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Submitter Information

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Organization: APS

General Comment

See attached file(s)

Attachments

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Add = K. Miller (KMM4)

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Palo Verde Nuclear Generating Station

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U.S. Nuclear Regulatory Commission
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Dear Sirs:

Subject: Docket ID NRC-2011-0013
Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket Nos. STN 50-528/529/530
Comments on Proposed Generic Communication
Draft NRC Regulatory Issue Summary 2011-XX
Adequacy of Station Electric Distribution System Voltages

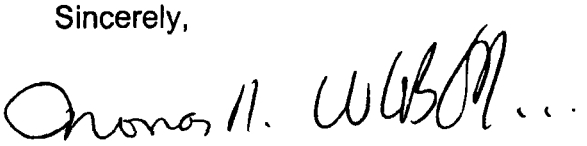
Federal Register Notice (76 FR 2924), dated Tuesday, January 18, 2011, provided an opportunity for public comment on the proposed generic communication, Draft NRC Regulatory Issue Summary (RIS) 2011-XX, *Adequacy of Station Electric Distribution System Voltages*. Comments were originally requested within 30 days, but the comment period was extended to March 19, 2011, by Federal Register Notice (76 FR 10072), dated Wednesday, February 23, 2011. The Enclosure to this letter provides the Arizona Public Service Company (APS) comments for the Palo Verde Nuclear Generating Station (PVNGS).

APS concurs with the generic industry comments provided by the Nuclear Energy Institute (NEI) and the Strategic Teaming and Resource Sharing (STARS) Alliance. Additionally, APS is providing plant specific comments to address the NRC inspection findings referenced in the draft RIS related to PVNGS.

APS believes that it is essential that the industry and NRC continue with an open and candid dialog to reach consensus on the optimum approach for addressing degraded voltage vulnerabilities.

No commitments are being made to the NRC by this letter. Should you need further information regarding these comments, please contact Russell A. Stroud, Licensing Section Leader, at (623) 393-5111.

Sincerely,



TNW/RAS/CJS/gat

Enclosure: PVNGS Comments on Proposed Generic Communication, Draft NRC Regulatory Issue Summary 2011-XX, *Adequacy of Station Electric Distribution System Voltages*

cc:	E. E. Collins Jr.	NRC Region IV Regional Administrator (enclosure)
	L. K. Gibson	NRC NRR Project Manager for PVNGS (enclosure)
	J. R. Hall	NRC NRR Senior Project Manager (enclosure)
	M. A. Brown	NRC Senior Resident Inspector for PVNGS (enclosure)

ENCLOSURE

PVNGS Comments on Proposed Generic Communication

Draft NRC Regulatory Issue Summary 2011-XX

Adequacy of Station Electric Distribution System Voltages

PVNGS Comments on Proposed Generic Communication
Draft NRC Regulatory Issue Summary 2011-XX
Adequacy of Station Electric Distribution System Voltages

Introduction

Federal Register Notice (76 FR 2924), dated Tuesday, January 18, 2011, provided an opportunity for public comment on the proposed generic communication, Draft NRC Regulatory Issue Summary (RIS) 2011-XX, *Adequacy of Station Electric Distribution System Voltages*. Comments were originally requested within 30 days, but the comment period was extended to March 19, 2011, by Federal Register Notice (76 FR 10072), dated Wednesday, February 23, 2011. The Enclosure to this letter provides the Arizona Public Service Company (APS) comments for the Palo Verde Nuclear Generating Station (PVNGS).

APS concurs with the generic industry comments provided by the Nuclear Energy Institute (NEI) and the Strategic Teaming and Resource Sharing (STARS) Alliance. Additionally, APS is providing plant specific comments to address the NRC inspection findings referenced in the draft RIS related to PVNGS.

APS believes that it is essential that the industry and NRC continue with an open and candid dialog to reach consensus on the optimum approach for addressing degraded voltage vulnerabilities. As part of this dialog, it is recommended that the NRC staff clarify the specific sequence of events that form the basis for the degraded voltage regulatory guidance. Obtaining a common understanding of the scenarios of concern can be the starting point for selecting the appropriate technical approach for issue resolution.

The comments are numbered sequentially, with headings to separate the various types of comments (i.e., General Comments, Technical Comments, and PVNGS Specific Comments). It is requested that the NRC staff assess these comments and take appropriate action to modify or not pursue the draft RIS.

APS supports the NRC objective of consistent and clear regulation. Additional time and effort in support of that objective seems appropriate at this point in the evaluation of this issue.

General Comments

1. The draft RIS asserts that there is a simple and singular set of design criteria that have been applied universally to the industry.

   Over the years the degraded voltage performance requirements have changed, as a specific issue, and on a component basis (e.g., motor operated valves and contactors), for individual nuclear power plants. As a result, each nuclear power plant has specific licensing bases, and there is no singular set of requirements that have been applied universally to the industry. In this regard, PVNGS is particularly unique, as will be discussed further in the detailed comments that follow.

PVNGS Comments on Proposed Generic Communication
Draft NRC Regulatory Issue Summary 2011-XX
Adequacy of Station Electric Distribution System Voltages

2. The draft RIS asserts that the guidance provided to the industry to address the Millstone and other degraded voltage events adequately addresses this potential common mode failure. The common mode failure potential is that multiple trains of safety equipment could be simultaneously negatively impacted if off-site power is degraded.

   The deterministic guidance provided does not appear to effectively address integrated plant response nor preclude a Millstone type event. The use of degraded voltage relays to address this potential failure mode is not consistent with operating experience and lacks adequate technical basis as described in the detailed technical comments that follow.

Technical Comments

3. The draft RIS (page 6 of 10) states:

   > "The staff considers degraded voltage conditions coincident with a postulated design basis accident to be a credible event."

   It is our understanding that the established staff interpretation is that this is not a credible event, as discussed and supported by analysis in NUREG-0933, Supplement 33, dated August 2010, *Resolution of Generic Safety Issues*, Issue 171, *ESF Failure from LOOP Subsequent to a LOCA*, and Brookhaven National Laboratory NUREG/CR-6538 (BNL-NUREG-52528), *Evaluation of LOCA With Delayed Loop and Loop With Delayed LOCA Accident Scenarios, Technical Findings Related to GSI-171, 'ESF Failure from LOOP Subsequent to LOCA'* published July 1997. This appears to be a new staff interpretation and no documented analysis is provided to support it. Therefore, if the scenario <u>is</u> credible, as the draft RIS asserts, then GSI-171 is not adequately resolved and should be reevaluated.

   Section 3 of the summary of the resolution of GSI-171 states:

   > "The loss of generation from the LOCA unit can also result in degraded voltage at the unit switchyard, resulting in actuation of degraded voltage protection and subsequent total LOOP."

   The summary of the resolution of GSI-171 discusses a number of possible plant failure mechanisms associated with this event: diesel generator damage, circuit breaker lockout, sequencer lockup, drain-back in coolant systems, water hammer, and electrical system overloading. It models these as "a failure of ECCS in the event of LOCA with no possibility of recovery." It concludes: "the issue is resolved with no new requirements."

PVNGS Comments on Proposed Generic Communication
Draft NRC Regulatory Issue Summary 2011-XX
Adequacy of Station Electric Distribution System Voltages

Although the summary of the resolution of this issue does not impose any new requirements, it provides three 'possible solutions' or alternatives:

(1) Analyze and reset protective relaying and control circuitry to respond properly to a LOOP during ESF sequencing.

(2) Analyze coolant systems to verify that a loss and restoration of power will not result in water hammer, cavitation, or other potentially damaging conditions.

(3) Analyze power transmission system and plant electrical distribution system capability under ESF sequencing conditions to demonstrate sufficient system capability.

The draft RIS does not describe this third alternative. APS is not aware of an analysis that demonstrates that either of the first two options is viable.

PVNGS operating experience (LER 50-528/529/530-93-011) identified the limitations of the degraded voltage (second level) protection scheme. The actual integrated plant response to a degraded voltage event is different than the response predicted by deterministic methods. The design approach of using relays to react solely to voltage is not capable of ensuring adequate protection for accident mitigation equipment. Since the relays see only voltage, and not off-site power capacity, accident mitigation equipment is initially always powered from the preferred off-site power sources, regardless of their capacity. If off-site power sources do not have sufficient capacity (which will lead to a reduction in voltage), the accident mitigation equipment loads are stripped from the bus and re-loaded using the on-site power sources, after a time delay. This design will always, if voltage or capacity is degraded, result in a delay in accident mitigation, and can also lead to accident mitigation equipment performance difficulties (e.g., water hammer, etc.) that have not been formally analyzed.

As a result of this operating experience, APS took the initiative to preclude such an outcome by establishing initial plant conditions that ensure adequate off-site power voltage and capacity. These initial conditions are implemented by Technical Specification (TS) Limiting Condition for Operation (LCO) 3.8.1, Condition G. This approach, while different from the deterministic guidance, is more realistic and risk informed. Controlling the plant initial conditions, such that the off-site power sources have adequate voltage and capacity, is a technically sound approach.

Should, however, the likelihood of a coincident degraded voltage event with a design basis accident remain a concern, despite the existence of the NUREG/CR-6538 and the GSI-171 resolution, the degraded voltage scenarios should be reassessed with actual plant transient response. The objective of such a reassessment would be to develop a predictive relaying design that would be realistic and effective, rather than trying to enhance the existing 'generic' requirements.

4. The recent licensing actions in the industry which have mandated setpoint changes for the degraded voltage relays (DVRs) and loss of voltage relays (such as the one cited in the draft RIS for Fermi-2) only serve to increase the probability of the 'ESF Failure from LOOP Subsequent to a LOCA' event discussed in NUREG/CR-6538 without providing an advantage for any credible scenario. As such, these changes may increase core damage frequency (CDF).

   The risk significance of offsite power voltage issues was analyzed in NUREG/CR-6538 to support resolution of GSI-171. NUREG/CR-6538 evaluated Loss of Coolant Accidents (LOCA) with delayed Loss of Offsite Power (LOOP) and LOOP with delayed LOCA. The evaluation in NUREG/CR-6538 indicated that LOCA with delayed LOOP scenarios can be risk significant for pressurized water reactors (i.e., CDF contribution between 1.2E-04/yr to 2.8E-6/yr). Palo Verde addresses this risk by minimizing the potential for this condition through a prevention strategy in accordance with TS LCO 3.8.1, Condition G. For LOOP with delayed LOCA scenarios, which are dominated by stuck open pressurizer safety valve scenarios, NUREG/CR-6538 indicates the CDF contribution from these scenarios to be lower than estimated in Individual Plant Examination (IPE) submittals and are not a vulnerability for most plants. Specifically for PVNGS, the CDF contribution from LOOP with delayed LOCA is less than 1E-8/yr. Thus, based on the evaluation in NUREG/CR-6538 and a Palo Verde plant specific analysis, the current strategy for addressing offsite power voltage degradation at Palo Verde appears adequately safe from a risk-informed perspective.

   It is APS's understanding that a comprehensive review of guidance related to degraded grid voltage has not been performed using the cost-benefit and risk criteria of 10 CFR 50.109 (backfit rule), nor is it apparent that risk insights have been used to inform this guidance.

5. The draft RIS does not address the implication of the Branch Technical Position (BTP) PSB-1 requirement that "The Class 1E bus load shedding scheme should automatically prevent shedding during sequencing of the emergency loads to the bus." A large variety of voltage conditions could exist during the sequencing period while the shedding is blocked, and no analytical methods are discussed that could demonstrate that equipment damage or malfunction would not occur.

6. In light of the summary of the resolution of GSI-171, the draft RIS statement (page 7 of 10) that "(t)he time-delays(s) chosen for DVRs during accident conditions should meet the accident analysis assumptions..." does not seem appropriate. The degraded voltage condition could occur at various times during the initial energization of the accident mitigation equipment, and the relay time delay value only affects the additional time until the subsequent LOOP occurs.

PVNGS Comments on Proposed Generic Communication
Draft NRC Regulatory Issue Summary 2011-XX
Adequacy of Station Electric Distribution System Voltages

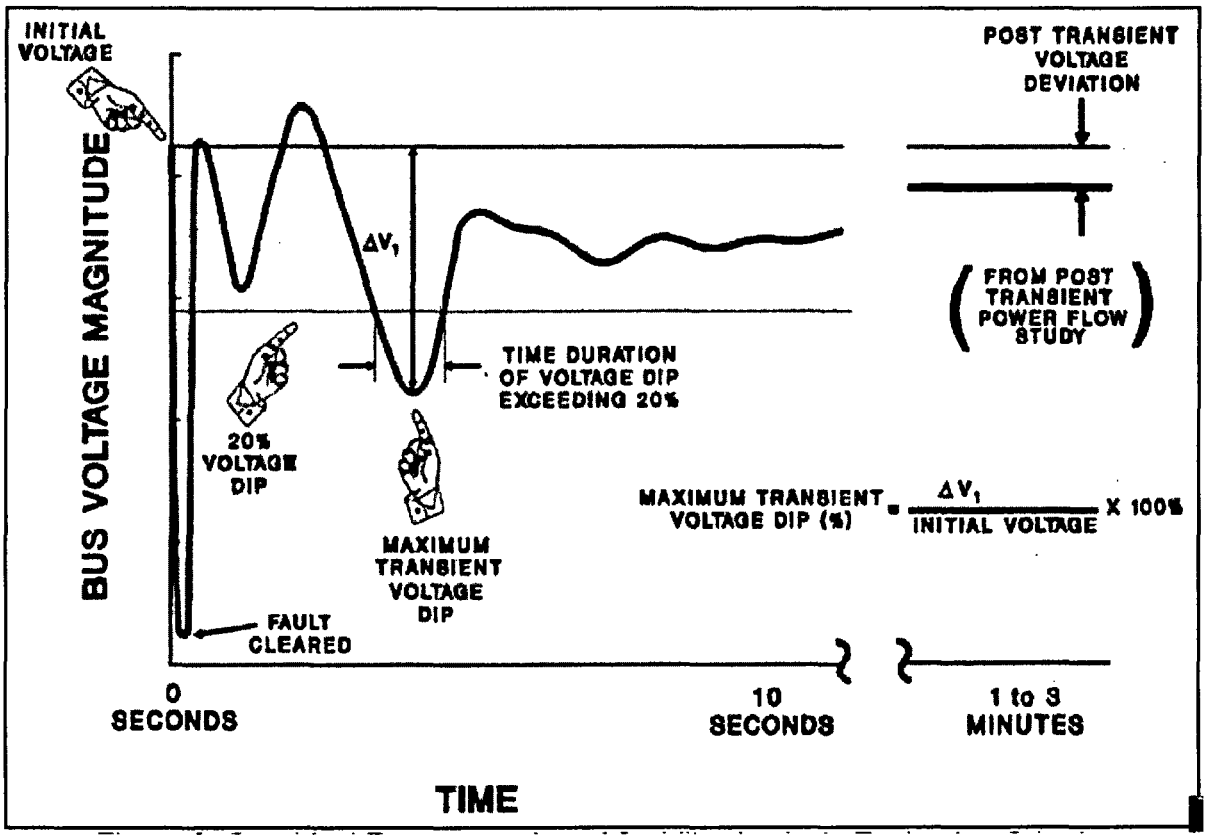
The two time delays associated with the timing of the delayed LOOP are discussed in NUREG CR-6538 as follows:

> "Thus, there are two types of delay before a LOOP occurs after a LOCA, i.e., the period after the LOCA (reactor and turbine trip) when the main generator is finally tripped (at least several seconds), and the delay of the undervoltage relays depending on the severity of the voltage drop (again, at least several seconds). In addition, these two types do not completely overlap because the delay related to the undervoltage relays will probably start timing-out some time during the delay related to the main generator trip, or even after this latter is completed. Therefore, to some extent, it is likely that the two delays will result in a total longer delay."

Furthermore, if load shedding is blocked during sequencing, as required by BTP PSB-1, the delayed LOOP will be delayed until sequencing is complete, regardless of the DVR time delay setting. Therefore, a defined correlation between the time of protective actuation and accident analysis assumptions does not appear to exist. Further, any basis or analysis to conclude that setting the DVR time delay in accordance with the specified criterion would be of any advantage to prevention of the failure mechanisms discussed in the resolution of GSI-171 is not provided; and shorter time delays increase the probability of spurious delayed LOOP events.

Western Electricity Coordinating Council (WECC) Reliability Standard TPL-(001 through 004)-WECC-1-CR, *System Performance Criteria*, includes the following limits for voltage performance following a disturbance, which includes generator trips:

PVNGS Comments on Proposed Generic Communication
Draft NRC Regulatory Issue Summary 2011-XX
Adequacy of Station Electric Distribution System Voltages



According to this graph, recovery to a steady-state condition is allowed to take as long as 3 minutes. This DVR time delay criterion of the draft RIS fails to address coordination of the DVR time delay setting with switchyard voltage transient recovery time to ensure that spurious tripping (i.e., delayed LOOP) does not occur as a result of the voltage transient.

7. It is not feasible for multi-unit nuclear plants to successfully demonstrate that voltage from the offsite circuits would be adequate, as described in the draft RIS (page 8 of 10), for:

   "(1) an accident in the unit being analyzed and simultaneous shutdown of all other units at the station; or (2) an anticipated transient (anticipated operation occurrence) in the unit being analyzed (e.g., unit trip) and simultaneous shutdown of all other units at that station."

   North American Electric Reliability Corporation (NERC) Standard TPL-004 recognizes that the design and operating constraints of the transmission network are such that the loss of all generating units at a station could result in portions or all of the interconnected system not achieving a new, stable operating point.

It is beyond the nuclear plant operator's authority or capability to ensure otherwise.

General Design Criterion (GDC) 5 states:

> "Structures, systems, and components important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units."

GDC-5 does not use the term "simultaneous shutdown" but rather describes an orderly shutdown and cooldown of the remaining units. The draft RIS position, while a reiteration of some previous guidance, appears to constitute a new requirement for many plants. As such, the RIS process would not be the appropriate method to communicate such a position.

8. The draft RIS (page 6 of 10) contains the following statement:

> "The Class 1E buses should separate from the offsite power system within a few seconds if an accident occurs coincident with sustained degraded voltage conditions."

This statement appears to reflect the position of Revision 3 of BTP 8-6, which states, in part:

> "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."

This is not currently a design or licensing requirement for all existing plants. As such the RIS process would not be the appropriate method to communicate a new regulatory position.

9. The draft RIS (page 6 of 10) contains the following statement:

> "The time delay chosen should be optimized to ensure that permanently connected Class 1E loads are not damaged under sustained degraded voltage

conditions (such as sustained degraded voltage just above the LVR voltage setting for the duration of the DVR time delay setting)."

This deterministic approach, while appearing conservative, has the net effect of increasing the frequency of delayed LOOP events during transients, even when the subsequent sustained voltage condition is not degraded (see Comment 4), with resulting adverse effects as discussed in the resolution of GSI-171. It also neglects consideration of the voltage levels that must be maintained in the event of a unit trip and coincident accident to prevent delayed LOOP events. Finally, the draft RIS is silent on the particulars of the voltage studies that would be acceptable to use to determine the optimum time delay (such as the plant operating conditions and voltage profile).

10. The *DVR Setting Design Calculations* section (page 6 of 10) indicates that:

> "models would allow calculation of voltages at terminals or contacts of all safety related equipment with the voltage of the DVR monitored bus at the DVR dropout setting, providing the necessary design basis for the DVR voltage settings. In this manner, the DVR ensures adequate operational (starting and running) voltage to all safety related equipment, independent of voltage controlling equipment external to the plant safety related electrical distribution system."

This seems to impose a new requirement. Further, the described model is of a non-degraded voltage scenario that does not result in DVR actuation. Therefore, it does not demonstrate that "required safety related components are provided adequate voltage" for accidents with degraded voltage scenarios. That conclusion could only be demonstrated by modeling degraded voltage scenarios that involve DVR actuation. However, in all cases involving degraded voltage coincident with postulated accidents, such models would result in delayed LOOP scenarios as discussed in GSI-171.

Also, it reflects a non-conservative voltage profile. If the voltage at the DVR monitored bus was at the DVR dropout setting prior to starting a motor, it would be lower than that during and after starting the motor, and the voltage at the motor terminals would be correspondingly lower, as well, compared to the results using the constant bus voltage methodology described in the draft RIS.

PVNGS Specific Comments

Page 5 of 10 of the draft RIS contains the PVNGS related discussion and is reprinted below, followed by the APS comments. In addition, since the PVNGS inspection findings are referenced in the draft RIS, the specific elements of the inspection report that require response are also addressed.

PVNGS Comments on Proposed Generic Communication
Draft NRC Regulatory Issue Summary 2011-XX
Adequacy of Station Electric Distribution System Voltages

Palo Verde Nuclear Generating Station Units 1, 2, and 3

In July of 2009, an NRC inspection team questioned the calculations that demonstrate adequate voltage to safety related loads during worst case loading conditions and the adequacy of a time delay of 35 seconds for transfer of safety buses to the onsite power supplies should an actual degraded voltage condition occur. The licensee's calculation assumed a voltage above the degraded bus setpoint to demonstrate adequate voltage at the terminals of the safety related loads rather than the degraded voltage dropout setpoint value. The licensee maintains that a degraded voltage condition concurrent with a design basis accident is not credible. See NRC Inspection Report 05000528; –529; and –530/2009008, ADAMS Accession No. ML093240524 regarding the inspection finding. The NRR technical staff reviewed the issue in TIA 2010–05 (ADAMS Accession No. ML102800340). The staff concluded that the licensee's calculation must demonstrate that the trip setpoint adequately protects the Class 1E equipment powered by the safety related bus from a potentially damaging degraded voltage condition, and the time delay to transfer from a degraded offsite source to the standby power source to support the emergency core cooling equipment operation must be consistent with accident analysis time assumptions, as required by BTP PSB–1 (NUREG 0800).

The discussion of Palo Verde in the draft RIS is not accurate in the following respects:

11. The draft RIS discussion asserts that the NRC Office of Nuclear Reactor Regulation (NRR) Task Interface Agreement (TIA) response (TIA 2010-05) "concluded ... the time delay to transfer from a degraded offsite source to the standby power source to support the emergency core cooling equipment operation must be consistent with accident analysis time assumptions, as required by BTP PSB-1 (NUREG 0800)." This statement is not included in the TIA response. The TIA response (pages 4 and 5) quotes the Palo Verde UFSAR description for the design requirements of the degraded voltage relays, and this specific time delay provision is not included in the PVNGS UFSAR.

    This specific time delay provision was removed as part of the PVNGS license amendment 123 process and was specifically addressed in the NRC and APS correspondence (NRC Letter dated June 14, 1999, and APS letter dated July 16, 1999, Question 13). The subject matter of the TIA did not include the time delay element of the design, with regard to the accident analysis time assumptions, but rather was focused upon whether license amendment 123 bounded the need to perform design basis electrical calculations for the degraded voltage relay low setpoint value of 3697 volts or below.

12. The draft RIS asserts that PVNGS erroneously maintains that a degraded voltage condition concurrent with a design basis accident is not credible. PVNGS had

originally implemented the design approach included in the NRC letter Qualification Review of the PVNGS Units 1, 2 and 3, dated December 12, 1977. Based on operating experience (LER 50-528/529/530-93-011) and site specific license amendment 123, PVNGS took action to preclude such an event, by implementing new TS LCO 3.8.1, Condition G. This approach was consistent with the resolution of GSI-171, alternative 3, and was approved.

The prevention strategy was implemented to preclude a concurrent degraded voltage condition and design basis accident because the PSB-1 type design is not capable of adequately coping with such an event. All such events would result in delayed LOOP/double sequencing scenarios, as described in GSI-171, for which there is no viable analytical approach.

13. PVNGS originally implemented the second level degraded voltage protection design consistent with NRC letter Qualification Review of the PVNGS Units 1, 2 and 3, dated December 12, 1977. As a result, reference to PSB-1 in the draft RIS for PVNGS does not reflect the historic licensing basis for PVNGS.

Inspection Report 2009-008 is described in the draft RIS. The specific elements of the inspection report that require response are next described.

14. The inspection report states:

> "the time delay of 35 seconds for transfer of safety buses to the onsite power supplies may be too long to prevent core damage in case of a sustained degraded voltage condition concurrent with an accident. This time delay could result in a delay in supplying water to the core in case of an accident concurrent with degraded voltage, due to the inability of electrical equipment to respond as required during the timeout period."

APS Response: This is a double sequencing scenario, which is a malfunction of an SSC with a different result than previously evaluated pursuant to 10 CFR 50.59, for PVNGS. It could result in core damage regardless of the time delay value at which the DVR actuation (delayed LOOP) occurs. This is the reason APS precludes such an event by establishing appropriate initial conditions, with TS LCO 3.8.1, Condition G, through license amendment 123.

15. The inspection report states:

> "A shorter time delay will not delay the time required to provide water to the core, but will actually improve it."

APS Response: APS is not aware of any analysis in the GSI-171 resolution document to suggest that a shorter time delay (e.g., delayed LOOP occurring sooner)

would be of any benefit in preventing the failure mechanisms associated with a delayed LOOP or assuring that water would be successfully provided to the core. See Technical Comment 6 for further discussion on the lack of correlation between the DVR time delay setting, accident analysis time, and core damage.

The PVNGS current licensing basis for the DVR time delay is ≥ 28.6 seconds. During the review that led to issuance of PVNGS license amendment 123, the staff expressed a concern that a minimum allowable time delay be specified to assure that unnecessary separation from offsite power would not occur. The safety evaluation for license amendment 123 states:

> "APS responded by adding a lower limit (≥ 28.6 seconds) to the time delay allowable value specified for the degraded voltage function in its revised submittal dated September 29, 1999. This change resolves the staff's concern on this matter."

The NRC staff was aware and approved the existing time delay values for the DVRs and the staff considered a shorter time delay to be a concern. The inspection report is inconsistent with the current safety evaluation.

16. The inspection report states:

> "The licensee had offered the proposition that degraded voltage concurrent with an accident was not credible, but the team could not find evidence that the NRC had accepted this position, or that the degraded voltage relays were no longer required to perform a protective function during accidents."

APS Response: The PVNGS current licensing basis is documented in the safety evaluation for PVNGS license amendment 123, which states:

> "The licensee's proposed revision to TS 3.8.1, Condition G is designed to preclude a degraded voltage/double sequencing scenario from occurring at the Palo Verde site. The staff finds this approach acceptable...."

The safety evaluation recognizes that the prevention strategy precludes degraded voltage conditions from occurring. All scenarios involving degraded voltage concurrent with an accident are delayed LOOP/double-sequencing scenarios. The purpose for PVNGS license amendment 123 was to implement a method to prevent this degraded voltage concurrent with an accident (which would always result in a delayed LOOP and double sequencing). APS is not aware of an accepted method to ensure that core damage will not result, if such an event were to occur. Design basis calculations to justify the function of the degraded voltage relays during accidents are not feasible, because they would be unable to justify the delayed LOOP/double sequencing effects discussed in GSI-171.