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SEP 22 2000
WS #14 (16)

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 629776

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
Distribution	CSB Subproject	N/A
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SNF/CSB	C. E. Swenson	N/A
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1	SNF-7000	N/A	0	Multi-Canister Overpack Handling Machine – Independent Review of Seismic Structural Analysis	Q, S_n	1, 2	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval	4. Review	1. Approved	4. Reviewed no/comment
	2. Release	5. Post-Review	2. Approved w/comment	5. Reviewed w/comment
	3. Information	6. Dist. (Receipt Acknow. Required)	3. Disapproved w/comment	6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
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		Design Agent			
		Cog. Eng.			
1	1	Cog. Mgr. G. D. Bazinet 9-18-00			
1	1	QA S. S. Moss 9-18-2000			
1	1	Safety L. J. Garvin 9/18/00			
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S. B. Harrington	N/A	G. D. Bazinet 9/21/00	Ctrl. No.
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Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
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SNF-7000
Revision 0

Multi-Canister Overpack Handling Machine - Independent Review of Seismic Structural Analysis

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200
Fluor Hanford
P.O. Box 1000
Richland, Washington

SNF-7000
Revision 0
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Multi-Canister Overpack Handling Machine - Independent Review of Seismic Structural Analysis

Project No: W-379 Document Type: RPT Division: SNF

C. E. Swenson
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Fluor Hanford
P.O. Box 1000
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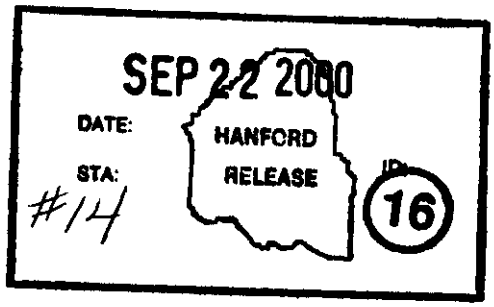

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Introduction

The following separate reports and correspondence pertains to the independent review of the seismic analysis. The original analysis was performed by GEC-Alsthom Engineering Systems Limited (GEC-ESL) under subcontract to Foster-Wheeler Environmental Corporation (FWEC) who was the prime integration contractor to the Spent Nuclear Fuel Project for the Multi-Canister Overpack (MCO) Handling Machine (MHM). The original analysis was performed to the Design Basis Earthquake (DBE) response spectra using 5% damping as required in specification, HNF-S-0468 for the 90% Design Report in June 1997. The independent review was performed by Fluor-Daniel (Irvine) under a separate task from their scope as Architect-Engineer of the Canister Storage Building (CSB) in 1997. The comments were issued in April 1998. Later in 1997, the response spectra of the Canister Storage Building (CSB) was revised according to a new soil-structure interaction analysis and accordingly revised the response spectra for the MHM and utilized 7% damping in accordance with American Society of Mechanical Engineers (ASME) NOG-1, "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)." The analysis was re-performed to check critical areas but because manufacturing was underway, designs were not altered unless necessary. FWEC responded to SNF Project correspondence on the review comments in two separate letters enclosed. The dispositions were reviewed and accepted. Attached are supplier source surveillance reports on the procedures and process by the engineering group performing the analysis and structural design. All calculation and analysis results are contained in the MHM Final Design Report which is part of the Vendor Information File 50100.

Subsequent to the MHM supplier engineering analysis, there was a separate analyses for nuclear safety accident concerns that used the electronic input data files provided by FWEC/GEC-ESL and are contained in document SNF-6248, "Evaluation of MHM Uplift Restraint for Seismic Event During Repositioning Operations," (EDT-629126 and EDT-629132).

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MHM Seismic Analysis Review Report

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Mr. M. K. Mahaffey
DE&S Hanford, Inc. R3-86
P. O. Box 350
Richland, WA 99352-0350

FLUOR DANIEL, INC.

Date: April 9, 1998

Reference: SNF Canister Storage Building
P. O. TVW-SVV-370252
Fluor Contract 4602

Dear Mr. M. K. Mahaffey

Transmittal No.: FDP-591

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We enclose 1 copies of the items listed below. These are issued for:

[ ] Approval [X] Reference [ ] Review and Comment [ ] Other

Response due to Fluor: N/A
Responds to: EDN-080

Number	Rev	Date	Title
N/A	A	04/02/98	MULTI-CANISTER OVERPACK HANDLING MACHINE SEISMIC ANALYSIS REVIEW REPORT

Distribution:
G. D. Bazinet, NHC, w/1
A. S. Daughtridge, DESH, w/1

Very truly yours,

P. J. Bedell
Project Director

PJB·RPK:tjr
Attachment

Multi-Canister Overpack Handling Machine
Seismic Analysis Review Report

REVIEWER: _____ DATE: 4/2/98
Geyergy Kuilanoff, P.E.

APPROVED BY: _____ DATE: 4/2/98
Robert Bachman, P.E.

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Executive Summary

This report contains the review of the seismic analysis and seismic structural calculations for the Multi-Canister Overpack (MCO) Handling Machine (MHM). The work was authorized by DE&S Hanford letter DESH-97622009, dated January 5, 1998 and Engineering Deviation Notice #080. The seismic analysis of the MHM was performed by GEC Alsthom Engineering Systems Ltd. (GECA) in England. The detailed design of the MHM for the operational and seismic loads was performed by Ederer Incorporated, Seattle, WA.

The specification (HNF-S-0468) required the crane system be designed for Design Basis Earthquake in accordance with ASME NOG-1 and structural requirements of Section NOG-4000.

The design reports reviewed are listed in the Scope section of this report. In general seismic analysis, modeling approach, load combinations, and the design of the MHM meets the project requirements. Our comments are listed for each design report (DR) in the attached Review Comment Record forms. The key issues are summarized below:

- longitudinal stiffeners in the girder beams are not located in accordance with CMAA section 3.5.2.2. (DR-3)
- CMTR based yield stress values were used to justify the design adequacy and not the code minimum specified yield strength values. (DR-1, DR-2, DR-4, DR-5)
- combined stress through section at bolt holes exceed the allowables in the 41"x9"x1-3/4" trolley seismic restraint plate. (DR-5)
- use of SAE Grade 5 and 8 bolts which are not listed as an acceptable type per NOG-1. (bolts for trolley seismic restraint, for bridge seismic restraint, for bridge wheel retaining plate, and for bridge truck pin end plate). (DR-5)
- use of "insignificant modes" setting of 0.001. (DR-1, DR-2)
- "total mass" extracted in the dynamic analysis. (DR-1, DR-2)
- need alternate calculations (by Ederer or GECA) to justify design adequacy of trolley festoon, trolley walkway, and trolley handrail, whose stress ratios exceed unity. (DR-1)
- none of the reports covered hoist and turret design calculations.

Introduction

This report contains the review of the seismic analysis and seismic structural calculations for the Multi-Canister Overpack (MCO) Handling Machine (MHM). The work was authorized by DE&S Hanford letter DESH-97622009, dated January 5, 1998 (Attachment - 1) and Engineering Deviation Notice #080. The seismic analysis of the MHM was performed by GEC Alsthom Engineering Systems Ltd. (GECA) in England. The detailed design of the MHM for the operational and seismic loads was performed by Ederer Incorporated, Seattle, WA. The analysis and design is in accordance with the MCO Handling Machine Specification WHC-S-0468, Rev.2, dated 10/96. This specification is retitled as Integrated MCO Handling Machine Specification HNF-S-0468, Rev. 3, dated 5/97.

The specification required the crane system be designed in accordance with ASME NOG-1 and structural requirements of Section NOG-4000. Figures 1 and 2 in Appendix B of the specification (Attachment - 2) defined the response spectra which were to be used as the basis for design. These design response spectra were taken as the Design Basis Earthquake (DBE) horizontal and vertical input response spectra accelerations, at 5% damping, respectively. GECA also performed a confirmatory seismic analysis for the in-structure response spectra at 7% damping (Attachment - 3) which were developed after the MHM had been designed and was being fabricated.

Scope

The scope of work included review of the following referenced design reports (DR) and drawings:

DR-1 "Hanford MHM Seismic Analysis of the Hanford MCO Handling Machine," GEC Alsthom Report ESL/R(96)083, Rev. 2, dated October 1997.

DR-2 "Hanford MHM 7% Damping Response Spectra Seismic Analysis of the Hanford MCO Handling Machine," GEC Alsthom Report ESL/R(97), Issue A, dated October 1997.

DR-3 "Crane Operational Loads NOG-4000," Ederer Cranes Report, Sections A, B, & C.

DR-4 "Bridge Girder and End Tie: Seismic Loading," Ederer Cranes Report, Section D.

DR-5 "Trolley: Seismic Loading," Ederer Cranes Report, Section E.

The following referenced drawings and data were also used in the above design reports review:

- GEC Alsthom drawings 362A0551, Sheets 1 thru 7, Rev A, Turret Assembly Scheme.
- GEC Alsthom drawings 362A0559, Sheets 1 thru 3, Rev A, Trolley Seismic Restraint 'X' direction, (portions of drawings only)
- Reference 9, in the DR-1, GECA Calc Hanford MCO Handling Machine Section Properties and Lump Masses, File Ref JH4683/31/ST/208 Vol 1 Calc 480/1
- Ederer Drawings:
  D-34960 Rev B, Trolley Arrangement
  D-35205 Rev A, Bridge Erection Drawing MHM Gantry Crane
  D-34777 Sht 1 of 3, Rev B, "A" Girder Detail
  D-34777 Sht 2 of 3, Rev C, "A" Girder Detail
  D-34777 Sht 3 of 3, Rev B, "A" Girder Detail
  D-34778 Sht 1 of 3, Rev B, "B" Girder Detail
  D-34778 Sht 2 of 3, Rev C, "B" Girder Detail
  D-34778 Sht 3 of 3, Rev B, "B" Girder Detail
  D-35203 Sht 1 of 2, Rev A, End Tie Beam
  C-34322, Rev C, Drive Truck Assembly
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  D-34942 Sht 1 of 4, Rev F, Trolley Frame Plan & Elev. Views
  D-34942 Sht 2 of 4, Rev E, Trolley Frame Bottom View & Details
  D-34942 Sht 3 of 4, Rev D, Trolley Frame Details
  C-35188 Trolley Drive Assy, dated 1/6/97
  C-34650, Rev B, Seismic Restraint Assy, (portions of drawing only)
  B-34675 Bearing Cap - Outer, Thru Shaft - 22226 Brg, dated 12/4/96
  B-34674 Bearing Cap - Inner - 22226 Brg, dated 12/4/96
  B-34673 Bearing Cap - Outer - 22226 Brg, dated 12/4/96
  C-34680, Rev B, Bridge Drive Assy, (portions of drawing only)
  B-34671 Idler Shaft - Trolley, dated 12/4/96
  B-34672 Driver Shaft - Trolley, dated 12/4/96
  B-34633 Sill Pin, dated 2/5/97
  B-34654 Retainer Plate, dated 2/5/97
  B-34670 Wheel Trolley, dated 12-4-97
  B-34676 Bearing Cap Spacer 22226 Brg, dated 12/4/96
  C-34669 Wheel Assy - Driver Trolley, dated 1/6/97

Our review has been limited to the above referenced documents with the primary focus on design reports DR-1 through DR-5. We have not performed a detailed check of the analysis and calculations but, where available, we have reviewed to assess if the seismic analysis, modeling, input parameters, assumptions, results, and design conform to the structural design requirements of Specification WHC (or HNF)-S-0468 and ASME NOG-1, Section NOG-4000. No independent analysis or calculations were performed to verify the mathematical accuracy of the design inputs and results. A brief description of the analysis methodology, design, and results are given herein for each report. Specific comments on each design report are included in the Review Comment Record (RCR) forms.

Design Report 1 - "Hanford MHM Seismic Analysis of the Hanford MCO Handling Machine", GEC Alsthom Report ESL/R(96)083, Rev. 2, dated October 1997.

This report presents results of seismic analysis of the MHM subjected to a Safe Shutdown Earthquake (SSE). The results are in support of and for use in the detailed design of the MHM, trolley, main gantry beams, end carriages and seismic restraints performed by Ederer in DR-3, DR-4, and DR-5. Seismic input data for the MHM Design Response Spectra which is taken as the Design Basis Earthquake (DBE), which is equivalent to a SSE, are found in Appendix B, Figures 1 and 2, of the specification HNF-S-0468, Rev 3. The design response spectra in these figures were based on the a damping value of 5% of critical damping. These response spectra are based on the analysis performed in Structural Calculations CSB-S-0009, "Crane Loads (Vault ISRS)", dated 6/10/96.

The 3D finite element modal and response spectrum analysis has been performed using ANSYS Version 5.2. We reviewed Reference 9, in the DR-1, Hanford MCO Handling Machine Section Properties and Lump Mass and find its methods and results acceptable. The MHM model for seismic analysis, restraint conditions at the nodes, trolley positions, and combination of modal responses (grouping method was used), and combination of three components of earthquake are all in conformance with NOG-1-1995. The resultant forces, and moments due to seismic plus dead load combinations were post processed in accordance of NOG-4321, 4322 and 4324.

The report stated that the requirements of NOG-4330 Buckling, NOG-4340 Allowable Deflection and Cambers, and NOG-4350 Fatigue were not included. These requirements have been addressed by Ederer in their design report DR-4.

The objectives of the analysis as outlined in Section 1.3 of the DR-1 were to:

a) Calculate the maximum seismic stresses in the gantry, trolley, turntable and turret and show that they are linear-elastic and below the allowable stresses of ASME NOG-1-1995;

b) Calculate the maximum nose unit displacements due to translation and rotation of the MHM in order to be able to demonstrate that the MCO will not lock-up between the turret and storage tube during transfer and that loss of containment does not result from excessive movement at the 'O'-ring seals between the turret and the interface ring;

c) through k) Calculate forces and moments in various component of the MHM for use in design by Ederer.

Analysis was performed with the assumption that all active seismic restraints are engaged and the passive restraints are in contact with the rails. Trolley vertical direction seismic loads are transmitted downward through the wheels and upward through the seismic

restraint. The upward seismic restraint is through connection between the trolley and the underside of the top inner flange on the bridge girders. The combination of vertical forces and horizontal seismic accelerations may cause uplift on one side and downward force on the other side. To cover these cases the following combination of wheel and seismic restraints have been analyzed and presented in the report:

A) All load vertical down at wheels.
B) Uplift at seismic restraint on girder A, downward at wheels on girder B.
C) Uplift at seismic restraints on girder B, downward at wheels on girder A.
D) Uplift at seismic restraint at trolley east end, downward on wheels at trolley west end.
E) Uplift at seismic restraints at trolley west end, downward on wheels at trolley east end.

These have been analyzed for all trolley positions (midspan, quarter span, end span) and results presented in Appendices A to E of DR-1.

The appendices consist of summary tables, which present the seismic analysis results. Each appendix consists of the following tables:

Table 1 Forces at trolley seismic restraints
Table 2 Forces at bridge seismic restraints
Table 3 Nose unit displacements
Table 4 Summary of trolley stresses
Table 5 Summary of gantry stresses
Table 6 Summary of end carriage stresses
Table 7 Summary of turret stresses
Table 8 Summary of turntable stresses
Table 9 Summary of trolley festoon stresses
Table 10 Summary of trolley walkway stresses
Table 11 Summary of trolley handrail stresses
Table 12 Forces and moment summary - turntable bearing
Table 13 Forces and moments summary - nose casting bearing
Table 14 Forces and moments summary on turret bolted joint
Table 15 Forces and moments summary on plug shield bolted joint
Table 16 Forces and moments on main gantry beam to end carriage bolted joints
Table 17 Forces and moments main gantry beams bolted joints
Table 18 Walkway bolt forces acting on a pair of vertically aligned bolts
Table 19 Handrail bolt forces acting on a pair of vertically aligned bolts
Table 20 Summary of gantry stresses under the trolley
Table 21 Summary of gantry forces and moments under the trolley

The girder beam and trolley are a welded fabrication of A516 Grade 70 and A36 steels. In the stress evaluation of the girder and trolley 40.2 ksi yield strength of steel was used, which is based on certified material test report (CMTR). Our review of the CMTR indicate the lowest yield value of 39.2 ksi. Generally for analysis/design purposes, one would normally use the minimum specified yield strength value, which is 38 ksi for A516 Grade 70, and 36 ksi for A36 steel.

Tables 4 through 11, of the Design Report 1, summarized element stresses, for the three trolley positions. The highest stress ratios, from these tables are listed in Table DR1 below:

Item	Tables A Stress Ratio	Tables B Stress Ratio	Tables C Stress Ratio	Tables D Stress Ratio	Tables E Stress Ratio
trolley	0.77	0.88	0.92	0.8	0.85
gantry	0.75	0.78	0.78	0.73	0.75
end carriage	0.88	0.84	0.85	0.79	0.87
turret	0.67	0.76	0.72	0.66	0.73
turntable	0.55	0.58	0.6	0.63	0.68
trolley rotate festoon	0.82	0.95	**1.07**	0.93	0.85
trolley walkway	**1.66**	**1.47**	**1.53**	**1.58**	**1.55**
trolley handrail	**1.8**	**1.83**	**1.84**	**1.77**	**1.91**

Table DR1 - Highest Stress Ratios

Our comments on this report are listed in the Review Comment Record (RCR) forms. The significant issues are: a) the use of "insignificant modes" setting of 0.001, b) the "total mass" extracted in the dynamic analysis, and c) the use of CMTR based yield strength values versus ASTM standard minimum specified yield strength in the stress demand/capacity ratio checks. Also, the trolley walkway and handrail are overstressed as shown in the Table DR-1 and they need further evaluation by GECA or Ederer to demonstrate their acceptance.

Design Report 2 - "Hanford MHM 7% Damping Response Spectra Seismic Analysis of the Hanford MCO Handling Machine", GEC Alsthom Report ESL/R(97), Issue A, dated October 1997.

This confirmatory analysis report presents results of the seismic analysis performed on the MHM subjected to the 7% damped response spectra and provides comparison with the 5% damped spectra results in the Design Report 1. The 7% damped design spectra used in this analysis were based on SASSI analysis which considered soils structure interaction, variation of soil properties (Cv=1.0), and input motion applied at top of the competent soil layer at 8 ft below grade. The SASSI analysis was completed after the MHM had been designed in accordance with Design Response Spectra and was in fabrication. Per NOG-4153.8, the 7% is an appropriate damping value for crane analysis with SSE. The SASSI analysis generated in-structure response spectra are more appropriate and accurate for the design of the MHM.

The analysis results are presented only for the case of "all load downward at trolley wheels", which corresponds to load case A, Appendix A, of the Design Report 1. We expect similar results for the other cases (i.e. corresponding to Appendices B through E).

Table DR2A lists the governing stress ratios from the two analysis reports, and the percent reduction in the stress demand for the 7% damped response spectra.

Item	7% damping Stress Ratio	5% damping Stress Ratio	stress reduction in percent
trolley	0.73	0.77	5.2
gantry	0.73	0.75	2.7
end carriage	0.84	0.88	4.5
turret	0.64	0.67	4.5
turntable	0.51	0.55	7.3
trolley rotate festoon	0.74	0.82	9.8
trolley walkway	1.37	1.66	17.5
trolley handrail	1.74	1.8	3.3

Table DR2A - Governing Stress Ratio Comparison for Load Case A

Trolley and bridge seismic forces comparison are shown in Table DR2B and Table DR2C, respectively.

Load Case	Element Number	Fx@7% (kN)	Fx@5% (kN)	reduction	Fy@7% (kN)	Fy@5% (kN)	reduction	Fz@7% (kN)	Fz@5% (kN)	reduction
trolley mid span	323				290.3	307.3	5.5%	493.7	539.5	8.5%
	324									
	326	493.1	543.3	9.2%						
	328									
	329				424.8	447.4	5.1%	648.1	703	7.8%
	330				428.4	451	5.0%	484.4	529.9	8.6%
	331									
	333	480	529	9.3%						
	335									
	336				428.4	451	5.0%	635.1	687.9	7.7%
trolley quarter span	321				280.6	296.2	5.3%	428.7	470.3	8.8%
	322									
	324	690.1	727.3	5.1%						
	326									
	327				539.8	565.9	4.6%	780	835.6	6.7%
	328				548.3	575.2	4.7%	415.6	456	8.9%
	329									
	331	692.1	730.1	5.2%						
	333									
	334				548.3	575.2	4.7%	750.2	802.3	6.5%
trolley end span	325				196.4	207.2	5.2%	395.2	434.4	9%
	326									
	328	549.1	593.8	7.5%						
	330									
	331				438.6	472.1	7.1%	569.5	604.9	5.9%
	332				455.8	489.8	6.9%	372.4	408.3	8.8%
	333									
	335	536.1	576.1	6.9%						
	337									
	338				455.8	489.8	6.9%	573.3	613.1	6.5%

Table DR2B - Trolley Seismic Forces Comparison

Load Case	Element Number	Fx@7% (kN)	Fx@5% (kN)	reduction	Fy@7% (kN)	Fy@5% (kN)	reduction	Fz@7% (kN)	Fz@5% (kN)	reduction
	764	998.4	1188	16.0%						
	768	1002	1120	10.5%						
	755				1040	1086	4.2%			
trolley mid	781				1031	1078	4.4%			
span	737							828.3	872.3	5.0%
	742							806.9	849.8	5.0%
	764							878.5	931.7	5.7%
	768							868.5	921.9	5.8%
	763	1148	1249	8.1%						
	767	1157	1260	8.2%						
	753				853.1	906.2	5.9%			
trolley	780				731.6	772.2	5.3%			
quarter	735							504.6	538	6.2%
span	740							474.6	506.1	6.2%
	763							961.5	1023	6.0%
	767							973.3	1036	6.1%
	765	841.1	930.3	9.6%						
	769	857.6	950.7	9.8%						
	756				533.8	568.4	6.1%			
trolley end	782				1416	1526	7.2%			
span	738							469.5	508.7	7.7%
	743							468.7	507.7	7.7%
	765							901.3	953.8	5.5%
	769							915.5	960.2	4.7%

Table DR2C - Bridge Seismic Forces Comparison

The comparison of the 7% damped spectra versus the Design Response Spectra (DBE) are shown on pages 13, 14 and 15 of the DR-2. The 7% damped response spectra in the East-West direction are lower, and in the North-South direction are generally lower with few exceptions. Vertical direction response spectra are higher for frequencies above 3 Hz, however, the horizontal response spectra are significantly lower in the same frequency range. Since the design is based on the SRSS of the three components of earthquake, the net effect was lowering of resultant stresses and loads.

We concur with the Design Reports 2 conclusion that there is an overall reduction in response of the MHM subjected to the 7% damped response spectra compared to the Design Response Spectra used in the original design analysis. The 7% damped spectra reduces the stress demands in the range between 2.7% and 7.3% in the main components of MHM. The 7% damped spectra reduces the seismic support loads for trolley between 5.1% to 9.3%, and for the bridge between 4.2% to 16.0%.

Design Report 3 - "Crane Operational Loads NOG-4000", Ederer Cranes Report, Sections A, B, & C.

This report documents MHM design for the operational loads (dead load, lifted load, vertical and horizontal impact loads). Section A covers Trolley and Trolley Drive, Section B covers Bridge Truck and Bridge Design, and Section C covers Bridge Girder and End Tie Beam

design. The design of the MHM is governed by operational plus seismic loading which are covered in DR-4 and DR-5. However, the element section properties derived in the Design Report 3 and the design methodology are used later by Ederer for operational plus seismic loading in Design Reports 4 and 5.

Our comments are included in the RCR forms. The key issue is the location of the longitudinal stiffeners in the girder beams are not located in accordance with CMAA section 3.5.2.2.

Design Report 4 - "Bridge Girder and End Tie: Seismic Loading," Ederer Cranes Report, Section D.

This report covers detailed analysis of the MHM bridge girder and end tie beam for seismic plus operational loading. Seismic forces were obtained from GECA DR-1, "Hanford MHM Seismic Analysis of the Hanford MCO Handling Machine", Rev 2, dated October 1997. This calculation covers design details of the bridge girder and end tie beam, including design of girder splice, girder section at manhole, rail support beam, girder plate buckling, rail clips, girder connection to end tie beam, end tie beam lug plates and welds, and (Johnson Industries Dual SBC100) rail clamp bolts.

Our comments are included in the RCR forms. The main concern is that CMTR based yield stress values were used to justify the design adequacy and not the code minimum specified yield strength values. Furthermore, each built up section of the girder design is based on CMTR yield strength specific to the section rather than using the lowest CMTR value throughout the length of the girder. As shown in DR-4, sheets MAT21 and MAT22, typically, the higher strength CMTR plates were located in the center of the bridge girder and the lower strength CMTR value plates were located farther away from the center. These design CMTR values for individual plates in accordance to their placement in the bridge girder are not identified anywhere on the drawings. It is apparent that the design would not meet the requirements if the minimum specified yield values were used, but confirmed to be adequate based on CMTR values.

Design Report 5 - "Trolley: Seismic Loading," Ederer Cranes Report, Section E.

This report covers detailed analysis of the trolley and parts of the bridge truck for seismic plus operational loads. Seismic forces were obtained from GECA DR-1, "Hanford MHM Seismic Analysis of the Hanford MCO Handling Machine", Rev 2, dated October 1997. Our comments are included in the RCR forms. The calculations cover design of the trolley frame section at the wheel, trolley wheel retaining plates, trolley seismic uplift restraint, bridge truck seismic uplift restraint, bridge wheel flange, bridge truck section at the wheel, bridge wheel retaining plates, bridge truck center section, and bridge truck pin. The main concerns are:

1. Trolley seismic restraint plate, the 41"x9"x1-3/4", the combined stresses through section at bolt holes exceed the allowables.
2. SAE Grade 5 bolts were used for the trolley seismic restraint bolts. These bolts are not listed as an acceptable type in Table NOG-4221-1. Furthermore, the four 1 inch diameter bolts specified are overstressed in shear.
3. SAE Grade 5 bolts were used for the bridge seismic restraint, for the bridge wheel retaining plate, and SAE Grade 8 bolts were used for the Bridge Truck Pin End Plate Bolts. These bolts are not listed as an acceptable type in Table NOG-4221-1.
4. Classification of bolts as mechanical vs. structural.

Conclusions and Recommendations

The seismic analysis computer model, boundary restraints, loading combinations, and "global" stress evaluation analysis of the MHM given in GECA DR-1 and DR-2 are in conformance with NOG-1-1995. "Grouping Method" for mode combination used in the response spectrum analysis is also in accordance with NOG-1-1995, Section 4153.1. It should be noted that the "global" stress evaluation of the girder and trolley are based on the 40.2 ksi yield strength as determined by CMTRs and not on the code minimum specified values. The governing "global" demand/capacity stress ratios results are:

Item	5% Damped DBE Stress Ratio
trolley	0.92
gantry	0.78
end carriage	0.88
turret	0.76
turntable	0.68
trolley rotate festoon	**1.07**
trolley walkway	**1.66**
trolley handrail	**1.91**

The stress ratio exceed the allowable unity for the trolley festoon, trolley walkway, and trolley handrail. GECA explanation is that the high stresses are due to the limitations of the modeling approach used. It is recommended that alternate calculations be provided to justify design adequacy of these components. Also, the calculated nose unit displacements due to seismic loads needs to be compared with the available clearance to assure no interaction with the deck occurs.

The confirmatory analysis of MHM for the 7% damped response spectra showed that there is an overall reduction in the stress ratios, and forces as compared to the original design in-structure response (DBE) spectra.

In general, Ederers design calculations in DR-3, DR-4 and DR-5 were difficult to follow due to little explanations given. The evaluation of very complex weldments with formulas for somewhat similar cases in referenced publications is questionable, considering the minimal margins with allowable stresses often provided. We recommend that confirmatory analysis of some critical weldments be performed using finite element analysis. We also recommend that a summary report be included to document the contents of each calculation section and summary table of the demand/capacity ratios for critical components.

Final analysis and design calculations from GECA and Ederer for project records should include all computer analysis files on CD ROM, hard copies of analysis models, nodal numbering, input parameters, design calculations and the computer code verification and validation documentation.

None of above reports covered hoist and turret design calculations.

List of Attachments:

1. Work authorization letter by DE&S Hanford, DESH-97622009 dated January 5, 1998.
2. Design Basis Earthquake Response Spectra at 5% critical damping.
3. Earthquake Response Spectra at 7% critical damping.
4. Review Comment Records (RCR) Forms.

A1H M

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Subject: REVIEW OF SEISMIC ANALYSIS AND SEISMIC STRUCTURAL CALCULATIONS FOR THE MULTI-CANISTER OVERPACK HANDLING MACHINE, LETTER OF INSTRUCTION #28, PROJECT W-379

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P.O. Box 350
Richland, WA 99352

January 5, 1998

DESH-9762009

Mr. P. J. Bedell, Project Director
Fluor Daniel Northwest, Inc. SO-04
Post Office Box 1050
Richland, Washington 99352

Dear Mr. Bedell:

REVIEW OF SEISMIC ANALYSIS AND SEISMIC STRUCTURAL CALCULATIONS FOR THE MULTI-CANISTER OVERPACK HANDLING MACHINE, LETTER OF INSTRUCTION #28, PROJECT W-379

Fluor Daniel, Inc. (FDI) is authorized to proceed with a review of the seismic analysis and seismic structural calculations for the Multi-Canister Overpack Handling Machine (MHM) as outlined in the attached Statement of Work (SOW).

FDI is requested to review the SOW and prepare an Engineering Deviation Notice for DE&S Hanford, Inc. (DESH) review and approval consistent with the requested workscope and target completion dates.

The technical review materials as referenced on the SOW will be provided to you separately. Questions or clarifications on these materials should be referred to C. E. Swenson on 376-0288. If you have any other questions regarding this action, please contact me on 376-3059.

Sincerely,

G. D. Bazinet, Design Authority
Spent Nuclear Fuel Canister Storage Building
Spent Nuclear Fuel Project

tdm

Attachment

DESH-9762009

ATTACHMENT

Statement of Work

Consists of 2 pages,
including cover page

Rev 0, 12/12/97

Statement of Work
Review of Seismic Analysis and Seismic Structural Calculations
for
Spent Nuclear Fuel Canister Storage Building
MCO Handling Machine

1. Review the seismic analysis report (Reference 1) for accuracy and consistency in assumptions and that the analytical methods are consistent with the stress results and design/capacity ratios.

2. Perform a detailed review of the manual structural calculations (References 4 and 5) at key critical sections (bridge mid-span, end-tie to bridge girder connection, end-tie to truck connection, and both bridge & trolley seismic restraints) with with seismic loads.

3. Review the seismic 7% analysis (Reference 2) for correct application and that the results are either bounded by Reference 1 or does not cause stresses that exceeds design code allowables.

4. Provide a draft letter report, reviewer qualifications, and one-over-one supervisory review and approval.

   Target Date: February 2, 1998.

5. Present and discuss the results of the review to DESH Engineering in Richland., Wa. Incorporate any comments to review report and clarify questions concerning analytical methods and assumptions.

   Target Date: February 16, 1998.

6. Consult with MHM supplier design analysts to address DESH and other open questions (as required).

References (technical review materials):

1. "Hanford MHM Seismic Analysis of the Hanford MCO Handling Machine," GEC-Alsthom Report ESL/R(96)083, Rev.2, dated October 1997.

2. "Hanford MHM 7% Damping Response Spectra Seismic Analysis of the Hanford MCO Handling Machine," GEC-Alsthom Report ESL/R(97)038, Issue A, dated October 1997.

3. "Crane Operational Loads NOG-4000," Ederer Cranes Report, sections A, B, and C.

4. "Bridge Girder and End Tie: Seismic Loading," Ederer Cranes, Section D.

5. "Trolley: Seismic Loading," Ederer Cranes, Section E.

6. GEC-Alsthom drawings 362A0551.

7. Ederer drawings D-34960 Issue B and D-35205 Issue A.

APPENDIX B

FIGURE 1

T (sec.)	0.01	0.03	0.13	0.68	4.00	10.00
S_a (g)	0.35	0.35	0.74	0.74	0.11	0.02

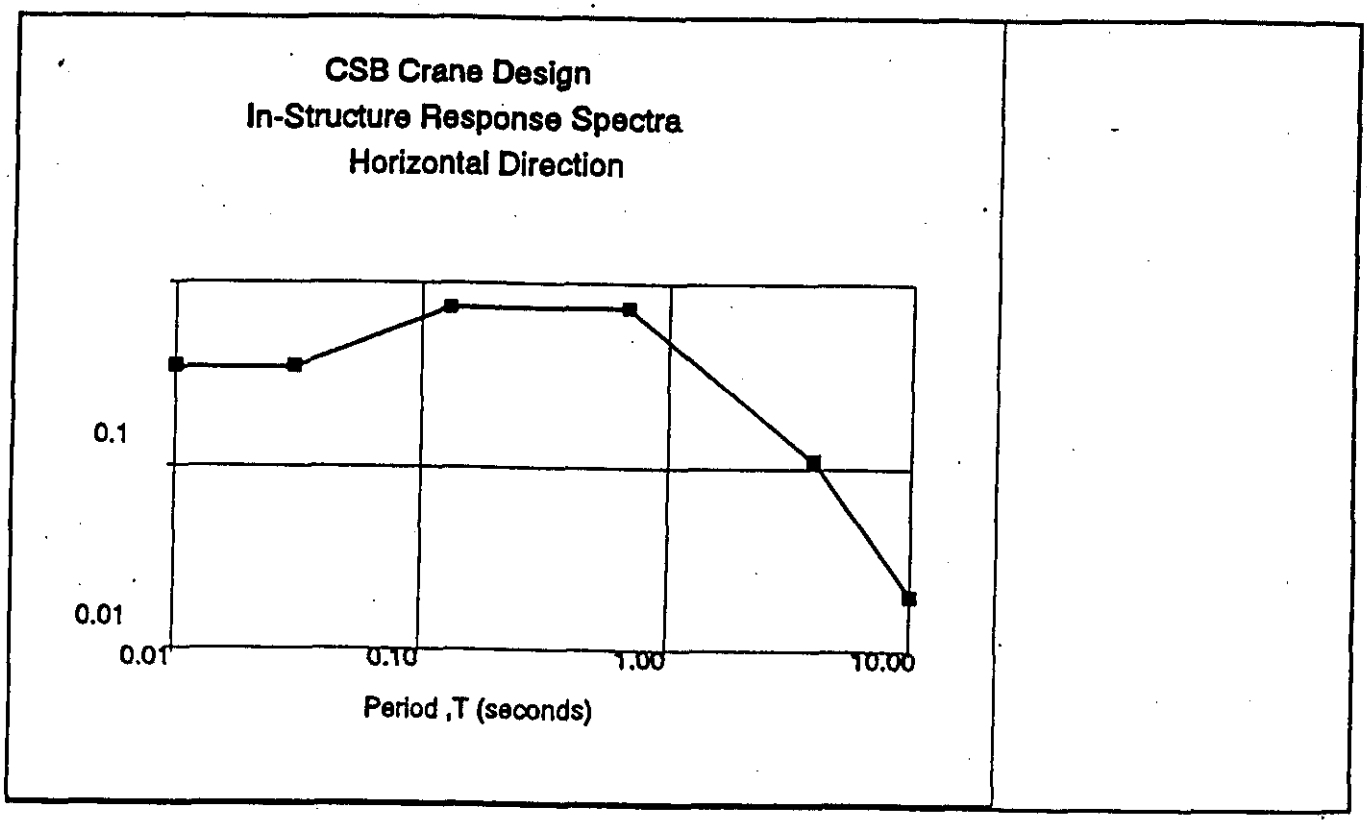
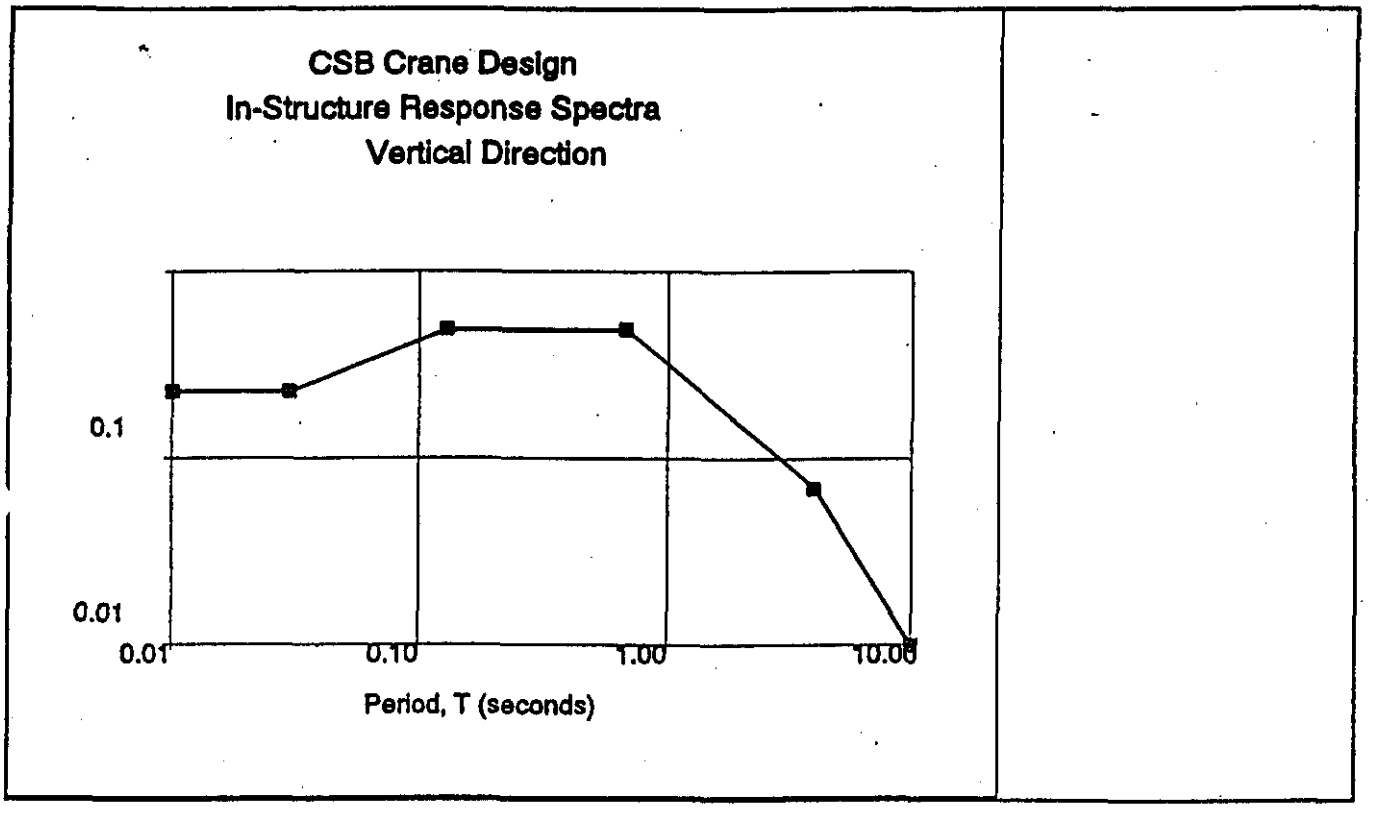


FIGURE 2

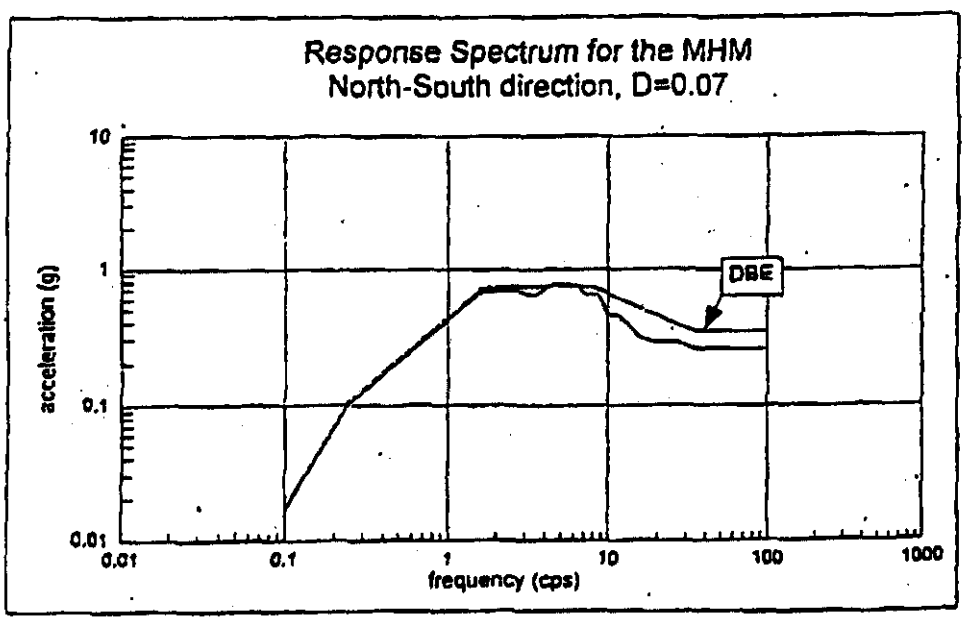
T (sec.)	0.01	0.03	0.13	0.68	4.00	10.00
S_a (g)	0.23	0.23	0.49	0.49	0.07	0.01



SNF-CSB
FDI Contract 60460200
Sept 5, 1997

Response Spectrum for the MHM North-South Direction

frequency (cps)	period (sec)	accel @ D=7% (g)	DBE @ D=5% (g)	% change from DBE
0.100	10.00	0.017	0.0178	-6.2
0.248	4.034	0.102	0.1096	-6.6
1.600	0.625	0.680	0.7213	-5.7
2.070	0.483	0.700	0.7405	-5.5
2.530	0.395	0.700	0.7405	-5.5
3.450	0.290	0.640	0.7405	-13.6
4.500	0.222	0.770	0.7405	4.0
5.670	0.176	0.770	0.7405	4.0
5.850	0.171	0.750	0.7405	1.3
6.350	0.157	0.750	0.7405	1.3
7.150	0.140	0.650	0.7405	-12.2
8.550	0.117	0.650	0.7149	-9.1
10.00	0.100	0.460	0.6580	-30.1
11.50	0.087	0.460	0.6112	-24.7
12.90	0.078	0.410	0.5751	-28.7
16.00	0.063	0.310	0.5132	-39.6
20.00	0.050	0.290	0.4581	-36.4
27.00	0.037	0.290	0.3892	-25.5
34.00	0.029	0.260	0.3500	-25.7
100.0	0.010	0.260	0.3500	-25.7



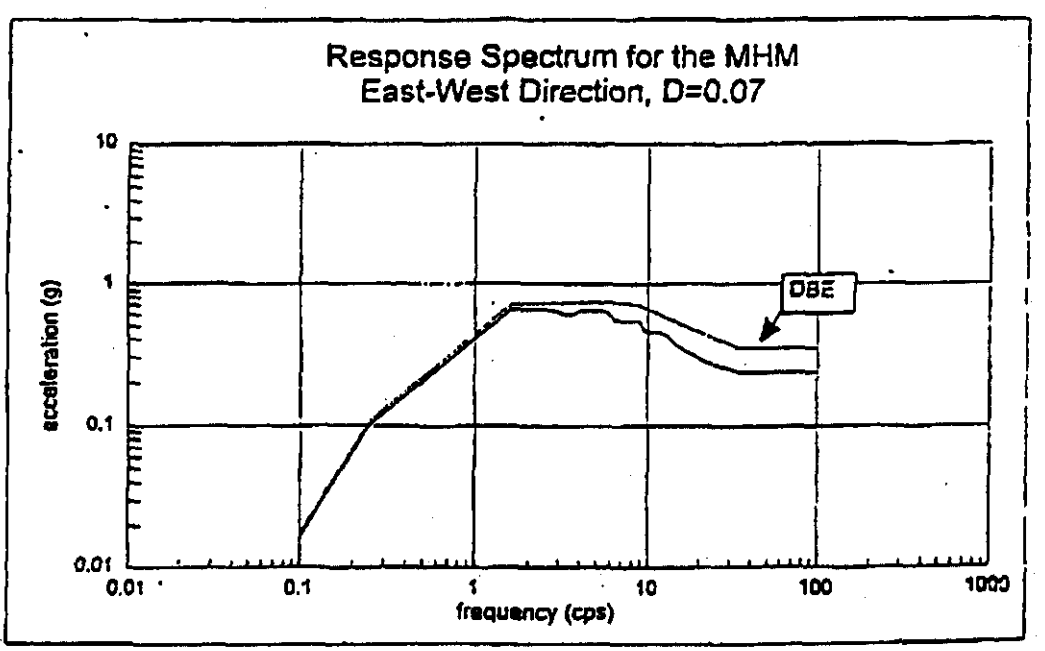
Note: This Spectrum is based on 3D-SSI Analysis (CSB-S-0052) using "SASSI" computer code and ISRS developed in calculation CSB-S-0053

Figure 2. Response Spectrum for the MHM North-South Direction. Damping = 7%.

SNF-CSB
FDI Contract: 60460200
Sept 5, 1997

Response Spectrum for the MHM East-West Direction

frequency (cps)	period (sec)	accel @ D=7% (g)	DBE @ D=5% (g)	% change from DBE
0.100	10.00	0.017	0.0178	-6.2
0.248	4.034	0.102	0.1096	-6.6
1.600	0.625	0.660	0.7213	-8.5
2.530	0.395	0.660	0.7405	-10.9
3.550	0.282	0.590	0.7405	-20.3
3.950	0.253	0.640	0.7405	-13.6
5.610	0.178	0.640	0.7405	-13.6
6.400	0.156	0.550	0.7405	-25.7
8.750	0.114	0.550	0.7062	-22.1
9.600	0.104	0.460	0.6724	-31.6
11.50	0.087	0.460	0.6112	-24.7
12.90	0.078	0.430	0.5751	-25.2
14.40	0.069	0.370	0.5428	-31.8
22.00	0.045	0.280	0.4337	-35.4
34.00	0.029	0.240	0.3500	-31.4
100.0	0.010	0.240	0.3500	-31.4



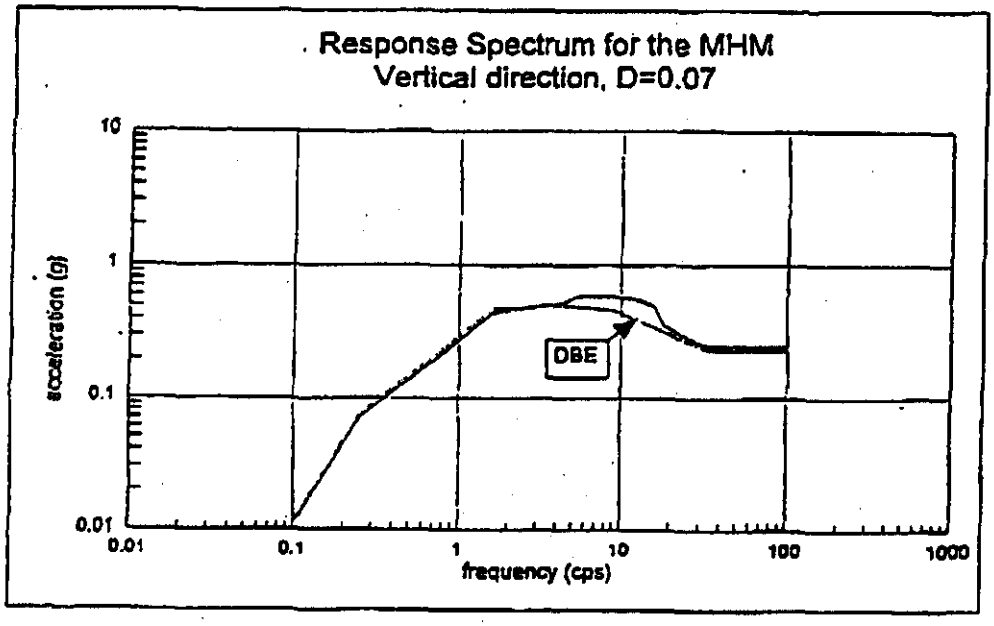
Note: This Spectrum is based on 3D-SSI Analysis (CSB-S-0052) using "SASSI" computer code and ISRS developed in calculation CSB-S-0053

Figure 1. Response Spectrum for the MHM East-West Direction. Damping = 7%.

SNF-CSB
FDI Contract: 8046020(
Sept 5, 199?

Response Spectrum for the MHM Vertical Direction

frequency (cps)	period (sec)	accel @ D=7% (g)	DBE @ D=5% (g)	% change from DBE
0.100	10.00	0.011	0.0119	-6.2
0.248	4.034	0.068	0.0731	-6.6
1.600	0.625	0.445	0.4809	-7.5
4.500	0.222	0.530	0.4937	7.4
6.310	0.158	0.585	0.4937	18.5
9.030	0.111	0.586	0.4630	26.3
12.32	0.081	0.565	0.3929	41.3
15.70	0.063	0.506	0.3456	46.1
18.00	0.056	0.360	0.3215	12.0
29.00	0.036	0.265	0.2498	6.1
34.00	0.029	0.260	0.2333	7.1
100.0	0.010	0.250	0.2333	7.1



Note: This Spectrum is based on 3D-SSI Analysis (CSB-S-0052) using "SASSI" computer code and ISRS developed in calculation CSB-S-0053

Figure 3. Response Spectrum for the MHM Vertical Direction. Damping = 7%.

REVIEW COMMENT RECORD (RCR)	1. Date 04/01/98	2. Review No. 1
	3. Project No. CSB	4. Page 1 of 4

5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 1: GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
1	Tables A2, B2, C2, D2, E2 of the report: Summation of Static Loads Fz for Trolley Quarter Span is 3413.2kN, versus 3948.8kN for Trolley Midspan, and End Span Load Cases. (Note: this is 535.6kN or 120,400 lbs difference.) Figure G13 depicting the Trolley Quarter Span model indicates that erroneous element numbers were used to print Bridge Seismic Restraint Forces. We believe these should be 766, 770, 757, 783, 739, 744, 766, 770. Review all results affected by this comment.			
2	Section 10.3, Nose Unit Displacement, Page 24 of the report: a) Using total weight of the MHM to predict static deflection due to shield skirt mass is incorrect. Conservatively, the static deflection, including shield skirt mass, could be calculated in proportion to the total weight of trolley (including turret and MCO). Total weight of trolley (including turret and MCO) is 1624.6 kN based on Table A1, or 165.7 Tonne. Therefore, the predicted static deflection including the shield skirt mass is (42.21mm x (1+12.3/165.7)) = 45.34 mm. b) Verify the maximum nose displacements (horizontal and vertical) does not exceed available clearance with the deck.			

REVIEW COMMENT RECORD (RCR)	1. Date 04/01/98	2. Review No. 1
	3. Project No. CSB	4. Page 2 of 4

5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 1: GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
3	Tables 10 and 11, Appendices A to E, and page 25 of the report: ".... inspection showed that the high stresses are due to limitations of the modeling approach...." Provide alternate calculations to demonstrate that the stresses for "overstressed" members are within acceptable limits.			
4	Sheet 1: Actual Yield Strength of Steel used: The actual yield strength of steel based on CMTRs have been used in the code assessment and not the code minimum specified material strength. Client should review this for acceptability.			
5	Section 1.1, Page 3 of the report states that this report does not cover the requirements of NOG-4330 Buckling, NOG-4340 Allowable Deflection and Cambers, and NOG-4350 Fatigue. Need a statement explaining why these are not covered.			
6	In Tables F1, F2, F3 the extracted mass varies from 308.9 to 397.7 tonnes however the total mass fraction for all modes extracted is always 1.000. (The total mass of the structure, as modeled, is 414.86 tonne.) Explain how was total mass fraction calculated.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 1: GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
7	a) Section 6.0, page 14 of the report: insignificant mode limit was set at 0.001. (Note *this is the default value in ANSYS program.) All modes less than this threshold were* excluded from the modal combinations. In the Table F1 in X direction 54 modes out of 73 total modes extracted fall into the "insignificant" mode category. This is typical for all Tables F1 through F3. Provide justification for setting insignificant mode limit at 0.001. b) Section 6.0, page 14: the total missing mass has been calculated as the sum of all the insignificant modes below 33.33Hz plus the missing mass above 33.33Hz. The ZPA acceleration was applied to the "missing mass" in an equivalent static analysis and scaling up the results by the ratio of the missing mass to the total mass. If the ZPA acceleration was applied to the "insignificant" modes, it is incorrect. The modes <u>below</u> 33.33 Hz should have acceleration as defined by the response spectrum for the frequency of that mode, regardless of its mode coefficient value.			

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Design Report 1: GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
8	Seismic analysis was done without shield skirt in the raised position. It is possible that during transport of the MCO earthquake event could occur. An evaluation of increased stresses in the crane when the skirt is in the up position needs to be documented.			
9	MCO hoist: The seismic loads on the hoist and its design were not included in the calculation package.			
10	The design of the turret is not documented in the calculation package.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 2: GEC-Alsthom Report ESL/R(97)038, Issue A, dated October 1997 (7% Damping Response Spectra Seismic Analysis)	CSB	G. Kuilanoff	FDI Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
1	(This comment is similar to comment #1 for GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997) Tables A2 and C2 of the report: Summation of Static Loads Fz for Trolley Quarter Span is 3413.2kN, versus 3948.8kN for Trolley Midspan, and End Span Load Cases. (Note: this is 535.6kN or 120,400 lbs difference.) Figure G13, (from GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997) depicting the Trolley Quarter Span model indicates that erroneous element numbers were used to print Bridge Seismic Restraint Forces. We believe these should be 766, 770, 757, 783, 739, 744, 766, 770. Review all results affected by this comment.			
2	This report evaluated the case for all loads vertical downward at the wheels. Is this the governing case? Include an assessment of results expected for other cases covered in Appendices B, C, D, and E of the original report, GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 3: Crane Operational Loads NOG-4000, Ederer Cranes Report, Sections A,B, and C	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
1	Sections A sheet TF1 and Section B sheet TS1: a) Extreme environmental loads are not evaluated in this section. It would be preferable for clarity to say so. b) The statement concerning Pc3 governs for operational loads needs to be demonstrated. Otherwise all applicable loading combinations need to be evaluated.			
2	Section B, Sheet TS5: a) Longitudinal Horizontal Load should be based on 10% of the trolley dead load and the maximum lifted load, i.e. 0.10(347.9+30)= 37.7kips. This load should be applied to one side of the end truck only, having 4 wheels. Therefore, the side force on wheels should be 9.45k per wheel. b) The 48.14k transverse force should be distributed in proportion to trolley location on the bridge. The trolley at end location would be most critical. (See section 3.3.2.1.1.5 CMAA #70) Review all other results affected by this comment (i.e. on sheets TS7, TS8, TS23, TS24)			

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Design Report 3: Crane Operational Loads NOG-4000, Ederer Cranes Report, Sections A,B, and C	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
3	Section B, Sheet TS20: a) Section properties for the bridge truck main section should be based on the net section at the center line of the pin. Review section properties used in the calculations. c) Explain use of 27in for the moment arm instead of 30in which is the dimension between center of wheel and the centerline of the truck.			
4	Section C, Sheet MM1: A review of computer runs, indicate that Trolley was not modeled. (Nodes 46, 47, 48, and 52 are not attached to the structure. See computer output page 6). Trolley load was applied at nodes at trolley wheel point locations. Add explanatory note of what was modeled, and justification for the approach taken.			
5	Section C, Sheet MM5: a) Boundary conditions modeled are not according to NOG-4154.3-1. b) Explain reason for using springs in the X direction.			
6	Section C, Sheet L-1: Critical Load and Credible Critical Loads? Should this be a Lifted Load? Per HNF-S-0468 Rev. 3, Section 3.2.1.1 crane is to be designed , fabricated, etc. primarily in accordance with ASME NOG-1 Type I. In Sect 3.2.1.4 it is stated the MHM does not have a critical load per the definitions of NOG-1.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 3: Crane Operational Loads NOG-4000, Ederer Cranes Report, Sections A,B, and C	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
7	Section C, Computer Analysis Results: Load Case 4 and Load Case 6 displacements in X are approximately 9.5 inches. This is unrealistic. See Trolley Center Span Computer output pages 32, 33 , 40 and 41, and Trolley End Computer output pages 31, 32, 39 and 40. See also comment # 5.			
8	Section C, Sheet L-4: Py loads should be Pz loads.			
9	Section C, Sheet G18: per CMAA section 3.5.2.2 longitudinal stiffeners should be placed so that their centerlines are approximately 0.25 and 0.55 times the distance, respectively from the inner surface of the compression flange plate to the neutral axis. Based on 41.61 in distance to the neutral axis, longitudinal stiffeners should be located at 10.4 inches and 22.9 inches respectively. On the drawing, D34778 Sht 3, and in the calculations, they are located at 18.31 inches and 35.69 inches respectively. Provide justification.			
10	Section C, Sheet G23: Maximum wheel load used from load case 6 which included impact is 109.81k. In Table C1, of GECA ESL/R(96)083 report, the maximum trolley wheel load for static load case only is 592kN=133k. Reconcile the difference, even though the stress check may still be OK. (Note: The difference, we believe is because Ederer hand calculated trolley wheel reactions, which did not include trolley frame and bridge girder interactions.)			

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Design Report 3: Crane Operational Loads NOG-4000, Ederer Cranes Report, Sections A,B, and C	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
11	Section C, Sheet G50: In calculation of the net areas through the bolt holes, the width of the bolt hole should be taken as 1/16 in greater than the nominal diameter of the hole. (Ref. AISC ASD Specification, Sect B2)			
12	Section C, Sheet ET6: In the calculation of Ixx and Izz, the moment of inertia for the 75.5"x 5/8" plate which is at an angle, is incorrect. See AISC ASD pg 6-18 for proper formulation. In both cases the calculated moment of inertia of the plate at an angle was larger than the actual values.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 3: Crane Operational Loads NOG-4000, Ederer Cranes Report, Sections A, pages B, C, TF-1 through TF-9, and Section B, pages TS-13 through TS19	CSB	J. K. Strickler	FDRL/Mechanical	Richland, WA/ 509-376-5279

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
13	On page TF-7 at the bottom of the page in the calculation for the twist in the trolley drive shaft a formula is given with the terms in the denominator as E_s and I. I am assuming that "I" is the "K" term in Kent's Mechanical Engineers' Handbook Ed12 page 8-29 and not the moment of inertia which it generally represents. Also, that E_s is the modulus of rigidity which for steel is 11E6 (from Kent's page 8-05). Using 11E6 instead of 12E6 gives a torsional twist of 0.081radians/ft which is very slightly above the allowable.			
14	The arithmetic on the third equation from the top of page TS-19 is incorrect but the margin of safety is greater than shown so this is acceptable.			
15	General: The calculations were difficult to follow at times because many terms were not defined or references given.			

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Design Report 4: Bridge Girder and End Tie Beam Loading: Seismic Ederer Cranes, Section D	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
1	Sheet SG1: How was the "governing case" determined? i.e. how does one know that for girder splice Table C17 Element 244 is governing over others in Tables A17, B17, D17, and E17? A general question to all of the calculations which use loads extracted from GECA Seismic Analysis Report - Provide explanation of how the "governing cases" were determined?			
2	Sheet SG3: In the referenced sheets G50 and G51, in the calculation of the net areas through the bolt holes, the width of the bolt hole should have been taken as 1/16 in greater than the nominal diameter of the hole. Revise sheets G50 and G51, and then revise SG3.			
3	Sheet SG5: Weld Check, Provide justification for using 11/16 of wheel load for the design of the weld. Generally, the maximum shear for a continuous two span beam with the concentrated wheel load at any point is equal to the applied concentrated wheel load. Review weld size requirement.			
4	In the calculation of the plate length to width ratio (α) , incorrectly, 60 inches was used for the plate length. The correct length is 72 inches, the distance between the vertical web stiffeners. Calculation needs to be revised.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 4: Bridge Girder and End Tie Beam Loading: Seismic Ederer Cranes, Section D	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
5	a) Sheet SG7: Explain reason for using Fy=46.3ksi based on CMTR. The lowest value we see for the web plate is 39.2 ksi, based on the sample QA7210, Sheet MAT14. b) Sheet SG11: Explain reason for using Fy=52.6 ksi based on CMTR. The lowest value we see for the flange plate is 50.4 ksi, based on the sample QA7197, Sheet MAT3.			
6	Sheet SG12 and SG14: a) Rail clip spacing varies from minimum of 6-3/4" to a maximum of 15-1/2". b) 4 clips effective assumed on Sheet SG12, and 6 clips effective are assumed on Sheets SG13 and SG14. Explain reason for variation in assumptions.			
7	Sheet SG16: How was the "governing case", presumably, Table C-16, quarter span, end 4, selected? The table lists "combined "as static plus seismic. Sometimes static minus seismic governs design, as was for the calculation on Sheet SG16. How was the "governing" dead minus seismic load selected?			
8	Sheet SG17: For the same bolt, p=3 inches (lengh of plate tributary to each bolt) along other direction governs. Review plate thickness required.			

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Design Report 4: Bridge Girder and End Tie Beam Loading: Seismic Ederer Cranes, Section D	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
9	Sheet SG21: Weld lug plate to web plate: 3.99 k/in reflects weld stress due to vertical load, and vertical component of horizontal load . Evaluate stresses in the weld due to X and Y horizontal loads, and then evaluate the resultant stress in the weld.			
10	Sheet SG21: Weld diaphragm plate to lug plates and web plates: Provide justification for using 1/2 of the total horizontal load in calculation of the torsional moment (My) for the weld evaluation.			
11	Sheet SG22: Reference should be made to Sheets ET24 and ET25, of Section C, for information on Johnson Industries Dual SB C100 Rail Clamp.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 5: Trolley: Seismic Loading, Ederer Cranes, Section E	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
1	Seismic Restraint Uplift Trolley, Sheet STF9: Check stresses for bending and tension at section through bolt holes. (With net section through bolt holes per AISC (Sect B2), the combined stress is 66.3 ksi > 45ksi allowable.)			
2	Sheet STF10: SAE Grade 5 bolts have been specified. Per NOG-1, Section NOG-4221 (a), fastener material for Type I cranes is acceptable if it is listed in Table NOG-4221-1. Also, see NOG-4252.2 and NOG-4315 (b). SAE Grade 5 bolts are not listed. The four 1 inch diameter bolts specified are overstressed. Review Design.			
3	Sheet STF11: 1-5/8 inches eccentricity of the load does not include fabrication nor misalignment tolerances. Weld size specified (5/16) is too close to what is calculated. Check weld to account for fabrication and misalignment tolerances.			
4	Sheet STS2: This Table D2, is different than Table D2 in the GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997, which we have in our possession. (The difference in the Trolley Quarter Span Loads. We believe this to be a correct Table, however we wonder why Table D2 and others in the GECA report are not.) We do not have these corrected(?) Tables A2 through E2 and cannot verify if Table D2 loads are governing.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 5: Trolley: Seismic Loading, Ederer Cranes, Section E	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
5	Sheet STS4, STS10 and STS11: a) We question the validity of hand analysis for such a complicated weldment . Ideally we would like to see finite element analysis of the section using shell elements. b) With the assumption used, on sheet STS10, the 24.4 ksi stress for the "circle reinforcement" is not the total stress at the section. The axial and shear stresses need to be added to obtain the total stress.			
6	Sheet STS6: Check maximum combined shear stress in the pin due to shear plus bending. (Ref NOG-4324.)			
7	Sheet STS7: Bridge Restraint, Check stresses for bending and tension using net section at bolt holes. (Ref to AISC Sect B2.)			
8	Sheet STS8: SAE Grade 5 bolts, SAE Grade 5 bolts are not listed as acceptable type in Table NOG-4221-1.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 5: Trolley: Seismic Loading, Ederer Cranes, Section E	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
9	Sheet STS9: In the sketch 112k lateral load should be 161k.			
10	Sheet STS9: Using 12 in wheel width in conjuction with 1-5/8" thickess we believe overestimates section modulus of the wheel section under consideration. Stresses are low however.			
11	Sheet STS10 and STS11: a) For section properties used, on sheet STS10, reference should be made to Sheet TS10 of Section B. b) We question the validity of hand analysis for such a complicated weldment, particularly with stress so high that yield based on CMTR had to be used. Ideally we would like to see finite element analysis of the section using shell elements.			
12	Sheets STS12 and STS13: wheel retaining plate, a) Explain reasoning for load sharing between 2 sides, i.e between 10 bolts. b) SAE Grade 5 bolts are not listed as acceptable type in Table NOG-4221-1. c) Explain the rational used to evaluate wheel retaining plate with formula for somewhat similar case from Roark, considering the minimal margin between resultant stresses versus allowable based on CMTR values.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 5: Trolley: Seismic Loading, Ederer Cranes, Section E	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
13	Sheet STS14: Section properties used were calculated in Section B, Sheet TS20. a) Make reference to Section B, Sheet TS20 for section properties used. b) See RCR comment # 3, to Section B, calculations Sheet TS20. Section properties used for the bridge truck main section should be based on the net section at the center line of the pin, whereas they were based on gross section properties. Revise Sheet TS20, in Section B, and then STS14. c) Explain use of 27in for the moment arm instead of 30in, which is the dimension between center of wheel and the centerline of the truck.			
14	Sheet STS17: SAE Grade 8 bolts are used. SAE Grade 8 bolts are not listed as acceptable type in Table NOG-4221-1.			
15	Sheet STF3: a) For section properties and other information, reference should be made to sheets TF11 and TF12 of Section C. b) We question the validity of hand analysis for such a complicated weldment. Ideally we would like to see finite element analysis of the section using shell elements.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 5: Trolley: Seismic Loading, Ederer Cranes, Section E	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
16	Sheet STF7: Wheel retaining plate: Explain rational for using Roark's (4th edition) case 15, page 220, formulas for flat circular plates with concentric circular holes in evaluation of wheel retaining plate.			
17	Design of trolley seismic restraint in "X" direction is not included in the calculation package.			
18	Bolts for trolley seismic restraint, bridge seismic restraint, bridge wheel retaining plate, and bridge truck pin end plate were designed as **mechanical** bolts with 0.9 times the yield strength allowable combined stress for seismic loads per NOG-5456.2. In our opinion these bolts should be considered as **structural** bolts per NOG-4252, NOG-4441.1, NOG-4315, and Table NOG-4315-1, with 0.5 times the ultimate strength for tension and 0.26 times the ultimate strength for shear for seismic load (for bolts other than ASTM A325 or A490).			

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REVIEW COMMENTS TO SEISMIC ANALYSES AND STRUCTURAL CALCULATIONS

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___ Other

Reference: (1) Specification HNF-S-0468 Revision 4.

(2) Letter, C. E. Swenson, DESH, to R. J. Roberts, FWEC, "Revised Seismic Response Spectra" DESH-9759774 (MHM/BTR-081), dated October 17, 1997.

DE&S Hanford, Inc. (DESH) has performed a review of the seismic analyses and the structural calculations listed below. Comments are included with the Attachment and DESH requests that the comments be addressed in the Final Seismic Analysis and separately dispositioned prior to final acceptance of the machine. Please review and advise how you plan to resolve the comments. Section 3.2.1.4.e of Reference 1 allows use of a 7% damping factor and the response spectra curves with Reference 2 can be utilized, if needed, to resolve any material stress exceedances that may have occurred.

Reviewed materials are as follows.

a) Hanford MHM - Seismic Analysis of the Hanford MCO Handling Machine, GEC-Alsthom Report ESL/R(96)083, Revision 2, dated October 1997.
b) Hanford MHM - 7% Damping Response Spectra Analysis of the Hanford MCO Handling Machine, GEC-Alshom Report ESL/R(97)038, Issue A, dated October 1997.
c) Crane Operational Loads NOG-4000, Ederer Cranes Report, Sections A, B, and C.

d) Bridge Girder and End Tie: Seismic Loading, Ederer Cranes Report, Section D.
e) Trolley: Seismic Loading, Ederer Cranes Report, Section E.

DESH requests that the comments be dispositioned by July 1, 1998 to support the input for the Safety Analysis Report for the Canister Storage Building Project.

If you believe there is a change to the existing work scope as a result of the above information, call D. E. Kidder (509) 376-7285 within five days of receipt and notify him of your concerns. Do not proceed with any work that you consider a change without a notification from the Buyer in accordance with Clause 7.1.3 "Changes" and Clause 5.2 "Delivery, Completion" of the General Provisions (Long Form - Revision 2) and Clause G03 "Authorized Personnel" of the Contract.

If there are any technical questions, you may call me at 376-0288.

Very truly yours,

Craig E. Swenson
Buyer's Technical Representative
Canister Storage Building Project

cs/rit

FWEC - T. Gado

DESH-9853642

ATTACHMENT

Comments to Seismic Analyses and Selected Structural Calculations

Consisting of 18 pages,
including cover page.

REVIEW COMMENT RECORD (RCR)	1. Date 04/01/98	2. Review No. 1
	3. Project No. CSB	4. Page 1 of 4

5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 1: GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
1	Tables A2, B2, C2, D2, E2 of the report: Summation of Static Loads Fz for Trolley Quarter Span is 3413.2kN, versus 3948.8kN for Trolley Midspan, and End Span Load Cases. (Note: this is 535.6kN or 120,400 lbs difference.) Figure G13 depicting the Trolley Quarter Span model indicates that erroneous element numbers were used to print Bridge Seismic Restraint Forces. We believe these should be 766, 770, 757, 783, 739, 744, 766, 770. Review all results affected by this comment.			
2	Section 10.3, Nose Unit Displacement, Page 24 of the report: a) Using total weight of the MHM to predict static deflection due to shield skirt mass is incorrect. Conservatively, the static deflection, including shield skirt mass, could be calculated in proportion to the total weight of trolley (including turret and MCO). Total weight of trolley (including turret and MCO) is 1624.6 kN based on Table A1, or 165.7 Tonne. Therefore, the predicted static deflection including the shield skirt mass is (42.21mm x (1+12.3/165.7)) = 45.34 mm. b) Verify the maximum nose displacements (horizontal and vertical) does not exceed available clearance with the deck.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 1: GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
3	Tables 10 and 11, Appendices A to E, and page 25 of the report: ".... inspection showed that the high stresses are due to limitations of the modeling approach...." Provide alternate calculations to demonstrate that the stresses for "overstressed" members are within acceptable limits.			
4	Sheet 1: Actual Yield Strength of Steel used: The actual yield strength of steel based on CMTRs have been used in the code assessment and not the code minimum specified material strength. Client should review this for acceptability.		Acceptable CES 4/28/98	
5	Section 1.1, Page 3 of the report states that this report does not cover the requirements of NOG-4330 Buckling, NOG-4340 Allowable Deflection and Cambers, and NOG-4350 Fatigue. Need a statement explaining why these are not covered.		Reference Ederer calculation.	
6	In Tables F1, F2, F3 the extracted mass varies from 308.9 to 397.7 tonnes however the total mass fraction for all modes extracted is always 1.000. (The total mass of the structure, as modeled, is 414.86 tonne.) Explain how was total mass fraction calculated.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 1: GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
7	a) Section 6.0, page 14 of the report: insignificant mode limit was set at 0.001. (Note this is the default value in ANSYS program.) All modes less than this threshold were excluded from the modal combinations. In the Table F1 in X direction 54 modes out of 73 total modes extracted fall into the "insignificant" mode category. This is typical for all Tables F1 through F3. Provide justification for setting insignificant mode limit at 0.001. b) Section 6.0, page 14: the total missing mass has been calculated as the sum of all the insignificant modes below 33.33Hz plus the missing mass above 33.33Hz. The ZPA acceleration was applied to the "missing mass" in an equivalent static analysis and scaling up the results by the ratio of the missing mass to the total mass. If the ZPA acceleration was applied to the "insignificant" modes, it is incorrect. The modes <u>below</u> 33.33 Hz should have acceleration as defined by the response spectrum for the frequency of that mode, regardless of its mode coefficient value.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 1: GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
8	Seismic analysis was done without shield skirt in the raised position. It is possible that during transport of the MCO earthquake event could occur. An evaluation of increased stresses in the crane when the skirt is in the up position needs to be documented.			
9	MCO hoist: The seismic loads on the hoist and its design were not included in the calculation package.			
10	The design of the turret is not documented in the calculation package.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 2: GEC-Alsthom Report ESL/R(97)038, Issue A, dated October 1997 (7% Damping Response Spectra Seismic Analysis)	CSB	G. Kuilanoff	FDI Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
1	(This comment is similar to comment #1 for GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997) Tables A2 and C2 of the report: Summation of Static Loads Fz for Trolley Quarter Span is 3413.2kN, versus 3948.8kN for Trolley Midspan, and End Span Load Cases. (Note: this is 535.6kN or 120,400 lbs difference.) Figure G13, (from GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997) depicting the Trolley Quarter Span model indicates that erroneous element numbers were used to print Bridge Seismic Restraint Forces. We believe these should be 766, 770, 757, 783, 739, 744, 766, 770. Review all results affected by this comment.			
2	This report evaluated the case for all loads vertical downward at the wheels. Is this the governing case? Include an assessment of results expected for other cases covered in Appendices B, C, D, and E of the original report, GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 3: Crane Operational Loads NOG-4000, Ederer Cranes Report, Sections A,B, and C	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
1	Sections A sheet TF1 and Section B sheet TS1: a) Extreme environmental loads are not evaluated in this section. It would be preferable for clarity to say so. b) The statement concerning Pc3 governs for operational loads needs to be demonstrated. Otherwise all applicable loading combinations need to be evaluated.			
2	Section B, Sheet TS5: a) Longitudinal Horizontal Load should be based on 10% of the trolley dead load and the maximum lifted load, i.e. 0.10(347.9+30)= 37.7kips. This load should be applied to one side of the end truck only, having 4 wheels. Therefore, the side force on wheels should be 9.45k per wheel. b) The 48.14k transverse force should be distributed in proportion to trolley location on the bridge. The trolley at end location would be most critical. (See section 3.3.2.1.1.5 CMAA #70) Review all other results affected by this comment (i.e. on sheets TS7, TS8, TS23, TS24)			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 3: Crane Operational Loads NOG-4000, Ederer Cranes Report, Sections A,B, and C	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
3	Section B, Sheet TS20: a) Section properties for the bridge truck main section should be based on the net section at the center line of the pin. Review section properties used in the calculations. c) Explain use of 27in for the moment arm instead of 30in which is the dimension between center of wheel and the centerline of the truck.			
4	Section C, Sheet MM1: A review of computer runs, indicate that Trolley was not modeled. (Nodes 46, 47, 48, and 52 are not attached to the structure. See computer output page 6). Trolley load was applied at nodes at trolley wheel point locations. Add explanatory note of what was modeled, and justification for the approach taken.			
5	Section C, Sheet MM5: a) Boundary conditions modeled are not according to NOG-4154.3-1. b) Explain reason for using springs in the X direction.			
6	Section C, Sheet L-1: Critical Load and Credible Critical Loads? Should this be a Lifted Load? Per HNF-S-0468 Rev. 3, Section 3.2.1.1 crane is to be designed , fabricated, etc. primarily in accordance with ASME NOG-1 Type I. In Sect 3.2.1.4 it is stated the MHM does not have a critical load per the definitions of NOG-1.		This is definition flaws. MHM critical load is equivalent to an MCO. Credible critical load (ie. critical load during DBE) requires wire rope time-history analysis for slack rope check, ccs	

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 3: Crane Operational Loads NOG-4000, Ederer Cranes Report, Sections A,B, and C	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
7	Section C, Computer Analysis Results: Load Case 4 and Load Case 6 displacements in X are approximately 9.5 inches. This is unrealistic. See Trolley Center Span Computer output pages 32, 33 , 40 and 41, and Trolley End Computer output pages 31, 32, 39 and 40. See also comment # 5.			
8	Section C, Sheet L-4: Py loads should be Pz loads.			
9	Section C, Sheet G18: per CMAA section 3.5.2.2 longitudinal stiffeners should be placed so that their centerlines are approximately 0.25 and 0.55 times the distance, respectively from the inner surface of the compression flange plate to the neutral axis. Based on 41.61 in distance to the neutral axis, longitudinal stiffeners should be located at 10.4 inches and 22.9 inches respectively. On the drawing, D34778 Sht 3, and in the calculations, they are located at 18.31 inches and 35.69 inches respectively. Provide justification.			
10	Section C, Sheet G23: Maximum wheel load used from load case 6 which included impact is 109.81k. In Table C1, of GECA ESL/R(96)083 report, the maximum trolley wheel load for static load case only is 592kN=133k. Reconcile the difference, even though the stress check may still be OK. (Note: The difference, we believe is because Ederer hand calculated trolley wheel reactions, which did not include trolley frame and bridge girder interactions.)			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 3: Crane Operational Loads NOG-4000, Ederer Cranes Report, Sections A,B, and C	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
11	Section C, Sheet G50: In calculation of the net areas through the bolt holes, the width of the bolt hole should be taken as 1/16 in greater than the nominal diameter of the hole. (Ref. AISC ASD Specification, Sect B2)			
12	Section C, Sheet ET6: In the calculation of Ixx and Izz, the moment of inertia for the 75.5"x 5/8" plate which is at an angle, is incorrect. See AISC ASD pg 6-18 for proper formulation. In both cases the calculated moment of inertia of the plate at an angle was larger than the actual values.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 3: Crane Operational Loads NOG-4000, Ederer Cranes Report, Sections A, pages B, C, TF-1 through TF-9, and Section B, pages TS-13 through TS19	CSB	J. K. Strickler	FDRL/Mechanical	Richland, WA/ 509-376-5279

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
13	On page TF-7 at the bottom of the page in the calculation for the twist in the trolley drive shaft a formula is given with the terms in the denominator as E, and I. I am assuming that "I" is the "K" term in Kent's Mechanical Engineers' Handbook Ed12 page 8-29 and not the moment of inertia which it generally represents. Also, that E, is the modulus of rigidity which for steel is 11E6 (from Kent's page 8-05). Using 11E6 instead of 12E6 gives a torsional twist of 0.081radians/ft which is very slightly above the allowable.			
14	The arithmetic on the third equation from the top of page TS-19 is incorrect but the margin of safety is greater than shown so this is acceptable.			
15	General: The calculations were difficult to follow at times because many terms were not defined or references given.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 4: Bridge Girder and End Tie Beam Loading: Seismic Ederer Cranes, Section D	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
1	Sheet SG1: How was the "governing case" determined? i.e. how does one know that for girder splice Table C17 Element 244 is governing over others in Tables A17, B17, D17, and E17? A general question to all of the calculations which use loads extracted from GECA Seismic Analysis Report - Provide explanation of how the "governing cases" were determined?			
2	Sheet SG3: In the referenced sheets G50 and G51, in the calculation of the net areas through the bolt holes, the width of the bolt hole should have been taken as 1/16 in greater than the nominal diameter of the hole. Revise sheets G50 and G51, and then revise SG3.			
3	Sheet SG5: Weld Check, Provide justification for using 11/16 of wheel load for the design of the weld. Generally, the maximum shear for a continuous two span beam with the concentrated wheel load at any point is equal to the applied concentrated wheel load. Review weld size requirement.			
4	In the calculation of the plate length to width ratio (α), incorrectly, 60 inches was used for the plate length. The correct length is 72 inches, the distance between the vertical web stiffeners. Calculation needs to be revised.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 4: Bridge Girder and End Tie Beam Loading: Seismic Ederer Cranes, Section D	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
5	a) Sheet SG7: Explain reason for using Fy=46.3ksi based on CMTR. The lowest value we see for the web plate is 39.2 ksi, based on the sample QA7210, Sheet MAT14. b) Sheet SG11: Explain reason for using Fy=52.6 ksi based on CMTR. The lowest value we see for the flange plate is 50.4 ksi, based on the sample QA7197, Sheet MAT3.			
6	Sheet SG12 and SG14: a) Rail clip spacing varies from minimum of 6-3/4" to a maximum of 15-1/2". b) 4 clips effective assumed on Sheet SG12, and 6 clips effective are assumed on Sheets SG13 and SG14. Explain reason for variation in assumptions.			
7	Sheet SG16: How was the "governing case", presumably, Table C-16, quarter span, end 4, selected? The table lists "combined "as static plus seismic. Sometimes static minus seismic governs design, as was for the calculation on Sheet SG16. How was the "governing" dead minus seismic load selected?			
8	Sheet SG17: For the same bolt, p=3 inches (lengh of plate tributary to each bolt) along other direction governs. Review plate thickness required.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 4: Bridge Girder and End Tie Beam Loading: Seismic Ederer Cranes, Section D	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
9	Sheet SG21: Weld lug plate to web plate: 3.99 k/in reflects weld stress due to vertical load, and vertical component of horizontal load . Evaluate stresses in the weld due to X and Y horizontal loads, and then evaluate the resultant stress in the weld.			
10	Sheet SG21: Weld diaphragm plate to lug plates and web plates: Provide justification for using 1/2 of the total horizontal load in calculation of the torsional moment (My) for the weld evaluation.			
11	Sheet SG22: Reference should be made to Sheets ET24 and ET25, of Section C, for information on Johnson Industries Dual SB C100 Rail Clamp.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 5: Trolley: Seismic Loading, Ederer Cranes, Section E	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
1	Seismic Restraint Uplift Trolley, Sheet STF9: Check stresses for bending and tension at section through bolt holes. (With net section through bolt holes per AISC (Sect B2), the combined stress is 66.3 ksi > 45ksi allowable.)			
2	Sheet STF10: SAE Grade 5 bolts have been specified. Per NOG-1, Section NOG-4221 (a), fastener material for Type I cranes is acceptable if it is listed in Table NOG-4221-1. Also, see NOG-4252.2 and NOG-4315 (b). SAE Grade 5 bolts are not listed. The four 1 inch diameter bolts specified are overstressed. Review Design.			
3	Sheet STF11: 1-5/8 inches eccentricity of the load does not include fabrication nor misalignment tolerances. Weld size specified (5/16) is too close to what is calculated. Check weld to account for fabrication and misalignment tolerances.			
4	Sheet STS2: This Table D2, is different than Table D2 in the GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997, which we have in our possession. (The difference in the Trolley Quarter Span Loads. We believe this to be a correct Table, however we wonder why Table D2 and others in the GECA report are not.) We do not have these corrected(?) Tables A2 through E2 and cannot verify if Table D2 loads are governing.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 5: Trolley: Seismic Loading, Ederer Cranes, Section E	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
5	Sheet STS4, STS10 and STS11: a) We question the validity of hand analysis for such a complicated weldment . Ideally we would like to see finite element analysis of the section using shell elements. b) With the assumption used, on sheet STS10, the 24.4 ksi stress for the "circle reinforcement" is not the total stress at the section. The axial and shear stresses need to be added to obtain the total stress.			
6	Sheet STS6: Check maximum combined shear stress in the pin due to shear plus bending. (Ref NOG-4324.)			
7	Sheet STS7: Bridge Restraint, Check stresses for bending and tension using net section at bolt holes. (Ref to AISC Sect B2.)			
8	Sheet STS8: SAE Grade 5 bolts, SAE Grade 5 bolts are not listed as acceptable type in Table NOG-4221-1.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 5: Trolley: Seismic Loading, Ederer Cranes, Section E	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
9	Sheet STS9: In the sketch 112k lateral load should be 161k.			
10	Sheet STS9: Using 12 in wheel width in conjuction with 1-5/8" thickess we believe overestimates section modulus of the wheel section under consideration. Stresses are low however.			
11	Sheet STS10 and STS11: a) For section properties used, on sheet STS10, reference should be made to Sheet TS10 of Section B. b) We question the validity of hand analysis for such a complicated weldment, particularly with stress so high that yield based on CMTR had to be used. Ideally we would like to see finite element analysis of the section using shell elements.			
12	Sheets STS12 and STS13: wheel retaining plate, a) Explain reasoning for load sharing between 2 sides, i.e between 10 bolts. b) SAE Grade 5 bolts are not listed as acceptable type in Table NOG-4221-1. c) Explain the rational used to evaluate wheel retaining plate with formula for somewhat similar case from Roark, considering the minimal margin between resultant stresses versus allowable based on CMTR values.			

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5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 5: Trolley: Seismic Loading, Ederer Cranes, Section E	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
13	Sheet STS14: Section properties used were calculated in Section B, Sheet TS20. a) Make reference to Section B, Sheet TS20 for section properties used. b) See RCR comment # 3, to Section B, calculations Sheet TS20. Section properties used for the bridge truck main section should be based on the net section at the center line of the pin, whereas they were based on gross section properties. Revise Sheet TS20, in Section B, and then STS14. c) Explain use of 27in for the moment arm instead of 30in, which is the dimension between center of wheel and the centerline of the truck.			
14	Sheet STS17: SAE Grade 8 bolts are used. SAE Grade 8 bolts are not listed as acceptable type in Table NOG-4221-1.			
15	Sheet STF3: a) For section properties and other information, reference should be made to sheets TF11 and TF12 of Section C. b) We question the validity of hand analysis for such a complicated weldment. Ideally we would like to see finite element analysis of the section using shell elements.			

SNF-7000 REV 0

REVIEW COMMENT RECORD (RCR)	1. Date 04/01/98	2. Review No. 1
	3. Project No. CSB	4. Page 5 of 5

5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 5: Trolley: Seismic Loading, Ederer Cranes, Section E	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
16	Sheet STF7: Wheel retaining plate: Explain rational for using Roark's (4th edition) case 15, page 220, formulas for flat circular plates with concentric circular holes in evaluation of wheel retaining plate.			
17	Design of trolley seismic restraint in "X" direction is not included in the calculation package.		See GEC calculation 110/8 & 110/9	
18	Bolts for trolley seismic restraint, bridge seismic restraint, bridge wheel retaining plate, and bridge truck pin end plate were designed as mechanical bolts with 0.9 times the yield strength allowable combined stress for seismic loads per NOG-5456.2. In our opinion these bolts should be considered as structural bolts per NOG-4252, NOG-4441.1, NOG-4315, and Table NOG-4315-1, with 0.5 times the ultimate strength for tension and 0.26 times the ultimate strength for shear for seismic load (for bolts other than ASTM A325 or A490).			

FOSTER WHEELER ENVIRONMENTAL CORPORATION

3200 George Washington Way, Suite G
Richland, WA 99352
(509) 372-5800 · FAX (509) 372-5801

Facsimile Transmittal

To:	Jim Cheshire	**Date:**	6/12/98
From:	Randy Roberts	**Recipient's Fax #:**	
Pages:	____ (includes cover sheet)	**Charge #**	

Message: ☐ **Urgent** ☐ **For Your Review** ☐ **Reply ASAP** ☐ **Please Comment**

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FOSTER WHEELER ENVIRONMENTAL CORPORATION

June 12, 1998
1510-0336

Mr. James Cheshire
DE&S Hanford Company
P.O. Box 350, MSIN G1-59
2355 Stevens Drive
Richland, WA 99352

SUBJECT: RESPONSE TO SEISMIC REPORT COMMENTS MULTICANISTER OVERPACK HANDLING MACHINE (MHM) PURCHASE ORDER MDK-SDX-452656

Reference: Letter, C.E. Swenson, DESH, to R.J. Roberts, FWENC, "Review Comments to Seismic Analyses and Structural Calculations", MHM/BTR-124, DESH-9853642, dated April 24, 1998.

Dear Mr. Cheshire:

Attached are the preliminary responses to the seismic report comments received via the referenced correspondence. Those Ederer comments which require more in depth review are so noted and were not completed because the technical staff were unavailable. Some of the comments could potentially result in additional work scope and further discussion with DESH is required before proceeding.

Please contact me at 372-5812 if you have any questions.

Sincerely,

Randal J. Roberts, Project Manager
Foster Wheeler Environmental Corporation

RJR/drw
Attachment

cc: D. Tulberg
R. Gambuti
File

3200 GEORGE WASHINGTON WAY, SUITE G, RICHLAND, WA 99352
TEL: 509-372-5800 FAX: 509-372-5801

FAX

GEC ALSTHOM
ENGINEERING SYSTEMS

To:	RANDY ROBERTS FWENC	From:	CHRIS CARTER Chief Engineer
Fax:	001 509 372 5801	Fax:	011 44 116 201 5111
Copy to:		Direct Tel: or:	011 44 116 201 5060 011 44 116 275 0750
No of pages:	8	Date:	1 May 1998
		ESL ref:	JH4683/465

SUBJECT: HANFORD MHM - RESPONSES TO SEISMIC REPORT COMMENTS

The attached replies are provided to Craig Swenson's FAX of April 21, 1998.

Due to lack of space on report 1, sht 4/4, the response is given below:

Note ①: During transport of the MHM (with the MCO inside) the Shield Skirt is raised and the seismic clamps are disengaged. In the event of an earthquake occurring in this condition the total loads will be a lot less because the Trolley and Bridge will roll/slide on the rails due to lack of positive connection to ground. Extrapolation of the loads obtained from the 'Machine connected to Storage Tube' are not valid for that condition. The analysis already considers the horizontal inertia of the Shield Ring when it is lowered on the deck. When the Shield Skirt is raised and held on the Turret, its mass is not that significant compared to the mass of the Turret and the clearance under the nose is increased by the amount that the Shield Ring is raised and so vertical deflection of the Nose cannot strike the deck.

Hopefully these answers will do away with the need for a conference call to discuss.

Please remind DESH that we still await formal confirmation of the 7% seismic spectrum that is to be used for the final analysis.

Regards,

CHRIS

cc: A.L.T.VYNER
A.MACMILLAN
J.FULTHORPE

REVIEW COMMENT RECORD (RCR)	1. Date 04/01/98	2. Review No. 1
	3. Project No. CSB	4. Page 1 of 4

5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 1: GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997	CSB	G. Kulapoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
1	Tables A2, B2, C2, D2, E2 of the report: Summation of Static Loads Fz for Trolley Quarter Span is 3413.2kN, versus 3948.8kN for Trolley Midspan, and End Span Load Cases. (Note: this is 535.6kN or 120,400 lbs difference.) Figure G13 depicting the Trolley Quarter Span model indicates that erroneous element numbers were used to print Bridge Seismic Restraint Forces. We believe these should be 766, 770, 757, 783, 739, 744, 766, 770. Review all results affected by this comment.		THIS HAS ALREADY BEEN ADDRESSED. SEE ATTACHED FAX DATED 14 NOV 1997	
2	Section 10.3, Nose Unit Displacement, Page 24 of the report: a) Using total weight of the MHM to predict static deflection due to shield skirt mass is incorrect. Conservatively, the static deflection, including shield skirt mass, could be calculated in proportion to the total weight of trolley (including turret and MCO). Total weight of trolley (including turret and MCO) is 1624.6 kN based on Table A1, or 165.7 Tonne. Therefore, the predicted static deflection including the shield skirt mass is (42.21mm x (1+12.3/165.7)) = 45.34 mm.		THIS IS MORE CONSERVATIVE THAN THE ESL METHOD AND EQUALLY AS VALID.	
	b) Verify the maximum nose displacements (horizontal and vertical) does not exceed available clearance with the deck.		THE DECK MINIMUM CLEARANCE = 11 MM. SEE ATTACHED SKETCH.	

REVIEW COMMENT RECORD (RCR)	1. Date 04/01/98	2. Review No. 1
	3. Project No. CSB	4. Page 2 of 4

5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 1: GEC-Alstbom Report ESL/R(96)083, rev.2, dated October 1997	CSB	G. Kuilanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
3	Tables I0 and 11, Appendices A to E, and page 25 of the report: "... inspection showed that the high stresses are due to limitations of the modeling approach..." Provide alternate calculations to demonstrate that the stresses for "overstressed" members are within acceptable limits.		THIS WILL BE REVIEWED IN THE FINAL ANALYSIS.	
4	Sheet 1: Actual Yield Strength of Steel used: The actual yield strength of steel based on CMTRS have been used in the code assessment and not the code minimum specified material strength. Client should review this for acceptability.		Acceptable. CES 4/21/98	
5	Section 1.1, Page 3 of the report states that this report does not cover the requirements of NOG-4330 Buckling, NOG-4340 Allowable Deflection and Cambers, and NOG-4350 Fatigue. Need a statement explaining why these are not covered.		Reference Ederer calculation.	
6	In Tables F1, F2, F3 the extracted mass varies from 308.9 to 397.7 tonnes however the total mass fraction for all modes extracted is always 1.000. (The total mass of the structure, as modeled, is 414.86 tonne.) Explain how was total mass fraction calculated.		WASN'T THIS COVERED IN THE CONFERENCE CALL?	

REVIEW COMMENT RECORD (RCR)	1. Date 04/01/98	2. Review No. 1
	3. Project No. CSB	4. Page 3 of 4

5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 1: GEC-Alsthom Report ESL/R(96)083, rev 2, dated October 1997	CSB	G. Kulanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
7	a) Section 6.6, page 14 of the report: insignificant mode limit was set at 0.001. (Note this is the default value in ANSYS program.) All modes less than this threshold were excluded from the modal combinations. In the Table F1 in X direction 54 modes out of 73 total modes extracted fall into the "insignificant" mode category. This is typical for all Tables F1 through F3. Provide justification for setting insignificant mode limit at 0.001. b) Section 6.6, page 14: the total missing mass has been calculated as the sum of all the insignificant modes below 33.33Hz plus the missing mass above 33.33Hz. The ZPA acceleration was applied to the "missing mass" in an equivalent static analysis and scaling up the results by the ratio of the missing mass to the total mass. If the ZPA acceleration was applied to the "insignificant" modes, it is incorrect. The modes below 33.33 Hz should have acceleration as defined by the response spectrum for the frequency of that mode, regardless of its mode coefficient value.		THIS WAS DISCUSSED LAST SEPTEMBER OUR POSITION IS THAT OUR APPROACH IS CONSERVATIVE BECAUSE WE ABSOLUTLY SUMMED THE MISSING MASS INSTEAD OF SRSS	

TEL:5093725801

FOSTER WHEELER ENV

REVIEW COMMENT RECORD (RCR)	1. Date 04/01/98	2. Review No. 1
	3. Project No. CSB.	4. Page 4 of 4

5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 1: GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997	CSB	G. Kullanoff	FDI/Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
8	Seismic analysis was done without shield skirt in the raised position. It is possible that during transport of the MCO earthquake event could occur. An evaluation of increased stresses in the crane when the skirt is in the up position needs to be documented.		SEE NOTE ① ON FAX 4683/465	
9	MCO hoist: The seismic loads on the hoist and its design were not included in the calculation package.		SEE CALCULATIONS 493/1, 498/1, 499/1, 500/3 & 501/1	
10	The design of the turret is not documented in the calculation package.		SEE DESIGN CALCS VOL 1 & VOL 2	

REVIEW COMMENT RECORD (RCR)	1. Date 04/03/98	2. Review No. 1
	3. Project No. CSB	4. Page 1 of 1

5. Document Number(s)/Title(s)	6. Program/Project/ Building Number	7. Reviewer	8. Organization/Group	9. Location/Phone
Design Report 2: GEC-Alsthom Report ESL/R(97)038, Issue A, dated October 1997 (7% Damping Response Spectra Seismic Analysis)	CSB	G. Kuilanoff	FDI Structural	Irvine, CA/ 714-975-5301

12. Item	13. Comment(s)/Discrepancy(s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/problem indicated.)	14. Hold point	15. Disposition (Provide justification if NOT accepted)	16. Status
1	(This comment is similar to comment #1 for GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997) Tables A2 and C2 of the report: Summation of Static Loads Fz for Trolley Quarter Span is 3413.2kN, versus 3948.8kN for Trolley Midspan, and End Span Load Cases. (Note: this is 535.6kN or 120,400 lbs difference.) Figure G13, (from GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997) depicting the Trolley Quarter Span model indicates that erroneous element numbers were used to print Bridge Seismic Restraint Forces. We believe these should be 766, 770, 757, 783, 739, 744, 766, 770. Review all results affected by this comment.		SEE PREVIOUS ANSWERS AND ATTACHED FAX.	
2	This report evaluated the case for all loads vertical downward at the wheels. Is this the governing case? Include an assessment of results expected for other cases covered in Appendices B, C, D, and E of the original report, GEC-Alsthom Report ESL/R(96)083, rev.2, dated October 1997.		ONE CASE WAS AGREED AT THE TIME DOES THIS MATTER SINCE THE FINAL ANALYSIS WILL BE WITH 7% DAMPING.	

FAX

GEC ALSTHOM
ENGINEERING SYSTEMS

To:	L Hudak, EDERER Inc.	From:	J N Fulthorpe
Fax:	001-206-623-8583	Fax:	011-44-116-286-1637
		Tel Ext:	
Copy to:	C C Carter, A MacMillan A L T Vyner, D A Burton	G Net:	
		Our Ref:	
Your Ref:		Date:	14 November 1997
No of pages:	8		

SUBJECT: **JH4683 Hanford MHM - Seismic Analysis, ESL/R(96)083 Rev 1, Tables A2 - E2 Bridge Seismic Restraints**

Ref (1) Fax L. Hudak, EDERER Inc. to Chris Carter, GAES, Seismic Report - Model Error, Dated 13th November 1997.
Ref (2) Hanford MHM Seismic Analysis of the Hanford MCO Handling Machine. Report ESL/R(96)083
Ref (3) Hanford MHM 7% Damping Response Spectra Seismic Analysis of the Hanford MCO Handling Machine. Report ESL/R(97)038

With regard to ref (1) and Tables A2 - E2, report ESL/R(96)083 Rev 2 Ref (2).

Unfortunately it is the tables that are in error and Figure G13 Ref (1) that is correct. The mistake is in the post processing of the results of the Quarter span analysis and for the Bridge seismic restraints only. All the other results For the Quarter span analysis are correct.

All results for the mid and end span analysis are unaffected by this mistake.

In order to redress the situation I have correct the mistake and re-run the post processing for these cases. The attached next five sheets are the corrected tables A2 - E2 for Ref (2).

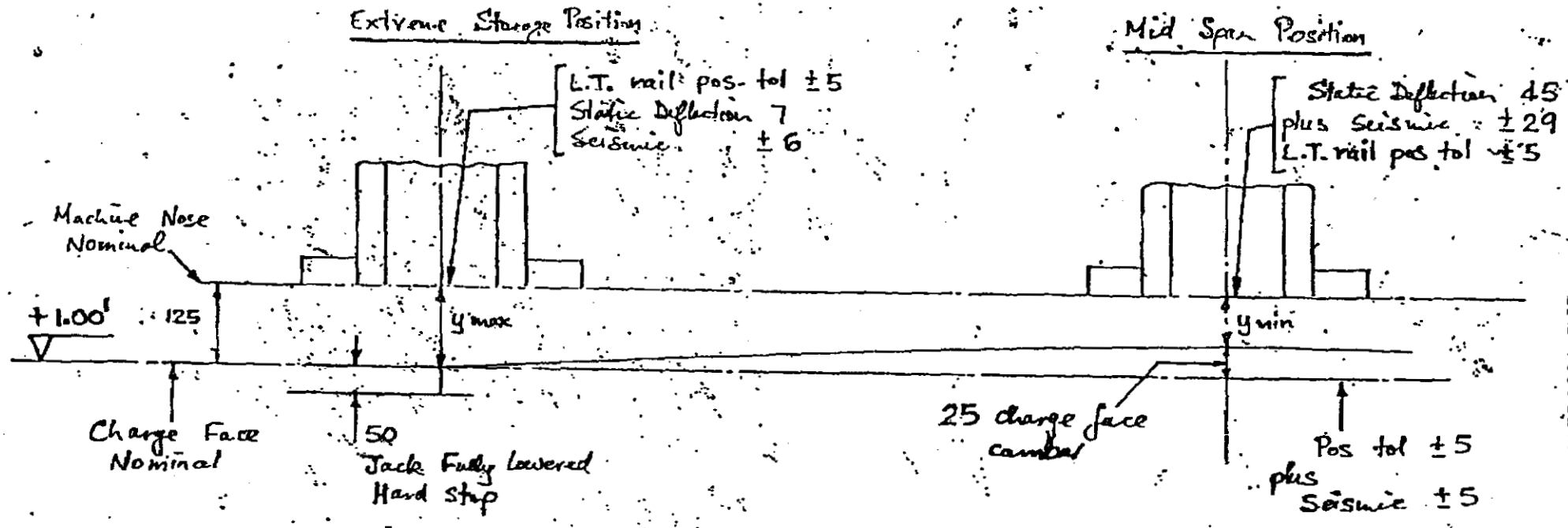
Unfortunately the same mistake has been made in Ref (3) tables A2 and C2. I have also re-run the post processing for these cases and the last two of the following sheet are the corrected tables A2 and C2 for Ref (3).

I have scaled up these tables to make them clearer when faxed.

Regards
J N Fulthorpe
Ext 4985.

Industrial Equipment Division

GEC ALSTHOM ENGINEERING SYSTEMS LTD, Cambridge Road, Whetstone, Leicester, LE8 6LH, England
Telephone: 0116 275 0750 - Fax: 0116 275 0787
Registered Office: Cambridge Road, Whetstone, Leicester. Registered in England No. 2435397



$y_{max} = 125 + 5 + 5 - 7 + 6 + 5$

$= 139$

$y_{min} = 125 - 45 - 29 - 25 - 5 - 5 - 5 = 11$

FIGURE 1. Nose / Charge Face Clearances.

EDERER INCORPORATED ISO 9001 CERTIFIED

Date:	15 May, 1998	Doc #	FaxForm.doc
To:	Dean Tulberg	From:	Paul Longthorpe
Company:	Foster Wheeler	Title:	Project Manager
Fax No:	(509) 372 5801	Tele:	(206) 622-4421 Fax: (206)623-8583
Pages transmitted, including this sheet::		cc:	

Re: REVIEW COMMENT RECORD

The following is Ederer's response to the above document dated 04/01/98.

DESIGN REPORT 3: PAGE 1 THRU 5

Item 1. We can add the words needed to clarify.
Item 2. This item will require engineering review.
Item 3. This item will require engineering review.
Item 4. We can add the words needed to clarify.
Item 5. This was done per NOG. The springs are required to stabilize the model for a valid computer solution.
Item 6. Swenson answered.
Item 7. This was done per NOG 's model.
Item 8. We can revise this.
Item 9. CMAA does not apply. Must be designed for seismic loads.
Item 10 This assumption is correct.
Item 11. Our design used reamed holes.
Item 12. We can revise this.
Item 13. Our references give E as 12 E6
Item 14. The equation is correct and so is the answer.
Item 15. We followed Ederer's engineering manual as defined in our Q A Plan.

DESIGN REPORT 4: PAGE 1 THRU 3

Item 1. We did direct comparison and used largest values.
Item 2. Our design used reamed holes.
Item 3. This item will require engineering review.
Item 4. We can revise.
Item 5. Actual plate locations are known from our Q A files and actual yield values are used from CMTR's.
Item 6. Wheels are located by seismic restraints. Clips are located about wheel locations. The beaming of the wheel reaction across (shear) and back for uplift clips is at 45 degree. Four clips are used for shear and six clips are used for uplift.

Ederer Incorporated
Post Office Box 24708
Seattle, WA 98124-0708

Via Express :
2925 1st Avenue South
Seattle, WA 98134

Item 7. Largest absolute value is selected.
Item 8. We use the average length in each direction for the corner bolt.
Item 9. The Y horizontal load is reacted at the rail clamps and the stress due to X horizontal load comes at the bottom flange.
Item 10. We can revise.
Item 11. We can revise.

DESIGN REPORT 5: PAGE 1 THRU 5

Item 1. We used NOG - 5481 (1) (b) " The gross cross section shall be used in determining stress levels.
Item 2. We consider these to be mechanical fasteners.
Item 3. We do not consider fabrication tolerance since these are eliminated during assembly.
Item 4. We have the correct tables.
Item 5. This will require engineering review.
Item 6. Shear at surface of pin = 0.
Item 7. See NOG 5481.
Item 8. We consider these to be mechanical fasteners.
Item 9. Sketch value to be corrected.
Item 10. This will require engineering review.
Item 11. We followed Ederer's engineering manual as defined in our Q A Plan.
Item 12. a) Load sharing due to wheel assembly details.
b) We consider these to be mechanical fasteners.
c) This will require engineering review.
Item 13. This will require engineering review.
Item 14. We consider these to be mechanical fasteners.
Item 15. We followed Ederer's engineering manual as defined in our Q A Plan.
Item 16. This will require engineering review.
Item 17. See GEC calculations.
Item 18. We consider these to be mechanical fasteners.

Ederer Incorporated
Post Office Box 24708
Seattle, WA 98124-0708

Via Express :
2925 1st Avenue South
Seattle, WA 98134

FOSTER WHEELER ENVIRONMENTAL CORPORATION

April 26, 1999
1510-0525

Mr. John Robinson
Principal Procurement Specialist
DE&S Hanford Company
P.O. Box 350, MSIN R3-11
Richland, WA 99352

SUBJECT: UNSOLVED SEISMIC ANALYSIS COMMENTS
MULTI-CANISTER OVERPACK HANDLING MACHINE (MHM)
PURCHASE ORDER NO. 00000244

Reference: Letter, J. M. Robinson, DESH, to R. J. Roberts, "Unresolved Seismic Analysis Comments", DESH-9952455, dated April 13, 1999.

Dear Mr. Robinson:

Enclosed is a copy of the comment responses requested in the reference letter.

Should you have any comments or questions on the information provided, please contact me at 372-5809.

Sincerely,

Dean M. Tulberg, P.E.
MHM Resident Engineer
Foster Wheeler Environmental Corporation

Attachment

cc: C. Swenson
C. Nash
R. Roberts
S. Viskup
File: D. Wagner
File: Richland

3200 GEORGE WASHINGTON WAY, SUITE G, RICHLAND, WA 99352
TEL: 509-372-5800 FAX: 509-372-5801

DESIGN REPORT #3

Item 1a
Comment: Extreme environmental loads are not evaluated in this section. It would be preferable for clarity to say so.

Reply: Sheet A of Section A clearly identifies the loading as operational. No revision required.

Item 1b
Comment: The statement concerning Pc3 govern for operational loads needs to be demonstrated.

Reply: The statement "P3 governs design" is based on inspection of the load cases and the factors included within. P3 was chosen because it included a side force on the wheel. The side force developes the max. stress in the trolley frame, wheel axle and bearing loads. The wheel is sized for the static load only, ie., max bearing load for the load cases would be as follows:

Pc1 = 51.62k
Pc2 = 52.43k
Pc3 = 56.91k > Governs
Pc4=54.89k [(103.237 + 3.34kx2x173.25]/2
Pc5=46.23k. 177
No changes are required to calculations.

Item 2a Section B Sheet TS5

Comment: Longitudinal horizontal load should be 37.7kips. This load should be applied to one side of the end truck only, having 4 wheels.

Reply: The weight of the crane is such that the vertical wheel reactions x a minimum coefficient of friction of .1 exceeds the applied force of 37.7k/8 wheels or 4.71k/ wheel. The actual coefficient of friction per CMAA Table 5.2.9.1.2.1-B is .20. Therefore all wheels are effective in resisting the 10% longitudinal horizontal load. Calculations revised.

Item 2b
Comment: The 48.14 kip transverse force should be distributed in proportion to trolley location.

Reply: Calculations revised for IFD Horz=31.90kips.

DESIGN REPORT #3

Item 3a Section B, Sheet TS20

Comment: Section properties for the bridge truck.... should be based on the net section at the center line of the pin.

Reply: A 12" diameter hole was cut into each 2 ½ inch web plate and a 12 inch OD x 2" wall pipe inserted into the hole. The net reduction in section modulus is 1% which produces an increase of .03 ksi in stress level. Calculations are not revised.

Item 3c

Comment: Explain use of 27 in for moment arm.

Reply: See page TS8. The vertical load at the pin was assumed to be distributed over 12". Therefore x. = $\frac{169(30-6) + 169\ (6)\ ½}{169} = 27.$

Item 4 Section C

Comment: A review of the computer run indicates that trolley was not modeled. Add explanatory note of what was modeled and justified the approach taken.

Reply: Modeling the trolley with the bridge structure would provide erroneous results. The trolley loads the bridge. The bridge does not load the trolley. To connect the nodes would provide a load path thru the trolley for the vertical and horizontal forces. The stiffness of the trolley distorts the moment distribution in the bridge girder. The solution was run with the nodes connected and determined to be an incorrect approach. See CMAA Section 3.3.2.1.1 Principal Loads Modeling the trolley integral with the bridge does not take into account that the wheel thread is wider than the rail head or that the uplift restraints provided have a vertical clearance between the lip of the girder top flange and the restraint. See NOG-4154.1

Item #5a

Comment: Boundary conditions are not according to NOG-4154-3.

Reply: NOG-4154-3 is entitled Crane Mathematical Model for Seismic Analysis – Not Operating Conditions.

Item 5b Explain reasons for using springs in the X direction.

Reply: The springs provided allows both ends of the gantry frame to spread out as the frame would do under actual loading conditions, ie. Trolley at the center of span and with bridge travel. The vertical and horizontal deflections are critical and are a function of the model. Due to the high dead load contribution to the wheel loads and small longitudinal load the friction force (.2x wheel load) exceeds the applied longitudinal load. Therefore all four corners are considered as effective in reacting the longitudinal forces.

Item 6

Comment: Section C, Sheet L-1 critical load and credible critical load? Should this be a lifted load?

Reply: PLC and PCO are for seismic analysis and are not used in Operational loads. These values should be 0 per HMF-S-0468 Rev. 3, section 3.2.1.1 Values changed from 30 to 0.

Item 7

Comment: Section C....displacements are in a ..... are unrealistic.

Reply: The springs provided in the model allow the whole crane to shift as unit. The relative deflections between nodes are the difference between the values shown. No correction required.

DESIGN REPORT #3

Item 8

Comment: Section C Sheet L-4 Py load should be Pz loads.

Reply: Page L-4 corrected.

Item 9

Comment: Section C, Sheet G18 per CMAA... Longitudinal stiffener.

Reply: CMAA does not govern. The girder must be capable of resisting the seismic loads.

Item 10

Comment: Section C Sheet G23 Max. wheel load used is 109.8k GEC reports max. static wheel load of 133k. Reconcile the difference.

Reply: GEC modeled the trolley integral with the girder per NOG-4154, 3-1. This model assumes that uplift can occur during a seismic event, therefore provisions have to be made to account for these vertical loads. As a result the static solution is influenced by the modeling. The values used in GEC's report can only be used in conjunction with the seismic loading and should not be used during operational load. Our assumptions are correct and no corrections will be made.

Item 11

Comment: Section C Sheet G50...width of the bolt holes should be taken as 1/16 greater...

Reply: Dwg D-3477 shows the holes to be reamed to ¾" diameter – As built. No correction required.

Item 12

Comment: Section C Sheet ETG. In the calculation of Ixx and Izz. The moment of inertia for the 75 1/2 x 5/8 plate is incorrect. See AISC ASD p6-18 for proper formulation.

Reply: The calculations provided were to produce a set of relative I values to be used in the computer run. The difference between the two methods is less than 1%, ie., for Ixx 216196 / 218141 in =.991. Using the AISC method would not produce any noticeable change in the output. No correction are made to the calculations.

DESIGN REPORT #3

Item 13

Comment: ....I is the "K" term.... That E5 is the modules of rigidity which for steel is 11E6.

Reply: I represents the polar moment of inertia. According to our references E5 can be taken as 12 E6. Eshbach defines E5 as approximately .4x the tensile modules of elasticity. No correction is made.

Item 14

Comment: page TS-19, the arithmetic on the third equation is incorrect....

Reply: Arithmetic corrected

Item 15

Comment: The calculations were difficult to follow...

Reply: We followed Ederer's engineering manual as defined in our QA plan.

DESIGN REPORT #4

Item 1

Comment: SG1. How was the governing case detemined.

Reply: A direct comparison of the tables provided by GEC was made and the largest values were used in the analysis.

Item 2

Comment: Sheet SG3: In the reference sheets G50 and G51...bolt hole should have been taken as 1/16 inch greater...

Reply: Drawing D-3477 shows that the holes are reamed to ¾ inch diameter. No correction required.

Item 3

Comment: SG5 Weld check. Provide justification for using 11/16 of the wheel load for the design of the weld.

Reply: The MHM is locked into position by the seismic restraints therefore the location of the wheel along the girder is known. For Table E2 (max. wheel load) trolley at quarter span element #334. The wheel is 45' – 9 5/8 off the center line of the girder using the nearest restraint location). This places the wheel 2 3/8" off the diaphragm. CMAA 3.3.2.3 longitudinal distribution of the wheel load is = 2H + 2 in or 12.26." This means that the wheel load would be distributed to both sides of the diaphragm for the max shear in the weld. The load would be ((12.26(.5) + 2.375)/12.26) WL or .69 WL or 11/16 WL. No correction are made to the calculation.

Item 4

Comment: In the calculations of the plate to width ratio...60 inches was used.

Reply: Calculations revised using T2.

Item 5

Comment a&b Explain reason for using Fy.....

Reply: Actual plate locations are known from our QA files and the actual yield values are used per the CMTR's.

DESIGN REPORT #4

Item 6

Comment a: Rail clip spacing varies.....
Comment b: Explain reason for variation.....

Reply: Wheels are located by seismic restraints. Clips are located about wheel locations. The beaming of the wheel reaction across (shear) and back for uplift on clips is at 45 degrees. Therefore 4 clips are effective for shear and 6 clips are effective for uplift.

Item 7

Comment: Sheet SG16 How was the governing case ...selected.

Reply: Bolts designed for tension therefore seismic – static produces max tension.

Item 8

Comment: Sheet SG17. For the same bolt, P=3 inches

Reply: AISC defines "P" as the length of flange, parallel to stem or leg, tributary to each bolt. The max bolt load occures in the corner bolt and the length attributed to this bolt is the average of the bolt spacings in the two directions. No correction is required..

Item 9
Comment; Sheet SG21. Weld lug plate to web plate.... Evaluate stress in the weld due to X and Y horizontal loads.

Reply: There are no Y horizontal loads in the lug. The Y horizontal load is reacted by the seismic rail clamps. The X horizontal load was assumed to go into the diaphragm placed between the two lug plates. Calculation revised.

Item 10
Comment: Weld diaphragm to lug plate and web plate.

Reply: Calculations revised using full horizontal load.

Item 11
Comment: Sheet SG22 Reference should be made to Sheets ET24 and ET25.

Reply: References made

DESIGN REPORT #5

Item 1

Comment: Seismic Restraints Uplift trolley sheet STF9 check stresses for bending....thru bolt holes – net section.

Reply: NOG-5481(3) b. "The gross section shall be used in determining stress levels." No corrections required.

Item 2

Comment: Sheet STF10 SAE GR5 bolts have been specified – GR5 bolts not listed in Table NOG-4221-1.

Reply: Table NOG-4221-1 pertains to structural connections. Ederer considered these bolts to be mechanical fasteners. No corrections required.

Item 3

Comment: Sheet STF11. Check weld to account for fabrication and misalignment tolerances.

Reply: We do not consider fabrication tolerances since these are eliminated during assembly.

Item 4

Comment: Sheet ST52. This table D2 is different than Table D2 in the GECA report.

Reply: Sheet ST52 is the correct table.

DESIGN REPORT #5

Item 5

Comment: Sheet STS4, STS10 and STS11. (a) We question the validity of hand analysis for such a complicated weldment.

Reply: Simple assumption are used to obtain stress levels which are within the allowables. This method produces a robust design. Finite element analysis is not required.

Comment: (b) With the assumption used in sheet STS10 the 24.4ksi stress level (Sheet STS4) for the circle reinforcement is not the total stress at the section. The axial and shear stress need to be added to obtain the total stress.

Reply: The stress of 24.4 ksi on sheet STS4 is not additive to those found on STS10. On STS 4 the circle reinforcement was used to brace the 2 ½ web plates between support points assumed to be 60 degrees apart. This plate was not considered to be welded to the side plates and was positioned at the neutral axis of the 45 degree section analyzed on STS10. The stress of 39.80ksi on STS10 is the combined stress requested. Calculations updated.

Item 6

Comment: Sheet STS6. Check max combined shear stress in pin due to shear + bending.

Reply: The shear at the surface of the pin = 0. No corrections made.

Item 7

Comment: Sheet STS7 Bridge restraints check stress using net section.

Reply: Sec NOG-5481 (3) b – gross section to be used. No correction made.

Item 8

Comments: Sheets STS8: SAE GR5 Bolts

Reply: These bolts are considered as mechanical fasteners. Therefore Table NOG-4221-1 does not apply. No correction made.

Item 9

Comment: Sheet STS9: In sketch 112K...should be 161k.
Reply: Calculations revised.

DESIGN REPORT #5

Item 10

Comment: Sheet STS9: Using 12 inch wheel width in conjunction with 1 5/8 thickness we believe overestimates section modulus.

Reply: Max stress are 18% of allowable. The 12" represents the length of wheel that can be loaded by the rail. No change are required.

Item 11

Comment: Sheets STS10 and 11
(a) Reference Sheet TS10

Reply: Reference provided.

Comment: (b) ...use finite element analysis.

Reply: We followed Ederer's Engineering manual as defined in our QA plan. No changes made.

Item 12

Comment: STS12 and 13
(a) Explain reasoning for load sharing between 2 sides, ie. 10 bolts.

Reply: The wheel assembly allows load sharing to all 10 bolts.
(b) SAE Grade 5 bolts.

Reply: The bolts in question are considered to be mechanical fasteners and are not subjected to Table NOG-4221-1.
(c) Explain the rational use evaluate wheel retaining plate....

Reply: The case from Roark assumes a full circle. The side load was increased to load a full circle to obtain the stress level. No corrections made.

Item 13

Comment: Sheet STS14
(a) Make reference to Section B Sheet TS20

Reply: Reference made

(c&d) see reply for Item 3 Report 3. No corrections made.

DESIGN REPORT #5

Item 14

Comment: Sheet STS17 SAE GR 8 bolts used.

Reply: The bolts are considered to be mechanical fasteners therefore Table NOG-4221-1 does not apply. No corrections made.

Item 15 Sheet STF3

Comment: (a)..Reference should be made to sheets TF11 and TF12 of Section C.

Comment: (b) We question the validity of hand analysis. Ideally we would like to see finite element analysis of the section using shell elements.

Reply: We followed Ederer's Engineering manual as defined in our QA Plan. No corrections made.

Item 16

Comment: Sheet STF7 Wheel retaining plate. Explain rational for using Roak's case 15 page 220 formula for flat circular plates with concentric holes in evaluation of wheel retaining plate.

Reply: The formulas are for a full circle. The retaining plates are for a partial circle. The load was increased to load a full circle, ie load =127.8k/2 plates = 63.9k, load applied = 101.6k/plate. No correction made.

Item 17

Comment: Design of trolley seismic restraint in X direction is not included in calculation package.

Reply: GEC's scope of work is to design the mechanical components of the seismic restraints including the bolt required to bolt it to the trolley. Ederer's scope of work is to design the pads on the girder which reacts the seismic loads. Revised Sheet SG15 – Add calculations.

Item 18

Comment: Bolts....

Reply: Ederer considers these bolts to be mechanical components – See attached Design Report faxed June 16, 1998. No correction required.

Revision _____ ATTACHMENT A Revision 1 - 12/7/89

DESIGN VERIFICATION LIST FOR APPROVED

Multi-Canister Handling Machine 4/14/89

Chief Mechanical Engineer

S.O. No. F-256C

	Drawing Number	Description	Design Verification	Verification Located On	Complete By/Date
BRIDGE				L1, L9	
B.1		Girder Structure	CLBC CLrCa RSA		
B.2		Sill Structure	CLBC	Rev A ET17, ET18, ET19	LH 9/14/89
B.3		Truck Structure	CLBC	Rev A TS6, TS7, TS8 TS11, TS12, TS13	LH 9/14/89
B.4		Walkways	ClrCb		
B.5		Bridge Drive	PAa		
B.6		Bridge Wheel Assembly	CLBC	Rev A SG7, →SG12 SG15, SG21 SG22	LH 4/14/89
B.7		BRIDGE SEISMIC	RSA		

FREDERIC EVERETT LANGFORD STATE OF WASHINGTON 4/14/89 9379 REGISTERED PROFESSIONAL ENGINEER

EXPIRES 4/1/00

SECTION B

COMPONENTS: BRIDGE TRUCK AND BRIDGE DRIVE
LOADING: OPERATIONAL

DESIGN BY: DON MCGHEE
CHECKED BY: JUDY FOGELQUIST
SUPERVISOR: FRED LANGFORD, P.E.

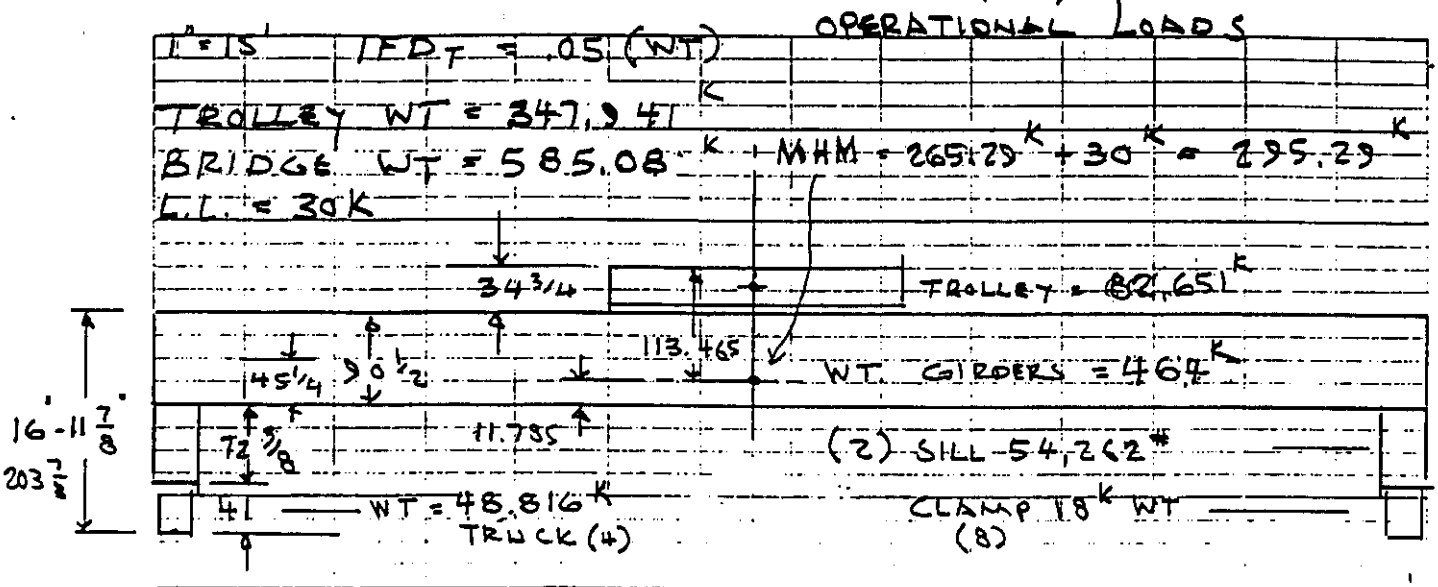
TABLE OF CONTENTS

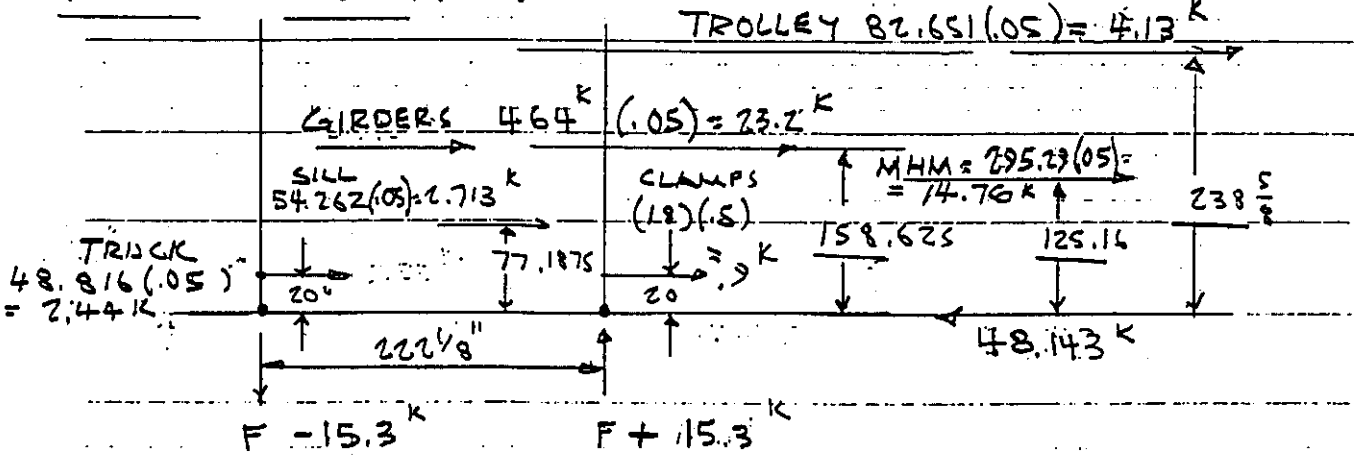
REV A SHEET NO'S TS5,TS7,TS8,TS11,TS12,TS19

By DEM Date 12-5-96 — T S — Sheet No. 5 of ___

Chkd. JLF Date 1-27-97 — Job No. F2566

Subject: BRIDGE DIMENSIONS IFD$_T$ & LFD$_L$





$F = 20(3.34) + (77.1875)\,2.713^{K} + (125.16)(14.76) + 158.625(23.2) + 238.625(4.13) \;/\; 222.125 = 30.56^{K}$

FOR (2) SIDES $F/2 = 15.3^{K}$ ↑ ±

TRANSVERSE $F_T = 48.143^{K}$

FORCE IFD$_L$ = 34.29 (.10) / 8* WHEELS = 4.35 = SIDE FORCE

Pc 3" GOVERNS FOR OPERATIONAL LOADING

*NOTE Coef. Friction x WL > IFF ∴ All Wheel EFFECTIVE

A

Rev.	Description	Date	By	Chkd.
A	8 Wheels Was 16	4-3-97	ZH	DEM

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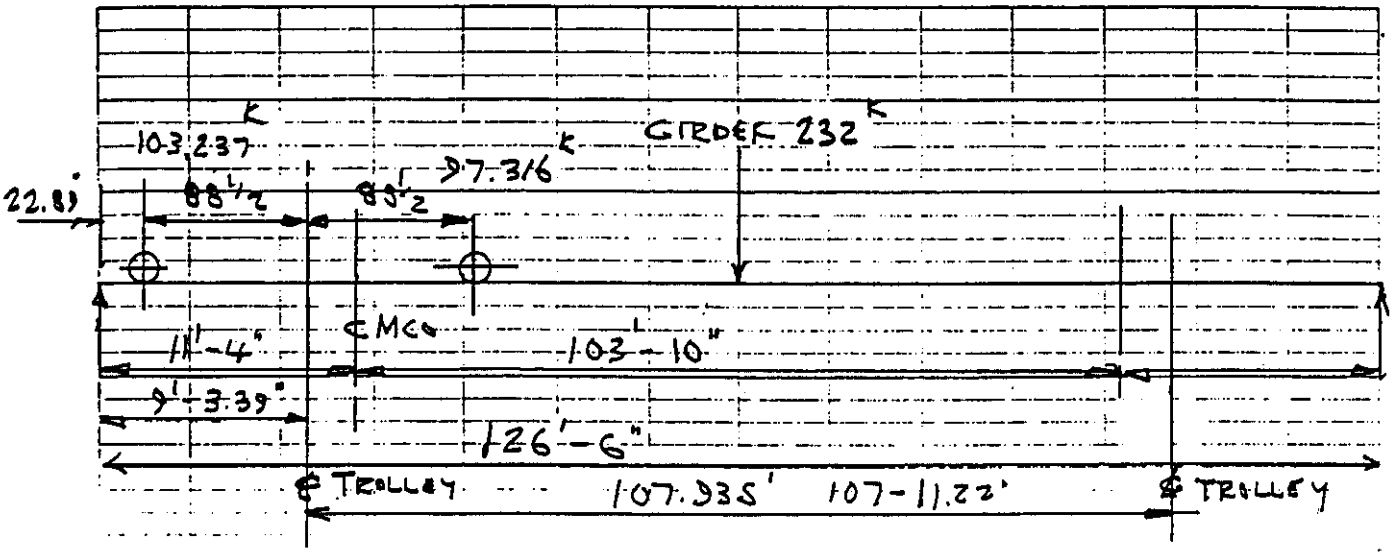
By DEM Date 1-3-97 TS Sheet No. 7 of ___

Chkd. JLF Date 1-27-97 Job No. F-2566

Subject: BRIDGE OPERATIONAL LOAD TO TRUCK



TRUCK IDLER DRIVER
12.204 K - 2.56 - 2.64 = 7 K

GIRDER 1/2 =
11.6 K

SILL 1/2
13.56 K

$$R_1 = \frac{103.237(1495.11) + 97.316(1318.11)}{1518} = 186.18\ K$$

$\Sigma = 7 + 11.6 + 13.56 + 186.18 = 322.74$ K ON TRUCK PIN

LED = 15.4 K VERT. ON TRUCK PIN

TFD HORTIZONTAL (ALONG RAIL)

$$= \frac{(3.34^K + 2.713^K + 23.2^K)63.25' + 4.13^K \times 107.935' + 19.76^K \times 103.83'}{126.5'}$$

$= 30.26^K$ (A)

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Rev.	Description	Date	By	Chkd.
A	30.26 K WAS 24 K	9-9-99	LH	DEM

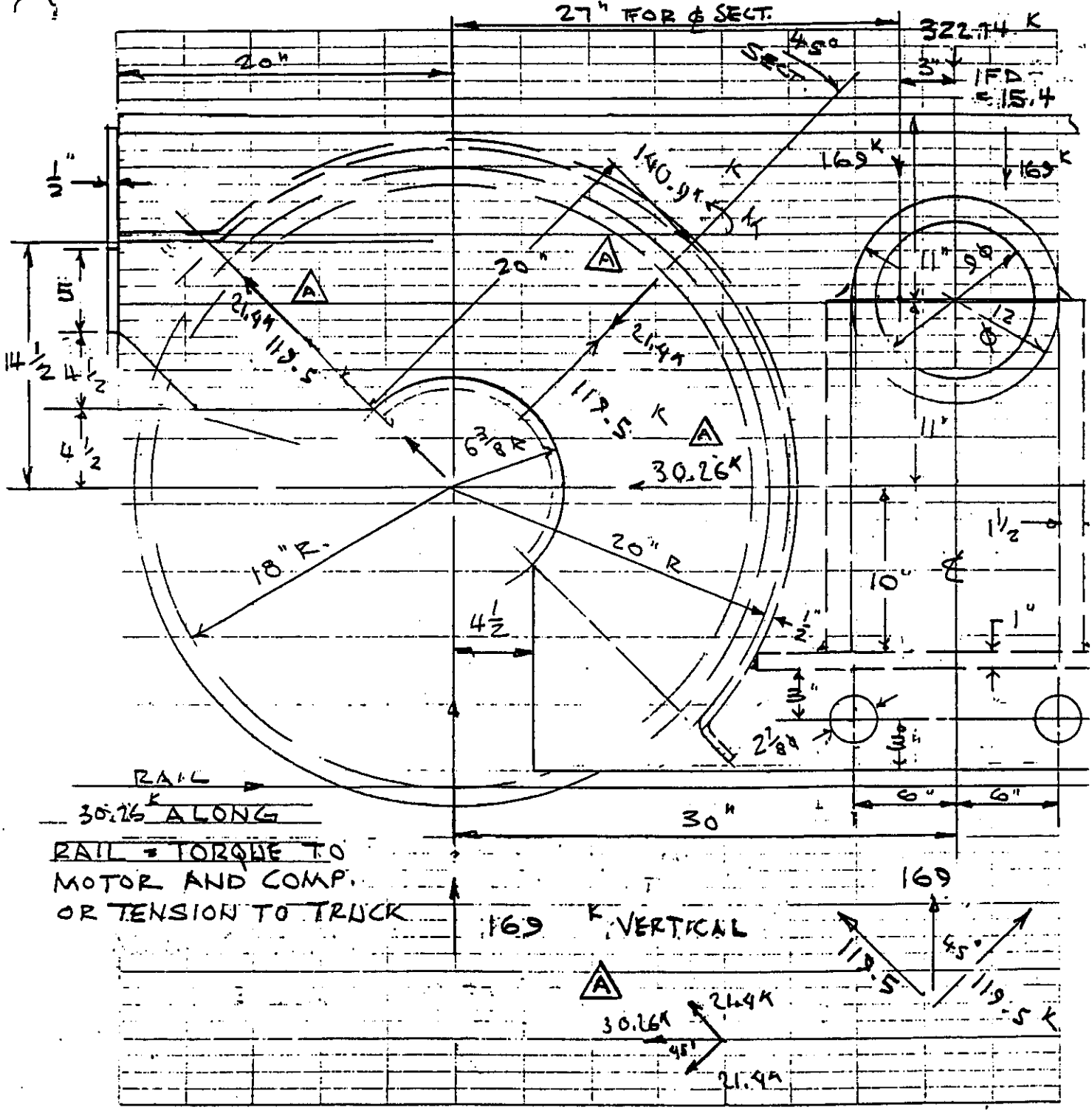
By DEM Date 8-29-96

Chkd. JLF Date 1-27-97

TS
Sheet No. 8 of ___

Job No. F.2566

Subject: TRUCK DIMENSIONS BRIDGE OPERATIONAL LOADS



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Rev.	Description	Date	By	Chkd.
A	30.26K WAS 24K	4-3-97	JH	DEM

By DEM Date 8-16-96 Sheet No. 11 of ___
Chkd. JLF Date 1-27-97 Job No. F2566

Subject: BRIDGE TRUCK OPERATIONAL STRENGTH STRESS

CLASS 70
MATL. ASTM A516 38 YIELD UCT 70 TO 90 KSI

P = 140.9 K (A) ON SECTION FROM TS-8

P_1 = 0 ON (1) PLATE

A = 138.51 SECTION FROM SH. TS-10

A_1 = 58.32 (1) PL

I = 8111.6 SECT. $\bar{Y}$ = 13.62 L = 20.0'

$Z_{1PL} = \frac{23.33^2(2.5)}{6} = 226.8 IN^3$ $L = 23.33/2 + 6.375 = 18.04'$

TABLE NO. 43H-1

FOR $\tau_{BA} = 0.5(\tau_y) = .5(38) = 19$ KSI

$\tau_A = 0.4(\tau_y) = .4(38) = 15.2$ KSI

$\tau_{B_P} = \frac{140.90^K (13.62)^{in} (20)}{8111.6\ IN^4} = 4.73^K$ KSI (A)

$\tau_{BP_1} = \frac{-0.(18.04)'}{226.8} = \pm 0.00$ KSI

$P/A_{SECT.} = \frac{140.90\ K}{138.51\ IN^2} = 1.02$ KSI (A)

$P_1/A_{1PL} = \frac{0\ K}{58.32} = 0.00$ KSI

FLAT PL (TS-10) $\tau = 0.116(P_H) = 0.116(0.0) = 0.00$ KSI

TOTAL = 5.74 KSI BENDING (A)

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Rev.	Description	Date	By	Chkd.
A	140.9 WAS 119.5	4/3/99	LH	DBH

By DEM Date 8-16-96 TS
Chkd. JLF Date 1-27-97 Sheet No. 12 of ___
Job No. F2566

Subject: BRIDGE TRUCK OPERATIONAL STRENGTH - SHEAR

A

P = 190.7 K SECT. = V_1

P_{1PL} = 0.0 (1) PLATE = V_2

HORIZONTAL P_H = 0.0 K = V_3

I_x = 8111.6 IN^4, A = 138.51 SECT, A = 59.32 IN^2 1 PL

b = 5"

$Q = 13.62"(5")\left(\frac{13.62"}{2}\right) = 463\ IN^3$

A

(1) $\tau_1 = \frac{VQ}{Ib} = \frac{190.7(463)}{8111.6(5)} = 1.03$ KSI HORIZONTAL SHEAR

(2) $\frac{V_1}{A\ SECT.} = \frac{190.7^K}{138.51} = 0.65$ KSI ↑ A

(3) $\frac{V_2}{A\ 1PL} = \frac{0.0\ K}{59.32} = 0.0$ KSI ↑

(4) $\frac{V_3}{SECT.} = \frac{0.0^K}{138.51} = 0.0$ →

$\tau_{AVG} = (0.00^2 + (.65 + 0.00)^2)^{.5} = 0.65$ KSI

$\sigma_{EB} = (\sigma_b^2 + 3\tau_{AVG}^2)^{.5} = ((5.74)^2 + 3(0.65)^2)^{.5}$

$\sigma_{EB} = 5.84$ KSI < 15 KSI ALLOW. O.K.

$\tau_{MAX} = \left(\left(\frac{\sigma_x}{2}\right)^2 + \tau_{xy}^2\right)^{.5}$

$\tau_{MAX} = \left(\left(\frac{5.74}{2}\right)^2 + (1.03)^2\right)^{.5} = 3.05$ KSI

A

ALLOWABLE (.4)(38) = 15.2 > 3.05

OK

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Rev.	Description	Date	By	Chkd.
A	90.7 K WAS 115.5 K	4/5/99	LH	DEM

17

By DEM Date 12-6-96 Sheet No. 12 of ___

Chkd. ILF Date 1-27-97 Job No. F-2566

Subject: BRIDGE DRIVE SHAFT

NOG 5453.1(a)-1 ALLOWABLE STRESS 0.2 YLT

STRENGTH AT X, $\tau_{BA} = (.2)164 = 32.8$ KSI

$\tau_{TS} = (.2)(123) = 24.6$ KSI

$\tau_B = \frac{37.3 \text{ kN}}{6.28 \text{ IN}^3}(1) = 6 \text{ KSI}\ (1.59) = 9.54 \text{ KSI}$

$\tau_T = \frac{100 \text{ kN}}{12.57 \text{ IN}^3}(1) = 8 \text{ KSI}\ (1.375) = 11 \text{ KSI}$

$\tau_{EB} = \left[9.54^2 + \left[\frac{32.8}{24.6}\right]^2 11^2\right]^{.5} = 17.50 \text{ KSI} < 32.8 \text{ KSI}$

$\tau_S = \frac{1.33(6.6 + 2.035)}{12.56}(1) = .91 \text{ KSI}$ $\tau_{ET} = 11 + .9 = 11.9 < 24.6$ KS

SEISMIC NOT APPLICABLE

BRIDGE DRIVE AXLE NOG 5453

AT X_1: $\frac{D}{d} = \frac{7.375}{6.75} = 1.09$ $\frac{r}{d} = \frac{.5}{6.75} = .07$

$K_{NB} = 1.6$, $K_{NS} = 1.2$

STRENGHT AT X_1 : (1) GOVERNS

$\tau_B = \frac{(80.7)(3.5')(32)}{6.75^3 \text{ IN}^3} = 9.35 \text{ KSI}(1.6) = 14.96 \text{ KSI}$

$\tau_T = \frac{100(16)}{6.75^3 \text{ IN}^3} = 1.65 \text{ KSI}\ (1.2) = 1.98 \text{ KSI}$

$\tau_{EB}\left[14.96^2 + \left[\frac{32.8}{24.6}\right]^2 1.98^2\right]^{.5} = 15.19 < 32.8 \text{ KSI}$

$\tau_S = \frac{80.75(1.33)}{3.375^2 \text{ IN}^3} = 3.00 \text{ KSI}$

$\tau_{ET} = 3.00 + 1.98 = 4.98 < 24.6 \text{ KSI}$

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Rev.	Description	Date	By	Chkd.
A	Value corrected	9/18/97	DEM	DEM

SECTION C

COMPONENTS: BRIDGE GIRDER AND END TIE BEAM
LOADING: OPERATIONAL

DESIGN BY: LARRY HUDAK
CHECKED BY: DON MCGHEE
SUPERVISOR: FRED LANGFORD, P.E.

TABLE OF CONTENTS

REV. A SHEET NO'S L1, L4,ET17,ET18,ET19,SG7 → SG12,SG15,SG21,SG22

By L. Hudek Date 3-3-97 Sheet No. 1 of ___
Chkd. DEM Date 3-20-97 Job No. E-2566

Subject: LOADS

NOG-4140 LOAD COMBINATIONS

TROLLEY DEAD LOAD	$P_{dt} = 347.991^{K}$
BRIDGE/GANTRY DEAD LOAD	$P_{db} = 529.114^{K}$
RATED LOAD (15 Tons)	$P_{tr} = 30^{K}$
CRITICAL LOAD	$P_{tc} = 30^{K}$
CREDIBLE CRITICAL LOAD WITH OBE	$P_{co} = 0$ A
CREDIBLE CRITICAL LOAD WITH SSE	$P_{cs} = 0$ A
CONSTRUCTION LOAD	NA
VERTICAL IMPACT LOAD (15% MAX LOAD)	$P_v = 4.5^{K}$
TRANSVERSE HORIZONTAL LOAD (5% Y)	$P_{HT_{T+HL}} = 18.90^{K}$
	$P_{FT_B} = 26.46^{K}$
LONGITUDINAL HORIZONTAL LOAD (10% X)	$P_{hL} = 37.8^{K}$
OPERATING WIND LOAD	P_{wo} 0
DESIGN WIND LOAD	P_{wd} 0
TORNADO WIND LOAD	P_{WT} 0
PLANT OPERATION INDUCED LOADS	P_{PT} P_{TD} 0
SSE LOADS	P_e' 0
OBE LOADS	P_e By OTHERS
ABNORMAL LOADS	P_a 0

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Rev.	Description	Date	By	Chkd.
A	P_{LL} & P_{CS} W.S. 30	4-8-97	LH	DEM

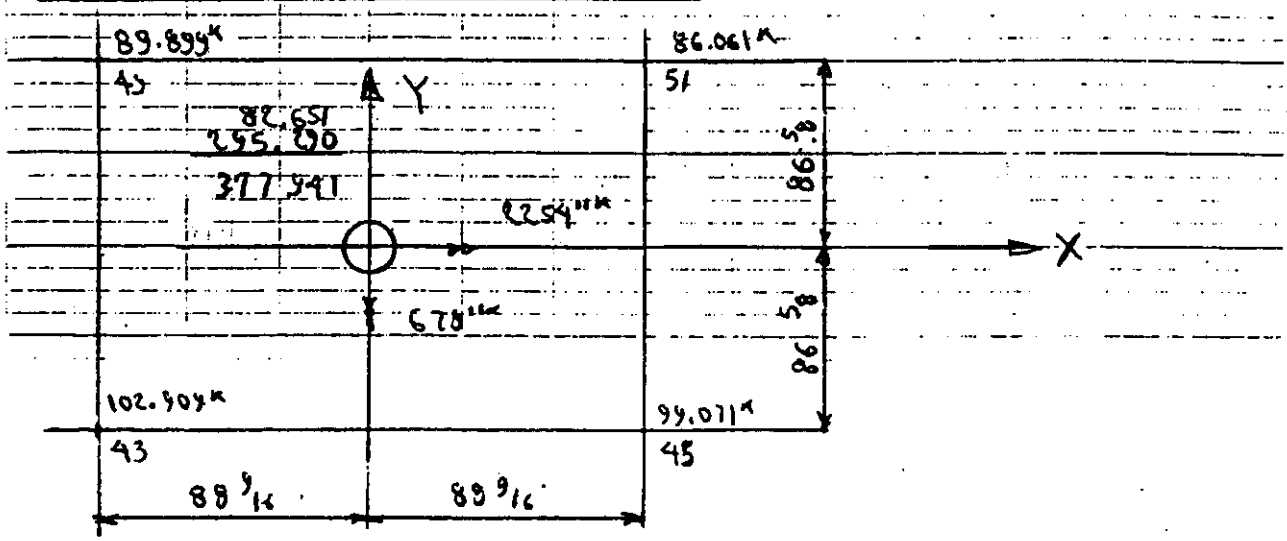
By L. Hulek Date 3-3-97 Sheet No. 1-9 of ___

Chkd. DEM Date 3-24-97 Job No. F-2666

Subject: COMPUTER SLOUTION CHECK

L.C. 1 TROLLEY @ CENTER OF SPAN

TROLLEY WHEEL REACTIONS



$R = \frac{377.941}{4} \pm \frac{2254}{86\frac{5}{8} \times 2 \times 2} \pm \frac{678}{88\frac{9}{16} \times 2 \times 2} = 94.485 \pm 6.505 \pm 1.919$

$R_{43} = 102.909$

$R_{45} = 94.485 + 6.505 - 1.919 = 99.091$ K

$R_{49} = 94.485 - 6.505 + 1.919 = 89.899$ K

$R_{51} = 94.485 - 6.505 - 1.919 = \frac{86.061}{377.941}$ K

A

Node	Px	Pz	Py	Mx	My	Mz
43		-102.909				
45		-99.091				
49		-89.899				
51		-86.061				

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Rev.	Description	Date	By	Chkd.
A	Py Was Pz	4-8-97	YH	DEM

By L. Hudak Date 3-3-97 Sheet No. 11 of ET

Chkd. DEM Date 3-26-97 Job No. F-2566

Subject:

END TIE BEAM

Item	Size	No.	Wt.	ASTM MATERIAL
LUG PL	PL 9½ x 20 x 55¾	4	5987	A36 (A)
BOT PL	PL 1¼ x 39 x 69½ - 5⅛	1	4024	A-516 GR 70 Normalized
TOP PL	PL ⅝ x 30 x 11½ - 2⅛	1	750	A36
CON PL	PL 1¼ x 67 x 81	2	3841	A-516 GR 70 Normalize.
WEB PL	PL ⅝ x 70'9 x 25½ - 10⅞	2	7145	A36
DIAG	PL ⅝ x 25 x 70'9	3	934	
	PL ⅝ x 20½ x 69⅞	2	508	
END PL	PL ⅝ x 69⅞ x (34½ + 6⅛)½	2	1197	
STIFF PL	PL ⅝ x 6 9⅞ (7⅜ + 35)½	4	1056	
EAST PL	PL ⅝ x 75½ x 32 1/16	2	858	
	PL ⅝ x 75½ x 40 13/16	2	1092	
Short Diag Gussets	PL ½ x 9 x 25	3	90	
	PL ½ x 6" x 9	30	230	
	Net ½ x 5 x 3 (½)	30	-85	A36
			27 131	

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Rev.	Description	Date	By	Chkd.
A	AS BUILT MAT WAS A516 GR 70	10/5/99	LH	DEM

By L. Hudek Date 3-3-97 Sheet No. 18 of ET
Chkd. DEM Date 3-20-97 Job No. F-2566

Subject:

END TIE BEAM NOG 9311

Check LUG 4½ x 20" MAT. A36 (A)

$F_y = 44.8$ CMYK

$A_2 = 4\frac{1}{2} \times 20 = 90^{in^2}$

$I_{yy} = \frac{20\,(4\frac{1}{2})^3}{12} = 151.9\ in^4$

$\rho_{2\frac{1}{2}} = \sqrt{\frac{I}{A}} = \sqrt{\frac{151.9}{90}} = 1.299$

$\frac{Kl}{\rho} = \frac{2 \times 12''}{1.299} = 18.47$

(A)

$C_c = \sqrt{\frac{2\pi^2 E}{\sigma_y}} = \sqrt{\frac{2\pi^2 \times 29000}{44.8}} = 113. > 18.47$

$\sigma_2 = \left[1 - \left(\frac{Kl}{\rho}\right)^2 / 2C_c^2\right]\left(\frac{\sigma_y}{F.S.}\right)$

$F.S. = N\left(\frac{5}{3} + \frac{3}{8}\left(\frac{\frac{Kl}{\rho}}{C_c}\right) - \frac{1}{8}\left(\frac{\frac{Kl}{\rho}}{C_c}\right)^3\right) = N\left(\frac{5}{3} + \frac{3}{8}\left(\frac{18.47}{113}\right) - \frac{1}{8}\left(\frac{18.47}{113}\right)^3\right)$

$F.S. = 1.73N = 1.73 \times 1.2 = 2.07$ (A)

$\sigma_2 = \left[1 - \frac{(18.47)^2}{2(113)^2}\right]\frac{44.8}{2} = 22.10^{ksi}$

$\sigma'_{e_Y} = \frac{12\pi^2 E}{23N\left(\frac{Kl}{\rho}\right)^2} = \frac{12\pi^2 29000}{23N(18.47)^2} = \frac{937.79}{N} = 364^{ksi}$

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Rev.	Description	Date	By	Chkd.
A	MAT. WAS SIG GR 56	10/9/98	LH	DEM

By L. Hudek Date 3-3-97 Sheet No. ET 11 of ___

Chkd. DEM Date 3-26-97 Job No. F-2566

Subject: ___

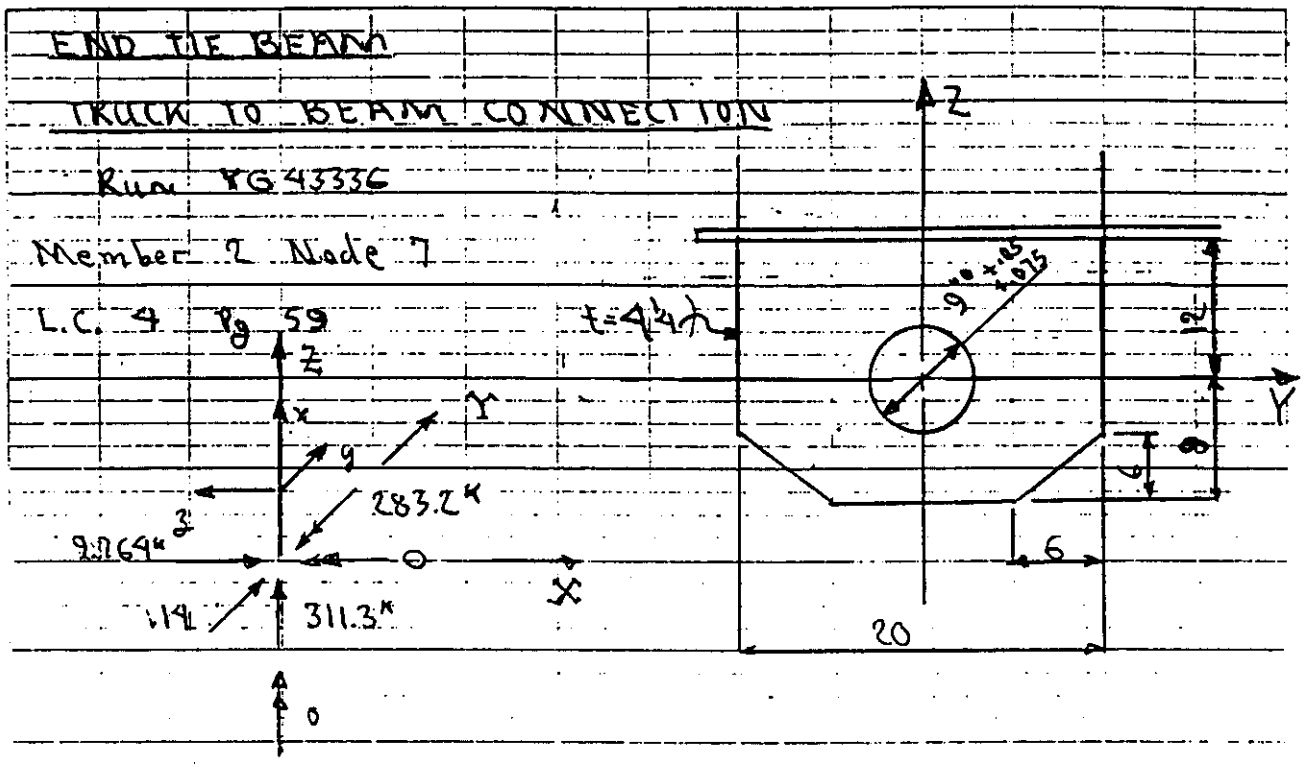
END TIE BEAM

TRUCK TO BEAM CONNECTION

Run YG43336

Member 2 Node 7

L.C. 4 P_y 59



Check Bearing on 4½ R 9" Bore Material A36

F_y = 44.8 CMTR

$P_z = \frac{311.3^K}{2} \pm \frac{283.2^K}{25"} = 155.6^K + 11.33^K$

$P_{z_{max}} = 166.92^K$ (A)

$\sigma = \frac{P}{Dt} = \frac{166.92^K}{9" \times 4\frac{1}{2}} = 4.12^{KSI} < 33.6^{KSI}$ (.75 F_y)

Check Lug Bending Stress (A)

$\sigma = \frac{Y_c}{A} + \frac{M_y}{S} = \frac{166.92^K}{4\frac{1}{2} \times 20"} \pm \frac{9.269^{K/C} \times 12"}{20(4\frac{1}{2})^2} = 1.85^{KSI} \pm 1.73^{KSI} = 3.58^{KSI} < 22$

Combined Stresses NOG-9321

$\frac{\sigma_z}{\sigma_{2z}} + \frac{\sigma_{by}}{\sigma_{2by}} = \frac{1.85}{18.78} + \frac{1.73}{19.6} = .1 \pm .1 = .2 < 1.0$ OK

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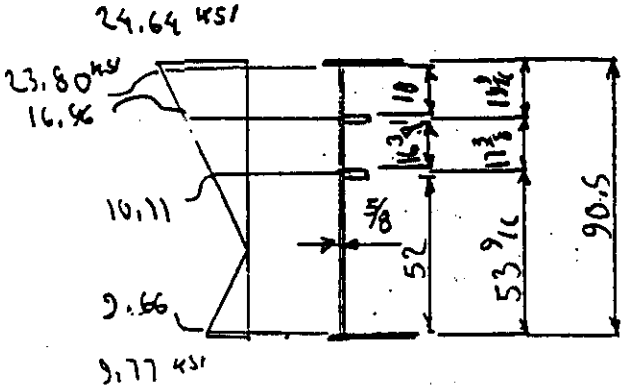
Rev.	Description	Date	By	Chkd.
A	MAT. WAS A516 GR 70	10/9/98	LH	DEM

By L. Hudek Date 11-11-97 Sheet No. 37 of ___
Chkd. DEM Date 11-18-97 Job No. F-2566

Subject: SEISMIC ANALYSIS

GIRDER PLATE BUCKLING CHECK

WEB PL x 5/8 REF Y_g G1, G18 Q.A. #7236 F_y = 46.3 KSI



$$\sigma_e = \frac{\pi^2 E}{12(1-\mu^2)}\left(\frac{t}{b}\right)^2$$

$$\sigma_e = 26.21\times10^3\left(\frac{t}{b}\right)^2$$

$$\frac{b/t}{\sqrt{K}} \geq \sqrt{\frac{2.62\times10^7}{.757\times38\times10^3}} \geq 30.18$$

TABLE NOG-4332.1-1

NO 2 Non uniform compression

$$\alpha = \frac{a}{b} = \frac{72}{18} = 4.071 \text{ (A)}, \quad \beta = \frac{16.96}{23.80} = .7126$$

$$K_\sigma = \frac{8.4}{\beta+1.1} = \frac{8.4}{.7126+1.1} = 4.63$$

$$K_T = \left(5.34 + \frac{4}{\alpha^2}\right)\sqrt{3} = \left(5.34 + \frac{4}{(4)^2}\right)\sqrt{3} = 10.98 \text{ (A)}$$

$$\sigma_e = 26.21\times10^3\left(\frac{5/8}{18}\right)^2 = 31.6 \text{ KSI}$$

$$\frac{b/t}{\sqrt{K_\sigma}} = \frac{18/(5/8)}{\sqrt{4.63}} = 13.38 < 30.18, \quad \frac{b}{t\sqrt{K_T}} = \frac{18/(5/8)}{\sqrt{10.98}} = 8.69 < 30.18 \text{ (A)}$$

$$\sigma_{cr} = \frac{\sigma_y(\sigma_e K_\sigma)^2}{.1836(\sigma_y)^2+(\sigma_e K_\sigma)^2} = \frac{46.3(31.6\times4.63)^2}{.1836(46.3)^2+(31.6\times4.63)^2} = 45.46$$

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Rev.	Description	Date	By	Chkd.
A	72 W23 G6	ZH	9-8-97	DEM

By L. Hudek Date 11-11-97 Sheet No. 8 of 30
Chkd. DEM Date 11-13-97 Job No. E-2566

Subject: SEISMIC ANALYSIS

GIRDER PLATE BUCKLING CHECK

WEB 8 (Cont.)

$$\tau_{cr} = \frac{\sigma_y (\sigma_e K_\tau)^2}{\sqrt{3}\left(.1836(\sigma_y)^2 + (\sigma_e K_\tau)^2\right)} = \frac{46.3\,(31.6 \times 10.98)^2}{\sqrt{3}\left(.1836(46.3)^2 + (31.6 \times 10.98)^2\right)}$$ (A)

$\tau_{cr} = 26.65$ KSI (A)

$$\sigma_{crc} = \frac{\sqrt{\sigma_c^2 + 3\tau^2}}{\left(\frac{1+\beta}{4}\right)\left(\frac{\sigma_c}{\sigma_{cr}}\right) + \sqrt{\left(\frac{3-\beta}{4} \times \frac{\sigma_c}{\sigma_{cr}}\right)^2 + \left(\frac{\tau}{\tau_{cr}}\right)^2}}$$

$$\sigma_{crc} = \frac{\sqrt{(23.80^{12} + 3(11.98)^2}}{\left(\frac{1+.7126}{4}\right)\left(\frac{23.80}{45.96}\right) + \sqrt{\left(\frac{3-.7126}{4} \times \frac{23.80}{45.96}\right)^2 + \left(\frac{11.98}{26.65}\right)^2}} = \frac{31.57}{.7642}$$

$\sigma_{crc} = 41.31$ KSI (A)

$\sigma_{ce} = \sqrt{\sigma_c^2 + 3\tau^2} = 31.57$

$FSB = 1.35 + .075(\beta - 1) = 1.35 + .075(.7126 - 1) = 1.328$

$\sigma_{ce} \times FSB = 31.57 \times 1.328 = 41.9 \approx 41.31$ (A)

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Rev.	Description	Date	By	Chkd.
A	10.98 was 9.87	11/13/97	LH	DEM

By L. Hudak Date 11-11-97 Sheet No. 9 of 26
Chkd. DEM Date 11-18-97 Job No. F 25EC

Subject: SEISMIC ANALYSIS

GIRDER PLATE BUCKLING

WEB R

TABLE NOG-4332.1-1
NO3 Bending with Tension Preponderant

$\alpha = \frac{a}{b} = \frac{72}{52} = 1.38$ A, $\beta = -\frac{10.11}{9.66} = -1.05$

$K_\sigma = 23.9$ $\quad K_\tau = \left(5.34 + \frac{4}{(1.38)^2}\right)\sqrt{3} = 12.89$ A

$\sigma_e = 26.21 \times 10^3 \left(\frac{\frac{5}{8}}{52}\right)^2 = 3.786$

$\frac{\frac{b}{t}}{\sqrt{K_\sigma}} = \frac{\frac{52}{5/8}}{\sqrt{23.9}} = 17.02 < 30.18$, $\frac{\frac{b}{t}}{\sqrt{K_\tau}} = \frac{\frac{52}{.625}}{\sqrt{12.89}} = 23.17 < 30.18$ A

$\sigma_{cr} = \frac{963(3.786 \times 23.9)^2}{.1836(963)^2 + (3.786 \times 23.9)^2} = 44.18$ ksi

$\tau_{cr} = \frac{463(3.786 \times 12.89)^2}{\sqrt{3}\left(.1836(963)^2 + (3.786 \times 12.89)^2\right)} = 22.94$ ksi A

$\sigma_{crc} = \frac{\sqrt{(10.11)^2 + 3(11.98)^2}}{\left(\frac{1-1.05}{4}\right)\left(\frac{10.11}{44.18}\right) + \sqrt{\left(\frac{3+1.05}{4} \times \frac{10.11}{44.18}\right)^2 + \left(\frac{11.98}{22.94}\right)^2}} = \frac{23.08}{.568}$ A

$\sigma_{crc} = 40.60$ ksi A

$FSB = 1.35 + .075(-1.05 - 1) = 1.196$

$23.08 \times 1.196 = 27.61 < 41.6$ OK

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Rev.	Description	Date	By	Chkd.
A	72 WAS 60	11/19/97	LH	DEM

By L. Hudek Date 11-11-97 Sheet No. 10 of 56
Chkd. DEM Date 11-18-97 Job No. F-2566

Subject: SEISMIC ANALYSIS

GIRDER PLATE BUCKLING CHECK

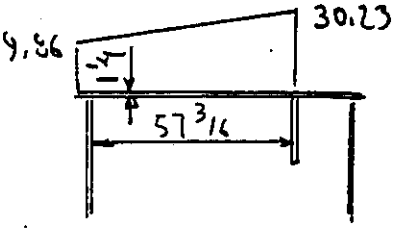
TOY R x1¼ Ref Dg G1, G18, G19 QA 7192 F_y = 52.6 KSI

Point 4 σ = .95 KSI + 16.30 KSI − 7.39 KSI = 9.86 KSI

Point 6

$$\sigma = \frac{313.83^K}{329.375} + \frac{1860.42^{IN\text{-}K}}{114.17} + \frac{47.475^{IN\text{-}K}}{13.575} = .9 + 16.30 + 3.49 = 20$$

$\Sigma\sigma$ = 20.74 KSI + 9.49 KSI = 30.23 KSI < 34.2 KSI For F_y = 38 KSI



$$\tau_{TOY\ R} = \frac{80.53^K}{196.875^{IN}} + \frac{84.17^{IN\text{-}K}}{2(89.25 \times 74.125)1\frac{1}{4}} = .41^{KSI} + 5.08 = 5.49^{KSI}$$

TABLE NOG-4332.1-1

No 2 Non Uniform Compression

$$\alpha = \frac{72}{57\frac{3}{16}} = 1.26 > 1 \text{ (A)} \qquad \beta = \frac{9.86}{30.23} = .326, \quad \sqrt{\frac{2.6 \times 10^7}{.757 \times 52.6 \times 10^3}} = 21$$

$$K_\sigma = \frac{8.4}{.326 + 1.1} = 5.82 \qquad K_\tau = \left(5.34 + \frac{4}{(1.26)^2}\right)\sqrt{3} = 13.61 \text{ (A)}$$

$$\sigma_e = 26.21 \times 10^3 \left(\frac{1\frac{1}{4}}{57\frac{3}{16}}\right)^2 = 12.522$$

$$\frac{b/t}{\sqrt{K\sigma}} = \frac{\frac{57\frac{3}{16}}{1\frac{1}{4}}}{\sqrt{5.82}} = 18.85 < 26.21 \text{ (A)}; \qquad \frac{\frac{b}{t}}{\sqrt{K\tau}} = \frac{\frac{57\frac{3}{16}}{1\frac{1}{4}}}{\sqrt{13.61}} = 12.90 < 25.65 \text{ (A)}$$

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Rev.	Description	Date	By	Chkd.
A	72 WAS 60	4-6-99	LH	DEM

By L. Hudak Date 11-11-97 Sheet No. 11 of ___
Chkd. DEM Date 11-18-97 Job No. F-2566

Subject: SEISMIC ANALYSIS

GIRDER PLATE BUCKLING CHECK

TOP PL x 1'4 (Cont.) F_y per CMTR = 52.6 KSI QA # 7192

$$\sigma_{CR} = \frac{52.6\,(12.522 \times 5.89)^2}{.1836\,(52.6)^2 + (12.522 \times 5.89)^2} = 48.11 \text{ KSI}$$

$$\tau_{cr} = \frac{52.6(12.522 \times 13.61)^2}{\sqrt{3}\,(.1836(52.6)^2 + (12.522 \times 13.61)^2)} = 29.85 \text{ KSI}$$ A

$$\sigma_{crc} = \frac{\sqrt{(30.23)^2 + 3(5.41)^2}}{\left(\frac{1+.326}{4}\right)\left(\frac{30.23}{52.6}\right) + \sqrt{\left(\frac{3-.326}{4} \times \frac{30.23}{52.6}\right)^2 + \left(\frac{5.41}{29.85}\right)^2}}$$

$$\sigma_{crc} = \frac{31.62}{.616} = 51.40$$ A

$FS_B = 1.35 + .075\,(.326 - 1) = 1.296$

$31.69 \times 1.299 = 41.16 \text{ KSI} < 51.40 \text{ KSI}$ OK USING CMTR F_y A

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Rev.	Description	Date	By	Chkd.
A	13.61 WAS 15.53	9-8-99	LH	DEM

By L. Hudak Date 11-12-97 Sheet No. 15 of ___
Chkd. DEM Date 11-18-97 Job No. F-2596

Subject: SEISMIC ANALYSIS

GIRDER - RAIL CLIP

CHECK 7/8" ø STUD

$q_{avg} = .848^K/_{in} + \frac{17.68}{6.37/.4555} = 2.11^K/_{in}$

$F = 2.11^K/_{in} \times 3.142" = 6.64^K/_{STUD}$

REF. AWS D1.1-92

SEC 7.3 MECHANICAL REQUIREMENTS

TYPE A $F_u = 55^{KSI}$ (STUD)

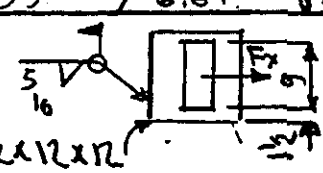
TABLE NO G-4315-1

$F_{allow} = .5F_u = .5 \times 55^{KSI} = 27.5^{KSI}$

$A_{7/8\ STUD} = \frac{\pi (\frac{7}{8})^2}{4} = .6013^{in^2}$

$q_{allow} = .6013^{in^2} \times 27.5^{KSI} = 16.53^K > 6.64^K$ OK

A SEISMIC RESTRAINTS
TROLLEY IN X DIRECTION
WELD TO TOY GIRDER



MAX LOAD TO GIRDER $F_x = 877.1\ KN = 197^K$ TABLE D1

WELD BLOCK 2½ x 12 x 12 TO TOP GIRDER MAT. A516GR7
USE 5/16" fillet Weld all around.

$q_{allow} = 6.44^K/_{in}$ $F = 6.44^K/_{in} \times 12(4) = 309^K > 197^K$

$F_{Tnet\ SECTION} = \frac{197^K}{2} \times \frac{1}{2\frac{1}{2}(12-9)} = 13.13^{KSI} < 34.2^{KSI}$

REF Pg MAT 1,

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Rev.	Description	Date	By	Chkd.
A	Added Calculation	11/12/97	LH	DEM

By L. HUDAK Date 11-13-97 Sheet No. 21 of ___
Chkd. DEM Date 11-18-97 Job No. F-2566

Subject: SEISMIC ANALYSIS

END TIE BEAM - LUG Cont

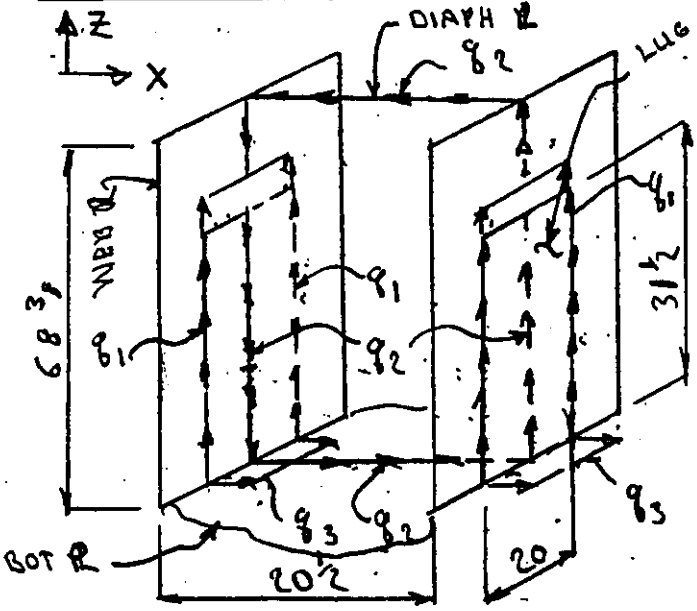
COMBINED STRESSES Cont.

$$\frac{\sigma}{\sigma_{2c}} + \frac{C_m \sigma_b}{\left(1-\frac{\sigma}{\sigma_e}\right)\sigma_{2b}} = \frac{7.36}{34.36} + \frac{.85 \times 28.62}{\left(1-\frac{7.36}{653}\right)40.32} = .21 + .61 = .82 < 1.0$$

$$\frac{\sigma}{\sigma_{2c}} + \frac{\sigma_b}{\sigma_{2b}} = \frac{7.36}{34.36} + \frac{28.62}{40.32} = .21 + .71 = .92 < 1.0$$

WELD CHECK REF P_2 ET 20

WELD LUG ℄ to WEB ℄ AND DIAPH ℄ (A)



q_1 WEB $= \frac{578^k}{2[2\times 9\frac{1}{2}+20]} = 3.48^k/_{in}$

q_2 DIAPH $= \frac{322^k \times 76\frac{3}{16}}{2(68\frac{3}{8}+20\frac{1}{2})} = 8.75^k/_{in}$

q_3 BOT ℄ $= \frac{322^k}{2\times 20''} = 8.05^k/_{in}$

$q_{allow} = 12.88^k/_{in} > 8.75^k/_{in}$
$(2-5/16''$ fillets)

$P_x = 322^k$ $\bar{x} = 76\frac{3}{16}$ off ℄ P_{in}

$P_z = 578^k$

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Rev.	Description	Date	By	Chkd.
A	Revised Analysis	4-9-98	LH	DEM

By L. Hudak Date 11-11-97 Sheet No. 22 of ___
Chkd. OEM Date 11-18-97 Job No. F-2566

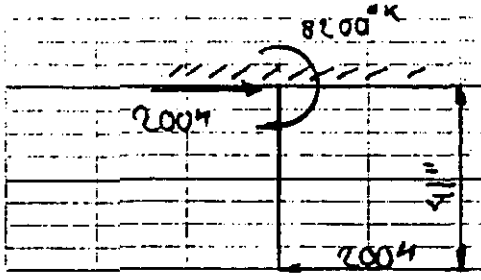
Subject: SEISMIC ANALYSIS

A Ref ET 24 & ET 25

JOHNSON INDUSTRIES DUAL SBC100 RAIL CLAMP

CAPACITY = 100^K x 4 = 400^K > 357^K TABLE E2 ELEM. 182

CHECK BOLTS TO END TIE BEAM TRY A325 Bolts



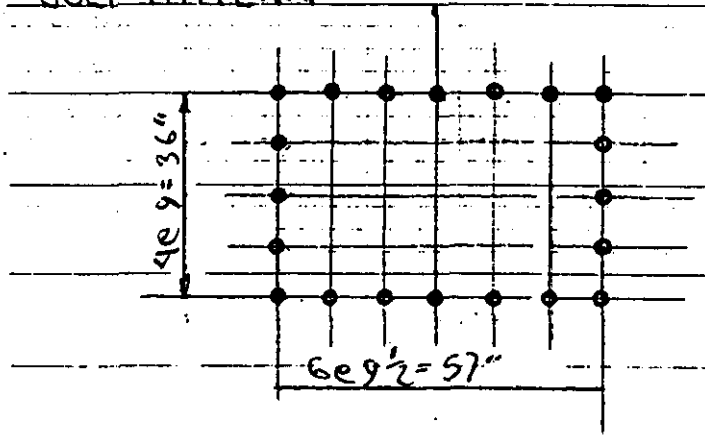
BOLT ALLOWABLE

NOG-4323 Shear & Tension

(b) A325 Bolt

$T_z = 15000(1 - \sigma_t A_B / T_B)$

BOLT PATTERN



$T_z = 15000(1 - 23.59^{\#}/71^{\#})$

$T_z = 10.027^{K}$

$F_v = 1.227 \times 10.027 = 12.302^{K} > 10$

SPECIAL REQUIREMENTS

NOG-4222 Fracture Toughness

Bolt $\phi = 1\frac{1}{4}" > 1"$

Cherry V notch Test Required

Test Temp. = -25° F

See Table NOG-4222-1 For Cv Energy Values For Fastener Materials

$I = 10(28.5)^2 + 4(19)^2 + 4(9.5)^2 = 9927.5$

$S = 398.3$

$N_o = 20$

$F_v = 200^{K}/20 = 10^{K}$

$f_z = \frac{8200}{398.3} = 23.59^{\#} < 59^{K}$ ($1\frac{1}{4}"\phi$ A325 Bolt)

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Rev.	Description	Date	By	Chkd.
A	Added Ref	4/9/99	LH	OEM

Revision _____ ATTACHMENT A Revision 4 - 12/7/89

DESIGN VERIFICATION LIST FOR APPROVED

Multi Canister Handling Machine 4/19/89

Chief Mechanical Engineer

S.O. No. F-256C

	Drawing Number	Description	Design Verification	Verification Located On	Complet By/Date
TROLLEY			ClrCa		
T.1		Trolley Structure	CLBC		
T.2		Trolley Drive	PAa		
T.3		Trolley Wheel Assembly	CLBC	Rev A STF1/STF3 STF4 STS10, STS11, STS12 STS14 102 101	LH 4/19
T.4		TROLLEY SEISMIC	RSA		

DESIGN VERIFICATION KEY:

CLBC=Check of Load Bearing Calculations
- a=Performance of Alternate or Simplified Calculations
- b=Deleted
- c=Detailed Check of Non-Standard Calculations

ClrC=Clearance Check
- a=Equipment/Facility Interferences
- b=Personnel Safety

PA=Performance Assessment
- a=Guaranteed Performance
- b=Drive Train Failure Analysis (X-SAM Only)
- c=Wire Rope Failure Analysis (Balanced Dual Reeved Only)
- d=Two Blocking Analysis (X-SAM Only)

SST=Special Shop Testing of Initial Production Unit

RSA=Review of Seismic Analysis

DR=Design Review
- a=Were the design inputs correctly selected?
- b=Are assumptions necessary to perform the design activity adequately described and reasonable?
- c=Was an appropriate design method used?
- d=Were the design inputs correctly incorporated into the design?
- e=Is the design output reasonable compared to design inputs?
- f=Are the necessary design input and verification requirements for interfacing organizations specified?

*=X-SAM Only
+=Balanced Dual Reeved Only

FREDERIC EVERETT LANGFORD STATE OF WASHINGTON 4/14/89 9879 REGISTERED PROFESSIONAL ENGINEER EXPIRES 4/7/100

SECTION E

COMPONENTS: TROLLEY
LOADING: SEISMIC

DESIGN BY: DON MCGHEE
CHECKED BY: LARRY HUDAK
SUPERVISOR: FRED LANGFORD, P.E.

TABLE OF CONTENTS

REV A – SHEETS NO'S, STF1, STF3, STF9, STS10, STS11, STS12, STS14.
NEW SHEETS – 10a, 10b

STP

Koon-Hall-Adrian Metallurgical

K-H-A

5687-A S.E. International Way, Portland, Oregon 97222

PHONE: 503-653-2904
FAX: 503-653-9591

CUSTOMER SAMPLE DESCRIPTION

CUSTOMER EDERER INCORPORATED PAGE 1 OF 1

ORDER NUMBER P.O. 135266

SPECIFICATIONS ASTM A370-95; ASTM A36-93a

TEST DESCRIPTION ROOM TEMPERATURE TENSILE TEST AND CHEMISTRY

MATERIAL IDENTITY A36 STEEL PLATE; 1/2" THICK; SAMPLE QA7361

ITEM (5) DATE 2-28-97 WORK ORDER 50407

TROLLET 1/2" PLS - PC. D, M & P (A)

CERTIFICATION

LABORATORY NUMBER	UTS (PSI)	YIELD POINT(PSI)	ELONG. IN 4D(%)	TEMP°F		DIRECTION
C2905-1A	63,000	41,900	32.0	ROOM		TRANSVERSE
SPECIFIED						
REQ.(MAX)	80,000	----	----			
REQ.(MIN)	58,000	36,000	23.0			
		ACCEPTANCE LIMITS				
C2905-2	CHEMISTRY(%)	MIN.	MAX.			
CARBON	0.11	- -	0.25			
MANGANESE	0.69	- -	- -			
PHOSPHORUS	0.020	- -	0.04			
SULFUR	0.042	- -	0.05			
SILICON	0.28	- -	0.40			
IRON	BALANCE					
	SAMPLE MEETS SPECIFIED REQUIREMENTS					

ITEM: STOCK (5/16/97)

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KHA-101

NADCAP PRI PERFORMANCE REVIEW INSTITUTE Accredited MATERIAL TESTING LABORATORY

"A" REV WAS PC "P" ONLY

BY KHA 7

By _____ Date _____ Sheet No. ___ of ___

Chkd. L. Hulzk Date 4-14-97 Job No. F-2566

Subject: TROLLEY FRAME 45° SECTION SEISMIC

A

Ref TF 11 and TF 12 Sec E

$P = 237.6^K$

$P_1 = 70.7^K$

$A = 114.25\ IN^2$

$A_1 = 48.125\ IN^2$

$SB = 393\ IN^3 \quad L = 16.638$

$SB_1 = 154.4\ IN^3 \quad L = 15.125$

ALLOW STRESS

$\sigma_{BA} = (.3)(38) = 34.2\ KSI$

$\tau_A = (.5)(38) = 19\ KSI$

$\sigma_{BP} = \frac{237.6\,(16.638)}{393.0} = 10\ KSI$

$\sigma_{BP_1} = \frac{70.7\,(15.125)}{154.4} = 6.925$

$P/A = \frac{237.6}{114.25} = 2.08\ KSI$

$P_1/A_1 = \frac{70.7}{48.125} = 1.469$

$FCAT\ FL = .079(127.3) = 10\ KSI$

$\sigma_B = 30.53\ KSI$

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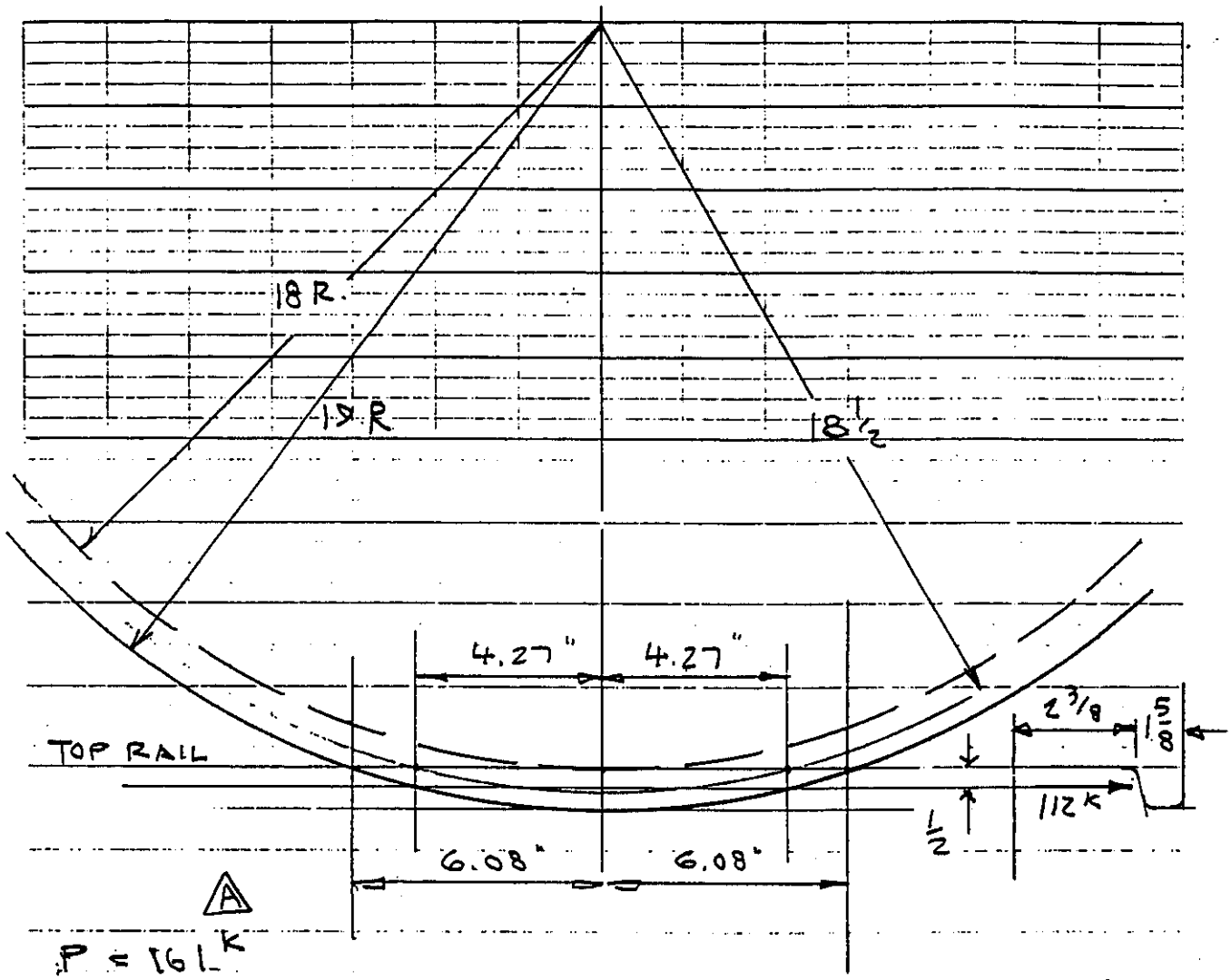
Rev.	Description	Date	By	Chkd.
A	Ref provided	4/8/97	[illegible]	DEM

By DEM Date 9-6-96 STS Sheet No. 9 of ___

Chkd. JLF Date 1-27-97 Job No. F2566

Subject: WHEEL FLANGE SEISMIC LOAD BRIDGE



$P = 161^K$

$S_B = \frac{12(1.63^2)}{6} = 5.3\ IN^3$ MATL: 1070 320 BHN YIELD = 130 KSI

$M_B = (.5)\,161L = 81.\ K\text{-}IN$

$f_B = \frac{81.}{5.3} = 15.28\ KSI < f_{EB\ ALLOW} = .9(130) = 117\ KSI$ (A)

$\tau_S = \frac{161}{1.63(8.52)} = 11.7\ KSI < \tau_{TA} = .5(130) = 65\ KSI$ (A)

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Rev.	Description	Date	By	Chkd.
A	161K Was 112K	4-9-99	LH	DEM

By DEM Date 8-16-96 Sheet No. 10 of 113
Chkd. JLF Date 1-27-97 Job No. F2566

Subject: TRUCK STRUCTURAL ON 45° SECTION SEISMIC BRIDGE

MAT'L ASTM-A516 CLASS 70 — 38 YIELD, ULT 70-90 KSI CMTR YS = 45.30 KSI (A) QA-7015

$P = 209.4\ K$ $P_H = 1620^{15}$

$P_1 = 132.2\ K$ (REF TS10) (A)

$A = 138.51$ SECT. IN^2

$A_1 = 58.32$ IR

$I = 8116$ SECT. $\bar{Y} = 13.52"$ $L = 20.0"$

$Z_{IR} = 226.8\ IN^3$ $L = 18.04"$

$K_{SB} = K_{SS} = 1.0$ $K_{NB} = K_{NS} = 1.0$

FOR $T_{NB} = (.9)(45.3) = 40.77$ KSI (A)

$T_A = (.5)(95.3) = 22.65$ KSI

$T_{BP} = \frac{209.4(13.62)(20)}{8116\ IN^4} = 6.86$ KSI

$T_{BP_1} = \frac{(132.2)(18.04)}{226.8\ IN^3} = 10.51$ KSI

$P/A = \frac{209.4\ K}{138.51} = 1.48$ KSI

$P_1/A_1 = \frac{132.2\ K}{58.32} = 2.27$ KSI

FLAT PLATE FROM TS-10 = .116 $(P_H) = .116(161.0) = 18.60$ K

TOTAL = 57.50 KSI < 40.77 KSI (A)

SEE SH 11 FOR SHEAR

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Rev.	Description	Date	By	Chkd.
A	ADDED REF ADDED CMTR Fy	4/4/97	JLH	DEM

Koon-Hall-Adrian Metallurgical

K-H-A

10a

5687-A S.E. International Way, Portland, Oregon 97222

PHONE: 503-653-2904
FAX: 503-653-9591

CUSTOMER SAMPLE DESCRIPTION

PAGE 1 OF 1

CUSTOMER: EDERER INCORPORATED

ORDER NUMBER: P.O. 134226

SPECIFICATIONS: ASTM A370-95; ASTM A516-90, GR. 70

TEST DESCRIPTION: ROOM TEMPERATURE TENSILE TEST AND CHEMISTRY

MATERIAL IDENTITY: 2-1/2" STEEL PLATE; QA #7014

CORRECTED CERTIFICATION

~~*CORRECTED CERTIFICATION*~~

DATE: 11-19-96

WORK ORDER: 08572

CERTIFICATION

LABORATORY NUMBER	UTS (PSI)	.2% OFFSET Y.S. (PSI)	ELONG. IN 4D(%)	TEMP°F	DIRECTION	
B13804-1	75,200	46,500	**32.0	ROOM	TRANSVERSE	
SPECIFIED						
REQ.(MAX)	90,000	---	---			
REQ.(MIN)	70,000	38,000	21.0			
B13804-2	CHEMISTRY(%)	SPECIFIED REQ.				
		MIN.	MAX.			
CARBON	0.23	---	0.30			
MANGANESE	1.06	0.79	1.30			
PHOSPHORUS	0.005	---	0.035			
SULFUR	0.002	---	0.035			
SILICON	0.26	0.13	0.45			
IRON	BASE					
	*SAMPLE MEETS SPECIFIED REQUIREMENTS					

SEE REVERSE SIDE FOR STATEMENT OF WARRANTIES

**BY: [signature] (QA) DATE: 12-10-96

*BY: [signature] (QA) DATE: 12-10-96

BY [signature] (QA)

NADCAP

MATERIAL TESTING LABORATORY

1-101

TOTAL P.02

ITEM: E2566-03#63-1 E-11-19-96

Koon-Hall-Adrian Metallurgical

K-H-A

106

5687-A S.E. International Way, Portland, Oregon 97222

PHONE: 503-653-2904
FAX: 503-653-9591

CUSTOMER SAMPLE DESCRIPTION

CUSTOMER: EDERER INCORPORATED — PAGE 1 OF 1

ORDER NUMBER: P.O. 134226

SPECIFICATIONS: ASTM A370-95; ASTM A516-90, GR. 70

TEST DESCRIPTION: ROOM TEMPERATURE TENSILE TEST AND CHEMISTRY

MATERIAL IDENTITY: 2-1/2" STEEL PLATE; QA #7015.

DATE: 11-19-96 — WORK ORDER: 08572

CERTIFICATION

LABORATORY NUMBER	UTS (PSI)	.2% OFFSET Y.S. (PSI)	ELONG. IN 4D(%)	TEMP° F	DIRECTION	
B13803-1	77,400	45,300	31.5	ROOM	TRANSVERSE	
SPECIFIED						
REQ.(MAX)	90,000	---	---			
REQ.(MIN)	70,000	38,000	21.0			
B13803-2	CHEMISTRY(%)	SPECIFIED REQ.				
		MIN.	MAX.			
CARBON	0.24	---	0.30			
MANGANESE	1.06	0.79	1.30			
PHOSPHORUS	0.005	---	0.035			
SULFUR	<0.001	---	0.035			
SILICON	0.26	0.13	0.45			
IRON	BASE					
	SAMPLE MEETS SPECIFIED REQUIREMENTS					

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NADCAP — MATERIAL TESTING LABORATORY — 1-101

BY Robert L. Adrian (KHA 2)

TOTAL P.09

By DEM Date 8-16-96 Sheet No. 11 of ___
Chkd. JLF Date 1-27-97 Job No. F2566

Subject: SHEAR ON 45° SECTION SEISMIC LOADING
BRIDGE

P = 202.4 K = V_1 (A)
P_L = 132.2 K = V_2
HORIZONTAL P_H = 161 = V_3

I = 8111.6 IN^4 A = 138.51 SECT A_{PL} = 58.32 IN^2
b = 5"
Q = 463 IN^3

(1) $\tau_1 = \frac{V_1 Q}{I b} = \frac{202.4(463)}{8111.6(5)} = 2.31$ KSI HORIZONTAL

(2) $\frac{V_1}{A} = 202.4 / 138.51 = 1.46$ KSI ↑

(3) $\frac{V_2}{A_{PL}} = \frac{132.2}{58.32} = 2.27$ KSI ↑

(4) $\frac{V_2}{SECT.} = \frac{161}{138.51} = 1.16$ KSI →

$\tau_{AVG} = (1.16^2 + (2.27 + 1.46)^2)^{.5} = 3.91$ KSI

$\tau_{EB} = (39.80^2 + 3(3.91)^2)^{.5} = 40.37$ KSI

40.37 < 40.77 KSI O.K. ($.9 \times 45.3^{KSI}$ CMTR = 41.85) (A)

τ_S = 3.91 < 22.65 KSI

WELD: V_1, Q = 1.41(15.5")(10.4) = 227 I = 8111.6 2 WELDS

K/IN = $\frac{202.4(227)}{8111.6(2)}$ = 2.8 K/IN

W = $\frac{2.8}{(.45)(1.5)(38)}$ = .90 ^{K} USE $\frac{5}{16}$ AWS MIN.

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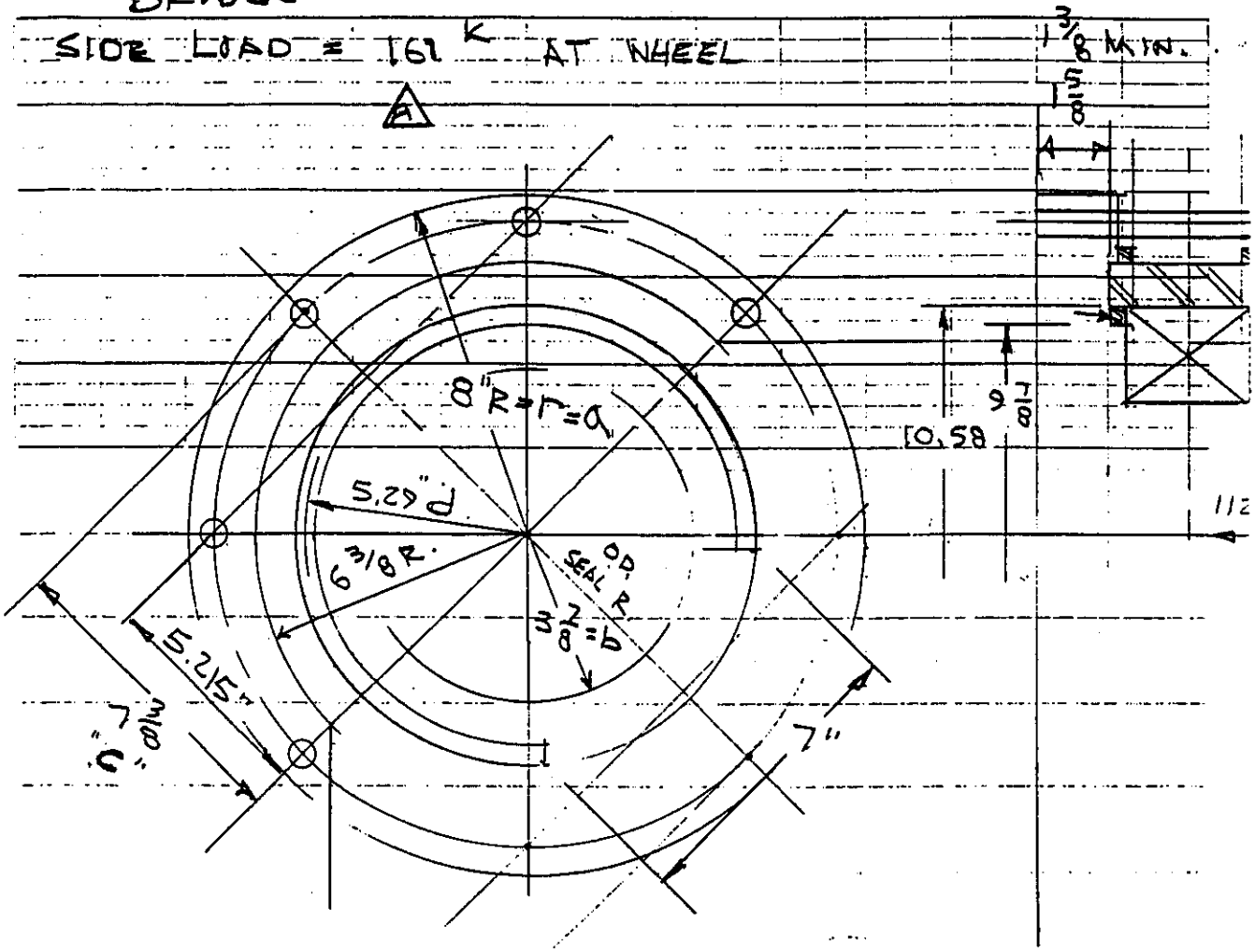
Rev.	Description	Date	By	Chkd.
A	REV LOADS REV ALLOWABLES	4/16/97	JLF	DEM

By DEM Date 8-12-96 Sheet No. 12 of ___

Chkd. JLF Date 1-27-97 Job No. F2566

Subject: WHEEL RETAINING PLATE SEISMIC LOAD
BRIDGE

SIDE LOAD = 161 K AT WHEEL



5 BOLTS IN LOAD PATH. PER SIDE

$P = \frac{161}{5(2)} = 16.1\ K$ 5/8 Ø BOLT STRESS A = .226 IN²

$P/A = \frac{16.1}{.226} = 71.23$ KSI TENSION, < 85 (.9) = 76.5 KSI
SAE GR 5
85 Proof Load

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Rev.	Description	Date	By	Chkd.
A	161K W23 112	4-9-97	LH	DEM

By DEM Date 8-20-96 Sheet No. 14 of ___
Chkd. JLF Date 1-27-97 Job No. F2566

Subject: TRUCK CENTER SECTION SEISMIC BRACKET

$P_V = 289.0^{K} = V_1$ (Ref SEC B ST 20) A

$P_H = 161^{K} = V_2$

$A = 218.5\ IN^2$

$S_{BX} = 1564\ IN^3$ $I_X\ 30,699\ IN^4$

$S_{BY} = 1334\ IN^3$ $I_Y\ 12004\ IN^4$

$M_{BX} = 289\ (27) = 7803\ K_{IN}$

$M_{BY} = 161\ (27) = 4347\ K_{IN}$

$M_T = 161\ (20.63) = 3321\ K_{IN}$

$\sigma_{BA} = (.9)(38) = 34.2$

$\tau_{TA} = T_A = (.5)(38) = 19\ KSI$

$\sigma_{B P_V} = \frac{7803}{1564} = 4.99\ KSI$ A

$\sigma_{B P_H} = \frac{4347}{1334} = 3.25\ KSI$

$\tau_T = \frac{3321}{(.592)(1)} = 3.35\ KSI$, FOR WELD $\frac{3321}{.992} = 3.35\ K_{IN}$

$\tau_S = 161\ (.5 \cdot 10^{-3}) = .82\ KSI$ A

$T_{MAX} = (4.99/2^2 + 3.35^2)^{.5} = 4.18\ KSI < 19\ KSI$ A

$\sigma_{EB} = \left(4.99^2 + (3)\ (.82 + 3.35)^2\right)^{.5} = 8.8^{KSI} < 34.2\ KSI$

$V_1 Q = 15.5\ (18.87) = 292\ K/IN = \frac{289\ (292)}{30699\ (2)} = 1.37\ K/IN$

$V_2 Q = 2.5(38)(7.75) = 736\ K/IN = \frac{161\ (736)}{12004\ (2)} = 4.94\ K/IN$

$w = \frac{7.14\ K/IN}{(.5)(145)(38)} = 0.25''$ USE 5/16 FILLET AWS MIN. $\neq (6.31^2 + 3.35^2)^{.5} = 7.14$

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Rev.	Description	Date	By	Chkd.
A	REV. LOADS Add'l REF -	9-1-99	LH	DEM

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F2566 DESIGN REVIEW COMMENTS

REFERENCE: DESIGN REPORT 5.
ITEMS: 2,8,12,14,18

COMMENT: PER NOG-1, SECTION NOG-4221 (2) fastener material for type 1 cranes is acceptable if it is listed in table NOG-4221-1.

RESPONSE: SECTION NOG-4000 states the requirements for structural components. The items found in the above reference are considered by Ederer to be mechanical components and are thus governed by SECTION NOG-5000 - MECHANICAL. Note that these fasteners do not appear in NOG Section 4000, but do appear in NOG 5141 as mechanical components.. It is Ederer's standard practice to use SAE Grade 5 and SAE Grade 8 bolts in place of ASTM A325 and ASTM A490 bolts in mechanical design. The two sets of bolts have identical physical properties. See the attached pages (3) for a direct comparison of the physical properties. The major difference between the two sets of bolts (SAE vs ASTM) is that the SAE bolt allows for a more compact design.

Ederer see no benefit or improvement in the design in swaping out the bolts other than to satisfy a rigid interpretation of the NOG specification since the bolts are of equal strength.

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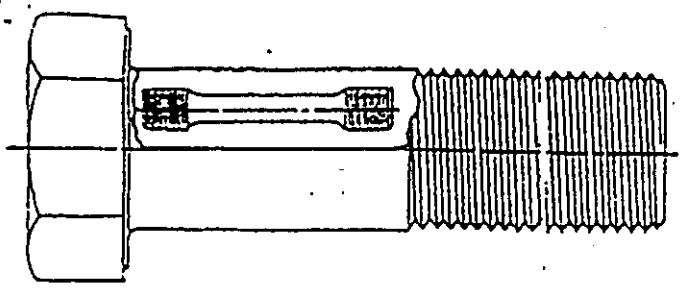

FIG. 4—LOCATION OF STANDARD ROUND 2 IN GAGE LENGTH TENSILE TEST SPECIMEN WHEN TURNED FROM LARGE SIZE BOLTS OR SCREWS

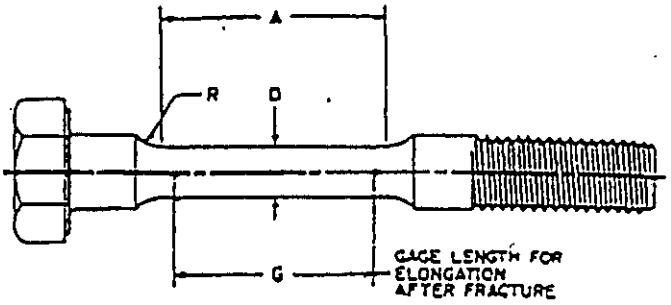

FIG. 5—TENSILE TEST SPECIMEN FOR BOLTS OR SCREWS WITH TURNED DOWN SHANK

to or greater than the values for these properties specified for the applicable product size and grade in Table 1.

5.7 Common Test Fixture Details—The grips of the tensile testing machine shall be self-aligning to avoid side thrust on the specimen.

The wedge shall have a minimum hardness of Rockwell C45.

The hole in the fixture or washer used under the head of bolts and screws during proof load and tensile testing shall have the same clearance as that specified for wedges (paragraph 5.5.1).

Wedges, nuts, and fixtures into which bolts, screws, and studs are threaded for proof load, tensile strength, and wedge tensile testing shall have threads which are of the same size, pitch, and tolerance class as the product being tested. (For *standard products*, Class 3B tolerances are normally applicable.) For studs having interference fit threads, wedges shall be threaded to provide a *finger-free fit*.

6. *Marking*—Unslotted bolts, screws, and hex head cap screws shall be marked with the grade identification symbol shown in Table 1. In addition, bolts and screws shall be marked with the manufacturer's identification symbol. Markings shall be located on the top of the head, and may be either raised or depressed, at option of the manufacturer.

Studs need not be marked.

TABLE 5—PROOF LOAD AND TENSILE STRENGTH REQUIREMENTS[A]

Nominal Dia of Product and Threads per in	Stress Area, in²	Grade 1		Grade 2		Grade 4		Grades 5 and 5.2[B]		Grade 5.1		Grade 7		Grades 8, 8.1, 8.2[B]	
		Proof Load, lb	Tensile Strength Min, lb	Proof Load, lb	Tensile Strength Min, lb	Proof Load, lb	Tensile Strength Min, lb	Proof Load, lb	Tensile Strength Min, lb	Proof Load, lb	Tensile Strength Min, lb	Proof Load, lb	Tensile Strength Min, lb	Proof Load, lb	Tensile Strength Min, lb
Coarse Thread Series—UNC															
No. 6–32	0.00909	—	—	—	—	—	—	—	—	750	1100	—	—	—	—
8–32	0.0140	—	—	—	—	—	—	—	—	1200	1700	—	—	—	—
10–24	0.0175	—	—	—	—	—	—	—	—	1500	2100	—	—	—	—
12–24	0.0242	—	—	—	—	—	—	—	—	2050	2900	—	—	—	—
1/4–20	0.0318	1050	1900	1750	2250	2050	3650	2700	3800	2700	3800	3350	4250	3800	4750
5/16–18	0.0524	1750	3150	2900	3500	3400	6000	4450	6300	4450	6300	5500	6950	6300	7850
3/8–16	0.0775	2550	4650	4250	5750	5050	8400	6600	9300	6600	9300	8150	10 300	9200	11 600
7/16–14	0.1063	3500	6400	5850	7850	6900	12 200	9050	12 800	9050	12 800	11 200	14 100	12 800	15 900
1/2–13	0.1419	4700	8500	7800	10 500	9200	16 300	12 100	17 000	12 100	17 000	14 900	18 900	17 000	21 200
9/16–12	0.182	6000	10 900	10 000	13 500	11 800	20 900	15 500	21 800	15 500	21 800	19 100	24 200	21 800	27 300
5/8–11	0.226	7450	13 600	12 400	16 700	14 700	25 400	19 200	27 100	19 200	27 100	23 700	30 100	27 100	33 900
3/4–10	0.334	11 000	20 000	18 400	24 700	21 700	38 400	28 400	40 100	—	—	35 100	44 400	40 100	50 100
7/8–9	0.462	15 200	27 700	15 200	27 700	30 000	53 100	39 200	55 400	—	—	48 500	61 400	55 400	69 200
1 –8	0.606	20 000	36 400	20 000	36 400	39 400	69 700	51 500	72 700	—	—	63 600	80 600	72 700	90 900
1-1/8–7	0.763	25 200	45 800	25 200	45 800	49 600	87 700	56 500	80 100	—	—	80 100	101 500	91 600	114 400
1-1/4–7	0.969	32 000	58 100	32 000	58 100	63 000	111 400	71 700	101 700	—	—	101 700	127 700	116 300	145 400
1-3/8–6	1.155	38 100	69 300	38 100	69 300	75 100	132 800	85 500	121 300	—	—	121 300	153 600	138 600	173 200
1-1/2–6	1.405	46 400	84 200	46 400	84 200	91 300	161 600	104 000	147 500	—	—	147 500	186 900	168 600	210 800
Fine Thread Series—UNF															
No. 6–40	0.01015	—	—	—	—	—	—	—	—	850	1200	—	—	—	—
8–36	0.01474	—	—	—	—	—	—	—	—	1250	1750	—	—	—	—
10–32	0.0200	—	—	—	—	—	—	—	—	1700	2400	—	—	—	—
12–28	0.0258	—	—	—	—	—	—	—	—	2200	3100	—	—	—	—
1/4–28	0.0364	1200	2200	2000	2750	2250	4200	3100	4350	3100	4350	3800	4850	4350	5450
5/16–24	0.0580	1900	3500	3200	4350	3750	6700	4900	6950	4900	6950	6100	7700	6950	8700
3/8–24	0.0878	2900	5250	4800	6550	5700	10 100	7450	10 500	7450	10 500	9200	11 700	10 500	13 200
7/16–20	0.1187	3900	7100	6550	8850	7700	13 650	10 100	14 200	10 100	14 200	12 500	15 800	14 200	17 800
1/2–20	0.1599	5300	9600	8800	11 850	10 400	18 400	13 600	19 200	13 600	19 200	16 800	21 300	19 200	24 000
9/16–18	0.203	6700	12 200	11 200	15 050	13 200	23 300	17 300	24 400	17 300	24 400	21 300	27 000	24 400	30 400
5/8–18	0.256	8450	15 400	14 100	18 950	16 600	29 400	21 800	30 700	21 800	30 700	26 900	34 000	30 700	38 400
3/4–16	0.373	12 300	22 400	20 500	27 600	24 200	42 900	31 700	44 800	—	—	39 200	49 600	44 800	56 000
7/8–14	0.509	16 800	30 500	16 800	30 500	33 100	58 500	43 300	61 100	—	—	53 400	67 700	61 100	76 400
1 –12	0.663	21 900	39 800	21 900	39 800	43 100	76 200	56 400	79 600	—	—	69 600	88 200	79 600	99 400
1 –14 uns	0.679	22 400	40 700	22 400	40 700	44 100	78 100	57 700	81 500	—	—	71 300	90 300	81 500	101 900
1-1/8–12	0.856	28 200	51 400	28 200	51 400	55 600	98 400	63 300	87 900	—	—	89 900	113 800	102 700	128 400
1-1/4–12	1.073	35 400	64 400	35 400	64 400	69 700	123 400	79 400	112 700	—	—	112 700	142 700	128 800	161 000
1-3/8–12	1.315	43 400	78 900	43 400	78 900	85 500	151 200	97 300	138 100	—	—	138 100	174 900	157 800	197 200
1-1/2–12	1.581	52 200	94 900	52 200	94 900	102 800	181 800	117 000	166 000	—	—	166 000	210 300	189 700	237 200

[A] Proof loads and tensile strengths are computed by multiplying the proof load stresses and tensile strength stresses given in Table 1 by the stress area of the thread.

The stress area of sizes and thread series not included in Table 5 may be computed from the formula $A_s = 0.7854\left[D - \frac{0.9743}{n}\right]^2$ where D equals nominal diameter in inch, and n equals threads per inch.

[B] Grades 5.2 and 8.2 applicable to sizes 1/4 through 1 in.

TABLE 5 Tensile Requirements for Full-Size Bolts

Bolt Size, Threads per Inch, and Series Designation	Stress Area,[A] in.²	Tensile Load,[B] lbf		Proof Load,[C] lbf	Alternative Proof Load,[B] min, lbf
		min	max	Length Measurement Method	Yield Strength Method
Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
½-13 UNC	0.142	21 300	24 150	17 050	18 500
⅝-11 UNC	0.226	33 900	38 400	27 100	29 400
¾-10 UNC	0.334	50 100	56 800	40 100	43 400
⅞-9 UNC	0.462	69 300	78 550	55 450	60 100
1-8 UNC	0.606	90 900	103 000	72 700	78 800
1⅛-7 UNC	0.763	114 450	129 700	91 550	99 200
1⅛-8 UN	0.790	118 500	134 300	94 800	102 700
1¼-7 UNC	0.969	145 350	164 750	116 300	126 000
1¼-8 UN	1.000	150 000	170 000	120 000	130 000
1⅜-6 UNC	1.155	173 250	196 350	138 600	150 200
1⅜-8 UN	1.233	185 000	209 600	148 000	160 300
1½-6 UNC	1.405	210 750	238 850	168 600	182 600
1½-8 UN	1.492	223 800	253 650	175 050	194 000

[A] The stress area is calculated as follows:

$$A_s = 0.7854\,[D - (0.9743/n)]^2$$

where:

A_s = stress area, in.²,
D = nominal bolt size, and
n = threads per inch.

[B] Loads tabulated and loads to be used for tests of full-size bolts larger than 1½ in. in diameter are based on the following:

Bolt Size	Column 3	Column 4	Column 5	Column 6
½ to 1½ in., incl	150 000 psi	170 000 psi	120 000 psi	130 000 psi

strength, yield strength, reduction of area, elongation, and hardness.

9.4.4 From each shipping lot, the minimum number of tests of each required property shall be in accordance with Table 8.

9.4.5 If any test specimen shows defective machining, it may be discarded and another specimen substituted.

9.4.6 A copy of the inspection test report for each shipping lot shall be furnished to the purchaser when specified in the order. Individual heats of steel are not identified in the finished product.

10. Test Methods

10.1 Tests shall be conducted in accordance with Method F 606.

10.2 Proof load testing of bolts tested in full size shall preferably be conducted in accordance with Method 1, Length Measurement, described in 3.2.3 of Method F 606.

10.3 Bolts tested in full size shall be tested in accordance with the Wedge Test method described in 3.5 of Method F 606. Fracture shall be in the body or threads of the bolt, without any fracture at the junction of the head and body.

TABLE 6 Tensile Requirements for Specimens Machined from Bolts

Bolt Size, in.	Tensile Strength, psi		Yield Strength (0.2 % offset), min, psi	Elongation in 2 in. or 50 mm, min, %	Reduction of Area, min, %
	min	max			
½ to 1½ in., incl	150 000	170 000	130 000	14	40

10.4 Machined specimens shall be tested in accordance with the method described in 3.6 of Method F 606.

10.5 The speed of testing as determined with a free-running cross head shall be a maximum of 0.125 in./min for the bolt proof load determination, and a maximum of 1 in./min for the bolt tensile strength determination.

11. Magnetic Particle and Visual Inspection for Surface Discontinuities

11.1 Bolts shall be examined by magnetic particle inspection for longitudinal discontinuities and transverse cracks, and shall conform to an AQL of 0.25 when inspected in accordance with the sampling plan described in 11.4. Eddy-current inspection may be substituted, at the option of the manufacturer, for the 100 % magnetic particle inspection specified in 11.4.1 and 11.4.2, provided that the bolts, after eddy current inspection, are subsequently randomly sampled according to Table 9 and subjected to the magnetic particle inspection and acceptance requirements as described above. In the case of dispute, the magnetic particle test shall govern.

TABLE 7 Production Lot Sample Size With Acceptance and Rejection Numbers for Inspection of Mechanical and Dimensional Requirements

Lot Size	Sample Size	Acceptance Number	Rejection Number
25 and less	2	0	1
26 to 150	3	0	1
151 to 1 200	5	0	1
1 201 to 35 000	8	0	1
35 001 to 150 000	13	0	1
150 001 and over	20	0	1

TABLE 3 Hardness Requirements for Bolts

Bolt Size, in.	Hardness Number			
	Brinell		Rockwell C	
	Min	Max	Min	Max
½ to 1, incl	248	331	24	35
1⅛ to 1½, incl	223	293	19	31

bolts and nuts are zinc-coated, and the nuts lubricated, prior to shipment. After the rotational capacity test, the assembly shall show no signs of failure. Failure is defined as: (*1*) inability to assemble to the nut rotation specified in Table 8 or by an inability to remove the nut following the test, (*2*) shear failure of threads as determined by visual examination of bolt and nut threads following removal, and (*3*) torsional failure of the bolt. Elongation of bolt, in the threads between the nut and bolt head, is to be expected at the required rotation and is not to be classified as a failure.

6.6 When hot-dip zinc-coated Type 2 bolts are supplied, they shall be tension tested after galvanizing in accordance with 6.2 or 6.3 depending on the diameter. The number of tests from each lot shall be in accordance with 9.2.4 or 9.3.4.

7. Dimensions

7.1 Bolts with hex heads shall be full-body bolts conforming to the dimensions for heavy hex structural bolts specified in ANSI/ASME B18.2.1 (see S1).

7.2 Threads shall be the Unified Coarse Thread Series as specified in ANSI/ASME B1.1, and shall have Class 2A tolerances. When specified, 8-pitch thread series may be used on bolts over 1 in. in diameter.

TABLE 4 Tensile Requirements for Full Size Bolts

Bolt Size, Threads per Inch and Series Designation	Stress Area,[A] in.²	Tensile Strength,[B] min, lbf	Proof Load,[B] Length Measurement Method	Alternative Proof Load[B] Yield Strength Method, min
Column 1	Column 2	Column 3	Column 4	Column 5
½–13 UNC	0.142	17 050	12 050	13 050
⅝–11 UNC	0.226	27 100	19 200	20 800
¾–10 UNC	0.334	40 100	28 400	30 700
⅞–9 UNC	0.462	55 450	39 200	42 500
1–8 UNC	0.606	72 700	51 500	55 750
1⅛–7 UNC	0.763	80 100	56 400	61 800
1¼–8 UN	0.790	82 950	58 400	64 000
1⅜–7 UNC	0.969	101 700	71 700	78 500
1½–8 UN	1.000	105 000	74 000	81 000
1⅜–6 UNC	1.155	121 300	85 400	93 550
1⅝–8 UN	1.233	129 500	91 200	99 870
1½–6 UNC	1.405	147 500	104 000	113 800
1½–8 UN	1.492	156 700	110 400	120 850

[A] The stress area is calculated as follows:

$$As = 0.7854\,[D - (0.9743/n)]^2$$

where:
As = stress area, in.²,
D = nominal bolt size, and
n = threads per inch.

[B] Loads tabulated are based on the following:

Bolt Size, in.	Column 3	Column 4	Column 5
½ to 1, incl	120 000 psi	85 000 psi	92 000 psi
1⅛ to 1½, incl	105 000 psi	74 000 psi	81 000 psi

TABLE 5 Tensile Requirements for Specimens Machined from Bolts

Bolt Size, in.	Tensile Strength, min, psi	Yield Strength (0.2 % Offset) min, psi	Elongation in 2 in., min, %	Reduction of Area, min, %
1¼, 1⅜ and 1½	105 000	81 000	14	35

7.3 Unless otherwise specified, bolts to be used with nuts or tapped holes which have been tapped oversize, in accordance with Specification A 563, shall have Class 2A threads before hot-dip or mechanically deposited zinc coating. After zinc coating, the maximum limit of pitch and major diameter may exceed the Class 2A limit by the following amount:

Diameter, in.[A]	Oversize Limit, in.[A]
Up to ⅞, incl	0.016
Over ⅞ to 1, incl	0.021
Over 1	0.031

[A] These values are the same as the minimum overtapping required for zinc-coated nuts in Specification A 563.

7.4 The gaging limit for bolts shall be verified during manufacture or use by assembly of a nut tapped as nearly as practical to the amount oversize shown above. In case of dispute, a calibrated thread ring gage of that same size (Class X tolerance, gage tolerance plus) is to be used. Assembly of the gage, or the nut described above, must be possible with hand effort following application of light machine oil to prevent galling and damage to the gage. These inspections, when performed to resolve disputes, are to be performed at the frequency and quality described in Table 6.

8. Test Methods

8.1 Tests shall be conducted in accordance with Method F 606.

8.2 For tension tests a proof load determination is preferred conducted in accordance with Method 1, Length Measurement, of Method F 606.

8.3 Bolts tested in full size shall be tested in accordance with the wedge test method described in 3.5 of Method F 606. Fracture shall be in the body or threads of the bolt, without any fracture at the junction of the head and body.

8.4 The speed of testing as determined with a free-running cross head shall be a maximum of ⅛ in./min for the bolt proof-load determination, and a maximum of 1 in./min for the bolt tensile-strength determination.

8.5 The zinc-coated bolt shall be placed in a steel joint and assembled with a zinc-coated washer and a zinc-coated nut with which the bolt is intended to be used. The nut shall have been provided with the lubricant described in 4.8 of Specification A 563. The joint shall be one or more flat structural steel plates with a total thickness, including the washer, such that 3 to 5 full threads of the bolt are located between the bearing surfaces of the bolt head and nut. The hole in the joint shall have the same nominal diameter as the hole in the washer. The initial tightening of the nut shall produce a load in the bolt not less than 10 % of the specified

DE&S HANFORD

P.O. Box 350
Richland, WA 99352

May 19, 1998

DESH-9853935
MHM/BTR-125
Cask_X_Crane_X_

Response Required
Yes

Mr. R. J. Roberts
Foster-Wheeler Environmental Corp.
3200 George Washington Way - Suite G
Richland, Washington 99352

Spent Nuclear Fuel Project Canister Storage Building
Multi-Canister Overpack Handling Machine
Purchase Order #MDK-SDX-452656

Dear Mr. Roberts:

DESIGN VERIFICATION

___ Technical Direction
_X_ Technical Request for Information from Vendor
___ Transmittal of Technical Information to Vendor
___ Conveyance of Conversation or Meeting
___ Other

DE&S Hanford, Inc. (DESH) has reviewed the design verification procedures and practices for the design of the Multi-Canister Overpack (MCO) Handling Machine. Concurrent with Final Design Report, DESH requests submittal of the Ederer design review checklist documentation by independent reviewers and the GEC-Alsthom Change Design Review Form completed by an independent reviewer for each design calculation. Design Verification is part of Basic Requirement 3, Design Control, of the American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance Requirements (NQA-1), which is a requirement of contract Clause B04. The calculations also must be submitted according to section 4.2.3 of specification HNF-S-0468.

If you believe there is a change to the existing work scope as a result of the above information, call D. E. Kidder (509) 376-7285 within five days of receipt and notify him of your concerns. Do not proceed with any work that you consider a change without a notification from the Buyer in accordance

with Clause 7.1.3 "Changes" and Clause 5.2 "Delivery, Completion" of the General Provisions (Long Form - Revision 2) and Clause G03 "Authorized Personnel" of the Contract.

If there are any technical questions, you may call me at 376-0288.

Very truly yours,

Craig Swenson

Craig E. Swenson
Buyer's Technical Representative
Canister Storage Building Project

cs/rit

FWEC - T. Gado

SUPPLIER ASSESSMENT REPORT

Date: 23 September 1998

Company Assessed: Alstom Automation Ltd.

Address: Cambridge Road,Whetstone, LE8 6LH

Assessor: K.J. Bennett

Persons interviewed:

Tony Penn	Quality Assurance Engineer
Chris Carter	Chief Engineer
Alex Macmillan	Lead Design Engineer
Tony Viner	Project Manager
Ian Brown	Manager Quality Control

Summary of the Assessment:

The assessment was performed to confirm the tracability of Design Review, Verification, Validation and change controls per FWENC QAPP Section 3 . (Hanford MHM Project). Additionally, a review was performed to determine the status of MHM associated QA/QC Plans and Data Packages.

The meeting was conducted to the following Agenda:

1) Introductions/Opening Meeting.
2) Procedures Review
3) Audit of selected calculations and records
4) Close out meeting.

Summary of the Assessment findings:

Subject/Activity Requirement Reference	Evidence Examined and Personnel Contacted	Observations and Comments	comply		
			yes	no	n/a
Control of work Process (FWENC QAPP Section III)					
1. Verification activities on analysis and calculation were performed by individuals or groups other than those who performed the original activity	Design Quality Plan Design Reports Design Review Sheets --- Alex Macmillan M. Blackbourn I. Spence	See, ONC1,2,3and 4 below	✓		
2. The method of verification to be applied was specified and documented.	Design Review sheets NQA-1 Requirement 3 --- Alex Macmillan M. Blackbourn	See, ONC1,2,3and 4 below	✓		
3. A history file was maintained which provides a record of review and	Thermal Analysis file Shielding Analysis file ---	See, ONC1,2,3and 4 below	✓		

approval.	M.Blackbourn				

Observations, Comments and Notes

OCN1; The Alstom Quality System is certified to ISO 9001. The project requirement is for QA to be applied to the level and requirements of ASME NQA-1. In all discussions Alstom were adamant that the judgment of the executed work could only be made against the requirements of the level required by the project i.e. NQA-1

OCN2; The findings noted in the table above reflect that, the system as audited and assessed, met the requirements as stated by the project

OCN3; If the audit had been conducted to the letter of ISO 9001 there would have been notable comments as the scheme of their own procedures had not been fully followed.

OCN4; At the opening meeting the question of terminology was raised and it's influence on the QA execution on this project. Below listed are the agreed terms by which the assessment was conducted.

Design Review: The process by which the required calculations are produced, verified and approved to be issued to the client. The final product being the Review Report.

Verification: For this project to comply to NQA-1 wherein the methods of Verification are noted as, Design Review, Alternate Calculation and Qualification Test, of which any one or more can be used for this purpose.

Validation: The testing programs to ensure compliance to the specified requirements.

Alstom advised that their policy on this project was that Design Review would be carried out in accordance with the Design Quality Plan; that the Design Reviews represent the Verification. It would be at the discretion of the Lead Engineer or Engineering manager whether alternate calculations or independent verification from an "outside body" would be required.

ASSESSMENT DETAILS:

Reference Documents:

a) ISO 9001; 1994
b) NQA-1
c) Alstom Quality Manual; MSP Manual Rev.3, Nuclear, Marine and Division.
d) Codes of Practices Manual
e) COP 103 Design Calculations

Assessment Execution:

1.0: Introductions and opening meeting

1.1: The purpose of the meeting was explained and the agenda for the visit discussed. No objections were raised and the assessment visit proceeded. Alstom stated that as the project requirement was for a Quality Assurance system to comply with NQA-1, they did not claim that the findings would necessarily meet the requirements of the letter of ISO 9001.

2.0: Procedures Review

2.1 A review was made of all the listed reference documents in relation to the design control features and notes taken for future reference in the execution of the audit.

2.2 A discussion followed wherein Alstom were asked to demonstrate how the selected parts of their procedures worked in practice. The first level document and the prime control reference is the Design Quality Plan with a second tier of Design Reports and a third tier of Design Review sheets which are supported by calculation worksheets in a workfile.

Examples of the various documents were seen and the routing for the checking process was demonstrated.

3.0: Audit of Records.

3.1: The following calculations were traced from the request by the Lead Engineer (Alex Macmillan) to the appropriate Section Head through to the design engineer who carried out the work back to the Checker (IE: The person delegated to review the work of the Design Engineer and carry out cross reference calculations if necessary).:This is then passed back via the Lead Engineer to the Reviewer (Usually Alex Macmillan).
ESL/R (96) 083 Seismic Report
ESL/R (96) 085 Shielding Report

ESL/R (96) 009 Thermal Report.
ESL/R (96) 99 Mechanical Design Report

3.2: A fuller review took place of the files related to the Seismic and the ThermalReports.
The detailed worksheets and calculation worksheets were seen to be present. However; the level of documented work did not extend to documented evidence of cross analysis or comparison analysis, although it was stated by those interviewed that this was definitely done.
Again on the question of computer initiated calculation it was stated that Calibration took place by running the software manufacturers verification program and by cross check analysis but this was not documented.
Despite these comments, the level of documentation available met the project requirements.

3.3: Design change practices were reviewed and it was confirmed that a change having an impact on the calculations sets in motion another round of reviews resulting in an additional report with a unique number that is then recorded on the Design Quality Plan.

4.0: Close Out Meeting

4.1: Alstom were advised of the initial findings of this visit. Although the program met the requirements of NQA-1, if the visit had been an audit to comply with their own quality system (ISO 9001) there would have been a number of Observations related to the lack of compliance to their own procedures. Quality systems should not operate on a multi level basis. No comments or objections were raised on these findings and the visit was terminated.

5.0: Review of Quality Test and Inspection Plans.

5.1 A comment was made to Alstom that despite all activities on the Quality Test and Inspection Plan being complete none had been "signed off" by any of the inspecting bodies including their own. Alstom explained that it is their practice to record all inspection activities on the " Job Control Sheet" and on test reports. At a later date the QC manager reviews all the steps indicated on the plan ensuring that all Job Control Sheets and Test reports are present and correct. If all is in order he then endorses the Quality test and Inspection Plan. A random review was requested but none of the desired documents could be retrieved from the system. An example of one sheet was retrieved and was not complete in it's detail.. There was evidence of "sign off" by Merz and Mclellen and FDNW representatives.

5.2: In the close out meeting this was raised as an observation of undesirable practice and a lack of tracability at this stage.

6.0: Review of the Data Package Status

6.1: The Data package was seen to be approximately 95% complete in content. However; many documents still remained to be endorsed by the inspecting bodies. The comment was made to Alsthom that many of these documents could have been

endorsed on an ongoing basis. This would have made the endorsement more topical and have saved a lot of time at this stage.

ATTACHMENTS:

1) Draft version of rev. 3 of the Design Quality Plan.

Report Ends

Swenson, Craig E

From: T_Z_King_Anderson@apexc.rl.gov
Sent: Monday, October 26, 1998 6:06 AM
To: Craig_E_Swenson@apimc01.rl.gov
Subject: Re: FDL SUPPLIER ASSESSMENT REPORT


MS Word Document

King,

hereto attached is the revised edition of the report of the assessment visit to Alstom.

Please see my comments to the notes below.

Regards

ken

_____ Reply Separator _____
Subject: FDL SUPPLIER ASSESSMENT REPORT
Author: T Z (King) Anderson at ~HANFORD14B
Date: 30/09/98 14:53

Ken,

Appreciate the opportunity to review this draft.

Craig wondered if we would be open to additional questions on the following two items?

OCN4 - should we indicate that terminology was determined to not be an issue?I have added a sentence stating that what was presented met project requirements.

3.2 - should we indicate that lack of documentation is acceptable based on procurement requirements imposed? Done.

Editorial:

Summary of Assessment - suggest rewording slightly for clarity, possibly two sentences.

Example: This assessment was performed to confirm the traceability of Design Review, Verification, Validation and change controls per FWENC QAPP Section 3 (Hanford MHM project). Additionally, a review was performed to determine the status of MHM associated QA/QC Plans and Data Packages.Done.

OCN1, 2.2 and 4.1 - should "Alstom were" be "Alstom was"? I always refer to companies in the Plural representing the Body Corporate.

3.1 - should "Section Head Through" be "Section Head through"? Also, what does "NB" stand for?Done

3.2 - first sentence seems to be incomplete (...and the Thermal ? .).
Also third sentence appears to have a line feed after "However;".Done

5.1 - should "signed Off" be "Signed Off" or "signed off"?Done.

King

ALSTOM

AUTOMATION

Foster Wheeler Environmental Corporation
3200 George Washington Way
Suite G
Richland
WASHINGTON
99352
United States of America

Our ref: JH4683/542/NRR
NO REPLY REQUIRED
Your ref: 1510-676

22 September 1998

For the attention of Mr Randy Roberts

Dear Sirs,

JH4683: HANFORD MHM
DESIGN VERIFICATION OF THE MHM FINAL DESIGN ANALYSIS

We refer to the e-mail dated 14 September 1998 from Craig Swenson requesting the design verification forms for the 100% Design Analyses and an explanation of how ALSTOM's procedures meet the requirements of NQA-1, section 3. Please transmit the contents of this letter to DESH in response to that e-mail request.

The general requirements that define how we have performed the MHM design verification are:

- The MHM engineering design work at ALSTOM has been carried out in accordance with our company Quality Procedures which invoked the use of the Engineering Management System Procedures, manual revision 3.
- Project specific QA requirements are covered in our Project Quality Program PQP5366. The PQP ensures that specific QA requirements prescribed by the purchase order are invoked in the contract.
- The QA requirements for the MHM Engineering activities are listed on the project specific Design Quality Plan 36250548 which identifies the design review and submission requirements as part of the overall design verification process.
- Design Control procedures are spelt out in the Engineering Management System Procedures, manual revision 3, sections 4.1 to 4.8 inclusive. During the course of the MHM contract these procedures have been satisfactorily audited by both FWENC and DESH/FDNW for compliance against the requirements of NQA-1. FW have a copy of the ALSTOM Engineering Management System Procedures, manual revision 3 and DESH are recommended to review those specific sections of the manual for further detail. We believe that Mike Mahaffey may

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ALSTOM

already have been given a copy of those sections of our manual during visits to our facility.

The 100% design report and supporting output consists of the following type of analyses:

a. Hand design calculations which use recognised text-book formulas and/or design code formulas to prove compliance with the design code requirements.

b. Seismic analysis modelling and calculations which require specialist knowledge of ANSYS finite element modelling and stress analysis.

c. Shielding analysis requiring specialist knowledge and computer programs.

d. Thermal analysis requiring specialist knowledge and computer programs.

We can demonstrate design verification of the 100% design analyses has taken place by reference to the following practises, output documents and actions:

1. Initial hand calculations are done at the design scheme stage by the designers to get the component dimensions. During preparation (or after completion) of the detail manufacturing drawings the formal calculations for customer submission are prepared by the Technical Services Group. These calculations are then independently checked by a professional grade engineer in that department. These checks are not only arithmetical checks but also consider the validity of all the input data, the methodology, the assumptions and the way the results have been interpreted. Corrections are incorporated before the calculations are sent to the design department for final review. This is review number 4683/471/002. This procedure fully meets the requirements of our Engineering Procedures and fully meets the requirement of NQA-1, section 3, paragraph 4: Design Verification.

2. The specialist knowledge required for the seismic, shielding and thermal computer programs and input/output manipulation is contained within our Technical Services Group. The output associated with these analyses requires the same specialist knowledge to perform an engineering review and so the output is therefore checked and reviewed within the department by an independent engineer of equal or higher status to the originator. Again validity and source of the input data, the methodology, the simplifying modelling assumptions and the interpretations of the results are of prime concern to the reviewer.

Copies of the following documents are attached in support of the above claims:

- Design Quality Plan 362S0548, sheet 1.
- Document Design Review sheet 4683/437/003: Shielding Analysis Report ESL/R(96)085
- Document Design Review sheet 4683/437/004: Thermal Analysis Report ESL/R(97)009
- Document Design Review sheet 4683/471/002: Design Calculations
- Document Design Review sheet 4683/471/022: Design Calculations Report ESL/R(96)099
- Document Design Review sheet 4683/401/025: Seismic Analysis Report ESL/R(96)083

ALSTOM

In addition, we are due to be audited by Fluor Daniel, UK, on Wednesday 23 September 1998, when our engineering verification procedures will be reviewed against the contract requirements. The results of that audit will, we assume, be fed back directly to DESH.

Yours faithfully
For and on behalf of
ALSTOM Automation Ltd

C.C.CARTER
Chief Engineer
Nuclear and Power Business Sector

Encl.

cc: M.FAWCETT
A.MACMILLAN

Spec. No. 361 S 9940

DESIGN QUALITY PLAN

Design Activity/Output				EES Design Assessment		External Submissions		Associated References and Information
No.	Description	Design Responsibility	Output Document Reference No.	Type	Participants	Routing	Purpose	
3.3	Block Interconnection Diagram (BID)	CSEG	3614M019	Review 007	FNMG	Editor FVEHC DESE	Review Information Approval	
4.0	Seismic Analysis	TSG	EEL/E(96)083	Review 025	TSG	FVEHC DESE	Information Approval	
5.0	Shielding Analysis	TRPAG	EEL/E(96)045	Review 4683/437/01 4683/437/003	TRPAG FNMG	FVEHC DESE	Information Approval	
6.0	Thermal Analysis	TRPAG	EEL/E(96)004	Review 4683/457/004	TRPAG FNMG	FVEHC DESE	Information Approval	
7.0	Radiological/Survey Specification	TRPAG	3617?527	Review 4683/437/02	TRPAG FNMG	FVEHC DESE	Information Approval	
8.0	Mechanical Design Calculations	FNMG	EEL/E(96)99	Review 041 022	FNMG	FVEHC DESE	Information Approval	
9.0	[illegible]/Ventilation Commissioning Specification	FNMG	3617?533	Review 003	FNMG TRPAG CSEG	Editor FVEHC DESE	Review Information Approval	
10.0	Turret Works Assembly & Test Specification	FNMG	3617?537	Review 006	FNMG TRPAG CSEG	FVEHC DESE	Information Approval	

	A	B
DATE	22/7/96	25/2/98
APPD	M. Lund	[signature]
		M. Lund
		09595

UP DATED

GEC ALSTHOM ENGINEERING SYSTEMS LTD
WHETSTONE LEICESTER LE8 6LH ENGLAND

TITLE HANFORD [illegible]

AMEND BY A.H.

APPROVED BY C.C.C

Q.A. ENDORSEMENT A.P.

DWG. No. 361 S 9940

SHEET No. 1

No. of SHEETS 1

OFFICE [illegible]

CONTRACT JH 4683

[illegible]

GEC ALSTHOM ENGINEERING SYSTEMS LTD	DOCUMENT DESIGN REVIEW
Title HANFORD MHM PHASE III: SHIELDING ANALYSIS	Drawing / Specification / Issue ESL/R(96)085 Draft Issue B1
Supplier	Contract Reference 4683
Scope of Review Required Review technical content of report for suitability for inclusion in the final design submission (Note: Changes from Issue A are sidelined in this updated draft version of the report. Colour versions of contour plots have been e-mailed to you today)	Related Documents DJI 4683/471/461 Issue A DQP 362S0548 Issue B
Requested by: PAUL SYMONS Date requested: 2nd June 1998	Office: THERMAL & PHYSICS ANALYSIS Date Review Required: 9th June 1998

Reviewer's Comments (Nil Returns Required)

1. Page 9 bottom of page. Is 4:4 m rem/h a typing error?
2. Update figure 23.
3. Figure 29. – Delete the bellows.

Re-issue as Revision 1, July 1998

Nomenclature changes noted on copy issue B:

- fuel reload → upper dectum
- heat containment → heat enclosure

Design Decision

1. Accepted – typographical error will be corrected
2. Accepted – latest assembly drawing will be used on a basis for the updated Figure
3. Accepted – Figure will be updated to remove bellows
4. Accepted – formal issue will be Revision 1
5. All nomenclature changes accepted

P.K Dyer 8/7/98

Reviewer's Signature: Aulay Millar Date: 22/6/98 7/7/98

Lead Eng Signature: R Scott

Date: 8.7.98

Circulation for Review
CC CARTER
M BLACKBOURN

Contract / Section No. / Serial No.
..4683../..437../..003.....

Date of recirculation to Reviewers after close out of comments
5 7 98

Sheet 1 of 1

GEC ALSTHOM ENGINEERING SYSTEMS LTD	DOCUMENT DESIGN REVIEW
Title HANFORD MHM PHASE III: SHIELDING ANALYSIS	Drawing / Specification / Issue ESL/R(96)085 Draft Issue B1
Supplier	Contract Reference 4683
Scope of Review Required Review technical content of report for suitability for inclusion in the final design submission (Note: Changes from issue A are sidelined in this updated draft version of the report. Colour versions of contour plots have been e-mailed to you today)	Related Documents DJI 4683/471/461 Issue A DQP 362S0548 Issue B
Requested by: PAUL SYMONS	Office: THERMAL & PHYSICS ANALYSIS
Date requested: 2nd June 1998	Date Review Required: 9th June 1998
Reviewer's Comments (Nil Returns Required) [illegible] [illegible]? Will Fig 22 illustrate the ø240mm hole for the [illegible] system? Section 7.2.2 the statistical uncertainties should be reduced, 87% ⇒ 8.7%? P64/65 "M[illegible]" is on the wrong chart. Figure 24 should include ø1010mm PCD. Sect[illegible] 7.3.2.4 (p13) and Fig 27 are not consistent w.r.t. the [illegible] cutout dimensions. Reference 10 — WHC drawing numbers not correctly transcribed (items 2 & 3). Refer to the use of the HCO mechanical closure 362R500269/3LC.	Design Decision 1. Yes 2. MCBEND runs have now been run to obtain lower uncertainty e.g. ±87.0% on value at 30cm has now reduced to ±3.1%. 3. Accepted - corrected in Issue B 4. OK - will try to include dimension, although may not be possible 5. Text amended to be consistent with Fig 27 in Issue B 6. Accepted - corrected in issue B 7. Accepted - section 7.1 will explain that the closure is not represented P.R. [signature] 7/7/98
Reviewer's Signature: [signature] Date: 16/6/98	Lead Eng Signature: [signature] Date: 7.7.98
Circulation for Review C CARTER M BLACKBOURN	Contract / Section No. / Serial No. ..4683.../..437.../..003................
Date of recirculation to Reviewers after close out of comments	Sheet 1 of 2.

GEC ALSTHOM ENGINEERING SYSTEMS LTD	DOCUMENT DESIGN REVIEW
Reviewer's Comments (Nil Returns Required)	Design Decision
8. Section 9 - References - there are numerous minor corrections to the drawing numbers and issues - see the attached marked-up sheets.	8. Accepted - List updated
9. Appendix C :- the datasets refer to drawings not given in the Reference section. Also the issues in the dataset are not the current ones. The dataset should be revised or the intention should be justified or the list of drgs enhanced.	9. Noted - however it is impracticable to update the comments in over 500 datasets - only comments associated with baddies that have been ~~given~~ changed since Issue A have had their comments updated. This will be clarified in Appendix C of Issue B
10. App C. some comments which refer to sketch/dimensioning etc should be clarified. There should be a preamble to App C explaining the situation.	10 See response to point 9
11. 7.3.1 P10 ~~3.%~~ 0 ⇒ 3.9%	11. Accepted - corrected in Issue B
12. Reference should be made to Vol 4, Calc 16 which gives the shortcut hand done for a fault causing shortcut.	12. This calc is already listed in Appendix B. No change required.
13. Section 7.2.2 The dose rates presented in calc 6, (Rev A), Vol 2 do not agree with the values in the report, also the location of the maximum dose rate is at the tank (not the side)	13 Accepted - Calc 6 has been updated since Draft Issue B1 was produced. Text will be modified accordingly
14. Section ~~7.5~~ 7.5 - As for item 13.	14. Accepted - see response to 13
	DR Symon 7/7/95
	Lead Eng Signature .....
	Date: 7.7.95
Reviewer's Signature	Contract / Section No / Serial No
Date: 22nd June 1995	4683/437/003
	Sheet 2 of 2

GEC ALSTHOM ENGINEERING SYSTEMS LTD	DOCUMENT DESIGN REVIEW
Title HANFORD PHASE 3 MHM - THERMAL ASSESSMENT	Drawing / Specification / Issue REPORT ESL/R(97)9 DRAFT ISSUE B1
Supplier	Contract Reference jh4683
Scope of Review Required Review technical content of report for suitability for inclusion in the final design submission. C C Carter. Please note that your copy does not include appendices A1,A2 & A3 (the calcs). C C Carter to advise regarding ESL or AA report format	Related Documents DJI 4683/471/451Issue A DQP 362S0548 Issue B
Requested by: Ian Spence Date requested: 12-2-98	Office: Thermal & Physics Date Review Required:

Reviewer's Comments (Nil Returns Required)	Design Decision
Several editorial comments added to copy issued.	Noted.
depression system, should be called Cask Extract system	Noted
seal ring is Interface Ring	Noted
Contract spec is now HNF-S-0448?	Noted
Identify exact source of data used - section 2	Noted.
Leave report reference as ESL/R(97)/xx as it is referenced from other reports.	Noted
Clarify revision status & re-issue as revision 1.	Noted.
how do you show that the temperature of the MCO during fault (from a max of 121.7°) when it enters the MHM?	The steady state temperatures for the MCO when in the MHM are lower than the maximum allowed value of 121.7°C. Therefore the MCO temperature reduces in response to the cooler MHM environment.
Reviewer's Signature: ..... Date: 7/7/98	Lead Eng Signature: I D Spence Date: 9/7/98.
Circulation for Review C C Carter M Blackbourn	Contract / Section No. / Serial No. 4683/437/004
Date of recirculation to Reviewers after close out of comments	Sheet 1 of

GEC ALSTHOM ENGINEERING SYSTEMS LTD	DOCUMENT DESIGN REVIEW
Title HANFORD PHASE 3 MHM - THERMAL ASSESSMENT	Drawing / Specification / Issue REPORT ESL/R(97)9 DRAFT ISSUE B1
Supplier	Contract Reference jh4683
Scope of Review Required Review technical content of report for suitability for inclusion in the final design submission. C C Carter. Please note that your copy does not include appendices A1,A2 & A3 (the calcs). C C Carter to advise regarding ESL or AA report format	Related Documents DJI 4683/471/451Issue A DQP 362S0548 Issue B
Requested by: Ian Spence	Office: Thermal & Physics
Date requested:	Date Review Required:
Reviewer's Comments (Nil Returns Required) The report as presented is acceptable and I have no comments to make. It incorporates all of the comments I made in a previous "draft version".	Design Decision Noted.
Reviewer's Signature: [signature] Date: 5.7.98	Lead Eng Signature: [signature] Date: 9/7/98
Circulation for Review C C Carter M Blackbourn	Contract / Section No. / Serial No. 4683/437/004
Date of recirculation to Reviewers after close out of comments:	Sheet 1 of 1

GEC ALSTHOM ENGINEERING SYSTEMS LTD	DESIGN REVIEW
Title Hanford MHM Mechanical design Calculations.	Drawing/Specification/Issue See SHT 2 & 3.
Supplier	Contract Reference Hanford MHM 4683.
Scope of Review Required Gen... review of the design Calc... Index of Calc...tions attached.	Related Documents WHC Spec 04-68 ESL P&P 5366 ASME NQA-1.
Requested by A. MacMillan.	Office FWMG
Date Requested 9/10/96.	Date Review Required 23/10/96.
Reviewer's Comments (Nil Returns Required) The ...ations use the output loads from the initial seismic runs. Loads required after the final seismic run to confirm that the loads have not increased and, if they have, that the calcs are ... No ... TAP comments	Design Decision NOTED, CALCS TO BE RE-CHECKED WHEN FULL SEISMIC ANALYSIS AVAILABLE.
Reviewer's Signature A. MacMillan Date 17/10/96	Lead Eng Sig. Wardwell Date 25/7/96
Circulation for Review	Contract/Section No/Serial No 4683, 471, 002. Sheet 1 of 3 Rev 0 See Revision
Date of recirculation to Reviewers after close out of comments:	

Form No ESL ...D 031

HANFORD: MCO HANDLING MACHINE - CONTRACT 4683 DESIGN CALCULATIONS			
VOLUME 1			
ITEM	CALCULATION NO	CALCULATION TITLE	ISSUE
Seismic Restraints General	110/1	Jack Components. Screws, Nut, Retaining Plate/Bolt, Anti-Rotation Pin Stress Analysis - 2000kN Load.	A
	110/2	Jack Components. Housing, Mounting Plate, Studs, Nut Flange Stress Analysis - 200kN Load.	A
Seismic Restraints Trolley	110/3	Traversing Shaft Drive Torque.	A
Seismic Restraints General	110/4	Jack Components. Traversing Shaft and Bearing Stress Analysis - Normal Loads.	A
	110/5	Jack Components. Traversing Drive Shaft Pinion Stress Analysis - Normal Loads.	A
	110/6	Jack Components. Screw, Nut, Traversing Shaft, A.R Pin, Ret Plate, Bolts Stress Analysis - Normal Loads.	A
	110/7	Jack Components. Housing, Mounting Plate, Studs, Nut Flange Stress Analysis - Normal Loads.	A
Seismic Restraints Trolley	110/8	Traversing Shaft and Locking Pin. Stress Analysis - 2000kN Proof Load.	A
	110/9	Bolting. Assembly/Trolley Structure Stress Analysis - 2000kN Proof Load.	A
Seismic Restraints General	110/10	Jack Components. Locking Pin Component Stress Analysis - Normal Loads.	A
	110/11	Jack Components. Anti-Rotation Assembly Stress Analysis - 2000kN Load.	A

HANFORD: MCO HANDLING MACHINE - CONTRACT 4683 DESIGN CALCULATIONS			
VOLUME 1			
Seismic Restraints General	110/12	Jack Components. Locking Pin Anti-Rotation Roller Stress Analysis - Normal Loads.	A
Turret	150/1	Hanford MHM Turret Assembly Bolted Joints.	A
Turret Turntable	160/1	Hanford MHM Turret Turntable Drive Motor.	A
Turret Locking Pin	170/1	Analysis of Hanford MHM Turret Locking Pins during Seismic Conditions.	A
Base Locking Pin	180/1	Analysis of Hanford MHM Base Locking Pin during Seismic Conditions.	A
Shield Skirt	200/1	Hanford MHM Retractable Shield Skirt.	A

MHM Routing/Distribution/Action Items

Date Received: 9/22/98

STANDARD ROUTING/DISTRIBUTION

- Project Manager (R. Roberts) ☒
- Project Manager (T. Gado) ☐
- Project Engineer (C. Nash) ☒
- Quality Assurance (S. Viskup) ☒
- Project Files (File #1510-____) ☒

OPTIONAL ROUTING/DISTRIBUTION

GEC ALSTHOM ENGINEERING SYSTEMS LIMITED

- C. C. Carter ☐
- A. MacMillan ☐
- A. L. T. Vyner ☐
- M. Carter ☐

EDERER INCORPORATED

- Paul Longthorpe ☐
- Paul McAfee ☐

FOSTER WHEELER ENVIRONMENTAL CORP.

- Dean Tulberg ☒
- R. Gambuti ☐
- N. Wold ☒

ACTION TAKEN: _____

ACTION TAKEN BY: _____

ACTION DATE: _____

FOSTER WHEELER ENVIRONMENTAL CORPORATION

3200 George Washington Way, Suite G
Richland, WA 99352
(509) 372-5800 ▫ FAX (509) 372-5801

Facsimile Transmittal

To:	John Robinson	**Date:**	9/23/98
From:	Nickie Wold	**Recipient's Fax #:**	376-9016
Pages:	____ (includes cover sheet)	**Charge #**	

Message: ☐ **Urgent** ☐ **For Your Review** ☐ **Reply ASAP** ☐ **Please Comment**

Please call me at (509) 372-5822 if you have any questions.

We offer a full range of environmental services to complement our capabilities as a full-service contractor. These services include:

Hazardous Waste Services	Consulting and Engineering Services
• Risk-Based Management Services	• Regulatory Compliance and Permitting
• Remediation Services	• Natural Resource Management
• Remedial Design	• Air, Water and Wastewater Engineering
• Assessments and Investigations	• Ecological/Geoscience Services
• Operations and Maintenance	• Economic, Social and Cultural Services
• Waste Management	• Occupational Safety and Health

Our mission is to conduct a global business directed toward cleaning up and protecting the environment while facilitating economic growth, and to do so in a safe, compliant, cost-effective manner. Of paramount importance to us is providing ***Client Service Quality*** *which translates to responsiveness and best value.*

IF YOU DO NOT RECEIVE ALL PAGES, PLEASE NOTIFY IMMEDIATELY.

FAXFORM3

INTEROFFICE CORRESPONDENCE

To: Distribution

Date: October 28, 1998

From: Craig E Swenson,
Buyer's Technical Representative
And Design Authority

Telephone: 376-0288

cc: J. M. Robinson, R3-11
M. K. Mahaffey, R3-86
T. Z. Anderson, B7-41
A. S. Daughtridge, R3-86
C. S. Haller, R3-11
CSB Project Files, S8-06

Subject: MCO Handling Machine (MHM) – Final Design Report

The Final Design Report (FDR) was received from Foster-Wheeler Corp (FWEC) per the attached transmittal letter. A confirmatory review has been performed that previous design media incrementally submitted to DESH for review and approval was incorporated for the removal of the inert gas system and that the functional requirement changes in specification HNF-S-0468 Revision 4, have been generally included in the FDR. The exceptions noted in the attached transmittal letter have been received and are acceptable also.

Attachment:
Letter, R.J. Roberts, FWEC, to J.M. Robinson, DESH, "100% Design Report," 1510-0382, dated August 21, 1998.

Craig Swenson

FOSTER WHEELER ENVIRONMENTAL CORPORATION

August 21, 1998
1510-0382

Mr. John Robinson
Principal Procurement Specialist
DE&S Hanford Company
P.O. Box 350, MSIN R3-11
Richland, WA 99352

SUBJECT: 100% DESIGN REPORT
MULTICANISTER OVERPACK HANDLING MACHINE (MHM)
PURCHASE ORDER MJX-SDX-452656

Dear Mr. Robinson:

Twelve copies of the MHM 100% Design Package were provided to Mr. Mahaffey on August 21, 1998. This satisfies Milestone Payment Line Item 49, Incentive #3 for delivery of the Final Design Report. The attachment identifies those items that are included with the Final Design Report.

Please contact me at 372-5812 if you have any questions.

Sincerely,

Randal J. Roberts
Project Manager
Foster Wheeler Environmental Corporation

RJR/drw
Attachment

cc: C. Nash
D. Tulberg
N. Wold
File

3200 GEORGE WASHINGTON WAY, SUITE G, RICHLAND, WA 99352
TEL: 509-372-5800 FAX: 509-372-5801

ATTACHMENT - FINAL DESIGN REPORT

The following documents form the 100% Design submission:

1. ESL/R(96)065, Rev. D 100% Design Report
2. ESL/R(96)083, Rev. 1 MHM Seismic Report
3. ESL/R(96)085, Rev. 3 MHM Shielding Report
4. ESL/R(96)099, Rev. 3 Turret Design Calculations (Volume 1 and 2)
5. ESL/R(97)008, Rev. F Interlock Requirements Schedule
6. ESL/R(97)009, Rev. 1 MHM Thermal Assessment
7. ESL/R(97)036, Rev. C MCO Hoist FMEA
8. ESL/R(97)043, Rev. A MCO Hoist Control System FMEA
9. 362F0031, Rev. 3 Technical Specifications
10. Turret Mechanical Drawings
11. Turret Electrical Drawings
12. Turret Parts List
13. Bridge Electrical and Control Systems Drawings
14. Bridge and Trolley Mechanical Drawings

The following items were not included as part of the submittal:

- The Electrical Interconnect Drawings and Bill of Materials are being revised and will be issued as a supplement.
- The Bridge Festoon modification is being redesigned and will be issued as a supplement.
- The extract system final design details will be submitted following completion of the design modifications.
- The Bridge and Trolley Calculations were previously submitted and are not included in this submittal.

☐ NOR ISSUED
☒ ACTION REQUIRED
☐ PHONE CONTACT
☒ SURVEILLANCE VISIT

FLUOR DANIEL
SURVEILLANCE REPORT

FILE NO. LHP 001

PAGE 1 OF 3

TO: KING ANDERSON LOCATION: FLUOR DANIEL NORTH WEST FROM: DOUG HARDIE CC: K BENNETT P RIDGEWAY FILE COPY D Scalon FDNW EQUIPMENT CASK HANDLING EQUIPMENT DESCRIPTION: Design Element Review TAG /ITEM CODE NO. N/A S/O NO.	P.O. NO: 1510-676 (FOSTER WHEELER) ISSUED TO: FOSTER WHEELER ENVIRONMENTAL (USA) SUPPLIER: GEC ALSTHOM -ESL LTD SUB SUPPLIER LOCATION WHETSTONE, LEICESTERSHIRE REPORT DATE:03/07/97 REPORT NO.: DH004 ESTIMATED DATE NEXT REPORT: TBA ALL ITEMS THIS P.O. (UK CONTENT) SCHEDULED TO COMPLETE BY: DEC 97 CONTACTS: DEREK EARWAKER PROJECT QA/QC MANAGER GEC A R PENN QUALITY ASSURANCE MANAGER DESIGN GEC D BURTON CHIEF ENGINEER HEAD OFFICE GEC A MACMILLAN LEAD DESIGN ENGINEER GEC ☒ IN PROCESS REPORT ☐ FINAL REPORT ☐ RELEASE REPORT DRAWINGS ATTACHED
SURVEILLANCE INFORMATION	

VISIT PURPOSE:-

1 To carry out an audit visit to determine effectiveness of the (GEC ESL) Design Verification Programme as applied to the work being carried out on the Hanford MHM Project

2 Establish the effectiveness of the quality systems employed to control design activities on the Hanford MHM Project as applied by (GEC ESL)

3 Establish the record of quality and quality status of design verification activities to date

Documentation used to support the visit :-

Instruction fax dated 23/6/97 Signed T Z Anderson FDNW
Surveillance check list dated 06/23/97
Description specification from spec 0468
Applicable document list from specification 0468
Portion of FW PO
(GEC ESL) code of practice for design calculations
(GEC ESL) technical computing procedure, sect NMP 4.11 of Nuclear Marine And Defence management system procedure

Conduct of audit:-

The audit was carried out at (GEC ESL) facility at Whetstone and a review of documentary evidence in support of the design verification procedures applied by (GEC ESL)

Summary of visit :-

The visit went well with the full co operation of GEC ESL . Design is well advanced and verification activities have been carried out as per project requirements
The design control programme as applied by GEC ESL ,was found to be generally in line with the (GEC ESL) Design Quality Plan and internal procedures. On review of the documentary evidence, design verification is considered to be generally satisfactory. It should be noted that the activity marked on the plan do not reflect the actual status of the verification work carried out to date, however the verification activities are ahead of the plan therefore this is not considered to be detrimental.

FLUOR DANIEL
INSPECTION REPORT
(Continuation Sheet)

FILE NO. LHP 001
PAGE .2 OF 3
DATE: 03/07/97

1.0 Detail Report

1.1 Completed Check List Matrix:-

SUBJECT /ACTIVITY REQUIREMENT REFERENCE	EVIDENCE EXAMINED / PERSONNEL CONTACTED	OBSERVATIONS / COMMENTS	COMPLY YES	NO	N/A
CONTROL OF WORK PROCESSES (FWENC QAPP SECTION 3)					
1. Verification activities are performed by individuals groups other than those who performed the original activity	drawing checks (Drawing annotation) calculations (sheet annotations and signatures)	None	√		
2. The method of verification to be applied has been specified and documented.	Design Quality Plan	Not up to date as per status mark up	√		
	design job instruction (Calcs)	None	√		
	company code of practice design calculations	None	√		
3. Review Of Drawings Is Being Carried Out As Required .	various drawings as held on "cad"system " and hard copies	None	√		
4. A history file is maintained which provides a record of review and approval.	Design assessment register	None	√		

1.2 Calculations reviewed

1.2.1 The following calculations were reviewed for compliance with the requirements outlined in the Table Matrix above point 1, point 2 & point 4 :-

Seismic restraints general , calculation Nb 110 / 12
Turrett, calculation No 150 / 1
Base Locking Pin calculation No 180 / 1
Seismic restraints general , calculation No 110 / 1
Seismic restraints general , calculation No 110 / 7
Seismic restraints general , calculation No 110 / 9

1.3 Design change control

1.3.1 design change control was audited to verify that this aspect of design was being controlled in an adequate manner as is required by ISO 9001 4. 4 & 4.4.9.

Drawing 362A0637 issue D was used as the example. A change was initiated to accommodate camber and unevenness of concrete deck. The change allowed shield skirt jack screws clearance at extremes of deck tolerances .The change to drawing was carried out in the appropriate manner and the change authorised by independent check (as noted on the drawing amendment box). A note was added for additional manufacturing instructions .These instructions are verified as being transmitted to the sub supplier via a drawing transmittal and will be followed up by an official change to the purchase order, reference P.O. on Manthorpe No P403283

1.4 Design Verification Programme CAlcs

1.4.1 The method of validating the computerised design verification programme was reviewed and verified. Programme ANSYS VER5.2 BY SWANSON ANALYSIS SYSTEMS was used for the audit

Design Verification Programme

1.4.1

The programme is described as a general purpose Finite element programme for structural analysis ,heat transfers, fluid flow and magnetics. The programme was validated against the ANSYS verification manual, known GEC problems and the validation methods were as follows:-

A Known Theoretical solutions
B Known computer solutions
C Experimental / test results
D problems vm6,vm7 vm9 vm59 &fhmz -us

all the above are as per (GEC ESL) technical computing procedure, sect NMP 4.11 of Nuclear Marine And Defence management system procedure

Results were found to be satisfactory.

1.4.2 verification activities using manual calculations were verified as having been carried out in accordance with the (GEC ESL) company code of practice Design calculations issue A

2.0 Conclusion

It is concluded that from the audit findings that the design control procedures , design review procedures , drawing checking procedure calculation procedures and design verification procedures are able to meet and have met project requirements.

T405205

Master of this Document held in GEC ALSTHOM ENGINEERING SYSTEMS LIMITED Drawing Registry

Plant Item or System	Contract
MCO HANDLING M/C	4683 HANFORD,
Assembly, Sub-Assembly, Cubicle Ref, Etc.	**Raised by:**
RETRACTABLE SHIELD SKIRT.	R.E.HEMPSTOCK.
	Date: 29/4/97.

Initiation of Change		Reason for Change (Technical)
Department	F & W M.	TO ACCOMMODATE CAMBER AND UNEVENESS OF CONCRETE DECK. MODIFICATION ALLOWS SHIELD SKIRT JACK SCREWS CLEARANCE AT EXTREMES OF DECK TOLERANCES.
Reason (Tick as Appropriate)		
Design Change	✓	
D.O. Error		
Additional Information		
Assist Manufacture		
Customer Request		
		References (Letter, NCR, etc)
		Basis for Customer Claim YES/NO

Drawings Altered or Added Due to Modification

Drawing Number	New Issue	Ref. to Notes	Description of Modification
362A0556 SHT 3	D	1	NOTE 1 ITEMS 3 & 4 UPDATED PICTORIALLY.
362A0637 SHT 1	D	2	NOTE 2 2 HOLES MOVED [72] WAS [168] [159.5] WAS [63.5]
362A0638 SHT 1	D	3	NOTE 3 ASS'Y 501 ITEM 1 SHORTENED. 132 WAS 228 2 HOLES REPOSITIONED [72] WAS [168]

Notes – and additional manufacturing instructions

PROCUREMENT TO ACTION.

NOTE.
362A0637_1 ASS'Y 501 JACK SUPPORT FAB.
IF THIS ASS'Y HAS BEEN MANUFACTURED. THE TWO REDUNDANT HOLES MAY BE LEFT IN.

Design Quality Plan No. 362S0548

Signature Reqd. if box is ticked			
✓	Principal Engineer	A Abercrombie	
	Group Engineer		
	Commercial		
✓	D.O. Sect. Leader	M Lund	

Circulation	Qty.
All Recipients of Drgs.	As listed
Tech. Publications	1
Spares Office	1
Office of Origin	1
Project Planning	

GEC ALSTHOM ENGINEERING SYSTEMS LTD

MANUFACTURING MODIFICATION NOTE

Product Ref.	Serial Number	Sheet No.	No. of Sheets
362	07463	1	1

Form No. ESL 1320/1/C

FAO D. HARDIE
FLUOR DANIEL.
01276411001 (FAX)

GEC ALSTHOM ENGINEERING SYSTEMS LTD
DOCUMENT TRANSMITTAL NOTE

From/To:	From/To:
GEC ALSTHOM ENGINEERING SYSTEMS LTD. CAMBRIDGE ROAD, WHETSTONE, LEICESTER. LE8 6LH. F.A.O. A. YEADON Tel. LEICESTER (0116) 275 0750 Telex: 34611 Fax: (0116) 275 0787	MANTHORPE F.A.O. MARK ELLIOT

Contract: HANFORD MHM-JH4683

ESL PO. No. 2QRF P403283

Subcontractor Ref. No. E10-10-96A

Subject Matter: DRAWING CHANGES

ESL Internal Circulation: S.BROUGHTON, QC, MASTER FILE

Purpose of Transmittal:

Your Approval/Comment	☐
Your Action	☑
Your Information	☑
Your Request	☐

Document Ref.	Issue.	Description/Title	No. of Prints	No. of Transp.
362A055 SHT3	D	RETRACTABLE SHIELD SKIRT ASSY	3	—
" 637 " 1	D	JACK SUPPORT TAB DETAIL	3	—
" 638 " 1	D	FABRICATION DETAILS	3	—

Comments: Please notify any cost impact

ESL Int. Ref.

Signed: A. Yeaden — Date: 6/5/97

Receipt Acknowledged: — Date Returned:

ESL Transmittal Ref. No. MS/AY/ME/4683/008

DISTRIBUTION AS FOLLOWS:-
1. WHITE copy signed and dated by receiver and retained.
2. BLUE copy must be signed and dated and returned by receiver.
3. GREEN copy retained by originator.

Form No. ESL 1704/A

GEC ALSTHOM ENGINEERING SYSTEMS LTD	DESIGN JOB INSTRUCTION -
Contract and Job Title: HANFORD MHM PHASE III Stress Analysis MCO Hoist System Components	To: MR. D. Burton Stress Office.
Design Class & Quality Level Requirements: Refer to PQP 5366 and DQP 362S0548	Required output: Design Job specification o 1 Design Quality Plan o 2 Scheme Design Drawings o 3 Detail Drawings o 4 Design Report o 5 Design Calculations ✓ 6 ---------- o 7 ---------- o 8 ---------- o 9 ---------- o 10
Target Dates for Completion 11th July 1997.	
Design Working Number: 468322/452	Budget: 111 Man Hours.
Starting Data Reference Documents WHC ENQUIRY SPEC. FOR THE MHM, REF No. 0468 ESL OFFER TO FW E4730, DATED 8/5/96 FWENC OFFER TO WHC (Ref WHC O/No MDK-SDX-452656) DATED 9/5/96 ASME NQA-1 Design scheme 362A0545 Parts list 362P0578 and detail drawings as necessary.	Note: It is the responsibility of the Engineer/Office carrying out the work to recommend to the originator any need to revise this Instruction to take account of additional output requirements identified during the execution of the work.

Special Notes: See sheet 2 attached.

Budget awareness is critical to the success of this project and you must monitor your spend, output and remaining budget. The issued budget must be worked within.

Copies to:	Issue	Authorising Signature	Date
File 4683/471/099 A.MACMILLAN	A	A. MacMillan	24/6/97
	No of shts:	DJI 4683 / 471 / 493	

DJI 4683/471/493.

Stress Analysis of MCO Hoisting System Components.

Provide stress analysis calculations to ASME NOG-1 Type 1 on the following hoisting system components:-

Parts List 362P0578 items 1, 5, 12, 15, 16, 17, 18, 20, 37, 38, 39, 40, 41, 43, 45, 46, 47, 48, 55.

The hoist is rated at 15 tons (30,000 lbs) and during normal operation, there are 2 ropes and 2 falls per rope. This results in a nominal rope tension of 7500 lbs. A balancing beam, item 38, ensures load equalisation on the ropes.

If one rope should fail, the shock absorber, item 109, limits the load in the remaining rope to 20,997 lbs.

In accordance with NOG-5475 the service factor used in the calculations will be 1.3. For the analysis of item 1 only, the service factor will be doubled to comply with NOG-5121 (b) (2).

The calculations have to be typed on MS Word on American A4 paper. They are to be incorperated into the "Structural Design Calculations" report ESL/R(96)99. Update the index of the report to suit.

The calculations are to be independently checked and reviewed by the stress office.

In all cases the comparison for both British and American material allowable stresses must be made and tabulated.

Alan Miller
24/6/97.

GEC ALSTHOM ENGINEERING SYSTEMS	COP103 Issue A Page 1 of 4
COMPANY CODE OF PRACTICE **DESIGN CALCULATIONS**	Originator: A R Penn Div/Dept: QA Department Authorising Signature [signature] Date 5.10.92

1.0 SCOPE

This Code of Practice defines the procedure for the preparation, scope, content and control of all calculations performed by the Design Offices, Technical Offices, Service Groups and Development Laboratories which are part of the permanent record supporting development and design undertaken as contract work. Calculations produced for tenders and non-contract development work that are to be filed in the record system of the Design Offices, Technical Offices, Service Groups and Development Laboratories, will be subject to checking only if specified as part of the job instruction or if subsequently used as a permanent record supporting contract work.

2.0 IDENTIFICATION AND CONTENT

2.1 The Company's standard calculation sheets are to be used, namely:

ESL Form No.	1650/1 : A4 size	Sheet 1 to all calculations.
	1650/2 : A4 size	Plain continuation sheet.
	1650/3 : A4 size	5mm grid continuation sheet.
	1650/4 : A3 size	5mm grid continuation sheet.
	1650/5 : A4 size	Sheet 2 to all calculations requiring computer information.

These make specific provision for meeting identification requirements and for recording other essential information.

2.2 Sheet 1 of each calculation is to be completed in accordance with the margin notes. This sheet should be raised and dated at the beginning of the calculation and the basic information required in boxes in the upper section should be filled in at the same time. Sheet 1 will be progressively completed as appropriate to the nature of the calculation.

2.3 All calculations are to be uniquely identified in accordance with the system operating in the office in question; the system should provide for calculations to be numbered sequentially within their file.

2.4 Calculation sheets and included items are to be numbered sequentially, signed and dated as the calculation progresses and the total number of sheets is to be stated on sheet 1 at the completion of the calculation. The calculation number is to be entered on each sheet to provide for traceability to sheet 1.

2.5 Where graphs, sketches, and computer output are included in the calculation each item must be identified in accordance with this procedure so that traceability and collation sequence is protected. Endorsing stamps are available to assist in the identification of these 'included items'. As a general rule each sheet is to be identified, but computer hard copy which remains as one piece or has its own unique numbering system need only be identified on its first page.

The object and method statements on sheet 1 may be covered by cross referring to a subsequent sheet in the calculation or to an associated document.

2.6 Calculations must be written with sufficient connective English and detail, and be clearly presented, such that a person technically qualified in the subject (but not necessarily familiar with the job) can understand the analyses and review/verify the results without recourse to the originator.

The results of calculations and conclusions shall be summarised and clearly stated. The Results Summary Box on sheet 1 may be completed by adding a cross reference to a subsequent sheet in the calculation where this is appropriate.

All hand calculations may be written in pencil unless specific contract conditions require otherwise.

2.7 The following shall apply to calculations which will form part of the permanent design record.

a) Authentication - Should pencil written calculations be unacceptable as a permanent record they shall be xeroxed and the front sheet carry original signatures of the Originator, Checker and the Approver of the calculation.

b) Alterations - Calculations written in ink, xerox copied or output from PC printer are not to be altered by use of correcting fluid (white out) or by 'blacking out'. Crossing out is permissible provided the detailed written matter is discernable, initialled and dated.

3.0 CHECKING

3.1 All calculations which are important to the final design must be checked for mathematical accuracy and for correct transposition of data, i.e. data extracted from curves and tables, and endorsed to this effect. It is the responsibility of the Lead Engineer/Office Head to determine which calculations requiring checking. Unchecked calculations retained in the Design Record File are to be identified as unchecked and signed by the Lead Engineer/Office Head on sheet 1 of the calculation in the appropriate box.

3.2 Types of calculations that do not require checking can include the following:

a) Calculations made in the process of checking other work.

b) Scoping calculations not resulting directly or indirectly in the final output.

The checking of calculations is to be carried out by a person other than the originator of the calculations. The Lead Engineer/Office Head advises the nominated checker as to the extent and method of checking taking into account the relative importance of the work.

3.3 Errors identified by the checking process shall be over marked on a copy of the calculation using a distinctive coloured pen/pencil. The corrected figure to be written above by the checker and agreed by both.

Any disagreement on the change is to be resolved by the Lead Engineer/Office Head. Changes agreed as a result of checking are to be incorporated into the calculation before release.

4.0 REVIEW/VERIFICATION OF CALCULATIONS

4.1 Where the Design Quality Plan (Design and development plan) identifies a requirement for the formal review of a calculation, and/or for verification additional to that provided for by the checking procedure in para 3.0 above, this is to be performed and documented in accordance with the formal design review/design verification procedures operated by, or agreed with, the Division for whom the work is being performed.

The Lead Engineer/Office Head of the section responsible for initiating the review/verification must ensure that the review/verification box on sheet 1 is completed.

5.0 RECORDS

5.1 Calculations must be filed in the formal office record system and be so arranged and indexed that the logic of the system and the totality of the work undertaken can be readily identified. In design offices they will normally be included as part of the Design Record File; in other offices they will be included in their formal record systems.

5.2 Computer output, in hard copy or magnetic tape form, may be stored separately but the same principles of identification and indexing apply. A cross reference identification is to be included on sheet 2 of the calculation.

6.0 REVISION TO CALCULATIONS

6.1 Calculations that have been released to other Offices, Divisions, or outside ESL will require revision where the change is of a significant nature.

6.2 All revision made to authenticated signed and released calculations shall be identified clearly, checked as defined previously and the revision status updated on sheet 1 of the calculation sheet.

6.3 Calculations that are superseded as the design develops shall be retained in the record files and the box on sheet 1 completed. Where a calculation has been revised the previous issue shall also be retained in the record files.

All those persons within or outside ESL who were in receipt of a formal transmitted copy of the calculation must be notified of any significant change.

7.0 ATTACHMENTS

Worked example of a design calculation.

NUCLEAR, MARINE & DEFENCE DIVISION MANAGEMENT SYSTEM PROCEDURE	Title TECHNICAL COMPUTING Originator D Bartlett Date 1.6.95

Contents

Approved by R Jones

Signature: R.P. Jones Title: TSG Manager Date: 22/6/95

Authorised by

Signature: Title: QA Manager Date: 22.6.95

WP ref K:\SECUMANUAL\NMP\NMP4.11

Form No MSP F001

GEC ALSTHOM Engineering Systems Ltd | TECHNICAL PROGRAM AUTHORISATION AND VALIDATION RECORD

PROGRAM: ANSYS

VERSION/UPDATE: V5.2 DATE: 18/10/95

ORIGIN/DEVELOPER: Swanson Analysis Systems Inc DATE: /

PROGRAM DESCRIPTION:
General Purpose finite element program for structural analysis, heat transfer, fluid flow and Magnetics

SUPPORT PERSON: D Bartlett SUPPORT CATEGORY A/B/C: C

SUPPORT AGENCY: Structures & Computers Ltd (Strucom)

COMPUTER(S): D3601 (DEC 3000-600 AXP OSF/1)

VALIDATION METHOD:

[✓] Known theoretical solutions, reference: ANSYS Verification Manual for Rev 5.0/5.0A/5.1

[✓] Known computer solutions, reference: see file JH0000/941/PD/102 Vol 4

[✓] Experimental/Test results, reference:

Problems VM6, VM7, VM9, VM59 run successfully
also problem "flume_us"

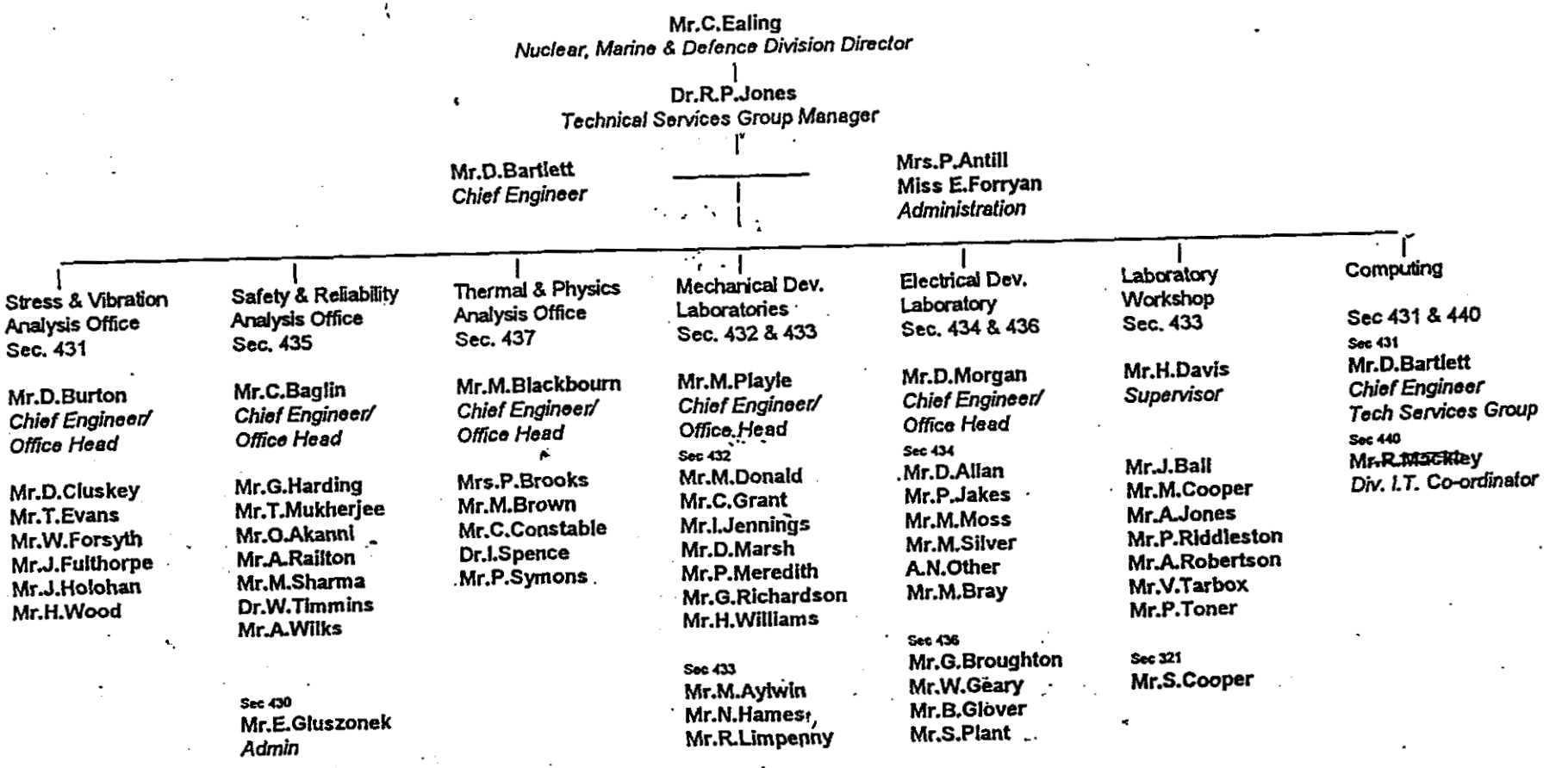
DOCUMENTATION REFERENCE: On-line ANSYS User Manual for Version 5.2 + Rev 5.2 release notes

ERROR REPORT REFERENCE: file JH0000/941/PD/103

PROGRAM LIMITATIONS:
See program errata sheet rec'd 18/10/95

REQUESTED BY: D Bartlett DATE: 21/10/95

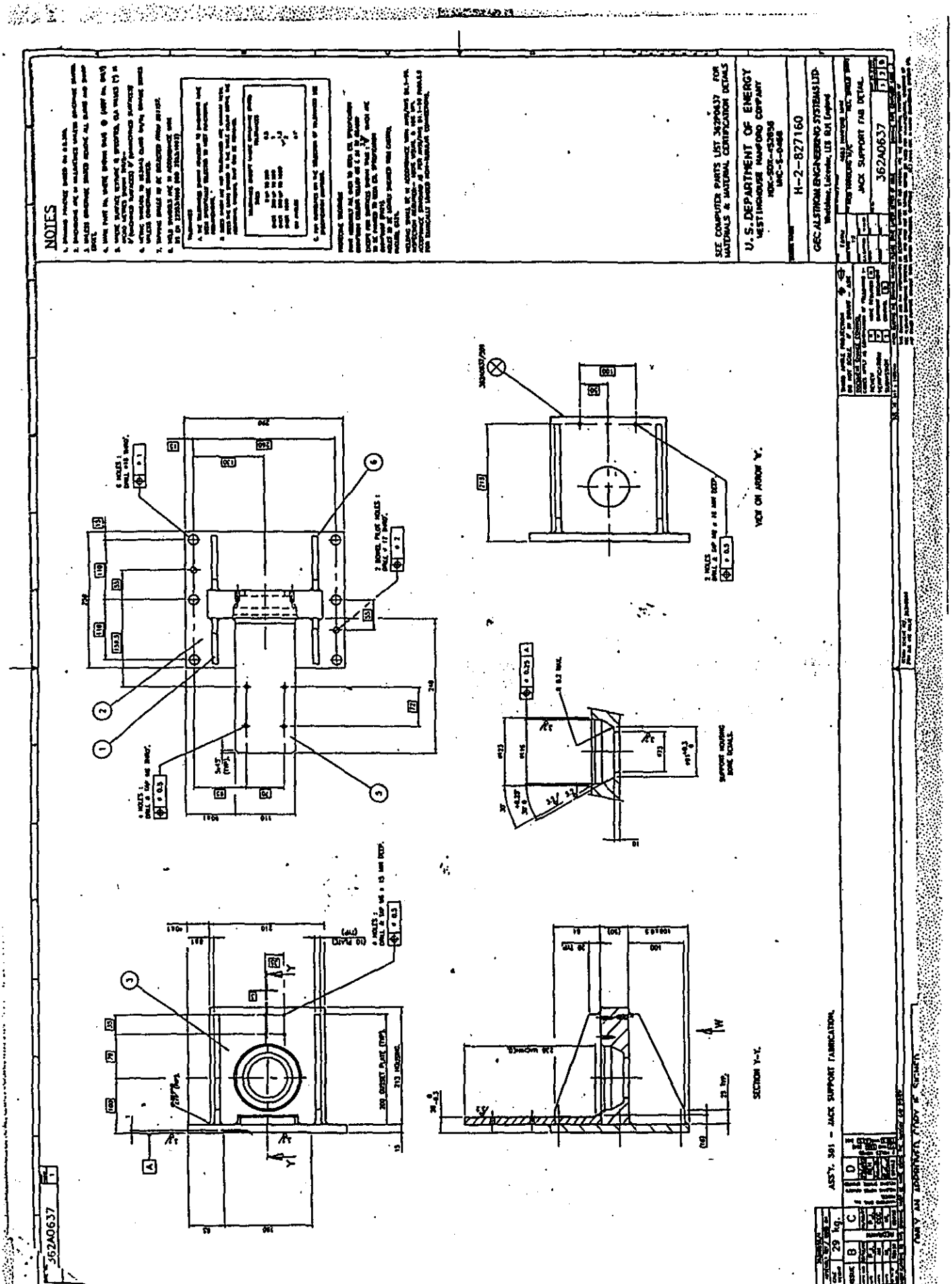
APPROVED BY: D Bartlett DATE: 21/10/95
(Technical Services Manager/Group Engineer)



Technical Services Group Organisation Chart

07-Oct-96

SNF-7000 REV 0


NOTES
U.S. DEPARTMENT OF ENERGY
WESTINGHOUSE HANFORD COMPANY
H-2-827160
362A0637
JACK SUPPORT FAB DETAIL
SECTION Y-Y.
VIEW ON ARROW 'X'.
ASSY. 361 - JACK SUPPORT FABRICATION.

FLUOR DANIEL LIMITED
Fluor Daniel Centre, Watchmoor Park, Riverside Way, Camberley, Surrey. GU15 3AQ.
Telephone 01276 62424 Fax: 01276-402278

FACSIMILE LEAD SHEET

TO:	King Anderson.	FROM:	Pam Ridgeway.
COMPANY:	Fluor Daniel.	LOCATION:	Camberley.
LOCATION:	Washington.	DATE:	08 July 1997
FAX No:	001-509-372-1490.	NUMBER OF PAGES:	16
SUBJECT:	G.E.C.		

King,

Please find attached the Report from the visit to GEC by Doug Hardie as previously sent to you via E-Mail.

The original Report will follow for your attention in the next package.

best regards as always,

PAM RIDGEWAY.

Ken Bennett 01276-402062
Doug Hardie 01276-411197
Keith Hills 01276-402057
Pam Ridgeway 01276-402064

Main Switchboard 01276-62424

fax: 01276-402278