In addition, the Unit 1 license will be conditioned to state that an implementation letter report (Enclosure 1 to the enclosed evaluation report) must be provided for staff review 90 days following completion of the preoperational testing of the RVLIS system at the beginning of the 2nd cycle of operation.

This letter serves to resolve SER Oustanding Issue 5 pertaining to TMI Action Plan Item II.F.2 (SER Section 22).

Sincerely,

ORIGINAL SIGNED BY:

B. J. Youngblood, Chief
Licensing Branch No. 1
Division of Licensing

Enclosure: As stated

cc: See next page

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

JUL 1 9 1984

Docket Nos.: 50-445/446

Mr. M. D. Spence
President
Texas Utilities Generating Company
400 N. Olive Street, L. B. 81
Dallas, Texas 75201

Dear Mr. Spence:

Subject: Acceptability of Comanche Peak Steam Electric Station (Units 1 and 2) Conformance with TMI Action Plan Item II.F.2, "Inadequate Core Cooling Detection System"

The NRC staff has completed its review of the Texas Utilities' submittals dated January 3, 1984 and May 21, 1984, which describes the Inadequate Core Cooling (ICC) system proposed for Comanche Peak, Units 1 and 2. These submittals were reviewed in particular for conformance with the provisions of NUREG-0737, Item II.F.2, "Instrumentation for Detection of Inadequate Core Cooling;" Item II.F.2, Attachment 1, "Design and Qualification Criteria for Pressurized Water Reactor Incore Thermocouples;" and Appendix B, "Design and Qualification Criteria for Accident Monitoring Instrumentation." The staff finds that the Comanche Peak implementation schedule is acceptable and that the ICC detection system is in conformance with these provisions. The staff will assure that Technical Specifications relating to the final ICCI system are submitted and approved prior to fuel load.

The staff's evaluation findings, which we propose to incorporate in an SER supplement prior to licensing of Unit 1 are enclosed.

COMANCHE PEAK

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INPUT TO SSER FOR COMANCHE PEAK UNITS 1 AND 2

4.4.6.3 Instrumentation for Inadequate Core Cooling Detection

4.4.6.3.1 Clarification of Requirements

A clarification of requirements for inadequate core cooling instrumentation (ICCI) which is to be installed and operational prior to fuel load was provided in Item II.F.2 of NUREG-0737 "Clarification of TMI Action Plan Requirements." On November 4, 1982, the Commission determined that an instrumentation system for detection of inadequate core cooling (ICC) consisting of an upgraded subcooling margin monitor, core exit thermocouples, and a reactor coolant inventory tracking system is required for the operation of pressurized water reactor facilities.

4.4.6.3.2 Inadequate Core Cooling Detection System Design

In response to NUREG-0737 requirements, the applicant has transmitted the following letters:

(1) R. J. Gary (Texas Utilities) to H. R. Denton (NRC) dated January 3, 1984.
(2) H. C. Schmidt (Texas Utilities) to H. R. Denton (NRC) dated May 21, 1984.

The applicant has selected an ICCI system for use in CPSES which provides the three functions required by NUREG-0737, namely, the determination of subcooled margin, core exit temperature, and reactor vessel level. The ICC monitoring system at CPSES employs two separate types of instrumentation systems to monitor the parameters discussed above. The Core Cooling Monitor (CCM) instrumentation system is designed to perform two functions. Output from this system provides indication of the reactor coolant temperature at various core exit locations and also indicates the RCS saturation margin. The Heated Junction Thermocouple (HJTC) instrumentation system is employed to monitor the collapsed water level in the upper head and plenum regions of the reactor vessel. These instrumentation systems are described below.

4.4.6.3.3 Core Cooling Monitor System

Two qualified, redundant CCM's are used for ICC monitoring in each reactor unit at CPSES. Each CCM is designed to indicate core exit thermocouple temperatures (CET function) and to monitor the RCS saturation margin (SMM function).

4.4.6.3.4 Core Exit Thermocouple

To provide input temperature data to the CCM microprocessor, the NSSS-supplied array of fifty CET's have been divided into two separate, redundant trains with each set of CET's having a distribution representative of all four quadrant of the reactor core exit area. Each CET is a Type K (chromel-alumel) thermocouple contained within an aluminum-oxide insulated, stainless steel sheathed cable (1/8-in.OD). Each cable passes through one of four vessel head penetrations (located 90 degrees apart and near the core periphery) which contain pressure-boundary sealing assemblies.

The CET signals are used in the CCM to monitor coolant temperatures over the entire range including normal operation conditions and extending to beyond accident extremes. The design input/output useful range limits and system accuracy are listed Table I. Each thermocouple is periodically checked for open or shorted conditions, and the signal is adjusted to account for the in-containment cold reference junction conditions based on the reference RTD measurements. The highest, valid CET signal is displayed on the Control Board and is also employed by the microprocessor to determine the RCS saturation margin.

4.4.6.3.5 Saturation Margin Monitor

In addition to the highest CET temperature, the SMM function of the CCM makes use of RCS measurements of T_{hot}, T_{cold} and reactor pressure. Redundant, diverse temperature measurements are provided by RTD's located such that each SMM train employs the hot or cold leg RCS temperature from each of the four reactor coolant loops. Train A employs the hot leg temperatures from Loops 1 and 2 and the cold leg temperatures from Loops 3 and 4; Train B employs the cold leg temperatures from Loops 1 and 2 and the hot leg temperatures from Loops 3 and 4. Also employed are the hot leg RCS wide-range pressure measurements (Loop 1 for Train A and Loop 4 for Train B) and redundant narrow-range pressurizer pressure measurements. These temperature and pressure measurements are used in conjunction with a stored steam-table algorithm to compute the saturation margin. Conservatively, the computation is based upon the highest valid RCS temperature and the lowest valid RCS pressure. Thus, under normal operating subcooled conditions, the SMM output signal represents the minimum possible margin to saturation.

4.4.6.3.6 Heated Junction Thermocouple System-Reactor Vessel Level Measurement

To provide redundant capability for measurement of the reactor coolant inventory in the upper head and plenum regions of the reactor vessel, CPSES is in the process of installing the Heated Junction Thermocouple (HJTC) system supplied by Combustion Engineering, Inc. (C-E) which has been previously reviewed and approved by the staff. The principal function of the HJTC system is to obtain an unambiguous, direct indication of the existence of coolant voids and (hence an indication of reduced RCS coolant inventory) in the vessel space above the reactor core. The HJTC measurements will assist in the timely detection of the approach to ICC and subsequent restoration of optimal core cooling in the event that an ICC condition should occur.

The basic measuring device of the HJTC system is a probe assembly consisting of a number of thermocouple sensors with individual splash shields distributed axially at selected locations inside a separator tube. The purpose of the separator tube is to create a single-phase collapsed water level inside the tube while a steam-water two phase mixture may exist in the surrounding medium outside the tube. Each sensor consists of two chromel-alumel thermocouple junctions positioned approximately 4.5 inches apart, the lower one of which is heated by an Inconel electric coil. The principle of measurement corresponds to the temperature differential between the heated and unheated thermocouple junctions as affected by the heat transfer characteristics of the sensor-immersion medium inside the separator tube. In a normal operating state where the sensor is immersed in a subcooled liquid medium (water), the temperature difference is quite small (<<100°F) due to the relatively high heat transfer capability of water. However, when the collapsed water level falls below the heated junction, the reduced heat transfer capability of the surrounding medium (containing steam) causes the temperature at the bottom of the sensor to rise, producing a much larger temperature difference (as much as several hundred degrees). Thus, the measured temperature difference, ΔT, provides direct indication of the presence of water voids in the sensor-immersion medium. Changes in reactor coolant inventory above the reactor core can be monitored based on results obtained from the local, direct measurements by different sensors within the probe assembly.

4.4.6.3.7 ICC Monitoring Displays

The combined ICC monitoring system instrumentation includes a minimum of three different displays (for each separate, redundant train). In the case of the Core Cooling Monitor (CCM), a fourth display capability is also available to provide continuous indication and recording of the signal data obtained from each train of CET measurements.

In accordance with requirements of NUREG-0737, the primary display of CET measurements at CPSES is the Emergency Response Facility (ERF) computer system. ERF is a highly reliable qualified computer system.

With one temporary exception, the ERF computer system meets all specific requirements of NUREG-0737 Item II.F.2, Attachment 1, for the primary display of CET measurements. Currently, the system software does not include provision of a spatially oriented core map of CET temperature readings. However, the design calls for this feature to be included prior to October 1985. Meanwhile, core-map capability is provided by a computer-based backup display discussed below.

Various other display channels are available to assure capability for monitoring ICC conditions based on CET measurements. The most reliable CCM displays are the redundant Control Board analog meters. These displays and associated hardware are fully-qualified, Class 1E.

The Control Board meter displays (which employ the highest valid CET temperature measurement) meet the specific back-up display requirements delineated in NUREG-0737, Attachment 1, except for the requirement for selective reading of a limited number of thermocouples from each core quadrant. However, multiple, additional CET-measurement displays which will provide redundant information from which selective readings can be obtained to determine changes in the radial distribution of the reactor coolant temperature are available. These additional display channels include continuous output from the Plant Process Computer (which provides core-map capability) and optional auxiliary output directly from the CCM via an instrument service port to which a standard computer terminal (moveable CRT and/or printer) can be connected. As in the case of the primary display, both of these available backup displays receive signal data from redundant, qualified CCM-output channels which are separated up to and including the isolation device. In both cases, displayed information available on demand includes an array of all CET measurements from which selective readings or the radial distribution of readings within each core quadrant can easily be obtained.

The Figure 1 illustrates the various displays available for use at CPSES to indicate plant status based on CET measurements.

The applicant has noted as described below an exception to the periodic testing requirements for ICC monitoring systems in Regulatory Guide 1.118 Revision 2 and IEEE Std. 338-1977.

The design of the core exit thermocouple system requires the lifting of some leads for testing. This exception to item 5 in Section 6.4 of IEEE Std. 338-1977 and position C.6 in Regulatory Guide 1.118 Revision 2 originates from the fact that the core exit thermocouples were provided prior to the addition of the ICC monitoring system.

The applicant has stated in their submittals that this is an acceptable exception to the regulatory guidance. The staff has reviewed this exception and has found it to be acceptable.

4.4.6.3.8 Implementation Schedule

The implementation of the CPSES instrumentation for the detection of inadequate core cooling will be completed prior to fuel load except for the HJTC System. The implementation of the HJTC System is scheduled for prior to startup following the first refueling outage.

4.4.6.3.9 Staff Evaluation

The staff has reviewed the applicants submittals (January 3, 1984 and May 21, 1984) which describe the ICC system proposed for CPSES Units 1 and 2. These submittals were reviewed in particular for conformance to the requirements of NUREG-0737 II.F.2, "Instrumentation For Detection of Inadequate Core Cooling", Item II.F.2, Attachment 1, "Design and Qualification Criteria for Pressurized Water Reactor Incore Thermocouples" and Appendix B, "Design and Qualification Criteria for Accident Monitoring Instrumentation". The staff finds that the CPSES implementation schedule is acceptable and the ICC detection system is in conformance with these requirements, subject to the following:

> The staff will assure that Technical Specifications relating to the final ICCI system are submitted and approved prior to fuel load.

In addition the applicant's license will be conditioned for Unit 1 as follows:

An implementation letter report (Enclosure 1) must be provided for staff review 90 days following completion of the preoperational testing of the RVLIS system at the beginning of Cycle 2.

TABLE I. CORE COOLING MONITOR SIGNAL SPECIFICATION SUMMARY

PARAMETER	NO. PER TRAIN	RANGE DESCRIPTION
Input:		
Coolant Pressure	1	0 - 1700 PSIG
Pressurizer Pressure	1	1700 - 2500 PSIG
Hot Leg Temperature	2	50 - 695°F
Cold Leg Temperature	2	50 - 695°F
Core Exit T/C Temperature	25	50 - 2300°F
Cold Junction Temperature	3	50 - 500°F
Output:		
Saturation Margin	1	300°F Subcool to 300°F Superheat
Highest Core Exit T/C	1	50 - 2300°F
Signal Data Sets	2	Engineering Units
System:		
Accuracy		±2.5°F
Resolution		0.1°F

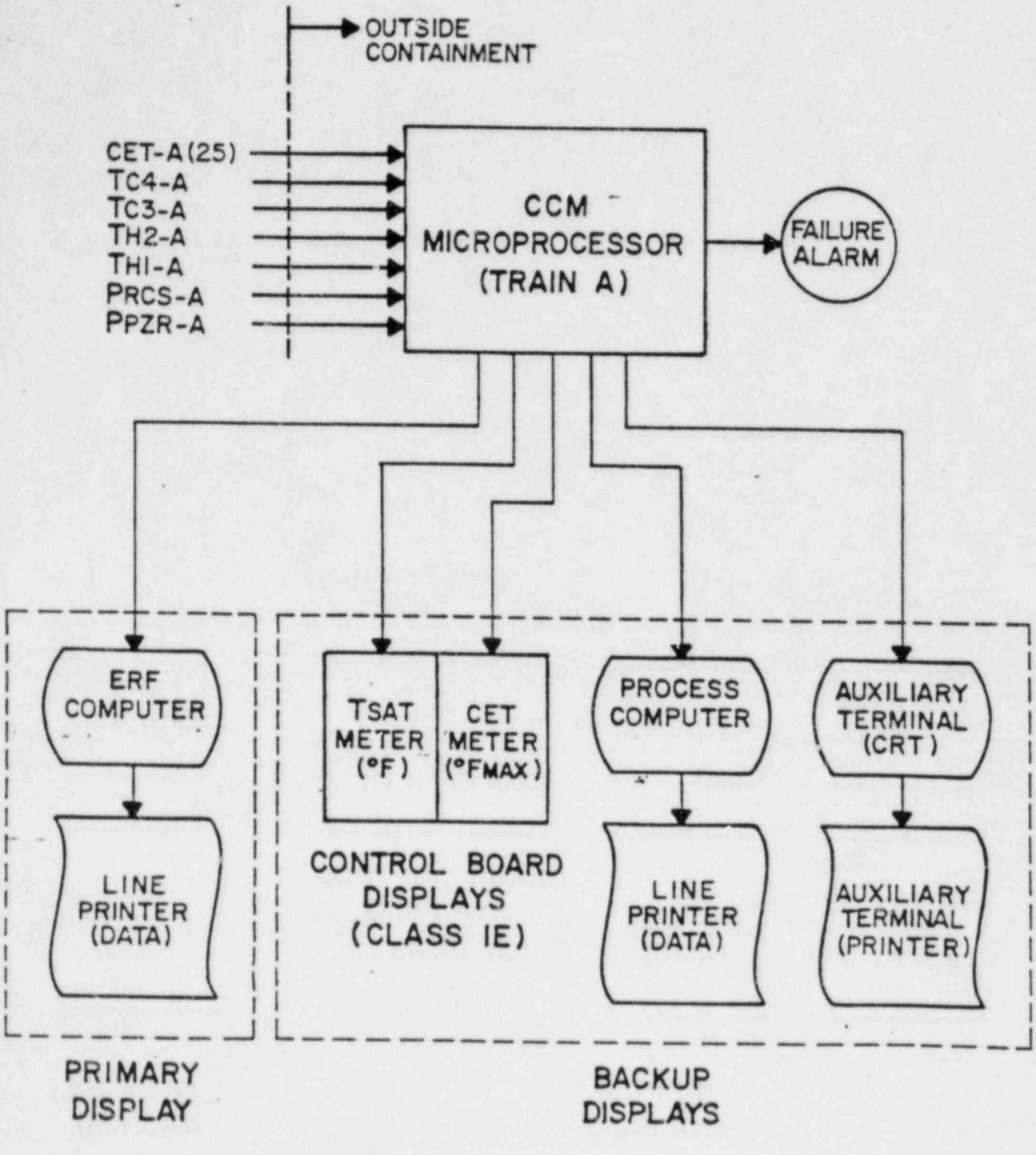

FIG. 1 CORE EXIT THERMOCOUPLE TRAIN A
DISPLAYS (TRAIN B SIMILAR)

ENCLOSURE 1

MILESTONES FOR IMPLEMENTATION OF INADEQUATE CORE COOLING INSTRUMENTATION

1. Submit final design description (by licensee) (complete the documentation requirements of NUREG-0737, Item II.F.2, including all plant-specific information items identified in applicable NRC evaluation reports for generic approved systems).
2. Approval of emergency operating procedure (EOP) technical guidelines - (by NRC).

   Note: This EOP technical guideline which incorporates the selected system must be based on the intended uses of that system as described in approved generic EOP technical guidelines relevant to the selected system.
3. Inventory Tracking Systems (ITS) installation complete (by licensee).
4. ITS functional testing and calibration complete (by licensee).
5. Prepare revisions to plant operating procedures and emergency procedures based on approved EOP guidelines (by licensee).
6. Implementation letter* report to NRC (by licensee).
7. Perform procedure walk-through to complete task analysis portion of ICC system design (by licensee).
8. Turn on system for operator training and familiarization.
9. Approval of plant-specific installation (by NRC).
10. Implement modified operating procedures and emergency procedures (by licensee).

    - System Fully Operational -

*Implementation Letter Report Content

(1) Notification that the system installation, functional testing, and calibration is complete and test results are available for inspection.

(2) Summary of licensee conclusions based on test results, e.g.:

   (a) the system performs in accordance with design expectations and within design error tolerances; or

   (b) description of deviations from design performance specifications and basis for concluding that the deviations are acceptable.

(3) Description of any deviations of the as-built system from previous design descriptions with any appropriate explanation.

(4) Request for modification of Technical Specifications to include all ICC instrumentation for accident monitoring.

(5) Request for NRC approval of the plant-specific installation.

(6) Confirm that the EOPs used for operator training will conform to the technical content of NRC approved EOP guidelines (generic or plant specific).