Materials Reliability Program: MRP-146/MRP-146S Implementation Survey Summary Report (MRP-275)

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Technical Update, April 2010

EPRI Project Manager

S. Chu

Work to develop this product was completed under the EPRI Nuclear Quality Assurance Program in compliance with 10 CFR 50, Appendix B and 10 CFR 21.

YES NO

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Structural Integrity Associates, Inc

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REPORT SUMMARY

Background

In June 2005, the Electric Power Research Institute (EPRI) Materials Reliability Program (MRP) published and provided "needed" guidelines and other good practice recommendations for evaluating and inspecting regions in normally stagnant pressurized water reactor (PWR) coolant system branch lines where there might be the potential for thermal fatigue cracking induced by swirl penetration. In January 2009, supplemental guidance was published with revised guidance and new analytical methods to manage branch piping found susceptible to swirl penetration cyclic stratification. Throughout the development of this guidance, the exact population of affected branch lines, including their configurations and construction, was estimated based on data gathered during EPRI-sponsored training for the U.S. PWR fleet.

Objective

- To provide summary information regarding specific actions or planned actions by utilities to address screened-in lines including analysis, monitoring, and/or inspection

Approach

The EPRI MRP decided to query all PWR sites with a survey to gather MRP-146 and MRP-146S implementation information in order to assist utilities in addressing their screened-in lines and guide future MRP activities. This report summarizes the survey responses. In accordance with MRP requirements, MRP-146 and MRP-146S will be reviewed bi-annually for possible revision. Monitoring data will continue to be collected by the MRP to guide potential future revisions, and this survey summary may be updated accordingly.

Results

Information regarding specific actions or planned actions by utilities to address screened-in lines including analysis, monitoring, and/or inspection has been collected and is presented in summary format here.

EPRI Perspective

This report presents a summary of data that EPRI has been able to collect and provide as a result of our unique position as an industry collaborative organization. The information will be used by both EPRI and our utility customers for planning future research and outage activities. EPRI will continue to collect data in order to stay current with industry status.

Keywords

NRC Bulletin 88-08
Reactor coolant piping
Thermal cycling
Thermal fatigue
Thermal stratification

ACKNOWLEDGMENT

This program has progressed under the support and guidance of the EPRI Materials Reliability Program (MRP) Technical Support Committee (TSC). Members of the TSC are thanked for their efforts that led to the successful completion of this report.

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1 INTRODUCTION

1.1 Background

In June 2005, MRP-146 [1] was published and provided "Needed" guidelines and other good practice recommendations for evaluating and inspecting regions in normally stagnant pressurized water reactor (PWR) coolant system branch lines where there may be the potential for thermal fatigue cracking induced by swirl penetration. This cracking could lead to leakage and forced plant outages. MRP-146 was issued under the Nuclear Energy Institute (NEI) industry materials initiative, NEI 03-08 [2]. In January 2009, a supplement to MRP-146 was published, MRP-146S [3]. This supplement provides revised guidance and new analytical methods to manage branch piping found susceptible to swirl penetration cyclic stratification. MRP-146S also provides revised "Needed" requirements superseding those listed in MRP-146.

Throughout the development of MRP-146 and MRP-146S, the exact population of affected branch lines, including their configurations and construction, was estimated based on data gathered during EPRI sponsored MRP-146 training for the U.S. PWR fleet. In addition, specific actions or planned actions by utilities to address screened-in lines including analysis, monitoring and/or inspection have not been documented. Thus, the EPRI Materials Reliability Program (MRP) decided to query all PWR sites with a survey to gather this information in order to assist utilities in addressing their screened-in lines and guide future MRP activities. This report summarizes the survey responses.

In accordance with MRP requirements, MRP-146 and MRP-146S will be reviewed bi-annually for possible revision. Monitoring data will continue to be collected by the MRP to guide potential future revisions and this survey summary may be updated accordingly.

1.2 MRP-146/MRP-146S Implementation Survey

The MRP-146/MRP-146S implementation survey consists of three separate tables. Table 1 focuses on the MRP-132/170 [4, 5] screening. The number and configuration of branch lines screened and those that screen-in are requested. Table 2 focuses on the stratification temperature difference of screened-in lines compared to the stratification temperature difference threshold given in Section 2.1.5 in MRP-146 (now superseded by Appendix E of MRP-146S). Table 3 asks for more detailed information on screened-in branches where augmented inspection is required. This information includes whether or not this line was within the scope of NRC Bulletin 88-08 [6], if thermal fatigue potential has been found significant, if initial inspections consistent with the requirements of MRP-146 have been completed or are planned, if monitoring data is being collected or planned, and has the inspection frequency been determined by either a fatigue analysis or flaw tolerance evaluation. The complete survey has been reproduced in Appendix A of this report.

1.3 Report Outline

This report provides a summary of the MRP-146/MRP-146S implementation survey described above.

Section 2 of the report provides text and graphical summaries of the information received from the survey responses. The section is divided into three sub-sections; each sub-section presenting the data from each table of the survey.

Section 3 of this report summarizes the document and highlights important survey findings.

Appendix A provides the implementation survey sent to PWR plants from the MRP TSC.

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MRP-146/MRP-146S IMPLEMENTATION SURVEY SUMMARY

The MRP-146/MRP-146S implementation survey responses are summarized herein. The information is presented in three sub-sections aligning with the tables of the survey (see Appendix A). Survey feedback and comments are provided in the fourth sub-section.

Many survey responses are specific to a particular branch line configuration. That is, RCS-attached piping off the top of RCS lines (up-horizontal, UH), off the side of RCS lines (horizontal, H) or off the lower portion of RCS lines (down-horizontal, DH). Horizontally attached piping with a second horizontal pipe section below the RCS nozzle and inboard of the first isolation valve (horizontal-down-horizontal, HDH) are categorized as an H configuration subset.

A distinction is made between PWR sites and units throughout this survey summary. PWR sites (total of 41) refer to a specific geographic location where 1, 2 or 3 separate PWR operating units (total of 69) may be present.

Survey participation was near 93% with 38 of 41 PWR sites responding. The survey summary is based only on the responses received.

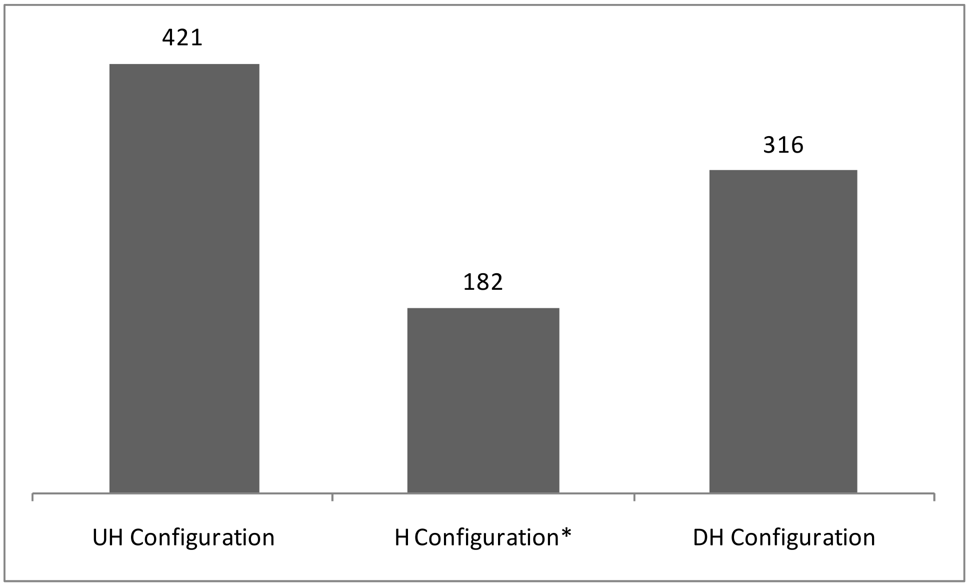
2.1 Table 1, Screening Status - Cycling

Table 1 of the implementation survey focuses on the MRP-132/170 screening of RCS branch piping. Screening has been completed by 100% of PWR sites. Name and contact information of those engineers responsible for MRP-146/MRP-146S site implementation were collected in Table 1 of the survey.. Of those engineers listed, over half (58%) participated in the original MRP-146 training given in 2005/2006.

A total of 919 RCS branch lines were reported screened. Figure 2-1 shows the number of each branch line configuration comprising the total line population. Of the 919 lines screened, 279 screened-in (about 30%). Figure 2-2 shows the number of each branch line configuration comprising the population of screened-in lines. Note that 10 UH and 2 H configuration branch lines also screened-in as a DH configuration since each had a horizontal pipe section below the RCS piping inboard of the first isolation valve. These lines are not counted twice in Figure 2-2 (or any subsequent figure).

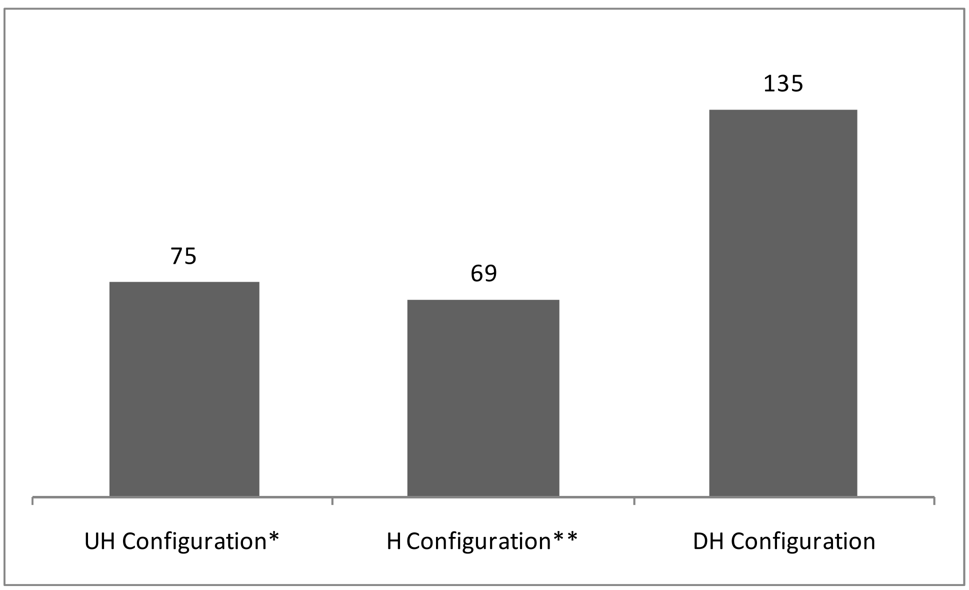
Table 1 of the survey also inquired as to the presence of IUx or IDx inclined line configurations. These configurations are branches attached to the RCS loop piping with an axis not perpendicular (i.e., an inclined nozzle attachment) to the RCS pipe axis. Five PWR sites (7 total units) acknowledged the presence of these configuration types. These branch lines are outside the scope of MRP-132 and not included in the total population count.

Three PWR units had zero screened-in branch lines (all of Combustion Engineering design).



*Of these lines, 37 are in an HDH configuration.

Figure 2-1
Total Population of Screened Lines by Line Configuration Type



*Ten of these lines also screened-in as DH configurations and are not included in the DH total.
**Two of these lines also screened-in as DH configurations and are not included in the DH total.

Figure 2-2
Population of Screened-in Lines by Line Configuration Type

2.2 Table 2, Screening Status – Temperature Threshold

Table 2 of the implementation survey specifically identifies the screened-in lines and inquires as to how the stratification temperature difference (ΔT) is determined and if this ΔT exceeds the significant temperature difference threshold defined in Section 2.1.5 of MRP-146. Note that Appendix E of MRP-146S supersedes this threshold. For UH/H configurations, the threshold is not changed however limitations on applicability are noted; for DH configurations, the threshold is increased also with limitations on applicability.

Of the 279 screened-in lines, 144 lines are UH/H and 135 are DH. Figure 2-3 shows a more detailed breakdown of the various types of UH/H branch lines. Similarly, Figure 2-4 provides additional detail for the DH configurations.

Table 2 of the survey also inquires if there is a socket weld in the cycling region. The MRP-146S significant temperature threshold does not apply to UH/H lines with socket welds between the RCS piping and the first valve. More importantly, the significant temperature threshold and generic thermal fatigue evaluation does not apply to DH lines with socket welded elbows. This impacts many drain and excess letdown lines. Figure 2-5 shows the approximate 40/60 split between socket and butt welded construction for these lines, respectively.

Nearly all sites used the MRP-170 output for the determination of a stratification temperature difference (only one RHR suction line was found to have a ΔT less than the significant temperature threshold using MRP-170). Four sites used monitoring data (most in place as part of their NRC Bulletin 88-08 commitments) resulting in 28 lines having a ΔT less than the significant temperature threshold.

Of the 279 screened-in lines, 250 lines were found to have a predicted or measured stratification temperature difference greater than the MRP-146 defined threshold.

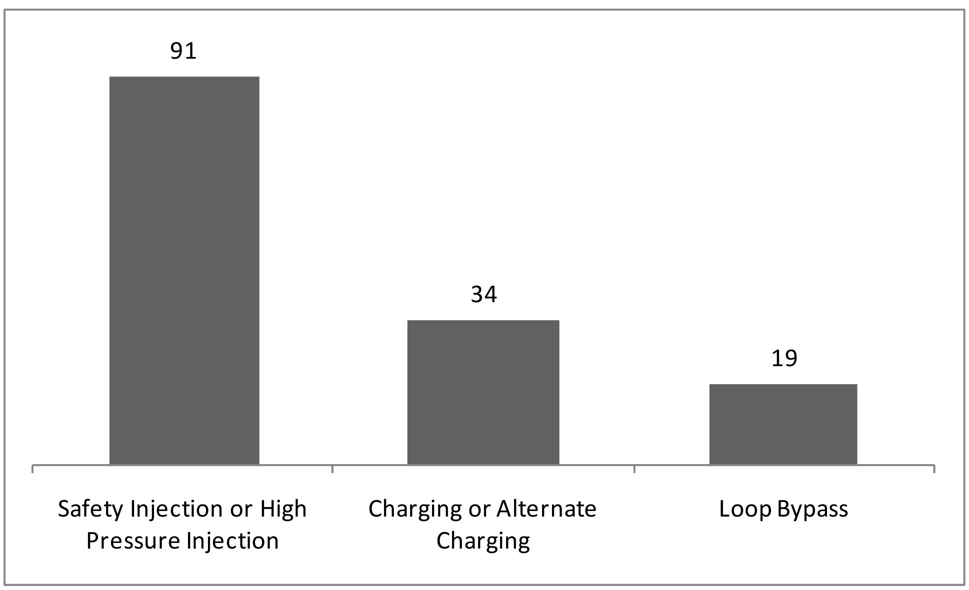
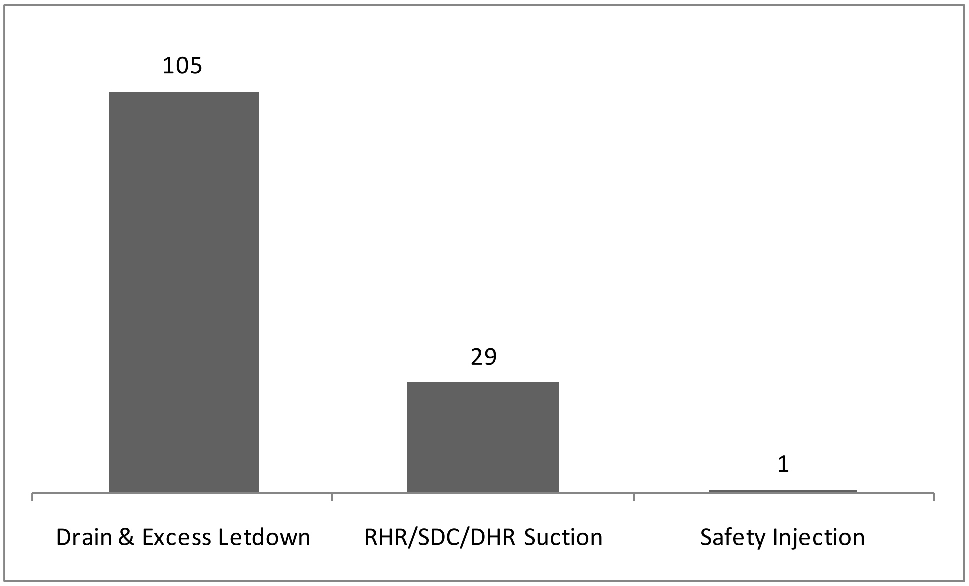
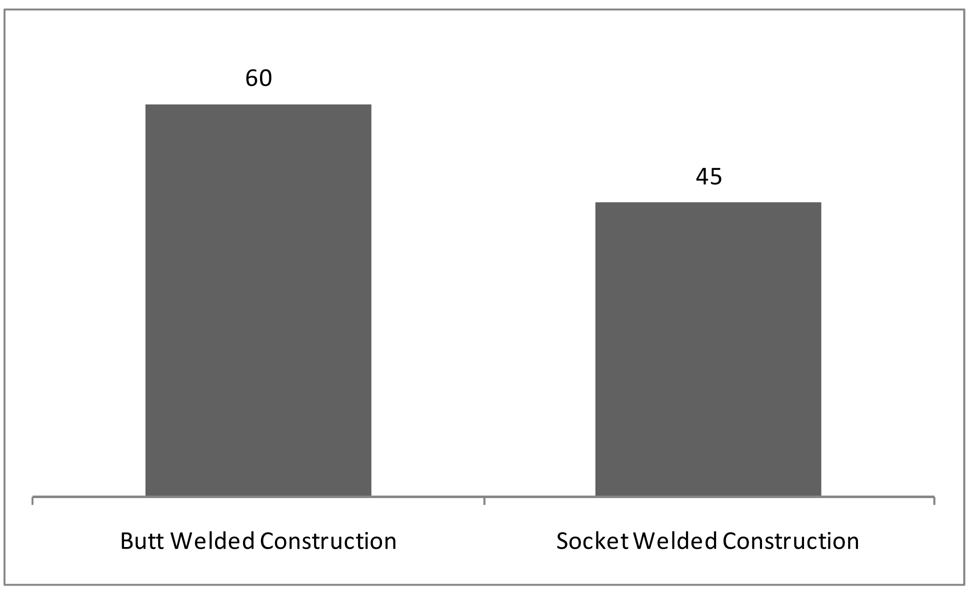


Figure 2-3
Breakdown of Screened-in UH/H Branch Lines



Notes: Ten UH safety injection lines and two H charging lines also screened-in as DH configurations and are not included in this figure. The single safety injection line (HDH) screened-in as a DH configuration, but not as an H configuration.

Figure 2-4
Breakdown of Screened-in DH Branch Lines



Note: The single safety injection line identified in Figure 2-4 that screened-in as a DH configuration is also of socket welded construction.

Figure 2-5
Construction Detail of Drain and Excess Letdown Lines

2.3 Table 3, Screened-in Lines Details – Inspection/Monitoring/Evaluation

Table 3 of the implementation survey includes questions relative to MRP-146S. Since Appendix E of MRP-146S has replaced Section 2.1.5 of MRP-146 regarding the determination of a significant temperature threshold, lines previously found to have a ΔT less than the threshold need to confirm that the applicability criteria of Appendix E are met. Thus, the initial number of lines considered in Table 3 is 279 – the same number of lines found to screen-in from Table 1 of the survey.

2.3.1 Comparison of Screened-in Branch Line Population with 88-08 Scope

NRC Bulletin 88-08 was issued to address several instances of thermal fatigue cracking in normally stagnant lines attached to RCS piping. The scope of 88-08 was primarily focused on safety injection piping where cold water in-leakage was possible. Actions were assigned to utilities to assess if susceptible piping existed and if so, inspect welds and other high stress locations for thermal fatigue damage and implement some type of mitigation or monitoring to assure that further cracking would not occur. The implementation survey asks several questions related to screened-in branch lines and how these lines may have been impacted by 88-08.

Figure 2-6 shows the number of screened-in lines within the scope of 88-08.

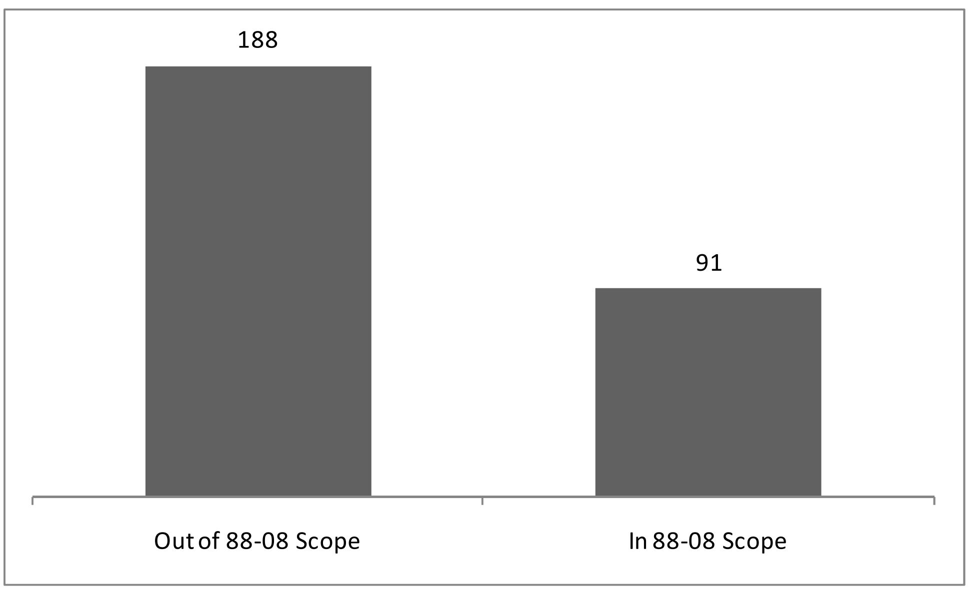


Figure 2-6
Number of Screened-in Branch Lines within Scope of NRC Bulletin 88-08

According to the survey responses, 80 screened-in lines were inspected for 88-08. However, it was noted that 11 of these lines were not within the scope of 88-08, but were proactively inspected by utilities due to thermal fatigue concerns raised by the Bulletin. Only two lines at one site were modified as a result of 88-08 actions and about 90% of 88-08 scope lines continue to be monitored.

2.3.2 Comparison of Stratification ΔT with Significant Temperature Threshold

Due to the higher significant temperature thresholds for DH configurations provided in Appendix E of MRP-146S, the endorsed use of plant specific heat transfer models to determine stratification ΔT and utilization of monitoring data, fewer lines are predicted to have significant thermal fatigue potential when compared to previous MRP-146 guidance (250 using MRP-146 vs. 214 using MRP-146S). Figure 2-7 illustrates this finding. Four sites have used plant specific heat transfer analyses to disposition screened-in lines (note that plant specific heat transfer analyses must consider the elements described in Section B.3.2 of MRP-146S; the EPRI MRP has not verified any heat transfer analysis).

Figure 2-8 shows the line configuration breakdown of the 214 screened-in branches where significant thermal fatigue is predicted based on ΔT.

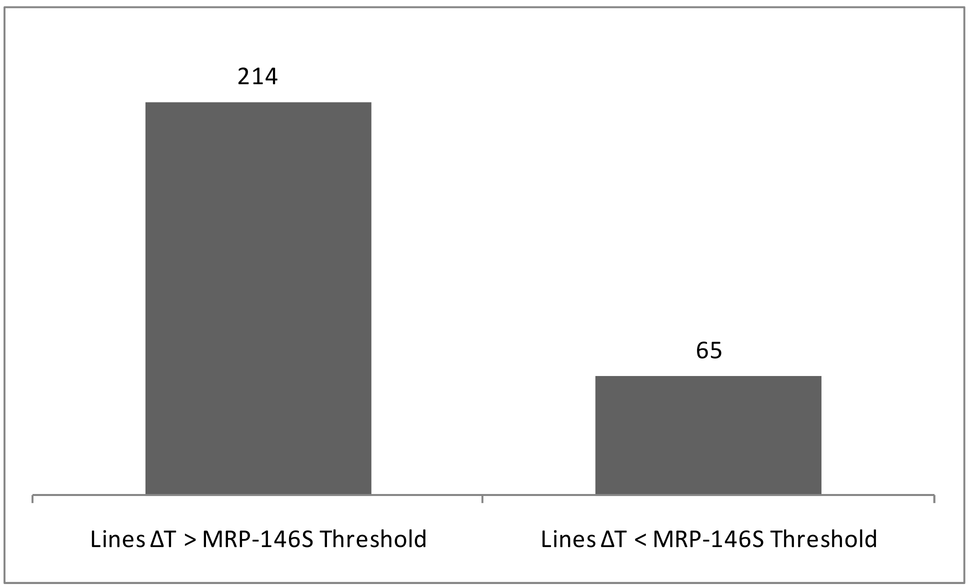
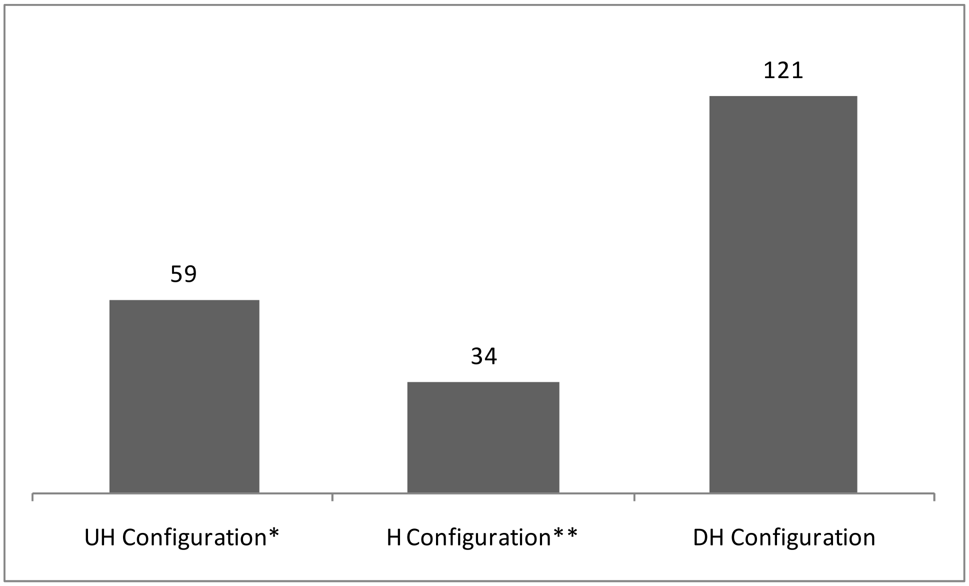


Figure 2-7
Thermal Fatigue Significance of Screened-in Branch Lines Based on Stratification ΔT



*Ten of these lines also screened-in as DH configurations and are not included in the DH total.
**Two of these lines also screened-in as DH configurations and are not included in the DH total.

Figure 2-8
Population of Screened-in Lines with Stratification ΔT > MRP-146S Threshold

2.3.3 Implementation of Generic Thermal Fatigue Evaluation

One objective of MRP-146S was to provide a generic fatigue evaluation to show thermal fatigue is not significant in less rigid screened-in DH lines. The generic fatigue evaluation is line size specific and requires applicability criteria to be met for its use. Figure 2-9 shows the applicability of the MRP-146S generic thermal fatigue evaluation to the 121 screened-in DH lines shown in Figure 2-8 with a stratification ΔT greater than the significant temperature threshold.

For those lines meeting the applicability criteria, Figure 2-10 illustrates the generic fatigue evaluation results. The generic evaluation finds thermal fatigue not significant in about 43% of analyzed lines. Note that several lines remain to be evaluated as utilities are not required to complete this effort until the end of July 2010.

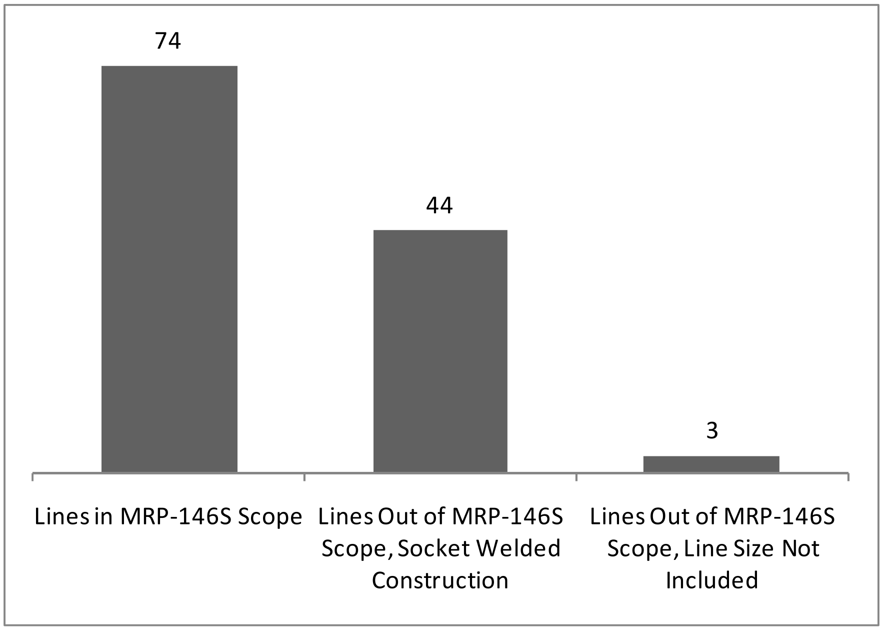


Figure 2-9
MRP-146S Generic Fatigue Evaluation Applicability to Screened-in DH Branch Lines

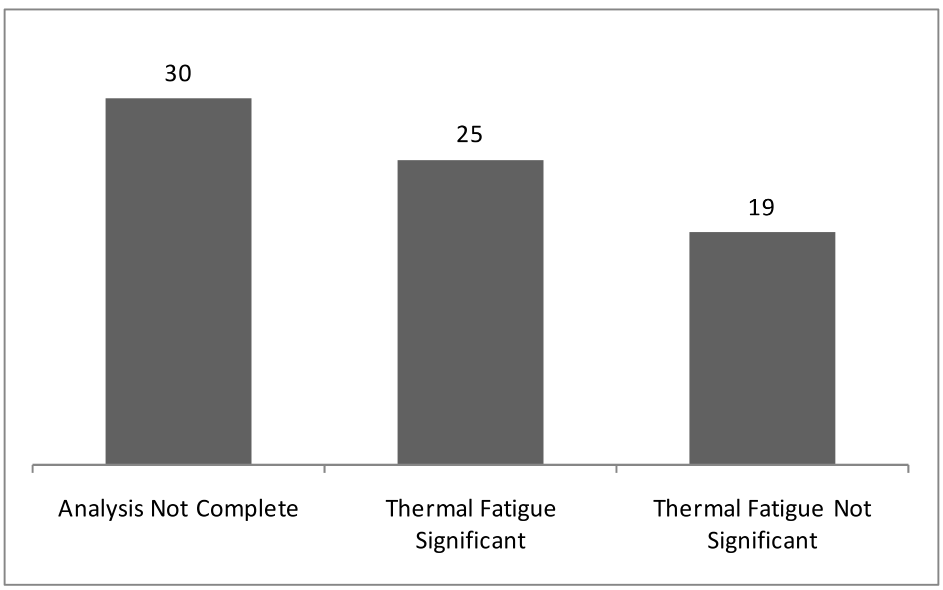


Figure 2-10
MRP-146S Generic Fatigue Evaluation Results

2.3.4 Inspection

For screened-in branch lines where thermal fatigue potential is considered significant, augmented inspection is required by MRP-146S. While the inspection frequency may be determined either by a fatigue usage calculation or a flaw tolerance evaluation, initial inspections are a “Needed” requirement that must be completed prior to the end of the next refueling outage that initiates after January 31, 2009. These initial inspections are to be completed in accordance with Section 2.4 of MRP-146. If such inspections have previously been performed, the requirement is satisfied. Figure 2-11 shows if these initial inspections have been completed or when they are scheduled. Note that even though 19 DH lines were found not to have significant thermal fatigue (see Figure 2-10), 18 of these lines have already been inspected or will be inspected anyway.

Indications have been found on one socket welded 2-inch DH drain line at Beaver Valley Unit 1. The indications were described as two parallel, linear, circumferential indications and were discovered in the RC-41 2-inch loop drain. At this time, no additional details are available.

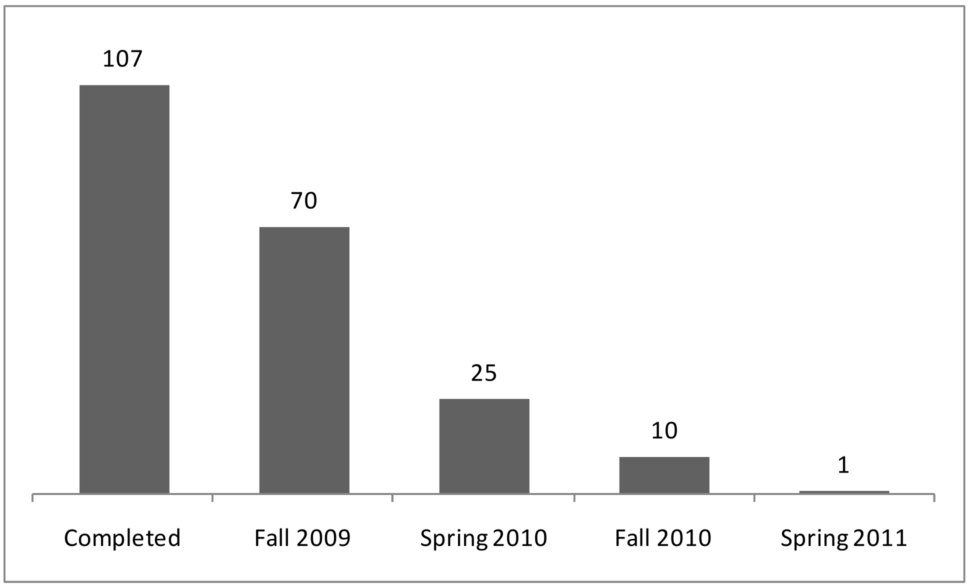


Figure 2-11
Status of Screened-in Branch Line Inspections

2.3.5 Monitoring

MRP-146/MRP-146S allows for monitoring data to be used as an alternative to analytical modeling for screening and defining the thermal loading for stress analysis. Section 2.3 of MRP-146 provides guidance for monitoring. The implementation survey asks whether plants currently have data and if not, if monitoring is planned for screened-in lines. Figure 2-12 shows the survey responses.

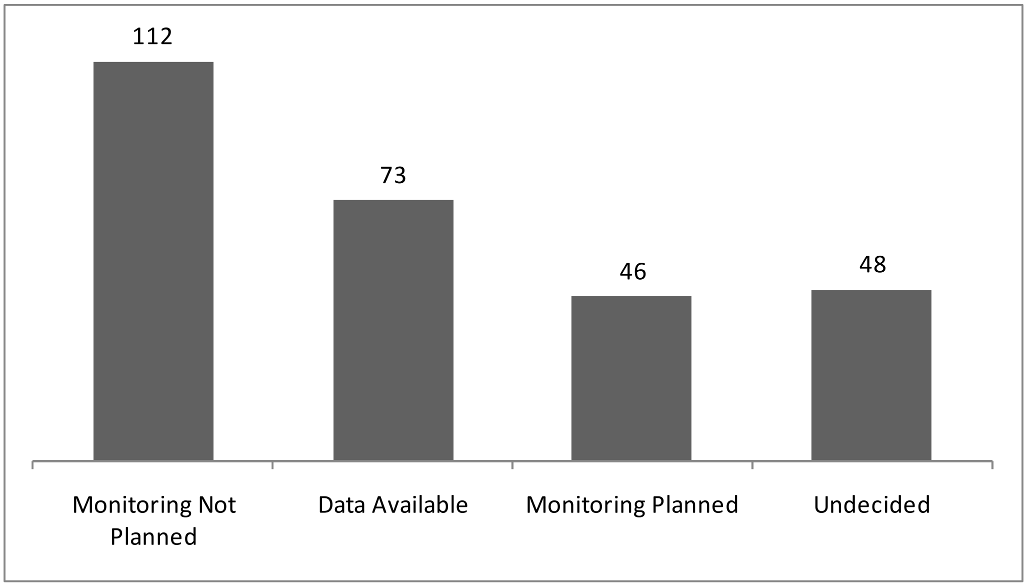


Figure 2-12
Plant Responses Regarding Monitoring of Screened-in Branch Lines

2.3.6 Analysis and Evaluation

MRP-146S allows for either a fatigue usage calculation or flaw tolerance evaluation to determine the frequency of augmented inspection for screened-in lines where the potential for thermal fatigue is significant. The implementation survey inquires which approach plants are planning to use and their results, if available. Only three sites have completed a fatigue analysis for a portion of their screened-in piping. A total of 8 drain lines have been analyzed. Two of these lines, one being of socket welded construction, exceeded a cumulative usage factor (CUF) of 0.7 for 60 years (however, both were below 1.0). No plants have completed a flaw tolerance evaluation and most have not determined if an evaluation will be conducted.

Sites are planning to conduct the fatigue analysis or flaw tolerance evaluation starting fall of 2009 through fall of 2012. The implementation of the MRP-146S "Needed" requirements stipulates that these evaluations be completed within 48 or 60 months of MRP-146S publication if analytical data or monitoring data are relied upon, respectively. No plant has committed to using monitoring data as input for their determination of inspection frequency.

2.4 Feedback and Comment Responses

Overall, the implementation survey responses providing additional feedback, questions or other comments relative to MRP-146 and MRP-146S were limited. The majority of comments given were related to clarifications of answers provided. The comments that are of general interest were all related to branch line monitoring. The following list summarizes these comments:

- Section 2.1.2.1 of MRP-146 states that: *"Thermal cycling is judged not significant if the minimum temperature sensor reading during normal plant operation is no more than ΔT below the normal reactor coolant temperature at the location where the potentially affected* *branch piping is attached, where ΔT is defined in [Appendix E of MRP-146S].”* This seems overly conservative and seems to contradict other guidance provided in MRP-146 and MRP-146S that clearly identify that if temperature ‘cycling’ can be shown to be below ΔT threshold in magnitude, it is insignificant and screens out. It is suggested that additional clarification or justification of the requirements of this section be provided.

- Maintaining good thermocouple-to-pipe contact for accurate temperature measurements from monitoring currently in-place is a challenge.
- Options for temperature and pressure monitoring are being considered by several sites to address branch lines that have screened-in with significant thermal fatigue potential.

3
DISCUSSION OF SURVEY RESULTS

The implementation survey responses demonstrate that nearly all PWR sites have screened-in piping requiring future action. About 30% of branch lines screened were found to have the potential for cyclic stratification (total of 279 lines). Using the significant temperature difference threshold guidance in MRP-146S, 65 lines were found not to have the potential for significant thermal fatigue. Of the remaining 214 lines, 93 are UH/H configurations requiring augmented inspection. Of the 121 DH configurations, 74 are within the scope of the MRP-146S generic fatigue evaluation. Of the 44 lines that have applied the generic thermal fatigue evaluation, 19 lines were found not to have the potential for significant thermal fatigue (30 lines still require evaluation – "Needed" requirement #3 in MRP-146S). Table 3-1 summarizes these survey results with some additional detail.

Initial inspections ("Needed" requirement #2 in MRP-146S) are progressing with 50% of lines completed and nearly all inspections are planned to be completed by the end of 2010.

While the survey responses were fairly clear as to the extent of lines affected and inspection status, actions being taken to address the frequency of future augmented inspections ("Needed" requirement #4 in MRP-146S) and possible monitoring were generally undecided. Only a handful of drain lines (8) have completed a fatigue analysis and determined a cumulative usage factor (two of the lines exceeded a CUF of 0.7 for 60 years; however, both were below 1.0). No flaw tolerance evaluation has been performed. The limited feedback/comments provided with the survey responses were focused on monitoring and the difficulty in obtaining accurate data. Further clarification of the MRP-146 monitoring guidance may be helpful.

The MRP-146/MRP-146S implementation survey provides valuable information regarding the management of thermal fatigue in normally stagnant non-isolable RCS branch piping in the U.S. PWR fleet. Understanding the population and configuration of affected branch piping, and actions planned by utilities to address screened-in lines will help guide future EPRI efforts in this area.

Table 3-1
Survey Summary of Branch Line Screening Details

	UH Configurations				H Configurations					DH Configurations				
LINE TYPE	Safety Injection	Normal & Alt Charging	Loop Bypass	Total UH	Safety Injection	Normal & Alt Charging	Loop Bypass	Total H	Total UH/H	Drain & Excess Letdown	RHR/SDC/ DHR Suction	Safety Injection	Total DH	**Total All**
ALL LINES SCREENED				421				182	603				316	**919**
SCREENED-OUT				346				113	459				181	**640**
SCREENED-IN	55	17	3	75	36	17	16	69	144	105	29	1	135	**279**
Percent of All Lines Screened				***18%***				***38%***	***24%***				***43%***	***30%***
Thermal Fatigue Not Significant														
by MRP-146S ΔT threshold											1			
by temperature monitoring	11	5				3					9			
by in-leakage monitoring					16									
by heat transfer analysis							16			2	2			
by generic fatigue analysis										16	3			
Thermal Fatigue Significant	44	12	3	59	20	14	0	34	93	87	14	1	102	**195**
Percent of All Lines Screened				***14%***				***19%***	***15%***				***32%***	***21%***

4
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1. *Materials Reliability Program: Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines (MRP-146).* EPRI, Palo Alto, CA: 2005. 1011955.

2. NEI 03-08, Guideline for the Management of Materials Issues, Nuclear Energy Institute, Washington DC: May 2003.

3. *Materials Reliability Program: Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines - Supplemental Guidance (MRP-146S).* EPRI, Palo Alto, CA: 2009. 1018330.

4. *Materials Reliability Program: Thermal Cycling Screening and Evaluation Model for Normally Stagnant Non-Isolable Reactor Coolant Branch Line Piping with a Generic Application Assessment (MRP-132).* EPRI, Palo Alto, CA: 2004. 1009552.

5. *Materials Reliability Program: MRP-170 EPRI Thermal Fatigue Evaluation per MRP-146, Version 1.0*. EPRI, Palo Alto, CA: 2006. 1013270.

6. United States Nuclear Regulatory Commission, Bulletin 88-08, "Thermal Stresses in Piping Connected to Reactor Coolant Systems" 6/22/1988, including Supplements 1, 2, and 3, dated 6/24/88, 8/4/88 and 4/11/89.

A

MRP-146/MRP-146S IMPLEMENTATION SURVEY

Instructions

Note this survey has three tables. Please fill in the data requested and attach additional details and information where applicable. Table 2 has space for 6 unique configurations of lines, if your plant has more than 6 unique configurations of lines that screen in for cycling potential, please submit multiple sheets to include them all. Table 3 has space for 6 unique configurations of lines, if your plant had more than 6 unique configurations of lines that screen in for cycling and exceed the temperature threshold in MRP-146 or MRP-146S, please submit multiple sheets to include them all.

Definitions and Clarifications

An applicable inspection is one that is consistent with the requirements and recommendations of the inspection guidance provided in MRP-146 and the associated reference material, including the most recent revisions.

There is a field in this survey that requests you to indicate if there were "recordable indications" found during inspections.

A "recordable indication" is:

1) for visual inspections - an "indication of leakage (moisture or boric acid residue) regardless of whether the flaw is confirmed by non-visual methods"

2) for NDE methods – any recordable indication per the applied inspection procedure (see MRP-36, Revision 1 for guidance)

The TSC is requesting that utilities report the visual indication of leakage in the form of moisture or boric acid residue as a "recordable indication" regardless of whether a flaw is confirmed. Any recordable indication that is found during the inspections conducted to comply with MRP-146 and MRP-146S should be described in an attachment to the survey. Details should include the nature of the indication, the inspection methods applied, whether or not craze cracking was identified, and how the finding was resolved. It is expected that the TSC will contact plants that report indications for further information and discussion.

Table 1
Screening Status – Cycling

Have all of the normally stagnant non-isolable RCS branch lines been screened for cycling using MRP-132 and/or 170?	
Who is responsible for MRP-146/MRP-146S evaluation and implementation activities? (name and contact info)	
Did this person receive MRP-146 training (original training in 2005/2006)?	
How many normally stagnant non-isolable RCS branch lines were screened using MRP-132/MRP-170 at your plant? (total) =	
Number of UH lines =	
Number of H lines =	
Number of H lines with HDH configuration (this would be a sub-population of the above) =	
Number of DH lines =	
Does your plant have any branch lines that are not oriented normal to the RCS axis (IUx or IDx configuration)? See Figure 3-1 of MRP-132, and note that the swirl penetration model does not apply.	
How many lines screened in? (total) =	
Number of UH lines screened in =	
Number of H lines screened in =	
Number of DH lines screened in =	

Table 2
Screening Status – Temperature Threshold (submit multiple sheets if needed)

This section should be completed for all lines that screened in above. The results should be reported based on the original MRP-146, any changes due to the revisions in MRP-146S should be reported in Table 3.

Data	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6
Line Description (system name and nozzle function)						
Line Geometry (UH/H/DH)						
Number of equivalent lines installed in plant (enter 1 if unique)						
Is there a socket-weld in the cycling region?						
How was the ΔT determined (MRP-170, monitoring data[1])?						
Does the line screen in ($\Delta T >$ Threshold) per MRP-146 Section 2.1.5?[2] (if no, do not include in Table 3)						
What is the ΔT value for the line? (Maximum T_{hot}-T_{cold})						

[1] Should be collected in accordance with MRP-146 Section 2.3.

[2] Note that MRP-146S supersedes this threshold, for UH/H configurations the value is not changed however limitations on applicability are noted, for DH configurations the value is increased also with limitations on applicability.

Table 3
Screened-in Lines Details – Inspection/Monitoring/Evaluation (submit multiple sheets if needed)

This section should include all lines that screened in for cycling and exceeded the temperature threshold in MRP-146[3]. This survey includes questions relative to MRP-146S. If your plant has not yet implemented this guideline, please enter TBD for these items. If implementation of MRP-146S has cause additional lines to screen in (due to limitations on applicability noted in Appendix E) please include these lines below, and call Shannon Chu at 650-855-2987 to report this unexpected result.

Data	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6
Line Description (system name and branch function)						
Line Geometry (UH/H/DH)						
Number of equivalent lines installed in plant (enter 1 if unique). If identical trains have different inspection/monitoring/evaluation histories list them as if they were unique.						
Was this line identified as being subjected to thermal cycling in response to NRC Bulletin 88-08?						
Was this line inspected in response to Bulletin 88-08?						
Was this line modified in response to Bulletin 88-08?						
Is this line continuing to be monitored as part of commitments made in response to Bulletin 88-08?						

[3] Note that MRP-146S supersedes the temperature threshold in MRP-146; however, this document may not have been implemented prior to the response to this survey.

Table 3
Screened-in Lines Details – Inspection/Monitoring/Evaluation (cont.)

Data	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6
Was this line inspected in response to the now superseded Interim Thermal Fatigue Management Guideline (MRP-24)?						
Does the line screen in (ΔT > Threshold) per MRP-146S (revised threshold in Appendix E)?[4]						
DH Lines Only (green shaded rows)						
Has the line been evaluated (using the R_{strat} curves) based on the generic stress analysis provided in MRP-146S?						
Is thermal fatigue significant per MRP-146S?						
If not yet completed, please enter the date that evaluation based on MRP-146S is expected to be complete.						
Have inspections that meet the guidelines in Section 2.4 of MRP-146 been performed on this line?						
Date (spring/fall and year) of most recent inspection completed, or the date of next planned inspection if none completed.						

[4] MRP-146S Appendix E supersedes MRP-146 section 2.1.5. This document includes revised temperature thresholds for DH lines, and revised applicability of the temperature threshold values for all geometries.

Table 3
Screened-in Lines Details – Inspection/Monitoring/Evaluation (cont.)

Data	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6
Inspection results - if no indications of cracking or crazing, please indicate "no indications", otherwise please note "see attached" and provide details of findings.						
Is temperature (DH) and/or leakage (UH/H) monitoring data available and/or currently being collected for this line?						
If temperature (DH) and/or leakage (UH/H) monitoring is planned in the future, please enter the date (spring/fall and year) that monitoring will start.						
Has the CUF been determined for this line?[5]						
What is the CUF?						
Will a flaw tolerance calculation be used in place of a CUF analysis?						
Has a flaw tolerance evaluation been completed for this line?[6]						
If flaw tolerance evaluation has been completed, what was the required inspection frequency?						
If no CUF or flaw tolerance evaluation has been completed, when is this evaluation planned to be complete (spring/fall and year)?						
Will/Does the CUF or flaw tolerance evaluation rely on monitoring data?						

Please provide additional feedback, questions, or other comments relative to MRP-146 and the supplemental guidance in the space below or use an attachment.

[5] CUF calculation should use revised heat transfer coefficients in MRP-146S and (for DH lines) rely on assumptions and methodology similar to the generic analysis described in MRP-146S.

[6] Flaw tolerance evaluation as described in ASME Code Section XI, Appendix L. MRP-146S requirements allow for inspection frequencies based on this evaluation. Note that NRC approval of ASME Code Section XI, Appendix L is still pending.

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