The damping recommendations have been studied using response spectrum method of analysis. However, the basic data are independent of analysis method.

Additional damping for specific parts of the total system, like snubbers and supports, should not be utilized unless one of the testing options described below has been implemented.

In addition to the generic data-based conclusions noted in the foregoing, higher damping values for seismic and damping values for other excitation forces can be determined experimentally. The following methods are acceptable:

- Perform a test on similar (nearly identical) system to determine the damping for each mode. The damping allowed for each mode of the system in question would be either:
  1. 2/3 of the mean value of damping found for that mode in the test system, or
  2. 2/3 of the damping for that mode taken from a smoothed curve of the test data when plotted graphically to show the relationship between damping and frequency.

- Perform a test on the actual system in question to determine the damping for each mode. When multiple values of damping for each mode are determined, the mean value of damping for each mode may be used.

The Interim Summary Report which includes the technical position on damping has been recently approved for publication later this year as a WRC Bulletin. In addition to the technical position, the report outlines the purpose, scope and approach used in evaluating the damping data, describes the data collection methods and sources, summarizes the data evaluations and presents the overall results of the five independent assessments that were performed to assure overall design margins were retained. The report concludes with technical discussions and recommendations. Over twenty data sets involving several hundred data points were used. The data were evaluated using three different methods—individual judgment, regression analysis and engineering assessments.

Depending upon the system, the application of the PVRC frequency-dependent damping values to piping systems selected from actual nuclear power plants demonstrated significant reductions (up to about 50 percent) in both piping stresses and number of restraints and snubbers required.

Jerry L. Bitner, Chairman
PVRC Task Group on Damping Values
Mem. ASME

To the Editor:

The cost of nuclear power plant construction in the United States far exceeds the worst predictions of ten years ago. A large portion of this increased cost is related to delays and unnecessary repairs and rework. With high inflation and high interest rates, construction delays are amounting to one million dollars per day at many nuclear sites. The situation is even more frustrating when it is realized that most of the repairs and rework performed as part of construction are caused by overly strict evaluations of welds and could be avoided if adequate specifications were used.

Inspectors must accept welds on the basis of the acceptance criteria in the specifications, not on their own judgment. Therefore, these specifications must provide a practical acceptance criteria which is based on the requirements for the end use of the product and good engineering judgment. The use of the AWS D1.1 Structural Welding Code causes many problems when the engineer does not provide exceptions in the specifications. The fact that exceptions to this Code are required is obvious from the following quote from AISC, "Quality Criteria and Inspection Standards."

"The AWS Structural Welding Code, D1.1, is the principal code governing the welding of fabricated structural steel. This code, supplemented by a number of other codes and/or contract special provisions, generally presents workable and practical guidelines for fabricator welding operations. Accordingly, it is not the purpose of this commentary to write a new code to govern welding in steel fabricating plants.

Nevertheless, AISC recognizes that, in certain specific areas of existing codes and contract special provisions, improper interpretations are occurring. Further, certain of the restrictions set up in these codes are not necessary for the safe and satisfactory end use of the product and are impractical from a production standpoint. What follows, then, is a review of operational elements with recommendations for solutions in problem areas, directed to the short-comings inherent in existing codes." [Emphasis added.]

Note that AISC considers that AWS D1.1 is a set of guidelines. It must be treated as a guideline-type document because it can easily be shown that it is impossible to strictly adhere to the exact wording of the document. This has been understood by building and bridge constructors for years, and those inspectors have been able to work with the intent of the document. Unfortunately, that "intent" cannot be used in the nuclear industry if the specifications do not take exceptions to D1.1.

Welding at nuclear power plant sites is under the auspices of both the American Welding Society (AWS) for structural welding and the ASME Code (Section III) for welding of pressure components and associated supports. There have been misunderstandings and misinterpretations regarding both documents. Although exceptions cannot be taken regarding the ASME Section III Code, proper guidance in the Design and Construction Specifications would eliminate the unnecessary weld repairs that are currently being made. Some specific areas in which proper guidance in the specifications would eliminate or greatly reduce weld repairs are:

1. continuous measurement of fillet welds;
2. grinding of all fillet and butt welds;
3. undercut and;
4. encroachment on minimum thickness.

Both AWS D1.1 and the ASME Boiler and Pressure Vessel Code have requirements which have been in existence for many years for minimum size fillet welds. During this time (at least until three or four years ago), inspectors were able to adequately evaluate fillet welds without continuously measuring each inch of welding. Several years ago this practice changed when a welding material supplier furnished free fillet weld gages to QC inspectors at several construction sites. The result was that some inspectors used the gages to measure each inch of fillet weld to verify that the specified minimum weld size was met for the continuous length of weld. Welds that had previously been accepted on the basis of spot checking and judgment were suddenly unacceptable. Not surprisingly, slightly undersized welds were found in minor local areas, and many nonconformance reports were written. If the designer reviewed and accepted these local conditions as adequate, the inspector sometimes objected on the basis that the specifications were not met.

The nuclear industry has many levels of inspection, including the inspectors working for the manufacturer, the
insurance agency, the installer, the owner and the NRC. Because inspectors do not want to be "second guessed," the tendency is for all discrepancies to be reported, regardless of how minor the deviation may be. This is extremely time consuming, costly, and in most cases, does not add to overall plant safety. One acceptable way for an experienced, qualified inspector to evaluate fillet welds is as follows:

- review the weld procedure;
- review and evaluate the welder's performances;
- visually examine the weld pattern and using sample measurements, determine the adequacy of the weld deposit size.

There is no requirement in either the ASME Section III Code or the AWS D1.1 Standard to continuously measure the full length of fillet welds. Both ASME and AWS permit deviations from minimum size fillets. This is documented in NB-4427 of ASME, Section III and paragraphs 8.15.1.7 and 9.25.1.7 of AWS D1.1.

Minor imperfections exist in every man-made object. Because of this, the ASME Code imposes a safety factor of 4 or 3 depending on the design and intended use of the item. These safety factors are provided to account for unknowns and minor imperfections such as weld size discrepancies and slight thickness variations.

For AWS welding, the Design and Construction Specifications should refer to the guidance given in AISC "Quality Criteria and Inspection Standards" which states:

"In AWS D1.1-79, the acceptable and unacceptable weld profiles in Fig. 3.6 and the provisions of Arts. 8.15.1.6 and 9.25.1.6, are restrictive in regard to oversize welds and convexity, and are subject to misinterpretation. AISC Recommendation:

1. Either leg or both legs should have an allowable oversize of 1/8 in. without correction. If occasional fillet welds are inadvertently made in excess of this oversize, and if there is no excess distortion, removal or correction is not required. Such welds have no detrimental effect, but removal and rewelding may induce serious shrinking stresses and distortion.

2. Either leg or both legs may be undersize by 1/16 in. without correction, in accordance with the provisions of AWS D1.1-79, Arts. 8.15.1.6 and 9.25.1.6.

3. The allowable convexity should be 0.1 times the actual leg size, or 0.1 times the longer actual leg size in the case of unequal leg fillet welds, plus 0.06 in."

An important reason that codes and standards specify maximum and minimum fillet weld sizes is to ensure proper weld heat input in order to control cracking and distortion. Once the weld is made, if there are no cracks or distortion, there is no need for repair unless the design requirements cannot be accommodated. Again, AISC has the following comments:

"The human element is involved in all phases of structural design and fabrication; therefore, it is not surprising that an unintentional deviation from a drawing or specification can occur.

Not all errors or deviations need to be altered or repaired; many could be accepted without change, with no penalty to the structure or its end use. There are times when repair work creates higher residual stresses and does more harm than good. In general, it should be the engineer's decision whether or not the deviation is harmful to the end use of the product.

The correction of weld distortion causes additional stresses which do more harm than good. In many cases the end use of the weldment does not justify corrective action."

[Emphasis added.]

There is an unnecessary practice developing in the nuclear industry requiring fillet and butt welds to be ground to eliminate ripples or to make surfaces flush. This is neither a requirement of AWS D1.1 nor ASME Section III, although some grinding might be required for in-service inspection in accordance with ASME Section XI. Paragraph NB-4424 of Section III specifically states that "as-welded" conditions are permitted as long as any possible defects, as shown by nondestructive examinations, are not masked.

The "as-welded" condition has no impact on safety (provided the ripples do not mask the detection of unacceptable defects) but grinding welds significantly increases the cost of the plant. In addition, the grinding itself may cause other safety problems.

The third problem regarding welding pertains to weld undercut. Recent editions of AWS D1.1 have restrictions on the depth of undercut. However, the restriction is based on the direction of primary stress in the member, and the depth of undercut allowed depends on the thickness of the member and varies from 0.01 in. to 1/16 in. (How can an engineer logically interpolate between a decimal and a fraction?) Considering that undercut cannot be measured with any accuracy and that the inspectors do not know the direction of primary stress, the requirements are almost impossible to meet.

Section III, NB-4424(c), allows 1/32 in. undercut. Inspectors have been able to make adequate evaluations based on this provision, but problems arise when inspectors become overly strict and insist on elimination of all undercut, or engineers insist that the undercut cannot encroach on the specified thickness. An ASME Code Interpretation explains how undercut which encroaches 10 percent into the minimum thickness can be accepted.

There are cases where inspectors have noted that minimum thickness requirements may not be met for local areas of the items being inspected. These local thin areas may be caused either by undercut or grinding. The resultant weld repairs to restore minimum thickness can cause more problems than accepting the area on the basis of engineering evaluation.

The ASME Code philosophy of design allows local discontinuities. The design engineer can often justify the shallow spots by showing that the local area involved is less in diameter than the Code allowed diameter of an unreinforced opening. Also, the ASME Code allows the primary stresses in areas of local discontinuities to be 110 percent of the allowable stress. When the design engineer evaluates and accepts local conditions in this way, the Code requirements are met and unnecessary weld repairs are avoided.

In the preceding areas of concern, there is no safety problem, except for the potentially damaging repair welding performed when emphasis is placed on the wrong acceptance criteria. For the nuclear plants under construction today, owners and engineers should review their Design and Construction Specifications and make all necessary modifications and changes. Such changes will help keep plant construction on schedule.

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Fellow ASME

To the Editor:

One of the most persistent misconceptions in Section VIII-Division 1, of the ASME Boiler and Pressure Vessel Code is...