HR
T2	200 – 800 MREM/HR	2 – 8 MREM/HR	<0.25 MREM/HR

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

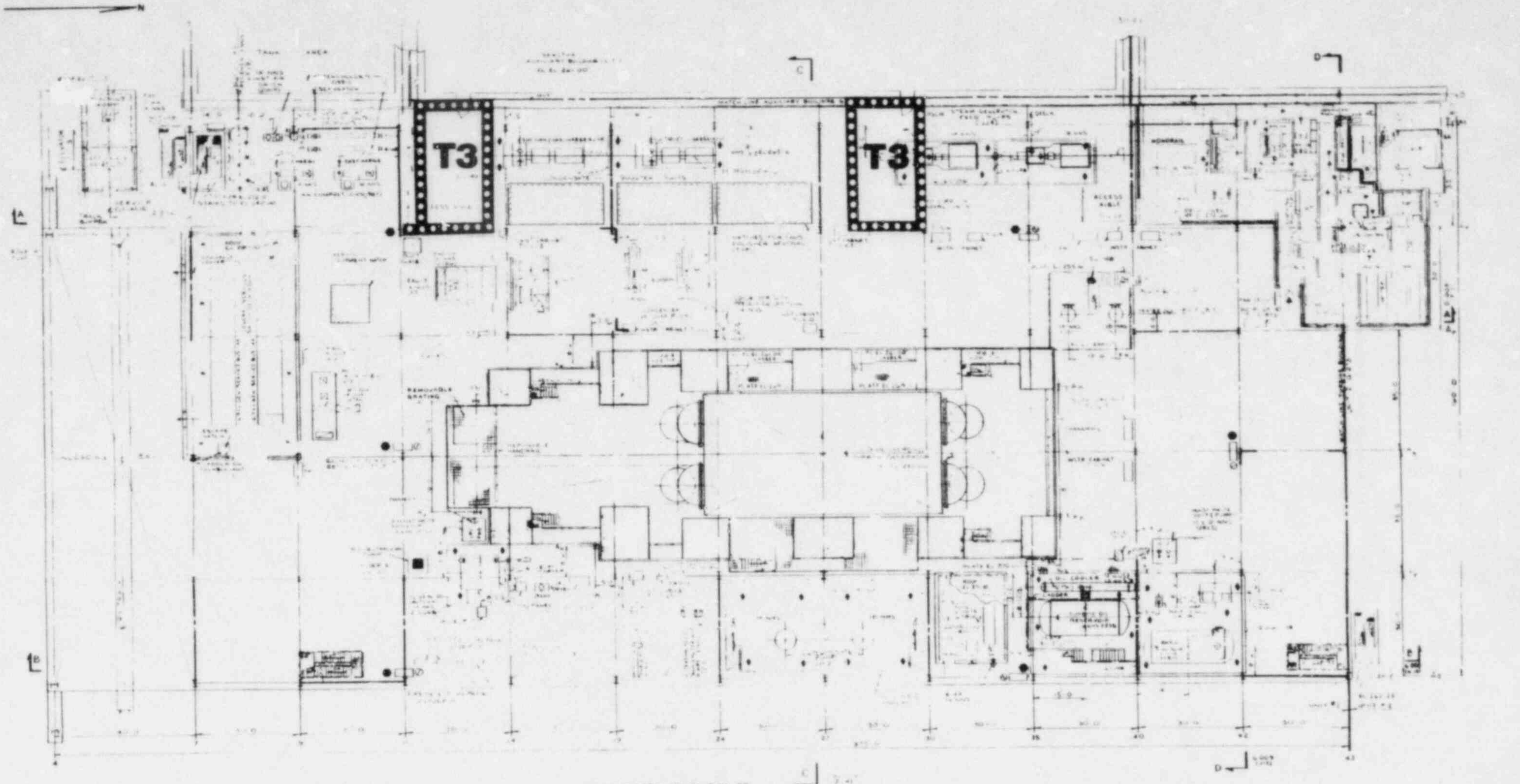
REF DWG: CAR-2165-G-004 (REV. 5)

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

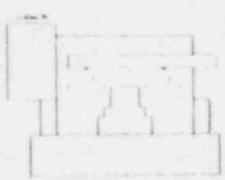
POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-3



GROUND FLOOR PLAN EL 261.00

TURBINE BUILDING



NOTES

ZONE	DOSE RATE / ACCESSIBILITY		
	1 HA	1 DA	1 MA
T3	30 MREM/HR – 10 R/HR	2.5 MREM/HR	<0.25 MREM/HR
	-----	-----	-----

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

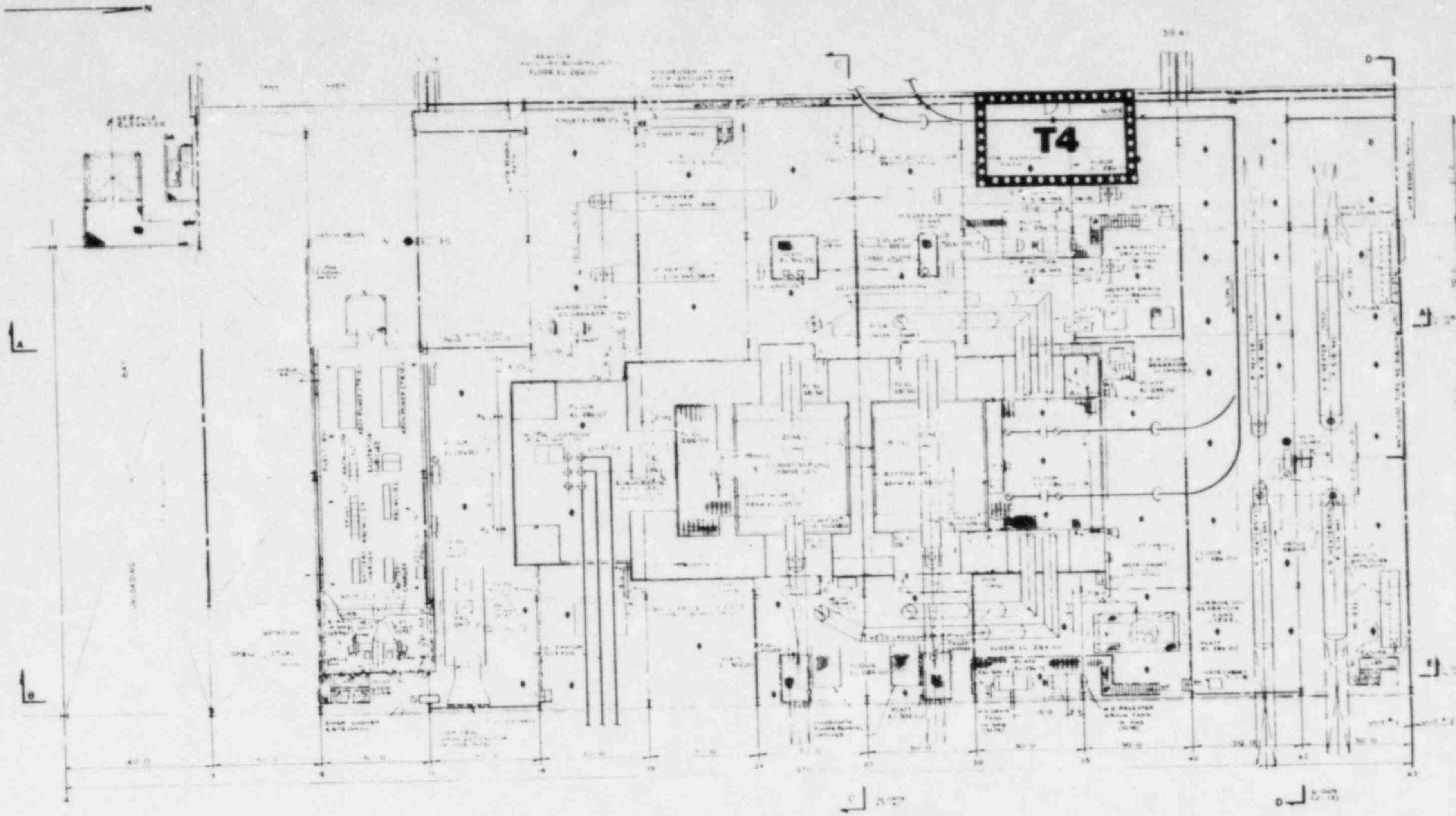
REF DWG: CAR-2165-G-005 (REV. 8, OPEN)

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

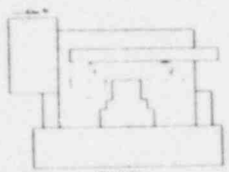
POST ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-4



TURBINE BUILDING

MEZZANINE FLOOR PLAN EL. 286.00'



ZONE	DOSE RATE / ACCESSIBILITY		
	1 HA	1 DA	1 MA
T4	100 – 300 MREM/HR	1 – 5 MREM/HR	<0.25 MREM/HR

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

REF DWG: CAR-2165-G-006 (REV. 7, OPEN)

Amendment No. 5

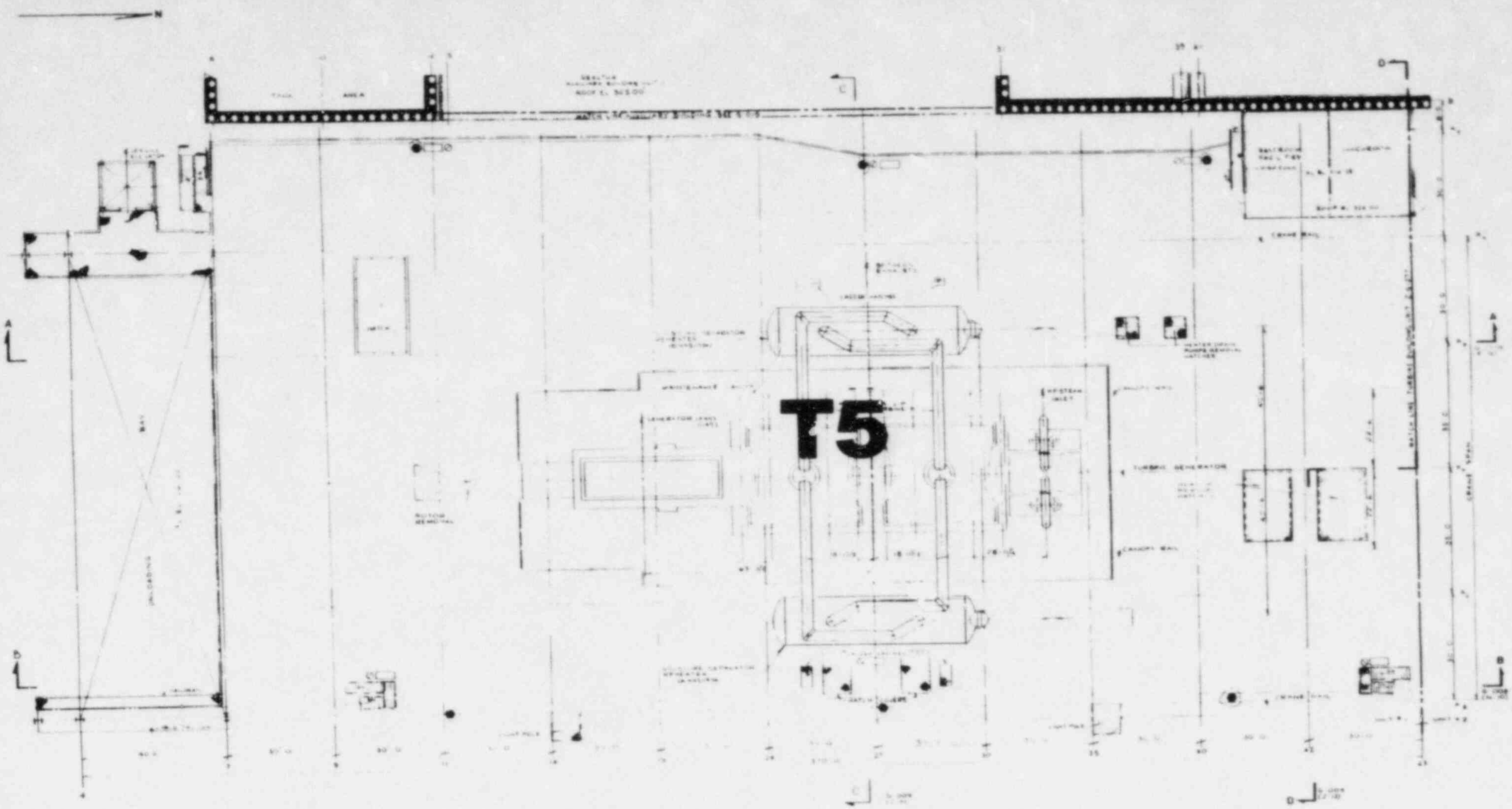
SHEARON HARRIS NUCLEAR POWER PLANT

Carolina Power & Light Company

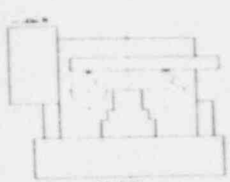
FINAL SAFETY ANALYSIS REPORT

POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-5



OPERATING FLOOR PLAN EL. 314.00
TURBINE BUILDING



ZONE	DOSE RATE / ACCESSIBILITY		
	1 HA	1 DA	1 MA
T5	60 MREM/HR	25 MREM/HR	<0.25 MREM/HR
	----- -----	----- -----	-----

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

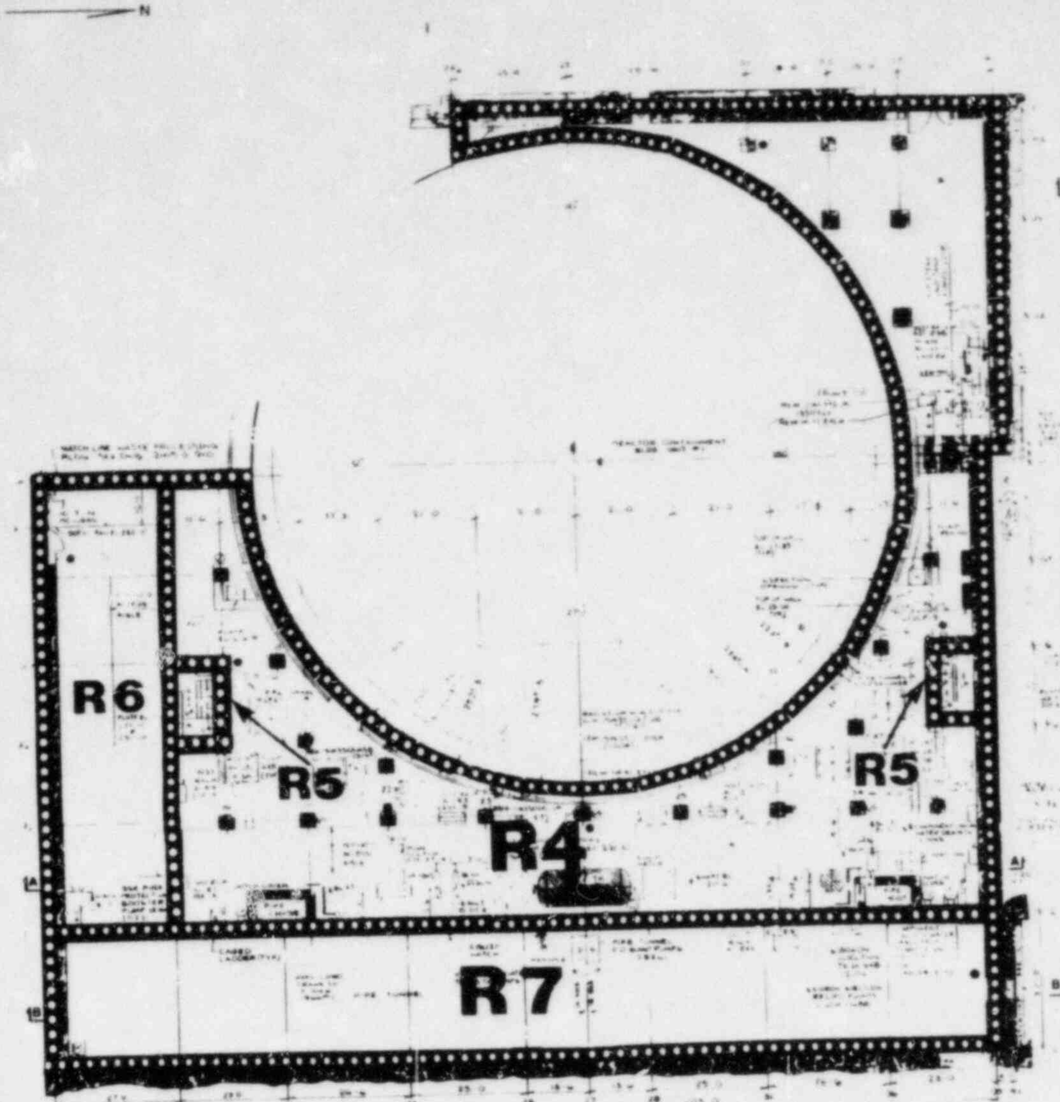
REF DWG. CAR-2165-G-02 (REV. 6)

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

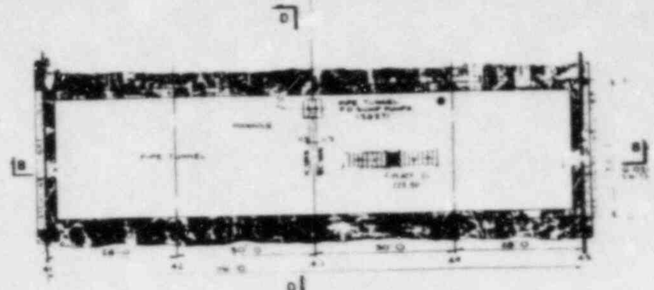
POST ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-6

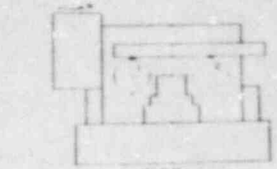


PLAN AT EL. 216.00

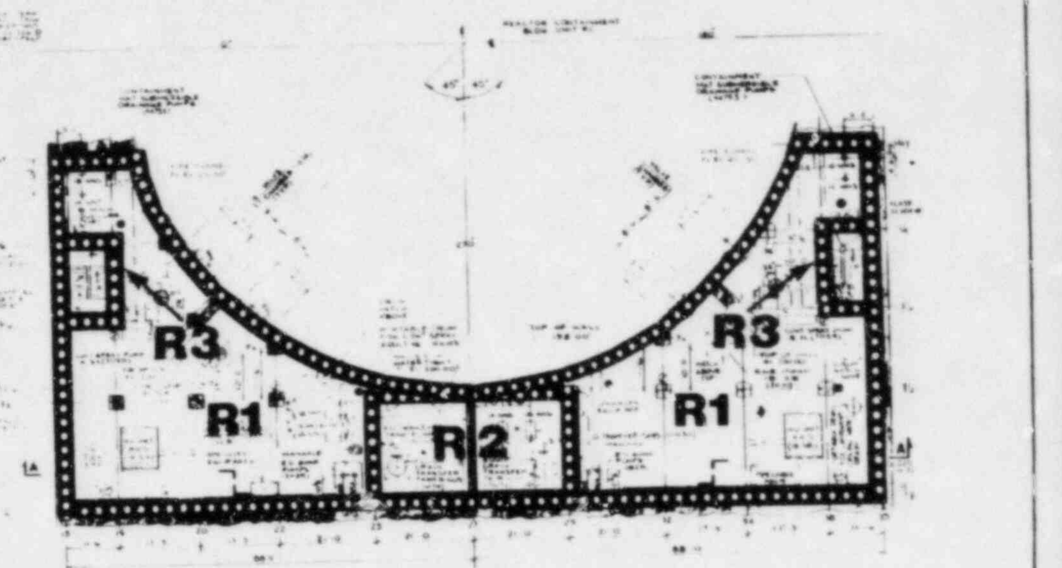
REACTOR AUXILIARY BUILDING



PLAN AT EL. 216.00



NOTE



PLAN AT EL. 190.00

REACTOR AUXILIARY BUILDING

ZONE	DOSE RATE / ACCESSIBILITY		
	1 HA	1 D	1 MA
R1	10 - 500 R/HR	5 - 10 R/HR	2.5 - 5.0 MREM/HR
R2	1000 R/HR	20 R/HR	800 MREM/HR
R3	5 - 10 R/HR	10 - 20 MREM/HR	0.25 MREM/HR

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

ZONE	DOSE RATE / ACCESSIBILITY		
	1 HA	1 DA	1 MA
R4	200 MREM/HR 8 R/HR	175 MREM/HR 7 R/HR	2.5 MREM/HR
R5	1 R/HR	15 MREM/HR	< 0.25 MREM/HR
R6	20 - 50 MREM/HR	10 - 40 MREM/HR	2.5 MREM/HR
R7	10 - 15 MREM/HR	5 - 10 MREM/HR	0.25 MREM/HR

REF DWG: CAR-2165-G-015 (REV. 10, OPEN)

Amendment No. 5

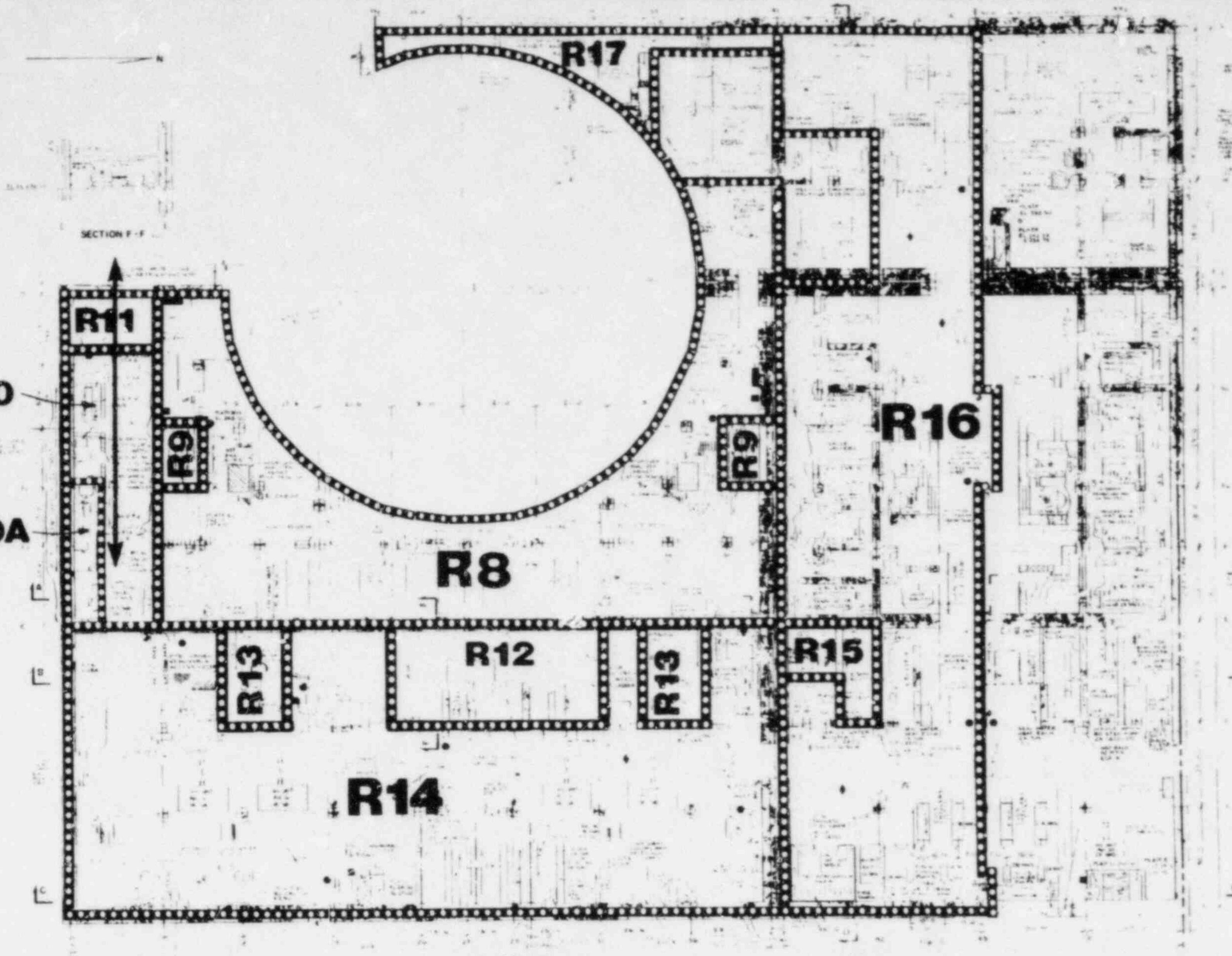
SHEARON HARRIS NUCLEAR POWER PLANT

Carolina Power & Light Company

FINAL SAFETY ANALYSIS REPORT

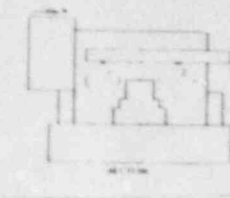
POST ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-7



PLAN AT EL

REACTOR AUXILIARY BUILDING



ZONE	DOSE RATE / ACCESSIBILITY		
	1 HR	1 DA	1 MO
R8	[illegible] – 50 R/HR	7 – 20 R/HR	2.5 MREM/HR
R9	[illegible] MREM/HR	[illegible] MREM/HR	0.25 MREM/HR
R10	20 – 50 MREM/HR	15 – 40 MREM/HR	0.25 MREM/HR
R10A	[illegible] – 1000 R/HR	500 MREM/HR – 20 R/HR	50 – 300 MREM/HR
R11	380 MREM/HR – 8.8 R/HR	175 MREM/HR – 4.2 R/HR	2.5 MREM/HR
R12	2.0 [illegible] R/HR	2 R/HR	100 MREM/HR
R13	8.0 (+4) – 2.0 (+5) R/HR	800 – 2000 R/HR	100 MREM/HR – 2 R/HR
R14	200 – 800 R/HR	2 – 8 R/HR	2.5 MREM/HR
R15	1000 R/HR	25 R/HR	800 MREM/HR
R16	10 – 15 MREM/HR	2.5 MREM/HR	0.25 MREM/HR
R17	170 MREM/HR – 10 R/HR	80 MREM/HR – 4.5 R/HR	2.5 MREM/HR

NOTE REFER TO LEGEND ON FIGURE 12.3A-1

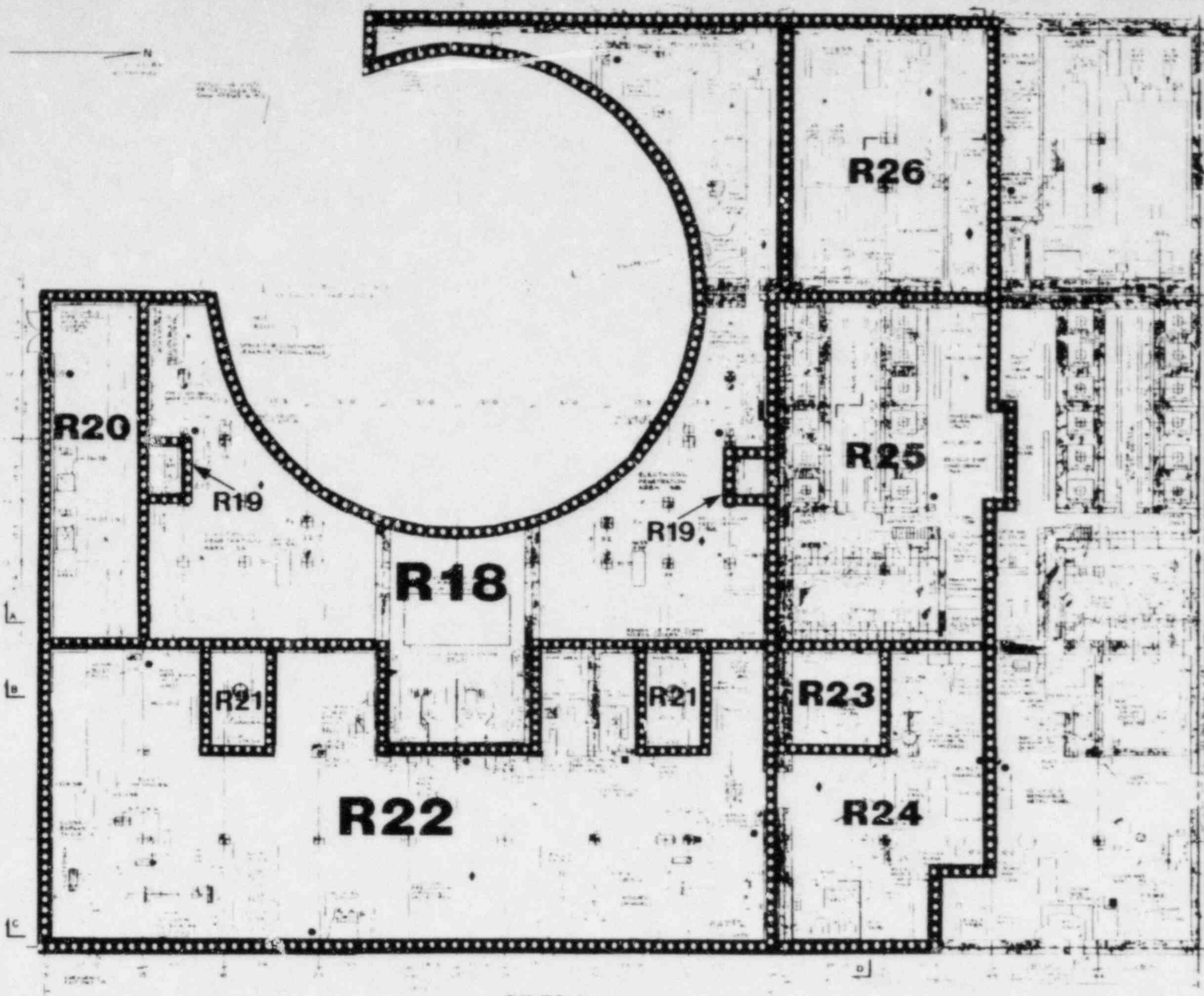
REF DWG CAR-2165-G-016 (REV. 10, OPEN)

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

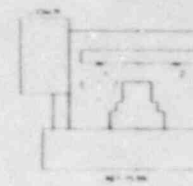
POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-8



PLAN AT EL. 261'

REACTOR AUXILIARY BUILDING



ZONE	DOSE RATE / ACCESSIBILITY 1 HA	1 DA	1 MA
R18	8 R/HR	7 R/HR	2.5 MREM/HR
R19	1 R/HR	800 MREM/HR	0.25 MREM/HR
R20	20 – 50 MREM/HR	15 – 40 MREM/HR	2.5 MREM/HR
R21	750 R/HR	15 R/HR	700 MREM/HR
R22	1 – 2.8 R/HR	20 – 80 MREM/HR	2.5 MREM/HR
R23	1000 R/HR	20 R/HR	800 MREM/HR
R24	140 MREM/HR – 7 R/HR	10 – 100 MREM/HR	0.25 – 2.5 MREM/HR
R25	10 – 750 MREM/HR	2 – 5 MREM/HR	0.25 – 2.5 MREM/HR
R26	15 – 300 MREM/HR	10 – 280 MREM/HR	0.25 – 2.5 MREM/HR

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

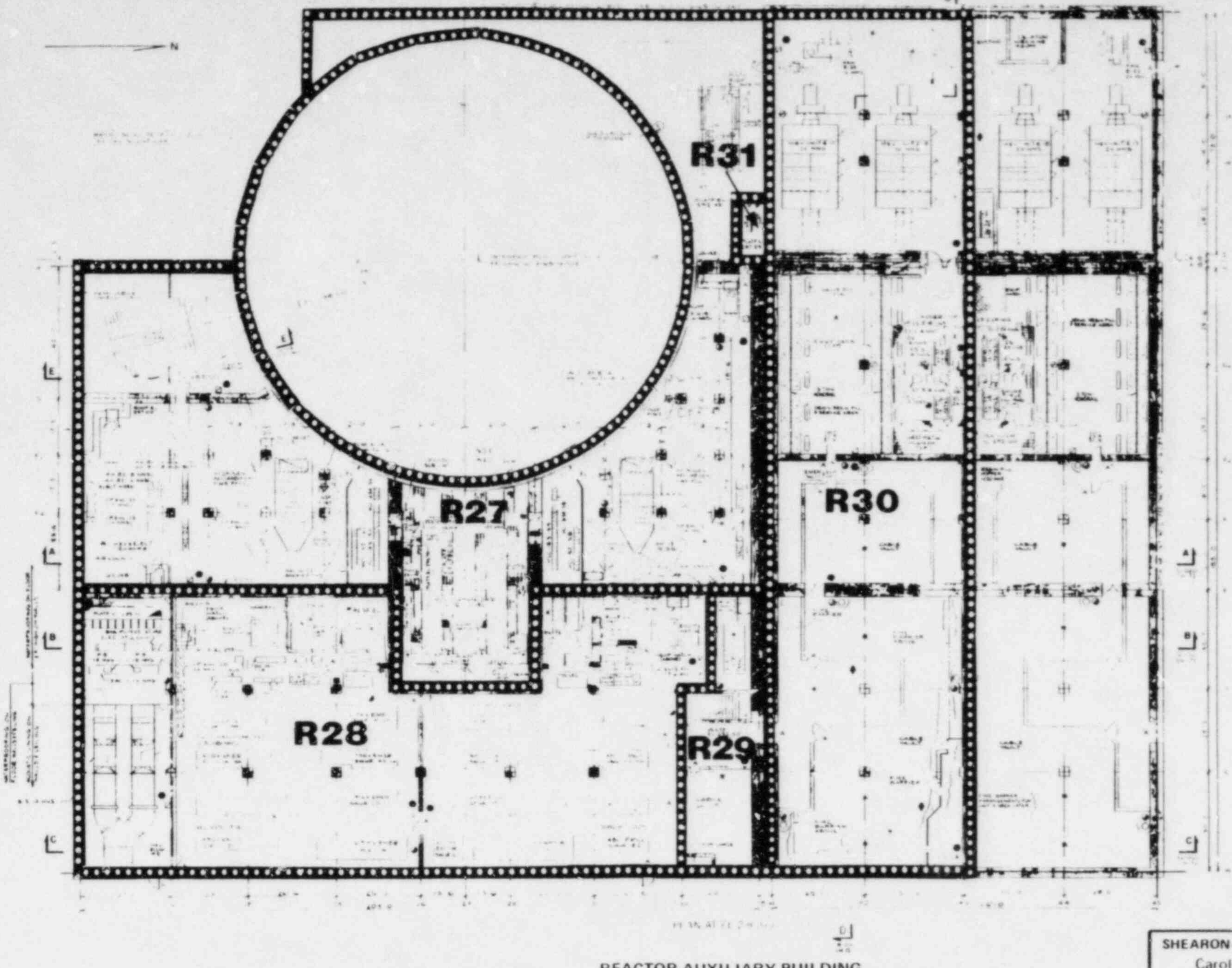
Amendment No. 5

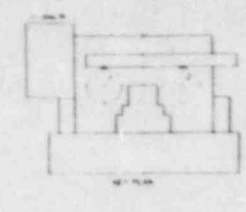
REF DWG: CAR-2165-G-017 (REV. 9, OPEN)

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-9





ZONE	DOSE RATE 1 HR	DOSE RATE 1 DA	ACCESSIBILITY 1 MA
R27	[illegible]	[illegible]	[illegible]
R28	10 - 100 [illegible]	5 - 50 [illegible]	[illegible]
R29	[illegible]	[illegible]	[illegible]
R30	5 - 10 [illegible]	2 - 5 [illegible]	[illegible]
R31	[illegible]	[illegible]	[illegible]

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

REACTOR AUXILIARY BUILDING

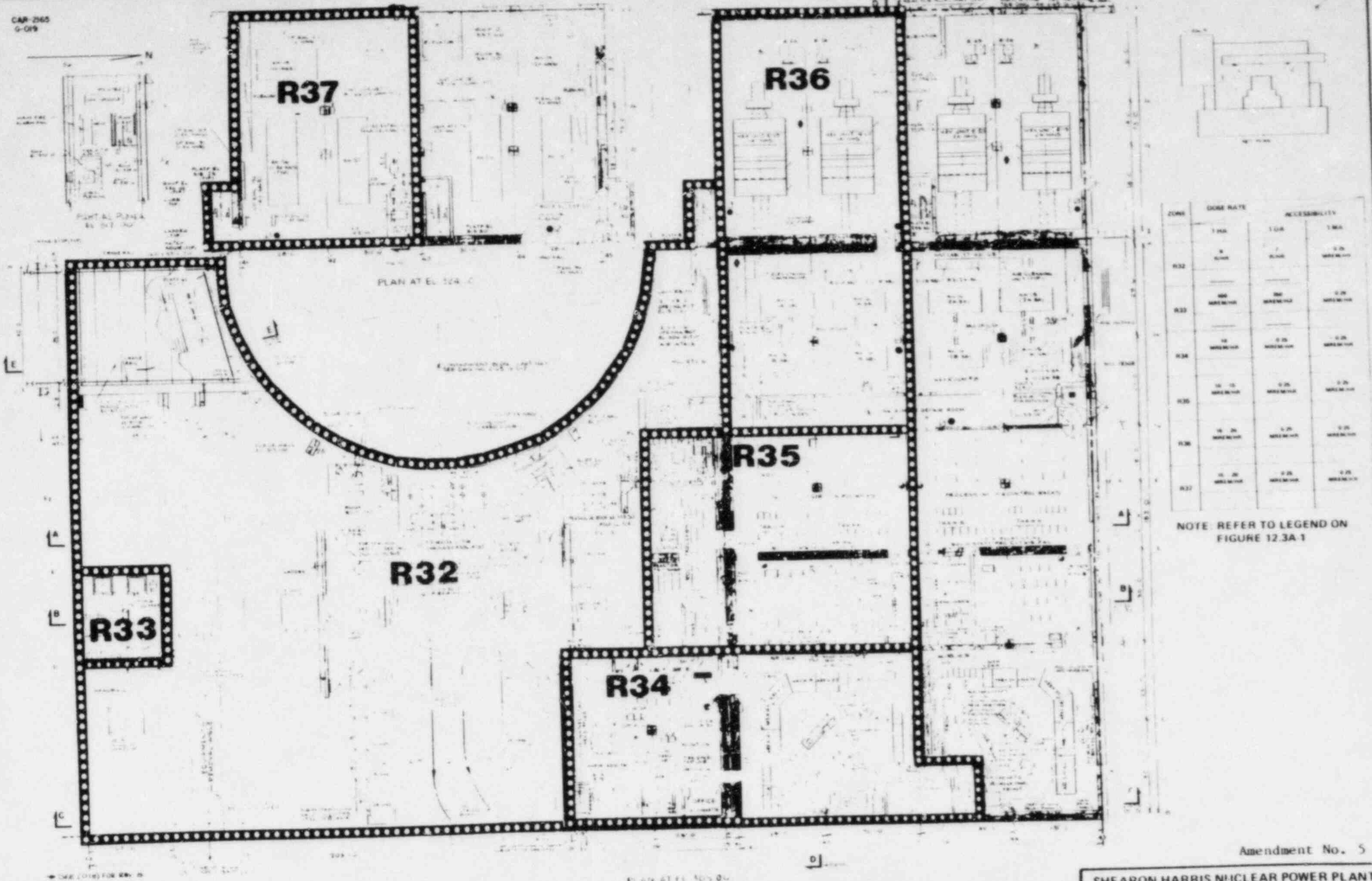
REF DWG: CAR-2165-G-018 (REV. 8, OPEN)

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-10



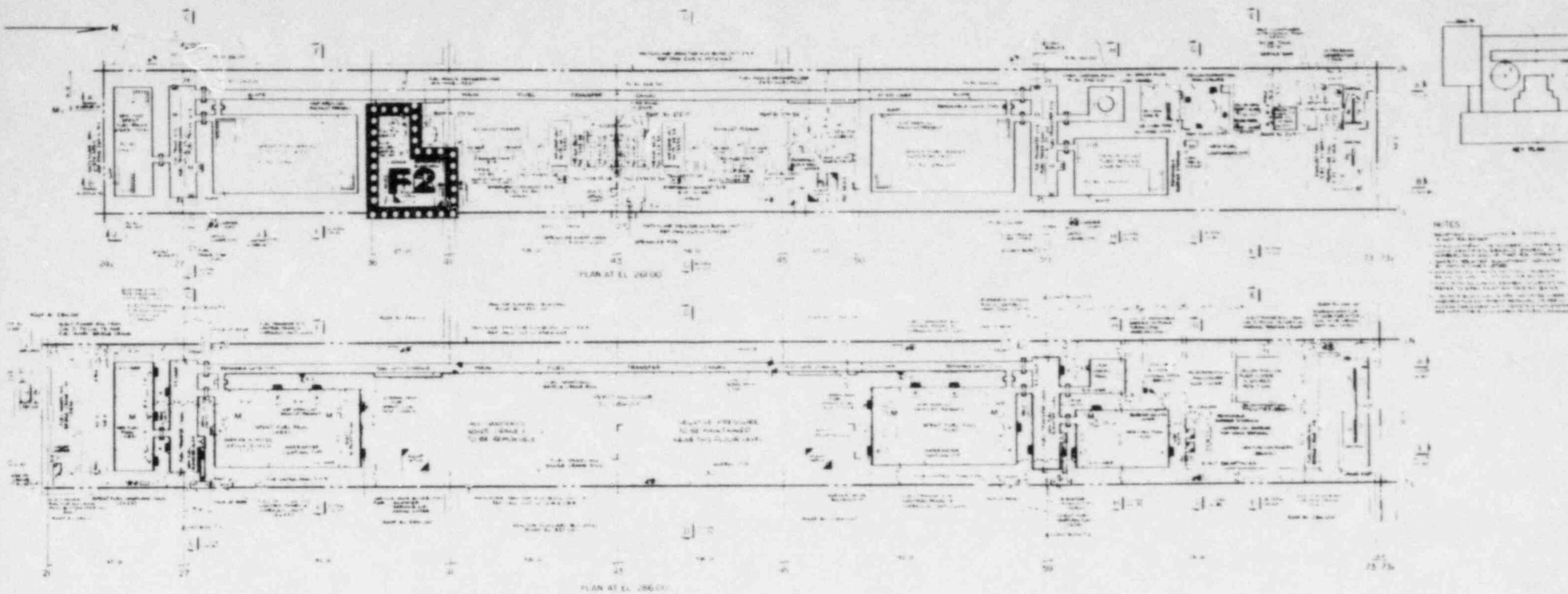
REACTOR AUXILIARY BUILDING

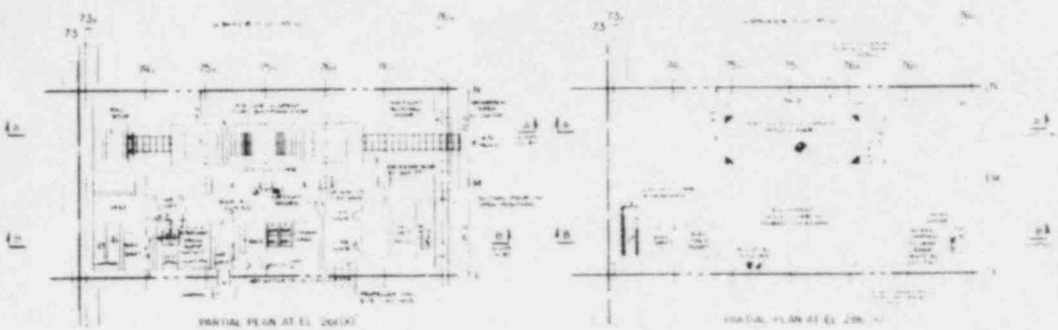
REF DWG: CAR-2165-G-019 (REV. 8, OPEN)

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST ACCIDENT DOSE RATES AND
ACCESSIBILITY ANALYSIS – UNIT 1
FIGURE 12.3A-11





ZONE	DOSE RATE / ACCESSIBILITY		
	1 HA	1 DA	1 MA
F2	5 – 160 MREM/HR	4.4 – 140 MREM/HR	<0.25 MREM/HR
	-----	-----	-----

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

FUEL HANDLING BUILDING

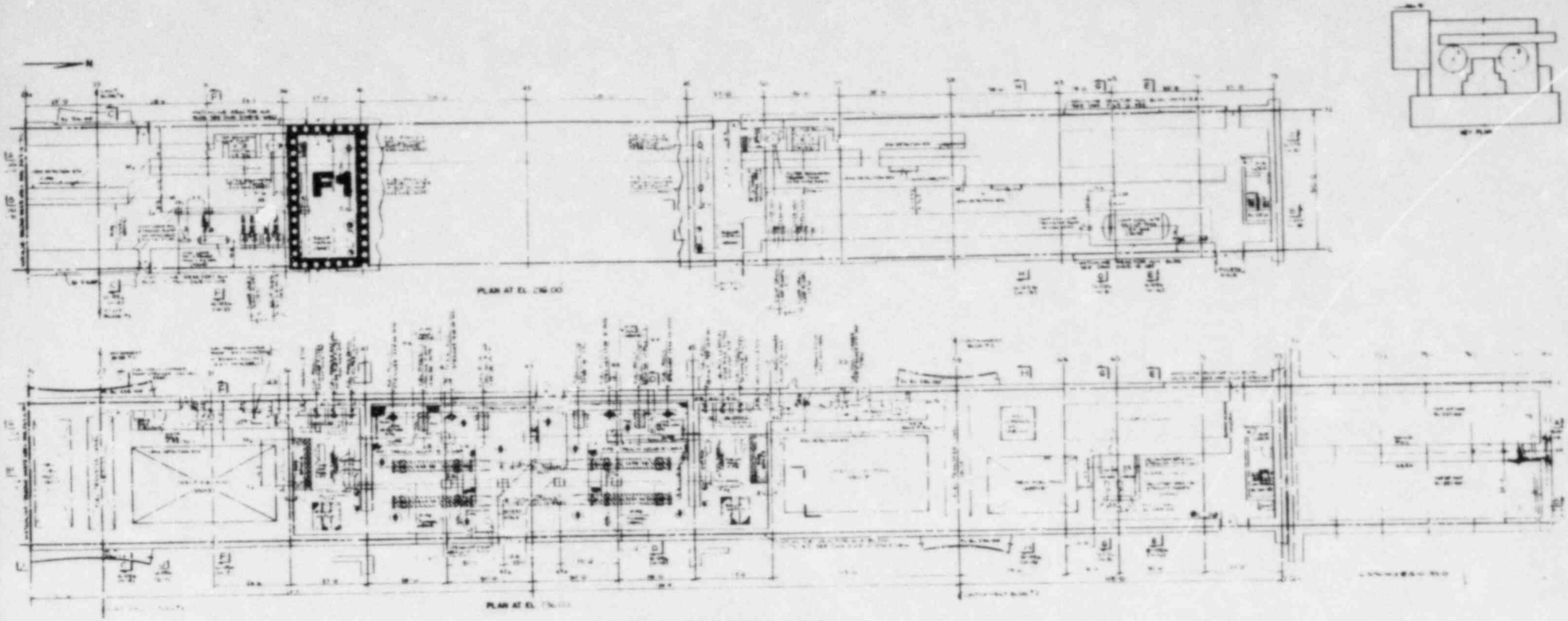
REF DWG: CAR-2165-G-022 (REV. 7)

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-12



FUEL HANDLING BUILDING

ZONE	DOSE RATE / ACCESSIBILITY		
	1 MA	1 DA	1 MA
F1	10 – 200 MREM/HR	5 – 175 MREM/HR	<0.25 MREM/HR

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

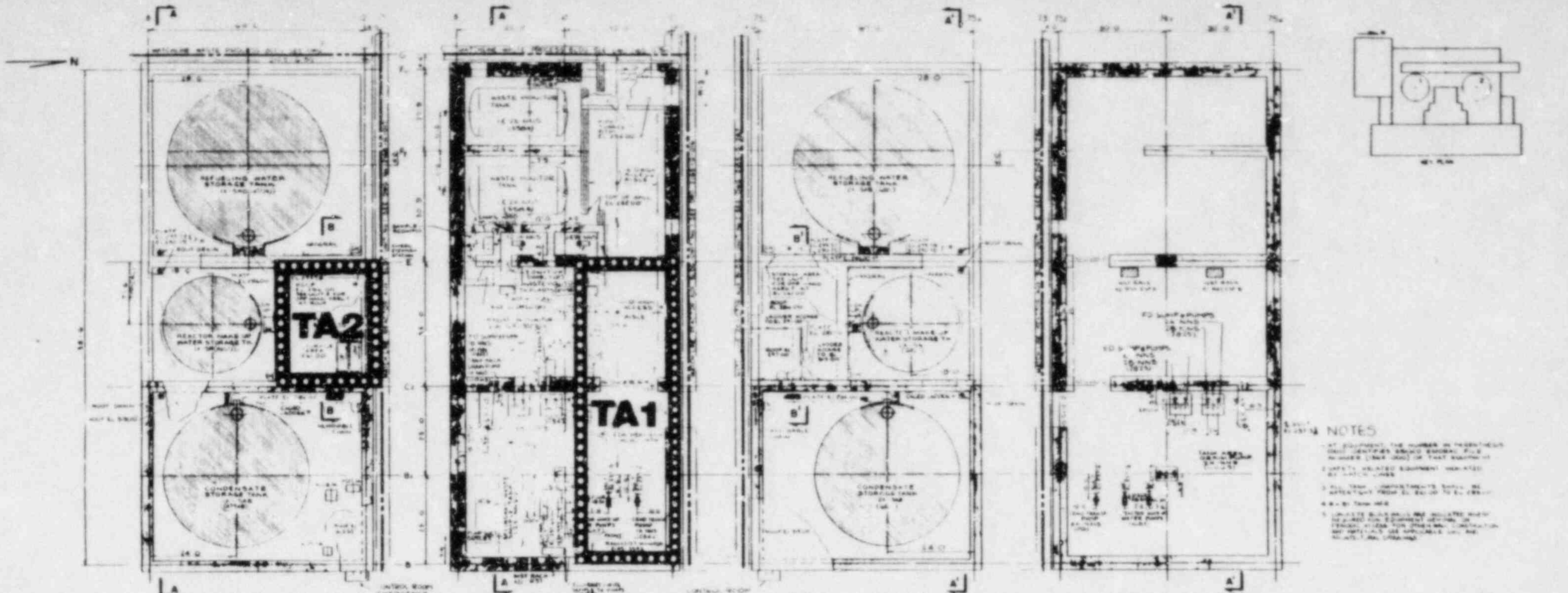
REF DWG: CAR-2165-G-023 (REV. 7)

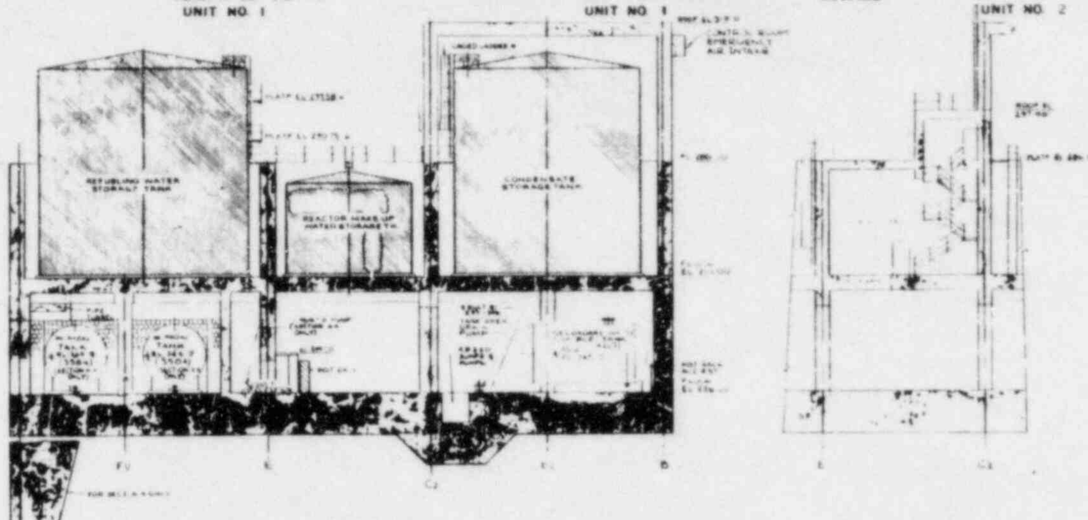
Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-13





TANK AREA

ZONE	DOSE RATE / ACCESSIBILITY		
	1 HA	1 DA	1 MA
TA1	20 – 200 R/HR	200 MREM/HR – 2 R/HR	2.5 MREM/HR
	——— ———	- - - - - ———	- - - - -
TA2	280 MREM/HR – 2.8 R/HR	3 – 300 MREM/HR	2.5 MREM/HR
	- - - - - ———	- - - - - ———	- - - - -

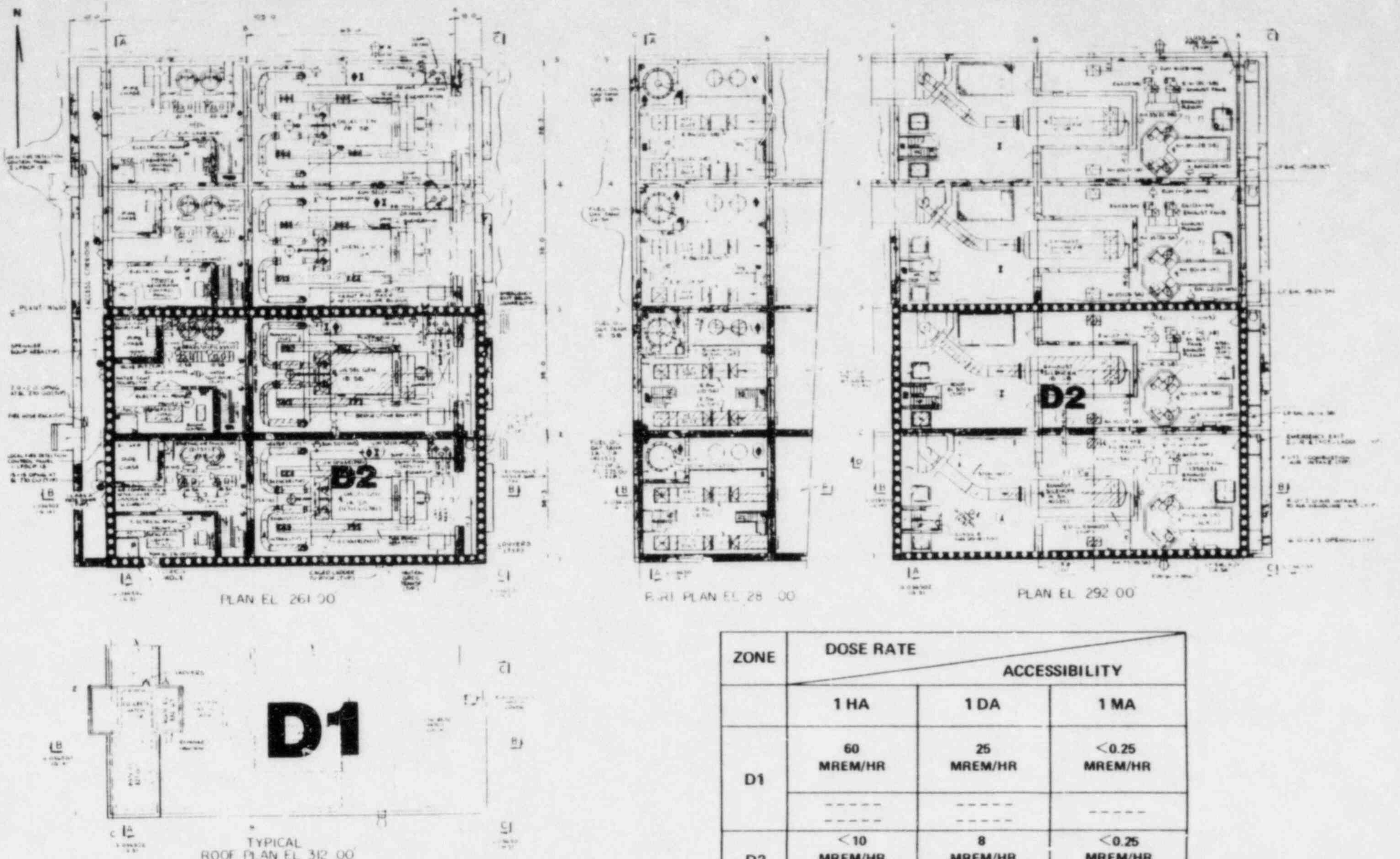
NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1
FIGURE 12.3A-14

REF DWG: CAR-2165-G-033 (REV. 7, OPEN)



DIESEL GENERATOR BUILDING

ZONE	DOSE RATE / ACCESSIBILITY		
	1 HA	1 DA	1 MA
D1	60 MREM/HR	25 MREM/HR	<0.25 MREM/HR
	-----	-----	-----
D2	<10 MREM/HR	8 MREM/HR	<0.25 MREM/HR
	------	------	-----

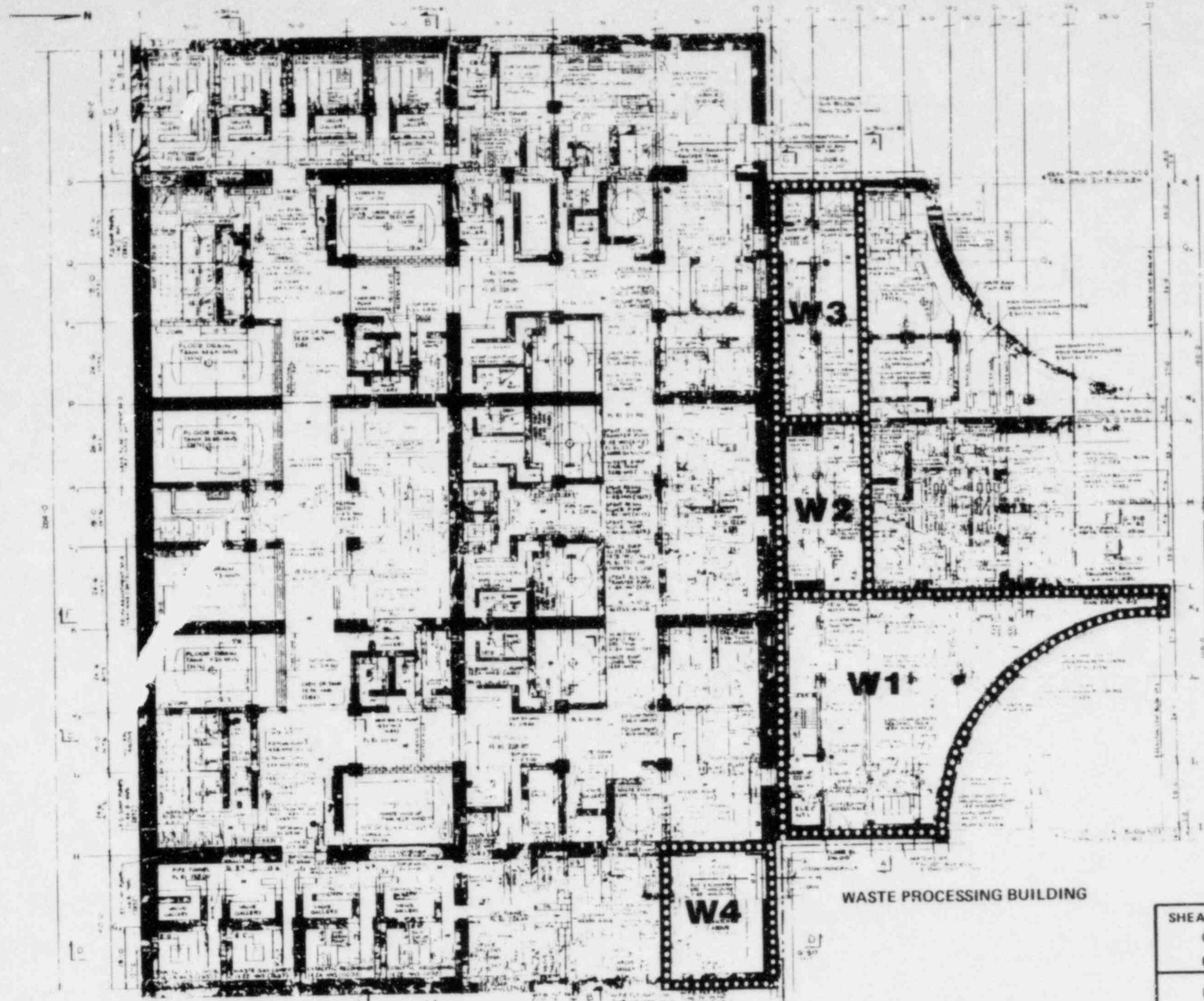
NOTE REFER TO LEGEND ON FIGURE 12.3A-1

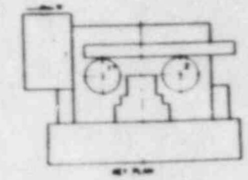
Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1
FIGURE 12.3A-15

REF DWG: CAR-2165-G-036 SH. 1 (REV. 2)





ZONE	DOSE RATE / ACCESSIBILITY		
	1 HA	1 DA	1 MA
W1	140 MREM/HR 8 R/HR	120 MREM/HR 7 R/HR	0.25 MREM/HR
W2	20 - 140 MREM/HR	18 - 140 MREM/HR	0.25 MREM/HR
W3	0.25 - 15 MREM/HR	0.25 - 13 MREM/HR	< 0.25 MREM/HR
W4	0.1 - 2.6 MREM/HR	0.1 - 2.0 MREM/HR	< 0.25 MREM/HR

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

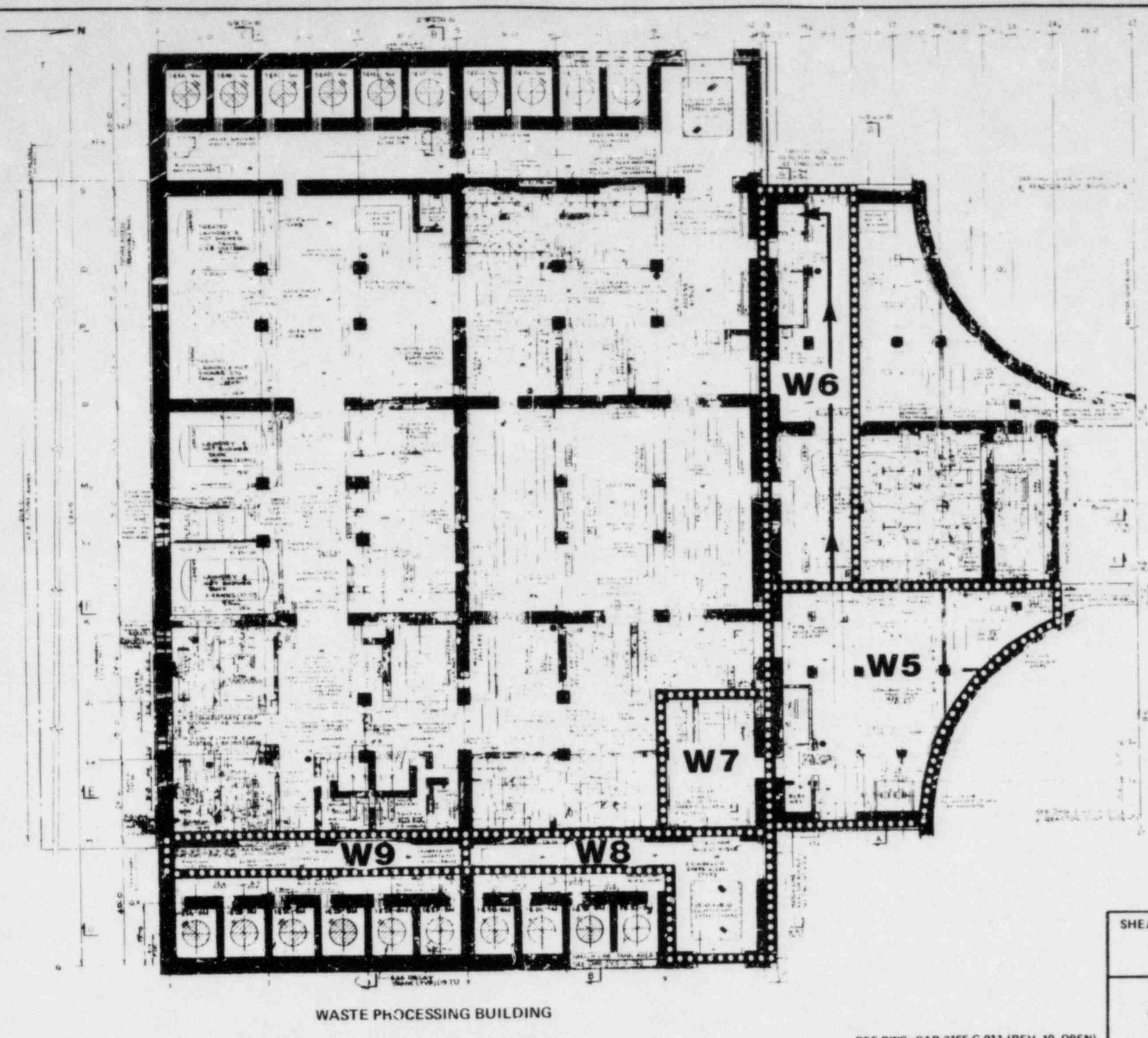
Amendment No. 5

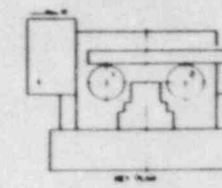
SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-16

REF DWG: CAR-2165-G-910 (REV. 10, OPEN)





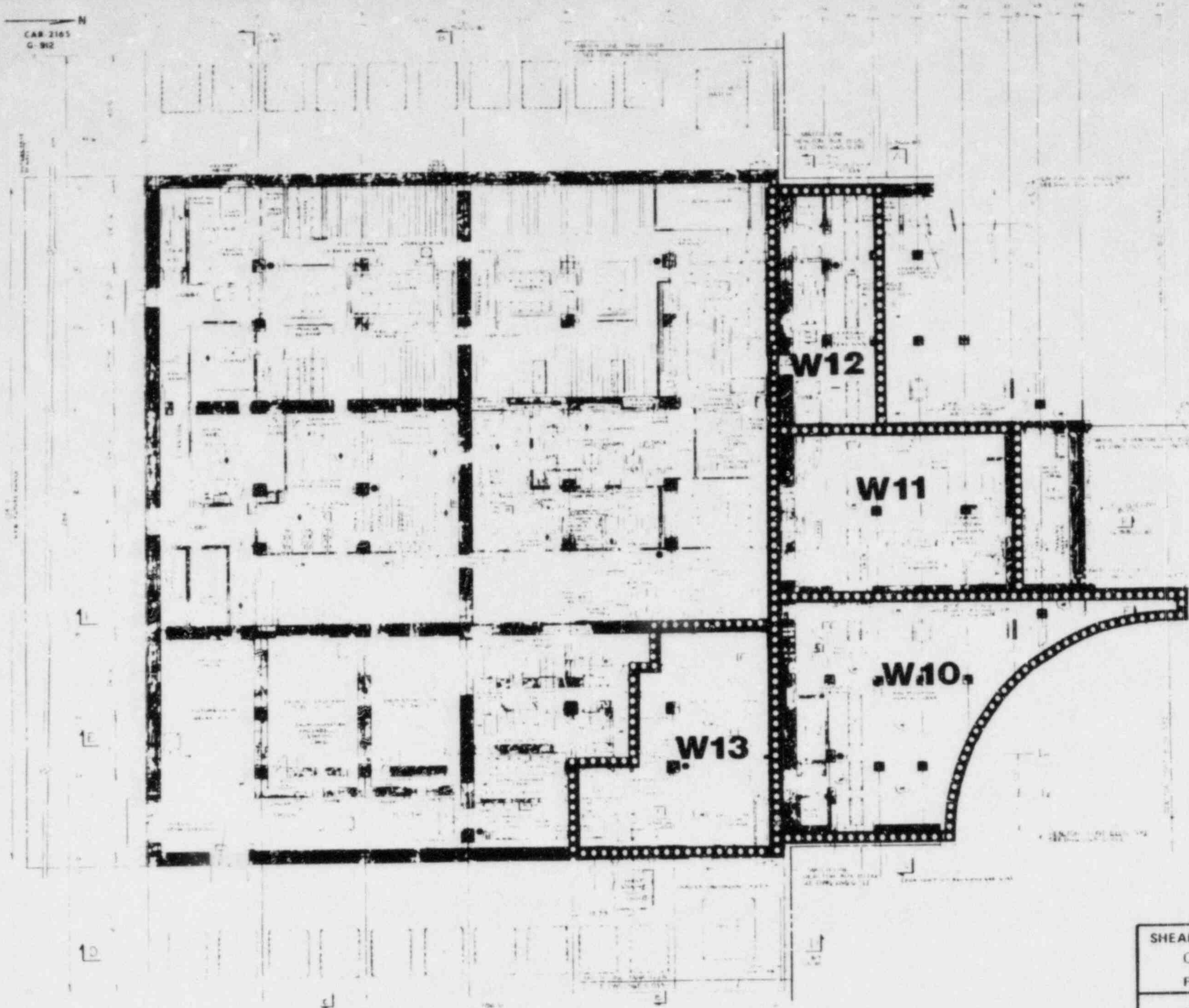
ZONE	DOSE RATE / ACCESSIBILITY 1 HA	1 DA	1 MA
W5	140 MREM/HR 8 R/HR	120 MREM/HR 7 R/HR	0.25 MREM/HR
W6	0.25 - 100 MREM/HR	0.25 - 60 MREM/HR	0.25 MREM/HR
W7	15 - 140 MREM/HR	12 - 120 MREM/HR	0.25 MREM/HR
W8	75 - 380 MREM/HR	60 - 330 MREM/HR	0.25 MREM/HR
W9	1 - 75 MREM/HR	1 - 65 MREM/HR	0.25 MREM/HR

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

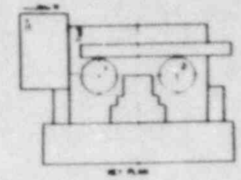
Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1
FIGURE 12.3A-17



WASTE PROCESSING BUILDING



ZONE	DOSE RATE		ACCESSIBILITY
	[illegible]	1 DA	[illegible]
W10	[illegible]	[illegible]	[illegible]
W11	[illegible]	[illegible]	[illegible]
W12	[illegible]	[illegible]	[illegible]
W13	[illegible]	[illegible]	[illegible]

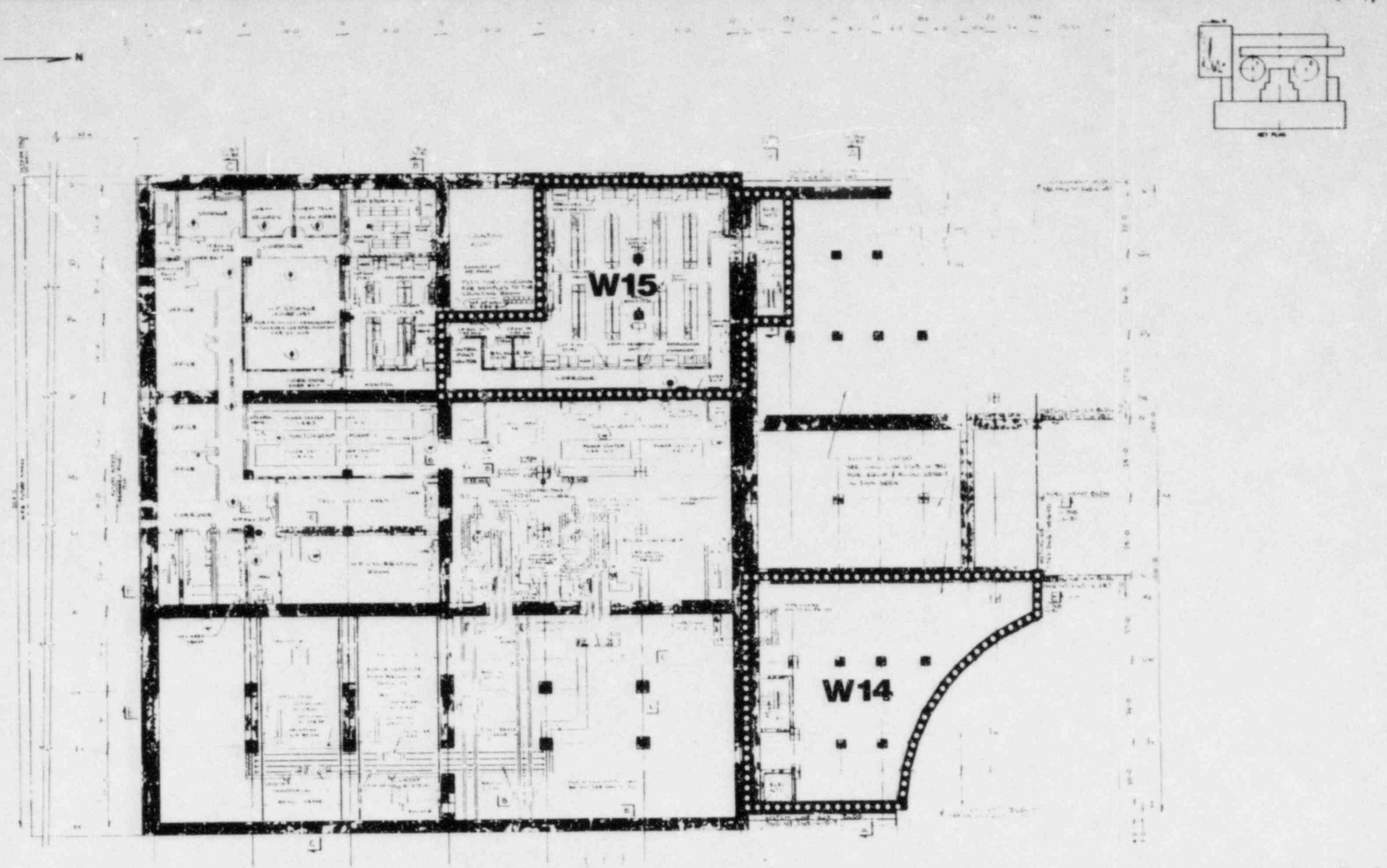
NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

REF DWG: CAR-2165-G-912 (REV. 7)

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1
FIGURE 12.3A-18



WASTE PROCESSING BUILDING

ZONE	DOSE RATE / ACCESSIBILITY		
	1 HA	1 DA	1 MA
W14	140 MREM/HR 8 R/HR	120 MREM/HR 7 R/HR	0.25 MREM/HR
W15	0.25 MREM/HR	0.25 MREM/HR	0.25 MREM/HR

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

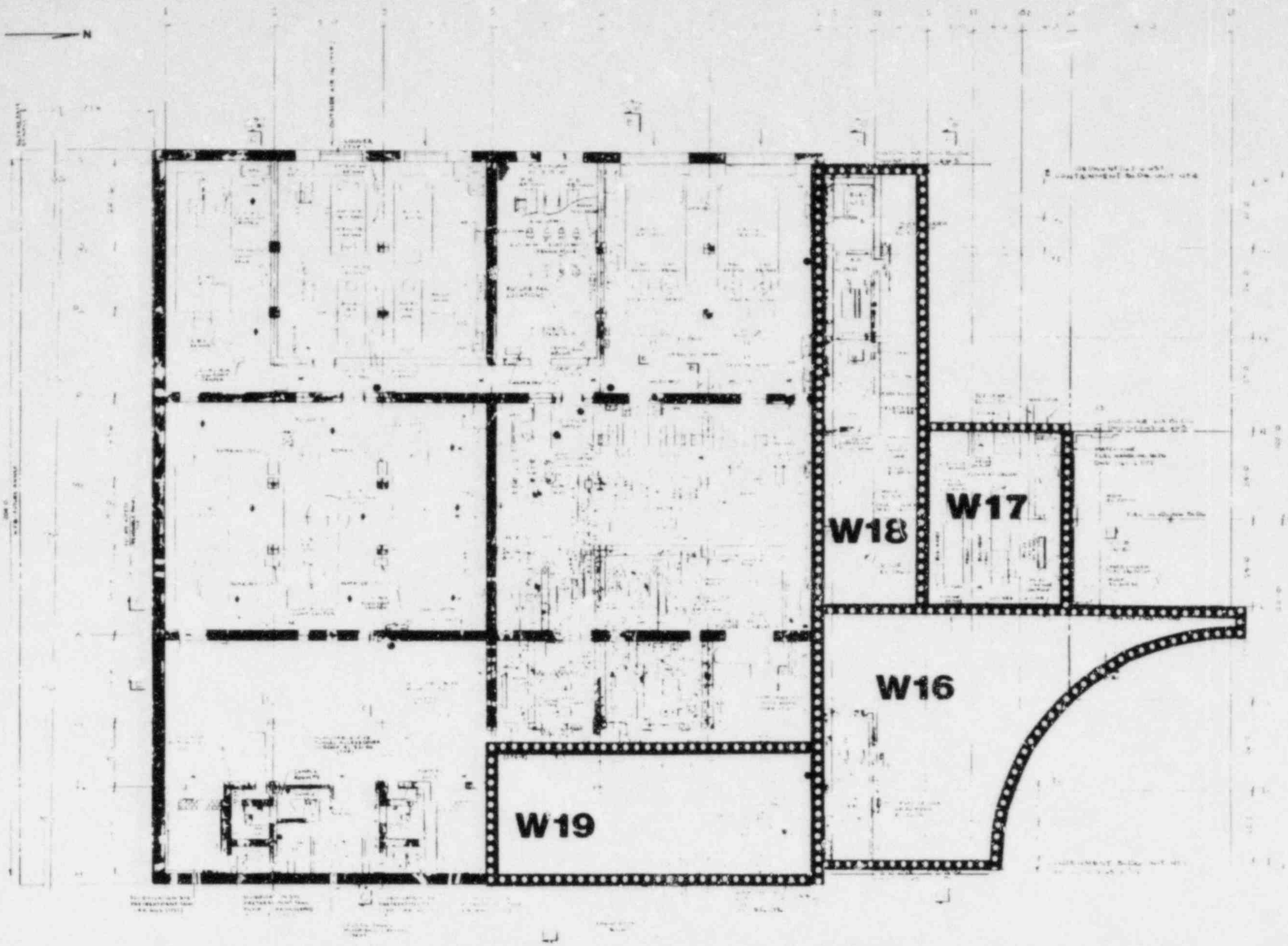
REF DWG: CAR-2165-G-913 (REV. 7)

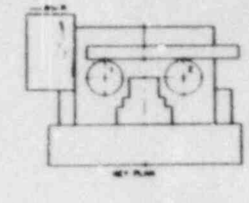
Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS – UNIT 1

FIGURE 12.3A-19





ZONE	DOSE RATE 1 HA	1 DA	ACCESSIBILITY 1 MA
W16	100 MREM/HR - 8 R/HR	[illegible] MREM/HR - 7 R/HR	[illegible] MREM/HR
W17	2 - 180 MREM/HR	1.8 - 160 MREM/HR	[illegible] MREM/HR
W18	0.25 - 100 MREM/HR	0.25 - [illegible] MREM/HR	[illegible] MREM/HR
W19	1.5 - 180 MREM/HR	1.3 - 130 MREM/HR	[illegible] MREM/HR

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1

WASTE PROCESSING BUILDING

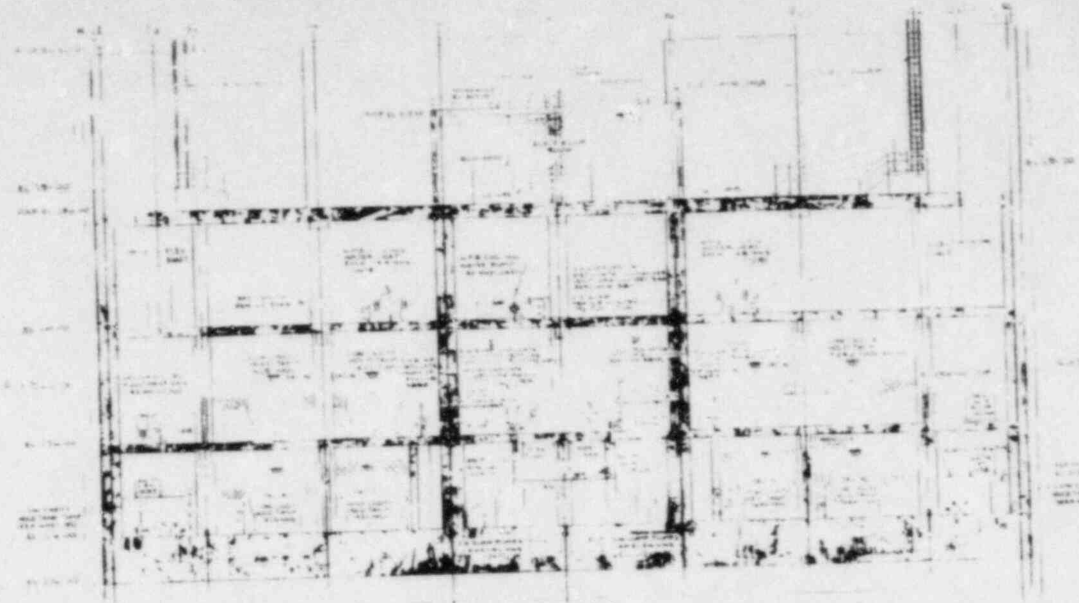
REF DWG: CAR-2165-G-914 (REV. 8, OPEN)

Amendment No. 5

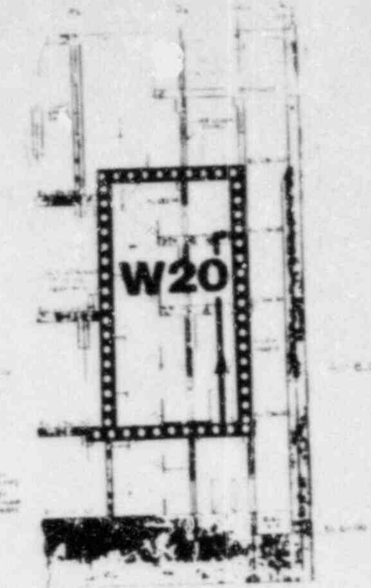
SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS - UNIT 1

FIGURE 12.3A-20



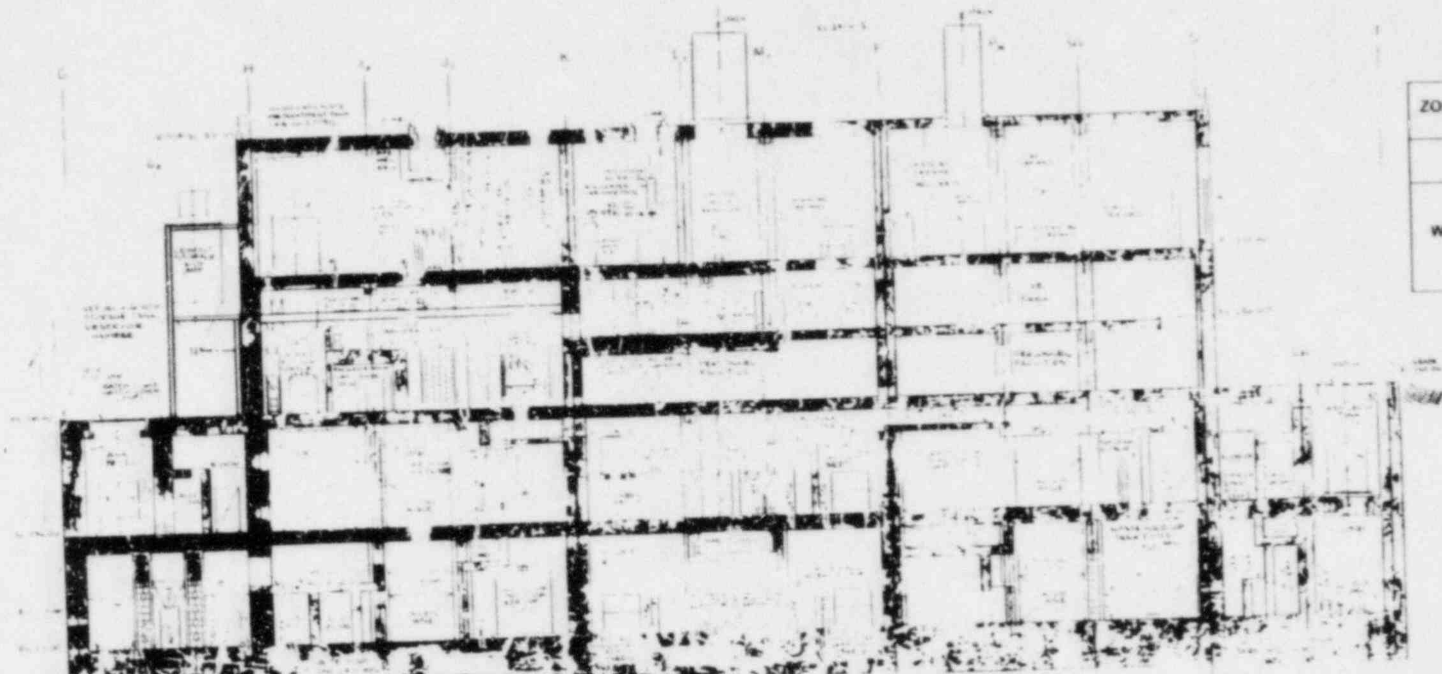
SECTION A-A



SECTION G-G

ZONE	DOSE RATE / ACCESSIBILITY 1 HA	1 DA	1 MA
W20	0.25 MREM/HR	0.25 MREM/HR	0.25 MREM/HR

NOTE: REFER TO LEGEND ON FIGURE 12.3A-1



SECTION B-B

WASTE PROCESSING BUILDING

REF DWG CAR 2165-G-916 (REV 11, OPEN)

Amendment No. 5

SHEARON HARRIS NUCLEAR POWER PLANT
Carolina Power & Light Company
FINAL SAFETY ANALYSIS REPORT

POST-ACCIDENT DOSE RATES AND ACCESSIBILITY ANALYSIS -- UNIT 1

FIGURE 12.3A-21

6.1.5 RADIOLOGICAL MONITORING

The objectives of the Shearon Harris Nuclear Power Plant Environmental Monitoring Program are to: (1) measure exposure rates and radionuclide concentrations within the important exposure pathways to man in the plant environs, (2) determine and assess trends of radionuclide concentrations in the plant environs, and (3) provide data to support public reassurance that dose rates and radionuclide concentrations within transport pathways contribute only insignificant radiation exposure to the public. In general the environmental data serves to demonstrate that the mathematical models used to estimate population exposure generated by plant effluent releases are reasonable and that all significant transport pathways to man have been included in estimating the public exposure.

The program is conducted in two phases (preoperational and operational). The preoperational phase determines the pre-existing baseline data representative of the air, water, shoreline sediments, and other food chain components of the plant environs prior to fuel loading. The operational phase extends such determinations throughout the operating life of the plant. Direct comparisons of operational data to the baseline data provide information concerning the radiological impact of the operating plant on the environment.

External exposure to gaseous radioactive wastes and ingestion of radioactive contaminated food and water are the primary exposure pathways to man. The proposed monitoring program emphasizes sampling and analyzing environmental elements which include these pathways. The proposed sample types. locations, frequencies, and analyses are included in Table 6.1.5-1 in accordance with current guidance (Reference 6.1.5-1). This proposal is considerably different from the Construction Permit Environment Report and the Final Environmental Statement which was based on previous guidance policy (Reference 6.1.5-2).

6.1.5.1 Preoperational Phase

The preoperational phase of the program begins with gathering local and regional radiological data from existing literature. This information provides the initial guidance as to the existing radiological status of the environs. Such information is valuable in selection and design of the analytical elements of the program. Such data is presented in Tables 6.1.5-2, 6.1.5-3, 6.1.5-4, and 6.1.5-5.

The program is designed considering the major or significant transport pathways that will deliver a radiological dose to man during normal plant operations. The environmental sampling surveillance program accumulates data at various stages within each pathway. Existing data from these stages serve to indicate the desired sensitivity of the analytical procedures to facilitate a comparison of preoperational data to post-operational data.

The sampling for the preoperational program begins in graduated steps. The first field sampling is to be initiated two years prior to fuel loading. Table 6.1.5-6 outlines the schedule for the environmental monitoring program in this phase.

6.1.5.1.1 Background Radiological Characteristics

The background radiological characteristics of a site will vary as a function of time and location and will be due to natural background and manmade sources. Table 6.1.5-2 presents a summary of the exposures associated with some of the more significant sources of natural background and manmade exposures.

a) Natural Background (References 6.1.5-3, 6.1.5-4, and 6.1.5-5) - Natural background exposures consist of internal exposures from naturally occurring radionuclides incorporated into body tissues following ingestion or inhalation and external exposures from terrestrial and cosmic radiation.

The internal exposures are predominantly from radioactive potassium, K-40. These exposures vary slightly as a function of age and sex.

The exposures from terrestrial radiation are predominantly due to the radionuclides of the uranium and thorium natural decay series and K-40. The exposures from this source can vary greatly as a function of location because of the variability of the K-40, uranium and thorium content of different mineral formations. In addition, the exposures can change as a function of time at a given location. One of the major causes of this variability is the changing moisture content of the soil. Following a heavy rainfall, the high moisture content of the soil can act as a shield. On the other hand, the water can also act as a barrier to the natural diffusion of radon (Rn-222) and thoron (Rn-220) gas, resulting in their buildup in the soil and associated increase in the radiation field above the soil.

External exposure to cosmic radiation is due to galactic and solar radiation. Galactic radiation is composed predominantly of protons and alpha particles of uncertain extraterrestrial origin. These particles strike the atmosphere and produce secondary radiations which result in exposures. Solar radiation is due to the outward flux of charged particles from the surface of the sun. These particles are of relatively low energy and cannot penetrate the earth's magnetic field. However, large magnetic disturbances on the sun can result in solar flares and the release of highly energetic emissions which can result in human exposures to radiation.

The exposures from cosmic radiation vary as a function of latitude and altitude. Exposure is higher closer to the North and South Poles, and it increases with altitude (see Table 6.1.5-3). The exposures also vary as a function of time because of magnetic disturbances associated with solar flares, as discussed above.

b) Manmade Exposures - Fallout and the diagnostic use of x-rays are the major sources of manmade exposures. The dose to any organ from x-rays varies greatly depending on the organ exposed.

The average exposure from fallout in the northern hemisphere was 4 mrem/yr. in 1969 (Reference 6.1.5-4). This source of exposure has declined sharply since the nuclear test ban treaty. However, recent atmospheric testing by the

People's Republic of China has perturbed this general downward trend (Reference 6.1.5-6).

c) Regional Data - Table 6.1.5-4 presents a year summary of airborne particulate gross beta concentrations compared with the activity of the rainfall per unit area at Columbia, South Carolina. Table 6.1.5-5 presents a year summary of pasteurized milk in Charlotte, North Carolina.

6.1.5.1.2 Preoperational Environmental Radiological Surveillance Program

a) The objectives of the preoperational program are:

1) To measure background levels and their variations along the anticipated critical pathways in the area surrounding the Harris Site.

2) To train personnel

3) To evaluate procedures, equipment and techniques.

4) To ensure compatible operability of all elements of the environmental monitoring program prior to fuel loading.

b) The sampling design of the preoperational program is identical to that of the operational program as described in the following section.

6.1.5.2 Operational Phase

6.1.5.2.1 Sampling Design

a) General Design of Sampling and Analyses - The sampling design of the operational phase of the environmental monitoring program is summarized in Table 6.1.5-1 and Figure 6.1.5-1. Table 6.1.5-1 describes the sampling media, frequency of sampling, sampling location and types and frequency of laboratory analyses. Figure 6.1.5-1 displays the positions of the sampling locations relative to the plant.

The program, as described, is subject to some modification as it progresses. The bases for modification may include:

1) Inaccessibility of selected sites due to conditions not currently existing.

2) Identification of new sample types, analytical techniques, sample locations, etc. which may provide more meaningful data

3) Seasonal unavailability of specified environmental material

4) malfunction of automatic sampling equipment (however every effort will be made to complete corrective action prior to the next sampling period.)

All deviations from the sampling schedule will be documented. This program will operate in accordance with guidance of the Radiological Effluent Technical Specification and the Offsite Dose Calculation Manual (ODCM).

The Operational Phase will include an annual census during the growing season to determine the location of the nearest milk animal and nearest garden greater than 500 square feet producing broad leaf vegetation in each of the 16 meteorological sectors within a distance of 5 miles. If it is learned from this census that the milk animals or gardens are present at a location which yields a calculated thyroid dose greater than those previously sampled, then the higher calculated dose sample locations will be added to the surveillance program as soon as practicable. The sampling location (excluding the control sample location) having the lowest calculated dose will be dropped from the surveillance program at the end of the grazing or growing season during which the census was conducted.

b) Rationale for Sampling Locations

1) Airborne Iodine and Particulate

The air sampling program was designed to provide basic data in estimating the radiation dose to man delivered through the air transport pathway. The primary elements affecting the dose to man from the SHNPP plant through this pathway is the activity from radioactive iodines and airborne particulates. This activity is inhaled and otherwise ingested by man; thereby, developing an internal dose to man. The program provides an estimator that is in addition to the effluent diffusion and dose models which apply to all sectors on a continuous and integrated annual dose basis. The additional estimator will serve to validate or refute the model predictions.

The air sampling program samples environmental air which is representative of breathing air within the selected sectors at zones near the plant boundary. Three sectors were chosen on the basis of predicted annual average D/Q values and, in part, land use. The three sectors N, NNE, and NE represent three of the four sectors which had the highest predicted D/Q values (See Tables 6.1.5-7 and 6.1.5-8). These sectors contain an area that, although sparsely populated, is accessible by the public; some reasonable probability exists that individuals of the general public could from time to time become dose recipients in these sectors.

The sector having the third highest D/Q value was the south sector. Sampling in this sector was rejected because the plant property extends about 3.5 miles from the plant or another 2.1 miles beyond the exclusion boundary. In this area there are no accessible sites with utilities available and public occupancy would be extremely low. As such, measurements made in this area would have little relevancy to estimating dose to the general public.

A fourth air sampling site is located at New Hill, N. C. in the north sector which is 3.5 miles from the plant. New Hill represents the community having the highest D/Q value. Data from this position will

be used to similarly evaluate the diffusion and dispersion calculations as they would relate to this population.

A fifth sampling station is located ≥12 miles in the west northwest sector, a low D/Q sector, to provide a control data point for comparison with the data from the other four sites. The control station should be minimally affected by plant effluents and therefore will serve to delineate the net plant effect at the other four stations.

2) Water Sampling

(a) Surface Water Sampling Locations - Surface water of the Main Reservoir will be sampled to provide a sensitive trend indicator of the potential dose available to man in the aquatic transport pathway. Although surface water is not directly consumed by the public without considerable processing, it does contribute to the raw water used by several municipal water systems and also provides the drinking water for the Shearon Harris Nuclear Power Plant. Data from the surface water sampling will also be useful in determining the adequacy of the drinking water sampling program as a primary estimator of population dose.

Two surface water sampling stations were chosen to optimize the sensitivity of the cooling tower blowdown lines. After mixing with the average Main Reservoir volume of 75,000 ac. ft., a small fraction will flow over the Main Dam Spillway and into the Cape Fear River.

The unaffected surface water sampling site is at CP&L's Cape Fear Plant near Moncure, N. C. This site is upstream on the Cape Fear River near the confluence of the Haw River and the Deep River about 4.5 miles downstream of the Jordan Dam. Data from this location will be indicative of trends occurring in background unaffected by the plant operations.

The affected surface water sampling location is at the spillway of the plant's 4,000 acre Main Reservoir which will be the receiving body for some low level quantities of liquid radioactive wastes. These wastes would be treated wastes released in limited quantities through the cooling water system to the surface water.

(b) Ground Water Sampling Locations - Data from the ground water sampling system will be used to demonstrate that no significant liquid transport of radioactive wastes is occurring within the ground water system. Since the plant is situated on only one minor aquifer flowing within the Triassic rock formation, only negligible transport should occur in the single aquifer.

The aquifer will be sampled from a common header of deep wells in the proximity of the diabase dikes. The header combines the well

waters which will most likely be affected by plant radioactivity releases.

(c) Drinking Water - Samples representative of radioactivity in public drinking water are to be used to directly monitor the ingestion of radioactivities in the water-to-man pathway. This will be accomplished using raw untreated water at the point where the nearest downstream municipality draws its water supply from the Cape Fear River. Such samples will in some cases exhibit higher activities than will occur in the processed water since for some radionuclides the water treatment and distribution process will provide a reduction of activity in the consumed water.

The sampling point for the drinking water pathway is located at the intake of the Lillington, North Carolina water treatment plant. Lillington is the first downstream municipality utilizing the waters of the Cape Fear River for a source of drinking water. The single point will also serve as a conservative estimator for the municipalities of Dunn, North Carolina and Fayetteville, North Carolina both withdrawing water a few miles downstream from Lillington.

The control or unaffected sample point used to compare with the drinking water sample will be the surface water sampled at CP&L's Cape Fear Plant. Comparisons of data from this control point with the samples at Lillington will provide the most sensitive estimator of the activity consumed through the public drinking water supplies downstream on the Cape Fear River.

3) Shoreline Sediments

Shoreline sediments are sampled in the zone in which cooling tower blowdown water discharged from the plant mixes with the Main Reservoir water. The information from this sample will provide an indication of the trends with which radionuclides pool in the benthic sediments component of the Main Reservoir system. Sampling at this point provides the optimum sensitivity for the indicator in that Main Reservoir concentrations of discharged radionuclides should be the highest in this zone.

4) Milk

Milk is sampled at four locations within a five-mile radius to provide primary data on the transport of radionuclides along the air-pasture-cow-milk transport pathway to man. The locations include three operating commercial dairies and a single family milk cow. The family milk cow was selected because it grazes at a distance of 1.9 miles from the plant site, the closest milk producer to the plant. The other three locations include all commercial milk producers located within the five-mile radius of the plant.

A fifth milk sampling location was chosen in the WNW sector at a distance of greater than 10 miles. This information is to provide an

estimate of activity in the unaffected milk. Such an estimate or control data will provide a comparison basis for the other sampling points.

It should be recognized that the single family cow sampling point will periodically be an unreliable sample source in that the cow will not produce milk during periods of breeding and pregnancy. This is obviously no great problem because during these periods the pathway to man ceases to exist also and loss of data becomes unimportant.

5) Fish

Fish sampling produces data indicative of the potential radionuclide consumption by man through an aquatic pathway. In addition, the data provides an integrating trend monitor of the radioactivities in the Main Reservoir. The fish sampling is accomplished in the Main Reservoir itself and upstream of the Buckhorn Dam on the Cape Fear River. The two data points provide the most valid comparisons for affected and unaffected samples.

6) Food Products

Food products are sampled to provide data on ingestion of radionuclides near the end of the air-vegetation-man pathway. The most sensitive sample media was determined to be broad leaf plants whose leaves constitute the consumed product. Three sampling points are family gardens located in three sectors having predicted D/Q values higher than the median for the surrounding area.

The locations were chosen on the basis of proximity to the plant, reliability of the garden's existence and representation of existing residents. The control location was placed in Pittsboro, N. C. approximately 12 miles from the plant in the west northwest sector which has a lower than average D/Q value. Comparisons of these data points provide the most sensitive evaluations of the air-food crop-man transport pathway.

7) External Radiation Measurements

Thermoluminescent dosimeters (TLD) will be used to determine external gamma exposure in each of the sectors around the plant. This is accomplished by locating dosimeters in each of sixteen sectors around the plant. The location will form two concentric rings; the inner ring at the site exclusion boundary and the outer ring with a variable radius of from four to five miles. In addition TLD Stations will be established in four of the nearby communities; Apex, Holly Springs, New Hill and Fuquay-Varina to provide a better estimate of the population doses there.

Two control stations are located in separate sectors having lower than average D/Q values. These stations are located at distances greater than 10 miles from the plant. To provide added insurance that at least one of these locations is an effective control station, they are placed

in nearly opposite sectors, one in the WNW sector and one in the east sector.

At each location the site is surveyed to determine the nature of the external radiation fields and to detect anomalies that may affect the TLD results. The TLD stations were placed in locations with minimum radiation rates. In addition the dosimeters will be placed approximately 2 meters above the ground level in unpopulated areas and 3 meters above ground level in the populated areas. The higher position was deemed necessary to discourage vandalism and theft of the dosimeters.

6.1.5.3 Analytical Techniques

Sampling and radiochemical analysis will be conducted by CP&L at the Shearon Harris Energy & Environmental Center. The collection, processing, radiochemical separations and analysis of environmental samples will be performed in accordance with the techniques (or comparable techniques) described in HASL-300 (Reference 6.1.5-7), Regulatory Guide 4.15 (Reference 6.1.5-8), and NCRP-50 (Reference 6.1.5-9). The following are the analytical techniques that will be used:

a) External Gamma Dosimetry - External gamma dosimetry will be performed using a thermoluminescent dosimetry (TLD) system. The TLD system will meet the performance and acceptance criteria presented in Regulatory Guide 4.13. Each TLD station will have two or more phosphors in a packet.

b) Gross Beta - The analysis of gross beta radioactivity measurements will be made utilizing a Beckman Widebeta II proportional counter. The air particulate samples will be mounted in two-inch stainless steel planchets and counted directly.

c) Tritium - Tritium measurements will be made by using a Beckman LS-233 liquid scintillation counter. Water samples requiring tritium analysis will be distilled prior to analysis.

d) Gamma Spectral Analyses - Gamma spectrum analysis will utilize a lithium-drifted germanium detector with a thin aluminum window housed in a steel and lead shield. The analyzer system will be a Nuclear Data 4420 with ND 812 computer.

e) Radiochemical Analyses - Iodine-131 in milk will be analyzed by using anion exchange resin, sodium hypochloride leach, and organic extraction. Iodine is precipitated as silver iodide, collected on a tared filter, dried, and counted on a beta-gamma coincidence system.

6.1.5.4 Lower Limits of Detection

The lower limits of detection (LLD) will be sufficiently sensitive to permit the program to detect concentrations of radionuclides in the environment which could cause exposures in excess of the limitations of Appendix I to 10CFR50. Table 6.1.5-9 presents the lower limits of detection for selected

6.1.5 RADIOLOGICAL MONITORING

The objectives of the Shearon Harris Nuclear Power Plant Environmental Monitoring Program are to: (1) measure exposure rates and radionuclide concentrations within the important exposure pathways to man in the plant environs, (2) determine and assess trends of radionuclide concentrations in the plant environs, and (3) provide data to support public reassurance that dose rates and radionuclide concentrations within transport pathways contribute only insignificant radiation exposure to the public. In general the environmental data serves to demonstrate that the mathematical models used to estimate population exposure generated by plant effluent releases are reasonable and that all significant transport pathways to man have been included in estimating the public exposure.

The program is conducted in two phases (preoperational and operational). The preoperational phase determines the pre-existing baseline data representative of the air, water, shoreline sediments, and other food chain components of the plant environs prior to fuel loading. The operational phase extends such determinations throughout the operating life of the plant. Direct comparisons of operational data to the baseline data provide information concerning the radiological impact of the operating plant on the environment.

External exposure to gaseous radioactive wastes and ingestion of radioactive contaminated food and water are the primary exposure pathways to man. The proposed monitoring program emphasizes sampling and analyzing environmental elements which include these pathways. The proposed sample types, locations, frequencies, and analyses are included in Table 6.1.5-1 in accordance with current guidance (Reference 6.1.5-1). This proposal is considerably different from the Construction Permit Environment Report and the Final Environmental Statement which was based on previous guidance policy (Reference 6.1.5-2).

6.1.5.1 Preoperational Phase

The preoperational phase of the program begins with gathering local and regional radiological data from existing literature. This information provides the initial guidance as to the existing radiological status of the environs. Such information is valuable in selection and design of the analytical elements of the program. Such data is presented in Tables 6.1.5-2, 6.1.5-3, 6.1.5-4, and 6.1.5-5.

The program is designed considering the major or significant transport pathways that will deliver a radiological dose to man during normal plant operations. The environmental sampling surveillance program accumulates data at various stages within each pathway. Existing data from these stages serve to indicate the desired sensitivity of the analytical procedures to facilitate a comparison of preoperational data to post-operational data.

The sampling for the preoperational program begins in graduated steps. The first field sampling is to be initiated two years prior to fuel loading. Table 6.1.5-6 outlines the schedule for the environmental monitoring program in this phase.

6.1.5.1.1 Background Radiological Characteristics

The background radiological characteristics of a site will vary as a function of time and location and will be due to natural background and manmade sources. Table 6.1.5-2 presents a summary of the exposures associated with some of the more significant sources of natural background and manmade exposures.

a) Natural Background (References 6.1.5-3, 6.1.5-4, and 6.1.5-5) - Natural background exposures consist of internal exposures from naturally occurring radionuclides incorporated into body tissues following ingestion or inhalation and external exposures from terrestrial and cosmic radiation.

The internal exposures are predominantly from radioactive potassium, K-40. These exposures vary slightly as a function of age and sex.

The exposures from terrestrial radiation are predominantly due to the radionuclides of the uranium and thorium natural decay series and K-40. The exposures from this source can vary greatly as a function of location because of the variability of the K-40, uranium and thorium content of different mineral formations. In addition, the exposures can change as a function of time at a given location. One of the major causes of this variability is the changing moisture content of the soil. Following a heavy rainfall, the high moisture content of the soil can act as a shield. On the other hand, the water can also act as a barrier to the natural diffusion of radon (Rn-222) and thoron (Rn-220) gas, resulting in their buildup in the soil and associated increase in the radiation field above the soil.

External exposure to cosmic radiation is due to galactic and solar radiation. Galactic radiation is composed predominantly of protons and alpha particles of uncertain extraterrestrial origin. These particles strike the atmosphere and produce secondary radiations which result in exposures. Solar radiation is due to the outward flux of charged particles from the surface of the sun. These particles are of relatively low energy and cannot penetrate the earth's magnetic field. However, large magnetic disturbances on the sun can result in solar flares and the release of highly energetic emissions which can result in human exposures to radiation.

The exposures from cosmic radiation vary as a function of latitude and altitude. Exposure is higher closer to the North and South Poles, and it increases with altitude (see Table 6.1.5-3). The exposures also vary as a function of time because of magnetic disturbances associated with solar flares, as discussed above.

b) Manmade Exposures - Fallout and the diagnostic use of x-rays are the major sources of manmade exposures. The dose to any organ from x-rays varies greatly depending on the organ exposed.

The average exposure from fallout in the northern hemisphere was 4 mrem/yr. in 1969 (Reference 6.1.5-4). This source of exposure has declined sharply since the nuclear test ban treaty. However, recent atmospheric testing by the

People's Republic of China has perturbed this general downward trend (Reference 6.1.5-6).

c) Regional Data - Table 6.1.5-4 presents a year summary of airborne particulate gross beta concentrations compared with the activity of the rainfall per unit area at Columbia, South Carolina. Table 6.1.5-5 presents a year summary of pasteurized milk in Charlotte, North Carolina.

6.1.5.1.2 Preoperational Environmental Radiological Surveillance Program

a) The objectives of the preoperational program are:

1) To measure background levels and their variations along the anticipated critical pathways in the area surrounding the Harris Site.

2) To train personnel

3) To evaluate procedures, equipment and techniques.

4) To ensure compatible operability of all elements of the environmental monitoring program prior to fuel loading.

b) The sampling design of the preoperational program is identical to that of the operational program as described in the following section.

6.1.5.2 Operational Phase

6.1.5.2.1 Sampling Design

a) General Design of Sampling and Analyses - The sampling design of the operational phase of the environmental monitoring program is summarized in Table 6.1.5-1 and Figure 6.1.5-1. Table 6.1.5-1 describes the sampling media, frequency of sampling, sampling location and types and frequency of laboratory analyses. Figure 6.1.5-1 displays the positions of the sampling locations relative to the plant.

The program, as described, is subject to some modification as it progresses. The bases for modification may include:

1) Inaccessibility of selected sites due to conditions not currently existing.

2) Identification of new sample types, analytical techniques, sample locations, etc. which may provide more meaningful data

3) Seasonal unavailability of specified environmental material

4) malfunction of automatic sampling equipment (however every effort will be made to complete corrective action prior to the next sampling period.)

All deviations from the sampling schedule will be documented. This program will operate in accordance with guidance of the Radiological Effluent Technical Specification and the Offsite Dose Calculation Manual (ODCM).

The Operational Phase will include an annual census during the growing season to determine the location of the nearest milk animal and nearest garden greater than 500 square feet producing broad leaf vegetation in each of the 16 meteorological sectors within a distance of 5 miles. If it is learned from this census that the milk animals or gardens are present at a location which yields a calculated thyroid dose greater than those previously sampled, then the higher calculated dose sample locations will be added to the surveillance program as soon as practicable. The sampling location (excluding the control sample location) having the lowest calculated dose will be dropped from the surveillance program at the end of the grazing or growing season during which the census was conducted.

b) Rationale for Sampling Locations

1) Airborne Iodine and Particulate

The air sampling program was designed to provide basic data in estimating the radiation dose to man delivered through the air transport pathway. The primary elements affecting the dose to man from the SHNPP plant through this pathway is the activity from radioactive iodines and airborne particulates. This activity is inhaled and otherwise ingested by man; thereby, developing an internal dose to man. The program provides an estimator that is in addition to the effluent diffusion and dose models which apply to all sectors on a continuous and integrated annual dose basis. The additional estimator will serve to validate or refute the model predictions.

The air sampling program samples environmental air which is representative of breathing air within the selected sectors at zones near the plant boundary. Three sectors were chosen on the basis of predicted annual average D/Q values and, in part, land use. The three sectors N, NNE, and NE represent three of the four sectors which had the highest predicted D/Q values (See Tables 6.1.5-7 and 6.1.5-8). These sectors contain an area that, although sparsely populated, is accessible by the public; some reasonable probability exists that individuals of the general public could from time to time become dose recipients in these sectors.

The sector having the third highest D/Q value was the south sector. Sampling in this sector was rejected because the plant property extends about 3.5 miles from the plant or another 2.1 miles beyond the exclusion boundary. In this area there are no accessible sites with utilities available and public occupancy would be extremely low. As such, measurements made in this area would have little relevancy to estimating dose to the general public.

A fourth air sampling site is located at New Hill, N. C. in the north sector which is 3.5 miles from the plant. New Hill represents the community having the highest D/Q value. Data from this position will

be used to similarly evaluate the diffusion and dispersion calculations as they would relate to this population.

A fifth sampling station is located $\geq$12 miles in the west northwest sector, a low D/Q sector, to provide a control data point for comparison with the data from the other four sites. The control station should be minimally affected by plant effluents and therefore will serve to delineate the net plant effect at the other four stations.

2) Water Sampling

(a) Surface Water Sampling Locations - Surface water of the Main Reservoir will be sampled to provide a sensitive trend indicator of the potential dose available to man in the aquatic transport pathway. Although surface water is not directly consumed by the public without considerable processing, it does contribute to the raw water used by several municipal water systems and also provides the drinking water for the Shearon Harris Nuclear Power Plant. Data from the surface water sampling will also be useful in determining the adequacy of the drinking water sampling program as a primary estimator of population dose.

Two surface water sampling stations were chosen to optimize the sensitivity of the cooling tower blowdown lines. After mixing with the average Main Reservoir volume of 75,000 ac. ft., a small fraction will flow over the Main Dam Spillway and into the Cape Fear River.

The unaffected surface water sampling site is at CP&L's Cape Fear Plant near Moncure, N. C. This site is upstream on the Cape Fear River near the confluence of the Haw River and the Deep River about 4.5 miles downstream of the Jordan Dam. Data from this location will be indicative of trends occurring in background unaffected by the plant operations.

The affected surface water sampling location is at the spillway of the plant's 4,000 acre Main Reservoir which will be the receiving body for some low level quantities of liquid radioactive wastes. These wastes would be treated wastes released in limited quantities through the cooling water system to the surface water.

(b) Ground Water Sampling Locations - Data from the ground water sampling system will be used to demonstrate that no significant liquid transport of radioactive wastes is occurring within the ground water system. Since the plant is situated on only one minor aquifer flowing within the Triassic rock formation, only negligible transport should occur in the single aquifer.

The aquifer will be sampled from a common header of deep wells in the proximity of the diabase dikes. The header combines the well

waters which will most likely be affected by plant radioactivity releases.

(c) Drinking Water - Samples representative of radioactivity in public drinking water are to be used to directly monitor the ingestion of radioactivities in the water-to-man pathway. This will be accomplished using raw untreated water at the point where the nearest downstream municipality draws its water supply from the Cape Fear River. Such samples will in some cases exhibit higher activities than will occur in the processed water since for some radionuclides the water treatment and distribution process will provide a reduction of activity in the consumed water.

The sampling point for the drinking water pathway is located at the intake of the Lillington, North Carolina water treatment plant. Lillington is the first downstream municipality utilizing the waters of the Cape Fear River for a source of drinking water. The single point will also serve as a conservative estimator for the municipalities of Dunn, North Carolina and Fayetteville, North Carolina both withdrawing water a few miles downstream from Lillington.

The control or unaffected sample point used to compare with the drinking water sample will be the surface water sampled at CP&L's Cape Fear Plant. Comparisons of data from this control point with the samples at Lillington will provide the most sensitive estimator of the activity consumed through the public drinking water supplies downstream on the Cape Fear River.

3) Shoreline Sediments

Shoreline sediments are sampled in the zone in which cooling tower blowdown water discharged from the plant mixes with the Main Reservoir water. The information from this sample will provide an indication of the trends with which radionuclides pool in the benthic sediments component of the Main Reservoir system. Sampling at this point provides the optimum sensitivity for the indicator in that Main Reservoir concentrations of discharged radionuclides should be the highest in this zone.

4) Milk

Milk is sampled at four locations within a five-mile radius to provide primary data on the transport of radionuclides along the air-pasture-cow-milk transport pathway to man. The locations include three operating commercial dairies and a single family milk cow. The family milk cow was selected because it grazes at a distance of 1.9 miles from the plant site, the closest milk producer to the plant. The other three locations include all commercial milk producers located within the five-mile radius of the plant.

A fifth milk sampling location was chosen in the WNW sector at a distance of greater than 10 miles. This information is to provide an

estimate of activity in the unaffected milk. Such an estimate or control data will provide a comparison basis for the other sampling points.

It should be recognized that the single family cow sampling point will periodically be an unreliable sample source in that the cow will not produce milk during periods of breeding and pregnancy. This is obviously no great problem because during these periods the pathway to man ceases to exist also and loss of data becomes unimportant.

5) Fish

Fish sampling produces data indicative of the potential radionuclide consumption by man through an aquatic pathway. In addition,the data provides an integrating trend monitor of the radioactivities in the Main Reservoir. The fish sampling is accomplished in the Main Reservoir itself and upstream of the Buckhorn Dam on the Cape Fear River. The two data points provide the most valid comparisons for affected and unaffected samples.

6) Food Products

Food products are sampled to provide data on ingestion of radionuclides near the end of the air-vegetation-man pathway. The most sensitive sample media was determined to be broad leaf plants whose leaves constitute the consumed product. Three sampling points are family gardens located in three sectors having predicted D/Q values higher than the median for the surrounding area.

The locations were chosen on the basis of proximity to the plant, reliability of the garden's existence and representation of existing residents. The control location was placed in Pittsboro, N. C. approximately 12 miles from the plant in the west northwest sector which has a lower than average D/Q value. Comparisons of these data points provide the most sensitive evaluations of the air-food crop-man transport pathway.

7) External Radiation Measurements

Thermoluminescent dosimeters (TLD) will be used to determine external gamma exposure in each of the sectors around the plant. This is accomplished by locating dosimeters in each of sixteen sectors around the plant. The location will form two concentric rings; the inner ring at the site exclusion boundary and the outer ring with a variable radius of from four to five miles. In addition TLD Stations will be established in four of the nearby communities; Apex, Holly Springs, New Hill and Fuquay-Varina to provide a better estimate of the population doses there.

Two control stations are located in separate sectors having lower than average D/Q values. These stations are located at distances greater than 10 miles from the plant. To provide added insurance that at least one of these locations is an effective control station, they are placed

in nearly opposite sectors, one in the WNW sector and one in the east sector.

At each location the site is surveyed to determine the nature of the external radiation fields and to detect anomalies that may affect the TLD results. The TLD stations were placed in locations with minimum radiation rates. In addition the dosimeters will be placed approximately 2 meters above the ground level in unpopulated areas and 3 meters above ground level in the populated areas. The higher position was deemed necessary to discourage vandalism and theft of the dosimeters.

6.1.5.3 Analytical Techniques

Sampling and radiochemical analysis will be conducted by CP&L at the Shearon Harris Energy & Environmental Center. The collection, processing, radiochemical separations and analysis of environmental samples will be performed in accordance with the techniques (or comparable techniques) described in HASL-300 (Reference 6.1.5-7), Regulatory Guide 4.15 (Reference 6.1.5-8), and NCRP-50 (Reference 6.1.5-9). The following are the analytical techniques that will be used:

a) External Gamma Dosimetry - External gamma dosimetry will be performed using a thermoluminescent dosimetry (TLD) system. The TLD system will meet the performance and acceptance criteria presented in Regulatory Guide 4.13. Each TLD station will have two or more phosphors in a packet.

b) Gross Beta - The analysis of gross beta radioactivity measurements will be made utilizing a Beckman Widebeta II proportional counter. The air particulate samples will be mounted in two-inch stainless steel planchets and counted directly.

c) Tritium - Tritium measurements will be made by using a Beckman LS-233 liquid scintillation counter. Water samples requiring tritium analysis will be distilled prior to analysis.

d) Gamma Spectral Analyses - Gamma spectrum analysis will utilize a lithium-drifted germanium detector with a thin aluminum window housed in a steel and lead shield. The analyzer system will be a Nuclear Data 4420 with ND 812 computer.

e) Radiochemical Analyses - Iodine-131 in milk will be analyzed by using anion exchange resin, sodium hypochloride leach, and organic extraction. Iodine is precipitated as silver iodide, collected on a tared filter, dried, and counted on a beta-gamma coincidence system.

6.1.5.4 Lower Limits of Detection

The lower limits of detection (LLD) will be sufficiently sensitive to permit the program to detect concentrations of radionuclides in the environment which could cause exposures in excess of the limitations of Appendix I to 10CFR50. Table 6.1.5-9 presents the lower limits of detection for selected

radionuclides and sample types. However, LLDs well below these values should be achievable.

6.1.5.5 Quality Control Program

The purpose of this program is to assure that the preoperational and operational radiological monitoring measurements are valid. This program will include the use of control logs or charts, splitting samples with independent laboratories, separate technician analysis of duplicate or spike samples, and participation in the EPA's Environmental Radioactivity Laboratory Intercomparison Studies (cross-check) Program.

Control charts or logs record the periodic analyses of standard radionuclide samples and backgrounds. These document the stability of each counting instrument. Any significant deviation in the measurement of a standard sample from previous analysis may indicate a system malfunction or calibration shift which causes erroneous results. Sample splitting consists of dividing an environmental sample, such as milk, surface water or food crop, etc., into two or more portions prior to processing. Each portion is sent to independent laboratories for analyses. Participation in the EPA Intercomparison Program and comparisons of analyses with independent laboratories provide additional checks to either validate the program's analyses or to detect significant analytical errors as they develop.

Quality controls will be applied to the entire sample collection procedure to ensure that representative samples are obtained and that samples are not changed, cross-contaminated, or otherwise affected prior to their analysis because of handling errors or because of their storage environment.

The quality control program applied to the sample collection, handling, transport, storage, and documentation is primarily based on detailed procedures. The program is strengthened by periodic administrative checks and inspections as well as by continuous monitoring of the "error" rate detected by the analytical group.

The procedures contain detailed instructions on the sample size, location, frequency, labeling, transportation, storage, and corrective action to be taken if a sampler is out of service. They also detail the required documentation and chain of custody of the samples.

TABLE 6.1.5-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
1. Airborne Particulates and Radio-iodine	1	0.3 mi. S. on Rd. #1134 from Rd. #1011 intersection 2.5 mi. N. sector of site.	Continuous operating sampler with sample collection as required by dust loading, but at least once per 7 days	Weekly Weekly Quarterly	Gross Beta[2] I-131 (charcoal canisters[3]) Gamma Isotopic[5] Composite by Location
	2	1.6 mi. S. on Rd. #1134 from Rd. #1011 intersection 1.5 mi. NNE sector of site	Continuous operating sampler with sample collection as required by dust loading, but at least once per 7 days	Weekly Weekly Quarterly	Gross Beta[2] I-131 (charcoal canisters[3]) Gamma Isotopic[5] Composite by Location
	3	0.9 mi. S. on Rd. #1135 from U.S. #1 intersection 2.6 mi NE sector of site	Continuous operating sampler with sample collection as required by dust loading, but at least once per 7 days	Weekly Weekly Quarterly	Gross Beta[2] I-131 (charcoal canister[3]) Gamma Isotopic[5] Composite by Location

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
	4	New Hill 3.5 mi. NNE sector of site	Continuous operating sampler with sample Collection as required by dust loading but at least once per 7 days	Weekly Weekly Quarterly	Gross Beta[2] I-131 (charcoal canisters[3]) Gamma Isotopic[5] Composite by Location
	5	Pittsboro ≥12 mi. WNW sector of site (Control Station)[4]	Continuous operating sampler with sample collection as required by dust loading, but at least once per 7 day	Weekly Weekly Quarterly	Gross Beta[2] I-131 (charcoal canisters[3]) Gamma Isotopic[5] Composite by Location
2. Direct Radiation	1	0.3 mi. S on Rd. #1134 from Rd. 1011 intersection 2.5 mi. N. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	2	1.6 mi. S. on Rd. #1134 from Rd. 1011 intersection 1.5 mi. NNE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
2. Direct Radiation (Continued)	3	0.9 mi. S. on Rd. #1135 from U.S. #1 intersection 2.6 mi. NE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	4	New Hill 3.5 mi. NNE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	5	Pittsboro ≥12 mi. WNW sector of site (control station)4	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	6	Intersection of Rd. #1134 & #1135 0.9 mi. ENE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	7	House Ruins on Rd. #1134 0.8 mi. E. sector of site	Continuous mesurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	8	Dead End of Rd. #1134 0.7 mi. ESE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
2. Direct Radiation (Continued)	9	1 mi. W. of Hollomans xRd. 2.3 mi. SE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	10	Train Crossing under Rd. 1130 2.2 mi. SSE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	11	0.3 mi. E. of intersection Rd. 1131 & 1134 0.7 mi. S. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	12	Intersection @ Rd. #1131 & #1133 0.8 mi. SSW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	13	1.0 mi. S. of R/R on Rd. 1131 0.7 mi. SW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	14	Dead End of Rd. 1191 1.1 mi. WSW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
2. Direct Radiation (Continued)	15	Cem. on Rd. 1191 1.8 mi. W. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	16	1.2 mi. E. of intersection of U. S. #1 and Rd. 1011 1.7 mi. WNW sector of site.	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	17	Intersection of US #1 and Aux. Res. 1.4 mi. NW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	18	0.6 mi. N. on U.S. #1 from Station #17 1.3 mi. NNW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	19	Triple H Dairy 4.9 mi. NNE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	20	Intersection 1149 & U. S. #1 4.7 mi. NE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
2. Direct Radiation (Continued)	21	1.3 mi. E. of intersection 1152 & 1153 on Rd. 1152 4.8 mi. ENE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	22	Ragan's Dairy Farm 4.6 mi. E. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	23	Holloman Cem. 5.0 mi. ESE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	24	Sweet Springs Church 4.7 mi. SE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	25	0.23 mi. W. of intersection of 1401 & 1402 on Rd. 1402 4.8 mi. SSE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	26	Spillway on Main Res. 4.6 mi. S. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
2. Direct Radiation (Continued)	27	Buckhorn Church 4.8 mi. SSW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	28	0.6 mi. from Inter-section 1916 & 1924 on Rd. 1924, 4.8 mi. SW sector of	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	29	Industrial waste pond on Rd. 1916, 5.6 mi. WSW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	30	Exit intersection of Rd. 1700 & U.S. #1 5.1 mi. W. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	31	Intersection of Rd. 1910 & 243 4.5 mi. WNW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	32	Intersection of Rd. 1008 & 262, 4.8 mi. NW sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
2 Direct Radiation (Continued)	33	1.6 mi. E. from intersection 1008 & 1903 on Rd. 1903, 4.5 mi. from site NNW sector.	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	34	Apex (Population Center) 8.6 mi. NE. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	35	Holly Springs 6.9 mi. E. sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	36	Intersection of Rd. 1393 & 1421 11.2 mi. E. sector of site (Control Station)[4]	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
	37	Fuquay-Varina (Population Center) 9.7 mi. ESE sector of site	Continuous measurement with an integrated readout at least once per quarter	Quarterly	Gamma Dose
3. Waterborne					
a. Surface Water	26	Spillway on Main Res. 4.6 mi. S. sector of site	Composite sample[5] collected over a period of ≤31 days	Monthly Monthly Quarterly	Gross Beta Gamma Isotopic Tritium

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
3. Waterborne (Continued) a. Surface Water (Continued)	38	Cape Fear Steam Electric Plant Intake Structure (Control Station)[4] 6.1 mi. WSW sector of site	Composite sample[5] collected over a period of ≤31 days	Monthly Monthly Quarterly	Gross Beta Gamma Isotopic Tritium
	40	Lillington's Water Municipality 15.0 mi. SSE sector of site	Composite sample[5] collected over a period of ≤31 days	Monthly Monthly Quarterly	Gross Beta Gamma Isotopic Tritium
b. Groundwater	39	On site, deep well in the proximity of the diabase dikes	Grab sample Quarterly	Quarterly Quarterly	Gamma Isotopic[4] Tritium
c. Drinking	38	Cape Fear Steam Electric Plant Intake Structure (Control Station)[3] 6.1 mi. WSW sector of site	Composite sample[5] over two-week period if I-131 analysis is performed, monthly composite otherwise	I-131 on each composite when the dose[6] calculated for the consumption of the water is greater than 1 mrem per yr. Monthly Monthly Quarterly	I-131 Gross Beta Gamma Isotopic Tritium

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
3. Waterborne (Continued) c. Drinking (Continued)	40	Lillington's Water Municipality 15.0 mi. SSE sector of site	Composite sample[5] over two-week period if I-131 analysis is performed, monthly composite otherwise	I-131 on each composite when the dose[6] calculated for the water is greater than 1 mrem per yr.	I-131
				Monthly	Gross Beta
				Monthly	Gamma Isotopic
				Quarterly	Tritium
d. Sediment from Shoreline	41	Shoreline of Mixing Zone of Cooling Towers 2.8 mi. SSW sector of site	Surface soil sample semiannually	Semiannually	Gamma Isotopic[4]
4. Ingestion					
a. Milk	42	Louis Fish Res. (single cow) 1.9 mi. NW sector of site	Grab samples semi-monthly when animals are on pasture, monthly @ other times	Each sample	I-131 & Gamma Isotopic[4]
	19	Triple H. Dairy 4.9 mi. NNE sector of site	Grab samples semi-monthly when animals are on pasture, monthly @ other times	Each sample	I-131 & Gamma Isotopic[4]

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
4. Ingestion (Continued) a. Milk (Continued)	43	Goodman's Farm 2.3 mi. N. sector of site	Grab samples semi-monthly when animals are on pasture, monthly @ other times	Each sample	I-131 & Gamma Isotopic[4]
	22	Ragan's Dairy Farm 4.6 mi. E. sector of site	Grab samples semi-monthly when animals are on pasture, monthly @ other times	Each sample	I-131 & Gamma Isotopic[4]
	5	Pittsboro (Control Station)[4] >12 mi. WNW sector of site	Grab samples semi-monthly when animals are on pasture, monthly @ other times	Each sample	I-131 & Gamma Isotopic[4]
b. Fish	44	Site varies within the Harris impoundment	One sample of each of the following: 1. Free Swimmers 2. Bottom Feeders semiannually	Semiannually	Gamma Isotopic[4] on edible portion for each
	45	Site varies above Buckhorn Dam on Cape Fear River (Unaffected by Site) (Control Station)[4]	One sample of each of the following: 1. Free Swimmers 2. Bottom Feeders semiannually	Semiannually	Gamma Isotopic[4] on edible portion for each
c. Food Products	46	Behind nursing home 2.3 mi. NE. sector of site	Broad leaf vegetation at time of each harvest	At time of each harvest	Gamma Isotopic[4]

4

TABLE 6.1.5-1 (Continued)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Sample Point	Sample Point, Description Distance, & Direction[1]	Sampling and Collection Frequency	Analysis Frequency	Analysis
4. Ingestion (Continued) c. Food Products (Continued)	47	Plant access Rd. 1.7 mi. NNE sector of site	Broad leaf vegetation at time of each harvest	At time of each harvest	Gamma Isotopic[4]
	43	Goodman's Farm 2.3 mi. N. sector of site	Broad leaf vegetation at time of each harvest	At time of each harvest	Gamma Isotopic[4]
	5	Pittsboro ≤12 mi. WNW sector of site (Control Station)[3]	Broad leaf vegetation at time of each harvest	At time of each harvest	Gamma Isotopic[4]

4

NOTES TO TABLE 6.1.5-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

1. Sample locations are shown on Figure 6.1.5-1.

2. Particulate samples will be analyzed for gross beta radioactivity 24 hours or more following filter change to allow for radon and thorium daughter decay. If gross beta activity is greater than ten times the yearly mean of the control sample station activity, gamma isotopic analysis will be performed on the individual samples. | 4

3. Control sample stations (or background stations) are located in areas that are unaffected by plant operations. All other sample stations that have the potential to be affected by radioactive emissions from plant operations are considered indicator stations.

4. Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the plant operations.

5. Composite samples will be collected with equipment (or equivalent) which is capable of collecting an aliquot at time intervals which are very short (e.g., every 2 hours) relative to the compositing period (e.g., monthly).

6. The dose will be calculated for the maximum organ and age group, using the methodology contained in Regulatory Guide 1.109, Rev. 1 and the actual parameters particular to the site.

TABLE 3.12-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

	Reporting Levels				
Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m^3)	Fish (pCi/Kg, wet)	Milk (pCi/l)	Food Products (pCi/Kg, wet)
H-3	2×10^4 (a)				
Mn-54	1×10^3		3×10^4		
Fe-59	4×10^2		1×10^4		
Co-58	1×10^3		3×10^4		
Co-60	3×10^2		1×10^4		
Zn-65	3×10^2		2×10^4		
Zr-Nb-95	4×10^2 (b)				
I-131	2	0.9		3	1×10^2
Cs-134	30	10	1×10^3	60	1×10^3
Cs-137	50	20	2×10^3	70	2×10^3
Ba-La-140	2×10^2 (b)			3×10^2 (b)	

(a) For drinking water samples. This is 40CFR Part 141 value.
(b) Total for parent and daughter.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of)) CAROLINA POWER & LIGHT COMPANY) AND NORTH CAROLINA EASTERN) MUNICIPAL POWER AGENCY)) (Shearon Harris Nuclear Power) Plant, Units 1 and 2))	Docket Nos. 50-400 OL 50-401 OL

CERTIFICATE OF SERVICE

I hereby certify that copies of all the documents listed on the attached Document List were served this ninth day of March, 1984, by deposit in the U.S. mail, first class, postage prepaid, to the parties on the attached Service List.

Pamela H. Anderson

Pamela H. Anderson

Dated: March 9, 1984

DOCUMENT LIST

1. "Applicants' Motion For Summary Disposition Of Joint Intervenors' Contention VI (Monitoring Systems)."

2. "Affidavit Of Dr. William H. Wilkie And Ronald L. Shearin In Support Of Applicants' Motion For Summary Disposition Of Joint Intervenors' Contention VI" with Attachments A through E thereto.

3. "Applicants' Statement Of Material Facts As To Which There Is No Genuine Issue To Be Heard On Joint Contention VI."

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of CAROLINA POWER & LIGHT COMPANY and NORTH CAROLINA EASTERN MUNICIPAL POWER AGENCY (Shearon Harris Nuclear Power Plant, Units 1 and 2)	))))))))	Docket Nos. 50-400 OL 50-401 OL

SERVICE LIST

James L. Kelley, Esquire
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. Glenn O. Bright
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dr. James H. Carpenter
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Charles A. Barth, Esquire
Janice E. Moore, Esquire
Office of Executive Legal Director
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Docketing and Service Section
Office of the Secretary
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. Daniel F. Read, President
CHANGE/ELP
5707 Waycross Street
Raleigh, North Carolina 27606

John D. Runkle, Esquire
Conservation Council of North Carolina
307 Granville Road
Chapel Hill, North Carolina 27514

M. Travis Payne, Esquire
Edelstein and Payne
P.O. Box 12607
Raleigh, North Carolina 27605

Dr. Richard D. Wilson
729 Hunter Street
Apex, North Carolina 27502

Mr. Wells Eddleman
718-A Iredell Street
Durham, North Carolina 27705

Richard E. Jones, Esquire
Vice President and Senior Counsel
Carolina Power & Light Company
P.O. Box 1551
Raleigh, North Carolina 27602

Dr. Phyllis Lotchin
108 Bridle Run
Chapel Hill, North Carolina 27514

Dr. Linda W. Little
Governor's Waste Management Board
513 Albemarle Building
325 North Salisbury Street
Raleigh, North Carolina 27611

Bradley W. Jones, Esquire
U.S. Nuclear Regulatory Commission
Region II
101 Marrietta Street
Atlanta, Georgia 30303

Ruthanne G. Miller, Esquire
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. Robert P. Gruber
Executive Director
Public Staff - NCUC
P.O. Box 991
Raleigh, North Carolina 27602