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ACCESSION NBR:9209020011 DOC.DATE: 92/08/24 NOTARIZED: NO DOCKET #
FACIL:50-397 WPPSS Nuclear Project, Unit 2, Washington Public Powe 05000397
AUTH.NAME AUTHOR AFFILIATION
SORENSEN,G.C. Washington Public Power Supply System
RECIP.NAME RECIPIENT AFFILIATION
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SUBJECT: Responds to Insp Rept 50-397/91-27 re EOPs & emergency procedure guidelines.Original deviation re use of ATWS injection sys that inject inside vs outside reactor pressure vessel shroud should be reinstated.

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August 24, 1992
G02-92-201

Docket No. 50-397

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Subject: WNP-2, OPERATING LICENSE NPF-21
NRC INSPECTION OF WNP-2 EMERGENCY OPERATING PROCEDURES
(NRC INSPECTION REPORT NO. 91-27)

Referece: Letter G02-91-214, dated November 21, 1991, GC Sorensen (SS) to NRC, same subject

With the reference the Supply System submitted justifications for deviations from the BWR Owners Group (BWROG) Emergency Procedure Guidelines (EPGs). The reference included Design Deviation #16 that concerned the use of ATWS injection systems that inject inside, versus outside, the Reactor Pressure Vessel (RPV) shroud.

The EPGs specify the use of systems that inject outside the RPV shroud as the first response systems for vessel makeup during an ATWS. The EPGs do not specify injection with the systems that inject inside the shroud until after those systems that inject outside the shroud have not been successful in controlling RPV water level. The intent of the EPG limitation is to minimize the potential for power excursions due to the addition of cold water.

The Supply System originally proposed using High Pressure Core Spray (HPCS), which injects inside the shroud, with the initial set of reactor water level recovery systems at WNP-2. This was believed to be desirable as HPCS would only be used when SLC was injecting and because WNP-2 was designed and analyzed to use the HPCS spray header as the method for introducing Standby Liquid Control (SLC) sodium pentaborate into the RPV. If boron were not being injected by SLC, the use of HPCS would not be allowed. Because of stated NRC concerns with the use of HPCS injection during an ATWS; specifically the potential for boron dilution and core instability resulting from the injection of subcooled water, the Supply System proposed by the reference to withdraw this deviation during the EOP Phase II implementation.

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As a result of further review of the limited capability of WNP-2 systems to inject outside the shroud and review of the originally proposed deviation with the BWROG and General Electric, the Supply System has determined that the original deviation should be reinstated. The attachment provides the justification for this deviation and addresses the NRC concerns for ATWS instability.

Please consider this attachment as a replacement for Deviation #16 of the reference (pages 37 through 39 of Appendix 1).

Sincerely,

G. C. Sorensen, Manager
Regulatory Programs (Mail Drop 280)

AGH/bk
Attachments

cc: JB Martin - NRC RV
NS Reynolds - Winston & Strawn
RR Assa - NRC
DL Williams - BPA/399
NRC Site Inspector - 901A

DESCRIPTION OF DESIGN DEVIATION NO. 16:

In the initial EPG Revision 4 implementation at WNP-2, the HPCS system, which is an inside the shroud injection system, was identified for use with the initial set of reactor water level recovery systems which, per the EPG strategy were limited to outside the shroud systems. The intent of this EPG limitation is to minimize the potential for power excursions due to the addition of cold water. Although use of HPCS in this application was allowed only when Standby Liquid Control (SLC) was injecting and was supported by a plant unique analysis, it was removed due to concerns raised by the NRC over core stability, and the WNP-2 strategy was realigned with the generic guidance. However, HPCS is again identified in the family of outside the shroud injection systems, provided that the SLC system is operating and boron is being injected through the HPCS piping. The justification for reinstating this deviation is discussed below.

JUSTIFICATION OF DESIGN DEVIATION NO. 16:

WNP-2 is a late generation GE BWR-5 plant. As such, all of the plant's emergency core cooling systems are designed to inject inside the shroud region. Consequently, under emergency conditions it is possible that the only systems which will be available to the operators will be these diesel backed emergency systems. Other factors to be considered in establishing viable reactor injection systems are makeup capacity and delivery pressure. Immediately following a scram, or under ATWS conditions, the only plant systems capable of adequate makeup to the reactor are the ECCS and condensate/feedwater. Of these systems at WNP-2, only the feedwater injects outside the shroud region. However, feedwater requires that offsite power be available and main steam isolation valves must remain open to provide the high pressure makeup capability.

In light of the limited outside the shroud injection capability at WNP-2, providing adequate outside the shroud injection systems in compliance with the generic EPG strategy is a major concern. To better align the plant's emergency response capability with the EPG strategy, WNP-2 has performed analysis and established procedures to allow the RHR core injection mode to be realigned to allow water to be injected to the reactor via the shutdown cooling piping (see deviation # 2 above). This realignment provides the plant with a diesel backed makeup system which injects outside the shroud area. However, this makeup system has two major drawbacks. First, it takes the operators several minutes to install jumpers and bypass the required interlocks to realign the system. And second, the system can only inject at low reactor pressures. With this alignment, the reactor would have to be depressurized for the system to inject water to the reactor. Also, depressurization under ATWS conditions may complicate or worsen the situation.

Due to WNP-2's limited outside the shroud injection capability, concerns over the time required to realign RHR, the distraction the realignment represents to the operators during event recovery and the possibility that depressurization may further complicate recovery, WNP-2 believes additional makeup capability is vital to plant safety. Consequently, HPCS, which injects inside the shroud, is allowed as an RPV injection source to flood or refill the RPV during an ATWS, provided that boron is being injected via the SLC system. As recommended by the BWROG Guidelines, if boron is not being injected, use of the HPCS system would not be allowed. It should be noted that WNP-2 is designed and analyzed to use the HPCS spray header as the method for introducing SLC sodium pentaborate into the RPV. Operation of the HPCS system decreases the transport time for the boron to reach the core and is therefore desirable for ATWS events.

There have been concerns raised over the use of HPCS due to the potential of core instability being brought on by injection of sub-cooled water directly into the core region. At the NRC meeting on 8/28/91 Supply System was asked to reconsider this deviation in light of this core stability concern. Subsequent to this meeting, the Supply System decided to withdraw this EPG deviation but after further review and discussions with both GE and the Owners' Group we have concluded that maintaining this deviation provides the operators with a capability which is critical to overall plant safety while maintaining a strategy which is consistent with both the EPG intent and latest stability initiatives. The following additional discussion is provided in support of this position.

The BWROG Guidelines discuss the reasons for using outside the shroud injection systems in Appendix B of the EPGs under the discussions on contingency C5-3. The main theme of these discussions is as follows:

> "The systems identified for use here are those utilizing motor-driven pumps and injecting outside the shroud. These systems are used preferentially in order to mix cold, unborated water injected into the RPV with warm, borated water prior to it reaching the core.
>
> The operator is cautioned during use of these systems (WNP-2 Caution 5, EPG Caution #7) to highlight the concern regarding a reactor power excursion occurring if injection is performed too rapidly."

WNP-2 utilizes the HPCS sparger to inject boron into the RPV. With this method of boron injection, the water injected by the HPCS would be borated and it is unnecessary to circulate the borated water from the lower plenum to maintain borated water in the core. In addition, because the water is introduced as a spray in the upper plenum, near thermal equilibrium with the mixture in the plenum is achieved before the borated water enters the core. A plant specific best estimate analysis for WNP-2

(FSAR section 15.8) shows that good mixing of boron will occur between the lower plenum, core, upper plenum and shroud areas.

Furthermore, at the joint EPG/stability BWROG meeting on 5/27/92 in San Jose, GE technical experts and BWROG stability committee members agreed that for WNP-2 it is more appropriate to maintain HPCS injection for high power MSIV isolation ATWS scenario than to depressurize. General Electric is in the process of making a TRAC-G run to validate this engineering judgement but it is not scheduled to be complete until 7/92. EPG committee members present agreed that HPCS was specifically excluded from initial injection sources for two reasons. The first reason was concern over the impact of HPCS injection on boron concentration in the RPV. This issue was specifically part of our ATWS analysis which is discussed below. The second reason is the concern of a reactor returning to critical due to subcooling impact of HPCS injection during a low power ATWS scenario. To avoid this concern, HPCS injection will not be authorized if reactor power is below 2% or is increasing. This power level provides for a transition point above which RCIC system alone may not be able to control and maintain RPV water level and thus HPCS injection would be required. It also ensures sufficient reactor power is available to preheat the HPCS flow prior to entering the core region.

Finally, in support of the initial EPG Revision 4 implementation, WNP-2 relied on a best estimate ATWS analysis as its basis for taking this deviation. This analysis indicates that reactor power is rapidly reduced when sodium pentaborate is injected via the HPCS spray header into the core. Control of reactor power by this method is preferred to an inevitable reduction in RPV water level leading to emergency depressurization of the RPV and requires the operator to use the fuel zone level instrumentation to monitor RPV level.

This best estimate analysis was originally prepared to confirm that the WNP-2 plant specific response to ATWS meets the requirement of 10CFR50.62. This analysis was performed using the RETRAN-03 computer code. The RETRAN-03 results were benchmarked against RETRAN-02, Mod 4 to validate code performance. Based on a bounding analysis of MSIV closure with failure of alternate rod insertion, it was shown that the plant could be rapidly brought to a shutdown condition via SLC injection without challenging primary containment integrity. The analysis assumed no direct operator actions are initiated to lower RPV water level. For WNP-2, the SLC system injects the sodium pentaborate into the vessel via the HPCS sparger. HPCS injection water flow rates determined from the analyses range between 2000 and 3500 gpm. The concentration of boron in the injected water will range from about 1200 ppm to 600 ppm, assuming the sodium pentaborate in the SLC tanks is at the WNP-2 Technical Specification lower limit and both SLC pumps are operating. Injection via the sparger provides a direct path for boron to enter the reactor core. The analysis shows that with initiation of the SLC pumps at the suppression pool temperature limit, 110°F, the core fission power will be less than 5% within about 12 minutes following

event initiation. The analysis shows that if operator action is taken to isolate HPCS and RCIC, the fission power will be less than 5% within about eight minutes following initiation.

The RETRAN model of the reactor vessel includes a core bypass region; i.e., that region between the fuel assemblies. The model results show that the borated water enters the bypass region at the top of the core and, because of natural circulation flows downward into the core, mixing with the upward flow through the fuel assembly. Therefore, the mixing problem in the lower vessel head experienced by a lower head boron injection location is eliminated and the reactor power is immediately influenced by the boron as it is injected. This mechanism for coolant flow into the core after being sprayed onto the top of the core has recently been confirmed by testing and analysis performed by GE to support the SAFER/PERFORM program.

Parametric studies indicate that delaying SLC injection for five minutes does not significantly increase the challenge to the design limits of the WNP-2 primary containment. The base case analysis, which assumes initiation of SLC at 110°F wetwell temperature and no operator action to lower reactor water level results in a peak containment pressure of approximately 3 psig (< < 45 psig design pressure) and a peak wetwell temperature of 123°F. (< < 275°F design temperature). A five minute delay in initiating SLC results in only a 1 psi increase in peak containment and a 15°F increase in wetwell temperature. During an ATWS, the WNP-2 EOPs direct the operators to reduce reactor water level if power is not decreasing irrespective of whether the SLC pumps are injecting. The above cited parametric study indicates a delay in operator actions of five minutes has very little impact and remains well below the containment design limits.

The WNP-2 EOPs also permit boron injection anytime before the 110°F limit. For ATWS events resulting in a reactor at power, it is reasonable to assume that the operator will inject boron earlier than that assumed by the realistic analysis.