1.4 PRINCIPAL ARCHITECTURAL AND ENGINEERING CRITERIA FOR DESIGN

The principal architectural and engineering criteria for design of the plant are summarized below.

1.4.1 PLANT DESIGN

Principal structures and equipment which may serve either to prevent incidents or to mitigate their consequences are designed, fabricated and erected in accordance with applicable codes to withstand the most severe earthquakes, flooding conditions, windstorms, ice conditions, temperature, and other deleterious natural phenomena which could be reasonably assumed to occur at the site during plant lifetime. Units 1 and 2 are sufficiently independent so that the safety of one unit will not be impaired in the unlikely event of an incident in the other unit. Principal structures and equipment are sized for the maximum expected NSSS and turbine outputs.

Redundancy is provided in reactor and safety systems so that no single failure of any active component of the systems can prevent the action necessary to avoid an unsafe condition. The plant is designed to facilitate inspection and testing of systems and components whose reliability is important to the protection of the public and plant personnel.

Provisions are made to protect against the hazards of such events as fires or explosions.

Systems and components which are significant from the standpoint of nuclear safety are designed, fabricated, and erected to quality standards commensurate with the safety function to be performed.

1.4.2 REACTOR

The following apply to the reactor of either unit:

a. The reactor is of the pressurized water type, designed to produce steam to drive a turbine generator. The reactor was initially licensed and operated at a core thermal output of 2,560 MWt; the license was later amended and the reactor now operates at 2,737 MWt.

b. The reactor is fueled with slightly enriched uranium dioxide contained in Zircaloy, ZIRLO, or M5® tubes.

c. Minimum departure from nucleate boiling ratio (DNBR) during normal operation and anticipated transients will not be below that value which could lead to fuel rod failure. The maximum fuel center line temperature evaluated at the design overpower condition will be below that value which could lead to fuel rod failure. The melting point of the UO_2 will not be reached during normal operation and anticipated transients.

d. Fuel rod clad is designed to maintain cladding integrity throughout fuel life. Fission gas release within the rods and other factors affecting design life are considered for the maximum expected exposures.

e. The reactor and control systems are designed so that any xenon transients will be adequately damped.

f. The reactor is designed to accommodate the anticipated transients safely and without fuel damage.

g. The RCS is designed and constructed to maintain its integrity throughout expected plant life. Appropriate means of test and inspection are provided.

h. Power excursions which could result from any credible reactivity addition incident will not cause damage to the pressure vessel either by deformation or rupture, or impair operation of the ESF.

i. Control element assemblies are capable of holding the core subcritical at hot zero power conditions with adequate margin following a trip, even with the most reactive rod stuck in the fully withdrawn position.

j. The CVCS is capable of adding boric acid to the reactor coolant at a rate sufficient to maintain an adequate shutdown margin during maximum design rate RCS cooldown following a reactor trip. The system is independent of the CEA system.

k. The combined response of the fuel temperature coefficient, the moderator temperature coefficient (MTC), the moderator void coefficient, and the moderator pressure coefficient to an increase in reactor thermal power is a decrease in reactivity. In addition, the reactor power transient remains bounded and damped in response to any expected changes in any operating variable.

l. Automatic and redundant reactor trips are provided to prevent anticipated plant transients from producing fuel or clad damage.

1.4.3 REACTOR COOLANT AND AUXILIARY SYSTEMS

Heat removal systems are provided which can safely accommodate core heat output. Each of these heat removal systems is designed to provide reliable operation under all normal and expected transient circumstances.

1.4.4 CONTAINMENT STRUCTURE

The Containment Structure, including the associated access openings and penetrations, is designed to contain the pressures and temperatures resulting from a LOCA in which the following occur:

a. The total energy contained in the RCS water is assumed to be released into the containment through a double-ended break of one of the reactor coolant pipes adjacent to the reactor vessel outlet nozzle.

b. External electric power is lost simultaneously.

c. Heat is transferred from the reactor to the containment by water supplied from the Safety Injection System.

d. Either the containment air recirculation subsystem or the containment spray subsystem functions.

e. The containment ESF do not operate until 30 seconds following the incident.

Means are provided for pressure and leak rate testing of the entire containment system including provisions for leak rate testing of individual piping and electrical penetrations that rely on gasketed seals, sealing compounds, or expansion bellows.

1.4.5 ENGINEERED SAFETY FEATURES

The design for either unit incorporates redundant ESF systems. These, in conjunction with the containment systems, ensure that the release of fission products, following any credible LOCA, will not exceed the guidelines set forth in 10 CFR 50.67. The ESF systems include: (a) independent systems, each with redundant features, to remove heat from the Containment Structure in order to reduce containment pressure; (b) a Safety Injection System to limit fuel and cladding damage to an amount which would not interfere with adequate emergency core cooling (ECC) and to limit metal-water reactions to negligible amounts; (c) a system to remove radioactive iodine for the post-incident containment atmosphere; (d) a system to recirculate conditioned air to Control Room and ensure habitability of Control Room in the case of an emergency. The ESF are designed for all break sizes in the RCS piping up to and including the double-ended rupture of the largest reactor coolant pipe.

1.4.6 PROTECTION, CONTROL, AND INSTRUMENTATION SYSTEMS

Interlocks and automatic protective systems are provided along with administrative controls to insure safe operation of the plant.

An RPS is provided which initiates reactor trip if the reactor approaches an unsafe condition.

Sufficient redundancy is installed to permit periodic testing of the RPS so that failure or removal from service of any one protective system component or portion of the system will not preclude reactor trip or other safety action when required.

1.4.7 ELECTRICAL SYSTEMS

Normal, standby, and emergency sources of auxiliary power are provided to assure both the safe and orderly shutdown of the plant and the ability to maintain a safe shutdown condition under all credible circumstances.

1.4.8 WASTE PROCESSING AND RADIATION PROTECTION

The waste treatment systems are designed so that the discharge of radioactivity to the environment is in accordance with the requirements of 10 CFR Part 20.

The plant is provided with a centralized Control Room having adequate shielding to permit occupancy during all credible accident conditions.

The radiation shielding in the plant and the radiation control procedures ensure that operating personnel do not receive radiation exposures in excess of the applicable limits of 10 CFR Part 20 during normal operation and maintenance.

1.4.9 FUEL HANDLING AND STORAGE

Fuel handling and storage facilities are provided for the safe handling, storage and shipment of fuel and will preclude accidental criticality.

1.4.10 NIL DUCTILITY TRANSITION TEMPERATURE

Components of the RCS are designed and will be operated so that no deleterious pressure or thermal stress will be imposed on the structural materials. Consideration is given to the ductile characteristics of the materials at low temperature.

1.4.11 FIELD RUNNING OF 2" AND SMALLER DIAMETER PIPE

All 2" and smaller piping with the exception of portions of the charging, letdown, and some few branch connections tied into the Safety Injection System (these systems are classified in ANSI B 31.7 Class I and are routed by the engineering office) were field-run during plant construction and initial modification work.

All piping for field-run essential systems (Section 1.8.1, II.E.4.2), including all ESF, were routed by experienced piping designers. This piping was routed and support points selected in accordance with the field installation manual. The spacing of supports and type of support used are such that the combination of stresses due to thermal, dead load, and seismic does not exceed the allowable stresses. Prior to installation, all field piping isometric drawings were routed to the engineering office for comments. After installation and before start-up, surveillance by the field quality assurance personnel and by the respective engineering specialist group was performed to ensure that all piping is installed per the design drawings. Prior to start-up, each system was checked off showing that all hangers and supports are located as designed.

During start-up, each system was observed under conditions which simulate operating conditions. This included the starting and stopping of pumps and opening and closing of valves.