5.3 REACTOR

Applicability

Applies to the reactor core, Reactor Coolant System, and Safety Injection System.

Objective

To define those design features which are essential in providing for safe system operations.

Specifications

A. Reactor Core

1. The reactor core contains approximately 176,200 lbs of uranium dioxide in the form of slightly enriched uranium dioxide pellets. The pellets are encapsulated in Zircaloy-4 tubing to form fuel rods. All fuel rods are pressurized with helium during fabrication. The reactor core is made up of 157 fuel assemblies. Each fuel assembly contains 204 fuel rods except for fuel assemblies which may be reconstituted to replace leaking fuel rods with non-fueled rods (e.g. zircaloy or stainless steel).

2. The average enrichment of the initial core is 2.51 weight percent of U-235. Three fuel enrichments are used in the initial core. The highest enrichment is 3.12 weight percent of U-235.

ATTACHMENT 2

DISCUSSION OF PROPOSED TECHNICAL SPECIFICATION CHANGE

Virginia Power is pursuing fuel assembly reconstitution as a means to enable the company to utilize the remaining energy in fuel assemblies which contain small numbers of leaking fuel rods. In the reconstitution process, the fuel rods which are known to have failed would be removed and replaced with dummy rods. This would be accomplished by inverting the assembly; removing the bottom nozzle; inspecting and removing the failed rods; replacing the rods with dummy rods containing no fuel, and replacing the bottom nozzle. The reconstituted assembly will comply with the original assembly design criteria.

Surry Units 1 and 2 Technical Specification 5.3.A.1 describes the reactor core to consist of assemblies containing 204 fuel rods or be a part of the Region 4 fuel demonstration program. The demonstration program assemblies have been permanently discharged and will not be reinserted into the core. In order to allow for the insertion of reconstituted assemblies into the core, this Technical Specification must be modified slightly to state:

> Each fuel assembly contains 204 fuel rods except for fuel assemblies which may be reconstituted to replace leaking fuel rods with non-fueled rods (e.g. zircaloy or stainless steel).

The impact of the change is negligible, since the reconstituted assemblies will comply with the original assembly design criteria. Virginia Power and the reconstitution vendor have performed evaluations of the reconstitution process in order to support this conclusion. A summary of the required 10CRF50.59 evaluations for the fuel assembly reconstitution process are included in support of this Technical Specification Change.

The specific areas of the reconstitution program that are addressed by the 10CFR50.59 evaluations are 1) inversion of the fuel assembly, 2) removal of the lower end fitting, 3) withdrawal, inspection and reinsertion of fuel rods, 4) modification and replacement of the lower end fitting, 5) storage of defective fuel rods, 6) local nuclear peaking resulting from replacement of fuel rods with dummy zircaloy rods, 7) local thermal hydraulic effects and 8) reload safety limits. These evaluations and other bounding accident evaluations are summarized as follows:

1) During the fuel assembly reconstitution process, the fuel assembly is inverted in the tilting basket of the fuel assembly reconstitution unit. The tilting basket is designed to provide the necessary structural support for the fuel assembly during the inversion process.

2) The lower end fittings will be removed by a spark erosion process using electro discharge machining (EDM) to remove the screw lock wires. EDM has been extensively qualified. The process will slightly change the lower end fitting configuration, requiring special replacement screws. The screws are designed to satisfy the same criteria as the original screws. They provide a positive mechanism for preventing screw rotation. The modified nozzle also meets all the original design requirements.

3) The fuel rod withdrawal, eddy-current inspection, and reinsertion of rods is consistent with nuclear industry practice and has a substantial experience base.

4) Dummy rods will be inserted in place of defective fuel rods. The use of dummy rods does not significantly change fuel assembly mechanical characteristics. In addition, the use of dummy rods and the adjustment of grid springs as necessary will eliminate possible grid spring fretting failure.

5) The failed fuel rods which have been removed from the assembly will be stored in a fuel rod canister. It has been designed with the same basic outer dimensions and upper end fitting as a fuel assembly in order to facilitate handling and storage. It has been designed to prohibit the loss of fuel material while providing adequate cooling. Thermal/hydraulic evaluations have been performed to show that sufficient cooling will exist within the completely filled canister due to natural convection flow. Criticality analyses have been performed to demonstrate that the rods in the canister will remain subcritical in the most reactive configuration.

6) The assemblies will be reconstituted in the spent fuel cask loading area on the cask pad. Since only one fuel assembly will undergo reconstitution at any time, any handling accident will be bounded by the Fuel Handling Accident described in Section 14.4.1.3 of the Surry UFSAR. Any handling accident involving the entire reconstitution fixture will be bounded by cask drop structural and nuclear consequence analyses.

7) The use of the reconstituted assemblies in future core designs will not result in any new accident since the reconstituted assemblies must comply to the original design criteria. This will be verified through inspection procedures.

8) Nuclear peaking was conservatively assessed on a generic basis for replacement of clusters of up to four rods and determined to be a small factor. Each reconstituted assembly will be specifically treated during reload analysis to confirm this.

9) Local thermal/hydraulic effects resulting from rod replacement have been evaluated and shown not to be a problem since reduced local power dominates the cold-wall effect.

10) As discussed, in each reload core the reconstituted assembly will be specifically treated and the existing safety criteria and design limits will apply. Therefore, there will be no reduction in safety margin.

In conclusion, no unreviewed safety question exists as defined in 10CFR50.59 since

1) The probability of occurrence of an accident or malfunction of equipment important to safety previously evaluated in the safety analyses is not increased. The reconstituted fuel assemblies meet essentially the same design requirements, satisfy the same design criteria as the original fuel assembly, and the use of assemblies will not result in a change to existing safety criteria and design limits.

2) The possibility for an accident or malfunction of a different type than any evaluated in the safety analysis is not created because a single fuel assembly is moved at a time, and the consequences of an accident are bounded by the fuel handling accident which is the most severe accident related fuel manipulation. The reconstitution equipment will be set up on the cask pad and any accident involving this equipment will be bounded by the cask drop structural and nuclear consequence evaluation.

3) The margin of safety as defined in the basis for any technical specification is not reduced as is demonstrated by the review of fuel assembly mechanical changes and since the existing safety criteria and design limits will not be changed.

It has been determined that the use of reconstituted fuel assemblies in Surry reload cores does not pose a significant hazards consideration. This is based on Example iii of those examples of amendments that are considered not likely to involve significant hazards considerations (48 FR 14870). Example iii states: "For a nuclear power reactor, a change resulting from a nuclear reactor core reloading, if no fuel assemblies are significantly different from those found previously acceptable to the NRC for a previous core at the facility in question are involved. This assumes that no significant changes are made to the acceptance criteria for the technical specifications, that the analytical methods used to demonstrate conformance with the technical specifications and regulations are not significantly changed and that the NRC has previously found such methods acceptable". The analyses show that the reconstituted assemblies will comply with original design criteria. The analytical methods used by Virginia Power will remain unchanged.