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 at Elevation 91 ft 6 in (C.D.) to its refueling floor at Elevation 234 ft 0 in (C.D.). Above this floor, the building superstructure consists of metal siding and decking supported on structural steel framework. The building is nominally 150 ft by 150 ft in plan below Elevation 135 ft 0 in (C.D.) and is 150 ft by 120 ft in plan above this level. 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 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 through 12.1.7.

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,

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"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 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 engineered safeguards equipment housed in the reactor building from missiles associated with a tornado, or those 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 tornado missile or a wheel or bucket of the turbine-generator will not penetrate through the 2 to 3 ft thick concrete walls and endanger the functional integrity of the secondary containment.

e. Flooding: The reactor building substructure design below Elevation 135 ft 0 in (C.D.) was reviewed for the effects of the design basis flood. Under this condition, the water level may reach an elevation of 135 ft (C.D.). This elevation includes 1.2 ft of freeboard. This structure has a minimum number of doors below Elevation 135.0 ft (C.D.). They are watertight. Reactor building doors above Elevation 135.0 ft (C.D.) 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 below Elevation 135 ft 0 in (C.D.) is waterproofed to Elevation 128 ft 0 in (C.D.), 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 is nominally 600 ft by 150 ft in plan 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 through 12.1.7 show the building layout and general equipment arrangement.

This building is founded on sound rock at various elevations below Elevation 116 ft (C.D.). The external and some internal walls are cast-in-place concrete up to the operating floor of the turbine building at Elevation 165 ft 0 in (C.D.). The structure above this level is metal siding and deck above a 20-ft band of precast concrete wall panels all supported by structural steel frames. Frames also support two 110-ton overhead bridge cranes in tandem.

The floors of the turbine building at Elevations 135 ft 0 in (C.D.) and 165 ft 0 in (C.D.) 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 nominally 225 ft by 42 ft and 50 ft high. 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 (Figures 12.1.3 and 12.1.4). 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 missiles associated with a tornado or with 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. The emergency switchgear room is at Elevation 135.0 ft (C.D.), well above the maximum still water level of 132.0 ft (C.D.). 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 through 12.1.7). 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 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 at Elevation 88 ft 0 in (C.D.) 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 to Elevation 135.0 ft (C.D.).

The heating and ventilating equipment located at elevation 165 ft 0 in (C.D.) is considered essential for a safe shutdown of the plant, and thus is protected from tornado missiles. The cable trays which originate in the reactor buildings and terminate in the control room are protected by concrete.

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 are protected by 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 offsite 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 to above Elevation 138.0 ft (C.D.) or more than 1.1 ft above the maximum wave runup.

12.2.6 Off-Gas Filter Station

The off-gas filter station consists of three 14-ft high cells, nominally 10 ft by 10 ft, 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. The stack is located approximately 670 ft west of the reactor buildings, at Plant Coordinates North 1200 and West 2000, where the grade elevation is approximately 265 ft 0 in (C.D.).

The stack is a tapered, reinforced concrete structure 500 ft high. 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 30 ft 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 is nominally 80 ft by 60 ft in plan 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 is approximately 60 ft by 160 ft in plan and is south of, and adjacent to, the administration building. 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 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 roofing.

12.2.9 Water Treatment Building

This is a single story building, nominally 60 ft by 60 ft in plan, located south of the pump structure. 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 built-up roofing.

12.2.10 Circulating Water Pump Structure

The pump structure complex, nominally 280 ft by 80 ft of reinforced concrete founded on rock, consists of several sections (Figure 12.2.2). 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 to Elevation 135 ft 0 in (C.D.) by means of watertight doors and sealed floor penetrations. The parapet around the roof of the critical pump area is at Elevation 137.5 ft (C.D.) or 0.6 ft above the estimated maximum wave runup of Elevation 136.9 ft (C.D.). The floor slab in the structure is at Elevation 112.0 ft (C.D.). Watertight exterior flood doors at the north and south ends will remain closed for fire protection purposes.

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. The floor slab in this area is at Elevation 116 ft 0 in (C.D.) and the room does not have flood protection above this level.

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 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 along the west wall of the building and at Elevation 116 ft (C.D.) on the concrete substructure to the east, 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.

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 five mechanical-draft cooling towers are conventional multi-cell units constructed of polyvinylchloride fill and asbestos covered wood fan deck with asbestos cement louvers and sheathing, and having 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, nominally 73 ft by 24 ft with a height of 35 ft, 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 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 roofs on metal decking.

The intake screen structure is nominally 450 ft by 60 ft with the bottom slab elevation at 84 ft (C.D.) and the grade slab elevation at 116 ft (C.D.). 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 frazil ice.

The cooling tower pump structures, housing the A,B, and C pumps, consist of a pump bay, nominally 30 ft by 40 ft with the grade slab elevation at 116 ft 0 in (C.D.). 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 D and E cooling tower pumps are housed in one pump structure, nominally 70 ft by 60 ft, with grade slab elevation at 116 ft 0 in (C.D.). There are two pump bays in the structure, each containing one cooling tower pump which serves its respective D or E cooling tower.

The discharge control structure has four flow openings between Elevations 85 ft 0 in (C.D.) and 116 ft 0 in (C.D.), three of which have gates to control the discharge velocity of the circulating water system.

The bridge structure has a nominal span of 114 ft and width of 20 ft. The bridge utilizes five 20-ft sections supported on piers with a roadway elevation of 116 ft (C.D.). The top of the pier foundation slabs is at elevation 88.5 ft (C.D.). The bridge crosses the discharge canal to provide access to the cooling towers.

The minimum suction water elevation to maintain normal operation is 98.5 ft (C.D.). The minimum water level for safe plant shutdown is discussed in subsection 2.4. The elevation of the cooling water intake invert at the screen structure is 84.0 ft (C.D.).

At the pump structure the water intake invert is 79.83 ft (C.D.) (Figure 12.2.2). For location on site refer to Figure 2.2.9.

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 3.7 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 and (2) the Unit 3 condensate 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.

Approximate plan sizes are 55 ft by 100 ft for Unit 2 and 44 ft by 75 ft for Unit 3. Unit 2 dikes are formed by the reactor building wall on the north, the auxiliary boiler building and the railroad lock on the west and east, respectively, and a cantilever concrete wall on the south. 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 Building

This building is a two story metal building located 95 feet north of the Unit 3 Turbine Building and covers an area 61 feet by 116 feet. This building houses site work groups that are required to support the plant.

12.2.18 Site Management Building

Located on the south end of the parking lot, this 190' x 110' four story Site Management Building and attached shop house 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 encompasses approximately 6000 square feet and 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.

The radwaste onsite storage facility is not located within the protected area boundary (P.A.B). However, appropriate security provisions have been incorporated into the facility design. 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

The Warehouse Complex is located in the far north east section of the protected area and its dimensions are approximately 395′ (north to south) by 272′ (east to west). 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

This building is a single story 52' x 30' pre-engineered structure located east of the emergency cooling tower inside the protected area boundary (P.A.B.). The building houses the security computer, backup security console, and administrative offices for the onsite security force.

12.2.22 Plant Entrance and Radiochemistry Laboratory

The Plant Entrance and Radiochemistry Laboratory is a three (3) story structure located north of the Unit 3 Turbine Building. The first floor will house an entrance area into the plant RCA. The second floor will house a Radiochemistry Laboratory and Counting Room.