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POWER SYSTEMS

Docket No.: STN 50-470F

May 25, 1983
LD-83-049

Mr. Darrell G. Eisenhut, Director
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Compliance with CP/ML Rule

Dear Mr. Eisenhut:

Based on recent discussions with the Staff, it appears as though the CP/ML rule [10 CFR 50.34(f)] will be a minimum requirement for forward referenceability of CESSAR-F. Attachment (1) of this letter is C-E's review of CESSAR-F against the requirements of the CP/ML rule. Our review shows that of the requirements identified in the rule, only a fraction are within the scope of CESSAR-F. The remainder are applicable to either BWR's, other PWR designs, or to the balance-of-plant design.

For your information, the statements referenced in Attachment (1) have been culled from Appendix B and Section 3.2 of CESSAR-F and are presented in Attachment (2). We therefore request that the Staff take the actions necessary to make the finding in the Final Design Approval that CESSAR-F is in compliance with the CP/ML rule.

Should you have any questions on the attached, please contact me or Mr. G. A. Davis of my staff at (203) 688-1911, extension 2803.

Very truly yours,

COMBUSTION ENGINEERING, INC.

A. E. Scherer
Director
Nuclear Licensing

AES:las
Attach.

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COMPLIANCE OF COMBUSTION ENGINEERING
STANDARD SAFETY ANALYSIS REPORT
WITH THE CP/ML RULE (10 CFR 50.34(F))

(1)(i) Perform a plant/site specific Probabilistic Risk Assessment (PRA)

The CP/ML rule requires that "...no later than two years following issuance of the construction permit...", the applicant shall "perform a plant/site specific probabilistic risk assessment, the aim of which is to seek such improvement in the reliability of core and containment heat removal systems as are significant and practical and do not impact excessively on the plant" (emphasis added).

The reliability of containment heat removal systems in not within the scope of CESSAR-F. Core decay heat removal is accomplished by the Emergency Feedwater System (EFWS), which is not in the CESSAR-F scope, and by the Shutdown Cooling System (SDCS), which is within CESSAR-F scope. In Section 5.1.4, CESSAR-F contains an interface requirement on the reliability of the EFWS. Since the SDCS is a fully qualified, safety-grade system (and since the NRC has expressed no concerns about its adequacy), the system is presently considered to be acceptable. Therefore, any plant/site specific PRA would be the responsibility of a future applicant referencing CESSAR-F for the balance-of-plant scope.

(1)(ii) Perform an evaluation of the proposed Auxiliary Feedwater System (AFWS)

The AFWS is not within the CESSAR-F scope. This information would be provided by future applicants referencing CESSAR-F.

(1)(iii) Perform an evaluation of reactor coolant pump seal damage following a small break LOCA with loss of offsite power

This item is addressed in Appendix B to CESSAR-F and was approved in the Staff's Safety Evaluation Report.

(1)(iv) Perform an analysis of the probability of a small break LOCA caused by a stuck open Power-Operated Relief Valve (PORV)

The System 80™ design does not utilize PORV's; therefore, this item is not applicable to CESSAR-F.

(1)(v) Perform an evaluation of the safety effectiveness of providing separation of high pressure coolant injection and reactor core isolation cooling system initiation levels

This item is applicable to BWR's only.

(1)(vi) Perform a study to reduce challenges and failures of relief valves

This item is applicable to BWR's only.

(1)(vii) Perform feasibility and risk assessment study to determine optimum automatic depressurization system design modifications

This item is applicable to BWR's only.

(1)(viii) Perform a study of the restart of core spray and low-pressure coolant-injection systems

This item is applicable to BWR's only.

(1)(ix) Confirm the adequacy of space cooling for high-pressure coolant-injection and reactor core isolation cooling systems

This item is applicable to BWR's only.

(1)(x) Verify the qualification of accumulators, valves and associated equipment and instrumentation on the automatic depressurization system

This item is applicable to BWR's only.

(1)(xi) Perform an evaluation of depressurization methods, other than by full actuation of the automatic depressurization system

This item is applicable to BWR's only.

(1)(xii) Perform an evaluation of alternative hydrogen control systems

Hydrogen control is not in the CESSAR-F scope.

(2)(i) Provide simulator capability

A control room simulator is not in the CESSAR-F scope.

(2)(ii) Establish a program to improve plant procedures

Plant procedures are not in the CESSAR-F scope.

(2)(iii) Provide, for Commission review, a control room design that reflects state-of-the-art human factor principles

The control room design is not in the CESSAR-F scope.

(2)(iv) Provide a plant safety parameter display console

The Critical Function Monitoring System (CFMS) portion of the Accident Monitoring System provides the primary safety parameter displays in the control room. This item is addressed in Appendix B to CESSAR-F and was approved in the Staff's Safety Evaluation Report.

(2)(v) Provide for automatic indication of the bypassed and operable status of safety systems

Status indication of safety systems is not in the CESSAR-F scope.

(2)(vi) Provide the capability for high point venting of the Reactor Coolant System (RCS) and Reactor Vessel Head (RVH) from the control room

Remotely operated RCS and RVH high point vent systems are not in the CESSAR-F scope. However, the present System 80™ design has a vent line for pre- and post-refueling venting that is suitable (subject to loading restrictions) for use in a head vent system. This item is addressed in Appendix B to CESSAR-F and was approved in the Staff's Safety Evaluation Report.

(2)(vii) Perform radiation and shielding design reviews of spaces around systems that may, as a result of an accident, contain TID 14844 source term radioactive material

The radiation and shielding design is not in the CESSAR-F scope.

(2)(viii) Provide for post-accident sampling capability

Post-accident sampling is not in the CESSAR-F scope.

(2)(ix) Provide a system for hydrogen control

Hydrogen control is not in the CESSAR-F scope.

(2)(x) Provide a test program to qualify reactor coolant system relief and safety valves

This item is addressed in Appendix B to CESSAR-F and was approved in the Staff's Safety Evaluation Report.

(2)(xi) Provide direct indication of relief and safety valve position in the control room

Valve position indication is not in the CESSAR-F scope.

(2)(xii) Provide automatic and manual Auxiliary Feedwater (AFW) system initiation

This item is addressed in Appendix B to CESSAR-F and was approved in the Staff's Safety Evaluation Report.

(2)(xiii) Provide emergency power supply for pressurizer heaters

Emergency power supplies are not within the CESSAR-F scope.

(2)(xiv) Provide containment isolation systems

This item is addressed in Appendix B to CESSAR-F and was approved in the Staff's Safety Evaluation Report.

(2)(xv) Provide a capability for containment purging/venting

Containment purging/venting is not in the CESSAR-F scope.

(2)(xvi) Establish a design criterion for the allowable number of actuation cycles of the emergency core cooling system and reactor protection system

This item is applicable to B&W designs only.

(2)(xvii) Provide additional accident monitoring instrumentation

The accident monitoring instrumentation identified in this item is not within the CESSAR-F scope.

(2)(xviii) Provide instruments that provide, in the control room, an unambiguous indication of Inadequate Core Cooling (ICC)

This item is addressed in Appendix B to CESSAR-F and was approved in the Staff's Safety Evaluation Report.

(2)(xix) Provide instrumentation adequate for monitoring plant conditions following an accident that includes core damage

The instrumentation cited here is not in the CESSAR-F scope.

(2)(xx) Provide emergency power supplies for pressurizer relief valves, block valves and level indicators

Emergency power supplies are not in the CESSAR-F scope.

(2)(xxi) Design auxiliary heat removal systems such that necessary actions can be taken to ensure proper functioning when main FWS is not operable

This item is applicable to BWR's only.

(2)(xxii) Perform a failure modes and effects analysis of the integrated control system

This item is applicable to B&W designs only.

(2)(xxiii) Provide an anticipatory trip actuated on loss of main feedwater and on turbine trip

This item is applicable to B&W designs only.

(2)(xxiv) Provide the capability to record reactor vessel water level

This item is applicable to BWR's only.

(2)(xxv) Provide an onsite Technical Support Center (TSC), onsite Operational Support Center (OSC) and onsite Emergency Operations Facility (EOF)

The onsite TSC, OSC and EOF are not in the CESSAR-F scope. However, the accident monitoring system and related display stations transmit information to the TSC, OSC and EOF. This item is addressed in Appendix B to CESSAR-F and was approved in the Staff's Safety Evaluation Report.

(2)(xxvi) Provide for leakage control and detection in the design of systems outside containment

This item is addressed in Appendix B to CESSAR-F and was approved in the Staff's Safety Evaluation Report.

(2)(xxvii) Provide for monitoring of inplant radiation and airborne radioactivity

Inplant radiation monitoring is not within the CESSAR-F scope.

(2)(xxviii) Evaluate potential pathways for radioactivity and radiation that may lead to control room habitability problems

Control room habitability is not within the CESSAR-F scope.

(3)(i) Provide administrative procedures

Administrative procedures are not within the CESSAR-F scope.

(3)(ii) Ensure that the Q/A list required by Criterion II, Appendix B, 10 CFR Part 50 includes all structures, systems and components important to safety

Safety classifications of structures, systems and components important to safety and within the CESSAR-F scope are listed in Section 3.2 of CESSAR-F, and were approved in the Staff's Safety Evaluation Report.

(3)(iii) Establish a Quality Assurance (Q/A) program

C-E has a Q/A program for all design, procurement, manufacturing, construction and installation activities within the C-E scope. The program is described in C-E's topical report CENPD-210-A, "Quality Assurance Program", which has been reviewed and approved by the NRC Staff.

(3)(iv) Provide one or more dedicated containment penetrations

Containment penetrations are not within the CESSAR-F scope.

(3)(v) Provide preliminary design information sufficient to demonstrate that the containment integrity will be maintained

The containment design is not within the CESSAR-F scope.

(3)(vi) For plant designs with external hydrogen recombiners, provide redundant dedicated containment penetrations

Containment penetrations and hydrogen recombiners are not within the CESSAR-F scope.

(3)(vii) Provide a description of the management plan for design and construction activities

Management of plant design and construction is not within the CESSAR-F scope.

Attachment (2)

SELECTED SECTIONS OF APPENDIX B* AND CHAPTER 3 OF CESSAR-F

* Includes Amendment 8 and the modification to Table 3-1 of II.F.2 as documented in C-E Letter LD-83-046, dated May 13, 1983

I.D.2
PLANT SAFETY PARAMETER DISPLAY CONSOLE

SUMMARY

Each applicant and licensee shall install a safety parameter display system (SPDS) that will display to operating personnel a minimum set of parameters which define the safety status of the plant. This can be attained through continuous indication of direct and derived variables as necessary to assess plant safety status. 6

RESPONSE

The Critical Function Monitoring System (CFMS) portion of the AMS provides the primary SPDS displays in the control room, the Technical Support Center (TSC), and the Emergency Operations Facility (EOF). The Qualified Safety Parameter Display System (QSPDS) portion of the AMS provides the seismic backup SPDS. Refer to the Accident Monitoring System (AMS) description (III.A.1.2) for more detail.

Amendment No. 6
November 20, 1981

II.B.1
REACTOR COOLANT SYSTEM VENTS

SUMMARY

Each applicant and licensee shall install reactor coolant system (RCS) and reactor vessel head high point vents remotely operated from the control room. Although the purpose of the system is to vent noncondensible gases from the RCS which may inhibit core cooling during natural circulation, the vents must not lead to an unacceptable increase in the probability of a loss-of-coolant accident (LOCA) or a challenge to containment integrity. Since these vents form a part of the reactor coolant pressure boundary, the design of the vents shall conform to the requirements of Appendix A to 10 CFR Part 50, "General Design Criteria." The vent system shall be designed with sufficient redundancy that assures a low probability of inadvertent or irreversible actuation.

Each licensee shall provide the following information concerning the design and operation of the high point vent system:

1. Submit a description of the design, location, size, and power supply for the vent system along with results of analyses for loss-of-coolant accidents initiated by a break in the vent pipe. The results of the analyses should demonstrate compliance with the acceptance criteria of 10 CFR 50.46.

2. Submit procedures and supporting analysis for operator use of the vents that also include the information available to the operator for initiating or terminating vent usage.

RESPONSE

In the present System 80 NSSS design, the reactor vessel head has a 3/4" schedule 80 vent line with design pressure and temperature of 2485 psig and 650°F. The purpose of the vent line is for venting the reactor head during pre and post-refueling. The vent line is attached to the reactor head by a partial penetration weld and supported from the lift rig skirt. The vent line is suitable for use for a head vent system, subject to loading restrictions.

The pressurizer is provided with sampling and vent lines, as shown in the Reactor Coolant System P&ID, Figure 5.1.2-1.

A description of any remotely operated vent systems which may be added to the vessel head and pressurizer as a result of this post-TMI concern will be provided in the applicants' SAR.

II.D.1
PERFORMANCE TESTING OF BOILING-WATER REACTOR AND PRESSURIZED-WATER REACTOR RELIEF AND SAFETY VALVES

SUMMARY

Pressurized-water reactor and boiling-water reactor licensees and applicants shall conduct testing to qualify the reactor coolant system relief and safety valves under expected operating conditions for design-basis transients and accidents.

RESPONSE

A qualification testing program of reactor coolant system relief and safety valves under expected operating conditions for design basis transients and accidents has been undertaken on an industry-wide generic basis. The Electric Power Research Institute is conducting the qualification testing program.

By letter dated December 17, 1979, Mr. Williams J. Cahill, Jr., Chairman of the EPRI Safety and Analysis Task Force, submitted "Program Plan for the Performance Verification of PWR Safety/Relief Valves and Systems", December 13, 1979. As an activity for the C-E Owners Group, Combustion Engineering developed input to this program plan. This input was provided to EPRI and its consultants.

By letter dated December 15, 1980, R. C. Youngdahl of Consumers Power Company has provided, on EPRI's behalf, the current PWR Utilities' positions on NUREG-0737, Item II.D.1 clarifications.

C-E is continuing to support the EPRI test program as an Owners Group activity. Input has been generated which includes System 80 valve design data, piping diagrams and steam leakage acceptance criteria. The report being prepared which contains this information will be forwarded to EPRI as additional input to the EPRI valve test program.

Refer to the Applicant's SAR for a discussion of those activities necessary to address the applicability of EPRI test results to the as-installed safety valves and associated discharge piping, since valve installation and discharge piping are outside of CESSAR scope.

II.E.1.2
AUXILIARY FEEDWATER SYSTEM AUTOMATIC INITIATION
AND FLOW INDICATION

PART 1: Auxiliary Feedwater System Automatic Initiation

SUMMARY

Consistent with satisfying the requirements of General Design Criterion 20 of Appendix A to 10 CFR Part 50 with respect to the timely initiation of the auxiliary feedwater system (AFWS), the following requirements shall be implemented in the short term:

1. The design shall provide for the automatic initiation of the AFWS.

2. The automatic initiation signals and circuits shall be designed so that a single failure will not result in the loss of AFWS function.

3. Testability of the initiating signals and circuits shall be a feature of the design.

4. The initiating signals and circuits shall be powered from the emergency buses.

5. Manual capability to initiate the AFWS from the control room shall be retained and shall be implemented so that a single failure in the manual circuits will not result in the loss of system function.

6. The ac motor-driven pumps and valves in the AFWS shall be included in the automatic actuation (simultaneous and/or sequential) of the loads onto the emergency buses.

7. The automatic initiating signals and circuits shall be designed so that their failure will not result in the loss of manual capability to initiate the AFWS from the control room.

In the long term, the automatic initiation signals and circuits shall be upgraded in accordance with safety-grade requirements.

PART 2: Auxiliary Feedwater System Flowrate Indication

SUMMARY

Consistent with satisfying the requirements set forth in General Design Criterion 13 to provide the capability in the control room to ascertain the actual performance of the AFWS when it is called to perform its intended function, the following requirements shall be implemented:

1. Safety-grade indication of auxiliary feedwater flow to each steam generator shall be provided in the control room.

2. The auxiliary feedwater flow instrument channels shall be powered from the emergency buses consistent with satisfying the emergency power diversity requirements of the auxiliary feedwater system set forth in Auxiliary Systems Branch Technical Position 10-1 of the Standard Review Plan, Section 10.4.9.

RESPONSE

Automatic initiation of the emergency feedwater system is accomplished by the Emergency Feedwater Actuation Signal (EFAS). As described within Section 7.3 of CESSAR-F, the EFAS complies with the NRC position for this item. Design of the Auxiliary Feedwater System (AFS), which is actuated by the EFAS, is in the Applicant's scope.

Indication of emergency feedwater flow is in the Applicant's Scope.

II.E.4.2
CONTAINMENT ISOLATION DEPENDABILITY

SUMMARY

1. Containment isolation system designs shall comply with the recommendations of Standard Review Plan Section 6.2.4 (i.e., that there be diversity in the parameters sensed for the initiation of containment isolation).

2. All plant personnel shall give careful consideration to the definition of essential and nonessential systems, identify each system determined to be essential, identify each system determined to be nonessential, describe the basis for selection of each essential system, modify their containment isolation designs accordingly, and report the results of the reevaluation to the NRC.

3. All nonessential systems shall be automatically isolated by the containment isolation signal.

4. The design of control systems for automatic containment isolation valves shall be such that resetting the isolation signal will not result in the automatic reopening of containment isolation valves. Reopening of containment isolation valves shall require deliberate operator action.

5. The containment setpoint pressure that initiates containment isolation for nonessential penetrations must be reduced to the minimum compatible with normal operating conditions.

6. Containment purge valves that do not satisfy the operability criteria set forth in Branch Technical Position CSB 6-4 or the Staff Interim Position of October 23, 1979 must be sealed closed as defined in SRP 6.2.4, Item II.3.f during operational conditions 1, 2, 3, and 4. Furthermore, these valves must be verified to be closed at least every 31 days.

7. Containment purge and vent isolation valves must close on a high radiation signal.

RESPONSE

The System 80 design provides for diverse signals for containment isolation as described in CESSAR Section 7.3.2.2.4. The actuation and isolation of the Containment Isolation System, as described in CESSAR Section 6.2.4 and 7.3.1, comply with the requirements for this item. The esstial systems in the scope of CESSAR with ESF functions are described in Table 6.2.4-1. See Applicants SAR for systems outside of CESSAR scope.

There is no automatic resetting of the actuating signal as described in CESSAR Section 7.3.1.1.2.2. See Applicants SAR for response of individual components to the Resetting of the Containment Isolation Signal, for systems outside of CESSAR scope.

Amendment No. 2
March 12, 1981

II.F.2
INSTRUMENTATION FOR DETECTION OF
INADEQUATE CORE COOLING

SUMMARY

Licensees shall provide a description of any additional instrumentation or controls (primary or backup) proposed for the plant to supplement existing instrumentation (including primary coolant saturation monitors) in order to provide an unambiguous, easy-to-interpret indication of inadequate core cooling (ICC). A description of the functional design requirements for the system shall also be included. A description of the procedures to be used with the proposed equipment, the analysis used in developing these procedures, and a schedule for installing the equipment shall be provided.

RESPONSE

The following provides a preliminary description of the C-E Accident Monitoring System (Refer to III.A.1.2) as it is intended for II.F.2 ICC.

1.0 INTRODUCTION

1.1 BACKGROUND

C-E Owners Group efforts on the evaluation of Inadequate Core Cooling have been ongoing since early 1979. Results of initial studies by the C-E Owners Group are documented in reports CEN-117 (Reference 2) and CEN-125 (Reference 3). These results have been considered in the preparation of emergency operating procedures guidelines. All studies have been based on the requirements to indicate the approach to, the existence of, and the recovery from ICC.

The C-E Owners Group has performed an evaluation of response characteristics
of potential Inadequate Core Cooling (ICC) detection instrumentation. This 6
study provided detailed analyses of the existing instruments, as well as investigating the performance characteristics of selected new instruments. Specifically, the instruments whose response characteristics have been evaluated are the subcooled margin monitor, the heated junction thermocouple reactor vessel level monitor, core-exit thermocouples, in-core thermocouples, self powered neutron detectors, hot leg resistance temperature detectors and ex-core neutron detectors. A summary of the details of this effort is contained in Appendix A.

Based on the results of the above instrument evaluation study, C-E has selected a Generic Inadequate Core Cooling Instrumentation (ICCI) package consisting of:

1) hot and cold leg Resistance Temperature Detectors (RTDs)

2) pressurizer pressure sensors

3) Core Exit Thermocouples (CETs)

4) Reactor Vessel Level Monitoring System (RVLMS) probes employing the Heated Junction Thermocouple (HJTC) concept

These sensor inputs have been integrated into the Accident Monitoring System core heat removal safety function and displayed via the primary SPDS in the Critical Function Monitoring System. The QSPDS portion of the AMS provides the Class 1E signal processing for the ICC sensors.

1.2 BASES FOR ICC INSTRUMENT SELECTION

The ICC instrumentation sensor package selected is designed to:

1) provide the operator with an advanced warning of the approach to ICC

2) cover the full range of ICC from normal operation to complete core uncovery

The Accident Monitoring System employing the ICC sensors package enables the reactor operator to monitor system conditions associated with the approach to, existence of, and the recovery from ICC.

1.2.1 DESCRIPTION OF ICC PROGRESSION (COOLANT STATES RELATED TO ICC)

The instrument sensor package for ICC detection provides the reactor operator a continuous indication of the thermal-hydraulic states within the Reactor Pressure Vessel (RPV) during the progression towards and away from ICC. This progression can be divided into conditions based on physical processes occurring within the RPV. These are characterized as follows: 6

Conditions Associated with the Approach to ICC

Condition 1a Loss of fluid subcooling prior to the first occurrence of saturation conditions in the coolant.

Condition 2a Decreasing coolant inventory within the upper plenum, (from the top of the vessel to the top of the active fuel).

Condition 3a Increasing core exit temperature produced by uncovery of the core resulting from the drop in level of the mixture of vapor bubbles and liquid from the top of the active fuel.

Conditions Associated with Recovery from ICC

Condition 3b Decreasing core exit steam temperature resulting from the rising of the level within the core.

Condition 2b Vessel fill by the increase in inventory above the fuel.

Condition 1b Establishment of saturation conditions followed by an increase in fluid subcooling.

These conditions encompass all possible coolant situations associated with any ICC event progression. The conditions denoted with an "a" refer to fluid situations that occur during the approach to ICC. Conditions denoted by a "b" refer to fluid situations which occur during the recovery from ICC. Thus, "a" conditions differ from "b" conditions in the trending (directional behavior) of the associated parameters.

In order to provide indicators during the entire progression of an event, an ICC instrument system consists of instruments which provide at least one appropriate indicator for each of the physical Conditions described above.

Applying this description of the "approach to", and "recovery from" ICC to ICC instrument selection:

1) provides assurance that the selected ICC system detects the entire progression

2) demonstrates the extent of instrument diversity or redundancy which is possible with the available instruments.

Furthermore, by defining the ICC progression on a physical basis the general labels of "approach to", and "recovery from" ICC can now be associated with specific physically measurable processes. (See Section 1.2.2, 1.2.3, and 1.2.4).

The instrument sensor package selected to monitor the ICC event progression 6
consists of (1) Resistance Temperature Detectors (RTDs) (2) pressurizer pressure sensors, (3) reactor vessel level monitors employing the HJTC design concept and (4) core exit thermocouples. The signals from the RTDs, unheated thermocouples in the HJTC system, and pressure sensors can be combined to indicate the loss of subcooling and occurrence of saturation (Condition 1a) and the achievement of a subcooled condition following core recover (Condition 1b). The reactor vessel level monitors provide information to the operator on the decreasing liquid inventory in the reactor pressure vessel (RPV) regions above the fuel alignment plate (FAP), as well as the increasing RPV liquid inventory above the FAP following core recovery (Conditions 2a and 2b). The core exit thermocouples (CETs) monitor the increasing steam temperatures associated with ICC and the decreasing steam temperatures associated with recovery from ICC (Conditions 3a and 3b).

1.2.2 ADVANCED WARNING OF THE APPROACH TO ICC

The ICC instrumentation provides the operator with an advanced warning of the approach to ICC by providing indications of:

1) the loss of subcooling and occurrence of saturation (Condition 1a) with a saturation margin monitor (SMM) receiving input from primary system RTDs, upper head HJTCs, and the pressurizer pressure sensors.

2) the loss of inventory in the RPV (Condition 2a) with the RVLMS.

3) the increasing core coolant exit temperature (Condition 3a) with CETs.

It should be noted that the RVLMS measures inventory (collapsed liquid level) rather than two-phase level. This measurement provides the operator with an advanced indication of the coolant level should conditions arise to cause the two-phase froth to collapse via system overpressurization, or the loss of operating reactor coolant pumps.

1.2.3 APPLICATION OF ICC INSTRUMENTS

Following an event leading to ICC the ICC instruments will provide information to the reactor operator so that he may:

1) verify that the core heat removal safety function is being met,

2) establish the potential for fission product release.

ICC Instrumentation indications will be used to support the operator in helping to verify that the core heat removal safety function is being met. ICCI indications available to the operator are (1) an increasing inventory level above the fuel alignment plate, (2) an increasing subcooling in the RPV and RCS piping or (3) a decreasing core exit steam superheat. The operator is informed about the progression of an event by both static and trend displays. The trending of ICC information enables the operator to quickly assess the success of automatically or manually performed mitigating actions. A chart indicating the ICCI trending during the various ICC progression conditions associated with the approach to and recovery from ICC is presented in Table 1-1. 6

1.2.4 INSTRUMENT RANGE

In the ICCI sensor package, saturation temperature and water inventory are used as indicators for the approach to and recovery from ICC when there is water inventory above the fuel alignment plate. These measurements characterize conditions 1a, 1b, 2a, and 2b of the ICC progression.

When the two-phase level is below the fuel alignment plate, the measurement of core exit fluid temperature represents a direct indication of the approach to, and recovery from ICC (Conditions 3a and 3b). Therefore, the ICC sensor package is sufficient to provide information to the reactor operator on the entire progression of an event with the potential of resulting in ICC.

TABLE 1-1

ICC STATUS AS AVAILABLE TO THE OPERATOR FROM ICC INSTRUMENTATION TRENDING

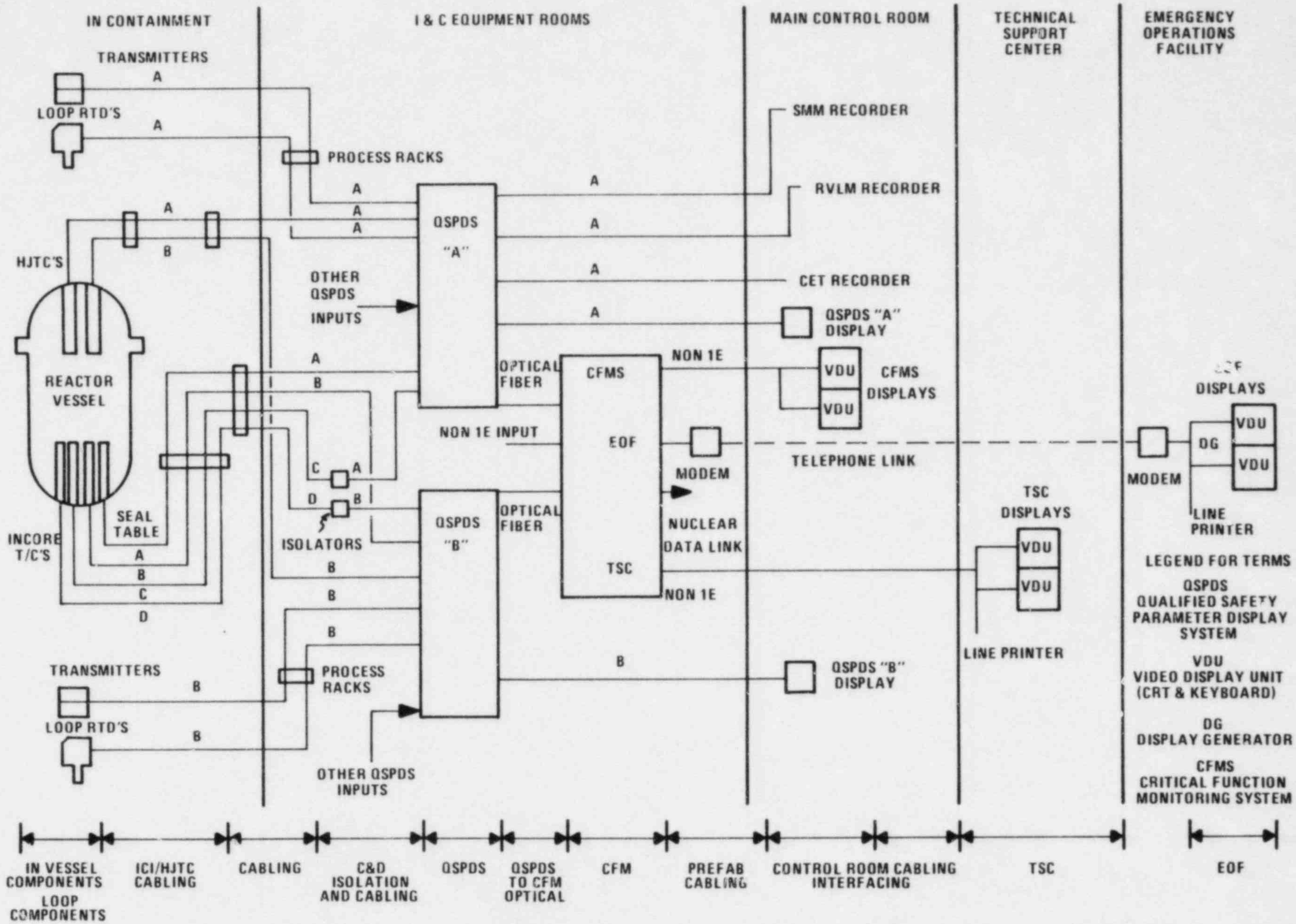
I. APPROACHING AN ICC CONDITION

CONDITION	SUBCOOLING MEASURED BY SMM	WATER INVENTORY MEASURED BY HJTC PROBE	COOLANT SUPERHEAT MEASURED BY CET
1a	DECREASING	CONSTANT	CONSTANT
2a	CONSTANT	DECREASING	CONSTANT
3a	CONSTANT	CONSTANT	INCREASING

II. RECEDING FROM AN ICC CONDITION

CONDITION	SUBCOOLING MEASURED BY SMM	WATER INVENTORY MEASURED BY HJTC PROBE	COOLANT SUPERHEAT MEASURED BY CET
3b	CONSTANT	CONSTANT	DECREASING
2b	CONSTANT	INCREASING	CONSTANT
1b	INCREASING	CONSTANT	CONSTANT

Amendment No. 6
November 20, 1981



C-E SYSTEM 80

C-E ACCIDENT MONITORING SYSTEM

Figure 2-1

Amendment No. 6
November 20, 1981

2.0 INADEQUATE CORE COOLING INSTRUMENTATION DESIGN DESCRIPTION

This section provides a preliminary description of a generic Accident Monitoring System (AMS) approach to address II.F.2, Inadequate Core Cooling (ICC) requirements. The Accident Monitoring System (AMS) consists of two major subsystems; 1) Critical Function Monitoring System (CFMS) and 2) Qualified Safety Parameter Display System (QSPDS). A functional overview of the AMS highlighting the ICC sensor inputs is shown in Figure 2-1. As discussed previously, the reactor vessel liquid inventory above the core and the fluid conditions at various locations in the primary system will be measured by RTDs, pressurizer pressure sensors, reactor vessel level HJTCs, and CETs. As shown in Figure 2-1 the ICC sensors are input to the Qualified Safety Parameter Display System (QSPDS) for processing and then integrated into the Primary Safety Parameter Display in the Critical Function Monitoring System (CFMS) portion of the AMS.

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2.1 SENSOR DESIGN

Detailed information on the associated ICC sensors is presented in the following sections.

2.1.1 SATURATION MARGIN

Saturation Margin Monitoring (SMM) provides information to the reactor operator on (1) the approach to and existence of saturation and (2) existence of core uncovery.

The SMM includes inputs from RCS cold and hot leg temperatures measured by RTDs, the temperature of the maximum of the top three Unheated Junction Thermocouples (UHJTC), and pressurizer pressure sensors. The UHJTC input comes from the output of the HJTCS processing units. In summary, the sensor inputs are as follows:

Input	Range
Pressurizer Pressure	0-3000 psia
Cold Leg Temperature	50-750°F
Hot Leg Temperature	50-750°F
Maximum UHJTC Temperature of top three sensors (from HJTC processing)	32-2300°F
Representative CET Temperature	32-2300°F

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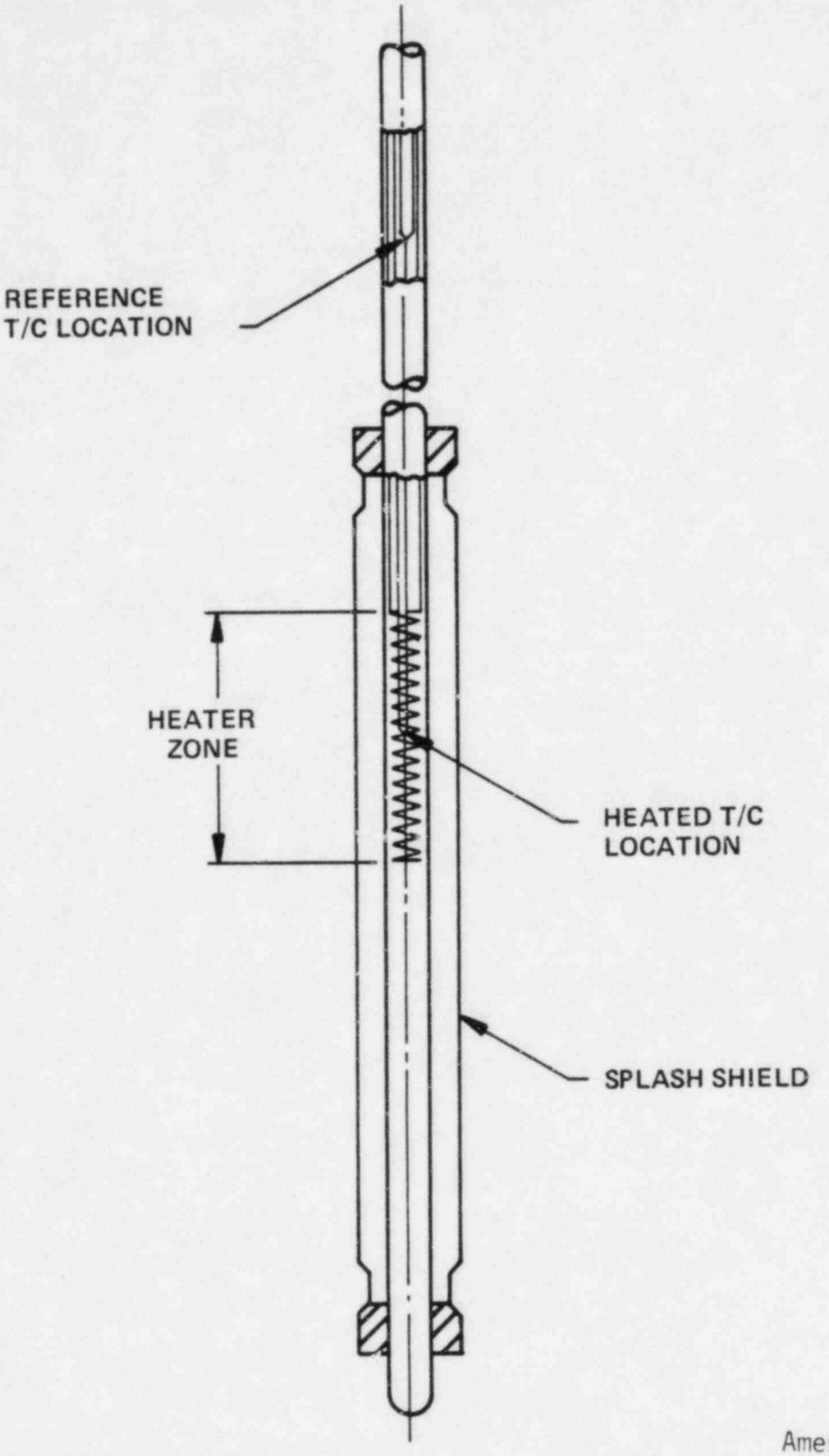
2.1.2 HEATED JUNCTION THERMOCOUPLE (HJTC) PROBE ASSEMBLY

The HJTC Probe Assembly measures reactor coolant liquid inventory above the fuel alighment plate with discrete HJTC sensors located at different levels within a separator tube ranging from the top of the fuel alignment plate to 6



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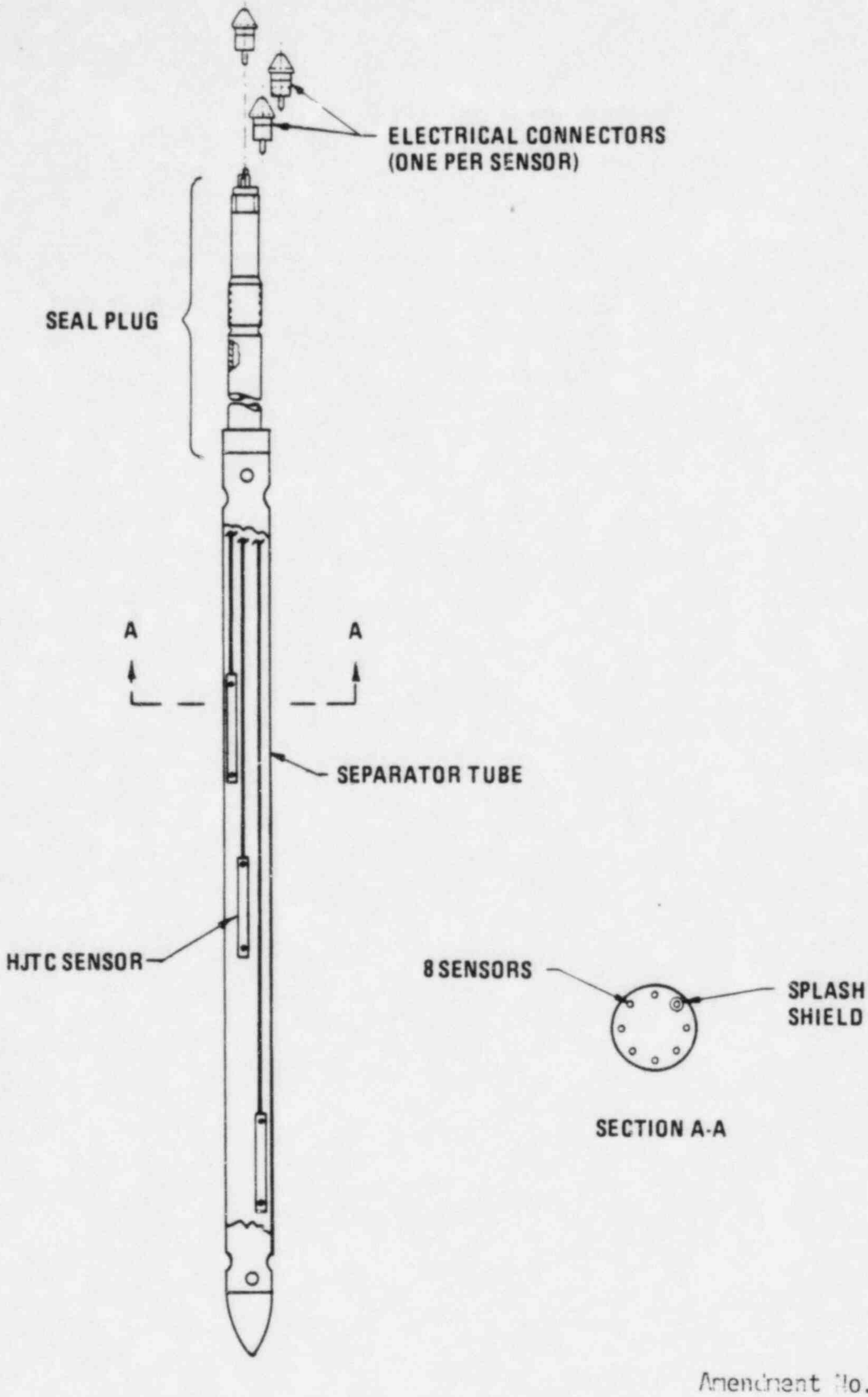
C-E SYSTEM 80	HJTC SENSOR - HJTC/SPLASH SHIELD	Figure 2-2



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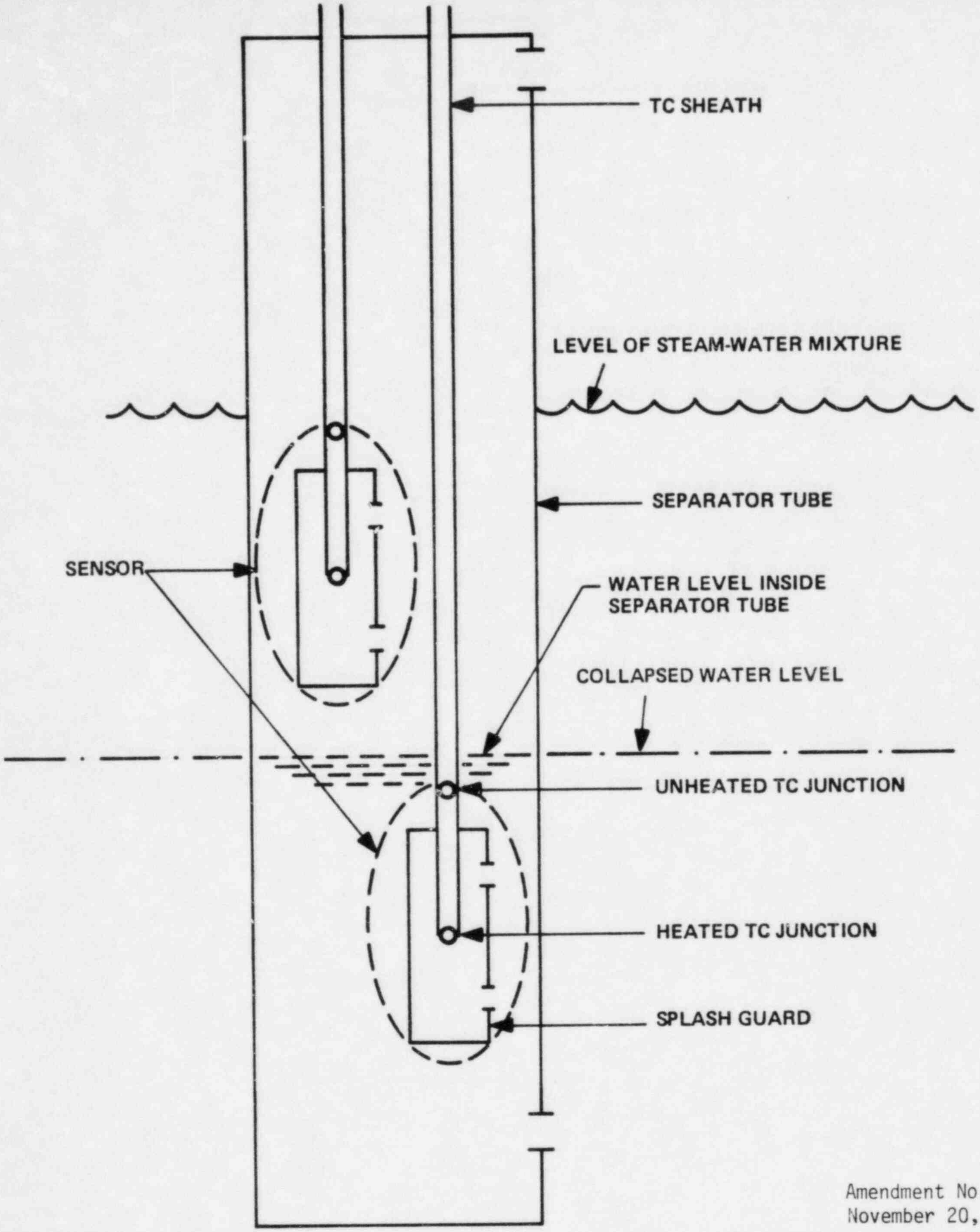
C-E SYSTEM 80	HEATED JUNCTION THERMOCOUPLE PROBE ASSEMBLY	Figure 2-3



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C - E SYSTEM 80	HJTC SENSOR AND SEPARATOR TUBE	Figure 2-4

the reactor vessel head. The basic principle of operation is the detection of a temperature difference between adjacent heated and unheated thermocouples.

As pictured in Figure 2-2, the HJTC sensor consists of a Chromel-Alumel thermocouple near a heater (or heated junction) and another Chromel-Alumel thermocouple positioned away from the heater (or unheated junction). In a fluid with relatively good heat transfer properties, the temperature difference between the adjacent thermocouples is small. In a fluid with relatively poor heat transfer properties, the temperature difference between the thermocouples is large.

Two probe assemblies are provided to allow two channels of HJTC instruments. Each HJTC probe assembly includes eight (8) HJTC sensors, a separator tube, a seal plug, and electrical connectors (Figure 2-3). The eight (8) HJTC sensors are electrically independent.

Two design features ensure proper operation under all thermal-hydraulic conditions. First, each HJTC is shielded to avoid overcooling due to direct water contact during two phase fluid conditions. The HJTC with the splash shield is referred to as the HJTC sensor (See Figure 2-2). Second, a string of HJTC sensors is enclosed in a tube that separates the liquid and gas phases that surround it. 6

The separator tube (See Figure 2-4) creates a collapsed liquid level that the HJTC sensors measure. This collapsed liquid level is directly related to the average liquid fraction of the fluid in the reactor head volume above the fuel alignment plate. This mode of direct in-vessel sensing reduces spurious effects due to pressure, fluid properties, and non-homogeneities of the fluid medium. The string of HJTC sensors and the separator tube is referred to as the probe assembly.

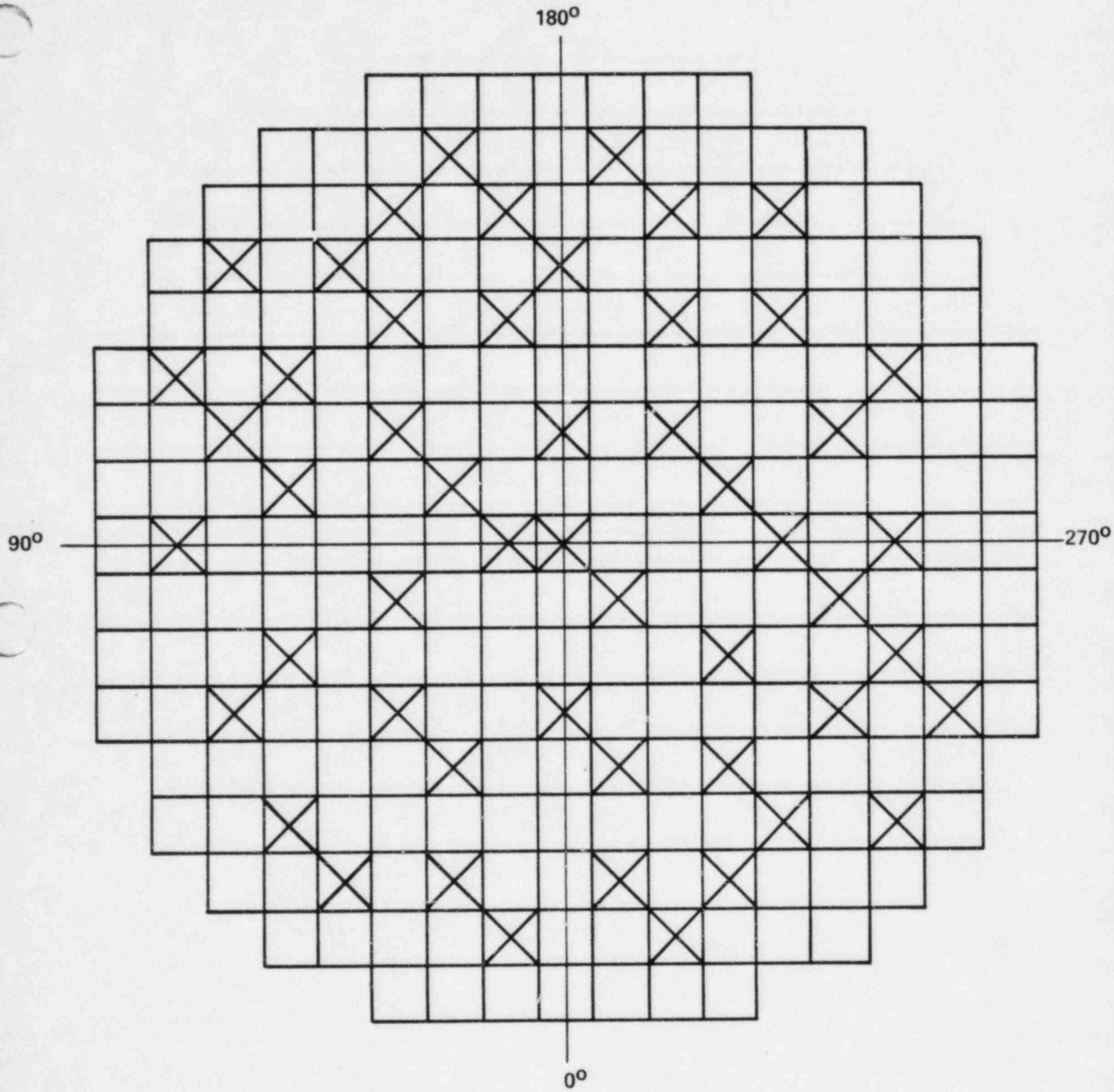
The probe assembly is housed in a stainless steel structure that protects it from flow loads.

2.1.3 CORE EXIT THERMOCOUPLES (CET)

The core exit thermocouples provide a measure of core heatup via measurement of core exit steam temperature.

The design of the System 80 In-core Instrumentation (ICI) system will be modified to include Type K (Chromel-Alumel) thermocouples within each of the ICI detector assemblies. These Core Exit Thermocouples (CET) monitor the temperature of the reactor coolant as it exits the fuel assemblies. The core locations of the ICI detector assemblies are shown in Figure 2-5.

The CETs have a usable temperature range from 200°F to up to 2300°F.



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C-E SYSTEM 80	INCORE INSTRUMENTATION LOCATIONS	Figure 2-5

2.2 DESCRIPTION OF ICC PROCESSING

The following sections provide a preliminary description of the processing control and display functions associated with each of the ICC detection instruments in the AMS. The sensor inputs for the major ICC parameters; saturation margin, reactor vessel inventory/temperature above the core, and core exit temperature are processed in the two channel QSPDS and transmitted to the CFMS for primary display and trending.

2.2.1 SATURATION MARGIN

The QSPDS processing equipment will perform the following saturation margin monitoring functions:

1. Calculate the saturation margin

   The saturation temperature is calculated from the minimum pressure input. The temperature subcooled or superheat margin is the difference between saturation temperature and the sensor temperature input. Three temperature subcooled or superheat margin presentations will be available. These are as follows:

   a. RCS saturation margin - the temperature saturation margin based on the difference between the saturation temperature and the maximum temperature from the RTDs in the hot and cold legs. 6

   b. Upper head saturation margin - temperature saturation margin based on the difference between the saturation temperature and the UHJTC temperature (based on the maximum of the top three UHJTC)

   c. CET saturation margin - temperature saturation margin based the difference between the saturation temperature and the representation core exit temperature calculated from the CETs (Section 2.2.3).

2. Process sensor outputs for determination of temperature saturation margin.

3. Provide an alarm output for an annunciator when temperature saturation margin reaches a preselected (to be determined) setpoint for RCS or upper head saturation margin. CET saturation margin is not alarmed to avoid possible spurious alarms.

2.2.2 HEATED JUNCTION THERMOCOUPLE

The QSPDS processing equipment performs the following functions for the HJTC:

1. Determine collapsed liquid level above core.

   The heated and unheated thermocouples in the HJTC are connected in such a way that absolute and differential temperature signals are available. This is shown in Figure 2-6. When liquid water surrounds

the thermocouples, their temperature and voltage output are approximately equal. The voltage $V_{(A-C)}$, on Figure 2-6 is, therefore, approximately zero. In the absence of liquid, the thermocouple temperatures and output voltages become unequal, causing $V_{(A-C)}$ to rise. When $V_{(A-C)}$ of the individual HJTC rises above a predetermined setpoint, liquid inventory does not exist at this HJTC position.

2. Determine the maximum upper plenum/head fluid temperature of the top three unheated thermocouples for use as an output to the SMM calculation. (The temperature processing range is from 100°F to 2300°F).

3. Process input signals to display collapsed liquid level and unheated junction thermocouple temperatures.

4. Provide an alarm output when any of the HJTC detects the absence of liquid level.

5. Provide control of heater power for proper HJTC output signal level. Figure 2-7 shows the design for one of the two channels which includes the heater controller power supplies.

2.2.3 CORE EXIT THERMOCOUPLE SYSTEM

The QSPDS performs the following CET processing functions:

1. Process core exit thermocouple inputs for display.

2. Calculate a representative core exit temperature. Although not finalized, this temperature will be either the maximum valid core exit temperature or the average of the five highest valid core exit temperatures.

3. Provide an alarm output when temperature reaches a preselected value. 6

4. Process CETs for display of CET temperature and superheat.

These functions are intended to meet the design requirements of NUREG-0737, II.F.2 Attachment 1.

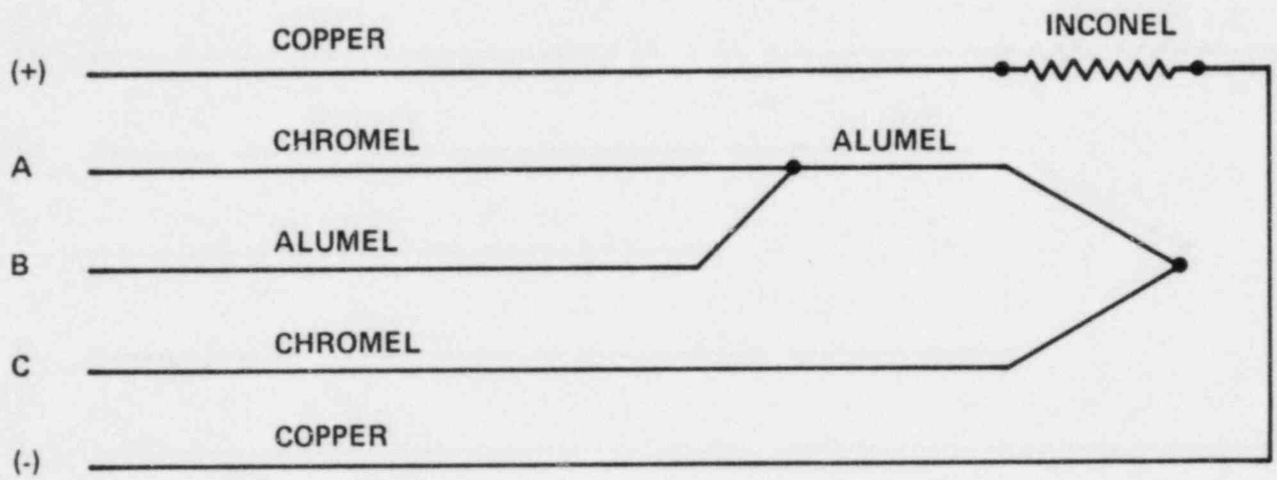
2.3 SYSTEM DISPLAY

The QSPDS ICC outputs are incorporated into the Critical Function Monitoring System (CFMS) alarm logic and displays. The CFM is a dedicated, computer-based plant information and display system that provides a Primary Safety Parameter Display directly monitoring critical plant functions:

1. Core reactivity control

2. Core heat removal control

3. RCS inventory control



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V (A - B) = ABSOLUTE TEMPERATURE, UNHEATED JUNCTION
V (C - B) = ABSOLUTE TEMPERATURE, HEATED JUNCTION
V (A - C) = DIFFERENTIAL TEMPERATURE

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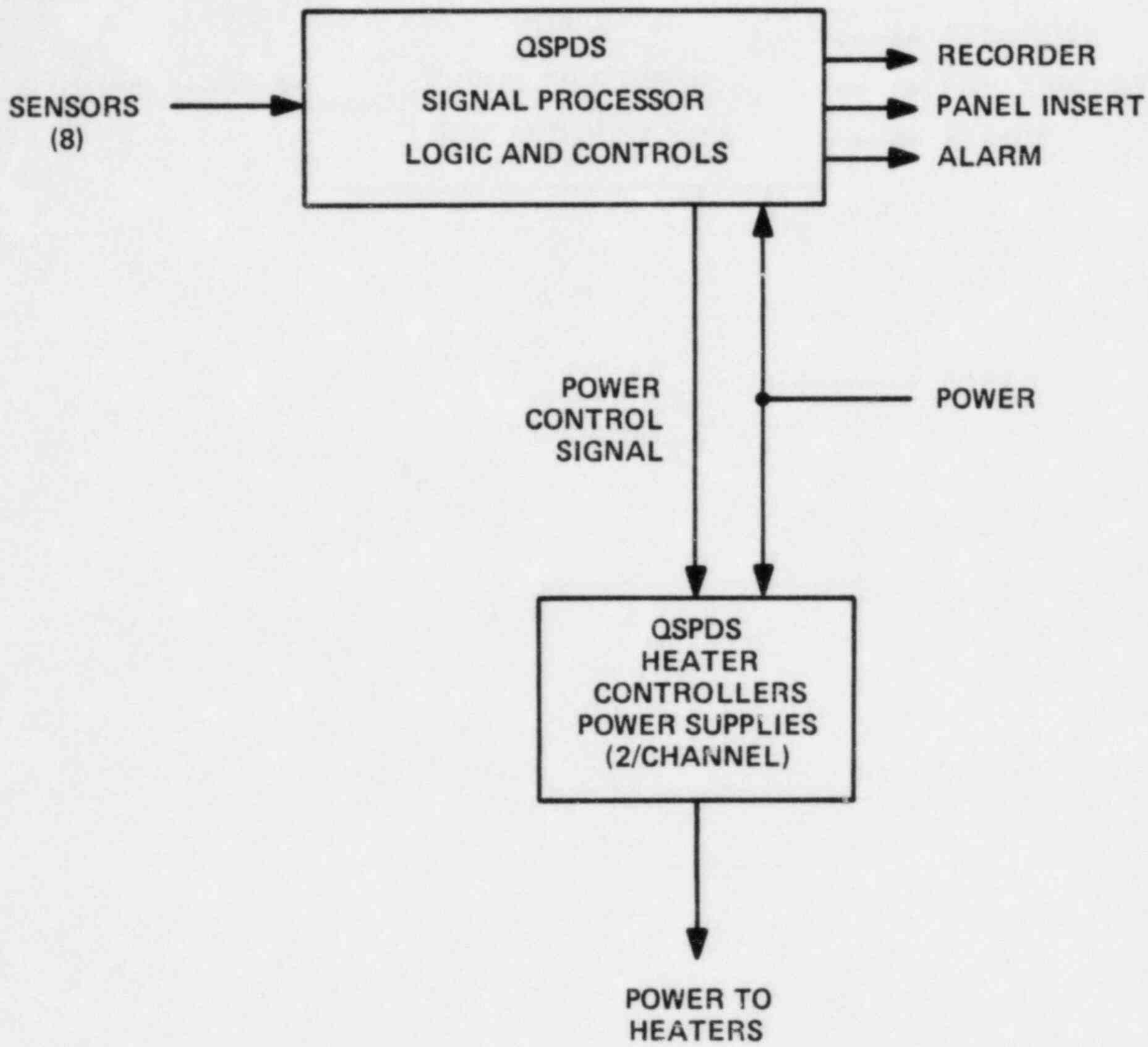
C - E SYSTEM 80	ELECTRICAL DIAGRAM OF HJTC	Figure 2-6



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C - E SYSTEM 80	HJTC SYSTEM PROCESSING CONFIGURATION (ONE CHANNEL SHOWN)	Figure 2-7

4. RCS pressure control

5. RCS heat removal control

6. Containment pressure/temperature control

7. Containment isolation control

8. Radiation emissions control

These critical safety functions are directly monitored by a set of algorithms which process the measured plant variables to determine the plants safety status relative to safety functions control. If any of the critical functions are violated, (by exceeding logic setpoints) a Critical Function Alarm (CFA) is initiated. The ICC instruments outputs are incorporated in this critical function alarm logic. Specifically the ICC inputs are incorporated into the core heat removal control level 1 display and also lower level detail displays.

The CFMS displays data on six cathode ray tubes; two each in the control room, TSC, and EOF. The data has three levels of information:

Level 1 - Monitor (Critical functions status)

Level 2 - Control (System overview) 6

Level 3 - Diagnostic (System detail)

This hierarchy allows the operator to progress from an overall plant safety status, to system overview to a detailed diagnostic view. The ICC instrument outputs are incorporated in all three levels of display. The detailed ICC information is anticipated to be displayed on a dedicated display. ICC trending displays for saturation margin, reactor vessel inventory, representative core exit temperature, and representative core exit temperature saturation margin are also provided with the CFMS. The CFMS is the Primary Control room display of ICC information.

Each QSPDS safety grade backup display also has available the most reliable basic information for each of the ICC instruments. These displays are human engineered to give the operator clear unambiguous indications. The backup displays are designed:

1. to give instrument indications in the remote chance that the primary display becomes inoperable.

2. to provide confirmatory indications to the primary display.

3. to aid in surveillance tests and diagnostics.

The following sections describe displays as presently conceived for each of the ICC instrument systems. Both primary and backup displays are intended

to be designed consistent with the criteria in II.F.2 Attachment 1 and Appendix B.

2.3.1 ICC Displays

The ICC detection instrumentation displays in both the CFMS (primary displays) and the QSPDS (backup displays) have an ICC summary page as part of the core heat removal control critical function supported by more detailed display pages for each of the ICC variable categories.

The summary page will include:

1. RCS/Upper Head saturation margin - the maximum of the RCS and Upper Head saturation margin.

2. Reactor vessel level above the core.

3. Representative core exit temperature.

Since the CFMS has more display capabilities than the QSPDS such as color-graphics, trending, and a larger format, additional information may be added and with a better presentation than is available with the QSPDS. These variables are incorporated in other CFMS system displays.

Since the CFMS receives both QSPDS channels of ICC input, the CFMS displays both channels of ICC information. The QSPDS displays only one channel of ICC information for each video display unit. 6

Although all inputs are accessible for trending and historical recall, the CFMS has a dedicated ICC trend page for RCS/upper head saturation margin, reactor vessel level, and representative core exit temperature and core exit saturation margin. These are also available as analog outputs from the QSPDS cabinet.

2.3.2 Saturation Margin Display

The following information is presented on the primary (CFMS) and backup (QSPDS) displays:

1. Temperature and pressure saturation margins for RCS, Upper Head, Core Exit Temperature.

2. Temperatures and pressure inputs.

2.3.3 Heated Junction Thermocouple System Display

The following information is displayed on the CFMS and QSPDS displays:

1. Liquid inventory level above the fuel alignment plate derived from the eight discrete HJTC positions.

2. 8 discrete HJTC positions indicating liquid inventory above the fuel alignment plate.

3. Inputs from the HJTCS:

   a. Unheated junction temperature at the 8 positions.

   b. Heated junction temperature at the 8 positions.

   c. Differential junction temperature at the 8 positions.

2.3.4 Core Exit Thermocouple Display

The following information is displayed on the CFMS display:

1. A spatially oriented core map indicating the temperature at each of the CET's.

2. A selective reading of CET temperatures. 6

3. The representative core exit temperature.

The following information is displayed on the QSPDS display:

1. Representative core exit temperature.

2. A selective reading of the CET temperatures.

3. A listing of all core exit temperatures.

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3.0 COMPARISON OF DOCUMENTATION REQUIREMENTS OF POSITION II.F.2, ATTACHMENT 1 AND APPENDIX B WITH CESSAR, APPENDIX B

Tables 3-1 through 3-3 provide a point by point comparison of the documentation required by NUREG-0737, Item II.F.2, the requirements of Attachment 1 of Item II.F.2, and the Criteria of Appendix B of NUREG-0737 with the inadequate core cooling detection instrumentation described previously. 6

TABLE 3-1
EVALUATION OF ICC DETECTION
INSTRUMENTATION TO DOCUMENTATION
REQUIREMENTS OF NUREG-0737 ITEM
II.F.2

ITEM	RESPONSE
1.a.	Description of the ICC Detection Instrumentation is provided in Section 2.0.
1.b.	The instrumentation described in Section 2.0 will be the ICC detection instrumentation design for the System 80 plant.
1.c.	Any modification would be plant specific.
2.	The design analysis and evaluation of the ICC detection instrumentation is presented in Section 1.0 and Appendix A. The HJTC-based reactor vessel level monitoring system has been tested in two phases: Phase 1 - Proof of Principle Tests, and Phase 2 - Design Development Tests. The results of these tests are available in the Phase 1 Test Report and the Phase 2 Test Report. 6
3.	The HJTCS has one remaining test phase. The Phase 3 test program will consist of high temperature and pressure testing of a manufactured production prototype system HJTC probe assembly and processing electronics. The Phase 3 test program will be executed at the C-E test facility used for the Phase 2 test and is expected to be completed by the first quarter of 1982. No special verification or experimental tests are planned for the hot leg and cold leg RTD sensors, the pressurizer pressure sensors, or the Type K (chromel-alumel) core exit thermocouples since they are standard high quality nuclear instruments with well known responses. For qualification testing, all out-of-vessel sensors and equipment, including the OSPDS up to and including the CFMS isolation, will be environmentally qualified according to the methodology presented in Section 3.11, and seismically qualified according to the methodology presented in Section 3.10.

4. This table evaluates the ICC Detection Instrumentation's conformance to the NUREG-0737, Item II.F.2 documentation requirements. Table 3-2 evaluates conformance to Attachment 1 of Item II.F.2. Table 3-3 evaluates conformance to Appendix B of NUREG-0737.

5. The ICC detection instrumentation processing and display consists of two computer systems; the 2 redundant channel safety grade microcomputer based QSPDS, and the single large scale non safety grade minicomputer based CFMS. The ICC inputs are acquired and processed by the safety grade QSPDS and isolated and transmitted to the primary display in the non-safety-grade CFMS. The QSPDS also has the seismically qualified backup displays for the ICC detection instruments. The software functions for processing are listed in Section 2.2; the functions for display are listed in Section 2.3.

The software for the QSPDS is being designed consistent to the recommendations of the draft standard, IEEE Std. P742/ANS 4.3.2, "Criteria for the Application of Programmable Digital Computer Systems in the Safety Systems of Nuclear Power Generating Stations". This design procedure verifies and validates that the QSPDS software is properly implemented and integrated with the system hardware to meet the system's functional requirements. This procedure is quality assured 6
by means of the C-E QADP. Since C-E has designed the only licensed safety grade digital computer system in the nuclear industry, C-E has the facilities and experience to design reliable computer systems. Although the CFMS is designed as a non-safety class system, the same procedure is being applied to the CFMS design to assure compatibility with the QSPDS.

The QSPDS hardware is designed as a redundant safety grade qualified computer system which is designed to the unavailability goal of 0.01 with the appropriate spare parts and maintenance support. The CFMS is a single highly reliable minicomputer system that is designed to the unavailability goal of 0.01 with the appropriate spare parts and maintenance support.

6. This requirement is plant specific.

7. Guidelines and procedures for the use of the ICC instruments will be addressed on a plant-specific basis.

8. Key operator actions for ICC contained in emergency procedures will be addressed on a plant specific basis. The C-E Owner's Group has developed generic emergency procedure guidelines addressing ICC.

9. No additional submittals are required on the CESSAR-F docket.

TABLE 3-2
EVALUATION OF ICC DETECTION INSTRUMENTATION
TO ATTACHMENT 1 OF II.F.2

ITEM	RESPONSE
1.	The System 80 design has 61 core exit thermocouples (CETs) distributed uniformly over the top of the core. Section 2.1.3 has a description of the CET sensors. Figure 2-5 depicts the locations of the CETs.
2.	The CFMS meets the primary display requirements for CET temperatures. Section 2.3 describes the CFMS and Section 2.3.3 describes the CFMS displays for the CET temperatures.
2.a.	A spatial CET temperature map is available on demand.
2.b.	A selective representative CET temperature will be displayed continuously on demand. Although not finalized, this temperature will be either the maximum CET temperature or the average of the five highest CET temperatures.
2.c.	The CFMS provides direct readout of CET temperatures with a dedicated display page. The line printer provides the hard-copy capability for recording CET temperatures. 6
2.d.	The CFMS has an extensive trend and historical data storage and retrieval system. The Historical Data Storage and Retrieval System (HDSR) function allows all ICC inputs to be recorded, stored, and recalled by the operator. The operator (and other user stations) can graphically trend any CET value on the display screen. A dedicated ICC trend page which includes the representative CET temperature and representative CET saturation margin will be accessible to the users.
2.e.	The CFMS has alarm capabilities through the Critical Functions Alarm described in Section 2.3 and visually displayed value alarms on the system level pages.
2.f.	The CFMS is an extensively human-factor designed display system which allows quick access to requested displays by means of the hierarchy described in Section 2.3 and III.A.1.2.
3.	The QSPDS displays fulfill the requirements for the safety grade backup displays. Both channels of QSPDS displays together display all CET temperatures. All CET temperatures can be displayed within 6 minutes.

4. The types and locations of displays and alarms are determined by performing a human-factors analysis. The CFMS incorporates extensive human-factors engineering. The QSPDS also incorporates human factors engineering. The use of these display systems will be addressed in operating procedures, emergency procedures, and operator training.

5. The CET display is evaluated with the other ICC instruments in the Appendix B evaluation in Table 3-3.

6. The CFMS (primary display) and the QSPDS (two redundant safety grade display channels) are electrically independent. The QSPDS channels are powered from the Class 1E power sources for channel A & B and physically separated according to Reg. Guide 1.75 up to and including the isolation device portion transmitting data to the CFMS (see Figure 2-1). The CFMS is highly reliable non safety grade system which is powered by a highly reliable battery-backed power source. 6

7. The ICC detection instrumentation is environmentally and seismically qualified as specified in the response to Appendix B Item 1 in Table 3-3. The CFMS is not seismically qualified. The isolation devices in the QSPDS are accessible for maintenance following an accident.

8. The CFMS and QSPDS are designed to the .01 unavailability goal in NUREG 0696 with the appropriate spare parts and maintenance support.

9. The quality assurance provision of Appendix B, Item 5, will be applied to the ICC detection instruments as described in the Appendix B evaluation in Table 3-3.

TABLE 3-3
EVALUATION OF ICC DETECTION INSTRUMENTATION
TO APPENDIX B OF NUREG-0737

ITEM	RESPONSE
1.	The qualification for the ICC Detection instrumentation can be divided into three categories:

(1) Instrumentation components and systems which extend from the primary pressure boundary up to and including the primary display isolator and including the backup displays.

(2) Sensor instrumentation within the pressure vessel.

(3) Instrumentation systems which comprise the primary display equipment.

All out-of-vessel sensors and equipment, including the QSPDS up to and including the CFMS isolation, will be environmentally qualified to IEEE Std. 323-1974 as interpreted by CENPD-255 Rev. 01, "Qualification of C-E Class 1E Instruments", and seismically qualified to IEEE Std. 344-1975 as interpreted by CENPD-182, "Seismic Qualification of C-E Instrumentation Equipment". 6

The "best available equipment" is designed for the in-vessel equipment, including the HJTC probe assemblies and Core Exit Thermocouple (CET) sensors. This equipment is designed consistent with industry practice for components which are located inside the reactor vessel.

The CFMS (primary display) will not be designed as a safety grade system, but will be designed for high reliability; thus it will not be qualified environmentally or seismically to the standards listed. However, the CFMS will be separated from the safety grade sensors, processing and backup display equipment by means of an isolation device which will be qualified to the standards listed and be accessible for maintenance following an accident.

2. All ICC instrumentation is designed with two redundant safety grade channels. The sensor inputs are fed into the QSPDS. The QSPDS is a safety grade two redundant channel microcomputer based processing and backup display system that transmits the ICC instrument variables to the nonsafety

grade CFMS via isolated data links. (See Figure 2-1) See Table 3-2, Item 5, for description of Regulatory Guide 1.75 compliance.

If (in the remote chance) one complete channel of the QSPDS fails, the operator deduces ICC conditions by the following means:

(1) Cross-checking the variables in the available channel. Each ICC function (SMM, HJTCS and CET) have multiple variables which can be cross-checked.

(2) Cross-checking the variables with other instruments on the control board which have a known relationship to the QSPDS variables. For example additional safety-grade instruments exist for hot leg and cold leg temperatures, and pressurizer pressure.

3. The ICC detection instrumentation through the QSPDS is powered from the Class 1E power sources for Channels A and B.

4. The ICC detection instrumentation through the QSPDS is designed to function during normal operation as well as emergency conditions. The CFMS and QSPDS are designed to operate during normal conditions with an availability of 99% 6
with appropriate spare parts and maintenance support.

5. The ICC detection instrumentation through the QSPDS incorporates the recommendations of Regulatory Guides 1.28, 1.30, 1.38, 1.58, 1.64, 1.74, 1.88 as discussed in CESSAR, Appendix A.

6. The ICC Detection Instrumentation outputs are continuously available on the QSPDS displays.

7. The CFMS provides trending display and historical data storage and retrieval (HDSR) capabilities to meet this requirement.

8. The QSPDS displays are clearly identified on the control panel. The CFMS displays are appropriately placed for effective man-machine interface.

9. The signals transmitted to the CFMS from the QSPDS are isolated with isolation devices qualified to the provisions of Appendix B.

10. The operational availability of the ICC instruments of each channel can be checked according to the description addressing single failure in item 2. In addition periodic tests of the QSPDS verify complete system operability. (see Item 15).

11. Servicing, testing, and calibrating programs shall be specified for the ICC detection instruments.

12. The ICC instrumentation, including the QSPDS, are not intended to be removed or bypassed during operation. Administrative control will be necessary to remove power from a channel.

13. The QSPDS facilitates administrative control for access to setpoints by using programmable read-only memory modules which can be changed by removing and reprogramming the modules. Calibration and testing can be accessed at the input/output (I/O) equipment at the QSPDS cabinets.

14. The design meets this requirement.

15. The design meets this requirement. The QSPDS performs on-line surveillance tests to detect malfunctions.

The following on-line surveillance tests are performed in the QSPDS:

1. The temperature inside the QSPDS cabinet with a cooling system alarm on high temperature.

2. Power failure to the processor with alarm on failure. 6

3. Bad sensors and broken communication links with indication on the display.

4. CPU memory check and data communication checks with alarm and indication on the plasma display and digital panel meter on the cabinet. (These checks are performed periodically.)

5. Analog input offset voltage with compensation performed automatically.

6. Inputs out of range with alarm.

7. Low HJTCS differential temperature with alarm.

16. The design meets this requirement.

17. The design meets this requirement.

18. Periodic testing according to Reg. Guide 1.118 can be performed on the ICC instruments.

Appendix II.F.2-A

Evaluation of Instrumentation for Detection of Inadequate Core Cooling

6

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November 20, 1981

APPENDIX II.F.2-A

Evaluation of Instrumentation for Detection of Inadequate Core Cooling

The C-E Owners Group has conducted an evaluation of instrumentation for the potential application to the detection of Inadequate Core Cooling. The performance characteristics of selected instruments were compared for representative transients resulting in various degrees of reactor coolant system voiding. The respective instruments then were evaluated based on their developmental and post-accident qualification status, response characteristics, and signal clarity.

A.1 DESCRIPTION OF ICC EVENT PROGRESSION

The state of progression of an event resulting in ICC can be divided based on physical processes occurring within the RPV, into the following six conditions:

Conditions Associated with the Approach to ICC

Condition 1a — Loss of fluid subcooling prior to the first occurrence of saturation conditions in the coolant.

Condition 2a — Decreasing coolant inventory within the upper plenum, from the top of the vessel to the top of the active fuel. 6

Condition 3a — Increasing core exit temperature produced by uncovery of the core resulting from the drop in level of the mixture of vapor bubbles and liquid below the top of the active fuel.

Conditions Associated with Recovery From ICC

Condition 3b — Decreasing core exit steam temperature resulting from the rising of the level within the core.

Condition 2b — Increasing inventory above the fuel.

Condition 1b — Establishment of saturation conditions followed by an increase in fluid subcooling.

The instrument system used for the detection of ICC should provide the reactor operator with the current status of selected key parameters and the trending of prior status of selected key parameters as the event progresses through each of the above conditions.

A.2 SUMMARY OF SENSOR EVALUATION

The instruments evaluated in this effort were the subcooled margin monitor (SMM), resistance temperature detectors (RTDs), reactor vessel level monitor employing the heated junction thermocouples (HJTC), core exit thermocouples (CETs), self-powered neutron detectors (SPNDs), ex-core detectors and in-

core thermocouples. The instruments are listed in Table A-1, where their capabilities are summarized. Significant conclusions about each instrument are given below.

A.2.1 Subcooled Margin Monitor

The Subcooled Margin Monitor (SMM), using input from existing Resistance Temperature Detectors (RTD) in the hot and cold legs and from the pressurizer pressure sensors, will detect the initial occurrence of saturation during LOCA events and during loss of heat sink events.

The usefulness of the SMM will be significantly increased by also feeding into it the signals from the fluid temperature measurements from the HJTCS and by modifying the SMM to calculate and display degrees superheat in addition to degrees subcooling. The signals from the HJTCS temperature measurements provide information about possible local differences in temperature between the reactor vessel upper head/upper plenum (location of the HJTCS) and the hot or cold legs (location of the RTDs).

With these modifications, the SMM can be used not only for detection of the approach to ICC, namely Condition 1a (loss of subcooling), but also for Conditions 3a and 3b (core uncovery) and Condition 1b (core recovery). Even with the modifications, the SMM will not be capable of indicating the existence of Conditions 2a and 2b when the coolant is at saturation conditions and the level is between the top of the vessel and the top of the core. 6

A.2.2 Resistance Temperature Detectors (RTD)

The RTD are adequate for sensing the initial occurrence of saturation for events initiated at power and for events initiated from zero power or shutdown conditions.

The RTD range is not adequate for ICC indications during core uncovery. For depressurization LOCA events, the core may uncover at low pressure, when the saturation temperature is below the lower limit of the hot leg RTD. Initial superheat of the steam will therefore not be detected by the hot leg RTD. As the uncovery proceeds, the superheated steam temperature may quickly exceed the upper limit of the RTD range.

A.2.3 Heated Junction Thermocouple System (HJTCS)

The HJTC probe is designed to create and measure a collapsed liquid level in a localized plenum region. The height of the collapsed liquid level within the probe is sensed using pairs of heated junction thermocouples. This mode of sensing reduces spurious effects due to pressure, fluid properties, and non-homogeneities of the fluid medium.

The signal which is produced by the HJTC probe is a small electrical current similiar in magnitude to, or greater than, the current produced by typical temperature sensing devices presently used in the reactor coolant

system. This signal may be transmitted from within the reactor vessel to outside of the containment building with no intermediate electronics. Furthermore, the signal is not subject to external disturbances, such as containment environment as would be present with a hydraulic signal transmission system.

The HJTC can provide significant information to the operator for two conditions associated with an ICC event - Condition 2a, the approach to uncovery and Condition 2b, the refill. For a large small break event, the two-phase level drops to the top of the core within 5 to 15 minutes of the break initiation. In this event, the HJTC would show the rapidly decreasing coolant inventory and would quantify for the operator the status of the degrading situation which is otherwise evident to him from numerous existing instruments. For smaller breaks, the progression of the event is slower, and the HJTC can provide significant information on the effectiveness of his mitigating actions. It is probably for such long term conditions, prior to core uncovery, that the HJTC would have its greatest usefulness.

Following recovery of the core, the operator could use the HJTC to verify that the core is again covered and therefore is being adequately cooled. Through monitoring the HJTC level the operator has better indication of the correctness and effectiveness of this actions in maintaining the coolant inventory.

A.2.4 Core Exit Thermocouples (CETs)

The core exit thermocuples will show the approach to and existence of ICC after core uncovery for the events analyzed. The core exit thermocouples respond to the coolant temperature at the core exit and indicate superheat after the core is no longer completely covered by coolant. The trend of the change in superheat corresponds to the trend of the change in cladding temperature. 6

Existing thermocouples in C-E reactors have been qualified to industry standard accuracy for operation to 750°F. However, thermocouples of this design (i.e., stainless steel sheathed, alumina insulated, Type K, Chromel-Alumel) are suitable for nuclear service to 1650°F. Tests have been run on such thermocouples to simulate severe accidents (See Reference 4 of text). Results from these tests demonstrated the shunting error caused by the increase in electrical conductance of the alumina at high temperature is shown to be negligible up to 1650°F and is acceptably small to 1800°F. It is concluded that the thermocouples in operating C-E designed reactors could satisfy the minimum NRC requirement for 1650°F and are adequate to 1800°F. In addition, tests performed at ORNL indicate that CETs may be used for purposes of trending of steam temperatures up to 2300°F.

A.2.5 Self-Powered Neutron Detectors (SPND)

The SPND yield a signal caused by high temperature as the two-phase level falls below the elevation of the SPND. However, testing would be required

to identify the phenomena responsible for the anomalous behavior of the SPND at TMI-2. At the present, their use is limited to low temperature events (less than 1000°F clad temperature) or to only the initial uncovery portion of an event.

A.2.6 Ex-Core Neutron Detectors

Existing source range neutron detectors are sensitive enough to respond to the formation of coolant voids within the vessel during the events analyzed. However, the signal magnitude is ambiguous because of the effects of varying boron concentration and deuterium concentration in the reactor coolant.

A stack of ex-core detectors gives less ambiguous information on voids and level in the vessel. The relative shape of the axial distribution of signals from a stack of five detectors shows promise as an ICC indicator, 6
but additional development would be needed.

A.2.7 In-Core Thermocouples

Although the loss of other instrumentation such as the SPND's would have to be considered, in general, it appears feasible that in-core thermocouples may be added to or substituted for some SOND in the in-core instrument string. In-core thermocouples sense the surrounding environment via radiation, as well as, steam convection. The information provided to the operator by in-core thermocouples is qualitatively the same as that provided by CETs.

Amendment No. 6
November 20, 1981

TABLE A-1

INSTRUMENT INCLUDED IN EVALUATIONS FOR ICC INSTRUMENTATION SYSTEM

INSTRUMENTS	DEVELOPMENT STATUS	POST-ACCIDENT QUALIFICATION STATUS	INDICATION PROVIDED BY INSTRUMENT	CLARITY OF SIGNAL	CONDITIONS MONITORED
Subcooled Margin Monitor	Exists	Qualified	Degree Of Subcooling In RCS	Good	1a, 1b
Reactor Vessel Level Monitor	Under Develop.	Will Be Qualified	1) Liquid Inventory In Upper Head	Good	2a, 2b
			2) Liquid Inventory in Upper Plenum	Good	
			3) Axial Temperature Distribution In Head And Plenum	Good	
Core Exit Thermocouples	Exist	Can Be Done	1) Fluid Temperature at Core Exit	Good	3a, 3b
In-Core Thermocouples	Concept Stage	Can Be Done	1) Metal Temperature Inside Guide Tube When RCP Off	Good	3a, 3b
Self-Powered Neutron Detectors	Exist	Can Be Done	Indirect Measure of Mixture Level (Low Pressure Uncovery)	Poor	3a, 3b
Hot Leg RTD (5 Each)	Exist	Qualified	Fluid Temperature in Hot Leg	Good	1a, 1b, 3a, 3b
Ex-Core Neutron Detector (Off, Source Range)	Exist	Can Be Done	Indirect Measure of Gross Voiding	Fair	3a, 3b
			Indirect Indication of Mixture Level Level in Core, RCP Off	Fair	
Ex-Core Neutron Detector (Stack of 5, Source Range)	Concept	Can Be Done	Same as One Ex-Core Detector, But More Axial Resolution	Fair	3a, 3b

6

Amendment No. 6
November 20, 1981

II.K.3.25
EFFECT OF LOSS OF ALTERNATING-CURRENT POWER
ON PUMP SEALS

SUMMARY

The licensees should determine, on a plant-specific basis, by analysis or experiment, the consequences of a loss of cooling water to the reactor recirculation pump seal coolers. The pump seals should be designed to withstand a complete loss of alternating-current (ac) power for at least 2 hours. Adequacy of the seal design should be demonstrated.

RESPONSE

C-E has recently submitted to the NRC Supplement I to Topical Report CENPD-201-A, which demonstrates that the System 80 Reactor Coolant Pumps are capable of operating without component cooling water for 30 minutes without sustaining serious damage. It is C-E's engineering judgement that the RCP seals would not lose function following a loss of power for at least two hours in duration.

III A.1.2
UPGRADE EMERGENCY SUPPORT FACILITIES

SUMMARY

Additional clarification will be provided in the near future.

RESPONSE

The Accident Monitoring System and related display stations transmit and provide plant information to the control room, Technical Support Center, and Emergency Operations Facility as required by NUREG-0696.

AMS DESCRIPTION

Background

The Accident Monitoring System (AMS) is a unified systems approach to meeting the NRC's processing and display requirements for accident monitoring instruments. The NRC has provided numerous requirements as an outgrowth of studies performed following the accident at TMI-2. Included among these are additional requirements on accident monitoring, emergency response facilities, inadequate core cooling, and control room upgrade. Taken together, requirements in these four areas translate into a significant upgrade of present nuclear power plant instrumentation. An integrated approach can significantly reduce cost and schedule impact while allowing for system expandability to meet future requirments. 6

A discussion of the TMI related requirements for Emergency Response Facilities, Inadequate Core Cooling, Control Room Upgrade, and Accident Monitoring is in order to gain a perspective of how the AMS was developed. NUREG-0737 "Clarification of TMI Action Plan" specifies action items which utilities must complete. Action Item 1.D.2 requires a Safety Parameter Display System (SPDS) which displays the minimum set of parameters for the operator to monitor the safety status of the plant. Action Item III.A.1.2 requires emergency support facilities to display and transmit plant status to personnel other than control room operators. Action Item II.F.2 requires instrumentation to detect inadequate core cooling. Also related to any major display system is an evaluation to Action Item 1.D.1, which requires a control room design review, and addresses improvements in safety monitoring and human factors enhancement of controls and control displays.

The specific requirements for the SPDS and the Emergency Response Facilities are defined in NUREG-0696, "Functional Criteria for Emergency Response Facilities". This document provides basic design and qualification criteria for the Safety Parameter Display System (SPDS), the onsite Technical Support Center (TSC), the nearsite Emergency Operations Facility (EOF), and the Nuclear Data Link (NDL). Requirements specified in NUREG-0696 have evolved from numerous industry actions pertaining to earlier NRC documents such as NUREG-0585, "TMI-2 Lessons Learned Task Force Final Report".

Another TMI related requirement which has a great impact on utilities is the requirement for Inadequate Core Cooling (ICC) instrumentation and display. Action Item II.F.2 of NUREG-0737 requires that additional ICC detection instruments be evaluated and implemented according to specified design and qualification criteria. C-E has determined that ICC monitoring requirements can be met by appropriately measuring and displaying margin to saturation, reactor vessel water level above the core, and core exit temperatures. C-E has developed the Subcooled Margin Monitor (SMM) to measure saturation margin and is developing the Heated Junction Thermocouple System (HJTCS) to measure reactor vessel liquid inventory above the fuel alighment plate. Additional processing of Core Exit Thermocouple outputs (core exit temperature) is needed to provide adequate capability to assess inadequate core cooling. The AMS addresses this requirement (refer to II.F.2).

The Revision 2 of Regulatory Guide 1.97, [1] "Instrumentation for Light Water Cooled Nuclear Power Plant to Assess Plant and Environs Conditions During and Following an Accident", specifies parameters and associated design criteria for monitoring accident situations. The AMS provides capability fo integrated, human factors presentation and recall of the post-accident monitoring information associated with Regulatory Guide 1.97.

SYSTEM DESCRIPTION

The Accident Monitoring System (AMS) consists of two major subsystems:

1. Critical Function Monitoring System (CFMS). 6

2. Qualified Safety Parameter Display System (QSPDS) (including processing and display for Inadequate Core Cooling (ICC detection instruments).

The AMS overview is depicted in Figure III.A.1.2-1.

CFMS

The CFMS is the heart of the integrated AMS and is designed to meet criteria set forth in NUREG-0696; "Functional Criteria for Emergency Response Facilities". The CFMS is a dedicated, computer based plant information and display system. Specifically, the CFMS:

1. Provides primary SPDS/ICC display in Control Room, Technical Support Center (TSC), and Emergency Operations Facility (EOF).

2. Includes the Historical Data Storage and Retrieval (HDSR) System.

3. Provides the capability for transmitting data to the NRC Operations Center via the Nuclear Data Link (NDL).

4. Provides the capability to display Regulatory Guide 1.97 and 1.23 input parameters in the Control Room, TSC and EOF.

The CFMS man/machine interface inludes two color-graphic CRT's in the Control Room, two color-graphic CRT's and a line printer in the TSC and two color-graphic CRT's and a line printer in the EOF. (See Figure III.A.1.2-1) A keyboard is associated with each supplied CRT.

Following is a design description of the CFMS.

1.0 DESIGN BASES

The CFMS design bases are divided into three areas: functional, hardware, and software.

1.1 FUNCTIONAL DESIGN BASES

A. The CFMS shall provide the capability to display the status of the following critical functions:

1. Core Reactivity Control

2. Core Heat Removal Control

3. Reactor Coolant System Inventory Control

4. Reactor Coolant System Pressure Control 6

5. Reactor Coolant System Heat Removal Control

6. Containment Pressure/Temperature Control

7. Containment Isolation Control

8. Radiation Emission Control

B. The CFMS shall alarm deviations of the critical functions.

C. The CFMS shall provide the user with concise, understandable, integrated information to assist in assessing plant status during all modes of plant operation. The CFMS displays shall utilize proven human-engineering principles.

D. The CFMS shall be capable of measuring the value of plant process input signals.

E. The CFMS shall be capable of storing the values of plant process signals for a minimum of 16 hours. The values shall be time tagged.

F. The CFMS shall be capable of determining the alarm status of each process parameter.

1. Each analog process parameter shall have the capability of 8 individual alarm settings.

   - o High-out of range alarm
   - o High-high alarm
   - o High alarm
   - o Low alarm
   - o Low-low alarm
   - o Low out of range alarm

2. Each digital process parameter shall have the capability of having one of its two-states be alarmed.

G. The CFMS shall be capable of displaying information to the operator by means of a color cathode ray tube (CRT). The CFMS shall be capable of utilizing alphanumeric data formats, shapes, symbols, color coding, and blinking for information display in accordance with established human engineering guidelines.

H. The CFMS shall be capable of utilizing greater than 20 fixed format displays (pages) for information presentation. Page selection shall be under control of the operator. Each display station (CRT and keyboard) shall be capable of independently calling up any fixed format display page in the repertoire. 6

I. The CFMS shall be capable of activating a plant annunciator.

J. The CFMS shall be capable of providing a simultaneous trend of up to four analog parameters. Analog outputs shall also be provided to allow capability for sine chart recording.

1.2 HARDWARE DESIGN BASES

A. The CFMS hardware shall have sufficient calculational and memory capacity to support the functional requirements delineated in section 2.1.

B. The CFMS hardware shall have sufficient hardware features to support the functional requirements delineated in section 2.1.

C. The CFMS input hardware shall be capable of measuring a minimum of 600 plant process signals. Analog signals shall be measured with an overall accuracy of 0.25%.

D. The CFMS hardware shall be capable of providing output to:

- o Six independent CRT display stations
- o Analog output for strip chart recorder
- o Digital output for alarm annunciation

E. The CFMS shall be capable of operator interaction in the following manners:

1. Operator's Keyboard

   The operator shall have the capability of interacting with the CFMS through the use of a keyboard. The operator can perform the following functions:

   - o Display select
   - o Alarm acknowledge (only for control room operator)
   - o Alarm reset
   - o Trend selection
   - o Historical data recall and trending

2. System Console 6

   The system console provides for control and monitoring of internal computer system operation. It is used by technicians to monitor the system's operation, to perform periodic testing, and to initiate software loading and maintenance.

F. The CFMS hardware shall utilize sufficient peripherals to support:

1. CFMS functional requirements delineated in section 1.1.
2. Sufficient bulk storage for:
   - o Program load function
   - o Historical data storage functions
   - o Online software functions
   - o Offline software maintenance

G. The CFMS shall utilize the following design techniques to achieve high reliability:

1. Minimize reliance on rotating memory for online operation
2. Burn-in of central processor and main memory at elevated temperature

3. Utilize an uninterruptable battery backed source of a-c power

4. Utilize on-line diagnostics to minimize mean time to repair (MTTR)

1.3 SOFTWARE DESIGN BASES

A. The software for the CFMS shall be designed utilizing a modular, top-down design approach whenever practical.

B. The software for the CFMS shall be thoroughly documented including:

- o Functional specification
- o Software specification
- o Program listings

C. The software shall be subjected to:

1. Verification by design review at each step in the design process in accordance with a verification plan

2. Validation by test in accordance with a validation plan (following the guidelines in the draft standard IEEE Std. P742/ANS 4.3.2) 6

D. The CFMS software shall provide the implementation of the functional requirements of section 2.1.

E. The CFMS software shall have the capacity to be maintained in the following modes:

1. Calibration - Offline

   The CFMS software shall support calibration of the process sensors including:

   - o Engineering unit conversion constants
   - o Alarm setpoints

2. Source Code Maintenance

   The CFMS shall be capable of providing source code maintenance including the following utility program:

   - o Editor
   - o Debugger
   - o Assembler/Compiler
   - o Loader

2.0 SYSTEM DESCRIPTION

The following sections describe the CFMS.

2.1 CRITICAL FUNCTIONS

The CFMS monitors the status of the following critical functions:

- Core Reactivity Control
- Core Heat Removal Control
- RCS Inventory Control
- RCS Pressure Control
- RCS Heat Removal Control
- Containment Pressure/Temperature Control
- Containment Isolation Control
- Radiation Emission Control

2.2 USER INTERFACE 6

The CFMS user interface consists of human engineered graphic and alphanumeric displays, alarms, and user input capability.

2.2.1 DISPLAYS

The primary user interface to the CFMS is through multicolored cathode ray tube (CRT) display stations. Each display station is capable of providing any one of the CFMS fixed format displays. Two CRT display stations for each unit will be located in the control room, TSC, and EOF.

2.2.2 DISPLAY STYLE

A. The CFMS utilizes the display methodology developed for the Combustion Engineering Nuplex 80™ Advanced Control Center, including:

- Symbology
- Alarm Color Code
- Operational Color Code
- Page Formats
- Page Number Scheme
- Numeric Formats
- Dynamic Behavior

B. The CFMS shall utilize loop mimic displays. When loop mimics are not possible, a left to right, top to bottom flow shall be assumed.

2.2.3 HIERARCHY

A. In order to effectively organize the information presented by the CFMS a top down, three level hierarchy is used.

B. The CFMS display pages are arranged in a three level hierarchy which consists of:

- o Level 1 - Monitor (critical functions status)
- o Level 2 - Control (system overview)
- o Level 3 - Diagnostic (system detail)

C. Level 1 display pages provide overview information about both the plant and the CFMS. Level 1 displays are primarily alphanumeric.

D. The Level 1 display pages include:

1. Display Directory

An alphanumeric display which lists the display page titles and page numbers.

2. Current Alarm List

An alphanumeric display which lists parameter alarms in chronological order. As alarms clear they are removed from the Current Alarm List. Pressing the RESET button compresses the remaining alarms. Computer alarms are also displayed on the Current Alarm List.

3. Critical Function Monitor Page

The Critical Function Monitor Page displays each critical function, its alarm state and the presence of a failed sensor in the alarm logic.

4. Failed Sensor List

An alphanumeric alarm list which displays all input sensors which have failed out of range. Sensor point ID, English descriptor, time of failure and substituted value if appropriate are displayed. Indication is also made if the sensor is used for Critical Function Alarm purposes.

E. Level II display pages include:

- o Core Systems Display
- o Primary Systems Display
- o Secondary Systems Display
- o Containment Systems Display

F. Level III display pages include:

- o Main Steam System Display
- o Feedwater System Display
- o Emergency Feedwater System Display
- o Letdown Charging Display (CVCS-1)
- o Boric Acid System Display (CVCS-2)
- o Pressurizer Display
- o Safety Injection System Display
- o Containment Heat Removal Systems Display 6
- o Containment Isolation Systems Display
- o Shutdown Cooling System Display

G. Each CFMS display page is assigned a unique three digit page number. The first digit of the page number indicates the level of the display.

H. Movement through the display hierarchy is provided by using the PAGE, SECTOR, EXECUTE, FORWARD, and BACK keys on the CFMS alpha-numeric keyboard.

I. Lateral movement through each level is provided by using the FORWARD and BACK keys. Each level page loop is closed so that paging forward from the last page moves the first page to the display screen.

J. Vertical movement between levels is made by using the SECTOR key followed by the sector number and the EXECUTE key. This key combination moves the display page associated with that sector to the screen. Each display page has up to nine available sectors.

K. When the SECTOR key alone is pressed, sector indicators are displayed which indicate all sectors available from the present display. Sector indicators are removed from the display after 30 seconds.

L. The key stroke combination of SECTOR and 0 returns the previous high level display to the screen. If the present page was reached by direct paging a default upper level page returns to the screen when SECTOR 0 is pressed.

M. Direct paging is provided to go directly to any page in the display hierarchy. Pressing the PAGE key followed by a three digit page number and the EXECUTE key displays the selected page.

N. Trend displays are accessed using a dedicated function button. One dedicated function button is provided for each trend page.

O. Error messages are provided for illegal page or sector commands. Error messages are removed after 5 seconds.

2.2.4 TREND DISPLAYS

A. Two trend display pages provide graphical, time based trends.

B. Each trend display page can trend up to four parameters.

C. Parameters to be trended are assigned from the CFMS Programmers Console and the CFMS User Display Station.

D. All four trends on a display page utilize the same time scale. Each trend display page may have a different time scale.

E. Alphanumeric annotation is provided on each trend page. This includes scales, axes, and labels. 6

F. Each trend page is displayed by pressing a function key which provides direct access to the trend. Trend pages are not sectored to but may be accessed by direct paging. The trend function buttons may be activated at any time. Return from the trend pages is provided by a RETURN FROM TREND button which restores the page that was active when a trend was requested.

2.2.5 HISTORICAL DATA STORAGE AND RETRIEVAL (HDSR)

A. All inputs to the CFMS are stored for review by users.

B. At least 14 hours of data is directly available to users. Data of more than 14 hours duration can be stored on the tape recorder system. Historical data can be transferred between the CFMS and tape recorder without interruption to the CFMS functions.

C. Historical data can be trended from the CFMS programmer's console and the CFMS user display station.

D. Historical data can be printed out with the line printer in a log format.

2.2.6 ALARMS

The CFMS alarms annunciate specific information which is of importance to the user.

A. Five classifications of alarms are provided:

- o Critical Function Alarms
- o Parameter Alarms
- o Sector Alarms
- o Failed Sensor Alarms
- o Computer Failure Alarms

Critical Function Alarms

1. Critical function alarms are provided on the level 1 Critical Functions Monitor Page. These alarms are generated whenever alarm logic indicates that a critical function is not being maintained.

2. Critical function alarms are only set when the required input signals are of good quality.

3. Critical function alarms are only cleared when the required input signals are of good quality.

4. Critical function alarm logic consists of software algorithms composed of arithmetic, comparison and Boolean capability. 6

5. Critical function alarms provide an output signal to go to a supplied audible annunciator.

6. Critical function alarms are annunciated by color change and blink.

7. Critical function alarms retain the alarm color following acknowledgement. The audible alarm and blink are suppressed following acknowledgement.

8. Critical function alarms are acknowledged by the ACKNOWLEDGE button on the primary display station in the control room. Only this one display station is capable of acknowledging alarms. The ACKNOWLEDGE button only acknowledges CFMS alarms and does not affect other control room alarms.

9. Critical function alarm status is displayed on all display pages using a three by three annunciator matrix.

10. A visual indication of a failed sensor input to the critical function alarm logic is provided on each page.

11. Critical function alarms displayed on the Level I page include time and an English description of the alarm.

Parameter Alarms

1. Parameter alarms are provided whenever a parameter exceeds a High-High, High, Lo, Lo-Lo setpoint.

2. High-High, High, Lo, and Lo-Lo setpoints with deadbands are required for each parameter alarm.

3. Parameter alarms are annunciated by color change and blink.

4. Parameter alarms are not audibly annunciated.

5. Parameter alarm blink is suppressed when the ACKNOWLEDGE button is pressed.

6. All Parameter Alarms are listed on the Current Alarm List.

7. The Current Alarm list includes:

   o Name - Alphanumeric description of alarm

   o Current Value - the currently measured value of the process parameter in engineering units

   o Setpoint - the alarm violated setpoint

   o Severity - the severity indicator of the alarm (Hi-Hi, Hi, Lo, Lo-Lo) 6

Sector Alarms

1. Sector alarms are provided to alert the user that important changes have occurred on a lower level page. Up to nine sector alarms may appear on each page except Level III pages.

2. Sector alarms blink until acknowledged. Sector alarms remain lit until cleared. Sector alarms are not audibly annunciated.

3. Sector alarms are displayed in yellow when alarmed.

Failed Sensor Alarms

1. In order to ensure a high availability system a failed sensor alarm is generated when a FAILED HIGH OUT OF RANGE or FAILED LOW OUT OF RANGE sensor is recognized. The failed sensor alarm message is written at the bottom of each page and remains until cleared. Each time a failed sensor is recognized the audible alarm output is activated and the alarm message blinked until acknowledged.

2. All failed sensors are listed on the failed sensor list.

3. Out-of-range setpoints are required to alarm the failed sensors.

Computer Alarms

Alarm outputs indicating computer malfunction are provided. These alarms generate an annunciator window and audible output signal. An alarm shall be provided to indicate failure of the CFMS. The presence of a computer alarm is indicated on every display page.

2.2.6 USER ERROR MESSAGES

A. User error messages are displayed on the bottom of each display as appropriate. User error messages remain on the display for 5 seconds and are then removed. 6

B. User error messages are generated by improper page or sector requests.

3.0 HARDWARE DESCRIPTION

A block diagram of the configuration is provided in Figure 1.

3.1 USER INTERFACE STATIONS

A. User interface stations will be provided. Each user interface station shall consist of:

- o A high resolution color CRT monitor
- o An alphanumeric keyboard
- o Function Keys to include:
  - EXECUTE
  - SECTOR
  - PAGE

- FORWARD
- BACK
- ACKNOWLEDGE
- TREND 1
- TREND 2
- RETURN FROM TREND
- CURRENT ALARM LIST COMPRESSION (RESET)
- HDSR

o Numeric Key Pad

B. Numeric keypad and function keys will be arranged in a fashion which is consistent with human factors considerations.

3.2 COMPUTER

3.2.1 COMPUTING CAPABILITY

Computing capability will be provided which will allow:

o Update of CRT displays

o Online conversion from plant signals to engineering units

o Offline data base maintenance 6

o Calculation of alarm algorithms

o Generation of 8-color graphical CRT displays

o Graphical video trending

o Online diagnostics

o Real time clock

o Watch dog timer - failure alarm

3.2.2 PROGRAMMER'S CONSOLE

A programmer's console will be provided which will allow:

o Administrative control of access via password, key switch or comparable means

o Interactive alphanumeric access to the CFMS computer

3.2.3 STORAGE

Sufficient storage will be provided to allow:

- Storage and support of greater than 20 displays
- Storage and support of CFMS data base
- Storage and support of required operating system software, etc.
- Storage and support of historic trend displays
- System load and support utilities

3.2.4 INPUT/OUTPUT CAPABILITY

Sufficient input/output capability will be provided to support a minimum of 600 process signal inputs.

A. Alarm digital outputs - The following contact outputs are provided.

   1. CFMS Alarm
   2. CFMS failure alarm
   3. CFMS failed sensor alarm

B. Four analog outputs - Four analog outputs are provided for hard copy recorders. The parameters which are output are selected from the programmer's console. 6

C. Conversion of signals to digital representations suitable for computer processing.

4.0 SOFTWARE REQUIREMENTS DESCRIPTION

The requirements for CFMS software are listed below.

4.1 ONLINE CAPABILITIES

The CFMS software will be capable of providing:

- Online User interaction
- Online engineering units conversion
- Input validity checking
- Video data trending
- Alarm generation, acknowledge and reset
- Calculational capability
- Capability

- o Online CFMS diagnostic and checking capability
- o Online trend point select and time increment select
- o Bootstrap loader

4.2 OFFLINE CAPABILITIES

The CFMS software will be capable of providing:

A. Offline data base maintenance and editing. An offline interactive input maintenance facility will be provided which allows:

1. Initial input, allocation and error checking of CFMS input data base files

2. Modification, addition, and deletion of points in the CFMS data base

3. Report generation to provide formalized listings of the offline CFMS input data base files

B. Offline diagnostic and maintenance capabilities.

C. System generation facilities to be used to generate the CFMS software.

5.0 FAILURE CONSIDERATIONS

A. The CFMS will utilize high reliability inputs and equipment but is not a Class 1E system.

B. Following recovery from a power failure to the CFMS, the system will be capable of returning to an operational mode automatically. 6

C. No one out-of-range failed sensor will cause the critical function alarms to give misleading indication.

D. The CFMS will provide indications of:

- o Sensor out-of-range failures
- o Recoverable computer errors and exceptions
- o Fatal computer errors
- o Sensor out-of-range failures which affect the critical function alarm logic

6.0 TESTING

The CFMS will be tested to provide assurance that the CFMS meets the following requirements:

- o Hardware Requirements
- o Software Requirements
- o System Requirements
- o Functional Requirements
- o Human Engineering Requirements

QSPDS

The QSPDS provides a two-channel, seismically qualified Class 1E display of safety parameters (including the ICC information processing necessary to address NUREG-0737, II.F.2) in the control room. In addition, the QSPDS satisfies criteria set forth in NUREG-0696 regarding uninterrupted performance during and subsequent to events expected to occur during the life of the plant (including earthquakes). Human factors engineering and man/machine interface considerations are also integral to the QSPDS display design.

The QSPDS utilizes a microprocessor-based design for the signal processing equipment in conjunction with an alphanumeric display and associated keyboard for each of the two channels. Each channel will accept and process QSPDS/ICC input parameter signals and transmit its output to the alphanumeric display. In addition, each channel will transmit its output to the CFMS. 6

The Primary SPDS/ICC Display in the CFMS incorporates human factors engineering and will include enhanced trending capabilities.

The QSPDS display (located in the control room) will also incorporate human factors engineering. Alphanumeric display of ICC parameters (SMM temperature margin, HJTC and CET temperature) with paging capabilities will also be provided.

The QSPDS provides:

1. A qualified NUREG-0696 backup Safety Parameter Display System.
2. A qualified signal processing/display to address NUREG-0737, II.F.2 including:
   a. Core exit thermocouple signal processing and display
   b. Subcooled margin computation and display.
   c. Heated junction thermocouple heater controllers, signal processing, and display.

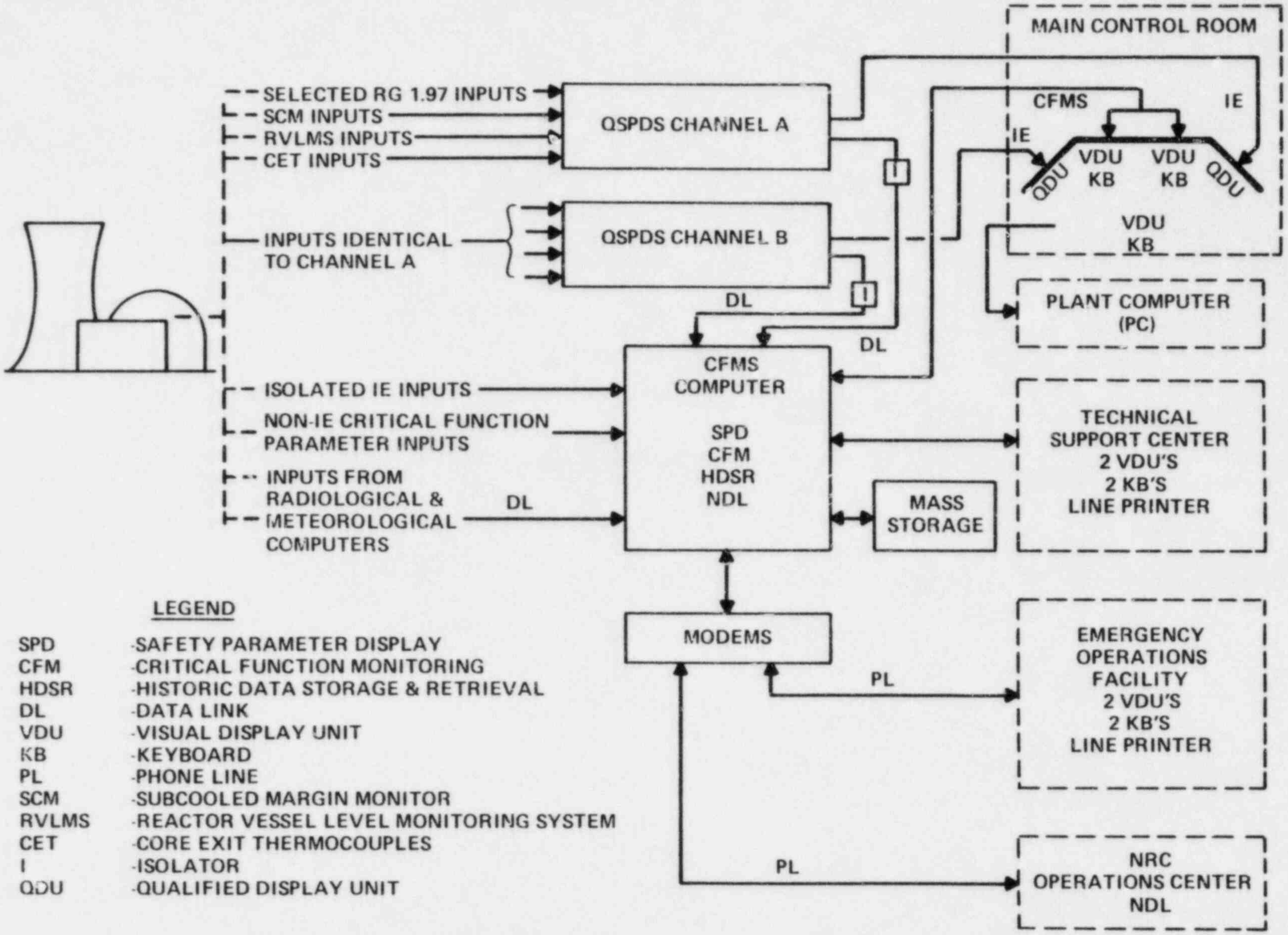
3. Class 1E control room display of the above.

4. A data link to the Critical Function Monitor allowing human engineered display of the above with other CFM parameters. The data link eliminates the need for CFM input/output cabinets and provides Regulatory Guide 1.75 isolation for the above parameters.

5. The capability to add safety grade Regulatory Guide 1.97 parameters into an integrated display, thereby saving valuable control room space. 6

COMPARISON OF THE AMS TO NUREG 0696

Table III.A.1.2-1 provides a comparison of the AMS with the criteria listed in NUREG 0696. The applicable sections are listed in the left hand column with responses written to the right. For sections with more detail, the sections are addressed by paragraphs.



C-E SYSTEM 80

ACCIDENT MONITORING SYSTEM (AMS)

Figure 2-8

Amendment No. 6
November 20, 1981

TABLE III.A.1.2-1
COMPARISON OF THE AMS TO NUREG 0696

A. SPDS

Section - Paragraph

5.1-1 The Critical Function Monitor System provides the primary SPDS. The safety parameter displays consist of the Critical Function algorithm displays supported by lower level system displays. The critical functions in the CFMS are a functional analysis method as opposed to event symptom oriented approaches and is thus designed for the rapid and direct evaluation of the plant safety status particularly during situations when individual plant parameters are ambiguous relative to plant state. Each of the critical function states is determined by an algorithm which monitors plant inputs and logically combines them and compares them to setpoints to determine if critical function control is maintained. When all eight critical functions (see 5.5-3) are satisfied, the plant conditions are safe. If any critical function is alarmed, control is lost for that function and the operator must perform actions to prevent further degradation. Hence a simple and direct safety status is provided to the operator. The lower level displays then provide a self guiding display of information for further verification and plant diagnosis.

Although the critical function approach is adaptable to all plant states, both normal and abnormal, the Critical Functions are especially useful for ill-defined events. In an ill-defined event the operator has a starting point to diagnose the event and monitor to see if previous actions were effective.

The backup SPDS in the QSPDS (see 5.6-3) also lists a minimum number of eventual plant status variables by the same eight critical functions. Since it is a backup, the QSPDS does not contain the alarm algorithms nor the degree of plant diagnostic information. They are intended only for events occurring during a seismic event. 6

5.1-2 The CFMS provides a hierarchal display system to give the operator more information for monitoring and diagnostics. Section 2.2 of the CFMS design description explains the user interface.

5.1-3 The critical function algorithms acquire inputs and perform logical comparisons to display the status of the plant in eight critical functions. The backup SPDS (5.6-3) also lists a minimum number of essential variables according to the same eight critical functions.

5.1-4 The primary SPDS in the CFMS is simple and human engineered. The eight-critical-functions matrix is displayed on the critical function monitor page and in the lower left-hand corner on all

system pages. The CFMS design description (section 3.0) has a more detailed description. The backup SPDS function in the QSPDS is also human engineered so that the operator can easily monitor the variable values for each of the eight functions.

5.1-5 The AMS identifies invalid inputs. The critical function (CF) algorithms acquire redundant inputs for each variable if available. A quality algorithm in each CF monitors the validity of each input, portions of the algorithm, and the total algorithm. If any of these three do not have good quality, it is noted on the display to the operator. In the system displays, the CFMS identifies variables that are not reliable. The QSPDS also identifies each variable that is not reliable.

Operating procedures and operator training shall contain information and guidance for resolution of unsuccessful data validation.

5.1-6,7 Both the CFMS and the QSPDS shall be operational during normal and abnormal operating conditions, displaying information during steady state and transient conditions. See section 5.6-2 for design conditions for environmental and seismic operability. Both the CFMS and QSPDS display the magnitudes of the monitored variables. The CFMS has graphical trending capabilities to trend any variable accessed by the operator (see section 2.2.4 of the CFMS design description).

5.1-8 The CFMS is also the primary display for ICC detection instruments (see II.F.2) and the data acquisition system for the emergency response facilities. The QSPDS, in addition to performing the backup SPDS function in section 5.6-3, performs the safety grade processing and display for the ICC instruments (see II.F.2) and is a safety grade processing and isolation system for safety grade inputs into the CFMS. The QSPDS is isolated from the CFMS according to IEEE Std. 279-1971, IEEE Std. 384-1977, and Reg. Guide 1.75. 6

The I/O system of the CFMS is designed so that no failure of a non-safety grade input will degrade the operation of the CFMS.

5.1-9 The AMS design will be subjected to a rigorous verification and validation program described in sections 7.4 and 9.0. The QSPDS containing the backup SPDS will undergo a safety grade validation and verification program as well as the appropriate seismic and environmental qualification tests. An important part of these tests will be functional integration tests to assure that the hardware and software perform to the functional criteria.

5.2 The CFMS is designed to have two user stations (each consisting of 1 CRT and 1 keyboard) in the control room, TSC and EOF. The QSPDS has two safety grade displays in the control room.

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5.3 The AMS displays are designed to fulfill these requirements but depends on plant specific design.

5.4 Staffing is plant specific.

5.5 A detailed description of the following responses is contained in section 2.0 of the CFMS design description.

5.5-1 As described in 5.1-1, the Critical Functions display in the CFMS provides a simple human engineered means for the operator to assess the plant safety status. The operator can further monitor and diagnose a critical function by accessing system displays and trending the desired variables. Certain variables such as the ICC variables will have dedicated trend pages.

5.5-2 The primary SPDS is tne Critical Function display which monitors plant inputs for each of the eight critical functions, performs logical operations on the inputs, and presents the status for a minimum set of critical functions.

5.5-3 The eight critical functions monitored in the AMS are:

1. Core reactivity control
2. Core heat removal control
3. RCS heat removal control
4. RCS inventory control
5. RCS pressure control 6
6. Containment pressure and temperature control
7. Containment isolation control
8. Radiation emissions control

5.5-4 The display formats for the CFMS are described in section 2.2 of the CFMS design description.

5.5-5 The CFMS is a flexible computer based display system which can be modified to include advanced diagnostic and evaluation techniques.

5.6-1 The CFMS is a single, non safety grade highly reliable computer based system. The QSPDS (which performs the backup SPDS function) is a two redundant channel microcomputer based safety grade system. All inputs to the QSPDS meet class 1E standards and all safety grade inputs into the CFMS are isolated to class 1E standards e.g. IEEE Std. 279-1971 and 384-1977). All inputs identical to the Reg. Guide 1.97 inputs will be evaluated to the criteria of Reg. Guide 1.97. The CFMS will acquire data from the QSPDS with qualified isolated data links.

5.6-2,3 The AMS, composed of the CFMS and the QSPDS (Figure 1), is designed to operate during normal and abnormal events. The CFMS is not class 1E and is not designed to operate during earthquakes. The backup SPDS (the QSPDS) is designed to operate during and after earthquakes. The QSPDS displays are designed to meet the requirements of class 1E standards (such as IEEE Std. 279-1971) and Reg. Guide 1.97 criteria. The AMS is capable of functioning during and following all design bases events for the plant.

5.6-4 The CFMS employs color graphic CRT displays, and the QSPDS employs two monochromatic plasma dot matrix displays.

5.6-5 The dynamic loading shall be specified and incorporated in the training program. Operation of the AMS during earthquake conditions shall be included in procedures and training.

5.6-6,7 The QSPDS and CFMS are each designed to the operational unavailability design goals of 0.01 and 0.2 during cold shutdown and refueling modes as defined in section 1.5 with the appropriate spare parts and maintenance support.

B. TSC

Section - Paragraph

2.1 The CFMS performs the TSC data system function for the TSC personnel. The CFMS date is accessed through the two user display stations. The CFMS can supply all the information available to the control room operator including radiological and environmental information.

2.2 Not applicable.

2.3 Staffing is plant specific. Adequate training on the CFMS will be provided. 6

2.4 Not applicable.

2.5 Not applicable.

2.6 Not applicable.

2.7 Communications requirements are not applicable. Since the CFMS has identical display accessibility for the control room, TSC, and EOF, voice communications concerning data will be simplified.

2.8-1,2 The CFMS performs the gathering, storing, and display functions for the TSC. Users can acquire these functions independent of the other user stations in the control room and EOF. The same set of displays can be accessed by user stations in the control room, TSC, or EOF. The CFMS is powered by a highly reliable uninterruptible power supply. All safety grade inputs will be isolated (see section 5.1-8 and 5.6-1).

2.8-3 The QSPDS and CFMS each are designed to the operational unavailability design goals of 0.01 and 0.2 during cold shutdown and refueling modes as defined in section 1.5 with the appropriate spare parts and maintenance support.

2.8-4 The CFMS is a stand alone data processing system with adequate capability to meet the loads of the TSC.

2.8-5 The CFMS is not seismically qualified and is human engineered for operating and maintenance personnel.

2.9-1,2 The CFMS allows users in the TSC to access the SPDS displays and system displays which include the Type A,B,C,D and E variable of Reg. Guide 1.97, Rev. 2. The TSC can access the same displays as the control room and EOF with the same accuracy and time resolution. The TSC has both CRT displays and a 600 line per minute printer.

2.9-3 The historical data storage and retrieval (HDSR) system stores at least 14 hours of all input data for direct access by any user station. After at least 14 hours the data can be transferred to tape without interruption of the CFMS functions. A number of tapes can be used to record the two weeks of post-event data.

2.9-4 The CFMS contains displays to meet this requirement.

2.9-5 The personnel in the TSC have the capability:

1. to graphically trend selected CFMS variables from the present time
2. to graphically trend historical data

The TSC also has a printer for printed logs of selected variables.

2.9-6 The SPDS displays shown in the control room are available for access in the TSC.

2.10 Not applicable.

C. EOF 6

4.1 The CFMS can provide data and display to the EOF for radiological, meteorological, and plant system data. The CFMS displays the same information to the TSC and control room.

4.2 Not applicable.

4.3 Staffing is plant specific. Adequate training on the CFMS will be provided.

4.4 Not applicable.

4.5 Not applicable.

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4.6 Communications requirements are not applicable. Since the CFMS has identical display accessibility for the control room, TSC, and EOF, voice communications concerning data will be simplified.

4.7-1,2 The CFMS performs the gathering, storing, and display functions for the EOF. User stations can acquire these functions independent of the other user stations in the control room and TSC. The same set of displays can be accessed by user stations in the control room, TSC, or EOF. The CFMS is powered by a highly reliable uninterruptible power supply. All safety grade inputs will be isolated (see section 5.1-8 and 5.6-1).

4.7-3 The QSPDS and CFMS each are designed to the operational unavailability design goals of 0.01 and 0.2 during cold shutdown and refueling modes as defined in Section 1.5 with the appropriate spare parts and maintenance support.

4.7-4 The CFMS is a stand alone data processing system with adequate capability to meet the loads of the EOF.

4.7-5 The CFMS is not seismically qualified and is human engineered for operating and maintenance personnel.

4.8-1,2,3,4 The CFMS allows users in the EOF to access the SPDS displays and system displays which include the Type A,B,C,D and E variables of Reg. Guide 1.97, Rev. 2 and Reg. Guide 1.23. Users in the EOF can access the same displays as the control room and TSC with the same accuracy and time resolution. The EOF has both CRT displays and a 600 line per minute printer.

4.8-5 The historical data storage and retrieval (HDSR) system stores at
least 14 hours of all input data for direct access by any user
station. After at least 14 hours the data can be transferred to
tape without interruption of the CFMS functions. A number of 6
tapes can be used to record the two weeks of post event data.
The CFMS contains sufficient displays and print devices to allow
personnel adequate access to the CFMS information. Additional
devices can be added to allow more access.

4.8-6 The personnel in the EOF have the capability:

1. to graphically trend selected CFMS variables from the present time (dynamic)

2. to graphically trend historical data (static)

The EOF also has a printer for printed logs of selected variables.

4.8-7 The SPDS displays shown in the control room are available for access in the EOF.

4.9 Not applicable.

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D. Acquisition and Control of Technical Data

This section is the response addressing section 7.0 of NUREG 0696.

7.1 The AMS which consists of the CFMS and QSPDS is comparable to the Data Acquisition System (DAS) described in this section. Parameters specified in Reg. Guide 1.97, Rev. 2 and Reg. Guide 1.23 can be input into the AMS. Inputs from safety systems are isolated with isolation devices meeting the requirements of GDC 24 and IEEE 279-1971.

7.2 The AMS, shown in Figure 1 of this document, is a stand alone system similar to that depicted in Figure 3 of NUREG 0696.

7.3 The AMS will not be subject to external demands for processing or services. The output data from the AMS will be consistent with readings from other instruments in the control room.

7.4 The AMS will undergo a stringent validation and verification program to assure that the software and integrated system perform their functions properly. The guidelines of the draft standard IEEE P742/ANS 4.3.2 "Criteria for the Application of Programmable Digital Computer Systems in the Safety Systems of Nuclear Power Generating Stations" will be applied to the QSPDS. The QSPDS is quality assured according to the C-E QADP. Although the CFMS is not designed as a safety system like the QSPDS, the same procedure is applied to the CFMS design and AMS design as a whole.

The design procedure for the AMS follows the format referred to in NUREG 308 for the core protection calculators which is also a C-E product. Since C-E has designed the only licensed safety grade digital computer system in the nuclear industry, C-E has the facilities and experience to design reliable computer systems. The software is subjected to tests that check all branches for proper implementation. Static and dynamic integration tests check proper functional operation of the QSPDS, CFMS and AMS as a system. The functional, software, and hardware designs and test programs are documented. Design modifications are incorporated according to procedure. Any modifications will undergo verification and validation testing. 6

7.5 The AMS is designed as a dependable system as the previous sections have described. The AMS computers have the capability for modest increases and modular expansion in the future.

8.0 The AMS is designed as a fully integrated system to meet the functional criteria as follows:

a. The AMS will not degrade the performance or reliability of any reactor safety or control system or of any safety-related displays in the control room.

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b. Actions in the control room and operation of control room systems will not degrade or interfere with the functional operation of the AMS.

c. Normal operation of the AMS in the ERFs will not degrade or interfere with the functional operation of other systems in those facilities. 6

The AMS can accept data included in Reg. Guide 1.97 Rev. 2, type A,B,C,D and E variables, Reg. Guide 1.23, and variables displayed by the SPDS.

Any safety grade signal input to the AMS shall be isolated according to safety grade criteria including GDC 24 and IEEE Std. 279-1971.

9.0 Section 7.4 describes the validation and verification techniques for the AMS.

III.D.1.1
PRIMARY COOLANT SOURCES OUTSIDE CONTAINMENT

SUMMARY

Evaluate current design features which reduce leakage from systems outside containment that would or could contain highly radioactive fluids during a serious transient or accident; describe current means of leakage detection and control to as-low-as practical levels.

RESPONSE

Systems outside the containment structure which have the potential for containing post-accident primary coolant consist of the Chemical and Volume Control System, Safety Injection System, and Shutdown Cooling System.

1. Chemical and Volume Control System (CVCS)

   Control of Leakage from the CVCS is accomplished by the following:

   a. Overpressure protection through the installation of relief valves to protect system piping and components. This is further described in section 9.3.4.3.3.

   b. Automatic isolation of letdown flow upon SIAS, resulting in minimization of quantity of post-accident coolant influent to the CVCS. This is further described in section 9.3.4.3.5.

   c. Automatic containment isolation of reactor coolant pump controlled bleedoff upon CIAS, resulting in redirection of RCP controlled bleedoff to the reactor drain tank within the containment structure. 6
   This is further described in sections 9.3.4.3.1 and 9.3.4.3.5.

   d. Maximum utilization of welded connections on CVCS piping and 6
   components.

   e. Minimization of valve leakage through use of diaphragm valves, or 6
   use of double-packing and lantern rings, and leakoff connections.

   f. Monitoring of RCS water inventory.

2. Safety Injection/Shutdown Cooling/Containment Spray Systems 6

   Control of leakage from the SIS, SCS, and CSS is accomplished by the following:

   a. Overpressurization protection through installation of relief valves to protect system piping and components.

   b. Appropriate valving between high pressure sources and low pressure piping.

   c. Conservative system piping design, including maximum utilization of welded connections.

d. Use of mechanical shaft seals (HPSI pumps) and leakoff collection devices.

These items are further described in section 6.3.2.2 (SIS), section 5.4.7.2.2 (SCS), and section 3.2 of Appendix 6A (CSS). 6

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3.2 CLASSIFICATION OF STRUCTURES, COMPONENTS, AND SYSTEMS

3.2.1 SEISMIC CLASSIFICATION

Structures, systems, and components which are important to safety and designed to remain functional in the event of a safe shutdown earthquake (SSE) are designated as Seismic Category I.

Seismic Category I structures, systems, and components are those necessary to ensure:

1. The integrity of the reactor coolant pressure boundary;

2. The capability to achieve safe shutdown of the reactor and keep it in a safe shutdown condition; or

3. The capability to prevent or mitigate the consequences of accidents that could result in potential offiste exposures in excess of 10CFR100 guidelines;

Mechanical structures, systems, and components not classified as Seismic Category I have no seismic classification.

The selection of Category I structures, systems, and components is in accordance with the definition above and the guidance provided by Regulatory Guide 1.29. Individual components in Category I systems are classified by reference to the safety classes assigned in accordance with ANSI N18.2 (see Section 3.2.2). All components in Safety Classes 1, 2, and 3 are Seismic Category I.

The seismic category and safety and quality classification of mechanical components within the CESSAR scope are listed in Table 3.2-1. The only process piping included in the CESSAR scope is the RCS main loop piping. The safety class boundaries of other process piping, (not included in CESSAR scope) is indicated on the P&ID's (Chapters 5.0, 6.0, and 9.0). Seismic Category I includes all mechanical components within the safety class boundaries and extends to the first seismic restraint beyond the boundary. Structures or supports essential to the performance of a safety function by a mechanical component or capable of disabling interaction with it are designed to Seismic Category I requirements for structural integrity only. Where structures or supports essential to the performance of a safety function are not provided by C-E, interface requirements are stated in the interface sections. This allows the Applicant to design in such a way that any structures, systems, or components that could potentially have a disabling interaction with C-E supplied Seismic Category I mechanical structures, systems, or components are either prevented from doing so or are designed to meet Seismic Category I structural integrity requirements. 6

The listing of major electrical components, which are normally in the C-E scope of supply is listed in Section 3.11, which also includes safety and quality classification. Electrical structures, systems, and components not classified as Seismic Category I, but whose failure could represent a hazard 6

to the operator or could interfere with the performance of required safety functions of electrical structures systems and components, are classified as Seismic Category II[2]. Any electrical system or structure or component not in Seismic Category I or II is considered non-seismic; see Section 3.10. The use of Seismic Category II is limited to non-safety control system 6
components, which are designed and documented to maintain structural integrity during an SSE.

For purposes of this discussion, the motors and solenoids used to provide motive power to mechanical components are treated as part of the mechanical component.

3.2.2 SYSTEM QUALITY GROUP CLASSIFICATIONS (SAFETY CLASS)

Fluid system components important to safety are classified in accordance with ANSI N18.2[1]. For purposes of CESSAR, Safety Class 1, 2, 3, 4 of ANSI-N18.2 are equivalent to Quality Groups A, B, C, D of Regulatory Guide 1.26. The criteria establish safety classes which are used as a guide to 6
the selection of codes, standards, and quality assurance provisions for the design and construction of the components. The safety class designations are also used as a guide to those fluid system components to be classified as Seismic Category I (see Section 3.2.1).

The Safety Class definitions in ANSI N18.2 are summarized as follows:

1. Safety Class 1 applies to components whose failure could cause a condition III or IV loss of reactor coolant;

2. Safety Class 2 applies to reactor containment, and to those components in the reactor coolant pressure boundary not in Safety Class 1, and to those components of safety systems that are necessary to:

    a) Remove heat directly from the reactor or reactor containment;
    b) Circulate reactor coolant for any safety system purpose;
    c) Control radioactivity released within the reactor containment, or
    d) Control hydrogen in the reactor containment;

3. Safety Class 3 applies to those components not in Safety Class 1 or 2:

    a) The failure of which would result in release to the environment of radioactive gases normally required to be held for decay; or
    b) That are necessary to:
        (1) Provide or support a safety system function; or
        (2) Control airborne radioactivity released outside the reactor containment in an accident; or
        (3) Remove decay heat from spent fuel.

4. Safety Class 4 (non-nuclear safety[1]) applies to those components not in Safety Class 1, 2, or 3 that:

    a) Could influence safe normal operation; or
    b) May contain radioactive fluids.

The safety classifications of major components which are in the CESSAR licensing scope are listed in Table 3.2-1 and Section 3.11. Seismic category designations and quality assurance requirements are also included. Small

components, such as piping and strainers are not listed; they may be found by reference to the P&ID's (Chapters 5.0, 6.0, and 9.0) where the exact boundaries are indicated.

All pressure containing components in Safety Classes 1, 2, and 3 are designed, manufactured, and tested in accordance with the rules of the ASME Boiler and Pressure Vessel Code, Section III. Components in Safety Class 4 are designed and constructed with appropriate consideration of the intended service using applicable industry codes and standards. The relationship between safety class and code class is shown in Table 3.2-2. A higher code class may be used for component without changing the safety class or affecting the balance of the system in which it is located.

Fracture toughness requirements are imposed on materials for pressure retaining parts of ASME Class 2 and 3 CESSAR system components. Test methods, acceptance, and exemption criteria are in conformance with the ASME Code, Section III.

The safety classification system is also used to identify those components to which the requirements of 10CFR50, Appendix B, are applicable. Components in Safety Classes 1, 2, and some components in Safety Class 3 are designed and manufactured under a rigorous quality assurance program reflecting the requirements of Appendix B, and are designated Quality Class 1. The Quality Class 1 quality assurance program is described in Chapter 17. Components which do not serve a safety related function are designated Quality Class 2. Quality Class 2 components will be designed and manufactured in accordance with the pertinent requirements of the Quality Assurance Program as given in Chapter 17. 7

The quality class of major mechanical and electrical components are shown in Table 3.2-1 and Section 3.11, respectively, in conjunction with the safety and seismic classifications.

The use of the above outlined safety and quality classification systems meets the intent of Regulatory Guide 1.26 and the requirements of 10CFR50 Section 50.55a.

REFERENCES FOR SECTION 3.2

1. ANSI N18.2a-1975 (ANS 51.8), "Revision and Addendum to Nuclear Safety Criteria for the Design of Stationary Pressurized WaterReactor Plants," ANSI N18.2-1973.

2. CENPD-182, Seismic Qualification of C-E Instrumentation Equipment, May 1977.

TABLE 3.2-1

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CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS

	Safety Class	Seismic Category	Quality Class	
Reactor Coolant System				
* Reactor Vessel	1	I	1	6
* Steam generators (primary/secondary)	1/2 (1)	I	1	
* Pressurizer	1	I	1	
* Reactor coolant pumps (3) (4) (10)	1	I	1	7
Piping within reactor coolant pressure boundary (6)	1/2 (5)	I	1	6
Control element drive mechanisms (7)	N/A	N/A	1	
Core support structures (8)	N/A	I (2)	1	
Fuel assemblies (9)	N/A	I	1	
Control element assemblies (9)	N/A	I	1	
Closure Head Lift Rig	4	N/A	2	7
Safety Injection System				
* Low pressure safety injection pumps	2	I	1	6
* High pressure safety injection pumps	2	I	1	
* Shutdown cooling heat exchangers	2/3 (1)	I	1	
* Safety injection tanks	2	I	1	
Chemical and Volume Control System				
* Regenerative heat exchanger	2	I	1	6
* Letdown heat exchanger	2/3 (1)	I	1	
* Seal injection heat exchanger	2/3 (1)	I	1	
* Purification ion exchangers	2	I	1	
* Deborating ion exchanger	2	I	1	
* Volume control tank	2	I	1	
* Chemical addition package	4	N/A	2	
* Boric acid batching tank	4	N/A	2	
* Charging pumps	2	I	1	
* Boric acid makeup pumps	3	I	2	
* Reactor Makeup water pumps	4	N/A	2	
* Boric acid concentrator	4	N/A	2	
* Preholdup ion exchanger	3	I	2	

N/A is Not Applicable

Footnotes to this table are given at the end of the table.

* including component supports down to (but not including) embedments. 6

CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS

	Safety Class	Seismic Category	Quality Class	
Chemical and Volume Control System (Cont'd.)				
* Boric acid condensate ion exchanger	4	N/A	2	
* Reactor drain pumps	3	I	2	
* Holdup pumps	4	N/A	2	
* Reactor drain tank	4	N/A	2	
* Holdup tank	4	N/A	2	
* Equipment drain tank	3	I	2	
* Refueling water tank	2	I	1	
* Reactor makeup water tank	4	N/A	2	
* Gas stripper	3	I	2	
* Purification filters	2	I	1	6
* Reactor drain filter	3	I	2	
* Seal injection filters	2	I	1	
* Reactor makeup filter	4	N/A	2	
* Boric acid filter	3	I	2	
Letdown Strainer	2	1	1	
Preholdup Strainer	3	1	1	
Boric Acid Condensate Ion Exchanger Strainer	4	N/A	2	
Ion Exchanger Drain Header Strainer	4	N/A	2	
Boric Acid Batching Strainer	4	N/A	2	
Chemical Addition Strainer	4	N/A	2	
Fuel Handling System				
Refueling Machine	N/A	N/A	2	
Fuel Transfer System	N/A	N/A	2	
1. Transfer Carriage	N/A	N/A	2	
2. Upending Machine	N/A	N/A	2	
3. Hydraulic Power Unit	N/A	N/A	2	
Fuel Transfer Tube, Valve	N/A	N/A	2	
CEA Change Platform	N/A	N/A	2	
Long and Short Fuel Handling Tools	N/A	N/A	2	6
Reactor Vessel Head Lifting Rig	4	N/A	2	
Upper Guide Structure Lifting Rig	N/A	N/A	2	
Core Barrel Lifting Rig	N/A	N/A	2	
Spent Fuel Handling Machine	N/A	N/A	2	
New Fuel Elevator	N/A	N/A	2	
Underwater Television	N/A	N/A	2	
Dry Sipping Equipment	N/A	N/A	2	
Refueling Pool Seal	N/A	N/A	2	
In-Core Instrumentation and CEA Cutter	N/A	N/A	2	
Extension Shaft Uncoupling Tool	N/A	N/A	2	
Fuel Transfer Tube Blind Flange	2	1	2	
CEA Handling Tools	N/A	N/A	2	

TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES 7

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Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class
Reactor Coolant System (RCS) (12)				7
RC-212	Reactor vessel vent	1	I	1
RC-214	Refueling level indicator	1	I	1
RC-215, 216, 232, 332, 233, 333, 234, 334, 235, 335	RCS drains	1	I	1
RC-248, 249, 252, 253, 256, 257, 260, 261	Reactor coolant pump (RCP)	2	I	1
RC-206, 207, 208, 209	Pressurizer level indicator	2	I	1
RC-204, 205	Pressurizer pressure indicator	2	I	1
RC-239	Pressurizer vent	1	I	1
RC-200, 201, 202, 203	Pressurizer safety	1	I	1
RC-240, 241, 242, 243, 236, 237	Pressurizer spray line	1	I	1
RC-100E, 100F	Pressurizer spray line control	1	I	1
RC-244	Pressurizer spray line check	1	I	1
RC-210, 213, 238	Sample System	2	I	1
RC-211	Reactor Vessel Closure Head Leakoff	2	I	1
RC-292, 293, 294, 295, 296, 297, 298, 299	RCS pressure differential	2	I	1
RC-752, 753, 754, 755	RCP Seal Housing Drain	1	I	1
RC-712, 713, 714, 715	RCP Vent	1	I	1
RC-446, 447, 448, 449, 450, 451, 452, 453	RCP HP Cooler	1	I	1
RC-772, 773, 774, 775	RCP HP Cooler vent	1	I	1
RC-868, 869, 870, 871, 700, 701, 702, 703	RCP filter drain	1	I	1
RC-724, 725, 726, 727, 736, 737, 738, 739	RCP seal cooler pressure	2	I	1
RC-430, 431, 432, 433, 344, 345, 346, 347	RCP controlled bleedoff	2	I	1
RC-380, 381, 382, 383	RCP vapor seal pressure indicator	2	I	1
Chemical and Volume Control System (CVCS) (12)				
CH-100	VCT Vent Isolation	3	I	1
CH-101	Letdown Check	2	I	1 7
CH-103	VCT Vent Pressure Indicator Isolation	2	I	1
CH-104	VCT Vent Isolation	2	I	1
CH-110P	Letdown Control	2	I	1
CH-110Q	Letdown Control	2	I	1
CH-112	VCT Gas Supply Line Check	2	I	1
CH-113	VCT Level Indicator Isolation	2	I	1

TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 4 of 20) 7

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class
CH-114	VCT Level Indicator Isolation	2	I	1
CH-115	VCT to EDT Relief	2	I	1
CH-116	VCT Local Sample Line Isolation	2	I	1
CH-117	CVT to DRDH Isolation	2	I	1
CH-118	VCT Check	2	I	1
CH-124	RWT Supply Isolation	2	I	1
CH-126	BABT Line to RWT Isolation	3	I	1
CH-127	BAC Line to RWT Check	3	I	1
CH-128	RWT Level Indicator Isolation	2	I	1
CH-129	RWT Level Indicator Isolation	2	I	1
CH-130	BAMP Recirc Isolation	3	I	1
CH-131	Boric Acid Filter D/P Indicator Isolation	3	I	1
CH-132	BAMP Discharge Filter Vent	3	I	1
CH-134	BAMP to DRDH Isolation	3	I	1
CH-135	RWT Level Indicator Isolation	2	I	1
CH-136	RWT Level Indicator Isolation	2	I	1
CH-137	RWT Level Indicator Isolation	2	I	1
CH-138	RWT Level Indicator Isolation	2	I	1
CH-139	Gas Stripper to VCT Check	2	I	1
CH-143	BAMP Suction Isolation	3	I	1
CH-144	RWT to PCPS Isolation	3	I	1
CH-145	BAMP Suction Isolation	3	I	1
CH-146	RAMP Discharge Pressure Indicator Isolation	3	I	1
CH-147	BAMP Discharge Pressure Indicator Isolation	3	I	1 7
CH-152	BAMP Discharge Isolation	3	I	1
CH-153	BAMP Discharge Isolation	3	I	1
CH-154	BAMP Discharge Check	3	I	1
CH-155	BAMP Discharge Check	3	I	1
CH-156	RWT Level Indicator Isolation	2	I	1
CH-157	RWT Level Indicator Isolation	2	I	1
CH-158	RWT Level Indicator Isolation	2	I	1
CH-159	RWT Level Indicator Isolation	2	I	1
CH-161	Boric Acid Makeup to VCT Check	3	I	1
CH-164	Boric Acid Filter Bypass	3	I	1
CH-165	Boric Acid Filter D/P Indicator Isolation	3	I	1
CH-166	Boric Acid Makeup to VCT Isolation	3	I	1
CH-172	Boric Acid Makeup to VCT Isolation	3	I	1
CH-174	Boric Acid Makeup Cross-connect	3	I	1
CH-176	Boric Acid Local Sample Isolation	3	I	1
CH-177	Boric Acid Line to Charging Pump Suction Check	2	I	1

TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 5 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class
CH-179	RMW Line to Charging Pump Suction Check	2	I	1
CH-184	RMW Line to VCT Check	3	I	1
CH-185	RMW Local Sample Isolation	3	I	1
CH-188	VCT Check	2	I	1
CH-190	RWT Gravity Feed Check	2	I	1
CH-192	BAMP to RWT Recirc	3	I	1
CH-197	Sampling System Check	2	I	1
CH-198	RCP Controlled Bleedoff Isolation	2	I	1
CH-199	RCP Controlled Bleedoff to RDT Relief	2	I	1
CH-201P	Letdown Backpressure	2	I	1
CH-201Q	Letdown Backpressure	2	I	1
CH-203	Auxiliary Spray	1	I	1
CH-204	PRM Flow Control	2	I	1
CH-205	Auxiliary Spray	1	I	1
CH-210Y	Boric Acid Makeup Control	3	I	1
CH-231P	Seal Injection Isolation	2	I	1
CH-240	Charging Line Backpressure	1	I	1
CH-241	Seal Injection Flow Control	2	I	1
CH-242	Seal Injection Flow Control	2	I	1
CH-243	Seal Injection Flow Control	2	I	1
CH-244	Seal Injection Flow Control	2	I	1
CH-255	Seal Injection Containment Isolation	2	I	1
CH-300	RCP Controlled Bleedoff Pressure Indicator Isolation	2	I	1
CH-305	RWT Gravity Feed Check	2	I	1
CH-306	RWT to SIS Check	2	I	1
CH-314	Hydrostatic Test Pump Isolation	2	I	1
CH-315	Charging Pump to EDT Relief	2	I	1
CH-316	Charging Pump Suction Isolation	2	I	1
CH-317	Charging Pump Suction to DRDH Isolation	2	I	1
CH-318	Charging Pump to EDT Relief	2	I	1
CH-319	Charging Pump Suction Isolation	2	I	1
CH-320	Charging Pump Suction to DRDH Isolation	2	I	1
CH-321	Charging Pump to EDT Relief	2	I	1
CH-322	Charging Pump Suction Isolation	2	I	1
CH-323	Charging Pump Suction to DRDH Isolation	2	I	1
CH-324	Charging Pump Relief	2	I	1
CH-325	Charging Pump Relief	2	I	1
CH-326	Charging Pump Relief	2	I	1
CH-327	RWT Gravity Feed Isolation	2	I	1
CH-328	Charging Pump Discharge Check	2	I	1
CH-329	Charging Pump Discharge to DRDH Isolation	2	I	1

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TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 6 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class
CH-330	BAMP Line to HT Isolation	3	I	1
CH-331	Charging Pump Discharge Check	2	I	1
CH-332	Charging Pump Discharge to DRDH Isolation	2	I	1
CH-334	Charging Pump Discharge Check	2	I	1
CH-335	Charging Pump Discharge Isolation	2	I	1
CH-336	Charging Pump Discharge to DRDH Isolation	2	I	1
CH-337	Charging Pump Discharge Isolation	2	I	1
CH-339	Charging Pump Discharge Isolation	2	I	1
CH-340	Letdown Control Valve Isolation	2	I	1
CH-341	Letdown Control Valve Isolation	2	I	1
CH-342	Letdown Control Valve Isolation	2	I	1
CH-343	Letdown Control Valve Isolation	2	I	1
CH-344	Letdown Flow Indicator Isolation	2	I	1
CH-345	Letdown to EDT Relief	2	I	1
CH-346	Letdown Pressure Control Isolation	2	I	1
CH-347	Letdown Backpressure Valve Isolation	2	I	1
CH-348	Letdown Backpressure Valve Isolation	2	I	1
CH-349	Letdown Backpressure Valve Isolation	2	I	1
CH-350	Letdown Backpressure Vavle Isolation	2	I	1
CH-351	Letdown Flow Indicator Isolation	2	I	1
CH-352	Letdown Pressure indicator Isolation	2	I	1
CH-353	Sampling System Isolation	2	I	1
CH-354	Letdown to EDT Relief	2	I	1
CH-355	Letdown Filter Bypass	2	I	1
CH-356	Letdown Filter D/P Isolation	2	I	1
CH-357	Letdown Filter D/P Isolation	2	I	1
CH-358	Letdown Filter Isolation	2	I	1
CH-359	Letdown Filter Vent	2	I	1
CH-360	Letdown Filter Isolation	2	I	1
CH-361	Letdown to DRDH Isolation	2	I	1
CH-362	Shutdown Cooling Check	2	I	1
CH-363	Shutdown Cooling Isolation	2	I	1
CH-364	PRM and Boronometer Isolation	2	I	1
CH-366	Letdown Filter Vent	2	I	1
CH-367	PRM Flow Control Valve Isolation	2	I	1
CH-368	PRM Flow Control Valve Isolation	2	I	1
CH-369	IX Isolation	2	I	1
CH-370	IX Check	2	I	1
CH-371	IX Vent to GWMS	2	I	1
CH-372	IX Resin Fill Isolation	2	I	1
CH-373	Letdown Filter Isolation	2	I	1
CH-374	IX Isolation	2	I	1
CH-375	Letdown to DRDH Isolation	2	I	1

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TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 7 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class
CH-376	Letdown Filter Isolation	2	I	1
CH-378	IX Isolation	2	I	1
CH-379	RSSH to IX Isolation	2	I	1
CH-380	IX to SWMS Isolation	2	I	1
CH-381	IX Bypass	2	I	1
CH-382	IX Isolation	2	I	1
CH-383	IX Isolation	2	I	1
CH-384	IX Check	2	I	1
CH-385	IX Bypass	2	I	1
CH-386	IX Vent to GWMS	2	I	1
CH-387	IX Resin Fill Isolation	2	I	1
CH-389	IX Isolation	2	I	1
CH-390	RSSH to IX Isolation	2	I	1
CH-391	IX to SWMS Isolation	2	I	1
CH-392	IX Isolation	2	I	1
CH-393	RHTX Vent	2	I	1
CH-394	IX Bypass	2	I	1
CH-395	IX Isolation	2	I	1
CH-396	LPSI Check	2	I	1
CH-397	LPSI Isolation	2	I	1
CH-398	IX Isolation	2	I	1
CH-399	RSSH to IX Isolation	2	I	1
CH-400	IX to SWMS Isolation	2	I	1
CH-401	IX Vent to GWMS	2	I	1
CH-402	IX Resin Fill Isolation	2	I	1
CH-403	IX Check	2	I	1
CH-404	IX Isolation	2	I	1
CH-405	Charging Line Backpressure D/P Isolation	2	I	1
CH-406	Charging Line Backpressure D/P Isolation	1	I	1
CH-407	IX D/P Isolation	2	I	1
CH-408	IX D/P Isolation	2	I	1
CH-413	PRM Bypass	2	I	1
CH-414	Letdown Strainer Bypass	2	I	1
CH-415	IX Isolation	2	I	1
CH-418	Letdown to VCT Isolation	2	I	1
CH-419	Letdown Strainer to SWMS Isolation	2	I	1
CH-420	IX Effluent Sample Isolation	2	I	1
CH-421	Boronometer Isolation	2	I	1
CH-422	PRM Flow Indicator Isolation	2	I	1
CH-423	PRM Flow Control Spring Loaded Check Bypass	2	I	1
CH-424	PRM Flow Control Bypass	2	I	1
CH-425	Charging Line Pressure Indicator Isolation	2	I	1

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TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 8 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class
CH-426	Letdown Sample Isolation	2	I	1
CH-427	Charging Line Flow Indicator Isolation	2	I	1
CH-428	Charging Line Flow Indicator Isolation	2	I	1
CH-429	Charging Line Isolation	2	I	1
CH-431	Auxiliary Spray Check	1	I	1
CH-433	Charging Line Check	1	I	1
CH-434	Charging Line Backpressure Bypass	1	I	1
CH-435	Charging Line Backpressure Spring Loaded Bypass Check	1	I	1
CH-436	Hydrogen Addition Line Isolation	2	I	1
CH-437	Charging Pump Pressure Switch Isolation	2	I	1
CH-438	Charging Pump Pressure Switch Isolation	2	I	1
CH-439	Charging Pump Pressure Switch Isolation	2	I	1
CH-440	Charging to HPSI Check	2	I	1
CH-444	Letdown Heat Exchanger Vent	3	I	1
CH-445	Letdown Line Vent	2	I	1
CH-449	PRM and Boronometer Check	2	I	1
CH-450	RDH to EDT Check	3	I	1
CH-459	EDT Line to GWMS Pressure Indicator Isolation	3	I	1
CH-460	EDT Level Indicator Isolation	3	I	1
CH-461	EDT Level Indicator Isolation	3	I	1
CH-464	EDT to RDP Check	3	I	1
CH-465	RDP Suction Isolation	3	I	1
CH-466	RDP Suction Isolation	3	I	1
CH-467	Gas Stripper to GWMS Isolation	3	I	1
CH-468	RDP Discharge Pressure Indicator Isolation	3	I	1
CH-469	RDP Discharge Pressure Indicator Isolation	3	I	1
CH-470	RDP Discharge Check	3	I	1
CH-471	RDP Discharge Check	3	I	1
CH-472	RDP Discharge Isolation	3	I	1
CH-462	EDT Drain Isolation	3	I	1
CH-473	RDP Discharge Isolation	3	I	1
CH-474	Reactor Drain Filter Bypass	3	I	1
CH-475	RDP Discharge to RDH Isolation	3	I	1
CH-476	Reactor Drain Filter D/P Isolation	3	I	1
CH-477	Reactor Drain Filter Isolation	3	I	1
CH-478	Reactor Drain Filter Isolation	3	I	1
CH-479	Reactor Drain Filter D/P Isolation	3	I	1
CH-480	IDH to EDT Check	3	I	1
CH-485	Pre-Holdup IX to RSSH Isolation	3	I	1
CH-486	Pre-Holdup IX DiDH Isolation	3	I	1

TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 9 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class	
CH-488	Pre-Holdup IX D/P Isolation	3	I	1	
CH-489	Pre-Holdup Strainer to SWMS Isolation	3	I	1	
CH-490	Pre-Holdup IX Isolation	3	I	1	
CH-491	Pre-Holdup IX Strainer Isolation	3	I	1	
CH-492	Pre-Holdup IX D/P Isolation	3	I	1	
CH-493	Pre-Holdup IX Effluent Sample Isolation	3	I	1	
CH-494	RSSH and RDP to RDH Check	2	I	1	
CH-495	Pre-Holdup IX to RWT Isolation	3	I	1	
CH-496	Pre-Holdup IX to GS/EDT Isolation	3	I	1	
CH-500	VCT Inlet Diverting	2	I	1	
CH-501	VCT Discharge Isolation	2	I	1	
CH-505	RCP Controlled Bleedoff Containment Isolation	2	I	1	
CH-506	RCP Controlled Bleedoff Containment Isolation	2	I	1	
CH-507	RCP Controlled Bleedoff Containment Isolation	2	I	1	
CH-510	RWT Recirc	3	I	1	
CH-512	VCT Makeup Supply Isolation	3	I	1	
CH-513	VCT Vent	2	I	1	7
CH-514	Boric Acid Makeup Bypass to Charging Pumps	3	I	1	
CH-515	Letdown Isolation	1	I	1	
CH-516	Letdown Isolation	1	I	1	
CH-520	Purification and Deborating IX Bypass	2	I	1	
CH-521	PRM and Boronometer Bypass	2	I	1	
CH-523	Letdown Isolation	2	I	1	
CH-524	Charging Line Isolation	2	I	1	
CH-526	Letdown Control Valve Bypass	2	I	1	
CH-527	Load Follow Supply	3	I	1	
CH-530	RWT Suction to ESFP's Isolation	2	I	1	
CH-531	RWT Suction to RSFP's Isolation	2	I	1	
CH-532	RWT Suction to RDP's Isolation	2	I	1	
CH-536	RWT Gravity Feed to Charging Pumps Isolation	3	I	1	
CH-560	RDT Suction Isolation	2	I	1	
CH-561	RDT Isolation	2	I	1	
CH-562	RDH Isolation	3	I	1	
CH-563	EDT Discharge Isolation	3	I	1	
CH-564	EDT Vent Isolation	3	I	1	
CH-565	Pre-Holdup IX Bypass	3	I	1	
CH-566	Gas Stripper Diversion	3	I	1	
CH-567	Diversion to HT from VCT Inlet	3	I	1	

TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 10 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class	
CH-580	RMWS to RDT Isolation	2	I	1	
CH-612	Seal Injection Line Vent Isolation	2	I	1	
CH-613	Seal Injection Line Vent Isolation	2	I	1	
CH-614	Seal Injection Vent	3	I	1	
CH-639	Charging Line Check	2	I	1	
CH-642	Hydrostatic Test Pump Isolation	2	I	1	
CH-643	VCT Vent to GWMS Isolation	3	I	1	
CH-645	Gas Addition to VCT Isolation	2	I	1	
CH-646	RCP Controlled Bleedoff Line Check	2	I	1	
CH-647	RWT Recirc Check	2	I	1	
CH-648	RWT Recirc Sample Isolation	3	I	1	
CH-649	Boric Acid Line to RWT Isolation	3	I	1	
CH-653	Boric Acid Line Isolation	3	I	1	
CH-654	MSH to Gas Stripper Isolation	3	I	1	
CH-655	Pre-Holdup IX to Radiation Monitor Isolation	3	I	1	
CH-656	Gas Stripper to HT Isolation	3	I	1	
CH-657	EDT Relief to Misc Radioactive Sump	3	I	1	
CH-659	Chemical Addition Line Isolation	2	I	1	
CH-660	Gas Stripper Inlet Isolation	3	I	1	
CH-663	Reactor Drain Filter Vent	3	I	1	
CH-665	RDP Discharge Sample Isolation	3	I	1	7
CH-668	BAM Line to VCT Check	3	I	1	
CH-686	Holdup Pump Bypass to Reactor Drain Filter Isolation	3	I	1	
CH-721	Letdown to Pre-Holdup IX Isolation	3	I	1	
CH-722	Letdown to Pre-Holdup IX Check	3	I	1	
CH-723	Reactor Drain Line Sample Isolation	3	I	1	
CH-724	Pre-Holdup IX Isolation	3	I	1	
CH-725	Pre-Holdup IX Check	3	I	1	
CH-726	Pre-Holdup IX Resin Fill Isolation	3	I	1	
CH-727	Pre-Holdup IX D/P Isolation	3	I	1	
CH-728	Pre-Holdup IX Vent Isolation	3	I	1	
CH-730	Pre-Holdup IX to SWMS Isolation	3	I	1	
CH-740	RCP Controlled Bleedoff Test Connection Isolation	2	I	1	
CH-741	RCP Controlled Bleedoff Test Connection Isolation	2	I	1	
CH-742	RCP Controlled Bleedoff Test Connection Isolation	2	I	1	
CH-743	RCP Controlled Bleedoff Test Connection Isolation	2	I	1	
CH-753	BAMP Recirc Isolation	3	I	1	

TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 11 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class
CH-755	Gravity Feed to Charging Pump Isolation	2	I	1
CH-756	Gravity Feed to Charging Pump Isolation	2	I	1
CH-757	Gravity Feed to Charging Pump Isolation	2	I	1
CH-787	Seal Injection Check	1	I	1
CH-789	Seal Injection Flow Indicator Isolation	2	I	1
CH-796	Charging to HPSI Isolation	2	I	1
CH-797	Charging to HPSI Isolation	2	I	1
CH-798	Charging to HPSI Isolation	2	I	1
CH-800	Seal Injection Flow Indication Isolation	2	I	1
CH-802	Seal Injection Check	1	I	1
CH-804	Seal Injection Flow Indicator Isolation	2	I	1
CH-805	Seal Injection Flow Indicator Isolation	2	I	1
CH-807	Seal Injection Check	1	I	1
CH-809	Seal Injection Flow Indicator Isolation	2	I	1
CH-810	Seal Injection Flow Indicator Isoaltion	2	I	1
CH-812	Seal Injection Check	1	I	1
CH-814	Seal Injection Flow Indicator Isolation	2	I	1
CH-815	Seal Injection Flow Indicator Isolation	2	I	1
CH-816	Seal Injection Filter Isolation	2	I	1
CH-818	Seal Injection Filter Isolation	2	I	1
CH-819	Seal Injection Filter Isolation	2	I	1
CH-821	Seal Injection Filter Isolation	2	I	1
CH-822	Seal Injection to DRDH Isoaltion	2	I	1
CH-823	Seal Injection to DRDH Isolation	2	I	1
CH-825	Seal Injection Filter D/P Isolation	2	I	1
CH-826	Seal Injection Filter D/P Isolation	2	I	1
CH-830	Nitrogen Supply to EDT Isolation	3	I	1
CH-831	Nitrogen Supply Pressure Control	3	I	1
CH-833	Seal Injection Test Connection Isolation	2	I	1
CH-834	Seal Injection Test Connection Isolation	2	I	1
CH-835	Seal Injection Check	2	I	1
CH-836	Seal Injection Isolation	2	I	1
CH-839	Seal Injection Isolation	2	I	1
CH-843	RHTX Vent Isolation	2	I	1
CH-844	Seal Injection Filter Vent	2	I	1
CH-845	Seal Injection Filter Vent	2	I	1
CH-848	Seal Injection Test Connection Isolation	1	I	1
CH-849	Seal Injection Test Connection Isolation	1	I	1
CH-853	Letdown Line Test Connection Isolation	1	I	1
CH-854	Charging Line Test Connection Isolation	2	I	1
CH-855	Letdown Line Test Connection Isolation	2	I	1
CH-856	BAMP Suction Line Test Connection Isolation	3	I	1

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TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 12 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class	
CH-858	RSSH Line to EDT Check	3	I	1	
CH-859	Seal Injection Test Connection Isolation	1	I	1	
CH-860	Seal Injection Test Connection Isolation	1	I	1	
CH-861	RSSH to EDT Isolation	3	I	1	
CH-862	RMWT Supply to RDT Isolation	3	I	1	
CH-863	Chemical Addiition Isolation	2	I	1	
CH-865	Seal Injection Relief to EDT	2	I	1	
CH-866	Seal Injection Check	1	I	1	
CH-867	Seal Injection Check	1	I	1	
CH-868	Seal Injection Check	1	I	1	
CH-869	Seal Injection Check	1	I	1	
Safety Injection and Shutdown Cooling Systems (SIS) (SCS) (12)					
SI-104	CSP Suction Isolation	2	I	1	
SI-105	CSP Suction Isolation	2	I	1	
SI-140	Sump Suction Thermal Relief	2	I	1	
SI-141	PCPS Suction Thermal Relief	2	I	1	7
SI-150	PCPS Suction Thermal Relief	2	I	1	
SI-151	Sump Suction Thermal Relief	2	I	1	
SI-157	CSP Suction Check	2	I	1	
SI-158	CSP Suction Check	2	I	1	
SI-161	PCPS Discharge Thermal Relief	2	I	1	
SI-162	PCPS Discharge Thermal Relief	2	I	1	
SI-170	SDCHX Vent	2	I	1	
SI-172	SDCHX Drain	2	I	1	
SI-174	CS Flow Inst Isolation	2	I	1	
SI-175	CS Flow Inst Isolation	2	I	1	
SI-176	CS Flow Inst Isolation	2	I	1	
SI-177	CS Flow Inst Isolation	2	I	1	
SI-180	SDCHX Vent	2	I	1	
SI-182	SDCHX Drain	2	I	1	
SI-184	LPSI-CSP Interconnection	2	I	1	
SI-185	LPSI-CSP Interconnection	2	I	1	
SI-191	CS Header Relief	2	I	1	
SI-192	PCPS Discharge Thermal Relief	2	I	1	
SI-193	PCPS Discharge Thermal Relief	2	I	1	
SI-194	CS Header Relief	2	I	1	
SI-200	LPSI Suction Check	2	I	1	
SI-201	LPSI Suction Check	2	I	1	
SI-202	Sample Line Isolation	2	I	1	
SI-203	Sample Line Isolation	2	I	1	

TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 13 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class	
SI-204	PCPS Suction Isolation	2	I	1	
SI-205	Sump Suction Check	2	I	1	
SI-206	Sump Suction Check	2	I	1	
SI-207	Sump Suction Test	2	I	1	
SI-208	Sump Suction Test	2	I	1	
SI-218	HPSI Orifice Bypass	2	I	1	
SI-219	HPSI Orifice Bypass	2	I	1	
SI-256	PCPS Suction Isolation	2	I	1	
SI-257	PCPS Sample Isolation	2	I	1	
SI-260	SDCHX Vent Isolation	2	I	1	
SI-262	SDCHX Drain Isolation	2	I	1	
SI-264	SDCHX Vent Isolation	2	I	1	
SI-266	SDCHX Drain Isolation	2	I	1	
SI-268	PCPS Sample Isolation	2	I	1	
SI-285	RWT Recirc Line Relief	2	I	1	
SI-286	RWT Recirc Line Relief	2	I	1	
SI-287	SDCHX Bypass Relief	2	I	1	
SI-288	RWT Return Relief	2	I	1	
SI-289	SDCHX Bypass Relief	2	I	1	7
SI-298	RWT Line Isolation	2	I	1	
SI-306	SCS Bypass Flow Control	2	I	1	
SI-307	SCS Bypass Flow Control	2	I	1	
SI-400	RWT Return Line Isolation	2	I	1	
SI-402	HPSI Suction Isolation	2	I	1	
SI-404	HPSI Discharge Check	2	I	1	
SI-405	HPSI Discharge Check	2	I	1	
SI-407	RWT Return Line Relief	3	I	1	
SI-408	Pressure Gage Isolation	2	I	1	
SI-409	HP Header Relief	2	I	1	
SI-416	Pressure Gage Isolation	2	I	1	
SI-417	HPSI Header Relief	2	I	1	
SI-418	Shutdown Purif. Suction Isolation	2	I	1	
SI-419	Shutdown Purif. Suction Isolation	2	I	1	
SI-420	Shutdown Purif. Isolation	2	I	1	
SI-421	Shutdown Purif. Isolation	2	I	1	
SI-424	HPSI Mini-flow Check	2	I	1	
SI-426	HPSI Mini-flow Check	2	I	1	
SI-427	HPSI Discharge SS Isolation	2	I	1	
SI-429	Shutdown Cooling Line SS Isolation	2	I	1	
SI-433	LPSI Discharge Pressure Ind. Iso.	2	I	1	
SI-434	LPSI Discharge Check	2	I	1	
SI-435	LPSI Discharge Isolation	2	I	1	
SI-436	LPSI Discharge Isolation	2	I	1	

TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 14 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class
SI-437	LPSI Flow Inst. Isolation	2	I	1
SI-438	LPSI Flow Inst. Isolation	2	I	1
SI-439	LPSI Discharge Relief to EDT	2	I	1
SI-440	LPSI Flow Inst. Isolation	2	I	1
SI-441	LPSI Flow Inst. Isolation	2	I	1
SI-442	PCPS Suction Isolation	2	I	1
SI-443	PCPS Suction Isolation	2	I	1
SI-445	LPSI Suction SS Isolation	2	I	1
SI-446	LPSI Discharge Check	2	I	1
SI-447	LPSI Discharge Check	2	I	1
SI-448	LPSI Mini-flow Check	2	I	1
SI-449	LPSI Discharge Relief to EDT	2	I	1
SI-450	LPSI Discharge PCPS Isolation	2	I	1
SI-451	LPSI Mini-flow Check	2	I	1
SI-454	LPSI Discharge PCPS Isolation	2	I	1
SI-455	LPSI Discharge PCPS Isolation	2	I	1
SI-458	LPSI Discharge PCPS Isolation	2	I	1
SI-459	RWT Return Line Isolation	2	I	1
SI-460	RWT Return Line Isolation	2	I	1
SI-461	SIT to EDT Isolation	3	I	1
SI-462	SIT Local Sample Isolation	3	I	1
SI-463	SIT Isolation	2	I	1
SI-464	RWT REturn Line Isolation	2	I	1
SI-465	RWT REturn Line SS Isolation	2	I	1
SI-470	HPSI Suction Isolation	2	I	1
SI-473	SIT Relief to RDT	2	I	1
SI-474	SIT Relief to RDT	2	I	1
SI-476	HPSI Discharge Isolation	2	I	1
SI-478	HPSI Discharge Isolation	2	I	1
SI-482	CSP Discharge Pressure Ind. Iso.	2	I	1
SI-483	CSP Discharge Pressure Ind. Iso.	2	I	1
SI-484	CSP Discharge Check	2	I	1
SI-485	CSP Discharge Check	2	I	1
SI-486	CSP Mini-flow Check	2	I	1
SI-487	CSP Mini-flow Check	2	I	1
SI-508	Charging Pump Isolation	2	I	1
SI-509	Charging Pump Isolation	2	I	1
SI-550	LPSI Suction Test Isolation	2	I	1
SI-551	CSP Suction Test Isolation	2	I	1
SI-552	HPSI Suction Test Isolation	2	I	1
SI-553	HPSI Suction Test Isolation	2	I	1
SI-554	CSP Suction Test Isolation	2	I	1
SI-555	LPSI Suction Test Isolation	2	I	1
SI-604	HPSI Hot Leg Injection Isolation	2	I	1
SI-609	HPSI Hot Leg Injection Isolation	2	I	1

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TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 15 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class
SI-657	SDCHX Discharge Throttle	2	I	1
SI-658	SDCHX Discharge Throttle	2	I	1
SI-659	Mini-flow to RWT Isolation	2	I	1
SI-660	Mini-flow to RWT Isolation	2	I	1
SI-661	RDT Isolation	2	I	1
SI-664	CSP Mini-flow Isolation	2	I	1
SI-665	CSP Mini-flow Isolation	2	I	1
SI-666	HPSI Mini-flow Isolation	2	I	1
SI-667	HPSI Mini-flow Isolation	2	I	1
SI-668	LPSI Mini-flow Isolation	2	I	1
SI-669	LPSI Mini-flow Isolation	2	I	1
SI-671	CSS Isolation	2	I	1
SI-672	CSS Isolation	2	I	1
SI-673	Containment Sump Isolation	2	I	1
SI-674	Containment Sump Isolation	2	I	1
SI-675	Containment Sump Isolation	2	I	1
SI-676	Containment Sump Isolation	2	I	1
SI-678	CSP Flow Control	2	I	1
SI-679	CSP Flow Control	2	I	1
SI-682	SIT Fill Line Isolation	2	I	1
SI-683	LPSI Pump Suction Isolation	2	I	1
SI-684	CSP Discharge Isolation	2	I	1
SI-685	LPSI Disch. SDCHX Intake Cross Connect Line Isolation	2	I	1
SI-686	SDCHX Disch. LPSI Header Cross Connect Line Isolation	2	I	1
SI-687	SDCHX Disch. Isolation to CSS Header	2	I	1
SI-688	SDCHX Spray Bypass	2	I	1
SI-689	CSP Discharge Isolation	2	I	1
SI-692	LPSI Suction Isolation	2	I	1
SI-693	SDCHX Spray Bypass	2	I	1
SI-694	LPSI Disch. SDCHX Intake Cross Connect Line Isolation	2	I	1
SI-695	SDCHX Disch. Isolation to CSS Header	2	I	1
SI-696	SDCHX Disch. LPSI Header Cross Connect Line Isolation	2	I	1
SI-698	HPSIP Orifice Bypass	2	I	1
SI-699	HPSIP Orifice Bypass	2	I	1
SI-113	HP Header Check	1	I	1
SI-114	LP Header Check	1	I	1
SI-115	HP Header Flow Ind. Isolation	2	I	1
SI-116	HP Header Flow Ind. Isolation	2	I	1
SI-117	SIT Pressure Ind. Isolation	2	I	1
SI-119	SIT Pressure Ind. Isolation	2	I	1

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TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 16 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class	
SI-123	HP Header Check	1	I	1	
SI-124	LP Header Check	1	I	1	
SI-125	HP Header Flow Ind. Isolation	2	I	1	
SI-126	HP Header Flow Ind. Isolation	2	I	1	
SI-127	SIT Pressure Ind. Isolation	2	I	1	
SI-129	SIT Pressure Ind. Isolation	2	I	1	
SI-133	HP Header Check	1	I	1	
SI-134	LP Header Check	1	I	1	
SI-135	HP Header Flow Ind. Isolation	2	I	1	
SI-136	HP Header Flow Ind. Isolation	2	I	1	
SI-137	SIT Pressure Ind. Isolation	2	I	1	
SI-139	SIT Pressure Ind. Isolation	2	I	1	
SI-143	HP Header Check	1	I	1	
SI-144	LP Header Check	1	I	1	
SI-145	HP Header Flow Ind. Isolation	2	I	1	
SI-146	HP Header Flow Ind. Isolation	2	I	1	
SI-147	SIT Pressure Ind. Isolation	2	I	1	
SI-149	SIT Pressure Ind. Isolation	2	I	1	
SI-164	CS Header Check	2	I	1	
SI-165	CS Header Check	2	I	1	7
SI-166	HP Header Relief to EDT	2	I	1	
SI-169	HP Header Relief to EDT	2	I	1	
SI-179	HP Header Relief to Cont. Sump	2	I	1	
SI-189	HP Header Relief to Cont. Sump	2	I	1	
SI-210	SIT Fill & Drain Isolation	2	I	1	
SI-211	SIT Relief to Atmosphere	2	I	1	
SI-212	SIT Level Ind. Isolation	2	I	1	
SI-213	SIT Level Ind. Isolation	2	I	1	
SI-214	SIT Local Sample Isolation	2	I	1	
SI-215	SIT Check	1	I	1	
SI-216	Injection Line Press. Ind. Iso.	1	I	1	
SI-217	Safety Inj. Line Check	1	I	1	
SI-220	SIT Fill & Drain Isolation	2	I	1	
SI-221	SIT Relief to Atmosphere	2	I	1	
SI-222	SIT Level Ind. Injection	2	I	1	
SI-223	SIT Level Ind. Injection	2	I	1	
SI-224	SIT Local Sample Isolation	2	I	1	
SI-225	SIT Check	1	I	1	
SI-226	Inj. Line Pressure Ind. Iso.	1	I	1	
SI-227	Safety Inj. Line Check	1	I	1	
SI-228	SIT Level Ind. Isolation	2	I	1	
SI-229	SIT Level Ind. Isolation	2	I	1	
SI-230	SIT Fill & Drain Isolation	2	I	1	
SI-231	SIT Relief to Atmosphere	2	I	1	

TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 17 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class	
SI-232	SIT Level Ind. Isolation	2	I	1	
SI-233	SIT Level Ind. Isolation	2	I	1	
SI-234	SIT Local Sample Isolation	2	I	1	
SI-235	SIT Check	1	I	1	
SI-236	Inj. Line Pressure Ind. Iso.	1	I	1	
SI-237	Safety Inj. Line Check	1	I	1	
SI-238	SIT Level Ind. Isolation	2	I	1	
SI-239	SIT Level Ind. Isolation	2	I	1	
SI-240	SIT Fill & Drain Isolation	2	I	1	
SI-241	SIT Relief to Atmosphere	2	I	1	
SI-242	SIT Level Ind. Isolation	2	I	1	
SI-243	SIT Level Ind. Isolation	2	I	1	
SI-244	SIT Local Sample Isolation	2	I	1	
SI-245	SIT Check	1	I	1	
SI-246	Inj. Line Pressure Ind. Iso.	1	I	1	
SI-247	Safety Injection Line Check	1	I	1	
SI-248	SIT Level Ind. Isolation	2	I	1	
SI-249	SIT Level Ind. Isolation	2	I	1	
SI-258	SIT Level Ind. Isolation	2	I	1	7
SI-259	SIT Level Ind. Isolation	2	I	1	
SI-321	HP Hot Leg Injection Isolation	2	I	1	
SI-322	Hot Leg Check Leakage Valve	1	I	1	
SI-331	HP Hot Leg Injection Isolation	2	I	1	
SI-332	Hot Leg Check Leakage Valve	1	I	1	
SI-468	HP Header Relief to EDT	2	I	1	
SI-469	SDC Line Relief to RDT	1	I	1	
SI-500	CSS Test Line Isolation	2	I	1	
SI-501	CSS Test Line Isolation	2	I	1	
SI-506	HP Header Pressure Ind. Iso.	1	I	1	
SI-510	CSS Test Line Isolation	2	I	1	
SI-511	CSS Test Line Isolation	2	I	1	
SI-516	HP Header Pressure Ind. Iso.	1	I	1	
SI-522	HP Header Check	1	I	1	
SI-523	HP Header Check	1	I	1	
SI-525	HP Header Flow Ind. Isolation	2	I	1	
SI-526	HP Header Flow Ind. Isolation	2	I	1	
SI-532	HP Header Check	1	I	1	
SI-533	HP Header Check	1	I	1	
SI-535	HP Header Flow Ind. Isolation	2	I	1	
SI-536	HP Header Flow Ind. Isolation	2	I	1	
SI-605	SIT Atmospheric Vent Isolation	2	I	1	
SI-606	SIT Atmospheric Vent Isolation	2	I	1	
SI-607	SIT ATmospheric Vent Isolation	2	I	1	
SI-608	SIT Atmospheric Vent Isolation	2	I	1	

TABLE 3.2-1

SAFETY CLASS 1, 2 & 3 VALVES

(Sheet 18 of 20)

Component Identification	Location/Description	Safety Class	Seismic Category	Quality Class
SI-611	SIT Fill & Drain Isolation	2	I	1
SI-612	SIT N_2 Supply Isolation	2	I	1
SI-613	SIT Atmospheric Vent Isolation	2	I	1
SI-614	SIT Isolation	1	I	1
SI-615	LPSI Header Isolation	2	I	1
SI-616	HPSI Header Isolation	2	I	1
SI-617	HPSI Header Isolation	2	I	1
SI-618	Check Valve Leakage Line Iso.	1	I	1
SI-619	SIT N_2 Supply Isolation	2	I	1
SI-621	SIT Fill & Drain Isolation	2	I	1
SI-622	SIT N_2 Supply Isolation	2	I	1
SI-623	SIT Atmospheric Vent Isolation	2	I	1
SI-624	SIT Isolation	1	I	1
SI-625	LPSI Header Isolation	2	I	1
SI-626	HPSI Header Isolation	2	I	1
SI-627	HPSI Header Isolation	2	I	1
SI-628	Check Valve Leakage Line Iso.	1	I	1
SI-629	SIT N_2 Supply Isolation	2	I	1
SI-631	SIT Fill & Drain Isolation	2	I	1
SI-632	SIT N_2 Supply Isolation	2	I	1
SI-633	SIT Atmospheric Vent Isolation	2	I	1
SI-634	SIT Isolation	1	I	1
SI-635	LPSI Header Isolation	2	I	1
SI-636	HPSI Header Isolation	2	I	1
SI-637	HPSI Header Isolation	2	I	1
SI-638	Check Valve Leakage Line Iso.	1	I	1
SI-639	SIT N_2 Supply Isolation	2	I	1
SI-641	SIT Fill & Drain Isolation	2	I	1
SI-642	SIT N_2 Supply Isolation	2	I	1
SI-643	SIT Atmos. Vent Isolation	2	I	1
SI-644	SIT Isolation	1	I	1
SI-645	LPSI Header Isolation	2	I	1
SI-646	HPSI Header Isolation	2	I	1
SI-647	HPSI Header Isolation	2	I	1
SI-648	Check Valve Leakage Line Iso.	1	I	1
SI-649	SIT N_2 Supply Isolation	2	I	1
SI-651	SCS Suction Line Isolation	1	I	1
SI-652	SCS Suction Line Isolation	1	I	1
SI-653	SCS Suction Line Isolation	1	I	1
SI-654	SCS Suction Line Isolation	1	I	1
SI-655	SCS Suction Line Isolation	2	I	1
SI-656	SCS Suction Line Isolation	2	I	1
SI-690	SCS Warmup Line Isolation	2	I	1
SI-691	SCS Warmup Line Isolation	2	I	1

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TABLE 3.2-1

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NOTES:

(1) Two safety classes are used for heat exchangers to distinguish primary and secondary sides where they are different.

(2) Only those core support structures necessary to support and restrain the core and to maintain safe shutdown capability are classified as Seismic Category I.

(3) Loss of cooling water and/or seal water service to the reactor coolant pumps (RCP's) may require stopping the pumps. However, the continuous operation of the pumps is not required during or following an SSE. The auxiliaries are therefore not necessarily Safety Class 3 or Seismic Category I. Provision for cooling water to the pump bearing oil cooler and pump motor air cooler will not comply with the requirements of Regulatory Guide 1.29 (see Subsection 5.4.1.3). 6

(4) Only those structural portions of the RCP's which are necessary to assure the integrity of the reactor coolant pressure boundary are Safety Class 1.

(5) Safety class of piping within the reactor coolant pressure boundary (as defined in 10CFR50) is selected in accordance with the ANSI N18.2 criteria identified in Subsection 3.2.2. For purposes of CESSAR, Safety Class 1, 2, 3, 4 of ANSI-N18.2 are equivalent to Quality Groups A, B, C, D of Regulatory Guide 1.26. 6

(6) Flow restricting orifices are provided in the nozzles for the RCS sampling lines, the pressurizer level and pressure instruments, the RCP differential pressure instrument lines, the common SI header pressure instrument lines, the RCP seal pressure instrument lines, the charging line differential pressure instrument line, and the SI hot leg injection pressure instrument lines, to limit flow in the event of a break downstream of a nozzle. The orifice size, 7/32 inch diameter x 1 inch long, precludes exceeding fuel design limits while utilizing minimum makeup rates. This permits an orderly shutdown in the event of a downstream break in accordance with General Design Criterion 33 (see Section 3.1.29). A reduction may, therefore, be made in the safety classification of lines downstream of the orifice.

(7) The pressure boundary housing for this component is a reactor vessel appurtenance and is Safety Class 1 and Seismic Category I, as described in 3.9.4.3. 6

(8) Core Support structures are designed to the criteria described in 3.9.5.4.

(9) CEA and fuel assemblies are designed to the criteria described in 4.2.

(10) Reactor coolant pump auxiliary components required for lubrication and cooling of pump seals and thrust bearings are Quality Class 2. 7

TABLE 3.2-1 (Cont'd)

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(11) Safety-related instrumentation and controls (I & C) described in Sections 7.1 through 7.6 of the FSAR plus safety-related I & C for safety-related fluid systems will be subject to the pertinent 7
requirements of the Quality Assurance Program as given in Chapter 17.

(12) All containment isolation values (and their operators) within C-E's scope of supply - including manual valves, check valves, and relief valves which also serve as isolation valves will be subject to the pertinent requirements of the Quality Assurance Program as given in Chapter 17.

TABLE 3.2-2

RELATIONSHIP OF SAFETY CLASS TO CODE CLASS

Safety Class	Code Class (ASME Section III)
SC-1	1
SC-2 for reactor containment components	MC
SC-2 for fluid system components	2
SC-3	3
NNS	Industry Standards