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August 30, 1982

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4

Re: Catawba Nuclear Station
Docket Nos. 50-413 and 50-414

Dear Mr. Denton:

Ms. Elinor G. Adensam's letter of June 9, 1982 transmitted five additional questions from the Mechanical Engineering Branch. Attached are Duke Power Company's responses.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

ROS/php
Attachment

cc: (w/o attachment)
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cc: Mr. Jesse L. Riley
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943 Henley Place
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(w/attachment)
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Mr. S. E. Moore
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210.117 In the staff's review of the design documents for the auxiliary feedwater pumps, it was determined that the design report by McDonald Engineering (Report No. ME-751) entitled, "Seismic Stress Analysis of Motor Driven Pumps," did not adequately address the pressure boundary checks required by the ASME B&PV Section III Code. It is requested that the applicant obtain and provide to the staff, the manufacturer's (Bingham-Willamette Co.) calculations for the Code-required pressure boundary checks.

Additionally, it is requested that the applicant clarify the following questions from our review of the McDonald Engineering stress report:

a. What is meant in 5.8 of ME-751 by "proof tests?"

b. What is the basis for each of the allowables shown in the "Summary of Results" (p. 3 of ME-751)?

Response:

1. The design calculations required by paragraph ND-3442.7 of the ASME Code, 1977 Edition, were not included in the seismic report, as the ASME Boiler and Pressure Vessel Code, Section 3, Subsection ND-1977 Edition does not require that the design calculations performed to verify the integrity of the pressure boundary be submitted. They are available for audit at Bingham-Willamette's factory in Portland.

2. Paragraph 5.8 of report ME-751 refers to the hydrotest performed in accordance with the Hydrostatic Test Procedure and Addendum #12, dated 6/21/79. The procedure for this test was approved by Duke and the test was witnessed by Duke.

3. Individual references for the values listed as "allowables" in Table 3 appear at various points in the seismic report ME-751. Although all of the individual references do not show the source, they do identify the material and value so that they can be easily checked. An example of this is on page 17 where the allowable stresses for A-307 are shown as 11,980 psi shear and 29,000 psi tensile per ASME App. XVII and Subsection NF.

210.118 As a result of the staff's review of Design Specification No. CNS-1205.00-5, "Nuclear Safety-Related Stainless Steel Valves," we find that Attachment 5.8, Class 1 Valve Transients, is still incomplete. Provide the seven missing figures for our review.

Additionally, provide Attachments 5.14, 5.15, and 5.16. (As an editorial comment there are currently two 5.14's and no. 5.15 attachments.)

The design specification (CNS-1205.00-5) should be revised to consider the crucial aspect of design pressure and temperature and provided to the staff.

Response:

Group III, Class 1 Valve Transients for the charging line nozzle, plant startup and shutdown is correct in being upset transient category according to Westinghouse NSSS Design Transients. (Pages attached).

Enclosed are the following items:

1. Missing seven figures of Attachment 5.8 of specification CNS-1205.00-00-0005, Class 1 Valve Transients.
2. Addendum No. 10 to the specification CNS-1205.00-00-0005. This addendum covers the aspect of design conditions and attachment numbering.
3. Additional attachments to specification.

2.4 Reactor Coolant Piping Branch Connections

The temperature transients included in this chapter for reactor coolant piping branch connections are those resulting from flow discharging into the Reactor Coolant System through these connections. The temperature transients on the branch connections resulting from changes in the reactor coolant temperature are included in Section 2.2.

It should be noted that some nozzles on the reactor coolant system serve dual functions, such as one connection per loop for both the accumulators and the low head injection lines. In such cases the nozzle should be sized for the combination of the two sets of transients.

2.4.1 Charging Line Nozzle

Variation in the temperature of the charging fluid downstream of the regenerative heat exchanger can be due to any one, or a combination of, the following changes:

a. Variations in the letdown and/or charging line flow rate.

b. Variation in the charging stream temperature upstream of the regenerative heat exchanger.

c. Variation of the letdown stream temperature upstream of the regenerative heat exchanger. Since letdown normally is drawn from the cold leg, such temperature variations normally come from variation in T_{cold}.

As can be seen from the figures describing each design transient, variation in T_{cold} are comparatively minor. Therefore, transients falling under Item c above are omitted in the charging line nozzle analysis.

To refer transients under Item a and b to actual plant operations, they are divided up as follows:

1. Transients occurring when the charging line and the letdown line are removed from service and put back in service.

2. Transients occurring during plant operation when charging and letdown flow rates are changed.

The following assumptions are made throughout this analysis, unless otherwise noted:

a. Cold leg temperature, T_{cold} = 560°F.

b. Hot leg temperature, T_{hot} = 630°F.

c. Temperature of the charging fluid 40°F. This is based on the assumption that water is drawn from a tank outside the Auxiliary Building during the cold season.

d. Temperature to which the charging line inside the containment will be cooled when the water in the charging line is stationary 70°F.

e. Temperature of the charging fluid downstream of the regenerative heat exchanger, 500°F.

f. Valves controlling flow in the letdown and charging lines take 10 seconds to fully open or to fully close.

It should be noted that all temperatures are the temperatures of the water in contact with the nozzle.

1. Transient Occurring When the Charging Line and the Letdown Line Are Removed from and Put Back in Service

The complete charging line nozzle transient for one cycle of operation is shown on Figure 25. This figure assumes that letdown is never in operation unless charging is in operation. As can be seen from the figure, this method of operation will expose the charging line nozzle to cold water for short periods of time but it will insure that the letdown stream always be cooled and thus flashing is prevented in the letdown orifices. If the letdown stream, by error is initiated before charging, a less severe transient on the charging line nozzle will result, but components in the letdown line may be damaged.

The charging line nozzle transient has been broken down into the following steps to facilitate the description of it.

Step 1. The plant is operating with a charging line temperature of 500°F (assumption e).

Step 2. The letdown is shut off during a period of 10 seconds (assumption f). It is assumed that the charging flow temperature has reached its low temperature 40°F (assumption c) when letdown is shut off. The heat capacity of the regenerative heat exchanger is neglected.

Step 3. The temperature of the charging stream remains at 40°F for 5 minutes after which time charging is shut off.

Step 4. Charging is shut off over a period 10 seconds (assumption f). The temperature of the water around the charging line nozzle increased to the loop temperature, $T_{hot} = 630$, $T_{cold} = 560$ (assumption a and b).

Step 5. At this point both charging and letdown is shut down and are assumed to remain shutdown during approximately one day. This period of time will provide time for desired maintenance on equipment in the letdown and charging line.

Step 6. Charging is again initiated. The water in the charging line is now 70°F (assumption d) and is assumed to move as a cold front and hit the charging nozzle. It is assumed that the temperature of the fluid reaches 70°F in 1 second. This accounts for the fact that while charging is shut off, a portion of the charging line close to the nozzle will be heated by conduction from the loop.

Step 7. The charging fluid is assumed to remain at 70°F as long as letdown is not initiated. It is assumed that up to the moment when letdown is initiated, water is not drawn from an outside tank of 40°F but from the Volume Control Tank. For that situation, the 70°F is a conservative temperature.

It is assumed that when the charging and letdown lines have to be shutdown this is a result of some equipment failure and has to be done suddenly. Consequently, the operator may not have control over where the charging water comes from and the worst possible condition is when water is drawn from an outside tank at 40°F. When charging and letdown is again initiated it is assumed that water will be drawn from the Volume Control Tank at least until letdown is initiated.

Step 8. Letdown is initiated over a period of 10 seconds (assumption f) and the charging fluid temperature increases to normal.

The charging line flow rate can be varied either manually or automatically, whereas the letdown flow rate only can be varied manually. Normally the operator will not change the charging line flow rate manually, unless the letdown flow rate is changed. The letdown flow rate will normally only be changed towards the end of core life, for load follow purposes, to compensate for core burnup or to initiate maximum purification. Each such change in letdown flow rate must be followed by an adjustment in charging line flow rate to keep the pressurizer level at a desired point.

An exception to the above occurs when the pressurizer is drained or filled during plant shutdown or startup respectively. This will occur when the primary system is at low temperatures, with very slight temperature transients on the charging line nozzles. This case is therefore omitted for the nozzle analysis.

The charging line flow rate is assumed to vary each time the plant power level changes. Following an increase in the reactor power level, T_{avg} in the primary system will increase and as a consequence of that, the Reactor Coolant System will expand. This will be noticed as an increase in the pressurizer level. The pressurizer level setpoint is a function of power, such that a higher power level will allow a higher pressurizer level. However, the increase in pressurizer level as a result of an increase in power is assumed to be larger than the programmed increase in pressurizer level. Consequently to keep the pressurizer level at the desired level more reactor coolant has to be let down from the Reactor Coolant System than is charged in with the charging pumps. This is accomplished by automatically controlling the charging line flow rate, using pressurizer level and reactor power as controlling parameters. In short, it is assumed for design purposes that an increase in reactor power increases the pressurizer level above the programmed level for the new power level, which results in a decrease in charging line flow rate. Letdown flow rate remains constant. A decrease in reactor power results in an increase in charging line flow rate.

For design purposes it is assumed that the plant may change load twice per day and that for each load cycle the charging line flow rate will increase by 50 percent once and decrease by 50 percent once. The total number of charging line increases and decreases during the 40-year design life of the plant will thus be 24,000 for each. This is a very conservative assumption since the programmed pressurizer level versus load, closely follows the expansion and contraction of the reactor coolant system for reactor power increases and decreases respectively. It is further assumed that once the charging line flow rate has been changed from its design value by 50 percent, it will remain at the new value for 17 minutes before the flow rate is brought back to the design value. The 17 minutes is consistent with the time it takes to load (or unload) the plant from 15 percent to 100 percent power. Any charging line flow rate changes are assumed to occur instantaneously.

The letdown flowrate is assumed to increase by 60 percent (assuming one 75 gpm orifice in service and one 45 gpm orifice added) twice per day during plant life or 24,000 occurrences during the 40 year design life of the plant. It is assumed that the increased letdown will continue for 6 hours once it is initiated. This corresponds to the time the reactor will be at a low power level, assuming an 18-6 load cycle. During this time a high letdown flow rate is required to follow the Xenon transient.

A decrease in the letdown flow rate is not a normal operating occurrence. However, for conservatism 2000 cycles are included, corresponding to one occurrence per week during the 40 year desing life of the plant. It is arbitrarily assumed that once the letdown flow rate has been decreased it remains at the low value for 6 hours and then increased back to the design value. Any letdown line flow rate changes are assumed to occur instantaneously.

The magnitude of the temperature transients are based on values calculated for INT operating conditions (reference calculation RFS-I-1109). Approximately 30 percent margin has arbitrarily been added on top of the INT numbers.

a. Charging line flow rate increased by 50 percent and then reduced back to normal.

   INT numbers indicate that the temperature of the charging steam downstream of the Regenerative Heat Exchanger is reduced by 62°F. Use 80°F for design purposes. See Figure 26A.

b. Charging line flow rate decreased by 50 percent and increased back to normal.

   INT numbers indicates that the temperature of the charging stream increases by 38°F. Use 50°F for design purposes. See Figure 26B.

c. Letdown line flow rate increased by 60 percent and then reduced back to normal.

   INT numbers indicates that the temperature of the charging line is increased by 30°F. Use 50°F for design purposes. See Figure 27A.

d. Letdown line flow rate is decreased by 50 percent and then reduced back to normal.

INT numbers indicates that the temperature of the charging stream decreases by 95°F. Use 125°F for design purposes. See Figure 27B.

2.4.2 Accumulator Connections Nozzle

For design purposes, it is assumed that the accumulators discharge into the reactor coolant system five times during the 40 year design life of the plant. This can happen during an accident condition or if the isolation valve is inadvertently opened when the reactor coolant system is depressurized. It is assumed that the nozzle is located on the cold leg and is hot, 560°F, and that the water in the accumulator is 70°F. It is also assumed, for design purposes, that the accumulator is emptied in 30 seconds. See Figure 28A.

2.4.3 Residual Heat Removal System Return Nozzle

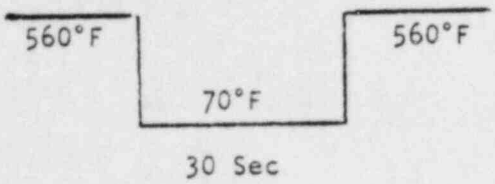
During the beginning of a cooldown it is assumed that the reactor coolant system temperature is 400°F. The letdown to the residual heat exchangers is cooled to 200°F and returned to the reactor coolant system. During initiation of the cooldown the nozzle is subject to a temperature shock from 400°F to 200°F. Based on five cooldowns per year, 200 cooldowns occur during the 40 year design life of the plant. See Figure 28B.

2.4.4 Low Head Safety Injection Nozzle (on loops and reactor vessel)

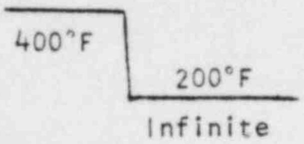
Initiation of safety injection does not effect the low head safety injection nozzles unless the primary coolant system pressure is below approximately 150 psig. When that is the case, water from the refueling water storage tank, at a temperature of 40°F for design purposes, will be pumped into the reactor coolant system which at that time, in the extreme case, is still hot. Water at a temperature of 40°F will thus be pumped through nozzles with a temperature of 560°F for cold leg nozzles and 630°F for hot leg nozzles. This will only occur subsequent to a large loss of coolant accident and

Figure 26. Design Transients for Miscellaneous Nozzles

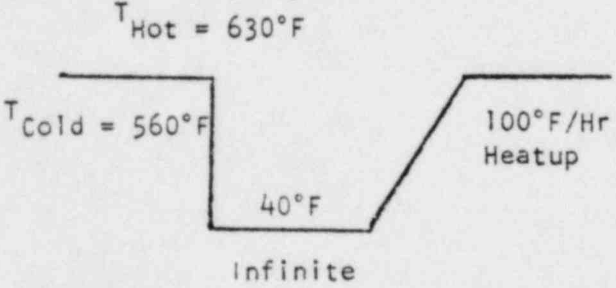
A. Accumulator Connection



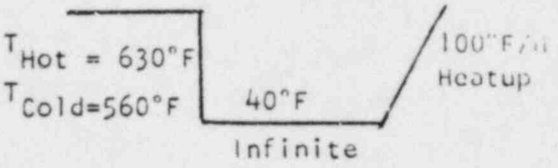
B. Residual Heat Removal System Return Nozzle



C. Low Head Safety Injection



D. High Head Safety Injection



E. RTD Manifold Return Nozzle

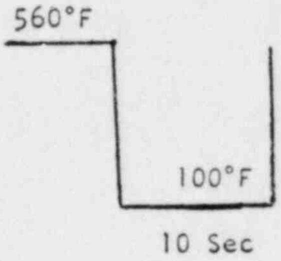


Figure 27A. Letdown Line Flowrate Increased by 60% and then Reduced Back to Normal

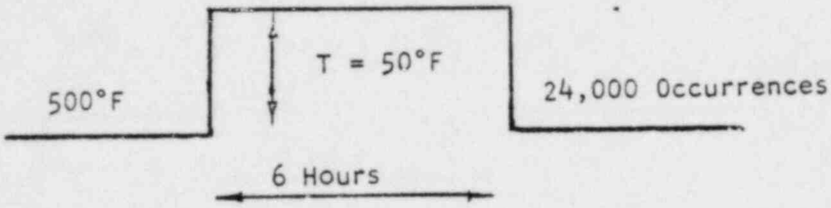


Figure 27B. Letdown Line Flowrate Decreased by 50% and then Increased Back to Normal