14.3 FINAL STATION PREPARATION

The Phase III Plant Operational Test Program and initial fuel loading began when all prerequisite system tests and operations were satisfactorily completed and the facility operating license obtained. Upon completion of fuel loading, the reactor upper internals and pressure vessel head were installed and additional mechanical and electrical operational tests were performed. The purpose of this phase of activities was to prepare the system for nuclear operation and to establish that all design requirements necessary for operation had been achieved. The core loading and post loading tests are described below.

14.3.1 Core Loading

The overall responsibility and direction for initial core loading was exercised by the Station Manager. The overall process of initial core loading was, in general, directed from the operating floor of the Containment Building. Standard procedures for the control of personnel and the maintenance of containment security were established prior to fuel loading. Westinghouse provided technical advisors to assist during the initial core loading operation.

The as-loaded core configuration was specified as part of the core design studies conducted well in advance of station startup and, as such, was not subject to change at startup. In the event that mechanical damage was sustained during core loading operations by a fuel assembly of a type for which no spare was available onsite, an alternate core loading scheme whose characteristics closely approximated those of the initially prescribed pattern would have been determined.

The core was assembled in the reactor vessel, submerged in water containing enough dissolved boric acid to maintain a calculated core effective multiplication constant < 0.95 or a boron concentration of > 2000 ppm, whichever was more restrictive. Core moderator chemistry conditions (particularly, boron concentration) were prescribed in the core loading procedure and were verified periodically by chemical analysis of moderator samples taken prior to and during core loading operation.

Core loading instrumentation consisted of two permanently installed source range (pulse type) nuclear channels and two temporary in-core source range channels plus a third temporary channel which could be used as a spare. The permanent channels when responding were monitored in the Control Room by licensed reactor operators; the temporary channels were installed in the containment structure and were monitored by reactor engineering personnel. At least one permanent channel was equipped with an audible count rate indicator. Both plant channels have the capability of displaying the neutron flux level on strip chart recorders. The temporary channels indicated on rate meters with a minimum of one channel recorded on a strip chart recorder. Minimum count rates of two counts per second, attributable to core neutrons, were required on at least two of the four (i.e., two temporary and two permanent source range detectors) available nuclear source channels at all times following installation of both core sources.

At least two neutron sources were introduced into the core at appropriate specified points in the core loading program to ensure a neutron population of a minimum of two counts per second for adequate monitoring of the core.

Fuel assemblies together with inserted components (control rod assemblies, burnable poison inserts, source spider, or thimble plugging devices) were placed in the reactor vessel one at a time according to a previously established and approved sequence which was developed to provide reliable core monitoring with minimum possibility of core mechanical damage. The core loading procedure documents include a detailed tabular check sheet which prescribed and verified the successive movements of each fuel assembly and its specified inserts from its initial position in the storage racks to its final position in the core. Checks were made of component serial numbers and types at successive transfer points to guard against possible inadvertent exchanges or substitutions of components, and at least two fuel assembly status boards were maintained throughout the core loading operation.

An initial nucleus of eight fuel assemblies, the first of which contained a neutron source, was the minimum source-fuel nucleus which permitted subsequent meaningful inverse count rate monitoring. This initial nucleus was determined by calculation and previous experience to be markedly subcritical under the required conditions of loading.

Each subsequent fuel addition was accompanied by detailed neutron count rate monitoring to determine that the just loaded fuel assembly did not excessively increase the count rate and that the extrapolated inverse count rate ratio was not decreasing for unexplained reasons. The results of each loading step were evaluated by Public Service Electric and Gas (PSE&G) and its technical advisors before the next prescribed step was started.

Criteria for safe loading required that loading operations stop immediately if:

1. An unanticipated increase in the neutron count rates by a factor of two occurred during any single loading step after the initial nucleus of eight fuel assemblies were loaded (excluding anticipated change due to detector and/or source movement).

2. The neutron count rate on any individual nuclear channel increased by a factor of five during any single loading step after the initial nucleus of eight fuel assemblies were loaded (excluding anticipated changes due to detector and/or source movements).

An alarm in the containment and Control Room was coupled to the source range channels with a setpoint at five times the current count rate.

This alarm would automatically alert the loading operation to an indication of high count rate and required an immediate stop of all operations until the situation had been evaluated. The alarm used for this purpose was the containment evacuation alarm. In the event the evacuation alarm was actuated during core loading and after it had been determined that no hazards to personnel existed, special preselected personnel were permitted to remain in the containment vessel to evaluate the cause and determine future action. The preselected who were allowed to remain in the containment vessels were the Senior Reactor Operator designated by PSE&G and its technical advisers.

Core loading procedures specified alignment of fluid systems to prevent inadvertent dilution of the reactor coolant, restrict the movement of fuel to preclude the possibility of mechanical damage, prescribe the conditions under which loading could proceed and provide for continuous fuel and fuel assembly insert identification.

14.3.2 Post Loading Tests

Upon completion of core loading, the reactor upper internals and the pressure vessel head were installed and additional operational, mechanical, and electrical tests were performed prior to initial criticality. The final pressure tests were conducted after filling and venting was completed.

Mechanical and electrical tests were performed on the control rod drive mechanisms (CRDMS). These tests included a complete operational checkout of the mechanisms. Checks were made to ensure that the control rod assembly position indicator coil stacks were connected to their position indicators. Similar checks were made on CRDM coils.

Tests were performed on the reactor trip circuits to test manual trip operation, and actual control rod assembly drop times were measured for each control rod assembly. By use of dummy signals, the Reactor Control and Protection System was made to produce trip signals for the various unit abnormalities that require tripping.

At all times that the CRDMS were being tested, the boron concentration in the coolant-moderator was high enough that criticality could not be achieved with all control rod assemblies out.

A complete functional electrical and mechanical check was made of the in-core nuclear flux mapping system at operating temperature and pressure.

A listing of tests required prior to initial criticality is contained in Table 14.3-1.