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82 OCT 15 A9: 18

October 8, 1982

Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
IE Bulletin 79-02 Response

Dear Sir:

Attached is a copy of Revision 5 to Duke Power Company's response to IE Bulletin 79-02. This Revision is submitted to satisfy NRC Region II inspector comments noted in Inspection Report Number 82-18 regarding Oconee Nuclear Station.

Very truly yours,

H.B. Tucker/Ad

Hal B. Tucker

JFN/php
Attachment

cc: Mr. W. P. Ang
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

Mr. Philip C. Wagner
Office of Nuclear Reactor Regulation
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Washington, D. C. 20555

Mr. W. T. Orders
NRC Resident Inspector
Oconee Nuclear Station

IE11

OCONEE NUCLEAR STATION

Responses to USNRC Bulletin 79-02, Revision 2

Original: July 6, 1979

Revision 1: August 14, 1979

Revision 2: October 23, 1979

Revision 3: December 7, 1979

Revision 4: July 21, 1980

Revision 5: September 15, 1982

Oconee Nuclear Station is a three (3) unit operating station located near Seneca, South Carolina. The following is a summary, by item, of the extent and manner in which Duke Power Company intends to satisfy Actions 1 through 8 of IE Bulletin 79-02, Revision 2.

Response 1: Duke Power Company is accounting for base plate flexibility in the calculation of expansion anchor bolt loads for all Nuclear Safety Related/seismic pipe support base plates using a conservative hand calculation method which has been verified by non-linear finite element analysis. The models and boundary conditions, including appropriate load displacement characteristics of the anchors used for the finite element analyses, are based on Duke studies and on work performed by Teledyne Engineering Services which was sponsored by a group of fourteen (14) utilities formed to respond to generic items of IE Bulletin 79-02. A complete description of the finite element model is submitted in the Teledyne Engineering Services report attached (Attachment #1). A description of the hand calculation method is also attached (Attachment #2).

All re-analysis is complete for Nuclear Safety Related/seismic support base plates located in Unit #3 Containment, Auxiliary Building, and Turbine Building; in Unit #1 Containment, Auxiliary Building, and Turbine Building; and in Unit #2 Containment, Auxiliary Building, and Turbine Building. In some cases, conservatively including the effect of plate flexibility has reduced the expansion anchor factor of safety below that outlined in Response 2. Any that had a factor of safety less than two were given immediate attention and determination of system operability was immediately begun in parallel with a rigorous (finite element model) analysis of the expanison anchor factor of safety. All anchors in this category have been resolved by demonstrating computed factors of safety in excess of two (2) or that the expansion anchor is on a non-essential segment of pipe.

Response 2: Self-drilled shell type, wedge type, and sleeve type expansion anchors have been used in Nuclear Safety Related/seismic pipe support applications at Oconee Nuclear Station. The majority of expansion anchors are of the self-drilled shell type. Duke Power Company has verified that the minimum factor of safety between expansion anchor design load and anchor ultimate capacity determined from static load tests, is five (5) for shell type expansion anchors and four (4) for wedge and sleeve type expansion anchors. This process of verification is outlined in Response 1.

Oconee Nuclear Safety Related/seismic pipe support expanison anchor installations are restricted to normal weight structural concrete of varying nominal strengths. Expansion anchor bolt ultimate load capacities are based on manufacturer's test results and recommendations for normal weight concrete and installed concrete strenghts. None are installed in concrete block masonry.

The effects of shear-tension interaction, minimum edge distance and bolt spacing on expansion anchor ultimate capacity is properly accounted for in computing the expansion anchor factors of safety.

Response 3: Duke Power Company designs pipe supports to resist all applicable loadings including seismic loads, hydro test loads, normal operating loads, thermal loads, etc. Each support is designed for a static or quasi-static load resulting from the most critical combination of applicable loadings. Duke Power Company co-sponsored tests performed by Teledyne Engineering Services to demonstrate that expansion anchors installed at Oconee Nuclear Station will perform adequately under both low cycle/high amplitude loading (seismic) and high cycle/low amplitude loading (operating). The report on cyclic testing of concrete expansion anchors by Teledyne Engineering Services is provided in Attachment #1.

Response 4: Existing QC documentation for expansion anchor installations at Oconee is not sufficient to provide written verification that each expansion anchor meets the requirements of Action 4(a) and 4(b) of IE Bulletin 79-02. Duke Power Company has initiated a test program as required by IE Bulletin 79-02 to verify that applicable design and installation requirements have been met.

The program consists of two (2) phases. Phase 1 is a field surveillance program to identify each Nuclear Safety Related/seismic pipe support which was installed using expansion anchors and compare its "as-built" configuration, location, and expansion anchor size and type to existing documents. Phase 2 is a field inspection and testing program to verify that specified design size and type is correctly installed.

The Phase 2 program for shell type expansion anchors was developed and initially implemented on Unit 3 in accordance with the requirements of IE Bulletin 79-02, Revision 0. Pull testing and thread engagement check were required for one randomly selected shell-type anchor per plate on each pipe support hanger in addition to a general visual inspection. Also, in response to numerous discussions with Region II Inspectors, two additional items, oversize holes in plates and anchor shoulder to plug depth, were measured for each anchor that had its bolt removed during testing. The anchors were pull tested at 25 percent of ultimate load which is 25 percent in excess of the maximum envelope design load. If the anchor failed pull test or thread engagement, then each anchor on the plate was tested or inspected for the parameter which failed. All holes identified as being oversized were repaired where required by analysis. Approximately 15% of the Unit 3 plate bolt holes inspected were oversized, the typical Oconee supports/restraints transmit shear load to the supporting structure by baseplate/concrete friction and/or bolt shear. Generally one (1) bolt will provide adequate shear area while a minimum of two (2) bolts (most conservative assumption) is available for each Unit 3 support/restraint as a result of the field inspections and subsequent modifications which were implemented in the expansion anchor program. The acceptable shoulder to plug dimension was the anchor length minus plug length + 1/8" or - 1/4". Any bolt exceeding the + 1/8" tolerance was subjected to a pull test of 25% of the ultimate load. Even if the bolt passed the pull test, each bolt was accepted only after a case-by-case supplemental review by Design Engineering which required that only 80 percent of the ultimate capacity be used in the design check and that the total support design and support as-built condition be considered. The 80 percent reduction factor was confirmed by testing performed at the University of Tennessee. A review of all supports after the completion of the IE Bulletin 79-02 modifications show an average of 160 concrete anchors per unit in this category and distributed approximately as one anchor per base plate. The average safety factor for these concrete anchors exceeds 40 with the minimum being 6.25. Any bolt exceeding the - 1/4" tolerance was rejected, even if it passed the pull test, due to possible insufficient shear cone capacity.

Any anchor tested in the Unit 3 program that passed the pull test and had minimum acceptable embedment depth was considered fully adequate even though it may have failed to meet certain visual requirements deemed to be indications of proper installation. After completion of the inspection and testing program in Unit 3, each support containing anchors passed by the pull test but having a visual deficiency was reviewed by Design Engineering for adequate margins of safety and future repairs deemed prudent. A pull test is an actual capability test assuring a minimum anchor capacity equal to the test load and has sufficient margin of safety due to the following reasons:

a. The test load (Pu/4) is 25 percent greater than the maximum envelope design load. The actual expansion anchor design loads were not available for each anchor prior to testing, therefore, each shell anchor design load was conservatively assumed to be equal to the full Pu/5 for purposes of the testing.

b. Calculation techniques to establish expansion anchor design loads contain inherent margins for the following reasons:

   1. Conservative specification of site seismic event.

   2. Conservative generation of "in structure" response spectrums.

   3. Conservative structural damping used.

   4. Seismic input spectra used for piping analysis is enveloped by elevation, then each support is simultaneously subjected to this input.

   5. Inherent conservatism in response spectrum analysis technique when combining intermodal components without phase consideration.

   6. Conservative piping damping used in dynamic analysis.

   7. Conservative "hand calculation technique" used to include base plate flexibility.

   8. Differential seismic building motions conservatively input to piping analysis.

c. There were just three anchors with deficient shoulder to plug dimensions which failed pull test out of a sample of 282 anchors.

d. The shear-tension interaction relationship used is a very conservative relationship with which to establish anchor factor of safety. This is verified by the Teledyne Engineering Services report attached (Attachment #1).

e. It is conservative to assume that the anchors carry all the shear. All or some of the plate shear will be taken through concrete/plate friction without or with limited bolt engagement. The anchor allowable tensile load is unfairly reduced by assuming frictionless concrete/plate interface and theoretically relying on the anchor to carry the full shear.

Duke revised its shell type expansion anchor testing and inspection program for Units 1 and 2 to include revisions as required to comply with IE Bulletin 79-02, Revision 1. The sleeve and wedge type expansion anchor testing and inspection program fully complies with IE Bulletin 79-02, Revision 1.

In addition to revising the testing and inspection program for Units 1 and 2 to include Revision 1 of IE Bulletin 79-02, the sample size for both the inspection and the pull test were revised. Based on the data obtained from Unit 3, it was concluded that the visual inspection program was very significant in identifying anchor deficiencies and the pull test was insignificant in identifying anchor deficiencies. The test and inspection data supporting this conclusion was presented to USNRC, Region II, in a meeting on October 9, 1979. Therefore, the program was modified to require 100% visual inspection of Nuclear Safety Related/seismic expansion anchors and to require a "confirmation" pull test of 3% of the Nuclear Safety Related/ seismic expansion anchors. The 3% pull test sample consists of anchors which have passed the visual inspection. The pull test is performed to confirm that the visual inspection adequately identifies an anchor deficiency which has the potential for causing a pull test failure. The Unit 1 and 2 tolerances for shoulder to plug dimension were revised for anchor sizes 3/4" and 7/8" to + 1/4" and - 3/8".

In order to address the question of relationship of cyclic load carrying capacity to installation procedure (anchor preload), the tests referred to in Response 3, performed by Teledyne Engineering Services and sponsored by the group of fourteen (14) utilities, have been performed on anchors installed in accordance with manufacturer's recommended installation procedures and have no more preload than is provided by the use of these procedures. Based on Duke's understanding of the behavior of expansion anchors and on the cyclic testing which has been performed, Duke Power Company is confident that the anchors will perform adequately. A summary of the Test and Inspection Program results follows:

Unit 1: Testing and inspection of all supports for Nuclear Safety Related/seismic piping system is completed with the exception of those supports determined to be inaccessible due to mechanical interferences or high radiation. Documentation justifying the inaccessiblity of these supports is available at the site.

Statistical sampling considerations are not applicable for Unit 1 since 100% of the anchors were visually inspected. A total of 726 hangers with 2954 anchors were inspected in the Auxiliary and Turbine Buildings. A total of 351 hangers with 1110 anchors were inspected in the Reactor Building. The 3% pull test sample of visually acceptable anchors was completed with 194 anchors being tested. One anchor out of the 194 failed thus assuring a 95% confidence level. A summary of deficiencies found during the Unit 1 test and inspection program is given in Attachment #3.

Unit 2: Testing and inspection on all supports for Nuclear Safety Related/seismic piping system is completed.

Statistical sampling considerations are not applicable for Unit 2 since 100% of the anchors were visually inspected. A total of 743 hangers with 2969 anchors were inspected in the Auxiliary and Turbine Buildings. A total of 331 hangers with 1165 anchors were inspected in the Reactor Building. The 3% pull test sample of visually acceptable anchors was completed with 191 anchors being tested. One anchor out of the 191 failed thus assuring a 95% confidence level. A summary of deficiencies found during the Unit 2 test and inspection program is given in Attachment #4.

Unit 3: Testing and inspection on all supports for Nuclear Safety Related/seismic piping systems is complete with the exception of those supports determined to be inaccessible due to mechanical interferences or high radiation. Documentation justifying the inaccessiblity of these supports is available at the site.

A total of 304 pipe supports were inspected inside Unit 3 Containment. 560 shell type anchors were pull tested and/or visually inspected with bolts removed. 32 anchors were classified as having rejectable installation deficiencies. One anchor failed the pull test and the remaining deficiencies were identified visually. 178 of the 304 pipe supports are actually Nuclear Safety Related/seismic. 15 of these supports contained one or more expansion anchors which were classified as rejectable.

The 15 supports were well distributed among the Nuclear Safety Related/seismic systems, i.e, there was no grouping preference for a single system. A total of 26 Nuclear Safety Related/seismic anchors were rejected for installion deficiencies, from a test and inspection sample of 353 anchors. This sample represents approximately 49 percent of the Nuclear Safety Related/seismic anchors in Unit 3 Containment. Further review of the 32 rejected anchors indicates that 17 had deficiencies which significantly reduced their ultimate load carrying capacity while 15 contained deficiencies of a lesser nature (see Attachment #5). Duke Power Company has additionally analyzed the 15 pipe supports with all deficient anchors assumed to be absent and concluded that existing design margins were adequate to assure operability of all Nuclear Safety Related/seismic piping systems in accordance with the plant design bases.

A total of 742 supports have been tested in the Unit 3 Auxiliary Building. 1196 shell type anchors have been pull tested and/or visually inspected. 189 anchors were classified as having rejectable installation deficiencies. 10 anchors failed the pull test and the remaining deficiencies were identified visually. The 189 anchors were in a total of 100 supports. Further review of the 189 rejected anchors indicates that 42 had deficiencies which significantly reduced their ultimate load carrying capacity while 147 had deficiencies of a lesser nature (see Attachment #5). The 42 anchors were located in 22 supports.

A total of 39 supports have been tested in the Unit 3 Turbine Building. 101 shell type anchors have been pull tested and/or visulaly inspected. 15 anchors were classified as having rejectable installation deficiencies. No anchors failed the pull test and the remaining deficiencies were identified visually. The 15 anchors were in a total of four (4) supports.

Not all Nuclear Safety Related/seismic pipe supports could be inspected due to high radiation considerations or Mechanical interferences. The total number of supports in this category is 17 with 9 on Unit 1, 0 on Unit 2, and 8 on Unit 3. In order to justify omitting these supports from the inspection program, an evaluation was performed which substantiated system operability in the absence of these supports.

Response 5: Nuclear Safety Related/seismic pipe supports are prohibited from being attached to block (masonry) walls using concrete expansion anchors. In response to Revision 2 of IE Bulletin 79-02, Duke Power Company has conducted a confirmatory review of Nuclear Safety Related/seismic pipe supports to assure that no such installations exist. Results of this review have confirmed that there are no installations of this type at Oconee Nuclear Station.

Response 6: A limited number of Nuclear Safety Related/seismic pipe supports, installed with concrete expansion anchors, do utilize structural steel shapes instead of base plate. These hangers were included in actions performed to satisfy the requirements of IE Bulletin 79-02.

Response 7: The following schedule details the completion dates for IE Bulletin Number 79-02, Revision 2, Items 1, 2, and 4:

ITEM 1: As outlined in Response 1, all currently identified Unit 1 2, and 3 Nuclear Safety Related/seismic pipe support base plates have been reanalyzed as required to comply with Item 1 of the Bulletin. Field surveillance activities have identified a small number of additional supports installed using concrete expansion anchors. These supports were expeditiously reanalyzed in accordance with the requirements of Item 1.

ITEM 2: Final verification that concrete expansion anchors meet the interim criteria established in Supplement 1 of IE Bulletin 79-02 will be complete following reanalysis, surveillance, testing, inspection and any modification necessary to comply with the Bulletin requirements. This verification is complete for Units 1, 2, and 3.

ITEM 4: The concrete expansion anchor surveillance, testing and inspection program implemented by Duke Power Company to comply with the Item 4 Bulletin requirements is complete for Units 1, 2, and 3. All expansion anchors used in Nuclear Safety Related/seismic pipe supports have been fully verified, as discussed in Item 2, above, to have factors of safety in excess of 2. All expansion anchor and/or pipe support modifications necessary to satisfy solely the requirements of IE Bulletin 79-02 have been completed.

Response 8: The Duke Power Company program for resolution of IE Bulletin 79-02 fully complies with the revised sections of Items 2 and 4 issued in Revision 2 to the Bulletin. There are no previously unreported instances in which Revision 2 of Items 2 and 4 were not met prior to its issuance.

ATTACHMENT 1

TR-3501-1, Revision 1

Summary Report

Generic Response to U. S. NRC I & E Bulletin 79-02

Base Plate/Concrete Expansion Anchor Bolts

August 30, 1979

(Attachment 1 was previously submitted in Revision 2 of Duke response dated October 23, 1979)

ATTACHMENT 2

Duke Power Company

"Hand Calculation Technique Procedure"

Revised Through May 30, 1980

(Attachment 2 was previously submitted in
Revision 4 of Duke response dated
July 21, 1980)

ATTACHMENT 3

Oconee Nuclear Station

Anchor Bolt Deficiency Summary

Unit 1

Revision 5

SUMMARY

Auxiliary-Turbine Building (Deficiencies per 2954 anchors inspected and/or tested)

Significant		Other	
1	Failed Sample Pull Test	266	Excessive Shoulder to Plug
8	Welded Anchor	70	Not Perpendicular
36	Loose Anchor	69	Shell Not Flush
5	Broken Shell	24	Damaged Threads
9	Damaged Concrete	437	Reduced Spacing
44	Insufficient Shoulder to Plug		
2	No Plug	866	
20	Anchor Sleeve Missing		
125			

Reactor Building (Deficiencies per 1110 anchors inspected and/or tested)

Significant		Other	
11	Loose Anchors	95	Excessive Shoulder to Plug
3	Broken Shell	18	Not Perpendicular
17	Insufficient Shoulder to Plug	22	Shell Not Flush
5	Anchor Sleeve Missing	1	Anchor Cut Off
		2	Damaged Threads
36		295	Reduced Spacing
		433	

TOTAL (Deficiences per 4064 anchors inspected and/or tested)

Significant		Other	
1	Failed Sample Pull Test	361	Excessive Shoulder to Plug
8	Welded Anchors	88	Not Perpendicular
47	Loose Anchors	91	Shell Not Flush
8	Broken Shell	1	Anchor Cut Off
9	Damaged Concrete	26	Damaged Threads
61	Insufficient Shoulder to Plug	732	Reduced Spacing
2	No Plug		
25	Anchor Sleeve Missing	1299	
161			

Auxiliary - Turbine Buildings

System	Significant	Other
01A	2 - Loose Anchor 4 - Damaged Concrete	1 - Damaged Threads 16 - Reduced Spacing
03	2 - Loose Anchors	1 - Excessive Shoulder to Plug 1 - Damaged Threads
03A	6 - Welded Anchors 3 - Loose Anchors 1 - No Plug 3 - Insufficient Shoulder to Plug 2 - Anchor Sleeve Missing	57 - Excessive Shoulder to Plug 5 - Not Perpendicular 1 - Damaged Threads 65 - Reduced Spacing
04A	1 - Insufficient Shoulder to Plug 2 - Anchor Sleeve Missing	16 - Excessive Shoulder to Plug 2 - Shell Not Flush 2 - Damaged Threads 15 - Reduced Spacing
07A	0	0
11	0	0
13	0	2 - Not Perpendicular
14B	2 - Loose Anchors 1 - Broken Shell 5 - Insufficient Shoulder to Plug	43 - Excessive Shoulder to Plug 8 - Not Perpendicular 26 - Shell Not Flush 10 - Damaged Threads 44 - Reduced Spacing
19	0	2 - Excessive Shoulder to Plug
20B-20	1 - Insufficient Shoulder to Plug 1 - Loose Anchor 5 - Anchor Sleeve Missing	10 - Excessive Shoulder to Plug 3 - Not Perpendicular 5 - Shell Not Flush 32 - Reduced Spacing
31	1 - Loose Anchor	2 - Reduced Spacing
48	0	2 - Reduced Spacing
51	1 - Failed Sample Pull Test 5 - Loose Anchors 11 - Insufficient Shoulder to Plug 1 - Anchor Sleeve Missing	36 - Excessive Shoulder to Plug 24 - Not Perpendicular 11 - Shell Not Flush 3 - Damaged Threads 63 - Reduced Spacing

System	Significant	Other
53	1 - Welded Anchor 16 - Loose Anchor 4 - Broken Shell 5 - Damaged Concrete 8 - Insufficient Shoulder to Plug 1 - No Plug 9 - Anchor Sleeve Missing	46 - Excessive Shoulder to Plug 10 - Not Perpendicular 9 - Shell Not Flush 3 - Damaged Threads 77 - Reduced Spacing
54A	2 - Loose Anchor 7 - Insufficient Shoulder to Plug	20 - Excessive Shoulder to Plug 9 - Not Perpendicular 2 - Shell Not Flush 78 - Reduced Spacing
55	1 - Loose Anchor	14 - Excessive Shoulder to Plug 3 - Not Perpendicular 5 - Shell Not Flush 1 - Damaged Threads 26 - Reduced Spacing
56	1 - Loose Anchor 1 - Anchor Sleeve Missing	9 - Excessive Shoulder to Plug 1 - Not Perpendicular 2 - Shell Not Flush 1 - Damaged Threads 4 - Reduced Spacing
57	1 - Insufficient Shoulder to Plug	0
58	1 - Insufficient Shoulder to Plug	1 - Excessive Shoulder to Plug 1 - Not Perpendicular 5 - Reduced Spacing
59	0	2 - Not Perpindicular
61	2 - Insufficient Shoulder to Plug	2 - Excessive Shoulder to Plug 2 - Not Perpendicular 3 - Shell Not Flush
64	1 - Welded Anchor 3 - Insufficient Shoulder to Plug	6 - Excessive Shoulder to Plug 3 - Shell Not Flush 8 - Reduced Spacing
67	0	0
69	1 - Insufficient Shoulder to Plug	4 - Excessive Shoulder to Plug 1 - Shell Not Flush 1 - Damaged Threads

Reactor Building

System	Significant	Other
03	0	1 - Excessive Shoulder to Plug
03A	2 - Loose Anchor 5 - Insufficient Shoulder to Plug	2 - Excessive Shoulder to Plug 2 - Not Perpendicular 10 - Reduced Spacing
04A	1 - Insufficient Shoulder to Plug	6 - Excessive Shoulder to Plug 3 - Not Perpendicular (Sleeve Anchors) 4 - Not Flush (Sleeve Anchor) 8 - Reduced Spacing
14B	2 - Loose Anchor 2 - Insufficient Shoulder to Plug	5 - Excessive Shoulder to Plug 1 - Anchor Cut Off 12 - Reduced Spacing
19	0	0
31	0	2 - Reduced Spacing
48	0	1 - Excessive Shoulder to Plug 4 - Reduced Spacing
50	0	9 - Excessive Shoulder to Plug 1 - Not Perpendicular 12 - Reduced Spacing
51	4 - Loose Anchor 3 - Broken Shell 2 - Anchor Sleeve Missing	30 - Excessive Shoulder to Plug 6 - Not Perpendicular 9 - Shell Not Flush 94 - Reduced Spacing
53	2 - Loose Anchors 5 - Insufficient Shoulder to Plug	25 - Excessive Shoulder to Plug 1 - Not Perpendicular 4 - Shell Not Flush 40 - Reduced Spacing
55	0	1 - Excessive Shoulder to Plug 22 - Reduced Spacing
56	1 - Insufficient Shoulder to Plug	3 - Excessive Shoulder to Plug 13 - Reduced Spacing
57	2 - Insufficient Shoulder to Plug 1 - Anchor Sleeve Missing	4 - Excessive Shoulder to Plug 2 - Not Perpendicular 3 - Shell Not Flush 42 - Reduced Spacing

System	Significant	Other
64	1 - Loose Anchor 1 - Insufficient Shoulder to Plug 2 - Anchor Sleeve Missing	5 - Excessive Shoulder to Plug 3 - Not Perpendicular 2 - Shell Not Flush 2 - Damaged Threads 30 - Reduced Spacing

ATTACHMENT 4

Oconee Nuclear Station

Anchor Bolt Deficiency Summary

UNIT 2

Revision 5

SUMMARY

Auxiliary-Turbine Building (Deficiencies per 2969 anchors inspected and /or tested)

Significant		Other	
37	Insufficient Shoulder to Plug	207	Excessive Shoulder to Plug
15	Welded Anchors	12	Damaged Threads
13	Loose Anchor	59	Not Perpendicular
5	Broken Shell	100	Shell Not Flush
4	No Plug	2	Cut Off Shell
3	Damaged Concrete	658	Reduced Spacing
8	Anchor Sleeve Missing		
85		1038	

Reactor Building (Deficiencies per 1165 anchors inspected and/or tested)

Significant		Other	
1	Failed Sample Pull Test	36	Excessive Shoulder to Plug
37	Insufficient Shoulder to Plug	7	Damaged Threads
6	Welded Anchors	19	Not Perpendicular
5	Loose Anchors	19	Shell Not Flush
2	Broken Shell	4	Cut Off Shell
		223	Reduced Spacing
51		308	

TOTAL (Deficiencies per 4134 anchors inspected and/or tested)

Significant		Other	
1	Failed Sample Pull Test	243	Excessive Shoulder to Plug
74	Insufficient Shoulder to Plug	19	Damaged Threads
21	Welded Anchors	78	Not Perpendicular
18	Loose Anchor	119	Shell Not Flush
7	Broken Shell	6	Cut Off Shell
4	No Plug	881	Reduced Spacing
3	Damaged Concrete		
8	Anchor Sleeve Missing		
136		1346	

Auxiliary-Turbine Buildings

System	Significant	Other
01A	4 - No Plug	3 - Reduced Spacing
03	3 - Welded Anchor	1 - Excessive Shoulder to Plug 9 - Shell Not Flush 28 - Reduced Spacing
03A	7 - Insufficient Shoulder to Plug 8 - Welded Anchor 3 - Loose Anchor 4 - Anchor Sleeve Missing 1 - Damaged Concrete	1 - Anchor Cut Off 3 - Damaged Threads 78 - Excessive Shoulder to Plug 4 - Not Perpendicular 13 - Shell Not Flush 47 - Reduced Spacing
04A	3 - Insufficient Shoulder to Plug	1 - Excessive Shoul r to Plug 6 - Reduced Spacing
07A	0	2 - Excessive Shoulder to Plug 8 - Reduced Spacing
08	0	0
13	0	0
14B	3 - Insufficient Shoulder to Plug 1 - Broken Shell	22 - Excessive Shoulder to Plug 9 - Not Perpendicular 16 - Shell Not Flush 125 - Reduced Spacing
19	0	0
20B-20	1 - Insufficient Shoulder to Plug	10 - Excessive Shoulder to Plug 2 - Reduced Spacing
31	0	2 - Reduced Spacing
48	0	12 - Reduced Spacing
51	17 - Insufficient Shoulder to Plug 1 - Welded Anchor 4 - Loose Anchor 1 - Damaged Concrete 3 - Anchor Sleeve Missing	53 - Excessive Shoulder to Plug 4 - Damaged Threads 30 - Not Perpendicular 30 - Shell Not Flush 193 - Reduced Spacing

System	Significant	Other
53	2 - Insufficient Shoulder to Plug 3 - Welded Anchor 4 - Loose Anchor 4 - Broken Shell 1 - Damaged Concrete 1 - Anchor Sleeve Missing	20 - Excessive Shoulder to Plug 1 - Cut Off Shell 3 - Damaged Threads 7 - Not Perpendicular 9 - Shell Not Flush 120 - Reduced Spacing
54A	4 - Insufficient Shoulder to Plug 2 - Loose Anchor	12 - Excessive Shoulder to Plug 1 - Damaged Threads 6 - Not Perpendicular 9 - Shell Not Flush 68 - Reduced Spacing
55	0	2 - Not Perpendicular 5 - Shell Not Flush 1 - Excessive Shoulder to Plug 13 - Reduced Spacing
57	0	1 - Shell Not Flush
59	0	2 - Reduced Spacing
61	0	2 - Reduced Spacing
64	0	7 - Excessive Shoulder to Plug 1 - Damaged Threads 1 - Not Perpendicular 8 - Shell Not Flush 27 - Reduced Spacing
67	0	0
69	0	0

Reactor Building

System	Significant	Other
03	0	0
03A	5 - Insufficient Shoulder to Plug 2 - Welded Anchor 1 - Loose Anchor	2 - Not Perpendicular 4 - Shell Not Flush 6 - Reduced Spacing
04A	2 - Insufficient Shoulder to Plug 1 - Failed Sample Pull Test	5 - Shell Not Flush 4 - Reduced Spacing
14B	1 - Loose Anchor	48 - Reduced Spacing
19	0	0
31	0	0
48	0	0
50	1 - Insufficient Shoulder to Plug	0
51	6 - Insufficient Shoulder to Plug 2 - Welded Anchors	5 - Excessive Shoulder to Plug 5 - Damaged Threads 2 - Not Perpendicular 85 - Reduced Spacing
53	2 - Insufficient Shoulder to Plug 1 - Broken Shell	2 - Cut Off Shell 10 - Not Perpendicular 4 - Shell Not Flush 7 - Excessive Shoulder to Plug 8 - Reduced Spacing
55	9 - Insufficient Shoulder to Plug 2 - Loose Anchor 1 - Broken Shell	13 - Excessive Shoulder to Plug 2 - Damaged Threads 3 - Not Perpendicular 1 - Shell Not Flush 28 - Reduced Spacing
56	1 - Loose Anchor	3 - Excessive Shoulder to Plug
57	10 - Insufficient Shoulder to Plug	1 - Excessive Shoulder to Plug 1 - Shell Not Flush 1 - Reduced Spacing
59	2 - Welded Anchor	3 - Excessive Shoulder to Plug 1 - Not Perpendicular 2 - Shell Not Flush 22 - Reduced Spacing

System	Significant	Other
64	2 - Insufficient Shoulder to Plug	4 - Excessive Shoulder to Plug 2 - Cut Off Shell 1 - Not Perpendicular 2 - Shell Not Flush 21 - Reduced Spacing

ATTACHMENT 5

Oconee Nuclear Station

Anchor Bolt Deficiency Summary

UNIT 3

(Attachment 5 was previously submitted in
Revision 4 of Duke response dated
July 21, 1980)