Responses to NRC Request for Additional Information for the Westinghouse Electric Company Topical Report WCAP-17769-P/ WCAP-17769-NP, Revision 0, "Reference Fuel Design SVEA-96 Optima3"

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RAI-02

Section 3.2.5 mentions using collapse load analysis criteria as an alternative to the design limits for stress determined by the American Society of Mechanical Engineers (ASME) boiling and pressure vessel committee (BPVC), yet the discussion also says it is based on the ASME BPVC. Please clarify this contradiction. Assuming both methods are part of the ASME BPVC, there should be some discussion regarding the criteria used to determine the appropriate method. Describe how the collapse load analysis will be selected as opposed to the nominal ASME BPVC approach to establish design limits for stress during normal operation and anticipated operational occurrences.

Response to RAI-02

The proposed methodology is based on ASME Boiler and Pressure Vessel Code 2010, Section III Subsection NB. The Westinghouse collapse load analysis is the Plastic Analysis defined in ASME BPVC 2010 NB-3228.3. The Westinghouse collapse load analysis is performed using nonlinear finite element simulations based on large deformation theory in order to capture cladding ovality effects on collapse.

[

]a,c

[

(Description of the Westinghouse collapse load analysis method)

]^{a,c}

RAI-06

The use of ANSYS was approved for determining assembly stress in Reference 2 of the submittal, but not for determining cladding stress. The description of the ANSYS model is very limited. With regard to Table 4.3.3-1 on Page 4-89, please explain what is meant by items in the first column. Also, how is maximum allowed differential pressure calculated?

Additional Request for RAI-06 (NRC RAI #1)

RAI#6 sought more detail regarding the stress analyses of the cladding and asked the meaning/basis for the value(s) presented in Table 4.3.3-1. In order to review the cladding stress calculations in greater detail, an audit was conducted at the Westinghouse Electric Company (Westinghouse) Rockville Office on May 17-20, 2016. During the audit, cladding stress calculations were reviewed and the linear heat generation rate (LHGR) value given in Table 4.3.3-1 [ ]^{a,c} was understood to represent a limiting value (the Thermal Mechanical Operating Limit at the Beginning of Life). Westinghouse suggested that it might increase this limit with additional justification. NRC requested that the TR be revised to clarify the basis for the LHGR value in the table and demonstrate that the full range of LHGR was evaluated. This was documented as Open Item #2 during the audit. As written, the proposed Westinghouse revision to the TR (i.e., labeling the LHGR values as "Example Power") does not appear to address Open Item #2 from the audit and an additional RAI will be necessary.

Response to RAI-06 and the Additional Request for RAI-06

The original response to RAI-06 was provided to the NRC in Westinghouse Letter LTR-NRC-16-52 dated August 1, 2016. The original response has been revised to address the additional request. The changes and additions to the original response are marked with rev bars in the right margin.

The unmarked column in Table 4.3.3-1 is the fuel rod power during the AOO overpressure transient. Included in the table are two examples of fuel rod power [ ]^{a,c} for limiting AOO overpressure transients. As can be seen, the margin to Maximum Allowed Differential Pressure is [ ]^{a,c} It can then be concluded that the margin to the stress limits for the SVEA-96 Optima3 will be acceptable for any credible BWR application. For example [ ]^{a,c}

Maximum allowed differential pressure is calculated by using Westinghouse collapse load analysis. [ ]^{a,c}

[

(Description of calculation of allowed differential pressure using collapse load analysis)

]^{a,c}

[

(Description of calculation of allowed differential pressure using collapse load analysis)

]^{a,c}

Westinghouse has performed additional calculations of the differential pressure across the cladding wall at BOL. These calculations used values for LHGR in the range from [ ]^{a,c} The chosen values cover the expected range of pressurization transients in existing BWR plants.

To avoid confusion, a portion of Section 4.3.3 of the licensing topical report will be modified, starting in the middle of page 4-88 of the report. The changes are as follows. Note that in the first table, the only change is to the value of the [ ]a,c

Current Rev. 0:

a,c

Parameter	Deviation from Nominal Value	Value

The results of these calculations are summarized in Table 4.3.3-1.

Table 4.3.3-1 Maximum Differential Pressure Over Cladding

a,c

	Coolant Pressure	Cladding Temperature	Maximum Allowed Differential Pressure	Calculated Differential Pressure Over Cladding

Since the maximum allowed differential pressure exceeds the calculated differential pressure over the cladding [ ]a,c it is concluded that the margin to the stress limits for the SVEA-96 Optima3 will be acceptable for any credible BWR application.

Revised:

Parameter	Deviation from Nominal Value	Value

a,c

The results of these calculations are summarized in Table 4.3.3-1.

Table 4.3.3-1 Maximum Differential Pressure Over Cladding

Coolant Pressure	Cladding Temperature	Example Power(1)	Maximum Allowed Differential Pressure	Calculated Differential Pressure Over Cladding	Margin in Differential Pressure

a,c

(1) [

]^{a,c}

Since the maximum allowed differential pressure exceeds the calculated differential pressure over the cladding [ ]^{a,c} it is concluded that the margin to the stress limits for the SVEA-96 Optima3 will be acceptable for any credible BWR application. For example [

]^{a,c}

RAI-09

On TR Page 4-108 the cladding temperature methodology does not specify that [ ]^{a,c} be accounted. Please provide justification for not considering [ ]^{a,c} in the cladding temperature analysis.

Additional Request for RAI-09 (NRC RAI #2)

RAI #9 references page 4-108 and asks for additional justification for not including [ ]^{a,c} in the ***cladding temperature*** methodology. However, the discussion on page 4-108 actually refers to the ***fuel temperature*** methodology, which is what RAI#9 was intended to address. So, while Westinghouse did respond regarding the [ ]^{a,c} in cladding temperature methodology, it is still necessary to understand why [ ]^{a,c} doesn't appear to be considered in the fuel temperature methodology as described on page 4-108.

Response to RAI-09

Cladding failure due to overheating is not a credible mechanism during normal operation or anticipated operational occurrences (AOOs). Cladding temperature calculations are therefore not performed for normal operation and AOOs and consequently, [ ]^{a,c} Specific cladding temperature calculations are performed for initiating events of lower frequency of occurrence. Methods and methodologies for analysis of these accidents are described in other Licensing Topical Reports and are outside the scope of WCAP-17769-P.

As stated in Section 4.3.9, the Westinghouse methodology for evaluating the potential for cladding failure due to overheating follows the traditional industry practice of assuming that failures will not occur if adequate margin to boiling transition (the Safety Limit Minimum Critical Power Ratio, SLMCPR) is maintained. The plant Operating Limit Minimum Critical Power Ratio (OLMCPR) is established for this purpose considering all possible plant transients classified as AOOs. The OLMCPR is determined such that MCPR reduction due to anticipated operational transients does not result in a MCPR below the SLMCPR. The criterion is, however, considered to be overly conservative regarding cladding overheating damage.

Response to the Additional Request for RAI-09

The original response to RAI-09 was provided to the NRC in Westinghouse Letter LTR-NRC-16-52 dated August 1, 2016. The additional information in response to the additional request is marked with rev bars in the right margin.

The response to RAI-10 in Reference 1 addressed the point of this request. The reason for not including the [ ]^{a,c} in the fuel temperature analyses, besides the fact that [

]^{a,c} We quote from the response to RAI-10 in Reference 1:

> *[*
>
> *]^{a,c}*

[

]^{a,c}

Westinghouse performed additional evaluations for the impact of the [ ]^{a,c} on the fuel centerline temperature analysis. The evaluations used the [ ]^{a,c} as described in Reference 1, with an [ ]^{a,c} It is noted that this approach models [ ]^{a,c} The impact of the [ ]^{a,c} on the margins to melt is [ ]^{a,c} These are considered insignificant compared to the margins to melt which are [ ]^{a,c}

Given the fact that the Westinghouse [ ]^{a,c} as discussed in Reference 1, and that the effect of the [ ]^{a,c} on the fuel temperature predictions are negligible when compared to the effects already accounted for in the methodology, and particularly when compared to the available margins, as demonstrated by the calculations described above, Westinghouse deems it unnecessary [ ]^{a,c} in the current fuel centerline temperature methodology.

Reference:

1. Westinghouse Report WCAP-15942-P-A, Rev. 0, “Fuel Assembly Mechanical Design Methodology for Boiling Water Reactors Supplement 1 to CENP-287,” March 2006.