PSEG Site
ESP Application
Part 5, Emergency Plan

ATTACHMENT 9

U.S. EPR – SPECIFIC INFORMATION

TABLE OF CONTENTS

SECTION 1: INTRODUCTION

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

1. U.S. EPR DESCRIPTION

The PSEG unit is an AREVA U.S. Evolutionary Power Reactor (EPR) which is an evolutionary Pressured Water Reactor (PWR) designed by Framatome ANP, Inc., a jointly-owned subsidiary of AREVA and Siemens. It is a four loop plant with a rated thermal power of 4,590 MWt. The primary system design, loop configuration, and main components are similar to those of currently operating PWRs.

The U. S. EPR safety design features include four redundant trains of emergency core cooling, containment and Shield Building, and a core melt retention system for severe accident mitigation, which meet applicable regulatory and commercial requirements.

The safety design of the U. S. EPR is based primarily on deterministic analyses complemented by probabilistic analyses. The deterministic approach is based on the “defense-in-depth” concept which comprises four levels:

1. A combination of conservative design, quality assurance, and surveillance activities to prevent departures from normal operation

2. Detection of deviations from normal operation and protection devices and control systems to cope with them (this level of protection is provided to ensure the integrity of the fuel cladding and of the reactor coolant pressure boundary (RCPB) in order to prevent accidents)

3. Engineered safety features and protective systems that are provided to mitigate accidents and consequently to prevent their evolution into severe accidents

4. Measures to preserve the integrity of the containment and enable control/mitigation of severe accidents

Low probability events with multiple failures and coincident occurrences up to the total loss of safety-grade systems are considered in addition to the deterministic design basis. Representative scenarios are defined for preventing both core melt and large releases in order to develop parameters for risk reduction features. A probabilistic approach is used to define these events and assess the specific measures available for their management. Consistent with international and U. S. probabilistic safety objectives, the frequency of core melt is less than 10-5/reactor-year including all events and all reactor states.

Design provisions for the reduction of the residual risk, core melt mitigation, and prevention of large releases are:

- Prevention of high pressure core melt by high reliability of decay heat removal systems, complemented by primary system overpressure protection (OPP)
- Primary system discharge into the containment in the event of a total loss of secondary side cooling
- Features for corium spreading and cooling
- Prevention of hydrogen detonation by reducing the hydrogen concentration in the containment at an early stage with catalytic hydrogen recombiners
- Control of the containment pressure increase by a dedicated severe accident heat removal system (SAHRS) consisting of a spray system with recirculation through the cooling structure of the melt retention device

External events such as an aircraft hazard, explosion pressure wave (EPW), seismic events, missiles, tornado, and fire have been considered in the design of Safeguard Buildings and the hardening of the Shield Building.

<u>Overview of the U. S. EPR Design</u>

The U. S. EPR is furnished with a four-loop, pressurized water, reactor coolant system (RCS) composed of a reactor vessel that contains the fuel assemblies, a pressurizer including control systems to maintain system pressure, one reactor coolant pump (RCP) per loop, one SG per loop, associated piping, and related control and protection systems.

The RCS is contained within a concrete Containment Building. The Containment Building is enclosed by a Shield Building with an annular space between the two buildings. The post-tensioned concrete shell of the Containment Building is furnished with a steel liner and the Shield Buildings comprise the Reactor Building. The Reactor Building is surrounded by four Safeguard Buildings and a Fuel Building. The internal structures and components within the Reactor Building, Fuel Building, and two Safeguard Buildings (including the plant Control Room) are protected against aircraft hazard and external explosions. The other two Safeguard Buildings are not protected against hazard or external explosions. However, they are separated by the Reactor Building, which restricts damage from these external events to a single safeguards building.

Redundant capacity safety systems for certain major safety systems are separated into four divisions. With four divisions, one division can be out-of-service for maintenance and one division can fail to operate, while the remaining two divisions are available to perform the necessity safety functions, even if one is ineffective due to the initiating event.

In the event of a loss of off-site power, each safeguard division is powered by a separate emergency diesel generator (EDG). In addition to the four safety-related diesels that power various safeguards, two independent diesel generators are available to power essential equipment during a postulated Station Blackout (SBO) event—loss of off-site ac power with coincident failure of all four EDGs.

Water storage for safety injection is provided by the In-containment refueling water storage tank (IRWST). Also inside containment, below the reactor pressure vessel (RPV), is a dedicated spreading area for molten core material following a postulated worst-case severe accident.

The fuel pool is located outside the Reactor Building in a dedicated building to simplify access for fuel handling during plant operation and handling of fuel casks. The Fuel Building is protected against aircraft hazard and external explosions. Fuel pool cooling is assured by two redundant, safety-related cooling trains.

SECTION 2 EMERGENCY FACILITIES AND EQUIPMENT

1. UNIT-SPECIFIC EMERGENCY FACILITIES

Section 9 of the Plan contains information regarding the function and operation of the emergency response facilities. This section describes the U.S. EPR 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 Safeguards Building 2. 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 in the Control Room. Control Room habitability and radiation protection are 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 in the Access Building within the Protected Area, separate from the Control Room and the TSC. 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 on the Control Room floor level outside the Control Room and has a separate access. It is located in the fully hardened Safeguards Building 2. Therefore, the TSC is protected against radiological hazards, internal and external missiles, and seismic activity.

The minimum size of the working space of the TSC is 1875 square feet. The TSC is sized for a minimum of 25 persons, including 20 persons designated by PSEG and five NRC personnel.

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 radiochemistry laboratories located in the Auxiliary Building are available for emergency response during an accident. The on-site laboratory sampling system is designed to provide gas and liquid samples of containment atmosphere following an accident.

All modules, the sampling box and the local control cabinet are located in the Fuel Building. To ensure protection of the operating staff while taking a sample in the sampling box, all modules and pipes which convey highly contaminated fluids are located behind a biological shield.

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 Access Building 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. On-Site Meteorological Monitoring Instrumentation

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. On-Site Radiological Monitoring Instrumentation

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 each unit's 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

The seismic monitoring system (SMS) measures and records the acceleration (earthquake ground motion) of selected structures. Earthquakes produce frequency dependent accelerations which, when detected by the remote sensing devices, are permanently recorded as information which defines the seismic input. The system remains in a standby condition until an earthquake, above a preset target acceleration, causes the remote unit(s) to activate the recording circuits and signals the Main Control Room (MCR) that a seismic event is being recorded.

The SMS consists of field-mounted sensors, recording and data storage equipment, central controller, power supply, and ancillary support equipment. The system equipment cabinet houses the seismic recorders, central controller, and power supplies. The equipment cabinet is located in the computer room of SB Division 2. All equipment except for the field-mounted triaxial accelerometers is located in this seismically qualified equipment rack.

The field-mounted sensors are triaxial accelerometers (three elements supplied and mounted in a mutually orthogonal array) that produce a response that is proportional to the time varying acceleration at the location of the sensor. The sensors are rigidly mounted and located free-field, in the primary containment structure, and an independent Seismic Category I structure not influenced by or connected to the primary containment structure. The accelerometers are chosen to respond to a maximum acceleration that is 1.2 times the SSE acceleration for the intended instrument location. The accelerometer outputs are used by the seismic recorders to produce time-history accelerographs.

Each seismic recorder (or data acquisition unit) is of modular design and mounted in the system cabinet. The sampling rate of the recorder is a minimum of 200 samples per second for each of the three directions (axis). Bandwidth is at least 0.20 to 50 Hz. The dynamic range of the recorder is at least 1000:1 zero-to-peak, and the instrumentation is able to record at least 1.0 g zero-to-peak. The trigger threshold is selectable from 0.01 to 100 percent of full scale with the trigger set 0.001g to 0.02g but not more than 0.02g. The recorders record pre-earthquake data three seconds prior to the trigger actuation and continue to record the motion during the period in which the earthquake motion exceeds the seismic trigger threshold, and continue to record low-amplitude motion for a minimum of five seconds beyond the last exceedance of the seismic trigger threshold. Additional prevent memory (for up to 30 seconds of pre-earthquake recording) is provided for “P” wave correlation.

The central controller (or computer) is used to provide control and monitoring of all of the recorders or data acquisition units, interfaces with external control systems and alarm functions. The controller provides two seismic triggered annunciations in the MCR; the first indicates a seismic event occurrence, and the second indicates exceedance of the OBE. The seismic event alarm is triggered by the digital recorders, and the OBE exceedance alarm is triggered by the centralized computer.

The system components are powered from the plant-supplied, non-vital batterybacked uninterruptible power supply (UPS) to provide continuous operation following a station blackout. A backup battery system is provided for each recorder adequate to supply power to the equipment for a minimum of 25 minutes in a 24-hour period without recharging. The system equipment cabinet includes an internal UPS and charger capable of operating the central controller and support equipment.

Seismic instrumentation is not located on equipment, piping, or supports since experience has shown that data obtained at these locations is obscured by vibratory motion associated with normal plant operation.

e. On-Site Fire Detection Instrumentation

The fire detection system is designed in accordance with applicable National Fire Protection Association (NFPA) standards and detection is generally provided in areas containing safety related components/systems as recommended in Regulatory Guide 1.189, “Fire Protection for Operating Nuclear Power Plants.” The plant fire alarm system is furnished with electrically supervised circuits that monitor field input devices and output devices such as suppression releasing and alarm notification devices. Instrumentation is provided in the Control Room and at local fire control panels to alert operators of the location of a detected fire, the release of a suppression system. Or the annunciation of a trouble condition within a portion of the system.

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. BELL BEND NUCLEAR POWER PLANT COLA, EMERGENCY PLAN, REV. 1

2. U.S. EPR DESIGN CONTROL DOCUMENT, REV. 0