ATTACHMENT A

NEW AND REVISED PAGES FOR THE

SEFOR TECHNICAL SPECIFICATIONS

PROPOSED CHANGE NO. 4

3.10 Approach to Power

Applicability

Applies to reactor power limits during the initial approach to full power for Core I and also for Core II.

Objective

To provide a method of assuring a safe and orderly approach to full power.

Specification

A. Reactor power shall be limited to 2 MWt initially, This limit shall be successively increased to values of 5, 10, 15, 17.5, and 20 MWt provided the conditions listed in Section 3.3C, D & E are satisfied at each of these limits in the approach to rated flux (power). Satisfactory results obtained at a given limit shall permit reactor operation up to and including the next scheduled step in the approach to power.

B. If at any power level, the analysis of the conventional oscillator tests indicates that the stability criterion of specification 3.3 F will not be met at some higher level of power, the reactor power may be raised only as high as the halfway point between the level at which the test is made and that at which the failure to meet the specification is indicated.

C. The reactor power limit shall not be increased above 15 MWt or above 17.5 MWt unless analysis of results from guinea pig fuel rod examinations shows that no damage to standard fuel rods is to be expected by operation at the next scheduled power level.

D. A reactor heat balance shall be made as soon as practicable after achieving steady state power levels of 5, 10, 15, 17.5, and 20 MWt, to determine the correlation between rated flux and reactor power.

E. The specifications previously identified in this section have been approved and are incorporated into the SEFOR Technical Specifications as Section 3.13.

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Bases

The reactor power limit 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. 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.

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 satisfactory operation of standard fuel rods at the next higher power level.

Guinea pig rods nearest the center of the core will be removed prior to reactor operation above 17.5 MWt, so that no fuel rods will be operated at power densities in excess of that experienced by the hottest standard fuel rod at 20 MWt. (See Specification 3.3.H).

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.

Reference

1. SEFOR FDSAR, Volume I, Para. 4.2.2.4, p. 4-9.

3.13 Operating Limits

Applicability

Applies to parameters observed or measured during steady state reactor operation.

Objective

To establish limits on important parameters which will detect anomalous reactor behavior and to establish limits for steady state operation with known loss of clad integrity.

Specification

A. The limits for unexplained behavior shall be as given below. If these limits are exceeded, the actions specified in Section 4.9.B shall be taken.

1. A gross cover gas monitor indication greater than normal background by a factor of three at the indicated power level shall be considered anomalous. If it is determined that it is safe to resume reactor operations (using the steps outlined in 4.9.B.1) operation may be resumed following the selection of a new limit for the gross cover gas monitor which will assure that an equivalent release of fission gas from another fuel rod will be detected. The new limit shall be reported in the Quarterly Operations Report.

2. A change in steady state reactivity of more than ±10 cents from the predicted value at the reactor operating conditions shall be considered anomalous.

3. A change in main primary coolant flow rate of more than ±10% from the predicted value when the coolant flow rate is greater than 1500 GPM shall be considered anomalous.

4. A difference of more than 60°F between the upper reactor vessel outlet temperature and the Resistance Temperature Detectors (RTD's) in the reactor vessel main primary outlet pipe shall be considered anomalous.

B. A cover gas monitor indication greater than 10 times normal background at the indicated power level and the presence of noble gas isotopes in the cover gas shall be considered a possible indication of failed fuel. Two or more guinea pig rods shall be examined in addition to the surveillance required by 4.9.B.4 and 4.4.P. Subsequent reactor operations will be allowed, provided that the investigations conclude it is safe to proceed (using the steps outlined by 4.9.B). The response to additional fission gas releases to the cover gas will follow the procedures outlined in 4.9.B, utilizing the information obtained from the initial release.

Bases

The reactor and auxiliary systems (including the radwaste system) have been designed so that steady state operation with five failed fuel rods can be accommodated[1,2]. The cover gas monitor is capable of detecting loss of clad integrity if it occurs[3]. The cover gas monitor will also respond to fission products escaping from pin hole leaks, which may occur in some fuel rods but which are not classed as failures[4]. The normal cover gas activity due to A-41 will be about .024 μCi/cc at 20 MWt, and the corresponding indication on the cover gas monitor will be about 20 mR/h. If 1% of the 20 MWt equilibrium fission products from a single rod were released to the cover gas, the cover gas activity would increase by about 3 μCi/cc,[5] which is a factor of more than 100 above the normal reading. The normal cover gas activity may increase over a long period of time due to the possibility of pin hole leaks in some fuel rods. By limiting any unexplained increased in the cover gas monitor reading to a factor of three times the normal reading, the capability of detecting new leaks and/or cladding failure is assured.

The SEFOR reactor operates over a wide range of temperature and power conditions in the course of the defined experimental program. To follow normal experimental reactor conditions requires a predictive capability for a broad range of conditions. To establish definitive criteria for anomalous reactivity, careful reactivity balances and comparisons have been maintained during zero power testing, fuel arrangement and the power ascension to 10 MWt. Inconsequential random and systematic errors normally are less than the ± 10 cents maximum disparity between predicted and measured reactivity values. The limit is restrictive enough to alert the operator and staff to items of consequence, e.g. significant changes in the reactor coefficients, erroneous fuel arrangements or other problems.

Comparison of the coolant flow rate to the pump characteristic provides a cross comparison between the pump performance and the magnetic flowmeter. The plant is protected from abrupt and large losses of flow by the low flow trips at 80% of the set point flow rate. The requirement for comparison of measured flow to predicted flow will alert the operator to any deterioration in performance of either the pump or the magnetic flowmeter. The limit of ±10% is large enough to exclude variations due to random errors and

repeatability considerations, but is small enough to detect incipient problems before they have a detrimental effect on reactor cooling.

Because the outlet temperatures vary so widely over the course of the experiments, it is necessary to have criteria which will be applicable to all conditions. The comparison between the vessel exit RTD's and the upper reactor vessel outlet temperatures provides a cross-check on both instruments. The allowable variation was obtained by examining the difference between these two temperature devices over the testing completed up to 10 MWt, including the natural circulation tests. The value of $\pm$60°F is slightly larger than any variation obtained to date. Calculations indicate that for full flow, full power, there should be 12°F difference for the as-designed core. A difference in these temperatures of 60°F would correspond to approximately 35% of the total vessel flow bypassing the core compared to the design condition of 10% bypass leakage. It could also be caused by changes in flow distribution due to orificing effects at low flow rates.

These conditions are not detrimental to the core. The resulting upper region temperatures would be below the trip limit of 900°F for these sensors. The 60°F limit would assure detection of such a condition before the situation became serious.

A GCGM (gross cover gas monitor) indication of 10 times normal background supplemented by a spectral analysis which indicates noble gases in the reactor cover gas would provide a positive indication of a fission gas release from a fuel rod into the reactor cover gas. It is possible that small pin hole leaks from one or more fuel rods will occur during operation(6). However, the first observation of a fission gas release to the reactor cover gas resulting in a GCGM indication of 10 times background will be treated as a possible indication of a fuel rod failure. A spectral analysis of a cover gas sample will be performed (as required by 4.4.P) to establish the age of the gas. Two or more of the guinea pig rods will be examined to verify that a damage threshold for the fuel has not been reached. Sodium samples (as required by 4.9.B.4) will be taken and analyzed for fission products. The results from these investigations will be used as required by 4.9.B to determine if it is safe to resume reactor operation. The frequency of routine surveillance (such as cover gas samples for spectral analysis) will be increased as required to determine the behavior of the fission

gas release from fuel rods in the SEFOR system. The response to any additional indications of fission gas release will depend on the nature of the release and the information obtained from the investigations of the initial release.

References

1. SEFOR Technical Specifications, p 3.7-4, bases for 3.7.H.
2. SEFOR FDSAR, Supplement 21, Section I.
3. SEFOR FDSAR, Supplement 21, Section II.
4. SEFOR Technical Specifications, pp 3.3-5,6, bases for 3.3.K.
5. SEFOR FDSAR, Supplement 21, p 14.
6. G. Kayser, "Problems Due to Fission Products in Circuits of Sodium-Cooled Fast Reactors in the Event of Can Fractures," EURFNR-593 (Original Report Number DRP/SEMTR/CAD.68.R.575), Nuclear Research Center Cadarache & Saclay (France), December, 1968.