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Washington, D.C. 20545
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JAN 11 1983

Mr. Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Check:

ADDITIONAL INFORMATION ON CORE INSTRUMENTATION

Enclosed is modified Preliminary Safety Analysis Report (PSAR) page 4.4-80 that provides additional information on core instrumentation for the Clinch River Breeder Reactor Plant project. This enclosed page documents information discussed as a result of the November 25 and 26, 1982, project/Nuclear Regulatory Commission meeting on PSAR Chapter 4. The revised page will be included in a future amendment to the PSAR.

Questions regarding the enclosure may be addressed to Mr. C. Wilson (FTS 626-6129) or Mr. W. Pasko (FTS 626-6096) of the Project Office Oak Ridge staff.

Sincerely,

John R. Longenecker

John R. Longenecker
Acting Director, Office of
Breeder Demonstration Projects
Office of Nuclear Energy

Enclosure

cc: Service List
Standard Distribution
Licensing Distribution

D001

A Natural Circulation Verification Program is underway to develop and validate computer codes capable of core-wide T&H transient analysis through the descent and during natural circulation operation. Validation will be accomplished by comparison to low flow steady state and transient test data, including the EBR-II natural circulation and FFTF Acceptance Test Phase startup testing.

A test of the performance of the fuel transfer and storage assembly is underway to verify the performance of that component.

As more data from the experimental efforts become available, the analytical techniques and computer codes (see Section 4.4.3.4) will be calibrated accordingly and the uncertainty analyses (see Section 4.4.3.2) revised to reflect such additional information.

4.4.5 Core Instrumentation

51 The core instrumentation for the CRBR is core exit thermocouples. The bases for this selection are provided in Reference 67.

Insert 4.4.5

4.4.5.1 Design Bases

The functions identified for the core exit thermocouples located above the selected core assemblies are:

- o reactor control;
- o surveillance (primarily for assessment of cladding cumulative damage function);
- o design verification (verification of design margins, power distribution, symmetry, operational slow transients, assessment of uncertainty factors).

Core instrumentation (i.e., core exit thermocouples) is not required to perform any PPS function.

4.4.5.2 Design Description

To provide these functions a single thermocouple is provided above each of the selected core assemblies as follows:

- o Fuel Assemblies: 148 positions out of a total of 156 are instrumented;
- o Inner Blanket Assemblies: 72 positions out of a total of 76 are instrumented;
- 54 o Alternating Fuel/Inner Blanket Assemblies: all 6 positions are instrumented;

INSERT 4.4.5

In-core instrumentation, specifically designed to monitor the detailed core power distribution, is not provided in CRBRP. Liquid Metal Fast Breeder Reactors have inherent differences relative to LWR's that permit operation without in-core power monitoring. In addition, selective CRBRP design features have been incorporated to eliminate possible perturbations caused by complicated fuel management schemes and control and movement. The rationale supporting this decision is provided below.

CRBRP, like FFTF, is instrumented with assembly-outlet thermocouples to monitor the coolant temperatures and to detect gross asymmetries in the radial or azimuthal power distribution. Nuclear control is provided by ex-vessel neutron detectors which view the core as a whole. The batch fuel management scheme incorporates a single fuel enrichment, and, since there is no scatter refueling or assembly shuffling, there is therefore minimal potential for refueling or loading errors to lead to unplanned power peaks. In addition, the power distribution is relatively flat, symmetric, and predictable in a fast neutron spectrum reactor like CRBRP. This power distribution has been thoroughly characterized in the ZPPR (Engineering Mockup Critical) program where extensive isotopic fission and capture rate distributions have been analyzed with CRBRP design calculational methodology and cross section data. The power shape is accurately predicted with an uncertainty in the fission rates of approximately $\pm 2\%$ (1σ).

Unlike an LWR, there is no power peaking caused by local moderating regions. Sodium is a relatively weak moderator, so the power shape is relatively insensitive to sodium channels and sodium density variations. In a light water reactor, the extremely high thermal absorption cross section for fission product daughters (particularly Xe^{135}) can lead to power oscillations. However, in a fast reactor system, such as CRBRP, the fission product cross sections are relatively low so that Xe-induced power oscillations will not be present. To minimize azimuthal power perturbations, the CRBRP control rods are operated in a uniformly-inserted bank. The control rod bank position is monitored by two independent systems, and interlocks maintain relatively close tolerances on the control rod banking. Selection of the R7C operating control rod bank location in the core was designed to minimize adverse global power peaking, and, in fact, the BOL control insertion tends to suppress the power peak in CRBRP. Because of the relatively long neutron mean free path in a fast reactor, the presence of this uniform absorber material does not cause severe local perturbations in the neutron flux (power).

As noted above, potential mechanisms for producing significant power perturbations, as in a light water reactor, do not exist in a fast reactor system. In addition, CRBRP has a well characterized flat, unperturbed power distribution which is the result of a simplified fuel management scheme. In addition, tight controls are exercised on control rod movement to insure symmetric control rod operation. Based on these observations and design features, it has been concluded that there is no need for in-core power monitoring in CRBRP.