

TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401

400 Chestnut Street Tower II

February 7, 1983

WBRD-50-390/82-32
WBRD-50-391/82-29
BLRD-50-438/82-29
BLRD-50-439/82-26

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

Dear Mr. O'Reilly:

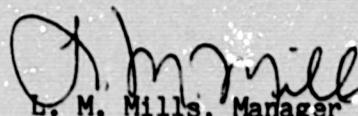
WATTS BAR AND BELLEFONTE NUCLEAR PLANTS UNITS 1 AND 2 - ERRORS IN WERCO
PROGRAM DISTRIBUTED BY AAA TECHNOLOGY - FOURTH INTERIM REPORT

The subject deficiency was initially reported to NRC-OIE Inspector
D. Quick on April 9, 1982 in accordance with 10 CFR 50.55(e) as NCRs
WBN CEB 8204 and BLN CEB 8204. This was followed by our interim
reports dated May 10, June 22, and November 4, 1982. Enclosed is our
fourth interim report. We expect to submit our next report by April 22,
1983.

If you have any questions concerning this matter, please get in touch with
R. H. Shell at FTS 858-2688.

Very truly yours,

TENNESSEE VALLEY AUTHORITY


L. M. Mills, Manager
Nuclear Licensing

Enclosure

cc: Mr. Richard C. DeYoung, Director (Enclosure)
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

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ENCLOSURE

WATTS BAR AND BELLEFONTE NUCLEAR PLANTS UNITS 1 AND 2
ERROR IN WERCO PROGRAM DISTRIBUTED BY AAA TECHNOLOGY
NCR'S WBN CEB 8204 AND BLN CEB 8204
WBRD-50-390/82-32, WBRD-50-391/82-29; BLRD-50-438/82-29, BLRD-50-439/82-26
10 CFR 50.55(e)
FOURTH INTERIM REPORT

Description of Condition

Originally, the description of deficiency was stated:

The documentation of the WERCO program, as distributed by AAA Technology (Houston), does not include a complete description of the assumptions and limitations of the program. This has contributed to unacceptable usage of the program in the design of TVA nuclear plants.

During the course of the investigation of this problem, a better understanding of the WERCO program and the relationship to its parent article (Welding Research Council Bulletin 107, "Local Stresses in Spherical and Cylindrical Shells Due to External Loadings") has been achieved. It is now apparent that WERCO is consistent with the WRC 107 article.

A revised general description of this deficiency is as follows:

Engineers of the Tennessee Valley Authority have in a few cases erroneously analyzed pressure vessel stresses at attachments and nozzles. TVA's errors were contributed to by the lack of clear and specific warnings in the WERCO documentation which would have called attention to subtleties of application in the WERCO/WRC 107 analysis procedure.

Detailed descriptions of the errors are as follows:

1. TVA engineers have erroneously assumed that WERCO uses the maximum stress curves in figures SR-1 through SR-3, SP-1 through SP-10, and SM-1 through SM-10 from the WRC 107 article. Originally, it was stated that, "The WERCO documentation alludes to, but does not state, that these curves are not used by the program." Further investigation has indicated that no allusion to this is made in the WERCO program manual. Erroneous stresses in these cases were because of TVA engineer oversight and/or failure to contact the proper authorities at AAA technology to confirm the assumption.
2. Some potentially unconservative cylindrical shell stresses were computed in the analysis of a few penetrations. Errors have occurred when TVA engineers neglected to consistently investigate the use of extended curves noted by the WERCO program. Originally, it was stated:

The WERCO program uses curves which have been extended beyond the curves presented in WERCO Bulletin 107. In particular, figures 1C and 2C are extended into regions where the WRC bulletin states the curves are unextendable. The WERCO documentation fails to present the extended curves or state that unwarranted extensions were made.

Further study of the problem has indicated that graphical extension of 14 of the 16 curves is acceptable. Two curves, figures 1C and 2C, were revised in the March 1979 update of WRC Bulletin 107. These curves were truncated across a specific line with a warning of possible unconservative results if extended beyond the cutoff line (appendix A). WERCO automatically generated data based on extended curves as commanded and labeled it as such. No special warning was generated for data from extension of the 2 revised curves and therefore errors were made by uninformed TVA users.

3. TVA engineers using WRC Bulletin 107 approach to the stress analysis of cylindrical shells and the WERCO program did not realize that stresses because of torsional moments on rectangular attachments are not calculated because of the complexity of the stress effect. WERCO and WRC Bulletin 107 are completely consistent on this point and this caveat is specifically noted in WRC Bulletin 107. No additional warning is made in the WERCO output. Again, uninformed TVA users misinterpreted the data.

Interim Progress

To prevent further misuse, the WERCO user manual has been made a controlled computer program document within the Division of Engineering Design (EN DES). This process requires registration of the manuals with specific users. This allows communication with all WERCO users to provide program update information, notice of program application problems, a standard program execution procedure, which can print out user information messages, and copies of the WRC Bulletin 107 on which the WERCO program is based.

All projects and branches within EN DES with design responsibilities requiring the WERCO program were contacted to determine the impact of the usage of the WERCO program on design. All analyses utilizing the WERCO program have been reviewed and reanalyses are being performed as applicable.