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SUBJECT: Forwards response to questions re proposed change NPF-10/15-138 re CEA position & insertion limits,CEA softwear changes conducted per Rev 2 to CEN-39(A).

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August 1, 1984

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

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
San Onofre Nuclear Generating Station
Units 2 and 3

SCE's letter dated April 10, 1984 requested that the staff review and approve proposed change NPF-10/15-138. This proposed change to Technical Specifications 3.1.3.1, "CEA Position", 3.1.3.6, "Regulating CEA Insertion Limits", and 3.1.3.7, "Part Length CEA Insertion Limits" reduces the sensitivity of the CEAC's to inward deviations of the CEA's by setting the inward CEAC CEA deviation penalty factor to 1.0.

Subsequently on June 29, 1984, SCE received an informal request for clarification of Technical Specification change NPF-10/15-138 addressing the following considerations:

1. Clarify "inward deviation" of CEA's.

2. Do the CPC/CEAC modifications affect this type of CEA deviation only?

3. Provide a description of the CPC/CEAC software modifications.

4. Are the CPC/CEAC software changes done in accordance with the procedures described in CEN-39(A), Rev. 2, "CPC Protection Algorithm Software Change Procedure"?

5. Provide in detail your analysis to demonstrate that operation in accordance with the proposed Technical Specifications provides enough margin to compensate for the reduction of the CEAC deviation factors to 1.0.

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SCE responded to the above NRC (Mr. Y Hsii) concerns during a July 23, 1984 conference call. At the conclusion of the conference call, Mr. Y. Hsii indicated that all of the considerations mentioned above had been adequately resolved. The enclosure provides formal documentation of SCE's responses to the NRC's (Mr. Hsii) June 29, 1984 informal request for additional information regarding proposed change NPF-10/15-138. Additionally, Mr. Hsii indicated that his review/approval of proposed change NPF-10/15-138 would be facilitated by receipt of Phase I and Phase II CPC/CEAC Software Verification Test Reports relative to the reduction of penalty factors for inward CEA deviations.

The Phase I and Phase II CPC/CEAC Software Verification Test Reports are being transmitted to the NRC under separate cover due to the proprietary nature of these reports (via SCE to NRC letter dated August 1, 1984).

SCE believes that the responses provided by this letter resolve NRC concerns regarding this proposed change. In that proposed change NPF-10/15-138 provides substantial benefits for the remainder of Cycle 1 for both Units 2 and 3 and forms part of the ground rules for Cycle 2 reload analysis for Units 2 and 3, and that all questions concerning this change have been answered, SCE considers this proposed change appropriate for prenoticing in the Federal Register in order to expedite its subsequent approval.

If you have any questions or comments concerning the enclosed information, please let me know.

Very truly yours,

cc: Harry Rood, NRC Project Manager (to be opened by addressee only)
Y. Hsii, NRC Core Performance Branch (to be opened by addressee only)
A. E. Chaffee, NRC Resident Inspector

Response to NRC Questions

1. The April 10, 1984 submittal indicates that the proposed Technical Specifications changes reduce the sensitivity of the CEAC's to inward deviations of the CEA's by setting the inward CEAC CEA Deviation penalty factors to 1.0.

   (a) Question:

   Please clarify "inward deviations" of CEA's.

   Response:

   An "inward deviation" as used in the CEAC description means a situation where one CEA of a four CEA subgroup is inserted substantially further into the core than the remaining three CEA's which are all at essentially the same insertion. This situation could occur through either the insertion of a single CEA or through the withdrawal of a subgroup with one CEA failing to move.

   (b) Question:

   Do the CPC/CEAC modifications affect this type of CEA deviation only?

   Response:

   Yes. The CEAC penalty factor selection algorithm for single CEA deviations characterize a deviation by direction of the odd CEA from the subgroup (inward or outward), magnitude of the deviation, general CEA bank configuration of the regulating CEA's and PLR's and specific CEA that has deviated. For the CEAC change referenced, this characterization process is used to set all inward single CEA deviation penalty factors to 1.0 while retaining all outward deviation penalty factors at their present values.

   (c) Question:

   Provide a description of the CPC/CEAC software modifications.

   Response:

   CPC/CEAC software modifications are generally characterized as being of one of two types: Algorithm changes and data base constant changes. The modifications to the CPC/CEAC software to support the reduction of the penalty factors to 1.0 for inward single CEA deviations does not require modifications of either kind to the CPC

software and only requires modification to the data base constant values in the CEAC. The existing algorithms in both systems are sufficiently general to support this change (to 1.0 penalty factors) without algorithm changes.

(d) Question:

Are the CPC/CEAC software changes done in accordance with the procedures described in CEN-39(A), Revision 2, "CPC Protection Algorithm Software Change Procedure"?

Response:

Reference: "Response to NRC Questions Regarding System 80™ CPC/RPCS," Enclosure 1-NO to Letter LO-83-031, April 1983

CPC/CEAC software changes are done in accordance with the procedures described in CEN-39(A), Revision 2. The software changes are also being done using a checklist document described in the Reference. As indicated in the Response to Question 14 of the Reference, the checklist will not be considered a supplement to CEN-39(A) and will not supersede C-E's own internal QA procedures. Rather, it is an aid to software design personnel to ensure the checking of items to be verified during the generation and review of the software implementation documentation. These items are already being applied to CPC software implementation, documentation generation and review. This checklist document has been formally issued within C-E and is available for review at C-E, Windsor, Connecticut.

2. Question:

In order to compensate for the reduction of CEA deviation penalty factors used in CPC/CEAC, the proposed changes of Technical Specifications require:

(a) a core power reduction in accordance with Figure 3.1-1A when one CEA deviates more than 19 inches, or one or more CEA's deviate between 7 and 19 inches;

(b) limiting the regulating CEA groups to the Short Term Steady State Insertion Limit when COLSS is out of service; and

(c) limiting the part length CEA's to the Insertion limit imposed in Figure 3.1-3.

Provide in detail your analysis to demonstrate that operation in accordance with these proposed requirements in Technical Specifications provides enough margin to compensate for the reduction of the CEAC deviation factors to 1.0.

Response:

The analysis methods used to demonstrate acceptable operation with the proposed technical specification requirements and the reduction of the CEAC deviation factors to 1.0 involved only one change to the analysis methods used to determine the deviation penalty factors originally. This change was to include explicit determination of deviation penalty factors for certain CEA's and initial CEA configurations that previously used conservative, bounding values of deviation penalty factors. Other than this change the methods used the same full-core, three-dimensional simulation of the reactor with numerous CEA insertions and drops from a range of initial CEA Bank configurations and power levels. The analysis to determine the time-dependent, xenon component of the penalty factor has not been changed. Both the "static" and xenon components of the penalty factors include allowances for calculational uncertainties. The result of this portion of the analysis was a complete set of deviation penalty factors applicable for inward deviations of any CEA up to the full core height.

Recent instances of CEA position sensor noise have been interpreted in CEAC logic as significant inward deviations. Due to the use of overly conservative penalty factors, there have been unnecessary reactor scrams. To avoid these challenges to the protection system, the thermal margin assured by COLSS can be credited in the CPC system. Clearly, if the penalty factor required for a CEA drop event is less than one plus minimum margin assured by COLSS, there is no need to have a reactor scram. If, however, one plus the minimum margin set aside by COLSS is less than the required penalty factor, then a trip may be required. To assure that a trip will be provided when needed, a deviation penalty factor will not be reduced for any condition for which one plus the COLSS minimum margin is less than the penalty factor. With this general material as background, the responses to the specific questions are:

(a) The thermal margin set aside by COLSS is sufficient to accommodate the deviation penalty factor that occurs immediately after the CEA deviation. There are some specific combinations of initial CEA configuration and dropped CEA for which the build-in of the xenon penalty factor will exceed the minimum COLSS margin after 15 minutes. Figure 3.1-1A requires a power reduction to accommodate this xenon factor build-in in a manner analogous to that presently used on C-E's plants with analog protection systems.

The slopes for the two curves are determined from the largest xenon penalty factor that can occur for any deviation of the specified CEA from any initial CEA Bank configuration. The limit on power reduction to 60% of rated power is based on the existence of a minimum power, below which it is impossible to reach a power operating limit (POL) within the LCO-space monitored by COLSS. This minimum power was adjusted for the worst static and xenon combined CEA deviation penalty factor. On this basis, at any power below 60% of rated power, the worst deviation will not cause a violation of the thermal limits.

The length of a CEA deviation directly affects the size of the deviation penalty factor in a near linear manner. However, all the margin assessments were based on evaluations bounding full height CEA drops. The allowed deviations without power reduction, which amount to between 5 and 12% of core height require substantially lower total penalties and are covered by the existing thermal margin.

(b) The COLSS thermal margin is set by two components of the algorithm; the underflow fraction associated with the LOF event and the power dependent power operating limit bias included to accommodate CEA drops and deviations from lower power CEA configurations. During operation with the COLSS out of service, the CPC's are used to monitor plant operation using a limit that includes the required underflow fraction only. The inclusion of the power dependent POL bias in the CPC operating limit would unnecessarily complicate the procedure. Thus the need for this component in the CPC operating limit for COLSS out of service was avoided by restricting the CEA initial configurations to those which do not require the margin set aside by the COLSS POL bias term.

(c) The part length CEA's (PLR) are unique among the CEA's of the plant in that, under the wrong set of circumstances, a PLR drop can cause a reactivity increase rather than the decrease that is caused by other CEA drops. This reactivity increase will cause a temporary power excursion until the feedback mechanisms return the core to approximately its initial power.

The restriction of PLR insertion per Figure 3.1-3 will prevent situations where a PLR drop could insert positive reactivity for power above 50% of rated. For power below 50% of rated the long term insertion limit will still prevent positive reactivity insertion on a PLR drop. The region between the long term and transient insertion limits could have a positive reactivity on a PLR drop but the margin available at those power levels is sufficient to accommodate the temporary power increase.