UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
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February 21, 2007

EA-06-296

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SUBJECT: FINAL SIGNIFICANCE DETERMINATION FOR A WHITE FINDING AND NOTICE OF VIOLATION - NRC SPECIAL INSPECTION REPORT 05000528/2006-012; 05000529/2006-012; 05000530/2006-012 - PALO VERDE NUCLEAR GENERATING STATION

Dear Mr. Edington:

The purpose of this letter is to provide you the final results of our significance determination of the preliminary White findings identified in the subject inspection report. The NRC's risk informed conclusion is that the violations of NRC requirements discussed in this letter are best characterized as a single White finding, that is, a finding with low to moderate increased importance to safety. Our rationale for this conclusion is discussed in the remainder of this letter.

NRC Inspection Report 05000528; 05000529; 05000530/2006-012 (ML063400561) described the results of the special inspection conducted in response to the failures of the Unit 3, Train A Emergency Diesel Generator (EDG A). This report identified findings involving failures of EDG A to perform its safety function when tested on July 25 and September 22, 2006. These findings also represented two violations of NRC requirements. The first violation involved a failure to develop adequate instructions for corrective maintenance of the EDG A K-1 relay. The second violation involved the failure to identify and correct the cause of erratic K-1 relay operation before installation in the EDG A voltage excitation circuit on July 26, 2006. The K-1 relay is a key component, which must operate properly in order for the EDG's mechanical output to be converted and routed as electricity for safety components during certain types of accidents. These two violations resulted in EDG A not being able to perform its safety function between September 4 and September 22, 2006.

The NRC's preliminary assessment of the safety significance of these inspection findings, which is documented in Attachment 3 of NRC Inspection Report 05000528; 05000529; 05000530/2006-012, resulted in an upper bound increase in core damage frequency (CDF) of 8.5E-6/year, or White and close to the White/Yellow threshold for safety significance. Our preliminary assessment assumed the loss of offsite power (LOOP) initiating event frequency and EDG non-recovery/repair probabilities, as described in NUREG/CR-6890, "Reevaluation of Station Blackout Risk at Nuclear Power Plants, Analysis of Loss of Offsite Power Events: 1986-

2004." The NRC assessment also quantified the risk associated with the 40-day period prior to the failure of EDG A, in which there was a higher probability of failure of the K-1 relay. Finally, we assumed a gas turbine generator (GTG) 1 hour recovery value of 0.1 and a 2-hour battery depletion time for station blackout (SBO) sequences.

At the request of the Arizona Public Service Company (APS), a Regulatory Conference was held on January 16, 2007, to discuss APS's position on the accuracy of, corrective actions for, and safety significance of the findings. In APS's letter dated January 9, 2007 (ML070180148), APS accepted the findings described in NRC Inspection Report 05000528; 05000529; 05000530/2006-012 and indicated that APS had no substantive disagreement with the facts, as documented in the report.

During the Regulatory Conference, APS reiterated its view, which was provided to NRC staff on January 12, 2007, that the violations were Green, which is of very low safety significance. The APS determination was made based on some key assumptions, including that EDG A was unavailable for 18 days between September 4 and 22, 2006; using a LOOP frequency based on historic events in the Western United States; adding a K-1 relay recovery action to the Palo Verde probabilistic risk assessment (PRA) model; using a GTG 1 hour recovery value of 0.16; and completing an analysis which extended the service life of safety and non-safety related batteries from 3 to 7 hours. The extended battery service life was used in the Palo Verde PRA model to: (1) extend the operating time of the auxiliary feedwater system, and (2) increase the probability of recovery actions for starting the GTGs located at the Palo Verde water reclamation facility, as well as, recovery of offsite power or recovery of the EDGs. Using these assumptions, APS stated that the increase in CDF was approximately 3.1E-7/year (Green). The January 16, 2007, Regulatory Conference meeting summary, dated January 26, 2007 (ML070260550), includes a copy of the APS presentation.

During the Regulatory Conference, APS also asserted that adding the risk associated with the 40-day period, in which there was a higher probability of failure of EDG A, to the risk from the 18 days when the EDG was known to be unavailable was, in essence, a double counting of the risk impact. For our final analysis, the NRC only assessed the 18 day period of EDG A unavailability.

APS presented information regarding how long the safety related and non-safety related batteries would function under SBO conditions. The duration of battery operation is a key assumption in assessing the risk of this condition because the longer the batteries function, the higher the probability that electrical power from other sources could be restored before core damage occurs. The design life of the batteries was two hours. The APS PRA model assumed that the safety related batteries would last 3 hours based on generic industry guidance for PRA models. During the Regulatory Conference, APS presented information from an engineering analysis which extended the battery service life to a best estimate value of 7 hours. While the NRC staff determined that there may be some uncertainty associated with aspects of the APS analysis (e.g., the technical basis of the newly analyzed load profile), the NRC staff concluded that APS provided sufficient information to justify a more realistic estimate of battery duration. As a result, the NRC used a 7-hour best estimate of battery duration in the final analysis.

The NRC determined that APS did not provide a sufficient basis to demonstrate that the NRC staff used overly conservative LOOP frequency and EDG non-recovery/repair probability assumptions. The information APS provided did not sufficiently demonstrate that recovery of

the EDG A K-1 relay failure would have been more rapid or probable than that expressed by the time-weighted recovery curves used in the NRC's PRA model for Palo Verde. In particular, the NRC's review of the APS risk analysis identified significant uncertainties in the risk estimates and analysis methods which were inconsistent with Regulatory Guide 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk Informed Activities," and the associated American Society of Mechanical Engineers PRA standard. APS's credit for the EDG A K-1 relay repair relied on appropriate maintenance activities being performed which conflicts with the cause of the underlying performance deficiency (i.e., the failure to perform adequate maintenance on a risk-significant component). Therefore, the NRC determined that the standard values provided in NUREG/CR-6890, which are based on industry EDG experience and provide a more robust statistical basis for completing EDG repairs, should be used.

The NRC determined that the higher LOOP frequency is justified on the basis of the actual operating history at Palo Verde. A LOOP event occurred in June of 2004 when the operational age of the three Palo Verde units was less than 20 years.

During the Regulatory Conference, APS presented information to support the use of a nominal recovery value of 0.16 for starting and aligning the GTGs to the safety related switchgear within 1 hour. The NRC questioned the validity of the nominal recovery value given recent performance deficiencies involving starting and aligning the GTGs to a safety related electrical bus. Specifically, in October 2005, the NRC raised concerns associated with testing of the GTGs and the amount of time required to align a GTG to a safety related electrical bus. In May 2006, operations personnel failed to properly align the GTGs to the Unit 3 Train A safety bus resulting in a loss of power and automatic start of EDG A. The underlying causes involved the adequacy of procedures for aligning the GTGs and training of water reclamation and operations personnel. APS completed corrective actions for these issues in November 2006. In December 2006, APS identified additional concerns associated with the time required for water reclamation personnel to start and align the GTGs.

In February 2007, following the Regulatory Conference, APS completed a timing study of the starting and electrical alignment of the GTGs by four different operating crews during a simulation of the implementation of the SBO emergency operating procedure. The timing study revealed that none of the crews could align the GTGs to the electrical safety bus within 1 hour. The underlying factors associated with the delay involved work processes, procedure adequacy, training, and the complexity of the task.

Given the problems associated with GTG operation, the NRC determined that an increase in the 1 hour recovery value for the GTG was appropriate. Using the NRC's method for assessing performance shaping factors, the NRC determined that the best estimate value in the model for recovery of the GTG within 1 hour was between a lower bound of 0.23 and an upper bound of 0.6. Using the NUREG/CR-6890 assumptions, a 7 hour battery life, 18 days of EDG A unavailability, and a 0.23 GTG recovery value, the APS model yielded a delta CDF of approximately 1.1E-6/year. With a GTG recovery value of 0.6, the APS model yielded a delta CDF of approximately 1.8E-6/year. These values closely aligned with the results obtained from the NRC's analysis.

After careful consideration of the information provided at the Regulatory Conference, the information provided in your letter of January 9, 2007, and the information provided in your subsequent letter of January 24, 2007 (ML0703900400), the NRC determined that the best approximation of the safety significance of the EDG A failures is in the range of 1.1E-6/year to 1.8E-6/year. Therefore, the NRC has concluded that this issue is appropriately characterized as White, that is, a finding with low to moderate increased importance to safety.

The actual safety significance of these findings could have been much greater. In response to the degraded spray pond issues described in NRC Inspection Report 05000528; 05000529; 05000530/2006-011 (ML062710607), APS implemented corrective actions to increase the monthly EDG testing frequency to approximately once every two weeks to monitor the rate of fouling of the EDG heat exchangers. If it had not been for the increased testing of the EDGs, then EDG A would not have been able to perform its safety function for as long as 38 days before the discovery of the latent failure through Technical Specification required surveillance testing.

You have 30 calendar days from the date of this letter to appeal the staff's determination of significance for the White finding. Such appeals will be considered to have merit only if they meet the criteria in NRC Inspection Manual Chapter 0609, "Significance Determination Process," Attachment 2, "Process for Appealing NRC Characterization of Inspection findings (SDP Appeal Process)."

As previously discussed, the NRC determined that the failure to establish appropriate instructions for performing corrective maintenance activities on a K-1 relay and the failure to identify and correct the cause of erratic K-1 relay operation prior to installation in the EDG A voltage regulator circuit and returning EDG A to service represent violations of 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," and 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," respectively. The violations are cited in the enclosed Notice of Violation (Notice). In accordance with the NRC Enforcement Policy, the Notice is considered escalated enforcement action because it is associated with a White finding.

APS's January 9, 2007, letter also indicated that the root causes associated with the EDG A failures involved: (1) inconsistent equipment root cause of failure program management, resulting in varying degrees of document quality, (2) no formal problem solving and troubleshooting process in place to establish evaluation consistency, (3) inconsistent management reinforcement of the equipment root cause of failure application methodology resulting in inconsistent evaluation quality, and (4) inconsistent application of a problem solving methodology, as evidenced by varying degrees of rigor in root cause of failure determinations. APS's corrective actions included, in part: (1) planning to replace all EDG automatic voltage regulators, including replacement of the K-1 relays, with a different design during the next refueling outage for each unit, (2) assessing and improving the equipment root cause of failure analysis program, (3) developing a troubleshooting and problem solving process to be used by operations, maintenance, and engineering, (4) establishing a quality checklist for engineering product review board and corrective action review board assessments of engineering root cause of failure evaluations, and (5) training selected personnel on the new troubleshooting and problem solving process. On the basis of the information provided in the January 9, 2007 letter, the NRC has determined that no additional response to the enclosed Notice is required.

The NRC notes that the root causes for the EDG A failures are similar to the causes associated with other recent inspection findings, and to findings documented in NRC inspection reports and assessments since 2004. For example, troubleshooting and problem solving processes lacked the technical rigor necessary to ensure deficiencies were properly identified and resolved. The NRC's determination that station personnel were not providing adequate technical rigor during the evaluation of degraded or failed structures, systems, and components was a significant factor in the NRC's decision to hold open the Yellow finding associated with voiding of the emergency core cooling system that was documented in our letters dated January 27, 2006 (ML060300193), and October 11, 2006 (ML062840601). Additionally, the lack of technical rigor by personnel contributed to the failure of the spray pond chemistry controls and the resultant fouling of safety-related heat exchangers supplied by the spray pond as documented in our December 22, 2006 letter (ML063600175). As stated in our December 22, 2006 letter, these performance deficiencies indicate that your performance improvement initiatives have not been effective. Therefore, the NRC will continue to monitor your progress in implementing performance improvement initiatives to address the area of technical rigor during future inspections.

In addition, we will use the NRC Action Matrix to determine the most appropriate NRC response and any increase in NRC oversight, or actions you need to take in response to the most recent performance deficiencies. We will notify you by separate correspondence of that determination.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. The NRC also includes significant enforcement actions on its Web site at www.nrc.gov; select **What We Do**, **Enforcement**, then **Significant Enforcement Actions**.

Sincerely,

/RA/

Bruce S. Mallett
Regional Administrator

Docket Nos. 50-528; 50-529; 50-530
License Nos. NPF-41; NPF-51; NPF-74

Enclosure: Notice of Violation

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NOTICE OF VIOLATION

Arizona Public Service Company
Palo Verde Nuclear Generating Station

Docket No. 50-530
License No. NPF-74
EA-06-296

During an NRC inspection completed November 30, 2006, violations of NRC requirements were identified. In accordance with the NRC Enforcement Policy, the violations are listed below:

A. 10 CFR Part 50, Appendix B, Criterion V, “Instructions, Procedures, and Drawings,” states, in part, that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings.

Contrary to the above, between July 25 and September 22, 2006, activities affecting quality were not prescribed by documented instructions appropriate to the circumstances. Specifically, the licensee failed to develop appropriate instructions or procedures for corrective maintenance activities on the Unit 3, Train A Emergency Diesel Generator K-1 relay. This resulted in the emergency diesel generator being inoperable between September 4 and September 22, 2006.

B. 10 CFR Part 50, Appendix B, Criterion XVI, “Corrective Action,” states, in part, that for significant conditions adverse to quality, measures shall assure that the cause of the condition is determined and corrective action taken to preclude repetition.

Contrary to the above, on July 26, 2006, the licensee failed to assure that the cause of a significant condition adverse to quality was determined and that corrective action was taken to preclude repetition. Specifically, the licensee did not identify and correct the cause of the erratic Unit 3, Train A Emergency Diesel Generator K-1 relay operation prior to installation of the relay on July 26, 2006. This resulted in the emergency diesel generator being inoperable between September 4 and September 22, 2006.

These violations are associated with a White SDP finding.

The NRC has concluded that information regarding the reason for the violations, the corrective actions taken and planned to correct the violation and prevent recurrence and the date when full compliance will be achieved is already adequately addressed on the docket in your letter dated January 9, 2007 (ML070180148). However, you are required to submit a written statement or explanation pursuant to10 CFR 2.201, if the description therein does not accurately reflect your corrective actions or your position. In that case, or if you choose to respond, clearly mark your response as a "Reply to a Notice of Violation," include the EA number, and send it to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001 with a copy to the Regional Administrator, Region IV, and a copy to the NRC Resident Inspector at the facility that is the subject of this Notice, within 30 days of the date of the letter transmitting this Notice of Violation (Notice).

Enclosure

If you choose to respond, your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's document system (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. Therefore, to the extent possible, the response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the Public without redaction.

In accordance with 10 CFR 19.11, you may be required to post this Notice within two working days.

Dated this 21st day of February 2007