

Joseph M. Farley Nuclear Power Plant - Units 1&2
Pressurized Water Reactors (PWRs)
Fact Sheet
March 17, 2011

- Plant Farley is designed to withstand an earthquake equal to the plant's maximum projected seismic event without any release of radioactive materials.
- Plant Farley Units 1 & 2 are pressurized water reactors (PWRs).
- Plant Farley was designed in accordance with Nuclear Regulatory Commission (NRC) requirements related to natural events such as earthquakes, tornadoes, flooding (including tsunamis) and hurricanes. These requirements ensure that the plants can be safely shutdown and maintained in shutdown status after these events. The NRC requirements provide a design margin above historical event levels.
- Plant Farley, as well as federal, state, and local officials, has a detailed comprehensive emergency plan to respond to events within the plant's design and beyond the plant's design. Our trained, skilled staff is on-site 24 hours per day and is trained to recognize and respond to problems. If an emergency occurs, the plant has the necessary equipment and plant personnel have detailed procedures and training to respond appropriately.
- Environmental hazards differ depending on location. For example, tsunamis or giant tidal waves are not credible events at Plant Farley because it is an inland site - located approximately 75 miles from the Gulf coast at an elevation of approximately 155 feet above sea level. Also, the Plant Farley site is located in an area of low seismic activity.
- Plant Farley is designed to withstand 0.10g horizontal peak ground acceleration which is well above any predicted earthquake ground motion in the area. This ground motion approximately represents an earthquake magnitude of 5.5.
- An independent seismic review that was peer reviewed by seismic experts and submitted to the NRC, has confirmed Plant Farley is capable of sustaining an earthquake as designed.
- There are no active faults in the Plant Farley area and the site is in a low seismic zone. The site has had seismic instrumentation installed for over 30 years and has never recorded any earthquake ground motion. No earthquakes with an intensity greater than a magnitude 4.1 have occurred in the East Gulf Coastal Plain.
- Plant Farley is equipped with seismic monitoring systems that are set at extremely low triggering levels. If a seismic event triggers the seismic monitoring system, it would provide seismic ground motion data to the control room so the operators can determine the severity of the event and per procedures make appropriate decisions concerning plant safety.
- The building and structures that are necessary to maintain the plant in a safe condition are designed to withstand flooding and high winds. This includes flying debris produced by tornadoes with wind speeds up to 360 mph. The river water intake structure is designed to operate at very high river levels. Given the drainage capabilities of the Chattahoochee River basin, it is highly unlikely a water source of this quantity would ever threaten the intake structure.
- Each Plant Farley reactor uses a steel lined prestressed concrete containment structure designed by Bechtel Power Corporation. The containment structure surrounds the reactor and is designed to prevent the release of reactivity to the environment under both normal and accident conditions.
- Plant Farley has a wide array of plant systems that ensure redundancy and the capability to ensure the plant reaches cold shut down and maintains it.

Information from Plant Farley Media Guide

Complete Plant Farley Media Guide available online at:

<http://www.southerncompany.com/nuclearenergy/SNCmedia/0700688-Plant%20Farley%20Media%20Guide.pdf>

Plant Farley Background Information

Plant Farley sits on a 1850 acre site along the Chattahoochee, one of Alabama's largest rivers. Since it began operation in 1977, Plant Farley has supplied, on average, approximately nineteen percent of Alabama Power's total electricity needs. The site includes two reactor units, six cooling towers, a turbine room the size of two football fields, a state-of-the-art control room, an environmental lab and a high-voltage switching yard or substation. About 850 people—engineers, mechanics, control room operators, lab technicians, instrument and control technicians, electricians, security officers and others --- oversee the plant's operations 24 hours a day, every day of the year. Full-time, on-site inspectors from the U.S. Nuclear Regulatory Commission monitor the plant to ensure it is maintained and operated safely, efficiently and in accordance with established nuclear operating procedures.

Plant Farley- Accident prevention details

One essential point about a Plant Farley is that it cannot explode like a nuclear weapon. Nuclear weapons are made of highly enriched uranium or virtually pure plutonium. No nuclear explosion is possible with the low-enriched fuel used to produce electricity.

The core of a light water reactor like Plant Farley contains a large amount of highly radioactive material at high temperature and pressure. The chief danger is a loss of cooling water, causing a build-up of heat that would damage or melt the fuel rods.

To prevent this, commercial nuclear power plants are designed with a strategy of defense-in-depth. The first layer of designed features is essentially self-regulating. In general, the fission process slows as the coolant temperature rises.

Other passive systems include physical barriers that restrict the spread of contamination outside the primary systems. Barriers such as the fuel's zirconium alloy cladding, the thick reactor vessel and the thick concrete containment provide protection in case of an accident.

Following is a description of these physical barriers at Plant Farley that keep radioactive fission products from reaching the environment. Active systems are designed to ensure continuous core cooling and safe shutdown of the plant.

Containment – The containment building is constructed to prevent the inadvertent release of radioactivity to the environment under both normal operating conditions and the most severe of accident conditions. Therefore, all systems that potentially could release large amounts of radioactivity are located in the containment structure.

At Plant Farley, the containment structure houses the reactor vessel and the reactor cooling system with its steam generators, reactor coolant pumps and pressurizer. The containment building is made of concrete with thick walls. The concrete is post-tensioned and reinforced with a network of steel rods (rebar), each about the thickness of a human forearm.

The structure is lined with thick steel and is designed to withstand extremes of temperatures and pressures which might result from a serious accident. The containment is sealed and must be entered and exited through special air-lock chambers. Most penetrations such as pipes entering the containment walls have automatic valves that close at the first sign of trouble, isolating and sealing off the containment to prevent leakage.

As a Category 1 Seismic structure, the containment building can withstand powerful earthquakes and high winds. It can survive tornado winds of 360 miles per hour, as well as the impact of tornado missiles such as utility poles or even something as massive as an automobile.

In addition, since 9-11, studies have been conducted to analyze a commercial aircraft crash into the reactor containment building and the impact on the containment building's structural strength. A comprehensive study conducted by the Electric Power Research Institute concluded that the containment structures that house nuclear fuel are robust and protect the fuel from impacts of large commercial aircraft.

Fuel cladding – Uranium fuel used at Plant Farley is in the form of a ceramic “pellet” which normally houses 99.99% of the radioactive fission products. These fuel pellets are stacked inside tubes. The tubes are arranged in fuel assemblies and are placed within the reactor vessel, comprising the core.

Reactor vessel – The reactor vessel is a barrel-like structure about 13 feet in diameter with carbon steel walls lined with stainless steel. It is located inside the lower part of the containment building. The reactor vessel with its attached pipes, reactor coolant pumps and the pressurizers comprise the primary coolant system boundary. This keeps any fission products, which may escape the cladding in the event of broken fuel tubes, from reaching the rest of the plant.

Engineered safety systems

The function of the Engineered Safety Systems is to contain, control, mitigate, and terminate accidents and to maintain safe radiation exposure levels below applicable federal limits and guidelines. Some of the safety-related systems defined as Engineered Safety Systems for Plant Farley are:

Reactor protection system – The reactor protection system is designed to shut down the reactor safely. The system continuously monitors important plant parameters. If a problem occurs and causes the reactor power, pressures, temperatures, coolant flow rates or other plant parameters to exceed prescribed limits, the reactor shuts down automatically by the immediate insertion of all control rods into the core. The reactor also can be shut down manually if the reactor operator determines that a potentially unsafe condition exists.

Emergency core cooling systems (ECCS) – The most immediate action to be taken after a Loss of Coolant Accident is to replenish cooling water back into the reactor and to assure that the core remains under water. The function of the ECCS is to provide the reactor with emergency cooling water after normal cooling water has been lost.

There are two Emergency Core Cooling Systems, each designed to be completely redundant. Their operation is initiated either manually by an operator or automatically when the control systems in the plant detect an accident condition.

Both the High Pressure Injection and Low Pressure Injection systems can inject water for long periods, pumping water supplied either from the refueling water storage tank or through recirculation from the containment sump.

Auxiliary feedwater system – The auxiliary feedwater system (AFW) serves a dual purpose. During normal plant startup or hot standby, it provides the secondary side of the steam generators with condensate. As mentioned before, the condensate picks up the heat from the primary coolant, boils and becomes the main steam for the turbine. This lowers the heat of the primary coolant, while providing steam for plant-related operations. During accident conditions, the AFW receives heat from the primary coolant. For example, if the plant were to lose all electric power, the AFW – using pumps driven by steam turbines (not requiring electricity) – could cool down the primary side and maintain the plant in a safe shutdown condition until power is restored.

Emergency power – During normal operations and when the plant is shut down, components that could be used in emergency situations are powered with electricity from the off-site power grid.

Plant Farley Units 1 and 2 have two emergency diesel generators each. As an added feature, a fifth diesel generator is available to supply power to either unit should the two primary diesel generators be unavailable. These generators are designed to supply the power needed for safe operation of the plant's emergency systems if off-site power is not available.

Additionally, most of the safety-related instrumentation needed for safe shutdown of the plant can be operated by DC batteries that are constantly kept charged and ready for service if all other power sources should fail.

Finally, even without any electrical power available, the plant can be shut down safely and cooled by using the natural circulation of the primary system while manually venting steam from the secondary side of the steam generator. Water for the steam generator is provided using the steam-driven auxiliary feed pump.

Containment isolation system – The purpose of this system is to isolate and close all openings to the containment if a high radiation situation exists in the containment building. Automatic signals are sent to appropriate valves and dampers to close, thus isolating all containment penetrations – except for those needed for the operation of the Emergency Core Cooling Systems.

Habitability systems – The control room heating, ventilation and air conditioning (HVAC) system protects control room personnel from accident conditions. The atmosphere inside the control room can be isolated from the rest of the plant and the outside environment to keep out radiation, smoke, toxic substances and other harmful airborne contaminants.

Combustible gas control system – The combustible gas control system monitors the atmosphere inside containment.

In summary, Plant Farley has a number of redundant safety systems to prevent an emergency at the plant or to restore the plant to a safe condition should an emergency occur.

Plant Farley –Facts and Statistics

Owner

Alabama Power Company

Operator

Southern Nuclear Operating Company

Location

Houston County Alabama, 20 miles east of Dothan on the Chattahoochee River

Acreage

Plant site is 1,850 acres; 400 acres used for power generation

Reactors

Two 3-loop Pressurized Water Reactors (PWR) with a rated capacity of ~910 electrical megawatts per unit

Reactor manufacturer

Westinghouse Electric Company

Containment

Vertical, cylindrical, reinforced concrete structure with a dome and a flat base

Each containment building houses a reactor, reactor coolant system (RCS), and other Nuclear Steam Supply System components.

Each containment building is 130 feet in diameter and 183 feet high.

Construction Start Date

1972

Commercial operation

Unit 1-December 1977

Unit 2-July 1981

Cost

\$1.57 billion

License Extensions

Unit 1-Licensed to operate until June 25, 2037. The extension was granted in May 2005.

Unit 2-Licensed to operate until March 31, 2041. The extension was granted in May 2005.

Approximate Employment

850

Engineer/Construction firms:

Bechtel Corporation

Daniel Construction Company

Southern Company Services

Fuel (17x17 array)

Fuel Assemblies: 157

Overall length of fuel assembly: approximately 12 feet

Fuel rods per assembly: 264

Control Rods (Rod Cluster Assemblies-RCCAs)

Number of RCCAs: 48

Control rods per RCCA: 24

Absorber material composition: silver-indium-cadmium

Cladding: stainless steel

Emergency Power System**(Safety Related)**

Diesel generators: 1 dedicated per unit + 3 others as back-up

Rated capacity: 4 MW each

Reactor Coolant System (RCS)

Three loops

Each loop with a reactor coolant pump and steam generator

Operates at a nominal pressure of 2,235 pounds per square inch in gauge (psig)

577 degrees Fahrenheit

Reactor Coolant Pumps (RCP)

Three pumps

Each pump 7,000 horsepower with 90,000 gallons per minute capacity

Operating voltage is 4,160

Steam Generators

Three generators

Each with 3,592 stainless steel tubes

Circulating Water Systems (CWS)

The condenser is cooled by the circulating water system, which transfers heat to the cooling towers. Water comes from the Chattahoochee River via the Service Water Pond.