

PHILADELPHIA ELECTRIC COMPANY

2301 MARKET STREET

P.O. BOX 8699

PHILADELPHIA, PA. 19101

50-352
353

EDWARD G. BAUER, JR.

VICE PRESIDENT
AND GENERAL COUNSEL

EUGENE J. BRADLEY

ASSOCIATE GENERAL COUNSEL

DONALD BLANKEN

RUDOLPH A. CHILLEMI

E. C. KIRK HALL

T. H. MAHER CORNELL

PAUL AUERBACH

ASSISTANT GENERAL COUNSEL

EDWARD J. CULLEN, JR.

THOMAS H. MILLER, JR.

IRENE A. McKENNA

ASSISTANT COUNSEL

(215) 841-4000

June 27, 1983

Mr. A. Schwencer, Chief
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Limerick Generating Station, Units 1 and 2
Request for Additional Information

Dear Mr. Schwencer:

In accordance with Robert Martin's telephone request of June 9, 1983, we are forwarding to him directly two copies of the following documents listed below that were used by Structural Mechanics Associates:

1. List of drawings used in the Limerick seismic fragility development
2. Fragility calculations for the items listed in Table 3-1 of Severe Accident Risk Assessment Report
3. Fragility calculations for block walls at El 332'
4. Fragility calculations for shear walls at El 177'-217' (Included in Item S₄ of Table 3-1)
5. Fragility calculations for weakest relay (see Item S₁₁ of Table 3-1)

Very truly yours,

Eugene J. Bradley
Limited Dist
Boo 11

8306300024 830627
PDR ADDCK 05000352
A PDR

Attachment

Copy to: See Attached Service List

cc: Judge Lawrence Brenner	(w/o enclosure)
Judge Richard F. Cole	(w/o enclosure)
Judge Peter A. Morris	(w/o enclosure)
Troy B. Conner, Jr., Esq.	(w/o enclosure)
Ann P. Hodgdon	(w/o enclosure)
Mr. Frank R. Romano	(w/o enclosure)
Mr. Robert L. Anthony	(w/o enclosure)
Mr. Marvin I. Lewis	(w/o enclosure)
Judith A. Dorsey, Esq.	(w/o enclosure)
Charles W. Elliott, Esq.	(w/o enclosure)
Jacqueline I. Ruttenberg	(w/o enclosure)
Thomas Y. Au, Esq.	(w/o enclosure)
Mr. Thomas Gerusky	(w/o enclosure)
Director, Pennsylvania Emergency Management Agency	(w/o enclosure)
Mr. Steven P. Hershey	(w/o enclosure)
Donald S. Bronstein, Esq.	(w/o enclosure)
Mr. Joseph H. White, III	(w/o enclosure)
David Wersan, Esq.	(w/o enclosure)
Robert J. Sugarman, Esq.	(w/o enclosure)
Martha W. Bush, Esq.	(w/o enclosure)
Spence W. Perry, Esq.	(w/o enclosure)
Atomic Safety and Licensing Appeal Board	(w/o enclosure)
Atomic Safety and Licensing Board Panel	(w/o enclosure)
Docket and Service Section	(w/o enclosure)



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

SMA 14302.01

5160 Birch Street, Newport Beach, Calif. 92660 (714) 833-7552

June 22, 1983

Mr. Howard Hansell
Philadelphia Electric Company
2301 Market Street, Building N2-1
Philadelphia, PA 19101

Dear Mr. Hansell:

Per our recent telephone conversation, I am sending herewith the following items:

1. List of drawings used in the Limerick seismic fragility development
2. Fragility calculations for the items listed in Table 3-1 of Severe Accident Risk Assessment Report
3. Fragility calculations for block walls at E1 332'
4. Fragility calculations for shear walls at E1 177'-217'
(Included in Item S₄ of Table 3-1)
5. Fragility calculations for weakest relay (see Item S₁₁ of Table 3-1)

If you have any questions or need any further information, please do not hesitate to call me.

Very truly yours,

STRUCTURAL MECHANICS ASSOCIATES, INC.

M. K. Ravindra
Project Manager

MKR:kc

Limerick Drawing List

Attached is a list of structural drawings used to perform the Limerick PRA. The first page lists the various tank drawings. The rest of the attachment is a partial listing of the Bechtel drawings for Limerick. Those drawings with check marks (✓) by them in the left margin were the ones supplied to SMA.

Nooter Corporation Tank Drawings

JN-D 42717

42718

42719

42762

Condensate Storage Tank

JN-D 42770

42771

42772

42773

49712

49713

49714

Refueling Water Storage Tank

Bethlehem Steel Corporation (Buffalo Tank Division) Tank Drawing

L-3979

Diesel Oil Storage Tank

— DRAWING STARTED
☒ ISSUED FOR APPROVAL
☒ ISSUED FOR CONST

PROGRESS LAST PERIOD 
PROGRESS THIS PERIOD 
ISSUED FOR A APPROVAL O QUOTATION
C CONSTRUCTION P PURCHASE

BECHTEL
SAN FRANCISCO

POWER H
AND
INDUSTRIAL
DIVISION

CIVIL
ENGINEERING
DEPT

JOB NO. 8021 PERIOD ENDING 4-1-64
JOB LIMERICK GENERATING STATION
CONT. SHEET 5A
SHEET 5 OF 5 SHEETS

DRAWING NUMBER	TITLE	START DATE		COMP DATE		DATE ISSUED		REMARKS	
		REV 1	REV 2	REV 1	REV 2	REV 1	REV 2	DESIGNATES PRINCIPAL DRAWING	
	REACTOR BUILDING								
▽ C-101	FOUNDATIONS-MAT PLAN-AREA 11	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-102	FOUNDATIONS-MAT PLAN-AREA 12	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-103	FOUNDATIONS-MAT PLAN-AREA 13	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-104	FOUNDATIONS-MAT PLAN-AREA 14	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-105	FOUNDATIONS-MAT PLAN-AREA 15	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-106	FOUNDATIONS-MAT PLAN-AREA 16	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-107	FOUNDATIONS-MAT PLAN-AREA 17	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-108	FOUNDATIONS-MAT PLAN-AREA 18	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-109	FOUNDATIONS-EXTERIOR WALLS-AREA 11, 12 & 13	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-110	FOUNDATIONS-EXTERIOR WALLS-AREA 12, 13 & 14	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-111	FOUNDATIONS-EXTERIOR WALLS-AREA 13, 14 & 15	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-112	FOUNDATIONS-EXTERIOR WALLS-AREA 14, 15 & 16	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-113	FLOOR PLAN-EL. 201'-0"-AREA 11	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-114	FLOOR PLAN-EL. 201'-0"-AREA 12	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-115	FLOOR PLAN-EL. 201'-0"-AREA 13	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-116	FLOOR PLAN-EL. 201'-0"-AREA 14	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-117	FLOOR PLAN-EL. 201'-0"-AREA 15	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-118	FLOOR PLAN-EL. 201'-0"-AREA 16	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-119	FLOOR PLAN-EL. 201'-0"-AREA 17	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-120	FLOOR PLAN-EL. 201'-0"-AREA 18	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-121	FLOOR PLAN-EL. 201'-0"-SECTIONS & DETAILS	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-122	FLOOR PLAN-EL. 217'-0"-AREA 11	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-123	FLOOR PLAN-EL. 217'-0"-AREA 12	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-124	FLOOR PLAN-EL. 217'-0"-AREA 13	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78
▽ C-125	FLOOR PLAN-EL. 217'-0"-AREA 14	4-1-78	2-1-78			1/1/78	3/1/78	4/1/78	5/1/78

BECHTEL
SAN FRANCISCO

POWER
AND
INDUSTRIAL
DIVISION



CIVIL
ENGINEERING
DEPT.

JOB NO. 8011 PERIOD ENDING ED
JOB LIMERICK GENERATING STATION
SHEET 6 OF CONT SHEET GA SHEETS

[illegible]

LEGEND		PROGRESS LAST PERIOD		PROGRESS THIS PERIOD		ISSUED FOR A APPROVAL		ISSUED FOR CONST.		C - CONSTRUCTION		P - PURCHASE	
— DRAWING STARTED		PROGRESS LAST PERIOD		PROGRESS THIS PERIOD		ISSUED FOR A APPROVAL		ISSUED FOR CONST.		C - CONSTRUCTION		P - PURCHASE	
▽ ISSUED FOR APPROVAL		PROGRESS THIS PERIOD		ISSUED FOR A APPROVAL		ISSUED FOR CONST.		C - CONSTRUCTION		P - PURCHASE			
▽ ISSUED FOR CONST.		PROGRESS THIS PERIOD		ISSUED FOR A APPROVAL		ISSUED FOR CONST.		C - CONSTRUCTION		P - PURCHASE			
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB LIMERICK GENERATING STATION	
DRAWING CONTROL		BECHTEL		SAN FRANCISCO		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8021 PERIOD ENDING		JOB	

LEGEND

— DRAWING STARTED

ISSUED FOR APPROVAL

ISSUED FOR CONST

PROGRESS LAST PERIOD

PROGRESS THIS PERIOD

ISSUED FOR A - APPROVAL

C CONSTRUCTION P PURCHASE

Q ORKUTATION

P PURCHASE

DRAWING CONTROL

RECHTEL

SAN FRANCISCO

PURVEY
AND
INDUSTRIAL
DIVISION



CIVIL
ENGINEERING
DEPT.

JOB NO. 8021 PERIODS ENDING

LIMERICK GENERATING STATION

SHEET B OF CONT SHEET BA SHEETS

DRAWING NUMBER	TITLE	START DATE DESIGN	START DATE CONSTRUCTION	DATE ISSUED (REV. 1)	DATE ISSUED										REMARKS * DESIGNATES PRINCIPAL DRAWING
					REV. 2	REV. 3	REV. 4	REV. 5	REV. 6	REV. 7	REV. 8	REV. 9	REV. 10		
	REACTOR BUILDING														
▽ C-176	FLOOR PLAN - EL 238'-0" & EL 241'-3" UNIT NO.2	4-8-74			4/2/74	4/7/74	4/20/74	4/26/74	4/30/74	5/6/74					
▽ C-177	FLOOR PLAN AT EL 238'-0" & EL 241'-3" UNITS 1 & 2 SECTIONS & DETAILS	6-21-74			4/24/74	4/27/74	5/1/74	5/13/74	5/17/74	5/21/74	5/24/74	5/28/74	6/1/74	6/4/74	
▽ C-178	AIR LOCKS - PLAN, SECTS. & DETS. UNITS 1 & 2	8-1-78			7/23/78	7/26/78	7/27/78	7/31/80	8/4/81						
▽ C-179	EXTERIOR WALLS COL. LINE J ABOVE EL 217'-0" UNIT 1	8-20-74			7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	
▽ C-180	EXTERIOR WALLS COL. LINE J ABOVE EL 217'-0" UNIT 2	9-1-74			7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	
▽ C-181	EXTERIOR WALLS COL. LINE 14.1 ABOVE EL 217'-0" UNIT 1	8-25-74			7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	
▽ C-182	EXTERIOR WALLS COL. LINE 29 ABOVE EL 217'-0" UNIT 1	9-19-74			7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	
▽ C-183	EXTERIOR WALLS COL. LINE D ABOVE EL 217'-0" UNIT 1	9-1-74			7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	
▽ C-184	EXTERIOR WALLS COL. LINE D ABOVE EL 217'-0" UNIT 2	9-8-74			7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	
▽ C-185	EXTERIOR WALLS LINE 31.9 ABV. EL 217'-0	7-3-74			7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	
▽ C-186	SECTIONS & DETAILS - EL 283'-0" & EL 300'-5" UNIT 2	7-7-74			7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	
▽ C-187	EXTERIOR WALL COLUMN LINE (D) ELEVATIONS 217'-0" TO 283'-0" UNITS 1 & 2	11-17-74			7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	
▽ C-188	STEAM RELEASE TUNNELS UNITS 1 & 2 PLAN AT EL. 307'-1"	9-13-74			7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	
▽ C-189	PRIMARY CONTAINMENT ELEV. UNIT 2	9-4-74			7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	
▽ C-190	PRIMARY CONTAINMENT ELEVATION UNIT 1	4-23-74			7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	7/27/74	
	REACTOR BUILDING														
	STRUCTURAL STEEL														
▽ C-191	COLUMN SCHEDULE - UNIT NOS. 1 & 2	10-1-74	2-1-74		4/16/74	4/17/74	4/17/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	
▽ C-192	COLUMN SCHEDULE & BASE PLATE DETAILS	7-24-74			4/16/74	4/17/74	4/17/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	
▽ C-193	TYPICAL CONNECTION DETAILS				4/16/74	4/17/74	4/17/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	
▽ C-194	FRAMING PLAN - EL. 201'-0" UNIT No. 1	8-1-74	3-1-74		4/16/74	4/17/74	4/17/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	
▽ C-195	FRAMING PLAN - EL. 201'-0" UNIT No. 2	8-1-74	8-1-74		4/16/74	4/17/74	4/17/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	
▽ C-196	KHR HEAT EXCHANGER SUPPORT PLANS & SECTIONS	8-4-74			4/16/74	4/17/74	4/17/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	
▽ C-197	FRAMING PLAN - EL. 217'-0" UNIT No. 1	8-1-74	8-1-74		4/16/74	4/17/74	4/17/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	
▽ C-198	FRAMING PLAN - EL. 217'-0" UNIT No. 2	8-1-74	8-1-74		4/16/74	4/17/74	4/17/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	
▽ C-199	FRAMING PLAN - EL. 238'-0" UNITS No. 1 & 2	7-5-74			4/16/74	4/17/74	4/17/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	
▽ C-200	FRAMING PLAN - EL. 283'-0" UNIT No. 1	8-5-74	8-5-74		4/16/74	4/17/74	4/17/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	4/24/74	

LEGEND		PROGRESS LAST PERIOD		DRAWING CONTROL		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT		JOB NO. 80.1 PERIOD ENDING	
ISSUED FOR APPROVAL		PROGRESS THIS PERIOD		BECHTEL		CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
ISSUED FOR CONST		ISSUED FOR A APPROVAL		SAN FRANCISCO		CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
		C CONSTRUCTION		Q QUOTATION		CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
		P PURCHASE				CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENERATING STATION		CONT. SHEET 10A	
						CIVIL ENGINEERING DEPT		JOB LIMERICK GENER			

LEGEND

— DRAWING STARTED
 ▽ ISSUED FOR APPROVAL
 ▽ ISSUED FOR CONST

PROGRESS LAST PERIOD
 PROGRESS THIS PERIOD
 ISSUED FOR A - APPROVAL Q QUOTATION
 C - CONSTRUCTION P PURCHASE

DRAWING CONTROL

BECHTEL
SAN FRANCISCO

POWER
AND
INDUSTRIAL
DIVISION

CIVIL
ENGINEERING
DEPT

JOB NO. 8021 PERIOD ENDING 12-31-62
 JOB LIMERICK GENERATING STATION
CONT. SHEET 11A
 SHEET 11 OF SHEETS

[illegible]

LEGEND

— DRAWING STARTED

— ISSUED FOR APPROVAL

— ISSUED FOR CONSTRUCTION

— PHASES LAST PERIOD

— PHASES THIS PERIOD

— ISSUED FOR A APPROVAL

— CONSTRUCTION

— PURCHASE

DRAWING CONTROL

POWER AND INDUSTRIAL DIVISION

CIVIL ENGINEERING DEPT

JOB NO 8021 PERIOD ENDING

JOB LIMERICK GENERATING STATION

SHEET 12 OF 12A

CONT. SHEET 12A

SHEETS

DRAWING NUMBER	15	TITLE	START DATE		END DATE		ISSUED IN		DATE ISSUED		REMARKS	
			ACTUAL	PLANNED	ACTUAL	PLANNED	NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6
REACTOR BUILDING												
C-276		GENERAL OUTLINE	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-277		LINER LAYOUT & PENETRATION LOCATION	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-278		LINER LAYOUT & PENETRATION LOCATION	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-279		PENETRATION SCHEDULE	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-280		PENETRATION SCHEDULE	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-281		FLOOR PLAN & DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-282		SUPPRESSION POOL LINER DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-283		SUPPRESSION POOL DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-284		DIAPHRAGM SLAB ANCHORAGE DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-285		DRYWELL LINER DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-286		DRYWELL LINER - SECTIONS & DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-287		DRYWELL PENETRATIONS - SECTIONS & DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-288		DRYWELL PENETRATION DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-289		PIPE RESTRAINT - SCHEDULE & DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-290		TOP HEAD & SEAL PLATE DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-291		PIPE RESTRAINT DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-292		PIPE RESTRAINT - DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-293		PRIMARY CONTAINMENT DOWNCOMER DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-294		LINER PLATE REQUIREMENTS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-295		DIAPHRAGM FLOOR PLAN & DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-296		PIPE RESTRAINTS - SECTIONS & DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-297		PRIMARY CONTAINMENT DIAPHRAGM SLAB - STRUCTURAL SUPT.	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-298		PENETRATION DETAILS	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-299		REACTOR SHIELD ANCHOR BOLT TEMPLATE	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	
C-300		STEEL COLUMNS IN SUPPRESSION POOL	5-1-70	5-1-70					4/10/71	4/10/71	4/10/71	

LEGEND
 --- DRAWING STARTED
 ▽ ISSUED FOR APPROVAL
 ▽ ISSUED FOR CONST
 PROGRESS LAST PERIOD
 PROGRESS THIS PERIOD
 ISSUED FOR A APPROVAL
 C CONSTRUCTION P PURCHASE
 QUOTATION

DRAWING CONTROL

BECHTEL
 SAN FRANCISCO

POWER
 AND
 INDUSTRIAL
 DIVISION



CIVIL
 ENGINEERING
 DEPT

JOB NO. 8021 PERMIT ENDING
 JOB LIMERICK GENERATING STATION
 SHEET 13 OF 13A
 CONT SHEET 13A

DRAWING NUMBER	25	TITLE	START DATE		STOP DATE		DESIGNED BY	DATE ISSUED												REMARKS
			PLN	ACT	PLN	ACT		REV 0	REV 1	REV 2	REV 3	REV 4	REV 5	REV 6	REV 7	REV 8				
		TURBINE BUILDING																		
▽	C-301	FOUNDATIONS - MAT PLAN - AREA 1	6-1-70	1-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73					
▽	C-302	" " " AREA 2	5-20-70	1-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-303	" " " AREA 3	5-1-70	1-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-304	" " " AREA 4	11-1-70	6-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73					
▽	C-305	FOUNDATIONS - MAT PLAN - AREA 5	11-1-70	6-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73					
▽	C-306	FLOOR PLANS - EL 217'-0" AREAS 2 & 4 UNIT Nos 1 & 2	5-23-70					1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-307	FOUNDATIONS - WALL ELEV'S - AREA 1	7-1-70	2-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-308	" " " AREA 2	7-1-70	2-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-309	" " " AREA 3	7-1-70	2-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-310	" " " AREA 4	7-1-70	2-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-311	FOUNDATIONS - WALL ELEV'S - AREA 5	7-1-70	2-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
25-C ▽	C-312	FOUNDATIONS - STEAM FLOOD VENTING AREAS 2 & 4	9-24-71				5-1-73	1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73			CANCELLED		
▽	C-313	FOUNDATIONS - MAT & WALL SECTIONS	7-1-70	2-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-314	FOUNDATIONS - MAT & WALL SECTIONS & DETAILS	6-1-70	2-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-315	STEAM FLOOD VENTING - PRECAST PANEL DETS. UNITS 1 & 2	1-15-72				5-1-73	1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73			CANCELLED		
▽	C-316	FLOOR PLAN - EL. 239'-0" AREA 1	8-15-70	10-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-317	" " " " AREA 2	8-15-70	10-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-318	" " " " AREA 3	8-15-70	10-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-319	" " " " AREA 4	8-15-70	10-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-320	FLOOR PLAN - EL. 239'-0" AREA 5	8-15-70	10-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-321	WALL DETAILS - COL. LINE (18) AREA 2 UNIT 1	11-26-71					1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73					
▽	C-322	FLOOR PLAN - EL. 254'-0" AREA 1	1-17-72					1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73					
▽	C-323	FLOOR PLAN - EL. 254'-0" AREA 5	1-19-72					1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73					
▽	C-324	FLOOR PLAN - EL. 269'-0" AREA 1	10-1-70	12-1-70				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				
▽	C-325	FLOOR PLAN - EL. 269'-0" AREA 2	10-1-70	12-1-71				1/25/70	2/11/71	4/23/71	4/24/71	9/9/71	11/9/71	5/2/72	11/24/73	3/15/74				

LEGEND

DRAWING STARTED

ISSUED FOR APPROVAL

ISSUED FOR CONST

PROGRESS LAST PERIOD

PROGRESS THIS PERIOD

ISSUED FOR A - APPROVAL

C - CONSTRUCTION P - PURCHASE

Q - QUOTATION

DRAWING CONTROL

BECHTEL

SAN FRANCISCO

POWER
AND
INDUSTRIAL
DIVISIONCIVIL
ENGINEERING
DEPT

JOB NO. 8031 PERIOD ENDING 1-1-77

JOB LIMERICK GENERATING STATION

SHEET 14 OF 14 CONT. SHEET 14A

8	DRAWING NUMBER	TITLE	START DATE PERIOD ACTUAL	STOP DATE PERIOD ACTUAL	ISSUED FOR (CONST) UNIT	DATE ISSUED										REMARKS * DESIGNATES PRINCIPAL DRAWING
						REV. 1	REV. 2	REV. 3	REV. 4	REV. 5	REV. 6	REV. 7	REV. 8	REV. 9	REV. 10	
		TURBINE BUILDING														
14-C	▽ C-326	FLOOR PLAN - EL 269'-0" AREA 3	10-1-70	12-1-71	—	11/1/70	2/27/70	4/1/70	9/10/70	1/24/71	4/27/71	1/7/72	3/2/72	8/2/72	8/2/72	
	▽ C-327	" " " " AREA 4	3-1-71	5-1-72	—	12/1/70	1/1/71	9/24/71	9/10/71	1/11/72	4/27/72	1/7/73	3/2/73	8/2/73	8/2/73	
	▽ C-328	FLOOR PLAN - EL 269'-0" AREA 3	3-1-71	5-1-72	—	12/1/70	1/1/71	9/24/71	9/10/71	1/11/72	4/27/72	1/7/73	3/2/73	8/2/73	8/2/73	
	C-329		4-19-71													
	C-330															
	▽ C-331	WALL ELEVATION @ COL. LINE 8 AREA 1	2-11-71		—	7/1/71	11/21/71	3/9/72	3/9/72	11/24/72	3/9/73	11/10/73	5/9/74	5/9/74	5/9/74	
	▽ C-332	" " " " " 18 AREA 2	3-11-71		—	11/21/71	4/9/72	3/9/72	11/24/72	3/9/73	11/10/73	5/9/74	5/9/74	5/9/74	5/9/74	
	▽ C-333	" " " " " 28 AREA 4	4-11-71		—	11/21/71	4/9/72	3/9/72	11/24/72	3/9/73	11/10/73	5/9/74	5/9/74	5/9/74	5/9/74	
	▽ C-334	WALL ELEVATION @ COL. LINE 38, AREA 392 & Q 3	4-11-71		—	11/21/71	4/9/72	3/9/72	11/24/72	3/9/73	11/10/73	5/9/74	5/9/74	5/9/74	5/9/74	
	▽ C-335	WALL ELEVATION @ COL. LINES R & N AREA 1	3-12-71		—	11/21/71	4/9/72	3/9/72	11/24/72	3/9/73	11/10/73	5/9/74	5/9/74	5/9/74	5/9/74	
	▽ C-336	" " " " " AREA 2	3-12-71		—	11/21/71	4/9/72	3/9/72	11/24/72	3/9/73	11/10/73	5/9/74	5/9/74	5/9/74	5/9/74	
	▽ C-337	" " " " " AREA 3	11-16-71		—	11/21/71	4/9/72	3/9/72	11/24/72	3/9/73	11/10/73	5/9/74	5/9/74	5/9/74	5/9/74	
	▽ C-338	" " " " " AREA 4	5-7-72		—	12/2/72	8/10/72	11/24/72	1/20/73	7/24/73	8/1/73	11/1/73	7/15/74	7/15/74	7/15/74	
	▽ C-339	WALL ELEVATION @ COLS. R & N AREA 5	11-17-71		—	12/2/72	8/10/72	11/24/72	1/20/73	7/24/73	8/1/73	11/1/73	7/15/74	7/15/74	7/15/74	
	▽ C-340	FOUNDATIONS & WALL ELEVATION UNITS 1 & 2 FLOOR PLAN AT ELEV. 225'-0"	11-17-71		—	12/2/72	8/10/72	11/24/72	1/20/73	7/24/73	8/1/73	11/1/73	7/15/74	7/15/74	7/15/74	
		TURBINE BUILDING														
		TURBINE GENERATOR PEDESTAL														
	▽ C-341	FOUNDATION PLAN & SECTIONS UNIT No. 1	6-1-70	10-1-70	—	7/1/70	10/1/70	12/1/70	8/1/71	12/1/71	5/1/72	10/1/72	7/29/72	10/1/72	10/1/72	
	▽ C-342	FOUNDATION PLAN & SECTIONS UNIT No. 2	1-1-70	4-1-71	—	7/1/70	5/19/71	1/30/72	4/10/72	2/1/73						
	▽ C-343	ELEVATIONS UNIT No. 1	6-1-70	10-1-70	—	7/1/70	10/1/70	12/1/70	8/1/71	12/1/71	5/1/72	10/1/72	7/29/72	10/1/72	10/1/72	
	▽ C-344	ELEVATIONS UNIT No. 2	11-1-70	4-1-71	—	7/1/70	10/1/70	12/1/70	8/1/71	12/1/71	5/1/72	10/1/72	7/29/72	10/1/72	10/1/72	
	▽ C-345	TYPICAL CROSS SECTIONS UNIT No. 1	6-1-70	10-1-70	—	7/1/70	10/1/70	12/1/70	8/1/71	12/1/71	5/1/72	10/1/72	7/29/72	10/1/72	10/1/72	
	▽ C-346	TYPICAL CROSS SECTIONS UNIT No. 2	11-1-70	4-1-71	—	7/1/70	10/1/70	12/1/70	8/1/71	12/1/71	5/1/72	10/1/72	7/29/72	10/1/72	10/1/72	
	▽ C-347	ANCHOR BOLT PLAN UNIT No. 1	6-1-70	10-1-70	—	7/1/70	10/1/70	12/1/70	8/1/71	12/1/71	5/1/72	10/1/72	7/29/72	10/1/72	10/1/72	
	▽ C-348	ANCHOR BOLT PLAN UNIT No. 2	11-1-70	4-1-71	—	7/1/70	10/1/70	12/1/70	8/1/71	12/1/71	5/1/72	10/1/72	7/29/72	10/1/72	10/1/72	
	▽ C-349	ANCHOR BOLT SCHEDULE & DETAILS UNIT No. 1 & 2	6-1-70	10-1-70	—	7/1/70	10/1/70	12/1/70	8/1/71	12/1/71	5/1/72	10/1/72	7/29/72	10/1/72	10/1/72	
	C-350															

LEGEND

— DRAWING STARTED

▽ ISSUED FOR APPROVAL

▽ ISSUED FOR CONST

PROGRESS LAST PERIOD

PROGRESS THIS PERIOD

ISSUED FOR A APPROVAL

C CONSTRUCTION P PURCHASE

DRAWING CONTROL

BECHTEL

SAN FRANCISCO

POWER
AND
INDUSTRIAL
DIVISIONCIVIL
ENGINEERING
DEPT.

JOB NO. 8021 PERIOD ENDING

JOB LIMERICK GENERATING STATION

SHEET 16 OF 16 SHEETS

DRAWING NUMBER	TITLE	START DATE REV. 1 TOP REV. 2 BOTTOM	COMP. DATE REV. 1 TOP REV. 2 BOTTOM	ISSUED FOR (DATE)	DATE ISSUED												REMARKS * DESIGNATES PRINCIPAL DRAWING
					REV. 1	REV. 2	REV. 3	REV. 4	REV. 5	REV. 6	REV. 7	REV. 8	REV. 9	REV. 10	REV. 11	REV. 12	
	TURBINE BUILDING																
	STRUCTURAL STEEL																
✓ C-376	COLUMN SCHEDULE UNIT NO. 111	8-1-70	4-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-377	BASE PLATE DETAILS UNIT NO. 1 & 2	8-1-70	4-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-378	FRAMING PLAN EL. 239' 0" AREAS 1 & 2	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-379	" " " " AREA 3	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-380	FRAMING PLAN ELEV'S. 217' 0" THRU 254' 0" AREAS 4 & 5	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-381	MISC. STEEL SHIELDING PLATES AREAS 1, 3, 6, 10	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-382	FRAMING DETAILS EL. 239' & 269' AREA 3	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-383	STRUCTURAL STEEL CRANE GIRDER AT EL. 231' 6"	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-384	FRAMING PLAN EL. 269' 0" AREAS 1 & 2	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-385	" " " " AREA 3	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-386	FRAMING PLAN EL. 269' 0" AREAS 4 & 5	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-387	PANCL SUPPORT FRAMING EL. 284' 0" UNIT 1 & 2	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
C-388																	
✓ C-389	CRANE GIRDER - PLAN & DETAILS	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-390	" " - DETAILS & SECTIONS	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-391	CRANE GIRDER - DETAILS & SECTIONS	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-392	ROOF FRAMING PLAN AREAS 1 & 2	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-393	" " " " AREA 3	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-394	ROOF FRAMING PLAN AREAS 4 & 5	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-395	STEAM FLOOD VENTING AREAS 2 & 4 UNITS 1 & 2	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-396	RIGID FRAME COLUMN & BEAM DETAILS UNIT NO. 1 & 2	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-397	FRAMING ELEVATIONS UNIT NO. 1 & 2	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-398	STEAM FLOOD VENTING - SECTS. & DETS.	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
✓ C-399	STEAM EVAPORATOR SEAL COVER	7-1-70	8-2-71	—	2/10/71	3/2/71	4/3/71	4/21/71	2/10/71	1/24/71	2/15/71	2/19/71	4/1/71				
C-400																	

LEGEND
 — DRAWING STARTED
 ▽ ISSUED FOR APPROVAL
 ▽ ISSUED FOR CONST

PROGRESS LAST PERIOD
 PROGRESS THIS PERIOD
 ISSUED FOR A APPROVAL
 C CONSTRUCTION P PURCHASE

DRAWING CONTROL

BECHTEL
 SAN FRANCISCO

POWER
 AND
 INDUSTRIAL
 DIVISION



CIVIL
 ENGINEERING
 DEPT

XIB NO 8031 PERIOD ENDING
 XIB LIMERICK GENERATING STATION
 CONT. SHEET 17A
 SHEET 17 OF SHEETS

NO	DRAWING NUMBER	TITLE	START DATE		1/20 FOR 1 DAY DATE	DATE ISSUED										REMARKS
			NO	1/20		REV	REV	REV	REV	REV	REV	REV	REV	REV	REV	
	15	TURBINE AUXILIARY BAY														
▽	C-401	FOUNDATIONS - MAT PLAN - AREA 6	6-1-70	12-19-70	—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-402	" " " AREA 7	6-1-70	12-19-70	—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-403	CONTROL ROOM AREA FOUNDATIONS " " AREA 8	6-1-70	12-19-70	—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-404	FOUNDATIONS " " AREA 9	12-1-70	4-5-71	—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-405	FOUNDATIONS - MAT PLAN - AREA 10	12-1-70	4-5-71	—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-406	FOUNDATIONS - FOUND. ELEV. - AREA 6	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-407	FOUNDATIONS - WALL ELEVATIONS - AREA 6	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-408	" " " AREA 7	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-409	CONTROL ROOM AREA FOUNDATIONS " " AREA 8	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-410	FOUNDATIONS " " AREA 9	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-411	FOUNDATIONS - WALL ELEVATIONS - AREA 10	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-412	CONTROL ROOM AREA FLOOR PLAN - EL. 200'-0" AREA 8	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-413	FOUNDATIONS - MAT & WALL DETAILS UNIT NOS 1 & 2	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-414	FOUNDATIONS - FOUND. ELEV. - AREA 7	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-415	FLOOR PLAN - EL. 217'-0" AREA 6	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-416	" " " " AREA 7	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-417	CONTROL ROOM AREA FLOOR PLAN " " AREA 8	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-418	FLOOR PLAN " " AREA 9	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-419	FLOOR PLAN - EL. 217'-0" AREA 10	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-420	REINFORCED CONCRETE SECTIONS & DETAILS UNIT NOS 1 & 2	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-421	TURBINE BUILDING - CONCRETE & REINFORCING SECTIONS UNIT NOS 1 & 2	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-422	TURBINE BUILDING - CONCRETE & REINFORCING SECTIONS UNIT NOS 1 & 2	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-423	HATCH PLUG DETAILS UNIT NOS 1 & 2	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-424	FLOOR PLAN - EL. 239'-0" AREA 6	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	
▽	C-425	FLOOR PLAN - EL. 239'-0" AREA 7	1-8-71		—	1/4/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	1/21/71	

LEGEND
 — DRAWING STARTED
 ▽ ISSUED FOR APPROVAL
 ▽ ISSUED FOR CONST

PROGRESS LAST PERIOD
 PROGRESS THIS PERIOD
 ISSUED FOR APPROVAL
 C CONSTRUCTION P PURCHASE

DRAWING CONTROL

BECHTEL
 SAN FRANCISCO

POWER
 AND
 INDUSTRIAL
 DIVISION



CIVIL
 ENGINEERING
 DEPT.

KIB NO 8021 PERIOD ENDING
 J78 LIMERICK GENERATING STATION
 SHEET 18 OF SHEETS

NO	DRAWING NUMBER	TITLE	START DATE REV. TIME REVISION	CLAMP DATE REV. TIME REVISION	REV. D FOR (1845) DATE	DATE ISSUED										REMARKS * DESIGNATES PRINCIPAL DRAWING
						REV. 1	REV. 2	REV. 3	REV. 4	REV. 5	REV. 6	REV. 7	REV. 8	REV. 9	REV. 10	
		TURBINE AUXILIARY BAY														
C	✓	C-426 CONTROL ROOM AREA FLOOR PLAN EL. 239'-0" AREA 8	10-1-70	10-1-71	—	1/30/71	2/3/71	2/10/71	2/17/71	2/24/71	3/1/71	3/8/71	3/15/71	3/22/71	3/29/71	4/5/71
C	✓	C-427 FLOOR PLAN " " AREA 9	4-1-71	4-1-71	—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
C	✓	C-428 FLOOR PLAN EL. 239'-0" AREA 10	4-1-71	4-1-71	—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
C	✓	C-429 TURBINE BUILDING- SECTIONS & DETAILS UNIT NO. 112	8-15-70		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
		C-430														
	▽	C-431 CONTROL ROOM - ELECTRICAL EMBED LOCATION PLAN AT EL. 254'-0" AREA 8	5-17-70		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-432 CONTROL ROOM AREA FLOOR PLAN EL. 254'-0" AREA 8	5-10-71		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-433 FLOOR PLAN EL. 269'-0" AREA 6	5-24-71		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-434 " " " " AREA 7	5-24-71		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-435 CONTROL ROOM AREA FLOOR PLAN " " AREA 8	10-3-70		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-436 " " " " AREA 9	10-3-70		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-437 " " " " AREA 10	10-3-70		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-438 " " " " AREA 10	10-3-70		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-439 " " " " AREA 10	10-3-70		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-440 CONTROL ROOM AREA - SECTIONS & DETAILS AREA 8	5-20-74		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-441 FLOOR PLAN EL. 289'-0" AREA 8	5-20-71		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-442 FLOOR PLAN EL. 301'-0" AREA 6	4-18-71		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-443 FLOOR PLAN EL. 302'-0" AREA 7	4-18-71		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-444 CONTROL ROOM AREA FLOOR PLAN EL. 304'-0" AREA 8	10-7-70		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-445 FLOOR PLAN EL. 302'-0" AREA 9	5-2-71		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-446 FLOOR PLAN EL. 302'-0" AREA 10	5-6-71		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
	▽	C-447 CONTROL ROOM AREA MAIN STEAM LINE ANCHOR BOLT ARRGT.	8-15-70		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
		C-448														
C	✓	C-449 CONTROL ROOM AREA FLOOR PLAN EL. 332'-0" AREA 8	5-18-71		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71
C	✓	C-450 FLOOR PLAN EL. 299'-0" & 285'-0" AREA 6	4-7-71		—	1/24/71	2/1/71	2/8/71	2/15/71	2/22/71	2/29/71	3/6/71	3/13/71	3/20/71	3/27/71	4/3/71

LEGEND

— DRAWING STARTED
 ▽ ISSUED FOR APPROVAL
 ▽ ISSUED FOR CONST

PROGRESS LAST PERIOD
 PROGRESS THIS PERIOD
 ISSUED FOR A APPROVAL 0 QUOTATION
 C CONSTRUCTION P PURCHASE

DRAWING CONTROL

BECHTEL
 SAN FRANCISCO

POWER
 AND
 INDUSTRIAL
 DIVISION



CIVIL
 ENGINEERING
 DEPT

XIB NO 8031 PERIOD ENDING
 XIB LINERICK GENERATING STATION
 SHEET 10 OF 19 SHEETS
 CONT SHEET 10A

DRAWING NUMBER	TITLE	START DATE	COMP DATE	FOUR D PUR (ON) DATE	DATE ISSUED								REMARKS				
		24H 1700 ACTUAL	24H 1700 ACTUAL		REV 0	REV 1	REV 2	REV 3	REV 4	REV 5	REV 6	REV 7		REV 8	* DESIGNATES PRINCIPAL DRAWING		
	TURBINE AUXILIARY BAY																
▽ C-451	FLOOR PLANS - EL. 255'-3" & 285'-3" AREA 7	4-8-71			4/20/71	4/24/71	4/24/71	4/24/71	4/24/71	4/24/71	4/24/71	4/24/71	4/24/71	4/24/71			
▽ C-452	FLOOR PLANS - EL. 255'-3" & 285'-3" AREA 9	5-1-71			5/1/71	5/1/71	5/1/71	5/1/71	5/1/71	5/1/71	5/1/71	5/1/71	5/1/71	5/1/71			
▽ C-453	FLOOR PLANS - EL. 255'-3" & 285'-3" AREA 10	5-1-71			5/1/71	5/1/71	5/1/71	5/1/71	5/1/71	5/1/71	5/1/71	5/1/71	5/1/71	5/1/71			
▽ C-454	CONTROL ROOM PARTIAL FLOOR PLAN AT ELEV 350'-0" AREA 8	9-1-76			1/1/77	1/1/77	1/1/77	1/1/77	1/1/77	1/1/77	1/1/77	1/1/77	1/1/77	1/1/77			
▽ C-455	CONTROL ROOM ROOF PLAN & SECTIONS AREA 8	5-26-71			5/26/71	5/26/71	5/26/71	5/26/71	5/26/71	5/26/71	5/26/71	5/26/71	5/26/71	5/26/71			
▽ C-456	CONTROL RM EXT WALLS (ELEV. - EL. 217'-0" - EL. 234'-0" COL LINES MH. 19.4 & 26.6 AR. 8	9-1-76			9/1/76	9/1/76	9/1/76	9/1/76	9/1/76	9/1/76	9/1/76	9/1/76	9/1/76	9/1/76			
▽ C-457	CONTROL RM EXT WALLS (EL. 217'-0" - EL. 289'-0" COL LINES MH. 19.4 & 26.6 AR. 8	10-5-78			10/5/78	10/5/78	10/5/78	10/5/78	10/5/78	10/5/78	10/5/78	10/5/78	10/5/78	10/5/78			
▽ C-458	CONTROL ROOM EXT. WALLS ELEV. 289'-0" THRU 332'-0" COL LINES MH. 19.4 & 26.6 AREA 8	12-1-74	1-9-75		12/1/74	1/9/75	1/9/75	1/9/75	1/9/75	1/9/75	1/9/75	1/9/75	1/9/75	1/9/75			
▽ C-459	CONTROL ROOM EXT WALLS EL. 332'-0" TO ROOF COL LINES MH. 19.4 & 26.6 AREA 8	1-20-75			1/20/75	1/20/75	1/20/75	1/20/75	1/20/75	1/20/75	1/20/75	1/20/75	1/20/75	1/20/75			
	TURBINE AUXILIARY BAY																
	STRUCTURAL STEEL																
▽ C-460	COLUMN SCHEDULE UNIT NOS. 1 & 2	4-1-70	8-7-71		4/1/70	4/1/70	4/1/70	4/1/70	4/1/70	4/1/70	4/1/70	4/1/70	4/1/70	4/1/70			
▽ C-461	BASE PLATE DETAILS UNIT NOS. 1 & 2	11-15-70	8-1-71		11/15/70	11/15/70	11/15/70	11/15/70	11/15/70	11/15/70	11/15/70	11/15/70	11/15/70	11/15/70			
▽ C-462	FRAMING PLAN EL. 200'-0" & EL. 217'-0" AREAS 6 & 7	1-1-70	8-1-71		1/1/70	1/1/70	1/1/70	1/1/70	1/1/70	1/1/70	1/1/70	1/1/70	1/1/70	1/1/70			
▽ C-463	CONTROL ROOM FRAMING PLAN - EL. 200'-0" & 217'-0" AREA 8	4-1-70	8-1-71		4/1/70	4/1/70	4/1/70	4/1/70	4/1/70	4/1/70	4/1/70	4/1/70	4/1/70	4/1/70			
▽ C-464	FRAMING PLAN - EL. 217'-0" AREAS 9 & 10	11-1-70	2-1-72		11/1/70	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72			
▽ C-465	CONTROL ROOM FRAMING PLAN & DETAILS AREA 8	3-2-73			3/2/73	3/2/73	3/2/73	3/2/73	3/2/73	3/2/73	3/2/73	3/2/73	3/2/73	3/2/73			
▽ C-466	MAIN STEAM LINE BLOW OUT PANEL SUPPORTS UNITS 1 & 2																
▽ C-467	FRAMING PLAN - EL. 231'-3" & EL. 239'-0" AREAS 6 & 7	1-1-71	8-1-71		1/1/71	1/1/71	1/1/71	1/1/71	1/1/71	1/1/71	1/1/71	1/1/71	1/1/71	1/1/71			
▽ C-468	CONTROL ROOM FRAMING PLAN - EL. 239'-0" AREA 8	10-1-70	8-1-71		10/1/70	10/1/70	10/1/70	10/1/70	10/1/70	10/1/70	10/1/70	10/1/70	10/1/70	10/1/70			
▽ C-469	FRAMING PLAN - EL. 231'-3" & EL. 239'-0" AREAS 9 & 10	8-1-71	2-1-72		8/1/71	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72			
▽ C-470	FRAMING PLAN - EL. 235'-3" & EL. 285'-3" AREAS 6 & 7	2-10-71			2/10/71	2/10/71	2/10/71	2/10/71	2/10/71	2/10/71	2/10/71	2/10/71	2/10/71	2/10/71			
▽ C-471	FRAMING PLAN - EL. 233'-3" & EL. 285'-3" AREAS 9 & 10	8-7-71			8/7/71	8/7/71	8/7/71	8/7/71	8/7/71	8/7/71	8/7/71	8/7/71	8/7/71	8/7/71			
▽ C-472	FRAMING PLAN - EL. 269'-0" AREAS 6 & 7	2-1-72	8-7-71		2/1/72	8/7/71	8/7/71	8/7/71	8/7/71	8/7/71	8/7/71	8/7/71	8/7/71	8/7/71			
▽ C-473	CONTROL ROOM FRAMING PLAN - EL. 254'-0" & 269'-0" AREA 8	10-1-70	8-1-71		10/1/70	10/1/70	10/1/70	10/1/70	10/1/70	10/1/70	10/1/70	10/1/70	10/1/70	10/1/70			
▽ C-474	FRAMING PLAN - EL. 269'-0" AREAS 9 & 10	4-1-71	2-1-72		4/1/71	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72	2/1/72			
▽ C-475	MISC STEEL SHIELD EL. 217'-0" UNITS AREAS 7 & 9	1-6-71			1/6/71	1/6/71	1/6/71	1/6/71	1/6/71	1/6/71	1/6/71	1/6/71	1/6/71	1/6/71			

LEGEND			DRAWING CONTROL			POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT		JOB NO. 8021 PERIOD ENDING								
DRAWING STARTED ISSUED FOR APPROVAL ISSUED FOR CONST.			PROGRESS LAST PERIOD PROGRESS THIS PERIOD ISSUED FOR A. APPROVAL C. CONSTRUCTION P. PURCHASE			BECHTEL SAN FRANCISCO		BECHTEL CIVIL ENGINEERING DEPT		JOB LIMBRICK GENERATING STATION SHEET 20 OF 20 SHEETS								
8	DRAWING NUMBER	TITLE	START DATE	COMP. DATE	SHEET NO. (OF TOTAL)	DATE ISSUED												REMARKS * DESIGNATES PRINCIPAL DRAWING
			1948	1949		REV. 1	REV. 2	REV. 3	REV. 4	REV. 5	REV. 6	REV. 7	REV. 8	REV. 9	REV. 10			
		TURBINE AUXILIARY BAY																
		STRUCTURAL STEEL																
	C-476																	
SV	C-477	FRAMING PLAN-EL. 302'-0" AREAS 6 & 7	8-1-78	8-1-78		1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
SV	C-478	CONTROL ROOM AREA-EL. 289'-0" & 304'-0" AREA 8	11-1-78	8-1-78		1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
SV	C-479	FRAMING PLAN-EL. 302'-0" AREAS 9 & 10	8-1-78	8-1-78		1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-480	CONTROL ROOM AREA 8 STRUCTURAL STEEL - PARTIAL FRAMING PLAN EL. 290'-0"	8-1-78			1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-481	CONTROL ROOM AREA 8 PARTIAL FRAMING PLAN AT EL. 290'-0" SECT'S & DET'S	8-1-78			1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-482	CONTROL ROOM FRAMING PLAN - EL. 332'-0" & EL. 350'-0" AREA 8	11-1-78	8-1-78		1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-483	ROOF FRAMING AREAS 6 & 7	8-1-78	8-1-78		1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-484	CONTROL ROOM ROOF FRAMING - AREA 8	11-1-78	8-1-78		1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-485	ROOF FRAMING PLAN AREAS 9 & 10	8-1-78	8-1-78		1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-486																	
	C-487																	
	C-488	MAIN STEAM PIPE RESTRAINTS PLAN SECTIONS & DETAILS UNITS 1 & 2	9-28-76			1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-489	MAIN STEAM PIPE RESTRAINTS SECTIONS & DETAILS UNITS 1 & 2	9-28-76			1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-490																	
SV	C-491	FRAMING ELEVATIONS UNIT NO. 1 & 2	8-1-78			1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-492																	
	C-493																	
SV	C-494	CONTROL ROOM RECONNAISSANCE AREA SHIELDING PLAN AT EL. 190'-0"	2-10-77	5/15/80		1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-495	CONTROL ROOM AREA 8 MISC. STEEL HATCH COVERS - SECT'S & DET'S	8-1-78			1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-496	CONTROL ROOM AREA 8 HVAC AIRTIGHT DUCT PLAN, SECT'S & DETAILS	8-1-78			1/8/78	1/14/78	1/21/78	1/28/78	2/4/78	2/11/78	2/18/78	2/25/78	3/4/78	3/11/78	3/18/78		
	C-497																	
	C-498																	
	C-499																	
	C-500																	

476
500

ISSUED FOR CONST

ISSUED FOR A APPROVAL

ISSUED FOR	A	APPROVAL	Q	QUOTATION
	C	CONSTRUCTION	P	PURCHASE

SAN FRANCISCO

POWER
AND
INDUSTRIAL
DIVISION

CIVIL
ENGINEERING
DEPT

25 CONT. SWEET 25A

SHEET 25 OF SHEET 2

DRAWING NUMBER	TITLE	START DATE		FIXED FOR (DATE)	DATE ISSUED								REMARKS * DESIGNATES PRINCIPAL DRAWING	
		REV. 1 DATE	REV. 2 DATE		REV. 1 DATE	REV. 2 DATE	REV. 3 DATE	REV. 4 DATE	REV. 5 DATE	REV. 6 DATE				
	PROJECT CIVIL STANDARDS													
1	C-601	TYPICAL REINFORCING AND CONCRETE DETAILS	6-15-74	8-1-74	—	1/10/74	1/2/74	1/17/74	1/29/74	2/10/74	2/27/74	3/14/74	3/28/74	IV
2	C-602	REACTOR BUILDING CONCRETE & REINFORCING DETAILS	2-24-75		—	1/10/74	1/21/74	1/29/74	2/10/74	2/27/74	3/14/74	3/28/74	IV	
5-C	C-603	TYPICAL CONCRETE EMBEDMENT DETAILS	2-1-74	2-1-74	—	1/29/74	1/30/74	2/17/74	2/27/74	3/11/74	3/16/74	3/20/74	IV	
6	C-604	TYPICAL CONCRETE EMBEDMENT & MISCELLANEOUS DETS	3-1-74		—	2/27/74	3/10/74	3/20/74	3/27/74	4/10/74	4/27/74	5/11/74	IV	
7	C-605	TYPICAL CONCRETE MASONRY WALL DETAILS	1-1-74	2-1-74	—	3/10/74	3/27/74	4/10/74	4/27/74	5/11/74	5/27/74	6/10/74	IV	
8	C-606	TYPICAL STEEL FLOOR DECKING SUPPORT DETAILS	6-24-74		—	4/10/74	4/27/74	5/11/74	5/27/74	6/10/74	6/27/74	7/11/74	IV	
9	C-607	TYPICAL CONCRETE DETS. HATCH & RUG DETAILS	3-16-74		—	5/11/74	5/27/74	6/10/74	6/27/74	7/11/74	7/27/74	8/10/74	IV	
10	C-608	TYPICAL CONCRETE MASONRY WALL DETAILS	11-16-74		—	7/11/74	7/27/74	8/10/74	8/27/74	9/10/74	9/27/74	10/11/74	IV	
11	C-609	TYPICAL BEAM SUPPORTS-INSBOLT DETAILS	5-24-74		—	8/10/74	8/27/74	9/10/74	9/27/74	10/11/74	10/27/74	11/10/74	IV	
12	C-610	ATTACHMENT TO CONC. MASONRY WALLS	2-27-74	3-6-74	—	10/11/74	10/27/74	11/10/74	11/27/74	12/10/74	12/27/74	1/10/75	IV	
13	C-611	BUILDING FOUNDATIONS MISCELLANEOUS EMBEDDED ITEMS	9-14-74		—	1/10/75	1/21/75	1/29/75	2/10/75	2/27/75	3/14/75	3/28/75	IV	
14	C-612	TEMPORARY BLOCKOUT SEALING DETAILS & SECTIONS	11-10-74		—	3/28/75	4/10/75	4/27/75	5/11/75	5/27/75	6/10/75	6/27/75	IV	
15	C-613	PROJECT CIVIL STANDARDS TYP. CONC. EMBEDMENT DETAILS			—	6/27/75	7/11/75	7/27/75	8/10/75	8/27/75	9/10/75	9/27/75	IV	
16	C-614	TYPICAL CONCRETE MASONRY WALL DETAILS	2-3-72		—	9/27/75	10/11/75	10/27/75	11/10/75	11/27/75	12/10/75	12/27/75	IV	
17	C-615	STANDARD ANCHOR BOLTS SCHEDULE AND DETAILS	10-13-74		—	1/10/76	1/21/76	1/29/76	2/10/76	2/27/76	3/14/76	3/28/76	IV	
18	C-616	CLASS I SEISMIC HVAC DUCTS - WALL & FLOOR PENETRATIONS - STAND. DET'S.	4-1-74		—	3/28/76	4/10/76	4/27/76	5/11/76	5/27/76	6/10/76	6/27/76	IV	
19	C-617	CLASS I SEISMIC HVAC DUCTS - WALL & FLOOR PENETRATIONS - STAND. DET'S.	10-13-74		—	6/27/76	7/11/76	7/27/76	8/10/76	8/27/76	9/10/76	9/27/76	IV	
20	C-618	CLASS I SEISMIC HVAC DUCTS - WALL & FLOOR PENETRATIONS - STAND. DET'S.	2-10-74		—	9/27/76	10/11/76	10/27/76	11/10/76	11/27/76	12/10/76	12/27/76	IV	
21	C-619				—	1/10/77	1/21/77	1/29/77	2/10/77	2/27/77	3/14/77	3/28/77	IV	
22	C-620	REACTOR BUILDING TOWER CRANE FOUNDATION NO. 2	11-1-74		—	3/28/77	4/10/77	4/27/77	5/11/77	5/27/77	6/10/77	6/27/77	IV	
23	C-621	REACTOR BUILDING - HYDRAULIC PEDESTAL CRANE - SUPPORT STRUCT 1 & 2	1-24-73		—	6/27/77	7/11/77	7/27/77	8/10/77	8/27/77	9/10/77	9/27/77	IV	
24	C-622	RADWASTE BUILDING TOWER CRANE FOUNDATION NO. 1	6-23-72		—	9/27/77	10/11/77	10/27/77	11/10/77	11/27/77	12/10/77	12/27/77	IV	
25	C-623	ADMINISTRATION & WAREHOUSE BLDG. TOWER CRANE FOUNDATION NO. 3	6-20-73		—	1/10/78	1/21/78	1/29/78	2/10/78	2/27/78	3/14/78	3/28/78	IV	
26	C-624				—	3/28/78	4/10/78	4/27/78	5/11/78	5/27/78	6/10/78	6/27/78	IV	
27	C-625				—	6/27/78	7/11/78	7/27/78	8/10/78	8/27/78	9/10/78	9/27/78	IV	

LEGEND

— DRAWING STARTED
 ▽ ISSUED FOR APPROVAL
 ▽ ISSUED FOR CONSTRUCTION
 PROGRESS LAST PERIOD
 PROGRESS THIS PERIOD
 ISSUED FOR APPROVAL
 ISSUED FOR CONSTRUCTION
 PURCHASE
 BECHTEL
 SAN FRANCISCO

DRAWING CONTROL

BECHTEL
 SAN FRANCISCO

POWER
 AND
 INDUSTRIAL
 DIVISION



CIVIL
 ENGINEERING
 DEPT

SHEET NO. 27 OF 27 SHEETS
 PERIOD ENDING
 LIMEHURST GENERATING STATION
 SHEET 27A

DRAWING NUMBER	TITLE	START DATE	ISSUED FOR	DATE ISSUED	REMARKS
C-651	PRIMARY CONTAINMENT STRUCTURAL INSTRUMENTATION INSTALLATION			4/22/71	
C-652	PRIMARY CONTAINMENT STRAIN GAGE STRUCTURAL INSTRUMENTATION - PLACEMENT			4/23/71	
C-653	CABLE TRAYS & JUNCTION BOXES FOR STRUCT. INSTRUMENTATION			4/23/71	
C-654	JUNCTION BOX FOR STRAIN GAGE INSTRUMENTATION			4/23/71	
C-655					
	DIESEL GENERATOR BUILDING				
C-656	FOUNDATION PLAN AT ELEV 217'-0" UNITS 1&2	7-9-76		4/24/71	
C-657	PIPE TUNNEL UNIT FOUNDATION PLANS AT EL. 217'-0" & EL 217'-0"	7-9-76		4/24/71	
C-658	PIPE TUNNEL UNIT 1 WALL ELEVATIONS	7-9-76		4/24/71	
C-659	PIPE TUNNEL UNIT 1 & 2 SECTIONS & DETAILS	7-9-76		4/24/71	
C-660	CONCRETE ROOF PLAN UNITS 1&2	7-9-76		4/24/71	
C-661	WALL ELEVATIONS (C) & (D) UNIT 1	7-9-76		4/24/71	
C-662	WALL ELEVATIONS (B) (17) (18) (20) & SECTIONS	7-9-76		4/24/71	
C-663	WALL ELEVATIONS (21) (22) (23) & (B) UNIT 1	7-9-76		4/24/71	
C-664	EQUIPMENT FOUNDATION SECTS & DETS UNITS 1&2	7-9-76		4/24/71	
C-665	PIPE TUNNEL UNIT 1&2 FRAMING PLAN & SECTS AT ELEV 217'-0"	7-9-76		4/24/71	
C-666	STRUCTURAL STEEL UNITS 1&2 COLUMN SCHEDULE AND BASE R. DETAILS	7-9-76		4/24/71	
C-667	STRUCTURAL STEEL ROOF FRAMING PLAN UNITS 1&2	7-9-76		4/24/71	
C-668	CRANE GIRDER UNITS 1&2 PLAN, SECTIONS, & DETAILS	7-9-76		4/24/71	
C-669	PLATFORMS AT ELEV 217'-0" UNITS 1&2	7-9-76		4/24/71	
C-670	REACTOR BUILDING FLOOR PLAN AT ELEV 225'-0" SECTIONS & DETAILS	7-9-76		4/24/71	
C-671	PLATFORMS AT ELEV 225'-0", 233'-10" UNITS 1&2 SECTIONS & DETAILS	7-9-76		4/24/71	
C-672	BAFFLE PLATES UNITS 1&2 SECTIONS & DETAILS	7-9-76		4/24/71	
C-673					
C-674					
C-675					

LEGEND

— DRAWING, STARTED

ISSUED FOR APPROVAL

▽ USED FOR COST

PROGRESS LAST PERIOD

PROGRESS THIS PERIOD

ESRD FOR A APPROVAL

	C	CONSTRUCTION	P	PURCHASE
1	1	1	1	1
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1
5	1	1	1	1
6	1	1	1	1
7	1	1	1	1
8	1	1	1	1
9	1	1	1	1
10	1	1	1	1
11	1	1	1	1
12	1	1	1	1
13	1	1	1	1
14	1	1	1	1
15	1	1	1	1
16	1	1	1	1
17	1	1	1	1
18	1	1	1	1
19	1	1	1	1
20	1	1	1	1
21	1	1	1	1
22	1	1	1	1
23	1	1	1	1
24	1	1	1	1
25	1	1	1	1
26	1	1	1	1
27	1	1	1	1
28	1	1	1	1
29	1	1	1	1
30	1	1	1	1
31	1	1	1	1
32	1	1	1	1
33	1	1	1	1
34	1	1	1	1
35	1	1	1	1
36	1	1	1	1
37	1	1	1	1
38	1	1	1	1
39	1	1	1	1
40	1	1	1	1
41	1	1	1	1
42	1	1	1	1
43	1	1	1	1
44	1	1	1	1
45	1	1	1	1
46	1	1	1	1
47	1	1	1	1
48	1	1	1	1
49	1	1	1	1
50	1	1	1	1
51	1	1	1	1
52	1	1	1	1
53	1	1	1	1
54	1	1	1	1
55	1	1	1	1
56	1	1	1	1
57	1	1	1	1
58	1	1	1	1
59	1	1	1	1
60	1	1	1	1
61	1	1	1	1
62	1	1	1	1
63	1	1	1	1
64	1	1	1	1
65	1	1	1	1
66	1	1	1	1
67	1	1	1	1
68	1	1	1	1
69	1	1	1	1
70	1	1	1	1
71	1	1	1	1
72	1	1	1	1
73	1	1	1	1
74	1	1	1	1
75	1	1	1	1
76	1	1	1	1
77	1	1	1	1
78	1	1	1	1
79	1	1	1	1
80	1	1	1	1
81	1	1	1	1
82	1	1	1	1
83	1	1	1	1
84	1	1	1	1
85	1	1	1	1
86	1	1	1	1
87	1	1	1	1
88	1	1	1	1
89	1	1	1	1
90	1	1	1	1
91	1	1	1	1
92	1	1	1	1
93	1	1	1	1
94	1	1	1	1
95				

DRAWING CONTROL

BECHTEL

SAN FRANCISCO

PUBLIC
AND
INDUSTRIAL
DIVISION



CIVIL

ENGLISH & HISTORY
DEPT

$$h(H, N) = \frac{H(H+1)}{2} - PL(H, N) \text{ ENDING}$$
RHD LIMETICK GENERATING STATION

SHEET 38 OF 39 CONT. SHEET 28A

DRAWING NUMBER	21	TITLE	START DATE		STOP DATE		ISSUED DATE	DATE RECD										BY MARK'S
			DATE	TIME	DATE	TIME		NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6	NO. 7	NO. 8			
		DIESEL GENERATOR BLDG. (CONT)																
	C-676																	
▽	C-677	PIPE TUNNEL PLANS AT ELEV. 198' 0" & EL. 212' 0" UNIT 2			2-3-75			7/1/77	7/2/78	7/2/78								
▽	C-678	PIPE TUNNEL UNIT 2 WALL ELEVATIONS			2-3-75			7/1/77	7/10/77	7/17/78	8/11/78							
	C-679																	
▽	C-680	WALL ELEVATIONS (6) & (A) UNIT 2			4-6-77			4/11/77	7/10/78	7/12/78	7/12/78	11/2/80						
▽	C-681	WALL ELEVATIONS (24) & (26), (27), (29) UNIT 2			4-6-77			4/19/77	7/10/78	7/12/78								
▽	C-682	WALL ELEVATION (19) & 6 SECTIONS UNIT 2			4-6-77			4/11/77	7/1/78	7/14/78	5/3/79							
▽	C-683	HVAC AND ELECTRICAL EMBED LOCATIONS WALL ELEVATION COL. LINES 18.5 & 20			7-13-77			11/11/77	2/24/79									
▽	C-684	HVAC AND ELECTRICAL EMBED LOCATIONS WALL ELEVATION COL. LINES 22.5 & 29			7-13-77			11/11/77										
	C-685																	
	C-686																	
▽	C-687	PRECAST CONC. WALL PANELS TYPICAL CONNECTION DETAILS			3-7-77			3/11/77	8/11/77	7/2/78	7/8/80	2/6/81	7/8/81					
▽	C-688	PRECAST CONC. WALL PANELS TYPICAL CONNECTION DETAILS			11-9-76			3/10/77	8/11/77	6/7/78	6/10/80							
▽	C-689	PRECAST CONC. WALL PANELS REINFORCING DETAILS			11-4-76			9/10/77	3/12/78	8/11/78	7/2/79	4/9/79						
▽	C-690	SCHEDULE FOR SEISMIC PIPE RESTRAINT EMBEDS UNIT 1						10/24/78	2/2/79	1/10/79	2/19/79	1/21/79	10/20/79	3/3/79	8/11/79			
▽	C-691	" " " " UNIT 2			1-15-75			1/24/75	3/2/75	1/11/77								
▽	C-692	SCHEDULE FOR SEISMIC CABLE TRAY EMBEDS UNIT NO. 1						7/1/77	8/14/79	2/2/79	1/23/79	3/20/78	10/25/79	3/3/79	7/29/79			
▽	C-693	SCHEDULE FOR SEISMIC CABLE TRAY EMBEDS UNIT NO. 2			8-28-74			2/21/75	2/21/75	3/11/75	7/24/75	2/29/75	1/27/76	1/23/76	4/29/76			
▽	C-694	SCHEDULE FOR SEISMIC CABLE TRAY EMBEDS UNIT NO. 1						2/27/75	2/10/79	1/10/79	2/2/76	1/21/76	8/11/76	2/12/76				
▽	C-695	SCHEDULE FOR SEISMIC CABLE TRAY EMBEDS UNIT NO. 2			3-21-74			2/27/75	2/10/79	1/27/76	1/27/76	2/27/76	1/14/76	1/15/77				
▽	C-696	SCHEDULE FOR SEISMIC CABLE TRAY EMBEDS - CONTROL ROOM AREA B			10-17-75			1/27/75	1/10/76	1/21/76	2/1/76	8/19/76	1/11/76	3/1/77	7/1/77			
▽	C-697	SCHEDULE FOR SEISMIC HVAC WALL EMBEDS UNIT 1			2-3-74			2/1/74	10/2/74	2/4/75	2/10/75	10/2/75	1/20/76	3/23/76	3/3/76	4/28/76		
▽	C-698	CONTROL ROOM AREA B - SCHEDULE FOR SEISMIC HVAC BLAD & WALL EMBEDS			2-17-74			1/21/74	2/4/75	3/23/76	2/10/75	2/21/76	8/19/76	1/10/76	5/15/77	7/21/77		
▽	C-699	REACTOR BUILDING - SCHEDULE FOR SEISMIC HVAC WALL EMBEDS - UNIT 2			1-25-75			2/20/75	2/23/75	7/2/76	7/2/76	11/8/76	1/19/77	7/10/77	3/2/78	8/11/78		
▽	C-700	PLAN FOR BLDG. CONTROL ROOM & DIESEL BLDG. UNIT 6 SCH. FOR SEISMIC HVAC INSERTS & WALL EMBEDS UNIT 6			1-15-75			1/24/75	3/2/75	1/11/77	7/1/77	8/11/77	7/2/78	6/10/80	7/8/81	7/8/81		

LEGEND		PROGRESS LAST PERIOD		PROGRESS THIS PERIOD		ISSUED FOR A APPROVAL		ISSUED FOR O QUOTATION		ISSUED FOR C CONSTRUCTION		ISSUED FOR P PURCHASE		DRAWING CONTROL		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT		JOB NO. 8111 PERIOD ENDING 4-5-72		JOB LIMERICK GENERATING STATION		CONT. SHEET 31A		SHEET 31 OF 31 SHEETS	
DRAWING NUMBER		15		TITLE		START DATE		COMP. DATE		REVISION		DATE ISSUED		REMARKS													
				CONTROL ROOM AREA B																							
✓	C-751	FLOOR PLANS & SECTS - EL 183'-0" TO 211'-0" UNIT 1		3-26-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-752	FLOOR PLANS & SECTS - EL 239'-0" TO 366'-0" UNIT 1		3-30-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-753	FLOOR PLANS & SECTS - EL 183'-0" TO 253'-0" UNIT 2		3-30-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-754	WALL ELEVATION COLUMN LINE Kα SECTIONS AND DETAILS UNIT 1		10-1-72								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-755	FLOOR PLAN EL. 191'-0" WALL & FLR. SECTNS.		1-27-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-756	KEY PLANS - INTERIOR WALLS EL. 180'-0" TO 332'-0"		4-1-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-757	INTERIOR WALL ELEV'S. WALL NOS. 1 THRU 8		1-26-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-758	INTERIOR WALL ELEV'S. WALL NOS. 9 THRU 21		4-1-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-759	INTERIOR WALL ELEV'S. WALL NOS. 25 THRU 30, 33 & 36		6-30-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-760	INTERIOR WALL ELEV'S. WALL NOS. 31, 32, 34, 35, 37, 39, 41 THRU 49, 105 & 106		7-1-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-761	INTERIOR WALL ELEV'S. WALL NOS. 50 THRU 58, 98 THRU 101		6-30-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-762	INTERIOR WALL ELEV'S. WALL NOS. 59 THRU 67 & 107		7-1-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-763	INTERIOR WALL ELEV'S. WALL NOS. 68 THRU 75, 102 THRU 104		7-1-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-764	INTERIOR WALL ELEV'S. WALL NOS. 76 THRU 79, 82 & 83 MISSILE BARRIER WALLS		7-9-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-765	INTERIOR WALL ELEV'S. WALL NOS. 83 THRU 94, 97 & 98 91 & 98 MISSILE BARRIER WALL		7-16-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-766	INTERIOR WALL ELEV'S. WALL NOS. 106 THRU 119		8-21-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-767	INTERIOR WALL ELEV'S. WALL NOS. 120 THRU 126		8-21-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-768	INTERIOR WALL ELEV'S. WALL NOS. 95, 96, 99 & 100		10-9-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-769	FLOOR PLANS & SECTIONS UNIT 2 EL. 343'-0" TO ROOF		11-19-71								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
		REACTOR BUILDING																									
✓	C-770	POST-TENSIONED FUEL POOL GIRDERS CONSTRUCTION SEPARATIONS UNIT 1 & 2		8-30-72								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-771	REACTOR BUILDING UNIT 1 AND 2 NORTH FUEL POOL GIRDER - ELEVATIONS		9-1-72								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-772	REACTOR BUILDING UNIT 1 SOUTH FUEL POOL GIRDER - ELEVATIONS		9-1-72								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-773	POOL LINERS & ACCESSORIES - REACTOR WELL & SPENT FUEL POOL UNIT 1		9-6-72								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-774	STEAM DRYER & SEPARATOR STORAGE POOL SECTIONS UNIT 1		9-8-72								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	
✓	C-775	SPENT FUEL POOL - SECTIONS UNIT 1		9-12-72								10/1/71		5/8/72		12/1/72		2/1/73		6/1/73		2/1/74		7/29/74		10/1/74	

LEGEND

— DRAWING STARTED
 ▽ ISSUED FOR APPROVAL
 ▽ ISSUED FOR CONST

PROGRESS LAST PERIOD
 PROGRESS THIS PERIOD
 ISSUED FOR A APPROVAL U QUOTATION
 C CONSTRUCTION P PURCHASE

DRAWING CONTROL

BECHTEL
 SAN FRANCISCO

POWER
 AND
 INDUSTRIAL
 DIVISION



CIVIL
 ENGINEERING
 DEPT

XIB NO 8031 PERIOD ENDING
 XIB LIMERICK GENERATING STATION
 SHEET 32 OF 32 CONT SHEET 32A

DRAWING NUMBER	2D	TITLE	START DATE WKS 1700 ACTUAL	COMP DATE WKS 1700 AS ISSUED	ISSUED FOR DATE	DATE ISSUED												REMARKS * DESIGNATES PRINCIPAL DRAWING
						REV 0	REV 1	REV 2	REV 3	REV 4	REV 5	REV 6	REV 7	REV 8	REV 9	REV 10	REV 11	
		REACTOR BUILDING																
		C-776																
		C-777																
		▽ C-778	POOL LINERS & ACCESSORIES - REACTOR WELL & SPENT FUEL POOL UNIT 2	3-12-75		3/27/75	4/9/75	4/11/77	4/22/78	4/4/78	4/17/79	5/10/80	4/4/80					
		▽ C-779	REACTOR BLDG UNITS 1 & 2 POOL LINERS & ACCESSORIES INPL. SEAL NO.2.	12-8-75		3/27/75	4/14/81											
		C-780																
		▽ C-781	REACTOR BLDG UNITS 1 & 2 REFUELING POOL SEAL PLAN, SECT'S & DET'S.	12-12-74		3/27/75	4/14/75	7/27/78	7/20/80	8/3/80	7/21/80							
		▽ C-782	REACTOR BLDG UNITS 1 & 2 NEW FUEL STORAGE VAULT SECTIONS & DET'S.	11-20-74		4/17/75	4/17/78	4/10/78	4/25/78	7/5/79								
		▽ C-788	STRONGBACKS FOR PLUGS & STOP LOGS ASSEMBLIES, SECTIONS & DETAILS UNITS 1 & 2	6-22-75		7/10/75	4/14/78	4/14/80	3/27/81	5/1/81								
		▽ C-784	PLUGS & STOP LOGS REINFORCING SECTIONS & DETAILS	2-21-76		7/20/75	4/17/77	7/10/78	4/4/80	7/10/80	11/24/80	2/2/81						
		▽ C-785	STOP LOG DETAILS FOR ALIGNMENT UNITS 1 & 2	8-22-76		11/17/75	4/14/79	5/4/79										
		▽ C-786	STRONGBACKS FOR PLUGS & STOP LOGS ASSEMBLIES, DETAILS & PROCEDURES UNITS 1 & 2	5-20-76		7/10/75	4/14/76											
		▽ C-787	REFUELING HATCH COVER MISCELLANEOUS DETAILS	10-12-76		7/10/75	4/17/77	4/17/78	4/2/78	7/10/79	7/10/79	7/24/80	4/4/80					
		▽ C-788	HATCH PLUGS UNITS 1 & 2	6-12-76		4/17/75	4/17/75	4/17/77	4/2/78	7/10/80								
		▽ C-789	HATCH PLUG DETAILS CONTROL ROOM AREA B	5-4-75		4/17/75	4/20/75	4/17/77	7/5/80									
		▽ C-790	EMBED LOCATION FOR EXTERIOR WALL ELEV'S 14.1 & 31.9	10-12-76		4/17/75	4/10/76	3/27/77	7/10/77	4/9/77	7/10/78	5/20/79						
		PRECAST CONCRETE WALL PANELS																
		▽ C-791	REACTOR BLDG - REINFORCING DETAILS	7-3-72		4/14/76	7/29/76	7/27/75	7/27/76	11/21/76								
		▽ C-792	REACTOR BLDG - REINFORCING DETAILS	7-7-72		4/14/76	7/29/75	4/20/76	11/19/76	8/4/77								
		▽ C-793	REACTOR BLDG - REINFORCING DETAILS	7-11-72		4/14/76	7/29/75	4/20/76	11/19/76									
		▽ C-794	REACTOR BLDG. PANELS INSTALLED AFTER POST-TENSIONING - PLANS, SECTIONS & DET'S.	2-28-76		4/14/76	4/10/76	7/27/78										
		▽ C-795	REACTOR BUILDING - TYPICAL CONNECTION DETAILS	7-12-72		4/14/76	4/10/76	4/10/76	7/12/75	4/10/76	7/27/76	11/27/76	1/7/77					
		▽ C-796	TURB. BLDG. - TYPICAL DETAILS	11-1-71		4/14/76	4/10/76	4/10/76	7/12/75	4/10/76	7/27/76	11/27/76	1/7/77					
		▽ C-797	TURB. BLDG. - REINFORCING DETAILS	11-1-71		4/14/76	4/10/76	4/10/76	7/12/75	4/10/76	7/27/76	11/27/76	1/7/77					
		▽ C-798	RADWASTE BLDG. PRECAST CONCRETE WALL PANELS TYPICAL CONNECTION DET'S.	2-24-74		4/14/76	4/10/76	4/10/76	7/12/75	4/10/76	7/27/76	11/27/76	1/7/77					
		▽ C-799	RADWASTE BLDG. - REINFORCING DETAILS	2-17-74		4/14/76	4/10/76	4/10/76	7/12/75	4/10/76	7/27/76	11/27/76	1/7/77					
		▽ C-800	REACTOR BLDG - TYP. CONNECTION DETAILS	2-18-74		4/14/76	4/10/76	4/10/76	7/12/75	4/10/76	7/27/76	11/27/76	1/7/77					

BECHTEL
SAN FRANCISCO

POWER
AND
INDUSTRIAL
DIVISION



CIVIL
ENGINEERING
DEPT

JOB NO. 6031 PERIOD ENDING
JOB 1 IN NO. OF 1 PRELIMINARY 1 OF 1 OF 1
SHEET 35 OF SHEETS

[illegible]

[illegible]

LEGEND

DRAWING STARTED

PROGRESS LAST PERIOD

ISSUED FOR APPROVAL

PROGRESS THIS PERIOD

ISSUED FOR CONST

ISSUED FOR A APPROVAL

U ORKATION

C CONSTRUCTION P PURCHASE

DRAWING CONTROL

BECHTEL

SAN FRANCISCO

POWER
AND
INDUSTRIAL
DIVISIONCIVIL
ENGINEERING
DEPT.JOB NO. 8031 PERIOD ENDS 12-31-79
JOB LIMERICK GENERATING STATION
CONT SHEET 38A
SHEET 38 OF 38 SHEETS

DRAWING NUMBER	TITLE	START DATE	STOP DATE	ISSUED FOR (CONST)	DATE ISSUED										REMARKS
					REV 1	REV 2	REV 3	REV 4	REV 5	REV 6	REV 7	REV 8	REV 9	REV 10	
	REACTOR BUILDING PRIMARY CONTAINMENT														
C-926	DRYWELL INTERIOR STRUCTURAL STEEL FRAMING PLAN ELEVATION 293'-0" UNIT 1	12-6-71			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-927	" " " " " " UNIT 2	1-29-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-928	DRYWELL INTERIOR STRUCTURAL STEEL FRAMING PLAN ELEVATION 272'-9" UNIT 1	12-6-71			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-929	" " " " " " UNIT 2	4-4-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-930	DRYWELL INTERIOR STRUCTURAL STEEL FRAMING PLAN ELEV. 277'-6" UNIT 1	1-2-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-931	" " " " " " UNIT 2	4-11-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-932	DRYWELL INTERIOR STRUCTURAL STEEL FRAMING PLAN AT ELEV. 286'-1" UNIT 1	11-8-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-933	" " " " " " UNIT 2	4-15-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-934	DRYWELL INTERIOR STRUCTURAL STEEL FRAMING PLAN AT EL 295'-11 1/2" & EL 303'-6" UNIT 1	11-8-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-935	" " " " " " UNIT 2				2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-936	SEISMIC STABILIZER PLAN & DETAILS UNITS 1 & 2	4-15-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-937	DRYWELL INTERIOR STRUCTURAL STEEL RESTRAINTS DETAILS UNITS 1 & 2	10-23-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-938	DRYWELL INTERIOR STRUCTURAL STEEL - RESTRAINT DETS & SCHED UNITS 1 & 2	2-23-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-939	DRYWELL INTERIOR STRUCTURAL STEEL - RESTRAINT DETAILS UNITS 1 & 2	11-9-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-940	" " " " " " UNITS 1 & 2	5-8-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-941	DRYWELL INTERIOR STRUCTURAL STEEL - BEAM CONNECTION DETS UNITS 1 & 2	7-23-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-942	" " " " " " UNITS 1 & 2	2-23-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-943	DRYWELL PLATFORM PLANS 11' 243'-6" THRU EL 265'-3" UNITS 1 & 2	6-16-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-944	DRYWELL PLATFORM SECTIONS AND DETAILS UNITS 1 & 2	8-20-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-945	DRYWELL PLATFORM SECTIONS AND DETAILS UNITS 1 & 2	8-20-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-946	RPV PEDESTAL UNITS 1 & 2	8-29-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-947	DRYWELL PLATFORM AT SEISMIC STABILIZER, PLAN SECT & DETAILS UNITS 1 & 2	12-31-79	12-31-79		2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-948	PRIMARY CONTAINMENT RPV PEDESTAL BEAM INSERTS & PIPE RESTRAINTS UNITS 1 & 2	11-10-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-949	DRYWELL INTERIOR STRUCTURAL STEEL DETAILS & SECTIONS UNITS 1 & 2	6-12-71			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	
C-950	REACTOR SHIELD UNITS 1 & 2	8-10-72			2/2/72	3/10/72	2/10/72	2/2/72	2/1/72	3/2/72	3/2/72	3/2/72	3/2/72	3/2/72	

ISSUED FOR CONSIDERATION

ISSUED FOR	A	APPROVAL	Q	QUOTATION
	C	CONSTRUCTION	P	PURCHASE

SAN FRANCISCO



CIVIL
ENGINEERING
DEPT

RJB NO. 8031 PERIOD ENDING 12
JOB LIMERICK GENERATING STATION
CONF. 304
SHEET 39 OF SHEETS

DRAWING NUMBER	18	TITLE	START DATE	STOP DATE	ISSUED FOR	DATE ISSUED												REMARKS
			8-10-72	8-10-72	UNIT	REV. 0	REV. 1	REV. 2	REV. 3	REV. 4	REV. 5	REV. 6	REV. 7	REV. 8	* DESIGNATES PRINCIPAL DRAWING			
		REACTOR SHIELD - CONT.																
		C-951																
▽		C-952 REACTOR SHIELD UNITS 1 & 2	8-14-72		--	8/10/72	8/20/72	9/12/72	9/17/72	9/17/72	9/17/72							
		C-953																
▽		C-954 REACTOR SHIELD - SECTIONS & DETAILS	8-15-72		--	8/10/72	8/20/72	9/12/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72			
		C-955																
▽		C-956 REACTOR SHIELD - SECTIONS & DETAILS	8-15-72		--	8/10/72	8/20/72	9/12/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72			
▽		C-957 REACTOR BUILDING FIXTURE REFUELING SHIELD REQUIREMENTS	11-3-72		--	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72			
▽		C-958 REACTOR SHIELD - PLANS, SECTIONS & DETAILS	10-6-72		--	8/10/72	8/20/72	9/12/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72	9/17/72		
▽		C-959 REACTOR BLDG CRUSHABLE ALUM. HONEYCOMB ENERGY ABSORBER PLAN & SECS	2-2-77		--	9/17/72	9/24/72	9/29/72	9/30/72	9/30/72	9/30/72	9/30/72	9/30/72	9/30/72	9/30/72	9/30/72		
▽		C-960 REACTOR SHIELD - DOORS WITH PLUGS	3-27-73		--	9/17/72	9/17/72	9/10/72	9/14/72	9/15/72								
▽		C-961 REACTOR SHIELD - DOOR & PLUG DETAILS	4-1-73		--	9/17/72	9/17/72											
▽		C-962 REACTOR SHIELD - DOOR & PLUG DETAILS	4-29-73		--	9/17/72	9/17/72	9/17/72										
▽		C-963 REACTOR SHIELD - DOOR & PLUG DETAILS	4-29-73		--	9/17/72	9/17/72											
▽		C-964 REACTOR SHIELD - DOOR & PLUG DETAILS	4-13-73		--	9/17/72	9/17/72											
▽		C-965 REACTOR SHIELD - DOOR & PLUG DETAILS	4-13-73		--	9/17/72	9/17/72											
▽		C-966 DRYWELL MISC. JET BARRIERS PLANS	1-10-77		--	9/17/72	9/17/72	9/27/80	9/30/80									
		C-967																
		C-968																
		C-969																
		C-970																
		C-971																
		REACTOR BLDG. PRIMARY CONTAINMENT																
▽		C-972 CRD JET BARRIERS PLANS UNITS 1 & 2	7-13-76		--	9/17/72	9/21/77	9/10/77	9/10/80	9/27/80	9/30/81							
▽		C-973 CRD JET BARRIERS SECTIONS AND DETAILS UNITS 1 & 2	7-26-76		--	9/17/72	9/17/77	9/12/79	9/30/80	9/30/80								
▽		C-974 CRD JET BARRIERS SECTIONS AND DETAILS UNITS 1 & 2	8-9-76		--	9/17/72	9/17/77	9/17/79	9/10/80	9/24/80	9/30/80	9/30/81	9/30/81	9/30/81	9/30/81			
▽		C-975 CRD JET BARRIERS DETAILS UNITS 1 & 2	8-27-76		--	9/17/72	9/17/77	9/10/80	9/30/80	9/30/81	9/30/81	9/30/81	9/30/81	9/30/81	9/30/81			
▽		C-976 DRYWELL INTERIOR STRUCTURAL STEEL MISC. DETAILS & SECTIONS UNITS 1 & 2	12-31-78		--	9/17/72	9/30/79	9/17/79	9/6/78	9/24/79	9/12/79	9/30/80	9/30/81	9/30/81				

LEGEND

— DRAWING STARTED

☒ ISSUED FOR APPROVAL

ISSUED FOR CONST

PROGRESS LAST PERIOD:

PROGRESS THIS PERIOD

ISSUED FOR A APPROVAL () DUTATION

C CONSTRUCTION P PURCHASE

DRAWING CONTROL

RECHTEL

SAN FRANCISCO

PLUMB
AND
INDUSTRIAL
DIVISION



CIVIL

ENGINEERING
DEPT

KID NO: 0031 PERIOD ENDING: 6/4/57

JOB LIMERICK GENERATING STATION
CONT SHEET 11A

CONT. SHEET 41A

PAGE 41 OF PAGES

DRAWING NUMBER	TO	TITLE	START DATE		COMP. DATE		DATE	DATE ISSUED												REMARKS
			REV. 1	REV. 2	REV. 1	REV. 2		REV. 1	REV. 2	REV. 3	REV. 4	REV. 5	REV. 6	REV. 7	REV. 8	* DESIGNATES PRINCIPAL DRAWING				
		TURBINE BLDG. & AUX. BAY																		
✓ C-1001		KEY PLANS-INTERIOR WALL -EL.200'-0" & 217'-0"	4-1-71					11/21/71	3/7/72	3/24/75	3/20/75	1/24/77	7/24/77							
✓ C-1002		KEY PLANS-INTERIOR WALL -EL.239'-0" & 269'-0"	4-5-71					11/19/71	12/14/76	3/4/77	3/4/80									
✓ C-1003		KEY PLAN-INTERIOR WALL -EL.302'-0"	4-10-71					10/6/76	3/6/77	7/12/80										
		C-1004																		
✓ C-1005		INTERIOR WALL ELEVATIONS- WALL NOS. 1106	UNIT 1					4/27/71	8/22/76	6/24/76	12/14/76	11/13/78								
✓ C-1006		INTERIOR WALL ELEVATIONS- WALL NOS. 301 TO 306	UNIT 2					3/4/75	1/29/76											
✓ C-1007		INTERIOR WALL ELEVATIONS- WALL NOS. 81 TO 86	UNIT 1					4/27/71	3/6/75	1/20/76	4/3/76	3/31/76	10/20/76	12/14/76	8/6/77	10/19/77				
✓ C-1008		INTERIOR WALL ELEVATIONS- WALL NOS. 281 TO 288	UNIT 2					3/6/75	1/21/76	12/14/76	8/9/77	8/21/78	11/2/78	3/20/79						
✓ C-1009		INTERIOR WALL ELEVATIONS- WALL NOS. 89 TO 93 & 100 TO 102	UNIT 1					3/6/75	3/6/76	3/24/76	3/2/77	11/2/78	11/7/79	4/6/79	11/15/79	3/4/80				
✓ C-1010		INTERIOR WALL ELEVATIONS- WALL NOS. 603 TO 602	UNIT 2					4/27/71	3/7/77	4/17/77	3/6/78	11/1/78								
✓ C-1011		INTERIOR WALL ELEVATIONS- WALL NOS. 94 TO 99 & 289 TO 294	UNIT 1 & 2					3/4/75	3/29/76	4/20/76	4/14/77	4/1/78	5/5/79	4/22/81	3/24/81					
✓ C-1012		INTERIOR WALL ELEVATIONS- WALL NOS. 216 TO 223	UNIT 1					4/27/71	11/21/76	8/9/77	7/6/78	4/4/79	2/26/79	4/4/79	1/3/80	3/7/80				
✓ C-1013		INTERIOR WALL ELEVATIONS- WALL NOS. 200 TO 202, 204, 212, 200 TO 202, 204 & 212	UNIT 1 & 2					3/4/75	3/7/77	7/5/77	10/1/79	5/1/80								
✓ C-1014		INTERIOR WALL ELEVATIONS- WALL NOS. 712 TO 723	UNIT 2					11/21/76	8/10/77	3/20/78	7/20/79									
✓ C-1015		INTERIOR WALL ELEVATIONS- WALL NOS. 73 & 74	UNIT 1					4/27/71	11/21/76	7/1/78	3/20/75	11/21/76	3/2/77	3/9/79	9/6/79	4/6/80				
✓ C-1016		INTERIOR WALL ELEVATIONS- WALL NOS. 273 & 374	UNIT 2					4/27/71	11/21/76	7/2/76	7/20/78	11/2/78								
✓ C-1017		INTERIOR WALL ELEVATIONS- WALL NO. 224	UNIT 1					4/27/71	11/21/76	3/24/77	7/20/77	3/6/77	3/27/78	7/24/79	7/21/79	3/24/79				
✓ C-1018		INTERIOR WALL ELEVATIONS- WALL NO. 724	UNIT 2					11/21/76	7/20/77	7/5/78	3/24/79	7/24/79	11/1/81							
✓ C-1019		INTERIOR WALL ELEVATIONS- WALL NOS. 225 THRU 231	UNIT 1					4/27/71	11/21/76	7/9/78	7/6/78	4/4/79	3/27/79	11/4/80	3/2/80	4/17/80				
✓ C-1020		INTERIOR WALL ELEVATIONS- WALL NOS. 725 THRU 732	UNIT 2					11/21/76	7/24/76	9/1/77	11/2/78									
✓ C-1021		INTERIOR WALL ELEVATIONS- WALL NOS. 301-302 & 801-802	UNITS 1 & 2					11/21/76	5/20/78											
		C-1022																		
		C-1023																		
		C-1024																		
		C-1025																		

LEGEND
 — DRAWING STARTED
 ▽ ISSUED FOR APPROVAL
 ▽ ISSUED FOR CONST

PROGRESS LAST PERIOD
 PROGRESS THIS PERIOD
 ISSUED FOR A - APPROVAL
 Q - QUOTATION
 C - CONSTRUCTION P - PURCHASE

DRAWING CONTROL

BECHTEL
 SAN FRANCISCO

POWER
 AND
 INDUSTRIAL
 DIVISION



CIVIL
 ENGINEERING
 DEPT.

JOB NO. 8921 PERIOD ENDING
 JOB LIMERICK GENERATING STATION
 CONT ON 45A
 SHEET 42 OF SHEETS

DRAWING NUMBER	TITLE	START DATE	COMP DATE	DATE ISSUED	DATE ISSUED												REMARKS
					REV. 1	REV. 2	REV. 3	REV. 4	REV. 5	REV. 6	REV. 7	REV. 8	REV. 9	REV. 10	REV. 11	REV. 12	
113	YARDWORK																
▽ C-1051	TRANSFORMER FOUNDATIONS & FIREWALLS - UNIT-1	6-30-77	6-30-77	—	9/2/77	1/31/77	1/2/77	1/11/78	1/1/78	1/1/78	1/1/80	1/1/81					
▽ C-1052	TRANSFORMER FOUNDATIONS & FIREWALLS - UNIT-2	6-30-77	6-30-77	—	9/2/77	1/2/77	1/2/77	1/11/78	1/1/78	1/1/78	1/1/80	1/1/81					
▽ C-1053	TRANSFORMER FOUNDATIONS & FIREWALLS - UNIT-3	6-30-77	6-30-77	—	9/2/77	1/2/77	1/2/77	1/11/78	1/1/78	1/1/78	1/1/80	1/1/81					
▽ C-1054	CHLORINE IN-LOADING FACILITIES & FIRE HOSE CARRIAGES & CRYSTAL TRANSFORMER FOUNDATIONS	6-30-77	6-30-77	—	1/12/77	1/12/77	1/12/77	1/11/78	1/1/78	1/1/78	1/1/80	1/1/81					
▽ C-1055	FUEL OIL PUMPHOUSE & FACILITIES PLANS & SECTIONS	7-31-78	7-31-78	—	9/19/77	1/5/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1056	FUEL OIL PUMPHOUSE & FACILITIES PIPES, ASST. PANELS, SECTIONS & DETAILS	7-31-78	7-31-78	—	9/19/77	1/5/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1057	REFUELING WATER TANK AREA PLANS & SECTIONS	7-11-77	7-11-77	—	9/2/77	1/10/77	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1058	REFUELING WATER TANK AREA SECTIONS & DETAILS	7-11-77	7-11-77	—	9/2/77	1/10/77	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1059	REFUELING WATER TANK AREA DETAILS & SECTIONS	7-11-77	7-11-77	—	9/2/77	1/10/77	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1060	OILY WASTE & NORMAL WASTE HOLDING TANKS STRUCTURES PLANS & SECTIONS	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1061	OILY WASTE & NORMAL WASTE HOLDING TANKS STRUCTURES PLANS & SECTIONS	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1062	OILY WASTE & NORMAL WASTE HOLDING TANKS STRUCTURES PLANS & SECTIONS	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1063	DIESEL OIL STORAGE TANK STRUCTURES PLANS & SECTIONS	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1064	DIESEL OIL STORAGE TANK STRUCTURES SECTIONS & DETAILS	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1065	CIRCULATING WATER CHORINATION & SULFURIC ACID FEED STRUCTURES PLANS, SECTIONS AND DETAILS	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1066	CIRCULATING WATER CHORINATION & SULFURIC ACID FEED STRUCTURES DETAIL AND SECTIONS	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1067	TRANSFORMER BUS DUCTS UNIT 1 STRUCTURAL STEEL SUPPORT	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1068	TRANSFORMER BUS DUCTS UNIT 2 STRUCTURAL STEEL SUPPORT	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1069																	
▽ C-1070	24" & 36" ESW PIPING - KEY PLAN	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1071	24" & 36" ESW PIPING SOUTH PLANT AREA - WEST	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1072	24" & 36" ESW PIPING SOUTH PLANT AREA - EAST	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1073	24" & 36" ESW PIPING NORTH PLANT AREA - WEST	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1074	24" & 36" ESW PIPING NORTH PLANT AREA - EAST	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						
▽ C-1075	24" & 36" ESW PIPING TOWER AREA - WEST	7-17-78	7-17-78	—	9/2/77	1/12/78	1/2/78	1/1/78	1/1/78	1/1/80	1/1/81						

SHEET 46 OF _____ SHEETS (CONT ON 46A)

[illegible]

LEGEND

— DRAWING STARTED
 ✓ ISSUED FOR APPROVAL
 ✓ ISSUED FOR CONST

PROCESS LAST PERIOD

PROCESS THIS PERIOD

ISSUED FOR APPROVAL

ISSUED FOR CONST

C - CONSTRUCTION P - PURCHASE

DRAWING CONTROL

EECHTEL

SAN FRANCISCO

POWER
AND
INDUSTRIAL
DIVISIONCIVIL
ENGINEERING
DEPT.

JOB NO. 9921 PERIOD ENDING

JOB LIMERICK GENERATING STATION

SHEET 47 OF 47A

SHEETS

DRAWING NUMBER	TITLE	START DATE 2000 1900 1900 1900	END DATE 2000 1900 1900 1900	REV. 1 REV. 2 REV. 3 REV. 4 REV. 5 REV. 6 REV. 7 REV. 8 REV. 9 REV. 10	DATE ISSUED	REMARKS * DESIGNATES PRINCIPAL DRAWING
	SPEAR POND PUMP HOUSE					
✓ C-1151	SCREENS ELEVATIONS, DETAILS & SECTIONS				1/10/77	
✓ C-1152	PC PANELS AND MISCELLANEOUS STEEL DETAILS AND SECTIONS				1/10/77	
✓ C-1153	PRECAST PANEL BEAMS, DETAILS				1/10/77	
✓ C-1154	PRECAST PANEL TYPICAL CONN. DETAILS				1/10/77	
C-1155						
C-1156						
C-1157						
✓ C-1158	PLATFORMS - AREA 8 ELEVATIONS 210'-7 1/2" & 340'-6" UNIT 2				1/10/77	
✓ C-1159	PLATFORMS - AREAS 13 THRU 16 ELEVATIONS - 223'-0" THRU 340'-6" UNIT 2				1/10/77	
	REACTOR BLDG. - PLATFORMS					
✓ C-1160	PLATFORMS AT ELEV. 592'-2" THRU 598'-4" SOUTH EXHAUST STACK UNIT 1 & 2				1/10/77	
✓ C-1161	PLATFORMS AREA 11 ELEVATION 190'-5" UNIT 1				1/10/77	
✓ C-1162	PLATFORMS AREA 12 ELEVATION 190'-5" UNIT 1				1/10/77	
✓ C-1163	PLATFORMS AREA 13 ELEVATIONS 182'-10" THRU 191'-0" UNIT 1				1/10/77	
✓ C-1164	PLATFORMS AREA 16 ELEVATIONS 182'-10" & 191'-0" UNIT 1				1/10/77	
✓ C-1165	PLATFORMS AREA 15 & 14 ELEVATION 190'-5" UNIT 2				1/10/77	
C-1166						
✓ C-1167	PLATFORMS AREA 17 ELEVATIONS 182'-10" THRU 191'-0" UNIT 2				1/10/77	
✓ C-1168	PLATFORMS AREA 18 ELEVATIONS 182'-10" THRU 191'-0" UNIT 2				1/10/77	
✓ C-1169	PLATFORMS AREAS 13 & 14 ELEVATIONS 229'-6" & 299'-3" UNIT 2				1/10/77	
✓ C-1170	PLATFORMS AREAS 17 & 18 ELEVATIONS 291'-0" THRU 341'-0" UNIT 2				1/10/77	
✓ C-1171	PLATFORMS AREAS 8, 13, 14, 17 & 18 ELEVATIONS 263'-9" THRU 311'-3" UNIT 2				1/10/77	
✓ C-1172	PLATFORMS AREAS 13 THRU 18 ELEVATIONS 291'-6" THRU 302'-0" UNIT 2				1/10/77	
✓ C-1173	PLATFORMS DETAILS AND SECTIONS UNIT 2				1/10/77	
✓ C-1174	PLATFORMS AREAS 13 THRU 18 ELEVATIONS 319'-3" THRU 339'-0" UNIT 2				1/10/77	
✓ C-1175	PLATFORMS AREAS 8, 11, 12 & 15 ELEVATIONS 263'-9" THRU 272'-6" UNIT 1				1/10/77	

LEGEND

— DRAWING STARTED
 ▽ ISSUED FOR APPROVAL
 ▽ ISSUED FOR CONST

PROGRESS LAST PERIOD 
 PROGRESS THIS PERIOD 
 ISSUED FOR A - APPROVAL Q - QUOTATION
 C - CONSTRUCTION P - PURCHASE

DRAWING CONTROL

ECHTEL
 SAN FRANCISCO

POWER
 AND
 INDUSTRIAL
 DIVISION



CIVIL
 ENGINEERING
 DEPT.

JOB NO. 8021 PERIOD ENDING
 JOB LIMERICK GENERATING STATION
 CONT. SHEET 40A
 SHEET 48 OF SHEETS

DRAWING NUMBER	18	TITLE	START DATE REV. TYPE	COMP. DATE REV. TYPE	ISSUED FOR REV. TYPE	DATE ISSUED												REMARKS * DESIGNATES PRINCIPAL DRAWING
						REV. 0	REV. 1	REV. 2	REV. 3	REV. 4	REV. 5	REV. 6	REV. 7	REV. 8	REV. 9	REV. 10	REV. 11	
▽ C-1176		PLATFORMS AREA 9, 11, 12, 13 & 16 UNIT 1 ELEVATIONS 270'-0" THRU 244'-8"			—	1/14/77	4/18/77	7/9/77	8/7/78	9/24/78	7/2/79	7/13/79	5/9/79	7/27/77				
▽ C-1177		PLATFORMS AREA 8, 11, 12, 13 & 16 UNIT 1 ELEVATIONS 279'-6" THRU 244'-8"	9-25-75		—	1/19/77	3/4/77	3/29/77	4/29/77	4/11/77	11/24/77	7/1/78	5/9/78	4/5/79				
▽ C-1178		PLATFORMS AREA 11, 12, 13 & 16 UNIT 1 ELEVATIONS 264'-0" THRU 302'-0"	10-13-75		—	3/10/77	6/10/77	7/9/77	6/1/78	7/4/78	5/13/79	7/28/79	7/4/79	7/29/80				
▽ C-1179		PLATFORMS AREA 11, 12, 13 & 16 UNIT 1 ELEVATION 300'-0" THRU 334'-0"	10-16-75		—	3/29/77	9/2/77	1/9/78	1/18/78	5/19/78	7/24/78	7/22/79	7/12/79	4/11/80				
▽ C-1180		PLATFORMS AREA 15 ELEVATIONS 291'-0" THRU 333'-3"	10-21-75		—	9/23/77	9/21/77	4/4/78	7/21/78	7/25/78	10/10/78	7/12/79	11/29/79	7/1/80				
▽ C-1181		PLATFORMS AREA 12, 15 & 16 UNIT 1 ELEVATIONS 323'-0" THRU 328'-10 1/4"	6-29-77		—	7/23/77	11/5/77	1/12/78	9/20/78	7/25/79	7/10/80	10/10/80	10/11/80	7/9/81				
▽ C-1182		PLATFORMS - DETAILS & SECTIONS UNITS 1 & 2	2-11-77		—	7/29/77	10/16/77	1/27/78	2/28/78	4/9/79	7/29/79	7/4/79	7/12/80	11/18/80				
▽ C-1183		PLATFORMS - DETAILS & SECTIONS UNITS 1 & 2			—	8/20/78	3/1/77	7/29/77	8/10/77	7/14/77	1/6/78	7/8/78	7/8/78	7/2/79				
▽ C-1184		PLATFORMS - DETAILS & SECTIONS UNITS 1 & 2	5-24-78		—	9/24/78	7/16/76	3/9/76	7/2/76	1/4/77	9/9/77	9/11/77	9/6/77	8/10/78				
		CONTROL ROOM - AREA B																
▽ C-1185		PLATFORMS ELEV'S. 190'-6" THRU 229'-8"	7-16-76		—	10/21/76	11/30/76	2/11/77	11/7/77	2/6/78	6/14/79	4/17/80	10/10/80	7/10/81				
▽ C-1186		PLATFORMS ELEV'S. 186'-3" THRU 261'-6"	7-30-76		—	9/20/76	4/9/77	4/19/77	7/12/77	7/24/78	7/5/78	10/1/79						
▽ C-1187		PLATFORMS ELEV. 313'-0"	12-8-76		—	4/14/77	7/12/77	9/18/77	9/25/78	7/8/78	7/29/79	10/1/79	7/20/80	7/2/81				
▽ C-1188		PLATFORMS ELEV'S. 320'-6" THRU 340'-6"	12-9-76		—	2/14/77	6/10/77	8/4/77	9/29/77	1/3/78	5/12/78	6/24/78	7/4/79	4/9/79				
▽ C-1189		PLATFORMS ELEV'S. 350'-0" & 357'-6"	12-21-76		—	2/14/77	8/6/77	11/2/77	3/3/78	7/8/78	7/6/78	7/23/79	7/2/79	7/9/80				
C-1190																		
C-1191																		
C-1192																		
C-1193																		
C-1194																		
C-1195																		
▽ C-1196		PLATFORMS - SECTIONS & DETAILS	6-28-76		—	9/21/76	11/30/76	2/4/77	11/7/77	6/4/79	4/17/80	7/4/81						
▽ C-1197		PLATFORMS - SECTIONS & DETAILS	4-13-77		—	4/14/77	6/10/77	8/4/77	11/2/77	7/1/78	7/7/78	7/1/78	4/9/79	7/2/80				
▽ C-1198		PLATFORMS - SECTIONS & DETAILS	6-28-77		—	7/23/77	10/2/77	8/18/78	9/11/78	7/20/78	11/14/79	10/9/80						
C-1199																		
▽ C-1200		SCHEDULE FOR SEISMIC CABLE TRAY EMBEDS UNIT 1			—	1/30/78	4/17/76	5/7/76	6/10/76	9/12/76	3/4/77	4/27/81						

LEGEND		DRAWING CONTROL		POWER AND INDUSTRIAL DIVISION		CIVIL ENGINEERING DEPT.		JOB NO. 8921 PERIOD ENDING 12/31/77								
— DRAWING STARTED		PROGRESS LAST PERIOD		TECHTEL		ENGINEERING DEPT.		JOB LINDECA GENERATING STATION								
✓ ISSUED FOR APPROVAL		PROGRESS THIS PERIOD		SAN FRANCISCO				CONT. SHEET 82A								
✓ ISSUED FOR CONST.		ISSUED FOR A - APPROVAL Q - QUOTATION C - CONSTRUCTION P - PURCHASE						SHEET 50 OF 50 SHEETS								
DRAWING NUMBER	22	TITLE	START DATE	COMP. DATE	ISSUED FOR	DATE ISSUED										REMARKS
			REV. 0	REV. 1	REV. 2	REV. 3	REV. 4	REV. 5	REV. 6	REV. 7	REV. 8		* DESIGNATES PRINCIPAL DRAWING			
		REACTOR BUILDING														
✓	C-1226	NORTH FUEL POOL GIRDER REINFORCING ELEVATIONS UNIT 1	3-10-76		—	7/2/76	9/10/76	12/12/76	12/30/76	4/24/77	7/20/77	10/10/77	2/23/78	⊗		
✓	C-1227	SOUTH FUEL POOL GIRDER REINFORCING ELEVATIONS UNIT 1	3-13-76		—	7/2/76	9/10/76	12/12/76	12/30/76	4/24/77	7/20/77	10/10/77	2/23/78	⊗		
✓	C-1228	FUEL POOL GIRDER HINGE - LINK SECTIONS & DETAILS UNITS 1 & 2	3-3-76		—	4/10/76	7/10/76	7/1/77	7/4/77	9/20/77	9/23/77	7/20/78		⊗		
✓	C-1229	STEAM DRYER & SEPARATOR - STORAGE POOL REINFORCING - SECTIONS UNIT 1	3-16-76		—	7/2/76	9/10/76	12/12/76	12/30/76	7/20/77	5/24/78			⊗		
✓	C-1230	SPENT FUEL POOL REINFORCING SECTIONS UNIT 1	3-16-76		—	7/2/76	9/10/76	12/12/76	12/30/76	7/20/77	5/24/78			⊗		
✓	C-1231	FUEL POOL GIRDER - REINFORCING SECTIONS & DETAILS UNITS 1 & 2	6-18-76		—	7/2/76	9/10/76	12/12/76	12/30/76	7/20/77	5/24/78	6/1/78	8/6/78	⊗		
	C-1232															
	C-1233															
	C-1234															
	C-1235															
✓	C-1236	NORTH FUEL POOL GIRDER REINFORCING ELEVATIONS UNIT 2	3-18-76		—	9/10/77	10/10/77	1/7/78	4/5/78	7/10/78	11/23/78	1/10/79	7/14/79	2/10/80	⊗	
✓	C-1237	SOUTH FUEL POOL GIRDER REINFORCING ELEVATIONS UNIT 2	3-31-76		—	9/10/77	10/10/77	2/9/78	4/9/78	7/10/78	11/23/78	1/10/79	7/14/79	2/10/80	⊗	
✓	C-1238	STEAM DRYER & SEPARATOR - STORAGE POOL REINFORCING - SECTIONS UNIT 2	1-3-77		—	7/20/77	7/24/78	7/10/81							⊗	
✓	C-1239	SPENT FUEL POOL REINFORCING SECTIONS UNIT 2	1-9-77		—	7/20/77	7/24/78	7/10/81							⊗	
✓	C-1240	CONTROL ROOM AREA B CABLE TRAY & HVAC EMBEDS - 2, 6, 7, 8, 40, 50, 52, 119, 121, 122	1-5-76		—	7/20/77	7/24/78	7/10/81							⊗	
✓	C-1241	CONTROL ROOM AREA B CABLE TRAY & HVAC EMBEDS BLOCK WALLS 99, 60, 62, 63, 102, 116, 117, 118	11-8-76		—	7/20/77	7/24/78	7/10/81							⊗	
✓	C-1242	CONTROL ROOM AREA B CABLE TRAY & HVAC EMBEDS BLOCK WALLS 102, 103, 104	1-18-77		—	7/20/77	7/24/78	7/10/81							⊗	
✓	C-1243	REACTOR BLDG. UNIT 1 CABLE TRAY & HVAC EMBEDS BLOCK WALLS 70, 71, 80, 138, 139, 140, 142	11-8-76		—	7/20/77	7/24/78	7/10/81	7/10/81	7/10/81	7/10/81	7/10/81	7/10/81	7/10/81	⊗	
✓	C-1244	REACTOR BLDG. UNIT 1 CABLE TRAY & HVAC EMBEDS BLOCK WALLS 81, 87			—	7/20/77	7/24/78	7/10/81	7/10/81	7/10/81	7/10/81	7/10/81	7/10/81	7/10/81	⊗	
✓	C-1245	REACTOR BLDG. UNIT 1 CABLE TRAY & HVAC EMBEDS BLOCK WALLS 217, 218, 219, 222, 223, 224, 225, 226	11-17-76		—	7/20/77	7/24/78	7/10/81	7/10/81	7/10/81	7/10/81	7/10/81	7/10/81	7/10/81	⊗	
✓	C-1246	REACTOR BLDG. UNIT 2 CABLE TRAY & HVAC EMBEDS BLOCK WALLS 107 & 108	11-26-76		—	7/20/77	7/24/78	7/10/81							⊗	
✓	C-1247	REACTOR BLDG. UNIT 2 CABLE TRAY & HVAC EMBEDS BLOCK WALLS 41, 408, 409, 410, 411, 412, 413, 414	11-29-76		—	7/20/77	7/24/78	7/10/81							⊗	
✓	C-1248	REACTOR BLDG. UNIT 1 CABLE TRAY & HVAC EMBEDS BLOCK WALLS 209, 215, 216, 245, 301, 308, 310, 311, 313	3-15-77		—	7/20/77	7/24/78	7/10/81	7/10/81	7/10/81	7/10/81	7/10/81	7/10/81	7/10/81	⊗	
✓	C-1249	REACTOR BLDG. UNIT 2 CABLE TRAY & HVAC EMBEDS BLOCK WALLS 114, 174, 421, 425 & 444	3-15-77		—	7/20/77	7/24/78	7/10/81							⊗	
✓	C-1250	REACTOR BLDG. UNIT 1 CABLE TRAY & HVAC EMBEDS BLOCK WALLS 428, 507, 508, 510, 511, 519	3-17-77		—	7/20/77	7/24/78	7/10/81							⊗	
✓	C-1251	SHIELDING DOOR SUPPORTS UNITS 1 & 2 PLAN AT ELEVATION 283'-0"	6-25-76		—	7/2/76	9/10/76	12/12/76	12/30/76	7/20/77	5/24/78				⊗	

ISSUED FOR CONSIDERATION

ISSUED FOR A - APPROVAL Q - QUOTATION
C - CONSTRUCTION P - PURCHASE

SAN FRANCISCO

POWER
AND
INDUSTRIAL
DIVISION



CIVIL
ENGINEERING
DEPT.

SHEET 51 OF SHEETS

[illegible]

TITLE Limerick
 BY RBN DATE 10/16/81
 CHKD. BY _____ DATE 11



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 1 OF _____ Job No. 14302
 COMMENTS Condensate
Storage Tank

References 49 and 50 will be used to determine the seismic response of the tank, even though $\frac{H}{R} > 1.2$.

The condensate storage tank is 30'-0" in diameter, 42'-0" in height, with a spherical dome roof (30'-0" radius) with a height of 4'-0". Capacity appears to be 200,000 gallons. The tank bottom is $\frac{1}{4}$ " thick. The 2 lower shell rings are $\frac{5}{16}$ " thick; the 3 upper shell rings are $\frac{1}{4}$ " thick. The roof is $\frac{3}{16}$ " thick. All steel is 304 S.S. The tank has 26 anchor bolts with spacing varying between 7.5" to 15" with most (18) at 15". The bolts are 1" in diameter and made of A-307 steel.

$$\text{Capacity} = 200,000 \text{ gal.} = 26,740 \text{ ft}^3$$

$$\text{Wt.} = (200,000 \text{ gal.} \times 8.33 \frac{\text{lb}}{\text{gal}}) = 1666 \text{ k}$$

$$\text{Mass} = (1666 \text{ k}) / (386.4 \frac{\text{in}}{\text{sec}^2}) = 4.31 \frac{\text{k-sec}^2}{\text{in}}$$

$$\text{Fluid height} = 26,740 / (\pi \cdot 15^2) = 37.8' \approx 37\frac{2}{3}'$$

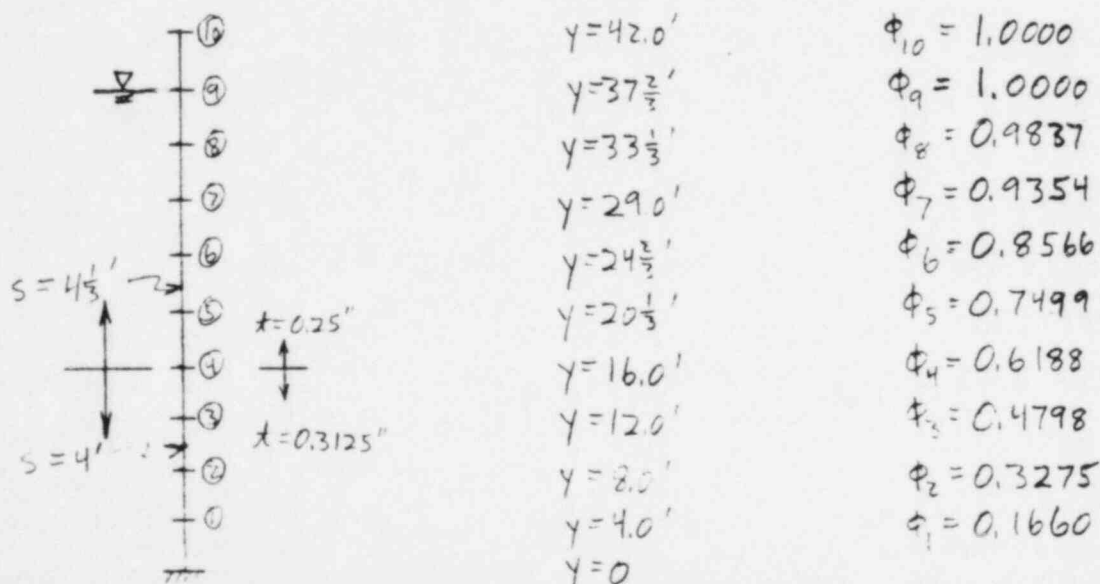
$$\rightarrow \text{Wt.} = 1659 \text{ k}$$

$$\rightarrow \text{Mass} = 4.29 \frac{\text{k-sec}^2}{\text{in}}$$

Dynamic Model

Mass of the fluid and the tank will be lumped at 10 nodes as defined by the ring heights. Rayleigh's method will be used with a sinusoidal mode shape initially assumed:

$$\Phi(y) = \sin\left(\frac{\pi y}{2H}\right) = \sin\left(\frac{3\pi y}{226}\right) \text{ for } y < 37\frac{2}{3}' ; \Phi(y) = 1.0 \text{ for } y \geq 37\frac{2}{3}'$$





Tank Weights

$$W_1 = (30' \times \pi \times \frac{0.3125}{12} \times 0.49 \text{ kcf} \times 4') = 4.81 \text{ k}$$

$$W_2 = W_3 = W_1 = 4.81 \text{ k}$$

$$W_4 = (30' \times \pi \times 0.49 \text{ kcf}) \left[\left(\frac{0.3125}{12} \times 2' \right) + \left(\frac{0.25}{12} \times 2' \right) \right] = 4.49 \text{ k}$$

$$W_5 = W_6 = W_7 = W_8 = W_9 = (30' \times \pi \times \frac{0.25}{12} \times 0.49 \text{ kcf} \times 4\frac{1}{3}') = 4.17 \text{ k}$$

$$W_{10} = (30' \times \pi \times 0.49 \text{ kcf} \times \frac{0.25}{12} \times 2') + 2(30' \times \pi \times 4.0192' \times \frac{0.1875}{12} \times 0.49 \text{ kcf}) = 7.88 \text{ k}$$

$$\text{Total} = \underline{47.65 \text{ k}}$$

Tank Inertial Forces

These forces will be calculated assuming a 1.0g spectral acceleration for the tank vibrating in a sinusoidal manner.

$$P_1 = (4.81 \times 0.1660) = 0.8 \text{ k}$$

$$P_2 = (4.81 \times 0.3275) = 1.6 \text{ k}$$

$$P_3 = (4.81 \times 0.4798) = 2.3 \text{ k}$$

$$P_4 = (4.49 \times 0.6188) = 2.8 \text{ k}$$

$$P_5 = (4.17 \times 0.7499) = 3.1 \text{ k}$$

$$P_6 = (4.17 \times 0.8566) = 3.6 \text{ k}$$

$$P_7 = (4.17 \times 0.9354) = 3.9 \text{ k}$$

$$P_8 = (4.17 \times 0.9837) = 4.1 \text{ k}$$

$$P_9 = (4.17 \times 1.0000) = 4.2 \text{ k}$$

$$P_{10} = (7.88 \times 1.0000) = 7.9 \text{ k}$$

Fluid Hydrodynamic Forces

The method presented in Ref. 50 for determining hydrodynamic forces in a flexible tank will be used.

$$p_0(y, \theta, t) = (b_0(y) \times H A_0(t)) \cos \theta$$

$$\text{The force/unit ht.} = \int_{\theta=0}^{2\pi} p_0(y, \theta, t) \cos \theta d\theta = P(y, t)$$



$$\therefore P(y, t) = C b_0(y) \gamma \pi a H \frac{A_0(t)}{g}$$

$$C = \frac{m_{x,s} + m_{x,l}}{m_{w,s} + m_{w,l}}$$

$$m_{x,s} = \sum \text{Tank Inertial Forces} = \underline{34.3 k}$$

$$m_{w,s} = \sum W_i \phi_i^2 = \underline{28.6 k}$$

$$\frac{m_{x,l}}{m} = \frac{8H}{a\pi^2} \sum_{i=1}^{\infty} \frac{(-1)^{i+1}}{(2i-1)^2} \delta_i \varepsilon_i$$

$$\delta_i \text{ for } \phi(y) = \sin\left(\frac{\pi y}{2H}\right) : \delta_i = \frac{1}{i\pi} \quad i = 1, 3, 5, 7, \dots$$

$$= -\frac{1}{(i-1)\pi} \quad i = 2, 4, 6, 8, \dots$$

$$\varepsilon_i = \frac{I_1[(2i-1)x]}{I_1'[(2i-1)x]}, \quad x = \frac{\pi a}{2H}$$

$$\text{For } \frac{a}{H} = \frac{15}{37\frac{1}{2}} = 0.398 :$$

i	1	2	3	4	5	6	7	8
ε_i	0.5706	1.0577	1.1095	1.0961	1.0800	1.0676	1.0582	1.0510
δ_i	0.3183	-0.3183	0.1061	-0.1061	0.06366	-0.06366	0.04547	-0.04547

$$\therefore m_{x,l} = \frac{8(37\frac{1}{2})}{\pi^2(15)} (0.2282) m = 0.468 (1659) = \underline{770.6 k}$$

$$\frac{m_{w,l}}{m} = \frac{4H}{\pi a} \sum_{i=1}^{\infty} \frac{\delta_i^2 \varepsilon_i}{2i-1} = 0.3185 \Rightarrow m_{w,l} = 0.3185 (1659) = \underline{528.4 k}$$

$$\therefore C = \frac{34.3 + 770.6}{28.6 + 528.4} = \underline{1.45}$$

$$\therefore P(y, t) = 1.45 b_0(y) (0.0624 \pi (15) (38)) \frac{A_0(t)}{g} = 162.0 \frac{A_0(t)}{g} b_0(y)$$

$$= 162.0 b_0(y) \text{ for } A_0(t) = 1g$$

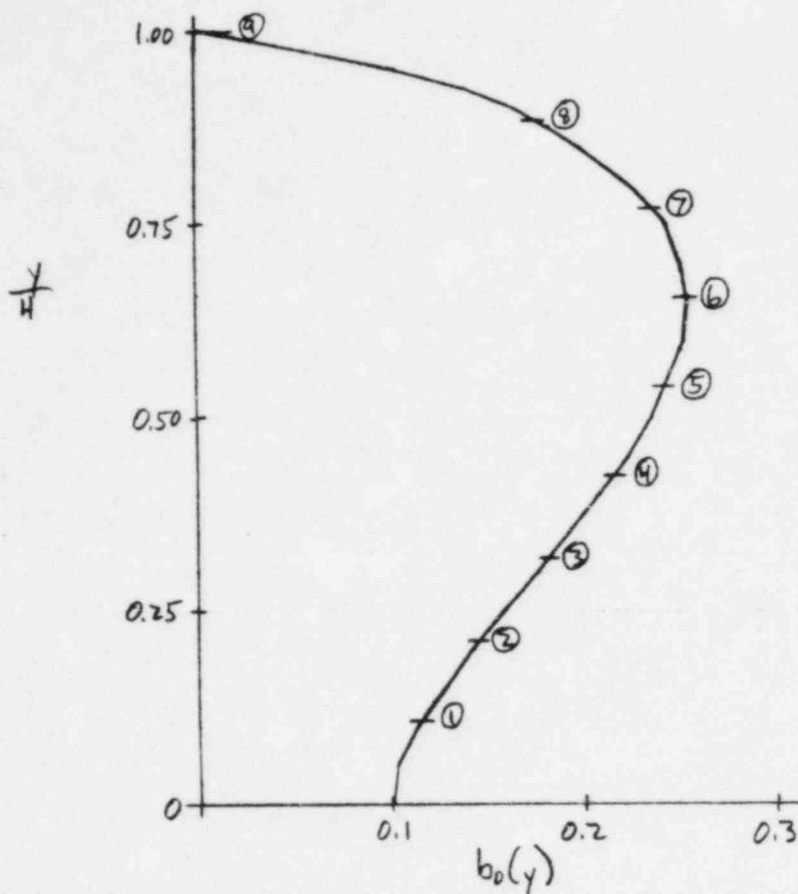
$$b_0(y) = \frac{4}{\pi} \sum_{i=1}^{\infty} \frac{\delta_i \varepsilon_i}{2i-1} \cos\left[\frac{(2i-1)\pi y}{2H}\right]$$

TITLE Limerick
 BY RBN DATE 10/19/81
 CHKD. BY _____ DATE 11



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 4 OF _____ Job No. 14322
 COMMENTS Condensate
Storage Tank



Hydrodynamic Forces

$$F_1 = 162.0 (0.115 \times 4.0') = 74.5 \text{ k}$$

$$F_2 = 162.0 (0.146 \times 4.0') = 94.6 \text{ k}$$

$$F_3 = 162.0 (0.183 \times 4.0') = 118.6 \text{ k}$$

$$F_4 = 162.0 (0.216 \times 4.17') = 145.9 \text{ k}$$

$$F_5 = 162.0 (0.243 \times 4.33') = 170.6 \text{ k}$$

$$F_6 = 162.0 (0.254 \times 4.33') = 178.3 \text{ k}$$

$$F_7 = 162.0 (0.239 \times 4.33') = 167.8 \text{ k}$$

$$F_8 = 162.0 (0.176 \times 4.33') = 123.6 \text{ k}$$

$$F_9 = 162.0 (0.044 \times 2.17') = 15.4 \text{ k}$$

$$F_{10} = 0$$

Total Forces

$$P_1 + F_1 = 75.3 \text{ k}$$

$$P_2 + F_2 = 96.2 \text{ k}$$

TITLE LimerickBY RBN DATE 10/19/81CHKD. BY _____ DATE 11STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 5 OF _____ Job No. 14302.01COMMENTS CondensateStorage Tank

$$P_3 + F_3 = 120.9k$$

$$P_4 + F_4 = 148.7k$$

$$P_5 + F_5 = 173.7k$$

$$P_6 + F_6 = 181.9k$$

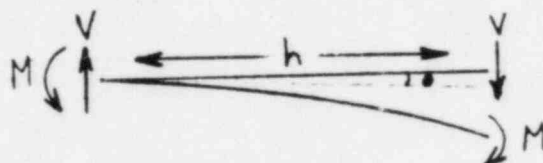
$$P_7 + F_7 = 171.7k$$

$$P_8 + F_8 = 127.7k$$

$$P_9 + F_9 = 19.6k$$

$$P_{10} + F_{10} = 7.9k$$

Deflected Shape due to Total Forces



Shear deflection $\Delta_v = \frac{Vh}{A_s G}$

$$A_s = 2\pi r t \left(\frac{1}{2}\right) = 2(\pi)(15)(12)\left(\frac{1}{2}\right)t = 565.5t$$

$$G = \frac{E}{2(1+\nu)} = \frac{28.3 \times 10^3}{2(1.3)} = 10.9 \times 10^3 \text{ ksi}$$

Bending deflection $\Delta_B = \frac{Vh^3}{3EI} + \frac{Mh^2}{2EI} + \theta h$

$$I = \pi r^3 t = \pi [(15)(12)]^3 t = (1.83 \times 10^7)t \text{ in}^4$$

$$\epsilon = \sum \Delta \theta = \sum \left(\frac{Vh^2}{2EI} + \frac{Mh}{EI} \right)$$

TITLE LimerickBY RBN DATE 10/20/81CHKD. BY _____ DATE 11
**STRUCTURAL
MECHANICS
ASSOCIATES**
A Calif. Corp.
PAGE 6 OF _____ Job No. 1430COMMENTS CondensateStorage Tank

Node	t (in)	h (in)	P (k)	V (k)	M ($\times 10^3$ in-k)	Δ_V (in)	Δ_B (in)	$\Delta_V + \Delta_B$ (in)	δ (in)	θ (rad)
10			7.9		0				0.2597	2.658×10^{-4}
9	0.25	52	19.6	7.9	0.41	0.0003	0.0138	0.0141	0.2456	2.657×10^{-4}
8	0.25	52	127.7	27.5	1.84	0.0009	0.0138	0.0147	0.2309	2.652×10^{-4}
7	0.25	52	171.7	155.2	9.91	0.0052	0.0137	0.0190	0.2119	2.629×10^{-4}
6	0.25	52	181.9	326.9	26.91	0.0110	0.0135	0.0245	0.1874	2.555×10^{-4}
5	0.25	52	173.7	508.8	53.37	0.0172	0.0129	0.0301	0.1573	2.394×10^{-4}
4	0.25	52	148.7	682.5	88.86	0.0230	0.0118	0.0348	0.1225	2.109×10^{-4}
3	0.3125	48	120.9	831.2	128.76	0.0207	0.0094	0.0301	0.0924	1.786×10^{-4}
2	0.3125	48	96.2	952.1	174.46	0.0237	0.0076	0.0313	0.0611	1.337×10^{-4}
1	0.3125	48	75.3	1048.3	224.77	0.0261	0.0051	0.0312	0.0299	7.457×10^{-5}
0	0.3125	48		1123.6	278.71	0.0280	0.0019	0.0299	0	0

TITLE LimerickBY RBNDATE 10/20/81

CHKD. BY

DATE 11STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 7 OF Job No. 14302COMMENTS CondensateStorage Tank

Dividing the deflected shape by the deflection at node 9 and comparing it to the assumed mode shape:

Node	Φ_{CALC}	Φ_{ASSUME}	% Dif.
10	1.0574	1.0000	
9	1.0000	1.0000	
8	0.9401	0.9837	
7	0.8628	0.9354	<u>NG</u>
6	0.7630	0.8566	
5	0.6405	0.7499	
4	0.4988	0.6188	
3	0.3762	0.4798	
2	0.2488	0.3275	
1	0.1217	0.1660	

Try a different mode shape:

$$\Phi(y) = 0.0315y, \quad 0 \leq y \leq 20\frac{1}{3}'$$

$$= 1.5868 - \frac{25.4593}{y} + \frac{126.4304}{y^2}, \quad 20\frac{1}{3}' \leq y \leq 42'$$

Tank Inertial Forces

$$P_1 = 4.81(0.1260) = 0.6 \text{ k}$$

$$P_2 = 4.81(0.2520) = 1.2 \text{ k}$$

$$P_3 = 4.81(0.3780) = 1.8 \text{ k}$$

$$P_4 = 4.49(0.5040) = 2.3 \text{ k}$$

$$P_5 = 4.17(0.6405) = 2.7 \text{ k}$$

$$P_6 = 4.17(0.7625) = 3.2 \text{ k}$$

$$P_7 = 4.17(0.8592) = 3.6 \text{ k}$$

$$P_8 = 4.17(0.9368) = 3.9 \text{ k}$$

$$P_9 = 4.17(1.0000) = 4.2 \text{ k}$$

$$P_{10} = 7.88(1.0523) = 8.3 \text{ k}$$

TITLE LimerickBY RBNDATE 10/20/81STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 8 OF Job No. 143026COMMENTS CondensateCHKD. BY DATE 11Storage TankFluid Hydrodynamic Forces

$$m_{x,s} = \sum W_i \phi_i = \sum \text{Tank Inertial Forces} = \underline{31.8k}$$

$$m_{w,s} = \sum W_i \phi_i^2 = \underline{26.0k}$$

For this mode shape, δ_i is approximately as follows:

$$\delta_1 = 0.268741$$

$$\delta_6 = -0.062187$$

$$\delta_{10} = -0.034870$$

$$\delta_2 = -0.290625$$

$$\delta_7 = 0.046560$$

$$\delta_{11} = 0.029332$$

$$\delta_3 = 0.113307$$

$$\delta_8 = -0.044697$$

$$\delta_{12} = -0.028689$$

$$\delta_4 = -0.100528$$

$$\delta_9 = 0.035743$$

$$\delta_{13} = 0.024732$$

$$\delta_5 = 0.064397$$

$$\therefore m_{x,l} = \frac{8(37\frac{2}{3})}{\pi^2(15)} (0.1971)(1659) = \underline{665.6k}$$

$$m_{w,l} = \frac{4(37\frac{2}{3})}{\pi(15)} (0.07686)(1659) = \underline{407.7k}$$

$$\therefore C = \frac{31.8 + 665.6}{26.0 + 407.7} = \underline{1.61}$$

$$P(y, t) = 1.61 b_0(y) (0.0624)(\pi)(15)(37\frac{2}{3}) \frac{A_0(t)}{g}$$

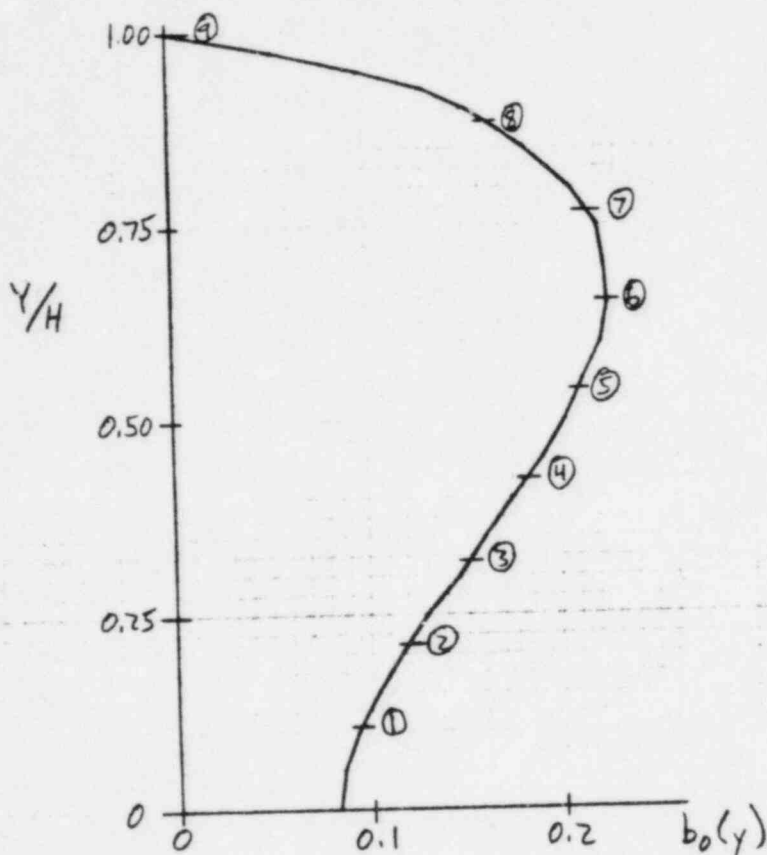
$$= 178.3 b_0(y) \quad \text{for } A_0(t) = 1g$$

TITLE Limerick
 BY RBN DATE 10/2/81
 CHKD. BY _____ DATE 11



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 9 OF _____ Job No. 14302
 COMMENTS Condensate
Storage Tank



Hydrodynamic Forces

$$\begin{aligned}
 F_1 &= 178.3 (0.0935 \times 4.0) = 66.7 \text{ k} \\
 F_2 &= 178.3 (0.119 \times 4.0) = 84.9 \text{ k} \\
 F_3 &= 178.3 (0.152 \times 4.0) = 108.4 \text{ k} \\
 F_4 &= 178.3 (0.182 \times 4.17) = 135.3 \text{ k} \\
 F_5 &= 178.3 (0.210 \times 4.33) = 162.3 \text{ k} \\
 F_6 &= 178.3 (0.225 \times 4.33) = 173.8 \text{ k} \\
 F_7 &= 178.3 (0.217 \times 4.33) = 167.7 \text{ k} \\
 F_8 &= 178.3 (0.164 \times 4.33) = 126.7 \text{ k} \\
 F_9 &= 178.3 (0.041 \times 2.17) = 15.8 \text{ k}
 \end{aligned}$$

Total Forces

$$\begin{aligned}
 P_1 + F_1 &= 67.3 \text{ k} \\
 P_2 + F_2 &= 86.1 \text{ k} \\
 P_3 + F_3 &= 110.2 \text{ k} \\
 P_4 + F_4 &= 137.6 \text{ k}
 \end{aligned}$$

TITLE LimerickBY RBN DATE 10/21/81CHKD. BY _____ DATE 11STRUCTURAL
MECHANICS
ASSOCIATESPAGE 10 OF _____ Job No. 14302COMMENTS CondensateStorage Tank

$$P_5 + F_5 = 165.0 \text{ k}$$

$$P_6 + F_6 = 177.0 \text{ k}$$

$$P_7 + F_7 = 171.3 \text{ k}$$

$$P_8 + F_8 = 130.6 \text{ k}$$

$$P_9 + F_9 = 20.0 \text{ k}$$

$$P_{10} + F_{10} = 8.3 \text{ k}$$

Deflected Shape due to Total Forces

See p. 11

Mode Shape Comparison

Node	Φ_{CALC}	Φ_{ASSUME}	% Dif.
10	1.0578	1.0523	0.52
9	1.0000	1.0000	0
8	0.9393	0.9368	0.27
7	0.8606	0.8592	0.16
6	0.7587	0.7625	-0.50
5	0.6348	0.6405	-0.89
4	0.4921	0.5040	-2.36
3	0.3698	0.3780	-2.17
2	0.2438	0.2520	-3.25
1	0.1190	0.1260	-5.56

OK

Fundamental Frequencies

Tank Frequency

Let $\lambda_i = (\Phi_i/\delta_i)g$ for $i=1-10$ (assumed mode shape) ($g=386.1 \text{ in/sec}^2$)

Then $\frac{1}{2\pi} \sqrt{(\lambda_i)_{\min}} < f < \frac{1}{2\pi} \sqrt{(\lambda_i)_{\max}}$

$(\Phi_i/\delta_i)_{\text{ave}} = 4.22 \text{ in}^{-1} \therefore f \approx \frac{1}{2\pi} \sqrt{4.22(386.1)} = \underline{6.42 \text{ Hz}}$

Slosh Frequency

Since $\frac{H}{a} = \frac{37.67}{15} = 2.51 > 1.5$, use $H = 1.5(15') = 22.5'$

TITLE Limerick
 BY RBN DATE 10/20/81
 CHKD. BY _____ DATE 11



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 11 OF _____ Job No. 143
 COMMENTS Condensate
Storage Tank

Node	t (in)	h (in)	P (k)	V (k)	M ($\times 10^3$ in-k)	Δ_V (in)	Δ_B (in)	$\Delta_V + \Delta_B$ (in)	δ (in)	θ (rad)
10			8.3		0				0.2543	2.625×10^{-4}
9	0.25	52		8.3	0.43	0.0003	0.0136	0.0139		
			20.0			0.0010	0.0136	0.0146	0.2404	2.624×10^{-4}
8	0.25	52	130.6	28.3	1.90	0.0054	0.0136	0.0189	0.2258	2.619×10^{-4}
7	0.25	52	171.3	158.9	10.17	0.0111	0.0133	0.0245	0.2069	2.595×10^{-4}
6	0.25	52	177.0	330.2	27.34	0.0171	0.0127	0.0298	0.1824	2.520×10^{-4}
5	0.25	52	165.0	507.2	53.71	0.0227	0.0116	0.0343	0.1526	2.357×10^{-4}
4	0.25	52	137.6	672.2	88.67	0.0202	0.0092	0.0294	0.1183	2.072×10^{-4}
3	0.3125	48	110.2	809.8	127.54	0.0229	0.0074	0.0303	0.0889	1.751×10^{-4}
2	0.3125	48	86.1	920.0	171.70	0.0251	0.0049	0.300	0.0586	1.300×10^{-4}
1	0.3125	48	67.3	1006.1	219.94	0.0267	0.0018	0.0286	0.0286	7.280×10^{-5}
0	0.3125	48		1073.4	271.51				0	0

TITLE Limerick
 BY RBN DATE 10/22/81
 CHKD. BY DATE 11



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 12 OF Job No. 14302
 COMMENTS Condensate
Storage Tank

$$f = \frac{1}{2\pi} \left[\frac{1.84g}{a} \tanh\left(\frac{1.84H}{a}\right) \right]^{\frac{1}{2}} = \frac{1}{2\pi} \left[\frac{1.84(386.4)}{180} \tanh(1.84 \cdot 1.5) \right]^{\frac{1}{2}}$$

$$= \frac{1}{2\pi} [3.95 \tanh(2.76)]^{\frac{1}{2}} = \underline{0.32 \text{ Hz}}$$

Median Tank Response

From the FSAR, 5% damping was used. Using the SSE spectrum:

$$A + f = 6.42 \text{ Hz} \quad , \quad S_a = 0.41g$$

$$A + f = 0.32 \text{ Hz} \quad , \quad S_a = 0.038g$$

Base Shear

$$Q_0 = C S_a \sum_{i=1}^{10} M_i \phi_i + Q_{0,e} \quad \quad Q_{0,e} = C(m_{x,e}) S_a$$

$$= 1.61(0.41) [4.81(0.1190 + 0.2438 + 0.3698) + 4.49(0.4921) + 4.17(0.6348 +$$

$$0.7587 + 0.8606 + 0.9393 + 1.0000) + 7.88(1.0578)] + 1.61(0.41) \cdot$$

$$(665.6)$$

$$= \underline{460.2 \text{ k}}$$

Shear due to sloshing:

$$W_c = 0.455 \left(\frac{g}{a} \right) W_t \tanh\left(1.84 \frac{H}{a}\right)$$

$$= 0.455 \left(\frac{15}{22.5} \right) (1659 \times \frac{22.5}{57.5}) \tanh\left(1.84 \cdot \frac{22.5}{15}\right)$$

$$= 298.2 \text{ k}$$

$$\therefore Q_c = 298.2(0.038) = \underline{11.3 \text{ k}}$$

$$\text{Total Base Shear} = 460.2 + 11.3 = \underline{471.5 \text{ k}}$$

Overturning Moment

$$M_0 = C \left(\frac{S_a}{g} \right) \left[\sum_{i=1}^{10} (W_i \phi_i + F_i) y_i \right] = 2.262 \times 10^4 \text{ k-ft}$$

Moment due to sloshing:

$$h_c = 22.5 \left[1 - \frac{\cosh(x) - 1}{x \sinh(x)} \right] + (37 \frac{2}{3} - 22.5) \quad , \quad x = 1.84 \left(\frac{22.5}{15} \right)$$

$$= 30.5'$$

TITLE Limerick
 BY RBN DATE 10/23/81
 CHKD. BY _____ DATE 11



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 13 OF _____ Job No. 14302
 COMMENTS Condensate
Storage Tank

$$\therefore M_c = (11.3)(30.5) = 0.034 \times 10^4 \text{ k-ft}$$

$$\text{Total Moment} = (2.262 + 0.034) \times 10^4 = \underline{2.296 \times 10^4 \text{ k-ft}}$$

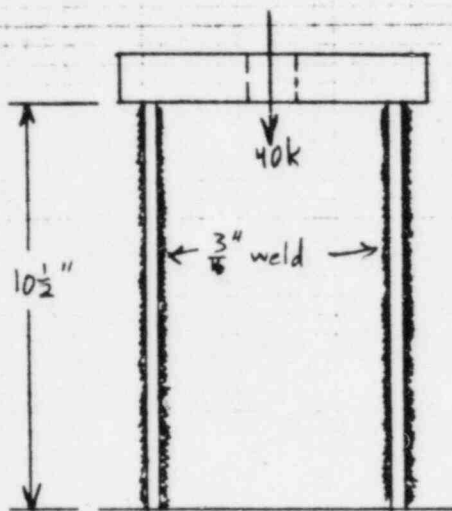
Anchor Bolt Capacity

Bolts are 1" ϕ and made of A-307 steel

$$\text{Tensile area} = 0.606 \text{ in}^2 \Rightarrow \bar{F}_s = 0.606(66) = \underline{40 \text{ k}}$$

Anchor Bolt Chairs

Load acts $2\frac{1}{8}$ " away from shell



Effective throat thickness:

$$a = 0.1875(0.707) = 0.13"$$

Total weld area:

$$A = 4(10.5)(0.13) = 5.46 \text{ in}^2$$

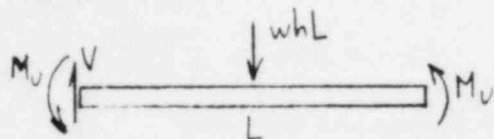
$$I = 4 \frac{(0.13)(10.5)^3}{12} = 50.2 \text{ in}^4$$

$$M = 2.125(40) = 85 \text{ in-k}$$

$$\therefore f_{\max} = \sqrt{\left[\frac{40}{5.46}\right]^2 + \left[\frac{85(5.25)}{50.2}\right]^2} = 11.5 \text{ ksi } \underline{\underline{OK}}$$

Base Plate Capacity

Base plate is 304 S.S. with $a = \frac{1}{4}$ ". It participates in resisting tensile shell forces by mobilizing the fluid weight above it. It will be assumed that the plate forms a plastic hinge where it is welded to the shell and where it contacts the foundation.



$$V = whL$$

$$M_u = \frac{a^2}{4} f_y$$

$$2M_u = wh\left(\frac{L^2}{2}\right) = \frac{a^2 f_y}{2}$$

$$\therefore L = a \sqrt{\frac{f_y}{wh}} = 0.25 \sqrt{\frac{38,000}{62.4(37\%)}} = 1.0' = 12"$$

TITLE Limerick
BY RBN DATE 10/23/81
CHKD. BY _____ DATE 11



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 14 OF _____ Job No. 14302
COMMENTS Condensate
Storage Tank

$$V = whL = 62.4(37\frac{2}{3} \times 1.0) = 2,350 \text{ lb/ft}$$

$$\text{Equivalent shell stress} = \frac{2350}{(0.3125 \times 12)} = 627 \text{ psi} = 0.627 \text{ ksi}$$

Equivalent shell stress for bolt load of 40 k:

Assume bolt spacing is 15°

$$\therefore \text{Area of shell in } 15^\circ = 2\pi(15 \times 12 \times 0.3125 \times \frac{15}{360}) = 14.73 \text{ in}^2$$

$$\therefore \sigma = \frac{40}{14.73} = 2.716 \text{ ksi}$$

$$\text{Total equivalent stress} = 2.716 + 0.627 = \underline{\underline{3.343 \text{ ksi}}}$$

Yield Moment

Yielding will begin when the anchor bolts begin to yield.
Base plate resistance is not yet mobilized.

Tank dead wt. = 47.65 k

$$\sigma = -\frac{P}{A} + \frac{Mc}{I} \Rightarrow M = \frac{I}{c}(\sigma + \frac{P}{A})$$

$$\sigma = 3.343 \text{ ksi}$$

$$P = 47.65 \text{ k}$$

$$A = 2\pi(15 \times 12 \times 0.3125) = 353.4 \text{ in}^2$$

$$\frac{I}{c} = \pi[(15 \times 12)]^2(0.3125) = 31,809 \text{ in}^3$$

$$\therefore M = 31,809(2.716 + \frac{47.65}{353.4}) = 90,682 \text{ k-in} = \underline{\underline{7,557 \text{ k-ft}}}$$

Ultimate Moment

Shell buckling governs the ultimate capacity. The buckling criteria on pp. MC-48 to MC-52A will be used.

$$Z = \frac{t^2}{R\lambda} \sqrt{1-\nu^2} = \frac{(8^2 \times 12^2)}{(15 \times 12 \times 0.3125)} \sqrt{1-0.3^2} = 156 > 80 \quad \text{OK for clamped edge}$$

$$\frac{R}{\lambda} = \frac{15(12)}{0.3125} = 576 \Rightarrow C_b \approx 0.23 \quad (\text{p. MC-52})$$

To account for the increase in buckling capacity due to pressurization, the average hydrostatic pressure in the bottom ring will be used.

$$h_{\text{avg}} = 33\frac{2}{3}' \Rightarrow P_{\text{avg}} = \frac{62.4(33.67)}{144} = 14.6 \text{ psi}$$

TITLE LimerickBY RBN DATE 10/23/81CHKD. BY _____ DATE 11STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 15 OF _____ JOB NO. 14302.6COMMENTS CondensateStorage Tank

$$\frac{P}{E} \left(\frac{R}{x} \right)^2 = \frac{14.6}{28.3 \times 10^6} (576)^2 = 0.17 \Rightarrow \Delta C_b \approx 0.26$$

$$\therefore C_b = 0.23 + 0.26 = 0.49$$

$$\bar{\sigma}_{cr,e} = 1.4 \eta C_b \frac{E}{R/x} = 1.4 (1.0) (0.49) \frac{28.3 \times 10^3}{576} = 33.7 \text{ ksi}$$

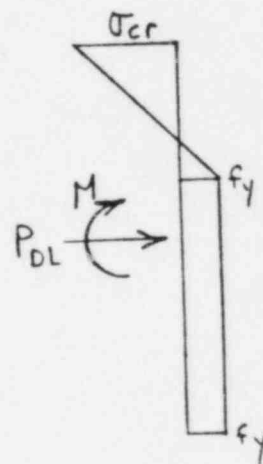
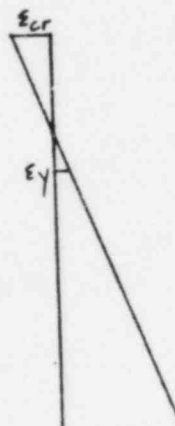
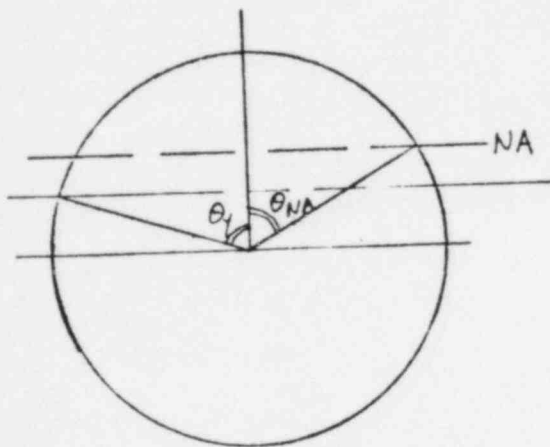
Check η

$$\eta = \frac{(\bar{\sigma}_y)(\bar{\sigma}_{cr,e})}{0.1836 \bar{\sigma}_y^2 + \bar{\sigma}_{cr,e}^2} = \frac{(38)(33.7)}{0.1836(38)^2 + 33.7^2} = 0.91 < 1$$

$$\therefore \bar{\sigma}_{cr,e} = 1.4 \left[\frac{38 \bar{\sigma}_{cr,e}}{0.1836(38)^2 + \bar{\sigma}_{cr,e}^2} \right] (0.49) \frac{28.3 \times 10^3}{576} \Rightarrow \bar{\sigma}_{cr,e} = \underline{31.9 \text{ ksi}}$$

$$\bar{\epsilon}_{cr} = \frac{\bar{\sigma}_{cr,e}}{E} = 0.00113$$

$$f_y = 3.343 \text{ ksi} \quad \epsilon_y = \frac{3.343}{28.3 \times 10^3} = 1.18 \times 10^{-4}$$



$$\epsilon = -\epsilon_{cr} \frac{R \cos \theta - R \cos \theta_{NA}}{R - R \cos \theta_{NA}} = \epsilon_{cr} \frac{\cos \theta_{NA} - \cos \theta}{1 - \cos \theta_{NA}}$$

$$\therefore \theta_y = \cos^{-1} \left[\cos \theta_{NA} - \frac{\epsilon_y}{\epsilon_{cr}} (1 - \cos \theta_{NA}) \right]$$

$$\therefore -P_{DL} = 2 \left[\int_0^{\theta_y} E_s \left(\epsilon_{cr} \frac{\cos \theta_{NA} - \cos \theta}{1 - \cos \theta_{NA}} \right) R t d\theta + \int_{\theta_y}^{\pi} f_y t R d\theta \right]$$

$$= 2 \left[\frac{E_s \epsilon_{cr} R t}{1 - \cos \theta_{NA}} \int_0^{\theta_y} (\cos \theta_{NA} - \cos \theta) d\theta + f_y R t \int_{\theta_y}^{\pi} d\theta \right]$$



$$-P_{DL} = 2 \left[\frac{E_s E_{cr} R t}{1 - \cos \theta_{NA}} (\theta_y \cos \theta_{NA} - \sin \theta_y) + f_y R t (\pi - \theta_y) \right]$$

$$= 2 \left[\frac{(28300)(0.00113)(180)(0.3125)}{1 - \cos \theta_{NA}} (\theta_y \cos \theta_{NA} - \sin \theta_y) + 3.343(180)(0.3125)(\pi - \theta_y) \right]$$

$$\therefore 3,597.6 \left(\frac{\theta_y \cos \theta_{NA} - \sin \theta_y}{1 - \cos \theta_{NA}} \right) + 376.1(\pi - \theta_y) + 47.65 = 0$$

$$\therefore \theta_{NA} = \underline{0.4427 \text{ rad.}} \quad \text{and} \quad \theta_y = \underline{0.4657 \text{ rad.}}$$

$$M_u = -2 \left[\int_0^{\theta_y} E_s E_{cr} \frac{\cos \theta_{NA} - \cos \theta}{1 - \cos \theta_{NA}} R t (R \cos \theta) d\theta + \int_{\theta_y}^{\pi} f_y t R (R \cos \theta) d\theta \right]$$

$$= -2 \left[\frac{E_s E_{cr} R^2 t}{1 - \cos \theta_{NA}} \int_0^{\theta_y} (\cos \theta_{NA} - \cos \theta) \cos \theta d\theta + f_y R^2 t \int_{\theta_y}^{\pi} \cos \theta d\theta \right]$$

$$= -2 R^2 t \left[\frac{E_s E_{cr}}{1 - \cos \theta_{NA}} \left(\cos \theta_{NA} \sin \theta_y - \frac{\theta_y}{2} - \frac{\sin 2\theta_y}{4} \right) - f_y \sin \theta_y \right]$$

$$\therefore M_u = 216,508 \text{ in-k} = \underline{18,042 \text{ ft-k}}$$

$$\text{From p. 13, } M_s = 22,960 \text{ ft-k} \Rightarrow \bar{F}_s = \frac{18,042}{22,960} = \underline{0.79}$$

$$\text{From p. MC-50: } \beta_R = 0.10 \text{ and } \beta_u = 0.24$$

Inelastic Energy Absorption

An effective ductility ratio of 1.3 will be used. The following is from Ref. 27.

Median damping is assumed to be 7% $\Rightarrow \beta = 7$

$$q = 3.00 \beta^{0.30} = 1.673$$

$$p = q + 1 = 2.673$$

$$r = 0.48 \beta^{0.08} = 0.411$$

$$\therefore \bar{F}_u = \frac{1}{\phi_u} = [2.673(1.3) - 1.673]^{0.411} = \underline{1.27}$$

$$\beta_{uR} \approx 0.05 \Rightarrow \beta_R = \frac{0.411(2.673)(0.05)(1.3)}{2.673(1.3) - 1.673} = \underline{0.04}$$



$$\beta_{nu} \approx 0.15 \Rightarrow \beta_u = 0.04 \left(\frac{0.15}{0.05} \right) = \underline{0.12}$$

Damping

From p. M-12, 5% damping is considered to be at 10.
 Comparing the WASH-1255 5% spectra to the 7% spectra
 at $F = 6.42 \text{ Hz}$, $\beta_c = \ln\left(\frac{0.265}{0.245}\right) = 0.078$

$$\text{From p. M-11, } \beta_R = \frac{\beta_c}{\sqrt{1.25}} = \underline{0.07} \text{ and } \beta_u = \frac{\beta_R}{2} = \underline{0.04}$$

Spectral Shape

The spectral shape factor will be based on the fundamental tank frequency of 6.42 Hz.

Acceleration from WASH-1255 7% spectrum = 0.245g
 " " Limerick 5% " = 0.41g

$$\therefore \ddot{F}_{ss} = \frac{0.41}{0.245} = \underline{1.67}$$

Randomness

Acceleration from 84.1 percentile WASH-1255 7% damped spectrum at 6.42 Hz is 0.289g.

$$\therefore \beta_R = \ln\left(\frac{0.289}{0.245}\right) = \underline{0.17}$$

Modelling

$$\text{From p. M-14, } \beta_f = 0.20 \Rightarrow f_{1g} = 6.42 e^{0.20} = 7.84 \text{ Hz}$$

Acceleration from WASH-1255 7% damped spectrum at 7.84 Hz = 0.222

$$\therefore \beta_{mf} = \ln\left(\frac{0.245}{0.222}\right) = 0.10$$

$$\beta_{ms} = 0.10 \text{ (p. M-14)} \quad \therefore \beta_u = \sqrt{0.10^2 + 0.10^2} = \underline{0.14}$$

Modal Combination

According to the FSAR, the modal responses are combined by the sum of the absolute sum method. The SRSS method is considered to be median centered.

$$\therefore \ddot{F}_{MC} = \frac{22960}{\sqrt{22620^2 + 340^2}} = \underline{1.02}$$

TITLE LimerickBY RBN DATE 10/26/81CHKD. BY _____ DATE 11STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 18 OF _____ Job No. 14302COMMENTS CondensateStorage Tank

$$\beta_R \approx \frac{1}{3} \ln \left(\frac{22960}{22620} \right) = \underline{0.01}$$

Combination of Earthquake Components

From the FSAR, the response is given by the greatest horizontal response combined absolutely with the vertical response. From p. M-17, the median response is considered to be the vector sum of 100% of the response due to the principal component and 40% of the responses due to the two orthogonal components. Since the vertical response is negligible:

$$\check{F}_{Ec} = \frac{1}{\sqrt{1.0^2 + 0.4^2}} = \underline{0.93}$$

$$\beta_R = \frac{1}{3} \ln \sqrt{\frac{2}{1^2 + 0.4^2}} = \underline{0.09}$$

Soil - Structure Interaction

The foundation rests on 18" min. of either fillcrete or structural backfill. This, in turn, rests on bedrock. The total depth to bedrock is about 15'. This is not expected to cause any amplification.

$$\therefore \check{F}_{ss} = 1.0$$

$$\beta_R = 0$$

$$\beta_U = 0.05 \text{ (estimated)}$$

TITLE Limerick
 BY RBN DATE 10/26/81
 CHKD. BY _____ DATE 11



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 19 OF _____ Job No. 2432

COMMENTS Condensate

Storage Tank

Item	Median P.S.	β_e	β_u	β_c
Strength	0.79	0.10	0.24	0.2
Inelastic Energy Absorption	1.27	0.04	0.12	0.1
Spectral Shape	1.67	0.17	0	0.1
Damping	1.0	0.07	0.04	0.0
Modelling	1.0	0	0.14	0.1
Model Combination	1.02	0.01	0	0.0
Combination of Earthquake Components	0.93	0.09	0	0.0
Soil-Structure Interaction	1.0	0	0.05	0.0
Total	1.59	0.23	0.31	0.3

Median Acceleration Capacity = $1.59(0.15g) = 0.24g$

TITLE Limerick PRABY CSA DATE 9/5/82CHKD. BY ELS DATE 9/5/82STRUCTURAL
MECHANICS
ASSOCIATESPAGE 1 OF Job No. COMMENTS 14302.01Reactor Internal Summary

1.) Capacity Factor

$$F_C = 2.98$$

$$\beta_{CR} = 0.11$$

$$\beta_{Cu} = 0.27$$

2.) Equipment Response Factor

$$F_{ER} = 1.50$$

$$\beta_{ER_R} = 0.25$$

$$\beta_{ER_u} = 0.19$$

3.) Structural Response Factor

$$F_{SR} = 1.0$$

$$\beta_{SR_R} = 0.0$$

$$\beta_{SR_u} = 0.05$$

Since a time history analysis was performed, only the soil structure interaction factor applies.

Ground Acceleration Capacity

$$\ddot{A} = 2.98 \times 1.0 \times 1.5 \times 0.15g = 0.67g$$

$$\beta_R = (0.11^2 + 0.25^2 + 0.0^2)^{1/2} = 0.28$$

$$\beta_u = (0.27^2 + 0.19^2 + 0.05^2)^{1/2} = 0.32$$

$$\beta_C = (0.27^2 + 0.33^2)^{1/2} = 0.43$$

TITLE Limerick PRABY RPC DATE 9/15/82CHKD. BY Cal H DATE 9/15/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 2 OF Job No. COMMENTS Shroud SupportSource = GE Meeting with
R.D. CampbellFor Limerick the most critically stressed
location is the jet pump support plate,Design Loads and Stresses

$$P_c = 33,640 \text{ psi for } H = 1824 \text{ k}$$

Wave Loads

$$SSE = 1184 \text{ k}$$

$$SRV = 249 \text{ k for Susquehanna, Limerick}$$

Load unknown.

Per conversations with NUS, the control rods
will be fully inserted before the SRV's discharge,
failure mode of concern is failure to screw
due to core misalignment, therefore, ignore SRV.

$$\sigma_{y, \text{code}} = 18.2 \text{ ksi} \quad \frac{\sigma_y}{\sigma_{y, \text{code}}} = 1.25 (18.2) \quad \text{median yield}$$

Assume gross plasticity at shape factor of 1.5 for local
membrane. (per ASME code criteria)

Also allow for strain hardening of material. ($F_{SH} \approx 1.1$)

$$F_s = \frac{1.25 (18.2) (1.5) (1.1)}{21.836} = 1.72$$

$$SSE \text{ stress} = \frac{1184}{1824} = 0.65$$

TITLE _____
BY RDC DATE 9/5/82
CHKD. BY ECS DATE 9/15/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 3 OF _____ JOB NO. _____
COMMENTS _____

Shroud at Lower Support

Estimate β 's

Bar material $T_y = 0.14$ from literature.
 $\beta_R = 0.05$ $\beta_U = 0.13$

Product of shape factor and strain hardening factor
is $1.5(1.1) = 1.65$

Assume that 1.2 is about a 95% bound (-1.65σ)

$$\beta = \frac{\ln \frac{1.65}{1.2}}{1.65} = 0.19 \quad - \beta_U$$

$$\beta_R = \sqrt{0.19^2 + 0.19^2} = 0.24$$

$$\left. \begin{array}{l} \beta_R = 0.05 \\ \beta_U = 0.23 \end{array} \right\} \text{ (Engineering Judgement) }$$

Structural Response Factors are the same as for the Reactor Internals,
* CRD Guide Tubes & Fuel Rods.

TITLE Limerick PRA
 BY ASH DATE 6/16/82
 WRO. BY RK DATE 9/5/82



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 1 OF Job No.
 COMMENTS

✓ ECE 4/5/82

Shroud Support (Cont.)

Ductility

Assume $\mu = 2.0$ median due to large amount of plastic deformation occurring in internal components at this acceleration level.

$$\therefore F_M = \sqrt{\mu - 1} = 1.73$$

$$\beta_M' = \pm \ln \frac{1.73}{1.22} = 0.37$$

$$\beta_e = 0.02 \quad (\text{from Basic Calc.})$$

$$\beta_M = (0.17^2 + 0.02^2)^{1/2} = 0.17$$

$$-2\beta \approx \mu = 1.25$$

$$F_{Mip} = 1.22$$

$$\beta_{M_R} = 0.10 \quad \beta_{M_U} = 0.14$$

$$\therefore F_C = 1.72 \times 1.73 = 2.98$$

$$\beta_C = (0.29^2 + 0.17^2)^{1/2} = 0.29$$

$$\beta_R = (0.05^2 + 0.10^2)^{1/2} = 0.11$$

$$\beta_U = (0.23^2 + 0.14^2)^{1/2} = 0.27$$

$$\ddot{A} = 110(1.5)(2.98)(0.15) = 0.67 \text{ g}$$

$$\beta_C = (0.05^2 + 0.31^2 + 0.29^2)^{1/2} = 0.43$$

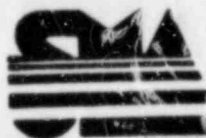
$$\beta_R = (0 + 0.25^2 + 0.11^2)^{1/2} = 0.27$$

$$\beta_U = (0.05^2 + 0.19^2 + 0.27^2)^{1/2} = 0.33$$

TITLE Response Factors

BY M. K. Rasmussen DATE 10/15/81

CHKD. BY GAH DATE 9/12/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 18 OF Job No.

COMMENTS

EQUIPMENT RESPONSE FACTOR FOR RPV INTERNALS
CRD HOUSINGS AND GUIDE TUBES

All components are modeled in Time History Analysis Model (FSAR FIGURE 3.7-19)

Spectral Shape Factor

See derivation for Primary Containment, Shield wall and RPV Support.

$$\check{F}_{SS} = 1.24 \quad \beta_{SS} = \beta_R = 0.22.$$

Qualification Method

Time history analysis is median centered; Uncertainty is due to modeling, damping, earthquake component combination, etc.

$$\check{F}_{QM} = 1.0 \quad \beta_{QM} = 0$$

Damping

RPV and internals : 2% damping is used in design. 5% is considered a median value.

From FSAR Figure 3.7-31

$f_n = 4.5 \text{ Hz}$ for dominant RPV pedestal mode for concrete structures. 5% damping used in analysis. 10% is considered median

Use median spectrum for damping factor and β evaluation.

TITLE: Response FactorsBY: MKR DATE: 10/15/87CHKD. BY: ASH DATE: 9/12/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 14 OF Job No. COMMENTS

✓ ECS 9/15/82

Since we do not have the response spectra for RPV Pedestal at these damping levels, we use WASH 1255 spectra.

$$\bar{F}_D = \frac{S_{a5\%}}{S_{a10\%}} \text{ at } f_n = \frac{2.12}{1.63} = 1.30$$

$$\beta_D = \ln \left(\frac{S_{a7\%}}{S_{a10\%}} \right) = \ln \left(\frac{1.30}{1.63} \right) = 0.15$$

$$\beta_R = 0.10 \quad \beta_U = 0.11$$

Modeling Error

$$\bar{F}_{ME} = 1.0$$

For MDOF systems, $\beta_{ME} = 0.15 = \beta_U$

Mode Combination

Does not apply. T/H analysis

Combination of Earthquake Components

Case 3, 2D Horizontal, Uncoupled

$$\bar{F}_{ECC} = 0.93 \quad \beta_{ECC} = \beta_R = 0.06$$

Combined Response Factor

$$\bar{F}_R = (1.24)(1.0)(1.30)(1.0)(0.93) = 1.50$$

$$\beta_{\text{Composite Response}} = (0.22^2 + 0 + 0.15^2 + 0.15^2 + 0.06^2)^{1/2} = 0.31$$

$$\beta_R = (0.22^2 + 0.06^2 + 0.06^2)^{1/2} = 0.25$$

$$(0.22^2 + 0.06^2 + 0.06^2)^{1/2} = 0.19$$

TITLE Limerick
 BY RBN DATE 12/8/81
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 1 OF _____ Job No. 14302
 COMMENTS Reactor + Containment
Buildings

The model in the FSAR and the model that Bechtel has for October, 1981, are exact except that node 1 in the FSAR model can rotate and translate while node 1 of Bechtel's model can not. Bechtel's model will be used for this analysis. The fixed-base cases for E-W and N-S will be used for frequencies and mode shapes.

Bechtel used $E_c = 840,000 \text{ ksf}$ for concrete. The calculated median value from p. MS-7 is $E = 4.51 \times 10^6 \text{ psi} = 649,000 \text{ ksf}$. Therefore, Bechtel frequencies will be scaled by $\sqrt{649/840} = 0.879$ to determine the median frequencies. The nodal weights used by Bechtel are:

$$W_2 = 26,725 \text{ k}$$

$$W_6 = 5,005 \text{ k}$$

$$W_{10} = 8,070 \text{ k}$$

$$W_3 = 36,515 \text{ k}$$

$$W_7 = 33,685 \text{ k}$$

$$W_{11} = 65,275 \text{ k}$$

$$W_4 = 4,605 \text{ k}$$

$$W_8 = 5,115 \text{ k}$$

$$W_{12} = 27,055 \text{ k}$$

$$W_5 = 35,065 \text{ k}$$

$$W_9 = 64,695 \text{ k}$$

$$\text{Total } W = \underline{\underline{311,810 \text{ k}}}$$

The 5% damped SSE response spectra will be used.

N-S Direction

Mode 1

$$f_{BEC} = 3.30 \text{ Hz} \Rightarrow \check{f} = 2.90 \text{ Hz}, \text{ Acc.} = 0.41 \text{ g}, \text{ Part. Fac.} = 87.5\%$$

Node	Mode Shape	Accel.	Node	Mode Shape	Accel.
2	0.001466	0.0827g	8	0.009869	0.3544g
3	0.002687	0.0965g	9	0.01065	0.3828g
4	0.004425	0.1589g	10	0.01194	0.4288g
5	0.005586	0.2006g	11	0.01328	0.4769g
6	0.006873	0.2476g	12	0.01696	0.6091g
7	0.008059	0.2894g			

TITLE Limerick
 BY RBN DATE 12/8/81
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 2 OF _____ Job No. 14302
 COMMENTS Reactor + Control
Buildings

Mode 1 (N-S)

$f_{BEC} = 3.30 \text{ Hz} \Rightarrow \ddot{y} = 2.90 \text{ Hz}$, Acc. = 0.410g , Part. Fac. = 87.596

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'	0.01696	0.6091g	16,479 k	16,479 k	0
11	65,275	175.0	20.0	0.01328	0.4769	31,130	47,609	955,782 k-ft
10	8,070	155.0	19.0	0.01194	0.4288	3,460	51,069	1,907,962
9	64,695	136.0	9.0	0.01065	0.3825	24,746	75,815	2,878,273
8	5,115	127.0	21.0	0.009869	0.3544	1,813	77,628	3,560,608
7	33,685	106.0	14.0	0.008059	0.2894	9,748	87,376	5,190,396
6	5,005	92.0	16.0	0.006893	0.2476	1,239	88,615	6,414,060
5	35,065	76.0	14.0	0.005586	0.2006	7,034	95,649	7,831,900
4	4,605	62.0	22.0	0.004425	0.1589	732	96,381	9,170,986
3	36,515	40.0	16.0	0.002687	0.0965	3,524	99,905	11,291,368
2	26,725	24.0	24.0	0.001466	0.0527	1,408	101,313	12,889,848
1	0	0.0		0	0	0		15,321,360

TITLE Limerick
 BY RBN DATE 12/8/81
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 3 OF _____ Job No. 14302
 COMMENTS Reactor + Control
Buildings

Mode 2 (1st)

$f_{BEC} = 8.98 \text{ Hz} \Rightarrow \ddot{y} = 7.89 \text{ Hz}$, Acc. = 0.410g , Part. Fac. = 29.086

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'	-0.02635	-0.3142g	-8,501 k	-8,501 k	0
11	65,275	175.0	20.0	0.000015	0.0002	13	-8,488	-493,058 k-ft
10	8,070	155.0	19.0	0.004234	0.0505	408	-8,080	-662,818
9	64,695	136.0	9.0	0.007935	0.0946	6,120	-1,960	-816,338
8	5,115	127.0	21.0	0.008659	0.1033	528	-1,432	-833,978
7	33,685	106.0	14.0	0.009994	0.1192	4,015	2,583	-864,050
6	5,005	92.0	16.0	0.009852	0.1175	588	3,171	-827,888
5	35,065	76.0	14.0	0.009431	0.1125	3,945	7,116	-777,152
4	4,605	62.0	22.0	0.008135	0.0970	447	7,563	-677,528
3	36,515	40.0	16.0	0.005797	0.0691	2,523	10,086	-511,142
2	26,725	24.0	24.0	0.003403	0.0406	1,085	11,171	-349,766
1	0	0.0		0	0	0		-81,662

TITLE Limerick
 BY RBN DATE 12/8/81
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 4 OF _____ Job No. 14302.1
 COMMENTS Reactor + Control
Buildings

Mode 3 (1st)

$f_{BEC} = 13.72 \text{ Hz} \Rightarrow \ddot{y} = 12.11 \text{ Hz}$, Acc. = 0.349g, Part. Fac. = -24.742

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'	-0.01380	0.1192g	3,225 k	3,225 k	0
11	65,275	175.0	20.0	0.01263	-0.1091	-7,122	-3,897	187,050 k-ft
10	8,070	155.0	19.0	0.007682	-0.0663	-535	-4,432	109,110
9	64,695	136.0	9.0	0.002312	-0.0200	-1,294	-5,726	24,902
8	5,115	127.0	21.0	-0.000902	0.0078	40	-5,686	-26,632
7	33,685	106.0	14.0	-0.008324	0.0719	2,422	-3,264	-146,038
6	5,005	92.0	16.0	-0.01098	0.0948	474	-2,790	-191,734
5	35,065	76.0	14.0	-0.01354	0.1169	4,099	1,309	-236,374
4	4,605	62.0	22.0	-0.01284	0.1109	511	1,820	-218,048
3	36,515	40.0	16.0	-0.01102	0.0952	3,476	5,296	-178,008
2	26,725	24.0	24.0	-0.006859	0.0592	1,582	6,878	-93,272
1	0	0.0		0	0	0		71,800

TITLE LimerickBY RBNDATE 12/18/81

CHKD. BY

DATE 1/1STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 5 OF Job No. 14302COMMENTS Reactor + Control
BuildingsMode 4 (11-5) $f_{BEC} = 19.39 \text{ Hz} \Rightarrow \check{f} = 17.04 \text{ Hz}$

, Acc. = 0.262g , Part. Fac. = -16.615

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'	0.004161	-0.0181g	-490 k	-490 k	0
11	65,275	175.0	20.0	-0.01150	0.0501	3,270	2,780	-28,420 k-ft
10	8,070	155.0	19.0	0.001230	-0.0054	-44	2,736	27,180
9	64,695	136.0	9.0	0.01306	-0.0569	-3,681	-945	79,164
8	5,115	127.0	21.0	0.01120	-0.0488	-250	-1,195	70,659
7	33,685	106.0	14.0	0.005544	-0.0241	-812	-2,007	45,564
6	5,005	92.0	16.0	-0.000105	0.0005	3	-2,004	17,466
5	35,065	76.0	14.0	-0.006583	0.0287	1,006	-998	-14,598
4	4,605	62.0	22.0	-0.009446	0.0411	189	-809	-28,570.
3	36,515	40.0	16.0	-0.01305	0.0568	2,074	1,265	-46,368
2	26,725	24.0	24.0	-0.009135	0.0398	1,064	2,329	-26,128
1	0	0.0		0	0	0		29,768

Mode 5 (N-S)

$$f_{BEC} = 25.90 \text{ Hz} \Rightarrow \ddot{y} = 22.77 \text{ Hz}, \text{ Acc.} = 0.205g, \text{ Part. Fac.} = -13.913$$

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'		-0.000653	0.0019g	51 k		0
			58.0'				51 k	
11	65,275	175.0		0.003284	-0.0094	-614		2,958 k-ft
			20.0				-563	
10	8,070	155.0		-0.003772	0.0108	87		-8,302
			19.0				-476	
9	64,695	136.0		-0.009402	0.0268	1,734		-17,346
			9.0				1,258	
8	5,115	127.0		-0.002540	0.0072	37		-6,024
			21.0				1,295	
7	33,685	106.0		0.01395	-0.0398	-1,341		21,171
			14.0				-46	
6	5,005	92.0		0.01351	-0.0385	-193		20,527
			16.0				-239	
5	35,065	76.0		0.01125	-0.0321	-1,126		16,703
			14.0				-1,365	
4	4,605	62.0		0.000883	-0.0025	-12		-2,407
			22.0				-1,377	
3	36,515	40.0		-0.01550	0.0442	1,614		-32,701
			16.0				237	
2	26,725	24.0		-0.01359	0.0388	1,037		-28,909
			24.0				1,274	
1	0	0.0		0	0	0		1,667

TITLE Limerick
 BY RBN DATE 12/8/81
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 7 OF _____ Job No. 14302
 COMMENTS Reactor + Control
Buildings

Mode 6 (1-5)

$f_{BEC} = 35.60 \text{ Hz} \Rightarrow \ddot{y} = 31.29 \text{ Hz}$, Acc. = 0.157g , Part. Fac. = -4.469

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'	0.000099	-0.00019	-3k	-3k	0
11	65,275	175.0	20.0	-0.000853	0.0006	39	36	-174 k-ft
10	8,070	155.0	19.0	0.002740	-0.0019	-15	21	546
9	64,695	136.0	9.0	0.004738	-0.0033	-213	-192	945
8	5,115	127.0	21.0	-0.003363	0.0024	12	-180	-783
7	33,685	106.0	14.0	-0.02101	0.0147	495	315	-4,563
6	5,005	92.0	16.0	-0.002689	0.0019	10	325	-153
5	35,065	76.0	14.0	0.01887	-0.0132	-463	-138	5,047
4	4,605	62.0	22.0	0.01099	-0.0077	-35	-173	3,115
3	36,515	40.0	16.0	-0.004722	0.0033	120	-53	-691
2	26,725	24.0	24.0	-0.008264	0.0058	155	102	-1,539
1	0	0.0		0	0	0		909

TITLE Limerick
 BY RBN DATE 12/8/81
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 5 OF _____ Job No. 14302
 COMMENTS Reactor + Control
Buildings

Mode 7 + Higher (N-5)

$f_{BEC} = \Rightarrow \checkmark \geq 33 \text{ Hz}$

Acc. = 0.15g, Part. Fac. = —

$1 - \sum_{i=1}^n \Gamma_i \phi_i$

Node	Nodal Wt.	Height	ΔH_t	Mult. S	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'	-0.0002	0.0g	0	0	0
11	65,275	175.0	20.0	-0.0004	-0.0001	-7k	-7k	0
10	8,070	155.0	19.0	0.0012	0.0002	2	-5	-140 k-ft
9	64,695	136.0	9.0	0.0009	0.0001	6	1	-235
8	5,115	27.0	21.0	-0.0029	-0.0004	-2	-1	-226
7	33,685	106.0	14.0	-0.0103	-0.0015	-51	-52	-247
6	5,005	92.0	16.0	0.0122	0.0018	9	-43	-975
5	35,065	76.0	14.0	0.0328	0.0049	172	129	-1,663
4	4,605	62.0	22.0	-0.0375	-0.0056	-26	103	143
3	36,515	40.0	16.0	-0.1302	-0.0195	-712	-609	2,409
2	26,725	24.0	24.0	0.2251	0.0338	903	294	-7,335
1	0	0.0		1.00	0.15	0		-279

N-S Combined Responses ($R = \sum_{i=1}^7 1r_i$)

Mode

$F_{BFC} =$

$\Rightarrow \ddot{F} =$

$\text{Acc.} =$

$\text{Part. Fac.} =$

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'			1.0626g			0
11	65,275	175.0	58.0'		0.6464		28,749k	1,667,442 k-ft
10	8,070	155.0	20.0		0.5639		63,380	2,716,058
9	64,695	136.0	19.0		0.5842		66,819	3,817,203
8	5,115	127.0	9.0		0.5243		85,897	4,498,910
7	33,685	106.0	21.0		0.5606		87,417	6,272,429
6	5,005	92.0	14.0		0.5026		95,643	7,472,803
5	35,065	76.0	16.0		0.5089		97,187	8,883,437
4	4,605	62.0	14.0		0.4237		106,704	10,100,797
3	36,515	40.0	22.0		0.3846		108,226	12,062,687
2	26,725	24.0	16.0		0.2707		117,451	13,396,797
1	0	0.0	24.0		0.1500		123,361	15,507,445

TITLE Limerick
 BY RBN DATE 12/19/81
 CADD. BY DATE 11



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A CORP. OFF.

PAGE 9 OF 14 Job No. 143021
 COMMENTS Reactor + Control
Buildings

N-S SRSS Combined Responses

Mode

~~$F_{BFC} =$~~

~~$\Rightarrow \frac{V}{F} =$~~

~~$A_{acc.} =$~~

~~$, Part. Fac. =$~~

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'			0.6959g			0
11	65,275	175.0	58.0'		0.4919		18,827 k	1,091,984 k-ft
10	8,070	155.0	20.0		0.4370		48,599	2,022,958
9	64,695	136.0	19.0		0.3995		51,968	2,993,001
8	5,115	127.0	9.0		0.3725		76,073	3,657,757
7	33,685	106.0	21.0		0.3248		77,869	5,264,486
6	5,005	92.0	14.0		0.2926		87,499	6,470,166
5	35,065	76.0	16.0		0.2619		88,739	7,873,945
4	4,605	62.0	14.0		0.2208		95,937	9,198,609
3	36,515	40.0	22.0		0.1695		96,708	11,304,476
2	26,725	24.0	16.0		0.1104		100,562	12,894,991
1	0	0.0	24.0		0.1500		102,194	15,321,775

TITLE Limerick
 BY RBN DATE 12/9/81
 CHKD. BY DATE 11



PAGE 10 OF 14302 Job No.
 COMMENTS Reactor + Control Buildings

TITLE Limerick
 BY RBN DATE 12/9/81
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 11 OF _____ Job No. 14302.1
 COMMENTS Reactor + Control
Buildings

Mode 1 (E-W)

$f_{BEC} = 4.14 \text{ Hz} \Rightarrow \ddot{y} = 3.64 \text{ Hz}$, Acc. = $0.410g$, Part. Fac. = 88.327

Node	Nodal Wt.	Height	$\Delta Ht.$	Mode Shape	Accel.	Inertio Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'	0.01589	0.5754g	15,567 k	15,567 k	0
11	65,275	175.0	20.0	0.01339	0.4849	31,652	47,219	902,886 k-ft
10	8,070	155.0	19.0	0.01212	0.4389	3,542	50,761	1,847,266
9	64,695	136.0	9.0	0.01088	0.3940	25,490	76,251	2,811,725
8	5,115	127.0	21.0	0.01015	0.3676	1,880	78,131	3,497,984
7	33,685	106.0	14.0	0.008461	0.3064	10,321	88,452	5,138,135
6	5,005	92.0	16.0	0.007243	0.2623	1,313	89,765	6,377,063
5	35,065	76.0	14.0	0.005862	0.2123	7,444	97,209	7,813,303
4	4,605	62.0	22.0	0.004601	0.1666	767	97,976	9,174,229
3	36,515	40.0	16.0	0.002673	0.0968	3,535	101,511	11,329,701
2	26,725	24.0	24.0	0.001544	0.0559	1,494	103,005	12,953,877
1	0	0.0		0	0	0		15,425,997

TITLE Limerick
 BY RBN DATE 12/9/81
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A CALIF. CORP.

PAGE 12 OF _____ Job No. 14302
 COMMENTS Reactor + Control
Buildings

Mode 2 (E-W)

$f_{BFC} = 12.28 \text{ Hz} \Rightarrow \ddot{y} = 10.79 \text{ Hz}$, Acc. = 0.385g , Part. Fac. = -29.595

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'	0.02307	-0.2629g	-7,113k	-7,113k	0
11	65,275	175.0	20.0	0.003861	-0.0440	-2,872	-9,985	-412,554 k-ft
10	8,070	155.0	19.0	-0.002238	0.0255	206	-9,779	-612,254
9	64,695	136.0	9.0	-0.007806	0.0889	5,751	-4,028	-798,055
8	5,115	127.0	21.0	-0.009025	0.1028	526	-3,502	-834,307
7	33,685	106.0	14.0	-0.01148	0.1308	4,406	904	-907,849
6	5,005	92.0	16.0	-0.01164	0.1326	664	1,568	-895,193
5	35,065	76.0	14.0	-0.01149	0.1309	4,590	6,158	-870,105
4	4,605	62.0	22.0	-0.009858	0.1123	517	6,675	-783,893
3	36,515	40.0	16.0	-0.006888	0.0785	2,866	9,541	-637,043
2	26,725	24.0	24.0	-0.004311	0.0491	1,312	10,853	-484,387
1	0	0.0		0	0	0		-223,915

TITLE Limerick
 BY RBN DATE 12/9/81
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 13 OF _____ Job No. 14302
 COMMENTS Reactor + Control
Buildings

Mode 3 (E-W)

$f_{BEC} = 18.52 \text{ Hz} \Rightarrow \ddot{y} = 16.78 \text{ Hz}$, Acc. = 0.272g , Part. Fac. = -21.451

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'	-0.01846	0.1077g	2,914 k	2,914 k	0
11	65,275	175.0	20.0	0.01070	-0.0624	-4,073	-1,159	169,012 k-ft
10	8,070	155.0	19.0	0.008375	-0.0489	-395	-1,554	145,832
9	64,695	136.0	9.0	0.005212	-0.0304	-1,967	-3,521	116,306
8	5,115	127.0	21.0	0.002110	-0.0123	-63	-3,584	84,617
7	33,685	106.0	14.0	-0.005313	0.0310	1,044	-2,540	9,353
6	5,005	92.0	16.0	-0.008849	0.0516	258	-2,282	-26,207
5	35,065	76.0	14.0	-0.01247	0.0728	2,553	271	-62,719
4	4,605	62.0	22.0	-0.01213	0.0708	326	597	-58,925
3	36,515	40.0	16.0	-0.01085	0.0633	2,311	2,908	-45,791
2	26,725	24.0	24.0	-0.007210	0.0421	1,125	4,033	737
1	0	0.0		0	0	0		97,529

TITLE LimerickBY RBN DATE 12/9/81CHKD. BY DATE STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 14 OF Job No. 14302COMMENTS Reactor + Control
BuildingsMode 4 (E-W)
 $f_{BEC} = 23.72 \text{ Hz} \Rightarrow \ddot{y} = 20.85 \text{ Hz}$, Acc. = 0.221g , Part. Fac. = -16.425

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Int. to Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'	0.007970	-0.0289g	-782 k	-782 k	0
11	65,275	175.0	20.0	-0.01257	0.0456	2,977	2,195	-45,356 k-ft
10	8,070	155.0	19.0	-0.000082	0.0003	2	2,197	-1,456
9	64,695	136.0	9.0	0.01180	-0.0428	-2,769	-572	40,287
8	5,115	127.0	21.0	0.01039	-0.0377	-193	-765	35,139
7	33,685	106.0	14.0	0.006010	-0.0218	-734	-1,499	19,074
6	5,005	92.0	16.0	0.000412	-0.0015	-8	-1,507	-1,912
5	35,065	76.0	14.0	-0.006011	0.0218	764	-743	-26,024
4	4,605	62.0	22.0	-0.008849	0.0321	148	-595	-36,426
3	36,515	40.0	16.0	-0.01239	0.0450	1,643	1,048	-49,516
2	26,725	24.0	24.0	-0.009007	0.0327	874	1,922	-32,748
1	0	0.0		0	0	0		13,380

TITLE Limerick
 BY RBN DATE 12/9/81
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 15 OF _____ Job No. 14302
 COMMENTS Reactor + Control
Buildings

Mode 5 (E-W)

$f_{BEC} = 31.28 \text{ Hz} \Rightarrow \ddot{y} = 27.50 \text{ Hz}$, Acc. = 0.175g, Part. Fac. = -14.386

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'	-0.001013	0.0026g	70k	70k	0
11	65,275	175.0	20.0	0.003423	-0.0086	-561	-491	4,060 k-ft
10	8,070	155.0	19.0	-0.003686	0.0093	75	-416	-5,760
9	64,695	136.0	9.0	-0.009380	0.0236	1,527	1,111	-13,664
8	5,115	127.0	21.0	-0.002908	0.0073	37	1,148	-3,665
7	33,685	106.0	14.0	0.01270	-0.0320	-1,078	70	20,443
6	5,005	92.0	16.0	0.01333	-0.0336	-168	-98	21,423
5	35,065	76.0	14.0	0.01224	-0.0308	-1,080	-1,178	19,855
4	4,605	62.0	22.0	0.001489	-0.0037	-17	-1,195	3,363
3	36,515	40.0	16.0	-0.01565	0.0394	1,439	244	-22,927
2	26,725	24.0	24.0	-0.01372	0.0345	922	1,166	-19,023
1	0	0.0		0	0	0		8,961

TITLE LimerickBY RBN DATE 12/9/81CHKD. BY DATE STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 16 OF Job No. 14302COMMENTS Reactor + Control
Buildings

Mode 6 Higher (E-W)

 $f_{BEC} =$ $\Rightarrow f \geq 3.3 \text{ Hz}$, Acc. = 0.15g , Part. Fac. = $1 - \sum_{i=1}^5 \Gamma_i \phi_i$

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'	-0.0004	-0.0001g	-3 k	-3k	0
11	65,275	175.0	20.0	0.0039	0.0006	39	36	-174 k-ft
10	8,070	155.0	19.0	-0.0115	-0.0017	-14	22	546
9	64,695	136.0	9.0	-0.0213	-0.0032	-207	-185	964
8	5,115	127.0	21.0	0.0105	0.0016	8	-177	-701
7	33,685	106.0	14.0	0.0804	0.0121	408	231	-4,418
6	5,005	92.0	16.0	0.0245	0.0037	19	250	-1,184
5	35,065	76.0	14.0	-0.0480	-0.0072	-252	-2	2,816
4	4,605	62.0	22.0	-0.0823	-0.0123	-57	-59	2,788
3	36,515	40.0	16.0	-0.1013	-0.0152	-555	-614	1,490
2	26,725	24.0		0.2361	0.0354	946	332	-8,334
1	0	0.0		1.00	0.15	0		-366

E-W Combined Responses ($R = \sum_{i=1}^n |r_i|$)

Mode

~~f_{BEC}~~

$\Rightarrow \ddot{y} =$

~~Acc.~~

~~Part. Fac.~~

Node	Nodal Wt.	Height	A Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'		0.9776g		26,449k	0
11	65,275	175.0	20.0		0.6461		61,085	1,534,042 k-ft
10	8,070	155.0	19.0		0.5246		64,729	2,613,114
9	64,695	136.0	9.0		0.5829		85,668	3,781,001
8	5,115	127.0	21.0		0.5293		87,307	4,456,413
7	33,685	106.0	14.0		0.5341		93,696	6,099,872
6	5,005	92.0	16.0		0.4853		95,470	7,322,982
5	35,065	76.0	14.0		0.4758		105,561	8,794,822
4	4,605	62.0	22.0		0.3978		107,097	10,059,624
3	36,515	40.0	16.0		0.3382		115,866	12,086,468
2	26,725	24.0	24.0		0.2497		121,311	13,499,106
1	0	0.0			0.1500			15,770,148

TITLE Limerick
BY RBN DATE 12/9/81
CHKD. BY DATE 1/1



STRUCTURAL
MECHANICS
ASSOCIATES
A Civil, Corp.
PAGE 17 OF 17 Job No. 14302
COMMENTS Reactor + Control
Buildings

E-W SRSS Combined Responses

Mode

$f_{BFC} =$

$\Rightarrow \ddot{y} =$

$\gamma_{Acc.} =$

$\rho_{\text{Post Fac.}} =$

Node	Nodal Wt.	Height	Δ Ht.	Mode Shape	Accel.	Inertia Wt.	Shear	Moment
12	27,055 k	233.0'	58.0'		0.6424g		17,379 k	0
11	65,275	175.0	20.0		0.4431		48,329	1,007,989 k-ft
10	8,070	155.0	19.0		0.4425		51,766	1,951,550
9	64,695	136.0	9.0		0.4080		76,449	2,925,411
8	5,115	127.0	21.0		0.3838		78,304	3,597,272
7	33,685	106.0	14.0		0.3370		88,506	5,218,398
6	5,005	92.0	16.0		0.3003		89,821	6,439,678
5	35,065	76.0	14.0		0.2626		97,414	7,861,921
4	4,605	62.0	22.0		0.2158		98,214	9,207,920
3	36,515	40.0	16.0		0.1528		102,007	11,347,820
2	26,725	24.0	24.0		0.1040		103,679	12,962,988
1	0	0.0			0.1500			15,427,939

TITLE Limerick

BY RBN

DATE 12/9/81

CHECKED BY

DATE 1/1



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. corp.

PAGE 18 OF Job No. 14302

COMMENTS Reactor + Control

Buildings

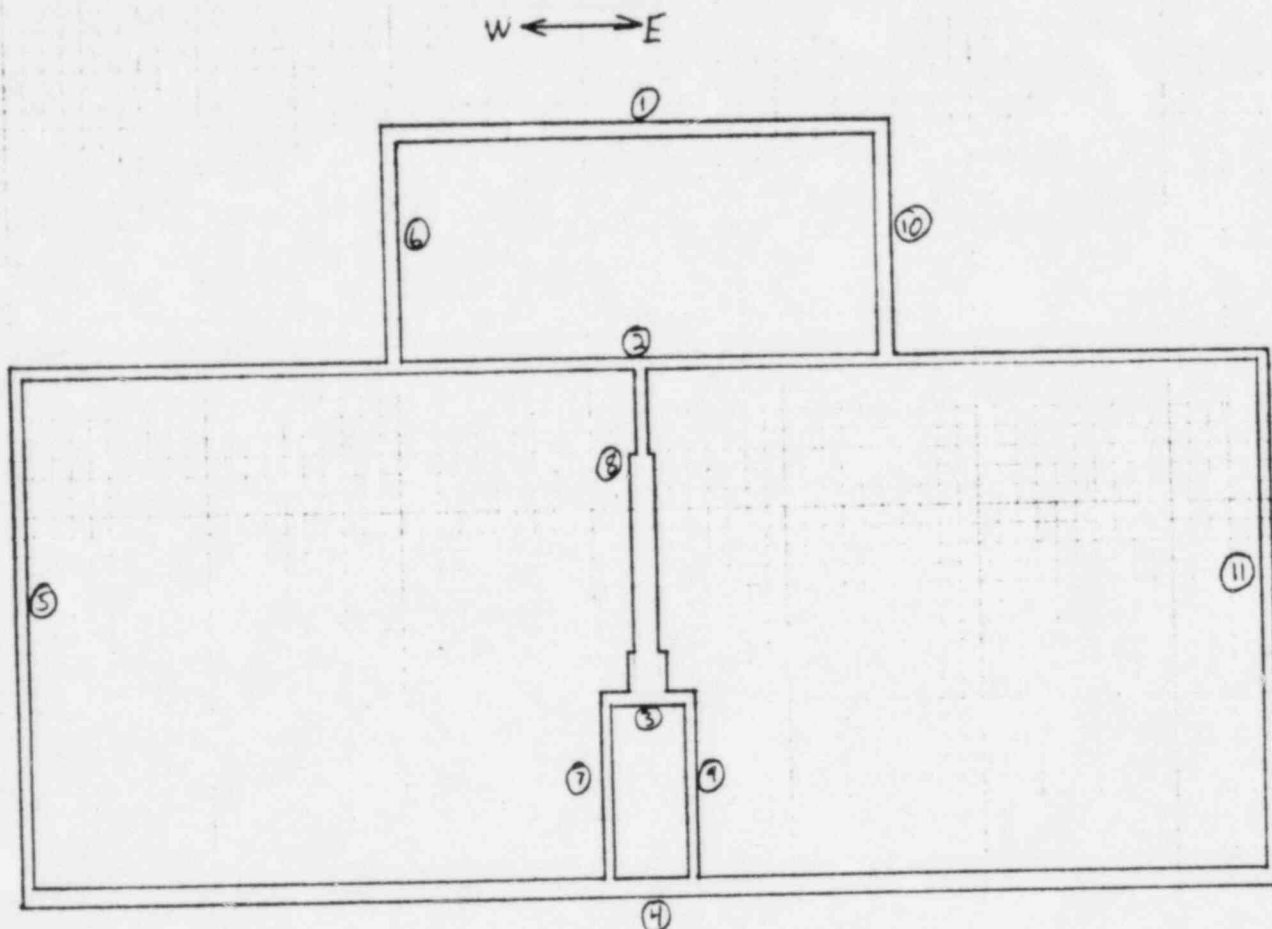
TITLE Limerick
 BY RBN DATE 12/11/81
 CHKD. BY _____ DATE 11



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 19 OF _____ Job No. 14302
 COMMENTS Reactor + Control
Buildings

Relative Stiffnesses of Walls b/w. El. 177'-0" + El. 201'-0"



$$K_{\text{SHEAR}} = \frac{A_s G}{h_w} \approx \frac{(bt)G}{h_w} = \frac{(bt)E}{2(1+\nu)h_w}$$

$$K_{\text{BEND}} = \frac{12EI}{h_w^3} \quad \text{for fixed-fixed pier}, \quad I = \frac{t(b)^3}{12}$$

$$K_{\text{TOT}} = K_s K_B / (K_s + K_B) = \left[\frac{btE}{2(1+\nu)h_w} \right] \left[\frac{Eb^3t}{h_w^3} \right] / \left[\frac{btE}{2(1+\nu)h_w} + \frac{Eb^3t}{h_w^3} \right]$$

$$= \frac{Eb^3t}{2(1+\nu)h_w} \left[\frac{1}{1 + \frac{h_w^2}{2b^2(1+\nu)}} \right]$$

$$\therefore \text{Rel. stiffness } K = K_{\text{TOT}}/G = \frac{bt}{h_w} \left[\frac{1}{1 + 0.427 \left(\frac{h_w}{b} \right)^2} \right], \quad \nu = 0.17$$

TITLE LimerickBY RBN DATE 12/11/81CHKD. BY _____ DATE 1 1STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 20 OF _____ Job No. 14302COMMENTS Reactor + Centre
BuildingsWall 1

$$h_w = (200'-0") - (180'-0") = 20'$$

$$t = 4'$$

$$b = 132'$$

$$\therefore K_1 = \underline{26.14}$$

Wall 2

$$h_w = (201'-0") - (177'-0") = 24'$$

$$t = 3'$$

$$b = 326'$$

$$\therefore K_2 = \underline{40.66}$$

Wall 3

$$h_w = 24'$$

$$t = 3'$$

$$b = 24'$$

$$\therefore K_3 = \underline{2.10}$$

Wall 4

$$(h_w)_{TOP} = 6'$$

$$t_{TOP} = 4'$$

$$b = 326'$$

$$\therefore K_{TOP} = 217.30$$

$$\therefore K_4 = (K_{TOP} \times K_{BOT}) / (K_{TOP} + K_{BOT}) = \underline{63.86}$$

$$(h_w)_{BOT} = 18'$$

$$t_{BOT} = 5'$$

$$b = 326'$$

$$\therefore K_{BOT} = 90.44$$

TITLE Limerick
 BY RBN DATE 12/11/81
 CHKD. BY _____ DATE 11



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 21 OF _____ Job No. 14302
 COMMENTS Reactor + Control
Buildings

Walls 5+11

$$h_w = 24'$$

$$t = 3'$$

$$b = 139'$$

$$\therefore K_5 = K_{11} = \underline{17.16}$$

Walls 6+10

$$h_w = 20'$$

$$t = 4'$$

$$b = 63.5'$$

$$\therefore K_6 = K_{10} = \underline{12.18}$$

Walls 7+9

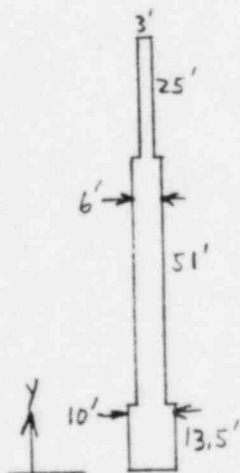
$$h_w = (201'-0") - (185'-0") = 16'$$

$$t = 2.5'$$

$$b = 52.5'$$

$$\therefore K_7 = K_9 = \underline{7.89}$$

Wall 8



$$\text{Area} = 3(25) + 6(51) + 10(13.5) = 516 \text{ ft}^2$$

$$\bar{y} = \frac{1}{516} [3(25)(77) + 6(51)(39) + 10(13.5)(6.75)]$$

$$= \underline{36.09'}$$

$$I = \frac{10(13.5)^3}{12} + 10(13.5)(36.09 - 6.75)^2 + \frac{6(51)^3}{12} +$$

$$6(51)(39 - 36.09)^2 + \frac{3(25)^3}{12} + 3(25)(77 - 36.09)^2$$

$$= \underline{316,608 \text{ ft}^4}$$

$$K_{\text{BEND}} = \frac{12E(316,608)}{24^3} = 274.83E = \underline{643.11G}$$

TITLE LimerickBY RBN DATE 12/11/81CHKD. BY _____ DATE 1/1STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 22 OF _____ Job No. 14302COMMENTS Reactor + Control
Buildings

$$K_{\text{SHEAR}} = \frac{516G}{24} = 21.5G$$

$$K_8 = \frac{(21.5 \times 643.11)}{(21.5 + 643.11)} = 20.80$$

From p. 9 + 17:

$$V_{N-S} = 123,361 \text{ k}$$

$$M_{N-S} = 15.51 \times 10^6 \text{ k-ft}$$

$$V_{E-W} = 121,311 \text{ k}$$

$$M_{E-W} = 15.77 \times 10^6 \text{ k-ft}$$

$$\sum_{i=1}^4 K_i = 132.76$$

$$\sum_{i=5}^{11} K_i = 95.26$$

$$V_1 = \frac{26.14}{132.76} (V_{E-W}) = 23,886 \text{ k}$$

$$M_1 = \frac{26.14}{132.76} (M_{E-W}) = 3.11 \times 10^6 \text{ k-ft}$$

$$V_2 = \frac{40.66}{132.76} (V_{E-W}) = 37,154 \text{ k}$$

$$M_2 = \frac{40.66}{132.76} (M_{E-W}) = 4.83 \times 10^6 \text{ k-ft}$$

$$V_3 = \frac{2.10}{132.76} (V_{E-W}) = 1,919 \text{ k}$$

$$M_3 = \frac{2.10}{132.76} (M_{E-W}) = 0.25 \times 10^6 \text{ k-ft}$$

$$V_4 = \frac{63.86}{132.76} (V_{E-W}) = 58,353 \text{ k}$$

$$M_4 = \frac{63.86}{132.76} (M_{E-W}) = 7.59 \times 10^6 \text{ k-ft}$$

$$V_5 = V_{11} = \frac{17.16}{95.26} (V_{N-S}) = 22,222 \text{ k}$$

$$M_5 = M_{11} = \frac{17.16}{95.26} (M_{N-S}) = 2.79 \times 10^6 \text{ k-ft}$$

$$V_6 = V_{10} = \frac{12.18}{95.26} (V_{N-S}) = 15,773 \text{ k}$$

$$M_6 = M_{10} = \frac{12.18}{95.26} (M_{N-S}) = 1.98 \times 10^6 \text{ k-ft}$$

$$V_7 = V_9 = \frac{7.89}{95.26} (V_{N-S}) = 10,217 \text{ k}$$

$$M_7 = M_9 = \frac{7.89}{95.26} (M_{N-S}) = 1.28 \times 10^6 \text{ k-ft}$$

$$V_8 = \frac{20.80}{95.26} (V_{N-S}) = 26,936 \text{ k}$$

$$M_8 = \frac{20.80}{95.26} (M_{N-S}) = 3.39 \times 10^6 \text{ k-ft}$$

Shear Capacities

See p. MC-1 to MC-5 for formulas

$$\sum_{i=2}^{12} W_i = 311,810 \text{ k}$$

This will be distributed by tributary area to the walls

$$(N_v)_1 = 18,006 \text{ k}$$

$$(N_v)_5 = (N_v)_{11} = 28,257 \text{ k}$$

$$(N_v)_2 = 44,037 \text{ k}$$

$$(N_v)_6 = (N_v)_{10} = 5,353 \text{ k}$$

$$(N_v)_3 = 1,027 \text{ k}$$

$$(N_v)_7 = (N_v)_9 = 18,525 \text{ k}$$

$$(N_v)_4 = 67,115 \text{ k}$$

$$(N_v)_8 = 27,353 \text{ k}$$

TITLE LimerickBY RBN DATE 12/14/81CHKD. BY _____ DATE 1 1STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 23 OF _____ Job No. 14302COMMENTS Reactor + Contr
BuildingsWall 1

$$v_c = \sqrt{6269} \left[10 - 3.4 \left(\frac{20}{132} \right) \right] + \frac{18006 \times 10^3}{4(4 \times 132 \times 144)} = 810 \text{ psi}$$

Steel consists of #11 bars @ 12" each way, each face

$$\therefore \rho_{se} = 2(1.56)/(12 \times 48) = 0.00542$$

$$\therefore v_{se} = 0.00542(66,000) = 358 \text{ psi}$$

$$v_u = v_c + v_{se} = 810 + 358 = 1,168 \text{ psi} = 168.2 \text{ ksf}$$

$$V_u = 168.2(132 \times 4) = \underline{88,810 \text{ k}} \Rightarrow \check{F}_s = \frac{88,810}{23,886} = \underline{3.71}$$

Wall 2

$$v_c = \sqrt{6269} \left[10 - 3.4 \left(\frac{24}{326} \right) \right] + \frac{94037 \times 10^3}{4(3 \times 326 \times 144)} = 939 \text{ psi}$$

Steel consists of #9 bars @ 8" vertical, each face, and #10 bars @ 9" each face horizontal. Since $h_w/l_w < 0.5$, only the vertical steel contributes.

$$\therefore \rho_{se} = 2(1.00)/(8 \times 36) = 0.00694 \Rightarrow v_{se} = 0.00694(66,000) = 458 \text{ psi}$$

$$v_u = 939 + 458 = 1,397 \text{ psi} = 201.2 \text{ ksf}$$

$$V_u = 201.2(326 \times 3) = \underline{196,774 \text{ k}} \Rightarrow \check{F}_s = \frac{196,774}{37,154} = \underline{5.30}$$

Wall 3This wall won't govern. To get $\check{F}_s = 3.71$, $V_u = 7,119 \text{ k}$

$$\therefore v_u = \frac{7,119}{3(24)} = 98.9 \text{ ksf} = 687 \text{ psi}$$

$$v_c = \sqrt{6269} \left[10 - 3.4 \left(\frac{24}{24} \right) \right] + \frac{1027 \times 10^3}{4(3 \times 24 \times 144)} = 547 \text{ psi}$$

 $\therefore v_{se}$ would only have to account for 140 psi

$$\therefore \rho_{se} = \frac{140}{66,000} = 0.00212$$

($\rho = 0.002$ is the min. possible)

TITLE LimerickBY RBNDATE 12/14/81STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 24 OF Job No. 14302COMMENTS Reactor + Control
Buildings

CHKD. BY

DATE 11Wall 4 (top of wall where $x=4'$)

$$v_c = \sqrt{6269} \left[10 - 3.4 \left(\frac{24}{326} \right) \right] + \frac{67115 \times 10^3}{4(4 \times 326 \times 144)} = 861 \text{ psi}$$

Vertical rebar varies. It is variously #11 bars @ 16" each face; #11 bars @ 6" far face and #10 bars @ 8" near face; #11 bars @ 5" far face and #10 bars @ 5" near face; and #10 bars @ 12" each face. The average $\rho = 0.008$

$$\therefore v_{se} = 0.008(66,000) = 528 \text{ psi}$$

$$v_v = 861 + 528 = 1,389 \text{ psi} = 200.0 \text{ ksf}$$

$$V_v = 200.0(4 \times 326) = \underline{260,800 \text{ k}} \Rightarrow \bar{F}_s = \frac{260,800}{58,353} = \underline{4.47}$$

Walls 5+11

$$v_c = \sqrt{6269} \left[10 - 3.4 \left(\frac{24}{139} \right) \right] + \frac{28257 \times 10^3}{4(3 \times 139 \times 144)} = 863 \text{ psi}$$

Vertical steel is #9 bars @ 8" each face

$$\therefore \rho_{se} = 2(1.00)/(8 \times 36) = 0.00694 \Rightarrow v_{se} = 0.00694(66,000) = 458 \text{ psi}$$

$$\therefore v_v = 863 + 458 = 1,321 \text{ psi} = 190.2 \text{ ksf}$$

$$V_v = 190.2(3 \times 139) = \underline{79,313 \text{ k}} \Rightarrow \bar{F}_s = \frac{79,313}{22,222} = \underline{3.57}$$

Walls 6+10

$$v_c = \sqrt{6269} \left[10 - 3.4 \left(\frac{20}{63.5} \right) \right] + \frac{5353 \times 10^3}{4(4 \times 63.5 \times 144)} = 744 \text{ psi}$$

Vertical steel is #9 @ 6" each face

$$\therefore \rho_{se} = 2(1.00)/(6 \times 48) = 0.00694 \Rightarrow v_{se} = 0.00694(66,000) = 458 \text{ psi}$$

$$\therefore v_v = 744 + 458 = 1,202 \text{ psi} = 173.1 \text{ ksf}$$

$$V_v = 173.1(4 \times 63.5) = \underline{43,967 \text{ k}} \Rightarrow \bar{F}_s = \frac{43,967}{15,773} = \underline{2.79}$$

TITLE Limerick
 BY RBN DATE 12/14/81
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 25 OF _____ Job No. 14302
 COMMENTS Reactor + Control
Buildings

Walls 7 + 9

$$v_c = \sqrt{6269} \left[10 - 3.4 \left(\frac{16}{52.5} \right) \right] + \frac{18525 \times 10^3}{4(2.5 \times 52.5 \times 144)} = 955 \text{ psi}$$

Vertical steel is #11 bars @ 12" each face

$$p_{se} = 2(1.56)/(30 \cdot 12) = 0.00867 \Rightarrow v_{se} = 0.00867(66,000) = 572 \text{ psi}$$

$$v_u = 955 + 572 = 1,527 \text{ psi} = 219.9 \text{ ksf}$$

$$V_u = 219.9(2.5 \times 52.5) = \underline{28,862 \text{ k}} \Rightarrow \bar{F}_s = \frac{28,862}{10,217} = \underline{2.82}$$

Wall 8

$$v_c = \sqrt{6269} \left[10 - 3.4 \left(\frac{24}{89.5} \right) \right] + \frac{27353 \times 10^3}{4(516 \times 144)} = 812 \text{ psi}$$

Vertical steel varies btw. #9 bars @ 6" each face and #9 bars @ 8" each face. Use #9 bars @ 7" each face.

$$p_{se} = 2(1.00 \times 89.5 \times \frac{17}{7}) / (516 \cdot 144) = 0.00413 \Rightarrow v_{se} = 0.00413(66,000) = 273 \text{ psi}$$

$$v_u = 812 + 273 = 1085 \text{ psi} = 156.2 \text{ ksf}$$

$$V_u = 156.2(516) = \underline{80,599 \text{ k}} \Rightarrow \bar{F}_s = \frac{80,599}{26,936} = \underline{2.99}$$

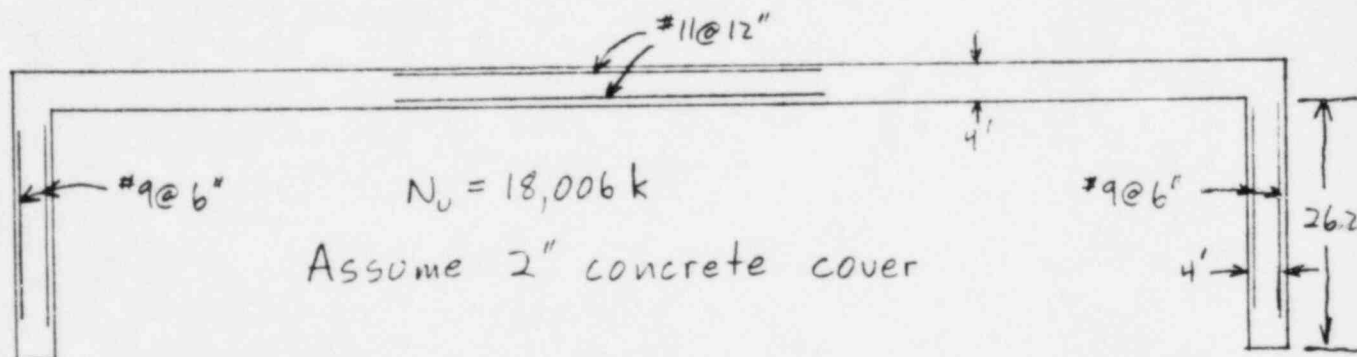
Moment Capacities

See p. M-21 to 23B for formulas

Wall 1

$$h = 66' \quad b = 2' \quad t = 4' \quad w = 28.25' \quad L = 186.5'$$

$$\therefore b_{fe} = 26.26'$$



TITLE Limerick
 BY RBN DATE 12/14/31
 CHKD. BY _____ DATE 1 1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 26 OF _____ Job No. 1430201
 COMMENTS Reactor + Control
Buildings

Assume neutral axis is in flange btw. 2 layers of rebar

$$P_{DL} = 18,006 \text{ k}$$

$$P_c = -0.85 (6.269 \text{ ksi}) \left(\frac{144 \text{ ksi}}{1 \text{ ksi}} \right) (30.26' \times 0.737c - \frac{1}{2})$$

$$(P_s)_{\text{COMP. FLAN.}} = -66 (30.26' \times \frac{1.00 \text{ in}^2}{6 \text{ in}} \times 12 \text{ in/ft}) = -3,994 \text{ k}$$

$$(P_s)_{\text{TEN. CH.}} = 2 (66 \text{ ksi}) \left(\frac{1.00 \text{ in}^2}{6 \text{ in}} \right) \times 12 \text{ in/ft} \times (30.26') = 7,989 \text{ k}$$

$$(P_s)_{\text{TEN. WEB}} = 2 (1.56 \text{ in}^2 \times 66 \text{ ksi}) \left[(132 - 1.711c) + \frac{1}{2} \left(\frac{4 - 0.789c}{0.711c} \times (1.711c - 4) \right) \right] < 26,358$$

$$(P_s)_{\text{TEN. FLAN.}} = \left(\frac{1.00 \text{ in}^2}{6 \text{ in}} \right) \times 12 \text{ in/ft} \times 66 \text{ ksi} \times (26.26' \times \frac{46 - c}{0.711c}) < 3,466$$

For $\sum P = 0$, $c = 2.93' = 35.16''$

$$P_{DL} = 18,006 \text{ k}$$

$$(P_s)_{\text{T.C.}} = 7,989 \text{ k}$$

$$P_c = -49,812 \text{ k}$$

$$(P_s)_{\text{T.W.}} = 26,307 \text{ k}$$

$$(P_s)_{\text{C.F.}} = -3,994 \text{ k}$$

$$(P_s)_{\text{T.F.}} = 1,504 \text{ k}$$

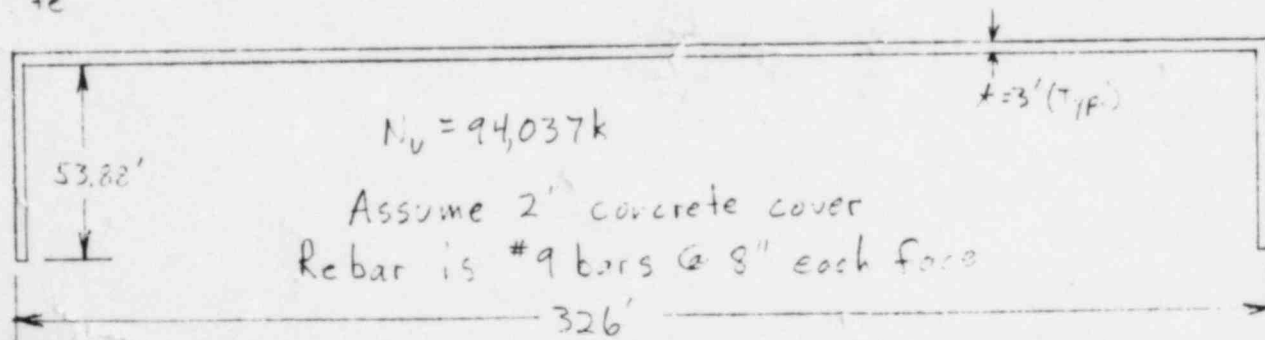
$$M = (49,812) \left[66 - \frac{0.737(2.93)}{2} \right] + (3,994) \left(66 - \frac{7}{2} \right) + (7,989) \left(66 - 2 \right) + (26,307) \left(66 - 65.892 \right) - (1,504) \left(66 - \frac{46}{12} \right)$$

$$= 3.92 \times 10^6 \text{ k-ft} \quad \Rightarrow \quad \bar{F}_s = \frac{3.92}{3.11} = 1.26$$

Wall 2

Flange effects due to Walls 6, 8, + 10 will be ignored.
 $h = 326'$ $b = 1.5'$ $t = 3'$ $w = 65.5'$ $L = 233'$

$$\therefore b_{fe} = 53.88'$$





Assume neutral axis is in web

$$P_{DL} = 94,037 \text{ k}$$

$$P_c = -0.85(6.269 \text{ ksi}) \left(\frac{144 \text{ ksi}}{1 \text{ ksi}} \right) \left[(56.88 \times 3 - \frac{1}{48}) + (0.737c - 3)(3 - \frac{1}{48}) \right]$$

$$= -2286(53.88 + 0.737c)$$

$$(P_s)_{\text{TEN. CH.}} = 2 \left(\frac{1.00 \text{ in}^2}{8 \text{ in}} \right) (12 \text{ in/ft}) (66 \text{ ksi}) (56.88') = 11,262 \text{ k}$$

$$(P_s)_{\text{COMP. FLAN.}} = - \left(\frac{1.65 \text{ in}^2}{8 \text{ in}} \right) (12 \text{ in/ft}) (66 \text{ ksi}) (56.88' \times 2)$$

$$= -11,262 \text{ k}$$

$$(P_s)_{\text{TEN. WEB}} = \left(\frac{1.00 \text{ in}^2}{8 \text{ in}} \right) (12 \text{ in/ft}) (2)(326 - 2c)(66 \text{ ksi}) = 198(326 - 2c)$$

For $\Sigma P = 0$, $c = \underline{17.02'}$

$$P_{DL} = 94,037 \text{ k}$$

$$(P_s)_{T.C.} = 11,262 \text{ k}$$

$$(P_s)_{C.F.} = -11,262 \text{ k}$$

$$P_c = -151,845 \text{ k}$$

$$(P_s)_{T.W.} = 57,808 \text{ k}$$

$$M = (151,845)(163 - 2.40) + 11,262(323) + 57,808(163 - 148.474)$$

$$= \underline{28.86 \times 10^6 \text{ k-ft}} \Rightarrow \bar{F}_s = \frac{28.86}{4.83} = \underline{5.98}$$

Wall 3

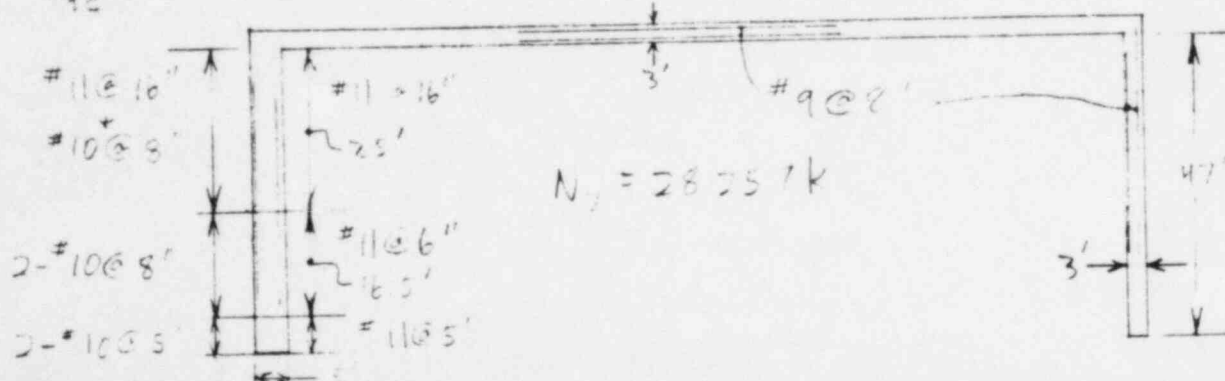
Not a critical wall

Wall 4

Will have on $\bar{F}_s$ about like Wall 2

Wall 5 + 11

b_{gc} will be set at 47', halfway between Wall 5 + Wall 6





The section is not symmetrical. Therefore, 2 capacities exist.
 1) Assume neutral axis is in 5'-wide flange btw. rebar layers

$$P_{DL} = 28,257 \text{ k}$$

$$P_c = -0.85(6.269 \text{ ksi} \times \frac{144 \text{ ksf}}{1 \text{ ksi}}) \left\{ (50.0' \times 0.737c) - \frac{1}{144} \left[\left(\frac{1.56 \text{ in}^2}{16 \text{ in}} \right) (12 \text{ in/ft}) \cdot (25') + \left(\frac{1.27 \text{ in}^2}{8 \text{ in}} \right) (12 \text{ in/ft}) (25') + 2 \left(\frac{1.27 \text{ in}^2}{8 \text{ in}} \right) (12 \text{ in/ft}) (16.5') + 2 \left(\frac{1.27 \text{ in}^2}{5 \text{ in}} \right) (12 \text{ in/ft}) (5.5') \right] \right\}$$

$$= -767.33 (36.85c - 1.203)$$

$$(P_s)_{\text{TEN. CH}} = 2 \left(\frac{1.00 \text{ in}^2}{8 \text{ in}} \times 12 \text{ in/ft} \times 66 \text{ ksi} \times 50' \right) = 9,900 \text{ k}$$

$$(P_s)_{\text{TEN. WEB}} = 2 \left(\frac{1.00 \text{ in}^2}{8 \text{ in}} \times 12 \text{ in/ft} \times 66 \text{ ksi} \right) \left[(136 - 1.711c) + \frac{1}{2} \left(\frac{5 - 0.789c}{0.711c} \right) \cdot (1.711c - 5) \right] = 25,938 \text{ k if } c < 2.92'$$

$$(P_s)_{\text{TEN. FLAN.}} = (66 \text{ ksi} \times \frac{58}{12} - c \times \frac{1}{0.711c}) \left[\left(\frac{1.56 \text{ in}^2}{16 \text{ in}} \right) (12 \text{ in/ft}) (25') + \left(\frac{1.56 \text{ in}^2}{6 \text{ in}} \right) (12 \text{ in/ft}) (16.5') + \left(\frac{1.56 \text{ in}^2}{5 \text{ in}} \right) (12 \text{ in/ft}) (5.5') \right] \\ = 9405.42 \left(\frac{58}{12c} - 1 \right) = 6,687 \text{ k if } c < 2.82'$$

$$(P_s)_{\text{COMP. FLAN.}} = -(66 \text{ ksi} \times 12 \text{ in/ft}) \left[\left(\frac{1.56}{16} \right) (25) + \left(\frac{1.27}{8} \right) (25) + 2 \left(\frac{1.27}{8} \right) (16.5) + 2 \left(\frac{1.27}{5} \right) (5.5) \right] \\ = -11,436 \text{ k}$$

For $\sum P = 0$, $c = 2.13' = 25.58''$ (all steel has yielded)

$$P_{DL} = 28,257 \text{ k}$$

$$(P_s)_{\text{T.W.}} = 25,938 \text{ k}$$

$$P_c = -59,346 \text{ k}$$

$$(P_s)_{\text{T.F.}} = 6,687 \text{ k}$$

$$(P_s)_{\text{T.C.}} = 9,900 \text{ k}$$

$$(P_s)_{\text{C.F.}} = -11,436 \text{ k}$$

$$M = (59,346) \left(61.736 - \frac{2.13 \cdot 0.737}{2} \right) + (9,900) (137.5 - 61.736) + (25,938) \left(70.5 - 61.736 \right) - (6,687) \left(61.736 - \frac{58}{12} \right) - (11,436) \left(61.736 - \frac{2}{2} \right) \\ = 4.92 \times 10^6 \text{ k-ft} \Rightarrow \bar{F}_s = \frac{4.92}{2.77} = 1.76$$



2) Assume neutral axis is in 3'-wide flange btw. rebar 6

$$P_{DL} = 28,257 \text{ k}$$

$$P_c = -0.85(6.269 \text{ ksi}) \left(\frac{144 \text{ ksi}}{1 \text{ ksi}} \right) \left[50' (0.737c) - \frac{75}{144} \right] \\ = -767.33(36.85c - 0.5208)$$

$$(P_s)_{\text{TEN. CH.}} = 11,436 + 6,687 = 18,123 \text{ k} \quad (\text{see section 1)})$$

$$(P_s)_{\text{TEN. WEB}} = 2 \left(\frac{100 \text{ in}^2}{8 \text{ in}} \right) (12 \text{ in/ft}) (66 \text{ ksi}) \left[(134 - 1.711c) + \right. \\ \left. \frac{1}{2} \left(\frac{3 - 0.789c}{0.711c} \right) (1.711c - 3) \right] = 25,938 \text{ k} \quad \text{if } c < 1.75'$$

$$(P_s)_{\text{COMP. FLAN.}} = \left(\frac{100 \text{ in}^2}{8 \text{ in}} \right) (12 \text{ in/ft}) (66 \text{ ksi}) (50') = -4,950 \text{ k}$$

$$(P_s)_{\text{TEN. FLAN.}} = \left(\frac{100 \text{ in}^2}{8 \text{ in}} \right) (12 \text{ in/ft}) (66 \text{ ksi}) (50') \left(\frac{34}{12} - c \right) \\ = 6,962.03 \left(\frac{34}{12} - c \right) = 4,950 \text{ k} \quad \text{if } c < 1.66'$$

$$\text{For } \sum P = 0, \quad c = 2.43' = 29.21''$$

$$P_{DL} = 28,257 \text{ k}$$

$$(P_s)_{\text{T.W.}} = 25,860 \text{ k}$$

$$P_c = -68,432 \text{ k}$$

$$(P_s)_{\text{C.F.}} = -4,950 \text{ k}$$

$$(P_s)_{\text{T.C.}} = 18,123 \text{ k}$$

$$(P_s)_{\text{T.F.}} = 1,141 \text{ k}$$

$$M = (68,432) \left[77.264 - \frac{0.737(2.43)}{2} \right] + (18,123)(137.111 - 77.264) - \\ (25,860)(77.264 - 68.5) + (4,950)(77.264 - \frac{34}{12}) - (1,141)(77.264 - \frac{34}{12}) \\ = 6.38 \times 10^6 \text{ k-ft} \quad \therefore \bar{F}_s = 1.76 \quad \text{from 1)}$$

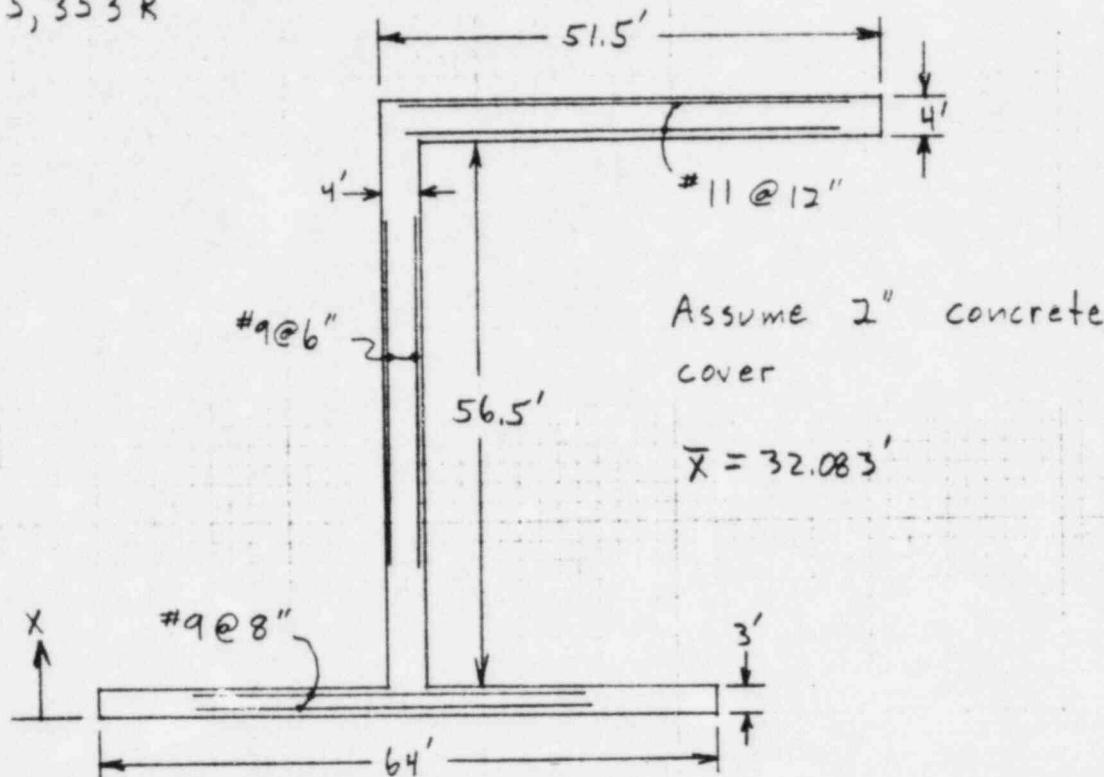
Wall 6+10

The method presented on p. MC-23A+23B will be used to determine the amount of Wall 1 to be used as a flange. Data used is $h = 63.5/2 = 31.75'$, $b = 4'$, $w = \frac{124}{2} = 62'$, $t = 3.5'$ (ave. btw. 1+2), and $L = 186.5'$. $\therefore b_{fe} = 47.50'$

The amount of Wall 2 that shall be used will be set at 30' on each side of Wall 6 (or Wall 10). 30' is half the distance btw. Wall 8 and Wall 6.



$$N_U = 5,353 \text{ k}$$



This section will have 2 moment capacities

- 1) Assume neutral axis is in 3'-wide flange btw. rebar layer

$$P_{DL} = 5,353 \text{ k}$$

$$P_c = -0.85(6.269 \text{ ksi}) \left(\frac{144 \text{ ksi}}{1 \text{ ksi}} \right) (64') \left[(0.737c) - \frac{1}{144} \left(\frac{1.00 \text{ in}^2}{8 \text{ in}} \right) (12 \text{ in/ft}) \right]$$

$$= -49,108.8 (0.737c - \frac{1}{96})$$

$$(P_s)_{\text{TEN. CH.}} = 2 \left(\frac{1.56 \text{ in}^2}{12 \text{ in}} \right) (12 \text{ in/ft}) (51.5') (66 \text{ ksi}) = 10,605 \text{ k}$$

$$(P_s)_{\text{COMP. FL.}} = - \left(\frac{1.00 \text{ in}^2}{8 \text{ in}} \right) (12 \text{ in/ft}) (64') (66 \text{ ksi}) = -6,336 \text{ k}$$

$$(P_s)_{\text{TEN. FL.}} = 6,336 \text{ k} \quad \text{if } c \leq 1.66'$$

$$(P_s)_{\text{TEN. WEB}} = 2 \left(\frac{1.00 \text{ in}^2}{6 \text{ in}} \right) (12 \text{ in/ft}) (56.5') (66 \text{ ksi}) = 14,916 \text{ k}$$

if $c < 1.75'$

$$\text{For } \sum P = 0, \quad c = 0.867' = 10.41''$$

$$P_{DL} = 5,353 \text{ k}$$

$$P_c = -30,874 \text{ k}$$

$$(P_s)_{\text{T.C.}} = 10,605 \text{ k}$$

$$(P_s)_{\text{C.F.}} = -6,336 \text{ k}$$

$$(P_s)_{\text{T.F.}} = 6,336 \text{ k}$$

$$(P_s)_{\text{W.B.}} = 14,916 \text{ k}$$



$$M = (30,874)(32.083 - \frac{0.737(0.867)}{2}) + 10,605(61.5 - 32.083) + (6,336)(\frac{72}{12}) - (14,916)(32.083 - 31.25) \\ = \underline{1.30 \times 10^6 \text{ k-ft}} \quad \Rightarrow \quad \check{F}_s = \frac{1.30}{1.98} = \underline{0.66}$$

2) Assume neutral axis is in 4'-wide Flange btw. rebar layers

$$P_{DL} = 5,353 \text{ k}$$

$$P_c = -0.85(6.269 \text{ ksi}) \left(\frac{144 \text{ ksf}}{1 \text{ ksi}} \right) (51.5') \left[0.737c - \frac{1}{144} \left(\frac{1.56 \text{ in}^2}{12 \text{ in}} \right) (12 \text{ in/ft}) \right] \\ = -39,517.3(0.737c - 0.0108)$$

$$(P_s)_{\text{TEN. CH.}} = 2 \left(\frac{1.00 \text{ in}^2}{8 \text{ in}} \right) (12 \text{ in/ft}) (64') (66 \text{ ksi}) = 12,672 \text{ k}$$

$$(P_s)_{\text{COMP. FL.}} = - \left(\frac{1.56 \text{ in}^2}{12 \text{ in}} \right) (12 \text{ in/ft}) (51.5') (66 \text{ ksi}) = -5,302 \text{ k}$$

$$(P_s)_{\text{TEN. FL.}} = 5,302 \text{ k} \quad \text{if } c < 2.24'$$

$$(P_s)_{\text{TEN. WEB}} = 14,916 \text{ k} \quad (\text{from before}) \quad \text{if } c < 2.34'$$

$$\text{For } \Sigma P = 0, \quad c = 1.15' = 13.75''$$

$$P_{DL} = 5,353 \text{ k}$$

$$(P_s)_{\text{C.F.}} = -5,302 \text{ k}$$

$$P_c = -32,941 \text{ k}$$

$$(P_s)_{\text{T.F.}} = 5,302 \text{ k}$$

$$(P_s)_{\text{T.C.}} = 12,672 \text{ k}$$

$$(P_s)_{\text{T.W.}} = 14,916 \text{ k}$$

$$M = (32,941) \left[31.417 - \frac{0.737(1.15)}{2} \right] + 12,672(32.083 - 1.5) + (14,916)(32.083 - 31.25) + (5,302)(\frac{44}{12}) \\ = \underline{1.44 \times 10^6 \text{ k-ft}} \quad \therefore \quad \check{F}_s = \underline{0.66}$$

Walls 7, 8, 9

These walls will act together to resist a moment of $M_{7,9} = [2(1.28) + 3.39] \times 10^6 = 5.95 \times 10^6 \text{ k-ft}$. (The individual wall stiffnesses are due almost entirely to shear stiffnesses. Therefore, the combined stiffness will be close to the sum of the individual stiffnesses.) The capacity of this wall will be at least as large as the capacity for Walls 5+1

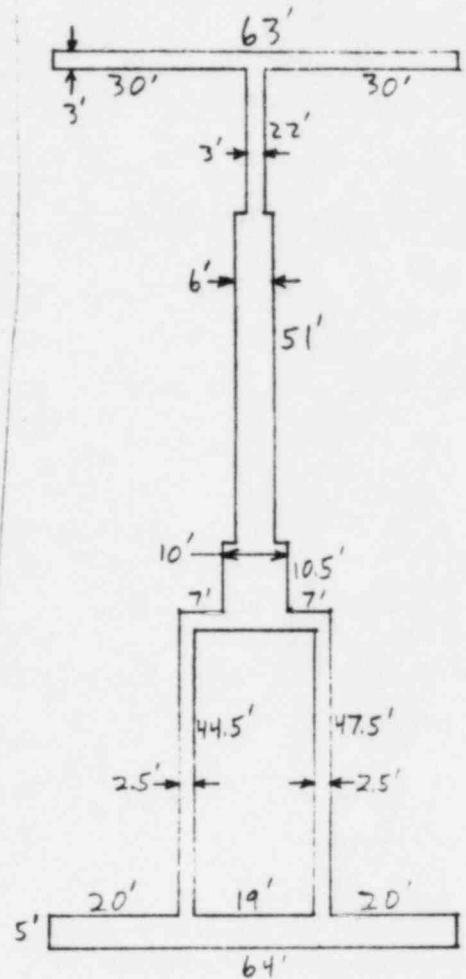
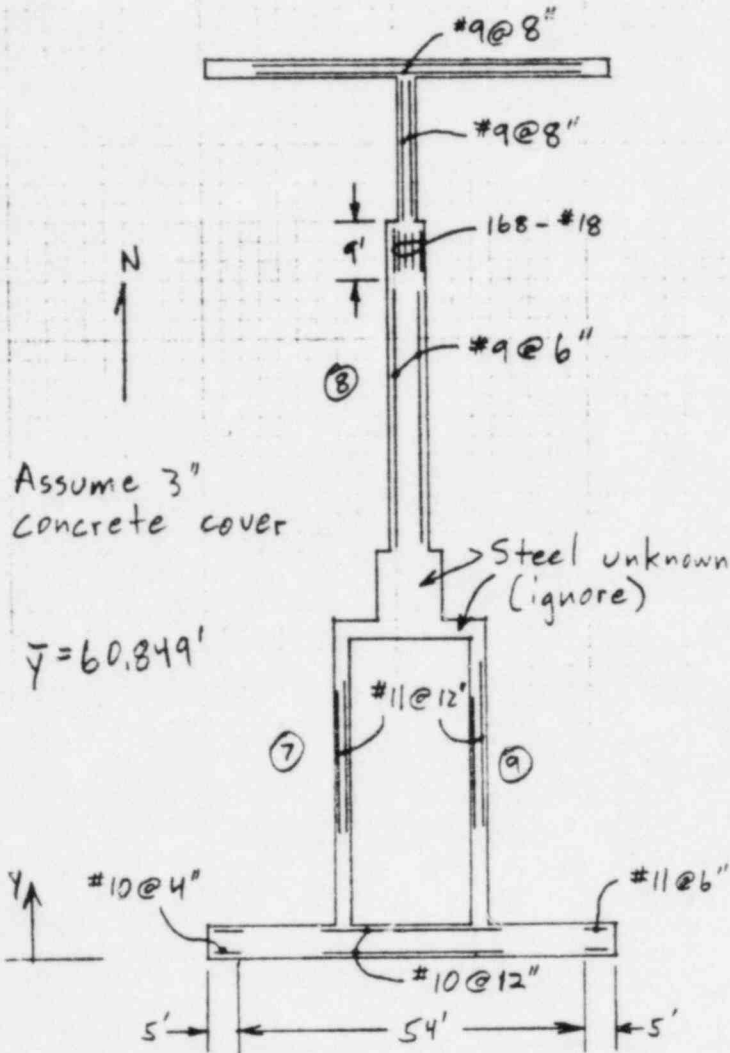
TITLE Limerick
 BY RBN DATE 1/19/82
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 31a OF _____ Job No. 14302
 COMMENTS Reactor + Centre
Buildings

The flange at the north end of the wall shall be set at 30' each side of wall 8. This is $\frac{1}{2}$ the distance between walls 6+8 and walls 8+10. The flange at the south end of the wall shall be set at 20' each side of walls 7 and 9.



$$P_{DL} = 2(18,525) + 27,353 = 64,403 \text{ k}$$

1) Assume neutral axis is in southern flange btw. rebar layers

$$P_{DL} = 64,403 \text{ k}$$

$$P_c = -0.85 (6.269 \text{ ksi}) \left(144 \frac{\text{ksf}}{\text{ksi}} \right) \left[(64' \times 0.737c) - \left(1.27 \frac{\text{in}^2}{\text{ft}} \times 54' \times \frac{1 \text{ ft}}{12 \text{ in}} \right) - \left(\frac{1.27 \text{ in}^2}{0.33 \text{ ft}} \times 2 \times 5' \times \frac{1}{144} \right) \right]$$



$$P_c = -767.33 (47.168c - 0.7408)$$

$$(P_s)_{CH.F.} = (66 \text{ ksi}) \left[\left(\frac{1.00 \text{ in}^2}{0.67 \text{ ft}} \times 2 \times 63' \right) + \left(\frac{1.00 \text{ in}^2}{0.67 \text{ ft}} \times 2 \times 22' \right) + 168(4.00 \text{ in}^2) + \left(\frac{1.00 \text{ in}^2}{0.5 \text{ ft}} \times 2 \times 51'-9'' \right) \right] \quad (\text{Steel in Wall } \textcircled{8} + \text{N. Flange})$$

$$= 72,270 \text{ k}$$

$$(P_s)_{WEB} = (66 \text{ ksi}) \times 4 \times (1.56 \text{ in}^2/\text{ft}) \left[52.5 - 1.711c + \frac{1}{2} (1.711c - 5) \left(\frac{5 - 0.289c}{0.711c} \right) \right]$$

$$= 411.84 \left[52.5 - 1.711c + \frac{(1.711c - 5)(5 - 0.289c)}{1.422c} \right]$$

$$= 21,622 \text{ k}, \quad c < 2.92'$$

$$(P_s)_{TEN. FL.} = (66 \text{ ksi}) \left[(1.27 \text{ in}^2/\text{ft} \times 54') + 2 \left(\frac{1.56 \text{ in}^2}{0.5 \text{ ft}} \times 5' \right) \right] \left(\frac{57 - c}{0.711c} \right)$$

$$= 6,585 \text{ k}, \quad c < 2.78'$$

$$(P_s)_{COMP. FL.} = -(66 \text{ ksi}) \left[(1.27 \text{ in}^2/\text{ft} \times 54') + 2 \left(\frac{1.27 \text{ in}^2}{0.33 \text{ ft}} \times 5' \right) \right]$$

$$= -7,041 \text{ k}$$

$$\text{For } \Sigma P = 0, \quad c = 4.165' = 49.98''$$

$$P_{DL} = 64,403 \text{ k}$$

$$(P_s)_{WEB} = 19,248 \text{ k}$$

$$P_c = -150,181 \text{ k}$$

$$(P_s)_{T.F.} = 1,301 \text{ k}$$

$$(P_s)_{T.C.} = 72,270 \text{ k}$$

$$(P_s)_{C.F.} = -7,041 \text{ k}$$

$$M_u = 64,403 \left(\frac{139}{2} - 4.165 \right) + 150,181 (4.165 \times 1 - \frac{0.737}{2}) + 72,270 (111.355 - 4.165) + 19,248 (24.126 - 4.165) + 1,301 (4.75 - 4.165) + 7,041 (4.165 - 0.250)$$

$$= 12.76 \times 10^6 \text{ k-ft}$$

2) Assume neutral axis is in web just below northern flange

$$P_{DL} = 64,403 \text{ k}$$

$$P_c = -0.85 (6.269 \text{ ksi} \times 144 \frac{\text{ksf}}{\text{ksi}}) \left[(3' \times 63') - 2 \left(\frac{1.00 \text{ in}^2}{0.67 \text{ ft}} \times 63' \times \frac{1 \text{ ft}^2}{144 \text{ in}^2} \right) + (0.737c - 3 \times 3') - 2 \left(\frac{1.00 \text{ in}^2}{0.67 \text{ ft}} \times 0.737c - 3 \times \frac{1}{144} \right) \right]$$

TITLE Limerick
 BY RBN DATE 1/20/82
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 31c OF _____ Job No. 14302
 COMMENTS Reactor + Control
Buildings

$$P_c = -767.33(178.719 + 2.2008c)$$

$$(P_s)_{\text{TEN. CH.}} = (66 \text{ ksi}) \left[2 \left(1.27 \frac{\text{in}^2}{\text{ft}} \times 54' \right) + 2 \left(\frac{1.56 \text{ in}^2}{0.5 \text{ ft}} \times 5' \right) + 2 \left(\frac{1.27 \text{ in}^2}{0.33 \text{ ft}} \times 5' \right) \right. \\
\left. (4 \times 1.56 \frac{\text{in}^2}{\text{ft}} \times 47.5') + 2 \left(\frac{1.00 \text{ in}^2}{0.5 \text{ ft}} \times 42' \right) + 168(4.00 \text{ in}^2) \right] \\
= 88,629 \text{ k}$$

$$(P_s)_{\text{COMP. FL.}} = -(66 \text{ ksi}) \left(\frac{1.00 \text{ in}^2}{0.67 \text{ ft}} \times 63' \right) \left[1 + \frac{c - 2.75}{0.711c} \right] \\
= -12,474 \text{ k}, \quad c > 9.52'$$

$$(P_s)_{\text{WEB}} = (66 \text{ ksi}) \left(2 \times \frac{1.00 \text{ in}^2}{0.67 \text{ ft}} \right) \left[25 - 1.711c + \frac{1}{2}(0.711c) - \left(\frac{1}{2} \right) \frac{(c-3)^2}{0.711c} \right]$$

$$\text{For } \Sigma P = 0, \quad \underline{c = 5.258' = 63.09''}$$

$$P_{DL} = 64,403 \text{ k}$$

$$(P_s)_{\text{C.F.}} = -10,421 \text{ k}$$

$$P_c = -146,016 \text{ k}$$

$$(P_s)_{\text{WEB}} = 3,404 \text{ k}$$

$$(P_s)_{\text{T.C.}} = 88,629 \text{ k}$$

$$M = 64,403 \left(\frac{13.9}{2} - 5.258 \right) + 146,016 (5.258 - 1.527) + 88,629 (66.976 - 5.258) \\
+ 10,421 (5.258 - 1.254) + 3,404 (13.518 - 5.258) \\
= \underline{10.22 \times 10^6 \text{ k-ft}} \quad \leftarrow \text{governs}$$

$$\therefore \check{F}_s = \frac{10.22 \times 10^6}{2(1.28 \times 10^6) + 3.39 \times 10^6} = \frac{10.22}{5.95} = \underline{1.72}$$



Walls b/w. EL 201'-0" + EL 217'-0"

are as follows:

1) There are some minor temporary openings in the control

building that will decrease their capacities slightly.

2) The wall on Line D is a constant 4' thick. The previous shear capacity was based on the 4' thickness. The bending capacity will be lowered slightly, but still won't govern.

3) The 6' width of the wall on Line 23 decreases to 3', This will decrease both the shear stiffness and shear capacity. Since the wall will attract less shear, the overall F_s will stay about the same (previously, it did not govern).

These walls are expected to have strength factors at least as large as the minimum factors for the walls below.

Walls at higher elevations are not expected to govern.

$$\therefore (F_s)_{\text{SHEAR}} = 2.79$$

Randomness and Uncertainty

Shear

From p. MC-5, $\beta_s = 0.15$

$$\beta_e \approx \sqrt{\beta_s^2 + (\frac{2}{3}\beta_{sc})^2 + (\frac{2}{3}\beta_{st})^2} = \sqrt{0.15^2 + 0.06^2 + 0.04^2} = 0.17$$

$$\beta_u \approx 0.10 \text{ (estimated)}$$

TITLE LimerickBY RBN DATE 12/1/82CHKD. BY _____ DATE 1/1STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 32a OF _____ Job No. 14302COMMENTS Reactor + Contro
Buildings

The moment of inertia of the section shown on p. 30 is

$$I = \frac{64(3)^3}{12} + 64(3)(32.083 - 1.5)^2 + \frac{4(56.5)^3}{12} + 4(56.5)(32.083 - 31.25)^2 + \frac{51.5(4)^3}{12} + 51.5(4)(61.5 - 32.083)^2$$

$$= 418,540 \text{ ft}^4$$

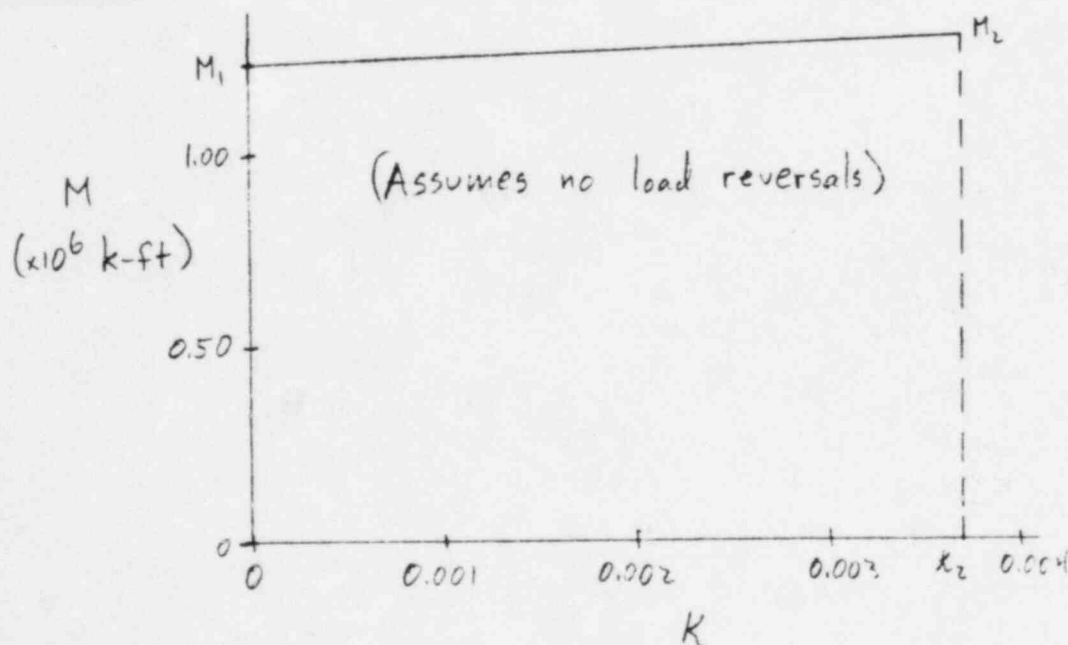
(This ignores the steel)

Until the maximum tensile stress exceeds 657 psi (p. MS-6) or 94.6 ksf, the section acts in a linear elastic manner. The moment at which this stress is reached is:

$$M_1 = \frac{94.6(418,540)}{32.083} = 1.23 \times 10^6 \text{ k-ft}$$

Curvature at this moment : $K_1 = \frac{M}{EI} = \frac{1.23 \times 10^6}{(4.51 \times 10^6)(0.144)(418,540)} = 4.53 \times 10^{-6}$

At the ultimate moment of $M_2 = 1.30 \times 10^6 \text{ k-ft}$, the strain at the outer compression fiber is 0.0032 and the distance from this fiber to the neutral axis is 0.867'. Therefore, $K_2 = \frac{0.0032}{0.867} = 3.69 \times 10^{-3}$.



TITLE LimerickBY RBN DATE 1/21/82CHKD. BY _____ DATE 1/1STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 326 OF _____ Job No. 14302COMMENTS Reactor + Control
Buildings

The moment of inertia of the section shown on p. 27 is

$$I = \frac{50(139)^3}{12} + 50(139)(69.5 - 61.736)^2 - \frac{47(131)^3}{12} - 47(131)(70.5 - 61.736)^2$$

$$= 2.33 \times 10^6 \text{ ft}^4$$

$$\therefore M_1 = \frac{94.6(2.33 \times 10^6)}{77.264} = 2.85 \times 10^6 \text{ k-ft}$$

$$K_1 = \frac{2.85 \times 10^6}{(4.51 \times 10^6)(0.144)(2.33 \times 10^6)} = 1.88 \times 10^{-6}$$

At the ultimate moment of $M_2 = 4.92 \times 10^6 \text{ k-ft}$, $K_2 = \frac{0.0032}{2.13} = 1.50 \times 10^{-3}$.

The moment of inertia of the section shown on p. 31a is

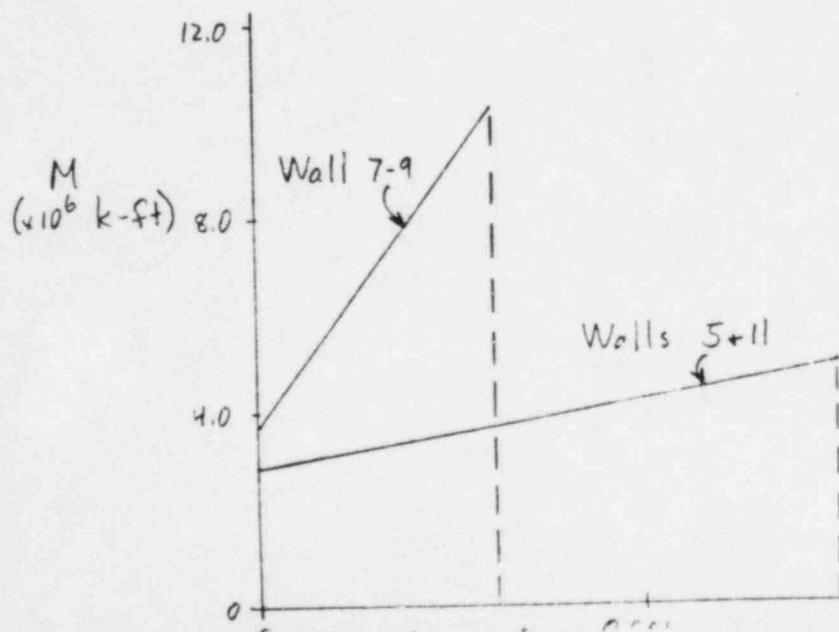
$$I = 3.07 \times 10^6 \text{ ft}^4$$

$$\therefore M_1 = \frac{94.6(3.07 \times 10^6)}{78.151} = 3.72 \times 10^6 \text{ k-ft}$$

$$K_1 = \frac{3.72 \times 10^6}{(4.51 \times 10^6)(0.144)(3.07 \times 10^6)} = 1.87 \times 10^{-6}$$

At the ultimate moment of $M_2 = 10.22 \times 10^6 \text{ k-ft}$,

$$K_2 = \frac{0.0032}{5.258} = 6.09 \times 10^{-4}$$



(Assumes no load reversal)

TITLE LimerickBY RBN DATE 1/22/82CHKD. BY _____ DATE 1/1STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 32c OF _____ Job No. 14302COMMENTS Reactor + Control
Buildings

Thus, even though Walls 6+10 have the lowest capacity, they also have the greatest curvature needed to achieve that capacity. In fact, Wall 7-9 would need a ductility of 6 to achieve the same ultimate curvature as Walls 6+10.

The distribution of the moments as done on p. 22 is not necessarily correct. It would be necessary to do a complete story-by-story analysis of the shear forces in order to determine the correct base moment. The control building and reactor building diaphragms are also not always continuous between the 2 structures (e.g., there is a reactor building diaphragm at El. 283'-0" while the closest control building diaphragm is at El. 289'-0"). Thus, reactor building shear forces would not get into control building walls and vice versa. There is also more weight per ft^2 in the reactor building than there is in the control buildings. This would lead to higher shear forces in the reactor building walls and lower forces in the control building walls than what is given on p. 22. The greatest possible $\check{F}_s$ would be:

$$(\check{F}_s)_{\max} = \frac{2(1.30 + 4.92) + 10.22}{15.51} = \underline{1.46} \quad \left(= \frac{\sum \text{Capacities}}{\text{Base Moment}} \right)$$

This would occur only if all 5 walls reached their ultimate capacities simultaneously. This is highly unlikely. The expected failure scenario is that the control building walls (Walls 6+10) will reach their ultimate capacity first, but will not cause structural failure due to there being an alternate load path for shear forces, namely the diaphragm at El. 201'-0". Only when 1 of the reactor building walls fail will there be structural collapse. Since the re-distribution of forces is unknown, an overall $\check{F}_s = 0.8 (\check{F}_s)_{\max}$ will be used.

$$\therefore \check{F}_s = 0.8(1.46) = \underline{1.17}$$



Bending

From p. MC-22, $\beta_s = 0.10$

$$\beta_R \approx \sqrt{0.10^2 + \beta_{ST}^2} = \sqrt{0.10^2 + 0.08^2} = \underline{0.13}$$

$$\beta_U \approx \underline{0.15} \text{ (estimated)}$$

Inelastic Energy Absorption

Shear

See p. MC-18 : $\ddot{F}_u = \underline{1.65}$ $\beta_R = \underline{0.11}$ $\beta_U = \underline{0.13}$

Bending

Ductility is slightly higher for bending. Therefore, $\mu = 2.5$ will be used with the same randomness and uncertainty values as were used for shear.

$$\ddot{F}_u = [(2.504)(2.5) - 1.504]^{0.399} = \underline{1.86}$$

$$\beta_R = \frac{0.399(2.504)(2.5)(0.20)}{2.504(2.5) - 1.504} = \underline{0.11}$$

$$\beta_{u_v} = \beta_R \left(\frac{0.15}{0.20} \right) = 0.079 \Rightarrow \beta_U = \sqrt{0.10^2 + 0.079^2} = \underline{0.13}$$

Spectral Shape

Both strength factors come from the N-S analysis.

Shear

Using the WASH-1255 10% ^{damped median} spectra, the shear for the N-S direction would be:

$$V \approx 101,313 \left(\frac{0.248}{0.410} \right) + 11,171 \left(\frac{0.221}{0.410} \right) + 6878 \left(\frac{0.185}{0.349} \right) + 2320 \left(\frac{0.160}{0.252} \right) \\ = 72,372 \text{ k}$$

$$\therefore \ddot{F}_{ss} \approx \frac{101,313 + 11,171 + 6878 + 2320}{72,372} = \frac{121,691}{72,372} = \underline{1.68}$$



Using the WASH-1255 10% damped 84.1 percentile spectra, the shear for the N-S direction becomes:

$$V_{1\sigma} = \left\{ [0.1, 313 \left(\frac{0.302}{0.410} \right)]^2 + [11, 171 \left(\frac{0.757}{0.410} \right)]^2 + [6878 \left(\frac{0.201}{0.349} \right)]^2 + [2329 \left(\frac{0.165}{0.262} \right)]^2 \right\}^{\frac{1}{2}}$$

$$= 75,072 \text{ k}$$

The SRSS shear using the median WASH spectra is

$$\check{V} = 61,701 \text{ k}$$

$$\therefore \beta_R = \ln \left(\frac{75,072}{61,701} \right) = \underline{0.20}$$

Bending

Since almost 99% of the moment at the base is due to the 1st mode, only that mode will be considered.

$$\check{F}_{ss} = \frac{0.410}{0.248} = \underline{1.65}$$

$$\beta_R = \ln \left(\frac{0.302}{0.248} \right) = \underline{0.20}$$

Damping

7% damping is considered to be 1 σ . (p. M-12)

Shear

$$V_{1\sigma} = \left\{ [10, 313 \left(\frac{0.285}{0.410} \right)]^2 + [11, 171 \left(\frac{0.246}{0.410} \right)]^2 + [6878 \left(\frac{0.196}{0.349} \right)]^2 + [2329 \left(\frac{0.163}{0.262} \right)]^2 \right\}^{\frac{1}{2}}$$

$$= 70,863 \text{ k}$$

$$\therefore \beta_C = \ln \left(\frac{70,863}{61,701} \right) = 0.14$$

$$\therefore \beta_R = \underline{0.12} + \beta_U = \underline{0.06}$$

Bending

$$\beta_C = \ln \left(\frac{0.285}{0.248} \right) = 0.14$$

$$\therefore \beta_R = \underline{0.12} + \beta_U = \underline{0.06}$$

Modelling

$$\beta_f = 0.20$$

$$\beta_{ms} = 0.10$$

$$\therefore \beta_{M_s} = \sqrt{\beta_{ms}^2 + 0.10^2}$$



$$\beta_{mf_i} \approx \ln(S_{f_i=f_i-10}/\ddot{y}_i)$$

where $S_{f_i=f_i-10}$ = spectral accel. for frequency at $f_i = \ddot{y}_i e^{-0.20}$

Shear

Mode	f_i	$f_i e^{-0.20}$	$\ddot{y}_i$	S_{f_i}	β_{mf_i}	β_{m_i}	$\ddot{y}_i$
1	2.90 Hz	2.37 Hz	0.248g	0.248g	0	0.10	61,382k
2	7.89	6.46 Hz	0.221	0.240	0.083	0.13	6,021
3	12.11	9.91 Hz	0.185	0.201	0.083	0.13	3,646
4	17.04	13.95 Hz	0.160	0.174	0.083	0.13	1,422

$$\therefore \beta_v = \left\{ \left[0.10 \left(\frac{61382}{61701} \right)^2 \right]^2 + \left[0.13 \left(\frac{6021}{61701} \right)^2 \right]^2 + \left[0.13 \left(\frac{3646}{61701} \right)^2 \right]^2 + \left[0.13 \left(\frac{1422}{61701} \right)^2 \right]^2 \right\}^{\frac{1}{2}}$$

$$= \underline{\underline{0.10}}$$

Bending

$\beta_v = \underline{\underline{0.10}}$ since first mode contributes 99%

Modal Combination

Shear

$$\ddot{F}_{Mc} = \frac{72,372}{61,701} = \underline{\underline{1.17}}$$

$$\beta_R = \frac{1}{3} (1.17) = \underline{\underline{0.05}}$$

Bending

$$\ddot{F}_{Mc} = \underline{\underline{1.00}}$$

$$\beta_R \approx \underline{\underline{0.01}}$$

Combination of EQ Components

By considering only the vertical response with the larger of the 2 horizontal responses, the load due to torsion from the other horizontal component is missed. The torsion due to the N-S load is virtually non-existent due to symmetry. However, there will be torsion due to the E-W load.

TITLE Limerick
BY RBN DATE 12/17/81
CHKD. BY _____ DATE 1/1



STRUCTURAL
MECHANICS
ASSOCIATES

PAGE 36 OF _____ Job No. 14302
COMMENTS Reactor + Contro
Buildings

Since the N-S load controls the shear and bending failure modes, this torsion must be included.

$$\ddot{F}_{EC} \approx 0.98 + \beta_R \approx 0.02 \text{ (estimated)}$$

Earthquake Duration

The approach used to calculate $\ddot{F}_u$ assumes 3-6 strong cycles in the earthquake. This corresponds to magnitudes of about 6.5 and higher. The median earthquake for Limerick has a much lower magnitude (~ 5.8) and will, therefore, have fewer strong cycles (~ 2). Fewer cycles means the structural element needs to absorb more energy during each cycle in order to fail.

Thus, the same peak effective acceleration in a 3-6 cycle earthquake has much more damage potential than in a 2 cycle earthquake. The difference is estimated to be a factor of 1.4. In estimating the variabilities, the factor is judged to have a 5% probability of being less than 1.0. This statement is made with 95% confidence.

$$\therefore 1.0 = 1.4 [e^{-1.65\beta_R}] [e^{-1.65\beta_U}] \Rightarrow \beta_U + \beta_R = 0.20$$

It is felt that this is more an earthquake-controlled response, so $\beta_R > \beta_U$. $\therefore \beta_R = \underline{0.12}$ $\beta_U = \underline{0.08}$

Soil-Structure Interaction

Nominal values will be used since the structure is on rock.

$$\ddot{F}_{SSI} = \underline{1.0} \quad \beta_U = \underline{0.05}$$

TITLE LimerickBY RBN DATE 12/16/81CHKD. BY _____ DATE 1 1STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 37 OF _____ Job No. 14302COMMENTS Reactor + Control
Buildings

Shear Failure of Shear Walls

Item	Median F.S.	β_R	β_U	β_C
Strength	2.79	0.17	0.10	0.20
Inelastic Energy Absorption	1.65	0.11	0.13	0.17
Earthquake Duration and Cycles	1.4	0.12	0.08	0.14
Spectral Shape	1.68	0.20	0	0.20
Damping	1.0	0.12	0.06	0.14
Modelling	1.0	0	0.10	0.10
Modal Combination	1.17	0.05	0	0.05
Combination of Earthquake Components	0.98	0.02	0	0.02
Soil-Structure Interaction	1.00	0	0.05	0.05
Total	12.4	0.34	0.22	0.40

Median Acceleration Capacity = $12.4(0.15g) = 1.9g$

Flexural Failure of Shear Walls

Item	Median	β_R	β_U	β_C
Strength	1.17	0.13	0.15	0.20
Inelastic Energy Absorption	1.86	0.11	0.13	0.17
Earthquake Duration and Cycles	1.4	0.12	0.08	0.14
Spectral Shape	1.65	0.20	0	0.20
Damping	1.0	0.12	0.06	0.14
Modelling	1.0	0	0.10	0.10
Modal Combination	1.0	0.01	0	0.01
Combination of Earthquake Components	0.98	0.02	0	0.02
Soil-Structure Interaction	1.0	0	0.05	0.05
Total	4.93	0.31	0.25	0.40

Median Acceleration Capacity = $4.93(0.15g) = 0.74g$

TITLE LimerickBY RBN DATE 1 1CHKD. BY DATE 1 1STRUCTURAL
MECHANICS
ASSOCIATESPAGE 1 OF Job No. 14302.01COMMENTS Addenda to
Reactor + Control Bldg.

From pp. 27-29 and 31-31c, the factor of safety on the Reactor Bldg. itself is about 1.7. From p. 38, the strength factor used for failure around the control room area is about 1.2. Therefore, the capacity of the Reactor Bldg. will be

$$\ddot{A} = \left(\frac{1.7}{1.2}\right) (0.74g) = \underline{1.05g}$$

Uncertainty and randomness variabilities are expected to remain the same as those listed on p. 33.

TITLE Limerick

BY ESH DATE 11

CHKD. BY DATE 11



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 2-1 OF Job No.

COMMENTS References

References

- 1) "Building Code Requirements For Reinforced Concrete (ACI 318-77)", American Concrete Institute, 1977.
- 2) Bonds, F., J.M. Hanson, and W.J. Corley, "Shear Strength of Low-Rise Walls With Boundary Elements", ACI Symposium, "Reinforced Concrete Structures In Seismic Zones", American Concrete Institute, Detroit, Michigan, 1976.
- 3) Shiga, T., A. Shibata, and J. Takahashi, "Experimental Study On Dynamic Properties of Reinforced Concrete Shear Walls", Fifth World Conference on Earthquake Engineering, Rome, Italy, 1973.
- 4) Condens, A.R., et. al., "Design Provisions For Shear Walls", ACI Journal, Vol. 70, No. 3, March, 1973.
- 5) Oesterle, R.G., et. al., "Earthquake Resistant Structural Walls - Tests of Isolated Walls - Phase II", Construction Technology Laboratories (Division of PCA), Skokie, Illinois, October, 1979.
- 6) Kennedy, R.P., "A Review of Procedures For The Analysis of Design of Concrete Structures To Resist Missile Impact Effects", Nuclear Engineering and Design, Vol. 37, No. 2, March, 1976.
- 7) Newmark, N.H., R.P. Kennedy, and S.A. Short, "Evaluation of a PWR Reactor Building Subjected to a High Acceleration, Short Duration Earthquake", prepared for Electricite de France, EDAC, August, 1979.
- 8) "Structural Condition Documentation and Structural Capacity Evaluation of the Battelle Memorial Institute Columbus Laboratories West Jefferson Site For Earthquake and Flood", Engineering Decision Analysis Co. report EDAC 75-080.02, 1979.
- 9) Birkeland, P.W. and H.W. Birkeland, "Connections in Precast Concrete Construction", ACI Journal, March, 1966.
- 10) Mast, R.P., "Auxiliary Reinforcement In Precast Concrete Connections", J. Structural Division, ASCE, June, 1968.
- 11) Becker, J. and C. Llorente, "Seismic Design of Precast Concrete Panel Buildings", Proc. Earthquake Resistant Reinforced Concrete Building Construction, Berkeley, California, July 11-15, 1977.

TITLE LimerickBY RCH DATE 11CHKD. BY DATE 11STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 2-2 OF Job No. COMMENTS Reference 2

- 12) Mattock, A.H., L. Johal, and H.C. Chow, "Shear Transfer In Reinforced Concrete With Moment or Tension Acting Across the Shear Plane", PCI Journal, July-August, 1975.
- 13) Manual of Steel Construction, 7th Ed., AISC, 1971.
- 14) Umemura, et. al. "As seismic Characteristics of R/C Box and Cylinder Walls", Experimental Studies on Reinforced Concrete Members and Composite Steel and Reinforced Concrete Members - Vol. 3, University of Tokyo, Dec., 1977.
- 15) Shell Analysis Manual - Vol. III, NASA, 1966.
- 16) Timoshenko, S. and S. Woinowsky-Krieger, Theory of Plates and Shells, McGraw-Hill, 1959.
- 17) Roark, R.J. and W.C. Young, Formulas For Stress and Strain, McGraw-Hill, 1975.
- 18) Blodgett, O., Design of Welded Structures, Lincoln Arc Welding Society, 1966.
- 19) Structural Analysis and Design of Nuclear Power Plant Facilities, ASCE M and R No. 58, 1980.
- 20) Wittenberg and A.H. Wilson, Design of Concrete Structures, McGraw-Hill, 1972.
- 21) Bresler, B. (ed.), Reinforced Concrete Engineering - Volume I, John Wiley and Sons, 1974.
- 22) "Code Requirements for Nuclear Safety Related Concrete Structures (ACI 349-76) and Commentary on Code Requirements for Nuclear Safety Related Concrete Structures", American Concrete Institute, 1976.
- 23) McMeekin, P.J., R.G. Slutter, and J.W. Fisher, "Headed Steel Anchors Under Combined Loading", AISC Journal, 2nd Quarter, 1975.
- 24) PCI Design Handbook, Prestressed Concrete Institute,
- 25) Ollgaard, J.G., R.G. Slutter, and J.W. Fisher, "Shear Strength of Stud Connectors in Lightweight and Normal-Weight Concrete", AISC Journal, April, 1971.
- 26) Kennedy, R.P., et. al., "Probabilistic Seismic Safety Study of an Existing Nuclear Power Plant", Nuclear Engineering and Design, August, 1980.
- 27) Riddell, R., and H.U. Newmark, "A Statistical Study of Inelastic Response Spectra", 2nd U.S. Conference on Earthquake Engineering, Stanford University, 1979.

TITLE Linerick

STRUCTURAL
MECHANICS
ASSOCIATES

PAGE 2-3 OF Job No.

BY PSH DATE 11

CHECKD. BY DATE 11



STRUCTURAL
MECHANICS
ASSOCIATES
A Civil, Corp.

COMMENTS Reference

- 28) "A Study of Vertical and Horizontal Earthquake Spectra", Nathan B. Newman Consulting Engineering Services, prepared for USAEC, April, 1973.
- 29) Newman, N. M. and W. J. Hall, "Development of Criteria for Seismic Review of Selected Nuclear Power Plants", NUREG/CR-0002, May, 1978.
- 30) USNRG Regulator's Guide 1.92, "Combining Model Responses and Spatial Components in Seismic Response Analysis", Rev. 1, February, 1976.
- 31) Trovelli, G. E., H. E. Davis, and J. W. Kelly, Composition and Properties of Concrete, 2nd ed., McGraw Hill, 1968.
- 32) Mirza, S. A., et. al., "Statistical Description of Strength of Concrete", J. Structural Division, ASCE, May, 1979.
- 33) Mirza, S. A. and J. E. MacGregor, "Variability of Mechanical Properties of Reinforcing Bars", J. Structural Division, ASCE, May, 1979.
- 34) Walsen, A. ^{of Sargent & Lundy} to D. A. Weale, personal communication, re. Eion, April, 1980.
- 35) Weaver, E. R. ^{of Sargent & Lundy} to D. Eiden, personal communication, re. Eion, 1981.
- 36) "Final Safety Analysis Report (FSAR), Eion Station", Commonwealth Edison Co.
- 37) Galambos, T. V. and M. K. Ravindra, "Properties of Steel For Use In LRFD", J. Structural Division, ASCE, September, 1978.
- 38) "Structural Condition Documentation and Structural Capacity Evaluation of the Westinghouse Laboratory Facility At Chalkville, Pennsylvania For Earthquake and Flood", prepared for Lawrence Livermore Laboratory, EDAC report no. EDAC 175-040-2R, July, 1978.
- 39) Plastic Design In Steel, ASCE Manual and Report No. 41, 1971.
- 40) Chote, et. al., "A Literature Survey - Transverse Strength of Welding Joints", UCB/EERC-77/57, University of California, Berkeley, March, 1977.
- 41) "Structural Condition Documentation and Structural Capacity Evaluation of the Buscock and Wilcox Facility At Cedarburg, Pennsylvania For Flood and Earthquake", Engineering Decision Analysis Co. report, EDAC 175-030-02, 1977.

TITLE LimerickBY PSH DATE 8/12/81CHKD. BY _____ DATE 1/1STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 2-9 OF _____ Job No. _____COMMENTS References

- 42) Meyer, R.L. and R.W. Clough, "State of the Art In Seismic Shear Strength of Masonry - An Evaluation and Review", EERC 75-21, University of California, Berkeley, October, 1975.
- 43) Ozalci, Y., et al., "Shear Strength Tests of Prestressed Concrete Containment Vessels", 4th SMIRT Conference, Paris, France, August, 1981.
- 44) Aougi, Y., et al., "Strength and Deformational Characteristics of Orthogonally Reinforced Concrete Containment Models Subjected to Lateral Forces", 4th SMIRT Conference, Paris, France, August, 1981.
- 45) Bader, U. and H. Krawinkel, "Shear Transfer in Thick-Walled Reinforced Concrete Cylinders", 4th SMIRT, Paris, France, August, 1981.
- 46) Certification of test results for A-421 post-tensioning wire, Florida Wire and Cable Company, Jan. and Feb. 1979.
- 47) Wesley, D.A. and P.S. Hashimoto, "Preliminary Evaluation of Nonlinear Seismic Response Effects For Nuclear Power Plant Shear Wall Structures", Structural Mechanics Associates Report SMA 12205.02, September, 1980.
- 48) Hadjian, A.H. and T.S. Atalik, "Discrete Modelling of Symmetric Box-Type Structures", International Symposium on Earthquake Structural Engineering, St. Louis, Missouri, August, 1976.
- 49) Veletsos, A.S., "Seismic Effects in Flexible Liquid Storage Tanks", Proc. 5th World Conference on Earthquake Engineering, Rome, 1974.
- 50) Veletsos, A.S., and J.H. Yang, "Dynamics of Fixed-Base Liquid Storage Tanks", Rice University, Houston, Texas, Nov. 1976.
- 51) Fattal, S.G. and L.E. Ottarso, "Evaluation of Structural Properties of Masonry in Existing Buildings", NBS G2, National Bureau of Standards, March, 1977.
- 52) "Uniform Building Code", International Conference of Building Officials, 1976.

TITLE Limerick PRA
BY RLH DATE 6/1/82
CHKD. BY HP DATE 6/17/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 1 OF 4 Job No. _____

COMMENTS _____

⑥ Control Rod Guide Tubes & Fuel Rods

A Given Information

Loads Information (R.D. Campbell meeting with G.E.)

Max Moment = 2358 in-kips for 185 tubes

$$\therefore M_{max} = 12.746 \text{ in-kip/tube}$$

Vertical Model (R.D. Campbell meeting with G.E.)

$F_v = 179 \text{ kips}$ for 185 tubes

$$F_v = 0.9676 \text{ kips/tube}$$

Stress Info. (from R.D. Campbell meeting with G.E.)

Faulted Loadings = SSE + Core Plate ΔP + SRV ADS + Chug

Material = 304 SS

Flange Stress = 8695 = P_b

Body Stress = 807.5 psi

B The above information is not descriptive enough to develop an accurate strength factor. The tube geometry is unknown, the breakdown in faulted condition loading is unknown and the failure threshold of tubes (ie point where they inhibit SCRAM) is unknown.

Therefore, the fragility of the guide tubes will be developed based on data developed for LaSalle and Susquehanna Plants. It has been shown on these two Plants that deflection of the fuel rod is the governing failure mode.

TITLE Limerick PRA
BY QJH DATE 6/15/82
CHKD. BY 171 DATE 6/17/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 2 OF 4 Job No. _____

COMMENTS _____

VECE 7/1/82

⑥ Control Rod Guide Tube & Fuel Rods

Fuel Rod Deflections (Information below obtained in GE meeting by R.D. Campbell)

Deflection Data for Limerick was not available, but data for Susquehanna & for LaSalle was available, & they were both 0.66" deflection for faulted loading.

∴ Limerick will be assume to respond the same as LaSalle since both of these rods were 100 mill channels.

∴ 0.2 g's cause 0.66" Deflection in LaSalle

∴ 0.15 g's Causes $\frac{0.15}{0.2} \times .66 = 0.50$ " for Limerick

Capacity = > 2.5 " mid fuel displacement (based on GE* study)

assume 2.5" = -1/3 value & that $\beta_1 = 0.20$ (judgement)

∴ Median Capacity = $2.5 \times e^{0.20} = 3.05$ "

Normal Loads were not delineated & will be assumed to be negligible.
(conservative assumption)

$$F_s = \frac{3.05}{0.50} = 6.1$$

Uncertainty on Limerick deflection estimation of 0.5" for the SSE is unknown but it is estimated to be no greater than $\beta_2 = 0.25$

$$\beta_s = (\beta_1^2 + \beta_2^2)^{1/2} \quad (\beta_1 = \beta \text{ on } 3.05, \beta_2 = \beta \text{ on } 0.50)$$

$$\therefore \beta_s = (0.25^2 + 0.20^2)^{1/2} = 0.32$$

* GE tests on typical fuel rods and guide tubes showed SCRAM capability at 2.5" mid-fuel deflections. Therefore, actual median failure deflection is somewhat greater.

TITLE Limerick PRA
BY BSH DATE 6/15/82
CHKD. BY fi DATE 6/17/82



STRUCTURAL
MECHANICS
ASSOCIATES

PAGE 3 OF 4 Job No. _____
COMMENTS _____

Control Rod Guide Tube & Fuel Rods (Cont.)

Ductility

$$F_u = 1.0 \quad \& \quad \beta_u = 0.0$$

since these fuel rod deflections are elastic type failures and there won't be any inelastic energy absorption.

Capacity Factor

$$F_c = F_s \cdot F_u = 6.1$$

$$\beta_c = 0.32$$

$$\beta_{cR} = 0.12 \quad \& \quad \beta_{cu} = 0.30 \quad (\text{estimated})$$

Equipment Response Factors

Calculations by M.K. Ravindra (attached) show the following:

$$F_{ER} = 1.50$$

$$\beta_{ERu} = 0.19$$

$$\beta_{ERR} = 0.25$$

$$\left. \begin{array}{l} \beta_{ERu} = 0.19 \\ \beta_{ERR} = 0.25 \end{array} \right\} \beta_{ER} = 0.31$$

Structural Response Factors

Since the structural response was generated using a time history input in lieu of a response spectrum loading, the values are:

$$F_{SR} = 1.0$$

$$\beta_{SRR} = 0.05$$

$$\beta_{SRu} = 0.0$$

(see structural
response factor
section)

TITLE Limerick PRA
BY GLH DATE 6/15/82
CHKD. BY GLH DATE 7/1/82



STRUCTURAL
MECHANICS
ASSOCIATES

PAGE 4 OF 4 Job No. _____

COMMENTS _____

✓ ESE 7/1/82
Control Rod Guide Tube & Fuel Rod (Cont.)

Ground Acceleration Capacity

$$\ddot{A} = F_L \times F_{ER} \times F_{SR} \times A_{SSE}$$

$$\ddot{A} = 6.1 \times 1.5 \times 1.0 \times 0.15 g_s = 1.37 g_s$$

$$\beta_c = (0.32^2 + 0.31^2 + 0.05^2)^{1/2} = 0.45$$

$$\beta_R = (0.25^2 + 0.12^2 + 0.05^2)^{1/2} = 0.28$$

$$\beta_u = (0.30^2 + 0.19^2)^{1/2} = 0.35$$

TITLE Response FactorsBY M. K. Ravnitzky DATE 10/15/81CHKD. BY ASH DATE 9/12/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 13 OF Job No. COMMENTS EQUIPMENT RESPONSE FACTOR FOR RPV, INTERNALS
CRD HOUSINGS AND GUIDE TUBES

All components are modeled in Time History
Analysis Model (FSAR FIGURE 3.7-19)

Spectral Shape Factor

See derivation for Primary Containment, Shield wall
and RPV Support.

$$\check{F}_{SS} = 1.24 \quad \beta_{SS} = \beta_R = 0.22.$$

Qualification Method

Time history analysis is median centered; Uncertain
is due to modeling, damping, earthquake component
Combination, etc.

$$\check{F}_{QM} = 1.0 \quad \beta_{QM} = 0$$

Damping

RPV and internals : 2% damping is used in
design. 5% is considered a median value.

From FSAR Figure 3.7-31

$f_n = 4.5 \text{ Hz}$ for dominant RPV pedestal mode.
for concrete structures, 5% damping used in
analysis. 10% is considered median.

Use median spectrum for damping factor and
 β evaluation.

TITLE Response factorsBY MKR DATE 10/15/81CHKD. BY [Signature] DATE 9/12/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 14 OF Job No. COMMENTS

✓ P.C.S. 7/15/82.

Since we do not have the response spectra for
RPV Pedestal at these damping levels, we use
WASH 1255 spectra.

$$\check{F}_D = \frac{S_{a5\%}}{S_{a10\%}} \text{ at } f_n = \frac{2.12}{1.63} = 1.30$$

$$\beta_D = \ln \left(\frac{S_{a7\%}}{S_{a10\%}} \right) : \ln \left(\frac{1.90}{1.63} \right) = 0.15$$

$$\beta_R = 0.10 \quad \beta_U = 0.11$$

Modeling Error

$$\check{F}_{ME} = 1.0$$

For MDOF Systems, $\beta_{ME} = 0.15 = \beta_U$

Mode Combination

Does not apply.

Combination of Earthquake Components

Case 3, 2D Horizontal, Uncoupled

$$\check{F}_{ECC} = 0.93 \quad \beta_{ECC} \beta_R = 0.06$$

Combined Response Factor

$$\check{F}_R = (1.24)(1.0)(1.30)(1.0)(0.93) = 1.50$$

$$\beta_{\text{Composite Response}} = (0.22^2 + 0 + 0.15^2 + 0.15^2 + 0.06^2)^{1/2} = 0.31$$

$$\beta_R = (0.22^2 + 0.10^2 + 0.06^2)^{1/2} = 0.25$$

- 1/4

STATUS OF BOILING WATER REACTOR STRUCTURAL INTEGRITY PROGRAMS AT THE GENERAL ELECTRIC COMPANY *

E. KISS and T.L. GERBER

General Electric Company, Nuclear Engineering Division San Jose, CA 95125 U.S.A.

The General Electric Company is actively involved in a variety of programs whose objective is to evaluate and improve the technology related to structural integrity of Boiling Water Reactors. This work covers many technical disciplines that fall broadly under the title of Applied Mechanics and includes the technologies of solid mechanics, structural dynamics, elasticity, plasticity, and fluid dynamics.

General Electric programs are directed at qualification of the predictive methodology, design bases and criteria used to evaluate and confirm the structural design margins of the Boiling Water Reactor Nuclear Steam Supply System. This includes the reactor pressure vessel, piping, fuel, core structures, and auxiliary equipment within General Electric's scope of supply. Focus of these programs includes identification, measurement and refinement of operational and postulated accident-type loads; prediction of structure and component response; study of damage mechanisms; and development of failure criteria, evaluation methods and design rules.

In this report, some specific activities and accomplishments during the last few years are summarized in order to provide a broad overview of the wide range of technical issues and programs undertaken. These activities have been grouped into areas of: I - Dynamic Modeling and Structural Analysis; II - Fatigue and Fracture Evaluations; III - Structural Capability Tests; and IV - Flow Induced Vibration Experiments.

I. Dynamic modeling and structural analyses

Nuclear power plant structures and components are designed for a large number of static and dynamic loadings plus combinations of these loads. These include normal operational type loadings such as weight, internal pressure and temperature; operational type transients such as turbine trip and Safety Relief Valve discharge; and extreme loadings resulting from a postulated earthquake (SSE) or a Loss-Of-Coolant-Accident (LOCA). Clearly, structural design and analysis for each type of loading requires application of appropriate models, methods and technology developed specifically for that purpose.

The following sections discuss several important technical issues in the area of dynamics modeling and structural analysis pursued by General Electric's Nuclear Engineering Division.

I.1. Standard plant seismic analysis

Adequate design for seismic events is fundamental to nuclear reactor safety, since seismic dynamic loads are often found to control the structural design for many components and structures in the nuclear plant. For this reason General Electric has undertaken a series of comprehensive seismic analyses of the BWR/6 Standard Nuclear Steam Supply System (NSSS) reactor structures and components housed in a nuclear power plant of standard design and arrangement. The objective is to provide and qualify a standard reactor which meets stringent NCR siting and design requirements for high-seismic plant sites. To achieve this objective, a set of bounding response spectrum envelopes for a wide range of possible site soil conditions have been established as the design bases for these reactor components.

To establish the all-soils envelopes for equipment design, a series of soil-structure interaction analyses was completed using finite element methods, in which the non-linear behavior of the soil is accounted for by an equivalent linear method. Fig. 1 shows the

* Paper presented at the SMIRT-5/USNRC Panel Session "Status of Research in Structural and Mechanical Engineering for Nuclear Power Plants", Berlin (West), 14 August, 1979.

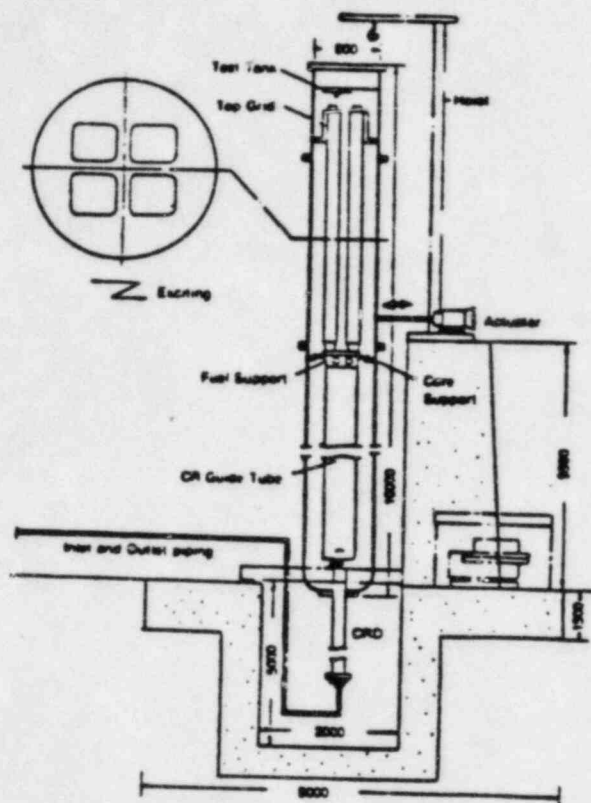


Fig. 19. Seismic scrammability test assembly schematic.

assembly by conducting tests at higher and higher g levels until some element of the assembly failed or until maximum capability of the test facility was reached. A dynamic shaker table test of the fuel bundle assembly was performed in air at room temperature. The fuel rods contained unenriched uranium for proper mass to obtain the correct dynamic characteristics and the fuel channel box used had full scale dimensions. The fuel bundle assembly was supported vertically in a test fixture exactly as it is in the reactor. The test fixture was mounted on the General Electric 13-foot electro hydraulic shaker table. During the course of a whole series of dynamic tests the fuel bundle was subjected to over 500000 cycles in the horizontal direction with an average input acceleration level of $0.5 g$ ($P-P$) and a maximum g level of $1.65 g$ ($P-P$). It was also subjected to over 250000 cycles in the vertical direction with an average g level of $1.25 g$ ($P-P$) and a maximum g level of $2.1 g$ ($P-P$). Key results of these tests were the quantification of dynamic characteristics and deter-

mination that the fuel bundle could survive this ultra-severe dynamic test with no major failure or damage.

3.3. Seismic scrammability test

A seismic scrammability test was designed by General Electric and conducted by General Electric's licensee, Hitachi, Ltd., to demonstrate the scrammability of a BWR plant during a seismic event. A schematic of the test fixture assembly utilized is shown in fig. 20. This test fixture was specially designed to accommodate a full-scale fuel module composed of four fuel bundles. The top guide and core plate were designed to simulate the actual hardware. All other components such as the fuel support casting, guide tube, and control rod were actual BWR production hardware. The driving mechanism for the control rod consisted of a complete hydraulic control unit and its accessories. The test fixture was approximately 45 ft high, with 15 ft below the ground to accommodate the control rod drive housing. The test fixture was mounted on a pivoting mechanism at the ground level, so that the fixture would swing rigidly about the pivoting point when it was excited by the horizontal hydraulic actuator input. Both sinusoidal and multi-frequency excitation were used to drive the shaker during scram events. However, in order to achieve large levels of displacement at the center of the fuel assembly, it was necessary to use a sinusoidal excitation at the resonance frequency of the fuel assembly. The scram was performed at various levels of mid-fuel displacement and the time required to reach 50%, 75% and 100% control blade insertion was measured. The dynamic response and scrammability time for various levels of seismic excitation and hydraulic control unit charging pressure were measured. In some tests a maximum value of mid-fuel displacement of 2.5 in (62.5 mm) was obtained. This corresponds to a ground peak acceleration which exceeds $0.5 g$. Even at these extremely high levels mechanical integrity was maintained and scrammability was demonstrated.

3.4. Seismic valve qualification test

In addition to seismic structural capability tests, equipment seismic qualification tests are also con-

TITLE Limerick PRA
 BY CSH DATE 6/9/82
 CHKD. BY RDC DATE 9/5/82



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 1 OF Job No.
 COMMENTS

✓ ELS 9/5/82

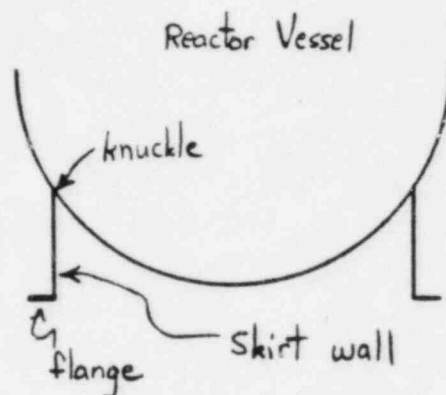
⑩ RPV Support Skirt

A. Given Information

Design Loads for Buckling Calc

$$\left. \begin{array}{l} V_1 = 2149 \text{ kips} \\ V_2 = 3064 \text{ kips} \\ H = 2600 \text{ kips} \\ M = 1,152,000 \text{ in-kips} \end{array} \right\} 5213 \text{ kips}$$

Skirt wall



Actual SSE Loads

$$\left. \begin{array}{l} V = 1173 \text{ kips} \\ H = 1376 \text{ kips} \\ M = 648,136 \text{ in-kips} \end{array} \right\}$$

skirt wall

Skirt Material = SA 516 - Grade 60

At ~250°F

$\sigma_y = 28,760 \text{ psi}$
code

$$\sigma_y^v = 1.2 (28,760) = 34,512$$

Knuckle material = SA 533 Grade B, Class 1 $\sigma_{y, \text{knuckle}} = 46.15 \text{ ksi}$

Skirt Geometry

$$A = 1387 \text{ in}^2$$

$$C = 125.5 \text{ in}$$

$$I = 1.0927 \times 10^7$$

Lower Flange

strain hardening

$$\begin{aligned} \text{Collapse Moment} &= 1.2 \times \sigma_y \times \frac{t^2}{4} = 1.2 \times (36,325) \times \frac{3.6875^2}{4} \\ &= 148,180 \text{ in-lb/inch of circumference} \end{aligned}$$

for the 303.9 kip bolt load

$$\Rightarrow \text{Bending Moment in Flange} = 137,706 \text{ in-lb/inch of circumference}$$

(Check) Collapse Moment $\Rightarrow \sigma_b = \frac{6M_b}{t^2}$ collapse $\sigma_c = 1.5 \sigma_y$

$M_b = 0.25 \sigma_y t^2$ (1.2 for strain hardening)

TITLE Limerick PRA
 BY PC/H DATE 6/9/82
 MKD. BY RDC DATE 9/5/82



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 2 OF Job No.
 COMMENTS

✓ ELS 9/15/82

(16) RPV Support Skirt (Cont.)

B. Capacity Calculation

There are two areas of the support skirt which will be analyzed.

- 1) The buckling in the skirt wall
- 2) Bending stress in the flange

There is some doubt as to whether an overstressed condition in the flange alone will cause a failure in the RV system, due to the upper support on the RV placing a strain controlled condition on the ~~lower~~ skirt. But, we will conservatively assume that it is a failure mode, due to adverse frequency changes and other problems which result from the flange failure.

∴ 1) Buckling Skirt Wall

$$\text{Interaction Formula} = \frac{P/A}{1.1 \times \sigma_y} + \frac{Mc/I}{1.3 \times \sigma_y} \leq 1.0$$

$\nwarrow$ estimated by RDC $\nwarrow$ bending modulus given by GF.
 (1.1)(1.2) ~ 1.3

$$\frac{P}{A} = \frac{1376 \text{ kips}}{1387 \text{ in}^2} = 992 \text{ psi}$$

$$\frac{Mc}{I} = \frac{648,136 \times 125.5}{1.0927 \times 10^7} = 7.444 \text{ kip/in}^2 = 7,444 \text{ psi}$$

$$\therefore \frac{992}{1.1 \times 36,325} + \frac{7,444}{1.3 \times 36,325} = 0.2705$$

$$F_c \approx \frac{1}{0.2705} = 3.7 \times 5.98$$

No Distortion for Buckling

$$B_{\text{small}} \quad B_R = 0.05 \quad B_U = 0.1$$

$$B_{\text{buckling}} = \frac{\ln 1.3}{2} = 0.13$$

$$B_{R2} = 0.08 \quad B_{U2} = 0.1$$

$$B_R = 0.16 \quad B_R = 0.09 \quad B_U = 0.13$$

$$\text{check} \quad \frac{5.98}{1.1 \times 36,325} + \frac{5.98}{1.3 \times 36,325} = 0.0002 \quad \checkmark$$

TITLE Limerick PRABY BLH DATE 6/10/82CHKD. BY RPC DATE 9/15/82STRUCTURAL
MECHANICS
ASSOCIATES
A Genl. Corp.PAGE 3 OF Job No. COMMENTS

✓ ELS 9/15/82

(16) RPV support Skirt (Cont.)2) Flange Bending Failurefor Design Loading $M_{\text{Flange}} = 137,706 \text{ in-lb/in}$

Scaling this value by the ratio of the actual moment in the skirt wall to the design moment in the skirt wall will give us our best estimate of the actual moment in the flange.

$$M_{\text{Flange Actual}} = 137,706 \times \frac{648,136}{1,152,000} = 77,476 \text{ in-lb}$$

Moment Capacity = $148,180 \text{ in-lb/in}$ (Plastic hinge)

$$\therefore F_s = \frac{148,180 - 0}{77,476} = 1.91$$

$$\beta_{\text{net}} = 0.11$$

$$\beta_R = 0.05$$

$$\beta_u = 0.10$$

Note: Normal Stress is assumed to be 0

* $\therefore \beta_{\text{NS}}$ is meaningless * $i = 0$ β on shape factor & strain hardening.

Assume 1.0 as min at -3P

$$\beta_{st} = \frac{\ln \frac{1.2(1.5)}{3}}{3} = 0.2$$

$$\beta_R = 0.1$$

$$\beta_u = 0.17$$

$$\beta_c = (0.11^2 + 0.2^2)^{\frac{1}{2}} = 0.23$$

$$\beta_{sR} = 0.11$$

$$\beta_{su} = 0.20$$

TITLE Limerick PRABY CSH DATE 6/10/82CHKD. BY RDC DATE 9/15/82STRUCTURAL
MECHANICS
ASSOCIATES
A Corp. Corp.PAGE 4 OF Job No. COMMENTS

✓ ELS 9/15/82

(16) RPV Support Skirt (Cont.)Ductility

Some ductility exists for the flange failure due to small amount of plastic flow which will occur.

$$\mu \approx 1.5$$

$$\therefore F_u = \sqrt{2\mu - 1} \quad \text{for } 8 \text{ Hz frequency range of the reactor vessel}$$

$$F_u = \sqrt{2 \cdot 1.5 - 1} = 1.41$$

$$\beta_u = \frac{1}{2} \ln \left(\frac{1.41}{1.0} \right) = 0.17$$

$$\beta_e = 0.045 \quad \text{from Table}$$

$$\beta_{u_{tot}} = (0.17^2 + 0.045^2)^{1/2} = 0.18$$

$$\beta_{u_r} = 0.1 \quad \text{estimated}$$

$$\beta_{u_u} = 0.15$$

Capacity

$$F_c = 1.41 \times 1.91 = 2.69$$

$$\beta_c = (0.23^2 + 0.18^2)^{1/2} = 0.29$$

$$\beta_{c_r} = (0.11^2 + 0.10^2)^{1/2} = 0.15$$

$$\beta_{c_u} = (0.20^2 + 0.15^2)^{1/2} = 0.25$$

This is the critical area

TITLE Limerick PRABY GHA DATE 6/18/82CHKD. BY RK DATE 9/14/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 5 OF Job No. COMMENTS 14302.01

✓ ELS 9/15/82

① RPV Stabilizer Bracket (Revision) (Attached to Shield Wall)

The New Loads Summary Sheet by Krepps contains conflicting information as to the correct load onto the stabilizer lugs. It is assumed that this load is equal to the load on the bracket.

The summary sheet states that the overall load on the vessel used for the design was 2760 kips and that the actual overall load should be 1008 kips (seismic only).

The values within the FSAR Table 3.9-6(a) page 6 are correct for design load.

Upset → OBE + Spring Preload → $f_b = 9390 \text{ psi}$ $f_v = 2715 \text{ psi}$ Emergency → SSE + Spring Preload → $f_b = 18,780 \text{ psi}$ $f_v = 5430 \text{ psi}$

FSAR

(bending tensile stress)

(shear stress)

∴ Normal stress = 0 = Spring Preload stress

SSE stress = Emergency Condition stress

$$\text{Actual SSE Stress} = \frac{1008}{2760} \times \text{FSAR stress}$$

Using Mohr's Circle

$$\begin{aligned} \sigma_{sse} &= \frac{\sigma_b}{2} + \left[\left(\frac{\sigma_b}{2} \right)^2 + \tau^2 \right]^{1/2} \\ &= \frac{18,780}{2} + \left[\left(\frac{18,780}{2} \right)^2 + 5430^2 \right]^{1/2} \\ &= 9,390 + 10,847 = 20,237 \text{ psi} \end{aligned}$$

$$\tau_{max} = 10,847$$

$$\text{Stress Intensity} = 2 \times \tau_{max}$$

$$SI = 21,694$$

$$\text{Actual SSE Stress} = \frac{1008}{2760} \times 20,237 = 7,391 \text{ psi}$$

$$\text{Actual Stress Intensity} = \frac{1008}{2760} \times 21,694 = 7,923$$

TITLE Limerick PRABY BSH DATE 6/8/82CHKD. BY RUC DATE 9/11/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 6 OF Job No. COMMENTS

✓ ECR 5/15/82

① RPV Stabilizer Bracket (Revision) Cont.

Capacity

The failure mode for the bracket occurs in the weld of the shield wall to bracket junction.

The weld material is unknown, but will conservatively be assumed to be E-~~60~~⁷⁰ electrode with a ~~60~~⁷⁰ ksi ultimate.
(E-70 is common Bechtel Practice)

We will compare the stress intensity to this ultimate ~~without adding~~ plus 10% to reflect median strength. ~~the 20% conservatism.~~ Also, since we are going up to the ultimate, & since the system ductility is negligible for the massive shield wall & reactor vessel in comparison to this relatively small connection, ∴ Ductility will be ignored.

$$F_a = \frac{70000(41)}{69000 - 0} = \frac{9.72}{7.57}$$

7923

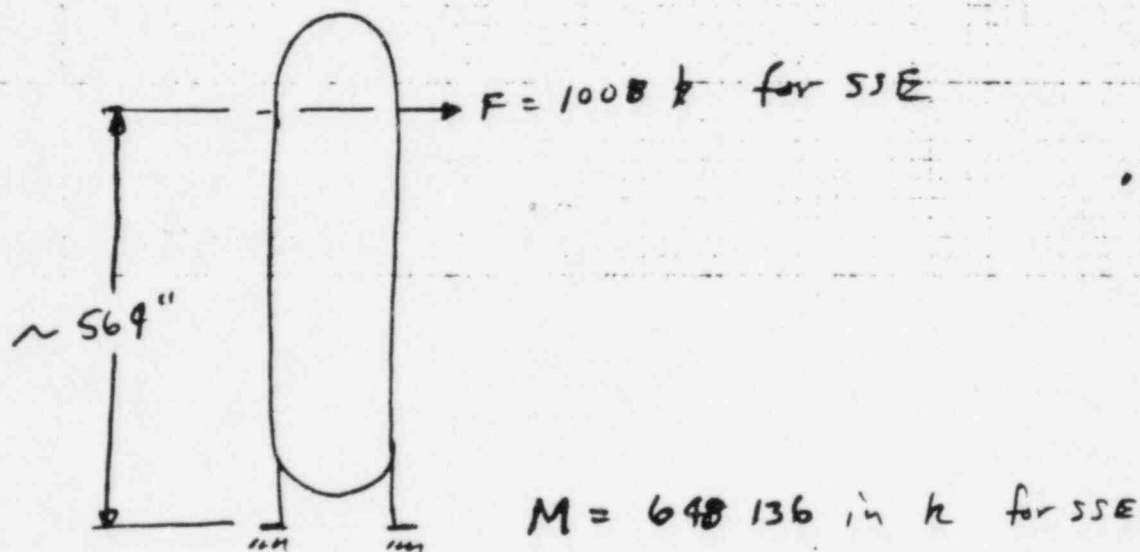
$$\beta_c = 0.25 \quad (\text{estimated due to uncertainty in weld type \& strength of joint})$$

$$\beta_{cr} = 0.10$$

$$\beta_{ou} = 0.23$$



Compute Ultimate Capacity of RPV support system. Lower skirt support is ductile failure while upper support is brittle failure. Compute Ultimate capacity of system assuming the limit moment capacity of the lower skirt and the ultimate capacity of the upper support brackets. No ductility is applicable for the system.



$F_c = 1.91$ from previous calculations (limit moment factor)

$$\text{Limit moment} = 1.91(648,136) = 1,238 \times 10^6 \text{ in k}$$

Ultimate force resistance at top from previous calculations is $9.72(1008) = 9798 \text{ k}$.

TITLE _____
BY RDC DATE 9/4/82
CHKD. BY ASH DATE 9/11/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 8 OF _____ Job No. _____
COMMENTS _____

VECS 9/15/82

M_{limit} is reached at $1.91(.15) = .287 g$

At $.287 g$, $F_{upper} = 1.91(1008) = 1925 k$

Above $0.287 g$ the moment is constant at the RPV base and all increased seismic OTM is resisted by the top support.

$$\text{Total moment} / g = \frac{1}{.15} (6.44 \times 10^6 + 1008(564)) = 8.11 \times 10^6$$

$$\text{Ultimate moment capacity} = (.287 + \Delta g)(8.11 \times 10^6)$$

$$M_L + 564 F_{uct} = (.287 + \Delta g)(8.11 \times 10^6)$$

$$1.238 \times 10^6 + 9798(564) = 2.327 \times 10^6 + 8.11 \times 10^6 \Delta g$$

$$\Delta g = 0.547$$

$$g_{max} = 0.547 + 0.287 = 0.834$$

$$B_c \text{ on } M_L = 0.23$$

$$B_R = 0.11 \quad B_U = 0.20$$

$$B_c \text{ on } F_u = 0.25$$

$$B_R = 0.15 \quad B_U = 0.20$$

Most of load is carried by upper support thus, we will let

$$B_c = 0.25 \quad B_R = 0.10 \quad B_U = 0.23$$

TITLE _____
BY RDC DATE 9/15/82
CHKD. BY ASH DATE 9/11/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 2 OF _____ Job No. _____
COMMENTS _____

VELS 9/15/82

$$F_s = \frac{0.834}{0.15} = 5.56$$

$$\ddot{A} = 1.0 (1.5) (5.56) (0.15) = 1.25$$

$$B_c = [0.05^2 + 0.31^2 + 0.25^2]^{\frac{1}{2}} = 0.40$$

$$B_R = [0 + 0.26^2 + 0.1^2]^{\frac{1}{2}} = 0.28$$

$$B_o = [0.05^2 + 0.17^2 + 0.23^2]^{\frac{1}{2}} = 0.29$$

TITLE: Response Factors.BY: M. K. Razindra DATE: 10/15/81CHKD. BY: CSH DATE: 9/12/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 13 OF Job No. COMMENTS

EQUIPMENT RESPONSE FACTOR FOR RPV, INTERVALS CRD HOUSINGS AND GUIDE TUBES

All components are modeled in Time History
Analysis Model (FSAR FIGURE 3.7-19)

Spectral Shape Factor

See derivation for Primary Containment, Shield wall
and RPV Support.

$$\bar{F}_{SS} = 1.24 \quad \beta_{SS} = \beta_R = 0.22.$$

Qualification Method

Time history analysis is median centered; Uncertainty
is due to modeling, damping, earthquake component
Combination, etc.

$$\bar{F}_{QM} = 1.0 \quad \beta_{QM} = 0$$

Damping

RPV and internals : 2% damping is used in
design. 5% is considered a median value.

From FSAR Figure 3.7-31

$f_n = 4.5 \text{ Hz}$ for dominant RPV pedestal mode
for concrete structures. 5% damping used in
analysis. 10% is considered median.

Use median spectrum for damping factor and
 β evaluation.

TITLE Response FactorsBY MKR DATE 10/15/81CHKD. BY CEH DATE 9/12/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 14 OF Job No. COMMENTS ✓ECS 9/15/82

Since we do not have the response spectra for RPV Pedestal at these damping levels, we use WASH 1255 spectra.

$$\check{F}_D = \frac{S_{a5\%}}{S_{a10\%}} \text{ at } f_n = \frac{2.12}{1.63} = 1.30$$

$$\beta_D = \ln \left(\frac{S_{a7\%}}{S_{a10\%}} \right) : \ln \left(\frac{1.90}{1.63} \right) = 0.15$$

$$\beta_R = 0.10 \quad \beta_U = 0.11$$

Modeling Error

$$\check{F}_{ME} = 1.0$$

For MDOF Systems, $\beta_{ME} = 0.15 = \beta_U$

Mode Combination

Does not apply. T/H analysis

Combination of Earthquake Components

Case 3, 2D Horizontal, Uncoupled

$$\check{F}_{ECC} = 0.93 \quad \beta_{ECC} \beta_R = 0.06$$

Combined Response Factor

$$\check{F}_R = (1.24)(1.0)(1.30)(1.0)(0.93) = 1.50$$

$$\beta_{\text{Composite Response}} = (0.22^2 + 0 + 0.15^2 + 0.15^2 + 0.06^2)^{1/2} = 0.31$$

$$\beta_R = (0.22^2 + 0.10^2 + 0.06^2)^{1/2} = 0.25$$

$$\beta_U = (0.11^2 + 0.15^2)^{1/2} = 0.19$$

TITLE HYDRAULIC CONTROLBY MKR DATE 11/7/81CHKD. BY CSH DATE 12/4/81STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 1 OF 1 JOB NO. 1111COMMENTS ✓ EC2 7/1/82HYDRAULIC CONTROL UNIT

Qualified by Test.

See SQRT Report for Susquehanna

C12 D001

f_n (Hz): Front to back 2.0, 4.2, 7.75, 12.5
 Side to side 2.75, 4.5, 8.5, 14.0
 Vertical 10, 38, 41, 49.5

Single axis tests

RRS (required response spectrum) multiplied by 1.4 to account for coupling.

Hydraulic control unit is an assembly of valves, tanks, piping and electrical controls.

Weight = 785 lb.

Elevation 719.1 ft.

Compare TRS (Test Response Spectrum) to RRS at Equipment Frequencies - Ratio of TRS/RRS is given below

Axis	Frequency				
	2	4	8	10	40
X	13.6	7.9	6.0		
Z	4.2	10.4	9.5		
Y				50.0	25.0

Horizontal governs

Average over-test =

$$\frac{13.6 + 7.9 + 6.0 + 4.2 + 10.4 + 9.5}{6}$$

= 8.6

Minimum overtest = 4.2

TITLE STRUCTURAL CONTROL UNIT
BY MKR DATE 11/7/81
CHKD. BY CSH DATE 12/4/81



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 2 OF 3 Job No. 1430

COMMENTS _____

✓ ECS 7/1/82

Assume minimum overtest is 95% probability of survival

Assume $\beta = 0.40$

$$\bar{F}_S^v = 4.2 \exp [1.65 \times 0.40] = 8.2$$

$$\beta_R = 0.15$$

$$\beta_U = 0.37$$

This is conservative since no failures were reported. Could have used the mean overtest factor of 8.6 plus some bump up factor. Will leave as is since it is conservative, CSH

Response Factor for Test Qualification

Variables are:

Damping

Boundary conditions

spectral shape

Instrument & Control Error

Acceleration Time History Variation

spectral Test Methods

Multidirectional Effects

Damping

Regardless of damping, overtest factor should remain about the same.

$$\bar{F}_D^v = 1.0 \quad \beta_D = 0.$$

Boundary Conditions

Equipment is bolted in laboratory and bolted in the plant

From NUREG-CR-1706 Table 4-6,

$$\beta_R = 0.05, \quad \beta_U = 0.05$$

$$\beta_{\text{composite}} = 0.07$$

BY MKR DATE 11/17/81

CHKD. BY CH DATE 12/14/81STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 2 OF 2 Job No. 4302

COMMENTS

✓ ESS 7/1/82
Spectral shape

Pick up variation in overtest factor here.

Horizontal governed Overtest factor varied from 4.2 to 13.6. Consider $\pm 2\beta$ range.

$$\beta_{SS} = \frac{\ln \frac{13.6}{4.2}}{4} = 0.29; \text{ this is all } \beta_U$$

Instrumentation and Control Error

NUREG - CR-1706 FIGURE 4-9.

for $f_n = 2 \text{ Hz}$, and damping = 0.05 = C

$$\Delta B = 0.2 C f_n = 0.2 (0.05) (2) = 0.02$$

$$\Delta A = \text{Analyzer Resolution} = 33/500 = 0.066$$

$$\Delta A / \Delta B = \frac{0.066}{0.02} = 3.3$$

Median $R_t / R_T \sim 1.75$ at 2 Hz

$$+2\beta \text{ value} = 2.3, \quad -2\beta \text{ value} = 1.2$$

$$\beta = 0.14$$

$$\beta = 0.19 \quad \therefore \beta \sim 0.17$$

$$\sqrt{F_{R_{IC}}} = 1/1.75 = 0.57 \text{ at } 2 \text{ Hz.}$$

$$\text{At } 4 \text{ Hz, } \Delta B = 0.04, \quad \Delta A / \Delta B = 1.65$$

$$\text{median } R_t / R_T = 1.25 \quad \pm 2\beta \text{ range } 1.1 \text{ to } 1.60$$

$$\beta = 0.06 \text{ or } 0.12 \quad \beta \sim 0.09$$

$$\sqrt{F_{R_{IC}}} = 1/1.25 = 0.8$$

$$\text{At } 8 \text{ Hz, } \Delta B = 0.08 \quad \Delta A / \Delta B = 0.825$$

$$\sqrt{F_{R_{IC}}} = 1.0 \quad \beta = 0$$

TITLE: _____

BY MKR DATE 11/7/81

CHKD. BY Calh DATE 12/4/81STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE _____ OF _____ JOB NO. 1700

COMMENTS _____

✓ ECS 7/1/82

Assume equal response from first three modes

$$\bar{F}_{R1c}^v = \frac{0.57 + 0.80 + 1.00}{3} = 0.79$$

$$\beta = \frac{0.17 + 0.09 + 0}{3} = 0.09 = \beta_U$$

Acceleration Time History

NUREG CR-1706 P. 4-35

$$\bar{F}_{TH}^v = 1.0 \quad \beta_{TH} = \beta_R = 0.17$$

Spectral Test Methods

$$\bar{F}_{ST}^v = 1.0 \quad \beta_{ST} = 0.11 \quad \beta_R = 0.05$$

$$\beta_U = 0.10$$

Multi directional Coupling Effect

$$\text{Uniaxial tests} \quad \bar{F}_R^v = 0.76$$

Getting weak Axis

See explanation in
Suoguehanna PRA

$$\beta = 0.09 = \beta_U \quad \text{Report sec. 5.3.6.1.}$$

Median Vector Horizontal is 1.08 single axis vector

$$\bar{F}_R^v = 0.93 \quad \beta = 0.06 = \beta_R$$

Alignment of peak vector with weak Axis

$$\bar{F}_R^v = 1.58 \quad \beta = 0.15 = \beta_R$$

$$F_{ECC} = (0.76)(0.93)(1.58) = 1.12$$

$$\beta_{ECC} = \sqrt{0.09^2 + 0.06^2 + 0.15^2} = 0.18$$

$$\beta_R = 0.16 \quad \beta_U = 0.09$$



JELS 7/1/82

Overall Response Factor

$$\bar{F}_R^V = (1)(1)(1)(0.79)(1)(1)(1.12) = 0.88$$

$$\beta_{\text{Composite}} = [0 + 0.07^2 + 0.29^2 + 0.09^2 + 0.17^2 + 0.11^2 + 0.18^2]^{1/2} = 0.41$$

$$\beta_R = [0.05^2 + 0 + 0 + 0.17^2 + 0.05^2 + 0.16^2]^{1/2} = 0.24$$

$$\beta_U = 0.33$$

Structure Response Factor

$$\bar{F}_{RS}^V = 1.72$$

$$\beta_{RS} = 0.27$$

$$\beta_{RS_R} = 0.23$$

$$\beta_{RS_U} = 0.13$$

$$\bar{A}^V = (1.72)(0.88)(8.2)/(1.5)(0.15) = 1.24g$$

$$\beta_A = (0.27^2 + 0.41^2 + 0.40^2)^{1/2} = 0.63$$

$$\beta_{AR} = (0.23^2 + 0.24^2 + 0.15^2)^{1/2} = 0.36$$

$$\beta_{AU} = 0.52$$

TITLE SLC Test TankBY MKRDATE 12/16/81CHKD. BY PCFDATE 9/15/82
**STRUCTURAL
MECHANICS
ASSOCIATES**
A Calif. Corp.
PAGE 1 OF 1 Job No. 14302

COMMENTS _____

✓ ECS 9/15/82

SLC Test tank in Reactor Building at El. 283'.

It is a rigid, passive equipment; qualified using static analysis. Fragility is estimated assuming the failure mode to be failure of supports.

For details see "Calculations for Generic Passive Equipment"

$$\check{F}_C = 2.65$$

$$\beta_R = 0.07$$

$$\beta_U = 0.33$$

$$\check{F}_{RE} = 1.04$$

$$\beta_R = 0.12$$

$$\beta_U = 0.10$$

$$\check{F}_{RS} = 1.72$$

$$\beta_R = 0.23$$

$$\beta_U = 0.13$$

Reactor
Building

$$\check{F} = 4.74$$

$$\beta_R = 0.27$$

$$\beta_U = 0.37$$

$$\check{A} = 4.74 \times 0.15 = 0.71 g.$$

TITLE N₂ ACCUMULATORSBY MKR DATE 12/4/81CHKD. BY ECS DATE 7/1/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 1 OF Job No. COMMENTS

Assume it is the same as Containment
Instrument gas accumulators. function: a source
of N₂ supply to MSRV and MSIV.

Susquehanna SQRT Package M-156. (60 in no.)

Accumulators are rigid $f_n > 33$ Hz.

In Primary containment 745' EL.

Size 18" ϕ - 48" high, anchored to the floor
using 6 - 5/8" diameter bolts.

Event	S_a 33Hz
OBE	2.00 g
SSE	2.19 g
SRV	0.50 g
LOCA	2.30 g

Assume normal load = 0. (Conservative)

$$N + (OBE^2 + SRV^2)^{1/2} \leq S_n = 0.5 S_y \quad \text{upset}$$

$$N + (SRV^2 + SSE^2 + LOCA^2)^{1/2} \leq 0.9 S_y \quad \text{Faulted.}$$

Faulted condition governs

Seismic and SRV are assumed to occur simultaneously.

From
governing
load
Combination

$$(SSE^2 + SRV^2 + LOCA^2)^{1/2} = (2.19^2 + 0.50^2 + 2.30^2)^{1/2} = 3.22 \text{ g}$$

$$3.22 \text{ g} = \text{total stress} = \sqrt{14170^2 + 4(3535)^2}$$

$$= 15835 \text{ psi.}$$

$$1 \text{ g} = 4918 \text{ psi.}$$

TITLE N₂ ACCUMULATORSBY MKR DATE 12/9/81CHKD. BY ELS DATE 7/1/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 2 OF Job No. COMMENTS

LOCA is not considered likely to occur with SSE.

Consider SRSS Combination of responses as median

$$(SSE^2 + SRV^2)^{1/2} = (2.19^2 + 0.50^2)^{1/2} = 2.25g = 11,048 \text{ psi.}$$

SRV contribution to median response = $2.25 - 2.19$

$$(\text{Treat as } P_N \text{ in } \bar{F}_S^V \text{ formula}) = 0.06g = 295 \text{ psi}$$

Assume failure at $1.1 \bar{S}_Y = (1.1)(1.2) S_{Y\text{code}}$

$$= (1.32)(36,000) = 47,520 \text{ psi.}$$

SA 307 bolt material

$$\beta = 0.12 \quad \beta_R = 0.06 \quad \beta_U = 0.10.$$

$$\bar{F}_S^V = \frac{47,520 - 295}{11,048} = 4.27$$

for in phase combination $SRV = 0.50g$.

Assume 3β from median to maximum.

$$\beta_{PN} = \ln \frac{0.50}{0.06} / 3 = \beta_R = 0.70$$

$$\beta_{SSE} = 0$$

$$\beta_S = \frac{[(47,520)^2(0.12)^2 + (295)^2(0.70)^2]^{1/2}}{(47,520 - 295)} = 0.12$$

$$\beta_R = 0.06 \quad \beta_U = 0.10$$

Use ductility for rigid equipment

$$\bar{F}_\mu = 1.05$$

$$\beta_{C\mu} = 0.03$$

$$\beta_{R\mu} = \beta_{U\mu} = 0.02$$

Standby Liquid Control
TITLE N₂ Accumulators

BY MKR DATE 12/9/81

CHKD. BY ECS DATE 7/1/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calli. Corp.

PAGE 3 OF Job No.

COMMENTS

$$\ddot{F}_C = (4.27)(1.05) = 4.48 \quad \text{on SSE} = 0.10g \quad \therefore \ddot{F}_C = 2.99 \text{ on SSE} = 0.15g$$

$$\beta_C = \sqrt{0.12^2 + 0.03^2} = 0.12$$

$$\beta_R = 0.06 \quad \beta_U = 0.10$$

Use generic equipment response factor for passive rigid equipment.

$$\ddot{F}_{RE} = 1.04$$

$$\beta_{CR} = 0.16 \quad \beta_{RR} = 0.12 \quad \beta_{UR} = 0.10$$

Structural Response Factor (Reactor Building)

$$\ddot{F}_{RS} = 1.72 \quad \beta_{RS} = 0.23 \quad \beta_{US} = 0.13$$

Ground Acceleration capacity

$$\ddot{A} = (\ddot{F}_C \ddot{F}_{RE} \ddot{F}_{RS}) (0.15g) = (2.99)(1.04)(1.72)(0.15g) = 0.80g$$

$$\beta_R = (0.06^2 + 0.12^2 + 0.23^2)^{1/2} = 0.27$$

$$\beta_U = (0.10^2 + 0.10^2 + 0.13^2)^{1/2} = 0.20$$

TITLE TankBY MKR DATE 12/10/81CHKD. BY BSA DATE 9/5/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 2 OF Job No. COMMENTS

✓ ECS 9/15/82

Assume it is similar to LaSalle SLC tank.

vertical vessel Elev 820' in RB of LaSalle.

ie high in the building. In Limerick, SLC tank is high in building.

No specific stresses for nozzles given. Similar amplification.

Section VIII ASME design.

Do generic evaluation.

For active fluid system equipment:

Allowable for N + SSE + other loads is

 S for σ_m $1.65 S$ for $\sigma_m + \sigma_b$.

Note LG: FSAR 3.9.3.1.7

uses $1.2 S$ and
 $1.8 S$ for
these two
stresses.Normal stress is very low since the wall is 0.187 in and only needs to be 0.015 per FSAR.Compressive stresses held to $\frac{1}{3} S_y$ Assume shell stress at nozzle is $1.80 S$ For stainless steel, $S = 18,750$ psi, $S_y = 30,000$ psi

$$\sigma = (1.80)(18,750) = 33,750 \text{ psi}$$

$$\text{Failure at } \sim 1.5 \bar{S}_y = (1.5)(1.25 \times 30,000) = 56,250 \text{ psi}$$

$$\bar{F}_s = \frac{56,250}{33,750} = 1.67$$

$$\beta_{matl} = 0.14$$

$$\beta_{\text{shape factor}} = 0.15$$

$$\beta_C = 0.21$$

$$\beta_R = 0.10$$

$$\beta_U = 0.19$$

Ductility

$$\bar{\mu} = 2.0$$

$$\mu_{-1\beta} = 1.5$$

$$\bar{F}_M = 1.73$$

$$F_{M-1\beta} = 1.414$$

Standby Liquid Control Tank

TITLE _____

BY MKR DATE 12/10/81

CHKD. BY [Signature] DATE 9/15/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 3 OF _____ Job No. _____

COMMENTS _____

✓ ECS 9/15/82

$$\beta = \ln \frac{1.73}{1.41} = 0.20$$

$$\beta_E = 0.06$$

$$\beta_M = \sqrt{0.20^2 + 0.06^2} = 0.21$$

$$\beta_R = 0.10 \quad \beta_U = 0.19$$

$$\check{F}_C = (1.67)(1.73) = 2.88$$

$$\beta_C = \sqrt{0.21^2 + 0.21^2} = 0.30$$

$$\beta_R = \sqrt{0.10^2 + 0.10^2} = 0.14$$

$$\beta_U = 0.26$$

For nozzle stresses, design loads are upper bound values. Calculated loads are compared to design loads.

Calculated loads are very conservative due to damping used for design vs median damping.

At RB Elev 820' (walls) compare Peak S_a for 2% design damping with ^{that for} 5 percent median damping

Dir.	$S_{a, 2\%}$	$S_{a, 5\%}$	$\check{F}_D$
N-S	2.0	1.4	1.43
EW	1.5	1.0	1.50

use avg of Peak S_a and ZPA factors.

$$\check{F}_D = \left[\left(\frac{1.43 + 1.5}{2} \right) - 1 \right] / 2 + 1 = 1.23$$

$$- 1 \beta \text{ value} = 1.12; \quad \beta = \ln \left(\frac{1.23}{1.12} \right) = 0.09$$

$$\beta_R = 0.06$$

$$\beta_U = 0.07$$

spectral shape

for peak broadening and smoothing

$$\check{F}_{SS} = 1.12$$

$$\beta_{SS} = 0.05$$

$$\beta_R = 0$$

$$\beta_U = 0.05$$

✓ ECS 9/15/82Mode Shape

$$\bar{F}_{MS} = 1.0$$

$$\beta_{MS} = 0.15 = \beta_U$$

Frequency

$$\bar{F}_f = 1.0$$

$$\beta_f = 0.15 = \beta_U$$

Mode combination

$$\bar{F}_{MC} = 1.0$$

$$\beta_{MC} = 0.15 = \beta_R$$

ECC

$$\bar{F}_{ECC} = 1.04$$

Case 1.

ABS H+V

$$\beta_{ECC} = 0.12 = \beta_R$$

$$\bar{F}_{RE} = (1.23)(1.12)(1.04) = 1.43$$

$$\beta_{CRE} = (0.09^2 + 0.05^2 + 0.15^2 + 0.15^2 + 0.12^2)^{1/2} = 0.30$$

$$\beta_{RE} = (0.06^2 + 0.15^2 + 0.12^2)^{1/2} = 0.20$$

$$\beta_{URE} = 0.23$$

Now look at the tank wall as a potential critical element

Compressive stress held to $1/3 S_y$

Assume plastic buckling at $1.1 \bar{S}_y$

$$\bar{F}_S = \frac{(1.1)(1.25 S_y)}{0.33 S_y} = 4.17$$

$$\bar{F}_S \text{ on } 0.15g = \frac{4.17 \times 0.20}{0.15} = 5.56$$

No ductility for buckling

$$\beta_{matl} = 0.14$$

$$\beta_{\text{Failure mode}} = 0.05$$

$$\beta_S = \sqrt{0.14^2 + 0.05^2} = 0.15$$

Standby Liquid Control Tank

TITLE _____
 BY MKR DATE 12/11/81
 CHKD. BY GJA DATE 9/5/82



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 5 OF _____ Job No. _____
 COMMENTS _____

✓ ECC 9/15/82

$$\beta_R = 0.10 \quad \beta_U = 0.11$$

Response Factors Tank is considered rigid.

Therefore damping, frequency, spectral shape and mode combinations are not relevant.

Modeling error

$$\check{F}_{ME} = 1.0 \quad \beta_{ME} = 0.10 = \beta_U$$

ECC Vertical tank Case 3 equipment.

$$\check{F}_{ECC} = 0.93 \quad \beta_{ECC} = 0.06 = \beta_R$$

$$\check{F}_{RE} = 0.93 \quad \beta_R = 0.06 \quad \beta_U = 0.10 ; \beta_C = 0.12$$

Tank wall governs ; $\check{F}_{RS} = 1.73$, $\beta_R = 0.23$, $\beta_U = 0.13$, $\beta_C = 0.2$

$$\check{A} = \check{F}_C \check{F}_{RE} \check{F}_{RS} (0.2) = (5.56)(0.93)(1.72)(0.15) = 1.33g$$

$$\beta_{CA} = \sqrt{0.15^2 + 0.12^2 + 0.27^2} = 0.33$$

$$\beta_{RA} = \sqrt{0.10^2 + 0.06^2 + 0.23^2} = 0.27$$

$$\beta_{UA} = \sqrt{0.11^2 + 0.10^2 + 0.13^2} = 0.19$$

Anchor Bolts

Assume A 307 bolts

$$S_y = 36,000 \text{ psi.}$$

$$S = 18,750 \text{ psi}$$

$$\check{S}_y = 1.2 S_{y \text{ code}} = 1.2 \times 36,000 = 43,200 \text{ psi.}$$

Faulted condition allowable $1.8 S = 33,750 \text{ psi.}$

Assume 70% of this is seismic stress.

Standby Liquid Control

TITLE Tank

BY MKR DATE 12/16/81

CHKD. BY CJM DATE 9/15/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 6 OF Job No.

COMMENTS

✓ ECS 9/15/82

Assume failure at $1.10 \bar{S}_y$ (shape factor for bolt pattern).

$$\bar{F}_S = \frac{1.10 \times 43,200}{0.70 \times 33,750} = 2.01$$

$$\beta_S = 0.12 \quad \beta_R = 0.07 \quad \beta_U = 0.10$$

Ductility

$$\bar{\mu} = 1.5$$

$$- 2 \beta \text{ value} = 1.20$$

$$F_{-2\beta} = \sqrt{2 \times 1.2} = 1.18$$

$$\bar{F}_\mu = 1.41$$

$$\beta_\mu = \frac{\ln(1.41/1.18)}{2} = 0.089$$

$$\beta_E = 0.045$$

$$\beta_{F_\mu} = \sqrt{0.089^2 + 0.045^2} = 0.10$$

$$\beta_R = 0.06, \quad \beta_U = 0.08$$

$$\bar{F}_C = (2.01)(1.41) = 2.83$$

$$\beta_C = \sqrt{0.12^2 + 0.10^2} = 0.16$$

$$\beta_R = \sqrt{0.07^2 + 0.06^2} = 0.09$$

$$\beta_U = \sqrt{0.10^2 + 0.08^2} = 0.13$$

Response Factor

Tank is considered rigid.

ZPA at Floor level El 283', DBE
for 5 percent damping.

$$N-S \quad 0.36g$$

$$EW \quad 0.50g$$

$$\text{Vertical} \quad 0.18g$$

TITLE TankBY MKR DATE 12/16/81CHKD. BY CLH DATE 9/15/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 7 OF Job No. COMMENTS

✓ ECS 9/15/82

Factor for Qualification

Tank is qualified for 1.5g horizontal and
0.14g vertical.

$$\check{F}_{QM} = \frac{(1.50 + 0.14)}{(0.50 + 0.18)} = 2.41 \quad p=0.$$

Since the tank is considered rigid, factors for frequency damping, spectral shape, and mode combinations are not relevant.

Modeling error

$$\check{F}_{ME} = 1.0 \quad \beta_{ME} = 0.10 = \beta_U$$

ECC Vertical tank Case 3 equipment

$$\check{F}_{ECC} = 0.93 \quad \beta_{ECC} = 0.06 = \beta_R$$

$$\check{F}_{RE} = (2.41)(0.93) = 2.24 \quad \beta_R = 0.07, \beta_U = 0.10; \beta_C = 0.12$$

$$\check{A} = \check{F}_C \check{F}_{RE} \check{F}_{RS} (0.15) = (2.83)(2.24)(1.54)(0.15)$$

↑
LGS SSE Since ZPA for floor is used

$$\check{A} = 1.46g$$

$$\beta_A = \sqrt{0.16^2 + 0.12^2 + 0.27^2} = 0.34$$

$$\beta_{RA} = \sqrt{0.09^2 + 0.07^2 + 0.24^2} = 0.27$$

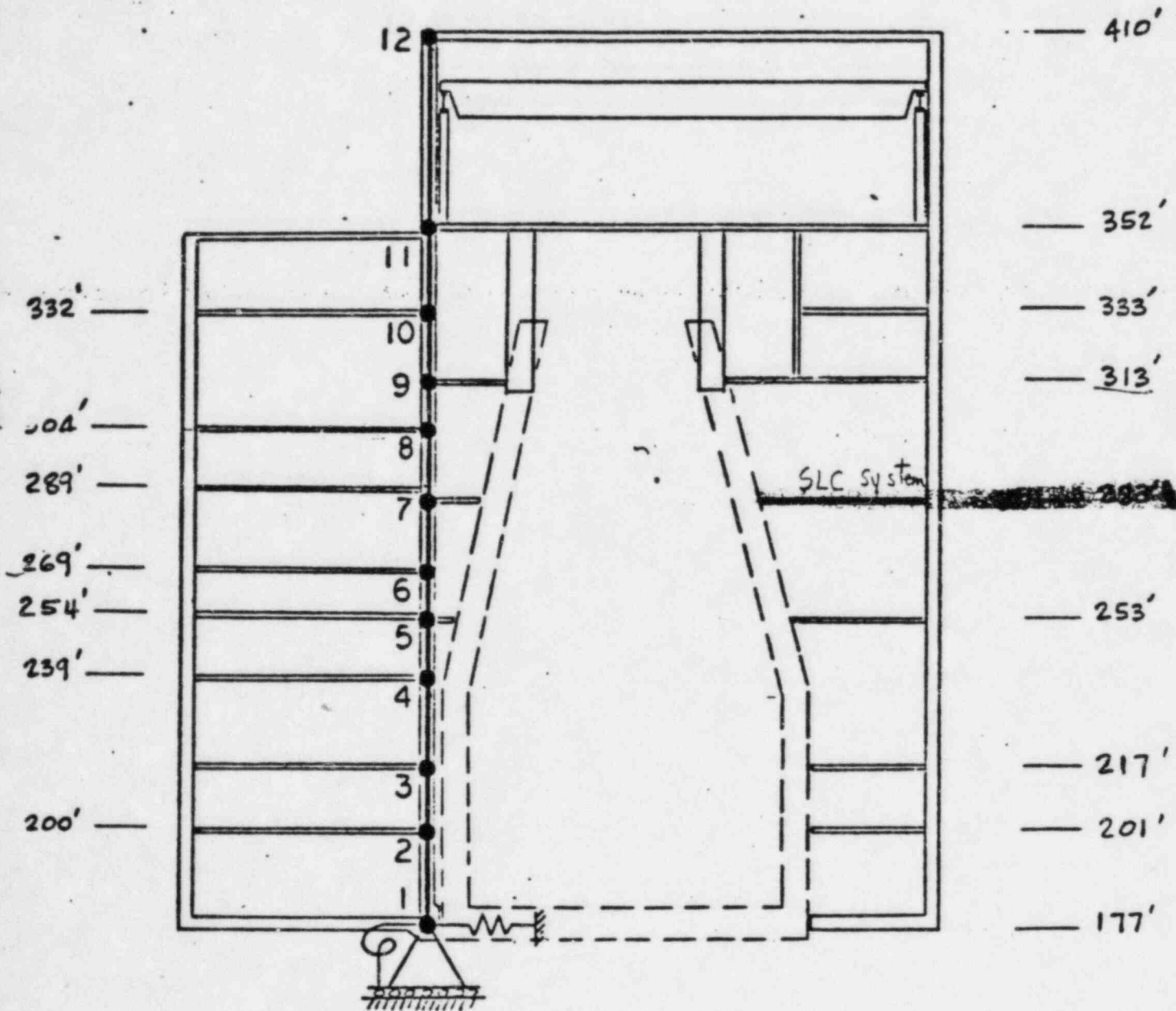
$$\beta_{UA} = \sqrt{0.13^2 + 0.10^2 + 0.12^2} = 0.20$$

SLC
Tank
Page 8

APPENDIX C

REACTOR BUILDING AND CONTROL ROOM STRUCTURE

MATHEMATICAL MODEL



L-03, REACTOR BLDG, VERTICAL SEISMIC RESPONSE DBE LC301/20/73

ACCELERATION SPECTRUM POINT = 7 DAMPING = 0.039

0.1 0.2 0.4 0.6 1.0 2.0 4.0 6.0 10. 20. 40. 60. 100.

1.000 0.900 0.800 0.700 0.600 0.500 0.400 0.300 0.200 0.100 0.

SPECTRUM AT EL. 283'

DBE VERTICAL

ACCELERATION



0.1 0.2 0.4 0.6 1.0 2.0 4.0 6.0 10. 20. 40. 60. 100. FREQUENCY (HZ)

U.S. REACTOR BLDG., HORIZ. N-S SEISH. FLOOR SPECTRUM DBE LCS01/20773

ACCELERATION SPECTRUM

DAMPING = 0.050

POINT = 7

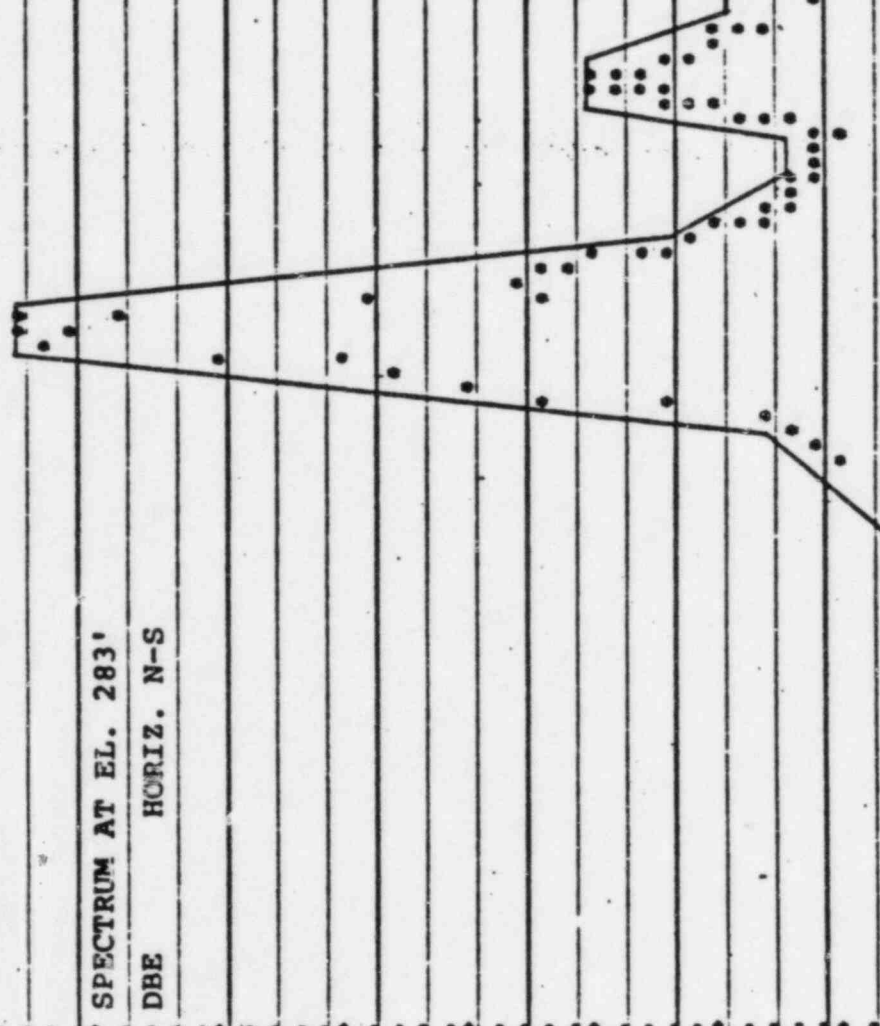
0.1 0.2 0.4 0.6 1.0 2.0 4.0 6.0 10. 20. 40. 60. 100.

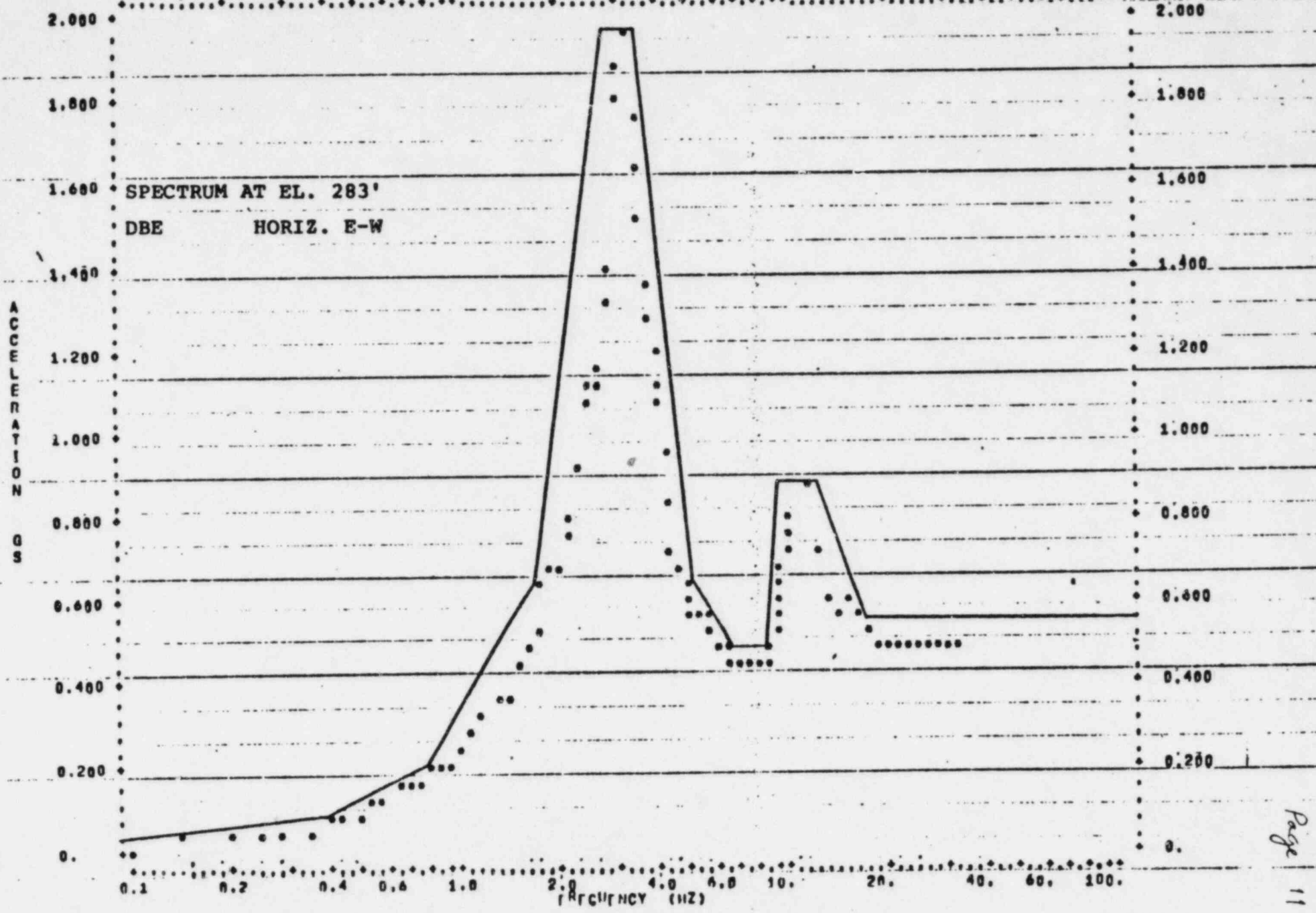
2.000 1.800 1.600 1.400 1.200 1.000 0.800 0.600 0.400 0.200 0.

SPECTRUM AT EL. 283'

DBE HORIZ. N-S

ACCELERATION





BY RDC DATE 6/19/82
CHKD. BY BJH DATE 6/26/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

FILE NO. _____ JOB NO. _____
COMMENTS _____

4160 / 480 V SWITCHGEAR ITE

LOAD CENTER D114, D124, D134, D144
D214, D224, D234, D244

Gas filled transformer and 2 frames of low voltage switchgear

2% damping curves used for test
Average damping from test was 8.6%
Lowest was 2.1% Highest was 22.6%

Elevs. 253, 283 + 313' in RB

3 elevations overlaid for RKS

Multifrequency amplification factor used
to qualify resale components

From Component Available accel / Req'd. Accel.
tabulation in test report

Over test factor mean is 3.42
min is 1.95 on Power Circuit Breaker.

Using this data as basis, 1.95 governs but
is considered a -1.65 value. Estimate $\beta_c = 0.4$

$$F_c = 1.95 e^{1.65(1.9)} = 3.77$$

$$\beta_R \sim 0.15$$

$$\beta_u \sim 0.37$$

Min component test margin considered here
as opposed to median since frequency uncertainty
is included in transmissibility factors.

BY RDC DATE 6/19/82CHKD. BY GLA DATE 6/26/82MECHANICS
ASSOCIATES
A Calif. Corp.

COMMENTS _____

✓ ECS 7/1/82

Compare 270 TRS/KRS for 270 Damped

Case		3 Hz	5 Hz	10 Hz	15 Hz	20 Hz
F-B/V	Horz, 3 Frame	1.16	2.81	2.8	7.15	10.3
F-B/V	V, 3 Frame	3.36	1.88	1.34	6.6	5.1
S-S/V	Horz, 3 Frame + Single Frame	1.7	3.03	4.8	7.25	9.67
S-S/V	V, 1 Frame	4.0	1.88	1.13	5.6	5.0
F-B/V	Horz, 1 Frame	1.5	3.12	3.1	5.26	7.75
Avg of H+V		2.34	2.54	2.63	6.37	7.56
Avg of V		3.68	1.88	1.23	6.1	5
Avg of H		1.45	2.98	3.56	6.55	9.24

consider fn Horz at 5 Hz and

fn Vert at 10 Hz

For Horz ≈ 3 For Vert ≈ 1.25

$$OT \text{ vector} = \sqrt{3^2 + 1.25^2} = 3.25$$

$$Req. \text{ vector} = \sqrt{2} = 1.414$$

$$OT = \frac{3.25}{1.414} = 2.30 \text{ avg,}$$

Use average here due to frequency uncertainty.
Component Fragility governs.

BY RDC DATE 6/19/82CHKD. BY JH DATE 6/26/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

COMMENTS _____

VECS 7/1/82Response FactorSpectral Shape

use peak broadening and smoothing factor

$$F_{ss} = 1.2$$

$$B = B_u = 0.08$$

Damping

Inherent in test

$$F_D = 1.0$$

$$\beta_D = 0$$

Boundary Conditionsuse multimode modeling error for differences
between field installation and test lab.

$$F_{bc} = 1.0$$

$$\beta_{bc} = 0.15 = B_u$$

I+C Error

Ref NUREG-CR-1706

$$\Delta B = 0.2 (.02)(5) = .02$$

$$\Delta A = .01$$

$$\frac{\Delta A}{\Delta B} = 0.05$$

$$\frac{R_t}{R_r} = 1$$

$$B = 0$$

Fig 4-9 of NUREG-CR-1706

BY RPC DATE 6/1/82
CHKD. BY BST DATE 6/26/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 01 OF 000 PGS.
COMMENTS _____

✓ ECL 7/1/82

Accel. Time History

$$F_{TH} = 1.0 \quad B_{TH} = 0.17 = P_R$$

Spectral Test Methods

$$F_{SM} = 1.0 \quad \beta_{SM} = 0.11 \quad P_R = 0.05 \quad \beta_U = 0.10$$

Multidirectional Effects for Biaxial Test

See MKR previous Calcs.

$$\bar{F}_{ECC} = 1.25$$

$$\beta_{ECC} = \beta_R = 0.19$$

RESPONSE FACTOR

$$F_R = 1.2(1)(1)(1)(1)(1)(1.25) = 1.5$$

$$\beta_{CC} = (0.08^2 + 0 + 0.15^2 + 0 + 0.17^2 + 0.11^2 + 0.19^2)^{\frac{1}{2}} = 0.33$$

$$\beta_R = (0 + 0 + 0 + 0 + 0.17^2 + 0.05^2 + 0.19^2)^{\frac{1}{2}} = 0.26$$

$$\beta_U = (0.08^2 + 0 + 0.15^2 + 0 + 0.17^2 + 0) = 0.20$$

ELECTRIC POWER
TITLE POWER SOURCE TRANS BREAKER

BY MKR DATE 12/4/81

CHKD. BY RAH DATE 1/26/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 1 OF 1 Job No. 14302.01

COMMENTS

✓ ECE 7/1/82

Treated as similar to

Diesel generator circuit breakers.

$$\check{F}_C = 5.16$$

$$\beta_C = 0.40$$

$$\beta_R = 0.15$$

$$\beta_U = 0.37$$

$$\check{F}_{RE} = 1.12$$

$$\beta_C = 0.28$$

$$\beta_R = 0.24$$

$$\beta_U = 0.14$$

$$\check{F}_{RS} = 1.72$$

$$\beta_C = 0.27$$

$$\beta_R = 0.23$$

$$\beta_U = 0.13$$

(Reactor Bldg)

$$\check{A} = (5.16)(1.12)(1.72) 0.15 g = 1.49 g$$

$$\beta_R = (0.15^2 + 0.24^2 + 0.23^2)^{1/2} = 0.36$$

$$\beta_U = (0.37^2 + 0.14^2 + 0.13^2)^{1/2} = 0.43$$

ELECTRIC POWER
TITLE 125 / 250 V DC BUS

BY MK DATE 12/6/81

CHKD. BY DAH DATE 6 DEC 81



STRUCTURAL
MECHANICS
ASSOCIATES

PAGE 1 OF 1 Job No. 14302.6

COMMENTS _____

✓ REC 7/1/82

Treated as similar to
Diesel Generator Circuit Breakers.

$$\bar{F}_C^v = 5.16$$

$$\beta_C = 0.40$$

$$\beta_R = 0.15, \beta_U = 0.37$$

$$\bar{F}_{RE}^v = 1.12$$

$$\beta_C = 0.28$$

$$\beta_R = 0.24, \beta_U = 0.14$$

$$\bar{F}_{RS}^v = 1.72$$

$$\beta_C = 0.27$$

$$\beta_R = 0.23$$

$$\beta_U = 0.13$$

(Reactor Bldg)

$$\bar{A}^v = (5.16)(1.12)(1.72)(0.15) = 1.49 g$$

$$\beta_R = (0.15^2 + 0.24^2 + 0.23^2)^{1/2} = 0.36$$

$$\beta_U = (0.37^2 + 0.14^2 + 0.13^2)^{1/2} = 0.43$$

TITLE: _____
BY RDC DATE 6/19/82
CHKD. BY ASH DATE 6/26/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE _____ OF _____ JOB NO. _____
COMMENTS _____

VECS 7/1/82

4160 / 480 V SWITCHGEAR ITE

LOAD CENTER D114, D124, D134, D144
D214, D224, D234, D244

Gas filled transformer and 2 frames of low
voltage switchgear

2% damping curves used for test

Average damping from test was 8.6%

Lowest was 2.1% Highest was 22.6%

Elevs. 253, 283 + 313' in RB

3 elevations overlaid for RRS

Multifrequency amplification factor used
to qualify resale components

From Component Available accel / Req'd. Accel.
tabulation. in test report

Over test factor mean is 3.42

min is 1.95 on Power Circuit Breaker.

Using this data as basis, 1.95 governs but
is considered a -1.65B value. Estimate $B_c = 0.4$

$$F_c = 1.95 e^{1.65(1.9)} = 3.77$$

$$B_R \sim 0.15$$

$$B_u \sim 0.37$$

Min component test margin considered here
as opposed to median since frequency uncertainty
is included in transmissibility factors.

BY RDC DATE 6/19/82CHKD. BY GAH DATE 6/26/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

COMMENTS

✓ ECS 7/11/82

Compare 2% TRS/RRS for 2% Damped

Case		3 Hz	5 Hz	10 Hz	15 Hz	20 Hz
F-B/V	Horz, 3 Frame	1.16	2.81	2.8	7.15	10.3
F-B/V	V, 3 Frame	3.36	1.88	1.34	6.6	5.1
S-S/V	Horz, 3 Frame + Single Frame	1.7	3.03	4.8	7.25	9.67
S-S/V	V, 1 Frame	4.0	1.88	1.13	5.6	5.0
F-B/V	Horz, 1 Frame	1.5	3.12	3.1	5.26	7.75
Avg of H+V		2.34	2.54	2.63	6.37	7.56
Avg of V		3.68	1.88	1.23	6.1	5
Avg of H		1.45	2.98	3.56	6.55	9.24

consider f_n Horz at 5 Hz and f_n Vert at 10 HzFor Horz ≈ 3 For Vert ≈ 1.25

$$OT \text{ vector} = \sqrt{3^2 + 1.25^2} = 3.25$$

$$Req. \text{ vector} = \sqrt{2} = 1.414$$

$$OT = \frac{3.25}{1.414} = 2.30 \text{ avg.}$$

Use average here due to frequency uncertainty.
Component Fragility governs.

BY RDC DATE 6/19/82CHKD. BY QJH DATE 6/26/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

COMMENTS _____

✓ ELS 7/1/82

Response Factorspectral Shapp

use peak broadening and smoothing factor

$$F_{ss} = 1.2$$

$$B = B_u = 0.08$$

Damping

Inherent in test

$$F_D = 1.0 \quad B_D = 0$$

Boundary ConditionsUse multimode modeling error for difference
between field installation and test lab.

$$F_{BC} = 1.0$$

$$\beta_{BC} = 0.15 = B_u$$

I+C Error

Ref NUREG-CR-1706

$$\Delta B = 0.2 (0.02) (5) = .02$$

$$\Delta A = .01$$

$$\frac{\Delta A}{\Delta B} = \frac{0.5}{0.02} = 0.05$$

$$\frac{R_t}{R_r} = 1$$

$$B = 0$$

Fig 4-9 of NUREG-CR-1706

BY RDC DATE 6/19/82
 CHKD. BY [Signature] DATE 6/26/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE OF JOB NO.

COMMENTS

✓ ECC 7/1/82

Accel. Time History

$$F_{TH} = 1.0 \quad \beta_{TH} = 0.17 = \beta_R$$

Spectral Test Methods

$$F_{SM} = 1.0 \quad \beta_{SM} = 0.11 \quad \beta_R = 0.05 \quad \beta_U = 0.10$$

Multidirectional Effects for Biaxial Test

See MKR previous Calcs.

$$\sqrt{F_{ECC}} = 1.25$$

$$\beta_{ECC} = \beta_R = 0.19$$

RESPONSE FACTOR

$$F_R = 1.2(1)(1)(1)(1)(1)(1.25) = 1.5$$

$$\beta_{CC} = (0.08^2 + 0 + 0.15^2 + 0 + 0.17^2 + 0.11^2 + 0.19^2)^{\frac{1}{2}} = 0.33$$

$$\beta_R = (0 + 0 + 0 + 0 + 0.17^2 + 0.05^2 + 0.19^2)^{\frac{1}{2}} = 0.26$$

$$\beta_U = (0.08^2 + 0 + 0.15^2 + 0 + 0.1^2 + 0)^{\frac{1}{2}} = 0.20$$

Structural Response Factor Reactor Bldg $\sqrt{F_{RS}} = 1.72$
 $F_R = 1.23 \quad F_U = 0.13$

$$\sqrt{F} = \sqrt{F_C} \sqrt{F_{RE}} \sqrt{F_{RS}} (0.15) = (3.77)(1.50)(1.72)(0.15) = 1.462$$

$$\beta_R = (0.45^2 + 0.26^2 + 0.23^2)^{\frac{1}{2}} = 0.38$$

$$\beta_U = (0.37^2 + 0.20^2 + 0.13^2)^{\frac{1}{2}} = 0.44$$



It is assumed that this component is similar to Susquehanna Generator Control Panel and high voltage cubicle and similarly located in the building; therefore the response amplifications are similar for these components.

Dimensions 144" x 48" x 93" H. 7800#
48" x 80" x 94" H.

Functional description Provide voltage and power control of generator

Bolted to floor with 5/8" 11 Holo Krome Cap screws, an bolts.

$f_n = 16 \text{ Hz}$ and 39 Hz Vert.
Horiz.

Tested by Wyle Labs.

Single axis multifrequency random input

Horizontal ^{test} level at 16 Hz = 1.0 g. at 1% damping.

Required = 0.24 g at 1%

Overtest = $\frac{1}{0.24} = 4.17$

Vertical test level = 0.28

Required = 0.07

Overtest = 4.0

Assume test level is 95% probability of survival

Let $\beta_C = 0.40$ $\beta_R = 0.15$ $\beta_U = 0.37$

(Judgement of the analyst)

$\check{F}_S = 4 \exp(1.65 \times 0.4) = 7.74$ on Susquehanna SSE = 0.15

$\check{F}_S = 7.74/1.5 = 5.16$ on Limerick SSE of 0.15g

Response Factors

Damping Regardless of actual damping, overtest factor should remain about the same.

ELECTRIC POWER
TITLE Diesel Gen/Circuit Breakers

BY M.K.R. DATE 12/3/81

CHKD. BY [Signature] DATE 12/10/81



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 2 OF Job No. _____

COMMENTS _____

✓ ECS 7/1/82

$$\ddot{F}_D = 1.0 \quad \beta_D = 0.$$

Boundary conditions Equipment bolted in the lab.
and bolted in the plant.

$$\ddot{F}_{BC} = 1.0 \quad \beta_R = \beta_U = 0.05.$$

Spectral shape

Variation in overtest between H and V is small.
i.e. 4 vs 4.17 Consider $\pm 2\beta$,

$$\beta_{SS} = \frac{\ln 4.17/4.00}{4} = 0.01 = \beta_U.$$

I & C Error

For 16 Hz f_n and 1% damping specified.

$$\Delta B = 0.2 \text{ cf} = 0.2 (0.01) (16) = 0.032$$

$$\Delta A = \text{Analyzer resolution} = \frac{40}{500} = 0.08$$

$$\frac{\Delta A}{\Delta B} = \frac{0.032}{0.08} = 0.4$$

$$R_t/R_T = 1.0 \quad \beta = 0$$

Acc. Time History

$$\ddot{F}_{TH} = 1.0 \quad \beta_{TH} = \beta_R = 0.17$$

Spectral Test Methods

$$\ddot{F}_{SM} = 1.0 \quad \beta_{SM} = 0.11; \quad \beta_R = 0.05 \quad \beta_U = 0.10$$

Multidirectional coupling

$$\ddot{F}_{ECC} = 1.12 \quad \beta_{ECC} = 0.18 \quad \beta_R = 0.16 \quad \beta_U = 0.09$$

Response Factor

$$\ddot{F}_{RE} = (1)(1)(1)(1)(1)(1)(1.12) = 1.12$$

TITLE Diesel Gen / Circuit BreakersBY MKRDATE 12/3/81STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 3 OF Job No. COMMENTS CHKD. BY RAHDATE 12/10/81✓ ECS 7/1/82

$$\beta_C = (0 + 0.07^2 + 0.01^2 + 0 + 0.17^2 + 0.11^2 + 0.18^2)^{1/2} = 0.28$$

$$\beta_R = (0 + 0.05^2 + 0 + 0 + 0.17^2 + 0.05^2 + 0.16^2)^{1/2} = 0.24$$

$$\beta_U = 0.14$$

F_{RS} Diesel Generator Building

$$\check{F}_{RS} = 1.80$$

$$\beta_{RS} = 0.19$$

$$\beta_{RS_R} = 0.15$$

$$\beta_{RS_U} = 0.11$$

$$\check{A} = (5.16)(1.12)(1.80)(0.15) = 1.56g$$

$$\beta_A = (0.40^2 + 0.28^2 + 0.19^2)^{1/2} = 0.53$$

$$\beta_{AR} = (0.15^2 + 0.24^2 + 0.15^2)^{1/2} = 0.32$$

$$\beta_{AU} = 0.41$$

TITLE _____
BY RDC DATE 3/2/82
CHKD. BY CHH DATE 3/24/82



STRUCTURAL
MECHANICS
ASSOCIATES

PAGE 1 OF _____ Job No. _____
COMMENTS _____

Limerick Diesel Generator H+V

H+V is exhaust fan & ducting.

Assume exhaust fan supports are most critical. See Draft Report Pg. 5-29 for generic support fragility for equipment. (see generic passive equipment derivation)

Assume flexible equipment

$$\bar{F} = 3.55$$

$$B_c = 0.38$$

$$B_R = 0.12$$

$$B_U = 0.36$$

Shock test data shows 9.5 g S_a thus generic fragility is more conservative.

For response, assume that fan is flexible equipment qualified by dynamic analysis. Use response factor from example for diesel generators.

$$F_R = 1.62$$

$$B_c = 0.29$$

$$B_R = 0.21$$

$$B_U = 0.20$$

TITLE _____

BY RDC DATE 3/12/82CHKD. BY EAH DATE 3/26/82STRUCTURAL
MECHANICS
ASSOCIATESPAGE 2 OF _____ Job No. _____

COMMENTS _____

✓ ECH 7/1/82

Structural Response (Diesel Bldg)

$$\ddot{F} = 1.80$$

$$B_c = 0.19$$

$$B_R = 0.15$$

$$B_u = 0.11$$

$$\ddot{A} = 3.55 (1.62)(1.80)(0.15) = 1.55 g$$

$$B_c = (0.38^2 + 0.29^2 + 0.19^2)^{\frac{1}{2}} = 0.51$$

$$B_R = (0.12^2 + 0.21^2 + 0.15^2)^{\frac{1}{2}} = 0.28$$

$$B_u = (0.36^2 + 0.20^2 + 0.11^2)^{\frac{1}{2}} = 0.43$$

TITLE Limerick PKHBY RDC DATE 7/30/82CHKD. BY JA DATE 7/30/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 1 OF 2 Job No. _____

COMMENTS _____

1.02 9/15/82LIMERICK RHR Heat Exchanger

Vertical Vessel, Use Susquehanna
Capacity Factor and scale by ratio
of $\frac{\text{Susquehanna } S_{a-z}}{\text{Limerick } S_{a-z}}$ ✓

Susquehanna S_a , 7Hz, 2%, 670' = 0.9g SSE
0.05g SRV

Susquehanna $F_c = 2.78$

$B_c = 0.16$

$B_R = 0.09$

$B_u = 0.13$

$F_R = 2.03$

$B_{cR} = 0.35$, $B_{RR} = 0.19$ $B_{uR} = 0.29$

Assumed Susquehanna response factors
are the same as for Limerick.

Limerick S_a , 7Hz, 2%, 177' 0.98 US

201' 1.2g US

Use 1.2g for upper support movement (conservative) ✓

$F_c = 2.78 \left(\frac{0.9}{1.2} \right) = 2.08$

$F_{sR} = 1.72$, $B_{sR} = 0.12$ $B_{LR} = 0.23$ $B_{uR} = 0.13$

TITLE _____
BY RDC DATE 7/30/82
CHKD. BY G.H. DATE 7/30/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 1 OF 2 Job No. _____

COMMENTS _____

✓ E.C.S. 9/15/82

$$\dot{A}^V = (1.72)(2.03)(2.08)(.15) = 1.09$$

$$B_c = [0.26^2 + 0.35^2 + 0.16^2]^{1/2} = 0.46$$

$$B_R = [0.23^2 + 0.19^2 + 0.09^2]^{1/2} = 0.31$$

$$B_u = [0.13^2 + 0.29^2 + 0.13^2] = 0.34$$



RHR HEAT EXCHANGER

Ref. SQR

$f_n = 7.1 + 7.4 \text{ Hz}$ Horiz $\downarrow > 60 \text{ Hz}$ V

18 modes to 155 Hz

2% Damping for Faulted Cords.

Upset Allowables used for Faulted Cords.

Critical Areas

Shell stresses are high but most is pressure stress. Lower Support Appears to be the most critical.

Bracket Welds

$S = 17,500$ (same as parent material) 54516-GR 70 or equiv.

$S_y = 29.3 \text{ ksi}$ at 575°F

$\bar{S}_y = 1.2(29.3) = 35.16$ $B_c = 0.11$ $B_x = 0.06$
 $B_z = 0.09$

Failure assumed at $1.1 \times \bar{S}_y \times K$

K for welded pattern is like K for thin rectangular tube, $K \sim 1.0$

$P_c = 35.16 \text{ ksi}$

MOST SEISMIC RESPONSE is E-W.

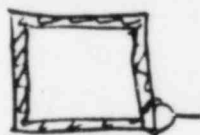
AT 670', 7 Hz. $S_{a20} = 0.9 g$ SSE
 $= 0.05 g$ SRV
 $= 0 g$ LOCA



VERTICAL - $> 40 \text{ lts}$

$$\begin{aligned}
 SSE &= .2469 \\
 SRV &= .079 \\
 LOCA &= .059
 \end{aligned}$$

For Rectangular weld pattern.



critical area.

At corner the relative contributions to stress are

$$\begin{aligned}
 DCW &= 1.0 \\
 \text{Horz SSE} &= .9 \\
 \text{Vert SSE} &= .25 \\
 \text{All Hydrodynamic} &= .17
 \end{aligned}$$

$$\text{Total Parts} = 2.32$$

$$P_N = 1.17$$

$$P_{SSE} = 1.15$$

Equal parts.

$$\sigma = 5877$$

$$P_N = 2964$$

$$P_{SSE} = 2913$$

Put uncertainty of ± 0.1 on each

$$F_s = \frac{35.16 - 2964}{2913} = 11.05$$

$$\beta_s = \frac{[(35.16)^2(.1)^2 + (35.16 - 2964)^2(.1)^2 + 2964^2(.1)^2]^{\frac{1}{2}}}{35.16 - 2964} = 0.16$$

$$\beta_R = \frac{35.16(.06)}{35.16 - 2964} = 0.07 \quad \beta_U = 0.14$$

$$B_u \ln \frac{1.47}{1.25} = 0.087 \quad B_E = 0.046$$

GENERIC PASSIVE EQUIPMENT

TITLE _____

BY M.K.R. DATE 12/2/81

CHKD. BY WJH DATE 12/9/81



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 1 OF _____ Job No. _____

COMMENTS _____

✓ RCS 7/1/82

Generic Passive Equipment (Tanks, Heat Exchangers)

Fragility is based on support or nozzle as most likely failure location.

Design Criteria

Supports

upset $N + (OBE^2 + SRV^2)^{1/2} \leq S_h$

Nozzles and shell

$$N + (OBE^2 + SRV^2)^{1/2} \leq \begin{matrix} 1.1 S \\ 1.65 S \end{matrix}$$

Faulted $NH(SSE^2 + SRV^2)^{1/2} \leq 0.9 S_y$

$$N + (SSE^2 + SRV^2)^{1/2} \leq \begin{matrix} 2.0 S \\ 2.4 S \end{matrix}$$

Assume typical material for supports and nozzles.

Most conservative material is SA 516 or equivalent

with $S_u = 2 S_y$ and $S_h = 1/4 S_u$ or $1/2 S_y$. Others such as

SA-36 and SA 106 B have $S_y < 1/2 S_u$ and $S_h < 1/2 S_y$.

Consider SRV loading as normal loading.

Assume $P_N = 0.1$ to $0.5 S_h = \pm 2 \beta$ range

$$\beta_{P_N} = \frac{\ln \frac{0.5}{0.1}}{4} = 0.4 = \beta_u$$

$$\tilde{P}_N = 0.1 \exp(2 \times 0.4) = 0.22$$

Assume $P_C = 1.1 \tilde{S}_y = 1.1 (1.2 S_{y \text{ code}}) = 1.32 S_{y \text{ code}} = 2.64 S_h$ ✓

$\beta_{P_C} = 0.11$ for material and 0.05 for failure point.

$$= \sqrt{0.11^2 + 0.05^2} = 0.12$$

$$\beta_{R_{P_C}} = 0.06 \quad \beta_{u_{P_C}} = 0.10$$

$$P_T = 0.5 \text{ to } 1.0 S_h$$

$$\beta_{P_T} = \frac{\ln \left(\frac{1.0}{0.5} \right)}{4} = 0.17$$

$$\tilde{P}_T = 0.5 \exp(2 \times 0.17) = 0.70 \quad \checkmark$$



ECS 7/1/82

$$\check{P}_{OBE} = 0.70 - 0.22 = 0.48 S_h \quad (\text{OBE load case governs?})$$

$$\text{OBE } 1/2 \text{ range} = 0.48 \text{ to } 0.90 \text{ ie } [0.9(\text{OBE}) + 0.1(P_h) = S_h]$$

$$\beta_{OBE} = \ln\left(\frac{0.9}{0.48}\right)/2 = 0.31 = \beta_U$$

$$\check{F}_S = \frac{2.64 - 0.22}{0.48} = 5.04 \text{ on OBE} = 2.52 \text{ on SSE.}$$

$$\beta_{SC} = \frac{[(2.64)^2(0.12)^2 + (2.64 - 0.22)^2(0.31)^2 + (0.22^2)(0.40)^2]^{1/2}}{(2.64 - 0.22)}$$

$$= 0.34$$

$$\beta_R = \frac{(2.64)(0.06)}{2.64 - 0.22} = 0.07$$

$$\beta_U = [0.34^2 - 0.07^2]^{1/2} = 0.33$$

Support ductility is not high. Assume $\mu_{median} = 1.5$.

Flexible Equipment

Rigid Equipment

$\check{F}_\mu$	1.41	1.05
β_μ	0.18	0.03
$\beta_{R\mu}$	0.10	0.02
$\beta_{U\mu}$	0.15	0.02

Generic Capacity

$$\check{F}_C = \check{F}_S \check{F}_\mu$$

	Flexible	Rigid
$\check{F}_C$	3.55	2.65
β_C	0.38	0.34
β_R	0.12	0.07
β_U	0.36	0.33

TITLE EQUIPMENT
 BY MKR DATE 12/2/81
 CHKD. BY [Signature] DATE 12/9/81



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 3 OF Job No.
 COMMENTS

✓ ECS 7/1/82

Similar strength factors could be derived for nozzles but ductility should be higher. Also, piping response factors apply to nozzles; again, they are generally higher than for supports.

Response Factors for Generic Equipment

Equipment frequency can vary appreciably from flexible to rigid.

Damping for equipment = 0.5% for OBE (OBE is the basis of fragility).

Derive response factors for flexible and rigid equipment.

Flexible Equipment

Need values for high and low elevations in R.B.

Spectral shape Peak broadening and smoothing

$$\bar{F}_{SS} = 1.20$$

$$\beta_{SS} = 0.08 = \beta_U$$

Damping Need high and low elevations ^{floor} spectra.

use Elev. 749' for high (Susquehanna) and Elev. 683' for low.

Use 5% as median damping and 3.5% as -1 β

683' EL. EW. floor spectra

Use average between peak S_a values and ZPA.

$$\text{at ZPA, } \bar{F}_D = 1.0 \quad \beta_D = 0$$

$$\text{at 8-11 Hz, } \bar{F}_D = \frac{S_{a0.5\%}}{S_{a5\%}} = \frac{4.77}{1.33} = 3.59$$

$$\bar{F}_D = \frac{3.59 + 1}{2} = 2.33$$

$$\beta_D = \ln \frac{S_{a3.5\%}}{S_{a5\%}} = \ln \left(\frac{1.9}{1.3} \right) = 0.38$$



✓ EC2 7/1/82

$$\bar{\beta}_D = 0.38/2 = 0.19$$

Check -3β value = $2.33 \exp(-3 \times 0.19) = 1.32$

Adjust β to give $F_D = 1.0$ at -3β

$$\beta = \frac{\ln 2.33}{3} = 0.28$$

$$\beta_R = 0.15 \quad \beta_U = 0.24$$

High Elev. 749' N-S

At 4 Hz,

$$F_D = \frac{4.9}{1.08} = 4.54$$

$$\bar{F}_D = \frac{4.54 + 1}{2} = 2.77$$

Make -3β value = 1.0

$$\beta_D = \frac{\ln 2.77}{3} = 0.34$$

$$\beta_R = 0.20 \quad \text{and} \quad \beta_U = 0.27$$

Frequency

Unknown frequency affects $\check{F}_D$

For range of $\check{F}_D$ from median to maximum, assume
 $3\beta = 3\beta_U$

Low
 $\check{F}_f = 1.0$
 $\beta_f = \frac{\ln 2.33}{3} = 0.15$

High
 $\check{F}_f = 1.0$
 $\beta_f = \frac{\ln 4.54}{3} = 0.16$

Mode Shape (Modeling Error).

Most equipment is simple such that mode shape error (modeling error) is $0.1 = \beta_U$

$$\check{F}_{ME} = 1.0$$

GENERIC PASSIVE
EQUIPMENT

TITLE _____
BY MKR DATE 12/2/82
CHKD. BY RLT DATE 12/9/91



STRUCTURAL
MECHANICS
ASSOCIATES
A Corp. Corp.

PAGE 5 OF _____ Job No. _____
COMMENTS _____

✓ ECC = 7/1/82
Mode Combination

Simple Equipment

$$\checkmark F_{MC} = 1.0 \quad \beta_{MC} = \beta_R = 0.1$$

Earthquake Components

Treat as general 3D case 1

$$F_{ECC} = 1.04 \quad \beta_{ECC} = 0.12$$

For flexible equipment

(Judgement, could vary this factor with the particular failure mode, Ok RLT)

Low

High

$$\checkmark F_R = (1.20) \left(\frac{2.30}{2.33} \right) (1)(1)(1)(1.04) = \frac{2.87}{2.91}$$

$$\checkmark F_R = (1.20)(2.77)(1)(1)(1)(1.04) = 3.46$$

$$\beta_C = [0.08^2 + 0.28^2 + \frac{3.14^2}{0.12^2} + 0.10^2 + 0.10^2 + 0.37^2]^{1/2} = 0.38$$

$$\beta_C = [0.08^2 + 0.34^2 + 0.16^2 + 0.1^2 + 0.1^2 + 0.12^2]^{1/2} = 0.41$$

$$\beta_R = [0 + 0.15^2 + 0 + 0 + 0.1^2 + 0.12^2]^{1/2} = 0.22$$

$$\beta_R = [0 + 0.20^2 + 0 + 0 + 0.1^2 + 0.12^2]^{1/2} = 0.25$$

$$\beta_U = 0.31$$

$$\beta_U = 0.33$$

For Rigid Equipment

Assume equipment designed to ZPA

Variables are Modeling Error and Earthquake Components

$$\checkmark F_{ME} = 1.0 \quad \beta_{ME} = \beta_U = 0.1$$

$$\checkmark F_{ECC} = 1.04 \quad \beta_{ECC} = \beta_R = 0.12$$

$$\checkmark F_{RE} = 1.04$$

$$\beta_{CRE} = [0.1^2 + 0.12^2]^{1/2} = 0.16$$

$$\beta_{RE} = 0.12$$

$$\beta_{URE} = 0.10$$

Spectral Shape Factors for Equipment3 Cases

1. Equipment mounted above base mat
2. Equipment at base mat in rock
3. Equipment at base mat in soil

Case 1

Spectral shape factor for structures account for differences in structural response and free floor spectra ZPA. Must develop special spectral shape factor for structures based upon converting Modified Taft time history spectra to median spec at the natural frequency of structure. Spectral shape factor for equipment is then due to peak broadening and smoothing only.

Case 2

At equipment fundamental frequency, compare design spectrum to median rock spectrum.

Case 3

At equipment fundamental frequency, compare design spectrum to median soil spectrum.

TITLE Spectral Shape FactorsBY MKR DATE 10/20/81CHKD. BY ECS DATE 7/1/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 2 OF Job No. COMMENTS Case 1 Spectral Shape Factors for Equipment

F_{ss} due to peak broadening and smoothing only
Only case where we have calculated spectra and smoothed and broadened spectra is for ESSW Pump house (in Susquehanna) which is not a good example.

Peaks are broadened $+ 12\%$ of f
 $- 14\%$ of f

Perform one example for ESSW Pump house

Compare the results with O'Connell and Brown's Ferry.

f	Design S_a	Calc. S_a	F_{ss}	
1	0.30	0.245	1.22	] $\bar{F}_{ss} = 1.19$
2	0.51	0.480	1.06	
3	0.64	0.53	1.21	
4	0.67	0.53	1.26	
5	0.67	0.55	1.22	] $\bar{F}_{ss} = 1.24$
6	0.67	0.54	1.24	
7	0.62	0.525	1.18	
8	0.57	0.45	1.27	
9	0.52	0.40	1.30	] $\bar{F}_{ss} = 1.63$
10	0.50	0.40	1.25	
12	0.46	0.37	1.24	
14	0.40	0.25	1.60	
16	0.36	0.23	1.56	
18	0.31	0.20	1.55	
20	0.27	0.15	1.80	

Spectral Shape Factor Calc.

Page 3

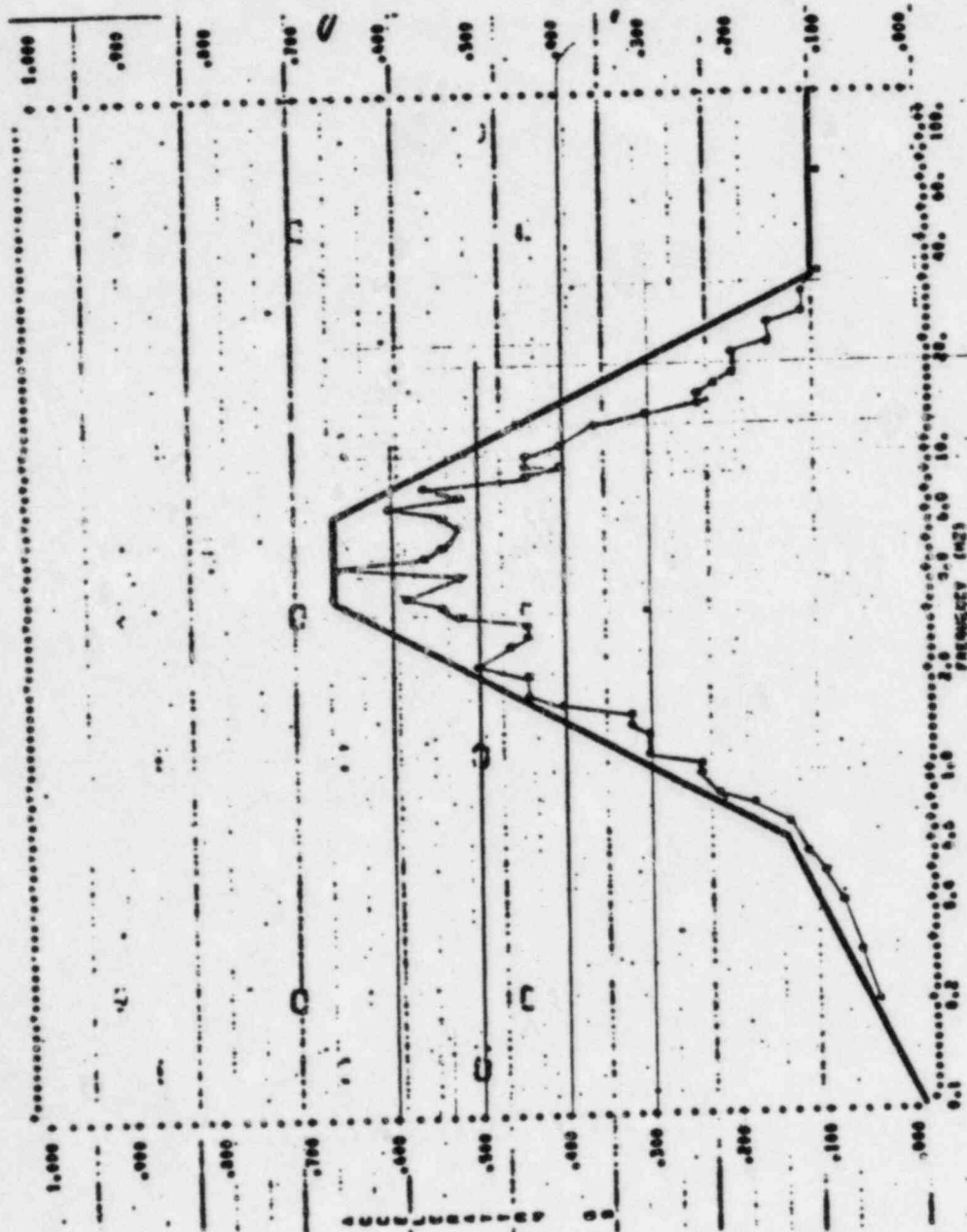


Fig. CV2-2 Acceleration Spectra for E55W PUMPHOUSE

Load Case: SUBSTANTIAL SSE, 19

Node: —, Direction VERT., Elev 685'-6"

Damping: 0.01

TITLE Spectral Shape FactorsBY MKR DATE 10/15/81CHKD. BY ECS DATE 7/1/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 4 OF Job No. COMMENTS

Compare Peak broadening and smoothing examples
All are about midheight of structures.

f range	Susquehanna ESW Pumpouse	Brown's Ferry RB	Oconee Aux Bldg
1-5	1.19	1.19	1.23
5-10	1.24	1.16	1.21
10-15	1.36	1.15	1.12
15-20	1.63	1.18	~ 1.12

Note: Oconee and Brown's Ferry not broadened

Average

f_n	$\bar{F}_{ss}$
1-5	1.20
5-10	1.21
10-15	1.21
15-20	1.31
At 30 Hz	1.0

Use 1.20 for all frequencies upto 20 Hz

1.0 is considered -2.33 β ie 1% probability of non exceedance

$$\beta = \frac{\ln(1/1.2)}{-2.33} = 0.08$$

TITLE Spectral Shape FactorsBY MKR DATE 10/15/81CHKD. BY ELS DATE 7/1/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 5 OF Job No. COMMENTS

Brown's Ferry Example Smoothing only.

Frequency	Period	$S_{a_{des}}$	$S_{a_{calc}}$	F_{ss}
1.00	1.00	0.219	0.204	1.07
1.25	0.80	0.265	0.176	1.51
1.50	0.67	0.265	0.243	1.09
2.00	0.50	0.429	0.413	1.04
2.50	0.40	0.429	0.361	1.19
3.00	0.333	0.429	0.393	1.09
3.50	0.286	0.429	0.279	1.54
4.00	0.250	0.429	0.371	1.16
4.50	0.222	0.429	0.385	1.11
5.00	0.200	0.719	0.666	1.08
5.50	0.182	0.938	0.835	1.12
6.00	0.167	0.915	0.760	1.20
6.50	0.154	0.701	0.622	1.13
7.00	0.143	0.406	0.305	1.33
7.50	0.133	0.285	0.253	1.13
8.00	0.125	0.269	0.230	1.17
8.50	0.118	0.259	0.230	1.12
9.00	0.111	0.246	0.201	1.22
10.00	0.100	0.233	0.204	1.14
11.00	0.091	0.220	0.184	1.20
12.00	0.083	0.206	0.193	1.07
13.00	0.076	0.199	0.181	1.10
14.00	0.071	0.187	0.157	1.19
15.00	0.066	0.181	0.150	1.21
16.00	0.063	0.176	0.151	1.16
17.00	0.059	0.172	0.147	1.17
18.00	0.056	0.167	0.142	1.17
19.00	0.053	0.163	0.137	1.19
20.00	0.050	0.158	0.132	1.20

 $\bar{F}_{ss} = 1.19$ $\bar{F}_{ss} = 1.16$ $\bar{F}_{ss} = 1.15$ $\bar{F}_{ss} = 1.1$

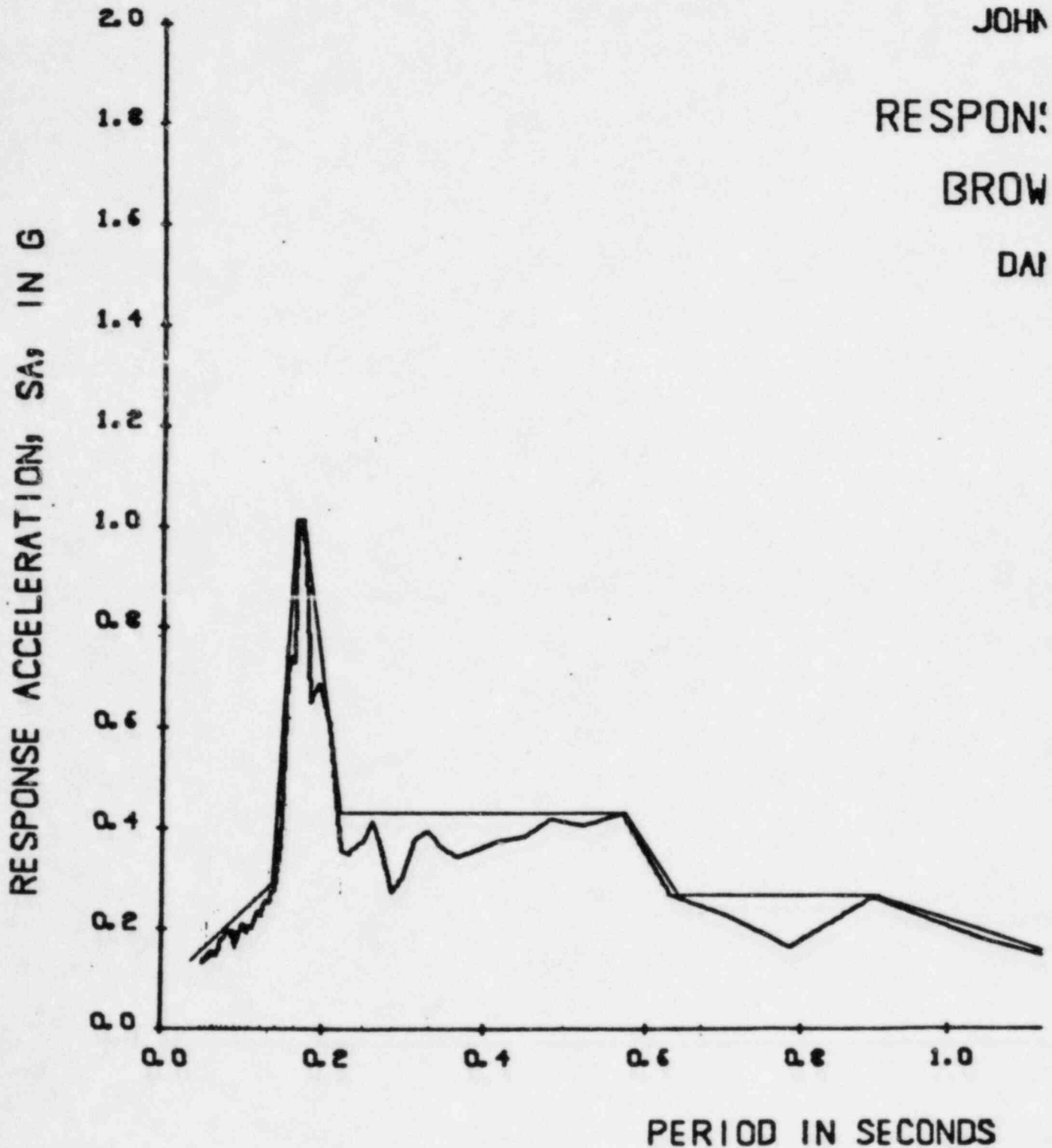
BROWNS FERRY EXAMPLE K.B

JOHN

RESPON:

BROW

DAI



TITLE Spectral Shape FactorsBY MKR DATE 10/15/81CHKD. BY ECS DATE 7/1/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 7 OF Job No. COMMENTS O'Conee Example

Use E-W 2% damping Aux Bldg Spectrum

f	$S_{a_{calc}}$	$S_{a_{des}}$	$F = \frac{S_{a_{des}}}{S_{a_{calc}}}$
1.0	0.20	0.220	1.10
1.25	0.165	0.265	1.60
1.50	0.240	0.265	1.10
2.0	0.425	0.445	1.05
2.5	0.360	0.445	1.24
3.0	0.385	0.445	1.16
3.5	0.265	0.445	1.68
4.0	0.380	0.445	1.17
4.5	0.385	0.445	1.16
5.0	0.505	0.505	1.00
			Avg 1.23
5.0	0.505	0.505	1.00
5.5	0.590	0.590	1.00
6.0	0.520	0.710	1.36
6.5	0.790	0.790	1.00
7.0	0.550	0.825	1.50
7.5	0.480	0.830	1.73
8.0	0.590	0.835	1.42
8.5	0.660	0.835	1.26
9.0	0.780	0.840	1.08
9.5	0.820	0.840	1.02
10.0	0.845	0.845	1.00
			Avg 1.21
10	0.845	0.845	1.00
11	0.44	0.610	1.39
12	0.33	0.360	1.09
13	0.26	0.280	1.08
14	0.24	0.265	1.10
15	0.24	0.250	1.04
			Avg 1.12

OCC
 V#
 STATION SPECTRUM
 BUILDING UNIT
 HORIZONTAL ACCELERATION IN G
 UNIT 3
 E-4 -- EL. 809.1
 IMPACT 0.020
 IF UNDAMPED PERIOD 12 SECONDS

OCONEE NUCLEAR STATION
 05-0270.03-NC-0002
 FIG. A- 156
 AUX. RLDG. UNIT 3
 E-W 1 1/2 G 3.02% DAMP
 EL. 809+3

OCONEE EXAMPLE
 AVX BLOC



Page 8
 Spectral Shape Factors Calc.

FIGURE 5-8. DESIGN VS CALCULATED SPECTRUM



F_{SS} due to Peak Broadening and Smoothing

Check using the Limerick Floor Spectra EL 201
RB - HORIZ NS.

f Hz	Design S_a	Calc. S_a	F_{SS}	
1	0.26	0.20	1.30	
2	0.77	0.66	1.17	
4	0.41	0.38	1.08	} 1.15
6	0.61	0.53	1.15	
10	0.59	0.54	1.09	
15	0.51	0.40	1.28	
20	0.40	0.26	1.54	

Floor spectra at EL 352'

f	Design S_a	Calc S_a	F_{SS}	
6	0.90	0.65	1.38	} avg 1.31
10	1.05	0.80	1.31	
15	0.62	0.50	1.24	

Therefore the use of 1.20 for F_{SS} is reasonable.

L-6.3. REACTOR BLDG.-HORIZ. N-S. SPECTRUM ORC LC801/20073

ACCELERATION SPECTRUM

0.1 0.2 0.4 0.6 1.0 2.0 3.0 4.0 6.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0

1.000

0.999

0.998

0.997

0.996

0.995

0.994

0.993

0.992

0.991

0.990

0.989

0.988

0.987

0.986

0.985

0.984

0.983

0.982

0.981

0.980

0.979

0.978

0.977

0.976

0.975

0.974

0.973

0.972

0.971

SPECTRUM AT EL. 201'

DBE HORIZ. N-S

0.970

0.969

0.968

0.967

0.966

0.965

0.964

0.963

0.962

0.961

0.960

0.959

0.958

0.957

0.956

0.955

0.954

0.953

0.952

0.951

0.950

0.949

1000 Spectral

1000 Shape

Factor calcs.

FREQUENCY (HZ)

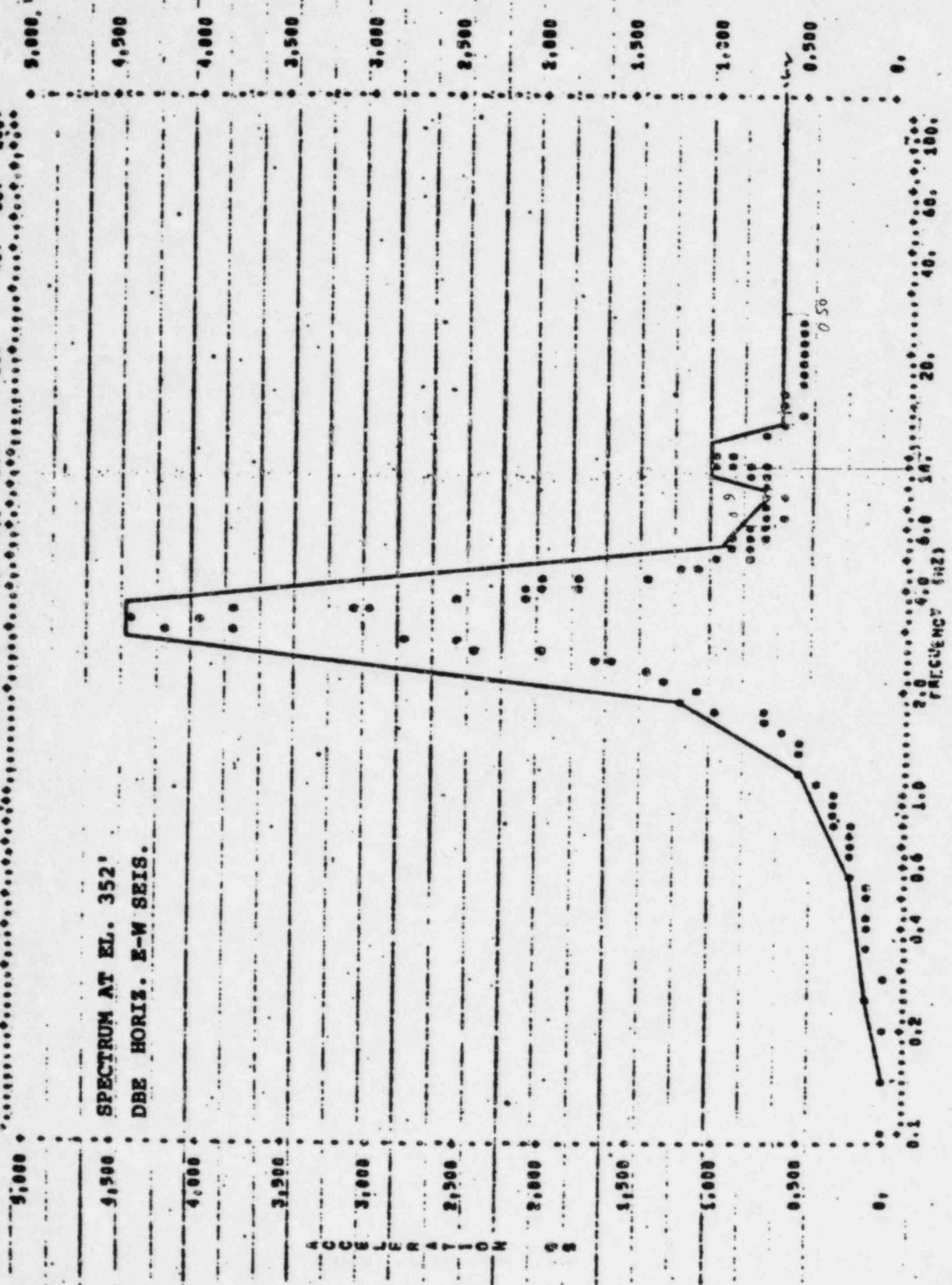
C-9a

REV. 0

LOS REACTOR BUILDING E-W SEISMIC FLOOR RESPONSE
ACCELERATION SPECTRUM

SPECTRUM AT EL. 352'
DBE HORIZ. E-W SEIS.

Spectral ⁰ 106
Shape Factor
Caks.



TITLE Spectral shape factors

BY MKR DATE 10/16/81

CHKD. BY ECS DATE 7/1/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 17 OF Job No.

COMMENTS

Case 1 Structural Shape Factors for Structures

Primary Containment, Shield wall and RPV Support

From FSAR, $f_n \sim 4.5, 8.5$ and 15.4 Hz

Table 3.7-5 Uncracked Condition.

Nodes 3 & 15, upper RPV support tied to Primary Containment Shell.

We don't have participation factors so we must make assumptions.

At nodes 7 and 18 at RPV support, the responses for the containment shell and RPV support are similar (Table 3.7-7).

Compare Taft Time history to WASH 1255 spectrum for rock at 4.5, 8.5 and 15.4 Hz (Figure 3.7-8)

From about 4-6 Hz, the average spectral shape factor is $F_{ss} = \frac{1.3}{1.05} = 1.24$ taken for 5% damping

$$\text{At } 8-10 \text{ Hz, } F_{ss} \sim \frac{1.25}{0.90} = 1.39$$

$$\text{At } 15-17 \text{ Hz, } F_{ss} \sim \frac{0.80}{0.55} = 1.45$$

Predominant mode is at 4.5 Hz,

$$\text{Use } F_{ss} = 1.24.$$

Coefficient of variation is calculated based on randomness is amplified acceleration from WASH 1255



At 5% damping, $COV = \frac{2.67 - 2.11}{2.11} = 0.265$

At 10% damping, $COV = \frac{2.01 - 1.65}{1.65} = 0.22$

Use 0.22 for 10% damping

$F_{SS} = 1.24$ $\beta_{SS} = \beta_R = 0.22$

Reactor Building and Control Buildings

There are several natural frequencies below 33 Hz
For NS, EW and Vertical, natural frequencies
start as low as

note ZPA = 0.50g.

2.5 Hz - N-S

3.2 Hz E-W

2.0 Hz Vertical.

f_n	5% S_a Taft	5% S_a Median WASH1255	F_{SS}
2	1.2	0.75	1.60
2.5	1.3	0.90	1.44
3	1.4	1.05	1.33
4	1.35	1.05	1.29
5	1.28	1.05	1.22
7	1.25	0.98	1.28
10	1.25	0.80	1.56
12	1.15	0.73	1.58
15	1.00	0.63	1.59
17	0.80	0.58	1.38
20	0.72	0.55	1.31

From mode shapes in FSAR,

N-S direction the first two modes are predominant
@ 2.5 Hz and 7.8 Hz (Fig 3.7-24)

$\bar{F} = 1.11 + 1.37 = 1.40$

TITLE Spectral Shape FactorsBY MKRDATE 10/17/81STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 13 OF Job No. COMMENTS CHKD. BY ECS DATE 7/1/82

E-W Direction (Fig 3.7-25)

First mode dominates. $\approx 3.2 \text{ Hz}$

$$F_{SS} = 1.32$$

For the vertical direction, mode 22 (10.6 Hz)

Figure 3.7-29 excites most of the floors

$$F_{SS} = 1.56$$

Use average of the three values.

$$F_{SS} = 1.42$$

$$\beta_{SS} = 0.22$$

Refueling AreaFrom spectra, $f_n = 3.2 \text{ Hz}, 2.5 \text{ Hz}, 9 \text{ Hz}$.

$$F_{SS} = \frac{1.44 + 1.32 + 1.49}{3} = 1.42$$

TITLE Spectral Shape FactorsBY MKR DATE 10/17/81CHKD. BY ECS DATE 7/1/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 14 OF Job No. COMMENTS Spectral Shape FactorCases 2 and 3.

FSAR LGS FIG 3.7-8

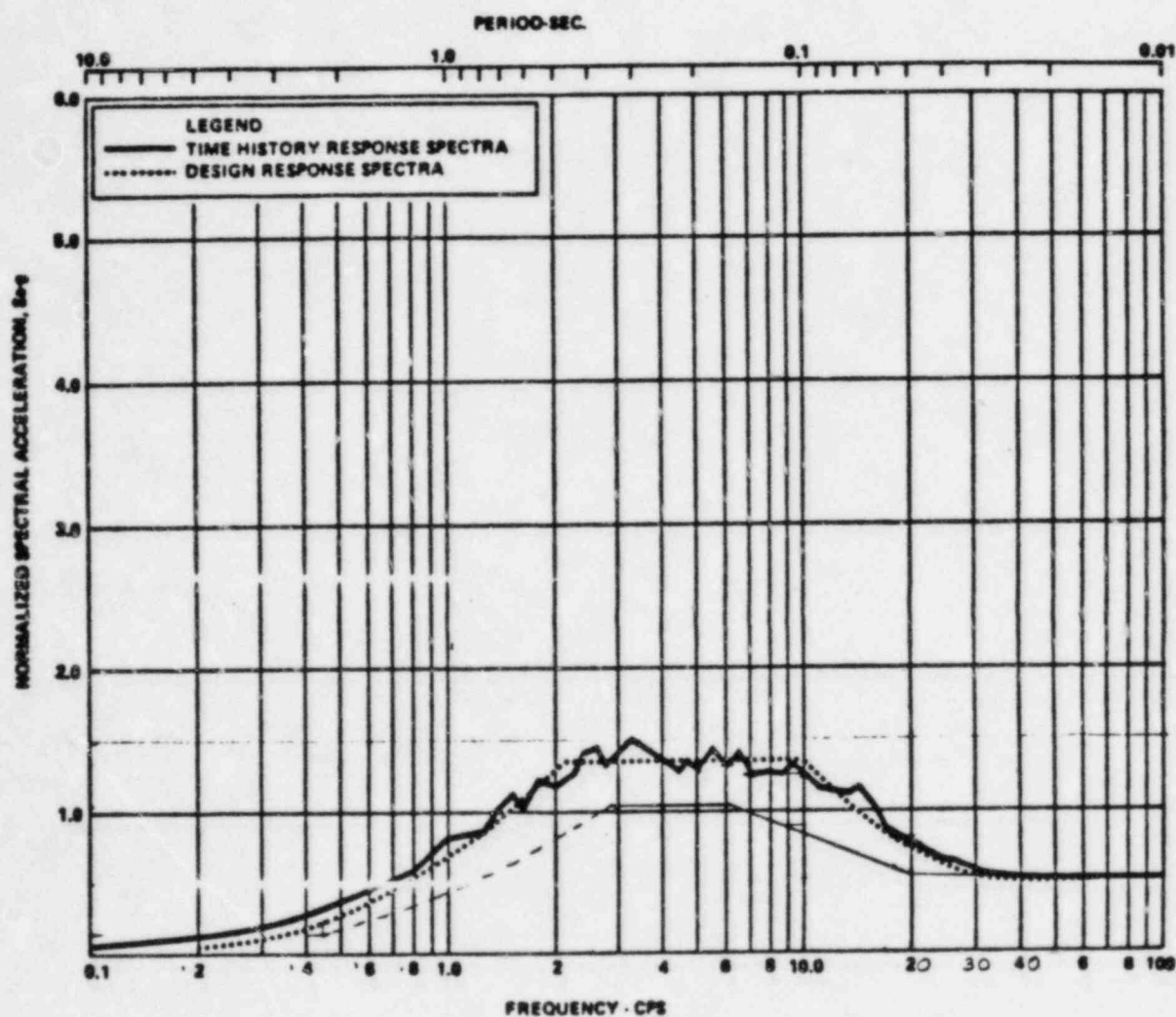
for frequency range of interest, ie > 3 Hz,
rock and alluvium spectra are the same.

$$F_{ss} = \frac{S_{aTajt}}{S_{a\text{median}}} \quad \text{at } 5\% \text{ damping}$$

$$\beta = \text{Cov} = \frac{S_{a+10} - S_{a\text{median}}}{S_{a\text{median}}} \quad \text{at } 5\% \text{ damping.}$$

f	S_{aTajt}	$S_{a\text{med}}$	F_{ss}	S_{a+10}	$\text{Cov} = \beta_{ss}$
3	1.40	1.05	1.33	1.34	0.27
4	1.35	1.05	1.29	1.34	0.27
5	1.28	1.05	1.22	1.34	0.27
6	1.30	1.05	1.24	1.34	0.27
7	1.25	0.96	1.30	1.19	0.24
8	1.25	0.88	1.42	1.08	0.23
9	1.28	0.82	1.56	0.99	0.21
10	1.25	0.76	1.64	0.91	0.20
12	1.15	0.68	1.69	0.78	0.15
15	1.00	0.60	1.67	0.68	0.10
17	0.80	0.55	1.45	0.56	0.05
20	0.72	0.50	1.44	0.50	0

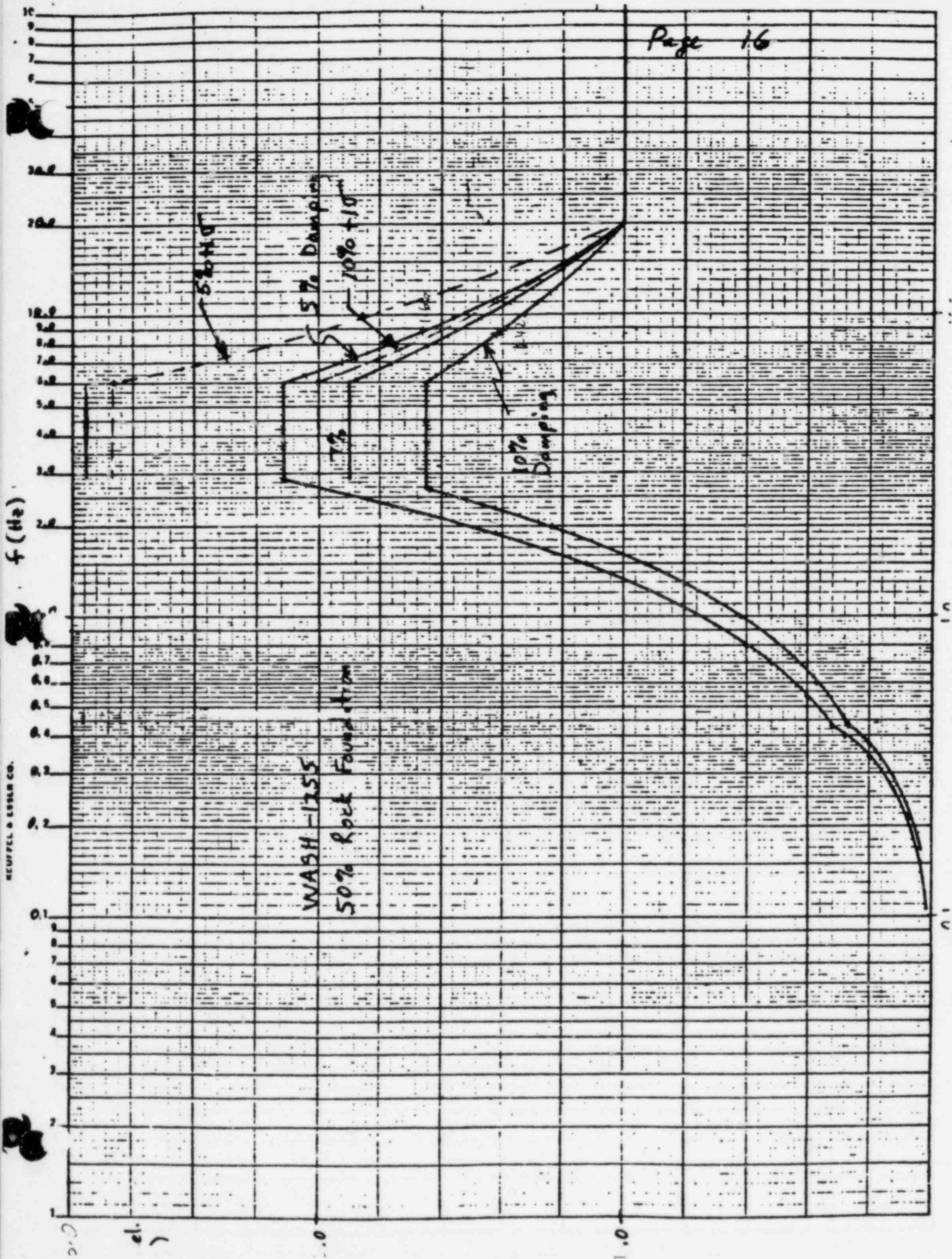
avg 1.44



LIMERICK GENERATING STATION
UNITS 1 AND 2
FINAL SAFETY ANALYSIS REPORT

COMPARISON OF TIME HISTORY
RESPONSE SPECTRA AND DESIGN
RESPONSE SPECTRA (5% DAMPING)

FIGURE 3.7-8



Spectral Shape Factor Calcs. Page 17

Design Spec.

1000 4 CYCLES TO FAILURE
KRIEGER & LORER CO.

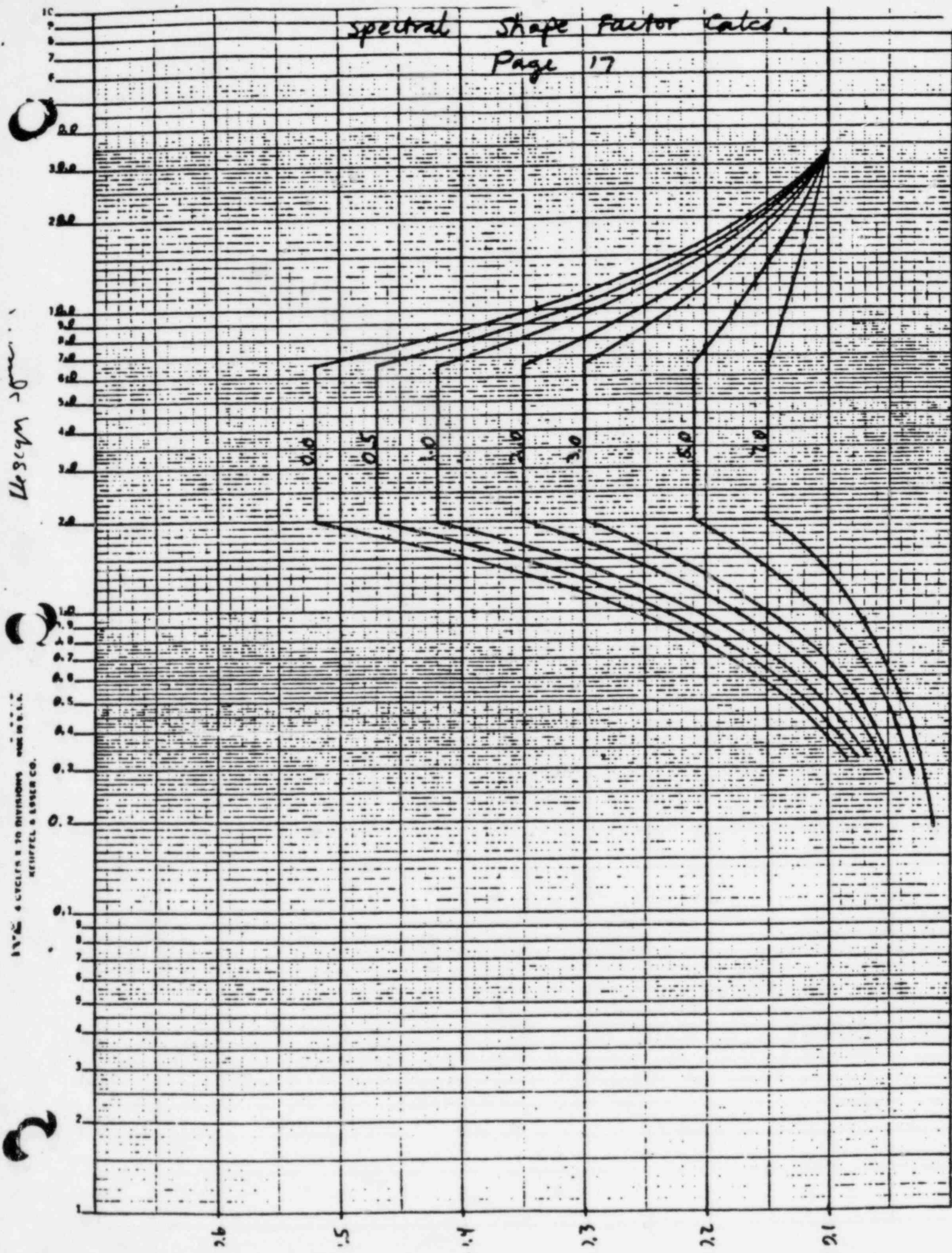


TABLE 5-4

EARTHQUAKE COMPONENT COMBINATION FACTORS

Equipment Characteristics	Case	F_{ECC}	$B_{R_{ECC}}$
Three-dimensional response, general coupling	1	1.04	0.12
Two-directional horizontal response, general coupling	2	0.82	0.09
Two-directional horizontal response, uncoupled	3	0.93	0.05
One horizontal direction plus vertical direction response, coupled	4	1.24	0.06
One horizontal direction plus vertical direction response, uncoupled	5	1.16	0.03
Uniaxial response only	6	1.0	0.0



Variables

Spectral shape

Damping

Modeling

Soil-Structure Interaction

Spectral shape factors were derived previously.

Damping Factors1. Primary containment, shield wall and RPV Support

Predominant mode is at 4.5 Hz. (WASH-1255)

Median response at 5% damping = 2.11 g

Median response at 10% damping = 1.65 g

Median damping factor = $\frac{2.11}{1.65} = 1.28$

$$\beta_S = \ln \left(\frac{S_{S=7\%}}{S_{S=10\%}} \right) = \ln \left(\frac{1.90}{1.65} \right) = 0.14 \quad \beta_R = 0.08$$

$$\beta_U = 0.11$$

2. Reactor Building and Control Building

Dominant modes 2.5 Hz, 7.8 Hz, 3.2 Hz, 10.6 Hz.

Median Response at
5% damping

1.88 1.79 2.11 1.48

Median Response at
10% damping

1.54 1.48 1.65 1.30

Median damping
factor

1.22 1.21 1.28 1.14

average

$$\bar{F}_D = 1.21$$

Mod. an. Response
at 7% damping

1.68

1.65

1.90

1.40

 β_D

0.09

0.11

0.14

0.07

avg $\beta_D = 0.10$ $\beta_R = 0.08$ $\beta_U = 0.06$

Assume

Modeling

 $\check{F} = 1.0$ $\beta = \beta_U = 0.11$

Soil str.

 $\check{F} = 1.0$ $\beta = \beta_U = 0.05$

Interaction

Overall structural response factors

1 Primary Containment, shield wall and RPV Support

$$\check{F}_{RS} = \check{F}_{SS} \check{F}_D \check{F}_M \check{F}_{SSI} = (1.24)(1.28)(1)(1) = 1.59$$

$$\beta_{RS} = (0.22^2 + 0.14^2 + 0.11^2 + 0.05^2)^{1/2} = 0.29$$

$$\beta_{R_{RS}} = (0.22^2 + 0.08^2)^{1/2} = 0.23$$

$$\beta_{U_{RS}} = (0.11^2 + 0.11^2 + 0.05^2)^{1/2} = 0.16$$

2 Reactor Building and Control Building

$$\check{F}_{RS} = \check{F}_{SS} \check{F}_D \check{F}_M \check{F}_{SSI} = (1.42)(1.21)(1)(1) = 1.72$$

$$\beta_{RS} = (0.22^2 + 0.10^2 + 0.11^2 + 0.05^2)^{1/2} = 0.27$$

$$\beta_{R_{RS}} = (0.22^2 + 0.08^2)^{1/2} = 0.23$$

$$\beta_{U_{RS}} = (0.06^2 + 0.11^2 + 0.05^2)^{1/2} = 0.13$$

Diesel Generator Building

$f_n = 11.06$ HZ EW. , 11.57 HZ for NS per RBN's calcs.

$$\check{F}_{SS} = \frac{S_{aTaft}}{S_{amed}} \text{ at } 5\% \text{ damping} = \frac{1.20}{0.76} = 1.58.$$

From WASH 1255, calculate β_{SS} as follows:

$$\beta_{SS} = \frac{S_{a10\%} - S_{amed}}{S_{amed}} \text{ at } 11 \text{ HZ for } 10\% \text{ damping}$$

$$= \frac{1.42 - 1.28}{1.28} = \underline{\underline{0.11}} = \beta_R.$$

Darr. f. d. median spectra WASH 1255

$$\check{F}_D = \frac{S_{a5\%}}{S_{a10\%}} = \frac{1.46}{1.28} = 1.14$$

$$\beta_D = \ln \left(\frac{S_{a7\%}}{S_{a10\%}} \right) = \ln \left(\frac{1.38}{1.28} \right) = 0.08$$

$$\beta_R = 0.06 \quad \beta_U = 0.05$$

Modeling RBN

$$\check{F}_{ME} = 1.0 \quad \beta_R = 0.00 \quad \beta_U = 0.09$$

SSI

$$\check{F}_{SSI} = 1.0 \quad \beta_R = 0 \quad \beta_U = 0.05$$

Flexural Failure of Shear Walls

Item	Median P.S.	β_e	β_u	β_s
Strength	2.16	0.13	0.15	0.
Inelastic Energy Absorption	1.86	0.11	0.13	0.
Spectral Shape	1.91	0.09	0	0.
Damping	1.0	0.06	0.03	0.
Modelling	1.0	0	0.09	0.05
Model Combination	1.02	0.01	0	0.
Combination of Earthquake Components	0.95	0.05	0	0.
Soil-Structure Interaction	1.0	0	0.05	0.
Total	7.44	0.21	0.23	0.

0.3

Median Acceleration Capacity = $7.44(0.15g) = 1.11g$

TITLE Structure Response Factor

BY MKR

DATE 6/18/82



STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.

PAGE 5 OF Job No.

COMMENTS

CHKD. BY ELS DATE 7/1/82

$$F_{RS} = (1.58)(1.14)(1)(1) = 1.80$$

$$\beta_{RR} = (0.11^2 + 0.06^2 + 0.09^2 + 0^2)^{1/2} = 0.15$$

$$\beta_{RU} = (0.05^2 + 0.09^2 + 0.05^2)^{1/2} = 0.11$$

$$\beta_{RC} = 0.19$$

SPRAY POND PUMP STRUCTURE

$$f_n = \begin{matrix} 13.2 \text{ Hz} \\ \text{NS} \end{matrix}, \quad \begin{matrix} 20.9 \text{ Hz} \\ \text{EW} \end{matrix} \quad \text{from RBN calcs.}$$

Spectral shape

$$\begin{aligned} \check{F}_{SS} &= \frac{S_{a1\%}}{S_{a\text{med}}} \text{ at } 5\% \text{ Damping at } 13.2 \text{ Hz} \\ &\quad (\text{WASH 1255}) \\ &= \frac{1.10}{0.70} = 1.57. \end{aligned}$$

β_{SS} is calculated using WASH 1255

$$\begin{aligned} \beta_{SS} &= \ln \left(\frac{S_{a1\%}}{S_{a\text{med}}} \right) \text{ at } 13 \text{ Hz for } 10\% \text{ damping} \\ &= \ln \left(\frac{1.28}{1.20} \right) = 0.07 = \beta_R \quad \beta_U = 0 \end{aligned}$$

Damping

$$\check{F}_D = \frac{S_{a5\%}}{S_{a10\%}} = \frac{1.30}{1.20} = 1.08.$$

$$\beta_D = \ln \left(\frac{S_{a7\%}}{S_{a10\%}} \right) = \ln \left(\frac{1.26}{1.20} \right) = 0.05 = \beta_R ; \beta_U = 0$$

Modeling

Per RBN

$$\check{F}_{ME} = 1.0$$

$$\beta_U = 0.09$$

$$\beta_R = 0$$

SSI : Per RBN

$$\check{F}_{SSI} = 1.0$$

$$\beta_U = 0.05$$

$$\beta_R = 0$$

BY RBN DATE 11/31/82CHKD. BY _____ DATE 11MECHANICS
ASSOCIATES
A CORP. CORP.COMMENTS Spray Pond
Pumphouse

Flexural Failure of Shear Wall

Item	Median P.S.	β_x	β_u	β_c
Strength	4.54	0.13	0.15	0.20
Inelastic Energy Absorption	1.86	0.11	0.13	0.17
Spectral Shape	1.81	0.07	0	0.07
Damping	1.0	0.04	0.02	0.05
Modelling	1.0	0	0.09	0.09
Model Combination	1.03	0.01	0	0.01
Combination of Earthquake Components	0.98	0.02	0	0.02
Soil-Structure Interaction	1.0	0	0.05	0.05
Total	15.4	0.19	0.22	0.30

Median Acceleration Capacity = $15.4(0.15) = 2.3g$

Page 7

TITLE Struct. Response FactorBY MR DATE 6/18/82CHKD. BY ECS DATE 7/1/82STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 8 OF Job No. COMMENTS

ESSW Pump House

$$F_{RS}^V = (1.57)(1.08)(1)(1) = 1.70$$

$$\beta_R = (0.07^2 + 0.05^2)^{1/2} = 0.09$$

$$\beta_U = (0.09^2 + 0.05^2)^{1/2} = 0.10$$

$$\beta_C = 0.14$$

Failure of Block Walls

Out-of-plane flexural capacity will be checked for block walls. Only walls at higher elevations will be checked since they will feel higher accelerations than walls near ground level.

1) El. 332'-0", Control Bldg., E-W Wall, 1'-6" wide

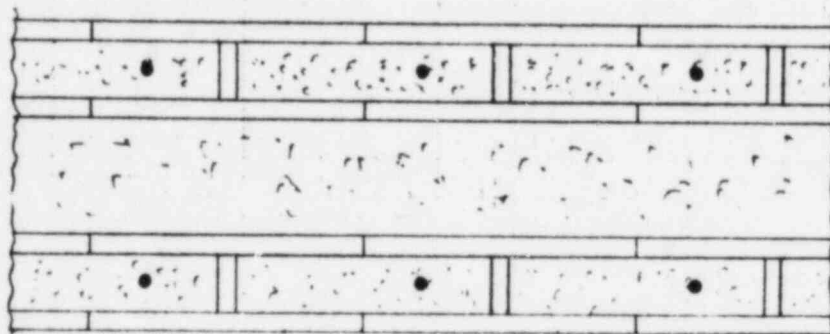
Vertical rebar is #6 @ 16" each face

All cells grouted

Standard weight concrete units are used throughout both buildings

Open end ("A") or double open end ("H") units are used

Assume this wall is composed of 2 outside rows of 6x8x16 with concrete or grout infill:



Each wall will be assumed to take half the mass of the infill. From Reinforced Masonry Engineering Handbook by J. E. Amrhein (2nd Ed.), p. 163, a solid grouted wall of nominally 6" wide blocks weighs 68 psf. The concrete infill is $18 - 2(5.625) = 6.75$ " wide. Therefore, each wall takes $145 \left(\frac{6.75}{12} \times \frac{1}{2} \right) = 41$ psf for a total of 109 psf.

Uncracked Moment of Inertia per foot of wall

$$I_g = \frac{1}{12} (5.625)^3 (12) = \underline{178 \text{ in}^4/\text{ft}}$$

Cracked Moment of Inertia per foot of wall

$$A_s = 0.44 \left(\frac{12}{16} \right) = 0.33 \text{ in}^2/\text{ft}$$



$$E_m = 1000 f'_m \quad (\text{p. MS-18})$$

f'_m = ultimate compressive stress. This depends on the type of mortar used. Values of f'_m are given in handbooks for mortar Types M, N, S, O & K. However, according to the specification for masonry at Limerick, the mortar is Type PL. From "Criteria for Re-evaluation of Concrete Masonry Walls in Response to the NRC I+E Bulletin 80-11 for Limerick Generating Station," Rev. B, $f'_m = 1250$ psi by ACI 531-79 standards and 1500 psi by UBC-70 standards. Therefore, an average value of 1375 psi will be assumed.

$$\therefore E_m = 1.375 \times 10^6 \text{ psi}$$

$$E_s = 29 \times 10^6 \text{ psi} \Rightarrow n = \frac{E_s}{E_m} = \frac{29}{1.375} = 21.1$$

Assume rebar is located in the middle of the wall.

$$\therefore 12 \left(\frac{x_{NA}}{2} \right) (x_{NA}) - 0.33 (21.1) (2.8125 - x_{NA}) = 0 \Rightarrow x_{NA} = \underline{1.317"}$$

$$I_{cr} = \frac{1}{12} (12) (1.317)^3 + 0.33 (21.1) (2.8125 - 1.317)^2 = \underline{24.7 \text{ in}^4/\text{ft}}$$

Modulus of Rupture

Due to lack of knowledge concerning the properties of mortar Type PL, the modulus of rupture shall be set at 20 psi.

$$\therefore M_{cr} = (0.020 \text{ ksi}) \left(\frac{178}{2.8125} \right) = \underline{1.27 \text{ in-k/ft}}$$

Due to the low compressive strength of masonry, the wall is over-reinforced. Therefore, yielding will be governed by crushing of the block. The yield moment will be taken as that which causes a block stress equal to 85% of the crushing stress (1.375 ksi).

$$M_y = \frac{24.7}{1.317} (0.85 \times 1.375) = \underline{21.9 \text{ in-k/ft}}$$

Equivalent Stiffness

Equation 9-7 of Ref. 1 will be used to determine the equivalent stiffness. This stiffness depends on the maximum moment in the member when deflections are being calculated. A typical value for this moment, M_a , will be taken as $\frac{1}{2} M_y$.

$$\therefore M_a = 0.5(21.9) = 11.0 \text{ in-k/ft}$$

$$I_c = \left(\frac{M_{cr}}{M_a} \right)^3 I_g + \left[1 - \left(\frac{M_{cr}}{M_a} \right)^3 \right] I_{cr}$$

$$= \left(\frac{1.27}{11.0} \right)^3 (178) + \left[1 - \left(\frac{1.27}{11.0} \right)^3 \right] (24.7) = \underline{24.9 \text{ in}^4/\text{ft}}$$

Equivalent Uniform Acceleration

Rather than attempt to determine the variation of seismic moments over the height of the wall, an equivalent uniform acceleration will be determined for each mode. This acceleration will be taken as the average over the height of the wall. Average modal values will be added together absolutely as required by the FSAR.

Dynamic Analysis

The wall will be assumed to be fixed at the base and pinned at the top. The mode shape is given in Vibration Problems in Engineering, by Timoshenko et. al., 4th Ed., p. 431, prob. 5.11-1, as:

$$X_i = \cosh k_i x - \cos k_i x - \alpha_i (\sinh k_i x - \sin k_i x)$$

$$\text{where } \alpha_i = (\cosh k_i l - \cos k_i l) / (\sinh k_i l - \sin k_i l)$$

The fundamental frequencies can be determined from the equation $\tan k_i l = \tanh k_i l$ with $f_i = \frac{1}{2\pi} (k_i)^2 \sqrt{\frac{EI}{\rho A}}$.

$$E = 1.375 \times 10^6 \text{ psi}$$

$$\rho A = (109 \text{ psf}) \left(\frac{1 \text{ ft}}{12 \text{ in}} \right) \left(\frac{1}{386.4} \frac{\text{sec}^2}{\text{in}} \right)$$

$$I = 24.9 \text{ in}^4/\text{ft}$$

$$= 0.0235 \frac{\text{lb-sec}^2}{\text{in}^2\text{-ft}}$$



$$L = (350'-0") - (1'-6") - (332'-0") = 16.5' = 198"$$

The mode shape given on p. 41 is mass-normalized; therefore, the fractional mass participating in each mode is given by:

$$FM_i = \left[\int_0^L X_i dx \right]^2$$

i	$k_i L$	F_i	FM_i	S_a	
1	3.9266	2.39 Hz	0.7396	3.24 g	} See below
2	7.0686	7.74	0.0068	0.67	
3	10.2102	16.15	0.1118	0.61	} $\frac{1}{2}(0.5639 + 0.6464)$
4	13.3512	27.62	0.0019	0.61	
5	16.4934	42.15	0.0429	0.61	

No floor spectra are given for 5% damping at El. 332'-0" and El. 352'-0". However, 5% damped floor spectra are presented at most lower elevations. The N-S floor spectra at these elevations peak at 2-3 Hz. Comparing the peak response in this band for 2% damped spectra to 5% damped spectra where possible, the 2% damped spectra peaks are about 1.5 times the 5% damped spectra peaks. The 2% damped spectrum at El. 332'-0" has a peak of 3.72 g for a peak floor accel. of 0.48 g. From p. 9, the peak floor accel. (PFA) should be 0.5639 g. Therefore, the assumed 5% damped spectrum peak would be

$$(S_a)_1 = 3.72 \left(\frac{0.5639}{0.48} \right) \left(\frac{1}{1.5} \right) = \underline{2.91 g} \quad \text{for this elevation}$$

The 2% damped spectrum at El. 352'-0" has a peak of 4.13 g for a PFA of 0.50 g. From p. 9, the PFA should be 0.6464 g. Therefore, the assumed 5% damped spectrum peak would be

$$(S_a)_2 = 4.13 \left(\frac{0.6464}{0.50} \right) \left(\frac{1}{1.5} \right) = \underline{3.56 g}$$



The average accel. is $\frac{1}{2}(S_{a_1} + S_{a_2}) = 3.24g$

The ratio of the accelerations of 2% damped spectra to 5% damped spectra at $f = 7.74 \text{ Hz}$ is approximately 1.7. The 2% damped spectrum for El. 332'-0" at $f = 7.74 \text{ Hz}$ is $0.98g$ for a PFA of $0.480g$.

$$\therefore (S_a)_1 = 0.98 \left(\frac{0.5639}{0.480} \right) \left(\frac{1}{1.7} \right) = \underline{0.68g}$$

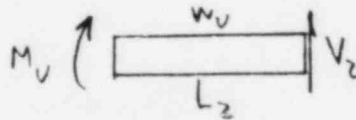
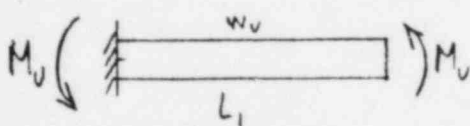
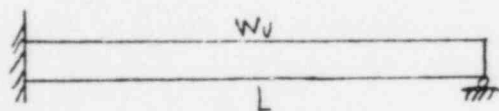
The 2% damped spectra for El. 352'-0" at $f = 7.74 \text{ Hz}$ is $0.86g$ for a PFA of $0.50g$.

$$\therefore (S_a)_2 = 0.86 \left(\frac{0.6464}{0.50} \right) \left(\frac{1}{1.7} \right) = \underline{0.65g}$$

Use an ave. accel. of $0.67g$

$$\text{Total accel.} = 0.7396(3.24) + 0.0068(0.67) + \overset{0.2536}{(1 - 0.7396 - 0.0068)(0.61)} \\ = \underline{2.56g}$$

Acceleration Capacity



$$2M_u = \frac{w_u L_1^2}{2}$$

$$w_u = \frac{4M_u}{L_1^2}$$

$$M_u = \frac{w_u L_2^2}{2}$$

$$w_u = \frac{2M_u}{L_2^2}$$

$$\therefore \frac{4M_u}{L_1^2} = \frac{2M_u}{L_2^2} \Rightarrow L_1 = \sqrt{2} L_2$$

$$\therefore L_1 = \left(\frac{\sqrt{2}}{1 + \sqrt{2}} \right) L + L_2 = \frac{L}{1 + \sqrt{2}}$$

$$\therefore w_u = \frac{2M_u}{L_2^2} = \frac{11.66 M_u}{L^2}$$

TITLE LimerickBY RBN DATE 11/27/82CHKD. BY _____ DATE 11STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 44 OF _____ Job No. 143021COMMENTS Reactor +Central Buildings

Research summarized in Ref. 40 indicates that the ultimate strength method developed for reinforced concrete may apply to concrete block. Assume $\epsilon_{mu} = 0.003$

$$c = \left[\frac{\epsilon_{mu}}{\epsilon_{mu} + \frac{f_s}{E_s}} \right] d \leq \frac{A_s f_y}{0.85(1375 \text{ psi} \times 12)} = \frac{0.33(66,000)}{14,025} = 1.55''$$

$$f_s = 29 \times 10^6 (0.003 \times \frac{2.8125}{c} - 1) = 87,000 (\frac{2.8125}{c} - 1)$$

$$\therefore c = \left[\frac{0.003}{0.003 + \frac{f_s}{29 \times 10^6}} \right] 2.8125 = \left(\frac{87,000}{87,000 + f_s} \right) 2.8125$$

$$0.85(1375 \text{ psi} \times 12 \times \underbrace{0.85c}_a) - 87,000 (\frac{2.8125}{c} - 1 \times 0.33) = 0$$

$$\therefore c = 1.66'' > 1.55'' \quad \underline{\text{NG}}$$

Therefore, the rebar has yielded and $c = 1.55''$

$$a = 0.85(1.55) = 1.32''$$

$$\therefore M_u = 0.85(1375 \times 12 \times 1.32) \left(\frac{1}{2} \right) + 0.33(66,000 \times 2.8125 - 1.55)$$

$$= 39,716 \text{ in-lb/ft}$$

$$w_u = \frac{11.66(39,716)}{148} = 11.8 \frac{\text{lb}}{\text{in-ft}} = \underline{142 \text{ psf}}$$

The wall weighs 109 psf $\Rightarrow$ Accel. = $\frac{142}{109} = 1.30g$

$$\therefore \check{F}_s = \frac{1.30}{2.56} = \underline{0.51}$$

Assume the wall is composed of 2 outside rows of 8x8x16 blocks with concrete infill.

$$\text{Width of infill} = 18 - 2(7.625) = 2.75''$$

$$\text{Wt. of } \frac{1}{2} \text{ of infill} = \frac{1}{2} (145 \times \frac{2.75}{12}) = 17 \text{ psf}$$

$$\text{Wt. of } 8 \times 8 \times 16 \text{ wall} = 92 \text{ psf}$$

$$\therefore \text{Total wt.} = 109 \text{ psf}$$

Uncracked Moment of Inertia

$$I_g = \frac{1}{12} (7.625)^3 (12) = 443 \text{ in}^4/\text{ft}$$

Cracked Moment of Inertia

$$12\left(\frac{1}{2}x_{NA}\right)^2 - 0.33(21.1)(3.8125 - x_{NA}) = 0 \Rightarrow x_{NA} = 1.602''$$

$$\therefore I_{cr} = \frac{1}{3}(12)(1.602)^3 + 0.33(21.1)(3.8125 - 1.602)^2 = 50.5 \text{ in}^4/\text{ft}$$

$$M_{cr} = (0.020 \text{ ksi})\left(\frac{443}{3.8125}\right) = \underline{2.32 \text{ in-k/ft}}$$

$$M_y = \frac{50.5}{1.602}(0.85)(1.375 \text{ ksi}) = \underline{36.8 \text{ in-k/ft}}$$

Equivalent Stiffness

$$M_a = \frac{1}{2}M_y = \frac{1}{2}(36.8) = 18.4 \text{ in-k/ft}$$

$$I_c = \left(\frac{2.32}{18.4}\right)^3(443) + \left[1 - \left(\frac{2.32}{18.4}\right)^3\right](50.5) = \underline{51.3 \text{ in}^4/\text{ft}}$$

Dynamic Analysis

$$E = 1.375 \times 10^6 \text{ psi}$$

$$\rho A = 0.0235 \frac{\text{lb-sec}^2}{\text{in}^2\text{-ft}}$$

$$I = 51.3 \text{ in}^4/\text{ft}$$

$$f_n = \frac{1}{2\pi} (k_n)^2 \sqrt{\frac{EI}{\rho A}} = \frac{1}{2\pi} (k_n l)^2 \sqrt{\frac{EI}{\rho A l^4}}$$

$$= (k_n l)^2 \left(\frac{1}{2\pi}\right) \sqrt{\frac{1.375 \times 10^6 (51.3)}{0.0235 (198)^4}} = (k_n l)^2 (0.2224)$$

i	$k_i l$	f_i	FM_i	S_a
1	3.9266	3.43 Hz	0.7396	2.27g
2	7.0686	11.11	0.0068	0.92g
3	10.2102	23.19	0.1118	0.61
4	13.3518	39.65	0.0019	0.61

At lower elevations, the ratio between accelerations at 3.43 Hz for 2% damped spectra to 5% damped spectra is about 1.55. At El. 332'-0", the accel. at 3.43 Hz for the 2% damped spectrum is 2.70g.

$$\therefore S_a = 2.70 \left(\frac{0.5639}{0.48} \times \frac{1}{1.55}\right) = \underline{2.05g}$$

At El. 352'-0", the accel. at 3.43 Hz for the 2% damped



spectrum is 2.99 g.

$$\therefore S_{a2} = 2.99 \left(\frac{0.6464}{0.50} \times \frac{1}{1.55} \right) = \underline{2.49g}$$

$$\text{Use } \frac{1}{2}(S_{a1} + S_{a2}) = \underline{2.27g}$$

At lower elevations, the ratio between accelerations at 11.1 Hz for 2% damped spectra to 5% damped spectra is about 1.40. At El. 332'-0", the accel. at 11.1 Hz for the 2% damped spectrum is 0.98 g.

$$\therefore S_{a1} = 0.98 \left(\frac{0.5639}{0.48} \times \frac{1}{1.40} \right) = \underline{0.82g}$$

At El. 352'-0", the accel. at 11.1 Hz for the 2% damped spectrum is 1.11 g.

$$\therefore S_{a2} = 1.11 \left(\frac{0.6464}{0.50} \times \frac{1}{1.40} \right) = \underline{1.03g}$$

$$\text{Use } \frac{1}{2}(S_{a1} + S_{a2}) = \underline{0.92g}$$

$$\begin{aligned} \text{Total accel.} &= 0.7396(2.27) + 0.0068(0.92) + (0.2536 \times 0.61) \\ &= \underline{1.84g} \end{aligned}$$

Acceleration Capacity

$$F_s = 87,000 \left(\frac{3.8125}{c} - 1 \right)$$

$$0.85(1375 \times 12 \times 0.85c) - 87,000 \left(\frac{3.8125}{c} - 1 \right) \times 0.33 = 0 \Rightarrow c = 2.056"$$

Since this is larger than 1.55", c = 1.55" (see p. 44)

$$M_u = 0.85(1375 \times 12 \times 1.32^2 \left(\frac{1}{2} \right)) + 0.33(66,000 \times 3.8125 - 1.55)$$

$$= 61,496 \text{ in-lb/ft}$$

$$w_u = \frac{11.66(61,496)}{10^2} = 18.3 \frac{\text{lb}}{\text{in-ft}} = \underline{219 \text{ psf}}$$

$$\therefore \text{Accel.} = \frac{219}{109} = 2.01g \Rightarrow \frac{F_s}{F_s} = \frac{2.01}{1.84} = \underline{1.09}$$

OK



2) EL. 332'-0", Control Bldg., E-W Wall, 2'-0" wide

Vertical rebar is #7@16" each face

All cells grouted

Assume this wall is composed of 2 outside rows of 8x8x16 blocks with concrete infill

$$\text{Wt of infill per wall} = \frac{1}{2}(145) \frac{24-2(7.625)}{12} = 53 \text{ psf}$$

$$\text{Total wt.} = 92 + 53 = 145 \text{ psf}$$

Uncracked Moment of Inertia per foot of wall

$$I_g = \frac{1}{12}(7.625)^3(12) = 443 \text{ in}^4/\text{ft}$$

Cracked Moment of Inertia per foot of wall

$$A_s = 0.60 \left(\frac{12}{16} \right) = 0.45 \text{ in}^2/\text{ft}$$

$$\therefore 12 \left(\frac{1}{2} X_{NA} \right)^2 - 0.45 (21.1 X 3.8125 - X_{NA}) = 0 \Rightarrow X_{NA} = 1.789"$$

$$I_{cr} = \frac{1}{3} (12 X 1.789)^3 + 0.45 (21.1 X 3.8125 - 1.789)^2 = 61.8 \text{ in}^4/\text{ft}$$

$$M_{cr} = 0.020 \left(\frac{145}{3.8125} \right) = 2.32 \text{ in-k/ft}$$

$$M_y = \frac{61.8}{1.789} (0.85 X 1.375) = 40.4 \text{ in-k/ft}$$

Equivalent Stiffness

$$M_a = \frac{1}{2} M_y = 20.2 \text{ in-k/ft}$$

$$I_c = \left(\frac{2.32}{20.2} \right)^3 I_g + \left[1 - \left(\frac{2.32}{20.2} \right)^3 \right] I_{cr} = 62.4 \text{ in}^4/\text{ft}$$

Dynamic Analysis

$$F_1 = (k_1 l)^2 \left(\frac{1}{2\pi} \right) \sqrt{\frac{EI}{\rho A l^4}}$$

$$\rho A = (145 \text{ psf}) \left(\frac{1 \text{ ft}}{12 \text{ in}} \right) \left(\frac{1}{386.4} \frac{\text{sec}^2}{\text{in}} \right) = 0.0313 \frac{\text{lb-sec}^2}{\text{in}^2\text{-ft}}$$

$$\therefore F_1 = (k_1 l)^2 \left(\frac{1}{2\pi} \right) \sqrt{\frac{1.375 \times 10^6 (62.4)}{(0.0313 X 198")}} = (k_1 l)^2 (0.2126)$$

TITLE LimerickBY RBNDATE 12782

CHKD. BY

DATE 11
**STRUCTURAL
MECHANICS
ASSOCIATES**
A Calif. Corp.
PAGE 48 OF Job No. 14302.
 COMMENTS Reactor + Contro
Buildings

i	$k_i l$	f_i	FM_i	S_a
1	3.9266	3.28 Hz	0.7396	2.53g
2	7.0686	10.62	0.0068	0.92
3	10.2102	22.16	0.1118	0.61
4	13.3518	37.90	0.0019	0.61

The first frequency is close enough to the 1^{st} frequency listed on p. 45 to use the 1.55 factor. At E1. 332'-0", the 2% damped spectral accel. at 3.28 Hz is 3.04g. At E1. 352'-0", the 2% damped spectral accel. is 3.30g. Using previously stated methods, $S_a = 2.53g$. The other accelerations stay the same.

$$\text{Total accel.} = 0.7396(2.53) + 0.0068(0.92) + 0.2536(0.61) \\ = \underline{2.03g}$$

Acceleration Capacity

$$C_{\max} = \frac{A_c f_y}{0.85 F_m (12)} = \frac{0.45 (66,000)}{0.85 (1375 \times 12)} = \underline{2.118''}$$

$$0.85 (1375 \times 12 \times 0.85c) - 87,000 \left(\frac{3.8125}{c} - 1 \right) 0.45 = 0 \Rightarrow c = \underline{2.259''}$$

$$\therefore c = 2.118''$$

$$a = 0.85c = 1.800''$$

$$\therefore M_u = 0.85 (1375 \times 12 \times 1.800^2) \left(\frac{1}{2} \right) + 0.45 (66,000 \times 3.8125 - 2.118) \\ = \underline{73,047 \text{ in-k/ft}}$$

$$w_u = \frac{11.66 (73,047)}{1982} = 21.7 \frac{\text{lb}}{\text{in-ft}} = \underline{261 \text{ psf}}$$

$$\therefore A_c = \frac{261}{145} = 1.80g \Rightarrow \ddot{F}_s = \frac{1.80}{2.03} = \underline{0.89}$$



Randomness and Uncertainty

From p. MS-16, $\beta_R = 0.10 + \beta_U = 0.20$

Inelastic Energy Absorption

Ref. 40 indicates that block walls do exhibit ductile behavior. A median ductility of 2 with logarithmic standard deviations associated with randomness and uncertainty of 0.20 and 0.20, respectively, are estimated. Use Ref. 27 to determine $\bar{F}_u$.

$$\beta = 10\%$$

$$q = 3.00 \beta^{-0.30} = 1.504$$

$$p = q + 1 = 2.504$$

$$r = 0.48 \beta^{-0.08} = 0.399$$

$$\bar{F}_u = (p\mu - q)^r = [(2.504)(2) - 1.504]^{0.399} = \underline{1.65}$$

$$\beta_R = \frac{0.399(2.504)(2.0)(0.20)}{2.504(2.0) - 1.504} = \underline{0.11} \quad (\text{p. M-5})$$

$$\beta_{\phi u} = 0.11 \Rightarrow \beta_U = \sqrt{0.10^2 + 0.11^2} = \underline{0.15} \quad (\text{p. M-6})$$

Spectral Shape (Subsystem)

This factor represents the conservatism of the time history response spectra vs. the SSE spectra at 5% damping as measured at the structure's natural frequencies. From the spectra on p. 63, an $\bar{F}_{ss} = 1.0$ appears appropriate.

Randomness

This variability will be based on a comparison of the 50% and the 84.1% WASH-1255 spectra at 5% damping.

F	$S_a(50\%)$	$S_a(84.1\%)$	$F = \frac{S_a(84.1\%)}{S_a(50\%)}$	$\beta = \ln F$
2.90 Hz	0.317g	0.401g	1.265	0.24
7.89	0.267g	0.320g	1.199	0.18
12.11	0.205g	0.226g	1.102	0.10
17.24	0.166g	0.171g	1.030	0.03



Since the lower modes contribute the most to the overall structure response, $\beta_R = 0.20$ appears reasonable.

Damping (Subsystem)

5% damping was used in the analysis while 10% damping is considered to be the median damping value. There is no 10% damped spectrum of the time history, however. Therefore, the WASH-1255 50 percentile spectra will be compared for 5% and 10% damping.

F	$S_a(\beta=5\%)$	$S_a(\beta=10\%)$	$F = \frac{S_a(5\%)}{S_a(10\%)}$	$\beta = \ln F$
3.28 Hz	0.317g	0.248g	1.278	0.25
10.62	0.222g	0.195g	1.138	0.13
22.16 on	0.150g	0.150g	1.0	0

$$\therefore \beta_c = 0.7396(0.25) + 0.0068(0.13) = 0.19$$

$$\beta_R = \frac{0.19}{\sqrt{1.25}} = \underline{0.17} \quad \beta_U = \frac{\beta_R}{2} = \underline{0.08}$$

Modelling (Subsystem)

See p. M-14 for methodology

$$\beta_f = 0.20 \Rightarrow f_i' = f_i \cdot e^{-0.20} = 0.8187 f_i$$

f_i	f_i'	S_a	FM
3.28 Hz	2.69 Hz	3.24g	0.7396
10.62	8.69	0.68g	0.0068
22.16 +	18.14	0.61g	0.2536

$$\text{Total } S_o = \sqrt{[0.7396(3.24)]^2 + [0.0068(0.68)]^2 + [0.2536(0.61)]^2}$$

$$= 2.40g$$

$$\text{SRSS Accel. from p. 48} = 1.88g$$

$$\therefore \beta_{11} = \ln \left(\frac{2.40}{1.88} \right) = \underline{0.24}$$



Modal Combination (Subsystem)

The FSAR specifies summing the absolute values of the responses. The SRSS response acceleration would be:

$$A_c = \sqrt{[0.7396(2.53)]^2 + [0.0068(0.92)]^2 + [0.2536(0.61)]^2}$$

$$= 1.88g$$

$$\therefore \check{F}_{Mc} = \frac{2.03}{1.88} = \underline{1.08}$$

$$\beta_R = \frac{1}{3} \ln \left(\frac{2.03}{1.88} \right) = \underline{0.03}$$

Combination of EQ Components (Subsystem)

E-W and Vertical EQ components are not expected to have much effect, if any, on the results.

$$\therefore \check{F}_{EQ} = \underline{1.0} + \beta_R = \underline{0.05}$$

Spectral Shape

The peak floor accelerations, 0.5639g at El. 332'-0" and 0.6464g for El. 352'-0", were obtained using the FSAR method for modal combination with the 5% damped SSE spectrum. Using the WASH-1255 10% damped median spectrum:

			El. 332'-0"			El. 352'-0"		
Mode	F	Part. Fac.	Mode Sh.	S _a	Accel.	Mode Sh.	S _a	Accel.
1	2.90 Hz	87.596	0.01194	0.2475g	0.2589g	0.01328	0.2475g	0.2879g
2	7.89	29.086	0.004234	0.2209	0.0272	0.000015	0.2209	0.0001
3	12.11	-24.742	0.007682	0.1848	0.0351	0.01263	0.1848	0.0577
4	17.04	-16.615	0.001230	0.1603	0.0033	0.01150	0.1603	0.0306
5+	>20	—	0.04146*	0.1500	0.0062	0.04229*	0.1500	0.0063

* Mass that has not participated yet = $\left| 1 - \sum_{i=1}^5 (P.F.)_i (M.S.)_i \right|$

SRSS Accel. for El. 332'-0" = 0.263g

" " " El. 352'-0" = 0.295g

Ave. Accel. = 0.5(0.263 + 0.295) = 0.279g

TITLE Limerick
 BY RBN DATE 1/28/82
 CHKD. BY _____ DATE 1/1



STRUCTURAL
 MECHANICS
 ASSOCIATES
 A Calif. Corp.

PAGE 52 OF _____ Job No. 14302.1
 COMMENTS Reactor + Control
Buildings

$$\therefore \ddot{F}_{ss} = \frac{0.605}{0.279} = \underline{2.17}$$

Randomness

Use WASH-1255 10% damped 84.1 percentile spectrum

			El. 332'-0"			El. 352'-0"		
Mode	F	Part. Fac.	Mode Sh.	S _a	Accel.	Mode Sh.	S _a	Accel.
1	2.90 Hz	87.596	0.01194	0.3015g	0.3153g	0.01328	0.3015g	0.3507g
2	7.89	29.086	0.004234	0.2572	0.0317	0.000015	0.2572	0.0001
3	12.11	-24.742	0.007682	0.2006	0.0381	0.01263	0.2006	0.0627
4	17.04	-16.615	0.001230	0.1646	0.0034	-0.01150	0.1646	0.0315
5+	>20	—	0.04146	0.1500	0.0062	0.04229	0.1500	0.0063

SRSS Accel. for El. 332'-0" = 0.319g

" " " El. 352'-0" = 0.358g

Ave. Accel. = 0.5(0.319 + 0.358) = 0.338g

$$\therefore \beta_R = \ln\left(\frac{0.338}{0.279}\right) = \underline{0.19}$$

Damping

7% damping is considered to be at 1σ. Using the WASH-1255 7% damped median spectrum:

			El. 332'-0"			El. 352'-0"		
Mode	f	Part. Fac.	Mode Sh.	S _a	Accel.	Mode Sh.	S _a	Accel.
1	2.90 Hz	87.596	0.01194	0.2850g	0.2981g	0.01328	0.2850g	0.3315g
2	7.89	29.086	0.004234	0.2463	0.0303	0.000015	0.2463	0.0001
3	12.11	-24.742	0.007682	0.1960	0.0373	0.01263	0.1960	0.0612
4	17.04	-16.615	0.001230	0.1634	0.0033	-0.01150	0.1634	0.0312
5+	>20	—	0.04146	0.1500	0.0062	0.04229	0.1500	0.0063

SRSS Accel. for El. 332'-0" = 0.302g }
 " " " El. 352'-0" = 0.339g } Ave. Accel. = 0.320g

$$\therefore \beta_R = \ln\left(\frac{0.320}{0.279}\right) = 0.14 \Rightarrow \beta_R = \frac{0.14}{1.25} = \underline{0.12} + \beta_v = \beta_R/2 = \underline{0.06}$$

TITLE LimerickBY RBNDATE 1/28/82

CHKD. BY

DATE 1/1STRUCTURAL
MECHANICS
ASSOCIATES
A Calif. Corp.PAGE 53 OF Job No. 14302COMMENTS Reactor + Control
BuildingsModelling

$\beta_f = 0.20$

$\beta_{ms} = 0.10$

$\Rightarrow \beta_{M_i} = \sqrt{\beta_{ms_i}^2 + 0.10^2}$

$$\beta_{ms_i} \approx \ln(S_{f_i} = f_i - 1\sigma / \ddot{y}_i) \quad \text{where } S_{f_i} = f_i - 1\sigma = \text{spectral accel. for frequency at } f_i = \ddot{y}_i e^{-0.20}$$

Mode	$f_i = \ddot{y}_i e^{-0.20}$	Part. Fac.	El. 332'-0"			El. 352'-0"		
			Mode Sh.	S_a	Accel.	Mode Sh.	S_a	Accel.
1	2.37 Hz	87.596	0.01194	0.2475g	0.2589g	0.01328	0.2475g	0.2879g
2	6.46	29.086	0.004234	0.2400	0.0296	0.000015	0.2400	0.0001
3	9.91	-24.742	0.007682	0.2009	0.0382	0.01263	0.2009	0.0628
4	13.95	-16.615	0.001230	0.1742	0.0036	-0.01150	0.1742	0.0333
5	18.64	-13.913	-0.003772	0.1545	0.0081	0.003284	0.1545	0.0071
b+	>20	—	0.01102	0.1500	0.0017	0.003398	0.1500	0.0005

Mode	El. 332'-0"				El. 352'-0"			
	$\ddot{y}_i$	S_{f_i}	β_{ms_i}	β_{M_i}	S_{f_i}	S_{f_i}	β_{ms_i}	β_{M_i}
1	0.2589g	0.2589g	0	0.10	0.2879g	0.2879g	0	0.10
2	0.0272	0.0296	0.085	0.13	0.0001	0.0001	0	0.10
3	0.0351	0.0382	0.085	0.13	0.0577	0.0628	0.085	0.13
4	0.0033	0.0036	0.087	0.13	0.0306	0.333	0.085	0.13
5	0.0078	0.0081	0.038	0.11	0.0069	0.0071	0.029	0.10
b+	0.0017	0.0017	0	0.10	0.0005	0.0005	0	0.10

For El. 332'-0" :

$$\beta_u = \left\{ \left[0.10 \left(\frac{0.2589}{0.263} \right) \right]^2 + \left[0.13 \left(\frac{0.0272}{0.263} \right) \right]^2 + \left[0.13 \left(\frac{0.0351}{0.263} \right) \right]^2 + \left[0.13 \left(\frac{0.0033}{0.263} \right) \right]^2 + \left[0.11 \left(\frac{0.0078}{0.263} \right) \right]^2 + \left[0.10 \left(\frac{0.0017}{0.263} \right) \right]^2 \right\}^{\frac{1}{2}}$$

$$= \underline{0.10}$$

For El. 352'-0" :

$\beta_u = \underline{0.10}$

TITLE LimerickBY RBN DATE 1/27/82CHKD. BY _____ DATE 1/1
**STRUCTURAL
MECHANICS
ASSOCIATES**
A Calif. Corp.
PAGE 54 OF _____ Job No. 143000COMMENTS Reactor + Control
BuildingsBlock Wall Failure

Item	Median F.F.	B _e	B _u	B _c
Strength	0.89	0.10	0.20	0.22
Inelastic Energy Absorption	1.65	0.11	0.15	0.19
Spectral Shape (Subsystem)	1.0	0.20	0	0.20
Damping (Subsystem)	1.0	0.17	0.08	0.19
Modelling (Subsystem)	1.0	0	0.24	0.24
Modal Combination (Subsystem)	1.25	0.03	0	0.03
Earthquake Components (Subsystem)	1.0	0.25	0	0.05
Spectral Shape	2.17	0.19	0	0.19
Damping	1.0	0.12	0.06	0.14
Modelling	1.0	0	0.10	0.10
Soil-Structure Interaction	1.0	0	0.05	0.05
Total	3.44	0.38	0.37	0.54

Median Acceleration Capacity = $3.44(0.15g) = 0.52g$