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AUTH.NAME AUTHOR AFFILIATION
VAN BRUNT,E.E. Arizona Public Service Co.
RECIP.NAME RECIPIENT AFFILIATION
TEDESCO,R.L. Assistant Director for Licensing

SUBJECT: Forwards responses to Mechanical Engineering Branch 810622 draft SER,App A,input.Tech Specs will include limiting condition for operation re limiting leakage from RCS pressure isolation valve.Notes from meeting w/NRC encl.

See Rpts

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	EMRG PRP DEV 35	1	1	EMRG PRP LIC 36	3	3
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September 2, 1981
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U.S. NUCLEAR REGULATORY COMMISSION

Mr. R. L. Tedesco
Assistant Director for Licensing
Division of Licensing
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Palo Verde Nuclear Generating Station
(PVNGS) Units 1, 2 and 3
Docket Nos. STN-50-528/529/530
File: 81-056-026, G.1.10

Reference: (A) Letter from R. L. Tedesco to E. E. Van Brunt, Jr. dated June 22, 1981, Subject: Draft Mechanical Engineering Input to Palo Verde SER
(B) Letter from W. H. Wilson to E. E. Van Brunt, Jr. dated August 28, 1981 B/ANPP-E-78216, Subject: Conference Notes From Meeting With NRC's MEB.

Dear Mr. Tedesco.

Attached please find responses to the MEB draft SER Appendix A transmitted by Reference (A). An informal submittal of responses and meeting notes was forwarded to the NRC on 7/31/81.

Reference (B) attached includes the final meeting notes along with revised responses to the draft SER open items discussed at the meeting held on July 14-16, 1981. Section 2 of the conference notes shows six open items on the PVNGS FSAR from the MEB Draft SER, the remaining items have been satisfactorily resolved. These open items are addressed as follows:

Open Item From Conference Notes	Subject	Date To Be Resolution/Forwarded
2a (Item #3)	Justification For Using 1.2 K Factor in Stress Calculations	Response Given In Conference Notes
2b (Item #32)	Postulated Break Locations For Non-Seismic Piping	12/81
2c (Item #48)	Acceptance Criteria for Steady State Vibrational Testing on Piping	12/81
2d (Item #20)	Static Analysis on Closed Discharge Systems	Response Given in Conference Notes

B001 S 1/1

Open Item From Conference Notes	Subject	Date to be Resolution/Forwarded
2e (Item #21/22)	Results of U-Strap Testing Program	Forward to NRC When Testing is Completed
2f (Item #53,54,55,56)	Leak Rate Testing of RCS Pressure Isolation Vanes	Response Included

The response to Item 2F from the Conference Notes (Item 53,54,55, and 56 from MEB MTG) is as follows:

QUESTION: (MEB SER ITEMS 53,54,55,56, Section 3.9.6)

There are several safety systems connected to the reactor coolant pressure boundary that have design pressure below the rated reactor coolant system (RCS) pressure. There are also some systems which are rated at full reactor pressure on the discharge side of pumps but have pump suction below RCS pressure. In order to protect these systems from RCS pressure, two or more isolation valves are placed in series to form the interface between the high pressure RCS and the low pressure systems. The leak tight integrity of these valves must be ensured by periodic leak testing to prevent exceeding the design pressure of the low pressure systems thus causing an inter-system LOCA.

Pressure isolation valves are required to be category A or AC per IWV-2000 and to meet the appropriate requirements of IWV-3420 of Section XI of the ASME Code except as discussed below.

Limiting Conditions for Operation (LCO) are required to be added to the technical specifications which will require corrective action i.e., shutdown or system isolation when the final approved leakage limits are not met. Also surveillance requirements, which will state the acceptable leak rate testing frequency, shall be provided in the technical specifications.

Periodic leak testing of each pressure isolation valve is required to be performed at least once per each refueling outage, after valve maintenance prior to return to service, and for systems rated at less than 50% of RCS design pressure each time the valve has moved from its fully closed position unless justification is given. The testing interval should average to be approximately one year. Leak testing should also be performed after all disturbances to the valves are complete, prior to reaching power operation following a refueling outage, maintenance and etc.

The staff's present position on leak rate limiting conditions for operation must be equal to or less than 1 gallon per minute for each valve (GPM) to ensure the integrity of the valve, demonstrate the adequacy of the redundant pressure isolation function and give an indication of valve degradation over a finite period of time. Significant increases over this limiting valve would be an indication of valve degradation from one test to another.

Leak rates higher than 1 GPM will be considered if the leak rate changes are below 1 GPM above the previous test leak rate or system design precludes measuring 1 GPM with sufficient accuracy. These items will be reviewed on a case by case basis.

The Class 1 to Class 2 boundary will be considered the isolation point which must be protected by redundant isolation valves.

In cases where pressure isolation is provided by two valves, both will be independently leak tested. When three or more valves provide isolation, only two of the valves need to be leak tested.

Provide a list of all pressure isolation valves included in your testing program along with four sets of Piping and Instrument Diagrams which describe your reactor coolant system pressure isolation valves. Also discuss in detail how your leak testing program will conform to the above staff position.

RESPONSE

PVNGS Operations plans to conduct periodic testing of the pressure isolation valves indicated below:

1. Loop 1A RC/S1 Check SIV237
2. Loop 1B RC/SI Check SIV247
3. Loop 2A RC/SI Check SIV217
4. Loop 2B RC/SI Check SIV227
5. Loop 1A SIT check SIV235
6. Loop IB SIT Check SIV245
7. Loop 2A SIT CHeck SIV215
8. Loop 2B SIT Check SIV225
9. Loop 1A SI Header Check SIV542

RESPONSE (Cont'd)

10. Loop 1B SI Header Check SIV543

11. Loop 2A SI Header Check SIV540

12. Loop 2B SI Header Check SIV541

13. Loop 1 HP Long Term Recirculation Check SIV522

14. Loop 1 HP Long Term Recirculation Check SIV523

15. Loop 2 HP Long Term Recirculation Check SIV532

16. Loop 2 HP Long Term Recirculation Check SIV533

Adequate test connections have been provided to facilitate testing of the above listed valves.

Surveillance Requirements will be included in the Technical Specifications to verify leakage is within limits:

- prior to reaching power operation following a refueling outage
- prior to returning the valve to service following maintenance, repair or replacement work on the valve
- following valve actuation due to system response to an engineered safety feature actuation signal

The Technical Specifications will include a Limiting Condition For Operation to address the NRC's present position to limit leakage from any reactor coolant system pressure isolation valve to 1 gallon per minute (GPM). Leak rates higher than 1 GPM will be considered acceptable if the leak rate changes are below 1 GPM above the previous test leak rate or system design precludes measuring 1 GPM with sufficient accuracy.

The Class 1 to Class 2 boundary will be considered the isolation point which must be protected by redundant isolation valves.

Where pressure isolation is provided by two valves, both will be leak tested. When three or more valves provide isolation, only two of the valves will be leak tested.

The four sets of P&ID's have previously been given to the NRC during the working meeting. Procedures for leak testing of these valves will be available on-site for NRC Review 60 days prior to fuel load of Unit One.

This item was also discussed in NRC Question No. 440.3 from the RSB. Our response to that question was forwarded to the NRC in a letter to R. L. Tedesco from E. E. Van Brunt dated August 28, 1981, ANPP-18786.

Please contact me if you have any other questions on these matters.

Very truly yours,

E. E. Van Brunt

E. E. Van Brunt, Jr.
APS Vice President,
Nuclear Project
ANPP Project Director

EEVBJr/KEJ/bj

Attachments

cc: J. Kerrigan (w/a)
J. Wermiel (w/a)
P. Hourihan (w/a)
A. C. Gehr (w/a)

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, Edwin E. Van Brunt, Jr., represent that I am Vice President Nuclear Projects of Arizona Public Service Company, that the foregoing document has been signed by me on behalf of Arizona Public Service Company with full authority so to do, that I have read such document and know its contents, and that to the best of my knowledge and belief, the statements made therein are true.

Edwin E. Van Brunt

Edwin E. Van Brunt, Jr.

Sworn to before me this 2nd day of September, 1981.

Connie Lou Armstrong
Notary Public

My commission expires:

June 24, 1983

'81 SEP -2 A8:53

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Bechtel Power Corporation

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B/ANPP-E-78216
MOC 163550
August 28, 1981

Arizona Nuclear Power Project
P.O. Box 21666 - Mail Station 3003
Phoenix, Arizona 85036

Attention: Mr. Edwin E. Van Brunt, Jr.
APS Vice President, ANPP Project Director

Subject: Arizona Nuclear Power Project
Bechtel Job 10407
ANPP Conference Notes No. CN-E-883
File: D.4.02.1

Dear Mr. Van Brunt:

Enclosed are five (5) copies of ANPP Conference Notes for the meeting held at Downey, California, July 14 through 16, 1981.

Very truly yours,

BECHTEL POWER CORPORATION

W. H. Wilson
Project Manager
Los Angeles Power Division

NB:pb

Enclosure: ANPP Conference Notes No. CN-E-883
(207 pages, 5 copies)

cc: F. W. Hartley w/encl.
D. B. Fasnacht w/encl.

Arizona Nuclear Power Project
Bechtel Job 10407
Date: August 27, 1981
File: D.4.02.1

ANPP CONFERENCE NOTES NO. CN-E-883

DATE OF MEETING: July 14 through 16, 1981

LOCATION: Downey, California

ATTENDEES:

ANPP	Bechtel	NRC	C-E	ETEC
*J. Allen	N. Baldasari	R. Bosnak	*M. Barnoski	*J. Prevost
K. Jones	*M. Contaoi	*J. Kerrigan	*L. Gerdes	
R. Kramer	*R. Gavankar	H. Brammer (MEB)	*T. Natan	
*C. Rogers	*O. Gurbuz	D. Terao (MEB)		
M. Winsor	*R. Johnson	G. Beeman (PNL)		
	D. Keith	R. Stephens (PNL)		
	G. Kopchinski			
	*R. Pachnanda			
	*R. Peters			
	*K. Schechter			

* Part time.

SUBJECT: MEB Draft SER

PURPOSE: Working meeting to resolve questions and provide requested information.

1. Discussion of Items Carried Over from MEB Draft SER on CESSAR:

   A. Include a table of modal damping values in PVNGS FSAR. (Bechtel ACTION).

   B. Question: At what actual deflection will the PVNGS load limiting device go solid?

      The calculated deformation of the reactor vessel lower key load limiting device under combined SSE and pipe rupture loads is less than 0.285 inches. This is 71 percent of the specified minimum deformation for the device.

      The minimum allowable load which the reactor vessel lower key can withstand is 2380 kips (key to vessel wall juncture).

   C. Reactor load limiting device test results to be included in CESSAR. (C-E ACTION)

   D. Provide values of RCS deformation under ASME allowable loadings. (C-E ACTION)

E. Provide discussion of acceptability for exceeding 110% of design pressure on the main feedwater system. (NRC memo, P. Check to J. Knight, 7/8/81) (C-E ACTION)

2. MEB Draft SER Open Items on PVNGS FSAR

A. Question:

What is the basis for the 1.2 factor used in the calculation of total longitudinal stress as discussed in MEB SER Item 3 of Appendix D?

Provide examples of when this factor is used.

Response:

The basis for K = 1.2 is Table NC 3218-1. This factor is used to evaluate ASME Class 2 and 3 integral piping attachments.

B. Question:

MEB's position on postulating breaks in nonseismic high energy piping is that breaks shall be assumed at the worst locations (whether or not a fitting is at that location). Does PVNGS comply with this position? (If yes, revise MEB SER Item 32 as appropriate.)

Response:

PVNGS is performing analyses of the effects of auxiliary steam line pipe breaks in the auxiliary building. PVNGS will review, and either defend or revise its current position upon completion of the analyses. A formal response will be submitted by December 1981.

C. Question:

What is PVNGS' criteria for acceptable results of steady state vibration testing?

Response:

PVNGS' criteria for acceptable results of steady state vibration testing are undergoing review. A response will be provided in a future FSAR Amendment.

D. If static analysis is performed on closed discharge systems, additional justification will be provided as discussed in amended FSAR Section 3.9.3.3. (Bechtel ACTION)

E. The results of U-strap testing program discussed in Item 21/22 will be forwarded to the NRC when the testing is completed. (Bechtel ACTION)

F. Items #53, 54, 55, 56 to be provided by APS following technical specification review.

G. The other responses to questions were accepted/revised at the meeting. A copy of the responses is provided as Appendix D.

3. ACTION ITEM SUMMARY

Item	Responsibility			Due Date	Comments
	ANPP	Bechtel	C-E		
1.A		X		N/A	Attached to Conference Notes as Appendix A.
1.C			X		
1.D			X		
1.E			X		
2.B		X		12/81	
2.C	X				
2.E		X			To be forwarded to NRC upon completion of testing.
2.F	X				

Recorded by: N. Baldasari
N. Baldasari

Reviewed by: A ... /fr
W. G. Bingham

WGB:NB:pb

Attachments:
(A) Agenda - MEB Draft SER Meeting (1 page)
(B) Appendix A - Response to Item 1A (13 pages)
(C) Appendix B - C-E Deformation Study (9 pages)
(D) Appendix C - NRC memo "Request Assessment of Acceptability for Exceeding 110% Design Pressure for PWR's" (5 pages)
(E) Appendix D - PVNGS NRC Questions: Mechanical Engineering (176 pages)

AGENDA - MEB Draft SER Meeting - 7/14/-7/16/81

I CESSAR OPEN ITEMS

1. NSSS Seismic Analysis
2. Comparison of PVNGS vs C-E Specification for Components and Supports
3. Load Limiting Device
4. Discussion of RCS 100 sq. inch Inlet Break
5. CEDM Maximum Calculated moments/stresses
6. Deformation of RCS Under ASME Maximum Allowable

II INTERFACE DOCUMENTS (Bechtel - C-E)

III WALKTHROUGH/REVIEW OF THREE DIMENSIONAL PVNGS SCALE MODEL

IV PVNGS QUESTIONS AND RESPONSES

APPENDIX A

Response to Item 1A of Conference Notes CN-E-883

Torsional effects are accounted for directly in the modeling for other subsystem analysis similar to the approach discussed in Section 3.7.2 and in Appendix C of BC-TOP-4-A.

3.7.3.12 Buried Seismic Category I Piping Systems and Tunnels

Section 6.0 of BC-TOP-4-A discusses the techniques used to calculate the stresses from seismic loadings for buried seismic piping. The buried Seismic Category I piping is designed to remain functional when subjected to seismic loads. This is accomplished by limiting the calculated stresses in the pipe material under loading combinations, including earthquake.

3.7.3.13 Interaction of Other Piping with Seismic Category I Piping

The techniques used to consider the interaction of Seismic Category I piping with non-Category I piping are described in BP-TOP-1.

3.7.3.14 Seismic Analyses for Reactor Internals

Refer to CESSAR Section 3.7.3.14 for NSSS seismic subsystems.

3.7.3.15 Analysis Procedure for Damping

3.7.3.15.1 NSSS Seismic Systems

Composite modal damping values are used in analyzing the major components of the reactor coolant system using a reactor coolant system model coupled with a model of the containment building with foundation springs. 5

The composite modal damping values are obtained in three steps. In the first step, the equivalent modal damping values for the fixed base model that consists of containment building

and reactor coolant system are calculated by the Mass Weighting Technique as described in Section 3.2 of BC-TOP-4A. In the second step, the complete coupled system damping matrix is formed by coupling the fixed base damping matrix and the soil impedances.[16] Finally, the composite modal damping values
5 for the coupled system are then calculated by assuming that normal modes exist in the classical sense which is equivalent to retaining the diagonal terms in the coupled system damping matrix in generalized coordinates.[17][18] The actual damping values used are contained in table 3.7-8A.

3.7.3.15.2 Systems Other Than NSSS

The analysis procedure for damping of Seismic Category I
5 subsystems is given in Section 3.2.1 of BC-TOP-4-A. The damping used in the analysis of piping systems is described in BP-TOP-1.

3.7.4 SEISMIC INSTRUMENTATION

3.7.4.1 Comparison with Regulatory Guide 1.12

Seismic instrumentation is provided on the basis of architect-engineer experience with seismic instrumentation used on other nuclear power plants and on the basis of currently available technology of equipment testing and qualification. In conformance with ANSI Standard N18.5, Section 4.4, only one complete set of seismic instrumentation as described below is provided for the site. Since the expected seismic response is the same for all units, one set of seismic instrumentation installed on Unit 1 meets the requirements of Regulatory Guide 1.12. The instrumentation program complies with Regulatory Guide 1.12 except as noted in section 1.8.

Table 3.7-8A

FREQUENCIES AND COMPOSITE MODAL DAMPING VALUES[a]
(Sheet 1 of 8)

Mode No.	Operating Basis Earthquake, (OBE)		Safe Shutdown Earthquake (OBE)		
	Frequency CPS	Composite Modal Damping Value	Frequency CPS	Composite Modal Damping Value	
1	1.735	1.1	1.668	11.5	
2	1.736	1.1	1.673	11.5	
3	1.877	10.4	1.740	2.3	
4	1.883	10.5	1.740	2.4	
5	3.266	63.8	3.266	63.8	
6	4.235	50.1	3.746	56.5	
7	4.249	49.8	3.762	56.3	
8	7.734	2.0	7.724	3.0	
9	7.858	1.0	7.858	2.0	5
10	10.060	5.4	9.981	9.3	
11	10.691	5.7	10.608	9.8	
12	12.018	32.6	10.792	36.4	
13	12.190	1.2	12.189	2.2	
14	12.500	1.0	12.500	2.0	
15	12.873	1.0	12.872	2.0	
16	12.876	1.1	12.874	2.0	
17	13.209	1.2	13.207	2.3	
18	13.857	1.7	13.851	2.9	
19	14.685	1.0	14.685	2.0	
20	14.743	1.1	14.741	2.1	
21	14.836	1.0	14.836	2.0	
22	14.858	1.1	14.857	2.1	
23	15.831	2.7	15.816	4.7	

a. Composite Modal Dampling Values are expressed as a percentage of critical modal damping.

Table 3.7-8A

FREQUENCIES AND COMPOSITE MODAL DAMPING VALUES[(a)]
(Sheet 2 of 8)

Mode No.	Operating Basis Earthquake (OBE)		Safe Shutdown Earthquake (OBE)	
	Frequency CPS	Composite Modal Damping Value	Frequency CPS	Composite Modal Damping Value
24	17.190	10.4	16.915	8.1
25	17.567	3.6	17.551	6.5
26	17.660	3.5	17.646	6.3
27	17.870	1.1	17.870	2.3
28	17.957	1.4	17.948	2.1
29	17.982	1.6	17.979	2.8
30	17.985	1.3	17.983	2.5
31	19.397	2.9	19.397	5.0
32	20.630	1.1	20.629	2.1
33	20.948	4.3	20.948	6.4
34	21.278	1.5	21.277	2.9
35	21.576	1.2	21.570	2.2
36	21.602	1.2	21.602	2.4
37	21.654	1.5	21.639	2.3
38	22.646	4.0	22.632	6.4
39	23.818	1.4	23.816	2.7
40	24.030	1.0	24.030	2.0
41	24.801	3.4	24.790	5.5
42	25.523	2.5	25.515	4.4
43	25.776	2.0	25.776	3.2
44	26.148	1.5	26.145	2.7
45	28.069	1.2	28.063	2.2
46	28.915	2.2	28.914	4.8
47	30.948	3.5	30.933	7.0
48	31.448	1.0	31.448	2.1
49	31.562	1.0	31.561	2.0

Table 3.7-8A

FREQUENCIES AND COMPOSITE MODAL DAMPING VALUES[a]
(Sheet 3 of 8)

Mode No.	Operating Basis Earthquake (OBE)		Safe Shutdown Earthquake (OBE)	
	Frequency CPS	Composite Modal Damping Value	Frequency CPS	Composite Modal Damping Value
50	31.930	1.0	31.930	2.0
51	31.970	1.2	31.969	2.3
52	32.327	1.0	32.317	6.6
53	32.333	3.8	32.327	2.0
54	34.204	2.4	34.201	5.4
55	34.226	2.5	34.223	5.5
56	38.536	1.1	38.536	2.2
57	38.542	1.0	38.542	2.0
58	38.598	1.2	38.597	2.4
59	38.716	1.0	38.716	2.0
60	40.817	3.7	40.813	6.3
61	41.536	1.0	41.535	2.1
62	45.848	1.1	45.848	2.2
63	46.469	2.1	46.468	5.0
64	46.645	2.2	46.644	5.2
65	47.415	1.0	47.415	2.0
66	47.451	1.0	47.451	2.0
67	47.752	1.0	47.752	2.0
68	48.040	2.6	48.040	5.6
69	48.069	1.0	48.069	2.0
70	50.883	1.0	50.883	2.0
71	51.105	1.0	51.105	2.1
72	51.188	1.0	51.188	2.0
73	51.581	2.2	51.580	3.9
74	52.502	1.0	52.502	2.0
75	52.510	1.0	52.510	2.0

5

Table 3.7-8A

FREQUENCIES AND COMPOSITE MODAL DAMPING VALUES[a]
(Sheet 4 of 8)

Mode No.	Operating Basis Earthquake (OBE)		Safe Shutdown Earthquake (OBE)	
	Frequency CPS	Composite Modal Damping Value	Frequency CPS	Composite Modal Damping Value
76	52.886	5.0	52.878	8.2
77	53.717	3.4	53.713	5.9
78	55.823	2.4	55.821	5.4
79	56.057	2.6	56.054	5.5
80	57.880	7.5	57.880	11.3
81	60.352	2.1	60.351	5.1
82	60.386	2.1	60.385	5.2
83	65.086	2.0	65.086	5.0
84	65.086	2.0	65.086	5.0
85	68.997	1.0	68.997	2.0
86	69.293	1.0	69.293	2.0
87	70.086	1.1	70.086	2.1
88	70.394	1.0	70.394	2.0
89	72.151	4.1	72.149	7.2
90	73.586	1.0	73.568	2.1
91	73.687	1.0	73.687	2.0
92	73.997	1.0	73.997	2.0
93	74.211	1.0	74.211	2.0
94	74.371	2.2	74.371	5.2
95	74.479	2.0	74.479	5.0
96	75.208	3.9	75.205	7.0
97	75.311	1.0	75.311	2.0
98	77.017	2.1	77.017	5.1
99	77.242	2.4	77.241	5.4
100	79.580	2.4	79.580	5.5
101	82.271	1.0	82.271	2.0

Table 3.7-8A

FREQUENCIES AND COMPOSITE MODAL DAMPING VALUES[a]
(Sheet 5 of 8)

Mode No.	Operating Basis Earthquake (OBE)		Safe Shutdown Earthquake (OBE)		
	Frequency CPS	Composite Modal Damping Value	Frequency CPS	Composite Modal Damping Value	
102	82.297	1.0	82.297	2.0	
103	82.756	1.1	82.756	2.2	
104	82.806	1.0	82.806	2.0	
105	87.271	2.3	87.270	5.3	
106	87.300	2.0	87.300	5.1	
107	87.732	4.2	87.729	7.4	
108	90.015	1.0	90.015	2.0	
109	90.019	1.0	90.019	2.0	
110	90.022	1.0	90.022	2.0	5
111	90.029	1.0	90.029	2.0	
112	91.225	2.0	91.225	5.0	
113	91.291	2.1	91.291	5.1	
114	96.475	4.3	96.473	7.4	
115	101.191	4.0	101.191	7.0	
116	104.724	4.0	104.724	7.0	
117	106.031	2.1	106.031	5.1	
118	108.968	4.0	108.967	7.0	
119	111.392	2.0	111.392	5.0	
120	111.437	2.1	111.437	5.1	
121	112.536	1.0	112.536	2.0	
122	112.642	1.4	112.642	2.6	
123	114.052	1.0	114.062	2.0	
124	114.474	1.0	114.474	2.0	
125	119.687	4.5	119.687	7.5	
126	124.152	1.0	124.152	2.0	
127	125.886	1.0	125.886	2.0	

Table 3.7-8A

FREQUENCIES AND COMPOSITE MODAL DAMPING VALUES[a]
(Sheet 6 of 8)

Mode No.	Operating Basis Earthquake (OBE)		Safe Shutdown Earthquake (OBE)	
	Frequency CPS	Composite Modal Damping Value	Frequency CPS	Composite Modal Damping Value
128	127.333	4.0	127.332	7.0
129	132.280	2.2	132.280	5.2
130	135.239	2.0	135.239	5.0
131	135.251	2.0	135.251	5.0
132	146.565	1.0	146.565	2.0
133	147.240	2.0	147.240	5.0
134	149.698	1.0	148.698	2.0
135	151.938	2.0	151.938	5.0
136	151.939	2.0	151.939	5.0
137	164.423	4.1	164.423	7.1
138	165.700	4.0	165.700	7.0
139	169.339	2.3	169.339	5.3
140	170.498	3.5	170.498	6.6
141	171.643	2.0	171.643	5.0
142	171.653	2.0	171.652	5.0
143	173.695	2.6	173.695	5.7
144	180.717	4.2	180.716	7.3
145	181.568	4.2	181.567	7.3
146	203.133	2.0	203.133	5.0
147	203.136	2.0	203.136	5.0
148	203.520	2.0	203.520	5.0
149	203.520	2.0	203.520	5.0
150	204.397	2.0	204.397	5.0
151	216.698	4.0	216.698	7.0
152	225.934	4.0	225.934	7.0
153	247.414	4.0	247.414	7.0

5

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Table 3.7-8A

FREQUENCIES AND COMPOSITE MODAL DAMPING VALUES[a]
(Sheet 7 of 8)

Mode No.	Operating Basis Earthquake (OBE)		Safe Shutdown Earthquake (OBE)	
	Frequency CPS	Composite Modal Damping Value	Frequency CPS	Composite Modal Damping Value
154	259.833	1.0	259.833	2.0
155	263.702	1.0	263.702	2.0
156	264.741	1.0	264.741	2.0
157	269.659	1.0	269.659	2.0
158	305.452	4.0	305.452	7.0
159	310.430	4.0	310.430	7.0
160	315.131	4.0	315.131	7.0
161	318.922	4.0	318.922	7.0
162	320.806	4.2	320.806	7.3
163	326.012	4.0	326.012	7.0
164	412.895	4.0	412.895	7.0
165	471.751	4.0	471.751	7.0
166	485.919	8.3	485.908	13.5
167	486.060	8.3	486.048	13.6
168	493.728	4.0	493.728	7.0
169	507.609	4.0	507.609	7.0
170	520.399	4.0	520.399	7.0
171	553.839	4.0	553.839	7.0
172	555.642	4.0	555.642	7.0
173	575.833	4.0	575.833	7.0
174	647.448	4.0	647.448	7.0
175	683.690	4.0	683.690	7.0
176	784.905	4.0	784.905	7.0
177	809.044	4.4	809.043	7.7
178	813.974	4.4	813.973	7.7
179	841.668	4.0	841.668	7.0

5

Table 3.7-8A

FREQUENCIES AND COMPOSITE MODAL DAMPING VALUES[a]
(Sheet 8 of 8)

5

Mode No.	Operating Basis Earthquake (OBE)		Safe Shutdown Earthquake (OBE)	
	Frequency CPS	Composite Modal Damping Value	Frequency CPS	Composite Modal Damping Value
180	894.070	4.0	894.070	7.0
181	1084.361	7.9	1084.361	13.1
182	1091.125	4.0	1091.125	7.0

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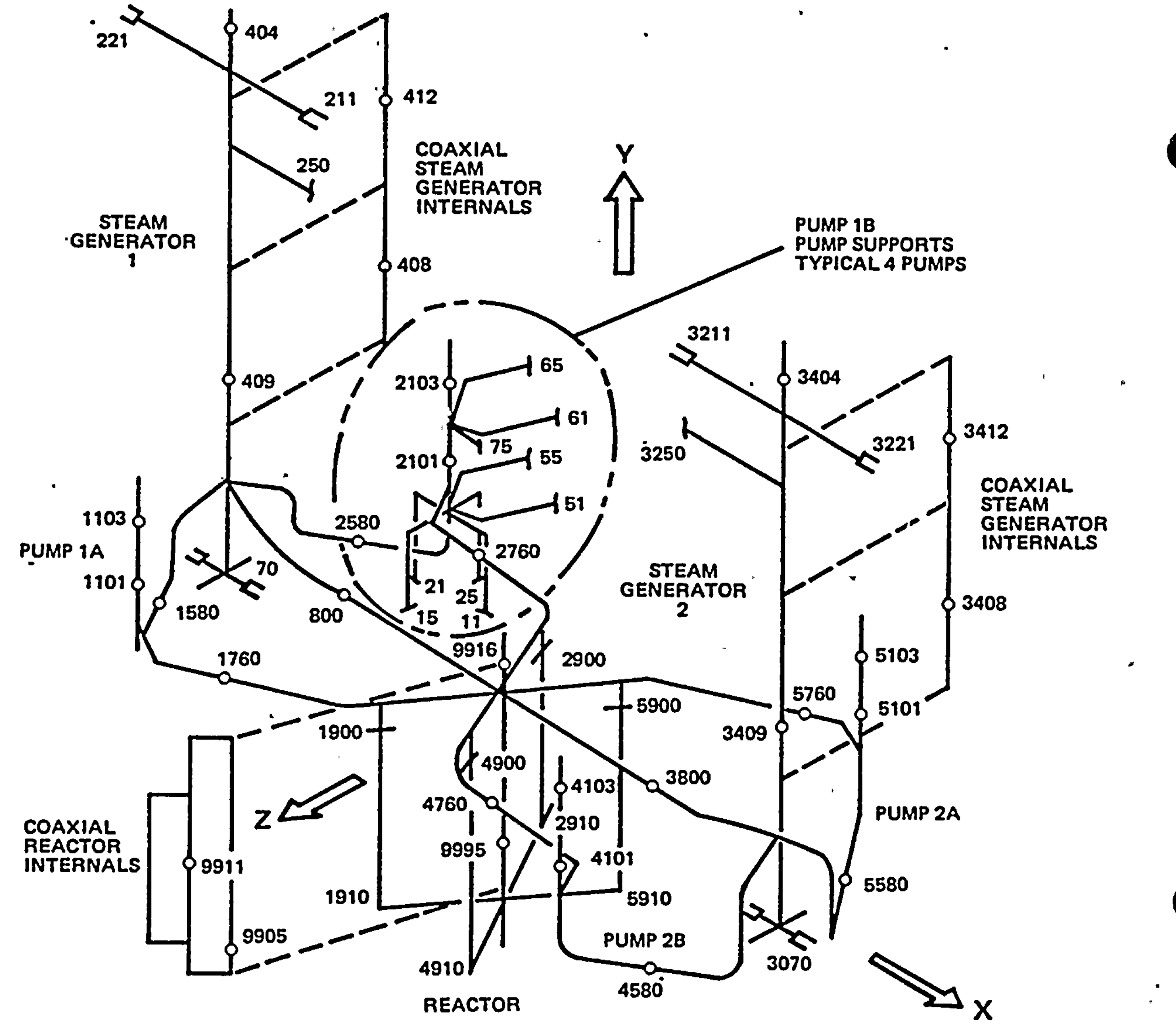
14. Jennings, P.E., and Bielak, J., "Dynamics of Building-Soil Interaction," Report No. EERL 71-04, Earthquake Engineering Research Laboratory, California Institute of Technology, April 1972.

15. Newmark, N.M., and Hall, W.J., "Development of Criteria for Seismic Review of Selected Nuclear Power Plants", NUREG/CR 0098, Section 7.7, p. 29, May 1978.

16. Pajuhesh, J., and Hadjian, A., "Damping Matrix for Component Structure and Foundation Interaction of Nuclear Power Facilities", Vol. K of 4th International Conference on SMiRT, August 1977.

17. Roesset, J., Whitman, F., and Dobry, R., "Modal Analysis for Structures with Foundation Interaction" presented at the ASCE National Structural Engineering Meeting, Cleveland, Ohio, April 24-28, 1972. 5

18. Thomson, W.T., Calkins, T., and Caravani, P., "A Numerical Study of Damping", Earthquake Engineering, No. 1/Vol. 3, July-September, 1974.



COMPONENT NAME	MASS POINT NUMBER	DEGREES OF FREEDOM
REACTOR	9916, 9911, 9905 9995	X, Y, Z X, Z
STEAM GENERATORS	404, 3404, 412, 3412 409, 3409 408, 3408	X, Y, Z X, Y X, Z
PUMPS	1103, 2103, 4103, 5103 1101, 2101, 4101, 5101	X, Y, Z X, Y, Z
REACTOR COOLANT PIPING	800, 3800 1760, 2760, 4760, 5760 1580, 2580, 4580, 5580	Y, Z X, Y, Z X, Y, Z

COMPONENT NAME	SUPPORT POINT NUMBER	RESTRAINT
REACTOR	1900, 2900, 4900, 5900 1910, 2910, 4910, 5910	FX, FZ FIXED
STEAM GENERATORS	70, 3070 250, 3250 211, 221 3211, 3221	FY, FZ FX FZ FZ
REACTOR COOLANT PUMPS (TYPICAL)	11, 15, 21, 25 51, 55, 61, 65 75	FY FX, FZ FX, FZ

Palo Verde Nuclear Generating Station
FSAR

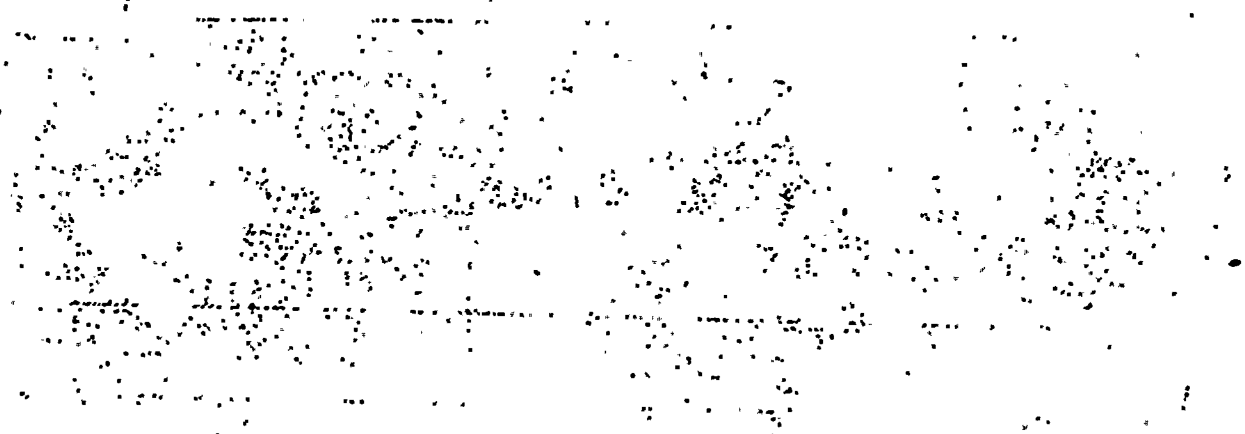
REACTOR COOLANT SYSTEM
SEISMIC ANALYSIS MODEL

Figure 3.7-9A

5

APPENDIX B

C-E Deformation Study



PALO VERDE

[illegible]

DYNAMIC ANALYSIS CASES ANALYZED

1. Elastic Analysis of longest and shortest nozzles for Hot Leg and Cold Leg Break.
2. Plastic Analysis of longest and shortest nozzles for Hot Leg Break.
3. Plastic Anlaysis of shortest nozzles for Cold Leg Break.
4. Plastic Analysis of shortest nozzle for Hot Leg Break and SSE.
5. Plastic Analysis of longest nozzle for Cold Leg Break and SSE.
6. Plastic Analysis of Intermediate nozzle for Cold Leg Break and SSE. (This produced the greatest bending moment).

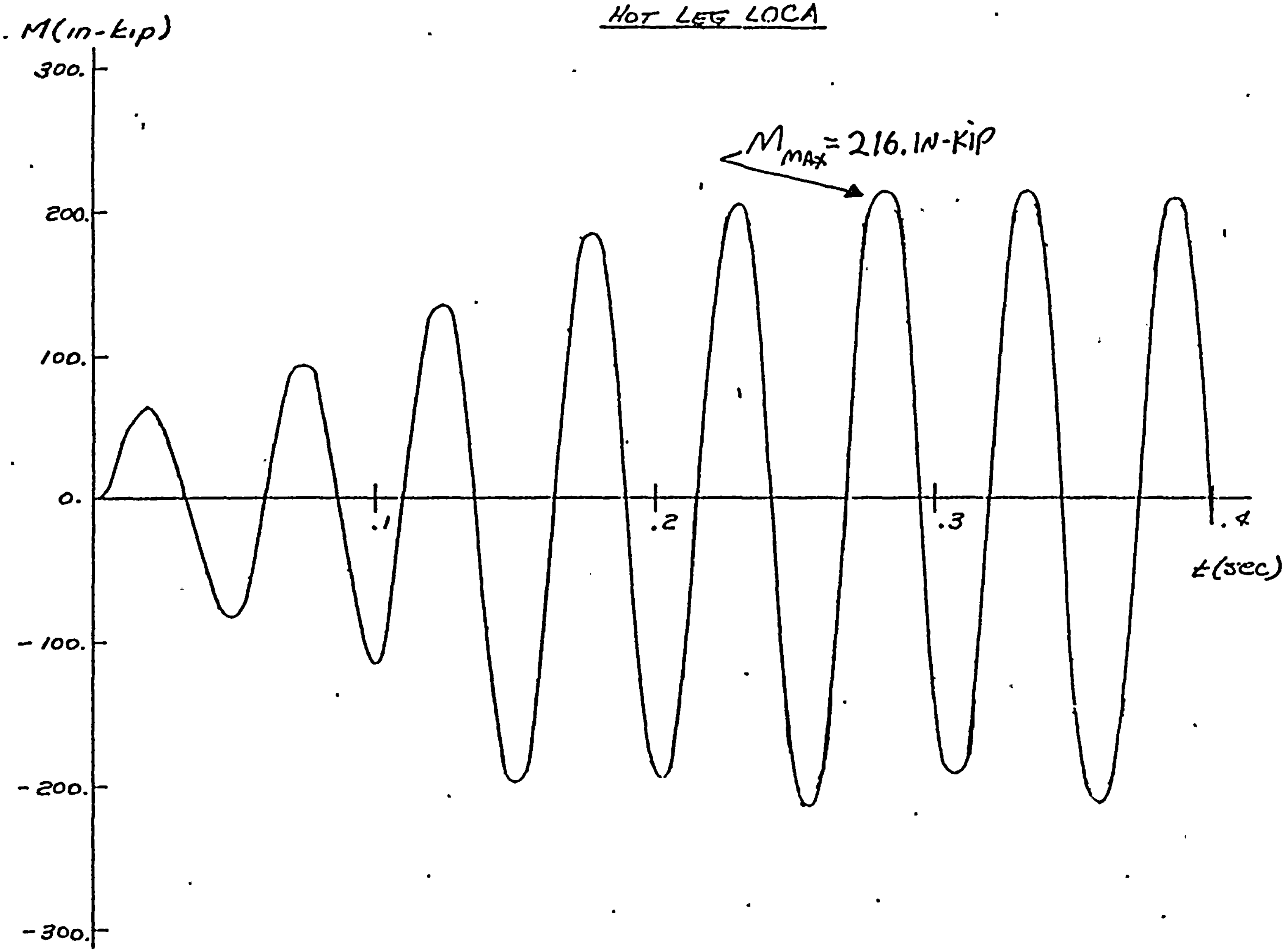
PALO VERDE CEDM

MOMENT VS TIME FOR LOCA CASE WITH MAXIMUM MOMENT

ELASTIC-PLASTIC RESPONSE

SHORT NOZZLE

HOT LEG LOCA



PREPARED	DATE	COMBUSTION ENGINEERING, INC. Chattanooga Nuclear Operations COMPONENT ENGINEERING.	SHEET OF
CHECKED	DATE		CALC. NO.
			CONTRACT NO.

TITLE ARIZONA I CEDM LOCA + SSE

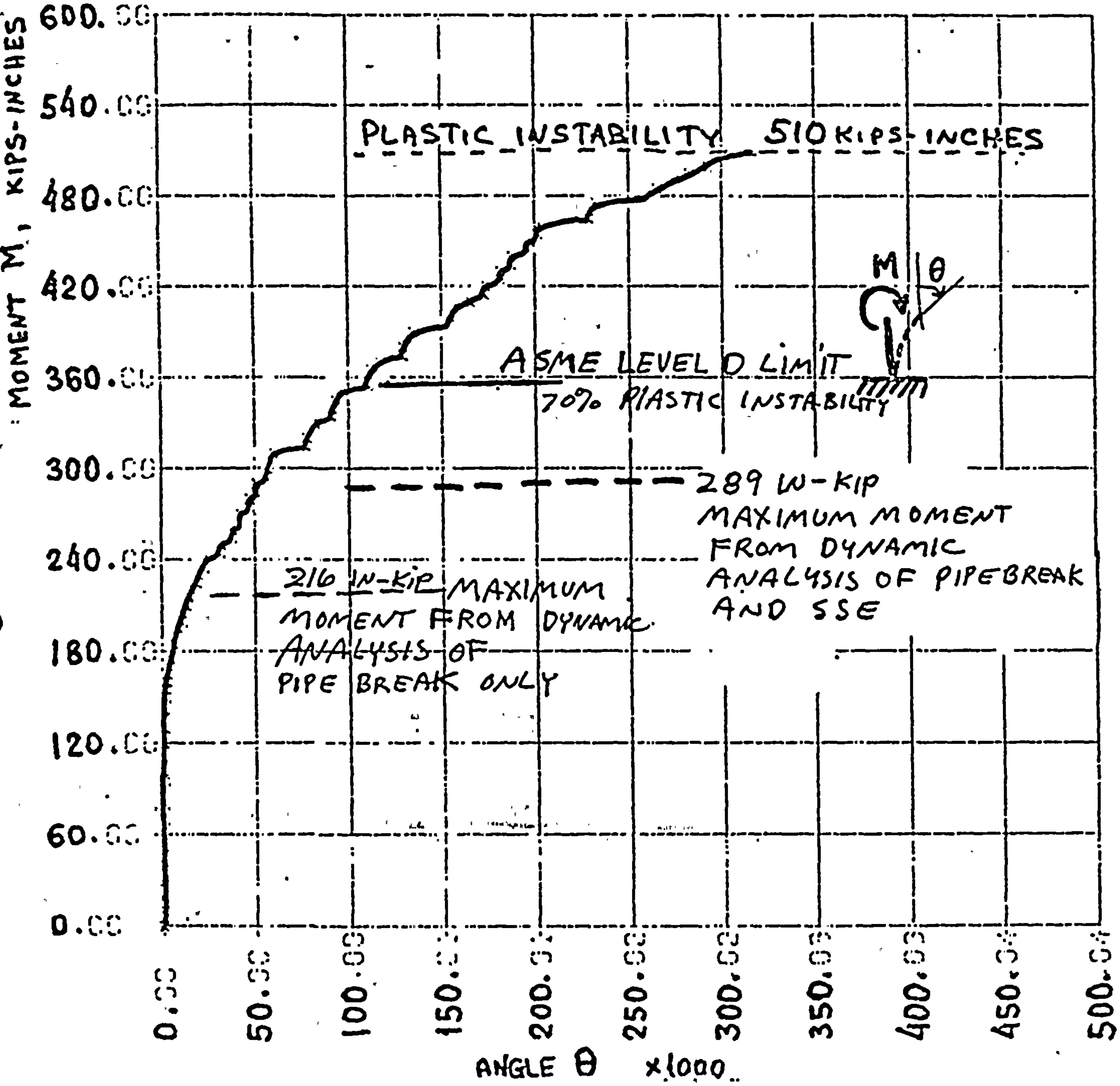
TABLE 1

NOZZLE LENGTH (IN)**	12.31	43.68	18.71		
LOADING	SSE+HLL	SSE+CLL	SSE+CLL		
BENDING MOMENT (IN-KIP)					
MAX.	286.2	251.1	262.8		
MIN.	-242.4	-247.2	-289.1		
STRESS - NOZ. (KSI)					
MAX.	37.6	37.8	45.0		
MIN	-35.5	-35.9	-42.8		
TOTAL STRAIN - NOZ. (%)					
MAX	0.25	0.26	0.37		
MIN	-0.21	-0.22	-0.34		
STRESS - UPR. HOUS. (KSI)					
MAX	21.2	48.3	25.9		
MIN	-13.8	-38.1	-18.5		
TOTAL STRAIN - UPR. HOUS.					
MAX	0.08	0.34	0.09		
MIN	-0.05	-0.26	-0.07		
MAX. DISPLACEMENTS					
NODE 9	*	.911	.216		
NODE 19	*	1.664	.790		
NODE 40	*	7.081	2.779		

* PRINTOUT LOST

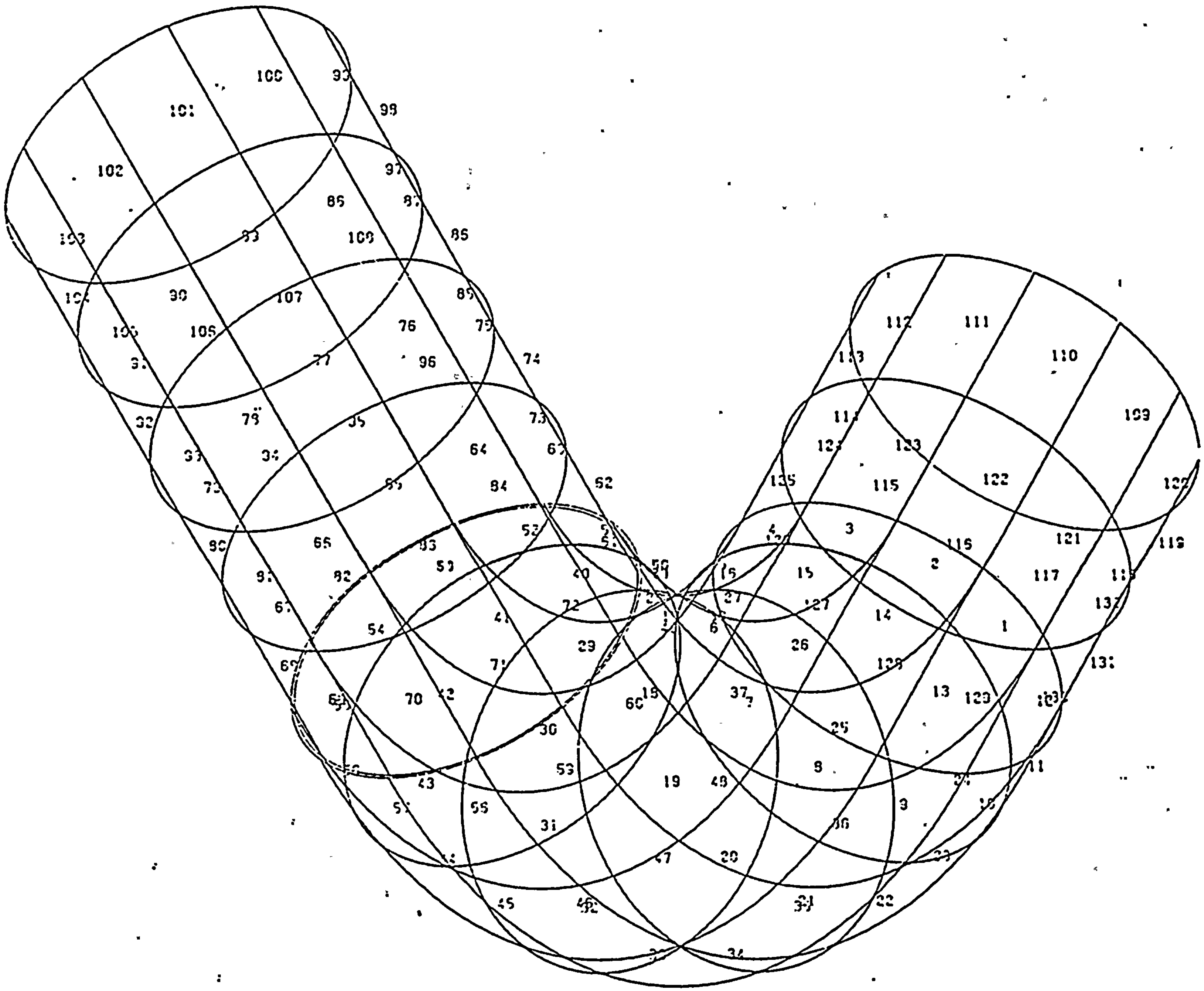
** INCLUDES 4.13" OF THREADS

REV.	DATE	BY	CHECK	REV.	DATE	BY	CHECK	REV.	DATE	BY	CHECK



PALO VERDE CEDM

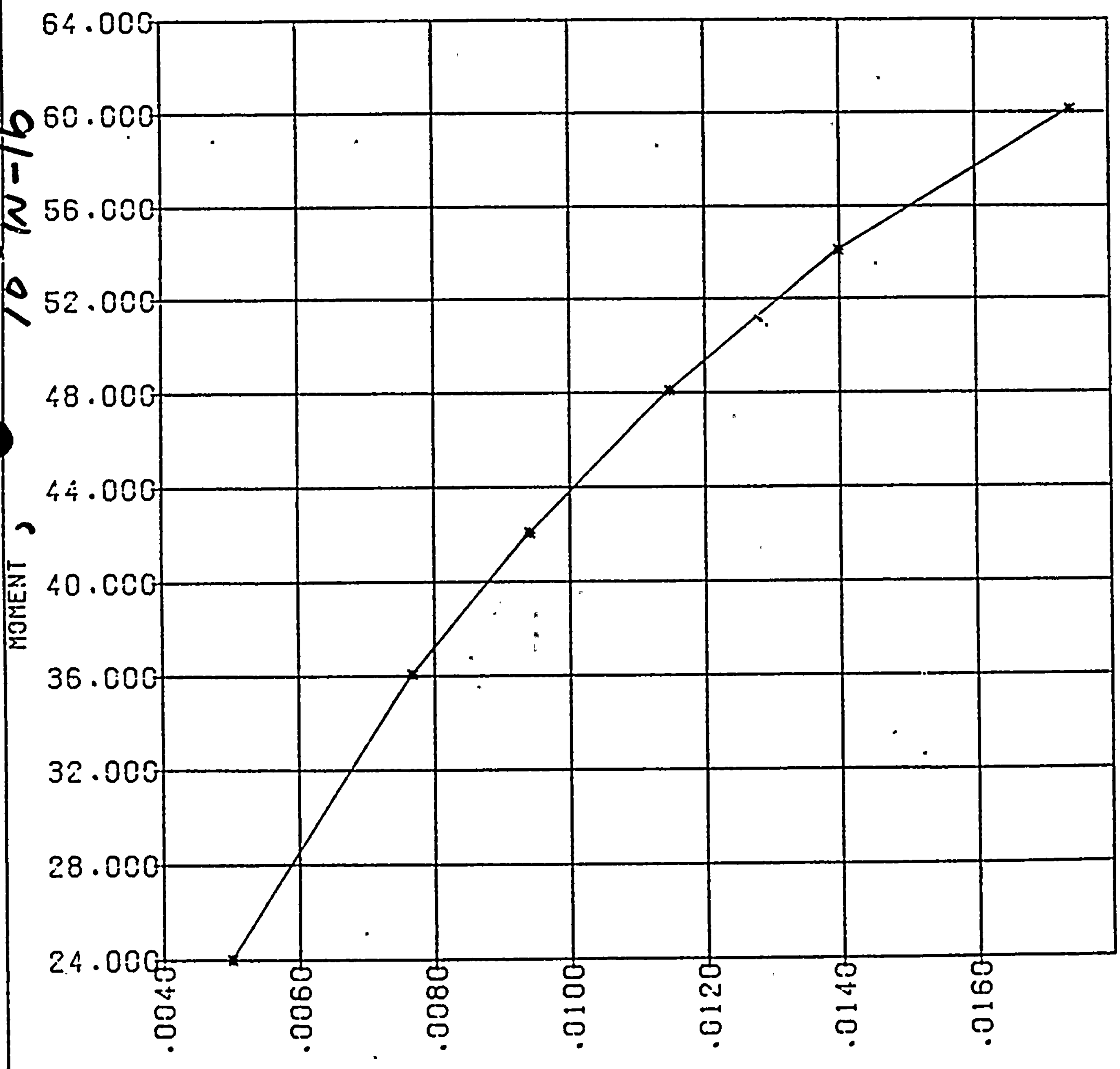
MOMENT CAPABILITY



SUCTION LEG ELBOW AT PUMP (SHELL ELEMENT)

SHELL (IN PLANE) 5 INC
TOTAL MOMENT

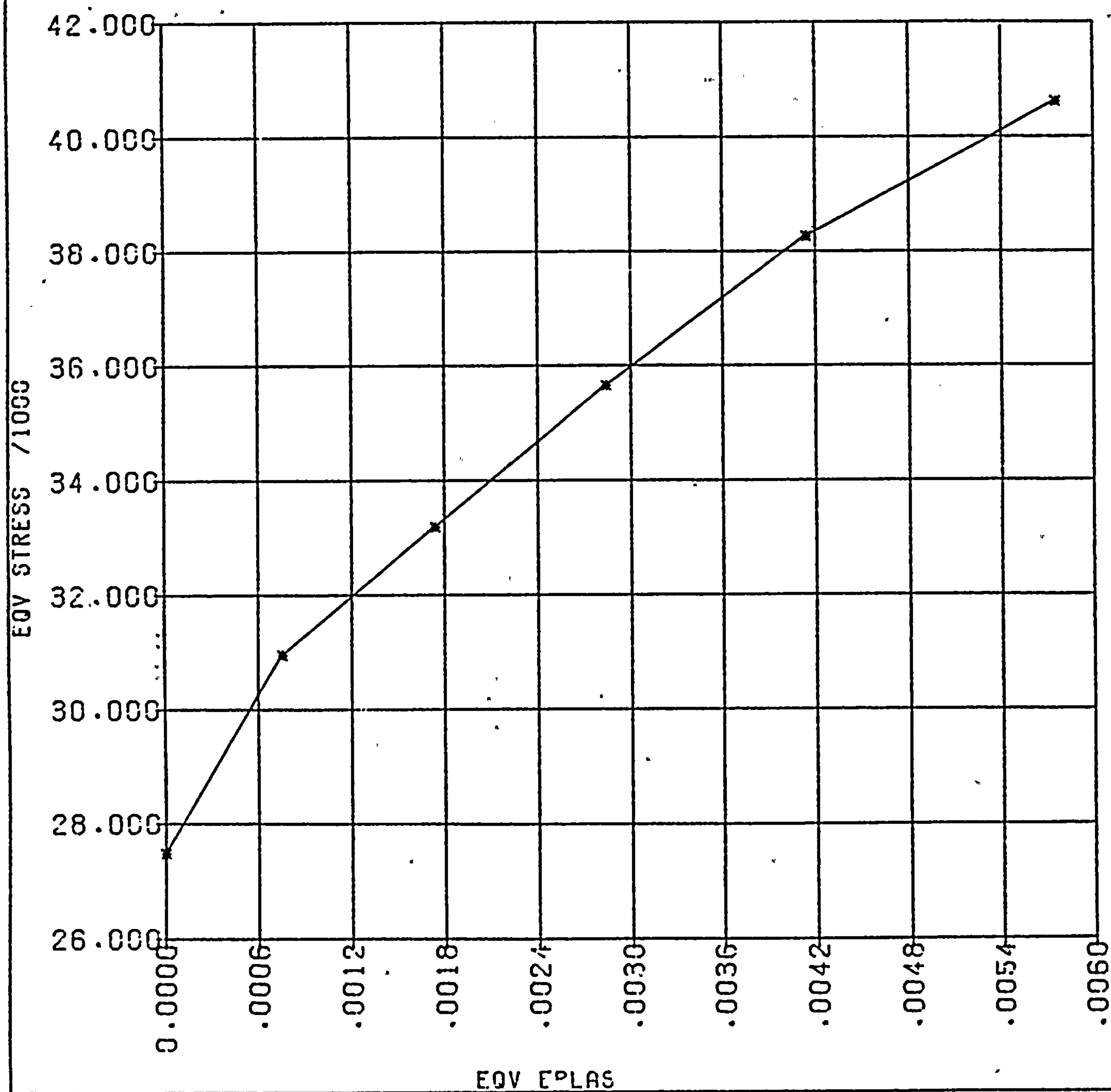
VERSUS
ROT AT NODAL PT 66 OR 72



DATA CREATED BY-
ULCCODX 07/06/81

DATA PLOTTED BY-
ULCCOL3 07/07/81

SHELL (IN PLANE) 5 INC
ELEM NUM INT NUM LAYER NUM
30 6 3
VERSUS
ELEM NUM INT NUM LAYER NUM
30 6 3



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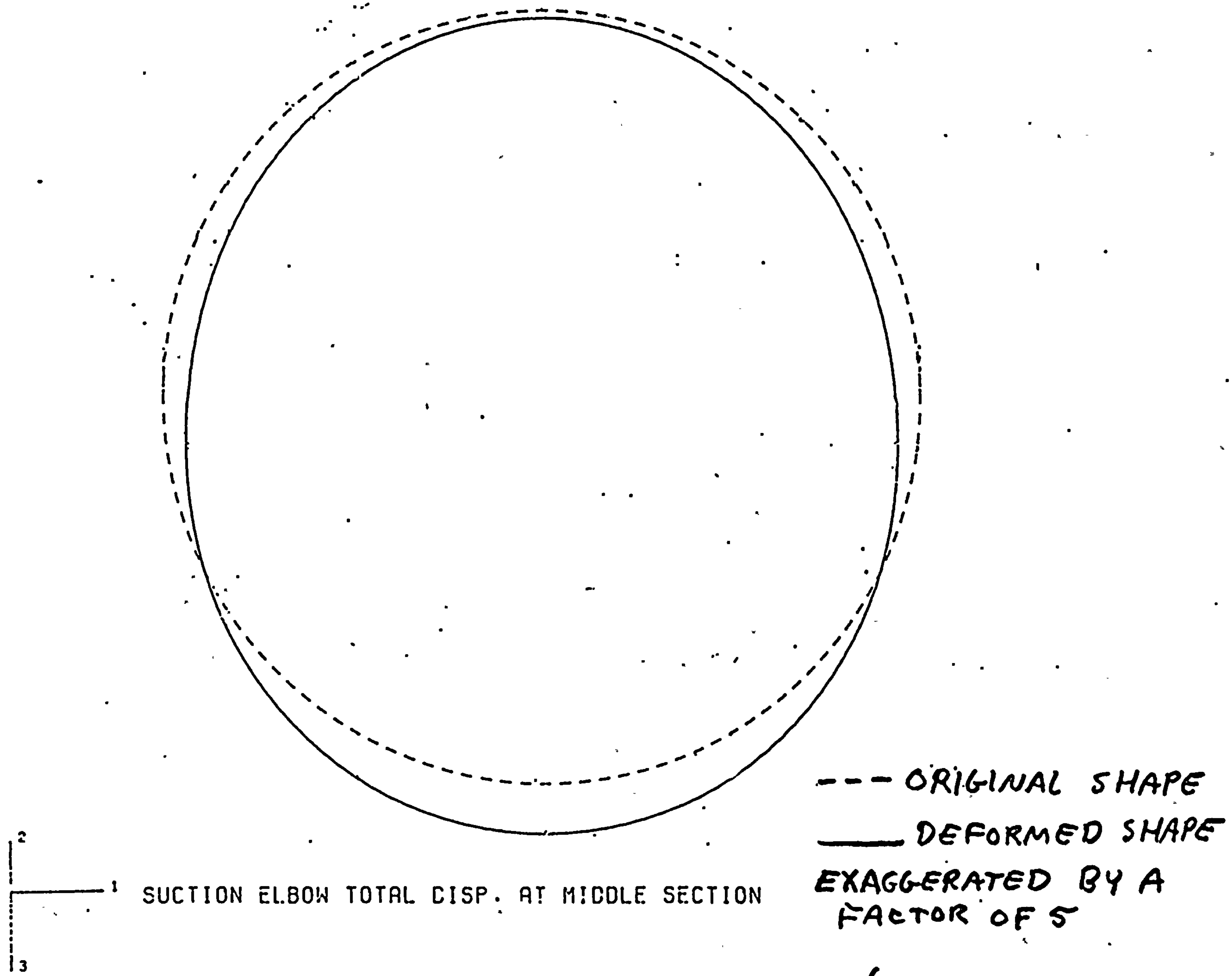
ULCCOE2 07/07/81



SUCTION ELBOW TOTAL DISP. AT MIDDLE SECTION

EFFECT OF MOMENT OF 60.2 X10^{6} IN-lb

APPENDIX C

NRC Memo:

"Request Assessment of Acceptability for Exceeding 110% Design Pressure for PWR's"