Commonwealth Edison
Dresden Nuclear Power Station
R.R. #1
Morris, Illinois 60450
Telephone 815/942-2920

June 23, 1992
CWS LTR #92-356

Dr. Thomas E. Murley
Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Document Control Desk

Dear Dr. Murley:

Subject: Reactor Containment Building Integrated Leak Rate Test
Dresden Nuclear Power Station
Docket No. 05000249, DPR-25

Enclosed please find the report "Reactor Containment Building Integrated Leak Rate Test, Dresden Nuclear Power Station, Unit 3, March 14-16, 1992" and related appendices describing the Type A test. This test was performed during the twelfth refueling outage for Unit 3. The results of this test were reviewed shortly after the completion of the test by representatives of the NRC Region III Office.

This report is submitted to you in accordance with the requirements of 10CFR50, Appendix J, Section V.B.1. The information contained in Appendix A of this report is intended to comply with requirements of 10CFR50, Appendix J, Section V.B.3. According to 10CFR50, Appendix J, Section III.A.6, the test schedule for the next Type A test is to be reviewed and approved by the Commission. The next Type A test for Dresden Unit 3 is scheduled for the thirteenth refuel outage.

Sincerely,

J Holmberg for

Charles W. Schroeder
Station Manager

CWS/RS:lrw

Enclosure

cc: A. B. Davis (U.S. NRC RIII)
G. Nejfeld (U.S. NRC RIII)
K. Graesser
T. Kovach
G. Diederich
R. Bax
M. Strait
J. Glover
File/NRC
File/Numerical

(ZCWSLT92/232)

010008

A017
1/1

Commonwealth Edison

DRESDEN

Docket # 50-249
Accession # 9207010083
Date 6/23/92 of Ltr
Regulatory Docket File

-NOTICE-

DRESDEN NUCLEAR POWER STATION

UNIT 3

REACTOR CONTAINMENT BUILDING

INTEGRATED LEAK RATE TEST

March 14-16, 1992

OUTLINE

TABLES AND FIGURES

INTRODUCTION

This report presents details of the Integrated Primary Containment Leak Rate Test (IPCLRT) successfully performed on March 14-16, 1992 at Dresden Nuclear Power Station, Unit 3 (Docket #05000249), during the twelfth refueling outage for Unit 3. The test was performed in accordance with 10CFR50, Appendix J and the Dresden Unit 3 Technical Specifications. Dresden Station is a BWR 3, Mark I containment, located near Morris, Illinois.

A short duration test (6.0 hours) was conducted using the general test method outlined in BN-TOP-1, Revision 1 (Bechtel Corporation Topical Report) dated November 1, 1972.

The as-left total primary containment integrated leakage rate was found to be 0.6706 wt%/day at a test pressure of 65.24 psig, which is within the 1.2 wt%/day acceptance criteria. This value is the sum of the 95% upper confidence limit (UCL) calculated leak rate of 0.5546 wt%/day plus, the leakage rate of all non-vented penetrations (0.104 wt%/day), and the leakage compensation for the change in Drywell sump levels (0.012 wt%/day).

Since the High Pressure Coolant Injection (HPCI) Turbine Exhaust Volume and H_2O_2 Monitor Return check valve had failed their Local Leak Rate Test (LLRT), which are minimum pathway volumes, the as-found ILRT had failed. Due to the magnitude of the leak and the limitations of range of the test equipment, a specific leak rate was not found. This is the second consecutive Type A test on Unit 3 that has failed, so an increased test schedule will occur.

The induced phase leakage test result was found to be 2.0801 wt%/day. This value should compare with the sum of the measured leak rate phase of 0.5105 wt%/day and the induced leakage rate of 1.6062 wt%/day, the sum being within the ± 0.40 wt%/day (0.25 La) tolerance band. The actual test results show a difference of 0.0366 wt%/day, which is within the acceptance criterion.

The next IPCLRT is scheduled to be performed during the thirteenth Unit 3 refueling outage.

SECTION A - TEST PREPARATIONS

A.1 Type A Test Procedure

The IPCLRT was performed in accordance with Dresden Technical Surveillance (DTS) 1600-7, Revision 12, dated March, 1992. Temporary Procedure Number 92-127 was made to DTS 1600-7 to add penetrations, X-123 and X-124 to the list of non-vented systems. These penetrations are the Reactor Building Closed Cooling Water (RBCCW) Inlet and Outlet to the Drywell, respectively. The volume of water past the isolation valves could not be drained, and the system could not be vented for the test.

This procedure was written to comply with 10CFR50 Appendix J, ANSI N45.4-1972, Dresden Unit 3 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 IPCLRT. Table Two and Figure 1 show the physical locations of the temperature (thermistors) and humidity sensors (dewcells) within primary containment.

a. Temperature

Twenty-nine thermistors were placed in primary containment to measure drybulb temperature during the test. Another thermistor was used to measure the temperature of the reactor water. The thermistor is a resistance thermometer made up of a solid semiconductor whose resistance varies exponentially with temperature. Each thermistor is connected to a signal conditioning card which converts the thermistor's resistance to a known voltage. This voltage is then read by the Data Acquisition System (DAS) and converted to a temperature value.

The sensors were suspended to prevent direct thermal influences from any metal surfaces. Sensors were also kept away from any direct air flows through the use of thermal shields on the thermistors.

Each thermistor was calibrated to yield an output of -99 mV to +99 mV over the range of 50°F to 210°F. Calibrations were performed by Volumetrics of Paso Robles, California.

b. Vapor Pressure

Ten lithium chloride dewcells were placed in the containment to determine the partial pressure of water vapor in containment during the test. The dewcell is made up of a thin metal tube, a woven glass cloth saturated with a lithium chloride solution, a heating element, and an internal thermistor. A voltage is applied to the heating element which is actually a double winding of silver wire covering the glass cloth. The electrical conductivity between these wires is directly proportional to the moisture that the salt takes on from the surrounding atmosphere. When the moisture is low, there is a small current flow, and the temperature rise within the tube is low. When the moisture is high, there is a high current flow and temperature within the tube is high. The thermistor within the metal tube will monitor this temperature which is a representation of the dewpoint temperature. The partial pressure of the water vapor can then be determined from the dewpoint temperature.

A calibration was done on each dewcell network over the range of dewpoint temperature of 50°F to 210°F. Calibrations were performed by Volumetrics, Inc.

c. Pressure

Two precision PPM-1000 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 gauges in parallel through a 1/4" tube connected to a test tap on a primary containment penetration.

Each precision pressure transmitter was calibrated over the range 4 psia to 100 psia in approximately 10 psia increments. The calibrations were performed by Volumetrics, Inc.

d. Flow

A rotameter flowmeter (Fischer - Porter serial number 91W801218) was used to measure the induced leak rate during the supplemental verification test. The flowmeter was connected to a one inch test tap on a primary containment penetration.

The flowmeter was calibrated by Fischer-Porter of Warminster, Pennsylvania.

A.3 Type A Test Measurement

The IPCLRT was performed utilizing an interface with the Volumetrics Data Acquisition System (DAS) and PRIME Computer. Information from the thermistors and dewcells is sent to a Dual Multiplexer Scanner in the Drywell. The scanner takes the data and sends it through an electrical penetration to the DAS. The DAS 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 diesel driven air compressors with a total capacity of 2700 scfm were brought on site to supply clean, oil free air to the primary containment through a 4 inch pipe tied into the LPCI system. Figure 2 shows a schematic of the pressurization system.

TABLE ONE
ILRT INSTRUMENT CALIBRATION TABLE
PAGE 1 OF 3

A. INSTRUMENTATION REQUIRED FOR THE ILRT:

INSTRUMENT	MANUFACTURER	MODEL No.	QA/SERIAL No.	RANGE	ACCURACY	REPEATABILITY
PRECISION PRESSURE GAUGES (2)	VOLUMETRICS	PPM-1000	(NOTE: COMPLETE ON PAGE 2 OF THIS CHECKLIST)	0-100 psia	0.015 %F.S.	0.001% F.S.
THERMISTORS (30)	VOLUMETRICS	418905000	(NOTE: COMPLETE ON PAGE 2 & 3 OF THIS TABLE)	50°-140°F	± 0.25°F	0.01°F
DEWCELLS (10)	VOLUMETRICS	LITHIUM CHLORIDE	(NOTE: COMPLETE ON PAGE 3 OF THIS TABLE)	30°-110°F	± 1.5°F	0.01°F
FLOWMETER (1)	FISCHER-PORTER	10A4555P	(NOTE: COMPLETE ON PAGE 3 OF THIS TABLE)	0-17.5 scfm AT 14.7 psia, 70°F	1.0%F.S	N/A
LEVEL TRANSMITTER 3-263-61	GE/MAC	50-553122CAAU2	(NOTE: COMPLETE ON PAGE 3 OF THIS TABLE)	125 TO 407 INCHES OF H_2O	± 2.5 INCHES	N/A

B. INSTRUMENTATION CALIBRATION DATES, QA/SERIAL NUMBERS:

1. Precision Pressure Gauges: (2)

QA/Serial No.: Q33050G0 (1) Calibration Date: 8-5-91

QA/Serial No.: Q33054G0 (2) Calibration Date: 8-5-91

2. Thermistors: (30)

QA/Serial No.: 171071GO (1) Calibration Date: 10-24-91

QA/Serial No.: 171072 (2) Calibration Date: 10-30-91

QA/Serial No.: 171073 (3) Calibration Date: 10-24-91

QA/Serial No.: 171074 (4) Calibration Date: 10-24-91

QA/Serial No.: 171075GO (5) Calibration Date: 10-24-91

QA/Serial No.: 171076 (6) Calibration Date: 10-24-91

QA/Serial No.: 171077 (7) Calibration Date: 10-24-91

QA/Serial No.: 171081 (8) Calibration Date: 10-24-91

QA/Serial No.: 171085 (9) Calibration Date: 10-24-91

QA/Serial No.: 171088 (10) Calibration Date: 10-24-91

QA/Serial No.: 171090 (11) Calibration Date: 10-24-91

QA/Serial No.: 171091 (12) Calibration Date: 10-24-91

QA/Serial No.: 171051 (13) Calibration Date: 10-24-91

QA/Serial No.: 171094 (14) Calibration Date: 10-24-91

QA/Serial No.: 171097 (15) Calibration Date: 10-24-91

QA/Serial No.: 171098 (16) Calibration Date: 10-24-91

QA/Serial No.: 171101 (17) Calibration Date: 10-24-91

QA/Serial No.: 171102GO (18) Calibration Date: 10-24-91

QA/Serial No.: 171126 (19) Calibration Date: 10-24-91

QA/Serial No.: 171127GO (20) Calibration Date: 10-24-91

QA/Serial No.: 171128 (21) Calibration Date: 10-24-91

QA/Serial No.: 171129 (22) Calibration Date: 10-24-91

QA/Serial No.: 171130 (23) Calibration Date: 10-24-91

QA/Serial No.: 171131 (24) Calibration Date: 10-24-91

QA/Serial No.: 171132GO (25) Calibration Date: 10-24-91

QA/Serial No.: 171134 (26) Calibration Date: 10-24-91

QA/Serial No.: 171137 (27) Calibration Date: 10-24-91

TABLE ONE (Continued)
ILRT INSTRUMENT CALIBRATION TABLE

2. Thermistors: (Continued)

QA/Serial No.: 171138 (28) Calibration Date: 10-24-91

QA/Serial No.: 171139 (29) Calibration Date: 10-24-91

QA/Serial No.: 171140 (30) Calibration Date: 10-24-91

3. Dewcells: (10)

QA/Serial No.: 171057GO (1) Calibration Date: 10-24-91

QA/Serial No.: 171063GO (2) Calibration Date: 10-24-91

QA/Serial No.: 171068GO (3) Calibration Date: 10-24-91

QA/Serial No.: 171119GO (4) Calibration Date: 10-24-91

QA/Serial No.: 171149GO (5) Calibration Date: 10-24-91

QA/Serial No.: 171148GO (6) Calibration Date: 10-24-91

QA/Serial No.: 171116GO (7) Calibration Date: 10-24-91

QA/Serial No.: 171111GO (8) Calibration Date: 10-24-91

QA/Serial No.: 171065GO (9) Calibration Date: 10-24-91

QA/Serial No.: 171145GO (10) Calibration Date: 10-24-91

4. Flowmeter: (1)

QA/Serial No.: 104238D (1) Calibration Date: 10-91

5. Level Transmitter: (1)

LT 3-263-61, COMPUTER POINT F386-Calibration Date: 7-23-91

TABLE TWO
SENSOR PHYSICAL LOCATIONS

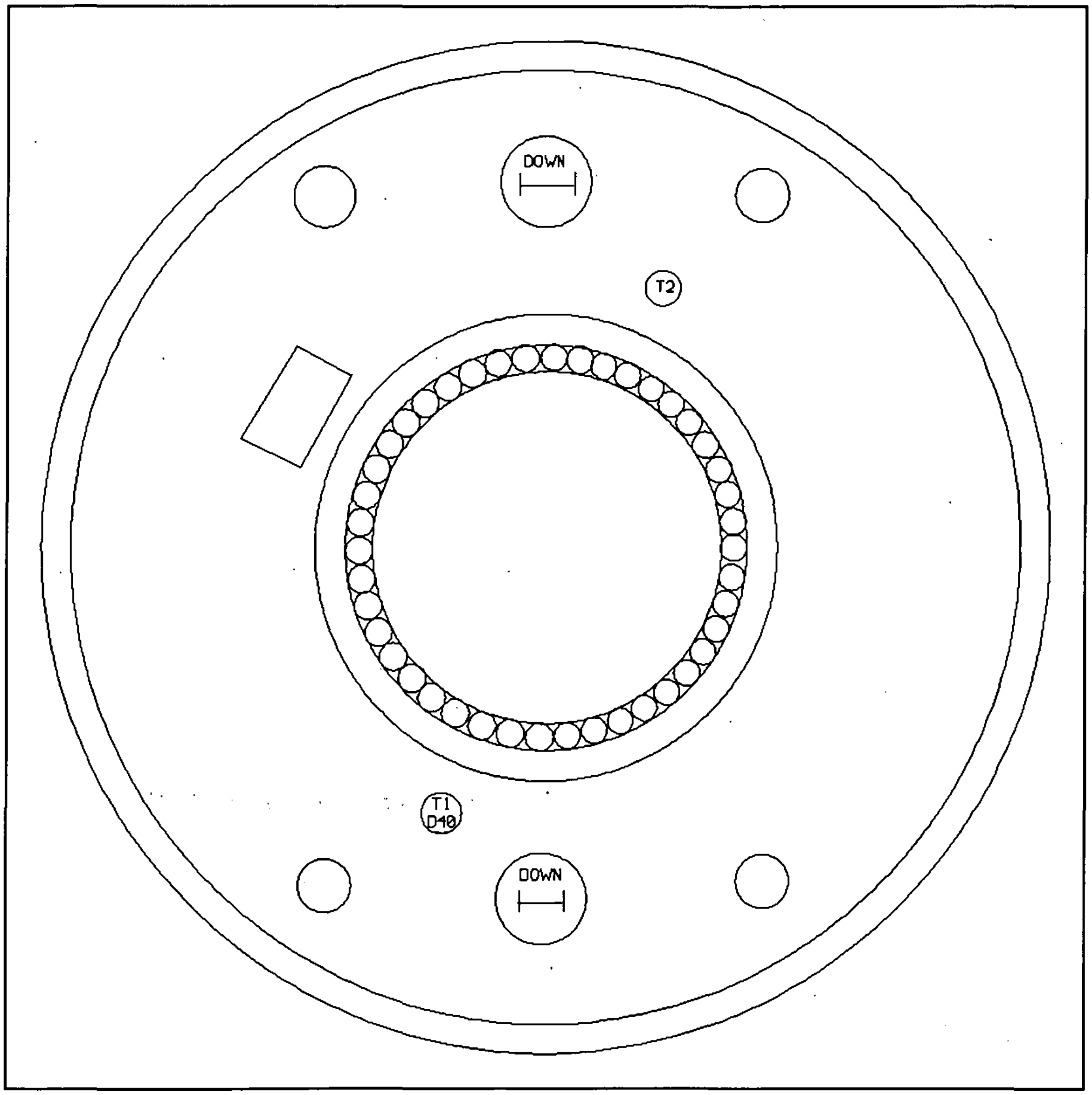
CHANNEL #	CABLE LENGTH	ELEV	AZI.	SUB-VOLUME	LOCATION
T1 T2 D40	150'	601'	190° 10° 190°	1	12' ABOVE BULKHEAD GRATING
T3 T4	175'	556'	330° 150°	2	INSIDE BIOLOGICAL SHIELD 24' BELOW THE TOP WALL
T5 T6 T7 D41	125' 150'	574'	270° 30° 150° 270°	3	2' BELOW 4th FLOOR GRATING
T8 T9 T10 D42	100'	574'	350° 220° 120° 120°	4	8' ABOVE 2nd FLOOR GRATING
T11 T12 T13 T14 D43 D44	100'	531'	270° 190° 90° 0° 90° 260°	5	6' BELOW 2nd FLOOR GRATING
T15 T16 T17 D45	100'	520'	165° 60° 300° 165°	6	5' ABOVE 1st FLOOR GRATING
T18 T19	100'	505	5° 185°	7	3' OFF FLOOR IN SUBPILE ROOM
T20 T21 T22 T23 D46 D47	100'	509'	140° 230° 50° 320° 50° 240°	8	6' BELOW 1st FLOOR GRATING (7' ABOVE BASEMENT FLOOR)
T24 T25 T26 T27 T28 T29 D48 D49	200' 150' 275' 325' 200' 275' 150' 325'	504'	223° 168° 280° 0° 101° 45° 168° 0°	9	HANG ABOUT EVEN WITH THE TOP RAILING OF THE CATWALK <u>INSIDE</u> THE TORUS
T30A T30B		517'		10	INSTRUMENT MAINTENANCE TO PLACE IN "A/B" SHUT DOWN COOLING PUMP

BULKHEAD	598' 2 1/2"	1st FLOOR	515' 3 3/4"
4th FLOOR	576' 7 1/2"	BASEMENT	502' 4"
3rd FLOOR	562' 0"	TOP OF BIO. SHIELD	579' 7"
2nd FLOOR	537' 1 1/4"		

FIGURE 1

INSTRUMENT PHYSICAL LOCATIONS

FIGURE 1 (Page 1 of 6)
ILRT INSTRUMENTATION LOCATIONS
UNIT 3 DRYWELL HEAD
SUBVOLUME 1



ILRT INSTRUMENTATION LOCATIONS
UNIT 3 4TH FLOOR
SUBVOLUME 2 & 3

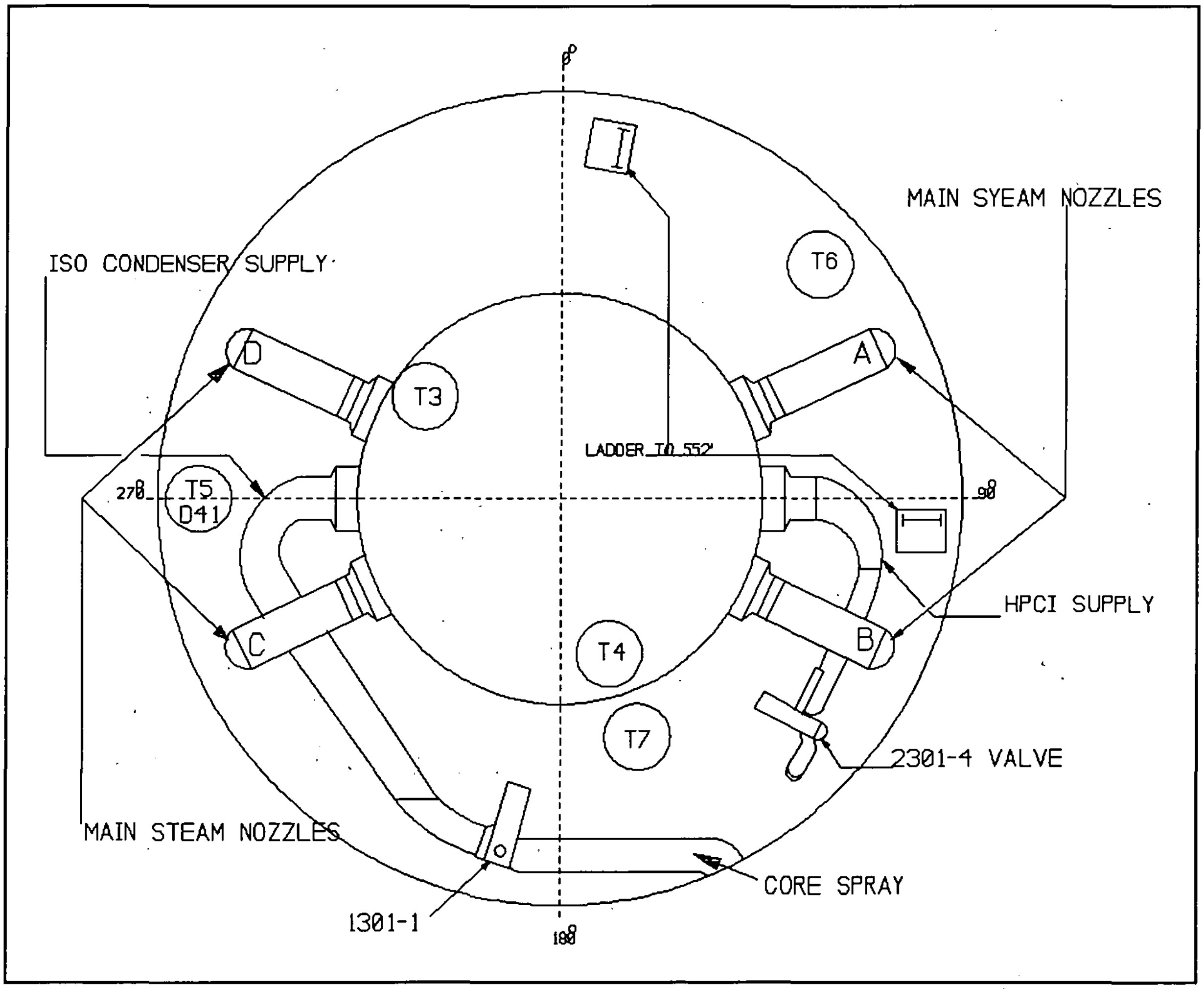
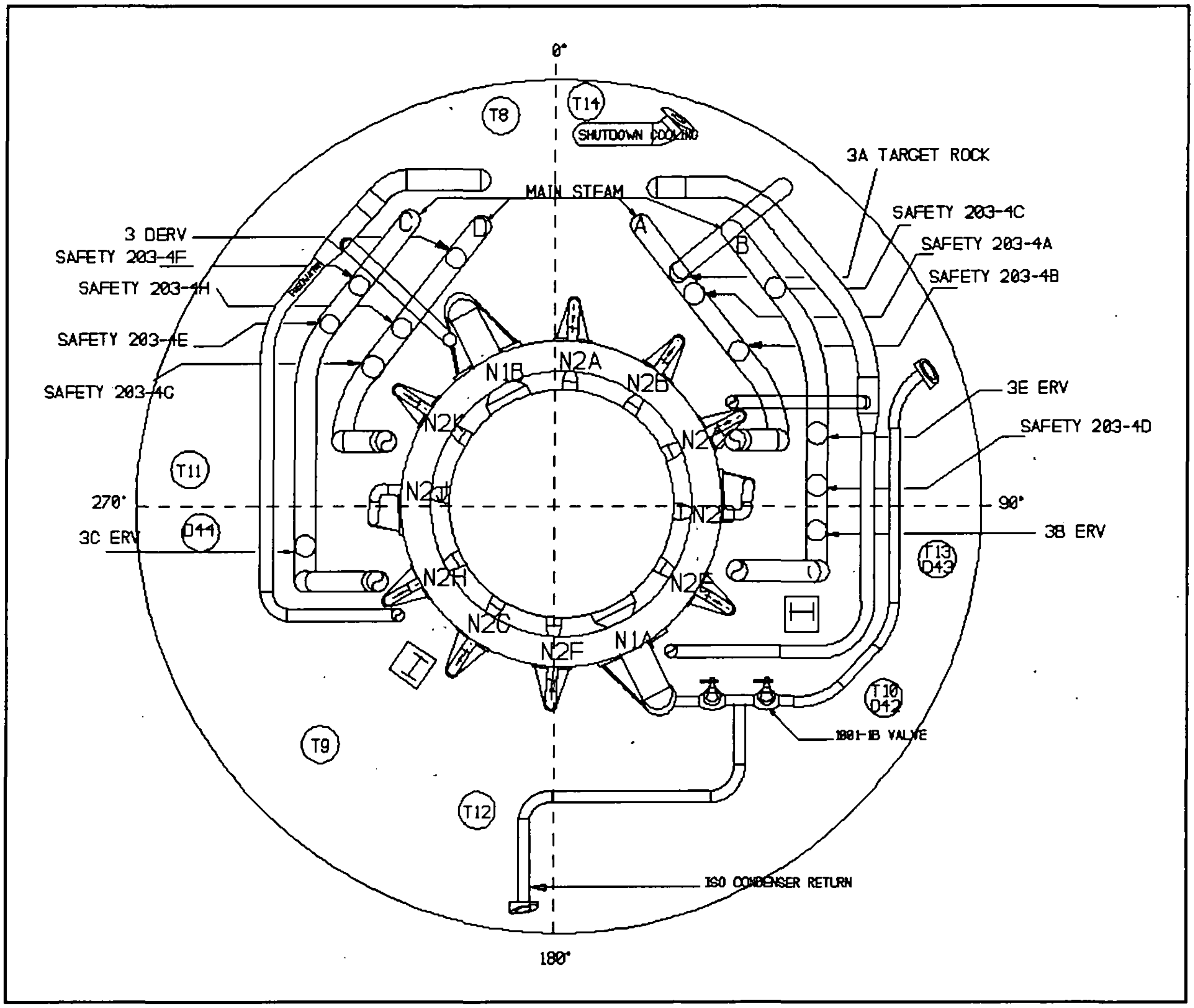
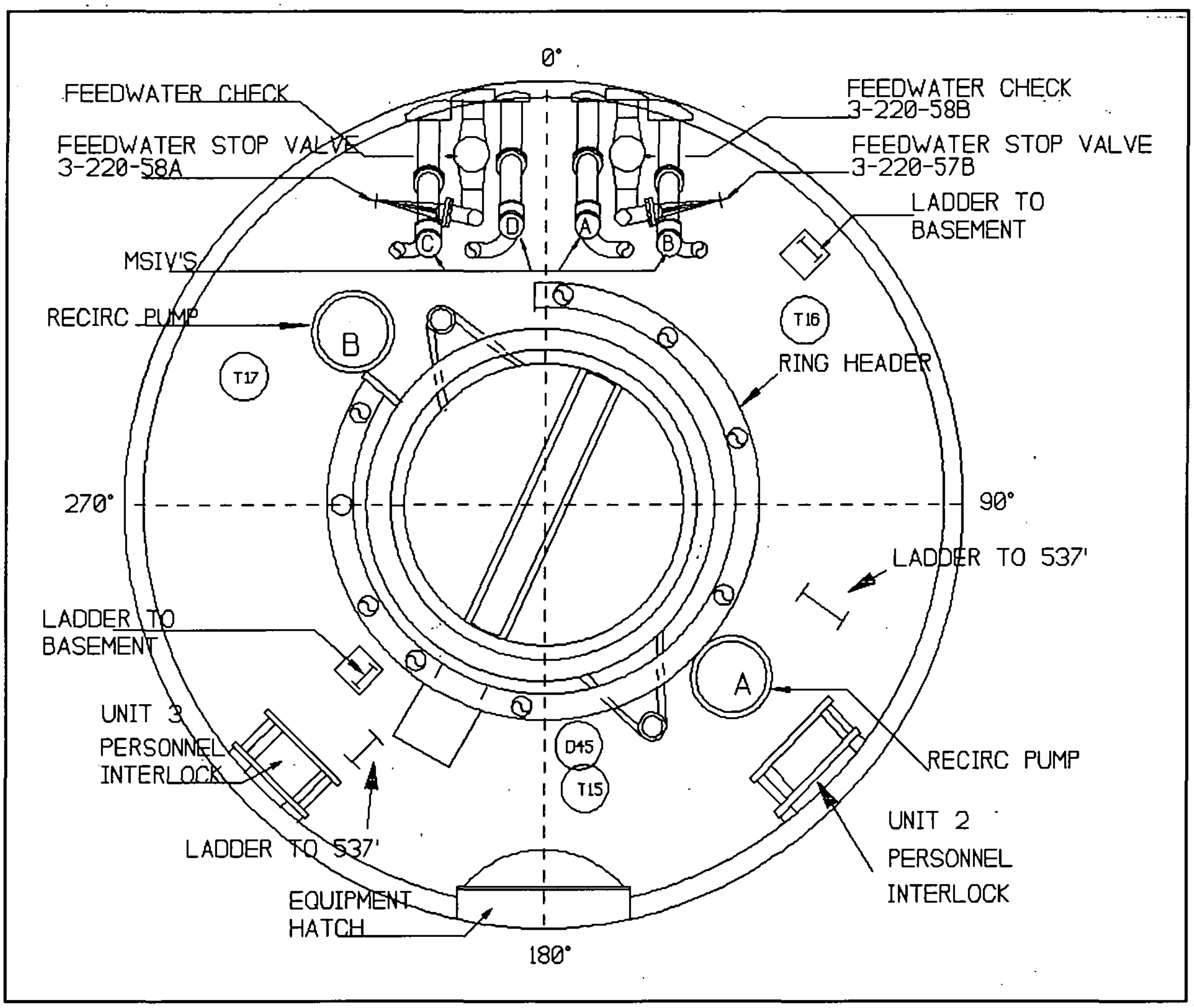


FIGURE 1 (Page 3 of 6)
ILRT INSTRUMENTATION LOCATIONS
UNIT 3 2ND FLOOR
SUBVOLUME 4 & 5



<u>FIGURE 1</u> (Page 4 of 6)
ILRT INSTRUMENTATION LOCATIONS
UNIT 3 1ST FLOOR
SUBVOLUME 6



<u>FIGURE 1</u> (Page 5 of 6)
ILRT INSTRUMENTATION LOCATIONS
UNIT 3 BASEMENT
SUBVOLUME 7 & 8

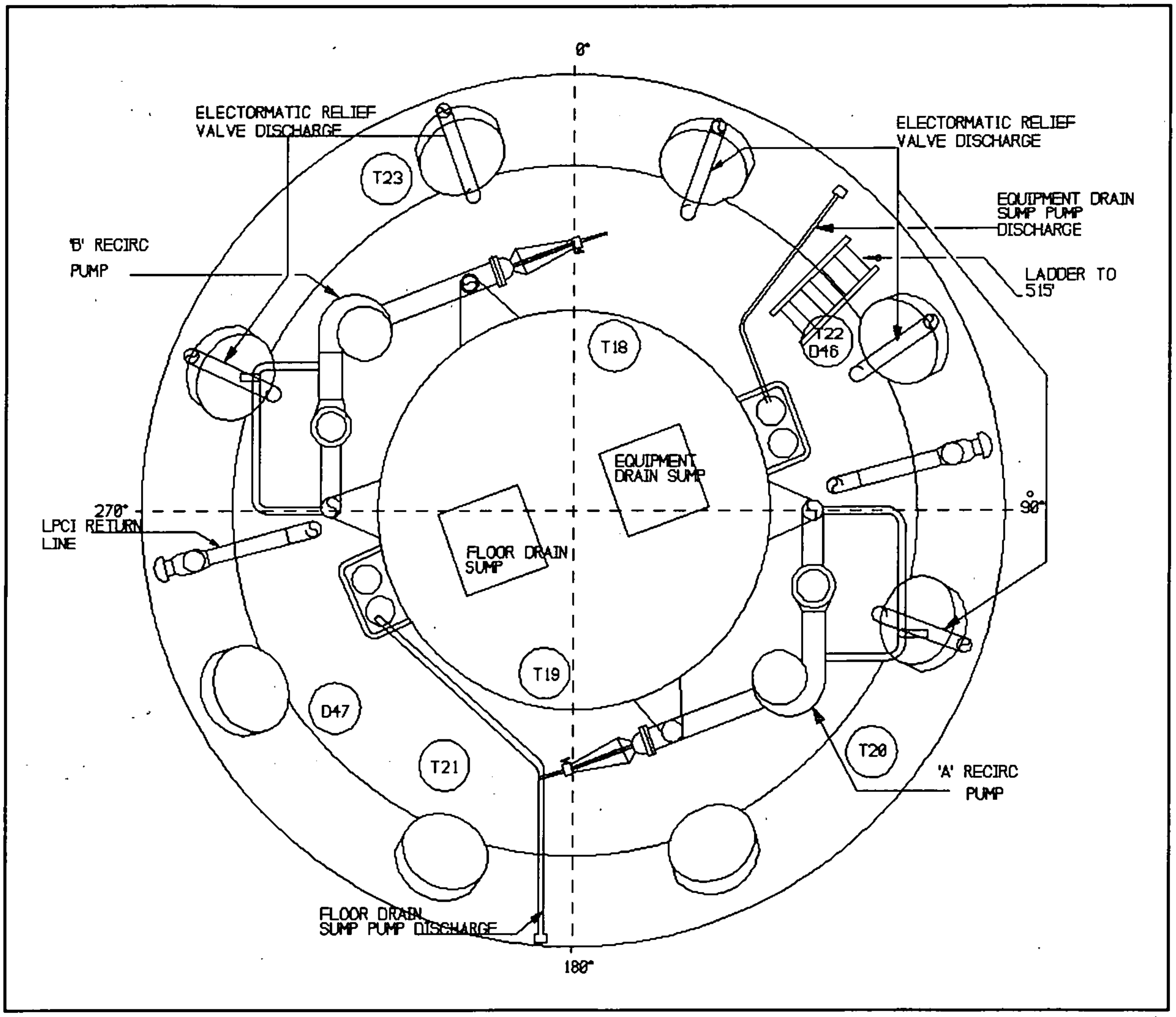


FIGURE 1 (Page 6 of 6)
ILRT INSTRUMENTATION LOCATIONS
UNIT 3 TORUS
SUBVOLUME 9

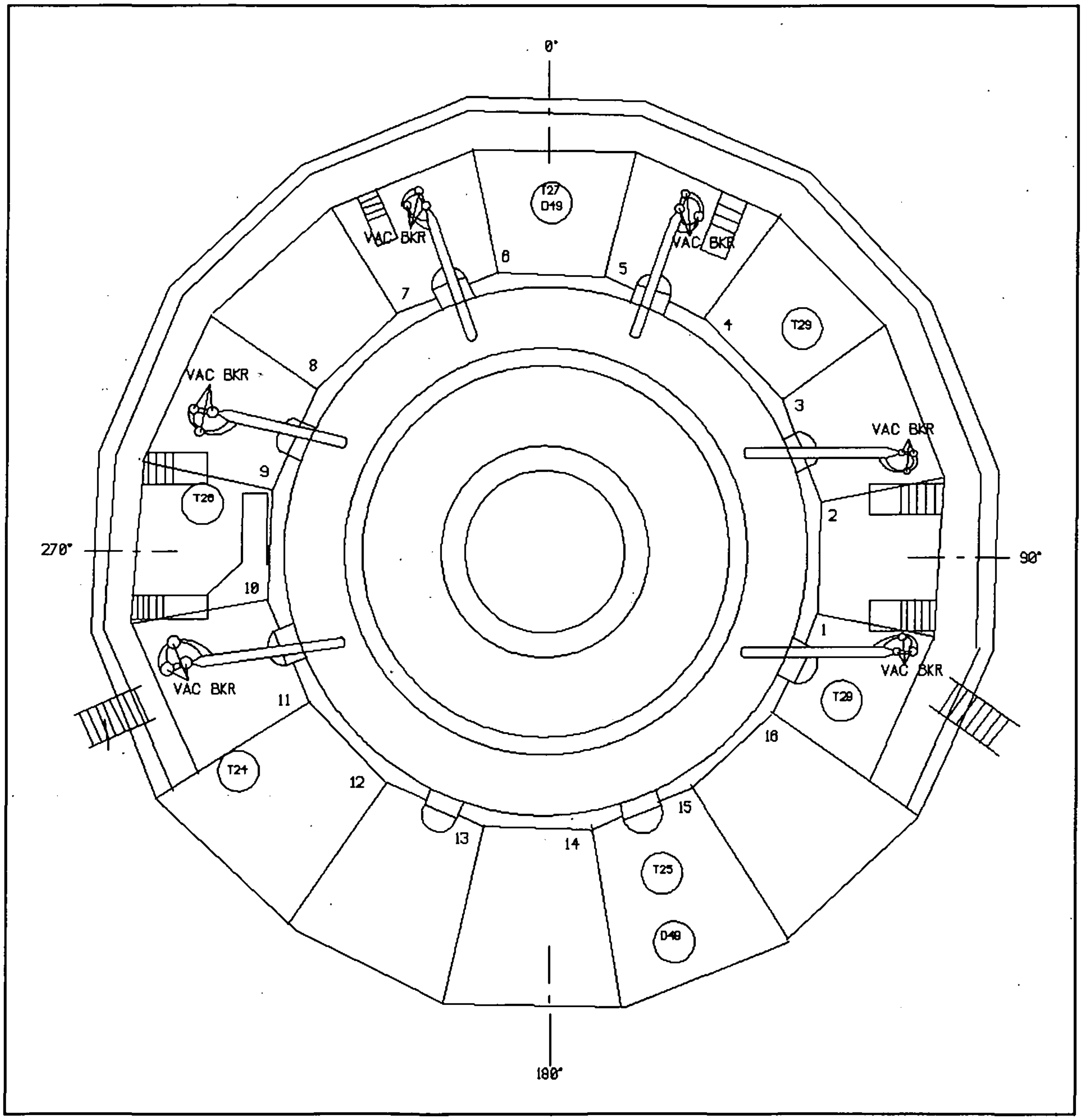
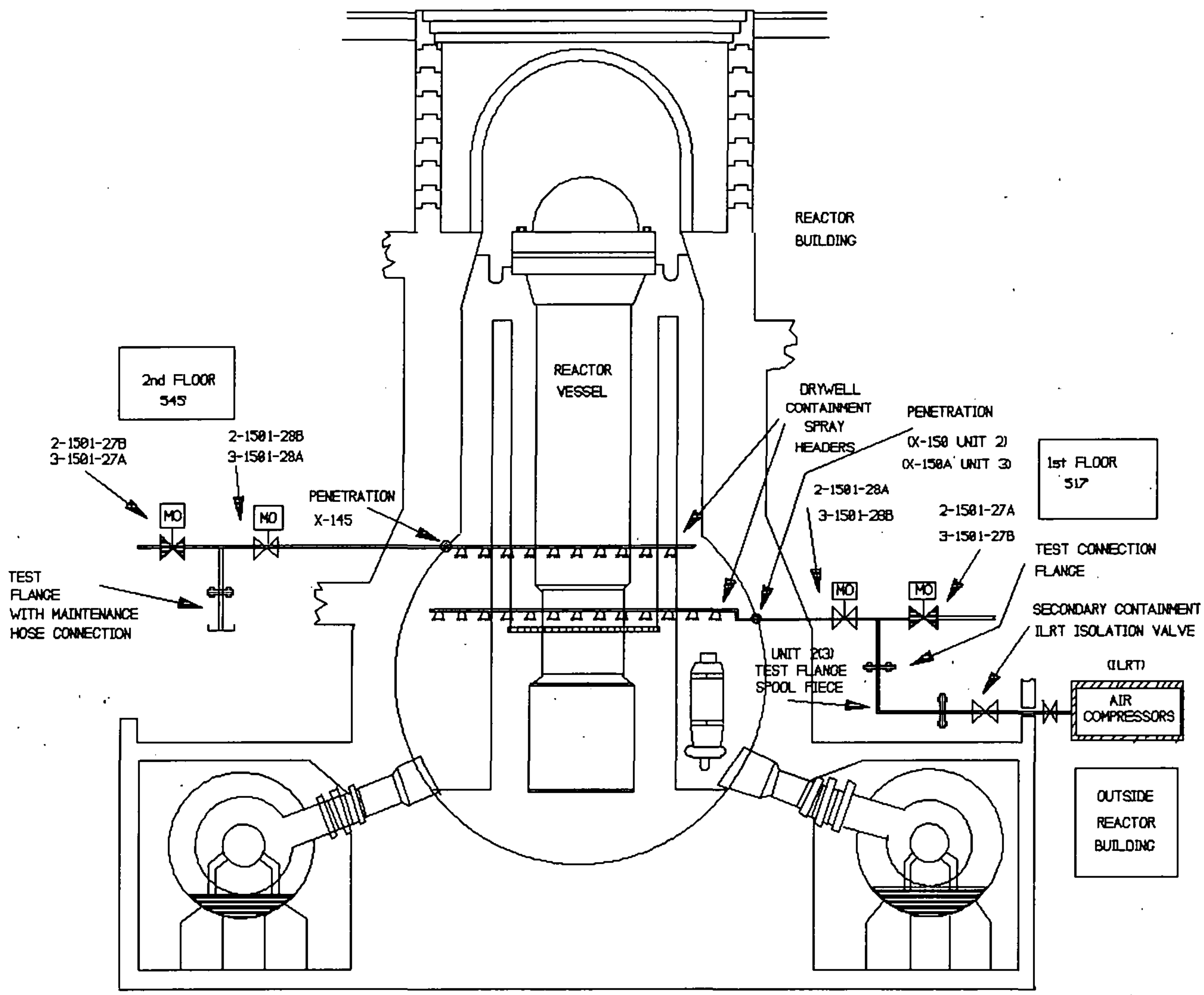


FIGURE 2
SCHEMATIC OF PRESSURIZATION SYSTEM



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 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 is performed by intentionally inducing a controlled leak of magnitude approximately equal to L_a (1.6 wt%/day). This induced leak is superimposed on the previously determined leak rate and compared with the leak rate calculated during the measured leak rate phase. The combined leak rate (calculated leak rate from measured phase plus induced leak rate) provides a basis for resolving any uncertainty associated with the calculated leak rate of the measured leak rate phase.

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 was performed and yielded a total instrument uncertainty of ± 0.01240 wt%/day.

The instrumentation uncertainty is used only to illustrate the system's ability to measure the parameters required 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, take 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 condition).

SECTION C - SEQUENCE OF EVENTS

C.1 Test Preparation Chronology

The pretest preparation phase and containment inspection were completed on March 14, 1992. Major preliminary steps included:

1. Satisfactory completion of all Type B&C tests
2. Completion of the pre-test valve line-up
3. Completion of the pretest checklists performed by the Mechanical Maintenance, Instrument Maintenance, Electrical Maintenance, Operations, and Technical Staff Departments.
4. Installation of the IPCLRT data acquisition system including computer programs, instrument console, instruments in containment, and associated wiring.

Log Entries:

Date	Time	Event
03-14-92	1900	The caution card for valve 3-1501-28B was changed from closed to open/close as required by ILRT director. This is in accordance with DTS 1600-07, Unit 2(3) Integrated Primary Containment Leak Rate. Control switch cards which require position changes will be verified against the procedure and caution card checklist prior to continuing the test. This review was completed at 1908.
	1915	The pretest preparation is complete.

C.2 Test Pressurization Chronology

During the pressurization phase DTS 1600-16, Drywell Torus Vacuum Breaker Leak Test, was performed. This test was satisfactory. During this phase, the primary containment was pressurized to 65.8 psia using the air compressors. The HPCI Pump Suction from the Condensate Storage Tank (CST) valve, 3-2301-6, was found to be open during this portion of the test. Subsequently, the breaker for this valve was racked out to maintain the valve in the close position. The valve was required to be closed so that the CST would not drain into the vent path. This valve is not a primary containment isolation valve, so no leakage from containment occurred. An investigation revealed that the 2330-112A relay was not jumpered properly while the containment was being pressurized to 48 psig. The procedure, DTS 1600-07, required the two leads on this relay to be lifted. However, the procedure did not instruct the electrician to leave the wires separated. The wires were taped together, and did not defeat the relay. When the Drywell pressure reached 2 psig, the signal for high Drywell pressure was recognized and the valve opened. Licensee Event Report (LER) 92-07 was written to document this event.

Log Entries:

Date	Time	Event
03-14-92	1922	DTS 1600-16, Drywell Torus Vacuum Breaker Leak Test, was started. The pressurization phase of DTS 1600-07 has begun.
	2040	DTS 1600-16 is complete. The test results are satisfactory.
	2125	The pressure between the Drywell and Torus was equalized through Dresden Operating Procedure

	2125(Cont.)	(DOP) 1600-18, Temporary Drywell To Torus Pressure Equalization. This procedure was used due to a conflict in DTS 1600-07, which requires the Drywell to Torus differential pressure to be equalized through valves 3-1601-23 and 3-1601-60, but also requires these valves to be caution-carded closed. In order to avoid a procedural conflict, another procedure was used to stroke these valves. The Shift Engineer, Shift Control Room Engineer and the Nuclear Station Operator found this to be acceptable.
	2150	After the pressure between the Drywell and Torus was equalized, valves 3-1601-23 and 3-1601-60 were closed to assume their correct test position. The Torus to Drywell vacuum breakers, 3-1601-32A, 32B, 32C and 32D, were blocked open to maintain an equal pressure.
	2202	Tech Staff resumed pressurizing the containment.
	2210	The containment was at 2 psig, and Tech Staff began inspecting the Reactor Building for excessive leakage from containment.
	2345	Operations identified that valve 3-2301-6, HPCI Pump Suction from Condensate Storage Tank, received an open signal due to the logic function of the valve. An out-of-service was initiated to rack out the breaker to maintain the valve in the desired position (closed) through the duration of the test. Out-of-service card XR was added to ILRT outage III-460.
03-15-92	0400	Primary containment pressure was read from the test pressure monitors in the Reactor Building. The pressure was 59.1 psia.

C.3 Stabilization Chronology

This portion of the test is to allow the containment to stabilize until the following conditions have been met:

1. The containment has been pressurized to greater than 48 psig at least four hours or more, and

2. The rate of change of the average volume weighted temperature is less than 1.0°F/hour over the last two hours, or

3. The rate of change of temperature changes is less than 0.5°F/hour/hour averaged over the last two hours.

The stabilization phase lasted two hours, and was recorded in data sets 125 through 137 in the ILRT program.

Log Entries:

Date	Time	Event
03-15-92	0446	The 3-1501-28B valve was closed, and the containment pressure was 65.8 psia. The Standby Gas Treatment System was initiated for a vent path. The stabilization part of the ILRT has begun.

0605 The inboard and outboard Unit 3 Reactor Building Secondary Containment Isolation Valves were closed, and the air compressors were shut down. Per DTS 1600-07, the four hour stabilization period has started.

0615 A fitting on the test line to the pressure monitors was found to be leaking. It was decided to replace the fittings while test data was not being taken. This was performed successfully without losing any data.

0700 Tech Staff finished walking down all appropriate penetrations and valves. No significant leakage was found. The equipment observed included the inboard flanges and penetrations listed in Attachment J, Tech Staff Post-Pressurization Checklist, of DTS 1600-07. Also included in the walkdown were penetrations X-209 and X-108B, bellows cover (clips and guides) of X-111B, X-125, X-107B and X-105, and bellows transition ring welds of X-107B and X-105, which were checked for leakage. These items were installed during D3R12 and were required to be tested using a Type A leakage test.

0900 The Mechanical Maintenance department started to replace the spool piece used to connect the air compressors to the LPCI containment spray line with the blind flange that is normally in place during operation. The test data is stable but the actual measured leak phase of the test will not begin until the blind flange is in place.

1122 The ILRT director has been notified that the blind flange is installed.

1145 Recording Reactor Building pressures and temperatures has begun and will continue for the rest of the duration of the test twice every hour.

1155 Stabilization criteria per DTS 1600-07 has been met, and the measured leak rate phase can begin. Data sets 125 through 137 of the ILRT program are used to meet this criteria.

C.4 Measured Leak Rate Phase Chronology

The measured leak rate phase had begun. However, forty minutes into the test, a leak was discovered on tubing connected to the precision pressure monitor at a different location than the previous occurence. The test was temporarily stopped to repair the leak. This tubing was isolated, and the leak was repaired. The data from the ILRT program was reviewed, and no significant change was noticed in the leakage rate. The temperature rate was -0.01367 °F/hour which is still acceptable per the stabilization criteria. After repairing the leakage, the precision pressure monitors measured differently by .0040 psia. To correct the difference, both pressure monitors were vented to the atmosphere and then reconnected to containment. The difference in measurements of the pressure monitors was lowered to .0015 psia. This difference is insignificant and the test was restarted. A six-hour measured leak rate test was successfully completed using the BN-TOP-1 calculations.

Log Entries:

Date	Time	Event
03-15-92	1200	The measured leak rate phase of the ILRT was begun at data set 138 at the computer time 1154. Visual Examination per Commonwealth Edison Company Special Process Procedure Manual (SPPM), Procedure VT-2-1 for ASME Section XI was performed on components listed in DTS 1600-07, Checklist M.
	1240	A leak was discovered on a tube connected to the precision pressure monitors. No significant changes in leakage data was observed, so the test was not interrupted.
	1315	After consideration, the test was stopped due to the leakage from the tubing.
	1410	The leak was repaired, and the data was verified to be acceptable. The difference in pressure measurement between the pressure monitors was corrected. The measured leak rate test was restarted at data set 152 at 1414.
	1500	Tech Staff was sent at 1300 to observe for any leakage from containment. It was reported that only minor leakage from the Reactor Building to Torus vacuum breaker seats was observed. No other leaks were reported.
	2024	The six-hour measured leak rate test was completed per BN-TOP-1 calculation. Data sets 152 through 189 record the data for this portion of the test.

C.5 Induced Leakage Test Chronology

The induced leakage phase is performed by allowing the containment to leak at a known rate by connecting a flowmeter to the test line. The induced leakage is initiated, and then the containment is allowed to stabilize for one hour. The test was performed for three hours (one-half of the length of time for the measured leak rate test). The induced leak rate was set at 13.6 scfm. Tech Staff personnel were stationed at the flowmeter to monitor the flowrate and correct any deviations from the set flowrate. The induced leakage test started on data set 203 and ended at 226. The induced leakage test results were acceptable.

Log Entries:

Date	Time	Event
03-15-92	2115	The Radiation Protection Department began taking an air sample of the containment atmosphere.
	2140	The Radiation Protection Department completed surveying the air sample, and the preliminary results of the survey found that it was acceptable to start inducing a flowrate from containment.
	2143	Induced leakage phase started at data set 197. The induced flowrate is set to 13.6 scfm.
	2244	The stabilization period of the induced

	2244(Cont.)	leakrate test is complete. The data for this portion of the ILRT is started at data set 203.
03-16-92	0150	The results from the radiation survey are complete and are acceptable.
	0234	The induced leakage test ended at data set 226, and the test results were acceptable.
	0250	Tech Staff was sent to close off the flowmeter.
	0330	Depressurization of primary containment was initiated by opening valves allowing the containment to vent through Reactor Building Ventilation.
	1910	Primary containment has been vented to atmospheric pressure. At 2130, an entry into the Drywell was performed. By 2300, all instruments in the Drywell were found to be satisfactory. The Drywell Equipment Sump level was checked, and the level was recorded to have overflown into the subpile room to a depth of 1/4 " above the floor. The Floor Drain Sump level was recorded as 31" deep.

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 3 through 11.

D.2 Induced Leakage Phase Data

A summary of the computed data for the induced leakage phase of the IPCLRT is found in Table 4. Graphic results of the test are found in Figures 12 through 19.

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

DRESDEN UNIT 3 20:09:33 MON, 22 JUN 1992

DATA SET 152 THROUGH 189

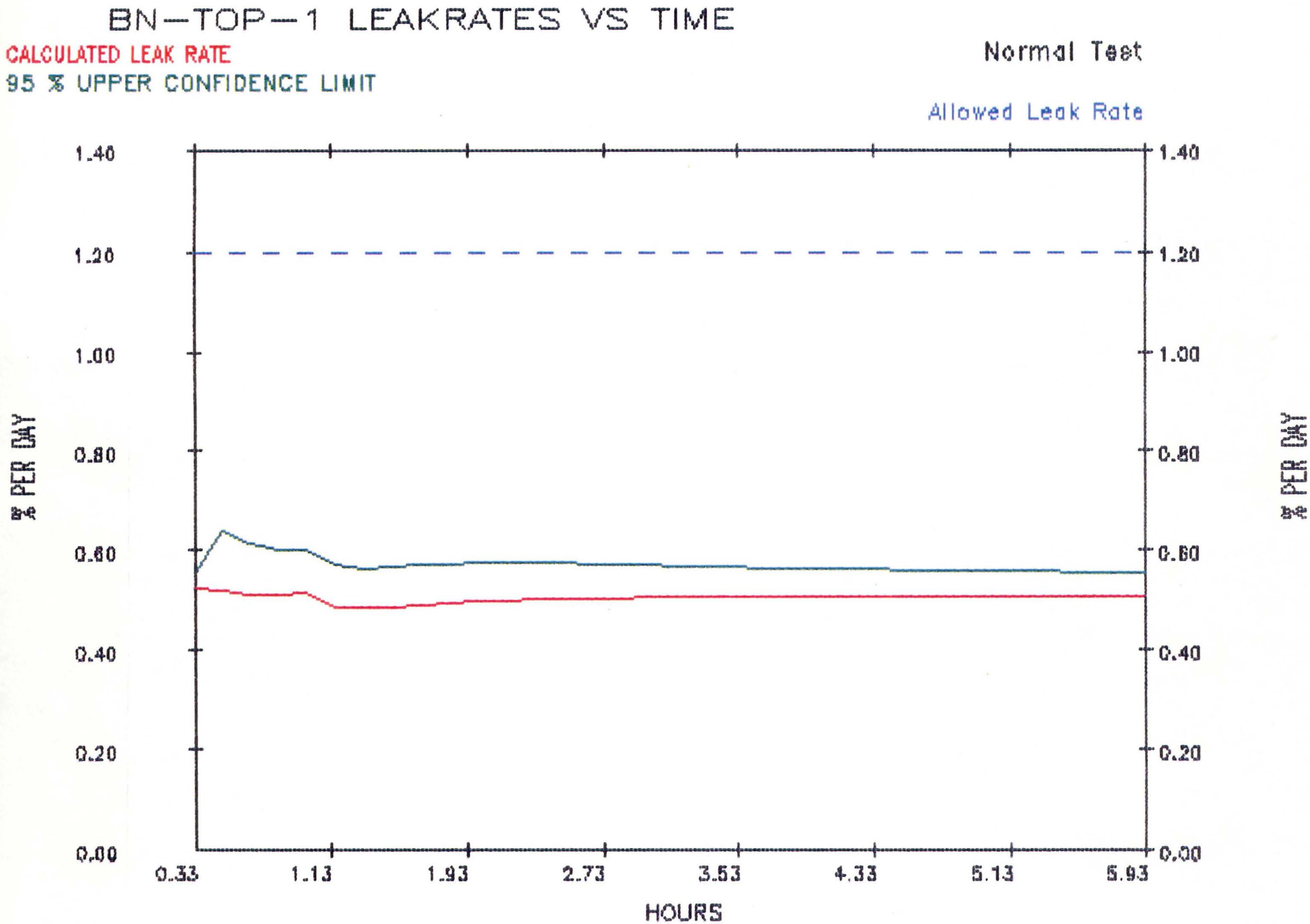
VERIFICATION TEST RESULTS CALCULATED USING THE BN-TOP-1 METHOD

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)
152	075 14:14:19	0.000	0.92968390E+05			
153	075 14:24:19	0.167	0.92964375E+05	0.6217		
154	075 14:34:19	0.333	0.92960937E+05	0.5769		
155	075 14:44:19	0.500	0.92958234E+05	0.5244	0.5257	0.5568
156	075 14:54:19	0.667	0.92954515E+05	0.5372	0.5192	0.6368
157	075 15:04:19	0.833	0.92951172E+05	0.5333	0.5154	0.6129
158	075 15:14:19	1.000	0.92947875E+05	0.5296	0.5125	0.5970
159	075 15:24:19	1.167	0.92943875E+05	0.5424	0.5176	0.6010
160	075 15:34:19	1.333	0.92944297E+05	0.4664	0.4895	0.5695
161	075 15:44:19	1.500	0.92938875E+05	0.5080	0.4873	0.5631
162	075 15:54:19	1.667	0.92934937E+05	0.5181	0.4897	0.5658
163	075 16:04:19	1.833	0.92931078E+05	0.5254	0.4940	0.5711
164	075 16:14:19	2.000	0.92928218E+05	0.5185	0.4955	0.5702
165	075 16:24:19	2.167	0.92923922E+05	0.5298	0.4999	0.5745
166	075 16:34:19	2.333	0.92920812E+05	0.5264	0.5026	0.5755
167	075 16:44:19	2.500	0.92917640E+05	0.5240	0.5043	0.5749
168	075 16:54:19	2.667	0.92914469E+05	0.5220	0.5052	0.5735
169	075 17:04:19	2.833	0.92911609E+05	0.5173	0.5051	0.5709
170	075 17:14:19	3.000	0.92907391E+05	0.5249	0.5066	0.5708
171	075 17:24:19	3.167	0.92904406E+05	0.5216	0.5073	0.5696
172	075 17:34:19	3.333	0.92901109E+05	0.5210	0.5078	0.5684
173	075 17:44:19	3.500	0.92897844E+05	0.5203	0.5081	0.5672
174	075 17:54:19	3.667	0.92894469E+05	0.5204	0.5085	0.5660
175	075 18:04:19	3.833	0.92891719E+05	0.5163	0.5082	0.5641
176	075 18:14:19	4.000	0.92887890E+05	0.5195	0.5084	0.5631
177	075 18:24:19	4.167	0.92884656E+05	0.5188	0.5085	0.5620
178	075 18:34:19	4.333	0.92881156E+05	0.5197	0.5088	0.5612
179	075 18:44:19	4.500	0.92877375E+05	0.5221	0.5094	0.5609
180	075 18:54:19	4.667	0.92874094E+05	0.5216	0.5099	0.5605
181	075 19:04:19	4.833	0.92871281E+05	0.5187	0.5100	0.5596
182	075 19:14:19	5.000	0.92867281E+05	0.5220	0.5105	0.5593
183	075 19:24:19	5.167	0.92864109E+05	0.5210	0.5108	0.5588
184	075 19:34:19	5.333	0.92861375E+05	0.5180	0.5108	0.5579
185	075 19:44:19	5.500	0.92858125E+05	0.5176	0.5107	0.5570
186	075 19:54:19	5.667	0.92855203E+05	0.5156	0.5104	0.5559
187	075 20:04:19	5.833	0.92851500E+05	0.5173	0.5104	0.5551
188	075 20:14:19	6.000	0.92847984E+05	0.5181	0.5104	0.5545
189	075 20:24:19	6.167	0.92844515E+05	0.5186	0.5105	0.5540

****

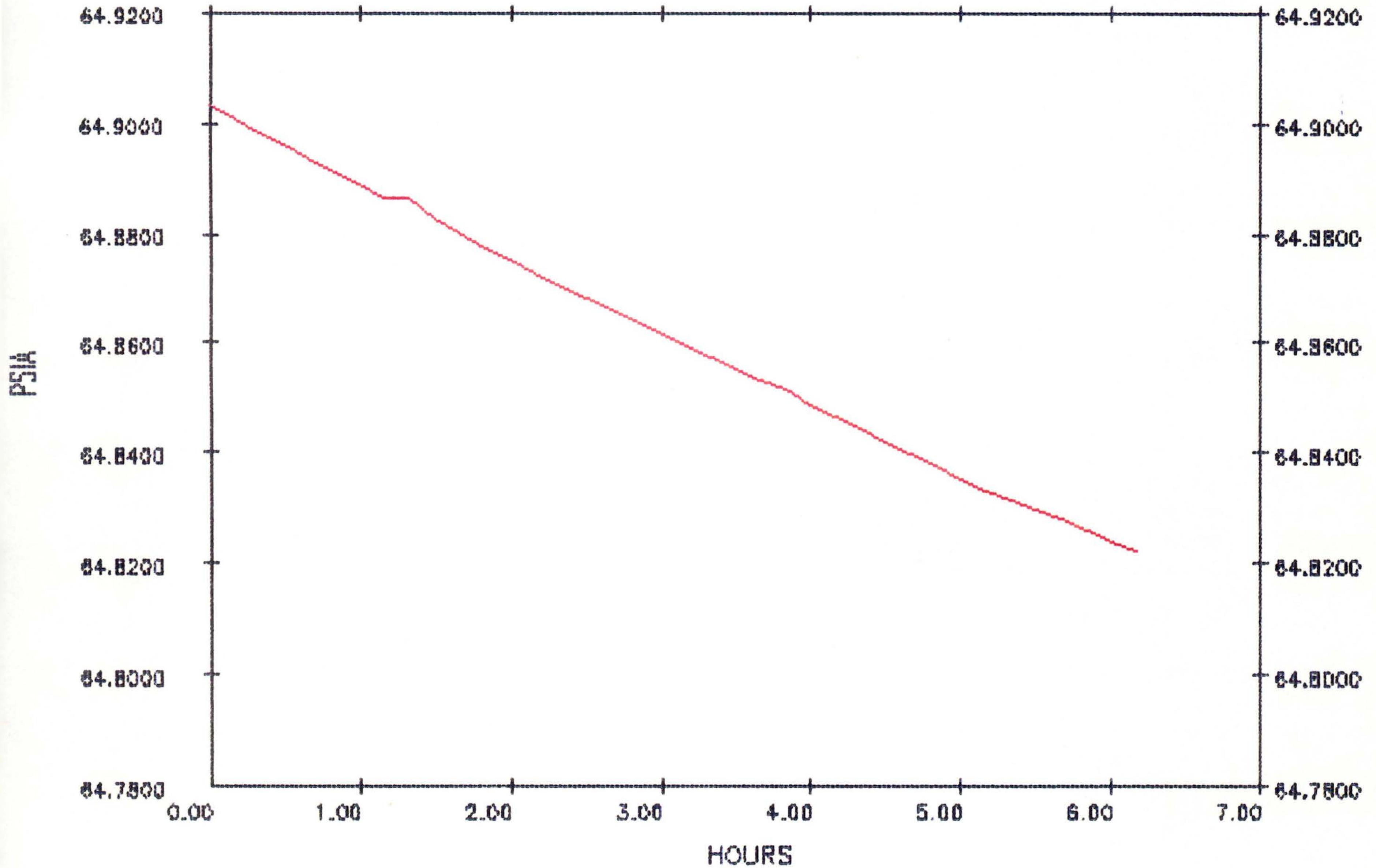
NO PRESSURE CHANNELS ARE LOCKED OUT

NO DAS CHANNELS LOCKED OUT


BN—TOP—1 LEAKRATES VS TIME
CALCULATED LEAK RATE
95 % UPPER CONFIDENCE LIMIT
Normal Test
Allowed Leak Rate
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
% PER DAY
0.33
1.13
1.93
2.73
3.53
4.33
5.13
5.93
HOURS

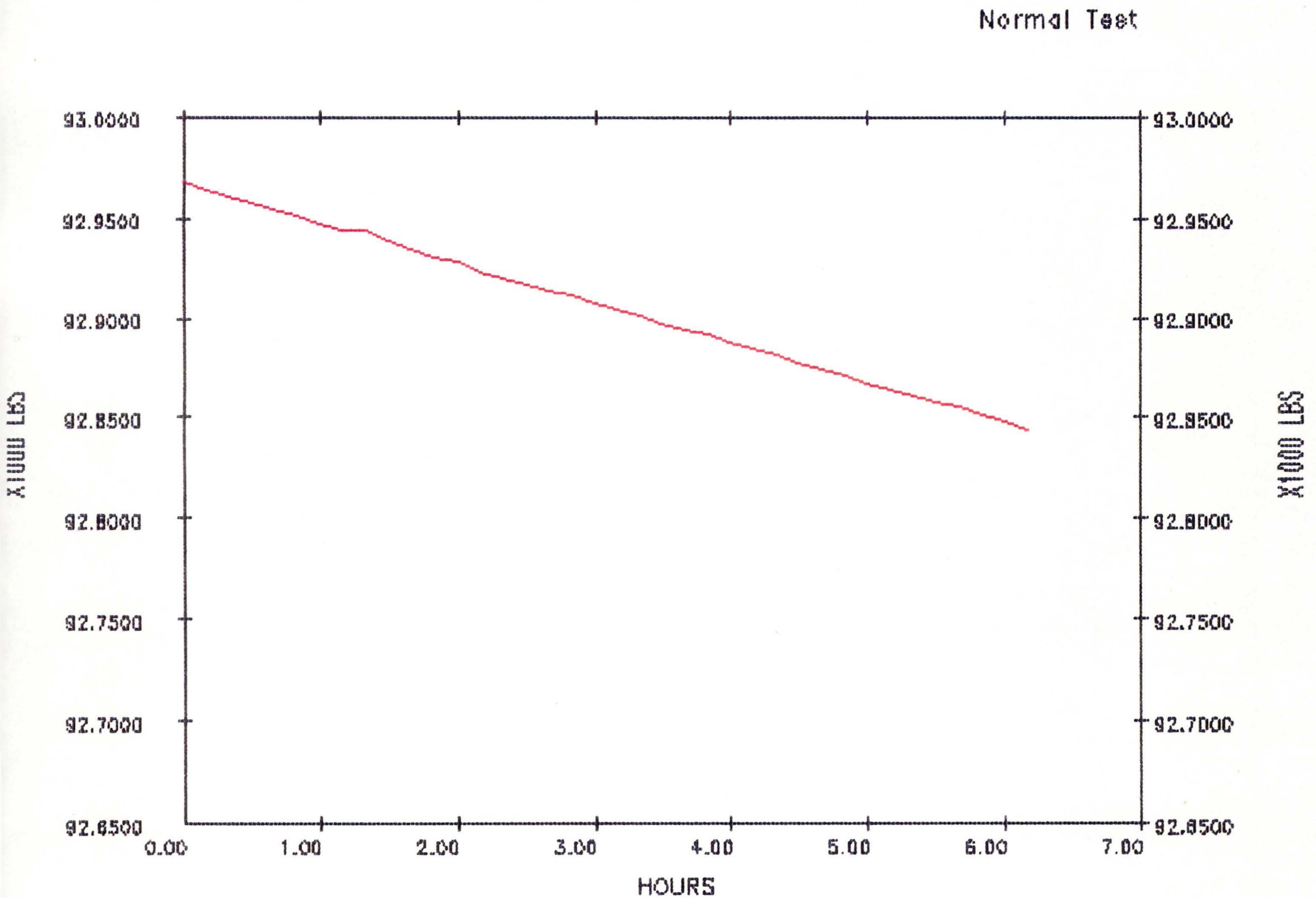
CONTAINMENT DRY AIR PRESSURE VS TIME

Normal Test

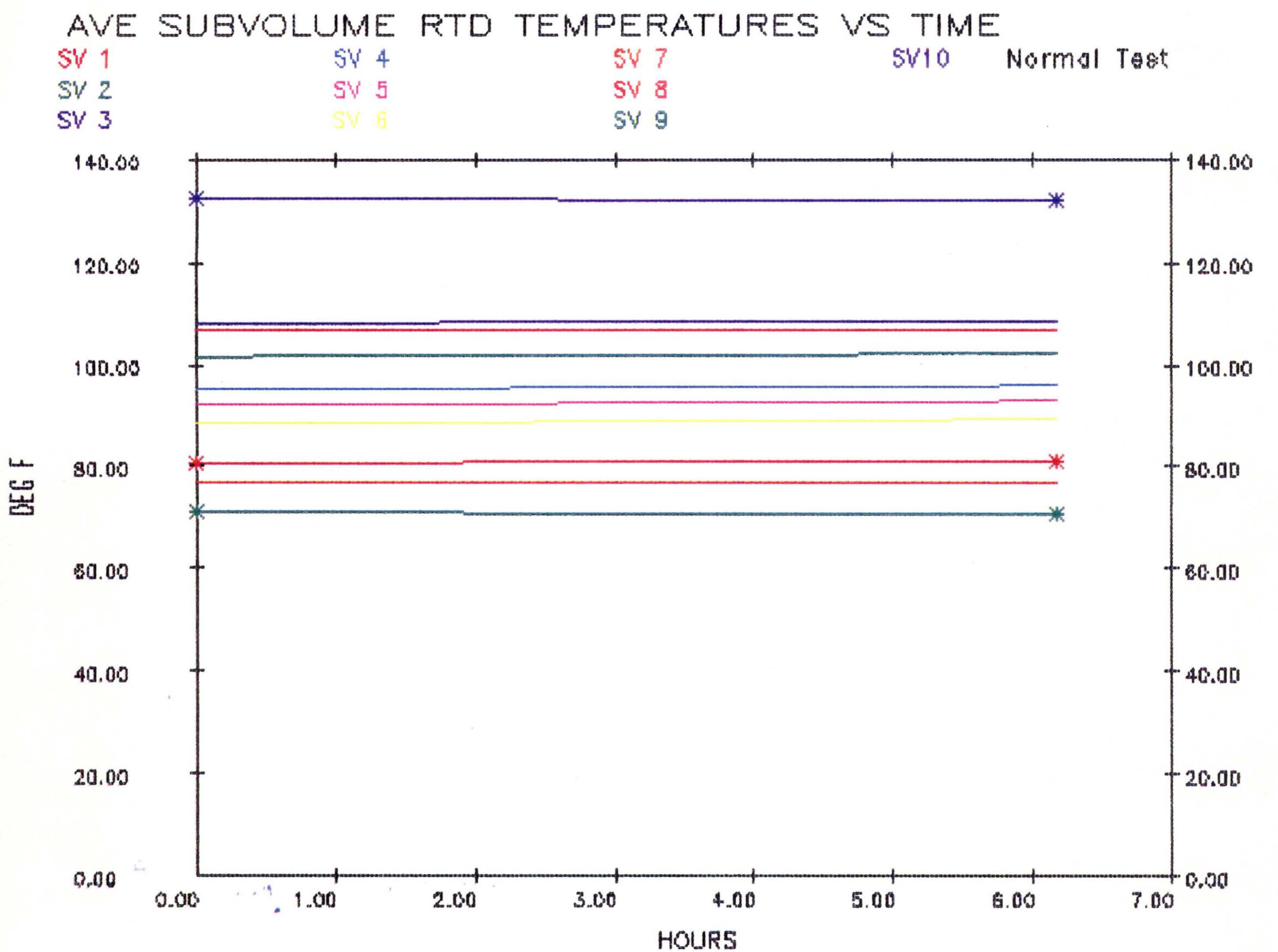


SOFTWARE ID NUMBER: GN01405-0.0

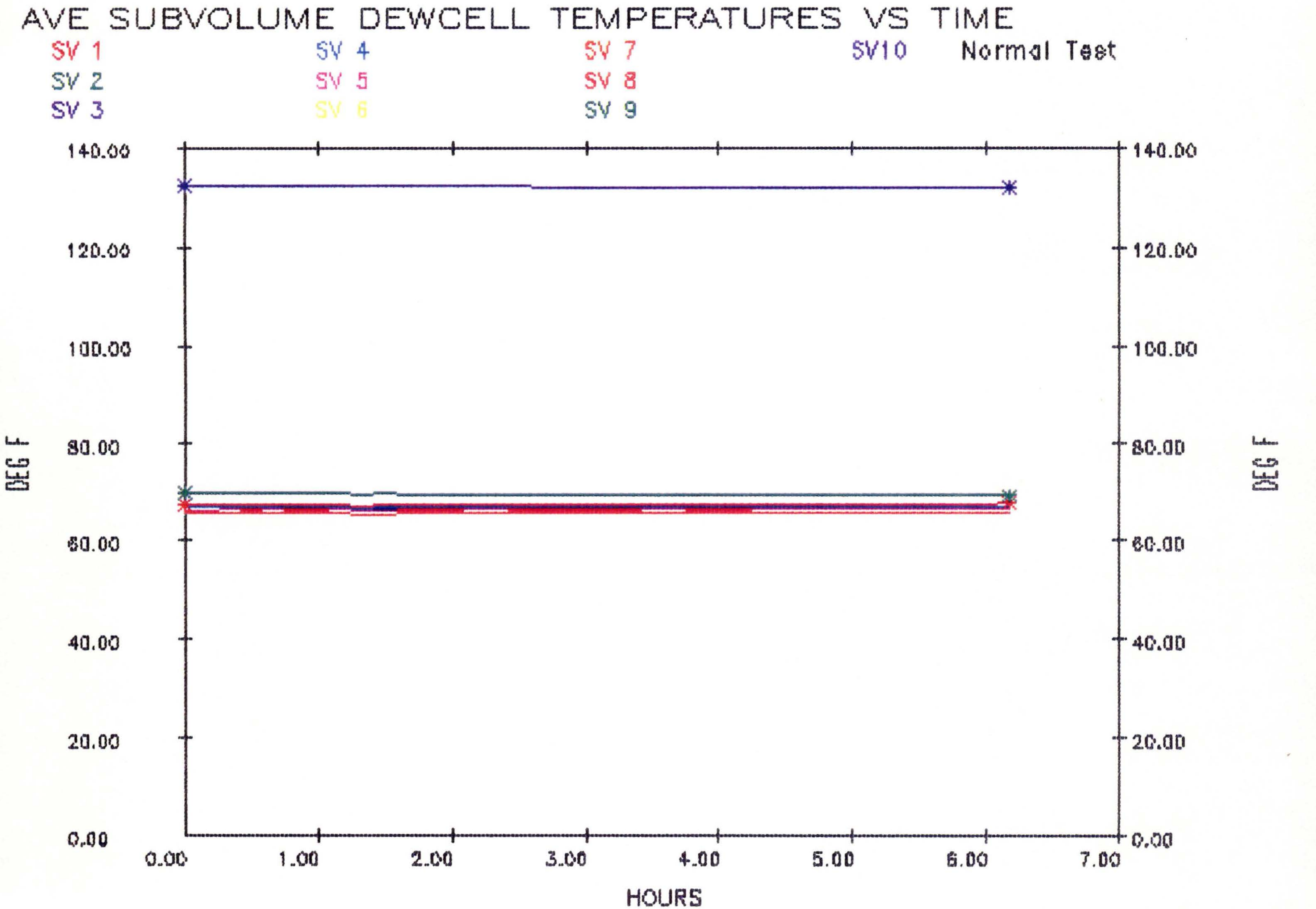
CONTAINMENT DRY AIR MASS VS TIME



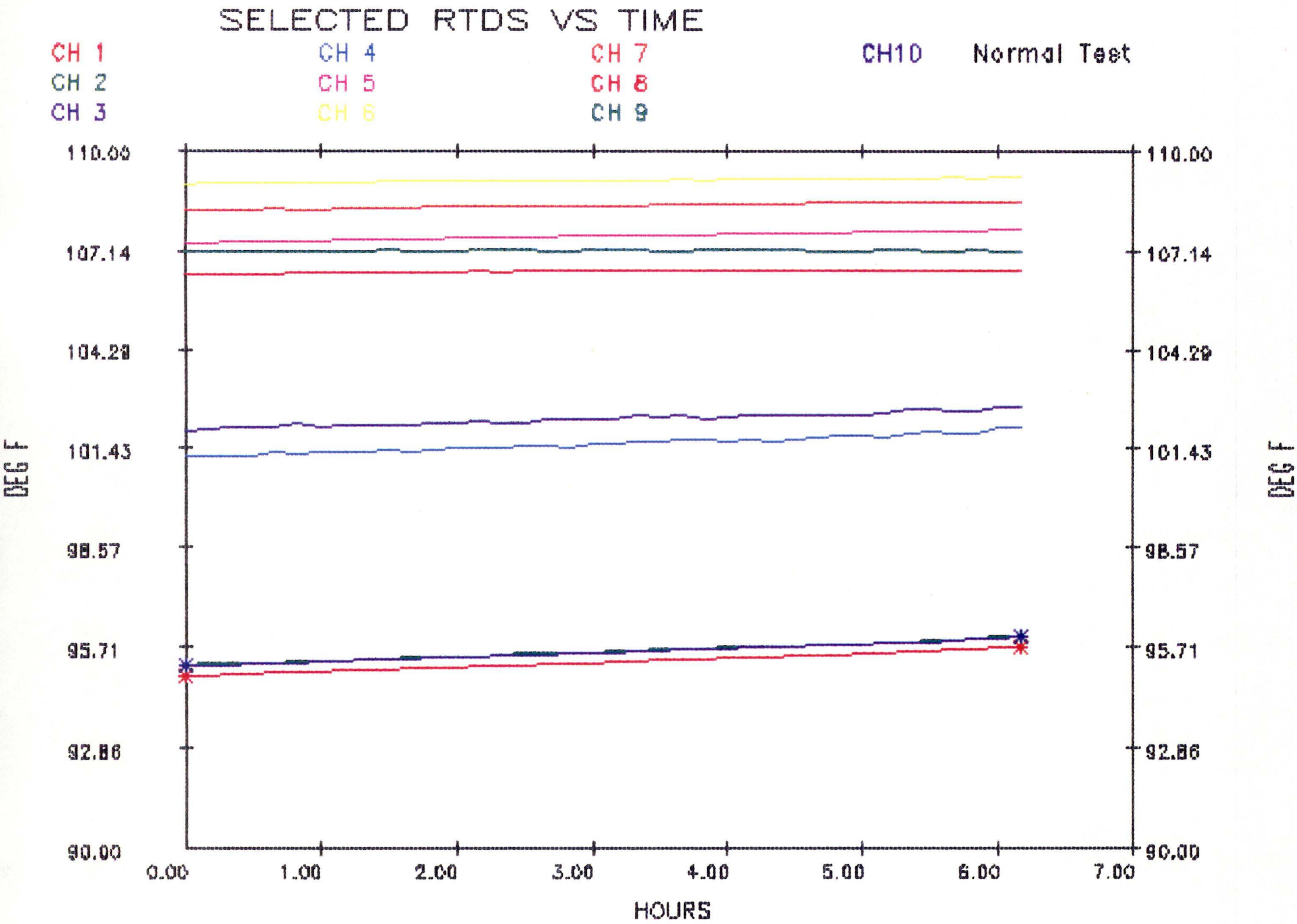
SOFTWARE ID NUMBER: GN01405-0.0



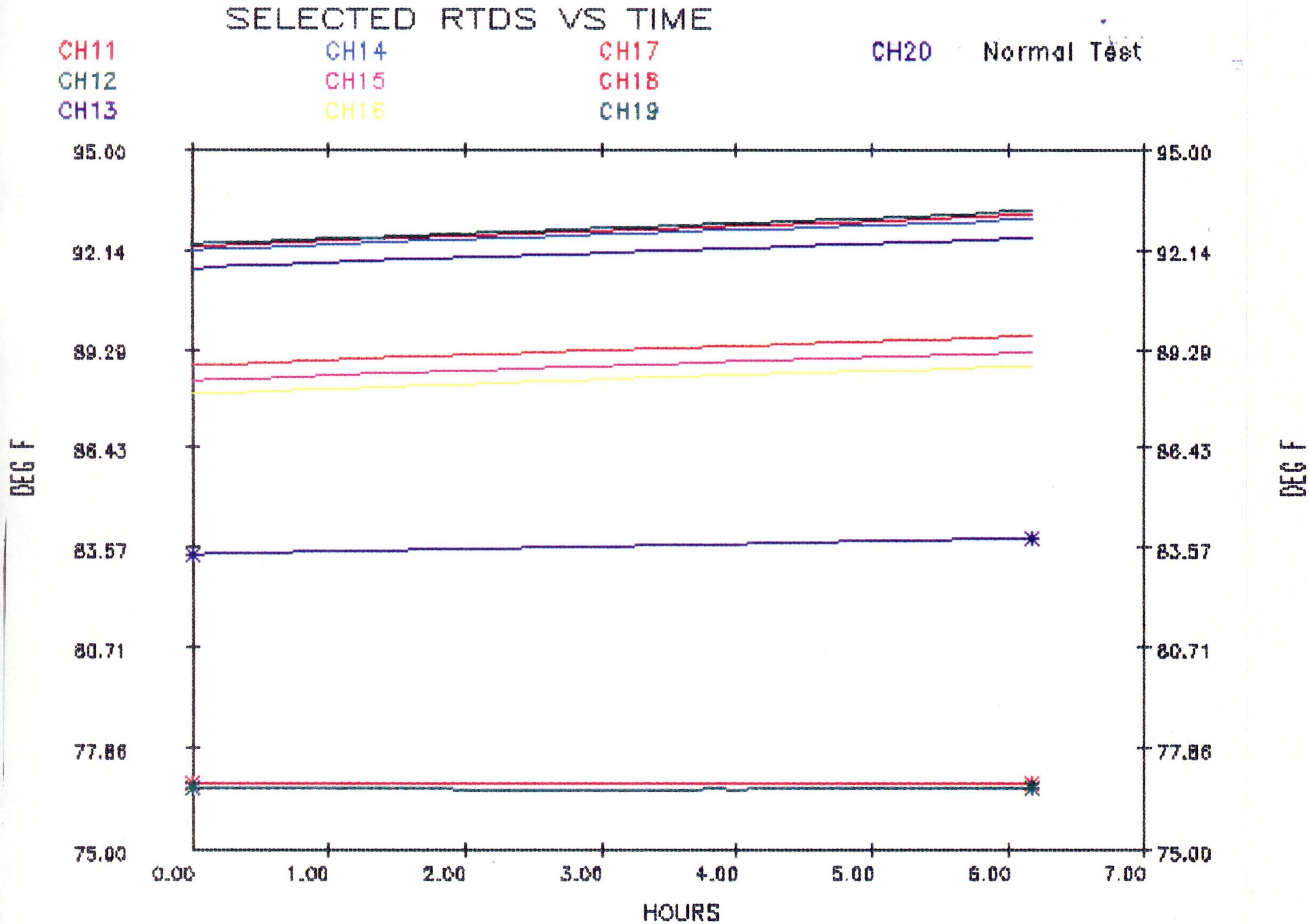
AVE SUBVOLUME RTD TEMPERATURES VS TIME
SV 1
SV 2
SV 3
SV 4
SV 5
SV 6
SV 7
SV 8
SV 9
SV10
Normal Test
DEG F
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
HOURS



AVE SUBVOLUME DEWCELL TEMPERATURES VS TIME
SV 1
SV 2
SV 3
SV 4
SV 5
SV 6
SV 7
SV 8
SV 9
SV10
Normal Test
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
DEG F
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
HOURS

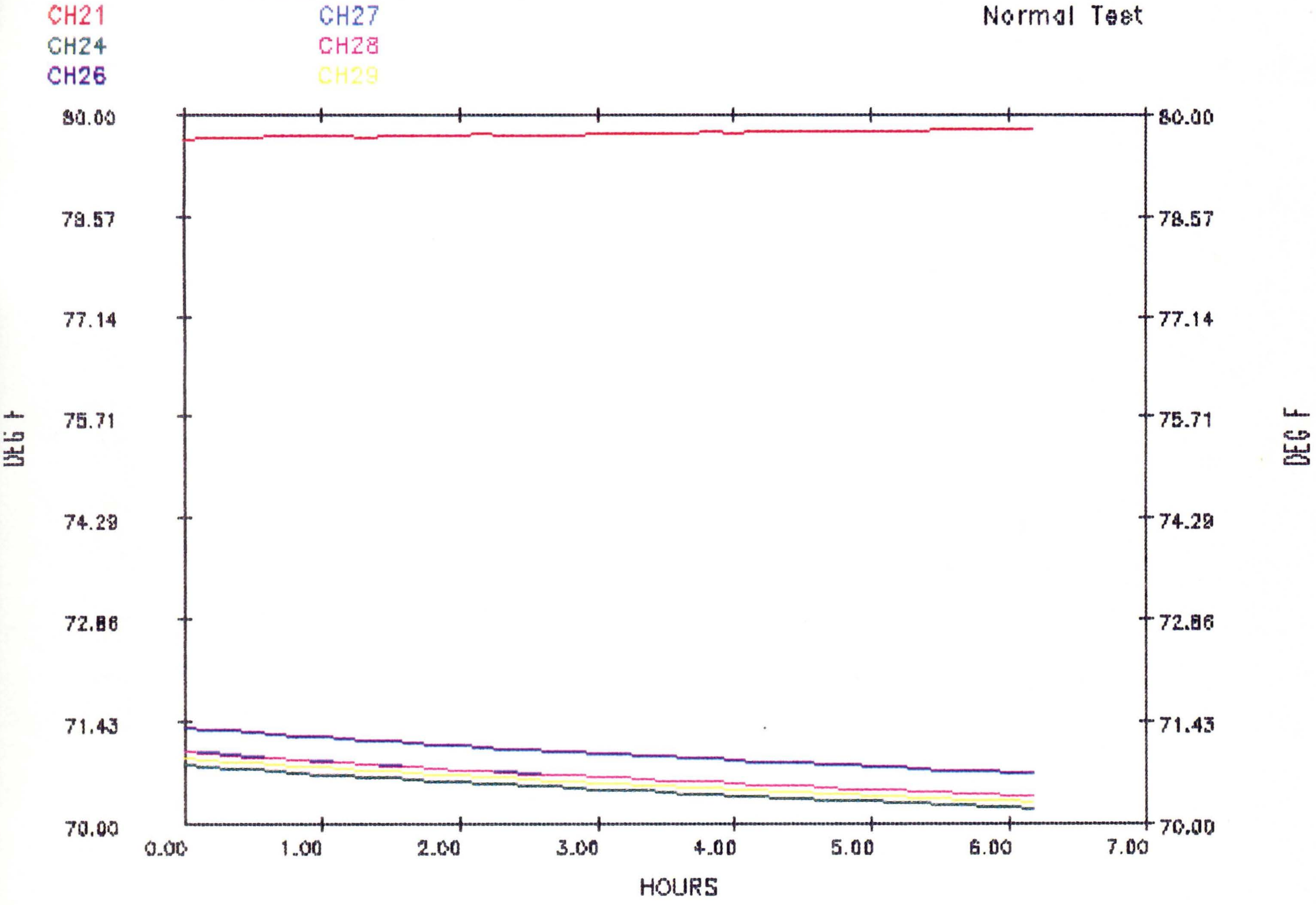


SOFTWARE ID NUMBER: GN01405-0.0

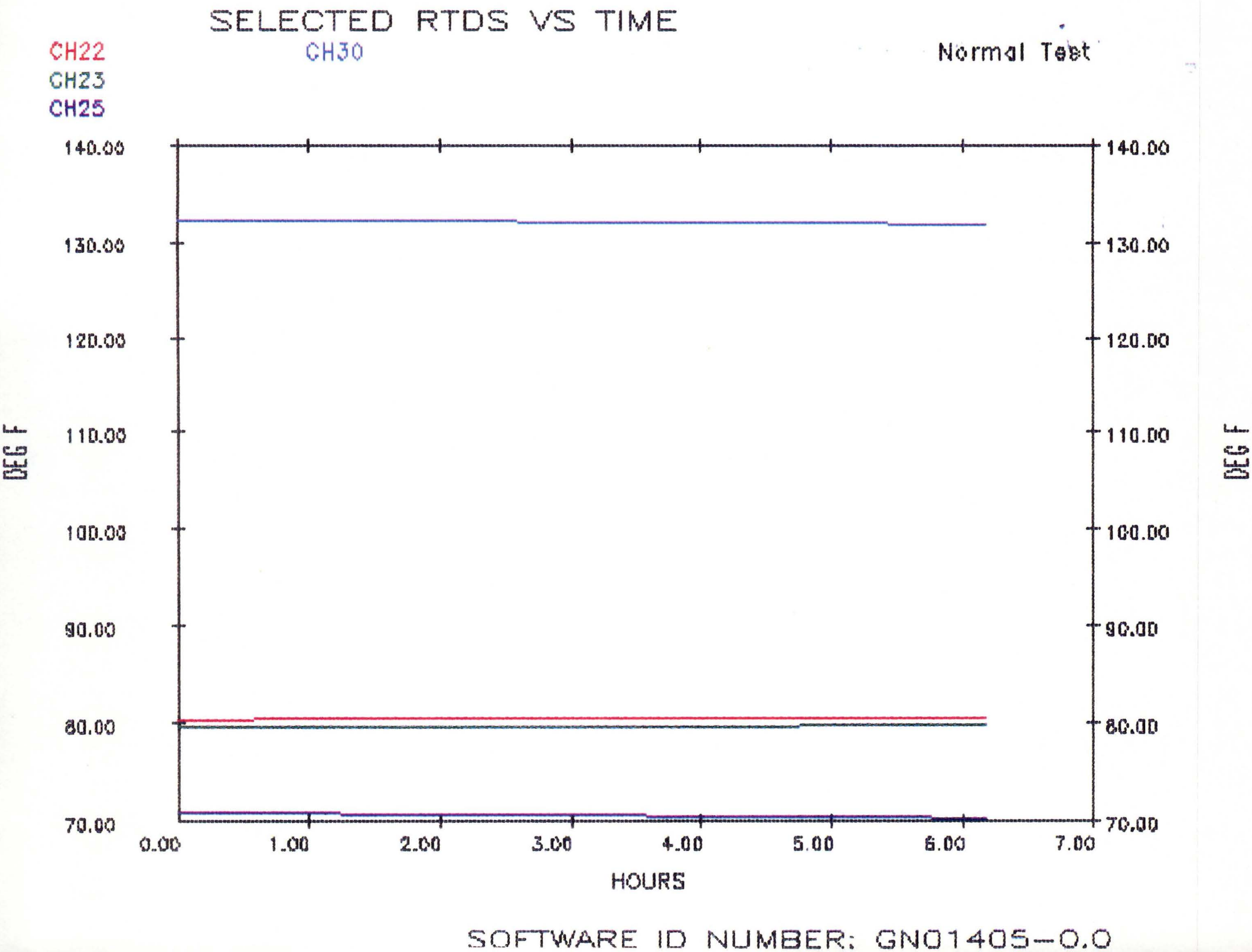


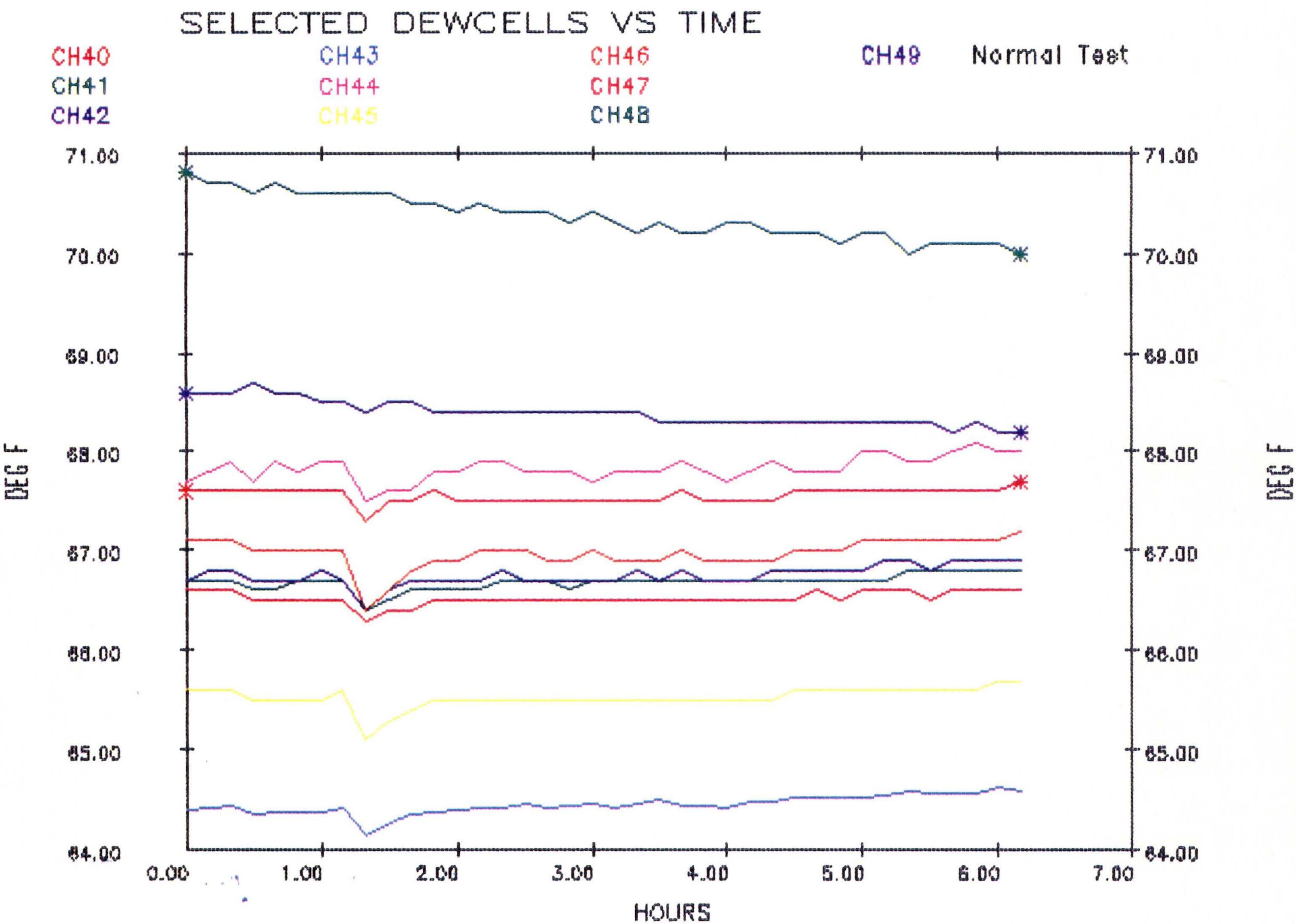
SOFTWARE ID NUMBER: GN01405-0.0

SELECTED RTDS VS TIME



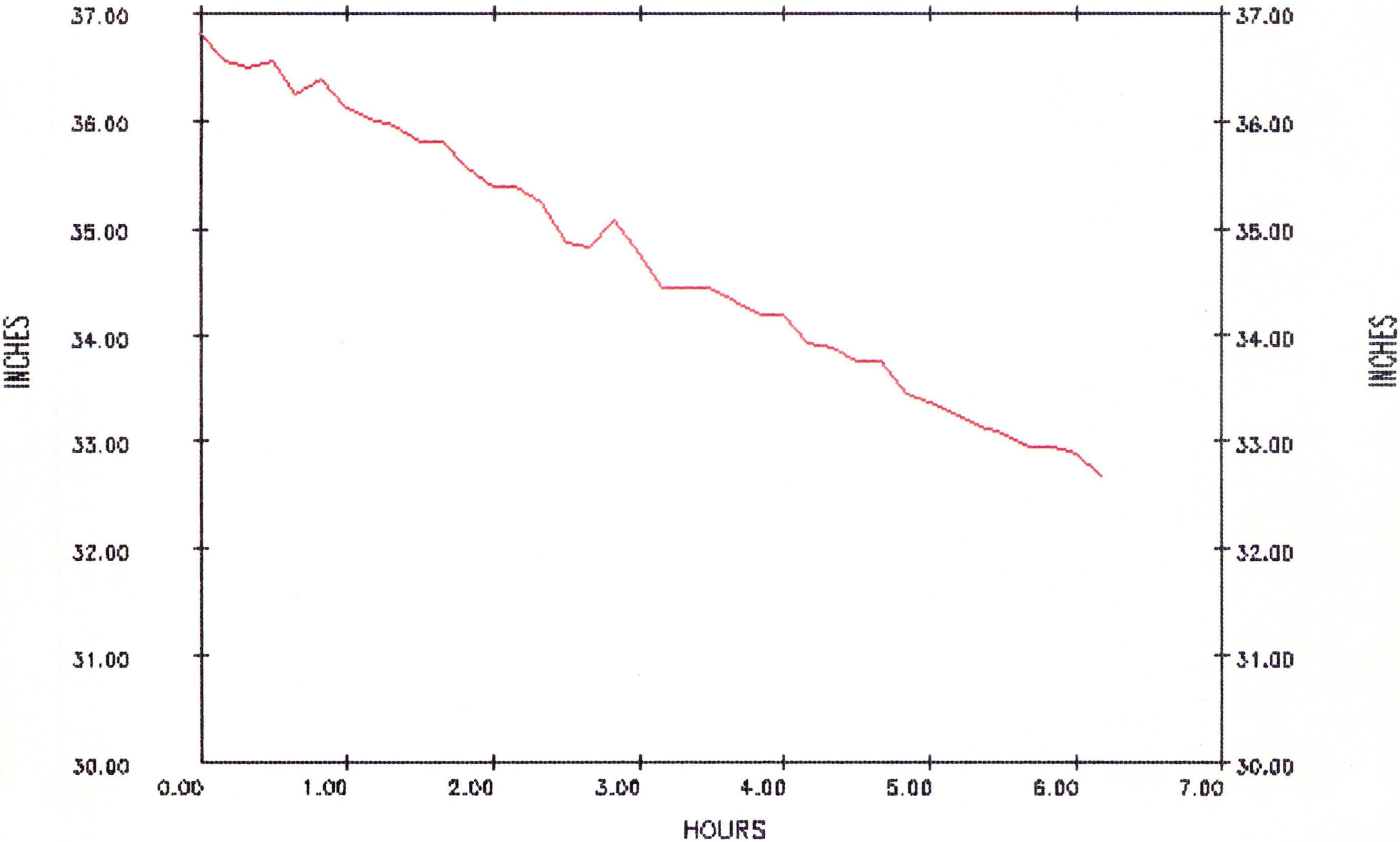
SOFTWARE ID NUMBER: GN01405-0.0

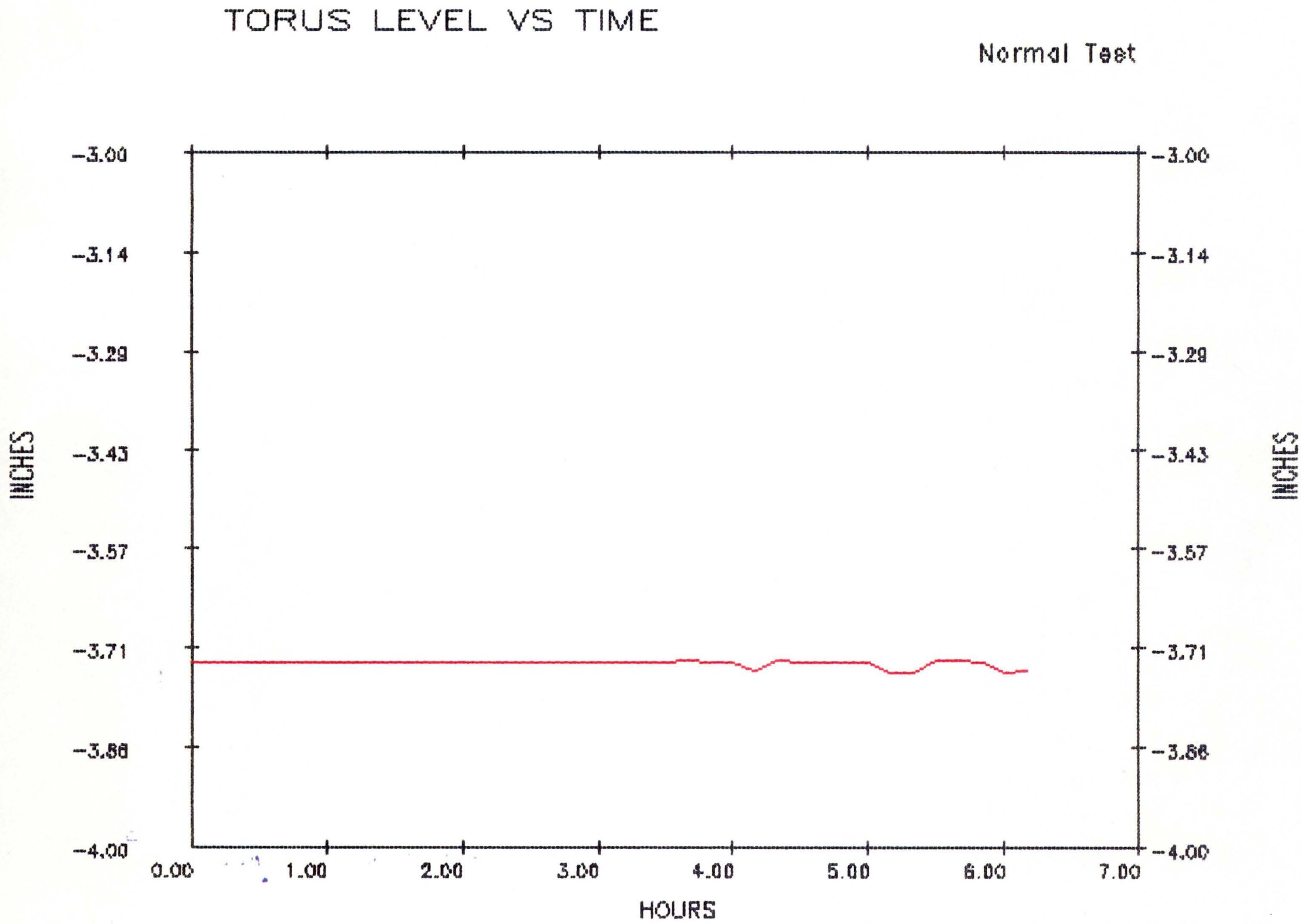

SELECTED RTDS VS TIME
CH22
CH30
CH23
CH25
Normal Test
140.00
130.00
120.00
110.00
100.00
90.00
80.00
70.00
DEG F
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
HOURS
SOFTWARE ID NUMBER: GN01405-0.0


SELECTED DEWCELLS VS TIME
CH40
CH41
CH42
CH43
CH44
CH45
CH46
CH47
CH48
CH49
Normal Test
DEG F
HOURS
71.00
70.00
69.00
68.00
67.00
66.00
65.00
64.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00

RX VESSEL LEVEL VS TIME

Normal Test





TORUS LEVEL VS TIME
Normal Test
-3.00
-3.14
-3.29
-3.43
-3.57
-3.71
-3.86
-4.00
INCHES
INCHES
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
HOURS

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

DRESDEN UNIT 3 15:20:09 MON, 22 JUN 1992

DATA SET 203 THROUGH 226

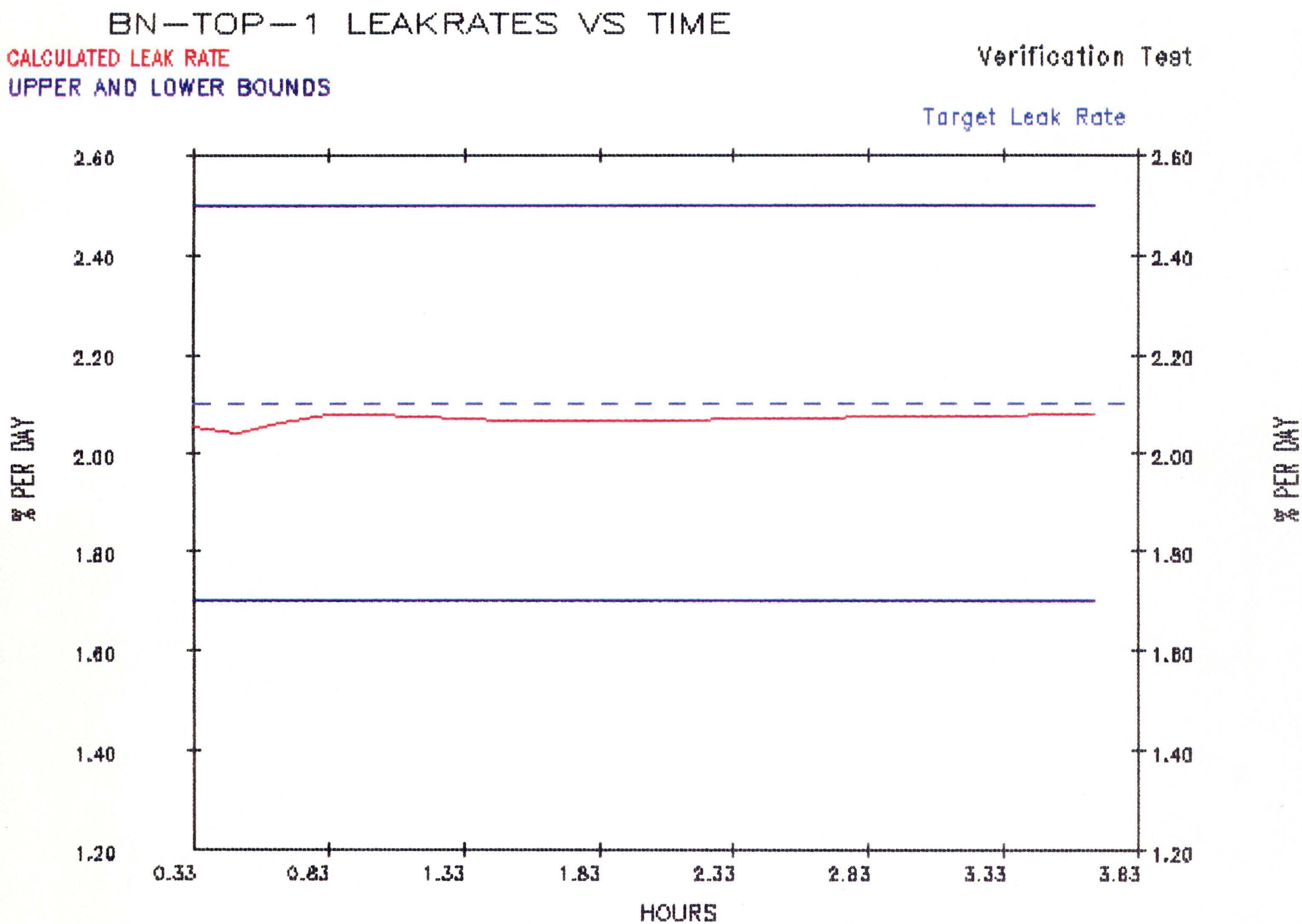
VERIFICATION TEST RESULTS CALCULATED USING THE BN-TOP-1 METHOD

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)
203	075 22:44:19	0.000	0.92725312E+05			
204	075 22:54:19	0.167	0.92712375E+05	2.0082		
205	075 23:04:19	0.333	0.92699140E+05	2.0312		
206	075 23:14:19	0.500	0.92685578E+05	2.0569	2.0564	2.0669
207	075 23:24:19	0.667	0.92673031E+05	2.0295	2.0449	2.1447
208	075 23:34:19	0.833	0.92658484E+05	2.0752	2.0667	2.1365
209	075 23:44:19	1.000	0.92644875E+05	2.0820	2.0810	2.1336
210	075 23:54:19	1.167	0.92632312E+05	2.0631	2.0799	2.1334
211	076 00:04:19	1.333	0.92619516E+05	2.0535	2.0748	2.1314
212	076 00:14:19	1.500	0.92606406E+05	2.0518	2.0705	2.1264
213	076 00:24:19	1.667	0.92593000E+05	2.0547	2.0684	2.1213
214	076 00:34:19	1.833	0.92579265E+05	2.0617	2.0690	2.1180
215	076 00:44:19	2.000	0.92565922E+05	2.0627	2.0696	2.1155
216	076 00:54:19	2.167	0.92553344E+05	2.0543	2.0676	2.1121
217	076 01:04:19	2.333	0.92539031E+05	2.0662	2.0691	2.1110
218	076 01:14:19	2.500	0.92525500E+05	2.0687	2.0708	2.1106
219	076 01:24:19	2.667	0.92512187E+05	2.0685	2.0721	2.1100
220	076 01:34:19	2.833	0.92499109E+05	2.0663	2.0726	2.1090
221	076 01:44:19	3.000	0.92484734E+05	2.0756	2.0748	2.1098
222	076 01:54:19	3.167	0.92471453E+05	2.0749	2.0765	2.1101
223	076 02:04:19	3.333	0.92458984E+05	2.0679	2.0766	2.1094
224	076 02:14:19	3.500	0.92444625E+05	2.0757	2.0780	2.1097
225	076 02:24:19	3.667	0.92431547E+05	2.0736	2.0788	2.1096
226	076 02:34:19	3.833	0.92417765E+05	2.0765	2.0799	2.1099

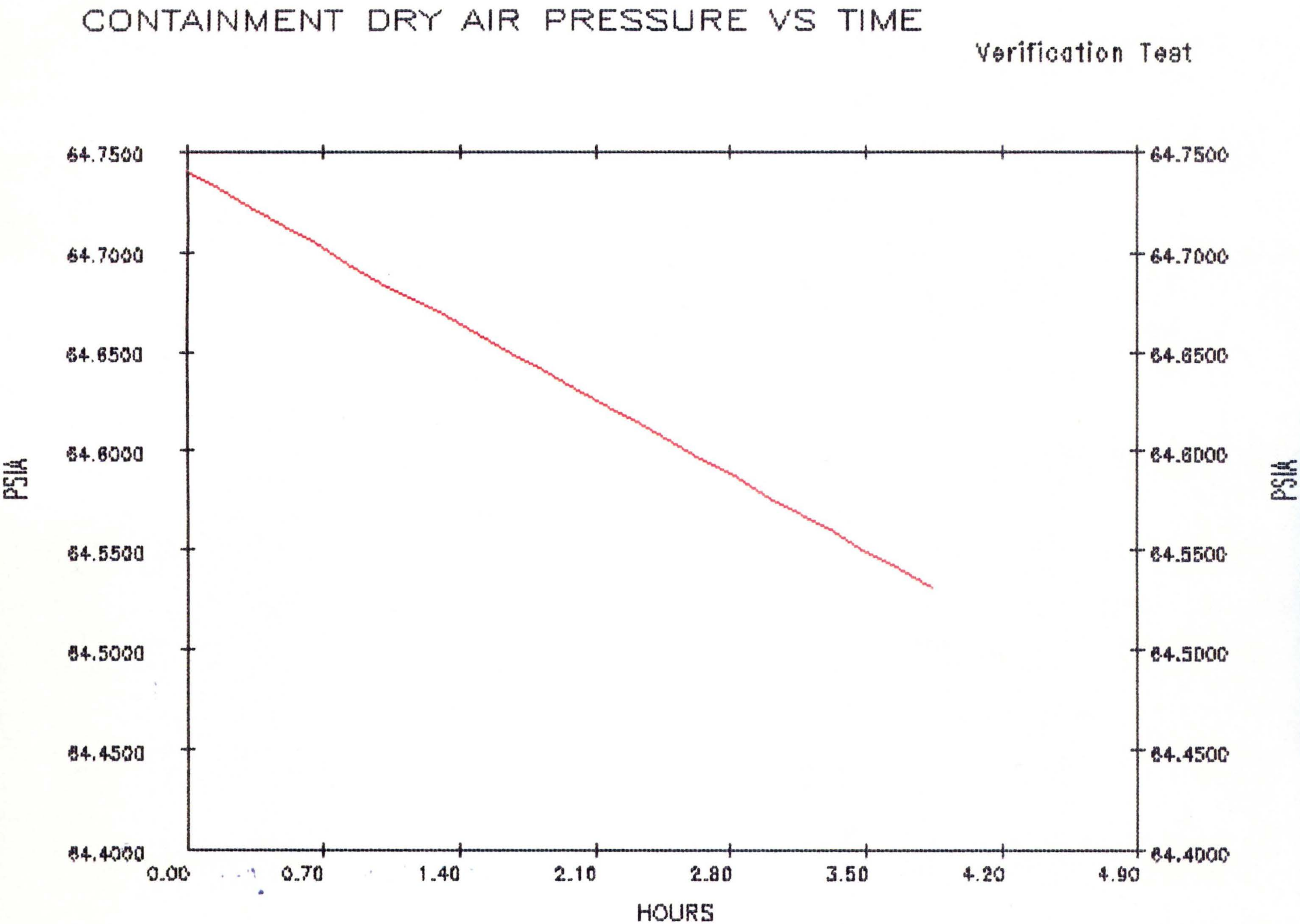
****

NO PRESSURE CHANNELS ARE LOCKED OUT

NO DAS CHANNELS LOCKED OUT

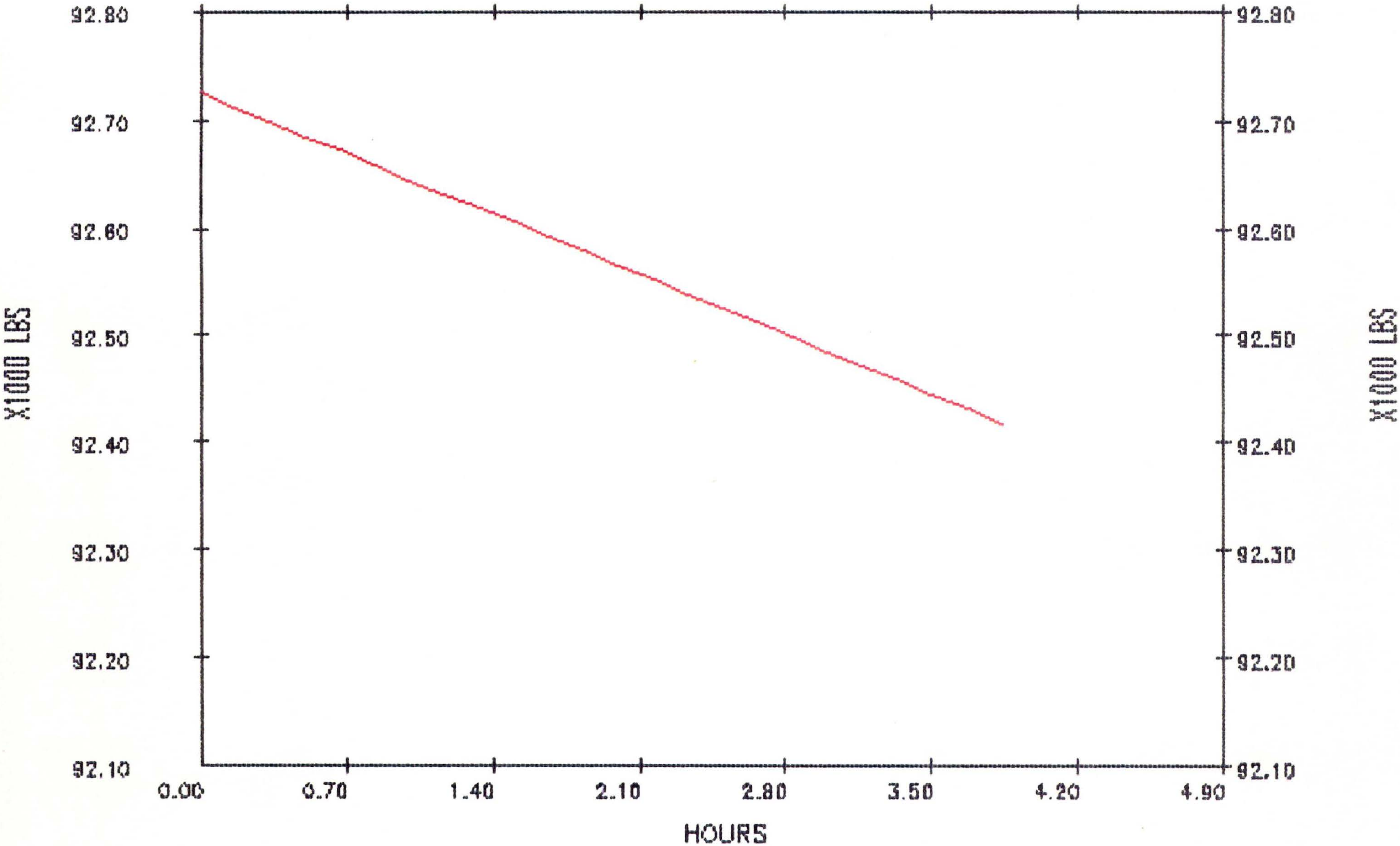


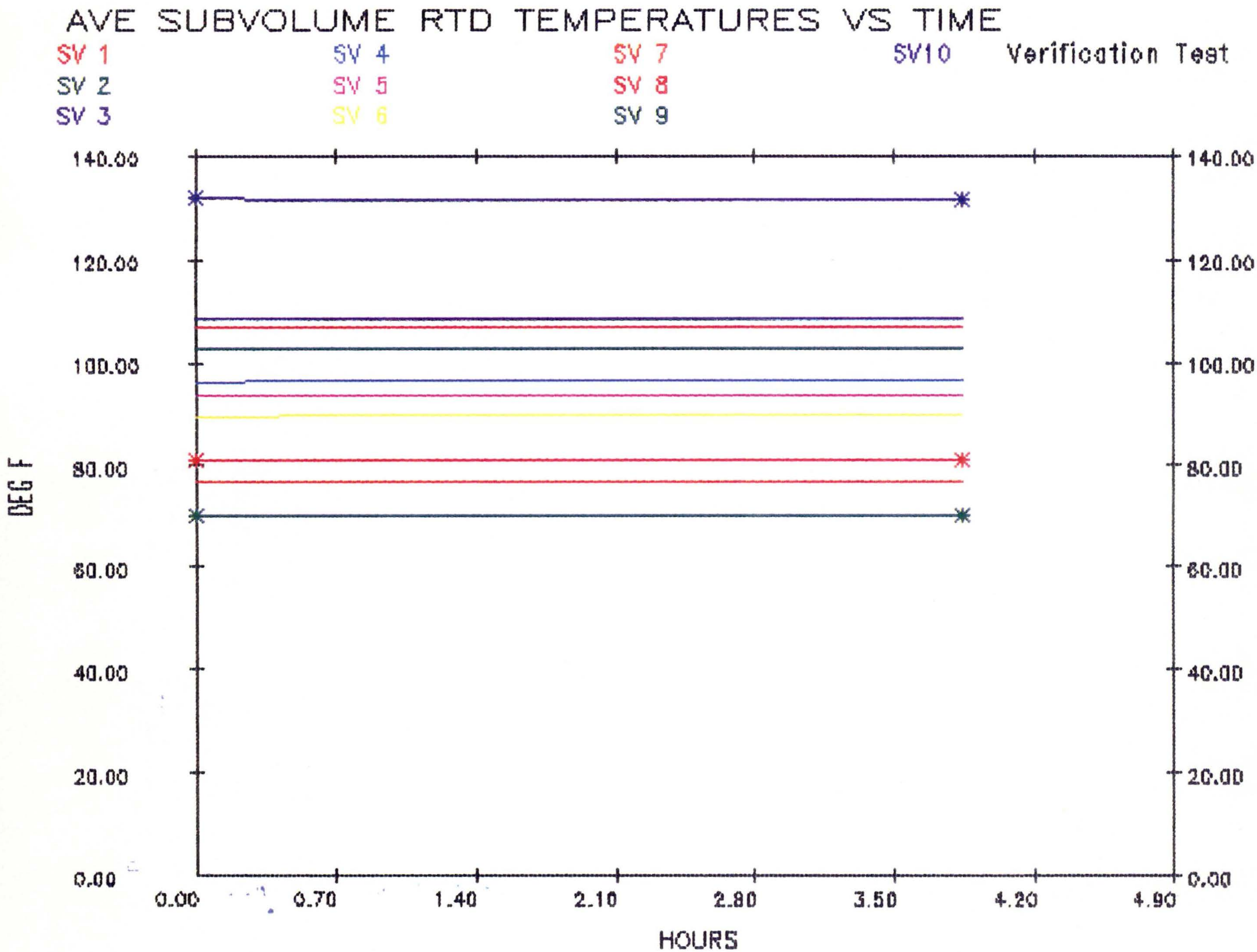
BN-TOP-1 LEAKRATES VS TIME
CALCULATED LEAK RATE
UPPER AND LOWER BOUNDS
Verification Test
Target Leak Rate
% PER DAY
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
0.33
0.83
1.33
1.83
2.33
2.83
3.33
3.83
HOURS

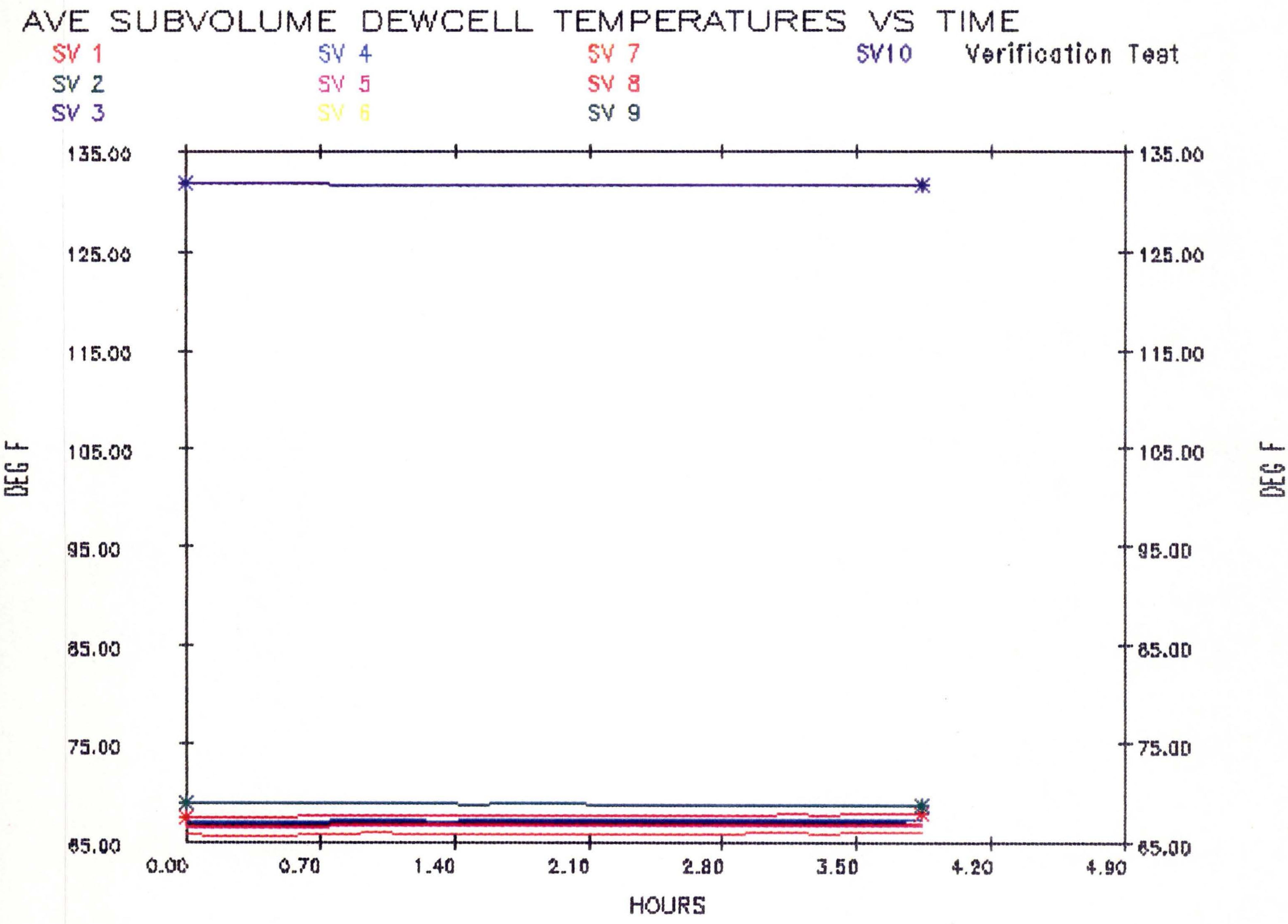

CONTAINMENT DRY AIR PRESSURE VS TIME
Verification Test
64.7500
64.7000
64.6500
64.6000
64.5500
64.5000
64.4500
64.4000
PSIA
0.00
0.70
1.40
2.10
2.80
3.50
4.20
4.90
HOURS

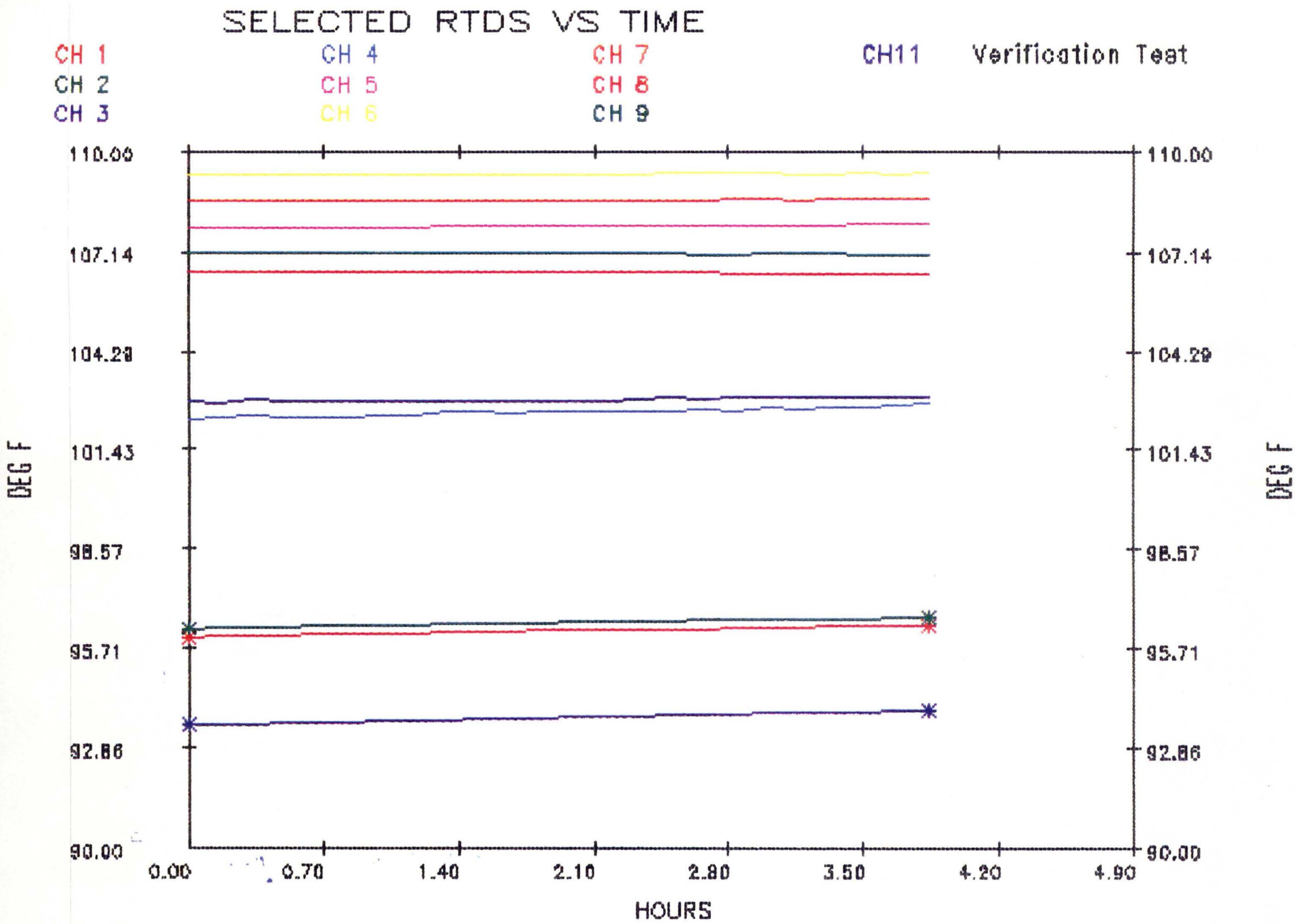
CONTAINMENT DRY AIR MASS VS TIME

Verification Test

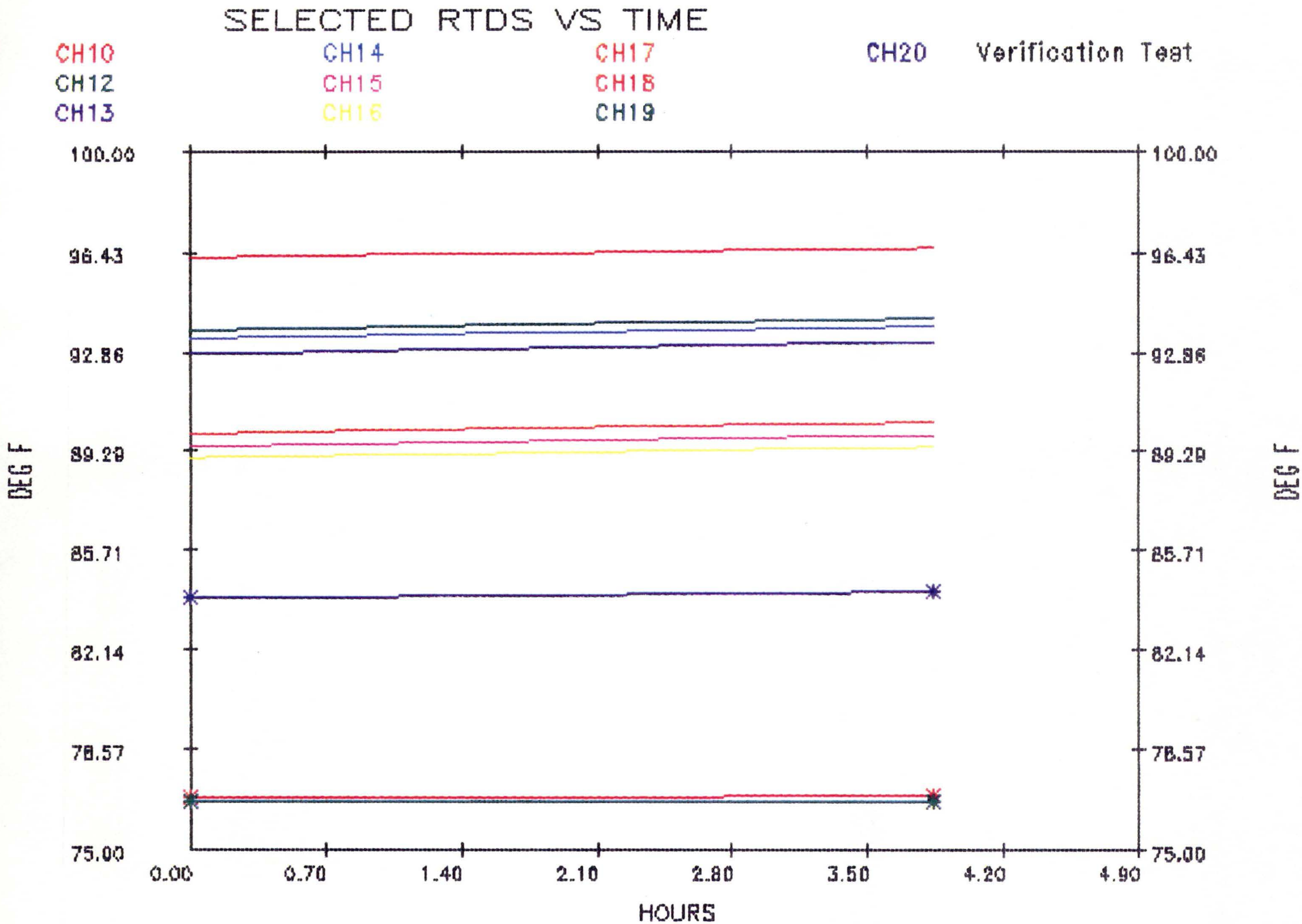


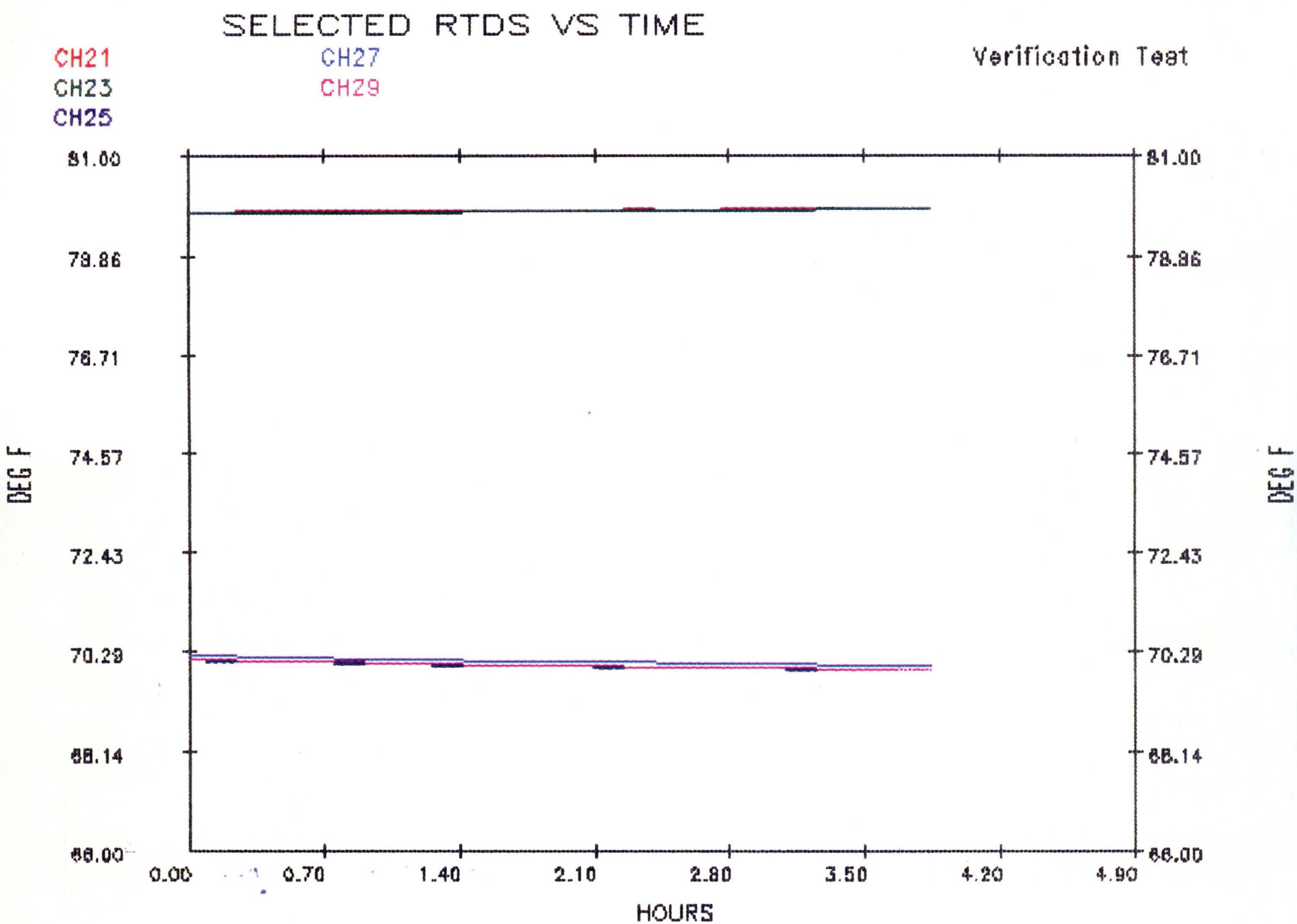

AVE SUBVOLUME RTD TEMPERATURES VS TIME
SV 1
SV 2
SV 3
SV 4
SV 5
SV 6
SV 7
SV 8
SV 9
SV10
Verification Test
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
DEG F
0.00
0.70
1.40
2.10
2.80
3.50
4.20
4.90
HOURS

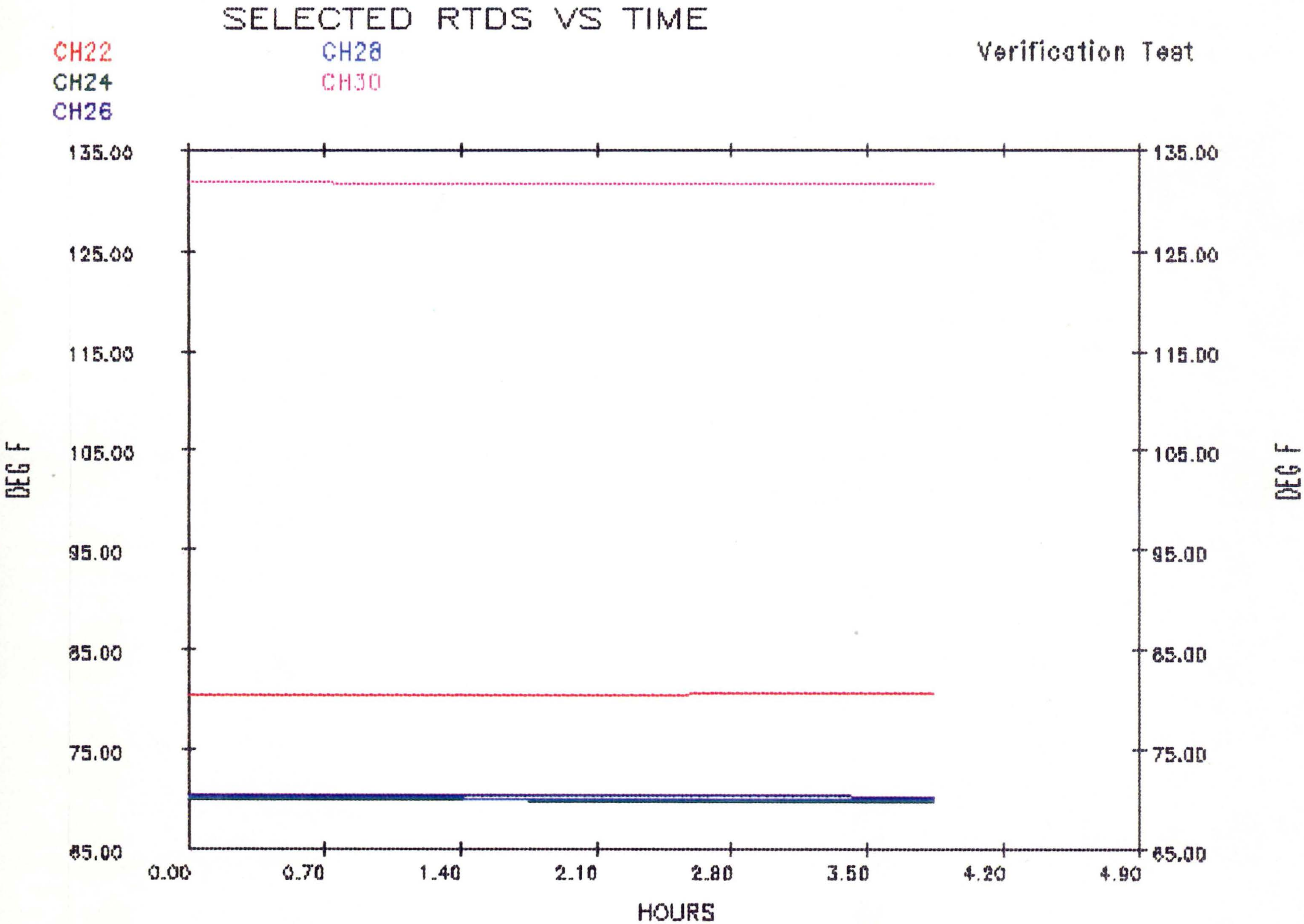

AVE SUBVOLUME DEWCELL TEMPERATURES VS TIME
SV 1
SV 2
SV 3
SV 4
SV 5
SV 6
SV 7
SV 8
SV 9
SV10
Verification Test
135.00
125.00
115.00
105.00
95.00
85.00
75.00
65.00
DEG F
0.00
0.70
1.40
2.10
2.80
3.50
4.20
4.90
HOURS



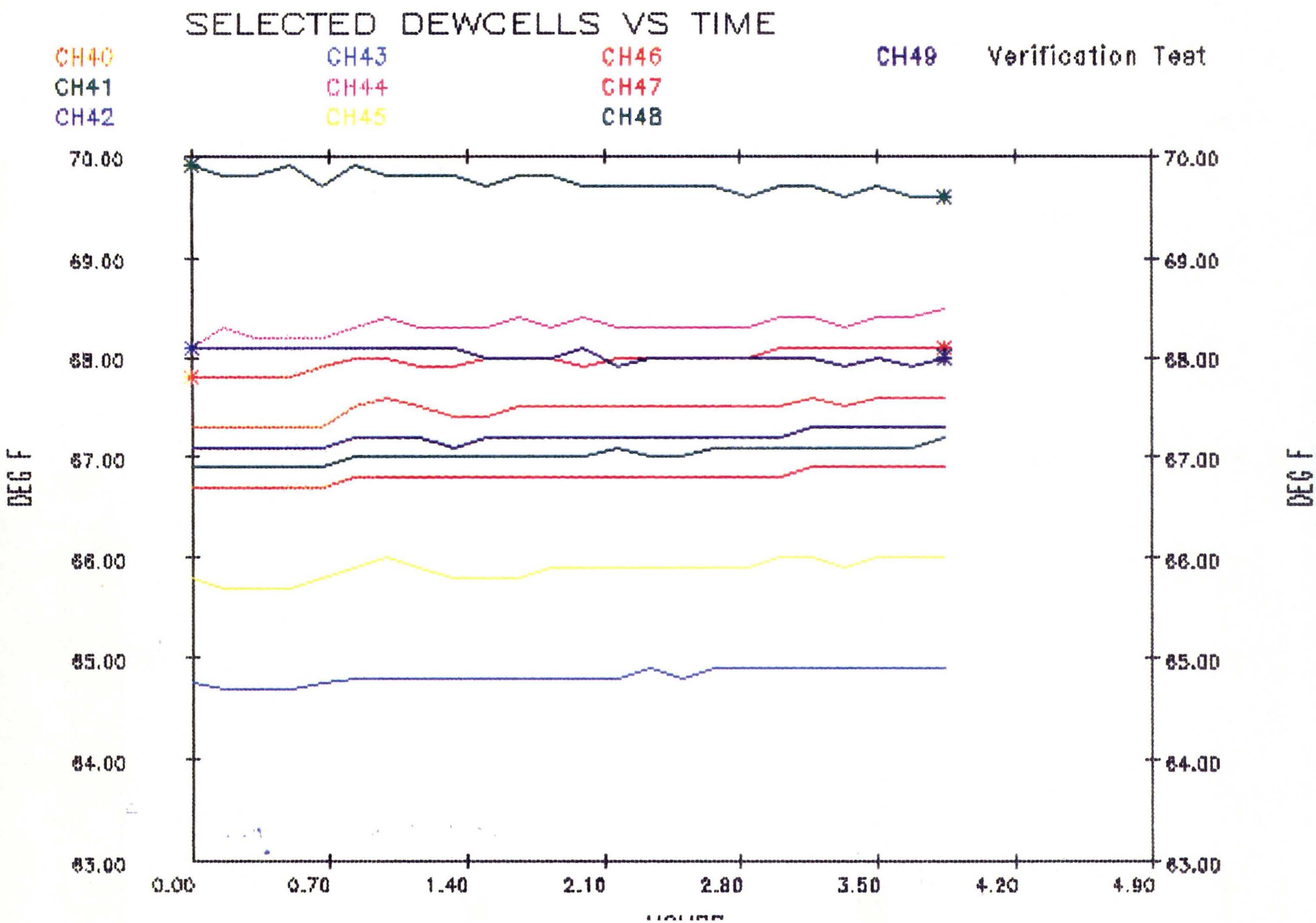
SELECTED RTDS VS TIME
CH 1
CH 2
CH 3
CH 4
CH 5
CH 6
CH 7
CH 8
CH 9
CH11
Verification Test
110.00
107.14
104.29
101.43
98.57
95.71
92.86
90.00
DEG F
0.00
0.70
1.40
2.10
2.80
3.50
4.20
4.90
HOURS


SELECTED RTDS VS TIME
CH10
CH12
CH13
CH14
CH15
CH16
CH17
CH18
CH19
CH20
Verification Test
100.00
96.43
92.86
89.29
85.71
82.14
78.57
75.00
DEG F
0.00
0.70
1.40
2.10
2.80
3.50
4.20
4.90
HOURS

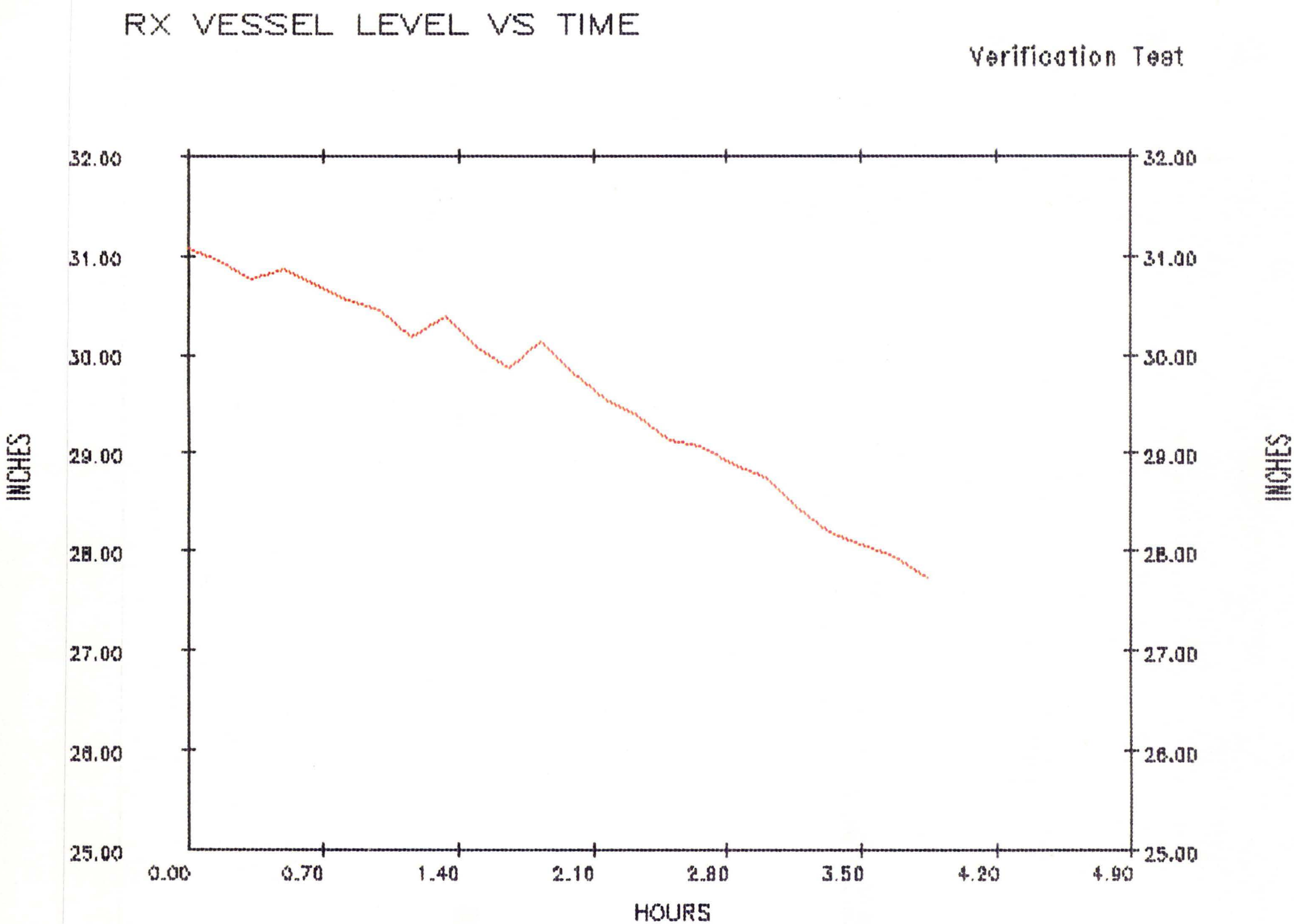

SELECTED RTDS VS TIME
CH21
CH23
CH25
CH27
CH29
Verification Test
81.00
78.86
76.71
74.57
72.43
70.29
68.14
66.00
DEG F
0.00
0.70
1.40
2.10
2.80
3.50
4.20
4.90
HOURS



SELECTED RTDS VS TIME
CH22
CH24
CH26
CH28
CH30
Verification Test
135.00
125.00
115.00
105.00
95.00
85.00
75.00
65.00
DEG F
0.00
0.70
1.40
2.10
2.80
3.50
4.20
4.90
HOURS



SELECTED DEWCELLS VS TIME
CH40
CH41
CH42
CH43
CH44
CH45
CH46
CH47
CH48
CH49
Verification Test
70.00
69.00
68.00
67.00
66.00
65.00
64.00
63.00
DEG F
0.00
0.70
1.40
2.10
2.80
3.50
4.20
4.90



RX VESSEL LEVEL VS TIME
Verification Test
INCHES
32.00
31.00
30.00
29.00
28.00
27.00
26.00
25.00
HOURS
0.00
0.70
1.40
2.10
2.80
3.50
4.20
4.90

SECTION E - TEST CALCULATIONS

The calculations performed for this IPCLRT were based on the absolute method of leak rate determination. The absolute method uses the ideal gas laws as a basis for determining the integrated leak rate. The ideal gas laws allow the mass of the containment dry air to be determined from inputs of containment temperature, pressure and dewpoint. The trend of containment dry air mass over time is then processed using the statistical methods outlined in BN-TOP-1 Rev. 1 to determine the calculated leak rate. All the calculations used to determine the calculated leak rate are laid out in Appendix B.

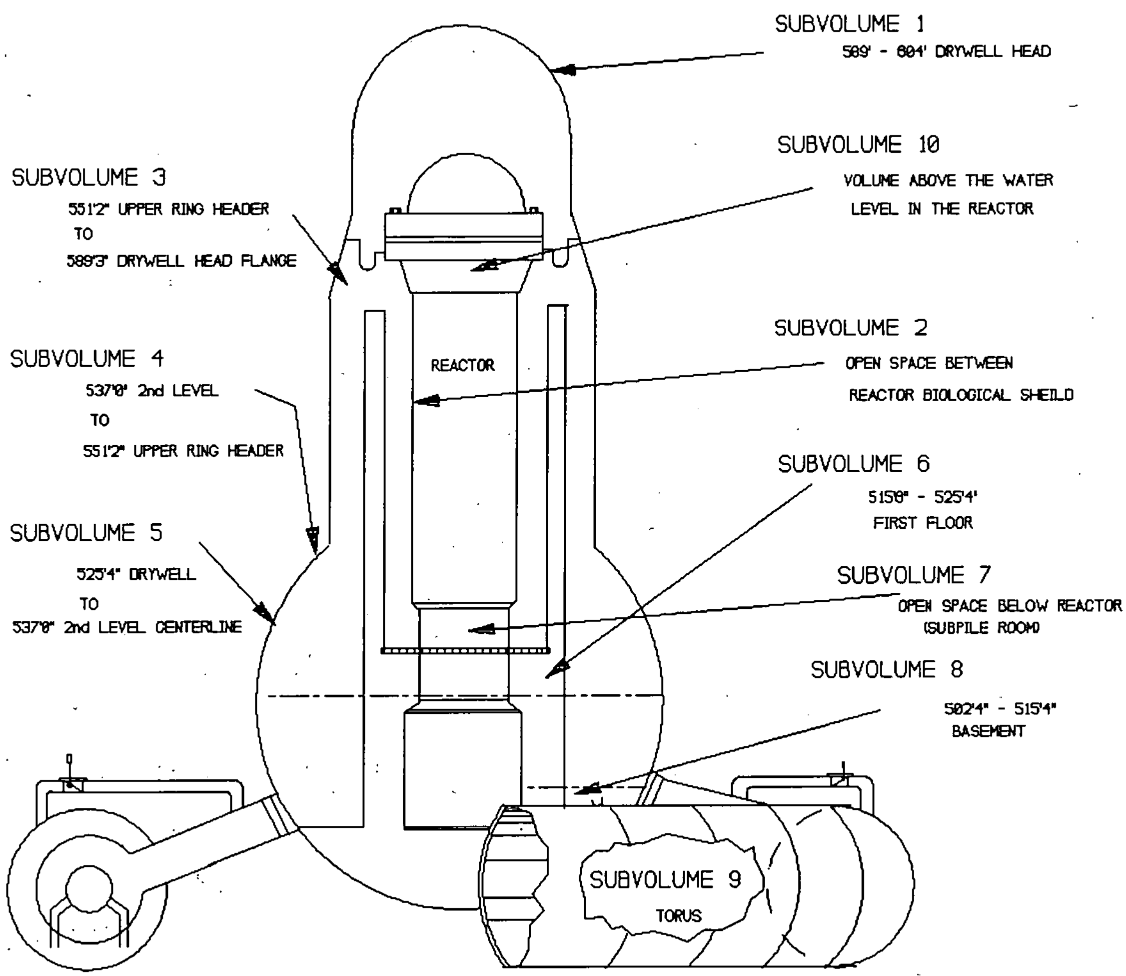
Appendix B contains calculations which adjust the calculated leak rate to compensate for changes in Torus level and Reactor Vessel level. However, these calculations were not used, for this test. The Torus level remained constant throughout the test. Consequently, an adjustment was not needed. The Reactor Vessel level on the other hand, declined during the course of the measured leak rate phase. However, it was decided that the conservative approach would be taken and the changes in Reactor Vessel level would not be compensated.

Due to the size and shape of the primary containment, a mathematical model had to be developed to account for the effects of temperature stratification and local temperature variations. The containment volume was theoretically divided into ten subvolumes with weighing factors assigned to each so that accurate values for containment average temperature and dewpoint could be determined. (The value of the weighing factor is equivalent to the fractional part of the total containment volume occupied by the associated subvolumes.) The volumes of the larger pieces of equipment were taken into account when calculating the subvolumes. (See Figure 20 for a diagram of the idealized containment and zoning configuration used.) Table 5 lists the subvolume weighing factors associated with each zone.

TABLE FIVE
SUBVOLUME WEIGHING FACTORS

SUBVOLUME NUMBER	BASE FREE VOLUME (Ft^3)	VOLUME FRACTION
1	11,373.00	0.03942
2	3,081.00	0.01068
3	20,989.00	0.07276
4	23,848.00	0.08267
5	31,896.00	0.11056
6	27,283.00	0.09457
7	7,226.00	0.02505
8	43,289.00	0.15005
9	113,080.41	0.39198
10	6,423.00	0.02226

FIGURE 20
PRIMARY CONTAINMENT SUBVOLUME LOCATIONS



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)
Calculated Leak Rate	0.5105	1.20
Upper 95% Confidence Limit (UCL) Leak Rate	0.5546	1.20
As-Left Leak Rate (95% UCL + Non-Vented Penetrations + Compensation for Sump Level Changes)	0.6706	1.20

F.2 Induced Phase Test Results

A leak of 1.6062 weight%/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 Leak Rate (Li)	1.6062
Calculated Leak Rate Prior To Verification Test (Lc)	0.5105
Calculated Leak Rate During Verification Test (Lv)	2.0801

Acceptance Criterion: $Lv - (Li + Lc) < 0.4$ wt%/day

$Lv-(Li+Lc) = .0366$ wt%/day < 0.4 wt%/day

F.3 Leak Rate Compensation for Non-Vented Penetrations

The Integrated Primary Containment Leak Rate Test was performed with several 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 in the Table 6:

An additional volume was added to this total. It was discovered after the Type A test that the H_2O_2 Monitor was not properly tested per 10CFR50 Appendix J. The volume was correctly tested recently through a Type C test. The leakage was 4.19 scfh. LER 92-016 was written to address this matter.

This total is equivalent to 0.104 wt%/day at IPCLRT pressure and temperature.

Non-Vented Penetration Penalty: 0.104 wt%/day

F.4 Compensation for Sump Level Changes

During the performance of the IPCLRT, the water level within the two Drywell sumps increased. Prior to the containment pressurization phase, the water levels within the Drywell equipment drain sump and the Drywell floor drain sump were 18" and 23" deep, respectively. During the course of the test, the equipment drain sump overflowed and flooded the floor to a depth of ¼", and the floor drain sump level rose to 31". Assuming this level increase occurred over 24 hours, calculations were performed to determine the leakage rate compensation. These calculations are contained below.

Volume of Water Added to Both Sumps:
(Note: Each sump measures 6' by 6' by 4' deep.)

$$\text{Volume of water} = \left(\frac{48-18}{12}\right)(6 \times 6) + \left(\frac{31-23}{12}\right)(6 \times 6) = 114 \text{ cu. ft.}$$

Volume of Water Added to the Drywell Basement Floor:
(Note: Radius of basement floor = 23')

$$\text{Volume of water } \Pi \times (23)^2 \times (1/48) = 34.6 \text{ cubic feet}$$

Total Volume of Water = 114.0 + 34.6 = 148.6 cubic feet

Assuming the volume of water accumulated over a 24 hour period, the corresponding leakage rate in weight %/day can be determined:

$$\left(\frac{148.6\ ft^3}{1\ day}\right)\left(\frac{14.7\ psia}{62.7\ psia}\right)\left(\frac{100\%}{286234 ft^3}\right) = 0.012 \text{ weight \%/day}$$

(volume of containment)

Compensation for Sump Level Change: 0.012 wt%/day

F.5 "As Left" Primary Containment Integrated Leak Rate

The "As Left" Primary Containment Integrated Leak Rate is the sum of the 95% UCL leak rate, the penalty for the non-vented systems (from Table 6), and the compensation for the Drywell sump level changes. The non-vented systems contain the as-left leakrates as of the ILRT dates. The results are as follows:

Upper 95% Confidence Limit: Leak Rate	0.5546 wt%/day
Penalty for Non-Vented Systems:	0.104 wt%/day
Compensation for Sump Level Changes:	0.012 wt%/day
Total:	0.6706 wt%/day

As-Left ILRT: 0.6706 wt%/day

F.6 "As Found" Primary Containment Integrated Leak Rate

The As-Found Primary Containment Integrated Leak Rate is the sum of the as-left leak rate and the back correction penalty which accounts for improvements made to Type B and C volumes during this outage. However, two minimum pathway volumes failed their Local Leak Rate Test at the beginning of the outage. The High Pressure Coolant Injection Turbine Exhaust check valve, 3-2301-45, and the H_2O_2 Monitor Return Check Valve, 3-2499-28B, had exceeded the allowable leakage for primary containment (.6 La). A specific leak rate on either volume was not obtained due to the magnitude of the leak and the capability of the test equipment. Therefore, the leakage was considered to be indefinite. Since these failures are through a pathway with only one isolation valve, 3-2301-45 or 3-2499-28B, the as-found ILRT result has failed. These failures have been addressed in Licensee Event Report (LER) 91-007. The safety significance for the 3-2301-45 was considered minimal since the other pressurized valve in the tested volume was satisfactory. This other valve is not a primary containment isolation valve because it cannot be tested correctly per 10CFR50 Appendix J. The safety significance for the 3-2499-28B can be considered minimal since this volume is in closed loop system. This closed loop system has been recently tested, after the ILRT, and the leakage was acceptable.

It should be noted that the rest of containment still failed the as-found ILRT. The acceptance criteria for an as-found Type A leakage test is 1.2 wt%/day (.75 La). The calculations below show the as-found leakage:

As-Left Leak Rate:	0.6706 wt%/day
Back Correction Penalty (APPENDIX A):	<u>0.7889 wt%/day</u>
Total:	1.4595 wt%/day

As-Found ILRT: 1.4595 wt%/day

During a previous Unit 2 ILRT, a significant leak was found on an inboard flange of a valve on the Reactor Building to Torus Vacuum Breaker Line, where an improper LLRT was performed after maintenance was performed on the valve. The inboard flange of this valve and ones with a similar configuration cannot be correctly tested, because the tested volume only contains the two isolation valve disks and the flanges within the valve disks. The inboard flange on the outside of the tested volume is not tested, but is a direct path to the atmosphere from primary containment. A modification is currently being reviewed and will be installed during the next refuel outage. This modification will allow this inboard flange to be tested from the inside of containment. An ILRT was performed this outage to perform a proper test on these flanges on Unit 3. During the ILRT, these flanges were observed for leakage with soap bubble solution. No leakage was observed from any of the tested flanges.

F.7 <u>Unit 3 Test Schedule</u>

The most recent Type A test on Unit 3 was performed in 1990. The test result for this test was 1.2495 wt%/day, which exceeded the 1.2 wt%/day criteria for a Type A test. For the current test, the "as found" integrated leak rate also exceeded the 0.75 La criteria. According to 10CFR50, Appendix J, if two consecutive periodic Type A tests fail to meet the applicable acceptance criteria, a Type A test shall be performed at each plant shutdown for refueling until two Type A tests satisfactorily meet the acceptance criteria. The next Unit 3 Type A test is therefore currently scheduled to be performed during the next refueling outage, D3R13.

TABLE 6
LEAK RATES OF NON-VENTED SYSTEMS

SYSTEM No.	PENETRATION No.	MIN PATH LEAK RATE (scfh)	
		AS FOUND	AS LEFT
220-57A & 220-58A	X-107A	-	-
220-57A & 220-62A	X-107A	18.0	2.3
220-57B & 220-58B	X-107B	-	4.5
220-57B & 220-62B	X-107B	12.0	-
301-95 & 301-99	X-109B	N/A	N/A
301-98 & 301-99	X-109B	N/A	N/A
1001-1A,1B,2A,2B & 2C	X-111A,X-111B	156.35	.145
1101-1 & 1101-15	X-138	-	-
1101-1 & 1101-16	X-138	2.0	2.0
1201-1, 2 & 3	X-113	.05	.05
1301-3 & 1301-4	X-109A	.05	.9
1402-4A,8A,25A & 36A	X-310A	0	0
1402-24A & 25A	X-149B	.05	.15
1402-4B,8B,25B & 36B	X-310B	.375	4.8
1402-24B & 25B	X-149A	.05	.9
1501-18A & 19A	X-311A	.075	.55
1501-18B & 19B	X-311B	.09	.10
1501-20A & 1501-38A	X-310A	.05	.81
1501-20B & 1501-38B	X-310B	.22	.05
1501-22A,26A & 1001-5A	X-116A	-	-
1501-25A & 1501-26A	X-116A	.10	.10
1501-22B,26B & 1001-5B	X-116B	19.0	-
1501-25B & 1501-26B	X-116B	-	10.1
1501-27A & 1501-28A	X-145	.05	3.3
1501-27B & 1501-28B	X-150A	.11	.11
220-44 & 220-45	X-122	.05	.05
9207A & 9207B	X-101	.30	.30
9208A & 9208B	X-101	2.6	2.6
Clean Demin Isolation	X-119	2.75	2.75
N_2 Inerting System	X-126	32.35	.55
CRD Charging System	X-139C	.10	.10
H_2O_2 Monitor (A&B)	X-127,X-139, X-146,X-316A&B	*	4.19
3706 and 3703	X-124	55.5	9.7
3702 and 3769-500	X-123	10.5	1.51
	TOTAL	312.77	52.615

The (-) indicates that the leakage through that isolation valve is not counted into the total because another valve in the leakage pathway has a lower leak rate. A Type A test uses minimum pathway leakrates, which is the leak rate of the best valve in a leakage pathway.

* - This system was not tested properly per 10CFR50 Appendix J prior to the Type A test.

APPENDIX A

Presented herein are the results of all Type B and Type C tests performed since the previous IPCLRT in 1990. Total leakage for double gasketed seals and total leakage for all penetrations and isolation valves following repairs satisfied the Technical Specification limits. A (-) in the tables indicates that the leakage through that isolation valve is not counted into the total because another valve in the leakage pathway has a lower leak rate. A Type A test uses minimum pathway leak rates, which is the leak rate of the best valve in a leakage pathway.

UNIT: D3R12

REFUEL OUTAGE: 91, 92

Year

TYPE OF PENETRATION: MSIVs

PENETRATION NUMBER	VOLUME BEING TESTED	MAXIMUM PATHWAY LEAKAGE: INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	MINIMUM PATHWAY LEAKAGE: AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-105A	**203-1A&203-2A**	1.62 / 9-8	1.62	3.03 / 3-28	3.03	1.40	2.63	0.0
X-105B	**203-1B&203-2B**	.10 / 9-8	.10	6.50 / 3-28	6.50	.09	5.62	0.0
X-105C	**203-1C&203-2C**	.10 / 9-8	.10	5.74 / 3-28	5.74	.09	4.96	0.0
X-105D	**203-1D&203-2D**	4.47 / 9-8	4.47	4.92 / 3-28	4.92	3.92	4.26	0.0
PAGE TOTALS			6.29		20.19	5.50	17.47	0.0

Repaired valves are in bold letters.

UNIT: D3R12

REFUEL OUTAGE: 91, 92
Year

TYPE OF PENETRATION: Primary Containment Isolation Valves

		MAXIMUM PATHWAY LEAKAGE				MINIMUM PATHWAY LEAKAGE		
PENETRATION NUMBER	VOLUME BEING TESTED	INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-147	205-2-4 & FLANGE	12.72 / 9-12	12.72	12.72 / 9-12	12.72	-	-	-
X-147	205-2-7 & FLANGE	.10 / 9-12	-	.10 / 9-12	-	.10	.10	0.0
X-106	**220-1 & 2**	14.6 / 9-9	14.6	6.50 / 2-14	6.50	6.5	0	6.50
X-122	**220-44 & 45**	.10 / 9-13	.10	.10 / 2-25	.10	.05	.05	0.0
X-107A	220-57A & **58A**	47.77 / 9-9	47.77	5.85 / 10-17	5.85	-	-	-
X-107A	220-57A & **62A**	17.71 / 9-9	-	2.32 / 12-24	-	17.71	2.32	15.39
X-107B	220-57B & **58B**	UND / 9-26	UND	4.45 / 11-10	-	-	4.45	-
X-107B	220-57B & 62B	11.86 / 9-26	-	11.86 / 9-26	11.86	11.86	-	7.41
NA	301-156A & 157A	2.10 / 10-3	2.10	2.10 / 10.3	2.10	1.05	1.05	0.0
NA	301-160A & 161A	.16 / 10-3	.16	.16 / 10-3	.16	.08	.08	0.0
NA	301-156B & 157B	.15 / 10-1	.15	.15 / 10-1	.15	.075	.075	0.0
NA	**301-160B & 161B**	9.04 / 10-1	9.04	4.20 / 3-14	4.20	4.52	2.10	2.42
X-109B	301-95 & 99 *	/		/				-
X-109B	301-98 & 99 *	/		/				-
X-111A,111B	1001-**1A,1B,2A,2B&2C**	312.73 / 9-23	312.73	.29 / 12-16	.29	156.37	.145	156.23
X-138	1101-1 & **15**	39.3 / 9-23	39.3	6.92 / 10-13	6.92	-	-	-
X-138	1101-1 & 16	1.98 / 9-23	-	1.98 / 9-23	-	1.98	1.98	0.0
	PAGE TOTALS		UND		50.85	200.29	12.35	187.95

Repaired valve are in bold letters.

* Line Removed

UNIT: D3R12

REFUEL OUTAGE: 91, 92
Year

TYPE OF PENETRATION: Primary Containment Isolation Valves

		MAXIMUM PATHWAY LEAKAGE				MINIMUM PATHWAY LEAKAGE		
PENETRATION NUMBER	VOLUME BEING TESTED	INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-113	**1201-1,1A,2&3**	.10 / 9-30	.10	1.82 / 3-20	1.82	.05	.91	0.0
X-108A	**1301-1&2**	.10 / 9-8	.10	.10 / 2-29	.10	.05	.05	0.0
X-109A	**1301-3&4**	.10 / 9-10	.10	1.83 / 3-3	1.83	.05	.92	0.0
X-108A,109A	1301-17&20	.10 / 9-11	.10	.10 / 2-12	.10	.05	.05	0.0
X-310A	1402-**4A**,8A,25A,36A	0 / 9-23	0	0 / 10-29	0	0	0	0.0
X-149A	1402-24A&25A	.10 / 9-23	.10	.30 / 10-30	.30	.05	.15	0.0
X-310B	1402-**4B**,8B,25B,36B	.75 / 9-23	.75	9.60 / 11-15	9.60	.375	4.80	0.0
X-149B	1402-**24B**&25B	.10 / 9-23	.10	1.80 / 3-12	1.80	.05	.90	0.0
X-311A	**1501-18A&19A**	.15 / 9-10	.15	1.10 / 1-9	1.10	.08	.55	0.0
X-311B	1501-18B&**19B**	.18 / 9-11	.18	.20 / 1-8	.20	.09	.10	0.0
X-310B	1501-**20B**&38B	.44 / 9-11	.44	.10 / 12-28	.10	.22	.05	.17
X-310A	1501-**20A**&38A	.10 / 9-11	.10	1.62 / 12-28	1.62	.05	.81	0.0
X-116A	1501-**22A**,26A,**1001-5A**	1.50 / 9-26	1.50	2.50 / 12-10	2.50	-	-	0.0
X-116A	1501-25A&26A	.10 / 9-24	-	.10 / 9-24	-	.10	.10	0.0
X-116B	**1501-25B&26B**	UND / 9-25	UND	10.10 / 12-8	-	-	10.10	8.70
X-116B	1501-**22B**,26B,**1001-5B**	18.80 / 9-24	-	29.10 / 12-21	29.10	18.80	-	-
X-145	**1501-27A&28A**	.10 / 4-10	.10	1.63 / 4-5	1.63	.05	.82	0.0
X-150A	1501-27B&28B **flange**	.21 / 9-11	.21	2.41 / 12-19	2.41	.11	1.21	0.0
NA	**1599-61&62**	71.5 / 9-11	71.57	3.76 / 9-20	3.76	35.79	1.88	33.91
	PAGE TOTALS		UND		57.97	55.97	23.4	42.78

Repaired valves are in bold letters.

APPENDIX A (Continued)
PRIMARY CONTAINMENT LEAK RATE TEST LOG.

UNIT: D3R12

REFUEL OUTAGE: 91, 92
Year

TYPE OF PENETRATION: Primary Containment Isolation Valves

PENETRATION NUMBER	VOLUME BEING TESTED	MAXIMUM PATHWAY LEAKAGE				MINIMUM PATHWAY LEAKAGE		
		INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-304	**1601-20A&31A**	UND / 9-15	UND	1.51 / 2-29	1.51	1.51	.76	.75
X-304	**1601-20B&31B**	UND / 9-15	UND	1.50 / 3-2	1.50	1.50	.75	.75
X-126,304	1601-**21**,**22**,**55**,56:8502-500	64.7 / 9-12	64.7	1.09 / 2-22	1.09	32.35	.55	31.80
X-125,318	1601-23,**24**,**60**,**61**,62,**63**	UND / 9-15	UND	4.78 / 2-28	4.78	2.35	2.39	0.0
X-126,304	1601-57,58,59	.10 / 9-12	.10	.10 / 9-12	.10	.05	.05	0.0
X-305	LT 1626	0 / 9-18	0	0 / 9-18	0	0	0	0.0
X-313A	1699-63A & **FLANGE**	.10 / 10-1	.10	.10 / 2-18	.10	.05	.05	0.0
X-313B	1699-63B & **FLANGE**	.10 / 9-19	.10	.10 / 2-29	.10	.05	.05	0.0
X-118	**2001-5 & 6**	20.85 / 10-12	20.85	6.76 / 3-11	6.78	10.43	3.39	7.04
X-117	**2001-105** & 106	.60 / 10-13	.60	.10 / 3-14	.10	.30	.05	.25
X-128	2301-4 & 5	3.86 / 9-8	3.86	1.42 / 3-6	1.42	1.93	.71	1.22
X-312	2301-34 & 71	.10 / 9-9	.10	.10 / 9-9	.10	.10	.10	0.0
X-317	2301-**45** & 74	UND / 9-9	UND	.14 / 2-28	.14	UND	.14	UND
X-202V	2499-1A & 2A	.10 / 9-15	.10	.10 / 9-15	.10	.05	.05	0.0
	PAGE TOTALS	/	UND	/	17.82	UND(50.67)	9.04	UND(41.81)

Repaired valves in bold letters

Values in () list the leakage total excluding the undetermined values.

UNIT: D3R12

REFUEL OUTAGE: 91, 92
Year

TYPE OF PENETRATION: Primary Containment Isolation Valves

PENETRATION NUMBER	VOLUME BEING TESTED	MAXIMUM PATHWAY LEAKAGE				MINIMUM PATHWAY LEAKAGE		
		INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-204B	2499-**1B** & 2B	.10 / 9-15	.10	.10 / 12-7	.10	.05	.05	0.0
X-316A	2499-3A & 4A	.10 / 9-17	.10	.10 / 9-17	.10	.05	.05	0.0
X-316B	2499-3B & 4B	.10 / 9-17	.10	.10 / 9-17	.10	.05	.05	0.0
X-139	2499-**28A**,29A	87.3 / 1-22	87.3	1.04 / 2-28	1.04	87.3	1.04	86.26
X-127	2499-**28B**,29B	UND / 2-6	UND	.22 / 2-28	.22	UND	.22	UND
X-202V	2599-2A & **23A**	6.80 / 9-18	6.80	1.61 / 11-14	1.61	1.61	0	1.61
X-204B	2599-2B & **23B**	6.28 / 9-18	6.28	.10 / 11-13	.10	.10	0	.10
X-316A	2599-3A & **24A**	UND / 9-18	UND	.38 / 12-3	.38	.38	0	.38
X-316B	2599-3B & 24B	.10 / 9-17	.10	.10 / 9-17	.10	.05	.05	0.0
X-125,318	2599-**4A** & 5A	7.2 / 9-17	7.20	6.98 / 11-25	6.98	3.60	3.49	.11
X-125,318	2599-4B & 5B	.22 / 9-17	.22	.22 / 9-17	.22	.11	.11	0.0
X-123	**3702** & 3799-126	12.08 / 9-14	12.08	1.51 / 12-10	-	-	1.51	8.82
X-123	**3769-500**	10.33 / 9-13	-	7.57 / 12-16	7.57	10.33	-	-
X-124	**3703 & 3706**	110.9 / 10-15	82.9	19.30 / 2-19	19.30	28.0	9.65	18.35
	PAGE TOTALS		UND		37.82	UND (131.63)	16.22	UND(115.63)

Repaired valves are in bold letters.

Values in () list the leakage total excluding the undetermined values.

UNIT: D3R12

REFUEL OUTAGE: 91,92
Year

TYPE OF PENETRATION: Primary Containment Isolation Valves

PENETRATION NUMBER	VOLUME BEING TESTED	MAXIMUM PATHWAY LEAKAGE				MINIMUM PATHWAY LEAKAGE		
		INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-139D	4720 & 4721	6.50 / 9-19	6.50	6.50 / 9-19	6.50	3.25	3.25	0.0
X-121	4722 & CHECK	.33 / 12-9	.33	.33 / 12-9	.33	.17	.17	0.0
X-101	9207A & END	.80 / 9-25	.80	.80 / 9-25	.80	-	-	-
X-101	9207B & END	.30 / 9-25	-	.30 / 9-25	-	.30	.30	0.0
X-101	9208A & END	3.98 / 9-25	3.98	3.98 / 9-25	3.98	-	-	-
X-101	9208B & END	2.58 / 9-25	-	2.58 / 9-25	-	2.58	2.58	0.0
X-136J	TIP VALVE A	.11 / 10-4	.11	.11 / 10-4	.11	.11	.11	0.0
X-136F	TIP VALVE B	1.78 / 10-4	1.78	1.78 / 10-4	1.78	1.78	1.78	0.0
X-136E	TIP VALVE C	.25 / 10-4	.25	.25 / 10-4	.25	.25	.25	0.0
X-136H	TIP VALVE D	1.29 / 10-4	1.29	1.29 / 10-4	1.29	1.29	1.29	0.0
X-136E	TIP VALVE E	4.45 / 10-4	4.45	4.45 / 10-4	4.45	4.45	4.45	0.0
X-309A	8501-1A & END	.79 / 9-25	.79	.79 / 9-25	.79	-	-	-
X-309A	8501-1B & END	.78 / 9.25	-	.78 / 9-25	-	.78	.78	0.0
X-204	8501-3A & 3B	2.39 / 10-1	2.39	2.39 / 10-1	2.39	1.20	1.20	0.0
X-143	8501-5A & END	.10 / 9-25	.10	.10 / 9-25	-	-	.10	-
X-143	8501-**5B** & END	.10 / 9-25	-	.61 / 4-1	.61	.10	-	0.0
X-143	9205A & END	1.78 / 9-24	1.78	1.78 / 9-24	1.78	-	-	-
	PAGE TOTALS		24.55		25.06	16.26	16.26	0.0

Repaired valves are in bold letters.

UNIT: D3R12

REFUEL OUTAGE: 91, 92
Year

TYPE OF PENETRATION: Primary Containment Isolation Valves

PENETRATION NUMBER	VOLUME BEING TESTED	MAXIMUM PATHWAY LEAKAGE				MINIMUM PATHWAY LEAKAGE		
		INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-143	9205B & END	.10 / 9-24	-	.10 / 9-24	-	.10	.10	0.0
X-143	9206A & END	.99 / 9-24	-	.99 / 9-24	-	.99	.99	0.0
X-143	9206B & END	1.18 / 9-24	1.18	1.18 / 9-24	1.18	-	-	-
X-120	S.A. ISOL VALVE	2.80 / 1-25	2.80	2.80 / 1-25	2.80	2.80	2.80	0.0
X-119	CLEAN DEMIN ISOL VLV	5.49 / 2-17	5.49	5.49 / 2-17	5.49	2.75	2.75	0.0
X-143	DW AIR SAMPLE VLVS	2.41 / 9-20	2.91	2.91 / 9-20	2.91	2.40	2.40	0.0
X-139B	**0399-506** & 220-112A,B, 113A,B	.10 / 10-10	.10	.10 / 2-19	.10	.05	.05	0.0
X-101	PERSONNEL AIRLOCK **SHAFT SEALS/ EQUALIZING VALVES**	3.68 / 8-9	3.68	7.14 / 14-2	7.14	1.84	3.57	0.0
X-136E	PURGE CHK VALVE (TIP)	.10 / 10-4	.10	.10 / 10-4	.10	.10	.10	0.0
	PAGE TOTALS		16.26		19.72	11.03	12.76	0.0

Repaired valves are in bold letters.

UNIT: D3R12

REFUEL OUTAGE: 91, 92
Year

TYPE OF PENETRATION: Electrical Penetrations

PENETRATION NUMBER	VOLUME BEING TESTED	MAXIMUM PATHWAY LEAKAGE				MINIMUM PATHWAY LEAKAGE		
		INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-200C	LV POWER & CONTROL	.10 / 9-18	.10	.10 / 9-18	.10	.05	.05	0.0
X-201B	HV POWER	.10 / 9-18	.10	.10 / 9-18	.10	.05	.05	0.0
X-202B	CRD INDICATION	.10 / 9-12	.10	.10 / 9-12	.10	.05	.05	0.0
X-202BB	CRD INDICATOR	.86 / 9-11	.86	.86 / 9-11	.86	.43	.43	0.0
X-202D	HV POWER	.15 / 9-12	:15	.15 / 9-12	.15	.08	.08	0.0
X-202F	**THERMOCOUPLES**	16.92 / 9-12	16.92	14.19 / 2-6	14.19	8.46	7.10	1.36
X-202J	NEUTRON MONITOR	.14 / 9-12	.14	.14 / 9-12	.14	.07	.07	0.0
X-202N	NEUTRON MONITOR	.17 / 9-12	.17	.17 / 9-12	.17	.09	.09	0.0
X-202Q	**INSTRUMENTATION**	1.19 / 9-12	1.19	.10 / 2-18	.10	.60	.05	.55
X-202S	**CRD INDICATORS**	4.17 / 9-12	4.17	1.65 / 4-3	1.65	2.09	.83	1.26
X-202W	CRD INDICATORS	8.45 / 9-12	8.45	3.45 / 9-12	8.45	4.23	4.23	0.0
X-203B	HV POWER	.10 / 9-18	.10	.05 / 9-18	.10	.05	.05	0.0
X-204A	HV POWER	1.29 / 9-12	1.29	1.29 / 9-12	1.29	.65	.65	0.
X-204E	NEUTRON MONITOR	.10 / 9-11	.10	.10 / 9-11	.10	.05	.05	0.0
X-204H	NEUTRON MONITOR	.10 / 9-11	.10	.10 / 9-11	.10	.05	.05	0.0
X-204L	**POWER & GROUND**	6.27 / 9-19	6.27	7.83 / 3-28	7.83	3.14	3.92	0.0
	PAGE TOTAL		40.21		35.43	20.14	17.75	3.17

Repaired valves are in bold letters.

UNIT: D3R12

REFUEL OUTAGE: 91, 92
Year

TYPE OF PENETRATION: Electrical Penetrations

PENETRATION NUMBER	VOLUME BEING TESTED	MAXIMUM PATHWAY LEAKAGE				MINIMUM PATHWAY LEAKAGE		
		INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-204M	LV POWER	3.71 / 9-19	3.71	3.71 / 9-19	3.71	1.86	1.86	0.0
X-204N	**CRD INDICATOR**	.10 / 9-19	.10	.62 / 3-30	.62	.05	.31	0.0
X-204Q	**CRD INDICATOR**	2.63 / 9-19	2.63	3.23 / 3-30	3.23	1.32	1.62	0.0
X-204S	LV POWER & CONTROL	7.87 / 9-19	7.87	7.87 / 9-19	7.87	3.94	3.94	0.0
X-205B	CRD INDICATOR	.10 / 9-18	.10	.10 / 9-18	.10	.05	.05	0.0
	PAGE TOTALS		14.41		15.43	7.22	7.78	0.0

Repaired penetraitons are in bold letters.

UNIT: D3R12

REFUEL OUTAGE: 91, 92
Year

TYPE OF PENETRATION: Drywell Bellows Seals

PENETRATION NUMBER	VOLUME BEING TESTED	MAXIMUM PATHWAY LEAKAGE				MINIMUM PATHWAY LEAKAGE		
		INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-105A	**MAIN STEAM**	19.69 / 9-7	19.69	.10 / 12-12	.10	9.85	.05	9.80
X-105B	MAIN STEAM	.10 / 9-7	.10	.10 / 9-7	.10	.05	.05	0.0
X-105C	MAIN STEAM	.10 / 9-7	.10	.10 / 9-7	.10	.05	.05	0.0
X-105D	MAIN STEAM	.10 / 9-7	.10	.10 / 3-24	.10	.05	.05	0.0
X-106	MAIN STEAM DRAIN	.10 / 9-7	.10	.10 /10-18	.10	.05	.05	0.0
X-107A	FEEDWATER	.10 / 9-7	.10	.10 / 10-19	.10	.05	.05	0.0
X-107B	**FEEDWATER**	.23 / 9-7	.23	2.18 / 3-23	2.18	.12	1.09	0.0
X-108A	ISO COND STEAM	.10 / 9-7	.10	.10 / 10-19	.10	.05	.05	0.0
X-109A	ISO COND CONDENSATE	.10 / 9-7	.10	.10 / 10-19	.10	.05	.05	0.0
X-111A	SHUTDOWN COOLING	2.76 / 9-7	2.76	2.89 / 10-18	2.89	1.38	1.45	0.0
X-111B	SHUTDOWN COOLING	.17 / 9-7	.17	.19 / 10-18	.19	.09	.10	0.0
X-113	CLEANUPS	.10 / 9-7	.10	.10 / 10-19	.10	.05	.05	0.0
X-128	HPCI STEAM	.10 / 9-7	.10	.10 / 9-7	.10	.05	.05	0.0
X-116A	LPCI INJECTION	.10 / 9-7	.10	.10 / 9-7	.10	.05	.05	0.0
X-116B	LPCI INJECTION	.10 / 9-7	.10	.10 / 9-7	.10	.05	.05	0.0
X-123	RBCCW INLET	.10 / 9-7	.10	.10 / 9-7	.10	.05	.05	0.0
X-124	RBCCW OUTLET	.10 / 9-7	.10	.10 / 9-7	.10	.05	.05	0.0
X-125	VENT FROM DW	.82 / 9-7	.82	.80 / 10-18	.80	.40	.40	0.0
	PAGE TOTALS		24.97		7.46	12.49	3.74	9.80

Repaired penetraions are in bold letters.

UNIT: D3R12

REFUEL OUTAGE: 91, 92
Year

TYPE OF PENETRATION: Drywell Bellows Seals

PENETRATION NUMBER	VOLUME BEING TESTED	MAXIMUM PATHWAY LEAKAGE				MINIMUM PATHWAY LEAKAGE		
		INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-126	VENT TO DW	.10 / 9-7	.10	.10 /9-7	.10	.05	.05	0.0
X-138	SBLC	.78 / 9-7	.78	.83 /10-18	.83	.39	.42	0.0
X-147	RX. HEAD SPRAY	.10 / 9-7	.10	.18 /10-18	.18	.05	.09	0.0
X-149A	CORE SPRAY	.10 / 9-7	.10	.10 /9-7	.10	.05	.05	0.0
X-149B	CORE SPRAY	7.10 / 9-7	7.10	6.80/10-18	6.80	3.55	3.40	.15
	PAGE TOTALS		8.18		8.01	4.09	4.01	.15

UNIT: D3R12

REFUEL OUTAGE: 91, 92
Year

TYPE OF PENETRATION: Double Gasketed Seals

PENETRATION NUMBER	VOLUME BEING TESTED	MAXIMUM PATHWAY LEAKAGE				MINIMUM PATHWAY LEAKAGE		
		INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-100	**DW EQUIP HATCH**	.10 / 9-8	.10	.10 / 3-14	.10	.05	.05	0.0
X-102	**CRD HATCH**	.10 / 9-20	.10	.10 / 3-20	.10	.05	.05	0.0
X-136A	TIP FLANGE	.10 / 10-3	.10	.10 / 10-3	.10	.05	.05	0.0
X-136B	TIP FLANGE	.10 / 10-3	.10	.10 / 10-3	.10	.05	.05	0.0
X-136C	TIP FLANGE	.10 / 10-3	.10	.10 / 10-3	.10	.05	.05	0.0
X-136D	TIP FLANGE	.10 / 10-3	.10	.10 / 10-3	.10	.05	.05	0.0
X-136E	TIP FLANGE	.87 / 10-3	.87	.87 / 10-3	.87	.44	.44	0.0
X-136F	TIP FLANGE	.10 / 10-3	.10	.10 / 10-3	.10	.05	.05	0.0
NA	**DW HEAD**	.10 / 9-8	.10	.10 / 3-9	.10	.05	.05	0.0
X-137	DW HEAD MANWAY	.10 / 9-30	.10	.10 / 9-30	.10	.05	.05	0.0
X-301F	TOR VAC BKR 32A	.50 / 9-29	.50	.50 / 2-29	.50	.25	.25	0.0
X-301F	TOR VAC BKR 32B	.50 / 9-29	.50	.50 / 2-29	.50	.25	.25	0.0
X-301E	TOR VAC BKR 32C	.50 / 9-29	.50	.50 / 9-29	.50	.25	.25	0.0
X-301E	TOR VAC BKR 32D	.50 / 9-29	.50	.50 / 12-9	.50	.25	.25	0.0
X-301D	TOR VAC BKR 32E	.50 / 9-29	.50	.50 / 11-19	.50	.25	.25	0.0
X-301D	TOR VAC BKR 32F	.50 / 9-29	.50	.50 / 11-19	.50	.25	.25	0.0
X-301A	TOR VAC BKR 33A	.50 / 9-29	.50	.50 / 12-9	.50	.25	.25	0.0
	PAGE TOTALS		5.27		5.27	2.64	2.64	0.0

Repaired seals are in bold letters.

UNIT: D3R12

REFUEL OUTAGE: 91, 92
Year

TYPE OF PENETRATION: Double Gasketed Seals

PENETRATION NUMBER	VOLUME BEING TESTED	MAXIMUM PATHWAY LEAKAGE				MINIMUM PATHWAY LEAKAGE		
		INITIAL AS FOUND MEASURED LEAK RATE/ TEST DATE	INITIAL AS FOUND REPORTED LEAKAGE	FINAL AS LEFT MEASURED LEAK RATE/ TEST DATE	FINAL AS LEFT REPORTED LEAKAGE	AS FOUND LEAKAGE	AS LEFT LEAKAGE	BACK CORRECTION
X-301A	TOR VAC BKR 33B	.50 / 9-29	.50	.50 / 9-29	.50	.25	.25	0.0
X-301B	TOR VAC BKR 33C	.50 / 9-29	.50	.50 / 9-29	.50	.25	.25	0.0
X-301B	TOR VAC BKR 33D	.50 / 9-29	.50	.50 / 9-29	.50	.25	.25	0.0
X-301C	TOR VAC BKR 33E	.50 / 9-29	.50	.50 / 9-29	.50	.25	.25	0.0
X-301C	TOR VAC BKR 33F	.50 / 9-30	.50	.50 / 9-30	.50	.25	.25	0.0
X-306A	**E. TORUS HATCH**	.10 / 9-7	.10	.10 / 3-14	.10	.05	.05	0.0
X-306B	**W. TORUS HATCH**	.10 / 9-7	.10	.10 / 3-20	.10	.05	.05	0.0
X-313A	E. TORUS DRAIN	.10 / 10-1	.10	.10 / 10-1	.10	.05	.05	0.0
X-313B	W. TORUS DRAIN	.10 / 10-1	.10	.10 / 10-1	.10	.05	.05	0.0
NA	SHEAR HATCH 1	.10 / 10-4	.10	.10 / 10-4	.10	.05	.05	0.0
NA	SHEAR HATCH 2	.10 / 10-4	.10	.10 / 10-4	.10	.05	.05	0.0
NA	SHEAR HATCH 3	.10 / 10-4	.10	.10 / 10-4	.10	.05	.05	0.0
NA	SHEAR HATCH 4	.10 / 10-4	.10	.10 / 10-4	.10	.05	.05	0.0
NA	SHEAR HATCH 5	.10 / 10-4	.10	.10 / 10-4	.10	.05	.05	0.0
NA	SHEAR HATCH 6	.10 / 10-4	.10	.10 / 10-4	.10	.05	.05	0.0
NA	SHEAR HATCH 7	.10 / 10-4	.10	.10 / 10-4	.10	.05	.05	0.0
NA	SHEAR HATCH 8	.10 / 10-4	.10	.10 / 10-4	.10	.05	.05	0.0
	PAGE TOTALS		3.70		3.70	1.85	1.85	0.0
	TOTAL OF PAGES 1 - 13		UND		284.54	UND (519.78)	145.27	UND(401.29)

Repaired valves are in bold letters.

Values in () list the leakage total excluding the undetermined values.

APPENDIX B
COMPUTATIONAL PROCEDURE

APPENDIX B
CALCULATIONS PERFORMED

Data collected from pressure sensors, dewcells, and thermistors located in the containment are processed using the following calculations.

A. Calculation of Containment Dry Air Mass

1. Average Temperature of Subvolume #i (T_i)

The average temperature of subvolume #i (T_i) equals the average of all thermistor temperatures in subvolume #i

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

Where:

N = The number of thermistors in subvolume #i

2. 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

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

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.

3. Total Corrected Pressure #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

4. 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.

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

where:

f_i = The volume fraction of the i^{th} subvolume

N = The total number of subvolumes in containment

5. 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 $32 \leq D_i \leq 80°F$

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

For $80 \leq D_i \leq 115°F$

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

For $115 \leq D_i \leq 155°F$

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

For $155 \leq D_i \leq 215°F$

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

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

6. Whole Containment Average Vapor Pressure, (Pv_o)

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

$$Pv_o = T_o \sum_{i=1}^{N} \frac{f_i \, Pv_i}{T_i}$$

Where

N = The total of subvolumes in containment

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

7. Calculation of the Whole Containment Average Dew Temperature, (D_o)

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_o is in units of °F.

For $0.08859 \leq Pv_o \leq 0.50683$ psia

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

$$D_o = -\,0.5593968 \times 10^1 + 0.6348248 \times 10^3\, Pv_o$$

$$-\,0.320306 \times 10^4\, Pv_o^2 + 0.1130089 \times 10^5\, Pv_o^3$$

$$-\,0.2411539 \times 10^5\, Pv_o^4 + 0.2796469 \times 10^5\, Pv_o^5$$

$$-\,0.1348916 \times 10^5\, Pv_o^6$$

For $0.50683 \leq Pv_o \leq 1.4711$ psia

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

$$D_o = +\,0.2334173 \times 10^2 + 0.2004024 \times 10^3\, Pv_o$$

$$-\,0.2785328 \times 10^3\, Pv^2 + 0.2765841 \times 10^3\, Pv_o^3$$

$$-\,0.168669 \times 10^3\, Pv_o^4 + 0.5658985 \times 10^2\, Pv_o^5$$

$$-\,0.7977715 \times 10^1\, Pv_o^6$$

For $1.4711 \leq Pv_c \leq 4.2036$ psia

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

$$D_c = + 0.5221757 \times 10^2 + 0.7391149 \times 10^2\ Pv_c$$
$$- 0.3306993 \times 10^2\ Pv_c^2 + 0.1074842 \times 10^2\ Pv_c^3$$
$$- 0.2169825 \times 101\ Pv_c^4 + 0.2432796\ Pv_c^5$$
$$- 0.1155358 \times 10^{-1}\ Pv_c^6$$

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.

8. Average Total Containment Vapor Pressure, (P)

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

where

N is the number of pressure transmitters used

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

$$P_d = P - Pv_c$$

10. Total Containment Dry Air Mass, (M)

<u>Type 1</u>:

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

where

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

V_c = Total containment free volume.

B. Reactor Vessel Free Volume Mass Calculation

The free volume of the Reactor Vessel subvolume is given by the below equation.

$$V_i = V_{io} - a\ (c - b)$$

The dry air mass in subvolume i can then be written as:

$$Mi = 144\ (\overline{P} - \overline{Pv_i})\ (V_i/R\overline{T_i})$$

Where: Mi is the dry air mass in subvolume i (lbm)

R is the gas constant of air

$\overline{T_i}$ is the average temperature of subvolume i (°R)

$\overline{Pv_i}$ is the average vapor pressure of subvolume i, (pisa)

$\overline{P}$ is the average containment pressure, (psia)

V_i is the free air volume in subvolume i, (ft^3)

a is the number of cubic feet or free volume per inch of vessel level

b is the base level of the vessel, (in.)

c is the actual water level in the vessel, (in.)

V_{io} is the volume of subvolume i when c equals b

C. Torus Free Volume Calculation

Free volume calculations of the Torus rely upon narrow range Torus water level inputs. These values range between plus and minus five inches. It is assumed that the Torus subvolume free air volume is that subvolume's volume when the Torus level equals zero.

The equations for Torus free volume in subvolume t are given:

$$V_t = V_{to} - (aL + bL + cL^3) \text{ when } L \geq 0$$

$$V_t = V_{to} - (-aL + bL^2 + cL^3) \text{ when } L \leq 0$$

The dry air mass in subvolume t can then be written as:

$$M_t = 144\ (\overline{P} - \overline{P_{vt}})\ Vt/R\overline{T_t}$$

Where: Mt is the dry air mass in subvolume t, (lbm)

$\overline{P}$ is the average containment pressure, (psia)

$\overline{Pvt}$ is the average vapor pressure of subvolume t (pisa)

V_t is the free volume of subvolume t, (ft^3)

R is the gas-constant of air

T_t is the average temperature in subvolume t (°R)

L is the Torus level, (inches)

a, b, c are Torus level constants

V_{to} is the free volume in subvolume T when L equals zero, taken from standard free volume inputs, (ft^3)

D. Instrument Accuracy Error Analysis.

Per Topical Report BN-TOP-1 the measured total time leak rate (M) in weight percent per day is computed using the Absolute Method by the formula:

$$M=\frac{2400}{H}\left[1-\frac{T_1\overline{P_N}}{T_N\overline{P_1}}\right] \quad (1)$$

where:

$\overline{P}_1 = P_1 - PV_1 =$ Total containment atmosphere absolute pressure, in psia, at the start of test, corrected for water vapor pressure.

$\overline{P}_n = P_n - PV_2 =$ Total containment atmosphere absolute pressure, in psia, at data point n after start of the test, corrected for water vapor pressure.

$T_1, T_n =$ Containment mean atmospheric temperature in or at the start and at data point n, respectively.

$H =$ Test interval in hours between time 1 and time n.

The change or uncertainty interval in M due to uncertainties in the measured variables is given by:

$$M = \frac{2400}{H}\left[\left(\frac{dM}{dP_2}\cdot\delta P_2\right)^2 + \left(\frac{dM}{dP_1}\cdot\delta P_1\right)^2 + \left(\frac{dM}{dT_1}\cdot\delta T_1\right)^2 + \left(\frac{dM}{dT_2}\cdot\delta T_2\right)^2\right]^{1/2} \quad (2)$$

Where δ is the standard error for each variable. This formula assumes that all errors are systematic rather than random in character. Even though the formula is deterministic it does, however, allow assessment of figure of merit for various equipment to be used in the measuring system without the need for assembling and calibrating the system as an entity.

The error in M after differentiating is:

$$e_M = \frac{2400}{H}\left[\left(-\frac{T_1}{\overline{P}_1T_2}\cdot e_{\overline{P}_2}\right)^2 + \left(\frac{\overline{P}_2\,T_1}{\overline{P}_1T_2^{\,2}}\cdot e_{\overline{P}_1}\right)^2 + \left(-\frac{\overline{P}_2}{\overline{P}_1T_2}\,e_T\right)^2 + \left(\frac{\overline{P}_2\,T_1}{\overline{P}_1T_2^{\,2}}\,e_T\right)^2\right]^{1/2} \quad (3)$$

where:

$$e_{\overline{P}_1} = \delta_{P_1}$$

$$e_{\overline{P}_2} = \delta_{P_2}$$

$$e_T = e_{T_1} = e_{T_2}$$

For the purpose of developing a finite number for e_M using equation (3), it is necessary to assume certain containment conditions made.

1. For purposes of comparison to other tests H = 24 hours.

2. Containment leak rate is essentially zero, that is:

$T_1 = T_2 = \overline{T}$	Where $\overline{T}$ is the average volume weighted primary containment air temperature (°R) during the test;
$P_1 = P_2$	Where P is the total containment atmospheric pressure (psia);
$PV_1 = PV_2$	Where PV is the partial pressure of water vapor in the primary containment;

Equation (3) becomes:

$$e_M = \frac{2400}{H}\left[2\left(\frac{e_P}{\overline{P}}\right)^2 + 2\left(\frac{e_T}{\overline{T}}\right)^2\right]^{1/2}$$

where:

e_P = The error in pressure which accounts for the error in the total pressure measurement system; both total absolute pressure and water vapor pressure.

$$e_P = \left[(e_{P_T})^2 + (e_{P_V})^2\right]^{1/2}$$

e_{P_T} = inst. accuracy error/$\sqrt{\text{no. inst.}}$ = error in total absolute pressure in psia.

e_{P_V} = inst. accuracy error/$\sqrt{\text{no. inst.}}$ = error in water vapor pressure (dewpoint) indicator in psia at 70°F.

e_T = inst. accuracy error/$\sqrt{\text{no. inst.}}$ = error in temperature, °R.

ATTACHMENT B
CALCULATION OF INSTRUMENT SELECTION GUIDE, (ISG)

Per ANS/ANSI- 56.8 - 1987 the computation of the leak rate is given by the equation:

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

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)

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

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

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

where: S_d is the sensitivity of a dew cell

RP_d is the repeatability of a dew cell

RS_d is the resolution of a dew cell

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

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

The ISG Calculation is < 0.25 La

ILRT DEFINITIONS (48 PSIG TEST PRESSURE)

A. Maximum Allowable Leakage Rate (La)

La = 1.6% of containment volume per day

= (0.016)(286,234 ft3)/24 hrs.

= 190.823 ft^3/hr.

$$= 192.644 \left(\frac{48 + 14.696}{14.696}\right) \text{ SCFH}$$

= 814.088 SCFH

B. Maximum Allowable Operation Leakage Rate (L_t)

L_t = 75% of Maximum Allowable Leakage Rate

= (0.75) (814.088) SCFH

= 610.566 SCFH

C. Maximum Allowable Leakage for any One Main Steam Isolation Valve

11.5 SCFH @ 25 psig test pressure

D. Maximum Allowable Leakage Rate for all testable penetrations and isolation valves except main steam isolation valves is 60 percent of L_a.

(60%) (814.088) = 488.453 SCFH

E. Maximum Allowable Leakage Rate of the personnel interlock door is 3.75 percent of La.

(3.75%) (814.088) = 30.528 SCFH

APPENDIX C

BN-TOP-1, REV. 1 CALCULATIONS

APPENDIX C
BN-TOP-1 CALCULATIONS (TEST DURATION AT LEAST 6 HOURS)

Data collected from pressure sensors, dew cells, and RTD's/Thermistors located in the containment are processed using the following equations. Some data needs to be analyzed using equations in Appendix C prior to use. The primary reference for these calculations is the Topical Report BN-TOP-1 Revision 1.

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:

$$Mi = \frac{2400}{ti}\left[1 - \frac{To\ \overline{P}_{ith}}{T_{ith}\ \overline{P}o}\right] \qquad [1]$$

Where:

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

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

To, 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

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

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

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

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

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

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

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

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%.

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 regression 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.

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

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

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:

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

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

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

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

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:

Confidence limits = L $\pm$ 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.