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IPN-94-142

U.S. Nuclear Regulatory Commission
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Subject: Indian Point 3 Nuclear Power Plant
Docket No. 50-286
License No. DPR-64
Supplement to a Report of a Defect Under 10 CFR 21
"Defect in a Valve Actuator for a Copes Vulcan Valve"

Reference: 1. NYPA Letter, W. A. Josiger to USNRC, dated June 22, 1994, regarding a Defect Under 10 CFR 21 in a Valve Actuator for a Copes Vulcan Valve.

Dear Sir:

The attached report on a Copes Vulcan valve actuator is being submitted to supplement Reference 1 which reported a defect as required by 10 CFR 21.21(c)(3)(i). During its continued investigation, the Authority determined that the valve actuator deficiency did not create a substantial hazard and, therefore, no report was required by 10 CFR 21.21(c)(3)(i).

The attached discusses the basis for the Authority's conclusion, makes editorial corrections and updates the commitments made in Reference 1. This letter makes no new commitments. If you have any questions, please contact Ms. C. Faison at (914) 681-6306.

Very truly yours,

William J. Cahill, Jr.
Executive Vice President and
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Nuclear Generation

att: as stated
cc: see next page

JE19

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ATTACHMENT I TO IPN-94-142

SUPPLEMENTAL 10 CFR 21 REPORT REGARDING A DEFECT IN A COPES VULCAN VALVE ACTUATOR

NEW YORK POWER AUTHORITY
INDIAN POINT 3 NUCLEAR POWER PLANT
DOCKET NO. 50-286
DPR-64

SUPPLEMENTAL 10 CFR 21 REPORT FOR COPES VULCAN VALVE

Summary of Changes - The changes made to the original report (sent by letter dated June 22, 1994) are indicated by a bar in the right hand margin. This supplemental report revises the original report to identify the results of additional evaluations without removing the results originally reported. The purpose of each change to the original report, by section and page number, is as follows:

- IV, page 2 - Descriptive material was removed from the nonconformance discussion and margins were changed.
- IV, page 2 - The first paragraph in the evaluation removes "recently" due to the passage of time. Two additional changes were made to the paragraph to clearly identify the date that the nonconformance was first identified as a defect and to clearly indicate the material discussing that conclusion.
- IV, page 3 - A sentence committing to this supplement was removed from the bullet starting "The loss of valve."
- IV, page 3 - In the bullet beginning "Copes Vulcan," the date was added to clarify the timing of the conclusions.
- IV, page 4 - The first and last sentences were revised in the paragraph beginning "Following the initial," to clarify the time during which information was identified.
- IV, pages 5 to 8 - Approximately 3 pages of information from the most recent evaluation was added to the end of the section to supplement the report.
- V, page 8 - The last two sentences of the section were added to complete the information on dates.
- VI, page 8 - The last sentence of the section was added to reflect the conclusions of the most recent evaluation.
- VII, pages 8 and 9 - The changes in this section identify the conclusions of the latest evaluation and update the status of the corrective actions.
- VIII, page 9 - The one sentence in the section was revised to reflect the conclusions of the latest evaluation.

I. Name and Address

W. J. Cahill, Jr.
New York Power Authority
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II. Basic Component

The defect was found in the Actuator Spring Adjusting Nut for the Pressurizer Power Operated Relief Valve (Copes Vulcan Part No. 137610, Drawing No. L-181214, Item 10). This defect was found while trying to install the actuator on a power operated relief valve (PORV) at the Indian Point 3 Nuclear Power Plant.

III. Supplier

The valve was originally supplied by Copes Vulcan, Inc. (Martin and Rice Avenues, Lake City, Pennsylvania 16423-0577) in 1986 to Consolidated Edison, who supplied it to the New York Power Authority (NYPA) in 1994.

IV. Defect and Safety Hazard

Nonconformance:

All spring adjusting nut threads were found stressed or loaded (damaged) to the point where the thread dimensions were either impossible to measure or were not within specified manufacturer drawing tolerances.

Evaluation:

The Authority discovered damaged threads in a spring adjusting nut that was supplied to the Authority as part of an assembled Copes Vulcan model D-100-160 diaphragm actuator. The discovery was made during an investigation which was conducted after an unsuccessful attempt to install the actuator on a power operated relief valve. An evaluation of this nonconformance was performed, and on May 25, 1994 the Authority determined that there could be a loss of valve function if the spring adjusting nut threads failed, and that the potential to create a substantial safety hazard therefore existed, as defined in 10 CFR 21.3 (m). The determination was based on the following:

- The PORVs are a basic component since they must operate to provide a Reactor Coolant System pressure boundary; mitigate a loss of all feedwater by allowing the use of safety injection pumps in the feed and bleed for recirculation mode; provide Reactor Coolant System overpressurization protection during transients; prevent undesirable opening of the pressurizer code safety valves; and provide low temperature overpressure protection of the reactor vessel.

- The nonconformance is classified as a deviation since the manufacturer's guidance for PORV actuator setup requires use of the spring adjusting nut to minimize the nitrogen volume used during each valve stroke. For the valve to perform the functional requirements, specified in the procurement document, there must be adequate nitrogen for operation. This is provided by minimizing the nitrogen required for each operation.

- There could be a loss of valve function if the spring adjusting nut threads failed. Spring adjusting nut failure was assumed because: Copes Vulcan could not calculate the strength of the damaged threads; Copes Vulcan confirmed the potential for undercut screw threads to cause nut thread damage; and, the defective assembly has not been tested (e.g., load tested) to evaluate whether there is a failure mechanism.

- The loss of valve function could create a substantial safety hazard because, considering an independent single failure, there could be a loss of Reactor Coolant pressure boundary isolation.

The spring adjusting nut nonconformance was recognized on February 4, 1994, following an unsuccessful NYPA attempt to install a new valve actuator assembly to valve RC-PCV-456 (Pressurizer PORV).

The new actuator was never installed on valve RC-PCV-456 because the new spare valve stem could not be screwed into the operator assembly during a trial installation performed in the NYPA maintenance shop. The spring hardware nonconformance was discovered at that time.

Three components were shipped to Copes Vulcan for evaluation. These were the spring adjusting nut (Copes Vulcan Part No. 137610, Drawing No. L-181214, Item 10), the spring adjusting screw (Copes Vulcan Part No. 137611, Drawing No. L-181214, Item 11), and the yoke (Copes Vulcan Part No. 137608, Drawing No. L-181214, Item 23). The following was determined:

- Copes Vulcan could not evaluate the spring adjusting nut since the threads appeared to have been stressed or loaded to the point that thread dimensions were not recoverable. As part of the May 25, 1994 evaluation, the Authority concluded that the high stresses could occur if the actuator was assembled and tested with the spring adjustment nut set at the lowest point on the screw threads (where, due to an undercut of the first three threads on the spring adjustment screw, incomplete thread engagement can occur).

- If the spring adjusting nut failed, the PORV actuator spring could lose approximately 2 1/8 inches of precompression and be unable to maintain the valve in the closed position under design or normal operating conditions.

At the time of the notification (May 25, 1994), the Authority believed that the hardware nonconformance had most probably existed when the valve was shipped from Copes Vulcan in 1986 because:

- The Authority did not perform any operational tests on this actuator prior to discovering the hardware nonconformance and the nonconformance was not consistent with cross-threading.

- Con Edison has confirmed that this actuator remained undisturbed in their warehouse from 1986 to 1994, when the Authority received the actuator from Con Edison.

- The nonconformance would not be detected by normal receipt inspection methods with the operator fully assembled.

Following the initial notification, the spring adjusting nut, the spring adjusting screw, and the yoke were returned to the Authority by Copes Vulcan on June 6, 1994. When received, the material condition of the components caused further evaluation of issues that had not been fully addressed when the deficiencies were first identified. The results were:

- The inside of the spring adjusting screw was observed to have scoring on one side. The maintenance engineer concluded that the scoring most probably resulted from screwing in the valve stem through the yoke when the trial installation was performed in the maintenance shop. The valve stem most probably entered the inside of the spring adjusting screw at an angle and off center due to a nonconformance in the valve yoke. The threaded hole for the stem in the actuator yoke (as originally shipped) did not meet manufacturer's drawing tolerances for concentricity and perpendicular alignment.

- The lower inside of the spring adjusting screw was observed to have relatively deep scoring on one side. Maintenance established that the yoke threads had been cleaned using a tap during the trial installation in the maintenance shop. The maintenance engineer has postulated that the observed spring adjusting screw thread damage could have been caused if the spring adjusting screw was turned while the actuator was loaded and the spring adjusting screw was off vertical. The maintenance engineer interviewed the work crew involved with this job to determine if the spring adjusting screw thread damage occurred during the tapping operation. The work crew can remember no movement of the spring adjusting screw or spring adjusting nut while the tapping was being performed. The spring exerts about 13,400 pounds on the top of the spring adjusting screw, which would limit movement of the spring adjusting screw or spring adjusting nut while tapping. Therefore, the maintenance engineer concluded that the spring adjusting screw thread damage was unlikely to have been caused by the tapping operation.

- The maintenance engineer identified damage to the threads of the spring adjusting screw which had not been previously identified by the Authority evaluators or discussed by Copes Vulcan in their communications. The damage was consistent with movement of the spring adjusting screw since the threads were rolled and not cross threaded.

The new information, summarized above, raised questions about the conclusions in the Part 21 notification. The Part 21 report submitted on June 22, 1994 committed to additional evaluations to address these questions. Lucius Pitkin, Inc. (LPI) was therefore contracted by the Authority to provide engineering services in the evaluation of the spring adjustment assembly. The purpose of this evaluation was to determine (1) the probable cause of the spring adjustment assembly damage, and (2) if the damaged assembly could adequately sustain the reported service load of 13,400 lb. The Authority accepted the LPI report on October 10, 1994 following a review by Copes Vulcan, disposition of their comments and internal review. The LPI report concludes that the spring adjusting screw/nut assembly would have performed its intended function. The nonconformance is, therefore, not reportable under 10 CFR 21. The LPI report presented the following information:

- Visual Examination Results

  1. Spring Adjustment Nut

     A visual examination of the spring adjustment nut revealed that the nut threads had sustained severe mechanical damage. Thread damage occurred primarily to the thread crowns and consisted of circumferentially oriented score or gouge marks. The most severely damaged threads were located near the bottom or yoke side of the nut. Several threads near the top of the nut were not damaged as evidenced by the presence of paint on the thread crowns. Further, examination of the threads revealed the top or trailing side flanks to exhibit a relatively uniform coating of green paint. In contrast, the bottom or pressure side flanks exhibited only small scattered patches of paint and circumferential score marks. The scattered patches of paint and score marks on the pressure side flanks of the nut indicate that the screw had been turned while the nut was under load, most probably from the spring.

     Measurements of the nut thread diameters indicated average major and minor diameters of 1.788 ($\pm$ 0.006) and 1.713 ($\pm$ 0.007) in., respectively. It is important to note that minor diameter measurements were unaffected by the damage, and the damaged and undamaged nut thread crowns were found to be similar.

     According to submitted drawing M-137610, the spring adjustment nut thread was specified as a 1-3/4-8N-2B thread. As such, the required minimum major diameter is 1.750 in. and the allowable variation in minor

diameter is 1.615 to 1.640 in. A comparison of the actual nut dimensions with the required dimensions clearly indicates that the actual minimum diameter is significantly greater than the required nut minor diameter.

2. Spring Adjustment Screw

Visual examination of the spring adjustment screw revealed that the bottom eight threads had sustained severe mechanical damage. Thread damage occurred primarily to the thread crowns and, similar to the adjustment nut thread damage, screw thread damage was circumferentially oriented. In contrast, the threads above the damaged eight threads were in good condition.

Measurements of the screw threads indicated major and minor diameters in the damaged thread region of 1.736 (± 0.020) and 1.586 (± 0.001) in., respectively. Similar measurements of the undamaged threads revealed major and minor diameters of 1.749 (± 0.001) and 1.586 (± 0.001) in., respectively. According to the submitted screw drawing, the spring adjustment screw thread was specified to be 1-3/4-8UN-2A. Consequently, the allowable variation in major diameter is 1.733 to 1.748 in., and the nominal minor diameter is 1.594 in. A comparison of the actual and specified screw thread dimensions indicates that the screw threads were within the specified tolerances.

Further examination of the spring adjustment screw revealed partially machined (cut) threads along the screw bore surface. It should be noted that although the screw bore had been painted, the partially cut threads were paint-free indicating that they had been introduced after the screw was fabricated. Further, the partially cut threads near the bottom of the bore were particularly deep suggesting that a relatively high torque had been imposed on the screw. The partially cut bore threads had a pitch of 8, similar to the pitch of the screw, nut and yoke threads. Given that the yoke was re-bored during installation of the valve actuator and the proximity of the screw bore to the threaded yoke hole, it is likely that the partially cut threads in the screw were formed by the tap used to re-bore the yoke.

3. Yoke

Examination of the yoke revealed that the threaded hole had been re-bored. Measurements indicated that the yoke hole had been machined off-center by approximately 0.15 in.

- Load Tests

The load carrying capacity of the screw/nut adjustment assembly was determined by three load tests. Following each of the load tests, the screw and nut were examined to determine the extent of load-induced thread damage, if any. In particular, the mode and orientation of thread damage was noted. The load test results were as follows:

1. Test 1 - A uniform load of 13,400 lb was applied to the spring adjustment nut with the nut positioned on the screw 2-1/8 in. above the screw flange. The results of load test 1 indicated the screw/nut assembly adequately resisted the 13,400 lb service load. Examination of the screw and nut threads following the load test did not reveal any evidence of thread damage.

2. Test 2 - A cyclic load of 0 to 13,400 lb was applied to the screw/nut assembly 200 times in a 10 minute period. The results for load test 2 indicated the screw/nut assembly adequately sustained 200 cycles of 0 to 13,400 lb in 10 minutes without damage to either the screw or nut threads.

3. Test 3 - The spring adjustment screw/nut assembly was loaded to its ultimate capacity. Since the spring adjustment screw/nut assembly did not fail under the advised service load conditions (load tests 1 and 2), the screw/nut assembly was loaded to its ultimate capacity. Results of load test (3) revealed an ultimate screw/nut thread load capacity of 61,000 lb - significantly higher than the advised service load of 13,400 lb. Severe mechanical damage occurred to the thread crowns in both the screw and nut. Furthermore, the load test induced mechanical thread damage was axially oriented, in contrast to the as-received circumferentially oriented thread damage.

- Discussion and Conclusion

The investigation of the spring adjustment assembly revealed the observed thread damage to have occurred due to relative circumferential movement between the screw and nut of the adjustment assembly. For threaded components with normal major and minor diameters, such circumferential motion (i.e., turning of the nut or screw) would not produce the observed thread damage. However, the subject spring adjustment nut was fabricated such that the minor diameter was significantly larger than required for a 1-3/4-8N-2B nut. The larger than specified minor diameter for the nut was such that the screw and nut thread crowns interacted to produce excessively high local stresses and thus deformation and scoring of the threads.

The circumferential thread damage probably occurred when the yoke hole was re-bored. During re-boring, the tap had apparently engaged the screw bore, as

evidenced by the partial threads on the screw bore surface, and turned the screw relative to the nut.

Due to the improper sizing of the nut thread diameters, the tap-induced screw movement caused the thread crowns to rub against each other thereby creating the circumferentially oriented mechanical damage. Had the nut thread diameters been properly sized, the tap-induced screw movement would not have produced the observed damage. Consequently, the root cause of the thread damage is the improperly sized nut thread diameter.

Results of the load tests, however, revealed that the spring adjustment screw/nut assembly could adequately sustain the advised service load of 13,400 lb. In fact, the screw/nut assembly exhibited an ultimate load carrying capacity of 61,000 lb, 4.5 times higher than the required service load.

V. Date

The nonconformance, identified on February 4, 1994, was determined to be a potential defect by the Authority on March 24, 1994, following receipt of Copes Vulcan's preliminary inspection results of the defective part. On May 25, 1994, the Authority's evaluation of the nonconformance concluded that the condition constitutes a defect as defined in 10 CFR 21.3(d)(1) since the deviation could create a substantial safety hazard. The Authority sent a Part 21 report to the NRC on June 22, 1994 that identified the need for additional evaluation. On October 10, 1994, the Authority's evaluation of the nonconformance concluded that the condition does not constitute a defect as defined in 10 CFR 21.3(d)(1) since the deviation could not create a substantial safety hazard.

VI. Location and Number of Defective Components

The number and location of all such components in use at, supplied for, or being supplied for one or more facilities or activities is not available to the Authority.

A review of the work history was performed on the INPO Nuclear Network for Copes Vulcan valve and PORV failures. The Nuclear Plant Reliability Data System work history was reviewed for the same model number actuator and no instances of failure were identified. Based on this review, the Authority has no reason to believe that this damage was generic in nature at Indian Point 3 or other plants. The latest evaluation confirms that components with similar damage could perform their intended function.

VII. Corrective Action

Copes Vulcan has instituted an upgrade on their spring adjustment screw which reduces the thread undercut area. The conclusion of this report is that the upgrade is unnecessary to prevent the possibility of the identified nonconformance.

The Authority has completed corrective action as follows:

1. Independent testing of the nonconformance was completed and the results and conclusions are presented in this report.

2. The Maintenance Department, by letter dated May 25, 1994, requested a list of design changes/upgrades from Copes Vulcan in order to evaluate the need for corrective action on existing valves. No additional actions are required based on Copes Vulcan's response.

3. The Maintenance Department reviewed its existing warehouse stock of Copes Vulcan valves and parts for deficiencies. No additional discrepancies were found.

4. The Authority completed an audit at Copes Vulcan on 6/13/94 - 6/15/94 to evaluate their Quality Assurance (QA) Program and their 10 CFR 21 Evaluation and Reportability Program. As a result of this audit there were three (3) audit findings and five (5) recommendations documented. The Authority QA concluded that the audit findings did not affect the quality of Copes Vulcan's products. Based on Copes Vulcan's response to the audit findings, the Authority closed the audit file on September 8, 1994.

VIII. Advice

No further action is required.