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SCHWENCER,A. Licensing Branch 2

SUBJECT: Forwards response to request for info re reactor fuel design, to be incorporated in future amend of FSAR. Sufficient info exists to allow SER section addressing fuel design to be written.

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July 21, 1981
G02-81-188
NS-L-02-PLP-81-009

Docket No. 50-397

Director, Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing

Subject: SUPPLY SYSTEM NUCLEAR PROJECT NO. 2
RESPONSE TO REQUEST FOR INFORMATION
RELATED TO THE WNP-2 REACTOR FUEL DESIGN

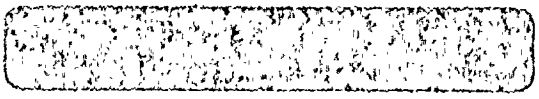
Ref.:
1) NRC letter, R. L. Tedesco (NRC) to R. L. Ferguson (Supply System) "Additional Requests for Information Related to the WNP-2 Reactor Fuel Design," dated March 24, 1981.

2) NRC letter, O. D. Parr to G. G. Sherwood (GE) "Review of General Electric Topical Report NEDE-20944-P, 'BWR/4 and BWR/5 Fuel Design'," dated September 30, 1977.

3) NRC letter, J. R. Miller to G. G. Sherwood (GE) "Modification to General Electric Topical Report NEDE-20944-P, 'BWR/4 and BWR/5 Fuel Design'," dated June 18, 1980.

Dear Mr. Schwencer:

Reference 1) requested further information relative to Section 4.2 of the WNP-2 FSAR. The response to Reference 1) is included as Attachment I to this letter, and will be incorporated into a future amendment of the FSAR. The response does not provide all the information requested but sufficient information exists on the docket, including the attached response, to allow a Safety Evaluation Report (SER) section to be written addressing the WNP-2 fuel design.



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The WNP-2 fuel design discussed in Section 4.2 of the WNP-2 FSAR is identical to designs previously approved by the NRC. The design is currently in use on all operating BWR/4 plants. In addition, SERs have recently been written on several near-term BWRs reaffirming the approval of the fuel design with two minor open items. These near-term BWRs (LaSalle, Susquehanna, Shoreham, and Zimmer) are members of the BWR Licensing Review Group (LRG) of which WNP-2 is also a member. The minor open items are discussed in the response to Question 231-05.

The fuel design was formally approved by the NRC in Reference 2) and reaffirmed in Reference 3). Reference 2) states:

> "Based on our review, we conclude that Sections 2 and 3 of NEDE-20944-P, which describes the core and fuel design for BWR/4 and BWR/5 plants, are acceptable for reference on license applications as specified in our evaluation.
>
> The staff does not intend to repeat its review of this topical report when it appears as a reference, in specific license applications, except to assure that the topical report is applicable to the specific plants involved.
>
> Should regulatory criteria or regulations change such that our conclusions concerning this topical report are invalidated, you will be notified and will be given the opportunity to revise and resubmit your topical report for review, should you so desire."

Section 2 of NEDE-20944-P is stated as applicable and is referenced in its entirety in Section 4.2 of the WNP-2 FSAR as providing the fuel system design information required. In addition, the Licensing Review Group (LRG) concept as stated and agreed to by the NRC affirmed that resolution bases on issues for one LRG plant would be applied to other LRG plants upon showing similar design. Since the fuel design is an approved design based on References 2) and 3), a resolution basis has been reached on other LRG plants as documented in their SERs, and the WNP-2 fuel design is identical to that of other LRG plants and operating BWR/4s, further review concerning Section 4.2 of the WNP-2 FSAR should not be required. A draft SER Section 4.2 should be able to be written and be virtually identical to that section in the SERs of the other LRG plants.

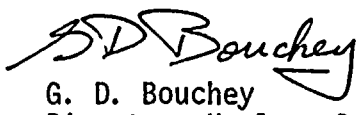
Question 231.04 requested revision of Section 4.2 of the FSAR per Revision 1 of the Standard Review Plan. Reference 1), which forwarded the question, referred to the provisions of a proposed rule requiring such revisions. This rule, the NRC proposed plan to implement the Bingham Amendment, is not yet law. In addition, even if it should become law, it would be recommended that the review of BWR fuel designs be conducted generically through General Electric. This would minimize the impact on critical manpower resources for providing such information.

Question 231.05 listed eleven various staff concerns regarding BWR fuel design and requested the FSAR be revised to address them. It should be noted that Reference 2) provided a vehicle for handling such items generically through General Electric. This would minimize the impact on critical manpower resources for providing such information.

Recognizing that the WNP-2 SER for Section 4.2 must be up-to-date regarding current issues, the same level of detail is being supplied on the WNP-2 docket as was supplied on Susquehanna for Question 231.05. This follows the LRG concept since both Susquehanna and WNP-2 are LRG plants. Additionally, Susquehanna has the most recently issued BWR SER and has an FSAR Section 4.2 virtually identical informat to that of WNP-2. This should allow completion of the WNP-2 draft SER for Section 4.2 without complication.

It should be noted that General Electric Company concurs with the contents of this letter, and urges the generic handling of issues related to the licensing of its fuel. GE essentially designs only one type of fuel rod and generic resolution of final design issues is in line with the topical report program.

Very truly yours,



G. D. Bouchey
Director, Nuclear Safety

GDB:PLP:nm

Enclosure

cc: HR Canter, B&R (RO)
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RE Snaith, B&R (NY)
S Smith, GE
JJ Verderber, B&R (NY)

ATTACHMENT 1

RESPONSE TO NRC QUESTIONS

1) Response to NRC Question 231.04

The WNP-2 fuel design is an approved fuel design currently in use in all operating BWR/4s. In addition, SERs have recently been written on several near-term BWRs reaffirming the approval of the fuel design. Reference 1) below is the NRC letter approving the design in line with the intent of the topical report program. Reference 1) is appropriately referenced in Section 4.2 of the FSAR as allowed by current NRC regulations. Accordingly, no further review or reformatting of Section 4.2 should be required. Reference 1), O. D. Parr (NRC) to G. G. Sherwood (GE), "Review of GE Topical Report NEDE-20944-P, 'BWR/4 and BWR/5 Fuel Design'," dated 9/30/77.

2) Response to NRC Question 231.05

The eleven issues in this question are generic concerns applicable to the General Electric Fuel Design. WNP-2 offers the following responses.

QUESTION 231.05

In preparing recent SERs for applications involving boiling water reactors, we have identified certain staff concerns which have been difficult to resolve in a timely manner. Accordingly, revise the appropriate sections of your FSAR to provide more detailed and specific information on the following matters:

a. Supplemental calculations using the models in NUREG-0630 when evaluating your emergency core cooling systems.

b. Periodic tests of channel box deflections.

c. The analysis of the combination of seismic loads with the dynamic loads resulting from a postulated loss-of-coolant accident.

d. Pellet/cladding temperature.

e. End-plug wear in the water rods of the 8x8 fuel assemblies.

f. Clad corrosion on the outside of the fuel elements (i.e., waterside).

g. Control rod bowing.

h. Cracking of the control rod blades due to stress-corrosion effects.

i. The effects of high fuel burnup.

j. Fuel assembly design shoulder gap analysis.

k. The analysis of the fuel element internal pressure at end-of-core life.

RESPONSE

a. Supplemental calculations using the models in NUREG-0630 when evaluating your emergency core cooling systems.

General Electric recently transmitted supplemental calculations to the NRC, "Fuel Swell and Rupture Model--Experimental Data Review and Sensitivity Studies," May 15, 1981. This document contains a discussion of the first stress and circumferential strain data applicable to the BWR, and presents results from the sensitivity studies performed comparing the NUREG-0630 models with the current GE models.

Hoop stress versus rupture temperature sensitivity studies were performed using a combination of the two curves (adjusted GE stress curve and NUREG-0630). These studies resulted in a change in PCT of $\leq 10^{o}$F. Even though this PCT impact is small, GE proposes to review the current stress model to incorporate the adjusted curve. Implementation of the adjusted curve will be coincidental with implementation of the complete LOCA model improvement package. Also, the document shows that NUREG-0630 perforation strain versus temperature curve is not applicable to BWR fuel and that substitution of a bounding NUREG-0630 curve into the current GE ECCS analysis has negligible effect on the peak clad temperature (PCT). Based on this, it is maintained that the current GE strain model is valid for the BWR and should continue to be used for ECCS calculations at WNP-2.

Reference: Letter to L. S. Rubenstein (NRC) from R. H. Buchholz (GE), "General Electric Fuel Clad Swelling and Rupture Model," dated May 15, 1981.

b. Periodic tests of channel box deflections.

General Electric Licensing Topical report NEDE-21354-P describes the fuel channel design of specific concern. Included in Section 4.4.2 of this report is a recommendation to conduct periodic control rod driveline friction tests. Operating experience with this channel design has demonstrated that excessive deflections and subsequent channel wear are unlikely. Consequently, the General Electric recommended periodic control rod driveline friction test is no longer necessary. The technical specification requirements for periodic scram time testing and rod notch testing would provide an indication of a pending driveline friction concern. Should either of these tests suggest a driveline friction problem, the pressure test described in NEDE-21534-P (4.4.2) would then be used to isolate the cause.

c. The analysis of the combination of seismic loads with dynamic loads resulting from a postulated loss-of-coolant accident.

General Electric has completed development of fuel assembly loads model and results acceptance criteria. A BWR/5 has been evaluated accordingly with acceptable results.

In response to specific NRC concerns about fuel life, a plant unique analysis was performed for a recent BWR/5 project (sent to NRC June 8, 1981). A similar analysis will be performed for WNP-2.

d. Pellet/Cladding interaction.

The General Electric report, "Safety Significance of Pellet Clad Interaction in a BWR," provides a summary of General Electric's programs initiated to evaluate the extent and safety significance of PCI. The basic conclusion is that while PCI included fuel failures remain a commercially undesirable problem, it is not considered a safety concern. General Electric BWRs, of which WNP-2 is one, have been designed and licensed with provisions to accommodate operation with fuel cladding perforation and field experience confirms that plants do indeed operate within radiological technical specifications release limits. However, in keeping with the "as low as reasonably achievable" philosophy, General Electric has pursued an aggressive action plan aimed at the minimization of the induced fuel failures. Short and long term design changes supplemented by plant operational restrictions have been implemented to ameliorate the effects of PCI. Additional improvements are currently being investigated in the continuing effort to minimize the occurrence of PCI.

Reference: Letter to V. Stello (NRC) from G. G. Sherwood (GE), "Information Concerning Feedwater Nozzles and Pellet Clad Interaction," November 10, 1976.

e. End-plug wear in the water rods of the 8x8 fuel assemblies.

General Electric observed wear on the water rods in 8x8R fuel assemblies in the fall of 1979. In Reference 3), it was concluded that the observed wear does not affect the functionality of the water rods in the bundle or plant safety.

Since the observed wear General Electric has modified the 8x8R water rod design. To improve the margin of reliability of the 8x8R fuel design, a modification to the water rod and spacer positioning/water rod has been developed. This modified design has shorter water rod and spacer positioning/water rod lower end plugs, and modified expansion springs on the upper end plugs. These changes have been shown to be effective by successful operation of the short shank 8x8 fuel design and from extensive flow-induced vibration testing. This modified water rod concept is being installed on new fuel as a prudent means of assuring increased margin of fuel reliability. Thus, the modification does not constitute an unreviewed safety question to WNP-2 based on the criteria given in 10CFR50.59.

Reference: Letter to T. A. Ippolito (NRC) from J. S. Charnley (GE), "Water Rod Lower End Plug Inspection Results," dated July 28, 1980.

f. Clad corrosion on the outside of the fuel elements (i.e., Waterside).

As indicated in the General Electric presentation given to the NRC in December 1979, the failures appeared to be associated with a metallic incursion in the feedwater. This event has occurred only once in the BWR operating history and is unlikely to reoccur.

Subsequent to this event, General Electric provided an operation recommendation for corrosion product control which should preclude this type of event at WNP-2.

Reference: Letter from R. E. Engel (GE) to M. Tokar (NRC), MFN-172-80, "Corrosion Product Control," dated October 3, 1980.

g. Fuel rod bowing.

General Electric's fuel surveillance program observations relative to fuel rod bowing are described in the reference letter together with the results of analytical evaluations of the probable extent of fuel rod bowing. Also presented are the results of an extensive thermal-hydraulic test program performed to assess the significance of rod bowing on fuel assembly thermal-hydraulic performance. Based on the presented information, it is concluded that fuel rod bowing does not constitute a viable failure mechanism or represent a significant safety concern for General Electric fuel in boiling water reactors.

Reference: Letter to James R. Miller (NRC) from R. H. Bucholz (GE), General Electric Company Licensing Topical Report NEDO-23284, "Assessment of Fuel-Rod Bowing in General Electric Boiling Water Reactors," dated April 6, 1981.

h. Cracking of the control rod blades due to stress--corrosion effects.

IE Bulletin 79-26 places requirements on BWR power reactors with an operating license to identify control blades which have high depletion and to remove these blades or show compliance with the shutdown margin requirements. These restrictions are due to an observed phenomenon in which cracking of the absorber tubes was determined to occur at high depletions resulting in a loss of $B_4C$. Additional requirements are included for destructive examination of high depletion control blades.

The bulletin is for information only for plants under construction, but it may be anticipated that control blade management programs will have to address several of the issues raised. While General Electric is currently engaged in both alternate tube material and alternate absorber development programs, these are long-term programs and no control blade design changes are anticipated in the near-term. Therefore, those plants under construction would be expected to establish a blade management program which accounts for the potential loss

of $B_4C$ and its resultant reduction in blade lifetime. The requirements of the subject bulletin would be expected to be applicable, with the exception of the requirement for destructive examination of a control blade. The current and near-term efforts should provide the data to resolve the NRC concerns as to the applicability of the $B_4C$ loss model, making destructive examinations in the future unnecessary.

General Electric has had a program in effect for some time to examine control blades from reactors with various operating histories, i.e., GE BWR Services Information Letter (SIL) No. 157, March 1979.

i. The effects of high fuel burnup.

The effects of high burnups on fuel thermal-mechanical design analyses was addressed in the proprietary General Electric presentation to the NRC on Extended Burnups, March 24, 1981. Burnups to 50 GWd/MT are considered in the analyses documented in NEDE-24011-PA. This analysis is applicable to WNP-2 fuel. This documentation will be revised before fuel burnups are increased.

j. Fuel assembly design shoulder gap analysis.

The analysis of fuel rod axial expansion is described in General Electric Licensing Topical Report, "General Reload Fuel Application," NEDE-24011-PA (Proprietary) and NEDO-24011, dated July 1979.

The results of the analysis verifies the fuel rod is designed to accommodate predicted acceptable fuel and cladding differential expansion.

k. The analysis of the fuel element internal pressure at end-of-core life.

The internal pressure is used in conjunction with other loads on the fuel rod cladding when calculating cladding stresses and comparing these stresses to the design criteria. This analysis is described in General Electric Licensing Topical Report, "Generic Reload Fuel Application," NEDE-24011-PA (Proprietary) and NEDO-24011, dated July 1979. The results of the analysis show that the calculated stresses on cladding can be accommodated.