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格納容器圧力抑制系信頼性実証試験
データレポート・5 (TEST 2101)

1980年3月

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格納容器圧力抑制系信頼性実証試験
データレポート・5（TEST 2101）

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（1980年2月4日受理）

格納容器圧力抑制系信頼性実証試験は，LOCA時にBWR用Mark Ⅱ格納容器圧力抑制系に発生すると予想される熱水力現象に関する試験を行い，格納容器信頼性の実証に資するデータを得ることを目的としている。試験装置の体積縮小率は1/18であり，ウェットウェル部は実炉のウェットウェルの実物大20°セクタ模型である。

本報告は，昭和54年4月27日に実施したTEST 2101のデータ報告である。本試験は破断口径74mmの水放出試験であり，低蒸気流速時の蒸気凝縮振動（チャギング）の試験を主要な目的としている。得られたベント管内蒸気重量速度は最大約20 kg/m^2-sであった。

本試験計画は，電源開発促進対策特別事業の一環として科学技術庁より原研に委託されたものである。

本報告は先に作成した原研所内資料JAERI－memo 8402（1979年8月）の内容に検討・修正を加え公開に付するものである。

Full-Scale Mark II CRT Program
Data Report No. 5 (TEST 2101)

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(Received February 4, 1980)

The Full-Scale Mark II CRT (Containment Response Test) Program* was initiated in 1977 to provide a data base for evaluation of the LOCA hydrodynamic loads for the Mark II pressure suppression system. The test facility is 1/18 in volume and has a wetwell which is a full-scale replica of one 20°-sector of that of a reference Mark II.

This report documents test data obtained from TEST 2101, which is a medium size (74 mm) water break test performed on April 27, 1979. TEST 2101 was designed to roughly approximate an intermediate break accident in which so-called chugging phenomenon associated with low-flux steam condensation is anticipated to continue for a longer duration than in a large break accident.

Keywords : BWR, LOCA, Pressure Suppression, Mark II Containment, Hydrodynamic Loads, Chugging, Full-Scale Test, Data

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* Work performed under the auspices of the Atomic Energy Bureau, the Science and Technology Agency of Japan.

This report supersedes JAERI internal document JAERI-memo 8402 (August 1979).

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1. まえがき

格納容器圧力抑制系信頼性実証試験は，わが国の最新型沸騰水型炉に使用されているMark II格納容器における冷却材喪失事故時の熱水力現象を模擬した試験を行い，格納容器の信頼性実証に資するデータを得ることを目的としている。本試験計画は，電源開発促進対策事業の一環として，科学技術庁より原研に委託されたものであり，昭和５２年度を初年度として５年間にわたり実施される予定である。原研内では，安全工学部安全工学第Ｉ研究室が試験計画の立案および試験結果の解析を担当し，同安全試験技術室が試験装置の建設，運転，管理を担当している。試験装置は昭和５４年３月原研東海研究所敷地内に完成し，以後１カ月に約１回の割合で試験を実施している。

本報告は，昭和５４年４月２７日に実施したTEST 2101のデータ報告である。本試験は，破断口径74 mmの水放出試験であり，低蒸気流速時の凝縮振動現象（チャギング）の試験を主要な目的としている。本試験ではドライウェル内の空気が充分に排除されるまでに放出開始後約７０秒を要し，以後約300秒間にわたり種々の形態のチャギングが発生した。なお，次回の試験TEST 3101は同様な試験条件のもとで放出開始前にプリパージを行った試験であり，両者の比較によってプリパージが低蒸気流速時の凝縮振動にもたらす効果を知ることができる。

2. 試 験 装 置

試験装置の概略をFig.2.1に示す。試験装置主要部は試験格納容器，圧力容器，放出配管等により構成される。試験格納容器ウェットウェル部は，1100MWe級Mark Ⅱ格納容器のウェットウェルの中心角20°の1セクタを模擬したものであり，各部の高さ，内部のベント管等の寸法は実炉とほぼ同一である。ドライウェル，1次系の容積は，実炉の相当部分の約1/18である。これらの諸元をTable 2.1に示す。

本試験装置における計測の項目をTable 2.2に，計測チャンネルリストおよび計測点位置をTables 2.5～2.7およびFigs. 2.2～2.9に示す。データは2系統の収録装置によって収録する。比較的変化の遅い信号（温度，水位計出力等）は小型計算機により1チャンネルあたり50 data/sのサンプリング速度で収録する。一方，比較的変化の速い信号（圧力，歪，加速度等）はPCM（Pulse Code Modulation）方式により455.55 data/sのサンプリング速度で収録し，試験後，小型計算機を介してデータを再編集する。以後の処理はいずれも原研計算センターの大型計算機によって行う。データ収録装置の主要諸元をTable 2.3に示す。

本試験における計測器の動作状態をTables 2.8～2.10に，圧力・差圧変換器の較正係数をTable 2.11に，計測レンジの設定値をTable 2.12に示す。

本試験に際して生じた計測上の障害は以下の通りである。

ラプチャディスクの破断信号と実際の破断との間に若干の時間のずれがあった。本報告に示す図表は破断の時点を0秒としたものである。

格納容器内温度の計測レンジは最高約150℃に設定したが，試験の後半ではドライウェル内は過熱状態となり，1部のチャンネルでは150℃以上の温度が計測されたため，直流増幅器において信号が飽和した。

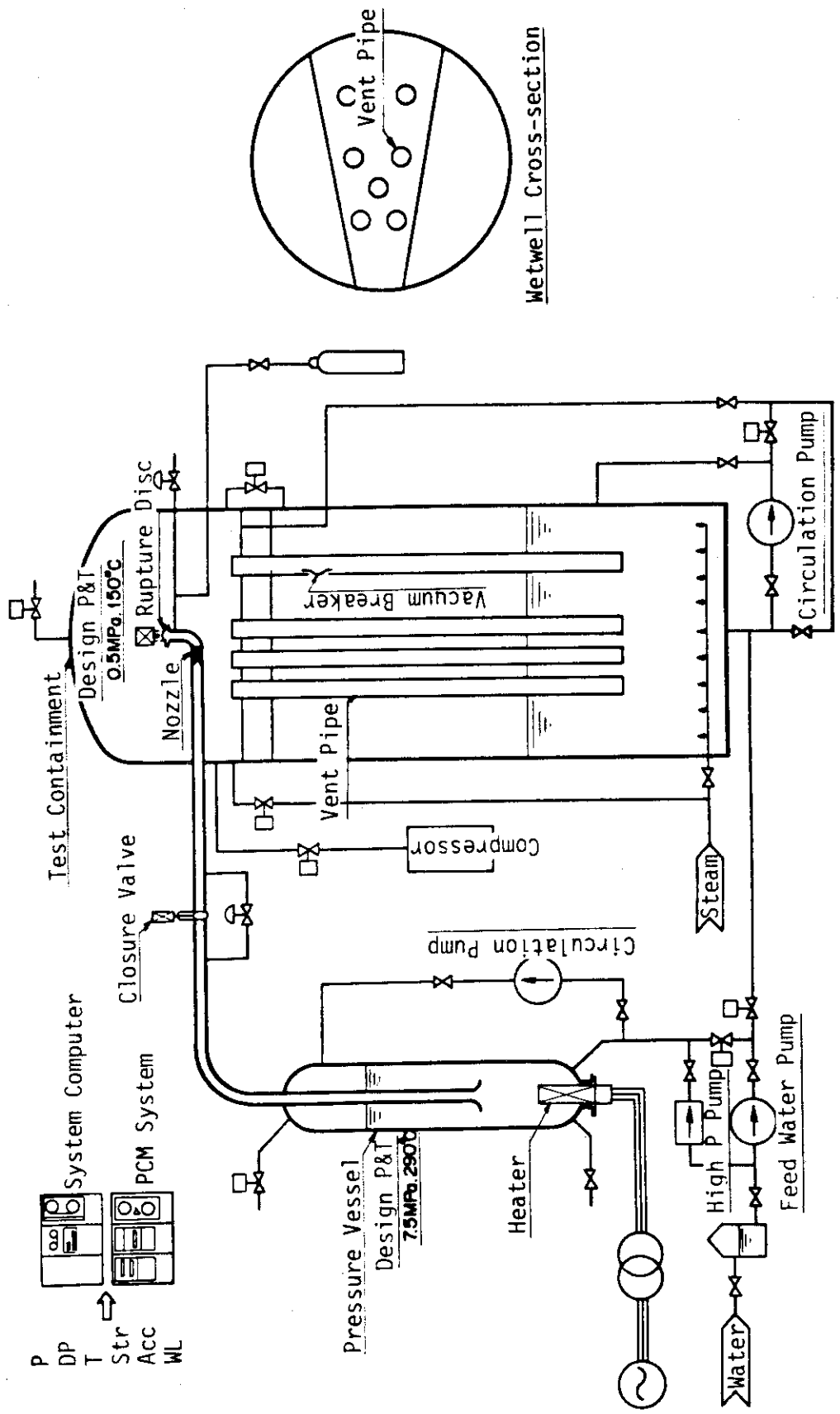

Fig. 2.1 Schematic Flow Diagram of Test Facility

Table 2.1 Comparison of Major Design Parameters

Parameter		Reference Mark II	CRT Facility
Drywell			
Free Volume, Including Air Volumes in Vent Pipes	(m^3)	5700	329
Vent Pipe			
Number	(-)	108	7
Length	(m)	14.2	13.6
Clearance, to Pool Bottom	(m)	3.66	3.66
Number of Vacuum Breakers	(-)	11	1
Wetwell			
Free Volume	(m^3)	4100	255
Water Volume	(m^3)	3200	188
Height, to Diaphragm Floor	(m)	17.3	17.0
Pressure Vessel			
Inside Diameter	(m)	6.4	2.2
Height	(m)	22.0	10.4

Table 2.2 Summary of Data Channels

Location	Item	Data Acqusition		
		Computer	PCM Track-1	PCM Track-2
Pressure Vessel	Pressure	2		
	Diff. Press.	6		
	Temperature	6		
	Water Level	6		
Blowdown Pipe	Pressure	2		
	Diff. Press.	1		
	Temperature	3		
	Timing Sig.	2	2	2
Drywell	Pressure	1	1	
	Temperature	8		
	Water Level	4		
Vent Pipe	Pressure		9	
	Temperature	6		
	Water Level	19		
	Strain		4	
	Acceleration			4
	Timing Sig.	1		
Wetwell	Pressure	1	20	
	Diff. Press.	2		
	Temperature	32		
	Water Level	80		15
	Acceleration			12

Table 2.3 Summary of Data Acquisition Systems

		Computer	PCM System
Max. Number of Channels		192	39 x 2 tracks
Input Range	(V)	±10.00	±10.00
Resolution	(mV/digit)	4.883	19.53
Sampling Rate	(data/ch./s)	50.00	455.56
Skew	(ms/ch.)	0.028	0.0488

Table 2.4 Identification of Data Channels

Channel Code = A B C D - E F G

A B Location

= P V Pressure Vessel
= B P Blowdown Pipe
= D W Drywell
= V P Vent Pipe
= W W Wetwell

C Measurement Item

= P Pressure
= D Differential Pressure
= T Temperature
= L Water Level Signal
= S Strain
= A Acceleration
= M Actuation Signal

D Data Acquisition System

= S Computer Recorded , 50 data/s
= F PCM Recorded , 455.6 data/s

E Group Number

F G Sequential Number

Table 2.5 List of Data Channels (Computer Recorded Channels)

Channel No.	Channel Code	Measurement Location
1	BPMS-001	RUPTURE DISC BREAK SIGNAL
2	BPMS-002	MAIN DISCHARGE VALVE CLOSE SIGNAL
3	VPMS-001	OPENING OF VACUUM BREAKER (5-STEPS)
4		
5	PVPS-001	VESSEL STEAM DOME
6	PVPS-002	VESSEL STEAM DOME
7	BPPS-001	BLOWDOWN PIPE (8.4M FROM OUTL.)
8	BPPS-002	BLOWDOWN PIPE (0.9M FROM OUTL.)
9	DWPS-001	DRYWELL
10	WWPS-001	WETWELL AIRSPACE (15.0M ABOVE BOTT.)
11		
12	PVDS-001	DP OVER VESSEL (EL = 0.0M - +9.2M)
13	PVDS-002	DP OVER VESSEL (EL = 0.0M - +2.6M)
14	PVDS-003	DP OVER VESSEL (EL = +2.2M - +4.2M)
15	PVDS-004	DP OVER VESSEL (EL = +3.8M - +5.8M)
16	PVDS-005	DP OVER VESSEL (EL = +5.4M - +7.4M)
17	PVDS-006	DP OVER VESSEL (EL = +7.0M - +9.2M)
18	BPDS-001	DYNAMIC PRESS. IN BLOWDOWN PIPE
19	WWDS-001	DP OVER POOL (EL = 4.5M -15.5M)
20	WWDS-002	DP ACROSS DIAPHRAGM FLOOR
21		
22	PVTS-001	VESSEL (EL = 0.6M)
23	PVTS-002	VESSEL (EL = 2.2M)
24	PVTS-003	VESSEL (EL = 3.8M)
25	PVTS-004	VESSEL (EL = 5.4M)
26	PVTS-005	VESSEL (EL = 7.0M)
27	PVTS-006	VESSEL (EL = 8.6M)
28	BPTS-001	BLOWDOWN PIPE (6.5M FROM OUTL.)
29	BPTS-002	BLOWDOWN PIPE (4.1M FROM OUTL.)
30	BPTS-003	BLOWDOWN PIPE (0.9M FROM OUTL.)
31	DWTS-101	DRYWELL (0.5M ABOVE DF)
32	DWTS-102	DRYWELL (2.5M ABOVE DF)
33	DWTS-103	DRYWELL (4.5M ABOVE DF)
34	DWTS-201	DRYWELL (0.5M ABOVE DF)
35	DWTS-202	DRYWELL (2.5M ABOVE DF)
36	DWTS-203	DRYWELL (4.5M ABOVE DF)
37	DWTS-301	DRYWELL (0.5M ABOVE DF)
38	DWTS-302	DRYWELL (3.5M ABOVE DF)
39	VPTS-101	VP1 (0.5M ABOVE OUTL.)
40	VPTS-102	VP1 (11.5M ABOVE OUTL.)
41	VPTS-201	VP2 (0.5M ABOVE OUTL.)
42	VPTS-202	VP2 (11.5M ABOVE OUTL.)
43	VPTS-301	VP3 (0.5M ABOVE OUTL.)
44	VPTS-302	VP3 (11.5M ABOVE OUTL.)
45	WWTS-101	WETWELL (T1, 1.0M ABOVE BOTT.)
46	WWTS-102	WETWELL (T1, 3.0M ABOVE BOTT.)
47	WWTS-103	WETWELL (T1, 5.0M ABOVE BOTT.)
48	WWTS-104	WETWELL (T1, 7.0M ABOVE BOTT.)
49	WWTS-105	WETWELL (T1, 9.0M ABOVE BOTT.)
50	WWTS-106	WETWELL (T1, 11.0M ABOVE BOTT.)
51	WWTS-107	WETWELL (T1, 13.0M ABOVE BOTT.)
52	WWTS-108	WETWELL (T1, 15.0M ABOVE BOTT.)

Table 2.5 (Continued)

Channel No.	Channel Code	Measurement Location
53	WWTS-201	WETWELL (T2, 1.0M ABOVE BOTT.)
54	WWTS-202	WETWELL (T2, 3.0M ABOVE BOTT.)
55	WWTS-203	WETWELL (T2, 5.0M ABOVE BOTT.)
56	WWTS-204	WETWELL (T2, 7.0M ABOVE BOTT.)
57	WWTS-205	WETWELL (T2, 9.0M ABOVE BOTT.)
58	WWTS-206	WETWELL (T2, 11.0M ABOVE BOTT.)
59	WWTS-207	WETWELL (T2, 13.0M ABOVE BOTT.)
60	WWTS-208	WETWELL (T2, 15.0M ABOVE BOTT.)
61	WWTS-301	WETWELL (T3, 1.0M ABOVE BOTT.)
62	WWTS-302	WETWELL (T3, 3.0M ABOVE BOTT.)
63	WWTS-303	WETWELL (T3, 5.0M ABOVE BOTT.)
64	WWTS-304	WETWELL (T3, 7.0M ABOVE BOTT.)
65	WWTS-305	WETWELL (T3, 9.0M ABOVE BOTT.)
66	WWTS-306	WETWELL (T3, 11.0M ABOVE BOTT.)
67	WWTS-307	WETWELL (T3, 13.0M ABOVE BOTT.)
68	WWTS-308	WETWELL (T3, 15.0M ABOVE BOTT.)
69	WWTS-401	WETWELL (T4, 1.0M ABOVE BOTT.)
70	WWTS-402	WETWELL (T4, 3.0M ABOVE BOTT.)
71	WWTS-403	WETWELL (T4, 5.0M ABOVE BOTT.)
72	WWTS-404	WETWELL (T4, 7.0M ABOVE BOTT.)
73	WWTS-405	WETWELL (T4, 9.0M ABOVE BOTT.)
74	WWTS-406	WETWELL (T4, 11.0M ABOVE BOTT.)
75	WWTS-407	WETWELL (T4, 13.0M ABOVE BOTT.)
76	WWTS-408	WETWELL (T4, 15.0M ABOVE BOTT.)
77		
78	PVLS-001	VESSEL (EL = 0.6M)
79	PVLS-002	VESSEL (EL = 2.2M)
80	PVLS-003	VESSEL (EL = 3.8M)
81	PVLS-004	VESSEL (EL = 5.4M)
82	PVLS-005	VESSEL (EL = 7.0M)
83	PVLS-006	VESSEL (EL = 8.6M)
84	DWLS-001	DRYWELL (0.048M ABOVE DF)
85	DWLS-002	DRYWELL (0.096M ABOVE DF)
86	DWLS-003	DRYWELL (0.144M ABOVE DF)
87	DWLS-004	DRYWELL (0.192M ABOVE DF)
88	VPLS-101	VP1 (0.042M ABOVE OUTL.)
89	VPLS-103	VP1 (2.042M ABOVE OUTL.)
90	VPLS-105	VP1 (4.042M ABOVE OUTL.)
91	VPLS-201	VP2 (0.042M ABOVE OUTL.)
92	VPLS-203	VP2 (2.042M ABOVE OUTL.)
93	VPLS-205	VP2 (4.042M ABOVE OUTL.)
94	VPLS-301	VP3 (0.042M ABOVE OUTL.)
95	VPLS-302	VP3 (1.042M ABOVE OUTL.)
96	VPLS-303	VP3 (2.042M ABOVE OUTL.)
97	VPLS-304	VP3 (3.042M ABOVE OUTL.)
98	VPLS-305	VP3 (4.042M ABOVE OUTL.)
99	VPLS-401	VP4 (0.042M ABOVE OUTL.)
100	VPLS-403	VP4 (2.042M ABOVE OUTL.)
101	VPLS-405	VP4 (4.042M ABOVE OUTL.)
102	VPLS-501	VP5 (0.042M ABOVE OUTL.)
103	VPLS-502	VP5 (1.042M ABOVE OUTL.)
104	VPLS-503	VP5 (2.042M ABOVE OUTL.)
105	VPLS-504	VP5 (3.042M ABOVE OUTL.)
106	VPLS-505	VP5 (4.042M ABOVE OUTL.)

Table 2.5 (Continued)

Channel No.	Channel Code	Measurement Location				
107	WWLS-104	WETWELL	(L1,	5.75M	ABOVE	BOTT.)
108	WWLS-105	WETWELL	(L1,	6.50M	ABOVE	BOTT.)
109	WWLS-106	WETWELL	(L1,	7.25M	ABOVE	BOTT.)
110	WWLS-107	WETWELL	(L1,	8.00M	ABOVE	BOTT.)
111	WWLS-108	WETWELL	(L1,	8.75M	ABOVE	BOTT.)
112	WWLS-109	WETWELL	(L1,	9.50M	ABOVE	BOTT.)
113	WWLS-110	WETWELL	(L1,	10.25M	ABOVE	BOTT.)
114	WWLS-111	WETWELL	(L1,	11.00M	ABOVE	BOTT.)
115	WWLS-112	WETWELL	(L1,	11.75M	ABOVE	BOTT.)
116	WWLS-113	WETWELL	(L1,	12.50M	ABOVE	BOTT.)
117	WWLS-114	WETWELL	(L1,	13.25M	ABOVE	BOTT.)
118	WWLS-115	WETWELL	(L1,	14.00M	ABOVE	BOTT.)
119	WWLS-116	WETWELL	(L1,	14.75M	ABOVE	BOTT.)
120	WWLS-201	WETWELL	(L2,	3.50M	ABOVE	BOTT.)
121	WWLS-202	WETWELL	(L2,	4.25M	ABOVE	BOTT.)
122	WWLS-203	WETWELL	(L2,	5.00M	ABOVE	BOTT.)
123	WWLS-204	WETWELL	(L2,	5.75M	ABOVE	BOTT.)
124	WWLS-205	WETWELL	(L2,	6.50M	ABOVE	BOTT.)
125	WWLS-206	WETWELL	(L2,	7.25M	ABOVE	BOTT.)
126	WWLS-207	WETWELL	(L2,	8.00M	ABOVE	BOTT.)
127	WWLS-208	WETWELL	(L2,	8.75M	ABOVE	BOTT.)
128	WWLS-209	WETWELL	(L2,	9.50M	ABOVE	BOTT.)
129	WWLS-210	WETWELL	(L2,	10.25M	ABOVE	BOTT.)
130	WWLS-211	WETWELL	(L2,	11.00M	ABOVE	BOTT.)
131	WWLS-212	WETWELL	(L2,	11.75M	ABOVE	BOTT.)
132	WWLS-213	WETWELL	(L2,	12.50M	ABOVE	BOTT.)
133	WWLS-214	WETWELL	(L2,	13.25M	ABOVE	BOTT.)
134	WWLS-215	WETWELL	(L2,	14.00M	ABOVE	BOTT.)
135	WWLS-216	WETWELL	(L2,	14.75M	ABOVE	BOTT.)
136	WWLS-303	WETWELL	(L3,	5.00M	ABOVE	BOTT.)
137	WWLS-305	WETWELL	(L3,	6.50M	ABOVE	BOTT.)
138	WWLS-307	WETWELL	(L3,	8.00M	ABOVE	BOTT.)
139	WWLS-309	WETWELL	(L3,	9.50M	ABOVE	BOTT.)
140	WWLS-311	WETWELL	(L3,	11.00M	ABOVE	BOTT.)
141	WWLS-313	WETWELL	(L3,	12.50M	ABOVE	BOTT.)
142	WWLS-315	WETWELL	(L3,	14.00M	ABOVE	BOTT.)
143	WWLS-401	WETWELL	(L4,	3.50M	ABOVE	BOTT.)
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147	WWLS-405	WETWELL	(L4,	6.50M	ABOVE	BOTT.)
148	WWLS-406	WETWELL	(L4,	7.25M	ABOVE	BOTT.)
149	WWLS-407	WETWELL	(L4,	8.00M	ABOVE	BOTT.)
150	WWLS-408	WETWELL	(L4,	8.75M	ABOVE	BOTT.)
151	WWLS-409	WETWELL	(L4,	9.50M	ABOVE	BOTT.)
152	WWLS-410	WETWELL	(L4,	10.25M	ABOVE	BOTT.)
153	WWLS-411	WETWELL	(L4,	11.00M	ABOVE	BOTT.)
154	WWLS-412	WETWELL	(L4,	11.75M	ABOVE	BOTT.)
155	WWLS-413	WETWELL	(L4,	12.50M	ABOVE	BOTT.)
156	WWLS-414	WETWELL	(L4,	13.25M	ABOVE	BOTT.)
157	WWLS-415	WETWELL	(L4,	14.00M	ABOVE	BOTT.)
158	WWLS-416	WETWELL	(L4,	14.75M	ABOVE	BOTT.)
159	WWLS-503	WETWELL	(L5,	5.00M	ABOVE	BOTT.)
160	WWLS-505	WETWELL	(L5,	6.50M	ABOVE	BOTT.)

Table 2.5 (Continued)

Channel No.	Channel Code	Measurement Location
161	WWLS-507	WETWELL (L5, 8.00M ABOVE BOTT.)
162	WWLS-509	WETWELL (L5, 9.50M ABOVE BOTT.)
163	WWLS-511	WETWELL (L5, 11.00M ABOVE BOTT.)
164	WWLS-513	WETWELL (L5, 12.50M ABOVE BOTT.)
165	WWLS-515	WETWELL (L5, 14.00M ABOVE BOTT.)
166	WWLS-604	WETWELL (L6, 5.75M ABOVE BOTT.)
167	WWLS-606	WETWELL (L6, 7.25M ABOVE BOTT.)
168	WWLS-608	WETWELL (L6, 8.75M ABOVE BOTT.)
169	WWLS-610	WETWELL (L6, 10.25M ABOVE BOTT.)
170	WWLS-612	WETWELL (L6, 11.75M ABOVE BOTT.)
171	WWLS-614	WETWELL (L6, 13.25M ABOVE BOTT.)
172	WWLS-616	WETWELL (L6, 14.75M ABOVE BOTT.)
173	WWLS-704	WETWELL (L7, 5.75M ABOVE BOTT.)
174	WWLS-706	WETWELL (L7, 7.25M ABOVE BOTT.)
175	WWLS-708	WETWELL (L7, 8.75M ABOVE BOTT.)
176	WWLS-710	WETWELL (L7, 10.25M ABOVE BOTT.)
177	WWLS-712	WETWELL (L7, 11.75M ABOVE BOTT.)
178	WWLS-714	WETWELL (L7, 13.25M ABOVE BOTT.)
179	WWLS-716	WETWELL (L7, 14.75M ABOVE BOTT.)
180	WWLS-804	WETWELL (L8, 5.75M ABOVE BOTT.)
181	WWLS-806	WETWELL (L8, 7.25M ABOVE BOTT.)
182	WWLS-808	WETWELL (L8, 8.75M ABOVE BOTT.)
183	WWLS-810	WETWELL (L8, 10.25M ABOVE BOTT.)
184	WWLS-812	WETWELL (L8, 11.75M ABOVE BOTT.)
185	WWLS-814	WETWELL (L8, 13.25M ABOVE BOTT.)
186	WWLS-816	WETWELL (L8, 14.75M ABOVE BOTT.)
187		
188		
189		
190		
191		
192		

Table 2.6 List of Data Channels (PCM Track-1 Channels)

Channel No.	Channel Code	Measurement Location
1	PPMF-001	RUPTURE DISC BREAK SIGNAL
2	BPMF-002	MAIN DISCHARGE VALVE CLOSE SIGNAL
3		
4	DWPF-001	DRYWELL
5	VPPF-101	VP1 (0.5M ABOVE OUTL.)
6	VPPF-201	VP2 (0.5M ABOVE OUTL.)
7	VPPF-301	VP3 (0.5M ABOVE OUTL.)
8	VPPF-302	VP3 (6.0M ABOVE OUTL.)
9	VPPF-303	VP3 (11.5M ABOVE OUTL.)
10	VPPF-401	VP4 (0.5M ABOVE OUTL.)
11	VPPF-501	VP5 (0.5M ABOVE OUTL.)
12	VPPF-502	VP5 (6.0M ABOVE OUTL.)
13	VPPF-503	VP5 (11.5M ABOVE OUTL.)
14	WWPF-101	POOL BOTT., UNDER VP1
15	WWPF-102	POOL BOTT., UNDER VP2
16	WWPF-103	POOL BOTT., UNDER VP3
17	WWPF-104	POOL BOTT., UNDER VP4
18	WWPF-105	POOL BOTT., UNDER VP5
19	WWPF-106	POOL BOTT., BETW. VP1, VP6 & PEDESTAL
20	WWPF-107	POOL BOTT., BETW. VP2 & VP3
21	WWPF-201	WALL BESIDE VP2 (P1, 1.8M ABOVE BOTT.)
22	WWPF-202	WALL BESIDE VP2 (P1, 3.6M ABOVE BOTT.)
23	WWPF-203	WALL BESIDE VP2 (P1, 6.0M ABOVE BOTT.)
24	WWPF-301	WALL BESIDE VP3 (P2, 1.8M ABOVE BOTT.)
25	WWPF-302	WALL BESIDE VP3 (P2, 3.6M ABOVE BOTT.)
26	WWPF-303	WALL BESIDE VP3 (P2, 6.0M ABOVE BOTT.)
27	WWPF-401	SHELL BESIDE VP3 (P3, 1.8M ABOVE BOTT.)
28	WWPF-402	SHELL BESIDE VP3 (P3, 3.6M ABOVE BOTT.)
29	WWPF-501	SHELL BESIDE VP4 (P4, 1.8M ABOVE BOTT.)
30	WWPF-502	SHELL BESIDE VP4 (P4, 3.6M ABOVE BOTT.)
31	WWPF-602	WALL BESIDE VP4 (P5, 3.6M ABOVE BOTT.)
32	WWPF-702	WALL BESIDE VP7 (P6, 3.6M ABOVE BOTT.)
33	WWPF-001	WETWELL AIRSPACE (15.0M ABOVE BOTT.)
34		
35	VPSF-101	LOWER BRACE BETW. VP1 & WALL
36	VPSF-102	LOWER BRACE BETW. VP1 & VP2
37	VPSF-103	LOWER BRACE BETW. VP1 & VP6
38	VPSF-201	UPPER BRACE BETW. VP1 & PEDESTAL
39		

Table 2.7 List of Data Channels (PCM Track-2 Channels)

Channel No.	Channel Code	Measurement Location
1	BPMF-001	RUPTURE DISC BREAK SIGNAL
2	BPMF-002	MAIN DISCHARGE VALVE CLOSE SIGNAL
3		
4	VPAF-101	VP2 OUTL. (0DEG)
5	VPAF-102	VP2 OUTL. (90DEG)
6	VPAF-201	VP5 OUTL. (0DEG)
7	VPAF-202	VP5 OUTL. (90DEG)
8	WWAF-001	POOL BOTT., UNDER VP5
9	WWAF-002	POOL BOTT., BETW. VP2, VP3, VP4 & VP7
10	WWAF-003	WALL BESIDE VP2 (3.0M ABOVE BOTT.)
11	WWAF-004	WALL BESIDE VP7 (3.0M ABOVE BOTT.)
12	WWAF-005	SHELL BESIDE VP3 (3.0M ABOVE BOTT.)
13	WWAF-006	SHELL BESIDE VP3 (6.0M ABOVE BOTT.)
14	WWAF-007	SHELL BESIDE VP4 (3.0M ABOVE BOTT.)
15	WWAF-008	SHELL BESIDE VP4 (6.0M ABOVE BOTT.)
16	WWAF-009	PEDESTAL (3.0M ABOVE BOTT.)
17	WWAF-010	PEDESTAL (6.0M ABOVE BOTT.)
18	WWAF-011	SHELL AT DF LEVEL (0DEG)
19	WWAF-012	SHELL AT DF LEVEL (90DEG)
20		
21	WWLF-101	PHASE BDRY. (0.9M BELOW OUTL., CENTER)
22	WWLF-102	PHASE BDRY. (0.9M BELOW OUTL., 0DEG)
23	WWLF-104	PHASE BDRY. (0.9M BELOW OUTL., 90DEG)
24	WWLF-106	PHASE BDRY. (0.9M BELOW OUTL., 180DEG)
25	WWLF-108	PHASE BDRY. (0.9M BELOW OUTL., 270DEG)
26	WWLF-201	PHASE BDRY. (0.6M BELOW OUTL., CENTER)
27	WWLF-203	PHASE BDRY. (0.6M BELOW OUTL., 45DEG)
28	WWLF-205	PHASE BDRY. (0.6M BELOW OUTL., 135DEG)
29	WWLF-207	PHASE BDRY. (0.6M BELOW OUTL., 225DEG)
30	WWLF-209	PHASE BDRY. (0.6M BELOW OUTL., 315DEG)
31	WWLF-301	PHASE BDRY. (0.3M BELOW OUTL., CENTER)
32	WWLF-302	PHASE BDRY. (0.3M BELOW OUTL., 0DEG)
33	WWLF-304	PHASE BDRY. (0.3M BELOW OUTL., 90DEG)
34	WWLF-306	PHASE BDRY. (0.3M BELOW OUTL., 180DEG)
35	WWLF-308	PHASE BDRY. (0.3M BELOW OUTL., 270DEG)
36		
37		
38		
39		

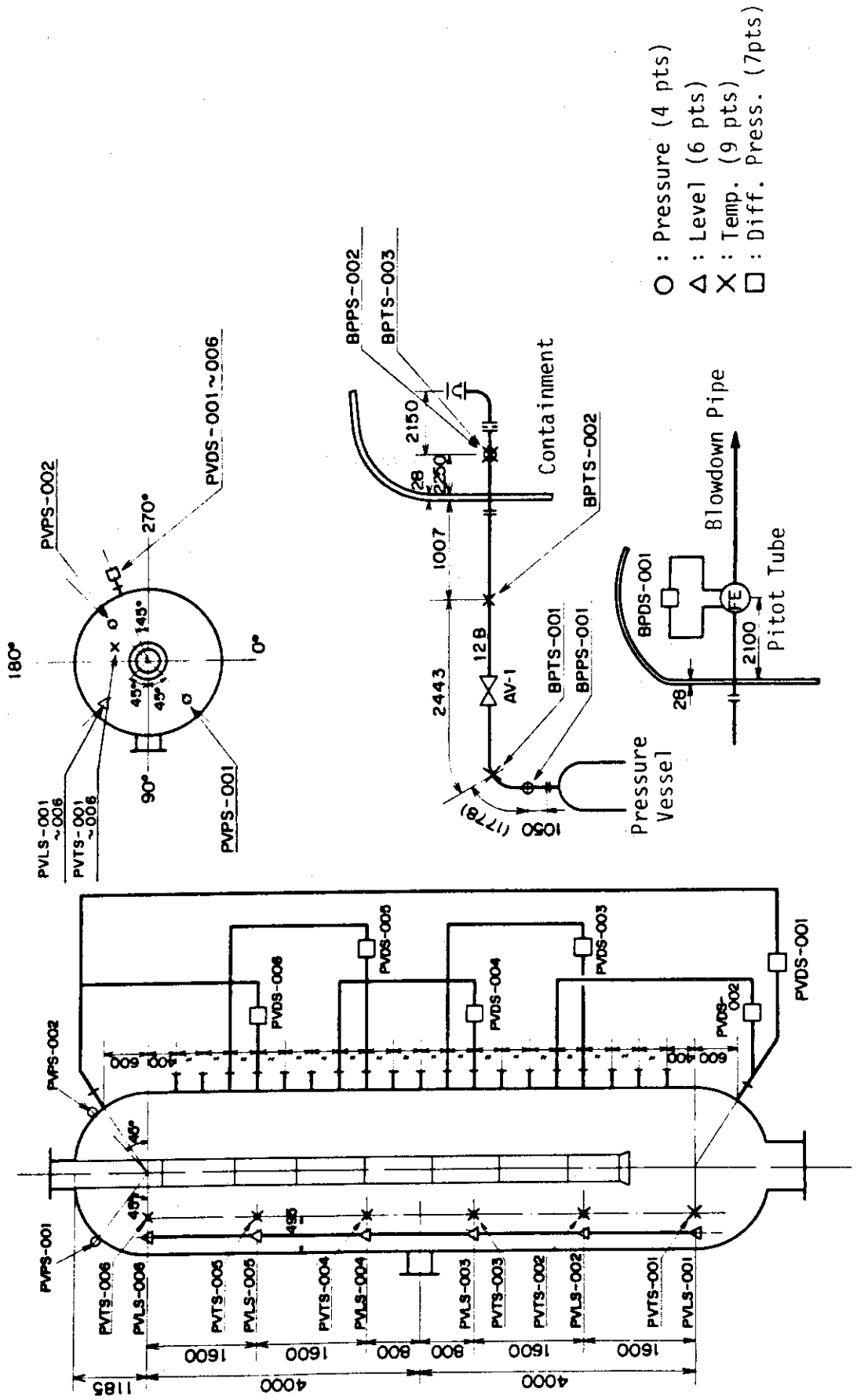

Fig. 2.2 Transducer Locations for Primary System

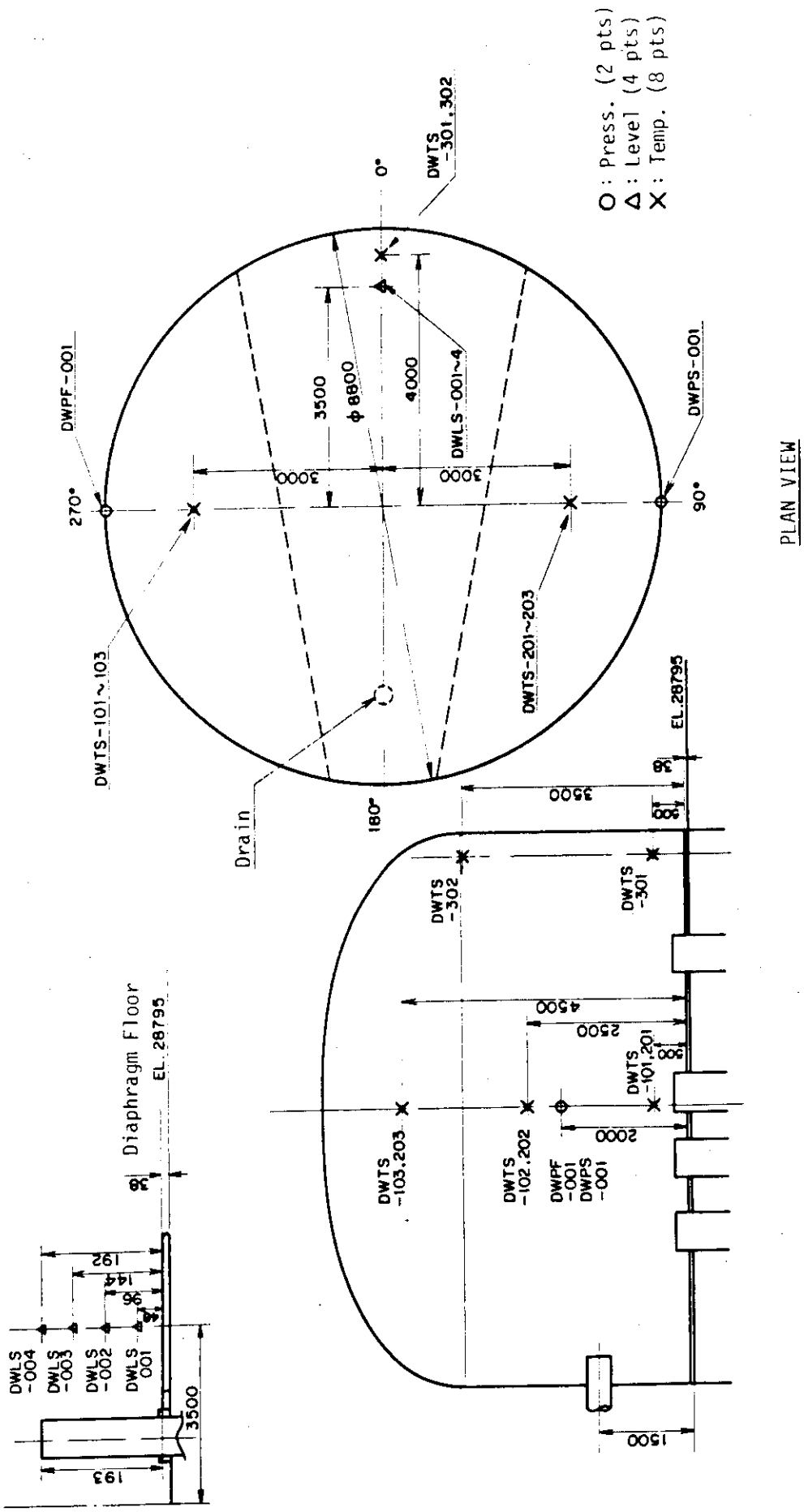

Fig. 2.3 Transducer Locations for Drywell

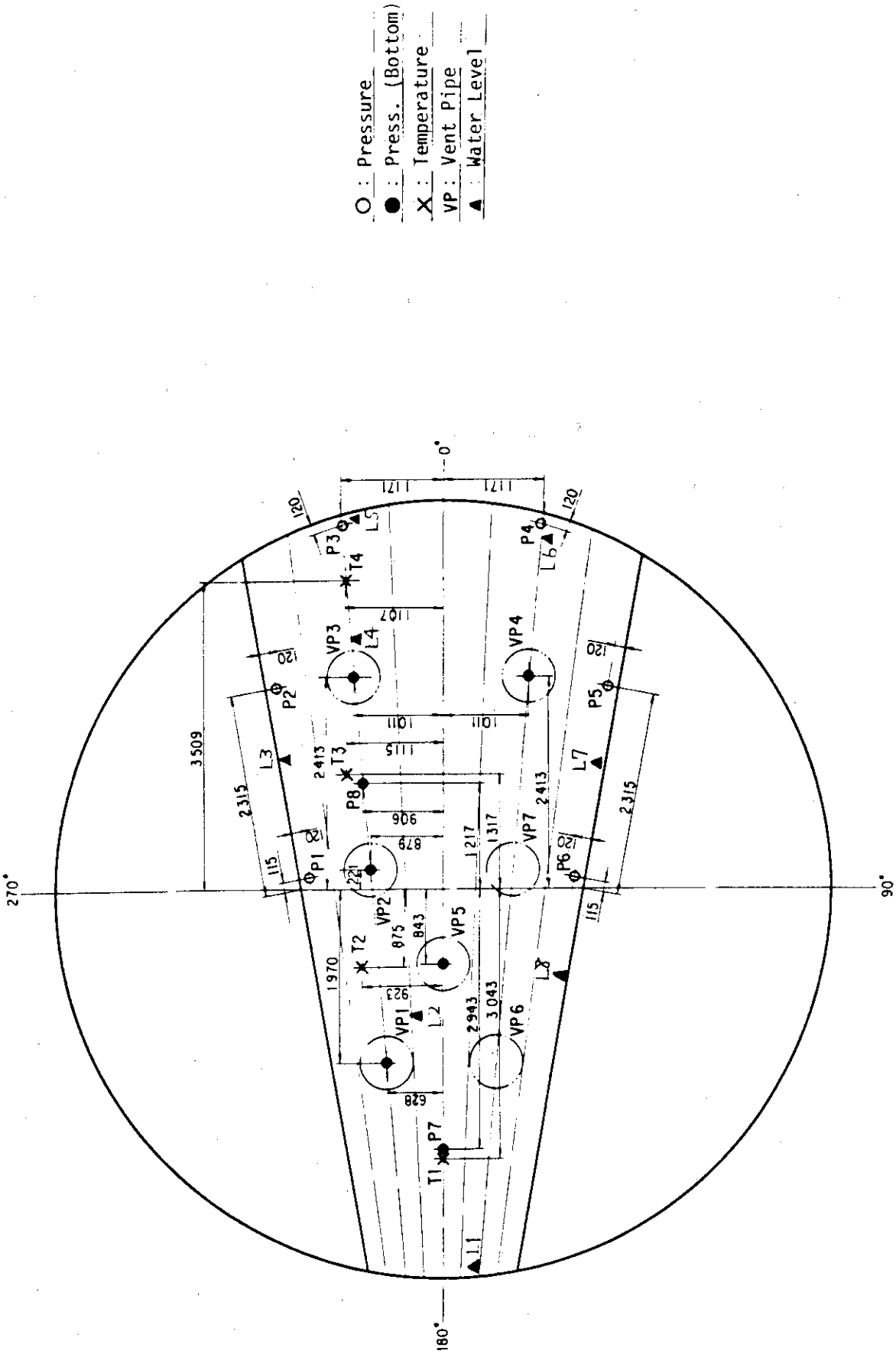

Fig. 2.4 Transducer Locations for Wetwell (Plan View)

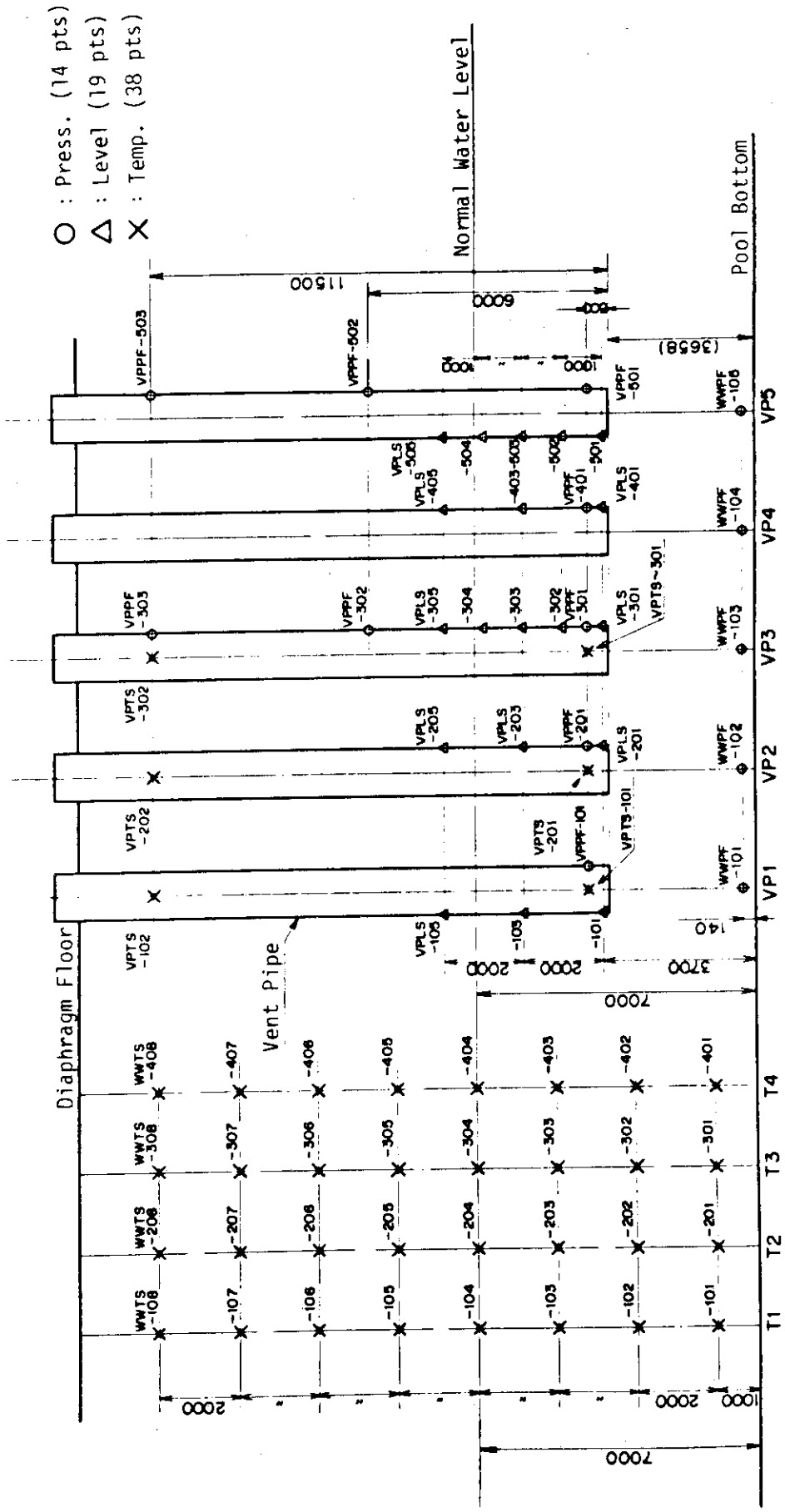

Fig. 2.5 Transducer Locations for Vent Pipes and Thermocouple Locations for Wetwell

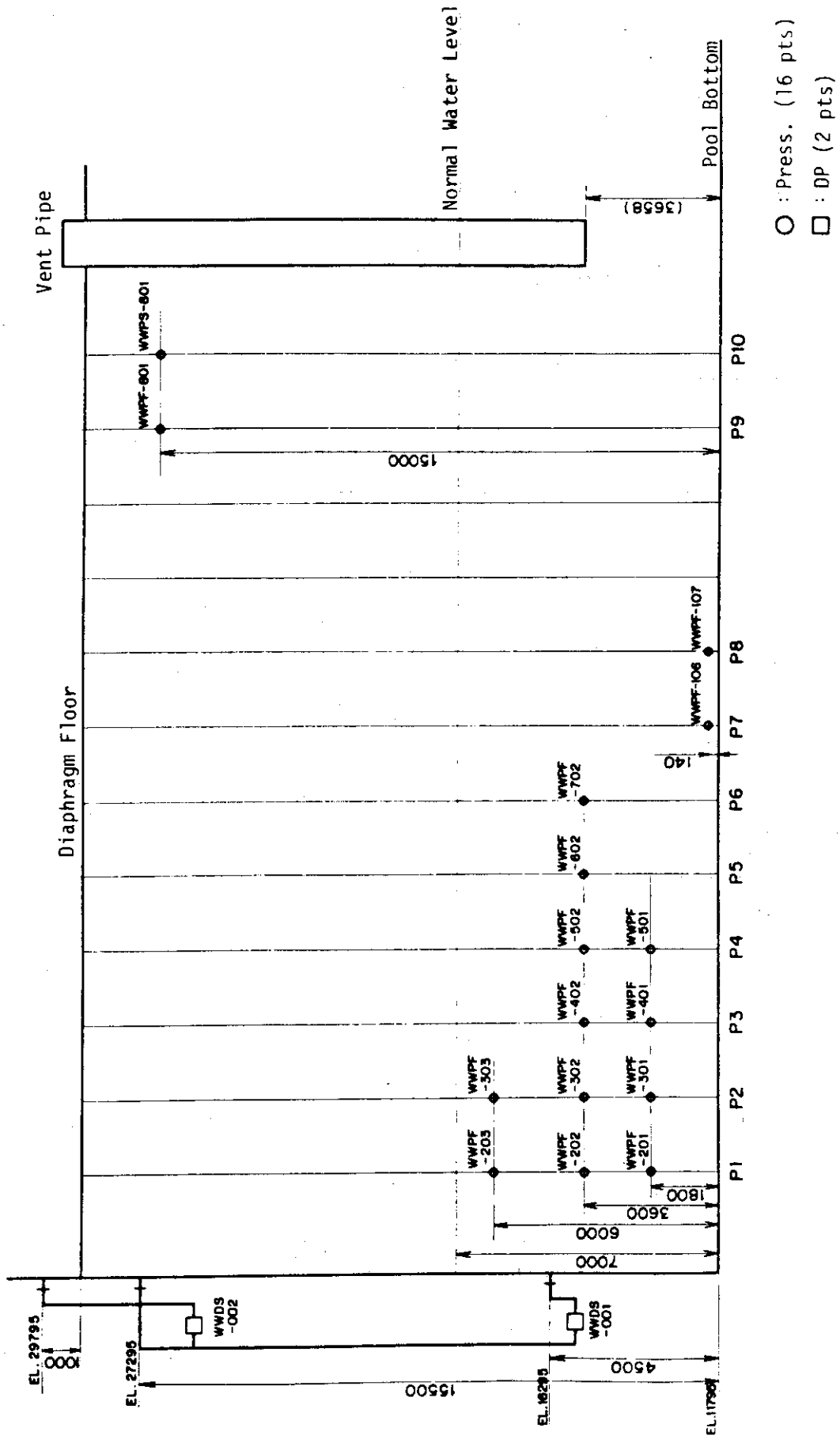

Fig. 2.6 Pressure and Differential Pressure Transducer Locations for Wetwell

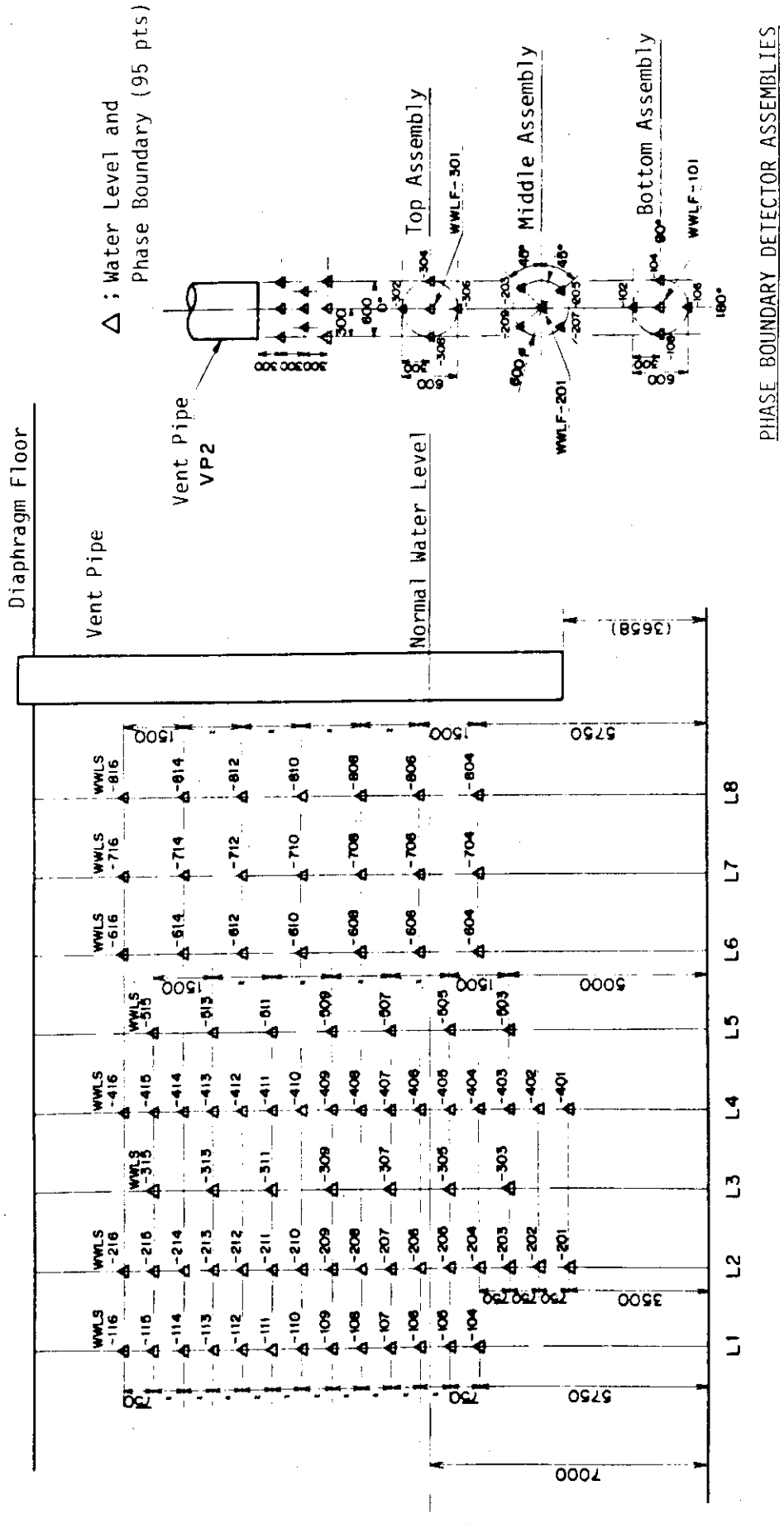

Fig. 2.7 Water Level Detector and Phase Boundary Detector Locations for Wetwell

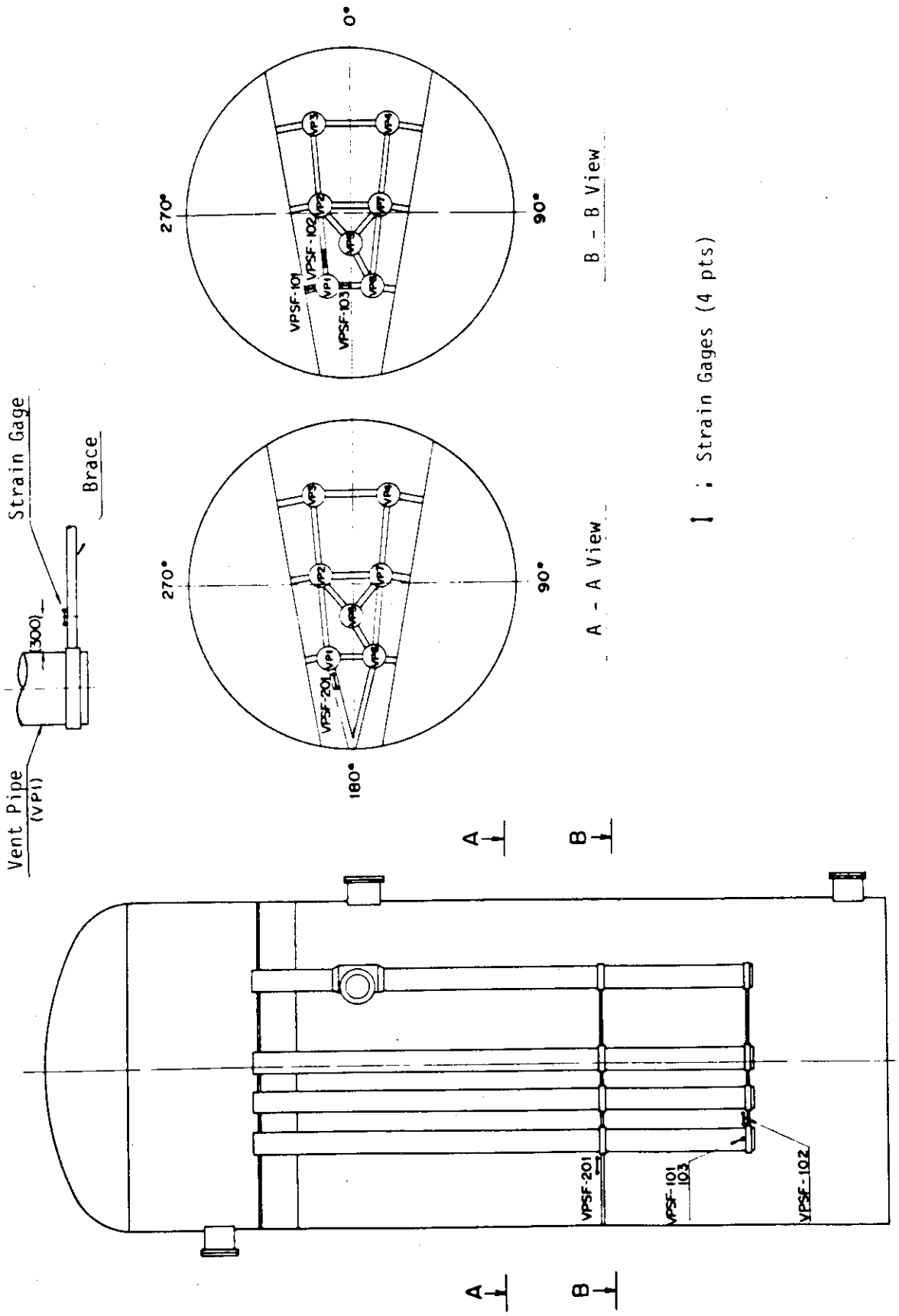

Fig. 2.8 Locations of Strain Gages

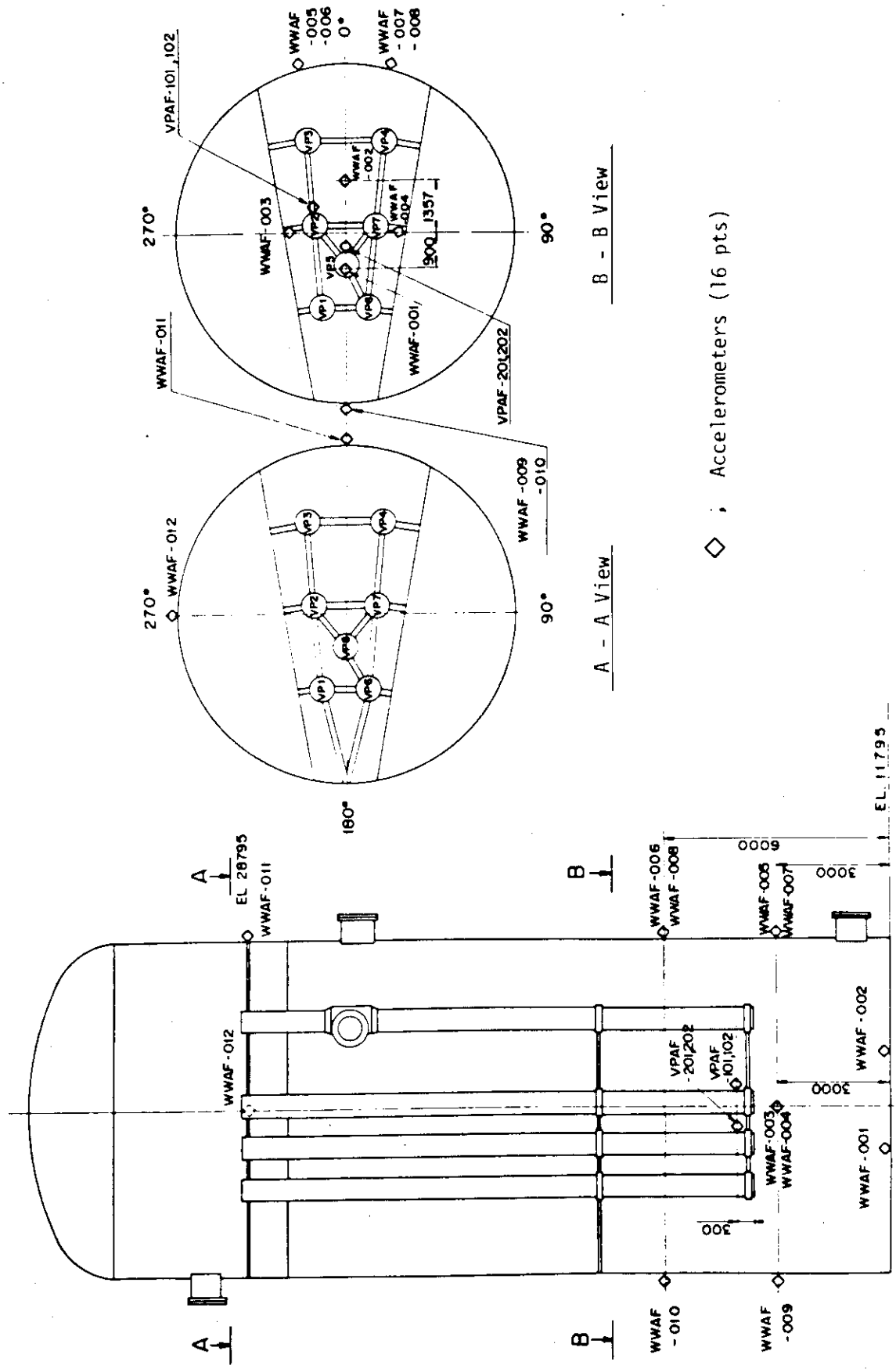

Fig. 2.9 Locations of Accelerometers

Table 2.8 State of Measurement Equipments (Computer Recorded Channels)

Channel No.	Channel Code	Acceptability o Yes ø No	Remarks
1	BPMS-001	o	
2	BPMS-002	o	
3	VPMS-001	o	
4			
5	PVPS-001	o	
6	PVPS-002	o	
7	BPPS-001	o	
8	BPPS-002	o	
9	DWPS-001	-	
10	WWPS-001	o	
11			
12	PVDS-001	o	
13	PVDS-002	o	
14	PVDS-003	o	
15	PVDS-004	o	
16	PVDS-005	o	
17	PVDS-006	o	
18	BPDS-001	ø	Unreasonable data.
19	WWDS-001	o	
20	WWDS-002	o	
21			
22	PVTS-001	o	
23	PVTS-002	o	
24	PVTS-003	o	
25	PVTS-004	o	
26	PVTS-005	o	
27	PVTS-006	o	
28	BPTS-001	o	
29	BPTS-002	o	
30	BPTS-003	o	

Table 2.8 (continued)

Channel No.	Channel Code	Acceptability o Yes	ø No	Remarks
31	DWTS-101	o		Saturated at 150°C
32	DWTS-102	o		
33	DWTS-103	o		
34	DWTS-201	o		
35	DWTS-202	o		
36	DWTS-203	o		
37	DWTS-301	o		
38	DWTS-302	o		
39	VPTS-101	o		
40	VPTS-102	o		
41	VPTS-201	o		
42	VPTS-202	o		
43	VPTS-301	o		
44	VPTS-302	o		
45	WWTS-101	o		
46	WWTS-102	o		
47	WWTS-103	o		
48	WWTS-104	o		
49	WWTS-105	o		Wetted during pool swell
50	WWTS-106	o		
51	WWTS-107	o		
52	WWTS-108	o		
53	WWTS-201	o		
54	WWTS-202	o		
55	WWTS-203	o		
56	WWTS-204	o		
57	WWTS-205	o		Wetted during pool swell
58	WWTS-206	o		
59	WWTS-207	o		
60	WWTS-208	o		

Table 2.8 (continued)

Channel No.	Channel Code	Acceptability o Yes	ø No	Remarks
61	WWTS-301		o	
62	WWTS-302		o	
63	WWTS-303		o	
64	WWTS-304		o	
65	WWTS-305		o	Wetted during pool swell
66	WWTS-306		o	
67	WWTS-307		o	
68	WWTS-308		o	
69	WWTS-401		o	
70	WWTS-402		o	
71	WWTS-403		o	
72	WWTS-404		o	
73	WWTS-405		o	Wetted during pool swell
74	WWTS-406		o	
75	WWTS-407		o	
76	WWTS-408		ø	Broken during the test
77				
78	PVLS-001		o	
79	PVLS-002		o	
80	PVLS-003		o	
81	PVLS-004		o	
82	PVLS-005		o	
83	PVLS-006		o	
84	DWLS-001		o	
85	DWLS-002		o	
86	DWLS-003		o	
87	DWLS-004		o	
88	VPLS-101		o	
89	VPLS-103		o	
90	VPLS-105		o	

Table 2.8 (continued)

Channel No.	Channel Code	Acceptability o Yes	ø No	Remarks
91	VPLS-201		o	
92	VPLS-203		o	
93	VPLS-205		o	
94	VPLS-301		o	
95	VPLS-302		o	
96	VPLS-303		o	
97	VPLS-304		o	
98	VPLS-305		o	
99	VPLS-401		o	
100	VPLS-403		o	
101	VPLS-405		o	
102	VPLS-501		o	
103	VPLS-502		o	
104	VPLS-503		o	
105	VPLS-504		o	
106	VPLS-505		o	
107	WWLS-104		o	
108	WWLS-105		o	
109	WWLS-106		o	
110	WWLS-107		o	
111	WWLS-108		o	
112	WWLS-109		o	
113	WWLS-110		o	
114	WWLS-111		o	
115	WWLS-112		o	
116	WWLS-113		o	
117	WWLS-114		o	
118	WWLS-115		o	
119	WWLS-116		o	
120	WWLS-201		o	

Table 2.8 (continued)

Channel No.	Channel Code	Acceptability o Yes	ø No	Remarks
121	WWLS-202	o		
122	WWLS-203	o		
123	WWLS-204	o		
124	WWLS-205	o		
125	WWLS-206	o		
126	WWLS-207	o		
127	WWLS-208	o		
128	WWLS-209	o		
129	WWLS-210	o		
130	WWLS-211	o		
131	WWLS-212	o		
132	WWLS-213	o		
133	WWLS-214	o		
134	WWLS-215	o		
135	WWLS-216	o		
136	WWLS-303	o		
137	WWLS-305	o		
138	WWLS-307	o		
139	WWLS-309	o		
140	WWLS-311	o		
141	WWLS-313	o		
142	WWLS-315	o		
143	WWLS-401	o		
144	WWLS-402	o		
145	WWLS-403	o		
146	WWLS-404	o		
147	WWLS-405	o		
148	WWLS-406	o		
149	WWLS-407	o		
150	WWLS-408	o		

Table 2.8 (continued)

Channel No.	Channel Code	Acceptability o Yes	ø No	Remarks
151	WWLS-409	o		
152	WWLS-410	o		
153	WWLS-411	o		
154	WWLS-412	o		
155	WWLS-413	o		
156	WWLS-414	o		
157	WWLS-415	o		
158	WWLS-416	o		
159	WWLS-503	o		
160	WWLS-505	o		
161	WWLS-507	o		
162	WWLS-509	o		
163	WWLS-511	o		
164	WWLS-513	o		
165	WWLS-515	o		
166	WWLS-604	o		
167	WWLS-606	o		
168	WWLS-608	o		
169	WWLS-610	o		
170	WWLS-612	o		
171	WWLS-614	o		
172	WWLS-616	o		
173	WWLS-704	o		
174	WWLS-706	o		
175	WWLS-708	o		
176	WWLS-710	o		
177	WWLS-712	o		
178	WWLS-714	o		
179	WWLS-716	o		
180	WWLS-804	o		

Table 2.8 (continued)

Channel No.	Channel Code	Acceptability o Yes	ø No	Remarks
181	WWLS-806		o	
182	WWLS-808		o	
183	WWLS-810		o	
184	WWLS-812		o	
185	WWLS-814		o	
186	WWLS-816		o	
187				
188				
189				
190				
191				
192				

Table 2.9 State of Measurement Equipments (PCM Track-1 Channels)

Channel No.	Channel No.	Acceptability o Yes	ø No	Remarks
1	BPMF-001	o		
2	BPMF-002	o		
3				
4	DWPF-001	o		
5	VPPF-101	o		
6	VPPF-201	o		
7	VPPF-301	o		
8	VPPF-302	o		
9	VPPF-303	o		
10	VPPF-401	o		
11	VPPF-501	o		
12	VPPF-502	o		
13	VPPF-503	o		
14	WWPF-101	o		
15	WWPF-102	o		
16	WWPF-103	o		
17	WWPF-104	o		
18	WWPF-105	o		
19	WWPF-106	o		
20	WWPF-107	o		
21	WWPF-201	o		
22	WWPF-202	o		
23	WWPF-203	o		
24	WWPF-301	o		
25	WWPF-302	o		
26	WWPF-303	o		
27	WWPF-401	o		
28	WWPF-402	o		
29	WWPF-501	o		
30	WWPF-502	o		

Table 2.9 (continued)

Channel No.	Channel Code	Acceptability o Yes	ø No	Remarks
31	WWPF-602		o	
32	WWPF-702		o	
33	WWPF-001		o	
34				
35	VPSF-101		o	
36	VPSF-102		o	
37	VPSF-103		ø	
38	VPSF-201		o	
39				

Table 2.10 State of Measurement Equipments (PCM Track-2 Channels)

Channel No.	Channel Code	Acceptability o Yes	Acceptability ø No	Remarks
1	BPMF-001		o	
2	BPMF-002		o	
3				
4	VPAF-101		o	
5	VPAF-102		ø	Sensor insulation failure.
6	VPAF-201		o	
7	VPAF-202		o	
8	WWAF-001		ø	Unreasonable data.
9	WWAF-002		ø	Unreasonable data.
10	WWAF-003		ø	Unreasonable data.
11	WWAF-004		ø	Unreasonable data.
12	WWAF-005		o	
13	WWAF-006		o	
14	WWAF-007		o	
15	WWAF-008		o	
16	WWAF-009		o	
17	WWAF-010		o	
18	WWAF-011		o	
19	WWAF-012		o	
20				
21	WWLF-101		o	
22	WWLF-102		o	
23	WWLF-104		o	
24	WWLF-106		o	
25	WWLF-108		o	
26	WWLF-201		o	
27	WWLF-203		o	
28	WWLF-205		o	
29	WWLF-207		o	
30	WWLF-209		o	

Table 2.10 (continued)

Channel No.	Channel Code	Acceptability o Yes	ø No	Remarks
31	WWLF-301		o	
32	WWLF-302		o	
33	WWLF-304		o	
34	WWLF-306		o	
35	WWLF-308		o	
36				
37				
38				
39				

Table 2.11 Calibration Data

PRESSURE CHANNELS (COMPUTER RECORDED)

Pressure Vessel

Date of Calibration Apr. 17, 1979

Range of Calibration Pressure (kPa) 101 - 7025

Water Level in Pressure Vessel (m) Full

Test Containment

Date of Calibration Mar. 27, 1979

Range of Calibration Pressure (kPa) 101 - 476

Water Level in Wetwell (m) 7.3

Channel No.	Channel Code	kPa/Digit	Max. Deviation kPa
System Computer			
5	PVPS-001	4.780	23.5
6	PVPS-002	4.732	28.1
7	BPPS-001	4.759	31.6
8	BPPS-002	4.776	23.8
9	DWPS-001	0.2395	
10	WWPS-001	0.2392	

DIFFERENTIAL PRESSURE CHANNELS (COMPUTER RECORDED)

Pressure Vessel

Data of Calibration Apr. 16, 1979

Calibration Conducted by Filling Water into Vessel.

Test Containment

Date of Calibration Feb. 24, 1979

Calibration Conducted by:

[] Filling Water into Containment

[X] Applying Known Pressure on Transducer

Channel No.	Channel Code	kPa/Digit	Max. Deviation kPa
System Computer			
12	PVDS-001	0.04850	
13	PVDS-002	0.02421	
14	PVDS-003	0.02342	
15	PVDS-004	0.02328	
16	PVDS-005	0.02328	
17	PVDS-006	0.02282	
18	BPDS-001	2.481	
19	WWDS-001	0.04451	
20	WWDS-002	0.05382	

Table 2.11 (Continued)

PRESSURE CHANNELS (PCM RECORDED)

Test Containment

Date of Calibration Apr. 25, 1979

Range of Calibration Pressure (kPa) 101 - 447

Water Level in Wetwell (m) 7.0

Channel No.	Channel Code	kPa/Digit	Max. Deviation kPa
PCM Track-1			
4	DWPF-001	0.9521	0.36
5	VPPF-101	0.9485	0.48
6	VPPF-201	0.9605	0.47
7	VPPF-301	0.9643	0.43
8	VPPF-302	0.9602	0.55
9	VPPF-303	0.9496	0.71
10	VPPF-401	0.9621	0.74
11	VPPF-501	0.9512	0.48
12	VPPF-502	0.9558	0.36
13	VPPF-503	0.9558	0.22
14	WWPF-101	0.9549	0.62
15	WWPF-102	0.9494	0.66
16	WWPF-103	0.9577	0.60

Channel No.	hannel Code	kPa/Digit	Max. Deviation kPa
PCM Track-1			
17	WWPF-104	0.9596	0.64
18	WWPF-105	0.9615	0.88
19	WWPF-106	0.9605	0.84
20	WWPF-107	0.9549	0.49
21	WWPF-201	0.9605	0.66
22	WWPF-202	0.9549	0.54
23	WWPF-203	0.9662	0.71
24	WWPF-301	0.9531	0.61
25	WWPF-302	0.9531	0.95
26	WWPF-303	0.9540	0.53
27	WWPF-401	0.9568	0.58
28	WWPF-402	0.9540	0.85
29	WWPF-501	0.9615	0.63
30	WWPF-502	0.9549	0.74
31	WWPF-602	0.9531	0.65
32	WWPF-702	0.9605	0.85
33	WWPF-001	0.9454	0.61

Table 2.12 Measurement Ranges

Ch. No.	Item 1)	Location 1)	Measurement Range: Manufacturer's Specification for Transducer	Measurement Range: Expected Overall Range	Measurement Range: Unit	LPF Cut-Off Freq. (Hz)
Computer Recorded Channels						
5 - 8	P	PV/BP	101 - 9908	101 - 10000	kPa	100
9	P	DW	0 - 591	0 - 600 2)	kPa	100
10	P	WW	0 - 591	0 - 600 2)	kPa	100
12	D	PV	0 - 98.1	0 - 100	kPa	100
13 - 17	D	PV	0 - 49	0 - 50	kPa	100
18	D	BP	0 - 4904	0 - 4950	kPa	100
19	D	WW	0 - 98.1	0 - 100	kPa	100
20	D	DW-WW	0 - 98.1	0 - 100	kPa	100
22 - 30	T	PV/BP		0 - 300	°C	250
31 - 38	T	DW		0 - 150	°C	250
39 - 44	T	VP		0 - 150	°C	250
45 - 76	T	WW		0 - 150	°C	250
PCM Track-1 Channels						
4	P	DW	0 - 591	0 - 600	kPa	250
5 - 33	P	WW	0 - 591	0 - 600	kPa	250
34 - 38	S	VP		-2300 - +2300	μm/m	250
PCM Track-2 Channels						
4 - 7	A	VP	-980 - +980 3)	-980 - +980	m/s^2	300
8 - 19	A	WW	-980 - +980 3)	-196 - +196	m/s^2	300

Notes:

1) For meaning of abbreviations see Table 2.5.

2) Linear response of transducers beyond manufacture-specified range was expected.

3) Range for transducer and charge preamplifier.

3. 試験条件と試験結果

TEST2101は，放出配管入口ノズルを圧力容器初期水面より下位に設けたいわゆる水放出試験であり，ブローダウン過程の巨視的様相は実炉における再循環系配管破断事故の場合に類似している。本試験における破断口面積とドライウェル容積（ベント管内気相部容積を含む）の比は $1.34 \times 10^{-5}\ m^{-1}$ ，破断口面積とベント管総断面積の比は0.0044であり，これらの値は，試験装置の設計にあたって参照したわが国のMark Ⅱプラントの再循環系配管両端破断事故において想定されている値のそれぞれ約26％および約22％に相当する。このように破断口面積を比較的小さく設定し，かつ水放出による試験を行うことによりベント管内の蒸気重量速度が比較的低い条件を長時間にわたり実現することができ，低蒸気流速時の凝縮振動（チャギング）に関する試験データを得るために有利である。なお本試験に引き続いて実施されたTEST 3101は，本試験と同様な試験条件のもとに，放出開始前にドライウェルのプリパージを行った試験であり，本試験結果との比較により蒸気凝縮振動に対するプリパージの効果を知ることができる。なお，昭和５４年１２月までに実施した試験の試験条件の要約をTable 3.1に，本試験の初期条件，データ収録の状況，試験中の物質・エネルギ移動の要約をTables 3.2～3.4にそれぞれ示す。

圧力容器の昇温・昇圧は２月２２日，２３日の２日間にわたって行った。放出に先立ち，ラプチャディスクの展開を確実にすることを目的として，放出配管の末端部から窒素ガスを注入した。まず主放出弁（ＡＶ－１）を閉じ冷水放出弁（ＣＶ－２）を開いて主放出弁下流側を2.4 MPaまで減圧し，放出配管内に窒素ガスを注入して圧力容器とほぼ等しい圧力まで加圧し，再び主放出弁を開いて放出配管内の流体の温度上昇を待った。放出開始前後の運転記録をFig. 3.1に，圧力容器，放出配管内の初期温度分布をFig. 3.2に，ドライウェル，ウェットウェル内の初期および放出終了後の温度分布をそれぞれFig. 3.3，Fig. 3.4に示す。

試験結果の定量的評価・解析は後報にゆずり，ここでは結果の概要のみを述べる。

放出開始直後，放出配管内には一時的に最大約1.2 MPaの減圧が生じた。なお放出開始前に窒素ガスの充てんを行ったため，放出配管内の初期水位は明らかでない。放出配管内流体の初期温度は飽和温度を最大13°C下回った。圧力容器内の水位は放出開始後約125秒で放出配管入口レベルまで下降し，以後放出流体のクォリティが上昇した。

ベントクリアリングは，放出開始約1.1秒後に，各ベント管においてほぼ同時に生じた。本試験では，ドライウェル圧力上昇率が小さいためベントクリアリング時のプール底面・壁面の圧力上昇，ベントクリアリング後のプール水位上昇（プールスウェル）はいずれも小さく，プール最高水位はほとんどの計測点において9.50 m（初期水位から2.5 m上方）以下であった。プールスウェルに際してバキュームブレーカは動作しなかった。

放出開始前のドライウェル温度は層状に分布し，最大約２０℃の温度差を示した。放出開始後約３０秒で温度は均一になり，飽和温度にほぼ一致する値となった。170秒以後，ドライウ

ェル雰囲気は上方から順次過熱状態となり，ベント管内の熱電対の一部も過熱状態を示した。また，ドライウェル内での気液分離の結果，放出流体の一部がドライウェル底面に蓄積した。試験中の蓄積水量は，試験終了後大気圧下での計量にて約8400 kgであり，これは全放出量の44％に相当する。

試験開始前のウェットウェル気相部温度，圧力抑制プール温度はそれぞれほぼ均一であった。試験開始後，プールスウェルによる気相部圧縮，およびベント管，ダイアフラムフロアからの熱伝達により気相部温度が上昇した。プール水の混合は不完全であり，プール底面および水面付近の温度上昇はベント管出口高さ付近の温度上昇より遅れた。ブローダウンの後半，ベント管内の蒸気中の空気分率が低下しチャギングが発生しはじめるとプール内の混合は良好となった。

本試験におけるベント管内蒸気重量速度は最大20 kg/m^2-s と評価される。放出開始後約6秒からベント管内へのプール水の間欠的な逆流が開始し，約74秒から約300秒までチャギングがくり返し発生した。チャギングに伴うプール内の圧力振動は約74秒から140秒にかけて振幅が大きく，プール底面における最大振幅は280 kPa_{p-p} に達した。大振幅のチャギングに際してベント管内の圧力はウェットウェル気相部圧力を一時的に下回り，ベント管VP3に設置されたバキュームブレーカが少くとも10回動作した。

主放出弁は，放出開始後343秒で全閉とし，試験を終了した。

謝　辞

本報告は，先に作成した非公開資料JAERI－memo 8402の内容に検討・修正を加えたものを，科学技術庁原子力局技術振興課の指導のもとに公開に付するものである。

試験装置の管理ならびに試験の実施は，安全工学部安全試験技術室の関口一雄室長，三森武男氏，宮本善夫氏，千葉辰夫氏，伊藤秀雄氏，大崎秀機氏，塚本導雄氏が担当した。本報告の刊行にあたり，ここに深甚なる謝意を表する。

ェル雰囲気は上方から順次過熱状態となり，ベント管内の熱電対の一部も過熱状態を示した。また，ドライウェル内での気液分離の結果，放出流体の一部がドライウェル底面に蓄積した。試験中の蓄積水量は，試験終了後大気圧下での計量にて約8400 kgであり，これは全放出量の44％に相当する。

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Table 3.1 Test matrix

(As of January 1980)

Test Number	DISCHARGE CONDITIONS					INITIAL CONDITIONS					Number of Open Vents	Vacuum Breaker Function-ability	Date of Perform-ance	Ref. Report Number JAERI-M	REMARKS
						Pressure Vessel			Wetwell						
	Disch. Fluid	Nozzle Diam. (mm)	Pipe Inlet Level (m)	Drywell Prepurge (%)	Time of Blowdown (s)	Press. (kPa)	Temp. (°C)	Water Level (m)	Pool Temp. (°C)	Vent Subm. (m)					
0001	water	100	2.105	none		ca.600			22.5	3.342	7	yes	2/18/79		Shakedown test performed by Hitachi Ltd. Excluded from reporting.
0002	water	100	2.105	none		7015	286	6.28	24.6	3.867	7	yes	2/21	8598	Shakedown test performed by Hitachi Ltd.
0003	water	100	2.105	none		6976	286	7.35	27.8	3.802	7	yes	2/23	8761	Shakedown test performed by Hitachi Ltd.
0004	water	200	2.105	none		7005	286	6.89	9.9	3.852	7	yes	2/28	8762	Shakedown test performed by Hitachi Ltd.
1101	water	200	2.105	none	72	7020	286	7.17	29.9	3.632	7	yes	3/30	8763	
2101	water	74	2.105	none	343	6966	287	7.99	14.2	3.345	7	yes	4/27	present	
3101	water	74	2.105	23	298	6887	286	7.79	18.9	3.347	7	yes	5/25	8665	
3102	water	200	2.105	98	68.5	6966	287	7.73	33.2	3.622	7	yes	6/29	8765	
1201	steam	200	9.105	none	85	6894	286	5.71	52.3	3.327	7	yes	8/24		
1202	steam	240	9.105	none	89.0	6976	286	5.44	53.5	3.342	7	yes	9/14		
1203	steam	220	9.105	none	91.9	6974	286	5.06	53.9	3.340	7	yes	10/05		
1204	steam	220	9.105	none	89.9	6971	286	5.32	18.7	3.338	7	yes	10/22		
1205	steam	220	9.105	none	94.5	6966	287	5.77	53.5	3.350	7	no	11/09		
1206	steam	220	9.105	none	85.1	6966				1.962	7	yes	11/29		

TEST NO. = A B C D

A = 1 Pool Swell Test
A = 2 Condensation Oscillation Test without Prepurge
A = 3 Condensation Oscillation Test with Prepurge
B = 1 Water Blowdown
B = 2 Steam Blowdown
B = 3 Air Blowdown
CD = Sequential Number

Table 3.2 Test Specifications

FULL-SCALE MARK II CRT DATA SHEET (TEST SPECIFICATIONS)

TEST NUMBER 2101 DATE OF PERFORMANCE Apr. 27, 1979

(A) SPECIFICATIONS FOR TEST FACILITY CONFIGURATION AND TEST PROCEDURE

(1) Diameter of Discharge Nozzle (mm) 74

(2) Inlet Level of Blowdown Pipe (m) 2.105

(3) Percentage of Prepurge, Specified/Performed (%) None

(4) Number of Open Vent Pipes 7

(5) Vacuum Breaker Functionability yes

(B) SPECIFICATIONS FOR INITIAL CONDITIONS

(1) Pressure Vessel

Item	Specified	Performed
Pressure (kPa)	6966	6966
Temperature (°C)	285	286.6
Water Level (m)	7.5	7.989

(2) Test Containment

Item		Specified	Performed	
			Before Prepurge	Before Break
Pressure (kPa)	Drywell	101		101
	Wetwell	101		101
Pool Temp. (°C)		25		14.2
Pool Level (m)		7.0		7.003

(C) AMBIENT CONDITIONS

Pressure (kPa) 100.5 Temperature (°C) 15

Table 3.3 Summary of Data Recording

(A) Structure of Computer Processed Tapes

Tape No.		21010		21011		21012	
File No.	Index	Contents	Period (s)	Contents	Period (s)	Contents	Period (s)
1		Tape No. Heading		Tape No. Heading		Tape No. Heading	
2	1	R0		R0		R0	
3	2	R1		R1		R1	
4	3	R2		R2		R2	
5	4	Data	-12 367	Data	-11 378	Data	-12 375
6	5						

(B) Structure of PCM Tape

Record No.	Tape Counter Indication	Time Code	Contents
1	2300 - 2350	22°20'03" -22°20'18"	R0
2	2350 - 2403	22°21'25" -22°21'41"	R1
3	2403 - 2455	22°22'50" -22°23'08"	R2
4	2455 - 4400	22°27'54" -22°34'22"	Data
5			
6			

Notes: 1. Last digit of tape number indicates contents of the tape;
- 0 Online data recorded by the system computer.
- 1 Data transferred from PCM recorder track 1.
- 2 Data transferred from PCM recorder track 2.

2. R0, R1, R2 are records for calibration of data channels;
- R0 Zero scale calibration outputs.
- R1 Full scale calibration outputs.
- R2 Initial values.

Table 3.4 Initial and Final Conditions

TEST NUMBER 2101 DATE OF PERFORMANCE Apr. 27, '79

	Unit	Before Test	350 s after* Break	Change
PRESSURE VESSEL				
Pressure	kPa	6966		
Averaged Liquid Temperature	°C	286.6	158.1	
Max./Min. Liquid Temperature	°C	287.0/286.2		
Averaged Steam Temperature	°C	286.9	200.7	
Sat. Press. Based on Liquid Temp.	kPa	7085	588.8	
Liquid Level Based on PVDS-001	m	7.989	1.041	
Liquid Level Based on PVDS-002 - 006	m	7.989	0.972	
Mass of Water	kg	2.29×10^{4}	3.98×10^{3}	-1.89×10^{4}
Energy of Water	kJ	2.95×10^{7}	2.86×10^{6}	-2.66×10^{7}
BLOWDOWN PIPE				
Max./Min. Temperature	°C	273.1/273.6		
DRYWELL				
Pressure	kPa	101	(262)	
Sat. Temp. Based on Pressure	°C		130.7	
Averaged Gas Phase Temperature	°C	34.7	148.4	
Max./Min. Gas Phase Temperature	°C	44.0/24.3	150.4/138.0	
Liquid Level	m		0.138-0.185	
VENT PIPES				
Max./Min. Inlet Temperature	°C	14.6/14.3	142.5/135.4	
Max./Min. Outlet Temperature	°C	14.5/14.2	41.0/35.6	
WETWELL				
Pressure	kPa	101	(262)	
Averaged Pool Temperature	°C	14.2	33.5	
Max./Min. Pool temperature	°C	14.5/13.4	36.1/30.8	
Averaged Airspace Temperature	°C	13.9	45.7	
Max./Min. Airspace Temperature	°C	14.7/13.4	54.8/34.1	
Liquid Level	m	7.003	(7.390)	
Mass of Water	kg	1.92×10^{5}	2.02×10^{5}	1.06×10^{4}
Energy of Water	kJ	1.14×10^{7}	2.83×10^{7}	1.69×10^{7}
Mass of Air	kg	321	721	

REMARKS

* Numbers in parentheses are data measured after opening the equalizer valve between drywell and wetwell.

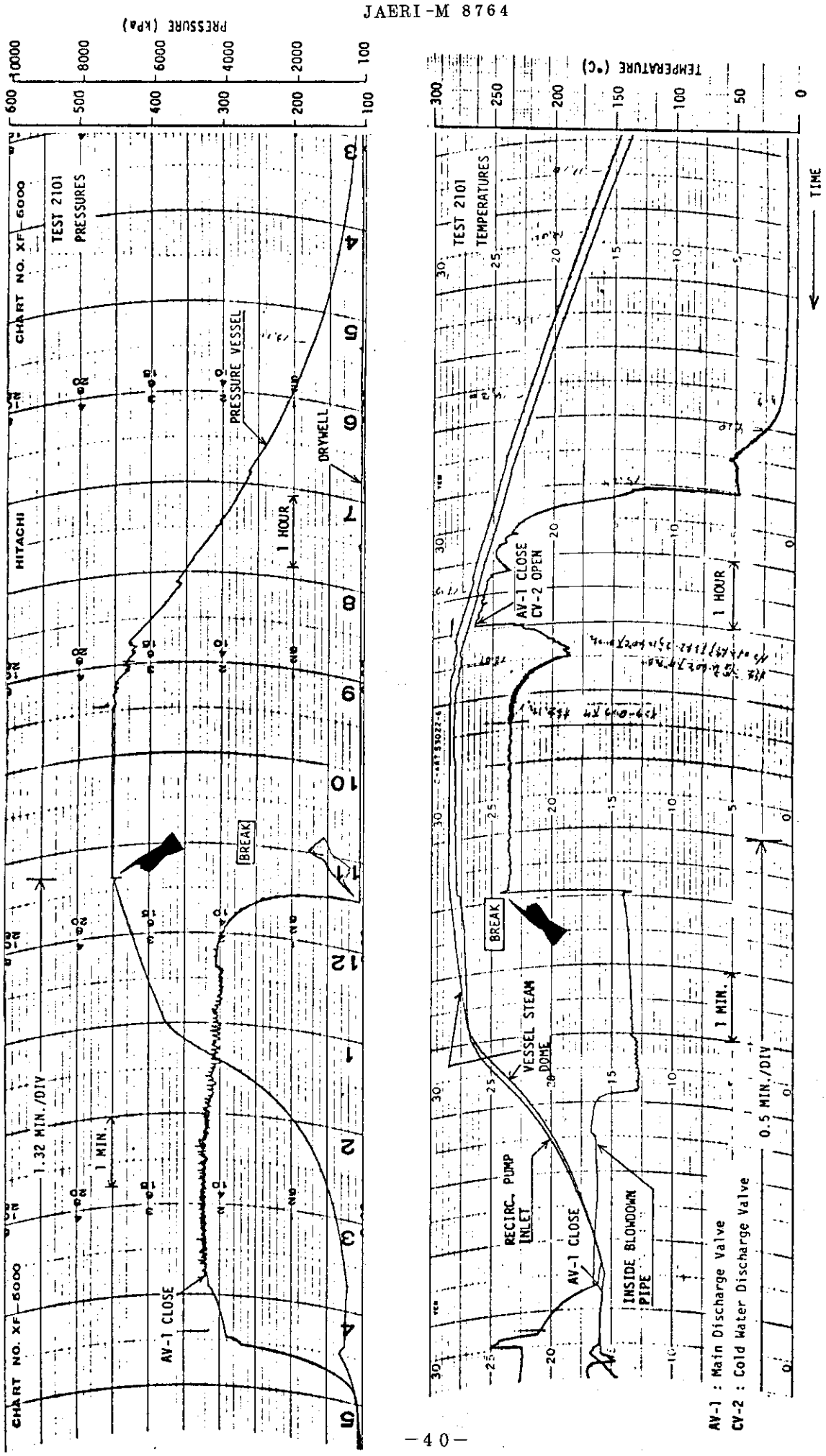


Fig. 3.1 Operation Records

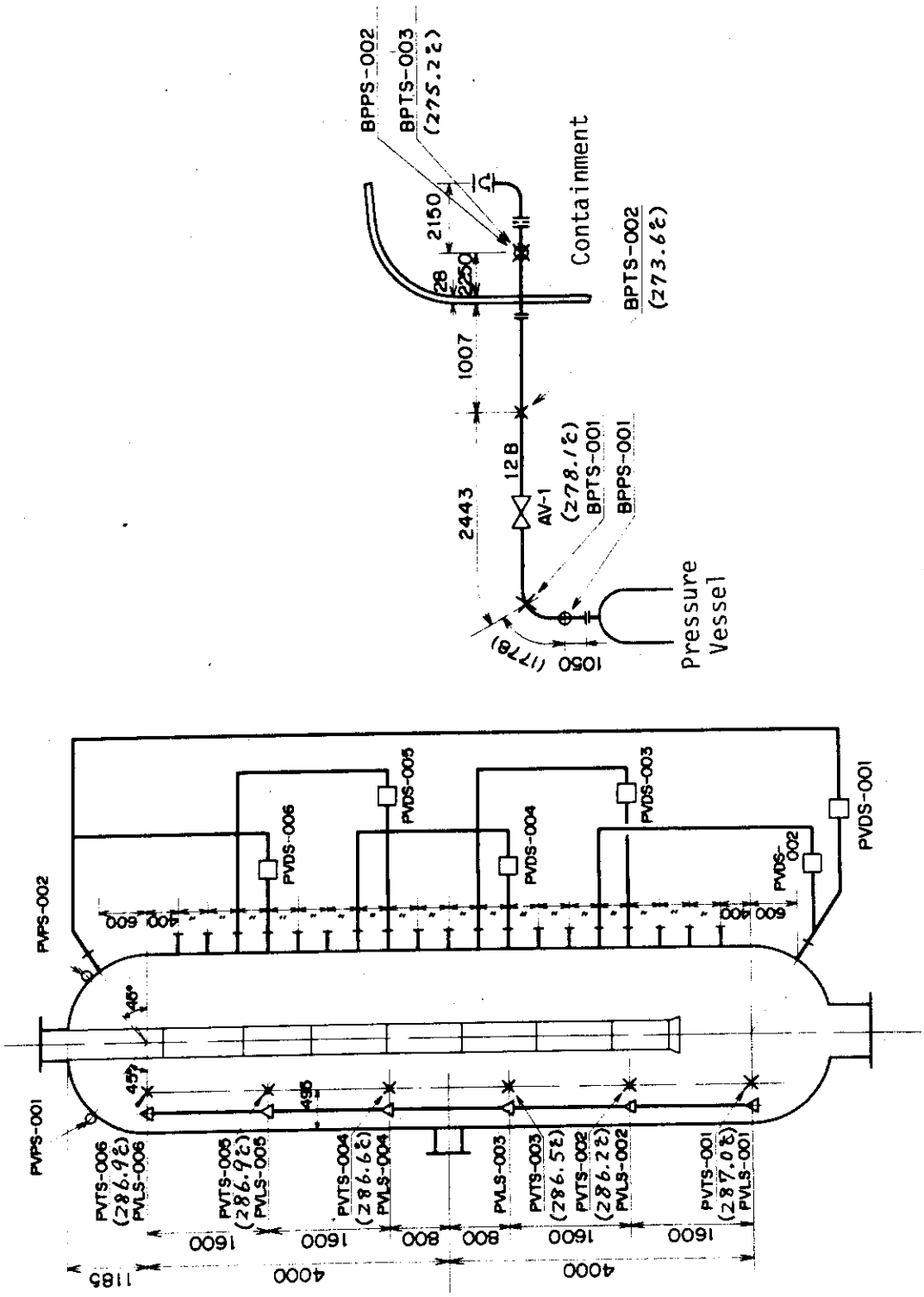
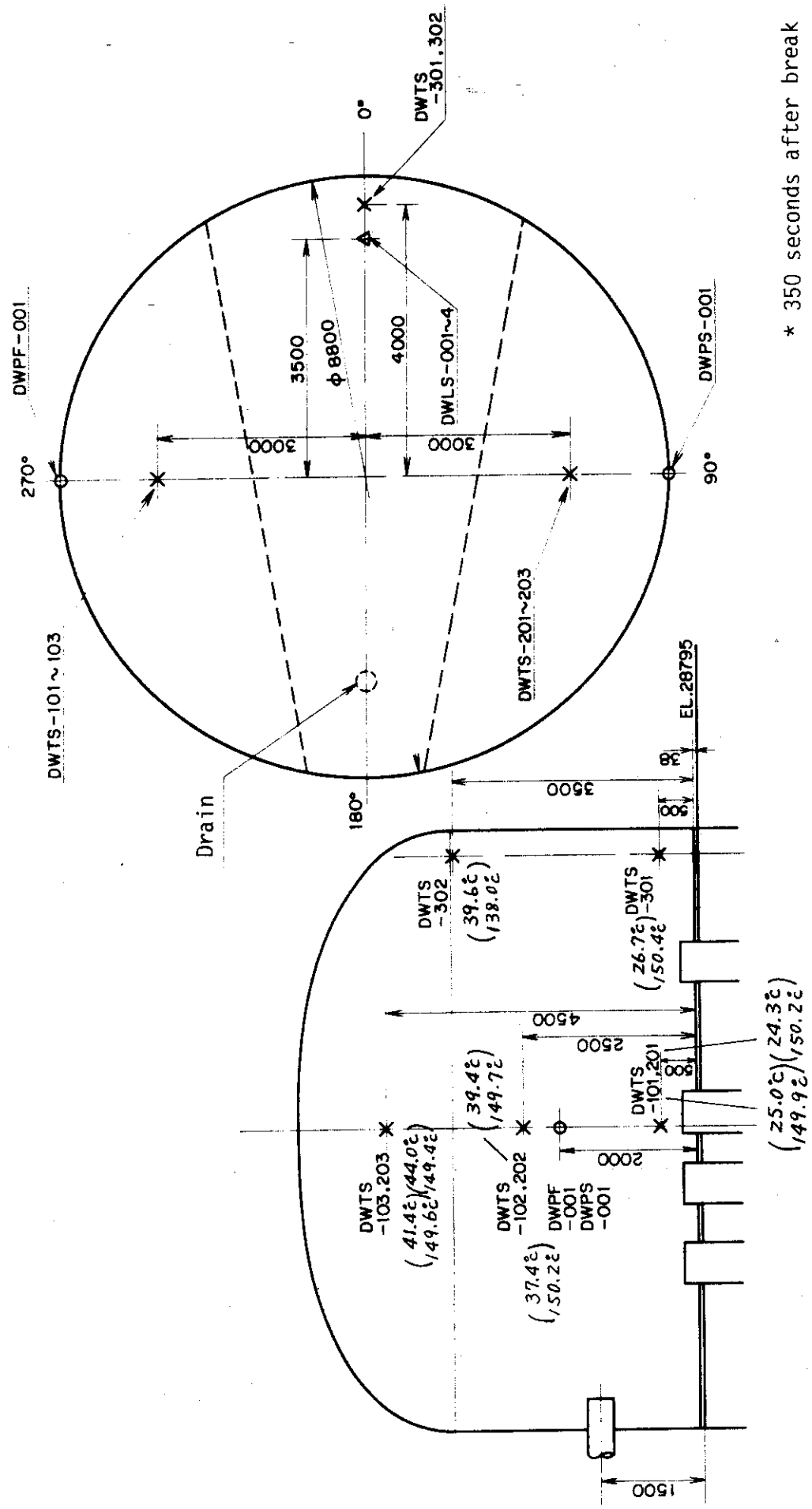
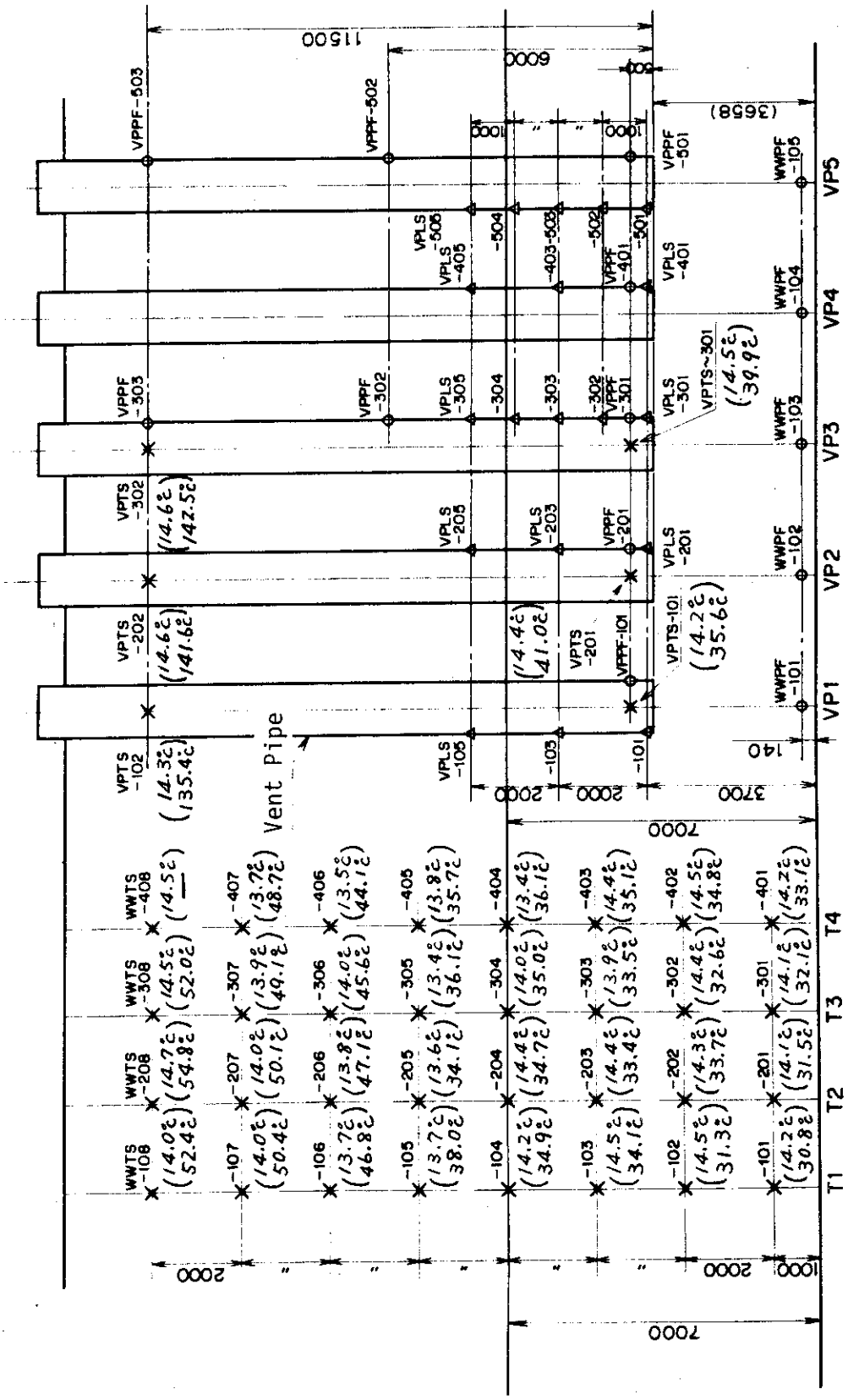


Fig. 3.2 Initial Temperature Distribution in Primary System



* 350 seconds after break

Fig. 3.3 Initial and Final* Temperature Distributions in Drywell



* 350 seconds after break

Fig. 3.4 Initial and Final* Temperature Distributions in Wetwell

Long Term Plots of Data

Long Term Plot Specification

Period 0 — 350 s

Plot No.	Recording System	Recording Rate (data/s)	Sampling Rate for Plots	Interval for Envelope Plots (s)	Remarks
L-0-1 to 37	Computer	50.00	1/9		
L-1-1 to 32	PCM Track - 1	455.56	1/91	4.19	
L-2-1 to 14	PCM Track - 2	455.56	1/82	3.42	

List of Long Term Plots

Computer Recorded Channels

Plot	L-0-1	Actuation Signals	
〃	L-0-2	Pressures in Pressure Vessel and Blowdown Pipe	
〃	L-0-3	Pressures in Drywell and Wetwell Airspace	
〃	L-0-4	DP over Pressure Vessel	
〃	L-0-5	DP across Wetwell Pool Surface	
〃	L-0-6	DP across Diaphragm Floor	
〃	L-0-7	Temperatures in Pressure Vessel	
〃	L-0-8	Temperatures in Pressure Vessel and Blowdown Pipe	
〃	L-0-9	Temperatures in Drywell	(DWTS-101 - 103)
〃	L-0-10	Temperatures in Drywell	(DWTS-201 - 203)
〃	L-0-11	Temperatures in Drywell	(DWTS-301 - 302)
〃	L-0-12	Temperatures in Vent Pipe	(VP 1)
〃	L-0-13	Temperatures in Vent Pipe	(VP 2)
〃	L-0-14	Temperatures in Vent Pipe	(VP 3)
〃	L-0-15	Temperatures in Wetwell	(WWTS-101 - 104)
〃	L-0-16	Temperatures in Wetwell	(WWTS-105 - 108)
〃	L-0-17	Temperatures in Wetwell	(WWTS-201 - 204)
〃	L-0-18	Temperatures in Wetwell	(WWTS-205 - 208)
〃	L-0-19	Temperatures in Wetwell	(WWTS-301 - 304)
〃	L-0-20	Temperatures in Wetwell	(WWTS-305 - 308)
〃	L-0-21	Temperatures in Wetwell	(WWTS-401 - 404)
〃	L-0-22	Temperatures in Wetwell	(WWTS-405 - 408)
〃	L-0-23	Water Level in Pressure Vessel	
〃	L-0-24	Water Level in Drywell	
〃	L-0-25	Water Level in Vent Pipe	(VP 1)
〃	L-0-26	Water Level in Vent Pipe	(VP 2)
〃	L-0-27	Water Level in Vent Pipe	(VP 3)
〃	L-0-28	Water Level in Vent Pipe	(VP 4)
〃	L-0-29	Water Level in Vent Pipe	(VP 5)
〃	L-0-30	Water Level in Wetwell	(WWLS-104 - 116)
〃	L-0-31	Water Level in Wetwell	(WWLS-201 - 216)
〃	L-0-32	Water Level in Wetwell	(WWLS-303 - 315)
〃	L-0-33	Water Level in Wetwell	(WWLS-401 - 416)
〃	L-0-34	Water Level in Wetwell	(WWLS-503 - 515)
〃	L-0-35	Water Level in Wetwell	(WWLS-604 - 616)
〃	L-0-36	Water Level in Wetwell	(WWLS-704 - 716)
〃	L-0-37	Water Level in Wetwell	(WWLS-804 - 816)

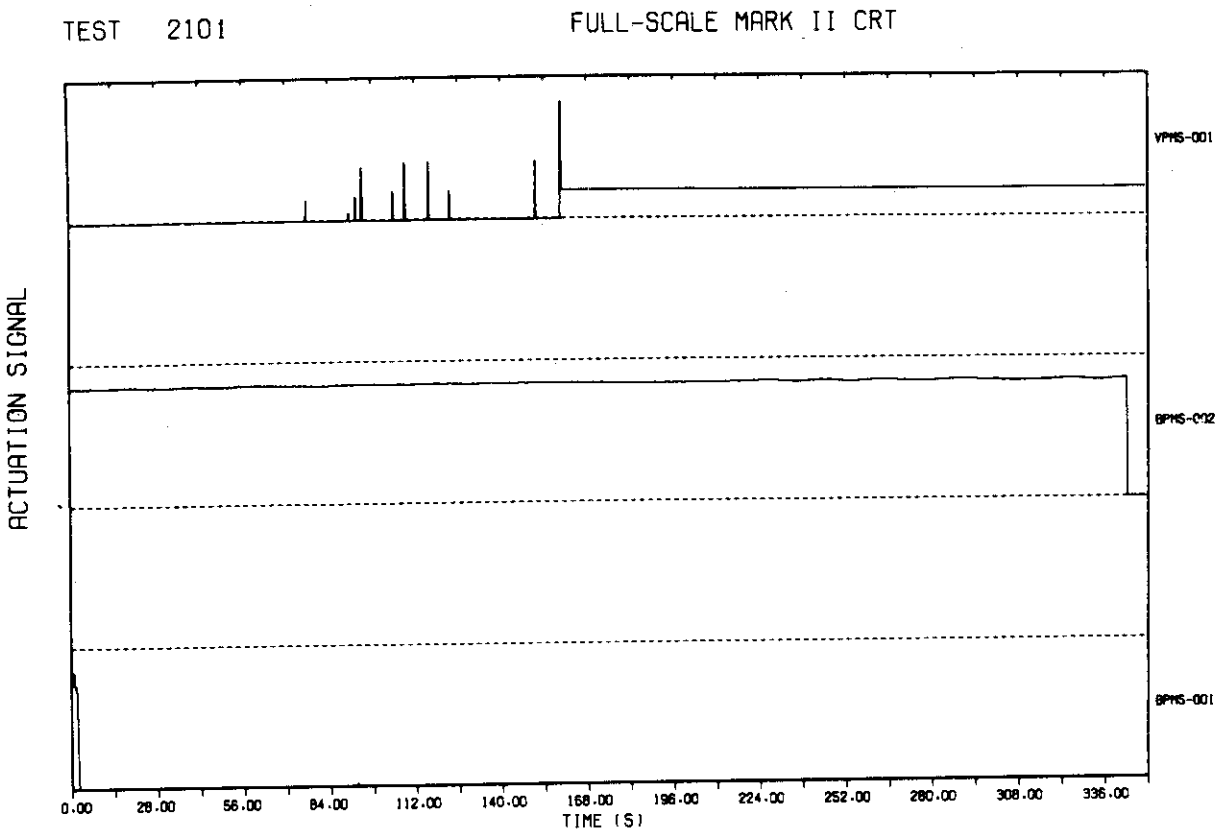
List of Long Term Plots (continued)

PCM Track-1 Channels

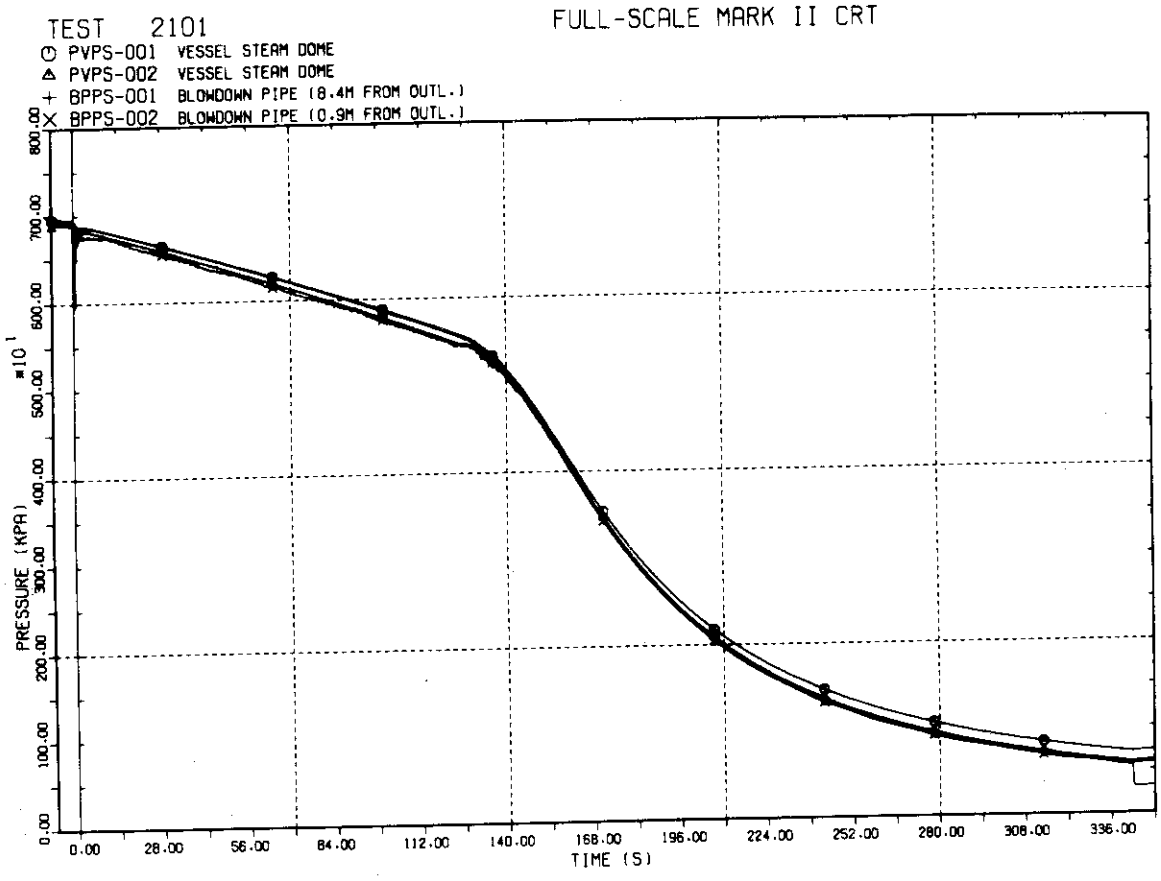
Plot	L-1-1	Pressures in Drywell and Wetwell Airspace	
〃	L-1-2	Pressure in Vent Pipe	(VPPF-101)
〃	L-1-3	Pressure in Vent Pipe	(VPPF-201)
〃	L-1-4	Pressure in Vent Pipe	(VPPF-301)
〃	L-1-5	Pressure in Vent Pipe	(VPPF-302)
〃	L-1-6	Pressure in Vent Pipe	(VPPF-303)
〃	L-1-7	Pressure in Vent Pipe	(VPPF-401)
〃	L-1-8	Pressure in Vent Pipe	(VPPF-501)
〃	L-1-9	Pressure in Vent Pipe	(VPPF-502)
〃	L-1-10	Pressure in Vent Pipe	(VPPF-503)
〃	L-1-11	Pressure in Wetwell	(WWPF-101)
〃	L-1-12	Pressure in Wetwell	(WWPF-102)
〃	L-1-13	Pressure in Wetwell	(WWPF-103)
〃	L-1-14	Pressure in Wetwell	(WWPF-104)
〃	L-1-15	Pressure in Wetwell	(WWPF-105)
〃	L-1-16	Pressure in Wetwell	(WWPF-106)
〃	L-1-17	Pressure in Wetwell	(WWPF-107)
〃	L-1-18	Pressure in Wetwell	(WWPF-201)
〃	L-1-19	Pressure in Wetwell	(WWPF-202)
〃	L-1-20	Pressure in Wetwell	(WWPF-203)
〃	L-1-21	Pressure in Wetwell	(WWPF-301)
〃	L-1-22	Pressure in Wetwell	(WWPF-302)
〃	L-1-23	Pressure in Wetwell	(WWPF-303)
〃	L-1-24	Pressure in Wetwell	(WWPF-401)
〃	L-1-25	Pressure in Wetwell	(WWPF-402)
〃	L-1-26	Pressure in Wetwell	(WWPF-501)
〃	L-1-27	Pressure in Wetwell	(WWPF-502)
〃	L-1-28	Pressure in Wetwell	(WWPF-602)
〃	L-1-29	Pressure in Wetwell	(WWPF-702)
〃	L-1-30	Strain of Vent Pipe Brace	(VPSF-101)
〃	L-1-31	Strain of Vent Pipe Brace	(VPSF-102)
〃	L-1-32	Strain of Vent Pipe Brace	(VPSF-201)

PCM Track-2 Channels

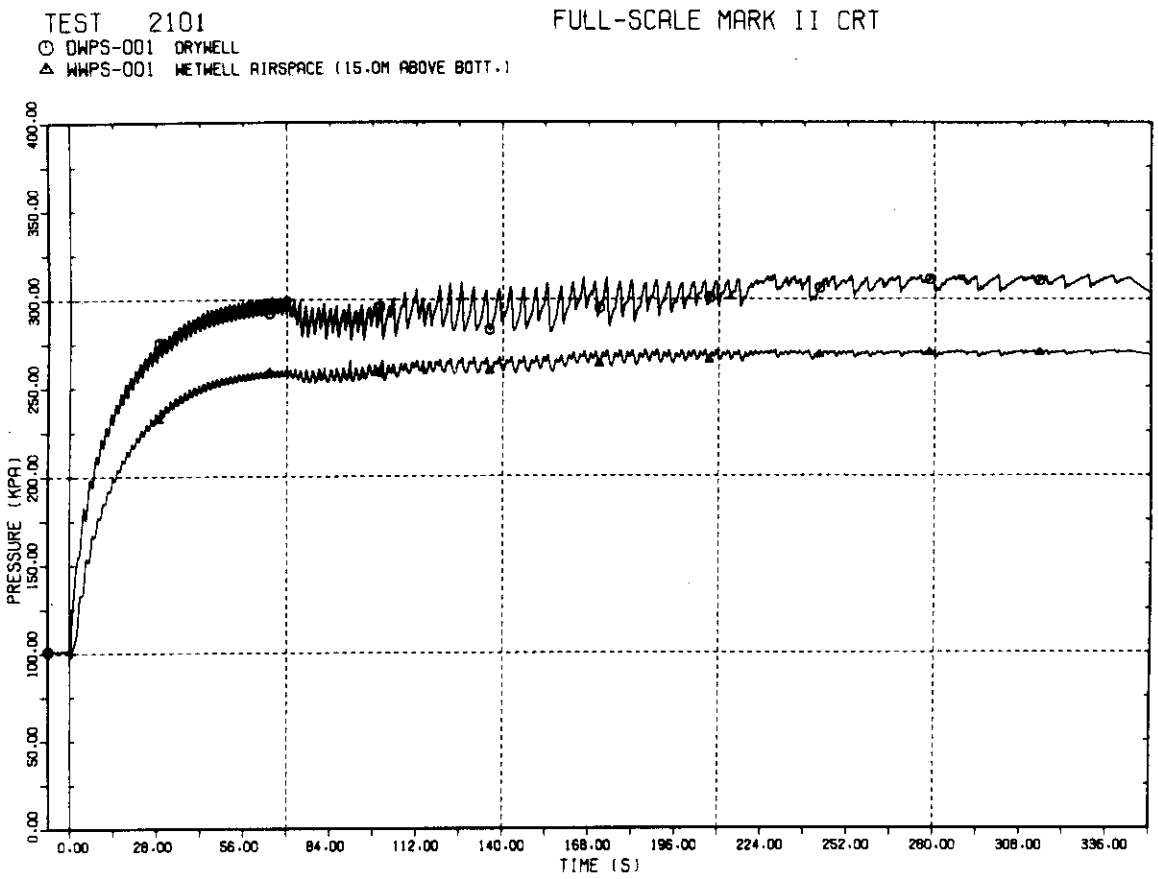
Plot	L-2-1	Acceleration of Vent Pipe Outlet	(VPAF-101)
〃	L-2-2	Acceleration of Vent Pipe Outlet	(VPAF-201)
〃	L-2-3	Acceleration of Vent Pipe Outlet	(VPAF-202)
〃	L-2-4	Acceleration of Containment Structure	(WWAF-005)
〃	L-2-5	Acceleration of Containment Structure	(WWAF-006)
〃	L-2-6	Acceleration of Containment Structure	(WWAF-007)
〃	L-2-7	Acceleration of Containment Structure	(WWAF-008)
〃	L-2-8	Acceleration of Containment Structure	(WWAF-009)
〃	L-2-9	Acceleration of Containment Structure	(WWAF-010)
〃	L-2-10	Acceleration of Containment Structure	(WWAF-011)
〃	L-2-11	Acceleration of Containment Structure	(WWAF-012)
〃	L-2-12	Phase Boundary Signals	(WWLF-101 - 108)
〃	L-2-13	Phase Boundary Signals	(WWLF-201 - 209)
〃	L-2-14	Phase Boundary Signals	(WWLF-301 - 308)



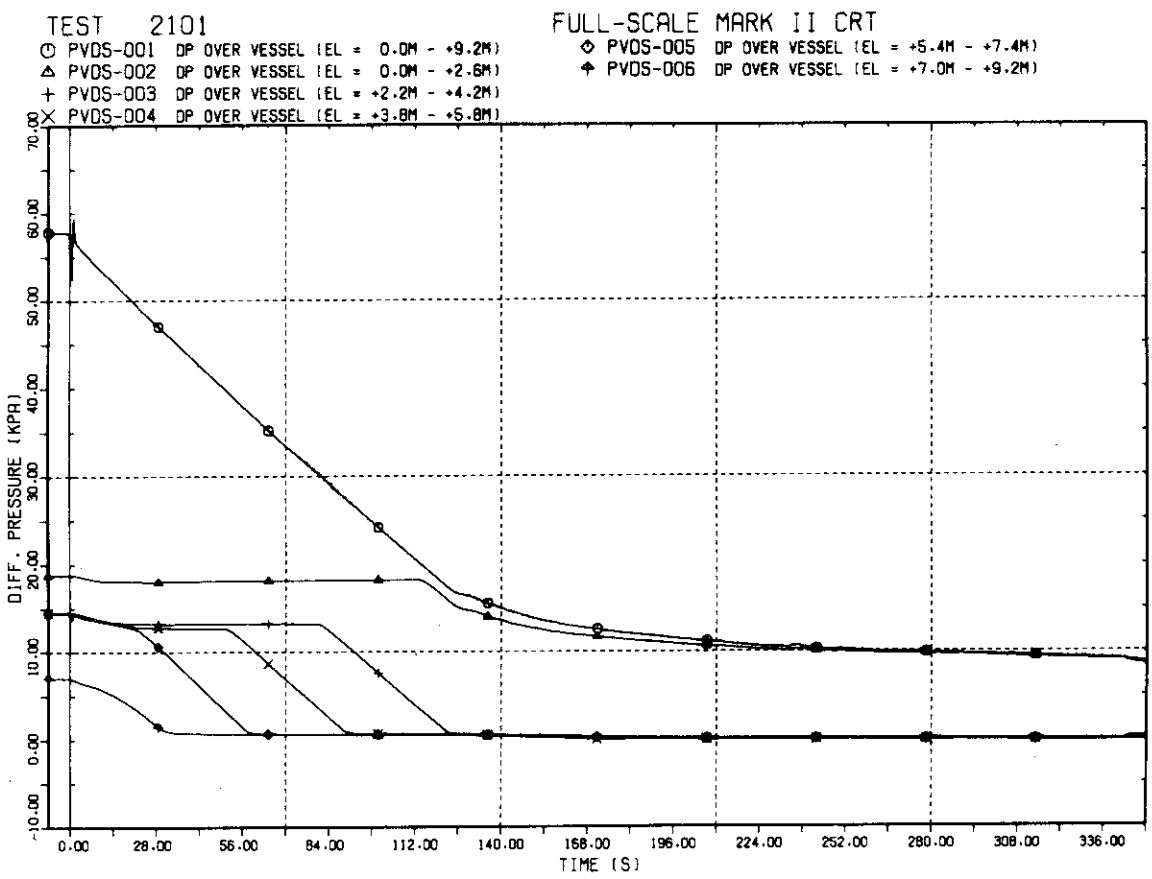
Plot L-0-1 Actuation Signals



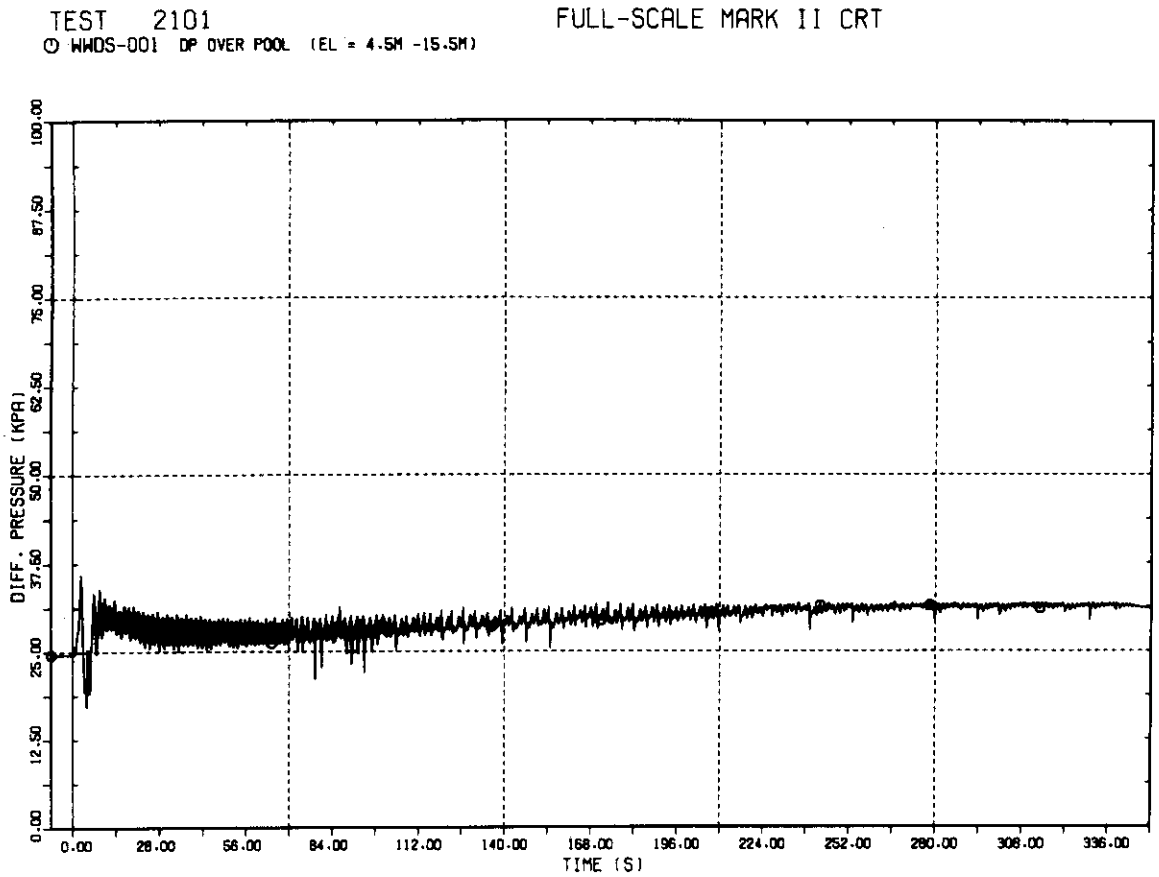
Plot L-0-2 Pressures in Vessel and Blowdown Pipe



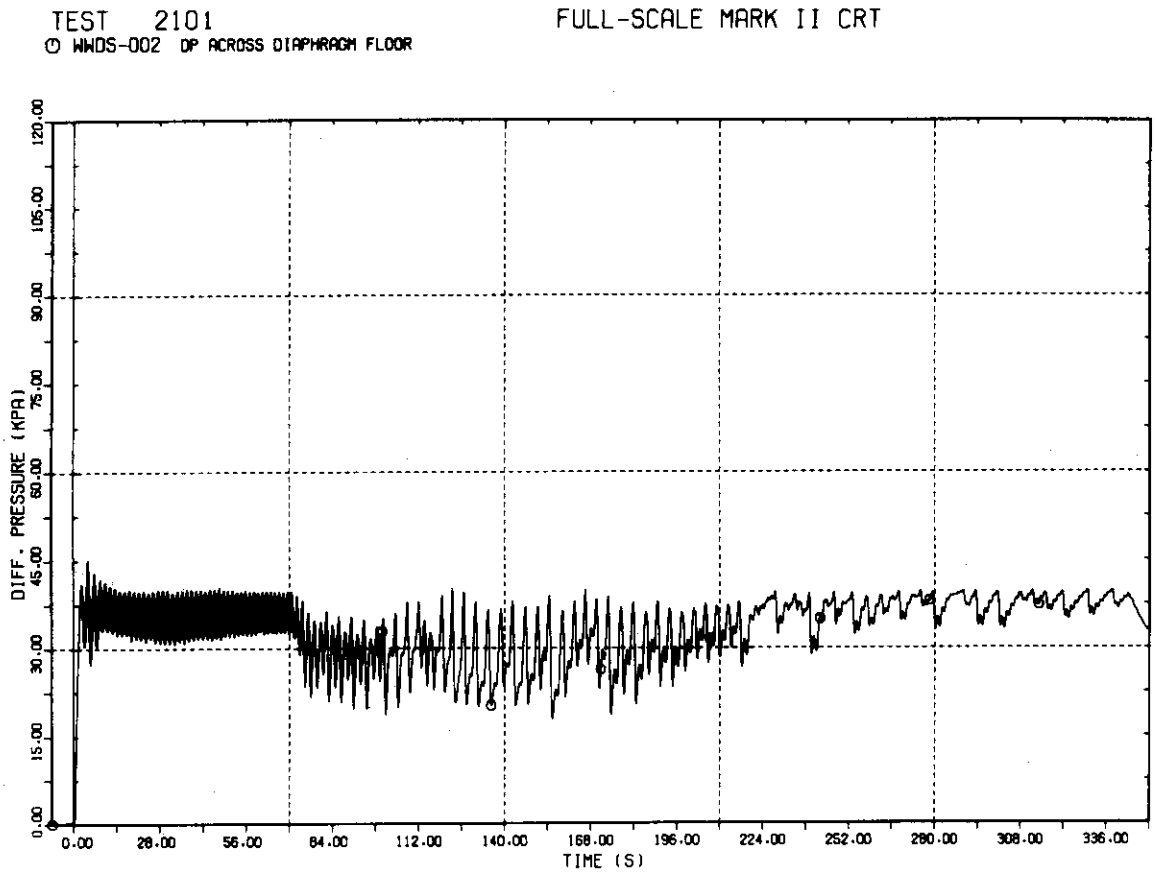
Plot L-0-3 Pressures in Drywell and Wetwell Airspace



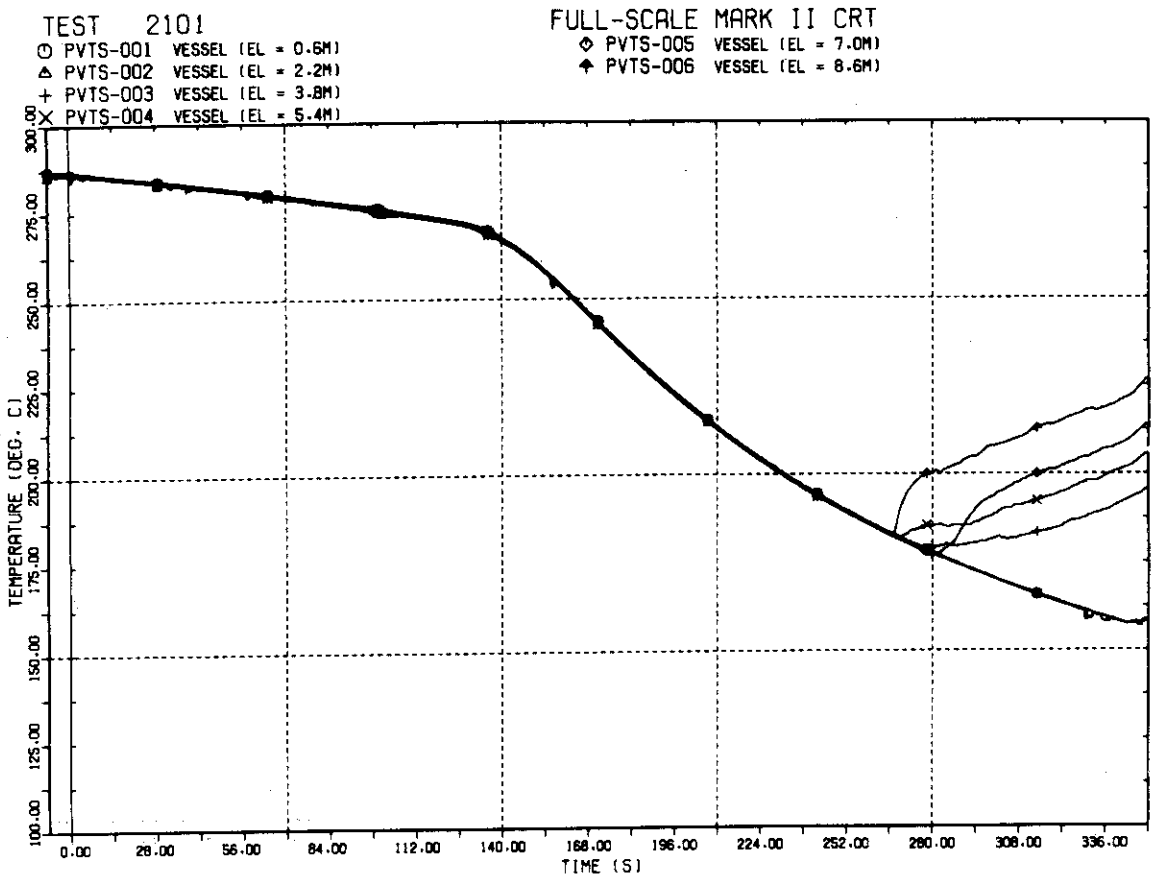
Plot L-0-4 DP over Vessel



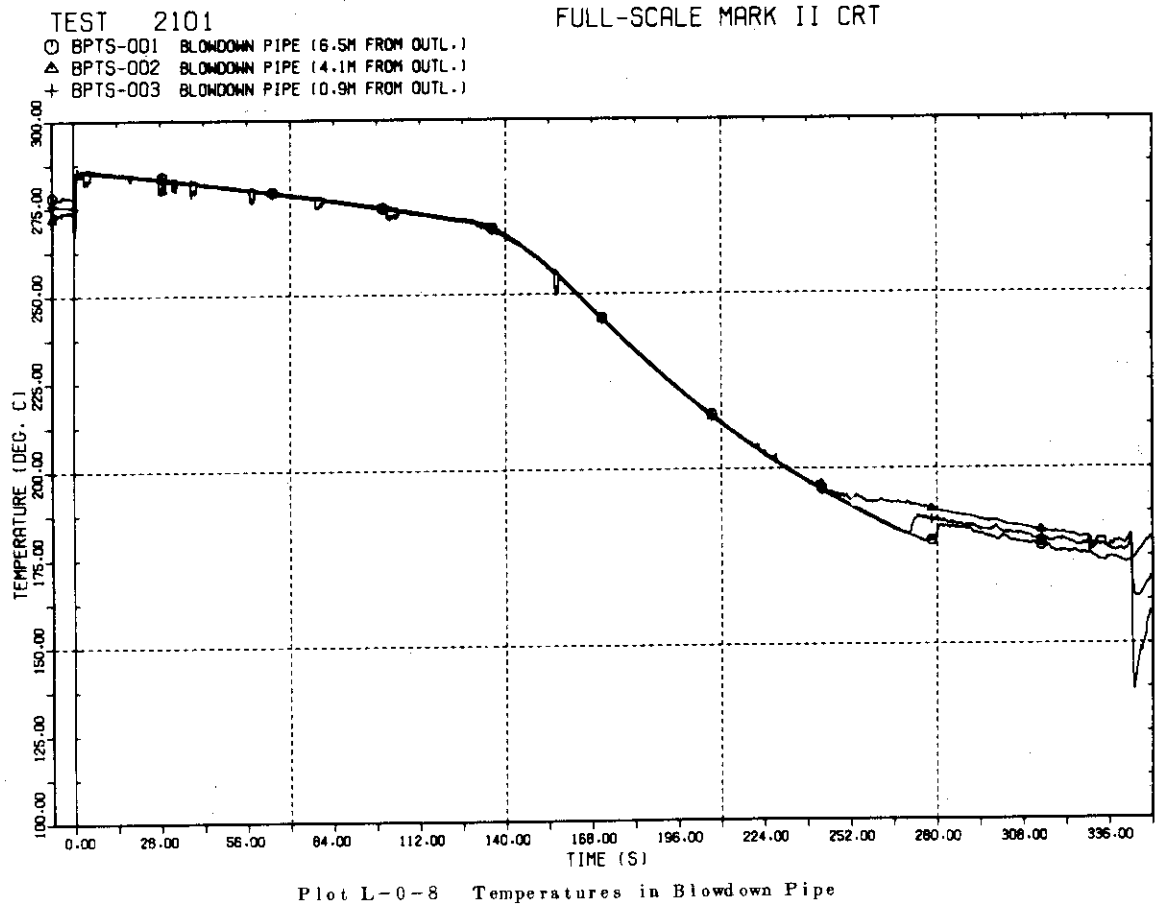
Plot L-0-5 DP across Pool Surface



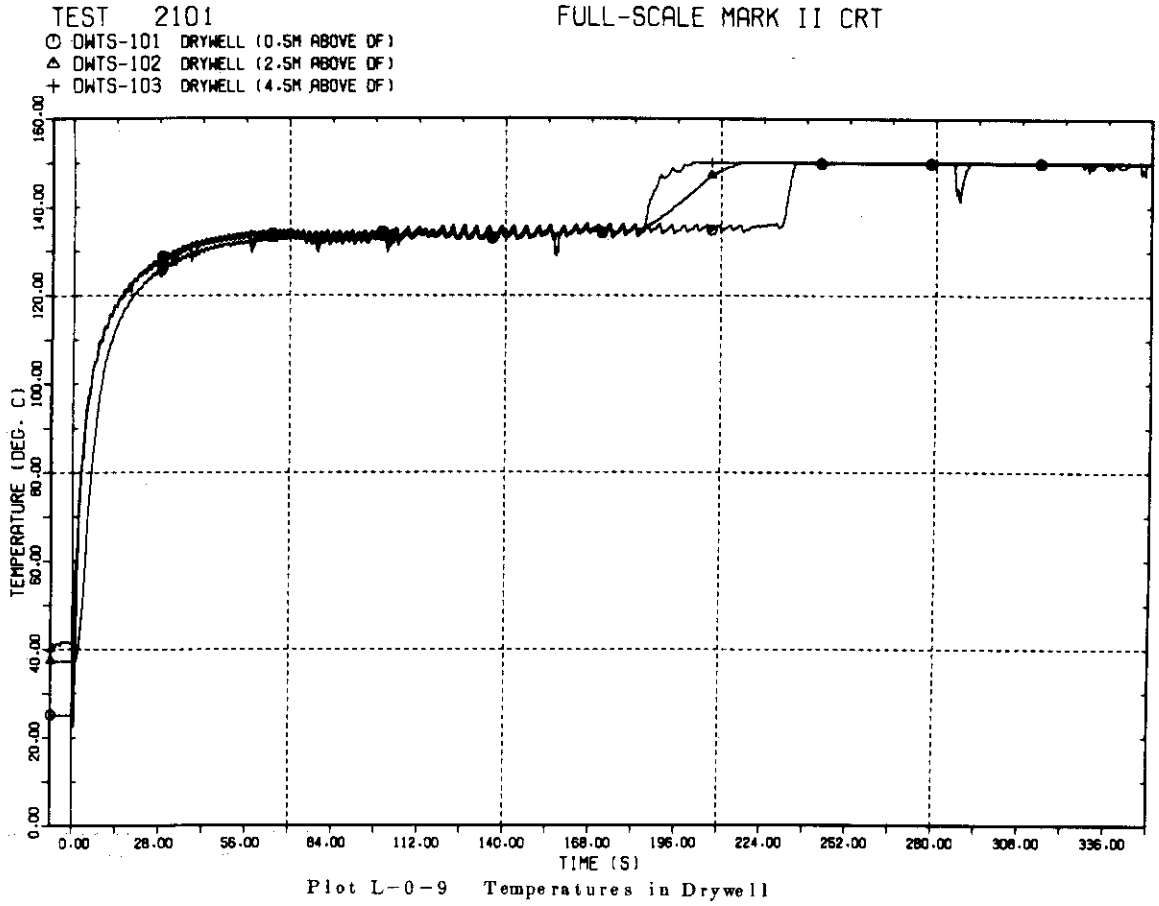
Plot L-0-6 DP across Diaphragm Floor



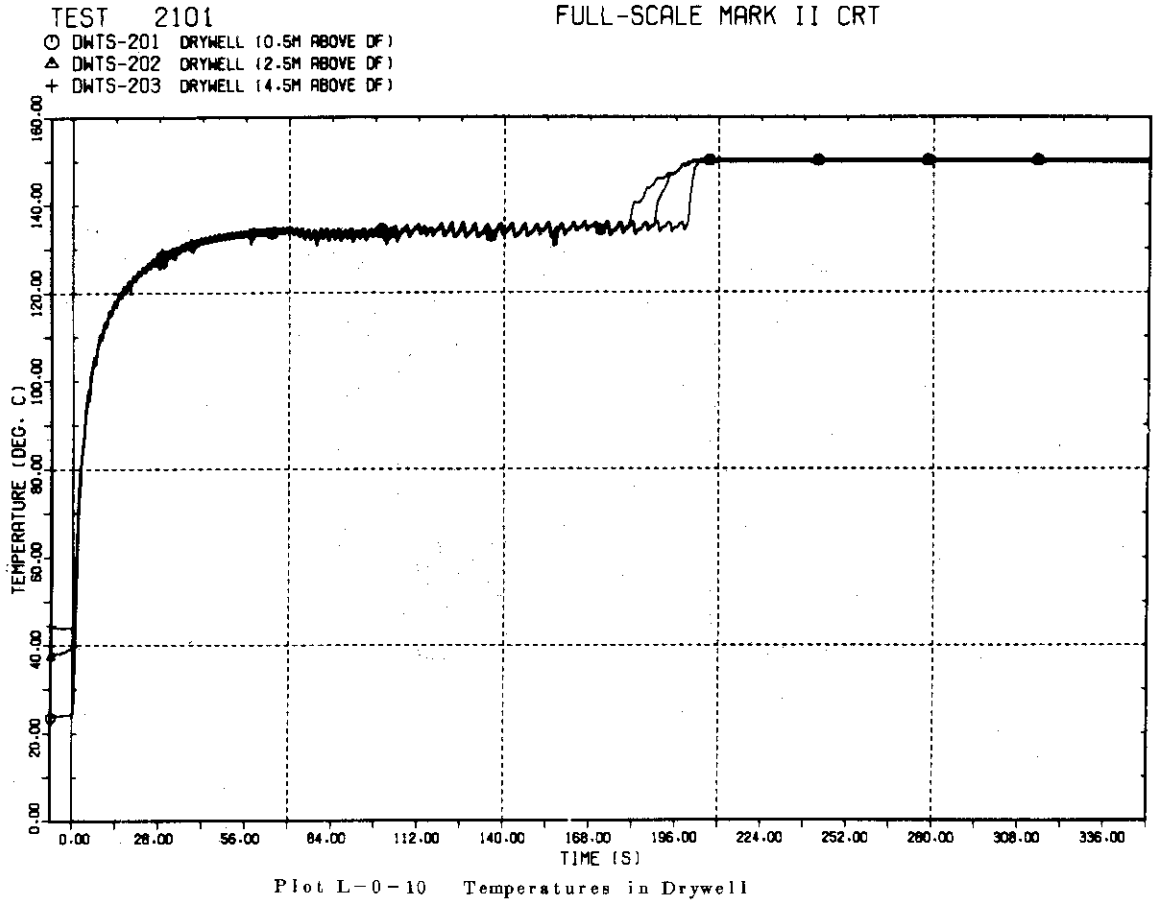
Plot L-0-7 Temperatures in Vessel



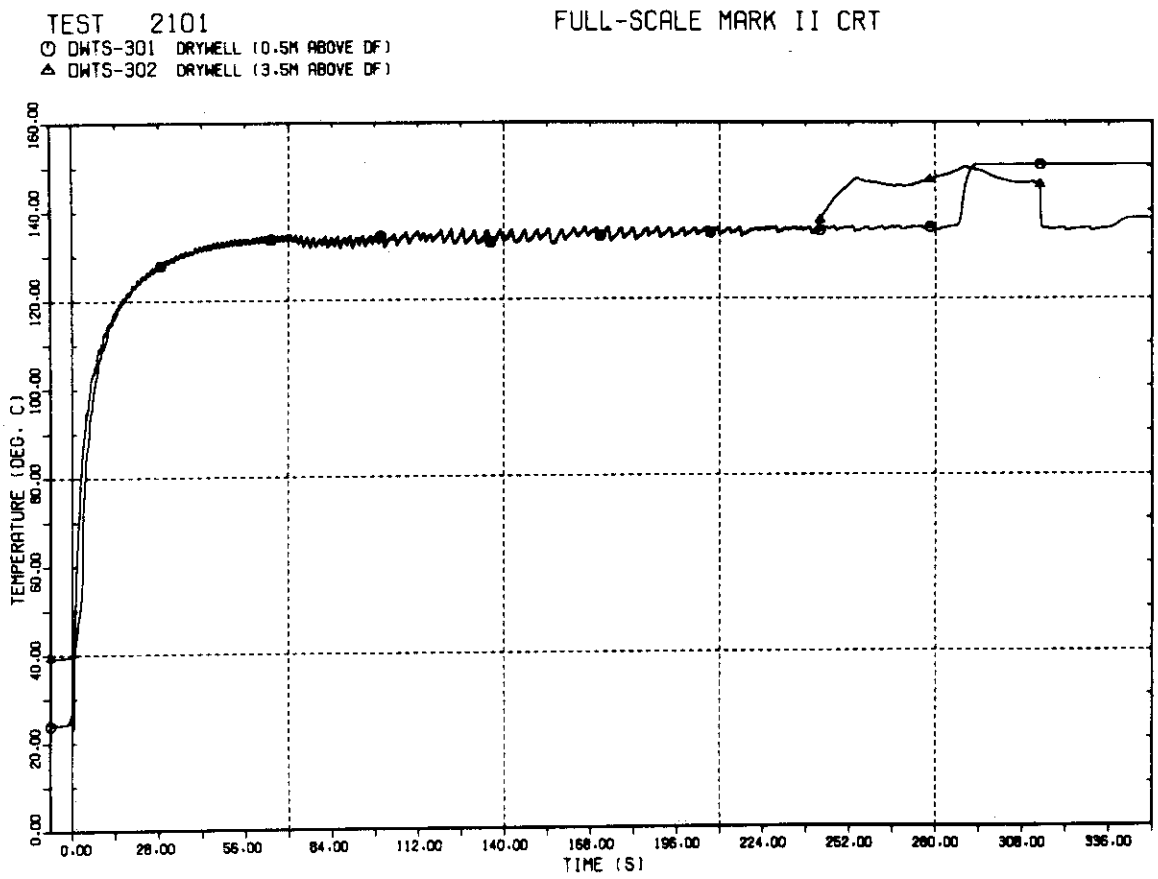
Plot L-0-8 Temperatures in Blowdown Pipe



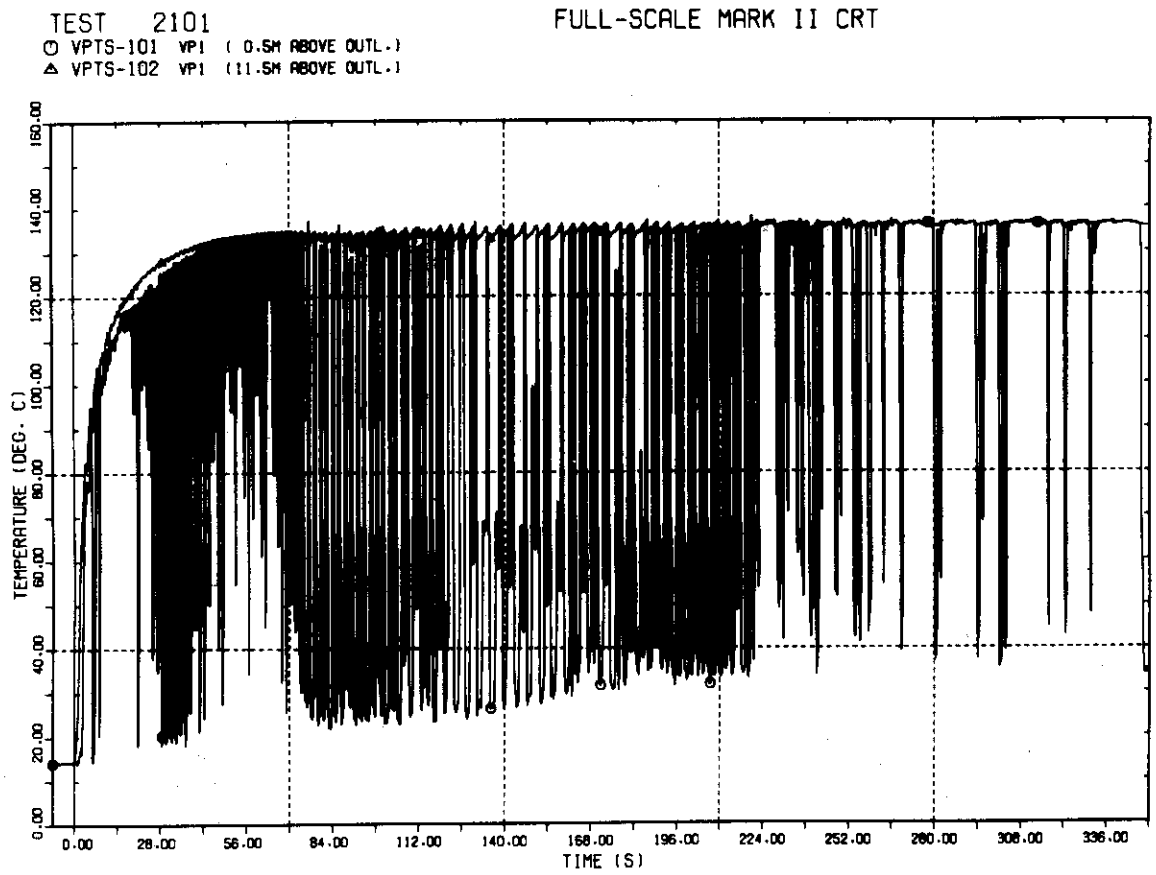
Plot L-0-9 Temperatures in Drywell



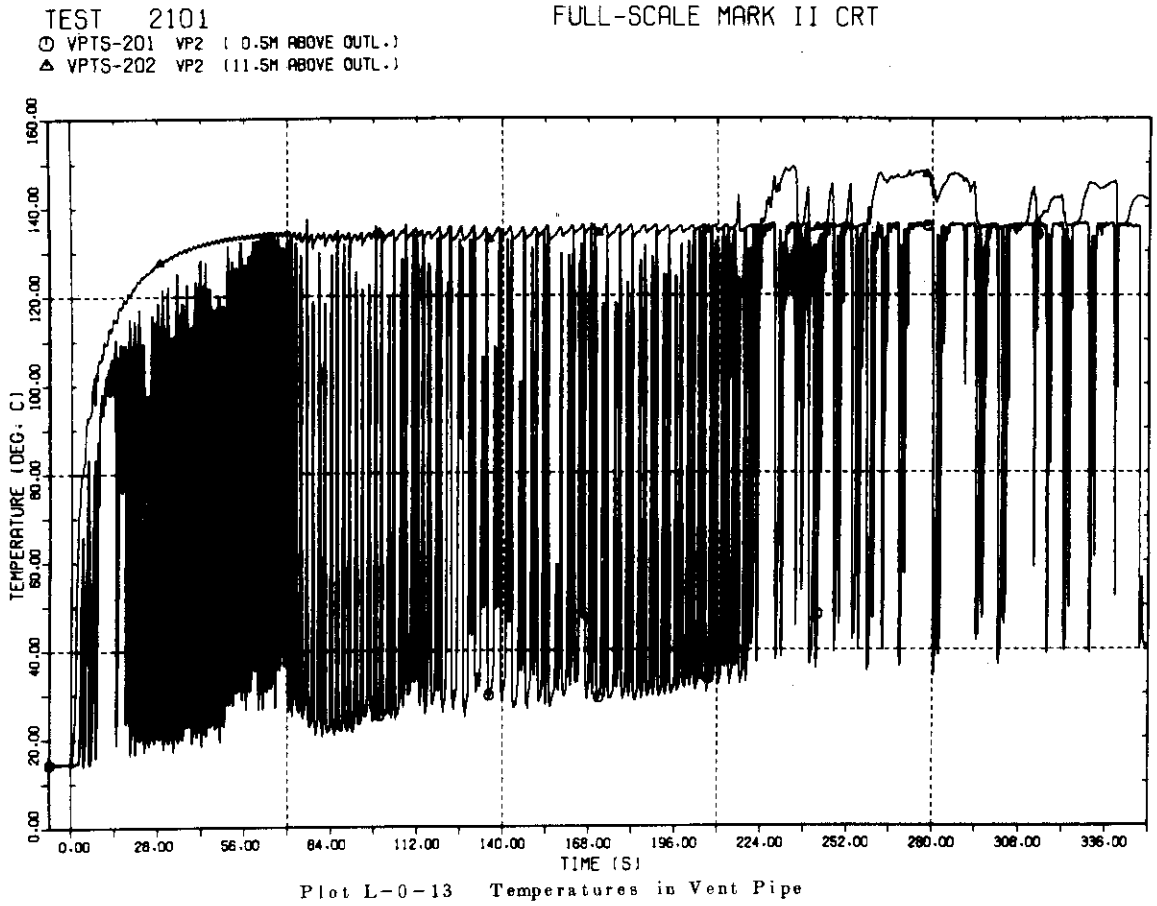
Plot L-0-10 Temperatures in Drywell



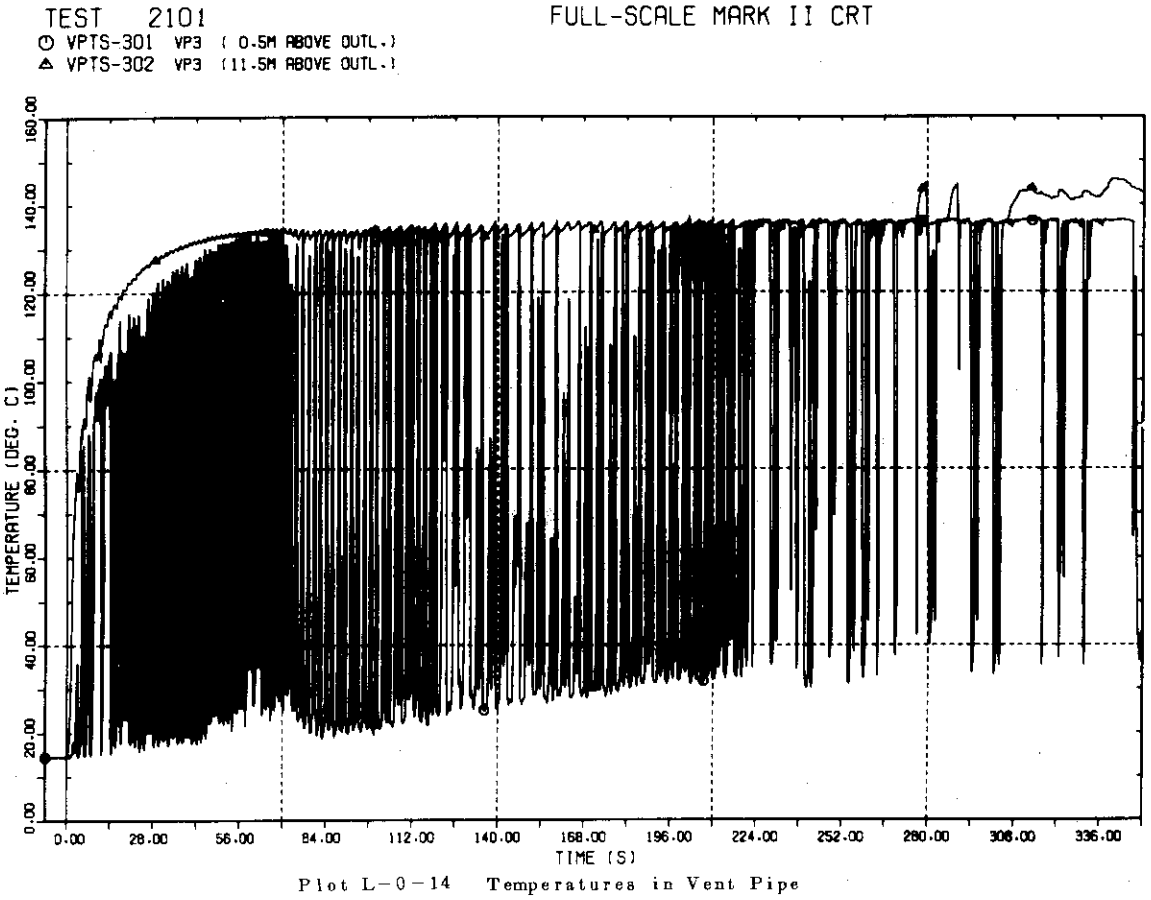
Plot L-0-11 Temperatures in Drywell



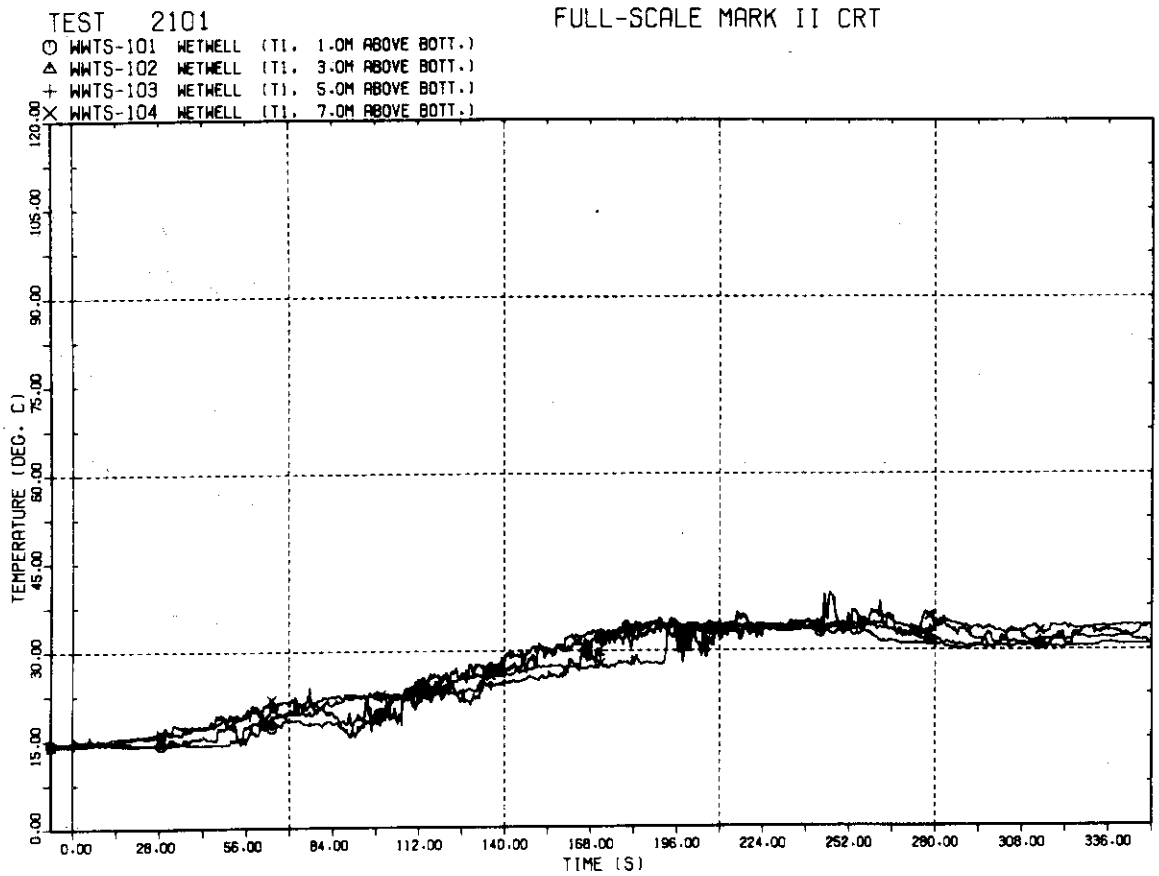
Plot L-0-12 Temperatures in Vent Pipe



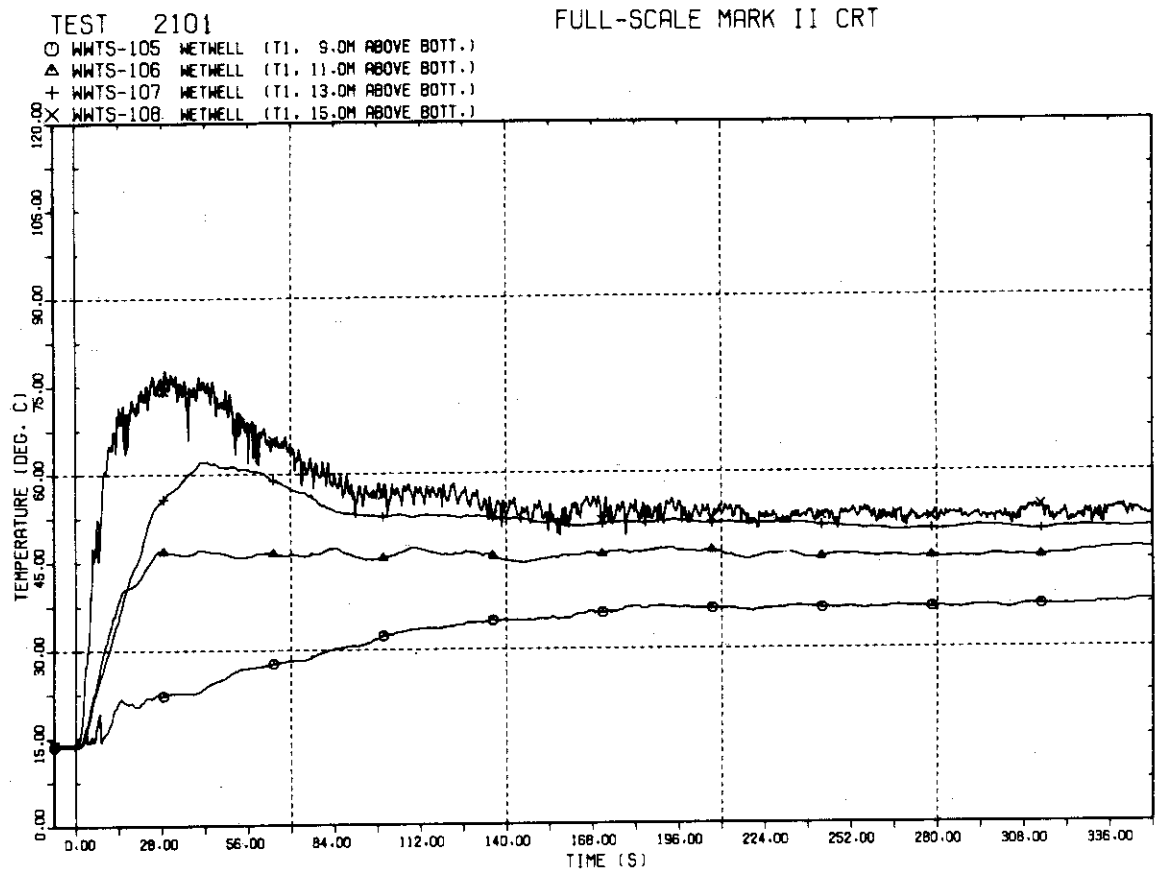
Plot L-0-13 Temperatures in Vent Pipe



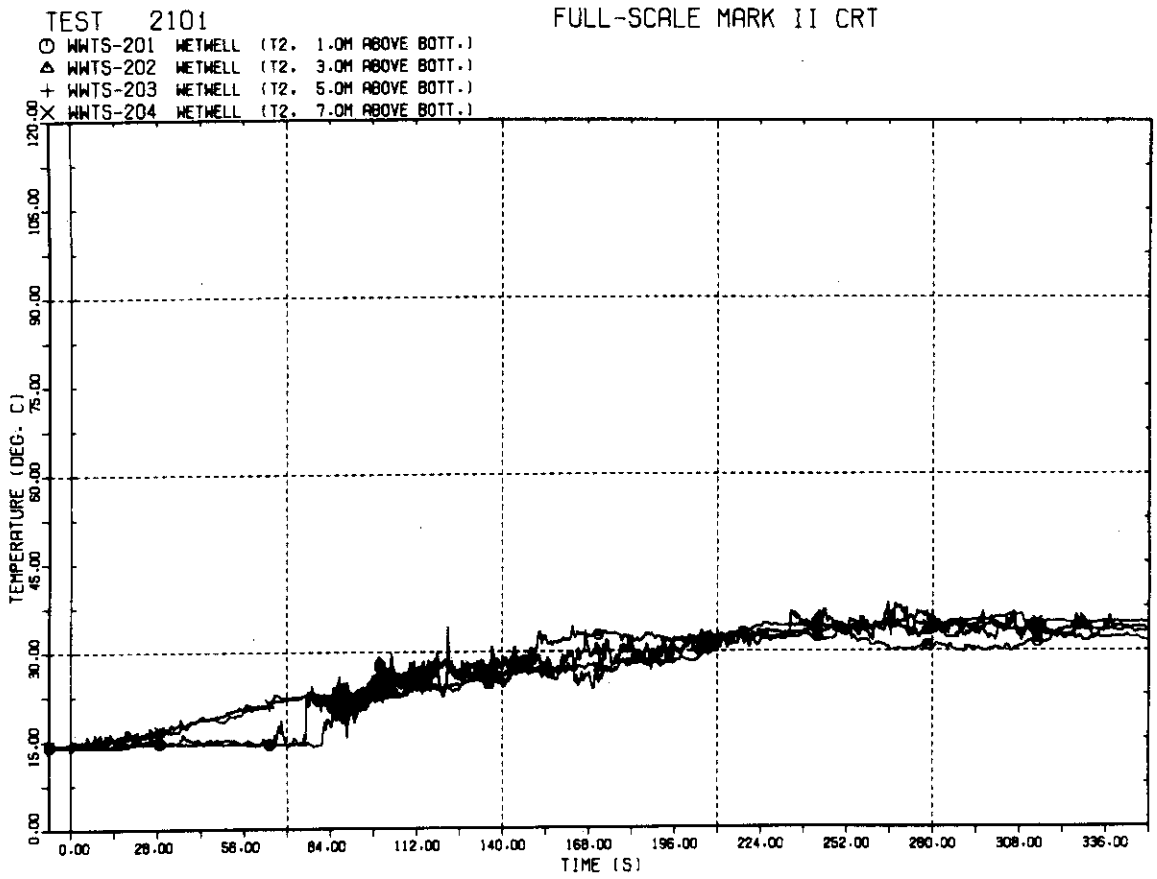
Plot L-0-14 Temperatures in Vent Pipe



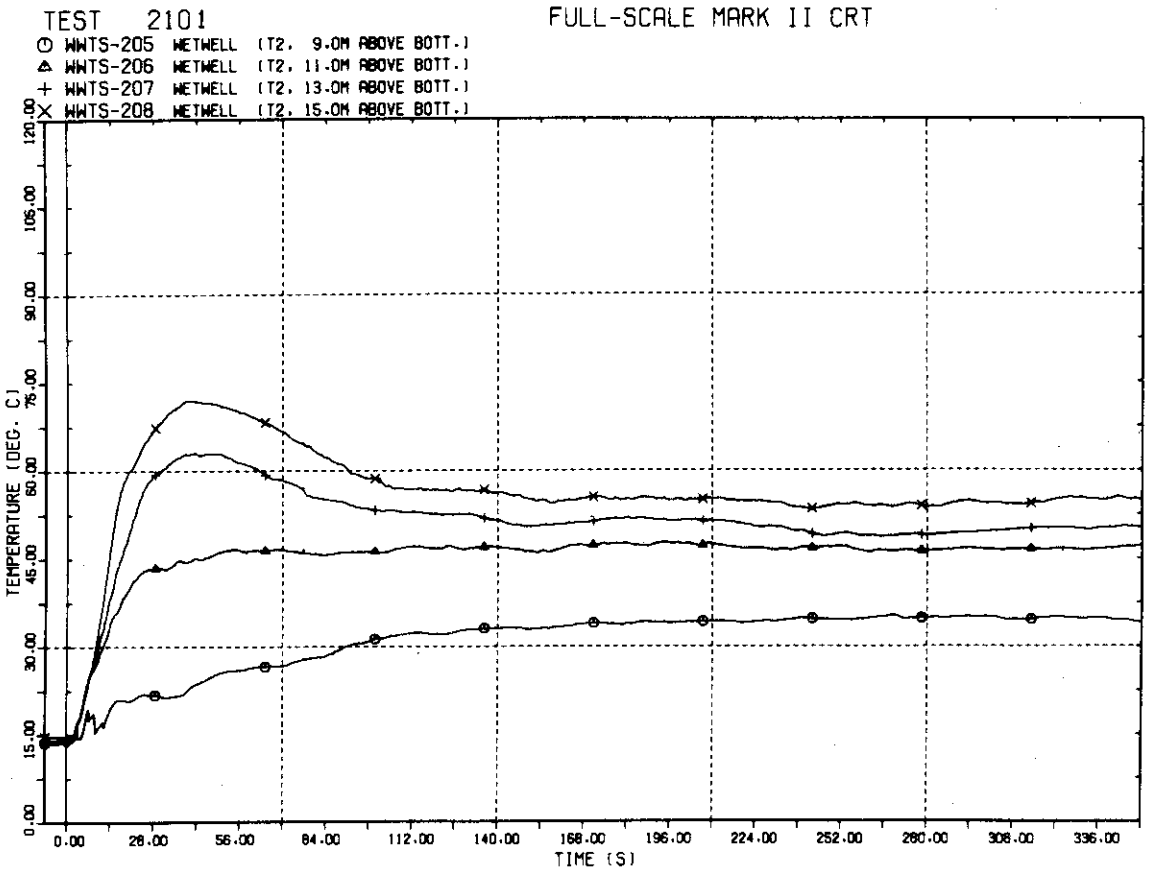
Plot L-0-15 Temperatures in Wetwell



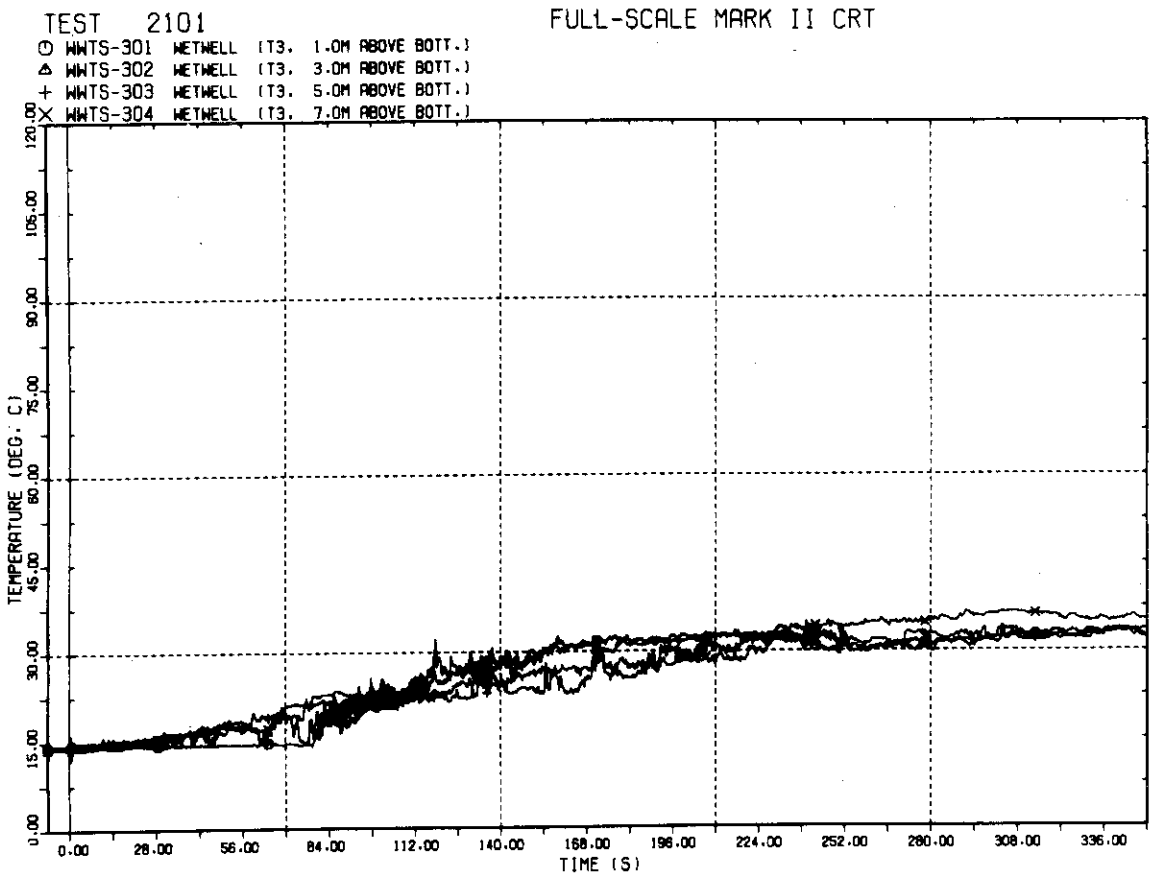
Plot L-0-16 Temperatures in Wetwell



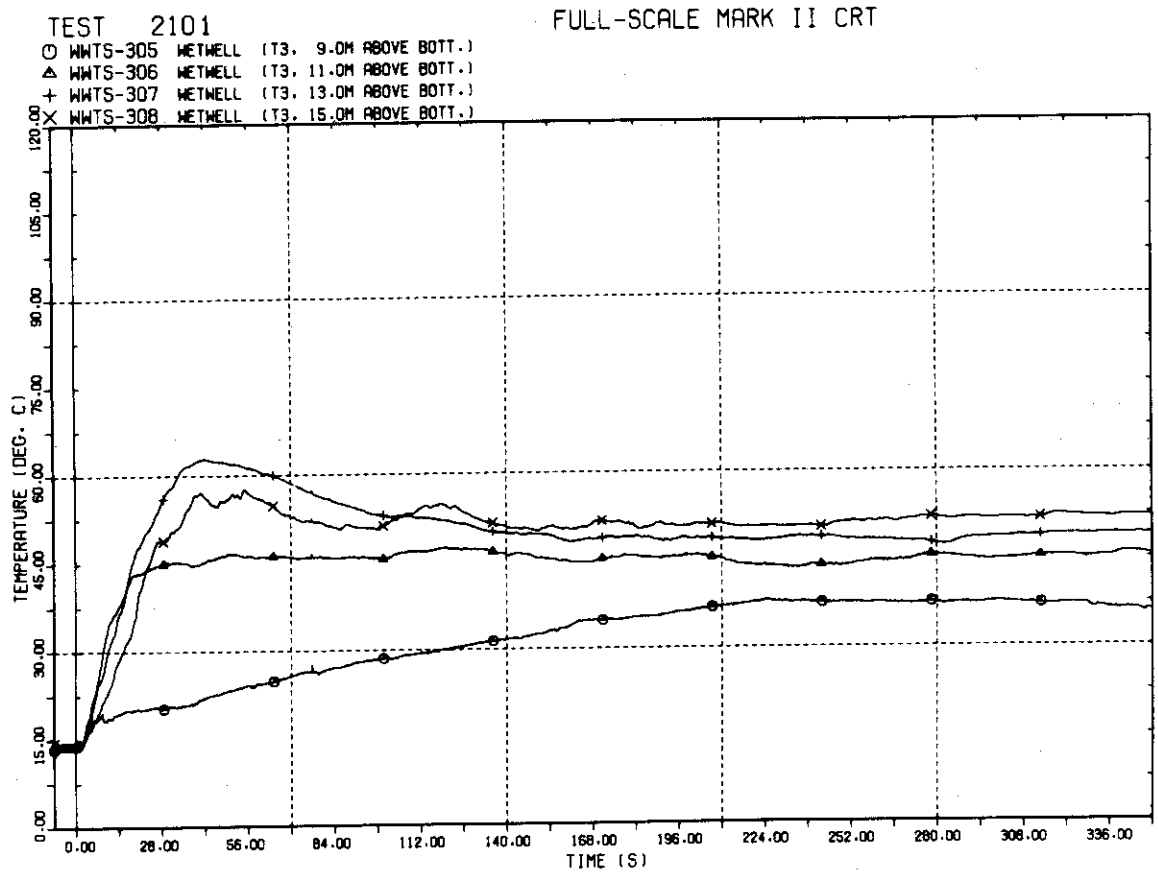
Plot L-0-17 Temperatures in Wetwell



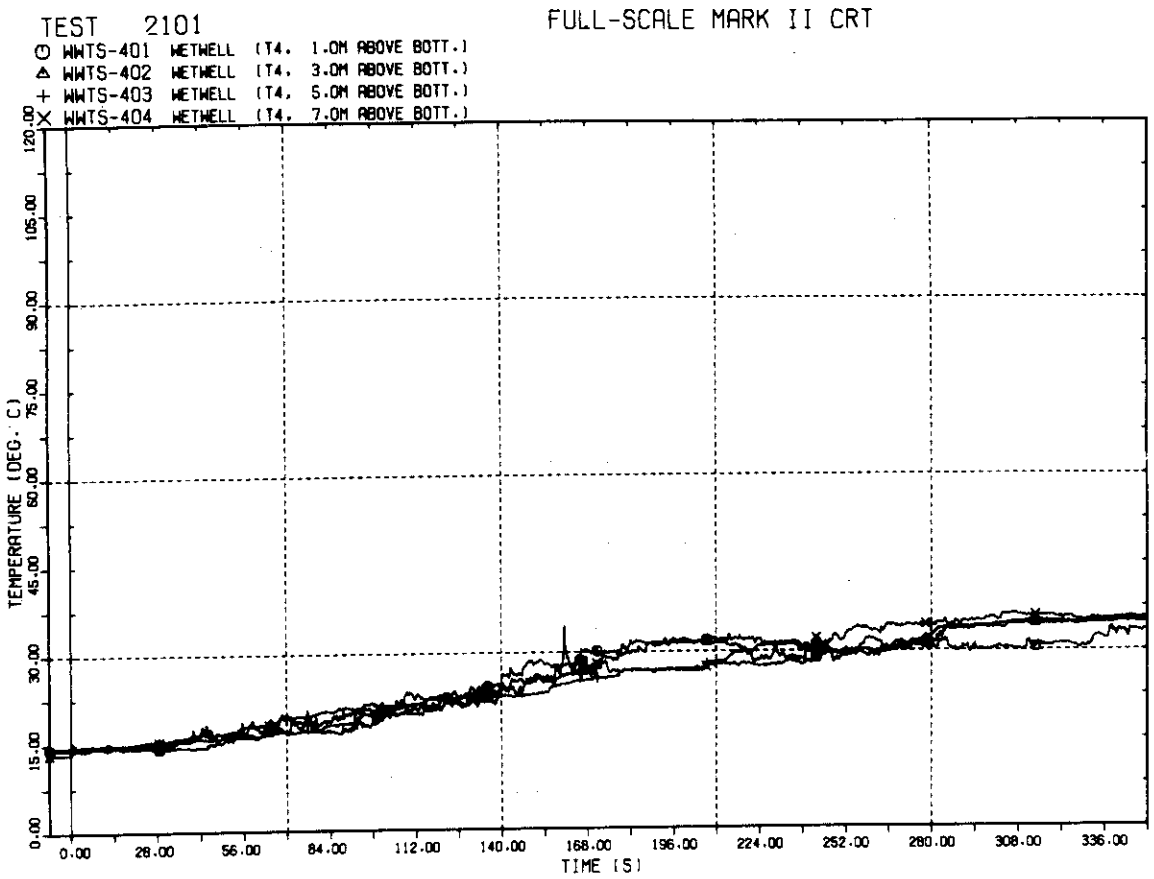
Plot L-0-18 Temperatures in Wetwell



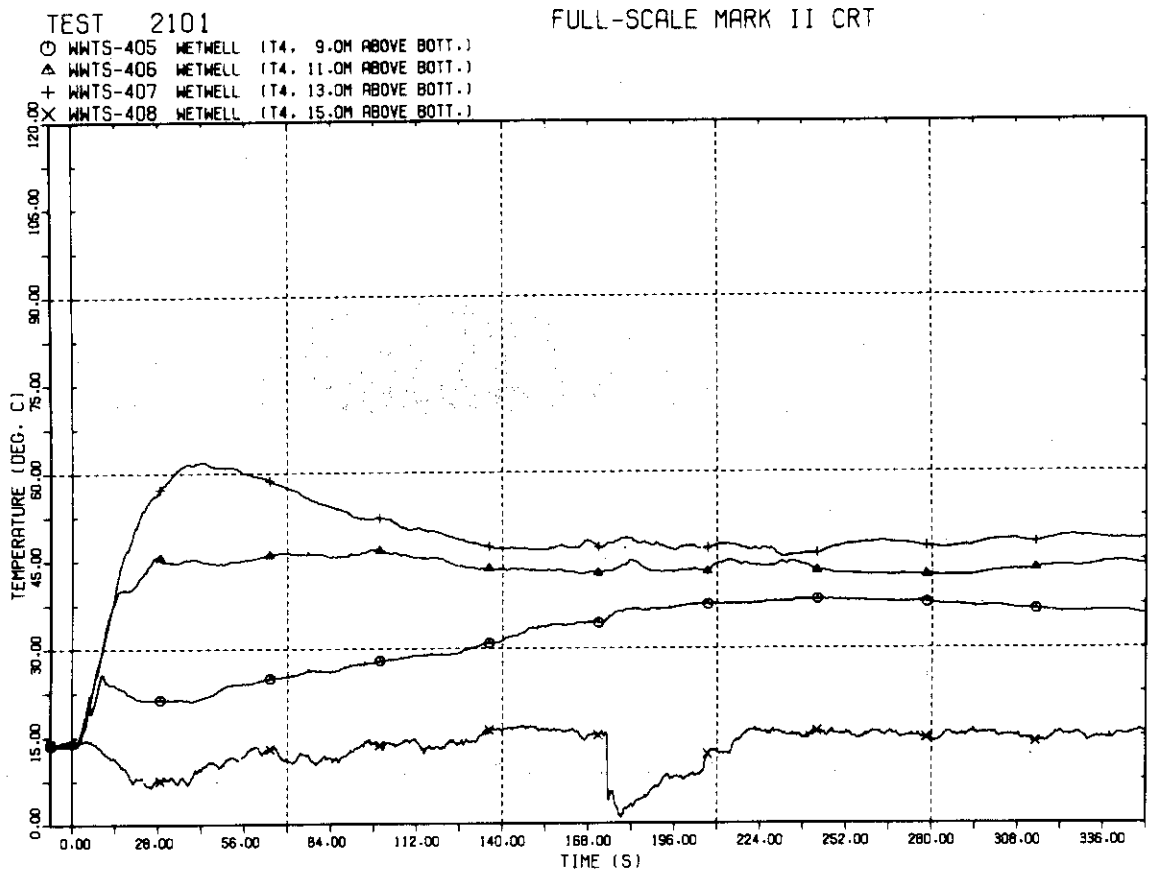
Plot L-0-19 Temperatures in Wetwell



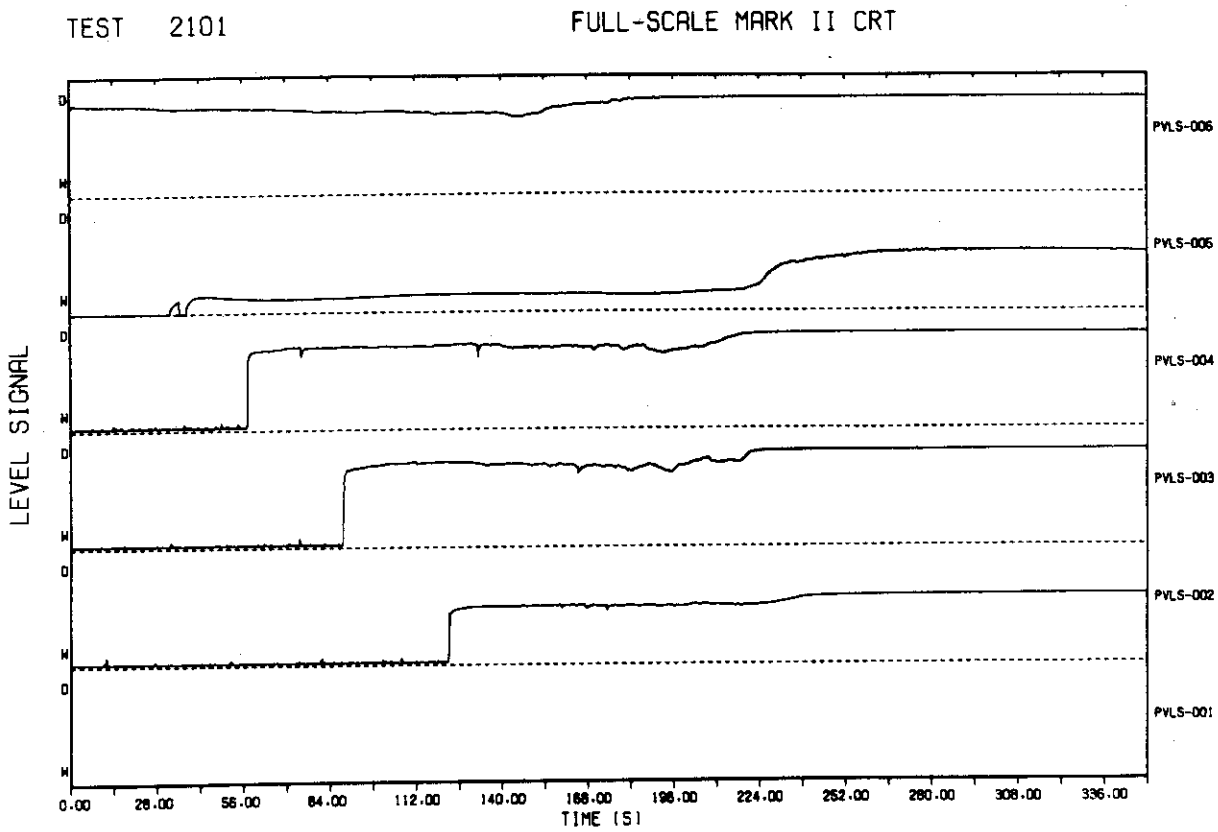
Plot L-0-20 Temperatures in Wetwell



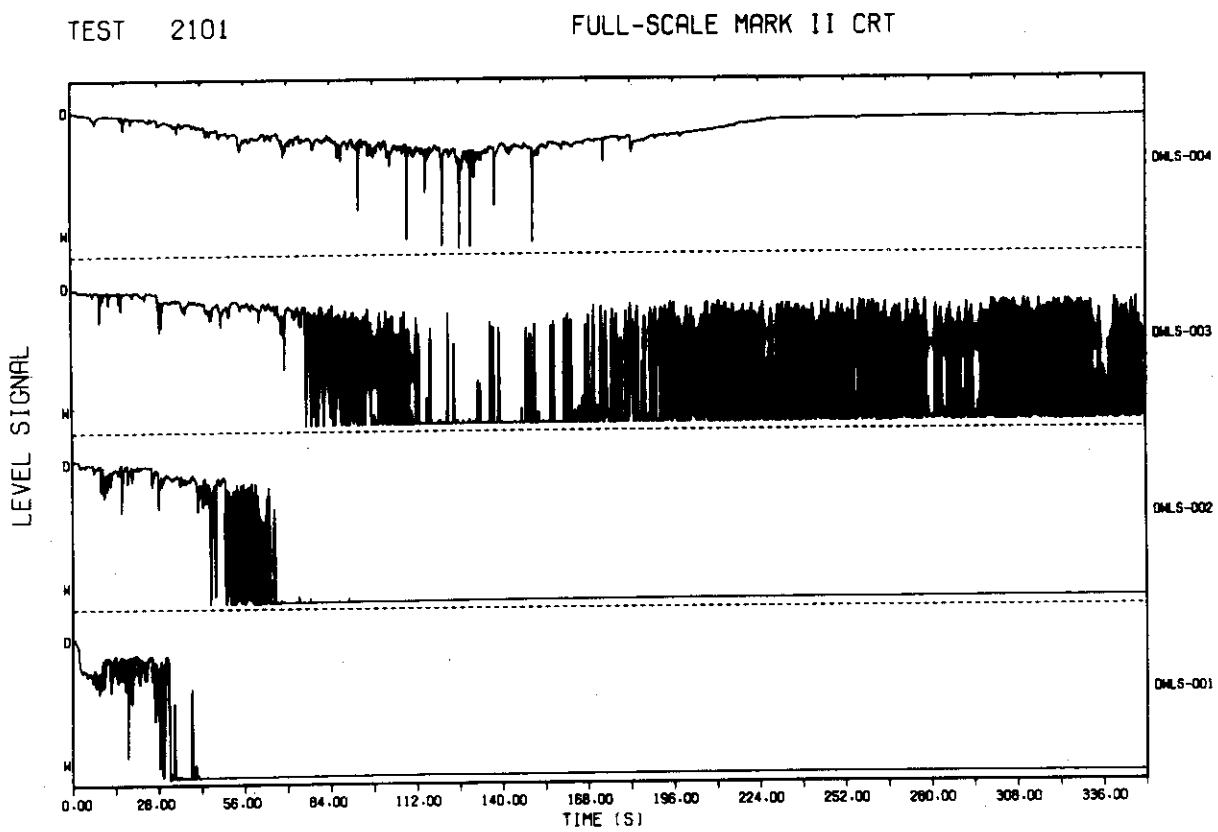
Plot L-0-21 Temperatures in Wetwell



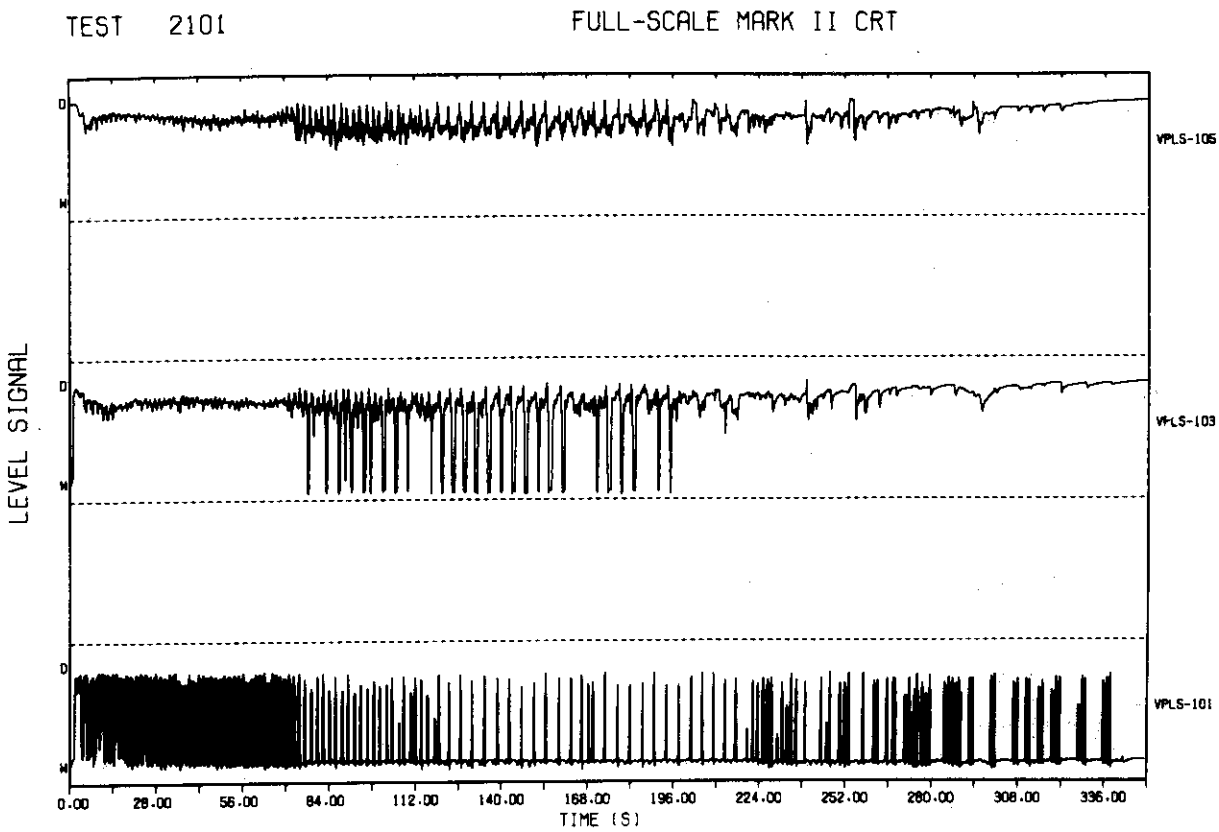
Plot L-0-22 Temperatures in Wetwell



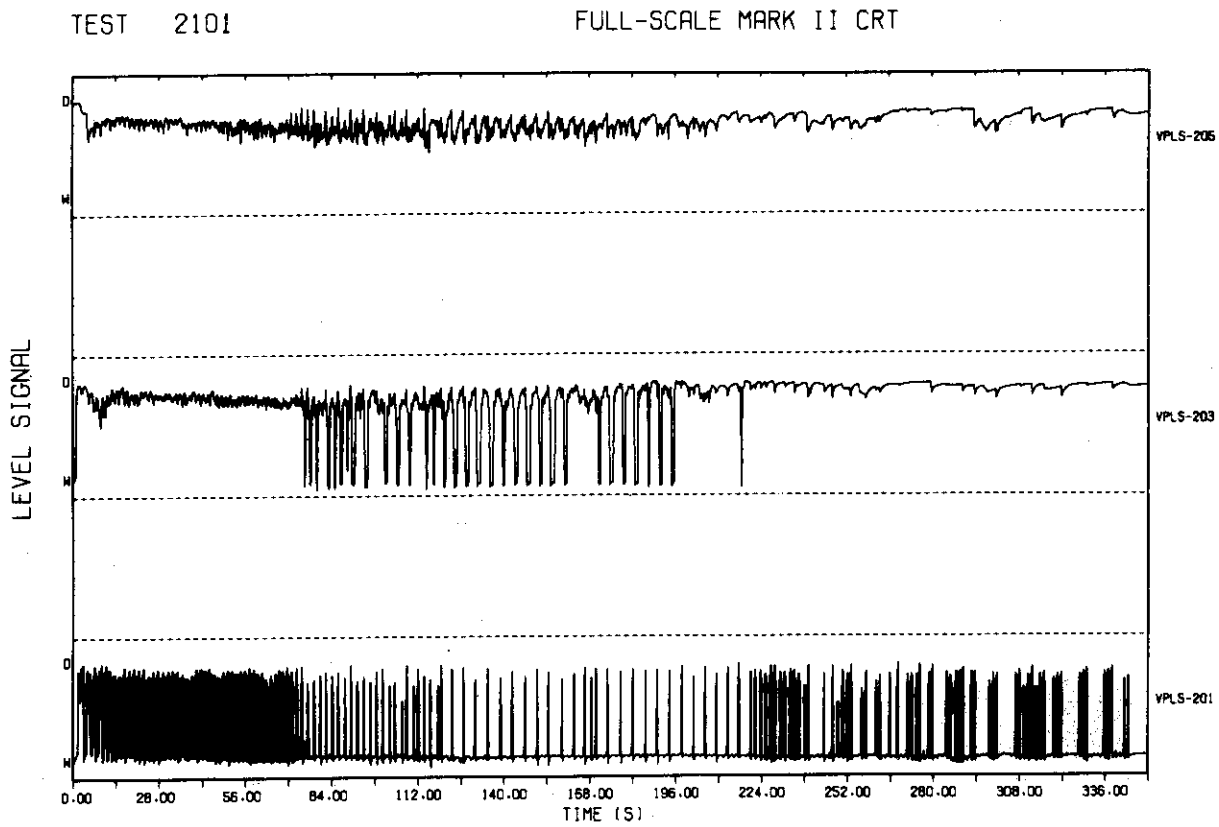
Plot L-0-23 Water Level in Vessel



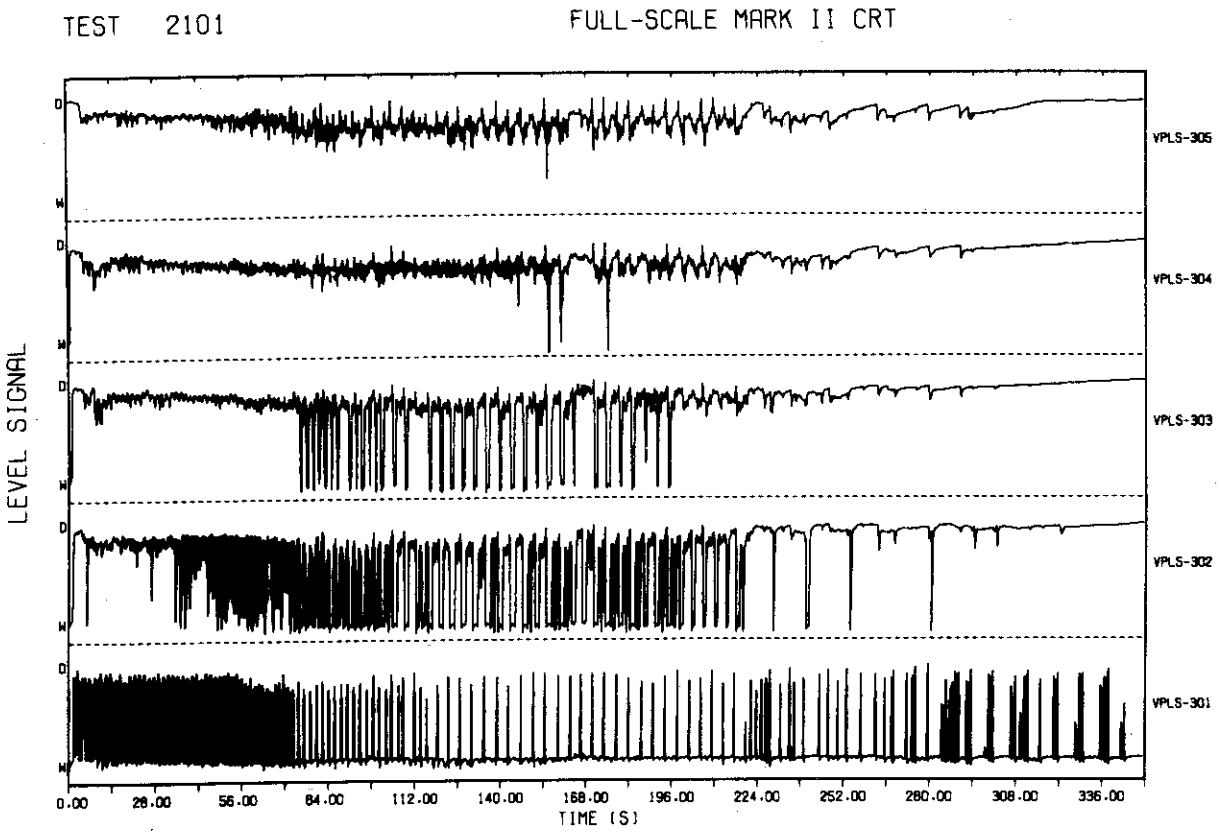
Plot L-0-24 Water Level in Drywell



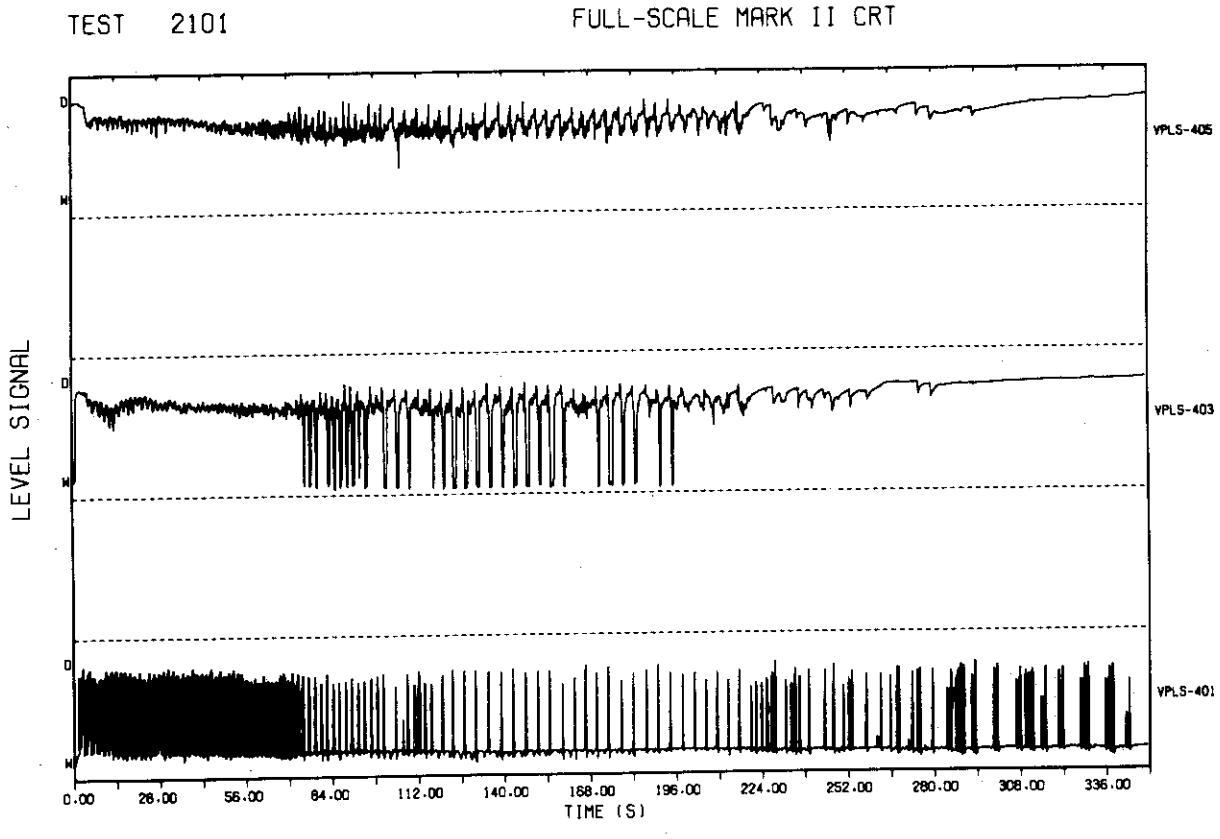
Plot L-0-25 Water Level in Vent Pipe



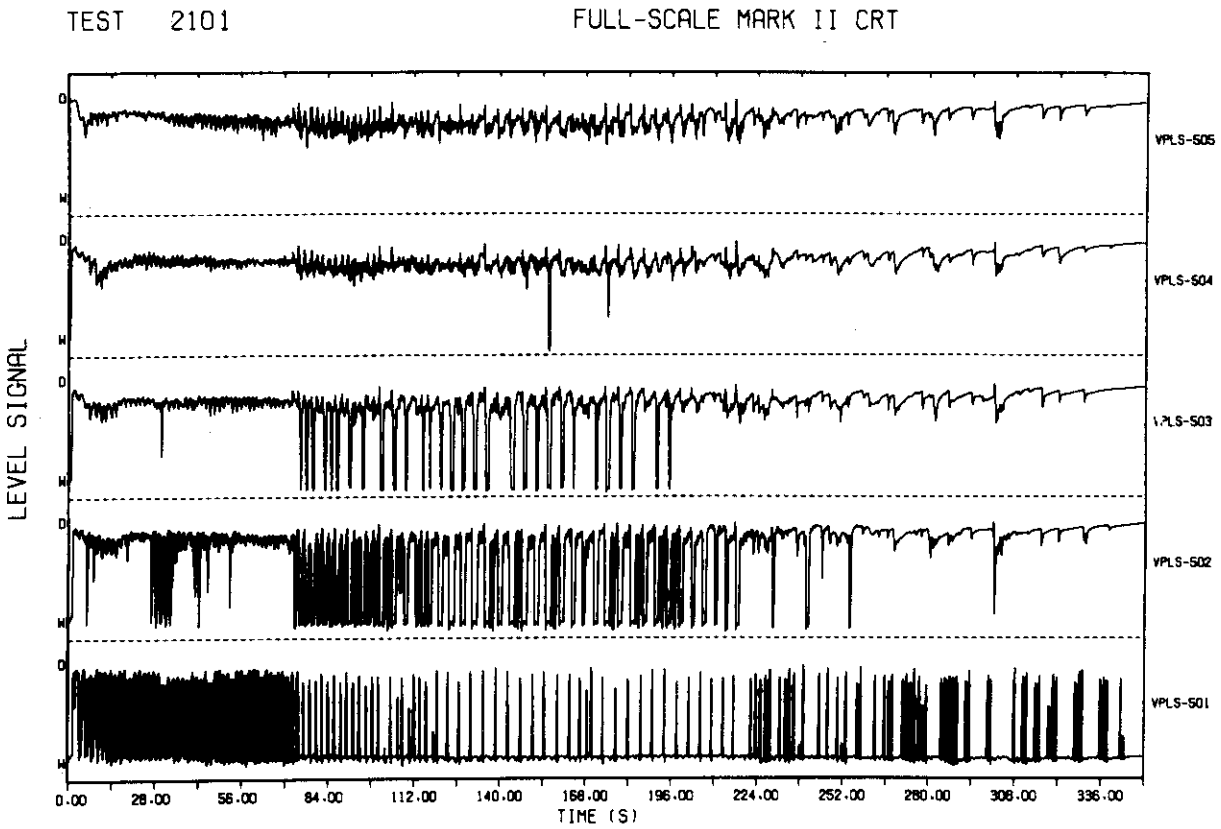
Plot L-0-26 Water Level in Vent Pipe



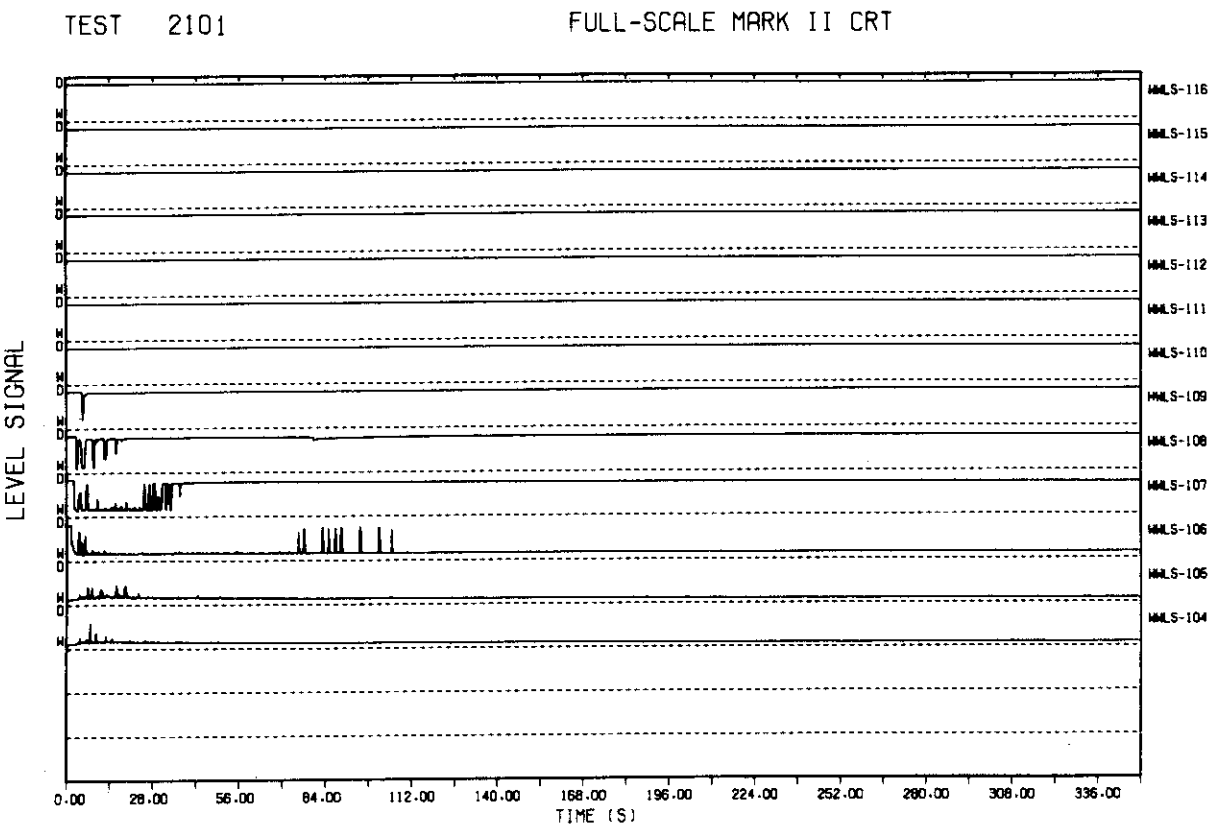
Plot L-0-27 Water Level in Vent Pipe



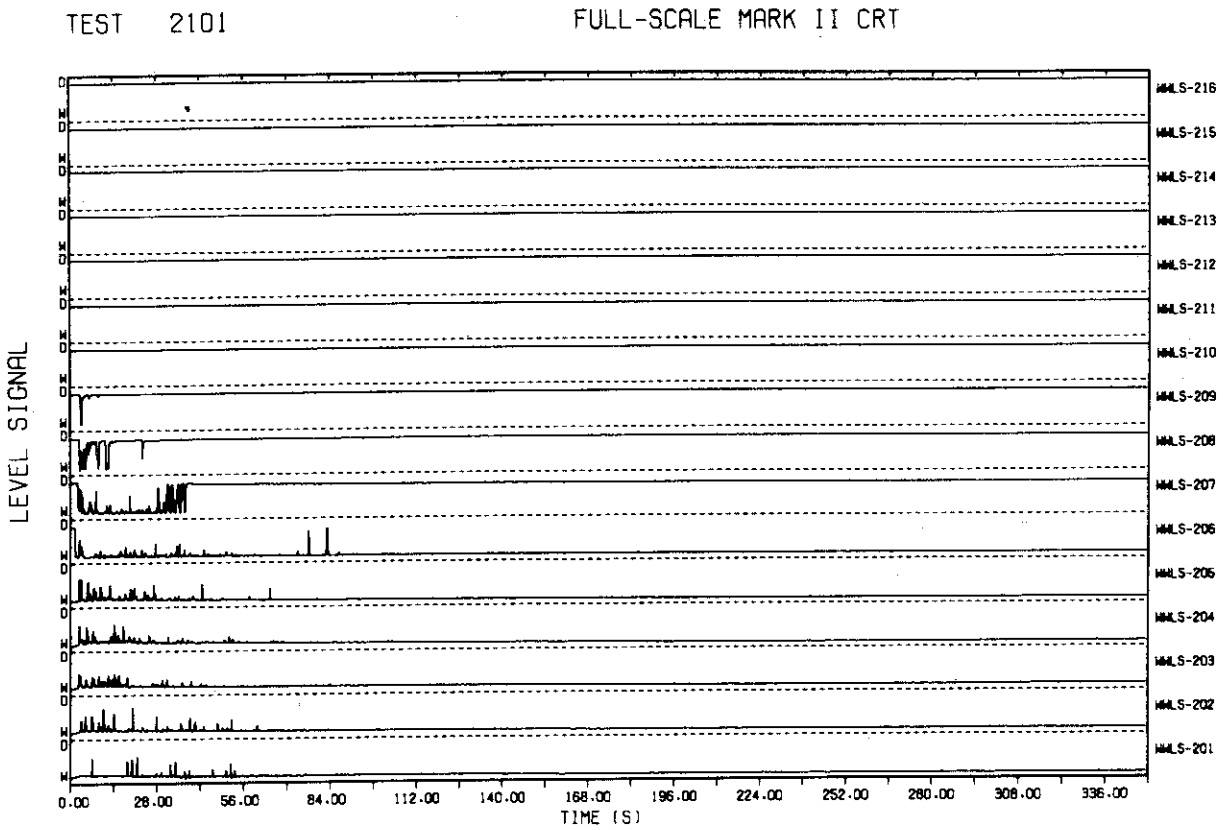
Plot L-0-28 Water Level in Vent Pipe



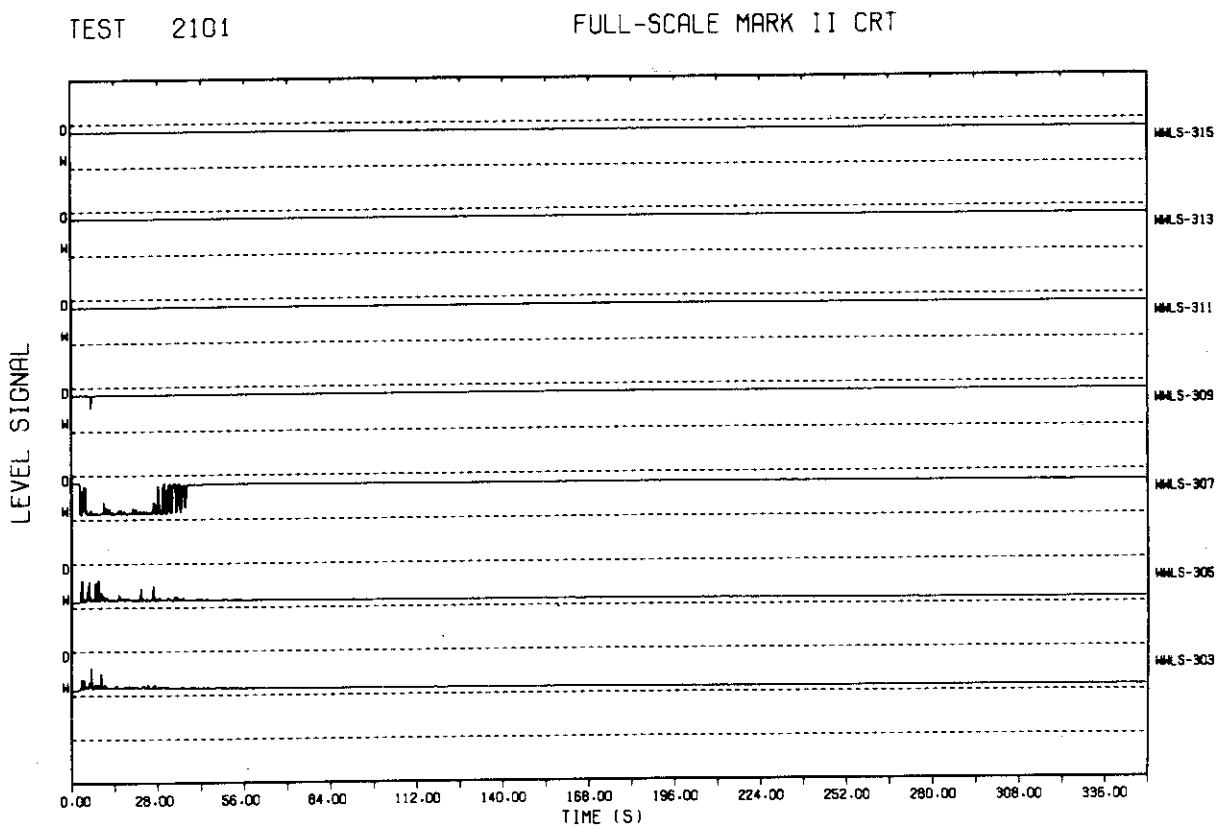
Plot L-0-29 Water Level in Vent Pipe



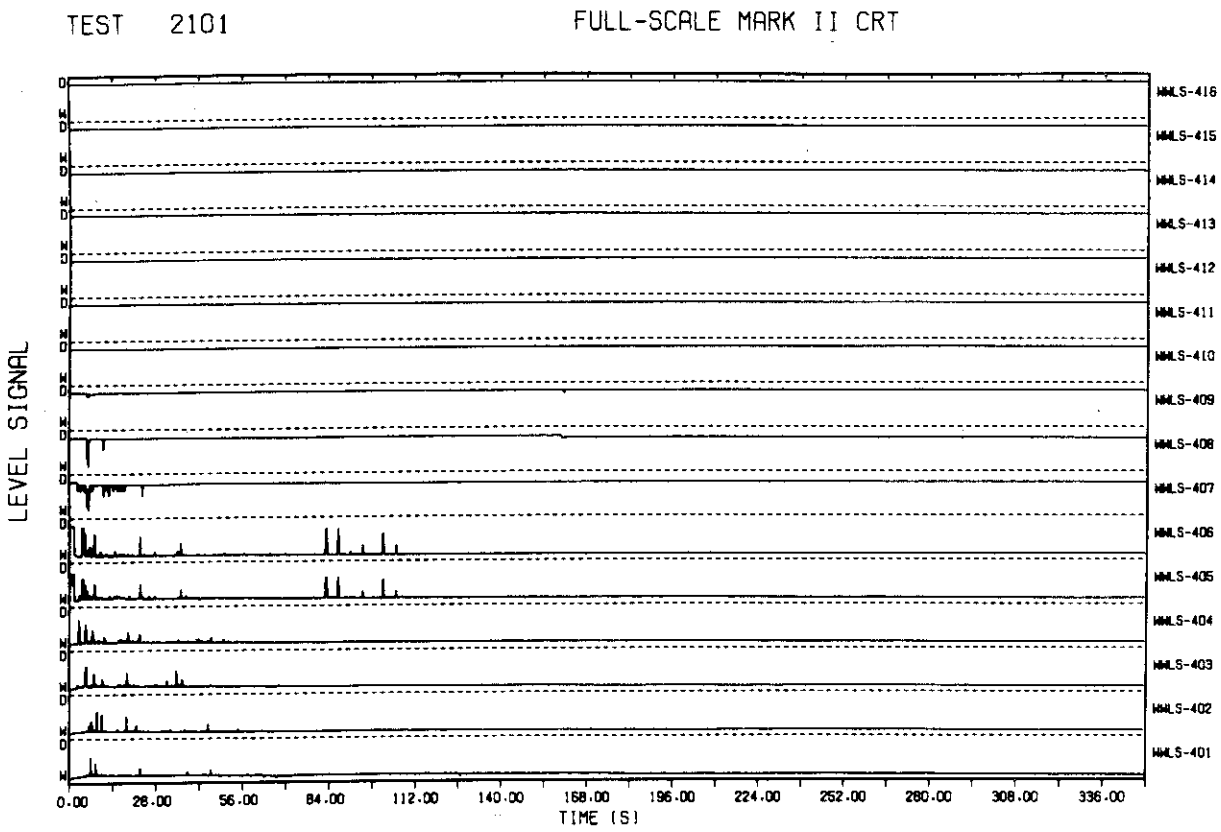
Plot L-0-30 Water Level in Wetwell



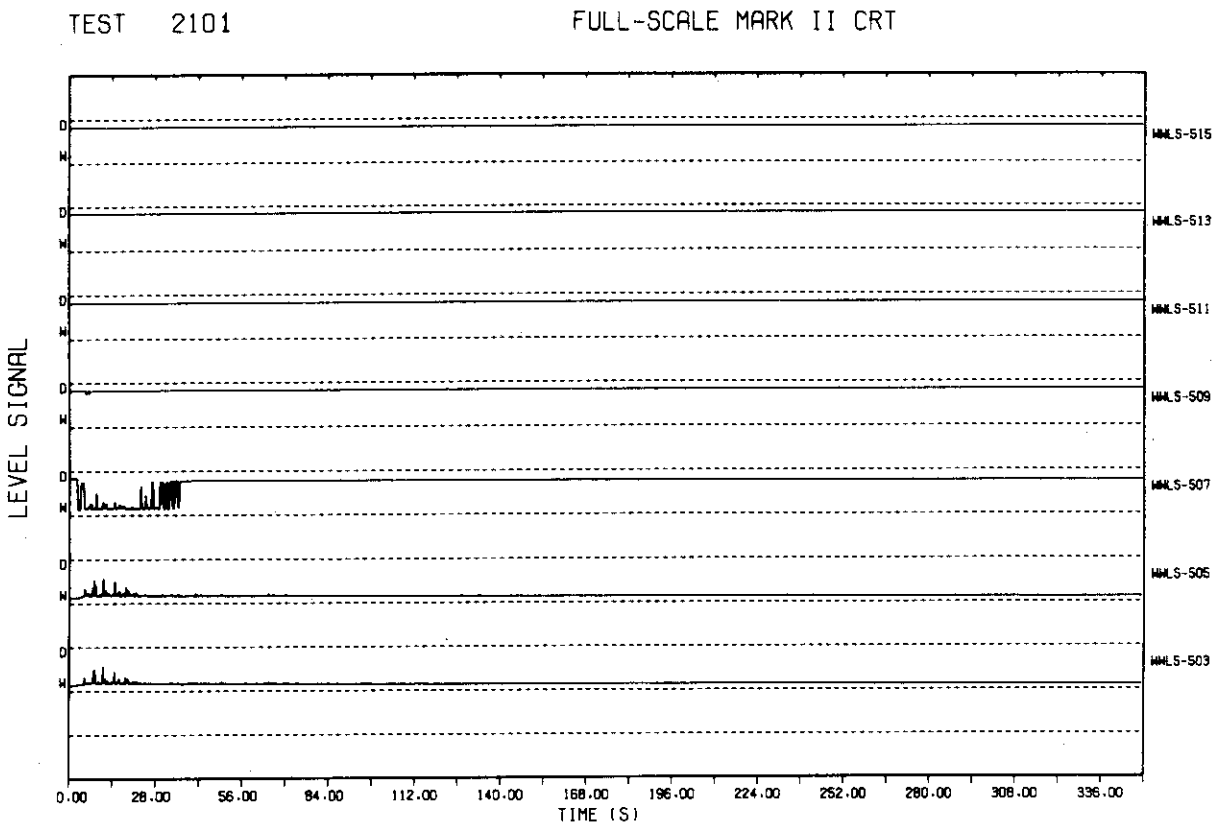
Plot L-0-31 Water Level in Wetwell



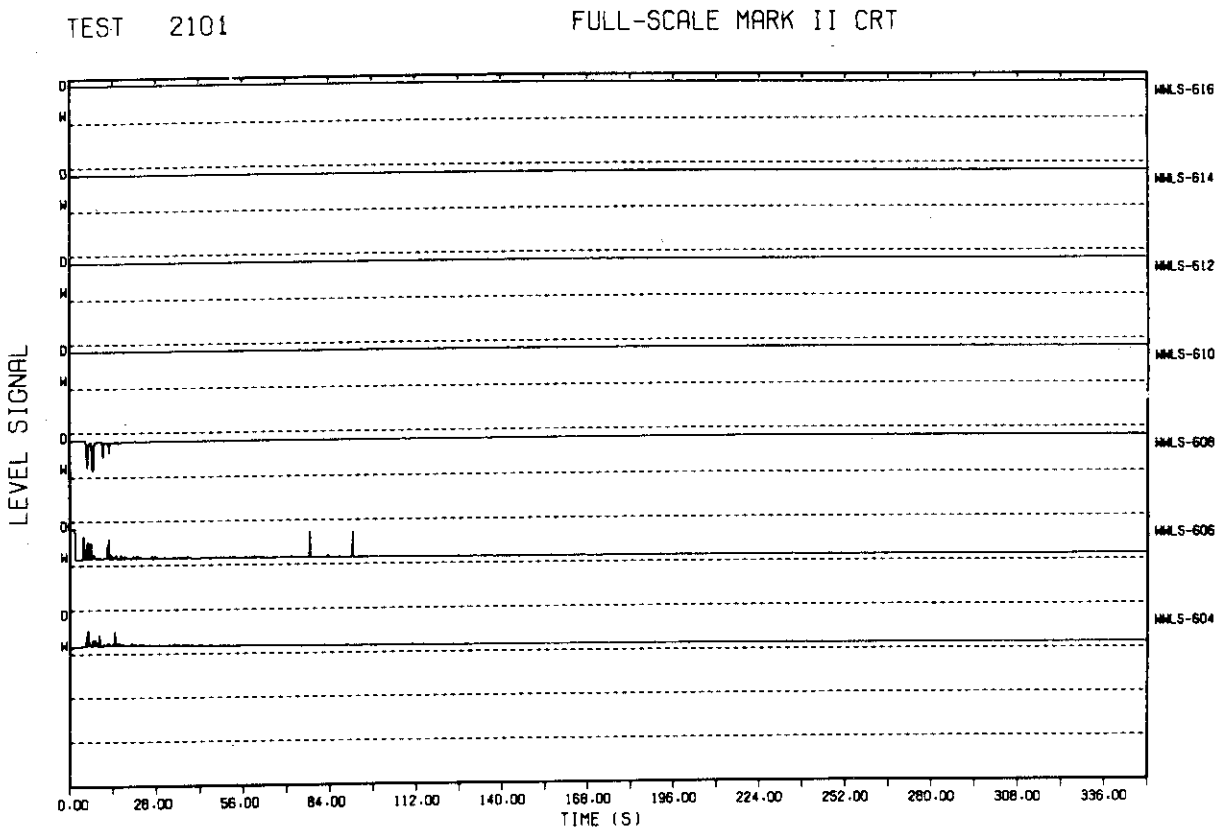
Plot L-0-32 Water Level in Wetwell



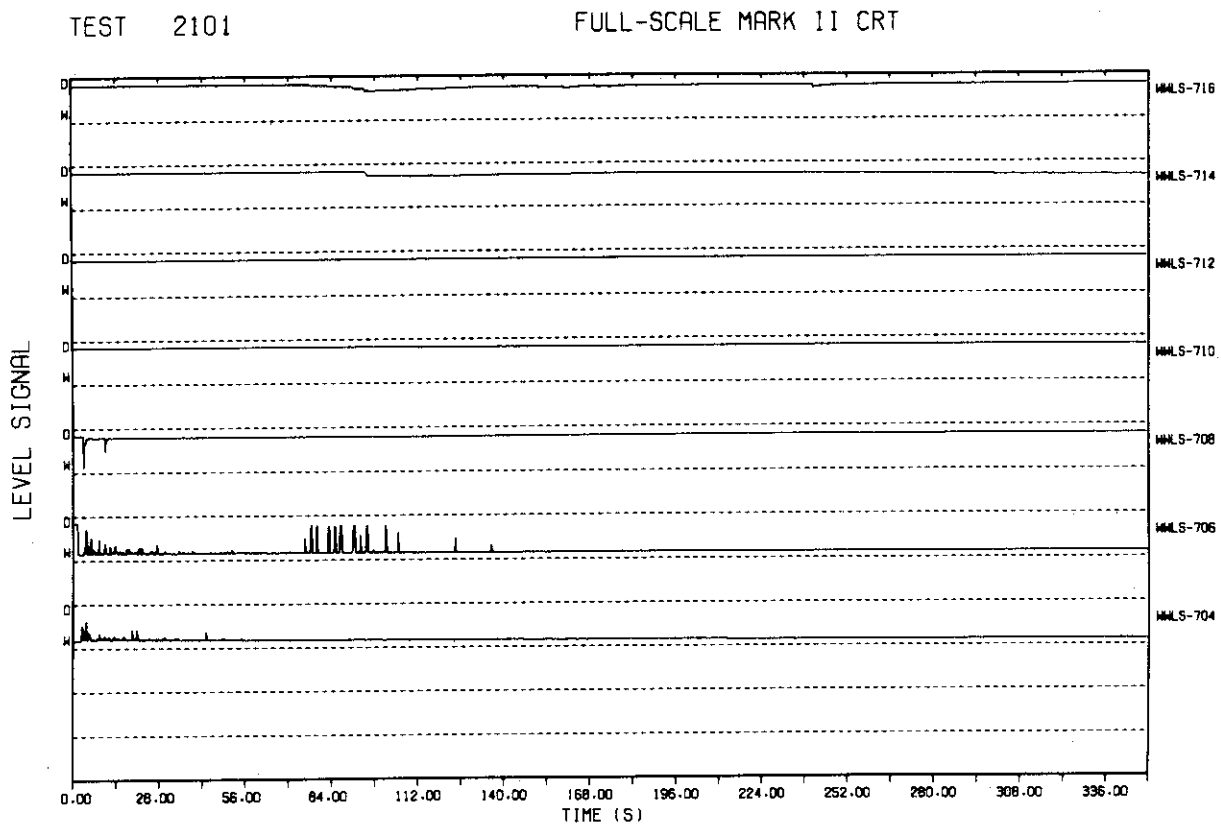
Plot L-0-33 Water Level in Wetwell



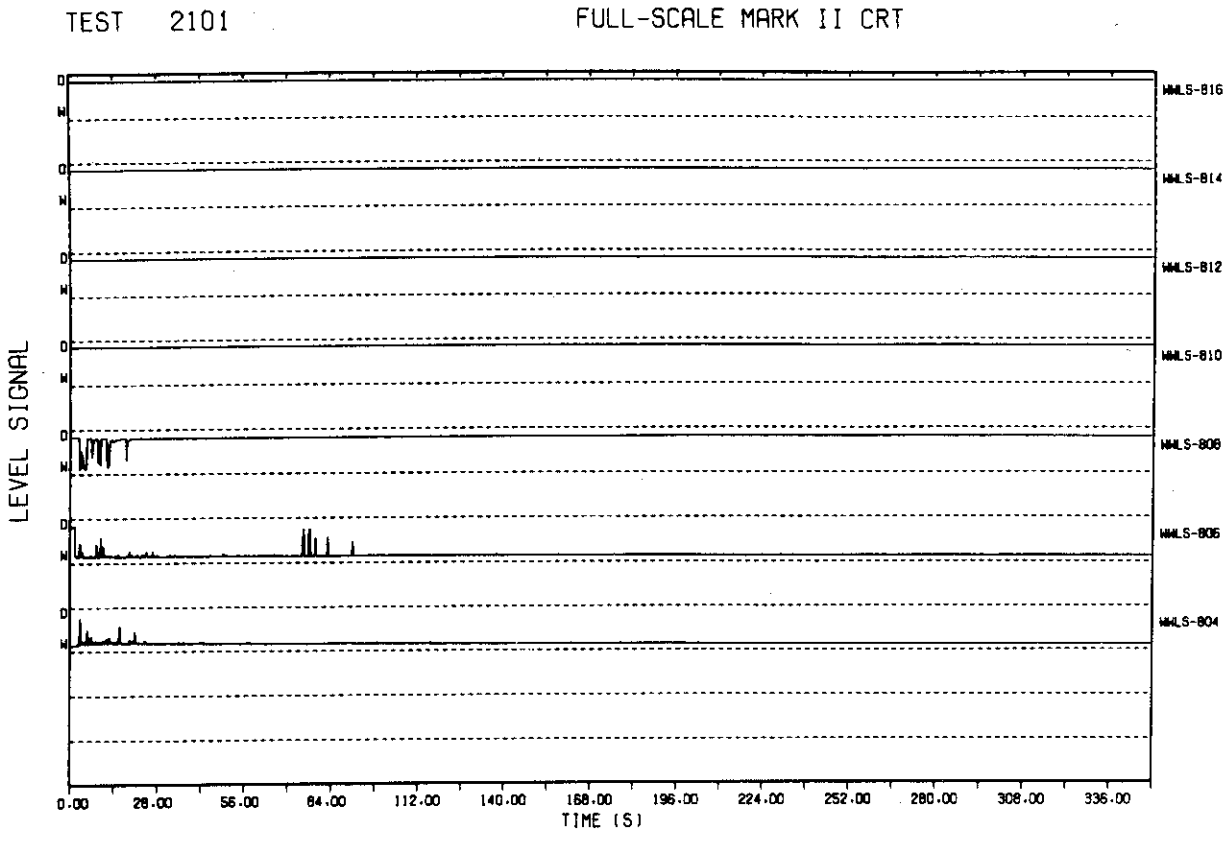
Plot L-0-34 Water Level in Wetwell



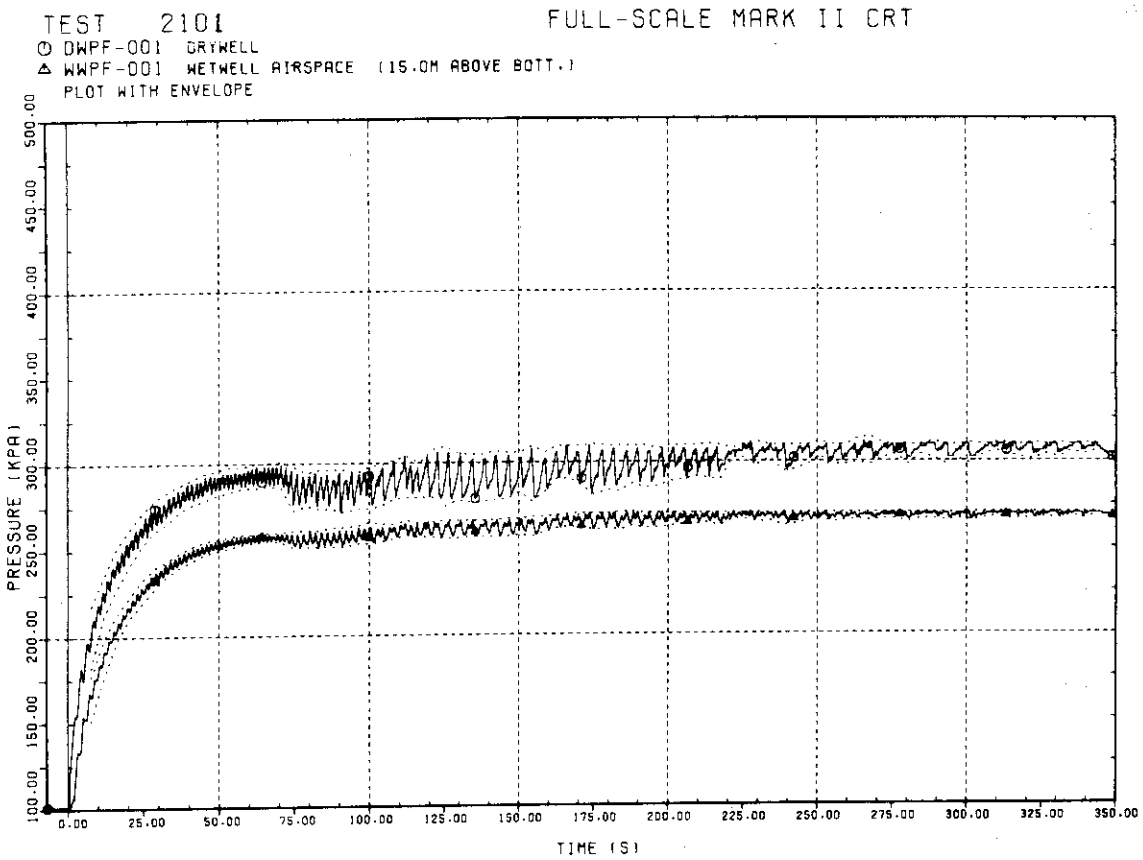
Plot L-0-35 Water Level in Wetwell



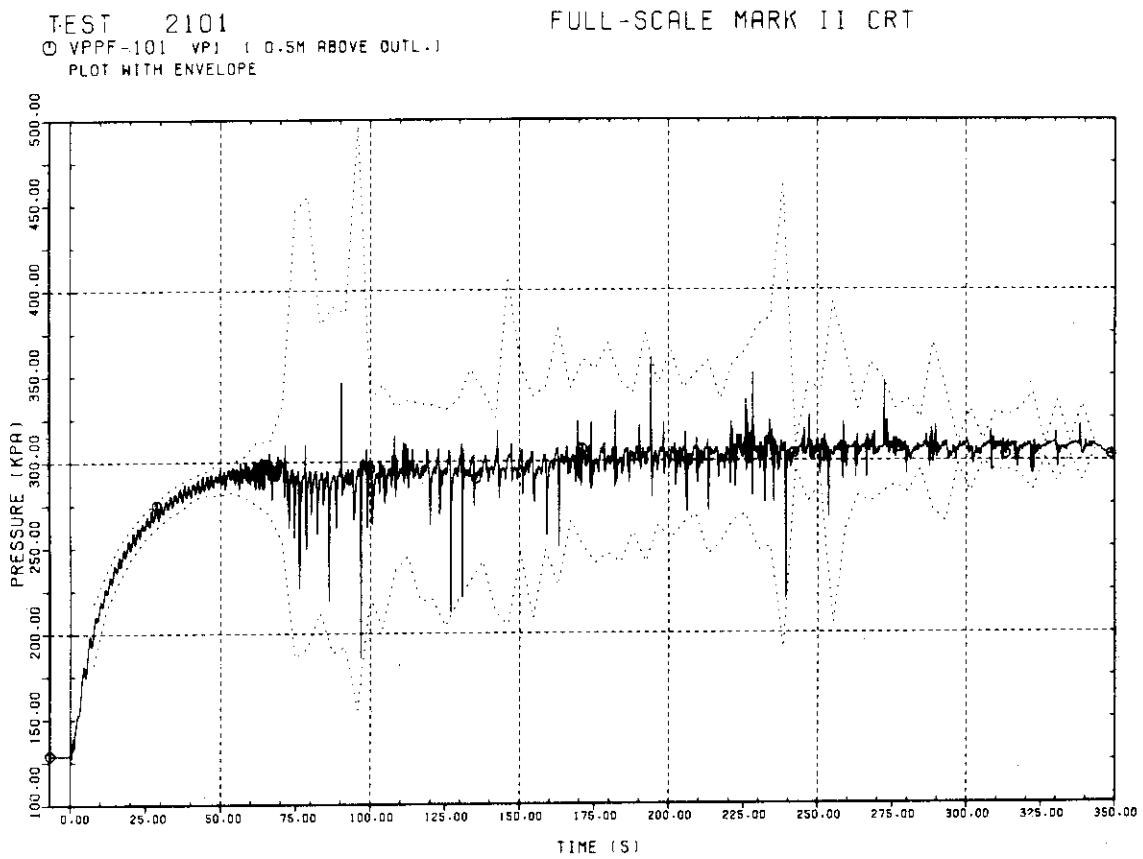
Plot L-0-36 Water Level in Wetwell



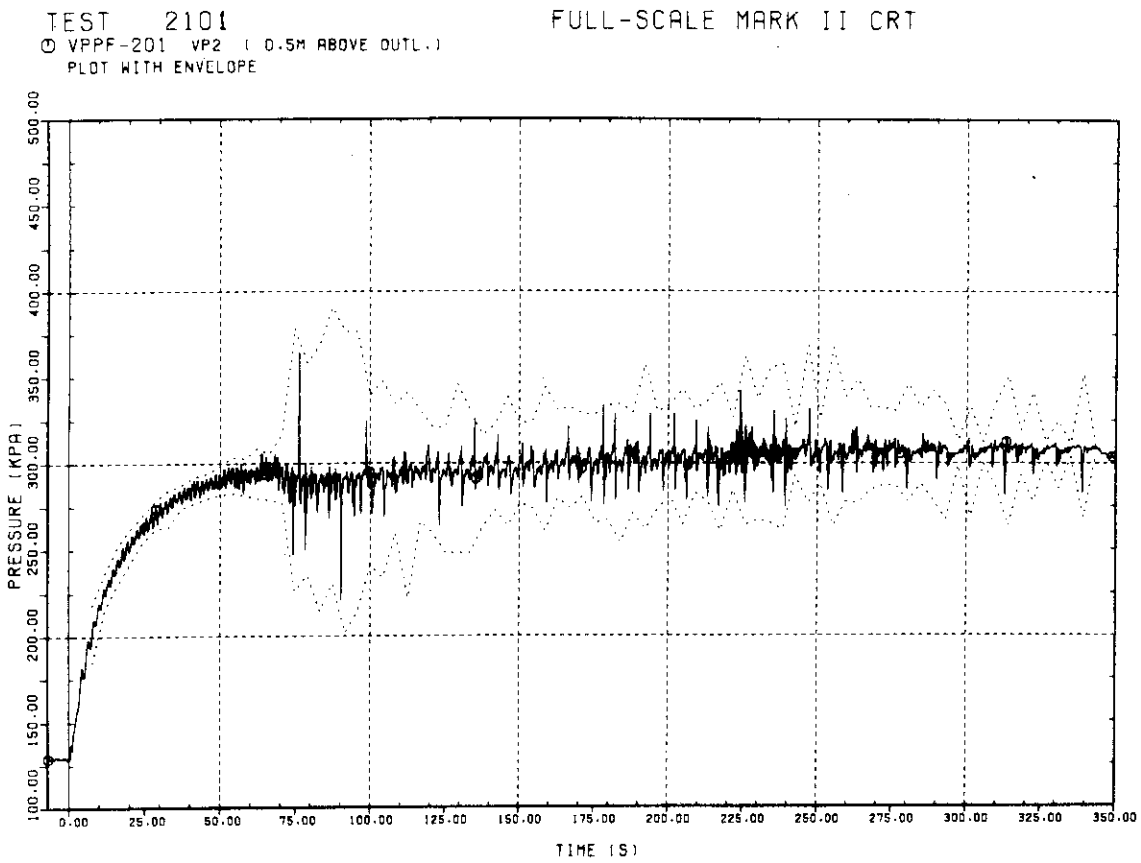
Plot L-0-37 Water Level in Wetwell



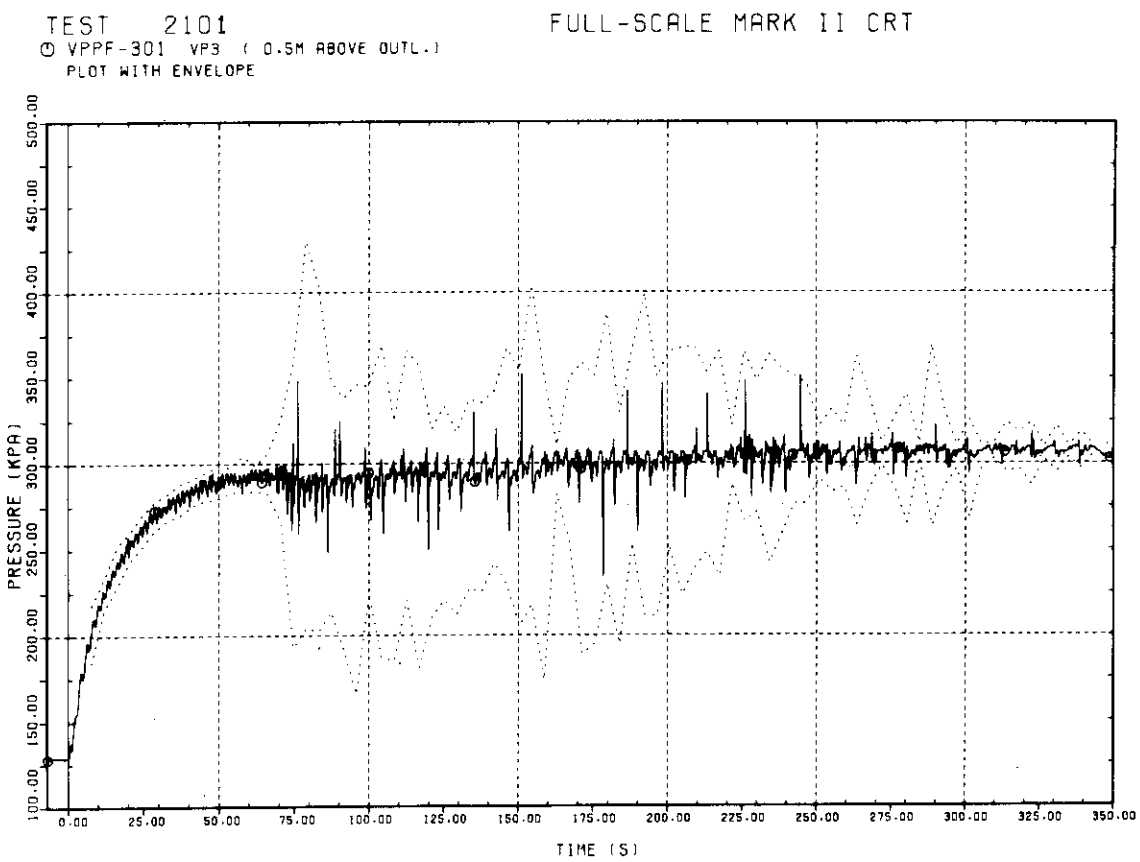
Plot L-1-1 Pressures in Drywell and Wetwell Airspace



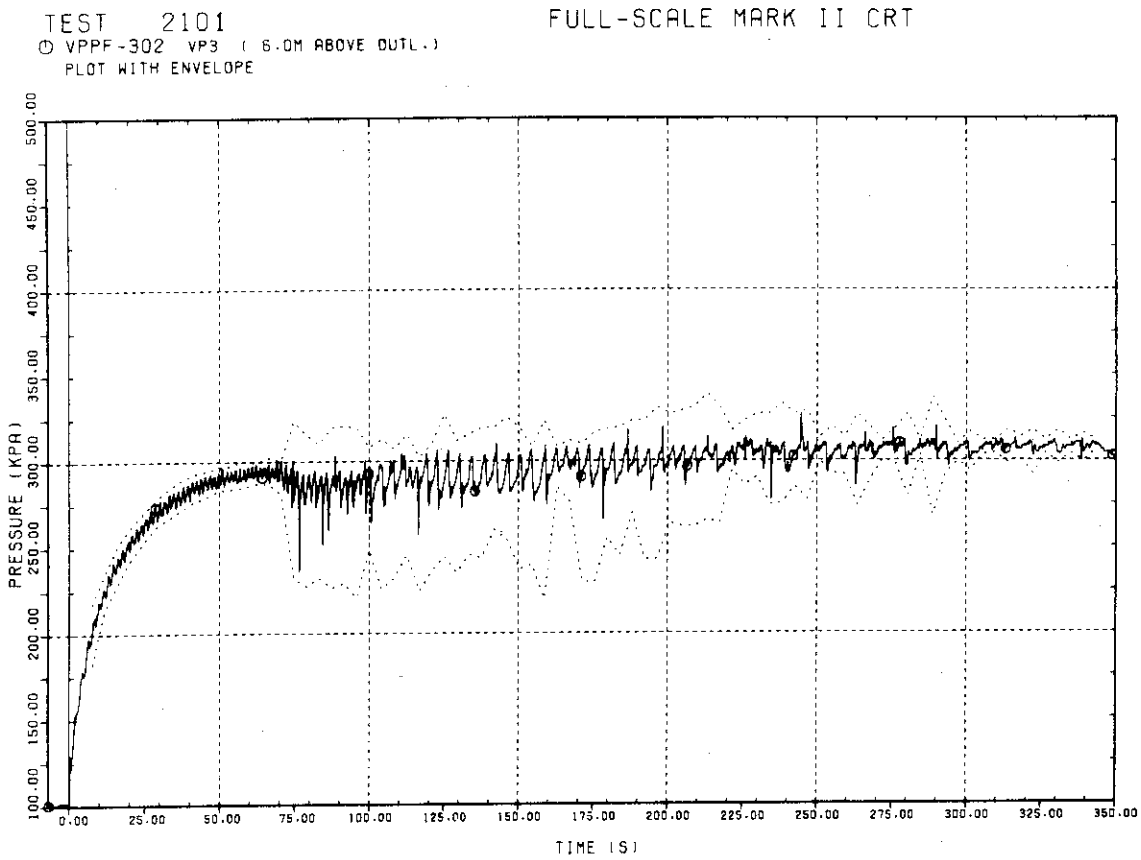
Plot L-1-2 Pressure in Vent Pipe



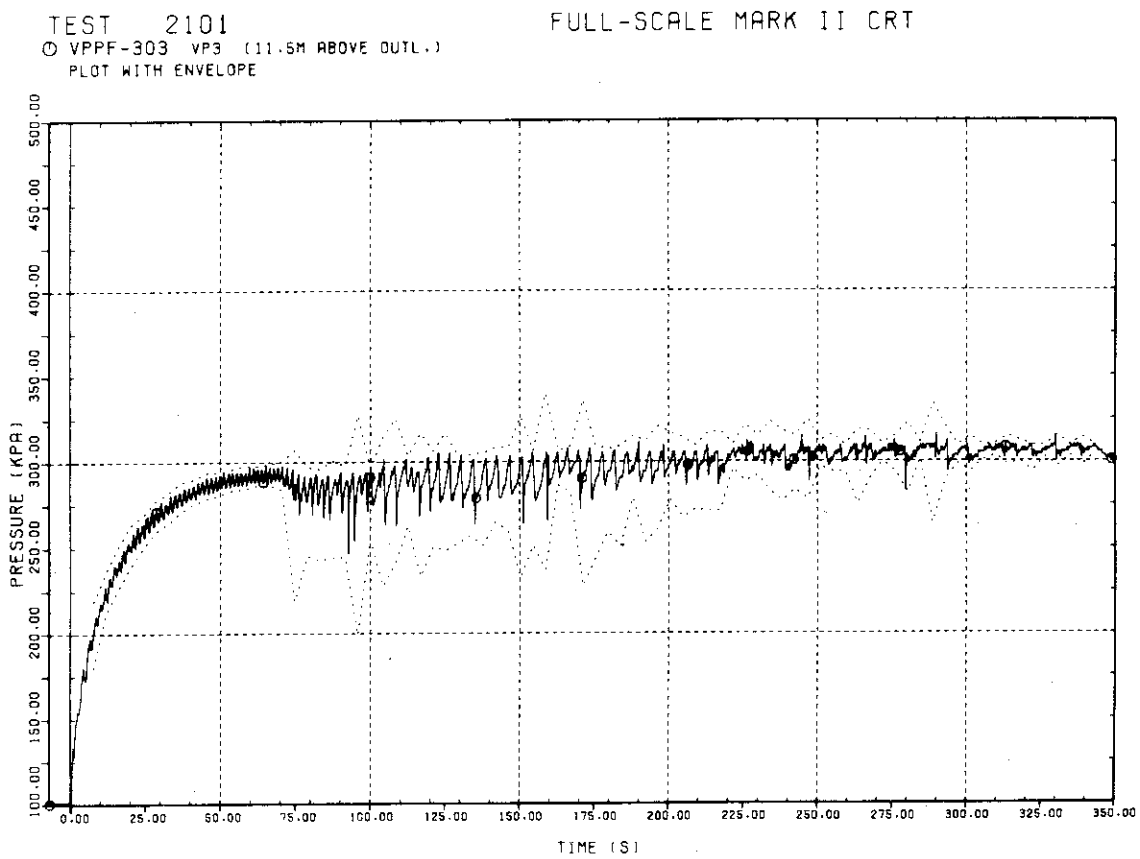
Plot L-1-3 Pressure in Vent Pipe



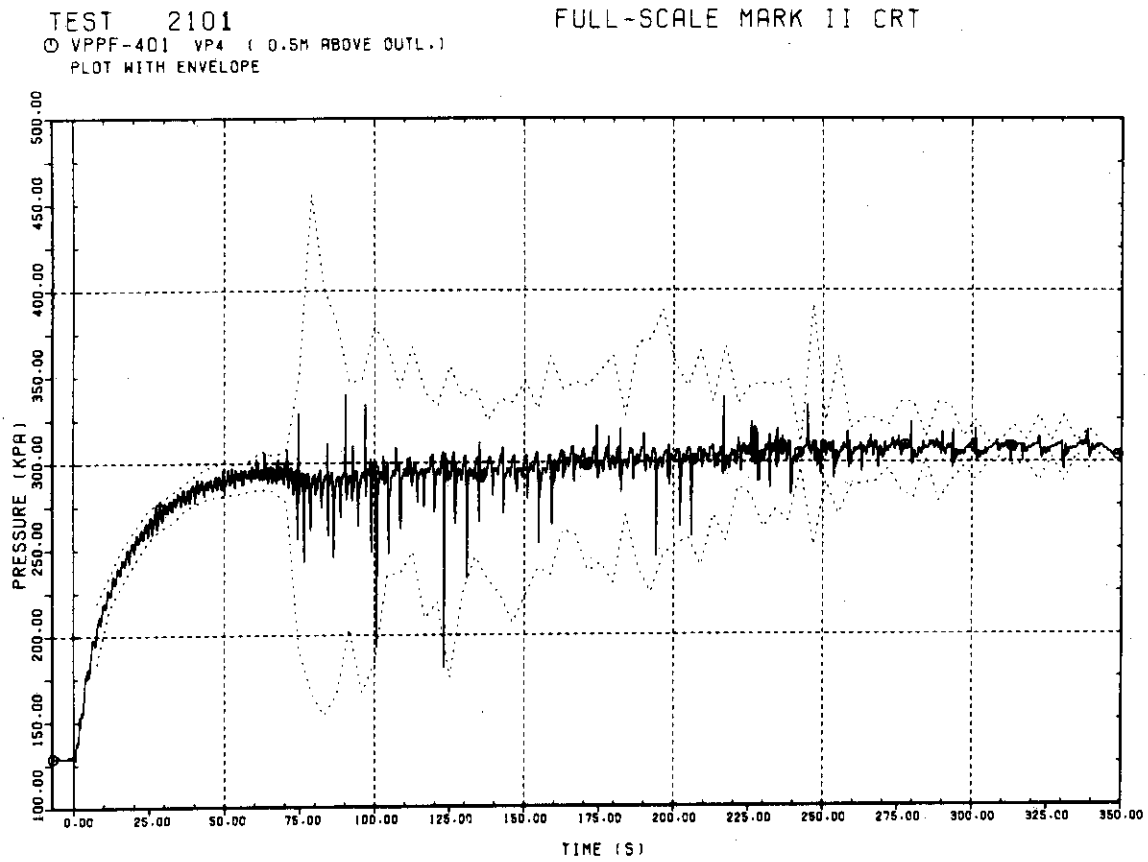
Plot L-1-4 Pressure in Vent Pipe



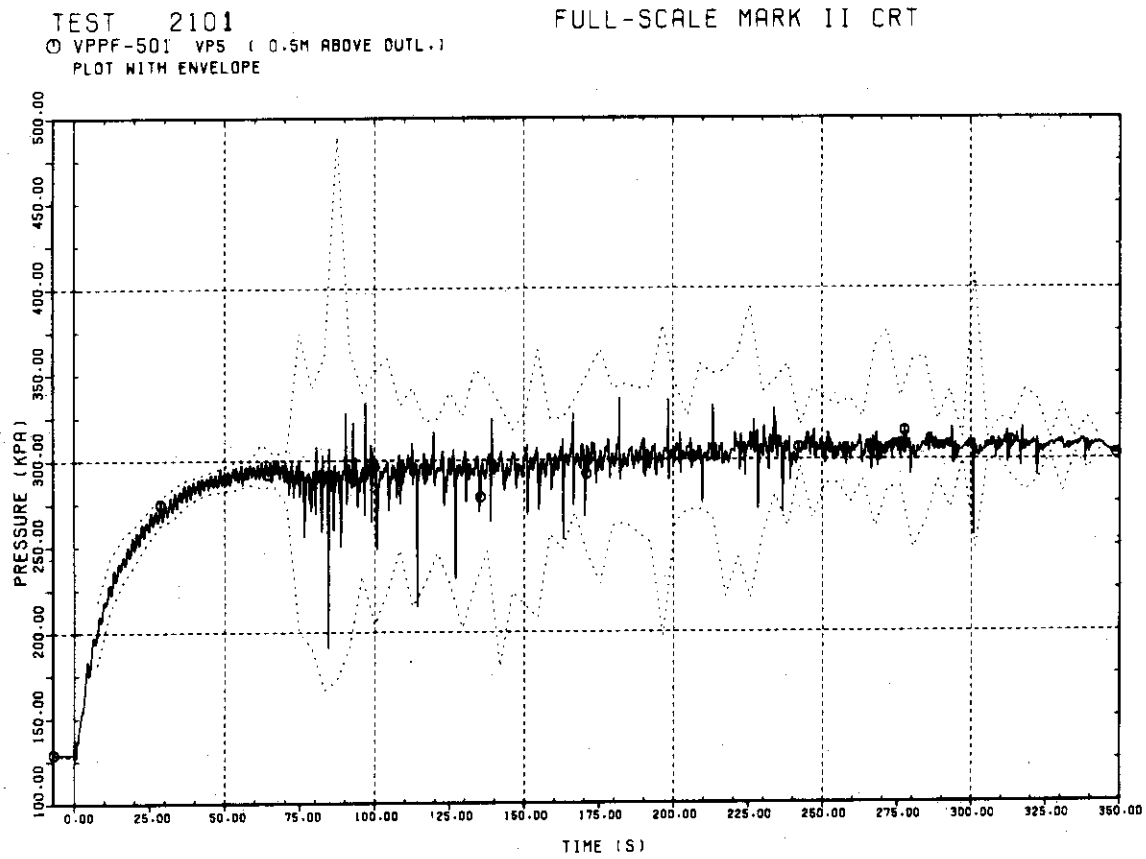
Plot L-1-5 Pressure in Vent Pipe



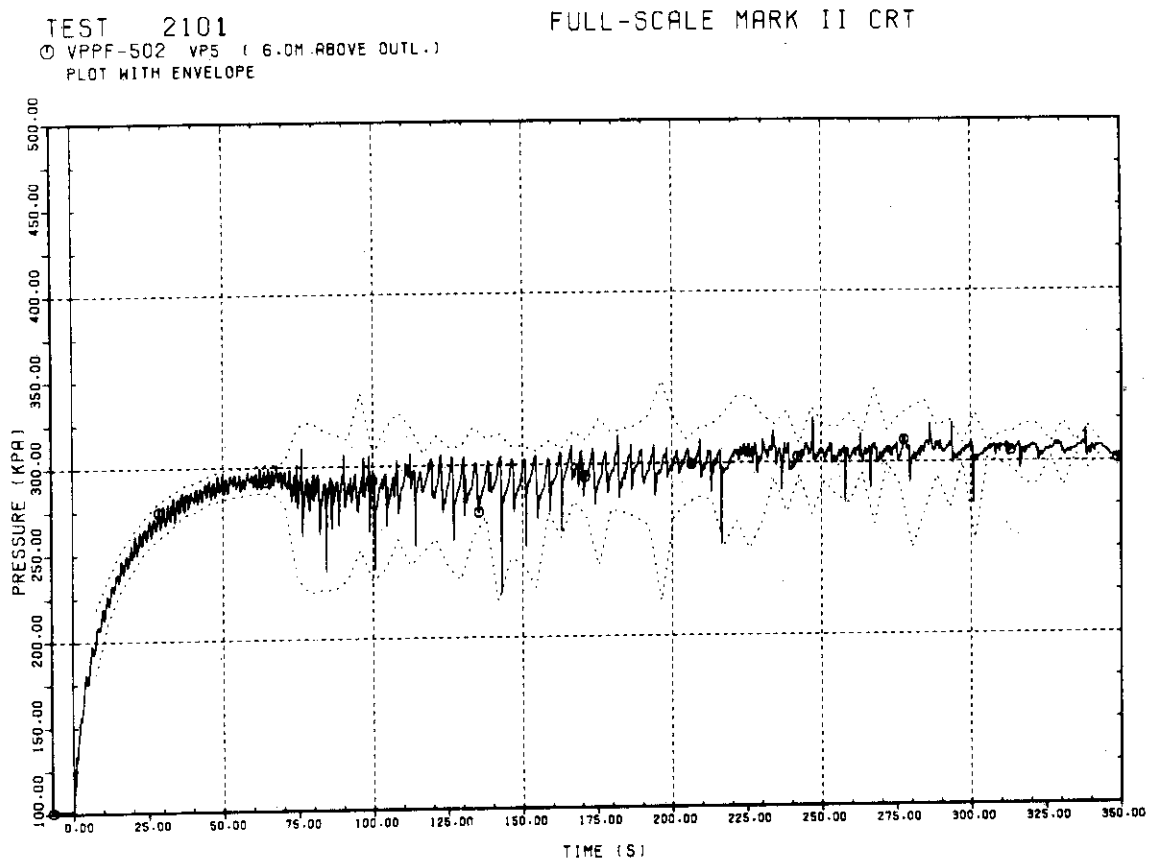
Plot L-1-6 Pressure in Vent Pipe



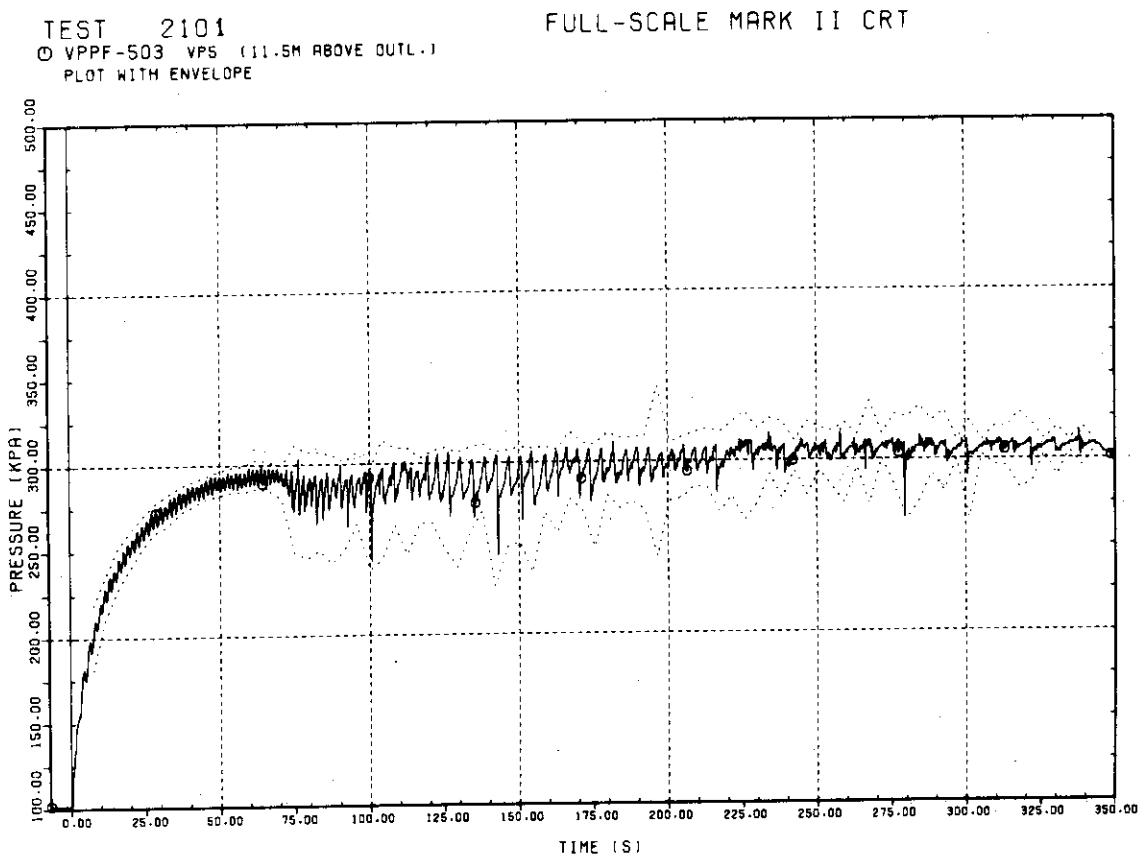
Plot L-1-7 Pressure in Vent Pipe



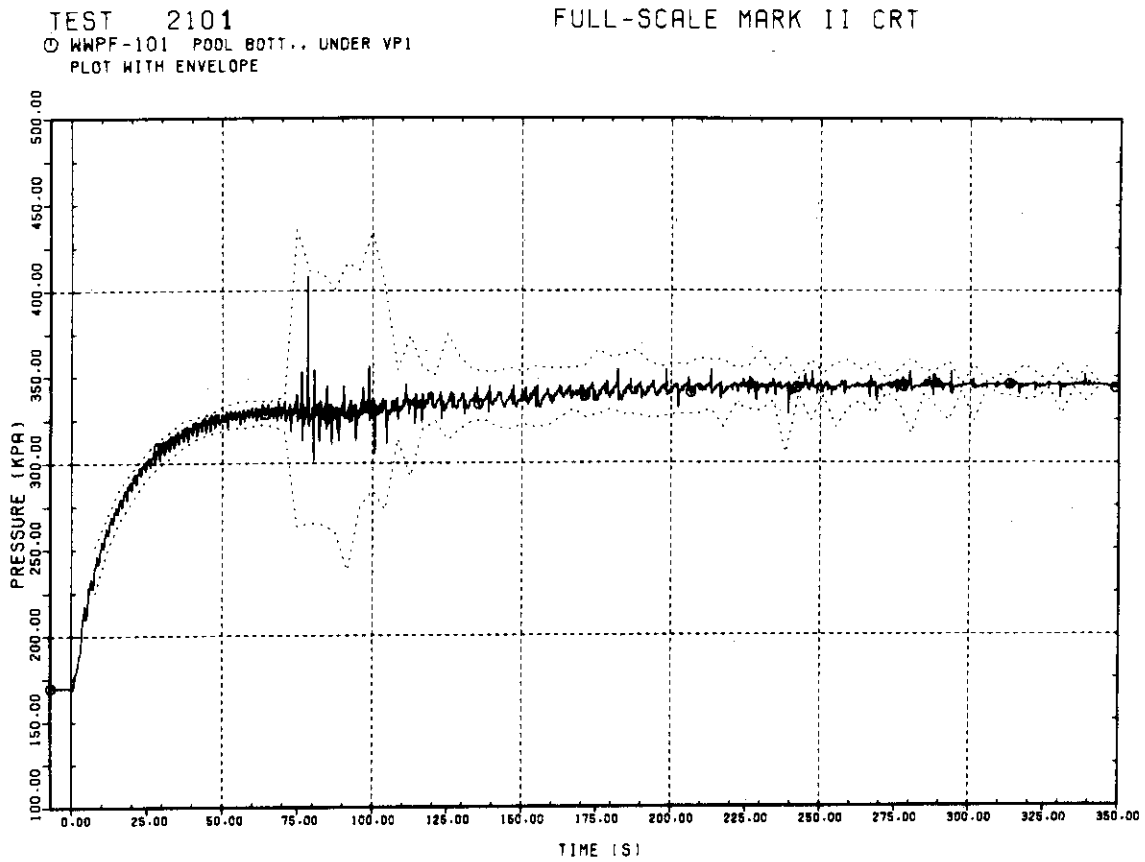
Plot L-1-8 Pressure in Vent Pipe



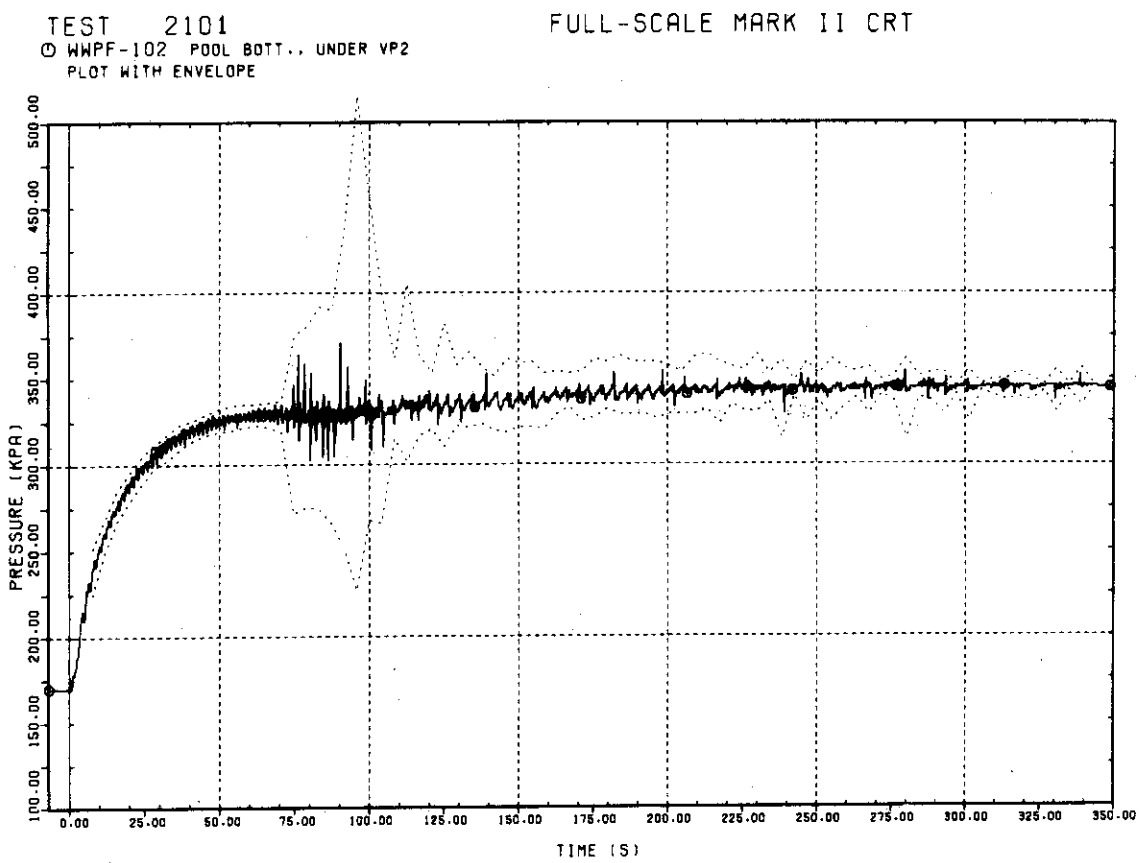
Plot L-1-9 Pressure in Vent Pipe



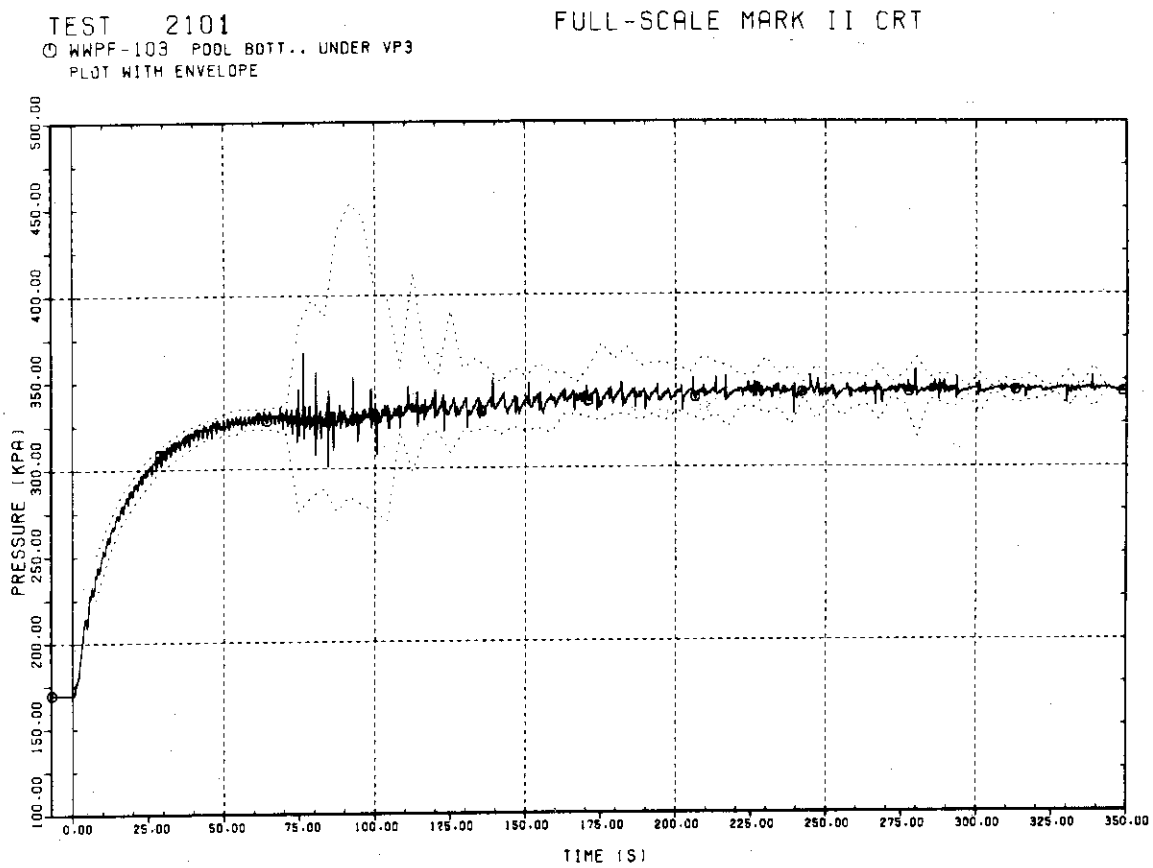
Plot L-1-10 Pressure in Vent Pipe



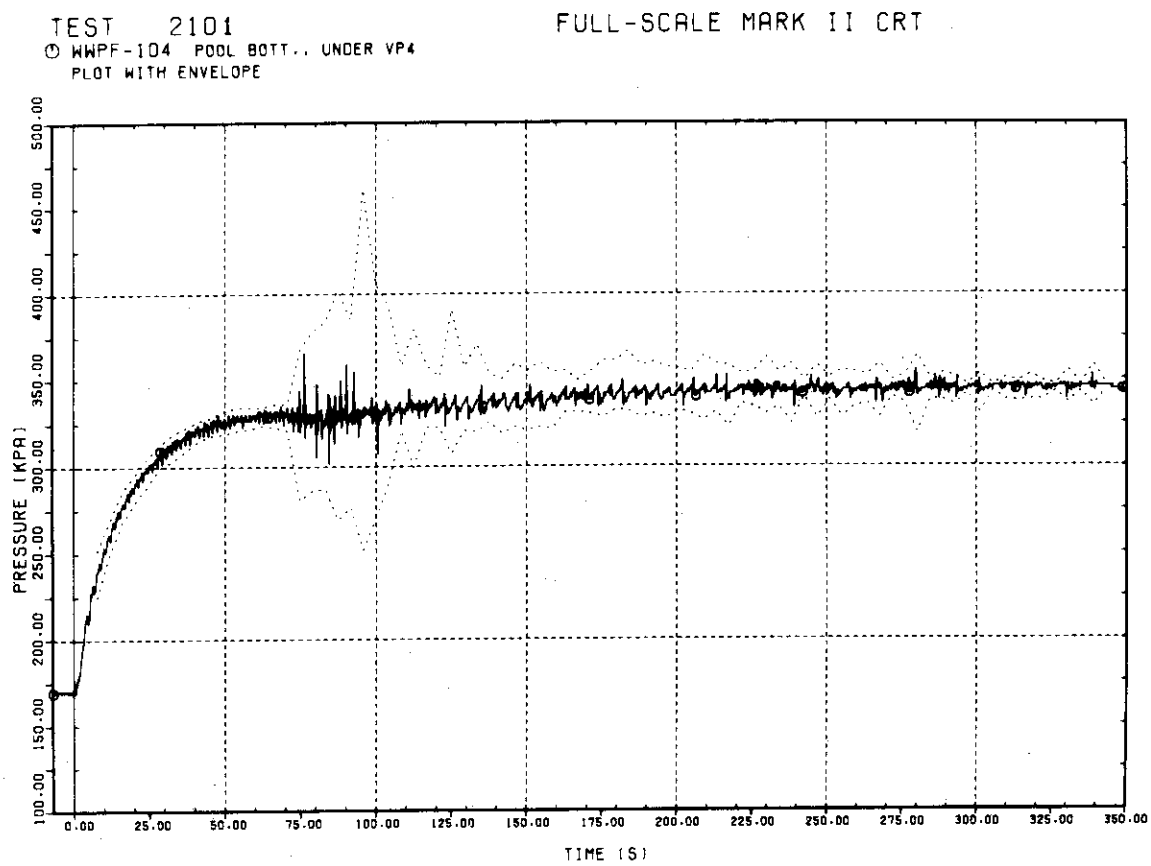
Plot L-1-11 Pressure in Wetwell



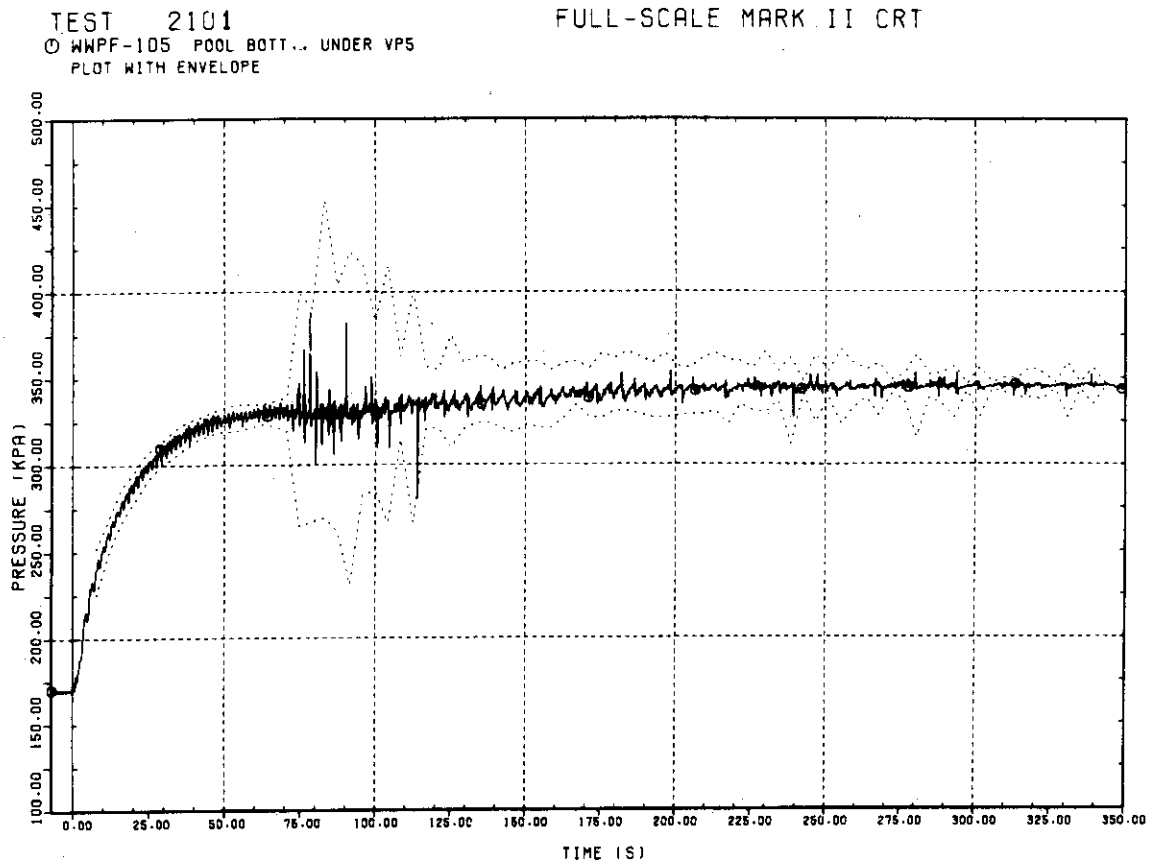
Plot L-1-12 Pressure in Wetwell



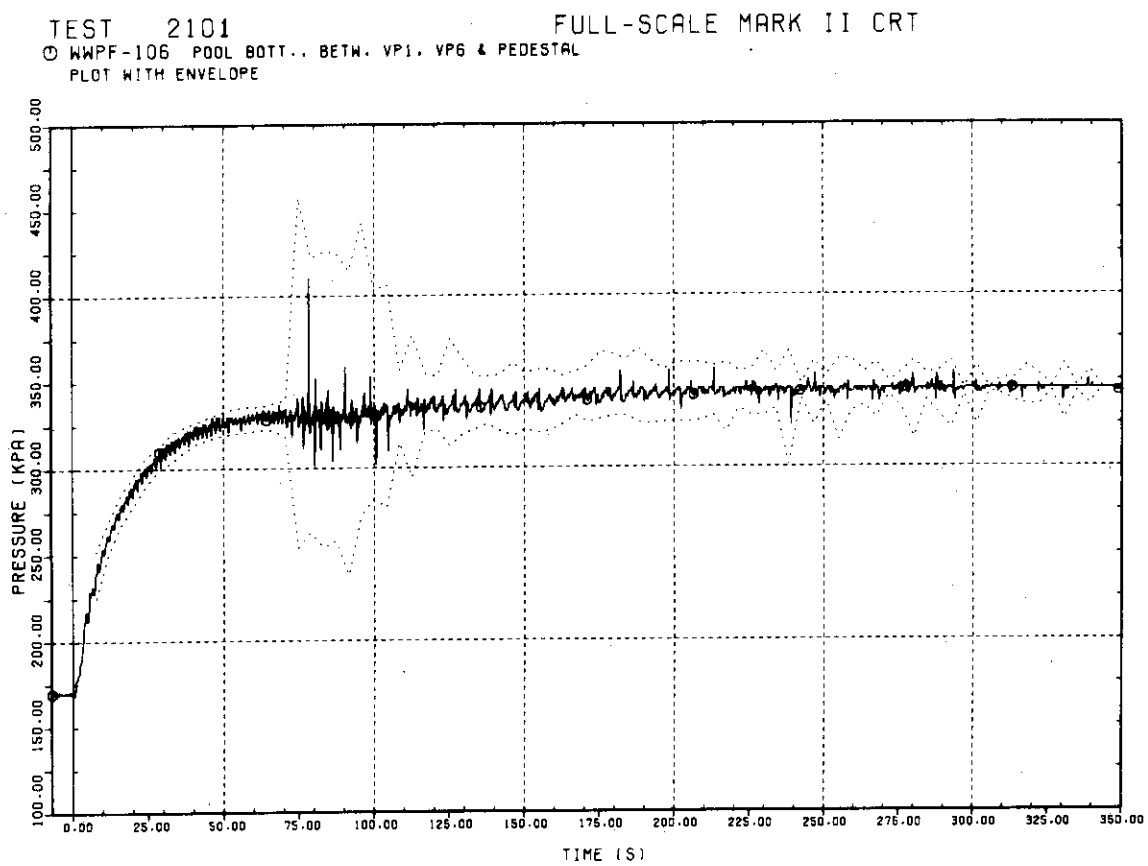
Plot L-1-13 Pressure in Wetwell



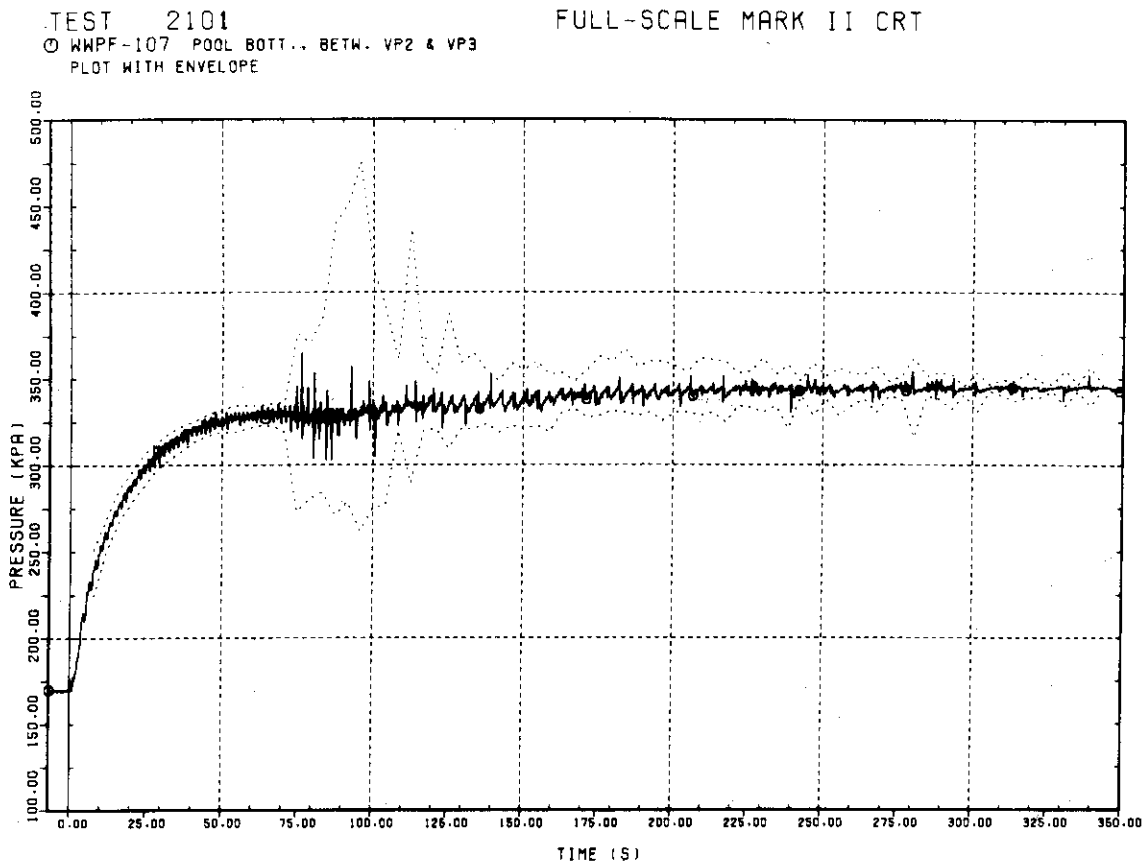
Plot L-1-14 Pressure in Wetwell



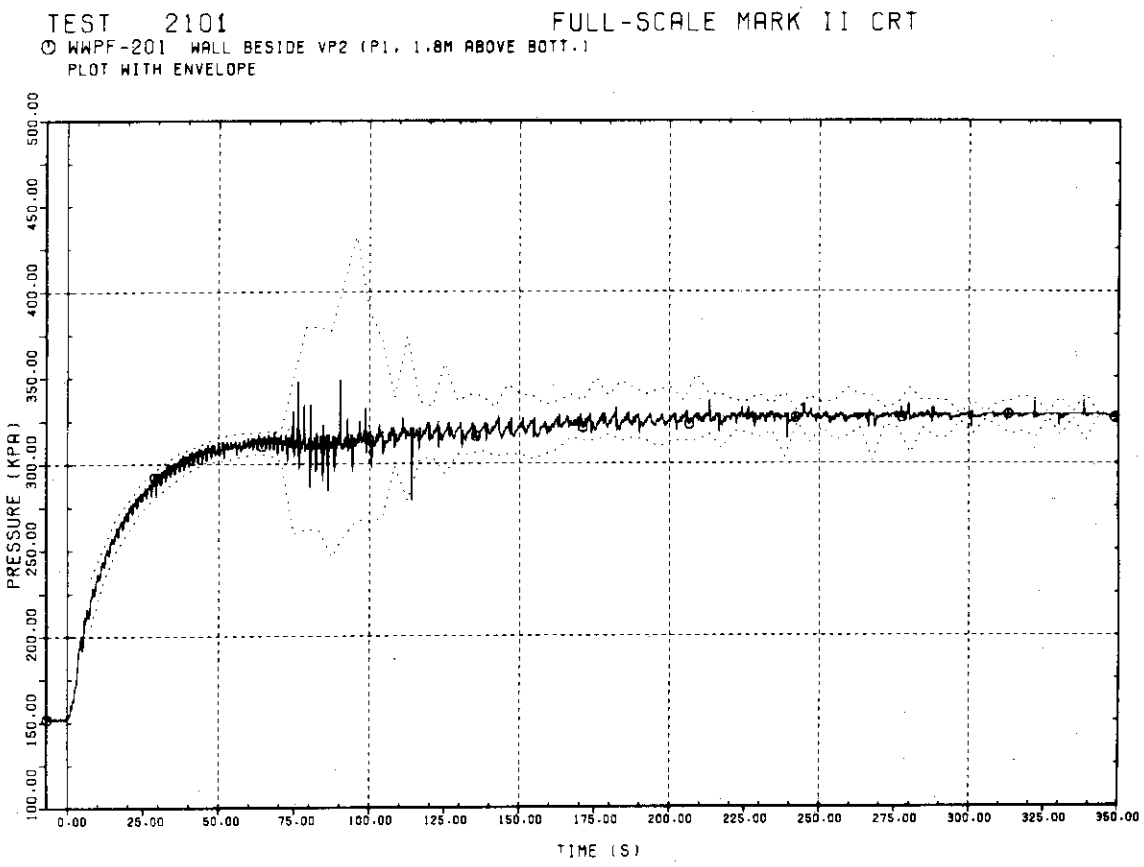
Plot L-1-15 Pressure in Wetwell



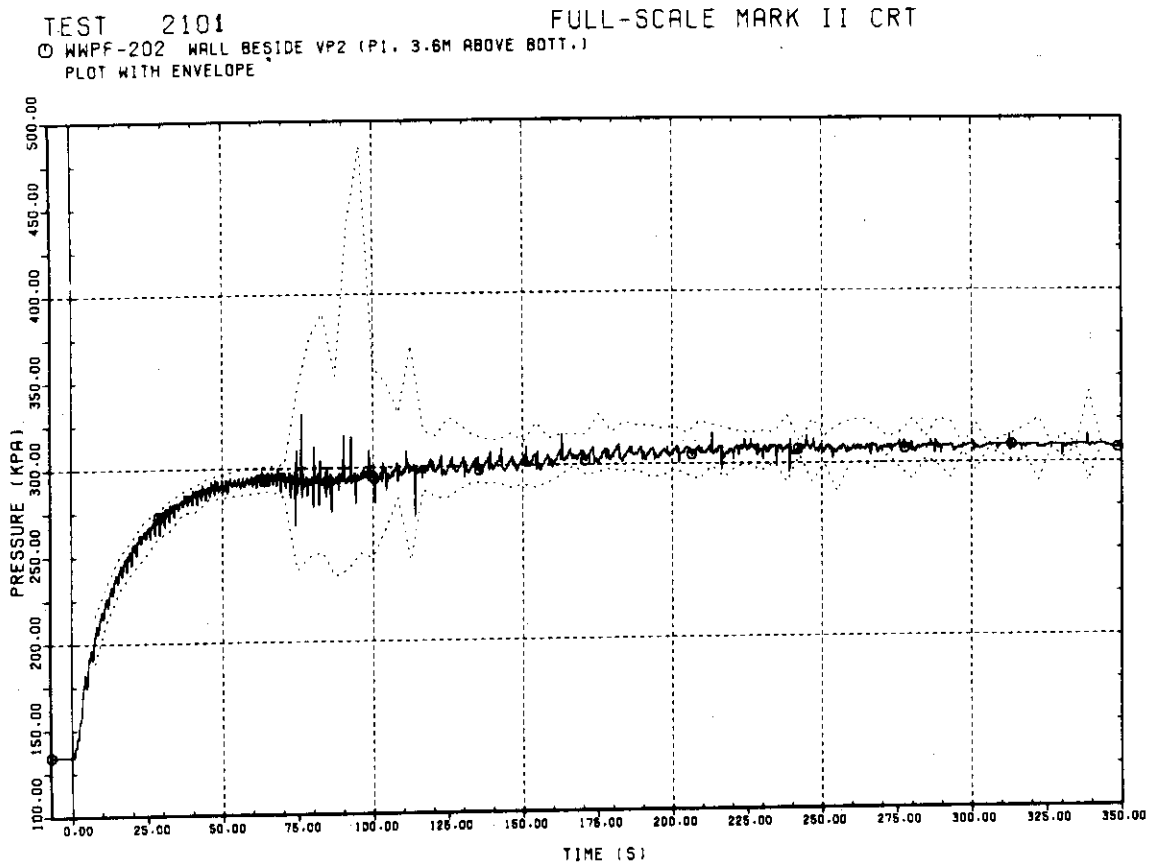
Plot L-1-16 Pressure in Wetwell



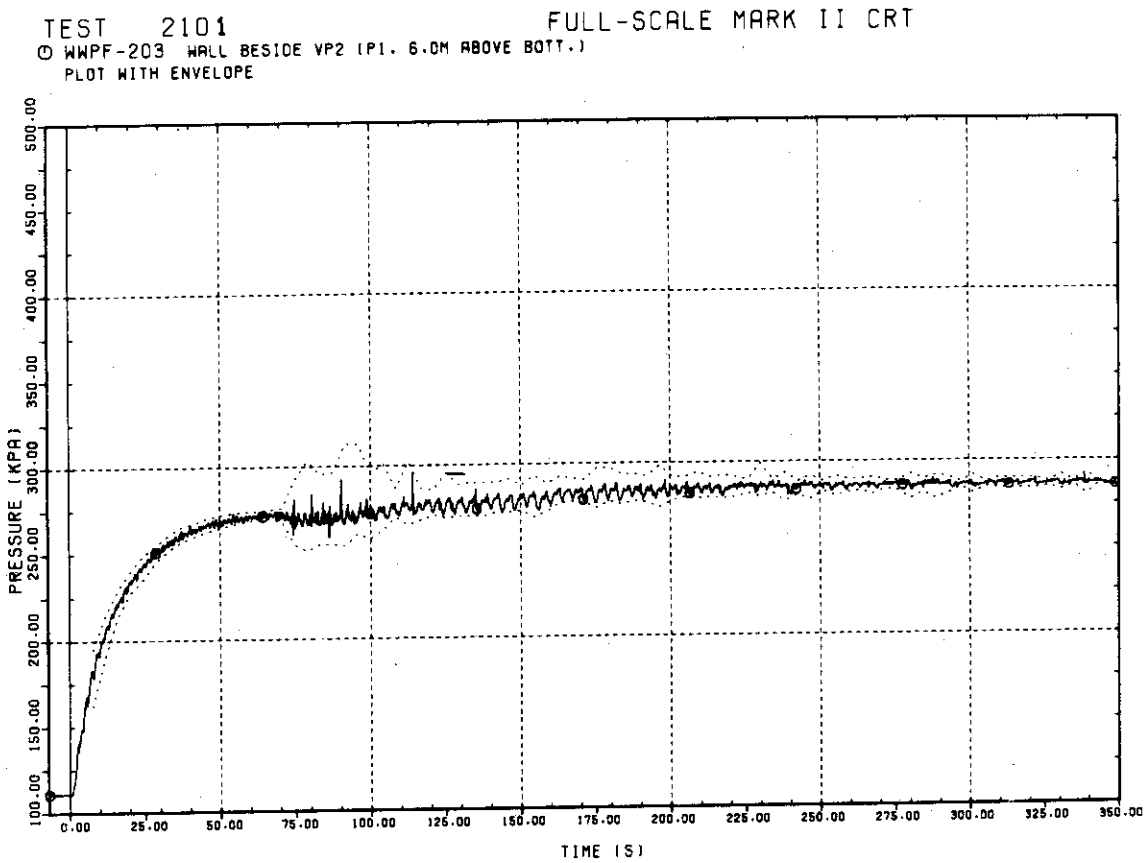
Plot L-1-17 Pressure in Wetwell



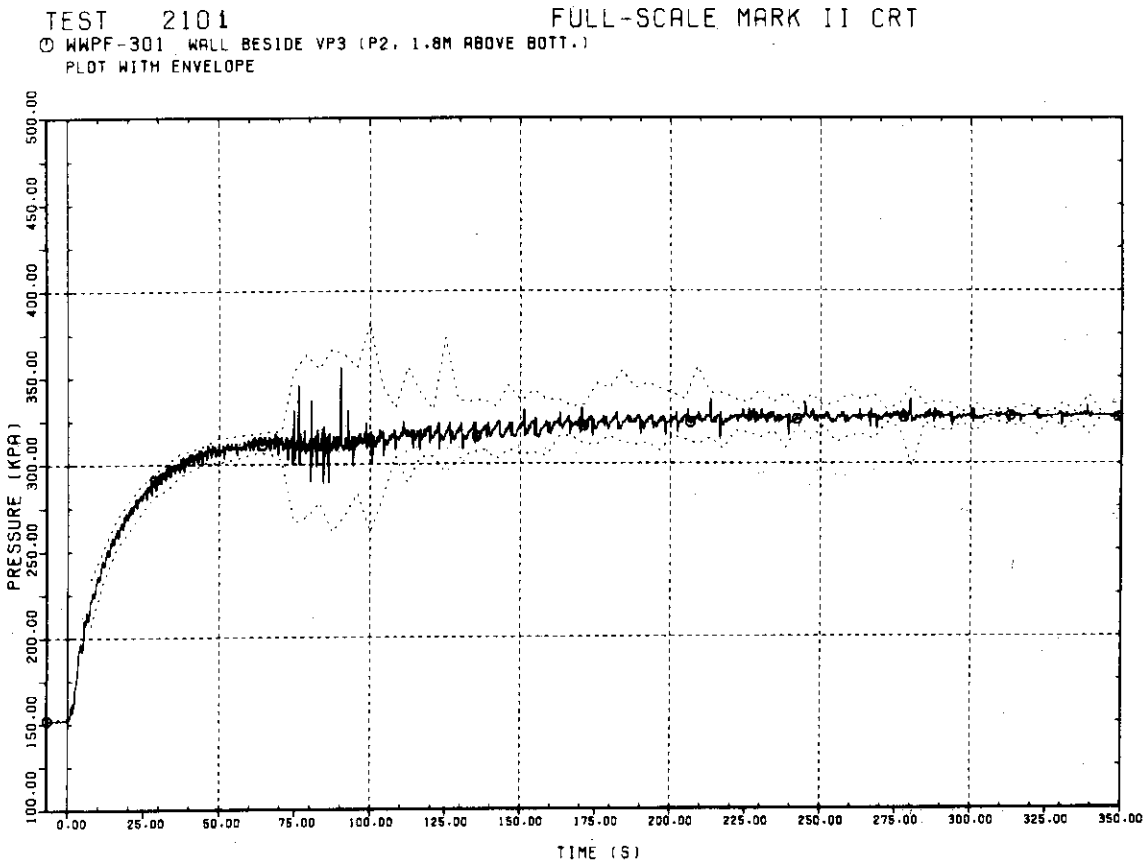
Plot L-1-18 Pressure in Wetwell



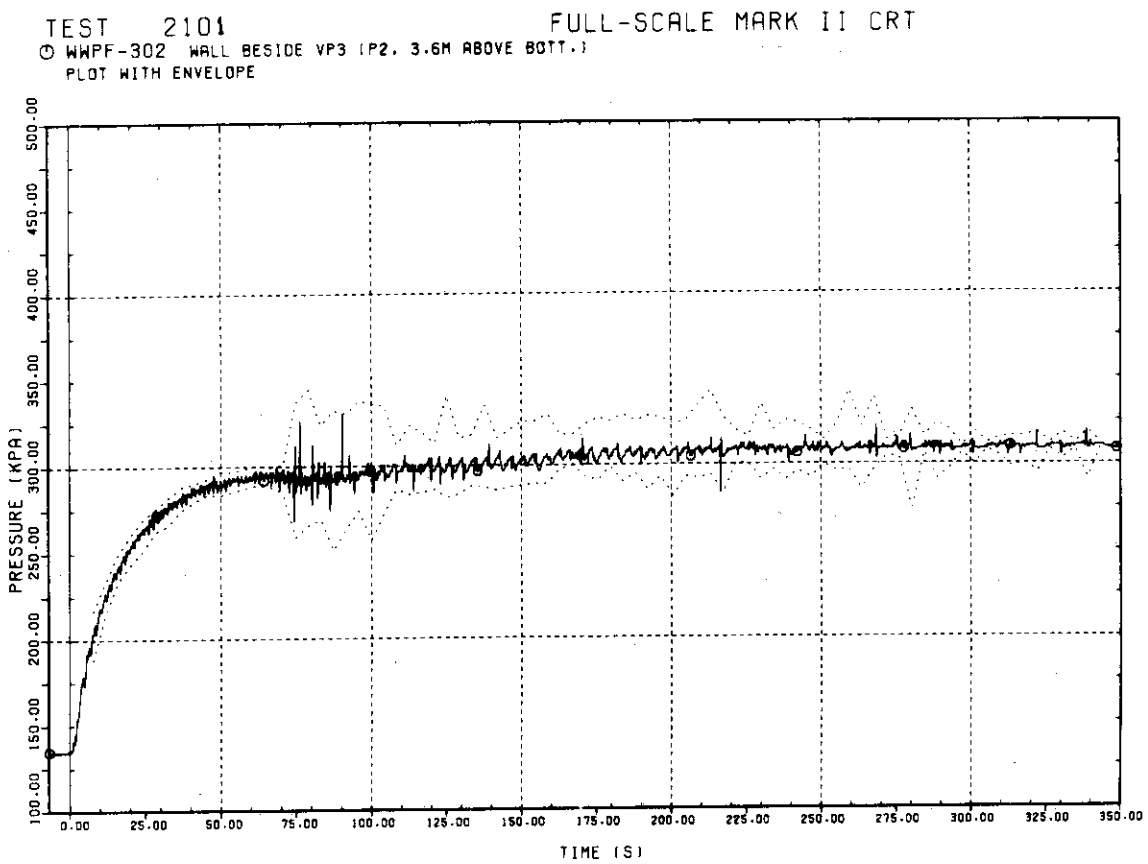
Plot L-1-19 Pressure in Wetwell



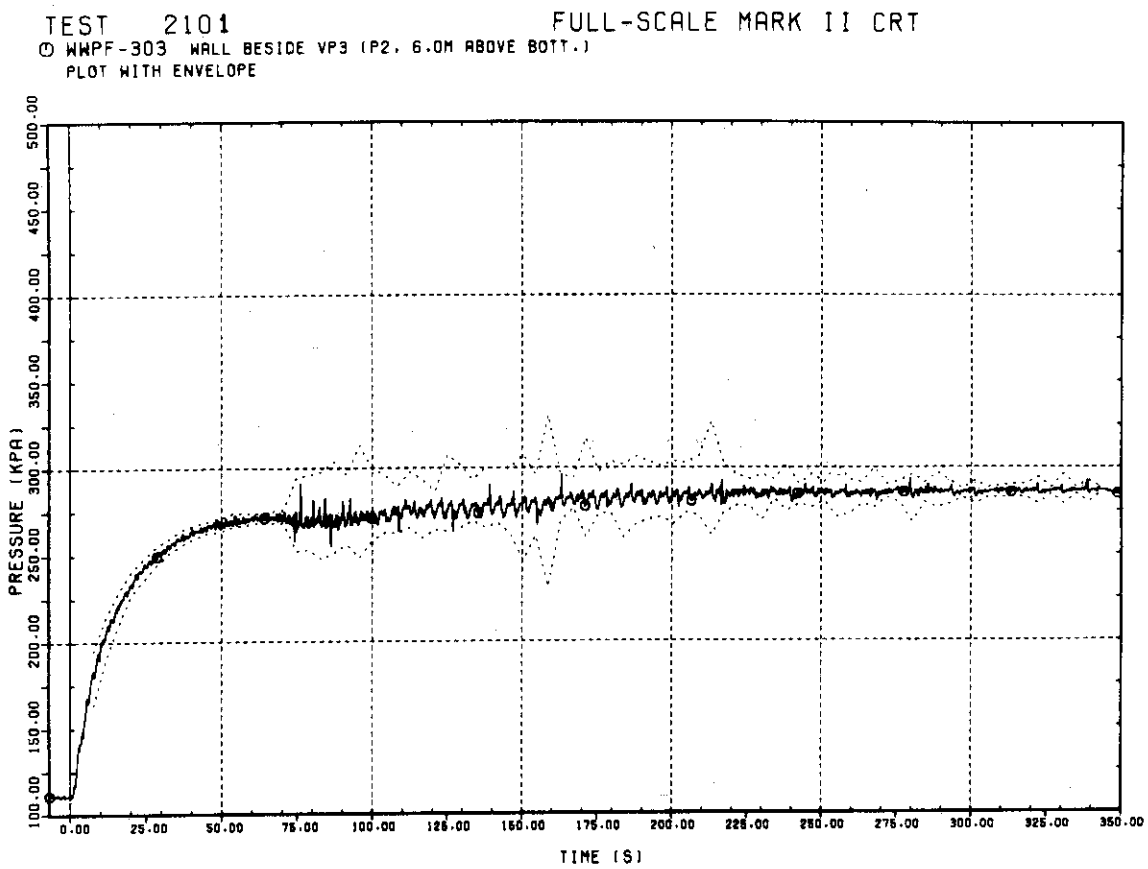
Plot L-1-20 Pressure in Wetwell



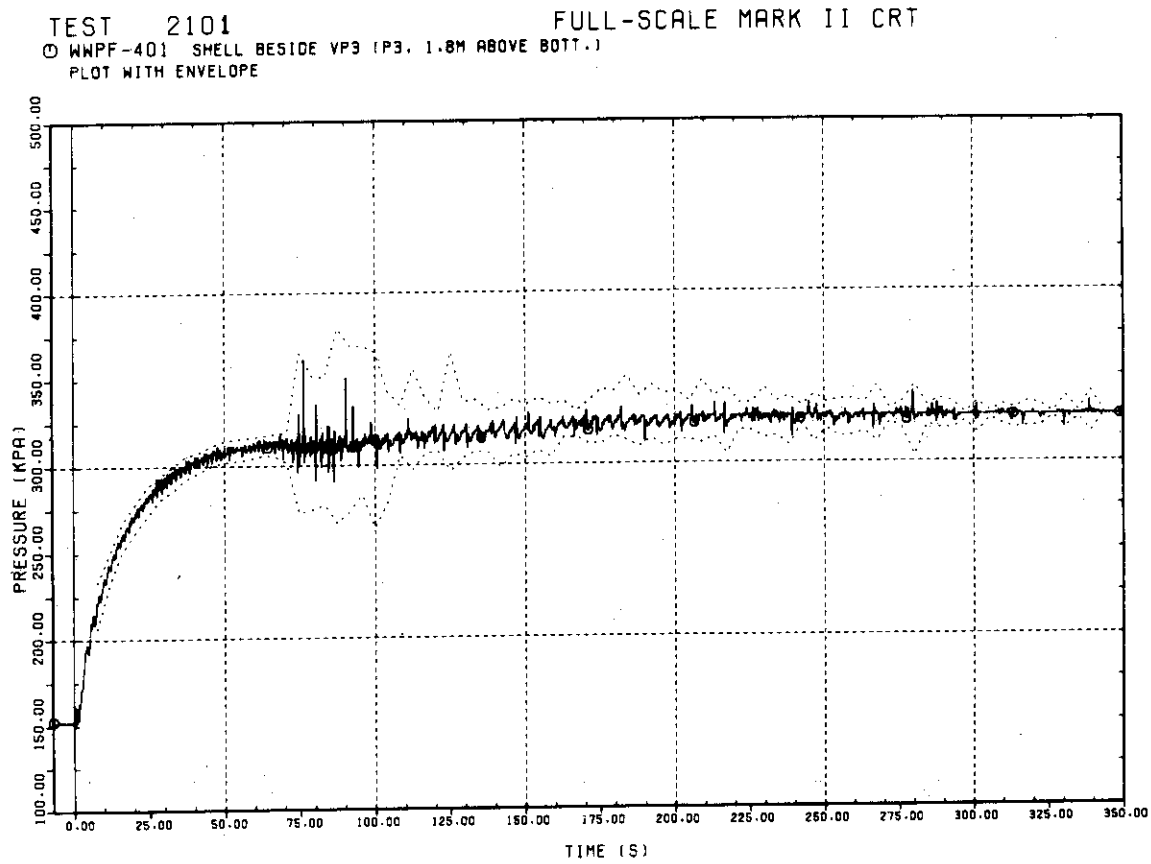
Plot L-1-21 Pressure in Wetwell



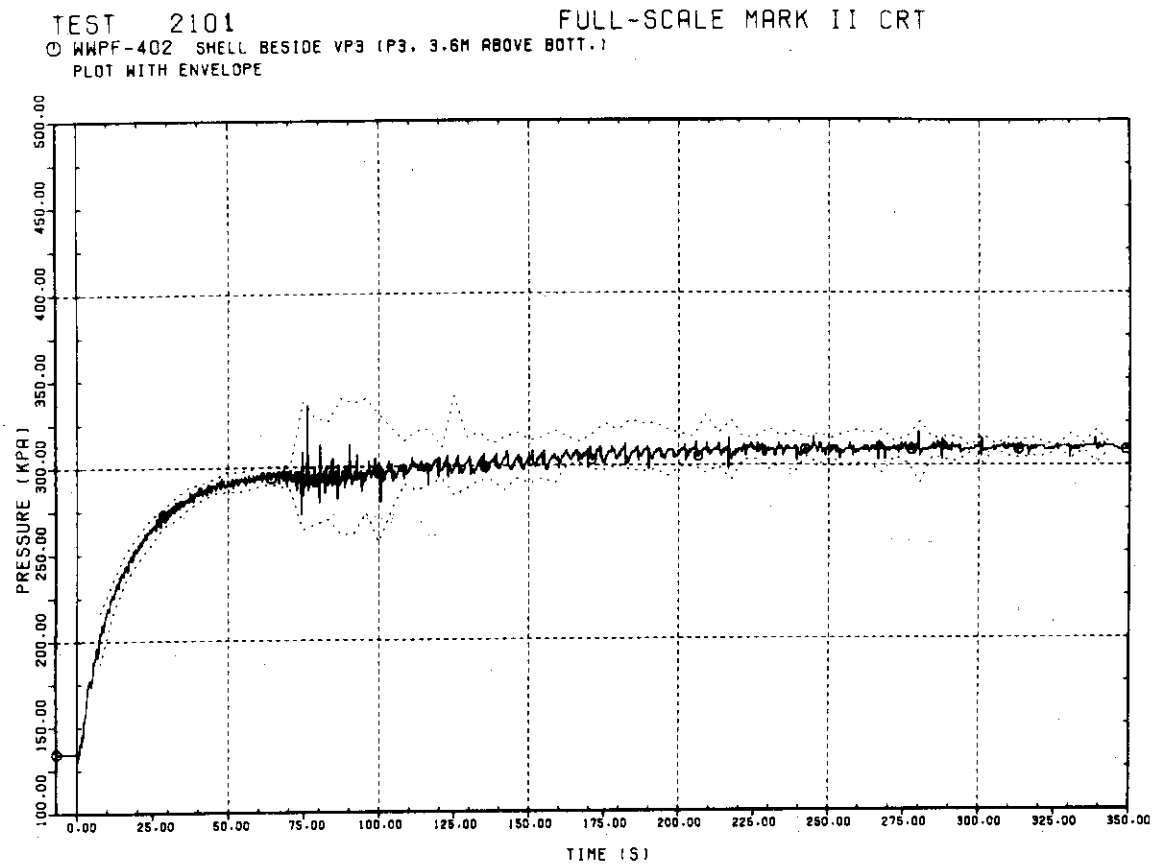
Plot L-1-22 Pressure in Wetwell



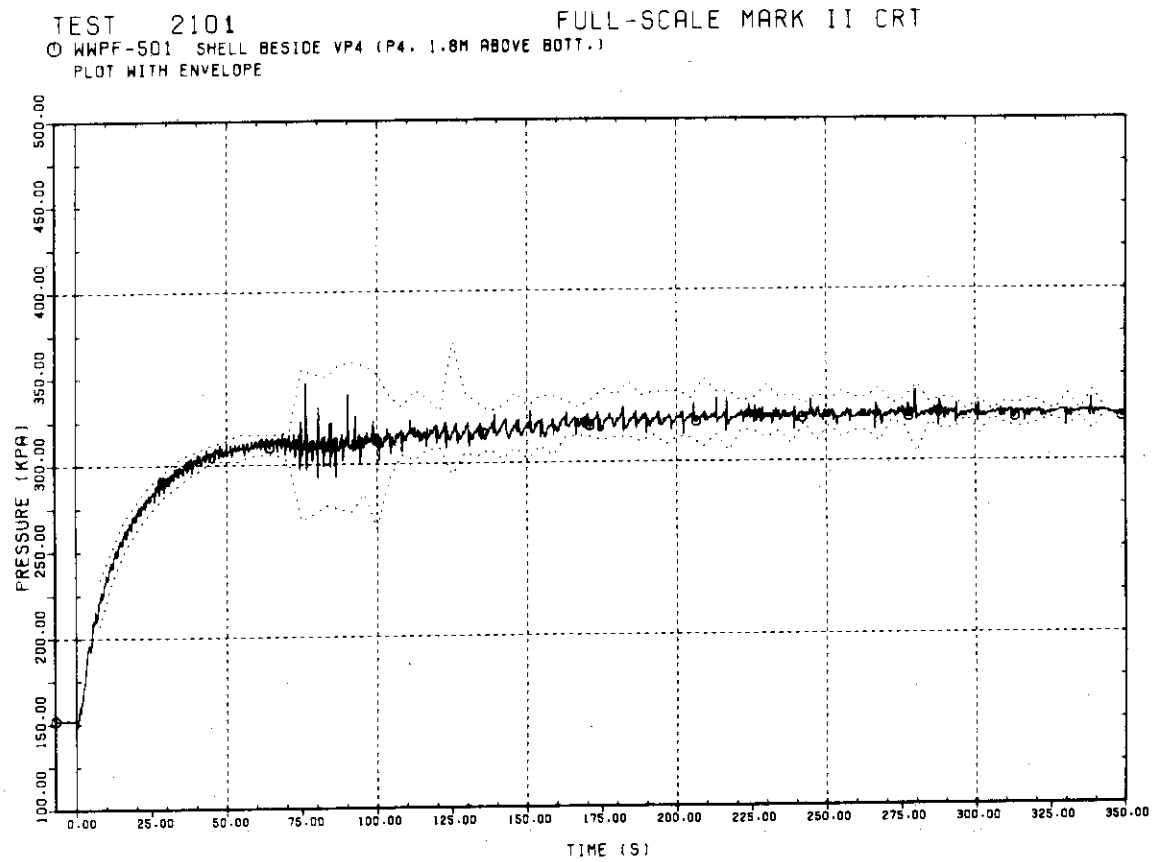
Plot L-1-23 Pressure in Wetwell



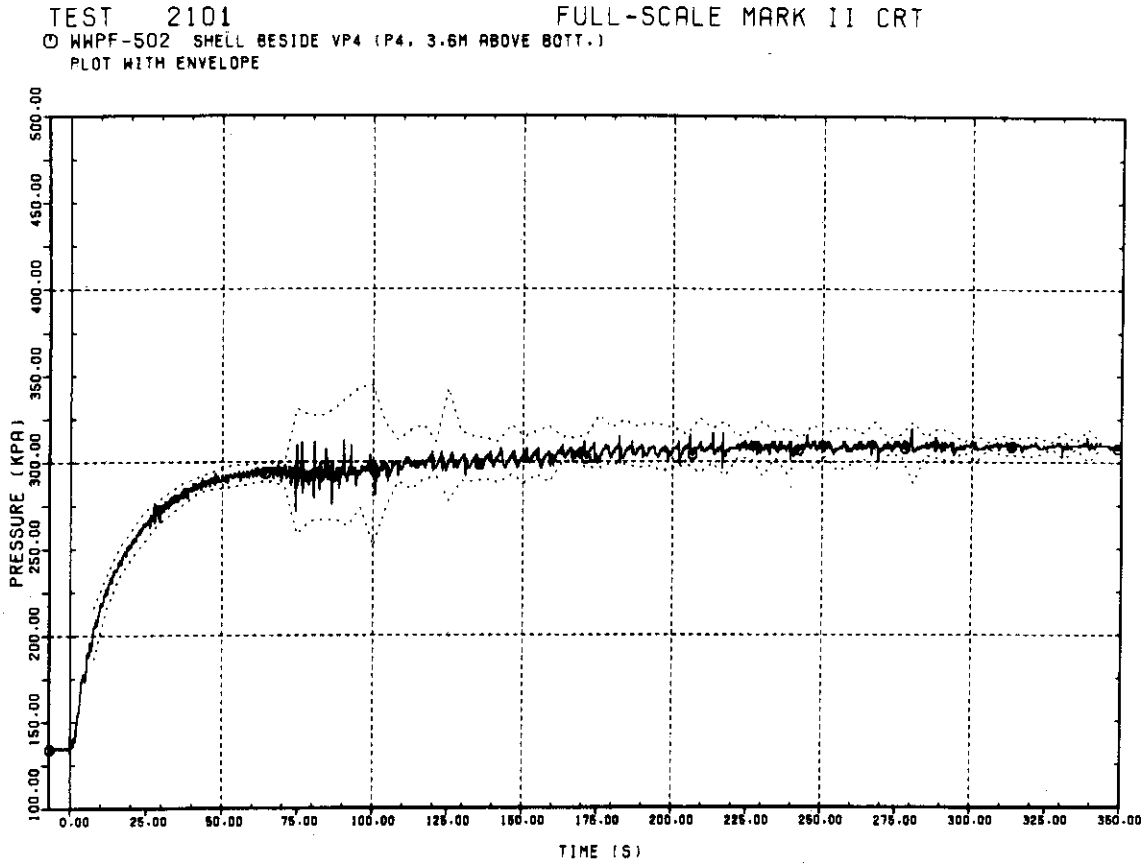
Plot L-1-24 Pressure in Wetwell



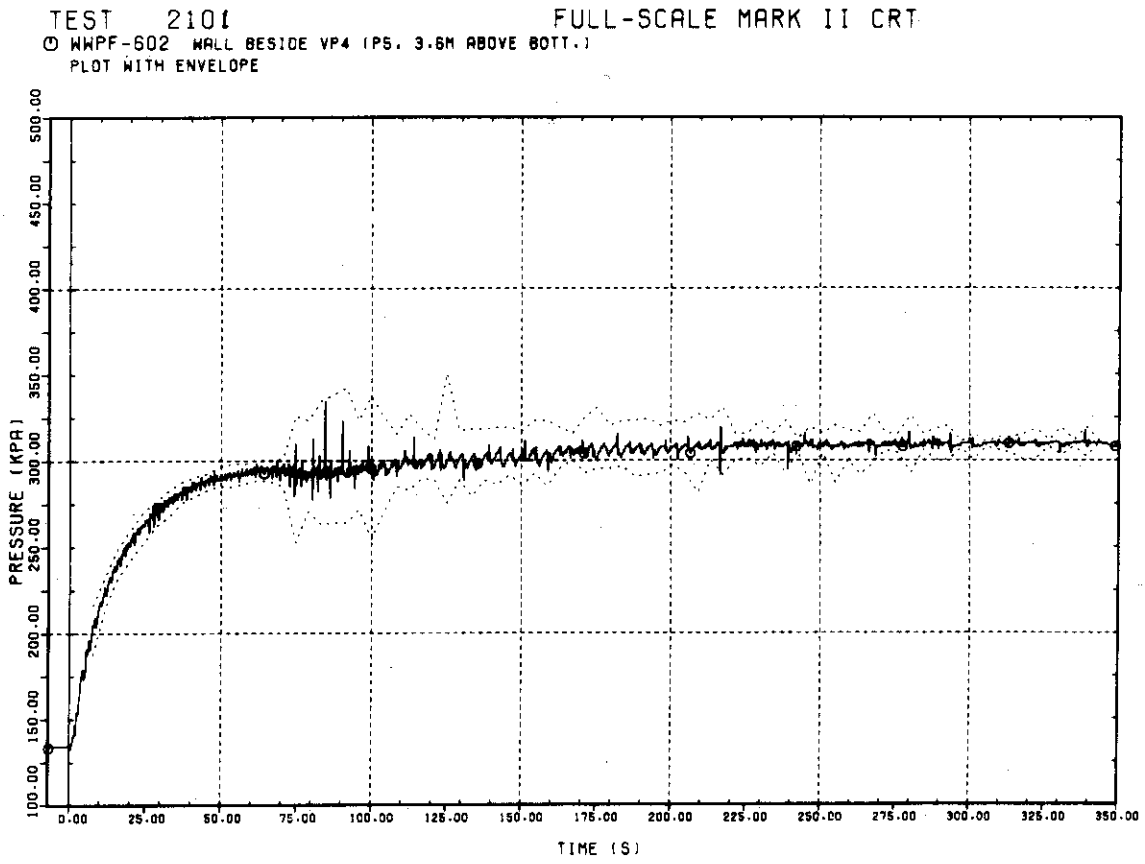
Plot L-1-25 Pressure in Wetwell



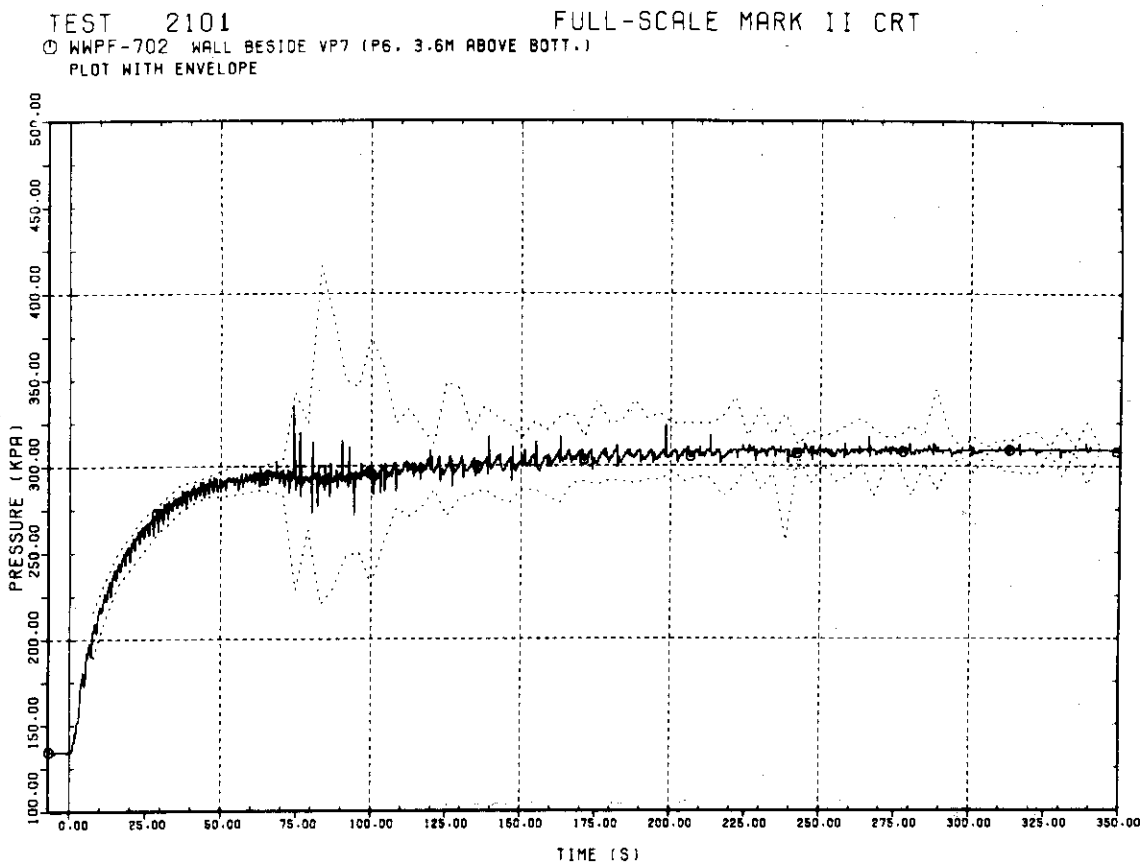
Plot L-1-26 Pressure in Wetwell



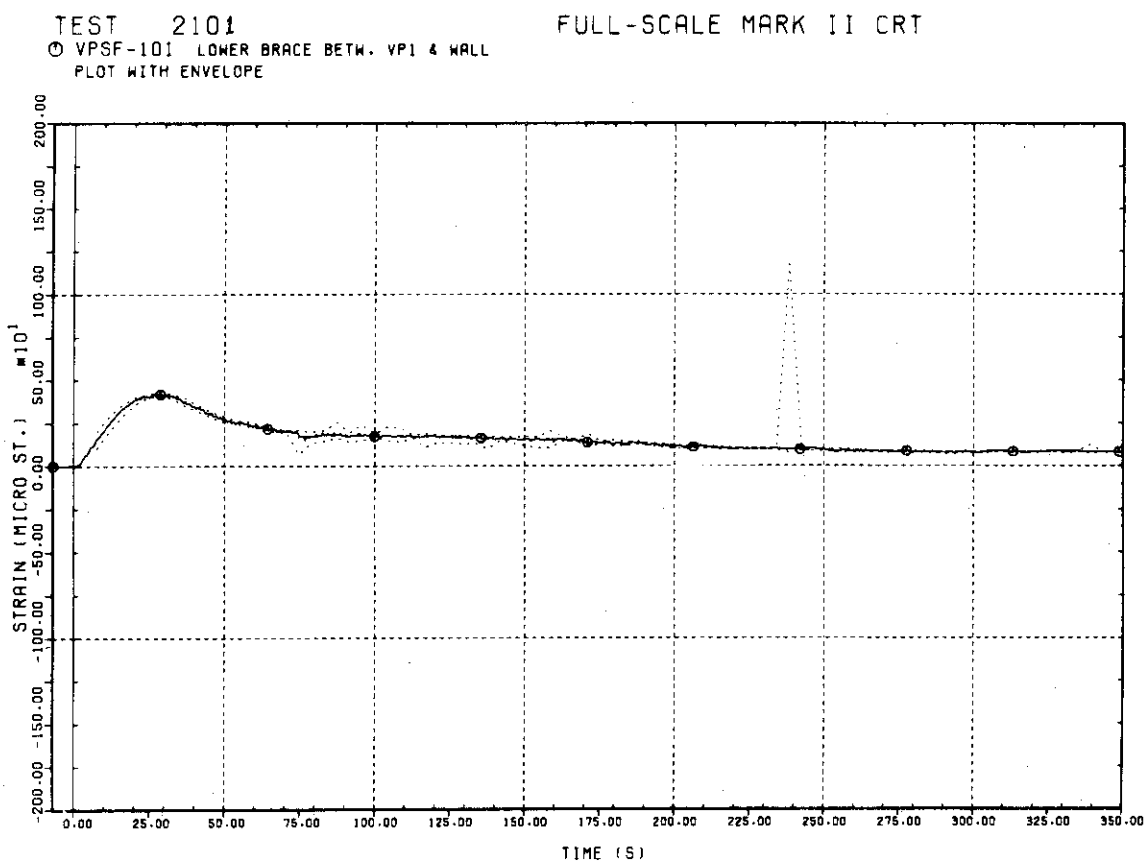
Plot L-1-27 Pressure in Wetwell



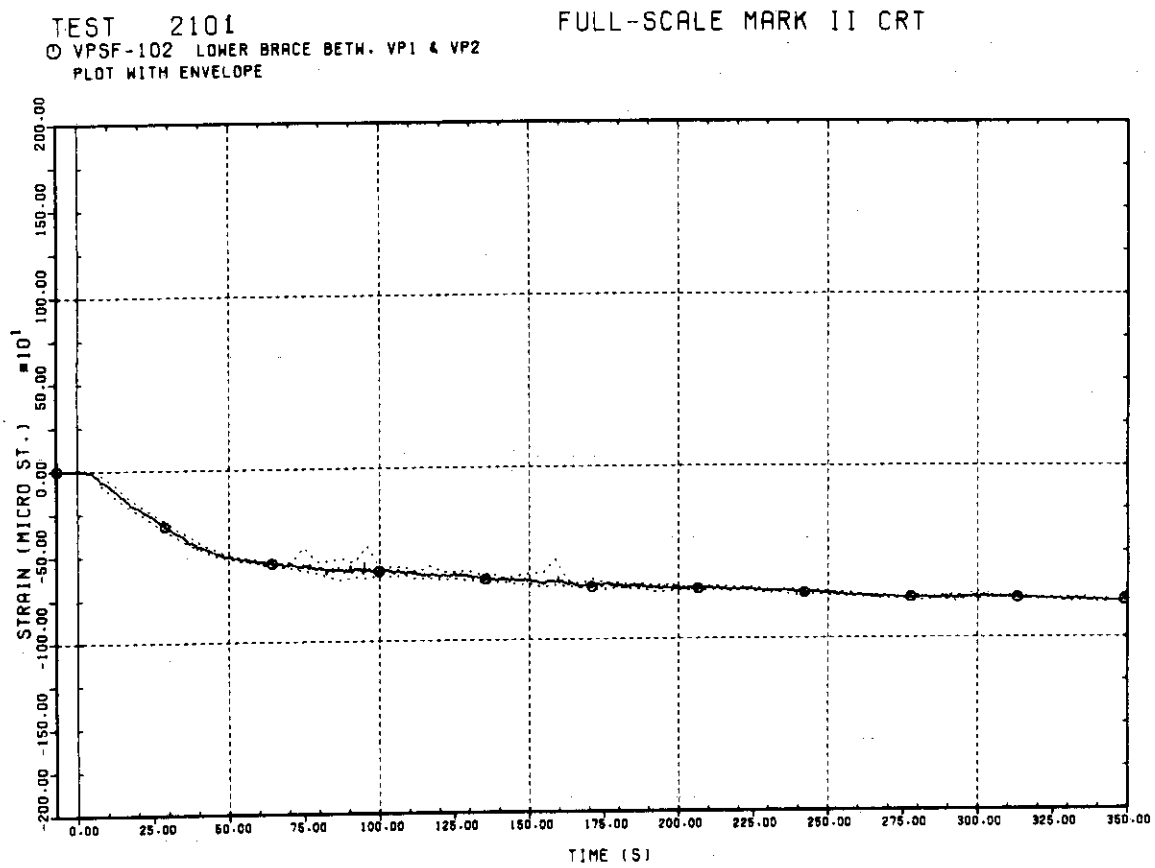
Plot L-1-28 Pressure in Wetwell



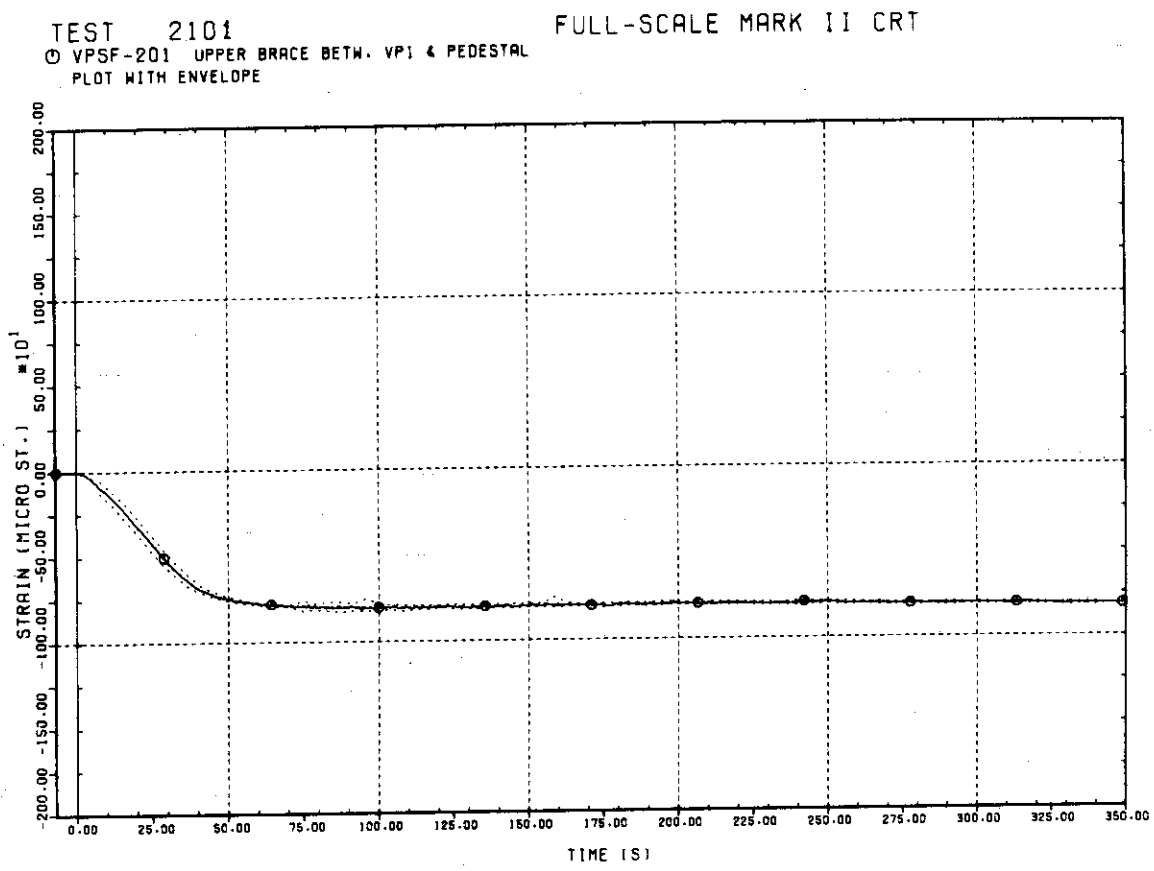
Plot L-1-29 Pressure in Wetwell



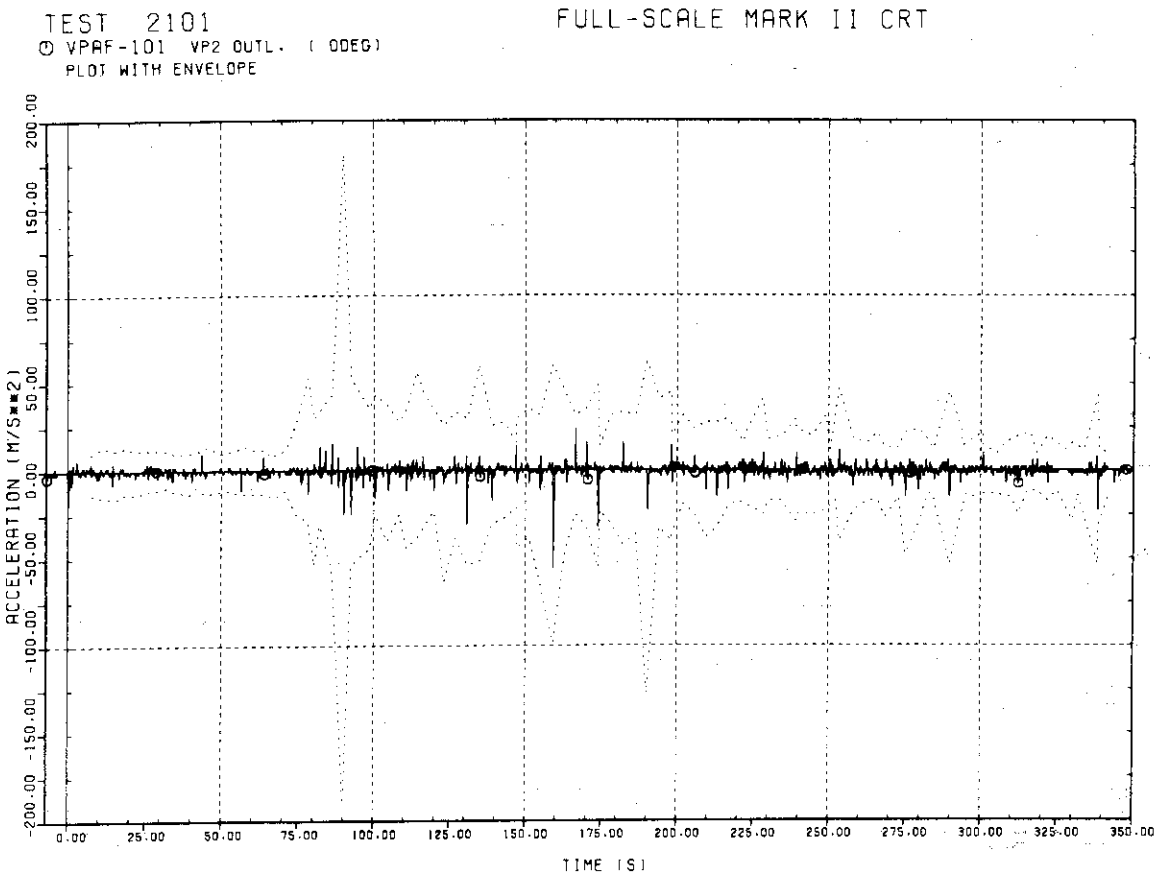
Plot L-1-30 Strain of Vent Pipe Brace



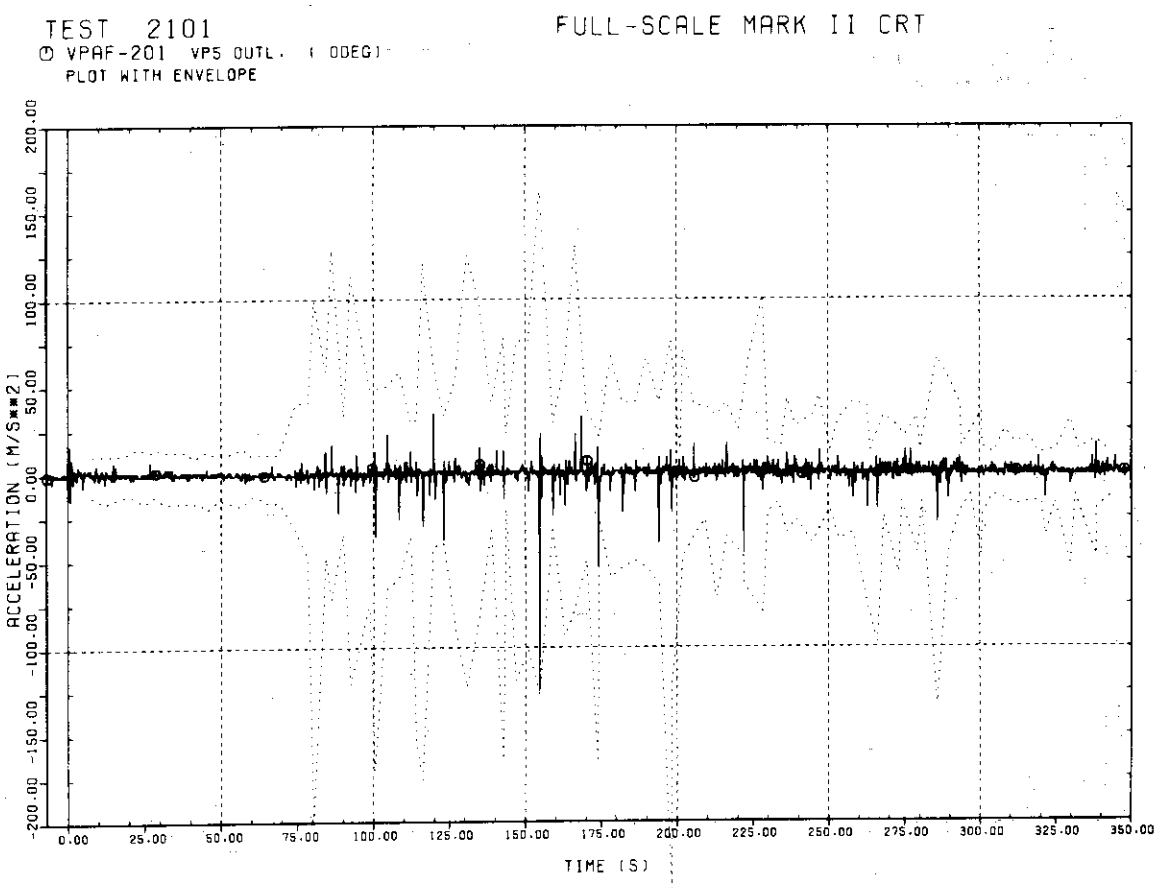
Plot L-1-31 Strain of Vent Pipe Brace



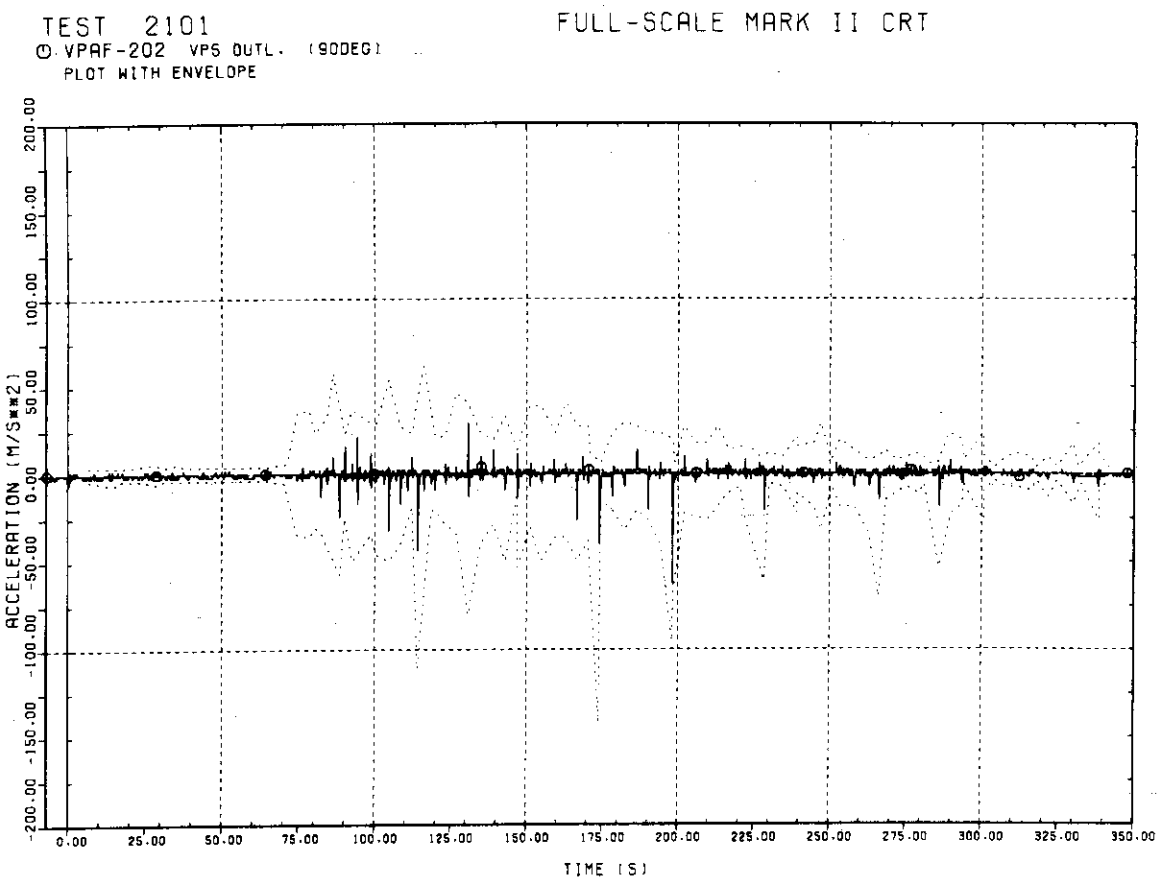
Plot L-1-32 Strain of Vent Pipe Brace



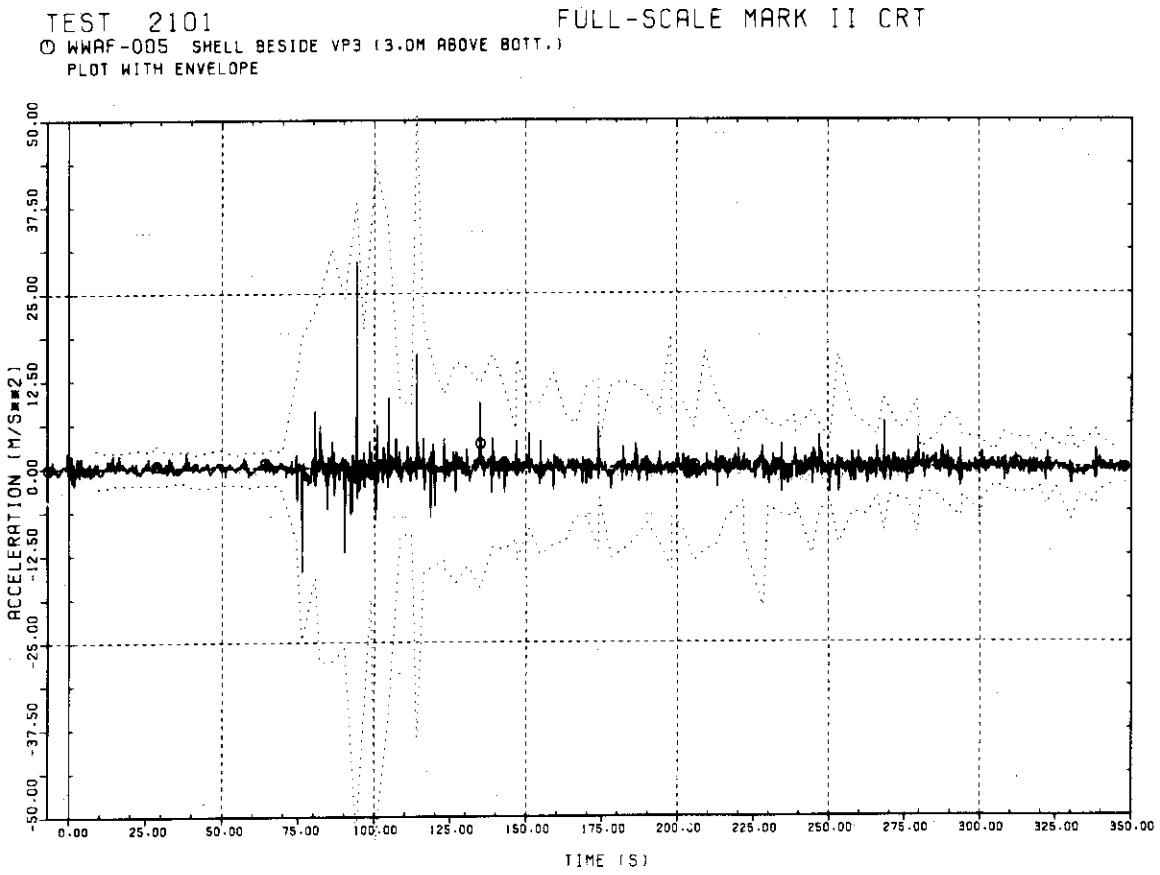
Plot L-2-1 **Acceleration of Vent pipe Outlet**



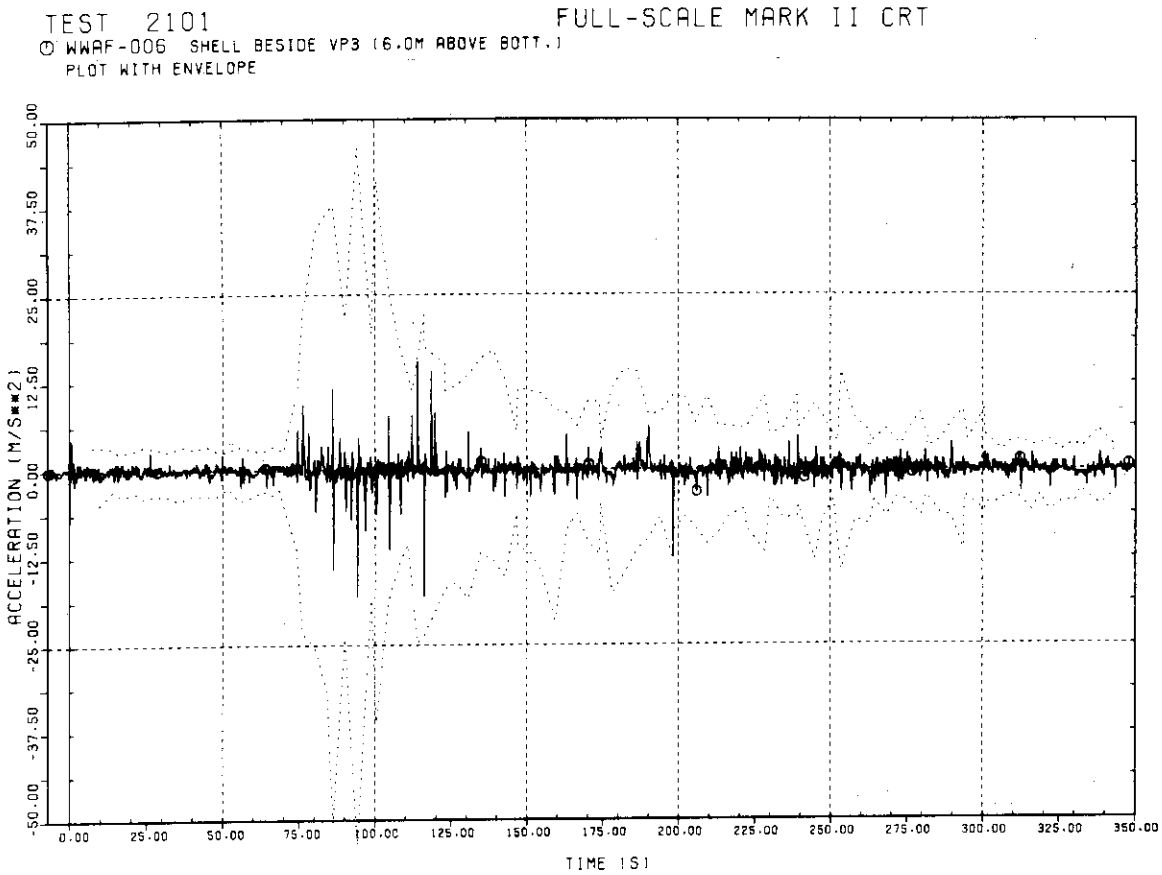
Plot L-2-2 **Acceleration of Vent pipe Outlet**



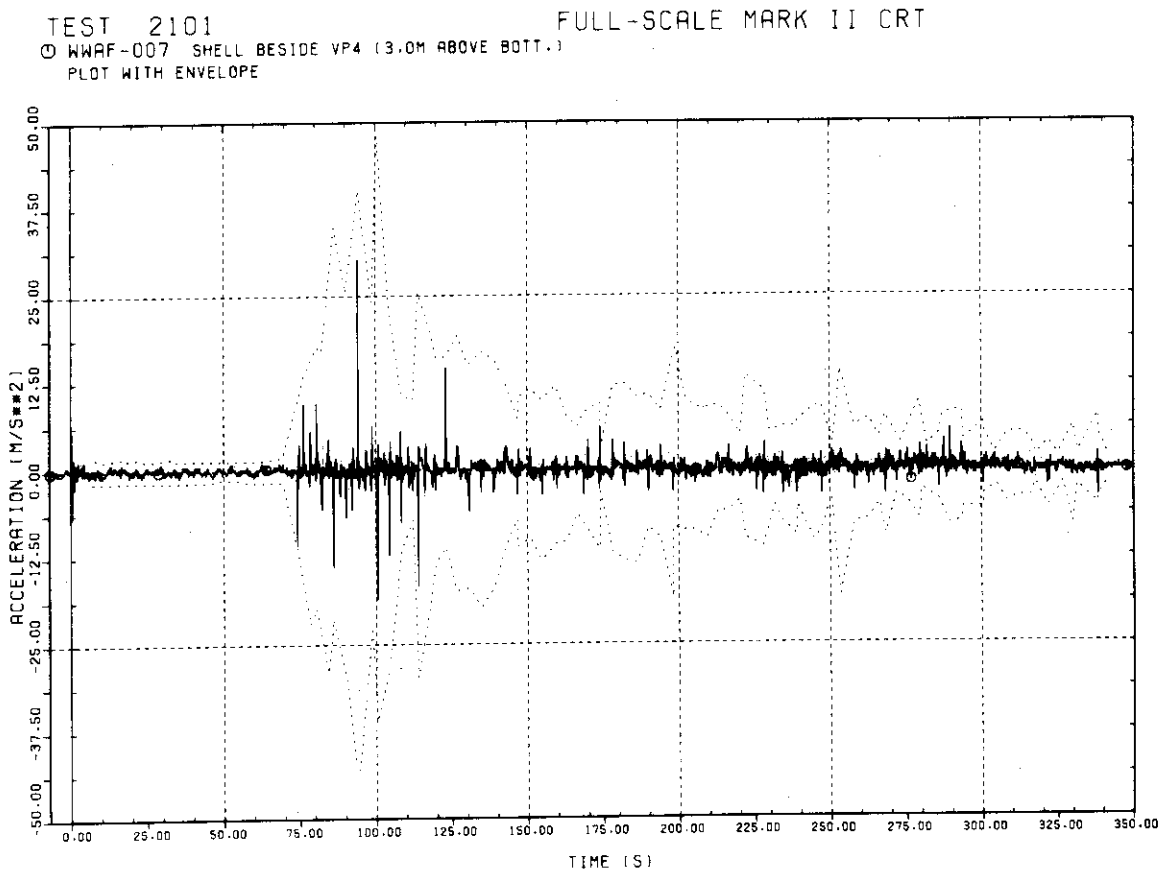
Plot L-2-3 Acceleration of Vent pipe Outlet



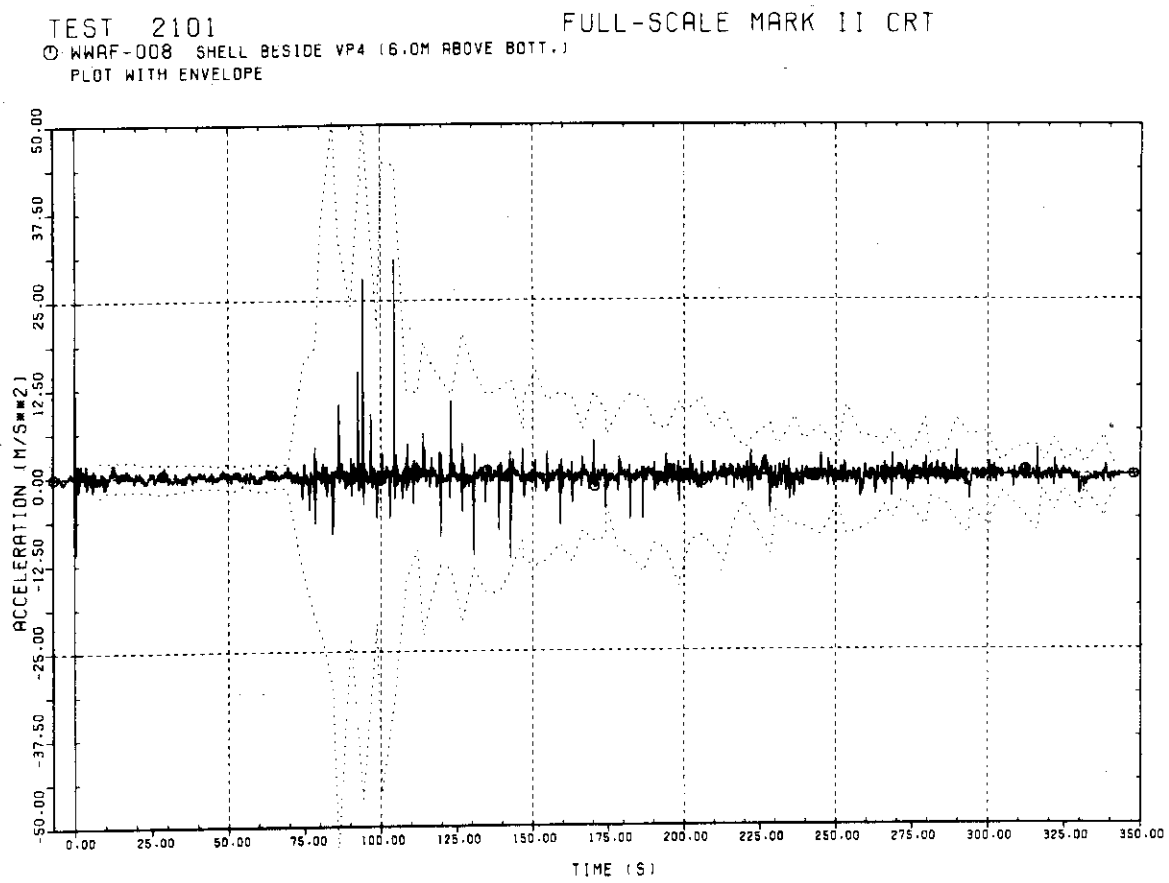
Plot L-2-4 Acceleration of Containment Structure



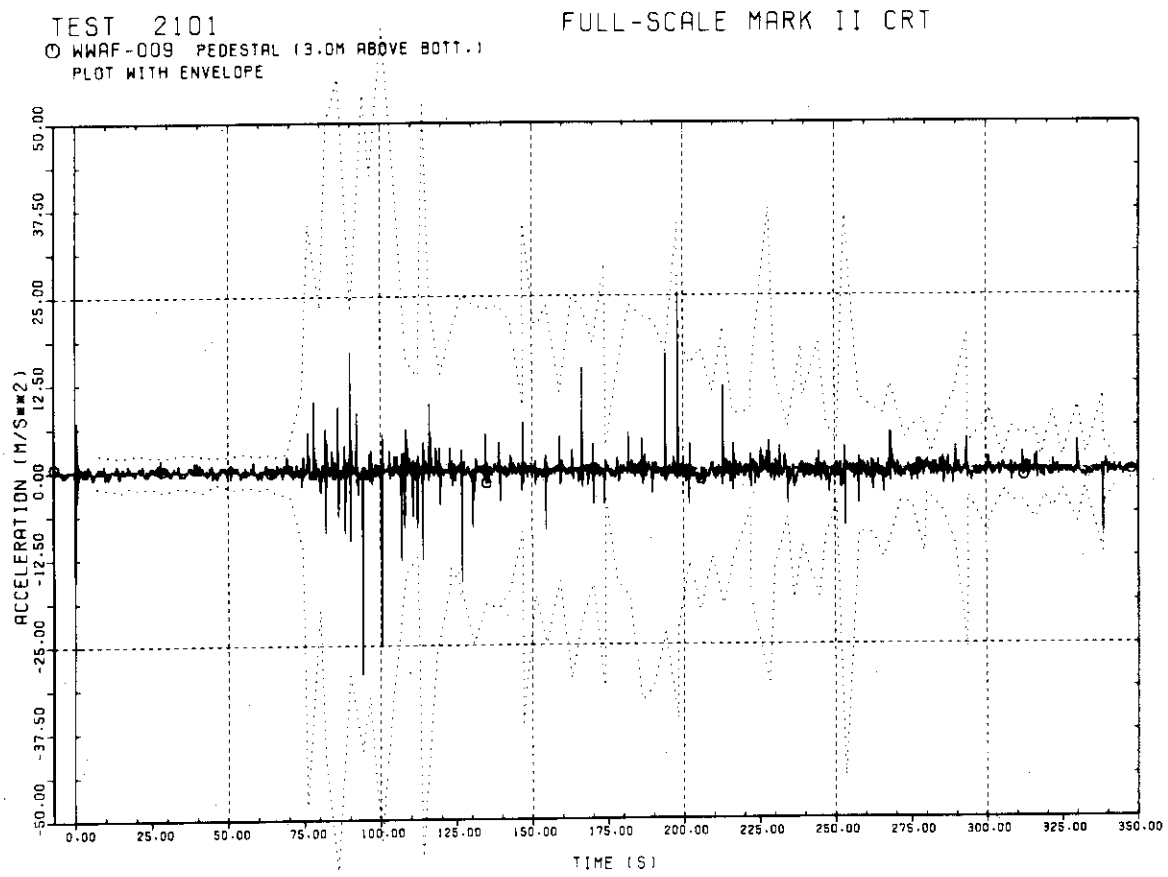
Plot L-2-5 Acceleration of Containment Structure



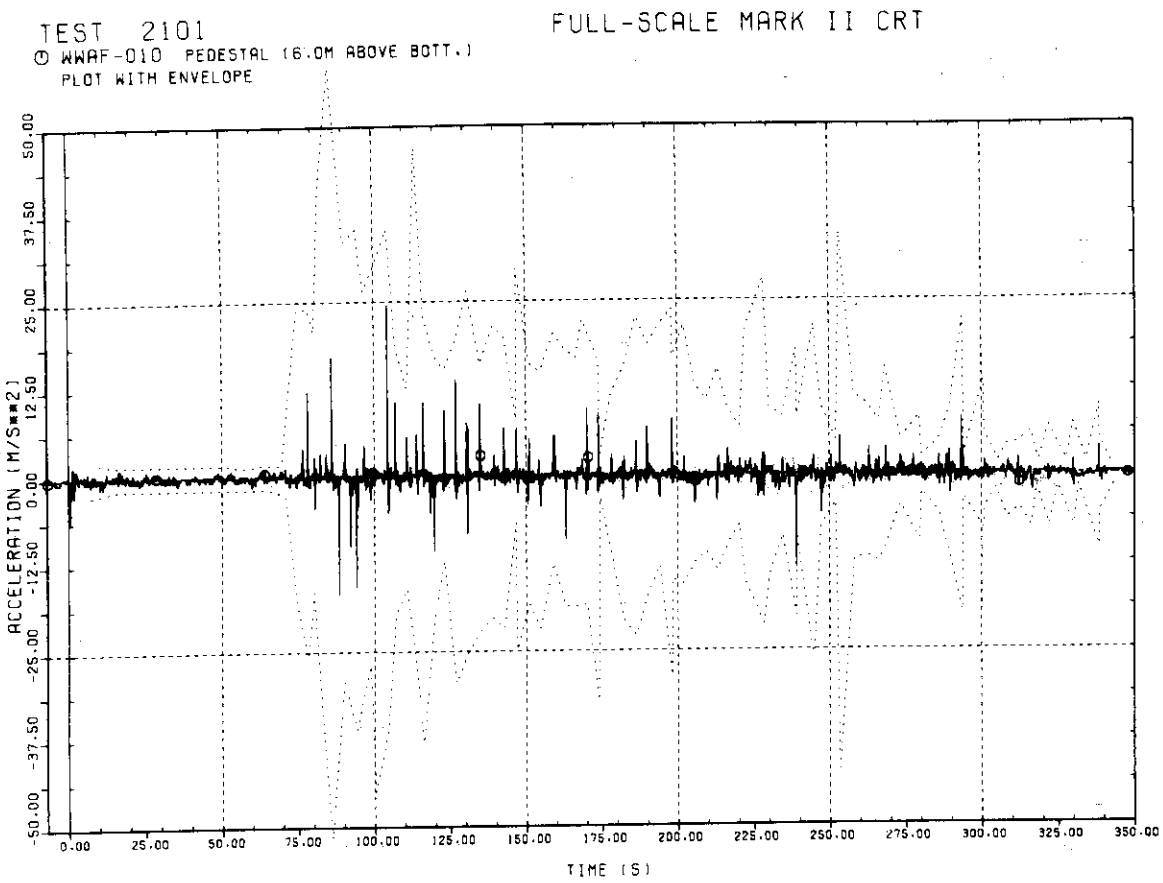
Plot L-2-6 Acceleration of Containment Structure



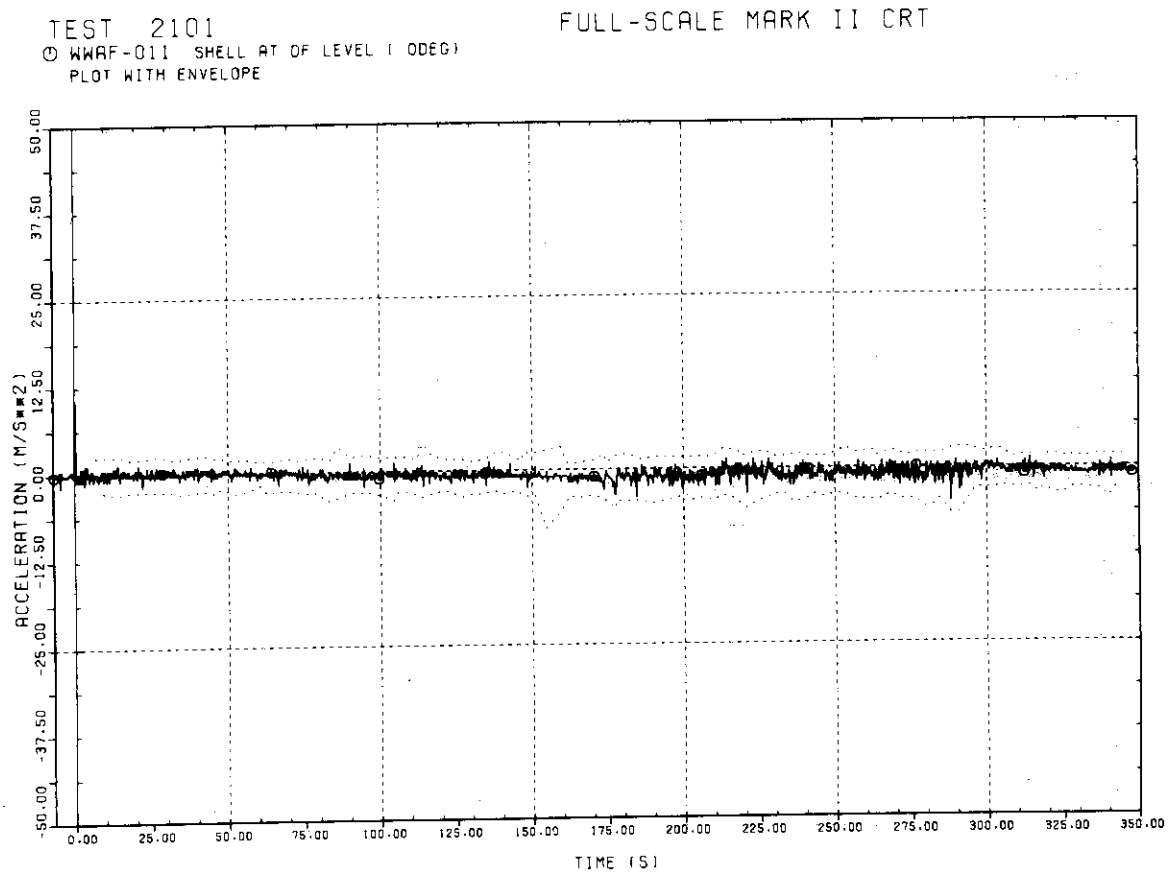
Plot L-2-7 **Acceleration of Containment Structure**



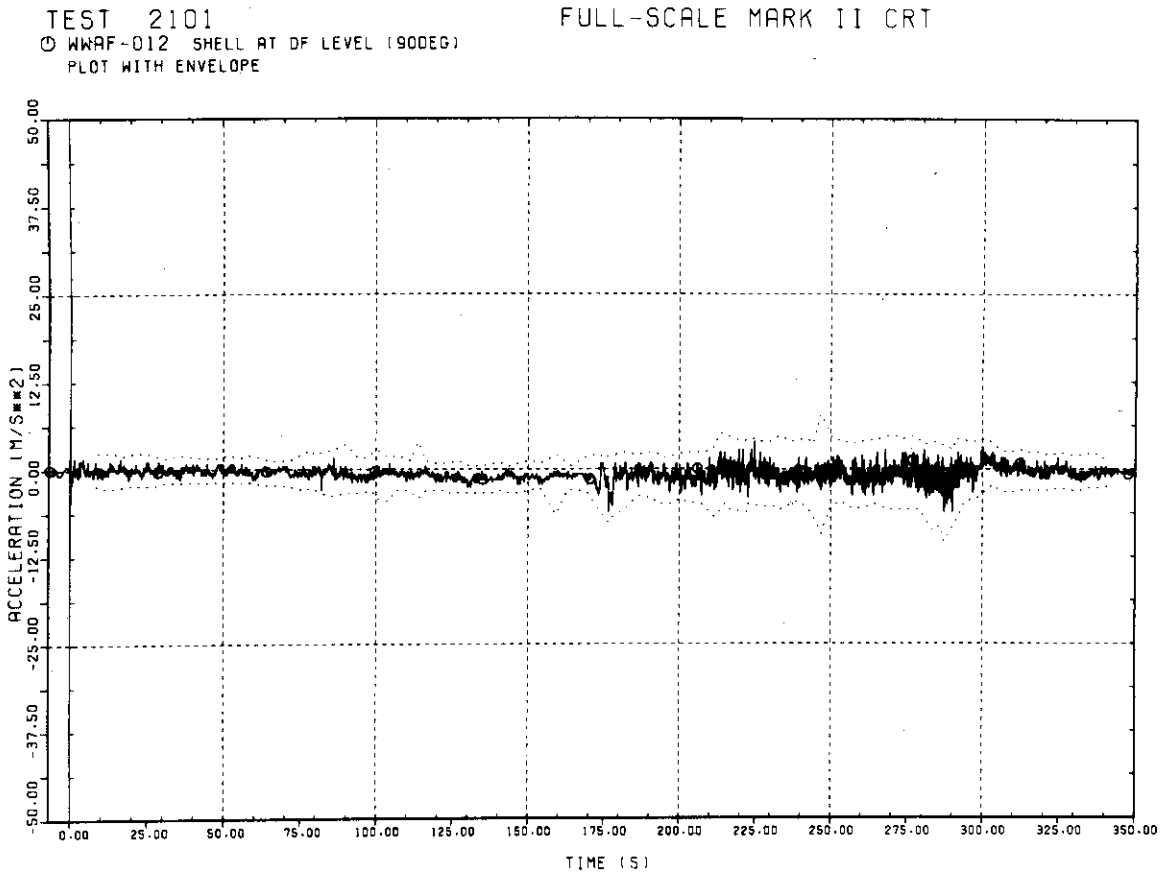
Plot L-2-8 **Acceleration of Containment Structure**



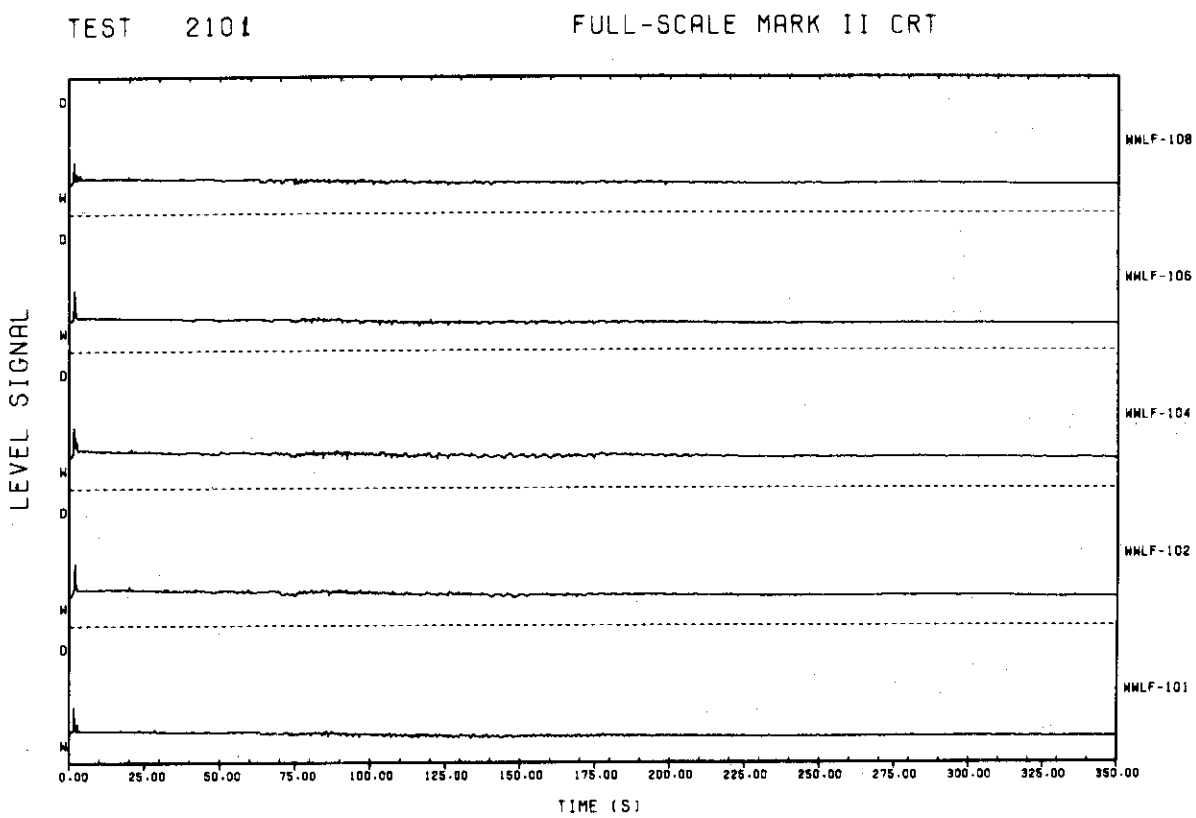
Plot L-2-9 Acceleration of Containment Structure



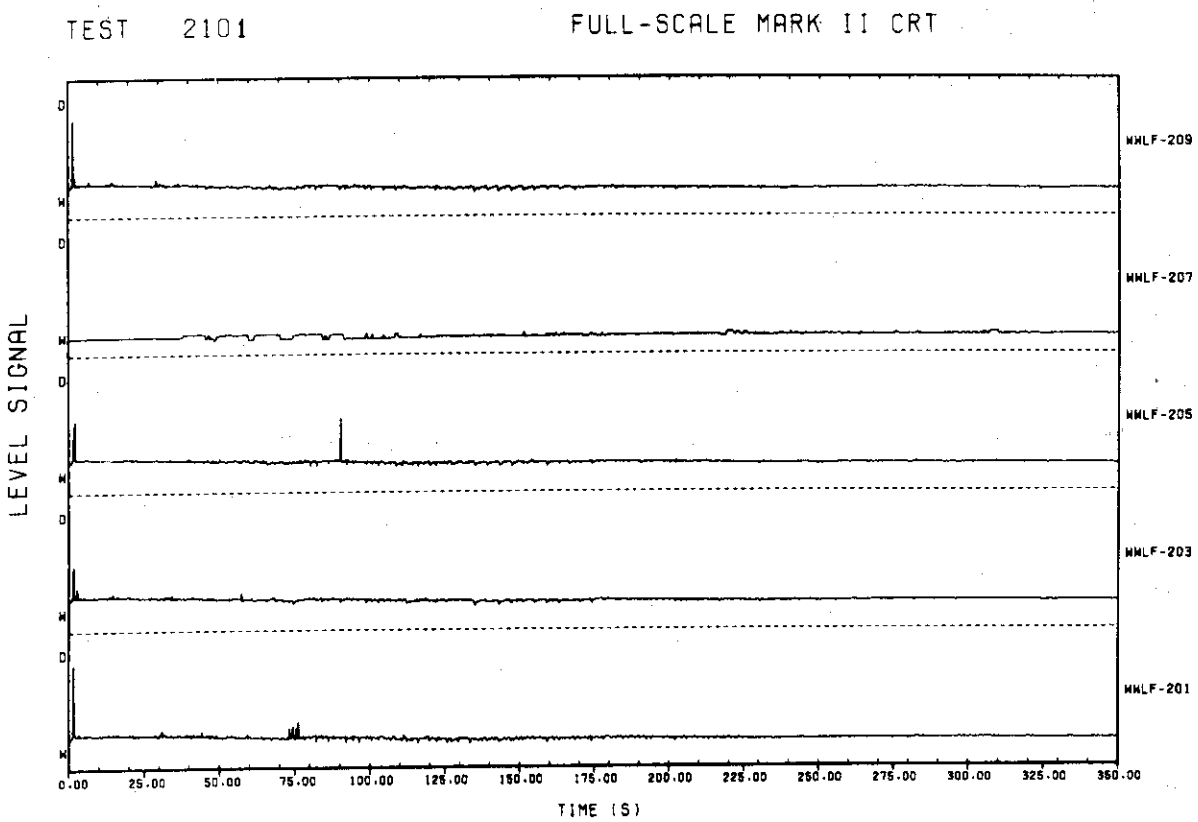
Plot L-2-10 Acceleration of Containment Structure



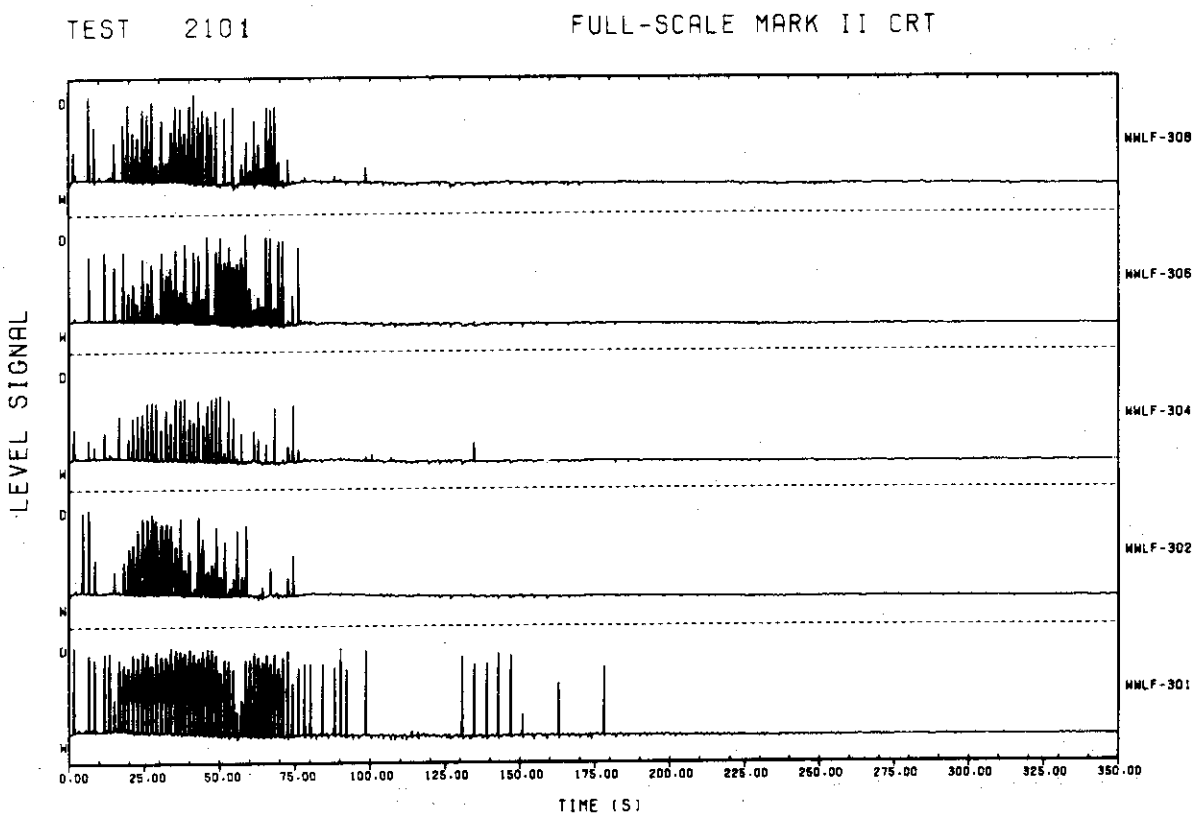
Plot L-2-11 Acceleration of Containment Structure



Plot L-2-12 Phase Boundary Signals



Plot L-2-13 Phase Boundary Signals



Plot L-2-14 Phase Boundary Signals

Short Term Plots of Data

Short Term Plot Specification

Period 85 – 95 s

Objective : Detailed Presentation of ☐ Pool Swell.

☐ High and Medium Steam Flux Condensation Oscillation.

☒ Chugging.

Plot No.	Recording System	Recording Rate (data/s)	Sampling Rate for Plots	Remarks
S-0-1 to 7	Computer	50.00	1/1	
S-1-1 to 32	PCM Track - 1	455.56	1/1	
S-2-1 to 14	PCM Track - 2	455.56	1/1	

List of Short Term Plots

Computer Recorded Channels

Plot	S-0-1	Temperatures in Vent Pipe	(VP1)
〃	S-0-2	Temperatures in Vent Pipe	(VP2)
〃	S-0-3	Temperatures in Vent Pipe	(VP3)
〃	S-0-4	Water Level in Vent Pipe	(VP's1 and 2)
〃	S-0-5	Water Level in Vent Pipe	(VP's3 and 4)
〃	S-0-6	Water Level in Vent Pipe	(VP5) and Vacuum Breaker Actuation Signal
〃	S-0-7	Water Level in Wetwell	(WWLS-106, 206, 406, 606, 706, 806)

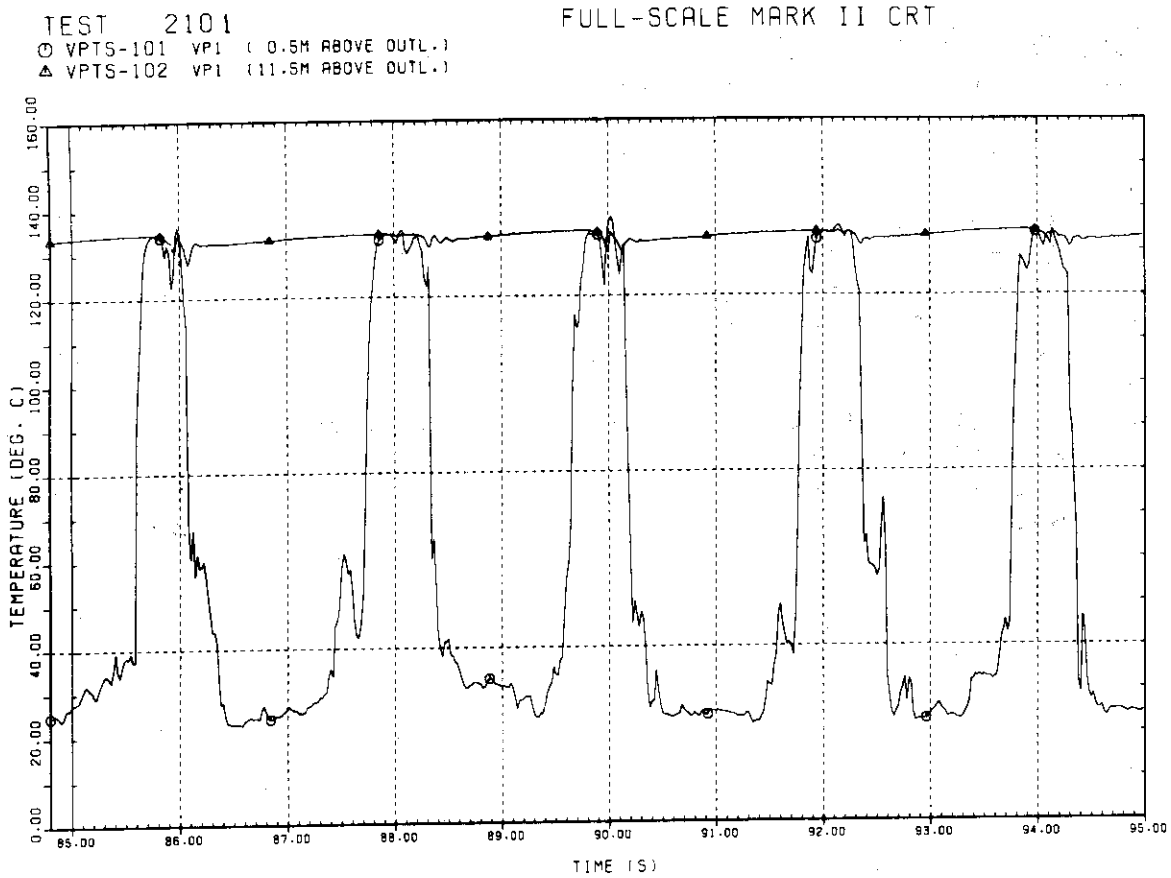
List of Short Term Plots (Continued)

PCM Track-1 Channels

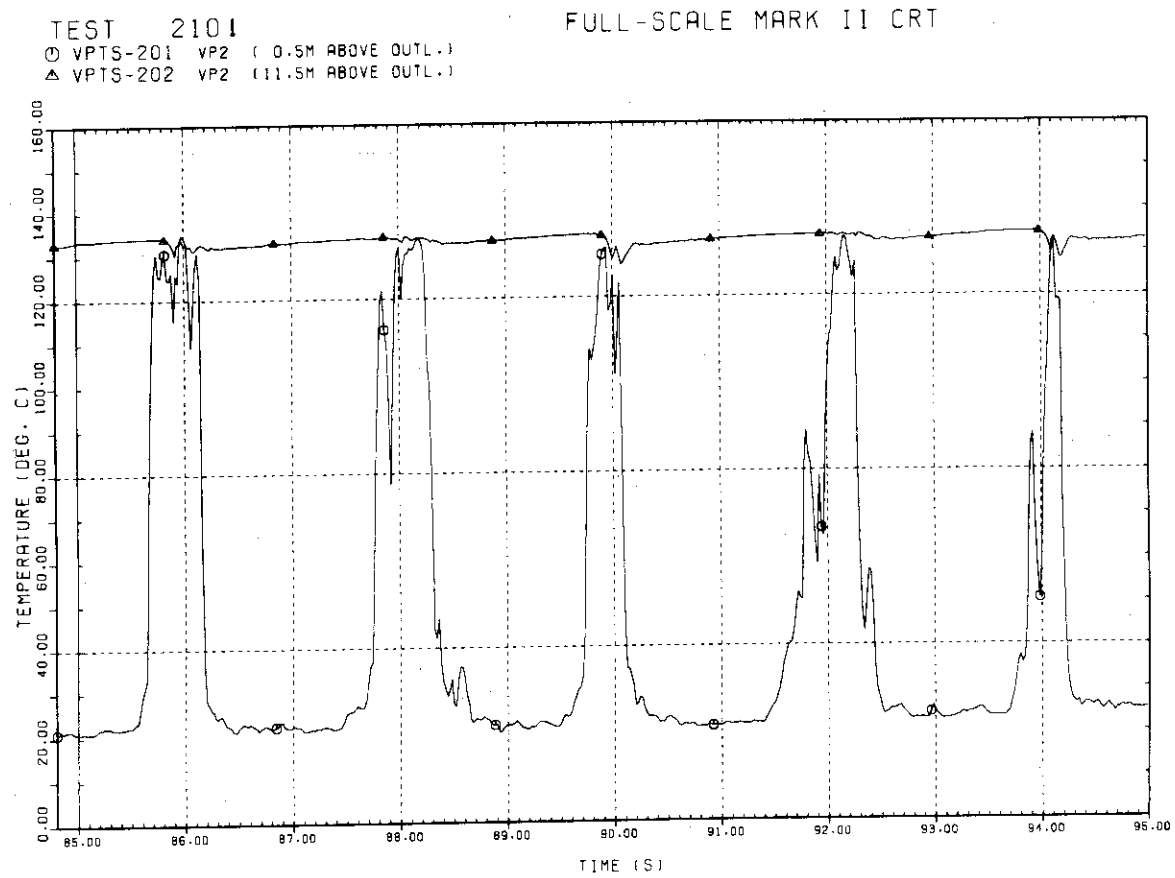
Plot	S-1-1	Pressures in Drywell and Wetwell Airspace	
〃	S-1-2	Pressure in Vent Pipe	(VPPF-101)
〃	S-1-3	Pressure in Vent Pipe	(VPPF-201)
〃	S-1-4	Pressure in Vent Pipe	(VPPF-301)
〃	S-1-5	Pressure in Vent Pipe	(VPPF-302)
〃	S-1-6	Pressure in Vent Pipe	(VPPF-303)
〃	S-1-7	Pressure in Vent Pipe	(VPPF-401)
〃	S-1-8	Pressure in Vent Pipe	(VPPF-501)
〃	S-1-9	Pressure in Vent Pipe	(VPPF-502)
〃	S-1-10	Pressure in Vent Pipe	(VPPF-503)
〃	S-1-11	Pressure in Wetwell	(WWPF-101)
〃	S-1-12	Pressure in Wetwell	(WWPF-102)
〃	S-1-13	Pressure in Wetwell	(WWPF-103)
〃	S-1-14	Pressure in Wetwell	(WWPF-104)
〃	S-1-15	Pressure in Wetwell	(WWPF-105)
〃	S-1-16	Pressure in Wetwell	(WWPF-106)
〃	S-1-17	Pressure in Wetwell	(WWPF-107)
〃	S-1-18	Pressure in Wetwell	(WWPF-201)
〃	S-1-19	Pressure in Wetwell	(WWPF-202)
〃	S-1-20	Pressure in Wetwell	(WWPF-203)
〃	S-1-21	Pressure in Wetwell	(WWPF-301)
〃	S-1-22	Pressure in Wetwell	(WWPF-302)
〃	S-1-23	Pressure in Wetwell	(WWPF-303)
〃	S-1-24	Pressure in Wetwell	(WWPF-401)
〃	S-1-25	Pressure in Wetwell	(WWPF-402)
〃	S-1-26	Pressure in Wetwell	(WWPF-501)
〃	S-1-27	Pressure in Wetwell	(WWPF-502)
〃	S-1-28	Pressure in Wetwell	(WWPF-602)
〃	S-1-29	Pressure in Wetwell	(WWPF-702)
〃	S-1-30	Strain of Vent Pipe Brace	(VPSF-101)
〃	S-1-31	Strain of Vent Pipe Brace	(VPSF-102)
〃	S-1-32	Strain of Vent Pipe Brace	(VPSF-201)

PCM Track-2 Channels

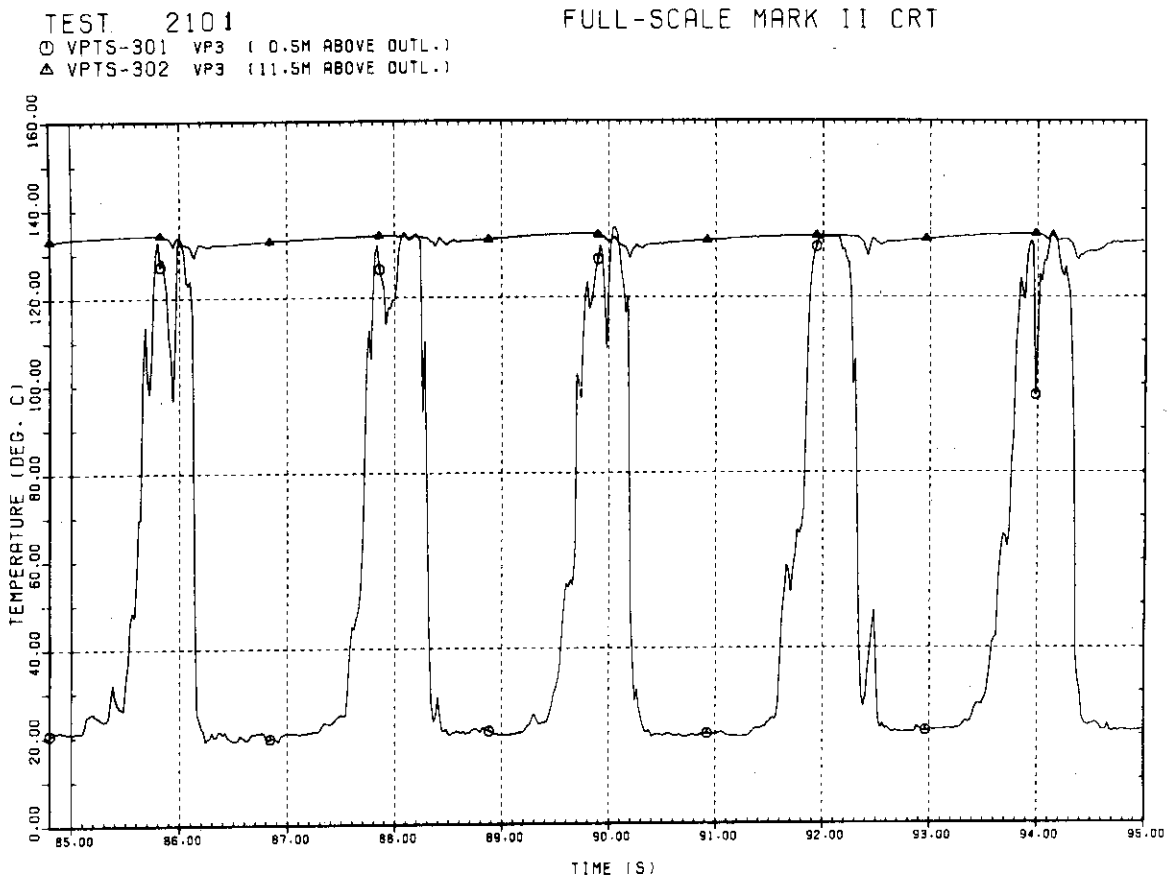
Plot	S-2-1	Acceleration of Vent Pipe Outlet	(VPAF-101)
〃	S-2-2	Acceleration of Vent Pipe Outlet	(VPAF-201)
〃	S-2-3	Acceleration of Vent Pipe Outlet	(VPAF-202)
〃	S-2-4	Acceleration of Containment Structure	(WWAF-005)
〃	S-2-5	Acceleration of Containment Structure	(WWAF-006)
〃	S-2-6	Acceleration of Containment Structure	(WWAF-007)
〃	S-2-7	Acceleration of Containment Structure	(WWAF-008)
〃	S-2-8	Acceleration of Containment Structure	(WWAF-009)
〃	S-2-9	Acceleration of Containment Structure	(WWAF-010)
〃	S-2-10	Acceleration of Containment Structure	(WWAF-011)
〃	S-2-11	Acceleration of Containment Structure	(WWAF-012)
〃	S-2-12	Phase Boundary Signals	(WWLF-101 - 108)
〃	S-2-13	Phase Boundary Signals	(WWLF-201 - 209)
〃	S-2-14	Phase Boundary Signals	(WWLF-301 - 308)



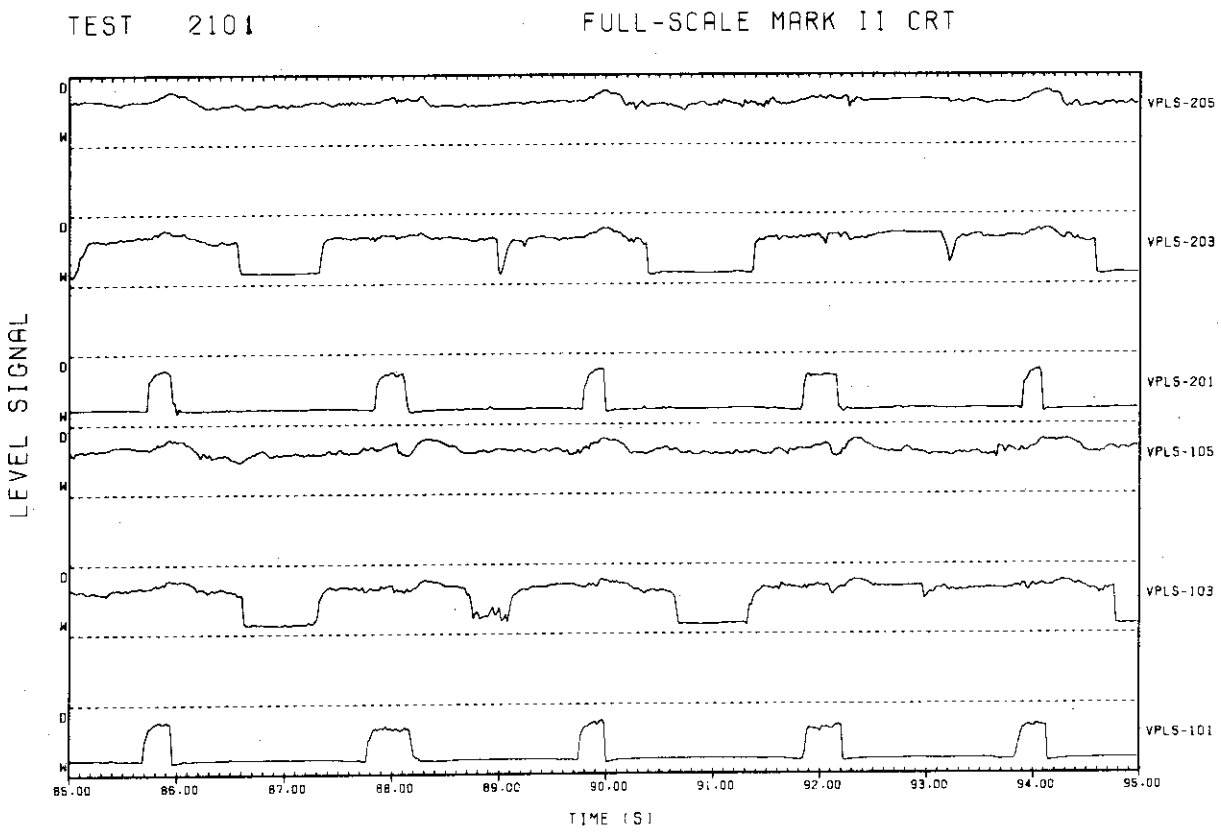
Plot S-0-1 **Temperatures in Vent Pipe**



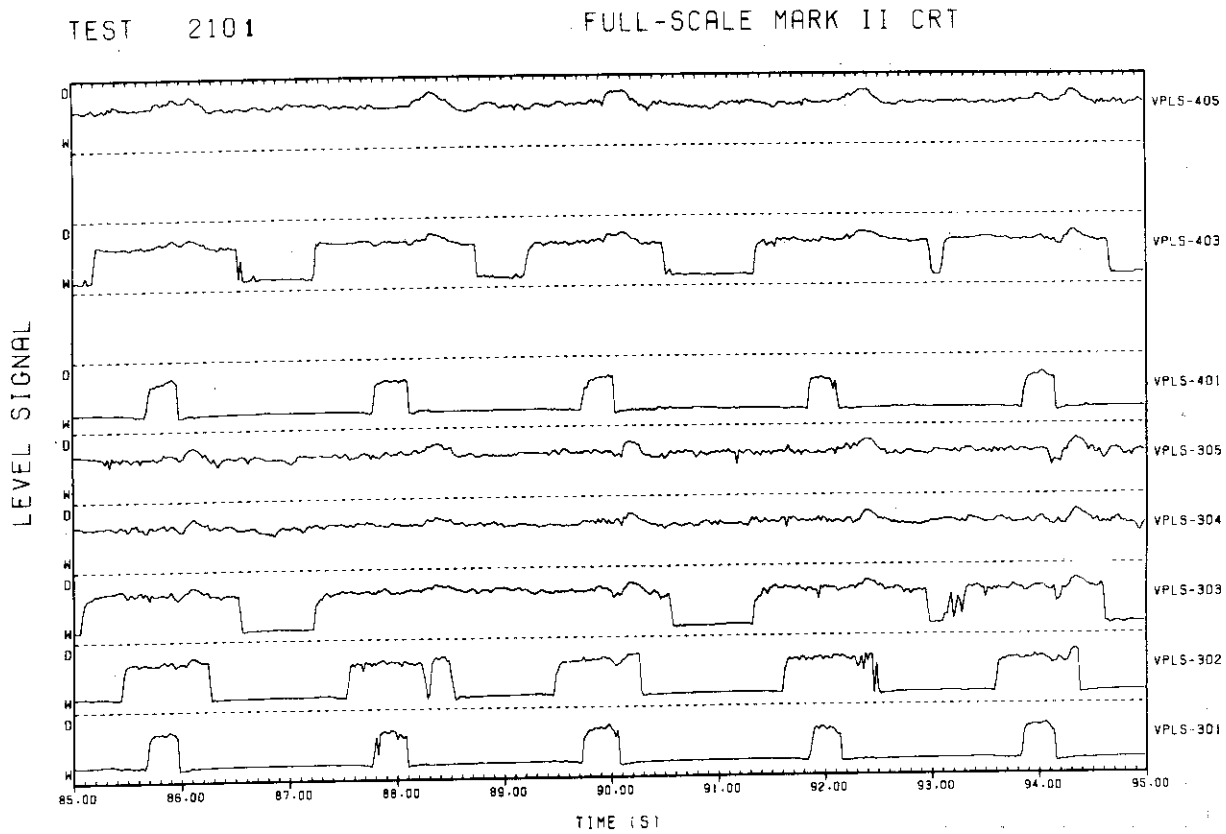
Plot S-0-2 **Temperatures in Vent Pipe**



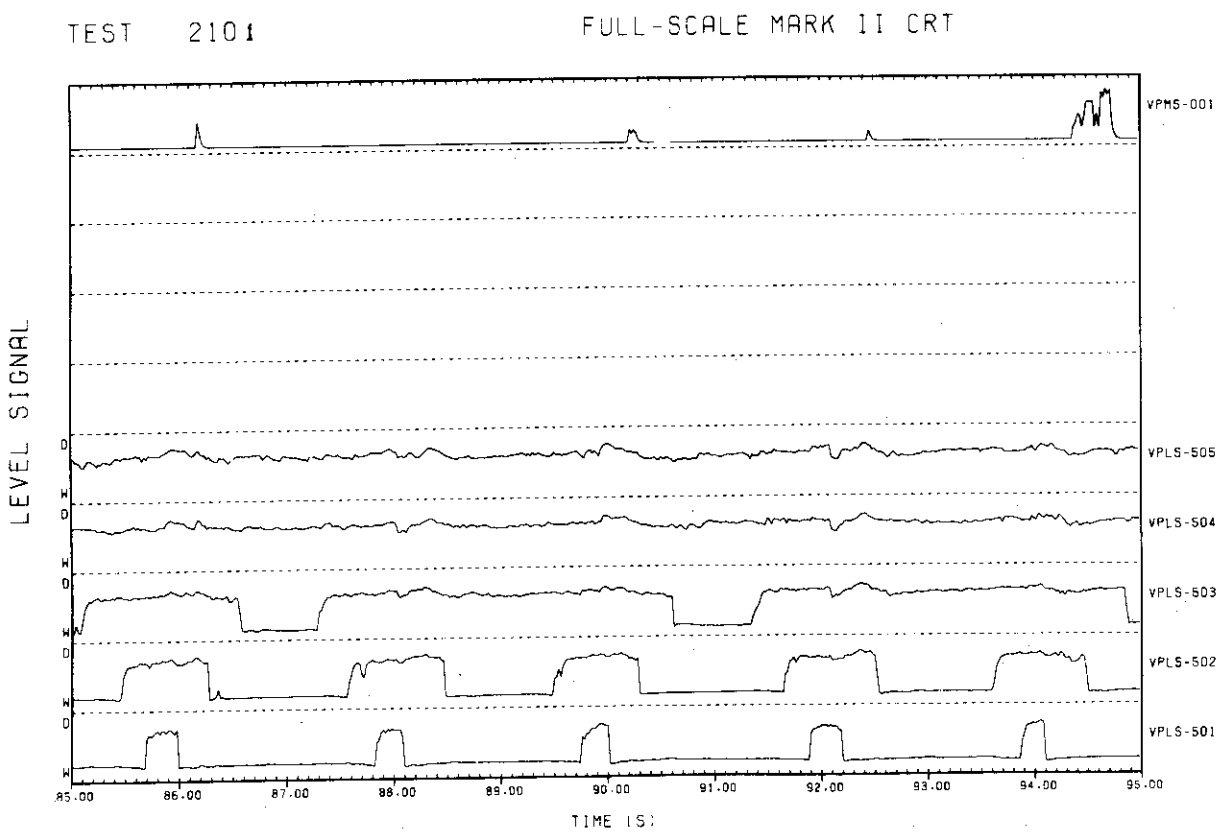
Plot S-0-3 **Temperatures in Vent Pipe**



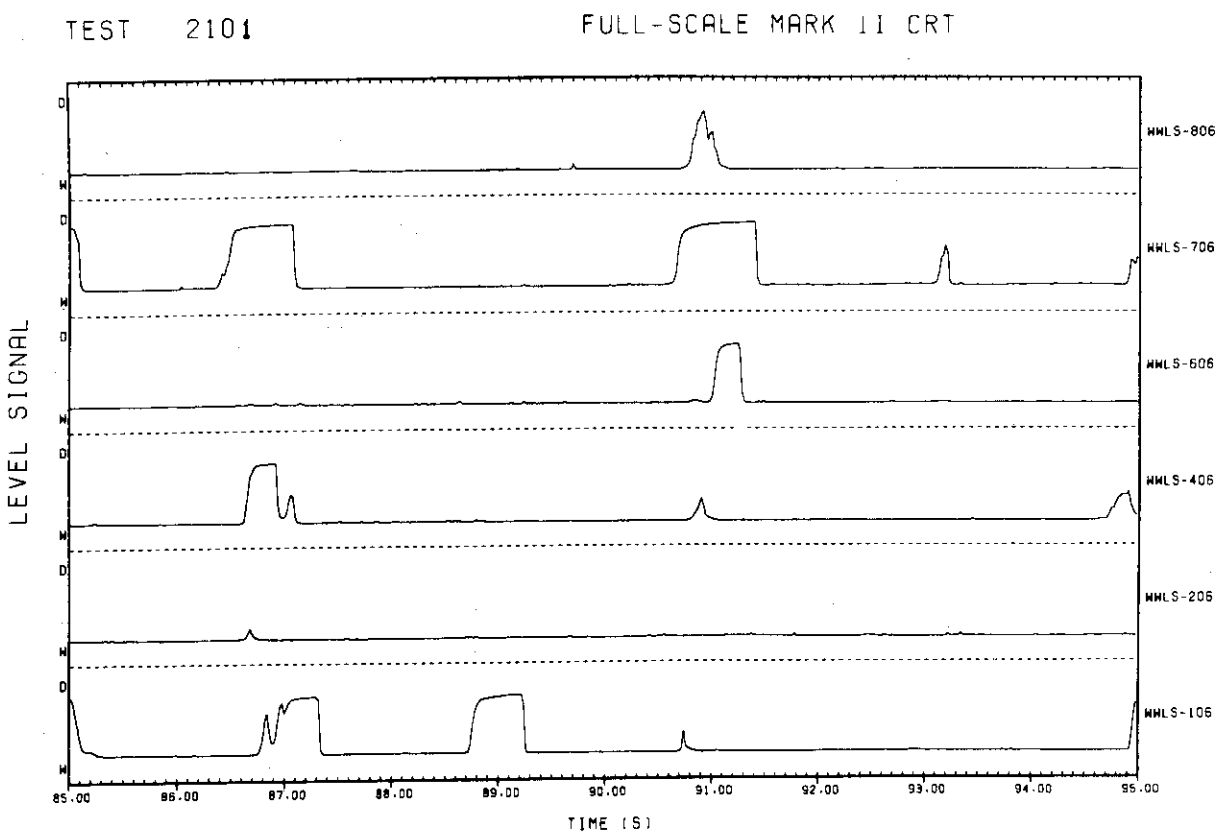
Plot S-0-4 **Water Level in Vent Pipe**



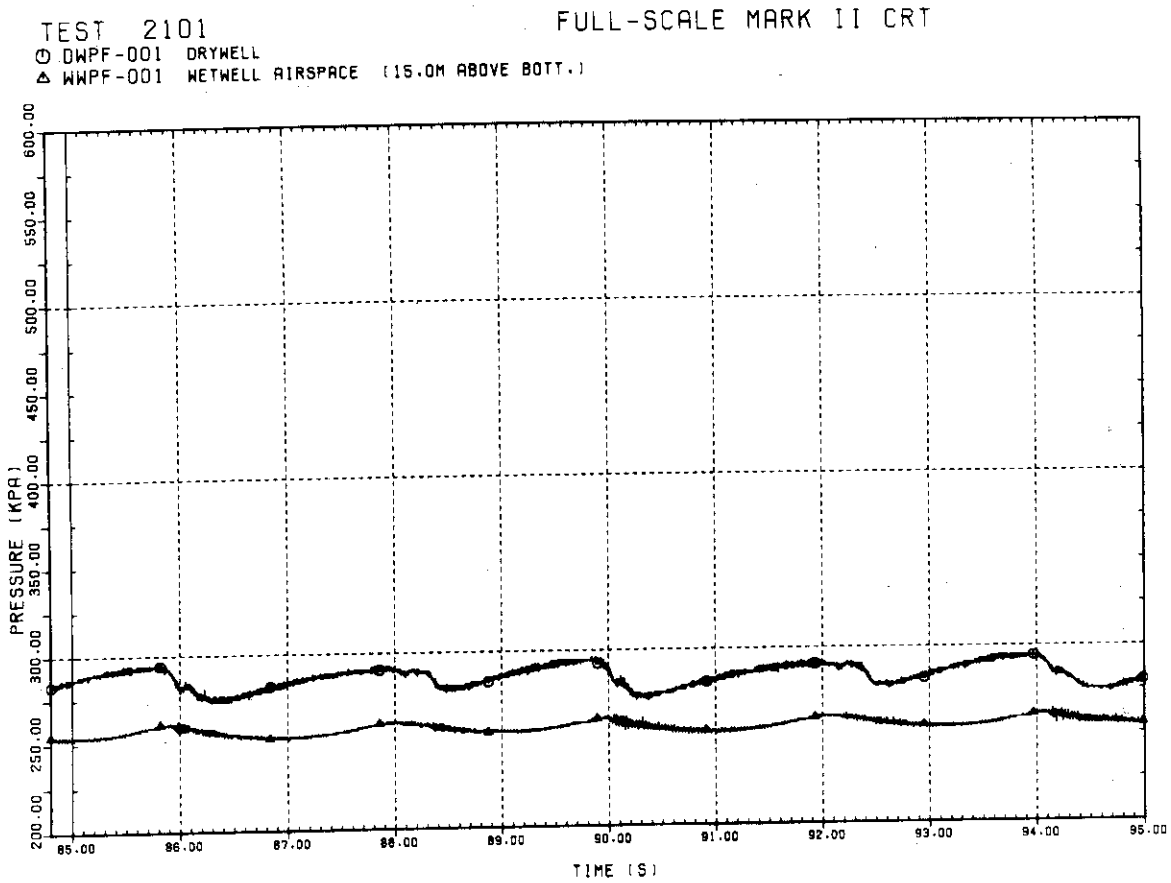
Plot S-0-5 **Water Level in Vent Pipe**



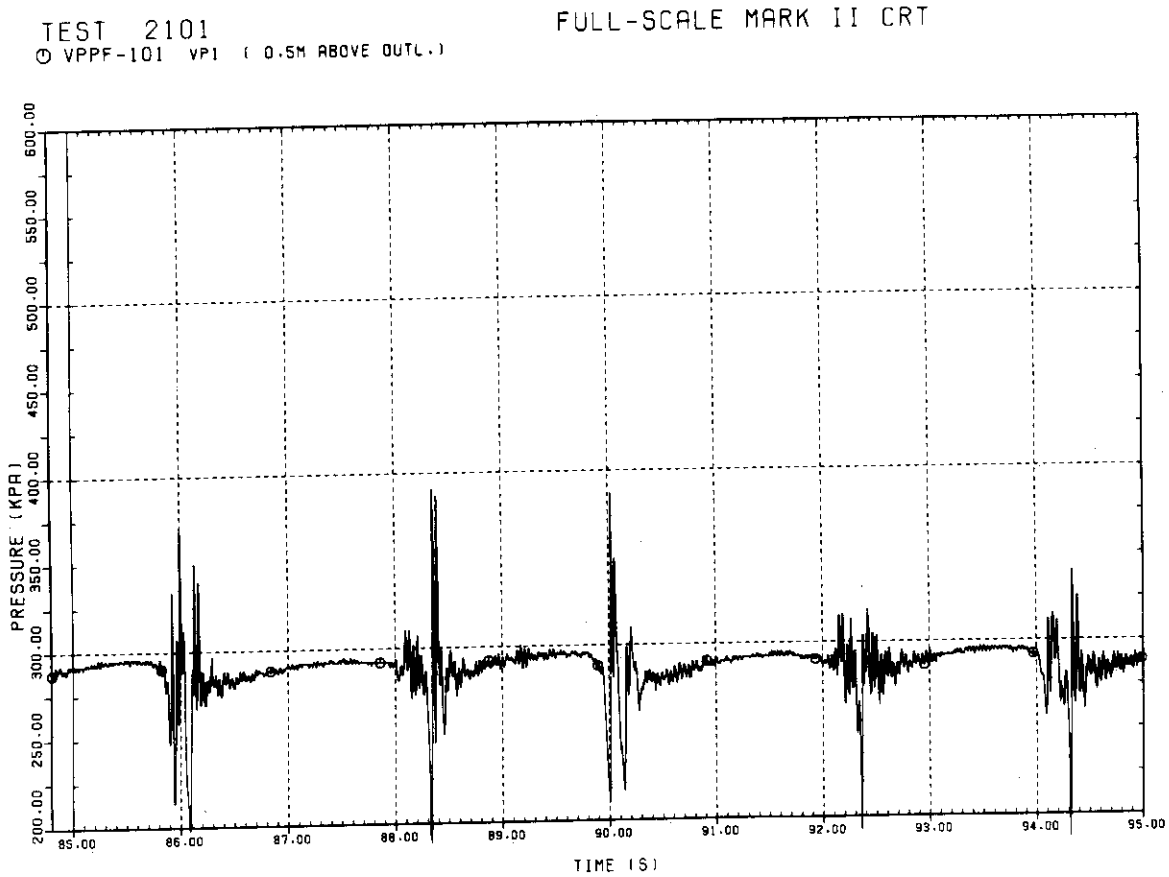
Plot S-0-6 **Water Level in Vent pipe and Vacuum Breaker Actuation Signal**



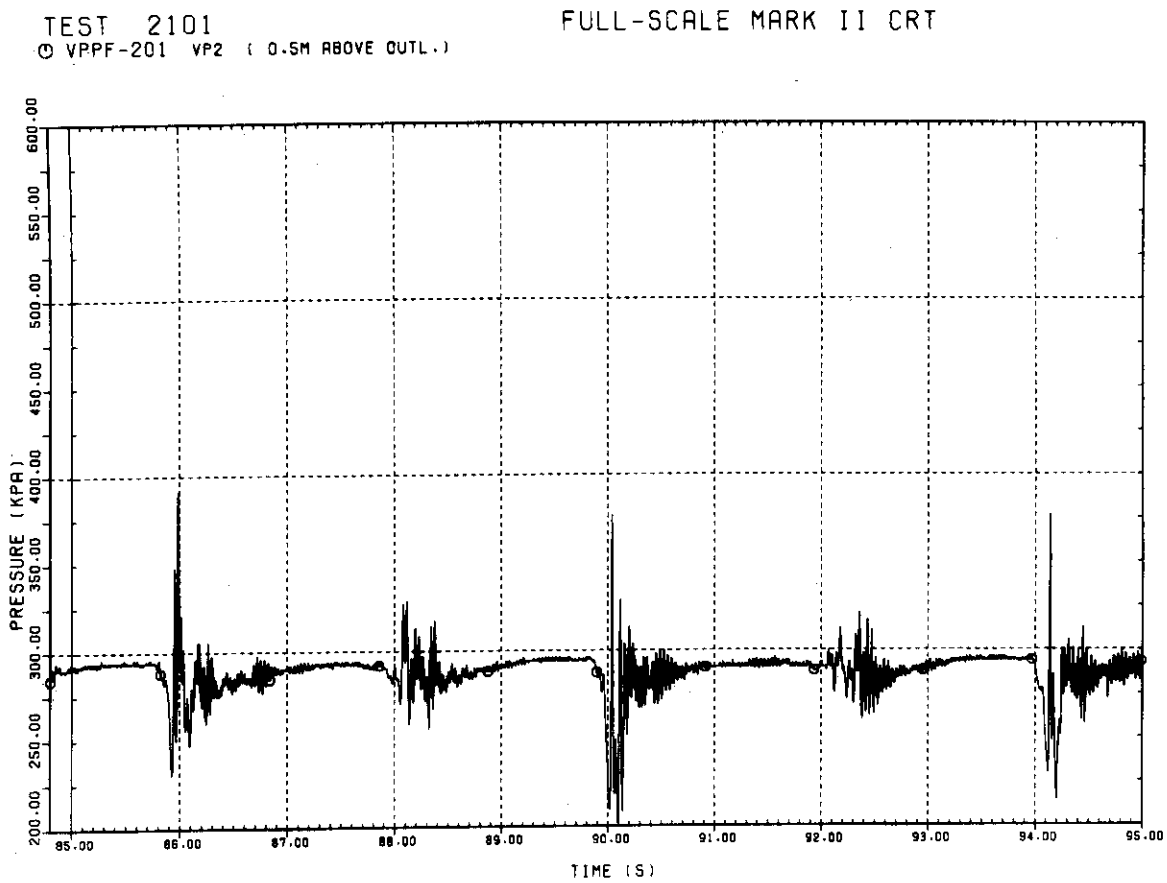
Plot S-0-7 **Water Level in Wetwell**



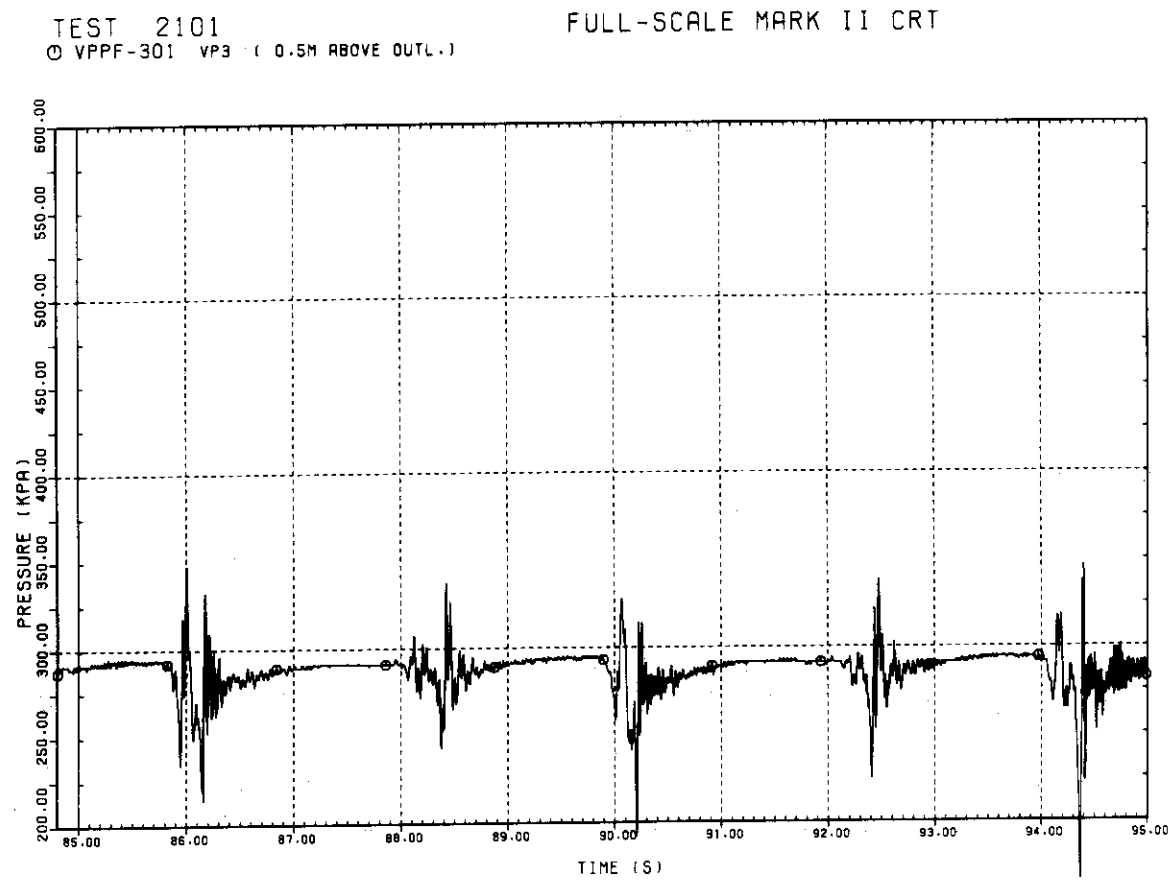
Plot S-1-1 **Pressures in Drywell and Wetwell Airspace**



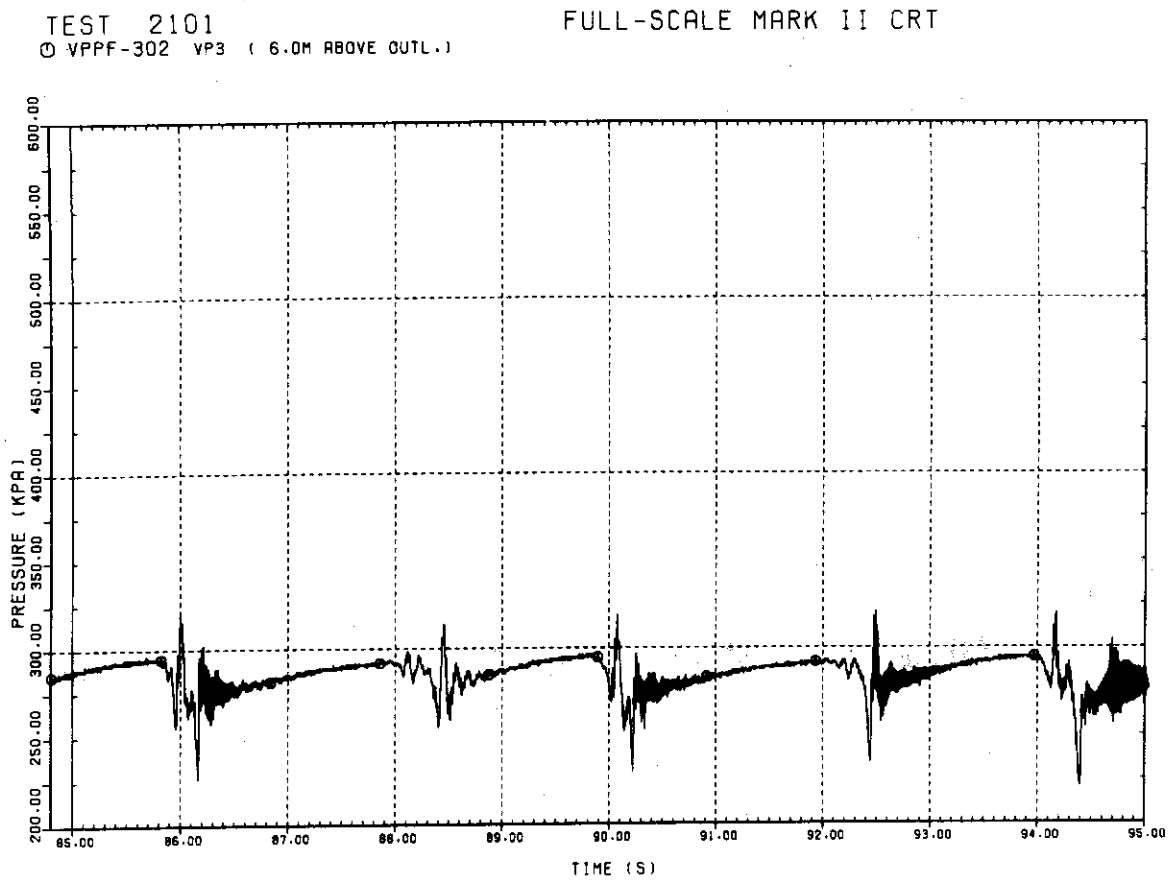
Plot S-1-2 **Pressure in Vent pipe**



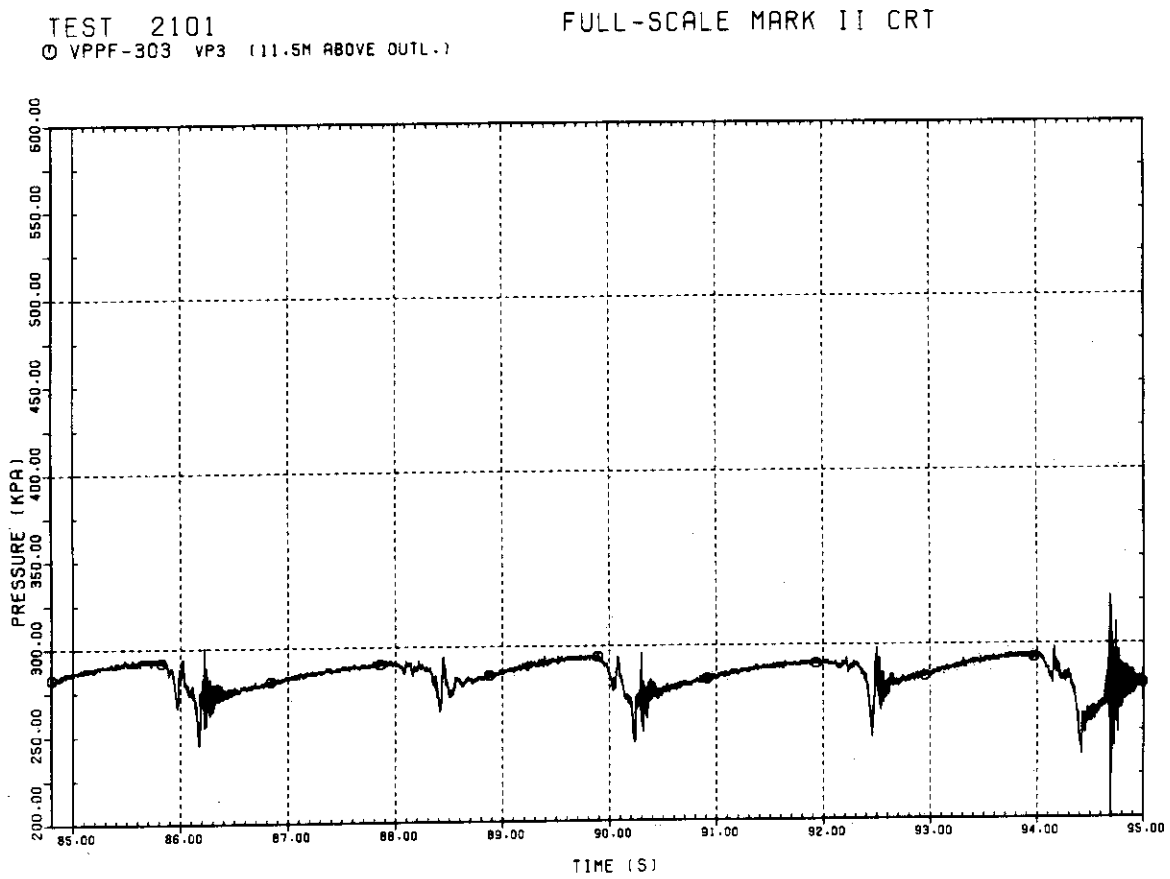
Plot S-1-3 **Pressure in Vent pipe**



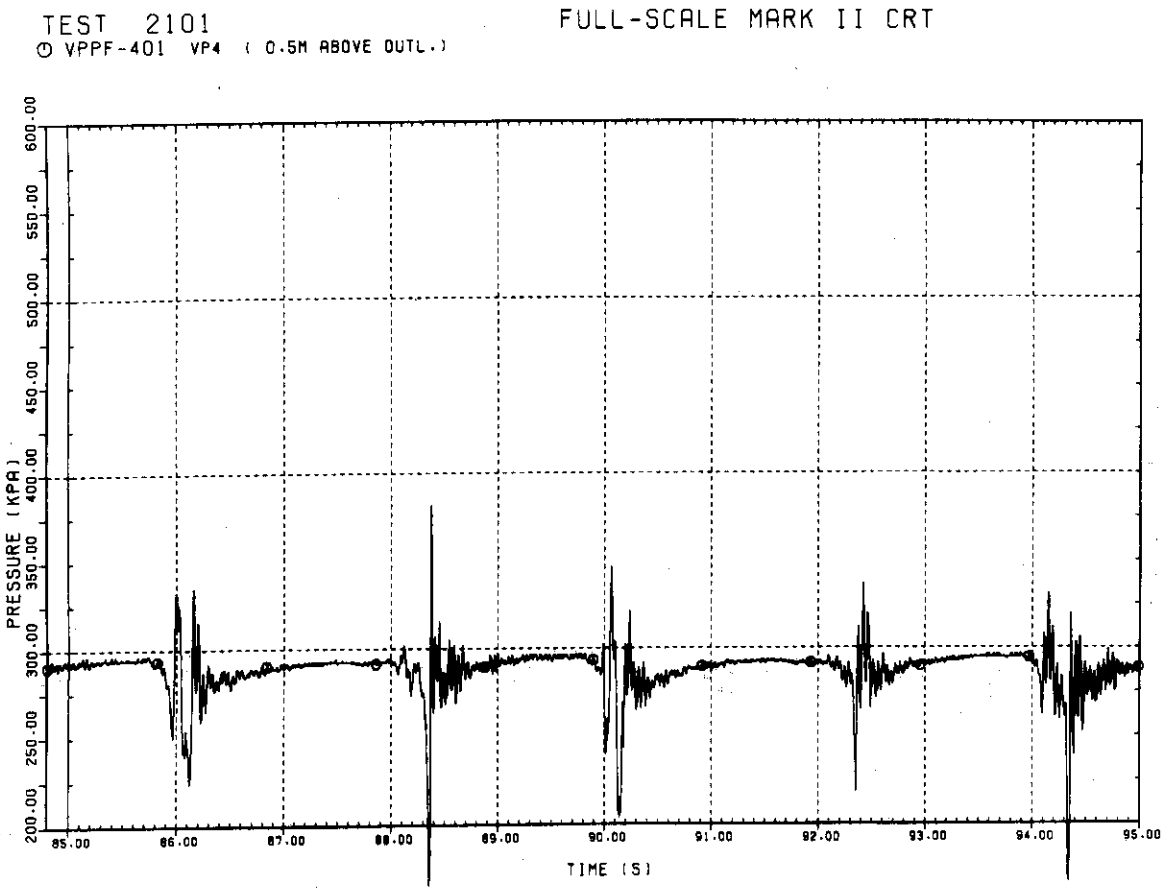
Plot S-1-4 **Pressure in Vent pipe**



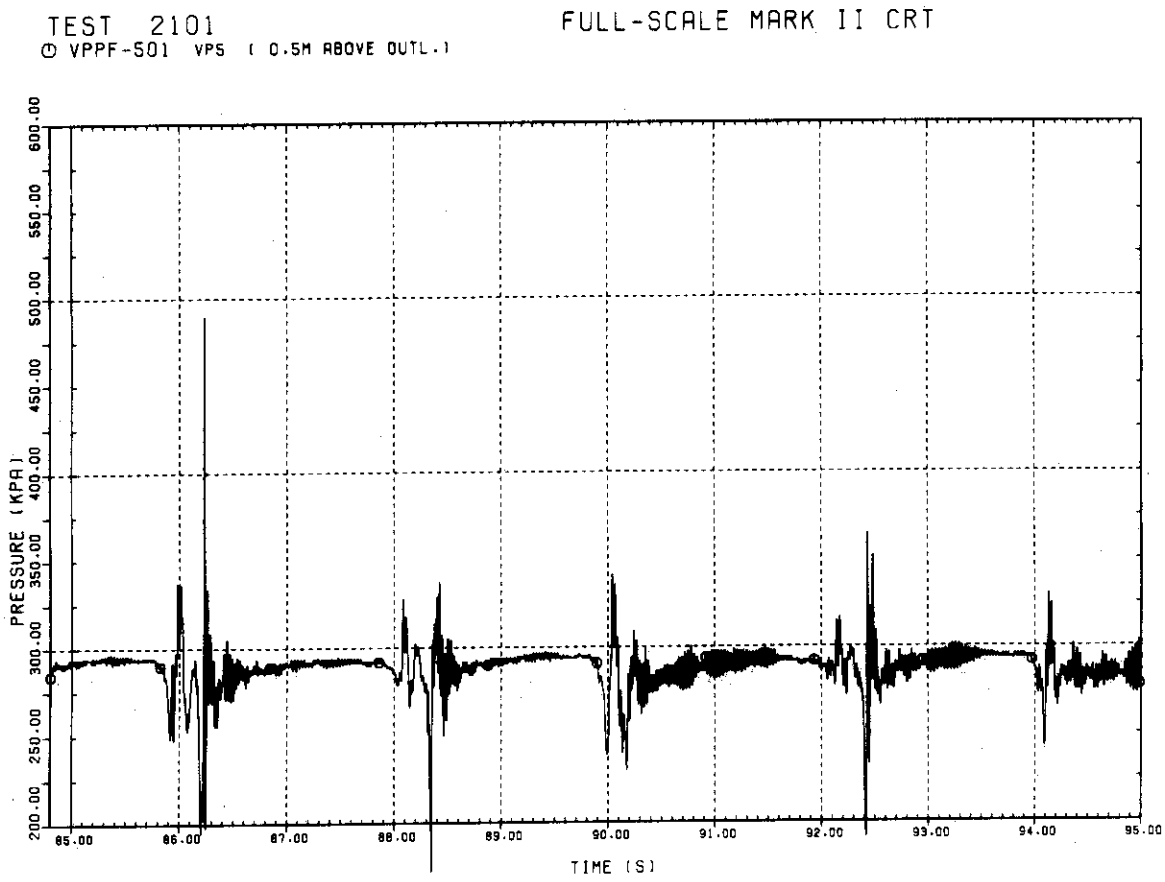
Plot S-1-5 **Pressure in Vent pipe**



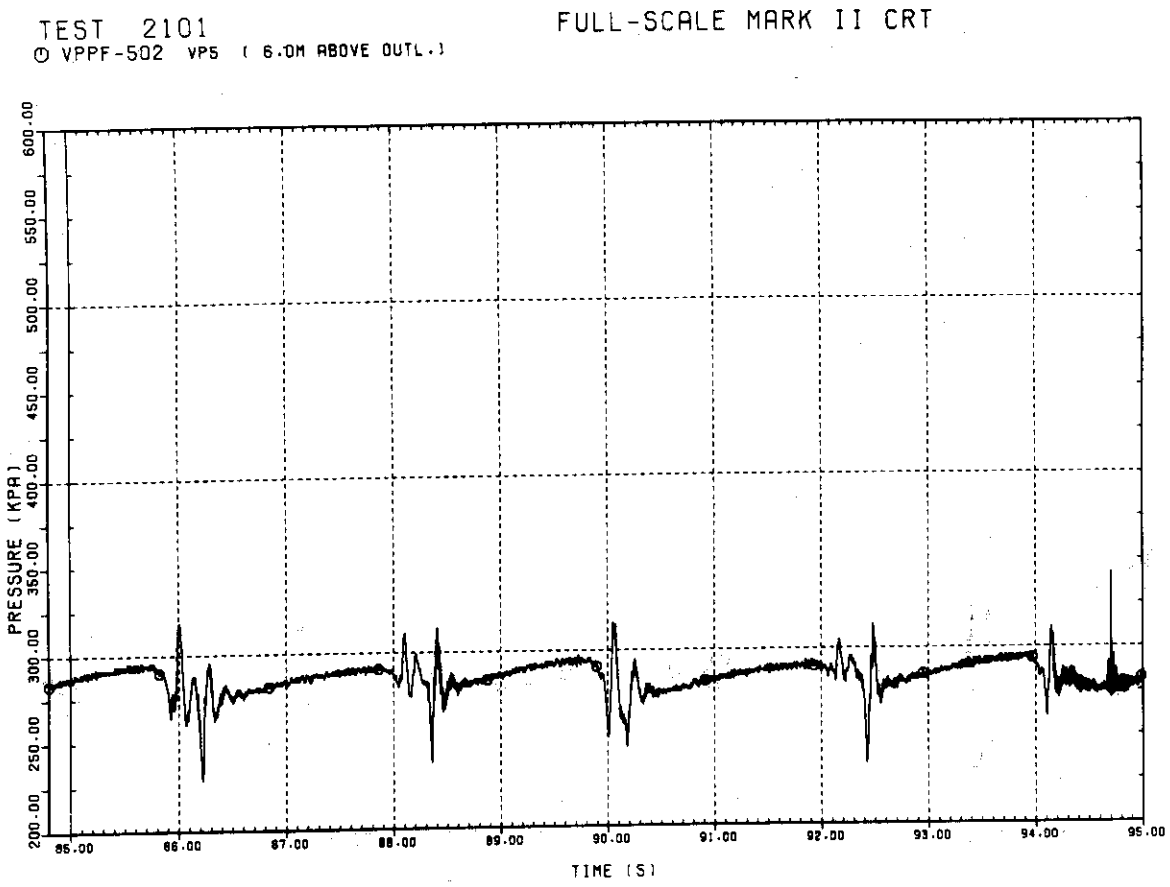
Plot S-1-6 **Pressure in Vent pipe**



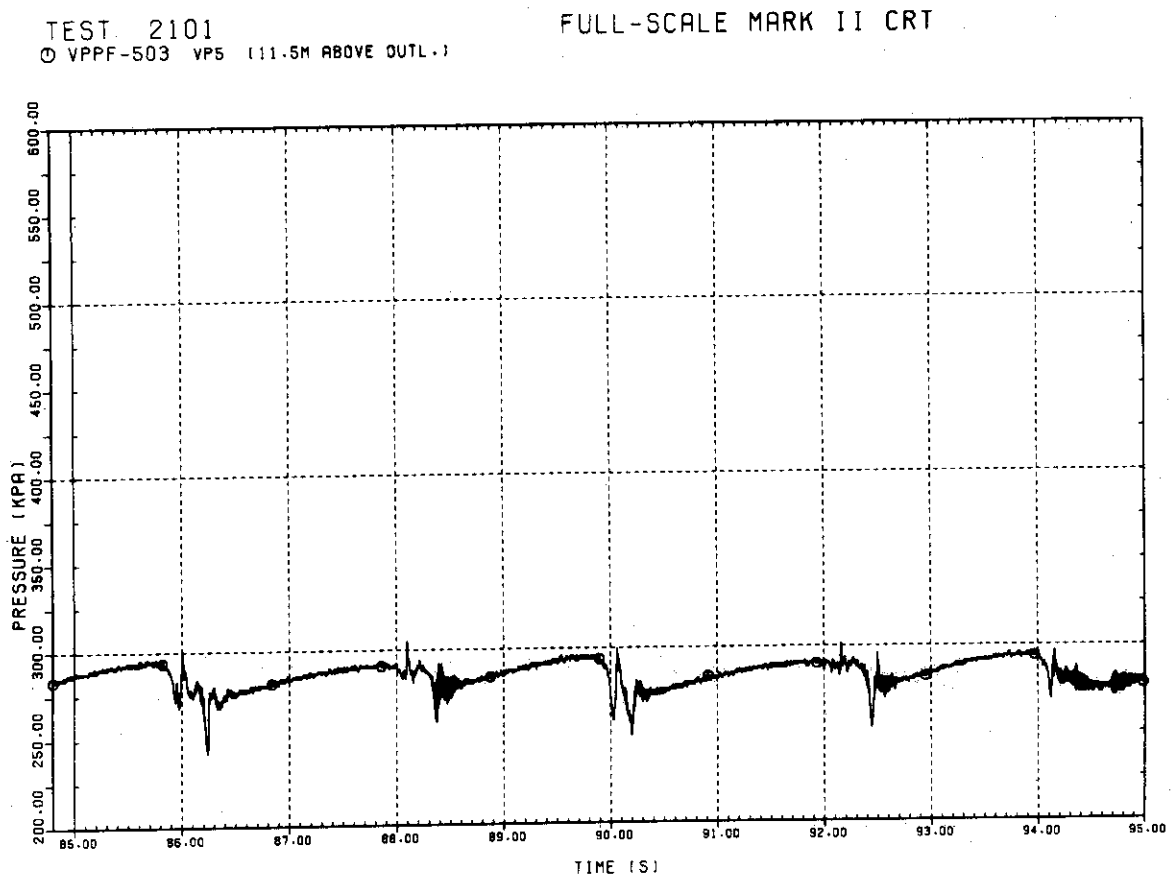
Plot S-1-7 **Pressure in Vent pipe**



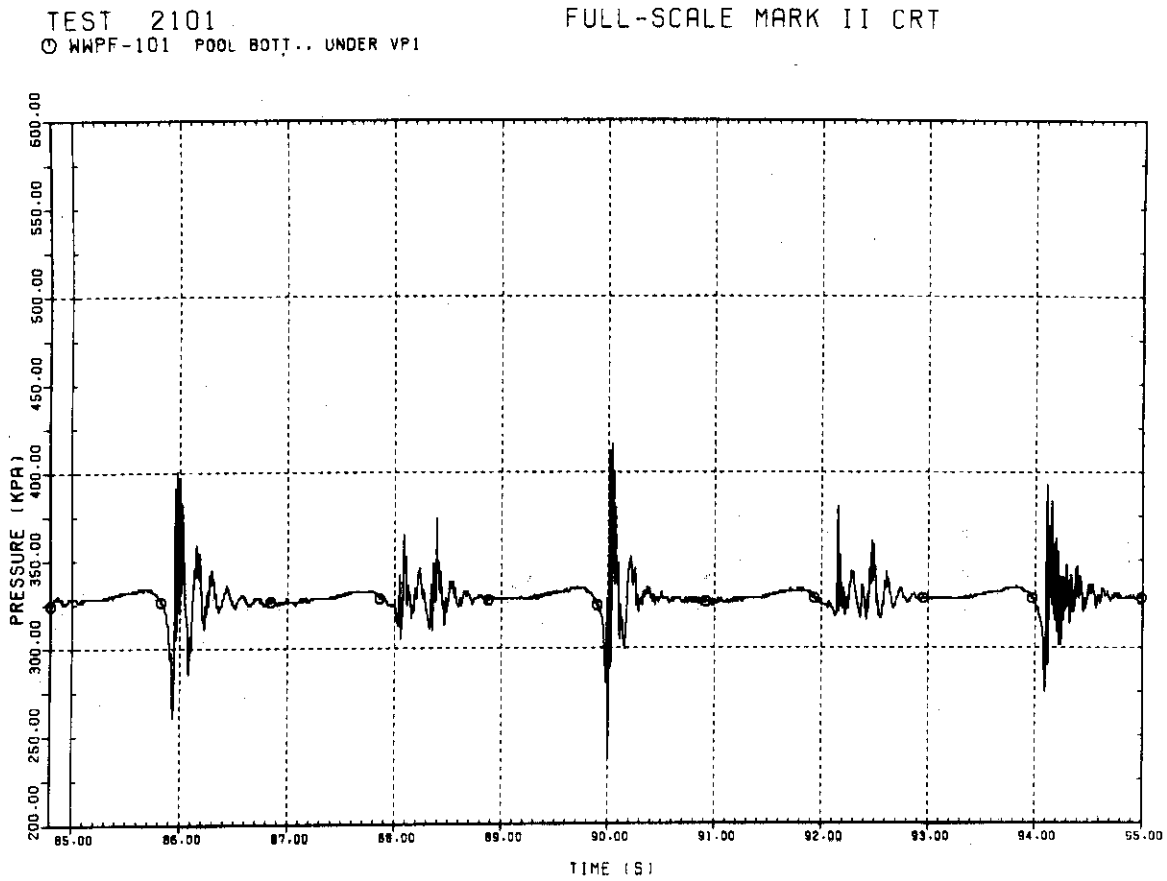
Plot S-1-8 **Pressure in Vent pipe**



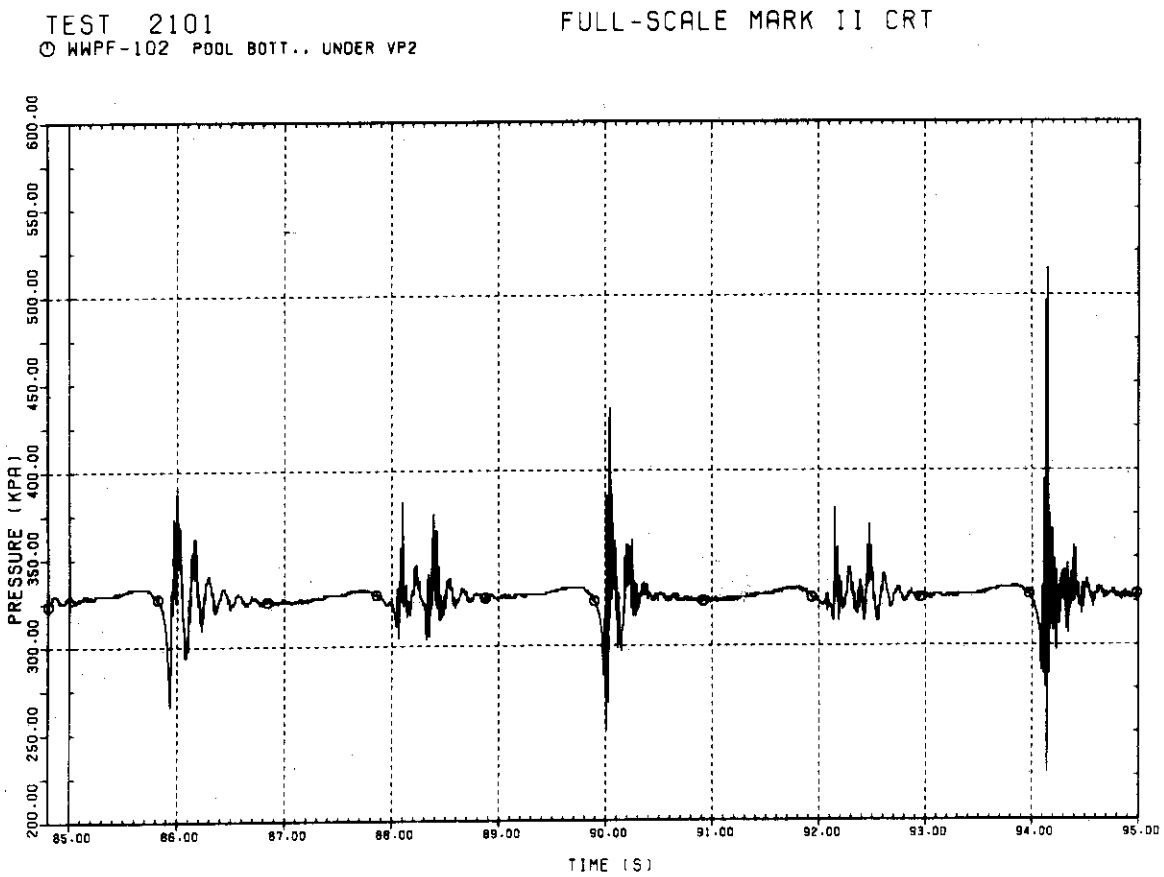
Plot S-1-9 **Pressure in Vent pipe**



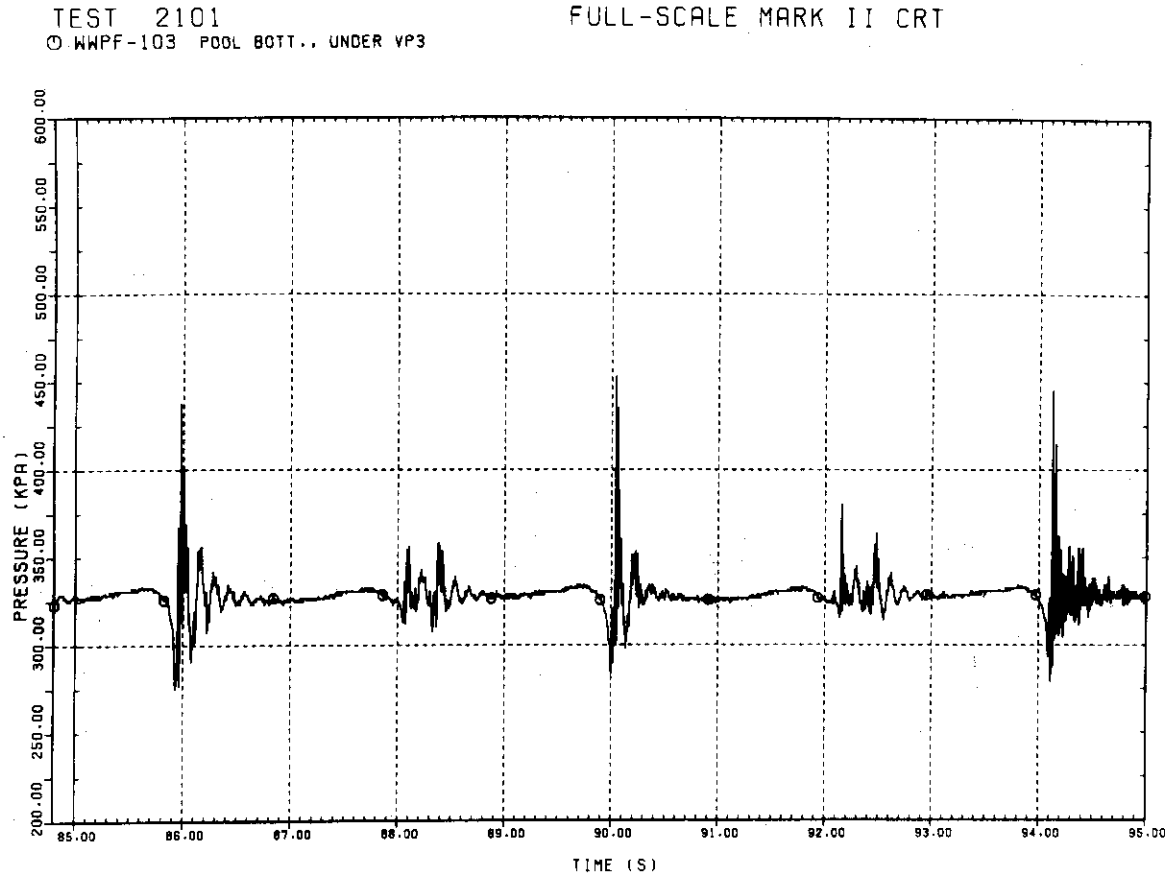
Plot S-1-10 **Pressure in Vent pipe**



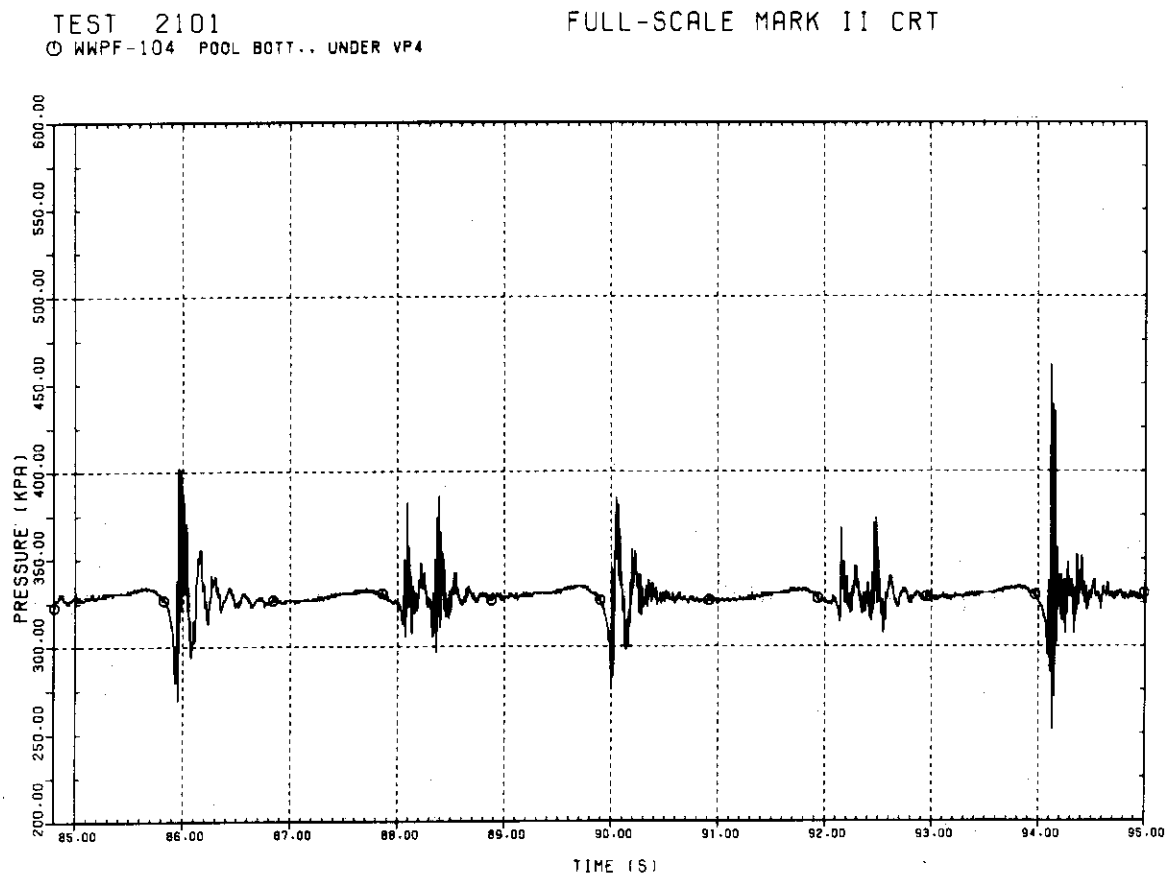
Plot S-1-11 **Pressure in Wetwell**



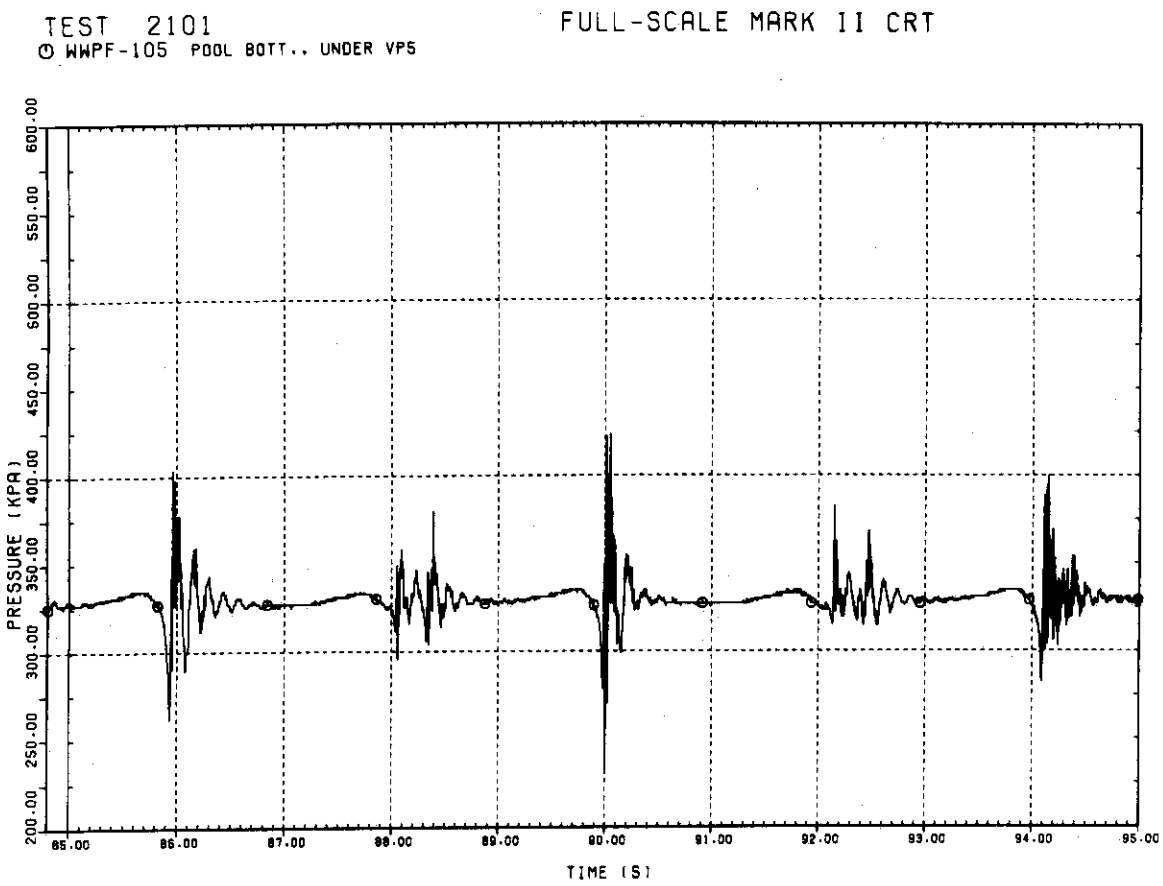
Plot S-1-12 **Pressure in Wetwell**



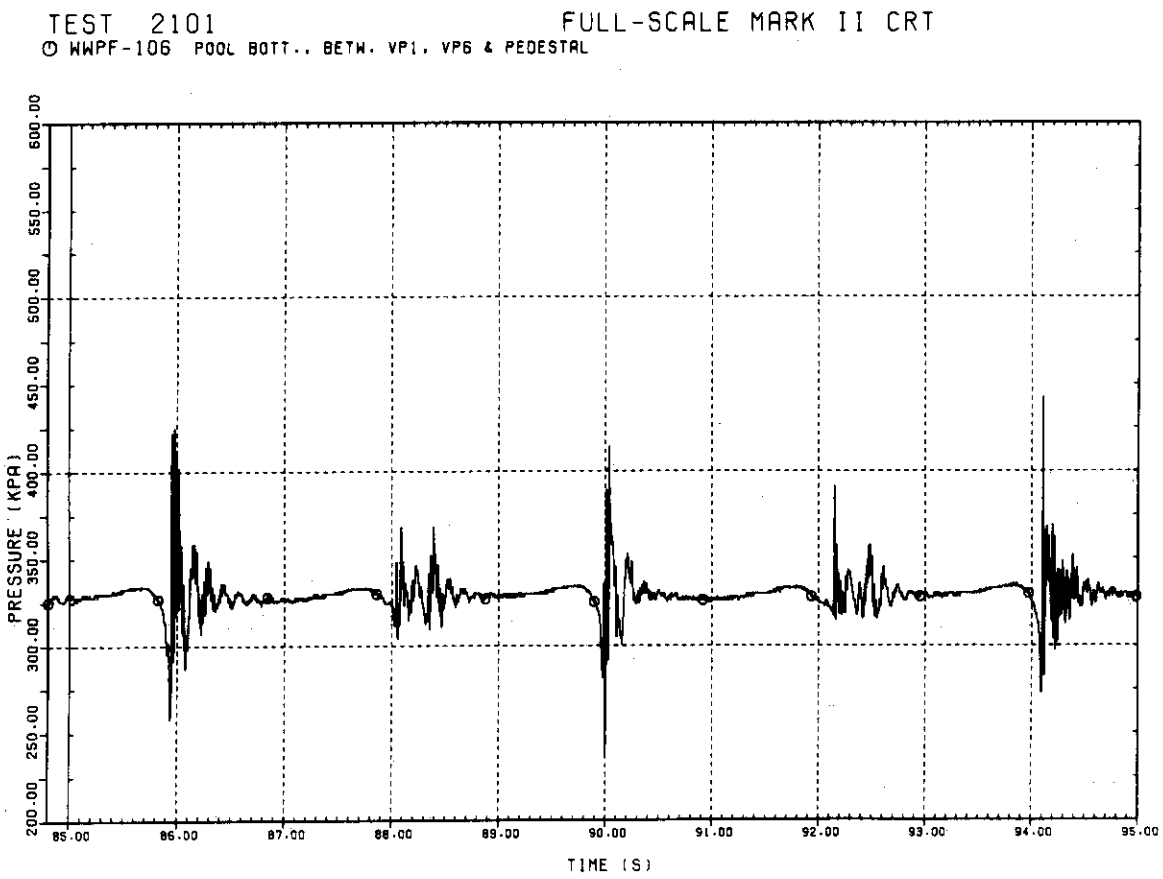
Plot S-1-13 Pressure in Wetwell



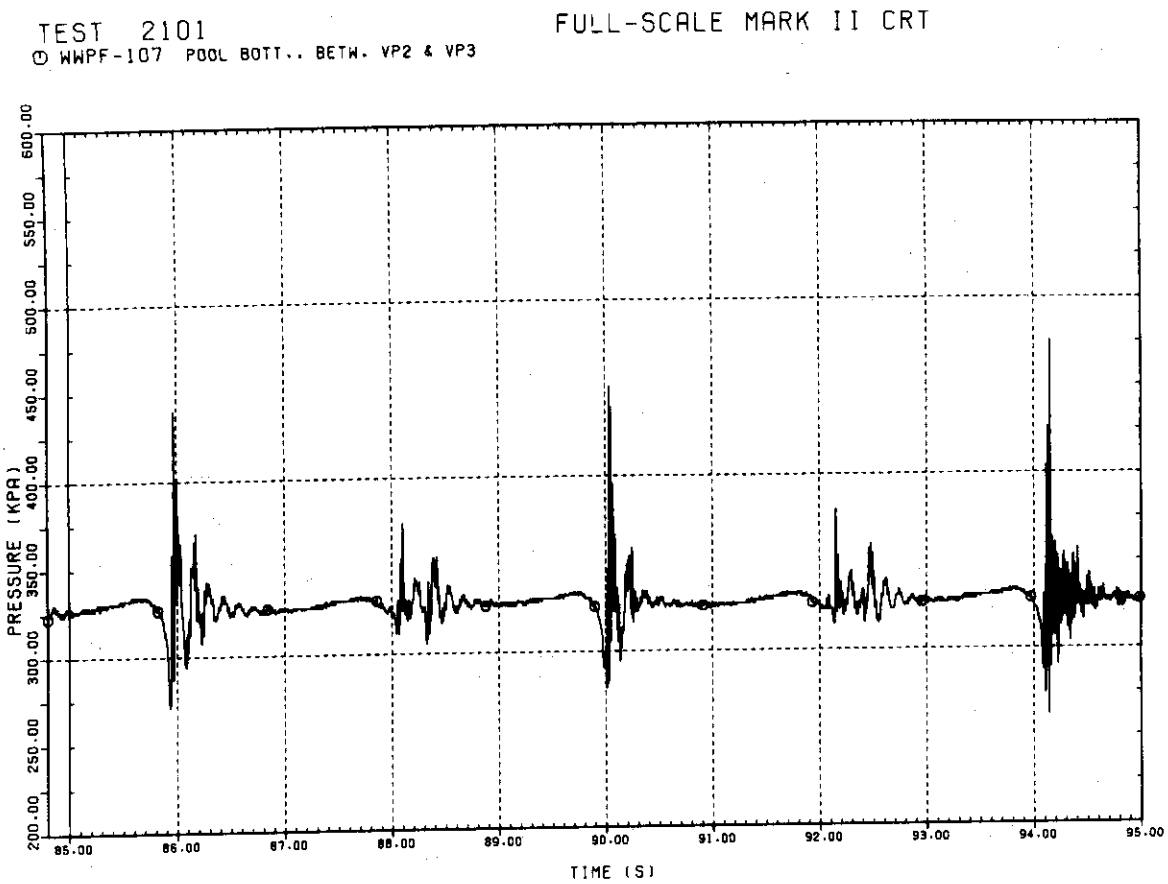
Plot S-1-14 Pressure in Wetwell



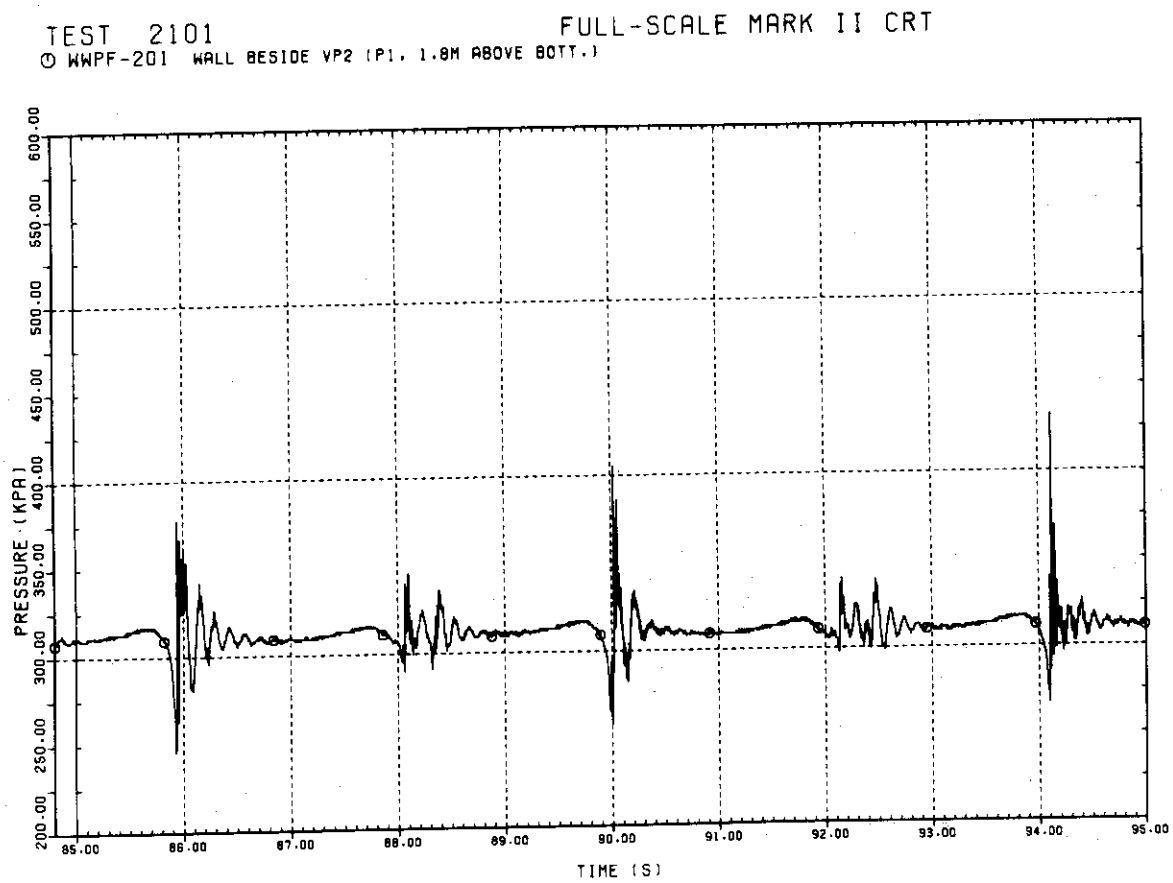
Plot S-1-15 **Pressure in Wetwell**



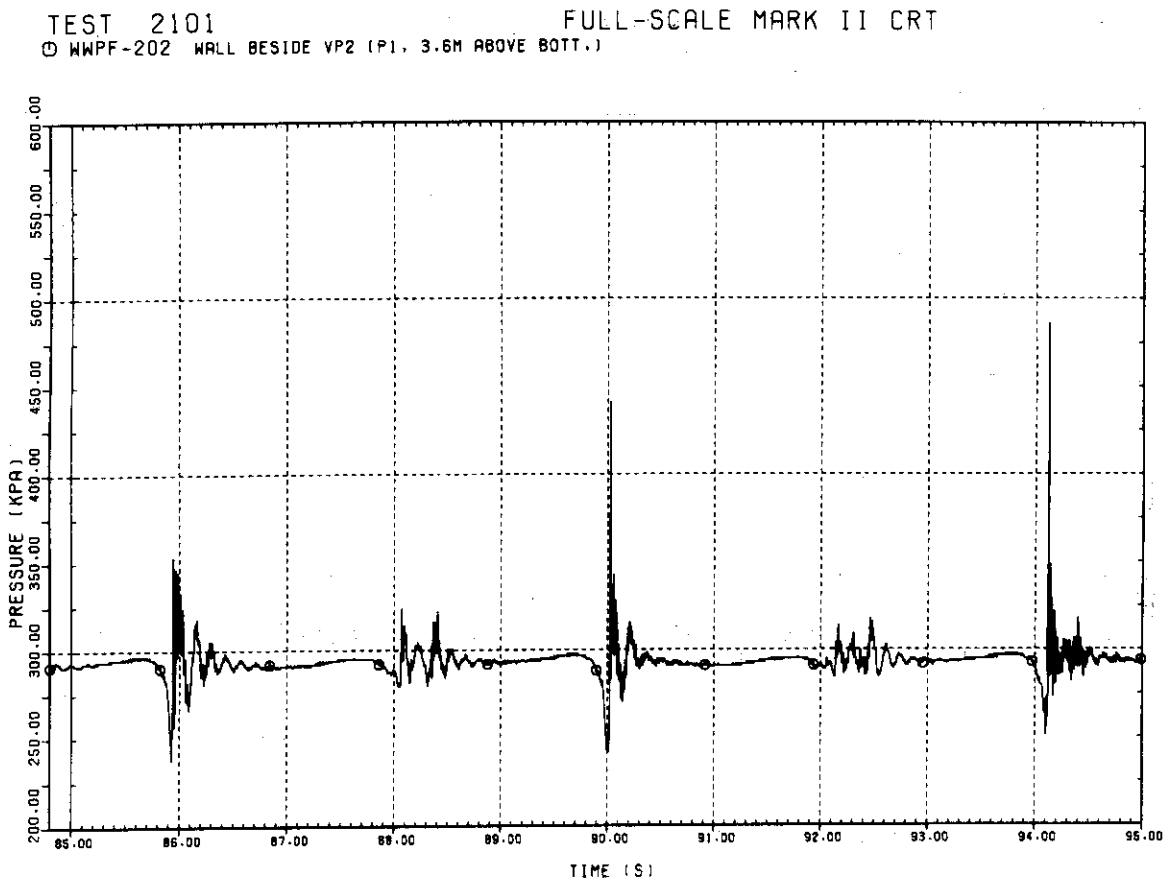
Plot S-1-16 **Pressure in Wetwell**



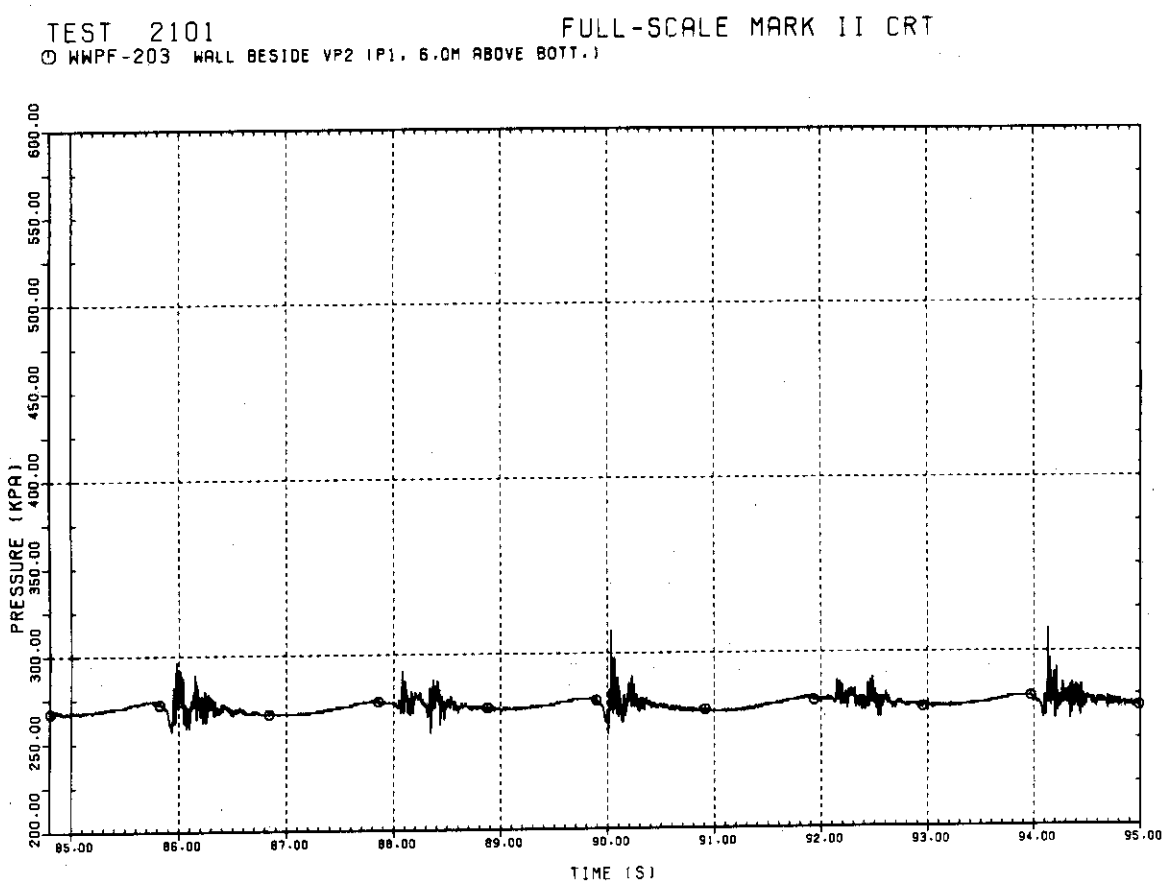
Plot S-1-17 **Pressure in Wetwell**



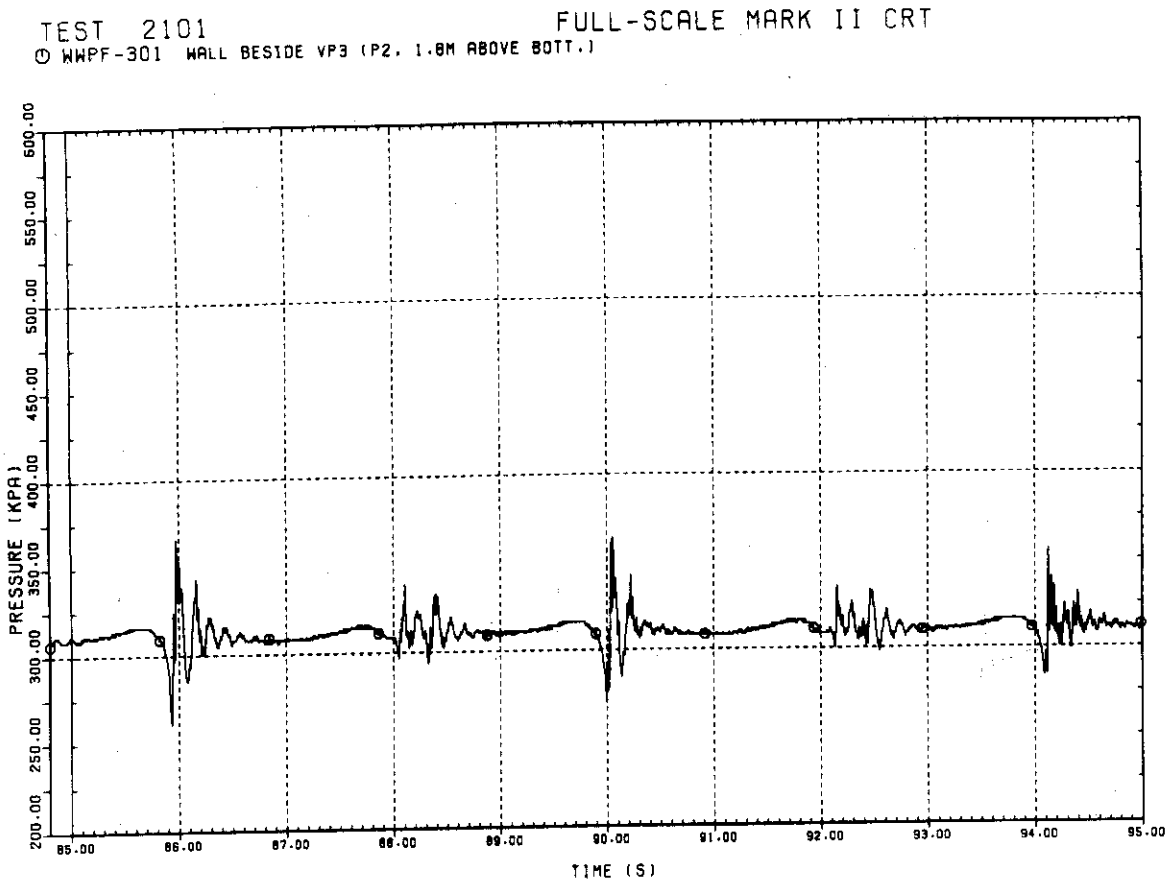
Plot S-1-18 **Pressure in Wetwell**



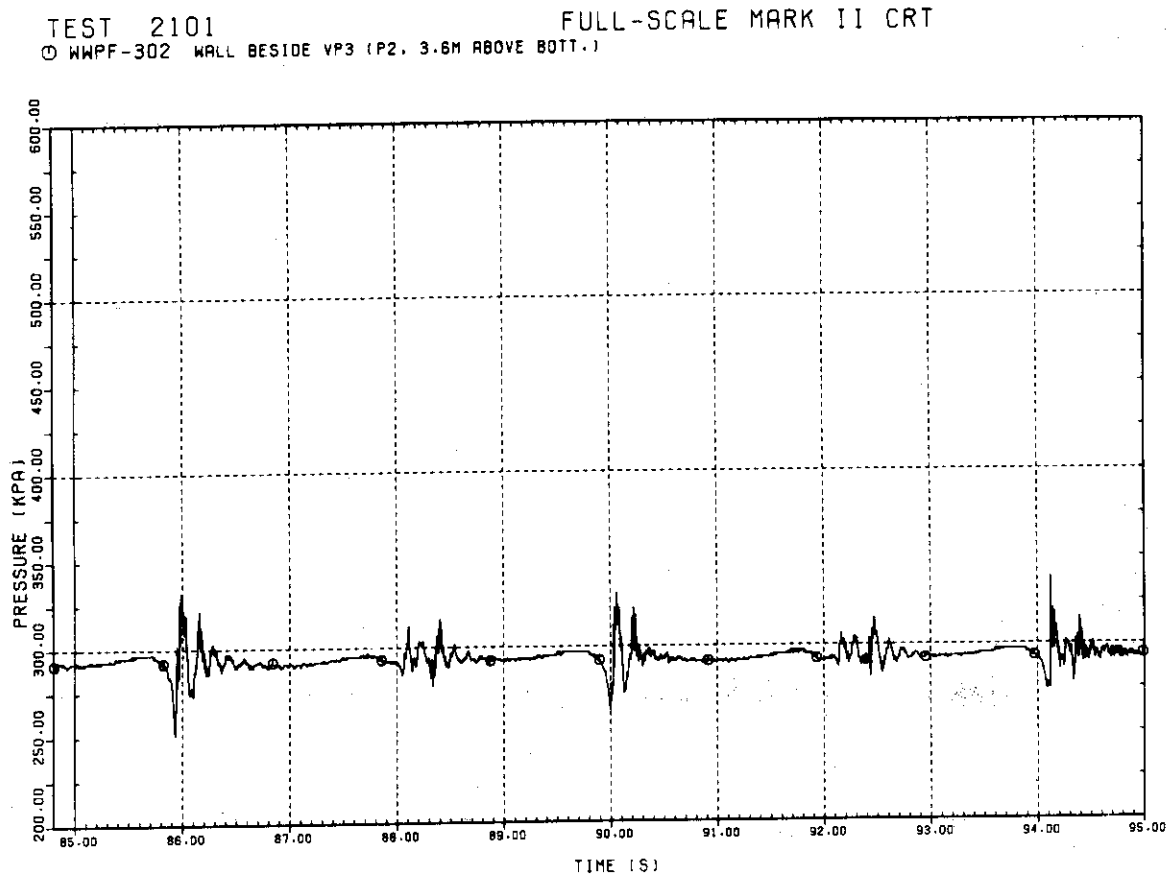
Plot S-1-19 **Pressure in Wetwell**



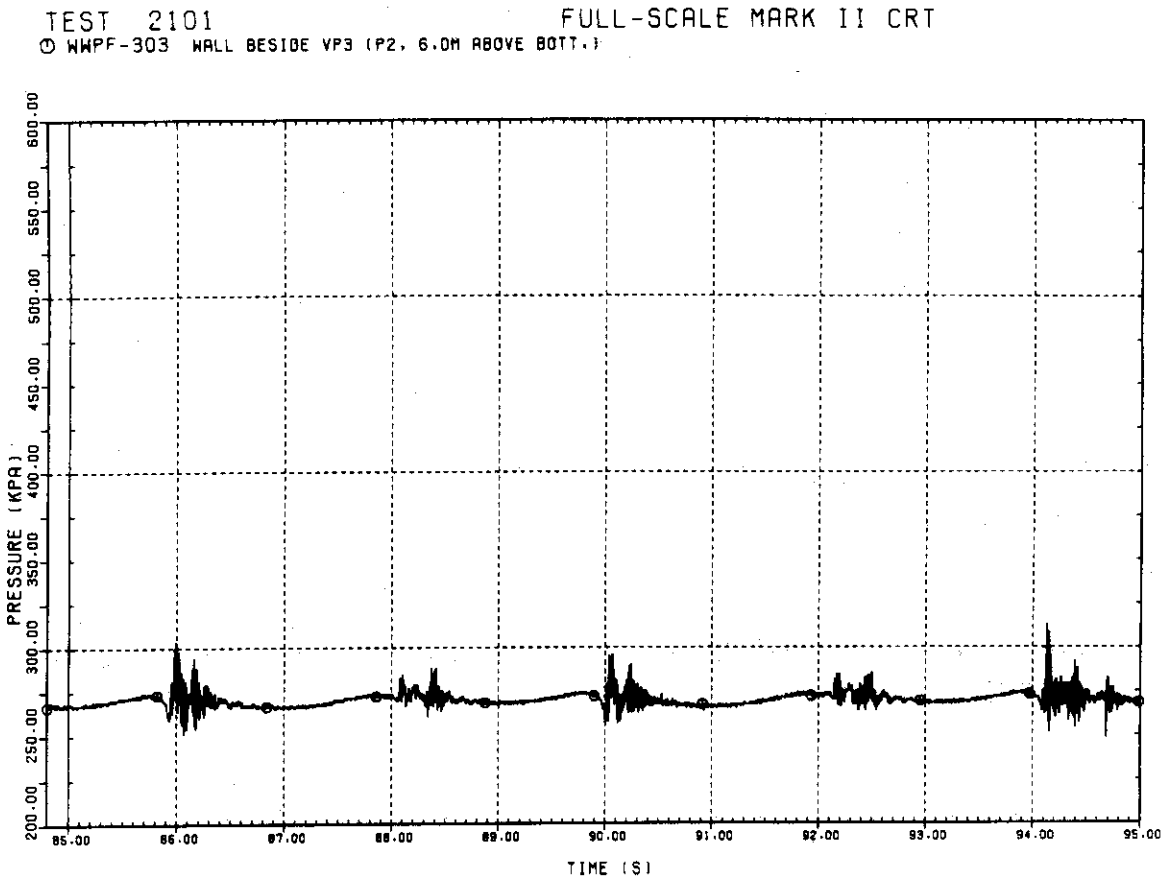
Plot S-1-20 **Pressure in Wetwell**



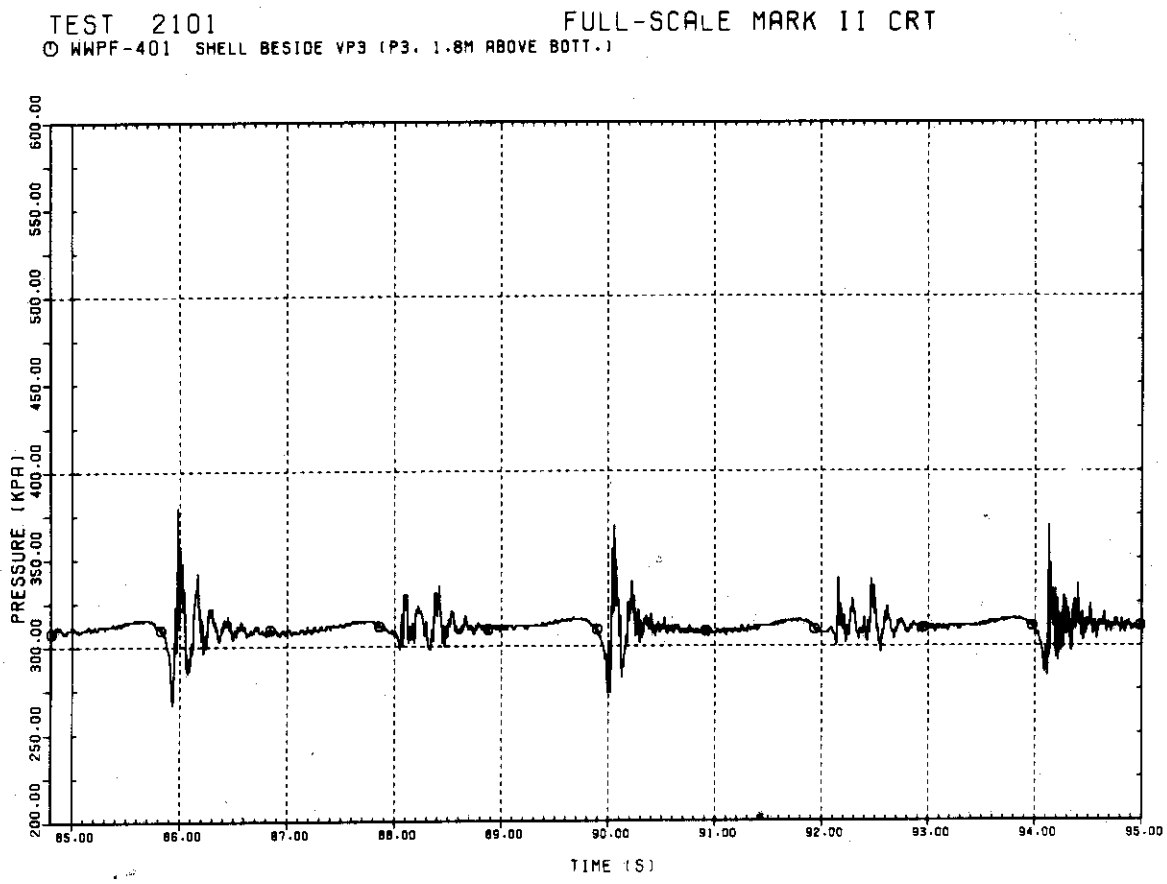
Plot S-1-21 **Pressure in Wetwell**



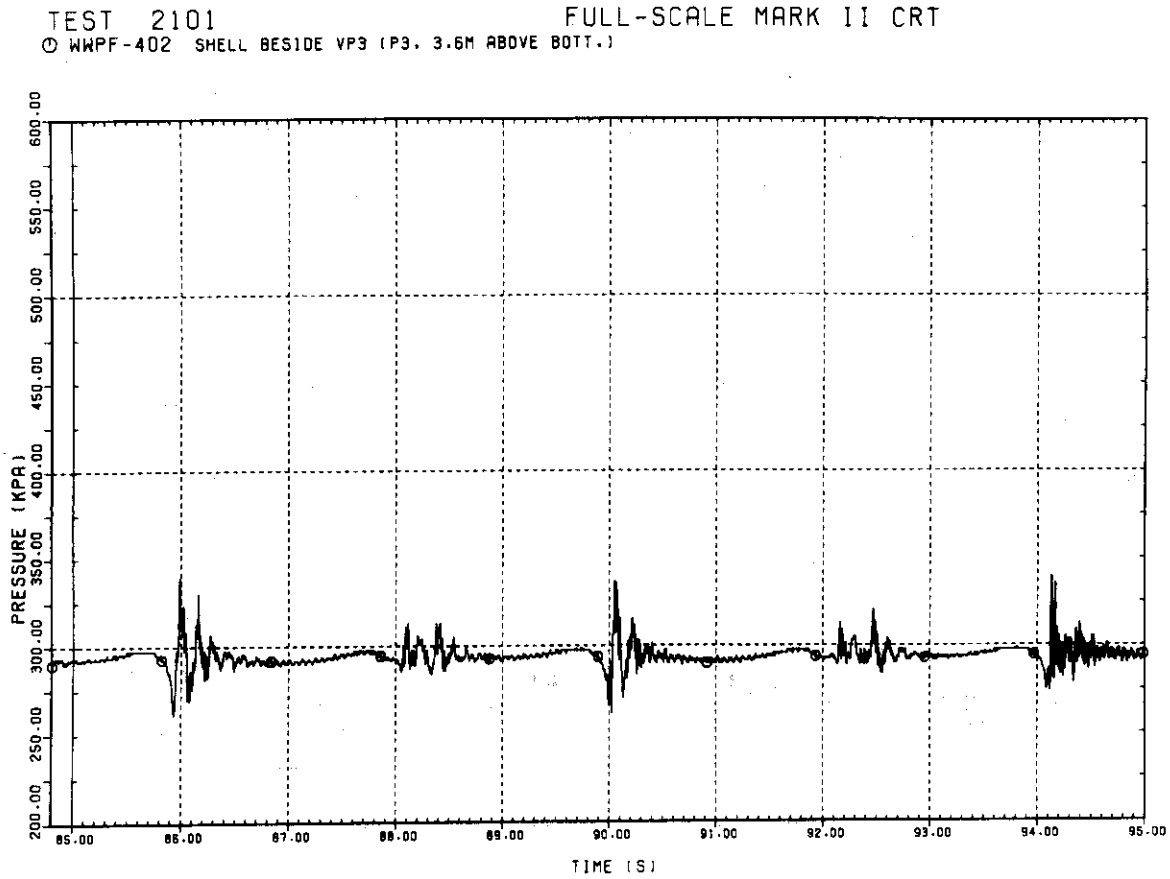
Plot S-1-22 **Pressure in Wetwell**



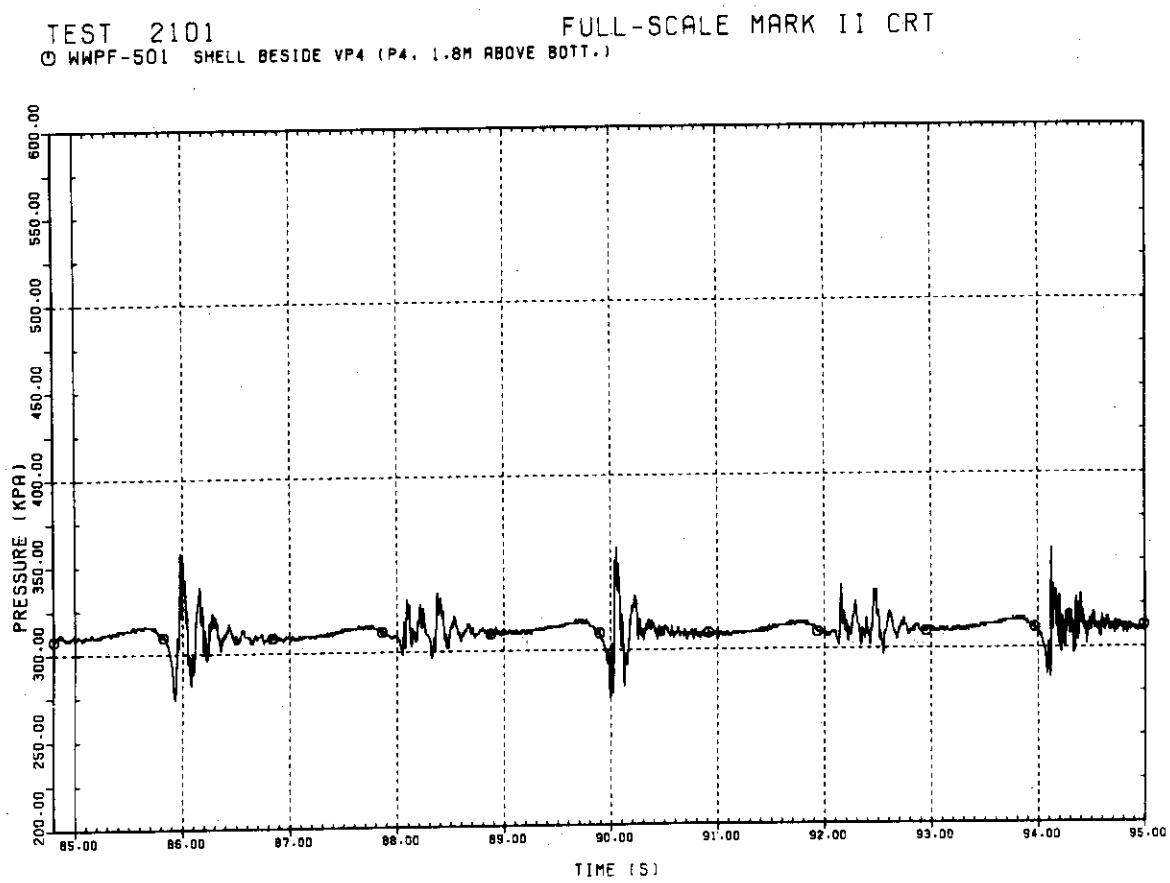
Plot S-1-23 **Pressure in Wetwell**



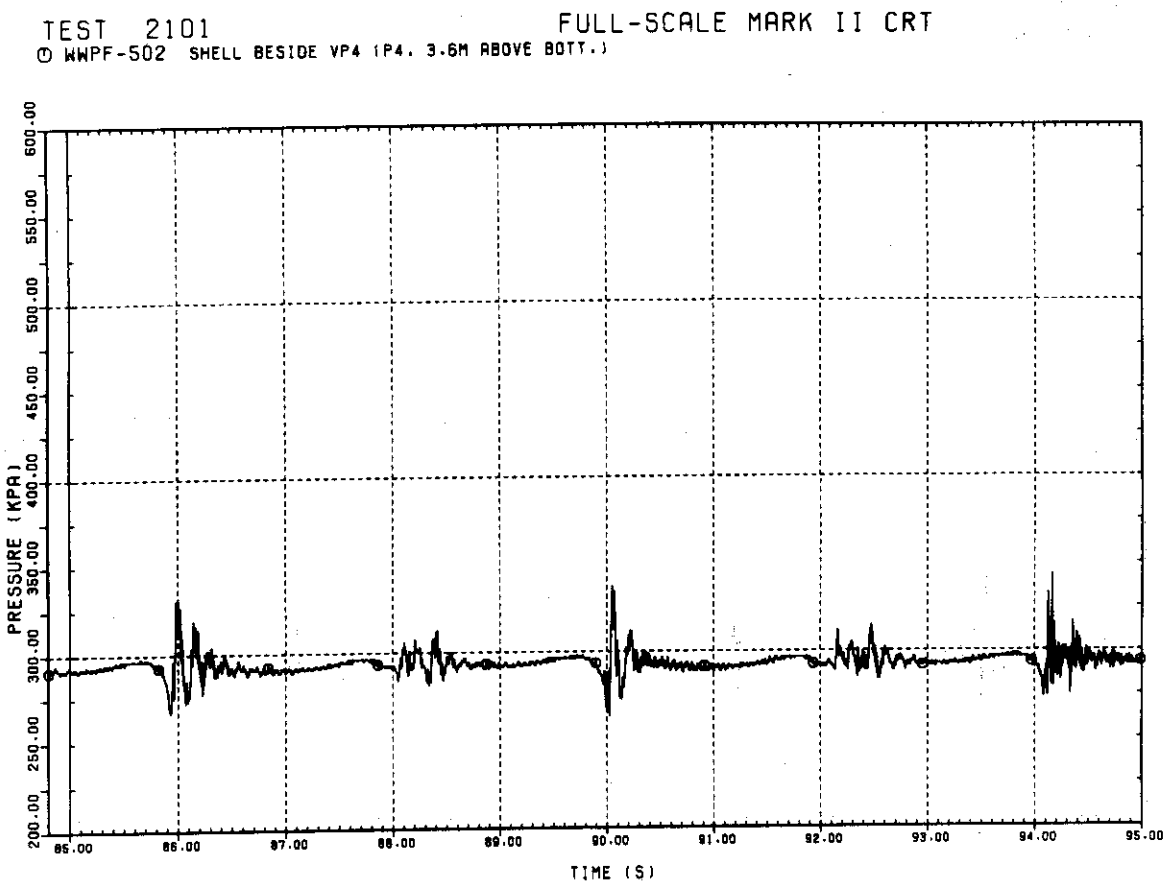
Plot S-1-24 **Pressure in Wetwell**



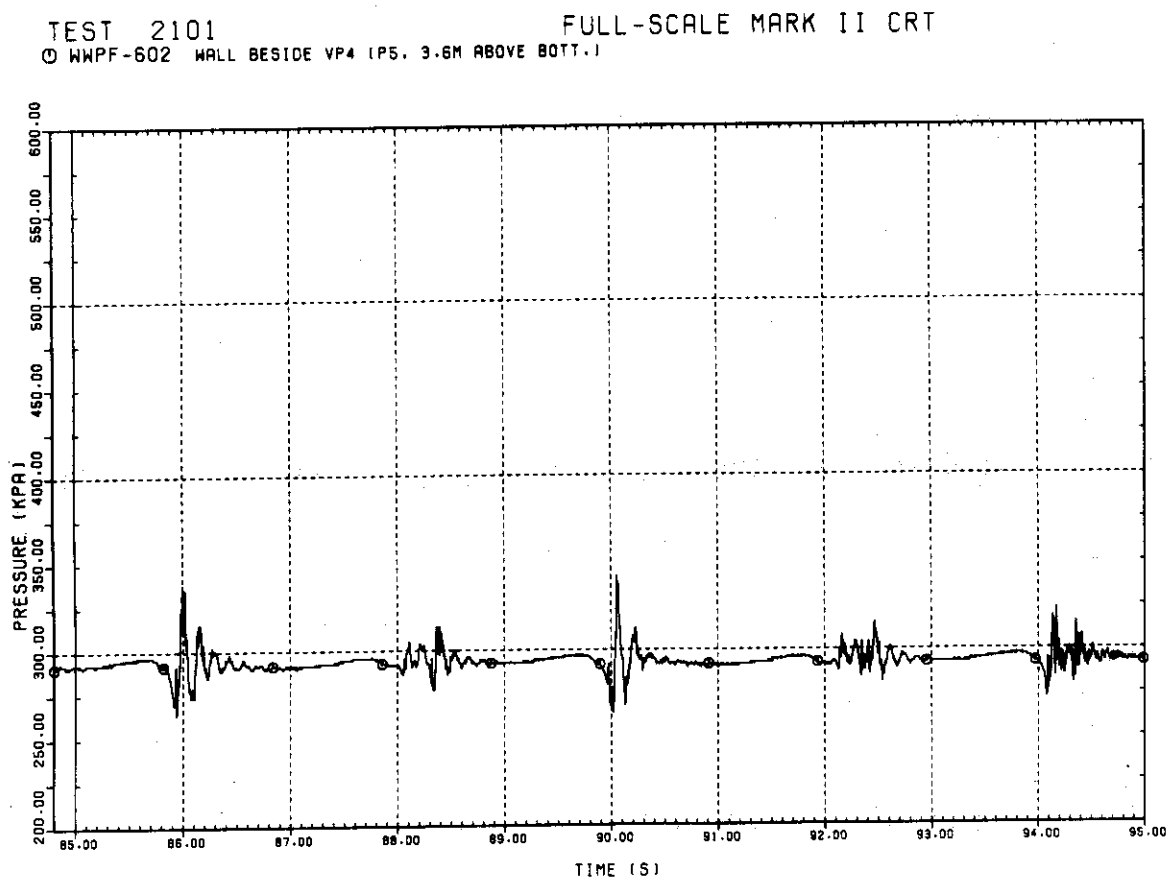
Plot S-1-25 **Pressure in Wetwell**



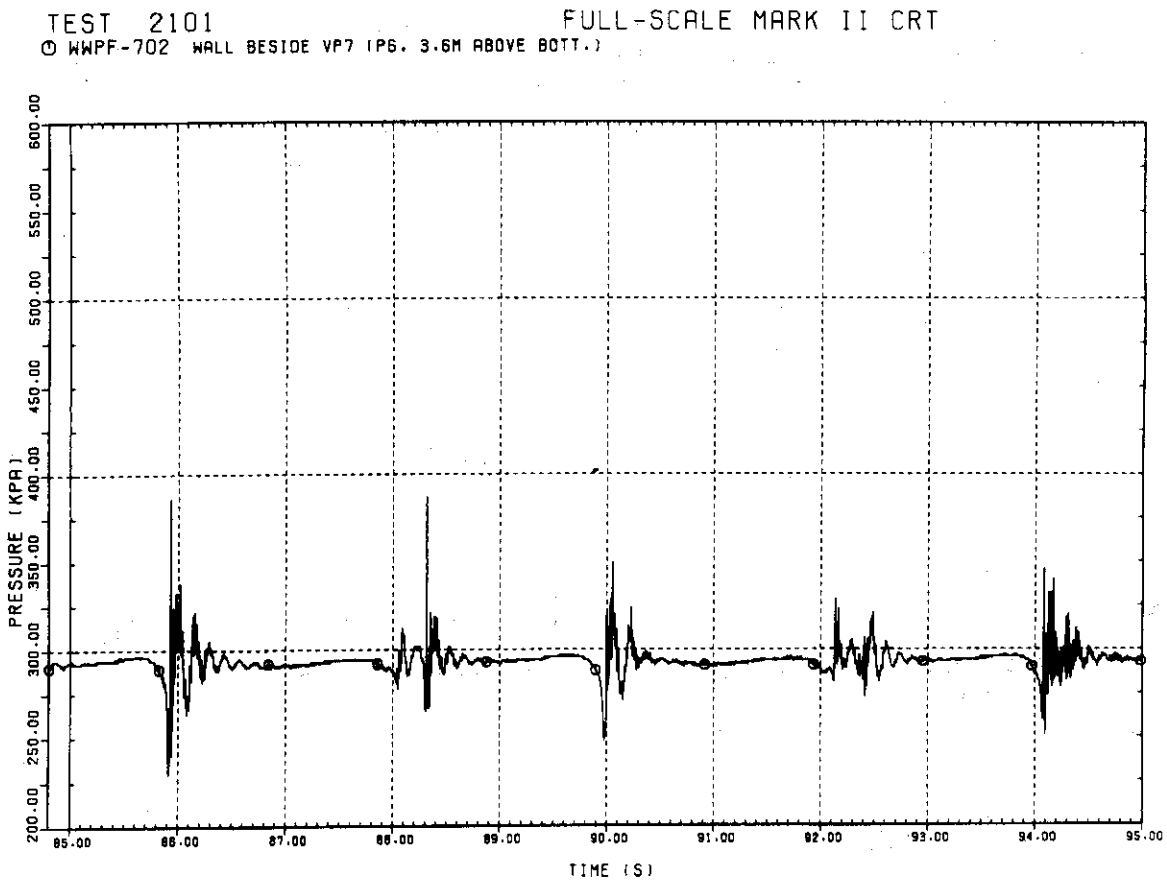
Plot S-1-26 **Pressure in Wetwell**



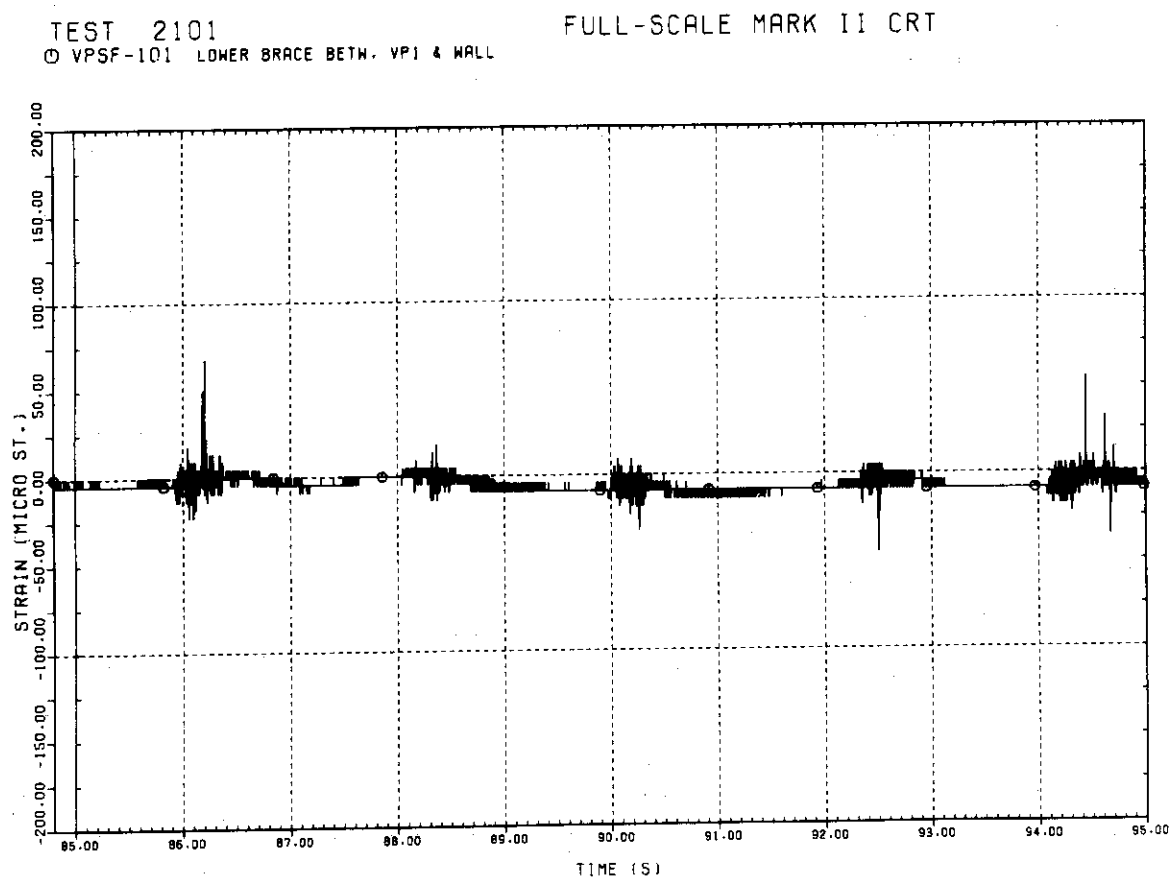
Plot S-1-27 **Pressure in Wetwell**



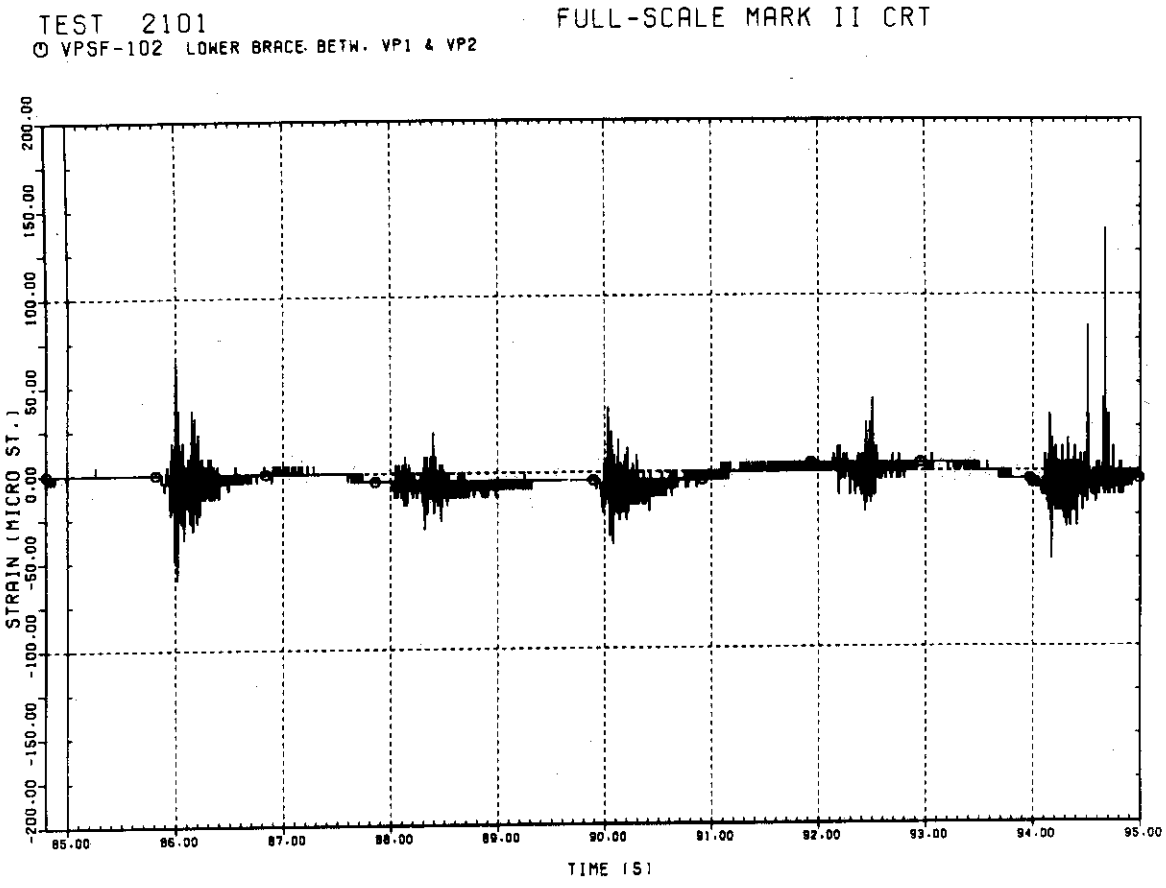
Plot S-1-28 **Pressure in Wetwell**



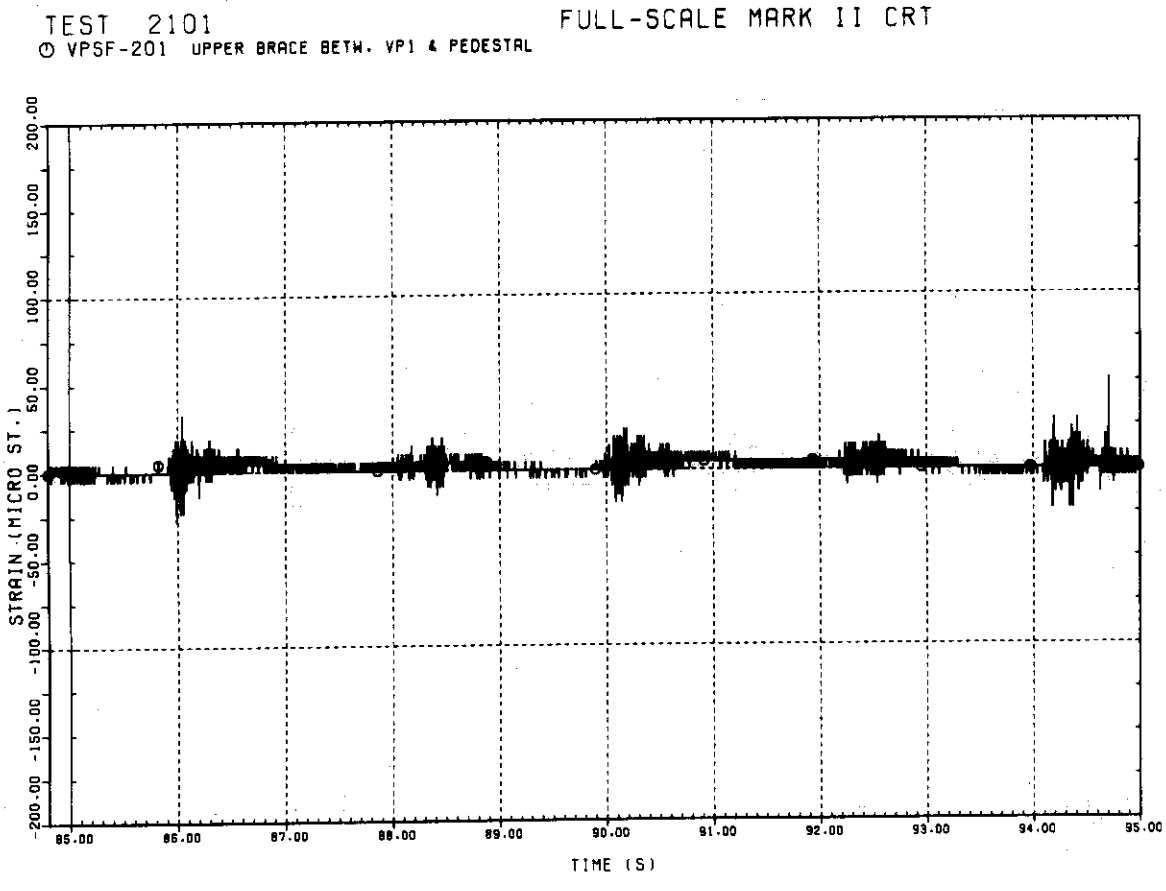
Plot S-1-29 **Pressure in Wetwell**



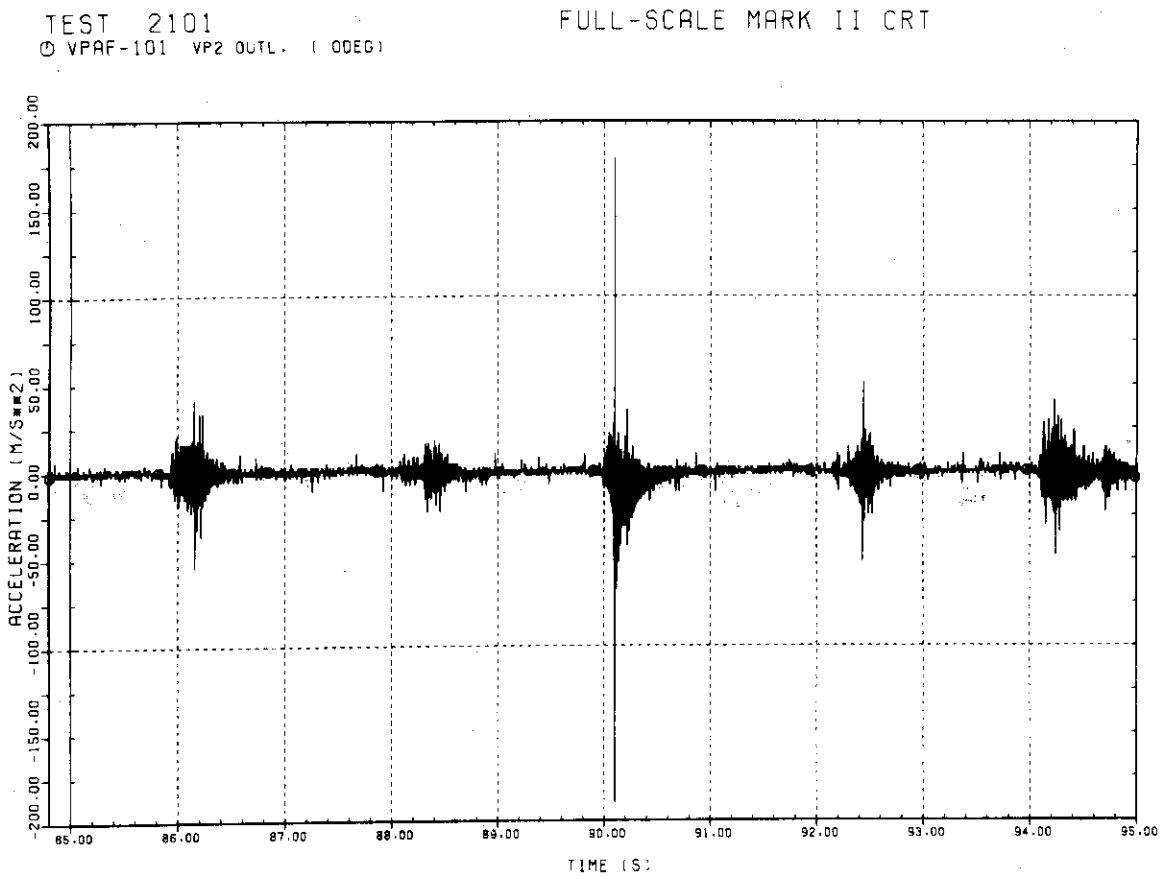
Plot S-1-30 **Strain of Vent pipe Brace**



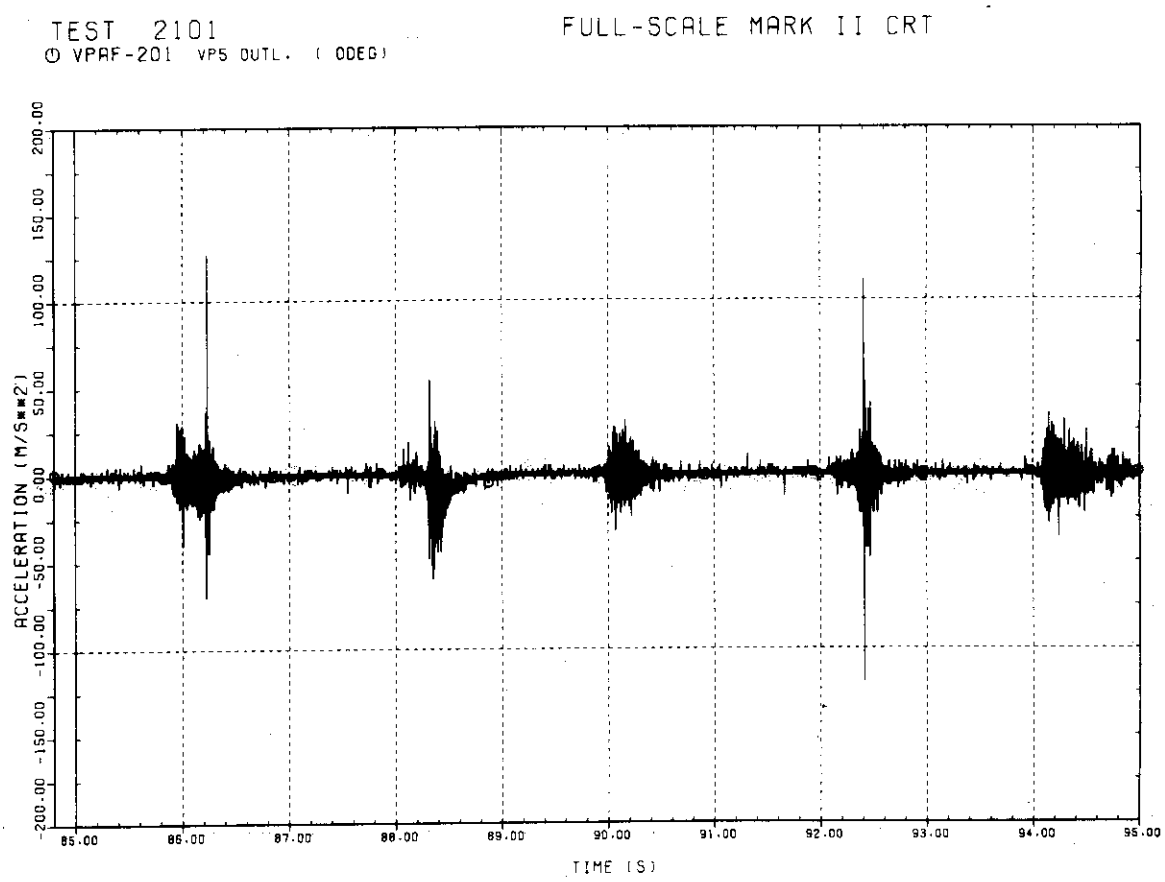
Plot S-1-31 **Strain of Vent pipe Brace**



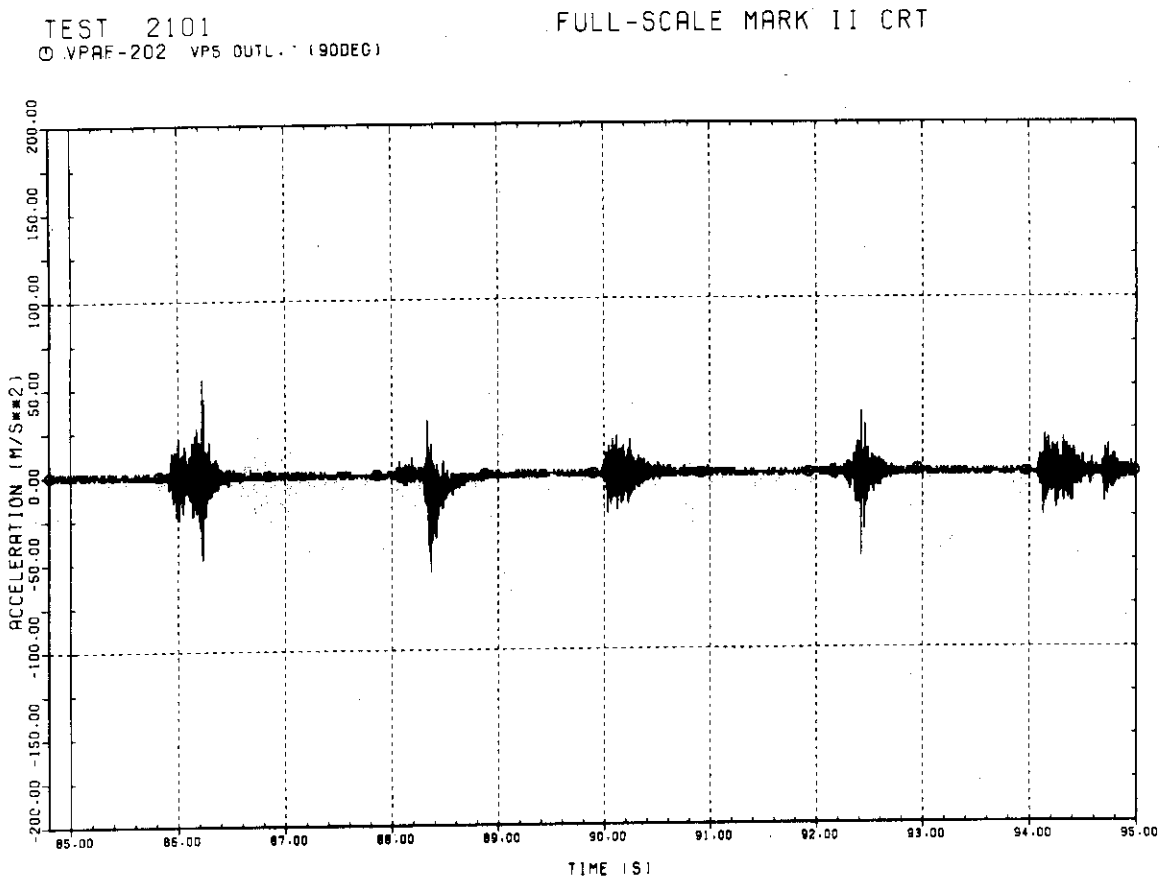
Plot S-1-32 **Strain of Vent pipe Brace**



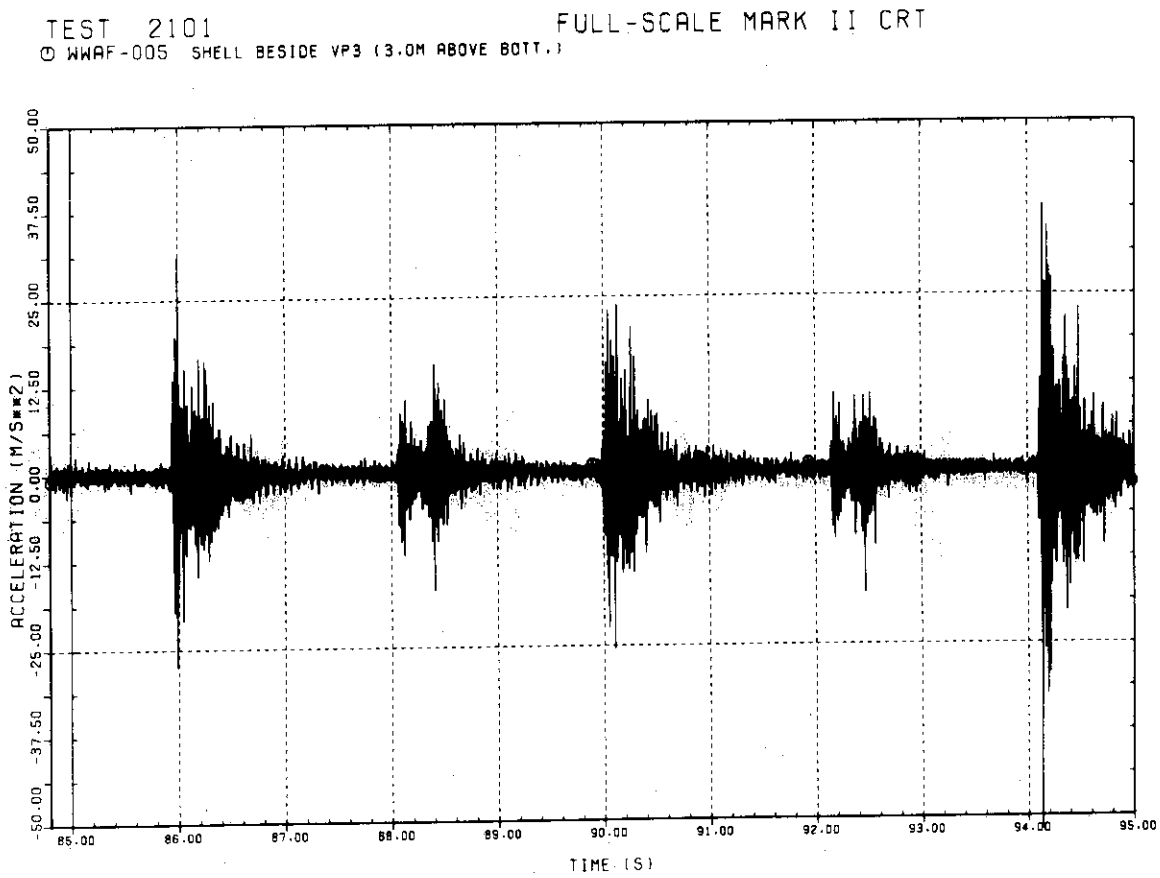
Plot S-2-1 Acceleration of Vent pipe Outlet



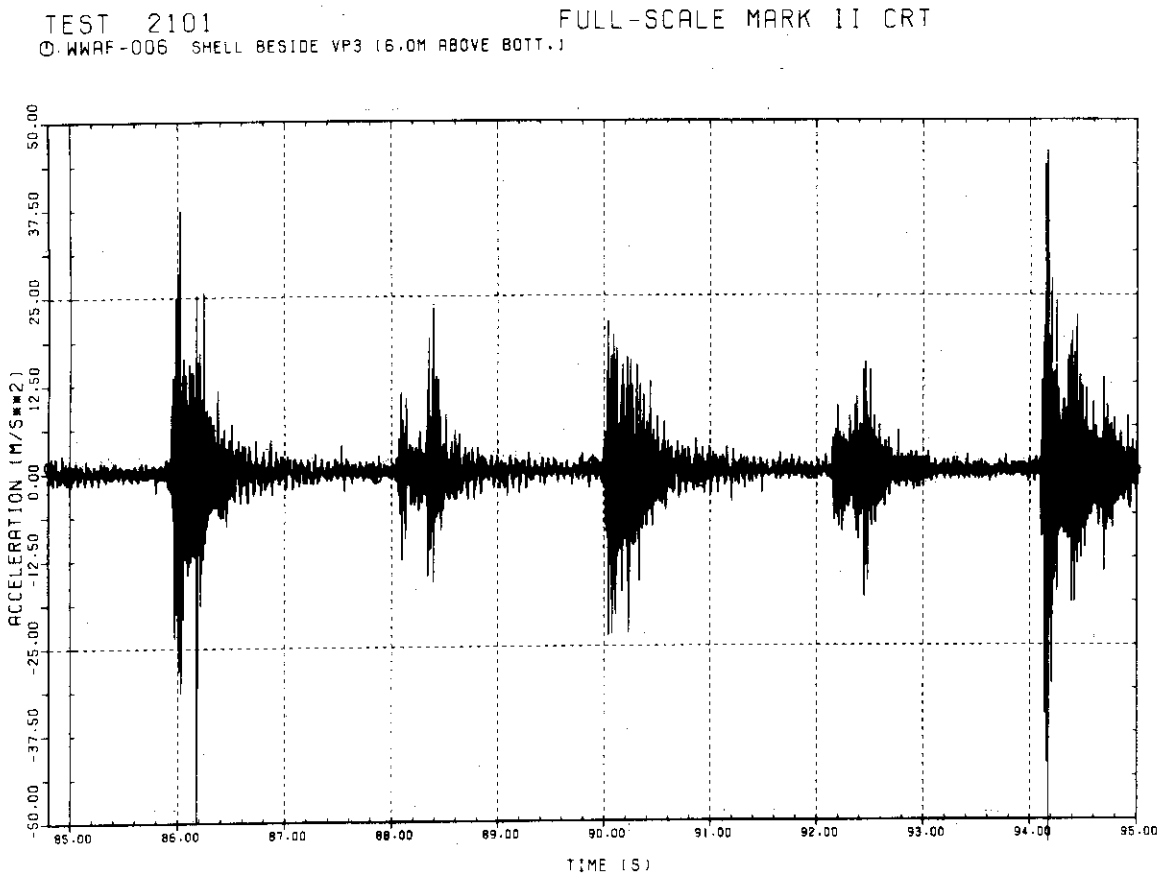
Plot S-2-2 Acceleration of Vent pipe Outlet



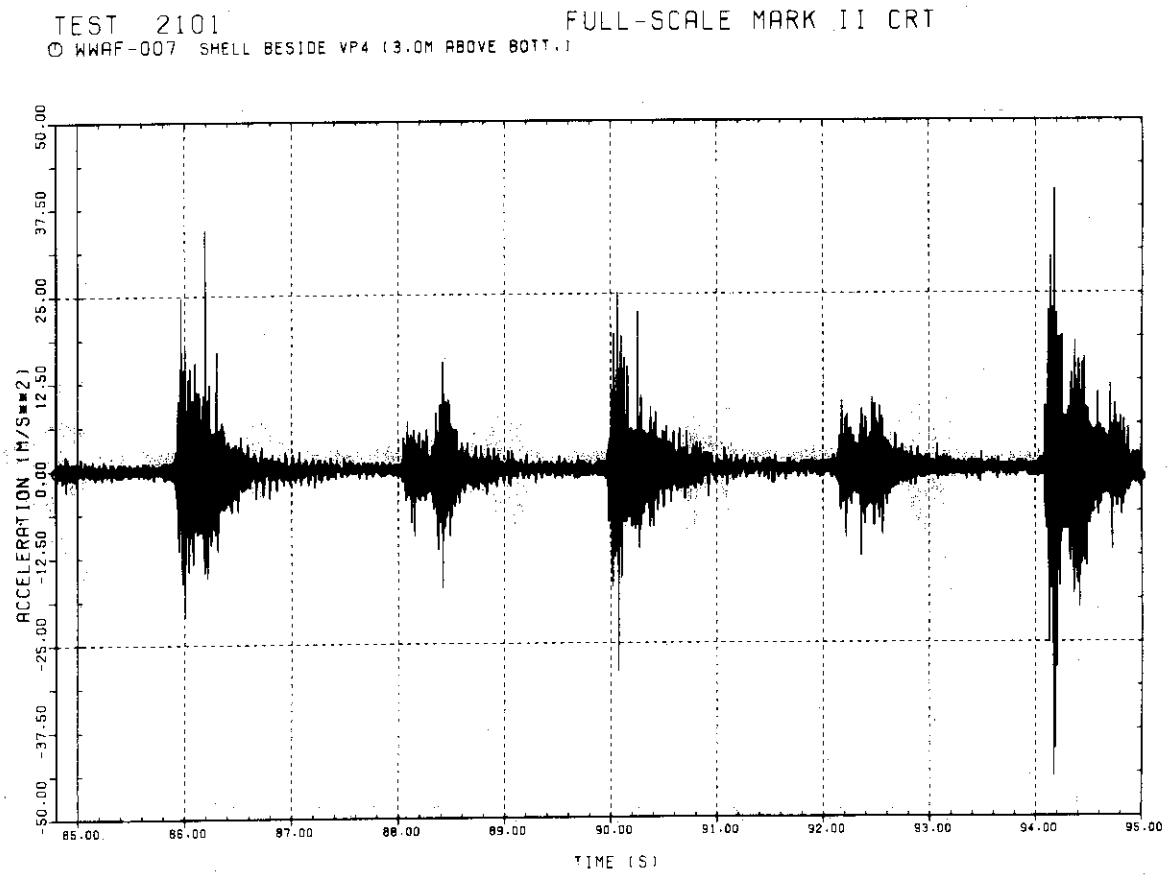
Plot S-2-3 **Acceleration of Vent pipe Outlet**



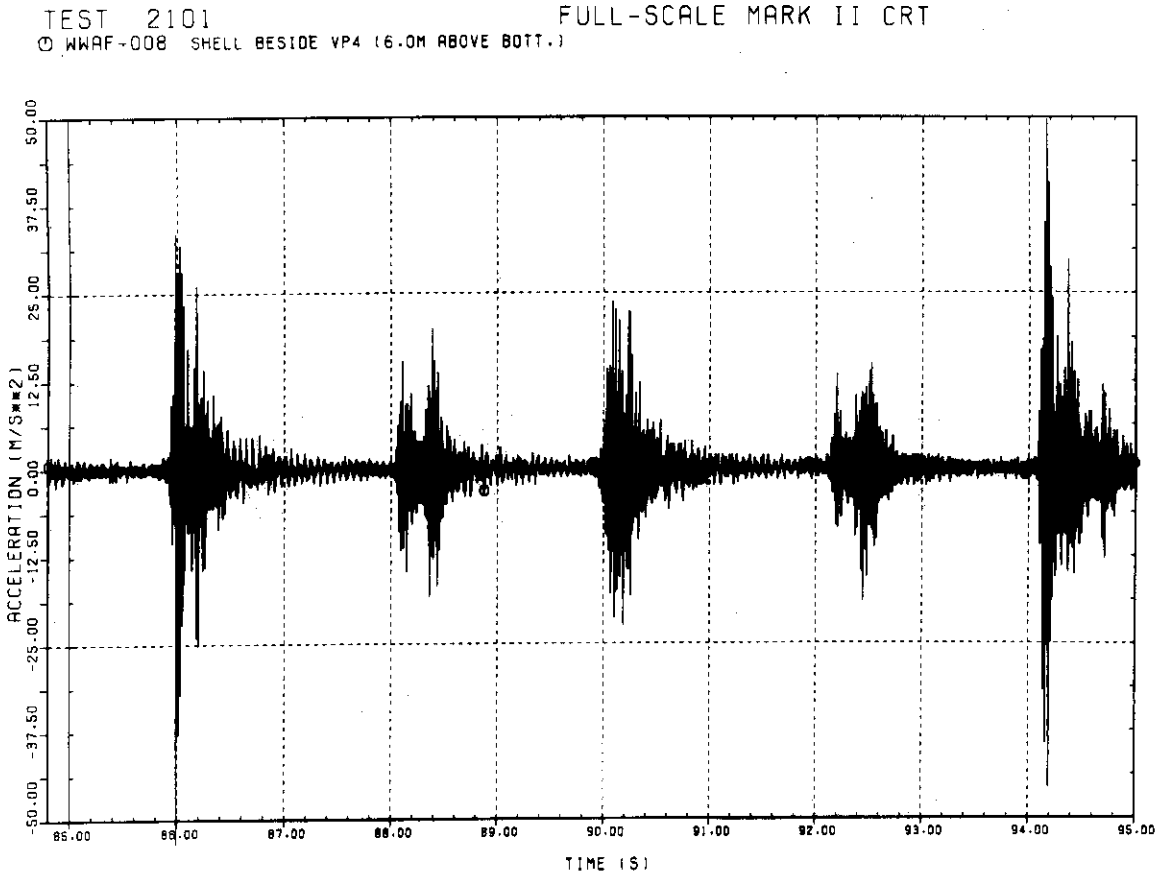
Plot S-2-4 **Acceleration of Containment Structure**



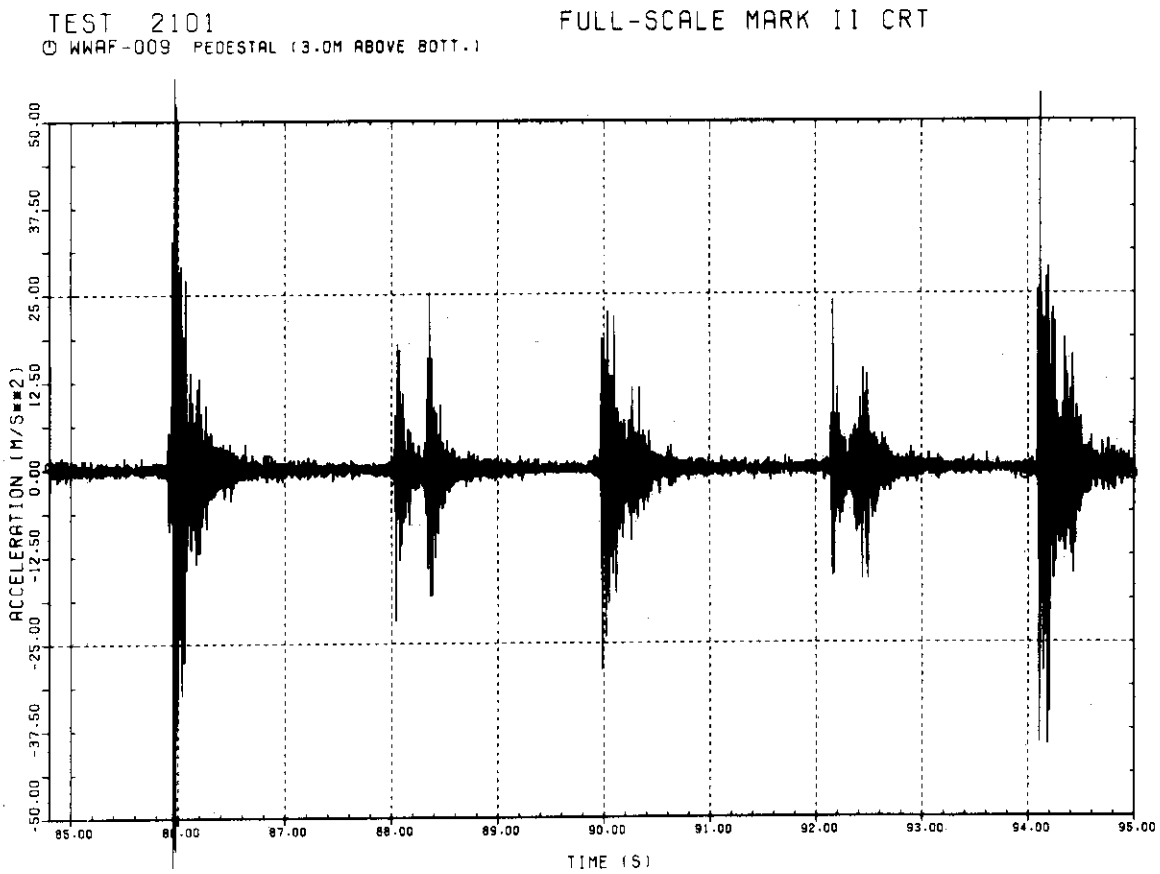
Plot S-2-5 **Acceleration of Containment Structure**



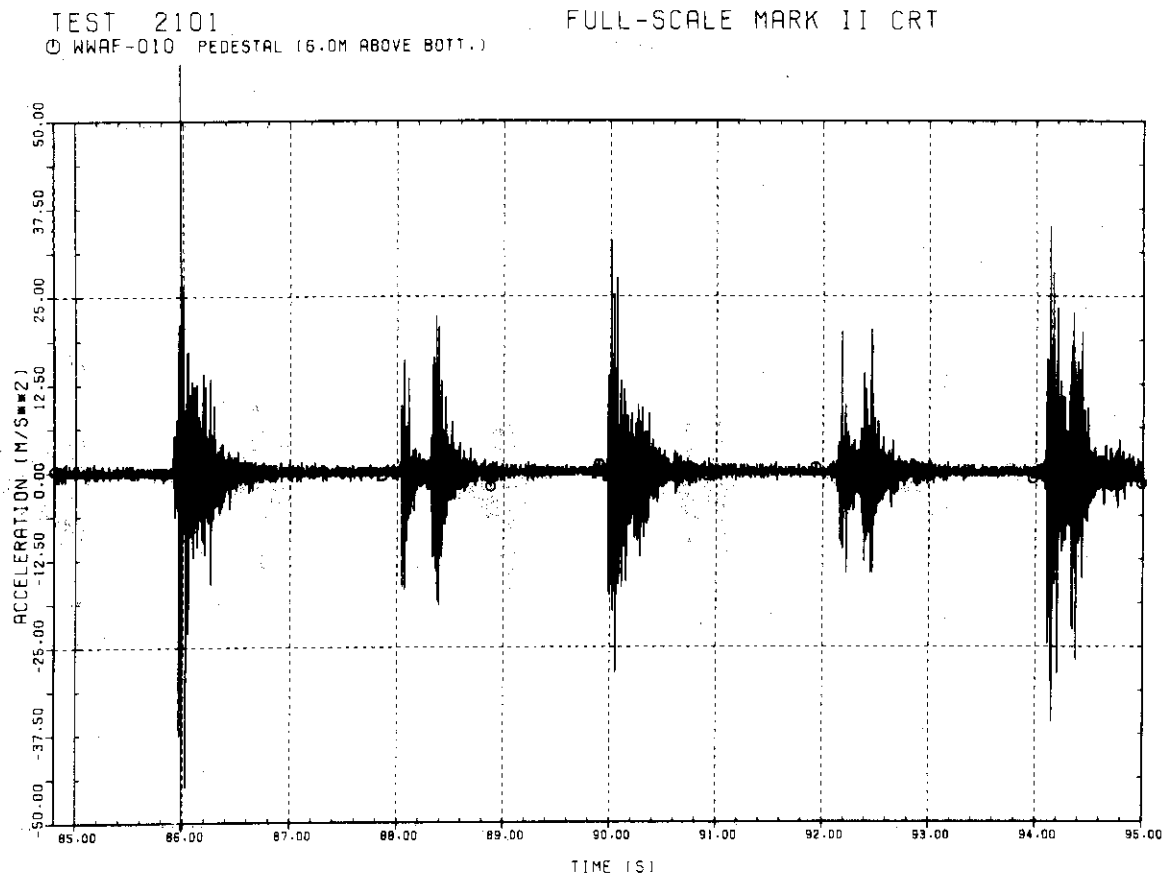
Plot S-2-6 **Acceleration of Containment Structure**



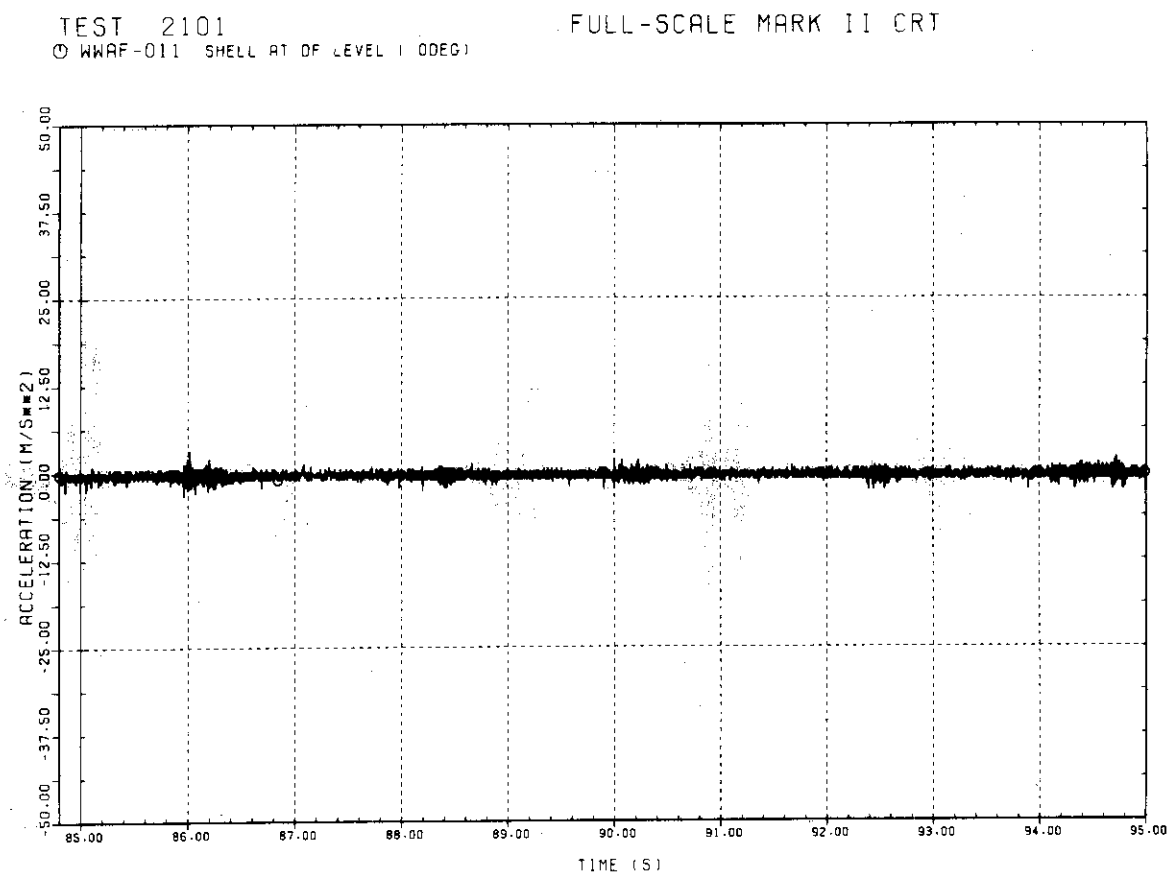
Plot S-2-7 Acceleration of Containment Structure



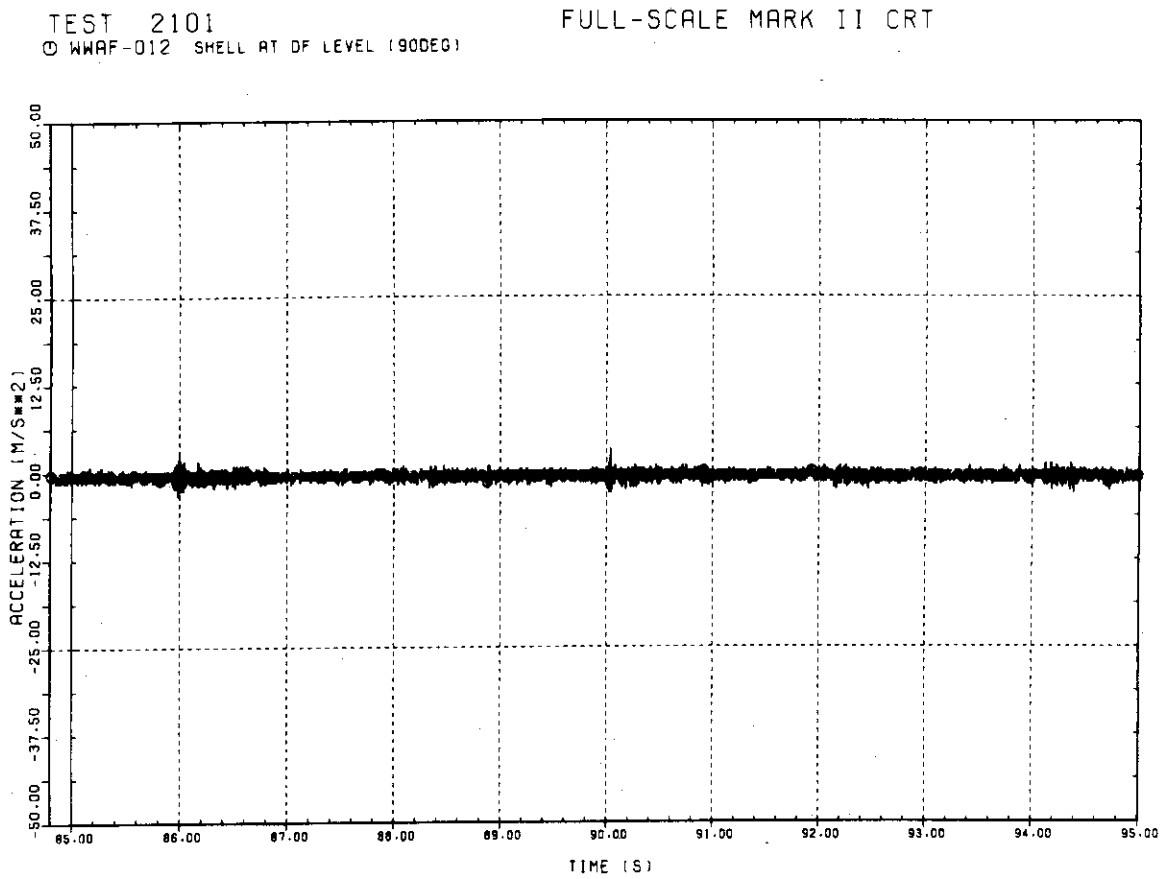
Plot S-2-8 Acceleration of Containment Structure



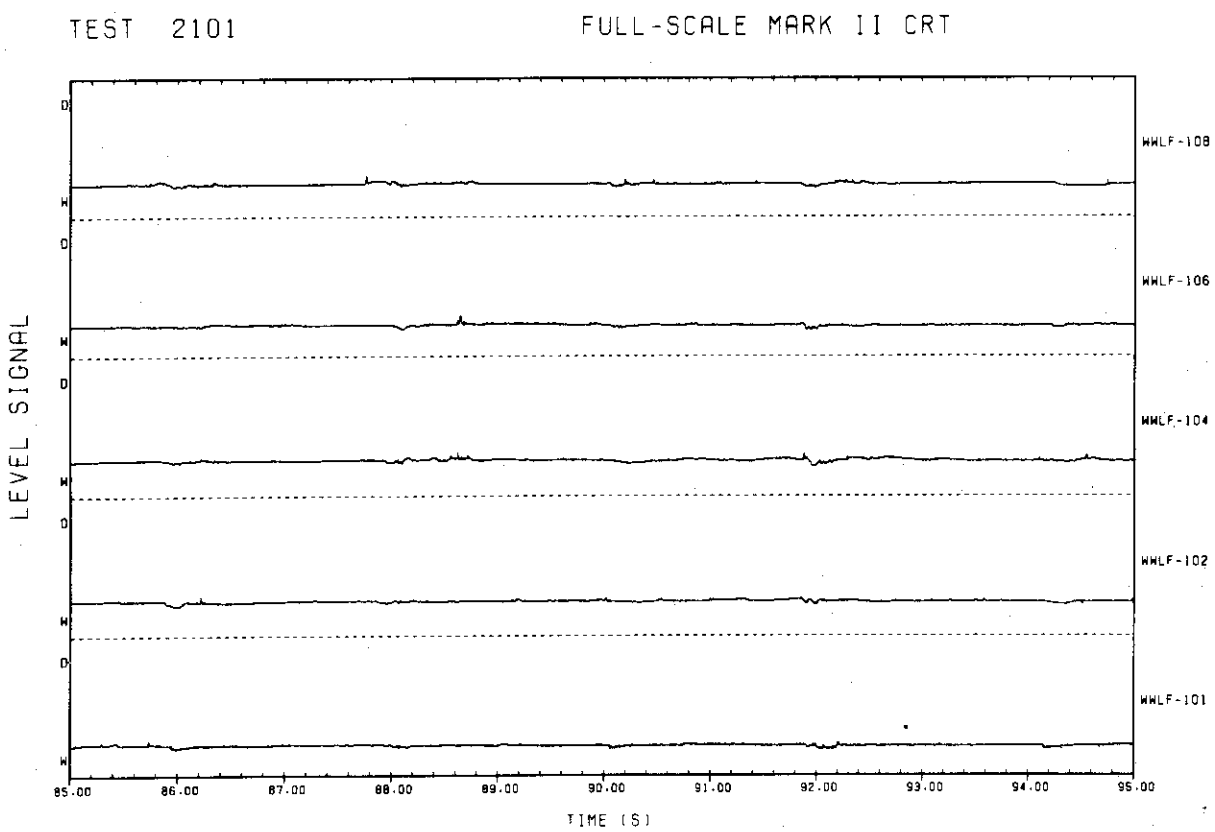
Plot S-2-9 **Acceleration of Containment Structure**



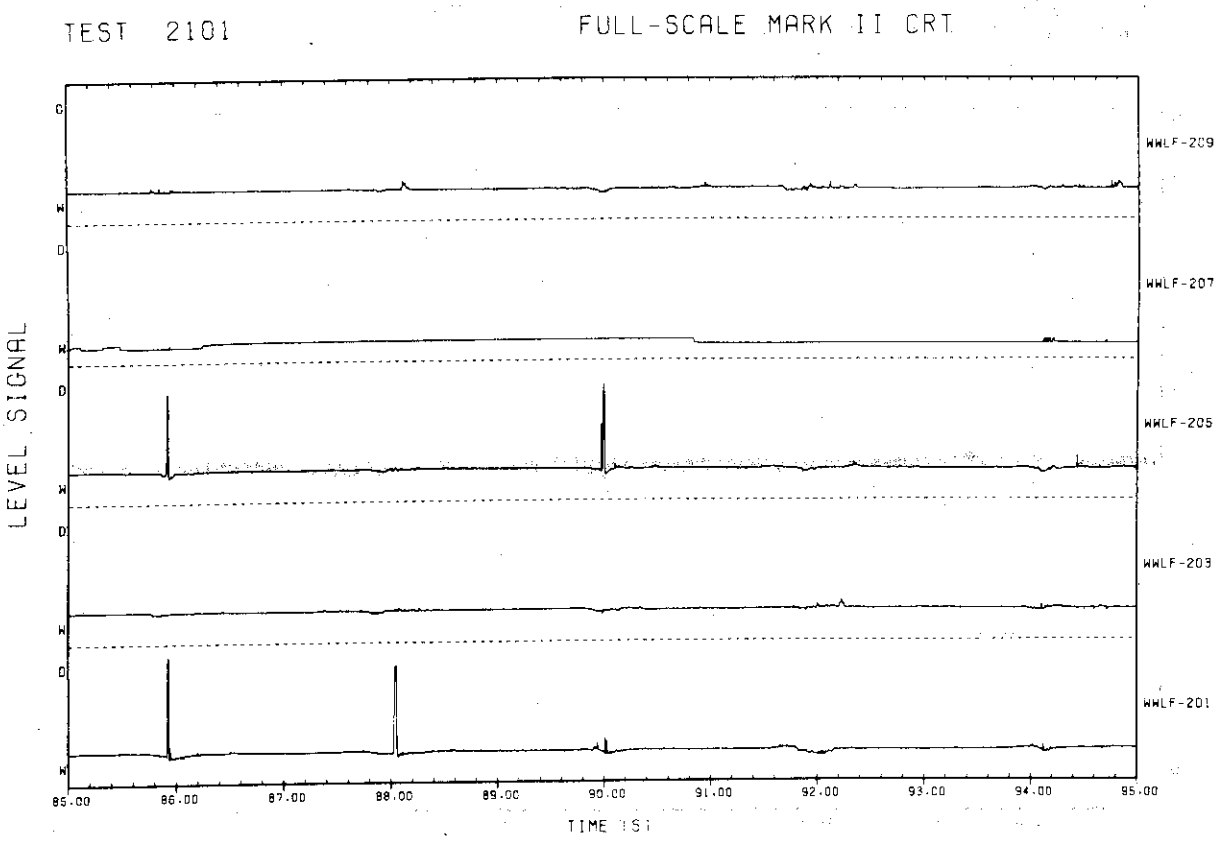
Plot S-2-10 **Acceleration of Containment Structure**



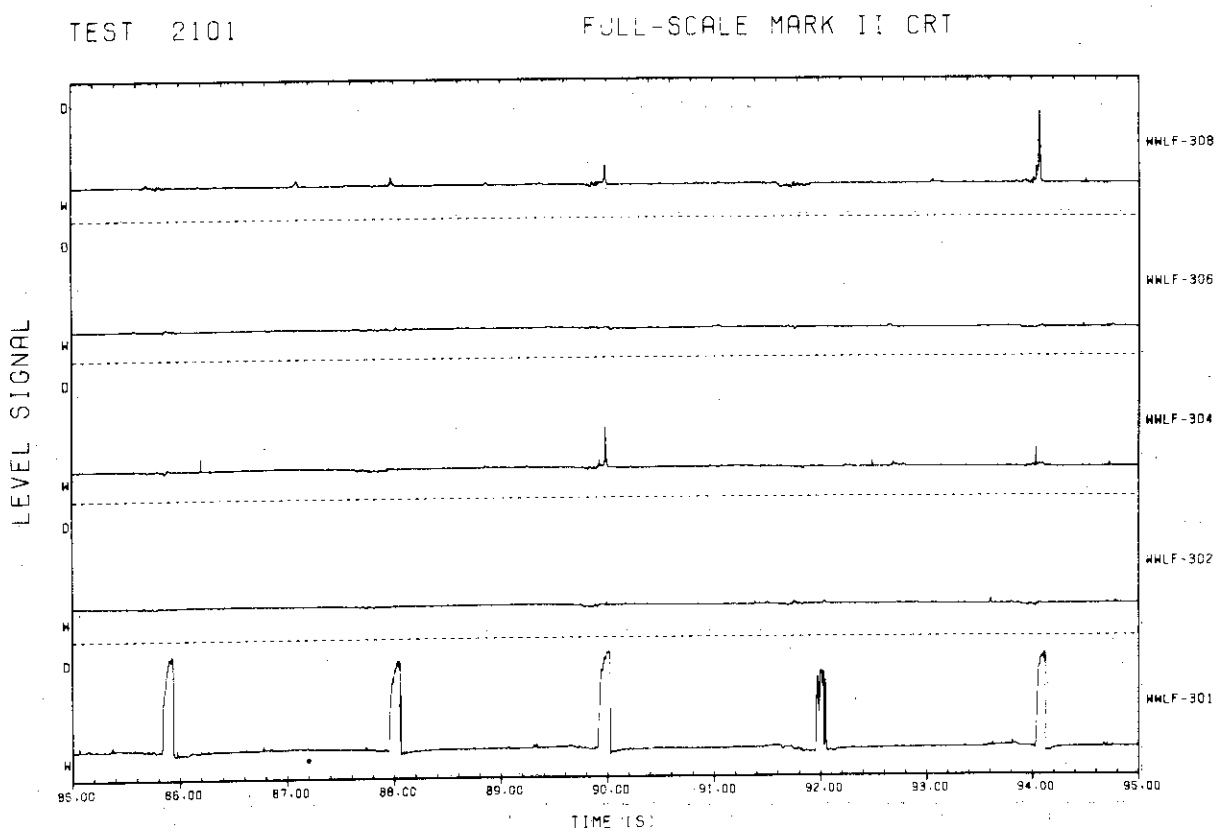
Plot S-2-11 **Acceleration of Containment Structure**



Plot S-2-12 **Phase Boundary Signals**



Plot S-2-13 **Phase Boundary Signals**



Plot S-2-14 **Phase Boundary Signals**