Public Service
Electric and Gas
Company

Stanley LaBruna

Vice President - Nuclear Engineering

Public Service Electric and Gas Company P.O. Box 236, Hancocks Bridge, NJ 08038 609-339-1700

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Gentlemen:

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
AMENDMENT REQUEST, LCR 93-27
SALEM GENERATING STATION
UNIT NOS. 1 AND 2
DOCKET NOS. 50-272 AND 50-311

Public Service Electric and Gas Company (PSE&G) hereby provides, in Attachment 1, our response to your request for additional information regarding a proposed change to the Salem Technical Specifications.

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

Sincerely,

S. LaBruna

Attachment (1)

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

Mr. L. N. Olshan
USNRC Senior Licensing Project Manager - Salem

Mr. C. S. Marschall
USNRC Senior Resident Inspector - Salem (S09)

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

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ATTACHMENT 1

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
LCR 93-27

ATTACHMENT 1

NRC OBSERVATION #1

The subject C&D letter states that a fully charged battery with all cells having a measured specific gravity of 1.190 (due to overwatering for example) will have approximately 93% of the performance capability of the same cells with 1.215 specific gravity. While this is probably a true statement for a specific gravity change due to electrolyte dilution in a battery design that is not electrolyte limited, it would not be the case for a specific gravity change due to a discharge condition in such a battery. If battery specific gravities are used as an indication of the state of charge of a battery (please address whether they are intended to monitor any other battery condition than this), then a battery or cell discharge due to load cycling, momentary loss of battery charger, or self discharge (internal action) is not accurately represented by the dilution example.

The C&D letter provides a laboratory report with specific gravity data on three fully conditioned LCU-23 cells that were given four carefully measured one hour discharges at rates of 200, 300, 400, and 500 amperes and then recharged. The specific gravity data was given at the start of the recharge and three subsequent periods during the charging routine. The specific gravity of the cells for the 500 amp discharge, at the start of the recharge, is approximately 1.185. If this is the same specific gravity as that at the end of the discharge (which it should be), and the cells were at 1.215 specific gravity prior to the discharge; then this represents a 30 point drop of specific gravity for an approximate 30% depth of discharge of the battery. This indicates a one point drop of specific gravity for each one percent of battery discharge. The specific gravity data supplied at the other discharge rates also indicate approximately the same value.

In conclusion it appears that, while a specific gravity of 1.190 due to dilution results in approximately only 7% loss of capacity, a specific gravity of 1.190 due to battery discharge results in approximately a 25% loss of capacity (this number would be greater for cells that have additional margin of electrolyte volume than the tested cells and less for cells that have less additional volume). Please comment.

Response to Observation #1:

There is no meaningful correlation between low specific gravities due to cell dilution and those due to cell discharge - without considering other battery parameters as well.

Observation #1, notes that the battery manufacturer states that a fully charged battery with all cells having a measured specific gravity of 1.190 (due to overwatering, for example) will have roughly 93% of the performance capability of the same cells with a 1.215 specific gravity and proposes that this would not be the case for a

specific gravity change due to a discharge condition for that battery. This is true; but then we are no longer discussing a **fully charged** battery with a low specific gravity, but, a **discharged** battery with a low specific gravity. The decreased performance capacity of the discharged battery is a function of multiple parameters - not just the specific gravity alone. Thus the correlation of a 30% depth of discharge directly, and singularly, to a 30 point drop in specific gravity is not appropriate.

A question is raised whether specific gravities are intended for monitoring any other battery condition than the state of charge...to which the answer is "no". The question not asked is whether any other parameter is used to monitor the state of charge of the battery...the answer to which is "yes", as described in Technical Specification (TS) Table 4.8.2.3-1 (electrolyte level and temperature, float voltage and battery charging current).

Based upon our compliance with Salem Technical Specification (TS) surveillance requirements, each of our batteries is supported by an operable battery charger. The system is designed such that a battery will not see a significant discharge unless there is a loss of the vital AC to its charger - or a failure of the charger itself. This condition would be apparent to control room operators, who could readily make a transfer of the affected battery to its redundant charger, powered from an different vital AC power source, thereby minimizing excessive discharge. The battery would then recharge to its fully charged condition. A battery discharge of the magnitude discussed in Observation #1, second paragraph, would not be the result of load cycling or the momentary loss of a battery charger. An internal fault or significant self discharge (which would affect other battery parameters that are required to be within TS limits) would be handled in accordance with TS ACTION statements. Based upon the above discussion and our compliance with the TS governing battery and battery charger operability, our batteries can be expected to normally be in a fully charged condition.

In the opening two sentences of Observation #2, the NRC agrees that, without correlating the values of voltage, charging current, and performance margins, specific gravity, solely, should not be used to determine a battery's operability. We, therefore, fail to see any meaningful correlation between battery specific gravities obtained by cell dilution or by cell discharge without taking into consideration the other TS Table parameters.

OBSERVATION #2

The C&D letter states that for lead calcium cells, specific gravity of the electrolyte, without correlating the values with voltage and charging current and existing performance margins, should not be used as the sole criteria for determining battery operability. We agree. However, in the interests of simplicity, clarity of interpretation, enforceability, and standardization some allowances must be made in standard technical specifications and plant technical specifications. We note, however, that the Salem Technical Specifications and the improved Standard Technical Specifications both allow the use of float charging current in lieu of specific gravity to determine battery operability following a battery recharge. The purpose of this exception is to avoid the problem of obtaining accurate specific gravity readings during the period of high electrolyte stratification that occurs following a battery recharge. The stratification problem following recharge appears to be the major reason in the C&D letter against using specific gravity readings as an indicator of operability, and the technical specifications do <u>not</u> rely upon them during this period. Please comment.

Response to Observation #2:

Float current monitoring is an accepted practice within IEEE 450 and is endorsed by the NRC (Reg Guide 1.129). Following a recharge, acid will always be present to facilitate a charge (even during electrolyte stratification), since most cells are plate limited.

The Standard Technical Specifications (STS) indicate the use of the charging current criteria to be applied for best obtaining the "state of charge" of the battery system. This charging current is in accordance with manufacturer's recommendations (C&D) and is intended to provide the utility with more than one avenue for battery charge determination. In accordance with the battery cell parameter surveillance table, the Specific Gravity measurements are always the primary indicator of charge. If a high stratification of battery fluids following a recharge are realized, the option of float charging current can be utilized for up to seven (7) days. Presently, Salem does not solely rely on specific gravity measurements to determine "state of charge"; electrolyte level and voltage are also used in accordance with the STS.

OBSERVATION #3

The C&D letter states that for LC/LCR-33 battery cells, a charging current of 3 amps or less would be indicative of a battery in an operable state of charge. Is this true for the period following a battery recharge when there may be substantial electrolyte stratification and adhesion of bubbles to the battery plates? Won't these phenomena result in some loss of battery capacity by impeding the discharge process? This may be especially pronounced immediately following a battery recharge that follows a performance discharge test that deep discharges the battery.

Response to Observation #3:

Bubbles are present during float conditions. Only after a battery is fully charged does the excess current flow create these bubbles (chemical process). IEEE 450 accounts for this bubble generation and stratification phenomena in its recommendations and our manufacturer (C&D) states, in their August 16, 1994 letter, that the reason for stratification following a charge (in lead calcium batteries as compared to lead antimony types) is that there is "practically no gassing...to mix the electrolyte". This is why specific gravity readings are considered less reliable for determining operability in the period (up to 7 days) following a charge.

In accordance with the STS, the 3 Amp float current can be used as an indicator for up to 7 days after a battery recharge (IEEE 450 charge time is 72 hours before critical measurements are taken). In accordance with IEEE 450 Appendix B, a stabilized charging current at float voltage indicates the battery as being charged regardless of the stability of the specific gravities. Following a service, or capacity, test discharge, the specific gravity is always the final (post-seven-day recharge period) indicator of battery charge in conjunction with the other parameters listed on Table 4.8.3.2-1 of our Technical Specifications.

In conclusion, based on historically good capacity data for all of our batteries and information provided by our battery manufacturer, any of our batteries that reach our Category "C" TS limits will retain adequate margin to support our design basis.