APS

A subsidiary of Pinnacle West Capital Corporation

Palo Verde Nuclear
Generating Station

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ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Docket Nos. STN 50-528, 50-529, and 50-530
Clarifications and Additional Information Requested at the November 20, 2006 NRC Regulatory Conference

At the November 20, 2006, regulatory conference in Arlington, Texas, Arizona Public Service Company (APS) provided the NRC its perspective on the facts and analytical assumptions relevant to determining the safety significance of potential findings related to spray pond chemistry controls in NRC Special Inspection Report dated September 28, 2006. The purpose of this letter is to provide clarifications and additional information requested by the NRC during the regulatory conference. Enclosure 1 to this letter contains the requested clarifications and additional information from the regulatory conference. Enclosure 2 to this letter contains the revised presentation slides for the November 20, 2006, NRC Regulatory Conference.

No commitments are being made to the NRC by this letter. Should you have any questions, please contact Thomas N. Weber at (623) 393-5764.

Sincerely,

James M Levine

JML/TNW/GAM

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Enclosures:
1. Clarifications and Additional Information Requested at the November 20, 2006 NRC Regulatory Conference
   Attachment 1: Scenario for Restoration of Normal Control Room Cooling During a Safety Injection Actuation Signal (SIAS)
   Attachment 2: Scenario for Restoration of Normal Control Building Cooling During a Safety Injection Actuation Signal (SIAS)
2. Revised Presentation Slides for the November 20, 2006 NRC Regulatory Conference

cc:	B. S. Mallett	NRC Region IV Regional Administrator
	M. B. Fields	NRC NRR Project Manager
	G. G. Warnick	NRC Senior Resident Inspector for PVNGS

ENCLOSURE 1
Clarifications and Additional Information Requested at the November 20, 2006 NRC Regulatory Conference

NRC Question 1

Were there any procedures associated with establishing cooling to the switchgear rooms after the loss of essential chiller 2B?

APS Response 1

Procedure 40AO-9ZZ20, "Loss of HVAC," addresses operator actions for total loss of Control Building HVAC. While this procedure does not provide specific operator actions for the ESF Switchgear rooms, the section for loss of HVAC to the Control Building states; "Ensure that the suction of any temporary blower(s) is from an area that has an air temperature less than that required for the room to be cooled." Entrance to this step is part of the directions for loss of cooling to the DC Equipment rooms.

To perform this step for the DC Equipment rooms the operator would line up the suction of the blowers for these rooms through the ESF Switchgear room (i.e., opening the ESF Switchgear Room doors).

This direction does not specifically direct blowers to be aligned to provide cooling to the ESF Switchgear Rooms but would result in the ESF Switchgear room doors being opened.

NRC Question 2

What were the heat exchanger heat loads while performing testing for essential cooling water (EW) 3A? What was the accuracy associated with that testing?

APS Response 2

General Discussion

The Palo Verde thermal performance test program for the Essential Cooling Water (EW) heat exchangers is based upon the guidance contained in EPRI NP-7552, "Heat Exchanger Performance Monitoring Guidelines." The EPRI guideline provides general guidance for the selection of test instrumentation and test performance. The Palo Verde test instrumentation meets or exceeds the EPRI guidelines for instrument accuracy. Instrument accuracy, test heat load, and heat exchanger temperature deltas are all important when determining heat exchanger performance. The test heat load is largely beyond the control of the test director since the test is routinely performed soon after entering Shutdown Cooling, at the beginning of a unit refueling. The following table provides both the EPRI NP-7552 guidance and the Palo Verde test instrumentation accuracies.

EW Heat Exchanger Thermal Performance Test Instrumentation:

Test Instrumentation	EPRI Guide NP-7552	PV EW Heat Exchanger Test	
		EW System	SP System
Temperature	+/- 5 % (HX differential temperature; 2 RTD's)	+/- 0.5% Reading (for each of two RTD's)	+/- 0.5% Reading (for each of two RTD's)
Flow	+/- 5% (calibrated span)	+/- 1.77% * (calibrated span)	+/- 2.5% ** (calibrated span)

* Calc. 13-JC-EW-0202, Rev. 4
** Calc. 13-JC-SP-0201, Rev. 9

Specific Discussion of Unit 3 Refueling 10 (U3R10) EW-A Tests

During the U3R10 refueling outage, the EW-A heat exchanger was tested twice. The first test was performed after entering shutdown cooling, following plant shutdown. The second test was performed following the refueling, prior to plant startup. Both tests had substantial heat loads that were sufficient for performance of a quality thermal performance test. Test conditions were as follows:

Unit 3 EW-A Heat Exchanger:

Test Date	Heat Load *	Heat Exchanger Differential Temperature
4/2/2003	49.5×10^6 Btu/hr	6.75°F
4/27/2003	75.2×10^6 Btu/hr **	10.09°F

* Design Heat Load = 145.2×10^6 Btu/hr
** Higher Heat Load due to RCP operation

Overall test accuracy for heat load, using the Square Root Sum of the Squares (SRSS) method for test instrumentation, is 10% or better; this is consistent with the EPRI NP-7552 guidelines.

Heat Balance Error (HBE), which is the difference between the calculated heat transfer rates for the hot (EW) and cold (SP) sides of the heat exchanger, is an indicator of the quality of a thermal performance test. For each of the U3R10 EW-A tests, the HBE was less than 1%; this indicates that both tests were of high quality and that the actual test accuracy should surpass the theoretical test accuracy.

NRC Question 3

Please provide your position on the impact of heat stress and radiological conditions on the human reliability analysis (HRA) of 0.14. This question is based upon the situation where control room cooling is lost and actions are taken to open the doors to provide ventilation.

APS Response 3

The HRA value of 0.14 considered the potential for a high stress environment. The actual actions that need to be taken to restore cooling in the high temperature environment are not complex and could be accomplished in a short enough time that the potential for heat stress could be effectively managed. A sensitivity study provided in this response also showed the final risk conclusion was not sensitive to the value of this HRA.

Engineering calculation 13-MC-HJ-0256 Revision 002 (issued February 1, 1996), "CTRM [Control Room] and SWGR [Switchgear Room] Room Temperature Rise Study," indicated (in figures 1 and 7) that, upon loss of all control room HVAC, the room temperature rises to 119°F in approximately seven hours (15 hours with open doors). Also, the room temperature rises to 104°F in about two hours (five hours with open doors).

In this accident scenario, loss of essential chillers (EC) (and consequently loss of control room essential HVAC) is probable only after the recirculation actuation signal. The accident scenarios analyzed (using the code NE100) indicated that loss of the essential chiller would occur at about 100 minutes post-LOCA (for a large break) with an assumed conservative degradation of 50% in the EW heat exchanger U value. Technical Support Center (TSC) personnel are expected to convene and be credited for accident mitigation guidance in about two hours from the initiation of LOCA. Thus, at least six hours are available for TSC/control room personnel to identify and document the most appropriate method to restore normal HVAC alignment to the control room.

This situation was presented to one of the HVAC Maintenance Engineers who would most likely be called to assist the TSC to develop a procedure. Within a few hours, this engineer developed written scenarios to restore control room HVAC via installation of electrical jumpers across the SIAS contacts in the control circuits for the HVAC dampers that are required to be realigned. This method allowed restoration from the control room, and Operations to maintain control of the system. (The restoration scenario also provided for jumpering the control room essential filtration actuation signal (CREFAS) and loss of offsite power (LOP) contacts, as necessary.) The restoration scenarios were developed by the HVAC engineer alone, but could have been developed by the Mechanical and Electrical engineers assigned to the TSC, along with assistance from the unaffected Unit Shift Technical Advisor (STA), Technical Engineering Manager, and Operations Advisor. These restoration scenarios did not exist during the 2002-2003 time frame, but were developed to help understand the complexity of the tasks.

The restoration scenarios are provided as Attachments 1 and 2. Note that restoration of control room HVAC would involve installation of four jumpers (two minimum for SIAS override), and seven simple steps by the control room Operator. Restoration of normal control building HVAC would involve installation of five jumpers and 11 simple steps by the control room Operator.

The jumpers are installed in the ESFAS auxiliary relay cabinets, located in the back panels of the control room. Failure to install the jumpers correctly would be self evident in that the damper would not operate.

The importance of the Operator actions to restore control room and control building HVAC [HRA Mean Probability = 0.14] is a function of both the importance of the event for the degraded condition and for the baseline condition. To evaluate the importance of the HRA, its value was set to the 95th percentile value of 0.5 and the results for the plant impact re-quantified. The table below presents the result of this comparison. The original results were reported in Engineering Study 13-NS-C082 Table 9.2.1, which was previously provided to the NRC Region IV. These results show that the only case where a significant difference is noted is the case where the control building is the only HVAC dependency, but this case is still not risk significant. The remaining cases are dominated by the pump dependencies and the HRA sensitivity is not significant.

HRA Sensitivity Analysis

Sensitivity Case	ΔCDF^{+} HRA=0.14 (mean value) From 13-NS-C082 Table 9.2.1	ΔCDF^{+} HRA=0.5 (95^{th} percentile)
A – No ESF pumps dependent on HVAC (control building impact only)	2.6e-7/yr	7.6e-7/yr
B – HPSI pump HVAC dependent	3.1e-6/yr	3.4e-6/yr
C – CS and LPSI HVAC dependent	3.4e-6/yr	3.6e-6/yr
D – HPSI, EW and AFB HVAC dependent	4.2e-6/yr	4.4e-6/yr
E – All Pumps HVAC dependent	4.3e-6/yr	4.5e-6/yr

($^{+}$The ΔCDF values here must be multiplied by the exposure time to determine the significance)

In general, operations at Palo Verde during summer months often involve areas where the ambient temperatures may exceed 100°F; e.g., ambient temperatures in the turbine building regularly exceed 110°F. The actions credited for core damage mitigation in the elevated temperature areas are light work loads, and are not performed in sunlit areas. Maintenance and Operations personnel at Palo Verde are acutely aware of heat stress and regularly briefed on the symptoms. It is concluded that the temperature range of equipment functionality (less than 119°F) will have no significant impact on the Operations and Maintenance staff during the course of event mitigation. Additionally, the calculations of room heatup rates assumed a consistent 113°F outside temperature. These temperatures are only attained for several hours during summer days. Thus, it can be assumed that lower temperature areas are available (outside, or in corridor buildings) to obtain temporary physical relief and recovery, if necessary.

In addition, credit may be taken for full Emergency Organization activation (OSC, TSC, and EOF) within the time to reach elevated temperatures within the control room. The engineering and operations personnel staffing these locations will be aware of the elevated room temperatures and be assisting with additional restoration and mitigation actions not credited by the HRAs modeled.

The effect of radiological conditions is not possible to calculate because the conditions are not known or knowable. Design basis calculations for radiological conditions are unsuitable for use in predicting realistic doses in these circumstances. However, all the actions are taken prior to any potential core damage. It would become a function of the emergency response organization to take actions necessary to manage the radiological effects of this beyond design basis scenario.

NRC Question 4

> **Was eddy current testing or other cleaning performed between April 1999 and March 2002 (2EW-B)?**

APS Response 4

Eddy current testing (ECT) of the 2EWB heat exchanger was performed in October 2000 (U2R9) and March 2002 (U2R10). However, no thermal performance testing was performed for 2EWB during the U2R9 (October 2000) refueling outage. Since ECT was performed during U2R9, the 2EWB heat exchanger would be expected to have a thermal performance margin of at least +25%. However, changes in spray pond chemistry were also being implemented during this U2 operating cycle 10 and the same degradation rate assumptions used in EPRI Report 1014505 for the U2 operating cycle 11 can not be similarly applied. The conclusions of the EPRI Assessment for the 2EWB heat exchanger are not affected by the lack of a specific degradation rate for the U2 operating cycle 10 for the following reasons:

- The U2R10 end-of-cycle margin was measured at the end of the U2R10 operating cycle and found to be -10%, which is above the projected U2 operating cycle 11 end-of-cycle margin value of -24.5%. The projected performance degradation on the 2EWB heat exchanger determined in the EPRI assessment is independent of the degradation prior to the end of U2 operating cycle 10.

- Unit 2 operating cycle 11 remains the operating cycle where the lowest value of thermal performance margin existed on the 2EWB heat exchanger. The degradation rate applicable to the 2EWB heat exchanger during this lowest performance period (i.e., U2 operating cycle 11) is dependent on the chemistry conditions present in the pond at that time. As noted in the EPRI Report, the available data was reviewed and reasonable assumptions derived to determine the degradation rate that could reasonably be expected to exist in the Unit 2 spray pond B and its system for the U2 operating cycle 11.

Eddy current testing was not performed on the 2EWB heat exchanger during U2R8 in April, 1999. In addition, mechanical cleaning was not performed on the 2EWB heat exchanger in the April 1999 to October 2002 time frame.

NRC Question 5

For all small LOCAs, do the steam generator (SG) tubes remain filled and capable of providing adequate heat transfer to allow the operator to effectively manage the transition to shutdown cooling.

APS Response 5

For small LOCAs, adequate steam generator heat transfer capability exists to manage the transition to shutdown cooling.

MAAP4.0.5 results for small LOCA indicate that the mixture water level in the primary system (ZWV) remains constant and equal to that during normal operations at all times (19 hours run duration). Whereas, the collapsed primary system water level (ZWCPS) dropped slightly between the times of 40 minutes and 75 minutes, it then recovered to normal operations level.

The primary system void fraction parameter (VFPS) indicated that the primary system void fraction peaked at 1 hour and returned to zero at about 1.5 hours within the transient (recirculation actuation signal began at 2.5 hours). In MAAP4, void-driven phase separation begins at a void fraction equal to 0.5. The small LOCA run indicated that VFPS was less than 0.5 at all times. Thus, the MAAP4 run shows the collapsed water level below the upper portion of SG tubes but no phase separation.

The primary system pressure remained (at all times) greater than that of the containment. This pressure differential indicates that flow is always out of the break regardless of the break location. Non-condensable gases would not be drawn into the primary system. Therefore, steam generator heat removal capability is available at the time of shutdown cooling initiation. The simulation results for the 2.3 inch diameter small LOCA (the largest end of the small LOCA spectrum) show that at the time of SDC initiation, near 18 hours, that the heat loads are approximately evenly split between the steam generators and the shutdown cooling heat exchanger. Adequate steam generator heat transfer capability exists to manage the transition to shutdown cooling.

NRC Question 6

Why is there a minor difference (approximately 2°F) in the initial essential cooling water (EW) temperatures as shown in the "Large LOCA," "Small LOCA," and "Forced Shutdown" charts in the risk analysis presentation?

APS Response 6

The difference in EW initial temperatures is due to a conservative treatment of the pre-recirculation actuation signal (RAS) heat loads in the large LOCA case.

The ultimate heat sink (UHS) thermal performance analysis is performed using Bechtel-developed computer code NE100. The initial EW temperature is not a direct user input, it is computed by the code based on the other inputs (such as the SP temperature, SP flow rate, EW heat exchanger U, EW heat exchanger heat transfer area, EW system heat loads and the EW system flow rate) by performing a heat exchanger calculation.

The "Large LOCA" chart was developed based on the design bases LOCA case whereas the "Small LOCA" and "Forced Shutdown" charts were developed based on a forced shutdown scenario of the design bases calculation 13-MC-SP-0307. The purpose of the former is to compute the maximum EW temperature for a design bases LOCA whereas the purpose of the latter is to be a representative case for a forced shutdown condition.

A review of the input files for these case runs (previously provided to the NRC in Appendix E of Engineering Study 13-NS-C082, starting on page 143) indicates that the heat loads considered to be imposed on the EW system from the beginning of the event to RAS or shutdown cooling entry (SDCE) are different for the large LOCA and the small LOCA/Forced Shutdown cases. The heat load for both the small LOCA and Forced Shutdown cases is 6.00E+06 BTU/hr from the beginning of the event to RAS or SDCE. This is comprised of the EC chiller and EW pump heat loads and is appropriate as the shutdown heat exchanger and fuel pool loads do not exist at this time. The heat load for the large LOCA case from the beginning of the event to RAS is 14.42E+06 BTU/hr. This is comprised of the EC chiller and EW pump heat load of 6.00E+06 BTU/hr plus an ECCS pumps heat load of 8.42E+06 BTU/hr. This is conservative in the analysis as the ECCS pumps heat load is not actually imposed on the EW system until after RAS. This conservatism results in the higher EW temperature in the large LOCA case (91°F vs. 88°F for the small LOCA or Forced Shutdown case). A sensitivity run performed for the large LOCA case with a heat load of 6.00E+06 BTU/hr prior to RAS resulted in the same starting EW temperature of 88°F. It was also noted that the peak EW temperature was not impacted by this change.

Thus, the conservative treatment of the ECCS pump heat load results in a higher EW temperature for the large LOCA case. The small LOCA/Forced Shutdown cases EW temperature is correct as shown in the presentation material.

NRC Question 7

> **What is the volume of oil in the LPSI and CS pump motors and what margins are involved (e.g., leak rates, time factors to failure)?**

APS Response 7

The quantity of oil in the upper and lower bearing assemblies for the pump motors is approximately 1 1/2 quarts per bearing assembly. The leakage from the LPSI/CS lower bearing sight glass at an ambient room temperature of 150°F observed during the testing was not quantified. If the LPSI/CS lower site glass leaked, then approximately 1/2-2/3 of the oil could slowly leak from the gauge. The motor would continue to run with the oil mist, however, due to the decreased volume of oil, the bearing would run hotter and result in accelerated bearing degradation. The motor could run until the vibration became unacceptable. The limiting item may be the vibration effect on the pump seals. The magnitude of bearing temperature increase and potential vibration has not been quantified.

NRC Question 8

> **Please provide the corrected charts for the presentation materials.**

APS Response 8

The revised charts are provided in Enclosure 2.

NRC Question 9

> **Given the uncertainty in the degree of heat exchanger performance improvement caused by the eddy current testing (assumed 25 percent), how is this uncertainty factored into the risk assessment?**

APS Response 9

The uncertainty in the degree of heat exchanger performance improvement that results from eddy current testing is acknowledged to be a contributor to the uncertainty in the risk assessment.

The effect of eddy current cleaning is treated as a reasonable assumption given the evidence from the Unit 3A heat exchanger. This heat exchanger realized almost a 50% increase in margin (from -22% to +26.8%) due to eddy current testing.

Based on our understanding that the cleaning is due to the interaction of the eddy current probe and plastic conduit with the foulant layer, this physical mechanism is assumed to return any fouled tube to a similar condition. This assumption is considered to be more reasonable and conservative than assuming a fixed increase in U value due to eddy current testing, regardless of the initial condition of the tube. Thus the benefit of eddy current testing in the Unit 2B heat exchanger is assumed to be an increase to a value of +25% margin rather than assume the same increase in U that was measured in Unit 3.

A geometric analysis, previously provided to Region IV staff, that assumes that only the eddy current probe itself provides cleaning, results in a minimum effect of +Δ10%U for the 2B heat exchanger. This model is shown to under-predict the actual Unit 3 results by a factor of approximately 3.

Thus the range of uncertainty on the effect of eddy current cleaning is from an increase in U of +Δ10% (approximately 0% U margin) as a conservative minimum value, to a possible +Δ50% (approximately a +40% U margin) based on the Unit 3 actual measured effect.

APS concluded that the most reasonable interpretation of the Unit 3 data, based on our best understanding of the physical process, would be an increase to a fixed value of +25% U margin due to the similar interaction to be expected between the heat exchanger tube and the eddy current probe and cable in all heat exchangers.

The risk results presented in engineering study 13-NS-C082 Table 9.2-1 include sensitivity analysis results for the risk associated with this range of cleaning assumptions.

NRC Question 10

What were the nuclear oversight functions related to the Chemistry Program for the spray pond?

APS Response 10

Oversight did exist and focused on overall Chemistry program health but did not specifically focus on the program controlling essential spray pond parameters.

Spray pond chemistry was reviewed during the most recent chemistry audit (06-004), which was performed from February 7 through 17, 2006. This audit included a broad range of chemistry issues, from primary, secondary, closed cooling water and the spray pond water chemistry to the post accident sampling system (PASS). Also included were programmatic issues like training of personnel and procedures. Spray pond chemistry was reviewed; however, the review was focused on verifying compliance with existing procedures and not the technical adequacy of the procedures. For example, the audit report states:

The audit team reviewed chemistry data for both spray ponds on all three units for the year 2005. The review consisted of each out of specification data point occurring in 2005 for corrective actions that were completed to restore the chemistry back to within control parameter limits.

Of the data reviewed a total of 5,953 data points were recorded in CLASS for the spray ponds on all three units. Of the 5,953 chemistry analyses, 100 test results were found to be out of specification, equating to the chemistry control of spray pond chemistry initially yielding 1.7% out of spec conditions. The low number of out of specification OOS results indicates that spray pond chemistry controls are being complied with to minimize piping and heat exchanger corrosion and fouling.

The most recent audit did verify compliance with control limits but did not verify that the control limits were adequate to preclude foulant formation.

Audit 04-003 identified that the change in bulk chemical vendors (used for spray pond and other systems for water chemistry control) was not adequately evaluated. CRDR 2683642 was initiated to ensure that changes in bulk chemical providers were adequately evaluated (February 13, 2004). This CRDR was closed based upon procedure changes that addressed the vendor interface concerns. At that time, Nuclear Assurance Division (NAD) was aware of an existing CRDR 2653867 related to foulant, and relied upon it to address that technical issue. As described in the Significant CRDR Report, at that time, the cause of the foulant was not correctly understood. The original misdiagnosis of the foulant was also described in APS letter no. 102-05593, dated November 14, 2006.

Oversight did exist and focused on overall Chemistry program health but did not specifically focus on the program controlling essential spray pond parameters. As described in APS letter no. 102-05593, dated November 14, 2006, in response to NRC Inspection Report 05000528/2006011; 05000529/2006011; 05000530/2006011, Palo Verde's Nuclear Assurance Division revised the generic activities master assessment plan to require procedures selected for reviews during audits to include a full basis review of the entire procedure against the applicable licensing and design basis.

<u>NRC Question 11</u>

Given that some equipment may end the 24 hour PRA mission time in operation, but in a degraded condition (i.e., LPSI and CS pumps), what is the risk impact for periods beyond the 24 hours?

<u>APS Response 11</u>

The risk impact for operation beyond 24 hours can be conservatively estimated by assuming that both the CS and LPSI pumps depend on the success of room cooling to remain functional. This result was provided by sensitivity Case C of Table 9.2-1 in Engineering Study 13-NS-C082.

If equipment has become degraded sufficiently so that the ability of the equipment to function much beyond 24 hours is in question, then stable conditions have not been achieved. For this specific assessment, the CS pump may be considered degraded to this extent because it has been operating in an elevated temperature environment for some part of the accident. The LPSI pump is never operated at elevated temperatures because it automatically trips on a RAS and is therefore is not operating at the time the chiller is presumed to be lost. The LPSI pump may be in a similar ambient air temperature, but with the pump not running, the oil, bearing and sight glass temperatures will be similar to the ambient temperature of the room (approximately 150°F), and not the elevated temperatures they normally see during operation (approximately 200°F).

It would be appropriate to consider that the operation of the CS pump is dependent on the successful operation of the room cooling. The additional actions to be modeled would then be the substitution of the LPSI pump as an alternative to the CS pump. Success of the LPSI pump would then also depend on successful restoration of room cooling for this pump. The uncertainty associated with the success probability for this action would be large.

Rather than add extra modeling with large uncertainties, it is conservative to assume that both the CS and LPSI pumps depend on the success of room cooling to remain functional. This is represented by Case C of Table 9.2-1 in Engineering Study 13-NS-C082.

<u>**NRC Question 12**</u>

> **LPSI/CS Pump Rooms – Did we credit opening the doors? Control room heat-up calculation uncertainty: Are we confident that the control room temperature would be less than what we assumed?**

<u>**APS Response 12**</u>

The room heat up calculation for the auxiliary building did not credit opening the doors to the LPSI/CS pump rooms.

We are confident that the control room temperature would be less than what is calculated for the following reason:

A control room heat up test was performed in July 1988 in order to compare the results of the APS analytical model to the actual control room heat up. The control room heat up experienced during the test was less than the heat up predicted by the analytical model.

NRC Question 13

In the risk analysis presentation, EW temperature response results were presented for large LOCA, small LOCA and Forced Shutdown. The LOCA analyses used a U value of 158 while the forced Shutdown result used a U of 165. What affect did this difference in U value used have on the risk analyses results?

APS Response 13

The difference in U value had no affect on the risk analysis results.

If the U value of 158 had been used, the EW temperature may have been slightly above 135°F, indicating the need for operators to control the evolution. However, the risk assessment was performed assuming that operator control is required for the initiation of SDC to avoid challenging the EW temperature limit during small LOCA events. This assumption was based on the design basis calculation, 13-MC-SP-0307. See Engineering Study 13-NS-C082, Section 5.3 for a complete discussion of the assumptions related to SDC initiation.

The simulation in the presentation was only used to determine the post shutdown cooling (SDC) behavior of the EW temperature, assuming the operator succeeded in the initiation of SDC without exceeding the temperature limit of 135°F, to determine if further control by the operator would be required. The only conclusion derived from the plot provided was that subsequent to the initiation of SDC, the operator would not be challenged further by an EW temperature approaching the 135°F limit.

Attachment 1:
Scenario for Restoration of Normal Control Room Cooling During a Safety Injection Actuation Signal (SIAS)

Assumptions:

- Both trains of SIAS actuated
- Instrument air is available in the control building
- Electrical power is available to run control room normal fan MHJNA02
- Both control room essential fans are running (MHJAF04 and MHJBF04)
- Both essential chillers have tripped or are not reliable (MECAE01 and ECBE01)
- Normal chilled water (WC) is available and running
- Radwaste and control header isolation valve JWCNUV0070 is open

Considerations:

- Only the "B" train essential filtration system will be overridden
- "A" train essential filtration system will run for cleanup and pressurization
- If control room pressure is too high or control room radiation levels show an increasing trend the outside air makeup volume damper for MHJNA02 will have to be closed
- The SIAS interlock for both A and B train control room isolation dampers for the normal cooling fan will have to be jumpered.
- Do you just bypass the SIAS interlock or do you also bypass the loss of offsite power (LOP) and control room essential filtration actuation signal (CREFAS) interlocks for the isolation dampers? These instructions assume that the SIAS, LOP and CREFAS relays will be bypassed to keep normal cooling to the control room.
- Manual control room ventilation isolation actuation signal (CRVIAS) will be available for both trains.
- The control room isolation dampers can still be operated from the control board handswitches with the electrical jumpers to bypass the SIAS, LOP, and CREFAS relays installed.

Work Instructions:

Caution

Electrical jumpers may be installed on energized 120 VDC circuits

1. Install electrical jumpers to be able to open dampers MHJAM01, MHJBM01, MHJAM52 and MHJBM55, as required.

Attachment 1:
Scenario for Restoration of Normal Control Room Cooling During a Safety Injection Actuation Signal (SIAS)

a. **<u>For dampers MHJAM01 and MHJAM52</u>**:

   i. Install a jumper between TB37 points 761 and 762 (SIAS Relay K311-1) in ESFAS Aux Relay **<u>cabinet A</u>** XJ-SAA-C01-03 (01-E-HJF-013, Sheet 1 of 4)

   ii. Install a jumper between TB66 points 12 and TB74 point 12 (LOP Relay K203-2 and CREFAS Relay K207-2) in BOP ESFAS cabinet XJ-SAA-C02AF (01-E- HJF-013, Sheet 1 of 4)

b. **<u>For dampers MHJBM01 and MHJBM55</u>**:

   i. Install a jumper between TB37 points 761 and 762 (SIAS Relay K311-1) in ESFAS Aux Relay **<u>cabinet B</u>** XJ-SAB-C01-03 (01-E-HJF-013, Sheet 3 of 4)

   ii. Install a jumper between TB66 points 12 and TB74 point 12 (LOP Relay K203-2 and CREFAS Relay K207-2) in BOP ESFAS cabinet XJ-SAB-C02BH (01-E-HJF-013, Sheet 3 of 4)

Operating Instructions:

- **<u>Override and shutdown control room essential filtration unit MHJBF04 as follows:</u>**
  - Override fan MHJBF04 by momentarily placing handswitch J-HJB-HS-029 to START. Verify WHITE light is lit at the handswitch.
  - Override outside air isolation damper MHJBM03 by momentarily placing handswitch J-HJB-HS-035 to OPEN. Verify WHITE light is lit at the handswitch.
  - Shutdown control room essential filtration unit fan MHJBF04 by placing handswitch J-HJB-HS-029 to STOP. Verify GREEN light is lit at the handswitch.
  - Close outside air damper MHJBM03 by momentarily placing handswitch J-HJB-HS-035 to CLOSED. Verify GREEN light is lit at the handswitch.

- **<u>Open the control room normal fan isolation dampers MHJA(B)M01, MHJAM52 and MHJBM55:</u>**
  - Open control room isolation dampers MHJAM01and MHJAM52 by momentarily placing handswitch J-HJA-HS-007 to OPEN. Verify RED light is lit at the handswitch.

Attachment 1:
Scenario for Restoration of Normal Control Room Cooling During a Safety Injection Actuation Signal (SIAS)

- Open control room isolation dampers MHJBM01and MHJBM55 by momentarily placing handswitch J-HJB-HS-008 to OPEN. Verify RED light is lit at the handswitch.

- **Start control room normal fan MHJNA02:**
  - Start control room normal ventilation fan MHJNA02 by placing handswitch J-HJN-HS-005 in START. Verify RED light is lit at the handswitch.

  - Close the control room normal outside air makeup volume damper if the control room static pressure is too high, or the decision is made to reduce the amount of outside air the normal fan contributed to the control room.

    - Setup the Man lift to gain access to the control room normal outside air makeup volume damper shown on drawing 0X-P-ZJC-0301 at coordinates D-3.
    - Loosen the wingnut on the damper quadrant (Locking device) and close the damper.
    - Tighten the damper quadrant wingnut.

Contingencies:

- **No instrument air to open control room isolation dampers:**
  - Isolate LAP panel JHJNLAP01 from the IA system. Stage a nitrogen bottle with a pressure regulator near the LAP panel and connect it to the common header inside the panel, using the panel air pressure regulator to control pressure to the dampers. Pressurize the LAP panel header as required.

- **FBEVAS / CREFAS signal received with the SIAS signal locked in:**
  - The load sequencer relay K127 should not reset with the SIAS signal locked in when another safety signal comes in. The control room essential fan should not restart if the fan override relay is energized and the fan is secured.
  - If Operations wants to secure the control room normal fan because of radiation levels in the OSA intake, they would have to shut isolation dampers from the damper control switches.

Attachment 1:
Scenario for Restoration of Normal Control Room Cooling During a Safety Injection Actuation Signal (SIAS)

- **<u>CRVIAS – Manual actuation:</u>**
    - If the control room ventilation isolation pushbuttons were depressed, the open isolation dampers would all go closed and the control room normal fan would trip. This would isolate the control room from all outside air sources. Control room essential ventilation fan MHJBF04 would not restart because the override relay is energized. Control room essential fan MHJAF04 would continue to run.

- **<u>Normal cooling not available to cool the control room:</u>**
    - Override and shutdown one train of essential control room filtration fan to reduce the heat load contributed by the fan to the control room.
    - If radiological conditions permit, consider bypassing the isolation signal on the smoke exhaust dampers (MHJA (B) M57) to allow these dampers to be open to get a higher exchange of air and to relieve pressure in the control room envelope.

References:

01-M-HJP-0001 – Control Building HVAC P&ID (Control Room)

01-P-ZJC-0301 – Control Building HVAC Plan

01-E-HJB-0013 – Elementary Diagram for Iso Dampers 1MHJAM01 and 1MHJAM52

01-E-HJF-0013 – CWD Diagram for Iso Dampers 1MHJAM01 and 1MHJAM52

01-E-HJB-0002 – Elementary Diagram for control room essential AFU MHJA (B) F04

01-E-HJB-0024 – Elementary Diagram for Iso Dampers 1MHJA (B) M02 and M03

01-E-HJF-0024 – CWD Diagram for Iso Dampers 1MHJA (B) M02 and M03

Attachment 2:
Scenario for Restoration of Normal Control Building Cooling During a Safety Injection Actuation Signal (SIAS)

Assumptions:

- Both trains of SIAS actuated
- Instrument air is available in the control building
- Electrical power is available to run Normal Fan MHJNA01 and A03
- SWGR essential fans are running (MHJA(B)Z03 and MHJA(B)F04)
- Both essential chillers have tripped or are not reliable (MECAE01 and ECBE01)
- Normal chilled water (WC) is available and running
- Radwaste and control header isolation valve JWCNUV0070 is open

Considerations:

- Battery room essential fans running (MHJA(B)J01A, B, C, and D)
- Normal battery room exhaust fans are available (MHJNJ01A, B, C, and D)
- Do you just bypass the SIAS interlock or do you also bypass the LOP for the isolation dampers? These instructions assume that only the SIAS relays will be bypassed to keep normal cooling to the essential switchgear rooms and the control building.
- The control building isolation dampers can still be operated from the control board handswitches with the electrical jumpers to bypass the SIAS relays installed.

Work Instructions:

Caution

Electrical jumpers may be installed on energized 120 VDC circuits

- Install electrical jumpers for:
    - **<u>To OPEN B and D DC equipment room isolation dampers MHJAM25, MHJAM28 dampers</u>**:
        i. Install a jumper between TB37 points 764 and 765 (SIAS Relay K311-1) in ESFAS Aux Relay **<u>cabinet A</u>** XJ-SAA-C01-03 (0X-E-HJF-014, Sheet 2)

Attachment 2:
Scenario for Restoration of Normal Control Building Cooling During a Safety Injection Actuation Signal (SIAS)

- **To align A Ess SWGR Room supply dampers to OPEN MHJAM36, MHJAM51, MHJAM66, and CLOSE MHJAM62**:
  - ii. Install a jumper between TB37 points 767 and 768 (SIAS Relay K311-1) in ESFAS Aux Relay **cabinet A** XJ-SAA-C01-03 (0X-E-HJF-014, Sheet 4)

- **To OPEN essential SWGR supply header isolation damper MHJAM23**:
  - iii. Install a jumper between TB37 points 770 and 771 (SIAS Relay K311-1) in ESFAS Aux Relay **cabinet A** XJ-SAA-C01-03 (0X-E-HJF-015)

- **To OPEN essential SWGR return header isolation damper MHJAM34**:
  - iv. Install a jumper between TB37 points 779 and 780 (SIAS Relay K311-2) in ESFAS Aux Relay **cabinet A** XJ-SAA-C01-03 (0X-E-HJF-016)
- **To align B Ess SWGR Room supply and return dampers to OPEN MHJBM34, MHJBM38, MHJBM66, and CLOSE MHJBM31 and MHJBM58**:
  - v. Install a jumper between TB37 points 770 and 771 (SIAS Relay K311-1) in ESFAS Aux Relay **cabinet B** XJ-SAB-C01-03 (0X-E-HJF-017)

Operating Instructions:

- **Override and shutdown essential SWGR fans MHJA(B)Z03 and MHJA(B)Z04 as follows:**
  - Override fan MHJAZ03 by momentarily placing handswitch J-HJA-HS-67 to START. Take the handswitch to STOP. Verify WHITE and RED lights are lit at the handswitch. (0X-E-HJB-0006)
  - Override fan MHJBZ03 by momentarily placing handswitch J-HJB-HS-66 to START. Take the handswitch to STOP. Verify WHITE and RED lights are lit at the handswitch. (0X-E-HJB-0006)
  - Override fan MHJAZ04 by momentarily placing handswitch J-HJA-HS-133 to START. Take the handswitch to STOP. Verify WHITE and RED lights are lit at the handswitch. (0X-E-HJB-0025)

Attachment 2:
Scenario for Restoration of Normal Control Building Cooling During a Safety Injection Actuation Signal (SIAS)

- Override fan MHJBZ04 by momentarily placing handswitch J-HJB-HS-136 to START. Take the handswitch to STOP. Verify WHITE and RED lights are lit at the handswitch. (0X-E-HJB-0025)

- **Position dampers as required**:
  - **<u>To OPEN B and D DC equipment room isolation dampers MHJAM25, MHJAM28 dampers</u>**:
    - Momentarily placing handswitch J-HJA-HS-61 to CLOSE. Verify RED light is lit at the handswitch. (0X-E-HJB-014)
  - **<u>To align A Ess SWGR Room supply dampers to OPEN MHJAM36, MHJAM51, MHJAM66, and CLOSE MHJAM62</u>**:
    - Momentarily placing handswitch J-HJA-HS-58 to NORMAL MODE position. Verify RED light is lit at the handswitch. (0X-E-HJB-014)
  - **<u>To OPEN essential SWGR supply header isolation damper MHJAM23</u>**:
    - Momentarily placing handswitch J-HJA-HS-106 to CLOSE. Verify RED light is lit at the handswitch. (0X-E-HJB-015)
  - **<u>To OPEN essential SWGR return header isolation damper MHJAM34</u>**:
    - Momentarily placing handswitch J-HJA-HS-96 to CLOSE. Verify RED light is lit at the handswitch. (0X-E-HJB-016)
  - **<u>To align B Ess SWGR Room supply and return dampers to OPEN MHJBM34, MHJBM38, MHJBM66, and CLOSE MHJBM31 and MHJBM58</u>**:
    - Momentarily placing handswitch J-HJB-HS-62 to NORMAL MODE position. Verify RED light is lit at the handswitch. (0X-E-HJB-017)
  - **<u>Start control building normal fan MHJNA01:</u>**
    - Start control building normal ventilation fan MHJNA01 by placing handswitch J-HJN-HS-054 in START. Verify RED light is lit at the handswitch.

Attachment 2:
Scenario for Restoration of Normal Control Building Cooling During a Safety Injection Actuation Signal (SIAS)

- **Start essential SWGR normal fan MHJNA03:**
    - Start essential SWGR normal ventilation fan MHJNA03 by placing handswitch J-HJN-HS-139 in START. Verify RED light is lit at the handswitch.

References:

01-M-HJP-0001 – Control Building HVAC P&ID (Control Room)

01-P-ZJC-0301 – Control Building HVAC Plan

01-E-HJB-0013 – Elementary Diagram for Iso Dampers 1MHJAM01 and 1MHJAM52

01-E-HJF-0013 – CWD Diagram for Iso Dampers 1MHJAM01 and 1MHJAM52

01-E-HJB-0002 – Elementary Diagram for control room essential AFU MHJA (B) F04

01-E-HJB-0024 – Elementary Diagram for Iso Dampers 1MHJA (B) M02 and M03

01-E-HJF-0024 – CWD Diagram for Iso Dampers 1MHJA (B) M02 and M03

ENCLOSURE 2

Revised Presentation Slides for the November 20, 2006 NRC Regulatory Conference

Results

CDP		Case A	Case B	Case C	Case D	Case E
ESF pumps HVAC dependent:		None	HPSI	LPSI CS	HPSI EW AFB	All
% U Degradation	Exposure Time, days	ΔCDF = 2.6e-7/yr	ΔCDF = 3.1e-6/yr	ΔCDF = 3.4e-6/yr	ΔCDF = 4.2e-6/yr	ΔCDF = 4.3e-6/yr
-30%	0	0.0	0.0	0.0	0.0	0.0
-35%	39	2.8e-8	3.3e-7	3.6e-7	4.5e-7	4.6e-7
-40%	78	5.6e-8	6.6e-7	7.3e-7	9.0e-7	9.2e-7
-45%	88	6.3e-8	7.5e-7	8.2e-7	1.0e-6	1.0e-6
-49% (See note)	105	7.5e-8	8.9e-7	9.8e-7	1.2e-6	1.2e-6

Note: The -49% endpoint value reflects the degradation trend line that has no credit for EC cleaning and the unit 2 degradation rate (the inspection report approach). The -40% curve would correspond to a +Δ9% credit for ECT cleaning and the Unit 2 degradation rate. In a similar manner, the -30% curve would correspond to a +Δ19% credit for EC cleaning and the Unit 2 degradation rate.

Assessment of Results

Equipment	Ambient Air temperature selected for equipment operation	Calculated Room ambient Temperature with no cooling
Motor Bearings LPSI, CS **Upper 219 S Ball Bearings** **Lower 7230DB Angular Contact Ball Bearing**	**170 °F for 135 days** **151 °F for 180 days** **<u>Basis:</u>** ▪SKF catalog data, ▪Obtained existing L10 life & bearing loading from the current seismic analysis ▪Subtracted existing used life of the bearings ▪Calculated the lubricant temperature that would result in a remaining life of 180 days (per SKF-L10 life method) ▪Verified lubricant minimum oil thickness > expected bearing surface finish	**146 °F**

Assessment of Results

Equipment	Ambient Air temperature selected for equipment operation	Calculated Room ambient Temperature with no cooling
HPSI, AFW, EW Sleeve Bearing	**170 °F – 180 days** **<u>Basis:</u>** ♦Started with a conservative value of 170 °F ambient air ♦Obtained expected bearing temp. rise from Westinghouse published calculations and test ♦Calculated minimum oil thickness for bearing operation using as-built bearing data, SSE Loads and standard industry published method ♦Verified minimum oil thickness > allowable bearing surface finish ♦Reviewed test results from the bearing testing completed by WEC on sleeve bearing at high temperatures for comparison of the conditions. Results indicate 170 °F ambient air temperature remains conservative	**154 °F**

Assessment of Results

Equipment	Ambient Air temperature selected for equipment operation	Calculated Room ambient Temperature with no cooling
Lubrication Shell Turbo T-46	**170 °F - > 50 hrs** **Basis:** ♦Westinghouse Comparison to Regal Oil (similar properties to T-46) ♦Testing was done on a irradiated oil ($5x10^7$ Rad) @ >248 °F for > 50 hrs ♦APS test of the lubricant @ 257°F for 160 hours ♦Minor oil darkening observed. ♦No effect on oil functionality	**154 °F**

Assessment of Results

Equipment	Ambient Air temperature selected for equipment operation	Calculated Room ambient Temperature with no cooling
Oil Site glass		
LPSI, CS	**150 °F** **Westinghouse test for 24 hours**	**146 °F**
AFW, EW, HPSI	**157 °F** **Westinghouse test for 51 hours**	**154 °F**

Assessment of Results

Equipment	Ambient Air temperature selected for equipment operation	Calculated Room ambient Temperature with no cooling
Motor Insulation Thermoplastic epoxy	**170 °F** **Basis:** Calculated maximum insulation temperature That includes: Max stator temp + ambient temp + 18 °F for hot spots Compared data to standard industry (NEMA) allowable operating temperature for the insulation system.	**154 °F**