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Georgia Power
the southern electric system

August 25, 1995

Docket No. 50-366 HL-5019

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555

Edwin I. Hatch Nuclear Plant - Unit 2
Response to Request for Additional Information
Regarding Core Shroud Modification

Gentlemen:

By letter dated August 17, 1995, the Nuclear Regulatory Commission Staff (NRC) requested Georgia Power Company (GPC) to provide additional information regarding the Core Shroud Modification scheduled for installation during the Fall 1995 Unit 2 refueling outage. The enclosure provides GPC's response.

Please be advised that the response contains information considered proprietary by the General Electric Company (GE). In accordance with the provisions of 10 CFR 2.790, GPC requests that the proprietary information be withheld from public disclosure. The proprietary information has been so designated and the required affidavit is enclosed.

Should the NRC staff require additional information relative to these questions, GPC is available to meet with the appropriate staff to discuss the information provided.

Sincerely,

J. T. Beckham, Jr.

JKB/eb

Enclosures:
1. Response to Request for Additional Information Regarding Core Shroud Modification
2. General Electric Affidavit

(See next page for attachment.)

A001 / NRC PDR / 1 / Change Ltr Encl 1 w/out Prop

Georgia Power

Attachment: DRF B11-00617-20 - A Stress Corrosion Cracking Evaluation of XM-19 in the BWR Environment

cc: *Georgia Power Company*
Mr. H. L. Sumner, Jr., Nuclear Plant General Manager
NORMS

U. S. Nuclear Regulatory Commission, Washington, D. C.
Mr. K. Jabbour, Licensing Project Manager - Hatch

U. S. Nuclear Regulatory Commission, Region II
Mr. S. D. Ebneter, Regional Administrator
Mr. B. L. Holbrook, Senior Resident Inspector - Hatch

Enclosure 1

Edwin I. Hatch Nuclear Plant - Unit 2
Response to Request for Additional Information
Regarding Core Shroud Modification

By letter dated August 17, 1995, the Nuclear Regulatory Commission (NRC) staff requested Georgia Power Company (GPC) to provide additional information regarding the Core Shroud Modification scheduled for installation during the Fall 1995 Unit 2 refueling outage. The NRC questions and GPC's response to the twenty-five questions are provided below:

NRC Question No. 1:

The core shroud stabilizer design submittal (GPC-HL-4877) states that the repair is designed to accommodate uprated power conditions corresponding to 105% rated power (2588 MWt). Provide additional information to verify that transient pressure and core flow conditions due to the uprated power have been considered in the design.

GPC Response:

The pressure and core flow for transient conditions, as well as normal operational conditions, due to power uprate were considered in Unit 2 Shroud Repair evaluations including all structural, preload and systems analyses. The pressures are as identified in the Design Specification (GENE Specification 25A5718), section 4.3.5.1. They are incorporated into the loads in the Code Design Specification (GENE Specification 25A5717) for the Reactor Pressure Vessel (RPV).

NRC Question No. 2:

In Table 6-5 of the shroud repair hardware stress analysis (GENE-B11-00637-002), it is stated that the maximum postulated crack opening for the design-basis earthquake (DBE) combined with a main steam line break (MSLB) loss-of-coolant accident (LOCA) is 0.588 in.. Provide the calculations for determining the projected vertical gap for this and other design conditions which could potentially lead to the development of a gap at a shroud weld location. Discuss whether the separation of the core shroud could impose any loading on the Control Rod Drive (CRD) guide tubes that might inhibit their function when required to scram during a transient condition. Provide an evaluation of the CRD guide tubes to assure their structural integrity and that they remain functional.

GPC Response:

The postulated crack openings were calculated by subtracting the initial tie-rod/shroud interference responsible for producing the shroud compression from the operative tie-rod stretch. The guide tubes are only loaded when a crack below the core plate (H6B, H7 or H8) opens greater than 0.5 in.. For all combinations of assumed cracks and the design conditions, this condition never occurred.

Only in one instance is a crack calculated to open more than 0.5 in.. This was for a single crack at weld H4 under DBE + MSLB LOCA. Since this crack location is above the core plate, the guide tubes are not loaded. Therefore, the guide tubes are not loaded as a result of calculated weld crack openings and their structural integrity and functional configuration will not be affected.

NRC Question No. 3:

The maximum calculated gap along part of the shroud circumference during a DBE is 0.244 in. (GENE-B11-00637-002). Provide the calculations for the projected gap during the faulted event of a DBE combined with a Recirculation Line Break (RLB) LOCA.

GPC Response:

The crack opening from the DBE load (0.244 in.) and RLB LOCA load (0.025 in.) add up to 0.269 in., which is enveloped by the 0.588 in. opening under DBE + MSLB LOCA load. In other words, the DBE + MSLB LOCA is the bounding faulted event, which is addressed in GENE-B11-00637-002 and shown to meet the design criteria.

NRC Question No. 4:

There appears to be a typographical error on the last line of page 24 of the GE shroud repair and hardware stress analysis report (GENE-B11-00637-002). "DBE + Normal" should read "DBE + MS LOCA." Also, in line 9 on page 14 of the same report, shroud "stiffness KP" should read "shroud stiffness KS." Confirm if you agree or disagree with our correction.

GPC Response:

The typographical errors exist as described above. However, these errors have no significant impact on the analysis or results.

NRC Question No. 5:

Provide projected (transient and permanent) core shroud top guide and core plate lateral deflections resulting from any of the design conditions. Provide a comparison of these deflections with the allowable values to assure adequate CRD function. Also, provide the basis for the allowable deflections.

GPC Response:

The core shroud top guide and core plate lateral permanent deflections are all zero. The maximum transient deflections are from table 6 of the Shroud Repair Seismic Analysis Report (GENE-B11-00637-003). The allowable transient deflections are from section 4.2.3 of the Design Specification (GENE Specification 25A5718). These are summarized in the following table.

Load Combination	Top Guide Displacement Actual/Allowable (in.)	Core Plate Displacement Actual/Allowable (in.)
OBE + Normal	0.09 / -	0.16 / 0.75
DBE + Normal	0.15 / -	0.24 / 1.12
DBE + MS LOCA	0.23 / -	0.24 / 1.50

The allowable core plate displacements are taken from GE proprietary report, "Justification of Allowable Displacements of the Core Plate and Top Guide-Shroud Repair," GENE-771-44-0894, Revision 2, dated November 1994. This report was previously reviewed by the NRC staff. The top guide allowable transient displacements were not specifically developed since they are known to be larger than the core plate values, and quite large compared to the maximum calculated transient displacements which, as identified above, are small.

NRC Question No. 6:

Provide justification for using linear-elastic methods in analyzing the cracked shroud with the stabilizer assembly. The presence of postulated gaps at weld locations and the shroud/stabilizer/pressure vessel interfaces introduce non-linearities in the system which may not lead to conservative results on the basis of a linear elastic analysis.

GPC Response:

The primary source of the nonlinearities associated with the shroud repair hardware evaluation is the assumption of 360° through-wall cracks at the core shroud horizontal welds. Consequently, as discussed below and depending on the excitation level, the shroud itself may respond in a nonlinear manner during dynamic excitation. Also, the individual shroud repair hardware components (stabilizer springs and tie rods) remain linear in the range of the calculated seismic responses. This is based on actual load/displacement curves for the components. However, the primary structure rotational stiffness due to the tie rods is highly dependent on the location of the axis-of-rotation used to calculate the stiffness. The location of the axis-of-rotation continually changes depending on the level of the dynamic excitation. In addition, only horizontal seismic analyses are performed for the shroud repair hardware evaluation. Consequently, the nonlinearities in question are horizontal in nature and, in addition to the continually changing axis-of-rotation of the rotational spring, are due to gaps and mechanical interferences which develop at the weld crack interfaces during dynamic excitation. The gaps and mechanical interferences at the weld crack interfaces alter the shroud stiffness and may result in linear, bilinear, and trilinear stiffness characteristics in the horizontal primary structure model.

When a weld crack gap is closed, and assuming an adequate normal force at the weld crack interface to develop mechanical interference, the horizontal stiffness in the shroud is commensurate with a "pinned" or "hinged" condition at the weld crack interface. Under this condition, the shroud cannot transmit a moment through the weld crack interface; however, the primary structure behaves in a linear manner. The responses from the linear pinned analyses will bound the corresponding nonlinear responses which result when the weld crack interfaces between pinned and roller conditions vary with time.

When the weld crack gap is open and the dynamic excitation is not sufficient to close the gap, the only seismic load path into the portion of the primary structure model above the gap is through the shroud repair hardware springs. For this condition, the shroud horizontal stiffness is commensurate with a "roller" shroud connectivity condition at the weld crack interface. The shroud cannot transmit either shear or moment across the weld crack interface. Again the primary structure model behaves in a linear manner if the dynamic loading is below a level such that the gap does not close during excitation.

During actual dynamic excitation, the shroud connectivity condition at each weld crack will continually vary with time between a pinned and a roller condition. It then follows that the dynamic characteristics of the primary structure seismic model also vary with time depending on the actual weld crack conditions which continually fluctuate between being pinned or roller.

As indicated above, nonlinear behavior results if either: (1.) a gap is closed and there is not sufficient preload to prevent it from opening during dynamic excitation, or (2.) the gap is open and the dynamic loading is sufficient to close the gap during excitation. These two conditions can exist during actual dynamic excitation. Corresponding nonlinear analyses, with the gap and friction characteristics appropriately modeled, will result in significant changes in the frequency content of the calculated loads. However, performing linear dynamic analyses with the postulated weld cracks modeled both as hinges and as rollers and then bounding the peak seismic loads and displacements from the different linear analyses will bound the seismic demands for both the design of the repair hardware and the analysis of the core shroud. The maximum values for both the design of the repair hardware and evaluation of the core shroud are conservatively calculated from the linear primary structure seismic analyses corresponding to the bounding "pinned" and "roller" shroud connectivity configurations at the shroud weld crack interfaces. The bounding linear analyses also account for the controller values of the rotational stiffness due to the tie rods. It should also be noted that there is an additional source of conservatism in performing a linear analysis in that it allows resonant buildup of the response whereas nonlinear behavior would detune the cracked shroud with the repair hardware and not allow the level of resonant buildup calculated in a linear analysis. Also, in performing the linear analysis the input time histories were shifted to maximize the seismic responses.

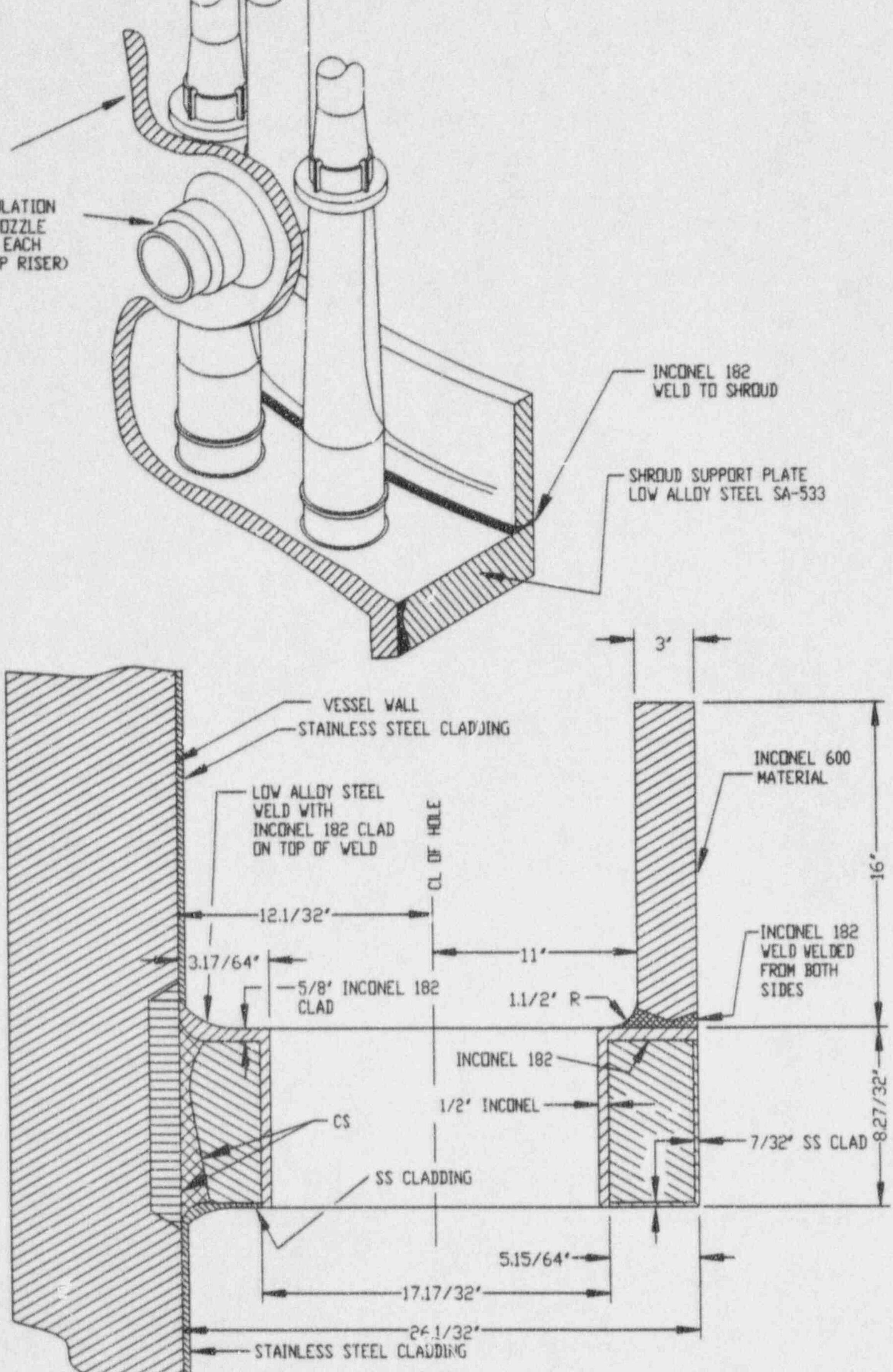
The objective of the shroud repair hardware seismic analysis is to demonstrate the seismic design adequacy of the repair hardware. Consequently, only bounding loads are required. Therefore, it is not required to obtain precise values for the nonbounding, nonlinear responses at each point in time.

NRC Questions No. 7:

Provide drawings showing the details of the shroud support plate and its attachment to the shroud. During a postulated faulted event of a DBE plus RLB LOCA, state the amount of lateral motion that is projected to occur at the core support plate. Indicate how control rod insertability is expected to be maintained during this accident.

GPC Response:

The following sketch (2-BN-6-2) provides the details of the shroud support plate. During a postulated faulted event of a DBE plus RLB LOCA, the maximum amount of transient lateral motion that is projected to occur at the core support plate is 0.24 in.. This is small compared to the allowable value of 1.50 in. for faulted events. Thus there is large margin for assuring control rod insertability.



DATE	3-30-92	PROJECT: E I HATCH UNIT 2	TITLE: SHROUD SUPPORT WELD PLATE DETAIL	
REV	1			
REFERENCE DRAWINGS: CE 11570; 844-001 REV 3; 841-001 REV 0; FDDR-HT2-081; FDDR-HT2-089; 842-002 REV 3	ITS REVIEW	ITS APPL	DRAWN BY: GS	SKETCH NUMBER: 2-BN-6-2

NRC Question No. 8:

In the Repair Hardware Stress Analysis (GENE-B11-00637-002), the calculated stresses for the thermal upset condition exceed the material yield stress for the shroud support plate and the repair upper support. Discuss the amount of preload that will result from the thermal upset condition due to yielding in these components. What is the resulting effect on the vertical gap calculations for the various design conditions.

GPC Response:

In the Repair Hardware Stress Analysis (GENE-B11-00637-002), Table 7-3 presents the stresses for the shroud support plate, and Table 8-3 presents the stresses for the repair upper support. For the shroud support plate, the maximum stress reported for the thermal upset condition is 25,770 psi with a yield stress of 42,200 psi. For the repair upper support, the maximum stress reported for the thermal upset condition is 41,550 psi with a yield stress of 92,000 psi. Thus, no yielding occurs in these components during a thermal upset event.

NRC Question No. 9:

Provide an analysis of the core spray piping which considers the Emergency and Faulted loading combinations of MSLB and RLB LOCA loads.

GPC Response:

The core spray line (CSL) is a run of 5 in. diameter pipe which conducts core spray flow from the RPV nozzle thermal sleeve to the shroud. The CSL does not provide significant restraint to the shroud; in fact, the CSL was specifically designed with flexibility to accommodate the relative thermal expansion of the shroud to the RPV. Shroud cracking has been shown to result in larger end-to-end seismic displacement (anchor movements) than considered in the original design. The larger end-to-end Operating Basis Earthquake (OBE) displacement for an assumed all welds cracked case was the subject of an analysis completed for another plant where the CSL design is similar to Unit 2's, and the end-to-end displacement for the other plant is larger. This analysis, using ASME Section III Subsection NB piping rules as a guide, demonstrated compliance with fatigue requirements for normal and upset events including ten cycles of OBE seismic. Since the primary plus secondary stress range (equation 10, NB-3653) exceeded 3 Sm, the simplified elastic-plastic method of NB-3653.6 was applied. The stress resulting from end-to-end CSL displacement for one cycle of steam line break LOCA plus DBE or 1/2 SME is classified as secondary and is therefore not required by Section III to be evaluated. However, as a functional check, it was shown that the maximum strain in the

CSL during this faulted event is less than 1 percent which is well below the minimum 25 percent ultimate strain for the 304 stainless steel piping material specification.

The displacements on the Unit 2 CSL are approximately 75 percent less than the CSL on the similar plant. This large reduction is due to the stiffer stabilizers utilized for Unit 2. The configuration is similar, and the piping is the same size and material. Since the previous analysis resulted in such a large margin to failure (less than 1 percent strain versus the maximum 25 percent ultimate strain) the acceptability of the Unit 2 CSL response is assured without further consideration.

NRC Question No. 10:

Provide the differential pressures at the core shroud head and the core plate for MSLB and RLB LOCA and the respective areas of the surfaces on which they act.

GPC Response:

The following table lists the differential pressures at the core shroud head and the core plate, and the respective areas of the surfaces on which they act. The RLB LOCA pressure differences were conservatively assumed to be the same as those during normal operation, since the pressure differences for the RLB LOCA are less than or equal to the normal pressure differences.

		Differential Pressure, psi		
	Area, in.^{2}	normal operation	MSLB LOCA	RLB LOCA
core plate assembly	10,954	19.9	23.5	19.9
core shroud head	21,679	8.5	30.5	8.5

NRC Question No. 11:

The postulated combined failure of welds H6B and H7 is likely to introduce flexibility in the vertical shroud stiffness in a manner similar to the postulated combined failure of H2 and H3 welds. Provide an analysis of the projected separation at the H6B weld location with postulated through-wall 360° failures of the welds at the H2, H3, H6B and H7 locations.

GPC Response:

The shroud section between welds H6B and H7 has a very steep cone angle with very large stiffness (approximately an order of magnitude) as opposed to the plate between the H2 and H3 welds. Therefore, the effect of a crack opening at H6B and H7 welds following preload is insignificant compared to the effect of cracks at H2 and H3 welds. Given the large preloads shown in Table 6-3 of the Stress Report (GENE-B11-00637-002), the effect of a crack opening at H6B and H7 is negligible.

NRC Question No. 12:

Provide a summary of the ANSYS output which led to the results shown as shaded areas in Figure 7-2, Shroud Repair Hardware Analysis Report (GENE-B11-00637-002) for the Shroud Support Plate analysis.

GPC Response:

Figure 7-2 in the report shows the analysis model rather than analysis results. Some areas of the model appear shaded because of the larger node and element density in these regions. Expanded views of the model are shown in the attached Figure Q12-1.

Typical stress distributions in the plate are shown in attached Figure Q12-2a. The stresses are localized near the points of load application and fall off rapidly in the plane of the plate as well as in the thickness direction as shown in the enlarged plot in attached Figure Q12-2b.

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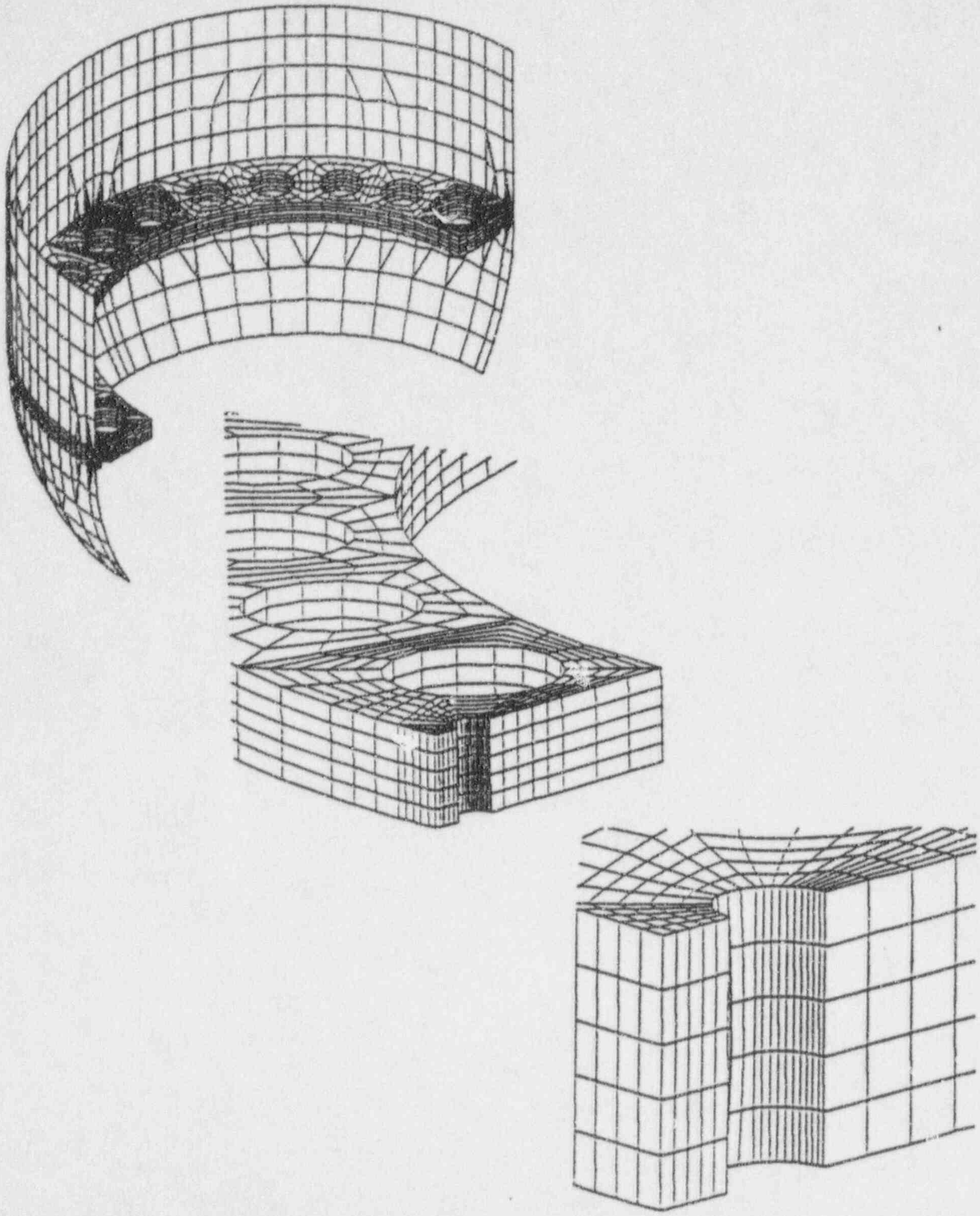

FIGURE Q12-1

Details of the Shroud Support Plate Analysis Model

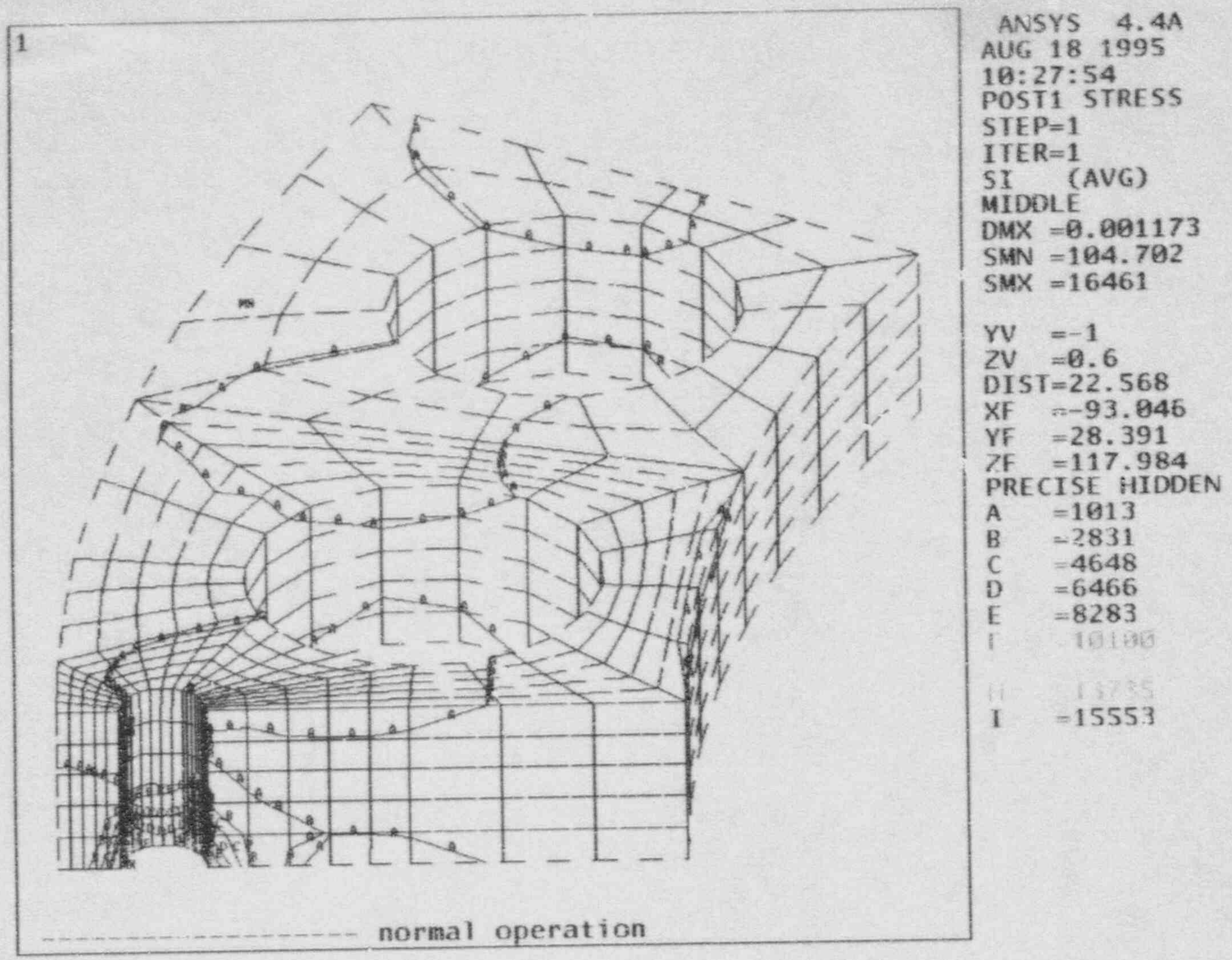

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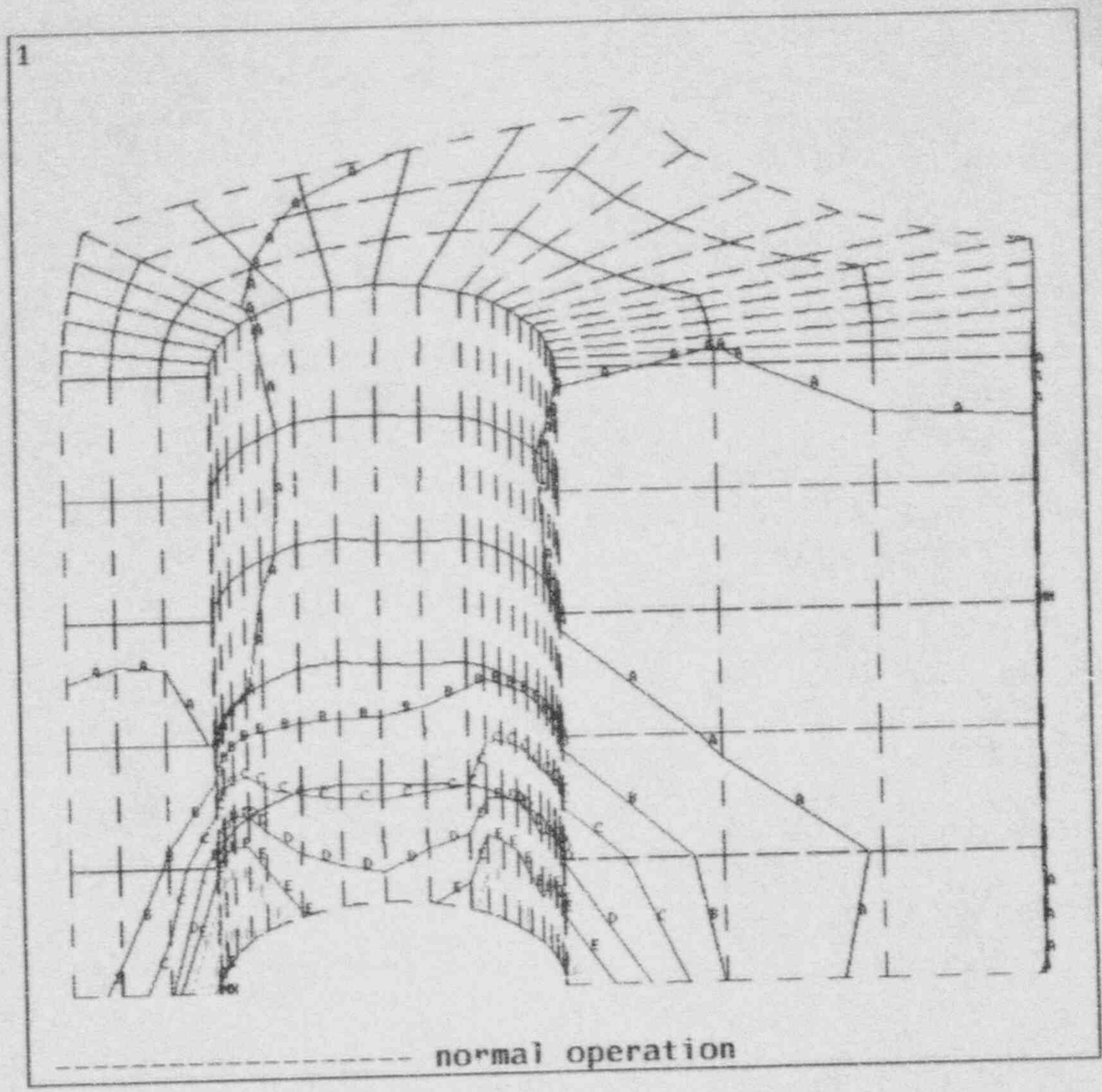
FIGURE Q12-2a



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AUG 18 1995
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ITER=1
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SMN =458.224
SMX =16461

YV =-1
ZV =0.6
DIST=6.438
XF =-106.544
YF =3.07
ZF =117.984
PRECISE HIDDEN
A =1347
B =3125
C =4904
D =6682
E =8460
F 10238
H 13794
I =15572

PRODUCE STRESS PLOT, LABEL= SI AT MIDDLE KAVG= 0
POST1 -INP=

FIGURE Q12-2b

NRC Question No. 13:

BWRVIP has issued the following documents to provide guidelines for visual examination (VT) and ultrasonic examination (UT) of core shrouds: (a) Standards for Visual Inspection of Core Shrouds and (b) Core Shroud NDE Uncertainty & Procedure Standard. The guidelines in these documents should be followed in the examination of the core shroud and repair assemblies. If you do not intend to reference the subject BWRVIP documents in your examination specifications or procedures, identify all the exceptions you are going to take against the referenced BWRVIP guidelines.

GPC Response:

On August 1, 1995, the Boiling Water Reactor Vessel Internals Project (BWRVIP) inspection subcommittee issued the Draft version of "Reactor Pressure Vessel & Internals Examination Guidelines," Rev. 0 for comments. This document incorporates and supersedes the above referenced documents. This new BWRVIP document is anticipated to be issued formally by the end of August and sent to the NRC as part of the reply to the Safety Evaluation Report on the original BWRVIP Uncertainty Standard.

Shroud examination procedures, both UT and VT, will reference this new document.

NRC Question No. 14:

When detailed heat treatment records (time, temperature and cooling rate) are not available, discuss the kind of testing that you do perform to ensure that the fabricated alloy X-750 components are properly heat treated.

GPC Response:

Detailed heat treatment records are available for all Unit 2 shroud repair components made of X-750 material. Furthermore, tensile tests are performed to assure the proper strength and ductility are achieved. Both longitudinal and transverse specimens are tested at both 70 and 550°F. Section 3.2.1 of the Fabrication Specification (GENE Specification 25A5719) identifies the X-750 requirements.

NRC Question No. 15:

If the re-solution annealing process was applied to any repair components after final fabrication, then identify those components; describe the process; provide details regarding how this process was qualified and controlled; and discuss the results of your metallurgical evaluation of the machined parts after re-solution annealing such as its effect on the material hardness, grain sizes, surface oxidation and the state of sensitization.

GPC Response:

No Unit 2 Shroud Repair Components are re-solution annealed.

NRC Question No. 16:

In your pre-modification inspection plan, there is no discussion of the inspection of the segment welds in the core shroud support rings and the core support plate. Provide your reasons for not inspecting those welds. Also, justify for the very limited inspection scope for weld H9 as proposed in your inspection plan.

GPC Response:

The Unit 2 core shroud support rings, which consist of the top guide support ring and the core support ring, are forgings manufactured to the requirements of ASME SA-182, Grade F304L. No segment welds are shown for these pieces on the Sun Shipbuilding fabrication drawings. However, even in the event that welding was utilized in the manufacturing process, the rings were solution annealed at 1960°F for 4 hours followed by water quenching to below 800°F in accordance with General Electric Purchase Specification 21A3319, Standard Requirements for Core Structure. This would eliminate any concern for intergranular stress corrosion cracking (IGSCC) in these parts. Since there are no identifiable segment welds on our design record documents, and the ring material is resistant to IGSCC, no inspection is necessary.

The core shroud support plate is fabricated from 8 in. thick low-allow steel plate meeting the requirements of ASME SA-533, Grade B, Class 1 and contains 4 segment welds located at 90° intervals. The plate is clad on the top surface with approximately 5/8 in. of Inconel Alloy 82 weld metal and on the bottom surface with approximately 7/32 in. of stainless steel weld metal. Also, the H9 weld joins the low-alloy steel core shroud support plate to the low-alloy steel reactor vessel shell and was postweld heat treated with the reactor vessel. These materials are not considered to be susceptible to IGSCC; therefore, it was determined that no inspection of the segment welds of H9 weld is necessary. The cladding also renders the segment welds inaccessible for visual examination. As sound engineering practice, GPC decided to visually inspect the accessible portions of the H9 weld adjacent to the repair installation location prior to performing the modification.

NRC Question No. 17:

The acceptable yield strength of XM-19 material is limited to 90 ksi. Discuss if this upper limit of the yield strength for XM-19 material is identified in your procurement specification.

GPC Response:

The upper limit of the yield strength is not specified in the procurement specification. Section 3.2.3 of the Fabrication Specification (GENE Specification 25A5719) identifies the XM-19 requirements. All XM-19 material is tested for yield strength. The maximum actual test value for the Unit 2 Shroud Repair tie rods is 64.8 ksi. The tie rods are the only Unit 2 Shroud Repair component made of XM-19 material.

NRC Question No. 18:

GE has referenced the good service experience of CRD components (pistons and index tubes) made of XM-19 material in BWR 6 and some BWR 4/5 plants to support the use of XM-19 material for tie rod application in core shroud repair. However, it is questionable that the good service experience in nitrided CRD components would ensure similar service experience in the tie rod application, because the material's susceptibility to IGSCC varies with its metallurgical conditions (heat treatment), surface condition (cold work and nitriding treatment), stress condition (applied stresses and residual stresses), component geometry (crevice and stress concentration) and environment (local ECP and conductivity). These conditions could be quite different between the two applications (CRD versus tie rod). Therefore, in view of the very limited service experience of XM-19 material in bolting application in the BWR environment and the concern that the critical areas of the tie rods are not accessible for in-service inspection, the staff recommends that an accelerated stress corrosion testing of a mock-up simulating the XM-19 tie rod threaded joint in a BWR environment should be performed to ensure there is no development of unexpected degradation.

GPC Response:

In addition to the testing discussed in the previously submitted document titled "GE Responses to NRC Questions for Unit 2" (GENE-B11-00637-006) and referred to in this question, additional testing on XM-19 has been performed. This additional testing is discussed in the attached GE proprietary report "A Stress Corrosion Cracking Evaluation of XM-19 in the BWR Environment," dated June 15, 1995. The positive laboratory and long term in-reactor IGSCC and, albeit, limited irradiated assisted stress corrosion cracking (IASCC) test results suggest that XM-19 appears to be an excellent alternate BWR structural material where high strength and high corrosion resistance are required. The sluggish kinetics of XM-19's sensitization reaction allows XM-19 to be used in the water quenched or air cooled condition with no impact on IGSCC performance.

NRC Question No. 19:

Discuss the characteristics of thread lubricant D50YP5B.

GPC Response:

The D50YP5B lubricant contains finely powdered nickel and carbon graphite in a light petroleum grease, with lithium or calcium soap thickener. It is ordered in accordance with GENE Specification D50YP5B. Chemistry controls are specified to assure compatibility with the reactor materials and environment. The applicable specifications for this lubricant limit the following elements known to promote intergranular stress corrosion crackling of stainless steel and high-nickel alloys:

- The maximum allowable level of halogens, when both sulfur and nitrates are less than 1 ppm, is 450 ppm.

- The maximum allowable level of sulfur, when both halogens and nitrates are less than 1 ppm, is 630 ppm.

- The maximum allowable level of nitrates, when both total halogens and total sulfur are less than 1 ppm, is 820 ppm.

- Allowable combined levels of halogens, sulfur and nitrates are limited by the following formula. (ppm Halogens)/35.453 + (ppm Sulfur)/48.096 + (ppm Nitrates)/ 62.004<13.2

This lubricant is typically used on RPV studs and other invessel bolting.

NRC Question No. 20:

Discuss the acceptance criteria for the metallography and microhardness tests used to verify that the component surface condition after final machining has very shallow cold work depth.

GPC Response:

Microhardness examinations were performed on each type of material subject to milling and turning operations followed by polishing, in their as-machined condition, to evaluate the extent of cold work. Polishing is performed to assure the removal of any smeared type surface layer, with excellent results which indicate the materials are acceptable from a hardness standpoint in their as-machined condition. Thus, the machining processes used for the Unit 2 shroud repair are qualified from a hardness standpoint.

The effectiveness of the polishing process for 316 Stainless Steel is evidenced by the following results (Knoop 25g):

Heat No.	**Core**	**.001 in.**	**.002 in.**	**.003 in.**
C30397	KHN 178 (RB 85)	KHN 127 (RB 64)	KHN 161 (RB 79)	KHN 174 (RB 83)
796WNA	KHN 156 (RB 77)	KHN 156 (RB 77)	KHN 165 (RB 80)	KHN 158 (RB 78)

No featureless region and twinned region were observed.

For both XM-19 and X-750, there is no evidence that surface cold working results in any adverse consequences. However, these materials were evaluated.

For XM-19, the result (Knoop 25g), shown in the table below were obtained. The data represent a section of XM-19 bar stock machined with 5-pitch stub acme threads, in the as-machined condition.

Depth (mils)	Raw KHN	Corrected KHN	Rockwell
0.6	382	357	c36
1.2	350	325	c32
1.8	315	290	c27
2.4	299	274	c24
3.0	297	272	c24
3.6	284	259	c22
4.2	289	264	c23
4.8	256	231	b96
5.4	266	241	b97.5
6.0	256	231	b96
6.6	254	229	b95.5
Deep	251	226	b95

Although there is a measurable gradient in hardness from the surface down, it is very slight and considered to be innocuous. Since GE limits the maximum bulk hardness of XM-19 bar stock to Rc 30 and ASTM A479 does not require hardness measurements at all, this material is acceptable from a hardness standpoint in its as-machined condition. The microscopic appearance of the surface and adjacent grains does not show any smeared metal or other distress.

The results (Knoop 100g) for X-750 are shown below. One sample was taken from a threaded stud which was machined, polished, and age hardened. Three samples were taken from another part subject to various machining operations which were first age hardened and then machined and polished.

		Rockwell C		
Depth (mils)	Stud Thread	Milled Flat	Outer Radius	Inner Hole
0.8	38	37.5	34.5	32
1.8	36	38	37	33
2.8	37	35	37	36
3.8	38	35.5	32	37
4.8	36	38	32	35
5.8	35.5	38.5	33.5	36
6.8	35.5	38	34	37.5
7.8	36	36	34	37
8.8	36.5	36.5	32.5	33.5

Photomicrographs do not show any altered or transformed metallurgical structures at the machined surfaces. There were no smeared or severely deformed amorphous surface layer.

NRC Question No. 21:

Discuss if pickling or exposure to any acid environment is permitted during the manufacturing of the repair components. If permitted, discuss the required testing for quality control of the pickled surface condition.

GPC Response:

No pickling is used for any Unit 2 Shroud Repair components.

The only Unit 2 Shroud Repair parts which are exposed to an acid environment are the 0.188 and 0.500 in. diameter stainless steel pins used to lock threaded connections by insertion in holes drilled at assembly. The electrolyzing process discussed in the response to Question No. 22 below includes an acid environment, but is clearly not a pickling type process.

NRC Question No. 22:

Discuss the electrolyzing process. Identify the components that will be subject to the application of the electrolyzing process. Also, describe how this process was qualified and its controlling parameters established. Discuss the required quality control testing to ensure that the plating has correct thickness and that the surface condition is acceptable (no surface defect in the plating and pitting in the base metal).

GPC Response:

Electrolyzing is an electrolytic chrome plating applied by a proprietary process of the Electrolyzing Corp. It is specified because of its precise control of uniformity and thickness. The only Unit 2 Shroud Repair parts which are plated are 0.188 and 0.500 in. diameter stainless steel pins used to lock threaded connections by insertion in holes drilled at assembly. The parts are plated to facilitate insertion. The process is performed to GE Specification P16BYP3A which includes qualification testing. The plated parts are visually inspected to assure they are free of pits, flaking, spalling, and chipping. The process is qualified by demonstrating these defects are not evident when a bend test specimen is picked with a sharp metal probe. Since plating is used simply to facilitate insertion, the thickness is not critical.

NRC Question No. 23:

If the credit for the fillet or any circumferential welds in the core shroud is taken in the design of the proposed repair to maintain the required preload, please discuss in detail and provide the justification regarding the measures you plan to take, such as inspection, to ensure the welds are and remain in the condition assumed in the analyses.

GPC Response:

No credit is taken for the fillet or any circumferential welds in the core shroud in the design of the proposed repair to maintain preload. As identified in Table 6-3 of the Shroud and Repair Hardware Stress Analysis (GENE-B11-00637-002), even if no credit is taken for the fillet weld, sufficient preload is maintained (59.4 kips) to assure that crack separation does not occur during normal operation.

NRC Question No. 24:

In the Shroud Stabilizer Hardware document, 25A5718 Rev. 0, Section 4.3.5.1, it states that the pressure difference during a LOCA is greater at the shroud head than at the core plate. Please state which LOCA event, MSLB or RLB, and explain why the pressure difference is higher at the shroud head during this event.

GPC Response:

The core plate and shroud head LOCA pressure differences in the referenced document correspond to the MSLB LOCA event. Core plate and shroud head pressure differences during an RLB LOCA are the same or lower than the normal condition values, and for this condition, the normal pressure values are conservatively assumed for all shroud repair evaluations.

The differential pressure across the core plate is greater than the differential pressure across the shroud head during normal operation. However, the increase in differential pressure across the shroud head is greater than that for the core plate during an MSLB LOCA event. During an MSLB LOCA event, the reactor pressure dome is depressurized rapidly, resulting in a large pressure difference across the shroud and shroud head. The increase in core plate differential pressure is the result of a relatively small increase in flow from the lower plenum into the core.

NRC Question No. 25:

In the Core Shroud Stabilizer Design Submittal, dated July 3, 1995, and in GE Responses to NRC Questions for Unit 2 Shroud Repair, GENE-B11-00637-006, Rev. 0, the flow characteristics of the downcomer with the four stabilizers installed were analyzed. In order to compare this flow area analysis with that of other projects, please provide the analysis with respect to pre-repair net flow area and post-repair net flow area. Discuss the increase in pressure drop through the downcomer due to reduction in flow area and its effect on the recirculation flow of the reactor.

GPC Response:

The closest distance between the jet pump suction nozzle inlet and the 3.75 in. diameter stabilizer tie rod is 5.7 in. At this distance, the predominately downward flow distribution near the jet pump nozzle will not be significantly affected.

The smallest vessel-to-shroud annulus plan area (downcomer flow area) is at the shroud head flange elevation. This flow area, based on the as-built vessel diameter and the items which block this annulus are summarized in the table below. The additional blockage at this elevation due to the shroud repair upper supports, is about 6 percent of the pre-repair minimum downcomer area. This blockage only applies to the short vertical distance corresponding to the shroud head lugs.

A second elevation having a less restrictive net flow area was also considered. This area is located at the upper stabilizers which are adjacent to the top guide wedges. Based on the as-built vessel diameter, this flow area and the items which block this annulus are summarized in the table below. The net flow area at this elevation, with the inclusion of blockage introduced by the shroud repair, is about 3 percent less than the pre-repair minimum downcomer area. This blockage applies only over the 5 in. height of the upper stabilizers. The additional horizontal flow blockage from shroud stabilizer hardware at other elevations in the shroud-to-vessel annulus will be less than this area. The impact of the additional flow blockage on the recirculation system loop hydraulic resistance, loop pressure drop, and coolant flow rate is estimated to be negligible.

Shroud Head Flange Elevation	
Gross annular area (220 in. vessel ID and 189.5 in. shroud OD)	9809. $in.^2$
36 - 3.75 x 3.88 in. shroud head bolts and lug sets	523. $in.^2$
4 - 7.25 in. OD core spray line riser couplings	165. $in.^2$
2 - 13.25 x 8.00 guide rod brackets (on shroud)	212. $in.^2$
Net annulus flow area before shroud repair	8909. $in.^2$
4 - shroud repair upper supports	540. $in.^2$
Post-repair net annulus flow area	8369. $in.^2$
Upper Stabilizer Elevation	
Gross annular area (220 in. vessel ID and 189.5 in. shroud OD)	9809. $in.^2$
4 - 7.25 in. OD core spray line riser couplings	165. $in.^2$
Net annulus flow area before shroud repair	9644. $in.^2$
4 - shroud repair upper supports and stabilizers assemblies	1036. $in.^2$
Post-repair net annulus flow area	8508. $in.^2$

Many system performance calculations were originally based on the 218 in. minimum specified RPV inner diameter. The additional flow area using the as-built 220 in. diameter, as opposed to the minimum 218 in. is 688 $in.^2$ which is greater than the 540 $in.^2$ blocked by the four shroud repair upper supports at the minimum net annulus flow area elevation. Thus, most previous flow calculations are still conservative with respect to flow area and velocity.

During a recirculation suction line break there may be a significant horizontal flow component in the lower vessel annulus. The four lower stabilizer springs are each located 45° from the recirculation outlet nozzle. The vertically oriented flow blockage area of the lower spring assembly is shown in Figure Q25-1. By inspection the net vertical flow area at the lower stabilizer spring locations is significantly greater than the net area at each of the 20 jet pump diffusers. Thus, the blockage effect of the lower springs will have an insignificant effect on recirculation line break blowdown calculations. Hence, emergency core cooling system performance is not impacted as a result of the flow blockage associated with the stabilizer mechanisms.

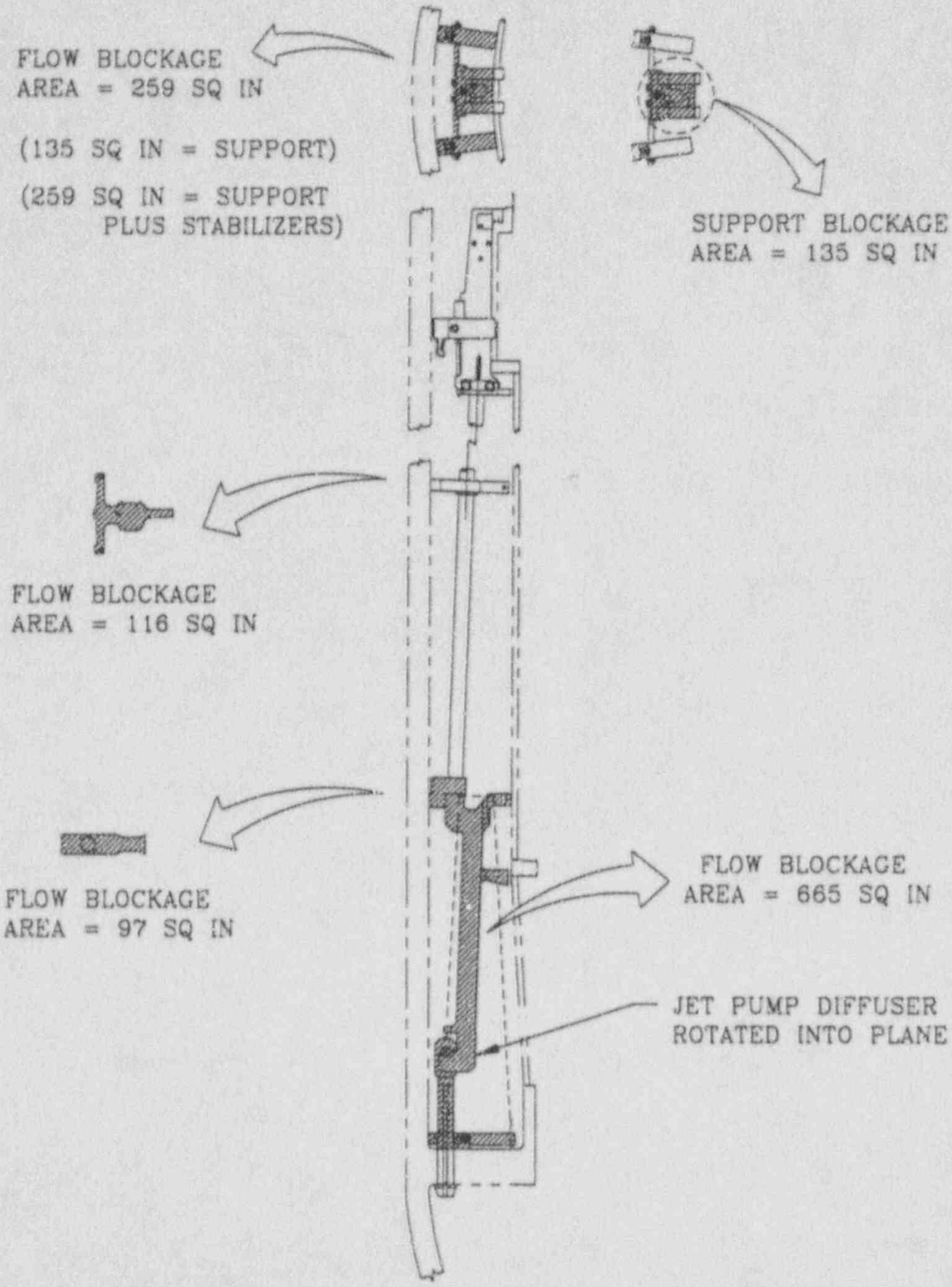
FLOW BLOCKAGE
AREA = 259 SQ IN
(135 SQ IN = SUPPORT)
(259 SQ IN = SUPPORT
PLUS STABILIZERS)
SUPPORT BLOCKAGE
AREA = 135 SQ IN
FLOW BLOCKAGE
AREA = 116 SQ IN
FLOW BLOCKAGE
AREA = 97 SQ IN
FLOW BLOCKAGE
AREA = 665 SQ IN
JET PUMP DIFFUSER
ROTATED INTO PLANE

Figure Q25-1

ENCLOSURE 2

GENERAL ELECTRIC AFFIDAVIT

General Electric Company

AFFIDAVIT

I, George B. Stramback, being duly sworn, depose and state as follows:

(1) I am Project Manager, Licensing Services, General Electric Company ("GE") and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in the GE proprietary report DRF B11-00617-20, *A Stress Corrosion Cracking Evaluation of XM-19 in the BWR Environment*, (GE Company Proprietary), dated June 15, 1995. The proprietary information is delineated by bars marked in the margin adjacent to the specific material.

(3) In making this application for withholding of proprietary information of which it is the owner, GE relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), 2.790(a)(4), and 2.790(d)(1) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information", and some portions also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals cost or price information, production capacities, budget levels, or commercial strategies of General Electric, its customers, or its suppliers;

d. Information which reveals aspects of past, present, or future General Electric customer-funded development plans and programs, of potential commercial value to General Electric;

e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in both paragraphs (4)a. and (4)b., above.

(5) The information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GE, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GE, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within GE is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his delegate), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GE are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains detailed results and analysis of material performance from plant environment exposure and experimentation to qualify XM-19 for application in the BWR environment. The qualification of this material has resulted in extensive design changes for application and use of this material in many BWR components. The qualification and design application of this material to both new and existing BWRs was at a significant cost to GE, on the order of several million dollars.

The development of the evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GE asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GE's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GE's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GE.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GE's competitive advantage will be lost if its competitors are able to use the results of the GE experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GE would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GE of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

STATE OF CALIFORNIA)
) ss:
COUNTY OF SANTA CLARA)

George B. Stramback, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at San Jose, California, this 29th day of June 1995.

George B. Stramback
General Electric Company

Subscribed and sworn before me this 29th day of June 1995.

Notary Public, State of California

JULIE A. CURTS
COMM. # 974657
Notary Public — California
SANTA CLARA COUNTY
My Comm. Expires SEP 30, 1996