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Our ref: LTR-NRC-17-56

July 5, 2017

Subject: Submittal of RAI Response Regarding WCAP-8354-P-A & WCAP-8355-A, "Long Term Ice Condenser Containment Code - Lotic Code"

Reference: Ekaterina Lenning to James A. Gresham, "Request for Additional Information Re: Westinghouse Electric Company letter 'Changes in Westinghouse WCAP-8354-P-A & WCAP-8355-A, Long Term Ice Condenser Containment Code - Lotic Code' (TAC No. MF9354)" June 6, 2017

The purpose of this letter is to transmit a response to the Nuclear Regulatory Commission's request for additional information (RAI) in the reference above. LTR-NRC-17-56 NP-Attachment provides this response.

The attached information is non-proprietary.

Correspondence concerning this submittal should be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, 1000 Westinghouse Drive, Suite 310, Cranberry Township, Pennsylvania 16066.

J A Gresham

James A. Gresham, Manager
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Enclosures

cc: Ekaterina Lenning (NRC)
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LTR-NRC-17-56 NP-Attachment

RAI Response Regarding WCAP-8354-P-A & WCAP-8355-A, "Long Term Ice Condenser Containment Code - Lotic Code"

In Section 5.2, page 5.2-6 of WCAP-8354-P-A and WCAP-8355-A, the following logic for the calculation of the instantaneous containment pressure (pressure between two consecutive time steps) is being revised:

FROM

[1] If the expanding volume is smaller than the lower compartment volume, the system pressure calculation is based on the upper compartment and the ice-filled part of the ice compartment.

[2] If the expanding volume occupies the lower compartment, the pressure calculation then includes the lower compartment conditions.

[3] If the expanding volume fills the lower compartment and the ice-empty part of the ice compartment, this calculation period is terminated.

TO

[1] If the expanding volume is smaller than the lower compartment volume and ice-empty part of the ice compartment, the system pressure calculation is based on the upper compartment and the ice-filled part of the ice compartment.

[2] If the expanding volume fills the lower compartment and the ice-empty part of the ice compartment, this calculation period is terminated.

SRXB-RAI 1 – The addition of "ice-empty part of the ice compartment" in [1] appears to be a significant change in the total volume (lower compartment volume + ice–empty volume) which is compared with the expanding volume, because the ice–empty volume varies from zero (or a small volume) to the full volume of the ice-compartment during the depressurization phase. Provide a quantitative impact of this change on the entire pressure response, including the peak pressure, by performing a sensitivity analysis for the most bounding ice-condenser plant in the United States.

Westinghouse Response: A temporary version of the LOTIC1 code was created to model the treatment of the lower compartment volume as it is currently described in WCAP-8354-P-A. The lower compartment conditions were considered in the system pressure calculation of this temporary LOTIC1 code version after the air bubble had expanded to fill the lower compartment.

The currently most limiting containment model input deck for the peak pressure case was used with this temporary LOTIC1 code version to generate a transient pressure response for a sensitivity comparison with the base case analysis results.

The calculated peak pressure from the base case analysis is 11.2053 psig. The calculated peak pressure from the sensitivity case is 11.1966 psig, which is 0.0087 psi lower. A comparison of the transient containment pressure, temperature, and sump temperature results for the two cases is shown in Figures 1 through 4 that follow. Changing how the lower compartment conditions are modeled during the bubble expansion period has a negligible effect on the calculated results.

SRXB-RAI 2 – Please explain what is meant by: [2] *If the expanding volume occupies the lower compartment, the pressure calculation then includes the lower compartment conditions.*

Westinghouse Response: As shown on page 4-2 of WCAP-8354-P-A, the LOTIC1 pressure equation is:

$$\text{Psys} = \frac{Ma + \sum_{i=1}^{n} \frac{PsiVi}{Ra(Tvi + 460)}}{\sum_{i=1}^{n} \frac{Vi}{Ra(Tvi + 460)}}$$

where Ma is the total air mass in the system, Ps is the steam partial pressure, V is the free volume, Tv is the vapor temperature, and Ra is the universal gas constant for air. The summation is calculated over the number of active volumes, n, which depend on the time after blowdown. After blowdown, all of the air is located in the upper compartment and ice-bed of the ice condenser compartment, so these are the active volumes that are considered in the system pressure equation.

The volume of the air bubble in the lower compartment begins to grow after the fans are started. The methodology report states that the lower compartment conditions (volume, air mass, steam partial pressure, and temperature) are to be included in the system pressure calculation after the air bubble volume exceeds the volume of the lower compartment. Although this is described in the methodology report, the current LOTIC1 code version does not include the lower compartment conditions in the system pressure calculation until after the bubble has completely filled the ice-empty section of the ice condenser volume; then the summation includes all of the active volumes including the lower compartment and ice-empty section of the ice condenser.

SRXB-RAI 3 – If the condition [1] is not met, i.e., expanding volume is greater than or equal to the lower compartment volume and ice–empty part of the ice compartment, what would be the system pressure based on?

Westinghouse Response: After the air bubble has expanded to fill the ice-empty part of the ice condenser, the system pressure is based on the combined conditions (volume, air mass, partial pressure, and temperature) in all of the active volumes (i.e. all volumes except the dead ended compartment).

SRXB-RAI 4 – The above referenced states:

A source code inspection revealed that the lower compartment conditions are not included until the end of the depressurization period. It has been determined that the affected portion of the transient is very short, and including the lower compartment conditions in the calculation would have a negligible impact on calculated containment conditions. Code updates regarding this issue would provide no improved transient behavior or influence on the limiting time of the event nor increase in nuclear safety.

Please state by what method it was determined that the affected portion of the transients (containment pressure, containment temperature, and sump temperature) would have a negligible impact. Provide quantitative results by performing sensitivity study showing negligible effect on the above transients and their peak values for the most bounding ice-condenser plant in the United States.

Westinghouse Response: Engineering judgment was originally used to determine that making this change would have a negligible impact on the analysis response. See the response to SRXB-RAI-1 for the requested quantitative results comparison.

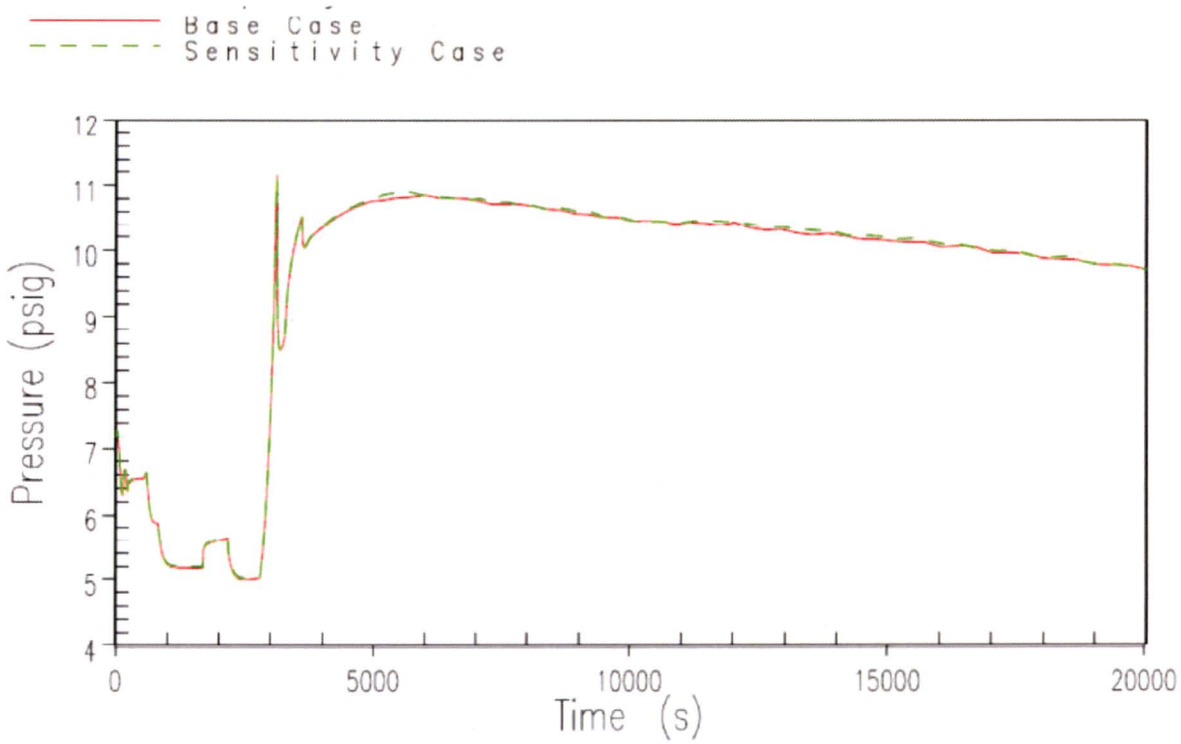

Figure 1 Containment Pressure Comparison

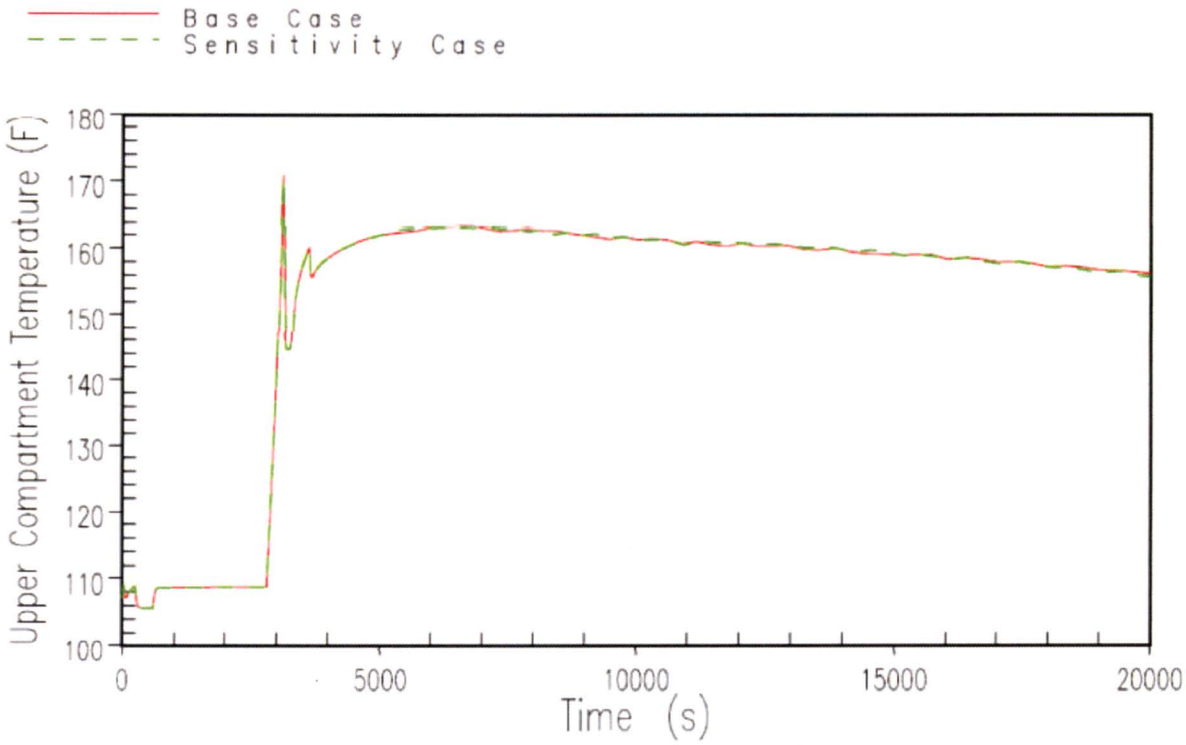

Figure 2 Upper Compartment Temperature Comparison

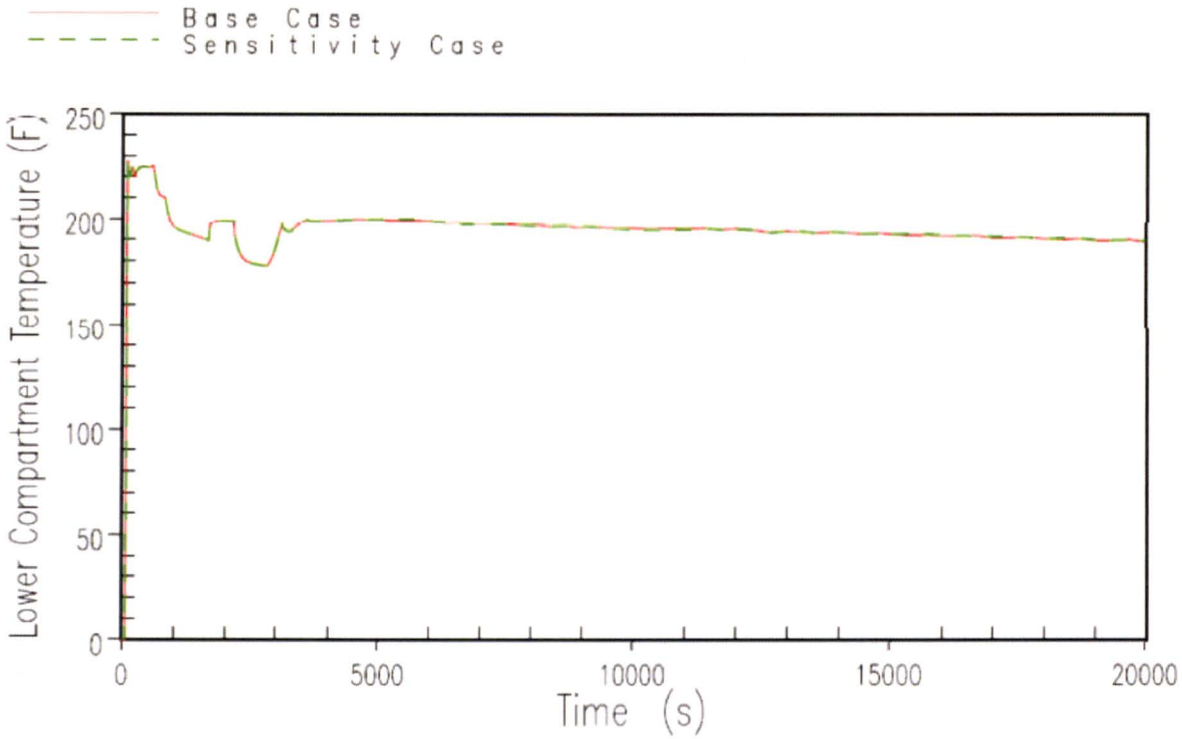

Figure 3 Lower Compartment Temperature Comparison

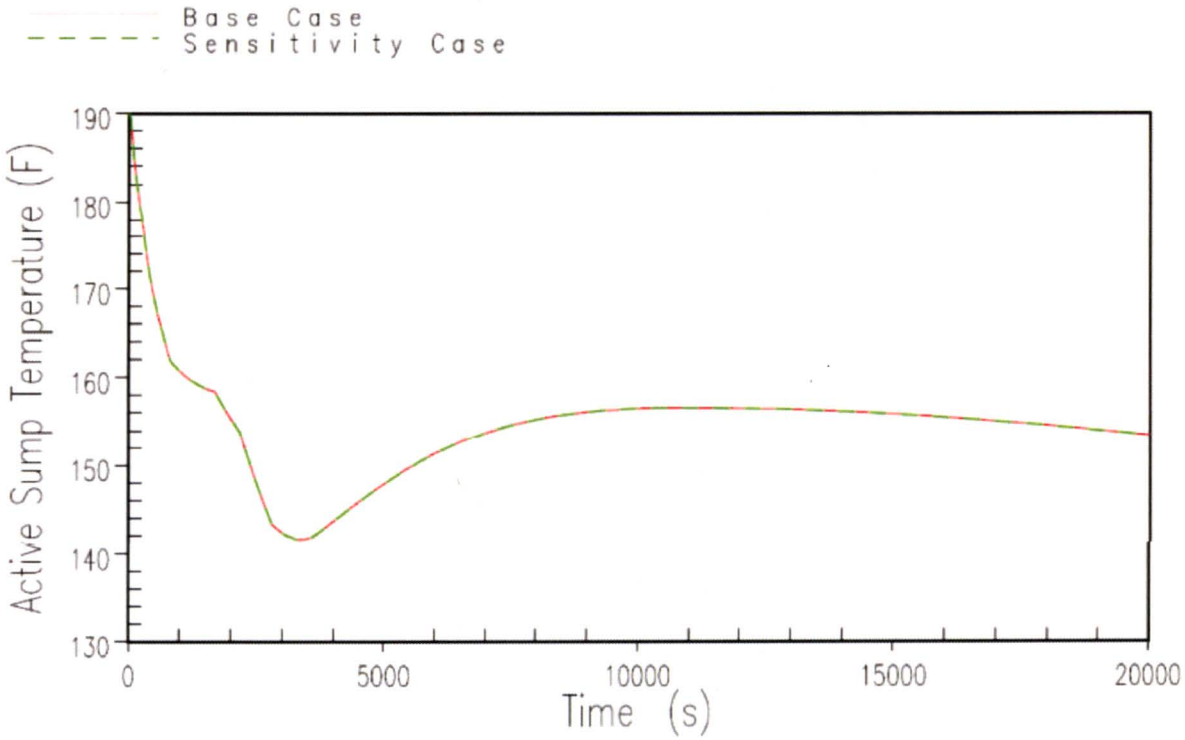

Figure 4 Sump Temperature Comparison