JANUARY 23, 2003 NRC MEETING RI-ISI RELIEF REQUEST CLARIFICATION ON THE USE OF SUB-SEGMENTS

Meeting Agenda

Kick-Off and Introductions.....Bud Gerling, Regulatory Affairs Supervisor Palisades Nuclear Plant

Palisades Application of Methodology......Mike Carlson, Programs Engineering Manager Palisades Nuclear Plant

Westinghouse Overview of Methodology......Paul Stevenson, Principal Engineer Westinghouse Electric Company LLC

Palisades Responses to Clarification Request

Summary of Requested Item #1.....Bruce Bishop, Principal Engineer Westinghouse Electric Company LLC

Summary of Requested Item #2.....Dick Haessler, Principal Engineer Westinghouse Electric Company LLC

Summary of Requested Item #3......Mark Cimock, Senior Engineer Palisades Nuclear Plant

Conclusion......Mike Carlson, Programs Engineering Manager Palisades Nuclear Plant

PALISADES RISK-INFORMED INSERVICE INSPECTION PROJECT CHRONOLOGY

- October 1999: Project Kickoff / Expert Panel Scoping Session.
- Development of engineering analyses (EAs) for segment definitions and associated direct and indirect consequences.
- Development of Win-SRRA failure probability analyses.
- Parina fee footbatton Performance of CDF/LERF analyses for all direct and indirect consequences on all segments modeled in the PSA. .
- Performance of risk ranking analysis.
- October 2000: Expert Panel Risk Ranking Meetings for categorization of high safety significant (HSS) and low safety significant (LSS) segments.

Change in (Delta) risk analysis.

- Statistical selection of number of welds to be inspected (Perdue Analysis).
- The is Conse Revision (by Palisades) due to segmentation/consequence changes on select systems. Revisions performed on: o Segmentation/Consequence analysis. o CDF/LERF analysis. o Risk Ranking analysis (Expert Panel reconvened).
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 - o Delta Risk analysis.
 - o Perdue analysis. State of the open the second state of the secon
- Selection of inspection locations and methods by Engineering Sub-Panel.
- March 2002: RI-ISI submittal to the NRC. Submittal to the NMC.
- May 2002: Request for additional information (RAI) issued by NRC.
- August 2002: Palisades response to May RAI.
- September 2002: NRC Audit of Palisades RI-ISI Program.
- October 2002: NRC submits draft of Request for Clarification on the Use of Sub-Segments in the RI-ISI Relief Request
- January 2003: Palisades, Westinghouse, and NRC meeting to discuss open Request for Clarification on pipe segment modeling.

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OVERVIEW OF WESTINGHOUSE OWNERS GROUP APPLICATION OF RISK-INFORMED METHODS TO PIPING INSERVICE INSPECTION (WCAP14572 REVISION 1-NP-A) RELEVANT TO TODAY'S DISCUSSION

a)	The methodology identified in WCAP-14572 is a risk-informed methodology incorporating both quantitative and qualitative (i.e. deterministic) aspects.						
b)	The quantitative portion of the process uses best estimates that in some cases, may be conservative but not overly conservative.						
C)	Segments are defined primarily on the direct consequences associated with a postulated piping failure.						
d)	Failure probabilities are calculated for each segment for use in generating a piping core damage frequency (CDF), large early release frequency (LERF), risk reduction worth (RRW) and other risk metrics to help the back sector and determine the safety significance of each segment.						
e)	All segments determined to be high safety significant by the expert panel receive examination. Volcel advances of matters of waters as a start of the set						
f)	For high safety significant segments, 100% of all welds subjected to an active failure mechanism, or analyzed as being highly susceptible to an active failure mechanism are examined.						
g)	The Perdue model analysis is used only on those welds in high safety significant segments where there is no active failure mechanism and the welds were not analyzed as being highly susceptible to an active failure mechanism. The Perdue Model is not used for socket welds.						
h)	Westinghouse provided training, technical review of Palisades' work, and worked closely with Palisades throughout their RI-ISI program to assure that Palisades correctly applied the methodology in WCAP-14572.						
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Requested Item

1. For the failure probability estimation for segments that were subdivided, please provide the definitions used to identify sub-segments. Also please explain how the failure probability estimates are developed for a segment that has been divided into sub-segments and how your methodology comports with the approved methodology.

Summary of Palisades Response and a data and a set

- a) Sub-segments within a segment are defined based on having the same consequence but having different pipe sizes.
- b) The segment probability is the highest value of the failure probabilities descent and the segments.
- c) Palisades application of the methodology fully comports with the approved methodology for the following reasons:
 - SRRA calculations on the sensitivity of pipe size, including the presence of butt or socket welds, are performed to ensure excessive conservatism does not unrealistically impact the risk categorization of the segment.
 - When multiple degradation mechanisms exist in a sub-segment, limiting input
 values for each mechanism are combined.
 - The failure probability for the segment is characterized as the highest subsegment value, which is the worst-case situation in each segment.
 - The results of the SRRA calculations for sub-segments and segments are reviewed by the engineering team relative to being reasonable and consistent with operating experience.
 - Use of the same four considerations in sub-segment failure probability (configuration, components, materials/chemistry and loads) also insures that excessive conservatism is not applied to the selection of inspection locations.
 - All requirements and guidance on probability estimation by the engineering team with the SRRA tool in the approved WCAP Report, its Supplement and the NRC-SE are fully considered.

Requested Item

2. For the Perdue method application on segments that were subdivided, please provide the definitions used to identify sub-segments. Also please explain how the Perdue input parameters are developed for a segment that has been divided into sub-segments, how the results are used to determine the number of locations for inspection in the segment, and how your methodology comports with the approved methodology.

Summary of Palisades Response

The Perdue Model is used to aid in the determination of the number of inspection locations for segments determined to be high safety significant by the plant RI-ISI expert panel. Palisades segments were divided into sub-segments (or lots) during the Perdue Model evaluation using the following cases:

Case A (a) Perform or application of the central study (eff) coursed by the market and the market of the following respect of

Segment has one pipe size, active failure mechanism postulated – susceptible locations are selected for inspection. Active failure mechanisms are removed from the Perdue Model is used for remaining locations.

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Case B

Segment has more than one pipe size, no active failure mechanism postulated – first approach is to use conservative input parameters and run the Perdue Model on all welds. If the results are too conservative, then subdivide the segment into lots by pipe size, run the Perdue Model on each pipe size, and multiply confidences of each lot to check against the acceptance criteria.

Case C • The coeffs of the SRPA provided use for other or providence of the second sec

Segment has more than one pipe size, active failure mechanism postulated – susceptible locations are selected for inspection. For the remaining locations, active failure mechanisms are removed from the Perdue Model inputs and the first approach is to use conservative input parameters and run the Perdue Model on all remaining welds. If the results are too conservative, then subdivide the segment into lots by pipe size, run the Perdue Model on each pipe size, and multiply confidences of each lot to check against the acceptance criteria.

The above cases used in the Palisades RI-ISI program are consistent with the methodology described in WCAP-14572, Section 3.7.

Requested Item

3. If you were to apply the failure probability estimation and the Perdue methodology to the entire segment for all segments, as opposed to subsegments, how would the total number of inspections required in the RI-ISI program change?

Summary of Palisades Response

The total number of inspections would not change.

Program specific data was evaluated to address this request. There are 193 segments that contain multiple pipe diameters and have some variation in the SRRA input parameters. All of the segments with SRRA input parameters that vary fall into one of three categories:

Only variation in inputs are pipe size and wall thickness
 (119 segments)
 Shopped are place size, address for large position of the formation of the

The only variations in the inputs are those associated with the actual physical makeup of the pipe. All other SRRA inputs are the same for each sub-segment.

2. Variations are all related to pipe and weld geometries (65 segments) (65 segments) (65 segments)

The more limiting inputs were consistently applied to the small-bore socket-welded sections of these segments. Numerous examples show that reevaluating the large bore sections of the pipe with the most limiting inputs would raise the failure probabilities for those sub-segments. However, in each example, the original limiting failure probability (for the small bore piping) associated with the segment remained the highest value and would still be chosen to represent the segment. Based on the evidence from the examples, applying the failure probability estimates to the entire segment as opposed to sub-segments for those in this category would not increase the number of inspections.

3. Variations are based on engineering judgment regarding potential degradation mechanisms (nine segments)

The justification for the variation in the inputs for these segments is sound and well documented. The decisions for the inputs were based on known and studied conditions specific to each section of the pipe. Additionally, because the segments in this category are low safety significant (LSS) and the most conservative failure probabilities of the sub-segments were used, had the segments in this category been split, the new segments would have also been LSS and there would have been no change to the number of inspections.

ENCLOSURE

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REQUEST FOR CLARIFICATION ON THE USE OF SUB-SEGMENTS IN THE RISK-INFORMED INSERVICE INSPECTION RELIEF REQUEST PALISADES NUCLEAR PLANT 45-DAY RESPONSE

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Introduction

During a September 12-13, 2002, site audit of the risk-informed documentation to support your inservice inspection relief request, we noted that humerous segments were divided into sub-segments, failure probability estimates were developed for one or more of the sub-segments, and the failure probability estimates of one of the sub-segments was used for the entire segment. Page 71 of the WCAP states the following.

"The failure probability of a segment is characterized by the failure potential (probability or frequency as appropriate) of the worst case situation in each segment (not a selected weld in each segment). This is calculated by the SRRA code by inputting the conditions (typically, the most limiting or bounding) for the entire piping segment. Essentially, the piping failure probability is a representation or characterization of the piping segment."

Our understanding is that your methodology applies this guidance to individual sub-segments but not to the entire segment and therefore deviates from the approved methodology.

There was also some discussion of your application of the Perdue methodology. We were informed that the Perdue methodology is also applied independently to individual sub-segments. Pages 170 and 171 of the WCAP discuss application of the Perdue methodology. The relevant text is provided below.

"Segment #: This is the name for the lot from which a sample of structural elements (such welds, pipe elbows, branch connections, etc.) is to be taken. Generally, each piping segment is defined as a lot. However, segments that are similar (e.g., all the cold legs on each reactor coolant loop with the same postulated failure mechanism) may be combined to define a lot.

<u>Number of Welds or Elements:</u> This is the number of structural elements in the lot.

<u>Probability of a Flaw (@specified year/weld):</u> The probability of an unacceptable flaw in the segment's 'most likely to fail' weld (or typical weld, if they are viewed as clones) at the current age of the weld (usually the current age of the plant unless the pipe has been repaired or replaced). An unacceptable flaw is defined by the ASME Section XI Code. This has been defined as a/t > 0.10 and is obtained from the probabilistic fracture mechanics code (e.g., SRRA)."

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Our understanding is that your methodology applies this guidance to individual sub-segments but not to the entire segment and therefore deviates from the (2) State (1) - grade and (2) (2007) (2) and state (2007) (2) - state (2) and (2) - state (2) approved methodology

At the exit meeting of the audit, we noted that supplemental information regarding the use of sub-segments will be needed to complete the review of the relief request. We therefore request the following information.

Requested Item

For the failure probability estimation for segments that were subdivided, please provide the definitions used to identify sub-segments. Also please 1. explain how the failure probability estimates are developed for a segment that has been divided into sub-segments and how your methodology and the party to party to party to be a segment of the second comports with the approved methodology." The methodology of the state of the second se jaj arg eQg istat."

Response

Contractions of the state of the second second second states and second s Failure consequences were used as the primary factor to initially divide segments (1996) the observation of the into sub-segments. This method led to some individual piping segments consisting of piping with a variety of pipe diameters. For example: a four-inch diameter pipe with a two-inch diameter branch line may be part of the same optimation of the Constant was the action of piping segment if a failure at any portion of the segment would result in the same is also and the second consequences. For multiple pipe size segments, sub-segments were defined by a data of the second participation of the pipe size for the failure probability analysis: howardlogy. The states of the argument of the object

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The failure probability estimates were developed for a segment that has been build to a build to another of a contract of a cont divided into sub-segments using the Westinghouse Structural Reliability And Risk for segmentation of the second Assessment Model (Win-SRRA). Some of the input parameters used by the other detailed and the the restored Win-SRRA code vary if the diameter of the pipe varies (eighnominal pipe size, and has an each memory of the thickness to outer diameter ratio). Failure probability estimates for segments (as forman) approximates the other made up of multiple pipe sizes were determined by performing multiple Win-SRRA cases. In instances with multiple cases, resulting in multiple failure probability estimates, the highest failure probability associated with the segment of the bar of successed was then used to represent the segment. The segment of the segment

For each case, the Win-SRRA code required 18 input parameters associated 2019/02 The prove bills of act with the piping. For segments with multiple pipe sizes, some of the input is must do not full work from a parameters varied from case to case even though they represented the same first event agree in the same first event of the sam segment. Different pipe diameters required different inputs for a number of the place has being adverted or parameters. Other inputs also varied based on expert engineering judgment. A Data and a standard to the to the standard to the Palisades subject matter experts in in-service inspection (ISI), non-destructive table of induced in the product of the service of the servic examination (NDE), materials, and pipe stress analysis worked together to develop the input parameters for each Win-SRRA code case run. Therefore,

each case represented a sub-segment and was evaluated for the expected conditions for the sub-segment. Sub-regime and a second sub-

Following the Westinghouse Owners Group WCAP-14572, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice the state of the second se Inspection Topical Report," Revision 1-NP-A and WCAP-14572, Supplement 1, "Westinghouse Structural Reliability and Risk Assessment (SRRA) Model for Piping Risk-Informed Inservice Inspection," Revision 1-NP-A (referred to as "WCAP-14572" for the remainder of this document) methodology, the group developed limiting inputs for evaluation of each segment or sub-segment. Input Constant Barren State States parameters varied for separate portions of the same segment for one of two reasons. One reason was that many segments contained multiple weld as a set of the second of the second sec geometries (both butt and socket-welds). In these segments specific geometries we are set to a local the second were reviewed. Different parameters to accurately model the geometry were to address the second and address input. Basic design practice would also suggest using more limiting inputs for dead weight and thermal stress, and design limiting stress for small bore (socket-welded) piping, where spacing tables were utilized in the routing design versus actual analysis results. The other reason was that input parameters for sub-segments varied slightly based on engineering judgment. For these cases which we which we want which the inputs were developed by plant subject matter experts and were based on consideration and the subject matter observed and recorded conditions. The basis for each judgment is documented when the state for the state in the Palisades Win-SRRA engineering analyses.) Though the input parameters of man as the second second second for different cases of the same segment may vary, the parameters that were the segment leaded inset to the series chosen for each case were the most limiting for that section of the plping benefits sub-nase parts were defined by 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. For segments with multiple line sizes, multiple failure lowelness for a segment of the base probabilities were determined. In every case the most limiting (highest) failure was shown in the and the and the probability associated with the segment was used to represent the segment. And provide the used by the Vin-SPRA code very if the discrete report of the plan verses (e.g. and and plan verses (e.g. and and plan verses). As shown in figure 3.5-1 and the accompanying text in the approved a two objects black stimules for abgreaned WCAP-14572, failure probability estimation is the responsibility of the Company perfective of the engineering team based upon their knowledge of the pertinent information at the storage during the additional and

their plant and any potential concerns identified in industry experience at other day as a claim, whether a graded plants. For example, recent PWR plants have evaluated the increased potential for stress corrosion cracking at the reactor vessel outlet nozzle weld based upon

the leak at V. C. Summer. The SRRA tool is used to quantify the effects of the black matagement and approximate engineering team's input on the calculated leak and break probabilities. We define a second state of the we parameters includ from coord to wave even in Juga they sepret in the terms

The second concern of the summary and conclusions of the Nuclear Regulatory search be sto for excel as of the Commission (NRC) safety evaluation (SE) (Section A.25 on page A-21) for the section and the section of the sect SRRA tool (supplement 1 to the approved WCAP-14572) endorses this position to be able (450 - an endorseive) via the following: teretar.

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"The results of SRRA calculations should always be reviewed to ensure that they are reasonable and consistent with plant operating experience. Data from plant operation should be used to review and refine inputs to calculations."

Nuclear Management Company's (NMC's) application of the methodology, taking the limiting SRRA probabilities from the sub-segments of different sizes in a segment, comports with the NRC approved methodology.

The fifth concern in the previously cited section of the NRC SE recommends:

"The simplified nature of the SRRA code has resulted in a number of the state of the state of the second state of the stat

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NMC's application of the methodology on how the degradation mechanisms in discusses. For these expect the different sized sub-segments are to be "combined" fully comports with the projects are to be "combined" fully comports with the projects are to be to be approved methodology as stated in the last paragraph of Section 3.2.3, "Pipings of bedgeers to dub a point and Failure Potential", of the NRC SE and in Section 3.2, "Simplified and Detailed. Thus are to be input," in the WCAP-14572 Supplement for SRRA: a state prove the methodology of the properties are to be approved be approved by the properties are to be approved by the properties and the properties are to be approved by the properties and the properties are to be approved by the prop

"If more than one degradation mechanism is present in a given piping as associated with and adjusted segment, then the limiting input values for each mechanism should be at highly associated with and adjusted for each mechanism should be at highly associated with a sector as the sector combined so that a limiting failure probability is calculated for risk ranking."

As indicated on page 84 in Section 3.5.6, "Failure: Probability Determination", of a spessort the angle of the approved WCAP-14572, combining degradation mechanisms does not imply

adding the failure probabilities for each mechanism. Typically, one degradation: to the sequenced mechanism will dominate the failure probability in the segment by several orders probability of has of magnitude. However, because of uncertainties, the engineering team may not confluent information at the know which of the potential degradation mechanisms will dominate respectively of the segments of different nominal pipe size in the segment. Multiple hailed the boreases to consider the nominal pipe sizes in a single segment arise due to the establishment of initial potential degradation segment boundaries based on consequence considerations as detailed on and to qualify the class of the page 57 of the approved WCAP-14572. An appropriate tool must be used to be approved boundaries defined the potential degradation mechanisms to

determine the dominant mechanism for the segment. As noted, the SBRA tool point the backet and be determined in the calculation of failure probability estimates at Palisades. (As the backet of the b

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- 1. degradation mechanisms.
- 2. pre-service construction and inspection history and practice.
- 3. and physical routing and configuration.

Table 3.5-1 of the WCAP-14572 and the WCAP-14572 supplement provide guidelines for items to consider. In section 3.5.4, the estimated failure probability is identified as being dependent on and significantly influenced by the following four items: configuration, components, materials/chemistry and loads.

A degradation mechanism's affect may vary based on the different physical configurations of the weld(s). Socket-welds are particularly noted as having low resistance to sustained vibration. It is also noted in this section that interactions among the factors are common. Distinction is made in the discussion between and and common descent component dependent failure modes, which are generally noted as localized within a segment and materials dependent or operational dependent to define the second state of the second mechanisms, which may be present throughout the entire segment. This directly as a selected on the supports the opening paragraphs of section 3.5 of the WCAP-14572, which identified that:

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HEAR Expedition of the mainted way and the differentiation management in "The failure probability of a segment is characterized by the failure company of the paper to some the potential (probability or frequency as appropriate) of the worst case a contract of Geodesia and situation in each segment (not a single selected weld in each segment).* 2 100 applied one thus had Theory, In the MC UP-04672 Supplement for BPC

Consider the following two hypothetical examples based on typical situations experienced by plant engineering teams for SRRA input: presention in present in a given public cogment, then the limiting loput volume for each machanism ender one

Example 1: Significant Differences in Pipe Sizes and Potential and is concluded for astronomy

Degradation Mechanisms Disatificated on page 34 in Section 0.5.6, (Paliture Probability Determinance), of the sector of the se In this example segment for high temperature and pressure piping, a lating mean address was and and six-inch sub-segment extends some distance from a check valve to a tee; Typiconty, one constraints where the flow is split into two, three-inch sub-segments that each extended share on the second orders to a pump. Because of a concern for water hammer that has occurred in the engineering Contenes not this system at other plants, a one-inch sub-segment was added at the number of connects, concerning it high-points (near each pump) of the three-inch piping to periodically ventice in the segment, whends the system. If the check valve leaked, then the weld in the six-inchange of the ostablishmetry of will all sub-segment closest to the valve could experience thermal stratification aderadous as downed on Although there is no evidence that the check valve is leaking, it has the protocol must be aved to happened in similar plants so a high fatigue stress range and number of debrar activation of cycles for stratification is selected by the team for the simplified SRRA state as acted, the SheAcool input. Because of the geometric layout of the piping, a weld in the day or timates at Paused as the three-inch portion would see the highest water-hammer loading, which the data factors rousi be team estimated only had a one-percent chance of occurring due to the corrective actions that had already been implemented. Another weld in the same size piping also had a pre-service inspection indication that was

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small enough that a repair was not required per the American Society of Mechanical Engineers (ASME) code. Because some imbalance of the pump was observed after the one-inch vent was installed, there is a concern for the potential effects of vibration in the three-inch pipe welds, but particularly in the one-inch pipe socket-welds nearest to the pumps. All the piping in the segment is subject to fatigue loading due to normal heat-up and cool-down and periodic pump testing. The consequence is loss of inventory and the system disabling leak rate has been conservatively assumed to be two gallons per minute (gpm) for all three pipe sizes in the segment.

The assumed SRRA large-leak probabilities after 40 years are as follows (the numbers given in this example are approximations based on expert engineering judgement):

- a) 3.3E-05 for the six-inch pipe with thermal stratification, because the constraint and a daught
- b) 1.5E-05 for the three-inch pipe with one-flaw, vibration (input second second
- c) 5.0E-04 for one-inch pipe with vibration (correction factor of persuited by the following one), potential (precidity or from one), of the new correction as expression of the new correction of the
- d) 4.0E-02 for one-inch pipe with thermal stratification, one-flaw, as the follow of the second of a vibration and a one-percent chance of a severe water harmer.

Catalog the folio and two hyperstinal exempts based on typical elements The SRRA probability of 5.0E-04 should be selected by the engineering hout team for risk ranking because the probability of option d) is unduly conservative relative to plant and industry experience. The SRRA inputs States and the statistic for option d) would also be unrealistic relative to assuming the same six-inch stratification loading near the check valve in the one-inch line far away from the valve and the worst three-inch water hammer loading in a serie produce of sign o one-inch branch line.

withtrashartion is split into two diversions sub-engineets that one or rand <u>Example 2: Small Differences in Pipe Sizes and Potential</u> for water has see that has seemed to <u>Degradation Mechanisms</u> his specific of other plants, a consist or sub-engineet was defended by:

bic backar over a data pump) of the line shack pilling to perform threat In this example segment for moderate temperature and pressure, three thread in the share of different pipe sizes are also used (nominal pipe size of one, one and a half do the read of the share and two-inch). All the piping in the segment is subject to fatigue loading ways to the temperature dedue to normal heat-up and cool-down and relatively high seismic (SSE) alloss long and the set of loading for the design-limiting event. The consequence is loss of the team or the direction of the test system function and disabling leak rate has been conservatively assumed using the set of to be ten-percent of the flow through the largest of the three pipe sizes in the address to the the segment.

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The assumed SRRA large-leak probabilities after 40 years are as follows (the numbers given in this example are approximations based on expert engineering judgement):

- a) 8.9E-05 for the two-inch pipe with its fatigue and SSE loading,
- b) 1.2E-06 for the one-and-a-half inch pipe with its fatigue and SSE loading,
- c) 7.5E-07 for one-inch pipe with its fatigue and SSE loading,
- d) 9.1E-05 for the two-inch pipe with the highest fatigue and highest SSE loading independent of pipe size.

The SRRA probability of 9.1E-05 could be selected by the engineering team for risk ranking because the probability of option d) is not overly conservative relative to plant and industry experience and the SRRA input would still be realistic relative to the uncertainties in the actual loading for the different pipe sizes (i.e. the difference between the SRRA calculated probability values of 8.9E-05 and 9.1E-05 is not statistically significant).

It is NMC's position that assessing the unique input parameters based on the configuration, components, materials/chemistry, and loads by distinct quantification of all of the potential degradation in regards to localized and generalized degradation mechanisms in the entire segment fully comports with the SE requirement to:

"...ensure that excessive conservatism does not unrealistically impact the categorization and selection of piping locations to be inspected"

The consistency in the items used in determining the critical location or locations for inspection is supported by the requirement in WCAP-14572 Section 3.7.3. This section identifies that the selection of inspection location be based on the postulated failure mechanisms and the loading conditions for the piping segment considering the same four items as in the determination of piping failure, namely: configuration, components, materials/chemistry and loads.

Furthermore, the inspection is not limited to a single degradation mechanism but must consider all possible mechanisms contributing to the potential pipe failure of previous and recommendates for a given segment at the most likely location of occurrence. The definition and previous and an and for a given segment at the most likely location of occurrence.

It is NMC's conclusion that the process followed in sub-dividing consequence defined segments fully supports the directive to apply all possible degradation mechanisms at a single weld and ensure that there is no excessive conservatism on the piping categorization or selection of inspection location.

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Requested Item

2. For the Perdue method application on segments that were subdivided, please provide the definitions used to identify sub-segments. Also please explain how the Perdue input parameters are developed for a segment that has been divided into sub-segments, how the results are used to determine the number of locations for inspection in the segment, and how your methodology comports with the approved methodology.

Response

The Perdue Model is used to aid in the determination of the number of inspection locations for segments determined to be high safety significant by the plant risk-informed inservice inspection (RI-ISI) expert panel. Segments were divided into sub-segments (or lots) during the Perdue Model evaluation using the following cases:

 (a) GARENARY constraints of the process of the base of the second se second sec

For this case, the piping in the segment is the same nominal diameter. One lot consists of the welds/locations susceptible to the degradation mechanism (Region 1A). Each susceptible location is included in the inspection program if it is not already part of an augmented inspection program. Welds/locations, which are included in an augmented program, remain in that program and are inspected in accordance with that program. The other lot consists of the remainder of the welds in the segment (Region 1B). These are evaluated with the Perdue Model based on SRRA parameters, which exclude the active degradation mechanism. The total number of inspections for the segment is the sum of the susceptible locations plus the number of inspections required to achieve a 95% confidence using the Perdue Model (a minimum of one location is specified even if the Perdue Model shows 100% confidence with no ISI). This comports with the description of segments in Region 1 on page 168

of WCAP-14572. Terconextores the tesperation is mail base to a blogle stuge and no mechanicant automation of wCAP-14572.

Case B: There is no identified active degradation mechanism and the second segment has been placed in Region 2 of WCAP-14572 Figure 3.7-1.

For this case, there are multiple pipe sizes in the segment. The Perdue transposition degree of Model inputs are specific to the pipe material and size. The first approach an approach as a specific to the pipe material and size, the first approach as a possible degree of the segment as the total or total or

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be achieved, then each pipe size is analyzed separately with the appropriate number of welds and the appropriate SRRA results. This divides the segment into lots according to pipe size. The confidence values of each lot are multiplied together to get the confidence for the segment. The resulting confidence level must be greater than or equal to 95% for the Perdue Model evaluation to be acceptable. The total number والمراجع والمعاقر والمراجع والمراجع والمراجع of inspections for the segment is the number of inspections required to achieve a 95% confidence using the Perdue Model. A minimum of one location is specified even if the Perdue Model shows 100% confidence. with no ISI. This comports with the description of segments in Region 2 on page 168 of WCAP-14572 and with the description of dividing a segment into multiple lots on pages 174 and 175. Before a state of the difference of the second and the second

Case C: There is an active degradation mechanism and the segment has been placed in Region 1 of WCAP-14572 Figure 3.7-1. a dhu kh kỳ trê 2048

For this case, there are multiple pipe sizes in the segment. One lot consists of the welds/locations susceptible to the degradation mechanism decision and the second sec (Region 1A). Each susceptible location is included in the inspection dealed and the program if it is not already part of an augmented inspection program. Welds/locations, which are included in an augmented program, remain in 2000 and the second second that program and are inspected in accordance with that program. For the state of the state of the state Perdue Model evaluation of the non-susceptible welds/locations approximate the sub-state base (Region 1B), the steps followed are the same as in Case B above. The first approach is to combine the most limiting inputs from each pipe size a sector at the another accesses. after removing the active degradation mechanism, use the total number of 2000 and 2000 and 2000 and welds minus the number of susceptible welds, and analyze the segment as one lot. If this is too conservative, then each pipe size is analyzed and the Dath o wood based separately with the appropriate number of welds and the appropriate of the depropriate methods and the appropriate methods are the second s SRRA results. The confidence values of each lot are multiplied together multiplied together to get the confidence for the segment. The resulting confidence level and added to the second a must be greater than or equal to 95% for the Perdue Model evaluation to the amount of the approximates be acceptable. The total number of inspections for the segment is the second because with accord. sum of the susceptible locations plus the number of inspections required to a Pagina and angle and to achieve a 95% confidence using the Perdue Model (a minimum of one location is specified even if the Perdue Model shows 100% confidence with no ISI). This comports with the description of segments in Region 1 and a deduction of the on page 168 of WCAP-14572 and with the description of dividing a state of the state of the segment into multiple lots on pages 174 and 175.

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For the case, there are multiple pipe strawing one sugniserie. The Forence Individual Perdue Model inputs are specific to the pipe material and size and size and size and the second Therefore, segments with multiple sizes must be evaluated in one of the three states and the and the second states ways discussed. In all three approaches the method for evaluating segments with the Perdue Model fully comports with the approved methodology.

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Requested Item

a maradalar. A filosofic a presidente a programa de la composición de la composición de la composición de la c La menetra presidente de la composición If you were to apply the failure probability estimation and the Perdue 3. methodology to the entire segment for all segments, as opposed to sub-segments, how would the total number of inspections required in the RIe total number of inspections required in the HI-ISI program change?

Response

and the second second NMC and Westinghouse are in concurrence that the approved WCAP-14572 . . î methodology in application of failure probabilities and in the application of the Perdue methodology to piping segments was followed by Palisades. Both 1997 parties agree that the responses prepared for the first two questions support and Reis Rolling and a line for an and a sub-state state of a clarify this position.

Program specific data were evaluated to approximate how the number of inspections would change if failure probability estimates for sub-segments were a sub-segment were a sub-seg evaluated with the most limiting Win-SRRA inputs for all portions of the segment. Concert Non-Carbon Sector There are 193 segments that consist of multiple pipe diameters boardoo is manufaction is the discrete sole and have some variation in the input parameters. All of the segments with input has added to be added parameters that vary fall into one of three categories on and fadaded in an approximation program concerns the programmed as formed an even-same with the program. For the

- Only variation in inputs are pipe size and wall thickness user or and wall thickness user or and the second source of the second source 1. Woylon 12, the stops followed are the cases to the Cesh Sinhere. Whe (119 segments)
- Variations are all related to pipe and weld geometries at the time incuts from accompany elem 2. al er retricklag fra active degredekon mechadens des helfetninnstor og (65 segments)
- Variations are based on engineering judgment regarding potential and an area area and and an area area. 3. degradation mechanisms (nine segments) conservative, nine or the developments expension with the appropriate number of which and the contocritica

For segments in the first category, the only variations in the inputs are those that are the set of the tage set associated with differences in the actual physical makeup of the pipe (nominals dence to be pipe size and thickness to outer diameter ratio). There are 18 input parameters who allow a second as a second sec for each Win-SRRA case run. For these segments, the other 16 input succession for the segment is the parameters were the same for all pipe size failure probability estimations. The Parameters were the same for all pipe size failure probability estimations. limiting case for each of the 119 segments in this category is the absolute limiting delige managements in this category is the absolute limiting delige managements in this category is the absolute limiting delige managements in this category is the absolute limiting delige managements in this category is the absolute limiting delige managements in the absolute limiting delige managements in the absolute limiting delige case for the segment, therefore, there would be no change to the number of a different sector. inspections. The Perdue Model was applied to the high safety significant (HSS) of pagmonds in Region a segments as described in the response to question 2; except in cases where it appendent of the date a was not applicable such as socket-welded piping. Thus, for this category, there would have been no changes to the number of inspections.

Relividur I revolue At dolllopette ava specific to the upermetured and erac. There are 65 segments in category two, All 65 segments include both small bore include of the one of the include (socket-weld) and large bore (butt-weld) piping." All had variations in the stand ibs contracting contraction Win-SRRA inputs due to pipe size differences or weld geometry differences. The analysis of the second states and the second small-bore socket welded piping consistently had more limiting Win-SRRA inputs

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for DW/Thermal Stress and Design Limiting Stress. A sample of four of the segments was reevaluated to run the Win-SRRA code on the larger bore piping with the more limiting inputs associated with the small bore portions of the segments. The fallure probability for the large bore piping did increase in every case. However, the original failure estimates generated for the small bore piping were still the highest overall in each of the four segments. The failure probabilities used to represent the segments in this category represent the most limiting inputs associated with those segments. Examples have shown that applying failure estimates for the entire segments as opposed to sub-segments for segments in this category would not have changed the number of inspections. As identified on page 178 of WCAP-14572, Revision 1-NP-A, the Perdue Model should not be used for socket-welded piping. For the HSS segments in this are the backet of the category, at least a portion of the piping is socket-welded. The SRRA runs day and stand a second second second associated with the socket-welded piping should not be used for the Perdue Model inputs. For the portions of the segments in this category that are not socket-welded, the SRRA runs representing the non-socket-welded portions of provide and the second the segment were used to determine the number of inspections. In determining the particulation of the the number of inspections using the Perdue Model, it would be inappropriate to the obtained of the error among use inputs for the socket-welded piping. Thus the appropriate inputs were used in the appropriate inputs were used in the socket-welded piping. for the Perdue Model for the segments in this category and, therefore, there a land an endow solution, justit would be no change to the number of inspections. Into an a bit here extended as

For segments in the third category, an evaluation using the most limitingsize and well that deces. Win-SRRA inputs was not performed. The decisions for the inputs that were used were based on known and studied conditions specific to each section of the <u>permetrics</u> pipe. A number of the segments in this category had variations in the flow accelerated corrosion (FAC) inputs for different sub-segments of the same g judgement regarder g perturbation segment. The inputs selected for FAC for each of the sub-segments are inputs; accordance with the rankings developed in the Palisades FAC Program for that portion of the system piping. The failure estimates generated for the cases are in the inputs are those realistic and reflect known conditions in the piping. In this and similar cases where of the piper perturbation there is actual plant specific data that was used to develop the Win-SRBA inputs, are 18 logont perameters for accelean SRPA page run. For these segments, the other 18 logont

Additionally, all nine segments in the third category ended up as low safety, probability activations. The significant (LSS). If the segments had been divided up and evaluated as is pathoday is the subclute inciding individual segments, none of the additional segments would have ended up HSS age to the purchase of The inputs associated with each sub-segment were limiting for that section of the category eightio-ad (e958) pipe. The most limiting failure probabilities were then used to represent the old, except in cases where it segment. If the segments were split, the failure probabilities would be the same stort this category, there or lower than the failure probabilities used for the nine segments and the risk actions, reduction worth (RRW) for the sub-segments would be the same or lower than

the RRW for the nine segments. Since the nine segments were categorized as real order to be a creative LSS, it is reasonable to assume that the sub-segments would also be made LSS. Screetings we doe Because the segments are LSS there are no inspections required as part of the sub-segments. The RI-ISI program. Thus there would be no change in the number of inspections for according with CHERAL sub-

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these nine segments. For each of the three categories of segments with multiple sizes, there is no change to the number of inspections. NMC would expect no changes to the number of inspections.

The following attachment provides additional information to further clarify and a response 3.

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For vegetants in the third order; cy, an statution using the most insting will STRV input the not potention. The decisions the heat was used there based on input and producted boundaries specified with realize of the pipe. A number of the segment on this caregory had the allow is the deviation landed correction (FAC) is just for different sub-significant of the same organisht. It is inputs start to for HAC for each of the sub-cagnues is and in second and with the realities deviced in the Fallences FAC here a context posted of the system piping. The tailur cost and generals of for the cares are usile to and relice the conditions in the piping. The tailer can be and for the cares are usiler and relice the conditions in the piping. To set and show one and show one of the system to be a classified to be an at was used to device the Winker Pict inputs.

Level charly, all also segments in the third catagory or tied up to have dely experimentation. If the segments had been divided up and evaluation as habitible segments none of the additional segments could us to anoth up it is a The lepide according with each sub-segment were the long for the because of the pipe. The prest if the probabilities were the long for the because of the pipe. The prest if the probabilities were the long for the because of the pipe. The prest if the probabilities were the long for the because the argument. If the regressive spatiality as a solution probabilities would be a second on the argument. If the regressive spatialities used for the nine or environments of the technic or the probabilities used for the nine or environments and the terms at the prime differe probabilities used for the nine or environments and the terms to DP V for the date segments. Since the nine of the second of the test of the next test of the states to be proved by the date of the test of the rescale to a sum a tractice subsection required as to be the set of press result of the state to be proved for the test of program. Thus there is could be no or the proved rest for the set of proved rest to be proved for the prime or the test of program. Thus there is could be no or the prime or the proved rest for the set of proved rest to be the set of the proved rest for the next of the prime of the prime test of the proved rest for the prime of the prime of the prime test of the proved rest for the set of the proved rest for the prime of the prime of the prime test of the proved rest for the set of the proved rest for the set of the proved rest for the proved rest for the prime of the prime test of the proved rest for the proved rest test of the proved rest for the proved rest test of the pr

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NUCLEAR MANAGEMENT COMPANY, LLC PALISADES NUCLEAR PLANT DOCKET 50-255

ADDITIONAL INFORMATION TO FURTHER CLARIFY RESPONSE 3

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Palisades risk-informed inservice inspection (RI-ISI) program divided the plant piping systems into 799 segments. To determine failure probability estimates, the Westinghouse Structural Reliability And Risk Assessment Model (Win-SRRA) code was used. Since some of the input parameters for the code reflect the physical characteristics of the pipe (e.g. nominal pipe size), each segment that was made up of more than one pipe diameter required more than one set of Win-SRRA input parameters. There are 193 segments that contain multiple pipe diameters and thus have some variation in the input parameters. All of the segments with inputs parameters that vary fall into one of three categories:

- 4. Only variation in inputs are pipe size and wall thickness (119 segments)
- 5. Variations are all related to pipe and weld geometries (65 segments)
- 6. Variations are based on engineering judgment regarding potential.

CATEGORY 1

Table 3.1 shows the Win-SRRA input parameters for a segment in category one. The only parameters listed in the table are those with different inputs for the subsegments. Inputs not listed in the table are identical for both sub-segments.

Table 3.1 Category 1 Segment CSW-004

Win-SRRA Input			Reason For Input Variation	
Parameters	16-inch	24-inch :		
Nominal Pipe Size (inches)	16	24	Physical characteristic of pipe	
Thickness to O.D. Ratio (inches)	0.023	0.016	Physical characteristic of pipe	

Table 3.2 shows the results of the Win-SRRA runs generated for the two sub-segments (one twenty-four-inch and one sixteen-inch) that make up CSW-004. Small leak probabilities are provided because they are used for comparison with experience while large leak probabilities are provided because they are used for risk ranking.

Table 3.2 Segment CSW-004 SRRA Results

Win-SRRA Case Results	Failure Probability		
	Without ISI	With ISI	
CSW-004 (16-inch) small leak	4.40E-3	1.86E-4	
CSW-004 (16-inch) large leak	4.40E-3	1.86E-4	
CSW-004 (24-inch) small leak	4.20E-3	1.07E-4	
CSW-004 (24-inch) large leak	4.20E-3	1.07E-4	

In the above example, the differences in the inputs to develop failure estimates are all specifically related to the physical makeup of the piping. The other 16 input parameters for the segment were the same for both pipe size failure

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probability estimations. Applying failure estimates for the entire segments as opposed to sub-segments for segments in this category would not have changed the number of inspections. an strande ordan -

CATEGORY 2

anna an stair an stàirtean an stài An 1912 - Martin Stàirtean an Stài Table 3.3 lists the Win-SRRA input parameters for a segment from category 2. The only parameters listed in the table are those with different inputs for the sub-segments. For these cases, all the variations in the inputs are due to pipe size differences or weld geometry differences. A. California for an inclusion of planets, and the control of the co

Win-SRRA Input	States Pipe	Sizes Charles	Reason For Input Variation	
Parameters	Sec 2-inch	4-inch		
Nominal Pipe Size (inches)	2	4	Nominal Pipe Size	
Thickness to O.D. Ratio	0.092	0.075	Thickness to O.D. Ratio	操作性的 化试算机 法
(inches)		C.20	n de la completa de l	
Design Limiting Stress	0.26	0.1	Medium (0.26) value recommended for	
	~ . 	And the second	small bore piping.	

perdensi in the second s

Table 3.4 below shows the results of the Win-SRRA runs generated for the two sub-segments (one two-inch and one four-inch) that make up BLD-009. The Budhalana Bulatu Puntan Jaha table also shows the results of the four-inch portion of the segment evaluated with the most limiting dead weight (DW), thermal stress and design limiting stress Table 3.4 Crisgory 1 Degrade - GGVI-994 Table 3.4 Crisgory 1 Degrade - GGVI-994 inputs.

Table 3.4 Segment BI D-009 SBRA Results

Win-SRRA Case Results	Fallure P	robability	
	Without ISI	With ISI Com	
BLD-009 (2-inch) small leak	1.50E-4	5.55E-7	
BLD-009 (2-inch) large leak	5.63E-5	5.38E-5	-
BLD-009 (4-inch) small leak	- 3.28E-5	3.51E-7	134
BLD-009 (4-inch) large leak	2.67E-7	1.71E-9	
The results below are revised. Th Limiting Stress were increased to	match the inputs for the	2-inch case.	101
BLD-009R (4-inch) small leak	3.28E-5	3.51E-7	b la s
BLD-009R (4-inch) large leak	5.36E-5	5.26 E-5	

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The example from category two (Table 3.3) is a segment that consists of two
different pipe diameters. The four-inch diameter piping consists of all butt-welds.
The two inch piping in the segment is small bore piping and all welds associated
with it are socket-welds. Due to differences in the specific geometries between 1984
socket-welds and butt-welds, more limiting inputs for DW, thermal stress and
design limiting stress were recommended for the small bore piping.

The results of applying the most limiting Win-SRRA inputs to each pipe size in the processory with the applying the most limiting win-SRRA inputs to each pipe size in the processory with the applying the most limiting win-SRRA inputs to each pipe size in the processory with the process the segment have no impact for this segment. The most limiting inputs were the second approximation of the second se applied to the small bore piping originally. Applying the same, higher values for or both and provide the states DW, thermal stress and design limiting stress to the large bore piping does

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increase the large leak failure probability for that portion of the segment. However, the original failure probabilities associated with the two-inch section are still the highest overall, and would be selected to represent the segment.

There are 65 segments that fit into category two. All 65 segments include both small bore (socket-weld) and large bore (butt-weld) piping. The more limiting Win-SRRA inputs were consistently applied to the small bore piping. A sample of four of the segments were reevaluated to run the Win-SRRA code on the larger bore piping with the more limiting inputs associated with the small bore portions of the segments. The failure probability for the large bore piping did increase in every case. However, the original failure estimates generated for the small bore every case. However, the original failure estimates generates to an application of the four segments. Additional piping were still the highest overall in each of the four segments. Additional examples from this category are included below.

Example 1: Category 2 Segment CBA-001

Design Limiting Stress		6.5 FC 0.1 : T1:2 T	Medium (0.26) value recommended for small bore piping.	은 \$200년에 1일은 것이라는 1997년 1997년 - 1999년 1월 1일은 1997년
Dead Weight & Thermal Stress Level		한 남자 일하고 말	small bore piping.	and the state the
Thickness to O.D. Ratio (inches)	0.101	0.027		n graffer ann an tha an tha an th
Nominal Pipe Size (inches)	1	4	Physical characteristic of pipe	n - San
			Reason For Input Variation	azat inter mislami are in

Win-SRRA Case Results	Fe State Fe	Ilure Probab	lity	(CHINA)	
	Without ISI	Cheford Street	With ISI	nt stratig	
CBA-001 (1-inch) large leak	2.52E-3	strie i en	2.74E-5	নির্বাচ্চ নির্ভাগন	1.F
CBA-001 (4-inch) large leak		e species and and	1.59E-4	C S al.	1 - robaledly
The results below are revised.				ign _{at} 📑	1 Calles
Limiting Stress were increased	to match the inputs f	or the 2-inch	case.	5.445	G,55557
CBA-001 R (4-inch) large leak	1.30E-3		1.96E-5	<u>'s 200</u> 8	
	BLU (19, Jacob	g chat he		3-28-5	0.511:-7
Example 2: Category 2	Segment AFW-	002		3-376-7	1.711-9
Win-SRRA Input	Sizes	the state of the state of the	Reason Fo	r Input Variatio	n konstruction S
Parameters	2-inch 3-inch	6-Inch -	230-7, 1 84 (5 M 194
Nominal Pipe Size (inches)	2 3	· 6	Physical ch	aracteristic of	pipe

Thickness to O.D. Ratio (inches)	0.092	0.062	0.065	Physical characteristic of pipe	19
Initial Flaw Conditions			ાંચ્ચત હો	3-inch and 6-inch butt-welds received past NDE (X-Ray) exams, 2-inch Socket-welds have not.	pediate of p
Dead Weight & Thermal Stress Level	0.11	0.05	0.05	Medium (0:11) value recommended for some small bore piping, the second states and the second states and the second states and the second states are second states and the second states are second are second states are second stat	into all'rectil
Design Limiting Stress	0.26	0.1	or 91 591	Medium (0.26) value recommended for small bore piping.	/. भे उप्ताली द

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The most studiopplying the most limiting Ville/ShiftA Inputs to being plac site in the surple. There no repeat for this ergman. The must be they would ware opplication and boughted grading organity. Copying the sector fugition where for LW, if the distance design limiting struct to the regention policy does

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Win-SRRA Case Results	Fallure P	robability (Second Second
	Without ISI	With ISI
AFW-002 (2-inch) large leak	2.64E-4	4.23E-5
AFW-002 (3-inch) large leak	3.99E-5	2.00E-7
AFW-002 (6-inch) large leak	4.31E-7	1.57E-9
The results below are revised. The Limiting Stress were increased to	ne inputs for DW & Therm match the inputs for the	al Stress and Design 2-inch case.
AFW-002R (3-inch) large leak	2.49E-5	2.64E-6
AFW-002R (6-inch) large leak	8.87E-6	8.19E-6
•	فياهاته والمناد والم	المحادثة والشاخ فيجرد أحدد

Example 3: Category 2 Segment CCS-021 and the term and the second s

Example 0. Outegoly				
			Reason For Input Variation	
Nominal Pipe Size (inches)	1		Physical characteristic of pipe	
Thickness to O.D. Ratio (inches)	0.136	0.034	Physical characteristic of pipe	
Dead Weight & Thermal Stress Level	0.11	0.05	Medium (0.11) value recommended for small bore piping.	
Design Limiting Stress	0.26	.0.1	Medium (0.26) value recommended for small bore piping.	

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Win-SRRA Case Results	Failure Probability					
	Without ISI -	With ISI				
CCS-021 (1-inch) large leak	2.25E-5	2.21E-5				
CCS-021 (10-inch) large leak	7.37E-11	2:75E-12				
The results below are revised. Th	e inputs for DW & Therm	al Stress and Design				
Limiting Stress were increased to						
CCS-021B (10-inch) large leak	6.95E-6	6.95E-6				

 1 (0.26) value recommended for

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The most limiting inputs for the segments in category two were always applied to the small bore piping. Applying failure probability estimates to the entire segment for these segments, as opposed to sub-segments would not change the number of inspections for the program.

CATEGORY 3

Penanglis 2: Category 2 Segment APW-202

The last of the three categories	includes the segme	nts whos	e Win-Sl	RRA inpu	istees na Ferlin nt Visbeling ItS
varied at different portions of th	e segment based or	n enginee	ring judg	ment	Pitysical distance adulto of pipo
regarding potential degradation	mechanisms. Ther	e are only	y nine se	gments i	n'i ye del characteriatio of pipe
this category representing appr	oximately one perce	nt of the	entire po	pulation	of
segments. Each segment and	the inputs associate	d with it a	are discu	ssed belo	Well ('s Play) en tine, set ind Sol (scherweig) fan
on a case-by-case basis.		1			loto at
	Chicaght & Iteanal	2.11	0.05	0.05	Modium (0,11) volue recommended for
· · · · · · · · · · · · · · · · ·	as the sector of				- senell tunth (griam)

Three of the segments in this category are main feedwater (MFW) segments. In this category are main feedwater (MFW) segments.

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Tables 3.5 and 3.6 show the Win-SRRA input parameters for the three MFW segments. The only parameters listed in the table are ones with different inputs for the sub-segments. Inputs not listed in the table are identical for the multiple sized cases of the same segment.

Table 3.5 Category Win-SRRA Input				Reason For Input Variation
Parameters		8-inch		
Nominal Pipe Size (inches)	6	. 8	18	Physical characteristic of pipe
Thickness to O.D. Ratio (inches)	0.065	0.058	0.064	Physical characteristic of pipe
Material Wastage Potential	0.05	0.1	0.1	FAC values are in accordance with known and documented FAC values in piping system.

Table 3.6 Category 3 Segments MFW-007A and MFW-008A (inputs are identical)

Win-SRRA Input	C. A CONST		- Pipe	Sizes	<u>Index Source</u>	en ne se su	Reason For Input Variation	
Parameters	6-inch	8-inch	10-inch	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	16-inch	 Aster Street Access Merick 		i gi manaka ay polokaki dina to gi Anim. Interneti ya kata kata kata kata kata kata kata k
Nominal Pipe Size (inches)	6	8	10	10	. 16	18	Physical characteristic of pipe	
Thickness to O.D. Ratio (inches)	0.042	0.037	0.047	0.055	0.041 <s ieati<="" td=""><td>0.047</td><td>Physical characteristic of pipe</td><td></td></s>	0.047	Physical characteristic of pipe	
Material Wastage Potential	0.05	0.05	0.05			0.1	FAC values are in accordance a with known and documented	
			tate of 2	19-3 0 M.C.	n general	la mata t	FAC values in piping system.	

(There are two different 10-inch pipe classes for these segments: One is EB-9 and the other is EBD-901. The 10-inch(a) is the EBD-901 portion.)

Palisades MFW system piping is susceptible to FAC. Piping for the system is ly submated as the entire connection currently in the Palisades FAC Program and the effects of FAC in MFW piping the rest of the traction have been studied at Palisades since 1988. The inputs selected for FAC for each of the sub-segments are in accordance with the rankings developed in the Palisades FAC Program for that portion of the system piping. The inputs are also

slightly conservative since all MFW piping was given, at a minimum, a medium

(0.05) FAC value. If a high FAC value had been input into one sub-segment only one sub-segment only because a different sub-segment (of the same segment) had a high input, it and the same segment would work to defeat the purpose of having a risk-informed approach. In this There are all hims segment in case the inputs are based on known plant specific data that is generated from a set of the set of t program whose purpose is to check and evaluate piping for FAC. These realistic at the the state state show inputs provide valuable risk insights that are lost if excessively conservative inputs are used in their place.

Three of the anginesity in this callegary are main regilitation (FISPH) acgments. At when we used the local that to see for different portions of the polyacet to be usse shied with their papelerated correction (FRC)), which is infer that in the metable wastage per initial (WVPP) input.

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Table 3.7 below shows the Win-SRRA input parameters for two BLD segments. The segments are nearly identical segments, one each from the two BLD piping trains. n an the second and the second se Second second

Win-SRRA Input	Sector Pipe	Sizes	Reason For Input Variation
Parameters	inch	4-inch	
Nominal Pipe Size (inches)	1	1997 (1997 (1997)	Physical characteristic of pipe
Thickness to O.D. Ratio (inches)	0.136	0.075	Physical characteristic of pipe _
Dead Weight & Thermal Stress Level	0.11	0.17	Medium (0.11) value recommended for small bore piping.
Design Limiting Stress	0.26	0.1 ·	Medium (0.26) value recommended for small bore piping.
Material Wastage Potential	0.001	0.05	FAC values are in accordance with known and documented FAC values in piping system.
		42 1 944	

Portions of the Palisades BLD piping are susceptible to FAC. Piping for the system is currently in the Palisades FAC Program and the effects of FAC in BLD piping has been studied since 1988. The inputs selected for FAC for each of the Star Cardada Star Santag sub-segments are in accordance with the rankings developed in the Palisades FAC Program for that portion of the system piping. The failure estimates generated for the cases are realistic and reflect known conditions in the piping. generated for the cases are realistic and reflect known conditions in the piping. Using only the worst of the input values for each size would be overly as the these or particulation of the input values for each size would be overly as the these or particulation. conservative and not produce realistic results a set. The table of the factor of the set of the set

Table 3.8 lists the Win-SRRA input parameters for segment BLD-008. The two particular fraction of the two sub-segments for BLD-008 have inputs that vary for pipe size differences, weld geometry differences, and thermal stratification potential differences. The sequence decision of the

Table 3.8 Category 3 Segment BLD-008 : Superior and that cation of the superior of the control of the control of the superior of the superior

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Win-SRRA Input	S Seyment BL		Boscon For Inord Veriation
Parameters		4-inch	
Nominal Pipe Size (inches)	% ****** 2200044	1 H distanant s	Physical characteristic of pipe
Thickness to O.D. Ratio (inches)	0.147	0.075	Physical characteristic of pipe
Dead Weight & Thermal Stress Level	0.11	0.17****	Medium (0.11) value recommended for small bore
Design Limiting Stress	0.26	0.1	Medium (0.26) value recommended for small bore piping.
Fatigue Stress Range	0.3	0.5	4-inch section has higher value due to its interface with the steam generator.
Low Cycle Fatigue Frequency	5	10	4-inch section has higher value due to its interface with the steam generator.

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Segment BLD-008 interfaces with the steam generator and has thermal stratification stress potential. The ¼-inch branch line on the segment is not near the generator and has significantly less thermal stratification stress potential. The inputs for both flow stress level and fatigue cycle frequency account for the

potential stratification near the generator for the four-inch section. Applying the same limiting inputs for both line sizes associated with the segment would be unrealistic and overly conservative (similar to example 1 in the response to question 1).

Table 3.9 lists the Win-SRRA input parameters for a segment from the heaters and extraction drain system (HED). The only parameters listed in the table are the ones with different inputs for the sub-segments. For these cases, all the variations in the inputs are due to FAC.

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Table AAA-Lease AA-		 이 지수는 것이 아이들은 것이 같은 것을 위해 있다.	
Lable 3.9 Catedory 3 Sec	nment HEI Julia		
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Win-SRRA Input	466 33	22.4.020	Pipe Siz	es 👘	A a trade	Reason For Input Variation
Parameters	3-inch	4-inch	8-inch	12-Inch	16-inch	
Nominal Pipe Size (inches)	3	1.4 4 .555 - 46-56-14	1 ° . 8 j⊈	12	G.4 16 :	Physical characteristic of pipe
Thickness to O.D. Ratio (inches)	0.062	0.053	0.037	0.029	0.023	Physical characteristic of pipe
Material Wastage Potential	0.2	0.1	0.1	0.2	.0.2	FAC values are in accordance with known and documented FAC values
	1		the second			in piping system.

Portions of the HED piping are susceptible to FAC. Piping for the system is the headest construction of the Palisades FAC Program and the effects of FAC in HED piping constructions is the palisades FAC Program and the effects of FAC in HED piping constructions is the palisades FAC Program and the effects of FAC in HED piping constructions is the palisades FAC Program and the effects of FAC in HED piping constructions is the palisades FAC Program. The failure estimates generated for the cases are realistic and reflect known conditions in the piping. Using only the worst of the input values for each size approach DLD-665. The two would be overly conservative and not produce realistic results for the 4-inch and approximate differences, weld 8-inch portions of the piping. Conservative and not produce realistic results for the 4-inch and approximate differences.

Table 3.10 shows the variation in the Win-SRRA inputs between the

sub-segments for two pressurizer (PZR) segments. The segments are nearly and the segments for two pressurizer (PZR) segments.	7
identical segments; each one is isolated from the primary coolant system (PCS)	
by a normally closed power-operated relief valve (PORV).	
. 1960-19 . 1960-1970 (2000) - 2,452 - 6,072 (11); 6,072 (2000) - 6,072 (2000)	-' i
Table 9.10 Catagory 9 Cogmonia B7D 011 and B7D 010 (insule are identical)	1

Frequency			with the PCS. The same for both segments from other examples this case is unique from other examples.
Low Cycle Fatigue	5	10	4-inch section has higher value due to its interface
Fatigue Stress Range	0.3	0.5 7	4-Inch section has higher value due to its interface with the PCS.
Thickness to O.D. Ratio (inches)	0.147	0.097	Physical characteristic of pipe
Nominal Pipe Size (inches)	%	n sester a 4 stati manan	Physical characteristic of pipe
Win-SRRA Input Parameters	Minch	Sizes 4-Inch 👾	Reason For Input Variation

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the original, thus no change.

Similar to segment BLD-008, the four-inch section of the segments is susceptible to thermal stratification. The four-inch sections of the segment are separated from the PCS by normally closed valves that have been known to leak. Due to the location on the segments of the ¾-inch branch lines, they are much less susceptible to the thermal stratification. The inputs reflect the actual piping conditions and are realistic. Using only the worst of the input values for each size would be overly conservative and not produce realistic results. the sector for the sec

restance of a lager of the second

SUMMARY

For two of the three categories of segments with multiple Win-SRRA inputs parameters, applying the failure probability estimates to the entire segment as opposed to sub-segments would not increase the number of inspections. For segments in the first category, the inputs to determine the failure estimates are the same for each pipe size. The only variations in the inputs are those associated with the actual physical makeup of the pipe. For segments in category two, the more limiting inputs were consistently applied to the small bore reevaluating the large bore sections of the pipe with the most limiting inputs would raise the failure probabilities for those sub-segments. However, in each Piore fa dio systemas example, the original limiting failure probability (for the small bore piping) associated with the segment remained the highest value and would still be chosen to represent the segment. Based on the evidence from the examples. applying the failure probability estimates to the entire segment as opposed to sub-segments for those in category two would not increase the number of the second as the state of the second second as the second seco

As discussed in the response to question one of the request for additional information (RAI), applying the most conservative SRRA inputs for various pipe t de berador de sizes in a weld may result in excessive conservatism in the SRRA failure probability for that segment and therefore should not be considered. Applying the worst case inputs associated with any part of the segment to all portions of the segment might change the number of inspections for segments in category three. However, any additional inspections would be the result of using overly conservative and unrealistic data and therefore, are inappropriate. The justification for the variation in the inputs for these segments is sound and well documented. The decisions for the inputs were based on known and studied conditions specific to each section of the pipe. -Garay -Participaescish statist 05 D D B 2010

Because the segments in this category are low safety significant (LSS) and the most conservative failure probabilities of the sub-segments were used, had the sub-segments in this category been split, the new segments would have also been LSS and there would have been no change to the number of inspections.

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