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FROM:

DOC DT: 04/21/03

Robert Bryan, Jr.

NRR RCVD DATE: 04/24/03

TO:

Sam Collins

FOR SIGNATURE OF :

\*\* YEL \*\*

DESC:

Westinghouse Owners Group. NRC Requests for  
Additional Information (RAIs) Associated with  
Plant Specific Applications of the Methodology in  
WCAP-14572-NP-A, Rev.1"Westinghouse Owners Group  
Application of Risk-Informed Methods

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April 21, 2003

WOG-03-218

Mr. Samuel J. Collins  
 Director, Office of Nuclear Reactor Regulation  
 Office of Nuclear Reactor Regulation  
 U.S. Nuclear Regulatory Commission  
 Washington, DC 20555-0001

- Brian Shanon - Y.T. Action Item  
 note date of  
 next mtg...  
 mid-May. Saw  
 04/24

Subject: Westinghouse Owners Group  
NRC Requests for Additional Information (RAIs) Associated with Plant Specific Applications of the Methodology in WCAP-14572-NP-A, Rev. 1, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report"

References:

1. WCAP-14572 Revision 1-NP-A, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report."
2. Letter from Thomas H. Essig, (NRC) to Lou Liberatori, (Westinghouse Owners Group), Safety Evaluation of Topical Report WCAP-14572, Revision 1, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report," dated December 15, 1998.

Dear Mr. Collins:

WCAP-14572 Revision 1-NP-A, "Westinghouse Owners Group (WOG) Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report," (Ref. 1) contains a methodology for developing a risk-informed inservice inspection (ISI) program that is an alternative to the ASME Boiler and Pressure Vessel Code Section XI ISI requirements for piping. The NRC issued a Safety Evaluation (Ref. 2) for WCAP-14572 on December 15, 1998. The Safety Evaluation stated, "The staff will not repeat its review of the matters described in the WOG Topical Report WCAP-14572, Revision 1, when the report appears as a reference in license applications, except to ensure that the material presented applies to the specific plant involved."

Four licensees have received RAIs from the NRC in plant specific applications of the methodology contained in WCAP-14572 Revision 1-NP-A. Two of these RAIs are associated with the generic methodology that was approved by the Safety Evaluation. The issues are: 1) the failure probability determination for piping segments with multiple pipe sizes and 2) the expert panel decisions that may classify piping segments as low safety significant (LSS) when the segments were ranked as high safety significant (HSS). These issues were not raised during the NRC review of previously approved plant

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specific applications of the WCAP-14572 Revision 1-NP-A methodology. However the staff has stated that these issues could be raised as part of an initial submittal or a 10-year risk-informed ISI update.

In recent discussions with NRC staff, it was agreed that the RAI on calculating failure probabilities for segments with multiple sizes does not impact the areas involving active degradation mechanisms but instead impacts areas where inspection sampling is used to address unexpected degradation. The majority of these multiple pipe size segments are the result of the NRC requiring the WCAP-14572 Revision 1-NP-A methodology to include small-bore piping. Another risk-informed ISI methodology approved later by the NRC was not required to address small-bore piping. Having to include small-bore piping in the scope of the program significantly increases the potential number of piping segments. Therefore, multiple pipe size segments are needed to maintain a manageable number of piping segments for the analytical evaluations required as part of the risk-informed ISI methodology. The use of these multiple pipe size segments may result in combining small-bore piping with larger piping.

Plant specific responses to these RAIs have and will require the addition of examinations back into the risk-informed ISI program that were previously justified to be excluded from the program with the methodology contained in WCAP-14572 Revision 1-NP-A, due to implementation schedules and the resolution of these issues. All licensees implementing the methodology contained in WCAP-14572 Revision 1-NP-A have performed a change-in-risk analysis which demonstrated that the risk-informed ISI program submitted for approval was either risk neutral or showed a slight risk reduction versus the current ASME Section XI program. Therefore, adding these examinations back into the risk-informed ISI program, primarily to piping greater than 2 inches in diameter, provides at most a minimal safety benefit and results in a significant increase in radiation exposure. It is estimated that adding these examinations back into the risk-informed ISI programs for at least 12 units that could be impacted by these RAIs would result in additional radiation exposure of 35 to 170 rem over a 10 year inspection interval to the personnel performing the examinations.

These RAIs are associated with the WCAP-14572 Revision 1-NP-A methodology, and not the plant specific submittals. As such they are requesting more detailed information than was expected from the use of an approved Topical Report. The WOG is concerned that recent actions to address these RAIs, as noted above, are delaying plant-specific implementation and are imposing unnecessary radiation exposure with at most a minimal safety benefit.

In an effort to minimize the impact on NRC staff and licensee resources during the NRC review of current, as well as future and previously approved plant-specific applications of the methodology contained in WCAP-14572 Revision 1-NP-A, a background of the RAIs, the WOG position regarding these RAIs, and the impact of these RAIs on licensees implementing the WCAP-14572 Revision 1-NP-A methodology are provided in an attachment to this letter. A piping segment example is also provided in the attachment to help clarify the failure probability issue, and a recommended level of sufficient justification is provided for the issue regarding expert panel decisions.

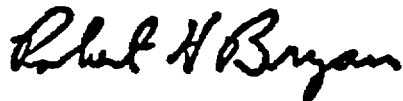
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The WOG has a broader concern of the precedent of the re-review associated with plant specific applications of the methodology contained in an approved topical report and the potential impact on other past, current, and future Owners Group and industry efforts that utilize the approach of obtaining NRC approval of a generic methodology with pilot plant applications.

Therefore, the WOG requests NRC management to review the issues discussed in this letter and attachment. Generic issues should be resolved on the Topical Report, as opposed to plant specific RAIs. The WOG believes that the issues are important to limiting unnecessary dose to workers and in support of a consistent regulatory process. It is our belief that the topical received a thorough review including the use of pilot plants in the approval process. It is in the interest of the WOG and our member utilities to reach a resolution with the NRC on these issues and we are willing to work to that end. We appreciate your consideration of this request. We look forward to meeting with you in mid-May 2003 to discuss these matters. Please direct any questions to me at 423-751-8201.

Very truly yours,



Robert Bryan, Jr., Chairman  
Westinghouse Owners Group

attachment

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All receive 1L, 1A

cc: Dr. Brian Sheron, NRC  
Mr. William Bateman, NRC  
Ms. Andrea Keim, NRC  
Mr. Gary Holahan, NRC  
Mr. Mark Rubin, NRC  
Mr. Ted Sullivan, NRC  
Mr. Stephen Dinsmore, NRC  
Mr. Drew Holland, NRC WOG Project Manager (Fed Ex)  
Mr. Ralph Beedle, NEI  
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WOG Steering Committee  
WOG Management Committee  
WOG Materials Subcommittee  
WOG Risk Management Subcommittee  
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N. J. Liparulo  
J. J. McNerney  
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K R. Balkey  
B. A. Bishop  
C. L. Boggess  
R. L. Haessler  
J. F. Kolonay  
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P. R. Stevenson

## Attachment

### NRC Requests for Additional Information (RAIs) Associated with Plant Specific Applications of the Methodology in WCAP-14572-NP-A, Rev. 1, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report"

#### Background

In August 2002, a licensee implementing the methodology contained in WCAP-14572 Revision 1-NP-A received a draft RAI requesting detailed information associated with the expert panel decision for moving some piping segments from the category of high safety significant (HSS) to low safety significant (LSS). In September 2002, the NRC conducted the first site audit of a plant specific application of the methodology contained in WCAP-14572 Revision 1-NP-A. During the audit, the NRC raised an issue regarding piping segments with multiple pipe sizes and the inputs for some of these piping segments where multiple Structural Reliability and Risk Assessment (SRRA) failure probability runs were made with different inputs for the different pipe sizes. After the audit, the NRC sent the licensee a draft RAI stating that utilizing segments with multiple pipe sizes was a deviation from the approved methodology in WCAP-14572 Revision 1-NP-A.

Three other licensees implementing the WCAP-14572 Revision 1-NP-A methodology have also received RAIs from the NRC regarding piping segments with multiple pipe sizes and the justification for expert panel decisions to move piping segments from the category of HSS to LSS.

#### Technical Discussion

##### Use of SRRA Failure Probabilities in Multiple Pipe Size Segments

A conference call between the NRC staff, WOG, Westinghouse, and several licensees was held on February 20, 2003 to discuss the NRC issues associated with the application of the WCAP-14572 Revision 1-NP-A methodology. Agreement was reached with the NRC on the following items:

- The use of multiple pipe size segments is acceptable in accordance with WCAP-14572 Revision 1-NP-A, and there is no issue of using multiple pipe size segments.
- WCAP-14572 Revision 1-NP-A addresses how to conduct the Perdue Model analysis on multiple pipe size segments, and there is no issue with using the Perdue Model on multiple pipe size segments.

The NRC staff has an issue with entering different SRRA inputs for different pipe sizes within a segment. The NRC's stated interpretation on calculating the SRRA failure probability for a multiple pipe size segment is:

- Place all the degradation mechanisms in the segment on a single weld (i.e., the worst degradation mechanisms should be combined or added and placed on the worst weld in the segment)
- If the results are reasonable (i.e., not overly conservative), use the calculated failure probability.
- If the results are overly conservative, split the segment and recalculate a failure probability for each of these new segments. If the results are reasonable, use these calculated failure probabilities. If the results are overly conservative, continue splitting the segment until reasonable results are obtained.

The WOG position for calculating the SRRA failure probability for a multiple pipe size segment is:

- A failure probability is calculated for every pipe size in the segment because some of the input parameters (e.g. nominal pipe size and thickness-to-outer diameter ratio) used by the SRRA code vary based on the pipe dimensions. In some, but not all cases, other input parameters vary for these “sub-segments” based upon the conditions for that particular sub-segment. The highest failure probability associated with the segment is then used to represent the segment.
- Though the input parameters for different cases of the same segment may vary, the parameters that are chosen for each case are the most limiting for that section (or size) of the piping segment. The limiting failure probability estimates associated with each pipe size for each segment are based on the realistic, limiting inputs associated with that section of piping.
- The WCAP-14572 Revision 1-NP-A methodology uses a relative ranking process in the risk evaluation. Use of overly conservative data can result in other segments being quantitatively ranked LSS, when they should have been ranked HSS. Generating the failure probability for each sub-segment ensures that overly conservative SRRA failure probabilities are not generated. Choosing the highest sub-segment failure probability to represent the segment ensures that the risk associated with any portion or sub-segment within the segment is appropriately represented, and that no portion or sub-segment within the segment is quantitatively ranked LSS when it should have been ranked HSS.
- The WCAP-14572 Revision 1-NP-A methodology requires the use of engineering experience in estimating the failure probability of piping segments. There are instances where it may be more appropriate to divide a multiple pipe size segment into separate segments in order that the categorization will be properly determined. So, in those cases, segments need to be split. The potential to divide a multiple pipe size segment is not considered just once, but multiple times by the engineering team developing the SRRA failure probabilities, the engineers conducting the risk evaluation, and the integrated decision-making (expert) panel.

An example of a segment with multiple pipe sizes is provided to illustrate the WOG position. In this example, the segment experiences high temperature and pressure. A 6-inch diameter portion of the segment extends some distance from a check valve to a tee, where the flow is split into two 3-inch branches that each extend to a pump. The consequences of a pipe failure are the same throughout the segment. Because of a concern for water hammer that has occurred in this system at other plants, a one-inch sub-segment was added at the high-points (near each pump) of the 3-inch piping to periodically vent the system. If the check valve leaked, then the weld in the 6-inch sub-segment closest to the valve could experience thermal stratification. Although there is no evidence that the check valve is leaking, it has happened in similar plants so a high fatigue stress range and number of cycles for stratification is selected for the simplified SRRA input. Because of the geometric layout of the piping, a weld in the 3-inch portion would see the highest water-hammer loading, which is estimated with a 1% chance of occurring due to the corrective actions that had already been implemented. Combining the water hammer and the postulated thermal stratification into one location for each pipe size may result in overly conservative results for a situation that physically does not exist. The NRC safety evaluation report (SER) (Reference 2) cautions that the failure probabilities should not be overly conservative. In this case, the failure probabilities for each pipe size would be determined using inputs applicable to the section of pipe, and the highest failure probability would be chosen to represent the segment.

The NRC Staff also has an issue with using the highest failure probability of a sub-segment to represent the segment based on the following:

- There is a potential that if the segment is HSS, there would be more examinations if the segment were split because a minimum of 1 examination is conducted per HSS segment.
- There is a potential that if the segment is LSS and each size had an ASME Section XI examination, the change-in-risk criteria may not be met. If this situation occurred, additional change-in-risk examinations may be needed to meet the change-in-risk criteria.

The WCAP-14572 Revision 1-NP-A methodology is based on the more global intent and purpose of a risk-informed ISI program rather than the absolute number of examinations. The WOG position is that the purpose of risk-informed ISI programs is to properly address areas of degradation with moderate to high safety consequences. (Areas of degradation with low safety consequence are evaluated as part of the risk-informed ISI program for consideration in a Licensee defined program.) During the February 20, 2003 conference call, the NRC staff stated that the proposed plant-specific applications of WCAP-14572 Revision 1-NP-A methodology, which are currently being reviewed, have properly identified those pipe segments with active degradation and moderate to high safety consequences. The NRC RAIs and the RAI responses regarding the calculation of failure probabilities for segments with multiple sizes do not impact the areas involving active degradation mechanisms, but instead impact areas where inspection sampling is used to address unexpected degradation.

Although there could be a difference in the absolute number of required examinations determined using the NRC interpretation versus the WOG interpretation of the WCAP-14572 Revision 1-NP-A methodology, the number of examinations must meet the acceptance criteria of the WCAP. For a HSS segment with multiple pipe sizes, the same number of examinations would be required for any active degradation. For the remaining elements where there is no expected degradation mechanism, the number of examinations is determined by the Perdue Model analysis. A sufficient number of examinations must be conducted to have a 95% confidence level that the current target leak rates will not be exceeded. In accordance with WCAP-14572 Revision 1-NP-A, a minimum of one examination will be conducted even if the Perdue Model analysis shows a 100% confidence level with no risk-informed ISI. It is this minimum that may result in a difference in the number of examinations, however it still meets the acceptance criteria of the WCAP.

The WOG position on LSS segments with multiple pipe sizes and multiple ASME Section XI examinations is the following:

- The segments that are defined as being LSS are not expected to have a significant impact on the change-in-risk calculations.
- The NRC has agreed that multiple pipe sizes in a segment are permitted in accordance with WCAP-14572 Revision 1-NP-A. It is possible that a multiple pipe size segment with the same SRRA inputs for each pipe size could have an ASME Section XI examination on each pipe size. If these segments were to be split, it is theoretically possible that the change-in-risk criteria would not be met. However, there is no requirement in the WCAP-14572 Revision 1-NP-A methodology or NRC SER that these multiple pipe size segments need to be split because there are multiple ASME Section XI examinations.
- There is conservatism built into the change-in-risk calculation. It is conservatively assumed that the ASME Section XI examinations address the risk associated with the segment, although in reality they may not. In a multiple pipe size segment with an ASME Section XI examination, it is possible that the ASME Section XI examination is not on the sub-segment with the highest failure probability. Furthermore, it is possible that on a single size segment, the ASME Section XI examination may not occur at the element with the controlling postulated degradation mechanism. In these cases, it is possible that the ASME Section XI examination does not address the majority of the risk associated with the segment. Thus, crediting the ASME Section XI examinations for addressing the risk in a segment results in a conservative evaluation relative to meeting the change-in-risk acceptance criteria.

The NRC staff stated that when evaluating the acceptability of differences between the WOG interpretation and the NRC interpretation of the WCAP, a change of a single exam represents a difference and may not be acceptable. Given this NRC perspective, hypothetical situations can be proposed that make it impossible to prove that there will be no difference in the inspection program. The WOG position is that this approach is placing too much emphasis on a change of a single examination in areas of low failure importance with no active



degradation mechanism. The WOG has no evidence that a relatively small number of these examinations have been considered significant because a formal benchmarking program during the original NRC review of the WCAP-14572 Revision 1-NP-A methodology and other risk-informed ISI methodologies was not conducted to investigate the differences in the resulting actual number of examinations. In addition, for the plants using the WCAP-14572 Revision 1-NP-A methodology that have multiple pipe size segments, the majority of these segments are associated with small bore piping, which is not required in the scope of application of another NRC-approved risk-informed ISI methodology.

The WOG position is that the intent of a risk-informed ISI program is not based on the specific number of examinations to be included in the program, but rather for the program to address the areas of highest risk. The WOG interpretation of these issues addresses this risk and meets the acceptance criteria in WCAP-14572, Revision 1-NP-A.

### Expert Panel Categorization

Another issue is the detail being requested in RAIs associated with the expert panel decisions for moving some piping segments from the category of HSS to LSS. This NRC RAI is associated with the expert panel moving piping segments to LSS when they had one or more calculated Risk Reduction Worth (RRW) values greater than 1.005. For example, one licensee's RAI requested detailed justification, including the identification and characterization of the performance shaping factors that might influence the ability of the operators to accomplish the task. This expert panel issue is addressed on page 20 of the NRC SER which states; "Item 8 (c) of Ref. 8 also states that segments that have been determined to be HSS should not be classified lower without sufficient justification that is documented as part of the program and that the expert panel should be focused primarily on adding piping segments to the higher classification." Page 20 of the NRC SER further states; "The staff finds that in the categorization of pipe segments, the use of an expert panel (as documented in Section 3.6.3 of WCAP-14572) to combine PRA and engineering information (as described in example Tables 3.6-9 and 3.6-12) is acceptable and necessary. In addition, guidance to be added to Section 3.6.3 of WCAP-14572 [Item 8(c), Ref. 8] will ensure consistent application of the expert panel process."

The WOG recognizes that requesting the basis for these expert panel decisions has merit. For expert panel decisions that take credit for operator action, the WOG position is that the following items provide sufficient justification for the expert panel decision:

- operator actions are relatively simple and contained in procedures (actions not contained in procedures require additional justification),
- sufficient indication and instrumentation is available to identify the pressure boundary failure, accounting for other actions being taken by the operator to respond to accident conditions,
- sufficient time is available to perform the action, and
- the ability to perform the action can be done with equipment that is functional.

It is expected that some cases will involve engineering judgment to decide if sufficient indication and time are available to the operator. The WOG position is that the plant expert panel, which includes members with expertise in plant operations and probabilistic risk assessment, contains the necessary expertise to make the appropriate engineering judgment.

For the majority of other situations where the expert panel changes a segment from HSS to LSS, revised values (e.g., failure probabilities, conditional CDF values, etc.) based on the expert panel recommended changes should be included in a revised risk evaluation.

## Impact of Addressing NRC RAIs on Plant Specific Applications

### Plant Specific Example

The impact of the two RAIs on a licensee proposing to implement the WCAP-14572, Revision 1-NP-A methodology has delayed the NRC approval of one submittal by at least 5 months. To obtain an SER on the risk-informed ISI program for implementation in an upcoming outage, the licensee volunteered to add examinations to resolve the NRC RAIs rather than prolong the review process by presenting additional technical justification or waiting for the issues to be resolved generically. The estimated cost for responding to the RAIs to date is more than \$74,000. By adding the additional examinations to the risk-informed ISI program, the licensee has increased the number of examinations by approximately 70, which is at least 60% above the originally proposed program, adding even more cost to the program. Adding these exams provides at most a minimal safety benefit, and will result in additional estimated radiation exposure of 113 rem over the remaining 40 year operating license.

### Impact on Plants Using the WCAP-14572 Revision 1-NP-A Methodology

There are currently five units which have received similar RAIs regarding piping segments with multiple pipe sizes and the expert panel classification of LSS when segments have RRWs greater than 1.005. All plants could be asked these questions as part of their initial submittal or as part of a 10-year risk-informed ISI update. For each unit, a change-in-risk analysis was performed which demonstrated that the risk-informed ISI program submitted for approval was either risk neutral or showed a slight risk reduction versus the current ASME Section XI ISI program. It is expected that at least 12 units have or will implement Class 1 and 2 or full scope risk-informed ISI programs using the WCAP-14572 Revision 1-NP-A methodology. The estimated average dose per examination is 0.2 rem. Assuming a range of 15 to 70 additional examinations per unit, this results in an additional estimated radiation exposure of 35-170 rem over a 10-year inspection interval, with at most a minimal safety benefit for these 12 units.

### Summary

In summary, the WOG position is that the NRC Staff's interpretation on calculating failure probabilities for multiple pipe size segments is delaying plant-specific implementation of risk-informed ISI programs while imposing unnecessary radiation exposure with at most a minimal safety benefit. The estimated additional radiation exposure that could result from these additional examinations is estimated to be 35-170 rem over a 10-year inspection interval for all of the licensees who have or are planning to submit Class 1 and 2 or full scope risk-informed ISI programs using the WCAP-14572 Revision 1-NP-A methodology. The WOG also provides a position on the elements that provide sufficient justification for the expert panel decision when segments are classified as low safety significant after being initially ranked as high safety significant. This position is provided to reduce the level of documentation that has been requested in recent NRC RAIs on this matter.

### References:

1. WCAP-14572 Revision 1-NP-A, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report."
2. Letter from Thomas H. Essig, (NRC) to Lou Liberatori, (Westinghouse Owners Group), Safety Evaluation of Topical Report WCAP-14572, Revision 1, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report," dated December 15, 1998.