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JEFF HATCH-MILLER, Chairman
WILLIAM A. MUNDELL
MIKE GLEASON
KRISTIN K. MAYES
BARRY WONG

IN THE MATTER OF THE APPLICATION OF ARIZONA PUBLIC SERVICE COMPANY FOR A HEARING TO DETERMINE THE FAIR VALUE OF THE UTILITY PROPERTY OF THE COMPANY FOR RATEMAKING PURPOSES, TO FIX A JUST AND REASONABLE RATE OF RETURN THEREON, TO APPROVE RATE SCHEDULES DESIGNED TO DEVELOP SUCH RETURN, AND TO AMEND DECISION NO. 67744.	DOCKET NO. E-01345A-05-0816 **STAFF'S NOTICE OF FILING TESTIMONY**
IN THE MATTER OF THE INQUIRY INTO THE FREQUENCY OF UNPLANNED OUTAGES DURING 2005 AT PALO VERDE NUCLEAR GENERATING STATION, THE CAUSES OF THE OUTAGES, THE PROCUREMENT OF REPLACEMENT POWER AND THE IMPACT OF THE OUTAGES ON ARIZONA PUBLIC SERVICE COMPANY'S CUSTOMERS.	DOCKET NO. E-01345A-05-0826
IN THE MATTER OF THE AUDIT OF THE FUEL AND PURCHASED POWER PRACTICES AND COSTS OF THE ARIZONA PUBLIC SERVICE COMPANY.	DOCKET NO. E-01345A-05-0827

Staff hereby provides notice of filing the surrebuttal testimony of William R. Jacobs.

RESPECTFULLY SUBMITTED this 13th day of October, 2006.

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Arizona Corporation Commission
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BEFORE THE ARIZONA CORPORATION COMMISSION

COMMISSIONERS
JEFF HATCH-MILLER, Chairman
WILLIAM A. MUNDELL
MIKE GLEASON
KRISTIN K. MAYES
BARRY WONG

IN THE MATTER OF APPLICATION OF ARIZONA PUBLIC SERVICE COMPANY FOR A HEARING TO DETERMINE THE FAIR VALUE OF THE UTILITY PROPERTY OF THE COMPANY FOR RATEMAKING PURPOSES, AND TO FIX A JUST AND REASONABLE RATE OF RETURN THEREON, AND TO APPROVE RATE SCHEDULES DESIGNED TO DEVELOP SUCH RETURN, AND TO AMEND DECISION NO. 67744	DOCKET NO. E-01345A-05-0816

SURREBUTTAL TESTIMONY OF

WILLIAM R. JACOBS, JR., Ph.D.

ON BEHALF OF

UTILITIES DIVISION

ARIZONA CORPORATION COMMISSION

October 13, 2006

ARIZONA PUBLIC SERVICE COMPANY'S
2006 RATE CASE

Before the
Arizona Corporation Commission
Docket No. E-01345A-05-0816

SURREBUTTAL TESTIMONY OF

WILIAM R. JACOBS, JR., Ph.D.

Q. PLEASE STATE YOUR NAME, TITLE AND BUSINESS ADDRESS.

A. My name is William R. Jacobs, Jr., Ph.D. I am a Vice President of GDS Associates, Inc. My business address is 1850 Parkway Place, Suite 800, Marietta, Georgia, 30067.

Q. DID YOU FILE DIRECT TESTIMONY IN ARIZONA PUBLIC SERVICE COMPANY'S 2006 RATE CASE IN DOCKET NUMBER E-01345A-05-0816?

A. Yes, I did.

Q. WHAT IS THE PURPOSE OF THIS SURREBUTTAL TESTIMONY?

A. The purpose of this surrebuttal testimony is to respond to the rebuttal testimony of APS Witnesses Levine, Mattson, Denton, Fitzpatrick, Wheeler, and Ewen.

Q. PLEASE EXPLAIN THE ORGANIZATION OF YOUR SURREBUTTAL TESTIMONY.

A. First, I will respond to the rebuttal testimony dealing with the Palo Verde outages. Since the Company's five rebuttal witnesses covered many of the same issues, my testimony is organized into responses to the following categories of issues:

- Palo Verde Performance
- The Use of NRC Reports and Self-critical Documents
- Imprudent Palo Verde Outages in 2005
- The Proposed Nuclear Performance Standard

I will respond to issues addressed by more than one witness by issue, and I will also respond specifically to some concerns raised by individual Company witnesses. Finally, I will respond to the rebuttal testimony of Mr. Ewen which deals with the quantification of the cost impacts of the Palo Verde outages.

PALO VERDE PERFORMANCE

Q. SEVERAL COMPANY WITNESSES, INCLUDING LEVINE, FITZPATRICK, AND MATTSON, OPINED THAT THE PERFORMANCE OF PALO VERDE SHOULD BE VIEWED OVER THE LONGER PERIOD OF THE PAST 10 YEARS RATHER THAN FOCUSING ON PERFORMANCE DURING 2005. PLEASE RESPOND.

A. I have several responses to this position by the Company witnesses. First, I think I need to put the performance of Palo Verde in 2005 in proper context. Palo Verde's performance in 2005 was very poor by almost any measure. As shown in Table 1 of my direct testimony, Palo Verde generation and capacity factor have been declining since 2002, and production costs have been increasing since 2002. Note that these data do not focus just on 2005 but go back to 2002. Looking at the period from 2003 through 2005, out of 104 U.S. nuclear plants, the Net Capacity Factor of Palo Verde Unit 3 ranked 99th, Palo Verde Unit 1 ranked 97th,

1 and Palo Verde Unit 2 ranked 93rd. Palo Verde Unit 3 had the greatest decrease in
2 Net Capacity Factor of all U.S. nuclear units when comparing the period 2000-
3 2002 to the period 2003-2005. Palo Verde ranked 35th out of 36 multi-reactor
4 sites in the United States. As reported in the Arizona Republic on February 12,
5 2006, Palo Verde received an INPO 3 rating, one of the lowest for an operating
6 plant, received cross-cutting issues in human performance and problem
7 identification and resolution from the NRC, and was one of only 2 plants
8 identified by the NRC as having a "degraded cornerstone." Palo Verde had not
9 suffered a mild decline in performance. It had plummeted to the bottom of the
10 nuclear industry. My conclusion in this regard is not based merely upon data and
11 information for 2005 but also considers information from as far back as 2000.
12 While the information that I rely upon does not extend as far back as ten years, it
13 is not accurate to conclude that my review focused only on 2005 and did not
14 consider earlier information in an effort to place Palo Verde's overall
15 performance in context. Furthermore, when considering any individual specific
16 outage, it is neither necessary nor appropriate to consider prior performance and,
17 in fact, the issue of prior performance is irrelevant when determining the
18 responsibility for additional costs incurred due to any individual imprudent event.
19 I have identified four outages during 2005 as being the result of imprudence. The
20 additional costs resulting from these outages are the responsibility of APS
21 regardless of prior operating performance.
22 **Q. DO YOU FIND THE POSITION OF THESE COMPANY WITNESSES**
23 **THAT 10 YEARS OF PRIOR PEFORMANCE SHOULD BE**

CONSIDERED TO BE SOMEWHAT IRONIC GIVEN APS' ADMITTED FAILURE TO RECOGNIZE THE DECLINE IN PALO VERDE PERFORMANCE?

A. Yes, I do. I believe that the comments of Palo Verde's top executive, Mr. Levine, and the other Company witnesses are quite ironic and misplaced given that their failure to recognize the decline in Palo Verde performance and take appropriate corrective action was due in part to their reliance on past performance. Their recommendation that the Commission focus on the prior 10 years of Palo Verde performance is exactly the management mindset that allowed the decline in Palo Verde to continue for several years without corrective action and led to Palo Verde residing at the bottom of the nuclear industry. The Palo Verde Performance Improvement Plan states:

> Site leadership did not fully accept that the Palo Verde performance indicators reflected actual performance until mid 2005. Management's mindset resulted in part from ten previous years of Palo Verde top quartile levels of performance.[1]

By focusing on prior good performance, Palo Verde management failed to recognize the declining performance until several years after the trend began. If the decline in performance had been recognized in 2003, management could have implemented measures to address the problem without Palo Verde sinking to the bottom of the nuclear industry.

Q. IN HIS DISCUSSION OF PALO VERDE PERFORMANCE MR. LEVINE STATES ON PAGE 10, LINE 22 OF HIS REBUTTAL TESTIMONY THAT

[1] Palo Verde Nuclear Generating Station Performance Improvement Plan, page 1. (Attachment 1 to GDS Associates' Report to the Arizona Corporation in Docket No. E-01345A-05-0826)

"...THE DECREASE IN PERFORMANCE IS DIRECTLY RELATED TO THE GREATER THAN TYPICAL NUMBER AND DURATION OF PLANT OUTAGES THAT WE EXPERIENCED IN 2005." DOES THIS STATEMENT AGREE WITH MR. LEVINE'S EARLIER OBSERVATIONS CONCERNING THE REASONS FOR THE DECLINING PERFORMANCE AT PALO VERDE?

A. No, it does not. The Performance Improvement Plan, issued under Mr. Levine's signature, states:

> In late 2002 or early 2003 performance indicators at Palo Verde began a downward trend relative to the sustained high performance levels in previous years. A cause of this trend appears to have been the realignment of key site leadership that in turn caused the team to be more focused on day-to-day tactical matters, and less focused on strategic planning, standards and accountability. Additionally, in 2004, two significant events occurred at Palo Verde. They are the three unit trip in June 2004 that resulted from a grid disturbance and, the discovery, in July 2004, of the absence of water in portions of Emergency Core Coolant System piping ("RAS[2] Sump Event"). These events also revealed issues with regard to various Palo Verde programs and processes that are in need of improvement.[3]

The cause of the performance decline is identified as key site leadership being "more focused on day-to-day tactical matters, and less focused on strategic planning, standards and accountability." Mr. Levine further states that two events in 2004 "revealed issues with regard to various Palo Verde programs and processes that are in need of improvement." Thus, APS has identified the cause

[2] "RAS" stands for Recirculation Actuation Signal, the signal that allows the Emergency Core Cooling Systems to take suction from the Containment Sump during a Loss of Coolant Accident.
[3] Palo Verde Nuclear Generating Station Performance Improvement Plan, October 15, 2005, page 1.

1 of declining performance as a loss of focus of key site leadership and programs
2 and processes that need improvement.

3 **Q. DO YOU AGREE WITH MR. FITZPATRICK'S PROPOSITION ON**
4 **PAGE 9, LINE 15 OF HIS REBUTTAL TESTIMONY THAT THE**
5 **COMMISSION "OUGHT TO GIVE CONSIDERABLE WEIGHT TO THE**
6 **SUPERIOR AND OFFSETTING PERFORMANCE OF THE COMPANY'S**
7 **COAL UNITS DURING THE SAME AND OTHER TIME PERIODS?"**

8 A. No, I do not. As discussed above, my testimony identifies additional costs
9 incurred due to specific instances of imprudent operation of Palo Verde.
10 Performance of the Company's coal units is irrelevant, and I believe is an attempt
11 to divert the Commission's attention from the abysmal performance of Palo Verde
12 in 2005.

13 **Q. WHAT IS APS WITNESS MATTSON'S POSITION ON APS'**
14 **REGULATORY PERFORMANCE?**

15 A. In response to the question on page 43 of his rebuttal testimony, "What
16 conclusions have you formed about APS' regulatory performance?" Dr. Mattson
17 states on page 44, line 19, "I conclude that there has been a decline in regulatory
18 performance at Palo Verde from the previous level of excellence, and that APS
19 and NRC are applying extra effort to reverse the trend."

20 **Q. DO YOU AGREE WITH DR. MATTSON'S CONCLUSION?**

21 A. Yes, I agree that there has been a decline in regulatory performance at Palo Verde
22 and that APS is trying to reverse the trend.

1 **Q. DR. MATTSON STATES ON PAGE 43, LINE 26 OF HIS REBUTTAL**
2 **TESTIMONY CONCERNING REGULATORY PERFORMANCE AT**
3 **PALO VERDE THAT "THERE ARE RECENT INDICATIONS THAT**
4 **THE STATION WILL BE SUCCESSFULLY RETURNED TO THE**
5 **LOWEST LEVEL OF NRC SCRUTINY." DO YOU AGREE WITH THIS**
6 **ASSESSMENT?**
7 A. No, I do not. Following a meeting with Company personnel in early 2006 in
8 which the Performance Improvement Program was described, I was optimistic
9 that the Performance Improvement Program would be successful in reversing the
10 decline in Palo Verde performance. However, it is worth noting that an NRC
11 inspection report on the area of problem identification and resolution issued in
12 May 2006 was not especially optimistic. Moreover, a more recent Midcycle
13 Performance Review issued by the NRC in August 2006 after the filing of the
14 GDS report has reduced my optimism in this regard.
15 **Q. PLEASE PROVIDE THE RESULTS OF THESE NRC ASSESSMENTS OF**
16 **PALO VERDE.**
17 A. An NRC inspection report dated May 10, 2006 provides the results of the NRC's
18 inspection of problem identification and resolution activities at Palo Verde. This
19 is essentially an inspection of Palo Verde's corrective action program. The results
20 of this inspection are not encouraging. The cover letter addressed to Mr. James
21 Levine states[4]:

[4] NRC letter dated May 10, 2006 from Anthony T. Gody, Chief Operations Branch, Division of Reactor Safety to James M. Levine, Executive Vice President, Generation, Arizona Public Service Company Subject: Palo Verde Nuclear Station – NRC Problem Identification and Resolution Inspection Report 05000528, 529, 530/2006008

> Overall, performance had declined since the last problem identification inspection. The team identified notable issues in both the processes and procedures of your corrective action program as described below. The team found that established thresholds for identifying and classifying issues were appropriately low, although several instances were identified where adverse conditions were not entered into the corrective action program for evaluation. Programmatic goals for completion of problem evaluations, consistent with industry standards, were routinely not met because of process problems and lack of management enforcement of timeliness goals. Ineffective and incomplete corrective actions led to a number of repeat problems that could have been prevented. Untimely problem evaluations and corrective actions continued to result in a significant number of self-disclosing and NRC-identified findings and violations. The team concluded that while a safety-conscious work environment exists at your facility, isolated concerns were raised by your staff during the interviews. These concerns were associated with not having sufficient personnel to accomplish long-term improvements, a loss of trust that management would not subject the staff to negative consequences for raising issues, some confusion about when to place an adverse condition into your corrective action program, and a decrease in confidence that the corrective action program will adequately address problems.

In its assessment of the effectiveness of corrective actions the inspection report states:

> The inspectors noted instances where corrective actions were closed without completion, where repeat events occurred because of slow or ineffective corrective actions, and other instances where corrective action implementation was delayed with no document or apparent reason.[5]

An effective corrective action program is the foundation of a well run nuclear plant. Problems must be identified and evaluated in a timely manner; corrective actions must be effective in preventing recurrence. This does not appear to be the

[5] Palo Verde Nuclear Station – NRC Problem Identification and Resolution Inspection Report 05000528, 529, 530/2006008, page 16

case at Palo Verde. The NRC found that problems are not addressed in an effective and timely manner. This led to repeat events. In addition, a number of problems were found by the NRC and not by APS, including the questions leading to the RWT outages. The NRC relies on a nuclear plant operator to identify and effectively correct problems. If the NRC is finding the problems, the plant operator is not doing a good job of managing the plant. This was the case at Palo Verde.

Q. DOES THIS INSPECTION REPORT ADDRESS THE SUBTANTIVE CROSS-CUTTING ISSUES IN HUMAN PERFORMANCE AND PROBLEM IDENTIFICATION AND RESOLUTION THAT HAVE BEEN IDENTIFIED BY THE NRC?

A. Yes, it does. The inspectors evaluated APS' actions to address the substantive cross-cutting issues. On this topic the report states:

> The inspectors observed that the licensee had developed an extensive performance improvement plan to address the substantive cross-cutting issues in human performance and PI&R, which included corrective actions and completion due dates. The evaluation of the issue required a substantial part of the remainder of 2005 to complete and only a small percentage of the corrective actions as defined in the performance improvement plan have been accomplished. The inspectors identified that many of the planned corrective actions were vague, and would require additional evaluation to identify specific corrective actions. The inspectors also noted that of the corrective actions that had been completed, several were not completed by the projected due dates, or were not fully effective. The inspectors also noted the trend of human performance and problem identification and resolution related problems remained essentially steady since identification of the cross-cutting issues. The inspectors could not evaluate the potential effectiveness of the actions taken in the performance improvement plan.

> The trend of NRC identified findings with PI&R aspects in effectiveness of corrective actions has been fairly steady since 2004 with seven findings in 2004, six in 2005 and one additional finding identified during this inspection in the effectiveness of corrective actions area. The inspectors concluded that the area of effectiveness of corrective actions continued to significantly challenge the organization.[6]

The observed problems with the corrective action program and the failure to improve the trend of human performance and problem identification and resolution issues is not encouraging.

Q. PLEASE DESCRIBE THE NRC'S FINDINGS PRESENTED IN ITS MIDCYCLE ASSESSMENT OF PALO VERDE PERFORMANCE THAT YOU MENTIONED ABOVE.

A. On August 31, 2006, the NRC issued the Midcycle Review and Inspection Plan for Palo Verde. This midcycle review, which was completed four months after the inspection report discussed above, identified many of the same problems. First, the assessment notes:

> Plant performance for the most recent quarter for all three units was within the Degraded Cornerstone column of the NRC's Action Matrix. This assessment is based on one Yellow finding, that has been open since the fourth quarter of 2004 in the Mitigating Systems Cornerstone involving a significant section of containment safety injection piping that was void of water at all three Palo Verde Nuclear Generating units.[7]

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[6] Palo Verde Nuclear Station – NRC Problem Identification and Resolution Inspection Report 05000528, 529, 530/2006008, page 16.

[7] NRC letter dated August 31, 2006 from Bruce Mallett, NRC Regional Administrator to James M. Levine, Executive Vice President, Generation, Arizona Public Service Company, Subject: Midcycle Performance Review and Inspection Plan – Palo Verde Nuclear Generating Station, page 1.

On April 15, 2006, APS notified the NRC of its readiness for the NRC to confirm that APS had completed the steps necessary to assure that the corrective actions are of sufficient scope to correct the performance deficiencies associated with the Yellow finding. An NRC inspection team conducted the onsite portion of the inspection during the week of July 24, 2006. The NRC's assessment letter states the following:

> While it appears that the issues specifically associated with the voided emergency core cooling system piping have been effectively addressed, we have concluded that the corrective actions taken in response to the root causes and related programmatic concerns involving questioning attitude, technical rigor, and operability determinations have not been fully effective. Also, we have determined that the performance monitoring measures (e.g., metrics) necessary to fully assess the effectiveness of the corrective actions within these areas do not take into account all the relevant data.[8]

Based on this assessment by the NRC, it appears that Dr. Mattson's belief that "there are recent indications that the station will be successfully returned to the lowest level of NRC scrutiny" is premature.

Q. DOES THE NRC'S MIDCYCLE ASSEMENT LETTER ALSO ADDRESS THE SUBTANTIVE CROSS-CUTTING ISSUES IN HUMAN PERFORMANCE AND PROBLEM IDENTIFICATION AND RESOLUTION?

A. Yes, it does. A cross-cutting issue is an issue or concern that affects several areas of the plant organization. The NRC identifies cross-cutting issues in the areas of human performance, problem identification and resolution, and safety conscious

[8] NRC letter dated August 31, 2006 from Bruce Mallett, NRC Regional Administrator to James M. Levine, Executive Vice President, Generation, Arizona Public Service Company, Subject: Midcycle Performance Review and Inspection Plan – Palo Verde Nuclear Generating Station, page 2

work environment. A cross-cutting issue is determined to be substantive if: 1) there are more than three similar issues; 2) the underlying concern is present in more than one of the NRC's cornerstones of safety; and 3) the plant operator's actions to correct the issue were insufficient or incomplete. The NRC reports that they continued to identify findings in both cross-cutting areas as described below in the midcycle assessment letter:

> During this assessment period, the NRC identified a total of 24 examples of Green finding with crosscutting aspects in the human performance area. These findings involved the Initiating Events, Mitigating Systems, and Occupational Radiation Safety cornerstones. Crosscutting themes were identified in the following area components: (1) Decision-making (instances of not utilizing a systematic decision making process and instances of ineffective communication of decisions to personnel), and (2) Work Practices (instances of ineffective human error prevention techniques and instances of not following procedures). Examples include: multiple instances of failing to comply with Technical Specification requirements during the process of unit startup; failures to perform technically adequate operability evaluations for degraded and nonconforming conditions of safety-related systems and components; instances of failing to follow procedures which resulted in consequential plant impacts; and instances of failing to use other appropriate error prevention techniques which resulted in appropriate system configurations, as well as other unintended, consequential impacts on plant systems and components. The crosscutting themes identified during this assessment are similar to those that have been identified in previous NRC assessments, particularly with respect to the themes of failure to follow procedures and ineffective interactions between engineering and operations personnel when assessing degraded and nonconforming conditions.
>
> Thirteen examples of Green findings and one Severity Level IV violation were identified in the corrective action component of the problem identification and resolution crosscutting area. These findings involved the Initiating Events, Mitigating Systems, and Emergency Preparedness

> cornerstones. Crosscutting themes identified in this component involved inadequate evaluations of problems and untimely implementation of corrective actions. Examples include: failures to address the extent of condition of problems; failures to fully evaluate problems resulting in repetitive or long-standing problems affecting safety systems and components; failures to correct known degraded conditions in a timely manner. The crosscutting themes identified during this assessment are similar to those that have been identified in previous NRC assessments, particularly with respect to inadequate evaluation of conditions adverse to quality, as well as inadequate and ineffective correction of problems.
>
> During the assessment period, the NRC performed periodic inspections of your corrective actions to address both crosscutting areas. The results of our inspections show that you have taken some corrective actions to address these issues; however, these actions have not been completely effective, are still being developed, or are only partially implemented. In many cases, metrics and measures did not effectively monitor performance or performance trends. This is the same performance status noted in March 2, 2006, assessment letter. Accordingly, we plan to continue to focus baseline inspections, as well as perform an additional problem identification and resolution inspection (as discussed in detail below), in order to assess your progress in implementing and verifying the effectiveness of your Integrated Improvement Plan as it relates to these two substantive crosscutting issues. The above crosscutting aspects will remain open until we determine that corrective actions implemented in accordance with your Integrated Improvement Plan have resulted in improved performance.[9]

In summary, the NRC is not convinced and results to date have not demonstrated that the corrective actions implemented to date are sufficient to resolve the problems in human performance and problem identification and resolution.

[9] NRC letter dated August 31, 2006 from Bruce Mallett, NRC Regional Administrator to James M. Levine, Executive Vice President, Generation, Arizona Public Service Company, Subject: Midcycle Performance Review and Inspection Plan – Palo Verde Nuclear Generating Station, pages 2 – 3.

1 Correction of these problem areas is key to returning Palo Verde performance to
2 its prior level.
3 **Q. ARE YOU AWARE OF A MORE RECENT INDICATION OF**
4 **DEFICIENCIES WITH PALO VERDE'S PROBLEM IDENTIFICATION**
5 **AND RESOLUTION PROCESS?**
6 A. Yes, I am. On July 25, 2006 a Unit 3 Emergency Diesel Generator failed to start
7 during testing. On September 22, 2006, the same Emergency Diesel Generator
8 failed to start again. While I have not investigated this event in detail, it appears
9 that the corrective action taken to resolve the problem following the July 25th
10 failure to start was ineffective. This is another example of failure to implement
11 effective corrective action to resolve a problem and prevent recurrence.
12 **Q. HAS THE NRC TAKEN NOTICE OF THIS EVENT?**
13 A. Yes, they have. On October 2, 2006 the NRC announced that they will conduct a
14 special inspection of Palo Verde as a result of this event. The purpose of this
15 inspection is to evaluate the adequacy of APS' response to this situation, the root
16 cause of the problem, the corrective actions, and to determine if there are generic
17 implications for other nuclear power plants.
18 **<u>USE OF NRC REPORTS AND SELF-ASSESSMENTS</u>**
19 **Q. SEVERAL COMPANY WITNESSES INCLUDING MATTSON AND**
20 **DENTON CRITICIZE YOUR USE OF NRC REPORTS AND COMPANY**
21 **PREPARED DOCUMENTS IN YOUR REVIEW OF PALO VERDE**
22 **PERFORMANCE AND OUTAGES. DO YOU AGREE WITH THEIR**
23 **COMMENTS?**

1 A. No, I definitely do not for several reasons. Any review of a plant outage must, by
2 definition, be retrospective. One cannot review an outage before it occurs. Root
3 cause evaluations and other outage reviews conducted by the Company do not
4 rely on hindsight but rather establish the facts and conditions related to the event
5 at the time of the event. The facts and conditions can be used to establish what
6 the plant operator knew or should have known at the time of the event.
7 Determining the facts that existed at the time of a nuclear plant outage does not
8 rely on hindsight but is an exercise in information gathering that is typically
9 initially performed by Company personnel. It would be extremely difficult for an
10 outsider, especially in the context of a rate case, to develop the required detailed
11 knowledge of the facts and circumstances surrounding a plant outage without the
12 benefit of the contemporaneous investigation conducted by Company personnel.
13 For this reason, I have relied heavily on the candid outage reviews prepared by
14 the Company. I have also relied on NRC documents that assess the performance
15 of Palo Verde's operator. These documents provide a contemporaneous
16 assessment by a knowledgeable and unbiased observer. The NRC does not rely
17 on hindsight but provides a clear, contemporaneous assessment of the facts and
18 circumstances surrounding an event. In addition, the use of Company
19 assessments and NRC documents has been allowed in every one of the many
20 jurisdictions in which I have testified on nuclear plant outages. Finally, the use of
21 NRC and Company documents in the determination of prudence was favorably
22 addressed in a particularly relevant decision by former FERC Judge Cowan in
23 *Connecticut Yankee Power Co.*, 84 FERC ¶ 63,009 (1998), where he relied

heavily upon NRC findings and company admissions in finding that a nuclear plant shut-down was the result of imprudent management. He noted that much of the record evidence on management reasonableness "derives from critical assessments of the Company's performance by the NRC and the admissions of Company officials to the NRC about their management and operation of the plant" and held:

> The Company is correct that these NRC findings do not translate directly into a finding of imprudence from an economic regulatory perspective ... But at some point, surely, a great number of NRC negative comments about a particular plant's management and operations and admissions by Company managers to such conduct become inconsistent with the notion of a prudently managed nuclear plant from any perspective, including economic regulation ... [and] these negative comments from nuclear safety regulators ... also provide evidence that can and should be used in reaching an economic regulatory judgment about the prudence of management conduct.
>
> * * *
>
> ... While, considered alone, the admissions of the Company managers about their shortcomings and weaknesses are not quite a "confession of imprudence" ... they nevertheless provide strong evidentiary support for a finding of imprudent management ... It would take tortured logic, indeed, to conclude that the NRC's hyper-critical comments about the Company's management of the plant and the Company's own admissions of significant failures and shortcomings described in this record are consistent with reasonable and prudent managerial conduct from either a safety or economic regulatory perspective.
>
> *Id.* at 65,110 - 65,111.

The Company is asking this Commission to accept their "tortured logic" that both NRC reports and Company reports that set forth the facts and circumstances

1 underlying individual outages should not be utilized in determining the cause, and
2 thus the prudence, of the Palo Verde outages.

3 **Q. DR. MATTSON COMPLAINS ON PAGE 11, LINE 10 – 11 OF HIS**
4 **REBUTTAL TESTIMONY THAT YOU HAVE TAKEN SOME OF THE**
5 **COMPANY'S ANALYSES OUT OF CONTEXT. PLEASE RESPOND.**

6 A. I disagree with Dr. Mattson's implication that I have taken findings presented in
7 the Company's analysis of Palo Verde out of context. I have taken care to
8 provide the relevant sections of Company reports and analyses. In fact, Dr.
9 Mattson also observes that I have "quoted liberally" from Company self-
10 assessments in my testimony. The reason for including the liberal quotations is to
11 provide the proper context. Finally, I included the full text of the relevant
12 sections of analyses and reports in the 18 attachments to my direct testimony.
13 The reason for including these attachments is to provide the reader the
14 opportunity to review the complete section of a report on a given subject. Dr.
15 Mattson's complaint is unfounded.

16 **REVIEW OF PALO VERDE OUTAGES**
17 **UNIT 1 EMERGENCY DIESEL "A" GOVERNOR FAILURE**
18 **MARCH 18 – 21, 2005**

19 **Q. HAVE YOU MADE A RECOMMENDATION TO DISALLOW THE**
20 **COSTS RESULTING FROM THIS OUTAGE?**

21 A. No, I have not. Since this outage occurred prior to implementation of the PSA
22 mechanism on April 1, 2005, I have not recommended a disallowance. However,
23 Company witness Levine states that he believes that it is important for the

1 Commission to understand that APS was not imprudent with respect to this
2 outage. I will respond to the Company's rebuttal concerning this outage.
3 **Q, ARE THERE AREAS IN WHICH YOU AGREE WITH THE COMPANY**
4 **CONCERNING THIS OUTAGE?**
5 A. Yes, there are. We agree that the outage was the result of water and rust that had
6 accumulated in the governor of the diesel generator. We agree that the Company
7 was not able to determine the source of the water and rust. I agree that the
8 Company has identified the most likely sources of the water and rust. Those
9 sources are:
10 • Rust caused by water left in the governor after refurbishment in June 2000
11 • Rust formed while the governor was stored drained of oil in the Palo
12 Verde warehouse for 9 months.
13 • Water introduced during an oil change in April 2004.
14 **Q. BEFORE DISCUSSING THE DETAILS OF THIS OUTAGE, PLEASE**
15 **EXPLAIN THE FUNCTION AND THE IMPORTANCE OF AN**
16 **EMERGENCY DIESEL GENERATOR AT A NUCLEAR POWER PLANT.**
17 A. The emergency diesel generators at a nuclear power plant are one of the most
18 important pieces of safety related equipment. They provide the electric power
19 necessary to operate the key safety systems in the event that off-site power is lost
20 during a loss of coolant accident or other emergency. Failure of a diesel generator
21 to function when needed could result in a serious nuclear accident. The diesel
22 generators at a nuclear plant must be operable for the plant to remain in power
23 operation. The critical safety function of the emergency diesel generators at a

1 nuclear power plant is the reason for the NRC's special inspection of the
2 emergency diesel generator failures at Palo Verde in July and September of this
3 year as described earlier in this testimony.

4 **Q. WHY IS THIS IMPORTANT TO UNDERSTANDING THE PALO VERDE**
5 **OUTAGE DUE TO CONTAMINATION OF THE DIESEL GENERATOR**
6 **GOVERNOR?**

7 A. It is important to understand that the care given to operating and maintaining a
8 piece of equipment must be commensurate with the importance and function of
9 the equipment. For example, the care given in maintenance of the engine of a
10 single engine airplane should be greater than given in maintaining an automobile
11 engine because the consequences of failure are much greater. Similarly,
12 maintenance of an emergency diesel generator at a nuclear power plant demands
13 the highest degree of care because the plant cannot operate safely without the
14 emergency diesel generators being in top condition.

15 **Q. IN YOU OPINION, DID THE COMPANY USE THE HIGHEST POSSIBLE**
16 **DEGREE OF CARE IN MAINTAINING THE GOVERNOR FOR THE "A"**
17 **EMERGENCY DIESEL GENERATOR?**

18 A. No, they did not. Despite a thorough investigation, the Company cannot
19 determine the source of the water and rust that caused the governor to
20 malfunction. The water may have been left in the governor after refurbishment.
21 It may have formed while the governor was left in a warehouse drained of oil for
22 9 months. It may have been introduced during an oil change in 2004. Although
23 they can list the possible causes, they simply do not know precisely which one

1 occurred. But, whatever the source of the water and rust, it is clear that the
2 Company did not use a standard of care commensurate with the importance of the
3 diesel generator.

4 **Q. DO YOU AGREE WITH THE COMPANY THAT THIS OUTAGE WAS**
5 **UNAVOIDABLE AND THAT THERE WAS NO WAY OF DISCOVERING**
6 **THE RUST SHORT OF DISASSEMBLING THE GOVERNOR?**

7 A. No, I do not agree with the Company on this point. A sample of the governor
8 lubricating oil was taken after the "A" Emergency Diesel Generator failed to
9 attain rated frequency and voltage on March 17, 2005. This oil sample was found
10 to have very high levels of water. The sample contained 5159 ppm of water. The
11 upper limit of water is 1500 ppm and the normal water content is in the 100-200
12 ppm range. The governor oil sample contained 25 to 50 times the normal amount
13 of water. This much water in the oil leads to the formation of rust and ultimately
14 to failure of the governor. This high degree of water could have been found with
15 a simple lube oil sample after installation of the refurbished governor or after the
16 oil change in 2004. A routine analysis of the governor lube oil would also have
17 identified the problem. It was not necessary to disassemble the governor to
18 discover the contamination as claimed by the Company.

19 **UNIT 1 REACTOR TRIP DUE TO OPERATOR ERROR**
20 **AUGUST 26 – 28, 2005**

21 **Q. PLEASE BRIEFLY DESCRIBE THIS OUTAGE.**

22 A. During a startup of Unit 1 on August 26, 2005, errors by the secondary control
23 room operator while attempting to place the Main Feedwater control in automatic

resulted in an excessive feed rate to the steam generator and ultimately to a reactor trip on high steam generator level.

Q. IS THIS OUTAGE REFLECTIVE OF THE CROSS-CUTTING ISSUES IN HUMAN PERFORMANCE AND PROBLEM IDENTIFICATION AND RESOLUTION IDENTIFIED BY THE NRC AND DISCUSSED EARLIER IN THIS TESTIMONY AND IN YOUR DIRECT TESTIMONY?

A. Yes, this outage clearly reflects the cross-cutting issues identified by the NRC. The outage was the result of a human performance error and failure of APS to resolve a known problem in a timely manner. The operator did not follow procedures and the shift crew members did not function as required to ensure that individual errors are promptly identified and corrected. As stated in the Root Cause Investigation Report:

> The direct causes were individual and crew failures to implement expected requirements and good practices prescribed by their training and delineated in procedures.[10]

This outage is also an excellent example of failures in the cross-cutting area of problem identification and resolution. Problems with the Digital Feedwater Controls System (DFWCS) were not identified in a timely manner and effectively resolved. Root Cause #2 states:

> Feedwater control system performance issues at low power levels have not been effectively resolved since the digital upgrade. This has led to acceptance of operational strategies to cope with perceived system instability at low power levels.[11]

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[10] CRDR Number 2825485, Reactor Trip on Steam Generator High Level Following Transition from Auxiliary to Main Feedwater during Unit 1 Startup, page 3 of 30. (Attachment 11 to the GDS Report on Palo Verde performance dated August 17, 2006)

[11] *Ibid,* page 10 of 30

A note following Root Cause # 2 confirms this observation stating:

> **Note that Effective Problem Resolution** (emphasis in original) as identified in Root Cause # 2 extends throughout the Palo Verde organization as previously identified in the NRC PI&R cross-cutting issue.[12]

Failures in the long standing problem areas of human performance and problem identification and resolution as identified in the NRC's cross-cutting issues and in the Company's own analysis of this event are clear evidence of imprudence.

Q. WHAT WAS THE COMPANY'S REBUTTAL TO YOUR CONCLUSION THAT THIS OUTAGE WAS THE RESULT OF IMPRUDENCE?

A. The Company's rebuttal to this outage was notably brief. Mr. Levine addressed it stating that the operator was performing an infrequent evolution, that it is easy to speculate that additional training was needed, and that the root cause analysis takes advantage of hindsight and is not sufficient to show imprudence.

Q. WHAT IS YOUR RESPONSE TO MR. LEVINE'S REBUTTAL?

A. Mr. Levine is notably silent on the human performance and problem identification and resolution aspects of this event that I have described above. While starting up a nuclear plant is normally an infrequent operation, it was actually a fairly frequent occurrence at Palo Verde in 2005. In addition, operators continuously receive training on plant simulators to allow them to perform infrequent evolutions. Operators' concerns about the ability of the DFWCS were well known and long standing. The Company's analysis of this event identified the following factors related to operator training and performance:[13]

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[12] *Ibid*

[13] *Ibid,* page 11 of 30

- Many licensed operators believed the DFWCS was not reliable in maintaining stable feedwater levels at low power levels.
- Reliance on individual experience and unconfirmed anecdotal accounts influenced operator opinion on low power DFWCS stability. This was not an isolated, single occurrence but rather a common mindset (culture) regarding expected system performance at low power levels.
- Past evaluations of system performance have not resulted in actions (procedure or training) to address how the system operated.

These observations are not made with the benefit of hindsight but rather are statements of the situation regarding the DFWCS prior to the outage. These observations identify deficiencies that were known or should have been known by APS prior to the event on which APS failed to act. This outage is clearly the result of imprudence based on what APS knew or should have known prior to the outage without benefit of hindsight.

Q. DOES THE COMPANY'S REBUTTAL TESTIMONY CHANGE YOUR CONCLUSIONS THAT THIS OUTAGE IS THE RESULT OF IMPRUDENCE?

A. No, it does not. This outage resulted from the Company's imprudence in failing to correct long standing problems in human performance and problem identification.

UNIT 2 AND 3 REACTOR WATER TANK (RWT) OUTAGES

OCTOBER 11 – 20, 2005

1 **Q. PLEASE BRIEFLY DESCRIBE THE UNIT 2 AND UNIT 3 RWT**
2 **OUTAGES DURING THE PERIOD OCTOBER 11 – 20, 2005.**
3 A. The issue that resulted in this outage was initiated during an NRC inspection that
4 began in September 2005. The inspection was a follow-up inspection resulting
5 from the Yellow finding identified by the NRC in 2004 when it was discovered
6 that piping from the containment sump to the emergency core cooling system
7 (ECCS) pumps had been left empty rather than being filled with water as
8 necessary to ensure proper operation of the pumps. The technical issues are quite
9 complicated and involve a question of whether or not air would be entrained in
10 suction piping leading to the emergency core cooling system pumps under certain
11 conditions following a loss of coolant accident. The technical issues are
12 discussed in some detail in the rebuttal testimony of Dr. Mattson. APS was not
13 able to demonstrate to the NRC that the emergency core cooling system pumps
14 would remain operable and the units were shutdown while outside consultants
15 hired by APS performed the analysis necessary to confirm that the design of the
16 plant was safe.
17 **Q. HOW IS THIS OUTAGE RELATED TO PRIOR PERFORMANCE**
18 **DEFICIENCIES IDENTIFIED BY THE NRC?**
19 A. This outage is related to deficiencies identified in the area of problem
20 identification and resolution. The problems in this area at Palo Verde are well
21 documented. Resolution of problems has not been timely and the actions taken to
22 resolve problems have been ineffective and too narrowly focused. As previously

described, these findings have recently been reconfirmed in the NRC's 2006 Midcycle Performance Review of Palo Verde which states:

> Crosscutting themes identified in this component involved inadequate evaluations of problems and untimely implementation of corrective actions. Examples include: failures to address the extent of condition of problems; failures to fully evaluate problems resulting in repetitive or long-standing problems affecting safety systems and components; failures to correct known degraded conditions in a timely manner. The crosscutting themes identified during this assessment are similar to those that have been identified in previous NRC assessments, particularly with respect to inadequate evaluation of conditions adverse to quality, as well as inadequate and ineffective correction of problems.[14]

APS' failure to adequately evaluate the scope of the Yellow finding outage in 2004 resulted in its failure to identify the RWT problem prior to 2005.

Q. HOW WERE THE QUESTIONS RAISED BY THE NRC RELATED TO THE YELLOW FINDING ISSUED TO APS IN 2004?

A. In preparation for the follow-up inspection, the NRC inspectors noted that the RWT was included in the scope addressed by APS in response to the Yellow finding but it was not included as a potential source of air entrainment into the ECCS. Therefore, the inspectors raised this question and APS was not able to demonstrate that air entrainment from the RWT would not render the ECCS pumps inoperable.

Q. WHAT DID THE NRC CONCLUDE ABOUT APS' HANDLING OF THIS ISSUE?

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[14] NRC letter dated August 31, 2006 from Bruce Mallett, NRC Regional Administrator to James M. Levine, Executive Vice President, Generation, Arizona Public Service Company, Subject: Midcycle Performance Review and Inspection Plan – Palo Verde Nuclear Generating Station, pages 2 – 3

A. The NRC inspectors concluded that Palo Verde personnel's reviews of the issue were narrowly focused, attention to detail was lacking, and there was poor inter- and intra-group coordination. The NRC's findings are summarized below and are provided in more detail in the GDS report on Palo Verde operation dated August 17, 2006.

- The inspectors determined that the licensee extent of cause and extent of condition reviews were narrowly focused. The licensee defined very extensive design criteria and features that could be pertinent to the original (Yellow) violation. However, if some design document or interface document addressed the design criteria, the licensee performed no further review. There was not a thorough effort by the licensee to validate the design criteria. This was clearly demonstrated in the RWT voiding issue. Examples included the licensee's misunderstanding of the maximum RWT Temperature, and their reliance on a Combustion Engineering interface requirement, for piping elevations, to meet all dynamic thermal-hydraulic design criteria for ECCS piping.

- The licensee also noted, in other ongoing programs at the facility, that design basis information was not handled with appropriate attention to detail.

- The inspectors determined that the licensee's evaluation of technical issues was iterative, which demonstrated a lack of thoroughness in reviews. The inspectors noted that engineering personnel would address one particular aspect or consideration when a design problem was presented. However, when questioned by the inspectors or engineering management, more discrepancies would be identified by the engineering personnel. The inspectors determined that design engineering personnel were making broad assumptions of criteria in their reviews, and in several cases, were using unverified or unstated assumptions from other groups.

- The inspectors noted a lack of communication between organizations, and a lack of attention to detail when coordinating critical design evaluations between organizations.

- The inspectors determined that the licensee had a very limited use of operating experience for the RWT issue. The licensee previously identified that ineffective use of operating experience was a contributor to the (Yellow) ECCS violation. The licensee also had several self-identified findings of ineffective operating experience use in the last year, following reviews of their substantive crosscutting problem identification and

resolution issue and their engineering program review. However, during the review of the RWT issue, the licensee did not consider all relevant operating experience.

- The inspectors determined that the schedule for effectiveness reviews did not ensure a timely review of the adequacy of corrective actions.

Thus, in its evaluation of the RWT outages, the NRC found many deficiencies in APS' evaluations of problems and in its management of the design basis information that led to the RWT outage.

Q. DID APS CONDUCT A ROOT CAUSE INVESTIGATION OF THIS OUTAGE?

A. Yes, they did. Palo Verde Engineering Manager Mr. Carl Churchman issued an Investigation Charter related to this event, stating that, while subsequent analysis adequately demonstrated operability of the ECCS and the units were restarted, the "inability of PVNGS to provide a timely response to the NRC question resulted in a manual trip of two reactors with concomitant plant transients, increased risk and economic harm." I would note that the economic harm referred to by Mr. Churchman will be to the ratepayers if this Commission allows APS to pass through the additional costs incurred. The results of this investigation are presented in CRDR 2835132: Plant Shutdown Due to Inoperable ECCS and CS Systems.

Q. WHAT DID APS' INVESTIGATION OF THIS EVENT CONCLUDE?

A. APS' investigation divides this event into two separate elements, each with its own causes. Element 1 involves the failure of the original design and licensing basis to adequately address the dynamic conditions likely present in the RWT during the drawdown period. Element 2 involves the failure of PVNGS to

identify and address the apparent design basis deficiency prior to its identification by the NRC. I will address APS' conclusions concerning Element 2, the failure of PVNGS to identify and address the apparent design basis deficiency prior to its identification by the NRC. APS determined the direct cause and root cause of Element 2 to be:

> The bases for NSSS to balance of plant (BOP) interface requirements are not sufficiently understood by PVNGS personnel because they have not been documented or maintained in a manner that supports technical challenges to their adequacy during engineering reviews.[15]

APS' root cause investigation contained the following supporting facts:

- Numerous operating experience documents related to ECCS net positive suction head issues have been evaluated at PVNGS but none of these evaluations identified this issue.

- PVNGS implemented a design bases review and documentation program consistent with NUMARC 90-12, Design Bases Program Guidelines. A Design Basis Manual (DBM) was developed for the SI system but there is no evidence that the lack of an analysis addressing the dynamic conditions in the RWT during the drawdown period was identified during this effort.

- PVNGS completed a design basis validation of the SI DBM, including a safety system functional inspection (SSFI). There is no evidence these validations efforts challenged this aspect of the system design.

- Calculation 13-MC-CH-201, Refueling Water Tank Sizing, addressed the possibility of continued flow from the RWT following a RAS, but did so in a manner that was not technically defensible.

[15] CRDR Number 2835132 Plant Shutdown Due to Inoperable ECCS and CS Systems, page 8 of 25.

PVNGS personnel did not identify this technical inadequacy during calculation revisions or DBM development/validation efforts.

- CRDR 2726509 was written to evaluate a longstanding issue involving the possible introduction of air into the ECCS pump suction following a RAS due to PVNGS failure to keep the piping from the containment sump filled with water as required by the design analysis. The evaluation of this CRDR included a review to identify other possible air entrainment scenarios but this review was not of sufficient depth to challenge the technical adequacy of the CE interface requirement relevant to the possible introduction of air through the RWT following a RAS.

- Calculation 13-MC-CH-201, Refueling Water Tank Sizing, revision 0 sheet 11 was performed by Bechtel in 1979 and is titled Flow From the RWT After RAS. It assumes a minimum containment back-pressure of 23 psia in validating the following assumption: "It is assumed that after the suction to ECCS pumps has been automatically realigned by the RAS, the suction flow from the RWT would be negligible or approximately equal to zero." In 1997, this calculation was revised by APS and the wording of the assumption supported by sheet 11 was changed to: "It is assumed that after the suction to ECCS pumps has been automatically realigned, the final RWT water level under all conditions would not result in air being introduced into the suction piping and gas binding the pumps." There is no evidence that the dynamic conditions in the RWT following a RAS were considered or the possibly non-conservative assumed containment pressure of 23 psia was challenged when this calculation revision was completed.

- The DBM Writers Guide (Procedure 83DP-4CC02) did not include detailed guidance on the review of source documents during the preparation of DBMs and did not include a requirement to verify the technical adequacy of source documents.

- By design, validation of the DBMs focused on validation of the information in the DBMs and did not include efforts to identify information that may be missing from the DBMs.

- The scope of the PVNGS calculation re-verification project did not include the SI, CH and CT systems.

- The PVNGS design basis reconstitution project did not specifically include a review/validation of CE interface requirements.

These supporting facts contain many examples of APS' failure to identify the inadequacies in the available design basis information and also identify many opportunities for APS to have identified the RWT issues sooner..

Q. DID APS' REVIEW OF OPERATING EXPERIENCE IDENTIFY OTHER OPPORTUNITIES FOR APS TO HAVE IDENTIFIED THIS PROBLEM?

A. Yes, it did. APS reviewed some 16 industry documents related to this issue. For many of these documents APS concluded that while the focus of the review was narrow, it was unlikely that even a more broadly based evaluation would have identified the problem. However, for CRDR 950891 and CRDR 971325, APS concluded that a more broad based CRDR response may have successfully identified the issue. CRDR 2726509 addressed the fact that the ECCS suction piping from the containment sumps was maintained unfilled since plant licensing despite the fact that several design documents indicate the pipe must be filled. In reviewing this CRDR, APS concluded "...the evaluation of CRDR 2726509 involved the same system and components and presented a missed opportunity for PVNGS personnel to challenge the design basis similar to how it was subsequently done by the NRC team.

1 **Q. APS HAS CHARACTERIZED THIS ISSUE AS A NEW ISSUE THAT**
2 **WAS BROUGHT UP BY THE NRC. DO YOU AGREE?**
3 A. No, I do not. First, the general concern of air entrainment is not a new technical
4 issue. Air entrainment is always a potential concern in the design of a fluid
5 system that is designed to draw down a tank providing a suction to a pump.
6 Second, it is a new issue only in the sense that APS failed to identify it despite
7 numerous opportunities during evaluation of the Yellow finding, during
8 development of the Design Basis Manual, and during review of operating events
9 and information notices as described above. APS should know and understand
10 the design of Palo Verde better than any other organization. After a review of a
11 prior inspection report, the NRC was able to come in and ask a question to which
12 APS' response was essentially, "Gee, we never thought of that." This speaks
13 volumes about APS' lack of understanding of the basic design of Palo Verde as
14 described above. While the question may have been new to APS, it should not
15 have been.
16 **Q. MR. LEVINE'S REBUTTAL TESTIMONY INCLUDES STATEMENTS**
17 **MADE BY DR. MALLET OF THE NRC TO THE ACC**
18 **COMMISSIONERS IN WHICH DR. MALLET OBSERVES THAT THE**
19 **RWT QUESTION WAS "...A NEW QUESTION, OK, ONE WHICH WE**
20 **HADN'T COME ACROSS BEFORE" AND THAT THE NRC "DIDN'T**
21 **DETERMINE THAT THEY SHOULD HAVE FOUND IT BEFORE**
22 **HAND." PLEASE RESPOND TO THESE STATEMENTS BY DR.**
23 **MALLET.**

A. The idea that this was a new question appears to be an attempt to shift responsibility for the design of Palo Verde to the NRC. There is no question that APS is responsible for the safety of the design of Palo Verde. APS' efforts to ensure that the plant is safely designed should not rely on the NRC asking the right question. Concerning the issue of whether this concern should have been identified before the NRC raised the question, I believe that it should have. Dr. Mallet's opinion on this is not supported by the facts or the NRC's findings. This question should have been raised during the review of the Yellow finding event in 2004. As described in more detail above, the NRC found that:

- APS' extent of cause and extent of condition reviews were narrowly focused;
- Design basis information was not handled with appropriate attention to detail;
- APS' evaluation of technical issues was iterative, which demonstrated a lack of thoroughness in reviews;
- APS had a very limited use of operating experience for the RWT issue;

A broader review of the Yellow finding issue, more attention to detail in handling of design basis information, more thoroughness in review of technical issues, and a broader review of operating experience should have identified the RWT issue before the NRC raised the question. In addition, APS' own root cause evaluation identified several opportunities to identify this issue prior to the NRC raising the question. These opportunities include:

- Development of the Design Basis Manual;

- Conduct of the Design Basis validation of the Safety Injection system;
- Conduct of a Safety System Functional Inspection;
- Conduct of CRDR 2726509 in sufficient depth to identify the issue;
- A more thorough and detailed review of similar operating experience;

In summary, notwithstanding Dr. Mallet's oral statements, which incidentally are not consistent with the NRC"s various written materials, a reasonable review of the facts reveals that APS missed many opportunities to identify this problem and should have identified it prior to the NRC posing the question.

Q. APS WITNESSES MATTSON AND LEVINE TAKE ISSUE WITH YOUR STATEMENT THAT THE NRC RESIDENT INSPECTIOR WAS OF THE OPINION THAT THE OUTAGE WAS AVOIDABLE. PLEASE RESPOND.

A. First, Mr. Levine's statement that "unlike the remarks of Mr. Warnick's superior, Dr. Mallet, there is no transcript of what Mr. Warnick told GDS" and Mr. Levine's implication that Mr. Warnick did not state his opinion that the outage could have been avoided is unwarranted. It is not my normal practice, nor do I believe it is Mr. Levine's, to be followed by a court reporter at all times to provide a transcript of discussions with NRC inspectors. I note that APS has had ample opportunity to discuss this statement with Mr. Warnick and has not contradicted my description of the discussion with Mr. Warnick. Additionally, I do not agree with Dr. Mattson's comment that "NRC inspectors are not trained or qualified to make such judgments." In my many years of evaluation of nuclear plant outages, I have always found the NRC resident inspectors to be a valuable and credible

1 source of information. Mr. Warnick was intimately familiar with the outage and
2 the findings in the NRC inspection report and, in his opinion, the outage was
3 avoidable.

4 **Q. HAS THE COMPANY'S REBUTTAL TESTIMONY CHANGED YOUR**
5 **CONCLUSION ABOUT THE CAUSE OF THIS OUTAGE?**

6 A. No, it has not.

7 **IMPLEMENTATION OF A NUCLEAR PERFORMANCE STANDARD**

8 **Q. COMPANY WITNESSES HAVE IDENTIFIED SEVERAL CONCERNS**
9 **WITH THE NUCLEAR PERFORMANCE STANDARD (NPS) THAT YOU**
10 **HAVE RECOMMENDED FOR PALO VERDE. PLEASE RESPOND TO**
11 **THESE CONCERNS.**

12 A. My proposed Nuclear Performance Standard is addressed by several of the
13 Company rebuttal witnesses including Mr. Levine, Dr. Mattson, Mr. Fitzpatrick,
14 and Mr. Wheeler. Before addressing the details of their concerns, I wish to point
15 out that my recommended NPS was provided as an example of an appropriate
16 performance standard for the Commission's consideration. I am well aware that
17 the Commission may add details to my proposal in order to tailor it for the
18 purposes of regulation in Arizona.

19 **Q. PLEASE RESPOND TO THE COMPANY'S COMMENT THAT THE NPS**
20 **SHOULD BE SYMMETRICAL AND SHOULD INCLUDE REWARDS**
21 **FOR GOOD PERFORMANCE AS WELL AS PENALTIES FOR POOR**
22 **PERFORMANCE.**

1 A. As described in my direct testimony, Palo Verde is a high capital cost plant and is
2 economic only when it operates at a high level of performance. A nuclear power
3 plant represents a bargain between the Company and its ratepayers. The
4 Company receives its reward in the form of a guaranteed rate of return on the
5 large capital investment in Palo Verde and, if the plant performs well, the
6 ratepayer benefits from the low production costs. However, the risk of poor
7 performance is borne solely by the ratepayer. As a matter of equity and fairness,
8 the Company should share the risk of poor performance and the resulting costs
9 with the ratepayer and should not receive additional compensation beyond the
10 large, guaranteed revenue stream generated by the plant in rate base. As a
11 practical matter, I do not believe that the reward provided by a symmetrical
12 program results in better plant performance and is merely additional expense
13 borne by the ratepayer for the Company merely doing what it should already be
14 doing. In a recent Georgia Power Company rate case, I was examining the
15 benefits of a nuclear performance incentive program in effect for Georgia Power's
16 nuclear power plants. The program was symmetrical with penalties and rewards
17 based on plant performance. The intent of the rewards aspect of the program was
18 to provide an incentive for better performance. I asked Georgia Power what
19 actions they had taken for improved performance that would not have been taken
20 absent the incentive provided by the program. The answer was one word –
21 "none." If an incentive program produces no resulting actions, it does not
22 produce the desired effect. I believe that APS' answer to this question would be
23 the same. The potential for a reward would have no effect on plant operation and

1 would merely provide additional revenue to the Company for no benefit to the
2 ratepayer.
3 **Q. PLEASE RESPOND TO THE COMPANY'S STATEMENT THAT THE**
4 **NPS SHOULD INCLUDE ALL BASE LOAD GENERATION.**
5 A. Nuclear and coal-fired generation are fundamentally different. Nuclear plants
6 have high capital costs and low production costs. Coal or gas-fired generation
7 have low capital costs and high fuel and production costs. The issues and
8 regulations affecting the operation of these plants are also very different. My
9 proposed NPS offers a method to share the risk of nuclear operation between
10 ratepayers and the Company. A company wide performance plan for all baseload
11 plants would be vastly different and is beyond the scope of my testimony. In
12 addition, I believe that the Company is rewarded by means of its opportunity to
13 earn a rate of return on rate base and does not need additional incentive.
14 **Q. PLEASE RESPOND TO THE COMPANY'S BELIEF THAT THE**
15 **COMPARISON GROUP SHOULD BE DIFFERENT THAN THE GROUP**
16 **DISCUSSED IN YOUR TESTIMONY AND THAT PALO VERDE IS A**
17 **"ONE OF A KIND" PLANT.**
18 A. I recommended a comparison group consisting of the 34 U.S. pressurized water
19 reactors (PWR) greater than 600 Mw capacity. Mr. Fitzpatrick recommends a
20 comparison group composed of the 27 U.S. PWRs greater than 1,000 Mw
21 capacity. I believe that the technology of the PWRs greater than 600 Mw is
22 fundamentally the same and that a larger comparison group is better. Mr.
23 Fitzpatrick testifies that the mean capacity factor for the period 2002-2004 for my

1 recommended comparison group is 90.8% while the mean capacity factor for his
2 recommended comparison group is 90.7%. I believe that either group will work
3 and I am willing to discuss this with the Company personnel. Concerning the
4 comment that Palo Verde is a "one-of-a-kind" plant, all nuclear plants are unique.
5 Even sister plants are not exactly the same. They all have their own sources of
6 cooling water and site specific design features. This does not mean, however, that
7 comparisons of plants are not useful. They utilize essentially the same technology
8 and are operated under the same regulations. Comparison of Palo Verde to the
9 proposed comparison group provides a meaningful basis to assess the
10 performance of Palo Verde.

11 **Q. PLEASE RESPOND TO THE COMPANY'S COMMENT THAT THE**
12 **PROPOSED 3-YEAR AVERAGE IS INAPPROPRIATE.**

13 A. The three-year evaluation cycle was proposed to allow for different refueling
14 cycle lengths among the comparison group plants. Also, from a practical
15 perspective, I do not think it should be much longer than three years so that the
16 calculation will reflect recent performance and to avoid the financial impact of
17 potentially large penalties. Therefore, I recommend that the three-year evaluation
18 cycle be adopted but I would be willing to consider a different evaluation cycle if
19 the Company could present a persuasive argument for a different length.

20 **Q. PLEASE RESPOND TO THE COMPANY'S STATEMENT THAT THE**
21 **NRC HAS INDICATED A CONCERN ABOUT NUCLEAR**
22 **PERFORMANCE STANDARDS.**

1 A. I believe that the Company's identification of this concern is something of a red
2 herring. Many nuclear plants have operated under a performance standard and
3 there has never been any indication that this has resulted in unsafe operation. In
4 addition, I would point out that the compensation of many of the plant's senior
5 managers and executives are closely tied to plant performance. This incentive is
6 surely more of a risk of impacting plant operation than a performance standard
7 that would penalize the Company. Finally, nuclear plant managers know that
8 even a slight indication of unsafe operation to meet a performance goal would
9 result in a high level of NRC scrutiny and possibly a lengthy plant outage.
10 **Q. PLEASE RESPOND TO THE COMPANY'S COMMENT THAT THE NPS**
11 **DOES NOT INCLUDE A CAP OR LIMITS ON THE AMOUNT OF**
12 **PENALTY OR REWARD THAT CAN BE INCURRED.**
13 A. I believe that a cap on the amount of penalty is a reasonable request, and I would
14 not be opposed to discussing a cap based on limiting the difference between the
15 actual capacity factor and the target value when calculating the penalty.
16 **Q. PLEASE RESPOND TO THE COMPANY'S OBSERVATION THAT THE**
17 **PROPOSED PLAN DOES NOT PROVIDE DETAILS OF HOW THE**
18 **PLAN WILL BE ADMINISTERED.**
19 A. As stated above, my recommended NPS was provided as an example of an
20 appropriate performance standard for the Commission's consideration. I am well
21 aware that the Commission may add administrative details to my proposal in
22 order to tailor it for the purposes of regulation in Arizona. Nonetheless, I believe
23 that my direct testimony contains sufficient detail to implement the NPS as

described. I would, however, be happy to consider any additional details that the Company may raise.

RESPONSE TO APS WITNESS EWEN

Q. WHAT IS THE PURPOSE OF YOUR SURREBUTTAL TESTIMONY RESPONDING TO MR. EWEN?

A. The purpose of this section of my surrebuttal testimony is to respond to the rebuttal testimony of APS Witness Ewen in which Mr. Ewen contends that I have overstated the net replacement power costs for imprudent Palo Verde outages that occurred subsequent to the beginning of the Company's PSA mechanism in April 2005 by $8.6 million. I will also respond to Mr. Ewen's comment that the Company's coal plants reduced outage costs by $10.0 million by performing above their normal levels in 2005.

Q. WHAT ARE YOUR CONCERNS AND PROBLEMS WITH THE REBUTTAL TESTIMONY OF APS WITNESS EWEN?

A. Mr. Ewen attempts to rebut the quantification of Staff's recommended disallowance for imprudent Palo Verde outages in 2005. He makes six complaints regarding the Staff's quantification of the disallowance. These potential issues are:

(1) The Unit 2 refueling water tanks ("RWT") outage replacement power costs quantification,

(2) The quantification of lower margins due to lost off-system opportunity sales,

(3) The Unit 3 RWT outage replacement power cost quantification,

(4) The replacement power costs for the Unit 1 reactor trip,

(5) A claim that some of the recommended disallowance has already been reflected in base rates, and

(6) His proposed offset to the imprudent Palo Verde outage disallowance for APS' coal plant performance.

Q. PLEASE RESPOND TO MR. EWEN'S CONTENTION THAT THE UNIT 2 RWT OUTAGE COSTS IN OCTOBER 2005 ARE OVERSTATED BY $5.6 MILLION.

A. The Unit 2 RWT outage began on October 11, 2005 and ended on October 20, 2005. Mr. Ewen claims that the "incremental outage duration" related to the RWT issue is less than three days because other work was done on Unit 2 during this outage. While it is normal to perform maintenance activities when a nuclear plant is shutdown for any reason, Mr. Ewen's claim that the work performed during the RWT outage would reduce the replacement power costs attributed to the RWT outage is flawed. The basis for Mr. Ewen's position is the testimony of APS witness Levine who states that Unit 2 "in all likelihood" would have had to shut down prior to the unit's next refueling outage to replace the Reactor Coolant Pump (RCP) oil seals. This is pure speculation. APS has provided no evidence that a subsequent outage was planned or would have occurred. Mr. Levine's basis of "in all likelihood" is speculative and should not form the basis for a $5.1 million adjustment to imprudently incurred costs that APS is asking the Arizona ratepayer to bear.

1 **Q. PLEASE EXPLAIN MR. EWEN'S PROPOSED REVISION TO STAFF'S**
2 **PROPOSED ADJUSTMENT TO REFLECT MARGINS RELATED TO**
3 **LOST OFF-SYSTEM OPPORTUNITY SALES.**
4 A. Mr. Ewen's rebuttal testimony on this issue is unclear. In addition, Mr. Ewen did
5 not file his analysis or study that quantifies his proposed adjustment. The Staff
6 has provided data requests to APS that we hoped would help clarify Mr. Ewen's
7 proposed adjustment.

8 **Q. HAVING REVIEWED THE ADDITIONAL INFORMATION THAT HAS**
9 **BEEN PROVIDED, DO YOU STILL HAVE ANY ISSUES WITH MR.**
10 **EWEN'S REBUTTAL REGARDING THE MARGINS ON LOST OFF-**
11 **SYSTEM OPPORTUNITY SALES?**
12 A. Yes, it appears that Mr. Ewen has only provided for an adjustment to margins for
13 lost off-system opportunity sales in those hours when both (1) Palo Verde was
14 shut down due to an imprudent outage and (2) APS was not buying power in the
15 wholesale market. He also states that Staff significantly understated the margin
16 amount per MWh in our disallowance quantification.

17 **Q. DO YOU AGREE THAT THE LOST MARGINS WOULD ONLY HAVE**
18 **OCCURRED DURING THOSE HOURS WHEN PALO VERDE HAD AN**
19 **IMPRUDENT OUTAGE AND APS WAS NOT BUYING POWER IN THE**
20 **WHOLESALE MARKET?**
21 A. No. The imprudent Palo Verde outage may be the event that caused APS to begin
22 making wholesale power purchases. If the imprudent outage had not occurred, it

is very possible that APS could have been making off-system sales during the outage period. APS has not attempted to analyze this impact.

Q. DO THE APS RESPONSES TO THE NEW DATA REQUESTS CLARIFY THE BASIS FOR MR. EWEN'S ADJUSTMENT FOR LOST MARGINS ON OFF-SYSTEM SALES?

A. While the data responses do clarify how Mr. Ewen calculated his adjustment, the analysis that was provided as an attachment to the response only raises additional issues or questions and does not appear to be reasonable.

Q. WHAT ARE THE PROBLEMS WITH THE ANALYSIS SUPPORTING MR. EWEN'S PROPOSED ADJUSTMENT?

A. That analysis compares the actual off-system sales margins with simulated off-system sales margins under the assumption that the outage had not occurred and Palo Verde was operating. Curiously, the analysis shows that, on some days during the imprudent outages, APS' simulation calculated lower off-system sales volumes when Palo Verde was running than when it was out of service. This result is illogical and makes Mr. Ewen's analysis suspect. In the same vein, Mr. Ewen's analysis also shows that, on some days during the imprudent outages the simulation results in lower margins although the level (MWh) of off-system sales increases. While this may be possible in certain situations, it is certainly highly unlikely and casts further doubt on Mr. Ewen's analysis.

Q. BASED ON THE NEW INFORMATION PROVIDED IN APS' DATA RESPONSES, DO YOU AGREE WITH MR. EWEN'S ADJUSTMENT FOR OFF-SYSTEM SALES MARGINS?

1 A. No. The information provided by APS in their data responses only raises new
2 questions and casts further doubt on their proposed adjustment.

3 **Q. HAVE YOU REVIEWED MR. EWEN'S PROPOSED ADJUSTMENT TO**
4 **STAFF'S RECOMMENDED DISALLOWANCE FOR THE UNIT 3 RWT**
5 **IMPRUDENT OUTAGE?**

6 A. Yes. While it seems counterintuitive that simultaneous outages for two units
7 would incur significantly different replacement power costs, this difference is
8 apparently the result of APS' arbitrary allocation of replacement power sources
9 between Palo Verde units 2 and 3. I believe that a more logical approach would
10 be to calculate the average replacement power costs for both outages and to apply
11 this average to the lost megawatt-hours from each unit. However, this result
12 would be the same as that calculated by Mr. Ewen. Therefore, I agree with the
13 amount of adjustment recommended by Mr. Ewen of $1.1 million.

14 **Q. MR. EWEN CLAIMS THAT THE NET REPLACEMENT POWER COSTS**
15 **FOR THE UNIT 1 OUTAGE FROM AUGUST 26 TO AUGUST 28, 2005**
16 **ARE OVERSTATED BY $88,000. DO YOU AGREE?**

17 A. I based my quantification of the net replacement power cost on a net replacement
18 power cost of $1.260 million provided by the Company. Mr. Ewen bases his
19 adjustment on the assertion that the unit was at a very low power level when the
20 trip occurred and would have remained out of service for an additional 6.5 hours
21 even if the trip had not occurred. I will accept this adjustment to the Company's
22 calculation of the net replacement power cost and the subsequent $88,000
23 adjustment to my recommended disallowance.

1 **Q. PLEASE DESCRIBE MR. EWEN'S PROPOSED ADJUSTMENT OF**
2 **$515,000 FOR HIS CLAIM THAT APS' BASE RATES ALREADY**
3 **PROVIDE FOR SOME NORMAL LEVEL OF PALO VERDE FORCED**
4 **OUTAGE REPLACEMENT POWER COSTS.**
5 A. Mr. Ewen is correct that base rates already reflect replacement power costs for a
6 "normal" level of Palo Verde forced outages. However, Mr. Ewen incorrectly
7 claims that since these replacement power costs are already recovered from
8 ratepayers, the 90/10 sharing factor should not apply to the base rate amounts for
9 disallowances due to imprudence.

10 **Q. PLEASE EXPLAIN MR. EWEN'S INCORRECT CLAIM REGARDING**
11 **REPLACEMENT POWER COSTS RECOVERED IN APS' BASE RATES.**
12 A. The problem with Mr. Ewen's proposed adjustment is that the amount of
13 replacement power costs recovered in base rates assumes that the outage was <u>not</u>
14 imprudent. Since Staff's recommended disallowance is only for imprudent
15 outages, the amounts recovered in base rates for forced outage replacement power
16 costs are irrelevant. If the replacement power costs are for imprudent outages,
17 they should be disallowed whether they are in the base rates, or in the PCA factor.

18 **Q. WHAT IS YOUR RECOMMENDATION REGARDING THIS PROPOSED**
19 **ADJUSTMENT BY MR. EWEN?**
20 A. I do not agree with Mr. Ewen's adjustment for the reasons previously discussed. I
21 recommend that the Commission reject this $515,000 proposed APS adjustment.

1 **Q. PLEASE RESPOND TO MR. EWEN'S STATEMENT THAT YOU**
2 **NEGLECTED TO REFLECT THE MITIGATING EFFECT ON**
3 **REPLACEMENT POWER DUE TO THE PERFORMANCE OF THE**
4 **COMPANY'S COAL-FIRED PLANTS.**
5 A. Mr. Ewen's discussion of the performance of coal-fired plants is unrelated to the
6 costs incurred due to specific imprudent outages at Palo Verde. The net
7 replacement power cost for each Palo Verde outage was provided by the
8 Company. This cost is the additional cost that was incurred to replace the power
9 that would have been generated by Palo Verde absent the imprudent outages.
10 This net replacement cost considers the cost of Palo Verde generation and the cost
11 of the required replacement power. This cost is unaffected by performance of the
12 Company's coal-fired plants. It is simply the additional cost incurred due to the
13 imprudent Palo Verde outages and there should be no offset due to coal plant
14 performance.
15 **Q. PLEASE SUMMARIZE YOUR RESPONSE TO MR. EWEN'S**
16 **REBUTTAL TESTIMONY.**
17 A. The following table summarizes my response to Mr. Ewen's proposed corrections
18 to my recommended disallowances due to imprudent Palo Verde outages:

Issue	Ewen's Proposed Correction	Staff' Position	Staff Adjustment to Filed Testimony
Unit 2 RWT	$5.1 million	Disagree	$0
Off-system Sales Impact	$1.8 million	Disagree	$0
Unit 3 RWT	$1.1 million	Agree	$1.1 million
Unit 1 Reactor Trip	$0.088 million	Agree/Company revised data response	$0.088 million
Costs Already Expensed	$0.515 million	Disagree	$0

Total Imprudent Outages	**$8.6 million**		**$1.188 million**
Coal Plant Performance Offset	$10.0 million	Disagree	$0
Total	**$18.6 million**		**$1.188 million**

Q. DOES THAT CONCLUDE YOUR SURREBUTTAL TESTIMONY?

A. Yes, it does.