Public Service
Electric and Gas
Company

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April 27, 1988
NLR-N88061

Mr. W. T. Russell, Administrator
United States Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406

Gentlemen:

SUPPLEMENTAL RESPONSE TO NRC COMPLIANCE BULLETIN 87-02
SALEM GENERATING STATION
UNIT NOS. 1 AND 2
HOPE CREEK GENERATING STATION
DOCKET NOS. 50-272/50-311/50-354

In our initial response to the subject NRC Compliance Bulletin dated January 22, 1988, Public Service Electric and Gas Company (PSE&G) reported the discovery of six noncompliances from the sample of forty (40) fasteners subjected to chemical, mechanical and hardness testing. PSE&G subsequently requested additional time for response so that the initial test results could be verified by an independent testing laboratory before performing an engineering evaluation relating to the safety significance of the fasteners in question.

A second sample from the initial test lot, which included those items found to be in noncompliance, was sent to the PSE&G Research and Test Laboratory (R&TL) for verification of the test results provided by Lehigh Testing Laboratories, Inc. (LTL). The PSE&G R&TL verification testing confirmed the initial LTL test results.

The test results for those fasteners found out of specification and the related safety significance are presented in the enclosure to this letter. Based on our evaluations, PSE&G feels that those safety-related fasteners that slightly exceed the HRB material hardness specification requirements may be used without compromising safety. While a high hardness test result may

IE57
1/1

indicate that a fastener could be brittle, the fact that the Reduction in Area and Elongation test results exceeded the ASME/ASTM requirements demonstrates that the material is ductile. Also, the measurement of the greater tensile and yield strengths than the ASME/ASTM minimum requirements further substantiate the use of these fasteners.

Should you have any questions with regard to this transmittal, please do not hesitate to contact us.

Sincerely,

Enclosure

C Mr. G. W. Rivenbark
USNRC Licensing Project Manager - Hope Creek

Mr. G. W. Meyer
USNRC Senior Resident Inspector - Hope Creek

Mr. D. C. Fischer
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ENCLOSURE
PUBLIC SERVICE ELECTRIC AND GAS COMPANY
NRC COMPLIANCE BULLETIN 87-02 TEST RESULTS
FOR FASTENERS FOUND OUT OF SPECIFICATION

Safety-Related Studs and Nuts Evaluated

- 7/8" X 4" Stud, ASTM A193 Gr. B8 (Mark: AB-8)
- 7/8" Nut, ASTM A194 Gr. 8 (Mark: T8 Dul)

- 1 1/4" X 6 1/2" Stud, ASTM A193 Gr. B8 (Mark: B8R NL)
- 1/14" Nut, ASTM A194 Gr. 8 (Mark: 8B CFC H4)

Non-Safety-Related Studs/Bolts and Nuts Evaluated

- 3/8" X 3/4" Bolt, ASTM A193 Gr. B8 (Mark: JB8)
- 3/8" Nut, ASTM A194 Gr. 2H (Mark: 2H-M)

- 7/8" X 5 1/2" Stud, ASTM A193 Gr. B7 (Mark: S B7)
- 7/8" Nut, ASTM A194 Gr. 2H (Mark: N/A)

- 1" X 2 1/2" Bolt, ASTM A193 Gr. B8 (Mark: JB8)
- 1" Nut, ASTM A194 Gr. 2H (Mark: N/A)

- 1" X 6" Stud, ASTM A193 Gr. B7 (Mark: DE B7)
- 1" Nut, ASTM A194 Gr. 2H (Mark: N/A)

Evaluation Results

A. Safety-Related Fasteners

1. 7/8" X 4" Stud (Mark: AB-8), ASTM A193 Gr. B8

° Chemical Analysis

	C	Mn	P	S	Si	Ni	Cr
Mat'l. Spec.	.08x	2.00x	0.045x	0.030x	1.00x	8-10.5	18-20
Test Report	0.06	0.85	0.028	0.030	0.73	8.28	18.24

x - Maximum

° Mechanical Requirements

	Tensile Strength psi	Yield Strength psi	Elongation %	Reduction of Area %
Mat'l. Spec.	75,000 min	30,000 min.	30 min.	50 min.
Test Report	104,000	75,400	40	68.6

° Hardness Requirements

	Rockwell Hardness HRB
Mat'l. Spec.	96 max.
Test Report	98

° Meets chemical and mechanical requirements.

° The test result for hardness marginally exceeds the ASTM material requirement. This is not considered as a detriment to safety as all remaining mechanical and chemical requirements are satisfied.

2. 7/8" Nut (Mark: T8 Dul), ASTM A194 Gr. 8

	C	Mn	P	S	Si	Ni	Cr
Mat'l. Spec.	0.08x	2.00x	0.045x	0.030x	1.00x	8-10.5	18-20
Test Report	0.07	0.99	0.023	0.007	0.56	8.15	18.37

x - Maximum

° Hardness Requirements

	Rockwell Hardness HRB
Mat'l. Spec.	60-105
Test Report	96.7

° No safety concern.

° Meets chemical and mechanical requirements.

3. 1 1/4" x 6 1/2" Stud (Mark: B8R NL), ASTM A193 Gr. B8

° Chemical Analysis

	C	Mn	P	S	Si	Ni	Cr
Mat'l. Spec.	0.08x	2.00x	0.045x	0.030x	1.00x	8-10.5	18-20
Test Report	0.06	0.91	0.025	0.021	0.65	8.56	18.27

x - Maximum

° Mechanical Requirements

	Tensile Strength psi	Yield Strength psi	Elongation %	Reduction of Area %
Mat'l. Spec.	75,000 min	30,000 min.	30 min.	50 min.
Test Report	107,500	74,600	38	69

° Hardness Requirements

	Rockwell Hardness HRB
Mat'l. Spec.	96 max.
Test Report	99.1

° Meets chemical and mechanical requirements.

° The test result for hardness marginally exceeds the ASTM material requirement. This is not considered as a detriment to safety as all the remaining mechanical and chemical requirements are satisfied.

4. 1 1/4" Nut (Mark: 8B CFC H4), ASTM A194 Gr. 8

° Chemical Analysis

	C	Mn	P	S	Si	Ni	Cr
Mat'l. Spec.	0.08x	2.00x	0.045x	0.030x	1.00x	8-10.5	18-20
Test Report	0.06	1.69	0.030	0.019	0.26	8.14	18.40

x - Maximum

° Hardness Requirements

	Rockwell Hardness HRB
Mat'l. Spec.	60-105
Test Report	99

° No safety concern.

° Meets chemical and mechanical requirements.

B. Non-Safety-Related Fasteners

1. 3/8" x 3/4" Bolt (Mark JB8), ASTM A193 Gr. B8

Chemical Analysis

	C	Mn	P	S	Si	Ni	Cr
Mat'l. Spec.	0.08x	2.00x	0.045x	0.030x	1.00x	8-10.5	18-20
Test Report	0.04	1.25	0.042	0.005	0.34	8.15	18.31

x - Maximum

° Hardness Requirements

	Rockwell Hardness HRB
Mat'l Spec.	96 max.
Test Report	31 HRC*

° Does not meet hardness requirements.

° 100 pieces were purchased under P.O. #P2-179396 but none have been issued to the stations.

* The hardness was reported by HRC number because the material is harder than the upper scale of HRB which ends at approximately 104. Extrapolation of the HRB scale would equate 31 HRC to about 108 HRB.

2. 3/8" Nut (Mark: 2H-M), ASTM A194 Gr. 2H

° Chemical Analysis

	C	P	S
Mat'l. Spec.	0.040 min.	0.040 max.	0.050 max.
Test Report	0.44	0.014	0.009

° Hardness Requirements

	Rockwell Hardness HRC
Mat'l. Spec.	24-38
Test Report	31

° Meets chemical and hardness requirements.

3. 7/8" x 5 1/2" Stud (Mark: S B7), ASTM A193 Gr. B7

° Chemical Analysis

	C	Mn	P	S	Si	Cr	Mo
Mat'l. Spec.	.37-.49	.65-1.1	0.035x	0.040x	.15-.35	.75-1.2	.15-.25
Test Report	.42	.90	0.016	0.012	0.23	1.02	0.16

x - Maximum

- No hardness requirements.
- Meet chemical requirements.

4. 7/8" Nut (Mark: N/A), ASTM A194 Gr. 2H

- Chemical Analysis

	C	Mn	P	S
Mat'l. Spec.	0.40 min.		0.040 max.	0.050 max.
Test Report	0.10*	0.36	0.016	0.014

- Hardness Requirements

	Rockwell Hardness HRC
Mat'l Spec.	24-38
Test Report	94.5 HRB*

- Does not meet chemical and hardness requirements.

*Carbon content and Hardness numbers are relative indicators of material strength. Although the carbon content is below the ASTM minimum requirement, the Hardness number exceeds the ASTM Hardness requirement. Generally, the Hardness number, as a result of a physical test, is a more reliable indicator of material strength than the carbon content. As such, all 7/8" nuts in Item 4 are deemed acceptable.

5. 1" x 2 1/2" Bolt (Mark: JB8), ASTM A193 Gr. B8 Gr. B7

- Chemical Analysis

	C	Mn	P	S	Si	Ni	Cr
Mat'l. Spec.	0.08x	2.00x	0.045x	0.030x	1.00x	8-10.5	18-20
Test Report	0.04	1.24	0.026	0.019	0.40	8.9	18.28

x - Maximum

° Hardness Requirements

	Rockwell Hardness HRB
Mat'l. Spec.	96 max.
Test Report	94.3

° Meets chemical and hardness requirements.

6. 1" Nut (Mark: N/A), ASTM A194 Gr. 2H

° Chemical Analysis

	C	P	S
Mat'l. Spec.	0.40 min.	0.040 max.	0.050 max.
Test	0.15*	0.013	0.019

° Hardness Requirements

	Rockwell Hardness HRC
Mat'l. Spec.	24-38
Test Report	75 HRB* (65 ksi tensile strength)

° Does not meet chemical hardness requirements.

* The nuts in question are utilized on non-safety related components in the plant. PSE&G performs generic calculations to qualify fasteners utilized for pipe supports and other relevant applications for tensile and shear stresses based on code allowables. The selection of nuts is not as critical as the selection of bolts. Frequently, a lower-grade material is suitable for the nuts than is required for the bolts.

Although the nuts are below the ASTM minimum hardness, this is not necessarily considered to be a detriment. Selection of a soft nut ensures plastic yielding of the nut threads which will enable the nut threads to divide the load more evenly. The intent is to ensure failure, if any, of the bolt in tension and to preclude nut stripping failure.

Bolted connections are torqued during installation to a specified value which is higher than the proof strength of the bolt. Because of this fastner pre-loading, it can be safely assumed that nuts with a lower proof strength than the bolt would fail during this fastener pre-loading procedure. Survivors of the installation torque will therefore develop at least the proof strength of the bolt.

Therefore, there is no safety significance involved in the use of these nuts. However, as a conservative approach, all remaining nuts of this type (of those discussed in Items 6. and 8.) shall be returned to the vendor or scrapped.

7. 1" x 6" Stud (Mark: DE B7), ASTM A193 Gr. B7

° Chemical Analysis

	C	Mn	P	S	Si	Cr	Mo
Mat'l. spec.	.37-.49	.65-1.1	0.035x	0.040x	.15-.35	.75-1.2	.15-.25
Test Report	0.40	0.85	0.011	0.018	0.27	0.94	0.16

x - Maximum

° No hardness requirements.

° Meets chemical requirements.

8. 1" Nut (Mark: N/A), ASTM A194 Gr. 2H

° Chemical Analysis

	C	Mn	P	S
Mat'l. Spec.	0.40 min.		0.040 max.	0.050 max.
Test Report	0.14*	0.45	0.018	0.024

° Hardness Requirements

	Rockwell Hardness HRC
Mat'l. Spec.	24-38
Test Report	77.8 HRB* (69 ksi tensile strength)

- Does not meet chemical and hardness requirements.

* See explanation delineated in Item 6 above.

C. Recommendations for Future Use of Evaluated Fasteners

1. Use AS-IS

Safety Related Studs and Nuts

- 7/8" x 4" Stud, A193 Gr. B8 (Mark: AB-8)
- 7/8" Nut, ASTM A194 Gr. 8 (Mark: T8 Dul)
- 1 1/4" x 6 1/2" Stud, ASTM A193 Gr. B8
- 1 1/4" Nut, ASTM A194 Gr. 8 (Mark: 8B CFC H4)

Non-Safety Related Studs and Nuts

- 3/8" Nut, ASTM A194 Gr. 2H (Mark: 2H-M)
- 7/8" x 5 1/2" Stud, ASTM A193 Gr. B7 (Mark: S B7)
- 1" x 2 1/2" Bolt, ASTM A193 Gr. B8 (Mark: JB8)
- 1" x 6" Stud, ASTM A193 Gr. B7 (Mark: DE B7)

2. SCRAPPED or Return to Vendor

Non-Safety Related Stud/Bolt and Nuts

- 3/8" x 3/4" Bolt, ASTM A193 Gr. B8 (Mark: JB8)
- 7/8" Nut, ASTM A194 Gr. 2H (Mark: N/A)
- 1" Nut, ASTM A194 Gr. 2H (Mark: N/A)