19.4 External Event Analysis and Shutdown Risk Analysis

The information in this section of the reference ABWR DCD, including all subsections, is incorporated by reference with the following departures and supplements.

STD DEP T1 2.15-1

STD DEP Admin

19.4.3.2.1 Structural Fragility

STD DEP T1 2.15-1

~~*The radwaste building does not contain safety-related equipment and its failure will not lead to core damage. Consequently, an estimate of the radwaste buiilding fragility is not required.*~~

19.4.3.4 Results of the Analysis

The following site-specific supplement addresses additional results of the analysis.

The STP 3 & 4 site-specific geology is bounded by the reference ABWR DCD seismic design.

19.4.4 Fire Protection Probabilistic Risk Assessment

The following site-specific supplement addresses additional results of the analysis.

The ABWR FIVE analysis was reviewed as discussed in Appendix 19M, based on the proposed plant departures and STP 3 & 4 site-specific characteristics. The existing ABWR FIVE results are considered bounding for the STP ABWR.

19.4.5 ABWR Probabilistic Flooding Analysis

The ABWR probabilistic flooding assessment considered internal flooding and external flooding events. The results of the internal and external flooding assessments are discussed below.

STD DEP Admin

~~*The results of the ABWR Probabilistic* Internal *Flooding Analysis show that the turbine, control, and reactor buildings are the only structures that required evaluations for potential flooding. The other buildings do not contain any equipment that could be used for safe shutdown or potential flooding would not result in a plant transient.*~~

The following site-specific supplement addresses probabilistic flooding analysis of the relocated Reactor Service Water pump house.

The results of the ABWR Probabilistic Internal Flooding Analysis show that the turbine, control, and reactor buildings and the Reactor Service Water pump house, are the only structures that required evaluations for potential flooding. The other buildings do not contain any equipment that could be used for safe shutdown or potential flooding would not result in a plant transient.

Flooding in the turbine building could result in a turbine trip due to loss of circulating water or feedwater. Automatic pump trips and valve closure on high water level should terminate the flooding. But if these were to fail, a non-watertight door at grade level in the turbine building should allow water to exit the building. If this door retained water, watertight doors would prevent water entering the control and reactor buildings. The core damage frequency (CDF) for turbine building flooding is extremely small.

The worst case flood in the control building is a break in the reactor service water system (RSW) which is an unlimited source. Floor drains and other openings in the floor would direct all flood water to the first floor where the reactor building cooling water (RCW) rooms are located. The RCW rooms contain sump pumps. Water level sensors in the RCW rooms should actuate alarms in the control room and send signals to trip the RSW pumps and close isolation valves in the RSW system. If these sensors were to fail, watertight doors on each room should limit flood damage to only one of the three RCW divisions. Breaks in the fire water system could result in interdivisional flooding in the upper floors but floor drains would limit water height to below installed equipment for the first hour. To prevent damage to safety-related equipment after this time requires operator actions to limit the depth of water. The CDF for control building flooding is extremely small.

The RSW pump house is contiguous with the Ultimate Heat Sink (UHS), and is separated into three divisions each with two levels, the pump room at elevation (-)22 feet nominal, and the Electrical and HVAC room at elevation14 feet nominal. Each division is separated from the other divisions by watertight, three-hour fire rated doors at both elevations (RSW Interface Requirements, Subsection 2.11.9 (2)). The normal operating level in the UHS basin is 63 feet 3 inches to 71 feet, or approximately 37 feet above site grade (nominally 34 feet). For each RSW division, the RSW supply line from the Ultimate Heat Sink (UHS) splits in the RSW pump house to provide water to both RSW pumps. The RSW pump discharge combines into a single supply line to the Control Building. RSW return from the Control Building passes through the RSW pump rooms and returns to the UHS above the normal operating level. Flooding in the RSW pump house could occur from failure of the supply line from the UHS, or from failure in the RSW return line to the UHS. The RSW pump rooms contain sump pumps and water level sensors that function to mitigate the effects of small breaks or leaks from the RSW lines in the RSW pump room. If the sensors were to fail, watertight doors on each room and level should limit flood damage to only one of the three RSW divisions. Large breaks in the supply lines from the UHS are unisolable before the pump discharge isolation motor-operated valve (MOV). Breaks after the pump discharge MOV and in the RSW return line to the UHS are isolable with the pump discharge MOV, which closes automatically on high level in the RSW pump room. Unisolable breaks in the RSW supply piping will result in draining the UHS to El. 50’ through the ventilation intake ducts in the top of the RSW pump house. Breaks in the fire water system could result in interdivisional flooding in the upper floors of the RSW pump house, but floor drains would limit water height to below installed equipment for the first hour. To prevent damage to safety-related equipment after this time requires operator actions to limit the depth of water. The CDF for internal flooding in the RSW pump house is very small.

The following standardsite-specific supplement addresses probabilistic flooding analysis for external flooding.

The ABWR Probabilistic External Flooding Analysis screened all except two external flooding events from consideration because flood waters would not rise to an elevation above the entrance to plant buildings. The two external flooding events with the potential to result in core damage are a) breach of the main cooling reservoir and b) multiple, concurrent failures of upstream dams.

Both external flooding events are assumed to cause a non-recoverable loss of offsite power as well as fail all equipment in the turbine building and the fire protection pump house.

Failure of any watertight door to prevent external flood waters from entering the reactor building was assumed to result in core damage since the essential AC switchgear is located below grade and there are no internal watertight barriers that would prevent water that enters the reactor building from causing failure of all three AC divisions.

Failure of any watertight door to prevent water from entering the control building was assumed to result in core damage because all three essential DC divisions and the main control room are located below grade and there are no internal watertight barriers that would prevent water that enters the control building from failing all three DC divisions or the main control room. For a breach of the main cooling reservoir, timely operator action is required to close the normally-open main control room access door. For multiple, concurrent upstream dam failures, many hours are available from failure of the last dam until flood waters reach the site. Therefore, failure of the operator action to close the main control room access door for the multiple, upstream dam failures is considered negligibleassured.

Additionally, failures that resulted in a station blackout were assumed to be non-recoverable and result in core damage.

The total CDF from external flooding events is very small.