Docket

PDR

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUN 16 1976

DOCKETS NOS.: 50-219, 50-220, 50-237, 50-245, 50-249, 50-254, 50-259, 50-260, 50-263, 50-265, 50-271, 50-277, 50-278, 50-298, 50-296, 50-298, 50-321, 50-324, 50-325, 50-331, 50-333, 50-341, 50-354, 50-355, and 50-366.

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FACILITIES: Oyster Creek Nuclear Generating Station, Nine Mile Point Unit 1, Pilgrim 1, Dresden Units 2 and 3, Millstone Unit 1, Quad Cities Units 1 and 2, Monticello, Peach Bottom Units 2 and 3, Browns Ferry Unit 1, 2 and 3, Vermont Yankee. Hatch Units 1 and 2, Brunswick Units 1 and 2, Duane Arnold Energy Center, Cooper, Fitzpatrick, Enrico Fermi Unit 2, and Hope Creek Units 1 and 2.

SUMMARY OF MEETING HELD ON JUNE 2, 1976 WITH REPRESENTATIVES OF THE MARK I OWNER'S GROUP

On June 2, 1976, a meeting was held in San Jose, California with representatives of the Mark I Owner's Group, General Electric Company (GE), and their technical consultants. The purpose of the meeting was to discuss general guidelines for defining "failure" for each structural failure mode being considered in the plant unique structural analyses. Enclosure 1 is a list of meeting attendees. Enclosure 2 contains the meeting agenda.

SUMMARY

W. E. Cooper, TELEDYNE, described the methods which he had developed on behalf of the Mark I Owners Group for computation of the plant unique structural element capacities of structural components in the torus support system. A detailed description of these methods is contained in Enclosure 3. General discussions between the NRC staff and the representatives of the Mark I Owners Group resulted in substantial

agreement on the acceptability of the above mentioned analysis methods. Several items requiring further clarification were identified:

a. Utilization of a strain ratio in place of a load or stress ratio should be limited to specific structural components (i.e., anchor bolts, pipe hangers, and sway braces).

b. Strain-rate effects which could potentially result in a non-conservative transference of load from one structural component to another must be considered.

c. When utilizing the procedures of Appendix F to Section III of the ASME Boiler and Pressure Vessel Code, a 0.75 factor should be applied to the strain limit curve to determine the useable ultimate strain for an inelastic analysis.

d. The short term program plant unique analysis must be based on the plant structural configuration as of the date that the plant unique analysis is submitted to the NRC.

e. The plant unique analysis must also be based on the plant operational conditions which will be in effect after the completion of the short term program, e.g., with or without continued ΔP operation.

The Owners Group agreed to document the information presented at this meeting, including the clarifications identified above, in a revision to NUTECH Report MKI-02-012, "Description of Short Term Program Plant Unique Torus Support Systems and Attached Piping Analysis".

The NRC staff stated that all structural failures predicted by the plant unique analyses must be reported, even if such failures do not lead to loss of containment function. In addition, the NRC staff stated that, if a facility does not meet the plant unique analysis acceptance criteria and a significant structural modification is required to restore adequate safety margin, such structural modifications should be designed to the applicable Code requirements.

John C. Guibert

John C. Guibert, Project Manager
Operating Reactors Branch #3
Division of Operating Reactors

JUN 1 6 1976

Enclosures:
1. Attendance List
2. Agenda
3. Letter from W. E. Cooper to R. H. Buchholz, dated May 21, 1976

ENCLOSURE NO. 1

ATTENDANCE LIST

MEETING WITH MARK I OWNERS GROUP

JUNE 2, 1976

GENERAL ELECTRIC COMPANY

R. W. Buchholz
L. V. Sobon
W. Z. Masters

BECHTEL POWER CORPORATION

B. S. Shicker
C. Y. Wang

KAISER ENGINEERS

D. W. Ogden

DECO/TRC

F. E. Gregor

NUTECH

N. W. Edwards
R. E. Keever

TOSHIBA

K. Saba
Y. Sunami

HITACHI

H. Ukaji
A. Nishimura

CHICAGO BRIDGE & IRON COMPANY

R. F. Reedy

TELEDYNE

W. E. Cooper

NPPD

R. P. Lovci

NRC - STAFF

G. Bagchi
B. D. Liaw
D. G. Eisenhut
R. J. Stuart
J. C. Guibert

ENCLOSURE NO. 2

MARK I CONTAINMENT PROGRAM

TRC/NRC MEETING

JUNE 2, 1976

MEETING AGENDA

1) IDENTIFICATION OF STRENGTH RATIO/FAILURE CRITERIA FOR FAILURE MODES

   a) TENSILE COMPRESSION AND SHEAR FAILURES
   b) FLEXURAL FAILURE
   c) STABILITY IN COLUMN, SHELLS
   d) ANCHOR FAILURE
   e) BEARING FAILURE
   f) OTHER, AND COMBINATIONS OF ABOVE

2) DEFINITION OF OPERABILITY FOR

   a) ACTIVE PUMPS AND VALVES ATTACHED TO ECCS PIPING
   b) ISOLATION VALVES ATTACHED TO OTHER LINES
   c) OTHER (BELLOWS, ETC.)

3) ADDITIONAL ANALYTICAL AND EXPERIMENTAL TECHNIQUES WHICH MAY BE USED IF FAILURE CRITERIA (ITEM 1 ABOVE) IS NOT SATISFIED

6/2/76
RHB

ENCLOSURE NO. 3

TELEDYNE
MATERIALS RESEARCH
353 BEAR HILL ROAD
WALTHAM, MASSACHUSETTS 02154
(617) 890-3350 TWX (710) 324 7451

May 21, 1976
2036-9

Mr. R. H. Buchholz
Manager, Special Utility Programs
General Electric Company - MC 883
175 Curtner Avenue
San Jose, CA 95125

Subject: Draft Criteria for Computation of
Structural Element Capacity (TRC-032)

References:

1. Mutech Report MK1-02-012, Description of Short Term Program, Plant Unique Torus Support Systems and Attached Piping Analysis, May, 1976.

2. TMR letter 2036-5, W. E. Cooper to Pio Ianni, GE-BWRPD, Recommended Design Criteria for BWR Mark I Suppression Chamber and Supports-Revised, March 1, 1976.

Dear Mr. Buchholz:

Introduction

Reference 1 describes the analytical program associated with the Mark I Containment - Short Range Program - Plant Unique Analysis. It contains specific acceptance criteria for associated piping, expressed in terms of an S_c value as tabulated in Section III, and general limiting criteria for other portions of the torus and supports. The general limiting criteria are expressed in terms of satisfaction of the appropriate Section III limits (for design, normal or upset conditions) or are expressed in terms of a quantity defined as a strength ratio (SR). The quantity SR is the ratio of the calculated stress or strain to that respective value of stress or strain which would result in structural failure of that portion of the structure. Note that structural failure may or may not result in loss of containment.

Analyses are performed for a set of loads to be defined by GE and either SR $\leq$ 0.5 or the Code rules must be satisfied. In addition, sensativity analyses are to be performed for certain higher load values and either SR $\leq$ 1.0 or the Code rules must be satisfied.

The specific purpose of this letter is to suggest methods for computation of the denominator in the SR ratio for consideration at an NRC-TAC-BE-AE meeting to be held in San Jose on Wednesday, June 2, 1976. Preparation of these suggestions was requested at a TAC meeting of May 14, 1976. We understand that you will arrange for a meeting room and inform the attendees as to time and place.

General Approach

In addition to piping for which specific criteria are contained in Reference 1, the portions of the containment of interest to the plant unique analysis are the torus (shell plates and stiffening rings) and the torus supports (torus attachment region, columns, column base and, when present, the column hold-down members). The loads under consideration are dead weight, seismic, pressure differentials within the torus, and those transmitted to the torus via the ring header support columns.

If the Section III rules for design, normal or upset conditions, as applicable, are satisfied in any portion of the structure, a specific SR value need not be calculated. When an SR value must be calculated, the precise value need not be calculated as long as the appropriate 0.5 or 1.0 limit can be conservatively calculated. That is, approximate but conservative methods may be used to evaluate the denominators required for SR evaluation. Either analytical or experimental methods may be used to evaluate the denominator. The value may be based upon published information which is sufficiently well documented to provide a basis for independent judgement as to adequacy for the intended purpose.

The following section of this letter describes some specific methods which may be used to compute the denominator. It is not intended that acceptable methods are limited to those included herein, only that those included are acceptable. As general guidelines:

1. Yield and tensile strength values shall be taken from Section III unless higher values can be justified on the basis of materials data for the specific material, as from plant records.

2. No credit may be taken for higher strengths as a result of strain rate effects unless a specific strain rate is calculated and data for the applicable class of materials is applied.

3. Neither of the above effects may be considered in computing the S_c value applicable to piping. The Section III tabulated value must be used.

4. Room temperature material properties may be used for all evaluations.

5. a. It is the intent of the plant unique analysis that the plant configuration and conditions (e.g., ΔP) considered represent those applicable at the time the analysis is complete. Credit may be taken for modifications implemented prior to that time. If acceptable SR values are not attained, an action plan must be submitted to NRC as described by Reference 1.

   b. The acceptable SR values and the methods described in this letter are applicable to modifications implemented prior to completion of the evaluation or proposed by the action plan. However, the fracture toughness of any added materials must be considered in addition to the strength considerations described by Reference 1. For pressure retaining materials and materials for nonpressure parts or pads which are permanently attached by welding to pressure parts, the requirements of the Code applicable to the initial construction or of a later revision should be considered. As guidance in this consideration for support materials:

      (1) Materials satisfying the exemption rules of Paragraphs AM-218.1 and AM-218.3 of Section VIII, Division 2 are acceptable without specific testing.

      (2) Materials not exempted for reasons of size or composition by NF-2311 (a) through (g) and which have a specified ultimate tensile strength in excess of 125 ksi shall satisfy the requirements of NE-2300.

   c. In considering modifications, the utility may choose to apply more conservative structural design criteria in anticipation of Long Term Program considerations. The draft Bounding Long-Term Criteria of Reference 2 provide guidance in this consideration. (Note, however, that the draft Short Term criteria contained in Reference 2 are not consistent with Short Term Program objectives as they have developed since March 1, 1976).

Specific Methods for Computation of Structural Element Capacity (SEC)

1. Modified Bechtel Criteria

The methods described herein assume the use of elastic stress analysis and are the criteria previously used by Bechtel in the Short Term Program modified to account for conservatisms inherent in the elastic analysis. The SEC equation contains two terms. The first of these is a modifying factor for analysis conservatisms which is based upon informal NRC-GE-Nutech-Bechtel-TMR discussions of March 2, 1976. The second term is the quantity used by Bechtel with the 110% factor for strain rate and property effects eliminated.

a. Column buckling

SEC = (1/0.6) (Column Research Council Static Capability with Bending Correction)

= (1.6) (CRC with bending correction)

The numerator of Equation (4) of Section III XVII-2213.2 may be used to compute the CRC static capability. XVII-2215.1 may be used to consider the effects of bending.

b. Column-Torus Weld Region Shear

SEC = (0.6/0.5) (0.57 S_u) = 1.2(0.57) S_u = 0.68 S_u

where S_u = ultimate tensile strength

c. Ring Girder and Local Torus Shell

SEC = (1/0.5) (S_y) = 2S_y

d. Pins and Lugs

(1) For shear stresses, use SEC = 0.68 S_u as in b, above.

(2) For bearing stresses

SEC = (1/0.6) (S_u) = 1.6 S_u

2. Appendix F Method

The procedures of Appendix F of Section III are intended to assure that violation of a pressure retaining boundary will not occur. Therefore, the methods of F-1330 can be used to establish conservative Structural Element Capacity (SEC) values. The following provide guidance in applying the methods of F-1320:

a. Re F-1322, system analysis considerations are not applicable to the plant unique analysis because the loadings are conservatively defined. The "systems" analysis which established the loads was essentially elastic, but it is known that an elastic-plastic "systems" analysis would have resulted in smaller loads. Therefore, the rules of F-1323 are not applicable and the rules of F-1324 may be used.

b. The equation of the form $S_y + (S_u - S_y)/3$ which appears five places in the lower half of Table F-1322.2-1 are developed to assure that the maximum strain does not exceed one-third of the uniform elongation of the material. This limit shall also be used as a strain limit in conjunction with F-1324.5. The uniform elongation may be taken as the strain hardening exponent given as a function of tensile strength by the attached figure which is taken from Welding Research Council Bulletin 101.

c. In applying the collapse load method of F-1324.2 to the ring girder, the guidance of Case 1733 shall be considered.

d. In the last column of Table F-1322.2-1, the reference to footnote (3) should be to footnote (3) and (6).

e. In Table F-1322.2-1, for the strain limit load, the symbol should be P_S rather than P_I.

3. Experimental Method

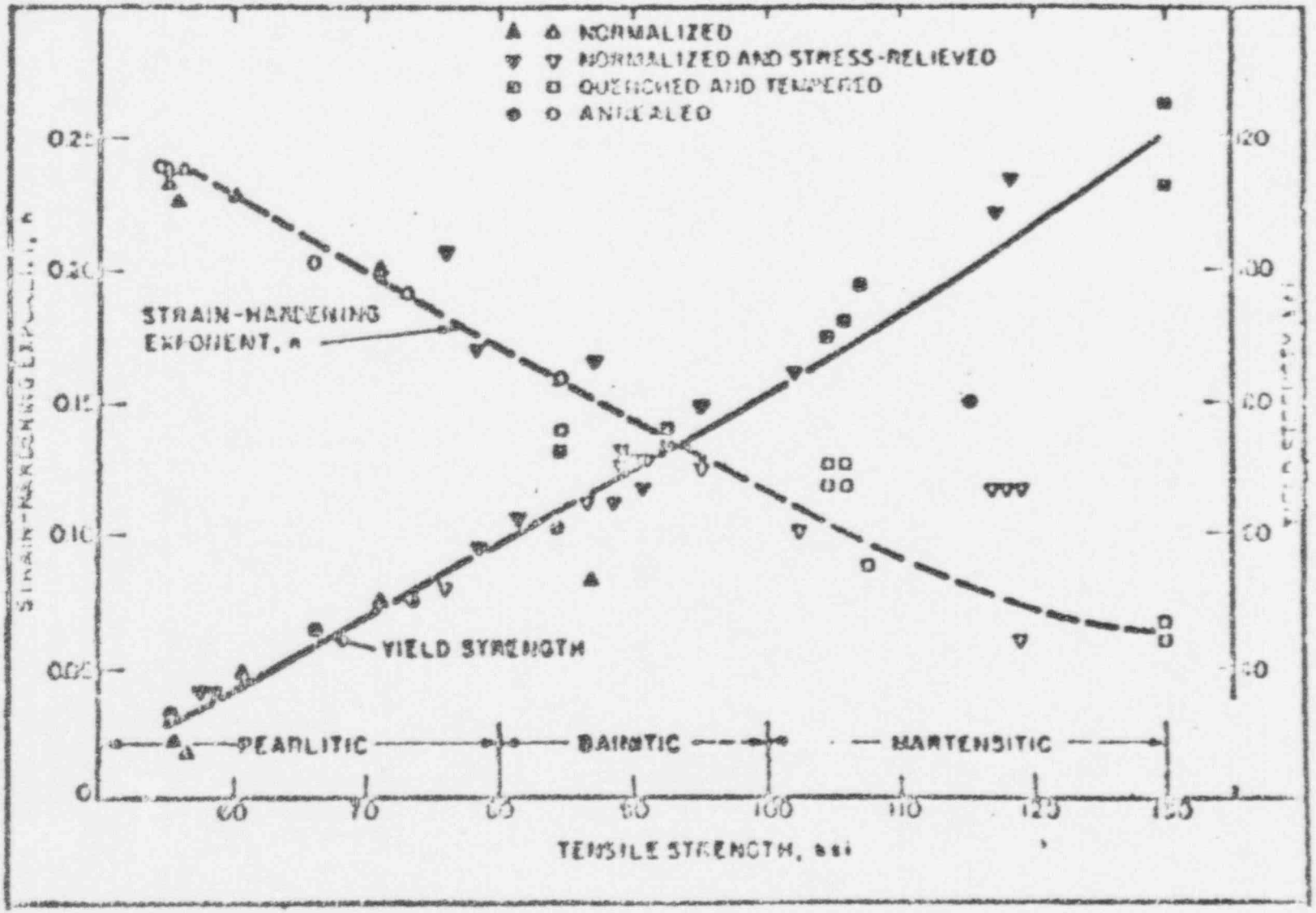
Experimental methods may be used in the manner described by F-1321.3 to establish P_C, P_I, or P_S or to provide data with respect to the inelastic response of a component. When these values are determined experimentally, the multiplying coefficient less than unity (0.9 for P_C, 0.7 for P_I and P_S) in Table F-1322.1 may be taken as unity.

Very truly yours,

TELEDYNE MATERIALS RESEARCH

William E. Cooper
Consulting Engineer

WEC:raj



—Variation in the strain-hardening exponent and yield strength with the tensile strength of typical pressure-vessel steels