3.4 WATER LEVEL (FLOOD) DESIGN

3.4.1 FLOOD PROTECTION

In accordance with 1OCFR50, GDC2, the basis of the Waterford 3 flood protection design is to ensure that "structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as ... floods, tsunami and seiches without loss of capability to perform their safety-related functions". To implement this criteria, all seismic Category I structures, safety-related systems, and components necessary for safe shutdown are located within the Nuclear Plant Island Structure (NPIS), which is designed against high water levels and wave run-up associated with probable maximum flood (PMF) to elevation +30.0 ft. MSL. The NPIS is a reinforced concrete box structure with solid exterior walls with few doors and penetrations, and design provisions exist (e.g., waterstops, door seals, waterproofing membranes) to ensure that water intrusion will be minimized. The plant grade around the structure varies from elevation +17.5 ft. MSL to the north side to elevation +14.5 ft. MSL on the south side.

All seismic Category I structures, safety-related systems, and components are protected against PMF by the following:

a) The NPIS is the common structure of Reactor Building, Reactor Auxiliary Building, Fuel Handling Building and Component Cooling Water System Structure. It is a rectangular box-like reinforced concrete structure 380 ft. long, 267 ft. wide and extending 64.5 ft. below grade. The general structural layout is shown on Figure 3.8-1. Its common foundation mat and exterior wall system are designed to withstand all loadings and postulated floods as well as to minimize water intrusion.

   The common foundation mat is 12 ft. minimum-in thickness and provided with double layers of nine inch PVC waterstop at all construction joints. The walls subjected to floods are provided with waterproofing membranes up to plant grade. In addition, vertical construction joints of the walls between plant grade and elevation +30.00 ft. MSL are provided with minimum six inch PVC waterstops (Figure 3.4-1). Uplift forces created by the PMF to elevation +30.0 ft. MSL are accounted for in the design as described in Subsections 3.8.4.3.1 and 3.8.4.3.2.

b) Housing within another structure (NPIS) designed to protect against flooding. The Reactor Building is enclosed within the NPIS and is thus protected against PMF.

Table 3.2-1 lists the flood protection criteria applied to plant structures, systems and components. The a or b designation in the table refers to item a or b above.

Figure 3.4-1 shows details of penetration, waterproofing and waterstops for the exterior walls of seismic Category I structures.

All exterior doors of the NPIS at plant grade or below the PMF elevation, which house and protect safety-related equipment, are designed as flood protection doors to withstand the hydrostatic pressures due to PMF while minimizing water intrusion. The doors, which are located in the Reactor Auxiliary Building, are swing type (single or double) for protection against tornado missiles and PMF. In order to meet the design basis, the doors are provided with a continuous silicone compression seal on the inner face and sealed by the use of six locking bolts placed around the perimeter of the door as shown on Figure 3.4-2.

→(EC-29230, R305; EC-41046, R307)
There are a total of seven exterior, flood-protected access doors and one flood protected gate below elevation +30.0 ft. MSL. In the Reactor Auxiliary Building there are three of the flood doors located in the east exterior wall, and two located in the west exterior wall above elevation +21.0 ft. MSL (Drawing G135). In the Component Cooling Water System area there are two flood doors located in the west exterior wall above elevation +21.0 ft. MSL (Figure 1.2-24). In the Fuel Building area there is one removable flood-protected gate (Gate 3A, presently welded shut) located by the spent fuel cask decontamination area above elevation +20.0 ft. MSL (Figures 1.2-15 and 16). Valves CMUMVAAA908, CMUMVAAA909, FS MVAAA201 and FS MVAAA202 form the flood barrier for the Design Basis Flood in the Fuel Handling Building.
←(EC29230, R305; EC-41046, R307)

Penetrations below elevation +30.0 ft. MSL are shown in Drawings LOU1564 G-499SO4 to S06, G-565 to 567, and G-593SO1 to S03. The penetrations in the exterior walls of Component Cooling Water System structure are shown in Sections A-A, B-B and E-E of Drawings G-499SO4 to S06. Those in the exterior walls of Reactor Auxiliary Buildings are shown in Sections A-A, B-B and F-F of Drawings G-565 to 567. Those in the walls subjected to flood in Fuel Handling Building are shown in Sections B-B, C-C, F-F and Y-Y of Drawings G-593SO1 to S03. Some of the penetrations are located in the temporary blockout as indicated in the drawings. All the temporary blockouts are provided with keyways and continuous PVC waterstop and they are placed and filled with concrete after pipe installation. A typical detail of waterproofing membrane at pipe penetration is shown on FSAR Figure 3.4-1 and Drawing LOU1564 G-499SO5. (Drawings submitted under separate cover). The NPIS is designed to withstand hydrostatic loadings due to postulated floods, and water leakage because of cracks in exterior structures, leaking waterstop and/or wind wave action is expected to be negligible. The NPIS is also provided with floor drainage system capable of disposing the accumulated water through the waste management system (refer to Section 11.2).

As discussed in the Technical Specifications, additional specific provisions for flood protection include administrative procedures to assure that all exterior access doors below elevation +30.0 ft. MSL will be locked closed in the event of a flood warning.

3.4.2 ANALYSIS PROCEDURES

The maximum water level in front of the Nuclear Plant Island Structure following a collapse of the Mississippi River levee in the immediate vicinity of the plant concurrent with the PMF and from windwaves superimposed on the overland PMH surge through Barataria Bay has been established in Section 2.4. It is calculated that the effective maximum water including dynamic head on the exterior wall is at elevation +27.6 ft. MSL. The NPIS is designed to withstand a static water level at elevation +30.0 ft. MSL, thus providing an adequate safety margin. In addition, the subject structure is designed to withstand a static water level at elevation +21.5 ft. MSL plus an additional uniform dynamic loading equivalent to 500 lb. per sq. ft. of exposure below elevation +21.5 ft. MSL.

In the design of walls and foundation slab of NPIS, the loads under flood condition are considered using the following load combination equation. (Refer to Table 3.8-39 and Subsection 3.8.4.3.1).

$C = (1.0 \pm 0.10) (D + L' + A + T) + 1.0 (B' + S)$

Where B' includes the effects of lateral, overturning, and upward hydrostatic pressures based on the postulated flood conditions as discussed in the preceding paragraph.

The exterior doors are designed for a 12 ft. head of water. The lateral hydrostatic pressure against the doors is treated as a triangular load, increasing at the rate of 62.4 lb per sq ft per vertical foot from the top of the water (elevation +30.0 ft. MSL) to the bottom of the doors.