REACTOR CONTAINMENT BUILDING

INTEGRATED LEAK RATE TEST

LASALLE COUNTY NUCLEAR POWER STATION

COMMONWEALTH EDISON COMPANY

DOCKET NUMBER 50-374

UNIT TWO

MARCH 27, 1992

ZCADTS/388

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TABLES AND FIGURES INDEX

INTRODUCTION

This report presen[illegible] [illegible]ils of the Primary Containment Integrated Leak Rate Test (PCILRT) suc[illegible]ly performed on March 27, 1992 at LaSalle County Nuclear Power Sta[illegible] Unit Two. The test was performed in accordance with 10CFR50, Appendix J and the LaSalle County Unit Two Technical Specifications. LaSalle County Station is a BWR 5, Mark II containment, located in Marseilles, Illinois. LaSalle Unit Two received its operating license in June, 1984.

A short duration test (7.0 hours) was conducted using the general test method outlined in BN-TOP-1, Revision 1 (Bechtel Corporation Topical Report) dated November 1, 1972.

The total primary containment integrated leakage rate was found to be 0.2771 wt%/day at a test pressure of 41.1 psig, which is within the 0.476 wt%/day acceptance criterion. This value is the sum of the calculated leakage rate of 0.2534 wt%/day plus the leakage rate of all non-vented penetrations which is 0.0237 wt%/day. The total 95% upper confidence limit leakage rate was found to be 0.3523 wt%/day. This value is the sum of the measured 95% upper confidence limit of 0.3286 wt%/day plus the leakage rate of all non-vented penetrations which is 0.0237 wt%/day.

The total "as-found" containment leakage rate was found to be 0.6155 wt%/day which exceeds the 0.476 wt%/day (0.75 La) acceptance criteria. This value is the sum of the "as-left" leak rate (0.3286 wt%/day), the non-vented penetrations (0.0237 wt%/day), and the back correction leak rate (0.2632 wt%/day) which takes into account the improvements made to type B and C pathways during the outage. The maximum allowable Leak Rate of 0.635 wt%/day (1.0 La) was not exceeded.

The Induced phase leakage test result was found to be 0.8285 wt%/day. This value should compare with the sum of the measured leak rate phase of 0.2534 wt%/day and the induced leakage rate of 0.6633 wt%/day (397.4 SCFH), the sum of which being within the ± 0.159 wt%/day (0.25 La) tolerance band. The actual test data results show a difference of 0.0882 wt%/day which is within the acceptance criterion.

The next integrated primary containment leak rate test is to be performed during the fifth Unit 2 Refuel Outage which is currently scheduled to begin September 4, 1993 based on two consecutive "as-found" ILRT failures per 10CFR50, Appendix J, III.A.6.b.

SECTION A - TEST PREPARATIONS

A.1 Type A Test Procedure

The PCILRT was performed in accordance with Procedure LTS-300-4, Revision 16, dated February 15, 1992. This procedure was written to comply with 10CFR50 Appendix J, ANSI N45.4-1972, and LaSalle County Unit Two Technical Specifications, and to reflect the Nuclear Regulatory Commission's, approval of a short duration test using the BN-TOP-1, Rev. 1 Topical Report as a test method.

A.2 Type A Test Instrumentation

Table One shows the specifications for the instrumentation used in the PCILRT. Table Two lists the physical locations of the temperature and humidity sensors within the primary containment.

a. Temperature

Sensors were suspended to prevent direct thermal influences from any metal surfaces. Sensors were also kept away from any direct air flows.

Each thermister was calibrated to yield an output of -99 mV to +99 mV over the range of 50°F to 140°F. Calibrations were done by Commonwealth Edison company, Operational Analysis Dept.

b. Pressure

Two precision PPM-1000 HR pressure transmitters were utilized. Each transmitter had a local digital readout in addition to a Binary Coded Decimal output to the process computer. Primary containment pressure was sensed by the pressure transmitters in parallel through a 3/8" tube connected to a primary Containment pressure sensing instrument line.

Each precision pressure transmitter was calibrated over the range 0 psia to 100 psia in approximately 5 psia increments using a Volumetrics Inc. VMC 836 calibration standard.

c. Vapor Pressure

Ten Lithium Chloride Dewpoint Temperature Units were installed throughout the Drywell and Suppression Pool. The dewpoint cells were placed in locations where the chance of the dewcell becoming damaged was slight.

A calibration was done on each dewcell network over the range of dewpoint temperatures of 34°C to 100°C. Calibrations were performed by Commonwealth Edison Company, Operational Analysis Dept.

d. Flow

A rotameter flowmeter, Fischer-Porter, calibrated to within ±1.0% by Fischer-Porter, was used for flow measurement. One half inch polyflow tubing connected the rotameter to a test connection on one of the primary containment penetration lines.

A.3 Type A Test Measurement

The PCILRT was performed utilizing an interface with the Volumetrics Data Acquisition System (DAS) and Prime Computer. Information from the thermisters and dewcells is sent to a Dual Multiplexer Scanner in the Drywell. The Scanner takes the data and sends it through an electrical penetration (E-20) to a System Console. The System Console takes the raw data and converts it into data readable to a computer and the test engineer. This information is then sent to the Prime Computer where all needed calculations are performed and a hard copy of the information is produced.

A.4 Type A Test Pressurization

Two 1500 CFM, diesel driven air compressors were used to supply clean, oil free air for containment pressurization.

The compressors were physically located outside the reactor building. The compressed air was piped into the reactor building through an existing PCILRT Pressurizing Line. For ease of handling, a flexible 4 inch pipe was used outside of the reactor building.

The drywell was pressurized through the "A" containment spray header 16 inch flange with an inboard valve 2E12-F017A, open during the pressurization process.

TABLE 1
(Sheet 1 of 2)

INSTRUMENT SPECIFICATIONS

INSTRUMENT	MANUFACTURER	SERIAL NO.	RANGE	ACCURACY	REPEATABILITY
Pressure Transmitter	Volumetrics	10141-1	4-100psia	±0.005%F.S.	0.001%PSI
Pressure Transmitter	Volumetrics	10255-1	4-100psia	±0.005%F.S.	0.001%PSI
Thermister 1	Volumetrics	12576-17	50-140°F	±0.25°F	±0.01°F
Thermister 2	Volumetrics	12576-11	50-140°F	±0.25°F	±0.01°F
Thermister 3	Volumetrics	12576-7	50-140°F	±0.25°F	±0.01°F
Thermister 4	Volumetrics	1	50-140°F	±0.25°F	±0.01°F
Thermister 5	Volumetrics	12576-18	50-140°F	±0.25°F	±0.01°F
Thermister 6	Volumetrics	11778-14	50-140°F	±0.25°F	±0.01°F
Thermister 7	Volumetrics	12576-15	50-140°F	±0.25°F	±0.01°F
Thermister 8	Volumetrics	12576-16	50-140°F	±0.25°F	±0.01°F
Thermister 9	Volumetrics	12576-23	50-140°F	±0.25°F	±0.01°F
Thermister 10	Volumetrics	12576-8	50-140°F	±0.25°F	±0.01°F
Thermister 11	Volumetrics	12576-28	50-140°F	±0.25°F	±0.01°F
Thermister 12	Volumetrics	12576-9	50-140°F	±0.25°F	±0.01°F
Thermister 13	Volumetrics	12576-10	50-140°F	±0.25°F	±0.01°F
Thermister 14	Volumetrics	12576-24	50-140°F	±0.25°F	±0.01°F
Thermister 15	Volumetrics	10533-26	50-140°F	±0.25°F	±0.01°F
Thermister 16	Volumetrics	12576-29	50-140°F	±0.25°F	±0.01°F
Thermister 17	Volumetrics	12576-30	50-140°F	±0.25°F	±0.01°F
Thermister 18	Volumetrics	12576-27	50-140°F	±0.25°F	±0.01°F
Thermister 19	Volumetrics	4	50-140°F	±0.25°F	±0.01°F
Thermister 20	Volumetrics	14	50-140°F	±0.25°F	±0.01°F
Thermister 21	Volumetrics	2	50-140°F	±0.25°F	±0.01°F
Thermister 22	Volumetrics	3	50-140°F	±0.25°F	±0.01°F
Thermister 23	Volumetrics	12576-20	50-140°F	±0.25°F	±0.01°F
Thermister 24	Volumetrics	12576-6	50-140°F	±0.25°F	±0.01°F
Thermister 25	Volumetrics	12576-22	50-140°F	±0.25°F	±0.01°F

TABLE 1
(Sheet 2 of 2)

INSTRUMENT SPECIFICATIONS

INSTRUMENT	MANUFACTURER	SERIAL NO.	RANGE	ACCURACY	REPEATABILITY
Thermister 26	Volumetrics	12576-25	50-140°F	±0.25°F	±0.01°F
Thermister 27	Volumetrics	11340-11	50-140°F	±0.25°F	±0.01°F
Thermister 28	Volumetrics	12576-21	50-140°F	±0.25°F	±0.01°F
Thermister 29	Volumetrics	11340-4	50-140°F	±0.25°F	±0.01°F
Thermister 30	Volumetrics	T-27	50-140°F	±0.25°F	N/A
Dewcell 1	Volumetrics	1020292	34-100°C	±0.25°F	±0.01°F
Dewcell 2	Volumetrics	0920292	34-100°C	±0.25°F	±0.01°F
Dewcell 3	Volumetrics	1060292	34-100°C	±0.25°F	±0.01°F
Dewcell 4	Volumetrics	0940292	34-100°C	±0.25°F	±0.01°F
Dewcell 5	Volumetrics	0890292	34-100°C	±0.25°F	±0.01°F
Dewcell 6	Volumetrics	0970292	34-100°C	±0.25°F	±0.01°F
Dewcell 7	Volumetrics	0850292	34-100°C	±0.25°F	±0.01°F
Dewcell 8	Volumetrics	0880292	34-100°C	±0.25°F	±0.01°F
Dewcell 9	Volumetrics	0950292	34-100°C	±0.25°F	±0.01°F
Dewcell 10	Volumetrics	0200292	34-100°C	±0.25°F	±0.01°F
Flowmeter	Fischer-Porter	8511A0113A7	60-870SCFH	±1.0%Max. Flow	N/A
Flowmeter	Fischer-Porter	8511A0113A8	60-870SCFH	±1.0%Max. Flow	N/A

TABLE 2A
(Sheet 1 of 2)

PCILRT INSTRUMENT PHYSICAL LOCATIONS

RTD NO.	EPN	SUBVOLUME	INSTRUMENT ELEVATION	INSTRUMENT AZIMUTH
1	2TE-CT001	9	708'	19°
2	2TE-CT002	9	724'	95°
3	2TE-CT003	9	708'	195°
4	2TE-CT004	9	724'	275°
5	2TE-CT005	6	746'	0°
6	2TE-CT006	6	750'	90°
7	2TE-CT007	6	754'	180°
8	2TE-CT008	6	758'	270°
9	2TE-CT009	5	762'	0°
10	2TE-CT010	5	767'	90°
11	2TE-CT011	5	772'	180°
12	2TE-CT012	5	777'	270°
13	2TE-CT013	4	785'	0°
14	2TE-CT014	4	791'	90°
15	2TE-CT015	3	797'	90°
16	2TE-CT016	3	808'	270°
17	2TE-CT017	3	811'	0°
18	2TE-CT018	3	815'	180°
19	2TE-CT019	2	804'	115°
20	2TE-CT020	2	804'	295°
21	2TE-CT021	1	822'	0°
22	2TE-CT022	1	826'	180°
23	2TE-CT023	8	743'	0°
24	2TE-CT024	8	743'	180°
25	2TE-CT025	7	730'	90°
26	2TE-CT026	7	730'	270°
27	2TE-CT027	4	791'	270°
28	2TE-CT028	9	724'	75°
29	2TE-CT029	4	785'	180°
30	2TE-CT030	9	708'	75°

TABLE 2A
(Sheet 2 of 2)

PCILRT INSTRUMENT PHYSICAL LOCATIONS

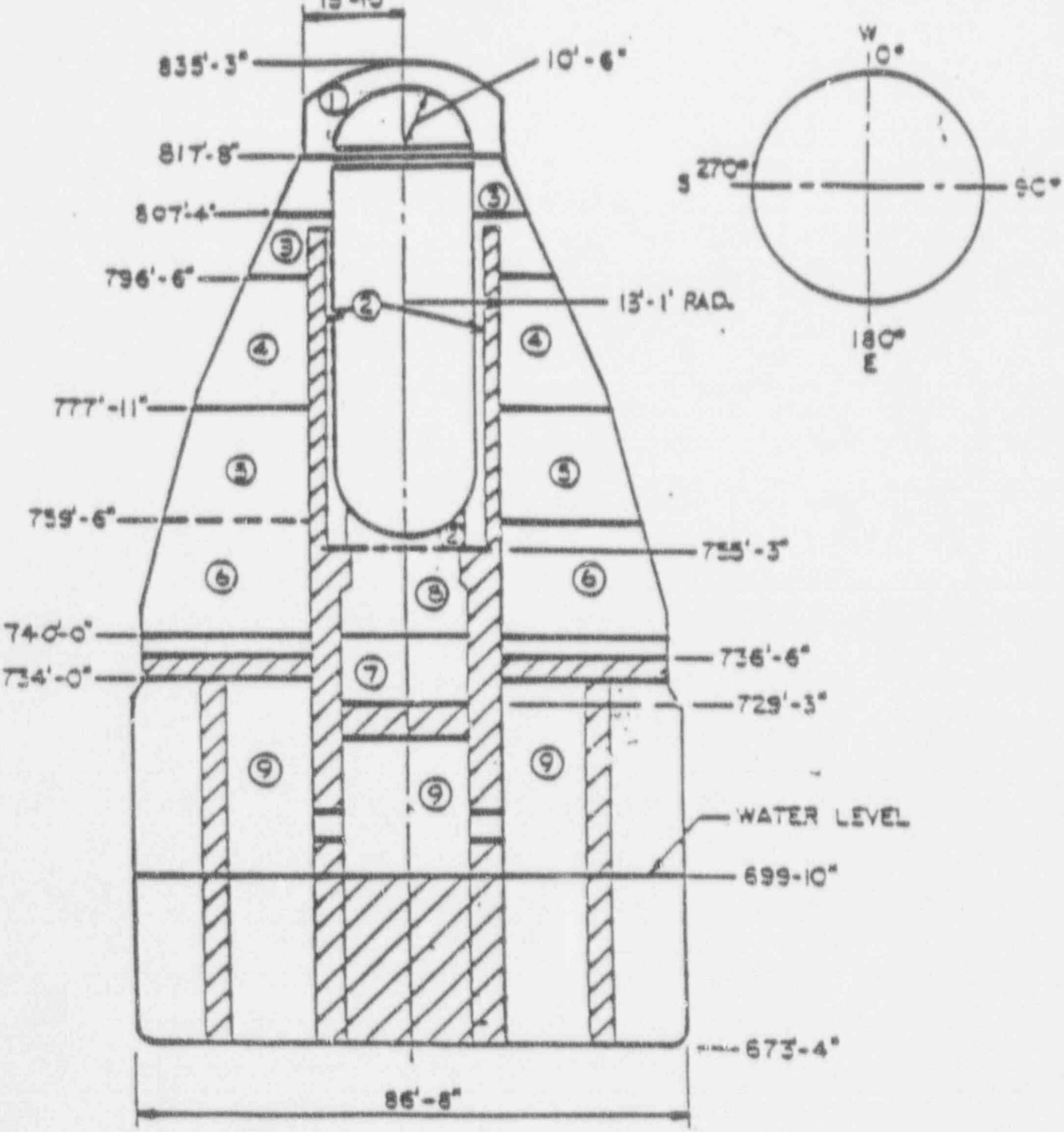
DEWCELL NO.	EPN	SUBVOLUME	INSTRUMENT ELEVATION	INSTRUMENT AZIMUTH
1	2ME-CT031	9	708'	195°
2	2ME-CT032	6	752'	0°
3	2ME-CT033	5	773'	180°
4	2ME-CT034	4	791'	0°
5	2ME-CT035	3	812'	180°
6	2ME-CT036	1	826'	0°
7	2ME-CT037	3	803'	180°
8	2ME-CT038	8	746'	270°
9	2ME-CT039	5	763'	0°
10	2ME-CT040	9	724'	75°

TABLE 2B

PCILRT SUBVOLUME SPECIFICATION

SUBVOLUME	LOCATION	VOLUME ft3	(wt. factor)
1	Drywell Head Area Above 818'-6"	7745	.01963
2	Annulus Between Rx Vessel and Shield	7126	.01806
3	Between Elev. 818'-6" and 796'-6"	18,357	.04652
4	Between Elev. 796'-6" and 777'-1"	36,786	.09321
5	Between Elev. 777'-11" and 759'-6"	55,595	.14088
6	Between Elev. 759'-6" and 734'-0"	95,910	.24303
7	Sump Area	3427	.00868
8	CRD Area	4592	.01164
9	Suppression Pool	165,100	.41836
	TOTAL	394,638	1.0000

FIGURE 1



ELEVATION VIEW OF CONTAINMENT AND SUBVOLUME LOCATIONS

SECTION B - TEST METHOD

B.1 Basic Technique

The absolute method of leak rate determination was used. The absolute method uses the ideal gas laws to calculate the measured leak rate, as defined in ANSI N45.4-1972. The inputs to the measured leak rate calculation include subvolume weighted containment temperature, subvolume weighted vapor pressure, and total absolute air pressure.

As required by the Nuclear Regulatory Commission, in order to perform a short duration test (measured leak rate phase of less than 24 hours), the measured leak rate was statistically analyzed using the principles outlined in BN-TOP-1, Rev. 1. A least squares regression line for the measured total time leak rate versus time since the start of the test is calculated after each new data set is scanned. The calculated leak rate at a point in time, t_i, is the leak rate on the regression line at the time t_i.

B.2 Supplemental Verification Test

The supplemental verification test superimposes a known leak of approximately the same magnitude as La (La = 385.7 SCFH or 0.6350 wt%/day as defined in the Technical Specifications). The degree of detectability of the combined leak rate (containment calculated leak rate plus the superimposed, induced leak rate) provides a basis for resolving any uncertainty associated with the measured leak rate phase of the test. The allowed error band is ± 0.25 La (0.159) wt%/day.

There are no references to the use of upper confidence limits to evaluate the acceptability of the induced leakage phase of the PCILRT in the ANS/ANSI standards or in BN-TOP-1, Rev. 1.

B.3 Instrumentation Error Analysis

An instrumentation error analysis was performed prior to the test in accordance with BN-TOP-1, Rev 1 Section 4.5. The instrument system error was calculated in two parts. The first part was to determine system accuracy uncertainty. The second and more important calculation (since the leak rate is impacted most by changes in the containment parameters) was performed to determine the system repeatability uncertainty. The maximum system error analysis performed prior to a 6 hour test yielded a total instrument uncertainty of ± 0.0112 wt%/day.

The instrumentation uncertainty is used only to illustrate the system's ability to measure the required parameters to calculate the primary containment leak rate.

It is extremely important during a short duration test to quickly identify a failed sensor and in real time back the spurious data out of the calculated volume weighted containment temperature and vapor pressure. Failure to do so can cause the upper confidence limit value to place a short duration test in jeopardy. It has been station experience that sensor failures should be removed from all data collected, not just subsequent to the apparent failure, in order to minimize the discontinuity in computer values that are related to the sensor failure (not any real change in containment conditions).

SECTION C - SEQUENCE OF EVENTS

C.1 Test Preparation Chronology

The pretest preparation phase and containment inspection were completed on March 26, 1992 with no visible structural deterioration being found. Major preliminary steps included:

1. Completion of all Type B and C tests, component repairs, and retests.

2. Completion of PCILRT pretest valve checklist including draining and/or venting systems as described in the UFSAR.

3. Blocking of four drywell to suppression chamber vacuum breakers in the open position for pressure equalization between the drywell and suppression chamber volumes.

4. Venting of the reactor vessel to the primary containment via the manual head vent line and the drywell equipment drain sump.

5. Completion of pretest data gathering system, including computer program, instrument console, and associated wiring.

6. An experimental test sensor installed in the suppression pool volume (Channel 39) malfunctioned and was locked out of the Data Acquisition System prior to containment pressurization.

DATE	TIME	EVENT
C.2 Test Pressurization Chronology		
03/27/92	0348	Primary Containment Pressurization Initiated. Atmospheric pressure is 14.31 psia.
03/27/92	0405	Groups 7 and 9 Isolations and Reactor Scram received.
03/27/92	0738	Found Personnel Airlock Inner Door Equalizing Valve leaking during containment walkdown at approximately 38 psia. Closed Personnel Airlock Outer Door and equalized pressure in the airlock. Attempted to open the inner door but would not open, appears to be mechanical problem. Equalizing Valve left full open to maintain equal pressure between containment and airlock. No leakage observed at outer airlock door.

03/27/92	0925	Primary Containment walkdown completed. No noticeable leaks observed.
03/27/92	1010	Closed the 2E12-F017A valve which terminated pressurization. Drywell pressure at 55.83 psia (41.45 psig). Pressurization line is vented per union connection at 0SA039.

C.3 Temperature Stabilization Chronology

DATE	TIME	EVENT
03/27/92	1300	Channel 49, Subvolume 9 Suppression Chamber Dewcell locked out due to erratic readings. The sensor shield was lost prior to the start of pressurization. Without the shield, the sensor is sporadic.
03/27/92	1550	Declared the Primary Containment is stable per Mass-plot and BN-TOP-1 criterion.

C.4 Measured Leak Rate Phase

03/27/92	1550	Declare start of ILRT Measured leak rate phase at Data Set #1 [15:38:07]. Base Data Set #111.
03/27/92	1848	ILRT in progress and test results are satisfactory at this point.
03/27/92	2238	The Measured leak rate phase is completed satisfactorily at Data Set #43 (Base Data Set #153), with a duration of 7.0 hours. RESULTS: Calculated Leakrate: 0.2534 wt%/day and 95% Upper Confidence Limit: 0.3286 wt%/day. Total 95% Upper Confidence Limit including non-vented penetrations: 0.3523 wt%/day.

C.5 Induced Leakage Rate Phase

03/27/92	2330	Imposed Induced leak rate of 400 SCFH. Started 1 hour stabilization time at a Base Data Set #158. [23:28:07].
03/28/92	0030	Started induced leak rate test at a Base Data Set #164. [00:28:07].

03/28/92	0430	The Induced leak rate phase is completed satisfactorily at a Base Data Set #188, with a duration of 4.0 hours. RESULTS: Induced Leakage: 0.6633 wt%/day and Induced Calculated Leak Rate: 0.8285 wt%/day.

C.6 Depressurization Phase

DATE	TIME	EVENT
03/28/92	0430	Isolated induced rig.
03/28/92	0500	Depressurized Personnel Airlock and opened outer airlock door.
03/28/92	0545	Commenced depressurization.
03/28/92	1310	Suspended containment depressurization at 16.7896 psia in preparation for Drywell Floor Bypass Test.
03/28/92	1545	Secured all vacuum breakers to closed position.
03/28/92	1630	Commenced depressurization of Suppression Chamber.
03/28/92	2000	Suppression Chamber depressurized to atmosphere.
03/28/92	2010	Commenced depressurizing drywell to obtain 1.7 psid for Floor Bypass Test.
03/28/92	2210	Drywell depressurized to approximately 1.7 psig.
03/28/92	2220	Start Drywell Floor Bypass Test stabilization period.
03/28/92	2250	Bypass Test stabilization period complete. Start Drywell Floor Bypass Test.
03/28/92	2350	Drywell Floor Bypass Test completed satisfactorily.
03/28/92	2359	Commenced depressurization of Drywell.
03/29/92	0027	Drywell depressurized to atmosphere and commenced Drywell inspection.

SECTION D - TYPE A TEST DATA

D.1 Measured Leak Rate Phase Data

A summary of the computed data using the BN-TOP-1, Rev. 1 test method for a short duration test can be found in Table 3. Graphic results of the test are found in Figures 2-8.

D.2 Induced Leakage Phase Data

A summary of the computed data for the Induced Leakage Phase of the PCILRT is found in Table 4. Graphic results of the test are found in Figures 9-15.

MEASURED LEAKRATE

PHASE

DATA SETS 111-153

SOFTWARE PRODUCT ID NUMBER: GN01405-0.0

TABLE 3

**************************SUMMARY TABLE OF LEAKRATES**************************

LASALLE UNIT 2 08:15:55 MON, 15 JUN 1992

DATA SET 111 THROUGH 153

VERIFICATION TEST RESULTS CALCULATED USING THE BN-TOP-1 METHOD

DATA SET #	DATA SET TIME DAY HH MM SS	TEST TIME, (HR)	DRY AIR MASS, (LBM)	TOTAL TIME LEAKRATES , (%/D)	LSF OF LEAKRATES , (%/D)	BN-TOP UCL , (%/D)
111	087 15:38:07	0.000	0.10558222E+06			
112	087 15:48:07	0.167	0.10558014E+06	0.2837		
113	087 15:58:07	0.333	0.10557470E+06	0.5130		
114	087 16:08:07	0.500	0.10557114E+06	0.5036	0.5434	1.4888
115	087 16:18:07	0.667	0.10557227E+06	0.3395	0.4336	1.1354
116	087 16:28:07	0.833	0.10556767E+06	0.3970	0.4179	0.8664
117	087 16:38:07	1.000	0.10556397E+06	0.4148	0.4188	0.7566
118	087 16:48:07	1.167	0.10556553E+06	0.3252	0.3776	0.6710
119	087 16:58:07	1.333	0.10556208E+06	0.3434	0.3596	0.6126
120	087 17:08:07	1.500	0.10555764E+06	0.3725	0.3591	0.5834
121	087 17:18:07	1.667	0.10555642E+06	0.3519	0.3518	0.5543
122	087 17:28:07	1.833	0.10555617E+06	0.3230	0.3377	0.5238
123	087 17:38:07	2.000	0.10555151E+06	0.3490	0.3352	0.5082
124	087 17:48:07	2.167	0.10554878E+06	0.3508	0.3341	0.4964
125	087 17:58:07	2.333	0.10554728E+06	0.3404	0.3307	0.4837
126	087 18:08:07	2.500	0.10554284E+06	0.3580	0.3325	0.4787
127	087 18:18:07	2.667	0.10554266E+06	0.3373	0.3293	0.4686
128	087 18:28:07	2.833	0.10554026E+06	0.3366	0.3268	0.4600
129	087 18:38:07	3.000	0.10553641E+06	0.3471	0.3269	0.4553
130	087 18:48:07	3.167	0.10553536E+06	0.3364	0.3251	0.4487
131	087 18:58:07	3.333	0.10553506E+06	0.3216	0.3209	0.4401
132	087 19:08:07	3.500	0.10553112E+06	0.3318	0.3192	0.4346
133	087 19:18:07	3.667	0.10553319E+06	0.3040	0.3132	0.4251
134	087 19:28:07	3.833	0.10553006E+06	0.3093	0.3090	0.4175
135	087 19:38:07	4.000	0.10552812E+06	0.3074	0.3051	0.4106
136	087 19:48:07	4.167	0.10552616E+06	0.3059	0.3016	0.4042
137	087 19:58:07	4.333	0.10552448E+06	0.3029	0.2982	0.3982
138	087 20:08:07	4.500	0.10552378E+06	0.2952	0.2942	0.3918
139	087 20:18:07	4.667	0.10551976E+06	0.3042	0.2920	0.3874
140	087 20:28:07	4.833	0.10552000E+06	0.2926	0.2885	0.3819
141	087 20:38:07	5.000	0.10551859E+06	0.2893	0.2851	0.3765
142	087 20:48:07	5.167	0.10551739E+06	0.2852	0.2816	0.3711
143	087 20:58:07	5.333	0.10551376E+06	0.2918	0.2794	0.3672
144	087 21:08:07	5.500	0.10551422E+06	0.2810	0.2761	0.3623
145	087 21:18:07	5.667	0.10551226E+06	0.2806	0.2732	0.3579
146	087 21:28:07	5.833	0.10551059E+06	0.2791	0.2705	0.3537
147	087 21:38:07	6.000	0.10550792E+06	0.2815	0.2683	0.3503
148	087 21:48:07	6.167	0.10550673E+06	0.2783	0.2660	0.3468
149	087 21:58:07	6.333	0.10550678E+06	0.2708	0.2632	0.3427
150	087 22:08:07	6.500	0.10550523E+06	0.2692	0.2606	0.3389
151	087 22:18:07	6.667	0.10550187E+06	0.2740	0.2586	0.3360
152	087 22:28:07	6.833	0.10550234E+06	0.2657	0.2561	0.3324
153	087 22:38:07	7.000	0.10550189E+06	0.2608	0.2534	0.3286

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SOFTWARE PRODUCT ID NUMBER: GN01405-0.0

DAS CHANNEL # 39 IS LOCKED OUT FROM DSN 1
DAS CHANNEL # 49 IS LOCKED OUT FROM DSN 1

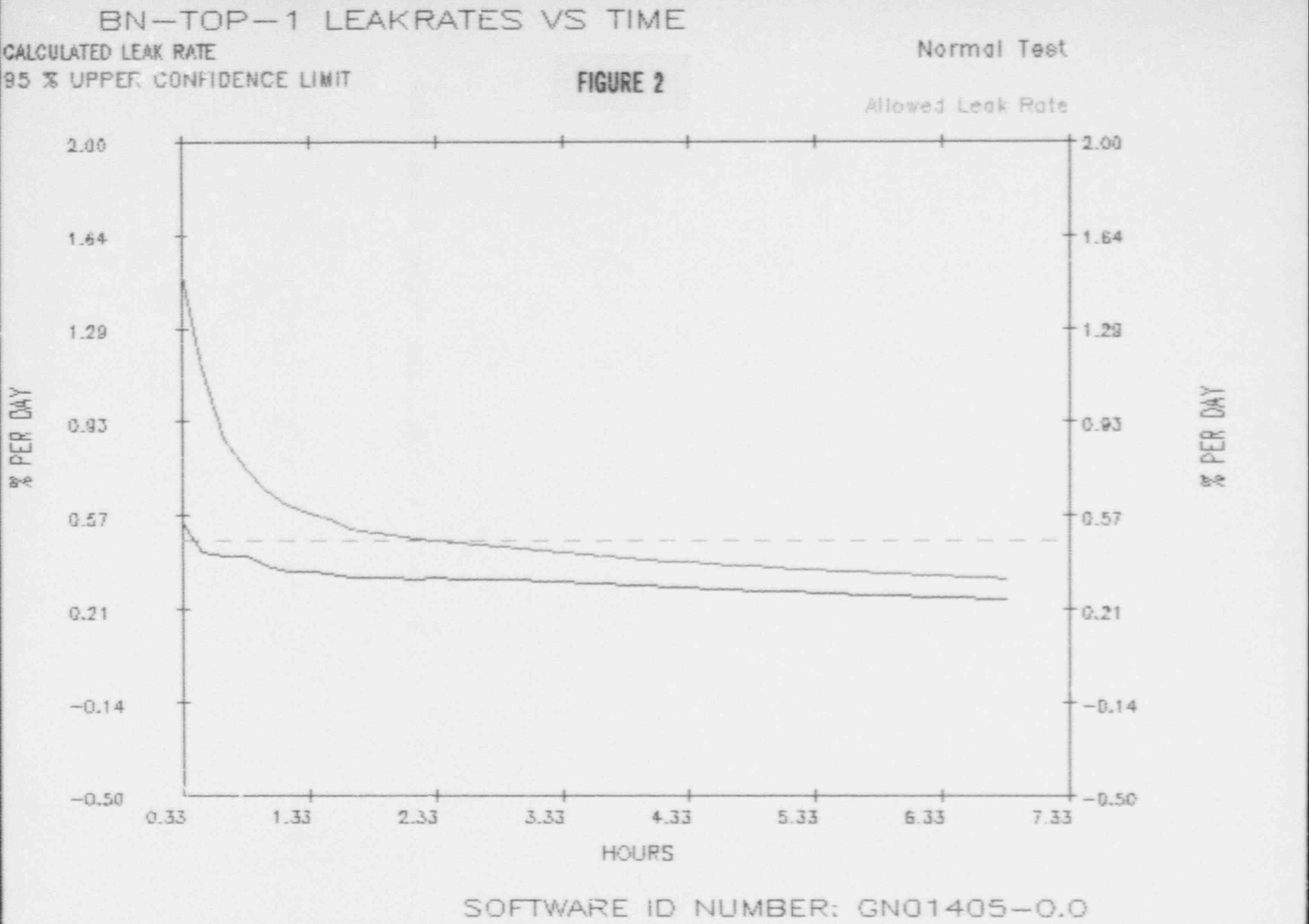
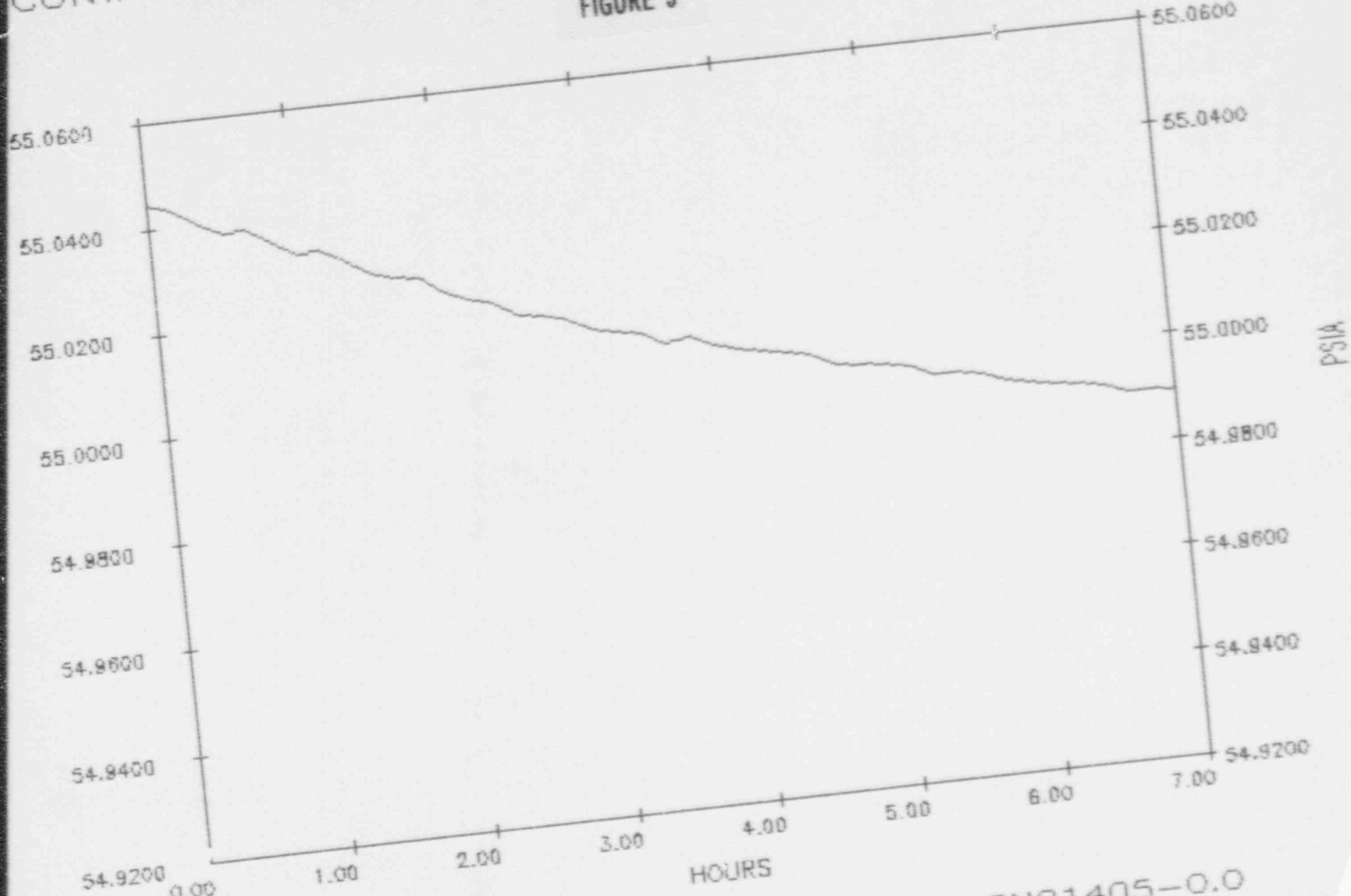

BN-TOP-1 LEAKRATES VS TIME
CALCULATED LEAK RATE
95 % UPPER CONFIDENCE LIMIT
Normal Test
Allowed Leak Rate
2.00
1.64
1.29
0.93
0.57
0.21
-0.14
-0.50
% PER DAY
0.33
1.33
2.33
3.33
4.33
5.33
6.33
7.33
HOURS
SOFTWARE ID NUMBER: GN01405-0.0

FIGURE 2

CONTAINMENT DRY AIR PRESSURE VS TIME

Normal Test

FIGURE 3

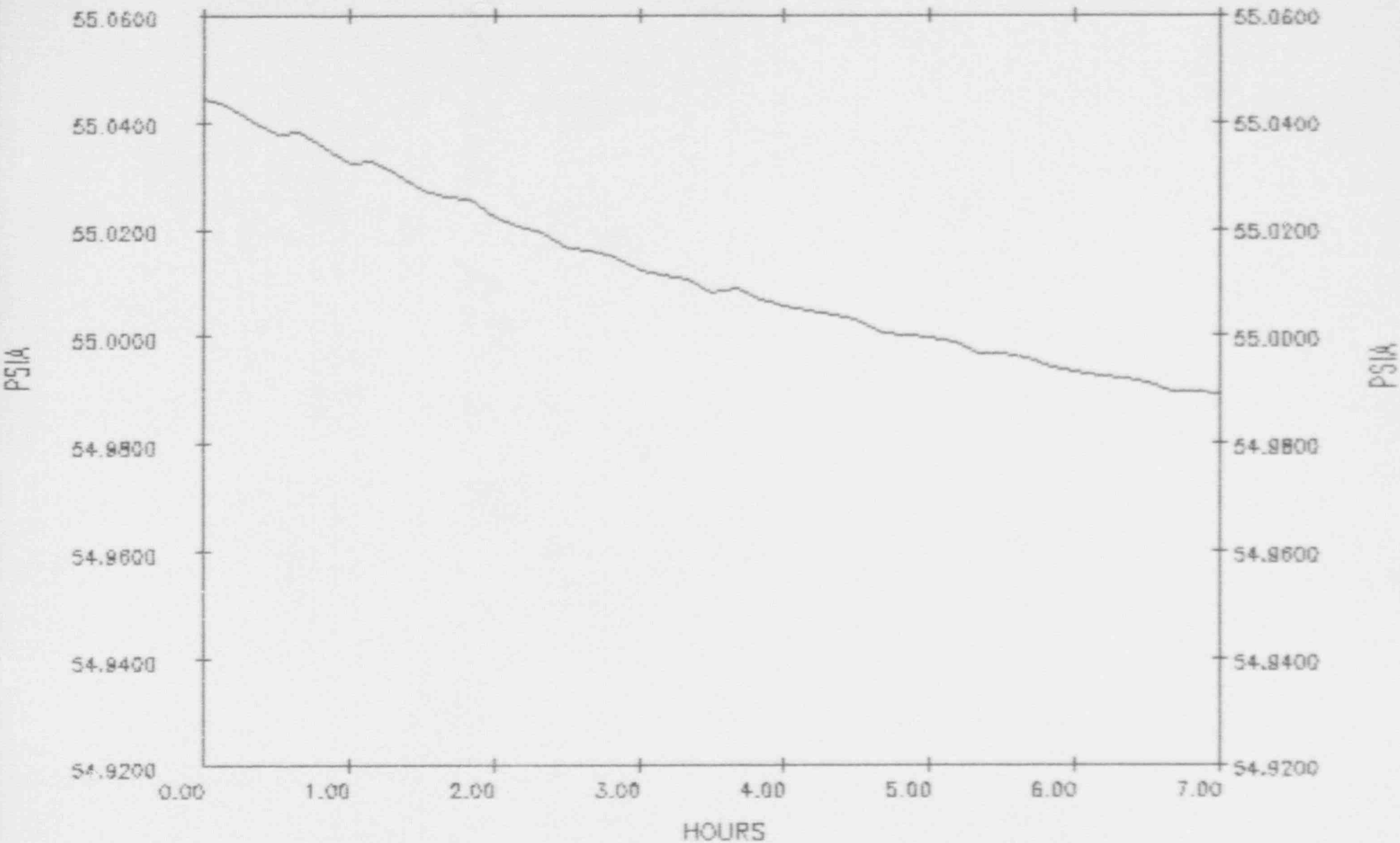


SOFTWARE ID NUMBER: GN01405-0.0

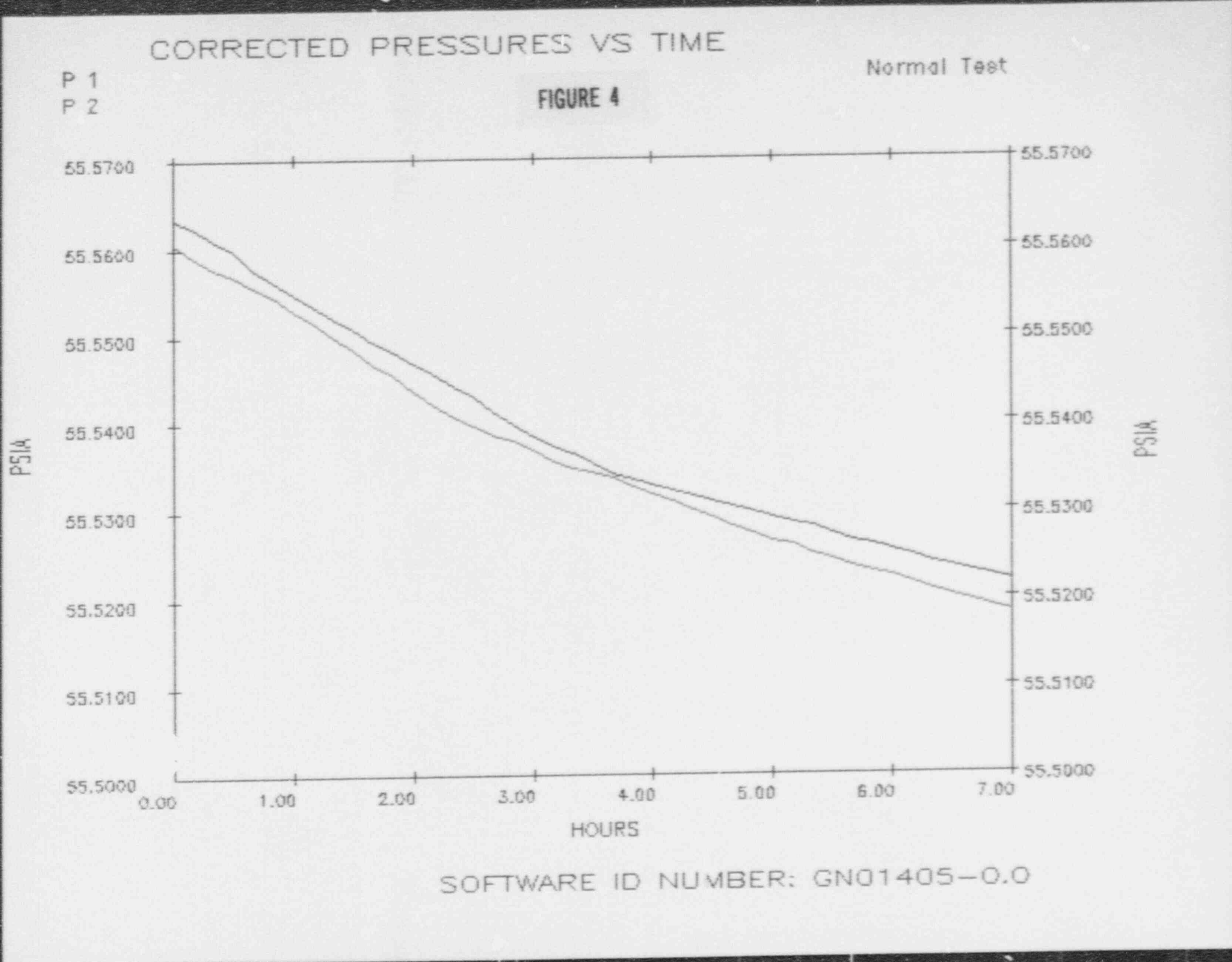
CONTAINMENT DRY AIR PRESSURE VS TIME

Normal Test

FIGURE 3



SOFTWARE ID NUMBER: GN01405-0.0



CORRECTED PRESSURES VS TIME
P 1
P 2
FIGURE 4
Normal Test
PSIA
55.5700
55.5600
55.5500
55.5400
55.5300
55.5200
55.5100
55.5000
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
HOURS
SOFTWARE ID NUMBER: GN01405-0.0

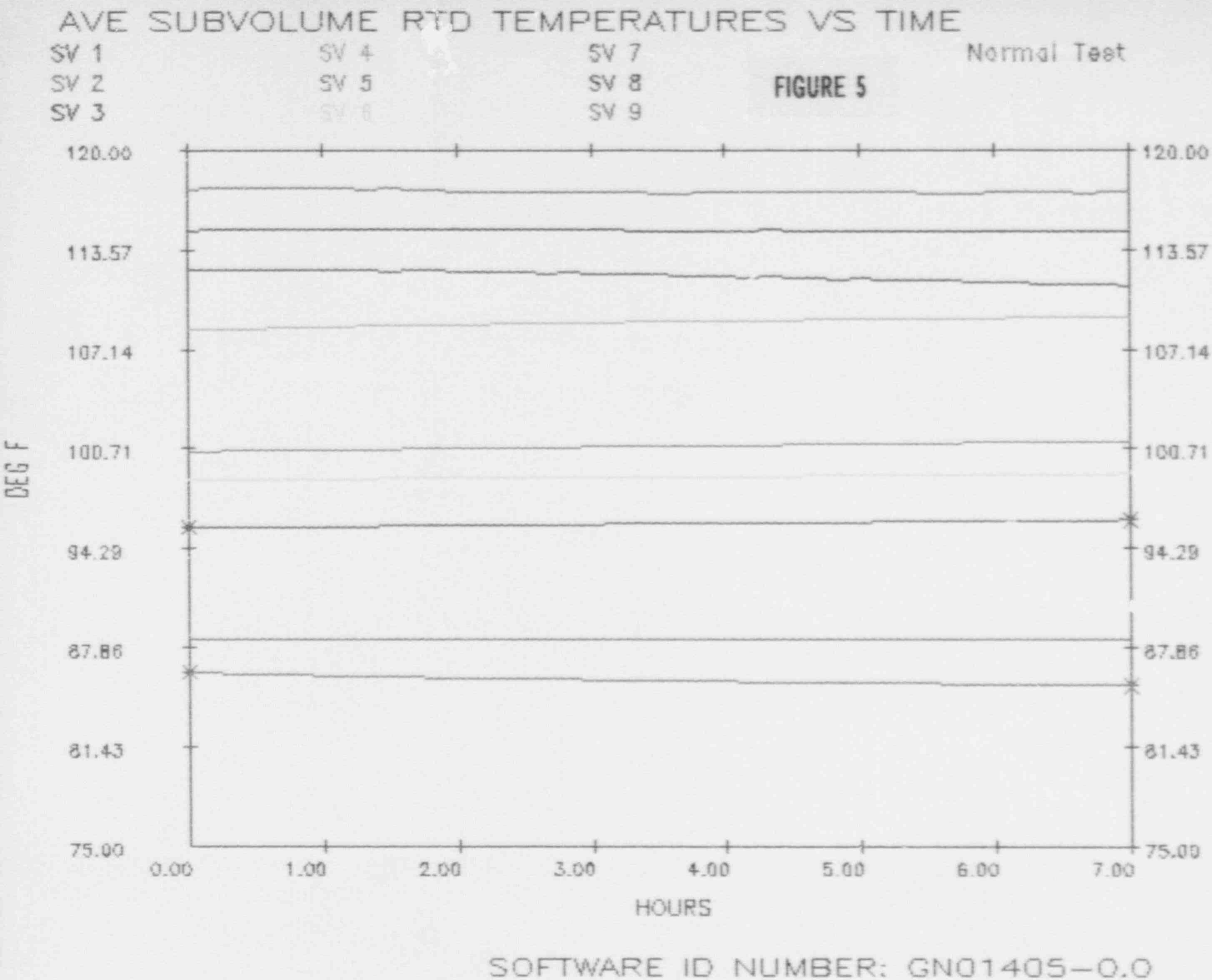

AVE SUBVOLUME RTD TEMPERATURES VS TIME
SV 1
SV 2
SV 3
SV 4
SV 5
SV 7
SV 8
SV 9
Normal Test
120.00
113.57
107.14
100.71
94.29
87.86
81.43
75.00
DEG F
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
HOURS
SOFTWARE ID NUMBER: GN01405-0.0

FIGURE 5

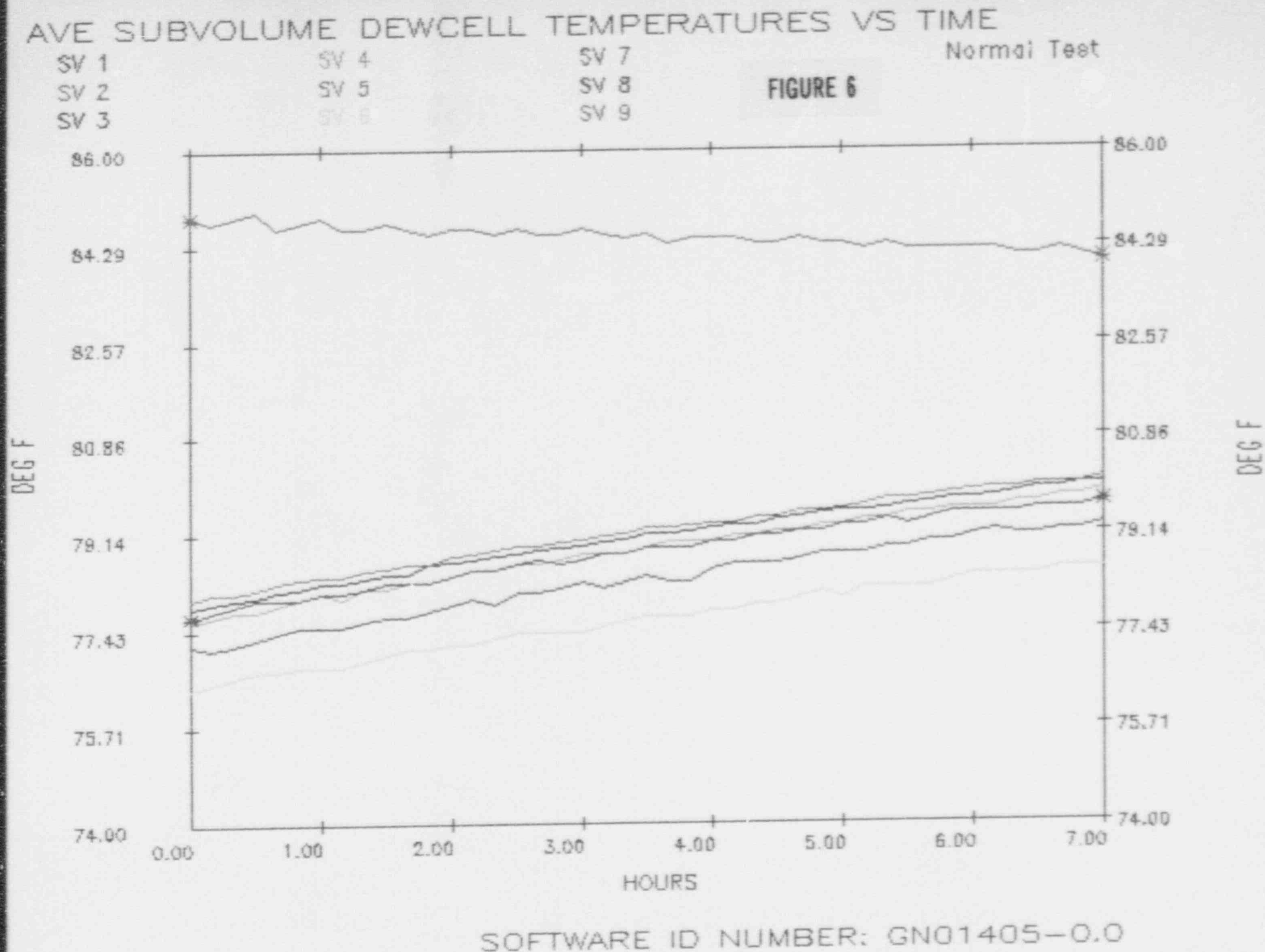
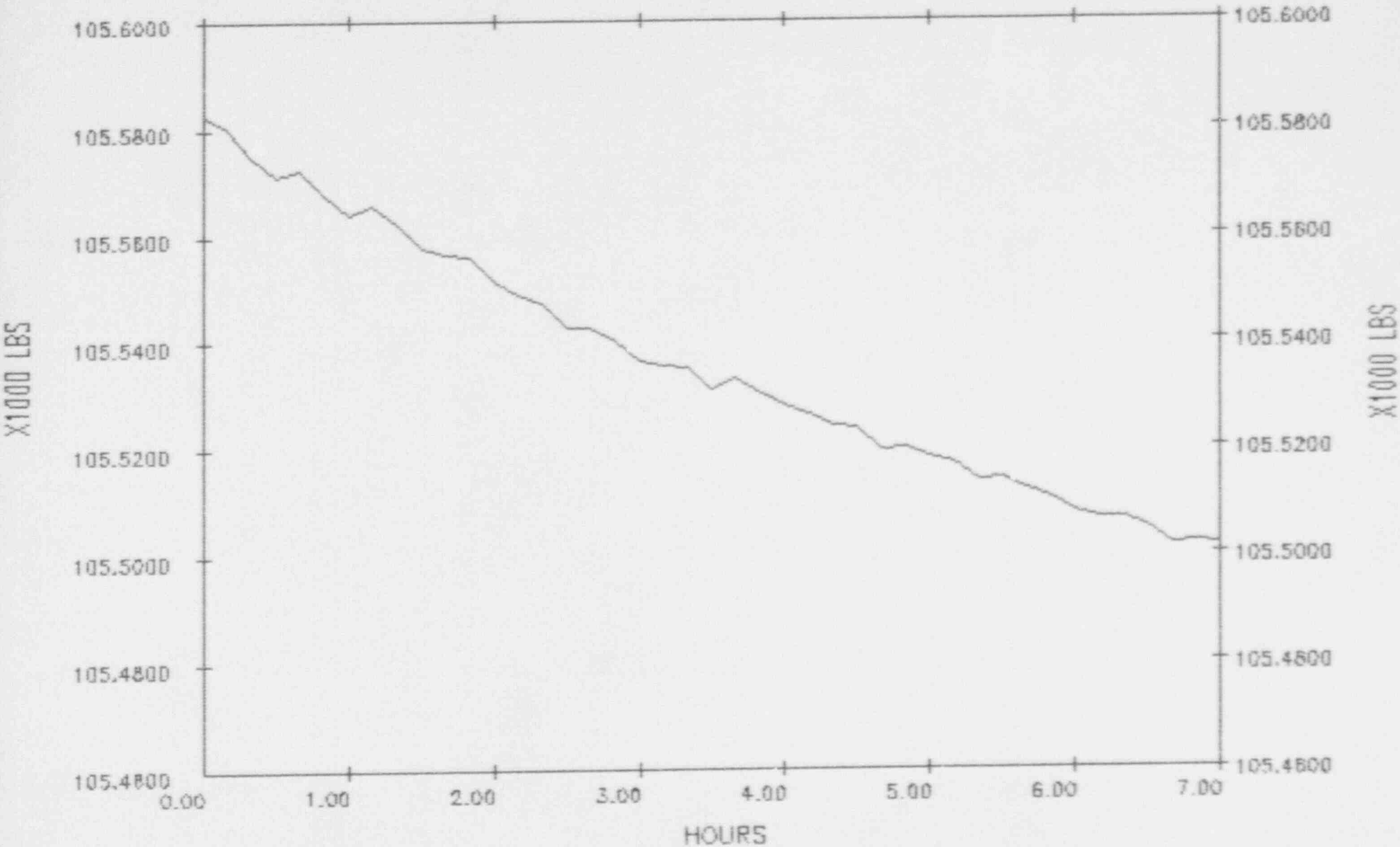

AVE SUBVOLUME DEWCELL TEMPERATURES VS TIME
Normal Test
SV 1
SV 2
SV 3
SV 4
SV 5
SV 7
SV 8
SV 9
86.00
84.29
82.57
80.86
79.14
77.43
75.71
74.00
DEG F
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
HOURS
SOFTWARE ID NUMBER: GN01405-0.0

FIGURE 6

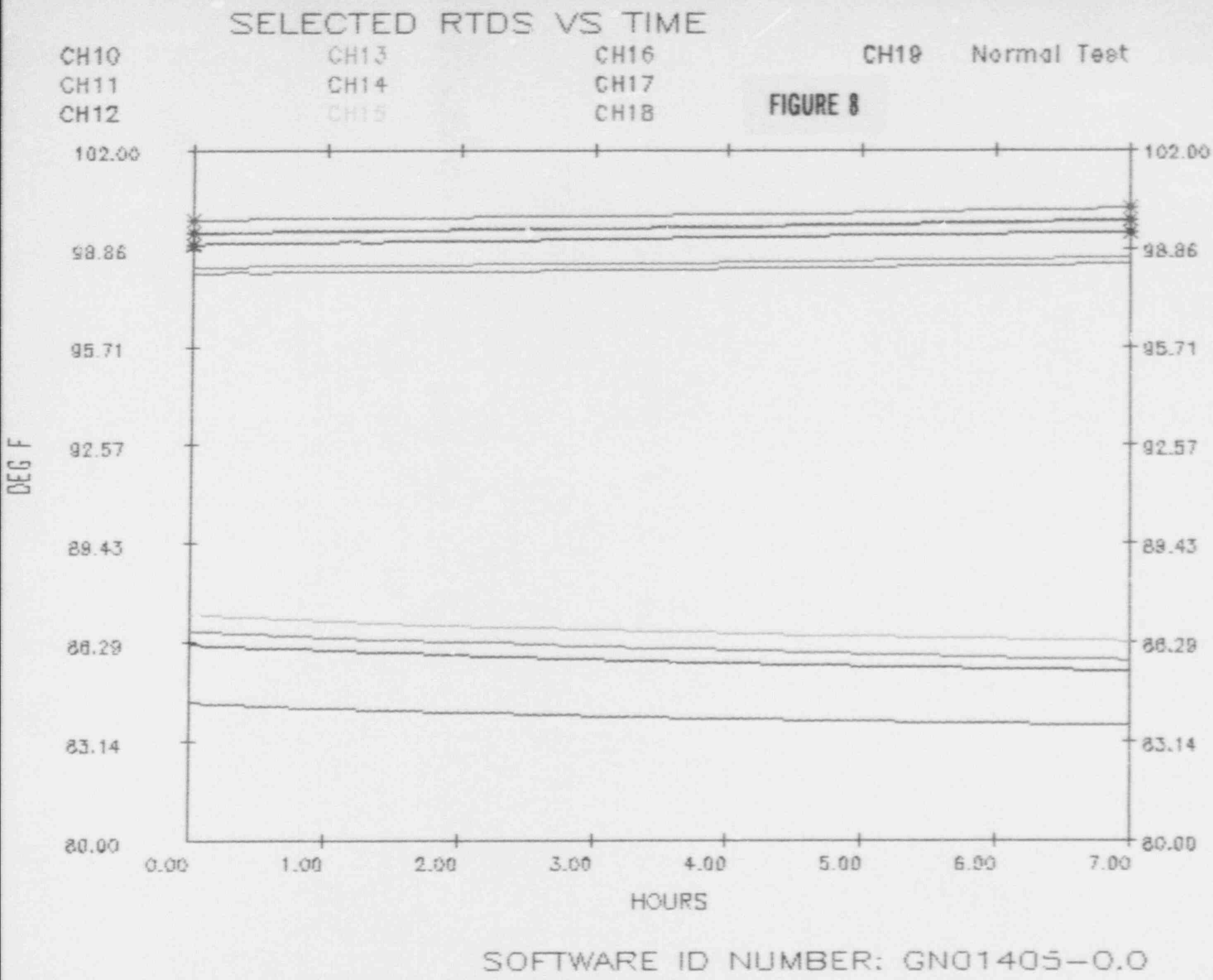
CONTAINMENT DRY AIR MASS VS TIME

Normal Test

FIGURE 7



SOFTWARE ID NUMBER: GN01405-0.0


SELECTED RTDS VS TIME
CH10
CH11
CH12
CH13
CH14
CH15
CH16
CH17
CH18
CH19
Normal Test
FIGURE 8
102.00
98.86
95.71
92.57
89.43
86.29
83.14
80.00
DEG F
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
HOURS
SOFTWARE ID NUMBER: GN01405-0.0

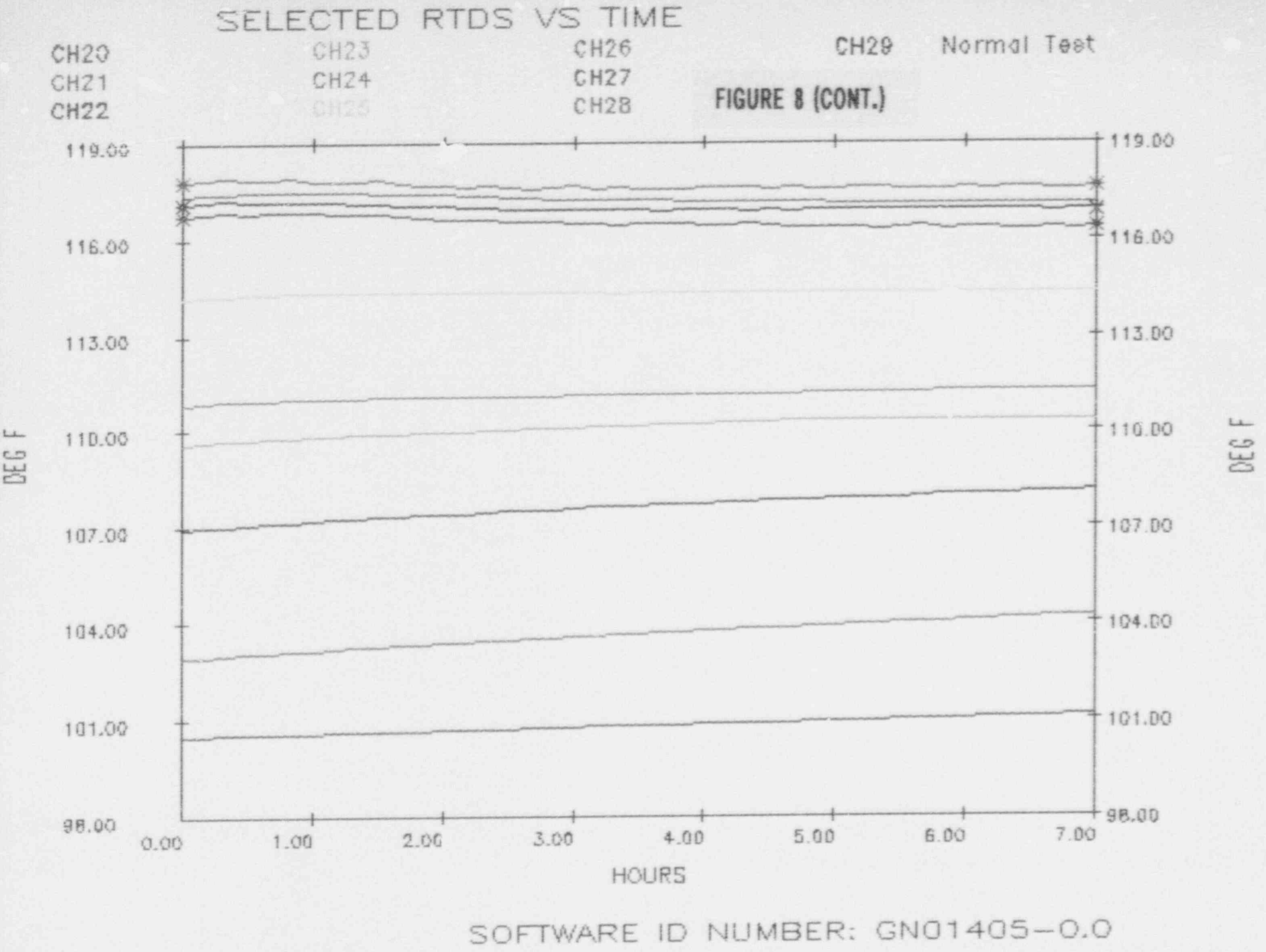
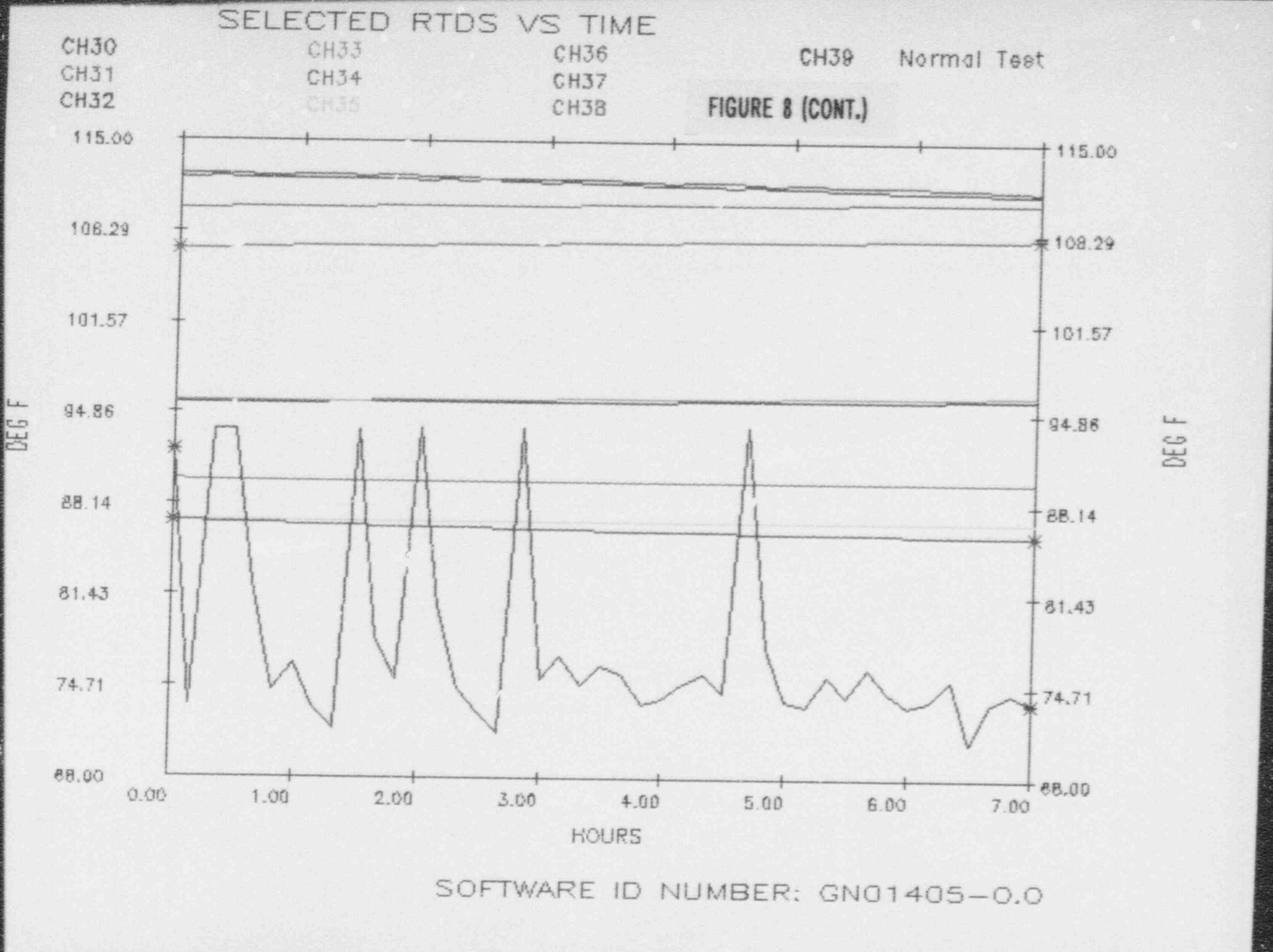
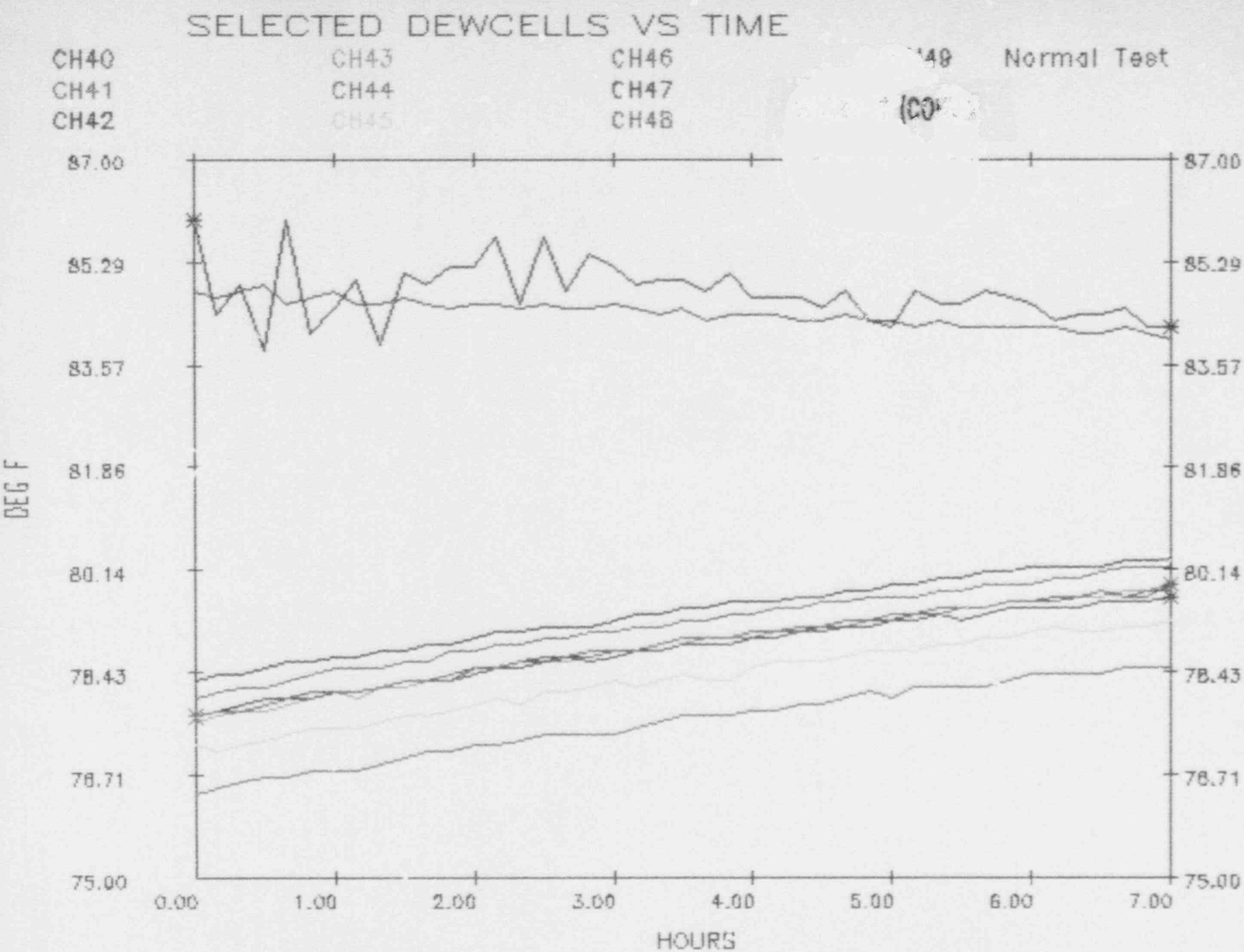


FIGURE 8 (CONT.)



SELECTED RTDS VS TIME
CH30
CH31
CH32
CH33
CH34
CH35
CH36
CH37
CH38
CH39
Normal Test
FIGURE 8 (CONT.)
115.00
108.29
101.57
94.86
88.14
81.43
74.71
68.00
DEG F
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
HOURS
SOFTWARE ID NUMBER: GN01405-0.0



SOFTWARE ID NUMBER: GN01405-0.0

INDUCED LEAKRATE

PHASE

DATA SETS 164-188

SOFTWARE PRODUCT ID NUMBER: GN01405-0.0

TABLE 4

***************************SUMMARY TABLE OF LEAKRATES***************************

LASALLE UNIT 2 08:16:47 MON, 15 JUN 1992

DATA SET 164 THROUGH 188

VERIFICATION TEST RESULTS CALCULATED USING THE BN-TOP-1 METHOD

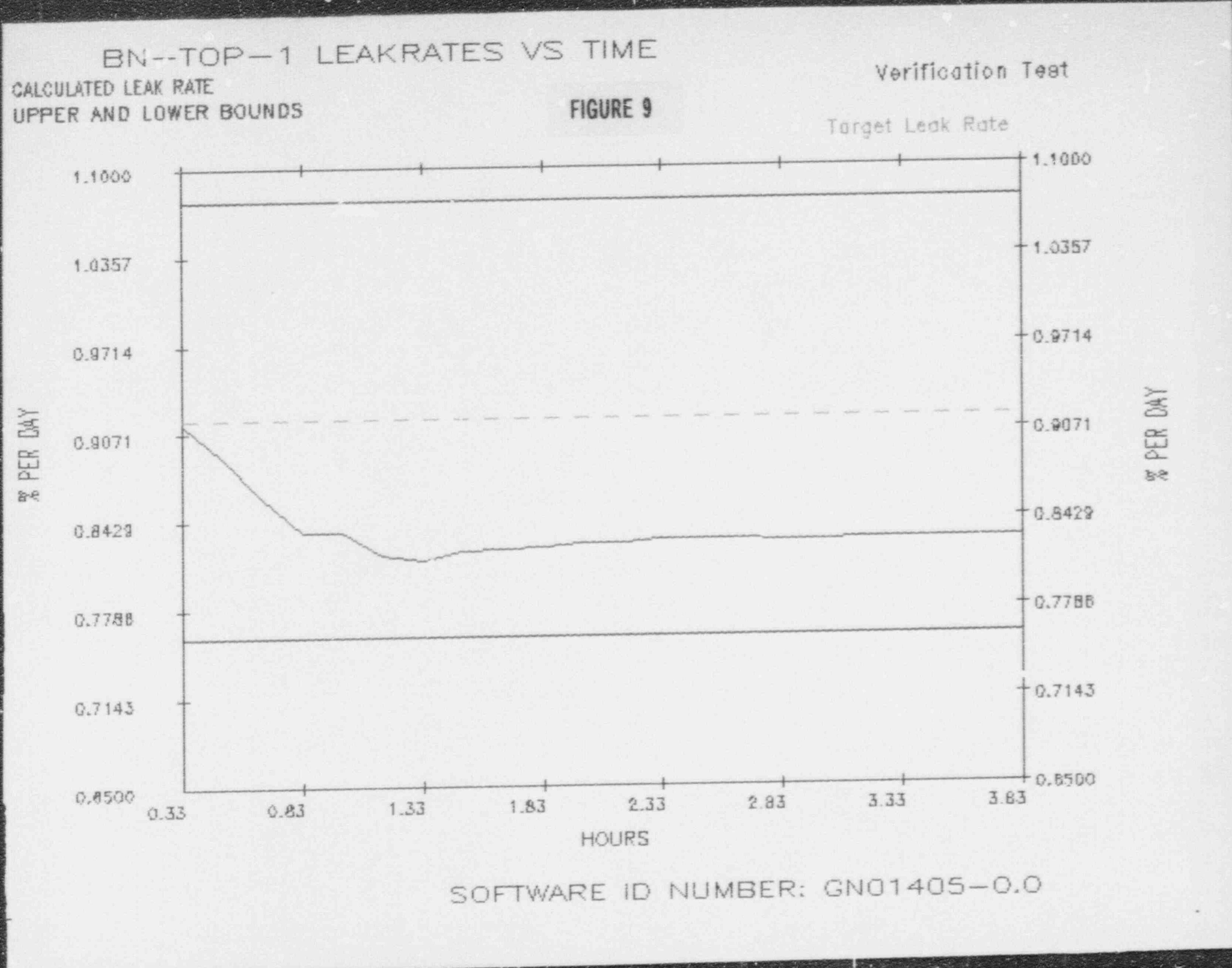
DATA SET #	DATA SET TIME DAY HH MM SS	TEST TIME, (HR)	DRY AIR MASS, (LBM)	TOTAL TIME LEAKRATES , (%/D)	LSF OF LEAKRATES , (%/D)	BN-TOP UCL , (%/D)
164	088 00:28:07	0.000	0.10545269E+06			
165	088 00:38:07	0.167	0.10544698E+06	0.7773		
166	088 00:48:07	0.333	0.10543989E+06	0.8733		
167	088 00:58:07	0.500	0.10543283E+06	0.9040	0.9149	1.1735
168	088 01:08:07	0.667	0.10542769E+06	0.8530	0.8906	1.1520
169	088 01:18:07	0.833	0.10542256E+06	0.8226	0.8601	1.0716
170	088 01:28:07	1.000	0.10541723E+06	0.8069	0.8356	1.0095
171	088 01:38:07	1.167	0.10540981E+06	0.8362	0.8350	0.9774
172	088 01:48:07	1.333	0.10540600E+06	0.7968	0.8183	0.9449
173	088 01:58:07	1.500	0.10539895E+06	0.8153	0.8144	0.9263
174	088 02:08:07	1.667	0.10539111E+06	0.8407	0.8207	0.9243
175	088 02:18:07	1.833	0.10538580E+06	0.8303	0.8219	0.9173
176	088 02:28:07	2.000	0.10537967E+06	0.8309	0.8231	0.9118
177	088 02:38:07	2.167	0.10537297E+06	0.8373	0.8258	0.9093
178	088 02:48:07	2.333	0.10536780E+06	0.8280	0.8255	0.9041
179	088 02:58:07	2.500	0.10536031E+06	0.8409	0.8284	0.9035
180	088 03:08:07	2.667	0.10535542E+06	0.8300	0.8283	0.8997
181	088 03:18:07	2.833	0.10534951E+06	0.8287	0.8279	0.8962
182	088 03:28:07	3.000	0.10534334E+06	0.8295	0.8278	0.8932
183	088 03:38:07	3.167	0.10533728E+06	0.8293	0.8277	0.8906
184	088 03:48:07	3.333	0.10533017E+06	0.8365	0.8289	0.8897
185	088 03:58:07	3.500	0.10532501E+06	0.8302	0.8288	0.8876
186	088 04:08:07	3.667	0.10531941E+06	0.8272	0.8283	0.8852
187	088 04:18:07	3.833	0.10531251E+06	0.8322	0.8286	0.8839
188	088 04:28:07	4.000	0.10530691E+06	0.8295	0.8285	0.8822

****

NO PRESSURE CHANNELS ARE LOCKED OUT

DAS CHANNEL # 39 IS LOCKED OUT FROM DSN 1

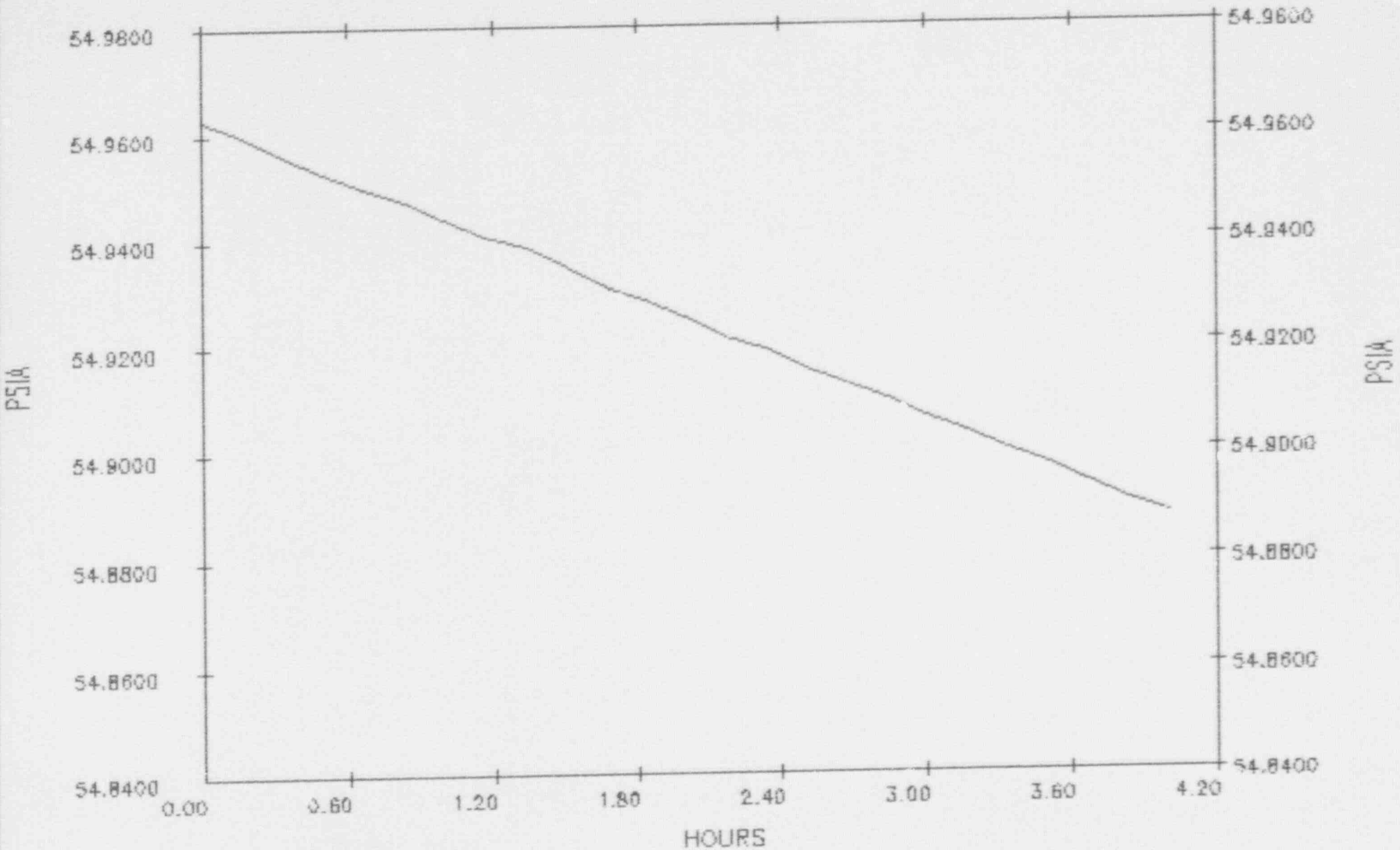
DAS CHANNEL # 49 IS LOCKED OUT FROM DSN 1


BN--TOP-1 LEAKRATES VS TIME
CALCULATED LEAK RATE
UPPER AND LOWER BOUNDS
FIGURE 9
Verification Test
Target Leak Rate
1.1000
1.0357
0.9714
0.9071
0.8429
0.7786
0.7143
0.6500
% PER DAY
0.33
0.83
1.33
1.83
2.33
2.83
3.33
3.83
HOURS
SOFTWARE ID NUMBER: GN01405-0.0

CONTAINMENT DRY AIR PRESSURE VS TIME

Verification Test

FIGURE 10

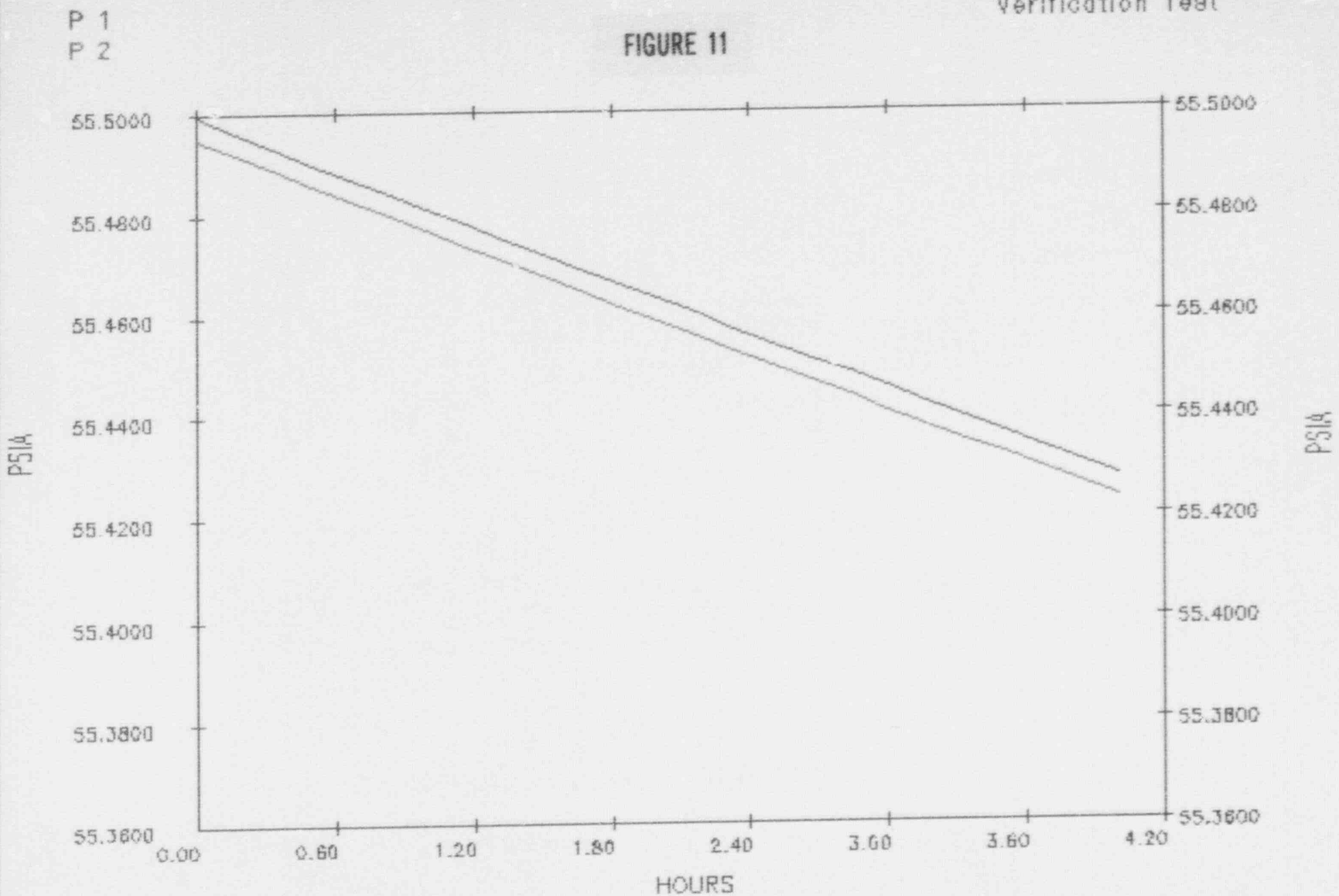


SOFTWARE ID NUMBER: GN01405-0.0

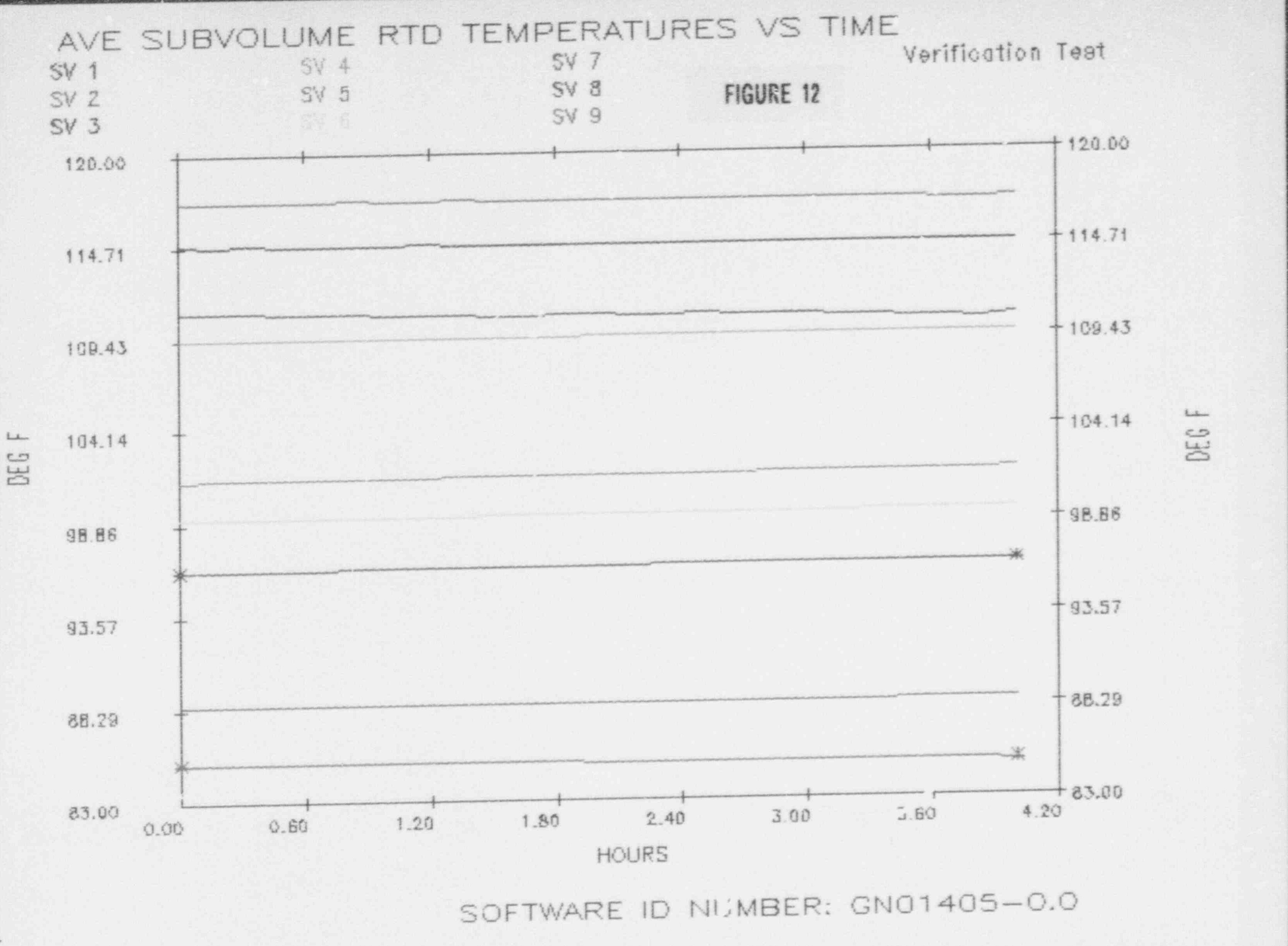
CORRECTED PRESSURES VS TIME

Verification Test

FIGURE 11



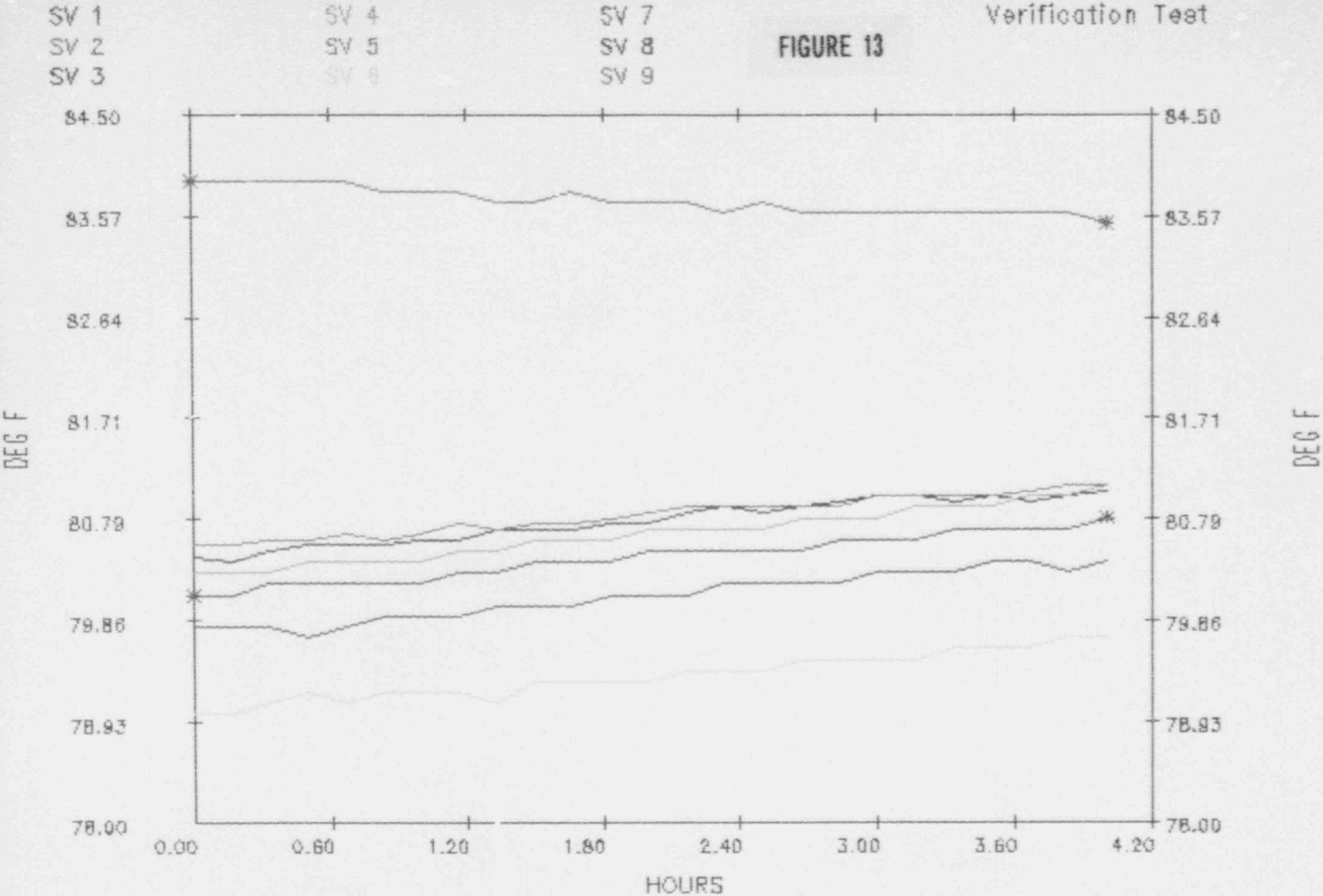
SOFTWARE ID NUMBER: GN01405-0.0


AVE SUBVOLUME RTD TEMPERATURES VS TIME
Verification Test
SV 1
SV 2
SV 3
SV 4
SV 5
SV 6
SV 7
SV 8
SV 9
FIGURE 12
120.00
114.71
109.43
104.14
98.86
93.57
88.29
83.00
DEG F
0.00
0.60
1.20
1.80
2.40
3.00
3.60
4.20
HOURS
SOFTWARE ID NUMBER: GN01405-0.0

AVE SUBVOLUME DEWCELL TEMPERATURES VS TIME

Verification Test

FIGURE 13

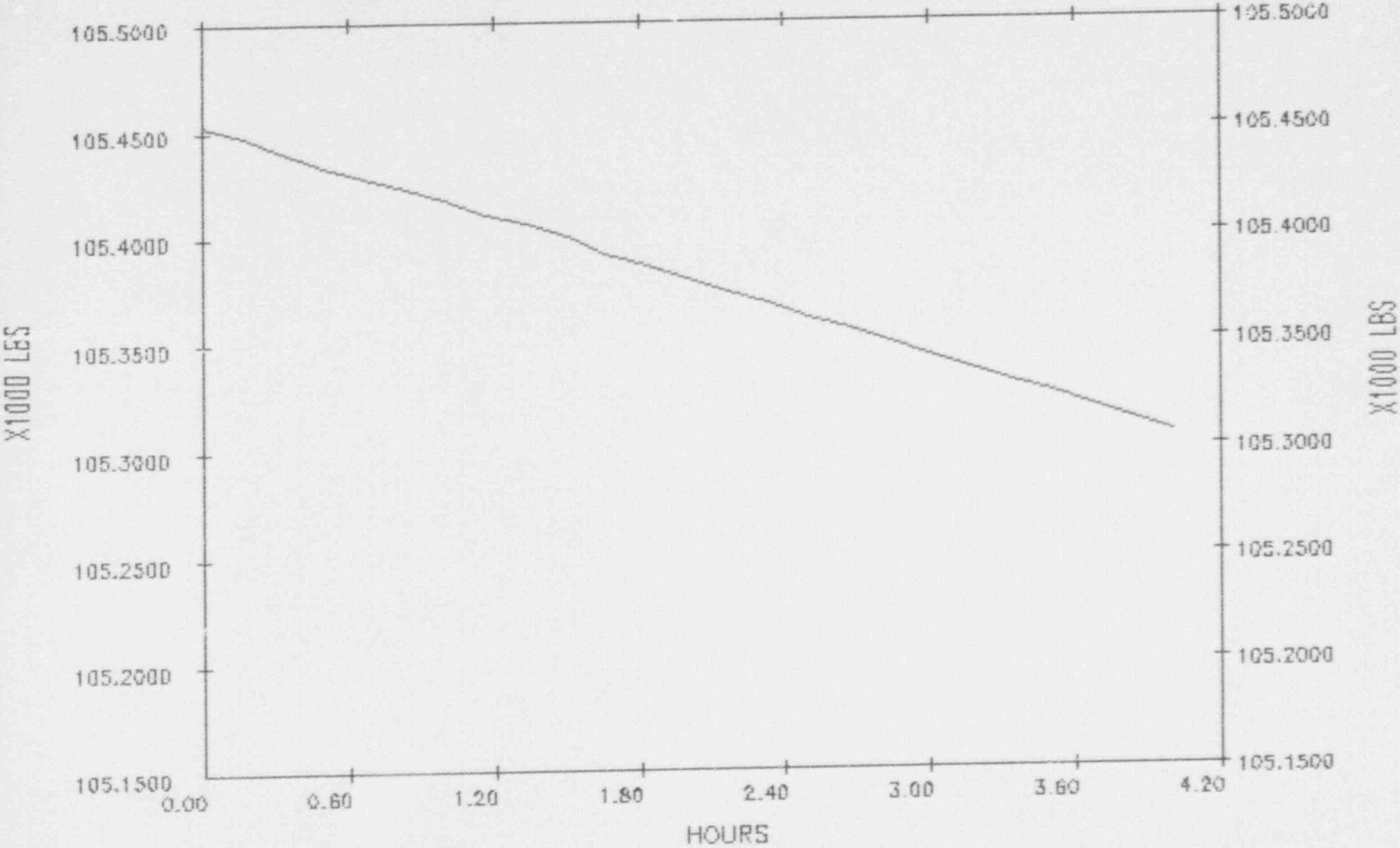


SOFTWARE ID NUMBER: GN01405-0.0

CONTAINMENT DRY AIR MASS VS TIME

Verification Test

FIGURE 14



SOFTWARE ID NUMBER: GN01405-0.0

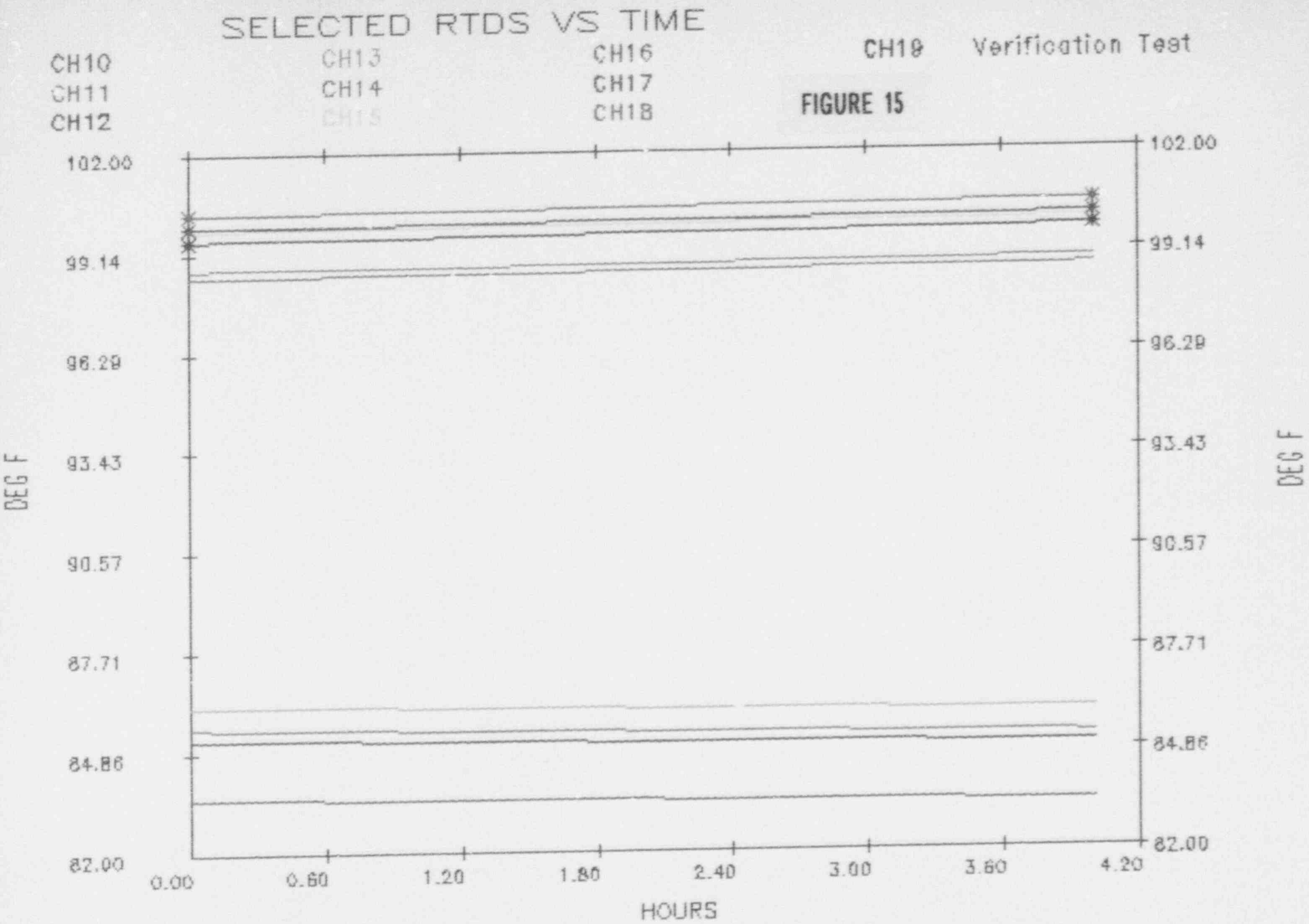


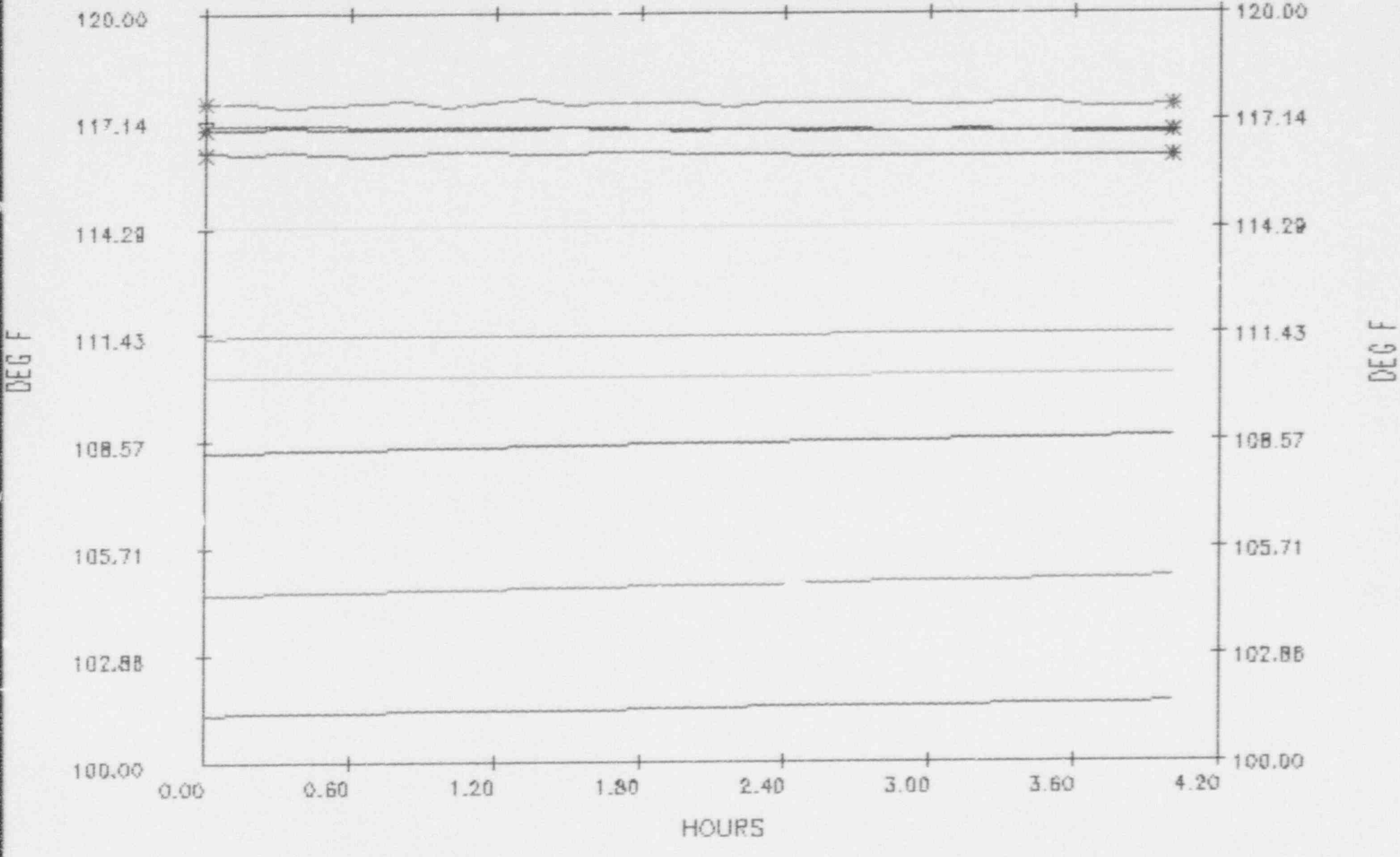
FIGURE 15

SOFTWARE ID NUMBER: GN01405-0.0

SELECTED RTDS VS TIME

CH20	CH23	CH26	CH29	Verification Test
CH21	CH24	CH27		
CH22	CH25	CH28		

FIGURE 15 (CONT.)



SOFTWARE ID NUMBER: GN01405-0.0

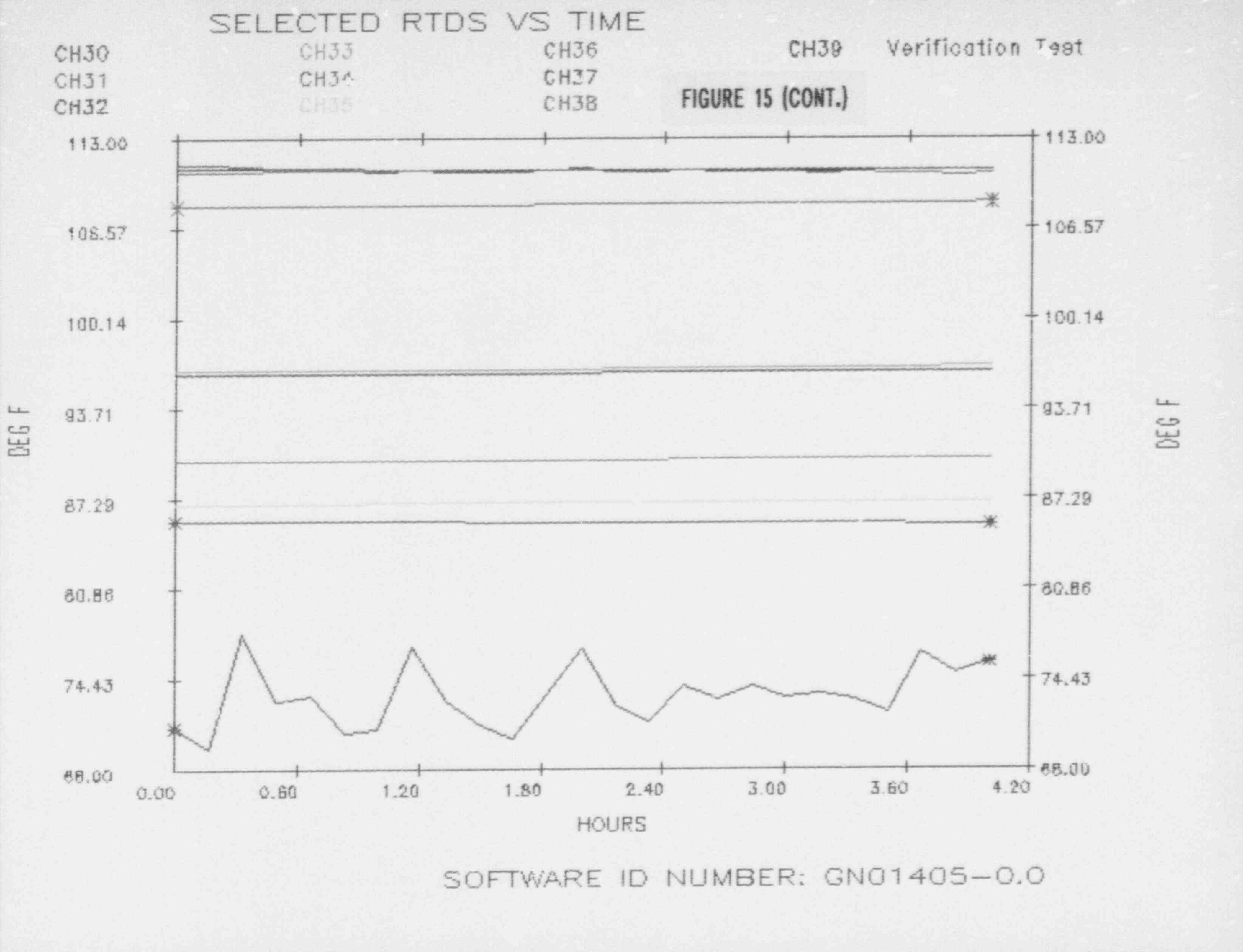


FIGURE 15 (CONT.)

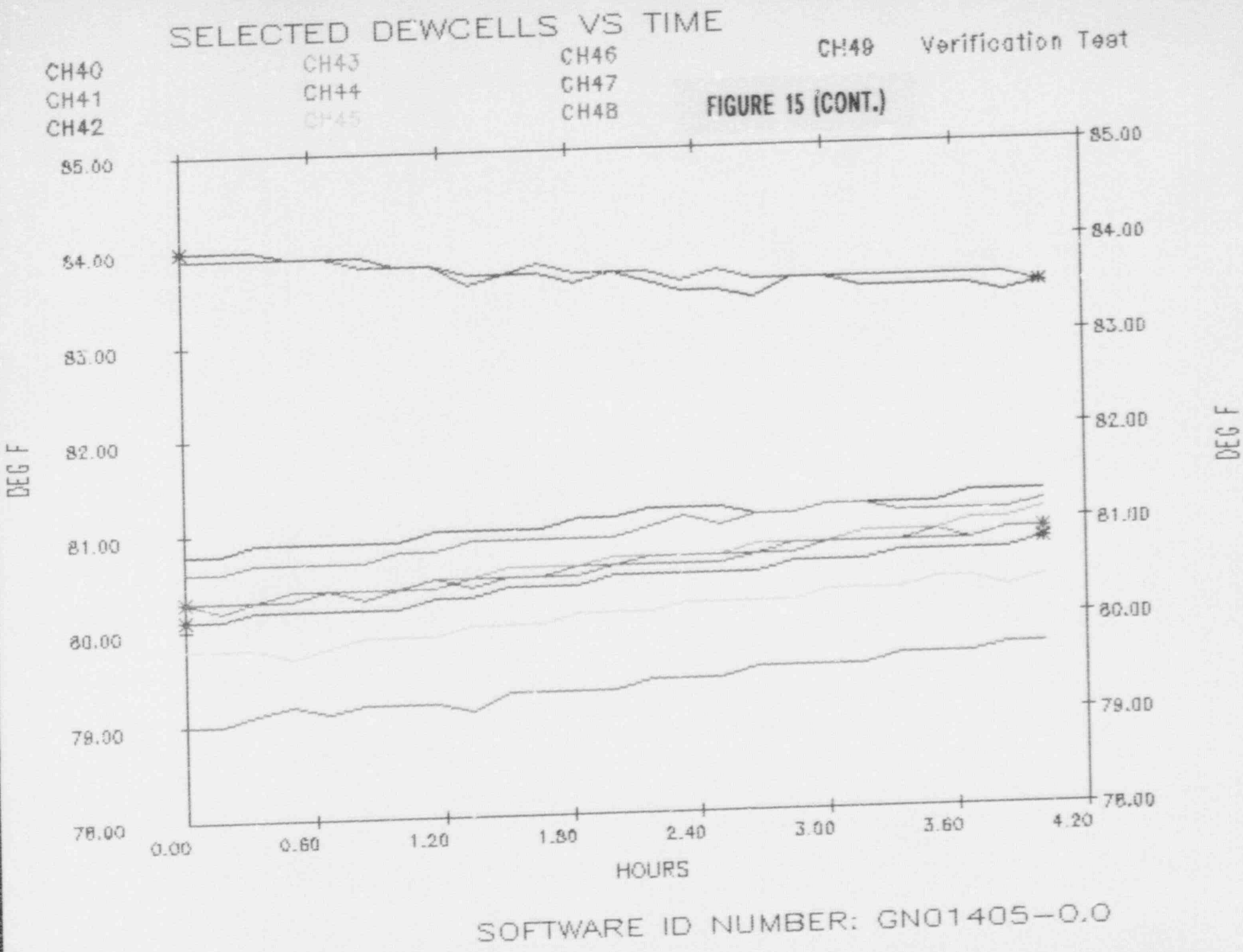


FIGURE 15 (CONT.)

SECTION E - TEST CALCULATIONS

Calculations for the test were based on LaSalle County Procedure LTS-300-4. A reproduction of this computational procedure is found in Appendix C. The instrument error analyses are also found in Appendix C. In preparing for the LaSalle Station short duration test using BN-TOP-1, Rev. 1 a number of editorial error and ambiguous statements in the topical report were identified. These errors are presented in Appendix D and are editorial in nature only. The Station has made no attempt to improve or deviate from the methodology outlined in the topical report.

SECTION F - TYPE A TEST RESULTS AND INTERPRETATION

F.1 Measured Leak Rate Test Results

Based upon data collected during the Short Duration Test, the following results were determined:

	Actual Leak Rate (wt%/day)	Acceptance Criterion (wt%/day)
Total time measured leak rate	0.2608	0.476
Calculated leak rate	0.2534	0.476
Upper 95% confidence limit leak rate	0.3286	0.476

F.2 Induced Phase Test Results

A leak of 397.4 SCFH (0.6633 wt%/day) was induced on the Primary Containment for this phase of the test. The following results were determined:

	Actual Leak Rate (wt%/day)
Superimposed Flowmeter Leakrate (L_o)	0.6633
Calculated Leakrate prior to verification test (L_i)	0.2534
Induced Calculated Leakrate during verification test (L_c)	0.8285

Acceptance Criterion: $|L_c - (L_i + L_o)| \leq 0.159$ wt%/day

$$|L_c - (L_i + L_o)| = 0.0882 \text{ wt\%/day}$$

F.3 Leak Rate Compensation for Non-Vented Penetrations

The Integrated Primary Containment Leak Rate Test was performed with the following penetrations not drained and vented as required by 10CFR50, Appendix J. The minimum pathway As Left Leak Rate of each of these penetrations, as determined by Type C testing is listed:

Penetration	Function	SCFH
M-16	RBCCW Supply	0.0
M-17	RBCCW Return	0.0
M-25	PCCW "A" Supply	0.695
M-26	PCCW "B" Supply	0.185
M-27	PCCW "A" Return	2.8
M-28	PCCW "B" Return	0.185
M-30	RWCU Suction	0.0
M-36	Recirc Loop Sample	0.0
M-96	Drywell Equipment Drain Sump	0.42
M-98	Drywell Floor Drain Sump	0.51
M-97	Drywell Equipment Sump Cooling	0.85
M-22	Inboard MSIV Drain	0.42
M-7	RHR Shutdown Cooling Suction	0.47
M-15	RCIC Steam Supply	3.95
ECCS/RCIC	Worst Division	2.01
M-HG	Unit 1 Hydrogen Recombiner	1.92
M-34	Standby Liquid Control	0.0
	TOTAL	14.415

This yields the following Non-Vented Penetration Penalty:

Total (SCFH) x 1.6473×10^{-3}

Non-vented Penetration Penalty : 0.0237 wt%/day

F.4 Change in Drywell Sump Level

Changes in drywell sump levels were not used in calculating the final leakage rate. The observed sump level increase during the test resulted in a net volume change of 8.7 Ft^3. This represents approximately 2.2×10^{-3} % of the total containment volume.

All inputs to the sumps were in all probability made through a leakage path directly from the Reactor vessel. There were no known inputs made from outside the containment throughout the test. The observed increase in sump level therefore, is considered to have negligible effects on the overall measured leakage rate.

F.5 Evaluation of Instrument Failures

There were no instruments or sensor rejected during the PCILRT Leakage and Verification Tests. Channel 39, an experimental test sensor installed in the Suppression Pool Volume, malfunctioned and was locked out of the Data Acquisition System prior to containment pressurization. Channel 49, Subvolume 9 Suppression Chamber Dewcell, was locked out during the ILRT Stabilization Period due to erratic readings. The Channel 49 sensor shield was lost during installation. Without the shield, the sensor was sporadic. No further instrument problems occurred during the PCILRT or verification test. These changes did not affect ISG calculations prior and post test for instrument errors.

F.6 As-Found (Calculated Adjusted) Local Leak Rate

The 95% Upper Confidence Limit, Type A test leak rate, plus the total leak rate penalty for non-vented penetrations, plus the sum of the Calculated Adjusted local leak rates must be less than 0.75 La. The Calculated Adjusted local leak rates are summarized in Table 5.

As Found Test Results

95% Upper Confidence Limit	0.3286 wt%/day
A Penalty for Non-Vented Penetrations	0.0237 wt%/day
Calculated Adjusted Leakage	0.2632 wt%/day
TOTAL	0.6155 wt%/day

The total "As Found" Containment leakage rate was above the Maximum allowable leakage rate of 0.75 La (0.476 wt%/day). Thus, the "AS-FOUND" Containment Integrated Leakage is unsatisfactory, and considered as a failure.

TABLE 5
(Sheet 1 of 5)

CALCULATED ADJUSTED LEAKAGE

VALVE(S) OR PENETRATION	TEST VOLUME	MINIMUM PATHWAY AS FOUND/AS LEFT (SCFH)	ADJUSTED LOCAL LEAK RATE (SCFH)
2B21-F016/F019	Inboard MSIV Drain	17.49/0.42	# 17.[illegible]7
2VQ026/27/43	Suppression Pool Vent	9.04/4.39	# 4.65
2VQ029/30/42	Drywell Vent	2.075/2.54	* 0.0
2VQ031/32/40	Suppression Chamber Purge	0.0/0.0	* 0.0
2B21-F010A/F032A	"A" FW to Reactor	12.08/3.04	@ 9.[illegible]4
2PC001A OUTBD Flange	Drywell Vacuum Bkr	0.65/0.0	$ 0.65
2PC001A INBD Flange	Drywell Vacuum Bkr	0.0/0.0	$ 0.0
2PC001A Actuator O-Ring	Drywell Vacuum Bkr	0.0/0.0	$ 0.0
2PC001A Actuator Seal	Drywell Vacuum Bkr	0.0/0.0	$ 0.0

TABLE 5
(Sheet 2 of 5)

CALCULATED ADJUSTED LEAKAGE

VALVE(S) OR PENETRATION	TEST VOLUME	MINIMUM PATHWAY AS FOUND/AS LEFT (SCFH)	ADJUSTED LOCAL LEAK RATE (SCFH)
2VQ027 INBD Flange	Suppression Pool Vent	0.0/0.0	$ 0.0
2RE024/2RE025	Drywell Equip Drain Sump	0.84/0.0	* 0.84
2G33-F001/F004	RWCU Suction	115.7/0.0	@ 115.7
2VP063B/113B	PCCW B Supply	0.23/0.185	# 0.045
2VP053A/114A	PCCW A Return	5.6/0.0	* 5.6
2HG001A/2A	Combustible Gas Control A Suction	0.57/0.0	* 0.57
2HG001B/2B	Combustible Gas Control B Suction	0.28/0.0	* 0.28
2HG005A/6A	Combustible Gas Control A Return	2.085/0.0	* 2.085
2HG005B/6B	Combustible Gas Control B Return	0.0/0.0	* 0.0

TABLE 5
(Sheet 3 of 5)

CALCULATED ADJUSTED LEAKAGE

VALVE(S) OR PENETRATION	TEST VOLUME	MINIMUM PATHWAY AS FOUND/AS LEFT (SCFH)	ADJUSTED LOCAL LEAK RATE (SCFH)
2E51-F063/76/64/08/91	RCIC Steam Supply	5.14/3.945	+ 1.195
2WR029/179	RBCCW Supply	0.0/0.0	@ 0.0
2WR040/180	RBCCW Return	0.0/0.0	@ 0.0
2IN074/75	DW Pneumatic Dryer Purge	1.67/2.775	* 0.0
2E22-F004	HPCS Injection	0.56/0.0	$ 0.56
2E12-F008/F009	RHR SDC Suction	0.37/0.47	@ 0.0
2C41-F004A/4B/F007	SBLC Injection	0.0/0.0	+ 0.0
2E51-F028/F069	RCIC Vacuum Pump Disch.	1.505/1.64	* 0.0
2VQ050/51	Suppression Pool Inerting Makeup	0.0/0.0	# 0.0

TABLE 5
(Sheet 4 of 5)

CALCULATED ADJUSTED LEAKAGE

VALVE(S) OR PENETRATION	TEST VOLUME	MINIMUM PATHWAY AS FOUND/AS LEFT (SCFH)	ADJUSTED LOCAL LEAK RATE (SCFH)
2E12-F016A/F017A	RHR A Drywell Spray	0.0/0.0	* 0.0
2E12-F016B/F017B	RHR B Drywell Spray	0.0/0.0	* 0.0
2E12-F042A	RHR A LPCI Injection	0.0/0.47	$ 0.0
2E12-F042B	RHR B LPCI Injection	1.48/0.0	$ 1.48
2E12-F053A	RHR A SCD Return	0.0/0.0	$ 0.0
TOTAL			159.765 SCFH

Total (SCFH) X 1.6473×10^{-3}

Calculated Adjusted Leakage = 0.2632 wt%/day

TABLE 5
(Sheet 5 of 5)

CALCULATED ADJUSTED LEAKAGE

@ In the case where individual leak rates are assigned to two valves in series (both before and after the R&A), the penetration through-leakage would simply be the smaller or best of the two valves' leak rates.

¢ The Minimum Pathway Leak Rate of a single valve pathway is equal to the measured leak rate past that single valve.

In the case where a leak rate is obtained by pressurizing between two isolation valves and the individual valve's leak rate is not quantified, the AS-FOUND and AS-LEFT penetration through-leakage for each valve would be one half the measured leak rate if both valves are repaired.

* In the case where a leak rate is obtained by pressurizing between two isolation valves and only one valve is repaired, the AS-FOUND penetration leak rate would conservatively be the final measured leak rate or one half of the measured value prior to repairs or adjustments, whichever is smaller. The AS-LEFT penetration through leak rate, in either case is zero. This assumes the repaired valve leaks zero.

+ The Minimum Pathway Leak Rate of a parallel multi-valve pathway is equal to the sum of the leakages of all the inboard valves or the sum of the leakages of all the outboard valves whichever is smaller. If individual valve leakage rates are not known and the system is tested by pressurizing between all the valves, the Minimum Pathway Leak Rate is equal to half the measured leakage rate.

The correction (Calculated Adjustment) for each pathway is that pathway's Minimum Path Leakage Rate before the R&A minus its Minimum Path Leakage after the R&A but before the Type A Test. Any negative corrections will be set equal to zero.

APPENDICES

APPENDIX A

TYPE B AND C TESTS

Pr sente] herein are the results of local leak rate tests conducted on all penetrations, double-gasketed seals, and isolation valves. Total leakage for double-gasketed seals and total leakage for all other penetrations and isolation valves following repairs satisfied all Technical Specification limits. These results are listed in Table 6.

TABLE 6
(Sheet 1 of 9)

PENETRATION	DESCRIPTION	VALVES(s)/COMPONENT	AS-FOUND (SCFH) DATE	AS-FOUND TOTAL	AS-FOUND MINIMUM PATHWAY	AS-FOUND MAXIMUM PATHWAY	AS-LEFT (SCFH) DATE	AS-LEFT TOTAL	AS-LEFT MINIMUM PATHWAY	AS-LEFT MAXIMUM PATHWAY
M-22	Inboard MSIV Drain	2B21-F016/2B21-F019	01/06/92	34.98	17.49	34.98	02/19/92	0.84	0.42	0.84
M-66	Suppression Chamber Vent	2VQ026/2VQ027/2VQ043	01/10/92	18.08	9.04	18.08	02/29/92	8.78	4.39	8.78
M-20	Drywell Vent	2VQ029/2VQ030/2VQ042	01/06/92	4.15	2.075	4.15	02/29/92	5.08	2.54	5.08
M-67	Suppression Chamber Purge	2VQ031/2VQ032/2VQ040	01/10/92	0.0	0.0	0.0	03/07/92	0.0	0.0	0.0
M-21	Drywell Purge	2VQ034/2VQ035/2VQ036 2VQ068	01/10/92	0.0	0.0	0.0	01/10/92	0.0	0.0	0.0
I-36	Suppression Chamber C.A.M.	2CM027/2CM028	01/07/92	0.0	0.0	0.0	01/07/92	0.0	0.0	0.0
I-11	Drywell C.A.M.	2CM029/2CM030	01/07/92	0.0	0.0	0.0	01/07/92	0.0	0.0	0.0
I-11	P.C. Air Sample	2CM031/2CM032	01/07/92	0.0	0.0	0.0	01/07/92	0.0	0.0	0.0
I-45	Sample Return to Suppression Chamber	2CM033/2CM034	01/07/92	0.0	0.0	0.0	01/07/92	0.0	0.0	0.0
M-5	A Feedwater	2B21-F010A	01/19/92	24.42			02/19/92	3.04		
		2B21-F032A	01/19/92	12.08			01/19/92	12.08		
		2B21-F065A	01/19/92	6.96	12.08	24.42	03/12/92	0.65	3.04	12.08
M-6	B Feedwater and RWCU Return	2B21-F010B	01/09/92	1.03			01/09/92	1.03		
		2B21-F032B	01/09/92	0.0			01/09/92	0.0		
		2B21-F065B	01/10/92	3.23			02/29/92	0.56		
		2G33-F040	01/10/92	0.0	0.0	1.03	02/29/92	0.83	0.0	1.03
M-54	Drywell Pneumatic Suction	2IN001A/2IN001B	01/06/92	0.56	0.28	0.56	01/06/92	0.56	0.28	0.56
M-36	Recirc Loop Sample	2B33-F019	01/15/92	0.0			01/15/92	0.0		
		2B33-F020	01/15/92	0.0	0.0	0.0	01/15/92	0.0	0.0	0.0
M-98	Drywell Floor Drain Sump	2RF012/2RF013	01/14/92	1.02	0.51	1.02	01/14/92	1.02	0.51	1.02
M-111	Drywell Personnel Access Hatch	Drywell Personnel Access Hatch	09/08/91	1.74	1.74	1.74	03/25/92	2.77	2.77	2.77
		PAGE TOTAL			43.215	85.98			13.95	32.16

TABLE 6
(Sheet 2 of 9)

PENETRATION	DESCRIPTION	VALVES(s)/COMPONENT	AS-FOUND (SCFH) DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	AS-LEFT (SCFH) DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-112	Drywell Equipment Hatch	Drywell Equipment Hatch	01/05/92	0.0	0.0	0.0	03/24/92	0.0	0.0	0.0
M-113	Suppression Pool Access Hatch #1	S.P. Access Hatch #1	01/03/92	0.0	0.0	0.0	03/24/92	0.0	0.0	0.0
M-114	Suppression Pool Access Hatch #2	S.P. Access Hatch #2	01/03/92	0.0	0.0	0.0	03/19/92	0.0	0.0	0.0
M-115	CRD Removal Hatch	CRD Removal Hatch	01/04/92	0.0	0.0	0.0	03/05/92	0.0	0.0	0.0
N/A	Drywell Head	Drywell Head	01/05/92	0.0	0.0	0.0	03/24/92	0.0	0.0	0.0
M-42	E T.I.P. Penetration Flange	E T.I.P. Penetration Flange	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-43	D T.I.P. Penetration Flange	D T.I.P. Penetration Flange	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-44	C T.I.P. Penetration Flange	C T.I.P. Penetration Flange	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-45	B T.I.P. Penetration Flange	B T.I.P. Penetration Flange	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-46	A T.I.P. Penetration Flange	A T.I.P. Penetration Flange	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-108/M-104	DW to S.P. Vacuum Breaker A Outboard Flange	2PC001A Outboard Flange Seal	01/04/92	0.65	0.65	0.65	03/05/92	0.0	0.0	0.0
M-108/M-104	DW to S.P. Vacuum Breaker A Inboard Flange	2PC001A Inboard Flange Seal	01/04/92	0.0	0.0	0.0	03/05/92	0.0	0.0	0.0
		PAGE TOTAL			0.65	0.65			0.0	0.0

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TABLE 6
(Sheet 3 of 9)

			AS-FOUND (SCFH)				AS-LEFT (SCFH)			
PENETRATION	DESCRIPTION	VALVES(s)/COMPONENT	DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-108/M-104	DW to S.P. Vacuum Breaker A Actuator O-Ring	2PC001A Actuator O-Ring	01/04/92	0.0	0.0	0.0	03/11/92	0.0	0.0	0.0
M-108/M-104	DW to S.P. Vacuum Breaker A Actuator Seal	2PC001A Actuator Seal	01/04/92	0.0	0.0	0.0	03/11/92	0.0	0.0	0.0
M-106/M-110	DW to S.P. Vacuum Breaker B Outboard Flange	2PC001B Outboard Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-106/M-110	DW to S.P. Vacuum Breaker B Inboard Flange	2PC001B Inboard Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-106/M-110	DW to S.P. Vacuum Breaker B Actuator O-Ring	2PC001B Actuator O-Ring	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-106/M-110	DW to S.P. Vacuum Breaker B Actuator Seal	2PC001B Actuator Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-103/M-107	DW to S.P. Vacuum Breaker C Outboard Flange	2PC001C Outboard Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-103/M-107	DW to S.P. Vacuum Breaker C Inboard Flange	2PC001C Inboard Flange Seal	01/04/92	0.368	0.368	0.368	01/04/92	0.368	0.368	0.368
		PAGE TOTAL			0.368	0.368			0.368	0.368

TABLE 6
(Sheet 4 of 9)

PENETRATION	DESCRIPTION	VALVES(s)/COMPONENT	AS-FOUND (SCFH) DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	AS-LEFT (SCFH) DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-103/M-107	DW to S.P. Vacuum Breaker C Actuator O-Ring	2PC001C Actuator O-Ring	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-103/M-107	DW to S.P. Vacuum Breaker C Actuator Seal	2PC001C Actuator Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-105/M-109	DW to S.P. Vacuum Breaker D Outboard Flange	2PC001D Outboard Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-105/M-109	DW to S.P. Vacuum Breaker D Inboard Flange	2PC001D Inboard Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-105/M-109	DW to S.P. Vacuum Breaker D Actuator O-Ring	2PC001D Actuator O-Ring	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-105/M-109	DW to S.P. Vacuum Breaker D Actuator Seal	2PC001D Actuator Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-20	Drywell Vent	2VQ030 Inner Flange Seal	01/03/92	0.0	0.0	0.0	01/03/92	0.0	0.0	0.0
M-82	HPCS Spare Penetration	HPCS Spare Flange	01/03/92	0.0	0.0	0.0	01/03/92	0.0	0.0	0.0
M-66	Suppression Pool Vent	2VQ027 Inner Flange Seal	01/03/92	0.0	0.0	0.0	02/29/92	0.0	0.0	0.0
M-67	Suppression Chamber Purge	2VQ031 Inner Flange Seal	01/03/92	0.0	0.0	0.0	01/03/92	0.0	0.0	0.0
			PAGE TOTAL		0.0	0.0			0.0	0.0

TABLE 6
(Sheet 5 of 9)

PENETRATION	DESCRIPTION	VALVES(s)/COMPONENT	AS-FOUND (SCFH) DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	AS-LEFT (SCFH) DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-21	Drywell Purge	2VQ034 Inner Flange Seal	01/03/92	0.0	0.0	0.0	01/03/92	0.0	0.0	0.0
M-20	Drywell Vent	2VQ030 Valve Stem Packing	01/03/92	0.0	0.0	0.0	01/03/92	0.0	0.0	0.0
M-66	Suppression Chamber Vent	2VQ027 Valve Stem Packing	01/03/92	0.0	0.0	0.0	02/29/92	0.0	0.0	0.0
M-67	Suppression Chamber Purge	2VQ031 Valve Stem Packing	01/03/92	0.0	0.0	0.0	01/03/92	0.0	0.0	0.0
M-38	SA to Drywell	Service Air Blind Flange Seal	01/03/92	0.0	0.0	0.0	03/25/92	0.0	0.0	0.0
M-37	MC to Drywell	MC Blind Flange Seal	01/03/92	0.0	0.0	0.0	03/25/92	0.0	0.0	0.0
M-21	Drywell Purge	2VQ034 Valve Stem Packing	01/03/92	0.0	0.0	0.0	01/03/92	0.0	0.0	0.0
M-103	C Vacuum Bkr Line	2PC003C Inner Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-104	A Vacuum Bkr Line	2PC003A Inner Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-105	D Vacuum Bkr Line	2PC003D Inner Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-106	B Vacuum Bkr Line	2PC003B Inner Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-107	C Vacuum Bkr Line	2PC002C Inner Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-108	A Vacuum Bkr Line	2PC002A Inner Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-109	D Vacuum Bkr Line	2PC002D Inner Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-110	B Vacuum Bkr Line	2PC002B Inner Flange Seal	01/04/92	0.0	0.0	0.0	01/04/92	0.0	0.0	0.0
M-97	DW Equipment Drain Sump Cooling	2RE026/2RE029	01/15/92	5.32	2.66	5.32	01/15/92	1.7	0.85	1.7
			PAGE TOTAL		2.66	5.32			0.85	1.7

TABLE 6
(Sheet 6 of 9)

PENETRATION	DESCRIPTION	VALVES(s)/COMPONENT	AS-FOUND (SCFH) DATE	AS-FOUND TOTAL	AS-FOUND MINIMUM PATHWAY	AS-FOUND MAXIMUM PATHWAY	AS-LEFT (SCFH) DATE	AS-LEFT TOTAL	AS-LEFT MINIMUM PATHWAY	AS-LEFT MAXIMUM PATHWAY
E-21	Electrical Penetration	Electrical Penetration	01/03/92	0.0	0.0	0.0	01/03/92	0.0	0.0	0.0
E-23	Electrical Penetration	Electrical Penetration	01/03/92	0.37	0.37	0.37	01/03/92	0.37	0.37	0.37
E-26	Electrical Penetration	Electrical Penetration	02/13/92	0.0	0.0	0.0	02/13/92	0.0	0.0	0.0
M-96	Drywell Equipment Drain Sump	2RE024/2RE025	01/15/92	5.05	2.525	5.05	03/16/92	0.84	0.42	0.84
M-30	Reactor Water Cleanup Suction	2G33-F001 2G33-F004	01/18/92 01/18/92	115.7 127.7	115.7	127.7	02/27/92 02/27/92	0.0 0.0	0.0	0.0
M-101	RCIC Turbine Exhaust Vacuum Breaker	2E51-F080/2E51-F086	01/06/92	0.74	0.37	0.74	01/06/92	0.0	0.0	0.0
N/A	Electrical Penetration Pressurization System	Electrical Penetration Pressurization System	01/16/92	0.95	0.95	0.95	01/16/92	0.95	0.95	0.95
M-25	PCCW A Supply	2VP063A/2VP113A	01/10/92	1.39	0.695	1.39	01/10/92	1.39	0.695	1.39
M-26	PCCW B Supply	2VP063B/2VP113B	01/12/92	0.46	0.23	0.46	03/06/92	0.37	0.185	0.37
M-27	PCCW A Return	2VP053A/2VP114A	01/10/92	24.5	12.25	24.5	03/14/92	5.6	2.8	5.6
M-28	PCCW B Return	2VP053B/2VP114B	01/12/92	0.37	0.185	0.37	01/12/92	0.37	0.185	0.37
M-47	T.I.P. Index Purge Air Supply	2IN031	01/10/92	0.0	0.0	0.0	01/10/92	0.0	0.0	0.0
M-54	Drywell Pneumatic Discharge to Drywell	2IN017 2IN018	01/10/92 01/10/92	0.47 0.0	0.0	0.47	01/10/92 01/10/92	0.47 0.0	0.0	0.47
M-53	Combustible Gas Control A Suction	2HG001A/2HG002A	01/10/92	1.07	0.535	1.07	02/20/92	0.57	0.285	0.57
			PAGE TOTAL		133.81	163.07			5.89	10.93

TABLE 6
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PENETRATION	DESCRIPTION	VALVES(s)/COMPONENT	AS-FOUND (SCFH)				AS-LEFT (SCFH)			
			DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-104	Combustible Gas Control A Return	2HG005A/2HG006A	01/10/92	4.17	2.085	4.17	03/13/92	6.51	3.255	6.51
M-33	Combustible Gas Control B Suction	2HG001B/2HG002B	01/10/92	0.56	0.28	0.56	02/20/92	0.56	0.28	0.56
M-106	Combustible Gas Control B Return	2HG005B/2HG006B	01/10/92	0.0	0.0	0.0	03/13/92	0.37	0.185	0.37
M-15	RCIC Steam Supply	2E51-F063/2E51-F076 2E51-F064/2E51-F008 2E51-F091	01/15/92	10.28	5.14	10.28	03/25/92	7.9	3.95	7.9
M-38	SA to Drywell	2SA042 & 2SA046 Packing	01/05/92	0.0	0.0	0.0	01/05/92	0.0	0.0	0.0
M-37	MC to Drywell	2MC027 & 2MC033 Packing	01/05/92	0.0	0.0	0.0	01/05/92	0.0	0.0	0.0
M-29	RHR/RCIC Head Spray	2E51-F013/2E12-F023	01/16/92	1.54	1.54	1.54	01/16/92	1.54	1.54	1.54
M-59	Cycled Condensate to Refueling Bellows	2FC113 2FC114	01/06/92 01/06/92	0.0 1.3	0.0	1.3	01/06/92 01/06/92	0.0 1.3	0.0	1.3
M-65	Reactor Well Drain	2FC115 2FC086	01/06/92 01/06/92	0.371 0.371	0.371	0.371	01/06/92 01/06/92	0.371 0.371	0.371	0.371
M-16	RBCCW Supply	2WR029 2WR179	01/12/92 01/12/92	0.0 0.0	0.0	0.0	02/29/92 02/29/92	0.0 0.0	0.0	0.0
M-17	RBCCW Return	2WR040 2WR180	01/12/92 01/12/92	0.0 0.0	0.0	0.0	02/29/92 02/29/92	0.0 1.3	0.0	1.3
I-4F	Drywell Humidity Monitor A Suction	2CM017A/2CM018A	01/07/92	0.0	0.0	0.0	01/07/92	0.0	0.0	0.0
			PAGE TOTAL		9.416	18.221			9.581	19.851

TABLE 6
(Sheet 8 of 9)

PENETRATION	DESCRIPTION	VALVES(s)/COMPONENT	AS-FOUND (SCFH) DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	AS-LEFT (SCFH) DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
I-5F	Drywell Humidity Monitor B Suction	2CM017B/2CM018B	01/07/92	0.0	0.0	0.0	01/07/92	0.0	0.0	0.0
I-45	Drywell Humidity Monitor A Discharge	2CM019A/2CM020A	01/07/92	0.0	0.0	0.0	01/07/92	0.0	0.0	0.0
I-45	Drywell Humidity Monitor B Discharge	2CM019B/2CM020B	01/07/92	0.0	0.0	0.0	01/07/92	0.0	0.0	0.0
M-54	Drywell Pneumatic Dryer Purge	2IN074/2IN075	01/06/92	3.34	1.67	3.34	03/05/92	5.55	2.775	5.55
M-11	HPCS Injection	2E22-F004	01/09/92	0.56	0.56	0.56	01/25/92	0.0	0.0	0.0
M-7	RHR Shutdown Cooling Suction	2E12-F008	01/17/92	0.37			03/02/92	0.47		
		2E12-F009	01/17/92	0.37	0.37	0.37	03/02/92	2.1	0.47	2.1
M-34	SBLC Injection	2C41-F004A/2C41-F004B	05/01/90	0.0			02/26/92	0.0		
		2C41-F007	02/26/92	0.37	0.0	0.37	02/26/92	0.37	0.0	0.37
M-81	RCIC Vacuum Pump Discharge	2E51-F028/2E51-F069	01/08/92	3.01	1.505	3.01	03/10/92	3.28	1.64	3.28
M-76	RCIC Turbine Exhaust	2E51-F040/2E51-F068	01/08/92	0.474	0.237	0.474	01/08/92	0.474	0.237	0.474
M-20	Drywell Inerting Makeup	2VQ047/2VQ048	01/06/92	0.565	0.2825	0.565	01/06/92	0.565	0.2825	0.565
M-66	Suppression Pool Inerting Makeup	2VQ050/2VQ051	01/06/92	0.0	0.0	0.0	02/14/92	0.0	0.0	0.0
M-46	A T.I.P. Penetration	T.I.P. Ball Valve A	01/09/92	0.65	0.65	0.65	01/09/92	0.65	0.65	0.65
		PAGE TOTAL			5.2745	9.339			6.0545	12.989

TABLE 6
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PENETRATION	DESCRIPTION	VALVES(s)/COMPONENT	AS-FOUND (SCFH) DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	AS-LEFT (SCFH) DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-45	B T.I.P. Penetration	T.I.P. Ball Valve B	01/09/92	0.37	0.37	0.37	01/09/92	0.37	0.37	0.37
M-44	C T.I.P. Penetration	T.I.P. Ball Valve C	01/09/92	0.65	0.65	0.65	01/09/92	0.65	0.65	0.65
M-43	D T.I.P. Penetration	T.I.P. Ball Valve D	01/09/92	0.37	0.37	0.37	01/09/92	0.37	0.37	0.37
M-42	E T.I.P. Penetration	T.I.P. Ball Valve E	01/09/92	1.21	1.21	1.21	01/09/92	1.21	1.21	1.21
M-18	RHR A Drywell Spray	2E12-F016A/2E12-F017A	01/16/92	0.0	0.0	0.0	02/17/92	1.6	0.8	1.6
M-19	RHR B Drywell Spray	2E12-F016B/2E12-F017B	01/31/92	0.0	0.0	0.0	02/26/92	13.8	6.9	13.8
M-13	RHR A LPCI Injection	2E12-F042A	01/17/92	0.0	0.0	0.0	02/23/92	0.47	0.47	0.47
M-14	RHR B LPCI Injection	2E12-F042B	01/31/92	1.48	1.48	1.48	02/25/92	0.0	0.0	0.0
M-8	A RHR Shutdown Cooling Return	2E12-F053A	01/16/92	0.0	0.0	0.0	02/17/92	0.0	0.0	0.0
M-9	B RHR Shutdown Cooling Return	2E12-F053B	02/01/92	0.0	0.0	0.0	02/01/92	0.0	0.0	0.0
M-10	LPCS Injection	2E12-F005	01/11/92	0.0	0.0	0.0	01/11/92	0.0	0.0	0.0
M-12	RHR C LPCI Injection	2E12-F042C	01/20/92	0.0	0.0	0.0	01/20/92	0.0	0.0	0.0
M-77	RCIC Test Return to Suppression Pool	2E51-F362/2E51-F363	N/A	N/A	N/A	N/A	03/10/92	0.46	0.23	0.46
		PAGE TOTAL			4.08	4.08			11.00	18.93
		TOTAL ALL PAGES			199.47	287.028			47.694	96.928

APPENDIX B

TYPE B AND C TEST SUMMARY

The As-Found leak rate for the Primary Containment Isolation Valves/Components, excluding the Main Steam Isolation Valves was below the Tech Spec Limit of 231.4 SCFH using the Minimum Path Methodology. The Tech Spec limit was exceeded using the Maximum Path Methodology due to a large leakage contribution from Reactor Water Cleanup Suction Isolation Valves which amounted to 127.7 SCFH or 44.5 % of the total. The 2G33-F001 and 2G33-F004 Reactor Water Cleanup Isolation Valves were replaced during the outage and other components repaired/adjusted to bring the total Type B and C leakage well below the Tech Spec limit.

	As-Found Min Path (SCFH)	As-Found Max Path (SCFH)	As-Left Max Path (SCFH)	Tech Spec Limit (SCFH)
Type B	4.078	4.078	4.458	-----
Type C	195.3955	282.95	92.47	-----
Total	199.47	287.03	96.93	231.4

Main Steam Isolation Valves (Tested at 25 psig)

STEAM LINE	AS FOUND LEAK RATE (SCFH)	AS LEFT LEAK RATE (SCFH)	TECH SPEC LIMIT (SCFH)
A	23.78	24.1	-----
B	28.1	8.67	-----
C	6.7	11.44	-----
D	7.1	7.65	-----
TOTAL	65.68	51.86	100

APPENDIX C
(Sheet 1 of 15)

CALCULATION OF CONTAINMENT DRY AIR MASS

A. Average Temperature of Subvolume #i (T_i)

The average temperature of subvolume #i (T_i) equals the average of all RTD/Thermister temps in subvolume #i

$$T_i = \frac{1}{N} \sum_{j=1} T_{i,j}$$

Where

N = The number of RTDs/Thermisters in subvolume #i

B. Average Dew Temperature of Subvolume #i (D_i)

The average dew temperature of subvolume #i (D_i) equals the average of all dew cell dew temps in subvolume #i

$$D_i = \frac{1}{N} \sum_{j=1} D_{i,j}$$

Where

N = the number of Dew Cells in subvolume #i

If the subvolume in question is the suppression pool, the above assumption may be used if it can be shown from previous test data that there is a very close correlation between suppression pool chamber and water temperature.

C. Total Corrected Pressure for Pressure transmitter #i (P_i)

The total corrected pressure #i, (P_i) is

$$P_i = C_i + M_i \, Pr_i$$

Where

C_i = Zero shift correction factor for raw pressure #i
M_i = Slope correction factor for raw pressure #i
Pr_i = Raw pressure #i, in decimal form

D. Whole Containment Volume Weighted Average Temperature, (T_c)

Calculate T_c using the below equation or one that yields equivalent values to two decimal places.

APPENDIX C
(Sheet 2 of 15)

CALCULATION OF CONTAINMENT DRY AIR MASS

$$T_c = \frac{1}{\sum_{i=1}^{N} \frac{f_i}{T_i}}$$

where

f_i = The volume fraction of the i^{th} subvolume
N = The total number of subvolumes in containment

E. Calculation of the Average Vapor Pressure of Subvolume i, (Pv_i)

Average Subvolume Vapor Pressure as functions of Average Dew Temperatures (D_i) are most accurately found from ASME Steam Tables. A similar correlation that is extremely accurate is given below. *

For $32 \le D_i \le 80°F$

$$Pv_i = 0.2105538 \times 10^{-1} + 0.1140313 \times 10^{-2} D_i + 0.1680644 \times 10^{-4} \times D_i^2 + 0.3826294 \times 10^{-6} D_i^3 + 0.5787831 \times 10^{-9} D_i^4 + 0.2056074 \times 10^{-10} D_i^5$$

For $80 \le D_i \le 115°F$

$$Pv_i = 0.18782 - 0.7740034 \times 10^{-2} D_i + 0.204009 \times 10^{-3} \times D_i^2 - 0.1569692 \times 10^{-5} D_i^3 + 0.1065012 \times 10^{-7} D_i^4$$

For $115 \le D_i \le 155°F$

$$Pv_i = 0.9897124 - 0.3502587 \times 10^{-1} D_i + 0.5537028 \times 10^{-3} \times D_i^2 - 0.3570467 \times 10^{-5} D_i^3 + 0.1496218 \times 10^{-7} D_i^4$$

For $155 \le D_i \le 215°F$

$$Pv_i = 0.3338872 \times 10^{1} - 0.9456801 \times 10^{-1} D_i + 0.1121381 \times 10^{-2} D_i^2 - 0.598361 \times 10^{-5} D_i^3 + 0.1882153 \times 10^{-7} D_i^4$$

*NOTE: Numbers from ASME Standard Steam Tables, Fifth Edition.

APPENDIX C
(Sheet 3 of 15)

CALCULATION OF CONTAINMENT DRY AIR MASS

F. Whole Containment Average Vapor Pressure, (Pv_c)

Calculate Pv_c using the below equation or one that yields equivalent values to two decimal places.

$$Pv_c = T_c \sum_{i=1}^{N} \frac{f_i \, Pv_i}{T_i}$$

where

N = The total of subvolumes in containment

f_i = Volume fraction of the i^{th} subvolume

G. Calculation of the Whole Containment Average Dew Temperature, (D_c)

Whole Containment Average Dew Temperature as functions of Whole Containment Average Vapor Pressures are most accurately found from ASME Steam Tables. A simpler correlation that is extremely accurate is given below. *

D_c is in units of °F.

For $0.08859 \leq Pv_c \leq 0.50683$ psia

Note: P_c (0.08859) = 32°F, P_c (0.50683) = 80°F

$$D_c = -0.5593968 \times 10^1 + 0.6348248 \times 10^3 \, Pv_c - 0.320306 \times 10^4 \, Pv_c^2 + 0.1130089 \times 10^5 \, Pv_c^3 - 0.2411539 \times 10^5 \, Pv_c^4 + 0.2796469 \times 10^5 \, Pv_c^5 - 0.1348916 \times 10^5 \, Pv_c^6$$

For $0.50683 \leq Pv_c \leq 1.4711$ psia

Note: P_c (0.50683) = 80°F, P_c (1.4711) = 115°F

$$D_c = + 0.2334173 \times 10^2 + 0.2004024 \times 10^3 \, Pv_c - 0.2785328 \times 10^3 \, Pv_c^2 + 0.2765841 \times 10^3 \, Pv_c^3 - 0.168669 \times 10^3 \, Pv_c^4 + 0.5658985 \times 10^2 \, Pv_c^5 - 0.7977715 \times 10^1 \, Pv_c^6$$

APPENDIX C
(Sheet 4 of 13)

CALCULATION OF CONTAINMENT DRY AIR MASS

For $1.4711 \leq Pv_c \leq 4.2036$ psia

Note: P_c (1.4711) = 115°F, P_c (4.2036) = 155°F

$$D_c = + 0.5221757 \times 10^2 + 0.7391149 \times 10^2 Pv_c - 0.3306993 \times 10^2 Pv_c^2 + 0.1074842 \times 10^2 Pv_c^3 - 0.2169825 \times 10^1 Pv_c^4 + 0.2432796 Pv_c^5 - 0.1155358 \times 10^{-1} Pv_c^6$$

For $4.2036 \leq Pv_c \leq 15.592$ psia

Note: P_c (4.2036) = 155°F, P_c (15.592) = 215°F

$$D_c = 0.8512278 \times 10^2 + 0.274613 \times 10^2 Pv_c - 0.3847812 \times 10^1 Pv_c^2 + 0.3909064 Pv_c^3 - 0.2451226 \times 10^{-1} Pv_c^4 + 0.8484505 \times 10^{-3} Pv_c^5 - 0.1237098 \times 10^{-4} Pv_c^6$$

*NOTE: Numbers from ASME Standard Steam Tables, Fifth Edition.

H. Average Total Containment Pressure, (P)

$$P = \frac{1}{N} \sum_{i=1}^{N} P_{ri}$$

where

N is the number of pressure transmitters used

I. Average Total Containment Dry Air Pressure, (P_d)

$$P_d = P - Pv_c$$

APPENDIX C
(Sheet 5 of 15)

CALCULATION OF CONTAINMENT DRY AIR MASS

J. Total Containment Dry Ai. Mass, (M)

Type 1:

$$M = \frac{P_d V_c}{R T_c}$$

where

R = Perfect gas constant of air, 53.35 lb_f - ft/lb_m - °R

V_C = Total containment free volume.

APPENDIX C
(Sheet 6 of 15)

BN-TOP-1 METHOD TEST CALCULATIONS

A. Measured Leak Rate (Total time calculations)

From BN-TOP-1 Revision 1, Section 6.0 the following equation is given for the measured leak rate using the total time procedure:

$$M_i = \frac{2400}{t_i} \left| 1 - \frac{T_o \bar{P}_{ith}}{T_{ith} \bar{P}_o} \right|$$

WHERE:

M_i = Measured leak rate in weight % per day for the ith data point

t_i = Time since the beginning of the test period to the ith data point in hours

T_o, T_{ith} = mean volume weighted containment temperature at the beginning of the test and at the ith data point (R)

P_1, P_2 = mean total absolute pressure, PSIA of the containment atmosphere at the beginning and end of test interval (t_i) respectively.

P_{v1}, P_{v2} = mean total water vapor pressure, PSIA, of the containment atmosphere at the beginning and end of test interval (t_i) respectively

$\bar{P}_o = P_1 - P_{v1}$

$\bar{P}_{ith} = P_2 - P_{v2}$

B. Calculated Leak Rate

The method of Least Squares is a statistical procedure for finding the "best fit" straight line, commonly called the regression line, for a set of measured data such that the sum of the squares of the deviations of each measured data point from the straight line is minimized.

To determine the calculated leak rate (L_i) at time t_i, the regression line is determined using the measured leak rate data from the start of the test to time t_i. The calculated leak rate is the point on this line at time t_i.

$$L_i = A_i + B_i(t_i) \quad [4]$$

APPENDIX C
(Sheet 7 of 15)

BN-TOP-1 METHOD TEST CALCULATIONS

Using differential calculus, the numerical values of A_i and B_i that will minimize the sum of the squares of the deviations can be shown to be:

$$A_i = \frac{(\Sigma Mi)\ (\Sigma ti^2)\ -\ (\Sigma ti)\ (\Sigma tiMi)}{n(\Sigma ti^2)\ -\ (\Sigma ti)^2} \quad [5]$$

$$B_i = \frac{n\Sigma tiMi\ -\ (\Sigma ti)\ (\Sigma Mi)}{n(\Sigma ti^2)\ -\ (\Sigma ti)^2} \quad [6]$$

WHERE:

n = number of data sets to time ti

Equations [5] and [6] are referred to as the Least Square equations and are used by the computer program to compute the calculated leak rate for the Total Time and Point to Point calculations.

C. Confidence Limits

Even though the regression line is statistically determined to minimize the sum of the squares of the error, the values of the calculated leak rate cannot be considered to be exactly correct. If the containment integrated leak rate test were run a number of times, under the same conditions, the calculated leak rates would be close in value but not exactly the same each time.

However, based on statistics we can establish confidence limits associated with the regression line such that the limits of the calculated leak rate computed would successfully enclose the true value of the desired parameter a large fraction of the time. This fraction is called the confidence coefficient and the interval within the confidence limits is the confidence interval.

Confidence limits for the integrated leak test computer program are determined based on a confidence coefficient of 95%. This means that the probability that the value of the calculated leak rate will fall within the upper and lower confidence limits, or confidence interval, is 95%.

APPENDIX C
(Sheet 8 of 15)

BN-TOP-1 METHOD TEST CALCULATIONS

To determine the value of the confidence limits the following statistical information is required: the variance, standard deviation, and the Student's T-distribution.

The variance, as the name implies, is a measure of the variability of individually measured data points from the mean, or in this case, from the regression line. The variance of the measured leak rate (Mi) from the calculated leak rate (Li) is given by:

$$s^2 = \frac{SSQ}{n-2} \qquad [7]$$

Where s is the variance and s is the standard deviation based on (n-2) degrees of freedom. SSQ is the sum of the squares of the deviations from the regresssion line and is mathematically expressed below:

$$SSQ = \Sigma\ (Mi - Ni)^2 \qquad [8]$$

Where: N_i = deviation from regression line

The standard deviation has more practical significance since computing the standard deviation returns the measure of variability to the original units of measurement. Additionally, it can be shown that given a normal distribution of measurements, approximately 95% of the measurements will fall within two standard deviations of the mean.

The number of standard deviations either side of the regression line which establish a upper confidence interval are more accurately determined using a statistical table called a "Table of Percentage Points of the T-distribution" and provide increased confidence in outcomes for small and large sample sizes.

Since we are interested in reporting a single value of calculated leak rate based on measurements taken over a specific time period, an additional factor is applied to the formula for computing the variance and hence, the standard deviation.

APPENDIX C
(Sheet 9 of 15)

BN-TOP-1 METHOD TEST CALCULATIONS

The Table of T-distributions has been formulized for use by the computer program as follows:

$$T = 1.95996 + \left|\frac{2.37226}{(n-2)}\right| + \left|\frac{2.8225}{(n-2)^2}\right| \quad [9]$$

WHERE: the value of T is based on 95% confidence limits and (n-2) degrees of freedom.

The application of the additional factor to the variance formula yields:

$$\sigma^2 = s^2 \left| 1 + \frac{1}{n} + \frac{(tp - \bar{t})^2}{\Sigma (ti - \bar{t})^2} \right| \quad [10]$$

WHERE:

tp = time from the start of the test of the last data set for which the standard deviation of the measured leak rates (Mi) from the regression line is being computed.

ti = time from the start of the test of the ith data set

n = number of data sets to time tp

$$\Sigma = \sum_{i=1}^{n} \quad ; \quad \text{and} \quad [11]$$

$$\bar{t} = \frac{1}{n} \Sigma \; ti$$

Taking the square root of equation [10] yields the standard deviation:

$$\sigma = s \left| 1 + \frac{1}{n} + \frac{(tp - \bar{t})^2}{\Sigma (ti - \bar{t})^2} \right|^{1/2}$$

The upper confidence limit can now be determined, the confidence limit being equal to T standard deviations above and below the regression line. Combining equations [10] and [11] yields:

APPENDIX C
(Sheet 10 of 15)

BN-TOP-1 METHOD TEST CALCULATIONS

Confidence limits = L ± Tσ [12]

or

UCL = Li + Tσ [13]

WHERE: UCL is the upper confidence limit respectfully.

WHERE: Li = Calculated Leak Rate at Time ti
T = T-Distribution value based on n, the number of data sets received up until time ti.
σ = Standard deviation of Measure Leak Rate (Mi) values about the regression line based on data from the start of the test until time ti.

APPENDIX C
(Sheet 11 of 15)

Data Rejection Criteria

1. If a sensor, in the opinion of the Tech Staff Engineer, is out of range, it will be ignored (i.e., set=0) and the number of operable RTD's/Thermisters or Dewcells in the subvolume will be reduced by one. The sensor should be considered out of range if it is evident that the sensor has malfunctioned. All rejected data should be maintained if possible and the reason for rejection documented on Attachment Z data sheet and in the Events log, (Attachment C).

   Should the number of RTD's/Thermisters or the number of Dew cells in a subvolume become equal to zero (accept for Subvolume, 2 and 7: Zero dewcells already) then with approval of the Technical Staff Supervisor, substitute the average temperature of the appropriate subvolume which is chosen based upon the temperature survey and/or temperature distribution prior to instrument failure. Document on Attachment Z data sheet and in Events Log, (Attachment C).

   NOTE

   If all RTD's/Thermisters in subvolume 9 are lost, then stop the test and repair the RTD's/Thermisters or if the AIR in Subvolume 9 can be shown to be near saturation, use Subvolume 9 average Dewcell temperature.

   If all Dewcells in Subvolume 9 are lost, and the Air in Subvolume 9 can be shown to be near saturation, use Subvolume 9 average RTD/Thermister temperature. Also, if the average RTD/Thermister temperature over the last 6 data sets is within 0.5°F of a specific RTD/Thermister, the specific RTD/Thermister may be chosen as the Dewcell.

2. If one pressure transmitter is out of the range of 14 < P (psia) < 60 the pressure transmitter will be ignored (set=0).

   NOTE

   All Data should be reculculated with bad element(s) deleted.

3. Raw temperature, pressure, and dew point data should not be rejected statistically, but may be rejected and not used in the final calculations provided there is a good physical reason for the rejection. Data rejected, including the cause or probable cause for the bad data, are to be documented. If the validity of certain data is suspect, but no physical reason is found, then a statistical rejection technique may be applied. (See ANSI/ANS 56.8-1987, for Data Rejection Criterion). A data point may be rejected if it is expected to occur statistically less than 5% of the time. The statistical rejection of more than 5% of a set of data should not be allowed.

APPENDIX C
(Sheet 12 of 15)

CALCULATION OF INSTRUMENT SELECTION GUIDE, (ISG)

$$ISG = \frac{2400}{t} \left[\frac{2}{N_p} (e_p/p)^2 + \frac{2}{N_r} (e_r/T)^2 + \frac{2}{N_d} (e_d/P)^2 \right]^{1/2}$$

where: t is the test time, in hours
p is test pressure, psia
T is the volume weighed average containment temperature, (°R)
N_p is the number of pressure transmitters
N_r is the number of RTDs/Thermisters
N_d is the number of dew cells
e_p is the combined pressure transmitters' error, (psia)
e_r is the combined RTDs'/thermisters error, (°R)
e_d is the combined dew cells' error, (°R)

$$ep = \left[(S_p)^2 + (RP_p + RS_p)^2 \right]^{1/2}$$

where: S_p is the sensitivity of a pressure transmitter
RP_p is the repeatability of a pressure transmitter
RS_p is the resolution of pressure transmitter

$$e_r = \left[(S_r)^2 + (RP_r + RS_r)^2 \right]^{1/2}$$

where: S_r is the sensitivity of an RTD/thermister
RP_r is the repeatability of an RTD/thermister
RS_p is the resolution of an RTD/thermister

$$e_d = \frac{\Delta P_v}{\Delta T_d} \bigg|_{T_d} \left[(S_d)^2 + (RP_d + RS_d)^2 \right]^{1/2}$$

where: S_d is the sensitivity of a dew cell
RP_d is the repeatability of a dew cell
PS_d is the resolution of a dew cell

$$\frac{\Delta P_v}{\Delta T_d} \bigg|_{T_d} = \frac{\text{change in vapor pressure}}{\text{change in saturation temperature}}$$

The above ratio is from ASME steam tables and evaluated at the containment's saturation temperature at that time.

APPENDIX C
(Sheet 13 of 15)

UPPER AND LOWER BOUNDING ISG VALUES

USE SENSOR CONFIGURATION IN CONFIG. FL

LASALLE Unit 2

TEST DURATION (HOURS)	MINIMUM ISG VALUE (%/DAY)	MAXIMUM ISG VALUE (%/DAY)
1	0.0625	0.0670
2	0.0312	0.0335
3	0.0208	0.0223
4	0.0156	0.0168
5	0.0125	0.0134
6	0.0104	0.0112
7	0.0089	0.0096
8	0.0078	0.0084
9	0.0069	0.0074
10	0.0062	0.0067
11	0.0057	0.0061
12	0.0052	0.0056
13	0.0048	0.0052
14	0.0045	0.0048
15	0.0042	0.0045
16	0.0039	0.0042
17	0.0037	0.0039
18	0.0035	0.0037
19	0.0033	0.0035
20	0.0031	0.0034
21	0.0030	0.0032
22	0.0028	0.0030
23	0.0027	0.0029
24	0.0026	0.0028

NO PRESSURE CHANNELS ARE LOCKED OUT

DAS CHANNEL #39 IS LOCKED OUT FROM DSN 1

APPENDIX C
(Sheet 14 of 15)

UPPER AND LOWER BOUNDING ISG VALUES

USE SENSOR CONFIGURATION IN CONFIG. FL

LASALLE Unit 2

TEST DURATION (HOURS)	MINIMUM ISG VALUE (%/DAY)	MAXIMUM ISG VALUE (%/DAY)
1	0.0626	0.0678
2	0.0313	0.0339
3	0.0209	0.0226
4	0.0157	0.0170
5	0.0125	0.0136
6	0.0104	0.0113
7	0.0089	0.0097
8	0.0078	0.0085
9	0.0070	0.0075
10	0.0063	0.0068
11	0.0057	0.0062
12	0.0052	0.0057
13	0.0048	0.0052
14	0.0045	0.0048
15	0.0042	0.0045
16	0.0039	0.0042
17	0.0037	0.0040
18	0.0035	0.0038
19	0.0033	0.0036
20	0.0031	0.0034
21	0.0030	0.0032
22	0.0028	0.0031
23	0.0027	0.0029
24	0.0026	0.0028

NO PRESSURE CHANNELS ARE LOCKED OUT

DAS CHANNEL #39 IS LOCKED OUT FROM DSN 1
DAS CHANNEL #49 IS LOCKED OUT FROM DSN 1

APPENDIX C
(Sheet 15 of 15)

DEFINITIONS

A. Maximum Allowable Leak Rate (L_A) at pressure Pa (39.6 psig)

L_a = 0.635% of containment volume per day
= 0.00635 x 394,638 ft ^{3}/24 hr
= 2506 ft ^{3}/24 hr
= 104.4 ft ^{3}/hr
= $104.4 \frac{(39.6 + 14.7)}{14.7}$ = 385.7 SCFH

B. Maximum Allowable Operational Leak Rate (L_T) at pressure P_A (39.6 psig)

L_T = 0.75 L_A
= 0.75 (.635%/day)
= 0.476%/day
= 289.3 SCFH

C. Maximum Allowable Total Type "B" and "C" tests (L_1)

L_1 = 0.60 L_A
= C.60 (.635%/day)
= 0.381%/day
= 231.4 SCFH

D. Induced Leak Rate Acceptance Criteria

L_o = superimposed flowmeter leak rate (%/day)
L_c = Induced Statistically Averaged/Calculated leak rate during verification test (%/day)
L_i = Statistically Averaged/Calculated leak rate prior to verification test (%/day)

$$\left| L_c - (L_o + L_i) \right| \leq 0.25\, L_a$$
$$\leq 0.25 L_a \text{ (.635\%/day)}$$
$$\leq 0.159\text{\%/day}$$

E. Rotometer: Induced Flowmeter Flowrate [L_o (scfh)] pressure-temperature correction

$$L_o = L_m \left[\frac{(Pm)(Tc)}{(Pc)(Tm)}\right]^{1/2}$$

Lm = Measured Flow (SCFH)
Pm = Rotometer Outlet Pressure (PSIA)
Pc = Calibrated Pressure (PSIA)
Tm = Rotometer Outlet Temperature (°R)[°F + 459.69]
Tc = Calibrated Temperature (°R)[°F + 459.69]

APPENDIX D
(Sheet 1 of 5)

BN-TOP-1, REV. 1 ERRATA

The Commission has approved short duration testing for the IPCLRT provided the Station uses the general test method outlined in the BN-TOP-1, Rev. 1 topical report. The primary difference between that method and the ones previously used is in the statistical analysis of the measured leak rate data.

Without making any judgements concerning the validity of this test method, certain errors in the editing of the mathematical expressions were discovered. The intent here is not to change the test method, but rather to clarify the method in a mathematically precise manner that allows its implementation. The errors are listed below.

EQUATION 3A, SECTION 6.2

Reads: $L_i = A + B\ t_i$

Should Read: $L_i = A_i + B_i\ t_i$

Reason: The calculated leak rate (L_i) at time t_i is computed using the regression line constants A_i, B_i (computed using equations 6 and 7). The summation signs in equation 6 are defined as $\Sigma = \sum_{i=1}^{n}$, where n is the number of data sets up until time t_i. The regression line constants change each time a new data set is received. The calculated leak rate is not a linear function of time.

PARAGRAPH FOLLOWING EQ. 3A, SECTION 6.2

Reads: The deviation of the measured leak rate (M) from the calculated leak rate (L) is shown graphically on Figure A.1 in Appendix A and is expressed as:

Deviation = $M_i - L_i$

Should Read: The deviation of the measured leak rate (M_i) from the regression line (N_i) is shown graphically on Figure A.1 in Appendix A and is expressed as:

Deviation = $M_i - N_i$

where $N_i = A_p + B_p * t_i$,

APPENDIX D
(Sheet 1 of 5)

BN-TOP-1, REV. 1 ERRATA

The Commission has approved short duration testing for the IPCLRT provided the Station uses the general test method outlined in the BN-TOP-1, Rev. 1 topical report. The primary difference between that method and the ones previously used is in the statistical analysis of the measured leak rate data.

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Should Read: $L_i = A_i + B_i\ t_i$

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PARAGRAPH FOLLOWING EQ. 3A, SECTION 6.2

Reads: The deviation of the measured leak rate (M) from the calculated leak rate (L) is shown graphically on Figure A.1 in Appendix A and is expressed as:

Deviation = $M_i - L_i$

Should Read: The deviation of the measured leak rate (M_i) from the regression line (N_i) is shown graphically on Figure A.1 in Appendix A and is expressed as:

Deviation = $M_i - N_i$

where $N_i = A_p + B_p * t_i$,

APPENDIX D
(Sheet 2 of 5)

A_p, B_p = Regression line constants computed from all data sets available from the start of the test to the last data set at time t_p,

t_i = time from the start of the test to the ith data set.

Reason: The calculated leak rate as a function of time during the test is based on a regression line. The regression line constants, A_i and B_i are changing as each additional data set is received. Equation 3A is used later in the test to compute the upper confidence limit as a function of time. For the purpose of this calculation, it is the deviation from the last computed regression line at time t_p that is important.

EQUATION 4, SECTION 6.2

Reads: $SSQ = \Sigma (M_i - L_i)^2$

Should Read: $SSQ = \Sigma (M_i - N_i)^2$

Reason: Same As Above

EQUATION 5, SECTION 6.2

Reads: $SSQ = \Sigma [M_i - (A + Bt_i)]^2$

Should Read: $SSQ = \Sigma [M_i - (A_p + B_p * t_i)]^2$

Reason: Same As Above

EQUATION ABOVE EQUATION 6, SECTION 6.2

Reads: $$B = \frac{(t_i - \bar{t})(M_i - \bar{M})}{\Sigma(t_i - t)^2}$$

Should Read: $$B_i = \frac{\Sigma[(t_i - \bar{t})(M_i - \bar{M})]}{(t_i - \bar{t})^2}$$

Reason: Regression line constant B_i changes over time (as a function of t_p) as each additional data set is received. Bar of "t" left out of denominator. Summation signs omitted.

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EQUATION 6, SECTION 6.2

Reads:
$$B = \frac{n \Sigma t_i M_i - (\Sigma t_i)(\Sigma M_i)}{n \Sigma t_i^2 - (\Sigma t_i)^2}$$

Should Read:
$$B_i = \frac{n \Sigma t_i M_i - (\Sigma t_i)(\Sigma M_i)}{n \Sigma t_i^2 - (\Sigma t_i)^2}$$

Reason: Same as above.

EQUATION 7, SECTION 6.2

Reads:
$$A = \bar{M} - B \bar{t}$$

Should Read:
$$A_i = \bar{M} - B_i \bar{t}$$

Reason: Same as above.

EQUATION 10, SECTION 6.2

Reads:
$$A = \frac{(\Sigma M_i)(\Sigma t_i^2) - (\Sigma \;\; _i)(\Sigma t_i M_i)}{n \Sigma t_i^2 - (\Sigma t_i)^2}$$

Should Read:
$$A_i = \frac{(\Sigma M_i)(\Sigma t_i^2) - (\Sigma t_i)(\Sigma t_i M_i)}{n \Sigma t_i^2 - (\Sigma t_i)^2}$$

Reason: Same as above.

EQUATION 13, SECTION 6.3

Reads:
$$\sigma^2 = s^2 \left[1 + \frac{1}{n} + \frac{(t_p - t)^2}{(t_i - t)^2}\right]$$

Should Read:
$$\sigma^2 = s^2 \left[1 + \frac{1}{n} + \frac{(t_p - \bar{t})^2}{\Sigma(t_i - \bar{t})^2}\right]$$

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where t_p = time from the start of the test of the last data set for which the standard deviation of the measured leak rates (M_i) from the regression line (N_i) is being computed;

t_i = time from the start of the test of the i^{th} data set;

n = number of data sets to time t_p

$\Sigma = \sum_{i=1}^{n}$; and

$t = \frac{1}{n} \Sigma t_i$

Reason: Appears to be error in editing of the report. Report does a poor job of defining variables.

EQUATION 14, SECTION 6.3

Reads: $\sigma = s\ [\ 1 + \frac{1}{n} + \frac{(t_p - t)^2}{(t_i - t)^2}$

Should read: $\sigma = s\ [\ 1 + \frac{1}{n} + \frac{(t_p - \bar{t})^2}{\Sigma (t_i - \bar{t})^2}$

Reason: Same As Above.

EQUATION 15, SECTION 6.3

Reads: Confidence Limit = L $\pm$ T

Should Read: Confidence Limits = L $\pm$ T x σ

where L = calculated lead rate at time t_p,

T = T distribution value based on n, the number of data sets received up until time t_p;

σ = standard deviation of measured leak rate values (M_i) about the regression line based on data from the start of the test until time t_p.

Reason: Same As Above.

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EQUATION 16, SECTION 6.3

Reads: UCL = L + T

Should Read: UCL = L + T * σ

Reason: Same As Above.

EQUATION 17, SECTION 6.3

Reads: LCL = L - T

Should Read: LCL = L - T * σ

Reason: Same As Above.