PSEG Site
ESP Application
Part 5, Emergency Plan

ATTACHMENT 7

ABWR – SPECIFIC INFORMATION

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SECTION 1: INTRODUCTION

1. ABWR DESCRIPTION

The PSEG Site is owned and operated by PSEG. An area map showing geographical location of the facility is provided in Section 1 of this Emergency Plan.

The ABWR is a single-cycle, forced circulation, boiling water reactor (BWR) with a maximum core thermal power of 4300 megawatts thermal (MWt). Unique features of the ABWR design include the internal recirculation pumps, fine-motion control rod drives, microprocessor-based digital control and logic systems, and digital safety systems.

Overview of Plant Buildings

The major buildings comprising the PSEG Site ABWR are the Reactor Building, the Control Building, the Service Building, the Turbine Building, and the Radwaste Building. The following provides a brief description of equipment and facilities associated with the respective buildings:

- The Reactor Building includes the containment, drywell, and major portions of the nuclear steam supply system, steam tunnel, refueling area, diesel generators, essential and non-essential power, emergency core cooling systems (ECCSs), and heating, ventilating, and air conditioning (HVAC) systems.
- The Control Building includes the Control Room, the computer facility, the cable tunnels, some essential switchgear, some essential power, the reactor core cooling water system, and essential HVAC systems.
- The Service Building houses the Technical Support Center, the Operations Support Center, and the counting room for analyzing post-accident samples.
- The Turbine Building includes all equipment associated with the main turbine generator.
- The Radwaste Building includes all equipment associated with the collection and processing of solid and liquid radioactive waste generated by the plant.

Overview of Plant Systems

The major systems comprising the PSEG ABWR are the reactor/core, the reactor core coolant system (RCS), the reactor protection system (RPS), the pressure suppression primary containment system, the electrical power distribution system, the emergency core cooling system (ECCS), and the power conversion system. These systems are described below.

The reactor design consists of the reactor pressure vessel (RPV), pressure containing appurtenances (control rod housings, in-core instrumentation housing, head vent and spray assembly) and internal components. The internal components include the core, the core support structure, the shroud head and steam separator assembly, the steam dryer assembly, the feedwater spargers, the core spray, and the core flooding spargers. Except for zircaloy in the reactor core, the internals are made of stainless steel or other corrosion-resistant alloys.

The reactor core consists of 872 bundles in an 8-by-8 array and 205 control rods operating at a power density of 50 kW/liter. The control rods, which enter from the bottom of the reactor core, perform dual functions of power distribution shaping and reactivity control. Manipulation of selected patterns of rods controls power distribution, while electro-hydraulic drive mechanisms or hydraulic rapid scram insertion controls reactivity.

The reactor coolant system (RCS) includes the nuclear boiling system; the main steam, feedwater, recirculation system; the reactor core isolation cooling (RCIC) system; the residual heat removal system; and the reactor water cleanup system. The design is different from current BWR designs in that 10 reactor internal pumps (RIPs) located within the reactor forcibly circulate reactor coolant. This eliminates large piping connections to the reactor vessel below the core and also eliminates reactor recirculation system piping. Eighteen safety/relief valves in six groups provide RCS overpressure protection.

The reactor protection system (RPS) initiates a rapid, automatic shutdown of the reactor to prevent fuel cladding damage and any nuclear system process barrier damage due to an abnormal transient. The RPS scram logic inputs are from the neutron monitoring system (NMS). The NMS is a system of in-core neutron detectors and out-of-core electronic monitoring equipment.

The ABWR has a pressure suppression primary containment system. The primary containment includes a drywell and a wetwell. The drywell consists of two volumes, an upper drywell surrounding the RPV and a lower drywell that houses RIPs, control rod drives, and service equipment. The wetwell consists of a suppression pool and an air volume that serves as a heat sink during normal and accident conditions. A secondary containment surrounds the primary containment and permits monitoring and treating of all potential radioactive leakage from the primary containment.

The electrical power distribution system is a complete load group distribution system with two independent off-site power sources, the main turbine generator, three on-site standby power sources (emergency diesel generators), and a combustion turbine generator located on-site. During normal plant operations, the main generator supplies power to the main power transformer (MPT) and three unit auxiliary transformers (UATs) through the main generator output breaker and an isolated phase bus. When the main generator is off line, power is supplied to the UATs and the MPT by the preferred off-site power source.

In the event of a breach in the reactor coolant pressure boundary that results in a loss of reactor coolant, three independent divisions of the ECCS maintain fuel cladding below the temperature limit as defined in 10 CFR 50.46. Each division contains one high-pressure and one low-pressure inventory makeup system. The following systems make up the ECCS:

- High-pressure core flooder (HPCF) system
- RCIC system
- Low-pressure flooder (LPFL) system
- Automatic depressurization system (ADS)

The power conversion system is designed to convert the heat energy generated in the reactor to electrical energy. This system includes the main steam system, main turbine generator system, main condenser, condenser evacuation system, condensate cleanup system, and condensate feedwater pumping and heating system.

SECTION 2: EMERGENCY FACILITIES AND EQUIPMENT

1. UNIT-SPECIFIC EMERGENCY FACILITIES

Section 9 of this Plan contains information regarding the function and operation of the emergency response facilities. This section describes the ABWR design-specific Control Room, Operations Support Center (OSC), and Technical Support Center (TSC).

a. <u>Control Room</u>

The Control Room is located in the Control Building. The Control Room includes the main control area, operations staff areas, and offices for the shift. Plant operations are directed from the Control Room. Nuclear Plant Instrumentation, Area and Process Radiation Monitoring System Instrumentation, Controls and Instrumentation for Reactor and Turbine Generator operation are provided here.

Control Room habitability and radiation protection is described in Sections 9.4 and 6.4 of the DCD, respectively. A description of the Control Room is in the DCD. Emergency equipment available to the Control Room is listed and maintained in accordance with emergency plan implementing procedures and/or administrative procedures.

b. OSC

The Operations Support Center (OSC) is located inside the Protected Area in the Service Building, which is adjacent to the Control Building. The lunch room located next to the TSC is designated as the OSC. The OSC is non-safety related and is not seismic Category I.

Both the Control Room and TSC have diverse means of communication with various plant locations including the OSC. During an emergency, if the OSC becomes uninhabitable, an alternate location for OSC activities is designated. Evacuation of the OSC is conducted in accordance with emergency plan implementing procedures.

c. TSC

The Technical Support Center (TSC) is located within the Protected Area in the Service Building which is adjacent to the Control Building. The TSC is at least 1875 square feet and is sized for a minimum of 25 persons, including 20 persons designated by PSEG and five NRC personnel. The TSC is non-safety related and is not seismic Category I.

The TSC is designed to include the following:

- Displays for the plant parameters which are included in the fixed position displays on the Control Room panels.
- Voice communications equipment for communication with the Control Room, the Emergency Operations Facility, the Operations Support Center, and the NRC Headquarters and Region 1 Operation Centers.
- Installed area radiation monitors
- Exterior walls, roof, and floor are built to seismic Category II requirements.
- Provided with radiation protection equivalent to Control Room habitability requirements, such that the dose to an individual in the TSC for the duration of a design basis accident is less than 5 rem TEDE.
- Environmentally controlled to provide room air temperature, humidity and cleanliness appropriate for personnel and equipment.

- Reliable power for habitability systems and battery pack emergency lighting are provided.

During an emergency, if the TSC becomes uninhabitable, an alternate location for TSC activities is designated. Evacuation of the TSC is conducted in accordance with emergency plan implementing procedures.

d. <u>On-Site Laboratories</u>

The counting room for analyzing post-accident samples is located in the Service Building. The post-accident sampling is available for emergency response during an accident. General capabilities include:

- Radionuclide identification in various sample media.
- Analysis and measurement of radionuclides in samples taken within the plant and samples taken in the plant site and off-site environment.

e. <u>Decontamination Facilities</u>

The personnel decontamination facility is located in the Service Building adjacent to the main change room and contains provisions for radiological decontamination of personnel, their wounds, supplies, instruments and equipment. This facility has extra clothing and decontaminants suitable for the type of contamination expected, including radioiodine skin contamination.

2. ASSESSMENT / MONITORING RESOURCES

a. <u>On-Site Meteorological Monitoring Instrumentation</u>

The PSEG Site uses the existing Salem and Hope Creek Generating Stations' meteorological monitoring program. The meteorological program is in accordance with the recommendation of NRC Regulatory Guide 1.23 "Onsite Meteorological Program" and Section 2.3.3 of NUREG 75/087 (Rev. 3).

b. <u>On-Site Radiological Monitoring Instrumentation</u>

The on-site radiation monitoring capability includes an installed process, effluent, and area radiation monitoring system (RMS); portable survey instrumentation; counting equipment for radiochemical analysis; and a personnel dosimetry program to record integrated exposure. Some on-site equipment is particularly valuable for accident situations.

1. Area Radiation Monitoring

   The area monitoring system provides information on existing radiation levels in various areas of the plant to ensure safe occupancy. It is equipped with Control Room and local readout and audible alarms to warn personnel of a raised radiation level.

2. Radiological Noble Gas Effluent Monitoring

   The wide range gas monitors are installed on normal station effluent release points. Each monitor system has a microprocessor which uses digital processing techniques to analyze data and control monitor functions. These monitors provide readout and alarm functions to the Control Room.

3. Radioiodine and Particulate Effluent Monitoring

   The wide range gas monitor includes a sampling rack for collection of the auxiliary building vent stack particulate and radioiodine samples. Filter holders and valves are provided to allow grab sample collection for isotopic analyses in the plant's counting rooms. The sampling rack is shielded to minimize personnel exposure. The sampling media is analyzed by a gamma ray spectrometer which uses a gamma spectrometer system. In addition, silver zeolite cartridges are available to further reduce the interference of noble gases.

4. High-Range Containment Radiation Monitors

   High-range containment radiation monitors are installed. The monitors detect and measure the radiation level within the reactor containment during and following an accident. The monitors are in range of postulated accidents and in support of emergency response.

5. In-Plant Iodine Instrumentation

   Effective monitoring of increasing iodine levels in buildings under accident conditions includes the use of portable instruments using silver zeolite as a sample media. It is expected that a sample can be obtained, purged, and analyzed for iodine content within a two-hour time frame.

c. On-Site Process Monitors

An adequate monitoring capability exists to properly assess the plant status for all modes of operation and is described in the DCD. The operability of the post-accident instrumentation ensures information is available on selected plant parameters to monitor and assess important variables following an accident. Instrumentation is available to monitor the parameters in Technical Specifications.

The unit's emergency operating procedures assist personnel in recognizing inadequate core cooling using applicable instrumentation.

d. Seismic Monitors

State-of-the-art solid-state digital instrumentation enables the prompt processing of the data at the plant site. A triaxial time-history accelerometer is provided at each of the following locations:

- One at the finished grade in the free-field
- Three in the Reactor Building
- Two in the Control Building

The seismic instrumentation operates during all modes of plant operation, including periods of plant shutdown. The maintenance and repair procedures provide for keeping the maximum number of instruments in service during plant operation and shutdown.

The design includes provisions for in-service testing. The instruments are capable of periodic channel checks during normal plant operation and are capable of in-place functional testing. The instrumentation on the foundation and at elevations within the same building or structure are interconnected for common starting and common timing, and the instrumentation contains provisions for an external remote alarm to indicate actuation. The pre-event memory of the instrumentation is sufficient to record the onset of the earthquake. It operates continuously during the period in which the earthquake exceeds the seismic trigger threshold and for a minimum of 5 seconds beyond the last trigger level signal. The instrument is capable of a minimum of 25 minutes of continuous recording. The acceleration sensors have a dynamic range of 1000:1 zero to peak (i.e., 0.001g to 1.0g) and the frequency is 0.20 Hz to 50 Hz.

The seismic instrumentation system is triggered by the accelerometer signals. The actuating level is adjustable for a minimum of 0.005g to 0.2g. The trigger is actuated whenever the acceleration exceeds 0.01g. The initial setpoint may be changed (but exceeds 0.02g) once sufficient plant operating data have been obtained which indicate that a different setpoint would provide better system operation.

The instrumentation is capable of on-line digital recording all components accelerometer signals. The digitized rate of the recorder is at least 200 samples per second, the frequency bandwidth is at least from 0.20 Hz to 50 Hz, and the dynamic range should be 1000:1. The instrumentation is capable of using the recorded signal to calculate the standardized cumulative absolute velocity (CAV) and the 5 percent of critically damped response spectrum.

The instruments are capable of having routine channel checks, functional tests, and calibrations. The CAV shutdown threshold of 0.16g-seconds is calibrated with the October, 1987 Whittier, California earthquake record or an equivalent calibration record provided for this purpose by the manufacturer of the instrumentation. In the event that an earthquake is recorded at the plant site, all calibrations including the CAV are performed to demonstrate that the system was functioning properly at the time of the earthquake.

Activation of the seismic trigger causes an audible and visual annunciation in the Control Room to alert the plant operator that an earthquake has occurred.

e. On-Site Fire Detection Instrumentation

The fire detection system is designed in accordance with applicable National Fire Protection Association (NFPA) standards. The system is equipped with electrically supervised ionization smoke and heat detectors to quickly detect any fires and the instrumentation to provide local indication and control room annunciation. In addition to the smoke and heat detection systems, each fire protection carbon dioxide, halon, or water system is instrumented to inform the Control Room of its actuation or of system trouble.

In the event that a portion of the fire detection instrumentation is inoperable, fire watches in affected areas may be required.

Further details on the unit fire detection system can be found in the unit DCD and Fire Protection Plan.

SECTION 3: REFERENCES

1. THE ABWR PLANT GENERAL DESCRIPTION (DECEMBER 2006)
2. ABWR DESIGN CONTROL DOCUMENT, REV. 0
3. NUREG-1503—FINAL SAFETY EVALUATION REPORT RELATED TO THE CERTIFICATION OF THE ADVANCED BOILING WATER REACTOR DESIGN (JULY 1994)