Thomas D. Gatlin
Vice President, Nuclear Operations
803.345.4342

SCE&G®
A SCANA COMPANY

November 5, 2012
RC-12-0170

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

Dear Sir / Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12
RELIEF REQUEST RR-III-09 SUPPLEMENTAL INFORMATION

Reference:

1. WCAP-15987-P-A Revision 2, "Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations" [ML040290246]

2. Letter from H. N. Berkow (U. S. NRC) to H. A. Sepp (Westinghouse Electric Company), "Acceptance for Referencing - Topical Report WCAP-15987-P, Revision 2, 'Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations,' (TAC NO. MB8997)," dated July 3, 2003 [ML031840237]

3. Letter from T. D. Gatlin (VCSNS) to Document Control Desk (NRC), "Reactor Vessel Head Penetration Weld Repair Under WCAP-15987," dated October 22, 2012

4. Letter from T. D. Gatlin (VCSNS) to Document Control Desk (NRC), "Relief Request RR-III-09 Alternative Weld Repair For Reactor Vessel Head Penetration," dated October 30, 2012

South Carolina Electric & Gas Company (SCE&G), acting for itself and as an agent for South Carolina Public Service Authority (Santee Cooper), hereby submits additional information to support the subject relief request. A revision to the relief request is provided in Attachment 4 of this letter that is consistent with the response to the NRC in the Enclosure.

A047
NRR

This letter contains no commitments. Should you have any questions, please call Bruce L. Thompson at 803-931-5042.

Very truly yours,

Thomas D. Gatlin

JG/TDG/bj

Enclosure: VCSNS Relief Request RR-III-09, Additional Information
Attachment 1: Wesdyne, V.C. Summer Summary of RVH Penetration Indications
Attachment 2: Wesdyne, NDE Data Sheets (Nozzles 19, 31, 37, 52)
Attachment 3: LTR-PAFM-12-137-NP, Revision 1
Attachment 4: VCSNS Relief Request RR-III-09, Revision 1

c: K. B. Marsh
S. A. Byrne
J. B. Archie
N. S. Carns
J. H. Hamilton
R. J. White
W. M. Cherry
V. M. McCree
R. E. Martin
NRC Resident Inspector
K. M. Sutton
NSRC
RTS (CR-12-04775, LTD 1331)
File (810.19-2)
PRSF (RC-12-0170)

VIRGIL C. SUMMER NUCLEAR STATION UNIT NO.1
REQUEST FOR ADDITIONAL INFORMATION
Relief Request RR-III-09
Alternative Weld Repair For Reactor Vessel Head Penetration
Additional Information

During teleconferences between NRC, Westinghouse and South Carolina Electric & Gas Company (SCE&G) on October 31, 2012 and on November 2, 2012, additional information was requested to support review of the subject relief request.

The following requests were developed as a result of discussions during the teleconferences.

1. ***VCSNS has identified the use of a different weld material identified as 309L that is intended to be used as a base layer of the Alloy 52. Please describe the purpose and proposed locations that 309L will be applied during the repair process.***

[VCSNS Response]
Embedded flaw repairs at VC Summer will employ Alloy 52M filler material (ERNiCrFe-7A) which is highly resistant to stress corrosion cracking. The repair of the head penetration nozzles 19, 31, 37 and 52 will have at least three layers of Alloy 52 material deposited (360 degrees full circumference) at the J-Groove weld. The penetration nozzle tube will receive at least two layers of Alloy 52 covering the outside surface (360 degrees full circumference). To mitigate the risk of solidification cracking or hot cracking in the region where the A52M weld beads intersect existing RPV head cladding, a buffer of 309L will be applied. This buffer layer serves to "insulate" the outermost Alloy 52 weld beads from contaminants in the cladding. The 309L is located outside of the J-Groove weld and begins approximately 0.5 inch beyond the J-Groove weld toe, and progresses outward from this point. This 0.5 inch separation between the 309L and the J-Groove weld is an important aspect of the repair process, since the 309L beads should not contact the nickel-based J-Groove weld itself. In this manner, the 309L partial weld layer will serve to protect the outermost Alloy 52 weld beads from any contaminants in the original clad material. Once the buffer is in place, three layers of Alloy 52 will be applied over the J-Groove weld and two layers of Alloy 52 will be applied to the nozzle tube. Section 5.1.1 has been revised to clarify where the 309L buffer will be located.

The use of 309L buffer is an enhancement based on industry operating experience. While it is not discussed in WCAP-15987, its use in this application has been reviewed and approved by the NRC as documented in the Safety Evaluation for the Byron and Braidwood relief requests 13R-09 and 13R-20 (ML120790647) dated March 29, 2012.

2. ***Please provide the details and/or NDE reports for the four penetrations requiring repair. Can VCSNS provide a correlation between the UT and PT data?***

[VCSNS Response]
Westinghouse and their subsidiary Wesdyne International performed the inspections on the reactor vessel head. Wesdyne has reviewed the inspection results and provided a summary report of the RVH penetration indications. This report is enclosed as Attachment 1. Wesdyne's Level 3 inspector determined that the flaws found during the inspection were in the tube material and had not propagated into the weld metal. This determination was substantiated by the penetrant testing (PT) reports which found no surface flaw indications in the J-Groove welds. The results of the ultrasonic Inspection and PT are provided as Attachment 2.

3. ***The flaw evaluation provided does not cover or analyze for a flaw located within the J-Groove weld. VCSNS should validate the flaw location and provide analyses if any of the weld areas are impacted by the flaw.***

[VCSNS Response]
As stated in the response to item 2, the flaws were determined to be in the nozzle tube material and not in the J-Groove weld. This determination was substantiated by the PT results. Westinghouse provided the appropriate flaw evaluation that supported the embedment flaw repair process for the tube material. It should be noted that SCE&G is using a standard repair process which is applied to both the J-Groove weld area and the nozzle penetration tube. The repaired penetrations will be inspected each refueling outage as directed by 10CFR50.55a(g)(6)(ii)(D)(5) and the Safety Evaluation Report (Reference 2).

4. ***What was the intent of VCSNS's discussion of the table located within section 5.0 "Conditions and Limitations" of the SER issued by the Office of Nuclear Reactor Regulation? What are the NDE requirements going forward now that four nozzles have been identified as needing repair?***

[VCSNS Response]
The intent of the discussion of the table in section 5.3 was to modify notes 2 and 3 to address changes in 10CFR50.55a. Future nondestructive examination (NDE) requirements will be as specified in note 2 of the table.

Notes 2 and 3 are modified as follows:
(2) Preservice and Inservice Inspection to be consistent with 10CFR50.55a(g)(6)(ii)(D), which requires implementation of Code Case N-729-1 with conditions.

(3) UT personnel and procedures qualified in accordance with 10CFR50.55a(g)(6)(ii)(D), which requires implementation of Code Case N-729-1 with conditions. Examine the accessible portion of the J-groove repaired region. The UT plus surface examination coverage equals to 100%.

Relief Request RR-III-09 has been revised to address the request for additional information as follows:

- Section 5.1.1 has been revised to better describe where the 309L buffer will be placed.
- Notes 2 and 3 in the table in section 5.3 have been revised to address changes in 10CFR50.55a.

Relief Request RR-III-09, Revision 1 is provided as Attachment 4.

VIRGIL C. SUMMER NUCLEAR STATION (VCSNS)
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12

Attachment 1

Wesdyne, V.C. Summer Summary of RVH Penetration Indications

WESDYNE INTERNATIONAL

V.C. Summer Summary of RVH Penetration Indications

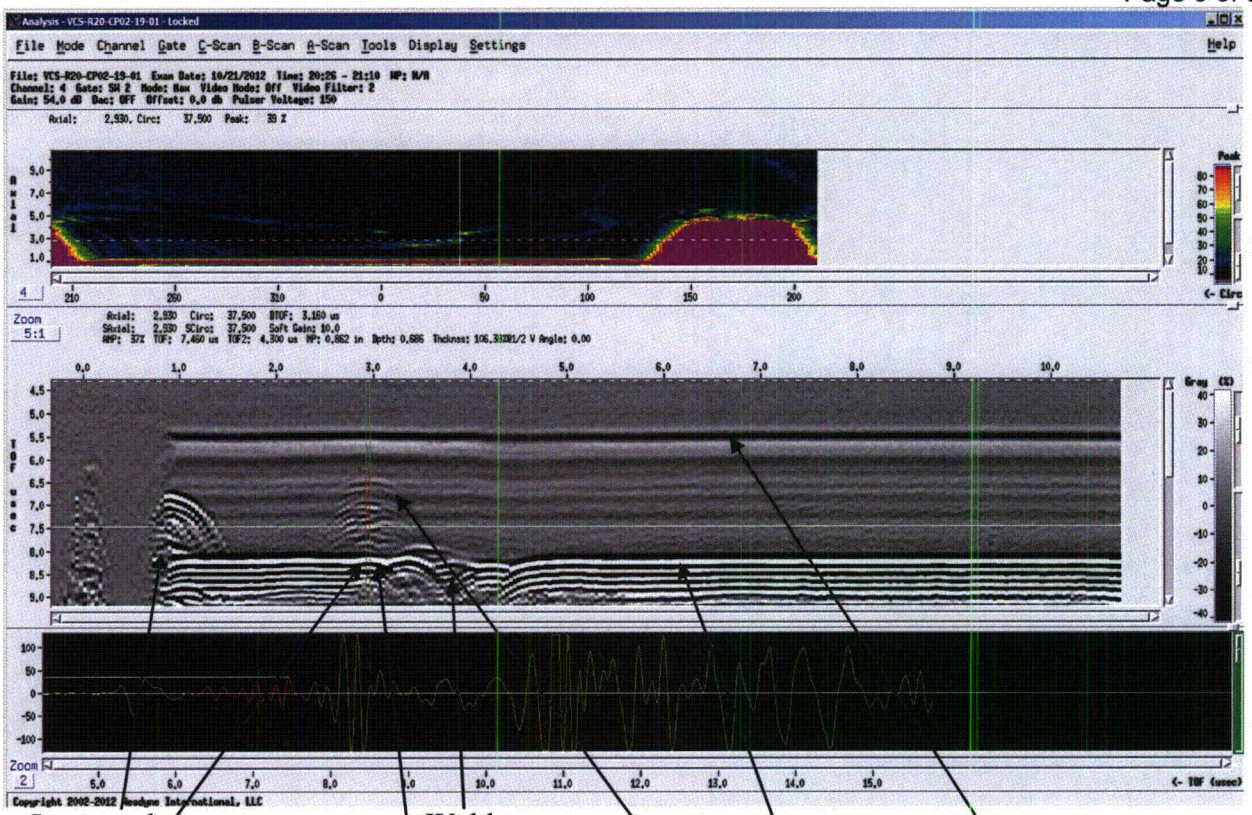
Discussion

The ultrasonic inspection method used for the RPV head inspection was qualified in accordance with the specification detailed in the NRC rulemaking in 10CFR50.55a in September, 2008 that required flaws depth and length sizing to satisfy an error band or +/-1/8" and +/-3/8" respectively. The qualification report issued by EPRI/MRP does not provide a specific RSME, but does state that the technique and analysts satisfy the specifications established in 10CFR50.55a. The ultrasonic testing tip diffraction technique is an extremely sensitive method and often identifies metallurgical conditions in the base metal associated with fabrication artifacts that are not actual PWSCC. When there is some uncertainty in the analysis of the UT data, PT or ET may be used as a confirmatory inspection to determine if an indication is surface connected (PWSCC related) or subsurface (fabrication artifact). There were four CRDM nozzles with indications that were suspect PWSCC and PT was performed on each of these. The indications in all four CRDM nozzles were confirmed by PT to be surface connected. In each case, the PT results displayed indications in the base metal of the nozzle and no indications were observed in the surface of the J weld itself and the location of the PT indications were in agreement with the UT indication locations. None of the PT indications were on the J weld surface. Also, in each case, the UT length measurement indicated that the flaws extended at least to the toe of the weld. Due to length measurement uncertainty, it is not certain whether these indications extend above the toe of the J weld in the nozzle base metal. As a confirmatory inspection, PT was performed on the base metal and J weld in the regions where UT indications were reported to determine if the UT indication in close proximity to the toe of the weld also propagated into the weld metal; the absence of PT indications on the J weld surface shows that no weld metal cracking was involved. Previous inspections of CRDMs have also had a similar result with cracking in the base metal that did not propagate across the interface into the weld metal.

Results

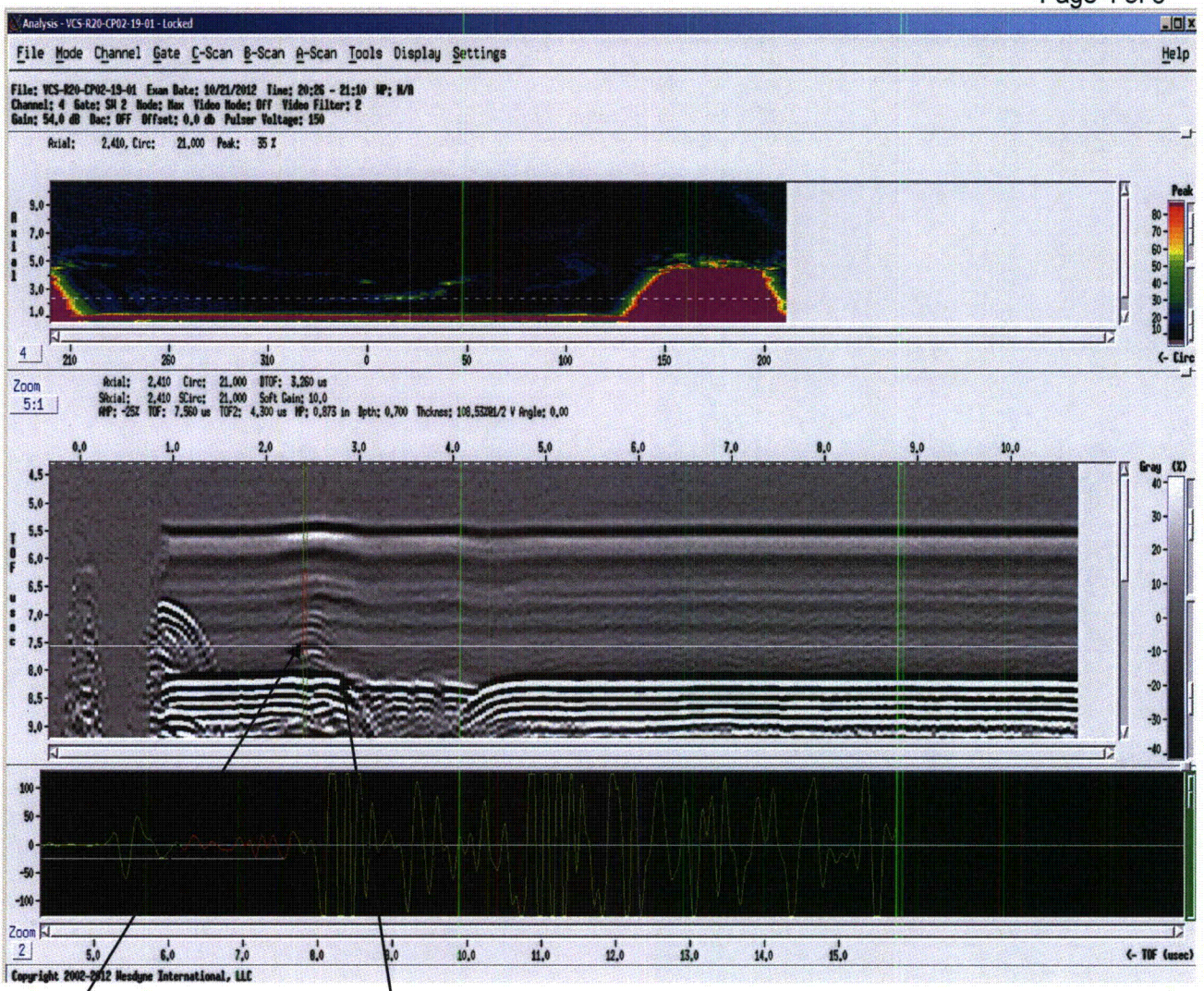
During the Fall, 2012 Ultrasonic Inspection of V.C. Summer head penetration J-Welds, four penetrations were identified as having suspected PWSCC. Most of the indications were identified from the previous inspection as fabrication type flaws with shallow diminutions. Our inspection flaw characterization show the flaws previously identified as growing in thru-wall height and length.

Each of the indications appeared to be starting just under or at the lower toe of the weld, in the tube (Penetration), and coming out at an angle below the weld. All of the flaws were identified in the downhill portion of each penetration (Lowest Point of the Weld). Each flaw starts on the OD of the tube wall, not in the weld. See Below, Typical of each flaw.



The toe of the weld is reported as our L3 dimension and the Flaw Edge is reported as our L2 dimension in the ultrasonic reports.

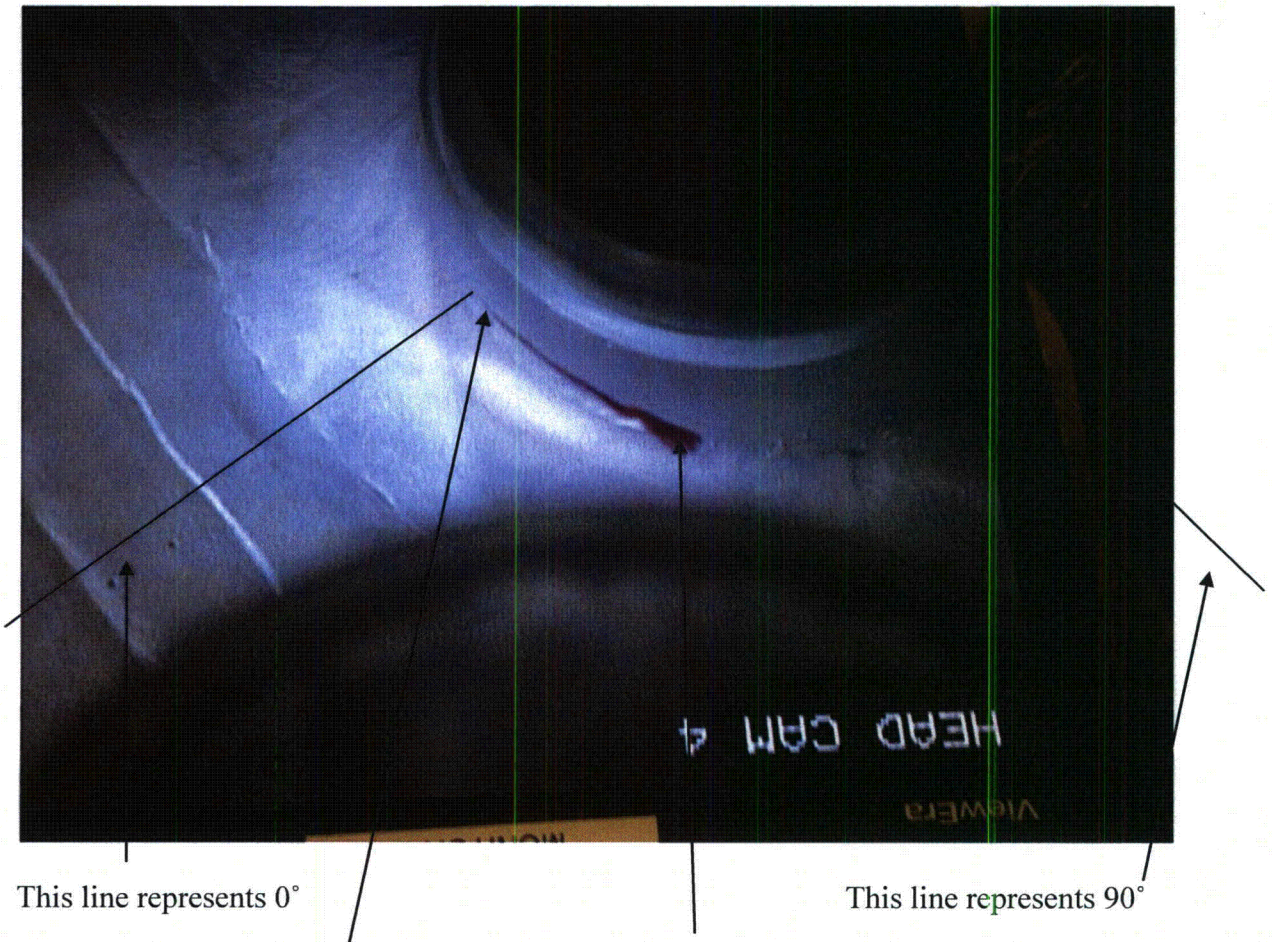
The picture below shows the lower extent of the same indication flaw in Penetration #19. The flaw is further away from the weld toe, in the tube wall as it moves closer to Zero (Lowest Point of Weld).



Flaw Center

Toe of Weld

This display of the flaw will look like it starts at the weld toe on the tube and hook down at an angle below the weld as it moves closer to the zero point as depicted in the PT Indication photo below.



PT Indication in Tube wall in Penetration 19: The circumferential indication is typical of a geometric artifact at the weld to nozzle interface. The elliptical area at the right edge of the PT indication is in the base metal and aligns with the UT indication results.

Note: There are no photographs available for the other nozzles, only the written PT reports.

Dye Penetrant examinations were performed in the lower half of the Penetrations. A sketch was provided from the UT reports of each penetration titled, Penetration Geometry, Top View. It was explained to the examiners that the location of the indication was from the top view of the head so if the document was flipped over the flaw would be in the correct position as they would have a bottom view.

In the case of Penetration #19 for example, the UT report reported the flaw from 0 to 39°. The PT report shows a flaw starting at 0°, 1.5" long in the positive direction. This matches precisely.

The UT indications in Penetration #52, 31 & #37 are all very similar to #19 except, each has more than one flaw.

Pen #52 show two UT flaws, one from 307° to 321° and another from 76° to 82°.
PT results showed only the flaw from 307° to 321°.

Pen #31 show three UT flaws:
1 - 333° to 337.5°
2 - 18° to 22.5°
3 - 6° to 13.5°
PT results show all three indications in those areas from UT.

Pen #37 show three UT flaws:
1 - 52° to 61.5°
2 - 345° to 348°
3 – 358.5° to 0° to 3°
PT results show 2 of the three flaws. #2 and #3.

VIRGIL C. SUMMER NUCLEAR STATION (VCSNS)
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12

Attachment 2

Wesdyne, NDE Data Sheets
(Nozzles 19, 31, 37, 52)

WESDYNE INTERNATIONAL
A Westinghouse Electric Company

ULTRASONIC REPORT DATA SHEET

Plant : VC Summer Unit: 1 File Name: VCS-R20-CP02-19-01

Penetration No: 19 Probe Type: Combo 2 UT Acquisition Procedure No: WDI-STD-1040 REV. 8 FCN 001/002

Test Surface: ID Nominal T: 0.622 UT Analysis Procedure No: WDI-STD-1041 REV. 7

Fingerprinting Process: ☐ UT Calibration Data Package #: VCS-R20-CP02-CAL-01R-4159

IND #	CH/PR	L @ max	Ø @ max	L 1	L 2	L 3	L 4	Ø 1	Ø 2	d l	d 0	IND	Evaluation Comments
1	4	2.930 "	36.0 °			2.850 "	4.570 "	0.0 °	39.0 °		0.283 "	PTI	See Note 1 & 2
1	1	2.960 "	36.0 °	2.400 "	3.120 "	2.850 "	4.570 "				0.274 "	*PTI	
	2											NDD	

Comments: Note 1: Indication #1 (2012) shows a change of 0.149" compared with the reported Indication #1 (2006)
Note 2: Indication #1 (2012) encompasses Indication 1 and 2 from 2006 data * Indication confirmed open to surface per PT report. See Attached.

Scan # 1 Degrees 0-366°
Scan # Degrees
Scan # Degrees
Scan # Degrees
Scan # Degrees

UTLP (UT Leak Path) Assessment Comments: None

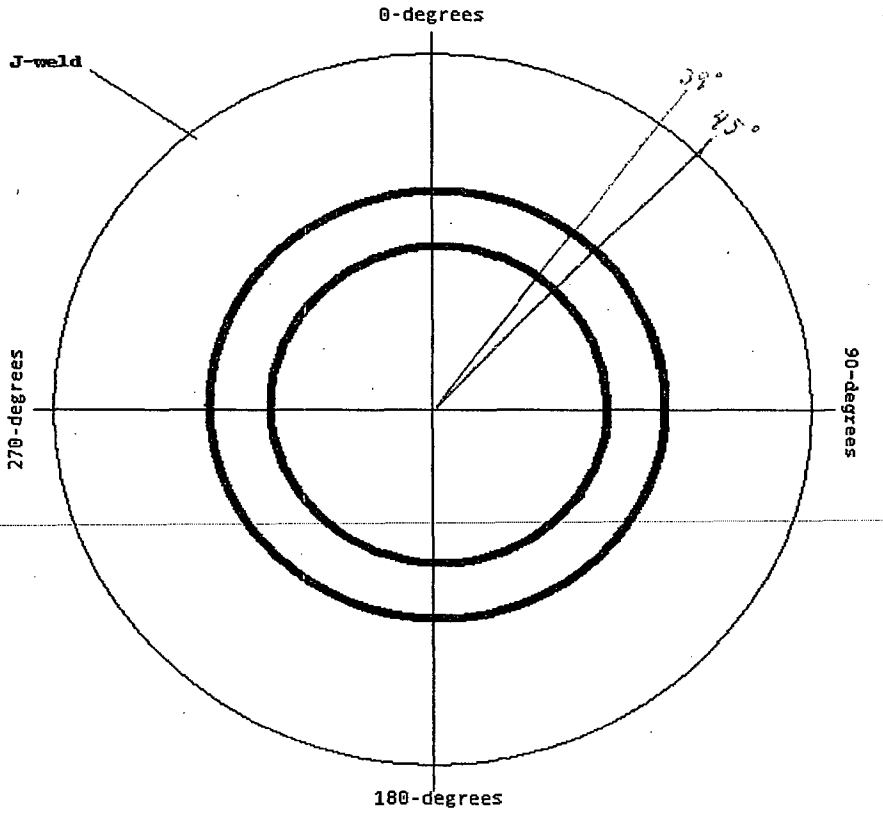
UTLP IND: N/A

AS MEASURED LOWER EXAM EXTENT			AS MEASURED UPPER EXAM EXTENT		
Axial Shooting TOFD @ 0°		Lower Exam Extent (Bottom - Start)	Axial shooting TOFD @ 180°		Upper Exam Extent (Stop - Top)
Start	Bottom		Top	Stop	
0.930	2.650	1.720	6.370	10.690	4.320

Analyst: Gunner Brauer Lv: II Date: 10/21/2012
Document Reviewer: Phillip L. Lancaster Lv: III Date: 10/24/2012
Customer Review: Lv: III Date: 10/24/12
ANII Review: (Optional) MUSTAFA EYOUM Date: 10/25/2012

Westinghouse

PENETRATION GEOMETRY, TOP VIEW



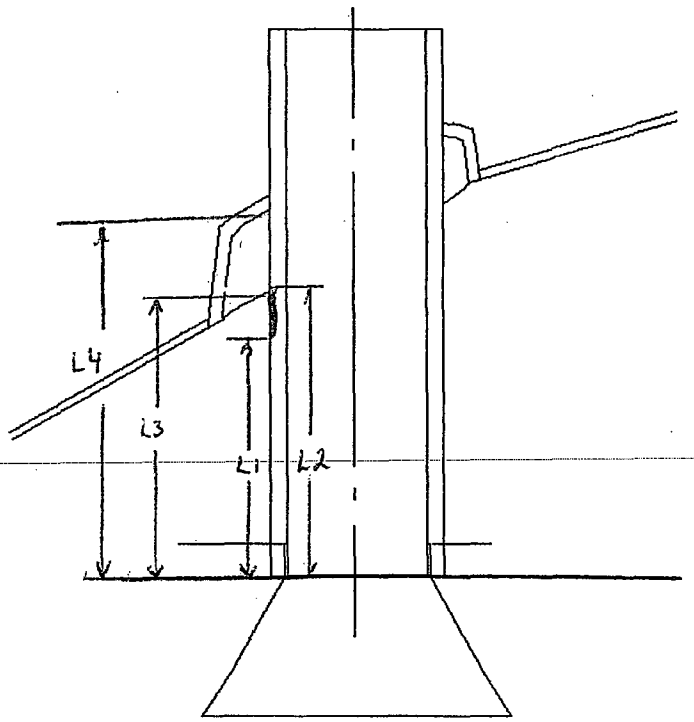
Penetration Tube/J-weld Inspection Diagram

NOTE
The table below shall be utilized in conjuction with this sketch.

Penetration Number	Indication Number	ϕ_1	ϕ_2	d i	d o	d t	Comments
19	1	0	39	0.339	0.283	0.339	

Westinghouse

PENETRATION GEOMETRY, SIDE VIEW



Penetration Tube/J-weld Repair Diagram

NOTE
The table below shall be utilized in conjuction with this sketch.

Penetration Number	Indication Number	L1 (in)	L2 (in)	L3 (in)	L4 (in)	Indication Type	Comments
19	1	2.4	3.10	2.85	4.570]		

WESDYNE INTERNATIONAL
A Westinghouse Electric Company

ULTRASONIC REPORT DATA SHEET

Plant: VC Summer Unit: 1 File Name: VCS-R20-CP02-52-01

Penetration No: 52 Probe Type: Combo 2 UT Acquisition Procedure No: WDI-STD-1040 REV. 8 FCN 001/002

Test Surface: ID Nominal T: 0.633 UT Analysis Procedure No: WDI-STD-1041 REV. 7

Fingerprinting Process: ☐ UT Calibration Data Package #: VCS-R20-CP02-CAL-01R-4151

IND #	CH/PR	L @ max	Ø @ max	L 1	L 2	L 3	L 4	Ø 1	Ø 2	d I	d 0	IND	Evaluation Comments
	1											NDD	
	2											NDD	
1	4	4.130 "	312.0 °							0.517 "		*PTI / NDD	
2	4	2.250 "	319.5 °	2.130 "	2.450 "	2.250 "	4.450 "	307.5 °	321.0 °	0.354 "	0.279 "	**PTI	
3	4	3.730 "	79.5 °	3.730 "	3.850 "	3.890 "	5.530 "	76.5 °	82.5 °	0.501 "	0.132 "	**PTI	
4	4	5.370 "	117.0 °							0.507 "		* PTI / NDD	
5	4	6.330 "	184.5 °							0.492 "		* PTI / NDD	

Comments: *Weld Fabrication Indication

**** Indication confirmed open to surface with PT. See attached.**

Scan # 1 Degrees 0-366°

Scan # Degrees

Scan # Degrees

Scan # Degrees

Scan # Degrees

UTLP (UT Leak Path) Assessment Comments: None

UTLP IND

N/A

AS MEASURED LOWER EXAM EXTENT			AS MEASURED UPPER EXAM EXTENT		
Axial Shooting TOFD @ 0°		Lower Exam Extent (Bottom - Start)	Axial shooting TOFD @ 180°		Upper Exam Extent (Stop - Top)
Start	Bottom		Top	Stop	
0.770	1.770	1.000	7.850	11.170	3.320

Analyst: Gary A. Johnston Lv: II Date: 10/23/2012

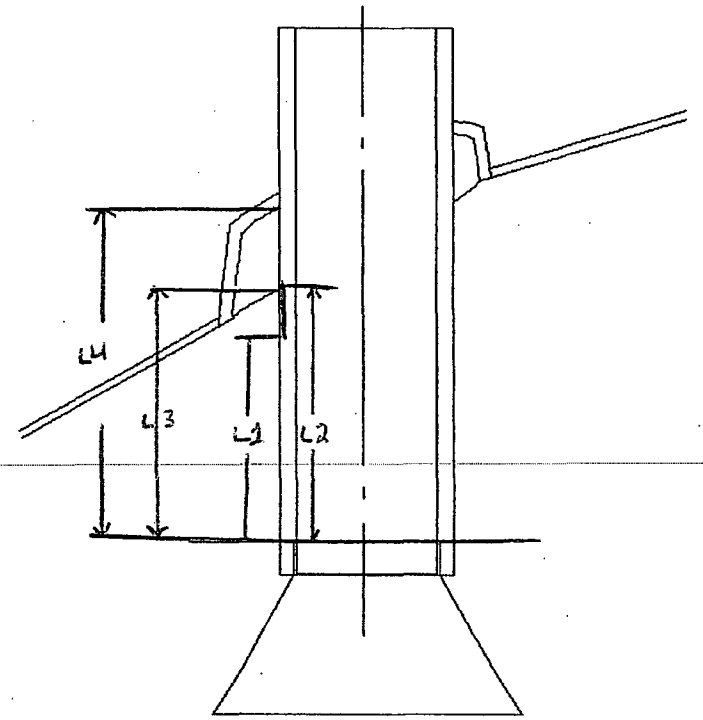
Document Reviewer: Phillip L. Lancaster Lv: III Date: 10/23/2012

Customer Review: J.M.C. Lv: III Date: 10/24/12

ANII Review: (Optional) AMOSTAFA AKOUSH Date: 10/25/2012

Westinghouse

PENETRATION GEOMETRY, SIDE VIEW



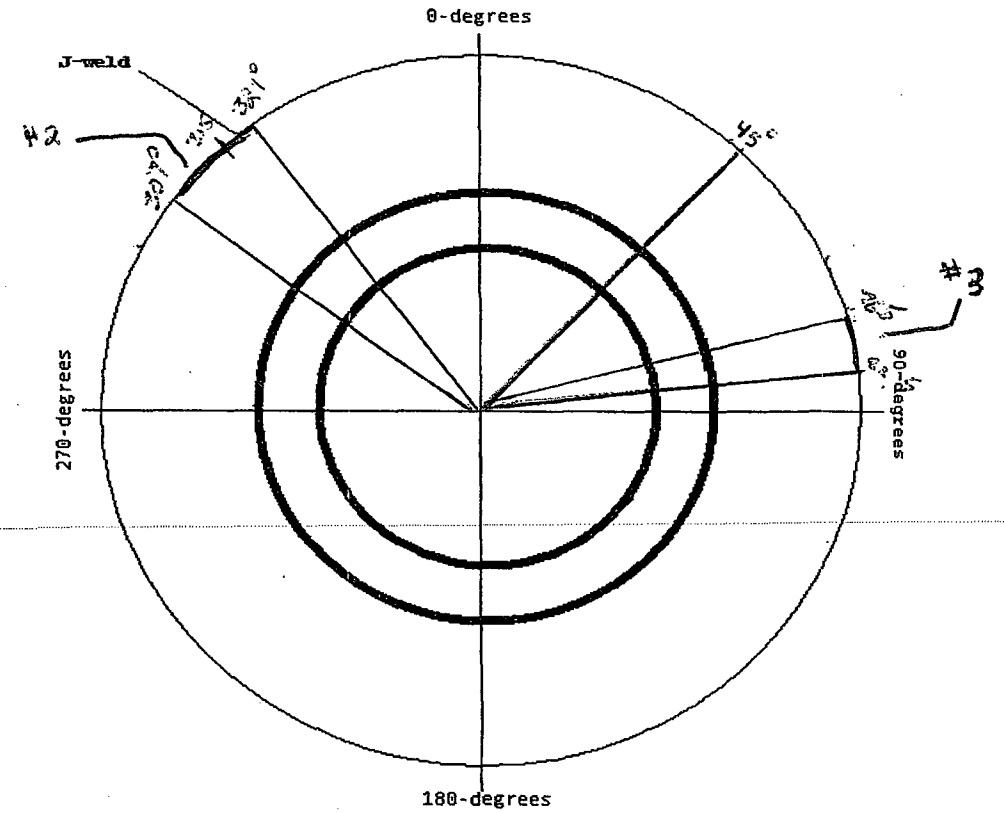
Penetration Tube/J-weld Repair Diagram

NOTE
The table below shall be utilized in conjuction with this sketch.

Penetration Number	Indication Number	L1 (in)	L2 (in)	L3 (in)	L4 (in)	Indication Type	Comments
52	2	2.13	2.45	2.25	4.45	PWSCC	
52	3	3.73	3.85	3.89	5.53	PWSCC	

Westinghouse

PENETRATION GEOMETRY, TOP VIEW



Penetration Tube/J-weld Inspection Diagram

NOTE
The table below shall be utilized in conjuction with this sketch.

Penetration Number	Indication Number	$\emptyset_1$	$\emptyset_2$	d i	d o	d t	Comments
52	2	307.5	321	.354	.279		
52	3	76.5	82.5	.501	.132		

QSP-501
ATTACHMENT I
PAGE 1 OF 1
REVISION 5

LIQUID PENETRANT INSPECTION REPORT

PAGE 1 OF 3

PROJECT	WORK REQUEST NUMBER	DATE
V.C. SUMMER	1207662-012	10 / 23 / 12

SYSTEM OR COMPONENT	DRAWING OR ISO. NO.	BLACK LIGHT READING	LOCATION
RPVH	N/A	N/A	RB-RFF

CODE/CLASS	NDE PROCEDURE NO.	SURFACE CONDITION	THERMOMETER #
1	QSP-501	As Found	FS-5614

CLEANER TYPE OF BATCH NO.	PENETRANT TYPE & BATCH NO.	DEVELOPER TYPE & BATCH NO.
SHERWIN DR-60 #03-J4	SHERWIN DP-S1 # 18-A47	SHERWIN D-100 #17-H6

WELD ID	ACCEPT	REJECT	DATE	TECHNICIAN	ASNT LEVEL
PEN #19		✓	10-23-12	MITCH PARKER / Phil DAVIS	II
PEN #52		✓	10-23-12	MITCH PARKER / Phil DAVIS	II

REMARKS _____

REVIEWED BY _____ DATE 10/24/12

WESDYNE INTERNATIONAL
A Westinghouse Electric Company

Attachment to :

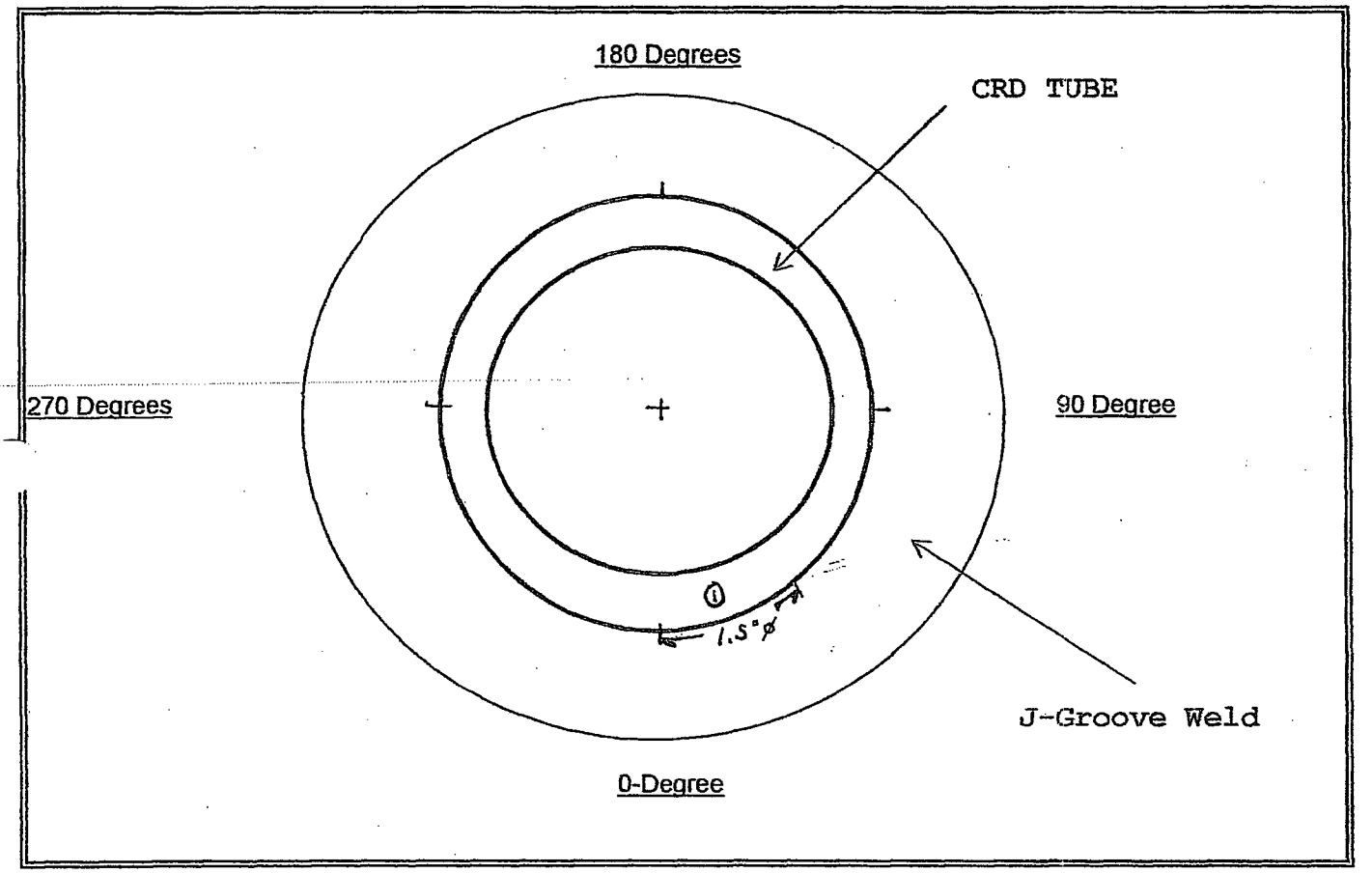
PT Sheet No. _____

Plant/Unit VC Summer
Comp/System: RPVH

Page 2 of 3

LIQUID PENETRANT INDICATION / LIMITATION SKETCH SHEET

Weld / Component ID Number: PEN # 19



COMMENTS: As viewed from under the head
1.5"ø LINEAR CCW FROM 0°

EXAMINER Mitchell Parker LEVEL II DATE 10-23-12
Print: MITCH PARKER
EXAMINER _____ LEVEL II DATE 10-23-12
Print: Phillip Davis
REVIEWER _____ LEVEL III DATE 10/24/12
Authorized Inspection Agency EMOSTAFA ELKOUM DATE 10/25/2012

WESDYNE INTERNATIONAL
A Westinghouse Electric Company

Attachment to :

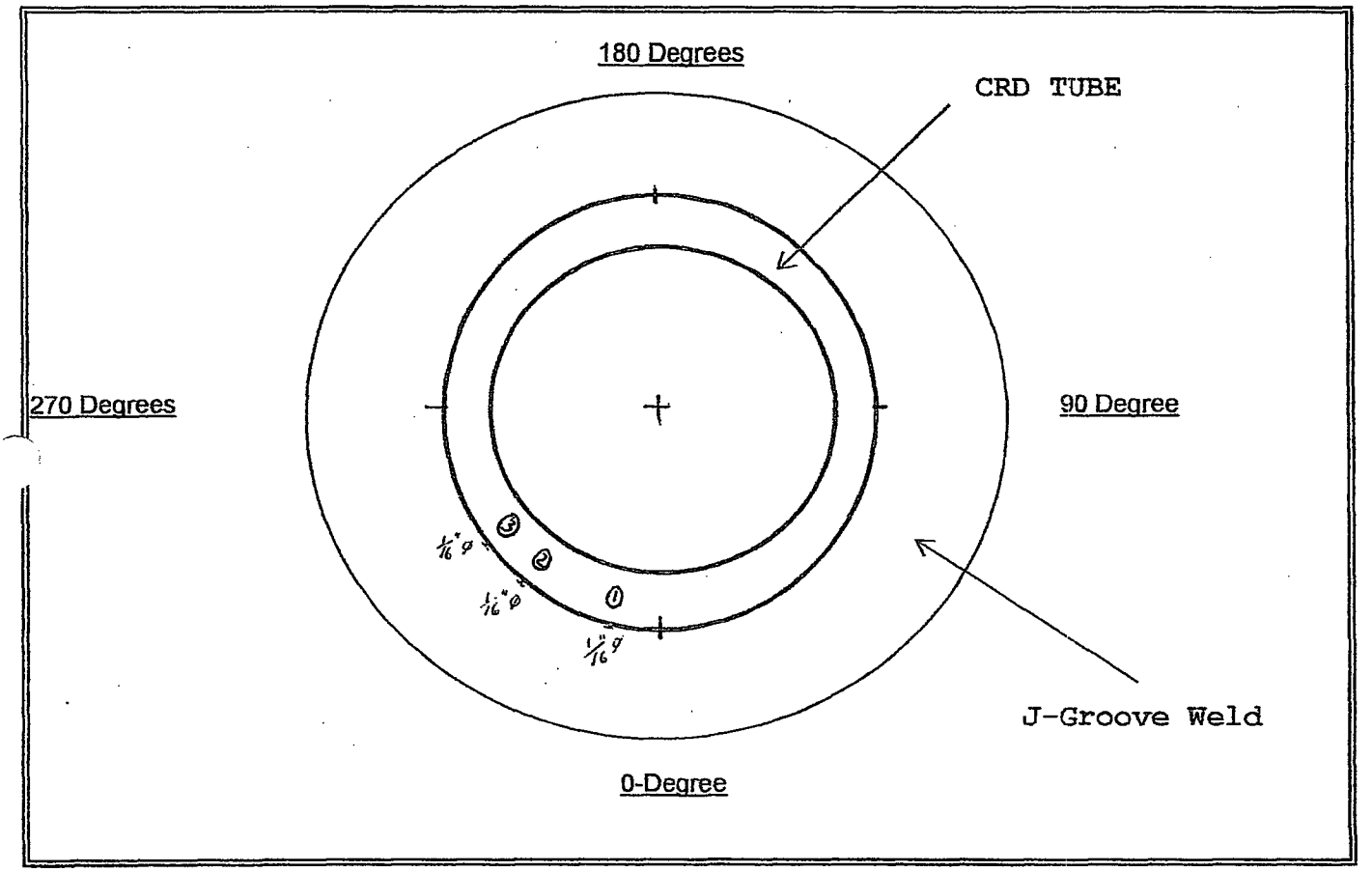
PT Sheet No. _____

Plant/Unit VC Summer
Comp/System: RPVH

Page 3 of 3

LIQUID PENETRANT INDICATION / LIMITATION SKETCH SHEET

Weld / Component ID Number: PEN #52



COMMENTS: As viewed from under the head
3 ROUNDED INDICATIONS 1/16" ø, ① FROM 0° CW .5", ② 45°, ③ FROM 45° CW .5"

EXAMINER Mitchell Parker LEVEL II DATE 10-23-12
Print: MITCH PARKER
EXAMINER [signature] LEVEL II DATE 10-23-12
Print: Philip DAVIS
REVIEWER [signature] LEVEL III DATE 10/24/12
Authorized Inspection Agency EMOSTIAN Bowl DATE 10/25/2012

WESDYNE INTERNATIONAL
A Westinghouse Electric Company

ULTRASONIC REPORT DATA SHEET

Plant : VC Summer Unit: 1 File Name: VCS-R20-CP02-37-01

Penetration No: 37 Probe Type: Combo 2 UT Acquisition Procedure No: WDI-STD-1040 REV. 8 FCN 001/002

Test Surface: ID Nominal T: 0.633 UT Analysis Procedure No: WDI-STD-1041 REV. 7

Fingerprinting Process: ☐ UT Calibration Data Package #: VCS-R20-CP02-CAL-01R-4151

IND #	CH/PR	L @ max	Ø @ max	L 1	L 2	L 3	L 4	Ø 1	Ø 2	d l	d 0	IND	Evaluation Comments
1	4	3.25"	57.0 °	2.93"	3.69"	3.25"	4.89"	52.5 °	61.5 °	0.384 "	0.249 "	PTI	see note
2	4	2.41"	346.5 °	2.09"	2.65"	2.4"	4.25"	345.0 °	348.0 °	0.419 "	0.214 "	PTI	see note
3	4	2.330 "	1.5 °	2.09"	2.61"	2.33"	4.21"	358.5 °	3.0 °	0.339 "	0.294 "	PTI	see note
	1											PTI	see note
	2											NDD	

Comments: Indicaitons not previously recorded. Observed on both channels (1 and 4).
All indications confirmed by PT Inspection

Scan # 1 Degrees 0-366°
Scan # Degrees
Scan # Degrees
Scan # Degrees
Scan # Degrees

UTLP (UT Leak Path) Assessment Comments: None

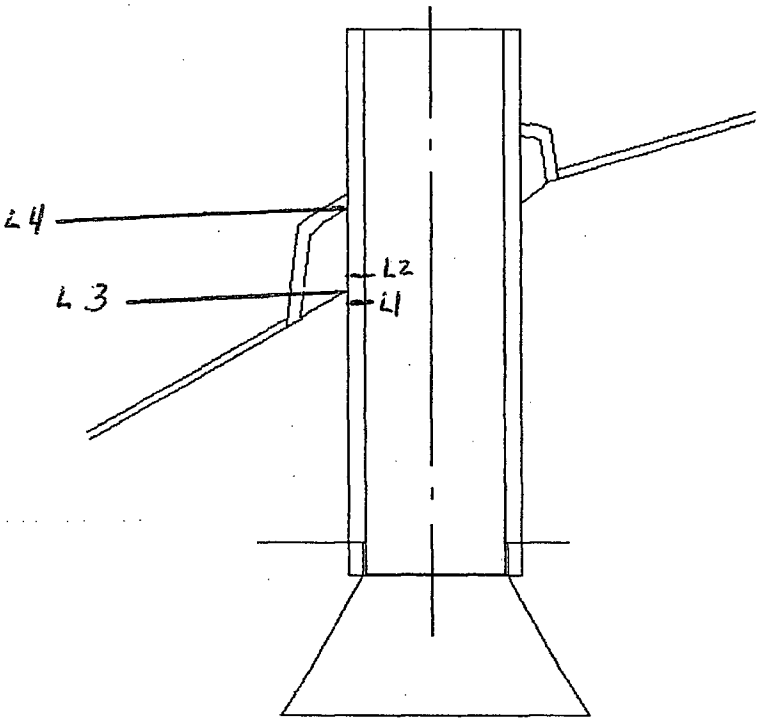
UTLP IND N/A

AS MEASURED LOWER EXAM EXTENT			AS MEASURED UPPER EXAM EXTENT		
Axial Shooting TOFD @ 0°		Lower Exam Extent (Bottom - Start)	Axial shooting TOFD @ 180°		Upper Exam Extent (Stop - Top)
Start	Bottom		Top	Stop	
0.730	2.530	1.800	7.130	10.690	3.560

Analyst: Gunner Brauer Lv: II Date: 10/24/2012
Document Reviewer: Phillip L. Lancaster Lv: III Date: 10/24/2012
Customer Review: Lv: III Date: 10/26/12
ANII Review: (Optional) B MOSTAFA ELIOUMI Date: 10/16/2012

Westinghouse

PENETRATION GEOMETRY, SIDE VIEW



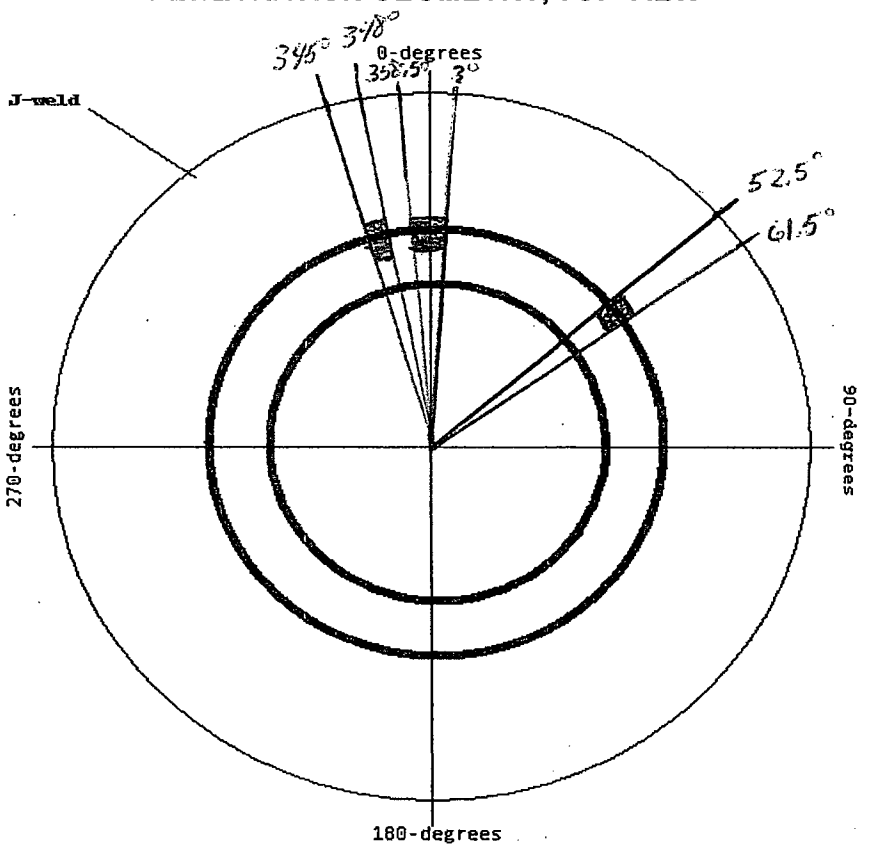
Penetration Tube/J-weld Repair Diagram

NOTE
The table below shall be utilized in conjuction with this sketch.

Penetration Number	Indication Number	L1 (in)	L2 (in)	L3 (in)	L4 (in)	Indication Type	Comments
37	1	2.93	3.69	3.25	4.89	PTI	
37	2	2.09	2.65	2.40	4.25	PTI	
37	3	2.09	2.61	2.33	4.21	PTI	

Westinghouse

PENETRATION GEOMETRY, TOP VIEW



Penetration Tube/J-weld Inspection Diagram

NOTE
The table below shall be utilized in conjuction with this sketch.

Penetration Number	Indication Number	ϕ_1	ϕ_2	d_i	d_o	d_t	Comments
37	1	52.5	61.5	.384	.249	.249	
37	2	345.0	348.0	.419	.214	.214	
37	3	358.5	3.0	.339	.294	.294	

WESDYNE INTERNATIONAL
A Westinghouse Electric Company

ULTRASONIC REPORT DATA SHEET

Plant: VC Summer Unit: 1 File Name: VCS-R20-CP02-31-01

Penetration No: 31 Probe Type: Combo 2 UT Acquisition Procedure No: WDI-STD-1040 REV. 8 FCN 001/002

Test Surface: ID Nominal T: 0.633 UT Analysis Procedure No: WDI-STD-1041 REV. 7

Fingerprinting Process: ☐ UT Calibration Data Package #: VCS-R20-CP02-CAL-01R-4151

IND #	CH/PR	L @ max	Ø @ max	L 1	L 2	L 3	L 4	Ø 1	Ø 2	d l	d 0	IND	Evaluation Comments
	1											NDD	
	2											NDD	
1	4	1.970 "	334.5 °	1.730 "	2.250 "	1.970 "	4.290 "	333.0 °	337.5 °	0.511 "	0.122 "	PTI	
2	4	2.130 "	19.5 °	1.930 "	2.290 "	2.130 "	4.290 "	18.0 °	22.5 °	0.456 "	0.177 "	PTI	
3	4	2.010 "	9.0 °	1.680 "	2.290 "	2.010 "	4.250 "	6.0 °	13.5 °	0.377 "	0.256 "	*PTI	

Comments: Indications also seen on channel 1 * Indication #3 recorded in previous data

All Indications confirmed with PT inspection

Scan # 1 Degrees 0-366°

Scan # Degrees

Scan # Degrees

Scan # Degrees

Scan # Degrees

UTLP (UT Leak Path) Assessment Comments: None

UTLP IND N/A

AS MEASURED LOWER EXAM EXTENT			AS MEASURED UPPER EXAM EXTENT		
Axial Shooting TOFD @ 0°		Lower Exam Extent (Bottom - Start)	Axial shooting TOFD @ 180°		Upper Exam Extent (Stop - Top)
Start	Bottom		Top	Stop	
0.890	2.050	1.160	6.490	10.170	3.680

Analyst: Gary A. Johnston Lv: II Date: 10/23/2012

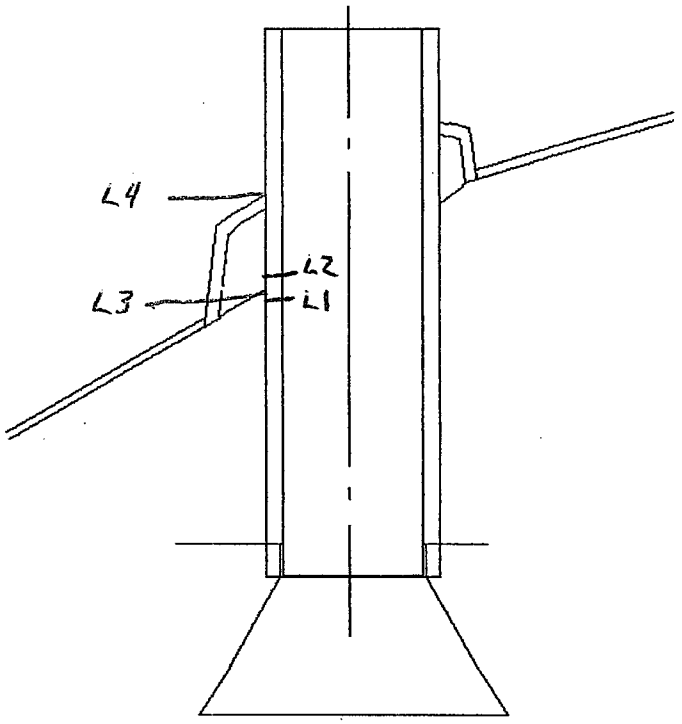
Document Reviewer: Phillip L. Lancaster Lv: III Date: 10/25/2012

Customer Review: Lv: III Date: 10/26/12

ANII Review: (Optional) MOSTAFA AKOUM Date: 10/26/2012

Westinghouse

PENETRATION GEOMETRY, SIDE VIEW



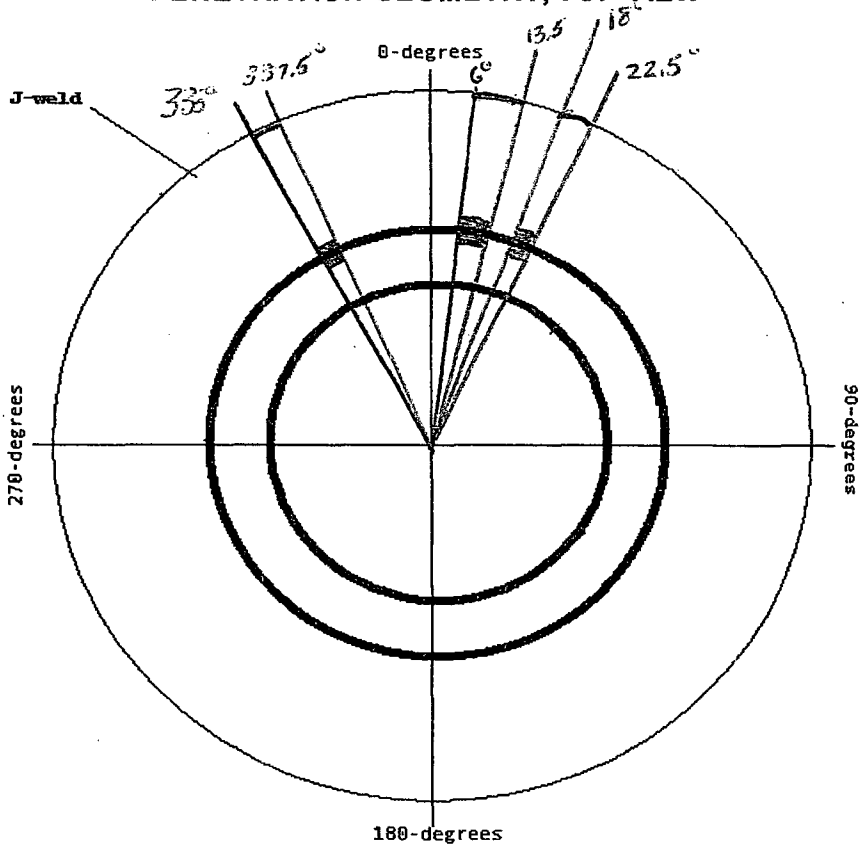
Penetration Tube/J-weld Repair Diagram

NOTE
The table below shall be utilized in conjuction with this sketch.

Penetration Number	Indication Number	L1 (in)	L2 (in)	L3 (in)	L4 (in)	Indication Type	Comments
31	1	1.73	2.250	1.970	4.290	PTI	
31	2	1.93	2.290	2.130	4.290	PTI	
31	3	1.68	2.290	2.010	4.250	PTI	

Westinghouse

PENETRATION GEOMETRY, TOP VIEW



Penetration Tube/J-weld Inspection Diagram

NOTE
The table below shall be utilized in conjuction with this sketch.

Penetration Number	Indication Number	Ø 1	Ø 2	d i	d o	d t	Comments
31	1	333	337.5	0.511	0.122	0.122	
31	2	18	22.5	0.456	0.177	0.177	
31	3	6	13.5	0.377	0.256	0.256	

QSP-501
ATTACHMENT I
PAGE 1 OF 1
REVISION 5

LIQUID PENETRANT INSPECTION REPORT

PAGE 1 OF 3

PROJECT	WORK REQUEST NUMBER	DATE
VC SUMMER	1207662-012	10 / 25 / 12

SYSTEM OR COMPONENT	DRAWING OR ISO. NO.	BLACK LIGHT READING	LOCATION
RPVH	n/a	n/a	RB - RFF

CODE/CLASS	NDE PROCEDURE NO.	SURFACE CONDITION	THERMOMETER #
1	QSP-501	As Found	FS-5614

CLEANER TYPE OF BATCH NO.	PENETRANT TYPE & BATCH NO.	DEVELOPER TYPE & BATCH NO.
SHERWIN DR-60 # 03-JY	SHERWIN DP-51 #18-A47	SHERWIN D-100 #17-H6

WELD ID	ACCEPT	REJECT	DATE	TECHNICIAN	ASNT LEVEL
PEN # 31		✓	10-25-12	MITCH PARKER / Philip Davis	II
PEN # 37		✓	10-25-12	MITCH PARKER / Philip DAVIS	II

REMARKS _____

REVIEWED BY _____ DATE 10/26/12

WESDYNE INTERNATIONAL
A Westinghouse Electric Company

Attachment to :

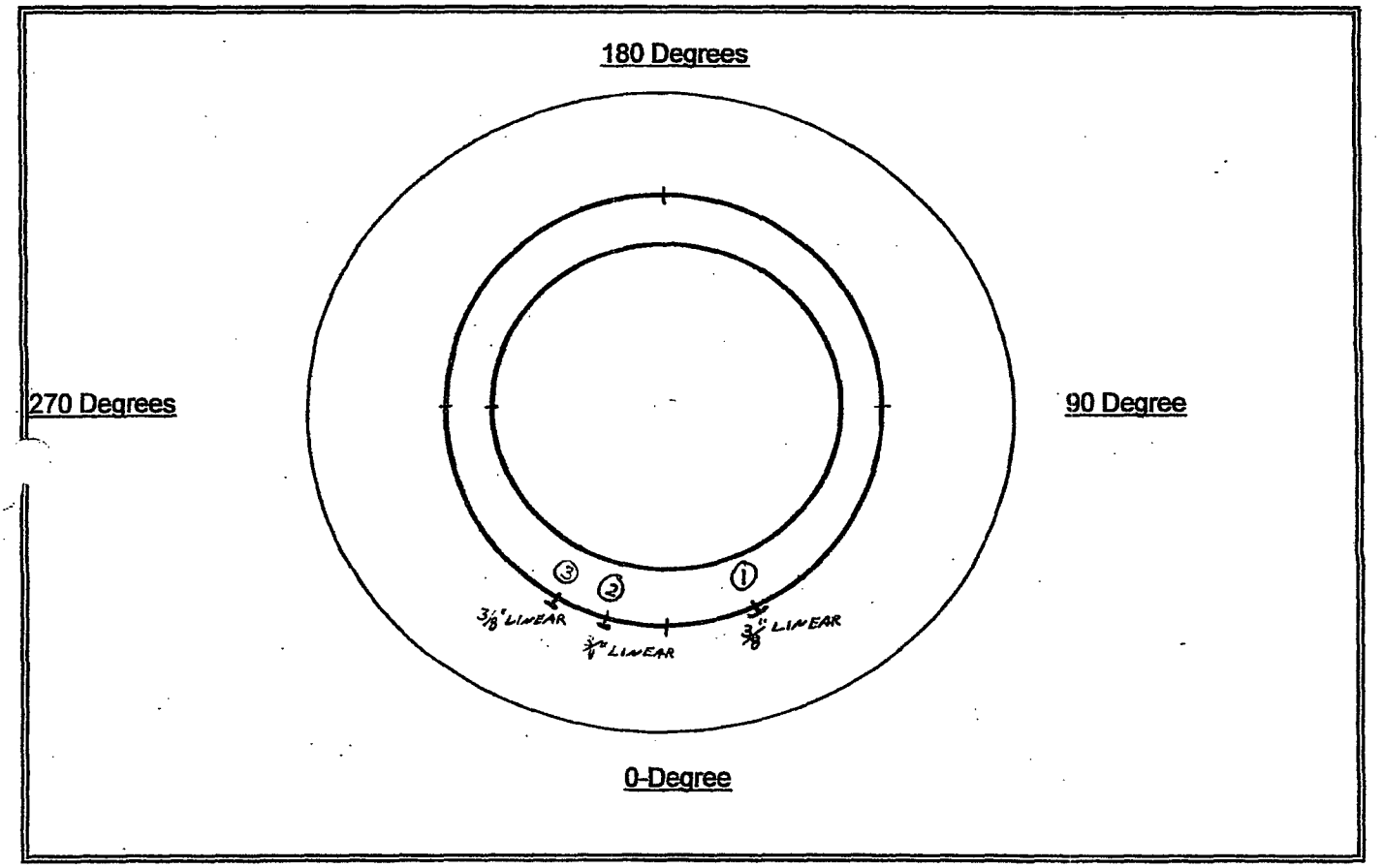
PT Sheet No. _____

Plant/Unit: VC Summer
Comp/System: RPVH

Page 2 of 3

LIQUID PENETRANT INDICATION / LIMITATION SKETCH SHEET

Weld / Component ID Number: PEN #31



COMMENTS: As viewed from under the head, ALL IND. ON NOZZLE SIDE
① 3/4" CCW OF 0° 3/8" LINEAR, ② 1/2" CW of 0° 3/4" LINEAR, ③ 1" CCW of 0° 3/4" LINEAR

EXAMINER Mitchell Parker LEVEL II DATE 10-25-12
Print: MITCH PARKER
EXAMINER Philip Davis LEVEL II DATE 10-25-12
Print: Philip Davis
REVIEWER [signature] LEVEL III DATE 10/26/12
Authorized Inspection Agency ELMOSTAFA ELKOUN DATE 10/26/2012

"A powerful part of your team"

WESDYNE INTERNATIONAL
A Westinghouse Electric Company

Attachment to :

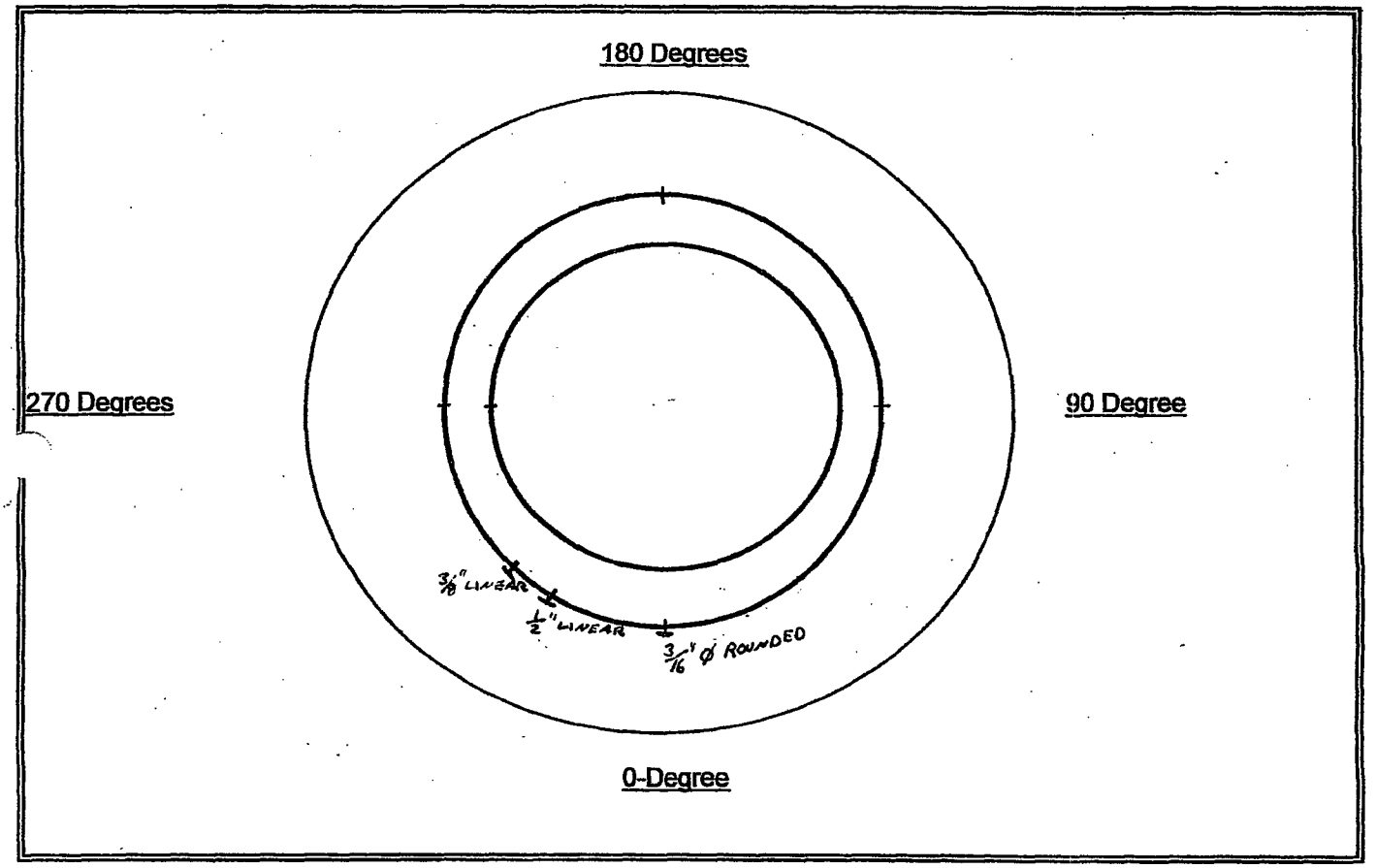
PT Sheet No. _____

Plant/Unit: VC Summer
Comp/System: RPVH

Page 3 of 3

LIQUID PENETRANT INDICATION / LIMITATION SKETCH SHEET

Weld / Component ID Number: PEN #37



COMMENTS: As viewed from under the head, ALL IND. ON NOZZLE SIDE
① AT 0°-3/16" Ø ROUNDED, ② 2" CW OF 0°-1/2" LINEAR,
③ 2 1/4" CW OF 0°-3/8" LINEAR

EXAMINER Mitchell Parker LEVEL II DATE 10-25-12
Print: MITCH PARKER
EXAMINER _____ LEVEL II DATE 10-25-12
Print: Philip Davis

REVIEWER _____ LEVEL III DATE 10-26-12
Authorized Inspection Agency MOSTAFA EL KOUH DATE 10/26/2012

"A powerful part of your team"

VIRGIL C. SUMMER NUCLEAR STATION (VCSNS)
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12

Attachment 4

VCSNS Relief Request RR-III-09, Revision 1

South Carolina Electric & Gas Co. (SCE&G)
Virgil C. Summer Nuclear Station Unit 1 (VCSNS)
VCSNS Relief Request RR-III-09, Revision 1

1

1. ASME Code Component(s) Affected

The affected VCSNS component is the reactor vessel head. The vessel head is required to be inspected under the augmented inspection plan conforming to 10CFR50.55a(g)(6)(ii)(D) and ASME Code Case N-729-1. The reactor vessel head is the original installed head and was constructed under ASME section III 1971 edition with no addenda. There have been no previous repairs to the reactor vessel head penetrations or J-Groove welds. VCSNS is in the third 10-year inservice inspection (ISI) interval which ends December 31, 2013.

2. Applicable Code Edition and Addenda

ASME Code Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1998 Edition through 2000 Addenda.

3. Applicable Code Requirement

Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1."

ASME Section XI, Article IWA-4000 of contains requirements for the repair/replacement activity regardless of the reason or method of identifying the need for the activity performed on ASME components. The specific Code requirements for which use of the proposed alternative are as follows:

ASME Section XI states, defects shall be removed or mitigated in accordance with the following requirements:

a) Defect removal by mechanical processing shall be in accordance with IWA-4462.
b) Defect removal by thermal methods shall be in accordance with IWA-4461.
c) Defect removal or mitigation by welding or brazing shall be in accordance with IWA-4400.
d) Defect removal or mitigation by modification shall be in accordance with IWA-4340.

Note that use of the "Mitigation of Defects by Modification" provisions of IWA-4340 is prohibited per 10CFR50.55a(b)(2)(xxv).

The applicable requirements of the Construction Code required by IWA-4420 for the removal or mitigation of defects by welding from which relief is requested are as follows:

Base Material Defect Repairs:
For defects in base material, ASME Section III, NB-4131 requires that the defects are eliminated, repaired, and examined in accordance with the requirements of NB-2500. These requirements include the removal of defects via grinding or machining per NB-2538. Defect removal must be verified by a Magnetic Particle (MT) or Liquid Penetrant (PT) examination in accordance with NB-2545 or NB-2546, and if necessary to satisfy the design thickness requirement of NB-3000, repair welding in accordance with NB-2539.

ASME Section III, NB-2539.1 addresses removal of defects and requires defects to be removed or reduced to an acceptable size by suitable mechanical or thermal methods.

ASME Section III, NB-2539.4 provides the rules for examination of the base material repair welds and specifies they shall be examined by the MT or PT methods in accordance with NB-2545 or NB-2546. Additionally, if the depth of the repair cavity exceeds the lesser of 3/8-inch or 10 percent of the section thickness, the repair weld shall be examined by the radiographic method in accordance with NB-5110 using the acceptance standards of NB-5320.

Weld Metal Defect Repairs (RVH Penetration J-Groove Weld):
ASME Section III, NB-4450 addresses repair of weld metal defects.

ASME Section III, NB-4451 requires unacceptable defects in weld metal shall be eliminated and, when necessary, repaired in accordance with NB-4452 and NB-4453.

ASME Section III, NB-4452 addresses elimination of weld metal surface defects by grinding or machining.

ASME Section III, NB-4453.1 addresses removal of defects in welds by mechanical means or thermal gouging processes and requires the defect removal to be verified with MT or PT examinations in accordance with NB-5340 or NB-5350 and weld repairing the excavated cavity.

4. Reason for Request

VCSNS has conducted examinations of the reactor vessel head penetrations (VHPs) in accordance with Code Case N-729-1, as amended by 10CFR50.55a. Based on the prescribed examinations VCSNS has identified four VHP nozzles (as reflected in Table 1) that need to be repaired to meet the requirements of 10CFR50.55a prior to returning the vessel head to service.

Table 1

Nozzle Number	Examination Category	Inspection Item	Description
19	N-729-1	B4.20	Part-Length Penetration
31	N-729-1	B4.20	CRDM Thermal Sleeve Penetration
37	N-729-1	B4.20	CRDM Thermal Sleeve Penetration
52	N-729-1	B4.20	Spare CRDM Thermal Sleeve Penetration

Relief is required because the use of the "Mitigation of Defects by Modification" provisions of IWA-4340 is prohibited per 10CFR50.55a(b)(2)(xxv). VCSNS will be conducting the repair as directed within WCAP-15987-P-A Revision 2, (Reference 1). VCSNS intends to follow this industry practice and use the embedded flaw technique to repair flaws on the outside diameter of the RVH penetration tubes. This repair methodology has been generically approved by the NRC in a letter from H. N. Berkow (U. S. NRC) to H. A. Sepp (Westinghouse Electric Company), (Reference 2).

Relief is needed from the requirements of ASME Section XI, IWA-4420 to perform permanent repair of the identified flaws in accordance with the rules of the ASME Section III Construction Code as described in this relief request. Specifically, relief is requested from:

- The requirements of ASME Section III, NB-4131, NB-2538, and NB-2539 to eliminate and repair defects in materials.
- The requirements of ASME Section III, NB-4450 to repair defects in weld metal.

5. Proposed Alternative and Basis for Use

5.1 Proposed Alternative

SCE&G proposes to use the less intrusive embedded flaw process (Reference 1) for the repair of reactor vessel head penetrations as approved by the NRC (Reference 2). This methodology is an alternative to the defect removal requirements of ASME Section XI and Section III. The reactor vessel head is the original installed head. There have been no previous in-service repairs to the reactor vessel head penetrations or J-Groove welds. Embedding a flaw within PWSCC resistant materials (i.e., Alloy 52 or 52M type weld metal) will assure structural integrity of the VHP nozzles as bounded within WCAP-15987 and the NRC Safety Evaluation Report. Further reference to the seal weld or weldment will be reflected as Alloy 52 indicating PWSCC resistant materials as approved by the NRC as reflected in WCAP-15987 and existing precedence.

5.1.1 Flaw Repair

For the repair of the unacceptable outside surface flaws in head penetration nozzles 19, 31, 37 and 52, at least three layers of Alloy 52 material will be deposited (360 degrees full circumference) covering the entire wetted surface of the attachment J-Groove weld as well as at least two layers of Alloy 52 covering the outside surface (360 degrees full circumference) of the head penetration nozzle tube as follows:

The interface boundary between the J-Groove weld and the stainless steel cladding will be located to positively identify the weld clad interface thus ensuring that all of the Alloy 82/182 material of the J-Groove weld is seal welded during the repair. 1

At least three (3) beads (one layer) of 309L stainless steel buffer will be installed on the clad surface approximately 0.5 inch beyond the interface of the clad and J-groove weld metal 360 degrees around.

The J-groove weld will then be completely covered with at least three (3) layers of Alloy 52, deposited 360 degrees around the nozzle and extends over the 309L buffer.

The outside surface of the Alloy 600 penetration tube will be covered with at least two (2) layers of Alloy 52 material and extend down at least 0.5 inches beyond the flaw indication.

5.1.2 Reporting Requirements and Conditions on Use

VCSNS will notify NRC of the Division of Component Integrity or its successor of changes in indication(s) or findings of new indication(s) in the penetration nozzle or J-Groove weld beneath a seal weld repair, or new linear indications in the seal weld repair, prior to commencing repair activities in subsequent inspections.

5.2 Technical Basis for Proposed Alternative

As discussed in WCAP-15987-P, the embedded flaw repair technique is considered a permanent repair. As long as a PWSCC flaw remains isolated from the Primary Water (PW) environment, it cannot propagate. Since an Alloy 52 weldment is considered highly resistant to PWSCC, a new PWSCC flaw should not initiate and grow through the Alloy 52 seal weld to reconnect the PW environment with the embedded flaw. Structural integrity of the affected J-Groove weld and/or nozzle will be maintained by the remaining unflawed portion of the weld and/or the VHP. Alloy 690 and Alloy 52 are highly resistant to stress corrosion cracking, as demonstrated by multiple laboratory tests, as well as over ten years of service experience in replacement steam generators.

The residual stresses produced by the embedded flaw technique have been measured and found to be relatively low because of the small seal weld thickness. This provides the basis that no new flaws will initiate and grow in the area adjacent to the repair weld. There are no other known mechanisms for significant flaw propagation in the reactor vessel head and penetration tube region since cyclic loading is negligible, as described in WCAP-15987-P. Therefore, fatigue driven crack growth should not be a mechanism for further crack growth after the embedded flaw repair process is implemented.

The thermal expansion properties of Alloy 52 weld metal are not specified in the ASME Code. In this case the properties of the equivalent base metal (Alloy 690) should be used. For Alloy 690, the thermal expansion coefficient at 600 degrees F is 8.2E-6 in/in/degrees F as found in ASME Section II, part D "Properties." The Alloy 600 base metal has a coefficient of thermal expansion of 7.8E-6 in/in/degrees F, a difference of about 5 percent. The effect of this small difference in thermal expansion is that the weld metal will contract more than the base metal when it cools, thus producing a compressive stress on the Alloy 600 tube or J-Groove weld. This beneficial effect has already been accounted for in the residual stress measurements reported in the technical basis for the embedded flaw repair, as noted in the WCAP-15987-P.

Attachment 1 provides the plant-specific analysis performed for VCSNS Unit 1 using the same methodology as WCAP-15987-P. The above proposed embedded flaw repair process is supported by applicable generic and plant specific technical bases, and is therefore considered to be an alternative to Code requirements that provides an acceptable level of quality and safety, as required by 10CFR50.55a(a)(3)(i).

5.3 Safety Evaluation Compliance

VCSNS intends to follow WCAP-15987-NP-Revision 2-P-A, "Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations." Below VCSNS has provided the applicability and compliance with each item of the NRC Safety Evaluation.

Item	Description
1	***Licensees must follow the NRC flaw evaluation guidelines.***
[VCSNS Response] VCSNS will follow 10CFR50.55a(g)(6)(ii)(D) and Code Case N-729-1. The inspection plan consists of performing volumetric and/or surface examination of essentially 100 percent of the required volume or equivalent surfaces of the nozzle housings. As stated within 10CFR50.55a(g)(6)(ii)(D)(1), once a licensee has implemented the requirements of ASME Code Case N-729-1 "the First Revised NRC Order EA-03-009 no longer applies to that licensee and shall be deemed to be withdrawn." VCSNS has implemented the first inspection under ASME Code Case N-729-1 during Fall 2009 (RF18).	
2	***The crack growth rate is not applicable to Alloy 600 or Alloy 690 weld material, i.e., Alloy 52, 82, 152, and 182 filler material.***
[VCSNS Response] Any cracks identified during subsequent inspections will be evaluated as directed by 10CFR50.55a(g)(6)(ii)(D) and Code Case N-729-1.	

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>3</td><td>
The NDE requirements listed in the Table below must be implemented for examinations of repairs made using the embedded flaw process.
<table>
<tr><th>Repair Location</th><th>Flaw Orientation</th><th>Repair Weld</th><th>Repair NDE</th><th>ISI NDE of the Repair Note 2</th></tr>
<tr><td>VHP Nozzle ID</td><td>Axial</td><td>Seal</td><td>UT and Surface</td><td>UT or Surface</td></tr>
<tr><td>VHP Nozzle ID</td><td>Circumferential</td><td>Note 1</td><td>Note 1</td><td>Note 1</td></tr>
<tr><td>VHP Nozzle OD above j-groove weld</td><td>Axial or Circumferential</td><td>Note 1</td><td>Note 1</td><td>Note 1</td></tr>
<tr><td>VHP Nozzle OD below j-groove weld</td><td>Axial or Circumferential</td><td>Seal</td><td>UT or Surface</td><td>UT or Surface</td></tr>
<tr><td>j-groove weld</td><td>Axial</td><td>Seal</td><td>UT and Surface, Note 3</td><td>UT and Surface, Note 3</td></tr>
<tr><td>j-groove weld</td><td>Circumferential</td><td>Seal</td><td>UT and Surface, Note 3</td><td>UT and Surface, Note 3</td></tr>
</table>
Notes:

Repairs must be reviewed and approved separately by the NRC.
Inspection consistent with the NRC Order EA-03-009 dated February 11, 2003 and any subsequent changes.
Inspect with personnel and procedures qualified with UT performance-based criteria. Examine the accessible portion of the repaired region. The UT coverage plus surface coverage must equal 100 percent.

</td></tr>
<tr><td colspan="2">[VCSNS Response]

Notes 2 and 3 are modified as follows:

(2) Preservice and Inservice Inspection to be consistent with 10CFR50.55a(g)(6)(ii)(D), which requires implementation of Code Case N-729-1 with conditions.

(3) UT personnel and procedures qualified in accordance with 10CFR50.55a(g)(6)(ii)(D), which requires implementation of Code Case N-729-1 with conditions. Examine the accessible portion of the J-groove repaired region. The UT plus surface examination coverage equals 100%.</td></tr>
</table>

1

6. Duration of Proposed Alternative:

VCSNS is in the last period of its third 10 year inservice inspection (ISI) interval that will end December 31, 2013. The duration of the proposed alternative is for the remainder of the period.

7. Precedents:

The NRC generically approved the embedded flaw repair process described in Reference 1. Requests to use the embedded flaw technique to repair cracks have been previously approved by the NRC on a plant specific basis. The NRC approved a similar repair for Byron Station Unit 2. On March 28, 2011, Byron Station Unit 1 received verbal authorization for use of the seal weld repairs methodology on P-64 and P-76, and again on April 10, 2011, for P-31 and P-43. (Reference 5 and 6)

8. References:

1. WCAP-15987-NP-A Revision 2, "Technical Bases for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations" [ML040290246]
2. Letter H. N. Berkow (U. S. NRC) to H. A. Sepp (Westinghouse Electric Company), "Acceptance for Referencing - Topical Report WCAP-15987-P, Revision 2, 'Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetration,' (TAC NO. MB8997)," dated July 3, 2003 [ML031840237]
3. Letter from T. D. Gatlin (VCSNS) to Document Control Desk (NRC), "Reactor Vessel Head Penetration Weld Repair Under WCAP-15987," dated October 22, 2012.
4. Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1."
5. NRC Memorandum, "Byron Station, Unit No. 1 - Verbal Authorization of Relief Request 13R-19 - Alternative Requirements for Repair of Reactor Vessel Head Penetrations 64 and 76 (TAC No. ME5877)," dated March 29, 2011
6. NRC Memorandum, "Byron Station Unit No. 1 - Verbal Authorization of Relief Request 13R-19 - Alternative Requirements for Repair of Reactor Vessel Head Penetrations Nos. 31 and 43 (TAC No. ME5948)," dated April 13, 2011