Northeast
Nuclear Energy

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Millstone Nuclear Power Station
Northeast Nuclear Energy Company
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Waterford, CT 06385-0128
(860) 447-1791
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The Northeast Utilities System

FEB 26 1999

Docket No. 50-336
B17682

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

Millstone Nuclear Power Station, Unit No. 2
Response to Request For Additional Information Concerning
Leak Before Break Evaluation of the Pressurizer Surge Piping

The purpose of this letter is to provide the NRC Staff with additional information pertaining to the NRC review and approval of Leak Before Break (LBB) methodology for the Millstone Unit No. 2 Pressurizer Surge piping. In a letter dated November 9, 1998,[(1)] Northeast Nuclear Energy Company (NNECO) requested that the NRC Staff review and approve the plant-specific LBB evaluation of the Millstone Unit No. 2 Pressurizer Surge piping. In a letter dated January 28, 1999,[(2)] the NRC requested that NNECO provide a response to two questions raised by the NRC Staff during their review of the November 9, 1998 LBB submittal. NNECO's response to the Request for Additional Information (RAI) is organized as follows:

Attachment 1 contains the response to Question 1. Confirmatory documentation supporting the fact that all elbows in the pressurizer surge piping are centrifugally cast CF8M stainless steel is enclosed.

Attachment 2 contains the response to Question 2. Attachment 2 provides the supplemental analyses report, SIR-99-021, Rev 0, by Structural Integrity Associates. This report presents critical flaw size/load margins analyses at data points 2, 3, 13 and 16 for six different pressure, temperature and thermal stratification conditions. NNECO believes that these six conditions are representative of the plant operations and have

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(1) Letter from Martin L. Bowling to U. S. Nuclear Regulatory Commission, "Millstone Nuclear Power Station, Unit No. 2, Request For Permission to Apply Leak Before Break Methodology To The Pressurizer Surge Piping," dated November 9, 1998.

(2) Letter from Stephen Dembek to Martin L. Bowling, Jr., "Request For Additional Information Regarding Submittal Requesting Leak-Before-Break Approval - Millstone Nuclear Power Station, Unit No. 2 (TAC No. MA4126)," dated January 28, 1999.

A001

been extracted from normal plant heatup and cooldown procedures as well as from actual recorded plant process computer data for recent heatup and cooldown events. It is noted that of the four critical data points analyzed, data points 2 and 3 are clearly the limiting locations in the pressurizer surge line.

These supplemental evaluations show that in all cases the critical flaw size was controlled by the criteria requiring a margin of 2 between the critical and the leakage size flaw. None of the critical flaw sizes were controlled by the criteria requiring a margin of $\sqrt{2}$ on the startup and shutdown stratification loads. Note that the Safe Shutdown Earthquake (SSE) loads were not considered in these supplemental evaluations because of the extremely low probability of having a SSE concurrent with the startup or cooldown transient; this is consistent with the guidance provided in your letter dated January 28, 1999.

The following discussion summarizes the results of these six supplemental LBB analyses for data points 2, 3, 13 and 16. Note that analysis for cases 5 and 6 was limited to controlling nodes 2 and 3.

Case 1: Worst Case Stratification During Heatup and Cooldown (p = 262 psig; ΔT = 340 °F)

During plant heatup, the worst case thermal stratification loading occurs when the Reactor Coolant Pumps are first started following an extended shutdown. At this time, the pressurizer could be at approximately 406°F (P_{sat} = 265 psia) and the Reactor Coolant System (RCS) could be as low as 70°F yielding the maximum stratification ΔT of 336°F.

During plant cooldown the worst case thermal stratification loading, with a stratification ΔT of 276°F, is expected to occur with pressurizer pressure at 265 psia (T_{sat} = 406°F) and with the RCS as cold as 130°F. This condition is not evaluated separately as it is clearly enveloped by the heatup case discussed above.

For Case 1, the actual analysis was performed for RCS pressure of 262 psig with a stratification ΔT of 340°F. It is shown that nodes 13 and 16 easily exceed a margin of two on critical flaw size. At nodes 2 and 3, the calculated margin on size is essentially 2.0 (actual 1.97 at node 2 and 1.99 at Node 3).

Case 2: Actual Observed Cooldown Stratification (p = 1270 psig; ΔT = 242 °F)

During cooldown following normal operation, as the RCS pressure is lowered, an intermediate data point consisting of maximum thermal stratification ΔT of 242°F (pressurizer at 576°F and RCS at 334°F) was recorded during an August 1995 cooldown. The corresponding RCS saturation pressure associated with 576°F is 1270 psig.

All evaluated data points for case 2 easily meet a margin of two on critical flaw size, except for node 2 where the calculated margin is essentially 2 (actual 1.98).

Case 3: Initial Cooldown Stratification (p = 2235 psig; ΔT = 170 °F)

During the initial phase of cooldown, stratification conditions can develop. To bound this condition, evaluations were performed to determine the maximum stratification ΔT that would meet NUREG 1061 LBB margins. A thermal stratification limit of approximately 170°F was calculated for this case. This limit easily bounds the worst case thermal stratification ΔT of 121°F that could occur at the beginning of cooldown. At this time the pressurizer pressure is 2235 psig (T_{sat} = 653°F) and the corresponding hot leg temperature could be as cold as 532°F.

For Case 3, all evaluated data points meet a margin of two on critical flaw size.

Case 4: Steady State Stratification (p = 2235 psig; ΔT = 49 °F)

During steady state operation, the maximum expected stratification ΔT of 49°F is easily bounded by the results of case 3. The flaw lengths for a Leakage-Size-Crack (LSC) at each critical data point 2, 3, 13 and 16 were determined based on this condition.

Cases 5 and 6: Intermediate Heatup/Cooldown Stratification (Case 5: p = 1645 psig; ΔT = 210 °F and Case 6: p = 635 psig; ΔT = 295 °F)

During heatup operation, the pressurizer pressure is increased once outside the RCS Low Temperature Overpressure Protection limits. Cases 5 and 6 with ΔT's of 210°F and 295°F are representative of the typical stratification loadings that would be expected.

For cases 5 and 6, all evaluated data points essentially meet a margin of two (actual 1.97) on critical flaw size.

The six different stratification load case evaluations discussed above are based on the expected magnitude of thermal stratification from operating procedures and actual plant records. NNECO believes that the conditions evaluated are sufficient to show the applicability of LBB for all stratification conditions. The result of these evaluations are plotted in Figure 1 and show the maximum pressurizer temperature as a function of the RCS hot leg temperature which would meet the LBB acceptance criteria.

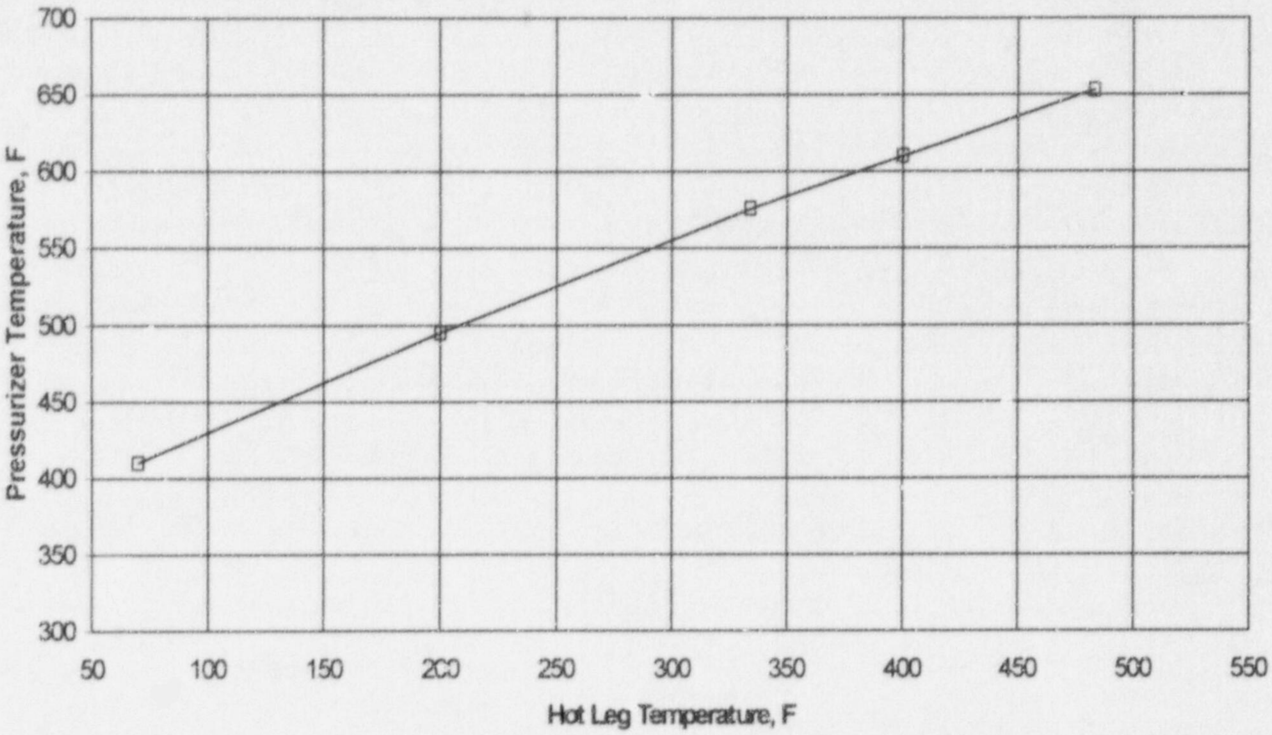

Figure 1. Maximum Pressurizer Temperature as a Function of RCS Temperature (Extracted from SIR-99-021, Rev. 0)

In actual practice, however, during startup, increasing pressure and stratification ΔT will lead to significant leakage from a LSC (i.e., a flaw that leaks at 10 gpm for normal operating conditions with a stratification ΔT = 49°F). Significant leakage will lead to a cooldown of the plant, such that decreasing pressure and ΔT will reduce the stresses in the piping prior to reaching the higher pressure/temperature conditions later in a heatup. On the other hand, detection of leakage during normal operation requires that all potential conditions associated with cooldown must be passed through. The evaluated conditions adequately bound all expected thermal stratification magnitudes and associated RCS pressures and temperatures.

In order to minimize/eliminate those plant conditions which could result in ΔTs in excess of those provided in Figure 1, NNECO will incorporate the information from Figure 1 into the appropriate plant procedures.

The regulatory commitments associated with this letter are contained in Attachment 3.

If you have any additional questions concerning this submittal, please contact Mr. Ravi G. Joshi at (860) 440-2080.

Very truly yours,
NORTHEAST NUCLEAR ENERGY COMPANY

Raymond P. Necci
Vice President - Oversight and Regulatory Affairs

Attachments

cc: H. J. Miller, Region 1 Administrator
J. P. Durr, Chief, Inspections Branch
S. Dembek, NRC Project Manager, Millstone Unit No. 2
D. P. Beaulieu, Senior Resident Inspector, Millstone Unit No. 2

Docket No. 50-336
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Attachment 1

Millstone Nuclear Power Station, Unit No. 2
Response to Request For Additional Information Concerning
Leak Before Break Evaluation of the Pressurizer Surge Piping

Response to RAI Question 1
Material Specification For Pressurizer Surge Piping Elbows

February 1999

Attachment 1

Response to RAI Question 1
Material Specification For Pressurizer Surge Piping Elbows

Question #1 - Material Specifications

Page 4-1, Section 4.2 - It is implied that all sections of the piping in the surge line are centrifugally cast CF8M stainless steel. Confirm that this is true for the surge line elbows and provide documentation which supports this conclusion.

Reply to Question #1:

The documentation provided below confirms that the material for the surge line elbows is centrifugally cast CF8M stainless steel

REFERENCES (Attached):

1. NU Drawing 25503-29152 Sheet 13
2. Certification of Chemical and Mechanical Properties of Surge Line Elbows
3. ABB CE Purchase Specification P8E7(a) - (Redacted)

Referenced Drawing shows the component specific material information for the pressurizer surge piping assembly including the information on all 90° and 30° elbows each uniquely identified with a Piece Number, Code Number, and the Heat Number. The table below summarizes this information.

Reference 2 provides copies of the Certified Material Test Report (CMTR) that tie the individual heat numbers with the material specification. Note that the CMTRs also refer to material specification ASTM-A-351-65 CF8M per ABB/CE Purchase Specification P8E7(a). As shown in Reference 3, CE specification P8E7(a) required centrifugally cast SA-351 Grade CF8M per Section II of ASME Code.

Thus, it is confirmed that all five elbows for the surge line were centrifugally cast CF8M stainless steel.

Surge Line Assembly No.	Part No.	Heat No.	Code No.
505-01	505-04-1 (90 degree ell)	S083	C-4620-2
	505-15-2 (90 degree ell)	S084	C-4620-3
	505-03 (30 degree ell)	S157	C-4621-1
505-12	505-04-2	S098	C-4620-4
505-07	505-15-1	S082	C-4620-1

Combustion Engineering Inc.
911 West Main Street
Chattanooga, Tennessee 37402

Attn: S. R. McFalls

WISCONSIN CENTRIFUGAL, INC.
WAUKESHA, WISCONSIN
8370
CERTIFICATION OF CHEMICAL AND MECHANICAL PROPERTIES

W-128

Your P.O. No. 40-83383
12" SCH 160 Elbow
Your Part No. Min. Wall 1.148" 30°

30°
6 11

Shipping Date 7/7/71

ASTM-A-351-65 CF8M per P8E7(a)
Spec. .10 Co. Max. 7% Min. Ferrite

No. Pcs. 1

Shipped Via.

CHEMICAL ANALYSIS | **MECHANICAL PROPERTIES**

HEAT NO.	NO. PCS.	C.	MN.	SI.	CR.	NI.	S.	P.	MO	CO	TENSILE	YIELD	R.A.	ELONG.
S157	1	.04	.86	.92	19.40	9.30	.014	.013	2.45	.023	79,500	39,100		46%
		.04	.91	.74	20.10	9.70	.015	.013	2.45	.025				

	N_2	FERRITE
S157	.087	18.4-22.7%

Solution annealed.

Physical taken from casting per specification.

~~Heat treat charts attached~~.

C-4621-1
75467

	SERIALIZATION
S157	WC 3119

Material has been subjected to the specified flattening test per ASTM-A-451 and found to be acceptable.

Material has been subjected to the specified penetrant inspection per P8E7(a) and Addendum 1(a) and USA B31.7 and found to be acceptable.

Casting has been subjected to the specified radiographic inspection per P8E7(a), Addendum 1(a) and USA B31.7 and Procedure #8370 and found to be acceptable.

Second chem analysis from casting.

R Hoyt Buchtel

We hereby certify that the heats listed above are correct to the best of our knowledge.

R W McQuillan
Inspector

Helen McDaniel
Notary Public

My commission expires Sept. 8, 1974

stion Engineering Inc.
West Main Street
Chattanooga, Tennessee 37402

Attn: S. R. McFalls

(E LL)

WISCONSIN CENTRIFUGAL, INC.
WAUKESHA, WISCONSIN
8369

W-128

CERTIFICATION OF CHEMICAL AND MECHANICAL PROPERTIES

Your P.O. No. 40-83383

Your Part No. ELLS - 12" SCH 160 Min. Wall 1.148" 90°

Shipping Date 7/7/71

Spec. ASTM-A-351-65 CF8M Per P8E7(a) .10 Co. Max. 7% Min. Ferrite

No. Pcs. 4

Shipped Via.

CHEMICAL ANALYSIS **MECHANICAL PROPERTIES**

HEAT NO.	NO. PCS.	C.	MN.	SI.	CR.	NI.	S.	P.	MO	CO	TENSILE	YIELD	R.A.	ELONG.
S082 #1	1	.04	.80	.90	20.20	9.00	.013	.014	2.65	.023	87,300	42,100		50%
		.04	.76	.60	20.00	9.20	.015	.013	2.50	.021				
S083 #2	1	.05	.75	1.02	19.96	10.03	.015	.013	2.68	.023	86,000	4[illegible],800		44%
		.05	.85	.68	20.70	9.00	.013	.013	2.55	.024				
S084 #3	1	.06	.83	1.14	20.10	9.87	.015	.013	2.56	.024	89,600	45,200		44%
		.06	.94	1.08	20.70	9.50	.015	.013	2.55	.027				
S098 #4	1	.05	.85	1.00	20.20	9.10	.015	.013	2.55	.024	91,200	48,200		46%
		.05	.92	.66	20.90	9.20	.015	.013	2.45	.023				

	N_2	FERRITE
S082	.083	23.7-27%
S083	.080	21.3-25.4%
S084	.089	26.4%-29.4%
S098	.087	21.4-24.5%

Solution annealed.

C-4620-1 thru 4

Physical taken from casting per specification.

75467

[redacted].

SERIALIZATION RECORD:	
S082	WC 3103
S083	WC 3105
S084	WC 3104
S098	WC 3102

Material has been subjected to the specified flattening test per ASTM-A-451 and found to be acceptable.

Material has been subjected to the specified penetrant inspection per P8E7(a) and Addendum 1(a) and USA B31.7 and found to be acceptable.

Casting has been subjected to the specified radiographic inspection per P8E7(a), Addendum 1(a) and USA B31.7 and Procedure #8369 and found to be acceptable.

Second chem analysis from casting. R Hoyt Bechtel

We hereby certify that the heats listed above are correct to the best of our knowledge.

A.W. McQuillan
Inspector

Helen McDaniel
Notary Public

My commission expires Sept. 8, 1974

REDACTED

COMBUSTION ENGINEERING, INC.
NUCLEAR COMPONENTS DEPARTMENT

C-E PROPRIETARY

Spec.No.: P8E7(a)
Date: December 17, 1968

PURCHASE SPECIFICATION FOR AUSTENITIC STAINLESS STEEL CASTINGS SECTION III, ASME CODE

1.0 Scope:

1.1 This purchase specification provides the requirements for austenitic stainless steel castings of weldable quality for use in the construction of Class A Nuclear Vessels in accordance with Section III, ASME Code (Rules for Construction of Nuclear Vessels).

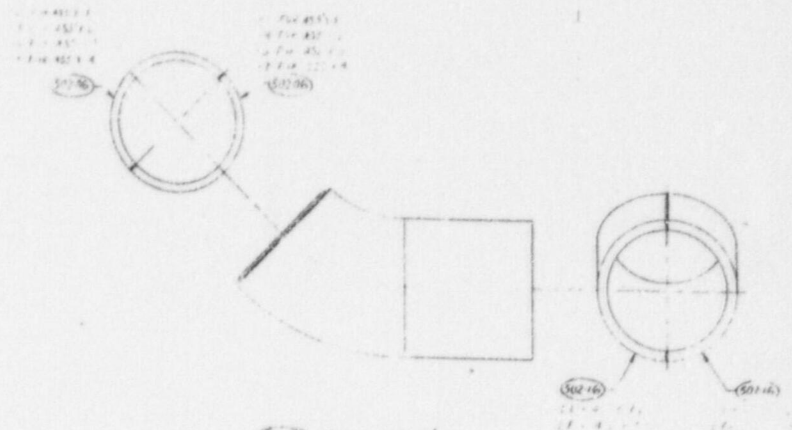
1.2 The provisions of SA-351 (Specification for Ferritic and Austenitic Steel Castings for High Temperature Service), Section II, ASME Code (Material Specifications), shall apply except where modified by this specification.

2.0 Basis of Purchase:

2.1 Material ordered to this specification shall be SA-351 Grade CF8M.

2.2 Material ordered to this specification shall be centrifugally cast.

E-234-015



PIPE ASS'Y

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LOCATION	PC. NO.	CODE NO.	HEAT
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F[illegible]	502-06-2	C4607	B1918-
F[illegible]	502-16-	C4603-1	C7715
A[illegible]	502-16-2	C4603-2	C7715

ASS'Y # 503-03-2			
LOCATION	PC. NO.	CODE NO.	HEAT
F[illegible]	502-06-3	C4607	B1918-
NS	502-06-4	C4607	B1918-
F[illegible]	502-16-1	C4603-1	C77[illegible]
A[illegible]	502-16-2	C4603-2	C77[illegible]

ASS'Y # 503-03-3			
LOCATION	PC. NO.	CODE NO.	HEAT
NS	502-06-5	C4607	B1918-
[illegible]	502-06-6	C4607	B1918
[illegible]	502-16-1	C4603-1	C77[illegible]
[illegible]	502-16-2	C4603-2	C77[illegible]

ASS'Y # 503-03-4			
LOCATION	PC. NO.	CODE NO.	HEAT
N[illegible]	502-06-7	C4601	B1918
F[illegible]	502-06-8	C4607	B1918-
[illegible]	502-16-	C4603-1	C7715
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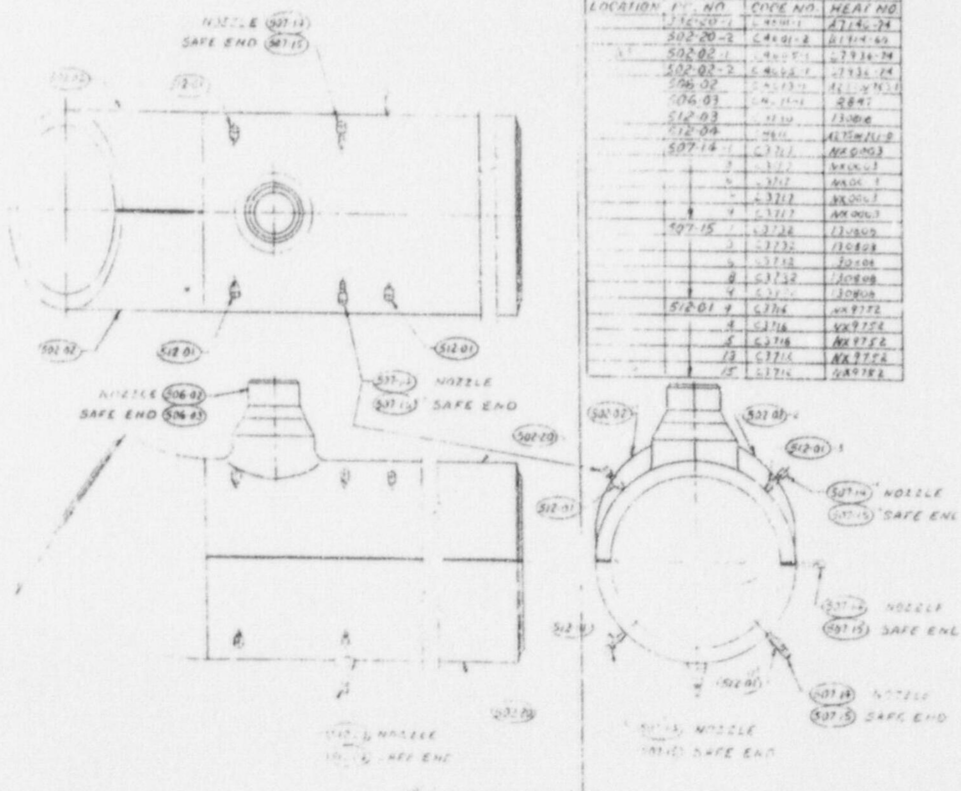

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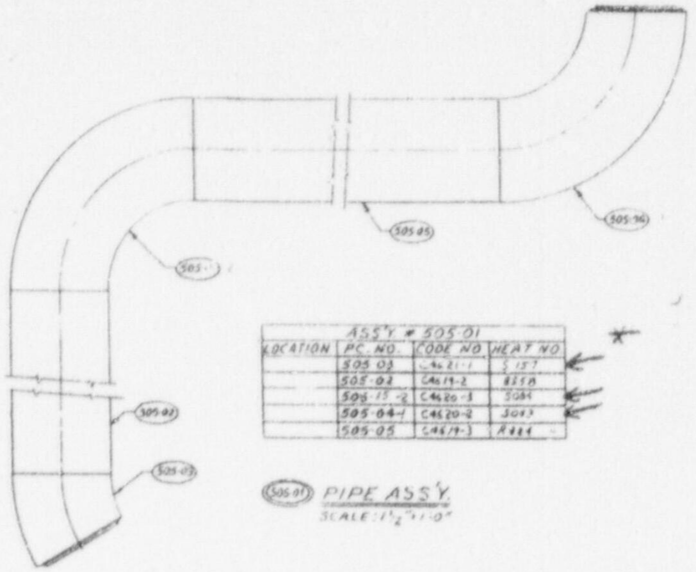
	502-20-2	C4601-2	B1914-60
[illegible]	502-02-1	C4605-1	C7936-74
	502-02-2	C4605-1	C7936-74
	506-02	C4513-1	[illegible]
	506-03	C4[illegible]	2847
	512-03	[illegible]	130816
	512-04	[illegible]	[illegible]
	507-14-1	C3717	NX0063
	3	C3717	NX0063
	[illegible]	C3717	NX0063
	[illegible]	C3717	NX0063
	9	C3717	NX0063
	507-15-1	C3732	130809
	3	C3732	130808
	[illegible]	C3732	130808
	8	C3732	130808
	9	C3732	130808
	512-01-1	C3716	NX9752
	4	C3716	NX9752
	5	C3716	NX9752
	13	C3716	NX9752
	15	C3716	NX9752

PIPE ASS'Y

REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
1	GEN	DELETED LETTER SUFFIX AT ASS'Y AND PC. NOS. REVISED TABLES.	[illegible]	[illegible]
2		MILL CODE AND HEAT NOS ADDED ASSY 505-07 AND 505-01 CHG ELLS NO 505-04 TO 505-15-1 and 2	[illegible]	



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	505-15-2	C4620-3	5084
	505-04-1	C4620-2	5093
	505-05	C4619-3	R884

(505-01) PIPE ASS'Y.
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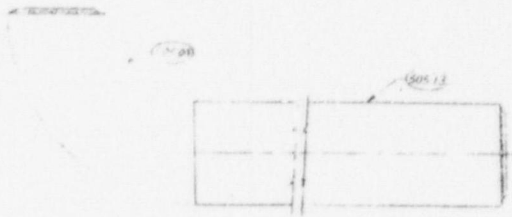

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	505-13	C4619-1	R84

(505-12) PIPE ASS'Y
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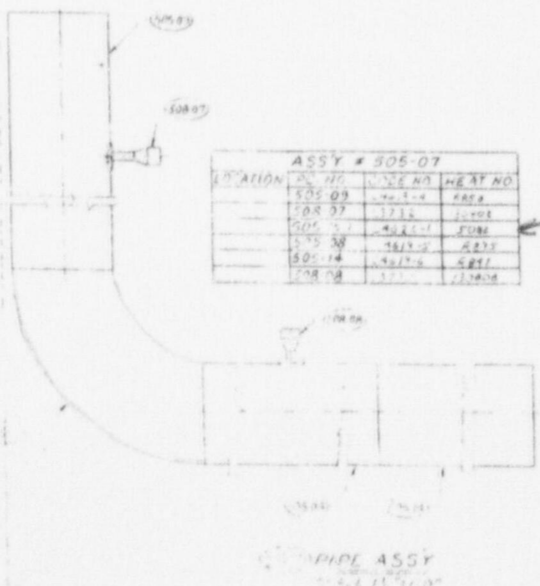
APERTURE CARD

Also Available on Aperture Card

CERTIFIED AS CONSTRUCTED
APPROVED [signature] DATE 9-16-76



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	505-15-1	[illegible]	5084
	505-38	[illegible]	R875
	505-14	[illegible]	[illegible]
	508-08	[illegible]	[illegible]

* (Elbows)

9903080040-01

PIPE ASS'Y
SCALE 1½"=1'-0"

7604-M770-25-3

COMBUSTION ENGINEERING, INC.
CHATTANOOGA DIVISION

MATERIAL IDENTIFICATION FOR PIPING

25203-29152 SHEET 1B

E 234-015

CONTRACT 75467