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January 7, 1994

Dr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Document Control Desk

Subject: Supplemental Information Regarding the September 2, 1993, Technical Specification Amendment Pertaining to the Electrical Power System, D. C. Sources

Byron Station Units 1 and 2
NPF-37/66; NRC Docket Nos. 50-454/455

Braidwood Station Units 1 and 2
NPF-73/77; NRC Docket Nos. 50-456/457

References:

1) D. Saccomando letter to Dr. Murley dated September 2, 1993, transmitting proposed revision to Braidwood and Byron Stations Technical Specifications Pertaining to the Electrical Power System, D.C. Sources

2) Teleconference between Commonwealth Edison Company (CECo) and the Nuclear Regulatory Commission (NRC) on December 22,1993, regarding the proposed Technical Specification pertaining to the Electrical Power System, D.C. Sources

Commonwealth Edison Company (CECo) is providing this supplemental information to NRR to revise portions of Section D.4, (Impact of Changes), of Attachment "A", (Description and Safety Analysis of Proposed Changes), in CECo's Technical Specification amendment submittal for the Class 1E 125 volt Battery Replacement Modifications at Byron and Braidwood Stations. This supplement is intended to correct and clarify the discussion associated with our submittal and does not alter the proposed changes to the Technical Specification or Technical Specification Bases.

Section D.4 of the reference Technical Specification Amendment submittal discusses battery sizing. The submittal presently states, in part:

> "... The AT&T battery sizing was then selected based on having sufficient capacity to energize the design basis DC loads for an operating unit with the IEEE-485 design margin of 15% while maintaining the desired limited DC load of 100 amps for a shutdown unit. The sizing of the AT&T battery is conservative compared to the sizing of the Gould battery because the crosstie load limit of 63 amps for the Gould battery utilizes a portion of the IEEE-485 15% design margin."

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CECo would like to replace this paragraph with the following:

"... The AT&T battery sizing was then selected based on having sufficient capacity to energize the design basis DC loads for an operating unit while carrying the desired limited DC load of 100 amps for a shutdown unit and still maintaining sufficient design margin for future load growth. The remaining design margin in the AT&T battery is higher than that currently available for the Gould battery, even though the 63 amp crosstie load has been increased to 100 amps."

This revision is necessary because the actual design margin of 15% as referenced in Section D.4 has been revised to range from 4.7% to 10.8% depending on the station and electrical division being considered.

CECo believes that the AT&T batteries have been conservatively sized and prudently designed. Attachment 1 provides additional information concerning battery sizing. As requested during the reference teleconference call, we are also providing a discussion of the events leading up to this supplemental response and portions of the appropriate calculations which support the design of the new batteries at minimum allowable terminal voltages of 105 V and 107.88 V. (See Attachments 2, 3 and 4 respectively)

Once again, this supplement is intended to correct and clarify the discussion associated with our submittal and does not alter the proposed changes to the Technical Specification, its bases or the associated significant hazards discussion. Commonwealth Edison apologizes for any inconvenience that was caused by amending Attachment "A". CECo has reviewed the submitted amendment, the battery design related to this modification and the calculations and considers them to be complete and finalized. We are confident at this time that there are no outstanding issues. We are currently reviewing the events involved in the preparation of this amendment to identify any actions which would preclude a similar recurrence.

Please address any further comments or questions regarding this matter to this office.

Sincerely,

Denise M. Saccomando
Nuclear Licensing Administrator

Attachments

cc: R. Assa, Braidwood Project Manager - NRR
H. Peterson, Senior Resident Inspector - Byron
S. Dupont, Senior Resident Inspector - Braidwood
J. Martin, Regional Administrator - Region III
Office of Nuclear Facility Safety - IDNS

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Attachment 1

The reduction of the design margin will not have a detrimental effect on the design of the plant. The design margin, also known as capacity margin, of 10%-15% is recommended by IEEE Std. 485 as a prudent design practice when sizing a new battery. It is intended to allow for unforeseen additions to the DC system and less than optimum operating conditions of the battery due to improper maintenance, recent discharge, or ambient temperatures lower than anticipated, or both. IEEE Std. 485 is applicable to generating stations and substations in both the nuclear and non-nuclear industries. While these variables are present in the electric industry as a whole, the administrative and design controls present at Byron and Braidwood Nuclear Stations preclude their occurrence.

The aging factor used in the Byron and Braidwood List 1SH cell battery design is very conservative and could have been used to provide additional margin. The Byron and Braidwood Technical Specifications require the battery is capable of delivering 80% of rated capacity when subjected to a performance discharge test every 60 months. In addition, IEEE Std. 450, (Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations), recommends that a battery be replaced when its actual capacity drops to 80% of its nominal rating. Therefore, the battery's rated capacity should be at least 125% of the load expected at the end of its service life. This increase is normally referred to as the 1.25 aging factor in battery sizing calculations. Since receiving the discharge data to an end voltage of 1.86 VPC from AT&T, CECo has performed battery sizing calculations that demonstrate that the List 1SH cells will meet the design requirements of the DC systems with a minimum allowable battery terminal voltage of 107.88 VDC (See Attachment 3). An aging factor of 1.25 was maintained as well as the minimum electrolyte temperature of 60 degrees F. Maintaining an aging factor of 1.25 for the List 1SH cells is considered very conservative. This aging factor is intended to account for the loss of capacity experienced by typical lead acid (lead calcium and lead antimony) storage cells over time. Based on the results of AT&T accelerated life testing, the capacity of AT&T Round cells has been demonstrated to increase with age. This is a result of the design of the round cell (plate configuration, stacking of the plates horizontally, and pure lead plates versus plates constructed of lead calcium or lead antimony alloys). The 1.25 aging factor for the List 1SH cell was included in the sizing calculations to maintain compliance with the Byron and Braidwood Technical Specifications which state that the battery is capable of delivering 80% of rated capacity when subjected to a performance discharge test every 60 months and the battery replacement recommendations of IEEE Std. 450. By incorporating an aging factor of 1.25 into the Byron and Braidwood Class 1E 125 volt List 1SH cell battery sizing calculations, the batteries will have 25% additional capacity from what is required to meet the DBA loads. IEEE P485 Draft, presently at the IEEE Standards Board for approval, addresses the issue of aging factors in sizing different types of lead acid storage batteries. This revision to IEEE Std. 485 states that there are exceptions concerning the use of an aging factor of 1.25 when sizing a lead acid battery. Depending on the cell design (e.g. Planté cells) an aging factor of 1.0 may be used provided the cell capacity is capable of remaining at or above 100% of the manufacturer's rating throughout the service life of the battery and that the battery be replaced when its capacity drops below 100% of the manufacturer's rating.

In conclusion, a decrease in the design margin to less than 15% is the result of increasing the minimum allowable battery terminal voltage. The use of the 10%-15% design margin in sizing a new battery installation is not a Technical Specification requirement rather it is a recommended practice based on IEEE Std. 485. CECo administrative controls preclude the variables that require the use of a design margin from occurring. Thus, maintaining a 15% design margin throughout the life of the battery is not required. CECo believes that the remaining design margin is sufficient for future load additions and that the proposed increase in minimum allowable battery terminal voltage can be considered a load addition that utilized part of the original 15% design margin that was available when the minimum allowable battery terminal voltage was at 105 VDC. In addition CECo has maintained an aging factor of 1.25 as opposed to an aging factor of 1.0 thereby providing additional capacity margin. By raising the minimum allowable battery terminal voltage from 105 volts to 107.88 volts, CECo has been proactive in resolving the voltage drop concern of the instrument power inverters and at the same time has increased the operating reliability of the inverters during a DBA. By utilizing the excess capacity of the new Class 1E 125 volt batteries, CECo will have provided both a technically and economically acceptable solution to this concern. CECo has fully demonstrated that the List 1SH cell is properly sized with ample capacity margin for the Class 1E 125 VDC applications at Byron and Braidwood Stations and meets the intent of IEEE Std. 485.

Attachment 2

The Byron and Braidwood Class 1E 125 volt batteries are presently scheduled to be replaced with AT&T List 1SH Round Cell batteries, (referred to as the List 1SH cell in this response). Each battery will consist of 58 cells and have a guaranteed minimum rating of 1760 ampere-hours at the 8 hour discharge rate to an end voltage of 1.75 volts per cell, (VPC). The nominal specific gravity of the cells is 1.300. The List 1SH cell is the largest ampere-hour capacity round cell available.

During the conceptual design stage of the battery replacement project, the design basis for the new batteries was determined to be the ability to supply the design basis accident (DBA) loads of the DC system plus 100 amps of crosstie load to the other unit without load shedding while maintaining a minimum battery terminal voltage of 105 V, (1.81 VPC). Initial battery sizing calculations were performed following the recommendations of IEEE Std. 485 using a minimum electrolyte temperature of 60 degrees F, a design margin of 15% and an aging factor of 1.25. This would assure that battery capacity would be 15% greater than that required to supply the DBA and crosstie loads while maintaining the battery voltage above 105 VDC assuming the battery capacity has dropped to an end-of-life value of 80% of the manufacturers guaranteed minimum rating, and the average electrolyte temperature of the battery was at the 60 degrees F Technical Specification Limit.

Concurrent with the design process of the battery replacement project, CECo identified a voltage drop concern regarding the 7.5 KVA instrument power inverters during preparation for the Byron and Braidwood EDSFIs. The inverters are specified to operate at a minimum input voltage of 105 VDC. During full load operation, a 2.6 volt drop exists between the battery and the DC input of the inverter. Therefore, 107.6 volts is required at the battery in order to ensure proper operation of the inverters during a DBA. A voltage drop calculation completed in May of 1993 demonstrated the voltage of the existing batteries would not drop below this 107.6 VDC limit.

Because this concern did not surface until after completion of initial battery sizing calculations and award of the contract for the replacement batteries, the CECo specification for the replacement batteries required ampere-hour capacity to meet the design requirements of the DC system with a minimum battery terminal voltage of 105 VDC. Once the voltage drop concern was identified, CECo considered several alternatives to resolve this issue. These included, testing of the inverters to determine if the inverters would maintain proper output voltage regulation at DC input voltages less than 105 VDC; increasing the size of the feeder cable from the distribution bus to the inverter to reduce the voltage drop; and reviewing the DC system loads to eliminate conservatism in the present design. Recognizing these alternatives may not yield results in the time frame required to support the installation of new batteries, CECo also pursued obtaining the data needed to complete the design calculations with a 107.6 VDC minimum voltage.

In order to accomplish this, cell discharge currents to an end voltage of 1.86 VPC (107.6 volts ÷ 58 cells) was required. This data would be used to determine if the List 1SH cells had the required capacity to meet the design requirements of the DC systems with an end voltage of 107.88 VDC, (1.86 VPC X 58 cells). It was discovered that AT&T did not have published discharge data to an end voltage of 1.86 VPC but agreed to perform discharge tests on the List 1SH cell in order to determine cell discharge characteristics to an end voltage of 1.86 VPC. The approved data was provided to CECo in November of 1993. Subsequently, this data was incorporated into design calculations to determine the effect of raising the minimum allowable battery terminal voltage. At this time it was discovered that by raising the minimum allowable battery terminal voltage to 107.88 VPC, part of the design margin was sacrificed.