LIMERICK GENERATING STATION UNITS 1 & 2

DESIGN ASSESSMENT REPORT

REVISION 10 PAGE CHANGES

The attached pages, tables and figures are considered part of a controlled copy of the Limerick Generating Station DAR. This material should be incorporated into the DAR by following the instructions below.

After the revised pages have been inserted, place the page that follows these instructions in the front of Volume 1.

REMOVE	INSERT
VOLUME 1	
Pages 2.2-1 thru -4	Pages 2.2-1 thru -4
Pages 7.2-5 thru -7	Pages 7.2-5 thru -8
VOLUME 2	
Page D.2-1	Page D.2-1
Figure D.2-7	Figure D.2-7

THIS DAR SET HAS BEEN UPDATED TO INCLUDE REVISIONS THROUGH 10 DATED 9/84.

2.2 DESIGN ASSESSMENT SUMMARY

Design assessment of the LGS structures and components is achieved by analyzing the response of the structures and components to the load combinations explained in Chapter 5. In Chapter 7, predicted stresses and responses (from the loads defined in Chapter 4 and combined as described in Chapter 5) are compared with the applicable code allowable values identified in Chapter 6.

2.2.1 CONTAINMENT STRUCTURE, REACTOR ENCLOSURE, AND CONTROL STRUCTURE ASSESSMENT SUMMARY

2.2.1.1 Containment Structure Assessment Summary

The primary containment walls, base slab, diaphragm slab, reactor pedestal and reactor shield are analyzed for the effects of SRV and LOCA in accordance with Table 5.2-1. The ANSYS finite element program is used for the dynamic analysis of structures.

Response spectra curves are developed at various locations within the containment structure to assess the adequacy of components. Stress resultants due to dynamic loads are combined with other loads in accordance with Table 5.2-1 to evaluate rebar and concrete stresses. Design safety margins are defined by comparing the actual concrete and rebar stresses at critical sections with the code allowable values. The assessment methodology of the containment structure is given in Section 7.1.1.1.

The containment mode shapes, modal frequencies, and hydrodynamic response spectra are given in Appendix A.

The results of the structural assessment of the containment structure are given in Appendix D.

2.2.1.2 Reactor Enclosure and Control Structure Assessment Summary

The reactor enclosure and control structure are assessed for the effects of SRV and LOCA loads in accordance with Table 5.2-1 and Table 5.3-1.

Pressure time histories in the wetwell are used to investigate the reactor enclosure and control structure response to SRV and LOCA loads. Maximum time history force responses and broadened response spectra curves are approximately used to assess the adequacy of associated structural components. The assessment methodology of the reactor enclosure and control structure is presented in Section 7.1.1.2.

The mode shapes, modal frequencies, and hydrodynamic response spectra of the reactor enclosure and control structure are presented in Appendix B.

The results of the structural assessment are summarized in Appendix E.

2.2.2 CONTAINMENT SUBMERGED STRUCTURES ASSESSMENT SUMMARY

Load combinations for the downcomer bracing and suppression chamber columns are presented in Table 5.3-1. Load combinations for the downcomers are presented in Table 5.5-1. The hydrodynamic design assessment methodology for the downcomers, bracing, and columns is presented in Sections 7.1.2 and 7.1.4. The results of the analysis are presented in Appendix D.

The suppression pool liner plate loads are combined in accordance with Table 5.2-1. Results from the analysis indicate that no structural modification is required (see Sections 7.1.3 and 7.2.1.5).

2.2.3 BOP PIPING SYSTEMS ASSESSMENT SUMMARY

Containment and reactor enclosure BOP piping systems were analyzed by the methods presented in Section 7.1.5. The load combinations for piping are described in Table 5.6-1. The results of the analysis are presented in Appendix F.

2.2.4 NSSS ASSESSMENT SUMMARY

2.2.4.1 Introduction

General Electric Company performed a design assessment of Limerick Unit 1 to demonstrate that the NSSS piping and safety-

related equipment and associated supports have sufficient capability to accommodate combinations of seismic and hydrodynamic loadings. The scope of the evaluation included the reactor pressure vessel (RPV), RPV internals and associated equipment, main steam and recirculation piping, and GE-supplied floor mounted equipment, pipe mounted equipment, and control and instrumentation equipment and all associated supports.

The methodologies described in Section 7.1.6 were used to perform the evaluation. Load combinations and acceptance criteria listed in Table 5-7.1 were used for the evaluation of ASME Class 1, 2 and 3 piping, equipment, and supports.

2.2.4.2 Design Assessment Results

The results of the assessment have demonstrated that the NSSS piping and safety-related equipment have sufficient capability to accommodate combinations of seismic and hydrodynamic loadings for the normal, upset, emergency and faulted conditions.

Detailed results of the NSSS piping and major safety-related equipment evaluations are given in FSAR Sections 3.9 and 3.10.

2.2.5 BOP EQUIPMENT ASSESSMENT SUMMARY

Safety related BOP equipment in the containment, reactor enclosure, and control structure are assessed by the methods contained in Section 7.1.7. Loads are combined as shown in Table 5.8-1.

2.2.6 ELECTRICAL RACEWAY SYSTEM ASSESSMENT SUMMARY

The electrical raceway system located in the containment, reactor enclosure, and control structure is assessed for load combinations in accordance with Table 5.9-1. The assessment methodology and analysis results are presented in Chapter 7.

2.2.7 HVAC DUCT SYSTEM ASSESSMENT SUMMARY

The HVAC duct system located in the containment, reactor enclosure, and control structure is assessed for load combinations in accordance with Table 5.10-1. The assessment methodology and analysis results are presented in Chapter 7.

2.2.8 SUPPRESSION POOL TEMPERATURE ASSESSMENT SUMMARY

Suppression pool temperature monitoring system (SPTMS) design criteria and adequacy assessment, analysis of suppression pool temperature response to SRV discharge, and analysis of the suppression pool local-to-bulk temperature difference (ΔT) are presented in Appendix I.

2.2.9 WETWELL-TO-DRYWELL VACUUM BREAKER AND DOWNCOMER CAPPING ASSESSMENT SUMMARY

The assessment of the wetwell-to-drywell vacuum breakers to adequately withstand the dynamic effects of poolswell and chugging is summarized in Appendix J. The design assessment of the downcomer capping arrangement is also summarized in Appendix J.

7.2.1.6 Downcomers

The downcomer vibration mode shapes are calculated for the modal analyses using computer program BSAP. The mode shapes are shown in Appendix D, Figures D.2-3 through D.2-5, for the three representative bracing system spring stiffnesses. The equivalent water mass included in the model is equal to the downcomer volume.

The downcomers were assessed in accordance with ASME Section III, Division 1, subsection NB-3652, using load combinations in Table 5.5-1. Stresses and design margins are given in Appendix D, Figure D.2-6.

Downcomer fatigue at three critical locations were also checked. Loads are combined by the absolute sum method. Figure D.2-7 shows the fatigue usage factors at these critical locations, computed in accordance with ASME Section III, Division 1, subsection NB-3650 (1979 Summer Addenda). Downcomers are adequate for fatigue considerations.

7.2.1.7 Electrical Raceway System

The electrical raceway system was analyzed using the load combinations in Table 5.9-1 in accordance with the methodology described in Section 7.1.8. The stress margins were found to be most critical under the abnormal/extreme load condition. Stresses are below allowable stress levels for all members of the electrical raceway system.

7.2.1.8 HVAC Duct System

The HVAC duct system was analyzed using the load combinations in Table 5.10-1 in accordance with the methodology described in Section 7.1.9. The stress margins were found to be most critical under the abnormal/extreme load condition. Stresses are below allowable stress levels for all members of the HVAC duct system.

7.2.1.9 ASME Class MC Steel Components Margins

7.2.1.9.1 Refueling Head And Flange

The refueling head and flange were found to have no stresses exceeding the specified allowable limits.

The leaktightness of the flanged joint is investigated for the combined effect of temperature, pressure, seismic, SRV, LOCA and jet forces. Vertical separation at the flange faces is prevented by providing sufficient bolt preload to offset uplift due to the applied loads. Similarly, relative horizontal movement between the flange faces is prevented by the bolt preload induced frictional forces. A preload of 157K per bolt is required to maintain leaktightness at the flange joints.

7.2.1.9.2 Suppression Chamber Access Hatch, CRD Removal Hatch, and Equipment Hatch

For these components, CBI's analysis indicated that there are no stresses in excess of the specified allowable limits when considering the additional hydrodynamic loading.

7.2.1.9.3 Equipment Hatch-Personnel Airlock

The equipment hatch with personnel airlock has been assessed for hydrodynamic and seismic loads. Modifications to some cap screws of the attachment brackets are required to accommodate the additional hydrodynamic loading. The equipment hatch with personnel airlock and all related components are within the specified allowable limits.

7.2.1.10 <u>BOP Piping and MSRV Systems Margins</u>

As described in Section 7.1.5, all seismic Category I BOP piping components and their supports located inside the containment, reactor enclosure, and control structure have been included in the design assessment and have been analyzed for seismic and hydrodynamic loads. The loads from the analyses are combined as described in Table 5.6-1. Additional supports and modification of existing supports where required to accommodate the hydrodynamic and seismic loads for some piping systems have been completed. Stresses and stress margins for selected BOP piping systems are summarized in Appendix F. The stress reports for the evaluation of the BOP piping will be available for NRC review.

7.2.1.11 BOP Equipment Margins

All seismic Category I BOP equipment and their supports have been included in the design assessment and analyzed for hydrodynamic and seismic loads (Section 7.1.7) via the Limerick Seismic Qualification Review Team (SQRT) program. Structural modifications necessitated by the addition of suppression pool hydrodynamic loads have been completed. For each piece of BOP equipment, a five-page SQRT summary form has been prepared documenting the re-evaluation of the equipment.

7.2.1.12 NSSS Margins

Safety-related NSSS piping, equipment and their supports have been assessed for hydrodynamic and seismic loads. Detailed results of the evaluation are given in FSAR Sections 3.9 and 3.10. Structural modifications necessitated by addition of suppression pool hydrodynamic loads have been completed. In addition, General Electric Co. has prepared Seismic Qualification Reevaluation (SQR) Program forms, NSSS Loads Adequacy Evaluation (NLAE) Program Summary reports, and design stress reports to document the assessment of seismic and hydrodynamic loads on NSSS piping, safety-related equipment and all related supports. These forms and reports will be available for NRC review.

7.2.2 ACCELERATION RESPONSE SPECTRA

7.2.2.1 Containment Structure

The method of analysis and load description for the acceleration response spectrum generation are outlined in Section 7.1.1.1.1.6.1. From a review of the acceleration response spectra curves for the containment structure, the maximum spectral accelerations are tabulated for 1 percent damping of critical. For SRV and LOCA loads, the maximum spectral accelerations are presented in Table 7.2-1.

The hydrodynamic acceleration response spectra of the containment structure are presented in Appendix A.2.

7.2.2.2 Reactor Enclosure and Control Structure

The method of analysis and load applications for the computation of the hydrodynamic acceleration response spectrum in the reactor enclosure and the control structure are described in

Section 7.1.1.2. The response spectra of the reactor enclosure and the control structure are shown in Appendix B.

D.2 SUBMERGED STRUCTURE DESIGN ASSESSMENT

The submerged structures in the suppression chamber include the diaphgragm slab support columns, the downcomer bracing system, and the downcomers. The bracing system and the columns are assessed in accordance with Table 5.3-1. In the column assessment, the dynamic loads are combined by the SRSS method and then combined with the static loads using the absolute sum procedure. In the assessment of the downcomer bracing system, all loads are combined using the absolute sum method. For both the downcomer bracing system and the columns, Equation 7 of Table 5.3-1 is the most critical combination.

The natural vibration frequencies and shapes of the suppression chamber columns are presented in Figure D.2-1, and the assessment results are summarized in Figure D.2-2. Bolt stresses are not shown in the bottom anchorage because the design is more critical at the connecting flange, which yields a design margin of 10 percent.

The natural vibration frequencies and mode shapes of the downcomers are presented in Figures D.2-3 through D.2-5. Downcomer design margins are provided in Figure D.2-6. Fatigue usage factors, fatigue cycles, and fatigue histogram are provided in Figures D.2-7, D.2-8, and D.2-9, respectively.

The downcomer bracing system mathematical model is shown in Figure D.2-10, and the design margins for the most critical member in each quadrant are summarized in Figure D.2-11.

USAGE FACTOR SUMMARY OF DOWNCOMERS

LOADS	NORMAL/UPSET CONDITION				EMERGENCY/FAULTED CONDITIONS			
	± OBE ± SRV_1 ± SRV_2	± SRV_1 ± SRV_2 ± CHUG	± SRV_1 ± SRV_2	± SRV_1	SBA o PRESSURE o THERMAL TRANSIENT o STEAM FLOW ± CHUG ± SRV_1 ± SRV_2	IBA OR SBA o PRESSURE o THERMAL TRANSIENT o STEAM FLOW ± CHUG ± SRV_1 ± SRV_2 ± SSE	DBA o PRESSURE o THERMAL TRANSIENT o STEAM FLOW ± CHUG ± SSE	CUMULATIVE USAGE
AT PLATFORM RING	0.001	0.600	0.116	0.080	0.003			0.80
AT 24" x 24" VACUUM BREAKER TEE	0.002	0.194	0.160	0.151	0.001			0.51
AT PIPE ATTACHMENT [(1)] ELEV. 221'-0"	0.001	0.545	0.078	0.071	0.003			0.70

(1) ORIGINAL LOCATION OF VACUUM BREAKER (ABANDONED)

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DOWNCOMER
FATIGUE USAGE FACTOR

FIGURE D.2-7

REV. 10, 09/84