UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
OFFICE OF NEW REACTORS
WASHINGTON, DC 20555-0001

March 19, 2013

NRC INFORMATION NOTICE 2013-05: BATTERY EXPECTED LIFE AND ITS POTENTIAL IMPACT ON SURVEILLANCE REQUIREMENTS

ADDRESSEES

All holders of an operating license or construction permit for a nuclear power reactor under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

All holders or applicants for a combined license under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees about recent issues involving licensees' nonconservative technical specifications (TSs) regarding surveillance requirements (SRs) for direct current (DC) power systems due to reductions in battery expected life. The NRC expects that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. Suggestions contained in this IN are not NRC requirements; therefore, no specific action or written response is required.

BACKGROUND

Class 1E batteries are used to supply DC loads at nuclear power plants and are designed consistent with the requirements in General Design Criterion (GDC) 17, "Electric Power Systems," and GDC 18, "Inspection and Testing of Electric Power Systems," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 or similar plant-specific design criteria.

The Class 1E batteries are lead-acid batteries which degrade over time, primarily as a result of the buildup of lead sulfates on the plates. The battery manufacturer's typical expected battery life curve indicates a 100 percent battery capacity over the initial 14 years of service. The capacity then decreases to 80 percent at the end of the expected 20-year life. At this point, the Institute of Electrical and Electronics Engineers (IEEE) Standard (Std.) 450-2002, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications," as endorsed by Regulatory Guide 1.129, "Maintenance, Testing, and Replacement of Vented Lead-Acid Storage Batteries for Nuclear Power Plants," recommends replacing the battery bank. To account for this degradation, IEEE Std. 485-1997, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications," as endorsed by Regulatory Guide 1.212, "Sizing of Large Lead-Acid Storage Batteries," recommends that when sizing batteries for use at nuclear power plants, the rated capacity of the battery, when put in service, should be at least 125 percent of the design load. This ensures that at least 80 percent of the battery nameplate capacity will be available at the end of the 20-year expected life of the batteries, which will be sufficient to serve 100 percent of the design load (80 percent of 125 percent equals 100 percent).

The NRC requires licensees to maintain batteries in an operable condition as specified in plant TS. As such, the batteries must be capable of performing their intended function of supplying 100 percent of design DC loads. Standard TSs have a SR to “Verify battery capacity is ≥ 80% of the manufacturer's rating when subjected to a performance discharge test or a modified performance discharge test.” The specified frequency of this surveillance is “60 months AND 12 months when battery shows degradation, or has reached 85% of the expected life with capacity < 100% of manufacturer’s rating AND 24 months when battery has reached 85% of the expected life with capacity ≥ 100% of manufacturer’s rating.” Note that the surveillance frequency uses the term “expected life” but does not include a specific value (e.g., 20 years). Because of this, licensees may not be immediately aware of the impact changes to the expected life of their Class 1E batteries can have on their plant’s TS SRs.

DESCRIPTION OF CIRCUMSTANCES

In the examples below, the licensees discovered conditions that either increased battery design loads or decreased rated battery capacity such that the battery no longer met the sizing design basis. The batteries remained operable, at least in the near term, as the batteries were still capable of supplying 100 percent of the design DC loads. However, the licensees did not recognize the need to ensure the “expected life” of Class 1E batteries appropriately accounted for the sizing requirements and post-accident DC loading assumptions contained in design basis documents. As a result, certain TS SR testing frequencies, specifically those associated with performance or modified performance discharge testing, were nonconservative.

Cooper Nuclear Station

On March 11, 2009, the licensee for Cooper Nuclear Station submitted a license amendment request to address nonconservative TSs regarding the SRs for 125 volt (V) and 250 V DC power systems. During its review of the amendment, the NRC staff noted that a reduction in the expected service life would be needed to ensure the batteries would be capable of providing 90 percent of their rated capacity at the end of their service life. The NRC issued a request for additional information that requested the licensee to describe the impact of this change on the expected life of Cooper Nuclear Station batteries (e.g., conclusions drawn from the battery life versus capacity curve for the batteries).

In its response to the NRC staffs’ request for additional information, the licensee noted that as loads have increased over time, the required battery capacity is now closer to 90 percent of the nameplate rating. The licensee further stated that its battery vendor does not estimate battery life for 90 percent capacity. Therefore, the licensee conservatively established 15 years as the point at which the batteries reach 85 percent of expected life. The licensee also conservatively defined battery degradation to be when capacity drops by more than 5 percent (normally 10 percent as defined by the IEEE Std. 450-2002,) relative to the capacity on the previous performance test or when the battery capacity reaches less than or equal to 95 percent of the manufacturer’s rating (normally 90 percent or when it is 10 percent below the manufacturer’s rating as defined by IEEE Std. 450-2002).

On March 18, 2010, the NRC issued the above mentioned license amendment for Cooper Nuclear Station. To address the above concern, the NRC staff required the licensee to update its updated safety analysis report and TS bases for the batteries upon implementation of the approved license amendment. These updates included the reduction to 15 years as the point at which the safety-related batteries have reached 85 percent of expected life. See the licensee amendment issuance package for further details (Agencywide Documents Access and Management System (ADAMS) Accession No. ML100610233).

Indian Point Nuclear Generating, Unit 2 (IP2)

On March 29, 2009, the licensee for IP2 submitted a license amendment request to address nonconservative TSs regarding SR 3.8.6.6 in TS section 3.8.6, "Battery Parameters," for 125 V DC power systems. The SR verifies battery capacity during a performance discharge test or a modified performance discharge test. The licensee discovered that the 80 percent capacity value was nonconservative with respect to the existing design basis calculation for battery capacity under minimum design temperature conditions. The licensee determined that it should implement a more restrictive battery acceptance criterion (≥ 85 percent of manufacturers rating) to ensure that sufficient battery capacity exists at limiting conditions. During its review of the amendment, the NRC staff identified that the licensee for IP2 applied a 117.6 percent (1.176) aging factor in its design calculation for sizing the Class 1E batteries. While the aging factor is less than that recommended by IEEE Std. 485-1997, the licensee followed this guidance since the aging factor is appropriate for the assumed end-of-life criterion (i.e., 85 percent). However, based on standard battery life versus capacity curves, the licensee noted that aging these batteries to 85 percent of rated capacity would indicate an expected battery life of approximately 18 years versus 20 years originally assumed.

On February 24, 2010, the NRC issued the above mentioned license amendment for IP2. To address the above concern, the NRC staff required the licensee to update its battery monitoring and maintenance program, TS bases for the batteries, and updated final safety analysis report upon implementation of the approved license amendment. These updates included the reduction to 18 years as the expected life of their safety-related batteries. See the licensee amendment issuance package for further details (ADAMS Accession No. ML100270051).

DISCUSSION

Licensees rely on Class 1E batteries to supply DC loads when battery chargers are not available. The batteries are sized in accordance with IEEE Std. 485-1997 to carry the expected shutdown loads following a plant trip and a loss of all alternating current power without battery terminal voltage falling below its minimum required voltage. This ensures that adequate DC power will be available for starting and loading the emergency diesel generators, emergency power to run instrumentation and controls, and emergency lighting.

IEEE Std. 485-1997, recommends applying at least a 125 percent (1.25) aging factor when sizing batteries for nuclear power plants, to ensure the battery can perform its design function with a greater than or equal to 80 percent capacity rating throughout its 20-year life. When using an aging factor less than 1.25, the result is a reduction in expected life of the batteries based on the manufacturers expected life versus capacity curves. The licensees identified above were not immediately aware that an increase in battery design loads or a decrease in rated battery capacity would result in a reduced expected life of the batteries. Certain TS SR testing frequencies, specifically those associated with performance and modified performance discharge testing, are directly tied to the expected life of batteries. The once per 60-month performance discharge test (which is based on 25 percent of a 20-year expected life) and the increased TS SR frequencies (i.e., 12 and 24 months), when batteries reach 85 percent of expected life, are consistent with the guidance provided in IEEE Std. 450 and are tied to known age-related degradation of vented lead-acid batteries. The events described in this IN illustrate the importance of considering the impact of a decrease in the battery expected life on plant TS SRs.

CONTACT

This IN requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below or the appropriate NRC project manager.

/RA/

Lawrence E. Kokajko, Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

/RA/

Laura A. Dudes, Director
Division of Construction Inspection
and Operational Programs
Office of New Reactors

Technical Contacts: Matthew McConnell, NRR
301-415-1597
E-mail: Matthew.McConnell@nrc.gov

Sergiu Basturescu, NRR
301-415-1237
E-mail: Sergiu.Basturescu@nrc.gov

Note: NRC generic communications may be found on the NRC public Web site, http://www.nrc.gov, under NRC Library.

performance discharge test (which is based on 25 percent of a 20-year expected life) and the increased TS SR frequencies (i.e., 12 and 24 months), when batteries reach 85 percent of expected life, are consistent with the guidance provided in IEEE Std. 450 and are tied to known age-related degradation of vented lead-acid batteries. The events described in this IN illustrate the importance of considering the impact of a decrease in the battery expected life on plant TS SRs.

CONTACT

This IN requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below or the appropriate NRC project manager.

/RA/

Lawrence E. Kokajko, Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

/RA/

Laura A. Dudes, Director
Division of Construction Inspection
and Operational Programs
Office of New Reactors

Technical Contacts: Matthew McConnell, NRR
301-415-1597
E-mail: Matthew.McConnell@nrc.gov

Sergiu Basturescu, NRR
301-415-1237
E-mail: Sergiu.Basturescu@nrc.gov

Note: NRC generic communications may be found on the NRC public Web site, http://www.nrc.gov, under NRC Library.

ADAMS Accession No.: ML122130601 *via e-mail TAC MF0492

OFFICE	NRR/DE/EEEB*	Tech Editor*	NRR/DE/EEEB/BC	NRR/DE/D	NRR/DPR/PGCB/PM
NAME	MMcConnell	CHsu	JAndersen (RMathew for)	PHiland	ARussell
DATE	02/13/13	01/18/13	02/14/13	02/14/13	02/19/13
OFFICE	NRR/DPR/PGCB/LA	NRR/DPR/PGCB/BC	NRO/DCIP/D	NRR/DPR/DD	NRR/DPR/D
NAME	CHawes, (GLappert for)	DPelton	LDudes	SBahadur	LKokajko
DATE	02/19/13	03/04/13	03/14/13	03/18/13	03/19/13

OFFICIAL RECORD COPY