G C Slagis Associates
CONSULTING ENGINEERING

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258 Hillcrest Place • Pleasant Hill • California • 94523-2184 • phone 925-687-8941

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OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

Secretary
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
ATTN: Rulemakings and Adjudications Staff

Subject: Comments on RIN 3150-AH76
Incorporate by Reference Section III 2004 Edition without Limitations

NRC proposes to incorporate, by reference, the 2004 Edition of Section III Division 1 into 10 CFR 50.55a for construction of nuclear power plant components. By this action, NRC accepts the Section III piping code rules (NB/NC/ND-3600) for evaluation of "reversing dynamic loads". In the past, NRC has taken exception to these particular design rules for "reversing dynamic loads".

The Section III piping rules for reversing dynamic loads were first introduced in 1994. Higher stress limits were specified for reversing dynamic loads in comparison to statically applied loads. NRC had technical concerns on the code rules, and NRC and the code committee have tried to resolve the technical concerns. There have been revisions made to the rules as first introduced in 1994.

I have been actively involved in this issue since the early 1980s. My technical position is that there are significant safety concerns with the piping code rules for reversing dynamic loads. The rules should not be approved by NRC for use in new construction.

The main safety concern is adequacy of the rules for preventing a fatigue failure. There are concerns with the Level D rules that apply for SSE and the Level B rules that apply for OBE.

Background

When originally introduced in 1994, the Level D stress limit was increased for "reversing dynamic loads" to $4.5S_m$ for Class 1, 2, and 3 piping in comparison to $3S_m$ for Class 1 and $3S_h$ for Class 2/3 for all other loads. For Level B, the primary stress limit in Class 1 (Eq. 9) was eliminated for reversing dynamic loads. For Class 2/3, reversing dynamic load moments were removed from Eq. 9 (which is equivalent to a primary bending stress check) and both the inertia and anchor motion effects of reversing dynamic loads are included in a new Eq. 11a that is a fatigue-based limit.

There have been various changes to the rules since 1994. In the 2004 Edition, the most significant change is that the B_2 index is replaced by a B_2' index for evaluation of primary stresses for reversing dynamic loads, and the stress limit is reduced from $4.5S_m$ to $3S_m$ for Level D for Class 1/2/3 piping. B_2' is specified as 2/3 of the B_2 index for elbows and tees. The net result is that the moment for a reversing dynamic load for elbows and tees is allowed to be 50% higher than for a static load. In order words, the new rules with B_2' and a $3S_m$ limit allow the elastically-predicted primary bending moment stress as predicted by B_2M/Z to be $4.5S_m$ for elbows and tees. In essence, the 1994 rules and the 2004 rules are the same for elbows and tees.

Template = SECY-067

SECY-02

Level D Stress Limits

The major safety issue is whether the Level D stress limit for reversing dynamic loads is acceptable for fatigue. The data given in NUREG/CR-5361 demonstrate an unacceptable margin of safety against fatigue failure for certain test conditions. "Dynamic Margins" as calculated by ETEC are provided in Table 4 of this NUREG. A dynamic margin of 2 was considered to be an acceptable level of margin. Results of margin calculations for 19 PFDRP component tests are reported in column V of Table 4. Of the 19 reported test values, 8 tests have margins of less than 2. Six tests have margins less than 1.5. Four have margins less than 1. A margin less than 1 indicates a fatigue failure.

Therefore, the NUREG margin calculations on the PFDRP component tests indicate that the Level D rules for reversing dynamic loads are unacceptable.

The safety concern of a fatigue failure at Level D limits is amplified by the fact that the margin calculations in NUREG/CR-5361, as described above, only consider primary stresses (inertia loads). The code rules allow a secondary stress range for anchor motions of $6S_m$ that could cause significant fatigue damage. Piping systems are typically subjected to both inertia and anchor motion loads. Therefore, the margins against fatigue failure are even less than reported by NUREG/CR-5361.

The safety concern of a fatigue failure at Level D limits is further amplified by the fact that a piping system, when subjected to an earthquake, may be at the end of its design fatigue life from thermal expansion cycling or thermal transients. In this case, the acceptable amount of earthquake fatigue damage is low.

There are other safety concerns with the adequacy of the Level D stress limits for reversing dynamic loads. The structural adequacy of lug/trunnion configurations, socket welded joints, and threaded joints for seismic loads are questionable. The B_2' index for "girth butt welds between items which do not have nominally identical wall thickness" is 1.33 (in comparison to the B_2 index of 1.0). This means that the allowable moment for reversing dynamic loads is only ¾ of the allowable moment for a static load for this type of weld joint referred to as a tapered transition joint. This means that for Class 1 piping, the primary bending stress as predicted by B_2M/Z is limited to $2.25S_m$ versus the static limit of $3S_m$ for a tapered transition butt weld. Two of the PFDRP components tested were a four-lug configuration on straight pipe. Both of these lug component tests failed during the first high level excitation. Hence, the seismic performance of the lug configuration was amongst the lowest of all the component tests. These two component tests were not evaluated in NUREG/CR-5361, and margins were not established. From my evaluation of the component test data and the lug test configuration, I concluded that the predicted test levels were grossly overestimated because the load applied to the lugs is limited by yielding in the 6-inch, sch 40 branch pipe [refer to JPVT, November 1998, Vol. 120, pg. 454]. Hence, the seismic performance of the lug configuration in the PFDRP component tests was much less than that of the tapered transition joints. The Level D allowable moment at lugs should be less than that at the tapered transition joints. But the Section III code does not penalize trunnion and lug configurations.

Other seismic testing has demonstrated that socket welded joints and threaded joints perform poorly in comparison to butt welded pipe. However, the Section III code does not penalize socket welded joints or threaded joints.

For Class 2/3 piping, the primary stress limits are the same as for Class 1 [$3S_m$ rather than $3S_h$ is used for the Level D Eq. 9 limit]. This is not valid. Class 2/3 piping should have a larger factor of safety than Class 1 piping consistent with existing Section III design criteria.

The higher allowable moments for reversing dynamic loads are applicable to flow transient reversing dynamic loads. The PFDRP water hammer test results do not support the use of higher allowable moments for reversing dynamic loads from flow transients. The reversing dynamic load rules should apply only to earthquake dynamic loads.

Level B Stress Limits

The Level B Stress Limits for reversing dynamic loads are not appropriate. The primary stress limit check for Level B (Eq. 9 $\leq$ $1.8S_m$ for Class 1, $\leq$ $1.8S_h$ for Class 2/3) that applies for static loads was eliminated for reversing dynamic loads. The technical basis was that collapse is not a potential failure mode. But that technical basis is wrong for two reasons. Collapse is a potential failure mode for certain configurations as demonstrated by the PFDRP tests. NUREG/CR-5361 specified the collapse failure mode as a critical area of deficiency in the technical basis for the rules. The second reason the technical basis for the changes to Level B is wrong is that collapse is not the only reason for the primary stress check in Level B. The other reason for the Level B primary bending stress check is to ensure that there is no significant material yielding. Hence, with the present code rules, material yielding may occur from the reversing dynamic loads, and this is unacceptable for Section III design. In addition, if there is material yielding from primary stresses, the code fatigue evaluation is not applicable.

Sincerely,

Gerry C. Slagis

From: Carol Gallagher
To: SECY
Date: Wed, Jun 13, 2007 10:00 AM
Subject: Comment letter on Industry Codes and Standards Proposed Rule

Attached for docketing is a comment letter on the above noted proposed rule from Gerry Slagis that I received via the rulemaking website on 6/12/07.

Carol

Mail Envelope Properties (466FF880.8EC : 5 : 35764)

Subject:	Comment letter on Industry Codes and Standards Proposed Rule
Creation Date	Wed, Jun 13, 2007 10:00 AM
From:	Carol Gallagher
Created By:	CAG@nrc.gov

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