

Public Service
Electric and Gas
Company

Stanley LaBruna

Public Service Electric and Gas Company P.O. Box 236, Hancocks Bridge, NJ 08038 609-339-4800

Vice President - Nuclear Operations

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United States Nuclear Regulatory Commission
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Gentlemen:

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING
BAILEY SOLID STATE LOGIC MODULE RELIABILITY - 1988 AND 1989
DOCKET NO. 50-354
HOPE CREEK GENERATING STATION

Public Service Electric and Gas Company (PSE&G) hereby provides material requested by Mr. Clyde Shiraki, NRC Licensing Project Manager for our Hope Creek Generating Station. Attached are copies of monthly reports submitted to the Hope Creek Station Operations Review Committee (SORC) regarding Bailey Solid State Logic Module (SSLM) failure rates subsequent to our March 31, 1988 report, "Reliability Summary Report For The Bailey 862 Solid State Logic Module". That report was submitted to NRC pursuant to a previous commitment. The subsequent Bailey 862 monitoring and monthly reports to SORC are part of a program to ensure continued SSLM reliability and to improve failure rates.

PSE&G has evaluated the performance of the Bailey 862 SSLMs with respect to module failure rates during 1988 and 1989. The total number of failed modules for those two years were thirty four per year and the corresponding number of failures per million hours of operation is, therefore, 1.70 for 1988 and 1989. When compared to the 1987 report failure rate of 1.8 failures per million hours of operation, a distinct improvement has been achieved, especially in light of the improved testing equipment/methodology and more extensive testing in use after 1987.

That the reduction in failure rate has been observed since the implementation of design changes to the ventilation supply to the Control Equipment Room (which houses the Bailey Logic System) and humidity control modifications to the SSLMs, themselves, indicates that our concerns regarding the relationship between humidity control and SSLM failure rate, identified in our 1987 summary report, were valid and have been adequately resolved. It should be noted that our peak failure periods are those related to unit outages which generally involve extensive testing due to Design Change implementation and trouble shooting efforts.

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The failure rates reported by PSE&G include, conservatively, not only service-related failures, but also:

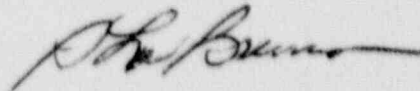
- 1) **failures on unused functions on the SSLMs...**while the modules have numerous circuits available, and only a few may actually be used in a particular application, all functions are tested and **any** failure is counted. By comparison, it is highly unlikely that unused relay contacts are tested or considered failures in IEEE reliability data, and
- 2) **storeroom spares that are tested prior to installation in the plant...**these modules are counted as failures contrary to industry practice for relays and other electronic components.

Although PSE&G does not believe that Bailey 862 SSLMs can, or should, be directly compared to relays, IEEE 500 Specification provides a relay reliability of 16.73 failures per thousand units per year. This corresponds to 523,969 hours between failures. If a standard SSLM were considered to be equivalent to a single relay, PSE&G's calculated Mean Time Between Failures (MTBF) for 1988 and 1989 would be 587,322 hours. This demonstrates a roughly 12% better level of performance for the SSLMs over relays. If, more consistent with circuit design, a single SSLM is considered to be equivalent to seven relays, the MTBF becomes $>4.1 \times 10^6$ hours or about 85% better performance than relays.

Finally, in response to Mr. Shiraki's request, Attachment 1 tabulates Bailey 862 SSLM reliability data for the two year period after that which was provided to NRC in our summary report for 1987.

Should you have any further questions, we will be pleased to discuss them with you.

Sincerely,



Attachment

C Mr. C. Y. Shiraki
USNRC Licensing Project Manager

Mr. T. P. Johnson
USNRC Senior Resident Inspector

Mr. T. T. Martin, Administrator
USNRC Region I

Mr. K. Tosch, Chief
Bureau of Nuclear Engineering
New Jersey Department of Environmental Protection

ATTACHMENT 1

BAILEY 862 LOGIC MODULE RELIABILITY FOR THE PERIOD 1988-89

MONTH	YEAR	# OF FAILURES (NOTE 7&8)	FAILURES PER MILLION HOURS (NOTE 9)	FAILURES PER MILLION HOURS (NOTE 10)
January	1988	1	0.590	0.084
February	1988	1	0.631	0.090
March	1988	4	2.360	0.337 (note 1)
April	1988	3	1.829	0.261 (note 1)
May	1988	4	2.360	0.337
June	1988	1	0.610	0.087 (note 3)
July	1988	4	2.360	0.337 (note 3)
August	1988	1	0.590	0.084 (note 3)
September	1988	2	1.219	0.174
October	1988	6	3.540	0.506 (note 2)
November	1988	4	2.439	0.348 (note 2)
December	1988	3	1.770	0.253
January	1989	1	0.590	0.084
February	1989	4	2.613	0.373 (note 4)
March	1989	6	3.540	0.506 (note 4)
April	1989	1	0.610	0.087
May	1989	1	0.590	0.084
June	1989	0	0.000	0.000 (note 3)
July	1989	2	1.180	0.169 (note 3)
August	1989	0	0.000	0.000 (note 3)
September	1989	5	3.048	0.435 (note 5)
October	1989	5	2.950	0.421 (note 5)
November	1989	9	5.487	0.783 (note 5)
December	1989	0	0.000	0.000

NOTES:

1. First refueling outage (note 6)
2. Forced outages (note 6)
3. High humidity period
4. Second mid-cycle outage (note 6)
5. Second refueling outage (note 6)
6. Outage periods involve extensive design change implementation as well as troubleshooting work which is not normally done during power operations. As a result, we generally experience abnormally high failure rates during these times.
7. Failed modules include those from all causes. These include storeroom spares tested prior to installation, modules which faulted as a result of troubleshooting and/or design implementation work, as well as modules which failed during operation.
8. Logic modules are considered failures even if the particular function which failed is not used in the specific application.
9. Failure rate considering one logic module as one relay.
10. Failure rate considering one logic module as seven relays. This rate is more consistent with circuit design wherein one module provides significantly more than one relay function.