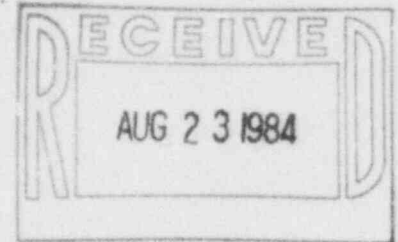


The Light company

Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

August 20, 1984
ST-HL-AE-1122
File Number: G12.206

Mr. John T. Collins
Regional Administrator, Region IV
Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, Texas 76012



Dear Mr. Collins:

South Texas Project
Units 1 & 2
Docket Nos. STN 50-498, STN 50-499
Final Report Concerning
ASTM A194 Grade 2H and ASTM A563 Grade A Nuts

On July 13, 1984, pursuant to 10CFR50.55(e), Houston Lighting & Power Company (HL&P) notified your office of an item concerning ASTM A194 grade 2H nuts. This item was expanded on July 26, 1984 to include ASTM A563 grade A nuts. Attached is the final report concerning this item.

If you should have any questions concerning this matter, please contact Mr. Michael E. Powell at (713) 993-1328.

Very truly yours,

G. W. Oprea, Jr.
G. W. Oprea, Jr.
Executive Vice President

MEP/mg

Attachment: Final Report Concerning ASTM A194 Grade 2H and ASTM A563
Grade A Nuts

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Revised 07/31/84

South Texas Project
Units 1 and 2
Final Report Concerning
ASTM A-194 Grade 2H and ASTM A563 Grade A Nuts

DER 84-016

I. Summary

Safety-related nuts 1½", 1 3/8" and 2½" in diameter procured as conforming to ASTM A194 grade 2H and some 1½" diameter nuts procured as conforming to ASTM A563 grade A, failed to meet the specified ASTM requirements when user tested by Southwestern Laboratories.

Retests and additional microstructural examinations of the A 194-2H nuts indicate that the suspect nuts contain an unusually thick decarburized layer that has affected the initial hardness test results. Based on tested proof loads the material lots in question have been determined to be acceptable for use.

1½" diameter standard hex nuts conforming to ASTM A563 grade A are being purged from the site without any additional investigation since their use is not required for any permanent plant construction work.

II. Description of the Deficiency

User testing of safety-related fasteners revealed the following non-conforming conditions.

1. Fourteen 1 3/8" diameter, heavy hex nuts purchased as conforming to ASTM A194 grade 2H failed to meet the specified hardness criteria.
2. One 1½" diameter heavy hex nut purchased as conforming to ASTM A194 grade 2H failed to meet the specified chemical requirements.
3. One 2½" diameter heavy hex nut purchased as conforming to ASTM A194 grade 2H failed to meet the specified hardness criteria.
4. Eight 1½" diameter standard hex nuts purchased as conforming to A563 grade A failed to meet the specified hardness and proof load requirements.

Following is a technical evaluation of these non-conforming conditions. The item numbers correspond to the non-conforming conditions described above.

1. Project specifications require that nuts for safety-related applications be qualified for installation through a user testing program. This

program requires verification of the mechanical properties and chemical composition in accordance with the requirements of the governing ASTM standard. Southwestern Laboratories test reports (#38597-1 thru 8, 38669-1 thru 5 and 38704) on these fourteen 1 3/8" diameter nuts revealed that in all cases the chemical composition was in accordance with the requirements of ASTM A194 grade 2H, but the hardness was significantly below the specified requirements and varied greatly over the sample population. To further investigate the problem, 16 additional sample nuts (1 3/8" diameter) from the same lot and representing two heat codes, were sent to the Bechtel Material Quality Services (M&QS) lab in San Francisco for retesting. In addition to the normal testing for hardness and chemistry, as required by ASTM A194, proof load testing and microstructural examination of the nuts was requested.

Initial Rockwell C hardness (HRC) retests were performed with minimal surface removal. All except one nut showed hardness below specification requirements. Two nuts with hardness between HRC 18 and 23 representing each heat code were selected for microstructural examinations. The remainder were subjected to full size proof load tests. All except one nut (which had the lowest hardness) passed the proof load test. After proof loading, nuts representative of low, medium and high initial HRC tests were selected for chemical analyses. All nuts tested met specified chemical requirements. During the microscopic examination of nuts selected on the basis of the initial hardness tests a significant amount of decarburization was noted. Although the surface hardness tests were performed in accordance with ASTM specifications, it was determined that the unusually thick decarburized layer could have affected the hardness test results. Therefore, retests for hardness were performed on surfaces with the decarburized layer removed by milling and grinding to depths not exceeding 1/16 inch. In the retests only three nuts failed to meet ASTM A194 grade 2H hardness requirements. The nut that failed the proof load test was again the sample with the lowest hardness. Five additional nuts that were proof tested earlier were further examined for microstructure in the threaded area. The examination revealed that the threads showed very little decarburization. Table 1 provides a summary of the testing program undertaken by the Bechtel M&QS lab.

Based on additional testing & examination it is concluded that the lot of 1 3/8" diameter, ASTM A194-2H nuts that was being qualified for use contains a somewhat higher than usual decarburized layer which results in lower hardness values when tested in accordance with the normal laboratory practice. In all but one case the proof load tests have met the specified ASTM A194-2H criteria. The failing nut narrowly missed the ASTM acceptance criteria, but it did exhibit strength in excess (factor of safety greater than 2) of the design requirements. The material lot represented by the 1 3/8" diameter sample nuts has been determined to be acceptable for use.

2. Southwestern Laboratories report #38615 indicates that while this sample nut met the proof load and hardness criteria of ASTM A194 grade 2H it failed the minimum carbon content requirement by 0.04%. The discrepancy in the carbon content is reduced to only .01% if the 0.03% tolerance prescribed in ASTM A29 is considered. It is concluded that since the test results show the sample nut meeting the proof load and hardness requirements, a discrepancy in carbon content of .04% is not meaningful. The material lot represented by this test sample has been determined to be acceptable for use.
3. Southwestern Laboratories report #36603 indicates that a 2½" diameter heavy hex nut, when user tested for conformance to ASTM A194 grade 2H, satisfied the chemical composition requirements but failed the hardness acceptance criteria. A further investigation was initiated by sending three additional samples from the same lot of nuts to Bechtel M&QS lab in San Francisco for retests. In addition to the normal testing for chemistry and hardness, microstructural examination and subsize tensile (full size tensile tests not practical for 2½" diameter nut) tests were performed for engineering evaluation.

Retest results (See Table 2) indicate that just as in the case of 1 3/8" diameter nuts discussed under item 1, the material lot represented by these 2½" diameter nuts also contains a decarburized layer which has obviously affected the initial hardness tests performed by Southwestern Laboratories. Retests after the removal of the decarburized surface provide hardness numbers that meet the requirements of ASTM A194-grade 2H nuts. Subsize tensile test results indicate values that are typical (See Table 3) for quenched and tempered AISI/SAE 1050 carbon steel. Microstructure examination revealed a heavy decarburized layer on the outside surface but very insignificant decarburization around the threads. The evidence collected provides positive assurance that the nuts in question would meet the proof load criteria of ASTM A194 grade 2H nuts. It is, therefore, concluded that the material lot represented by the sample nuts is acceptable for use.

4. Southwestern Laboratories report numbers 38601-1 thru 38601-8 indicate that eight 1½" diameter ASTM A563 grade A standard hex nuts with 8 threads per inch failed to meet the specified requirements for proof load and hardness.

Investigations have revealed that the lab has erroneously reported that the sample nuts contain 8 threads per inch. The correct number of threads per inch for these sample nuts is 6. Revised reports are being provided by the lab.

1½" diameter standard hex nuts conforming to ASTM A563 grade A have not been released to the Constructor since Bechtel assumed the construction management responsibility for the project. A review of the project drawings, indicate that the use of 1½" diameter ASTM A563 grade A standard hex nuts is not required for any permanent plant application. Inadvertent use of these 1½" ASTM A563 nuts in any safety-related

application is prevented since these applications are required by design to contain eight threads per inch whereas the nuts in question contain only six threads per inch.

Since this material will not be used on the project, no further investigation to determine the suitability of the material will be performed and the suspect material will be purged from the jobsite in accordance with approved procedures.

III. Corrective Action

The 1½" diameter ASTM A563 grade A, standard hex nuts will be purged from the site.

IV. Recurrence Control

No recurrence control is required since the material properties of the nuts used in permanent safety-related structures have been verified to meet design requirements. Since the size of the samples of A194 nuts subject to testing significantly exceeds the ASTM criteria and only one nut exhibited a tested proof load marginally below (approximately 5%) the ASTM specified minimum, we have not identified any systematic problem with the manufacture of these nuts. We believe that the demonstrated factor of safety in excess of two with respect to loadings per the design criteria is sufficient to justify their continued use.

Notwithstanding the above determination, the lots of material from which the subject nuts were drawn are not being used for further construction.

The conditions described in this report were identified as a result of user testing implemented May 21, 1984 as part of an enhanced materials control program. All further shipments of such material will be subjected to the same user testing before issuance for construction.

V. Safety Analysis

No safety hazard has been identified, therefore the item is not considered reportable pursuant to 10CFR50.55(e).

TABLE I
SUMMARY OF TEST RESULTS

Heat Code/ Sample No.	Hardness (Rockwell C)		Proof Load Test (Note 3)	Chemical Analyses	Micro-structural Examination
	First Test (Note 1)	Second Test (Note 2)			
F6-1	23*	31	Passed	Meets Spec	(Note 4)
2	6*	15* (97 HRB)	Passed	(NT)	(Note 5)
3	22*	29	(NT)	(NT)	(Note 4)
4	19*	27	Passed	Meets Spec	(NE)
5	20*	28	Passed	(NT)	(NE)
6	18*	28	(NT)	(NT)	(Note 4)
7	22*	30	Passed	(NT)	(NE)
8	1*	10* (90 HRB)	Failed**	Meets Spec	(Note 5)
J3-1	5*	15* (96 HRB)	Passed	Meets Spec	(Note 5)
2	23*	28	Passed	Meets Spec	(NE)
3	14*	31	Passed	(NT)	(Note 4)
4	23*	30	(NT)	(NT)	(Note 4)
5	23*	30	Passed	(NT)	(NE)
6	21*	29	Passed	(NT)	(NE)
7	26	31	Passed	Meets Spec	(NE)
8	19*	30	(NT)	(NT)	(Note 4)

*Failed to meet ASTM A194, Grade 2H requirements (24 to 38 HRC).
**Failed at 205,000 lbf.

- NOTES:
- 1) Tested after normal grinding and surface preparation in accordance with ASTM A370 and E-18 (normal laboratory practice).
 - 2) Tested same as in Note 1; however, 1/16 inch more material removed in order to insure decarburized layer completely removed.
 - 3) Per ASTM A370 and A194, Grade 2H at 215,000 lbf.
 - 4) Microstructural examination indicates heat treatment per ASTM A194, Grade 2H.
 - 5) Microstructural examination indicated that the material is in the annealed condition.

LEGEND: lbf = pounds force
HRC = Rockwell C
HRB = Rockwell B
NT = Not Tested
NE = Not Examined

TABLE II
SUMMARY OF TEST RESULTS

Heat Code/ Sample Number	Hardness Tests*			Chemical Analyses	Micro- structural Examination
	First Test Rockwell B HRB (Note 1)	Second Test Rockwell C HRC (Note 2)	Brinell BHN (Note 2)		
N3-1	100 (22.8 HRC)	27	260	Meets Spec	(Note 3)
N3-2	93 (12.8 HRC)	25	256	Meets Spec	(Note 3)
N3-3	97 (18.3 HRC)	25	264	Meets Spec	(Note 3)

* ASTM A194, Grade 2H requirements are 24 to 38 HRC or 248 to 352 BHN.

- NOTES:
- 1) Tested after normal grinding and surface preparation in accordance with ASTM A370 and E-18 (normal laboratory procedure).
 - 2) Tested the same as in Note 1; however, 1/16-inch material removed to insure decarburized layer completely removed.
 - 3) Microstructural examination indicates heat treatment per ASTM A194, Grade 2H.

LEGEND: HRC = Rockwell C 150 kg
HRB = Rockwell B 100 kg
BHN = Brinell hardness number

TABLE III

TENSILE TEST RESULTS
(Note 1)

Description	Heat Code/Sample Number			ASTM A194, Grade 2H (Note 2)
	N3-1	N3-2	N3-3	
Tensile Strength (ksi)	131.0	127.0	133.0	Information
Yield Strength (ksi)	85.4	78.9	87.1	Information
Elongation (percent)	20	19	19	Information
Reduction of Area (percent)	53.1	52.6	51.5	Information

NOTES: 1) From a 0.252-inch diameter tensile specimen from nut,
taken parallel to nut axis.

2) No requirements by ASTM A194, Grade 2H.