

A REPORT ON

**A PRELIMINARY REVIEW OF PUBLIC SERVICE ELECTRIC AND GAS
COMPANY CORRECTIVE ACTION PROGRAM RELATED TO REACTOR
TRIP BREAKER FAILURES AT SALEM GENERATING STATION, UNIT NO. 1**

CONDUCTED BY

BASIC ENERGY TECHNOLOGY ASSOCIATES, INC.
ARLINGTON, VIRGINIA

APRIL 14, 1983

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I. BACKGROUND

On April 5, 1983, Basic Energy Technology Associates, Inc. (BETA) was contracted by Public Service Electric and Gas Company (PSE&G) to conduct an independent evaluation of the corrective actions taken or planned by PSE&G as a result of the events surrounding the reactor breaker trip incidents of February 22 and 25, 1983.

BETA was requested to initially concentrate its efforts on the short term actions taken by PSE&G as they would apply to the restart of Unit 1 and to provide an interim report outlining its findings and recommendations by April 14, 1983. Due to this tight time constraint, BETA in its initial review, has focused its effort on those short term actions taken by PSE&G as outlined in its Supplement I Report dated April 8, 1983.

This phase of the review was performed by two BETA associates, Robert S. Brodsky and William Wegner. In addition, BETA engaged the services of Jack C. Grigg, an independent consultant with over thirty years of reactor electrical control and instrumentation experience and specifically with reactor trip breakers, to assist in the performance of this evaluation.

This report provides recommendations resulting from the BETA review to date. A more comprehensive report will be provided to PSE&G upon completion of the final review.

II. SUMMARY OF FINDINGS AND RECOMMENDATIONS

Based on the limited review conducted by BETA as previously described, the following summary of findings and recommendations are provided. Section III provides more detailed findings and recommendations.

1. The identification of the known and probable causes leading to the breaker failures as outlined in the April 8 Supplement I Report appears to be reasonable. At this time BETA has not identified any additional problem areas that have not already been identified by PSE&G or the Nuclear Regulatory Commission relating to this problem. BETA also considers that the actions listed as being short term (prior to restart) are adequate. Two additional short term actions, as outlined in Section III of this report, are recommended.

2. The short term actions taken by PSE&G as outlined in the April 8, 1983 Supplement I Report are appropriate and should, along with the two short term actions recommended by BETA, provide reasonable assurance that the immediate problems associated with the events leading to reactor breaker trips on February 22 and 25, should not recur prior to completion of the long term actions.

3. Interviews conducted by BETA of 16 PSE&G people at the site indicate a good understanding and appreciation of the problems which lead to the breaker trip incidents. The scope of the longer term actions would indicate there is also an appreciation for how these problems reflect on broader issues of the plant's overall operation. At this point, BETA is not in

a position to comment on the adequacy or completeness of the long term actions or on how deeply into the organization these understandings prevail. There is some concern by BETA that the majority of corrective actions taken so far have concentrated specifically on problems directly associated with the breakers rather than on some of the broader aspects. This is an area that BETA will pursue in greater detail in subsequent evaluations.

4. While post-incident investigations correctly identified a number of weaknesses throughout the PSE&G operation, BETA is of the opinion that there still exists a possible generic problem with breakers of this design and used in this application. Specific recommendations relating to additional long term improvements with respect to the breakers themselves are contained in Section III of this report.

III. DETAILED FINDINGS AND RECOMMENDATIONS

A. Short Term Findings and Recommendations

1. PSE&G should obtain confirmation in writing from the reactor trip breaker vendor that the installed breakers are satisfactory for plant operation and that Salem Maintenance Procedure M3Q-2 will provide the necessary basis to assure continuing operational reliability.

2. PSE&G's Station Operations Review Committee and the Nuclear Review Board should complete their reviews of the short term aspects of the trip breaker failures. Written reports should be available documenting their concurrence with restart.

B. Long Term Findings and Recommendations (Interim)

1. The manual trip switch trips both the under voltage and shunt trips. In order to provide a greater assurance of breaker action, it is suggested that the automatic trip also use the shunt device. The automatic trips use only the under voltage trip. A safety grade battery power supply will be required to support the shunt trip. It is understood that PSE&G is investigating the feasibility of providing a shunt trip.

2. In order to further decrease the possibility of a common mode failure, consideration should be given to replacing one of the two sets of installed breakers with breakers or contactors of another design or manufacture. If possible, the breaker design should incorporate a molded case. If an alternate device is selected it should be included in the PSE&G and NRC test programs.

3. The Salem breaker maintenance procedure, M3Q-2, will use periodic measurements of trip and release forces to identify degradation of breaker performance. As another indicator of possible breaker degradation, PSE&G should consider the use of the periodic data obtained from the voltage drop-out measurements which are also in the breaker maintenance procedure (step 9.7.3.10).

4. The PSE&G specifications for trip breakers should be modified to indicate that mounting brackets for over current trips should not be installed.

5. Additional experimental data is necessary to confirm that maintenance procedure M3Q-2 testing will provide a satisfactory indication of breaker degradation. This data should be obtained from the planned PSE&G and NRC testing.

6. Breaker maintenance procedure M3Q-2 will result in the trip breakers undergoing a large number of cycles. The PSE&G, NRC and vendor test programs should confirm that these tests will not result in the breaker exceeding breaker design cycle limits. In addition, the number of breaker cycles should be determinable and recorded.

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April 26, 1983

Mr. Richard M. Eckert
Senior Vice President
Public Service Electric & Gas Company
80 Park Place
Newark, New Jersey 07101

Dear Mr. Eckert:

This letter is in response to your request of April 22, 1983 asking whether or not BETA continues to support our letter to you of April 14, 1983, in light of the discovery on April 20, 1983, of the broken tab on a newly installed undervoltage trip assembly in Unit 2. The April 14, 1983 BETA letter contained findings and recommendations concerning the reactor trip breaker incidents at the Salem Generating Station.

As a result of your request, three representatives of BETA visited the Salem site on April 25, 1983, in order to review the circumstances surrounding this broken tab. This review consisted of interviewing PSE&G people, reading the investigative reports, and viewing the physical evidence, including photographs of the broken trip device.

Based on this review, BETA continues to support its findings and recommendations as contained in our April 14, 1983 letter to you. In addition, we do not have any additional short term action items which, in our opinion, need to be accomplished prior to restart.

This conclusion is based on the following considerations:

1. In BETA's opinion, the newly established procedures for installing and testing reactor trip breakers and equipment attached thereto would, and in fact did prevent the use of the malfunctioning device. Disregarding the question of when the breakage actually occurred, i.e., in shipment from the vendor or elsewhere, the ultimate test is performed with the unit installed, and, as presently written, this test would have detected the broken device prior to its actual use.
2. The evidence surrounding the broken trip device strongly supports the theory that it was improperly packaged and handled, and was probably damaged sometime between leaving the vendor's plant and installation by PSE&G. Based on this evidence and tests performed by Franklin Research Center and the vendor on the broken and unbroken devices, there is no reason to suggest that there is an inherent design or manufacturing deficiency in the tab lever.

BETA is of the further opinion that this incident provides additional support for the need for PSE&G to accomplish a number of the previously identified long term fixes. From PSE&G's viewpoint, it would have been beneficial had this broken device been discovered prior to installation. This would have been the case had there been a requirement for a PSE&G Quality Control inspection upon receipt at the site even though PSE&G QA inspectors witnessed the testing of these devices at the vendor's plant prior to shipment. At the present, commercial grade devices such as this, are inspected by PSE&G warehousemen for obvious shipping damage, counting and proper shipping papers only. It is our understanding that PSE&G procedures are being rewritten to accomplish this change.

Notwithstanding the above comment, BETA continues to support fully the findings and recommendations contained in our April 14, 1983 letter to you.

Sincerely,


W. Wegner
Associate