

Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

William J. Museler Site Vice President Watts Bar Nuclear Plant

SEP 2 8 1992

U.S. Nuclear Regulatory Commission ATTN: Document Control Desk Washington, D.C. 20555

Gentlemen:

In the Matter of the Application of
Tennessee Valley AuthorityDocket Nos. 50-390
50-391

WATTS BAR NUCLEAR PLANT (WBN) - UNITS 1 AND 2 - SUPPLEMENTAL INFORMATION ON SHALLOW UNDERCUT ANCHORS

Reference: TVA letter from J. H. Garrity to USNRC Document Control Desk dated October 16, 1991, "WBN Test Program for the Evaluation of Shear Capacity of Shallow Undercut Anchors - Summary Report"

As summarized in the referenced letter, TVA conducted a test program to evaluate the capacity of shallow undercut anchors. This test program was intended to verify that the ultimate shear capacity of shallow undercut anchors that are not installed near a free edge provide an acceptable safety margin. The following information supplements that referenced letter.

The four shallow undercut anchorage configurations listed below had an unacceptable factor of safety of less than 4 for shear loads. The ultimate shear capacity of these configurations was controlled by concrete failure.

Shallow UC Anchor Configuration

| <u>Diameter (in)</u> | <u>Embedment (in)</u> | Factor of Safety |
|----------------------|-----------------------|------------------|
| 1/2 | 3-1/4 | 3.46 |
| 5/8 | 3-3/4 | 2.57 |
| 3/4 | 3-1/2 | 1.81 |
| 3/4 | 5 | 3.50 |

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TVA usage of the first three configurations for new designs was discontinued with issuance of Revision 5 of Civil Design Standard DS-C1.7.1 on May 6, 1991 (Revision 5 placed a hold on usage of all shallow type II installations. The hold was removed and the three configurations were deleted by DSCN-CEB-91-03 on July 31, 1991). The fourth configuration was discontinued for use in new designs by DSCN-CEB-92-02 on August 21, 1992. Copies of Table 3 of DS-C1.7.1 for Revision 5, DSCN-CEB-91-03, and DSCN-CEB-92-02 are attached.

As part of the work performed in 1991, TVA established that the 3/4-inch diameter with 3-1/2-inch embedment anchor had not been utilized at WBN or other TVA plants. Similar steps have been initiated to verify either that the other three configurations have not been utilized or that appropriate factors of safety exist where these configurations have been used.

The current Table 3 (DSCN-CEB-92-02) provides the following minimum acceptable embedments for these anchor sizes: (Factors of safety less than 4 are for a steel shear failure mechanism.)

<u>REVISED</u> Shallow UC Anchor Configuration

| <u>Diameter (in)</u> | <u>Embedment (in)</u> | <u>Factor of Safety</u> |
|----------------------|-----------------------|-------------------------|
| 1/2 | 4-3/4 | 4.37 |
| 5/8 | 5-1/4 | 2.97 (steel failure) |
| 3/4 | 6-1/2 | 2.49 (steel failure) |

If any questions remain relative to this subject, please contact P. L. Pace at (615)-365-1824.

Very truly yours,

Museler

William J. Museler

Enclosure cc: See page 3 U.S. Nuclear Regulatory Commission Page 3

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cc (Enclosure): NRC Resident Inspector Watts Bar Nuclear Plant P.O. Box 700 Spring City, Tennessee 37381

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| $\begin{array}{ c c c c c c c c c c c c c c c c c c c$ | TABLE 3 ¹ This page added by R5. | | | | | | | | | | |
|---------------------------------------------------------|---------------------------------------------|-------|-------------------------------|---------------------------------------|--------------------|------------|----------------|-----------------------------------|--------|---------|--|
| $ \begin{array}{c c c c c c c c c c c c c c c c c c c $ | UNDERCUT ANCHOR INSTALLATION DATA | | | | | | | | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | ANCHOR ² LENGTH | LENGTH CODE | SLEEVE 3 Length | TYPE | MIN 8 SPAC | ed ce ⁹ Dist | ATTACH | PROJ | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | 4-1/4 | None | 2-3/4 | 1 | 4 | 3 | 3/4 | 1-1/2 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | - | None | | I | 6 | 5 | 3/4 | 1-1/2 | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | - | - | - | | | · · | - | | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | - | | | 1 1 | | • | 2 | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | ro | | • ' | | | п | | | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | OR: | | - | | | | _ | • | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | HC | | | | | п | | | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | ANG | | | | - | I | | | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | - | | | | _ | | • | | 5 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | ň | | | | | | | - | 2 | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | NT | | | | | п | | - | | 5- | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | MEI | | | | | | | • |]] | 5 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | IUS | | | 5 | | п | 8 | 6-1/2 | 2 | 5 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | (B) | | | 4 | | - | | 13 | 3 | 4-1/2 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | EN | | 17-1/2 | 4 | 13 | п | 12 | 11 | 2 | 4-1/2 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | R | | | 4 | 13 | п | 12 | 9 | 4 | 4-1/2 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 71 | | 15-1/2 | 2 | 11 | I | 12 | 11 | 3 | 4-1/2 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 1 <u>9</u> 2 | | 15-1/2 | i i i i i i i i i i i i i i i i i i i | 11 | π | 12 | 9 | 2 | 4-1/2 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | RI | 3/4 | 13-1/2 | | 9-1/4 | I | 12 | 9 | 3 | 4-1/4 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | 1 | 23-1/2 | 7 | 18 | I | 12 | 17 | 3 | 5-1/2 | |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | | 1 | 21-1/2 | 5 | 18 | I | 12 | 17 | 1 | 3-1/2 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | 1-1/4 | 25 | 5 | 18 | I | 24 | 21 | 3 · | 7 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | 1-1/4 | 23 | 3 | 18 | I | 24 | 21 | 1 | 5 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | P . | 1/2 | 8-1/4 | DITERNAL BOLL | 6-1/4 | 1 | 6 | 6 | 1 | 2 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | EN: | -1/2- | -8-1/4 | 1 | 8-1/4 | - n | 8 | 8 | -0 | -2 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | WE | 5/8 | | DITIONAL HEX | 6-3/4 | I | 6 | 6 | 2 | 3-1/4 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | ED | -5/8 | -10 | | -8-8/4 | -11 | 8 | 8 | - 8 | 8-1/4- | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | EN EN | 3/4 | 11-1/2 | 2 10 | 8-3/4 | I | 6 | 8-1/2 | 1-1/2 | 2-3/4 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | E L | -3/4- | 11-1/2 | 2 80 | 8-3/4 | -11 | 6 | 8-1/2 | 3 | 2-3/4 | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | 10-1/2 | | | I | 6 | 8 | 3/4 | 2-1/4 | |
| -3/4 9-1/2 4 min 0-1/2 11 0 0 - 1 - 3 - 3 | A ^k | | 1 | 1 | | -11 | - 0 | 8 | | | |
| -3/4 9-1/2 4 min 0-1/2 11 0 0 - 1 - 3 - 3 | SH/ UC | | | | | I | 6 | 6 | 1-1/2 | | |
| | | 3/4 | 9-1/2 | 4 80 EBAD | 0-1/2 | - n | 0 | 8 | 3 | 9 | |
| | | | | | | C | ivil Des | | | -C1.7.1 | |

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| U | NDERC | UT AN | СНО | R INS | STA | Τ.Τ.ΔΤ | ION | DATA | 1 |
| | ANCHOR SIZE | | | SLEEVE 3 LENGTH | | | EDGE 9 DIST | MAX 10 ATTACH THICK | |
| | 1/4 | 4-1/4 | None | 2-3/4 | I | 4 | 3 | 3/4 | 1-1/2 |
| | 3/8 | 6 | None | 4-1/2 | 1 | 8 | 5 | 3/4 | 1-1/2 |
| | 1/2 | 14-1/4 | 6 | 10 | I | 6 | 8-1/2 | 3 | 4-1:/4 |
| | 1/2 | 14-1/4 | 8 | 10 | п | 6 | 6-1/2 | 2 | 4-1/4 |
| | 1/2 | 14-1/4 | 8 | 10 | п | 6 | 5 | 4 | 4-1/4 |
| ANCHORS | 1/2 | 12-1/4 | 4 | 8 | 1 | 6 | 6-1/2 | 3 | 4-1-/4 |
| ;HC | 1/2 | 12-1/4 | 4 | 8 | п | 8 | 5 | 2 | 4-1/4 |
| INC | 1/2 | 10-1/4 | 2 | 6 | I | 2 | 5 | 3 | 4-1/4 |
| | 5/8 | 17 | 7 | 12 | I | 8 | 10-1/2 | - 3 | 5 |
| uc | 5/8 | 17 | 7 | 12 | п | 8 | 8-1/2 | 2 | 5 |
| Ę | 5/8 | 17 | 7 | 12 | п | 8 | 8-1/2 | 4 | 5 |
| REGULAR EMBEDMENT | 5/8 | 15 | 5 | 10 | 1 | 8 | 8-1/2 | 3 | 5 |
| ID1 | 5/8 | 15 | 5 | 10 | п | 8 | 6-1/2 | 2 | 5 |
| 181 | 3/4 | 17-1/2 | 4 | 13 | I | 12 | 13 | 3 | 4-1/2 |
| EN | 3/4 | 17-1/2 | 4 | 13 | i II | 12 | 11 | 2 | 4-1/2 |
| R. | 3/4 | 17-1/2 | 4 | 13 | Π | 12 | 9 | 4 | 4-1/2 |
| 715 | 3/4 | 15-1/2 | 2 | 11 | I | 12 | - 11 | 3 | 4-1/2 |
| 155 | ´ 3/4 | 15-1/2 | 2 | 11 | п | 12 | ່ອ | 2 | 4-1/2 |
| RI | 3/4 | 13-1/2 | DITICIDIAL, HELL | 9-1/4 | I | 12 | 9 | 3 | 4-1/4 |
| | 1 | 23-1/2 | 7 | 18 | I | 12 | 17 | 3 | 5-1/2 |
| | 1 | 21-1/2 | 5 | 18 | I | 12 | 17 | 1 | 3-1/2 |
| | 1-1/4 | | 5 | 18 | I | 24 | 21 | 3 | 7 |
| | 1-1/4 | 23 | 3 | 18 | I | 24 | 21 | 1 | 5 |
| F | 1/2 | 8-1/4 | DITERMAL MEX | 6-1/4 | I | 8 | 8 | 1 | 2 |
| EN | 1/2 | 8-1/4 | INTERNAL, BIEX | 6-1/4 | п | 8 | 8 | 1-1/2 | 2 |
| DM | 5/8 | 10 | ATTERSTAL. BREX | 6-3/4 | I | 8 | 6 | 2 | 3-1/4 |
| E E | 5/8 | 10 | ETTERMAL. | 6-3/4 | п | 6 | 6 | 1-1/2 | 3-1/4 |
| EM | 3/4 | 11-1/2 | 2 59 | 8-3/4 | 1 | 6 | 8-1/2 | 1-1/2 | 2-3/4 |
| SHALLOW EMBEDMENT | 3/4 | 11-1/2 | 2 89 EELD | | п | 6 | 8-1/2 | 3 | 2-3/4 |
| D'LO | 3/4 | 10-1/2 | 3 89 | 8-1/4 | I | 6 | 8 | 3/4 | 2-1/4 |
| IAL | 3/4 | 10-1/2 | 3 BOLLD | 8-1/4 | п | 6 | 6 | 3 | 2-1/4 |
| SI | | 9-1/2 | 4 80 HIRLAD | 6-1/2 | I | 6 | 6 | 1-1/2 | 3 |
| | 3/4 | 9-1/2 | 4 BRAD | 6-1/2 | п | 6 | 6 | 1-1/2 | 3 |
| | | | | | C | ivil Desi | gn Stand Revision | | -C1.7.1 |

Reference Calculation: CSG-91-005

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DSCN-CEB-01-03

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TABLE 3

UNDERCUT ANCHOR INSTALLATION DATA

| ANCHOR SIZE | ANCHOR LENGTH | LENGTH CODE | SLEEVE LENGTH | TYPE | MIN SPACING | EDGE DIST | MAX ATTACH THICK | PROJ | |
|----------------------------------------|----------------------------------------------------------|--------------------------------------|-------------------------------------|-------------------------------|----------------------------------------|--------------------------------------------|----------------------------|----------------------------------------------------|--|
| REGULAR EMBEDMENT UC ANCHORS | | | | | | | | | |
| 1/4 | 4-1/4 | None | 2-3/4 | I | 4 | 3 | 3/4 | 1-1/2 | |
| 3/8 | 6 | None | 4-1/2 | I | 6 | 5 | 3/4 | 1-1/2 | |
| 1/2 1/2 1/2 1/2 1/2 1/2 | 14-1/4 14-1/4 14-1/4 12-1/4 12-1/4 10-1/4 | 6 6 4 4 2 | 10 10 10 8 8 6 | 1 | 6 6 6 6 6 | 8-1/2 6-1/2 5 6-1/2 5 5 | 3 2 4 3 2 3 | 4-1/4 4-1/4 4-1/4 4-1/4 4-1/4 4-1/4 | |
| 5/8 5/8 5/8 5/8 5/8 | 17 17 17 15 15 | 7 7 5 5 | 12 12 12 10 10 | | 8 8 8 8 8 | 10-1/2 8-1/2 6-1/2 8-1/2 6-1/2 | 3 - 2 4 3 2 | 5 5 5 5 5 | |
| 3/4 3/4 3/4 3/4 3/4 3/4 | 17-1/2 17-1/2 17-1/2 15-1/2 15-1/2 13-1/2 | 4. 4 2 2 internal hex | 13 13 13 11 11 9-1/4 | | 12 12 12 12 12 12 12 | 13 11 9 11 9 9 | 3 2 4 3 2 3 | 4-1/2 4-1/2 4-1/2 4-1/2 4-1/2 4-1/2 | |
| 1 1 1 1 | 23-1/2 23-1/2 21-1/2 21-1/2 | 7 7 5 5 | 18 18 18 18 | 31 | 12 12 12 12 | 17 17 17 17 | 3 3 1 3 | 5-1/2 5-1/2 3-1/2 3-1/2 | |
| 1-1/4 1-1/4 | 25 23 | 5 3 | 18 18 | i I | 24 24 | 21 21 | 3 1 | 7 5 | |
| | | SHA | LLOW EM | BEDMEN | | ORS ¹ | | | |
| 1/2 | 8-1/4 | internal | 6-1/4 | I | 6 | 6 | • • | 2 | |
| 1/2 | 8-1/4 | hex internal hex | 6-1/4 | 11 | 6 | 6 | 1-1/2 | 2 | |
| 5/8 | 10 | internal | 6-3/4 | I | 6 | 6 | 2 | 3-1/4 | |
| 5/8 | 10 | hex internal hex | 6-3/4 | н | 6 | 6 | 1-1/2 | 3-1/4 | |
| 3/4 | 13-1/2 | internal hex | 9-1/4 | H . | 6 | 10 | 2-1/2 | 4-1/4 | |
| 3/4 | 11-1/2 | 2 sq head | 8-3/4 | 1 | 6 | 8-1/2 | 1-1/2 | 2-3/4 | |
| 3/4 | 11-1/2 | 2 sq head | 8-3/4 | lt | 6 | 8-1/2 | 2 | 2-3/4 | |
| 3/4 | 10-1/2 | 3 sq head | 8-1/4 | I | 6 | 8 | 3/4 | 2-1/4 | |
| 3/4 | 10-1/2 | 3 sq head | 8-1/4 | 11 | 6 | 8 | 1-1/2 | 2-1/4 | |
| 3/4 | 9-1/2 ² | 4 sq head | 6-1/2 | 1 | 6 | 6 | 1-1/2 | 3 | |

1 Reference Calculation: CSG-91-005

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2 Use of this anchor in Type II Installations shall be

discontinued upon implementation of DSCN-CEB-92-02

Civil Design Standard DS-C1.7.1 Revision 5

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DSCN-CEB-92-02