

1.3 SUMMARY PLANT DESCRIPTION

The inherent design of the pressurized water, closed-cycle reactor minimizes the quantities of fission products released to the atmosphere. Four barriers exist between the fission product accumulation and the environment. These are the uranium dioxide fuel matrix, the fuel cladding, the reactor vessel and coolant loops, and the reactor containment. The consequences of a breach of the fuel cladding are greatly reduced by the ability of the uranium dioxide lattice to retain fission products. Escape of fission products through a fuel cladding defect would be contained within the pressure vessel, loops, and auxiliary systems. Breach of these systems or equipment would release the fission products to the reactor containment where they would be retained. The reactor containment is designed to adequately retain these fission products under the most severe accident conditions, as analyzed in Section 15.

Several engineered safety features have been incorporated into the plant design to reduce the consequences of a loss-of-coolant accident (LOCA). These safety features include an Emergency Core Cooling System (ECCS). This system automatically delivers borated water to the reactor vessel for cooling the core under high and low reactor coolant pressure conditions. The ECCS also serves to insert negative reactivity into the core in the form of borated water during plant cooldown following a steam line break or an accidental steam release. Other safety features which have been included in the reactor containment design are a Containment Fan Cooler System which acts to effect depressurization of the containment following a LOCA and to remove particulate matter from the containment atmosphere, and a Containment Spray System which acts to depressurize the containment and remove elemental iodine from the atmosphere by washing action. The Containment Spray System provides redundant backup by an alternate principle for the Containment Fan Cooler System for heat removal.

1.3.1 Structures

The major structures include a separate and independent Containment and Fuel Handling Building for each reactor, a common Auxiliary Building with holdup tank vault, a common Turbine Building and a common Administration and Service Building. General layouts of the Reactor Containment, Auxiliary Building, and interior component arrangements are shown on Figures 1.2-1, 5.1-12 and Plant Drawings 204803, 204804, 204805, 204806, 204807 and 204808.

Seismic Criteria

For Category I (seismic) equipment, dynamic methods or conservative static equivalents were used to determine that components and structures will operate or maintain their integrity, as required. For Category II (seismic) equipment, static methods were used and non-seismic equipment meets applicable codes.

Definition of Seismic Categories

Particular structures and equipment are classified according to seismic design.

The seismic definitions are:

1. Category I (seismic)

Those structures, mechanical components, the Reactor Protection System, and Engineered Safety Features Actuation System whose failure might cause or increase the severity of a LOCA. Also, those structures and components vital to safe shutdown and isolation.

2. Category II (seismic)

Those structures and mechanical components that are not Category I (seismic), but which function in direct support of reactor operation.

1.3.2 Nuclear Steam Supply System

The Nuclear Steam Supply System for each unit consists of a pressurized water reactor, Reactor Coolant System (RCS), and associated auxiliary fluid systems. The RCS is arranged as four closed reactor coolant loops connected in parallel to the reactor vessel, each containing a reactor coolant pump and a steam generator. An electrically heated pressurizer is connected to one of the loops.

The reactor core is composed of uranium dioxide pellets enclosed in Zircaloy-based tubing with welded end plugs. The tubes are supported in assemblies by spring clip grid structures. The control rods consist of clusters of stainless steel clad silver-indium-cadmium absorber rods located within the fuel assemblies. The nuclear fuel is typically loaded in three regions, with the new fuel being introduced into the core interior and by its third cycle of operation being discharged from the core's outermost region to spent fuel storage.

The reactor vessel and reactor internals contain and support the fuel and control rods. The reactor vessel is cylindrical with hemispherical heads and is clad with stainless steel.

The pressurizer is a cylindrical pressure vessel with hemispherical heads and is equipped with electrical heaters and spray nozzles for system pressure control.

The steam generators are vertical U-tube units utilizing Inconel tubes. Integral moisture separating equipment reduces the moisture content of the steam at the turbine throttle to ≤ 0.25 percent for Unit 1 and ≤ 0.1 percent for Unit 2.

The reactor coolant pumps are vertical single stage centrifugal pumps equipped with controlled leakage shaft seals.

Auxiliary systems are provided to charge the RCS, add makeup water, purify reactor coolant water, provide chemicals for corrosion inhibition and reactor control, cool system components, remove residual heat when the reactor is shutdown, cool the spent fuel storage pool, sample reactor coolant water, provide for emergency safety injection, and vent and drain the RCS.

1.3.3 Reactor and Plant Control

The reactor is controlled by a coordinated combination of soluble neutron absorbers and mechanical control rods. The control system allows the plant to accept step load changes of 10 percent and ramp load changes of 5 percent per minute over the load range of 15 to 95 percent power under normal operating conditions.

Complete supervision of each reactor and turbine generator is accomplished from each unit's control room.

1.3.4 Waste Disposal System

The Waste Disposal Systems provide all the equipment necessary to collect, process, and prepare for disposal, all radioactive liquid, gaseous, and solid wastes produced as a result of reactor operation.

After collection, liquid wastes are evaporated and/or demineralized if necessary to reduce activity levels. The treated water from the demineralizers or the evaporator distillate may be recycled for use in the plant or may be discharged via the

condenser discharge at concentrations well within the limits set forth in 10CFR20. The evaporator concentrates and spent demineralizer resins are solidified, drummed, and shipped from the site for ultimate disposal in an authorized location.

Gaseous wastes are collected and held up for radioactive decay, after which they may be reused for blanketing tanks. Decayed gases are discharged to the environment in a controlled manner which maintains the offsite dose well below the limits set forth in 10CFR20.

1.3.5 Fuel Handling System

Each reactor is refueled with equipment designed to handle spent fuel under water from the time it leaves the reactor vessel until it is placed in a cask for dry storage at the Independent Spent Fuel Storage Installation (ISFSI) or for shipment from the site. Underwater transfer of spent fuel provides an optically transparent radiation shield as well as a reliable source of coolant for removal of decay heat. This system also provides capability for receiving, handling, and storing new fuel. The Spent Fuel Pool Cooling System has been redesigned to include a second permanent spent fuel pool cooling pump.

1.3.6 Turbine and Auxiliaries

The turbine is a four casing, tandem-compound, six flow exhaust, 1800 rpm unit with 44-inch last stage blades. There are six combination moisture separator-steam reheater assemblies. The turbine generators are rated as described in Section 1, with saturated inlet steam conditions of 765 psia, exhausting at 1.5 inches of mercury absolute, at zero percent makeup. There are six stages of feedwater heating.

The turbine is equipped with an Electro-Hydraulic Control System, which uses an electronic controller and a high-pressure fire resistant fluid system to control valve movement.

The condenser is of the single pass deaerating type. There are three strings of feedwater heaters, three one-third size condensate and heater drain pumps and two one-half size feedwater pumps. Drains from the two highest feedwater heaters are pumped into the Condensate System and drains from the four lowest feedwater heaters are cascaded to the condenser.

1.3.7 Electrical System

Each main generator is a 1300 MVA, 25 kV, 3 phase, 60 cycle, 0.9 pf, 1800 rpm, 75 psig hydrogen inner-cooled unit with water cooled stator windings. Field excitation is provided by a direct shaft driven brushless excitation system. Each generator is connected to the primary side of three single phase main stepup transformers through isolated phase buses. The secondary side of each main transformer delivers power to the 500 kV switchyard.

The station service systems consist of a 13.8 kV north ring bus, and 13.8 kV south bus sections, auxiliary and station power transformers, 4160 V, 460 V, 230 V, and 115 V ac and 250 V, 125 V, and 28 V dc buses and equipment. A third 500 kV system tie, the 13.8 kV north ring bus and 13.8 kV south bus sections, arrangement replaces the 69 kV single source described in the Preliminary Safety Analysis Report. This provides a superior power supply system to the station.

Three diesel-generators per unit are provided as onsite sources of power in the event of complete loss of normal ac power. These generators power the post-accident containment cooling equipment as well as the safety injection, centrifugal charging, and residual heat removal pumps to assure an acceptable post loss-of-coolant containment pressure transient and adequate core cooling. Two-out-of-the three diesel-generators can handle the electrical load required for a unit in the event of a LOCA.

1.3.8 Engineered Safety Features

The engineered safety features provided for each unit have sufficient redundancy of components and power sources such that under the conditions of a LOCA they can maintain the integrity of the containment and maintain the exposure of the public below the limits set forth in 10CFR50.67, even when operating with partial effectiveness. The engineered safety features incorporated in the design of each unit and the functions they serve are summarized below.

1. The ECCS injects borated water into the RCS. This system limits damage to the core and limits the energy and fission products released into the containment following a LOCA.

The system has been extensively redesigned by Westinghouse. The basic changes in the redesigned system are the use of two charging pumps from the Chemical and Volume Control System for high head injection in addition to their normal charging function and the relocation of the boron injection tank to the discharge side of these pumps. The design of these pumps was changed from reciprocating to centrifugal. Piping, valving, and instrumentation were also revised as a result of the system redesign.

2. A steel-lined concrete containment vessel consisting of reinforced concrete cylindrical wall, a hemispherical dome, and a reinforced concrete base with testable high integrity penetrations.

3. Reactor containment fan coolers and filters to reduce containment pressure and filter particulate matter following a LOCA.

4. A Containment Spray System to reduce containment pressure and remove iodine from the containment atmosphere.

5. The Containment Isolation System incorporates valves and controls on piping systems penetrating the containment structure. These valves are arranged to provide two barriers between the RCS or containment atmosphere and the environment. System design is such that failure of one valve to close will not prevent isolation, and no manual operation is required for immediate isolation.

Automatic isolation is initiated by a containment isolation signal, derived for Phase A isolation by the safety injection signal and high-high containment pressure signal for Phase B isolation.

6. Power sources for the engineered safety features for each unit are provided by two 4 kV power circuits fed from the 500 kV system through the south 13 kV substation in the 500 kV switchyard.

The 500 kV switchyard arrangement consists of three 500 kV transmission lines connected to a breaker-and-a-half design with four 500-13 kV transformers. Two of them are connected to the 500 kV main bus section 1, the other two are connected to Section 2.

Two 500-13 kV transformers provide power to the south 13kV bus sections (one transformer per section) while the other two transformers feed the north 13kV ring bus. Each south 13kV bus section feeds two 13-4 kV transformers, one for each unit, to provide off-site power for the engineered safety features and new Circulating Water Switchgear. The north 13 kV ring bus is normally operated split to allow one 500-13 kV transformer to feed two (one for each unit) 13-4 kV transformers for Group buses.

Should one out of two 500-13kV transformers feeding the north 13kV ring bus be out of service, the ring bus will be realigned to provide power to all four 13-4kV transformers for both unit group buses from the remaining transformer.

If one out of two 500-13kV transformers feeding the south 13kV bus is out of service, transformers connected to the ring bus will be realigned in such a way that one transformer replaces the lost one while the other provides power to all four 13-4kV transformers for the group buses. During this 500-13kV transformer swap over period, the double ended 4kV vital buses receive power from the second off-site power source.

Reliable diesel-generator power is provided for the engineered safeguards loads in the event of failure of station auxiliary power. In addition, if external auxiliary power to the station is lost concurrent with an accident, power is available for the engineered safeguards from the diesel-generators, which are capable of supplying the engineered safeguards load to assure protection of the health and safety of the public in the event of a LOCA.

7. All components necessary for the proper operation of the engineered safety features are operable from the control room.