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SUBJECT: Forwards summary of actions taken in response to NRC Bulletin 88-005,Suppls 1 & 2 re nonconforming matls. see Reply

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September 8, 1988

U.S. Nuclear Regulatory Commission
Document Control Desk
Attn: Mr. Carl Stahle
PWR Project Directorate No. 1
Washington, D.C. 20555

Subject: Response to NRC Bulletin 88-05, Supplements 1 & 2; Nonconforming Materials Supplied by Piping Supplies, Inc. (PSI) and West Jersey Manufacturing Company (WJM)
R.E. Ginna Nuclear Power Plant
Docket No. 50-244

Reference: (a) June 30, 1988 NUMARC Workshop on NRC Bulletin 88-05, Washington, DC
(b) NUMARC Generic Testing Program - Response to NRC Bulletin 88-05 - Interim Report dated July 29, 1988, Prepared by Bechtel National, Inc. for EPRI
(c) Report on Generic Analysis and Evaluation of Suspect Material Identified in NRC Bulletin 88-05, dated July 21, 1988, Prepared for NUMARC/EPRI by Bechtel Power Corporation

Dear Mr. Stahle:

The following submittal represents RG&E's summary of actions taken in response to NRC Bulletin 88-05 and Supplements 1 and 2 thereof.

BACKGROUND

NRC Bulletin 88-05, dated May 6, 1988 and received May 11, 1988, required a procurement records review for the period since January 1, 1976 for WJM material and January 1, 1985 for PSI material to determine if any such ASME or ASTM materials were furnished to the facility. A list of ASME or ASTM material used in safety-related systems found not in conformance with applicable code requirements was required, along with identification of the applications for which they were used. Demonstration that the material was suitable for the intended service or replacement was required. For non-safety-related applications, actions commensurate with the functions of the material was required. Documentation of the

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specific actions taken by licensees was required. Scheduled actions were required to be completed prior to restart from the next major outage starting after 180 days from date of receipt of the bulletin. A written report was required within 120 days from the date of receipt indicating the results of the records review and actions taken.

Supplement 1 to 88-05 dated June 15, 1988, received June 20, 1988, provided additional information, reduced the scope of the records review to flanges and fittings, required appropriate testing of identified flanges and fittings, and required Justifications for Continued Operations (JCO) for materials deviating from specifications or determined to be inaccessible. Appropriate testing and JCOs were required within 30 days from receipt of the Supplement for flanges and fittings identified as of that date. Nonconforming flanges and fittings were required to be retained until advised further by the NRC. Additionally, for items identified as needing a JCO, the NRC operations center was to be notified within 48 hours from time of identification of the need for a JCO.

RG&E initiated the records search based upon identification of all potential suppliers of safety-related piping materials within the required time frame. From this list of suppliers, records were reviewed to ascertain those items which were manufactured or supplied by WJM or PSI. Following this identification of materials, which could be linked to particular plant modifications, the material locations within the plant or warehouse were determined. Identified warehouse items were immediately placed on hold. During this review process, Supplement 1 was received and reduced the scope to flanges and fittings. Our search and identification was completed June 23, 1988.

A summary of the pertinent information relative to our records search of material location and application follows:

SUMMARY OF RECORDS SEARCH

1. A total of seventy-five (75) items were identified from the records search.

2. Seventy-one (71) of these seventy-five (75) items were carbon steel flanges. Seventy (70) were ASME SA-105 and one (1) was SA-181-1.

3. Twenty-nine (29) of the seventy-one (71) carbon steel flanges on Heats 4706, 30S, 816K, 03200, CFY, AAY-84, CMP, 6X11010 & AAR-84 were known to be installed in safety-related systems in the plant. Each flange was identified based on the plant modification for which it was procured.

4. Thirty-six (36) of the seventy-one (71) carbon steel flanges on Heats 6X11375, AAY-84, CFB, CFY, 816K, E1413, VP, COP, & COL were located in the warehouse as stock material and placed on hold.

5. Four (4) of the seventy-one (71) carbon steel flanges on Heat CFY had been previously scrapped.

6. Two (2) of the seventy-one (71) carbon steel flanges, one (1) on Heat E1413 and one (1) on Heat VP purchased for a specific plant modification, were not used in that modification nor were they requisitioned on another safety-related modification. Based on the information available, it is believed that these flanges were used in a non safety-related application at an indeterminate location.

7. Two (2) of the remaining four (4) items were identified as carbon steel fittings (caps) certified to ASME SA234 WPB (Heat COX), both of which were located in the warehouse.

8. The other two (2) of the remaining four (4) items were identified to be stainless steel flanges certified to ASME SA182 type 304L (Heat 472423), one (1) of which was installed and the other in the warehouse.

9. Material identified was either obtained directly from WJM and PSI or was obtained from one of three suppliers, Dubose Steel, Inc., Liberty Equipment and Supply and Guyon Alloys, Inc. All material was procured to ASME III Class 2 requirements.

Our records search, therefore, determined that thirty (30) items were installed in the plant in safety-related systems and thirty-nine (39) items were located in the warehouse.

NUMARC GENERIC GUIDANCE

Because of the strong generic considerations and concerns over what level of "appropriate testing" required by Supplement 1 would be considered acceptable to NRC, NUMARC held several industry wide workshops for the purpose of disseminating guidance on numerous generic concerns raised by Supplement 1, guidance which was consistent with discussions NUMARC had begun with NRC. NUMARC's efforts, combined with work by EPRI and Bechtel were to compile a database of industry test data and laboratory data on samples of the suspect material. The intent was to demonstrate that materials purchased from PSI and WJM were suitable for their intended service. Our tabulation of data obtained from our completed records search was forwarded to Bechtel on July 8, 1988 for incorporation into the database. A workshop on June

30, 1988 [documented by Reference (a)] and attended by RG&E representatives was held in Washington, DC and provided the following guidance and information:

1. An estimated 320 items would be tested covering a large range of heat numbers, sizes, ratings, etc. to help limit the scope of the utility testing and provide correlations to field test data.

2. The recommended in-situ field test was a hardness test utilizing the Equotip hardness tester.

3. The acceptance criteria* recommended for ferritic parts was:

   a. $\geq$ 137 BHN and $\leq$ 187 BHN acceptable. No further action required.

   b. < 137 and $\geq$ 116 BHN or > 187 BHN are questionable and require confirmatory hardness and supplementary tests.

   c. < 116 BHN are considered substrength.

   d. Assessments of fitness for service of installed parts was required for b. and c. above.

4. The acceptance criteria* recommended for austenitic parts was:

   a. Non-magnetic verification is provisionally acceptable.

   b. Magnetic indicates material that is not fully austenitic and composition should be established.

5. The basis for these recommendations was presented at the June 30, 1988 workshop and are attached herein as Attachment 4.

6. Equotip hardness test values were also known to be affected by environmental conditions of high temperature or vibration.

7. NUMARC would prepare a generic analysis for acceptance of items for the intended service, which would be provided to utilities at a later date.

*These recommendations had not been officially concurred with by the NRC as of the date of the workshop, but were considered an acceptable basis upon which to proceed at that time.

TEST RESULTS

RG&E adopted the program and recommendations offered by NUMARC and proceeded to perform in-situ Equotip hardness tests on all installed flanges and fittings. Temperature of the workpiece was recorded during the tests. The two stainless steel pieces were also magnetic checked.

All warehouse items were also given an Equotip hardness test as well as an additional bench Rockwell B hardness test and chemical analysis.

Testing was completed and data reviewed between July 12 and July 14, 1988 for compliance with the acceptance criteria recommended by NUMARC and Bulletin 88-05 guidance. During the period just prior to commencement of in-situ testing, guidance on the temperature corrections to be applied to Equotip hardness values was promulgated through the Nuclear Network.

The results of our in-situ Equotip hardness testing is shown in Tables 1-3 attached. This information was forwarded to Bechtel on July 14, 1988.

TABLE 1 TEST RESULTS

Table 1 represents Equotip hardness test results for all identified installed flanges with hardness measured* below 137 BHN. Thirteen (13) items were found in this category. Twelve (12) were carbon steel flanges and one (1) was a stainless steel flange. The table lists the uncorrected or measured hardness as well as the corrected hardness due to the temperature shown in the right hand column. The ultimate tensile strength equivalent to the uncorrected hardness is listed in the table. The corrected hardness values, shown in parenthesis, resulted in all values exceeding the criteria of 116 BHN established in Reference (a), which was considered the low limit in determining substandard material.

TABLE 2 TEST RESULTS

Table 2 represents Equotip hardness test results for all identified installed flanges with hardness measured* equal to or greater than 137 BHN. Seventeen (17) items, all SA-105 flanges, were found in this category.

*Equotip values are measured in terms of "L" or LEEB values and equated to the Brinell (BHN) value using conversion tables using ASTM XXXX-83 Equotip.

Hardness results were not corrected for temperature since this would only result in the hardness and equivalent tensile strength being above the code minimum. Consequently, these items were considered within the bounds defined by NUMARC as acceptable.

TABLE 3 TEST RESULTS

Table 3 represents Equotip hardness test results for all identified warehouse (non-installed) flanges and fittings. Thirty-nine (39) items were found in this category. Twelve (12) had hardness values less than 137 BHN and twenty-seven (27) were 137 BHN or above. No temperature correction was applied since ambient conditions existed.

NRC NOTIFICATION AND NEED FOR ANALYSIS

In accordance with the 88-05 Supplement 1 requirements, the items identified in Table 1 were identified as needing an analysis to justify continued operation. The NRC Operations Center was notified as required by telephone at 1345 on July 13, 1988 identifying the first 12 items in Table 1 and again at 0850 on July 15, 1988 identifying the last item (47-4375) on Table 1. These notifications met the 48 hour requirement as set forth in Supplement 1.

JUSTIFICATIONS FOR CONTINUED OPERATION (JCO)

RG&E prepared JCOs for items identified and reported to the NRC listed on Table 1. Our JCOs were completed by July 19, 1988, within 30 days of receipt of Supplement 1. (All items had been identified as of the date of receipt of Supplement 1.) The JCOs were done on a plant-specific basis. The equivalent tensile strength values used in the analyses and listed below were based on uncorrected Equotip hardness values, because this would represent the most limiting case in terms of strength requirements. Use of the corrected hardness and tensile strength would increase the margin of safety considerably. The summary of results of our JCOs follows.

ITEM NO. 2-1594
10" Weld Neck Flange - 150# - Heat AAR-84 - ASME SA-105

Hardness (Uncorrected)	Hardness (Corrected)	Equivalent Tensile Strength
134 BHN	140 BHN	64,500 PSI

This item is installed in the service water tie-in line for the spent fuel pool cooling system. The JCO is based on the determination that the allowable stress (at 200°F), equivalent to the tensile strength of 64,500 psi, is 16,125 psi and exceeds the actual stress of 3,650 psi. Therefore, the actual stress is about 23% of the allowable.

ITEM NOS. 37-4526 & 38-4526
2" Socket Weld Flange - 150# - Heat No. CFY - ASME SA-105

Hardness (Uncorrected)	Hardness (Corrected)	Equivalent Tensile Strength
(#37-4526) 117 BHN	125 BHN	55,500 PSI
(#38-4526) 111 BHN	121 BHN	52,500 PSI

These items are installed in the Diesel Generator Fuel Oil System duplex strainer piping. The JCO is based on the determination that the allowable stresses for sustained, occasional, expansion, and combined expansion and sustained loads, equivalent to the tensile strength of 52,500 psi, exceed the actual stresses by more than a factor of 20.

ITEM NO. 46-1601
3" Weld Neck Flange - 900# - Heat No. 03200 - ASME SA-105

Hardness (Uncorrected)	Hardness (Corrected)	Equivalent Tensile Strength
123 BHN	145 BHN	59,500 PSI

This item is installed in a section of piping in the Turbine Driven Auxiliary Feedwater System. The JCO is based on the determination that the allowable stresses for sustained and occasional loads, equivalent to the tensile strength of 59,500 psi, are 12,750 psi (sustained) and 15,300 psi (occasional), and exceed the actual stress of 3785 psi and 6717 psi, respectively.

ITEM NO. 51-1660
3" Blind Flange - 600# - Heat No. 816K - ASME SA-105

Hardness (Uncorrected)	Hardness (Corrected)	Equivalent Tensile Strength
130 BHN	140 BHN	62,500 PSI

This item is installed in a line near the relief valve mounting on the top of the Nitrogen accumulators. The JCO is based on the determination that the allowable stress, equivalent to the tensile strength of 62,500 psi, is 16,071 psi and exceeds the actual stress of 15,868 psi due to deadweight, seismic and relief valve thrust loads. The stresses listed above are conservative for two reasons:

1) The section modulus used to determine the actual stress for the plant modification was based upon 3/4" schedule 40 pipe (.0706 in^3) instead of the calculated modulus of the blind flange of 12.24 in^3.

2) The allowable stress of 16,071 psi was based upon the material for the pipe (SA 106) and not the flange. Utilizing the flange material would increase the allowable to 18,750 psi. The actual stress with this conservatism removed would then be 85% of the allowable stress.

ITEM NOS. 60-1024, 61-1024, 62-1024, 64-1024, 65-1024
6" Weld Neck Flange - 600# - Heat No. 30S - ASME SA-105

Hardness (Uncorrected)	Hardness (Corrected)	Equivalent Tensile Strength
(#60-1024) 112 BHN	134 BHN	52,500 PSI
(#61-1024) 108 BHN	133 BHN	51,500 PSI
(#62-1024) 117 BHN	134 BHN	55,500 PSI
(#64-1024) 108 BHN	133 BHN	51,500 PSI
(#65-1024) 117 BHN	138 BHN	55,500 PSI

These items are installed in the piping associated with the atmospheric relief valves. The JCO is based on the determination that the allowable stress, equivalent to the limiting case above of 51,500 psi, is 15,450 psi and exceeds the actual stresses due to sustained and dynamic loads of 13,382 psi. The piping stress analysis conducted under EWR 2512 indicated a maximum stress of 11,415 psi which is well below the allowable of 15,450 psi. Additional margin of conservatism exists when the temperature correction is applied to the above determination of the allowable stress. If applied, the allowable would be 19,200 psi, well above the actual of 13,382 psi.

ITEM NO. 72-2504
6" Weld Neck Flange - 150# - Heat No. CMP - ASME SA-105

Hardness (Uncorrected)	Hardness (Corrected)	Equivalent Tensile Strength
130 BHN	136 BHN	62,500 PSI

This item is installed in the shutdown mini-purge system. The JCO is based upon the determination that the allowable stress, equivalent to the tensile strength of 62,500 psi, is 15,625 psi and exceeds the maximum actual stress of 5000 psi due to pressure and seismic loading. Therefore, the actual stress is only 32% of the allowable.

ITEM NO. 75-2512
3" Weld Neck Flange - 150# - Heat No. 4706 - ASME SA 181-1

Hardness (Uncorrected)	Hardness (Corrected)	Equivalent Tensile Strength
117 BHN	126 BHN	55,500 PSI

This item is installed in a service water line to the containment recirculation fans' motor coolers. The JCO is based on the determination that the actual stresses due to deadweight, thermal, pressure and seismic conditions are only 30 psi. The minimum allowable stress, based on a tensile strength of 55,500 psi, is over 10,000 psi.

ITEM NO. 47-4375
1" Socket Weld Neck Flange - 150# - Heat No. 472423 - ASME SA-182 Type 304L Stainless Steel

Hardness (Uncorrected)	Hardness (Corrected)	Equivalent Tensile Strength
129 BHN	143 BHN	62,000 PSI

This item is installed in the CVCS system in a section of piping at the lower end of flow transmitter FT-110. The JCO is based on the determination that the allowable stress, equivalent to a tensile strength of 62,000 psi, is 14,880 psi and exceeds the maximum actual stress of 10,424 psi due to sustained and dynamic loads. The actual stress, therefore, is 70% of the allowable stress.

DISCUSSION

NUMARC provided an interim report, Reference (b), to utilities giving the results of the generic test program and analysis of utility and laboratory data. A generic analysis, Reference (c), was also generated which was intended for use by utilities to evaluate flange acceptability based upon satisfying code design rules. Since plant-specific JCOs had already been prepared, the use of the Reference (c) generic analysis was not applied.

A summary of Reference (b) will not be provided here, because it was made part of Supplement 2 to 88-05 discussed in the next section. The interim report, however, provided a Best Fit Equotip versus Tensile Strength Curve [Figure 3 of Reference (b)] which is intended to be applied to correlate Equotip field test data to material tensile strength. The best fit curve shows that an Equotip hardness "L" value of 374 (equivalent Brinell of 121) or above would correlate to a tensile strength of 70,000 psi or above, which is the code requirement.

Review of the Table 1 data for installed items indicates that of the thirteen (13) installed items (uncorrected for temperature) that fell below the limit of 137 BHN, only eight (8) would remain below the value of 121 BHN, which is considered to be the equivalent of the 70,000 psi code requirement. The lowest of these values uncorrected for temperature affects, was 108 BHN (Item Nos. 61-1024 and 64-1024) which would result in a tensile strength of 65,000 psi. A tensile strength of 51,500 psi was used as the basis for the JCO for these items. When considering the temperature corrections of installed flanges, none of the eight (8) fell below 121 BHN. Therefore, all these items are considered to have met the minimum code requirement of 70,000 psi.

Review of the Table 3 data for warehouse items indicates that four (4) items produced Equotip hardness less than 121 BHN. There was no temperature correction since ambient conditions existed. These were Item Nos. 42-4526, 43-4526, 44-4526 and 45-4526, all PSI heat CFY. The bench Rockwell B hardness test, a more reliable test, produced hardness values between 127 BHN and 131 BHN for the four (4) items. Since these items are less than the code minimum of 137 BHN they are considered nonconforming and will remain on hold pending further NRC information concerning disposition of material.

Review of the bench hardness tests for all warehouse items showed that, with the exception of the four (4) discussed above, all items produced hardness of 137 BHN or above and, therefore, are considered acceptable. Chemical analysis of the warehouse items compared closely to Certified Material Test Report (CMTR) data.

Item No. 63-1024 (Table 2), 6" - 600# weld neck flange on WJM heat 30S is an installed flange and had an uncorrected Equotip hardness of 160 BHN, equivalent to 78,000 psi tensile strength. The workpiece temperature was measured at 222°F during the test. The corrected hardness value would be 191 BHN based upon this temperature or just slightly above the code maximum of 187 BHN. The Reference (b) report indicates that the principle high hardness concern is weldability. In this regard, a value of 237 BHN is commonly applied to fabricated items, welds, base metals and heat affected zones (HAZ), where H_2S stress corrosion cracking (SCC) is a concern. This form of SCC induced by hydrogen embrittlement is not a concern for carbon steel SA-105 material. As indicated in Reference (b), since the installed item has had acceptable weld inspections, hydrostatic tests and has demonstrated acceptable functional performance in service for many years, then there are objective reasons to use as is. The benefit of replacing this high hardness item is minimal.

All other items represented on Table 2, installed items, meet the minimum code requirement of 70,000 psi equivalent tensile strength based upon the Equotip test results and best fit curve of Reference (b).

Based upon the recommendations made to NRC by NUMARC in a meeting July 22, 1988 (and in letters dated July 25, 1988 to Dr. Thomas Murley and July 29, 1988 to Dr. Thomas T. Martin, which enclosed the Reference (b) report), Supplement 2 to Bulletin 88-05 (dated August 3, 1988) was issued. Supplement 2 suspended field measurements, testing, records review and preparation of JCOs that were requested by Supplement 1 until further notice.

Supplement 2 required licensees to:

1) maintain for inspection, the documentation of specific actions taken for identified materials;

2) retain nonconforming materials until advised by the NRC;

Reporting of test results for industry dissemination was also encouraged.

RG&E provided a complete tabulation in final form of the results of our records review and testing to Bechtel on August 18, 1988 for use in generation of the final report to be issued by Bechtel and dissemination to the industry. A copy of this information is enclosed as Attachments 1-3.

Attachment 1 provides the results of the records review including location of material, source, heat numbers, size and manufacturer.

Attachment 2 provides the test data worksheets for the 30 installed flanges, indicating Equotip hardness test results and CMTR data.

Attachment 3 provides the test data worksheets for the thirty-nine (39) warehouse flanges and fittings, indicating Equotip hardness test results, chemical analysis of samples of material, and CMTR data. Additionally, Rockwell B tests were conducted on all pieces and converted to Brinell hardness.

SUMMARY AND CONCLUSIONS

Our records review found seventy-five (75) items which had been supplied by either Piping Supplies, Inc. or West Jersey Manufacturing. Of this number, thirty (30) items were known to be installed and thirty-nine (39) items were located in the warehouse. Six (6) items had been either scrapped or were believed to have been installed in a non safety-related application in an indeterminate location. Installed items were tested with the Equotip hardness tester. Warehouse items were given the Equotip hardness test as well as a bench Rockwell B hardness test and chemical analysis.

Equotip hardness tests on installed items indicated that thirteen (13) items were less than the code minimum of 137 BHN. Justifications for Continued Operation (JCO) were prepared for these items by July 19, 1988, within 30 days of receipt of Supplement 1. The JCOs were based on hardness values not corrected for temperature and were, therefore, very conservative. Application of the best fit criteria presented by NUMARC Reference (b), enclosed with Supplement 2

to 88-05, would indicate that all of the thirteen (13) items would be considered to meet the code minimum of 70,000 psi tensile strength.

Testing performed on warehouse items indicated that four (4) items on heat CFY (Nos. 42-4526, 43-4526, 44-4526 and 45-4526) produced bench hardness results less than 137 BHN. These items will remain on hold as required by Supplement 2 to 88-05, with disposition to be determined pending further NRC information relative to 88-05.

The above discussion summarizes RG&E's actions in response to NRC Bulletin 88-05. Based on the results of these investigations and those coordinated by NUMARC, no safety concern is represented by this issue. Therefore, it was determined that no actions were required relative to any non safety-related material obtained from the subject suppliers. Therefore, all scheduled actions required by NRC Bulletin 88-05, and Supplements 1 and 2 are complete.

Very truly yours,

Robert C. Mecredy
General Manager
Nuclear Production

Subscribed and sworn to before me
on this 8th day of September, 1988.

Sharon J. Schlegel

SHARON J. SCHLEGEL
NOTARY PUBLIC, State of N.Y., Wayne Co.
My Commission Expires March 30, 1989

Attachments

xc: U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406

Ginna Senior Resident Inspector

TABLES AND ATTACHMENTS

Tables

Attachments

NRC BULLETIN 88-05

TABLE 1

SHT. 1 OF 1

INSTRUMENTED FLANGES - SA 105 EXCEPT AS NOTED

EQUOTIP HARDNESS RESULTS LESS THAN 437 BHN

TRACKING NO.	TYPE - SIZE - RATING	BRINELL HARDNESS ( ) CORRECTED	EQUIV. STRESS PSI	HEAT NO.	LOCATION	TEMPERATURE
2-1594	10" WELD NECK FLANGE - 150#	134 (140)	64,500	AAR-84	SW - AUX. BLDG.	99°F
37-4526	2" SOCKET WELD FLANGE - 150#	117 (125)	55,500	CFY	FUEL OIL - D.G. BLDG.	115°F
38-4526	2" SOCKET WELD FLANGE - 150#	111 (121)	52,500	CFY	FUEL OIL - D.G. BLDG.	122°F
46-1601	3" WELD NECK FLANGE - 900#	123 (145)	59,500	03200	M.S. - INT. BLDG.	197°F
51-1660	3" BLIND FLANGE - 600#	130 (140)	62,500	816K	N_2 OVER PRES. - C.V.	120°F
60-1024	6" WELD NECK FLANGE - 600#	112 (134)	52,500	30S	MS - INT. BLDG.	210°F
61-1024	6" WELD NECK FLANGE - 600#	108 (133)	51,500	30S	MS - INT. BLDG.	224°F
62-1024	6" WELD NECK FLANGE - 600#	117 (134)	55,500	30S	MS - INT. BLDG.	167°F
64-1024	6" WELD NECK FLANGE - 600#	108 (133)	51,500	30S	MS - INT. BLDG.	225°F
65-1024	6" WELD NECK FLANGE - 600#	117 (138)	55,500	30S	MS - INT. BLDG.	201°F
72-2504	6" WELD NECK FLANGE - 150#	130 (136)	62,500	CMP	PURGE - AUX. BLDG.	101°F
75-2512*	3" WELD NECK FLANGE - 150#	117 (126)	55,500	4706	SW - C.V.	118°F
47-4375**	1" SOCKET WELD FLANGE - 150# SS	129 (143)	62,000	472423	CRS - AUX. BLDG.	142°F
			↑			
				THIS COLUMN	CORRESPONDS TO	
	* FLANGE IS CARBON STEEL SA 181-1			UNCORRECTED	HARDNESS VALUES	
	** FLANGE IS STAINLESS STEEL		SA 182 TY.	304L		

NRC BULLETIN 88-05

EQUOTIP HARDNESS RESULTS

INSTALLED FLANGES-SA 105 — 137 BHN AND GREATER

TABLE 2

TRACKING NO.	TYPE - SIZE - RATING	BRINELL HARDNESS *	EQUIV. STRESS PSI	HEAT No.	LOCATION	TEMPERATURE
1-1594	10" WELD NECK - 150#	141	68,000	AAR-84		93°F
3-1594	10" WELD NECK - 150#	145	70,000	AAR-84		86°F
4-1594	10" BLIND - 150#	147	71,000	6X11010		86°F
5-1594	10" WELD NECK - 150#	146	70,500	AAR-84		84°F
6-1594	10" WELD NECK - 150#	141	68,000	AAR-84		84°F
7-1594	10" WELD NECK - 150#	137	66,000	AAR-84		89°F
8-1594	10" BLIND - 150#	143	68,500	6X11010		89°F
9-1594	6" WELD NECK - 150#	167	81,000	CMP		84°F
10-1594	6" WELD NECK - 150#	143	68,500	CMP		87°F
11-1594	6" WELD NECK - 150#	143	68,500	CMP		84°F
12-1594	6" WELD NECK - 150#	143	68,500	CMP		91°F
14-4526	1" SCREWED - 150#	144	69,500	AAY-84		130°F
15-4526	1" SCREWED - 150#	147	71,000	AAY-84		127°F
50-1660	3" BLIND - 600#	138	66,500	816K		120°F
63-1024	6" WELD NECK - 600#	160	78,000	30S		222°F
73-2504	6" WELD NECK - 150#	140	67,500	CMP		114°F
74-2504	6" WELD NECK - 150#	137	66,000	CMP		119°F
	* HARDNESS NOT CORRECTED FOR TEMPERATURE					

NRC BULLETIN 88-05
FLANGES IN STOCK - SA 105

EQUOTIP HARDNESS RESULTS
WAREHOUSE ITEMS

TABLE 3

TRACKING NO.	TYPE - SIZE - RATING	BRINELL HARDNESS *	EQUIV. STRESS	HEAT NO.	LOCATION	TEMPERATURE
16- 4526	1" SCREWED - 150#	157	76,500	AAY-84		68°F
17-4526	1" SCREWED- 150#	157	76,500	AAY-84		68°F
18-4526	1" SCREWED- 150#	147	71,000	AAY-84		68°F
19-4526	1" SCREWED - 150#	156	76,000	AAY-84		68°F
20-4526	1" SOCKET WELD-150#	154	74,500	AAY-84		73°F
21-4526	1" SOCKET WELD - 150#	143	68,500	AAY-84		83°F
22-4526	1" SOCKET WELD- 150#	149	72,500	AAY-84		73°F
23-4526	1" SOCKET WELD- 150#	148	72,000	AAY-84		74°F
24-4526	1" SOCKET WELD- 150#	147	71,000	AAY-84		73°F
25-4526	1" SOCKET WELD- 150#	146	70,500	AAY-84		73°F
26-4526	1" SOCKET WELD- 150#	148	72,000	AAY-84		73°F
27-4526	1" SOCKET WELD - 150#	141	68,000	AAY-84		83°F
28-4526	3/4" SOCKET WELD-150#	138	66,500	CFB		74°F
29-4526	3/4" SOCKET WELD -150#	144	69,500	CFB		74°F
30-4526	3/4" SOCKET WELD -150#	136	65,500	CFB		73°F
31-4526	3/4" SOCKET WELD -150#	142	68,500	CFB		73°F
32-4526	3/4" SOCKET WELD - 150#	153	74,000	CFB		73°F
	* HARDNESS NOT CORRECTED FOR TEMPERATURE					

NRC B[redacted]IN 88-05
FLANGES IN STOCK - SA 105

EQUOTIP HARDNESS RESULTS
WAREHOUSE ITEMS

TABL[redacted]3

TRACKING NO.	TYPE - SIZE - RATING	BRINELL HARDNESS *	EQUIV. STRESS	HEAT NO.	LOCATION	TEMPERATURE
33-4526	3/4" SOCKET WELD - 150#	145	70,000	CFB		73°F
34-4526	3/4" SOCKET WELD - 150#	150	72,500	CFB		73°F
35-4526	3/4" SOCKET WELD - 150#	140	67,500	CFB		73°F
42-4526	2" SOCKET WELD - 150#	113	53,000	CFY		83°F
43-4526	2" SOCKET WELD - 150#	116	54,500	CFY		82°F
44-4526	2" SOCKET WELD - 150#	111	52,500	CFY		83°F
45-4526	2" SOCKET WELD - 150#	112	52,500	CFY		83°F
48-4375†	1" SOCKET WELD - 150#	148	72,000	472423		72°F
49-1660	3" BLIND - 600#	147	71,000	816K		72°F
52-1601	3/4" SOCKET WELD - 150#	133	64,000	E1413		72°F
53-1601	3/4" SOCKET WELD - 150#	127	61,000	E1413		69°F
54-1601	3/4" SOCKET WELD - 150#	128	61,500	E1413		69°F
56-1601	1/2" SOCKET WELD - 150#	170	82,000	VP		72°F
57-1601	1/2" SOCKET WELD - 150#	145	70,000	VP		72°F
58-1601	1/2" SOCKET WELD - 150#	137	66,000	VP		73°F
66-4526	1 1/2" BUTT WELD CAP	132	63,500	COX		75°F
67-4526	1 1/2" BUTT WELD CAP	134	64,500	COX		75°F
68-4526	3" BLIND - 150#	133 RIGHT EDGE 64,000 153 LEFT EDGE 74,000		COP		95°F

* HARDNESS NOT CORRECTED FOR TEMPERATURE. + DISK IS SA 182 TY 304L STAINLESS

NRC B[redacted]IN 88-05
FLANGES IN STOCK - SA 105

EQUOTIP HARDNESS RESULTS
WAREHOUSE ITEMS

TABLE 3

TRACKING NO.	TYPE - SIZE - RATING	HARDNESS *	EQUIV. STRESS	HEAT NO.	LOCATION	TEMPERATURE
69-4526	3" BLIND - 150#	185 LEFT EDGE 133 RIGHT EDGE	88,500 64,000	COP		—
70-4526	2" BLIND - 150#	146	70,500	COL		83°F
71-4526	2" BLIND - 150#	150	72,500	COL		83°F
13-1594	14" WELD NECK - 150#	160	78,000	6X11375		83°F

* HARDNESS NOT CORRECTED FOR TEMPERATURE

ATTACHMENT 1

MATERIALS DATABASE

PREPARED 17 AUGUST 1988

NRC BULLETIN 88-05

R.E. GINNA NUCLEAR POWER PLANT

PAGE NO: 1 OF 4
DATE: 17 AUG 88

NRC BULLETIN NO. 88-05
MATERIALS DATA BASE

ITEM NO.	PLANT	DIAMETER	COMM	RATING	TYPE	SPEC ASTM/ASME	GRADE	SCH	VNDR	HEAT/LOT	DATE	QTY	QTY ON HOLD	(-INSTALLED-) ACC	NOT ACC	SOURCE	ASME CLS	TEST	REMARKS
1-1594	GINNA	10.0	FLG	150	RF WN	105		40	P	AAR-84	12/16/87	1	0	1	0	DUBOSE	2	Y	
2-1594												1	0	1	0				
3-1594												1	0	1	0				
5-1594												1	0	1	0				
6-1594												1	0	1	0				
7-1594												1	0	1	0				
4-1594		10.0	FLG	150	BL	105		40	P	6X11010	12/16/87	1	0	1	0				
8-1594												1	0	1	0				
9-1594		6.0	FLG	150	RF WN	105		40	P	CMP	12/16/87	1	0	1	0				
10-1594												1	0	1	0				
11-1594												1	0	1	0				
12-1594												1	0	1	0				
72-2504											12/7/87	1	0	1	0				
73-2504												1	0	1	0				
74-2504												1	0	1	0				
13-1594		14.0	FLG	150	RF WN	105		40	P	6X11375	12/16/87	1	1	0	0				
14-4526		1.0	FLG	150	RF TH	105		80	P	AAY-84	12/29/87	1	0	1	0				
15-4526												1	0	1	0				
16-4526												1	1	0	0				
17-4526												1	1	0	0				
18-4526												1	1	0	0				
19-4526												1	1	0	0				

NRC BULLETIN NO. 88-05
MATERIALS DATA BASE

ITEM NO.	PLANT	DIAMETER	COMM	RATING	TYPE	SPEC ASTM/ASME	GRADE	SCH	VNDR	HEAT/LOT	DATE	QTY	QTY ON HOLD	(-INSTALLED-) ACC	NOT ACC	SOURCE	ASME CLS	TEST	REMARKS
20-4526	GINNA	1.0	FLG	150	RF SW	105		80	P	AAY-84	12/29/87	1	1	0	0	DUBOSE	2	Y	
21-4526												1	1	0	0				
22-4526												1	1	0	0				
23-4526												1	1	0	0				
24-4526												1	1	0	0				
25-4526												1	1	0	0				
26-4526												1	1	0	0				
27-4526												1	1	0	0				
28-4526		0.75	FLG	150	RF SW	105		80	P	CFB	12/22/87	1	1	0	0				
29-4526												1	1	0	0				
30-4526												1	1	0	0				
31-4526												1	1	0	0				
32-4526												1	1	0	0				
33-4526												1	1	0	0				
34-4526												1	1	0	0				
35-4526												1	1	0	0				
36-4526		2.0	FLG	150	RF SW	105		40	P	CFY	1/14/88	1	0	0	0			N	PIECE SCRAPPED
37-4526												1	0	1	0			Y	
38-4526												1	0	1	0			Y	
39-4526												1	0	0	0			N	PIECE SCRAPPED
40-4526												1	0	0	0			N	PIECE SCRAPPED
41-4526												1	0	0	0			N	PIECE SCRAPPED
42-4526												1	1	0	0			Y	
43-4526												1	1	0	0				
44-4526												1	1	0	0				
45-4526												1	1	0	0				

NRC BULLETIN NO. 88-05
MATERIALS DATA BASE

ITEM NO.	PLANT	DIAMETER	COMM	RATING	TYPE	SPEC ASTM/ASME	GRADE	SCH	VNDR	HEAT/LOT	DATE	QTY	QTY ON HOLD	(-INSTALLED-) ACC	NOT ACC	SOURCE	ASME CLS	TEST	REMARKS
46-1601	GINNA	3.0	FLG	900	RF WN	105		80	W	03200	4/12/80	1	0	1	0	LIBERTY	2	Y	
47-4375		1.0	FLG	150	RF SW	182	304L	40	P	472423	12/5/87	1	0	1	0	DUBOSE			
48-4375		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	1	1	0	0	--			
49-1660		3.0	FLG	600	RF BL	105			W	816 K	4/22/81	1	1	0	0	GUYON			
50-1660		↓	↓	↓	↓	↓			↓	↓	↓	1	0	1	0	↓			
51-1660												1	0	1	0				
52-1601		0.75	FLG	150	RF SW	105			W	E1413	2/17/81	1	1	0	0				
53-1601		↓	↓	↓	↓	↓			↓	↓	↓	1	1	0	0				
54-1601												1	1	0	0				
55-1601												1	0	0	0			N	LOCATION UNKNOWN
56-1601		0.50	FLG	150	RF SW	105			W	VP	2/17/81	1	1	0	0			Y	
57-1601		↓	↓	↓	↓	↓			↓	↓	↓	1	1	0	0			↓	
58-1601												1	1	0	0				
59-1601												1	0	0	0			N	LOCATION UNKNOWN
60-1024		6.0	FLG	600	RF WN	105		80	W	30S	3/17/81	1	0	1	0			Y	
61-1024		↓	↓	↓	↓	↓		↓	↓	↓	↓	1	0	1	0			↓	
62-1024												1	0	1	0				
63-1024												1	0	1	0				
64-1024												1	0	1	0				
65-1024												1	0	1	0				

NRC BULLETIN NO. 88-05
MATERIALS DATA BASE

ITEM NO.	PLANT	DIAMETER	CONN	RATING	TYPE	SPEC ASTM/ASME	GRADE	SCH	VNDR	HEAT/LOT	DATE	QTY	QTY ON HOLD	(-INSTALLED-) ACC	(-INSTALLED-) NOT ACC	SOURCE	ASME CLS	TEST	REMARKS
66-4526	GINNA	1.5	FIT		BW CAP	234	WPB		P	COX	1/6/88	1	1	0	0	DUBOSE	2	Y	
67-4526		↓	↓		↓	↓	↓		↓	↓	↓	1	1	0	0	↓	↓	↓	
68-4526		3.0	FLG	150	RF BL	105			P	COP	1/6/88	1	1	0	0				
69-4526		↓	↓	↓	↓	↓			↓	↓	↓	1	1	0	0				
70-4526		2.0	FLG	150	RF BL	105			P	COL	1/6/88	1	1	0	0				
71-4526		↓	↓	↓	↓	↓			↓	↓	↓	1	1	0	0				
75-2512		3.0	FLG	150	RF WN	181-1		40	W	4706	3/19/82	1	0	1	0	WJM	L	↓	

CODES

FLG = FLANGE
FIT = FITTING
RF = RAISED FACE
WN = WELDING NECK
BL = BLIND
TH = THREADED
SW = SOCKET WELD
W = WEST JERSEY MANUFACTURING
P = PIPING SUPPLIES, INC
Y = YES
N = NO

ATTACHMENT 2.

TEST DATA WORKSHEETS FOR
INSTALLED FLANGES

NRC BULLETIN 88-05

R.E. GINNA NUCLEAR POWER PLANT

NRC 88-05

TEST DATA WORKSHEET

HEAT AAR-84 -- Specimen ID (Required) 1-1594

		Test Data	CMTR Data
	Tensile Strength		90,100
	Yield Strength		77,009
	Percent Elongation		22%
	Percent Reduction In Area		50%
EQUOTIP	Hardness (BHN)	141 *	
	Carbon		.29
	Manganese		.77
	Silicon		.23
	Phosphorous		.025
	Sulfur		.014
	Chromium		NA
	Nickel		NA
	Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. IS 93°F. VALUE IS UNCORRECTED.

NRC 88-05

TEST DATA WORKSHEET

HEAT AAR-84 — Specimen ID (Required) 2-1594

	Test Data	CMTR Data
Tensile Strength		90,100
Yield Strength		77,009
Percent Elongation		22%
Percent Reduction In Area		50%
EQUOTIP Hardness (BHN)	134*	
Carbon		.29
Manganese		.77
Silicon		.23
Phosphorous		.625
Sulfur		.014
Chromium		NA
Nickel		NA
Molybdenum		NA

Heat Treatment

Add Remarks?

* 140 BHN WHEN ADJUSTED FOR TEMP. OF 99° F.

NRC 88-05

TEST DATA WORKSHEET

HEAT AAR-84 -- Specimen ID (Required) 3-1594

		Test Data	CMTR Data
	Tensile Strength		90,100
	Yield Strength		77,009
	Percent Elongation		22%
	Percent Reduction In Area		50%
EQUOTIP	Hardness (BHN)	145 *	
	Carbon		.29
	Manganese		.77
	Silicon		.23
	Phosphorous		.025
	Sulfur		.014
	Chromium		NA
	Nickel		NA
	Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. IS 86°F. VALUE IS UNCORRECTED.

NRC 88-05

TEST DATA WORKSHEET

HEAT 6x11010 -- Specimen ID (Required) 4-1594

	Test Data	CMTR Data
Tensile Strength		81,900
Yield Strength		46,200
Percent Elongation		28%
Percent Reduction In Area		49%
EQUOTIP Hardness (BHN)	147 *	
Carbon		.29
Manganese		.89
Silicon		.20
Phosphorous		.010
Sulfur		.020
Chromium		NA
Nickel		NA
Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. IS 86°F.
VALUE IS UNCORRECTED.

NRC 88-05

TEST DATA WORKSHEET

HEAT AAR-84 -- Specimen ID (Required) 5-1594

	Test Data	CMTR Data
Tensile Strength		90,100
Yield Strength		77,009
Percent Elongation		22%
Percent Reduction In Area		50%
EQUOTIP Hardness (BHN)	146 *	
Carbon		.29
Manganese		.77
Silicon		.23
Phosphorous		.025
Sulfur		.014
Chromium		NA
Nickel		NA
Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. IS 84°F. VALUE IS UNCORRECTED.

NRC 88-05

TEST DATA WORKSHEET

HEAT AAR-84 — Specimen ID (Required) 6-1594

	Test Data	CMTR Data
Tensile Strength		90,100
Yield Strength		77,009
Percent Elongation		22 %
Percent Reduction In Area		50 %
EQUOTIP Hardness (BHN)	141 *	
Carbon		.29
Manganese		.77
Silicon		.23
Phosphorous		.025
Sulfur		.014
Chromium		NA
Nickel		NA
Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. IS 84°F. VALUE IS UNCORRECTED.

NRC 88-05

TEST DATA WORKSHEET

HEAT AAR-84 — Specimen ID (Required) 7-1594

		Test Data	CMTR Data
	Tensile Strength		90,100
	Yield Strength		77,009
	Percent Elongation		22%
Percent	Reduction In Area		50%
EQUOTIP	Hardness (BHN)	137 *	
	Carbon		.29
	Manganese		.77
	Silicon		.23
	Phosphorous		.025
	Sulfur		.014
	Chromium		NA
	Nickel		NA
	Molybdenum		NA
	Heat Treatment		

Add Remarks?

* WORKPIECE TEMP. IS 89°F.
VALUE IS UNCORRECTED.

NRC 88-05

TEST DATA WORKSHEET

HEAT 6X11010 --> Specimen ID (Required) 8-1594

	Test Data	CMTR Data
Tensile Strength		81,900
Yield Strength		46,200
Percent Elongation		28%
Percent Reduction In Area		49%
EQUOTIP Hardness (BHN)	143 *	
Carbon		.29
Manganese		.89
Silicon		.20
Phosphorous		.010
Sulfur		.020
Chromium		NA
Nickel		NA
Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. IS 89°F. VALUE IS UNCORRECTED.

NRC 88-05

TEST DATA WORKSHEET

HEAT CMP --- Specimen ID (Required) 9-1594

	Test Data	CMTR Data
Tensile Strength		70,676
Yield Strength		36,150
Percent Elongation		25%
Percent Reduction In Area		53.3%
EQUOTIP Hardness (BHN)	167 *	
Carbon		.23
Manganese		.81
Silicon		.32
Phosphorous		.016
Sulfur		.021
Chromium		NA
Nickel		NA
Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. IS 84°F. VALUE IS UNCORRECTED.

NRC 88-05

TEST DATA WORKSHEET

HEAT CMP --> Specimen ID (Required) 10_1594

	Test Data	CMTR Data
Tensile Strength		70,676
Yield Strength		36,150
Percent Elongation		25%
Percent Reduction In Area		53.3%
EQUOTIP Hardness (BHN)	143 *	
Carbon		.23
Manganese		.81
Silicon		.32
Phosphorous		.016
Sulfur		.021
Chromium		NA
Nickel		NA
Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. IS 87°F. VALUE IS UNCORRECTED.

NRC 88-05

TEST DATA WORKSHEET

HEAT CMP — Specimen ID (Required) 11-1594

	Test Data	CMTR Data
Tensile Strength		70,676
Yield Strength		36,150
Percent Elongation		25%
Percent Reduction In Area		53.3%
EQUOTIP Hardness (BHN)	143 *	
Carbon		.23
Manganese		.81
Silicon		.32
Phosphorous		.016
Sulfur		.021
Chromium		NA
Nickel		NA
Molybdenum		
Heat Treatment		NA

Add Remarks?

* WORKPIECE TEMP. 84° F.
VALUE IS UNCORRECTED

NRC 88-05

TEST DATA WORKSHEET

HEAT CMP >-- Specimen ID (Required) 12-1594

		Test Data	CMTR Data
	Tensile Strength		70,676
	Yield Strength		36,150
	Percent Elongation		25%
	Percent Reduction In Area		53.3%
EQUOTIP	Hardness (BHN)	143*	
	Carbon		.23
	Manganese		.81
	Silicon		.32
	Phosphorous		.016
	Sulfur		.021
	Chromium		NA
	Nickel		NA
	Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. IS 91°F.
VALUE IS UNCORRECTED

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY-84 --- Specimen ID (Required) 14-4526

		Test Data	CMTR Data
	Tensile Strength		81,235
	Yield Strength		52,499
	Percent Elongation		24.0 %
	Percent Reduction In Area		43.0 %
EQUOTIP	Hardness (BHN)	144 *	
	Carbon		.28
	Manganese		.78
	Silicon		.23
	Phosphorous		.018
	Sulfur		.029
	Chromium		NA
	Nickel		NA
	Molybdenum		NA
	Heat Treatment		

Add Remarks?

* WORKPIECE TEMP. 130° F. VALUE IS UNCORRECTED

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY-84 — Specimen ID (Required) 15-4526

		Test Data	CMTR Data
	Tensile Strength		81,235
	Yield Strength		52,499
	Percent Elongation		24.0%
	Percent Reduction In Area		43.0%
EQUOTIP	Hardness (BHN)	147 *	
	Carbon		.28
	Manganese		.78
	Silicon		.23
	Phosphorous		.018
	Sulfur		.029
	Chromium		NA
	Nickel		NA
	Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. IS 127 °F
VALUE IS UNCORRECTED

NRC 88-05

TEST DATA WORKSHEET

HEAT CFY -- Specimen ID (Required) 37-4526

		Test Data	CMTR Data
	Tensile Strength		84,725
	Yield Strength		53,890
	Percent Elongation		35.0 %
	Percent Reduction In Area		67.8 %
EQUOTIP	Hardness (BHN)	117 *	
	Carbon		.25
	Manganese		1.35
	Silicon		.27
	Phosphorous		.010
	Sulfur		.039
	Chromium		NA
	Nickel		NA
	Molybdenum		NA

Heat Treatment

Add Remarks?

* 125 BHN WHEN ADJUSTED FOR TEMP. OF 115°F

NRC 88-05

TEST DATA WORKSHEET

HEAT CFY — Specimen ID (Required) 38-4526

		Test Data	CMTR Data
	Tensile Strength		84,725
	Yield Strength		53,890
	Percent Elongation		35.0 %
Percent	Reduction In Area		67.8 %
EQUOTIP	Hardness (BHN)	111 *	
	Carbon		.25
	Manganese		1.35
	Silicon		.27
	Phosphorous		.010
	Sulfur		.039
	Chromium		NA
	Nickel		NA
	Molybdenum		NA

Heat Treatment

Add Remarks?

* 121 BHN WHEN ADJUSTED FOR TEMP. OF 122 °F

NRC 88-05

TEST DATA WORKSHEET

HEAT 03200 — Specimen ID (Required) 46-1601

	Test Data	CMTR Data
Tensile Strength		72,255
Yield Strength		45,230
Percent Elongation		29 %
Percent Reduction In Area		39 %
EQUOTIP Hardness (BHN)	123 *	
Carbon		.30
Manganese		.85
Silicon		.32
Phosphorous		.013
Sulfur		.006
Chromium		NA
Nickel		NA
Molybdenum		NA
Heat Treatment		NORMALIZED

Add Remarks?

* 145 BHN WHEN ADJUSTED FOR TEMP. OF 197°F

NRC 88-05

TEST DATA WORKSHEET

HEAT 472423 — Specimen ID (Required) 47-4375

		Test Data	CMTR Data
	Tensile Strength		79,423
	Yield Strength		31,542
	Percent Elongation		61 %
	Percent Reduction In Area		78%
EQUOTIP	Hardness (BHN)	129 *	
	Carbon		.030
	Manganese		1.22
	Silicon		.31
	Phosphorous		.022
	Sulfur		.009
	Chromium		18.4
	Nickel		8.7
	Molybdenum		.18
	Heat Treatment		ANNEALED

Add Remarks?

* 143 BHN WHEN ADJUSTED FOR TEMP. OF 142°F

PIECE IS NON-MAGNETIC

NRC 88-05

TEST DATA WORKSHEET

HEAT 816 K -- Specimen ID (Required) 50-1660

	Test Data	CMTR Data
Tensile Strength		92,000
Yield Strength		62,000
Percent Elongation		26.5%
Percent Reduction In Area		54.6 %
EQUOTIP Hardness (BHN)	138 *	
Carbon		.30
Manganese		.86
Silicon		.07
Phosphorous		.019
Sulfur		.037
Chromium		NA
Nickel		NA
Molybdenum		NA
Heat Treatment		ANNEALED

Add Remarks?

* WORKPIECE TEMP. 120°F
VALUE IS UNCORRECTED

NRC 88-05

TEST DATA WORKSHEET

HEAT 816 K — Specimen ID (Required) 51-1660

	Test Data	CMTR Data
Tensile Strength		92,000
Yield Strength		62,000
Percent Elongation		26.5%
Percent Reduction In Area		54.6 %
EQUOTIP Hardness (BHN)	130*	
Carbon		.30
Manganese		.86
Silicon		.07
Phosphorous		.019
Sulfur		.037
Chromium		NA
Nickel		NA
Molybdenum		NA
Heat Treatment		ANNEALED

Add Remarks?

* 140 BHN WHEN ADJUSTED FOR TEMP. OF 120°F

NRC 88-05

TEST DATA WORKSHEET

HEAT 30 S -- Specimen ID (Required) 60-1024

		Test Data	CMTR Data
	Tensile Strength		80,000
	Yield Strength		51,000
	Percent Elongation		28.0 %
	Percent Reduction In Area		56.5 %
EQUOTIP	Hardness (BHN)	112 *	
	Carbon		.22
	Manganese		1.02
	Silicon		.24
	Phosphorous		.023
	Sulfur		.024
	Chromium		NA
	Nickel		NA
	Molybdenum		NA
	Heat Treatment		NORMALIZED

Add Remarks?

* 134 BHN WHEN CORRECTED FOR TEMP. OF 210° F

NRC 88-05

TEST DATA WORKSHEET

HEAT 30 S — Specimen ID (Required) 61-1024

	Test Data	CMTR Data
Tensile Strength		80,000
Yield Strength		51,000
Percent Elongation		28.0 %
Percent Reduction In Area		56.5 %
EQUOTIP Hardness (BHN)	108 *	
Carbon		.22
Manganese		1.02
Silicon		.24
Phosphorous		.023
Sulfur		.024
Chromium		NA
Nickel		NA
Molybdenum		NA
Heat Treatment		NORMALIZED

Add Remarks?

* 133 BHN WHEN CORRECTED FOR TEMP. OF 224° F

NRC 88-05

TEST DATA WORKSHEET

HEAT 30 S — Specimen ID (Required) 62-1024

		Test Data	CMTR Data
	Tensile Strength		80,000
	Yield Strength		51,000
	Percent Elongation		28.0 %
	Percent Reduction In Area		56.5 %
EQUOTIP	Hardness (BHN)	117 *	
	Carbon		.22
	Manganese		1.02
	Silicon		.24
	Phosphorous		.023
	Sulfur		.024
	Chromium		NA
	Nickel		NA
	Molybdenum		NA

Heat Treatment

Add Remarks?

* 134 BHN WHEN CORRECTED FOR TEMP. OF 167°F

NRC 88-05

TEST DATA WORKSHEET

HEAT 30 S — Specimen ID (Required) 63-1024

	Test Data	CMTR Data
Tensile Strength		80,000
Yield Strength		51,000
Percent Elongation		28.0 %
Percent Reduction In Area		56.5 %
EQUOTIP Hardness (BHN)	160 *	
Carbon		.22
Manganese		1.02
Silicon		.24
Phosphorous		.023
Sulfur		.024
Chromium		NA
Nickel		NA
Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. 222 °F
VALUE IS UNCORRECTED

NRC 88-05

TEST DATA WORKSHEET

HEAT 30 S — Specimen ID (Required) 64-1024

		Test Data	CMTR Data
	Tensile Strength		80,000
	Yield Strength		51,000
	Percent Elongation		28.0 %
	Percent Reduction In Area		56.5 %
EQUOTIP	Hardness (BHN)	108 *	
	Carbon		.22
	Manganese		1.02
	Silicon		.24
	Phosphorous		.023
	Sulfur		.024
	Chromium		NA
	Nickel		NA
	Molybdenum		NA

Heat Treatment

Add Remarks?

* 133 BHN WHEN CORRECTED FOR TEMP. OF 225 °F.

NRC 88-05

TEST DATA WORKSHEET

HEAT 30 S — Specimen ID (Required) 65-1024

	Test Data	CMTR Data
Tensile Strength		80,000
Yield Strength		51,000
Percent Elongation		28.0 %
Percent Reduction In Area		56.5 %
EQUOTIP Hardness (BHN)	117 *	
Carbon		.22
Manganese		1.02
Silicon		.24
Phosphorous		.023
Sulfur		.024
Chromium		NA
Nickel		NA.
Molybdenum		NA

Heat Treatment

Add Remarks?

* 138 BHN WHEN CORRECTED FOR TEMP. OF 201 °F.

NRC 88-05

TEST DATA WORKSHEET

HEAT CMP — Specimen ID (Required) 72-2504

	Test Data	CMTR Data
Tensile Strength		70,676
Yield Strength		36,150
Percent Elongation		25.0 %
Percent Reduction In Area		53.3 %
EQUOTIP Hardness (BHN)	130 *	
Carbon		.23
Manganese		.81
Silicon		.32
Phosphorous		.016
Sulfur		.021
Chromium		NA
Nickel		NA
Molybdenum		NA

Heat Treatment

Add Remarks?

* 136 BHN WHEN CORRECTED FOR TEMP. OF 101 °F.

NRC 88-05

TEST DATA WORKSHEET

HEAT CMP — Specimen ID (Required) 73-2504

	Test Data	CMTR Data
Tensile Strength		70,676
Yield Strength		36,150
Percent Elongation		25.0 %
Percent Reduction In Area		53.3 %
EQUOTIP Hardness (BHN)	140 *	
Carbon		.23
Manganese		.81
Silicon		.32
Phosphorous		.016
Sulfur		.021
Chromium		NA
Nickel		NA
Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. IS 114 °F. VALUE IS UNCORRECTED.

NRC 88-05

TEST DATA WORKSHEET

HEAT C.MP — Specimen ID (Required) 74-2504

	Test Data	CMTR Data
Tensile Strength		70,676
Yield Strength		36,150
Percent Elongation		25.0 %
Percent Reduction In Area		53.3 %
EQUOTIP Hardness (BHN)	137 *	
Carbon		.23
Manganese		.81
Silicon		.32
Phosphorous		.016
Sulfur		.021
Chromium		NA
Nickel		NA
Molybdenum		NA

Heat Treatment

Add Remarks?

* WORKPIECE TEMP. IS 119 °F. VALUE IS UNCORRECTED.

NRC 88-05

TEST DATA WORKSHEET

HEAT 4706 — Specimen ID (Required) 75-2512

	Test Data	CMTR Data
Tensile Strength		78,371
Yield Strength		43,950
Percent Elongation		29.8%
Percent Reduction In Area		54 %
EQUOTIP Hardness (BHN)	117 *	
Carbon		.22
Manganese		.93
Silicon		.22
Phosphorous		.010
Sulfur		.032
Chromium		NA
Nickel		NA
Molybdenum		NA

Heat Treatment

Add Remarks?

* 126 BHN WHEN CORRECTED FOR TEMP. OF 118°F.

ATTACHMENT 3

TEST. DATA WORKSHEETS FOR FLANGES AND FITTINGS IN PROJECT WAREHOUSE

NRC BULLETIN 88-05

R.E. GINNA NUCLEAR POWER PLANT

NRC 88-05

TEST DATA WORKSHEET

HEAT 6X11375 — Specimen ID (Required) 13-1594

	Test Data	CMTR Data
Tensile Strength		81,700
Yield Strength		52,800
Percent Elongation		33%
Percent Reduction In Area		60%
EQUOTIP Hardness (BHN) *	160	
Carbon	.21	.28
Manganese	1.16 **	.91
Silicon	.026	.19
Phosphorous	.020	.012
Sulfur	.017	.020
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA
Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 86.5$, EQUIVALENT TO 170 BHN

** PERMITTED BY SPECIFICATION CARBON LESS THAN 0.35

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY-84 — Specimen ID (Required) 16-4526

		Test Data	CMTR Data
	Tensile Strength		81,235
	Yield Strength		52,499
	Percent Elongation		24.0%
	Percent Reduction In Area		43.0%
EQUOTIP	Hardness (BHN) *	157	
	Carbon	.35	.28
	Manganese	.78	.78
	Silicon	.22	.23
	Phosphorous	.023	.018
	Sulfur	.015	.029
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA
	Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 88$, EQUIVALENT TO 173 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY-84 — Specimen ID (Required) 17-4526

		Test Data	CMTR Data
	Tensile Strength		81,235
	Yield Strength		52,499
	Percent Elongation		24.0 %
	Percent Reduction In Area		43.0 %
EQUOTIP	Hardness (BHN) *	157	
	Carbon	.32	.28
	Manganese	.74	.78
	Silicon	.22	.23
	Phosphorous	.022	.018
	Sulfur	.014	.029
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA
	Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 86.5$, EQUIVALENT TO 167 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY 84 -- Specimen ID (Required) 18-4526

	Test Data	CMTR Data
Tensile Strength		81,235
Yield Strength		52,499
Percent Elongation		24.0 %
Percent Reduction In Area		43.0 %
EQUOTIP Hardness (BHN) *	147	
Carbon	.32	.28
Manganese	.73	.78
Silicon	.23	.23
Phosphorous	.028	.018
Sulfur	.015	.029
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA
Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 87$, EQUIVALENT TO 172 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY 84 — Specimen ID (Required) 19-4526

	Test Data	CMTR Data
Tensile Strength		81,235
Yield Strength		52,499
Percent Elongation		24.0 %
Percent Reduction In Area		43.0 %
EQUOTIP Hardness (BHN) *	156	
Carbon	.31	.28
Manganese	.73	.78
Silicon	.23	.23
Phosphorous	.027	.018
Sulfur	.015	.029
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA
Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 85$, EQUIVALENT TO 165 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY 84 — Specimen ID (Required) 20-4526

		Test Data	CMTR Data
	Tensile Strength		81,235
	Yield Strength		52,499
	Percent Elongation		24.0 %
Percent	Reduction In Area		43.0 %
EQUOTIP	Hardness (BHN) *	154	
	Carbon	.35	.28
	Manganese	.76	.78
	Silicon	.22	.23
	Phosphorous	.023	.018
	Sulfur	.015	.029
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA
	Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED R_B = 87.9, EQUIVALENT TO 172 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY 84 — Specimen ID (Required) 21-4526

		Test Data	CMTR Data
	Tensile Strength		81,235
	Yield Strength		52,499
	Percent Elongation		24.0 %
Percent	Reduction In Area		43.0 %
EQUOTIP	Hardness (BHN) *	143	
	Carbon	.31	.28
	Manganese	.73	.78
	Silicon	.23	.23
	Phosphorous	.028	.018
	Sulfur	.015	.029
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA
	Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 85$, EQUIVALENT TO 162 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY 84 — Specimen ID (Required) 22-4526

	Test Data	CMTR Data
Tensile Strength		81,235
Yield Strength		52,499
Percent Elongation		24.0 %
Percent Reduction In Area		43.0 %
EQUOTIP Hardness (BHN) *	149	
Carbon	.31	.28
Manganese	.72	.78
Silicon	.23	.23
Phosphorous	.029	.018
Sulfur	.014	.029
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 88.7$, EQUIVALENT TO 176 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY 84 -- Specimen ID (Required) 23-4524

	Test Data	CMTR Data
Tensile Strength		81,235
Yield Strength		52,499
Percent Elongation		24.0 %
Percent Reduction In Area		43.0 %
EQUOTIP Hardness (BHN) *	148	
Carbon	.31	.28
Manganese	.73	.78
Silicon	.24	.23.
Phosphorous	.026	.018
Sulfur	.015	.029.
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA.

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 85.4$, EQUIVALENT TO 165 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY 84 — Specimen ID (Required) 24-4526

		Test Data	CMTR Data
	Tensile Strength		81,235
	Yield Strength		52,499
	Percent Elongation		24.0 %
Percent	Reduction In Area		43.0 %
EQUOTIP	Hardness (BHN)*	147	
	Carbon	.31	.28
	Manganese	.74	.78
	Silicon	.23	.23
	Phosphorous	.026	.018
	Sulfur	.015	.029
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA
	Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 83.7$, EQUIVALENT TO 158 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY 84 — Specimen ID (Required) 25-4526

	Test Data	CMTR Data
Tensile Strength		81,235
Yield Strength		52,499
Percent Elongation		24.0 %
Percent Reduction In Area		43.0 %
EQUOTIP Hardness (BHN) *	146	
Carbon	.32	.28
Manganese	.73	.78
Silicon	.23	.23
Phosphorous	.024	.018
Sulfur	.015	.029
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 85.6$, EQUIVALENT TO 166 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY 84 — Specimen ID (Required) 26-4526

		Test Data	CMTR Data
	Tensile Strength		81,235
	Yield Strength		52,499
	Percent Elongation		24.0 %
	Percent Reduction In Area		43.0 %
EQUOTIP	Hardness (BHN) *	148	
	Carbon	.34	.28
	Manganese	.73	.78
	Silicon	.23	.23
	Phosphorous	.023	.018
	Sulfur	.015	.029
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 84.6$, EQUIVALENT TO 161 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT AAY 84 — Specimen ID (Required) 27-4526

	Test Data	CMTR Data
Tensile Strength		81,235
Yield Strength		52,499
Percent Elongation	--	24.0 %
Percent Reduction In Area		43.0 %
EQUOTIP Hardness (BHN) *	141	
Carbon	.31	.28
Manganese	.72	.78
Silicon	.23	.23
Phosphorous	.024	.018
Sulfur	.016	.029
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 85.9$, EQUIVALENT TO 167 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT CFB — Specimen ID (Required) 28-4526

	Test Data	CMTR Data
Tensile Strength		76,190
Yield Strength		46,185
Percent Elongation		30.0 %
Percent Reduction In Area		58.1 %
EQUIP Hardness (BHN) *	138	
Carbon	.22	.22
Manganese	.90	.84
Silicon	.25	.25
Phosphorous	.020	.015
Sulfur	.039	.030
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 86$, EQUIVALENT TO 167 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT CFB — Specimen ID (Required) 29-4526

	Test Data	CMTR Data
Tensile Strength		76,190
Yield Strength		46,185
Percent Elongation		30.0 %
Percent Reduction In Area		58.1 %
EQUOTIP Hardness (BHN) *	144	
Carbon	.21	.22
Manganese	.90	.84
Silicon	.25	.25
Phosphorous	.022	.015
Sulfur	.037	.030
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 85.2$, EQUIVALENT TO 162 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT CFB — Specimen ID (Required) 30-4526

	Test Data	CMTR Data
Tensile Strength		76,190
Yield Strength		46,185
Percent Elongation		30.0 %
Percent Reduction In Area		58.1 %
EQUOTIP Hardness (BHN)*	136	
Carbon	.14	.22
Manganese	.95	.84
Silicon	.26	.25
Phosphorous	.020	.015
Sulfur	.030	.030
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 82.9$, EQUIVALENT TO 156 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT CFB — Specimen ID (Required) 31-4526

	Test Data	CMTR Data
Tensile Strength		76,190
Yield Strength		46,185
Percent Elongation		30.0 %
Percent Reduction In Area		58.1 %
EQUOTIP Hardness (BHN)*	142	
Carbon	.14	.22
Manganese	.94	.84
Silicon	.27	.25
Phosphorous	.021	.015
Sulfur	.030	.030
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 84.4$, EQUIVALENT TO 160 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT CFB -- Specimen ID (Required) 32-4526

		Test Data	CMTR Data
	Tensile Strength		76,190
	Yield Strength		46,185
	Percent Elongation		30.0 %
Percent	Reduction In Area		58.1 %
EQUOTIP	Hardness (BHN) *	153	
	Carbon	.14	.22
	Manganese	.96	.84
	Silicon	.27	.25
	Phosphorous	.021	.015
	Sulfur	.029	.030
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 85$, EQUIVALENT TO 162 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT CFB — Specimen ID (Required) 33-4526

	Test Data	CMTR Data
Tensile Strength		76,190
Yield Strength		46,185
Percent Elongation		30.0 %
Percent Reduction In Area		58.1 %
EQUOTIP Hardness (BHN)*	145	
Carbon	.21	.22
Manganese	.96	.84
Silicon	.27	.25
Phosphorous	.022	.015
Sulfur	.035	.030
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 82.4$, EQUIVALENT TO 153 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT CFB -- Specimen ID (Required) 34-4526

		Test Data	CMTR Data
	Tensile Strength		76,190
	Yield Strength		46,185
	Percent Elongation		30.0 %
	Percent Reduction In Area		58.1 %
EQUOTIP	Hardness (BHN)*	150	
	Carbon	.22	.22
	Manganese	.92	.84
	Silicon	.27	.25
	Phosphorous	.022	.015
	Sulfur	.037	.030
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA
	Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 86$, EQUIVALENT TO 167 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT CFB — Specimen ID (Required) 35-4526

		Test Data	CMTR Data
	Tensile Strength		76,190
	Yield Strength		46,185
	Percent Elongation		30.0 %
	Percent Reduction In Area		58.1 %
EQUOTIP	Hardness (BHN)*	140	
	Carbon	.22	.22
	Manganese	.92	.84
	Silicon	.29	.25
	Phosphorous	.020	.015
	Sulfur	.037	.030
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 85.2$, EQUIVALENT TO 162 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT CFY — Specimen ID (Required) 42-4526

	Test Data	CMTR Data
Tensile Strength		84,725
Yield Strength		53,890
Percent Elongation		35.0 %
Percent Reduction In Area		67.8 %
EQUOTIP Hardness (BHN)*	113	
Carbon	.19	.25
Manganese	.87	1.35
Silicon	.24	.27
Phosphorous	.027	.010
Sulfur	.026	.039
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 72.7$, EQUIVALENT TO 131 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT CFY — Specimen ID (Required) 43-4526

	Test Data	CMTR Data
Tensile Strength		84,725
Yield Strength		53,890
Percent Elongation		35.0 %
Percent Reduction In Area		67.8 %
EQUOTP Hardness (BHN)*	116	
Carbon	.20	.25
Manganese	.88	1.35
Silicon	.25	.27
Phosphorous	.024	.010
Sulfur	.026	.039
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 71.7$, EQUIVALENT TO 129 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT CFY — Specimen ID (Required) 44-4526

	Test Data	CMTR Data
Tensile Strength		84,725
Yield Strength		53,890
Percent Elongation		35.0 %
Percent Reduction In Area		67.8 %
EQUOTP Hardness (BHN)*	111	
Carbon	.20	.25
Manganese	.88	1.35
Silicon	.24	.27
Phosphorous	.028	.010
Sulfur	.027	.039
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 71.6$, EQUIVALENT TO 129 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT CFY — Specimen ID (Required) 45-4526

		Test Data	CMTR Data
	Tensile Strength		84,725
	Yield Strength		53,890
	Percent Elongation		35.0 %
	Percent Reduction In Area		67.8 %
EQUIP	Hardness (BHN)*	112	
	Carbon	.21	.25
	Manganese	.89	1.35
	Silicon	.24	.27
	Phosphorous	.033	.010
	Sulfur	.028	.039
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 70.9$, EQUIVALENT TO 127 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT 472423 — Specimen ID (Required) 48-4375

	Test Data	CMTR Data
Tensile Strength		79,423
Yield Strength		31,542
Percent Elongation		61 %
Percent Reduction In Area		78%
EQUOTIP Hardness (BHN) *	148	
Carbon	.05	.030
Manganese	.81	1.22
Silicon	.64	.31
Phosphorous	.027	.022
Sulfur	.014	.009
Chromium	18.86	18.4
Nickel	8.57	8.7
Molybdenum	.27	.18
Heat Treatment		ANNEALED

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 87.1$, EQUIVALENT TO 170 BHN

PIECE IS NON-MAGNETIC

NRC 88-05

TEST DATA WORKSHEET

HEAT 816 K — Specimen ID (Required) 49-1660

	Test Data	CMTR Data
Tensile Strength		92,000
Yield Strength		62,000
Percent Elongation		26.5%
Percent Reduction In Area		54.6 %
EQUOTIP Hardness (BHN) *	147	
Carbon	.31	.30
Manganese	.77	.86
Silicon	.20	.07
Phosphorous	.015	.019
Sulfur	.021	.037
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA
Heat Treatment		ANNEALED

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 82.8$, EQUIVALENT TO 156 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT E1413 — Specimen ID (Required) 52-1601

	Test Data	CMTR Data
Tensile Strength		78,200
Yield Strength		48,300
Percent Elongation		36 %
Percent Reduction In Area		60 %
EQUOTIP Hardness (BHN)*	133	
Carbon	.14	.24
Manganese	.48	.74
Silicon	.30	.24
Phosphorous	.033	.015
Sulfur	.033	.010
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 82.2$, EQUIVALENT TO 153 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT E1413 — Specimen ID (Required) 53-1601

	Test Data	CMTR Data
Tensile Strength		78,200
Yield Strength		48,300
Percent Elongation		36 %
Percent Reduction In Area		60%
EQUOTIP Hardness (BHN)*	127	
Carbon	.10	.24
Manganese	.49	.74
Silicon	.20	.24
Phosphorous	.026	.015
Sulfur	.027	.010
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA
Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 75.4$, EQUIVALENT TO 137 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT E1413 — Specimen ID (Required) 54-1601

	Test Data	CMTR Data
Tensile Strength		78,200
Yield Strength		48,300
Percent Elongation		36 %
Percent Reduction In Area		60 %
EQUOTIP Hardness (BHN) *	128	
Carbon	.14	.24
Manganese	.47	.74
Silicon	.30	.24
Phosphorous	.031	.015
Sulfur	.033	.010
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA
Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 79.9$, EQUIVALENT TO 147 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT VP — Specimen ID (Required) 56-1601

		Test Data	CMTR Data
	Tensile Strength		79,800
	Yield Strength		45,000
	Percent Elongation		30.0%
	Percent Reduction In Area		53.0 %
EQUOTIP	Hardness (BHN) *	170	
	Carbon	.27	.26
	Manganese	.74	.78
	Silicon	.23	.22
	Phosphorous	.021	.011
	Sulfur	.022	.020
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 82.2$, EQUIVALENT TO 153 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT VP — Specimen ID (Required) 57-1601

		Test Data	CMTR Data
	Tensile Strength		79,800
	Yield Strength		45,000
	Percent Elongation		30.0%
	Percent Reduction In Area		53.0 %
EQUOTIP	Hardness (BHN) *	145	
	Carbon	.28	.26
	Manganese	.74	.78
	Silicon	.23	.22
	Phosphorous	.020	.011
	Sulfur	.023	.020
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 76.7$, EQUIVALENT TO 139 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT VP — Specimen ID (Required) 58-1601

		Test Data	CMTR Data
	Tensile Strength		79,800
	Yield Strength		45,000
	Percent Elongation		30.0%
	Percent Reduction In Area		53.0 %
EQUOTIP	Hardness (BHN) *	137	
	Carbon	.27	.26
	Manganese	.72	.78
	Silicon	.23	.22
	Phosphorous	.020	.011
	Sulfur	.022	.020
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA
	Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 80.9$, EQUIVALENT TO 149 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT COX -- Specimen ID (Required) 66-4526

		Test Data	CMTR Data
	Tensile Strength		87,663
	Yield Strength		50,575
	Percent Elongation		22.0 %
	Percent Reduction In Area		43.0 %
EQUOTIP	Hardness (BHN) *	132	
	Carbon	.21	.28
	Manganese	.75	.75
	Silicon	.21	.22
	Phosphorous	.033	.017
	Sulfur	.036	.027
	Chromium	NA	NA
	Nickel	NA	NA
	Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 80.8$, EQUIVALENT TO 150 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT COX — Specimen ID (Required) 67-4526

	Test Data	CMTR Data
Tensile Strength		87,663
Yield Strength		50,575
Percent Elongation		22.0 %
Percent Reduction In Area		43.0 %
EQUOTIP Hardness (BHN) *	134	
Carbon	.21	.28
Manganese	.76	.75
Silicon	.21	.22
Phosphorous	.034	.017
Sulfur	.036	.027
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED R_B = 80.7, EQUIVALENT TO 150 BHN.

NRC 88-05

TEST DATA WORKSHEET

HEAT COP — Specimen ID (Required) 68-4526

	Test Data	CMTR Data
Tensile Strength		81,019
Yield Strength		44394
Percent Elongation		26.0 %
Percent Reduction In Area		60.0 %
EQUOTIP Hardness (BHN)	* 133 RIGHT EDGE 153 LEFT EDGE	
Carbon	.21	.27
Manganese	1.22 **	.99
Silicon	.26	.31
Phosphorous	.018	.010
Sulfur	.008	.023
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA
Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED R_B = 83.5 TO 93.8, EQUIVALENT TO 160 TO 199 BHN.

** ALLOWED BY SPECIFICATION FOR CARBON LESS THAN .35

NRC 88-05

TEST DATA WORKSHEET

HEAT COP — Specimen ID (Required) 69-4526

	Test Data	CMTR Data
Tensile Strength		81,019
Yield Strength		44394
Percent Elongation		26.0 %
Percent Reduction In Area		60.0 %
EQUOTIP Hardness (BHN) *	133 RIGHT EDGE 185 LEFT EDGE	
Carbon	.18	.27
Manganese	1.20 **	.99
Silicon	.25	.31
Phosphorous	.018	.010
Sulfur	.008	.023
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA
Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 82.6$, EQUIVALENT TO 156 BHN.

** PERMITTED BY SPECIFICATION FOR CARBON LESS THAN .35

NRC 88-05

TEST DATA WORKSHEET

HEAT COL — Specimen ID (Required) 70-4526

	Test Data	CMTR Data
Tensile Strength		95,680
Yield Strength		64,123
Percent Elongation		26.0 %
Percent Reduction In Area		51.0 %
EQUOTIP Hardness (BHN) *	146	
Carbon	.34	.29
Manganese	.67	.76
Silicon	.25	.27
Phosphorous	.029	.033
Sulfur	.017	.034
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA

Heat Treatment

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 86.3$, EQUIVALENT TO 170 BHN

NRC 88-05

TEST DATA WORKSHEET

HEAT COL — Specimen ID (Required) 71-4526

	Test Data	CMTR Data
Tensile Strength		95,680
Yield Strength		64,123
Percent Elongation		26.0 %
Percent Reduction In Area		51.0 %
EQUOTIP Hardness (BHN) *	150	
Carbon	.34	.29
Manganese	.68	.76
Silicon	.25	.27
Phosphorous	.030	.033
Sulfur	.017	.034
Chromium	NA	NA
Nickel	NA	NA
Molybdenum	NA	NA
Heat Treatment		

Add Remarks?

* ADDITIONAL BENCH TEST PRODUCED $R_B = 85.8$, EQUIVALENT TO 167 BHN.

Basis For NUMARC Recommendation

Screening Tests

- Supplement 1 Schedule Necessitates the Use of a Screening Test Approach
- Ferritic materials
  - –Main Concern is the Possibility that Strength is Inadequate
  - –Hardness is Well Correlated to Tensile Strength for Ferritic Materials and is Suitable for In–situ Use
  - –Hardness has Been Previously Used as a Screening Test in a Number of Industry Programs and is Familiar to Utilities and NRC

June 30, 1988

ATTACHMENT 4

Basis For NUMARC Recommendations

Screening Tests (Cont'd)

- Strength/Hardness Correlations are Not Very Reliable for Austenitic Materials but Inadequate Strength is Judged to be a less Significant Issue for Austenitic Items Than for Ferritic Items
  - --Main Concern For Austentitic Materials is Possibility that Corrosion Resistance is Inadequate
  - --A Manual Check With a Magnet is a Quick and Simple Way of Distinguishing a Fully Austenitic (Non-Magnetic) Material

ATTACHMENT 4

June 30, 1988

Basis For NUMARC Recommendations

Preference For Use of Equotip

- Comparability of Results Between Utilities Should Be Improved if All Use One Test Method
- Equotip Was Independent Choice of EPRI, NDEC and Bechtel
  - –Validity Well Demonstrated by Existing Correlations
  - –Easy to Use in Confined Spaces
  - –Already Widely Used by Utilities and Accepted By NRC (e.g., Cardinal Bolt Effort)
  - –Widely Available and Relatively Inexpensive
- Training in the Proper Use of Equotip is Being Provided in an Attempt to Maximize the Consistency of the Data Obtained by Different Utilities

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ATTACHMENT 4

Basis For NUMARC Recommendations

Preliminary Acceptance Criteria

- Hardness
  - –137BHN is the Code Minimum Value and 187 BHN is the Code Maximum Value
  - –116BHN is Equivalent to a Tensile Strength of 56KSI, Which is 80% of the Code Minimum Value. A Preliminary Assessment Indicates that a Tensile Strength $\geq$80% of the Code Minimum Can be Shown to be Acceptable on a Generic Basis
- Magnetic Check
  - –Austenitic Materials Should be Non–magnetic. Therefore, any Indication of Ferromagnetism Requires Further Investigation

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ATTACHMENT 4

Basis for NUMARC Recommdendations

Confirmatory and Supplementary Tests

- Confirmation of Questionable or Unacceptable (<116 BHN) Screening Test Results is Necessary Because Data Scatter is Expected Due To:
  - –Non–Homogenous Nature of Real Materials
  - –Differences Between Test Methods
  - –Calibration Accuracy
  - –Technique Problems
  - –Human Error
- Determination of Material Composition is the Major Supplemental Testing Suggested Because
  - –The Information Allows A More Meaningful Assessment of Fitness for Service and
  - –Methods Suitable for In–Situ Use Are Available

June 30, 1988

ATTACHMENT 4