U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Cooper Nuclear Station	0 5 0 0 0 2 9 8	1 OF 0 8

TITLE (4)
Pipe Support Design Deficiencies Discovered During Design Change Engineering Activities

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 5	1 7	8 8	8 8	0 1 6	0 1	1 0	2 1	8 8		0 5 0 0 0
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OPERATING MODE (9): N
POWER LEVEL (10): 0 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
20.405(a)(1)(iv)	X 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Donald L. Reeves, Jr.	AREA CODE 4 0 2 8 2 5 - 3 8 1 1

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)

YES (If yes, complete EXPECTED SUBMISSION DATE) X NO

EXPECTED SUBMISSION DATE (15) MONTH DAY YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

While evaluating a modification to the existing High Pressure Coolant Injection (HPCI) pump discharge piping at Cooper Nuclear Station, an existing support was found to be underdesigned for the design loads shown on the hanger drawing. As a result, further analyses of the HPCI pump discharge line supports were conducted. These analyses revealed that 50 percent of the supports were underdesigned for the maximum possible earthquake (Safe Shutdown Earthquake, or SSE) load case. The HPCI pump discharge system was subsequently modified to bring all supports up to code qualification (USAS B31.1.0, 1967 Edition). Additionally, an evaluation of a representative sample of supports from all other essential systems was performed to assess potential generic concerns. This evaluation resulted in the discovery of additional supports that did not meet code allowables.

A detailed operability analysis was performed on the as-found HPCI pump discharge line, and the line was determined to remain operable during the SSE load case. In addition, a sample of supports from the other remaining essential systems that had not been subject to reanalyses subsequent to their original design were selected. Through review and/or modification of these supports, the associated piping systems were determined to be operable. In addition, all original Class IS pipe supports were evaluated and modifications made as required to ensure their qualification to code allowables. A program has been implemented for the remaining large bore, essential, seismic, Class IS pipe supports to ensure their qualification to the CNS design basis prior to startup from the 1989 Refueling Outage.

A. Event Description

In January 1988, during an evaluation for a design change, one pipe support was identified on the High Pressure Coolant Injection (HPCI) discharge line that potentially did not meet the code stress allowables (USAS B31.1.0-1967) under the design basis loads for a seismic event (SSE). Based upon this finding, the evaluation was extended to include the remainder of the HPCI pump discharge system. This extended evaluation resulted in identifying 18 of 32 supports on the discharge line that potentially did not meet the code stress allowables.

In order to provide a basis for judging the extent and commonality of the issues raised, a sample of CNS Class IS pipe supports was selected for further detailed assessment. The population from which the sample was extracted included all Class IS piping supports excluding only those on piping which had been the subject of recent reanalyses. Supports on the HPCI pump discharge piping were also excluded due to the current reanalysis and code qualification effort. Supports on the Reactor Coolant Recirculation (RR), Reactor Water Cleanup (RWCU), and a portion of the Core Spray (CS) and Residual Heat Removal (RHR) piping were excluded because of the reanalysis effort performed in support of the Intergranular Stress Corrosion Cracking (IGSCC) pipe replacement program. Supports on torus attached piping were excluded by virtue of the reanalysis performed in support of the Mark I Containment modifications. In addition, all Class IN supports on essential systems were excluded, since it was decided to analyze, and modify as necessary, all Class IN supports to meet code compliance prior to startup from the 1988 refueling outage.

The resulting population of Class IS supports consisted of 1157 supports. A detailed breakdown of this population, by system, is presented in Table 1. This initial evaluation revealed that other apparently nonconforming supports existed.

B. Plant Status

At the time of discovery of the one pipe support on the HPCI discharge line that potentially did not meet code stress allowables, and its documentation as such on January 19, 1988, the plant was in operation. The pipe support was subsequently modified during an unscheduled plant outage in late January to ensure code compliance while a more rigorous analysis was performed. It should be noted that subsequent reanalyses conducted by an engineering consulting firm, Cygna Energy Services, revealed that the support in question was qualified to code requirements when actual pipe support stiffnesses were considered. When the full extent of this problem was recognized, the plant was in a Cold Shutdown condition for the 1988 Refueling Outage.

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C. Basis for Report

During the course of further engineering evaluations conducted to more rigorously assess the overall qualification of Class I supports, supports were found which potentially were overstressed. The analytical effort was not completed to verify operability in certain situations due to time and schedule considerations. Instead, modifications to the pipe supports and/or support schemes were implemented to ensure Code allowables and/or operability criteria were met. The specific hangers for which this situation applies is documented in the District's Justification for Interim Operation submitted on June 12, 1988. Therefore, this constitutes a situation where limited portions of essential piping systems and associated supports may have been in a condition outside the design basis of the plant, reportable in accordance with 10CFR50.73(a)(2)(ii)(B).

D. Cause of Event

The support design problems described were discovered during the analysis of a new 1-inch drain and vent line to be added to the 14-inch HPCI pump discharge line. Initially, one support was believed to be underdesigned which led to further analyses revealing additional underdesigned supports.

A root cause analysis to determine the full extent of the design problem as it may affect the qualification of essential, seismic Class IS pipe supports has been pursued. However, calculations associated with design activities for the original support design effort cannot be located. Without the capability to review these calculations, determination of the root cause is not possible.

Based upon a review of all available documentation and through discussions with architect engineer and constructor personnel who were either involved with the design of pipe supports for CNS or knowledgeable of support design practices when plant design and construction activities were in progress, it appears that standard industry practices for this time period were employed during the original design effort. However, as a result of discovery of this problem through employment of more rigorous design and analysis efforts, apparently the original pipe support design process was not sufficiently conservative in all cases.

E. Safety Significance

Upon determining that a number of supports on the HPCI discharge piping potentially did not meet code stress allowables, an assessment of the operability (i.e., capable of performing its intended function) of the HPCI pump discharge piping was conducted, with the pipe supports in the as-found condition. The HPCI pump discharge piping was determined to have remained operable, in accordance with the requirements of the CNS Technical Specifications, in the as-found condition, and under all design

E. Safety Significance (Continued)

basis loads. The operability criteria used for this assessment are described and justification provided in the June 12, 1988, Justification for Interim Operation.

Additionally, due to the initial determination that other apparently nonconforming supports existed within the population of supports identified in Table 1, an extensive review and evaluation of the total population of original design essential piping supports presently in service at CNS was performed. Operability of existing supports was evaluated and compared with the results of the HPCI operability evaluation, on a statistically valid sampling basis, by both system and support attribute. As a result of this methodology, all existing essential supports at CNS were found to be enveloped by the HPCI results, except those with unique attributes, specifically deadweight supports and welded pipe support anchors. It is believed that sophisticated analytical efforts could be performed, resulting in reduced loads, leading to a conclusion that the original deadweight supports and welded pipe anchors were acceptable. However, in the absence of this more rigorous evaluation, the response of limited portions of the essential piping systems affected under design basis loading conditions is unknown. Systems potentially affected are noted on Table 1. Also reflected in Table 1 is the fact that the Class IN supports were not considered in the operability analysis. Hence, a conclusion similar to the preceding regarding the associated piping is appropriate.

F. Corrective Action

As previously noted in Paragraph A, Event Description, as part of the corrective action, additional pipe supports on the HPCI discharge piping system were reviewed and additional nonconforming pipe supports were identified. As a result, the following actions were taken:

1. Based upon current piping analyses results, the HPCI discharge piping system supports were modified to achieve full code qualification.

2. An operability evaluation of the as-found HPCI discharge piping system was performed. It was concluded that the piping system was operable in accordance with the requirements of CNS Technical Specifications in the as-found condition.

3. As the scope of this effort became clear, and reflecting the importance of reactor coolant pressure boundary piping (Class IN/TS) to safety, modifications were made, as required, to achieve full code qualification of all supports associated with reactor coolant pressure boundary piping.

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F. Corrective Action (Continued)

4. Other essential piping systems were reviewed to ascertain whether the HPCI nonconforming supports were an isolated occurrence. The initial evaluation revealed that other apparently nonconforming supports existed. A further detailed evaluation of these essential systems concluded that all nonconforming supports were associated with the original design and construction of CNS. Subsequent design and analytical efforts, such as recirculation pipe replacement and torus attached piping modification, had been rigorously performed and documented, thus precluding similar nonconforming supports.

5. An extensive review and evaluation of the total population of these original design essential piping supports presently in service at CNS was performed. This review and evaluation was conducted on a sample of the 1157 Class IS pipe supports as previously noted in Paragraph A, Event Description. This assessment of the sampled Class IS supports focused on compliance with operability criteria paralleling those invoked in the HPCI pump discharge piping operability evaluation. The sampled supports were assessed for loads shown on the latest revisions of the support drawings. A load case consisting of the combination of deadweight (DW), thermal (TH) and twice the operating bases (OBE) seismic loads (conservative value for SSE event) was evaluated.

   The sample size was increased to ensure that an adequate number of the supports on each system identified in Table 1 were included. The total sample size for all systems considered was 170 supports, which represents 14.7 percent of the Class IS pipe support population identified previously. Operability of these existing supports was evaluated and compared with the results of the HPCI operability evaluation, on a statistically valid sampling basis, by both system and support attribute. As a result of this methodology, all existing essential supports at CNS were found to be enveloped by the HPCI results, except those with unique attributes, specifically deadweight supports and welded pipe support anchors.

6. One hundred percent of deadweight supports and welded pipe support anchors were then reviewed. During this review, it was revealed that certain deadweight supports could experience uplift during design basis seismic events. It was also discovered that certain welded pipe anchors were overstressed. Accordingly, all deadweight supports were reviewed and those which experienced uplift were modified to accommodate the uplift forces. Also, all welded pipe anchors were reviewed and those that were overstressed were modified.

F. Corrective Action (Continued)

As a result of these efforts, upon startup from the 1988 Refueling Outage, the status of pipe supports at CNS was as follows:

1. All pipe supports associated with the reactor coolant pressure boundary were fully code qualified.

2. All piping supports associated with the HPCI discharge line were fully code qualified.

3. All originally designed deadweight supports, which were shown to experience uplift during design basis seismic events, were modified to accommodate such loads.

4. All originally designed welded pipe anchors that were potentially overstressed were modified.

5. All other essential supports were statistically evaluated on the basis of the HPCI Pump Discharge System Operability Evaluation. With statistical certainty, the essential piping systems were considered to be operable. Note that pipe supports designed subsequent to initial CNS design (Table 1, Note 1) as an integral portion of major retrofit projects were not included within the scope of this evaluation. These support designs were appropriately documented during the course of the respective project activities and were qualified to meet the respective project design code of record.

With regard to continuing corrective action, expedited efforts to achieve full code qualification for all large bore essential seismic Class IS piping supports are in progress. A detailed plan for accomplishing these modifications entitled, "Long Term Plan for Code Qualification of Seismic Class IS Supports", was developed and submitted to the NRC on August 12, 1988. As specified therein, in order to ensure that all necessary pipe support populations are included in the long term re-evaluation program, any supports not rigorously re-analyzed as part of recent programs; for example, those noted in Paragraph A, Event Description, will be prioritized to ensure that the supports on the piping systems which are most critical to plant safety are reviewed and, if needed, upgraded first. Current plans are to have all nonconforming supports modified to meet the CNS design basis prior to startup from the 1989 refueling outage.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

G. Past Similar Events

Similar events which have occurred in the past and which were reported as LERs include:

LER 86-027 dated November 14, 1986, Safety Related Instrument Rack Seismic Deficiencies.

LER 86-028 dated November 20, 1986, Standby Gas Treatment system Seismic Deficiencies.

* U.S.GPO 1986-0-624-538/455

TABLE 1

ESSENTIAL SYSTEM PIPE SUPPORT EVALUATIONS OF CLASS IS SUPPORTS

	SYSTEMS	TOTAL NO. OF SUPPORTS (1)	SAMPLE TOTAL (2)
1.	Main Steam and Bleed Steam (MS & BS) (3) (4)	122	18
2.	Control Rod Drive (CRD)	30	4
3.	Core Spray (CS)	37	37
4.	Reactor Core Isolation Cooling (RCIC)	56	6
5.	Residual Heat Removal (RHR) (3) (4)	178	25
6.	Stand-by Liquid Control (LC)	6	2
7.	Reactor Building Closed Cooling Water (REC) (3)	202	22
8.	Service Water (SW) (3)	485	47
9.	Process Vent System (PV)	5	2
10.	Radioactive Floor Drain (FDR)	16	4
11.	Diesel Generator Starting Air (STA)	20	3
	TOTAL	1,157	170 (14.7%)

NOTES:

(1) Excludes Class IN supports and those supports on piping that have been subject to recent, rigorous reanalyses (e.g. HPCI, RF, RR, RWCU and Torus Attached Piping). In addition, one (1) constant support in the Reactor Water Cleanup System also required modification (weld buildup).

(2) The sample size represents approximately 14.7 percent of the support population exclusive of 35 additional deadweight supports that were addressed separately.

(3) Contains deadweight supports which were modified due to concerns with seismic uplift.

(4) Contains anchors that were modified in order to ensure operability.

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