Department of Energy
Washington, D.C. 20545

Docket No. 50-537
HQ:S:82:139

DEC 06 1982

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:

REACTOR DESIGN (CHAPTER 4) WORKING MEETING, NOVEMBER 25 AND 26, 1982 - ADDITIONAL INFORMATION

On November 25 and 26, 1982, the Applicant and the Nuclear Regulatory Commission (NRC) met to discuss open issues concerning the reactor (Chapters 4 and parts of 15). The enclosure to this letter documents the NRC issues and the project's resolutions thereof.

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
S
1/40

ENCLOSURE

RESOLUTION OF OPEN CHAPTER 4 LICENSING ITEMS

Chapter 4.2 Mechanical Design

Concern

1) It is our understanding the following items are agreed to by the applicant for resolution during final design. Documentation must be provided to confirm this:

   a) The Cummulative Damage Function (CDF) and Design Limiting Strain (DLS) models will be modified to account for fatigue.

Response

The applicant will evaluate the fatigue damage in the CDF and DLS models; it will be included in the final design or justification for its omission will be provided in the FSAR.

Concern

   b) Failed fuel, blanket or control assemblies will be removed at the first shutdown after the failure occurs (i.e. not necessarily the End-of-Cycle).

Response

Based on existing test data, the applicant and NRC agree to the following operational limitations: Upon the detection of a breached fuel or blanket pin, as indicated by fission gas, the assembly will be removed from the reactor at the first plant shutdown. Upon the detection of sodium-fuel contact, as indicated by a generally increasing delayed neutron signal, the reactor will be brought to a controlled shutdown and the assembly removed from the reactor.

Concern

c) Additional Steady State (SS) and transient test data will be obtained to:

- examine the fuel adjacency effect
- examine the effect of the following non-prototypicalities in the transient data:

  o pin length
  o radial power depression
  o lack of SS power preconditioning

Response

The NRC agreed that the fuel and blanket development programs are adequate to address the noted steady state and transient issues and will note the importance of these programs in the SER. The applicant will notify the NRC on programmatic changes that occur to the development programs.

Concern

d) CDF model will:

- include the fuel adequacy effect
- be verified against SS and transient test data
- use updated tensile properties which include fluence effects

Response

The fuel and blanket fuel design methodology will be verified against steady state and transient data and will be documented in the FSAR. Issues related to the "fuel adjacency effect" and fluence dependency of material properties will be explicitly addressed.

Concern

e) DLS Model will be verified against SS and transient data.

Response

The fuel and blanket fuel design methodology will be verified against steady state and transient data and will be documented in the FSAR. Issues related to the "fuel adjacency effect" and fluence dependency of material properties will be explicitly addressed.

Concern

f) A cladding temperature limit significantly lower than the clad melting temperature will be established for the coolable geometry limit.

Response

Prior to the FSAR submittal, the applicant will develop and submit to the NRC for approval quantitative limits to assure a core coolable geometry. The following potential mechanisms for compromising core coolable geometry will be addressed:

Fuel melting and explusion
Cladding melting and deformation
Coolant boiling and dryout.

2) The following are items for which a commitment from the applicant for resolution during final design is requested prior to issuing a CP:

Concern

a) Modify seismic analysis to include thermal uncertainties and to analyze bundle-to-duct interaction during the seismic event.

Response

The applicant will review the extent to which thermal uncertainties were included in the duct analyses and will reach agreement of their adequacy with the NRC. FSAR core seismic analyses will include bundle-to-duct interaction evaluations.

Concern

b) Provide the basis for using umbrella events in lieu of a detailed load history in analyzing fuel and blanket pins. Demonstrate that this is conservative.

Response

The applicant will describe the conservativeness of the umbrella events with respect to the temperature and loading potential of the fuel and blanket design events in the FSAR.

Concern

c) Modify the coolable geometry limit for Transient Overpower (TOP) events to include an additional limit to preclude molten fuel expulsion (such as an enthalpy limit).

Response

Prior to the FSAR submittal, the applicant will develop and submit to the NRC for approval quantitative limits to assure core coolable geometry. The following potential mechanisms for compromising core coolable geometry will be addressed:

Fuel melting and explusion
Cladding melting and deformation
Coolant boiling and dryout.

Concern

d) CDF methodology should:

- define the procedure for determining the load and temperature history used
- show that the confidence limits used for mechanical properties are conservative.
- show that the input parameters used are statistically independent or do a Monte Carlo analysis to determine the true uncertainty in the method.

Response

Final design documentation for the fuel and blanket design methodology will address the procedures for determining load and temperature history, will address the adequacy of confidence limits used for mechanical properties and will show that the statistical methods utilized are appropriate.

3) The following are items for discussion regarding resolution during final design:

Concern

a) Best approach for conservative analysis of control assemblies.

Response

The applicant will review with NRC the basis for control duct bowing used in control rod insertion evaluations.

Concern

b) Access to design codes.

Response

The applicant will submit to the NRC a revised response to question CS490.29

Chapter 4.3 Neutronic Design

1) The following are items requiring resolution prior to issuing a CP:

Concern

a) Commit to a program to verify power distribution.

Response

The adequacy of methods used to determine the core power distribution will be verified with ZPPR EMC data for the FSAR.

Concern

b) Need additional information to determine if Doppler coefficient used in Chapter 15 is correct.

Response

The applicant agrees to provide a description in Chapter 15 of the relationship between the Doppler constant used therein to those described in Chapter 4.3.

Concern

c) Commit to perform and document additional Doppler measurements in ZPPR.

Response

ZPPR EMC experimental data specific for Doppler constants have been performed and will be evaluated for the FSAR.

Concern

d) Commitment to provide descriptions of the codes, techniques and procedures used to obtain reactivity coefficients and a description of the experimental program to verify these.

Response

Nuclear codes and design procedures used for reactivity coefficient & control rod worth predictions, and verification of their adequacy based on experimental data, will be documented for the FSAR.

Concern

e) Commitment to provide description of the codes, techniques and procedures used to obtain control rod worths and a description of the experimental program to verify these.

Response

Nuclear codes and design procedures used for reactivity coefficient, control rod worth predictions, and verification of their adequacy based on experimental data will be documented for the FSAR.

Concern

f) Need to establish how reactor stability and power oscillations will be detected or measured. Requirements for instrumentation.

Response

The applicant agrees to examine FFTF stability tests and analyses to confirm that no power oscillations exist and will so document this in the FSAR.

Concern

g) Commit to establish limits for maximum linear heat generation rates of fuel and blanket.

Response

No action required.

2) The following are items which should be addressed during final design:

Concern

a) Fuel densification.

Response

The applicant will address fuel densification effects in the FSAR.

Concern

b) Describe how power distribution is to be monitored or provide justification for no monitoring.

Response

No action required at this time.

Chapter 4.4 Thermal/Hydraulics

1) The following are items requiring resolution prior to issuing a CP:

Concern

a) Commit to performing natural circulation testing during startup, including general approach on:

- scope of tests (DHRS, Main HTS loops)
- power levels
- duration of tests
- instrumentation
- acceptance criteria
- future calculations to investigate natural circulation capability.

Response

The applicant will perform tests during plant startup to verify the adequacy of natural circulation to remove core decay heat.

Concern

b) Commit to performing in-vessel passive dosimetry during initial startup to verify power distribution, flux distribution and temperatures, including general approach on:

- scope of test
- parameters to be measured.

Response

The applicant will review the margin existing between expected operating and design temperature conditions for the permanent reactor components; provisions for passive dosimetry will be considered where the above margins are not judged adequate.

Concern

c) Describe design features to prevent core assembly outlet flow blockages.

Response

The applicant will provide the NRC with the results of an analysis which demonstrates that should a total blockage of an assembly outlet nozzle occur six hours after shutdown, no significant assembly degradation will result.

Concern

d) Provide thermal/hydraulic analysis of secondary control assemblies.

Response

The PSAR will be amended to include the results of the Secondary Control Assembly thermal/hydraulic analysis.

Concern

e) Agree on methodology of selecting, categorizing, and applying Hot Channel Factors (HFC) including:

- which ones are direct/statistical
- use of same value for each factor unless otherwise justified
- establishment of confidence level on HCF values
- use of same HCF's on each component unless otherwise justified.

Response

The applicant will provide in the FSAR revised, self-consistent sets of hot channel factors for the core assemblies. Confidence levels of the hot channel factors will be established where appropriate. The effects of the non-linear application of the hot channel factors will be investigated; Monte Carlo analyses will be performed for representative core assemblies to substantiate the conservatism of the adopted factors and methodology.

Concern

f) Agree on margin against floatation of primary control rods during refueling.

Response

CRBRP will reanalyze primary control rod floation using a 5% pump overspeed condition and will provide the results to the NRC.

Concern

g) Provide values and uncertainties used for:

- irradiation induced swelling
- irradiation induced creep
- fuel thermal conductivity
- fuel clad gap conductance
- blanket pin power-to-melt correlation.

Response

No action is required

2) The following are items which should be addressed during final design:

Concern

a) Investigation of increased Delta P in FFTF.

Response

The applicant will consider the FFTF observed increased reactor/primary loop Delta P in the CRBRP final design and will provide documentation in the FSAR.

Concern

b) Provide complete descriptions of Codes and how verified.

Response

No new commitment is required.

Concern

c) Apply DEA-2 power-to-melt data.

Response

The project will incorporate results of the DEA-2 power-to-melt test into the final design methodology and will provide documentation in the FSAR.

Concern

d) More specific temperature and Delta P limits for in-vessel components should be established.

Response

The applicant will review the margin existing between expected operating and design temperature conditions for the permanent reactor components; provisions for passive dosimetry will be considered where the above margins are not judged adequate.

Chapter 15 - Items Related to Chapter 4

The following items require resolution prior to issuing a CP:

Concern

1) Specify fraction of fuel that can exceed the fuel melting temperatures or commit to provide such a limit as part of final design.

Response

Prior to the FSAR submittal, the applicant will develop and submit to the NRC for approval quantitative limits to assure core coolable geometry. The following potential mechanisms for compromising core coolable geometry will be addressed:

Fuel melting and explusion
Cladding melting and deformation
Coolant boiling and dryout.

Concern

2) Assess impact of "flux-tilting" on transient calculations or commit to this during final design.

Response

The nuclear impact of space-time kinetics will be accounted for and will be addressed in the FSAR for appropriate transient analyses.

Concern

3) Provide the response of the Secondary Shutdown System to extremely unlikely events or commit to this during final design.

Response

The applicant will include the response of the reactor to the SCRS for extremely unlikely events in the FSAR.