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May 12, 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:

My letter of April 8, 1982 transmitted responses to action items which were compiled during a December 15-18, 1981 meeting with the Structural Engineering Branch. As noted in my previous letter, responses to items 27, 31 and 32 were to be provided later. This is to advise that responses to these items will be discussed at a meeting with the Structural Engineering Branch scheduled for June 4, 1982 in Bethesda, Maryland.

Our previous response to item 11 has been revised to address Revision 1 of Regulatory Guide 1.142 and is attached.

Very truly yours,

William O. Parker, Jr.

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Attachment

cc: Mr. J. P. O'Reilly
Mr. P. K. Van Doorn
Mr. R. Guild
Palmetto Alliance
Mr. J. L. Riley
Mr. H. Presler

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11. Compare ACI 349 in conjunction with Regulatory Guide 1.142, to ACI 318 (basis of Duke's design of Category I concrete structures) justify deviations identified in this comparison including considerations of inherant conservatisms of the structures as appropriate.

Response:

The attached FSAR Table 3.8.1-5 provides a comparison of the Catawba design to that of ACI 349, in conjunction with Regulatory Guide 1.142.

Table 3.8.1-5 (Page 1)

Comparison of Concrete Design Criteria

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
Chapter 1 General Req.		Requires copies of structural drawings, typical details and specifications be signed by licensed engineer (seal not required).	Recommends inspectors be experienced and familiar with ACI and ASTM standards.	Duke requires drawings and specifications be prepared under supervision of licensed engineers.
		Requires inspection by Owner.		Inspections are performed by Owner representative (Quality Control).
Chapter 2 Definitions	Massive concrete not specifically mentioned.	Requires areas to be treated as massive concrete to be identified on drawings or specification.		Current practice is in accordance with ACI 349. Duke's concrete specification requires that areas treated as massive concrete to be designated on the drawings.
Chapter 3 Materials		Excludes use of air-entraining Portland Cement.		Duke concrete specification meets the intent of ACI 349 by requiring that Type I or II cement be used.

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Table 3.8.1-5 (Page 2)

Comparison of Concrete Design Criteria

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
Chapter 3 (cont'd)	No test reports required.	Requires test report on each cement shipment. No cement can be used prior to receipt of 7 day mill test strength. Excludes use of light weight aggregate concrete.		Duke QA Procedure requires mill tests for each shipment. Results are verified to meet ASTM C150 before use of cement is allowed. Duke concrete specification meets the intent of ACI 349 by requiring that agregrates comply with standards such as ASTM C33 which excludes light weight aggregrates.
	Allows use of rail-steel and axle steel bars. Allows Grade 90 bars.	Requires use of billet steel reinforcing bars of Grade 60 or less only.		Steel specification requires that rebar comply with ASTM A615 grades 40 and/or 60 as specified on the bill of materials which meets the intent of ACI 349.
Chapter 4 Concrete Quality	Gives mix design criteria for use in lieu of trial batch	Requires use of trial batch method of mix design.		Duke concrete specification which is in accordance with ACI

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Table 3.8.1-5 (Page 3)

Comparison of Concrete Design Criteria

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
Chapter 4 (cont'd)	method of proportioning mix.			349, requires that mixes be determined by trial batches.
		Gives method of determining water/cement ration for fly ash mixes.		Fly ash mixes are not used at Catawba in safety related structures.
	Requires use of Type V cement for sulfate exposure.	Defines sulfate exposure. Allows fly ash mix for sulfate exposure conditions.		Sulfate conditions do not exist at Catawba.
	Requires 1 strength test/day/concrete class.	Permits test internal increase by 50 Yd^3/100 psi lower standard deviation if standard deviation for 30 tests in a class is less than 600 psi.	Requires test frequency per ANSI N45.2.5-74.	Current practice is in accordance with Reg. Guide. Concrete specification requires test frequency found in ANSI N45.2.5.
Chapter 5 Mixing & Placing Concrete		Requires construction specifications specifically state: 1. Method of cleaning construction joints. 2. Method of curing.		Concrete specification does not state methods. It requires joints to be cleaned, concrete to be cured and the temperature of the concrete as placed to be main-

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Table 3.8.1-5 (Page 4)

Comparison of Concrete Design Criteria

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
Chapter 5 (cont'd)		3. Method of controlling temperature for hot weather concreting.		tained no higher than 85°F. Appropriate Chapters of ACI 301 are referenced but slelection of method is left to Construction Department.
	Allows placement of concrete without removal of water from place of deposit at the discretion of the owner.	Same as 318.	Requires removal of water before placement.	Duke Concrete specification references Chapter 8 of ACI 301 which complies with Regulatory Guide requirements.
	Allows partially hardened or contaminated concrete to be used at discretion of the Engineer.	Same as 318.	Prohibits use of such material.	Duke concrete specification references Chapter 8 of ACI 301 which prohibits the use of partially hardened material, therefore, it complies with the Reg. Guide.
Chapter 6 Form work, Embedded pipes, and construction	Requires pressure test of embedded pipe to 50% above max. pressure (150 psi min.) for 4 hours.	Requires pressure test of embedded pipe "in accordance with the applicable standard."	Rev. 1 accepts ACI 349's requirements.	Duke complies with the position taken in Rev. 1 of the Reg. Guide.

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Table 3.8.1-5 (Page 5)

Comparison of Concrete Design Criteria

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
Chapter 6 (cont'd)	Limits presssure and temperature of embedded piping to 200 psi and 150°F.	Allows 200°F for localized areas. Allows 350° for accident or short term periods. Allows 650°F for local areas from fluid jet from pipe failure. Allows higher temperatures if supported by test results.		ACI 318 is more conservative than ACI 349.
	Requires vertical construction joints to be wetted and coated with cement grout before placing next lift.	Requires all joints be shown on plans or approval by engineer. Defective or contaminated concrete to be removed. Vertical joints to be saturated with water. Grout not required.		Duke shows all joints on plans and complies to ACI 349 except that joints are dampened and not saturated prior to placement which is in accordance with ACI 301.
Chapter 7	Placement tolerances are stricter than ACI 301.	Tolerances on bar placement liberalized to ACI 301 standards.		Duke concrete specification complies with 349 except that a larger positive tolerance is allowed for clear distance to formed surfaces. This tolerance assures that adequate cover is maintained and correlated better with the design requirements on depth "d".

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Table 3.8.1-5 (Page 6)

Comparison of Concrete Design Criteria

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
Chapter 7 (cont'd)		Requires test on full welded splices and full positive connections.		Duke test positive connections in accordance with ANSI N45.2.5.
		Requires welded splices or positive connections for splicing load-carrying rebar located in regions with membrane tension normal to splice.		Duke practice does not comply with ACI 349.
Chapter 8 Analysis & Design General Considerations	Gives procedure for Alternate Design Method	Eliminates Alternate Design Method.	Strength Design Method is not applicable for structures intended as pressure barriers. Designs will be reviewed by NRC on a case-by-case basis.	Alternate Design Method is not used at Catawba.
	Allows use of fillers in concrete joint construction.	Prohibits use of fillers in concrete joint construction.		Fillers are not used at Catawba.
Chapter 9 Strength & Serviceability Requirements		Requires consideration of dynamic response of concrete structure, foundation, and surrounding soil.		Duke's practice is in accordance with ACI 349.

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Table 3.8.1-5 (Page 7)

Comparison of Concrete Design Criteria

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
Chapter 9 (cont'd)		Requires following load combinations:		Duke's practices are in accordance with the Reg. Guide and ACI 349. Duke's combinations are provided in Table 3.7.1-2 of the FSAR.
	1. $U = 1.4D + 1.7L$	1. $U = 1.4D + 1.7L + 1.7R_o$		
	2. $U = .75 (1.4D + 1.7L + 17.W)$	2. $U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7E_o + 1.7R_o$	2. $U = 1.4D + 1.4F + 1.7L + 1.7H + 1.9E_o + 1.7R_o$	
	3. $U = 0.9 + 1.3W$	3. $U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.7R_o$		
	4. $U = .75 (1.4D + 1.7L + 1.1E)$	4. $U = D+F+L+H+T_o+R_o+E_{ss}$		
	5. $U = 1.4D + 1.7L + 1.7H$	5. $U = D+F+L+H+T_o+R_o+W_T$		
	6. $U = 0.9D + 1.7H$	6. $U = D+F+L+H+T_a+R_a+1.25P_a$	6. $U = D+F+L+H+T_a+R_a+1.5P_a$	
		7. $U = D+F+L+H+T_a+R_a+1.15P_a +1.0(Y_r + Y_j + Y_m) + 1.15E_o$		
		8. $U = D+F+L+H+T_a+R_a+1.0P_a + 1.0 (Y_r + Y_j + Y_m) + 1.0 E_{ss}$		
		9. $U = 0.75 (1.4D + 1.7L + 1.4T_o + 1.7R_o)$	9. $U = .75 (1.4D + 1.7L + 1.7T_o + 1.7R_o)$	
		10. $U = 0.75 (1.4D + 1.4F + 1.7L + 1.7H + 1.7 E_o + 1.4T_o + 1.7R_o)$	10. $U = .75 (1.4D + 1.4F + 1.7L + 1.7H + 1.9E_o + 1.7T_o + 1.7R_o)$	

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Table 3.8.1-5 (Page 8)

Comparison of Concrete Design Criteria

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
Chapter 9 (cont'd)		11. $U = 0.75 (1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.4T_o + 1.7R_o)$	11. $U = .75 (1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.7T_o + 1.7 R_o)$	
		Requires consideration of prestress, crane loads, vibration, impact, shrinkage, creep and differential settlement. For normal loads (Comb. 1 to 3).	Effects of differential settlement should be included in all load combinations.	
		When D or L reduces effects of other loads, coefficients shall be .9D and 0L.	For all loading conditions, when any load reduces the effects of other loads, the coefficient for the load is always present and acts simultaneously, otherwise, coefficient = 0.	
		For combination 7 and 8 local strength can be exceeded for Y_r, Y_j, Y_m, if no loss of safety-related system results.	Section strenghts must be adequate for forces in comb. 7 and 8 without Y_r, Y_j, and Y_m.	

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Table 3.8.1-5 (Page 9)

Comparison of Concrete Design Criteria

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
		Allows time-history analysis for pipe-rupture loads (combinations 6, 7, and 8).	Local exceedance of section strength for tornado missiles for comb. 5 acceptable provided strength is adequate for forces of combination 5 without tornado missiles.	
Chapter 10 Flexure & Axial Loads		Specifies minimum temperature and shrinkage reinforcing for massive concrete.		There is no massive concrete in any nuclear safety related structures at Catawba.
Chapter 11 Shear & Torsion		Gives permissable shear stresses for slabs subject to loads with forces in the plane of the slab (i.e., missile loads).		Current practice is in accordance with ACI 349 and Reg. Guide.
	Specifically addresses openings in slabs.	Slab opening section deleated.	Provisions of AIC 318 are acceptable.	
		Sets allowable shear stress values for punching shear in walls.		
Chapters 12 thru 17		No significant changes.		

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Table 3.8.1-5 (Page 10)

Comparison of Concrete Design Criteria

Code Section	ACI 318	ACI 349	Regulatory Guide 1.142 Rev. 1, Oct. 1981	Justification
Chapter 18 Prestressed Concrete	Maximum water/cement ratio for grout for bonded tendons = 0.5.	Limits w/c ratio to .45.		There is no prestressed concrete in any of Catawba's nuclear safety related structures.
	Requires member temperature at time of grouting bonded tendons to be above 50°F. Temperature must be maintained above 50°F for 48 hours.	Requires member temperature above 35°F maintained until job cured grout cubes reach 700 psi. Grout temperature limited to 90°F during mixing and pumping.		
Chapter 19 Shells	Applys only to thin shell concrete structures.	Applys only to the design of shell concrete structures having thicknesses equal to or greater than 12 in.		Duke's design practice does comply with ACI 349.
Appendix A Special Provisions for Seismic Design		Not included in ACI-349.	ACI-349 lacks specific requirements to assure ductility of framed structures. Adherance to ACI-318 Appendix A is acceptable.	Current practice is in accordance with ACI-318.

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