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August 22, 1997

U.S. Nuclear Regulatory Commission
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Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket Nos. STN 50-528/529/530
Responses to June 19, 1997 NRC Request for Additional Information Regarding Charging System Commitments for the Palo Verde Nuclear Generating Station

Enclosed are responses to the NRC request for additional information regarding charging system commitments for the Palo Verde Nuclear Generating Station dated June 19, 1997.

Should you have any questions, please contact Scott A. Bauer at (602) 393-5978.

Sincerely,

James M. Levine

JML/AKK/SAB/GAM

Enclosure

cc: E. W. Merschoff
K. E. Perkins
K. M. Thomas
PVNGS Sr. Resident

A001

030058

Enclosure

Responses to June 19, 1997 NRC Request for Additional Information Regarding Charging System Commitments for the Palo Verde Nuclear Generating Station

Responses to June 19, 1997 NRC Request for Additional Information Regarding Charging System Commitments for the Palo Verde Nuclear Generating Station

Question 1:

The analysis was performed at an initial power corresponding to 100 percent of the plants licensed power. The licensee should provide an analysis for an initial power level of 102 percent or a sensitivity study addressing the additional 2 percent (for calorimetric and NI uncertainty) and its effects on the natural circulation cooldown and depressurization evolution.

Response 1:

Licensing criteria applicable to the Palo Verde Nuclear Generating Station (PVNGS) are found in NRC Branch Technical Position RSB 5-1 (Reference (B)). The pre-stretch power natural circulation cooldown analysis applicable to PVNGS was conducted consistent with Reference (B) criteria and was submitted to the Commission via Letter LD-83-074 (Reference (C)). This submittal was reviewed and approved by the Commission under the CESSAR-F docket.

The RSB 5-1 Natural Circulation Cooldown analysis has historically been conducted as a "best estimate" analysis (i.e., using best estimate vs. bounding assumptions) for ABB Combustion Engineering plants. Consistent with this baseline, Table III from Reference (C) lists initial plant power of 100% as the basis for PVNGS. The current analysis (Reference (A)) to support the 76 Mwt stretch power uprate approved for PVNGS in amendments 108, 100, and 80 for Units 1, 2, and 3, respectively, assumes an initial 100% power of 3876 Mwt.

Inspection of Reference (A) leads to the conclusion that 102% power (3954 Mwt) would have only minor impacts on the cooldown. The time required to cooldown and associated condensate usage would increase only slightly because, for much of the cooldown, the Atmospheric Dump Valves (ADVs) are not fully opened. Depressurization rates are primarily defined by thermodynamic conditions in the RCS. Impacts on depressurization rates for 102% power would be minimal because RCS operating conditions would not be significantly altered. Assuming a linear relationship between decay heat and condensate usage, the required condensate to accommodate an initial power of 102% would be approximately 216,138 gallons which is well below the available volume of 300,000 gallons. PVNGS Technical Specification requirements for condensate storage are bounding relative to RSB 5-1 criteria even assuming an initial steady state power of 102%. The PVNGS design provides significant margin relative to both RSB 5-1 cooldown time and condensate usage licensing criteria.

Question 2:

The licensee used nominal pressure and temperature values in the analysis (did not account for instrument uncertainties). The licensee should address the effects of instrument uncertainties on their analysis.

Response 2:

The RSB 5-1 analyses have been performed with due consideration to the impact of instrument uncertainties. The analysis was performed consistent with PVNGS emergency procedures and within the operating limits of the plant Technical Specifications, both of which account for instrument uncertainties. Reference (A) has been specifically reviewed relative to instrument uncertainties. Operator actions which could be influenced by instrument uncertainty factors include:

- establishment of auxiliary feedwater flow rate;
- RCS temperature control using ADVs;
- maintaining steam generator levels within acceptable control band;
- maintaining pressurizer level within acceptable bands;
- making a decision to commence collapse of postulated reactor vessel upper head steam void;
- making a decision to initiate bypass of SIAS;
- reactivity control considering refueling water tank (RWT) boron concentration uncertainties;
- control of RCS pressure;
- making a decision to commence RCS depressurization, and;
- making a decision to initiate Shutdown Cooling System operation.

The effects of instrument uncertainty associated with the above parameters and/or operator actions were reviewed with respect to Reference (A). The results and conclusions of the analyses in Reference (A) were determined to properly account for instrument uncertainty.

Question 3:

The charging pump and auxiliary pressurizer spray system (APSS) long term cooling (LTC) code run (May 1996 submittal) resulted in a duration of 10.7 hours to bring the plant to reactor heat removal (RHR) entry points. The actual test performed in January of 1986, which also used the charging pump and APSS resulted in a duration of 13.33 hours The licensee should explain the differences between the code run and the test performed in January of 1986 and account for the difference in time between the two.

Response 3:

The cooldown time of 13.33 hr (corrected time from the actual PVNGS test) remains a conservative representation of the time required to attain shutdown cooling entry conditions. Both the 13.33 hr time and the 10.7 hr from the latest analysis (Reference (A)) include a four hour hold period at hot standby conditions. The PVNGS test cooldown, the results of which are described in a test report (Reference (E)), was initiated from a RCS T_{hot} of 567 °F whereas the Reference (A) analyzed cooldown were both initiated from a somewhat higher initial RCS T_{hot}. The cooldown rate for both cases were comparable at about 46-51 °F per hour. The time to attain a shutdown cooling entry temperature of 350 °F is approximately 4.4 hours for the Reference (E) test case and is somewhat longer for the case analyzed in Reference (A) due to assumed charging pump availability.

A major difference between the test and analyzed cooldown times is the time required for RCS depressurization. The 1986 test was conducted during a time frame when void formation in the reactor vessel upper head was a relatively new issue being considered in the industry. Intentionally forming a steam bubble in the upper head was not a normal evolution. As a result, the test procedures associated with depressurization, void formation, and bubble collapse were developed to be intentionally deliberate and conservative. RCS depressurization commenced for both the analyzed and test cases upon attainment of approximate shutdown cooling temperature, i.e., 350 °F. RCS depressurization activities took approximately 3.5 hours for the PVNGS test. The depressurization phase for the analyzed transient in Reference (A) takes less than two hours which represents current expected operator actions.

Table 3-1 summarizes the relative comparisons for the required cooldown time from Reference (A) vs. the total natural circulation test duration (i.e., 14.8 hours) documented in Reference (E). The natural circulation test time was corrected to the licensing basis limit of 13.33 hours as described in Reference (E).

The Reference (A) analyzed time of 10.7 hours is consistent with current expected operator actions. The Technical Specification condensate inventory of 300,000 gallons conservatively represents enough condensate to support plant cooldown evolution for at least 16 hours. Reference (E) testing and evaluations demonstrated that operators could successfully attain shutdown cooling entry conditions within 13.3 hours. This limit remains valid for the PVNGS design based on the analysis in Reference (A). A best estimate margin of 5.3 hours and a limiting design margin of at least 2.7 hours exist before available condensate supplies would be exhausted.

Table 3-1
Reconciliation of Current Analysis (Ref (A)) vs. PVNGS Test Report (Ref (E))

Plant Evolution	PVNGS Test (Reference (E))	Current Analysis (Reference (A))	Reconciling Factor(s)
Hold at Hot Standby	6.6 hr	4.0 hr	Reference (E) includes 2.6 hr for Boron Mixing Test
Cooldown to SDC Entry Temp	4.4 hr	4.9 hr	Reference (E) Used 2 Charging Pumps, Reference (A) Assumed only one pump available
RCS Depressurization	3.8 hr	1.8 hr	Operators depressurized the plant slowly and cautiously during test to intentionally form Reactor Upper Head Steam Bubble
Total Time Required, RSB 5-1 Cooldown	14.8 hr	10.7 hr	Adjusted time to cooldown from Reference (E) was 13.33 hours

<u>Question 4:</u>

It was stated in the submittal that auxiliary feedwater (AFW) flow was assumed to be at least 500 gpm total or 250 gpm/steam generator (SG). However, in the analysis the licensee used a value of 275 gpm/SG. The licensee should justify the 275 gpm/SG.

<u>Response 4:</u>

The value of 275 gpm/SG was established as a reasonable flowrate that a PVNGS operator would typically establish under the conditions specified for the analysis. Use of an auxiliary feedwater flowrate of 500 gpm would not appreciably alter the results of the analysis. The only impact would be to delay slightly the actual time at which steam generator level is reestablished within the band specified in Emergency Operating Procedures.

Question 5:

In the May 1996 submittal, the licensee assumed that the system pressure at the end of the 4-hour hot-standby (HSB) period will be 1735 psia. In the August 31, 1994, Natural Circulation Analysis submittal, the licensee stated, "based on actual PVNGS test data, prèssurizer pressure remained at approximately 2000 psia during the 4-hr HSB period." Justify the use of 1735 psia in light of the August 1994 analysis.

Response 5:

The pressure of 1735 psia from Reference (A) was calculated by the pressurizer model in LTC. That model accounts for heat losses to the containment atmosphere plus heat transfer to cooler subcooled water in the bottom of the pressurizer following insurges. The LTC code along with its pressurizer model have been benchmarked on numerous occasions against actual plant data and have been shown to produce comparable results. The Reference (A) computer simulations were done in compliance with RSB 5-1.

Reference (E) presented the results of the natural circulation (NC) cooldown test performed at PVNGS. Although the overall objective of the test was to demonstrate compliance with RSB 5-1, for safety reasons and/or protection of plant equipment the test itself was not performed in strict accordance with RSB 5-1. This is consistent with how NC testing has been performed on other CE designed NSSSs. That is, the NC tests performed at the San Onofre Nuclear Generating Station, Saint Lucie Unit 2, Waterford Steam Electric Station Unit 3 and Palo Verde Nuclear Generating Station were designed to demonstrate certain aspects of RSB 5-1 (e.g., boron mixing under NC conditions, ability to establish and maintain NC, cooldown of the reactor vessel upper head, steam bubble formation in the reactor vessel upper head, etc.), however, for reasons of plant safety and/or protection of plant equipment strict RSB 5-1 conditions were not observed.

The use of pressurizer heaters during testing is an example of a deviation from RSB 5-1 that was allowed for safety reasons. During the testing performed in Reference (E), heaters were operated following plant trip until the plant was stabilized. This was done to minimize the risk of a loss of subcooling that might result due to equipment failure or operator error. As a result, actual pressurizer pressure during the test was higher at the end of four hours compared to the LTC computer code simulations. This difference in pressure does not effect the conclusion that PVNGS complies fully with the requirements of RSB 5-1.

Question 6:

The licensee assumed throttling of the high pressure safety injection (HPSI) header valves to the minimum flow rate which can be reliably read on the main control board indicators (75 gpm). The August 1994 submittal indicated that throttling should be limited to 30 percent. The licensee should provide an analysis with assumptions consistent with vendor recommendations for operation of the systems and components.

Response 6:

The throttling limitation of 30% from the August, 1994 submittal was a preliminary and very conservative limit which was easily verifiable. Use of that limit was only intended to facilitate preliminary evaluations of the RSB 5-1 scenario. The final analysis (Reference (A)) used a refined estimate for HPSI flow that was based on actual PVNGS operating procedures and operator training. PVNGS operating procedures give consideration to equipment operating limits. Cautions are provided and operators are trained to recognize such limits. PVNGS Emergency Operating Procedures are written and implemented to assure that operators will make informed decisions relative to proper operation of equipment to maintain plant safety functions under RSB 5-1 scenarios including consideration of equipment operating limits.

Question 7:

Times between cold starts of the HPSI pumps in the analysis were 31 and 35 minutes. This is inconsistent with the technical manual recommendation of at least 45 minutes between cold starts. The licensee stated that by inspection of the data, the Branch Technical Position (BTP) RSB 5-1 cooldown can be accomplished within the vendor specified recommendation: however, these recommendations should not be imposed in the PVNGS emergency procedures. The staff believes that it would not be prudent for the licensee to plan operation of safety-related equipment beyond the recommended limits specified in the vendor's technical manuals. Therefore, the licensee should provide an analysis which meets those recommendations.

Response 7:

The HPSI delivery curve in Figure 1-6 of Reference (A) does not represent a situation where the pump is jogged on and then off. Rather, the pump is started and remains running in accordance with the recommended limits in the vendor technical manual. Flow to the RCS is initiated by opening and closing of the discharge throttle valve and not by starting and stopping of the pump. During periods of time where flow to the RCS is zero, the pumps operate on mini-

recirculation flow back to the refueling water tank (RWT). Operation of a HPSI pump in this manner is consistent with the APS emergency procedures and operator training as indicated in Section 3.1.13 of Reference (A).

Question 8:

The licensee assumed all rods inserted on the reactor trip. The licensee's analysis should assume the most reactive rod does not insert.

Response 8:

Reference (A) is not intended to address plant reactivity criteria.

The PVNGS design does address boron concentrations under RSB 5-1 conditions relative to maintaining Technical Specification shutdown margins at various temperatures during a cooldown. The concentrations needed to maintain adequate shutdown margin are included in the PVNGS core data books and are calculated assuming that the worst control rod is stuck fully out.

Boron concentrations in the RCS for a cooldown from 580°F to 200°F (Tavg) have been calculated. This evaluation uses EOC conditions which are limiting with respect to boron concentration. Assuming an initial RCS boron concentration of 0 ppm and a RWT concentration of 3960 ppm (4000 ppm minus 1% measurement error), a cooldown to 200°F with charging only as necessary to makeup for contraction will yield a final RCS boron concentration of 962 ppm boron. The required boron concentration to attain Technical Specification shutdown margins with trip breakers open is, for all three PVNGS Units, currently less than 400 ppm. The PVNGS design satisfies reactivity design and licensing criteria relative to an RSB 5-1 natural circulation cooldown assuming the most reactive rod stuck out.

Question 9:

LTC code and input were not quality assurance(QA) verified for safety- related use. Since the code is being used for safety-related analyses it should be QA verified.

Response 9:

Licensing criteria applicable to the Palo Verde Nuclear Generating Station (PVNGS) are found in Branch Technical Position RSB 5-1 (Reference (B)). The pre-stretch power natural circulation cooldown analysis applicable to PVNGS was submitted to the Commission via Reference (C). This submittal was

reviewed and approved by the Commission under the CESSAR-F docket and specifically for PVNGS via letter correspondence (Reference (F)).

The RSB 5-1 Natural Circulation Cooldown analysis for PVNGS was conducted as a best estimate analysis (i.e., using best estimate vs. bounding assumptions). The best estimate LTC computer code as described in CEN-128, Response of Combustion Engineering Nuclear Steam Supply System to Transients and Accidents (Reference (D)), was established as the licensing basis methodology for the System 80™/PVNGS design. These groundrules were established between the PVNGS NSSS Vendor (ABB Combustion Engineering) and Mssrs. T. Marsh and C. Liang from the Reactor Systems Branch of the NRC. The original RSB 5-1 natural circulation cooldown results were independently confirmed for the NRC by Brookhaven National Labs using RETRAN coupled with independent calculations. These reviews were made a part of the public record at the time. The current analysis methodology as described in Reference (A) is consistent with the established PVNGS licensing basis and is appropriate.

The LTC computer code was used for the stretch power RSB 5-1 analysis to preserve the methodology of the original design/licensing basis analysis. QA verification of the LTC plant simulation code is not necessary to assure that PVNGS satisfies licensing criteria as defined in RSB 5-1. The original independent validation by Brookhaven National Labs justifies the methodology applied. Reference (A) addressed the fidelity of the LTC code relative to application at PVNGS (See section 2.1 and Reviewer's Comments). The analysis results were found to be reasonable based on output comparisons to plant testing and benchmarking. The LTC code has been historically proven to provide accurate representations of plant natural circulation cooldown transients.

<u>Question 10:</u>

The licensee credits the formation of the bubble in the reactor vessel upper head (RVUH) so that they can later cool the RVUH by using the reactor vessel upper head vents (injection into the RCS and venting of the upper head). Using the RVUH vents to cool the upper head in this fashion allows Palo Verde to cool the upper head sufficiently fast to allow the reactor coolant system (RCS) to be depressurized to the shutdown cooling entry points within their condensate storage tank (CST) available inventory. The licensee assumed no heat loss from the RVUH. This will maintain the RVUH at a higher temperature for the analysis and will therefore assist in the formation of the bubble. It appears that this assumption may be non-conservative and, therefore, should be further justified by the licensee.

Response 10:

The assumption of no heat losses from the reactor vessel upper head is conservative relative to the time required to attain shutdown cooling. Plant cooldown is significantly simplified if there is no voiding in the reactor vessel upper head.

During a natural circulation (NC) cooldown prior to steam bubble formation, three mechanisms exist for heat removal from the reactor vessel upper head. These mechanisms are 1) mixing due to flow past the core support barrel key ways, 2) heat transfer through the upper guide structure, and 3) heat transfer through the top of the upper head to containment. Although it is difficult to quantify the magnitude of any one of these mechanisms, it is known from review of data from various plant NC cooldowns that the combination of all three can serve to cool the upper head relatively fast.

With respect to Reference (A), heat transfer down through the upper guide structure and heat transfer to containment were not credited. This had the effect of keeping temperatures in the upper head artificially high in the analysis prior to void formation and collapse. This is in fact a conservative assumption in that more energy must be removed from the upper head via steam bubble formation and subsequent collapse and, thus, the time required to enter shutdown cooling is conservatively longer.

Question 11:

Explain the following parameters and values listed on Page 25 of 46 in the CE RSB 5-1 Natural Circulation Cooldown Analysis attached to the May 1996 submittal.

- SGIVLO(1) The lowest height of the upper wall for S/G 1 and 2 was SG2VLO(1) calculated as 36.08 ft (at the normal downcomer water level).

- SGIVHI(1) The highest height of the upper wall for S/G 1 and 2 was SG2VHI(1) calculated as 56.75 ft.

- SGIVLO(2) The lowest height of the upper wall for S/G 1 and 2 was SG2VLO(2) calculated as 0 ft (this is the reference elevation).

- SG1VHI(2) The highest height of the upper wall for S/G 1 and 2 SG2VHI(2) calculated as 36.08 ft (at the normal downcomer water level).

Response 11:

The parameters in question are used in the LTC code to establish nodal boundaries for wall heat transfer nodes in the steam generators. There are two nodes per steam generator that are defined by the SGIVLO and SGIVLH parameters. The code basedeck parameters have been checked and are correct for the application.

Question 12:

The method utilizing the pressurizer vents for depressurization has not been tested at PVNGS. Branch Technical Position (BTP) RSB 5-1 recommends that a test be run to confirm the analysis. Discuss your plans for testing this method in accordance with BTP RSB 5-1.

Response 12:

The PVNGS design was licensed and accepted by the NRC relative to RSB 5-1 licensing criteria solely based on auxiliary spray as the method for plant depressurization (Reference (F)). Deleting the charging system commitments does not specifically impact the plant licensing basis relative to RSB 5-1. Reference (A) demonstrates that the PVNGS design using the auxiliary spray system with a single active failure is capable of satisfying the RSB 5-1 PVNGS licensing basis requirements. The portion of the analysis using the Pressurizer Vents and HPSI pumps demonstrates only that the PVNGS design is robust and reliable relative to plant natural circulation cooldown functions and is not intended to represent the licensing basis methodology to satisfy criteria from RSB 5-1. PVNGS testing has successfully demonstrated the licensed basis methodology (i.e., depressurization via auxiliary spray) associated with RSB 5-1.

The operating characteristics of the HPSI and Pressurizer Vent Systems are well defined based on startup testing at Palo Verde and other similar ABB-CE plants (i.e., modified System 80™ Korean designs). Additional testing to demonstrate defense in depth for functional reliability is not warranted.

Question 13:

Provide a comparison of the depressurization rates using APSS (with the different configurations (i.e.. with one or two charging pumps running)) and pressurizer vent (one train) for different pressurizer levels and pressurizer surge rates.

Response 13:

Tables 13-1 and 13-2 provide the requested information which was generated by the LTC computer code. Table 13-1 provides depressurization rate over a one minute period for three pressurizer levels assuming 1 charging pump, 2 charging pumps, and one pressurizer vent valve (orificed line) operation. Table 13-2 shows depressurization rates for different pressurizer surge rates associated with RCS cooldown rates over the range of Technical Specification allowable cooldown rates (0-100 degrees F per hour).

Table 13-1
Depressurization Rate as a Function of Pressurizer Level

Initial Pzr Level	One Charging Pump	Two Charging Pumps	Single Pzr Vent
73%	25 psi/min	36 psi/min	19 psi/min
65%	20 psi/min	39 psi/min	20 psi/min
57%	22 psi/min	32 psi/min	15 psi/min

Table 13-2
Depressurization Rate as a Function of RCS Cooldown (Pzr Surge) Rate

Condition	One Charging Pump	Two Charging Pumps	Single Pzr Vent
ADVs Isolated	24 psi/min	36 psi/min	17 psi/min
50 deg/hr cooldown	25 psi/min	36 psi/min	20 psi/min
ADVs Full Open	25 psi/min	37 psi/min	19 psi/min

The above data indicates that pressurizer level and surge rates have little effect on depressurization rates in the operating ranges evaluated. The variations present can be attributed to factors associated with initialization of the code from restart files used for the RSB 5-1 analyses and are not considered to be significant.

Question 14:

Provide an analysis for PVNGS of the stuck open pressurizer vent valve scenario described in the August 1994 submittal.

Response 14:

The consequences of a stuck open pressurizer vent valve during plant cooldown were evaluated for PVNGS in prior bounding studies based on comparisons to detailed analyses for ABB-CE's modified System 80™ Korean design. The effects of the postulated failure are benign and a detailed transient analysis to prove such is not warranted. The following evaluation is provided to further demonstrate the benign nature of the transient:

Referring to Case 1 from Reference (A), failure of the pressurizer vent valve to close on demand would increase the depressurization rate during the time from approximately 10 to 10.6 hours after shutdown. In fact, the failure would actually reduce the time to attain shutdown cooling entry pressure conditions. The RCS would also be cooled somewhat due to the additional heat removed from the RCS.

There is substantial margin to the limit on subcooling during the time frame of interest and, by inspection, it is evident that subcooled margins would not be exceeded. Even if subcooled limits were approached, an operator could initiate HPSI flow to provide additional cooling if warranted. The stuck open vent would have no consequence on successful entry into shutdown cooling nor would it hamper subsequent cooldown of the RCS to 200 degrees F utilizing the Shutdown Cooling System.

Question 15:

Discuss the likelihood and consequences of failing the reactor drain tank rupture disk.

Response 15:

Receipt of steam from the Pressurizer and Reactor Head Vents is a design basis function for the Reactor Drain Tank (RDT). The mass of water in the tank at normal operating levels is 20,476 lb and nominal ambient temperature for the tank is 120 degrees F.

Review of Reference (A) data indicates that a steam mass of approximately 2830 lb would be discharged to the RDT under RSB 5-1 conditions where a Pressurizer Vent is the selected method to depressurize the RCS. Conservatively assuming a latent heat for the steam of 900 BTU/lb, the total heat input to the RDT would be approximately 2.55×10^6 BTU. Given:

- RDT liquid mass = 20,476 lb;
- specific heat for water = 1 BTU/lb-deg F;

- nominal ambient containment temperature = 120 degrees F; and
- final RDT pressure < 100 PSIG, Tsat=338 deg F (Rupture disc press is 120 PSIG +10/-5%),

The "limit" for heat input to the RDT would be 4.464×10^6 BTU.

Since the heat input under the RSB 5-1 scenario is far less than the calculated allowable, the pressure conditions in the RDT would not cause the rupture disc to burst.

Should the steam from the Pressurizer and Reactor Head Vents be discharged directly to containment there would be no appreciable impact on the analysis results. None of the process instrumentation used by operators under this scenario would be impinged upon by the vent system discharges. On a bulk basis, addition of 2830 lb of steam to a containment volume of 2.7×10^6 cubic feet represents less than a 2% moisture addition on a mass basis. Containment temperature and humidity would increase slightly but not enough to have appreciable impacts on in-containment instrumentation.

References:

(A) 25/26/27-AS95-C-016, Revision 00, RSB 5-1 Natural Circulation Cooldown Analysis At Uprated Power Conditions (3876 Mwt Core Power) For Palo Verde Nuclear Generating Station Units 1, 2, & 3, October 31, 1995 (Transmitted via letter 102-03703-WLS/SAB/GAM, from J. A. Bailey, APS, to the NRC, "Supplement to Submittal Related to Charging System/Auxiliary Pressurizer Spray System Commitments", May 21, 1996)

(B) NRC Branch Technical Position RSB 5-1, Design Requirements of the Residual Heat Removal System, Rev 1 (Attached to NRC NUREG 75-087)

(C) Letter LD-83-074, from A. E. Scherer, CE, to D. G. Eisenhut, Director, Division of Licensing, U.S. NRC, "Natural Circulation Cooldown Re-Analysis for CESSAR-F, Docket No. STN 50-470F", August 12, 1983

(D) CEN-128, Response of Combustion Engineering Nuclear Steam Supply System to Transients and Accidents, April, 1980

(E) Letter ANPP-40069-JGH/BJA/98.05, from J. G. Haynes, ANPP, to G. W. Knighton, NRC, "PVNGS Natural Circulation Cooldown Test Report", February 9, 1987

(F) Letter from E. A. Licitra, NRC, to E. E. Van Brunt Jr., ANPP, "Evaluation of the Natural Circulation Cooldown Capability for Palo Verde (TAC Nos. 56647 and 56648)", April 18, 1988