NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Catawba Nuclear Station, Unit 1	0 5 0 0 0 4 1 3	1 OF 0 5

TITLE (4) Failure Of ITT Grinnell Mini-Stiff Pipe Clamps - Figure 214- Due To Manfacturing Deficiency

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 9	0 9	8 7	8 7	— 0 3 7 —	0 1	0 1	1 5	8 8	Catawba, Unit 2	0 5 0 0 0 4 1 4
										0 5 0 0 0

OPERATING MODE (9): 1

POWER LEVEL (10): 1 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)	X 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)	10 CFR Part 21
☐ 20.405(a)(1)(iv)	☐ 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 (AREA CODE)	
Julio G. Torre, Associate Engineer - Licensing	7 0 4	3 7 3 - 8 0 2 9

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
B	- -	S P T	G 2 5 7	Y					

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)

On September 10, 1986 during Catawba Nuclear Station's Unit 1 End-Of-Cycle 1 refueling outage, visual inspection of snubbers per Technical Specification 4.7.8.b revealed two broken pipe supports which incorporated a figure 214N "ministiff clamp" especially manufactured for Catawba Nuclear Station. There are 1500 figure 214N ministiff clamps installed at Catawba ranging from 1/2" to 4" in size. The fractured part of the "ministiff clamp" was the metal strap which wraps around the pipe. This strap is fabricated from a precipitation hardened stainless steel, heat treated at 1975F. Failure analyses indicated an improper heat treatment of the strap. This resulted in a higher strength material, but lowered its fracture toughness and stress corrosion cracking resistance. On September 9, 1987, Duke Power discovered that over several years the ability of affected hangers to perform their intended function could be potentially degraded. An operability analysis was performed and it was determined that plant operation was unaffected by the failed pipe supports. Both units have been in all modes of operation since the pipe clamps were installed. This incident is attributed to a manufacturing deficiency because the material was improperly heat treated. The damaged pipe clamps were replaced on September 10, 1986 and additional inspections performed on all hangers in the same location. An additional statistical sampling of straps was inspected during Catawba's Unit 1 second refueling outage (September 2, 1987 to December 31, 1987). Two additional figure 214N ministiff clamps were discovered with fractured straps. These straps were replaced with properly heat treated straps. A replacement program is under development. The health and safety of the public were unaffected by this incident.

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BACKGROUND

The figure 214N ministiff clamp was manufactured by ITT Grinnel Pipe Hanger Division for Catawba Nuclear Station. The figure 214N ministiff clamps provide advantages in that the clamps are lighter than standard weight clamps. They are intended to occupy minimal space, and minimize stresses in the piping systems that they support. They consist of a bracket and strap assembly. The bracket attaches to either a pipe snubber or strut, via the strap assembly which wraps around the pipe. There are 1500 figure 214N ministiff clamps installed at Catawba ranging from 1/2" to 4" in size.

DESCRIPTION OF INCIDENT

On September 10, 1986 during Catawba Nuclear Station's Unit 1, refueling outage, the visual inspection of snubbers (per Technical Specification 4.7.8.b) revealed two broken pipe supports. Supports 1-R-NC-1269 and 1-R-NC-1238 incorporated the figure 214N ministiff clamps and both failed due to fracture of the strap portion. The failed straps are made from type 17-4 PH stainless steel purchased to ASME/ASTM specification SA-564 GR630. The two straps that failed were in service inside the Unit 1 containment building on 3 inch crossover lines between the hot and cold legs of the reactor coolant system. They are subject to operating temperatures of 500 degrees F to 600 degrees F.

These two broken straps were replaced on September 10, 1986 (per work request 3809 MNT) and the attached snubbers were functionally tested to verify operability. Four additional support/restraints were inspected in each direction of the failed supports (work request 3810 MNT). On September 9, 1987, following a detailed analysis and evaluation, Duke Power concluded that over several years the ability of the affected hangers to perform their intended function could be potentially degraded. Design Engineering performed an operational analysis and found that the plant's operability was unaffected by these failed straps.

Failure analysis on the failed straps have been performed by the Duke Power Company Metallurgy Laboratory, Thielsch Engineering Associate, Inc. (For ITT Grinnel Corporation) and Dominion Engineering, Inc. Reports of these analyses were reviewed thoroughly by Duke Power's Design Engineering and Nuclear Maintenance Metallurgy Group.

The strap material is a 17-4 PH martensitic stainless steel which achieves its strength through a combination of martensitic transformation and precipitation hardening. 17-4 PH is used for applications in which higher strength is required. Once this material is in its solution annealed condition, it can be hardened by a relatively low temperature precipitation treatment (900 - 1150 degrees F) followed by air cooling.

The strength achieved following the hardening treatment depends primarily on the temperature used. The maximum strength is achieved by the lowest recommended hardening temperature (1150 degrees F). However, the higher strength achieved with the lower hardening temperature is at the expense of fracture toughness and stress corrosion cracking resistance. The resistance of 17-4 PH to stress

corrosion cracking is very dependent on the hardening temperature used in the heat treatment. Manufacturer's literature indicates that material hardened at temperatures below 1000 degrees F should not be used for applications where stress corrosion cracking resistance is a criterion.

The H1075 heat treatment process required for these straps provide a hardness range of Rockwell C 32 to 39. The hardness readings on the failed straps ranged from 41.5 to 47.7. Fourteen additional straps were removed from stock and hardness readings taken. Out of the 14 straps, only two were in the desired hardness range and they were on the high side, averaging 37.2 Rockwell C.

A chemical analyses of the strap material was performed. This analyses indicated that the strap material was within the chemical specification for 17.4 PH stainless steel. After this was determined 18 small samples of strap and bar material were re-heat treated to determine if the desired hardness could be reached by using the H1075 process once the material had been resolution annealed. The sample material from two different sources consistently fell into the hardness range predicted by the metals handbook. A hardness change of 7.4 Rockwell C was realized after the 1075 degrees F aging treatment performed in the Duke Power metallurgy lab.

The remaining 755 spare straps were taken to a heat treating facility in Charlotte, North Carolina and re-heat treated to the original specification under Duke Power Company's QA program. Sample strap material from different batches and locations of the furnace were taken and tested for hardness. Each sample was well within the specified hardness range.

A statistical sampling inspection plan was developed by Design Engineering which would provide a 95% confidence level that 95% of the remaining 1,500 ministiff clamps are operable. This inspection was performed during Catawba's Unit 1 End-Of-Cycle 2 outage (September 2, 1987 to December 31, 1987). Two additional straps were found fractured (hanger 1-R-NC-1532 and 1-R-NV-2170) and were replaced with properly heat treated material.

CONCLUSION

The availed evidence suggests that the original aging temperature of the strap material was less than 1075 degrees F and probably closer to 900 degrees F. Age hardening at this temperature results in high yield strength, low fracture toughness, and low resistance to stress corrosion cracking. In order to have high fracture toughness and good resistance to stress corrosion cracking 17-4 PH material should be heat treated at 1075 degrees F or above.

This incident is attributed to a manufacturing deficiency because the material was improperly heat treated. Pipe strap material should have high fracture toughness and good resistance to stress corrosion cracking so that they can deform plastically without failing under the locally high stress conditions which can result from clamp installation, thermal expansion of the pipe and applied loads.

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

CORRECTIVE ACTIONS

IMMEDIATE

The two broken straps were replaced on September 10, 1986 per work request 3809 MNT.

SUBSEQUENT

(1) Four additional support/restraints were inspected on September 10, 1986 in each direction of the failed supports (per work request 3910 MNT). The snubbers which were inspected (per work request 3910 MNT) were also functionally tested to verify the unit fully operable.

(2) Design Engineering performed an operational analysis and found that the plant's operability was unaffected by these failed supports.

(3) An Inspection Plan, based on statistical sample provided 95% confidence that 95% of the Figure 214N ministiff clamps were operable, was performed during Catawba's Unit 1 second refueling outage (September 2, 1987 to December 31, 1987) per work requests 4689 MNT and 4803 MNT. Two additional straps were found fractured during this inspection and were repaired (under work request 4760 MNT).

(4) 755 spare ministiff clamp straps were re-heat treated. These straps were various sizes and have been put back into stock.

PLANNED

(1) Our 95/95 statistical sampling inspection will be performed during Catawba's Unit 2 initial refueling outage (under work request 4997 MNT).

(2) Design Engineering will continue to work with vendors to develop a suitable replacement hanger.

(3) A replacement program is being developed by Design Engineering and Nuclear Maintenance. This program will be based on material availability, inspection results, and unit schedule.

SAFETY ANALYSIS

Design Engineering performed an operational analysis and found that plant operability was unaffected by these failed supports. The failed supports are only required for seismic loading.

The ministiff clamp inspection plan provided a high confidence level that the ministiff clamps are operable. The re-heat treatment of the spare straps provides an acceptable replacement. Hardness readings were taken from each re-heat batch to verify proper heat treatment.

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

Both Units have been in all modes of operation since the pipe clamps were installed.

This incident is reportable pursuant to 10 CFR Part 21.

The health and safety of the public were unaffected by this incident.

DUKE POWER COMPANY
P.O. BOX 33189
CHARLOTTE, N.C. 28242

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January 15, 1988

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

Subject: Catawba Nuclear Station, Unit 1
Docket No. 50-413
LER 413/87-37, Revision 1

Gentlemen:

Pursuant to 10 CFR 50.73 Section (a) (1) and (d), attached is Licensee Event Report 413/87-37 concerning the failure of ITT Grinnel Mini-Stiff Pipe Clamps - Figure 214 - due to a manufacturing deficiency. This event was considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

JGT/1246/sbn

Attachment

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