Enclosure 1

ST–452, Revision 1

Structural Evaluation of the D. C. Cook Unit 1 SGLA Closures

PROPERTY OF DURATEK INC. AND ITS SUBSIDIARIES

DESIGN DOCUMENT COVER SHEET

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TITLE: **Structural Evaluation of the D.C. Cook Unit 1 SGLA Closures**

PREPARED BY: [signature] DATE: 03-10-2004

TITLE: Principal Engineer

REVIEWED BY: [signature] DATE: 3/16/04

TITLE: Chief Engineer

REVISION NOTES:
Revised to add the SGLA closure evaluations for one-foot free drop loading condition.

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DESIGN DOCUMENT REVIEW CHECKLIST

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	ITEM	YES	N/A*
1.	The purpose or objective is clear and consistent with the analysis.	√	
2.	Design Inputs such as design bases, regulatory requirements, codes, and standards are identified and documented.	√	
3.	Effect of design package on compliance with the Safety Analysis Report or Certificate of Compliance identified and documented.		√
4.	References are complete and accurate.	√	
5.	Latest version of the drawings is used, and the revision numbers are correct on the list of drawings.	√	
6.	Assumptions are reasonable, and the list of assumptions is complete and appropriate.		√
7.	Assumptions that must be verified as the design proceeds have appropriately identified.		√
8.	Analysis methodology is appropriate, and correct analysis method used.	√	
9.	Correct values used from drawings?	√	
10.	Answers and units correct?	√	
11.	Summary of results matches calculations?	√	
12.	Material properties properly taken from credible references?	√	
13.	Figures match design drawings?	√	
14.	Computer input complete and properly identified?		√
15.	Conclusions are consistent with the analysis results.	√	
16.	Documentation of all hand calculations attached?	√	
17.	Meeting minutes of the Design Review?		√

* Not Applicable, Explain

3. There is no Safety Analysis Report or Certificate of Compliance for this equipment.
6. No major assumptions that needed verification were made.
7. This document presents the evaluation of the final design.
14. No computer code is used.
17. No design review meeting is needed for this equipment.

Independent Reviewer [signature]

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DESIGN DOCUMENT REVIEW METHOD CHECKLIST

Document ID No.: ST-452 Revision No.: 1

Date: 3/16/04

ITEM		
1.	Alternate or simplified computational method.	
2.	Comparison of results to other calculations of a similar nature.	
3.	Numerical repetition of the calculations.	√
4.	Comparison of calculations with experimental results.	
5.	Other (specify)	
6.	Comments:	

Independent Reviewer [signature]

OBJECTIVE

Structural evaluation of the D.C. Cook Unit 1 steam generator lower assembly (SGLA) closure to demonstrate that they will maintain their integrity during transportation and one-foot free drop test.

INTRODUCTION

American Electric Power (AEP) Company has replaced the Donald C. Cook Nuclear Plant (CNP) Unit 1 four steam generators (Reference 1) in the year 2000. The steam dome portions of the old steam generators have been cut (Figure 1). The steam generator lower assembly (SGLA) packages are currently stored on site and will be transported to a burial site for disposal. These packages have been classified as SCO-II under 49 CFR Part 173 (Reference 2). Per 49 CFR 173.427, the SCO-II class materials are required to be shipped using IP-2 packages. Because of the unique size and shape of the SGLA, and controlled handling process during the transportation, an exemption from some of the requirements that an IP-2 package must meet, is requested from the DOT (Reference 3). The SGLA will be shipped without any additional packaging. Therefore, an exemption from the requirement to package an SCO-II material is one of the exemptions requested. The rationale for requesting this exemption is based on the fact that the SGLA is a robust unit that will maintain its integrity during the normal transportation and the required test conditions. This document provides the analyses performed to show that the SGLAs would maintain their integrity during these loading conditions. The loading conditions addressed in this document are due to:

- Highway and Railroad Transportation
- One-Foot Free Drop Test

The SGLAs have several openings that will be welded shut for the transportation. These openings and their circumferential locations are listed in Table 1. The details of the closure of these openings are shown in Reference 4, and Figures 2 to 4 of this document. The cut end of the steam generator will be closed using a 3" thick end plate that will be welded to the body using welds shown in Figure 4. Figure 1 of this document shows the location of openings that were listed in Table 1 as well as the openings that are closed with their original covers (manways and handholes).

Analyses are provided in this document to show that all the closures of the SGLAs have sufficient structural strength to maintain their integrity under the loading expected during the highway and railroad transportation of the SGLAs per References 5 and 6. They also show that the integrity of the package will be maintained during one-foot free drop test of 49CFR 173.465 (c).

The SGLA was analyzed for a free drop, oriented in the transport position, rather than the orientation that will cause maximum damage, without the benefit of any securement system. It has been shown that the SGLA units will maintain their integrity, thereby satisfying the regulatory acceptance criteria of 49 CFR 173.411 (b)(2)(i) and (ii).

REFERENCES

(1) Westinghouse Electric Corporation Drawing No. 1097J74, Rev.4, "51 Series Steam Generator General."

(2) Code of Federal Regulations, Title 49, Part 173.

(3) U.S. DOT exemption request made by Indiana Michigan Power for the transportation of the D.C. Cook Unit 1 SGLAs (Dockett No. 13357-N).

(4) Duratek Drawing No. C-068-163033-114, Rev.0, "D.C. Cook SGLA Unit 1 Cover Plates and Seal Plugs."

(5) Code of Federal Regulations, Title 49, Part 393.100.

(6) AAR Manual, Rev.9, Section No.1, General Rules, 1993.

(7) AISC, *Steel Construction Manual*, Ninth Edition.

(8) ANSYS/LS-DYNA Release 7.1, Ansys Inc., Cannonsburg, PA.

(9) Duratek proprietary document ST-462, Rev. 0, "One-Foot Drop Analysis of the D.C. Cook Unit 1 SGLA."

MATERIAL PROPERTIES

Shells

Specification: ASME SA-533 Type A, Class 1

Minimum Yield Strength, S_y = 50,000 psi

Minimum Ultimate Strength, S_u = 80,000 psi

Caps and Plugs

Specification: ASTM A-36

Minimum Yield Strength, S_y = 36,000 psi

Minimum Ultimate Strength, S_u = 58,000 psi

Welds

Rod Specification: E-70xx Electrodes

Minimum Ultimate Strength, S_u = 70,000 psi

ALLOWABLE STRESSES

Transportation Conditions

Stresses in the caps and plugs and the welds are conservatively based on the AISC (Reference 7) allowable values for A-36 material.

Caps and Plugs

Allowable bending stress = $0.66\ S_y$ = 24,000 psi

Allowable shear stress = $0.4\ S_y$ = 14,400 psi

Welds

Allowable shear stress in fillet welds = $0.3\ S_u$ = 21,000 psi

One-Foot Free Drop Test

The SGLAs must maintain their integrity during the one-foot free drop test. Minor deformation in the structure is permissible. The acceptance criteria for the stresses are set in such a way that the rupture of the material is prevented. Therefore, the normal stresses are limited to the ultimate tensile strength of the material and the shear stresses are limited to 60% of the ultimate tensile strength of the material.

Caps and Plugs

Allowable bending stress = S_u = 58,000 psi

Allowable shear stress = $0.6\ S_u$ = 34,800 psi

Welds

Allowable shear stress in fillet welds = $0.6\ S_u$ = 42,000 psi

EVALUATION OF THE CLOSURES FOR TRANSPORTATION LOADING

The closures of the SGLAs are evaluated for the largest acceleration that they may experience during the road and rail transportation per References 5 and 6. Of the two modes of transportation, the largest acceleration on the SGLAs occurs during the rail transportation. According to the requirements of the AAR Manual (Reference 6) the largest acceleration experienced by the SGLAs is 3g in the longitudinal direction. Conservatively, 3g acceleration is assumed to occur in all directions and the closures are analyzed for this loading.

Primary (Main) Inlet & Outlet Nozzle Closures (Reference 4, Item 1)

The primary (main) inlet and outlet nozzle closures are shown in Figure 2. The closure plates are 3" thick and have a diameter of 35 inch. The weight of the closure plate is:

$W = \pi/4 \times 35^2 \times 3 \times 0.283 = 817$ lbs

The maximum bending moment in the closure plate is:

$M_c = q \times a^2 \times (3+\nu)/16$

Where,

q = uniformly distributed load intensity for 3g acceleration

$q = 3 \times 817/(\pi/4 \times 35^2) = 2.55$ psi

a = radius of the plate = 35/2 = 17.5 in

Therefore,

$M_c = 2.55 \times 17.5^2 \times 3.3/16 = 161$ in-lb/in

The maximum bending stress in the plate is:

$\sigma_b = 6 \times M_c/t^2$

Where,

t = plate thickness = 3"

Therefore,

$\sigma_b = 6 \times 161/3^2 = 107$ psi << 24,000 psi O.K.

The closure plates are held by four 2" long segments of 5/16" fillet weld, and the remainder of the circumference of the plate is welded with a minimum of 3/16" fillet weld to the steam generator nozzle (Reference 4). Conservatively assuming that the closure plate is welded to the steam generator nozzle with continuous 3/16" fillet weld all around. The shear stress in the fillet weld is:

$\tau_v = 3 \times 817/[(\pi \times 35) \times 0.707 \times 3/16] = 168$ psi

Considering the inertia load to act at the C.G. of the plate, the bending moment on the weld group is:

$M = 3 \times 817 \times 1.5 = 3{,}677$ in-lb

$S = (\pi \times 35^2/4) \times 0.707 \times 0.1875 = 127.5$ in^3

Therefore, the shear stress in the weld group due to bending moment,

τ_b =3,677/127.5 = 29 psi

Total shear stress, τ = 168 + 29 = 197 psi << 21,000 psi O.K.

Manway Closures

The primary manways are closed with the original covers. These manways have a 16-inch inside diameter; the covers are 4.60 inches thick and are 26.75 inches in diameter (Per the Figure 1-1, outline drawing from Westinghouse Electric Corp, Steam Generator Manual). Then, the manway cover weight (W_m) is:

$W_m = (\pi/4)\times 26.75^2 \times 4.60\times (1/12)^3 \times 490 = 733$ lbs, say 1,000 lbs to account for the insert

Under 3g load the manway cover will be loaded by a uniform pressure of,

$q = (3\times 1{,}000)/[(\pi/4)\times 16^2] = 14.9$ psi

The primary side of these steam generators is designed for 2,485-psig internal pressure and is hydro tested to 3,106-psig (Per the Figure 1-1, outline drawing from Westinghouse Electric Corp, Steam Generator Manual). Under these pressures the manways remain closed and sealed. Therefore, under the small 14.9 psi transport loading the manways will remain intact.

Handhole Closures

The secondary handholes are closed with the original covers. These covers are fitted over 6" diameter nozzles, each cover is 11.62 inches in diameter and is 1.60 inches thick (Per the Figure 1-1, outline drawing from Westinghouse Electric Corp, Steam Generator Manual).

Then, the handhole cover weight (W_h) is:

$W_h = (\pi/4)\times 11.62^2 \times 1.60\times (1/12)^3 \times 490 = 48$ lbs, say 80 lbs

Under 3g load they will be loaded by a uniform pressure of,

$q = 3\times 80/(\pi/4\times 6^2) = 8.5$ psi

This pressure is even smaller than that of the manways shown above and therefore by the same justification the handholes will remain intact during transportation.

Bottom Blow-Down, Shell Drain and Wide Range Water Level Tap Nozzle Closures (Reference 4)

The bottom blow-down, shell drain and wide range water level tap nozzle closures are closed using plugs, as shown in Reference 4. The schedule of the plugs used for the closure of these openings is also given in Figure 3 of this document.

Per Reference 4 drawing, all plugs are welded in place using continuous seal weld all around the plug. For the evaluation purposes, this document considers a 1/8" continuous fillet weld all around. Conservatively using the largest plug diameter (1.6875") and a plug length of 3 ¼" to calculate the maximum plug weight. The maximum plug weight (W) is:

$W = (\pi/4) \times 1.6875^2 \times 3.25 \times 0.284 = 2.1$ lbs say 5 lbs

Calculating the weld shear stress using the smallest plug diameter, the weld shear stress (τ) is:

$\tau = 3\times5/(\pi\times0.57375\times0.707\times0.125) = 94.2$ psi << 21,000 psi O.K.

End Closure (Reference 4)

The end closure (transition cone cover plate) of the SGLA is made from a 3" thick by 167.75" diameter cover plate. The closure assembly is shown in Figure 4. The weight of the cover plate is:

$W = (\pi/4)\times167.75^2\times3\times0.284 = 18{,}830$ lbs

The maximum bending moment in the closure plate is:

$M_c = q\times a^2\times(3+\nu)/16$

Where,

q = uniformly distributed load intensity for 3g acceleration

$q = (3\times18{,}830)/[(\pi/4)\times167.75^2] = 2.56$ psi

a = radius of the plate = 167.75/2 = 83.875 in

Therefore,

$M_c = 2.56\times83.875^2\times3.3/16 = 3{,}715$ in-lb/in

The maximum bending stress (σ_b) in the plate is:

$\sigma_b = 6\times M_c/t^2$

Where,

t = plate thickness = 3"

Therefore,

$\sigma_b = 6\times3{,}715/3^2 =$ 2,477 psi << 24,000 psi O.K.

As shown in Figure 4, the maximum steam generator diameter (outside diameter at the transition cone) is 171.75 inches that exceeds the desired 168 inches (14'-0"). To allow for a 14'-0" maximum width, the transition cone will have to be trimmed. The 3" cover plate is held in place by a combination of the following welds:

1- One segment of ½" fillet weld, about 131 ¾" long that encompasses the bottom 90° segment of the cover plate (Reference 4).

2- The remaining perimeter of the cover plate is welded with minimum of 3/16" fillet weld.

To evaluate the welds for the transportation loading conservatively assuming that the end plate is welded to the steam generator with continuous 3/16" fillet weld all around. Due to trimming of the transition cone, a portion of the 3/16" fillet weld located near 90° and 270° (as shown in Figure 4) may also be removed with portions of the transition cone shell. In these particular areas a minimum weld built up of 3/16" will be provided after the transition cone has been trimmed. Therefore, the weld evaluation presented herein assumes credit for 3/16" fillet weld all around to withstand the imposed loads. The shear stress (τ_v) in the fillet weld due to the shear load is:

$\tau_v = 3\times18{,}830/[(\pi\times167.75)\times0.707\times3/16] = 809$ psi

Considering the inertia load to act at the C.G. of the plate, the bending moment on the weld group is:

$M = 3\times18{,}830\times1.5 = 84{,}735$ in-lb

$S = (\pi\times167.75^2/4)\times0.707\times0.1875 = 2{,}930\ \text{in}^3$

Therefore, the shear stress in the weld group due to bending moment,

$\tau_b = 84{,}735/2{,}930 = 29$ psi

Total shear stress, $\tau = 809 + 29 = 838$ psi << 21,000 psi O.K.

EVALUATION OF THE CLOSURES FOR ONE-FOOT FREE DROP TEST

For the one-foot free drop test requirement of the 49 CFR 173.465(c) the SGLAs were analyzed using ANSYS/LS-DYNA explicit dynamics code (Reference 8). A finite element model of a SGLA unit was developed which included the SGLA body and the closure plate in detail. The model was analyzed for a one-foot free drop on an unyielding surface. The results of the analyses are presented in a Duratek proprietary document (Reference 9). The main focus of the finite element analysis was on the closure plate and the welds connecting it to the SGLA. Various other closures (e.g. the inlet and outlet covers, manways and small nozzles) were not explicitly represented in the finite element model. The maximum acceleration experienced by these closures during the one-foot free drop test was determined by this analysis and is used in this document for the detailed evaluation. The inlet and outlet nozzles, located near the support pad of the SGLA experience the maximum acceleration during the one-foot free drop test. According to Reference 9 the magnitude of this acceleration is 124.1g. This acceleration has been conservatively increased to 150g for the closures analyzed in this document.

Primary (Main) Inlet & Outlet Nozzle Closures (Reference 4, Item 1)

The primary (main) inlet and outlet nozzle closures are shown in Figure 2. The closure plates are 3" thick and have a diameter of 35 inch. The weight of the closure plate is:

$W = \pi/4 \times 35^2 \times 3 \times 0.283 = 817$ lbs

The maximum bending moment in the closure plate is:

$M_c = q \times a^2 \times (3+\nu)/16$

Where,

q = uniformly distributed load intensity for 150g acceleration

$q = 150 \times 817/(\pi/4 \times 35^2) = 127.4$ psi

a = radius of the plate = 35/2 = 17.5 in

Therefore,

$M_c = 127.4 \times 17.5^2 \times 3.3/16 = 8{,}047$ in-lb/in

The maximum bending stress in the plate is:

$\sigma_b = 6 \times M_c/t^2$

Where,

t = plate thickness = 3"

Therefore,

$\sigma_b = 6 \times 8{,}047/3^2 = 5{,}365$ psi $<< 58{,}000$ psi O.K.

The closure plates are held by four 2" long segments of 5/16" fillet weld, and the remainder of the circumference of the plate is welded with a minimum of 3/16" fillet weld to the steam generator nozzle (Reference 4). Conservatively assuming that the closure plate is welded to the steam generator nozzle with continuous 3/16" fillet weld all around. The shear stress in the fillet weld is:

$\tau_v = 150\times817/[(\pi\times35)\times0.707\times0.1875] = 8{,}408$ psi

Considering the inertia load to act at the C.G. of the plate, the bending moment on the weld group is:

$M = 150\times817\times1.5 = 183{,}825$ in-lb

$S = (\pi\times35^2/4)\times0.707\times0.1875 = 127.5\ in^3$

Therefore, the shear stress in the weld group due to bending moment,

$\tau_b = 183{,}825/127.5 = 1{,}442$ psi

Total shear stress, $\tau = 8{,}408 + 1{,}442 = 9{,}850$ psi $\ll 42{,}000$ psi O.K.

Manway Closures

The primary manways are closed with the original covers. These manways have a 16-inch inside diameter; the covers are 4.60 inches thick and are 26.75 inches in diameter (Per the Figure 1-1, outline drawing from Westinghouse Electric Corp, Steam Generator Manual). Then, the manway cover weight (W_m) is:

$W_m = (\pi/4)\times26.75^2\times4.60\times(1/12)^3\times490 = 733$ lbs, say 1,000 lbs to account for the insert

Under 150g load the manway cover will be loaded by a uniform pressure of,

$q = (150\times1{,}000)/[(\pi/4)\times16^2] = 746$ psi

The primary side of these steam generators is designed for 2,485-psig internal pressure and is hydro tested to 3,106-psig (Per the Figure 1-1, outline drawing from Westinghouse Electric Corp, Steam Generator Manual). Under these pressures the manways remain closed and sealed. Therefore, under the 746 psi for the one-foot free drop test the manways will remain intact.

Handhole Closures

The secondary handholes are closed with the original covers. These covers are fitted over 6" diameter nozzles, each cover is 11.62 inches in diameter and is 1.60 inches thick (Per the Figure 1-1, outline drawing from Westinghouse Electric Corp, Steam Generator Manual). Then, the handhole cover weight (W_h) is:

$W_h = (\pi/4)\times11.62^2\times1.60\times(1/12)^3\times490 = 48$ lbs, say 80 lbs

Under 150g load they will be loaded by a uniform pressure of,

$q = 150 \times 80/(\pi/4 \times 6^2) = 425$ psi

This pressure is even smaller than that of the manways shown above and therefore by the same justification the handholes will remain intact during transportation.

Bottom Blow-Down, Shell Drain and Wide Range Water Level Tap Nozzle Closures (Reference 4)

The bottom blow-down, shell drain and wide range water level tap nozzle closures are closed using plugs, as shown in Reference 4. The schedule of the plugs used for the closure of these openings is also given in Figure 3 of this document.

Per Reference 4 drawing, all plugs are welded in place using continuous seal weld all around the plug. For the evaluation purposes, this document considers a 1/8" continuous fillet weld all around. Conservatively using the largest plug diameter (1.6875") and a plug length of 3 ¼" to calculate the maximum plug weight. The maximum plug weight (W) is:

$W = (\pi/4) \times 1.6875^2 \times 3.25 \times 0.284 = 2.1$ lbs say 5 lbs

Calculating the weld shear stress using the smallest plug diameter, the weld shear stress (τ) is:

$\tau = 150 \times 5/(\pi \times 0.57375 \times 0.707 \times 0.125) = 4{,}708$ psi $< 42{,}000$ psi O.K.

End Closure (Reference 4)

The end closure (transition cone cover plate) and the connecting welds are explicitly modeled in the finite element analysis of Reference 9. The analysis shows that the closure plate remains attached to the SGLA during the entire period of the one-foot free drop test (initial contact with the rigid surface and the slap-down). The stresses and strains are within the allowable limits in the entire structure – SGLA, end plate and the welds. The results of the analysis are summarized here as follows:

End Plate and Welds

Maximum Stress Intensity = 41,566 psi < 58,000 psi O.K.

Maximum Plastic Strain = 2.02 % < 10% O.K.

Maximum Acceleration at the Center of the Plate = 65.37 g

SGLA Body

Maximum Stress Intensity = 62,907 psi < 80,000 psi O.K.

Maximum Plastic Strain = 2.62 % < 10% O.K.

As a confirmatory check for the strength of the end plate welds, analysis is provided here to show that they have adequate margin under the 65.37 g acceleration calculated in finite element analysis.

As shown in Figure 4, the maximum steam generator diameter (outside diameter at the transition cone) is 171.75 inches that exceeds the desired 168 inches (14'-0"). To allow for a 14'-0" maximum width, the transition cone will have to be trimmed. The 3" cover plate is held in place by a combination of the following welds:

1- One segment of ½" fillet weld, about 131 ¾" long that encompasses the bottom 90° segment of the cover plate (Reference 4).

2- The remaining perimeter of the cover plate is welded with minimum of 3/16" fillet weld.

To evaluate the welds for the transportation loading conservatively assuming that the end plate is welded to the steam generator with continuous 3/16" fillet weld all around. Due to trimming of the transition cone, a portion of the 3/16" fillet weld located near 90° and 270° (as shown in Figure 4) may also be removed with portions of the transition cone shell. In these particular areas a minimum weld built up of 3/16" will be provided after the transition cone has been trimmed. Therefore, the weld evaluation presented herein assumes credit for 3/16" fillet weld all around to withstand the imposed loads. The shear stress (τ_v) in the fillet weld due to the shear load is:

$$\tau_v = 65.37 \times 18{,}830/[(\pi \times 167.75) \times 0.707 \times 3/16] = 17{,}620 \text{ psi}$$

Considering the inertia load to act at the C.G. of the plate, the bending moment on the weld group is:

$$M = 65.37 \times 18{,}830 \times 1.5 = 1{,}846{,}376 \text{ in-lb}$$

$$S = (\pi \times 167.75^2/4) \times 0.707 \times 0.1875 = 2{,}930 \text{ in}^3$$

Therefore, the shear stress in the weld group due to bending moment,

$$\tau_b = 1{,}846{,}376/2{,}930 = 630 \text{ psi}$$

Total shear stress, $\tau = 17{,}620 + 630 = 18{,}250$ psi $<< 42{,}000$ psi O.K.

CONCLUSIONS

It has been shown in this report that all the closures of the SGLA have adequate strength to react to the load normally expected during its transportation by road or rail (per References 5 and 6), and that due to the one-foot free drop test. The stress allowables for the transportation and the one-foot free drop test are satisfied by all the components of the closure assembly with an acceptable margin of safety. The SGLAs will, therefore, remain completely sealed and behave like a unitized body during transportation. An exemption from packaging the SGLAs during transportation has, therefore, been requested from the DOT.

Table 1: Location of the Welded Shut Protrusions on the D.C. Cook Unit 1 SGLA

Protrusion	Circumferential Location from the Top (Degrees), Figure 1
Primary Nozzle (Main) - Inlet	36.5
Primary Nozzle (Main) - Outlet	143.5
Bottom Blow-Down (Nozzle No.1)	90
Bottom Blow-Down (Nozzle No.2)	270
Shell Drain	206.5
Wide Range Water Level Tap	126.5
End Plate (Transition Cone Cover Plate)	- (1)

<u>Note:</u>

(1) 3" End-plate is used to close the cut end of the SGLA.

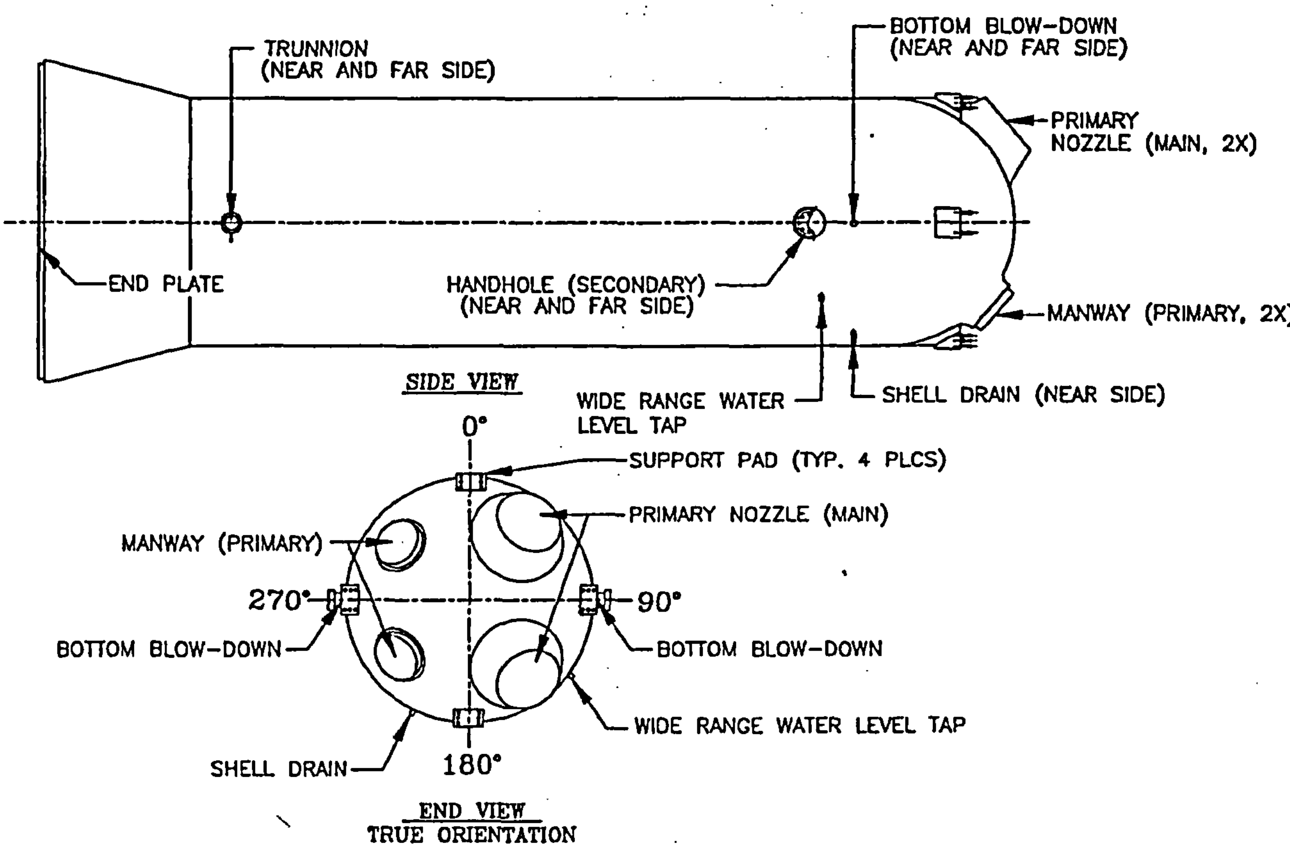


Figure 1: DC Cook Unit 1 SGLA Protrusion Location

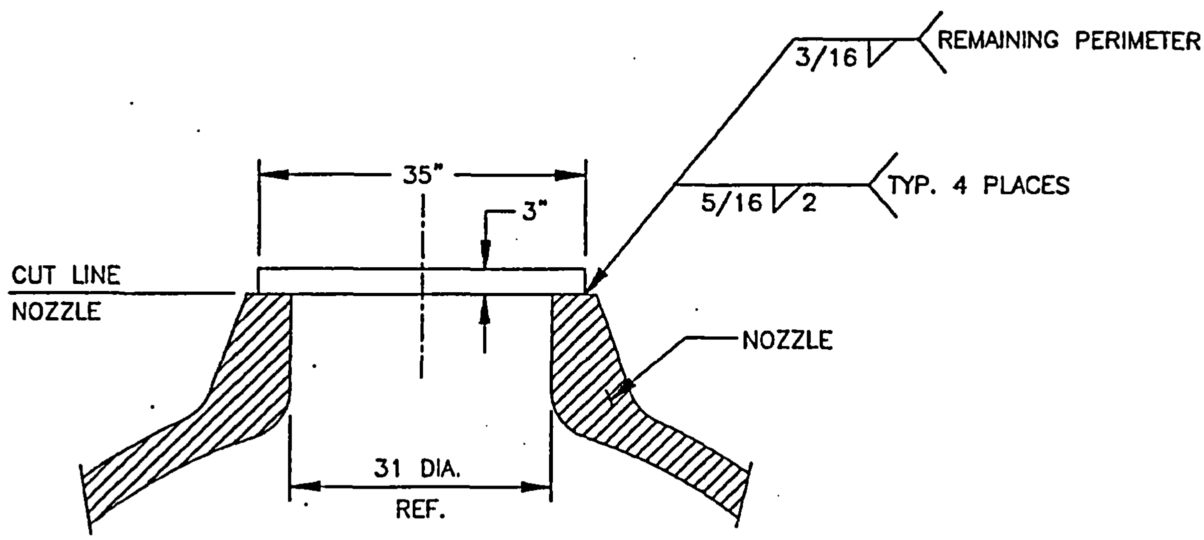
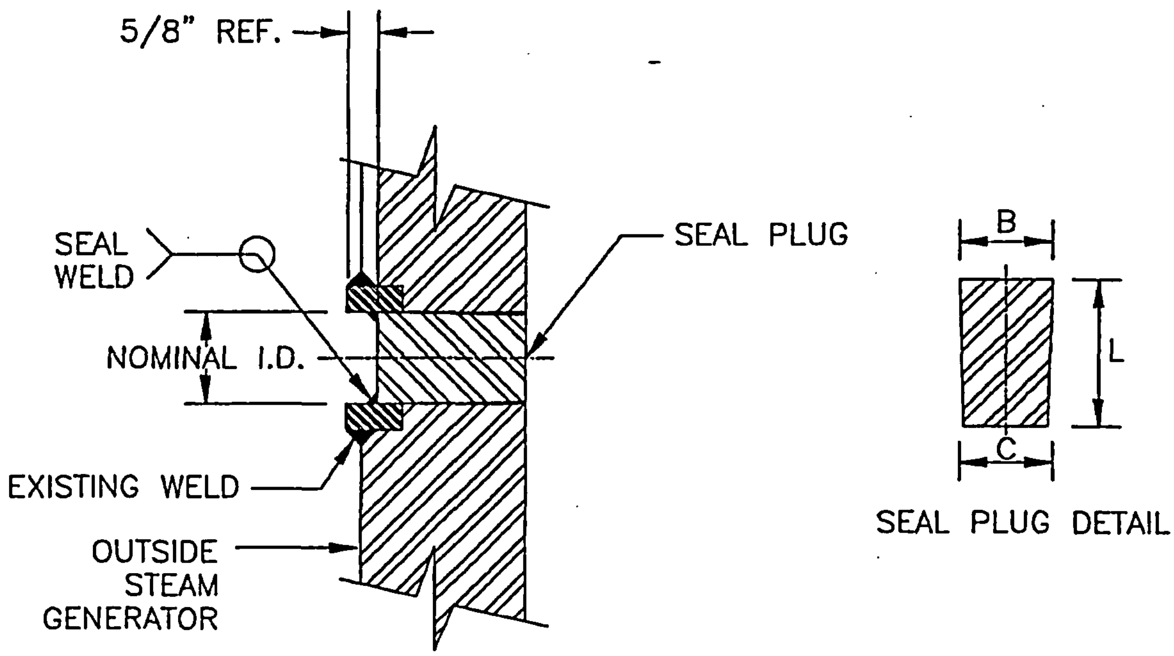


Figure 2: Primary Nozzle (Main) - Inlet/Outlet Closure Details



PLUG SCHEDULE						
Closure Description	Qty Per S.G.	"A" Nominal I.D.	Plug Dimension			Weld
			Maximum Plug Dia.	Minimum Plug Dia.	Maximum Plug Length	
			"B"	"C"	"L"	"D"
Bottom Blow-Down Nozzle	2	1 23/32"	1.6875"	1.6675"	3 ¼"	1/8"
Shell Drain	1	1"	0.8125"	0.7925"	3 ¼"	1/8"
Wide Range Water Level Tap	1	¾"	0.59375"	0.57375"	3 ¼"	1/8"

Figure 3: Small Nozzle Closure Using Plugs

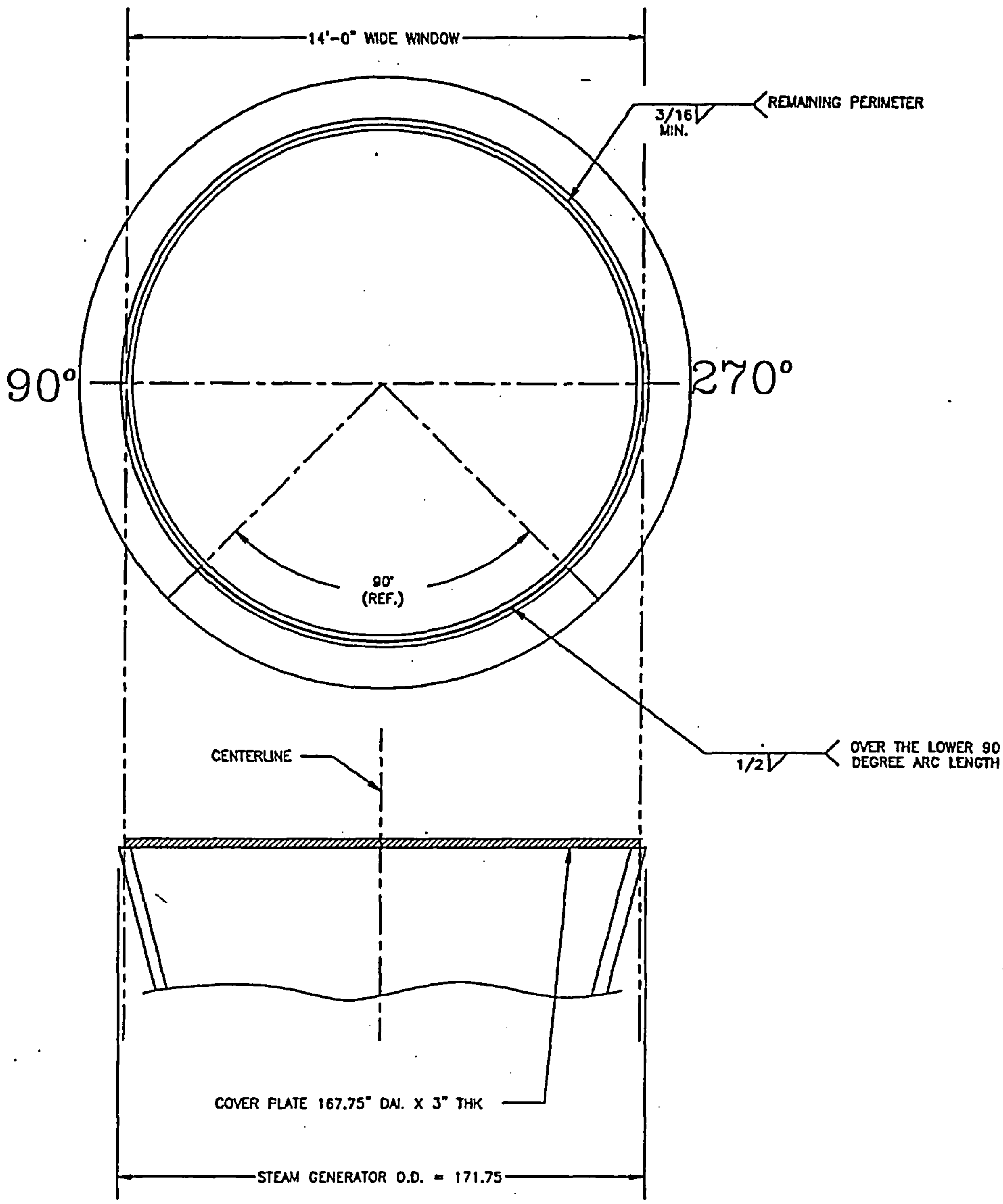


Figure 4: SGLA End Closure Details