DUKE POWER COMPANY
P.O. BOX 33189
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HAL B. TUCKER
VICE PRESIDENT
NUCLEAR PRODUCTION

TELEPHONE
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July 24, 1985

Dr. J. Nelson Grace, Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

Re: Catawba Nuclear Station, Unit 2
Docket No. 50-414
Significant Deficiency No. 414/85-08

Dear Dr. Grace:

Please find attached a supplement to our status report, dated July 15, 1985, which described corrective actions on the subject deficiency. This information, requested by Region II staff, consists of an engineering evaluation of over-pressurization of components of the Residual Heat Removal System, the Boron Recycle System and the Nuclear Sampling System.

Very truly yours,

Hal B. Tucker

LTP/mjf

Attachment

cc: Director
Office of Inspection and Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. Jesse L. Riley
Carolina Environmental Study Group
854 Henley Place
Charlotte, North Carolina 28207

Robert Guild, Esq.
P. O. Box 12097
Charleston, South Carolina 29412

Palmetto Alliance
2135½ Devine Street
Columbia, South Carolina 29205

NRC Resident Inspector
Catawba Nuclear Station

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Atlanta, Georgia 30339

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IE27

Catawba Nuclear Station
SD 414/85-08
Supplement
July 24, 1985

DUKE POWER COMPANY

DESIGN ENGINEERING-SYSTEMS AND EQUIPMENT SECTION

ENGINEERING JUSTIFICATION REPORT

Date: May 22, 1985

To: E. M. Couch

Station: Catawba 1-2

System: NB, ND, NM

File: CN-1206.00-02

Report No. MDS-JR-51

Originated By: [signature] 5-22-85

Checked By: [signature] 5/23/85

Approved By: [signature] 5/28/85

DMC RLW

QA Approval By: TC Roberts 6/3/85

Variation Reported By: NCIR 19,632

Description of Variation

Piping in the NB, ND, and NM systems was pressurized to 2000 Psig during testing as described by NCIR 19,632.

Engineering Evaluation

(1) ND System

Flow Diagrams: CN-2561-1.0, 1.1 Line 02
PS 601.2, Pipe SA 312 Tp 304 Smls./EFW

The allowable hydrotest pressures and the calculated stresses are tabulated by Table 1.

Evaluation for 6", 8", 12" and 14" piping:

6"

Piping was stressed to 83% of S_y based on the Minimum S_y required by the material specification.. Piping is acceptable since stresses < S_y.

8"

Piping was stressed < the actual material yield strength as determined by review of the mill test reports. The lowest S_y for pipe material was found to be 41,000 psi. The lowest yield strength of any fittings was found to be 39,800 psi. Thus the pipe was stressed to 91% S_y and the fittings were stressed to 94% S_y. Pipe and fittings are acceptable since stress < S_y and based on the following conservative factors:

(a) Evaluation is based on the material specification minimum wall thickness. Actual wall thickness of the piping is greater than the material specification minimum wall thickness. In addition fittings would be expected to have a wall thickness greater than the wall thickness of the pipe. So even though the fittings have a lower yield strength than the pipe, the stresses in the fittings would be expected to be lower than the stresses in the pipe because of the greater wall thickness of the fitting.

Table 1

ND System

Pipe Allowable Pressures and Theoretical Stresses for 2000 Psig

NPS	Sch.	Min. Wall (In.)	Pa (Psig) (1)	Max. Hydro Press. (Psig) (2)	Theo. Hoop Stress (Psi) (3)	% of Min Spec. Yield Strength (4)	% of Actual Yield Strength(s)
1/2	40	.095	3991	6346			
3/4	40	.099	3255	5175	Piping is acceptable since allowable hydrotest pressure > 2000 Psi.		
1	40	.116	3044	4840			
2	40	.135	1900	3021			
3	40	.189	1804	2868			
4	40	.207	1529	2431			
6	40	.245	1218	1937	25041	83%	---
8	20	.219	827	1315	37384	125%	94%
12	Std	.328	839	1334	36872	123%	85%
14	40	.383	894	1421	34554	115%	71%

Notes:
(1) From CNC-1232.00-00-0010 Table S using E = 0.85 at 100°F
(2) Max. Hydro Press = (Pa) (1.5) (1.06)
(3) Theo. Hoop Stress = (2000) (D-2 x t_M) / 2 t_M
(4) Min. S_y = 30,000 Psi per material specification.
(5) Actual S_y determined by review of Mill Test Reports.

(b) The actual yield strengths used in this evaluation are the worst case. Most materials have actual yield strengths greater than the yield strengths used in this evaluation.

12"

Piping was stressed to 85% of S_y based on review of mill test reports which found the lowest S_y = 43,300 psig. The 12" pipe and fittings are acceptable since stress $< S_y$ and based on the conservative wall thickness values used in this evaluation.

14"

The 14" piping consists only of 14" x 8" reducers. The reducer was stressed to 71% of S_y based on review of mill test reports which found the actual S_y = 48,800 psi. The 14" reducer is acceptable since stress $< S_y$ and the actual wall thickness value used in this evaluation is conservative.

Evaluation of Flanges:

Flanges are 600 lb, A182 F304 B16.5 Rating @ 100°F = 1140 Psig
Max. Hydrotest Pressure = (1.5) (1.06) (1440)
= 2290 Psig
The flanges are acceptable since maximum hydrotest pressure allowed, 2290 Psig > 2000 Psig test pressure.

(2) NB System

Flow Diagram: CN-1556-1.1
PS 151.3 Pipe SA 312 TP 304 EFW.

The allowable hydrotest pressures and the calculated stresses are tabulated by Table 2.

Evaluation for Flanges :

Flanges are 150 lb, A182 F304 (Reference Notes 1 and 2 on page 5)
B16.5 (1977) rating at 100°F = 275 Psig
Allowable Hydrotest Pressure = (1.5) (1.06) (275)
= 437 Psig
Flanges are not acceptable for 2000 Psig pressure.

(3) NM System

Flow Diagram: CN-2572-1.0 & 1.5
PS 1501.8, PS 2501.4, TS 2701.4

PS No.	Pa at 100°F, (PSIG) (1)	Maximum Hydrotest Pressure (Psig) (2)
1501.8	1420	2258
2501.4	3209	5102
2701.4	2900	4611

Notes: (1) Pa = Design pressure parameter from piping subtable
(2) Max. Hydro. Press - (1.5) (1.06) (Pa)

Piping is acceptable since maximum hydrotest pressure > 2000 Psig.

Table 2

NB System

Pipe Allowable Pressures and Theoretical Stresses for 2000 Psig

NPS	Sch.	tMin. (In.)	Pa (Psig) (1)	Max. Hydro Press. (Psig) (2)	Theo. Hoop Stress (Psi) (3)	% of Min. Spec. Yield Strength (4)
1	40	.116	2865	4555	Piping is acceptable since allowable hydrotest pressure > 2000 Psi	
2	40	.135	1788	2843		
3	40	.189	1698	2699		
6	40	.245	1146	1822	25,041	83%

(1) From CNC-1232.00-00-0010 Table H

(2) Maximum Hydro Pressure = (Pa) (1.5) (1.06)

(3) Theo. Hoop Stress = (2000) $(D - 2 \times t_M) / 2 t_M$

(4) Min. S_y = 30,000 Psi per material specification

Engineering Conclusions:

All piping subjected to the 2000 Psi pressure was found to be acceptable except for the 150 lb. flanges. The 8", 12" and 14" piping was qualified by using the yield strength values from the material test reports.

Engineering Disposition of Variation:

The 150 lb. flanges require replacement. All other piping is acceptable. This disposition is addressed by Attachment No. 2 to NCIR 19632.

T. F. Wyke, Chief Engineer
Mechanical & Nuclear Division

R. L. Williams

for S. S. Lefler, Jr., Design Engineer I

SSL:mmg

Attachments: Copy of NCIR 19632, Attachment Nos. 1 and 2

cc: D. R. Ingle w/o attachments
R. C. Gamberg "
T. E. Goodson "
T. C. Roberts "
T. D. Crom "
R. E. Miller "
R. L. Williams "
J. E. Cavender "

Note 1: Review by the Sttess Analysis Group found the 150 lb. flanges to be unacceptable following the 2000 psi test pressure. Reference Attachments No. 1 and No. 2.

Note 2: Review of NB flanges covered under PS 151.3 found that 300 lb. flanges were furnished with relief valves 2N1161, 2N1151 and 2N1119. The B16.5 rating fro SA 182 F304 flanges at 100°F is 720 psig corresponding to a allowable hydrotest pressure of 1145 psig. This value is less than 2000 psig test pressure however the Stress Analysis Group was able to qualify the flanges to be acceptable as stated by Attachment No. 2. Therefore the 300 lb. flanges are acceptable as installed.

2-ND-T44

4-25-85

25679 (Rev 2-84)

FORM Q-1A REVISION 15

DUKE POWER COMPANY

Project CATAWBA Unit 2

NONCONFORMING ITEM REPORT

Serial No. 19632

Requisition No.	Vendor/Location	Documents Violated
N/A	N/A	Flow Diagrams CN-2561-1.0, 2561-1.1, 2572-1.0, 2572-1.5 and CN-1556-1.1
MPS PO NO. N/A	Mech/Elec System NB, ND, NM	

Env Condition	Class	Identification Method	
1 & 2	E & B	☐ Q-IB's ☐ Other ~~Areas to numerous to tag~~	☐ NCI Tape ☒ Not Practical

Location of Item

Description of Nonconformance Various piping, valves and equipment were overpressurized by N.P.D. while operating the centrifugal charging pump "2B" during cold hydro. This problem was discovered when N.P.D. found water spraying from flanges on relief valves 2ND031 and 2NM296. Subsequent review of testing procedures then discovered the over-pressurization had occurred. See attached page #1 for additional information. This incident occurred during the a.m. hours of 4/19/85.

No physical damage is evident and Design Engineering (Sam Alexander) has authorized N.P.D. to continue testing, therefore, no tagging is necessary.

Responsibility for Nonconformance Disposition ☐ Const. ☒ Design ☐ QA ☐ Nuclear Production ☐ Group DM

Reportability Evaluation, Q-ID, Requested from DESIGN MECH (Provide Department or N/A)

Originated By Bill Shearin Date 4/23/85 | QA Review HC Hux Date 4/23/85

Disposition of Nonconformance

DNC (PR-202) Applicable (Design Eng. Only) ☐ Yes ☐ No

Spec/Calc/Dwg Revised | Rev No.

R-6A Assigned to ____ Dept.

For 10CFR 50 App. B Criterion XVI Evaluation

Resolved By Date | Technical Approval Date | QA Approval Date

REWORK/INSPECTION/REPLACEMENT TO IMPLEMENT DISPOSITION

	Assigned To	Performed By	Date

By Date | QA Approval Date

Inspection Remarks

Distribution		Const Mgr	Eng Mgr	Con Eng MECH	Con Eng	Project QA Mgr	QA Vendors	QA	QA	Whse Supv	Design MECH	ANI	NRC	NCI Orig		
Number of Copies	Initial	2	1	1							1	1	1	1		
	Final											1	1	1		

Trend Info. NAPD

Final QA Review Date

ATTACHMENT #1 ATTACHMENT # NCI NUMBER 14632

DESCRIPTION OF ITEM AND STATEMENT OF PROBLEM CONTINUED PAGE 1 OF 1

The affected piping, valves, and equipment described below were presurrized at approximately 2000 psig for approximately three hours.

From the intake side of valves 2NI179A and 2NI178B to isolation valves 2NS43A, 2NI183B, 2NI136B, 2NS38B, 2ND28A, 2ND33, 2ND25A, 2ND24A, 2ND58B, 2ND59B, 2ND90, 2ND91, 2ND78, 2NM59, 2NM483, 2NM46, 2NM47, 2NM295 - to vent, drain or test vent valves 2ND30, 2ND148, 2ND34, 2ND119, 2ND29, 2ND74, 2ND99, 2ND29, 2ND14, 2ND76, 2ND69, 2ND20, 2ND21, 2ND33, 2NB121, 2ND123, 2ND98, 2ND120, 2ND42, 2ND125, 2ND82, 2ND79, 2ND71, 2ND54, 2ND55, 2NM66, through valves 2ND27, 2ND32A, 2ND26, 2ND19, 2ND57, 2ND65B, 2ND60, 2ND53, 2ND68, 2NM48, 2NM39, 2NM41, 2NM265, 2NM45 and through Equip. Residual Heat Removal Heat Exchanger 2A and 2B and R.H.R. Loop Sample HX.2 - against discharge side of check valves 2ND10 and 2ND44 through relief valves 2ND31, 2ND35, 2ND67, 2NM296 (which may have lifted) against discharge side of relief valves 2NV278, 2NS19, 2NS2, 2NV988, 2NI169, 2NI151, 2NI119, 2NI110 - to vent valves 2NB500, 2NB499, 2NB498, 2NB504, 2NB497, 2NB496, 2NB495, 2NB494, 2NB501 and 2NB502 and to drain valve 2NB503 - against intake side of valves 2NB378 and 2NB395 which according to note #1 on Flow Diagram CN-1556-1.1 should be locked open when Unit #2 is brought into operation.

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BY Billy Greene DATE 4/23/85 | QA APPROVAL DATE 4/23/84

MDS-JR-51
Attachment No. 1
Page 1 of 1

NCI
REQUEST FOR REVIEW

MATERIALS GROUP

The attached NCI is being sent to you for your review and comments. Please respond by completing this form and returning it to the Materials Group.

NCI Number: 19632

Materials Group Responsible Engineer SS Lefler Jr.

Materials Group Need Date 5-22-85

150 lb. flanges for relief valves 2NV 273, 2NS 19, 2NS 2, 2NV 989, 2ND 35, 2NI 161, 2NI 151, 2NI 119, 2NI 102, 2ND 31, 2ND 64 (CN 1556-1.1) and relief valve 2NM 296 (CN 2572-1.5) were subjected to 2000 psi pressure as described by NCIR 19,632. Please advise as to acceptability of 150 lb. flanges and bolting materials following overpressurization.

Date sent: 5-8-85

CATAWBA STRESS ANALYSIS

Comments:

- ☐ NCI is acceptable
- ☑ NCI is not acceptable
- ☐ No Comments

Reason: Flange stresses exceeded yield and flanges should be replaced.

Bolt material did not exceed yield stress, therefore, bolts are still acceptable.

These comments address only valves 2ND31 & 64. The other valves are alternate analysis scope.

Specification/Calculation/Drawing Revised by Catawba Stress Analysis: N/A

Specification/Calculation/Drawing to be revised by other groups: N/A

By: D. R. Hyde

Technical Approval: R Wales

NCI
REQUEST FOR REVIEW

MATERIALS GROUP

The attached NCI is being sent to you for your review and comments. Please respond by completing this form and returning it to the Materials Group.

NCI Number: 19632

Materials Group Responsible Engineer SS Lefler Jr.

Materials Group Need Date 5-22-85

150 lb. flanges for relief valves 2NV 273, 2NS 19, 2NS 2, 2NV 989, 2ND 35, 2NI 161, 2NI 151, 2NI 119, 2NI 102, 2ND 31, 2ND 64 (CN 1556-1.1) and relief valve 2NM 296 (CN 2572-1.5) were subjected to 2000 psi pressure as described by NCIR 19,632. Please advise as to acceptability of 150 lb. flanges and bolting materials following overpressurization.

Date Sent: 5-8-85

CATAWBA STRESS ANALYSIS

Comments:

☐ NCI is acceptable

☒ NCI is not acceptable, Except as noted below.

☐ No Comments

Reason: The 1" & 2" - 150 lb Flanges have been permanently deformed from the 2000 PSIG pressure. These flanges need to be replaced. The bolt material can be reused since the pressure did not permanently deform the bolts. (See attached calculations). The 2½" - 300 lb flanges are still acceptable and can remain. (See attached Calculations)

Specification/Calculation/Drawing Revised by Catawba Stress Analysis: _____

Specification/Calculation/Drawing to be revised by other groups: _____

By: T. H. Crum

Technical Approval: ~~ft SR~~ 5/15/85

Dev./Station Catawba Unit 2 File No.

Subject NCI 19632 - Over Pressurization of Flanges

By TPC Date 5-10-85

Sheet No. 1 of 7 Problem No. Checked By [illegible] Date 5-15-85

Problem: NCI 19632 states that the NB relief valve discharge line was overpressurized to 2000 PSIG. Check if 2½"-300 lb flanges need to be be replaced. Calculations show that the flange material for 1" and 2" -150 lb flanges were overstressed into deformation Check if bolts are still acceptable.

References:

1) Catawba Piping Analysis Handbook -CNSA-DOC80-002. Section 10.12

2) ASME Boiler + Pressure Vessel Code Section III, 1977 Edition, Appendices

3) ITT Grinnel Welding Fittings + Flanges Catalog WFF-79

Body:

2½" Raised Face 300# Flange, Method 2A of ref. 1, SA182 F304

Gasket Code G-5, Bolt Code B-5

Gravity will be considered Negligable

$$N = \frac{3\frac{7}{8} - 3\frac{1}{4}}{2} = 0.3125"$$ Gasket Dimensions Control

$$b = b_o = \frac{0.3125}{2} = 0.1563"$$

$$G = \frac{3\frac{7}{8} + 3\frac{1}{4}}{2} = 3.563"$$

$m = 3.0$

$W_{m_1} = 0.785(3.563)^2 2000 + 6.28(0.1562)(3.563)(3.0\sqrt{2000}) = 40915$ lb

Dev./Station Catawba Unit 2 File No.

Subject NCI 19632 - Over Pressurization of Flanges

By TDC Date 5-10-85

Sheet No. 2 of 7 Problem No. Checked By [signature] Date 5-15-85

$S_y = 105,000$ PSI Yield Stress will be used to ensure that there is no permanent deformation or damage.

Required Bolt Area $= \frac{40915}{105000} = 0.3897$ IN^2

Actual Bolt Area $= 8(0.302) = 2.420$ IN^2

Bolts are OK Since they were NOT taken beyond yield stress.

$W_{m1} = 40915$ lb

$C = 5\frac{7}{8}$", 5.875"

$G = 3.563$"

$B = 2.47$"

$g_1 = 0.734$"

$g_0 = 0.205$"

$R = \frac{5.875 - 2.47}{2} - 0.734 = 0.9685$"

$h = 2$" "

$H = 0.785(3.563)^2 2000 = 19931$ lb

$H_G = 40915 - 19931 = 20984$ lb

$h_G = \frac{5.875 - 3.563}{2} = 1.156$"

$M_G = 20984(1.156) = 24250$ in-lb

Dev./Station Catawba Unit 2 File No.

Subject NCI 19632 -Over Pressurization of Flanges

By TDC Date 5-10-85

Sheet No. 3 of 7 Problem No. Checked By DP Dailey Date 5-15-85

$H_D = 0.785(2.47)^2 2000 = 9578$ lb

$h_D = 0.9685 + 0.5(.734) = 1.336$"

$M_D = 9578(1.336) = 12796$ IN-LB

$H_T = 19931 - 9578 = 10353$ lb

$h_T = \frac{0.9685 + .734 + 1.136}{2} = 1.429$"

$M_T = 10353(1.429) = 14794$ IN-LB

$h = 2$"

$h_o = \sqrt{2.47(.205)} = 0.712$"

$h/h_o = 2.8$ $g_1/g_o = 3.6$

$f = 1.0$ Conservative

$A = 7\ 1/2$"

$B = 2.47$"

$V = 0.0216$

$K = 3.036$

$$U = \frac{(3.036)^2(1 + 8.55246 \log_{10} 3.036) - 1}{1.36136\,(3.036^2 - 1)(3.036 - 1)} = 2.03$$

Dev./Station Catawba Unit 2 File No.
Subject NCI 19633 - Over Pressurization of Flanges
By TPC Date 5-10-85
Sheet No. 4 of 7 Problem No. Checked By [illegible] Date 5.15.85

$$d = \frac{2.03}{0.0216}(.712)(.205)^2 = 2.812$$

$$F = 0.4934$$

$$e = \frac{0.4934}{0.712} = 0.6930$$

$$T = \frac{(3.036)^2(1 + 8.55246 \log_{10} 3.036) - 1}{(1.04720 + 1.9448(3.036)^2)(3.036 - 1)} = 1.197$$

$$t = 1 - 1/16 = 15/16''$$

$$L = \frac{15/16\,(.6930) + 1}{1.197} + \frac{(15/16)^3}{2.812} = 1.671$$

$$Y = \frac{1}{3.036 - 1}\left[0.66945 + 5.71690 \frac{(3.036)^2 \log_{10} 3.036}{3.036^2 - 1}\right] = 1.847$$

$$Z = \frac{3.036^2 + 1}{3.036^2 - 1} = 1.24$$

$$M_o = 14794 + 12796 + 24258 = 51848 \text{ IN-LB}$$

Dev./Station Catawba Unit 2 File No.

Subject NCI 19632 over Pressurization of Flanges

By TDC Date 5-10-85

Sheet No. 5 of 7 Problem No. Checked By O'Reilly Date 5-15-85

$$S_H = \frac{1.0(51843)}{(1.671)(.734)^2(2.47)} + \frac{2000(2.47)}{4(.205)} = 29341 \text{ PSI}$$

$$S_R = \frac{\left(1.33\left(\frac{15}{16}\right)(.2930)+1\right)51848}{(1.671)\left(\frac{15}{16}\right)^2(2.47)} = 26643 \text{ PSI}$$

$$S_T = \frac{1.847(51849)}{\left(\frac{15}{16}\right)^2(2.47)} - 1.24(26643) = 11075 \text{ PSI}$$

Failure will be taken at the point the material yields and takes permenant deformation

$S_y = 30000$ PSI

Using the distortion energy theory for ductile failure

$\sigma_1 = 29341$ PSI, $\sigma_2 = 26643$ PSI, $\sigma_3 = 11075$ PSI

$$\frac{1}{2}\left[(29341-26643)^2 + (26643-11075)^2 + (11075-29341)^2\right] \leq 30000^2$$

$$291.644292 \leq 9 \times 10^8$$

Flange material was not permenantly deformed.

Dev./Station Catawba Unit 2 File No.

Subject NCI 19632 -Over Pressurization of Flanges

By TDC Date 5-10-85

Sheet No. 6 of 7 Problem No. Checked By [illegible] Date 5-15-85

1" Raised Face 150# Flange, Method 2A, SA 182 F304

Gasket Code G-5, Bolt Code B-5

Gravity will be considered negligable.

$N = \frac{1\ 7/8 - 1.25}{2} = 0.31$" Gasket dimensions control

$b = b_o = \frac{0.31}{2} = 0.155$"

$G = \frac{1\ 7/8 + 1.25}{2} = 1.56$"

$m = 3.0$

$W_{m_1} = .785(1.56)^2\ 2000 + 6.28(0.155)(1.56)(3.0)\ 2000 = 12932$ lb

$S_y = 105{,}000$ PSI

Required Bolt Area $= \frac{12932}{105000} = 0.123\ IN^2$

Actual Bolt Area $= 4(.1257) = 0.502\ IN^2$

Bolts Are OK since They Were not Taken Beyond Yield Stress.

Form 00184 (6-81) DUKE POWER COMPANY

Dev./Station Catawba Unit 2 File No.

Subject NCI 19632 Over Pressurization of Flanges

By TDC Date 5-10-85

Sheet No. 7 of 7 Problem No. Checked By [illegible] Date 5.15.85

2" Raised Face 150# Flange, Method 2A, SA182 F304

Gasket Code G-5, Bolt Code B-5

Gravity will be considered negligable.

$N = \frac{3\frac{3}{8} - 2\frac{3}{4}}{2} = 0.3125"$ Gasket dimensions Control

$b = b_0 = \frac{0.3125}{2} = 0.156"$

$G = \frac{3\frac{3}{8} + 2\frac{3}{4}}{2} = 3.06"$

$m = 3.0$

$W_{M1} = .785(3.06)^2(2000) + 6.28(.156)(3.06)(3.0)2000 = 32685\ lb$

$S_y = 105000\ PSI$

Required Bolt Area $= \frac{32685}{105000} = 0.3113\ IN^2$

Actual Area $= 4(.202) = 0.808\ IN^2$

Bolts are OK since they were not taken beyond yield stress

Conclusion: The 2½" 300 lb flanges + bolts were not permenantly deformed or damaged. Therefore they do not need to be replaced. Previous calculations show that the 1" + 2" 150 lb flanges were deformed and shall be replaced. Bolt material can be reused since no permanant deformation occured.

Form 0184 (6-81) DUKE POWER COMPANY

Dev./Station Catawba Unit 2 File No.

Subject NCI 19631

By TDC Date 6-3-85

Sheet No. 27 of 27 Problem No. Checked By EKR Date 6-5-85

Conclusion

Since the flanges listed in the problem were not permanantly yielded, deformed, or damaged, they will still have their same pressure and load carrying capability even though they were pressurized beyond their rated pressure. The original flanges and bolts can remain.