Entergy

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Joseph A Clark
Manager, Licensing

RBG-47197

December 22, 2011

U. S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, DC 20555-0001

SUBJECT: River Bend Station, Unit 1 - Requests for Relief
Request for Relief from ASME Boiler & Pressure Vessel Code Section III
Docket No. 50-458
License No. NPF-47

Dear Sir or Madam:

Pursuant to 10 CFR 50.55a, "Codes and Standards," paragraph (3)(i), Entergy requests relief from certain American Society of Mechanical Engineers (ASME) Section III. Entergy proposes an alternative to the postweld heat treatment exemption of Table ND-4622.7 to utilize Code Case N-804 which provides postweld heat treatment exemptions for these welds without the application of elevated preheat.

The specific details of the requested relief are enclosed in the Attachment. Although this request is neither exigent nor emergency, your prompt review is requested.

This letter contains no new regulatory commitments.

A047
NRR

If you have any questions concerning this letter, please contact Mr. Joseph A. Clark at (225) 381-4157.

Respectfully,

Manager, Licensing
River Bend Station - Unit 1

JAC/bmb

Attachments:
1. Attachment - Request for Relief

cc: Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
612 E. Lamar Blvd., Suite 400
Arlington, TX 76011-4125

NRC Senior Resident Inspector
P. O. Box 1050
St. Francisville, LA 70775

U. S. Nuclear Regulatory Commission
Attn: Mr. Alan B. Wang
MS O-7 D1
Washington, DC 20555-0001

Department of Environmental Quality
Office of Environmental Compliance
Radiological Emergency Planning and Response Section
JiYoung Wiley
P.O. Box 4312
Baton Rouge, LA 70821-4312

Public Utility Commission of Texas
Attn: PUC Filing Clerk
1701 N. Congress Avenue
P. O. Box 13326
Austin, TX 78711-3326

Attachment

RBG-47197

Request for Alternative to Utilize Code Case N-804

RBS-R&R-2011-001

ENTERGY OPERATIONS, INC.
RIVER BEND STATION
REQUEST NO. RBS-R&R-2011-001

I. COMPONENTS

Component Number and Description:

Various Size ASME Class 3 Valves:

E12-MOVF068A, Residual Heat Removal Heat Exchanger Service Water Return

E12-MOVF068B, Residual Heat Removal Heat Exchanger Service Water Return

SWP-MOV506A, High Pressure Core Spray Diesel Generator Engine Water Heat Exchange Service Water Header Isolation

SWP-MOV506B, High Pressure Core Spray Diesel Generator Engine Water Heat Exchange Service Water Header Isolation

SWP-MOV501A, Reactor Closed Cooling Water Heat Exchanger Service Water Supply Header Isolation Valve

SWP-MOV501B, Reactor Closed Cooling Water Heat Exchanger Service Water Supply Header Isolation Valve

SWP-MOV511A, Normal Service Water Return Isolation

SWP-MOV511B, Normal Service Water Return Isolation

SWP-MOV55A, Standby Service Water Cooling Tower 1 Inlet

SWP-MOV55B, Standby Service Water Cooling Tower 1 Inlet

CPP-MOV16A, Warehouse Storage

CPP-MOV16A, Warehouse Storage

CPP-MOV16A, Warehouse Storage

CPP-MOV16A, Warehouse Storage

CPP-MOV16A, Warehouse Storage

CPP-MOV16A, Warehouse Storage

Code Class:	3
References:	1. ASME Section XI, 2001 Edition through 2003 Addenda
	2. ASME Section III, 1974 Edition / Summer 1975 Addenda
	3. ASME Section III, 1992 Edition / No Addenda
	4. ASME Section III, Code Case N-804, *Alternative Preheat Temperature for Austenitic Welds in P-No. 1 Material without PWHT*
Unit:	River Bend Station (RBS)
Inspection Interval:	Third (3rd) 10-Year Interval

II. CODE REQUIREMENTS

IWA-4221(b)(1) states, "When replacing an existing item, the new item shall meet the Construction Code to which the original item was constructed."

IWA-4221(c) states in part, "As an alternative to (b), the item may meet all or portions of the requirements of different Editions and Addenda of the Construction Code, or Section III when the Construction Code was not Section III... Construction Code Cases may also be used."

ND-4600 of ASME Section III, 1992 Edition contains the following requirements regarding postweld heat treatment of ASME Class 3 welds:

- ND-4622.1 states that all welds, including repair welds, shall be postweld heat treated within the temperature ranges and holding times of Table ND-4622.1-1 except as otherwise permitted in ND-4622.7.

- ND-4622.7 states that postweld heat treatment is not required for nonferrous materials and welds exempted in Table ND-4622.7(b)-1.
- Table ND-4622.7(b)-1, *Exemptions to Mandatory PWHT*, states that all welds in P-Number 1 material over 1 ½ inch thick with a nominal thickness of ¾" or less are exempt from postweld heat treatment provided a minimum preheat of 200°F is applied.

III. PROPOSED ALTERNATIVE

Background

Entergy River Bend Station (RBS) purchased sixteen (16) ASME Class 3 valves from Weir Valves and Controls Company USA, Inc. All sixteen (16) valves, listed in Section I, were stamped and certified to be in compliance with ASME Section III. Ten (10) of these valves have been installed at RBS. The remaining six (6) valves are in warehouse storage at RBS.

On 8/2/2011, a letter was received from Weir Valves and Controls Company USA. The letter indicated that, during fabrication, the welding process used to install stainless steel (P-Number 8) seats to carbon steel (P-Number 1) bodies of the subject valves did not fully comply with Table ND-4622.7(b)-1 of the ASME Code. The condition noted was that the base material was not preheated to 200°F (minimum) as required by Table ND-4622.7(b)-1 for exemption from post weld heat treatment. The Weir welding procedure required a minimum preheat of 60°F instead of 200°F. These seat rings are attached to the valve body wall by a 3/16 or 1/4 inch fillet weld on both sides of the ring using GTAW or SMAW process. See Attachment 1 for a sketch of the valve seat ring attachment weld.

Proposed Alternative

Entergy considered several options to address the above condition including cut-out and replacement of the subject valves and performance of postweld heat treatment of the valve seat ring welds. However, neither of these options were desirous for various reasons. For example, to replace the Standby Service Water (SSW) valves, the affected piping section would require the divisional loop of SSW to be secured and drained. While the RBS Technical Specifications (TS) provides 72 hours to effect repairs to the system, doing so would result in the loss of an entire train of emergency core cooling components during the repair window. In addition, isolation and draining of a SSW loop during power operation is complex and would expend a significant portion of the 72-hour allowed outage period. There is no plan to drain either division of Standby Service Water (SSW) during the upcoming refueling outage (RF17). Draining a divisional loop of SSW during an outage typically extends the system outage window making emergency core cooling system components unavailable for longer periods of time. It also removes a source of cooling for the spent fuel pool heat exchangers. With regard to postweld heat treatment, this option is also not practical since a postweld heat treatment at 1100° - 1250°F, as required by Table ND-4622.1-1, would adversely affect the metallurgical properties (sensitize) of the austenitic stainless steel.

Pursuant to 10CFR50.55a(3)(i), Entergy proposes an alternative to the postweld heat treatment exemption of Table ND-4622.7 applicable to fillet and partial penetration welds in base materials over 1-1/2" and with nominal thicknesses ¾" or less. More specifically, Entergy proposes to utilize Code Case N-804 which provides postweld heat treatment exemptions for these welds without the application of elevated preheat. The adoption of Code Case N-804 would allow Entergy to accept the subject Weir valves as-is.

IV. BASIS FOR ALTERNATIVE

Postweld heat treatment (PWHT) temperature ranges and holding times for ASME Class 3 components are specified in Table ND-4622.1-1. However, in many cases, PWHT of ASME Class 3 welds in carbon steel (P-Number 1) components is not required, Table ND-4622.7(b)-1 exempts the following welds from PWHT:

Base Material P-Number	Type of Weld or Base Material Thickness at Welded Joint	Maximum Reported Carbon Content	Nominal Thickness[1]	Minimum Preheat Temp.
1	All welds where the materials being joined are 1-1/2" and less	0.30% and less	1-1/4" and less	---
			Over 1-1/4" to 1-1/2"	200°F
		Over 0.30%	3/4" or less	---
			Over 3/4" to 1-1/2"	200°F
	All welds in materials over 1-1/2"	---	3/4" or less	200°F

Note 1: ND-4622.3 defines nominal thickness as follows: "*Nominal thickness in Table ND-4622.7(b)-1 is the thickness of the weld, the pressure retaining material for structural attachment welds or the thinner of the pressure retaining materials being joined, which ever is least. It is not intended that nominal thickness include material provided for forming allowance, thinning, or mill overrun when the excess material does not exceed 1/8". For fillet welds the nominal thickness is the throat thickness, and for partial penetration and material repair welds, the nominal thickness is the depth of the weld groove or preparation.*"

The PWHT exemptions of Table ND-4622.7(b)-1 for P-Number 1 base materials are based on the material thickness at the weld joint, carbon content, nominal thickness of the weld and minimum preheat temperature. However, it is worth noting that some welds in P-Number 1 base materials, 1-1/2" and less, are exempt shown from PWHT without the application of elevated preheat as shown below.

Base Material P-Number	Type of Weld or Base Material Thickness at Welded Joint	Maximum Reported Carbon Content	Nominal Thickness	Minimum Preheat Temp.
1	All welds where the materials being joined are 1-1/2" and less	0.30% and less	1-1/4" and less	---
		Over 0.30%	3/4" or less	---

Code Case N-804, Alternate Preheat Temperature for P-No. 1 Material Without PWHT

Code Case N-804 was approved by the ASME Code Committee on 10/14/11. It was developed to expand the PWHT exemptions of Table NB/NC/ND/NE/NF/NG-4622.7(b)-1 applicable to welds in P-Number 1 base materials over 1-1/2" and with nominal thicknesses ¾" and less. Code Case N-804 states the following:

"It is the opinion of the Committee that, as an alternative to the minimum preheat temperature specified in Table NB/NC/ND/NE/NF/NG-4622.7(b)-1, preheat is not required for fillet or partial penetration welds of nominal thickness ¾" or less in P-Number 1, Group 1 or 2 material over 1-1/2" thick under the following conditions:

(1) Maximum reported carbon content of carbon steel base material shall be 0.30 or less.

(2) Weld filler metal shall be austenitic

(3) The provisions of this Case shall not be applied to vessels or tanks.

(4) Use of this Case shall be documented in the applicable Certificate Holder's Data Report.

Code Case N-804 only applies to austenitic fillet and partial penetration welds having a nominal thickness of ¾" or less. However, it was primarily developed to address the condition described in Section III of this Request by allowing welding of austenitic stainless steel seat rings in carbon steel valve bodies without preheat or postweld heat treatment. The Case does not apply to ferritic welds of any type or size.

Basis for Using Code Case N-804

A comparison of the PWHT exemptions in Table ND-4622.7(b)-1 and Code Case N-804 applicable to welds in P-Number 1 base materials over 1-1/2" in thickness is provided below:

PWHT Exemption Criteria	Table ND-4622.7(b)-1 of ASME Section III	Code Case N-804
Type of Weld	All ferritic/austenitic weld types	Austenitic fillet and partial penetration welds only
Nominal Thickness of Weld	¾"	¾"
Max. Reported Carbon Content	Any	0.30%
Minimum Preheat Temperature	200°F	Any

As shown in the comparison above, Table ND-4622.7(b)-1 requires an elevated preheat temperature of 200°F while the PWHT exemptions of Code Case N-804 do not include this requirement. While by itself, the elimination of a 200°F preheat temperature requirement would appear to be nonconservative, the PWHT exemption of Code Case N-804 includes two conservative restrictions that are not included in Table ND-4622.7(b)-1. These code case restrictions limit carbon content to 0.30% (max,) and weld types to austenitic fillet and partial penetration welds. These Code Case N-804 restrictions make it unnecessary to apply elevated preheat as a PWHT exemption.

Carbon Content Restriction

Code Case N-804 limits the carbon content to 0.30% (max.). That said, the hardenability of a material essentially describes its ability to form martensite. For plain carbon steels, the critical factors affecting martensitic formation are the cooling rate and carbon content. Because this Case can only be used on P-Number 1, Group 1 and 2 carbon steels with low carbon contents – 0.30% maximum, the applicability of the Case is limited to carbon steels that have low hardenability. This point is supported by the testing performed to develop Code Case N-804.

The ASME white paper supporting Code Case N-804 is available on the ASME C&S Connect website. According to the ASME white paper, microstructural evaluations of several mock-up test coupons were performed. The test coupons consisted of SA-516, Grade 70 (P-No. 1, Group 2) plate of various thicknesses and carbon equivalents. While the carbon content of SA-516, Grade 70 plate is limited to 0.31% (max.) by the ASME Section II, material specification, CMTRs indicate that the actual carbon contents of the test coupon base materials ranged from 0.18% to 0.25%. The test coupons were welded with 309L filler metal using 60°F preheat temperature (i.e., no elevated preheat), 300°F interpass temperature, and low heat inputs. Code Case N-804 mock-up welding and testing was performed under the sponsorship/direction of Weir Valves & Controls USA, Inc. Mock-up test results are provided below:

Mock-up Test Coupon No.	Test Coupon Information		Welding Process	HAZ Microstructure
	Thickness	Carbon Equivalent		
1	2"	0.40	GTAW	No martensite
3	3"	0.47	GTAW	No Martensite
4	5"	0.51	GTAW/SMAW	Approximately 50% martensite

The microstructural evaluations for test coupons 1 and 3 indicated that there was no martensite in the weld heat affected zone of the 2" and 3" SA-516, Grade 70 test coupons. Microstructural evaluations for test coupon 4, which was 5" thick, indicated that the weld heat affected zone contained approximately 50% martensite. Regarding test coupon 4, Weir Valves & Controls USA, Inc. provided the following observation in their justification for Code Case N-804 dated October 25, 2011:

> "It is virtually impossible to weld thick steel plate with a Ceq value near 0.5, with austenitic filler metal without some martensite adjacent to the fusion line. The test results showed approximately the same depth of martensite in both the preheated and nonpreheated samples, as well as nearly the same hardness levels. In other words, the Code-required preheat had no effect on prevention of martensite formation, or its hardness, in the HAZ."

Hydrogen Cracking and Austenitic Filler Metal Restriction

Hydrogen cracking is a form of cold cracking. It is produced by the action of internal tensile stresses acting on low toughness heat affected zones. The internal stresses are produced from localized build-ups of monatomic hydrogen. Monatomic hydrogen forms when moisture or hydrocarbons interact with the welding arc and molten weld pool. The monatomic hydrogen can be entrapped during weld solidification and tends to migrate to transformation boundaries or other microstructure defect locations. As concentrations build, the monatomic hydrogen will recombine to form molecular hydrogen, thus generating localized internal stresses at these internal defect locations. If these stresses exceed the fracture toughness of the material, hydrogen-induced cracking will occur. This form of cracking requires the presence of hydrogen and low toughness materials.

Hydrogen cracking is most likely to occur in steels that have a martensitic microstructure. Since Code Case N-804 limits its applicability to low carbon steels (carbon content less than or equal to 0.30%) that have low hardenability, it is unlikely for hydrogen cracking to occur in these materials. As a conservative step that provides increased assurance that hydrogen cracking will not occur, Code Case N-804 limits its applicability to fillet and partial penetration welds deposited with *austenitic* filler metal. Austenitic stainless steel and nickel alloy filler metals act like a sponge for hydrogen and provide added protection against hydrogen cracking. EPRI Report 1013558, Section 3.4 states:

> "Hydrogen is much more soluble in austenitic materials than in ferritic materials. Austenitic steels can hold up to five times more hydrogen than can carbon steel and about seven to eight times more than martensitic steels. However, the diffusivity of hydrogen in austenitic steels is lower than that of ferritic materials thereby facilitating the removal of hydrogen by heating for ferritic materials."

The ability of austenitic filler metal to reduce susceptibility to hydrogen cracking is well understood. When elevated preheat is not possible, Bailey, Coe, Gooch, Hart, Jenkins, and Pargeter make the following recommendation on page 28 of "Welding Steels Without Hydrogen Cracking," Second Edition:

> "The only alternative is then to use a combination of welding process and consumable which virtually prevents the introduction of hydrogen into the HAZ and which produces a weld metal insensitive to hydrogen. This is achieved by the use of austenitic (stainless steel) or nickel alloy electrodes, solid or flux cored wires."

Weir Valves Installed at RBS

The chart below lists the ten Weir valves installed at RBS. The valve bodies are castings manufactured from SA-216, Grade WCB (P-No.1, Group 2) low carbon steels and are over 1-1/2" thick. The valve seat rings were manufactured from SA-240, Type 316 (P-No. 8) austenitic stainless steel and were welded using 309L type filler metal. The carbon contents for these valves ranged from 0.192% – 0.234% while the carbon equivalents ranged from 0.37 – 0.43. The carbon equivalents were

calculated by Entergy using the equation provided by the ASME Section IX Committee in QW-403.26. The carbon equivalents for these valves are clearly bounded by the carbon equivalents of the test coupons used to support development of Code Case N-804.

RBS Valves and Carbon Equivalency Table

Valve Size and Tag #	Valve Noun Name	% Carbon	Carbon Equivalency (CE)
18" E12-MOVFO68A	RHR HX SVCE WTR RTN	0.234	0.43
18" E12-MOVFO68B	RHR HX SVCE WTR RTN	0.214	0.39
8" SWP-MOV506A	HPCS DG ENG WTR HEAT EXCHGR SVCE WTR HEADER ISOL VLV	0.209	0.40
8" SWP-MOV506B	HPCS DG ENG WTR HEAT EXCHGR SVCE WTR HEADER ISOL VLV	0.201	0.37
18" SWP-MOV501A	RX CLSD CLG WTR HT EXHGR SVCE WTR SPLHDR ISOL VLV	0.209	0.40
18" SWP-MOV501B	RX CLSD CLG WTR HT EXHGR SVCE WTR SPLHDR ISOL VLV	0.214	0.39
18" SWP-MOV511A	NORM SVCE WTR RETURN ISOL VLV	0.209	0.40
18" SWP-MOV511B	NORM SVCE WTR RETURN ISOL VLV	0.214	0.39
30" SWP-MOV55A	STBY CLG TOWER 1 INLET	0.192	0.37
30" SWP-MOV55B	STBY CLG TOWER 1 INLET	0.196	0.38

To summarize, the testing performed to support Code Case N-804 indicated that no martensite formed in the weld heat affected zones of the SA-516, Grade 70 test coupons that had carbon equivalents of 0.47 or less. Because the carbon equivalents of the SA-216, Grade WCB valve castings are less than 0.47, the Code Case N-804 testing bounds the ten valves installed at RBS and provides assurance that the weld heat affected zones are free from martensite. Since the subject RBS valves were constructed of low carbon steel, they have low hardenability which makes it unlikely for hydrogen cracking to occur in these materials. Furthermore, the use of austenitic stainless steel filler metal for the valve seat attachment welds provides added assurance that hydrogen cracking will not occur.

VI. CONCLUSION

10 CFR 50.55a(a)(3) states:

"Proposed alternatives to the requirements of (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that:

(i) The proposed alternatives would provide an acceptable level of quality and safety,

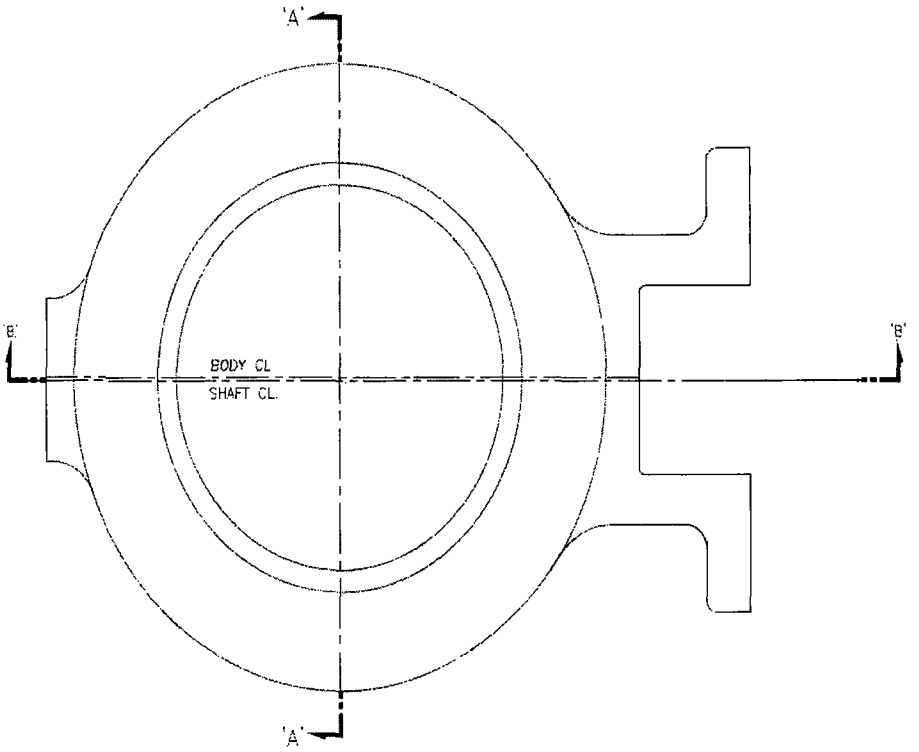
Entergy believes that the proposed alternative of this request will provide an acceptable level of quality and safety. The tests conducted in support of Code Case N-804, showed that the base material properties were not adversely affected by eliminating the Code required preheat; thus proving the use of ASME Code Case N-804 as an acceptable alternative. Therefore, Entergy requests that the NRC staff authorize the proposed alternative, and allow continued use of all affected valves in accordance with 10 CFR 50.55a(a)(3)(i).

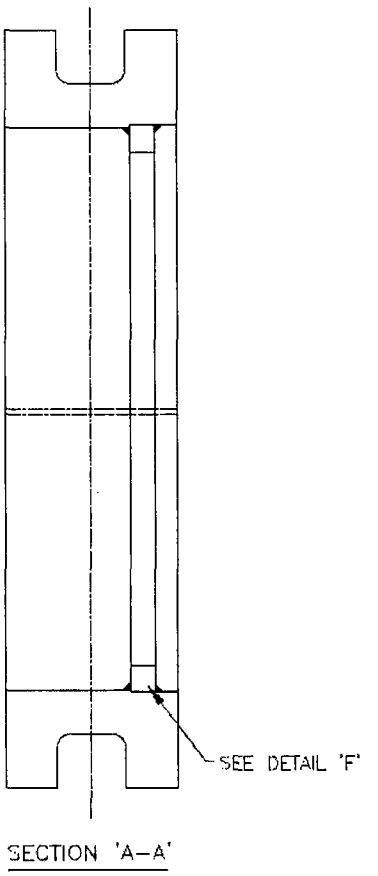
Upon NRC approval of this proposed alternative, Entergy will adopt Code Case N-804 for the valves listed in Section I of this Request and notify Weir Valves & Controls USA. Weir Valves & Controls USA will, then, provide Entergy with corrected data reports that reference Code Case N-804.

VII. Enclosure

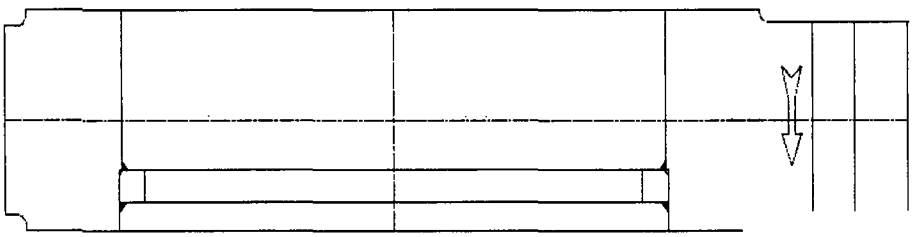
Valve Seat Ring Attachment Weld Sketch

Enclosure

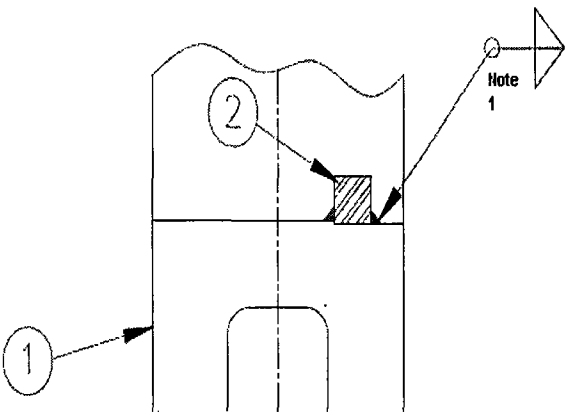




SECTION 'A–A'



SECTION 'B–B'



DETAIL 'F'

Item 1-
Valve Body SA-216 WCB

Item 2-
Seat Ring A240/A479 316L

Note 1:
Seat Rings are welded to Valve Bodies using either a 3/16" or 1/4" Fillet Weld, depending on valve size. These sketches are typical and for general understanding of weld location only.