ATTACHMENT

Consumers Power Company
Palisades Plant
Docket 50-255

Special Report

REACTOR CONTAINMENT BUILDING INTEGRATED LEAK RATE TEST
February 1991

Prepared by: Consumers Power Company
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21 Pages

PALISADES NUCLEAR PLANT

REACTOR CONTAINMENT BUILDING INTEGRATED LEAK RATE TEST

TABLE OF CONTENTS

FIGURES

TABLES

1.0 SUMMARY

1.1 INTRODUCTION

On February 16, 1991, Palisades Nuclear Plant, owned and operated by Consumers Power Company, successfully completed its sixth Type A Containment Integrated Leak Rate Test, and its first short duration full pressure test. The Containment Integrated Leak Rate Test was completed in conjunction with a Structural Integrity Test, necessitated by the replacement of the steam generators inside containment. A history of the past Type A tests is given in Table 2. In addition, the results of all Type B and C Local Leak Rate Tests conducted since the November 1988 Type A test are listed in Table 1.

Palisades containment is a steel-lined, steel reinforced concrete structure with a net free volume of 1,640,000 cu. ft. As a result, the containment air mass is essentially free from short-term daily changes in ambient conditions, including diurnal effects. The structure has a design pressure of 55 psig and a calculated accident peak pressure of 54.68 psig.

1.2 RESULTS

In accordance with 10 CFR 50, Appendix J, Consumers Power Company conducted a full pressure, short duration Type A Containment Integrated Leak Rate Test commencing with pressurization on February 12, 1991 and concluding with depressurization on February 17, 1991. The test was conducted in conjunction with the Structural Integrity Test (SIT) which was necessitated by modifications to containment during replacement of the steam generators.

The hold test lasted 14.75 hours utilizing the BN-TOP-1 test criteria, as permitted under our most recent Palisades Nuclear Plant Technical Specifications. The air mass at the beginning of the test was 594150.8 lbs at a test pressure (Pa) of 55.61 psig. The measured containment leak rate (Lam) for the 14.75 hour hold test was 0.02473 wt %/day and the BN-TOP-1 upper 95% confidence level (UCL) was 0.0700838 wt %/day. The addition of Type B and C penalties result in a calculated "as left" total containment leak rate of 0.070439 wt %/day at Pa.

Referencing 10 CFR 50, Appendix J, Section III.A.5.b.1, the maximum acceptable leak rate for a Type A test at the accident pressure (Pa) of 55 psig, is 0.075 wt %/day (0.75 La), including the corrective additions to account for omitted systems and the containment free volume changes. This criterion was met in the Type A "as left" test condition. As a result, the Palisades Nuclear Plant was allowed to return to operational status.

After the hold test was completed, a controlled leakage (Lo) of 5.5 scfm or 0.10023 wt %/day was imposed on Lam, as a verification test as suggested by N45.4-1972 and 10 CFR 50, Appendix J, for a period of 8.5 hours including a 1 hour stabilization. The composite leak rate (Lc) for the verification was then measured at 0.12213 wt %/day. The BN-TOP-1 criteria states that Lc shall be bound by Lam + Lo + 0.25 La, where La is the maximum allowable leak rate at test pressure. Those limits are 0.09996 and 0.14996 wt %/day

inclusive. Lc (0.12213 wt%/day) does indeed fall between those limits, and thus the Type A leak rate does meet the requirements and is verified.

The Type C additive corrections for containment pressure boundary systems that were not exposed to the test pressure and were added to the Type A test results (to obtain the Type A "as left") were:

Penetration No	Penetration Description	Leak Rate (SCCM)
15	Component Cooling Water in CV-0911 and CV-0940	9.3
17	Containment Pressure Instrument Line	165.1
36	Letdown to Purification Ion Exchange (CV-2009)	155.2
44	Controlled Bleed-off from PCP's	82.9
48	Containment Pressure Instrument Line	129.2
52	Containment Sump Drain Line	0.0
66	ILRT Instrument Line	9.9
	Total Untested Leak Rate	551.6

The conversion of 551.6 sccm to wt%/day equals 3.548×10^{-4} wt%/day.

2.0 DISCUSSION

2.1 ANALYSIS TECHNIQUES

A preoperational temperature and dewpoint temperature survey provided the initial results used in calculating the weighting factors assigned to each subvolume, based upon the number of both temperature and humidity sensors used in each. Because the temperature sensors are direct reading, they require no conversions to calculate the average temperature in containment. The humidity sensors do, however, require a mathematical conversion completed within the computer program to produce the average containment vapor pressure. The difference between the absolute pressure in containment and the average vapor pressure produces the containment dry air partial pressure. The dry air partial pressure and the weighted average containment temperature are then used to compute the mass of the containment air.

The absolute method was used to conduct the containment leak rate test. Measurements were recorded every 15 minutes and the data used to compute the leak rate by the total time method and applying the BN-TOP-1 criteria for a short duration test as allowed under the Palisades Plant's Technical Specifications. In the total time method of analysis, calculations are based on the most recent data and the start of test data. Each successive leakage computation is then based on a correspondingly longer time period. Each computation is least squares fit to a straight line until the duration of the test is sufficient to establish that the containment conditions are stable, a definite data trend is apparent, the test data are consistent, the extrapolated leakage rate and the upper 95% confidence level (UCL) is within the allowable limits as set forth in BN-TOP-1.

2.2 DATA ACQUISITION

The instrumentation system consisted of a sensor package of twenty-six (26) Resistance Temperature Detectors (RTD's), ten (10) humidity sensors, and two (2) quartz manometer pressure gauges. Measurements from the sensors were used to determine the average dry bulb temperature, humidity (for conversion to vapor pressure) and the containment pressure. All sensors were given an in-situ calibration check prior to the test. The sensors located within containment were connected to a multiplexer package (also located within containment) which provided signal conditioning. The multiplexer then scanned each sensor channel and transmitted the data through the electrical penetrations to a data-logger. The data-logger provided the following functions:

1. Test timing and scan command signal to the multiplexers at the appropriate time.

2. Data recording from the multiplexers and pressure gauges.

3. Data transmission to the two computers used for leak rate computation and other data manipulation.

The computers perform the following functions:

1. Records and reduces the raw data into weighted averages, vapor pressures, and containment pressure necessary for computing the containment leak rates.

2. Calculates the leak rate in wt %/day using the total time method.

3. Determines the 95% upper confidence limit (UCL) using the BN-TOP-1 criteria.

4. Provides plots of individual test parameters as well as containment average temperature, vapor pressure and containment mass as a function of time.

5. Provides plots of containment stabilization criteria, leak rates during hold and verification tests, as well as pass/fail criteria.

2.3 CONTAINMENT CONDITIONS

The average temperature in containment fulfilled the requirements for stabilization contained in ANSI 56.8 and Palisades Procedure RT-36, and was declared stable on February 15, 1991 at 14:30, 6 hours and 45 minutes after pressurization was completed. The hold test was declared at that time. The containment mass was 594150.8 lbs mass, and an average temperature of 60.43 degrees F. was measured in containment. The average containment pressure was measured at 55.61 psig. The end of the hold test was declared at 0515 on February 16, 1991, 14 hours and 45 minutes after the start. The test parameters have been plotted to illustrate the average test conditions within the containment throughout the hold test as shown in Figures 1 through 4. Figure 5 illustrates the containment leak rate using the BN-TOP-1 criteria.

In addition to the actual leak rate, a measured leak of 5.5 scfm was imposed on the containment immediately after the end of the hold test. The containment was allowed to stabilize. The verification test was initiated at 0630 on February 16, 1991 and was concluded at 1400 on the same day, 7 1/2 hours after the start. The Type A test was verified after meeting the acceptance criteria as set forth in BN-TOP-1 and Palisades Procedure RT-36.

3.0 CONCLUSIONS

3.1 The Palisades containment structure leak rate satisfied the acceptance criteria stated in RT-36, paragraph 6.3 for the Type A "as left" test.

3.2 The verification test results verified the hold test results, and met the acceptance criteria as found in Palisades Procedure RT-36, paragraph 6.3.

3.3 The calculated instrumentation selection guide (ISG) fulfilled the acceptance criteria of Palisades CILRT Procedure RT-36, paragraph 5.1.2.

4.0 REFERENCES

4.1 Consumers Power Company, "Palisades Nuclear Plant, Special Report No 13, Reactor Containment Building Integrated Leak Rate Test."

4.2 ANSI/ANS 56.8-1987, "American National Standard Containment System Leakage Testing Requirements."

4.3 10 CFR 50, Appendix J.

4.4 Palisades Technical Specifications, Sections 3.6.1, 3.6.2, 4.5.1.

4.5 Palisades CILRT Procedure RT-36, Revision 15.

4.6 NRC INFORMATION NOTICE 85-71: Containment Integrated Leak Rate Tests.

4.7 ANSI 45.4-1972, "American National Standard Leak Rate Testing of Containment Structures for Nuclear Reactors."

4.8 Criteria for Integrated Leak Rate Testing of Primary Containment Structures for Nuclear Power Plants, BN-TOP-1, Revision 1, November 1, 1972.

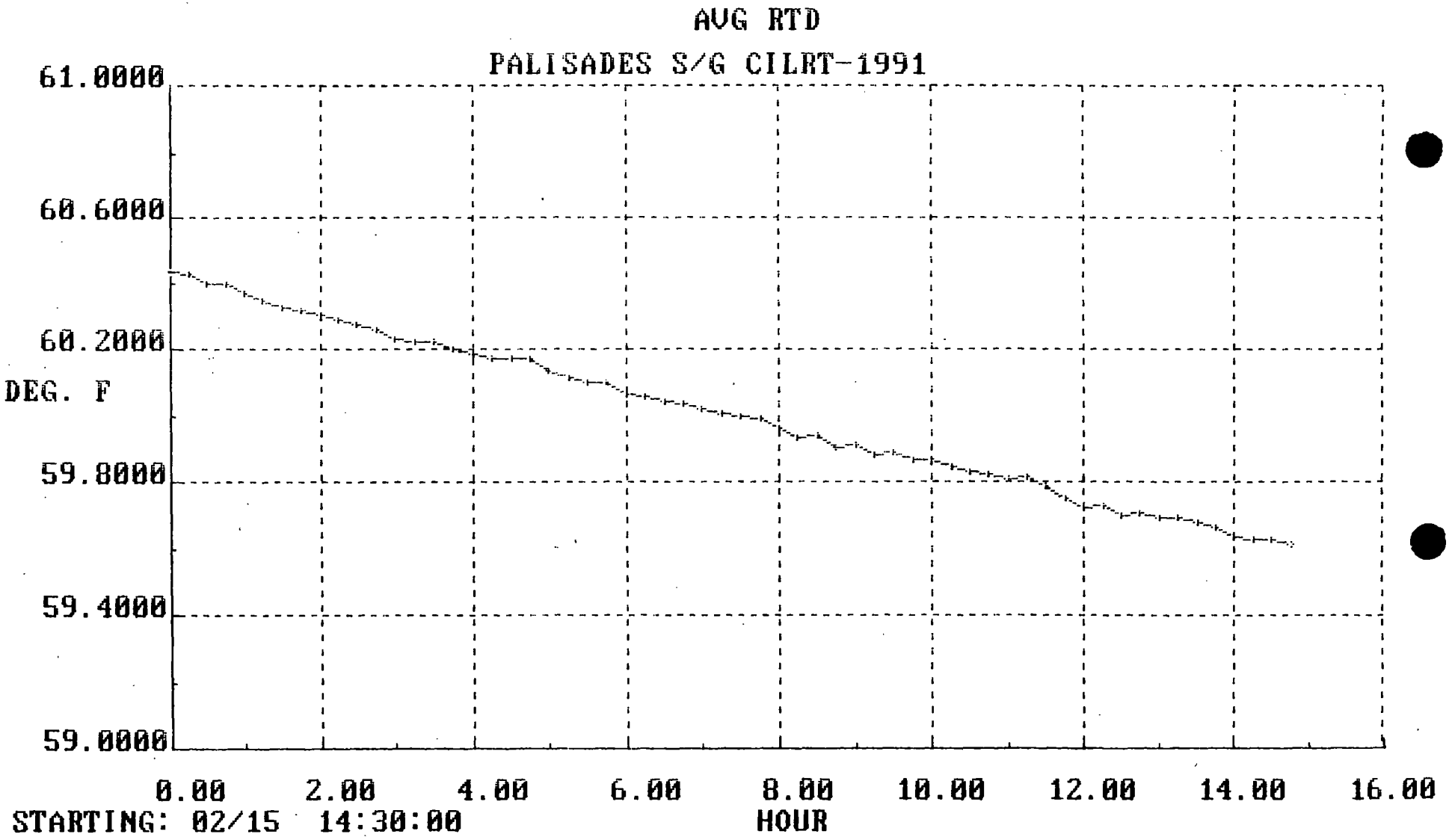
5.0 ATTACHMENTS

5.1 FIGURES

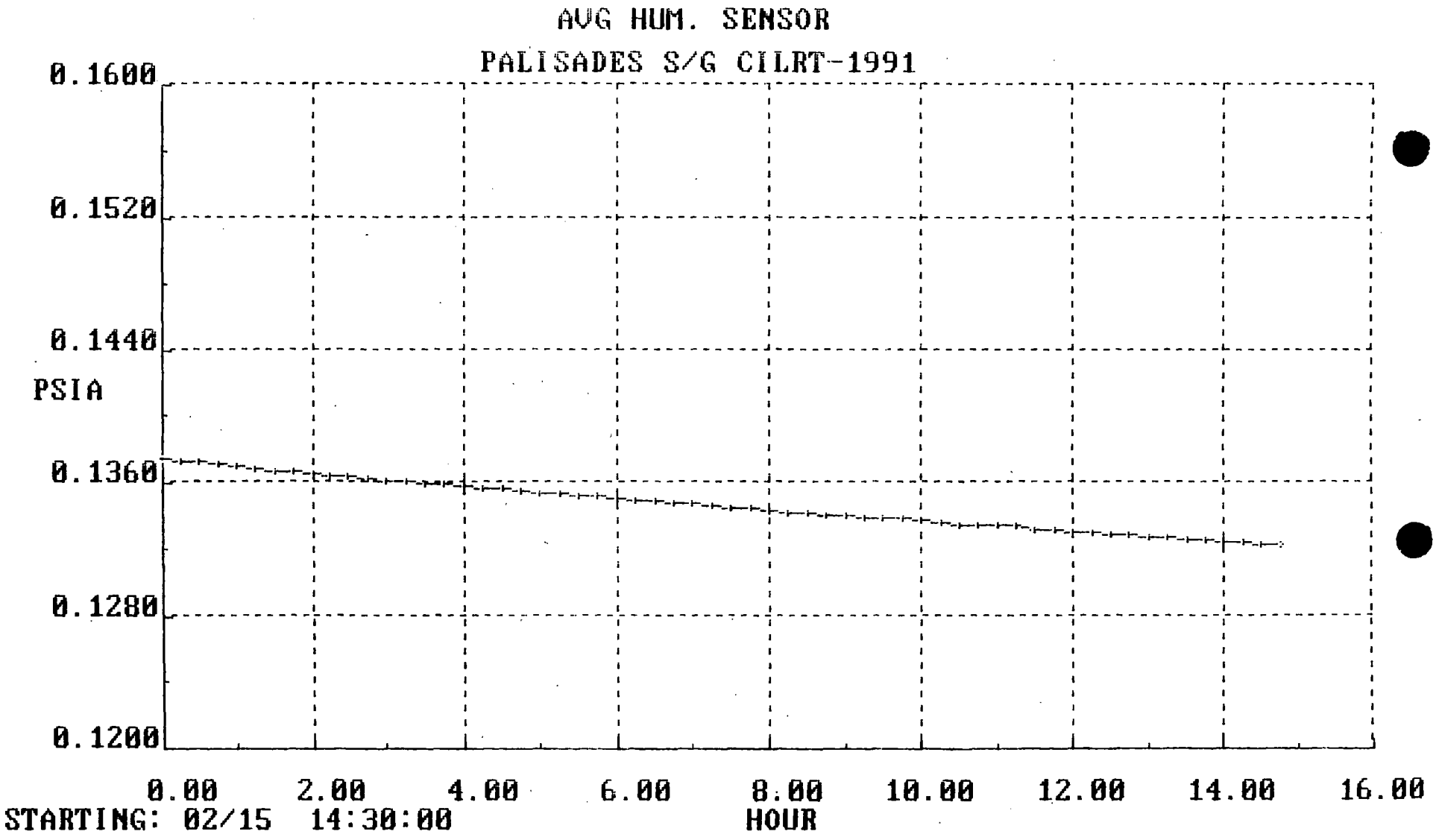
Figure 1 "AVG RTD"
Figure 2 "AVG HUM. SENSOR"
Figure 3 "AVG PRESSURE GAUGE "
Figure 4 "CONTAINMENT MASS"
Figure 5 "BN-TOP-1 DATA PLOT"
Figure 6 "MASS PLOT METHOD"
Figure 7 "CONTAINMENT MASS VERIFICATION"
Figure 8 "TOTAL TIME VERIFICATION"
Figure 9 "AVE PRESS GAUGE" (TIME LINE)
Figure 10 "AVE PRESS GAUGE" (TIME LINE)

5.2 TABLES

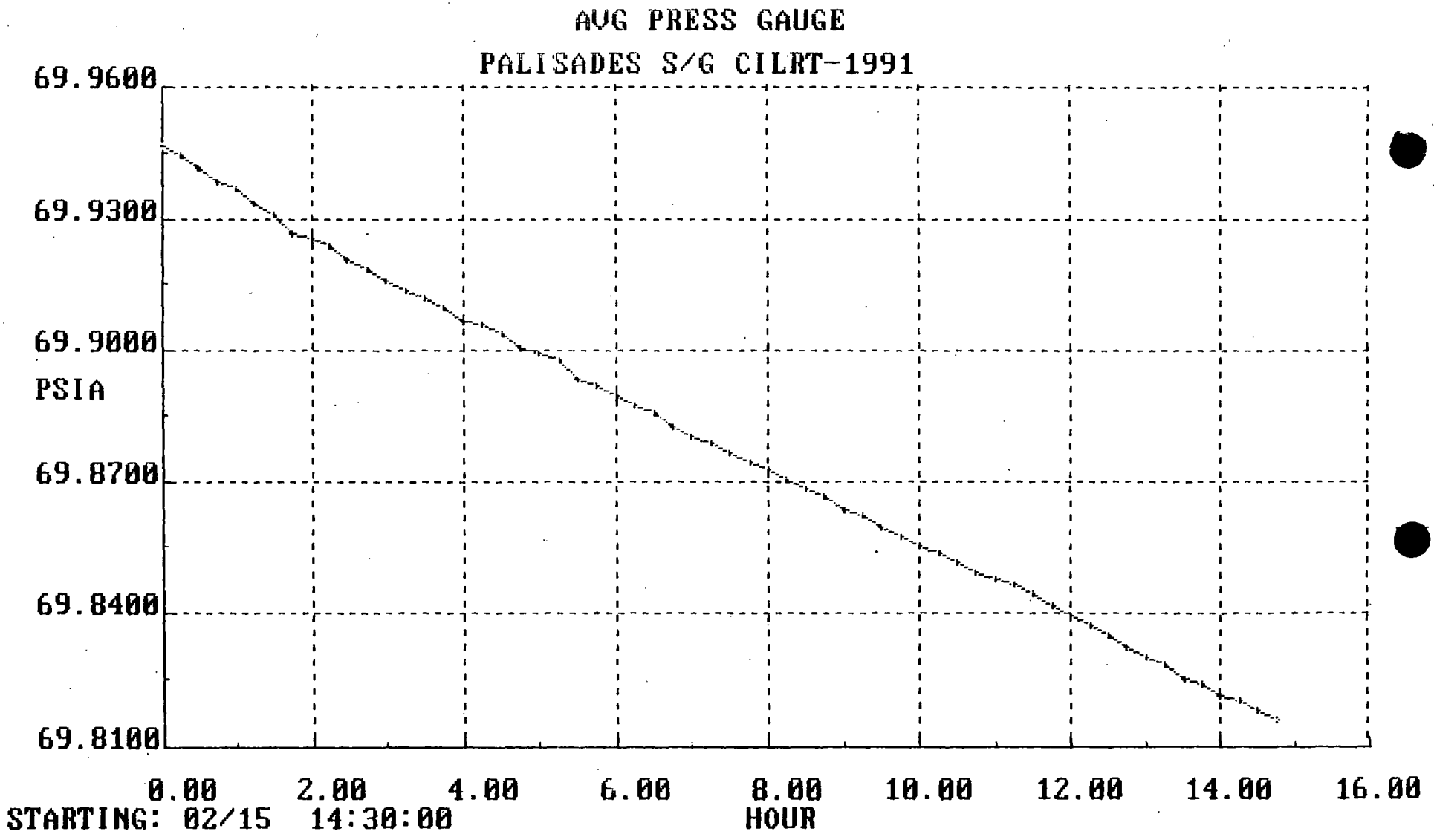
Table 1 "Historical Summation of Local Leak Rates Since 1988"
Table 2 "Summary of Palisades Containment Integrated Leak Rate Tests"


AVG RTD
PALISADES S/G CILRT-1991
61.0000
60.6000
60.2000
DEG. F
59.8000
59.4000
59.0000
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
STARTING: 02/15 14:30:00
HOUR

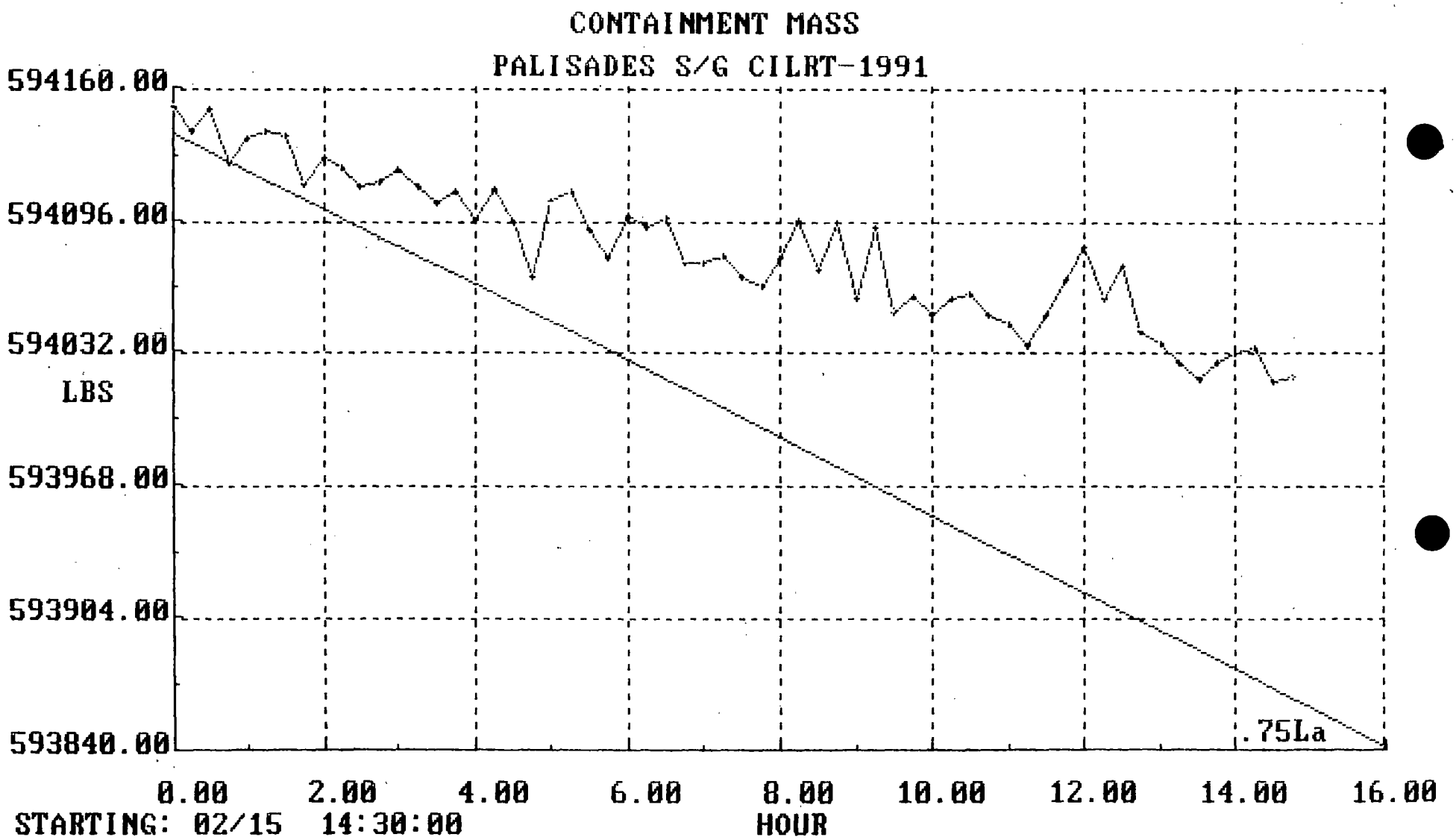
GRAPH 1


AVG HUM. SENSOR
PALISADES S/G CILRT-1991
0.1600
0.1520
0.1440
PSIA
0.1360
0.1280
0.1200
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
STARTING: 02/15 14:30:00
HOUR

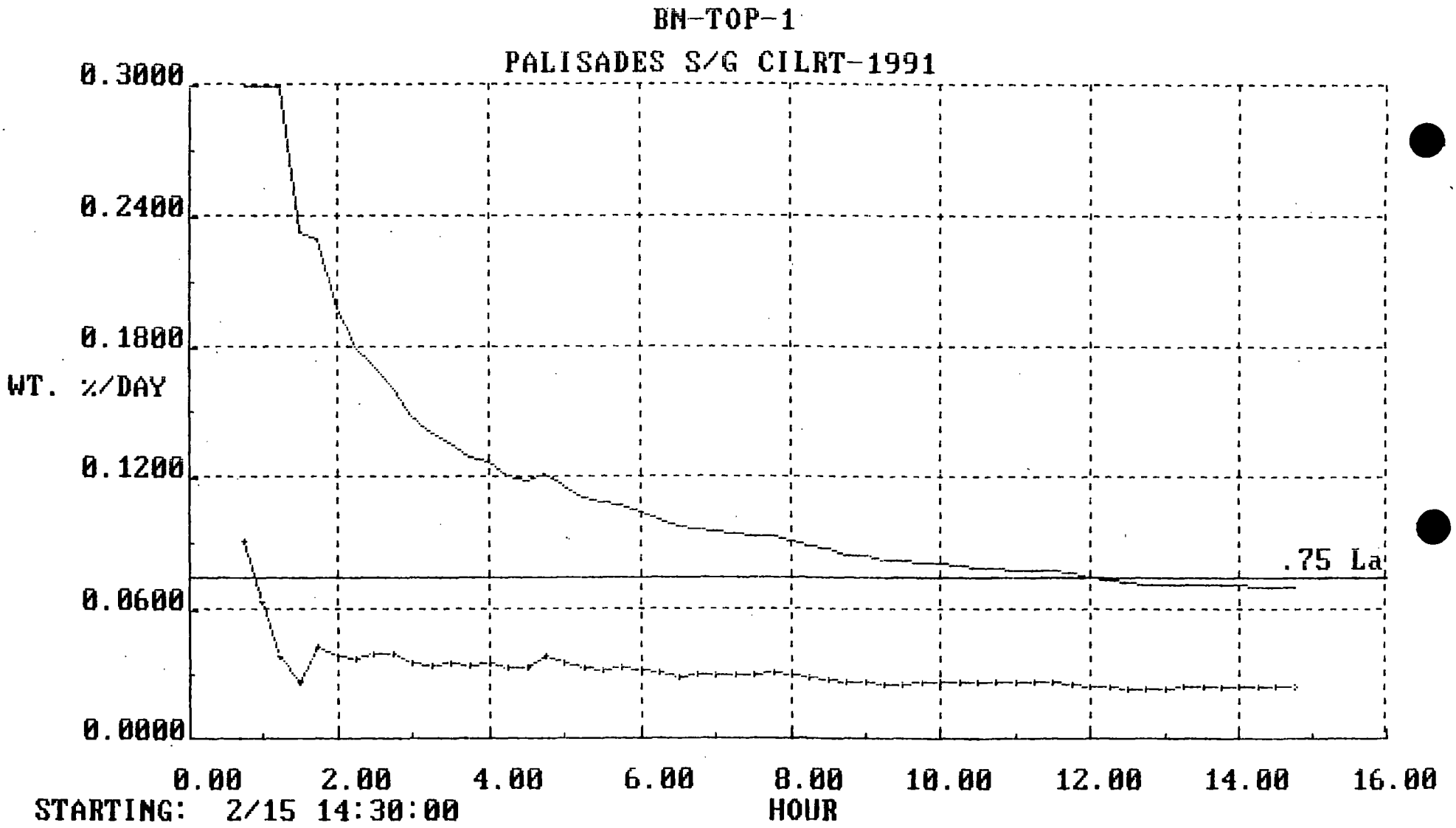
GRAPH 2


AVG PRESS GAUGE
PALISADES S/G CILRT-1991
69.9600
69.9300
69.9000
PSIA
69.8700
69.8400
69.8100
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
STARTING: 02/15 14:30:00
HOUR

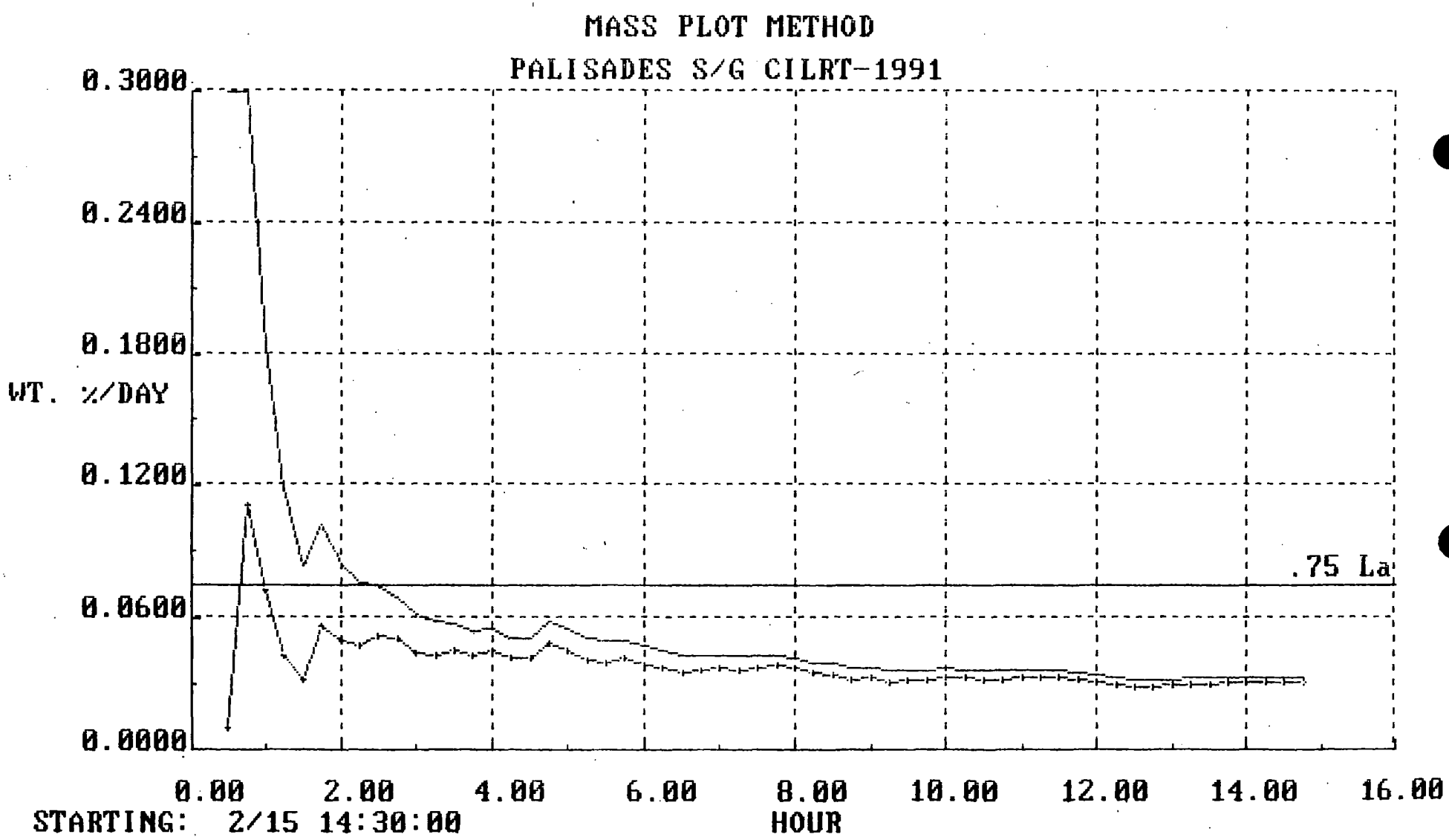
GRAPH 3


CONTAINMENT MASS
PALISADES S/G CILRT-1991
594160.00
594096.00
594032.00
LBS
593968.00
593904.00
593840.00
.75La
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
STARTING: 02/15 14:30:00
HOUR

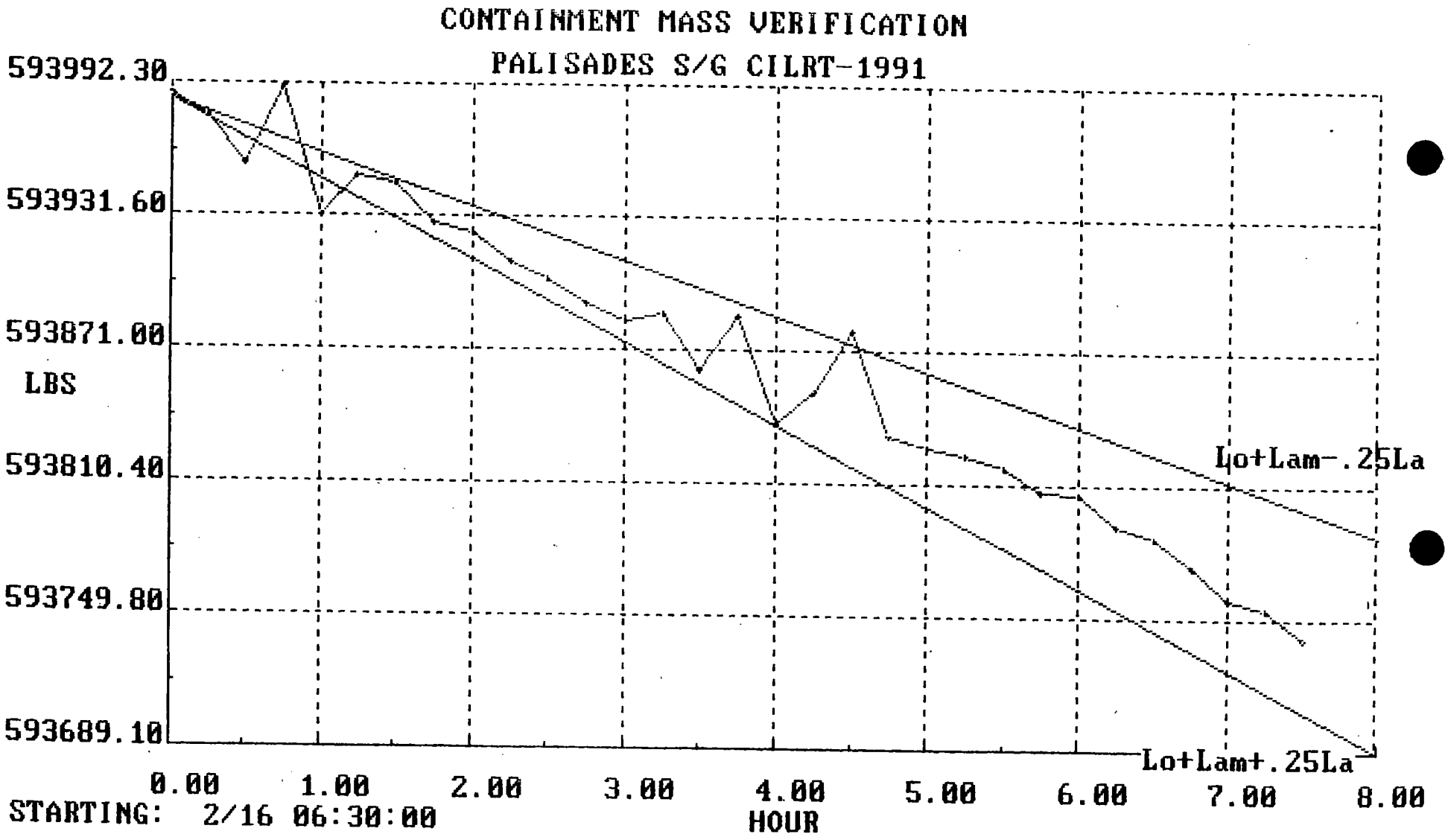
GRAPH 4


BN-TOP-1
PALISADES S/G CILRT-1991
0.3000
0.2400
0.1800
WT. %/DAY
0.1200
.75 La
0.0600
0.0000
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
STARTING: 2/15 14:30:00
HOUR

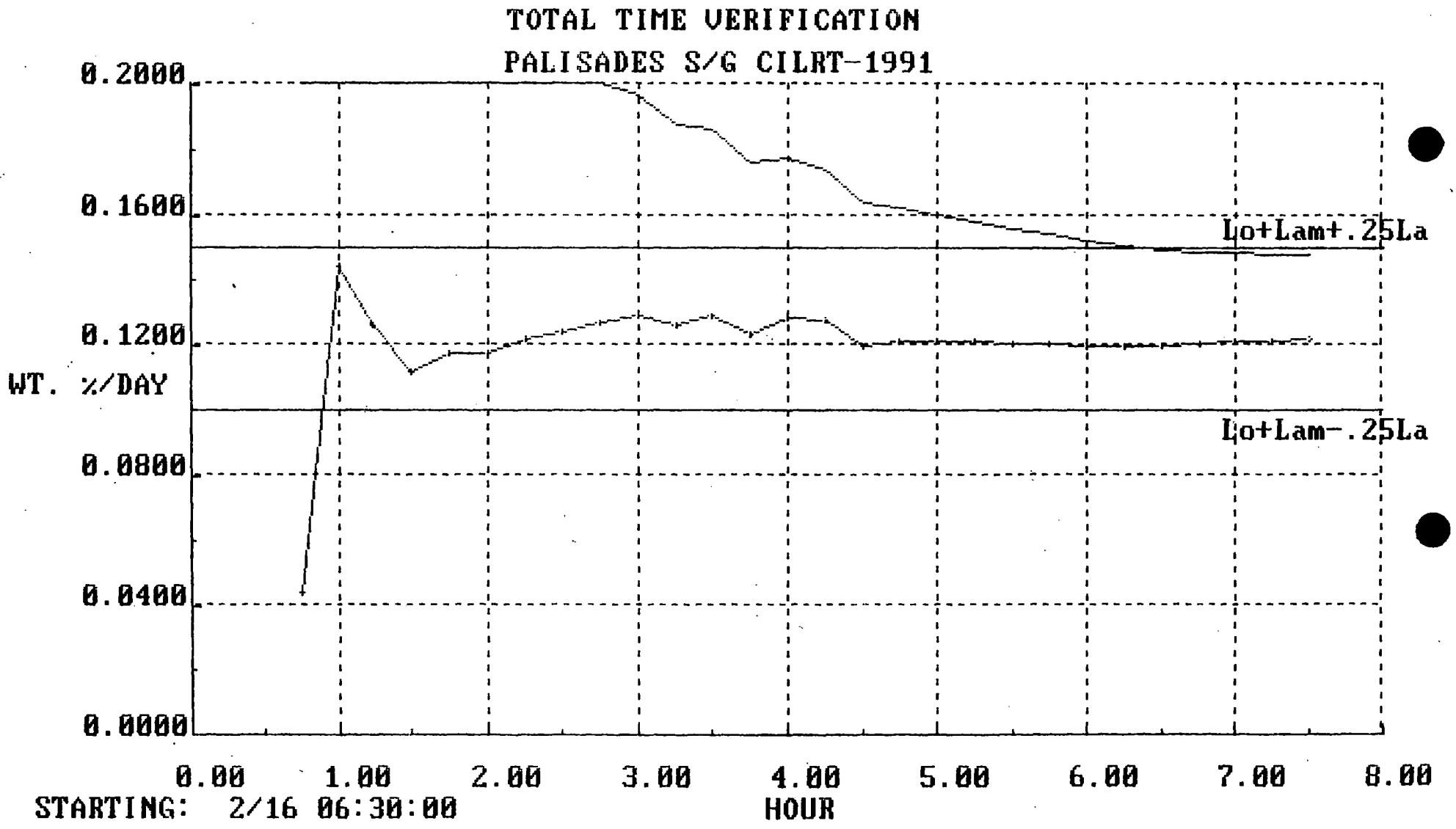
GRAPH 5


MASS PLOT METHOD
PALISADES S/G CILRT-1991
0.3000
0.2400
0.1800
WT. %/DAY
0.1200
.75 La
0.0600
0.0000
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
16.00
STARTING: 2/15 14:30:00
HOUR

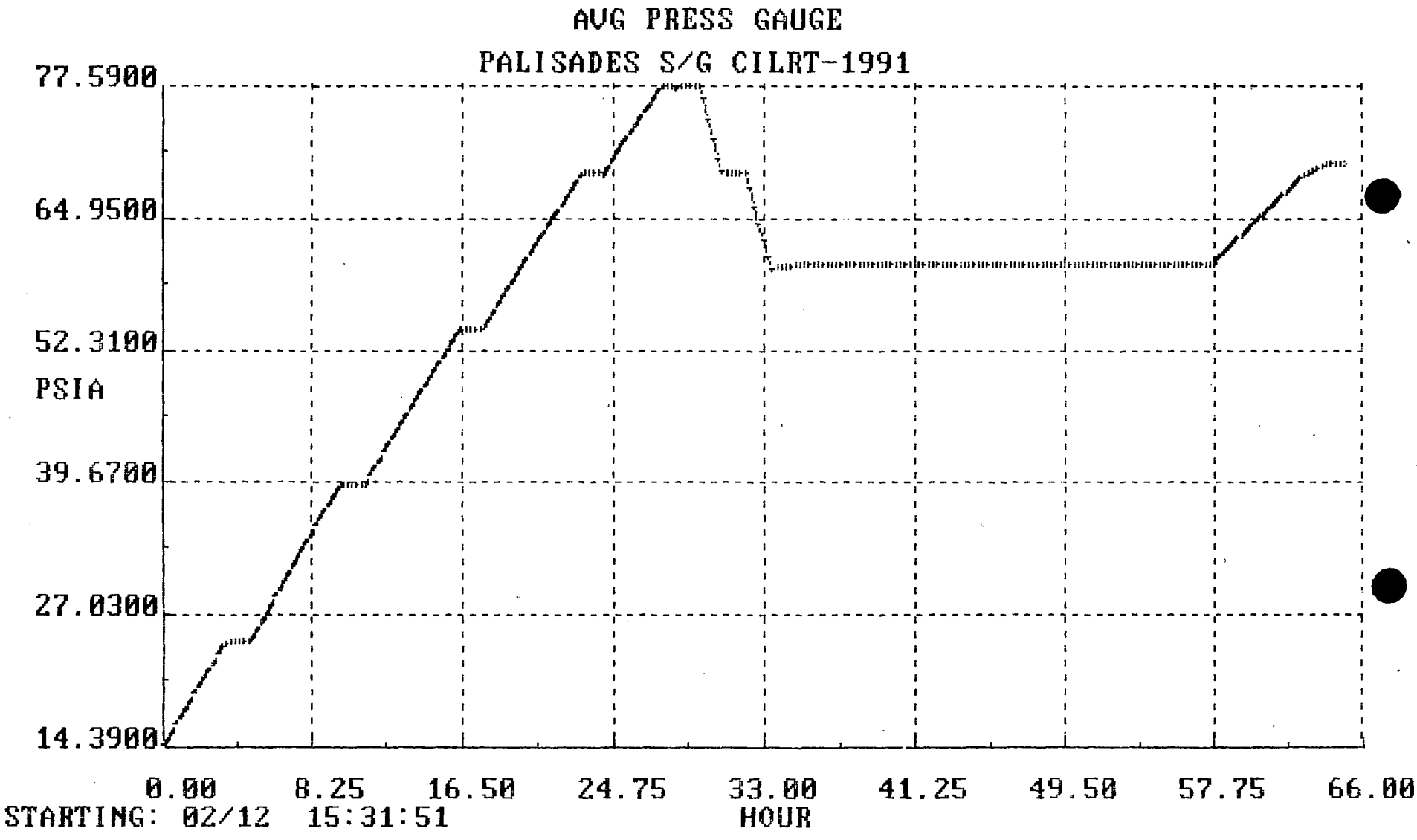
GRAPH 6


CONTAINMENT MASS VERIFICATION
PALISADES S/G CILRT-1991
593992.30
593931.60
593871.00
LBS
593810.40
593749.80
593689.10
Lo+Lam-.25La
Lo+Lam+.25La
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
STARTING: 2/16 06:30:00
HOUR

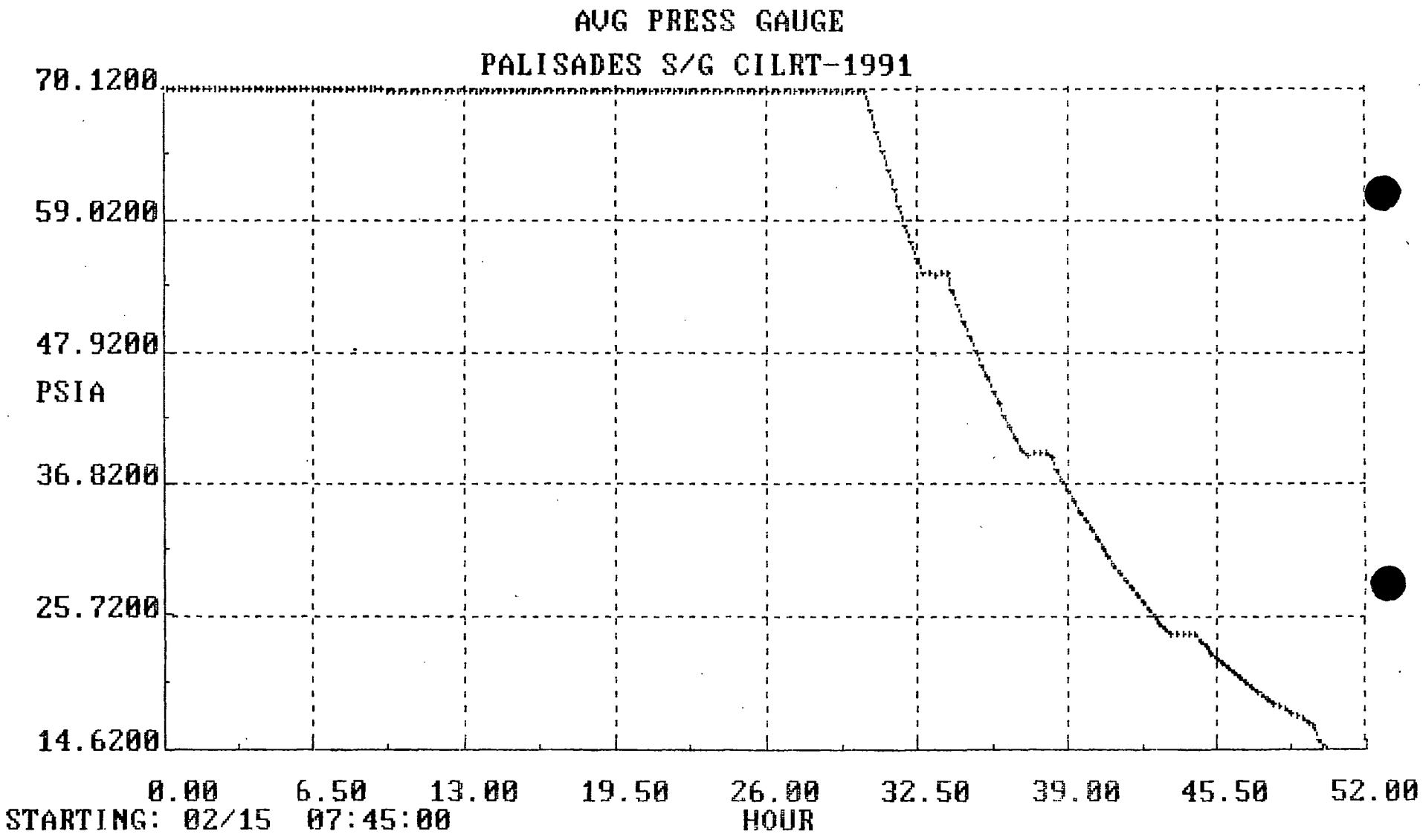
GRAPH 7


TOTAL TIME VERIFICATION
PALISADES S/G CILRT-1991
0.2000
0.1600
0.1200
0.0800
0.0400
0.0000
WT. %/DAY
Lo+Lam+.25La
Lo+Lam-.25La
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
STARTING: 2/16 06:30:00
HOUR

GRAPH 8


AVG PRESS GAUGE
PALISADES S/G CILRT-1991
77.5900
64.9500
52.3100
PSIA
39.6700
27.0300
14.3900
0.00
8.25
16.50
24.75
33.00
41.25
49.50
57.75
66.00
STARTING: 02/12 15:31:51
HOUR

GRAPH 9


AVG PRESS GAUGE
PALISADES S/G CILRT-1991
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59.0200
47.9200
PSIA
36.8200
25.7200
14.6200
0.00
6.50
13.00
19.50
26.00
32.50
39.00
45.50
52.00
STARTING: 02/15 07:45:00
HOUR

GRAPH 10

TABLE 1

HISTORICAL SUMMATION OF LOCAL LEAK RATES SINCE 1988

DATE	PENETRATIONS TESTED	AS FOUND LLRT Total cc/min.	AS LEFT LLRT Total cc/min.	SEQUENCE NUMBER
Dec 9,1988- Dec 12,1988	Pen. 51,67, B s/g N & B s/g S (RW89*003)	35587.1	21195.7	XVIIIa
Feb 4,1989- Feb 14,1989	Pen. 17,40,41,51,52 & 67 (RW89*003)	38750.9	20707	XVIIIb
Feb 22,1989- Mar 3,1989	Penetrations 36, 50,52 (RW89*012)	22760.7	22760.7	XVIIIc
Apr 11,1989- Apr 12,1989	Penetration 19, 50 (TCW89*003)	28548.2	28548.2	XVIIId
Apr 24,1989	Pen. 52 (TCW89*005)	28548.2	28548.2	XVIIIe
Jun 9,1989	Pen. 33 (TCW89*009)	28900	28900	XVIIIf
Jun 15,1989	Pen. 33(TCW89*011)	28625.4	28625.4	XVIIIg
Jul 20,1989- Aug 1,1989	Penetrations 17, 25 & 48 (TCW89*017)	29932.7	29932.7	XVIIIh
Sep 13,1989- Sep 15,1989	Pen. 19 & 50 (TCW89*021)	30582.4	30582.4	XVIIIi
Oct 3,1989- Nov 13,1989	Pen. 11,17,17a,21,21a, 33,40,46,47,48,51,52, 52a,52b,56,66,67,69 (TCW89*029)	30121	29662.1	XVIIIj
Dec 17,1989	Pen. 51 (TCW89*031)	29654.1	29654.1	XVIIIk
Mar 6,1990- Mar 7,1990	Penetrations 19 & 50 (TCW90*013)	26414.4	26414.4	XVIIIl
Apr 22,1990- May 10,1990	Pen. 1a,1b,1c,19,25, 26,28,37,38,39,40a, 40b,42,44,49,50,51, 52.52a,64,69,72, N Elec. (TCW90*016)	>.6 La	23968.1	XVIIIm
Aug 21,1990	Pen. 19 (TCW90*020)	23968.1	23968.1	XVIIIn
Sep 15,1990- Mar 2,1991	Penetration--All (TCW91*001)	>.6 La	16272.8	XVIIIo

TABLE 2

SUMMARY OF PALISADES CONTAINMENT INTEGRATED LEAK RATE TESTS

Date	(P_t) Nominal Test Pressure (psig)	(L_{tm}) Measured Leak Rate at Pt (wt %/day)	(L_{am}) Measured Leak Rate Adjusted to P_a (wt %/day)	(0.75 L_a) Plant Tech Spec Limit @ L_{am} (wt %/day)	Comments
05/70	55	NA	0.0048	0.075	Pre-operational
05/70	28	0.0233	0.0327	0.075	Pre-operational
04/74	28	0.0342/0.0436*	0.0479/0.0611*	0.075	"As Left" Leak Rate
03/78	28	-0.0071/0.0020*	0.0027*	0.075	"As Left" Leak Rate
		0.0924	0.1295/0.1422*	0.075	"As Found" Leak Rate
11/81	28	0.0328/0.0349*	0.0507*	0.075	L_{am} is "As Left" L_{tm} is w/o penalties
			0.1175	0.075	"As Found" Leak Rate
01/86	28	0.0157/0.0187*	0.0290*	0.075	L_{am} is "As Left" L_{tm} is w/o penalties
			0.1061*	0.075	"As Found" Leak Rate
11/88	28	0.01651/0.01758*	0.02617*	0.075	L_{am} is "As Left" L_{tm} is w/o penalties
			0.0408*	0.075	"As Found" Leak Rate
02/91**	55	NA	0.02473/0.07008*	0.075	L_{am} is "As Left" L_{am} is w/o penalties
			0.073017*	0.075	"As Found" Leak Rate

*Indicated data is the calculated 95% upper confidence limit (UCL).

**02/91 CILRT was in conjunction with structual integrity test (SIT).