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March 15, 1985

Dr. J. Nelson Grace, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

Re: Catawba Nuclear Station, Units 1 and 2
Docket Nos. 50-413 and 50-414

Dear Dr. Grace:

Please find attached a supplemental report concerning Significant Deficiency No. 413-414/84-16.

Very truly yours,

H.B. Tucker 1/SS

Hal B. Tucker

LTP:slb

Attachment

cc: Director
Office of Inspection & Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

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DUKE POWER COMPANY

CATAWBA NUCLEAR STATION

UNITS 1 & 2

EVALUATION OF MAIN STEAM LINE BREAK IN DOGHOUSE

SIGNIFICANT DEFICIENCY REPORT
NO. 413-414/84-16
SUPPLEMENT 2

Prepared By: J. L. Ritchie Date: 3-12-85
J. L. Ritchie, Senior Technical Specialist

Reviewed By: J. K. Ray, III Date: 3-13-85
J. K. Ray, III, Supervising Design Engineer

Approved By: R R Weidler Date: 3-13-85
R. R. Weidler, Supervising Design Engineer

Inspected By: C L Sansbury Date: 3-13-85
C. L. Sansbury, Senior Engineer

Inspected By: for R L Dobson Date: 3/13/85
J. E. Thomas, Senior Engineer

DUKE POWER COMPANY

CATAWBA NUCLEAR STATION

Report Number: 413-414/84-16, Supplement 2

Report Date: March 12, 1985

Facility: Catawba Nuclear Station Units 1 and 2

IDENTIFICATION OF DEFICIENCY: Unconsidered effects of superheated steam generated by steam generator for Main Steam Line Break analysis results in increased doghouse temperatures outside containment. This could possibly preclude safety related components from performing their intended safety function. The potential deficiency was initially identified May 11, 1984.

INITIAL REPORT: On June 8, 1984, Mr. Kerry Landis, NRC Region II, Atlanta, Georgia, was notified by telephone of the subject deficiency by L. M. Coggins and R. R. Weidler of Duke Power Company, Charlotte, N.C. 28242. Subsequently, deficiency report (413-414/84-16) as submitted on July 9, 1984, and Supplement 1 to the report was submitted on September 4, 1984.

COMPONENT AND/OR SUPPLIER: Duke Power Company is responsible for the doghouse environmental analysis. The MSLB analysis is accomplished utilizing input information supplied by Westinghouse Electric Corporation, Water Reactor Division.

DESCRIPTION OF DEFICIENCY: A potential deficiency was identified after revised information was received from Westinghouse giving mass/energy release rates for a Main Steam Line Break (MSLB) inside containment. The original Westinghouse information indicated a saturated steam condition from the steam generators; however, revised information identifies steam generator tube uncovery and the formation of superheated steam.

Duke Power had previously assumed the same saturated steam condition for an MSLB in the Doghouses located outside containment as for an MSLB inside containment. Consequently, environmental qualification parameters for the Doghouses were based on original analysis results of 330°F peak temperature. Utilizing the new data from Westinghouse, revised Duke Power environmental analysis with superheated steam conditions indicated a potential increase in Doghouse temperature from the 330°F parameter to approximately 457°F peak Doghouse temperature. Hence, the potential existed that safety related components could be subjected to temperatures higher than the qualification basis of 330°F, and could possibly preclude components from performing their intended safety functions following a postulated MSLB in either Doghouse. Therefore, on June 8, 1984 Duke Power reported this as a potentially reportable item and began a detailed engineering evaluation. This evaluation, based on conservative "worst case" conditions, was completed during August 1984. Results from this evaluation were transmitted to the NRC on September 4, 1984 under report number 413-414/84-16, Supplement 1. This report concluded that the analysis performed by Duke Power and Westinghouse demonstrated that no required safety components are precluded from performing their safety function prior to the on-set of adverse temperature effects and, therefore, no safety implications exist to prevent safe shutdown of the plant.

On September 28, 1984 representatives from Duke Power Company and Westinghouse met with the NRC to discuss proposed license condition 14b (FOL NPF-24) which concerns the MSLB in the Doghouse. The meeting concluded with the NRC stating their position that Duke had not demonstrated sufficient margin between completion of equipment safety functions and the time at which doghouse atmospheric temperature exceeds equipment qualification temperature.

On October 8, 1984 Duke Power Company submitted a summary of the Justification for Interim Operation for Catawba Unit 1. This summary included the results of a more realistic analysis of the time margins between completion of equipment actuation and the time at which the Doghouse atmospheric temperature exceeds the qualification temperature. In addition, the results of a Westinghouse scoping-type fracture mechanics study was included which showed that the worst case break would be limited to approximately 0.2 in.^{2} (.001 ft.^{2}). The more realistic analysis demonstrated substantial additional time margins. The fracture mechanics evaluation concluded that tube bundle uncovery would not occur due to limited break size. Therefore, the original equipment qualification temperature envelopes would not be exceeded. Again it was concluded that plant safety would not be adversely affected in the event of a MSLB in the Doghouse, and that qualification of the required Doghouse equipment had been demonstrated.

On the basis of the information discussed above, the NRC staff concluded (SER Supplement 4, Section 3.11) that acceptable justification for interim operation in accordance with Paragraph (i) of 10CFR 50.49 had been submitted. However, license condition (7) of FOL NPF-31 required that prior to March 31, 1985, Duke Power Company shall environmentally qualify all electrical equipment as required by 10CFR 50.49. This same license condition was carried over to FOL NPF-35 which superseded NPF-31.

ANALYSIS OF SAFETY IMPLICATIONS: A study has been conducted by Duke Power with assistance from Westinghouse to determine if subjecting safety related components to temperatures higher than the qualification basis of 330°F could possibly preclude components from performing their intended safety functions following a postulated MSLB in either doghouse. The results of these studies are presented under "Corrective Action," below.

CORRECTIVE ACTION: In order to resolve license condition (7), Duke Power has further evaluated the time margins between the completion of Doghouse equipment actuation and the onset of temperatures higher than the qualification parameters of the equipment at which time the analysis conservatively assumes equipment failure. In this analysis, conservative "worst case" conditions of significant deficiency report number 413-414/84-16, Supplement 1 are used. Attachment 1 outlines the results of the above analysis. The attachment also indicates which equipment is required to remain functional during and/or following an MSLB in the Doghouse. In addition, heat transfer analysis has been performed on the solenoid valves used to operate the Main Steam Isolation Valves (MSIV's) and Steam Generator Power Operated Relief Valves (PORV's) to take into account the temperature/time lag for this equipment. Attachment 3 contains pages from the NUREG-0588 response that are applicable to the MSLB in the Doghouses.

Although it is concluded from the temperature/time margin study that required equipment has sufficient margin between required actuation time and the time when equipment qualification temperature is exceeded, this report also includes a Westinghouse core response analysis (see Attachment 2) for the postulated consequential failure of the MSIV's, Steam Generator PORV's, and Main Feedwater Isolation Valves due to an MSLB and that are located in the faulted Doghouse. The Westinghouse analysis involves a 1.0 ft^2 MSLB upstream of the MSIV in one of the two doghouses. The 1.0 ft^2 maximum size break area is considered to be appropriate for this analysis because of the following reasons:

1. The conservative computer code SUPERPIPE was used by Duke Power in performing the Main Steam piping stress analysis. Resultant pipe break stress ratios (actual stress/allowable stress) are all less than 0.7.

2. Double-ended mechanistic pipe breaks are not required on the Main Steam Line in the doghouse due to application of the containment penetration area break exclusion criteria of Branch Technical Position MEB 3-1. Inservice inspection will be performed as required for application of the criteria. The 1.0 ft^2 minimum break size required by Branch Technical Position ASB 3-1 for environmental effects is met by the Westinghouse analysis.

3. Any break would most likely be postulated to occur at a branch line connection to the Main Steam piping. These connections in the doghouse involve piping with a maximum cross-sectional area of 0.2 $ft.^2$ which yields a safety factor of 5.

4. For any postulated break size greater than 1.0 ft^2, under the conservative "worst case" conditions of significant deficiency report number 413-414/84-16, Supplement 1, all safety actuations occur prior to tube uncovery, and therefore prior to the generation of the superheated steam and resulting harsh environment.

5. A 1.0 $ft.^2$ rupture size bounds smaller breaks because it results in a more severe cooldown of the reactor coolant system, and thus a greater peak heat flux.

The following is a summary of the results of our evaluations:

- All electrical equipment in the faulted Doghouse that is required to automatically actuate on a safety signal will perform its intended function for at least 30 minutes prior to reaching its qualification temperature, with at least a margin of 433% between the time actuation occurs and the equipment internals exceed their qualification temperature.

- The Westinghouse core response analysis demonstrates that it is acceptable for the MSIV's, Steam Generator PORV's and the Main Feedwater Isolation Valves located in the faulted Doghouse to fail during a MSLB in the Doghouse and still allow safe shutdown of the plant.

In conclusion, Duke Power Company's further evaluations have shown that the higher temperatures generated in the event of an MSLB in the Doghouse will not affect the capability to shutdown the reactor and to maintain it in a safe shutdown condition, and that qualification of all equipment in the Doghouse has been demonstrated.

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
Valve - Main Steam Isolation.	SM 1, 3, 5 & 7	Open	Closed	Isolate Steam Generator to Control Cooling	(1)		• Valves are air operated, fail closed, with redundant normally energized solenoids that deenergize to close on a main steam isolation signal. • During the "worst case" conditions (70%) power w/0.5 Ft^2 Break in compartment 3) the main steam isolation valves will actuate 338 sec. after the MSLB and 12 sec. before the atmosphere temperature reaches 340°F (Qualification Temperature). However, heat transfer analysis performed on the solenoid valves used to operate the main steam isolation valves show that the coil assembly

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
							temperature lags the atmosphere temperature and does not reach 340°F for at least 30 minutes after the MSLB, which is a margin of at least 433%. • See Attachment 3, page 32, for NUREG-0588 response.
Valve-Steam Generator Power Operated Relief Valve (PORV's)	SV1, 7,13 & 19	Closed	Closed	Isolate Steam Generator to Control Cooling	(1)		• Valves are air operated, fail closed, with redundant normally energized solenoids that deenergize to close. If open, valves close automatically on a main steam isolation signal. • During the "worst case" conditions (70%) power w/0.5 Ft.² break in compartment 3) the steam generator PORV's will actuate 338 sec. after the MSLB and 21

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
							sec. before the atmosphere temperature reaches 346°F (qualification temperature). However, heat transfer analysis performed on the solenoid valves used to operate the PORV's show that the coil assembly temperature lags the atmosphere temperature and does not reach 346°F for at least 30 minutes after the MSLB, which is a margin of at least 433%. • See Attachment 3, page 39 for NUREG-0588 response.
Valve-Main Steam Isolation By-Pass	SM9, 10, 11, & 12	Closed	Closed	Isolate Steam Generator to Control Cooling		√	• Valves are air operated, fail closed, with redundant normally energized solenoids that deenergize to close. If open, valves automatically close on a main steam isolation signal.

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	• Due to valve size (2"), flow rate will be minimal and cooldown rate will not be exceeded if these valves are lost as a consequence of the MSLB. • See Attachment 3, page 40 for NUREG-0588 response.
Valve-Main Feedwater Isolation	CF33, 42, 51 & 60	Open	Closed	Valves serve as a backup to prevent steam generator overfill and to prevent loss of feedwater from the steam generator.		√	• Electro-Hydraulic operated valves. • Steam generator overfill through the main feedwater lines is prevented by tripping the main feedwater pumps and closing the pump discharge isolation valves located in the turbine building. The main feedwater pump and isolation valves close automatically on a high steam generator level

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
							signal. In addition, steam generator overfill can be prevented by closing the feedwater control valves also located in the turbine building. Feedwater control valves close on both a feedwater isolation signal and high steam generator level signal. • Loss of feedwater is prevented through the main feedwater lines by two (2) check valves in series and by closure of the feedwater control valve (located in turbine building) in each flow path. The feedwater control valves close on a feedwater isolation signal.

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
							• See Attachment 3, page 33, for NUREG-0588 response.
Valve-Reverse Purge Isolation (Feedwater Purge Isolation)	CF87, 88, 89 & 90	Closed	Closed	Valves prevent loss of feedwater from the steam generator.		√	• Valves are air operated, fail closed, with redundant deenergize-to-close solenoids. • Valves are used only at low power and are normally closed. • Non-safety grade motor operated valves located in the turbine building can also be used to isolate flow. • See Attachment 3, page 40a, for NUREG-0588 response.

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
Valves-Feedwater Supply to upper Nozzle.	CA149, 150, 151 & 152	Closed	Closed	Valves serve as a backup to prevent steam generator overfill and to prevent loss of feedwater from the steam generator.		√	• Valves are air operated, fail closed gate valves • Steam generator overfill through the upper nozzle lines is prevented by tripping the main feedwater pump and closing the pump discharge isolation valves located in the turbine building. The main feedwater pump and isolation valves are tripped closed automatically on a high steam generator level signal. In addition, steam generator overfill can be prevented by closing the feedwater control valves also located in the turbine building.

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	Feedwater control valves close on both a feedwater isolation signal and high steam generator level signal. • Loss of feedwater through the upper nozzle lines is prevented by redundant check valves in series. • See Attachment 3, page 40b, for NUREG-0588 response.
Valves-Tempering Isolation	CA185, 186, 187 & 188	Open	Closed	Valves serve as a backup to prevent steam generator overfill and to prevent loss of feedwater from steam generator.		√	• Valves are air operated, fail closed gate valves. • Steam Generator overfill through the tempering lines is prevented by tripping the main feedwater pump and closing the pump discharge isolation valves located in the turbine building.

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
							The main feedwater pump and isolation valves close automatically on a high steam generator level signal. In addition, steam generator overfill can be prevented by closing the feedwater control valves also located in the Turbine Building. Feedwater control valves close on both a feedwater isolation signal and high steam generator level signal. • Loss of feedwater through the tempering lines is prevented by two (2) check valves in series in each flow path.

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB Yes	Required To Mitigate Effects of MSLB No	Discussion
							• See Attachment 3, page 40c, for NUREG-0588 response.
Valve-Auxiliary Feedwater Isolation	CA42, 46, 50, 54 58 & 62	Open	Open	Valves supply Auxiliary Feedwater flow and isolate the faulted steam generator.		√	• Electric motor operated gate valves with manual initiation.
	CA 38 & 66	Closed	Closed				• Flow to the faulted steam generator can be isolated by closing the control valves located in the feedwater pump room, by closing manual isolation valves or by tripping the pumps that are not required.
							• See Attachment 3, page 36, for NUREG-0588 response.
Valves-Steam Generator PORV Isolation	SV25, 26, 27 & 28	Open	Closed	Valve serve as a backup to isolate steam generator to control cooling		√	• Electric motor operated gate valves with manual initiation.

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
							• The PORV's are the primary source for isolating the steam generator pressure boundaries (see valves number SV1, 7, 13 & 19 above). • See Attachment 3, page 34, for NUREG-0588 response.
Valves-Main Steam Low Point Drain Isolation	SM 74, 75, 76 & 77	Open	Closed	Valves serve as a backup to isolate the steam generator pressure bouncary to control cooling		√	• Electric motor operated gate valves with manual initiation. • Drains are orificed to prevent excess steam flow. Limited flow through orifice will not effect cooldown during MSLB. • See Attachment 3, page 36a, for NUREG-0588 response.

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Preformed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
Valve-Steam Generator Blow-down isolation	BB10, 21, 57 & 61	Open	Closed	Valves serve as a backup to prevent loss of feedwater from the steam generator.		√	• Electric motor operated gate valve. • Loss of feedwater is prevented by the Electric Motor Operated gate valve located in the containment. • Blowdown can also be isolated by closing the non-safety blowdown control valve located in the turbine building. • All blowdown isolation valves close on automatic auxiliary feedwater pump start on a low-low steam generator level signal. • See Attachment 3, page 36b, for NUREG-0588 response.

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
Valve-Steam Generator Blow-down Isolation By-Pass	BB147, 148, 149 & 150	Closed	Closed	Valves serve as a backup to prevent loss of feedwater from the steam generator.		√	• Electric motor operated Globe valve. • Loss of Feedwater is prevented by the Electric Motor Operated gate valve located in the containment. • Blowdown can also be isolated by closing the non-safety blowdown control valve located in the Turbine Building. • All blowdown isolation valves close on automatic auxiliary feedwater pump start on a low-low steam generator level signal. • See Attachment 3, page 36c, for NUREG-0588 response.

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
Valves-Auxiliary Feedwater Pump Turbine Steam Suppy Isolation	SA 2 & 5	Closed	Either	Not Applicable See Discussion		√	• The turbine driven auxiliary Feedwater Pumps are not required for any steam line break. Assuming a single failure of one motor driven pump, adequate time is available for the operator to realign the other motor driven pump to supply flow to intact steam generators. Both the motor and turbine driven auxiliary feedwater pumps are located in the feedwater pump room so they are not affected by the steam line break. • See Attachment 3, page 40d, for NUREG-0588 response.
Instrumentation-Auxiliary Feedwater Flow TRANSMITTERS	CAFE5090 CAFE5100 CAFE5110 CAFE5120	-	-	-		√	• This equipment may fail under the higher MSLB temperatures. However,

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	Post-Accident monitoring of the auxiliary feedwater function can be accomplished by the steam generator level transmitters which will not be affected by a steamline break in the Doghouse since the level transmitters are located in the containment. • See Attachment 3, page 6, for NUREG-0588 response.
Instrumentation-Doghouse Water Level Transmitters	CFLS6000 CFLS6030 CFLS6060 CFLS6090	-	-	-		√	• The function of these transmitters is to determine water level for pipe breaks not associated with the MSLB. • See Attachment 3, page 14, for NUREG-0588 response.

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
Control and Power Circuits	-	-	-	-		√	• No safety-related cables are routed through the Doghouses which terminate at equipment located outside of the Doghouse. • A review was performed to determine if component failures in the harsh environment could cause any valves to reposition from the preferred position. No failures were identified that could cause undesirable repositioning. • All safety-related control circuits in the Doghouses were reviewed to determine if any component failures could affect other safety-related circuits. All safety-related control

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
							components in the Dog-houses are protected by separate fuses that are coordinated with upstream feeder breakers to avoid affecting any other related circuits.
Cable-S/G PORV and MSIV Control	EPR, FR-EPR and XLPE insulated cable	-	-	-		√	• The S/G PORV & MSIV control cables provide power to the redundant normally energized S/G PORV & MSIV air control solenoids. As stated above, these solenoids deenergize to close automatically on a main steam isolation signal. In the unlikely event of a cable failure, open or short, power to the solenoids would be

Catawba 1 & 2
Summary of Electrical Equipment
Exposed to Higher MSLB Temperatures

Equipment	Identification Number	Normal Operating Position	Preferred Position During MSLB	Function Performed During MSLB	Required To Mitigate Effects of MSLB		Discussion
					Yes	No	
							lost and the solenoids would go to their deenergized safety position. Additionally, the S/G PORV's & MSIV's preferred position during a MSLB is closed. Therefore, the solenoid cables are not essential to mitigate the consequences of a MSLB. • See response to NUREG-0588, Attachment 3, pages 44, 47, 51 & 52a. • See Note 2.

NOTES:
(1) Although it is desirable that valve(s) properly position, the Westinghouse analysis for the core response (Attachment 2) due to the consequential failure of the main steam isolation valves, PORV's, and the main feedwater isolation valves located in the faulted Doghouse has demonstrated that the reactor can be safely shutdown and maintained in a safe shutdown condition, even if these valves fail in the faulted doghouse.
(2) Valves that actuate on a safety signal (Main Steam Isolation, Feedwater Isolation, High Steam Generator Level, etc.) will not resposition after actuation because of electrical circuit design features such as isolation, interlocks and protective devices.

CATAWBA STEAM LINE BREAK CORE REPSONSE ANALYSIS WITH CONSEQUENTIAL FAILURES DUE TO SUPERHEATED STEAM

Background

The Catawba submittal on the effects of superheated steam mass and energy releases outside containment provided justification of safety related operation prior to equipment qualification (EQ) envelopes being exceeded. In addition, Duke Power provided arguments that the equipment would remain in their actuated positions even if the EQ envelopes were subsequently exceeded. As a result of NRC review on the environmental effects of superheated steam on equipment in the Catawba plant doghouses, Duke Power has requested an additional analysis of the effect of a consequential failure of affected equipment.

Identification of Causes and Accident Description

The steam release arising from a rupture of a main steam line would result in an initial increase in steam flow which decreases during the accident as the steam pressure falls. The energy removal from the RCS causes a reduction of coolant temperature and pressure. In the presence of a negative moderator temperature coefficient, the cooldown results in an insertion of positive reactivity. If the most reactive rod cluster control assembly (RCCA) is assumed stuck in its fully withdrawn position after reactor trip, there is an increased possibility that the core will become critical and return to power. A return to power following a steam line rupture is a potential problem mainly because of the high power peaking factors which exist assuming the most reactive RCCA to be stuck in its fully withdrawn position. The core is ultimately shut down by the boric acid injection delivered by the Safety Injection System.

The analysis of a main steam line rupture is presented in the Catawba FSAR to demonstrate that the following criteria are satisfied:

> Assuming a stuck RCCA with or without offsite power, and assuming a single failure in the engineered safety features, the core remains in place and intact. Radiation doses do not exceed the guidelines of 10CFR100.
>
> Although DNB and possible clad perforation following a steam pipe rupture are not necessarily unacceptable, the FSAR analysis, in fact, shows that no DNB occurs for any rupture assuming the most reactive assembly stuck in its fully withdrawn position.

The major rupture of a steam line is the most limiting cooldown transient and is analyzed at zero power with no decay heat. Decay heat would retard the cooldown thereby reducing the return to power. A detailed analysis of this transient with the most limiting break size, a double-ended rupture, is presented in the Catawba FSAR, Section 15.1.5.

The following functions provide the protection for a steam line rupture:

1. Safety Injection System actuation from any of the following:

   a. Two-out-of-three low steam line pressure signals in any one loop.

   b. Two-out-of-four low pressurizer pressure signals.

   c. Two-out-of-three high containment pressure signals.

2. The overpower reactor trips (neutron flux and delta-T) and the reactor trip occuring in conjunction with receipt of the safety injection signal.

3. Redundant isolation of the main feedwater lines.

   Sustained high feedwater flow would cause additional cooldown. Therefore, in addition to the normal control action which will close the main feedwater valves a safety injection signal will rapidly close all feedwater control valves and feedwater isolation valves, trip the main feedwater pumps, and close the feedwater pump discharge valves.

4. Trip of the fast acting steam line stop valves[1] (designed to close in less than 5 seconds) on:

   a. Two-out-of-three low steam line pressure signals in any one loop.

   b. Two-out-of-four high-high containment pressure signals.

   c. Two-out-of-three high negative steam line pressure rate signals in any one loop (used only during cooldown and heatup operations).

Fast-acting isolation valves[1] are provided in each steam line; these valves will fully close within 10 seconds of a large break in the steam line. For breaks downstream of the isolation valves, closure of all valves would completely terminate the blowdown. For any break, in any location, no more than one steam generator would experience an uncontrolled blowdown even if one of the isolation valves fails to close, unless a consequential failure results in reopening of both MSIVs in the doghouse. This would cause an additional cooldwon of the primary system, with a possible increase in the peak return to power. The following section of this report documents the analysis of these effects and consequences.

Besides the MSIVs, the affected equipment in the doghouse are the steam generator power-operated relief valves and the main feedwater isolation valves. The PORVs are assumed to open as a result of a consequential failure due to superheated steam. The consequential reopening of the main feedwater isolation valves would not affect the transient since the safety injection signal also trips the main feedwater pumps, and closes the feedwater control and feedwater pump discharge valves.

1 Main Steam Isolation Valves

Analysis of Effects and Consequences

Method of Analysis

The analysis of the steam line rupture has been performed to determine:

1. The core heat flux and RCS temperature and pressure transients resulting from the cooldown following the steam line break described below. The LOFTRAN code modified for the calculation of superheated steam enthalpy has been used.

2. The thermal and hydraulic behavior of the core following the steam line break. An evaluation of the transient statepoints from this analysis verifies that the Catawba FSAR analysis is bounding, and that DNB therefore does not occur.

The analysis assumptions are the same as those of the steam line break analysis in the Catawba FSAR, Section 15.1.5, with exceptions noted herein. The most restrictive single failure in the safety injection system is assumed. The major difference of this analysis is the assumption of a consequential failure of affected equipment in the doghouse due to superheated steam. Specifically, the following scenario of events is analyzed:

1. A 1.0 ft^2 rupture occurs in one of the steam lines upstream of the MSIV in one of the two doghouses. This case bounds smaller breaks because it results in a more severe cooldown of the reactor coolant system, and thus a greater peak heat flux.

2. All four steam generators blow down through the break until steam line isolation occurs by closure of the MSIVs.

3. Following steam line isolation, initially only the faulted loop steam generator (loop 1) blows down. Saturated steam is released to the doghouse until tube bundle uncovery occurs, after which the steam exiting the break becomes superheated.

4. The MSIVs in the affected doghouse are assumed to reopen when the superheated steam enthalpy reaches 1210 Btu/lb. This is conservative since the enthalphy is lower than the that which resulted in the EQ envelope to be exceeded in the compartment analyses performed for the Duke Power plants. The result is an uncontrolled blowdown of both affected steam generators (loops 1 and 2).

To ensure conservatism in the analysis, cases were analyzed for both a "late" and a "predicted" time of uncovery of the steam generator tube bundle. In addition, cases were analyzed with reactivity feedback calculations based on the core properties associated with an assumed stuck RCCA positioned in either the loop 1 or loop 2 core sectors.

Results

A time sequence of events for the four cases analyzed is shown in Table 1. As shown by Table 1, the consequential MSIV failures do not affect the peak return to power for cases in which reactivity feedback calculations are based on loop 1, since the peak occurs before the MSIVs open. For the cases in which reactivity feedback is calculated based on loop 2, the additional cooldown induced by the MSIV failures causes an increased return to power.

A comparison of transient statepoints for all cases analyzed to the FSAR transient conditions verifies that the FSAR case bounds the new analyses. Therefore, the DNBR remains above the limit value of 1.30, and the conclusions of the Catawba FSAR remain valid.

TABLE 1

TIME SEQUENCE OF EVENTS

Case 1 - Late Tube Uncovery, Reactivity Calculations Based on Loop 1.

Event	Time (sec)
Steam line ruptures	0
Steam line isolation occurs	9
Criticality attained	27
Steam generator tube bundle uncovery occurs	189
Peak heat flux reached	192
Consequential failure of MSIVs in affected doghouse	193

Case 2 - Late Tube Uncovery, Reactivity Calculations Based on Loop 2.

Event	Time (sec)
Steam line ruptures	0
Steam line isolation occurs	9
Criticality attained	43
Steam generator tube bundle uncovery occurs	217
Consequential failure of MSIVs in affected doghouse	226
Peak heat flux reached	267

Case 3 - Predicted Tube Uncovery, Reactivity Calculations Based on Loop 1.

Event	Time (sec)
Steam line ruptures	0
Steam line isolation occurs	9
Criticality attained	27
Steam generator tube bundle uncovery occurs	123
Peak heat flux reached	139
Consequential failure of MSIVs in affected doghouse	145

Case 4 - Predicted Tube Uncovery, Reactivity Calculations Based on Loop 2.

Event	Time (sec)
Steam line ruptures	0
Steam line isolation occurs	9
Criticality attained	43
Steam generator tube bundle uncovery occurs	136
Consequential failure of MSIVs in affected doghouse	177
Peak heat flux reached	233

ATTACHMENT 3

SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT

LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

Page	Rev.	Page	Rev.	Page	Rev.
1	3	35	4	52	5
2	D	36	5	52a	0
4	4	36b	0	53	6
5	4	36c	0	53a	0
6	6	36d	0	54	5
7	4	37	4	54a	0
8	4	38	4	55	D
9	4	39	6	56	4
10	4	40	6	57	2
11	4	40a	1	58	2
12	D	40b	0	59	2
13	4	40c	0	60	2
14	4	40d	0	61	D
15	D	40e	0	62	D
16	D	41	D	63	2
17	4	42	5	64	1
18	4	42a	0	65	1
19	4	43	6	66	1
20	3	43a	0	67	1
21	3	44	6	68	1
22	4	44a	0	69	1
23	4	45	6	70	1
24	4	45a	0	71	1
25	4	46	6	72	1
26	1	46a	0	73	1
27	4	47	6	74	1
28	D	47a	0	75	1
29	4	48	6	76	1
30	4	48a	0	77	D
31	D	49	6	78	D
32	6	49a	0	79	1
33	6	50	5	PRN-1	6
34	6	51	6	PRN-2	6
34a	0				

*D - Deleted: It has been determined that this equipment is not in the scope of 10CFR50.49 due to plant/system design changes, relocation to a mild environment area, or review of function and failure mode with respect to the event causing the harsh environment.

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Transmitter - Main Feedwater Flow (Doghouse)

MANUFACTURER: Veritrak (NSSS)

MODEL #: 76DP

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)

The Main Feedwater Flow signals are not required for pipe ruptures that cause a change in the normal Auxiliary Building (Doghouse) operating environment. Further, failure of this equipment as a result of exposure to a harsh environment will not preclude the safety function of other equipment claimed in the accident post accident analysis. Additionally, the information provided by this equipment is not employed as a post accident monitoring parameter for operator action.

QUALIFICATION REPORT: N/A

METHOD: N/A

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Transmitter-
Aux. FW Flow
(Doghouse)

MANUFACTURER: Barton

MODEL #: 764
(Lot 7)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 420°F Press: 75 psig RH: 100%	Continuous	Continuous	16.4%	15.6%

QUALIFICATION REPORT: Barton R3-764-3(CNM-1210.04-261)

METHOD: Test

REPLACEMENT INTERVAL: 10 Years

MPIC

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Level Switches-Doghouse Level MANUFACTURER: Magnetrol MODEL #: A-103F-3X-Y-MPG

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 285°F Press: 30 psig RH: 100%	Approximately 15 secs. prior to accomplishment of trip function, i.e., trip main fdw pumps	Continuous	± 1/4 inch	± 1/4 inch

QUALIFICATION REPORT: Duke Power Company Reports TR-053 and TR-060

METHOD: Test

REPLACEMENT INTERVAL: 15 Years

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Main Steam Isolation Valve (Doghouse)

MANUFACTURER: Atwood and Morrill

MODEL #: MSI Valve Actuator Assembly

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 325°F* Press: 8.85 psig RH: 100%	Temp: 340°F Press: 110 psig RH: 100%	5.63 min.	30 min. (Note 4)	N/A	N/A

*Doghouse environment at time safety function completed - Ref. CNC-1381.05-00-0067.

QUALIFICATION REPORT: Procedure 201-39500, Test Report STR-060578-1 (CNM-1205.12-0009)

METHOD: Test

REPLACEMENT INTERVAL: SLND & Elastomers - 5 years

MEQP

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Feedwater Isolation Valve (Doghouse)

MANUFACTURER: Borg-Warner (NVD)

MODEL #: Pneumatic-Hydraulic Operator P/N 38991

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F* Press: 8.85 psig RH: 100% (Note 5)	Temp: 340°F Press: 110 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: 1736 (CNM-1205.12-0014)

METHOD: Test

REPLACEMENT INTERVAL: N/A

MEQP

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Valve Motor Operators
S/G PORV Isolation
(Doghouse)

MANUFACTURER: Limitorque

MODEL #: SMB RH Insulation

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 340°F Press: 105 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: 600-376-A, September 1972; 600-456. December 1975 (CNM-1205.19-0001)

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Valve Motor Operators
Auxiliary Feedwater Isolation
(Doghouse)

MANUFACTURER: Rotork

MODEL #: NA-1

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 340°F Press: 70 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: N 11/4, December 1970; TR116, October 1973; TR222, June 1975 (CNM-1205.19)

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Valve Motor Operators-
Main Steam Low Point
Drain Isolation (Doghouse)

MANUFACTURER: Rotork

MODEL #: NA-1

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 340°F Press: 70 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: N 11/4, December 1970; TR116, October 1973; TR222, June 1975 (CNM-1205.19)

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Valve Motor Operators-
S/G Blowdown Isolation
(Doghouse)

MANUFACTURER: Rotork

MODEL #: NA-1

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 340°F Press: 70 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: N 11/4, December 1970; TR116, October 1973; TR222, June 1975 (CNM-1205.19)

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Valve Motor Operators-
S/G Blowdown Isolation
By-Pass (Doghouse)

MANUFACTURER: Rotork

MODEL #: NA-1

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 340°F Press: 70 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: N 11/4, December 1970; TR116, October 1973; TR222, June 1975 (CNM-1205.19)

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Valve Solenoid Operators- S/G PORV's (Doghouse)

MANUFACTURER: Valcor

MODEL #: V70900-39-3-1

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 300°F* Press: 8.85 psig RH: 100%	Temp: 346°F Press: 87 psig RH: 100%	5.63 min.	30 min. (Note 4)	N/A	N/A

*Doghouse environment at time safety function completed - Ref. CNC-1381.05-00-0067.

QUALIFICATION REPORT: Valcor Reports MR-70900-301-1 and MR-70900-39-1-1(CNM-1210.04-0309).

METHOD: Test/Analysis

REPLACEMENT INTERVAL: 5 Years

MPIC

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Valve Solenoid Operators-
Main Steam Isolation
by-pass (Doghouse)

MANUFACTURER: Valcor

MODEL #: V70900-39-3-1

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 346°F Press: 87 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: QR-70900-21-1 Rev. A; QR-52600-515 Rev. B, MR-70905-21-3-1 (CNM-1210.04-253 254 & MCM-1210.04-119)

METHOD: Test/Analysis

REPLACEMENT INTERVAL: 5 Years

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Valve Solenoid Operators-Reverse Purge Isolation (Doghouse)

MANUFACTURER: Valcor

MODEL #: V70900-21-3

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 346°F Press: 87 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: QR-70900-21-1 Rev. A; QR-52600-515 Rev. B, MR-70905-21-3-1 (CNM-1210.04-253 254 & MCM-1210.04-119)

METHOD: Test/Analysis

REPLACEMENT INTERVAL: 5 Years

MPIC

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Valve Solenoid Operators-Feedwater Supply to Upper Nozzle (Doghouse)

MANUFACTURER: Valcor

MODEL #: V70900-39-3-1

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 346°F Press: 87 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: Valcor Reports MR-70900-301-1 and MR-70900-39-1-1(CNM-1210.04-0309).

METHOD: Test/Analysis

REPLACEMENT INTERVAL: 5 Years

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Valve Solenoid Operators-Tempering Isolation (Doghouse)

MANUFACTURER: Valcor

MODEL #: V70900-21-3

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 346°F Press: 87 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: QR-70900-21-1 Rev. A; QR-52600-515 Rev. B, MR-70905-21-3-1 (CNM-1210.04-253 & MCM-1210.04-119)

METHOD: Test/Analysis

REPLACEMENT INTERVAL: 5 Years

MPIC

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Valve Solenoid Operators-
Auxiliary Feedwater Pump
Turbine Steam (Doghouse)

MANUFACTURER: Valcor

MODEL #: V70900-21-3

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 346°F Press: 87 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: QR-70900-21-1 Rev. A; QR-52600-515 Rev. B, MR-70905-21-3-1 (CNM-1210.04-253 254 & MCM-1210.04-119)

METHOD: Test/Analysis

REPLACEMENT INTERVAL: 5 Years

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable - Hookup Wire (Doghouse)

MANUFACTURER: Anaconda

MODEL #: FR-EPR Insulation (Procurement Spec: CNS-1354.04-00-0006)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 385°F Press: 66 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: 80205-1 (CNM-1354.00-0019)

METHOD: Test/Analysis

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable - Medium Voltage Power (Doghouse)

MANUFACTURER: Anaconda

MODEL #: EPR Insulation (Procurement Specs: CNS-1354.01-00-0001 & 0003)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 346°F Press: 113 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: 80205-1 (CNM-1354.00-0019)

METHOD: Test/Analysis

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable -MSIV & S/G PORV Control (Doghouse)

MANUFACTURER: Anaconda

MODEL #: FR-EPR Insulation (Procurement Specs: CNS-1354.02-00-0001 & 0002)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 385°F Press: 113 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: 80205-1 (CNM-1354.00-0019)

METHOD: Test/Analysis

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable - Instrumentation and Control (Doghouse)

MANUFACTURER: Anaconda

MODEL #: FR-EPR Insulation (Procurement Specs: CNS-1354.03-00-0001 0002 & 0003)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 385°F Press: 66 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: F-C4836-2 (CNM-1354.00-0020)

METHOD: Test/Analysis

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable - Low Voltage Power (Doghouse)

MANUFACTURER: Anaconda

MODEL #: FR-EPR Insulation (Procurement Specs: CNS-1354.01-00-0001 & 0003)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 385°F Press: 113 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: 80205-1 (CNM-1354.00-0019)

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable - MSIV & S/G PORV Control (Doghouse)

MANUFACTURER: Brand-Rex

MODEL #: XLPE Insulation (Procurement Specs: CNS-1354.02-00-0001 & 0002)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 385°F Press: 113 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: FC-5120-1 and FC-5120-3 (CNM-1354.00-0023) and CNM-1354.00-0024

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable - Coaxial (Doghouse)

MANUFACTURER: Brand-Rex

MODEL #: XLPE Insulation (Procurement Spec: CNS-1354.04-00-0004)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F* Press: 8.85 psig RH: 100% (Note 5)	Temp: 385°F Press: 113 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: FC-5120-2 and FC-5120-3 (CNM-1354.00-0021 and CNM-1354.00-0024)

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable - Instrumentation and Control (Doghouse)

MANUFACTURER: Eaton

MODEL #: FR-EPDM Insulation (Procurement Specs: CNS-1354.03-00-0001, 0002 & 0003)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 430°F Press: 15 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: Qualification test of electrical cables by Isomedix (CNM-1354.00-0035).

METHOD: Test/Analysis

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable - Medium Voltage (Doghouse)

MANUFACTURER: Okonite

MODEL #: EPR Insulation (Procurement Specs: CNS-1354.01-00-000 & 0003)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 440°F Press: 8.85 psig RH: 100%	Temp: 455°F Press: 32 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: Okonite Report #355 (CNM-1354.00-0022)

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable - MSIV & S/G PORV Control (Doghouse)

MANUFACTURER: Okonite

MODEL #: FR-EPR Insulation (Procurement Specs: CNS-1354.02-00-0001 & 0002)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 455°F Press: 32 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: Okonite Report #355 (CNM-1354.00-0022)

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable - Hookup Wire (Doghouse)

MANUFACTURER: Okonite

MODEL #: Tefzel Insulation (Procurement Spec: CNS-1354.04-00-0006)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERAEILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 440°F Press: 8.85 psig RH: 100%	Temp: 455°F Press: 32, psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: Okonite Report #344 (CNM-1354.00-0026)

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable - MSIV & S/G PORV Control (Doghouse)

MANUFACTURER: Rockbestos

MODEL #: XLPE Insulation (Procurement Specs: (CNS-1354.02-00-000 & 0002), CNS-1354.03-00-000 & 0002, 0003, CNS-1354.04-00-0006)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F* Press: 8.85 psig RH: 100% (Note 5)	Temp: 346°F Press: 113 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: FC-5120-1 and FC-5120-3 (CNM-1354.00-0023) and CNM-1354.00-0024

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Cable Termination Splice Material (Doghouse)

MANUFACTURER: Ray Chem

MODEL #: WCSF-N

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F* Press: 8.85 psig RH: 100% (Note 5)	Temp: 360°F Press: 70 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: 71100 & F-C4033-3 (CNM-1367.01-0001 & 2)

METHOD: Test

REPLACEMENT INTERVAL: N/A

CATAWBA NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO PIPE RUPTURE ENVIRONMENT

EQUIPMENT ID: Seal Material for Cable Entrance Fittings (Doghouse)

MANUFACTURER: 3M

MODEL #: Scotch Cast 9 Epoxy (XR-5240)

PIPE RUPTURE ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN PIPE RUPTURE ENVIRONMENT(2)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 240°F Press: 8.85 psig RH: 100% (Note 5)	Temp: 350°F Press: 18 psig RH: 100%	Continuous	Continuous	N/A	N/A

QUALIFICATION REPORT: CNC-1381.05-00-0039 and Wyle Report #44390-1, Rev. A (CNM-1364.00-0001)

METHOD: Test/Analysis

CATAWBA NUCLEAR STATION - UNITS 1 AND 2

ENVIRONMENTAL QUALIFICATION OF CLASS 1E ELECTRICAL EQUIPMENT LOCATED OUTSIDE CONTAINMENT EXPOSED TO PIPE RUPTURE ENVIRONMENT

Note 1

The methods employed to evaluate pipebreaks and to determine the resulting environmental parameters are discussed in Section 3.6 of the Catawba FSAR.

Note 2

The pipe rupture environment is assumed to exist for 2 1/2 hours (except for one area of the Auxiliary Building, Elevation 543' which exists for 2 5/6 hours) based on 30 minutes at the peak temperature after which action by the operator isolated the break and allows the Auxiliary Building temperature to decrease to normal in 2 hours. Use of the term "Continuous" indicates operability required/ demonstrated throughout the pipe rupture period.

The pipe rupture environmental analysis for the Doghouse was conducted seperately taking into consideration different sizes of main steam line breaks. All equipment located in the Doghouse is identified under "Equipment ID".

Pressure: Not a significant qualification parameter for pipe rupture outside the containment since all locations outside containment are open areas not susceptable to pressure build-up. It should be noted that the pressure in the doghouse is a spike (8.85 psig) of less than 1 sec. duration.

Relative Humidity: For outside containment ruptures of piping systems operating at temperatures less than 200°F, area relative humidity is not a significant qualification parameter. This pipe rupture temperature precludes flashing of the liquid which could significantly increase area relative humidity. Additionally, evaporation of the liquid does not significantly increase area relative humidity due to the large open areas in which the pipe rupture occurs and the relative short duration of the pipe rupture.

Radiation: There is no significant increase in radiation levels outside the containment as a result of a pipe rupture outside the containment.

Chemical Spray: Not a qualification parameter for pipe rupture outside the containment since there is no chemical spray outside the containment.

Submergence: Based on analysis performed by Duke Power Company, it has been determined that there is no safety-related electrical equipment, required to mitigate the event causing the flood (e.g., pipe rupture) or required to bring the plant to a safe shutdown condition given a flood event, located below the postulated flood levels.

Note 3

The equipment listed is a NEMA 4 enclosure containing general application devices (e.g., relays, switches, terminal blocks, etc.). The qualified environment is dictated by the single limiting device contained in the enclosure. The enclosure and device qualification is documented in calculation CNC-1381.05-00-0054.

Note 4

The 30 minute "Operability Demonstrated" parameter is based on Duke Power Company's Response to Significant Deficiency Report No. 413-414/84-16, Supp. 2.

Note 5

This equipment is not required to mitigate the consequences of a MSLB in the doghouse. Therefore, the "Pipe Rupture Environment" parameters are for the HELB for which the equipment is required.