ATTACHMENT A

Revised Pages of Technical Specifications.

I. No fuel rods shall be placed in the center drywell.

J. Fission chambers, experimental foils or oxide fuel samples having a total reactivity worth of less than 60c and containing a total of not more than 0.5 Kg fissile material may be placed in the center channel (or in a drywell in the center channel) for irradiation at power levels equal to or less than 100 KWt. Experimental foils containing less than 10 mg of fissile material may be irradiated at reactor levels above 100 KWt.

K. Fuel rods which have defects as defined below shall not be reinserted in the core:

1. Cladding rupture, cladding perforation, or other observable defects which may cast reasonable doubt on the integrity of the rods.
2. Local swelling of the cladding in excess of 10 mils or bowing of the rod sufficient to prevent reinsertion of the rod into the core.
3. An increase of more than 1/2 inch in the column height of either fuel segment.

L. The gross gamma cover gas monitor shall be demonstrated to be capable of detecting a fission gas release equivalent to about 1% of the 20 MWt equilibrium inventory in a fuel rod before the reactor is operated about 10 MWt. If such sensitivity is not demonstrated, a more sensitive monitor shall be installed.

M. If the gross gamma monitor becomes inoperable, the reactor shall be shut down, except under the following circumstances:

1. If a reactor test is in progress (other than FRED transient test program) and the monitor should fail, reactor operation may continue for 24-hours, if no unexpected changes in cover gas activity indicative of changing fuel condition have been observed just preceding the failure, and if cover gas samples are taken for spectral analysis at intervals of approximately four hours.
2. When the reactor head is not in place, the reactor may be operated, as permitted by Section 3.9, with the gross gamma monitor not operating.

N. When guinea pig rods are located under the innermost refueling ports, the B_4C poison rods in the core shall be distributed such that the number of poison rods in any quadrant of the core (determined by N-S, E-W center-lines) does not exceed the number of poison rods in any other quadrant by more than two. This specification shall not be applicable when the high flux trip level is set more than 10% below the LSSS.

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(1) observe the continuous monitoring system under operating conditions to diagnose the cause of failure or maloperation of the system;

(2) permit an orderly completion of a test series, so that tests completed prior to the failure do not have to be repeated;

(3) plan for an orderly shutdown of the reactor.

During periods of reactor operation when the continuous fission gas monitor is inoperable, batch samples will be taken at intervals of approximately four hours; <u>however samples need not be taken when operations are conducted with the reactor head removed.</u> This sampling frequency will assure that any trends that might develop will be identified.

Specification 3.3.N requires a reasonably uniform arrangement of B_4C poison rods in the core to provide assurance that the power density in guinea pig rods under the innermost refueling ports is not significantly greater than the value used to determine the LSSS. A uniform distribution of poison rods is desirable for most of the planned tests. However, some non-uniform arrangements at low or intermediate power may be required for special tests such as determination of material worths at zero power or determination of available excess reactivity during the approach to power. Such arrangements are permissible when the high flux trip level is reduced more than 10% below the LSSS, since the maximum effect of a single poison rod on guinea pig rod power density is only 1/4%.[13] The intent of limiting the applicability of this specification is not to permit grossly non-uniform arrangements of poison rods, but rather to permit the flexibil ity of arrangement which may be required during portions of the test program when the reactor is operated below the power levels at which special protection for guinea pig rods is required.

<u>References</u>

(1) SEFOR FDSAR, Volume I, Para. 4.5.3.1, pp 4-50 and 4-51.

(2) SEFOR FDSAR, Volume II, Para. 12.3.6, pp 12-15 and 12-16.

(3) SEFOR FDSAR, Para. 16.4.2.5 and 16.4.2.6.1.1, pp 16-26 and 16-28.

(4) SEFOR FDSAR, Para. 16.2.1, p 16-4.

(5) SEFOR FDSAR, Appendix B, Para. B.5, p B-3.

(6) SEFOR FDSAR, Supplement 10, p 3-10.

(7) SEFOR FDSAR, Volume I, Para. 4.2.2.2.2 , p 4-2

(8) SEFOR FDSAR, Volume II, Para. 12.2.1, pp 12-3.
(9) SEFOR FDSAR, Volume II, Para. 16.2.4.3.
(10) SEFOR FDSAR, Supplement 21 pp 2, 3.
(11) SEFOR FDSAR, Supplement 3.
(12) SEFOR FDSAR, Supplement 21, pp 1-17.
(13) Addendum No. 2 to Proposed Change No. 3 to the Technical Specifications, January 27, 1971.

Bases

The reactor power limit for Core I will be increased in a step-wise manner with static and oscillator measurements made at the indicated power levels. The results from tests at each power level will be evaluated and compared to predicted results before proceeding to the next higher power level. Results from static and oscillator tests will be analyzed to verify that the minimum conditions for operation specified in Section 3.3. C, D & E are being met.

Reactor stability will be determined by means of conventional oscillator tests at each step in the approach to power for Core I. These tests will consist of measuring reactor flux and input reactivity as a function of time while the reactivity is oscillated and coolant flow rate is held constant. Data from these tests will be used to make Nyquist plots for each power level.

A similar approach to power will be used for Core II, except that oscillator tests will be required only at 10 MWt to demonstrate compliance with Paragraph 3.3.F. Static tests through a power level of 10 MWt will be used to demonstrate the necessary requirements for initiation of the transient test program. If the reactor is to be operated at higher power levels than 10 MWt (excluding transient tests), a stepwise approach to the higher power will be used as specified in Section 3.10.

Guinea pig fuel rods[1] containing fuel pellets of 25% fissile plutonium will be placed in the core at positions located under through-head refueling ports, and will be removed for examination at scheduled intervals in the test program. Up to three of the guinea pig rods will operate at power densities up to 15% higher than a standard rod nearest the center of the core.

The specified guinea pig rod examinations after operation at power levels of 15 and 17.5 MWt were chosen such that satisfactory operating experience with the guinea pig rods at each of these power levels will provide assurance of satisfacto operation of standard fuel rods at the next higher power level.

The initial calibration of the Wide Range Flux Monitor will be based on physics calculations. This calibration will be verified by experimental data as soon as practicable, and will be checked at the specified steps in the approach to power.

Reactor operating data and experience up to and including 10 MWt were used to establish allowable limits for unexplained reactor behavior. Section 3.13 was added to these specifications to specify these limits.

3.12 Excursion Tests

Applicability

These limits apply when excursion tests are conducted with the Fast Reactivity Excursion Device (FRED). ~~The prompt critical test program for Core II shall not be initiated until DRL has completed its review of the special reports described in Specification 6.6.B.5 and determined whether or not additional specifications are required~~. For Core II, the transient test program may be initiated following satisfactory completion of static and oscillator tests at 10 MWt, provided the conditions listed in Section 3.3 and Paragraph 3.12 B.1 have been met.

Objective

To specify additional limits which are applicable only during the excursion tests.

Specifications

A. Experimental Program with FRED

The experiments with the FRED shall be carried out in three phases as indicated below. Progress to the next phase shall be contingent upon adequate agreement with predicted results.

1. Familiarization Tests

   a. The worth of the poison slug used in these tests shall be 0.5$ or less.

   b. The initial reactor power level shall be equal to or less than 15 MWt.

2. Sub-Prompt Critical Tests

   a. The worth of the poison slug used in the sub-prompt critical tests shall be 0.98$ or less.

   b. The initial reactor power level for sub-prompt critical tests with the FRED shall be equal to or less than 15 MWt.

3. Super-Prompt Critical Tests

   a. The worth of the poison slug used in the prompt critical tests shall be equal to or less than 1.3$ if the nominal value of the magnitude of the sodium-in negative Doppler coefficient ($T\frac{dk}{dT}$) is equal to or greater than 0.008. ~~The worth of the poison slug shall be equal to or less than 1.2$ if the nominal value of the magnitude of the sodium-in negative Doppler coefficient ($T\frac{dk}{dT}$) is less than 0.008.~~ If the nominal magnitude of the sodium-in negative Doppler Coefficient is less than 0.008 the worth of the poison slug shall be equal to or less than the value determined from the linear relationship in Figure 3.12-1.

   b. The initial reactor power level for prompt critical tests shall not exceed 11 MWt.

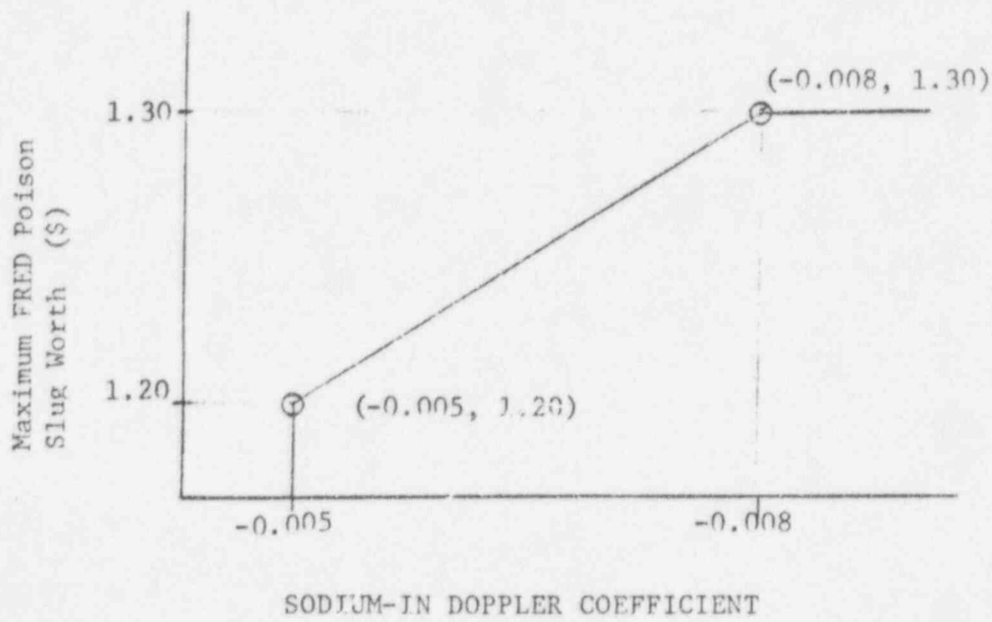

Figure 3.12-1 Limits for Poison Slug Worth

Bases

The experimental program with FRED is graded so that small transients precede larger transients. The information from the small transients will be used (1) to evaluate the performance of the reactor, (2) to compare the performance with predicted behavior, and (3) to predict performance of the reactor for the larger prompt critical transients.

The characterization of the tests into the categories of (1), (2), and (3) above is self-explanatory. The maximum power levels indicated in each case are to assure that the safety limits as given in Section 2.1 will not be violated and are in accordance with Figure 2.1-1 and the explanation in Section 2.1. The limits given in this specification also assure that the maximum energy addition to the core during a planned transient does not exceed that calculated for the Maximum Planned Transient.[10] This in turn assures that the maximum consequence of inadvertently running a transient with a defective (sodium-logged) fuel rod in the core would be limited to deformations corresponding to about 0.6% strain of the cladding of the defective fuel rod.[11] This amount of strain is only 4% of the minimum ductility of the SEFOR cladding at the end of the three-year experimental program.[12]

The value of the Doppler coefficient for SEFOR Core I with sodium in the core is estimated to be $T\frac{dk}{dT} = -0.0085$. This value was verified experimentally by means of Doppler measurements on the SEFOR mockup in the ZPR-III Critical Facility.[(] From further measurements on this mockup, it was established that the Doppler coefficient with sodium out is 17.5% lower than the value with sodium in, or $T\frac{dk}{dT} = -0.0070$ for SEFOR Core I with sodium out.
The value of the Doppler coefficient ($T\frac{dk}{dT}$) for SEFOR CORE II with sodium in the core is predicted to be -0.0069. This value is based on calculations which were normalized to the Core I value of the Doppler coefficient -0.0081.[14] The sodium out Doppler coefficient for Core II is estimated to be -0.0057.

The safety analysis of the MHA for SEFOR was based on a sodium-out Doppler coefficient of $T\frac{dk}{dT} = -0.004$, which corresponds to a sodium-in Doppler coefficient ($T\frac{dk}{dT}$) of -0.005.[2] The demonstration of a negative Doppler coefficient with a magnitude equal to or greater than 0.005 during the approach to maximum power will verify predicitions of this coefficient based on the ZPR-III measurements and will provide the basis for safe performance of prompt critical tests in SEFOR.

The total reactivity worth of each poison slug used in the FRED will be known and the value will be checked before each transient test. The maximum reactivity insertion rate will be limited to less than 20$ per second by limiting the reactivity worth of the slug to 1.3$ and by limiting the minimum allowable time for the slug to travel the first 20 inches to 0.097 second.[3] This time will be measured by means of the lift-off switch and a proximity switch which marks 20 inches of travel by the poison slug. The safety of the plant has been assessed for a maximum rate of 50$ per second with a sodium-out Doppler coefficien $(T\frac{dk}{dT})$ of -0.004. [4]

starting from initial power levels as low as 0.1 MWt is still well below the safety limit.

Initial checkout tests of the FRED after it is installed on the reactor head will be performed with the reactor either sub-critical or at low power level (less than 0.1 MWt). The FRED will have a negligible effect on reactivity when it is in a position more than 20 inches above the core midplane.

The minimum limit of 700°F on the core coolant inlet temperature is to assure that the total reactivity of the core is maintained at the equivalent of 50¢ excess at 20 MW conditions.[9] At lower temperatures, the excess core reactivity would be higher. The 50¢ excess limit assures that the Maximum Planned Transient will not be initiated from a power level in excess of 11 MWt, and also limits the final reactor power if the reactor does not scram and the FRED slug remains out of the core following any excursion test.

The requirement for redundant flux monitoring equipment during the transient tests will provide a cross check on data and will also assure monitoring of reactor flux throughout the transients while providing the flexibility to use wide range monitors, U-238 fission chambers or gamma chambers as required by the magnitude of each test.[13]

Obtaining overlapping data from both the U-238 fission chambers and the gamma chambers prior to switching from one instrument to the other for those transients whose magnitude require the use of both instruments will provide a cross check between instrument readings during switchover.

References

(1) SEFOR FDSAR, Appendix B, Section B.5, p. B-3.

(2) SEFOR FDSAR, Section 16.4.2.6.1.1, p. 16-28.

(3) Proposed Change No. 6 for the Southwest Experimental Fast Oxide Reactor, August 5, 1971.

(4) SEFOR FDSAR, Volume II, Section 16.2.7.

(5) SEFOR FDSAR, Volume II, Section 16.2.7, p. 16-10.

(6) SEFOR FDSAR, Supplement 17, p. G-1.

(7) SEFOR FDSAR, Supplement 3, Section 5.1.3.

(8) SEFOR FDSAR, Supplement 19, p. 57.

(9) SEFOR FDSAR, Volume II, Section 12.3.6, pp. 12-15, -16.

(10) SEFOR FDSAR, Supplement 10, p. 1-48.

(11) Additional Information Regarding Sodium Logging of SEFOR Fuel Rods, February 1, 1971.

(12) SEFOR FDSAR, Supplement 21, p. 4.

(13) "Results of the Familiarization and Sub-Prompt Critical Transients for Core I," pages 4 and 18, submitted to the AEC-DRL on July 16, 1971, by the Breeder Reactor Department of the General Electric Company.

(14) Op. Cit., Reference 13, p. 3.

4.3 Reactor Fuel Rods

Applicability

Applies to fuel rod examination made in the refueling cell.

Objective

To assure maintenance of fuel rod cladding integrity during reactor operation.

Specification

A. Two or more guinea pig fuel rods, which have operated at power densities higher than the power density of standard fuel rods nearest the center of the core, shall be removed from the reactor after operation at reactor power levels of 15, 17.5, and 20 MWt, and shall be examined in the refueling cell by visual observation, dimensional checks, and gamma scans. After reaching a power level of 15 MWt and before reaching 17.5 MWt, the interval between fuel rod examinations shall not exceed six months.

B. Before the start of the sub-prompt critical excursion tests and before the start of the prompt critical excursion tests, a minimum of one guinea pig fuel rod and one standard fuel rod shall be examined by the methods described in "A" above. If guinea pig rods are located under inner refueling ports, one of them should be the one examined.

C. After ~~each~~ every other prompt critical excursion test, at least one guinea pig rod and one standard rod shall be examined by the methods described in "A" above. If guinea pig rods are located under inner refueling ports, one of them should be the one examined.

D. If the examination of a fuel rod should indicate a defect as described in Section 3.3K, additional fuel rods shall be examined to determine the extent of additional defects if any.

E. Following the examination after operation at 20 MWt as specified in 4.3.A, two or more (if available) guinea pig fuel rods, which have operated at power densities higher than the power density of standard fuel rods nearest the center of the core, shall be examined by the methods described in "A" above at intervals such that the rod exposure during the first interval does not exceed a core integrated power

Q. Samples of the primary coolant shall be taken for analysis, at intervals not to exceed three months and following ~~each~~ every other prompt-critical FRED transient.

R. Three reactor vessel outer head bolts shall be removed annually for visual inspection, dimensional checks and dye penetrant testing.

S. Five reactor vessel outer head bolts shall be inspected annually using ultrasonic testing with straight beam longitudinal scan from the top of the bolt. This inspection may be made with the bolts in place or removed from the reactor. Bolts to be examined shall be selected so that all of the outer head bolts are examined within a 10-year period.