Department of Energy
Washington, D.C. 20545
Docket No. 50-537
HQ:S:82:089

SEP 01 1982

50-537

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:

ACTION PLAN RELATING TO MONITORING OF COMPONENT DEGRADATION IN THE NSSS

Enclosed with this letter is a CRBRP Action Plan to resolve questions relating to monitoring component degradation in the nuclear steam supply systems.

This action plan is being submitted to summarize planned activities which were first discussed with your staff in a meeting on February 24, 1982. As detailed in the enclosed plan, the Project will complete Phase I of the action plan and will be available to discuss the results with your staff in late November 1982.

Sincerely,

John R. Longenecker

John R. Longenecker
Acting Director, Office of the
Clinch River Breeder Reactor
Plant Project
Office of Nuclear Energy

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CRBRP ACTION PLAN FOR RESOLUTION OF QUESTIONS RELATING TO MONITORING OF COMPONENT DEGRADATION IN NSSS

I. INTRODUCTION

The purpose of this document is to provide the action plan for evaluation and resolution of questions relating to monitoring of component degradation in NSSS systems.

II. BACKGROUND

Recent operational events experienced in the Light Water Reactor field have highlighted the importance of providing the capability to monitor specific areas of concern for component or subsystem degradation.

Based on the type of reactor plant design, these capabilities may consist of specific design features and/or special diagnostic instrumentation to be used as aides in the detection of component and/or subsystem degradation. The primary objective of degradation monitoring is to ensure that detection will take place in time to prevent such degradation from resulting in the failure of the component or system to perform its safety function.

In addition, a review of technical questions and comments provided by NRC on CRBRP briefings and presentations further emphasized the need for an action plan addressing requirements, capabilities, and impacts to be developed.

III. SCOPE

In recognition of the complexity and diversity of questions to be resolved, it is recommended that the action plan be conducted in two phases:

- Phase I - Development of the basis for CRBRP component degradation monitoring
- Phase II - Identification of the requirements and implementation needed to support the basis

A. PHASE I SCOPE

NSSS systems to be evaluated in Phase 1 Scope shall consist of those in the heat generating and main Heat Transport Systems and shall also include those systems involved in Reactor Coolant Makeup, Decay Heat Removal, and Spent Fuel Storage.

The Phase I evaluation should be related to the specific CRBRP design; however, LWR incident data, supplied in Attachment 4, should be evaluated. The Phase I results will be used to make a recommendation as to whether Phase II will be required.

Overall, the objective is to demonstrate a level of safety comparable to current LWRs with respect to degradation mechanisms within the primary boundary or other key safety related systems.

Phase I should make the following assessments:

Task 1

(a) Loose Parts

(1) Potential effects of loose parts - assess effects of loose parts entering the component from the fluid system or generated internally to the component. Part sizes entering the component shall be based on the loose parts transport capability study of Task 2.

(2) Potential generation of loose parts - identify failures of the components that could create loose parts and release them to the system and the impact on the component itself.

(b) Crud

Similar to above for loose parts, but specifically covering crud. Crud is defined as corrosion, rust, oxides and wear generated material which can collect or build up over time in crevices and on component and/or heat transfer surfaces .

(c) Vibration

Assess the vibration potential of each component and the basis for the estimates, expected magnitude of impacting, maximum impact energy, current plant monitoring plans including plant surveillance plans, feasible means for monitoring, potential for identifying a vibration induced failure in the plant, etc.

These assessments should provide a basis for determining sensitivity of the component to loose parts, crud and vibration; the potential for creating loose parts and crud; current ability to detect a problem; ability to inspect the component, and the designer's judgment of instrumentation modifications or additions that would enhance detection of a problem.

The objective of these assessments would be twofold:

(1) Provide a data base for presenting a case to NRC on a low likelihood of a safety problem from loose parts, crud or vibration.

2. Identify the more significant potential problems from loose parts, crud and vibration for assessment of detection capability based on the instrument survey of Task 3.

Task 2

Development of Fluid Velocity Distribution and Loose Parts Transport Feasibility

For each system such as the PHTS identify the fluid velocities throughout the system. Develop parts mobility curves for a range of 3 to 6 part densities and shapes. These curves would relate parts size to the sodium velocity required to carry the parts with the fluid. The sodium velocities and mobility curves would be used to identify the range of parts and potential sources that could enter each component for the assessments of Task 1.

Task 3

Instrumentation Survey

Identify typical detection thresholds, accuracy, capability for interpretation of measurement signals, temperature limits, lifetime, etc., for potential monitoring devices useful for detection of loose parts, crud, and vibration or the effects of these items. Evaluate existing instrumentation and identify where these instruments do and do not satisfy the monitoring requirements.

In performing the above three tasks, the following questions should be considered:

- What are the safety requirements?
- What types of degradation are of concern? Some candidates include vibration, loose parts, flow blockage, wear effect, etc.
- What is the impact of degradation on safe operation and shutdown?
- What design features exist to prevent or mitigate degradation?
- What can be gained by modifying existing instrumentation?
- What can be gained from specific monitoring activities of existing instruments?
- What is the susceptibility of system degradation from construction and pre-op test abnormal occurrences?
- What is the susceptibility of degradation for CRBRP systems analogous to Light Water Reactor Plant?

o Does present design characteristics inhibit component degradation montoring?

o What is the potential for CRUD generation and deposition on heat transfer surfaces; what are the heat transfer effects on key components and subsystems?

Maximum use should be made in performing the above assessements of existing data bases using the FMEA, BOP, PRA, Inservice Inspection, and Surveillance data bases as appropriate.

SUMMARY

Phase I of the program should accomplish the following:

1. Establishment of what data needs to be obtained in order to assure that we meet safety goals comparable to LWRs and what additional benefit could be obtained with respect to enhancing plant availability, operability and maintainability (i.e., review LWR noise diagnostic experience and approach applicability to CRBRP).

2. Determine how to obtain the necessary data, e.g.:

   a. Judicious use or enhancement of existing process sensors and instrumentation (i.e., noise analysis, etc.).

   b. Use of Inservice Inspection Program, (i.e. pump vibration data, S.G. acoustic leak detection data, etc.)

   c. Addition of "new instrumentation (i.e., an LPMA and/or LPMS).

B. PHASE II SCOPE

The following are considered key elements of Phase II to be specifically addressed:

1. Requirements

   o Determination of specific monitoring requirements for for components deemed necessary to be monitored.

   o Identification of design changes (if any) needed to support specific monitoring requirements.

2. Criterion

   From an in-depth study of CRBRP system design and operational limits, determine appropriate criterion for the requirements identified above in B.1.

Determine characterization capabilities and expected lifetime degradation trends for support of the criterion developed for those CRBRP systems both unique and analogous to Light Water Plants.

3. Methodology and Implementation to Meet Criterion

- o Determination of the specific type of monitoring and diagnostic methods and/or instrumentation needed, such as vibration sensing, acoustical noise detection, process sensor, neutron flux measurements for noise detection, and loose parts monitoring to meet the specific monitoring requirement.
- o Evaluation of the present diagnostic instrumentation systems utilized in the Light Water Reactor field to determine their capability of providing reliable information for unique criterion in an LMFBR environment.
- o Development of an implementation program through periodic surveillance, utilizing an integrated diagnostic instrumentation system encompassing elements of vibration, acoustic sensing, noise monitoring and in-plant instruments.
- o Identification of the implementation impacts (if any) on present system design.
- o Determine the necessary methods of processing the data and the frequency of data taking required.
- o Determine whether a distributed or centralized system should be used for data taking and analysis.
- o Build a base of "noise signature and diagnostic data from the LWR industry, domestic LMFBRs and foreign exchanges.

4. State of the Art Development Requirements for CRBRP

- o Develop a plan of research and special tests as required to resolve incompatibilities and a review of off-the-shelf instrumentation to meet special requirements of CRBRP.

ACTION PLAN FOR RESOLUTION OF QUESTIONS RELATING TO MONITORING OF COMPONENT DEGRADATION IN CRBRP NSSS