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July 27, 1988

Mr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Attn: Document Control Desk

Subject: Byron Station Units 1 and 2
Braidwood Station Units 1 and 2
Regulatory Guide 1.97 Compliance
NRC Docket Nos. 50-454/455 and 50-456/457

References (a): February 27, 1987 K.A. Ainger letter to H.R. Denton
(b): September 1, 1987 S.C. Hunsader letter to T.E. Murley
(c): November 6, 1987 L. Olshan letter to L.D. Butterfield
(d): December 28, 1987 S.C. Hunsader letter to T.E. Murley
(e): May 5, 1988 L. Olshan letter to H.E. Bliss

Dear Mr. Murley:

Reference (a) provided our preliminary evaluation of the Byron and Braidwood instrumentation for compliance with Regulatory Guide 1.97, Revision 3. Reference (b) provided the results of our final evaluation which were included as Attachments to that letter. Attachment A to reference (b) provided an update of Table 5-1. Attachment B to reference (b) provided the revised Human Factors Engineering Review. These supplemented the information provided in reference (a) and, together, constituted our "Final Report" concerning Regulatory Guide 1.97 compliance.

Reference (c) provided the results of the initial NRC review and evaluation of references (a) and (b). Commonwealth Edison's (Edison) response to these was provided in reference (d). In reference (e), the NRC staff indicated that it had completed its review and had concluded that Edison's justification for the exceptions to Regulatory Guide 1.97, Revision 3 for some items was acceptable. However, for other items, additional justification was required.

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In response to the NRC staff's review, this letter provides the additional justification or provides an appropriate response to the NRC staff's concerns. These are included in Attachment "A". Please address any questions regarding this matter to this office.

Very truly yours,

S. C. Hunsader

S. C. Hunsader
Nuclear Licensing Administrator

cc: L. Olshan (NRR)
S. Sands (NRR)
W. Forney (NRC RIII)
Byron Resident Inspector
Braidwood Resident Inspector

TECHNICAL EVALUATION REPORT ITEM

3.3.5 Residual Heat Removal (RHR) System Flow

Regulatory Guide 1.97 recommends environmentally qualified instrumentation for this variable. The instrumentation installed to measure the RHR flow is not environmentally qualified. The licensee states that this instrumentation is back-up instrumentation for the key variables to monitor the operation of the RHR system: ESF status monitoring lights, component status indication, pump motor ammeters, and the refueling water storage tank level and the reactor vessel level indications.

The licensee has not verified that these key variables are all monitored by Category 2 instrumentation. Therefore, we do not find the deviation acceptable. The licensee should verify that all instrumentation provided for the identified key variables used to ascertain RHR system performance are Category 2.

CECo Response:

The ESF status monitoring lights, component status indication, and pump motor ammeters, including all associated circuits originate at the ESF electrical switchgear and are classified as safety related. These circuits are located in a mild environment and meet the recommendations of Regulatory Guide 1.97, Revision 3, for Category 2, Type D, instrumentation.

As evidenced by the "Regulatory Guide 1.97 Compliance Preliminary Report" submitted to the NRC on February 27, 1987, the refueliing water storage tank (RWST) and reactor vessel water level instruments are qualified to Category 2, Type D, and Category 1, Type B, recommendations, respectfully. Considering the previously identified instrumentation as the key variables, the recommended variable is classified as back-up instrumentation and is in compliance with the Category 3, Type D, recommendation of Regulatory Guide 1.97, Revision 3.

3.3.6 RHR Heat Exchanger Outlet Temperature

Regulatory Guide 1.97 recommends environmentally qualified instrumentation with a range of 40°F to 350°F for this variable. The licensee states that the sensors are not environmentally qualified and that the range of 50°F to 350°F is adequate for the intended monitoring functions.

This range deviation is less than three percent of the maximum recommended range. Considering instrument accuracy, and overall range, we consider this deviation minor and, therefore, acceptable.

Regulatory Guide 1.97 recommends environmentally qualified instrumentation for this variable. The instrumentation installed to measure the RHR heat exchanger outlet temperature is not environmentally qualified. The licensee states that this instrumentation is back-up instrumentation for the key variables to monitor the operation of the RHR system: ESF status monitoring lights, component status indication, pump motor ammeters, and the refueling water storage tank level and the reactor vessel level indications.

The licensee has not verified that these key variables are all monitored by Category 2 instrumentation. Therefore, we do not find the deviation acceptable. The licensee should verify that all instrumentation provided for the identified key variables used to ascertain RHR system performance are Category 2.

CECo Response:

The ESF status monitoring lights, component status indication, and pump motor ammeters, including all associated circuits, originate at the ESF electrical switchgear and are classified as safety-related. These circuits are located in a mild environment and meet the recommendations of Regulatory Guide 1.97, Revision 3, for Category 2, Type D, instrumentation.

As evidenced by the "Regulatory Guide 1.97 Compliance Preliminary Report" submitted to the NRC on February 27, 1987, the refueling water storage tank (RWST) and reactor vessel water level instruments are qualified to Category 2, Type D, and Category 1, Type B, recommendations, respectfully. Considering the previously identified instrumentation as the key variables, the recommended variable is classified as back-up instrumentation and is in compliance with the Category 3, Type D, recommendation of Regulatory Guide 1.97, Revision 3.

3.3.7 Accumulator Tank Level and Pressure

Regulatory Guide 1.97 recommends environmentally qualified instrumentation for this variable with a pressure range 0 to 750 psig. The licensee has supplied instrumentation with no environmental qualification. The provided range of the pressure instrument is 0 to 700 psig. The licensee states that the design pressure for the accumulator tank is 700 psig.

The accumulators are passive devices. Their discharge into the reactor coolant system (RCS) is actuated solely by a decrease in RCS pressure. Should three of the four accumulators discharge, the injection is considered successful. We find that the range of the pressure instrumentation supplied for this variable is adequate to determine that the accumulators have discharged. Therefore, the range of the instrumentation for this variable is acceptable. The licensee states that no operator action is specified by the Emergency Operating Procedures based on post-accident accumulator level or pressure.

The existing non-qualified instrumentation is not acceptable. An environmentally qualified instrument is necessary to monitor the status of these tanks. The licensee should designate either level or pressure as the key variable to directly indicate accumulator discharge and provide instrumentation for that variable that meets the requirements of 10 CFR 50.49 and Regulatory Guide 1.97.

CECo Response:

Commonwealth Edison Company will perform an engineering evaluation of the feasibility and cost of upgrading the existing accumulator tank instrumentation. If upgrade modifications are required, either level or pressure will be designated the key variable and modified to meet the applicable Regulatory Guide 1.97 recommendations. The schedule for implementing any required modifications will be developed pending resolution of all Regulatory Guide 1.97 issues.

3.3.9 High Pressure Safety Injection (HPSI) Flow

Regulatory Guide 1.97 recommends environmentally qualified instrumentation for this variable. The instrumentation installed to measure the HPSI flow is not environmentally qualified. The licensee states that this instrumentation is back-up instrumentation for the key variables to monitor the operation of the HPSI sytem: ESF status monitoring lights, component status indication, pump motor ammeters, and the refueling water storage tank level and the reactor vessel level indications.

The licensee has not verified that these key variables are all monitored by Category 2 instrumentation. Therefore, we do not find the deviation acceptable. The licensee should verify that all instrumentation provided for the identified key variables used to ascertain HPSI system performance are Category 2.

CECo Response:

The ESF status monitoring lights, component status indication, and pump motor ammeters, including all associated circuits originate at the ESF electrical switchgear and are classified as safety-related. These circuits are located in a mild environment and meet the recommendations of Regulatory Guide 1.97, Revision 3, for Category 2, Type D, instrumentation.

As evidenced by the "Regulatory Guide 1.97 Compliance Preliminary Report" submitted to the NRC on February 27, 1987, the refueling water storage tank (RWST) and reactor vessel water level instruments are qualified to Category 2, Type D, and Category 1, Type B, recommendations, respectfully. Considering the previously identified instrumentation as the key variables, the recommended variable is classified as back-up instrumentation and is in compliance with the Category 3, Type D, recommendation of Regulatory Guide 1.97, Revision 3.

3.3.10 Low Pressure Safety Injection (LPSI) Flow

Regulatory Guide 1.97 recommends environmentally qualified instrumentation for this variable. The instrumentatiion installed to measure the LPSI flow is not environmentally qualified. The licensee states that this instrumentation is back-up instrumentation for the key variables to monitor the operation of the LPSI system: ESF status monitoring lights, component status indication, pump motor ammeters, and the refueling water storage tank level and the reactor vessel level indications.

The licensee has not verified that these key variables are all monitored by Category 2 instrumentation. Therefore, we do not find the deviation acceptable. The licensee should verify that all instrumentation provided for the identified key variables used to ascertain LPSI system performance are Category 2.

CECo Response:

The ESF status monitoring lights, component status indication, and pump motor ammeters, including all associated circuits originate at the ESF electrical switchgear and are classified as safety-related. These circuits are located in a mild environment and meet the recommendations of Regulatory Guide 1.97, Revision 3, for Category 2, Type D, instrumentation.

As evidenced by the "Regulatory Guide 1.97 Compliance Preliminary Report" submitted to the NRC on Februray 27, 1987, the refueling water storage tank (RWST) and reactor vessel water level instruments are qualified to Category 2, Type D, and Category 1, Type B, recommendations, respectfully. Considering the previously identified instrumentation as the key variables, the recommended variable is classified as back-up instrumentation and is in compliance with the Category 3, Type D, recommendation of Regulatory Guide 1.97, Revision 3.

3.3.12 Quench Tank Temperature

Regulatory Guide 1.97 recommends a range of 50°to 750°F for this variable. The licensee has provided a range of 50°to 300°F. The licensee considers this range adequate since it covers the normal operating design conditions under which the tank is expected to maintain its integrity, and because the temperature indication, while not remaining on scale, will only exceed the range of approximately 6 percent.

The regulatory guide is specific that instrumentation should remain on scale or eliminate the potential of the operator misinterpreting an offscale instrument as a failed instrument. Therefore, the licensee should arrange this instrumentation to include the maximum expected saturation temperature (338°F at the relief disc set pressure of 100 psig), during any accident that is expected to lift the pressurizer relief valves.

CECo Response:

Commonwealth Edison Company will perform an engineering evaluation of the feasibility and cost of upgrading the existing quench tank instrumentation. If modifications are required, a schedule for implementation will be developed pending resolution of all Regulatory Guide 1.97 issues.

3.3.15 Safety/Relief Valve Position or Main Steam Flow

Regulatory Guide 1.97 recommends Category 2 instrumentation for this variable, that can be either safety relief valve position or main steam flow. The licensee has provided qualified valve position indication, but only for the power operated relief valves. The licensee also has main steam flow indication, however, it is not environmentally qualified for all analyzed events. The licensee states that steam genertor pressure is used to determine a faulted steam generator with the main steam isolation valves closed.

While excess pressure can indicate excess flow, it will not establish that a safety relief valve is open. The recommended instrumentation will establish that event. Therefore, the licensee should either add Category 2 instrumentation to monitor the safety valves or upgrade the main steam flow indication to meet the requirements of 10 CFR 50.49 and Regulatory Guide 1.97.

CECo Response:

In the event that reactor core/coolant temperature had risen to a value that caused one (1) or more steam generator safety valves to relieve, the control room operator would be, primarily, concerned with core cooling and would monitor reactor coolant average temperature and the core exit thermocouples (qualified to Category 1, Type A recommendations) to ensure that adequate core cooling was being provided. The key variable used to determine that the steam generator safeties had lifted would be a stable or decreasing reactor coolant average temperature with a differential temperature present in each reactor coolant loop. Additional indication is available by comparing the reactor coolant average temperature during forced circulation or reactor coolant cold leg temperature during natural circulation with the steam generator saturation temperature derived from steam pressure utilizing the steam tables. The presence of a primary-to-secondary differential temperature verifies that, at least, one (1) safety valve has lifted on that steam generator. Additionally, main steam flow is not utilized to assess plant conditions in, either, the Critical Safety Function Status Trees or the Function Recovery Guidelines for the Heat Sink and Core Cooling safety functions.

As evidenced by the "Regulatory Guide 1.97 Compliance Preliminary Report" submitted to the NRC on February 27, 1987, the reactor coolant temperature and steam generator pressure instruments are qualified to Category 1, Type A, recommendations. Based on the previous information, main steam flow instrumentation is classified as back-up instrumentation and is in compliance with the Category 3, Type D, recommendations of Regulatory Guide 1.97, Revision 3.

3.3.16 Auxiliary Feedwater Flow

Regulatory Guide 1.97 recommends instrumentation for this variable that meets Category 2 recommendations. Since the licensee has designated this instrumentation as Type A, this instrumentation should be Category 1. The licensee indicates that no recording or computer input is provided. The licensee states that this instrumentation is a back-up for steam generator level and is not otherwise required for any function.

We find the recording deviation unacceptable for Type A variables. Neither NUREG-0737, nor Regulatory Guide 1.97 require this instrumentation to be Type A. The licensee has determined that this instrumentation is Type A. Therefore, the licensee should provide Category 1 instrumentation for this variable. However, from the licensee's description, it is apparent that the licensee has classified this instrumentation as Type A as the result of a contingency action in the emergency operating procedures. If this is the case, it is classified as Type A in error, and would be acceptable as is. The licensee should evaluate the classification of this instrumentation.

CECo Response:

Regulatory Guide 1.97 identifies Type A variables as "Those variables that provide primary information needed for the control room operating personnel to take specified manually controlled actions for which no automatic control is provided and that are required for safety systems to accomplish their safety functions for design basis accident events." The Byron and Braidwood Station Emergency Operating Procedures do not specify any manual actions based on this variable and critical safety function assessment is provided by steam generator level indication in conjunction with AFW system component status indication. On this basis, the classification of 1A is unwarranted for this variable.

Auxiliary feedwater flow is utilized to diagnose the proper operation of the Auxiliary Feedwater System following the initial verification of proper component actuation in response to the ESF actuation signal. Regulatory Guide 1.97, Revision 3, states that "Those variables that provide information to indicate the operation of individual safety systems and other systems important to safety" shall be classified as Type D variables and recommends a Category 2 classification for key variables of this type. Auxiliary feedwater flow instrumentation should be re-classified as 2D and is, therefore, in compliance with the recommendations of the regulatory guide.

3.3.17 Condensate Storage Tank Water Level

Regulatory Guide 1.97 recommends Category 1 instrumentation for the primary source of auxiliary feedwater. The licensee states that the essential service water system, not the condensate storage tank, is the Category 1 source of auxiliary feedwater. The regulatory guide recognizes this possibility.

The licensee should provide information that shows that Category 1 instrumentation is available to show proper operation of the essential service water system. This instrumentation should show that water is available to and being used by the auxiliary feedwater system for post-accident situations.

CECo Response:

For assessing the overall performance of the essential service water (SX) system, supply and return header temperature indication is provided in the control room and input to the plant computer. Instrumentation available to serve as a back-up for the key variable are ESF monitor lights, component status indication, pump motor ammeters, and pump discharge pressure indication for monitoring the performance of the SX pumps. All of these instruments and associated circuitry are located in mild environments and comply with the criteria for Category 1, Type D, variables for the temperature instrumentation and Category 2, Type D, variables for the SX pump monitoring instruments.

The key variable utilized to evaluate the overall performance of the Auxiliary Feedwater (AF) system is the steam generator level indication. This instrumentation maintains a Category 1, Type A, qualification and is backed up by AF system flow instruments which permits the assessment of individual AF system train performance. The AF system flow instrumentation was originally classified as Category 1, Type A, and is now considered to be Category 2, Type D, instrumentation. In addition to these variables, low suction pressure alarms, with analog input to the plant computer, are associated with each of the AF pumps to monitor the adequacy of the water supply. This instrumentation is located in a mild environment and complies with the criteria delineated by Regulatory Guide 1.97, Revision 3, for Category 2, Type D, variables.

3.3.18 Containment Atmosphere Temperature

Regulatory Guide 1.97 recommends environmentally qualified instrumentation for this variable. The instrumentation installed is not environmentally qualified. The licensee has acknowledged this, and states that containment pressure initiates all ESF containment cooling functions.

The containment atmosphere temperature directly indicates the accomplishment of a safety function (containment cooling) and is, therefore, a key variable. Thus, Category 2 requirements should be met by the licensee for this variable. The licensee should provide instrumentation for this varialbe that is environmentally qualified to the requirements of 10 CFR 50.49 and Regulatory Guide 1.97.

CECo Response:

At the Byron and Braidwood Stations, the assessment of the Containment Critical Safety Function, per procedure, is based entirely on containment pressure. As evidenced by the Containment CSF Status Tree and Function Recovery Guideline Index (attached) for these stations, containment atmosphere temperature is not required or utilzed to diagnose the effectiveness of the containment cooling systems during accident conditions. Additionally, there are no operator contingency actions based on containment temperature and the emergency procedures and function recovery guidelines do not identify this variable as an alternate for assessing containment conditions. The use of containment temperature in lieu of pressure would, therefore, require the recommendation of the TSC and the approval of the shift supervisor and this variable would have to be converted to pressure, utilizing the steam tables, to be compatible with the function recovery guidelines. For these reasons, containment pressure is considered to be the key variable for assessing, both, containment conditions and the effectiveness of the containment cooling systems. Containment atmosphere temperature is considered to be a back-up variable and is in compliance with the Category 3, Type D, recommendations of Regulatory Guide 1.97, Revision 3.

IBST 5	CONTAINMENT	REV. 0

APPROVED

JAN 28 1984

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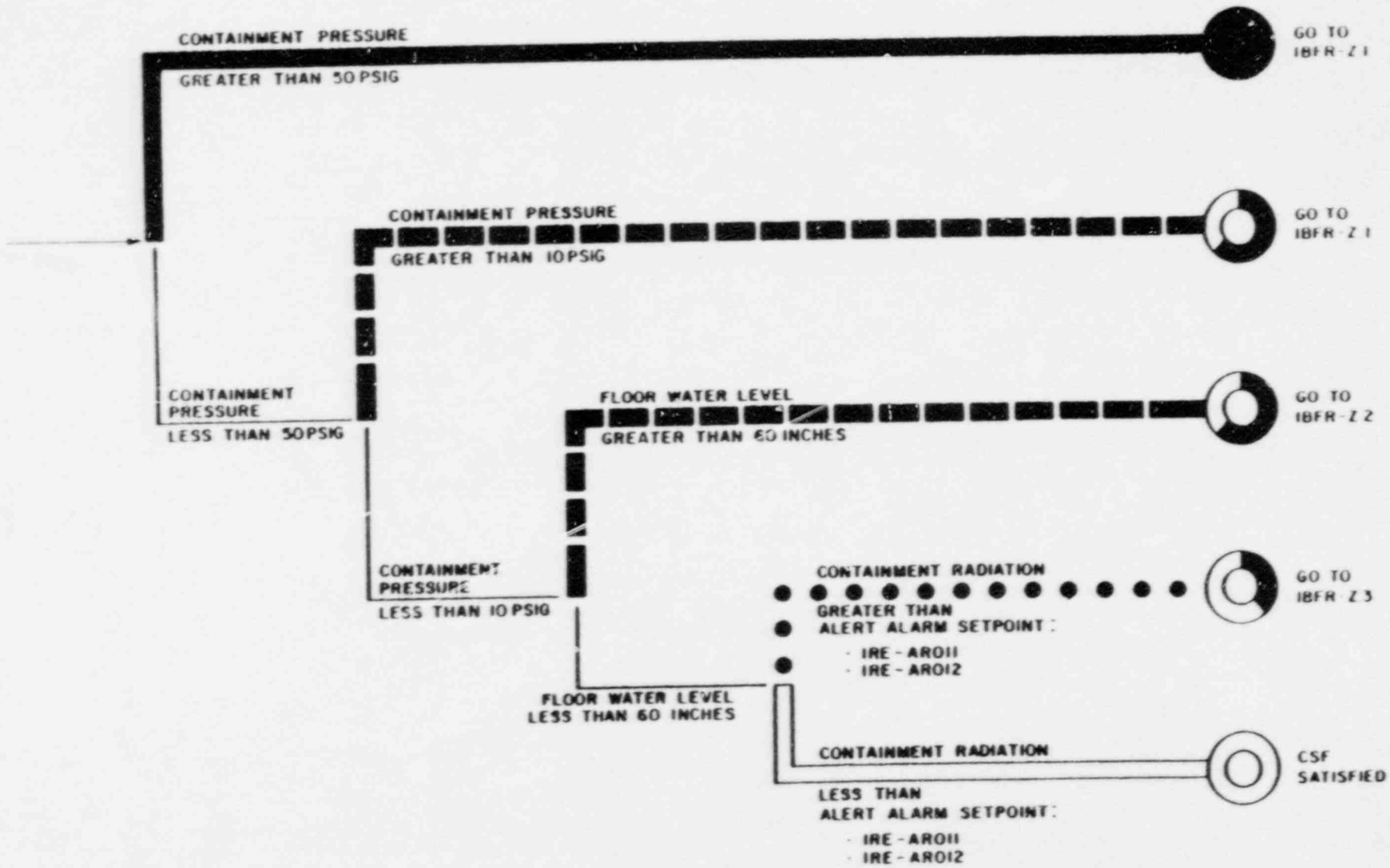

FINAL

PROCEDURE NUMBER	TITLE	NUMBER
CRITICAL SAFETY FUNCTION STATUS TREES		I
BST-1	Subcriticality (S)	A
BST-2	Core Cooling (C)	B
BST-3	Heat Sink (H)	C
BST-4	Integrity (P)	D
BST-5	Containment (Z)	E
BST-6	Inventory (I)	F
FUNCTION RECOVERY GUIDELINES		
SUBCRITICALITY		II
BFR-S.1	Response to Nuclear Power Generation	A
BFR-S.2	Response to Loss of Core Shutdown	B
CORE COOLING		III
BFR-C.1	Response to Inadequate Core Cooling	A
BFR-C.2	Response to Degraded Core Cooling	B
BFR-C.3	Response to Potential Loss of Core Cooling	C
BFR-C.4	Response to Saturated Core Cooling Conditions	D
HEAT SINK		IV
BFR-H.1	Response to Loss of Secondary Heat Sink	A
BFR-H.2	Response to Steam Generator Over Pressure	B
BFR-H.3	Response to Steam Generator High Level	C
BFR-H.4	Response to Steam Generator Low Level	D
BFR-H.5	Response to Loss of S/G PORVs or Steam Dumps	E
INTEGRITY		V
BFR-P.1	Response to Imminent Thermal Shock Condition	A
BFR-P.2	Response to Anticipated Thermal Shock Condition	B
CONTAINMENT		VI
BFR-Z.1	Response to High Containment Pressure	A
BFR-Z.2	Response to High Containment Sump Level	B
BFR-Z.3	Response to High Containment Radiation Level	C
INVENTORY		
BFR-I.1	Response to Pressurizer Flooding	A
BFR-I.2	Response to Low System Inventory	B
BFR-I.3	Response to Void in Reactor Vessel	C

3.3.19 Containment Sump Water Temperature

Regulatory Guide 1.97 recommends Category 2 instrumentation with a range of 50 to 250°F to monitor this variable. The licensee has not provided instrumentation for this variable, stating that the containment sump water temperature is not required to be monitored to detect RHR or containment spray pump cavitation when in the recirculation mode. This was previously accepted by the NRC.

This is insufficient justificatiion for this exception. The licensee should provide the recommended instrumentation for the functions outlined in Regulatory Guide 1.97 or identify other instruments that provide the same information (such as the residual heat removal heat exchanger inlet temperature) and that satisfies the regulatory guide.

CECo Response:

To detect or anticipate RHR and/or Containment Spray Pump Cavitation, utilizing this variable requires calculating the available Net Positive Suction Head (NPSH) for these components considering the effects of the existing containment pressure and component flow rate in addition to the containment sump water temperature.

During an accident, it is highly unlikely that the control room operator or the shift technical advisor will be in a position to perform this calculation or that the control room conditions will be conductive to it's completion. A more direct means of detecting pump cavitation is provided by the pump motor ammeters which are qualified to Category 2, Type D, requirements considering the mild environment that these instruments reside in. Additionally, these instruments constitute one (1) of the key variables utilized for assessing the performance of these safety systems. For this reason, containment sump water temperature is considered to be an unnecessary variable for diagnosing the performance of safety system components during the recirculation mode of operation. This deviation was originally accepted by the NRC on this basis.