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Power Plant System

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SLNRC 81-020 FILE: 0541
SUBJ: SNUPPS FSAR - NRC Request for Additional Information

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Docket Nos. STN 50-482, STN 50-483, and STN 50-486

Reference: NRC (Tedesco) letter to J. K. Bryan and G. L. Koester, dated February 25, 1981: Same subject

Dear Mr. Denton:

The referenced letter forwarded a request for additional information from the Reactor Fuels Section of the Core Performance Branch. The essence of the request was that the SNUPPS FSAR Section 4.2, "Fuel System Design", should be modified to include the information requirements of Revision 1 to Standard Review Plan 4.2.

The SNUPPS FSAR was written to meet the information requirements of Revision 3 to the Standard Format (Regulatory Guide 1.70). The NRC's stated purpose of the Standard Format is to describe the information needed in, and the format for, safety analysis reports. Even though the Standard Format is only a recommendation, not a requirement, SNUPPS attempted to meet the guide so that the NRC would have the necessary information and would be able to shorten the review process time. The Standard Format has different requirements than the Standard Review Plan.

In addition to the use of the Standard Format, SNUPPS used other information, such as NRC questions issued to other plants and the NRC's Standard Review Plans including Revision 0 to SRP 4.2, in order to provide a complete and comprehensive FSAR. The preparation and review of FSAR Chapter 4 started in 1978 and continued for many months. The SNUPPS FSAR was tendered on October 2, 1979. All information that was available during the FSAR preparation was used. The first feedback that SNUPPS has received on FSAR Chapter 4 is the referenced letter which was received 17 months after FSAR submittal.

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The Standard Review Plan is a document prepared for the guidance of **staff reviewers** in performing safety reviews. Attempts to assign Regulation or Regulatory Guide status to the SRP is considered to be inappropriate. The referenced request suggested a proposed rulemaking which would, if promulgated, require applicants to identify and justify deviations from the SRP. To suggest that SNUPPS should comply with a proposed rulemaking is considered inappropriate and in conflict with the regulatory process. A SNUPPS letter to the Secretary of the Commission (SLNRC 80-50) dated November 24, 1980 provided SNUPPS comments and disagreement with the proposed rule. If this regulation is placed in effect, SNUPPS will comply.

Notwithstanding all of the above, SNUPPS is committed to providing the necessary information to the NRC in order that a timely and complete safety review be conducted. SNUPPS has on numerous occasions offered to assist the NRC staff in many ways to meet this objective. SNUPPS is currently cooperating with several NRC review branches in the conduct of meetings that are intended to facilitate the review process. SNUPPS believes that FSAR Section 4.2 provides sufficient information for the NRC to complete its safety review. However, if additional information is required and if the information requirements are consistent with the scope of that provided by other recently licensed plants, SNUPPS will respond in a timely manner. SNUPPS will not support an inflation of unnecessary information requirements that would further slow the licensing process.

SNUPPS has developed the attached technical response to the referenced request and believes that this information along with the current Section 4.2 is responsive to the NRC's needs. Should this not be the case, it is suggested that NRC provide specific requests or that a meeting be held to discuss the matter.

Very truly yours,

Nicholas A. Petrick

RLS/mtk/2b3/4
Attachment

cc: J. K. Bryan UE
G. L. Koester KGE
D. T. McPhee KCPL
T. Vandel USNRC/WC
W. Hansen USNRC/CAL

S N U P P S

NRC Question

0490.1 Since the issuance of Construction Permits for SNUPPS plants, several significant changes have taken place that will affect our review of Section 4.2, "Fuel System Design." The most fundamental changes deals with the format and content of Section 4.2 as they relate to the Standard Review Plan; the other changes deal with technical issues that have arisen recently. All of these changes are discussed below.

Standard Review Plan

The basic fuels sections of the Standard Format (Rev. 3), the Standard Review Plan (Rev. 1, 1978), and the SNUPPS FSAR are all the same: 4.2.1 Design Bases, 4.2.2 Description and Design Drawings, and 4.2.3 Design Evaluation. Unfortunately, 4.2.1 of the Standard Format (and, hence, of the SNUPPS FSAR) does not clearly call for a quantitative (usually numerical) statement of all design bases as does the Standard Review Plan. Similarly, the other sections of the Standard Format and the SNUPPS FSAR mix up design bases, design descriptions, and design evaluations, but that information is sorted out clearly in the Standard Review Plan.

Because of improvements in clarity and completeness in this 1978 version of the Standard Review Plan, we will conduct our review and prepare the SER according to the SRP. Our questions, then, will not be open-end, but they will simply ask for the residual information called for in the SRP but not present in the SNUPPS FSAR. There are, thus, two options at this stage of the review.

Option 1 - You could revise Section 4.2 of the SNUPPS FSAR to follow the details of the SRP (remember, the basic organization structure would be unchanged). This would automatically bring out all of the information that is needed.

Option 2 - A cross reference could be provided to link each item in the SRP with a paragraph in the SNUPPS FSAR. This method would leave Section 4.2 of the SNUPPS FSAR in its present format, but might lead to additional questions since all of the information is not present.

We recommend Option 1. Revision 1 of the SRP, to which we refer, was formally issued more than two years ago. Therefore, we do not view this change as either precipitous or disruptive. Furthermore, it is likely that you will have to identify and justify all deviations from the SRP under the provisions of a proposed rule (Federal Register 45, p. 67099, October 9, 1980) since your SER will be issued after January 1, 1982.

NRC Question (cont.)

We urge you to provide the information that would be needed to demonstrate compliance with the SRP at your earliest convenience. To help you anticipate an imminent revision to SRP-4.2, the following comments are provided.

Revision 1 - This revision was issued in October 1978 and contains all of the basic requirements that you need to address. It will not be changed significantly by the planned revision.

Revision 2 - This revision is planned for April 1981 and is the revision alluded to in the notice of proposed rule-making on SRP compliance. In SRP-4.2 this revision will (a) add acceptance criteria for mechanical response to seismic and LOCA loads, and (b) make editorial changes largely confined to adding and correcting citations to regulations and regulatory guides that are already addressed in Rev. 1. The acceptance criteria for mechanical response were recently implemented as part of the resolution of Unresolved Safety Issue, Task A-2 and are given in Appendix E of NUREG-0609. Therefore, you can base the SNUPPS FSAR revisions on SRP-4.2 Rev. 1 (current version) plus Appendix E of NUREG-0609, and last-minute changes in referencing can be made in April prior to your submittal of the additional fuel-related information.

Recent Technical Issues

The following is a list of current technical issues that have frequently been noted as outstanding issues in recent SERs and that should be given special attention in the SNUPPS FSAR.

1. Supplemental ECCS analysis with NUREG-0630.
2. Combined seismic and LOCA loads analysis.
3. Enhanced fission gas release analysis at high burnups.
4. Fuel rod bowing analysis.
5. Fuel assembly control rod guide tube wear analysis.
6. Fuel assembly design shoulder gap analysis.
7. End-of-life fuel rod internal pressure analysis.

Response

The SNUPPS FSAR was written to meet the information requirements of Revision 3 to the Standard Format (Regulatory Guide 1.70). The purpose of the Standard Format is to define the information requirements, whereas the Standard Review Plan provides guidance to staff reviewers. SNUPPS believes that the information presented below, along with the current FSAR Section 4.2 provides sufficient information for the NRC to complete the safety review.

A. Further Quantification of Design Bases

SNUPPS has reviewed Section 4.2 of the NRC Standard Review Plan in order to identify those areas of the FSAR where more quantitative design basis information has been suggested. Although the design bases section of the FSAR is not as quantitative as is discussed in the Standard Review Plan, all of the fuel system damage and fuel rod failure mechanisms listed in subsection II.A of the SRP are included and discussed in the design analysis section (Section 4.2.3) of the SNUPPS FSAR. The information presented is intended to demonstrate that the functional capabilities of the fuel equal or exceed those assumed in the safety analysis. In some cases, empirically determined manufacturing or process specifications have been established that reduce failures due to a given postulated mechanism to a level where they cannot be distinguished from failures due to unknown causes, i.e. one defective fuel rod for each 10,000 rods in operation (Ref. 1). These specifications can not and should not be classified as design bases since no quantitative cause and effect relationship has been established between the mechanism and the specification.

The Standard Review Plan, in subsection I.A and subsection II.A.2 (b) on pellet/cladding interaction, recognizes that design bases for some potential failure mechanisms can only be expressed as general criteria. This is particularly true in cases where insufficient evidence exists to quantitatively describe known fuel rod failures in terms of a specific physical model. A considerable amount of operating data has been obtained on light water reactor fuel over the last ten years (Ref. 2). This experience has lead to the identification of many of the potential failure mechanisms that are discussed in the SRP. However, conclusive evidence has not been presented that links some of these postulated mechanisms with fuel failure. In fact, fuel rod bowing, strain cycle fatigue, and external corrosion are all mechanisms where fuel failure has not occurred in PWRs (Ref. 2). Both fuel rod bowing and fatigue are discussed in detail in FSAR Section 4.2.3 and the topical reports referenced in that section. For other mechanisms, such as zirconium hydriding, modification of a single design or fabrication specification has all but eliminated that mechanism as a significant contributor to fuel rod failures. Such a single specification change based on empirical evidence can not be treated as a design basis since it may be but one of many techniques for alleviating the cause of failure, which is not well understood. Elimination of fretting wear as a significant failure mechanism has been accomplished using a similar philosophy. In those few instances where failures have been associated with fretting phenomena, the failures have been traced to excessive localized hydraulic forces, (Ref. 2 and 3), and the failure mechanism was eliminated by design modifications that reduced the hydraulic imbalance, not by placing arbitrary limits on fretting wear. No significant wear of the SNUPPS clad or grid supports is

expected during the life of the fuel assembly based on out-of-pile flow tests, performance of similarly designed fuel in operating reactors, and design analyses. Evidence for this conclusion is provided in references 3 and 4 which are also listed references in Section 4.2 of the SNUPPS FSAR.

The design bases for fuel coolability given in subsection II A 3 of the Standard Review Plan, that are not presented in FSAR Section 4.2.1, are described in FSAR Sections 15.4 and 15.6.

SNUPPS believes that a quantification of the design bases beyond that required by Regulatory Guide 1.70 is premature in view of the current state of the art of fuel failure technology. Such quantification could place unwarranted confidence on empirically derived relationships between design parameters and failure mechanisms. In addition, SNUPPS believes that the large body of successful operating experience described in the FSAR references, combined with the design evaluation presented in Section 4.2.3, provides adequate evidence that the SNUPPS fuel has the required functional capabilities. It can be anticipated that further accumulation of operating data and out-of-pile examination of irradiated fuel specimens will contribute to an enhanced understanding of many of the fuel failure mechanisms.

References

1) Proceedings of the ANS Topical Meeting on Light Water Reactor Fuel Performance, Portland, Oregon, April 29, 1979.

2) F. Garzarilli, et. al., The Main Causes of Fuel Element Failure in Water Cooled Reactors, Atomic Energy Review, Vol. 17, No. 1 (1979)

3) Iorii, J. A. and Skaritka, J., "Operational Experience with Westinghouse Cores", WCAP-8183 (Reference 1 of Section 4.2).

4) Demario, E. E., Hydraulic Flow Test of the 17 x 17 Fuel Assembly", WCAP-8278 (WCAP 8279-Non proprietary) February 1974 (Reference 10 of Section 4.2)

B. Fuel System Description and Design Drawings

Much of the design data listed in subsection II.B of the SRP that is not included in FSAR Section 4.2 is included in other sections of the FSAR. The following tabulation presents the location of this information in the FSAR:

Table 4.1-1	Coolant System Pressure
Table 4.3-1A/1B	Cladding Outside Diameter Cladding Thickness Pellet Outside Diameter

Pellet Density
Pellet Length
Burnable Poison Content
Active Fuel Length
Fissile Enrichment

Section 4.2.2.1 Type and Metallurgical State of the Cladding

Figure 4.2-2 Overall Rod Length

Section 4.2.3.1b Fill Gas Type and Pressure

The figure numbers for design drawings are as follows:

4.2-1	Fuel assembly cross section
4.2-2	Fuel assembly outline
4.2-3	Fuel rod schematic
4.2-6	Top grid to nozzle point
4.2-7	Guide thimble to bottom nozzle joint
4.2-9	Control rod assembly cross section
	Control rod assembly outline
4.2-10	Control rod schematic
4.2-11	Burnable poison rod assembly outline
4.2-12	Burnable poison rod assembly cross section
	Burnable poison rod schematic
4.2-13	Primary source assembly
4.2-14	Secondary source assembly
4.2-15	Thimble plug assembly

C. Recent Technical Issues

With regard to the seven current technical issues presented in question 490.1, it is SNUPPS understanding that many of the generic issues have been resolved in connection with NRC staff reviews of similar plants with fuel assembly designs and fuel fabrication specifications that are the same as those for SNUPPS. The Safety Evaluation Report for the Virgil C. Summer Station (NUREG-0717) is an example of such a plant. The following paragraphs address these issues.

1. Supplemental ECCS analysis with NUREG-0630

NUREG-0717 describes the current status of NRC requirements relative to ECCS evalualtion models. SNUPPS plans to comply with current NRC requirements and provide a supplemental calculation of the plant ECCS analysis performed with the materials models of NUREG-0630 on a mutually agreeable schedule . We expect this calculation to demonstrate that no total peaking factor reduction will be required for the SNUPPS reactors.

2. Combined seismic and LOCA loads analysis

The combination of seismic effects and loads due to a double ended loss-of-coolant accident are discussed in the SNUPPS FSAR Section 4.2.3, Westinghouse topical report WCAP-8236/8288 (Reference 13 of Scetion 4.2 of the SNUPPS FSAR), and on page 4-6 of NUREG-0717. In the latter report, the response of the fuel assemblies for seismic and LOCA loads has been analyzed with a methodology acceptable to the NRC, and the results show that the assemblies will accommodate these loads. If a similar analysis is required for SNUPPS, we anticipate that it will also show that the SNUPPS assemblies will accomodate these loads in an acceptable manner.

3. Enhanced fission gas release analysis at high burnups

The subject of fission gas release is discussed in Westinghouse topical report WCAP-8720/8785 (Reference 5 in Section 4.2 of the SNUPPS FSAR) The NRC Safety Evaluation Report for the Virgil C. Summer Station (NUREG-0717) indicates that the analysis presently docketed for that plant is acceptable for first cycle operation at full power. Once the NRC review of WCAP-8720/8785 has been completed and the remaining issues have been resolved, SNUPPS anticipates that operation of the fuel for subsequent cycles will be shown to be acceptable.

4. Fuel rod bowing analysis

The subject of fuel rod bowing is discussed in Section 4.2.3 of the SNUPPS FSAR, as well as Westinghouse topical report WCAP-8691/8692 (Reference 11 of Section 4.2 of the SNUPPS FSAR). Although review of this topical report by the NRC has not been completed, SNUPPS anticipates that the current methods used by Westinghouse to evaluate fuel rod bowing will be found to be acceptable. This was the case with the Virgil C. Summer evaluation.

5. Fuel assembly control rod guide tube wear analysis

Westinghouse topical report WCAP-8278/8279 (Reference 10 of Section 4.2 of the SNUPPS FSAR) presents flow test results for fretting wear at contact points between the control rods and control rod guide thimbles. Additional experimental data has been submitted to the NRC by Westinghouse (see W letters NS-TMA-1936, 1992, and 2102), and a post irradiation examination program has been established to address this specific subject (See NUREG-0717). We anticipate that the information derived from this program will confirm the Westinghouse predictions, and that this issue will be resolved for SNUPPS as it was for Summer.

6. Fuel assemb.y design shoulder gap analysis

Appropriate rod to nozzle gaps will be provided in the SNUPPS fuel to accommodate thermal expansion and irradiation induced growth of the fuel rods relative to the overall fuel assembly structure. Westinghouse's ability to model fuel rod growth has been confirmed by comparison with measurements from 15 x 15 and 17 x 17 in-reactor data, and also is in good agreement with established experimental results as discussed in the reference below.

Reference

Balfour, J. B., Destefan, J., Melehan, M. G. and Cerni, S. "Evaluation and Performance of Westinghouse 17 x 17 Fuel", presented at the ANS Topical Meeting on LWR Fuel Performance held April 30 through May 2, 1979.

7. End of life fuel rod internal pressure analysis

For the SNUPPS safety analysis presented in Section 4.2, the internal fuel rod pressure criteria are as follows:

a) The internal pressure is limited such that the fuel-to-cladding gap does not increase during steady state operation.

b) Extensive departure from nucleate boiling propagation does not occur in postulated transients and accidents.

These criteria are described in approved Westinghouse topical report WCAP-8963/8964 (Reference 7 to Section 4.2 of the SNUPPS FSAR). These criteria and analyses are the same as those submitted in connection with the NRC evaluation of the Summer station (NUREG-0717).