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File No.: G20.01
10CFR50.59

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

South Texas Project Electric Generating Station
Unit 1
Docket No. STN 50-498
Revision to FSAR Section 14.2:
Axial Xenon Oscillation Test

Pursuant to license condition 2.C(4) of Facility Operating License No. NPF-71, Houston Lighting & Power Company (HL&P) submits the attached description of a change in the South Texas Project Electric Generating Station (STPEGS) Initial Test Program. The description addresses a change in the acceptance criteria of Initial Startup Test Description #18, "Axial Xenon Oscillation Test".

The revised acceptance criterion deletes reference to a specific reactor core stability index, and inserts the criterion that the reactor be controllable with respect to xenon oscillation. The FSAR Section 14.2.12.3 currently specifies that the reactor core stability index should be less than or equal to the value specified in the fuel vendor's core design report. However, Westinghouse (STPEGS fuel supplier) does not supply a design value of axial xenon stability index. The revised acceptance criterion is consistent with Revision 2 of Regulatory Guide 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants, "Appendix A.5.d. The attached evaluation pursuant to 10CFR50.59 confirms that this change does not constitute an unreviewed safety question.

The following FSAR sections are to be revised:

Section 4.3.1.6 - Clarification is provided that axial xenon spatial power oscillations may occur during core life, rather than just late in core life.

Section 4.3.2.7.6 - Clarification is provided that values for stability indexes depend on core design as well as burnup, and that the stability index can be positive throughout core life.

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Section 14.2.12.3 - The acceptance criterion for the axial xenon oscillation test is revised to delete reference to a specific reactor core stability index, and inserts the criterion that the reactor be controllable with respect to xenon oscillation.

Affected FSAR pages with the changes are attached. They will be incorporated in a future FSAR amendment.

If there are any questions on this matter, please contact Mr. M. A. McBurnett at (512) 972-8530.

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GEV/PLW/ls

Attachment: Unreviewed Safety Question
Evaluation 87-039
FSAR Pages 4.3-6, 4.3-36, 14.2-140

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Unreviewed Safety Question Evaluation #87-039

Subject: Axial Xenon Oscillation Test

Description: This evaluation addresses a change in the acceptance criteria of Initial Startup Test Description #18, "Axial Xenon Oscillation Test." The revised acceptance criterion deletes reference to a specific reactor core stability index and inserts the criterion that the reactor be controllable with respect to xenon oscillation. The FSAR currently specifies that the reactor core stability index should be less than or equal to the value specified in the fuel vendor's core design report. However, Westinghouse (STPEGS fuel supplier) does not supply a design value of axial xenon stability index. The revised acceptance criterion is consistent with Revision 2 of Regulatory Guide 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants," Appendix A.5.d.

Safety Evaluation:

1) Does the subject of this evaluation increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report?

   No assumption was made in the safety analysis in regard to the value of the stability index. The only assumption is that the axial flux difference is controlled as described in the Technical Specifications. As part of the safety analysis, a large number of axial power shapes and corresponding xenon spatial distributions representing normal operation and anticipated load follow maneuvers were generated to confirm that peaking factor limits were met when the axial offset was controlled to Technical Specification limits. Power level and axial offset control was achieved by a combination of control rod motion, constrained by the rod insertion limits, and soluble boron concentration changes.

   The axial xenon stability index is not a factor in any accidents analyzed in the FSAR, nor does it affect any equipment important to safety. Therefore, the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety is not affected.

Unreviewed Safety Question Evaluation #87-039 (Cont'd)

2) Does the subject of this evaluation create the possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report?

No assumption was made in the safety analysis in regard to the value of the stability index. The only design assumption is that the core is controllable against xenon oscillations, whether the stability index is positive or negative. Therefore, this change does not create the possibility for an accident or malfunction of a different type than any evaluated previously in the FSAR.

3) Does the subject of this evaluation reduce the margin of safety as defined in the basis for any technical specification?

The axial xenon stability index is not specified in the Technical Specifications. This change to Initial Startup Test Description #18 does not reduce the margin of safety as defined on the basis for any technical specification.

Based upon the above, there is no unreviewed safety question.

Approved: 01/13/88

The core is designed so that diametral and azimuthal oscillations due to spatial xenon effects are self-damping and no operator action or control action is required to suppress them. The stability to diametral oscillations is so great that this excitation is highly improbable. Convergent azimuthal oscillations can be excited by prohibited motion of individual control rods. Such oscillations are readily observable and alarmed, using the excore long ion chambers. Indications are also continuously available from incore thermocouples and loop temperature measurements. Moveable incore detectors can be activated to provide more detailed information. In all proposed cores these horizontal plane oscillations are self-damping by virtue of reactivity feedback effects designed into the core.

However, axial xenon spatial power oscillations may occur ~~late in~~ during core life. The control banks, and excore detectors are provided for control and monitoring of axial power distributions. Assurance that fuel design limits are not exceeded is provided by reactor overpower ΔT and overtemperature ΔT trip functions which use the measured axial power imbalance as an input.

4.3.1.7 <u>Anticipated Transients Without Trip (ATWT)</u>. The effects of anticipated transients with failure to trip are not considered in the design bases of the plant. Analysis has shown that the likelihood of such a hypothetical event is negligibly small.[4.3-1] Furthermore, analysis of the consequences of a hypothetical failure to trip following anticipated transients has shown that no significant core damage would result, system peak pressures would be limited to acceptable values and no failure of the Reactor Coolant System (RCS) would result. These analyses were documented[Ref. 4.3-2] in November, 1974 in accordance with the AEC policy outlined in WASH-1270 "Technical Report on Anticipated Transients Without Scram for Water-Cooled Power Reactors," September, 1973.

4.3.2 Description

4.3.2.1 <u>Nuclear Design Description</u>. The reactor core consists of a specified number of fuel rods which are held in bundles by spacer grids and top and bottom fittings. The fuel rods are constructed of Zircaloy cylindrical tubes containing uranium dioxide fuel pellets. The bundles, known as fuel assemblies, are arranged in a pattern which approximates a right circular cylinder.

Each fuel assembly contains a 17 x 17 rod array composed of 264 fuel rods, 24 rod cluster control thimbles and an incore instrumentation thimble. Figure 4.2-1 shows a cross sectional view of a 17 x 17 fuel assembly and the related rod cluster control locations. Further details of the fuel assembly are given in Section 4.2.

The fuel rods within a given assembly have the same uranium enrichment in both the radial and axial planes. Fuel assemblies of three different enrichments are used in the initial core loading to establish a favorable radial power distribution. Figure 4.3-1 shows the fuel loading pattern to be used in the first core. Two regions consisting of the two lower enrichments are interspersed so as to form a checkerboard pattern in the central portion of the core. The third region is arranged around the periphery of the core and contains the highest enrichment. The enrichments for the first core are shown in Table 4.3-1.

4.3.2.7.6 Stability Control and Protection: The excore detector system is utilized to provide indications of xenon-induced spatial oscillations. The readings from the excore detectors are available to the operator and also form part of the protection system.

1. Axial Power Distribution

For maintenance of proper axial power distributions, the operator is instructed to maintain an axial offset within a prescribed operating band, based on the excore detector readings. Should the axial offset be permitted to move far enough outside this band, the protection limit will be reached and power will be automatically reduced.

Both 12 and 14 ft PWR cores become less stable to axial xenon oscillations as fuel burnup progresses. However, free xenon oscillations are not allowed to occur except for special tests. The control rod banks are | 30
sufficient to dampen and control any axial xenon oscillations present. Should the axial offset be inadvertently permitted to move far enough outside the control band due to an axial xenon oscillation, or any other reason, the protection limit on axial offset will be reached and power will be automatically reduced.

At BOL (150 MWd/MTU) stability indexes of about -0.047 hrs^{-1} and -0.020 hrs^{-1} were obtained, respectively, for 12 ft and 14 ft cores. The axial stability index is essentially zero in the 11,000 to 12,000 MWd/MTU range for 12 ft cores and in the 8000 to 9000 MWd/MTU range for 14 ft cores. At extended burnup (~15,000 MWd/MTU) both 12 and 14 ft cores have essentially the same stability index of about 0.02 hrs^{-1} or less. The axial oscillation period for both 12 and 14 ft cores increases with burnup. A period of 27 to 28 hours is obtained for both 12 ft and 14 ft cores at BOL. At EOL periods of about 32 and 34 hours are obtained, respectively, for the 12 and 14 ft cores. ~~The~~ long periods and vertical control rod systems make axial xenon transients easily controllable in modern PWRs at all times of life.

These values depend upon the core design as well as burnup, and the stability index can be positive throughout core life for both 12 and 14 ft cores. However,

2. Radial Power Distribution

The core described herein is calculated to be stable against X-Y xenon induced oscillations at all times in life.

The X-Y stability of large PWRs has been further verified as part of the startup physics test program for cores with 193 fuel assemblies. The measured X-Y stability of the cores with 157 and 193 assemblies was in good agreement with the calculated stability as discussed in Subsections 4.3.2.7.4 and 4.3.2.7.5. In the unlikely event that X-Y oscillations occur, back-up actions are possible and would be implemented, if necessary, to increase the natural stability of the core. This is based on the fact that several actions could be taken to make the moderator temperature coefficient more negative., which will increase the stability of the core in the X-Y plane.

d. Method - The reactor power level is stabilized, and complete incore flux maps are obtained and processed.

18. Axial Xenon Oscillation Test

a. Test Objective - This test will demonstrate the stability of the 3,800-MWt core to axial xenon oscillations.

b. Acceptance Criteria - ~~The reactor core stability index is less than or equal to the value specified in the fuel vendors core design report~~. The reactor core is controllable with respect to xenon oscillations. 48

c. Prerequisites

1) The reactor is critical at a steady-state power level of approximately 75 percent.

2) Pertinent data to be monitored is specified and connected to recording devices as required by the test procedure.

d. Method

1) Axial xenon oscillations are introduced by a specified maneuvering of control rod banks over a specified time period.

2) Data is recorded and analyzed as required in the test procedure. 10 Q423. 22(4.t)

19. Power Coefficient and Power Defect Measurement Test

a. Test Objective - This test will determine the differential power coefficient of reactivity and the integral power defect.

b. Acceptance Criteria

1) The differential power coefficient is equal to or more conservative than the power coefficient assumed in the safety analysis. 10 Q423. 33(k)

2) The measured power defect agrees within ± 10 percent of the value shown in the fuel vendors core design report. 48

c. Prerequisites

1) The reactor is critical at specified power levels from zero to 100 percent.

2) The instrumentation necessary for data collection is installed, calibrated, and operable.