NRR-PMDAPEm Resource

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Subject: Palo Verde Nuclear Generation Plant, Units 1, 2, and 3 - Official EEEB RAIs for LAR Associated with Degraded and Loss of Voltage Relay Modifications (CAC Nos. MF7569, MF7570, and MF7571)

By letter dated April 1, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16096A337), as supplemented by letter dated July 21, 2016 (ADAMS Accession No. ML16203A381), Arizona Public Service Company (the licensee) submitted a license amendment request (LAR) for Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3, requesting an approval to revise the Technical Specifications (TSs). The proposed LAR would revise TS requirements regarding the degraded and loss of voltage relays (DVR and LVR) that are planned to be modified to be more aligned with designs generally implemented in the industry. Specifically, the licensing basis for degraded voltage protection will be changed from reliance on a TS initial condition that ensures adequate post-trip voltage support of accident mitigation equipment to crediting automatic actuation of the DVR and LVR to ensure proper equipment performance. The U.S. Nuclear Regulatory Commission (NRC) Electrical Engineering Branch (EEEB) has the following **official** requests for additional information (RAIs). We transmitted draft RAIs to you on August 31, 2016, and we had a clarification call on September 8, 2016. Please provide your RAI responses within 45 days from the date of this e-mail as agreed during the clarification call. Your timely responses will allow the NRC staff to complete its review on schedule.

Regulatory Requirements and Guidance:

Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 10 CFR 50.36(c), "Technical Specifications" requires that TS include, among other criteria, (1) process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier, and (2) surveillance requirements, which are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met.

General Design Criteria (GDC) 17, states that provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies.

NRC Standard Review Plan (SRP), NUREG-0800, Branch Technical Position (BTP) 8-6, Revision 3, "Adequacy of Station Electric Distribution System Voltages," dated March 2007 (ADAMS Accession No. ML070710478), outlines the purpose of the degraded voltage relays to protect Class 1E safety-related buses from sustained degraded voltage conditions on the offsite power system under accident and non-accident conditions. Specifically, SRP BTP 8-6, Section B.1, and subparagraphs (a) and (b), states that the second level of undervoltage protection should include two separate time delays:

(1) the first time delay should be long enough to establish the existence of a sustained degraded voltage condition (i.e., something longer than a motor starting transient). Following this delay, an alarm in the control room should alert the operator to the degraded condition. The subsequent occurrence of a safety injection actuation signal (SIAS) should immediately separate the Class 1E distribution system from the offsite power system. In addition, the degraded voltage relay logic

should appropriately function during the occurrence of an SIAS followed by a degraded voltage condition, and,

(2) the second time delay should be limited to prevent damage to the permanently connected Class 1 E loads. Following this delay, if the operator has failed to restore adequate voltages, the Class 1 E distribution system should be automatically separated from the offsite power system. The bases and justification for such an action must be provided in support of the actual delay chosen.

Requests for Additional Information

1. Section 2 of the submittal dated April 1, 2016, states that the Surveillance Requirement (SR) 3.3.7.3 would add a note indicating that the SR would only be applicable to Class 1E bus(es) that have not been modified to include a two stage time delay for the DVR , (and therefore its DVR have a single stage time delay) and an inverse time delay for the LVRs. The NRC staff understands that degraded voltage protection for accident and non-accident conditions is provided by the two stage DVRs and the existing single stage relays are still used at PVNGS. Please provide the following:

    a. A tabulated summary of the DVR setpoints (single stage and two stage) and the protective function performed by each relay for the postulated degraded conditions.
    b. A tabulated summary of the LVR setpoints and the protective function performed by each relay for the postulated degraded conditions.
    c. A diagram depicting the transitional, "in-progress," and final configuration of the safety-related buses in light of the DVR modifications discussed in this LAR.

2. Section 3.1.1 of LAR "Degraded Voltage Relay Short Stage Time Delay" states the following:

    > "The new short stage time delay for the DVRs, that is in effect when a SIAS also occurs, has analytical limits of 5.0 and 9.0 seconds. The corresponding allowable values are 5.5 and 8.5 seconds. The time delay is long enough to establish the existence of a sustained degraded voltage condition (i.e., something longer than a motor-starting transient), as described in BTP 8-6, Section B.1, subparagraph (b)(i). The lower analytical limit is based on ensuring the DVR will not trip due to voltage dips during SIAS load starts, which are 5 seconds apart. For an offsite source that is degraded but still allows loads to start, motors will accelerate and voltage will recover above DVR dropout prior to the next sequence step. The corresponding allowable value for the lower analytical limit is 5.5 seconds."

    The NRC Staff understands that the motor start, motor stall and motor withstand capability for all safety related motors was evaluated at the analytical limits for DVR dropout voltage of 3690 volts (V). The DVR will dropout during a motor start as the bus voltage will drop below 3690V. The assumption is that grid voltage may recover and allow the 4160V safety bus voltage to improve to a value above the DVR 'reset' (and not 'dropout' as stated above) voltage (3805V) to reset the relay prior to the next load sequencing. However, from an analytical perspective, the grid voltage should be maintained at degraded conditions to demonstrate the capability of large motors to successfully start and run under degraded voltage conditions at the safety busses. Page 9 of the LAR states, "For the defense-in-depth long stage timer scenario (AFAS [auxiliary feedwater actuation signal] actuation case), the largest motor at each load step was evaluated and shown to be able to start for voltages below the DVR dropout but above a point where the AFAS actuation would cause LVR actuation. If the degraded voltage is below a value where AFAS initiated equipment would successfully operate, the voltage dip from starting the AFP-B motor will cause an LVR actuation, resulting in a LOOP [loss of offsite power] signal and initiating the applicable BOP-ESFAS [balance of plant engineered safety features actuation system] sequence onto the EDG [emergency diesel generator]." The NRC staff understands that motor start and operation between the DVR dropout setpoint and LVR actuation point was analyzed. Please confirm that this methodology was used for the PVNGS DVR analyses.

3. For the scenarios where the voltage decreases below the DVR/LVR dropout setting but does not recover above the DVR/LVR reset setting prior to the DVR/LVR time delay limit being exceeded (DVR/LVR actuates and times out causing automatic disconnection of offsite power and automatic transfer to the onsite power supply), please address the following:

    a. Confirm if a range of initial bus voltages above the DVR dropout voltage was considered to envelope the limiting cases, and explain the methodology used to address this issue.
    b. Confirm whether the safety-related buses are protected in the operating band between the lower limit of the DVR and the upper limit of the LOV, and explain the methodology used to address this issue.

4. BTP 8-6, Section B, Item 2, states that the Class 1E bus load shedding scheme should automatically prevent shedding during sequencing of the emergency loads to the bus. Please confirm if the DVRs and LVRs are bypassed during load sequencing on the onsite emergency diesel generators.

5. Information Notice 95-05, "Undervoltage Protection Relay Settings Out of Tolerance Due to Test Equipment Harmonics," dated January 20, 1995 (ADAMS Accession No. ML031060397), discusses the effect of test equipment harmonics on offsetting relay operating points. Please confirm if the proposed new relays have harmonic filters to preclude spurious actuations due to bus harmonics.

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