CHAPTER 12 - RADIATION PROTECTION

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12.1 ENSURING THAT OCCUPATIONAL RADIATION EXPOSURES ARE AS LOW AS IS REASONABLY ACHIEVABLE (ALARA)

12.1.1 Policy Considerations

12.1.1.1 Occupational Radiation Exposure

Oyster Creek is committed to maintaining occupational radiation exposures as low as reasonably achievable (ALARA) while performing all activities related to operation of the station. This commitment is reflected by providing for effective control of radiation exposure in the following major areas:

a. Upper management direction and support

b. Detailed ALARA policy and procedures

c. Consideration of ALARA during design of facilities and equipment

d. Development of good procedures and radiation practices, including preplanning and proper use of appropriate equipment and work techniques by well trained personnel

e. Audit and appraisal of performance

f. Implementation of improvements wherever and whenever they are reasonably achievable.

12.1.1.2 Organizational Structure and Responsibilities

The organization is structured to provide assurance that the ALARA policy is effective in the areas described above. The individuals and groups responsible for these activities are identified in Section 13.1. The overall coordination of the ALARA program is assigned to the Radiological Engineering Department.

12.1.1.3 Station ALARA Policy

The Radiation Protection Plan implements the ALARA policy in all phases of station operation. Employees are trained in radiation protection, station layout and proper work practices. Procedures, facility modification, and equipment modifications are reviewed for ALARA prior to approval by station management. Routine and special surveys are performed to accurately assess radiological conditions. Radiation work permits (RWP) are required for the following conditions:

a. Entering a radiation area.

b. Entering an airborne radioactivity area.

c. Entering a contaminated area.

d. Entering a high radiation area.

e. Entering an area with unknown radiological conditions.

f. Maintenance of equipment, controls, or instrumentation which contain radioactive material.

Job surveillance/supervision assures that employees understand and follow the specified procedures and good work practices. The station ALARA policy incorporates the guidance provided in Regulatory Guides 8.8, 8.10, and 8.27 and in 10CFR20.

12.1.2 Design Considerations

The station was designed to minimize occupational exposures as much as possible, by using procedures and administrative controls to limit radiation exposures below the limits of 10CFR20. The considerations and methods employed are discussed in this subsection. The detailed facility design features for ensuring this are discussed in Subsection 12.3.1.

Material activation and the resulting impact on radiation fields is considered when procuring spare parts or when modifying a component that communicates with reactor coolant.

Considerations included in the design towards reducing the need for maintenance of equipment, reducing radiation levels and time spent where maintenance and other operational activities are required are:

a. Redundancy of equipment or components, where necessary, to reduce the need for immediate repair when radiation levels may be high.

b. Provisions to reduce the source intensity by isolating, draining and flushing, prior to maintenance.

c. Provision of easy access and space for tool laydown.
d. Standardized equipment design and design practices to enhance maintainability.

e. Provisions for isolation and flanged connections to facilitate quick removal of components from the system.

f. Locating equipment, instruments and sampling stations which will require routine maintenance, calibration, operation or inspection for ease of access and minimum required occupancy time in radiation areas.

g. Provisions for transporting equipment or components requiring service to a lower radiation area.

h. Providing adequate shielding or sufficient distance between radiation sources and maintenance areas.

i. Locating equipment, instruments and sampling stations in areas with the lowest practical radiation level.

Shielding design analysis and review was performed by personnel competent in radiation protection during all phases of the station design. All significant changes in the design which could affect the operations and maintenance procedures causing a substantial change in occupational exposure, were also reviewed. The following are specific examples of design alterations originating in radiation protection design reviews leading to reduced radiation exposures:

a. Addition of supplemental shielding between the Core Spray Booster Pumps and the personnel airlock (El. 51'-3" of the Reactor Building). This shielding will allow continuous occupation of the Control Room following postulated accidents.

b. Additional lead shielding was added to the reactor cavity drain line, located on the west side of the Reactor Building at El. 83'. This will allow personnel to perform maintenance work in the vicinity of the line without sacrificing ALARA considerations.

c. GPUN has a leakage reduction program aimed at reduced exposure due to leakage from systems containing radioactive fluids. This program includes periodic maintenance and inspection, as well as a design review of relevant systems at the station, and has resulted in systems design changes, station procedural changes, and creation of a leakage data base, to reduce the absolute number and volume of leaks.

d. During modifications to the Offgas and Radwaste Buildings, specific ALARA provisions were made to the design including:

1. Segregation of redundant equipment by shield walls.

2. Inclusion of roof hatches and knockout walls where extensive room is required for maintenance.

3. The fan coil units are located over the charcoal absorber of lowest expected activity and are equipped with special shielding.

4. Wherever possible new valve and instrument racks were located in low radiation areas to facilitate maintenance.

5. All equipment was designed to be drained or purged prior to servicing to reduce radworker exposure.

12.1.3 Operational Considerations

12.1.3.1 Operating Procedures and Techniques

Operating procedures, for Radiologically significant activities, are reviewed by the Radiological Engineering Department. Specific criteria, which define the Radiologically significant activities, are contained in the station 'Procedure Control' procedure. Operating procedures are reviewed for ALARA considerations in accordance with Regulatory Guide 8.8 criteria, and revised as necessary. Maintenance tasks are examined and compared with criteria contained in the “Occupational Alara Planning and Controls” procedure. Tasks which meet or exceed these criteria are identified to Radiological Engineering for planning and production support.

Information from other operating plants as well as plant information, if available, is considered during the review process.

The Radiological Controls Procedures establish requirements, responsibilities and procedures for all aspects of radiation control including ALARA. The Radiological Controls staff uses these procedures and controls to ensure that occupational radiation exposures are as low as is reasonably achievable. Routine and special surveys are performed, including air sampling, to determine radiation/contamination levels and sources, and to assure the adequacy of controls and protective measures. Exposures and radiation level trends are studied to determine the cause of normal and unusual exposures. Adequate surveillance and supervision is provided to ensure that the procedures are understood and followed.

Radiation Work Permits (RWPs), in conjunction with Radiological Engineering Reviews, are used to identify radiological conditions, and establish controls and proper work techniques for individual tasks that involve work in radiologically controlled areas. The RWPs specify survey requirements, protective equipment, exposure reduction measures and surveillance requirements for each situation. Individual exposure data obtained from self-reading dosimeters and Dosimeter of Legal Record (DLR) is correlated with the RWPs. This provides a means to track exposure by task, system and individual. The exposure information is used for timely identification and correction of exposure problems, identifying methods for further exposure reduction, determining working dose rates and sources of exposure, and for preplanning future jobs.

12.1.3.2 Planning Radiation Exposure Related Operation

All actions resulting in significant radiation exposure related to normal maintenance, radwaste handling, in-service inspection (ISI), and refueling are preplanned to assure that occupational radiation exposures are as low as is reasonably achievable. The Radiation Work Permit (RWP) described in Subsection 12.1.3.1, procedures, and Radiological Engineering Reviews are the principal means of planning and controlling exposure related operations.

Prior to each scheduled maintenance and refueling outage, meetings are held to plan the outage. Significant tasks and operations are identified and planned with respect to schedule, manpower requirements, exposure usage and radiation control. Previous outage exposure data, procedures, Radiological Engineering Reviews, and radiation survey data are used to identify areas with high potential for exposure usage enabling exposure reduction techniques to be implemented where reasonably achievable.

During outages, meetings are held to review progress, coordinate activities, and solve problems which may have occurred. RWPs are issued and/or updated to account for changing exposure conditions, and to effectively use personnel. Thus maintenance and refueling outages receive both long and short term planning and development.

12.1.3.3 Operational Changes for ALARA Considerations

An ALARA file is maintained for appraisals and future evaluations. The file maintains information on past exposure usage, evaluations, recommendations and actions. Exposure information from other plants is included in the ALARA file. The ALARA file is organized in such a manner as to provide timely information for job planning, procedure evaluation, and RWP preparation. This provides the ability to plan, prepare and modify operations, procedures and techniques which maintain occupational radiation exposure as low as is reasonably achievable.

Exposure usage is tracked and appraised on an ongoing basis. The ALARA status of the station is an ongoing daily project and this status is also assessed prior to scheduled outages and reviewed upon completion of the outage. An independent audit of various aspects of the station's radiological control program is performed on an ongoing basis. This program meets all 10CFR20 regulations and utilizes the guidance of Regulatory Guides 8.8 and 8.10.

12.2 RADIATION SOURCES

12.2.1 Contained Source

The sources contained in the equipment of the primary, auxiliary and radioactive waste management systems and all other major sources of radiation during normal operation are described in this subsection. Three types of radiation sources occur in the plant:

a. Primary radiation from the reactor core

b. Secondary radiation resulting from nuclear reaction between the primary radiation and the reactor environment

c. Release of radioactive materials from the reactor core to the coolant.

During normal plant operation, secondary sources and released radioactive materials are transported in either the reactor coolant or main steam to process equipment in the plant.

The source intensity in equipment and piping handling radioactive fluids was determined from that in the reactor water or reactor steam by considering the processes that the reactor water or steam have undergone (dilution, filtration, demineralization, delay, or change of phase) prior to entering the equipment or pipe. In all cases, the process or combination of process leading to the highest activity was considered.

The shield design of the Oyster Creek Nuclear Generating Station (OCNGS) is based on design radiation sources which provide a rational basis for design. The source data assumes plant operation is at maximum design power with a noble gas release rate of 0.3 curies per second at 30 minutes decay. Halogen concentrations in the reactor water are based on a fission product equilibrium halogen concentration as defined in Section 11.1. Concentration of other fission and activation products are based on information also provided in Section 11.1. The activities of these sources are considered to be maximum values although it is not anticipated that the plant will normally operate at these high levels.

For shielding, it is conservative to design for fission product sources at peak values. It should be noted that activation products, principally N-16, control shielding calculations in most of the primary system. In areas where fission products are significant, conservative allowance is made for transient decay, while at the same time providing for transient increase of the noble gas source, daughter product formation, and energy level of emission. Areas where fission products are significant relative to N-16 include: Offgas System downstream of offgas condenser, liquid or solid radwaste equipment, portions of the feedwater system downstream of the hotwell, including condensate treatment equipment.

12.2.1.1 Radiation from Reactor Core

During full power operation, radiation from the reactor core proper consists of neutrons and gamma radiation resulting from the fission process itself; gamma radiation resulting from capture or inelastic scattering of neutrons within the core; and gamma radiation resulting from fission product decay. In addition, inelastic neutron interactions with the core shroud and RPV result in the production of additional gamma rays.

12.2.1.2 Activity in Steam and Condensate

Piping and equipment that contain reactor water, steam, or condensate are principal sources of radiation. The predominant activity requiring shielding in these systems is the N-16 carried in the steam and water from the reactor. Usually, activity sources in the steam other than N-16 can be neglected since their magnitude is so much smaller. The radiation source strength at any of the various pieces of equipment containing steam or reactor water is then the RPV appropriate outlet nozzle activity of N-16 decayed by the transit time from the reactor outlet to the equipment.

12.2.1.3 Activity in Reactor Water Cleanup and Condensate Demineralizer

The radiation source in these systems is due to the radioisotopes originating in the reactor water and steam. In the RWCU system, radioisotopes (including corrosion products) present in the water are the source of activity. In the condensate demineralizer system, the sources are the non gaseous activity carried over in the primary steam and daughters resulting from radioactive gas decay in the condensate demineralizer system itself. In the Reactor Water Clean Up (RWCU) System, N-16 and similar short-lived activity were taken into account. However, this source was not considered in the condensate demineralizer systems where transit times from the reactor are long and N-16 has essentially decayed.

In the reactor water, the corrosion product activity is present in both soluble and insoluble forms. The latter is primarily removed by filtration and the former by ion exchange. When considering fission product accumulation, the predominant fission products were assumed to be essentially soluble. Activity accumulates in equipment such as filters and demineralizers. Activity levels in such equipment build up during plant operation until equilibrium is achieved or until the activity is removed (or reduced) by backwashing, or by disposal or by regeneration of resins.

12.2.1.4 Activity in Offgas Building

The expected maximum values of the radioisotopic inventory for each major piece of Augmented Offgas (AOG) System equipment with radioactive contents is listed on Table 12.2-1.

12.2.1.5 Activity in Radwaste Building

The expected maximum values of the radioisotopic inventory for each major piece of equipment in the Liquid Radwaste Treatment System are listed in Tables 12.2-2 and 12.2-3 for high purity waste and chemical waste/floor drain system respectively. The source for each equipment and components of the waste processing system were computed by using computer code "CORN". (Reference 1)

The design basis of radioactive isotopic for each major piece of equipment in the solid waste system, are listed in Table 12.2-4.

12.2.2 Airborne Radioactive Material Sources

Airborne activity sources result from leakage from the equipment and components of the Reactor Coolant System and other fluid systems containing radioactivity, into various plant areas.

12.2.3 References

(1) Computer Code "CORN", developed by Burns & Roe, 1977.

TABLE 12.2-1
(Sheet 1 of 4)

EQUIPMENT RADIOISOTOPIC INVENTORY
AUGMENTED OFFGAS SYSTEM

Volume of Component - cm^3		Delay Pipe 1.926(8)	HEPA Filter (Existing) 3.475(4)	Preheater 2.197(6)	Recombiner 8.908(5)	Cooler 1.085(6)	Water Separator (Water Cooled) 2.664(4)	Chiller (Freon Cooled) 9.434(4)	Freeze Out Drier (Freon Cooled) 8.544(4)
						INVENTORY* (Microcuries)			
Isotope	Half Life								
N-13	9.96 min.	1.8(7)	1.1(2)	7.0(3)	2.8(3)	2.4(4)	5.4(2)	1.9(3)	1.7(3)
N-16	7.14 sec.	1.1(11)							
N-17	4.14 sec.	6.1(6)							
O-19	26.8 sec.	2.3(9)	7.9(-28)	4.1(-26)	1.6(-26)	1.4(-25)	3.6(-28)	7.3(-28)	5.4(-28)
F-18	1.83 hr.	1.1(7)	1.4(3)	9.0(4)	3.6(4)	3.1(5)	7.5(3)	2.7(4)	2.4(4)
Kr-83m	1.86 hr.	2.6(7)	3.5(3)	2.2(5)	8.9(4)	7.6(5)	1.8(4)	6.5(4)	5.9(4)
Kr-85	10.74 yr.	1.5(5)	2.7(1)	1.7(3)	7.0(2)	6.0(3)	1.5(2)	5.2(2)	4.7(2)
Kr-85m	4.4 hr.	4.6(7)	7.4(3)	4.7(5)	1.9(5)	1.6(6)	3.9(4)	1.4(5)	1.3(5)
Kr-87	76 min.	1.5(8)	1.8(4)	1.1(6)	4.5(5)	3.8(6)	9.3(4)	3.3(5)	3.0(5)
Kr-88	2.79 hr.	1.5(8)	2.2(4)	1.4(6)	5.7(5)	4.9(6)	1.2(5)	4.2(5)	3.8(5)
Xe-131m	11.96 d.	1.1(5)	2.1(1)	1.3(3)	5.3(2)	4.5(3)	1.1(2)	3.9(2)	3.5(2)
Xe-133	5.27 d.	6.2(7)	1.1(4)	7.0(5)	2.9(5)	2.4(6)	6.0(4)	2.1(5)	1.9(5)
Xe-133m	2.26 d.	2.2(6)	3.9(2)	2.5(4)	1.0(4)	8.6(4)	2.1(3)	7.4(3)	6.7(3)
Xe-135	9.16 hr.	1.7(8)	2.9(4)	1.8(6)	7.5(5)	6.4(6)	1.6(5)	5.5(5)	5.0(5)
Xe-135m	15.7 min.	2.0(8)	4.3(3)	2.7(5)	1.1(5)	9.4(5)	2.2(4)	7.4(4)	6.8(4)
Xe-138	14.2 min.	6.8(8)	1.7(4)	1.1(6)	4.3(5)	3.7(6)	8.5(4)	3.0(5)	2.7(5)
I-131	8.10 d.	2.5(3)	4.5(-1)	2.8(1)	1.2(1)	9.8(1)	2.4(0)	8.6(0)	7.8(0)
I-132	2.30 hr.	9.2(3)	1.3(0)	8.3(1)	3.3(1)	2.9(2)	7.0(0)	2.5(1)	2.2(1)

* Note that inventory estimates are based on the inlet specific activities to each equipment item.

TABLE 12.2-1
(Sheet 2 of 4)

EQUIPMENT RADIOISOTOPIC INVENTORY
AUGMENTED OFFGAS SYSTEM

Isotope	Adsorber Bed I 9.755(6)	Adsorber Bed II 9.775(6)	Adsorber Bed III 9.775(6)	Adsorber Bed IV 9.775(6)	HEPA Filter 3.475(4)
	INVENTORY* (Microcuries)				
N-13	6.3(5)	3.8(5)	2.2(5)	1.3(5)	2.8(2)
N-16					
N-17					
O-19	8.1(-16)	7.1(-21)	6.2(-26)	5.5(-31)	1.7(-38)
F-18	3.6(5)				
Kr-83m	8.7(5)	7.8(5)	6.9(4)	6.1(3)	1.9(0)
Kr-85	6.4(3)	6.4(4)	6.4(4)	6.4(4)	2.3(2)
Kr-85m	1.8(7)	6.4(6)	2.3(6)	8.2(5)	1.1(3)
Kr-87	4.6(7)	1.3(6)	3.9(4)	1.1(3)	1.2(-1)
Kr-88	5.5(7)	1.1(7)	2.6(6)	4.4(5)	3.1(2)
Xe-131m	4.8(1)	3.5(4)	2.5(4)	1.8(4)	4.7(1)
Xe-133	2.6(7)	1.3(7)	6.4(6)	3.2(6)	5.5(3)
Xe-133m	9.1(5)	1.8(5)	3.5(4)	6.8(3)	4.7(0)
Xe-135	6.9(7)	3.4(3)	1.7(-1)	8.3(-6)	
Xe-135m	1.8(7)				
Xe-138	6.7(7)				
I-131	1.0(3)				
I-132	3.2(3)				

* Note that inventory estimates are based on the inlet specific activities to each equipment item.

TABLE 12.2-1
(Sheet 3 of 4)

EQUIPMENT RADIOISOTOPIC INVENTORY
AUGMENTED OFFGAS SYSTEM

Volume of Component - cm^3		Delay Pipe 1.926(8)	HEPA Filter (Existing) 3.475(4)	Preheater 2.197(6)	Recombiner 8.908(5)	Cooler 1.085(6)	Water Separator (Water Cooled) 2.664(4)	Chiller (Freon Cooled) 9.434(4)	Freeze Out Drier (Freon Cooled) 8.544(4)
					INVENTORY* (Microcuries)				
Isotope	Half Life								
I-133	21.0 hr.	7.7(3)	1.3(0)	8.5(1)	3.5(1)	2.9(2)	7.2(0)	2.6(1)	2.3(1)
I-134	53.0 min.	1.8(4)	1.7(0)	1.1(2)	4.4(1)	3.8(2)	9.1(0)	3.2(1)	2.9(1)
I-135	6.60 hr.	1.6(4)	2.6(0)	1.7(2)	6.7(1)	5.8(2)	1.4(1)	5.0(1)	4.5(1)
Rb-87	4.7(10) yr.		3.0(-11)	1.9(-9)	7.7(-10)	6.6(-9)	1.7(-10)	5.9(-10)	5.4(-10)
Rb-88	18.0 min.		2.0(4)	1.3(6)	5.2(5)	4.4(6)	1.1(5)	3.9(5)	3.5(5)
Cs-135	2.0(6) yr.		9.5(-7)	6.0(-5)	2.5(-5)	2.1(-4)	5.3(-6)	1.9(-5)	1.7(-5)
Cs-138	32.0 min.		2.9(4)	1.9(0)	7.5(5)	6.4(6)	1.6(5)	5.5(5)	5.0(5)
Total (Microcuries)		1.1(11)	1.6(5)	1.0(7)	4.2(6)	3.6(7)	8.7(5)	3.1(6)	2.8(6)

* Note that inventory estimates are based on the inlet specific activities to each equipment item.

TABLE 12.2-1
(Sheet 4 of 4)

EQUIPMENT RADIOISOTOPIC INVENTORY
AUGMENTED OFFGAS SYSTEM

	Adsorber Bed I 9.755(6)	Adsorber Bed II 9.775(6)	Adsorber Bed III 9.775(6)	Adsorber Bed IV 9.775(6)	HEPA Filter 3.475(4)
			INVENTORY* (Microcuries)		
Isotope					
I-133	3.2(1)				
I-134	4.7(3)				
I-135	6.3(3)				
Rb-87	5.4(-8)	1.9(-7)	2.0(-7)	2.0(-7)	7.0(-10)
Rb-88	4.3(7)	1.2(7)	2.5(6)	4.9(5)	3.5(2)
Cs-135	1.6(-3)	3.8(-2)	3.8(-2)	3.8(-2)	1.3(-4)
Cs-138	7.4(7)				
Total (Microcuries	4.3(8)	4.5(7)	1.4(7)	5.1(6)	7.8(3)

* Note that inventory estimates are based on the inlet specific activities to each equipment item.

TABLE 12.2-2
(Sheet 1 of 4)

EQUIPMENT RADIOISOTOPIC INVENTORY
HIGH PURITY WASTE SYSTEM

Volume of Component - cm^3		Collection Tank 1.1355(+8)	Filter 1.797875(+6)	First Demineralizer 1.08976(+7)	Second Demineralizer 1.08976(+7)	Resin Trap 1.4057(+4)	Sampling Tank 1.1355(+8)
		INVENTORY (Microcuries)					
Isotope	Half-Life						
N-13	9.96 min.	1.12(+4)	1.77(+2)	1.87(+3)	1.80(+1)	2.41(+0)	2.03(-27)
F-18	1.83 hr.	1.33(+4)	2.13(+2)	8.80(+3)	8.10(+1)	1.14(+1)	2.90(-2)
Br-83	2.41 hr.	2.38(+5)	4.09(+3)	1.77(+5)	1.63(+3)	2.28(+2)	2.26(+0)
Br-84	31.8 min.	1.00(+5)	1.59(+3)	3.22(+4)	3.01(+2)	4.15(+1)	1.06(-7)
Br-85	3.00 min.	6.15(+3)	9.74(+1)	7.23(+2)	7.10(+0)	9.33(-1)	0.0
Kr-83m	1.86 hr.	2.35(+5)	4.95(+3)	2.37(+5)	2.35(+4)	3.06(+2)	6.71(+2)
Kr-85	10.7 yr.	5.43(-1)	5.55(-1)	3.22(+1)	5.37(+2)	4.15(-2)	7.99(-1)
Kr-85m	4.4 hr.	5.79(+3)	2.21(+2)	5.58(+3)	5.56(+2)	7.20(+0)	4.47(+2)
Sr-89	50.0 d.	2.41(+5)	1.62(+5)	8.17(+6)	7.40(+4)	1.05(+4)	2.39(+2)
Sr-90	28.0 yr.	1.84(+4)	1.26(+4)	7.38(+5)	7.10(+3)	9.52(+2)	1.90(+1)
Sr-91	9.70 hr.	4.47(+6)	9.54(+5)	8.94(+6)	8.14(+4)	1.15(+4)	1.95(+3)
Sr-92	2.60 hr.	1.95(+6)	3.51(+4)	1.50(+6)	1.38(+4)	1.93(+3)	2.59(+1)
Y-90	64.0 hr.	1.70(+3)	3.51(+3)	6.26(+5)	6.08(+3)	8.08(+2)	4.87(+0)
Y-91	59.0 d.	2.19(+4)	3.80(+4)	2.26(+6)	2.04(+4)	2.92(+3)	5.20(+1)
Y-91m	50 min.	3.08(+6)	7.39(+5)	6.34(+6)	5.77(+4)	8.18(+3)	1.52(+3)
Y-92	3.53 hr.	1.80(+6)	8.62(+4)	2.11(+6)	1.93(+4)	2.72(+3)	2.26(+2)
Zr-95	64.0 d	3.13(+3)	4.13(+3)	9.94(+3)	3.00(+1)	1.28(+1)	3.10(+2)
Zr-97	17.0 hr.	2.58(+2)	4.98(+0)	1.29(+1)	2.47(+0)	1.66(-2)	3.06(-3)
Nb-95	3.5 d.	3.25(+3)	4.34(+3)	1.14(+4)	3.12(+1)	1.47(+1)	3.25(+2)
Mo-99	67.0 hr.	1.62(+6)	1.73(+6)	1.03(+6)	1.11(+5)	1.33(+3)	1.37(+5)
Te-99m	6.0 hr.	1.05(+7)	1.83(+6)	1.23(+7)	1.07(+5)	1.58(+4)	5.84(+4)

TABLE 12.2-2
(Sheet 2 of 4)

EQUIPMENT RADIOISOTOPIC INVENTORY
HIGH PURITY WASTE SYSTEM

Volume of Component - cm^3		Collection Tank 1.1355(+8)	Filter 1.797875(+6)	First Demineralizer 1.08976(+7)	Second Demineralizer 1.08976(+7)	Resin Trap 1.4057(+4)	Sampling Tank 1.1355(+8)
		INVENTORY (Microcuries)					
Isotope	Half-Life						
Tc-101	14.0 min.	2.32(+5)	3.64(+3)	4.51(+4)	4.30(+2)	5.82(+1)	2.78(-18)
Ru-103	40.0 d.	1.53(+3)	2.01(+3)	4.52(+3)	1.47(+1)	5.83(+0)	1.51(+2)
Ru-106	1.0 yr.	2.07(+2)	2.76(+2)	7.31(+2)	1.99(+0)	9.43(-1)	2.07(+1)
Te-129m	33.0 d.	3.11(+3)	2.08(+3)	9.73(+4)	8.82(+2)	1.26(+2)	3.06(+0)
Te-129	1.14 hr.	1.79(+3)	1.32(+3)	6.19(+4)	5.61(+2)	7.98(+1)	1.95(+0)
Te-132	3.25 d.	3.55(+6)	2.01(+6)	2.86(+7)	2.59(+5)	3.69(+4)	3.07(+3)
I-129	1.57×10^7 yr.	1.32(+0)	3.25(+0)	1.56(+3)	1.44(+1)	2.01(+0)	4.68(-3)
I-131	8.10 d.	1.03(+6)	6.51(+5)	1.76(+7)	1.59(+5)	2.27(+4)	9.17(+2)
I-132	2.30 hr.	4.77(+6)	2.08(+6)	3.03(+7)	2.75(+5)	3.91(+4)	3.17(+3)
I-133	21.0 hr.	5.34(+6)	1.82(+6)	1.36(+7)	1.24(+5)	1.75(+4)	3.12(+3)
I-134	53.0 min.	1.46(+6)	2.32(+4)	6.55(+5)	6.07(+3)	8.45(+2)	5.21(-3)
I-135	6.70 hr.	4.82(+6)	4.17(+5)	5.65(+6)	5.16(+4)	7.29(+3)	8.94(+2)
Xe-133	5.30 d.	2.72(+5)	4.43(+5)	1.38(+7)	1.58(+5)	1.78(+4)	2.55(+5)
Xe-133m	2.26 d.	1.47(+4)	2.20(+4)	3.49(+5)	4.24(+1)	4.50(+2)	1.23(+4)
Xe-135	9.10 hr.	2.67(+6)	1.16(+6)	6.84(+6)	2.95(+5)	8.82(+3)	8.02(+5)
Xe-135m	16.0 min.	1.29(+6)	1.16(+5)	1.58(+6)	1.40(+5)	2.04(+3)	7.70(+3)
Cs-134	2.20 yr.	1.24(+4)	8.47(+3)	4.89(+5)	4.44(+3)	6.31(+2)	1.24(+1)
Cs-135	2.3×10^6 yr.	2.16(+3)	1.08(+4)	7.29(+5)	2.21(+3)	9.40(+2)	7.19(+2)
Cs-136	13.0 d.	8.10(+3)	5.28(+3)	1.83(+5)	1.66(+3)	2.36(+2)	7.82(+0)
Cs-137	29.9 yr.	1.42(+4)	9.74(+3)	5.68(+5)	5.57(+3)	7.33(+2)	1.52(+1)
Cs-138	32. min.	7.32(+5)	1.16(+4)	2.36(+5)	2.20(+3)	3.04(+2)	8.79(-7)
Ba-137m	2.55 min.	1.32(+4)	9.10(+3)	5.31(+5)	5.21(+3)	6.85(+2)	1.42(+1)

TABLE 12.2-2
(Sheet 3 of 4)

EQUIPMENT RADIOISOTOPIC INVENTORY
HIGH PURITY WASTE SYSTEM

Volume of Component - cm^3		Collection Tank	Filter	First Demineralizer	Second Demineralizer	Resin Trap	Sampling Tank
		1.1355(+8)	1.797875(+6)	1.08976(+7)	1.08976(+7)	1.4057(+4)	1.1355(+8)
		INVENTORY (Microcuries)					
Isotope	Half-Life						
Ba-139	85.0 min.	1.61(+6)	2.55(+4)	9.43(+5)	8.69(+3)	1.22(+3)	6.07(-1)
Ba-140	13.0 d.	6.95(+5)	4.52(+5)	1.57(+7)	1.42(+5)	2.03(+4)	6.70(+2)
Ba-141	18.0 min.	3.83(+5)	6.07(+3)	8.62(+4)	8.16(+2)	1.11(+2)	.55(-14)
Ba-142	11.0 min.	2.26((+5)	3.57(+3)	3.94(+4)	3.78(+2)	5.08(+1)	.48(-23)
Ce-141	33.0 d.	7.22(+3)	1.07(+4)	7.89(+4)	1.43(+2)	1.02(+2)	7.14(+2)
Ce-143	33.0 hr.	2.32(+3)	1.97(+3)	7.82(+2)	1.59(+2)	1.01(+0)	1.64(+2)
Ce-144	284.0 d.	2.78(+3)	3.71(+3)	9.75(+3)	1.91(+2)	1.26(+1)	2.78(+2)
La-140	40.0 hr.	9.85(+4)	1.88(+5)	1.49(+7)	1.35(+5)	1.92(+4)	2.42(+2)
La-141	3.8 hr.	3.68(+5)	1.10(+4)	3.51(+5)	3.22(+3)	4.53(+2)	2.07(+1)
La-142	92.5 min.	2.26(+5)	3.58(+3)	1.51(+5)	1.39(+3)	1.95(+2)	1.75(-1)
Pr-143	13.6 d.	3.02(+3)	4.04(+3)	1.90(+4)	2.07(+2)	1.41(+1)	3.02(+2)
Pr-144	17.3 min.	2.72(+3)	3.71(+3)	9.98(+3)	1.86(+2)	1.29(+1)	2.78(+2)
Nd-147	11.1 d.	1.10(+3)	1.39(+3)	2.06(+3)	7.54(+1)	2.66(+0)	1.05(+2)
Np-239	2.33 d.	6.72(+6)	3.53(+6)	6.45(+5)	3.62(+5)	8.32(+2)	5.49(+3)
Na-24	15.0 hr.	3.08(+4)	8.02(+3)	6.06(+4)	5.52(+2)	7.82(+1)	1.45(+1)
P-32	14.3 d.	4.46(+2)	2.92(+2)	1.05(+4)	9.56(+1)	1.35(+1)	4.32(-1)
Cr-51	27.0 d.	1.13(+4)	1.47(+4)	3.04(+4)	1.08(+2)	3.92(+1)	1.11(+3)
Mn-54	310. d.	9.10(+2)	1.21(+3)	3.20(+3)	8.73(+0)	4.13(+0)	9.09(+1)
Mn-56	2.59 hr.	2.34(+5)	4.68(+3)	3.67(+4)	2.25(+3)	4.73(+1)	3.06(+2)
Co-58	70.0 d.	1.13(+5)	1.50(+5)	3.65(+5)	1.09(+3)	4.71(+2)	1.13(+4)
Co-60	5.21 yr.	1.14(+4)	1.52(+4)	4.11(+4)	1.09(+2)	5.30(+1)	1.14(+3)
Fe-59	45.0 d.	1.81(+3)	2.39(+3)	5.47(+3)	1.74(+1)	7.06(+0)	1.79(+2)

TABLE 12.2-2
(Sheet 4 of 4)

EQUIPMENT RADIOISOTOPIC INVENTORY
HIGH PURITY WASTE SYSTEM

Volume of Component - cm^3		Collection Tank 1.1355(+8)	Filter 1.797875(+6)	First Demineralizer 1.08976(+7)	Second Demineralizer 1.08976(+7)	Resin Trap 1.4057(+4)	Sampling Tank 1.1355(+8)
		INVENTORY (Microcuries)					
Isotope	Half-Life						
Ni-65	2.56 hr.	1.39(+3)	2.74(+1)	9.74(+1)	1.33(+1)	1.26(-1)	1.73(+0)
Zn-65	229. d.	4.54(+1)	3.09(+1)	1.74(+3)	1.58(+1)	2.24(+0)	4.53(-2)
Zn-69m	14.0 hr.	4.51(+2)	1.10(+2)	8.43(+2)	7.68(+0)	1.09(+0)	2.01(-1)
Ag-110m	270. d.	1.37(+3)	1.82(+3)	4.78(+3)	1.31(+1)	6.17(+0)	1.36(+2)
W-187	1.00 d.	5.33(+4)	3.84(+4)	1.37(+4)	5.11(+2)	1.77(+1)	3.33(+3)
Total (Microcuries)		6.14(+7)	1.89(+7)	2.00(+8)	2.55(+6)	2.58(+5)	1.32(+6)

TABLE 12.2-3
(Sheet 1 of 4)

EQUIPMENT RADIOISOTOPIC INVENTORY
CHEMICAL WASTE/FLOOR DRAIN SYSTEM

Volume of Component - cm^3		Collection Tank 5.6775(+7)	Filter 1.09765(+6)	Evaporator/ Concentrator 5.6778(+6)	First Demineralizer 2.4247(+6)	Second Demineralizer 2.4247(+6)	Sampling Tank 3.785(+7)	Filter (1 ft^3 RWCU Sludge)
		INVENTORY (Microcuries)						
Isotope	Half-Life							
N-13	9.96 min.	6.29(+3)	1.22(+2)	1.76(+2)	4.47(-2)	4.31(-4)	6.44(-39)	
F-18	1.83 hr.	7.48(+3)	1.48(+2)	2.39(+3)	2.57(+0)	2.37(-2)	1.91(-6)	
Br-83	2.41 hr.	1.35(+5)	2.88(+3)	5.38(+4)	5.68(+1)	5.22(-1)	2.22(-4)	
Br-84	31.8 min.	5.64(+4)	1.09(+3)	5.45(+3)	7.53(+0)	7.07(-2)	1.73(-13)	
Br-85	3.00 min.	3.46(+3)	6.69(+1)	3.16(+1)	1.77(-1)	1.75(-3)	0.0	
Kr-83m	1.86 hr.	1.34(+5)	3.62(+3)	8.80(+4)	5.73(-1)	9.71(-1)	4.71(-3)	
Kr-85	10.7 yr.	4.53(-1)	3.12(-1)	5.55(-1)	1.93(-6)	7.84(-6)	4.06(-5)	
Kr-85m	4.4 hr.	3.38(+3)	1.46(+2)	2.01(+3)	1.44(-2)	1.46(-2)	8.22(-2)	
Sr-89	50.0 d.	1.80(+5)	9.26(+4)	1.75(+5)	1.91(+3)	1.73(+1)	1.19(-2)	
Sr-90	28.0 yr.	1.37(+4)	7.15(+3)	1.34(+4)	5.01(+2)	4.47(+0)	9.27(-4)	5.00(+7)
Sr-91	9.70 hr.	2.85(+6)	5.45(+5)	2.92(+6)	4.53(+2)	4.13(+0)	5.87(-2)	
Sr-92	2.60 hr.	1.10(+6)	2.48(+4)	4.31(+5)	4.93(+1)	4.52(-1)	2.81(-4)	
Y-90	64.0 hr.	1.72(+3)	2.17(+3)	2.27(+3)	4.94(+2)	4.48(+0)	2.85(-4)	
Y-91	59.0 d.	2.00(+4)	2.09(+4)	2.59(+4)	5.88(+2)	5.35(+0)	2.78(-3)	
Y-91m	50.0 min.	1.99(+6)	4.21(+5)	2.12(+6)	3.37(+2)	3.07(+0)	4.58(-2)	
Y-92	3.53 hr.	1.07(+6)	5.85(+4)	7.87(+5)	9.26(+1)	8.45(+0)	3.73(-3)	
Zr-95	64.0 d.	2.34(+3)	2.34(+3)	2.27(+2)	2.76(+0)	1.00(-3)	1.55(-2)	
Zr-97	17.0 hr.	1.45(+2)	2.80(+0)	2.98(+0)	3.38(-4)	6.18(-5)	9.30(-9)	
Nb-95	3.5 d.	2.44(+3)	2.46(+3)	2.37(+2)	4.16(+0)	1.04(-3)	1.62(-2)	
Mo-99	67.0 hr.	1.18(+6)	9.74(+5)	1.10(+5)	6.85(+1)	5.04(-1)	6.31(+0)	
Tc-99m	6.0 hr.	6.50(+6)	1.06(+6)	4.09(+6)	5.65(+2)	4.77(+0)	4.37(-1)	

TABLE 12.2-3
(Sheet 2 of 4)

EQUIPMENT RADIOISOTOPIC INVENTORY
CHEMICAL WASTE/FLOOR DRAIN SYSTEM

Volume of Component - cm^3		Collection Tank 5.6775(+7)	Filter 1.09765(+6)	Evaporator/ Concentrator 5.6778(+6)	First Demineralizer 2.4247(+6)	Second Demineralizer 2.4247(+6)	Sampling Tank 3.785(+7)	Filter (1 ft^3 RWCU Sludge)
				INVENTORY (Microcuries)				
Isotope	Half-Life							
Tc-101	14.0 min.	1.30(+5)	2.53(+3)	5.12(+3)	1.08(+0)	1.03(-2)	8.43(-28)	
Ru-103	40.0 d.	1.14(+3)	1.14(+3)	1.11(+2)	8.99(-1)	4.89(-4)	7.52(-3)	
Ru-106	1.0 yr.	1.55(+2)	1.56(+2)	1.51(+1)	4.11(-1)	6.63(-5)	1.03(-3)	
Te-129m	33.0 d.	2.32(+3)	1.19(+3)	2.25(+3)	1.67(+1)	1.52(-1)	1.52(-4)	
Te-129	1.14 hr.	1.38(+3)	7.54(+2)	1.41(+3)	1.06(+1)	1.03(-1)	9.68(-5)	
Te-132	3.25 d.	2.59(+6)	1.14(+6)	2.43(+6)	1.91(+3)	1.74(+1)	1.43(-1)	
I-129	1.57 x 10^7 yr.	1.40(+0)	1.92(+0)	1.97(+0)	3.88(+0)	3.53(-2)	1.10(-6)	
I-131	8.10 d.	7.64(+5)	3.71(+5)	7.32(+5)	1.38(+4)	1.25(+2)	4.72(-1)	
I-132	2.30 hr.	3.30(+6)	1.18(+6)	2.83(+6)	3.21(+3)	2.93(+1)	1.51(-1)	
I-133	21.0 hr.	3.67(+6)	1.03(+6)	3.38(+6)	8.02(+3)	7.31(+1)	1.22(+0)	
I-134	53.0 min.	8.23(+5)	1.59(+4)	1.32(+5)	1.59(+2)	1.48(+0)	6.43(-8)	
I-135	67.0 hr.	2.94(+6)	2.52(+5)	2.08(+6)	2.56(+3)	2.34(+1)	2.21(-1)	
Xe-133	5.30 d.	2.54(+5)	2.53(+5)	3.39(+5)	1.08(+0)	6.50(+1)	1.53(+1)	
Xe-133m	2.26 d.	1.35(+4)	1.25(+4)	1.78(+4)	5.78(-2)	1.59(+0)	7.01(-1)	
Xe-135	9.10 hr.	1.99(+6)	6.44(+5)	2.17(+6)	8.52(+0)	2.53(+1)	2.74(+1)	
Xe-135m	16.0 min.	7.91(+5)	7.01(+4)	5.82(+5)	3.38(+0)	9.25(+0)	6.22(-2)	
Cs-134	2.20 yr.	9.30(+5)	4.83(+3)	9.04(+3)	3.04(+2)	2.76(+0)	6.20(-4)	3.38(+7)
Cs-135	2.3 x 10^6 yr.	2.30(+3)	6.01(+3)	5.28(+3)	1.97(+3)	4.25(+0)	5.58(-1)	
Cs-136	13.0 d.	6.04(+3)	3.01(+3)	5.81(+3)	1.73(+1)	1.58(-1)	3.84(-4)	
Cs-137	29.9 hr.	1.06(+4)	5.67(+3)	1.05(+4)	3.82(+2)	3.50(+0)	7.14(-4)	3.86(+7)
Cs-138	32.0 min.	4.12(+5)	7.95(+3)	3.69(+4)	5.52(+0)	5.17(-2)	1.48(-13)	

TABLE 12.2-3
(Sheet 3 of 4)

EQUIPMENT RADIOISOTOPIC INVENTORY
CHEMICAL WASTE/FLOOR DRAIN SYSTEM

Volume of Component -cm^3		Collection Tank 5.6775(+7)	Filter 1.09765(+6)	Evaporator/ Concentrator 5.6778(+6)	First Demineralizer 2.4247(+6)	Second Demineralizer 2.4247(+6)	Sampling Tank 3.785(+7)	Filter (1 ft^3 RWCU Sludge)
				INVENTORY (Microcuries)				
Isotope	Half-Life							
Ba-137m	2.55 min.	1.00(+4)	5.31(+3)	9.59(+3)	3.57(+2)	3.27(+0)	6.68(-4)	
Ba-139	85.0 min.	9.05(+5)	1.75(+4)	2.12(+5)	2.55(+1)	2.35(-1)	2.50(-6)	
Ba-140	13.0 d.	5.18(+5)	2.58(+5)	4.98(+5)	1.49(+3)	1.35(+1)	3.29(-2)	
Ba-141	18.0 min.	2.16(+5)	4.17(+3)	1.08(+4)	2.03(+0)	1.93(-2)	3.47(-22)	
Ba-142	11.0 min.	1.27(+5)	2.45(+3)	3.91(+3)	9.40(-1)	9.04(-3)	2.09(-34)	
Ce-141	33.0 d.	5.73(+3)	6.21(+3)	1.07(+3)	1.17(+1)	7.43(-2)	3.82(-2)	
Ce-143	33.0 hr.	1.64(+3)	1.10(+3)	1.46(+2)	4.90(-2)	7.00(-4)	7.00(-3)	
Ce-144	284. d.	2.08(+3)	2.10(+3)	2.03(+2)	5.20(+0)	8.90(-4)	1.39(-2)	
La-140	40.0 hr.	9.50(+4)	1.09(+5)	1.20(+5)	1.51(+3)	1.37(+1)	1.47(-2)	
La-141	3.8 hr.	2.13(+5)	7.52(+3)	1.14(+5)	1.33(+1)	1.22(-1)	3.35(-4)	
La-142	92.5 min.	1.27(+5)	2.47(+3)	3.58(+4)	4.19(+0)	3.86(-2)	8.41(-7)	
Pr-143	13.6 d.	2.26(+3)	2.29(+3)	2.20(+2)	5.99(+0)	8.21(-4)	1.28(-2)	
Pr-144	17.3 min.	2.05(+3)	2.10(+3)	2.02(+2)	5.20(+0)	8.75(-4)	1.39(-2)	
Nd-147	11.1 d.	8.18(+2)	7.85(+2)	7.86(+1)	1.82(-1)	3.49(-4)	5.16(-3)	
Np-239	2.33 d.	4.86(+6)	2.00(+6)	4.49(+6)	2.61(+3)	2.38(+1)	2.40(-1)	
Na-24	15.0 hr.	2.06(+4)	4.54(+3)	1.66(+4)	3.37(+0)	3.07(-2)	5.16(-4)	
P-32	14.3 d.	3.33(+2)	1.66(+2)	3.20(+2)	1.05(+0)	9.54(-3)	2.12(-5)	
Cr-51	27.0 d.	8.43(+3)	8.33(+3)	8.16(+2)	4.54(+0)	3.60(-3)	5.49(-2)	
Mn-54	310. d.	8.24(+2)	6.88(+2)	6.63(+1)	1.74(+0)	2.91(-4)	4.54(-3)	
Mn-56	2.59 hr.	1.33(+5)	3.36(+3)	5.16(+3)	5.42(-1)	5.66(-2)	3.31(-3)	

TABLE 12.2-3
(Sheet 4 of 4)

EQUIPMENT RADIOISOTOPIC INVENTORY
CHEMICAL WASTE/FLOOR DRAIN SYSTEM

Volume of Component - cm^3		Collection Tank 5.6775(+7)	Filter 1.09765(+6)	Evaporator/ Concentrator 5.6778(+6)	First Demineralizer 2.4247(+6)	Second Demineralizer 2.4247(+6)	Sampling Tank 3.785(+7)	Filter (1 ft^3 RWCU Sludge)
		INVENTORY (Microcuries)						
Isotope	Half-Life							
Co-58	70.0 d.	8.50(+4)	8.51(+4)	8.25(+3)	1.07(+2)	3.63(-2)	5.62(-1)	5.32(+8)
Co-60	5.21 yr.	8.54(+3)	8.62(+3)	8.33(+2)	2.69(+1)	3.65(-3)	5.69(-2)	6.13(+7)
Fe-59	45.0 d.	1.36(+3)	1.35(+3)	1.31(+2)	1.19(+0)	5.79(-5)	8.92(-3)	
Ni-65	2.56 hr.	7.87(+2)	1.97(+1)	3.03(+1)	3.19(-3)	3.36(-4)	1.84(-5)	
Zn-65	229. d.	3.40(+1)	1.76(+1)	3.31(+1)	8.77(-1)	7.97(-3)	2.26(-6)	
Zn-65m	14.0 hr.	2.99(+2)	6.22(+1)	2.38(+2)	4.62(-2)	4.21(-4)	6.99(-6)	
Ag-110m	270. d.	1.02(+3)	1.03(+3)	9.94(+1)	2.52(+0)	4.37(-4)	6.81(-3)	
W-187	1.00 d.	3.70(+4)	2.14(+4)	3.19(+3)	8.28(-1)	1.58(-2)	1.34(-1)	
Total (Microcuries)		4.13(+7)	1.07(+7)	3.11(+7)	5.89(+4)	6.14(+2)	.79(+2)	7.16(+8)

TABLE 12.2-4
(Sheet 1 of 1)

RADIOISOTOPIC INVENTORY OF EQUIPMENT COMPONENTS IN THE SOLID WASTE SYSTEM

	Concentrated Liquid Waste Tank	Spent Resin Tank	Holdup Tank	HN-100 Liner	[3]HN-200 Liner
Volume of Component, ft^3/cc	898/2.4+7	624/1.8+7	112.3/3.18+6	171.4/4.85+6	75.5/2.14+6
Number of Components in System	2	2	2	-	-
[1]Sources in Component	Concentrated Liquid Waste	RWCU Resin	RWCU Sludge and HP Sludge	HP Sludge	RWCU Sludge and HP Sludge
[2]Number of Batches Contained in Components	4.25	4.16	1.0 and 10	17.14	1.0 and 66.5
Total Activity in Components, Ci/Component	0.6-3/Tank (2Tanks)	14-41/Tank (2 Tanks)	12-61/Tank (2 Tanks)	3-5	5-10

Notes:
[1] Where more than one source is possible in a component, the most active source has been shown. The RWCU and HP filter sludge sources consists of $9ft^3$ of RWCU sludge with sufficient HP sludge to fill the component.

[2] For conservatism in shielding calculations, the source is assumed to fill the component.

[3] Because of the high activity in the HN-200 liners, these liners are to be kept within the shipping casks during both filling and storage.

12.3 RADIATION PROTECTION DESIGN FEATURES

12.3.1 Facility Design Features

A major objective in the design of the Oyster Creek Nuclear Generating Station is to limit the radiation exposures to operating personnel to below 10CFR20 guidelines; specific design features such as shield walls, ventilation system, and radiation monitors have been provided to achieve this objective.

Radiation sources and frequently occupied areas are separated wherever practicable, with adequate shielding provided to reduce the radiation levels. Potentially radioactive components are located in shielded cubicles with access provided through appropriate labyrinth type entrances. In general, pipes carrying potentially radioactive fluids do not pass through frequently occupied areas; long runs of radioactive piping are restricted to shielded pipe chases. Penetrations through shield walls are designed and located so as to minimize radiation streaming. Details of shielding design are discussed in Subsection 12.3.2.

Provisions are made to drain and vent most of the radioactive components before personnel entry into the associated cubicles for maintenance/testing activities; furthermore, provisions are made to flush certain critical components to reduce radioactivity to levels acceptable for maintenance. Design features are provided to minimize the spread of contamination and facilitate decontamination in the event excessive equipment leakages occur; equipment and floor drains have been provided to control and process any radioactive leakages.

The ventilation systems are designed to ensure control of airborne contamination, and for easy access/service to keep doses to low levels during maintenance/testing activities. Air flow patterns are controlled throughout the plant, such that the cleaner areas are exhausted to areas of higher potential airborne activity which are then exhausted to the atmosphere through HEPA and charcoal filters. Air cleanup units are designed for ease of maintenance and to facilitate the removal of filters to minimize personnel exposures from contaminated filters. Design of ventilation systems is discussed in Section 9.4; specific features incorporated into the design of ventilation systems, for radiological protection of plant personnel, are discussed in Subsection 12.3.3.

A sufficient number of radiation monitoring devices are located throughout the plant to assist in the control of personnel exposures. Wherever practicable, area and airborne radiation monitoring equipment with local readout is included in areas to which personnel normally have access. Portable instrumentation supplements the stationary equipment. The design and locations of the radiation monitoring equipment are discussed in Section 11.5 and Subsection 12.3.4.

12.3.2 Shielding

The radiation shielding is designed to minimize the exposure of plant personnel to radiations emanating from the reactor, turbine, and their auxiliary systems. The radiation levels prevalent during plant operation, as well as those experienced upon shutdown, are considered in the determination of the shielding requirements.

Radiation shielding also minimizes radiation effects on plant equipment. Specific fabrication materials are given individual consideration; of principal concern are organic materials used in various equipment, e.g., insulation, rubber linings and gaskets.

Shielding materials are generally 150 lb/ft^3 concrete and water. High density concrete, lead and special neutron absorption material are used as alternates in special applications.

The basis for the design is compliance with the requirements of 10CFR20. The compliance with these regulations is achieved by the shielding provided in the plant and is implemented by establishing occupancy requirements based on radiation dose levels in various areas of the plant. These occupancy requirements and radiation dose rates are presented in Table 12.3-1.

Equipment doses are limited to approximately 10^6 rads for the materials of concern for the expected service life of the equipment or individual parts.

Shielding analysis of system components is accomplished with the use of the digital computer codes QADBR, KAPV, LSD-2, GRIDS and other computer codes developed at Burns and Roe based on modified Rockwell methods. Gamma ray scattering doses are calculated using the Klein-Nishima correlations.

12.3.3 Ventilation

The plant ventilation systems are designed to maintain a suitable environment for personnel and equipment during all modes of plant operations, including anticipated operational occurrences and accidents. Ventilation air flow patterns are designed to direct air flow from areas of low airborne radioactivity to areas of progressively higher airborne radioactivity, and eventually exhausted through air filtration units to the atmosphere. Several of these plant ventilation systems are designed to perform safety related functions during accident conditions.

The radiological design objectives of the plant ventilation systems, with respect to the requirements of 10 CFR Parts 20, 50, and 100 are as follows:

a. During normal operations, the ventilation systems will limit the average in-plant airborne radioactivity levels to below the guideline limits in 10CFR20, Appendix B, Table I.

b. During normal operations, the ventilation systems are used, in conjunction with other design features, to reduce the offsite releases of radioactivity to as low as reasonably achievable levels.

c. During accident conditions, specific ventilation systems (e.g., Standby Gas Treatment System) are utilized to limit the radioactivity releases such that 10CFR100 exposure limits will not be exceeded.

d. During accident conditions, the ventilation systems will be used to control the radioactivity levels in the Control Room areas, so as to ensure overall compliance with 10CFR50, Appendix A, GDC 19.

The Control Room Ventilation System serves the Control Room area and the adjacent old Cable Spreading Room. The system is designed to maintain a slightly higher than atmospheric pressure, with recirculation ranging from 0 to 100 percent of rated flow; the outside air intake is located approximately 350 ft from the stack. Description of the system is presented in Subsection 9.4.1; safety evaluation of the system is presented in Section 6.4.

The Reactor Building is served by two ventilation systems: 1) the Reactor Building Heating and Ventilation System (RBHVS) during normal operations, and 2) the Standby Gas Treatment System during emergency conditions. During normal operations, air is circulated via the RBHVS to various areas of the Reactor Building, and exhausted through the exhaust fans to the stack; a slightly negative pressure inside the Reactor Building is maintained by the RBHVS. In an emergency condition, the RBHVS will be automatically isolated, and the Reactor Building will be served by the SGTS. The RBHVS is described in Subsection 9.4.2; the SGTS is described in Subsection 6.5.1.

The Turbine Building Heating and Ventilation System is designed to maintain proper environmental conditions within the Turbine Building, with specific subsystems devoted to the Feedwater and Condensate Pump area and the Reheater area. Description of the system is presented in Subsection 9.4.3.

The Radwaste Area ventilation systems are designed to serve the Old Radwaste Building, the New Radwaste Building, and the Offgas Building. The Hot Machine Shop in the New Maintenance Building has its own ventilation system. These ventilation systems are designed to control air movement from low contamination areas to high contamination areas, and to provide means for filtering and monitoring the exhaust air before discharging to atmosphere. These systems are described in Subsection 9.4.4.

The Office Building is served by six essentially independent ventilation systems; all, except for the North-End HVAC system, serve uncontrolled areas. The North-End HVAC system serves areas which are subject to minor contamination; these areas will be maintained at slightly negative pressures, with natural incoming air-flow from adjacent uncontaminated areas. All Office Building ventilation systems exhaust directly to the atmosphere. These systems are described in Subsection 9.4.5.

12.3.4 Area Radiation and Airborne Radioactivity Monitoring Instrumentation

12.3.4.1 Area Monitoring

12.3.4.1.1 Design Basis

The area radiation monitors are designed to:

a. Monitor the level of radiation in areas where personnel access may be required.

b. Alarm when the radiation levels exceed preset levels.

c. Provide a continuous record of the radiation levels in key locations throughout the plant, as a function of time.

12.3.4.1.2 General Description-In Plant and Refueling Bridge Area Monitors

All In Plant and Refueling Bridge area monitors are analog devices and are calibrated in mR/hr. Four different ranges are available: 1.0E-02 to 1.0E+02; 1.0E-01 to 1.0E+03; 1.0E+01 to 1.0E+06; and, 1.0E+01 to 1.0E+04.

Each monitor except the Chem Lab PASS Room consists of a gamma sensitive detector (Geiger Mueller) and a dedicated preamplifier/converter. The Chem Lab PASS Room ARM utilizes an ion chamber. All but three monitors are linked by cable to the readout, power supply, and recorder located in the Main Control Room. Two refueling bridge monitors and one located in the Chemistry Lab PASS Room are for local alarm and indication only.

Each monitor with the exception of the Chem Lab PASS Room has an adjustable upper and lower alarm setpoint, and all but the Chem Lab and Refueling Bridge ARM's are connected to an annunciator on the main control panel. The Chem Lab lower alarm setpoint is fixed at no counts for one minute. Both high and low level alarms require a manual reset. Those monitors located in areas where plant personnel need to be continuously informed of the radiation level are equipped with local indication and annunciation.

There are three channels with a range of 1.0 E-02 to 1.0 E+02 mR/hr. All are located in the Administration Building. All use the lower end of the range as the low level alarm. None has local indication.
12.3-4

There are twenty eight channels with a range of 1.0E-01 to 1.0E+03 mR/hr. They are located in the Turbine Building, the Old Radwaste Building, and the Reactor Building. All use the lower end of the range as the low level alarm except the Reactor Building equipment hatch monitor (which alarms if the reading goes below 0.3 mR/hr) and the Reactor Building fuel pool monitors (one which alarms below 0.3 mR/hr, and the other of which alarms below 10 mR/hr)(Range 1.0E+01 to 1.0E+06). Several of these monitors, principally those in the Radwaste Building, have local indication and annunciation.

Table 12.3-2 provides the listing of all In Plant and Refueling Bridge area radiation monitoring channels. The thirty one halogen quenched Geiger Mueller (GM) tube detectors with aluminum cases have an energy range of 80 KeV to 7 MeV. The Chem Lab PASS Room ion chamber has an energy range of +/-10% 50 KeV to 1.25 MeV.

The In Plant and Refueling Bridge Area Radiation Monitors receive 115 VAC power from the Instrument Electrical System, and ± 24 VDC from the 24 VDC Distribution System. Loss of 115 VAC results in inoperability of the GM detectors and recorders. Loss of ± 24 VDC results in inoperability of indication and alarm functions. Up to ten GM tubes are powered from each of four high voltage power supplies. The Refueling Bridge and Chem Lab PASS Room ARM's have their own power supplies.

Only two of the area monitors have automatic functions. Following a high level alarm at the Spent Fuel Storage Pool low range monitor or the Reactor Building Equipment Hatch monitor, a two minute timer is started. If the alarm has not cleared in two minutes, the Reactor Building normal ventilation is secured and the Standby Gas Treatment System initiated.

12.3.4.1.2.1 <u>Design Evaluation</u>

Thirty two points of area monitoring are ample to insure that no plant areas where personnel are likely to work for prolonged periods of time are left unmonitored. The equipment is rugged, being designed especially for this type of industrial use.

None of the area monitors are IEEE Class 1E.

12.3.4.1.2.2 Surveillance and Testing

The strip chart recorders in the Control Room keep a permanent record of all but three of the radiation levels and give direct indication of abnormalities in operation.

Each monitor alarms on loss of voltages, as well as having high and low level alarm setpoints. A portable gamma source is used to test and calibrate the detectors in the field.

Each detector for In Plant and Refueling Bridge area radiation monitors is equipped with a built-in check source. The low range and mid range GM tubes have 0.02 ûCi (microcuries) of Sr-90. The check sources maintain a constant low background radiation level to keep detector output above the downscale trip setpoint. Thus, a downscale trip is indicative of detector or channel failure, rather than area radiation levels below the downscale trip setpoint.

12.3.4.1.3 General Description - Augmented Offgas Building and New Radioactive Waste Building Area Monitors

The Augmented Offgas Building Area Monitors consist of four channels, each comprised of a detector, an alarm and meter module, and a readout module. The New Radioactive Waste Building Area Monitors consist of twenty channels, each comprised of a detector, an alarm and meter module, and a readout module. Both subsystems employ identical components.

Each detector assembly consists of a dual air filled ion chamber and a preamplifier in a cylindrical wall mounted container. The ion chamber has a dynamic range of 10^{-1} mR/hr to 10^{7} mR/hr, achieved by two coaxial ion chambers operating simultaneously. The detectors have an energy range of 0.8 keV to 3 meV. Table 12.3-3 identifies the locations of all ion chambers.

Each readout module receives and conditions the amplified output from the associated detector assembly for distribution to alert and high trip units, and to a logarithmic ratemeter. The alarm and meter modules provide local indication and annunciation.

Readout modules for the Augmented Offgas Building Area Monitoring channels are located in the Augmented Offgas Control Room. Output from the alert and high trip circuits also supply alert and high radiation indicator mounted at the stairwell entrance to the Augmented Offgas Building to warn personnel on entering of high radiation levels.

Readout modules for the New Radwaste Building are located on the Radwaste Control Panel.

The Augmented Offgas Building and New Radwaste Building Area Radiation Monitors receive 115 VAC power from the Instrument Electrical System.

12.3.4.1.3.1 Design Evaluation

Sufficient monitors are provided to ensure that no plant areas in which personnel are likely to work for prolonged periods of time are unmonitored. Ionization chambers are reliable. Delicate voltage regulation is not needed, since the number of ions collected per ionizing event is not sensitive to applied voltage.

12.3.4.1.3.2 Surveillance and Testing

Each detector has an 8 ûCi CS 137 check source which can be rotated next to the detector as a functional check of detector response.

A "fail" alarm light on the readout module is normally illuminated. When out, channel power failure or detector voltage supply failure is indicated.

12.3.4.1.4 High Range Area Monitors

The system has the capability to employ channels with a 1.0 E+01 to 1.0E+06 mR/hr range, but this is not currently utilized.

12.3.4.1.5 In-Containment Post-LOCA Monitors

Two high range radiation monitors are installed within the drywell (see Section 11.5.2.13). In addition, portable monitors are used for in-containment post-LOCA monitoring.

12.3.4.2 Airborne Radioactivity Monitoring

12.3.4.2.1 General Design Basis

The airborne radiation monitors are designed to:

a. Detect and measure the levels of radiation in the various rooms and air spaces of the plant.

b. Assist in maintaining occupational radiation exposures to airborne contaminants as low as reasonable achievable.

c. Alarm in the Control Room when radiation levels exceed a preset level.

d. Provide a continuous record of the radiation levels in key areas of the plant.

12.3.4.2.2 General Design Evaluation - Reactor Building Ventilation Monitoring

Under normal operating condition, the air in the plant contains only minute quantities of radioactive materials so that the ventilation exhaust can be discharged directly to the atmosphere without filtration. However, the ventilation exhaust must be continuously monitored so that appropriate action can be taken if the radiation level is excessive.

Two gross gamma detectors are located in the Reactor Building exhaust plenum upstream of the building ventilation system exhaust valve. The detectors are GM tubes identical to those used for area radiation monitoring (see Subsection 12.3.4.1), and have a range of 1.0E-01 to 1.0E+03 mR/hr (see Table 12.3-4).

When either of the two detectors indicates a radioactivity level above the high alarm setpoint, a high radiation alarm is given in the Control Room. The ventilation system isolation valves close automatically, and the exhaust is diverted to the Standby Gas Treatment System prior to release to the plant ventilation stack. As an extra safeguard, the exhaust is analyzed by the Radioactive Gaseous Effluent Monitoring System. (See Section 11.5).

TABLE 12.3-1
(Sheet 1 of 1)

DESIGN RADIATION DOSE RATES

Degree of Access Required	Design Radiation Dose Rate at Shield Wall (mrem/hr)
Continuous occupancy	
outside controlled areas	0.5
inside controlled areas	1
Occupancy up to 10 hours/week	6
Occupancy up to 5 hours/week	12

Note: High radiation areas with dose-rates higher than those listed above may be entered on the basis of stay time and based on administrative control of occupational radiation exposures.

TABLE 12.3-2
(Sheet 1 of 3)

GM TUBE AREA RADIATION MONITORS

Tag No.	Range mr/Hr	Local Ind.	Location
A-1	0.01-100	No	Entrance to Turbine Bldg. El. 23'6" from Ad. Bldg.
A-2	0.01-100	No	Entrance to Control Room El 46'6"
A-3	0.01-100	No	South Wall of Control Room El 46'6"
A-4	0.1-1000	No	Turbine Bldg. Operating Floor El. 46'6"
RE-507	1.0-10 R/Hr.	See Note 1	Chem. Lab PASS Room, Office Bldg. El. 35'
A-6	0.1-1000	No	Above Turbine Bldg. Lube Oil Bay El 0'0"
A-7	0.1-1000	Yes	Turbine Bldg. Feed Pump Area El. 3'6"
A-8	0.1-1000	No	Turbine Bldg. above Condensate Pumps El 0'0"
A-9	0.1-1000	No	Turbine Bldg. Bsmt. Cond. Demin. Vlv. Area El 23'6"
A-10	0.1-1000	Yes*	Turbine Bldg. Regeneration Area El. 23'6"
B-1	0.1-1000	No	Turbine Bldg. Bsmt., Makeup above sample sink demineralizer
B-2	0.1-1000	No	Turbine Bldg. Basmt., Air Comp. Area El 0'0"
B-3	0.1-1000	No	Radwaste Bldg. Pump Room
B-4	0.1-1000	Yes	Radwaste Bldg. Cont. Room, El. 23'6"

* After the Klaxton horn has been energized for 30 seconds, the alarm circuitry de-energizes the Klaxton horn and energizes a rotating blue beacon.

TABLE 12.3-2
(Sheet 2 of 3)

GM TUBE AREA RADIATION MONITORS

Tag No.	Range mr/Hr	Local Ind.	Location
B-5	0.1-1000	Yes	Radwaste Bldg. Conveyor, El. 23'6"
B-6	0.1-1000	Yes	Radwaste Storage Room, El. 23'6"
B-7	0.1-1000	Yes	Reactor Bldg. T.I.P. Area, El. 33'6"
B-8	0.1-1000	No	Personnel Hatch, El. 23'6"
B-9	0.1-1000	Yes	Reactor Bldg. Equip. Hatch, El. 119'
B-10	0.1-1000	Yes	Reactor Bldg. Drain Tank Area, El. 6'5"
C-1	0.1-1000	No	Reactor Bldg. Cleanup Pump Area, El. 51' 3"
C-2	0.1-1000	Yes	Radwaste Bldg. Fuel Pool Filter Area, El. 23’6”
C-3	0.1-1000	No	Reactor Bldg. Isolation Condenser Area, El. 95'3"
C-4	0.1-1000	No	Shutdown HX Area, El. 51'3"
C-5	0.1-1000	Yes	Reactor Bldg. Spent Fuel Pool, El. 119'3"
C-6	0.1-1000	No	Liquid Poison System, El. 95'3"
C-7	0.1-1000	No	Reactor Bldg. CRDM Area, El. 23'6"
C-8	0.1-1000	No	Air Ejector Area, Turb. Bldg., El. 0'0"
C-9	0.1-1000	Yes	Reactor Bldg. Fuel Pool Area, El. 119'

TABLE 12.3-2
(Sheet 3 of 3)

GM TUBE AREA RADIATION MONITORS

Tag No.	Range mr/Hr	Detection Type	Local Ind.	Location
C-10	$10\text{-}10^6$	GM	Yes	Reactor Bldg. Fuel Pool Area, El. 119'3"
D-1	0.1-1000	GM	See Note 1	Reactor Bldg. Refueling Bridge, El. 119'3"
D-2	0.1-1000	GM	See Note 1	Reactor Bldg. Refueling Bridge, El. 119'3"

Notes:

1. The Refueling Bridge Monitors and Chem Lab Monitor have local indication and alarm only.

TABLE 12.3-3
(Sheet 1 of 2)
ION CHAMBER AREA RADIATION MONITORS

Tag No.	Range mr/Hr	Local Ind.	Location
80	$0.1\text{-}10^7$	Yes	AOG Bldg. Control Panel
81	$0.1\text{-}10^7$	Yes	AOG HVAC Room, El. 23'6"
82	$0.1\text{-}10^7$	Yes	AOG CCW HX, El. 38'9"
135	$0.1\text{-}10^7$	Yes	AOG Flame Arrestor Room, El. 38'9"
RM-1	$0.1\text{-}10^7$	Yes	New Radwaste Bldg., RB-002 Cab. El 23'
RM-2	$0.1\text{-}10^7$	Yes	Solid Waste Capping Mach., El. 23'
RM-3	$0.1\text{-}10^7$	Yes	Chemical Filter Area, El. 48'
RM-4	$0.1\text{-}10^7$	Yes	Solid Radwaste Large Cont. Fill Station, El 23'
RM-5	$0.1\text{-}10^7$	Yes	HVAC Equip., El. 48'
RM-6	$0.1\text{-}10^7$	Yes	Radwaste Conc. Area, El. 23'
RM-7	$0.1\text{-}10^7$	Yes	Spent Resin Tank, El. 23'
RM-8	$0.1\text{-}10^7$	Yes	New Radwaste Bldg., West, El. 38'
RM-9	$0.1\text{-}10^7$	Yes	New Radwaste Bldg., East, El. 38'
RM-10	$0.1\text{-}10^7$	Yes	HP/Chem. Waste Feed Tank, El. 48'
RM-11	$0.1\text{-}10^7$	Yes	New Radwaste Bldg. RB-001, Cab. El. 48'
RM-12	$0.1\text{-}10^7$	Yes	Large Solid Waste Cont. Fill Area, El. 23'

TABLE 12.3-3
(Sheet 2 of 2)

ION CHAMBER AREA RADIATION MONITORS

Tag No.	Range mr/Hr	Local Ind.	Location	Notes
RM-51A	$0.1\text{-}10^7$	Yes	Conc. Waste Tank, SL-T-1A	*
RM-51B	$0.1\text{-}10^7$	Yes	Conc. Waste Tank, SL-T-1B	*
RM-58A	$0.1\text{-}10^7$	Yes	Spent Resin Tank, SL-T-2A	*
RM-58B	$0.1\text{-}10^7$	Yes	Spent Resin Tank, SL-T-2B	*
RE-72A	$0.1\text{-}10^7$	Yes	Hold Up Tank SL-T-3A	*
RE-72B	$0.1\text{-}10^7$	Yes	Hold Up Tank SL-T-3B-	*
RE-78A	$0.1\text{-}10^7$	Yes	Fill Station #2, Fill Aisle	*
RE-78B	$0.1\text{-}10^7$	Yes	Fill Station #3, Fill Aisle	*

Notes:

* Maintained in an operable limited use status and not calibrated unless maintenance is performed.

TABLE 12.3-4
(Sheet 1 of 1)

AIRBORNE RADIATION MONITORS

Name/Building	Detector Channel	Minimum Type	Sensitivity	Range
Reactor Building Ventilation Exhaust (on-line) (2 Channels)	Gross Gamma	GM	0.1 mR/hr	1.0E-01 to 1.0E+03

12.4 DOSE ASSESSMENT

12.4.1 Occupational Doses

12.4.1.1 Criteria and Objectives

The design objectives and criteria for the radiation doses incurred during normal operation and anticipated operational occurrences, including refueling and maintenance, are based on the requirements of 10CFR20, the expected station staffing, and ALARA considerations. Occupancy in areas normally having radiation levels above background are governed by administration controls set forth in the station Technical Specifications to ensure that doses do not exceed the requirements of 10CFR20. Regulatory Guide 8.8 Revision 3 (1978); 8.10 Revision 1-R (1975); Regulatory Guide 8.13 Revision 1 (1975); and Regulatory Guide 8.15 (1976) are implemented to the maximum extent possible.

12.4.1.2 Operating Station Data

Several factors are known to affect station personnel exposure. These factors are:

a. The number of years the station has been operating

b. Station design and equipment layout

c. Specific maintenance operations required in a given year

d. The amount of corrosion products, mainly Co-60, present in various station systems and components

e. The training and experience of workers

f. The extent of direct supervision inside the radiation zones

g. The extent to which non regular or contract personnel are used to perform work on the station.

The most recent figures for average annual exposure, both by work groups and by major tasks, can be found in the most recent OCNGS annual report.

12.4.1.3 Estimated Annual Occupancy Dose Rates and Doses

Data recorded during the operating history of OCNGS, as well as reviews of new techniques or procedures, are used to estimate the dose rates and doses to be encountered in the future. Estimates can be found in the most recent OCNGS annual report, which includes a detailed description of plant staffing.

12.4.2 Inhalation Exposures

Occupational exposures to airborne radioactivity are normally very low. Sources of airborne radionuclides as described in Subsection 12.2.2, have been reduced to as low as reasonably achievable for both occupational and non occupational exposures. The station's ventilation systems, described in Section 9.4, are designed to maintain airborne concentrations in occupied areas below 10CFR20, Appendix B, Table I, Column 3 levels for both routine operations and anticipated operational occurrences, with the radionuclide concentrations in most areas being only a small percentage of the allowable limits. The OCNGS Airborne Radiation Monitoring System, described in Subsection of 12.3.4, is designed to detect any significant changes in the radionuclide concentration. Continuous and portable air monitors, as well as administrative controls, are used to control airborne exposures for activities with the potential to create local areas of high airborne concentrations. Records are kept of internal exposure, as well as evaluations and corrective actions.

12.4.3 Non Occupational Exposures

Whole body doses at the site boundary and exclusion area boundary are reassessed periodically using Dosimeter of Legal Record (DLR). The most recently calculated doses, as well as the basis for their calculation, can be found in the latest OCNGS annual report.

12.5 RADIATION PROTECTION PROGRAM

12.5.1 Organization

The Radiation Protection Program at the Oyster Creek Nuclear Generating Station is under the general supervision of the Radiological Protection Manager (RPM), Oyster Creek and his staff. (The facility organization of the Oyster Creek Nuclear Generating Station is contained in Section 6, Administrative Controls, of the Technical Specifications. This section also defines the facility staff qualifications.) Under the supervision of the RPM, procedures have been established and implemented to ensure that radiation exposures to plant personnel and the public are maintained as low as reasonably achievable. A staff of Radiation Protection supervisors, engineers, and technicians with support from other plant departments perform or oversee duties which include:

a. Monitoring of plant effluents

b. Personnel radiation monitoring

c. Evaluation of radiation hazards, working times and protective devices to be used for specific tasks, by preparation and review of Radiation Work Permits. (See Subsection 12.1.1.3.)

d. Deleted

e. Maintaining records of radiation exposures. (See Section 12.5.3.5.).

Plant personnel are trained to perform certain monitoring activities such as personnel contamination monitoring (frisking).

12.5.2 Equipment, Instrumentation, and Facilities

12.5.2.1 Personnel Monitoring Systems

A Personnel Monitor device is required for:

a. All personnel entering Posted Radiologically Controlled Areas.

b. All persons directed by Radiation Protection supervision, and where posted.

A Personnel Monitoring Device shall be worn at all times, when required, except when personnel are donning/doffing protective clothing. Documentation is maintained to record visitor personnel monitoring device and exposure.

A Personnel Monitoring Device is defined as a Dosimeter of Legal Record (DLR), Electronic Self-Reading Dosimeter, or an equivalent device approved by Radiation Protection Supervisor.

12.5.2.2 Personnel Protective Equipment

Personnel protective equipment consists of protective clothing for the body, hands, feet, head and face. These items are worn as directed by a Radiation Work Permit (RWP).

Protection against airborne radioactive material is primarily provided by the use of engineering and/or process controls. A respiratory protection program has been established to provide protective devices for those cases where engineering and/or process controls are not practical or sufficient.

12.5.2.3 Personnel Decontamination Facility

The Personnel Decontamination Facility, equipped with a decontamination shower, is located in the Office Building.

12.5.2.4 Access Control

Access to the plant protected area is controlled by locked doors or gates. Free access within this controlled area is limited to personnel who have completed Category I General Employee Training (GET). Access to the Radiologically Controlled Area (RCA) is limited to personnel who have completed Category II GET. Visitors may gain access to plant areas only when escorted by personnel with the appropriate GET category and after specific control procedures have been met. The plant staff has been instructed to be alert to those not readily identified, and to challenge their presence.

12.5.2.5 Laboratory Facilities

The plant laboratory consists of facilities and equipment necessary to support various chemical and radiochemical analyses including reactor coolant, feedwater, offgas, liquid waste and auxiliary system chemistry.

12.5.2.6 Radiation Protection Instrumentation

A supply of calibrated portable radiation monitoring instruments is maintained at the plant. Exposure rates and contamination levels are determined by these instruments.

12.5.3 Radiation Protection Procedures

12.5.3.1 General

Plant radiation protection procedures are designed to minimize the exposure of personnel to radiation and contamination. They contain guides and limits for radiation protection and contamination control as well as detailed procedures to ensure that these limits are not exceeded.

12.5.3.2 Personnel Monitoring

Sections of the radiation protection procedures describe the equipment used and the practices followed by plant personnel to monitor their individual radiation exposure.

12.5.3.3 Personnel Protective Equipment

This section of the radiation protection procedures deals with the proper use of such items as protective clothing (coveralls, shoe covers, gloves, etc.) and respiratory equipment. The equipment is described in detail along with its protective qualities and limitations.

12.5.3.4 Area Control

This section of the plant radiation protection procedures describes each of the various classes of access areas (Radiologically Controlled Area, Radiation Area, High Radiation Area), along with the procedures for entry and exit from each area.

12.5.3.5 Records

The following logs are maintained by the operating staff as part of the plant records. The originals are kept in the Document Control Center.

a. Control Room Logbook - contains entries affecting plant output, changes in auxiliary equipment, unusual conditions, line trips, annunciator signals, etc.

b. Shift Supervisor's Logbook - contains an overall summary of plant operation.

c. Radioactive Waste Logbook - contains record of volume of radioactive waste and rate of release.

A large number of records are maintained by the radiation protection and plant operations staffs. These are retained for varying periods of time (generally either 1 year, 2 years or the life of the plant) by the Information Management Center.

12.5.3.5.1 Radiation Protection

The Radiological Protection Manager OC, is responsible for ensuring appropriate maintenance of the records relating to:

a. Personnel radiation exposure

b. Radiation monitoring instrumentation calibration

c. Plant radiological conditions such as radiation levels, contamination levels and airborne activity levels.

12.5.3.5.2 Special Nuclear Materials

Special nuclear materials records are maintained and reported in conformity with 10CFR70 and 10CFR73.

12.5.3.5.3 Calibration of Instruments

Calibration of instruments and controls, both nuclear and conventional, is recorded, as is any maintenance performed on them.

12.5.3.5.4 Administrative Records and Reports

Detailed procedures provide information on the plant records and reports.