50-237

9/14/77

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*OELD
*OI&E (3)
*NRC Participants
*ACRS (16)
W. Paulson
P. O'Connor
D. Jaffe
R. Snaider
T. Wambach
C. Trammell
M. Fletcher
P. Riehm
L. Kintner
*G. Lainas
*I. Sihweil
*J. Knight
*R. Tedesco
*R. Stuart
J. Siegel
R. Bevan
S. Nowicki
D. Verrelli
G. Vissing

*with enclosure

memo
4

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SEP 14 1977

DOCKETS NOS.: 50-219, 50-220, 50-237, 50-245, 50-249, 50-254, 50-259, 50-260, 50-263, 50-265, 50-271, 50-277, 50-278, 50-293, 50-296, 50-298, 50-321, 50-324, 50-325, 50-331, 50-333, 50-341, 50-354, 50-355, and 50-366.

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FACILITIES: Oyster Creek Nuclear Generating Station, Nine Mile Point Unit No. 1, Pilgrim Unit No. 1, Dresden Units Nos. 2 and 3, Millstone Unit No. 1, Quad Cities Units Nos. 1 and 2, Monticello, Peach Bottom Units Nos. 2 and 3, Browns Ferry Units Nos. 1, 2 and 3, Vermont Yankee, Hatch Units Nos. 1 and 2, Brunswick Units Nos. 1 and 2, Duane Arnold Energy Center, Cooper, Fitzpatrick, Enrico Fermi Unit No. 2, and Hope Creek Units Nos. 1 and 2.

SUBJECT: SUMMARY OF MEETING HELD ON AUGUST 8, 1977 WITH REPRESENTATIVES OF THE MARK I OWNER'S GROUP

On August 8, 1977, a meeting was held in Bethesda, Maryland with representatives of the Mark I Owner's Group and the Generic Electric Company (GE). The purpose of the meeting was to discuss the structural acceptance criteria for the Mark I Containment Long Term Program. Enclosure 1 is a list of the meeting attendees. Enclosure 2 is a copy of the meeting agenda.

Summary

The primary purpose of this meeting was to continue the discussions initiated at a previous meeting held on June 17, 1977 related to (1) the assignment of service levels for containment structures and supports subjected to particular postulated load combinations and (2) the assignment of basic allowable stress limits to be utilized in the analyses of these structures. Enclosure 3 is a preliminary table of the service levels proposed by the Mark I Owner's Group for the load combinations under consideration. Enclosure 4 is a summary of the material presented by the Mark I Owner's Group at this meeting.

T. Mulford, GE, provided an introduction to the meeting (1) by briefly discussing the areas where the Mark I Owner's Group believes that they are in agreement with the NRC staff, and (2) by identifying the areas where the Mark I Owner's Group believes it can provide justification for deviations from a "traditional" interpretation of the Code for service level assignments.

W. Cooper, Teledyne, indicated that the discussions would not include piping, piping supports, or the Brunswick concrete containment, but that these areas would be discussed at a future date. He also indicated that possible increases in allowable stresses on the basis of the dynamic nature of the loadings would not be discussed, but that any such increases which can be justified will be presented at a future date.

W. Cooper discussed the Mark I Owner's proposal that S_{Ml} allowable stress intensities be utilized for the LTP structural acceptance criteria rather than S_{MC} allowable stress intensities. (The S_{Ml} values are 11 to 21 percent higher than the S_{MC} values.) The detailed justifications for this proposal are presented in Enclosure 4.

With respect to the above-mentioned proposal, the NRC staff stated that it would consider S_{Ml} allowable stress intensities for application in the Mark I LTP only if the ASME Code Committee would approve such an approach for application "across-the-board". However, the staff expressed a concern that such a ruling by the Code Committee would most likely require a reinvestigation and subsequent revision of related requirements for fabrication procedures and preservice and inservice inspections.

W. Cooper presented a table (Chart No. 2 of Enclosure 4) of service level assignments (for certain structural components) and load combinations for which the Mark I Owner's believe they are in agreement with the NRC staff's previously stated (June 17, 1977 meeting) positions. The NRC staff stated that the general philosophy behind this table seemed appropriate, but that the staff needs some time to consider the matter further. The staff committed to provide comments to the Owner's Group within two weeks.

W. Cooper proceeded to discuss areas where the Mark I Owner's Group believes that justification for deviations from "traditional" interpretations of the Code for service level assignments are available. These areas are highlighted in Charts 3, 4 and 5 of Enclosure 4. In general, these proposed deviations would allow local plastic deformation of containment structures which provide a "channeling" function, e.g., the vent header between downcomer penetrations, the vent header in the pool swell impingement region. The staff reexpressed its position that external and internal pressure boundaries, in general, should be treated the same since they are both classified as MC by the Code. However, the staff also restated its position, as expressed in the June 17, 1977 meeting, that certain deviations allowed by the Code (e.g., local dynamic loads, jet impingement loads, impulsive loads) would be considered if adequately justified. With respect to deviations based on the dynamic nature of the loadings, the NRC staff requested the Mark I Owner's Group to discuss their programs, if any, designed to meet this objective. The NRC staff further expressed its opinion that efforts by the Mark I Owner's Group in this regard would have a higher likelihood of success.

The NRC staff requested information related to the schedule for discussion on piping, pipe supports, pumps, valves, etc.; the Mark I Owner's Group indicated that such discussions would take place in late August or early September 1977.

In conclusion, the NRC staff recommended that the Mark I Owner's Group submit their arguments formally with bases for any deviations from the Code, including a description of any analytical or experimental programs which they were conducting to support these exceptions.

John C. Guibert
Technical Assistant
Division of Operating Reactors

Enclosures:
As stated

Enclosure 1

ATTENDANCE LIST

MARK I CONTAINMENT PROGRAM
GE/TRC/NRC WORKING MEETING
STRUCTURAL ACCEPTANCE CRITERIA
AUGUST 8, 1977

NAME	REPRESENTING
K. Herring	NRC/DOR/EB
J. Guibert	NRC/DOR
George O'Connor	Yankee Atomic Electric Co.
Randy Broman	Bechtel San Francisco
Larry Steinert	GE
Elmer Mangbum	GE
Chris Grimes	NRC/DOR/PSB
Sal Mucciacciaro	Stone & Webster, Cherry Hill, NJ
Isa Sihweil	NRC/DSS/SEB
C. P. Tan	NRC/DSS/SEB
N. W. Edwards	NUTECH
B. D. Liaw	NRC/DOR/EB
D. Lynn Whitt	CBI
R. J. Stuart	NRC/DOR/EB
K. R. Wichman	NRC/DOR/EB
L. C. Shao	NRC/DOR/EB
T. J. Mulford	GE
Pei-Ying Chen	NRC/DSS/MEB
G. Bagchi	NRC/DOR/EB
F. E. Gregor	DECO

Enclosure 2

AGENDA

MARK I CONTAINMENT PROGRAM
STRUCTURAL ACCEPTANCE CRITERIA
MEETING WITH NRC
AUGUST 8, 1977

0900	INTRODUCTION	MULFORD
0915	BACKGROUND	COOPER
0930	DISCUSSION OF S_{M1} VS. S_{MC} ALLOWABLE STRESS INTENSITIES	COOPER
1015	DISCUSSION OF LEVEL ASSIGNMENT AGREEMENTS BETWEEN NRC AND UTILITIES	COOPER
1130	LUNCH	
1230	DISCUSSION OF LEVEL ASSIGNMENT DISAGREEMENTS BETWEEN NRC AND UTILITIES	COOPER
1500	CLOSURE - DISCUSSION OF FUTURE ACTIONS	STEINERT
1530	ADJOURNMENT	

TJM
8/8/77

Enclosure 4

MARK I CONTAINMENT PROGRAM

STRUCTURAL ACCEPTANCE CRITERIA

ACTIVITY 3.1.3

PLANT UNIQUE ANALYSIS APPLICATION GUIDE

August 8, 1977 Presentation to NRC Concerning

COMPONENT-LOADINGS - SERVICE LEVEL ASSIGNMENTS

TELEDYNE ENGINEERING SERVICES

303 BEAR HILL ROAD
WALTHAM, MASSACHUSETTS 02154
617-890-3350

MARK I CONTAINMENT - STRUCTURAL DESIGN CRITERIA

PURPOSE OF MEETING: TO EXCHANGE THOUGHTS WITH NRC CONCERNING SERVICE LEVEL ASSIGNMENTS FOR CONTAINMENT STRUCTURES AND SUPPORTS AND THE BASIC ALLOWABLE STRESS TO BE USED.

COMMENTS:

1. CHARTS DISCUSSED GO IN SECTION 5 OF PLANT UNIQUE ANALYSIS APPLICATION GUIDE.
2. PIPING AND PIPING SUPPORTS AND THE BRUNSWICK CONTAINMENT WILL BE DISCUSSED AT A LATER DATE.
3. ONLY LOAD COMBINATIONS INVOLVING "NEW" LOADS ARE DISCUSSED. LOAD AND LOAD COMBINATION DEFINITION ARE NOT PART OF THE SDC EFFORT.
4. THE CONTAINMENTS WERE ORIGINALLY CONSTRUCTED USING DESIGN PRESSURES AND DESIGN TEMPERATURES WHICH ARE NOT CHANGED AS A RESULT OF THE NEW LOADS.
5. POSSIBLE INCREASES IN ALLOWABLE STRESSES AS A RESULT OF THE DYNAMIC NATURE OF THE LOADINGS ARE NOT YET INCLUDED. ANY WHICH CAN BE JUSTIFIED WILL BE PRESENTED AT A LATER DATE.

Therefore, they are attempting to establish a base which will not require further conservatisms added on.

MARK I CONTAINMENT APPROACH TO STRUCTURAL DESIGN CRITERIA

1. PLANT UNIQUE ANALYSIS APPLICATION GUIDE (TES TR-2278(c)) WILL:

   A. CODE CLASSIFY THE STRUCTURAL ELEMENTS

   B. REFER TO LOADS AND LOAD COMBINATIONS CONTAINED IN THE LOAD DEFINITION REPORT

   C. REFERENCE THE CODE AND STANDARD RULES TO BE APPLIED, OR APPROVED ALTERNATIVE CRITERIA

   D. WHEN NECESSARY, PROVIDE ANALYSIS GUIDANCE (i.e. assume that appropriate dynamic analysis techniques are used if a deviation based on dynamic effects is proposed)

2. IN GENERAL, THE CODE RULES DEFINED ARE:

   CLASS MC VESSELS - SUMMER 1977 ADDENDA

   COMPONENT SUPPORTS - WINTER 1976 ADDENDA

3. WHEN COMPLETE APPLICATION OF THESE CRITERIA RESULT IN HARDSHIPS OR UNUSUAL DIFFICULTIES WITHOUT A COMPENSATING INCREASE IN THE LEVEL OF QUALITY AND SAFETY, OTHER STRUCTURAL ACCEPTANCE CRITERIA MAY BE CONSIDERED ON A PLANT SPECIFIC BASIS AFTER NRC APPROVAL. } on a case by case basis

as opposed to a quantifiable number

* "RESTORATION" OF THE ORIGINAL DESIGN MARGIN

1. DESIGN MARGIN IS A QUALITATIVE ASSESSMENT OF RISK THAT INCLUDES CONSIDERATION OF THE EXTENT OF KNOWLEDGE OF THE APPLIED LOADINGS, THE EXACTNESS OF THE STRESS ANALYSIS, AND THE EXTENT TO WHICH THE DESIGN CRITERIA ADDRESS SPECIFIC FAILURE MODES. IT IS NOT A NUMERICAL QUANTITY TO WHICH A SPECIFIC VALUE CAN BE ASSIGNED.

2. EARLY VESSEL DESIGNS FOLLOWED A "DESIGN BY RULE" APPROACH CONSIDERING ONLY A STATIC DESIGN PRESSURE AND SEISMIC ACCELERATION WITH THE STRESSES EVALUATED BY SIMPLE MEMBRANE ANALYSIS AND LIMITED TO 28 PERCENT OF THE MINIMUM TENSILE STRENGTH OR, FOR BUCKLING, NOMINALLY 25 PERCENT OF CRITICAL LOAD.

3. LATER VESSEL DESIGNS SUPPLEMENTED THE ABOVE PROCEDURES WITH MORE DETAILED, BUT STATIC, LOAD AND STRESS EVALUATIONS.

4. SUPPORT DESIGNS FOLLOWED STRUCTURAL STEEL PRACTICES (AISC) WHICH CONSIDERED THE SAME TYPES OF LOADS AND ANALYSIS AND LIMITED THE STRESSES TO 60 PERCENT OF THE MINIMUM YIELD STRESSES.

5. TES TR-2278(b) REVIEWS THE HISTORY OF THE CODE RULES IN DETAIL.

* Question: Does the Owners Group need to know our interpretation of this .... today?

BASIC ALLOWABLE STRESS VALUE

RECOMMENDATION: THE BASIC ALLOWABLE STRESS VALUE USED BE THOSE NORMALLY USED FOR SECTION III CLASS 2 VESSELS DESIGNED TO SUBARTICLE NC-3200 RATHER THAN THOSE NORMALLY USED FOR CLASS MC VESSELS.

NUMERICAL EXAMPLE: USING THE VARIOUS GRADES OF SA-516 AS A TYPICAL VESSEL MATERIAL:

GRADE:	60		65		70	
VALUE OF:	S_{MC}	S_{M1}	S_{MC}	S_{M1}	S_{MC}	S_{M1}
100F	16.5	20.0	17.8	21.7	19.3	23.3
200F	16.5	19.5	17.8	21.3	19.3	23.1
300F	16.5	18.9	17.8	20.7	19.3	22.5
400F	16.5	18.3	17.8	20.0	19.3	21.7

S_{MC} doesn't change as f (TEMP)

THE S_{M1} VALUES ARE 11 TO 21 PERCENT HIGHER THAN THE S_{MC} VALUES.

NOTES:

1. SA-36, IF APPLICABLE, DOES NOT HAVE S_{M1} VALUES, SO THE S_{MC} VALUE WOULD BE USED.

2. FOR LEVEL C SERVICE LIMITS THERE WOULD BE NO EFFECTIVE CHANGE SINCE S_y IS LARGER THAN 1.2 S_{M1} OR 1.2 S_{MC} FOR THE MATERIALS OF INTEREST. Therefore, only effective change would be to Level A & B limits.

① NC-3200 covers what kind of vessels?

thick shelled vessels

JUSTIFICATION FOR RECOMMENDED ALLOWABLES

1. CLASS 2: RULES ARE ACCEPTED FOR COMPONENTS WHICH FUNCTION IN PARALLEL WITH THE CONTAINMENT SYSTEM, INCLUDING (R.G. 1.26):

   A. EMERGENCY CORE COOLING SYSTEMS

   B. POST-ACCIDENT CONTAINMENT HEAT REMOVAL SYSTEMS

   C. POST-ACCIDENT FISSION PRODUCT REMOVAL SYSTEMS

   D. REACTOR SHUTDOWN SYSTEMS

   E. RESIDUAL HEAT REMOVAL SYSTEMS

   note: these systems have redundant functional requirements

2. MATERIALS: ALL MATERIALS PERMITTED FOR CLASS MC VESSELS ARE PERMITTED FOR NC-3200 VESSELS. (except for SA-36)

3. DESIGN: NEXT SHEET

4. FABRICATION: SINCE 1963, CLASS MC WELD JOINT DESIGNS FOR ALL CATEGORIES HAVE BEEN AS RESTRICTIVE AS FOR NC-3200 VESSELS.

5. EXAMINATION: THERE ARE NO SIGNIFICANT DIFFERENCES BETWEEN CLASS MC AND NC-3200 VESSELS FOR MATERIALS LESS THAN 2-1/2 INCHES THICK.

6. TESTING: THE TEST PRESSURE FOR CLASS MC VESSELS IS HIGHER THAN THAT REQUIRED FOR NC-3200 VESSELS. (135% vs. 125%)

Q? ① why was MC established in the first place? philosophy question?

DESIGN JUSTIFICATION FOR RECOMMENDED ALLOWABLES

1. SUMMER 1977 ADDENDA DESIGN AND ANALYSIS REQUIREMENTS FOR CLASS MC VESSELS ARE THE SAME AS THOSE REQUIRED FOR NC-3200 VESSELS EXCEPT FOR THE BASIC ALLOWABLE STRESS VALUE. THAT IS, A "DESIGN BY ANALYSIS" APPROACH IS USED.

2. "DESIGN BY ANALYSIS" REQUIRES DETAILED LOAD DEFINITION AND STRESS ANALYSIS AND COMPARISON OF THE CALCULATED STRESS INTENSITIES WITH DESIGN CRITIERA RELATED TO IMPORTANT FAILURE MODES, INCLUDING FATIGUE.

3. EXCEPT FOR CLASS MC VESSELS, WHERE CONSIDERATION HAS NOT YET BEEN GIVEN, THE CODE APPLIES A NOMINAL FACTOR OF SAFETY OF THREE ON THE MINIMUM TENSILE STRENGTH WITH THE "DESIGN BY ANALYSIS" APPROACH AND A NOMINAL FACTOR OF FOUR WITH THE "DESIGN BY RULE" APPROACH.

CONCLUSION

AS IS DEMONSTRATED BY THE ACCEPTANCE OF THE "DESIGN BY ANALYSIS" APPROACH AS AN ALTERNATIVE TO THE "DESIGN BY RULE" APPROACH FOR SECTION III, CLASS 2 AND SECTION VIII VESSELS, BOTH APPROACHES (WHEN COUPLED WITH THEIR RESPECTIVE RULES FOR MATERIALS, FABRICATION, EXAMINATION AND TESTING) ARE CONSIDERED TO RESULT IN EQUIVALENT DESIGN MARGINS.

Q: ① Difference between "Design by Analysis" & "Design by Rule"

Cooper believes that the Code Committee will consider this in the future — and favorably.

* We need to give them an opinion here too!

IMPLEMENTATION OF THIS RECOMMENDATION

Revise Table NE-3221-1 as Shown:

TABLE NE-3221-1 - SUMMARY OF STRESS INTENSITY LIMITS
SUMMER 1977 ADDENDA

	LOADING CONDITION SYMBOL	DESIGN STRESS INTENSITY LIMIT	LEVEL A SERVICE STRESS INTENSITY LIMIT (5)	LEVEL B SERVICE STRESS INTENSITY LIMIT AND LEVEL C SERVICE STRESS LIMIT WHERE THE STRUCTURE IS NOT INTEGRAL AND CONTINUOUS (5)	LEVEL C SERVICE STRESS INTENSITY LIMIT WHERE THE STRUCTURE IS INTEGRAL AND CONTINUOUS AND LEVEL D SERVICE STRESS LIMIT WHERE THE STRUCTURE IS NOT INTEGRAL AND CONTINUOUS AND AT PARTIAL PENETRATION WELDS (5)	LEVEL D SERVICE STRESS INTENSITY LIMIT WHERE THE STRUCTURE IS INTEGRAL & CONT. (ELASTIC ANALYSIS) (4)	LEVEL D SERVICE STRESS INTENSITY LIMIT WHERE THE STRUCTURE IS INTEGRAL AND CONTINUOUS (INELASTIC ANALYSIS) (4)
L1	P_m	$1.0\ S_{mc}$	$1.0\ S_{ml}$	$1.0\ S_{ml}$	$1.2\ S_{ml}$ or * $1.0\ S_y$	S_f	S_f
L2	P_L	$1.5\ S_{mc}$	$1.5\ S_{ml}$	$1.5\ S_{ml}$	$1.8\ S_{ml}$ or * $1.5\ S_y$	$1.5\ S_f$	S_f
L3	$P_L + P_b$	$1.5\ S_{mc}$	$1.5\ S_{ml}$	$1.5\ S_{ml}$	$1.8\ S_{ml}$ or * $1.5\ S_y$	$1.5\ S_f$	S_f
L4	$P_L + P_b + Q$	N/A (1)	$3.0\ S_{ml}$	$3.0\ S_{ml}$ (3)	N/A (1)	N/A (1)	N/A (1)
	$P_L + P_b + Q + F$	N/A (1)	S_a	S_a (3)	N/A (1)	N/A (1)	N/A (1)

NOTES:

1. N/A - No evaluation required.
2. Limits identified by (*) indicates a choice of the larger of two limits.
3. Evaluation not required for Level C Service.
4. S_f is 85% of the general primary membrane allowable permitted. In the application of the rules of Appendix F, S_{ml}, if applicable, shall be as specified in Table I-1.0.
5. If SA-36 material is used, S_{mc} values from Table I-1.10 shall be used.

STRUCTURAL-ELEMENT	ROW
External Class MC Torus Shell (General, Ring Girder, at Supports and Penetrations), External Vent Pipe, Bellows, Drywell (at Vent), Attachment Welds, Torus Supports, Seismic Restraints	1
Internal Vent Pipe General and Attachment Welds	2
At Penetrations (e.g., Header)	3
Pool Swell Impingement Region	4
Vent Header General and Attachment Welds	5
At Penetrations (e.g., Downcomers)	6
Pool Swell Impingement Region	7
Downcomers General and Attachment Welds	8
Pool Swell Impingement Region	9
Internal Supports	10
Internal Structures Submerged	11
Non-Submerged	12

Note: piping/piping supports/valves/pumps not included

vent header support columns

catwalks, monorails, etc.

non-safety related

COMPONENT - LOADINGS - SERVICE LEVEL ASSIGNMENTS

(SRV) (SBA/IBA) (SBA/IBA + SRV) (DBA)

EVENT COMBINATIONS		SRV	SRV + EQ		SBA	IBA	SBA + EQ		IBA + EQ		SBA + SRV	IBA + SRV	SBA, SRV, EQ		IBA, SRV, EQ		DBA		DBA + EQ			
																	PS	CO, CH	PS		CO, CH	
Type of Earthquake			O	S			O	S	O	S			O	S	O	S			O	S	O	S
COMBINATION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
LOADS																						
Normal (D + L + T_o + R_o)	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Earthquake	EQ		X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SRV Discharge	SRV	X	X	X							X	X	X	X	X	X						
LOCA Thermal	T_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Reactions	R_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Quasi-Static Pressure	P_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Pool Swell	P_{PS}																X		X	X		
LOCA Condensation Oscillation	P_{CO}																	X			X	X
LOCA Chugging	P_{CH}				X	X	X	X	X	X	X	X	X	X	X	X		X			X	X

Of these only X will be limiting combinations & will have to be a [illegible]

note: 21 combinations versus 33 (last time)

a) not necessary to establish which SRV loads are to be used (LDR)

b) combined condensation oscillation & chugging (may have to split back out)

THE FOLLOWING CHARTS CONTAIN THE COMPONENT-LOADINGS - SERVICE LEVEL ASSIGNMENTS, EXCEPT FOR PIPING. ALL CONTAIN THE SAME INFORMATION WITH RESPECT TO EVENT COMBINATIONS, COMBINATION NUMBERS AND LOADS. THE REMAINDER OF EACH CHART MAY BE DESCRIBED AS FOLLOWS:

CHART	CONTENT
1	COMPLETE CHART
2	CONSISTENT WITH PREVIOUS NRC COMMENT
3	MAY DEVIATE FROM PREVIOUS NRC COMMENT
4	DEVIATION BECAUSE OF POOL SWELL CONCERNS
5	DEVIATION BECAUSE OF CHUGGING CONCERNS
6	SUMMARY CONCERNING POOL SWELL
7	SUMMARY CONCERNING CHUGGING
8	SUMMARY CONCERNING SRV

KNOWN DEVIATIONS FROM PREVIOUS NRC COMMENTS ON GROUND-ZERO ACCEPTABILITY

COMPONENT - LOADINGS - SERVICE LEVEL A NMENTS

EVENT COMBINATIONS		SRV	SRV + EQ		SBA	IBA	SBA + EQ		IBA + EQ		SBA + SRV	IBA + SRV	SBA, SRV, EQ		IBA, SRV, EQ		DBA		DBA + EQ			
																	PS	CO, CH	PS		CO, CH	
Type of Earthquake			O	S			O	S	O	S			O	S	O	S			O	S	O	S
COMBINATION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
LOADS																						
Normal ($D + L + T_o + R_o$)	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Earthquake	EQ		X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SRV Discharge	SRV	X	X	X							X	X	X	X	X	X						
LOCA Thermal	T_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Reactions	R_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Quasi-Static Pressure	P_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Pool Swell	P_{PS}																X		X	X		
LOCA Condensation Oscillation	P_{CO}																	X			X	X
LOCA Chugging	P_{CH}				X	X	X	X	X	X	X	X	X	X	X	X		X			X	X
STRUCTURAL-ELEMENT	ROW																					
External Class MC Torus Shell (General, Ring Girder, at Supports and Penetrations), External Vent Pipe, Bellows, Drywell (at Vent), Attachment Welds, Torus Supports, Seismic Restraints	1	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	B	B	B	C	B	C
Internal Vent Pipe General and Attachment Welds	2	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	B	B	B	C	B	C
At Penetrations (e.g., Header)	3	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	C	C	C	C	C	C
Pool Swell Impingement Region	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	D	D	D	D	D
Vent Header General and Attachment Welds	5	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	B	B	B	C	B	C
At Penetrations (e.g., Downcomers)	6	A	B	C	C	C	C	D	C	D	C	C	C	D	C	D	C	C	C	C	D	D
Pool Swell Impingement Region	7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	D	D	D	D	D
Downcomers General and Attachment Welds	8	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	C	C	C	C	C	D
Pool Swell Impingement Region	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	D	D	D	D	D
Internal Supports	10	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	B	B	B	C	B	C
Internal Structures Submerged	11	A	B	C	A	A	C	D	C	D	C	C	D	E	D	E	E	E	E	E	E	E
Non-Submerged	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	D	E	E	E	E

OPERATIONAL EVENTS

COMPONENT - LOADINGS - SERVICE LEVEL ASSIGNMENTS

CONSISTENT WITH PREVIOUS NRC COMMENTS

EVENT COMBINATIONS		SRV	SRV + EQ		SBA	IBA	SBA + EQ		IBA + EQ		SBA + SRV	IBA + SRV	SBA, SRV, EQ		IBA, SRV, EQ		DBA PS	DBA CO, CH	DBA + EQ PS		DBA + EQ CO, CH	
Type of Earthquake			O	S			O	S	O	S			O	S	O	S			O	S	O	S
COMBINATION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
LOADS																						
Normal (D + L + T_o + R_o)	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Earthquake	EQ		X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SRV Discharge	SRV	X	X	X							X	X	X	X	X	X						
LOCA Thermal	T_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Reactions	R_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Quasi-Static Pressure	P_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Pool Swell	P_{PS}																X		X	X		
LOCA Condensation Oscillation	P_{CO}																	X			X	X
LOCA Chugging	P_{CH}				X	X	X	X	X	X	X	X	X	X	X	X		X			X	X
STRUCTURAL-ELEMENT	ROW																					
External Class MC Torus Shell (General, Ring Girder, at Supports and Penetrations), External Vent Pipe, Bellows, Drywell (at Vent), Attachment Welds, Torus Supports, Seismic Restraints	1	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	A B	A B	B	C	B	C
Internal Vent Pipe General and Attachment Welds	2	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	A B	A B	B	C	B	C
At Penetrations (e.g., Header)	3	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C				C		C
Vent Header General and Attachment Welds	5	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	A B	A B	B	C	B	C
At Penetrations (e.g., Downcomers)	6	A	B	C																C		
Downcomers General and Attachment Welds	8	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C				C		
Internal Supports	10	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	A B	A B	B	C	B	C
Internal Structures Submerged	11	A	B	C	A	A	C	D	C	D	C	C	D	E	D	E	E	E	E	E	E	E
Non-Submerged	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	D	E	E	E	E

possible exceptions to NRC general rules as expressed below.

if levels are in excess of D limits, than must assume structure fails & that you can sustain consequences.

service level assignment scheme consistent w/ seismic

a) NONE = A

levels A & B have same

COMPONENT - LOADINGS - SERVICE LEVEL ASSIGNMENTS

MAY DEVIATE FROM PREVIOUS NRC COMMENTS

EVENT COMBINATIONS		SRV	SRV + EQ		SBA	IBA	SBA + EQ		IBA + EQ		SBA + SRV	IBA + SRV	SBA, SRV, EQ		IBA, SRV, EQ		DBA		DBA + EQ			
																	PS	CO, CH	PS		CO, CH	
Type of Earthquake			O	S			O	S	O	S			O	S	O	S			O	S	O	S
COMBINATION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
LOADS																						
Normal (D + L + T_o + R_o)	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Earthquake	EQ		X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SRV Discharge	SRV	X	X	X							X	X	X	X	X	X						
LOCA Thermal	T_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Reactions	R_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Quasi-Static Pressure	P_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Pool Swell	P_{PS}																X		X	X		
LOCA Condensation Oscillation	P_{CO}																	X			X	X
LOCA Chugging	P_{CH}				X	X	X	X	X	X	X	X	X	X	X	X		X			X	X
STRUCTURAL-ELEMENT	ROW																					
Internal Vent Pipe																						
At Penetrations (e.g., Header)	3																C	C	C		C	
Pool Swell Impingement Region	4																D	D	D	D	D	D
Vent Header																						
At Penetrations (e.g., Downcomers)	6				C	C	C	D	C	D	C	C	C	D	C	D	C	C	C		D	D
Pool Swell Impingement Region	7																D	D	D	D	D	D
Downcomers																						
General and Attachment Welds	8																C	C	C		C	D
Pool Swell Impingement Region	9																D	D	D	D	D	D

COMPONENT - LOADINGS - SERVICE LEVEL ASSIGNMENTS

DEVIATION BECAUSE OF POOL SWELL CONCERN

EVENT COMBINATIONS		SRV	SRV + EQ		SBA	IBA	SBA + EQ		IBA + EQ		SBA + SRV	IBA + SRV	SBA, SRV, EQ		IBA, SRV, EQ		DBA		DBA + EQ			
																	PS	CO, CH	PS		CO, CH	
Type of Earthquake			O	S			O	S	O	S			O	S	O	S			O	S	O	S
COMBINATION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
LOADS																						
Normal ($D + L + T_o + R_o$)	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Earthquake	EQ		X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SRV Discharge	SRV	X	X	X							X	X	X	X	X	X						
LOCA Thermal	T_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Reactions	R_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Quasi-Static Pressure	P_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Pool Swell	P_{PS}																X		X	X		
LOCA Condensation Oscillation	P_{CO}																	X			X	X
LOCA Chugging	P_{CH}				X	X	X	X	X	X	X	X	X	X	X	X		X			X	X
STRUCTURAL-ELEMENT	**ROW**																					
Internal Vent Pipe																						
At Penetrations (e.g., Header)	3																C	C	C		C	
Pool Swell Impingement Region	4																D	D	D	D	D	D
Vent Header																						
At Penetrations (e.g., Downcomers)	6																C		C			
Pool Swell Impingement Region	7																D	D	D	D	D	D
Downcomers																						
General and Attachment Welds	8																C		C			
Pool Swell Impingement Region	9																D	D	D	D	D	D

a "blank" indicates that service level agre w/ NRC guide[illegible]

"C" permits local plastic deformations

COMPONENT - LOADINGS - SERVICE LEVEL ASSIGNMENTS

DEVIATION BECAUSE OF CHUGGING CONCERN

EVENT COMBINATIONS		SRV	SRV + EQ		SBA	IBA	SBA + EQ		IBA + EQ		SBA + SRV	IBA + SRV	SBA, SRV, EQ		IBA, SRV, EQ		DBA PS	CO, CH	DBA + EQ PS		CO, CH	
Type of Earthquake			O	S			O	S	O	S			O	S	O	S			O	S	O	S
COMBINATION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
LOADS																						
Normal (D + L + T_o + R_o)	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Earthquake	EQ		X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SRV Discharge	SRV	X	X	X							X	X	X	X	X	X						
LOCA Thermal	T_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Reactions	R_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Quasi-Static Pressure	P_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Pool Swell	P_{PS}																X		X	X		
LOCA Condensation Oscillation	P_{CO}																	X			X	X
LOCA Chugging	P_{CH}				X	X	X	X	X	X	X	X	X	X	X	X		X			X	X
STRUCTURAL-ELEMENT	ROW																					
Vent Header At Penetrations (e.g., Downcomers)	6				C	C	C	D	C	D	C	C	C	D	C	D		C			D	D
Downcomers General and Attachment Welds	8																	C			C	D

→ Lateral loads on downcomers may be the same for all types (size) of breaks

due to nature of load definition – loads w/ be conservative & bounding)

COMPONENT - LOADINGS - SERVICE LEVEL ASSIGNMENTS

SUMMARY CONCERNING POOL SWELL

EVENT COMBINATIONS		SRV	SRV + EQ		SBA	IBA	SBA + EQ		IBA + EQ		SBA + SRV	IBA + SRV	SBA, SRV, EQ		IBA, SRV, EQ		DBA PS	CO, CH	PS	DBA + EQ	CO, CH	
Type of Earthquake			O	S			O	S	O	S			O	S	O	S			O	S	O	S
COMBINATION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
STRUCTURAL-ELEMENT	ROW																					
		CONSISTENT WITH NRC COMMENTS																				
External Class MC Torus Shell (General, Ring Girder, at Supports and Penetrations), External Vent Pipe, Bellows, Drywell (at Vent), Attachment Welds, Torus Supports, Seismic Restraints	1																B		B	C		
Internal Vent Pipe General and Attachment Welds	2																B		B	C		
At Penetrations (e.g., Header)	3																			C		
Vent Header General and Attachment Welds	5																B		B	C		
At Penetrations (e.g., Downcomers)	6																			C		
Downcomers General and Attachment Welds	8																			C		
Internal Supports	10																B		B	C		
Internal Structures Submerged	11																E		E	E		
Non-Submerged	12																D		E	E		
		APPLY LEVEL C WHERE NRC HAS B																				
Internal Vent Pipe At Penetrations (e.g., Header)	3																C		C			
Vent Header At Penetrations (e.g., Downcomers)	6																C		C			
Downcomers General and Attachment Welds	8																C		C			
		APPLY LEVEL D WHERE NRC HAS B OR C																				
Internal Vent Pipe Vent Header Downcomers Pool Swell	4,7,9																D	D	D	D	D	D

agrees that the elements which prevent vent header from dipping due to raising are "B"
∴ a "C" for is OK

The earthquake is not significant compared to pool swell.

COMPONENT - LOADINGS - SERVICE LEVEL ASSIGNMENTS

SUMMARY CONCERNING CHUGGING

EVENT COMBINATIONS		SRV	SRV + EQ		SBA	IBA	SBA + EQ		IBA + EQ		SBA + SRV	IBA + SRV	SBA, SRV, EQ		IBA, SRV, EQ		DBA		DBA + EQ			
																	PS	CO, CH	PS		CO, CH	
Type of Earthquake			O	S			O	S	O	S			O	S	O	S			O	S	O	S
COMBINATION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
STRUCTURAL-ELEMENT	ROW																					
CONSISTENT WITH NRC COMMENTS																						
External Class MC Torus Shell (General, Ring Girder, at Supports and Penetrations), External Vent Pipe, Bellows, Drywell (at Vent), Attachment Welds, Torus Supports, Seismic Restraints	1				A	A	B	C	B	C	A	A	B	C	B	C		B			B	C
Internal Vent Pipe General and Attachment Welds	2				A	A	B	C	B	C	A	A	B	C	B	C		B			B	C
At Penetrations (e.g., Header)	3				A	A	B	C	B	C	A	A	B	C	B	C						C
Vent Header General and Attachment Welds	5				A	A	B	C	B	C	A	A	B	C	B	C		B			B	C
Downcomers General and Attachment Welds	8				A	A	B	C	B	C	A	A	B	C	B	C						
Internal Supports	10				A	A	B	C	B	C	A	A	B	C	B	C		B			B	C
Internal Structures Submerged	11				A	A	C	D	C	D	C	C	D	E	D	E		E			E	E
Non-Submerged	12				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		D			E	E
APPLY LEVEL C WHERE NRC HAS A OR B																						
Internal Vent Pipe At Penetrations (e.g., Header)	3																	C			C	
Vent Header At Penetrations (e.g., Downcomers)	6				C	C	C		C		C	C	C		C			C				
Downcomers General and Attachment Welds	8																	C			C	
APPLY LEVEL D WHERE NRC HAS B OR C																						
Vent Header At Penetrations (e.g., Downcomers)	6							D		D				D		D					D	D
Downcomers General and Attachment Welds	8																					D

devastation in all situations.

possible severe lateral loads likely to yield stresses ∴ require examination post-event.

consequences of failure ????

A/E'S should attempt to demonstrate that level "B" is met.

require two analyses

COMPONENT - LOADINGS - SERVICE LEVEL ASSIGNMENTS

SUMMARY CONCERNING SRV

EVENT COMBINATIONS		SRV	SRV + EQ		SBA	IBA	SBA + EQ		IBA + EQ		SBA + SRV	IBA + SRV	SBA, SRV, EQ		IBA, SRV, EQ		DBA PS	DBA CO, CH	DBA + EQ PS		DBA + EQ CO, CH	
Type of Earthquake			O	S			O	S	O	S			O	S	O	S			O	S	O	S
COMBINATION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
STRUCTURAL-ELEMENT	ROW																					
CONSISTENT WITH NRC COMMENTS																						
External Class MC Torus Shell (General, Ring Girder, at Supports and Penetrations), External Vent Pipe, Bellows, Drywell (at Vent), Attachment Welds, Torus Supports, Seismic Restraints	1	A	B	C							A	A	B	C	B	C						
Internal Vent Pipe General and Attachment Welds	2	A	B	C							A	A	B	C	B	C						
At Penetrations (e.g., Header)	3	A	B	C							A	A	B	C	B	C						
Vent Header General and Attachment Welds	5	A	B	C							A	A	B	C	B	C						
At Penetrations (e.g., Downcomers)	6	A	B	C																		
Downcomers General and Attachment Welds	8	A	B	C							A	A	B	C	B	C						
Internal Supports	10	A	B	C							A	A	B	C	B	C						
Internal Structures Submerged	11	A	B	C							C	C	D	E	D	E						
Non-Submerged	12	N/A	N/A	N/A							N/A	N/A	N/A	N/A	N/A	N/A						
APPLY LEVEL C WHERE NRC HAS A OR B																						
Vent Header At Penetrations (e.g., Downcomers)	6										C	C	C		C							
APPLY LEVEL D WHERE NRC HAS C																						
Vent Header At Penetrations	6													D		D						

ADDITIONAL FATIGUE EVALUATION

NORMALLY, EVALUATION OF SECONDARY AND FATIGUE STRESSES IN CLASS MC VESSELS IS NOT REQUIRED WHEN LEVEL C SERVICE LIMITS ARE PERMITTED.

FOR THE MARK I CONTAINMENTS, SECONDARY AND FATIGUE STRESS EVALUATION WILL BE REQUIRED FOR ALL CASES WHERE PREVIOUS NRC COMMENTS WOULD INDICATE A LEVEL A OR B ASSIGNMENT AND LEVEL C HAS BEEN USED, EXCEPT FOR POOL SWELL LOADING.

THIS ADDITIONAL REQUIREMENT WILL BE APPLIED TO:

ROW	COLUMNS
3	17, 20
6	4-6, 8, 10-12, 14
8	17, 20

ALSO, A NOTE TO THIS EFFECT WILL BE ADDED ON FIGURE NE-3221-1.

COMMENT APPROPRIATE ?

PROBABLE LIMITING STRESS LEVEL

THE NEXT, AND LAST CHART INDICATES A PRESENT ESTIMATE AS TO WHICH OF THE VARIOUS LEVELS WILL BE LIMITING FOR EACH STRUCTURAL ELEMENT.

OF THE 13 LIMITING CONDITIONS IDENTIFIED, NINE APPLY LEVELS CONSISTENT WITH PREVIOUS NRC COMMENTS. THE REMAINING FOUR APPLY LIMITS WHICH MAY BE INCONSISTENT WITH PREVIOUS NRC COMMENTS.

ONE OF THESE POSSIBLE DEVIATIONS IS AT THE DOWNCOMER PENETRATION IN THE VENT HEADER WHEN SUBJECTED TO IBA + SRV + OBE, WHERE LEVEL C IS PERMITTED.

THE REMAINING THREE POSSIBLE DEVIATIONS OCCUR AT THE POOL SWELL IMPINGEMENT REGION OF THE VENT HEADER, THE DOWNCOMERS AND THE INTERNAL VENT, WHERE LEVEL D IS PERMITTED. AT THE PRESENT ONLY THE FIRST OF THESE IS FELT TO BE OF SIGNIFICANCE.

THEREFORE, THE PRESENT JUDGEMENT IS THAT ONLY TWO LIMITING REGIONS WILL HAVE LIMITS WHICH MAY DEVIATE FROM PREVIOUS NRC COMMENTS.

COMPONENT - LOADINGS - SERVICE LEVEL ASSIGNMENTS

PROBABLY LIMITING

EVENT COMBINATIONS		SRV	SRV + EQ		SBA	IBA	SBA + EQ		IBA + EQ		SBA + SRV	IBA + SRV	SBA, SRV, EQ		IBA, SRV, EQ		DBA PS	DBA CO, CH	DBA + EQ PS		DBA + EQ CO, CH	
Type of Earthquake			O	S			O	S	O	S			O	S	O	S			O	S	O	S
COMBINATION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
LOADS																						
Normal (D + L + T_o + R_o)	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Earthquake	EQ		X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SRV Discharge	SRV	X	X	X							X	X	X	X	X	X						
LOCA Thermal	T_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Reactions	R_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Quasi-Static Pressure	P_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Pool Swell	P_{PS}																X		X	X		
LOCA Condensation Oscillation	P_{CO}																	X			X	X
LOCA Chugging	P_{CH}				X	X	X	X	X	X	X	X	X	X	X	X		X			X	X
STRUCTURAL-ELEMENT	ROW																					
External Class MC Torus Shell (General, Ring Girder, at Supports and Penetrations), External Vent Pipe, Bellows, Drywell (at Vent), Attachment Welds, Torus Supports, Seismic Restraints	1	A	B	C	A	A	B	C	B	C	A	A	B	C	Ⓑ	C	B	B	Ⓑ	C	B	C
Internal Vent Pipe General and Attachment Welds	2	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	B	B	Ⓑ	C	B	C
At Penetrations (e.g., Header)	3	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	C	C	C	Ⓒ	C	C
Pool Swell Impingement Region	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	D	D	◎D	D	D
Vent Header General and Attachment Welds	5	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	B	B	Ⓑ	C	B	C
At Penetrations (e.g., Downcomers)	6	A	B	C	C	C	C	D	C	D	C	C	C	D	☐ B ◎C	D	C	C	C	C	D	D
Pool Swell Impingement Region	7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	D	D	☐◎D	D	D
Downcomers General and Attachment Welds	8	A	B	C	A	A	B	C	B	C	A	A	E	C	Ⓑ	C	C	C	C	C	C	D
Pool Swell Impingement Region	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	D	D	◎D	D	D
Internal Supports	10	A	B	C	A	A	B	C	B	C	A	A	E	C	B	C	B	B	Ⓑ	C	B	C
Internal Structures Submerged	11	A	B	C	A	A	C	D	C	D	C	Ⓒ	D	E	D	E	E	E	E	E	E	E
Non-Submerged	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Ⓓ	D	E	E	E	E

SINGLE ○ = CONSISTENT W/ PREVIOUS NRC COMMENTS

DOUBLE ◎ = DEVIATIONS FROM " " "

☐ = TWO MOST PROBABLE CONCERN ~~AREAS~~ (OTHER 2 ◎ WILL PROBABLY DROP OUT)

A complete chart

COMPONENT - LOADINGS - SERVICE LEVEL ASSIGNMENTS

EVENT COMBINATIONS		SRV	SRV + EQ		SBA	IBA	SBA + EQ		IBA + EQ		SBA + SRV	IBA + SRV	SBA, SRV, EQ		IBA, SRV, EQ		DBA		DBA + EQ			
																	PS	CO, CH	PS		CO, CH	
Type of Earthquake			O	S			O	S	O	S			O	S	O	S			O	S	O	S
COMBINATION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
LOADS																						
Normal (D + L + T_o + R_o)	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Earthquake	EQ		X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SRV Discharge	SRV	X	X	X							X	X	X	X	X	X						
LOCA Thermal	T_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Reactions	R_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Quasi-Static Pressure	P_A				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
LOCA Pool Swell	P_{PS}																X		X	X		
LOCA Condensation Oscillation	P_{CO}																	X			X	X
LOCA Chugging	P_{CH}				X	X	X	X	X	X	X	X	X	X	X	X		X			X	X
STRUCTURAL-ELEMENT	ROW																					
External Class MC Torus Shell (General, Ring Girder, at Supports and Penetrations), External Vent Pipe, Bellows, Drywell (at Vent), Attachment Welds, Torus Supports, Seismic Restraints	1	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	B	B	B	C	B	C
Internal Vent Pipe General and Attachment Welds	2	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	B	B	B	C	B	C
At Penetrations (e.g., Header)	3	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	C	C*	C	C	C*	C
Pool Swell Impingement Region	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	D	D	D	D	D
Vent Header General and Attachment Welds	5	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	B	B	B	C	B	C
At Penetrations (e.g., Downcomers)	6	A	B	C	C*	C*	C*	D	C*	D	C*	C*	C*	D	C*	D	C	C	C	C	D	D
Pool Swell Impingement Region	7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	D	D	D	D	D
Downcomers General and Attachment Welds	8	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	C	C*	C	C	C*	D
Pool Swell Impingement Region	9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	D	D	D	D	D
Internal Supports	10	A	B	C	A	A	B	C	B	C	A	A	B	C	B	C	B	B	B	C	B	C
Internal Structures Submerged	11	A	B	C	A	A	C	D	C	D	C	C	D	E	D	E	E	E	E	E	E	E
Non-Submerged	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	D	E	E	E	E

* Analysis of secondary (NE-3221.4) and fatigue (NE-3221.5) stresses is required.

EVENT COMBINATIONS:			NORMAL + SRV		NORMAL + SRV + EQ						NORMAL + SBA + EQ		NORMAL + IBA + EQ		NORMAL + SBA + SRV		NORMAL + IBA + SRV		NORMAL + SBA + SRV + EQ				NORMAL + IBA + SRV + EQ				NORMAL + DBA			NORMAL + DBA + EQ					
			SRV ASY	SRV ALL	SRV ASY		SRV ALL		NORM + SBA	NORM + IBA	OBE	SSE	OBE	SSE	SRV ASY	SRV ADS	SRV ASY	SRV ADS	SRV ASY		SRV ADS		SRV ASY		SRV ADS		POOL SWELL	COND OSCIL	CHUG	POOL SWELL		COND OSCIL		CHUGGING	
LOADS					OBE	SSE	OBE	SSE											OBE	SSE	OBE	SSE	OBE	SSE	OBE	SSE				OBE	SSE	OBE	SSE	OBE	SSE
	DEAD LOAD, INCLUDING HYDROSTATIC	D	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	LIVE LOADS	L	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	THERMAL EFFECTS DURING OPERATION	T_o	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	THERMAL EFFECTS DUE TO LOCA	T_A							*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	PIPE REACTIONS DURING OPERATION	R_o	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	PIPE REACTIONS DUE TO LOCA	R_A							*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	OPERATING BASES EARTHQUAKE LOADS	E_o			*		*				*		*						*		*		*		*					*		*		*	
	SAFE SHUTDOWN EARTHQUAKE LOADS	E_s				*		*				*		*						*		*		*		*					*		*		*
	ASYMMETRIC SRV LOADS (7)	SRV_{ASY}	*		*	*									*		*		*	*			*	*											
	LOADS CAUSED BY ADS SRV DISCHARGING	SRV_{ADS}														*		*			*	*			*	*									
	LOADS CAUSED BY ALL SRV DISCHARGING	SRV_{ALL}		*			*	*																											
	QUASI-STATIC DBA PRESSURE	P_{DBA}																									*	*	*	*	*	*	*	*	*
	QUASI-STATIC IBA PRESSURE	P_{IBA}								*			*	*			*	*					*	*	*	*									
	QUASI-STATIC SBA PRESSURE	P_{SBA}							*		*	*			*	*			*	*	*	*													
	LOCA POOL SWELL LOADS (TRANSIENT PRES, ETC)	P_{PS}																									*			*	*				
	CHUGGING PRESSURE LOADS	P_{CH}							*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			*					*	*
	CONDENSATION OSSILATION PRES. LOADS	P_{CO}																										*				*	*		
	LOAD COMBINATION NUMBER:		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
EXTERNAL MC VESSELS	TORUS SHELL																																		
	GENERAL		B	B	B	C	3 (6)	4	3	3	28	29	28	29	25	25	25	25	28	29	28	29	28	29	28	29	B	25	25	B	C	28	29	28	29
	AT PENETRATIONS (1)		B	B	B	D																					C			C	D				
	AT TORUS SUPPORTS (2)		B	B	B	D																					C			C	D				
	AT PIPE SUPPORTS (2)		B	B	B	D																					C			C	D				
	AT SEISMIC RESTRAINTS (2)(3)		B	B	B	D																					C			C	D				
	RING GIRDER																																		
	GENERAL		B	B	B	C																					B			B	C				
	AT VENT HEADER SUPPORT ATTACH.(2)		B	B	C	D																					C			C	D				
	VENT PIPE-EXTERNAL																																		
	GENERAL		B	B	B	C																					B			B	C				
	VENT PIPE BELLOWS		B	B	B	C																					B			B	C				
	DRYWELL AT VENT PIPE (1)		B	B	C	D																					C			C	D				
	ATTACHMENT WELDS (INCLUDING SUPPORTS)(2)		B	B	B	C																					C			C	D				
EXTERNAL CLASS MC SUPPORTS	SUPPORT ASSEMBLY		B	B	B	C																					B			B	C				
	ATTACHMENT TO BUILDING		B	B	B	C																					B			B	C				
	SEISMIC RESTRAINTS (ALL)		B	B	B	C			▼	▼	▼				▼	▼			▼		▼						B			B	C				
EXTERNAL PIPING	ESSENTIAL PIPING																																		
	GENERAL																																		
	NOZZLE WELDS (4)																																		
	ATTACHMENT WELDS (2)(4)																																		
	NONESSENTIAL PIPING																																		
	GENERAL																																		
	NOZZLE WELDS (4)																																		
	ATTACHMENT WELDS (2)(4)																																		
EXTERNAL PIPING SUPPORTS	ESSENTIAL SYSTEM (5)																																		
	NON-ESSENTIAL (5)																																		
INTERNAL MC VESSELS	VENT PIPE AND VENT HEADER																																		
	GENERAL		B	B	B	D				3	28				25	25			28		28						C			C	D				
	AT PENETRATIONS (1)		B	B	B	D																					C			C	D				
	POOL SWELL IMPINGEMENT REGION		N/A	N/A	N/A	N/A																					D			D	D				
	ATTACHMENT WELDS (2)(4)		B	B	B	D																					C			C	D				
	DOWNCOMERS																																		
	GENERAL		B	B	B	D																					C			C	D				
	AT PENETRATIONS (1)		B	B	B	D																					C			C	D				
	POOL SWELL IMPINGEMENT REGION		N/A	N/A	N/A	N/A																					D			D	D				
	ATTACHMENT WELDS (2)(4)		B	B	B	D																					C			C	D				
INTERNAL MC SUPPORTS	VENT HEADER SUPPORT COLUMNS		B	B	B	D																					C			C	D				
	VENT HEADER STIFFENING RING		B	B	B	D																					C			C	D				
	ATTACHMENT WELDS (4)		B	B	B	D			▼	▼	▼				▼	▼			▼		▼						C			C	D				
INTERNAL PIPING	ESSENTIAL PIPING																																		
	GENERAL																																		
	ATTACHMENT WELDS (2)(4)																																		
	NOZZLE WELDS (4)																																		
	NONESSENTIAL PIPING																																		
	GENERAL																																		
	ATTACHMENT WELDS (2)(4)																																		
	NOZZLE WELDS (4)																																		
INTERNAL PIPING SUPPORTS	ESSENTIAL SYSTEMS (5)																																		
	NON-ESSENTIAL (5)																																		
PUMPS AND VALVES	ACTIVE, INCLUDING VACUUM BREAKERS																																		
	INACTIVE																																		
INTERNAL STRUCTURES	SUBMERGED		B	B	B	D	↑	↑	3	3	28	↑	↑	↑	D	D	D	D	28	↑	28	↑	↑	↑	↑	↑	E	↑	↑	E	E	↑	↑	↑	↑
	NON-SUBMERGED		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	D	N/A	N/A	E	E	N/A	N/A	N/A	N/A

PRELIMINARY

MARK I CONTAINMENT PROGRAM

STRUCTURAL ACCEPTANCE
CRITERIA

REVISION 0, JUNE 13, 1977

PLANT UNIQUE ANALYSIS
APPLICATION GUIDE

COMPONENT - LOADINGS -
SERVICE LIMIT

SERVICE LIMITS
LETTER SYMBOLS:

A. SERVICE LIMIT A - NO EVALUATION REQUIRED.
B. SERVICE LIMIT B.
C. SERVICE LIMIT C.
D. SERVICE LIMIT D.
E. STRESSES MAY EXCEED SERVICE LIMIT D. IF THEY DO, FAILURE MUST BE ASSUMED AND ABSENCE OF DAMAGED TO OTHER STRUCTURAL ELEMENTS DEMONSTRATED.
F. IN ADDITION TO THE STATED LIMIT, FUNCTIONAL ADEQUACY MUST BE DEMONSTRATED.

NOTES:

1. AT PENETRATIONS - WITHIN A RADIUS EQUAL TO THE PENETRATION DIAMETER.
2. AT SUPPORTS AND ATTACHMENTS - WITHIN A DISTANCE FROM THE SUPPORT EQUAL TO 16 TIMES THE SHELL THICKNESS AT THAT POINT.
3. AS APPLICABLE.
4. IN EVERY CASE AN ATTACHMENT WELD TO A PRESSURE BOUNDARY COMPONENT IS PART OF THAT PRESSURE BOUNDARY COMPONENT UNLESS THE WELD IS A PIPING CONNECTION. WELDS CONNECTING THE NOZZLE OR PIPING TO THE SHELL WHICH ARE WITHIN THE LIMIT OF REINFORCEMENT ARE CLASS MC WELDS. WELDS OUTSIDE THE LIMIT OF REINFORCEMENT ARE PIPING WELDS. IN THE GENERAL CASE, WELDS CONNECTING ELEMENTS WITH DIFFERENT SERVICE LEVELS WILL BE CONTROLLED BY THE WELD REQUIREMENTS OF THE ELEMENT WITH THE MORE RESTRICTIVE REQUIREMENTS.
5. FUNCTIONABILITY OF ACTIVE SUPPORT COMPONENTS MUST BE DEMONSTRATED.
6. N INDICATES THE SAME SERVICE LEVEL ▼ LIMITS AS SPECIFIED FOR LOAD COMBINATION NUMBER N.
7. SECOND ACTUATION OF A SINGLE VALVE OR SIMULTANEOUS OF TWO ADJACENT VALVES.