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LA SALLE II

UPPER VESSSEL FABRICATION SUMMARY

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LA SALLE II UPPER VESSEL-FABRICATION SUMMARY

1.0 INTRODUCTION

The following summary was prepared at Chicago Bridge & Iron (CBI) Records Center in Houston, Texas. The fabrication records were presented to GE personnel in their original condition. The entire vessel was fabricated at CBI Nuclear Co. in Memphis, Tennessee, under contract number 72-2046.

The information contained in this summary includes the Top Head Assembly, Vessel Shell Ring #4 to Vessel Flange Assembly and the girth seam between Shell Ring #3 and Shell Ring #4 (Seam CD).

2.0 MATERIAL CERTIFICATIONS

2.1 Top Head Side Plates and Dollar Plate

MATERIAL:	SA-533, GR. B, CL I per ASME Code 1968, W-70 thru W-71 Addenda
MANUFACTURER:	Lukens Steel Company
HEAT NUMBERS:	C9195-3, B3269-1, B3269-2
GRAIN SIZE:	5 or finer (after heat treatment)
VANADIUM CONTENT:	not recorded (not required by ASME Code nor CBI specification MS-1, Rev. 11)
AUSTENITIZED:	1625°F, held 1/2 hour/inch (min.) and water quenched
TEMPERED:	1280°F, held 1/2 hour/inch and air cooled
STRESS RELIEVED:	1150°F, held 1 hour (min.) and air cooled

2.2 Top Head Flange Forging

MATERIAL:	SA-508, CL II
MANUFACTURER:	Ladish Company.
HEAT NUMBER:	4P4739
GRAIN SIZE:	7-9 (after heat treatment)
VANADIUM CONTENT:	0.02% - 0.03%
AUSTENITIZED:	1590°F ±10°, held 6-1/2 hours followed by cold water quench
TEMPERED:	1240°F ±10°, held 9-1/2 hours followed by cold water quench

2.3 Shell Ring #4 Plate Segments

MATERIAL:	SA-533, GR. B, CL I per ASME Code 1968, W-70 thru W-71 Addenda
MANUFACTURER:	Lukens Steel Company
HEAT NUMBER:	C9481 and A8453
GRAIN SIZE:	5 or finer
VANADIUM CONTENT:	not recorded
AUSTENITIZED:	1625°F, held 1/2 hour/inch (min.) and water quenched
TEMPERED:	1260°F, held 1/2 hour/inch and air cooled
STRESS RELIEVED:	1150°F, held 1 hour (min.) and air cooled

2.4 Vessel Flange Forging

MATERIAL:	SA-508, GR. B
MANUFACTURER:	Ladish Company
HEAT NUMBER:	2V2237
GRAIN SIZE:	6 - 8 (after heat treatment)
VANADIUM CONTENT:	0.03% - 0.035%
AUSTENITIZED:	1590°F ±10°, held 5 hours, water quenched
TEMPERED:	1280°F ±10°, held 7 hours, water quenched

3.0 TOP HEAD ASSEMBLY

This assembly consists of the following sub-assemblies:
Top Head Plates (Torus)
Top Head Flange
Dollar Plate
The top head assembly is shown in Figure 1.

3.1 Top Head Plates (Torus)

The six Top Head Plates were fitted together and held in position by strongback attachments to the ID and back-up bars were installed in weld seams DH, DJ, DK, DM, DN, and DP. No evidence of mismatch was indicated in the reviewed documents. The single V weld prep seams were welded from the outside and inside by the Submerged Arc Welding (SAW) process per Weld Procedure Specification (WPS) 323-2F4F6, Rev. 4. This procedure requires backgouging the second side to sound metal, and verifying by Magnetic Particle Test (MT) examination, before resuming welding.

After the completion of all six seam welds, the Torus subassembly received intermediate Post Weld Heat Treatment (PWHT) for two hours at 1100°F to 1150°F. This PWHT is documented in Furnace Heat Report (FHR) #73-314. After the PWHT each seam was examined by MT from inside and outside, followed by Ultrasonic Testing (UT) and Radiographic Testing (RT). Slag inclusion defects were found by RT examination in seam DJ, DK, and DP. The repair cavity dimensions before welding were:

Seam DJ: 6-1/8" long, x 2" wide, x 2-3/4" deep
Seam DK: 7-1/4" long, x 2-3/8" wide, x 2" deep
Seam [illegible] 7-1/4" long, x 1-7/8" wide, x 2-3/8" deep

The repairs were made with SMAW, using electrode E8018NM. Following RT reexamination, the subassembly received intermediate PWHT for 5 hours and 49 minutes at 1100°F to 1150°F (FHR #73-317).

3.2 Top Head Flange and Torus

In the next fabrication step, the Torus section was preheated for cutting and grinding weld preps for attachment to the Head Flange (Seam AG) and to the Dollar Plate (Seam AH). The Top Head Dollar Plate and the Head Flange were fitted to the Torus section. No mismatch was reported in the reviewed documents. First, the Head Flange was welded to the Torus section by the SAW process per WPS 323-2F4F6, Rev. 4. After the completion of this weld and removal of strongbacks, the inside of seam AG was ground and examined visually and by hot Magnetic Particle Test (MT). The inside surface of Flange and Torus section was also ground to remove scale and oxides in preparation for stainless steel cladding. The cladding was applied by SAW process per WPS 123-1F7, Rev. 1 with single layer ER309L using two wires simultaneously. The cladding stopped 1" from the edge of Flange and Seam AH. Welding parameters were:

Current:	400-425
Volts:	32-35
Travel:	9.5 - 10 IPM (inches per minute)
Electrode Size:	5/32"

The cladding thickness specified on CBI Dwg. #35 Rev. 4 was 3/16" nominal, 1/8" minimum. The interpass temperature specified in the WPS was 400°F maximum.

The cladding was visually examined and hot (i.e., under preheat) pick-ups were made as required while the subassembly was under preheat. The subassembly then received intermediate PWHT for 1 hour and 19 minutes at 1100°F to 1150°F (FHR #73-330). After the PWHT, the cladding was 100% examined by Penetrant Testing (PT). Cold (i.e., no preheat) pick-ups with Shielded Metal Arc Welding (SMAW) were made as required. Locations are not documented. Seam AG was examined by MT from the outside; UT and RT were also performed. The MT examination revealed six scattered weld defects. The repair cavity was 9" long x 3/8" wide x 1/8" deep. The weld repair was made with SMAW process and reexamined by UT.

The fabrication of the Top Head Assembly continued with fitting the Dollar Plate (previously cladded with ER309L, single layer 2 wire SAW) to the Torus and Flange subassembly (Seam AH). The fit-up inspection step was signed off with no mismatch reported. Seam AH was then welded by the same welding procedure used for the other seam welds in the Top Head Assembly. The inside surface of Seam AH approximately 4" wide was backcladded with E309 (first layer) and E308L (second layer) using the SMAW process per WPS 103-1F5, Rev. 1. The first layer was 1/8" thick minimum, deposited with 200°F preheat. The second layer was deposited without preheat as specified in the WPS since the first layer had received intermediate PWHT at 1100°F - 1150°F for 2 hours (FHR #73-341).

3.3 Weld And Cladding Repairs

RT examination of weld seam AG, after intermediate PWHT, revealed two slag inclusion areas 1-1/2" above the seam centerline. These slag inclusions were removed by grinding to the base metal below the cladding. Cavity dimensions before welding were: 6-1/2" long x 3-1/4" wide x 1/2" deep and 3-1/2" long x 3-1/4" wide x 1/4" deep. Weld repairs were made using SMAW process per Cladding Repair Procedure GRP-2, Rev. 4 with electrode E309 and E308L (2 layers). Repair areas were blend ground and examined by PT. The repair areas were outlined with punch marks on the cladding. Two other arc gouge marks, 42" below the Torus to Dollar Plate seam were removed by grinding 5/32" deep into the cladding, weld repaired with preheat and blend ground. Both repairs were performed before PWHT. The fabrication process sheets indicate that numerous minor repairs (cold pick-ups) were made without preheat on the cladding after visual and PT examinations. Locations were not documented.

3.4 Top Head Nozzles

The Top Head Assembly was laid out for lifting lugs and nozzles N7, N8, and N18. The locations were preheated and cut into the assembly for nozzle installations. The cladding was stripped back from the cut-outs, ground, and inspected. The cladding strip-back area is also ground to the base metal and inspected. The nozzles which had their bore and inside radius previously cladded were fitted into the cutouts and supported by strongbacks attached to the cladding. The nozzles were welded from inside and outside by the SMAW process per WPS 303-1F4, Rev. 2. Lifting lugs were fitted and welded in the next weld fabrication sequence. After removal of nozzle strongbacks, hot pick-ups on weld cladding were made as required. The Top Head Assembly then received intermediate PWHT for 1 hour and 10 minutes at 1100°F to 1150°F (FHR #73-368). Stainless steel back cladding on nozzle seam welds was applied with the SMAW process using E309 and E308L electrodes. The examination reports of nozzle seam welds, back clad and strongback removal areas identified one location which required grinding and weld cladding repair. This repair was done with preheat using E308L.

Final PWHT was applied to the Top Head Assembly for 7 hours and 40 minutes at 1100°F - 1150°F (FHR #73-370). All weld seams on the Top Head Assembly were examined with UT. No indications requiring weld repair were reported. The surface for four stainless steel Steam Dryer Hold Down Brackets were prepared, examined, and the brackets were welded to the flange cladding. The assembly was released for machining of stud holes and flange O-Ring gasket grooves. Figure 1 illustrates weld locations and weld repair areas.

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TOP HEAD ASSEMBLY

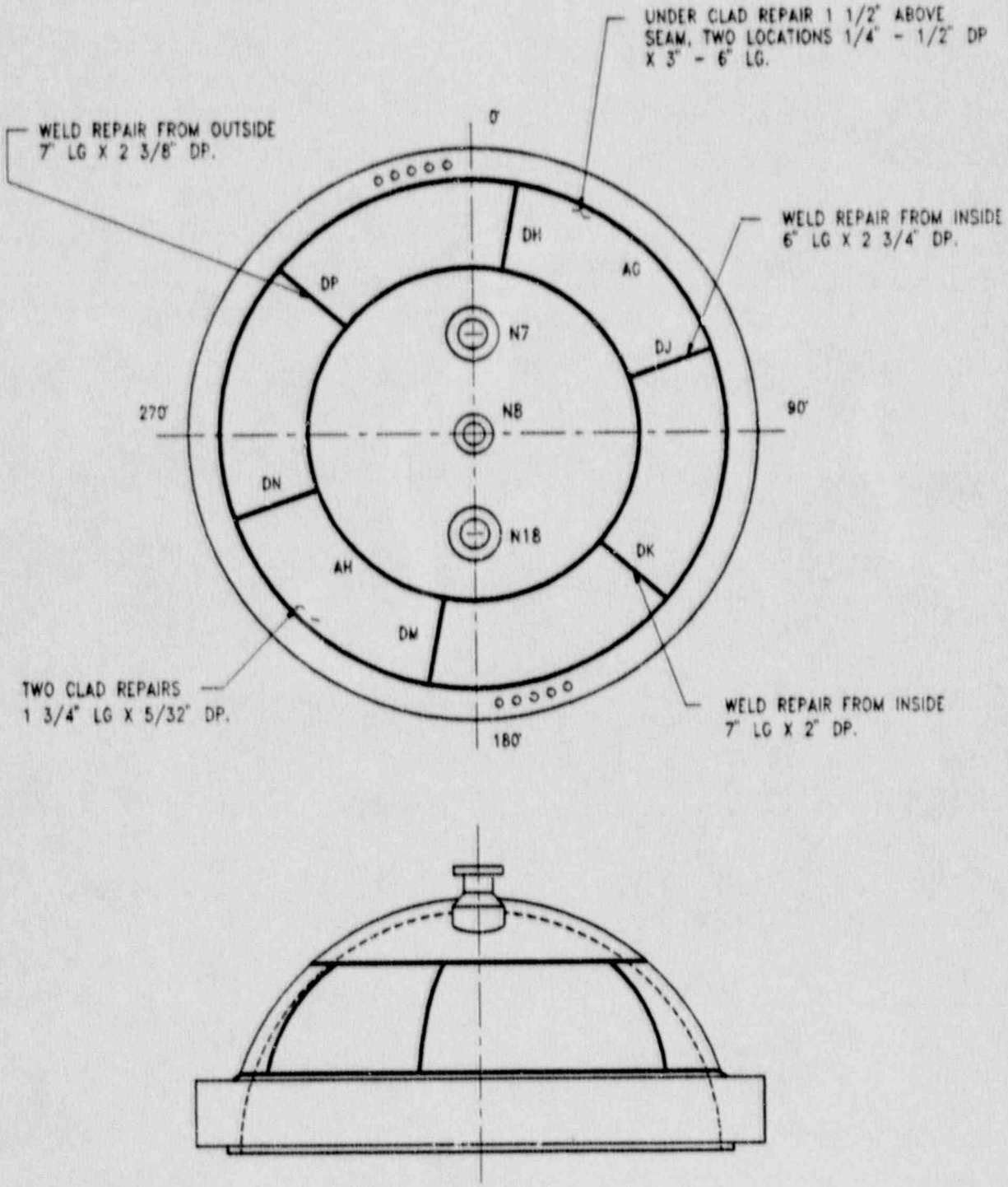

FIGURE 1

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4.0 SHELL FLANGE

The Shell Flange surface was 100% MT examined by CBI during receiving inspection. No indications were reported in the reviewed documents. The Shell Flange seal surface was cladded first with E309L (SMAW) followed with 2 layers of ER308L by SAW (WPS 123-3F5F7, Rev. 1). The inside bore of the flange adjacent to the seal surface was cladded with E308L and E309L (SMAW) per WPS 103-3F5. The flange received intermediate PWHT for 1 hour and 45 minutes at 1100°F - 1150°F (FHR #73-246). The cladding chemical composition and ferrite content checks were within CBI specifications (see Section 7.0). The flange seal surface cladding was PT and UT examined. The reviewed records indicate no weld repair was required. The upper vessel assembly is shown in Figure 2.

5.0 SHELL RING #4

5.1 Shell Plate Weld Repairs

Shell Ring #4 consists of three plates welded together with seams BK, BM, and BN. Visual inspection of the plates revealed surface defects, described as "mill slag snakes", which required weld repairs. These weld repairs in two areas between Seams BN and BK were made by grinding and welding. The cavity dimensions before welding were 68" long x 1-1/2" wide x 3/4" deep and 56" long x 3" wide x 3/4" deep. Weld repair was done with SMAW using electrode E8018NM. This plate also had 54 minor surface defects which were repaired by blend grinding or grinding and welding. The maximum ground depth of 9/32" before welding was reported in the reviewed documents. The plate between Seams BM and BN had 62 minor surface repairs with maximum ground depth of 3/8" before welding. One cavity size at the edge of Seam BK was 6" long x 2-3/8" wide x 5/16" deep. All weld repairs were made with a minimum preheat of 300°F.

5.2 Shell Vertical Welds

After completion of repairs, the plates were welded together with a combination process of SMAW and 2 wire SAW per WPS 323-2F4F6, Rev. 4. The weld joint is a double V design with a 5/8" spacer bar. The amount of weld metal deposited for each welding process was not recorded in the reviewed documents, but the shop practice was to apply ~95% of the weld by SAW. The subassembly received an intermediate PWHT for 1 hour and 53 minutes at 1100°F - 1150°F (FHR #73-247). No indications were reported in examination of seam welds.

5.3 Shell and Flange Welding

Examinations of weld prep for Seam AE (Shell Ring #4 to Shell Flange) reported mid-wall laminations from the 330° to 90° vessel azimuth. This required major weld repairs with grinding cavities up to 1-1/2" deep into the weld prep circumference. The subsequent weld repair was made with E8018NM electrodes using the SMAW process. MT and UT examinations following the repair reported no indications. The shell subassembly then received intermediate PWHT for 1 hour and 29 minutes at 1100°F - 1150°F (FHR #73-255). The fabrication continued with fitting the flange to Shell Ring #4 for Seam AE. The seam was welded with SMAW and 2 wire SAW per WPS 323-2F4F6, Rev. 4. The flange and Shell Ring #4 subassembly was cladded with a single layer, 2 wire ER309L per WPS 123-1F7, Rev. 1. The cladding stopped 1" from the edge of the weld seam.

In-process chemical analysis and ferrite checks met the acceptance criteria requirements specified by CBI. After completion of the cladding, the subassembly received an intermediate PWHT for 1 hour and 25 minutes at 1100°F - 1150°F (FHR #73-265). The RT examinations of Seam AE revealed slag inclusions in four areas. Repairs were made from the inside and outside of Seam AE. Cavity dimensions before welding were: 15-1/2" long x 2" wide x 3-1/4" deep; 9" long x 2-1/2" wide x

3-1/2" deep; 7-3/4" long x 4-1/2" wide x 3-1/2" deep; and 15-1/2" long x 4-1/2" wide x 5-1/2" deep. Repair welding was made with SMAW process using Procedure GRP-1, Rev. 2.

The cladding on the Shell Ring #4 subassembly was 100% PT examined. Minor cold pick-ups were made as required. The subassembly was preheated to 1000°F, removed from the furnace, and round-out-rings were installed. (Round-out-rings were ~4-6" thick rings which were installed to prevent warpage during PWHT.) The subassembly was then put back in the furnace and the PWHT run for 2 hours and 40 minutes at 1100°F - 1150°F (FHR #73-268).

5.4 Nozzle to Shell Welds

The fabrication process continued with layout, bore, and weld prep of four N14 instrumentation nozzles. The subassembly was locally preheated to 300°F for flame cut-out of openings for Main Steam nozzle N3A and N3C installation. The cladding was stripped back approximately 1" from the nozzle cut-outs. The N3A and N3C nozzles were fitted to the shell ring, supported by strongbacks attached to the cladding, and welded. The welds were made using SMAW and 2 wire SAW per WPS 323-2F4F6, Rev. 4. The SAW portion of the weld was ~95% of the joint thickness according to reported shop practices. After completion of the steam nozzle welds, the safe end weld preps of the four instrumentation nozzles were cladded with Inconel 182 per WPS 103-2F43, Rev. 1. The subassembly received intermediate PWHT for 2 hours and 23 minutes at 1100°F - 1150°F (FHR #73-280). The next process sequence was the fit-up and welding of Main Steam nozzles N3B and N3D and was performed the same as for N3A and N3C. The subassembly then went through a PWHT for 1 hour and 23 minutes at 1100°F - 1150°F (FHR #73-286).

5.5 Nozzle Weld Repairs

The RT and UT examination of all four nozzle seam welds revealed the following weld defects:

Nozzle N3C: Slag inclusions in two areas. Cavity dimensions from inside were 12" long x 2-1/4" wide x 2-1/2" deep and 12" long x 2-1/2" wide x 2-1/4" deep.

Nozzle N3D: Slag inclusion. Cavity dimensions from inside were 7" long x 1-1/2" wide x 2-1/2" deep.

Nozzle N3A: Slag inclusion. Cavity dimension from inside was 11-1/2" long x 1-3/4" wide x 2-3/4" deep.

The cavities were welded up with SMAW process Repair Procedure GRP-1, Rev. 2 using electrode E8018NM. The subsequent cladding over the repaired areas was made with electrodes E309L and E308L.

The stainless steel back clad on the N3 nozzle seam welds was applied with a combination process of SMAW and automatic Gas-Metal-Arc Welding (GMAW). The first layer was E309, the subsequent two layers were ER308L. In-process chemical samples and ferrite checks were taken from deposited weld metal. The acceptance criteria of the chemical analysis met the requirements specified by CBI (see Section 7). The back clad of the N3 nozzles was visually examined. The subassembly then received a final PWHT for 12 hours at 1100°F - 1150°F (FHR #73-292). The following PT on the back clad of the N3 nozzles revealed three areas of indications which required grinding and weld cladding repairs. Two areas were on nozzle N3D (2" long x 3/4" wide x 3/16" deep and 2-3/4" long x 1-3/8" wide x 1/4" deep) and one area on N3B (1" long x 1/4" wide x 1/16" deep).

UT examination of all seams on the Flange to Shell Ring #4 subassembly revealed slag and porosity in vertical weld BN. The cavity dimensions on the outside surface were 28" long x 2-3/4" wide x 4-1/2" deep. Weld repair followed with PWHT for 4 hours and 55 minutes at 1100°F - 1150°F (FHR #73-297).

6.0 SHELL RING #3 TO SHELL RING #4 & FLANGE ASSEMBLY

The next fabrication step was the machining of Seam AD weld prep for fitting Flange and Shell Ring #4 to Shell Ring #3, to which the bottom

portion of the vessel had been previously attached. This weld was made with the same welding process as Seam AE between the Flange and Shell Ring #4. The inside seam cladding (back clad) was made with automatic GMAW using ER309 for the first layer and ER308L for the second layer per WPS 143-8F7, Rev.4.

The reviewed fabrication documents do not indicate weld repairs on the seam weld or the cladding. Seam AD was locally PWHT with actual soak time of 8 hours and 28 minutes at 1100°F - 1155°F (FHR Local #27). Figure 2 illustrates weld seam locations and weld repair areas.

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SHELL COURSE #4 AND FLANGE ASSEMBLY

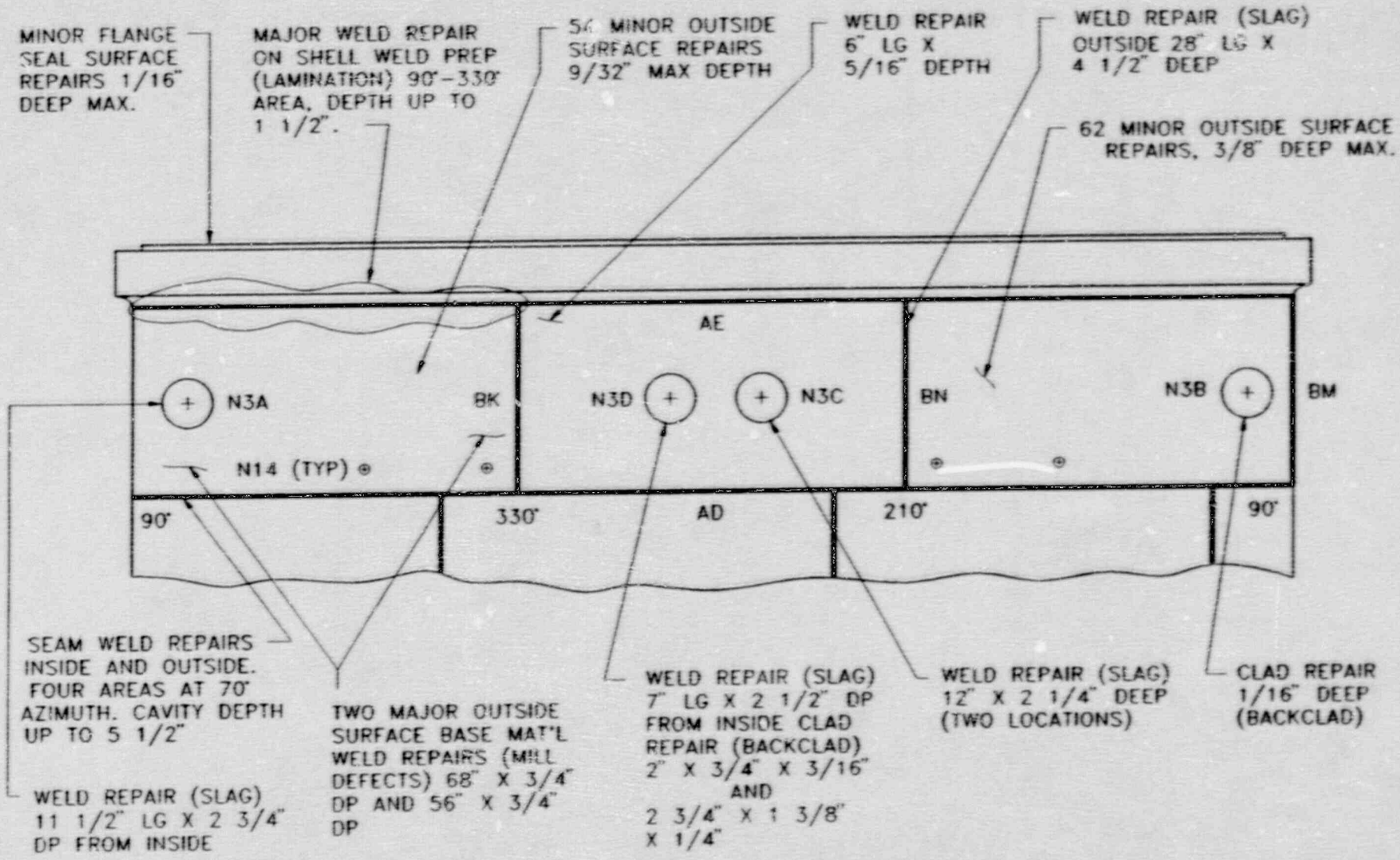

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FIGURE 2

7.0 WELD CLADDING CHEMICAL ANALYSIS

The ferrite content for all weld materials and for undiluted SMAW and SAW flux-wire combination deposits was reported and ranged from 5.5% to 9.5% by the Schaeffler Diagram. Sevren Gage checks were made on the as deposisted vessel clad surfaces prior to PWHT. No values were found below the CBI specified 7% for Sevren Gage or the 5% minimum for the Schaeffler Diagram. The acceptance criteria of the chemical analysis taken on the deposited weld sample claddings met the following requirements specified by CBI:

C = 0.08% max., (Flange seal surface: C = 0.035% maximum)
Cr = 18.0 - 24.0
Ni = 8.0 - 12.0
Mn = 3.0 maximum
Si = 1.0 maximum
P = 0.04 maximum
S = 0.03 maximum

A total of 45 in-process chemical analysis and ferrite check samples were taken during the cladding of the Top Head Assembly and the Vessel Flange and Shell Ring #4 Assembly by SAW and GMAW processes. Samples from SMAW cladding on the vessel were not required by CBI specifications. SMAW cladding was applied to the back clad of Seam AH, and on the Top Head Flange 3/4" into the bore as a tie-in to cladding deposited by SAW. The other areas were on seam back clad of nozzles N7, N8, and N18 and the first layer on nozzles N3A, N3B, N3C, and N3D. The deposited weld metal was tested as part of welding material certification. Ferrite checks after final PWHT of Top Head and Upper Vessel Assembly were not required by the CBI Specification.

8.0 POST WELD HEAT TREATMENT SUMMARY

The review of the Top Head Assembly and the Vessel Flange and Shell Ring #4 Heat Treatment Records show the following accumulated PWHT time at temperature (1100°F - 1150°F) was applied to the stainless steel clad:

Dollar Plate:	14 hours, 14 minutes
Top Head Flange & Torus:	12 hours
Nozzles N7, N8, & N18 seam back clad (SMAW):	7 hours, 40 minutes
Seam AH back clad (SMAW):	10 hours, 54 minutes
Vessel Flange:	26 hours, 30 minutes
Cladding 3/4" into Flange bore (SMAW):	15 hours
Shell Ring #4:	24 hours, 48 minutes
Nozzles N3A, N3B, N3C, & N3D (Seam KA):	16 hours, 55 minutes
Test coupons for all of the above:	50 hours (min) at 1150°F

9.0 Contract Variations

The Contract Variations (CV) for the entire vessel were reviewed. The records show no CV's relevent to the scope of this fabrication summary.