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August 12, 1996

U.S. Nuclear Regulatory Commission
Mail Station P1-37
Washington, D.C. 20555

Attention: Document Control Desk

Subject: Grand Gulf Nuclear Station
Docket No. 50-416
License No. NPF-29
Revision to Relief Request I-00014

GNRO-96/00093

Gentlemen:

By this letter, Entergy Operations, Inc. requests relief from the requirements of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Section XI Code in accordance with 10 CFR 50.55a(g)(5)(iv) and 10 CFR 50.55qa(g)(6)(i). The proposed relief request is needed to support the closure of our first interval.

Attachment 1 provides the justification for the relief.

This relief request is revised, in part, to incorporate changes to the Grand Gulf Nuclear Station pressure testing program resulting from the approval of Code Case N-498-1, similar to the relief requests submitted on May 21, 1996 (GNRO-96/00057). Part of the basis for the original relief request was the performance of a system hydrostatic test each interval which has now been replaced by a system leakage test as a result of the approval of Code Case N-498-1. Revision 0 of this relief request provided predicted limitations prior to actual performance of the examinations. This revision of the relief request records the actual limitations experienced during the first interval examinations.

If you have any questions, please contact Sheri Mahoney at 601-437-6552.

Yours truly,

MJM/SEM/mtc
attachment: Revised Relief Request I-00014
cc: (See Next Page)

A047
1/1

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Attachment 1 to GNRO-96/00093

Revised Relief Request I-00014

GRAND GULF NUCLEAR STATION
UNIT 1

RELIEF REQUEST I-00014, REVISION 1

INSERVICE INSPECTION
OF REACTOR PRESSURE VESSEL NOZZLE TO SHELL WELDS

I. Component:

Reactor pressure vessel (RPV) to nozzle welds and associated base material. (See Table 1 and Table 2 for nozzle identification.)

II. Code:

The Unit 1 RPV was designed and fabricated to ASME Section III, Class 1 requirements. Applicable inservice inspections are to be performed in accordance with Regulatory Guide 1.150, Revision 1, and ASME Section XI, 1977 Edition with Addenda through and including Summer 1979. Also, Relief Request I-00013 permits the use of ASME Section XI, 1983 Edition with the Summer 1983 Addenda, Figure IWB-2500-7(b), for identifying the code required examination volume of Examination Category B-D welds

III. Code requirements:

Table IWB-2500-1, Examination Category B-D, Full Penetration Welds of Nozzles in Vessels, items B3.90 and B3.100 requires a volumetric examination of the adjoining weld, base material for 1/2 thickness on each side of the weld, and inner radius (see Figure 1).

IV. Information to support the determination that the Code requirements are impractical:

Of the 35 nozzles requiring a volumetric examination of the weld and adjoining base material, 9 have been examined using automated remote techniques, and the remaining 26 nozzle-to-vessel welds have been examined using manual techniques .

Table 1 provides the limitations for the nozzles that were examined using the automated techniques and Table 2 provides the limitations for the nozzles that were examined using manual techniques. Both Tables compare the Code required examination volume against the examined volume. In this evaluation, the Code required volume has been subdivided into the areas recognized by Regulatory Guide 1.150 as being the more critical area and, additionally, the weld and heat affected zone coverage has been reported separately.

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In addition to the limitations that are specific to each technique, the Near Field effect which is common to most contact ultrasonic examinations provides a limitation that is generally accepted as being the first 1/4 inch of thickness from the surface that is in contact with the transducer. Although this limitation is typically not subject to relief, it has been conservatively included in this request for relief in the calculations used to determine the examined volume.

The calculations used to determine examination coverage are based only on the sound beam centerline and the volumes examined by beam spread is not considered in the coverage information provided in Tables 1 and 2.

Figures 2 through 8 depict the typical coverage pattern for each type nozzle with each beam angle.

A. Automated Examinations

The automated scanning mechanism utilizes two types of scanning packages:

1. The "T-scan" (shear wave sound beam transverse to the weld axis) transducer package consists of a 0° straight beam, 45° and 60° angle beams. The 45° and 60° angle beam wedges are angulated to produce a sound beam that is perpendicular to the weld centerline at the vessel inner surface. One complete revolution of the nozzle scanner, with the "T-scan" package will scan for parallel oriented reflectors using a 45° and 60° angle beam, and for planar and laminar reflectors using a 0° straight beam.

2. The "P-scan" (sound beam parallel to the weld axis) transducer package consists of 45° and 60° angle beam wedges. One wedge is pointed in the clockwise direction, and the other is pointed counterclockwise. The 45° and 60° angle beam wedges are angulated to produce a sound beam that is tangent to the weld centerline at the vessel inner surface. Two complete revolutions of the nozzle scanner with the "P-scan" package are performed to scan (from two directions) for transverse oriented reflectors.

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The nozzle design of the BWR 6 does not allow for a full volume examination of the weld and associated 1/2 T of base material on each side of the weld when performing the examination with the automated remote technique for the following reasons:

1. Due to the short distance from the weld centerline to the nozzle to shell radius, the examination volume can only be scanned from the shell side of the weld.

2. Also, this short distance prevents extending the scanning arm far enough past the weld towards the nozzle to obtain full coverage of the required volume while scanning from the shell side.

Performing supplemental manual examinations of the accessible volumes would provide very limited increases of total volumes examined. The additional volume coverage obtained by supplementing the automated examinations with manual examinations is not justified when compared to the manrem expenditure. The estimated average time required to supplement the automated examination with manual examinations is approximately 1 hour per nozzle, for two technicians. Using an average dose rate of 197 mr/hr for each of the nine nozzles based on measured doses taking during our fifth refuel outage after flushing, and assuming a stay time of 2 manhours per nozzle, the total manrem expenditure to perform the supplemental examinations would equal approximately 3.5 manrem. The averaged additional coverage would only equal approximately 10% for the N2 nozzles, 11% for the N3 nozzles, 8% for the N4 nozzles and 7% for the N6 nozzle.

B. Manual Examinations

Although manual techniques generally provide enhanced coverage compared to the automated technique, there are still limitations because of the interface problems with the ultrasonic transducer and the nozzle to vessel geometry. The examination volume required by the Code exceeds what is physically accessible with available manual or automated techniques and equipment. The coverage obtained with the

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manual technique represents the best obtainable coverage with any known NDE method for a volumetric examination from either surface.

To date, there has been no reported occurrence of cracking at nozzle/vessel weld locations and adjacent areas. It has been generally accepted that the nozzle/vessel welds are not the limiting location with respect to structural integrity. Cracking has been found at the feedwater nozzle blend radii and bore region at various domestic and foreign plants. The first cracking reported was discovered at the nozzle blend radii as well as the feedwater spargers and brackets and nozzle bore area. Cladding was present on the cracked nozzle, whereas there is no cladding on the Grand Gulf nozzles. The presence of the cracking was attributed primarily to rapid cycling of hot and cold water, and the presence of cladding. During the inspection which discovered the cracking, which was a liquid penetrant examination, no cracking of the nozzle/weld was observed. This indicated that the feedwater nozzle blend radii was limiting. Since Grand Gulf does not have cladding on the feedwater nozzles, has feedwater flow controller in operation, and triple thermal sleeve, cracking is not expected to occur at the feedwater nozzle blend radii. Therefore, since the nozzle blend radii is more limiting than the nozzle vessel weld, cracking at the weld is also less likely.

Since the feedwater nozzle is limiting, the discussions and conclusions to follow are also applicable to all nozzle/vessel welds on the Grand Gulf RPV.

Applied Stress Levels

The only significant loadings that could affect the feedwater nozzle and nozzle/vessel weld area are due to internal pressure and thermal cycling caused by the mixing of hot and cold fluids in the nozzle bore and blend radii regions. However, the rapid thermal cycling effects have significantly decreased near the nozzle/vessel weld and does not produce any significant thermal cycling. This same thermal cycling was the predominant contributor to the observed cracking at the feedwater nozzle blend radii and bore regions of other plants. In addition, the inner cladding which aided the occurrence of cracking is not present on the Grand Gulf nozzle.

Note that the nozzle/vessel weld location is far enough away from the blend such that stress magnification from the geometric discontinuity has reduced significantly.

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Fatigue Crack Initiation/Propagation

The occurrence of fatigue crack initiation and subsequent propagation requires the presence of cyclic loading. As stated above in Applied Stress Levels, the significant loadings come from internal pressure. As stated earlier, the rapid thermal mixing experienced at the feedwater nozzle bore and blend radii has diminished significantly at the nozzle/vessel weld. Therefore, fatigue crack initiation is not likely to occur since the only contributors are pressure stresses and startup/shutdown thermal gradient stresses and these events are limited in number.

This is consistent with the results of the feedwater nozzle blend radii UT results at Grand Gulf. Since initiation of flaws is not expected, propagation is not an issue. However, even if a crack is postulated, the predicted crack growth from cycling is small.

Stress Corrosion Cracking Potential

To date, both experimental and field experience has shown no evidence of SCC initiation in A508 material. SCC is only possible when an initial significant starter crack is present. Without this condition, SCC is not a concern in A508 material. Therefore, for the Grand Gulf nozzle/vessel welds, SCC is not a plausible failure mechanism.

Radiation Embrittlement

The presence of high radiation fluency levels could affect the Nil Ductility Transition Temperature (RTNDT), and therefore cause radiation embrittlement. However, all nozzles are located sufficiently away from the core such that the fluency levels are not high enough to cause material embrittlement. Therefore, radiation embrittlement is not a concern for the Grand Gulf nozzle/vessel welds. This is consistent with assumptions made in prior fracture mechanics evaluations performed for the nozzle blend radii cracking.

Consequences of Postulated Cracking

In the previous sections, a discussion of various aspects concerning the structural integrity of the nozzle/vessel weld have been presented. In this section, additional discussion demonstrating

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significant safety margin for this location even if an unlikely through-wall crack were to occur will be presented.

As discussed before, the limiting condition with respect to potential to failure is the nozzle bore radii and bore areas. The nozzle/vessel weld area is bounded by any analysis for the bore or blend radii areas. Significant analysis has been performed for the bore and blend radii locations. Therefore, the discussions provided in this section are a summary of the results determined for the limiting cases. It should be emphasized that a basic assumption in the design and licensing of light water systems in the USA is that failure of the RPV need not be postulated as a design basis event.

Allowable Crack Size

The basic requirement of Section XI of the ASME Code is that flaws greater than 10% of the critical flaw size is not permitted. Evaluations of a worst case thermal event in combination with pressure stress have shown that the lower bound fracture toughness of the A508 material is not exceeded even for crack depths approaching the vessel thickness. Since flaw sizes in excess of the wall thickness have no physical significance, it was conservatively assumed that a crack depth equal to the thickness was critical and thus a Section XI allowable crack depth of 10% of wall thickness was established.

Leak Before Break

Regardless of the examination and repair programs in place to ensure that nozzle flaws do not exceed Section XI allowables, it is useful to postulate one or more nozzle flaws becoming very large without being detected in order to determine whether a critical condition could exist and cause rapid crack propagation. As mentioned earlier, the stress intensity factor for a crack at the blend radii never exceeded the lower bound fracture toughness even for a crack equal to the thickness of the vessel.

Evaluations have been performed for an analogous case of cracking from a hole in a plate. The stress intensity factors as a function of through-wall crack length have been calculated. For large cracks (crack tip far away from the nozzle), the only contributing stress is due to pressure. The intersection of the fracture toughness and stress intensity factor prescribes the critical flaw size. The results of these calculations have shown that the critical crack size for each of the two cracks is

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29 inches (total length of 58 inches). It is virtually inconceivable that the leakage associated with cracking of this magnitude could escape detection in an operating BWR. Thus a leak before break condition is assured for the vessel, even in the unlikely event that nozzle flaws grow to depths greater than the Section XI allowables, as long as the vessel is at upper shelf temperature. Similar conclusions apply to the upset and emergency conditions with postulated crack lengths of 15 inches (30 inches total) and 11 inches (22 inches total), respectively, is required before rapid fracture could occur under these conditions.

Although the entire ASME Code-prescribed area was not ultrasonically examined, the ultrasonic data obtained can still be used to evaluate the potential for cracking. Figures 2 through 8 show typical areas of examination coverage for the various scanning techniques (Tables 1 and 2 provide specific quantities of coverage). It can be seen that at least one side of the weld and portions thereof are examined. Results of previous examinations revealed no rejectable indications exceeding ASME Section XI criteria. In addition, nozzle blend radii are also examined, and to date no relevant indications have been located. The results of previous UT examinations are consistent with the discussion provided in this request for relief.

Since no cracking has been found at a nozzle blend radius or at the examined nozzle/vessel area, it is unlikely that indications would be present in the unexamined area between the examined vessel/nozzle weld and the nozzle blend radius. There are no additional considerations at the unexamined area which would make cracking more likely than at the examined nozzle/vessel weld area. Therefore, it is concluded that examined areas of the nozzle/vessel weld area and the nozzle blend radii area are sufficient to identify any flaws that may occur.

V. Specific relief requested:

Permission is requested to perform ultrasonic examination of only those areas accessible with automated techniques for those 9 nozzle to vessel welds that are examined utilizing automated methods. Also, permission is requested to examine only those areas that are accessible with manual techniques for the 26 nozzles that are examined manually.

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VI. Reasons why relief should be granted:

Relief as described within should be granted for the following reasons:

1. The entire RPV was subjected to an ASME Section III hydrostatic test after fabrication.

2. The entire RPV will be subjected to pressure testing in accordance with the requirements of ASME Section XI.

3. The subject welds were volumetrically examined in accordance with ASME Section III during fabrication.

4. There is no history of service induced flaws in these areas of the RPV other than those of the feedwater nozzles discussed within this request for relief.

5. The areas being examined are the limiting areas of the nozzle to vessel configuration.

6. The performance of supplemental manual examinations to supplement the nine nozzles that received automated examinations would require significant expenditures of personnel exposure for a small increase of examined volume.

7. The potential for initiation and propagation of cracking has been discussed assuming both fatigue and stress corrosion cracking mechanisms. It was concluded by the use of limiting analyses results performed for the feedwater nozzle blend radii, that cracking is unlikely at Grand Gulf nozzle/vessel weld locations. In fact, even if it was hypothesized that these postulated cracks went undetected, a crack length of 58 inches was required before rapid crack growth was to occur during normal operation. It is unlikely that cracks of this size would go undetected. Therefore, a significant leak before break margin exists.

8. Known techniques that examine the RPV welds from either the inside or outside surfaces will not provide any additional coverage beyond what is described in this relief request for the manual techniques.

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VII. Alternative testing:

None

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Table 1
Code Coverage Based on Automated Examination of Nozzles to Vessel Welds

N2 (B, C, D, E) Nozzles, Recirc. Inlet

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	78.75 in^2	26.80 in^2	34%	18.37 in^2	6.89 in^2	38%	15.40 in^2	0.40 in^2	3 %
45° T-SCAN	78.75 in^2	50.36 in^2	64 %	18.37 in^2	17.78 in^2	97 %	15.40 in^2	13.10 in^2	85%
60° T-SCAN	78.75 in^2	59.29 in^2	75%	18.37 in^2	18.37 in^2	100%	15.40 in^2	14.00 in^2	91 %
45° P-SCAN	78.75 in^2	35.01 in^2	44%	18.37 in^2	9.60 in^2	52%	15.40 in^2	7.10 in^2	46%
60° P-SCAN	78.75 in^2	35.01 in^2	44%	18.37 in^2	11.02 in^2	60 %	15.40 in^2	12.20 in^2	79%

N3 (A , B) Nozzles, Steam Outlet

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	82.99 in^2	31.20 in^2	38 %	19.52 in^2	7.32 in^2	38 %	16.17 in^2	1.00 in^2	6%
45° T-SCAN	82.99 in^2	54.94 in^2	66%	19.52 in^2	19.12 in^2	98%	16.17 in^2	14.10 in^2	87%
60° T-SCAN	82.99 in^2	63.70 in^2	77%	19.52 in^2	19.52 in^2	100%	16.17 in^2	14.69 in^2	91 %
45° P-SCAN	82.99 in^2	31.38 in^2	38%	19.52 in^2	8.57 in^2	44 %	16.17 in^2	2.20 in^2	14 %
60° P-SCAN	82.99 in^2	31.38 in^2	38 %	19.52 in^2	11.11 in^2	57 %	16.17 in^2	9.90 in^2	61%

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N4 (A , B) Nozzles, Feedwater Inlet

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	60.16 in^2	21.49 in^2	36 %	14.08 in^2	5.28 in^2	38 %	12.70 in^2	0.53 in^2	4%
45° T-SCAN	60.16 in^2	38.21 in^2	64 %	14.08 in^2	13.49 in^2	96 %	12.70 in^2	10.59 in^2	83%
60° T-SCAN	60.16 in^2	44.87 in^2	75 %	14.08 in^2	14.08 in^2	100%	12.70 in^2	11.40 in^2	90 %
45° P-SCAN	60.16 in^2	26.87 in^2	45 %	14.08 in^2	6.98 in^2	50 %	12.70 in^2	6.20 in^2	49 %
60° P-SCAN	60.16 in^2	26.87 in^2	45 %	14.08 in^2	8.49 in^2	60%	12.70 in^2	10.52 in^2	83 %

N6 (A) Nozzles, RHR/LPCI Inlet

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	60.16 in^2	22.30 in^2	37%	14.08 in^2	5.28 in^2	38 %	12.70 in^2	0.80 in^2	6%
45° T-SCAN	60.16 in^2	39.05 in^2	65 %	14.08 in^2	14.08 in^2	100%	12.70 in^2	10.80 in^2	85%
60° T-SCAN	60.16 in^2	45.37 in^2	75%	14.08 in^2	14.08 in^2	100%	12.70 in^2	11.61 in^2	91%
45° P-SCAN	60.16 in^2	27.46 in^2	46 %	14.08 in^2	7.09 in^2	50%	12.70 in^2	6.90 in^2	54%
60° P-SCAN	60.16 in^2	27.46 in^2	46 %	14.08 in^2	8.61 in^2	61%	12.70 in^2	11.42 in^2	90 %

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Table 2
Code Coverage Based on Manual Examination of Nozzles to Vessel Welds

N1 (A & B) Nozzles, Recirc. Outlet

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	79.70 in^2	37.76 in^2	47%	18.37 in^2	9.93 in^2	54%	15.40 in^2	10.05 in^2	65%
45° T-SCAN	79.70 in^2	59.65 in^2	75%	18.37 in^2	18.37 in^2	100%	15.40 in^2	15.24 in^2	99 %
60° T-SCAN	79.70 in^2	63.74 in^2	80%	18.37 in^2	18.37 in^2	100%	15.40 in^2	15.24 in^2	99 %
45° P-SCAN	79.70 in^2	37.76 in^2	47%	18.37 in^2	9.93 in^2	54%	15.40 in^2	10.05 in^2	65%
60° P-SCAN	79.70 in^2	37.76 in^2	47%	18.37 in^2	9.93 in^2	54%	15.40 in^2	10.05 in^2	65%

N2 (A, F, G, H, J, K, M, N) Nozzles, Recirc. Inlet

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	78.75 in^2	38.48 in^2	49 %	18.37 in^2	9.93 in^2	54%	15.40 in^2	10.05 in^2	65%
45° T-SCAN	78.75 in^2	62.84 in^2	80 %	18.37 in^2	18.37 in^2	100%	15.40 in^2	15.24 in^2	99%
60° T-SCAN	78.75 in^2	66.88 in^2	85 %	18.37 in^2	18.37 in^2	100%	15.40 in^2	15.24 in^2	99 %
45° P-SCAN	78.75 in^2	38.48 in^2	49 %	18.37 in^2	9.93 in^2	54%	15.40 in^2	10.05 in^2	65%
60° P-SCAN	78.75 in^2	38.48 in^2	49 %	18.37 in^2	9.93 in^2	54%	15.40 in^2	10.05 in^2	65%

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N3 (C, D) Nozzles, Steam Outlet

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	82.99 in^2	40.50 in^2	49 %	19.52 in^2	10.24 in^2	52 %	16.17 in^2	8.32 in^2	51%
45° T-SCAN	82.99 in^2	65.38 in^2	79 %	19.52 in^2	19.52 in^2	100%	16.17 in^2	16.01 in^2	99%
60° T-SCAN	82.99 in^2	70.23 in^2	85 %	19.52 in^2	19.52 in^2	100%	16.17 in^2	16.01 in^2	99%
45° P-SCAN	82.99 in^2	40.50 in^2	49 %	19.52 in^2	10.24 in^2	52 %	16.17 in^2	8.32 in^2	51%
60° P-SCAN	82.99 in^2	40.50 in^2	49 %	19.52 in^2	10.24 in^2	52 %	16.17 in^2	8.32 in^2	51%

N4 (C, D, E, F) Nozzles, Feedwater Inlet

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	60.16 in^2	29.02 in^2	48%	14.08 in^2	7.55 in^2	54%	12.70 in^2	8.13 in^2	64 %
45° T-SCAN	60.16 in^2	46.92 in^2	78%	14.08 in^2	14.08 in^2	100%	12.70 in^2	12.53 in^2	99 %
60° T-SCAN	60.16 in^2	50.33 in^2	84 %	14.08 in^2	14.08 in^2	100%	12.70 in^2	12.53 in^2	99 %
45° P-SCAN	60.16 in^2	29.02 in^2	48%	14.08 in^2	7.55 in^2	54 %	12.70 in^2	8.13 in^2	64 %
60° P-SCAN	60.16 in^2	29.02 in^2	48%	14.08 in^2	7.55 in^2	54 %	12.70 in^2	8.13 in^2	64 %

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N5 (A & B) Nozzles, Core Spray Inlet (LPCS, N5A; HPCS, N5B)

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	60.16 in^2	29.02 in^2	48%	14.08 in^2	7.55 in^2	54 %	12.70 in^2	8.13 in^2	64 %
45° T-SCAN	60.16 in^2	46.92 in^2	78%	14.08 in^2	14.08 in^2	100%	12.70 in^2	12.53 in^2	99 %
60° T-SCAN	60.16 in^2	50.33 in^2	84 %	14.08 in^2	14.08 in^2	100%	12.70 in^2	12.53 in^2	99 %
45° P-SCAN	60.16 in^2	29.02 in^2	48%	14.08 in^2	7.55 in^2	54 %	12.70 in^2	8.13 in^2	64 %
60° P-SCAN	60.16 in^2	29.02 in^2	48%	14.08 in^2	7.55 in^2	54 %	12.70 in^2	8.13 in^2	64 %

N6 (B, C) Nozzles, RHR/LPCI Inlet

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	60.16 in^2	29.02 in^2	48%	14.08 in^2	7.55 in^2	54 %	12.70 in^2	8.13 in^2	64 %
45° T-SCAN	60.16 in^2	46.92 in^2	78%	14.08 in^2	14.08 in^2	100%	12.70 in^2	12.53 in^2	99 %
60° T-SCAN	60.16 in^2	50.33 in^2	84%	14.08 in^2	14.08 in^2	100%	12.70 in^2	12.53 in^2	99 %
45° P-SCAN	60.16 in^2	29.02 in^2	48%	14.08 in^2	7.55 in^2	54 %	12.70 in^2	8.13 in^2	64 %
60° P-SCAN	60.16 in^2	29.02 in^2	48%	14.08 in^2	7.55 in^2	54 %	12.70 in^2	8.13 in^2	64 %

GRAND GULF NUCLEAR STATION
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INSERVICE INSPECTION
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N7 Nozzle, RCIC Top Head Spray Inlet

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	20.80 in^2	10.46 in^2	50%	4.71 in^2	2.63 in^2	56 %	5.96 in^2	3.91 in^2	66%
45° T-SCAN	20.80 in^2	16.34 in^2	79%	4.71 in^2	4.71 in^2	100%	5.96 in^2	5.74 in^2	96%
60° T-SCAN	20.80 in^2	17.46 in^2	84 %	4.71 in^2	4.71 in^2	100%	5.96 in^2	5.74 in^2	96%
45° P-SCAN	20.80 in^2	10.46 in^2	50%	4.71 in^2	2.63 in^2	56 %	5.96 in^2	3.91 in^2	66 %
60° P-SCAN	20.80 in^2	10.46 in^2	50%	4.71 in^2	2.63 in^2	56 %	5.96 in^2	3.91 in^2	66 %

N8 Nozzle, Top Head Spare

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	20.80 in^2	10.46 in^2	50%	4.71 in^2	2.63 in^2	56 %	5.96 in^2	3.91 in^2	66 %
45° T-SCAN	20.80 in^2	16.34 in^2	79%	4.71 in^2	4.71 in^2	100%	5.96 in^2	5.74 in^2	96%
60° T-SCAN	20.80 in^2	17.46 in^2	84%	4.71 in^2	4.71 in^2	100%	5.96 in^2	5.74 in^2	96%
45° P-SCAN	20.80 in^2	10.46 in^2	50%	4.71 in^2	2.63 in^2	56 %	5.96 in^2	3.91 in^2	66%
60° P-SCAN	20.80 in^2	10.46 in^2	50%	4.71 in^2	2.63 in^2	56 %	5.96 in^2	3.91 in^2	66%

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INSERVICE INSPECTION
OF REACTOR PRESSURE VESSEL NOZZLE TO SHELL WELDS

N9 (A & B) Nozzles, Jet Pump Instrumentation Outlet

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	78.29 in^2	37.59 in^2	48%	18.37 in^2	9.76 in^2	53%	15.40 in^2	9.82 in^2	64%
45° T-SCAN	78.29 in^2	62.00 in^2	79%	18.37 in^2	18.37 in^2	100%	15.40 in^2	15.24 in^2	99 %
60° T-SCAN	78.29 in^2	66.22 in^2	85 %	18.37 in^2	18.37 in^2	100%	15.40 in^2	15.24 in^2	99 %
45° P-SCAN	78.29 in^2	37.59 in^2	48%	18.37 in^2	9.76 in^2	53%	15.40 in^2	9.82 in^2	64 %
60° P-SCAN	78.29 in^2	37.59 in^2	48%	18.37 in^2	9.76 in^2	53%	15.40 in^2	9.82 in^2	64 %

N10 Nozzle, Control Rod Drive (Capped)

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	63.14 in^2	30.09 in^2	48 %	14.08 in^2	7.53 in^2	53%	12.70 in^2	8.42 in^2	66%
45° T-SCAN	63.14 in^2	49.00 in^2	78 %	14.08 in^2	14.08 in^2	100%	12.70 in^2	12.57 in^2	99%
60° T-SCAN	63.14 in^2	52.92 in^2	84 %	14.08 in^2	14.08 in^2	100%	12.70 in^2	12.57 in^2	99%
45° P-SCAN	63.14 in^2	30.09 in^2	48 %	14.08 in^2	7.53 in^2	53%	12.70 in^2	8.42 in^2	66%
60° P-SCAN	63.14 in^2	30.09 in^2	48 %	14.08 in^2	7.53 in^2	53%	12.70 in^2	8.42 in^2	66%

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N16 Nozzle, Vibration Instrumentation (Flanged)

SCAN TYPE	TOTAL CODE AREA	TOTAL CODE AREA EXAMINED	% of TOTAL CODE AREA EXAMINED	AREA OF INNER 1/4 T	AREA OF INNER 1/4 T EXAMINED	% OF INNER 1/4 T EXAMINED	AREA OF WELD / HAZ	AREA OF WELD /HAZ EXAMINED	% OF WELD/HAZ EXAMINED
0°	84.46 in^2	41.25 in^2	49 %	19.52 in^2	11.69 in^2	60 %	16.17 in^2	10.58 in^2	65%
45° T-SCAN	84.46 in^2	61.83 in^2	73%	19.52 in^2	19.52 in^2	100%	16.17 in^2	16.01 in^2	99%
60° T-SCAN	84.46 in^2	67.83 in^2	80%	19.52 in^2	19.52 in^2	100%	16.17 in^2	16.01 in^2	99%
45° P-SCAN	84.46 in^2	41.25 in^2	49 %	19.52 in^2	11.69 in^2	60 %	16.17 in^2	10.58 in^2	65%
60° P-SCAN	84.46 in^2	41.25 in^2	49 %	19.52 in^2	11.69 in^2	60 %	16.17 in^2	10.58 in^2	65%

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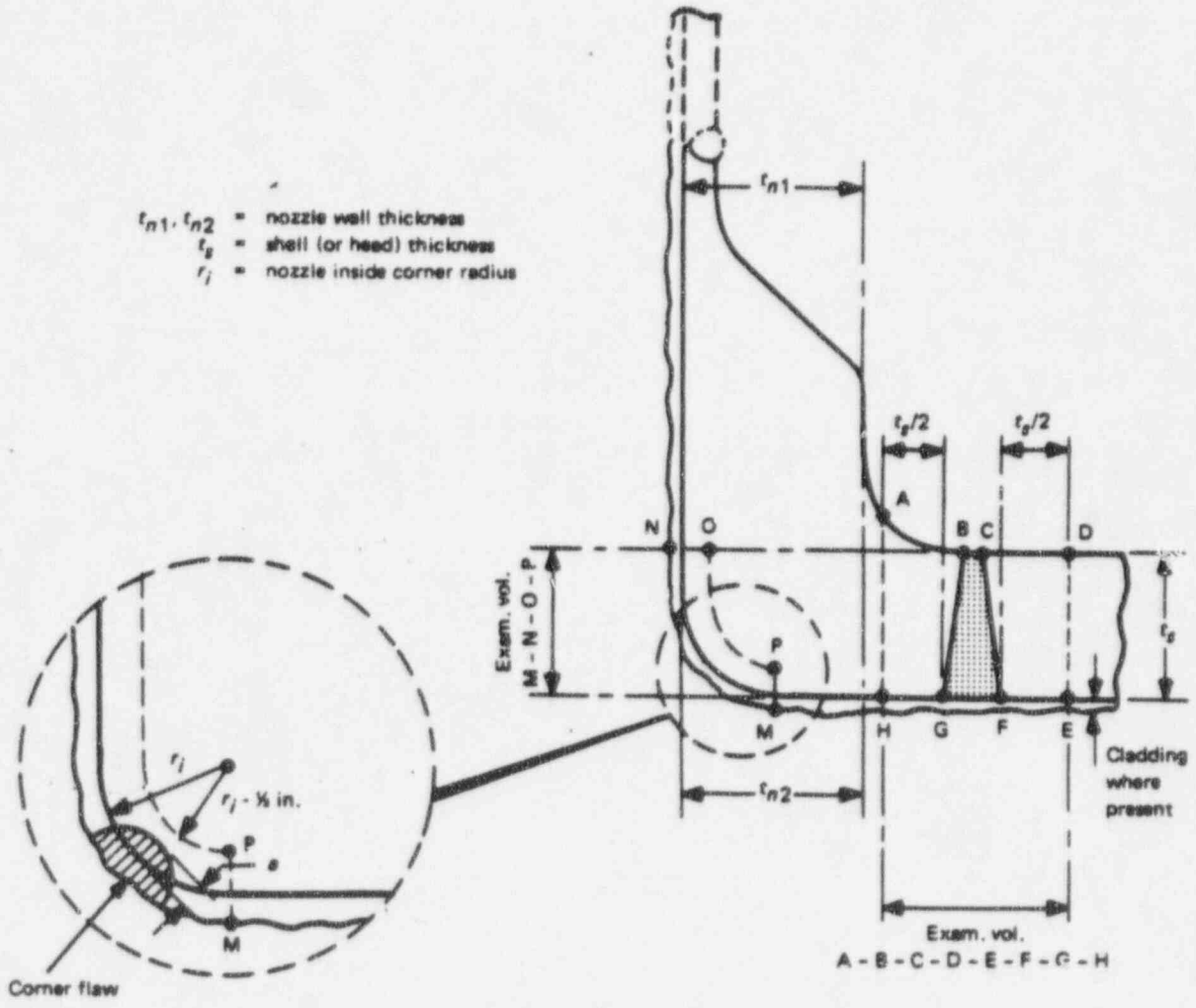

EXAMINATION REGION (Note (1))
Shell (or head) adjoining region
Attachment weld region
Nozzle cylinder region
Nozzle inside corner region

EXAMINATION VOLUME (Note (2))
C-D-E-F
B-C-F-G
A-B-G-H
M-N-O-P

FIGURE 1

GRAND GULF NUCLEAR STATION
UNIT 1

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INSERVICE INSPECTION
OF REACTOR PRESSURE VESSEL NOZZLE TO SHELL WELDS

Typical *Manual* Examination Scan Plots
Manual Scan Coverage, 0° Straight Beam
Manual Scan Coverage, 45° Angle Beam (P-Scan)
Manual Scan Coverage, 60° Angle Beam (P-Scan)

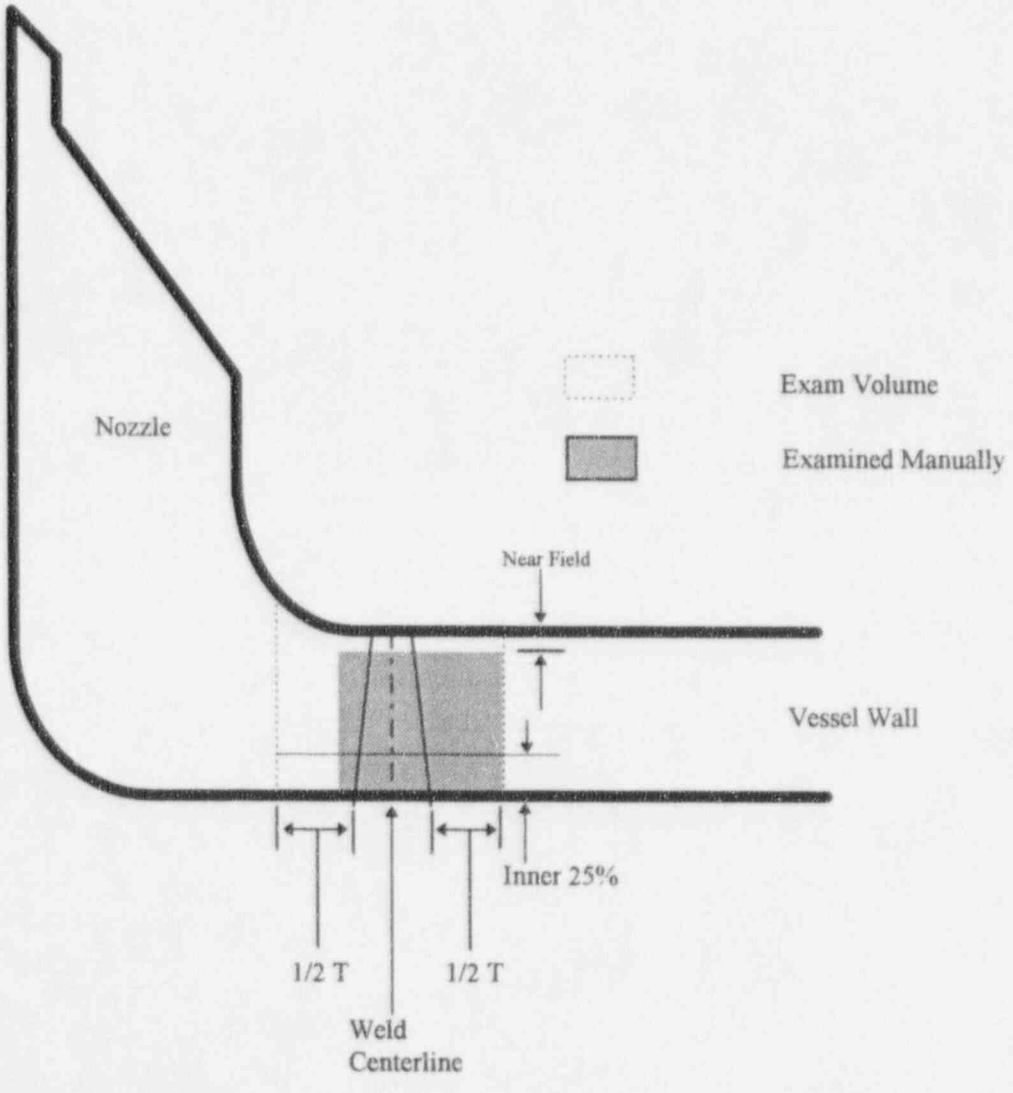

FIGURE 2

GRAND GULF NUCLEAR STATION
UNIT 1

RELIEF REQUEST I-00014, REVISION 1

INSERVICE INSPECTION
OF REACTOR PRESSURE VESSEL NOZZLE TO SHELL WELDS

Typical *Manual* Examination Scan Plots
Manual Scan Coverage, 45° Angle Beam (T-Scan)

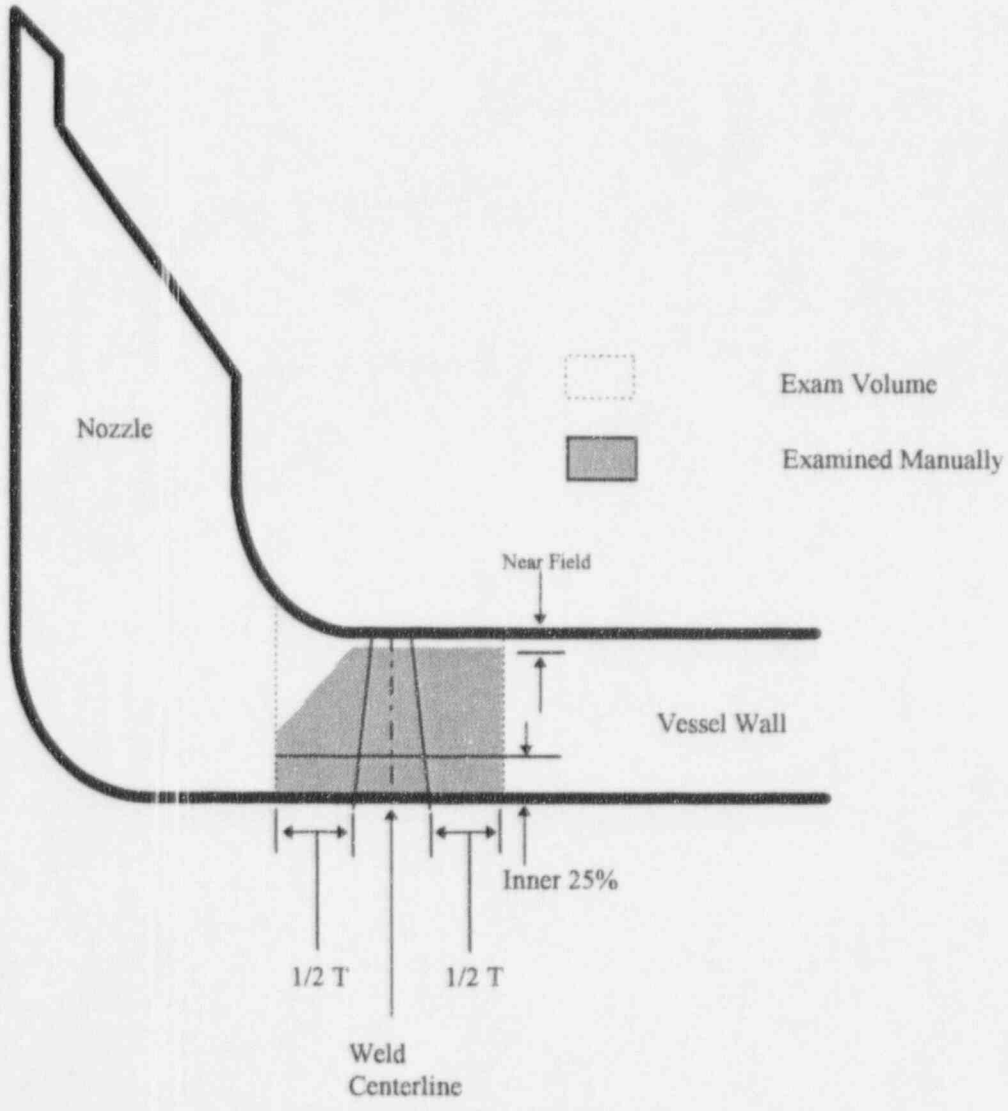

FIGURE 3

GRAND GULF NUCLEAR STATION
UNIT 1

RELIEF REQUEST I-00014, REVISION 1

INSERVICE INSPECTION
OF REACTOR PRESSURE VESSEL NOZZLE TO SHELL WELDS

Typical *Manual* Examination Scan Plots
Manual Scan Coverage, 60° Angle Beam (T-Scan)

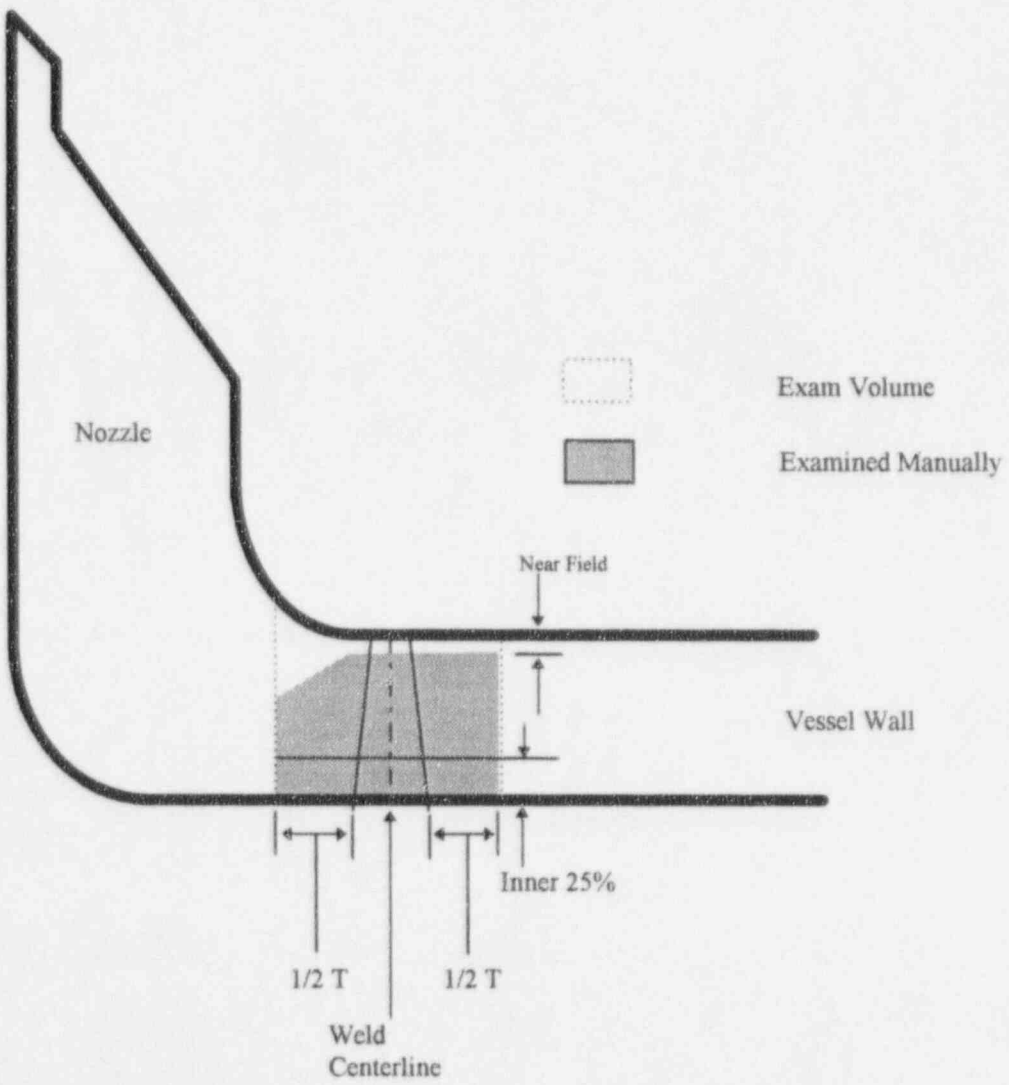

FIGURE 4

GRAND GULF NUCLEAR STATION
UNIT 1

RELIEF REQUEST I-00014, REVISION 1

INSERVICE INSPECTION
OF REACTOR PRESSURE VESSEL NOZZLE TO SHELL WELDS

Typical *Automated* Examination Scan Plots
Automated Scan Coverage, 0° Straight Beam

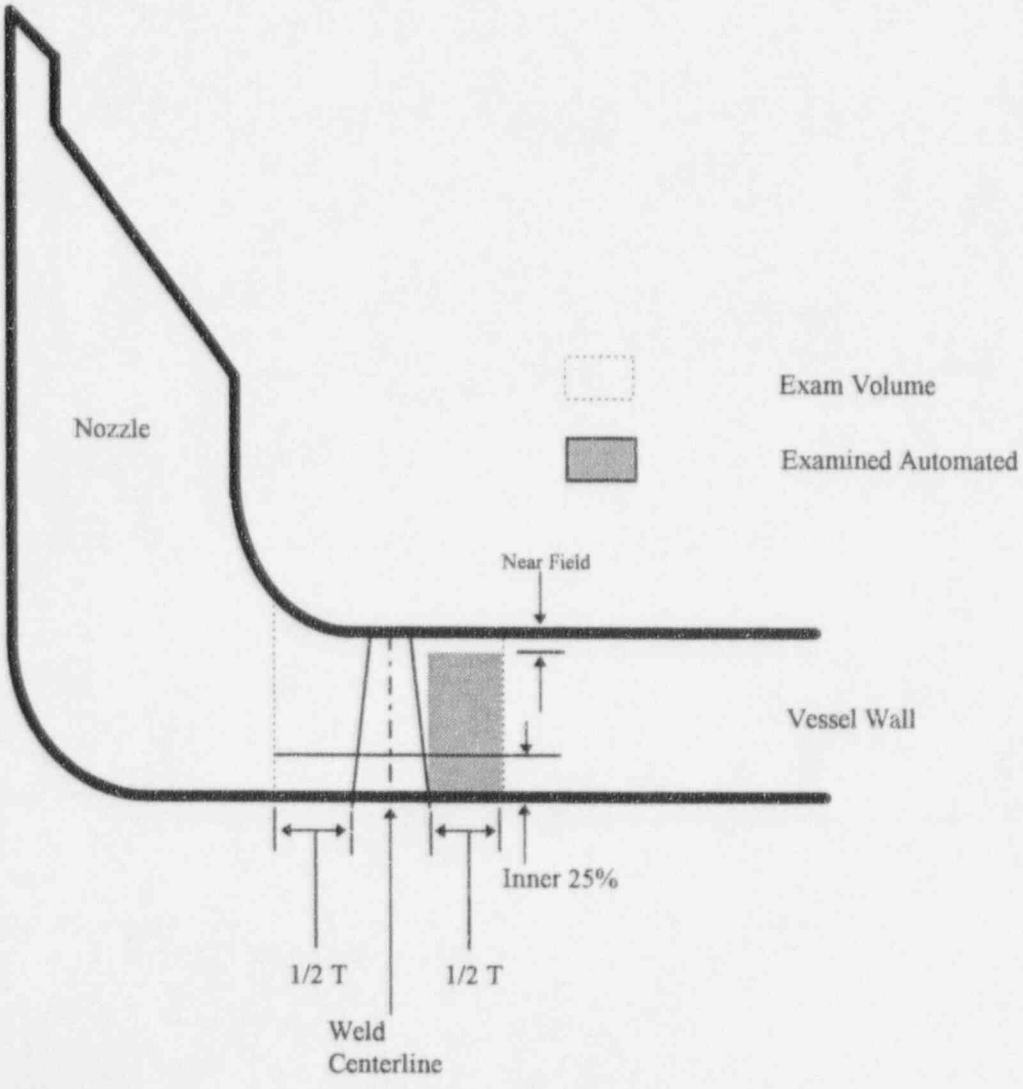

FIGURE 5

GRAND GULF NUCLEAR STATION
UNIT 1

RELIEF REQUEST I-00014, REVISION 1

INSERVICE INSPECTION
OF REACTOR PRESSURE VESSEL NOZZLE TO SHELL WELDS

Typical *Automated* Examination Scan Plots
Automated Scan Coverage, 45° Angle Beam (P-Scan)
Automated Scan Coverage, 60° Angle Beam (P-Scan)

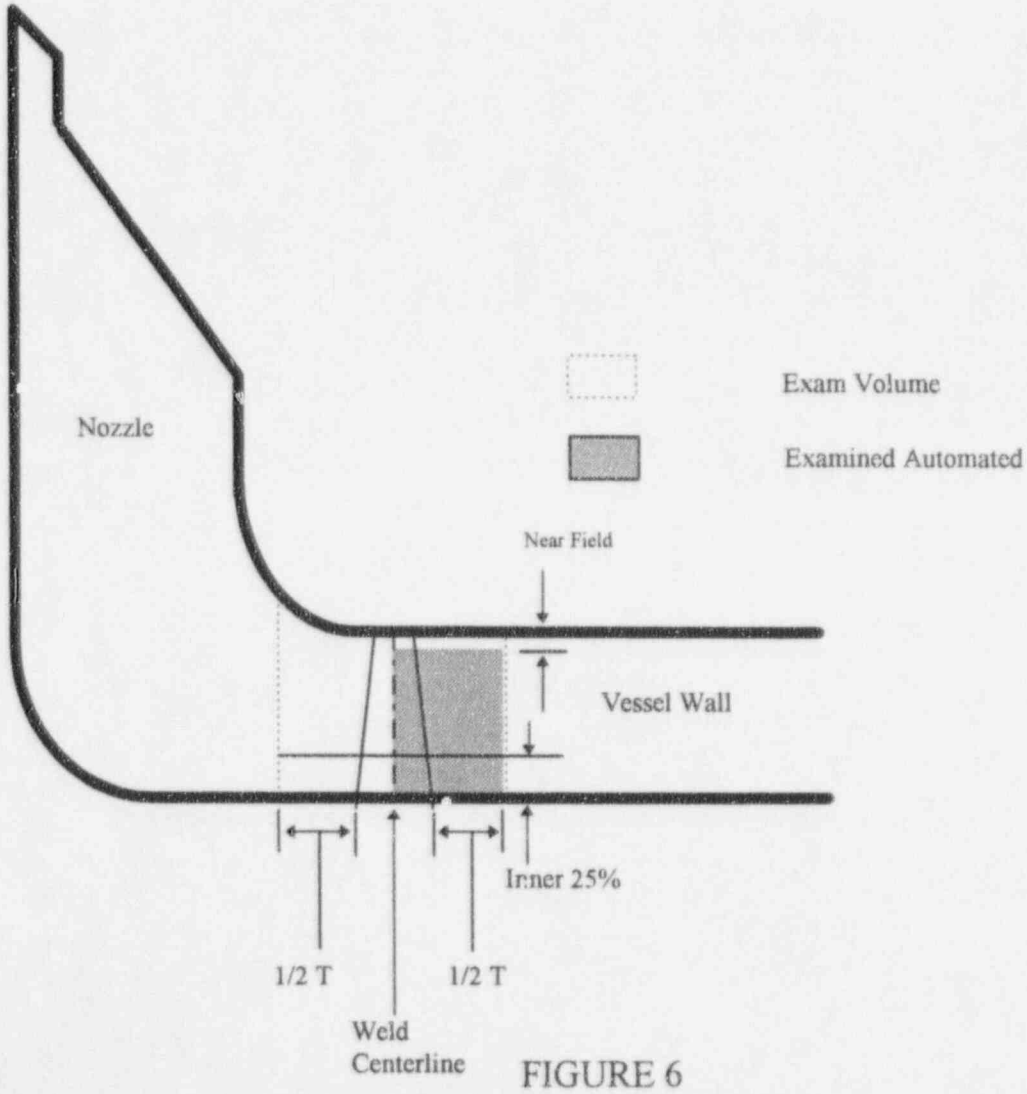

FIGURE 6

GRAND GULF NUCLEAR STATION
UNIT 1

RELIEF REQUEST I-00014, REVISION 1

INSERVICE INSPECTION
OF REACTOR PRESSURE VESSEL NOZZLE TO SHELL WELDS

Typical *Automated* Examination Scan Plots
Automated Scan Coverage, 45° Angle Beam (T-Scan)

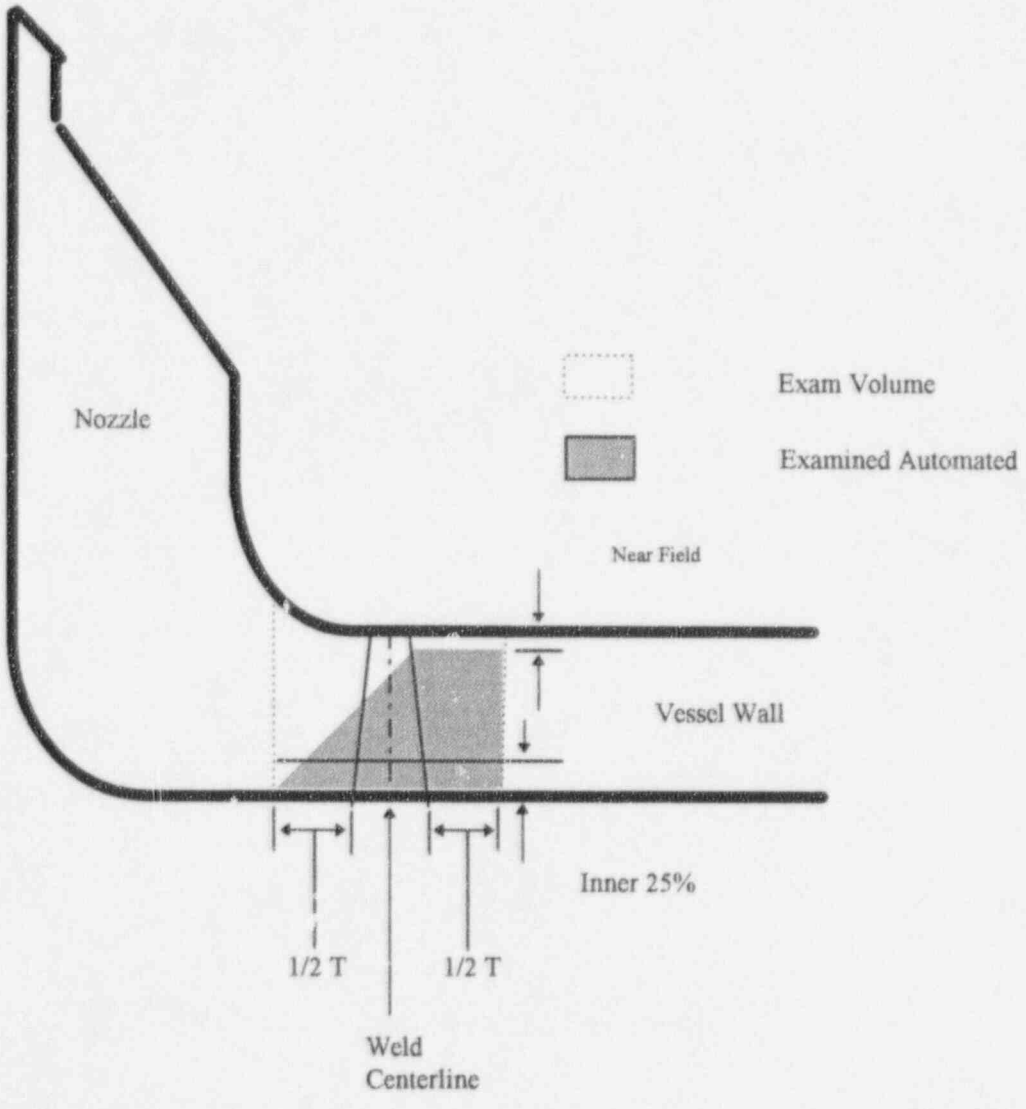

FIGURE 7

GRAND GULF NUCLEAR STATION
UNIT 1

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OF REACTOR PRESSURE VESSEL NOZZLE TO SHELL WELDS

Typical *Automated* Examination Scan Plots
Automated Scan Coverage, 60° Angle Beam (T-Scan)

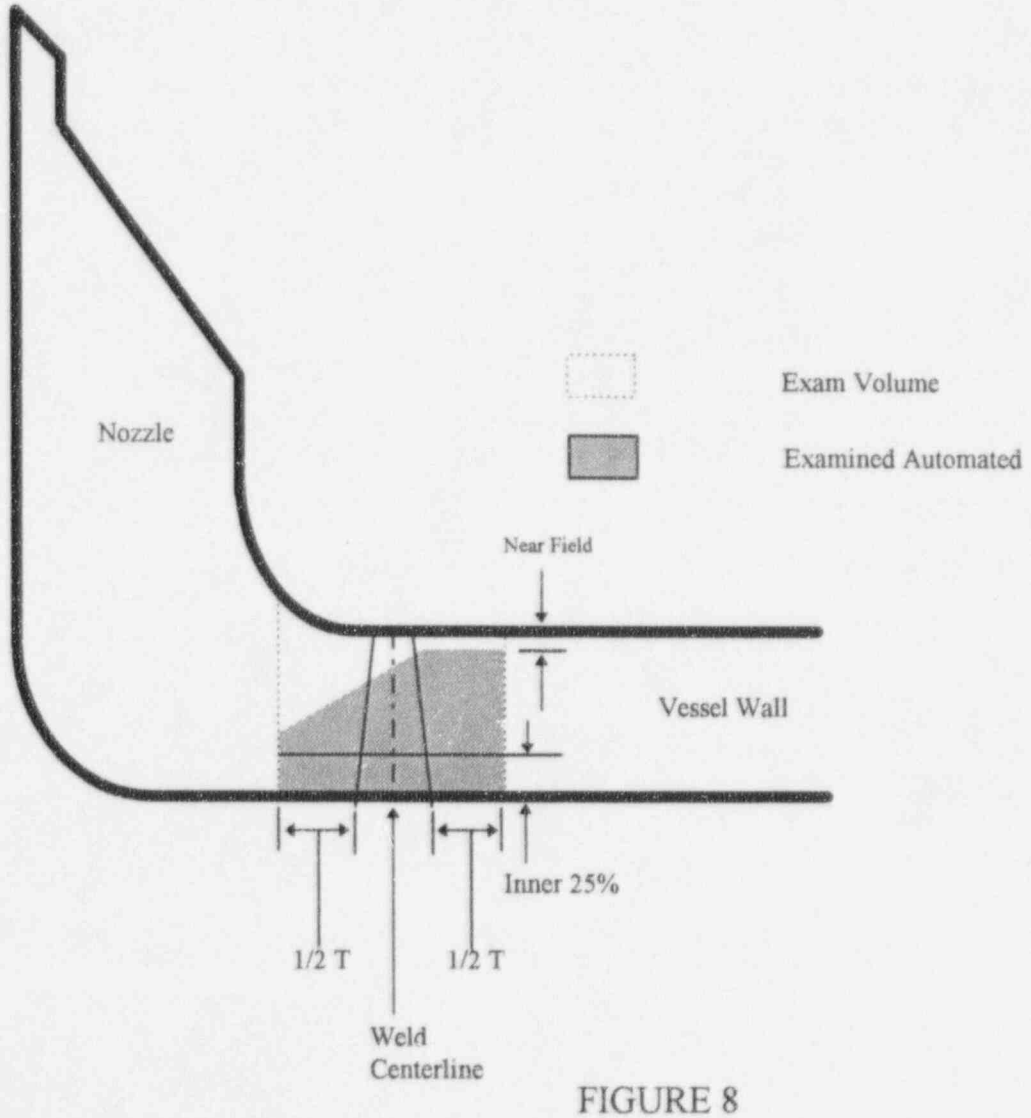

FIGURE 8