F. MINIMUM CONDITIONS FOR CRITICALITY

Specification:

1. Except during low-power physics tests, the reactor shall not be made critical when the moderator temperature coefficient is more positive than 5 pcm/°F.

2. Reactor power shall not exceed 70 percent of Rated Power if the moderator temperature coefficient is positive.

3. During an approach to criticality, at least one (1) count per second, attributable to neutrons, shall register on a narrow range source range nuclear instrument.

4. In no case shall the reactor be made critical (other than for the purpose of low level physics tests) to the left of the reactor core criticality curve presented in Figure 15.3.1-1.

5. The reactor shall be maintained subcritical by at least 1 percent $\frac{\Delta k}{k}$ until normal water level is established in the pressurizer.

Basis:

During the early part of the fuel cycle, the moderator temperature coefficient is calculated to be slightly positive at coolant temperatures below 70 percent of rated thermal power.[1][2] The moderator coefficient at low temperatures will be most positive at the beginning of life of the fuel cycle, when the boron concentration in the coolant is the greatest. Later in the life of the fuel cycle, the boron concentrations in the coolant will be lower and the moderator coefficients will be either less positive or will be negative. At all times, the moderator coefficient is negative when ≥70 percent of rated thermal power. Suitable physics measurements of moderator coefficient of reactivity will be made as part of the startup program to verify analytic predictions.

The limitations of the moderator temperature coefficient are provided to ensure that the assumptions used in the accident and transient analyses remain valid through each fuel cycle. This requirement is waived during low power physics tests to permit measurement of reactor moderator coefficient and other physics design parameters of interest. During physics tests, special operating precautions will be taken. In addition, the strong negative Doppler coefficient[3] and the small integrated Δk/k would limit the magnitude of a power excursion resulting from a reduction of moderator density.

Requiring that the source range instrumentation is registering a count rate attributable to neutrons of at least one (1) count per second insures that the source range instrumentation is functioning properly. A functional source range instrument permits the operator to monitor neutron flux levels and to observe the subcritical neutron multiplication during the positive reactivity addition of the reactor startup.

The requirement that the reactor is not to be made critical below the Reactor Core Criticality Curve provides assurance that a proper relationship between reactor coolant pressure and temperature will be maintained during system heatup and pressurization. Heatup to this temperature will be accomplished by operating the reactor coolant pumps. However, as provided in 10 CFR Part 50, Appendix G, Section IV.A.3, the reactor core may be taken critical below this curve for the purpose of low-level physics tests.

If the specified shutdown margin is maintained (Section 15.3.10), there is no possibility of an accidental criticality as a result of an increase of moderator temperature or a decrease of coolant pressure.[1]

The requirement for bubble formation in the pressurizer when the reactor has passed the threshold of 1 percent subcriticality will assure that the reactor coolant system will not be solid when criticality is achieved.

References:

(1) FSAR Table 3.2.1-1

(2) FSAR Table 3.2.1-9

(3) FSAR Figure 3.2.1-10

3. Burnable absorber and/or water displacer rods are incorporated for reactivity and/or power distribution control. The burnable absorber rods consist of borated pyrex glass clad with stainless steel[4]. The water displacer rods are empty burnable absorber rods containing no pyrex glass. Another type of burnable absorber may consist of a thin coating of zirconium diboride on the radial surface of selected fuel rod pellets.

4. There are 33 full-length RCC assemblies in the reactor core. The full-length RCC assemblies contain a 142-inch length of silver-indium-cadmium alloy clad with the stainless steel.

5. Neutron source assemblies may be used to provide a required minimum count rate during startup operations. A source assembly, if used, would typically consist of four source rodlets comprised of a mixture of antimony and beryllium.
~~Neutron source assemblies are used to provide a required minimum count rate during startup operations. The core contains at least two such assemblies, each containing four source rodlets comprised of a mixture of antimony and beryllium.~~

6. Peripheral power suppression assemblies (PPSA) are used to reduce neutron fluence at the welds in the beltline region of the reactor vessel. Peripheral fuel assemblies may contain PPSAs, which utilize part-length hafnium absorber rods in the assembly guide tubes.

B. <u>Reactor Coolant System</u>

1. The design of the Reactor Coolant System complies with the code requirements[6].

2. All high pressure piping, components of the Reactor Coolant System and their supporting structures are designed to Class I requirements, and have been designed to withstand:

   a. The design seismic ground acceleration, 0.06g, acting in the