

# Commonwealth Edison Company

QUAD-CITIES NUCLEAR POWER STATION

Address Reply to:

POST OFFICE BOX 216 ★ CORDOVA, ILLINOIS 61242

50-265

FAP-72-107

June 7, 1972

Mr. E. J. Bloch  
Acting Director, Directorate of Licensing  
U. S. Atomic Energy Commission  
Washington, D. C. 20545



Dear Mr. Bloch:

Ref: Quad-Cities Nuclear Power Station - Unit 2, DPR-30  
Appendix A - Section 1.A.4, Section 6.6.B.2 and  
Section 6.6.B.3

The purpose of this letter is to inform you of the details regarding the failure of four hanger bolts for the torus suction header at Quad-Cities Unit 2. This incident occurred on May 29, 1972 at 1:30 a.m.

## Description of Failure

During Phase IV startup testing on Unit 2 at Quad-Cities Nuclear Power Station with the reactor operating at 28 per cent thermal power, four torus suction header hanger bolts were found to have failed. The failure was discovered at 1:30 a.m. on May 29, 1972. The four respective hangers supported approximately a 90° segment of the suction header. The maximum downward displacement of the suction header was approximately 6 inches. Shutdown of the reactor was started immediately; all rods were inserted by 4:00 a.m. on the 29th.

## Immediate Actions

Station Maintenance personnel were called in immediately. A temporary rigging was constructed to support the ring headers at its displaced position. This rigging prevented any further displacement and prevented further stresses on the structural members. Visual inspection of the suppression chamber and suction header was completed indicating no deformation.

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Initial Investigation

Initial investigation of the four failed hanger bolts revealed that the bolt guide holes on the torus and header brackets had been torch cut to arbitrary sizes to allow the bolts to pass through, rather than cleanly drilled to the size specified on the construction drawing. Also, it was found that the respective bolt holes in the hanger strap pieces appeared to have been punched instead of drilled. The punching left a sharp edge and some holes were enlarged with a torch to achieve fit up. The torch cut hangers caused stress risers to develop in the support bolts. In addition, it was found that fully threaded bolts had been used, whereas partially threaded bolts should have been used.

The failed specimens, and the areas subjected to maximum stresses were visually inspected by; an Edison metallurgist, representatives of Chicago Bridge & Iron Company, and Sargent & Lundy Engineers. All inspections found no apparent yielding of the suppression chamber shell or of the suction header and its nozzles. Chicago Bridge & Iron also conducted an analytical stress analysis on the suction header. Approximate maximum stresses were calculated for the header, nozzles, and torus shell to nozzle insert plate junction. Chicago Bridge & Iron's conclusion based on the analytical calculations, visual examinations and the assumed satisfactory results of proposed non-destructive testing of the welds receiving maximum stress, was that the integrity of the vessel had not been jeopardized. The proposed non-destructive testing performed was liquid penetrant examination of the welds joining the neck to insert and insert to torus shell for suppression chamber penetrations X-204A and B. The results of these examinations were satisfactory.

Additionally, pieces forming one complete bolt were analyzed by the Charles C. Kavin Company for Sargent & Lundy. The bolts were within specified chemical and hardness limits. The failure mode for the bolts was confirmed to be shearing. There was no evidence of fatigue in the samples examined.

Reports of the above mentioned analyses are attached hereto.

Interim Fix

As an interim fix for the failed hangers, the corrective action was to replace all of the original 2-1/2 inch wide by 1/2 inch thick hanger straps with a 3 inch wide by 1/2 inch thick strap, and replace all original 3/4 inch cap screws for the hangers with bolts 1 inch diameter machine bolts. The original cap screws were ASTM-A-307 specification and the new bolts are A-325. The 1 inch diameter threaded

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bolts now installed are to be replaced with a 1-inch diameter bolt that has a non-threaded bearing surface. The new bolt hanger holes were in-line drilled. This fix was approved as adequate by Chicago Bridge & Iron. This work was completed and reviewed by the Quad-Cities Station Review Board and the Edison Nuclear Review Board and approval was authorized to return the unit to service. The results of the investigation and repairs were discussed with AEC Region III Compliance representative, Mr. E. Jordan prior to plant startup. The Unit was returned to service at 4:21 a.m. on June 4, 1972.

#### Continued Investigations

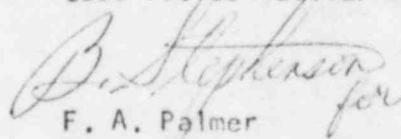
Continued investigations and tests are planned for the torus and suction header. General Electric is planning to install approximately 20 vibration detecting sensors at various locations on the suppression chamber and suction header. They propose a series of tests to monitor containment system vibration and torus movement. The tests will include simultaneous operation of all electromatic relief valves, and operation of the various ECCS pumps using the suppression chamber. During the tests vibration specialists will observe the performance and interpret the results. The results of the analysis performed from the data obtained on this test will be forwarded to you on a timely basis. These tests are tentatively scheduled for the last week of June, 1972, and the test results should be available by July 21, 1972.

Based on the results of these investigations, any proposed modifications of the existing suppression chamber design will be reviewed and installed as required.

The changes made on Unit 2 are also being done on Unit 1.

Very truly yours,

COMMONWEALTH EDISON COMPANY  
Quad-Cities Nuclear Power Station

  
F. A. Palmer  
Superintendent

FAP: REQ/zm

attachments: 1. Letter - S & L to General Electric - June 2, 1972

**SARGENT & LUNDY**

INCORPORATED

ENGINEERS

180 NORTH CLARK STREET

CHICAGO, ILLINOIS 60601

TELEPHONE (312) 467-7000

CABLE: SARGENT & LUNDY-CHICAGO

June 2, 1972

**Subject:**

Quad-Cities Station - Units 1 and 2  
General Electric Company for  
Commonwealth Edison Company

**Test Results**

Ring Header Support Bolts

Mr. R. Leesburg, Project Manager  
General Electric Company  
Quad-Cities Nuclear Power Station  
P. O. Box 291  
Cordova, Illinois 61242

Dear Mr. Leesburg:

We sent the pieces forming one complete bolt from the hangers on the Unit #2 torus ring header to Charles C. Kavin Company for analysis. We requested that they provide us with the following:

- a) Photograph the specimens
- b) Check hardness
- c) Determine chemistry
- d) Show cold work or shearing on one sample by obtaining a photomicrograph perpendicular to the fracture surface.

I am enclosing three (3) copies of the report received from Charles C. Kavin Company. This report contains all of the information which we requested.

The bolts were determined to be supplied to ASTM-A-307 Specification titled "Low Carbon Steel Externally and Internally Threaded Standard Fasteners".

Mr. R. Leeburg  
General Electric Company

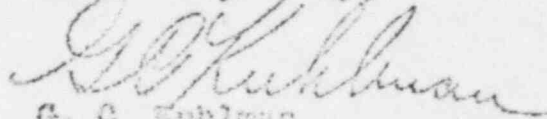
June 2, 1972  
Page Two

ASTM-A-307 hardness requirements for Grade B bolts are 121 to 207 Brinell or 69 to 93 Rockwell B. All segments of the bolts tested fall within these ranges. The higher hardness of the head section is believed to result from the method of manufacture, namely, cold heading. (ASTM-A-307 also has a Grade A bolt which has no maximum hardness limit specified and the same minimum limits.)

Chemistry required for Grade B bolts to ASTM-A-307 is phosphorous 0.04 and sulfur 0.05 maximum per cent. The check analysis indicated all three segments tested are within the allowable limits.

The photomicrographs taken perpendicular to the fracture surface illustrate cold work and metal flow in the shear area. There is no evidence of fatigue in the samples examined.

Yours very truly,



G. C. Kuhlman  
Mechanical Project Engineer

GCK/rsg

In Triplicate

Enclosures

CC: M. R. Potter (1w/O enc.)  
E. R. Weaver (1w/O enc.)  
S. A. Zych (1w/O enc.)

# CHARLES C. KAWTH COMPANY

## METALLURGICAL LABORATORIES

CHEMISTRY • METALLURGICAL TESTING • METALLOGRAPHY • CONSULTANTS

MAILING ADDRESS: P.O. BOX 3101 WAINWOOD, ILLINOIS 60153

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DATE: 5-31-72

Sargent & Lundy Engineers

DESCRIPTION:

L

J

Sheared Bolts

Lab. 885 to 67

✓ ✓ ASTM A 307

SAMPLE IDENT.	C	Mn	Si	P	S	Ni	Cr	Mo	Cu	Mg	Al	V
Head Section	.04	.44	.01	.002	.012	.01	.03	.01				
Long Threaded Section	.04	.45	.02	.024	.013	.01	.03	.01				
Short Threaded Section	.04	.41	.01	.021	.013	.01	.03	.01				
ASTM A 307 Range				0.014	0.05	max	for grade B					

CHARLES C. KAWTH COMPANY

*John P. H. [Signature]*



MAILING ADDRESS: P.O. BOX 210, HAYWOOD, KENTONS 60152

DATE: 5-31-72

DESCRIPTION:

### Sheared Bolts

## Head Section

95.0  
95.5  
95.5

207 Rhen. ang.

### Long Throated Section

78.5  
76.0  
75.0

137 *Aden. arg.*

Short Throated  
Section

84.0  
83.0  
83.0

156 *Alnus* - arg.

ASTM A307 — 121-207 Blm.

CHARLES C. KAWIN COMPANY

CHARLES C. KAWIN COMPANY  
*John P. McArthur*

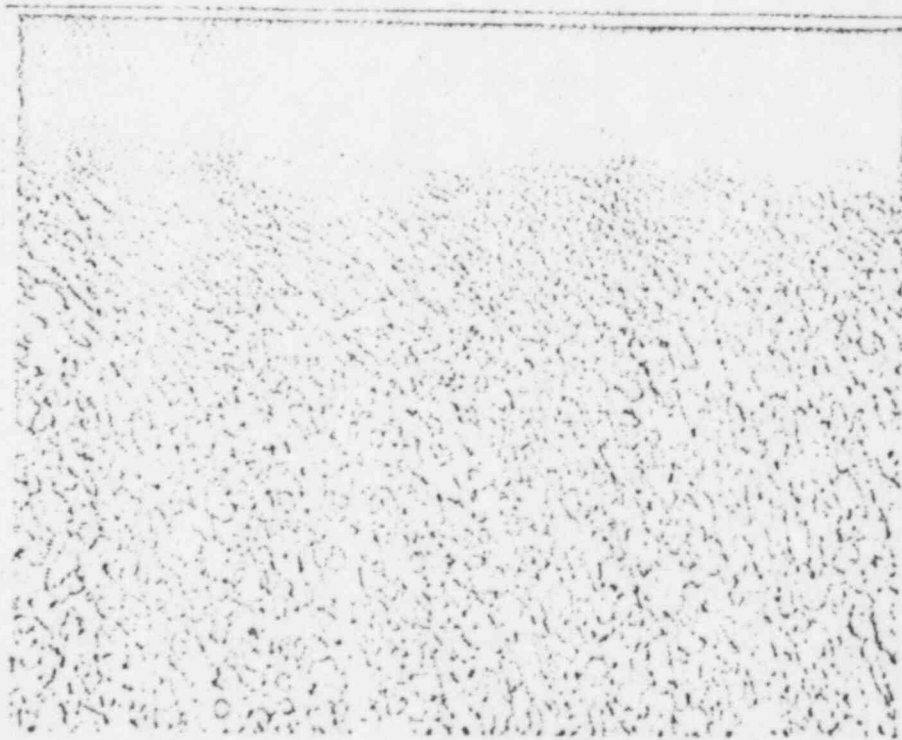
CLIENT: Sergeant Murphy

SUBJECT:

Sheared Bolt  
Short Threaded  
Section



Macro-photograph of what appears to be a shear fracture above and cross-section at the fracture surface illustrating cold work and metal flow below.



50X 2% Nital etch