12.1 SUMMARY DESCRIPTION

Station buildings and structures consist of the reactor buildings, turbine building, main control room, radwaste building, diesel generator building, off-gas filter station, stack, administration building, shop and warehouse, water treatment building, circulating water pump structure, cooling towers, intake screen structure, recombiner building, emergency cooling towers, and other auxiliary structures and systems.

Location, orientation, boundaries, and access to the site are shown on Drawing C-1. The arrangement of structures on the site are shown on Drawing C-2. The general arrangement of the reactor, radwaste, and turbine buildings is shown in Figure 12.1.1 and Drawings M-2 through M-7. The structural design criteria are given in Appendix C.

12.2 DESIGN AND DESCRIPTION

12.2.1 Reactor Buildings

Each reactor building is a seismic Class I structure completely enclosing the primary containment and auxiliary systems of one nuclear steam supply system, and housing the associated spent fuel storage pool, dryer and separator storage pool, and reactor well. The building is essentially a cast-in-place reinforced concrete structure from its foundation floor **Security Related Information Withheld under 10 CFR 2.390** to its refueling floor **Security Related Information Withheld under 10 CFR 2.390 .** Above this floor, the building superstructure consists of metal siding and decking supported on structural steel framework. **Security Related Information Withheld under**

The foundation of the building consists of a monolithic concrete mat supported on sound rock. This mat also supports the primary containment and its internals, including the reactor vessel pedestal. The exterior and some interior walls of the building above the foundation are cast-in-place concrete. Other interior walls are normal weight concrete block walls. The block walls were utilized for ease of equipment erection. Floor slabs of the buildings are of composite construction with cast-in-place concrete over structural steel beams and metal deck. The thicknesses of walls and slabs were governed by structural requirements or shielding requirements.

Each steel-framed superstructure is cross-braced to withstand wind and earthquake forces, and supports metal siding and metal deck for the roof. The roof consists of builtup or other approved FM Class I roofing system roofing over the metal deck. The frame also supports a runway for the 125-ton traveling bridge crane.

The configuration of the buildings and the general arrangement of equipment at various floor levels is shown by Figures 12.1.1 and Drawings M-2 through M-7.

The following paragraphs describe special design features of the reactor buildings:

a. Seismic analysis: A dynamic analysis of the reactor building was conducted for the design earthquake with 0.05g horizontal ground acceleration and for the maximum credible earthquake with 0.12g horizontal ground acceleration. The spectrum response curves used for the analysis are discussed in subsection 2.5, "Geology and Seismology" and in Appendix C, "Structural Design

Criteria." The various loading conditions combined with earthquake loads and a description of the dynamic analysis of a seismic Class I structure are also given in Appendix C.

b. Tornado loads: Under tornado loads described in Appendix C, the reactor building's roof and metal siding is considered expendable. However, the structural steel frame will withstand the full tornado pressure corresponding to 300 -mph wind. Under this condition, the stresses in the steel frame will approach yield stress. Even though portions of the siding and roofing may blow away, equipment required for a safe shutdown, located in the reactor building, is protected in the concrete portion of the building, which is capable of withstanding the tornado winds up to 300 mph and the design tornado-generated horizontal missiles.

   Associated with the postulated tornado is a possible sudden depressurization of the atmosphere equivalent to a 3 -psig internal pressure. The design of the concrete portion of the reactor building, and the individual compartments in the building housing engineered safeguards equipment, was checked to assure that these compartments are properly vented, interconnected, or adequately designed so that the bursting pressure is either vented, or the walls of the compartment can withstand the 3 -psig pressure.

c. Internal buildup of pressure: The building is designed to withstand 0.25 psi (7 in of water) pressure while maintaining the integrity of the secondary containment. If the internal pressure exceeds the anticipated 7 in of water pressure, the excess pressure is vented to the atmosphere through blow-out panels located in the superstructure of the buildings. These blow-out panels also function during a tornado and eliminate the possibility of building up to the 3 -psig maximum differential pressure.

d. Missiles: The reactor building also protects the necessary engineered safeguards equipment housed in the reactor building from horizontal missiles associated with a tornado, or missiles from a failure of rotating equipment, such as the turbine-generator or turbine pumps. The design of the exterior walls of the reactor building was checked to assure that a horizontal tornado missile or a wheel or bucket of the turbine-generator will not penetrate through the 2 to 3 ft 6 in thick concrete walls and endanger the functional integrity of the secondary containment.

e. Flooding: The reactor building substructure design Security Related Information Withheld under 10 CFR 2.390 was reviewed for the effects of the design basis flood. Security Related Information Withheld under 10 CFR 2.390

They are watertight. Reactor building doors Security Related Information Withheld under 10 CFR 2.390 are weatherstripped for leaktightness at secondary containment. Since these doors are well on the shoreside of the structures, maximum waves are not expected. Even if an excessive wave were to reach these doors, which are the most vulnerable part of the building envelope, no significant inflow is anticipated. Small amounts of water which might leak through the doors' weatherstripping would be handled by the building drainage system and pumped out. All the concrete construction Security Related Information Withheld under 10 CFR 2.390 is waterproofed Security Related Information Withheld under 10 CFR 2.390, and a fibrated bitumastic paint applied up to grade; also, any penetrations in the exterior walls are sealed to ensure leaktightness necessary to plant safety.

12.2.2 Turbine Building

This building Security Related Information Withheld under 10 CFR 2.390 and houses two units, each having a turbine-generator, a condensate and feedwater system, heating and ventilation equipment, and other auxiliary power plant equipment.

Figures 12.1.1 and Drawings M-2 through M-7 show the building layout and general equipment arrangement.

This building is founded on sound rock Security Related Information Withheld under 10 CFR 2.390. The external and some internal walls are cast-in-place concrete up to the operating floor of the turbine building Security Related Information Withheld under 10 CFR 2.390. The structure above this level is metal siding and deck above a Security Related Inform band of precast concrete wall panels all supported by structural steel frames. Frames also support two 115-ton overhead bridge cranes in tandem.

The floors of the turbine building Security Related Information Withheld under 10 CFR 2.390 are supported off the turbine pedestal for gravity loads, but are separated from the pedestal for lateral movement and to prevent transmitting vibrations from the turbine-generator to the adjoining floors.

Each turbine-generator is mounted on a massive concrete pedestal Security Related Information Withheld under 10 CFR 2.390. The pedestals are supported on a concrete mat and founded on rock. The turbine building is designed with the seismic design criteria for Zone 1 established by the Uniform Building Code. A multi-mass dynamic seismic analysis is performed to check the structure using the site spectra (design and maximum credible earthquakes). Stresses are found to be within the Class I allowable limits. The turbine building is located east of the two reactor buildings and is separated from them by a gap to accommodate movements of the structures during an earthquake.

The methods of construction and materials are basically identical for Class I and II buildings. Documentation is routinely kept the same way for both classes of buildings.

Therefore, the failure of the turbine building will not impair the safety function of any seismic Class I structure or equipment inside it or adjacent to it.

12.2.3 Main Control Room

The main control room, along with the cable spreading room, computer room, and emergency switchgear rooms, is located in the center portion of the turbine building (Drawings M-3 and M-4). This portion of the turbine building is designed as a seismic Class I structure, is separated from the rest of the turbine building structurally, and is connected to the radwaste building west of the control room. Control room walls are designed to withstand the force of horizontal missiles associated with a tornado or with missiles from the turbine-generator, and thus protect equipment in the control room vital to a safe shutdown of the plant.

The control room and cable spreading room are well above the flood level. Security Related Information Withheld under 10 CFR 2.390

Since it is inside the turbine building, no wave runup effects are anticipated. The turbine building will be allowed to flood to equalize the water level to avoid excessive unbalanced hydrostatic loads on the exterior walls.

12.2.4 Radwaste Building and Reactor Auxiliary Bay

The radwaste building and reactor auxiliary bay are connected to the control room and are located between the two reactor buildings (Figures 12.1.1 and Drawings M-2 through M-7). This complex is designed as a seismic Class I structure even though the radwaste system and most of the other equipment are not included in the seismic Class I items. Though located between the reactor buildings, the radwaste building is structurally separated from them. The dynamic seismic design of this complex is based on the acceleration spectrum response curves developed for the Peach Bottom site. The radwaste building houses various components of the radwaste system, the standby gas treatment system, and associated equipment. It also houses the recirculation system M-G sets (abandoned in place) for the two units of the power plant, along with the heating and ventilating equipment for the radwaste building and the main control room. The adjoining reactor auxiliary bay houses HPCI and RCIC turbine pumps, and RHRS equipment.

The building is founded on sound rock with a cast-in-place concrete mat. All walls except the west wall are concrete up to the roof. The west wall consists of concrete and metal siding for its full height.

Since HPCIS and RCICS equipment is located Security Related Information Withheld under 10 CFR 2.390 in the reactor auxiliary bay, it is protected by concrete walls and floor slabs from floods, missiles, and tornados, similarly to the reactor building.

Although not required for safe plant shutdown, the radwaste building is flood protected Security Related Information Withheld under 10 CFR 2.390 .

The heating and ventilating equipment Security Related Information Withheld under 10 CFR 2.390 that is considered essential for a safe shutdown of the plant, and thus is protected from horizontal tornado missiles. The cable trays necessary during a tornado event, which originate in the reactor buildings and terminate in the control room are protected from tornado missiles.

12.2.5 Diesel-Generator Building

The diesel generator building is founded on piles as described in paragraph 2.7.6.4.

The lateral loads (seismic and wind forces acting on the structure) are resisted by shear walls which carry lateral loads to the rock. The piles only support gravity loads. No credit was taken for the influence of the piles on the lateral dynamic characteristics of the structure or equipment response.

All piles, including those for Class 1 structures, are of materials for which physical and chemical tests verified their compliance with the material specifications. Pile driving was done under the quality control program for Class I construction. Pile driving records, material, identification, and inspection reports were maintained. All piles were connected to the plant cathodic protection system.

This building (Figure 12.2.1) is designed as a seismic Class I structure since it houses the four diesel -generators which provide the standby power supply essential for a safe shutdown of the plant upon loss of all off-site power. It has a fifth compartment which houses equipment required for operation of the emergency heat sink. The structure has been analyzed for seismic loading. The building is founded on steel H piles and concrete shear walls which are supported on the rock. The superstructure of the building consists of cast-in-place concrete walls and roof. Large openings in the diesel -generator building are either protected by missile-proof doors, by baffle walls located in front of them, or by blow-out panels. The diesel fuel supply is stored in underground steel tanks east of the building. The tanks are of seismic Class I construction.
This structure has watertight doors **Security Related Information Withheld under 10 CFR 2.390** or more than 1.1 ft above the maximum wave runup.

12.2.6 Off-Gas Filter Station

The off-gas filter station **Security Related Information Withheld under 10 CFR 2.390** , which house the off-gas filters. This structure is founded on rock and is partially buried in the side of the slope south of the Unit 2 portion of the turbine building. It is constructed of reinforced concrete, having a concrete and pre-cast panel superstructure and a concrete slab roof.

Access to the filters is provided from the top of the cells through circular openings provided with concrete plugs. A monorail is installed to permit removal of the filters through a door in the easterly wall.

12.2.7 Stack

A single stack is used to discharge gaseous waste from both Units 2 and 3 of PBAPS. **Security Related Information Withheld under 10 CFR 2.390**

The stack is a tapered, reinforced concrete structure **Security Related Information Withheld un**. The foundation is a concrete mat, octagonal in plan, and is approximately 7 ft thick. The dilution fans and eductor are housed in the lower **Security Related In** of the structure.

The stack is designed to seismic Class I criteria and for normal wind load; it is not designed to withstand tornado wind forces. The stack is located a sufficient distance from the reactor buildings that they would not incur any damage in the event of a complete stack failure.

12.2.8 Administration Building and Shop

This is a multi-story building located east of the turbine building. The administration building **Security Related Information Withheld under 10 CFR 2.390** and houses the administration offices, meeting rooms, and other auxiliaries associated with administration and maintenance.

The upper floor of the administration building is connected to the operating floor of the turbine building by an enclosed bridge.

The machine shop and laboratory structure **Security Related Information Withheld under 10 CFR 2.390**

. The machine shop houses equipment and tools required for repairs and maintenance.

The administration building and the shop are supported by steel H bearing piles driven to the rock in the reclaimed and backfilled portion of Conowingo Pond. The superstructure of the administration building consists of a steel framework with pre-cast concrete panel facing for the walls, and metal deck with built-up or other approved FM Class I roofing system roofing for the roof.

Floor slabs are of cast-in-place concrete and designed for applicable dead and live loads.

The superstructure of the shop building consists of pre-cast concrete wall panels, cast-in-place concrete columns connecting the pre-cast concrete panels, and steel bar joists with metal decks and built-up or other approved FM Class I roofing system roofing.

12.2.9 Water Treatment Building

This is a single story building, **Security Related Information Withheld under 10 CFR 2.390** . The foundation, wall, and floor slab construction is similar to the shop and warehouse building, with the exception of the roof, which consists of pre-stressed concrete double tees with a ballast secured EDPM membrane built-up or other approved FM Class I roofing system roofing.

12.2.10 Circulating Water Pump Structure

The pump structure complex, **Security Related Information Withheld under 10 CFR 2.390** of reinforced concrete founded on rock, consists of several sections (Drawing C-84, Sheet 1). The center section of the structure houses the service water pumps for both units with the circulating water pumps on the north and south ends of the structure. Along the easterly (water) side of the building are the circulating water and service water screens. The pump structure also houses additional pumps and related equipment.

The central portion is a reinforced concrete, seismic Class I, tornado-resistant structure. The substructure has two pump bays, one for Unit 2 and the other for Unit 3, in which the high-pressure service water pumps, the fire pumps, and the service water screen wash pumps are located. A third, smaller bay contains the two emergency service water pumps in individual cells. These pump bays are interconnected by openings equipped with sluice gates.

The superstructure over these pumps is constructed with reinforced concrete walls and floor and has a concrete roof supported on structural steel beams. Removable panels in the roof provide access to the pumps. A structural steel and plate wall divides the pump area into two rooms for additional protection. The rooms are flood protected **Security Related Information Withheld under 10 CFR 2.390** by means of watertight doors and sealed floor penetrations. **Security Related Information Withheld under 10 CFR 2.390**

Watertight exterior flood doors at the

north and south ends will remain closed for fire protection purposes. Floor and equipment drains associated with the Unit 2 and Unit 3 critical portions of the Circulating Water Pump Structure are collected in a common sump and pumped to the intake bay. Rainwater from the roof drain is normally routed directly to the intake bay.

To the east of this superstructure is a similar reinforced concrete, seismic Class I, tornado-resistant structure housing the service water traveling screens. Four screens, two per unit, screen the water before it goes into the pump bays. Each screen has a sluice-gated opening on each side. Security Related Information Withheld under 10 CFR 2.390

Between the central portion and the south end is an area housing the Unit 2 service water pumps and the Unit 1 service water transfer pumps. The seismic Class I pump bay substructure is common with that of the center area. The Unit 3 service water pumps are similarly located to the north. The superstructure over these areas has a single ply or other approved FM Class I roofing system roof on metal decking supported on a structural steel frame with pre-cast panel walls.

The three Unit 2 circulating water pumps are located further to the south within a continuation of the seismic Class II superstructure, while the Unit 3 circulating water pumps are similarly located to the north. To the east of the circulating water pumps are steel frame concrete panel superstructures housing the circulating water traveling screens.

Access for removal of equipment from the pump structure is provided by hatches in the structure roofs. A traveling gantry crane, supported on an elevated rail Security Related Information Withheld under 10 CFR 2.390

provides lifting facilities for maintenance and repair of the pumps. The traveling screens and trash collection areas are serviced by a cantilever extension of the gantry crane to the east. A dynamic analysis of the crane structure was made to establish its design parameters to seismic Class I requirements. A concrete slab at grade level has been provided on the extreme north for laydown. The gantry crane is parked over this laydown area when not in use, and is provided with tie-down anchors in this location for tornado protection.

The seismic Class I portion of the circulating water pump structure as described herein is designed such that no credible event, including internal flooding due to failure of a seismic Class II structure or component would prevent the equipment housed therein from functioning as necessary to assure safe shutdown of both Units 2 and 3. Sump pump operation, along with room flooding alarms and operator response is required for a postulated failure of the 12-inch fire line, transiting the area.

Seismic Class II structures are structurally separated from seismic Class I structures by means of sliding type expansion joints to provide for unequal deflections associated with independent movements of the structures. The circulating water pump structure is analyzed for dynamic loading as one structure and constructed integrally. In the design of the pump structure the normally allowed one-third increase in allowable stresses is not used even for the Class II portion of the structure which is integral with the Class I portion. Thus, it can be stated that the entire design met the Class I design criteria.

12.2.11 Cooling Towers

The three mechanical-draft cooling towers are conventional multi-cell units constructed of polyvinylchloride fill, wooden fan deck, fiberglass louvers and sheathing, and reinforced fiberglass fan cylinders. The superstructure is supported on concrete piers within a reinforced concrete water collection basin which rests on fill placed in the river.

The multi-cell cooling towers and associated mechanical and electrical equipment, as described in subsection 11.6, are seismic Class II.

12.2.12 Guardhouse

This one-story steel and masonry structure, west of the parking area and east of the turbine building, is the main access entrance to the plant. The guardhouse is arranged so the guards have the capability of visual control over ingress and egress to the plant. Portal personnel monitors are included in the guardhouse as final check points for persons leaving the station.

12.2.13 Boiler House

The boiler house, **Security Related Information Withheld under 10 CFR 2.390** contains two boilers with independent stacks. It is a separate building located south of the Unit 2 reactor building, alongside the condensate and refueling water storage tanks.

The superstructure consists of a steel frame with pre-cast panel walls, a metal deck, and built-up or other approved FM Class I roofing system roofing. Floor slabs are of cast-in-place concrete with a perimeter edge beam founded on rock.

12.2.14 Intake Screen Structure, Cooling Tower Pump Structures, Discharge Control Structure, and Bridge Structure

These reinforced concrete structures are constructed off-shore in Conowingo Pond. They are founded on rock, or on shallow depth gravel leveling courses just above the rock. The intake screen structure and cooling tower pump structures use a structural steel frame to support superstructures of pre-cast concrete panels and built-up or other approved FM Class I roofing system roofs on metal decking.

The intake screen structure **Security Related Information Withheld under 10 CFR 2.390**

It houses twenty-four 10-ft wide traveling water screens. The screens are protected by bar racks, with the up river three and one half bar racks closed off to create a debris barrier. All other bar racks remain open.

A gated, cross tie pipe, with fish screen, is installed between the Unit 2 intake canal and the discharge pond which can be opened during winter months to provide recirculation heating to mitigate the formation of ice in the intake pond.

The cooling tower pump structures, housing the A,B, and C pumps, consist of a pump bay **Security Related Information Withheld under 10 CFR 2.390**

. The bays each contain a cooling tower pump which serves one cooling tower. The northern cooling tower pump structure housing the A pump also houses the main screen wash pumps in a small adjoining pump bay. A switchgear structure is adjacent to each pump structure.

The discharge control structure has four flow openings **Security Related Informatio**

, three of which have gates to control the discharge velocity of the circulating water system.

The bridge structure **Security Related Information Withheld under 10 CFR 2.390** **Security**

Security Related Information Withheld under 10 CFR 2.390

Security Related Information Withheld under 10 CFR 2.390 . The bridge crosses the discharge canal to provide access to the cooling towers.

Security Related Information Withheld under 10 CFR 2.390 The minimum water level for safe plant shutdown is discussed in subsection 2.4. Security Related Information Withheld under 10 CFR 2.390

Security Related Information Withheld under 10 CFR 2.390

12.2.15 Emergency Cooling Tower and Reservoir

The emergency cooling tower and associated mechanical and electrical equipment are seismic Class I as described in subsection 10.24, "Emergency Heat Sink." The Class I elements of the emergency heat sink supported on ground are located on firm, sound rock, and a dynamic analysis of the structure was performed. The hydrodynamic effects of the reservoir water are considered.

The emergency heat sink cooling tower and water reservoir are located approximately 200 ft north of the plant. The reservoir has a 1-week water storage capacity, approximately 3.55 million gal.

The cooling tower is a mechanical induced-draft type, consisting of three cells. The reservoir and tower facility is a reinforced concrete structure. The cooling tower fill consists of dense vitreous clay tiles of multi-cell block design. The cooling tower is similar to the one installed at Stanford University in Palo Alto, California.

The reservoir is a reinforced concrete tank structure approximately 25 ft deep and with a pre-cast, reinforced, concrete roof. The tank structure is founded on rock.

This structure has one weathertight door below the maximum wave runup elevation (caused by the PMF) and is sealed against flooding to above this height (except at the door).

12.2.16 Watertight Dikes

The watertight dikes around (1) the refueling water storage tank and the Unit 2 condensate storage tank, (2) the Unit 3 condensate storage tank and (3) the torus water storage tank are seismically designed for the effects of maximum ground acceleration due to the design earthquake.

Due consideration was given to the postulated failure of a tank within the dike area and consequent hydrodynamic effects of the fluid, including sloshing, during a seismic event. The stresses in the dikes are within the allowable limits.

Security Related Information Withheld under 10 CFR 2.390

Unit 3 dikes are formed by cantilever concrete walls on all sides except for a small portion which consists of part of the recombiner building west wall.

Structural separations are specified between the buildings to eliminate interaction. Details used are industry standards for this type of wall construction; however, construction is to Class I QA/QC requirements. Continuous water stops made of soft annealed copper are provided at all construction joints. To protect the water stops, oversized rubber hose was inserted above and below the stop. The joint was then sealed with mastic waterproofing to the edges of the joint.

12.2.17 Plant Services BuildingOffice Building North of the Unit 3 Turbine Building

Security Related Information Withheld under 10 CFR 2.390 n Withheld under 10 CFR 2.390

. This building houses site work groups that are required to support the plant.

12.2.18 Site Management Building

Security Related Information Withheld under 10 CFR 2.390 , this Security Related Information Withheld under 10 CFR 2.390 Site Management Building and attached shop houses the various site work groups that are required to support the plant. The building is not located within the protected area boundary.

12.2.19 Radwaste Onsite Storage Facility

The radwaste onsite storage facility consists of three major areas including a cell storage area primarily for radioactive dewatered resins, a warehouse storage area for dry active waste, and a service head for material transfer and control operations.

The cell storage area consists of 30 concrete cells for storage of dewatered condensate and reactor water clean up resins and other appropriately packaged material. Five additional concrete partial cells are utilized for storage of miscellaneous items. All cells are designed for storage of waste with a maximum anticipated activity level based on operational experience.

The warehouse storage area **Security Related Information Withheld under 10 CFR 2.390** is utilized for the storage of packaged compactible or non-compactible dry active waste. Shield walls surround the storage area and the maximum activity of waste packages allowed in this area is controlled.

The service head adjoins both the cell storage area and the dry active waste storage area. The service head consists of an indoor and outdoor truck bay, a control room for remote waste transfer to and from storage cells, a local control room on the cell operating deck, an access control area with offices, sanitary and personnel decontamination facilities and a protective clothing storage and change area. Also contained in the service head are a dry active waste staging area, sump area and HVAC and electrical equipment rooms.

Security Related Information Withheld under 10 CFR 2.390

Security Related Information Withheld under 10 CFR 2.390

The structural design of the facility is discussed in Appendix C, section C.2.2. The building foundation is discussed in section 2.7.6.4.

12.2.20 Warehouse Complex

Security Related Information Withheld under 10 CFR 2.390

This complex includes the buildings formerly known as the Fabrication Shop and the Bechtel Building. This complex includes warehouse areas, storage rooms, a receiving area, office areas, and a fabrication shop area.

12.2.21 Secondary Alarm Station (S.A.S.) Building

Security Related Information Withheld under 10 CFR 2.390

12.2.22 Plant Entrance and Radiochemistry Laboratory

Security Related Information Withheld under 10 CFR 2.390

12.2.23 Independent Spent Fuel Storage Installation (ISFSI)

There are two ISFSIs **Security Related Information Withheld under 10 CFR 2.390** . One ISFSI (for storage of TN-68 casks) is an outdoor concrete slab **Security Related Information Withheld under 10 CFR 2.390** . The other ISFSI (for storage of HI-STORM FW casks) is an outdoor concrete slab **Security Related Information Withheld under 10 CFR 2.390** A Cask Transfer Facility (CTF)adjacent to the HI-STORM FW storage pad is a pit used to transfer a loaded Multi-Purpose Canister (MPC) from the HI-TRAC VW transfer cask to a HI-STORM FW storage cask. A prefabricated building **Security Related Information Withheld under 10 CFR 2.**

houses equipment associated with the spent fuel storage facility.

A Cask Transfer Facility (CTF) adjacent to the HI-STORM FW storage pad is a pit used to transfer a loaded Multi-Purpose Canister (MPC) from the HI-TRAC VW transfer cask to a HI-STORM FW storage cask. Both storage pads are protected from uphill and downhill slope slippage by retaining walls to the east and west.

12.2.24 Rock Run Creek Crossing (RRCC)

The RRCC is a reinforced concrete bridge that is used by the spent fuel cask transporter to travel between the plant and the two ISFSIs. The bridge is safety related and is designed to remain functional following design basis conditions in order to ensure that a cask can be returned to the plant within regulatory time limits for recovering a leaking cask.

12.3 RADIATION SHIELDING

12.3.1 Shielding Objective

The primary objective of radiation shielding is to restrict the exposure of operating personnel and the general public to radiation emanating from the reactor, turbine, and auxiliary systems, and to conform with applicable regulations.

The secondary objective of radiation shielding is to reduce radiation effects upon materials to acceptable levels. Of principal concern are organic materials used as insulation, rubber tank linings, gaskets, etc.

12.3.2 Shielding Design Basis

Shielding design for normal plant operations ensures that radiation exposures are in accordance with 10CFR20.

12.3.3 Design Considerations

12.3.3.1 Radiation Exposure of Personnel

The basis for the shielding design for normal plant operation is 10CFR20, "Standards for Protection Against Radiation." The exposure of individuals to concentrations of radioactive materials in air or water, above the contributions from natural background, is limited to values in Appendix B of 10 CFR 20.1001-20.2402, Appendix B.

The allowable design dose rate for all accessible areas of the plant is a maximum deep dose equivalent of 5 rems per calendar year. For all areas outside the plant, the allowable dose is in accordance with the requirements of 10CFR20.

All areas of the plant are subject to these regulations. The areas are zoned according to their expected occupancy by personnel and their designed radiation exposure level under normal operating conditions.

The Main Control Room (MCR) and the Technical Support Center (TSC) design is based on the airborne fission product inventory in the reactor building following the design basis LOCA in Unit 2 or 3, using a TID-14844 source term. Consistent with Alternative Source Term (i.e., 10CFR50.67), the MCR and TSC are currently evaluated based on the source term and guidance in Regulatory Guide 1.183 and NUREG-1465. Shielding and ventilation air treatment are provided such that operators occupying the MCR and the TSC, and traveling to and from the MCR across the site will receive an exposure of less than 5 Rem whole body or its equivalent over the course of the accident.

12.3.3.2 Radiation Exposure of Materials and Components

Materials and components are selected on the basis that radiation exposure as a result of the shielding design will not cause significant changes in their physical properties which adversely affect operation of equipment during the design life of the plant. Materials for equipment required to operate under accident conditions are selected on the basis of the additional exposure received in the event of a design basis accident.

Comparison of the potential exposures which equipment within the primary containment could experience from the design basis LOCA source terms (derived from GE-APED-5756, "Analytical Methods for Evaluating the Radiological Aspects of the General Electric Boiling Water Reactor") to the expected lifetime exposures shows that these expected lifetime doses are usually greater than the potential accident doses. The safety system equipment specification for components inside the primary containment requires that materials used in the component's fabrication are able to withstand a specific total integrated dose which is based upon the component's expected lifetime dose plus a LOCA.

RPS and engineered safety feature related electrical and mechanical equipment will withstand, without loss of capability for performance of their safety functions, the total exposure resulting from a design basis LOCA utilizing source terms, as stated in subsection 14.9, at the end of plant life.

Subsection 14.9 discusses the capability of engineered safety feature systems to withstand the radiation effects. This subsection contains the source term assumptions and specific evaluations of the standby gas treatment system, the CSCS components, and electrical penetrations.

The electrical power and control cabling for safety system equipment which must function in a radiation environment is not discussed in subsection 14.9 but has been tested under a simulated post-accident radiation environment. The cabling has been irradiated with a Co_{60}-60 source to a dose of at least 2×10^7 rads which is in excess of that which safety system cabling inside the primary containment would experience during 40 yr normal operations plus that which would be experienced according to the assumptions stated in subsection 14.9. The results of the test indicate that the power and control cabling of the safety systems is capable of satisfactory performance in a BWR primary containment environment.

The individual components and lubricants of electric motor operators have been reviewed by the manufacturer for their ability to withstand the design basis radiation environment; i.e., that experienced during 40 yr of normal operation plus that radiation which would be experienced resulting from a fission product release into the primary containment according to the assumptions stated in subsection 14.9 during that portion of a LOCA in which valve operation would be required. The manufacturer's review indicates that the Limitorque operators are capable of proper operation after irradiation in excess of the design basis radiation environment.

12.3.3.3 Radiation Zoning and Access Control

The areas inside the plant structures, as well as the general plant yard areas, are identified by different radiation zones.

The following list gives the individual zones which are used for the Peach Bottom plant:

Zone Designation	Design Dose Rate (mRem/hr on a 40 hr/week basis)	Description
I	≤ 0.5	Controlled, unlimited access
II	0.5 to 2.5	Controlled, limited access 40 hr/week
III	2.5 to 15	Controlled, limited access between 6-40 hr/week
IV	15 to 100	Controlled, limited access between 1-6 hr/week
V	over 100	Normally inaccessible

CONTROLLED, unlimited access areas are those that can be occupied by plant personnel or visitors on an unlimited time basis with a minimum probability of health hazard from radiation exposure.

CONTROLLED, limited access areas are those where higher radiation levels and/or radioactive contamination which have a greater probability of radiation health hazard to individuals can be expected. Only individuals directly involved in the operation of the plant are, in general, allowed to enter these areas.

ACCESSIBLE areas are those that receive radiation dose rates of less than 100 mrem/hr and which can be entered either through open passages or unlocked doors.

INACCESSIBLE areas are those where dose rates above 100 mrem/hr can be expected. Access to these areas is controlled by health physics in accordance with the Technical Specifications.

Controlled and limited access areas are identified by radiation caution signs at strategic locations.

Any area having a radiation level that would result in a dose in excess of 5 mrem in 1 hour at 30 centimeters from the source, will be posted as a "Radiation Area." Any area having a radiation level such that a dose in excess of 100 mrem in 1 hour at 30 centimeters from the source will be posted as a "High Radiation Area".

Whenever practical, the measured radiation level and the location of the source is posted at entry to the area.

Restrictions are enforced by removable concrete shielding blocks, locked doors, chains, and administrative control. In case of emergency, personnel will be able to use escape routes which involve the minimum of exit time.

The access control and radiation zones shown in Drawings A-50 and A-55 and in Figures 12.3.2 through 12.3.11 are historical and reflect the anticipated levels at the original startup of the units.

12.3.3.4 Design Conditions

The shielding design considers three conditions:

1. Operation at design power. This also includes shielding requirements for certain unusual conditions, such as release of fission products from leaking fuel elements.

2. Shutdown. This condition deals mainly with the radioactivity from the subcritical reactor core, with

radiation from spent fuel bundles during on-site transfer, and with the residual activity in the reactor coolant and neutron-activated materials.

3. Design basis accidents. This includes design considerations for accidents in either Units 2 or 3.

A list of docketed correspondence, publications and computer programs which have been used in the design and evaluation of the radiation shielding is provided in the references at the end of this subsection. This list of publications and computer programs are as applied in the original plant design and are not meant to be all-inclusive.

Shielding design for plant changes use programs and references which are industry standards at the time of the change. Examples of standards include those developed by the American Nuclear Society's ANS-6 Radiation Protection and Shielding Division, and the international Commission on Radiological Protection.

Computer programs used include those distributed by the Oak Ridge National Laboratory Radiation Safety Information Computational Center, or commercially developed programs implementing established methods and parameters in ANSI/ANS standards.

12.3.3.5 Specific Design Values

The material used for most of the plant shielding is ordinary concrete with a bulk density of 144 lb/cu ft. Wherever cast-in-place concrete has been replaced by concrete blocks, the design assures protection on an equivalent shielding basis. Only in a very few instances have steel or water been utilized as primary shielding materials.

At design power, the N-16 coolant activation leaving the pressure vessel is 9.75×10^5 Mev/cc-sec. The plant shielding is also based on a maximum stack release rate of 0.35 Ci/sec from each unit after a 30-min holdup time in the off-gas system. Reactor water fission product concentrations and activated corrosion products were assumed to be the maximum values expected; 7.4 µCi/cc, and 0.07 µCi/cc, respectively. These conditions yield maximum shielding requirements for the demineralizers, cleanup systems, and other associated radiation handling facilities.

The shutdown condition assumes that the reactor core has been operating at 4,030 MWt for 1,000 hours. At 1,000 hours the fission product inventory approaches the infinite operation case.

12.3.4 Shielding Design Descriptions

The different areas of radiation protection are described as listed by specific location or building for convenience.

12.3.4.1 Main Control Room

The design basis accidents defining the protection required for the main control room are described in Section 14.9.

12.3.4.2 Reactor Building

The reactor building contains four major shielding structures: the reactor sacrificial shield, the drywell biological shield, the main steam pipe chase, and the spent fuel pool.

The sacrificial shield has several shielding functions. It protects certain major portions of the drywell space from excessive nuclear radiation exposures during operation. After shutdown, it provides protection from reactor vessel radiation for plant personnel engaged in in-service inspection and maintenance and repair of drywell equipment and components. Also, together with the drywell biological shield, it protects the general reactor building work areas. The sacrificial shield is approximately 2 ft 3 in thick.

The drywell biological shield concrete together with the reactor sacrificial shield provides the main protection for the areas surrounding the reactor vessel, the primary coolant, and recirculation systems. More than 8 ft of concrete thickness is used to keep the radiation dose rates in the fully accessible reactor building work areas to less than 2.5 mRem/hr.

The main steam line pipe chase, with up to 3 ft 9 in thick concrete walls, is the connecting shield structure between the reactor and turbine buildings. The chase shielding protects against the N-16 gamma radiation which is contained in the passing steam.

The spent fuel pool contains the highly radioactive spent fuel assemblies, control and instrument rods. A minimum of 5 ft of concrete thickness is used for radiation protection at the sides and bottom of the storage pool. A minimum cover of water above the fuel assemblies is maintained to protect plant personnel during fuel storage and transfer operations.

The reactor cleanup system, the in-core flux monitoring equipment, radwaste equipment, and the reactor internals are housed in numerous concrete shielded rooms surrounding the drywell concrete structure. Enclosing these secondary sources of radiation in shielded rooms permits the adjacent areas to be accessible to personnel on a 40-hr week basis.

The entrances into the drywell space are well shielded with up to 4 ft 6 in thick shield plugs at the equipment lock and 3 ft 6 in shield plugs at the equipment and personnel access lock Security Related

12.3.4.3 <u>Turbine Building</u>

Fission product gases, N-16, and some radioisotopes enter the turbine and turbine condenser. Approximately 80 percent of the activity is discharged via the air ejector to the off-gas system while the other 20 percent follows the condensate and is treated by the condensate filter-demineralizers.

Radiation shielding is provided around the following areas:

1. Main steam lines
2. Primary and extraction steam piping
3. High-pressure and low-pressure turbines
4. Feedwater pumps and turbines
5. Moisture separators
6. Reactor feedwater system heaters
7. Main condenser and hotwell
8. Air ejectors and steam packing exhauster
9. Condensate demineralizer
10. Off-gas lines.

Some of the equipment, such as the air ejectors, feedwater pumps, and heaters, are in individual rooms enabling the shutdown of part of the system without interrupting plant operation.

A 4 1/2-in steel shield at the high-pressure end of the turbine provides protection for limited access for instrument check. An 8 1/2 in thick steel shield between turbines and generators allows

40 hr/week access to the generators, control room, and central laydown area, and also protects the main personnel entrance into the plant.

The radiation dose rate at the site boundary produced by the N-16 gamma in the steam lines is negligible. An evaluation was further made of the dose from this source that could possibly occur to an individual at the nearest point along the waterline. Even if a person were to remain in this location 1 hr/day for an entire year, the dose to that person would be insignificant as compared to existing limits. There are no known traffic patterns along the waterway, nor is there any known reason why an individual could reasonably spend even a fraction of the postulated time in that location.

12.3.4.4 Radwaste Building

The design basis for shielding of the radwaste facility assumes the quantity of radioactivity in the reactor coolant which results in an off-gas release of 0.7 Ci/sec (0.35 Ci/sec from each plant after a 30-min decay).

All areas for preparing, handling, or storing the radwaste are shielded to meet these conditions.

The individual radwaste systems have been separated from each other and shielded as much as practical in order to minimize personnel exposure during maintenance and repair of any of the equipment. The fully accessible areas surrounding the radwaste building are adequately shielded.

12.3.4.5 Administration Building and Shop and Warehouse

During normal operation all areas of the administration building and the adjacent shop and warehouse areas, with one exception, are fully accessible at all times. The exception is the equipment decontamination facility with its exhaust filter room. Adequate shielding and provisions for control of released airborne activities is provided to protect the surrounding areas.

12.3.4.6 Stack

The shielding design for the stack is based on a gaseous fission product release rate of 0.35 Ci/sec per plant as well as the accompanying radioactive particulates removed by the off-gas filters. Shielding is provided for controlled access at ground level to maintain the filters and instrumentation.

12.3.4.7 General Plant Yard Area

Plant yard areas which are frequently occupied by plant personnel receive a dose rate of less than 0.5 mRem/hr.

12.3.4.8 Radwaste Onsite Storage Facility

The radiation dose outside the facility is designed to average less than 1 mRem/hr from all sources. The interior wall thicknesses have been designed to maintain all normal access areas at a dose rate of less than 2.5 mRem/hr. This dose rate includes both direct and scattered radiation. The roof over the cell storage area contains adequate thickness to ensure that a sufficiently low off site dose to the public due to sky shine will be sufficiently low (<1mRem/yr).

12.3.4.9 Plant Entrance and Radiochemistry Laboratory

The counting room, located in the plant entrance and radiochemistry laboratory building, is shielded to minimize background radiation.

12.3.4.10 Independent Spent Fuel Storage Installation (ISFSI)

The radiation dose to any real individual is limited in accordance with 10CFR72.104. Direct radiation from ISFSI casks/containers is controlled to the values assumed in the analyses by appropriate shielding designed into the casks/containers, selective placement of fuel within the casks/containers and placement in appropriate locations on the ISFSI pad.

12.3.5 Plant Shielding for Post-Accident Access

As required by NUREG-0737 Action Item II.B.2, a review of the accessibility to specific plant areas for post-accident conditions was performed. The review compared the plant design with the post-accident criteria provided by the NRC in NUREG-0737, Action Item II.B.2 and NUREG-0578, Item 2.1.6.b.

Using the sources evaluated in UFSAR Section 14.9.2 to meet the requirements of 10CFR 50.67, the projected doses to individuals in vital areas requiring continuous occupancy Security Related Information Withheld und meet the General Design Criteria (GDC) 19 dose limits. Additionally, for vital area missions in the areas below requiring infrequent occupancy, dose rates have also been evaluated and meet the GDC 19 requirements:

Security Related Information Withheld under 10 CFR 2.390

Compliance with the dose limits of GDC 19 has been verified using the methodology described in the referenced list of docketed correspondence dated May 13, 1983, concerning the implementation of NUREG-0737, Action Item II.B.2. The updated dose analysis and results for operation at 4,030 MWt were submitted to the NRC (ML14023A659) in an Exelon letter dated January 17, 2014, Extended Power Uprate License Amendment Request - Supplement 17. Methodology inputs (e.g., travel time to perform missions) are based on walkdowns to support the associated dose calculation.

12.3 RADIATION SHIELDING

REFERENCES

List of Docketed Correspondence for Original Plant Design Shielding Evaluations

Letter from S. L. Daltroff (Philadelphia Electric Company - PECo) to Richard W. Starostecki (NRC), Peach Bottom Atomic Power Station, Response to Unresolved Items (277/82-23-01; 278/82-22-01), May 13, 1983.

Letter to Mr. D. C. Eisenhut (NRC) from S. L. Daltroff (PECo), dated July 7, 1982, entitled NUREG - 0737, Item II.B.2, Plant Shielding Evaluation - Peach Bottom Atomic Power Station.

Letter to Mr. D. C. Eisenhut (NRC) from S. L. Daltroff (PECo), dated October 15, 1980, entitled Implementation of NRC Action Plan Requirements.

Two letters to Mr. H. R. Denton (NRC) from S. L. Daltroff (PECo), dated January 2, 1980 and January 31, 1980, entitled Design Review Studies Required by Short-Term Lessons Learned - Peach Bottom Atomic Power Station..

List of Publications Used Extensively in the Shielding Design

Lederer, C.H.; Hollander, J.M.; and Perlman, I., "Table of Isotopes," John Wiley and Sons, Inc., 1967.

"Code of Federal Regulations," Title 10 (as of January 1, 1967) Office of Federal Register, USA.

"Report of Committee II on Permissible Dose for Internal Radiation (1959)," published 1960 for International Commission on Radiological Protection, Perganon Press.

"Calculation of Distance Factors for Power and Test Reactor Sites (TID-14844)," USAEC, March 23, 1962.

Walker, R.L. and Grotenhuis, M., "A Summary of Shielding Constants for Concrete," ANL-6443, Argonne National Laboratory, November 1961.

"Mass Absorption Coefficients," ANL-5800, USAEC, July 1963.

Kircher, J.K. and Bowman, R.E., "Effects of Radiation on Materials and Components," Reinhold Publishing Corp., 1964.

List of Computer Codes Used for the Shielding Design

GRACE II - For computing gamma-ray attenuation and heat generation (FORTRAN code developed by Atomics International)

FAIM - For computing neutron attenuation and heat generation (FORTRAN code modified by Bechtel Corporation)

GHT - For computing heat conduction problems due to gamma-ray and neutron attenuation (FORTRAN code developed by Oak Ridge National Laboratory)

These references and computer programs are as used in original plant design. Updated versions of programs, alternative programs applying industry standard methodologies, and industry recognized references may be used in evaluation of plant design changes.

12.4 RADIOACTIVE MATERIALS SAFETY

12.4.1 Material Safety Programs

Byproduct source materials and special nuclear materials are monitored for radiation and contamination levels upon delivery to the site. Source materials intended for use as calibration standards or for sample analyses are under the control of the Health Physics, Chemistry, and I&C organizations. These sources are stored in a locked source storage facility when not in use.

Records are maintained on radiation sources, including receipts, disposals, storage locations, and when significant, decay histories.

Unsealed sources (solid, liquid, or gas) are used as required by authorized personnel in the counting room, chemical laboratories, or in the plant where process or other radiation monitors are located.

High level sources are stored in the locked source storage facility described above. These sources are sealed and include shielding as an integral part of the assembly. When these sources are in use, barriers are erected and signs are posted to warn personnel of the existence of such sources. The roped off area is normally extensive enough to limit the radiation level at the barrier to 5 mRem/hr.

Sealed sources are tested for leakage using onsite instrumentation. Leaking sources are disposed of or returned to the vendor for repair or disposal. Sealed sources which are part of an integral shielded assembly are not removed for leak testing; however the assembly itself is checked for evidence of leakage from the source.

The sealed sources are handled and used in accordance with PBAPS Health Physics procedures. Recognized methods for the safe handling of radioactive materials (such as those recommended by NRC Regulatory Guide 8.8, part C.4, dated September 1975) are implemented to maintain potential external and internal doses at levels that are as low as reasonably achievable.

Special nuclear material inventory and control are the responsibilities of an assigned reactor engineer. Appropriate procedures ensure that the receipt, storage, and transfer of special nuclear material are controlled in accordance with 10CFR70.

12.4.2 Facilities and Equipment

A radiochemical laboratory is provided for handling and preparing radioactive samples. This laboratory has fume hoods with a vent system containing exhaust fans. The fans discharge to the ventilation stack, where plant releases are monitored, after passing through HEPA filters. A chemical laboratory is also provided which contains fume hoods. Part of this laboratory is used for chemical analyses. The other part is used for low level and background sample preparation. A separate counting room for analysis of radioactive content of samples is provided.

NUREG-0737, Item II.B.3 requires acceptable background levels of radiation in the radiochemistry counting facility, during the worst case postulated accidents, to permit post-accident counting of radioactive samples.

The use of the Facility is governed by the requirements of Federal Regulations and certain plant specific procedures in order to assure the safe operation of the counting facility, safety of personnel and the public. In particular, radiation protection control will be in accordance with 10 CFR Part 20 and applicable procedures. Periodic radiation surveys of the count room and appropriate shielding will be carried out to ensure an exposure rate of less than the permissible levels as specified in 10CFR20.1301 for unrestricted areas.

12.4.3 Personnel and Procedures

The Health Physics and Chemistry organizations consist of knowledgeable engineers, chemists, health physicists, and technicians. The organizations are responsible for the chemistry and radiation safety program necessary for the safe operation and maintenance of the equipment and for the safety of the public and of plant personnel.

The Manager, Radiation Protection, is responsible for the health physics activities and reports to the Plant Manager. The Manager, Chemistry/Radwaste is responsible for implementation of Plant Chemistry, Effluents, and Environmental and Controlled Materials programs and reports to the Plant Manager. The qualifications of the Manager, Radiation Protection and the Manager, Chemistry/Radwaste are discussed in Section 13.2.3.1. Health Physics managers and supervisors report to the Manager, Radiation Protection and are responsible for the activities described in section 13.2.2.1.2.

Chemistry managers and supervisors report to the Manager, Chemistry/Radwaste and are responsible for the activities described in Section 13.2.2.1.3.

Various health physics and chemistry procedures exist to describe methods for conducting radiation-oriented work and analyses. The topics of the procedures include such subjects as the following:

1. Area surveys
2. Radiation work permits
3. Personnel exposure and decontamination
4. Use of anti-contamination clothing and respiratory equipment
5. Radioactive waste disposal
6. Sampling
7. Sample analysis.