Evaluation Report
October 25, 1995

Evaluation of the Discrepancy in the RPV Internals Seismic Analysis Dresden Units 2 and 3 and Quad Cities Units 1 and 2

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1.0 Background Information and Introduction

The original General Electric (GE) design basis seismic analysis of the Dresden and Quad Cities Reactor Pressure Vessel (RPV) Internals were performed in the late nineteen sixties and early nineteen seventies using a primary structure seismic model (see References 1 and 2). These models included the Turbine and Reactor Buildings, the shield wall, the RPV and the RPV internals such as the core shroud and the fuel. As part of ComEds preparation to address issues associated with flaws in the RPV internals, new rebaselined seismic models were prepared for the Dresden and Quad Cities Stations in 1994 (References 3 and 4). The new models were verified versus the original GE design basis models. These rebaselined seismic models were then used as the primary design input for the analysis and design of the core shroud repair hardware.

As part of a recent internal review of the Dresden core shroud repair hardware design, a discrepancy was identified in the mass used at one node point representing the top guide, part of the fuel and a portion of the core shroud. The total mass modeled at this location, node 19 for Dresden (Reference 3) and node 16 for Quad Cities (Reference 4), represents the real mass plus hydrodynamic mass (including the mass of the top guide, the mass of part of the fuel and the hydrodynamic mass). The total mass at this node point was identified as being reduced by one order of magnitude. This is a single mass point discrepancy, out of many mass points in a very large seismic model. Consequently, the analytical impact is primarily limited to a localized area of the shroud at the top guide location. The total mass modeled at this node point was 1.73E3 slugs instead of 17.3E3 slugs. ComEd has determined that the root cause of the mass discrepancy was an error in the original design basis seismic analysis (Reference 1), which was replicated into the rebaselined seismic analysis (References 3 and 4).

There are four previously submitted evaluations that were directly affected by this seismic mass discrepancy. The first two are related to the core shroud flaw evaluations (References 16 and 18), which utilized the original design basis seismic analyses. These flaw evaluations were performed as part of the ComEd comprehensive evaluations of core shroud cracking at Dresden Unit 3 and Quad Cities Unit 1 and were a primary input to the NRC SER's (References 11 and 12). The second set of previously submitted evaluations are related to the core shroud repair design for the Dresden and Quad Cities Units and were a primary input to the NRC evaluations of the core shroud repair hardware for Quad Cities Units 1 and 2 (Reference 13). At the time of this report, Dresden Unit 2 and Quad Cities Unit 2 have installed a core shroud repair, while Dresden Unit 3 and Quad Cities Unit 1 are operating in their fuel cycle and are preparing for the installation of the core shroud repair during the next refueling outage.

A preliminary assessment of this seismic mass discrepancy for both the Dresden and Quad Cities Stations was prepared and submitted to the NRC on September 5, 1995 (Reference 9). The completed core shroud repair seismic analysis results for both stations were submitted to the NRC on October 2, 1995 (Reference 10). This evaluation has been prepared to provide a summary of various evaluations performed for each of the four units along with a summary of the results obtained in the referenced reports. The following sections of this report present the methodology and results of the completed evaluations. Section 2 addresses the revised seismic analysis results, and Section 3 addresses the evaluation of the impact on the Quad Cities Units. Section 4 addresses the evaluation of the impact on the Dresden Units. The conclusions of these evaluations are provided in Section 5 and the references are listed in Section 6.

2.0 Revised Seismic Analysis Results

2.1 Dresden Unit 3 and Quad Cities Unit 1 (Inspected Units)

These two units do not have the core shroud repair hardware installed, but were thoroughly inspected during the last refueling outages in 1994 (D3R13 and Q1R13). The previous core shroud weld flaw evaluations were performed using the original GE design basis seismic analysis (References 1 and 2). The NRC approved 15 months of hot operation on July 21, 1994 based on these flaw evaluations. These two units are currently operating in their fuel cycle and are scheduled to install core shroud repair hardware during the next refueling outage.

A new seismic analysis has been performed using the rebaselined seismic models for both Dresden and Quad Cities with the revised total mass at the top guide location. A comparison of the results of these new analyses versus the original design basis analysis is provided in Tables 2.1 and 2.2. Both of these models include the stiffness properties of a partially degraded core shroud. The effect of the mass change at this one specific node is most pronounced in the localized response of the core shroud. The results of these new analyses for a partially degraded core shroud were used to perform a reassessment of the previously identified core shroud circumferential weld flaws.

Table 2.1 Dresden Units 2 and 3 Summary of Design Basis OBE Seismic Moments

Horiz. Weld No.	Node No.	Original Design Basis Moment (In.-Kips)	Revised Analysis Moment (In.-Kips)
H1		3,240	5,100
H2		6,780	12,300
H3		7,220	13,300
H4		23,400	47,400
H5		40,100	81,200
H6		41,400	83,500
H7		60,300	116,000
H8	25	64,300	123,000

Notes:
1. The node numbers indicated correspond to the rebaselined seismic model (Reference 3).
2. The larger of the E-W or N-S moments are indicated.

Table 2.2 Quad Cities Units 1 and 2 Summary of Design Basis OBE Seismic Moments

Horiz. Weld No.	Node No.	Original Design Basis Moment (In.-Kips)	Revised Analysis Moment (In.-Kips)
H1		5,190	6,800
H2		11,600	14,400
H3		12,400	15,300
H4		43,100	50,900
H5		77,200	89,500
H6		79,600	92,100
H7		113,000	128,800
H8	22	119,000	135,900

Notes:
1. The node numbers indicated correspond to the rebaselined seismic model (Reference 4).
2. The larger of the E-W or N-S moments are indicated.

The revised analysis for a partially degraded core shroud shows that the primary impact in the seismic response is locally within the elements representing the core shroud. A review of the total mass modeled for the core shroud elements versus the other structural elements (see Table 2.3) shows that though the change is significant at the core plate location, the magnitude of the change is small in comparison to the total mass of the RPV internals (17%), and is insignificant in comparison to the mass of the rest of the RPV and building structures (0.1%). A comparison of the modal frequencies and participation factors from the rebaselined seismic analyses of Dresden Units 2 and 3 (with mass discrepancy) versus the revised analysis results (with the corrected mass) is provided in Tables 2.4 and 2.5 for the east-west and north-south seismic models. These tables illustrate that the effect of this localized mass discrepancy is minimal with respect to the overall seismic response. Note that a comparison of the Quad Cities modal frequencies produces similar results and thus have not been repeated in this summary evaluation.

Table 2.3 Comparison of Total Nodal Mass Dresden Model

Node No.	Elevation (Feet)	Component	Total Mass Slugsx10^3	Total Weight Kips	Remarks
1-3,5-9,11,12	594-532	RPV	130.76	4210.5	
14	574.84	Shroud	2.67	86.0	
17	565.67	Shroud	1.73	55.7	
19	561.92	Shroud	17.30	557.1	Top Guide
20	559.00	Shroud	15.60	502.3	
22	547.96	Shroud	17.73	570.9	Core Plate
24	542.92	Shroud	17.96	570.9	
14,17,19,20, 22,24	575-543	$\sum$Shroud	72.99	2350.3	
26-30	559-539	Fuel & Guide Tubes	15.25	491.1	
31-33	527-519	CRD Housings	5.26	169.4	
37-39	565-540	Shield Wall	44.03	1417.8	
40	517.33	RPV Pedestal	32.16	1035.6	
41-45, 47,49,50	659-517	Reactor Bldg.	6418.02	206,660.2	
52-55	622-561	Turbine Bldg.	2359.15	75,964.6	
Totals			9077.6	292,299.4	

Notes:
1. Values indicated include both the structural mass and the hydrodynamic mass.
2. The elevations and components indicated are an approximate representation of the actual modeling.
3. Values indicated are from Reference 3, Appendix C, with a correction of the mass at node 19. The corresponding Quad Cities values are approximately the same.
4. Only the nodes with lumped mass are included in this table, a complete listing of all nodes is provided in References 3 and 7.

Table 2.4 Comparison of Modal Frequencies and Participation Factors- Dresden Units 2 and 3 E-W

Mode	Rebaselined Model Frequency (Hz.) [1]	Modal Participation Factor [1]	Revised Model Frequency (Hz.) [2]	Modal Participation Factor [2]
1	2.64 - Turbine Bld.	-12.36	2.64 - Turbine Bld.	-12.36
2	2.73 - Reactor Bld.	-12.31	2.73 - Reactor Bld.	-12.32
3	4.12 - CRD Housing	-3.41	4.11 - CRD Housing	-8.65
4	4.36 - Fuel & G. Tubes	-7.50	4.14 - CRD Housing	-4.39
5	5.86 - RPV	-75.09	5.86 - RPV	-74.87
6	6.53 - RPV	21.93	5.95 - Shroud	-11.16
7	7.81 - Shroud	3.45	6.72 - RPV	19.75
8	8.51 - Reactor Bld.	5.93	8.51 - Reactor Bld.	5.89
9	11.58 - Turbine Bld.	-39.27	11.58 - Turbine Bld.	-39.27
10	13.92 - RPV	-10.54	13.90 - RPV	-10.42

Notes:

1. Reference GENE-523-A181-1294 Rev. 0, December 1994, Primary Structure Seismic Models Dresden Units 2&3; RUNID 4998V, model with mass discrepancy at the top guide.

2. Reference RUNID 5003V, Primary Structure Seismic Model with corrected mass at top guide.

Table 2.5 Comparison of Modal Frequencies and Participation Factors - Dresden Units 2 and 3 N-S

Mode	Rebaselined Model Frequency (Hz.) [1]	Modal Participation Factor [1]	Revised Model Frequency (Hz.) [2]	Modal Participation Factor [2]
1	2.36 - Reactor Bld.	-12.08	2.36 - Reactor Bld.	-12.09
2	3.99 - Turbine Bld.	-18.34	3.99 - Turbine Bld.	-18.77
3	4.12 - CRD Housing	-2.96	4.11 - CRD Housing	-6.99
4	4.36 - Fuel & G. Tubes	-6.84	4.14 - CRD Housing	-3.79
5	4.98 - Turbine Bld.	-30.06	4.98 - Turbine Bld.	-30.07
6	6.10 - RPV	-68.88	5.94 - Shroud	4.58
7	6.53 - RPV	28.26	6.11 - RPV	-70.87
8	7.33 - Reactor Bld.	12.46	6.71 - RPV	22.06
9	7.81 - Shroud	-3.28	7.33 - Reactor Bld.	13.05
10	12.97 - RPV	-39.08	12.97 - RPV	39.05

Notes:

1. Reference GENE-523-A181-1294 Rev. 0, December 1994, Primary Structure Seismic Models Dresden Units 2&3, RUNID 5004V, model with mass discrepancy at the top guide.

2. Reference RUNID 5005V, Primary Structure Seismic Model with corrected mass at top guide.

2.2 Dresden Unit 2 and Quad Cities Unit 2 (Repaired Units)

The previous seismic analyses used for the design of the core shroud repair hardware (References 5,6, 7 and 8) are also affected by this discrepancy. The previous core shroud repair seismic analyses were performed utilizing a conservative method of representing the core shroud weld crack interface through a series of postulated pinned and roller conditions. The revised analyses performed incorporated an improved representation of the weld crack conditions as summarized in section 2.2.1 below. A detailed description of the revised modeling methods is provided in Attachment 2 of Reference 10. The revised analyses incorporated the correction in the hydrodynamic mass as well as the revised modeling of the postulated circumferential weld cracks. A summary of the results of the revised seismic analyses is provided in sections 3.2 and 4.2 of this report for the Quad Cities and Dresden plants.

2.2.1 Refined Representation of Weld-Crack Interface and Tie Rod Stiffness

The conservative bounding "pinned" and "roller" shroud weld-crack connectivity conditions were replaced by single "pinned" connectivity conditions in conjunction with rotational springs. The improved configuration is more representative of the actual three-dimensional, cracked shroud continuum and will enable the cracked shroud, in the primary structure beam element seismic model, to transfer part of the fuel horizontal inertia loads to the RPV wall during seismic/dynamic excitation. The improved representation of the weld-crack interface connectivity is based on the fact that the three-dimensional geometry of the cracked shroud has a significant capacity to transmit moment across each weld-crack interface plane. This inherent capability was conservatively ignored in the bounding "pinned" and "roller" weld-crack shroud connectivity conditions currently utilized.

The tie-rods are attached to the shroud head support ring at the upper end and to the shroud support plate at the lower end. The tie rods act as axial members and can transmit only vertical loads. Consequently, in the seismic horizontal beam element model, the only elastic coupling between the plane of the shroud head support ring and that of the shroud support plate is rotational. Due to differential elongation, the tie rods give rise to a restoring moment between the shroud flange plane and that of the shroud support plate if, and only if, there is relative rotation between the two planes. No restoring moment develops between the two planes if there is no relative rotation. The restoring moment is due to tie rod differential elongation and is independent of whether or not the shroud compressive load, due to the tie rod preload is relieved during seismic/dynamic excitation. Additional extension of the tie rod due to rotation of an intermediate section of shroud between circumferential weld cracks does not change the tie rod rotational stiffness between the planes of the shroud flange and the shroud support plate.

The tensile loads which develop in the vertical tie rods, as a result of rotation of the shroud three-dimensional geometry, are applied to calculate equivalent rotational stiffness at the circumferential weld-crack in the horizontal seismic model. The equivalent rotational stiffnesses impede opening of the weld-crack and enables the shroud to transfer horizontal shear loads.

The initial preload in the tie rod (mechanical plus thermal) and the restoring moment due to dead weight are conservatively neglected in the calculation of the rotational stiffness. These effects, however, are included when calculating the tie rod maximum loads.

Because of the three dimensional geometry of the "shroud/tie rod" assembly, any rotation of the plane containing the tie rod upper supports relative to the shroud support plate will elongate the tie rods. Also, the rotation of any shroud section with circumferential weld cracks at the top and bottom will have the same effect. The elongation of the vertical tie rods can be modeled as equivalent rotational springs in the horizontal seismic model at weld cracks since they tend to impede opening of the weld cracks.

The rotational stiffnesses used in the new seismic analysis for the DBE and OBE cases are:

Tie rods - $2(AE/L)r^2$
At the shroud welds - $4(AE/L)r^2$

The rotational stiffnesses used in the new seismic analysis for the DBE plus MSLB event are:

Tie rods - $2(AE/L)r^2$
At the shroud welds - 0

where:

AE/L = axial stiffness of tie rod from FEA
r = radius of tie rod location

3.0 Evaluation of the Impact on Quad Cities Units 1 and 2

3.1 Quad Cities Unit 1 (Inspected Unit Evaluation)

The original seismic design basis results were previously used for the analysis and evaluation of the core shroud flaws identified at Quad Cities Unit 1 during the Spring refueling outage of 1994. The core shroud flaw evaluations and safety assessments for these plants were based on the results of the original seismic analysis with this seismic mass discrepancy. The effect of the discrepancy in the mass of the top guide is primarily concentrated in the response of the shroud. This has been determined based on the new seismic analyses utilizing the revised seismic model with the hydrodynamic mass correction. The change in the seismic response (moments) of the core shroud was summarized in Table 2.2, and was included in the following evaluations of the critical H5 flaw. The impact of the revised core shroud seismic response has been directly incorporated into this reevaluation of the flaw assessment and the safety assessment (References 17 and 18) which were submitted to the NRC on December 14, 1994.

3.1.1 Impact on the December 14, 1994 Quad Cities Unit 1 Flaw Evaluation Results

Several assessments were performed as part of the comprehensive core shroud flaw evaluations for the identified cracking at Quad Cities Unit 1. These evaluations were reviewed by the NRC and a Safety Evaluation was issued on July 21, 1994 (Reference 12). Updated flaw evaluations were completed and submitted to the NRC on December 14, 1994 (Reference 18). These updated flaw evaluations incorporated all of the results of the ComEd efforts to more clearly define the loadings, flaw size and crack growth parameters and thus serve as the basis for this revised flaw evaluation. This evaluation is based on a detailed assessment of the H5 circumferential weld location as it was the location with the most significant amount of cracking discovered during the Q1R13 refueling outage inspections. The same structural margin assessments as previously reported in Table 3.2 (Reference 18) have been performed for the governing loading cases and are summarized in Table 3.1 below. The required ligaments and operating time until the allowable depth is reached, were calculated using the same limit load approach as was used for the previous evaluations. These tables provide a direct comparison between the bounding results of the December 14, 1994 flaw evaluation and the revised results with the correction of the mass discrepancy.

Table 3.1 Quad Cities 1 Summary of Required Ligament at H5

Weld Location	Critical Loading Case	Maximum d/t Ratio	(Revised) Required Ligament (RL) t=2"	(Revised) Time Until Allowable Depth Is Reached (Months)[1&2]	(Previous) Time Until Allowable Depth Is Reached (Months)[1&2]
H5	Normal	1.0000	0.0000"	22.8	22.8
H5	SSE	0.9625	0.0750"	20.6	20.9
H5	MSLOCA	0.9975	0.0050"	22.6	22.6
H5	RRLOCA	0.9988	0.0024"	22.7	22.7
H5	SSE+MSLOCA	0.9593	0.0814"	20.4	20.7
H5	SSE+RRLOCA	0.9613	0.0774"	20.5	20.8

Notes:

1. The remaining ligament is based on an assumed upper bound crack depth of 1.24 inches with an original wall thickness of 2 inches. The additional ligament provided by the 1" fillet weld has been conservatively neglected for this evaluation.
2. The "Time Until Allowable Depth Is Reached" has been calculated as follows:
   Months = [(2.0"-RL"-1.24")/5.0 E-5 In./Hr.]/666.67 hours/month

3.1.2 Impact on the December 14, 1994 Safety Assessment For Quad Cities Units 1 and 2

A detailed safety assessment of postulated through wall cracking of the core shroud circumferential welds was prepared for Quad Cities Unit 2 (see Reference 17) and was submitted to the NRC on December 14, 1994. This safety assessment was reviewed by the NRC and a Safety Evaluation Report (SER) was issued for the continued operation of this unit on January 31, 1995 (Reference 11). This safety assessment which were specifically prepared for Quad Cities Unit 2 (uninspected unit) is also applicable for its sister unit Quad Cities Unit 1. The structural loadings used to perform the previous safety assessment are only marginally affected by this seismic analysis discrepancy as the calculated seismic displacements are not significantly affected. The seismic lifts used are not affected by this discrepancy as the vertical seismic response is based on a uniform seismic input acceleration. The conclusion of this safety assessment was that in the unlikely occurrence of a design basis accident, safe reactor shutdown will be achieved, and the short term and long term cooling requirements will be satisfied. Tables 2.1 through 2.6 of the referenced reports provide a detailed summary of the plants safety features under all of the postulated events, and still remain valid.

3.1.3 Impact on the NRC Safety Evaluation of Quad Cities Unit 1

The previous NRC SER for the inspected Quad Cities Unit 1 (Reference 12), was based partially on an assessment of the critical H5 flaw. This evaluation report provides the justification that the impact of the identified mass discrepancy on the previous flaw evaluation is minimal and that the conclusions remain valid. The effect of the mass discrepancy on the referenced SER is minimal and the overall impact on the core shroud response does not change the conclusions of the previous flaw evaluations or safety assessments.

3.2 Quad Cities Unit 2 (Repaired Shroud Evaluation)

The core shroud repair hardware seismic design loads obtained from the previous seismic analyses (References 5 and 6) are larger than those obtained from the revised seismic analyses (Reference 10, Attachment B) and thus the existing shroud repair hardware stress analysis represents an evaluation of the bounding repair hardware loads. It should be noted that the maximum tie rod load under the beyond design basis loading condition (MSLB plus DBE, faulted case) did increase from 126 Kips to 184 Kips (Table B3 of Reference 10), but is still less than the previous bounding design load of 306 Kips for the SSE condition (emergency case). Note that since the existing stress analysis was performed for the bounding emergency case with a larger load, the increase in the faulted tie rod loads remains bounded by the existing evaluation of the emergency case.

The bounding seismic loads on the RPV and Internals are summarized in Table B4 of Reference 10. The revised analyses resulted in some load increases for several components under a DBE loading case with an uncracked core shroud. These results are consistent with the load increases that were previously noted for the analysis of an uncracked core shroud without the shroud repair hardware (Table 2.2). The evaluation of the identified load increases on the RPV Internals was performed by comparing the new design loads to those used for the previously completed stress analyses. The previous stress analyses were performed for the bounding loading case (DBE with normal operating pressure - Emergency case) and thus still represents a qualification for the bounding conditions. The increases in the revised loads for all loading conditions are less than the previously qualified loads with single exception of the shear at the shroud support plate. An increase in the bounding design load of 961 Kips to 1190 Kips occurred for the emergency case with an uncracked shroud model. The design margin for the transfer of shear in the shroud support plate is quite large and can easily accommodate this load increase.

4.0 Evaluation of the Impact on Dresden Units 2 and 3

4.1 Dresden Unit 3 (Inspected Unit Evaluation)

The original seismic design basis results were previously used for the analysis and evaluation of the core shroud flaws identified at Dresden Unit 3 during the Spring refueling outage of 1994. The core shroud flaw evaluations and safety assessments for these plants were based on the results of the original seismic analysis with this seismic mass discrepancy. The effect of the discrepancy in the mass of the top guide is primarily concentrated in the response of the shroud. This has been determined based on the new seismic analyses utilizing the revised seismic model with the hydrodynamic mass correction. The change in the seismic response (moments) of the core shroud was summarized in Table 2.1, and was included in the following evaluations of the critical H5 flaw. The impact of the revised core shroud seismic response has been directly incorporated into this reevaluation of the flaw assessment and the safety assessment (References 15 and 16) which were submitted to the NRC on December 14, 1994.

4.1.1 Impact on the December 14, 1994 Dresden Unit 3 Flaw Evaluation Results

Several assessments were performed as part of the comprehensive core shroud flaw evaluations for the identified cracking at Dresden Unit 3. These evaluations were reviewed by the NRC and a Safety Evaluation was issued on July 21, 1994 (Reference 12). Updated flaw evaluations were completed and submitted to the NRC on December 14, 1994 (Reference 16). These updated flaw evaluations incorporated all of the results of the ComEd efforts to more clearly define the loadings, flaw size and crack growth parameters and thus serve as the basis for this revised flaw evaluation. This evaluation is based on a detailed assessment of the H5 circumferential weld location as it was the location with the most significant amount of cracking discovered during the previous inspections. The same structural margin assessments as previously reported in Table 3.2 (Reference 16) have been performed for the governing loading cases and are summarized in Table 4.1 below. The required ligaments and operating time until the allowable depth is reached, were calculated using the same limit load approach as was used for the previous evaluations. These tables provide a direct comparison between the bounding results of the December 14, 1994 flaw evaluation and the revised results with the correction of the mass discrepancy.

Table 4.1 Dresden Unit 3 Summary of Required Ligament at H5

Weld Location	Critical Loading Case	Maximum d/t Ratio	(Revised) Required Ligament (RL) t=2"	(Revised) Time Until Allowable Depth Is Reached (Months)[1,2]	(Previous) Time Until Allowable Depth Is Reached (Months)[1,2]
H5	Normal	1.0000	0.0000"	22.8	22.8
H5	SSE	0.9660	0.0680"	20.8	21.8
H5	MSLOCA	0.9985	0.0030"	22.7	22.7
H5	RRLOCA	0.9988	0.0024"	22.7	22.7
H5	SSE+MSLOCA	0.9636	0.0722"	20.6	21.7
H5	SSE+RR LOCA	0.9648	0.0704"	20.7	21.7

Notes:

1. The remaining ligament is based on an assumed upper bound crack depth of 1.24 inches with an original wall thickness of 2 inches. The additional ligament provided by the 1" fillet weld has been conservatively neglected for this evaluation.
2. The "Time Until Allowable Depth Is Reached" has been calculated as follows: Months = [(2.0"-RL"-1.24")/5.0 E-5 In./Hr.]/666.67 hours/month

4.1.2 Impact on the December 14, 1994 Safety Assessment For Dresden Units 2 and 3

A detailed safety assessment of postulated through wall cracking of the core shroud circumferential welds was prepared for Dresden Unit 2 (see Reference 15) and was submitted to the NRC on December 14, 1994. This safety assessment was reviewed by the NRC and a Safety Evaluation Report (SER) was issued for the continued operation of this unit on January 31, 1995 (Reference 11). This safety assessment which was specifically prepared for Dresden Unit 2 (uninspected unit) is also applicable for its sister unit Dresden Unit 3. The structural loadings used to perform the previous safety assessment are only marginally affected by this seismic analysis discrepancy as the calculated seismic displacements are not significantly affected. The seismic lifts used are not affected by this discrepancy as the vertical seismic response is based on a uniform seismic input acceleration. The conclusion of this safety assessment was that in the unlikely occurrence of a design basis accident, safe reactor shutdown will be achieved, and the short term and long term cooling requirements will be satisfied. Tables 2.1 through 2.6 of the referenced reports provide a detailed summary of the plants safety features under all of the postulated events, and still remain valid.

4.1.3 Impact on the NRC Safety Evaluation of Dresden Unit 3

The previous NRC SER for the inspected Dresden Unit 3 (Reference 12), was based partially on an assessment of the critical H5 flaw. This evaluation report provides the justification that the impact of the identified mass discrepancy on the previous flaw evaluation is minimal and that the conclusions remain valid. The effect of the mass discrepancy on the referenced SER is minimal and the overall impact on the core shroud response does not change the conclusions of the previous flaw evaluations or safety assessments.

4.2 Dresden Unit 2 (Repaired Shroud Evaluation)

The core shroud repair hardware seismic design loads obtained from the previous seismic analyses (References 7 and 8) are larger than those obtained from the revised seismic analyses (Reference 10, Attachment B) and thus the existing shroud repair hardware stress analysis represents an evaluation of the bounding repair hardware loads. It should be noted that the maximum tie rod load under the beyond design basis loading condition (MSLB plus DBE, faulted case) did increase from 169 Kips to 306 Kips (Table B1 of Reference 10), but is still less than the previous bounding design load of 310 Kips for the SSE condition (emergency case). Note that since the existing stress analysis was performed for the bounding emergency case with a larger load, the increase in the faulted tie rod loads remains bounded by the existing evaluation of the emergency case.

The bounding seismic loads on the RPV and Internals are summarized in Table B2 of Reference 10. The revised analyses resulted in some load increases for several components under a DBE loading case with an uncracked core shroud. These results are consistent with the load increases that were previously noted for the analysis of an uncracked core shroud without the shroud repair hardware (Table 2.1). The evaluation of the identified load increases on the RPV Internals was performed by comparing the new design loads to those used for the previously completed stress analyses. The previous stress analyses were performed for the bounding loading case and thus still represents a qualification for the bounding conditions. The increases in the revised loads for all loading conditions are less than the previously qualified loads with single exception of the RPV skirt moment. An increase in the bounding design moment of 50,870 Ft.-Kips to 54,070 Ft.-Kips occurred for the DBE plus MSLB pressure case. The design margin for the transfer of this moment is adequate to accommodate this load increase.

5.0 Summary and Conclusions

The evaluations of the inspected Units (Dresden Unit 3 and Quad Cities Unit 1) have shown that the effect of this discrepancy on the shroud seismic response will not invalidate the conclusions of the existing flaw evaluations (References 16 and 18). The identified safety margins for the critical H5 flaw are sufficient to account for this discrepancy in the seismic analysis and to demonstrate adequate margin to continue to operate these units. The results presented in this report in conjunction with the original safety assessment for a fully cracked core shroud (References 15 and 17), clearly demonstrate that the effect of this discrepancy will not change the conclusions of the previous assessments performed by both ComEd (References 15-18) and the NRC (References 11-14).

The evaluations of the Dresden Unit 2 and Quad Cities Unit 2 core shroud repair hardware show that the existing core shroud repair design is adequate with the correction of this discrepancy. The results of these new seismic analyses show that the loads previously used for the qualification of the core shroud repair hardware are larger and thus bound the new results. While all of the design loads for the core shroud repair hardware were bounded by the previous analysis, the loads on some of the RPV internals increased slightly. The affect of these load increases was evaluated and found to be within the existing design margin. The results of this evaluation apply to the core shroud repair design for the two repaired Units (Dresden Unit 2 and Quad Cities Unit 2) as well as for the planned repairs for the Dresden Unit 3 and Quad Cities Unit 1. The results presented in this report demonstrate that the effect of this discrepancy will not change the conclusions of the previous NRC Safety Evaluation of the Quad Cities Units 1 and 2 Core Shroud Repair (Reference 13).

6.0 References

1. GE Report 257HA718, Revision 0, "Seismic Analysis for Reactor Internals for Dresden II and Millstone Plants", December 24, 1968.
2. GE Report 257HA925, DAR 93, Revision 1, "Seismic Response of Quad Cities Reactor Pressure Vessel and Internals", February 1970.
3. GENE-523-A181-1294, Revision 0, "Dresden Units 2 & 3 - Primary Structure Seismic Models", December 1994.
4. GENE 523-A169-1194, "Commonwealth Edison Company Quad Cities Nuclear Power Station, Units 1 & 2, Primary Structure Seismic Models", November 16,1994.
5. GENE 771-71-1094, Revision 1, "Quad Cities Units 1 and 2 - Shroud Repair Seismic Analysis", January 5, 1995.
6. GENE 771-72-1091, Revision 1, "Quad Cities Units 1 & 2 Shroud Repair Seismic Analysis Backup Calculations", January 5, 1995.
7. GENE-771-84-1194, Revision 2, "Dresden Units 2 & 3, Shroud Repair Seismic Analysis", May 1, 1995.
8. GENE 771-85-1194, Revision 2, "Dresden Units 2 & 3, Shroud Repair Seismic Analysis Backup Calculations", May 1, 1995.
9. ComEd Letter, J. Schrage to the U.S. NRC Document Control Desk, Subject - "Dresden Station Units 2 and 3, Quad Cities Station Units 1 and 2, Design Basis Discrepancy Related to Core Shroud Seismic Calculations", Dated September 5, 1995.
10. ComEd Letter, P. Piet to the U.S. NRC Document Control Desk, Subject - "Dresden Station Units 2 and 3, Transmittal of the Dresden Design Documents for the Core Shroud Repair", Dated October 2, 1995.
11. U. S. Nuclear Regulatory Commission Letter, John F. Stang - Senior Project Manager, To D. L. Farrar - Manager, Nuclear Regulatory Service ComEd, Subject - Resolution of Generic Letter 94-03, Intergranular Stress Corrosion Cracking of Core Shrouds in Boiling Water Reactors at Dresden, Units 2 and 3, and Quad Cities , Units 1 and 2 (TAC NOS. M90088, M90089, M90109, and M90110), dated January 31, 1995.
12. U. S. Nuclear Regulatory Commission Letter, John F. Stang - Project Manager, To D. L. Farrar - Manager, Nuclear Regulatory Service ComEd, Subject - Resolution of Core Shroud Cracking at Dresden, Units 3, and Quad Cities , Units 1 (TAC NOS. M89871, and M89493), dated July 21, 1994.
13. U. S. Nuclear Regulatory Commission Letter, Robert M. Pulsifer - Project Manager, To D. L. Farrar - Manager, Nuclear Regulatory Service ComEd, Subject - Quad Cities Nuclear Power Station, Units 1 and 2, Safety Evaluation Regarding Core Shroud Repair (TAC NOS. M91301, and M91301), dated June 8, 1995.

14. U. S. NRC Letter, Mr. John Stang, to Mr D.L. Farrar - ComEd , Subject - Request for Additional information - Core Shroud Repair (TAC NOS M91301 and M91302), Dated July 26, 1995.
15. ComEd Letter, P. Piet to the U.S. NRC Document Control Desk, Subject - Response to NRC for request for additional information concerning Generic Letter 94-03, Dated December 14, 1994, Attachment B - "Safety Assessment of Horizontal Core Shroud Weld H1 through H7 for Cycle 14 Operation of for Dresden Unit 2".
16. ComEd Letter, P. Piet to the U.S. NRC Document Control Desk, Subject - Response to NRC for request for additional information concerning Generic Letter 94-03, Dated December 14, 1994, Attachment D - "Final Evaluation of the Core Shroud Flaws at the H5 Horizontal Weld For Dresden Unit 3".
17. ComEd Letter, P. Piet to the U.S. NRC Document Control Desk, Subject - Response to NRC for request for additional information concerning Generic Letter 94-03, Dated December 14, 1994, Attachment C - "Safety Assessment of Horizontal Core Shroud Weld H1 through H7 for Cycle 13 Operation of for Quad Cities Unit 2".
18. ComEd Letter, P. Piet to the U.S. NRC Document Control Desk, Subject - Response to NRC for request for additional information concerning Generic Letter 94-03, Dated December 14, 1994, Attachment E - "Final Evaluation of the Core Shroud Flaws at the H5 Horizontal Weld For Quad Cities Unit 1".