Georgia Power Company
Route 2, Box 299A
Waynesboro, Georgia 30830
Telephone 404 554-9961, Ext. 3360
404 724-8114, Ext. 3360

CORRECTED COPY: **FILE AND LOG NUMBERS WERE ACCIDENTALLY LEFT OFF OF THE ORIGINAL.**

PRP
OFFICIAL COPY

Georgia Power
the southern electric system

D. O. Foster
Vice President and Project
General Manager
Vogtle Project

84 JUL 30 A10: 02

July 20, 1984

United States Nuclear Regulatory Commission
Office of Inspection and Enforcement
Region II - Suite 3100
101 Marietta Street
Atlanta, Georgia 30303

File: X7BG03-M50
Log: GN-393

Reference: Vogtle Electric Generating Plant-Units 1 and 2, 50-424, 50-425; Strut Channel Installation Discrepancies, letter GN-361, dated May 14, 1984

Attention: Mr. James P. O'Reilly

Gentlemen:

In previous correspondence transmitted to the NRC, Georgia Power Company indicated that the NRC could expect a final report concerning the reportability of this subject by July 20, 1984. In previous correspondence Georgia Power Company stated that to evaluate the strut nut installation discrepancies in existing installations, random samples from the total population of installed cable tray supports with eight bolt connections were selected on a statistical basis. Specially trained Quality Control inspectors using a fiber optic scope then examined each selected installation to determine the angle of skew of the spring-loaded nut to the in-turned edge of the channel.

To correlate the inspection results with the load carrying capacity of the installations, test data was obtained from the manufacturers of the strut channel on load capacity of connections in which only partial engagement between the nut grooves and the edge of the strut channel is provided. The vendor test data was utilized to perform design calculations to determine if the strut nut installations would perform their intended safety function of supporting the cable trays. Based upon the results of the test data and engineering calculations, it has been concluded that the existing strut nut installations will perform their intended safety function. Therefore Georgia Power Company has concluded that a reportable event does not exist.

IE22

This response contains no proprietary information and may be placed in the NRC Public Document Room.

Yours truly,

D. O. Foster

CWH/DOF/tdm

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

R. J. Kelly
R. E. Conway
G. F. Head
W. T. Nickerson
D. N. MacLemore
D. E. Dutton
W. F. Sanders
R. H. Pinson
P. D. Rice
R. A. Thomas
J. A. Bailey
O. Batum
G. Bockhold
B. M. Guthrie
E. D.Groover
L. T. Gucwa
M. Malcom
H. H. Gregory
J. T. Beckham
J. L. Vota
C. S. McCall

EVALUATION FOR A SUBSTANTIAL SAFETY HAZARD
EVALUATION FOR A SIGNIFICANT DEFICIENCY

Strut Channel Installation Discrepancies

Initial Report:

On October 17, 1984, Mr. C. W. Hayes, Vogtle Quality Assurance Manager, reported a potential deficiency to Mr. John Rogge of the USNRC, Region II.

Strut channels and their connection assemblies are used as part of the load carrying system in the raceway supports. The installation requirements of the strut channel connection assemblies, of which the strut nut is a part, call for proper engagement between the strut nut grooves and the in-turned edges of the strut channel. During a GPC Quality Assurance audit, it was noted that, in some installations, the strut nut grooves were not properly engaged with the in-turned edges of the strut channel. Georgia Power Company believed that this situation represented a potentially significant deficiency and so notified the NRC.

Background Information:

Strut channels and their connection assemblies are used in safety-related and nonsafety-related cable tray raceway supports. Strut channel nuts are designed such that when inserted into the slot of the channel and turned 90°, the serrated grooves will line up and engage with the in-turned edges of the channel. When the bolt is tightened, the nut teeth will be forced into the in-turned edges of the channel. The design load data for the strut channels and their connections, of which the strut nuts are part, are provided by the manufacturer of the strut nuts. The recommended design load values are typically based on data from tests in which proper engagement between the nut grooves and the in-turned edges of the strut channel has been provided. In some installations, the strut nut grooves were not properly engaged with the in-turned edges of the strut channel.

In order to determine the extent of the strut nut installation discrepancies in the existing installations, GPC construction performed inspections of randomly selected strut nut installations. Bechtel Power Corporation correlated the results of the field inspection program with the load carrying capacity of the installations to determine the adequacy of the existing installations. For making this correlation, Bechtel utilized test data from the manufacturers of the strut nuts on the load capacity of connection assemblies in which only partial engagement between the nut grooves and the edge of the strut channel was provided. The manufacturers were:

- Power-Strut Division
  Van Huffel Tube Corporation
  Warren, Ohio 44481
- Unistrut Division
  GTE Products Corporation
  Wayne, Michigan 48184
- Mid-Land-Ross Corporation
  Superstrut Division
  Goshen, Indiana 46526
- Metal Products Division
  United States Gypsum Co.
  Chicago, Illinois 60606

Field Inspection -

To evaluate the strut nut installation discrepancies in the existing installations, a statistical approach was undertaken. The eight strut connection is the most widely used connection requiring strut nut installation, and it is also susceptible to improper installation due to the reduced visibility of the inner rows of strut nuts. Therefore the conclusions derived from the statistical evaluation of the existing eight strut connections can be conservatively extended to all the connections using strut nut installations.

GPC Construction (Electrical Section) identified the installed cable tray support arms with eight strut nut connections. From the total population of support arms, random samples were selected on a statistical basis and were identified to GPC Construction. From these samples, GPC Construction was asked to establish the angle of skew for each strut nut installation. The inspection of skew angle was accomplished by using a fiber optics scope. The inspection was carried out by QC personnel specifically trained for this inspection program. The field inspection results were transmitted to Bechtel.

Test Program -

To correlate the field inspection results with the load carrying capacity of the installations, Bechtel obtained test data from the manufacturers of the strut nuts on load capacity of connection assemblies in which only partial engagement between the nut grooves and the edge of the strut channel was provided.

The test program was designed to be used in conjunction with the statistical evaluation in order to establish safety factors for the tray support installations. The four manufacturers previously identified conducted independent tests of their products using consistent testing methods. The primary objective of the tests was to determine the load capacity in pullout and slip of the strut nut bolted to the strut channel, incorporating a top plate to simulate the Vogtle tray support arm attachment plate. The effects of improper installations, such as strut nuts installed at a skew or offset from proper alignment, were included in the test program. Samples were tested to determine the maximum pullout and slip resistance achievable without experiencing yielding of any of the components. The maximum pullout load establishes the tensile capacity of the strut nut connection and the maximum slip resistance establishes the shear capacity of the strut nut connection.

Test reports were received from each manufacturer and evaluated by Bechtel engineering. The following conclusions were made from the test results, which are summarized in Figure 1.

(1) The pullout and slip values obtained by all manufacturers were higher than those published by each manufacturer and used in the design. This is attributed to the additional clamping and

reinforcing provided by the attachment plate used to simulate the Vogtle tray support arm connection.

(2) Even though a general trend of degradation of pullout and shear value with increasing angle of skew was observed, strut nuts that were installed on a skew still exhibited substantial capacities.

(3) The data obtained for installations with only one of the two grooves of the strut nut engaged with the strut channel edges indicated that their load capacity for this case was assumed to be the same as that corresponding to a skew angle of forty-five degrees.

(4) Since the failure mechanism in slip and pull-out are different with one not having any adverse effect on the other, there is no reduction in the test shear load or tension load due to simultaneous application of these loads. It should be noted that this testing was completed without experiencing yielding of any of the components.

Load Capacity of Strut Nut Installations -

To evaluate the significance of the strut nut installation discrepancies, the safety factors for the samples inspected were calculated based on the as-installed conditions. The inspection data provided by GPC Construction consisted of identification of the improper installations in the samples inspected together with the range of skew angle for each of the eight strut nuts in a sample tray support arm connection. Strut nut connections, where only one side was properly engaged, were also identified. From this inspection data on samples, the pull-out and shear capacity for each strut nut installation was obtained from Figure 1. For this purpose, the lower bound curve shown in Figure 1 was conservatively used and, for each strut nut installation, the as-installed skew angle was taken as the highest of the range identified in the inspection. Because test data was not obtained for skew angles greater than forty-five degrees, the load capacity was conservatively assumed to be zero for such installations.

Safety Factors of Tray Support Arms -

In the design of cable tray support arm connections, the allowable design values for the strut nut installations under Safety Shutdown Earthquake (SSE) conditions are obtained by multiplying the allowable design values under Operating Basis Earthquake (OBE) conditions by 1.6. Since the loads on the support arms under SSE conditions are less than 1.25 times the loads under OBE conditions, the latter governed the design. Therefore, in this evaluation only OBE conditions were investigated.

In order to investigate the safety margins associated with the strength of the existing support arm connections, safety factors in four measures of connection strength, namely, strength in pure tension (T), shear (V), moment about the major axis (M_x) and moment about the minor axis (M_y) were evaluated. The tension strength requirement of the support arm connection is computed based on the allowable design tension of 2.0 kips for each of the eight strut nuts in the support arm connection. The use of an allowable value of 2.0 kips in tension for strut nut installation in the design of the support arm connection limits the maximum shear applied to each strut nut installation to less than 0.5 kip. If a load applied to the tray support arm were to cause a shear in excess of 0.5 kips in the strut nut installation, it would cause a tension in the strut nut installation that exceeds 2.0 kip allowable design tension, due to the resulting moment. Therefore the shear strength requirement of the support arm connection was computed using a shear value of 0.5 kips for the strut nut installation. The moment strength requirements of the support arm connection were computed based on the 2.0 kips allowable design tension for the strut nut installation.

Using the actual as-installed pull-out and shear capacities of each strut nut installation, the four as-installed measures of strength (T, V, M_x and M_y) of the tray support arm connection were calculated for each of the support arms sampled. The ratio of the as-installed capacity to the design strength requirement provides the safety factor. These ratios for T, V, M_x and M_y were calculated for each of the tray support arms sampled. These safety factors, calculated under pure tension, pure shear and pure moment conditions, bracket the safety factor for any combined load condition.

Statistical Evaluation -

The statistical analysis of support arm installations was performed by Dr. Carl W. Hamilton. Out of a total population of about 14,000 tray support arms, 301 tray support arms were inspected. Specifically, considering the entire population, the following safety factors provide a 95% confidence level in at least 95% of the total population of the existing installations (i.e. "95-95" confidence limits).

Shear Force	3.01
Tension Force	2.79
Moment about major axis	2.29
Moment about minor axis	2.26

It is to be noted again that these safety factors represent a lower bound since the lowest capacity applicable to the range of the skew angle identified for the as-installed condition is used in combination with the lower bound test load capacity curve. These safety factors provide adequate (more than 100%) safety margins for the installed tray support arm connections and demonstrate that the strut nut installations perform their intended safety function of supporting the cable trays. Therefore it can be concluded that had the deficiency relating to the strut nut installation discrepancies gone undetected, it would not have impacted the safety related functions of the plant. Therefore the deficiency is not considered reportable under 10 CFR 50.55 (e) or Part 10 CFR 21.

Evaluation of Breakdown of Quality Program:

A review of the quality assurance program at Bechtel Power did not indicate a program breakdown. Also, it was concluded that there was not a significant program breakdown at the site.

Conclusion:

Based upon the results of the engineering evaluation provided to Georgia Power Company, it has been concluded that a reportable condition does not exist.

Corrective Action:

To prevent the recurrence of subject installation discrepancies in future installations, the construction specification and the field procedure addressing the installation requirements of raceway systems were revised to specifically address the requirement for proper engagement of the strut nut grooves with the in-turned edges of the strut channel.

Recommendation:

Future GPC site quality assurance audits should verify that installation and inspection is being properly implemented.

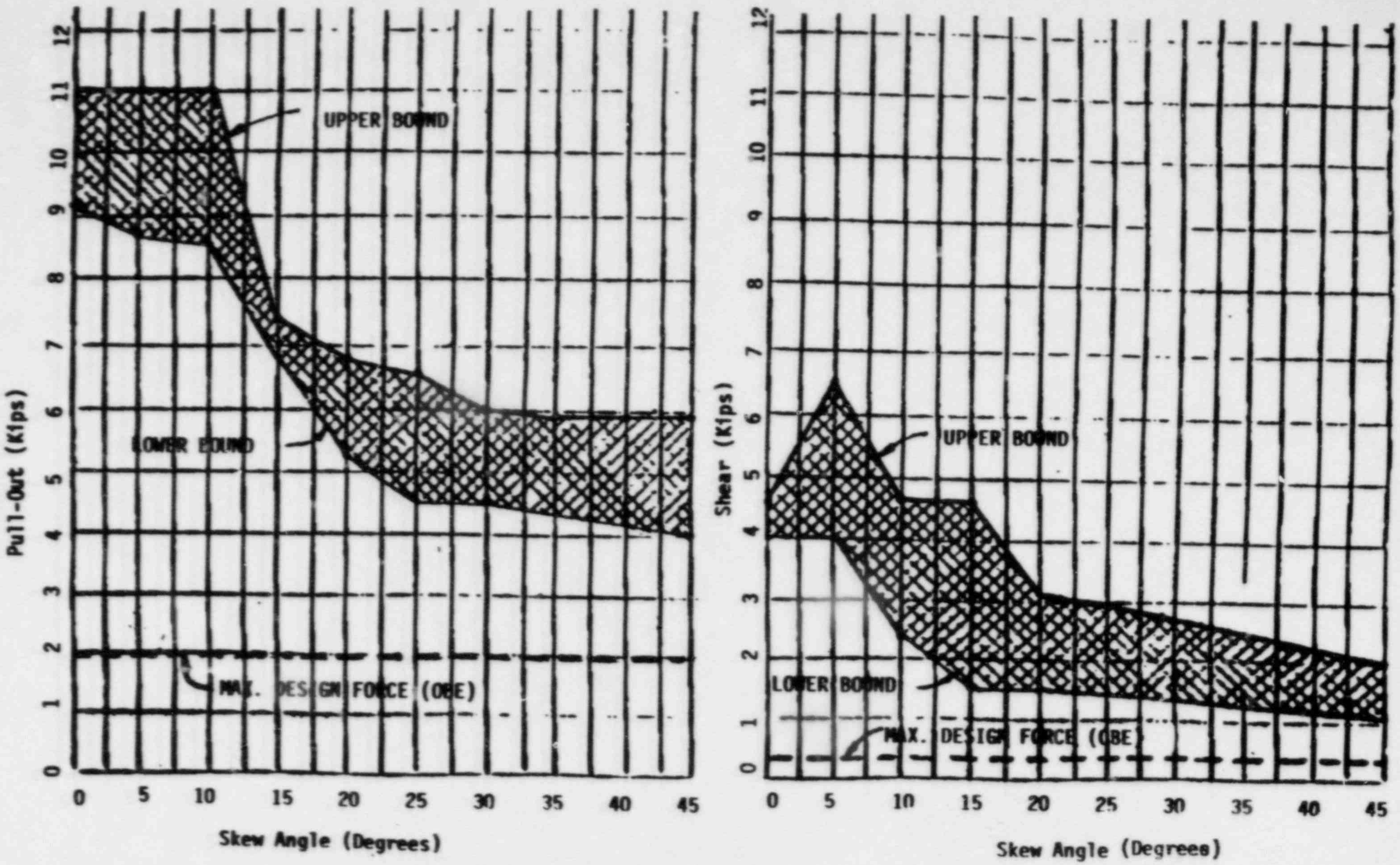

FIGURE 1

TEST LOAD CAPACITY VS. ANGLE OF SKEW