Draft

Generic Relief Request
In Accordance with 10 CFR50.55a(g)(3)(ii)

--Hardship or Unusual Difficulty without Compensating Increase in Level of Quality or Safety--

1. <u>ASME Code Component(s) Affected</u>

Class 1 pressure retaining dissimilar metal piping welds, containing Alloy 82/182. American Society of Mechanical Engineers (ASME) Code Case N-770-1, Table 1, Examination Categories, Inspection Item B – Unmitigated butt weld at cold leg operating temperature. For some units, this may also include Inspection Item D – Uncracked butt weld mitigated with stress improvement.

2. <u>Applicable Code Edition and Addenda</u>

The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Rules for Inservice Inspection of Nuclear Power Plant Components, Section XI, as amended by 10CFR50.55a, is the code of record for all US operating plants.

10CFR50.55a(g)(6)(ii)(F)(1), effective date August 22, 2011, requires "licensees of existing, operating pressurized water reactors as of July 21, 2011, shall implement the requirements of ASME Code Case N-770-1, subject to the conditions specified in paragraphs (g)(6)(ii)(F)(2) through (g)(6)(ii)(F)(10) of this section, by the first refueling outage after August 22, 2011."

Additionally, 10CFR50.55a(g)(6)(ii)(F)(3) states that the baseline examinations for welds in Code Case N-770-1, Table 1, Inspection Item B, "*shall be completed by the end of the next refueling outage after January 20, 2012. Previous examinations of these welds can be credited for baseline examinations if they were performed within the re-inspection period for the weld item in Table 1 using Section XI, Appendix VIII requirements and met the Code required examination volume of essentially 100 percent. Other previous examinations that do not meet these requirements can be used to meet the baseline examination requirement, provided NRC approval of alternative inspection requirements in accordance with paragraphs (a)(3)(i) or (a)(3)(ii) of this section is granted prior to the end of the next refueling outage after January 20, 2012.*"

3. Applicable Code Requirement

ASME Code Case N-770-1 as Amended by 10CFR50.55a(g)(6)(ii)(F)(4)		
CLASS 1 PWR Pressure Retaining Dissimilar Metal Piping and Vessel Nozzle Butt Welds Containing Alloy 82/182		
Parts Examined	Insp Item	Extent and Frequency of Examination
Unmitigated butt weld at Cold Leg operating temperature (-2410) ≥ 525°F (274°C) and < 580°F (304°C)	B	Bare metal visual examination once per interval Essentially 100% volumetric examination for axial and circumferential flaws in accordance with the applicable requirements of ASME Section XI, Appendix VIII, every second inspection period not to exceed 7 years. Baseline examinations shall be completed by the end of the next refueling outage after January 20, 2012.

As defined by ASME Code Case N-460, essentially 100% means greater than 90% of the examination volume of each weld where reduction in coverage is due to interference by another component or part geometry.

ASME Section XI, Appendix VIII, Supplement 10, "Qualification Requirements for Dissimilar Metal Piping Welds" is applicable to dissimilar metal welds without cast materials. ASME Section XI, Appendix VIII, states that the supplement for the examination of cast stainless steel is "in the course of preparation".

4. Reason for Request

The PWROG is requesting permission to utilize the Ultrasonic examinations performed in accordance with MRP-139 during outages conducted prior to the issuance of the revised rule (in June of 2011) to satisfy the baseline examination requirements of 10CFR50.55a(g)(6)(ii)(F)(3). However, the welds listed within this request did not satisfy the required ASME Code Case N-770-1, as amended by 10CFR50.55a(g)(6)(ii)(F)(3), volume coverage due to their configuration. The scanning limitations prohibited essentially 100% ultrasonic examination coverage of the required examination volume.

10CFR50.55a(g)(6)(ii)(F)(4) provides the following exception to ASME Code Case N-770-1, "the axial examination coverage requirements of -2500(c) may not be considered to be satisfied unless essentially 100 percent coverage is achieved."

Relief is requested from the 10CFR50.55a(g)(6)(ii)(F)(4) exception to ASME Code Case N-770-1 that essentially 100% coverage be achieved of the inspection volume for the baseline and future required volumetric examinations.

5. Proposed Alternative and Basis for Use

Proposed Alternative

1) Periodic system pressure tests in accordance with ASME Section XI Category B-P, Table IWB-2500-1.

2) Conduct ultrasonic examinations to the maximum extent possible.
3) During refueling outages, system engineers walkdown Class 1 systems inside containment. This walkdown is performed to look for system anomalies that could affect plant performance. Each unit has a Boric Acid program, ensuring careful inspections and serious treatment of any findings.
4) Bare metal visual examinations of the Inspection Item B welds in accordance with ASME Code Case N-722-1. Those examinations identified no evidence of leakage for these components. The combination of these examinations provides confidence that an acceptable level of quality and safety has been maintained.
5) Coverage results which are less than those obtained in earlier inspections, as shown in Table 1, will be compiled and provided to the NRC.

Basis

The Combustion Engineering design contains a thirty (30) inch I.D. inlet and a thirty (30) inch I.D. outlet weld connected to each of the four (4) reactor coolant pumps (RCPs). Each weld joins mill-clad SA-516, Grade 70 carbon steel pipe with SA-240-304L stainless steel cladding to a SA-351, Grade CF8M stainless steel safe end. During the past several years, examinations have been performed on the eight reactor coolant pump inlet/outlet dissimilar metal welds utilizing manual Ultrasonic (UT) techniques from the OD. In all cases, the examinations were ASME Section XI Appendix VIII qualified, and were performed from the carbon steel side of the weld. The equipment, procedure, and personnel utilized for the performance of the examinations were qualified in accordance with the requirements of ASME Section XI, Appendix VIII, Supplement 10, as implemented through the Performance Demonstration Initiative (PDI) program.

Prior to the issuance of the revised final rule 10CFR50.55a, (effective date August 22, 2011), that includes the requirement to implement the requirements of ASME Code Case N-770-1 as amended, the Materials Reliability Program issued "Primary System Piping Butt Weld Inspection and Evaluation Guidelines (MRP-139)". This document was classified as "mandatory" per the implementation protocol of the Nuclear Energy Institute (NEI) 03-08 initiative. MRP-139 provided a strategy to manage degradation of dissimilar metal butt welds with Alloy 82/182 in primary system piping that are 1" NPS or greater and exposed to temperatures greater than or equal to cold leg temperature. The guideline was structured to categorize weld inspections to acknowledge mitigation, temperature, safety significance of flaw orientation, and inspection capabilities. The guideline defined examination locations on the piping, examination requirements for various weld categories, and extent of examination for each location. Finally, the guideline provided evaluation procedures to determine acceptance of flaws, justification for mitigation actions, and changing examination categories.

MRP-139 delineated acceptable coverage of the required examination volume to be calculated separately for axial and circumferential flaw orientations using the actual weld configuration and the procedure's essential variables, if needed. Coverage calculations could be made by manual plotting or by using computer-aided design (CAD) or other software that models the procedure's beam angles and scan plans.

- The inspection was considered complete when, using the qualified procedure and personnel, the coverage for both axial and circumferential flaws was greater than 90% of the required examination volume.

- If >90% coverage for circumferential or axial flaws was not attained then the following independent actions were required:

  – If greater than 90% coverage for circumferential flaws could not be met (using qualified personnel and procedures), then specific actions described within the document were required.

  – If greater than 90% coverage for axial flaws could not be met, but greater than 90% coverage was obtained for circumferential flaws (using qualified personnel and procedures), then the examination for axial flaws would be completed to achieve the maximum coverage possible with limitations noted in the examination report.

The UT techniques proposed for each weld were reviewed to determine the amount of examination coverage that could be achieved. Surface conditioning was performed as appropriate to obtain the maximum amount of coverage. As a result, very good coverage of the susceptible material in all 8 welds was examined for circumferential flaws. However, due to the weld taper and the lack of access for examination from the CF8M safe-end side of the welds, limited examination volume coverage was noted for axial flaws. Even with these limitations, this examination satisfied the examination volume coverage requirements identified in MRP-139.

Examination coverage was determined utilizing field-obtained contours. Since qualification for the UT examination of the cast material is "in the course of preparation" and no access was available for scanning from the cast side of the weld, no coverage was claimed in the cast material for MRP-139 or ASME Code Case N-770-1. For the MRP-139 axial and circumferential flaw examination volume coverage achieved, the calculation includes the carbon steel base material and susceptible material. For the ASME Code Case N-770-1 axial and circumferential flaw examination volume coverage achieved, the calculation includes the volume identified in Figure 1 of the code case (which includes the cast stainless steel). The amount of coverage that could be credited was determined in accordance with the qualified examination procedure.

Table 1 provides the percent of coverage credited for MRP-139, and Code Case N-770-1 (as amended by 10CFR50.55a(g)(6)(ii)(F)(4)), for the most recent examination. It references specific figures that illustrate the extent of coverage for each weld. The angles, Ultrasonic wave modes (Shear-S or Longitudinal-L) that were employed for the examinations, and limitations encountered are listed for each weld.

The examination volume coverage for MRP-139 included the carbon steel base material and susceptible material. As shown in Table 1, very good coverage of the examination volume for the safety significant circumferential flaw in the carbon steel base material and susceptible material was achieved during the MRP-139 examinations. However, the MRP-139 axial flaw examination volume coverage did not meet the essentially 100% requirement. As identified in MRP-109, the axial flaw(s) that could result from a primary water stress corrosion cracking (PWSCC) mechanism in the susceptible alloy 82/182 butt weld are not safety significant. The axial critical flaw length for an RCP inlet and outlet alloy 82/182 butt weld is 38.2" (MRP-109 Table 5-2) which exceeds the width of the RCP inlet and outlet alloy 82/182 butt weld material width of 1.75"-2.5". Therefore a critical axial flaw in an RCP inlet or outlet alloy 82/182 butt resulting from a PWSCC

mechanism is not credible and improving the exam axial flaw examination volume coverage would not result in an increase in safety.

6. Structural Integrity of these Regions

All of the welds covered by this relief are found in lower temperature regions of the system, typically at temperatures near to T_{cold}. This means there is a lower probability of crack initiation, and a slower crack growth rate. These welds are also very highly flaw tolerant, as demonstrated in the MRP-109 report. As shown in these references, continued operation without repair can be demonstrated for substantial flaw sizes.

Because of the limited access available for these regions, complete inspection coverage is difficult to obtain, and mitigation is not practical in most cases.

Although, in some cases, some contouring has already been completed on the region, to improve inspection coverage, further contouring would likely be necessary. Such actions are limited by design minimum wall calculations for the piping. If additional axial coverage were to be obtained, it would require weld build up of the DM weld, additional contouring and a Construction Code required RT examination. This additional contouring to improve axial coverage would be a hardship that would not result in an increase to health and safety of the public.

No flaws have been found in these regions, even though most of the plants of interest have been in service for over 25 years. A statistical treatment of this inspection data leads to a probability of cracking of these welds of between one and seven percent, by the end of the 60^{th} year of operation.

Therefore, examination coverage meeting the MRP-139 volume, which includes a large percentage of the susceptible material for the safety significant circumferential flaw and a significant percentage of the susceptible material for the non safety significant axial flaw combined with the periodic system pressure tests and outage system walk downs, provides an acceptable level of quality and safety for identifying degradation from PWSCC prior to a safety significant flaw developing.

7. Duration of Proposed Alternative

[Plant specific input here]

8. Conclusions

In July 2011, the NRC incorporated by reference ASME Code Case N-770-1 into 10 CFR 50.55a. Specific implementing requirements are documented in 10 CFR 50.55a(g)(6)(ii)(F). The relevant conditions applicable to DM welds are shown in Table 1.

Item (2) of 10 CFR 50.55a(g)(6)(ii)(F) requires the applicable DM welds to be categorized in accordance with ASME Code Case N-770-1, Table 1. This relief applies only to those DM welds which have been categorized as Inspection Item B.

Item (3) of 10 CFR 50.55a(g)(6)(ii)(F) requires that baseline examinations for the welds in ASME Code Case N-770-1, Table 1 be completed by the end of the next refueling outage

after January 20, 2012. Previous examinations may be credited if they have met the following criteria:

1. Examinations were performed using a procedure that meets the requirements of ASME Code Section XI, Appendix VIII and;
2. The Code required examination volume of essentially 100 percent coverage has been obtained.

If the previous examinations do not meet these requirements, they still can be used to meet the baseline examination requirements, provided that NRC approval of alternative inspection requirements is granted prior to the end of the next refueling outage after January 20, 2012.

Due to the fact that not including the examination volume scanned from the cast stainless steel side and specific geometric limitations prevents essentially 100 percent examination volume coverage from being obtained, relief is requested for an alternative in order for the examinations previously conducted to meet the baseline examination requirements of Item (3).

All examinations were performed in accordance with MRP-139 requirements and meet current ASME Code Case N-770-1 requirements. Results from the examinations were documented in the ISI refueling outage report. However with the conditions imposed by 10 CFR 50.55a(g)(6)(ii)(F) (3) and (4), all welds with cast stainless steel material do not meet these conditions. Therefore, reasonable assurance of quality and safety is based on the achieved coverage and the ASME Code Case N-722 VE examinations performed.

9. References

10CFR50.55a

ASME Section XI, "Rules For Inservice Inspection of Nuclear Power Plant Components," 1998 Edition with Addenda through 2000

ASME Section XI, Division 1, Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1"

Material Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guideline (MRP-139, Revision 1), EPRI, Palo Alto, CA: 2008. 1015009

Nondestructive Evaluation: Procedure for Manual Phased Array Ultrasonic Testing (UT) of Dissimilar Metal Welds (DMW), EPRI Palo Alto, CA: 2008. 1016645

Material Reliability Program, Alloy 82/182 Pipe Butt Weld Safety Assessment for US PWR Plant Designs (MRP-109): Westinghouse and CE Design Plants, EPRI, Palo Alto, CA: 2005. 1009804.

"Changing the Frequency of Inspections for PWSCC Susceptible Welds at Cold Leg Temperatures", in Proceedings of 2011 ASME Pressure Vessels and Piping Conference, July 17-21, 2011, Baltimore, Maryland, USA .

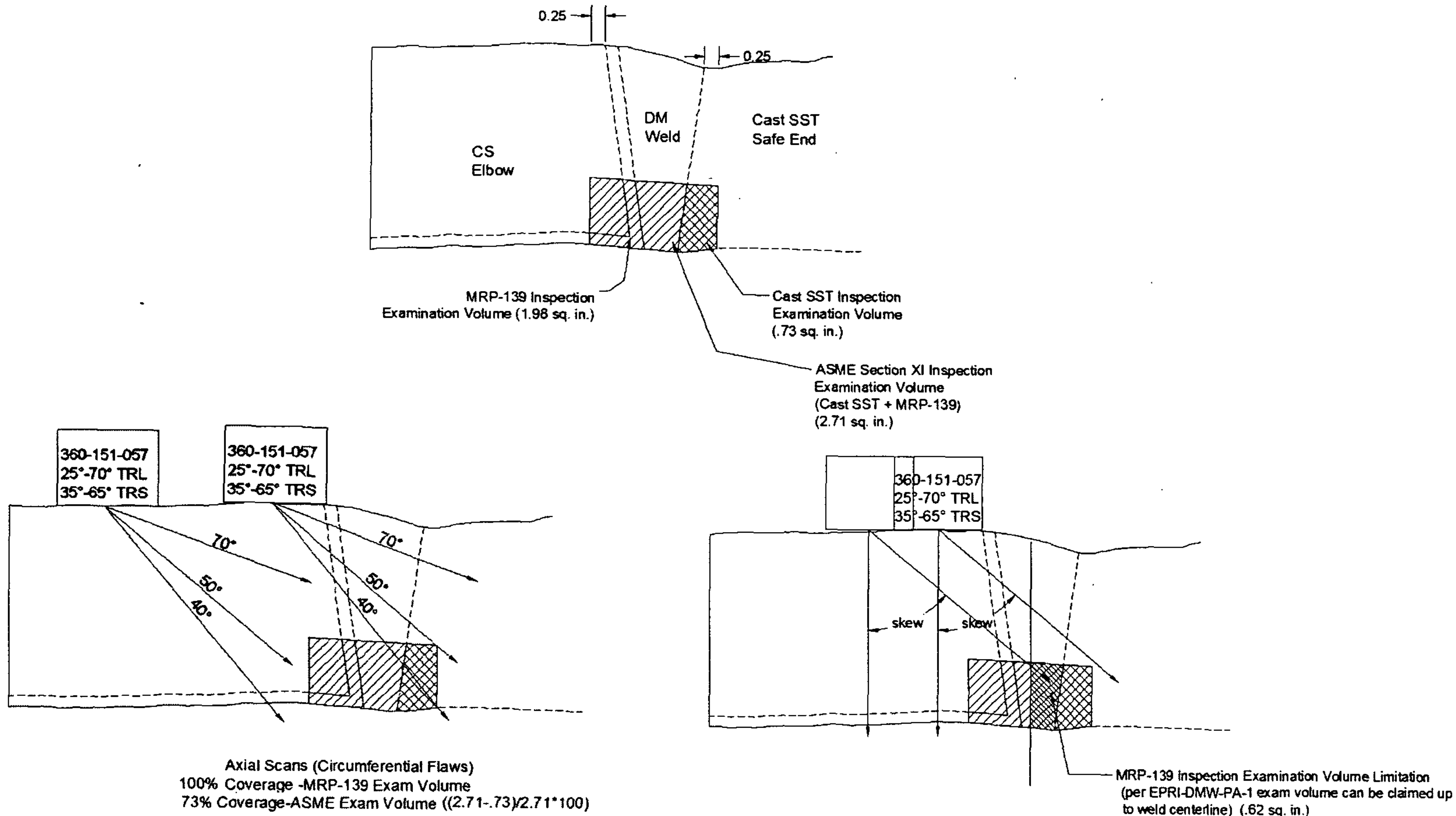
"Technical Basis for a Flaw tolerance Option for Code Case N-770-1 for Large Diameter Cold Leg Piping to Main Coolant Pump Welds, with Obstructions", in Proceedings of 2010 ASME Pressure Vessels and Piping Division Conference, July 2010, Bellevue, WA, USA

Table 1: Inspection Coverage (example1; plant specific input here)

Component	Component ID Thickness	MRP-139[1] Volume Coverage		N-770-1[2] Volume Coverage		Angle(s)/Wave Mode	Fig.	Comments/Limitation
		Axial Flaw	Circ Flaw	Axial Flaw	Circ Flaw			
RCP 2A1 Inlet Elbow(CS) to Safe-end (Cast SS)	RC-112-1501-771-C	69%	100%	50%	73%	25-70L 35-65S	1	Cast SS, Weld Taper
RCP 2A1 Outlet Safe-end (Cast SS) to Pipe(CS)	RC-112-1066-771	66%	100%	49%	74%	25-70L 35-65S	2	Cast SS, Weld Taper
RCP 2A2 Inlet Elbow(CS) to Safe-end (Cast SS)	RC-115-1501-771-A	64%	100%	52%	82%	25-70L 35-65S	3	Cast SS, Weld Taper
RCP 2A2 Outlet Safe-end (Cast SS) to Pipe (CS)	RC-115-701-771	68%	97%	49%	71%	25-70L 35-65S	4	Cast SS, Weld Taper
RCP 2B1 Inlet Elbow (CS) to Safe-end (Cast SS)	RC-121-1501-771-B	66%	99%	52%	78%	25-70L 35-65S	5	Cast SS, Weld Taper
RCP 2B1 Outlet Safe-end (Cast SS) to Pipe (CS)	RC-121-901-771	64%	99.4 %	51%	77.9 %	25-70L 35-65S	6,7	Cast SS, Weld Taper, Spray Nozzle
RCP 2B2 Inlet Elbow (CS) to Safe-end (Cast SS)	RC-124-1501-771-D	67%	100%	49%	72%	25-70L 35-65S	8	Cast SS, Weld Taper
RCP 2B2 Outlet Safe-end (Cast SS) to Pipe (CS)	RC-124-1301-771	66%	99.1 %	50%	77%	25-70L 35-65S	9, 10	Cast SS, Weld Taper, Spray Nozzle

Note 1-For the MRP-139 axial and circumferential flaw examination volume coverage achieved, the calculation includes the carbon steel base material and susceptible material.
Note 2-For the ASME Code Case N-770-1 axial and circumferential flaw examination volume coverage achieved, the calculation includes the volume identified in Figure 1 of the code case.

TABLE 1: INSPECTION COVERAGE OF DM WELD POPULATION (EXAMPLE 2, PLANT SPECIFIC INFORMATION HERE)									
DM Weld Designator / ID	Location	Nozzle Size	Inspection Item Category	ASME Section XI Coverage	ASME Axial Scan (%)	ASME Circ Scan (%)	MRP-139 Coverage	MRP-139 Axial Scan (%)	MRP-139 Circ Scan (%)
109280 / 30-RC-21A-7	**21A RCP Inlet**	30"	B	57.60%	68.6	46.5	91.50%	100	83
109310 / 30-RC-21A-10	**21A RCP Outlet**	30"	B	57.50%	64	51	89.50%	97	82
110280 / 30-RC-21B-7	**21B RCP Inlet**	30"	B	35.00%	40.7	29.4	94.50%	100	89
110310 / 30-RC-21B-10	**21B RCP Outlet**	30"	B	50.20%	60.3	40	89.50%	94	85
111280 / 30-RC-22A-7	**22A RCP Inlet**	30"	B	49.00%	55	43	92.50%	100	85
111310 / 30-RC-22A-10	**22A RCP Outlet**	30"	B	62.60%	68.2	57	92.50%	100	85
112280 / 30-RC-22B-7	**22B RCP Inlet**	30"	B	51.00%	58	44	93.50%	100	87
112310 / 30-RC-22B-10	**22B RCP Outlet**	30"	B	61.00%	72	50	87.00%	100	74
115140 / 12-SI-2009-15	**Safety Injection to 21B Cold Leg**	12"	B	68.00%	68	68	100%	100	100
116190 / 12-SI-2010-13	**Safety Injection to 21A Cold Leg**	12"	B	71.00%	71	71	100%	100	100
117120 / 12-SI-2011-13	**Safety Injection to 22B Cold Leg**	12"	B	68.50%	68.5	68.5	100%	100	100
118120 / 12-SI-2012-13	**Safety Injection to 22A Cold Leg**	12"	B	71.00%	71	71	100%	100	100
137010 / 3-PS-2001-1	**PZR Spray from 21A Cold Leg**	3"	B	100%	100	100	100%	100	100
138010 / 3-PS-2002-1	**PZR Spray from 21B Cold Leg**	3"	B	100%	100	100	100%	100	100



Axial Scans (Circumferential Flaws)
100% Coverage -MRP-139 Exam Volume
73% Coverage-ASME Exam Volume ((2.71-.73)/2.71*100)
(Cast SS exam volume excluded)

Circ Scans (Axial Flaws)
69% Coverage-MRP-139 Volume ((1.98-.62)/1.98*100)
50% Coverage-ASME Exam Volume (2.71-.62-.73)/2.71*100)
(cast SS exam volume excluded; exams not conducted on weld due to taper)

Figure 1
RCP Inlet Nozzle Coverage (example; Plant specific input needed here)

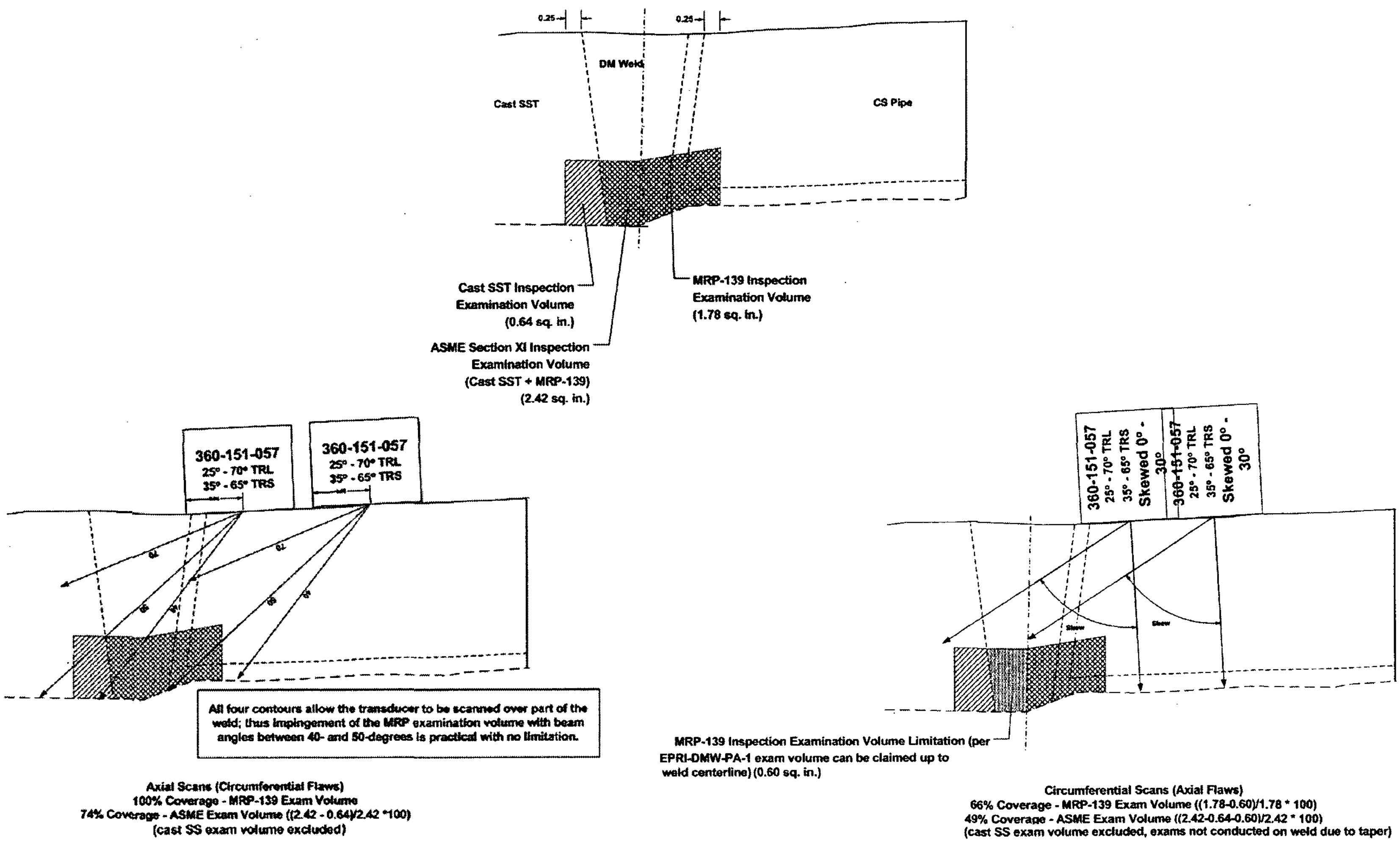


Figure 2
Outlet Nozzle (example; plant specific input here)