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RECIP.NAME RECIPIENT AFFILIATION
KNIGHTON,G.W. Licensing Branch 3

SUBJECT: Submits addl info re post-LOCA status of reactor coolant pumps seal cooling,per NRC 850719 request.Rev 1 to Procedure 41EP-12201 re emergency operations encl.

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Director of Nuclear Reactor Regulation
Attention: Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

September 10, 1985
ANPP-33433-EEVB/KLM

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket Nos. STN-50-528 (License No. NPF-41)/529/530
Post-LOCA Status of Reactor Coolant
Pumps Seal Cooling
File: 85-056-026; G.1.01.10

Reference: 1) Letter from G. W. Knighton, NRC, to E. E. Van Brunt, Jr., ANPP, dated July 19, 1985; Subject: Post-LOCA Status of Reactor Coolant Pumps Seal Cooling - Palo Verde
2) Letter from R. W. Wells, CEOG, to D. G. Eisenhut, NRC, dated February 28, 1984 (RWW-84-13); Subject: Transmittal of CEN-268
3) Letter from R. W. Wells, CEOG, to D. G. Eisenhut, NRC, dated November 30, 1984 (RWW-84-81); Subject: Supplement to CE Owners Group Report CEN-268
4) Letter to G. W. Knighton, NRC, from E. E. Van Brunt, Jr., ANPP, dated July 10, 1985 (ANPP-32987); Subject: License Condition 2.C(11)(a)-Procedure Generation Package (PGP)/Emergency Operating Procedures (EOPs)

Dear Mr. Knighton:

Attached, as requested in reference (1), are responses to the questions on Reactor Coolant Pumps Seal Cooling.

If you should have any questions on this matter, contact Mr. W. F. Quinn, of my staff.

Very truly yours,

E. E. Van Brunt

E. E. Van Brunt, Jr.
Executive Vice President
Project Director

EEVB/KLM/slh
Attachment

cc: E. A. Licitra
R. P. Zimmerman
A. C. Gehr

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RESPONSE TO NRC REQUEST
FOR ADDITIONAL INFORMATION
CONCERNING REACTOR COOLANT
PUMP SEAL COOLING - POST-LOCA

NRC Question 1)

Does any containment isolation signal result in the termination of systems essential for continued operation of the reactor coolant pumps? If so, identify the signals and systems affected.

Response

For the PVNGS design, a Containment Isolation Actuation Signal (CIAS) does not result in an interruption of cooling water to the Reactor Coolant Pump (RCP) motors and seals. Cooling water supply to RCP seals and motors is considered an essential function of the Nuclear Cooling Water System (NCWS). Cooling water is interrupted only with a Containment Spray Actuation Signal (CSAS), which has a trip setpoint greater than that of a CIAS.

NRC Question 2)

If essential water services are terminated, provide a description of the operator guidelines, training and procedures in place (or to be implemented) which assure that these services are restored in a timely manner to prevent seal damage or failure once a non-LOCA situation has been confirmed.

Response

Emergency Procedure Guidelines (CEN-152, Rev. 02), developed by Combustion Engineering (C-E) for the C-E Owners Group (CEOG) and which have been approved for implementation by the NRC, provide guidance with respect to maintenance of auxiliary systems which support RCP operation. ANPP's schedule for implementation of CEN-152, Rev. 02 was provided in Reference 4. This guidance, in combination with associated training materials and operating procedures, meets the operators' information needs concerning RCP seal protection. The following excerpt was obtained from CEN-152 training material prepared for the CEOG:

> "...the RCP operating strategy results in tripping the final two RCPs if RCP operating limits are not satisfied. The RCPs may be operating in a pressure-reduced RCS and, in some cases, degraded containment conditions are also possible. This could result in the loss of vital RCP auxiliaries. The operator must continuously monitor RCP operating limits (e.g., temperatures, seal flow, oil pressures, NPSH, motor amperage, vibration) and trip the remaining two RCPs if concerned about RCP operating equipment integrity."

Specific RCP operating limits for PVNGS are as follows (per Procedure No. 41AO-1ZZ29, Revision 0, page 3, paragraph 1.1):

	Trip	Alarm
Upper Thrust Bearing Temp	248°F	230°F
RCP Upper and Lower Radial Bear Temp	185°F	185°F
RCP Control Bleed Off Temp	176°F	158°F
RCP Control Bleed Off Pressure	1800 psig	1000 psig
RCP Control Bleed Off Flow	16 gpm	6 gpm
RCP Seal Cooler 1 Pressure	200 psig	200 psig
RCP Seal Cooler 1 or 2 Temp	176°F	158°F
RCP H.P. Cooler Inlet Temp	250°F	221°F
RCP Motor Stator Temp	311°F	311°F
RCP Motor Upper-Lower Radial Bear Temp	185°F	185°F
RCP Motor ARRD Temp	200°F	200°F
RCP Motor Thrust Bearing Temp	200°F	200°F
RCP H.P. Cooler Outlet Temp	176°F	158°F
RCP Motor Current	520 amps	520 amps

A CSAS is typically associated with LOCA events and sometimes non-LOCA situations such as a Main Steam Line Break (MSLB). For these types of events, Standard Post Trip Actions in the Emergency Procedure Guidelines (EPGs) include guidance for tripping two RCPs in opposite loops if pressurizer pressure decreases below a specified value. For a LOCA situation, operators are instructed to trip all four RCPs (i.e., the remaining two RCPs).

Once a non-LOCA situation has been confirmed (e.g., SGTR, excess steam demand), the operators are instructed to ensure that two of four RCPs are tripped in opposite loops if pressurizer pressure decreases below a specified value. Additional instructions associated with operating RCPs include the following guidance:

> "If RCP operating limits are not satisfied, Then trip the remaining two RCPs."

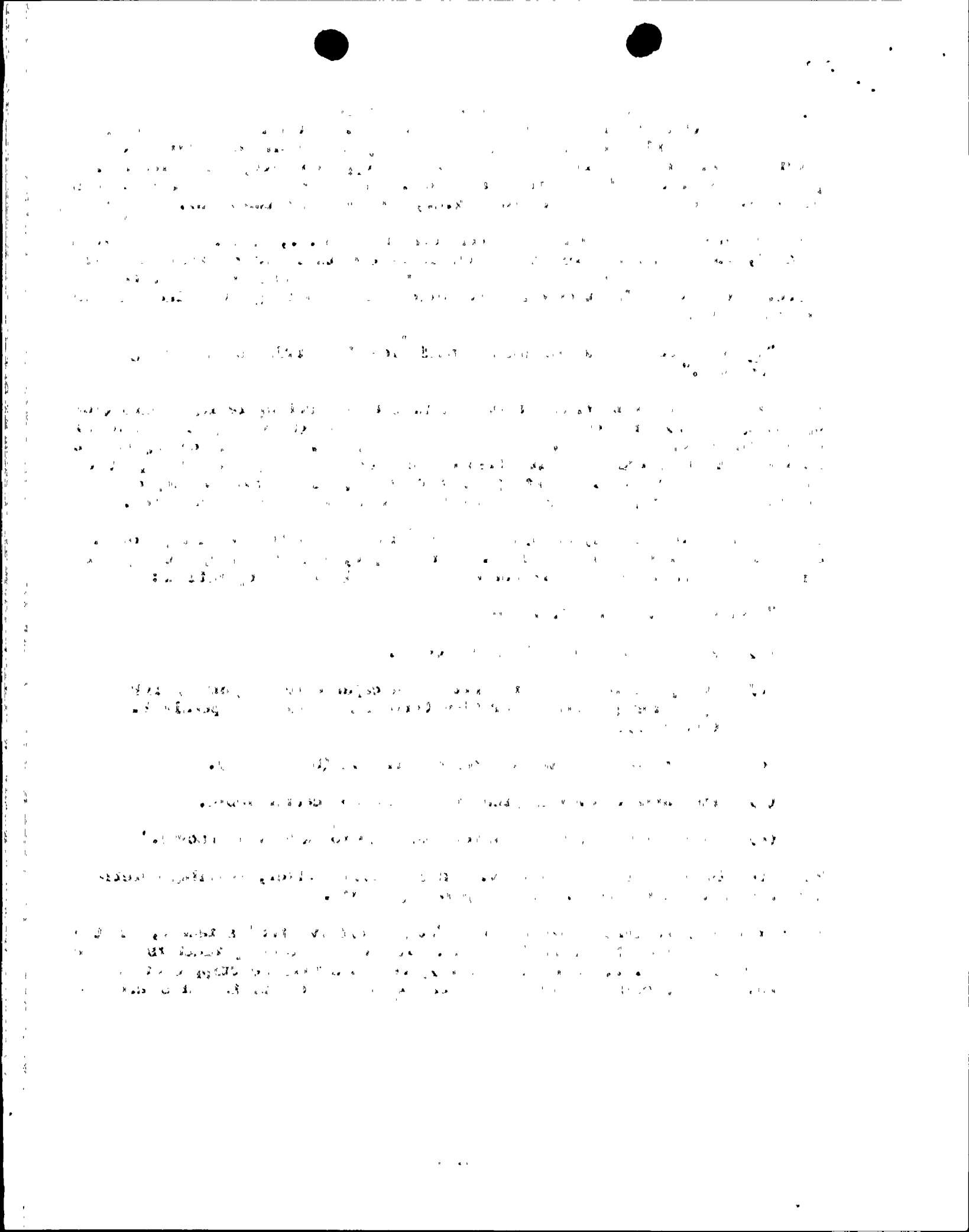
This step is performed continuously. Plant specific RCP operating limits (for operating pumps) include a specified time period (typically ten minutes) during which NCW may be unavailable for seal cooling. If seal cooling cannot be reestablished, the pumps are tripped to preclude any potential impact on future seal performance. Plant specific operating limits are developed from, and consistent with, guidelines provided by C-E and the pump manufacturer.

If all RCPs were stopped, the EPGs provide guidance for RCP restarts, provided all restart criteria are satisfied. For example, the following step appears in the PVNGS Station Manual Procedure 41EP-1ZZ01, Emergency Operations:

> "Verify RCP restart criteria -
>
> (a) The RCS is at least 28°F subcooled.
>
> (b) RCS pressure is under control and capable of supporting RCP operation per Pump Operation Curve and Standard Appendix F. (Attached).
>
> (c) Reactor Vessel level is greater than 67% (Upper Head).
>
> (d) Pressurizer level is greater than 33% and controllable.
>
> (e) At least one Steam Generator available for RCS heat removal."

This step is performed continuously. As discussed earlier, training materials indicate what parameters constitute operating limits.

In conclusion, in context of the RCP "trip two/leave two" strategy, if the operator is unable to maintain or restore RCP measured parameters within operating limits (e.g., seal temperature), the RCPs will be tripped or remain tripped. The effects of this situation are addressed in the EPGs and are



bounded by FSAR safety analyses which do not credit RCP operation. Sufficient guidance is therefore provided to the operator to preclude pump operation outside the pump operating limits. In addition, C-E plant operating experience and pump tests support assurance of seal integrity in the event of loss of NCW to an idle pump. In operating C-E plants, there has never been a complete loss of seal function. Complete loss of seal function is defined as failure of all three full pressure seals and the vapor seal, the result being the inability of the multi-stage seal package to hold system pressure, and is not considered to be a credible event.

NRC Question 3)

Provide confirmation, including the technical basis, that containment isolation with continued RCP operation will not lead to seal or pump damage or failure.

Response

As discussed in the response to Question 1, containment isolation does not result in an interruption of cooling water to the RCP motors and seals. Therefore, continued RCP operation will not lead to seal or pump damage or failure.

NRC Question 4)

Since RCP trip will be required for LOCA events, assurance must be provided that RCP trip, when required, will occur. To address this concern, provide the following information:

(a) Identify the components required to trip the RCPs. Include relays, power supplies and breakers. Address reliability and alternate trip methods.

(b) If necessary, as a result of the location of any critical component, include the effects of adverse containment conditions on RCP trip reliability. Describe the basis for the adverse containment parameters selected.

Response

(a) Components required to trip the RCP include the HGA "TR" relay and the 13.8KV breaker. Both are located in the switchgear building. The RCP trip can be made manually by the Handswitch "HS-1 for RCP-1A" (or HS-2, HS-3, HS-4 for RCP-1B, RCP-1C, and RCP-1D, respectively) in the Main Control Room or control switch "CS-1" on the associated breaker cabinets in the switchgear building. The 13.8KV breakers are identified as "E-NAN-S01M, E-NAN-S02L, E-NAN-S01L, and E-NAN-S02M (for RCP-1A, RCP-1B, RCP-1C, and RCP-1D, respectively)."

These components are judged to be highly reliable since they have a proven track record of high reliability in other power plant applications. An alternate trip method is to use the breaker manual trip lever to open the 13.8 KV breaker.

(b) Adverse containment conditions should have no effect on the ability to trip the RCPs since the switchgear, relays, control power supplies and switches are not located in areas which will be subject to a post-LOCA environment (e.g., no essential equipment is located in the containment or auxiliary buildings).