



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUL 9 1981

MEMORANDUM FOR: Gus C. Lainas, Assistant Director
for Safety Assessment,
Division of Licensing

FROM: L. S. Rubenstein, Assistant Director
for Core and Containment Systems
Division of Systems Integration

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION ON CE HEATED JUNCTION
THERMOCOUPLE REACTOR VESSEL LEVEL MEASUREMENT SYSTEM FOR
SAN ONOFRE

The Core Performance Branch has completed its review of the CE Heated Junction Thermocouple (HJTC) reactor vessel level measurement system, which was submitted in Amendment 23, dated February 1981, of San Onofre Units 2 and 3 response to NRC Action Plan NUREG-0660. The enclosed is a request for additional information, which should be provided by the San Onofre applicant prior to September 1, 1981.

L. S. Rubenstein
L. S. Rubenstein, Assistant Director
for Core and Containment Systems
Division of Systems Integration

Enclosure:
As stated

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REQUEST FOR ADDITIONAL INFORMATION OF CE
HEATED JUNCTION THERMOCOUPLE REACTOR
VESSEL LEVEL MEASUREMENT SYSTEM FOR SAN ONOFRE

Core Performance Branch

1. In the discussion of a suitable definition of Inadequate Core Cooling, the definition is constrained to fall within bounds of certain core conditions. Please discuss your approach to defining "inadequate core cooling". What are the limiting conditions for the applicability of the heated junction thermocouple level system?
2. Identify the maximum size break for which the system will still allow the operator to take corrective action under ICC procedures. Please include a discussion of the response capabilities of the heated junction thermocouple instrumentation with respect to the system dynamics. These questions should be answered for a small break, such as 3 inch.
3. Describe the Phase II test program or programs used in the evaluation of the heated junction thermocouple level measurement system. Please provide representative test results including any anomalous results. Explain the results with respect to expected behavior in operating reactors.
4. Discuss the survivability and outputs of the heated junction thermocouple level measurement system during and after a large break LOCA and support with test results.
5. Provide an analysis to determine if voiding can occur in the core of a CE reactor while the upper head is still filled with water. Discuss the extent of voiding which can occur and whether or not it can lead to inadequate core cooling. Please analyze the effect on the core-exit thermocouples should such an event occur and discuss how inadequate core cooling conditions would be determined under these conditions. There is experimental evidence that this can occur, i.e in tests SUT-2 (10% break), SUT-5 (2.5% break), SUT-7 (5% break) at Semi-scale, these effects were observed.

6. Discuss the expected response of the heated thermocouple level sensors during a repressurization with the water level below the sensor and the possible effects of condensation on the response of the sensors. Could this sequence of events lead to an indication which would imply that the sensor is covered when it is not? Please provide representative test data.
7. Discuss the expected time response of the system with respect to the individual components and as a whole. Identify and discuss the factors which limit the time response.
8. No specific information has been given for the spacing of the sensors in each heated junction thermocouple instrument string. Are the sensors to be spaced evenly from the core alignment plate to the top of the reactor vessel head? Discuss the spacing chosen. Will the spacing be the same in both instrument strings? If not, how would the decrease in resolution due to the loss of a single sensor affect the ability of the system to detect an approach to inadequate core cooling? (i.e. how is the redundancy of the system affected if dissimilar spacings are used in the two detector strings?)
9. Discuss how the core-exit thermocouples might be used to estimate the depth of core uncover. Also discuss how the rate of loss of coolant may affect the core-exit thermocouple response. Provide an evaluation of the pro's and con's of using the indications of the core-exit thermocouples as a measure of the liquid inventory in the vessel if the coolant level is below the top of the core.
10. Discuss the expected behavior of the level sensor shroud surrounded by a high velocity two-phase mixture. In particular, discuss how the system is protected from the effects of high velocity steam entering the bottom ports of the shroud and creating a two phase mixture within the shroud. If restrictions are placed in the bottom of the shroud to block the bottom drain paths, discuss or show experimental evidence that there is still adequate drainage and response time.
11. Describe the choice of heater power or range of heater powers to be used with the heated junction thermocouple sensors. Describe the heater power supply or heater power control system. Are separate supplies provided for each sensor heater? Discuss the heater supply system with respect to NUREG 0737 "single failure" criterion. Discuss how uncovered sensors are protected from overheating while covered sensors are supplied with

sufficient power for a clear indication of uncover. Will AC or DC power be used? Discuss the possible effects of leakage, particularly at high temperatures on the level measurement with both AC and DC heater power. Discuss the possible effects of AC pick-up on the instrumentation system.

12. Please describe the on-line test procedures for the heated junction thermocouple sensors. One test mentioned is based on a change in indication observed by varying heater power. Discuss how the operator or person testing the system will decide that the sensors are operating, i.e. how much temperature change would be expected for a given power change? Discuss the effectiveness of the test procedures under various reactor conditions, i.e. cold shut-down, full power, and post accident.
13. Describe how the operational availability will be determined. What criteria are used? Describe the servicing, testing and calibration programs

The following questions refer to the description of the QSPDS.

14. Describe how the processor tests operate to determine that the sensor outputs are within range. How are the ranges selected?
15. Describe the display measurement units.
16. Describe which parameter or parameters would need to be calculated from the sensor inputs. The description of the QSPDS implies that such a calculation might or might not be required. When would it be required? When would it not be required?
17. Specifically, describe the automatic on-line surveillance tests.
18. Describe the manual on-line diagnostic capability and procedures.
19. Discuss the predetermined setpoint for the heated junction thermocouple signals and how it will be selected.