



Nebraska Public Power District

COOPER NUCLEAR STATION
P.O. BOX 98, BROWNVILLE, NEBRASKA 68321
TELEPHONE (402)825-3811
FAX (402)825-5211

NLS970074

September 5, 1997

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

Subject: Alternate Allowable Stress Operability
Criteria for Piping and Pipe Supports;
Cooper Nuclear Station, NRC Docket 50-298, DPR-46

Reference: 1. NRC Generic Letter 91-18, "Information to Licensees
Regarding Two NRC Inspection Manual Sections on Resolution
of Degraded and Nonconforming Conditions and on
Operability," dated November 7, 1991.

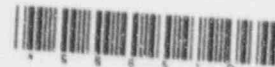
Gentlemen:

The Nebraska Public Power District (District) requests NRC review and approval of alternate allowable stress operability criteria for use in evaluation and interim resolution of degraded/non conforming conditions when identified in Cooper Nuclear Station piping or piping support systems. This request is made pursuant to 10CFR50.55a(a)(3)(i) which allows use of alternatives where it is demonstrated that the proposed alternatives provide an acceptable level of safety and has been authorized by the Director of the Office of Nuclear Reactor Regulation.

NRC Generic Letter 91-13 (Reference 1) provides guidance for licensees use in dispositioning degraded and nonconforming conditions in safety-related piping and pipe supports. GL 91-18 indicates that licensees may apply the criteria of Appendix F of the Section III of the ASME Code to provide a basis for interim operability. Reference 1 also allows additional criteria or evaluation methods to be employed to determine operability where NRC approval has been obtained. This position is in agreement with the requirements of 10CFR50.55a, section (a)(3)(i), which allows proposed alternatives which would provide an acceptable level of quality.

In accordance with the regulations and GL 91-18 the District submits for NRC staff review and approval proposed allowable stress operability criteria as an alternate supplement to the criteria contained in the ASME Code. The operability criteria, detailed in the attachment, will be used to evaluate conditions within a piping system and pipe supports to ensure that the safety-related piping system will continue to operate safely in the event that the piping system is found to exceed current design basis criteria described in the Updated Safety Analysis Report (USAR).

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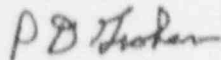
While the criteria are, in some cases, less restrictive than Appendix F of Section III of the ASME Code, they nevertheless provide a sound basis for interim operability until the subsequent refueling outage. In particular, the use of the $2S_y$ allowable for pipe stress is justified by test reports, actual plant experience and pipe strain arguments. Together these show that the $2S_y$ limit results in pipe flow area reductions well within recommended limits. The operability criteria for piping supports correlate to those recommended by Regulatory Guide 1.124 for emergency and faulted conditions which ensures structural integrity of the support as well as elastic restraint behavior. The proposed operability limits for penetrations, flanges, and snubbers are more restrictive than those for general piping and pipe supports.

In the event that these criteria are not met, the actions required by the applicable Technical Specification Limiting Condition for Operation (LCO) are implemented.

In the event that degraded conditions require an operability assessment to justify continued operation prior to NRC formal approval of this submittal, the District will contact the NRC to determine if it is possible to use the alternate allowable criteria on an interim basis.

Should you have any comments or questions concerning this matter, please contact my office.

Sincerely,



P. D. Graham
Vice President- Nuclear Energy

Attachment

/dm

cc: Regional Administrator
USNRC - Region IV

Senior Project Manager
USNRC - NRR Project Directorate IV-1

Senior Resident Inspector
USNRC - Cooper Nuclear Station

NPG Distribution

NLS970074
August 26, 1997

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Washington, D.C. 20555

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In accordance with the regulations and GL 91-18 the District submits for NRC staff review and approval proposed allowable stress operability criteria as an alternate supplement to the criteria contained in the ASME Code. The operability criteria, detailed in the attachment, will be used to evaluate conditions within a piping system and pipe supports to ensure that the safety-related piping system will continue to operate safely in the event that the piping system is found to exceed current design basis criteria described in the Updated Safety Analysis Report (USAR).

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use of the 2S, allowable for pipe stress is justified by test reports, actual plant experience and pipe strain arguments. Together these show that the 2S, limit results in pipe flow area reductions well within recommended limits. The operability criteria for piping supports correlate to those recommended by Regulatory Guide 1.124 for emergency and faulted conditions which ensures structural integrity of the support as well as elastic restraint behavior. The proposed operability limits for penetrations, flanges, and snubbers are more restrictive than those for general piping and pipe supports.

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PIPING SYSTEM OPERABILITY CRITERIA
FOR
COOPER NUCLEAR STATION

1.0 INTRODUCTION

The purpose of this document is to present operability criteria for piping systems at Cooper Nuclear Station. These criteria will be used to evaluate discrepant conditions within piping systems which may cause the piping or support stresses to exceed design limits. If the design limits are exceeded, an evaluation is required to determine if the system is still operable. The criteria defined herein provide stress limits for piping and supports which ensure the piping system can perform the intended design functions (i.e., maintain pressure boundaries and deliver required flows). Conformance to these criteria ensures that the affected piping systems will continue to operate safely during the interim period that a discrepant condition exists. Since the system would be considered operable if these criteria are met, an LCO would typically not be required. Implementation of these criteria will result in a net safety benefit by eliminating the potential for transients occurring during LCO-required forced shutdowns that are not otherwise necessary for plant safety.

The proposed criteria are intended to supplement those currently described and approved in the USAR, and Technical Specifications for Cooper Nuclear Station. These criteria are not design criteria. Rather, they are intended to be used to evaluate discrepant conditions for the interim period until a long term solution can be most conveniently implemented. Adverse discrepancies between the design documentation and the as-built configuration are considered as unanalyzed conditions. Examples may be (but are not limited to):

- Missing or inoperable supports
- Broken welds or supports
- Discovery of an error in the design documentation
- Snubber failures

2.0 SCOPE

This document applies to Essential Seismic Class IS piping systems (and other piping systems as deemed appropriate) installed at Cooper Nuclear Station. The operability criteria apply when a discrepant condition causes a piping system to exceed the current design limits in the plant's USAR.

Included as an appendix are discussions of operability criteria used at other nuclear facilities. The criteria proposed in this document are consistent with those currently approved for use at other facilities of the same vintage.

3.0 PIPING OPERABILITY CRITERIA

3.1 Piping Stress Criteria

The piping stresses are calculated in accordance with the piping codes and USAR methods with the exception that higher damping values may be used as long as they do not exceed those specified in Regulatory Guide 1.61 (Reference 4). The proposed operability criteria limits for primary piping stresses (including the effects of integral attachments) are as follows:

$$S_g + S_p \leq S_y \quad (1)$$

$$S_g + S_p + \text{SRSS} (S_{\text{SSE}}, S_{\text{TRANS}}) \leq 2 S_y \quad (2)$$

Equation (1) correlates with normal conditions and Equation (2) correlates with faulted conditions.

Stresses due to independent dynamic loadings such as Safety Relief Valve steam hammer or pump trip water hammer, if applicable, are combined with Safe Shutdown Earthquake or Mark I loads (applied by taking square root of the sum of their squares) and the results must be less than $2S_y$.

Piping secondary stresses are evaluated against the existing USAR allowables (i.e., standard code allowables). These stresses need not include anchor motion due to earthquakes.

3.2 Other Considerations

3.2.1 Flanges

Flanges must meet the standard requirements of the piping codes referenced in the USAR with the exception that the Operating Basis Earthquake need not be included (i.e., SSE governs).

3.2.2 Piping Deflections

Piping deflections are checked to ensure that they are not excessive. In instances where the calculated deflections have a potential for interaction with other plant items, walkdowns are performed. If no potential interactions are found, this piping operability criteria may be used. However, if interactions need to be evaluated, the evaluation of these interactions and the determination of piping operability is beyond the scope of these piping operability criteria.

4.0 PIPE SUPPORT OPERABILITY CRITERIA

In addition to the gravity and dynamic loadings in Section 3, the support loads must include pipe thermal loads and loads from seismic (i.e., SSE) anchor movements.

Should the support stresses not meet their operability limits, then additional iterative analyses of the piping may be required. The iterative analyses may use the knowledge that a support is not capable of withstanding the loads, and can be removed from the analysis. Where feasible, the actual support stiffness may be included in the iterative analyses.

4.1 Standard Pipe Supports

Standard pipe supports are those support components available in vendor catalogs. The operability criteria for these components will be based on Section 4.1.1 or Section 4.2.

4.1.1 Operability Criteria Using Manufacturer Allowables

The maximum calculated load in a standard support (excluding snubbers) obtained from the analysis of the unanalyzed condition must not exceed the greater of the following:

- a) Manufacturer's published ultimate capacity divided by a safety factor of 2, except that a safety factor of 3 will be used for U-bolts (Reference 5).
- b) Manufacturer allowable for Service Level D.*
- c) Manufacturer allowable for Service Level A multiplied by factor, f , as follows (Reference 6):

- For $S_u > 1.2 S_y$
 $f = \text{Min} (2.0, 1.167 S_u/S_y)$

- For $S_u \leq 1.2 S_y$
 $f = 1.4$

* Note: The criteria for linear type supports may be used in lieu of the manufacturer's load ratings, however in no instance can the capacity determined by testing (manufacturer's or otherwise) with a factor of safety equal to 2 be exceeded.

4.2 Linear Type Supports

4.2.1 Structural Steel

The maximum calculated stress obtained from the analysis of the discrepant condition must not exceed the operability criteria listed below:

Tension, Bending	$F_t, F_b = \text{Min. } (1.2 S_y, 0.7 S_u)$
Shear	$F_v = \text{Min. } (0.42 S_u, 0.72 S_y)$
Compression	$F_a = \text{Min. } (F_t, 0.67 S_{cr})$
Combined Stress	Axial tension (or compression) combined with bending using Reference 2.
Web Crippling	$= 1.0 S_y$
Fillet or Partial Penetration Welds	$F_w = 0.42 S_u$ (of weld material)
Weld Base Metal Shear	$F_v = \text{Min. } (0.42 S_u, 0.72 S_y)$

Stress limits will be based on code values for S_y and S_u .

4.2.2 Structural Bolts

The maximum calculated tensile stress based on the available tensile stress area in a structural bolt must not exceed the lesser of $1.0 S_y$ and $0.7 S_u$. The maximum calculated shear stress must not exceed the lesser of $0.42 S_u$ and $0.6 S_y$ (Reference 2).

For bolts subjected to combined shear and tension

$$\left(\frac{f_t}{F_{tb}} \right)^2 + \left(\frac{f_v}{F_{vb}} \right)^2 \leq 1.0$$

where,

f_t = computed tensile stress, ksi

f_v = computed shear stress, ksi

F_{tb} = allowable bolt tensile stress at temperature (from above)

F_{vb} = allowable bolt shear stress at temperature (from above)

4.2.3 Concrete Expansion Anchors

The operability limits for loads in tension and shear acting on concrete expansion anchors are obtained from the manufacturer's reported ultimate capacities with a safety factor of 2. Plate flexibility must be considered in the determination of anchor loads.

Anchors subjected to combined tension and shear must be evaluated using linear interaction.

$$\frac{T}{T_o} + \frac{V}{V_o} \leq 1.0$$

4.3 Other Considerations for Pipe Supports

4.3.1 Spring Hangers

Spring hangers are evaluated to accommodate the maximum pipe movement without topping/bottoming out. The total range of available movement (as opposed to working range) can be used to determine the topping/bottoming out condition. If a spring hanger is determined to bottom/top out, additional evaluations can be performed to determine the impact on the pipe and support(s).

4.3.2 Snubbers

The maximum calculated load taken by a snubber obtained from the analysis of the discrepant condition must not exceed the Level D allowable published by the vendor. For example, PSA mechanical snubbers define faulted allowables as 1.55 times the normal rated load.

Snubbers must also be reviewed to ensure they can accommodate thermal movements without exceeding travel limits. If the snubber cannot accommodate the range of full thermal movements, the loads are determined based on the limited travel available.

4.3.3 Containment Penetrations

The portions of the penetration boundaries governed by piping design requirements must meet the criteria detailed in Section 3 of this document.

The remaining portions must meet the limits given in ASME Section III, Subsection NE (Reference 3) for Level D conditions.

4.3.4 Special Items

Any special item which is not covered in these criteria must

be reviewed and analyzed in a rational manner. Assumptions and references must be indicated in the calculation and justification pertaining to their use should be provided.

4.3.5 Non-Conforming Supports

Pipe supports which do not meet the intent of these criteria are considered to be inactive. The piping system should then be studied for operability, per Section 3.0, excluding the restraint capabilities of the subject support.

5.0 SUMMARY

The piping operability criteria presented will assure safe operation of a piping system even if stresses and loadings exceed USAR limits. If a piping system is found to exceed USAR limits, but meets the operability limits, repairs, modifications and/or more detailed analysis will be made by the next refueling outage, or sooner, to return the system within USAR limits.

As detailed in Appendix A, the proposed piping operability criteria are consistent with criteria licensed at other nuclear facilities of the same vintage. The operability criteria limits proposed herein are typically equivalent to ASME Section III Level D limits. The operability criteria provide a simple approach for evaluating the interim acceptability of a discrepant condition.

6.0 REFERENCES

1. Transactions of the ASME "Fatigue Tests of Piping Components," by A.R.C. Markl, April 1952.
2. ASME Boiler and Pressure Vessel Code, Section III, Appendix F, 1986 Edition.
3. ASME Boiler and Pressure Vessel Code, Section III, Subsection NE, 1980 Edition.
4. US AEC Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plant," October 1973.
5. IE Bulletin No. 79-02, Revision No. 1, (Supplement No. 1), dated August 20, 1979.
6. Regulatory Guide 1.124, "Service Limits and Loading Combinations for Class 1 Linear-Type Component Supports," Revision 1, January 1978.

NOMENCLATURE

F_a	=	Axial stress permitted in the absence of bending moment
F_b	=	Bending stress permitted in the absence of axial force
F_t	=	Allowable Tensile Stress in the absence of bending moments
F_v	=	Allowable Shear Stress
F_w	=	Stress in a fillet weld
S_{cr}	=	Critical buckling load
SRSS	=	Square Root of Sum of Squares
S_{SSE}	=	Piping stress due to a Safe Shutdown Earthquake
S_g	=	Stress due to sustained loads, typically gravity
S_{TRANS}	=	Piping stress due to independent dynamic loads (e.g., Mark I loads)
S_p	=	Longitudinal pressure stress
S_u	=	Specified minimum tensile strength at temperature
S_y	=	Specified minimum yield strength at temperature
T	=	Tensile load in a concrete expansion anchor
T_c	=	Allowable tensile load in a concrete expansion anchor
V	=	Shear load in a concrete expansion anchor
V_c	=	Allowable shear load in a concrete expansion anchor

Appendix A

PRECEDENT FOR OPERABILITY CRITERIA

1. Generic Criteria for Justification of Continued Operation (JCO) Northern States Power, Prairie Island Nuclear Generating Plant (Reference A1).

This document details criteria for JCO when encountering major discrepancies in as-built safety related piping. These criteria were licensed for use at the Prairie Island Nuclear Station. The criteria for Cooper Nuclear Station are essentially the same, determining piping operability on the basis of limiting pipe stresses to ASME Section III Level D limits.

2. Modification Priorities for Pipe Supports on Rigorously Analyzed Piping - Sequoyah Units 1 and 2, TVA (Reference A2)

The criteria detailed in this document provide justification for continued operation of piping systems which require modifications to meet FSAR limits. These criteria allow the modifications to be delayed for an interim period. Once again, these criteria are essentially the same as those outlined in this document.

3. IEB 79-02 Supplement 1, "Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts" (Reference A3)

The bulletin allows interim operation of a piping system even though the installed piping system does not meet design allowables (i.e., using design factors of safety) for pipe supports. The recommended factors of safety for interim operation are adopted in this document. The linear interaction relation for combining shear/tension outlined in this document is conservative compared to those proposed in Reference A6.

4. Responses to NRC IE Bulletin 79-14 at Pilgrim Nuclear Power Station (Reference A4)

This document contains system operability criteria for addressing discrepancies found while the plant was operating. For piping and pipe supports which exceeded the operability criteria, Boston Edison implemented design modifications immediately. In some cases, the modifications were temporary and were made to restore the piping and supports to be within operability limits but not code limits.

The criteria limited piping stresses to ASME, Class 2/3 Level D allowables and support loads to values equivalent to those outlined in this document.

5. Proposed Short Term Functionality Criteria for SONGS-1 Piping Systems (Reference A5)

As part of the long term seismic upgrade program performed at San Onofre, short-term operability and functionality criteria were developed. The criteria were intended to be suitable for an interim

operation period until the plant could be modified to meet the NRC design requirements for a 2/3 g level earthquake.

The criteria limit for piping of $2S_y$ was based upon non-linear analyses to show that piping systems are maintained at conditions well within the bounds of that required for safe shutdown when elastic analyses identify stresses of $2S_y$. The criteria for pipe supports follow the recommendations of Regulatory Guide 1.124 and Standard Review Plan 3.9.3 and are essentially the same as those proposed in this document.

6. Piping System Operability Criteria for Commonwealth Edison's Dresden and Quad Cities Nuclear Generating Stations (Reference A7 and A8)

These criteria address both IEB 79-14 and Mark I loads and have been used to allow for interim operation until appropriate modifications to the system are implemented during the next refueling outage or sooner.

The acceptance criteria for pipe stresses are essentially identical to those proposed in this document. The criteria have been licensed for use in Reference A8.

REFERENCES

- A.1 Letter from David Musolf (Northern States Power) to the NRC "Generic Criteria for Justification of Continued Operation," Prairie Island Nuclear Generating Plant, Docket Nos. 50-282, 50-306, dated September 26, 1988.
- A.2 Letter from R. L. Gridley (TVA) to the NRC, "Sequoyah Nuclear Plant (SQN) - Unit 2 Pipe Support Modification Restart Criteria Meeting Summary," Docket Nos. 50-327, 50-328, October 6, 1987.
- A.3 IE Bulletin 79-02, Supplement 1, Revision 1, "Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts," August 20, 1979.
- A.4 Letter from Boston Edison Company to the NRC, "NRC IE Bulletin 79-02 and IE Bulletin 79-14, Final Report," Docket No. 50-293, July 19, 1982.
- A.5 NRC's Safety Evaluation Report, "Safety Evaluation by the Office of Nuclear Reactor Regulation Relating to the Long-Term Service Seismic Re-evaluation Program, Southern California Edison Company, San Diego Gas and Electric Company, San Onofre Nuclear Generating Station, Unit No. 1, Docket No. 50-206," provided by NRC letter to Kenneth P. Baskin (SCE) from Thomas M. Novak (NRR), dated July 11, 1986.
- A.6 Electric Power Research Institute Report No. NP-5228, "Seismic Verification of Nuclear Plant Equipment Anchorage," May 1987.
- A.7 Piping System Operability Criteria for Commonwealth Edison's Dresden & Quad Cities Nuclear Generating Stations, NRC Docket Nos. 50-237/249 and 50-254/265, March 22, 1991.
- A.8 NRC letter to Commonwealth Edison, "Piping System Operability Criteria Dresden/Quad Cities," dated September 27, 1991, Docket Nos. 50-237, 50-249, 50-254, and 50-265.

Correspondence No: NLS970074

The following table identifies those actions committed to by the District in this document. Any other actions discussed in the submittal represent intended or planned actions by the District. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the Licensing Manager at Cooper Nuclear Station of any questions regarding this document or any associated regulatory commitments.

COMMITMENT	COMMITTED DATE OR OUTAGE
The operability criteria will be used to evaluate conditions within a piping system and pipe supports to ensure that the safety-related piping system will continue to operate safely in the event that the piping system is found to exceed current design basis criteria described in the Updated Safety Analysis Report.	Following NRC approval.