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Georgia Power
the southern electric system

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July 3, 1984

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

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Reference: Vogtle Electric Generating Plant-Units 1 and 2, 50-424, 50-425;
Pacific-Scientific Shock Arrestors; also GN-354, dated 5/1/84.

Attention: Mr. James P. O'Reilly

In previous correspondence on this subject, Georgia Power Company stated that the NRC would be informed of the results of Georgia Power Company's evaluation by July 20, 1984. Georgia Power Company has been able to complete its evaluation earlier than previously forecast. Our evaluation has concluded that the metallurgical condition that caused the spring cracking in the Pacific Scientific snubbers could have adversely affected the Vogtle Electric Generating Plant and is therefore reportable to the NRC under the reporting criteria of Part 10 CFR 50.55(e) and Part 10 CFR 21. Since Pacific-Scientific has met with and informed the NRC concerning this subject, Georgia Power Company is reporting this condition under the reporting requirements of Part 10 CFR 50.55(e). A summary of our evaluation is attached for your information.

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

Yours truly,

D. O. Foster

D. O. Foster

REF/DOF/tdm

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EVALUATION FOR A SUBSTANTIAL SAFETY HAZARD
EVALUATION FOR A SIGNIFICANT DEFICIENCY

Pacific-Scientific Shock Arrestors

Initial and Subsequent Report:

On January 19, 1984, Mr. C. W. Hayes, Vogtle Quality Assurance Manager, reported a potential significant deficiency to Mr. John Rogge of the USNRC. In our letter GN-354 dated May 1, 1984, Georgia Power Company forecast the completion of this evaluation for July 20, 1984.

Background Information:

During testing of Pacific-Scientific (P-S) Company's PSA-1 shock arrestors at Union Electric's Callaway Station by Daniel International personnel, 4 of 7 snubbers tested revealed a broken capstan spring tang. Pacific-Scientific Company requested the return of the failed springs for an independent metallurgical examination. Failed components were returned and were furnished to Mettek, 1805 E. Carnegie, Santa Anna, CA 92105 for metallurgical and fracture analysis. Additionally, springs from the identical lot as those that failed were traced to snubbers located at Kansas Gas and Electric Company, Wolf Creek Station. These were also returned to Pacific-Scientific for testing and evaluation.

As a result of these tests, some of the spring tangs exhibited micro-crack indications. A metallurgical report by Mettek Material Engineering Technology Laboratories indicated that the spring cracking occurred because of stresses induced during spring forming which caused hydrogen cracking during subsequent silver plating. The metallurgical report also explained that although the spring fracture face exhibited brittleness at the crack onset, the core of the spring was ductile and spring fracture was simple ductile rupture. This accounted for the ability of the springs to withstand the full load functional and dynamic load testing conducted and also suggested that the useful life of the springs containing cracks were substantial.

It has been determined that the capstan springs used in the suspect PSA-1 and PSA-3 shock arrestors were manufactured by the backup supplier using a fabrication sequence which did not completely remove the stresses introduced into the material during cold forming of the tang bends. During subsequent silver plating of the springs, the combination of residual stress in the cold formed material and exposure to liberated hydrogen in the plating bath resulted in hydrogen embrittlement and material cracks. The fabrication sequence included surface nondestructive examination (NDE) after forming of the tangs but not after silver plating. Thus, the hydrogen embrittlement surface cracks were undetected and the capstan springs were installed in the shock arrestors. The part numbers for the capstan springs are:

PSA-1 (1801613)
PSA-3 (1801614)

One hundred fifty-one (151) shock arrestors of models PSA-1 and PSA-3 had been received at the Vogtle site. As a result of the failures at the other plants, the units were returned to Pacific-Scientific (P-S) in January 1984. All units were disassembled, the capstan springs were inspected, defective springs were replaced, and all units were reassembled. Those shock arrestors with new capstan springs were functionally tested and all units were returned to the site. Tables 1 and 2 identify the shock arrestors which were found to contain defective springs. These units were included in the final engineering evaluation.

Engineering Evaluation:

The design of the Pacific-Scientific shock arrestors is based on converting the linear motion imparted to the pipe by a seismic load to rotational motion within the shock arrestor mechanism. A key component of the design is a capstan spring. This spring transmits a seismic load to the shock arrestor mechanism by being compressed over a shaft. Spring compression occurs by application of a load to two tangs, one at each end of the spring. Should one tang break, the capstan spring becomes inoperable and the shock arrestor mechanism no longer functions. At two nuclear power generating plants other than Vogtle, some mechanical shock arrestors experienced broken/ cracked tangs on the capstan springs.

Each shock arrestor is designed, fabricated, and shipped to the site in accordance with the requirements of the Code applicable to the pipe it supports, the project specification and the purchase order. During fabrication the individual shock arrestor components are inspected and after assembly each unit is functionally tested. Inspection and testing is performed to ensure conformance to the documents mentioned above.

Shock arrestors that contained defective capstan springs which had to be replaced (tables 1 and 2) were conservatively evaluated on the basis that the deficiency would result in a pipe failure at the pipe support location should a seismic event occur. The following analysis was performed to determine the impact on plant safety:

A. A facility response analysis was conducted to determine if deficient shock arrestors in systems required to place the plant in a safe shutdown condition or mitigate the consequences of an event could result in unacceptable system functional performance and adversely affect plant safety. The analysis conservatively assumed the preexistence of a defective shock arrestor in one train, rendering the train inoperable (due to shock arrestor failure and subsequent failure of the pipe), concurrent with the most limiting single active failure following the onset of an event (transient or accident condition) which requires a response from that system.

   If it was determined that failure of the shock arrestor could result in unacceptable system functional performance, then the deficiency was determined to be reportable and no further analysis was performed. When failure of the shock arrestor did not result in unacceptable system performance, then further analyses were performed as indicated in items B, C and D below.

B. A review for potential flooding was performed to determine whether the existing plant analysis enveloped the effects of piping spool failure at the location of each of the potentially deficientt shock arrestors.

C. All lines were reviewed for radioactive content and the potential for exceeding offsite exposure guidelines stated in 10 CFR 100 and exposure limits for control room operators in 10 CFR 50, Appendix A, GDC 19.

D. The analysis included interaction of non-safety related piping with safety related equipment (seismic 2/1).

The results of the engineering evaluation indicated that the deficient shock arrestors noted in Table 3 could have unacceptably compromised system functional performance and adversely affected plant safety had the deficient capstan springs gone undetected.

Conclusion:

Since the defective Pacific-Scientific snubbers could have adversely affected the future safe operation of the unit had this defect not been discovered it has been concluded that a reportable condition does exist. The defect in the manufacturing of the spring tangs represents a significant deficiency and substantial safety hazard. However, since Pacific-Scientific has informed and met with the NRC concerning this subject, Georgia Power Company, based on regulatory guidance in NUREG-0302, Revision 1 and other letters, is reporting this event under the reporting requirements of Part 10 CFR 50.55(e).

Corrective Action:

All shock arrestors which were at the site when Pacific-Scientific notified Georgia Power Company of the potential capstan spring deficiency were returned to Pacific Scientific. Pacific-Scientific disassembled these units and inspected all capstan springs for deficiencies. Those capstan springs without NDE indications are acceptable for service for the design life of the component. Defective capstan springs were replaced and the units re-assembled. Shock arrestors with new capstan springs were functionally tested. All shock arrestors are presently in an acceptable condition.

Pacific-Scientific made revisions to the capstan spring fabrication sequence to ensure complete removal of all cold forming stresses in this material after the tangs are formed; and to confirm, by NDE, that hydrogen embrittlement did not occur in the silver plating operation. The former will be accomplished by first forming the tangs followed by age hardening this precipitation hardening material, 17-7 PH. The latter will be accomplished by performing surface NDE after precipitation hardening of the springs and, a second time, after silver plating.

Evaluation of Breakdown of Quality Program:

A review of the quality program at Pacific-Scientific was conducted and it was concluded that there was not a breakdown in their quality assurance program.

TABLE 2

PACIFIC-SCIENTIFIC (P-S)
PSA 3 SHOCK ARRESTORS

Capstan Springs Replaced

P-S Serial No.	Pipe Support No.
25370	V1-1202-072-H018
25375	V1-1202-181-H025
25376	V1-1202-004-H047
25381	V1-1407-004-H021
25382	V1-1204-042-H018
25501	V2-1206-006-H003
25502	V2-1202-006-H023
25503	V1-1202-004-H050
24693	V1-1202-088-H014
24696	V1-1202-104-H030
24698	V1-1205-010-H016
24700	V1-1205-010-H017
24701	V1-1202-006-H026
24704	V1-1203-063-H001
24705	V1-1202-088-H028
24706	V1-1202-151-H049
24708	V1-1202-134-H036
24709	V1-1203-021-H008
25051	V1-1205-027-H004
25366	V1-1407-002-H018
27246	V2-1206-055-H009
27250	V1-1201-064-H021
27252	V1-1305-110-H043
27262	V2-1206-007-H045

TABLE 1
PACIFIC-SCIENTIFIC (P-S)
PSA 1 SHOCK ARRESTORS

Capstan Springs Replaced

P-S Serial No.	Pipe Support No.
20172	V1-1206-006-H020
20173	V2-1205-009-H009
20355	V2-1205-003-H009
21662	V2-1305-081-H002
21663	V2-1305-081-H002
21664	V1-1202-002-H010
21665	V2-1204-007-H005
21668	V2-1204-038-H003
21670	V1-1202-072-H005
21672	V1-1407-004-H023
21673	V1-1407-001-H020
21674	V1-1202-184-H003
21677	V2-1205-010-H012
21678	V2-1301-010-H021
21680	V1-1205-008-H041
21682	V1-1208-003-H044
21683	V1-1205-007-H062
21684	V2-1205-007-H046
21900	V1-1217-025-H003
21901	V1-1204-057-H021
22316	V2-1204-192-H002

TABLE 3

Pacific-Scientific Reportable Defective PSA-1 & PSA-3 Shock Arrestors

Pipe Support No.	P-S Serial No.	P-S Model No.
System 1202 - Nuclear Service Cooling Water		
V1-1202-002-H010	21664	PSA-1
V1-1202-004-H047	25376	PSA-3
V1-1202-004-H050	25503	PSA-3
V1-1202-006-H026	24701	PSA-3
V1-1202-072-H005	21670	PSA-1
V1-1202-072-H018	25370	PSA-3
V1-1202-088-H014	24693	PSA-3
V1-1202-088-H028	24705	PSA-3
V1-1202-104-H030	24696	PSA-3
V1-1202-134-H036	24708	PSA-3
V1-1202-151-H049	24706	PSA-3
V1-1202-181-H025	25375	PSA-3
V1-1202-184-H003	21674	PSA-1
V2-1202-006-H023	25502	PSA-3
System 1203 - Component Cooling Water		
V1-1203-021-H008	24709	PSA-3
V1-1203-063-H001	24704	PSA-3
System 1204 - Safety Injection		
V1-1204-042-H018	25382	PSA-3
V1-1204-057-H021	21901	PSA-1
V2-1204-007-H005	21665	PSA-1
V2-1204-038-H003	21668	PSA-1
V2-1204-192-H002	22316	PSA-1
System 1205 - Residual Heat Removal		
V1-1205-007-H062	21683	PSA-1
V1-1205-008-H041	21680	PSA-1
V1-1250-010-H016	24698	PSA-3
V1-1250-010-H017	24700	PSA-3
V1-1205-027-H004	25051	PSA-3
V2-1205-003-H009	20355	PSA-1
V2-1205-007-H046	21684	PSA-1
V2-1205-009-H009	20173	PSA-1
V2-1205-010-H012	21677	PSA-1
System 1206 - Containment Spray		
V1-1206-006-H020	20172	PSA-1
V2-1206-005-H009	27246	PSA-3
V2-1206-006-H003	25501	PSA-3
V2-1206-007-H045	27262	PSA-3

Table 3
Pacific-Scientific Reportable Defective PSA-1 and PSA-3 Shock Arrestors (Continued)

Pipe Support No.	P-S Serial No.	P-S Model No.
System 1208 - Chemical and Volume Control		
V1-1208-003-H044	21682	PSA-1
System 1301 - Main Steam		
V2-1301-010-H021	21678	PSA-1