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1.0 Introduction and General Description of Plant

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1.1 Introduction

This updated Final Safety Analysis Report is submitted in support of Duke Power Company's licenses to operate the three-unit Oconee Nuclear Station located on the shore of Lake Keowee in Oconee County, South Carolina. The station location is shown on Duke's Service Area Map, Figure 1-1.

The organization of this report is in accordance with Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants - LWR Edition". Every attempt has been made to be responsive to the format and intent of that guide and to be consistent with the content of the original Final Safety Analysis Report (FSAR).

Construction of Oconee 1, 2, and 3 was authorized by the United States Atomic Energy Commission by issuance of construction permits CPPR-33, 34, and 35, on November 6, 1967, in Dockets 50-269, 270 and 287. Operation of Oconee 1, 2, and 3 was authorized by the United States Atomic Energy Commission by issuance of operating licenses DPR-38, 47, and 55 on February 6, 1973, October 6, 1973, and July 19, 1974 respectively.

The three units are substantially identical except for certain auxiliary systems which are shared. Sharing of these systems and components is not detrimental to the safe operation of any unit. General arrangements of major equipment and structures, including the Reactor Building, Auxiliary Building, and Turbine Building, are shown in Figure 1-2 through Figure 1-9.

The Oconee units are generally similar to those of other current pressurized water reactors. Differences include the generation of superheated steam in once-through steam generators, the use of Keowee Hydro Station as an emergency power source and the use of gravity flow for emergency condenser cooling.

The Nuclear Steam Supply System is a pressurized water type using chemical shim and control rods for reactivity control. The Babcock & Wilcox Company (B&W) is the supplier for the Nuclear Steam Supply System and the initial fuel cores and reloads for each of the three units. Replacement steam generators and reactor vessel heads were supplied by Babcock & Wilcox Canada (BWC).

All physics and core thermal hydraulics information in this report is based upon a reference core design of 2568 MWt. Site parameters, principal structures, engineered safeguards, and accidents are evaluated for a core output of 2568 MWt.

Duke is fully responsible for the complete safety and adequacy of the station. Company personnel perform most safety-related activities including design engineering, construction, maintenance, testing, and operating the station. Technical qualifications of key personnel are given in Chapter 13.

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1.2 General Plant Description

1.2.1 Site Characteristics

The site is characterized by a one-mile exclusion radius; remoteness from population centers; sound, hard rock foundation for structures; freedom from flooding; an abundant supply of cooling water; an on-site hydroelectric station capable of supplying ample emergency power; and favorable conditions of hydrology, geology, seismology, and meteorology.

1.2.2 Station Description

1.2.2.1 General Arrangement

The general arrangement of the major equipment and structures is shown in Figure 1-2 through Figure 1-9.

1.2.2.2 Nuclear Steam Supply System

Each Nuclear Steam Supply System consists of a pressurized water reactor and a two-loop Reactor Coolant System. The mechanical, thermal-hydraulic, and nuclear design of the reactor core is similar to other systems operating or under construction.

The fuel assembly design information is given in Section 4.2.2.

The control rod assembly design information is given in Section 4.5.2.2.

The two steam generators are vertical, straight tube units producing super-heated steam at constant pressure. With the once-through design, natural circulation flow is adequate to remove full decay heat without the use of reactor coolant pumps. Thus, with total loss of pumps, departure from nucleate boiling will not occur in the core.

An electrically heated pressurizer establishes and maintains the reactor coolant pressure and provides a surge chamber and a water reserve to accommodate reactor coolant volume changes during operation.

The reactor coolant pumps (two in each loop) are vertical, single speed, centrifugal units equipped with controlled leakage shaft seals.

1.2.2.3 Containment System

The prestressed, post-tensioned, steel lined, concrete Reactor Building is designed to withstand the maximum internal pressure resulting from an analysis of a spectrum of Reactor Coolant System and Main Steam line leaks.

Isolation valves are provided on fluid piping penetrating the Reactor Building to provide containment integrity when required. Isolation valves which are required to be closed for containment isolation function are either check valves, normally closed valves, or automatic remotely operated valves actuated by signals received from the Engineered Safeguards Protective System.

All electrical and fluid penetrations with the exception of those penetrations listed in Section 6.5.1.2 are grouped in a penetration room. Any leakage that might occur from any of these penetrations (except the noted lines) will be exhausted through a unit vent. Access hatches are provided with double seals, and the volume between the seals is piped to the penetration room. Provision is made to leak test all the access hatch closures.

1.2.2.4 Engineered Safeguards Systems

Engineered Safeguards Systems reduce the potential radiation dose to the general public from the Maximum Hypothetical Accident to less than the guideline values of 10CFR100. Automatic isolation of Reactor Building fluid penetrations that are not required for limiting the consequences of the accident reduces potential leakage paths. Long term potential releases following the accident are reduced by rapidly decreasing the Reactor Building pressure to near atmospheric, thereby reducing the driving potential for fission product escape.

In addition, the Engineered Safeguards System provides ample core cooling following the worst postulated loss-of-coolant accident. This is accomplished by the High Pressure Injection, Low Pressure Injection, and Core Flood Systems. These systems, coupled with the thermal, hydraulic, and blowdown characteristics of the reactors, reliably minimize metal-water reactions to acceptable values per 10CFR 50.46.

Each reactor unit has the following engineered safeguards equipment, with the normal operating mode of each as indicated:

1. High Pressure Injection System - a portion is used in normal reactor operation.
2. Low Pressure Injection System - operates for shutdown cooling.
3. Core flooding tanks - normally ready for operation.
4. Reactor Building Spray System - normally shutdown.
5. Reactor Building emergency coolers - operate for Reactor Building cooling during normal operation.
6. Penetration Room Ventilation System - test operation during normal operation. (not required for event mitigation due to adoption of alternate source term)
7. Reactor Building Isolation System - normally ready for operation and testable.
8. Low Pressure Service Water System - normally in service.

Except for the shared Unit 1&2 Low Pressure Service Water System, the Engineered Safeguards Systems are independent for each unit. Table 1-2 lists the major equipment in each system.

1.2.2.5 Unit Control

The reactor is controlled by control rod movement and regulation of the boric acid concentration in the reactor coolant. Between 15 percent and 100 percent full power the Integrated Control System maintains constant average reactor coolant temperature. Constant steam pressure is maintained over the full power range.

The Reactor Protective System and the Engineered Safeguards System automatically initiate appropriate action whenever the parameters monitored by these systems reach pre-established set-points. These systems act to trip the reactor, provide core cooling, close isolation valves, and initiate the operation of standby systems as required.

1.2.2.6 Electrical System and Emergency Power

Each of the three nuclear units at Oconee have up to eight available sources of electrical power:

1. Eight 230 kV transmission lines from three directions and three 525 kV transmission lines from three directions serve Oconee. (counts as one source).
2. The other two nuclear units. (counts as two sources).
3. The Central Switchyard or the Lee Steam Station Combustion Turbines via the 100 kV transmission line (capable of being separated from other system loads).
4. One of the quick-starting on-site Keowee Hydroelectric 87,500 KVA Generating Units connected to Oconee by an underground 13.8 kV cable.
5. The other Keowee Hydroelectric Generating Unit connected to Oconee by an overhead 230 kV transmission line.
6. One of the Keowee Hydroelectric Generator Units connected to the Protected Service Water building electrical equipment through an underground 13.8kV cable.
7. The other Keowee Hydroelectric Generator Unit connected to the Protected Service Water building electrical equipment through an underground 13.8kV cable.

Oconee has multiple redundant buses and tie buses supplying power to loads, instruments, and controls. The engineered safeguards for each unit are generally arranged on a three-component basis and supplied from three separate auxiliary power buses, each of which can be supplied from any of the six principal sources of power.

The sources of power and associated electrical equipment will insure safe functioning of the station and its engineered safeguards.

1.2.2.7 Steam and Power Conversion System

The Steam and Power Conversion System for each unit is designed to remove heat energy from the reactor coolant in the two steam generators and convert it to electrical energy. The closed feedwater cycle will condense the steam and heat feedwater for return to the steam generators.

1.2.2.8 Fuel Handling and Storage

Both new and spent fuel are stored in the spent fuel pool and transferred to and from the Reactor Building via the fuel transfer tubes. One spent fuel pool is shared between Oconee 1 and 2, and a separate spent fuel pool is provided for Oconee 3. The system is designed to minimize the possibility of mishandling or maloperations that could cause fuel assembly damage or potential fission product release, or both. In addition to the spent fuel pools, the Independent Spent Fuel Storage Installation (ISFSI) is available, at Oconee, to provide long-term storage of irradiated fuel assemblies. Refer to the Oconee Site Specific and General License System ISFSI UFSARs for further details.

1.2.2.9 Radioactive Waste Control

Gaseous Waste Disposal Systems collect, holdup as necessary, filter, monitor, release, and record the gaseous effluent from the station. Liquid Waste Disposal Systems provide for collection, holdup, treatment, monitoring, disposal, and recording of liquid wastes. Solid radioactive wastes are stored, packaged, and shipped off-site. Greater than originally anticipated gas and liquid waste volumes led Duke Power to build an Interim Radwaste Facility. This facility included liquid processing equipment, volume reduction equipment and associated auxiliary systems. Other than four holdup tanks used for decay of gaseous waste, there is no longer any waste processing done at the Interim Radwaste Facility. A separate Radwaste

Facility has been added to handle increased liquid waste volumes. The systems which comprise the facility are Resin Recovery, Liquid Processing and Recycle, and Waste Solidification. The facility is capable of processing and packaging for burial these types of waste in optimal fashion.

1.2.2.10 Standby Shutdown Facility (SSF)

The Standby Shutdown Facility provides capability to shutdown the nuclear reactors from outside the control room in the event of a fire, flood, or sabotage-related emergency. The SSF is also credited as the alternate AC (AAC) power source and the source of decay heat removal required to demonstrate safe shutdown during the required station blackout coping duration. It provides additional "defense-in-depth" by serving as a backup to safety-related systems. The SSF has the capability of maintaining Mode 3 (with Tave $\geq$ 525°F) in all three units for approximately three days following a loss of normal AC power. It is designed to maintain reactor coolant system (RCS) inventory, maintain RCS pressure, remove decay heat, and maintain shutdown margin.

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1.4 Identification of Agents and Contractors

Duke Power Company, through its corporate organization, is responsible for the design, purchasing, construction, and operation of Oconee, a practice successfully followed for all of the Company's major generating facilities now in service or planned.

Duke contracted with B&W to design, manufacture, and deliver to the site three complete Nuclear Steam Supply Systems and fuel. In addition, B&W supplied technical direction of erection; and consultation for initial fuel loading, testing, and initial startup of the complete Nuclear Steam Supply System with coordination, scheduling, and administrative direction by Duke.

The Bechtel Corporation was retained by Duke as a general consultant to provide such engineering assistance as needed during the design and construction of the station. Layout, engineering, and design of the Reactor Buildings were assigned to Bechtel.

Duke retained Pittsburgh Testing Laboratory for shop inspection of valves and piping as required. As consultants on seismology and meteorology, the firm of Dames & Moore was retained. Duke also retained Mr. William V. Conn from Atlanta, Georgia, for geology studies and the Law Engineering Testing Company for subsurface investigations under the direction of Dr. George F. Sowers.

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