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

ATTENTION: T. R. QUAY

REFERENCE: NRC Letter From Jackson To Liparulo dated October 3, 1995, "An Evaluation Of The Differences Between Revision 0 of ASME Code Case N-284 Related To The Design Of The AP600 Containment Vessel

SUBJECT: ASME BOILER AND PRESSURE VESSEL CODE CASE N-284 REVISION 1 FOR USE ON THE AP600

Dear Mr. Quay:

In response to your request for additional information in a letter from Jackson to Liparulo dated 10/3/95, an evaluation of the differences between Revision 0 and Revision 1 of ASME Code Case N-284 related to the design of the AP600 containment vessel has been completed and is enclosed. This additional information supplements the information provided in our letter NTD-NRC-95-4555, dated 9/13/95. Generally the changes in Revision 1 of the Code Case applied to the design of the AP600 containment vessel are paragraphs which were "In course of preparation" at the time of issue of Revision 0 and have now been incorporated in Revision 1.

If you need additional information, please contact D. A. Lindgren at (412) 374-4856.

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

/nja

Enclosure

cc: Diane Jackson, NRC
T. Cheng, NRC
N. J. Liparulo, Westinghouse (w/o enclosure)

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REQUEST FOR ADDITIONAL INFORMATION FOR THE USE OF ASME BOILER AND PRESSURE VESSEL CODE CASE N-284, REVISION 1 ON THE AP600 DESIGN

February 6, 1996

REQUEST FOR ADDITIONAL INFORMATION FOR THE USE OF ASME PRESSURE VESSEL CODE CASE N-284, REVISION 1 ON THE AP600 DESIGN

In the AP600 containment vessel design, ASME Code Case N-284 Revision 1 is used for the buckling evaluation of the cylindrical shell, the ellipsoidal bottom/top heads, and the spherical hatch covers†. Revision 1 is used since N-284, Revision 0 did not have sufficient information to perform the buckling evaluation. The significant differences between the two revisions are summarized as follows:

	N-284, REVISION 1	N-284, REVISION 0
1.	Allowable stress is calculated as: theoretical elastic instability stress multiplied by capacity reduction factor and plasticity reduction factor and divided by a factor of safety. Actual stress and the allowable stress are then used to check the buckling. This allowable stress approach is more straight forward than the amplified stress approach of Revision 0. Both approaches result in equivalent safety margins.	Actual stress is amplified as: actual stress multiplied by a factor of safety and divided by capacity reduction factor and plasticity reduction factor. Amplified actual stress and the theoretical elastic instability stress are then used to check the buckling.
2.	See text on the right. There is sufficient information in place of "In course of preparation" that can be used in the buckling evaluation.	There are a few paragraphs with insufficient information (for example, saying "In course of preparation") that makes it almost impossible to use Revision 0.
3.	See text on the right.	There are typos that make it difficult to interpret or use Revision 0. (For example, in paragraph -1713.1.2, σ_{2s} is not used in buckling check and therefore its use is not clear.)

†Since the spherical hatch covers are subjected to equal biaxial stresses due to external pressure loading, Revision 0 with some modifications based on engineering principles was used in 1991. Revision 1 supports the intended meaning behind these principles.

Specific differences applicable to the calculations performed for AP600 Containment Vessel are described on the pages 2 and 3.

DIFFERENCES BETWEEN N-284 REVISIONS 1 AND 0 APPLICABLE TO CYLINDRICAL SHELL

The description is applicable only to the N-284 paragraphs that were used in the evaluation.

N-284, REVISION 1	N-284, REVISION 0
Capacity Reduction Factors†	
From -1511. There is no significant difference between the two revisions.	From -1511. There is no significant difference between the two revisions.
Plasticity Reduction Factors†	
From -1610: η works out to be 1.0.	From -1610: η works out to be 1.0.
Theoretical Elastic Instability Stresses†	
From -1712.1.1. There is no significant difference between the two revisions.	From -1712.1.1. There is no significant difference between the two revisions.
Factors of Safety	
From -1400. (No Difference.)	From -1400. (No Difference.)
Allowable Stresses for Buckling and Interaction Checks	
From -1713.1.1. Uses different approach - see item 1 in the table on page 1.	From -1713.1.1. Uses different approach - see item 1 in the table on page 1. There are some typos.

†There are some new expressions in Revision 1 or differences in expressions or applicable ranges. But, they do not affect the results for the AP600 geometry parameters.

DIFFERENCES BETWEEN N-284 REVISIONS 1 AND 0 APPLICABLE TO ELLIPSOIDAL HEADS

The description is applicable only to the N-284 paragraphs that were used in the evaluation.

N-284, REVISION 1	N-284, REVISION 0
Capacity Reduction Factors†	
From -1513, -1512(b) and -1512(a): α_{2L} works out to be 0.124 and $\alpha_{1L} = \alpha_{2L}/0.6$	From -1513, -1512(b) and -1512(a): α_{2L} works out to be 0.124 and α_{1L} is not defined‡.
Plasticity Reduction Factors†	
From -1613(a), -1611(a): η works out to be 1.0.	Not explicitly given, however the intent is there in -1600.
Theoretical Elastic Instability Stresses†	
From -1712.1.4, -1712.1.3(a): C works out to be 0.605. (No Difference.)	From -1712.1.4, -1712.1.3(a): C works out to be 0.605. (No Difference.)
Factors of Safety	
From -1400. (No Difference.)	From -1400. (No Difference.)
Allowable Stresses for Buckling and Interaction Checks	
From -1713.1.3 and -1713.1.2.	From -1712.1.3 and -1713.1,2: α_{1L} and α_{3L} required to complete the calculation are not defined‡. Also, there seem to be errors in -1713.1.2.

†There are some new expressions in Revision 1 or differences in expressions or applicable ranges. But, they do not affect the results for the AP600 geometry parameters.

‡Says "In course of preparation."

DIFFERENCES BETWEEN N-284 REVISIONS 1 AND 0 APPLICABLE TO SPHERICAL HATCH COVERS

The description is applicable only to the N-284 paragraphs that were used in the evaluation.

N-284, REVISION 1	N-284, REVISION 0
Capacity Reduction Factors†	
From -1512(b): Since the spherical hatch covers are subjected to equal biaxial compressive stresses due to external pressure loading, only one capacity reduction factor, $\alpha_{\varphi L} = \alpha_{\theta L} = \alpha_{2L}$ needs to be calculated. The applicable expression $\alpha_{2L} = 0.826 / M^{0.6}$ is present in both the revisions.	From -1512(b): See text on the left‡.
Plasticity Reduction Factors†	
From -1611(a): η works out to be 1.0.	From -1610(a): η works out to be 1.0‡. (There are some typos in some of the 'non-applicable' expressions of this paragraph.)
Theoretical Elastic Instability Stresses†	
From -1712.1.3(a): C works out to be 0.605. (No Difference.)	From -1712.1.3(a): C works out to be 0.605. (No Difference.)
Factors of Safety	
From -1400. (No Difference.)	From -1400. (No Difference.)
Allowable Stresses for Buckling and Interaction Checks	
From -1713.1.2. See text on the right.	From -1713.1,2: α_{1L} and α_{3L} are not defined‡. Also, there seem to be errors in -1713.1.2. Since the hatch covers are subjected to equal biaxial compressive stresses, these omissions and errors, based on engineering principles, do not affect the results.

†There are some new expressions in Revision 1 or differences in expressions or applicable ranges. But, they do not affect the results for the AP600 geometry parameters.

‡Says "In course of preparation."