

January 3, 2017

MEMORANDUM TO: Robert J. Pascarelli, Chief  
Plant Licensing Branch IV  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

FROM: Sunil D. Weerakkody, Chief */RA/*  
PRA Operations and Human Factors Branch  
Division of Risk Assessment  
Office of Nuclear Reactor Regulation

SUBJECT: SAFETY EVALUATION INPUT REGARDING THE PALO VERDE  
NUCLEAR GENERATING STATION UNIT 3 EMERGENCY  
REQUEST TO EXTEND DIESEL GENERATOR 3B COMPLETION  
TIME (CAC NO. MF9019)

By letter dated December 30, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML16365A240), Arizona Public Service Company (APS), the licensee for Palo Verde Nuclear Generating Station (PVNGS) Unit 3, submitted an emergency license amendment request (LAR) requesting approval for an extension, on a one-time basis, of the Technical Specifications (TS) required action 3.8.1.B.4 completion time from 21 days to 62 days, for the purpose of completing repairs and testing, to re-establish operability of the Unit 3 train 'B' diesel generator. The Probabilistic Risk Assessment Operations and Human Factors Branch (APHB) staff has reviewed the human performance aspects of these submittals and finds the proposed LAR acceptable for implementation. The APHB staff's safety evaluation input is enclosed.

Enclosure:  
Safety Evaluation

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SAFETY EVALUATION INPUT REGARDING THE PALO VERDE NUCLEAR GENERATING STATION UNIT 3 EMERGENCY REQUEST TO EXTEND DIESEL GENERATOR 3B COMPLETION TIME (CAC NO. MF9019)

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**SAFETY EVALUATION INPUT REGARDING**  
**THE PALO VERDE NUCLEAR GENERATING STATION UNIT 3 EMERGENCY REQUEST**  
**TO EXTEND DIESEL GENERATOR 3B COMPLETION TIME (CAC NO. MF9019)**

**1.0 INTRODUCTION**

By letter dated December 21, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML16356A689), and supplemented by letter dated December 23, 2016 (ADAMS Accession Number ML16358A715), Arizona Public Service Company (APS), the licensee for Palo Verde Nuclear Generating Station (PVNGS) Unit 3, submitted an emergency deterministic license amendment request (LAR) to extend the Technical Specification (TS) required action 3.8.1.B.4 completion time from 10 days to 21 days, for the purpose of collecting and analyzing data associated with the diesel generator (DG) engine failure and to continue repair of the Unit 3 train 'B' emergency diesel generator (3B DG). The NRC staff issued LAR Number 199 for Unit 3 by letter dated December 23, 2016 (ADAMS Accession Number ML16358A676).

By letter dated December 30, 2016 (ADAMS Accession Number ML16365A240), APS submitted an emergency risk-informed LAR, requesting approval for an extension, on a one-time basis, of the TS required action 3.8.1.B.4 completion time from 21 days to 62 days, for the purpose of completing repairs and testing, to re-establish operability of the 3B DG.

By letter dated January 1, 2017 (ADAMS Accession Number ML17003A018), the NRC staff submitted a request for additional information (RAI). By letter dated January 2, 2017 (ADAMS Accession Number M17002A001), APS provided responses to the RAI. The Probabilistic Risk Assessment Operations and Human Factors Branch (APHB) staff have reviewed the human performance aspects of the APS submittal, and summarized the results below.

**2.0 REGULATORY EVALUATION**

The regulatory requirements and guidance which the NRC staff considered in its review of the LAR are as follows:

- 2.1 Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," *Criterion 19 – Control room*;
- 2.2 10 CFR 50.34(f), *Additional TMI-related requirements*;
- 2.3 10 CFR 50.120, "Training and qualification of nuclear power plant personnel;"
- 2.4 NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition." Chapter 18, Revision 2 provides review guidance for "Human Factors Engineering;"
- 2.5 NUREG-1764, "Guidance for the Review of Changes to Human Actions," Revision 1;

ENCLOSURE

- 2.6 NUREG-0700, "Human-System Interface Design Review Guidelines," Revision 2;
- 2.7 NUREG-0711, "Human Factors Engineering Program Review Model," Revision 3;
- 2.8 NUREG-0737, "Clarification of TMI Action Plan Requirements;"
- 2.9 Information Notice 97-78, "Crediting Operator Actions in Place of Automatic Actions and Modifications of Operator Actions, Including Response Times."

### **3.0 TECHNICAL EVALUATION**

#### **3.1 Description of Operator Action(s) and Assessed Safety Significance**

The licensee stated in their December 30, 2016 submittal that during the extended unavailability period of the 3B DG, APS will continue to deploy portable diesel generators connected to the 4.16 kV AC FLEX connection box that can supply the 'B' train 4.16kV Class 1E bus, as approved by the NRC license amendment number 199 for PVNGS Unit 3, dated December 23, 2016.

At steady state, full power operation, the 4160 VAC portable generators will be staged and connected to train 'B.' In the event of the loss of offsite power (LOOP), station blackout (SBO), and/or loss of power to Class 1E bus PBB-S04, Train 'B' EDG is unavailable, and Station Blackout Generators (SBOGs) fail to either start or load, operators will have to take manual actions to start the 4160 VAC portable generators, to provide power to PBB-S04 and start an auxiliary feedwater pump. Prior to any need to start the 4160 VAC portable generators, power will be supplied to the portable generator jacket water heaters, which will allow a fast start of 10 seconds or less. In the event of loss of all feedwater (main feedwater, auxiliary feedwater, and alternate feedwater), the operators will be required to cross-connect fire protection (FP) system and auxiliary feedwater (AF) system, in order to successfully feed the steam generator, to provide cooling to at least one steam generator, within 75 minutes following the start of a loss of all feedwater accident.

In accordance with the generic risk categories established in NUREG-1764, these actions are considered "risk-important" due to the fact that their failure could potentially complicate a LOOP, SBO, or loss of all feedwater accident by challenging the heat removal capability needed to put Unit 3 in a safe shutdown condition. Because of its high risk importance, the APHB staff performed a "Level One" review, i.e., the most stringent of the graded reviews possible under the guidance of NUREG-1764.

#### **3.2 Operating Experience Review**

The licensee stated in their submittal dated December 30, 2016 that they will deploy three portable DGs at Unit 3 connected to the 4.16 kV FLEX connection box that can supply the train 'B' 4.16 kV AC Class 1E bus, for the extended duration of TS completion time. The operations staff have received training for operation of the FLEX 1 and FLEX 2 DGs, as they were installed (pre-staged, on-site) in 2016. However, the licensee does not possess actual operating experience using the FLEX DGs.

Since the proposed temporary configuration with the use of FLEX DGs is unanticipated condition, due the failure of 3B DG, it is not reasonable to expect that the licensee would have

actual operating experience using the portable DGs for purposes other than mitigation of beyond design basis accidents. Therefore, this element was not reviewed further by the staff.

### 3.3 Functional Requirements Analysis and Function Allocation

The functions that must be performed to satisfy PVNGS Unit 3 power generation and safety goals are not affected by the change described in the proposed LAR. Therefore, no additional functional requirements analysis or function allocation are necessary. The staff finds this position to be acceptable.

### 3.4 Task Analysis

Most of the task requirements described in the licensee's original task analysis remain unchanged. New tasks associated with the changes described in the proposed LAR include pre-start checks of the portable generators (to be performed once per shift, each shift), starting the portable generators and performing the required electrical system alignments, as directed by the control room operators, to restore the power to the 'B' train Class 1E 4.16 kV bus using portable generators, and monitoring the operation of portable generators. These new tasks will be performed by an additional, dedicated auxiliary operator (AO) on each shift, who will not have any other duties assigned during the extended completion time. As such, no additional operational or cognitive burden is expected for the control room operations staff, other than occasional communication with the dedicated AO, as needed.

The staff concludes that with the use of additional dedicated AO, the additional workload to the operators will be minimal and will not prevent them from accomplishing their tasks. The staff finds this aspect of the proposed LAR to be acceptable.

### 3.5 Staffing

The licensee stated in their December 30, 2016 submittal, and further clarified in their response to APHB RAI-2, that an additional, dedicated auxiliary operator (AO) will be added to each shift, to implement the modification that cross-ties fire water to the train 'N' auxiliary feedwater system. The additional AO on each shift will also perform pre-start check of the portable generators each shift. This dedicated AO will perform the emergency start of the portable generators, when directed, and monitor their operation. The dedicated AO will have no other assigned duties during the extended completion time.

In the event of a reactor trip with a loss of off-site power, the Area 4 (Control Building) AO will perform the required electrical system alignments, as directed by the control room, to restore power to the 'B' train Class 1E 4.16 kV bus using the portable generators, in accordance with station procedures.

In the event of a reactor trip with a loss of off-site power, one of the on-shift reactor operators will be assigned to perform and direct actions to restore power to the 'B' train Class 1E 4.16 kV bus using the portable generators. During the event, this reactor operator will not be assigned other duties until completion of power restoration.

The licensee provided additional information regarding the total number of trained personnel that will be available to perform the duties of dedicated AO for the duration of the extended TS completion time; for more information, see Section 3.9 of this Safety Evaluation.

There are no other changes to operator staffing proposed by the licensee, in connection with the subject LAR. The staff concludes that the addition of a dedicated AO, with the duties limited to those as described above, to be adequate for the purpose of ensuring that, in the event of an accident involving the loss of preferred power, sufficient trained personnel will be available to perform the time-critical manual action. The staff finds this aspect of the proposed LAR to be acceptable.

### 3.6 Probabilistic Risk Assessment and Human Reliability Analysis

The review of PRA and HRA conducted by the licensee to evaluate changes proposed in this LAR was performed by APLA and is addressed in a separate safety evaluation input.

### 3.7 Human-System Interface Design

There are no changes to the control room Human-System Interface (HSI) design required in connection with the proposed LAR. Therefore, no further evaluation of review element is necessary. The staff finds this position to be acceptable.

### 3.8 Procedure Design

In response to APHB RAI-1.a, the licensee stated that the following three emergency operating procedures (EOPs) were revised, in order to improve efficiency and clarity of procedure guidance on the use of compensatory measures, such as the use of portable DGs and FP to AF system cross-connect. The revised procedures were identified as follows:

- 40MT-9ZZ01, Operations Maintenance Activities, was revised to improve operator response.
- 40EP-9EO06, Loss of All Feedwater, step 6.1 was revised to direct use of Functional Recovery Procedure, 40EP-EO09, Standard Appendix 118, to facilitate more timely restoration of feedwater when the FP to AF cross-connection is needed.
- 40EP-9EO10, Standard Appendices – Standard Appendix 118, Cross-connect FP to AF, was revised to provide comprehensive guidance on how to align the flow path and establish the feedwater flow from the fire protection header, including steps to align the feedwater system, select and depressurize a steam generator, establish a makeup to the reactor coolant system (RCS), start FP system pumps, and control bands for the steam generator water level and pressure. This change streamlines the actions by bringing all necessary guidance to establish feedwater from the FP header into one appendix, allowing different sections of the appendix to be executed concurrently, if required.

The licensee further noted that procedure 40EP-9EO09, Functional Recovery Procedure, could also be implemented during this event, however, a revision to the procedure was not required because it already contains direction for use of Standard Appendix 118.

The staff reviewed the information provided by the licensee regarding the revisions made to the affected procedures. The staff finds the changes are appropriate as they adequately address the changes in the use of portable DGs for the duration of the extended completion time and the associated manual operator actions. Therefore, the staff finds this aspect of the proposed LAR to be acceptable.

### 3.9 Training Program Design

Section 4.5, Operator Training, in the Enclosure to the APS submittal dated December 30, 2016, the licensee states that operators are trained on the strategies and hierarchy of procedures for LOOP that specify the use of alternate power sources, including the portable DGs. Further, in Section 4.3.1, the licensee stated that the use of cross-connect is proceduralized in the EOPs and is further described in the Unit 3 Operations Night Order, to emphasize the importance of timely use of this success path, if necessary to prevent core damage.

In their response to APHB RAI-2, the licensee stated that Night Orders are part of the formal shift turnover process and are required to be reviewed by the control room staff, at each shift. The Night Order process was selected as one of the methods to communicate important background information to on-shift operations personnel regarding the use of compensatory measures during the extended completion time, while 3B DG is out of service. Each dedicated AO will be required to complete a physical walkdown with the shift manager or designee, prior to assuming the dedicated FLEX diesel generator watch. The walkdown will be performed in the filed using operating instructions. Also, at the beginning of each shift, the shift manager will discuss the content of the Night Order and required compensatory actions with the dedicated operators and other operations staff. Each dedicated operator will be required to review the specific guidance document for the assigned compensatory actions, to ensure that no changes have been made and to ensure adequate understanding of actions. Each dedicated AO will performed a walkdown of their assigned equipment, verify equipment configuration, and perform pre-start checks for the portable DGs.

In their response to APHB RAI-3, the licensee stated that as of January 1, 2017, forty seven (47) AOs have received the initial briefing and focused walkdown with a shift manager or designee, and are proficient to perform the responsibilities of the dedicated portable DG operator position. Additional operators will become proficient when they complete the briefings and focused walkdowns, as additional operations crews rotate in accordance with the five-week operations crew rotation schedule. The briefings and focused walkdowns performed to ensure AO proficiency with the configuration of portable DG equipment as described in the proposed LAR included the FLEX 1 and 2 DGs, as well as the rental DG (as shown in Figure 4, in the Enclosure to the letter dated December 30, 2016). The licensee further stated that all three DGs have similar controls and hard card instructions, and use an automatic synchronization feature. The actions required to start the diesel engine and close the output breaker on each of the three DGs are the same.

In their response to APHB RAI-4, the licensee stated that, based on the nature of the operator actions needed in the event of a loss of feedwater or loss of all power, the implementation of 'continual focus' (i.e., discussing, reviewing, and walking down important actions every shift) was chosen, in lieu of a one-time training activity, such as a Job Performance Measure (JPM). The licensee further stated that this was done to provide additional rigor and maintain a heightened state of readiness to promptly initiate the assigned compensatory actions, throughout the 62-day extended completion time.

The staff concludes that the training on the use of compensatory measures, including the implementation of 'continual focus' strategy with shift briefings and the use of Night Orders, for the duration of the extended completion time is appropriate, and that sufficient number of

operations staff have received the requisite training. Therefore, the staff finds this aspect of the proposed LAR to be acceptable.

### 3.10 Human Factors Verification and Validation

In their response to APHB RAI-1.b, the licensee stated that two simulator sessions were used to evaluate and validate proposed changes to the EOPs. The first simulator session was staffed with shift operations personnel, and the second simulator session was staffed with shift operations and operations training personnel. Based on the results of the simulator sessions, additional enhancements were made to the procedures, to improve recovery time.

Additional operator walkthroughs of procedure 40MT-9ZZ01 were conducted in December, and further enhancements were made to the procedure, based on the walkthrough results. The maximum observed implementation time for the enhanced 40MT-9ZZ01 procedure during operator walkthroughs conducted in December 2016 was 23 minutes.

The staff concludes that the use of simulator runs, operator walkthroughs, and the use of iterative process to implement further enhancements following operator briefings is appropriate. The staff finds that this process for verification and validation of operator actions is acceptable.

### 3.11 Human Performance Monitoring Strategy

The change proposed by the licensee is a one-time, temporary extension of the TS required action 3.8.1B.4 completion time, from 21 days to 62 days. Because 3B DG would not be expected to be operated under normal, non-accident conditions, and during the period of unavailability of 3B DG, the FLEX portable DGs are also not expected to be operated, except for in case of an accident, long-term human performance monitoring strategy is considered to be neither viable nor necessary. The staff finds this position to be acceptable.

## **4.0 CONCLUSION**

Based on the statements provided by the licensee that: (1) an additional auxiliary operator will be dedicated on each shift to start the portable generators, if required, perform the required electrical system alignments, and monitor the performance of portable generators; (2) the appropriate emergency operating procedures were revised to reflect the use of portable generators in lieu of 3B DG, during the extended completion time; (3) sufficient number of operations staff received adequate training on the use of the revised emergency operating procedures; and (4) the licensee performed sufficient number of operator walk-throughs with revised procedures to verify that the required actions can be accomplished within the allowable time frame, the APHB staff finds the licensee's proposed LAR acceptable, from the human performance prospective.

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