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March 5, 2016

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Calvert Cliffs Nuclear Power Plant, Unit No. 1
Renewed Facility Operating License No. DPR-53
NRC Docket No. 50-317

Subject: Information Concerning Dissimilar Metal Weld in Pressurizer Safety Relief Nozzle-to-Safe-End Weld

References:
1. Letter from N. L. Salgado (NRC) to G. H. Gellrich (CCNPP), dated February 24, 2011, Relief from the Requirements of the ASME Code
2. Letter from D. T. Gudger (Exelon) to Document Control Desk (NRC), dated February 25, 2016, Report Concerning Dissimilar Metal Weld Flaw in Pressurizer Safety Relief Nozzle-to-Safe-End Weld

In Reference 1, Calvert Cliffs Nuclear Power Plant, LLC was granted a relief from certain requirements of the American Society of Mechanical Engineers Code for dissimilar metal weld repairs. Reference 1 required that certain information related to a repair performed using this Code relief be provided to the Nuclear Regulatory Commission prior to entry into Mode 4 following the weld repair. A dissimilar metal weld on the Unit 1 pressurizer safety valve line was repaired during the current refueling outage using techniques approved by the subject Code relief. Attachments (1) and (2) contain the required weld overlay sizing analysis and the weld overlay material and size dimension drawing. The attached information, when combined with information previously submitted in Reference 2, meets the requirement to submit the required information prior to Unit 1 entry into Mode 4 conditions.

A047
NRR

Should you have questions regarding this matter, please contact Mr. Larry D. Smith at (410) 495-5219.

Respectfully,

George H. Gellrich
Site Vice President

GHG/KLG/psf

Attachments: (1) Full Structural Weld Overlay Sizing for the Four-Inch Pressurizer Safety/Relief Valve Nozzles

(2) Drawing 12024-0051 SH0001

cc: NRC Project Manager, Calvert Cliffs
NRC Regional Administrator, Region I
NRC Resident Inspector, Calvert Cliffs
S. Gray, MD-DNR

ATTACHMENT (1)

FULL STRUCTURAL WELD OVERLAY SIZING FOR THE FOUR-INCH PRESSURIZER SAFETY/RELIEF VALVE NOZZLES

Calvert Cliffs Nuclear Power Plant
March 5, 2016

DESCRIPTION OF CONFIGURATION AND REPAIR PROCESS

The safety and relief valve nozzles are located in the upper head of the pressurizer and are fabricated with SA-508 Class 2 [7, Sections 2-2-4 and 2-2-5] and are fitted with a SA-182 F316 safe end [7, Sections 2-2-4 and 2-2-5]. The dissimilar metal weld (DMW) which joins the pressurizer safety/relief nozzles to the safe ends are fabricated using Alloy 82/182 [10] nickel based weld metal.

The full structural overlay repair will be performed using primary water stress corrosion cracking (PWSCC) resistant Alloy 52M material deposited around the circumference of the configuration. The overlay material will be deposited using the machine gas tungsten arc welding (GTAW) process. For the Alloy 52M weld overlay filler metal, the selected material is SB-166, Rod & Bar, Alloy 690 (58Ni-29Cr-9Fe) [6].

ASME CODE CRITERIA

The applicable ASME Code, Section XI edition for Calvert Cliffs Nuclear Power Plant, Units 1 and 2 is the 2004 Edition [3] per Section 1.4 of Reference 11. The basis for FSWOL sizing is the ASME Code, Section XI, Code Case N-740-2 [1] and the ASME Code, Section XI, Division 1, Class 1 [3] rules for allowable flaw sizes in austenitic and ferritic piping (IWB-3640). The ASME Code, Section XI, Code Case N-740-2 [1] incorporates the weld repair by overlay approach documented in Code Case N-504-3 [4], and the temper bead welding approach documented in Code Case N-638-1 [8], and applies these to similar and dissimilar metal welds. To determine the overlay thickness, Code Case N-740-2 refers to the requirements of ASME Code, Section XI, IWB-3640. IWB-3640 of the applicable Code refers to Appendix C, which contains the specific methodology for meeting the allowable flaw sizes. The overlays are to be applied using the GTAW process, which is a nonflux process. Therefore, for circumferential flaws, the source equations in Appendix C, Section C-5320 (limit load criteria) are the controlling allowable flaw size equations for combined loading (membrane plus bending) and membrane-only loading. These equations are valid for flaw depth-to-thickness ratios for flaw lengths ranging from 0 to 100% of the circumference as defined in Section C-5320 of Appendix C. For purposes of designing the overlay, a circumferential flaw is assumed to be 100% through the original wall thickness for the entire circumference of the item being overlaid.

The overlay is sized by using the source equations in Section C-5320 [3].

The allowable bending stress under combined membrane plus bending loads is given by the equation:

$$S_c = \frac{\sigma_b^c}{SF_b} - \sigma_m\left[1 - \frac{1}{SF_m}\right] \qquad \text{C-5321}$$

where,

$$\sigma_b^c = \frac{2\sigma_f}{\pi}\left(2 - \frac{a}{t}\right)\sin\beta, \text{ for } (\theta+\beta) > \pi,$$

$$\beta = \frac{\pi}{2 - \frac{a}{t}}\left(1 - \frac{a}{t} - \frac{\sigma_m}{\sigma_f}\right)$$

The allowable membrane stress is given by the equation:

$$S_t = \frac{\sigma_m^c}{SF_m} \qquad \text{C-5322}$$

where,

$$\sigma_m^c = \sigma_f\left[1 - \left(\frac{a}{t}\right)\left(\frac{\theta}{\pi}\right) - \frac{2\varphi}{\pi}\right],$$

$$\varphi = \arcsin\left[0.5\left(\frac{a}{t}\right)\sin\theta\right],$$

and

S_c = allowable bending stress for a circumferentially flawed pipe
σ^c_b = bending stress at incipient plastic collapse
SF_m = safety factor for membrane stress based on Service Level as shown in Table 1 [3, C-2621]
SF_b = safety factor for bending stress based on Service Level as shown in Table 1 [3, C-2621]
a = flaw depth
t = total wall thickness (includes overlay thickness, in this case)
S_t = allowable membrane stress for a circumferentially flawed pipe
σ^c_m = membrane stress at incipient plastic collapse
θ = half flaw angle [3, Figure C-4310-1], 180° or π for a 100% full circumferential flaw
β = angle to neutral axis of flawed pipe in radians
σ_m = unintensified primary membrane stress at the flaw location
σ_f = flow stress = $(S_y + S_u)/2$ [3, C-8200(a)]
S_y = specified value for material yield strength [6] at the evaluation (operating) temperature
S_u = specified value for material ultimate strength [6] at the evaluation (operating) temperature

Safety factors are provided in Appendix C of Section XI for evaluation of flaws in austenitic stainless steel piping. The safety factors used for the weld overlay sizing are shown in Table 1 and are taken from C-2621 [3].

Table 1: Safety Factors for Sizing – Circumferential Flaw

Service Level	Membrane Stress Safety Factor, SF_m	Bending Stress Safety Factor, SF_b
A	2.7	2.3
B	2.4	2.0
C	1.8	1.6
D	1.3	1.4

The overlay thickness must be established so that the flaw assumption herein meets the allowable flaw depth-to-thickness ratio requirement of the source equations [3, C-5320], for the thickness of the weld-overlaid item, considering primary membrane-plus-bending stresses, as well as membrane only stresses, per the source equations defined previously. Since the weld overlay is austenitic material and applied with a nonflux welding process, which has high fracture toughness, the limit load failure mode is applicable [3, Figure C-4210-1 for nonflux welds] and, hence, limit load evaluation techniques are used here.

The non-overlaid piping stresses for use in the equations are usually obtained from the applicable stress reports for the items to be overlaid. However, in this calculation, since the stresses are not provided, they are calculated based on forces and moments at the welds using equations from C-2500 of Section XI, Appendix C as described below.

Primary membrane stress (σ_m) is given by:

$\sigma_m = pD/(4t)$, where:

- p = maximum operating pressure for the Service Level being considered
- D = outside diameter of the component including the overlay
- t = thickness, consistent with the location at which the outside diameter is taken including the overlay (note that any inside diameter (ID) cladding is not counted toward wall thickness)

Primary bending stress (σ_b) is given by:

$\sigma_b = DM_b/(2I)$, where:

- D = outside diameter of the component including the overlay
- d = inside diameter consistent with the point at which the outside diameter is taken (note that ID cladding is not counted toward the inside diameter)
- M_b = resultant moment for the appropriate primary load combination for each Service Level (square root of the sum of the squares (SRSS) of three moment components in X, Y, and Z directions)
- I = moment of inertia, $(\pi/64)(D^4 - d^4)$.

The contribution of axial and shear forces to piping stress (other than force couples contributing to moments) is not included based on C-2500 of Section XI, Appendix C [3].

The following load combinations are used for the full structural weld overlay. These are equivalent to the load combinations defined in Reference 2 (Page 13):

Service Level A (Normal): Pressure (P) + Deadweight (DW)
Service Level B (Upset): P + DW + SRSS (Relief valve discharge transient (PORV) + Operating basis earthquake (OBE))
Service Level C (Emergency): P + DW + SRSS (PORV + Design basis earthquake (DBE))
Service Level D (Faulted): P + DW + SRSS (Safety valve discharge transient (SRV) or Once through core cooling transient (OTCC) + DBE)

Reference 2 (Page 13) states that the dynamic loads (PORV, OBE, DBE, SRV, OTCC) are combined using the SRSS method.

Service Levels A, B, C, and D in the ASME Code [3] are alternatively referred as Normal, Upset, Emergency, and Faulted conditions, respectively, in this evaluation. Per ASME Code, Section XI, C-5311 for the Combined Loading case, test conditions shall be included with the Service Level B Load Combination. However, the hydrostatic pressure test is not applicable to the weld overlay repair and is not included in the FSWOL design. In addition, the leak test requirement per ASME Code, Section XI, IWB-5220 is included in the design of the FSWOL since the leak test pressure (2250 psia given in Table 1-1, Pressure Vessel, of Reference 7) is the same as the operating pressure of 2250 psia [Table 1-1, Pressure Vessel, of Reference 7]. Therefore, no additional test condition needs to be included with the Service Level B Load Combination.

The weld overlay sizing is an iterative process, in which the allowable stresses are calculated and then compared to the stresses in the overlaid component. If the stresses in the component are larger than the allowable stresses in the component then the overlay thickness is increased, and the process is repeated until it converges to an overlay thickness which meets the allowable stresses.

The thickness of the weld overlay is determined through an iterative process. The thickness of the overlay (t_{ol}) is assumed resulting in total thickness of ($t_p + t_{ol}$) where t_p is the original pipe thickness. The applied flaw size-to-thickness ratio based on a FSWOL (flawed through the original pipe wall thickness, t_p) is $t_p/(t_p + t_{ol})$. The allowable stresses are then determined from the source equations (see Section 3.0). If this allowable stress value is greater than the calculated stress for the overlaid component, the overlay thickness (t_{ol}) is reduced. On the other hand, if the allowable stress value is less than the calculated stress for the overlaid component, the overlay thickness (t_{ol}) is increased. The process is repeated until the assumed overlay thickness results in a stress ratio of the calculated stress to the allowable stress that is equal or less than 1.0. As the maximum allowed value for a/t is 0.75 [3, C-5320], t_{ol} is initially set as $t_p/3$. If the overlay thickness of $t_p/3$ meets the allowable stresses for pure membrane and combined membrane plus bending stresses, then no more iterations are performed. If the allowable stresses are not met, then the overlay thickness is increased until the ratio of the computed stress to the allowable stress is less than or equal to 1.0.

WELD OVERLAY THICKNESS SIZING

The operating pressure [7, Table 1-1], dimensions [5] and overlay thickness are shown in Table 4. At the nozzle side of the DMW, Location 1A includes the thickness of the ferritic nozzle plus the thickness of the ID clad/buttering, while Location 1B considers only the thickness of the ferritic nozzle (excluding the thickness of the ID clad/buttering) (see Figure 1). An initial a/t value of 0.75 (the limiting value as stated in C-5322 of Appendix C of Section XI [3]) was the initial input to the iteration. The assumed 360° flaw results in a flaw length to circumference ratio of 1.0. Figure 1 shows the locations for full structural weld overlay (FSWOL) sizing.

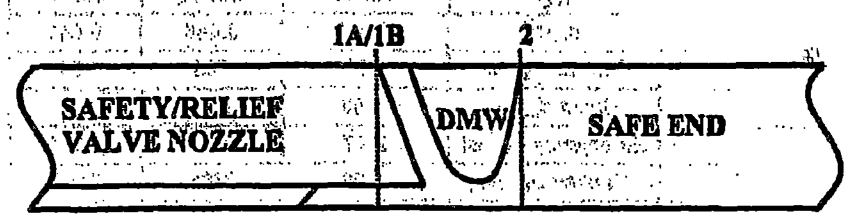


Figure 1: Locations Examined for FSWOL Sizing

Table 4: Dimensions for Overlay Sizing

	Location 1A Nozzle (w/butter)	Location 1B Nozzle (w/o butter)	Location 2 Nozzle/SE Weld
p, psig	2235	2235	2235
t_{pipe}, in	1.313	1.094	1.313
a/t	0.75	0.75	0.75
t_{ol}, in	0.438	0.365	0.438
$t_{pipe+ol}$, in	1.75	1.46	1.75
D_{ol}, in	6.938	6.792	6.938
I, in^4 Pipe + Overlay	106.85	93.38	106.85

The final calculated membrane stresses (σ_m) and bending stresses (σ_b) at each service level for the pipe + overlay configuration are shown in Table 5. This table also shows the ratio of the membrane stress (σ_m) to the flow stress (σ_f) at the selected locations. The material properties are evaluated at the normal operating temperature of 653° F [7, Table 1-1] using Section II, Part D of the ASME Code [6].

Table 5: Calculated Stresses

		Location 1A Nozzle (w/butter)	Location 1B Nozzle (w/o butter)	Location 2 Nozzle/SE Weld
Service Level	σ_m, psi	2215	2602	2215
	S_y, psi	27500	27500	27500
	S_u, psi	79988	79988	79988
	σ_f, psi	53744	53744	53744
	σ_m/σ_f	0.041	0.048	0.041
A	Normal σ_b, psi	701	785	701
B	Upset σ_b, psi	1553	1740	1553
C	Emergency σ_b, psi	2077	2327	2077
D	Faulted σ_b, psi	2108	2361	2108

Table 6 shows the allowable stresses as determined from the source equations discussed in Section 3.0. The membrane and bending stresses from Table 5 are compared to the allowable stresses as shown by the ratios in Table 6. The limiting cases for the membrane and bending stresses are shown in bold. In the limit load analyses, the flow stress of the Alloy 52M weld overlay material is used, consistent with the assumption of a full 360° flaw through the original pipe wall for the design of the full structural weld overlay.

Table 6: Allowable Stresses and Calculated Stress to Allowable Stress Ratios

Service Level		Location 1A Nozzle (w/butter)	Location 1B Nozzle (w/o butter)	Location 2 Nozzle/SE Weld
	β	0.5247	0.5066	0.5247
	σ^c_b, psi	21426	20753	21426
Level A	Normal S_c, psi	7921	7385	7921
Level B	Upset S_c, psi	9421	8859	9421
Level C	Emergency S_c, psi	12407	11814	12407
Level D	Faulted S_c, psi	14793	14223	14793
Level A	Normal σ_b/S_c	0.0884	0.1063	0.0884
Level B	Upset σ_b/S_c	0.1648	0.1964	0.1648
Level C	Emergency σ_b/S_c	0.1674	0.1970	0.1674
Level D	Faulted σ_b/S_c	0.1425	0.1660	0.1425
	σ^c_m, psi	13436	13436	13436
Level A	Normal S_t, psi	4976	4976	4976
Level B	Upset S_t, psi	5598	5599	5598
Level C	Emergency S_t, psi	7464	7465	7464
Level D	Faulted S_t, psi	10335	10336	10335
Level A	Normal σ_m/S_t	0.4451	0.5229	0.4451
Level B	Upset σ_m/S_t	0.3957	0.4648	0.3957
Level C	Emergency σ_m/S_t	0.2967	0.3486	0.2967
Level D	Faulted σ_m/S_t	0.2143	0.2518	0.2143

Notes: σ_c^b –Bending stress at incipient plastic collapse [3, C-5320]
S_c –Allowable bending stress [3, C-5320]
S_t –Allowable membrane stress [3, C-5320]
σ_c^m –Membrane stress at incipient plastic collapse [3, C-5320]
(All terms defined in Section 3.0)

WELD OVERLAY LENGTH REQUIREMENTS

The weld overlay length must consider three requirements: (1) length required for structural reinforcement, (2) length required for preservice examination access of the overlaid weld, and (3) limitation on the area of the nozzle surface that can be overlaid.

Structural Reinforcement

Structural reinforcement requirements are expected to be satisfied if the weld overlay length is $0.75\sqrt{Rt}$ on either side of the susceptible weld being overlaid [1], where R is outside radius of the item and t is the nominal thickness of the item at the applicable side of the overlay. However, to assure ASME Code, Section III, NB-3200 [9] compliance, detailed shear stress calculations are instead performed to determine the minimum required structural length.

The section along the length of the overlay is evaluated for axial shear due to transfer of axial load and moment from the overlaid item to the overlay. Subparagraph NB-3227.2 [9] limits pure shear due to Design Loadings, Test Loading or any Service Level loadings except Service Level D to $0.6S_m$. Therefore, $0.6S_m$ is used for Service Levels A, B, and C. For Service Level D (Faulted) conditions, the stress intensity limit is the lesser of $2.4S_m$ or $0.7S_u$ [9, NB-3225 and Appendix F], equivalent to the lesser of $1.2S_m$ or $0.35S_u$ for shear stress. These values are shown in Table 7 for the safe end, nozzle and weld overlay materials.

Shear stress around the circumference at the overlay-base material interface due to axial force and moment loading equals:

$$\tau = P \times \pi \times R_o^2/A_s + M/S_s$$

where:

- R_o = outside radius of overlaid item at crack
- L = length of overlay at outside surface of overlaid item on one side of crack
- A_s = shear area, $2\pi R_o L$
- S_s = $\pi R_o^2 L$
- P = pressure, psig
- M = resultant moment from piping interface loads at crack

Thus $$\tau = P\pi R_o^2/(2\pi R_o L) + M/(\pi R_o^2 L)$$

Solving for L and equating τ with the allowable shear stress (S_{allow}) yields:

$$L = [PR_o/2 + M/(\pi R_o^2)]/S_{allow}, \text{ where:}$$

S_{allow} = $0.6S_m$ (Service Levels A, B, and C)
= Lesser of $1.2S_m$ and $0.35S_u$ (Service Level D)

The evaluation for required length is documented in Table 7 for the pressurizer safety/relief valve nozzles and safe ends. The overlay weld metal is also evaluated (at the smallest diameter) as it may control if the base metal has a higher value of S_m. The greater value of the required overlay length will be taken. The material properties are evaluated at the normal operating temperature of 653°F [7, Table 1-1] using Section II, Part D of the ASME Code [6].

Table 7: Minimum Required Overlay Length

	Location 1A, 1B	Location 2	Location 1A/1B/2
	Nozzle Side of DMW	Safe End Side of DMW	Weld Metal at Nozzle/Safe End Side of Weld
R_o, in	3.03	3.03	3.03
Material	SA-508 Class 2	SA-182 F316	Alloy 52M
Sm, ksi	26.70	16.58	23.30
Service Level A $0.6S_m$, ksi	16.02	9.95	13.98
Service Level B $0.6S_m$, ksi	16.02	9.95	13.98
Service Level C $0.6S_m$, ksi	16.02	9.95	13.98
Service Level D $1.2S_m$, ksi	32.04	19.90	27.96
S_u, ksi	80	71.8	79.99
Service Level D $0.35S_u$, ksi	28	25.13	28.00
Service Level A L, in	0.258	0.416	0.296
Service Level B L, in	0.316	0.507	0.361
Service Level C L, in	0.350	0.563	0.401
Service Level D L, in	0.201	0.283	0.202

The required overlay length is calculated at Locations 1A, 1B, and 2 along the nozzle and safe end configuration (see Figure 1). Note that these locations are evaluated twice; with WOL metal and nozzle and safe end base metal (see Table 7). The design drawing implements a configuration that meets all the designed FSWOL thickness and length requirements.

The lengths shown in Table 7 ensure adequate shear stress transfer along the length of the weld overlay. Service Level C is the most limiting of all cases. This length is sufficient to transfer the imposed loads and maintain stresses (shear) within the appropriate ASME Code allowable limits.

In addition to the necessary shear transfer length, the overlay must be inspectable by PDI qualified UT methods. Any additional length determined to be necessary by the UT personnel for proper PDI qualified inspection will be noted on a design drawing.

Preservice Examination

Weld overlay access for preservice examination requires that the overlay length and profile be such that the overlaid weld and any adjacent welds can be inspected using the required NDE techniques. This requirement could cause the overlay length to be longer than required for structural reinforcement. The specific overlay length required for preservice examination is determined based on the examination techniques and proximity of adjacent welds to be inspected.

Area Limitation on Nozzle

The total weld overlay surface area is limited to 500 in^2 [1, Section I-1] (this value will be specified in the relief request) on the nozzle (ferritic base material) when using ambient temperature temper bead welding to apply the overlay. Using an outside diameter of 6.0625", the maximum length is limited to $500/(\pi D_o) = 26.25$" on the ferritic steel nozzle material. The required overlay length on the nozzle is less than this limit (see Table 7).

Maximum Overlay Sizing

This calculation documents the minimum overlay thickness and length necessary for structural requirements. Additional thickness and length may be added to address inspectability and crack growth concerns. In addition, a maximum overlay thickness (typically an additional 0.25") and a maximum overlay length will be determined. The determination of the maximum length is based on implementation factors and is intended to be large enough so as to not unnecessarily constrain the overlay process. These dimensions will be indicated on a subsequent design drawing to create a "box" within which the overlay is analyzed. In the subsequent analyses, the finite element models use the geometry (minimum or maximum) that will produce conservative results.

DISCUSSIONS AND CONCLUSIONS

Table 8 and Figure 2 summarize the minimum required overlay dimensions. This calculation documents the development of a weld overlay design for the pressurizer safety/relief valve nozzle-to-safe end DMWs at the Calvert Cliffs Nuclear Power Plant, Units 1 and 2. The design meets the requirements of the ASME Code, Section XI, Code Case N-740-2 [1] and ASME Code, Section XI, Appendix C [3] for a full structural weld overlay.

The weld overlay sizing presented in Table 8 is based upon the primary loadings documented in Section 4.0 and using the criteria from the ASME Code, Section XI, Appendix C. The overlay thicknesses and lengths listed in Table 8 meet ASME Code stress criteria.

Table 8: Minimum Required Overlay Dimensions

Location	Thickness (in)	Length (in)
Nozzle Side of DMW (1A/1B)	0.438	0.401
Safe End Side of DMW (2)	0.438	0.564

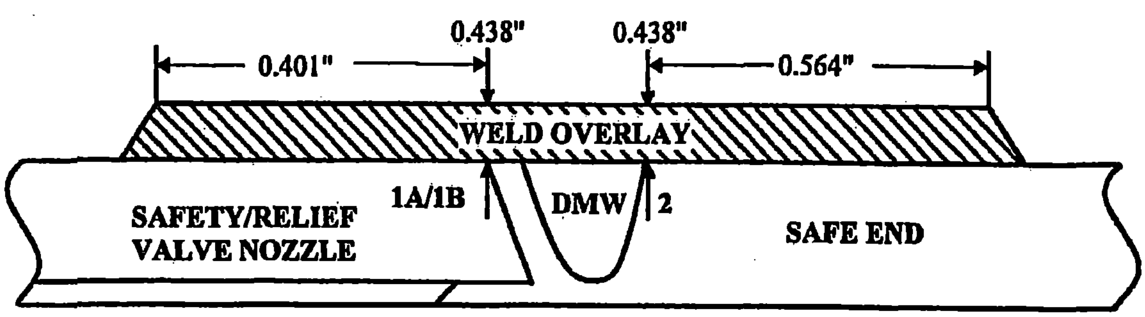


Figure 2: Full Structural Weld Overlay Geometry, Minimum Dimensions (Schematic Representation)

REFERENCES

1. ASME Boiler and Pressure Vessel Code, Code Case N-740-2, "Full Structural Dissimilar Metal Weld Overlay for Repair or Mitigation of Class 1, 2, and 3 Items, Section XI, Division 1."

2. Calvert Cliffs Design Calculation No. CA05999, "Unit 2 Pressurizer Relief Valve Class 1 Analysis," Rev. 0, SI File No. 0801014.216.

3. ASME Boiler and Pressure Vessel Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, 2004 Edition.

4. ASME Boiler and Pressure Vessel Code, Code Case N-504-3, "Alternative Rules for Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1."

5. Calvert Cliffs Drawing No. 12019-12, Rev. 2, "Nozzle Details for 6750-M-485-15-4, 96" I.D. Pressurizer," SI File No. 0801014.215.

6. ASME Boiler and Pressure Vessel Code, Section II, Part D, Material Properties, 2004 Edition.

7. Combustion Engineering Book No. 72367, "Instruction Manual, Pressurizer, Calvert Cliffs Station" SI File No. 0801014.213.

8. ASME Boiler and Pressure Vessel Code, Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique, Section XI, Division 1."

9. ASME Boiler and Pressure Vessel Code, Section III, Rules for Construction of Nuclear Facility Components, 2004 Edition.

10. CCNPP Table 21-4, "Unit 1 Alloy 82/182 Full Penetration Welds," SI File No. 0801014.205.

11. Attachment (1) to Constellation Energy Letter to USNRC, December 29, 2008, "Fourth Interval Inservice Inspection Program Plan for Calvert Cliffs Nuclear Power Plant Units 1 and 2," Rev. 0, SI File No. 0801014.211.

12. CCNPP Design Specification No. 8067-31-4, "Project Specification for a Pressurizer Assembly for Calvert Cliffs 1 & 2," Rev. 12, Feb 2006, SI File No. 0801014.212.

ATTACHMENT 2

DRAWING 12024-0051 SH0001

STOP, THINK, ACT AND REVIEW

NOTES:

1. COMPONENT SURFACE IS TO BE EXAMINED BY THE LIQUID PENETRANT METHOD (IN ACCORDANCE WITH THE CALVERT CLIFFS RELIEF REQUEST WHICH IS BASED ON ASME CODE CASE N-740-2) AND DETERMINED TO BE ACCEPTABLE PRIOR TO OVERLAY APPLICATION. THE SURFACE TO BE EXAMINED SHALL EXTEND BEYOND THE SURFACE TO BE OVERLAYED BY ½". IN THE EVENT THAT THE ORIGINAL COMPONENT SURFACE IS FOUND UNACCEPTABLE, THE SURFACE SHALL BE PREPARED/REPAIRED IN ACCORDANCE WITH THE OWNERS ASME SECTION XI PROGRAM AND APPLICABLE RELIEF REQUEST AND REEXAMINED. ANY DEPOSITED WELD LAYER(S) REQUIRED FOR COMPONENT SURFACE REPAIR SHALL NOT BE CREDITED TOWARD MEETING THE REQUIRED MINIMUM THICKNESS, NOR COUNT AGAINST THE MAXIMUM (MAXIMUM THICKNESS OF ALL LAYERS SHALL BE LIMITED TO 1.35" MAXIMUM TO MEET UT PROCEDURE REQUIREMENTS).
2. WELD FILLER METAL SHALL BE ASME CODE, SECTION II, SFA-5.14, ERNiCrFe-7A (ALLOY 52M), CERTIFIED TO SECTION III, SUBSECTION NB.
3. THE THICKNESS SHOWN ON THE DRAWING IS THE THICKNESS BEYOND ANY SURFACE PREPARATION REQUIRED BY NOTE 1 ABOVE. THE OVERLAY THICKNESS SHOWN IN THE DRAWING ASSUMES NO DILUTION LAYER. IF A DILUTION LAYER IS REQUIRED, THE DILUTION LAYER THICKNESS SHALL NOT BE CREDITED TOWARDS THE REQUIRED STRUCTURAL MINIMUM, NOR SHALL BE COUNTED AGAINST THE ALLOWED MAXIMUM.
4. THE OVERLAY IS TO BE APPLIED WITH EITHER AIR-BACKING OR WATER BACKING, OR A TRANSITION BETWEEN THE TWO FOR ANY OR ALL LAYERS.
5. THE INSTALLER WILL USE THE AMBIENT TEMPERATURE TEMPERBEAD WELDING PROCESS FOR LOCATIONS REQUIRING TEMPERBEAD. THE NUMBER AND PLACEMENT OF LAYERS SHALL COMPLY WITH THE RELIEF REQUEST (N-740-2, APPENDIX I). THIS METHOD SHALL BE LIMITED TO LESS THAN 500 IN^2 COVERAGE ON THE FERRITIC STEEL NOZZLE.
6. DESIGN STRUCTURAL THICKNESS INCLUDES NO ALLOWANCE FOR SURFACE CONDITIONING TO FACILITATE UT INSPECTION OF THE COMPLETED OVERLAY. THE SURFACE OF THE OVERLAY SHALL BE MECHANICALLY FINISHED AND HAVE A FINISH OF 250 RMS OR SMOOTHER. IN ADDITION THE SURFACE SHALL BE FLAT WITH NO OUT OF FLATNESS GREATER THAN 1/32" WITHIN ANY 1" DISTANCE.
7. DIMENSIONS APPLY TO ALL AZIMUTHS UNLESS OTHERWISE NOTED. AXIAL SHRINKAGE MEASUREMENTS SHALL BE MEASURED AT FOUR AZIMUTHS AROUND THE PIPE AND RECORDED IN IMPLEMENTATION DOCUMENTATION. MEASUREMENT RESOLUTION SHALL BE ±0.02".
8. CALCULATION INFORMATION: THE NECESSARY OVERLAY LENGTH FOR STRUCTURAL PURPOSES, FROM THE WELD FUSION LINE, IS 0.41" ON THE NOZZLE SIDE AND 0.57" ON THE SAFE END SIDE. THE LONGER LENGTH SHOWN ON THE DRAWING AS THE MINIMUM (2.47" ON THE NOZZLE SIDE AND 2.27" ON THE SAFE END SIDE) IS REQUIRED DUE TO UT EXAMINATION CONSTRAINTS.

9> THE BLENDED TRANSITION OF THE WELD OVERLAY INTO THE BASE MATERIAL SHALL HAVE A SMOOTH BLEND RADIUS AND HAVE AN INCLUDED ANGLE OF 135° OR GREATER.

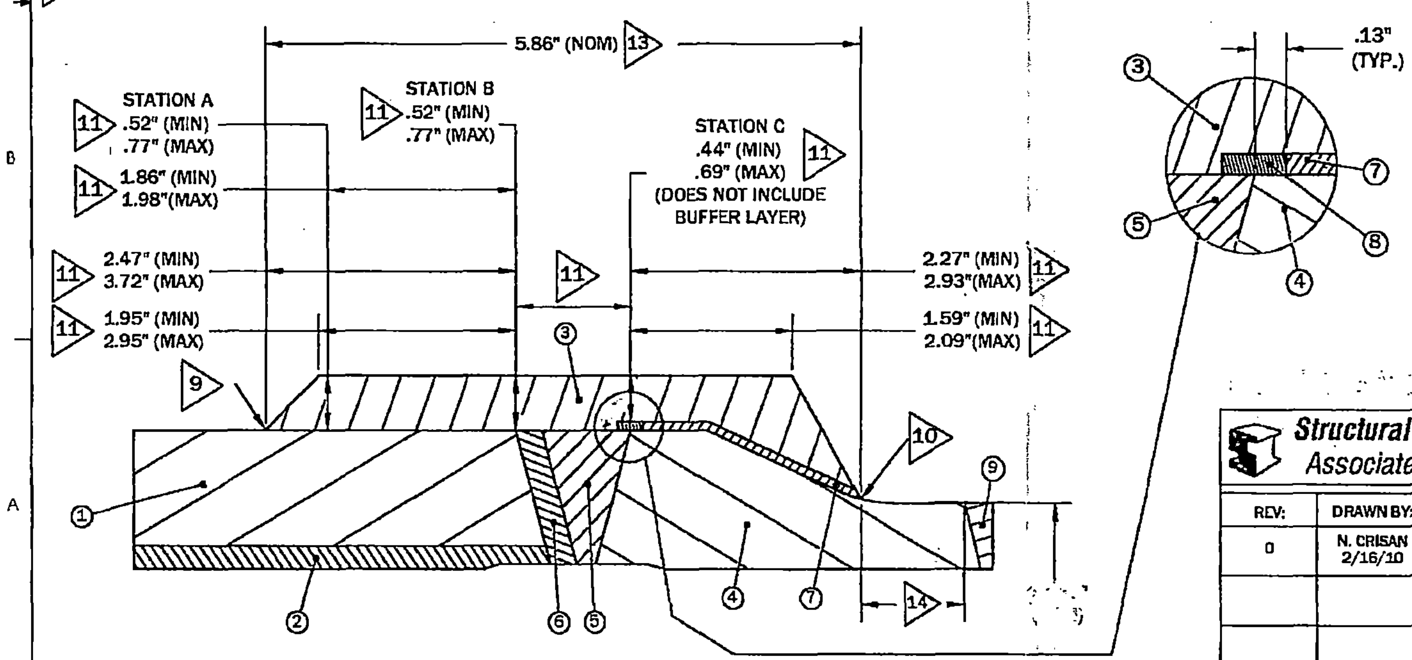
10> THE BLENDED TRANSITION OF THE WELD OVERLAY INTO THE BASE MATERIAL SHALL HAVE A SMOOTH BLEND RADIUS AND HAVE AN INCLUDED ANGLE OF 120° OR GREATER.

11> THE DIMENSION SHALL BE MEASURED AND RECORDED.

12> A STAINLESS STEEL BUFFER LAYER (ITEM 7) SHALL BE INSTALLED. BUFFER LAYER TO CONSIST OF A SINGLE LAYER AND SHALL COVER THE STAINLESS STEEL SAFE END WITHOUT CONTACTING THE DM WELD. THE BUFFER LAYER SHALL BE PLACED AS CLOSE AS PRACTICAL TO THE DM WELD (ITEM 5) FUSION LINE, BUT SHALL NOT TOUCH THE DM WELD. BUFFER LAYER SHALL NOT COUNT TOWARD MEETING THE REQUIRED MINIMUM OVERLAY THICKNESS NOR COUNT AGAINST THE MAXIMUM. WELD FILLER METAL SHALL BE SFA-5.9 ER308L, CERTIFIED TO SECTION III, SUBSECTION NB. NOMINAL BUFFER LAYER THICKNESS IS 0.08". THE BUFFER LAYER MAY BE CONNECTED TO THE DM WELD, COVERING THE NOMINAL GAP SHOWN, USING ONE TO THREE BRIDGE BEADS CONSISTING OF WELD FILLER METAL SFA-5.14, ERNiCr-3 (ALLOY 82): CERTIFIED TO SECTION III, SUBSECTION NB. IF REQUIRED, ONE OR MORE LAYERS OF ALLOY 82 WELD METAL SHALL BE USED TO SEAL UNACCEPTABLE INDICATIONS IN THE BRIDGE BEAD AREA TO BE WELDED, WITH OR WITHOUT EXCAVATION. THE THICKNESS OF THE ALLOY 82 BRIDGE BEADS OR THE REPAIR, IF REQUIRED, SHALL NOT COUNT TOWARDS MEETING THE WELD REINFORCEMENT DESIGN THICKNESS REQUIREMENTS.

13> MINIMUM CONFIGURATION OF OVERLAY SHOWN. LENGTH OF OVERLAY IS NOT A CONTROLLED DIMENSION.

14> MAINTAIN A MINIMUM OF 0.50" CLEARANCE FROM THE TOE OF THE OVERLAY TO THE TOE OF THE FIRST STAINLESS STEEL WELD (ITEM 9).



PARTS LIST		MATERIAL
1.	NOZZLE BODY	SA-508, Class 2
2.	CLADDING	STAINLESS STEEL
3.	WELD OVERLAY	ALLOY 52M
4.	SAFE END	SA-182 F316
5.	DM WELD	ALLOY 82/182
6.	BUTTER	ALLOY 82/182
7.	BUFFER LAYER	ER 308L
8.	BRIDGE BEAD(S)	ALLOY 82
9	SM WELD	STAINLESS STEEL

Structural Integrity Associates, Inc.

TITLE: REACTOR COOLANT SYSTEM PRESSURIZER SAFETY/RELIEF VALVE NOZZLE FULL STRUCTURAL WELD OVERLAY (FSWOL) DESIGN

PLANT: CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2

REV:	DRAWN BY:	ENGINEER:	REVIEWED BY:	APPROVED BY:
0	N. CRISAN 2/16/10	C. LOHSE 2/16/10	N. FINNEY 2/16/10	M. LASHLEY 2/16/10

PROJECT NO. 0801014
DRAWING NO. 0801014.570
SIZE: B FILE NO. 0801014.570
REVISION: 0 SCALE: NONE
NUCLEAR SAFETY RELATED Yes [X] No [ ]
SHEET: 1 OF 1

ECN #: ECP-16-000027-MU-03 ECN REV: 000

NOTE: SEE CA07281 FOR MINIMUM WELD OVERLAY SIZING DIMENSIONS.

REV	DATE	DESCRIPTION	DWN	DSGN	QC	IR	APPROVED
N/A		ISSUED FOR CONSTRUCTION ECP-16-000027 ECN REV. 000	ELECTRONIC SIGNATURES				

REACTOR COOLANT SYSTEM PRESSURIZER SAFETY/RELIEF VALVE NOZZLE FULL STRUCTURAL WELD OVERLAY (FSWOL) DESIGN

CALVERT CLIFFS NUCLEAR POWER PLANT
ENGINEERING SERVICES DEPARTMENT
CALVERT CLIFFS UNIT 1&2 SIZE C CAT. 3
SCALE: NONE VENDOR DWG. NO. 0801014.570 REV.
DWG. NO. 12024-0051SH0001 N/A