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March 17, 1994

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

SUBJECT: Reactor Containment Building Integrated Leak Rate Test
LaSalle County Nuclear Power Station
Docket No. 50-374, NPF-18, Unit 2

Enclosed please find the report "Reactor Containment Building Integrated Leak Rate Test", LaSalle County Nuclear Power Station, Unit 2, December 8, 1993 and related appendices describing the Type A test.

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.D., the next Type A test is presently scheduled to be performed at the next refueling outage (Spring 1995).

Sincerely,

D.J. Ray
Station Manager
LaSalle County Station

Enclosure

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REACTOR PRIMARY CONTAINMENT

INTEGRATED LEAK RATE TEST

LaSALLE COUNTY NUCLEAR POWER STATION

COMMONWEALTH EDISON COMPANY

DOCKET NUMBER 50-374

UNIT 2

DECEMBER 8, 1993

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INTRODUCTION

This report presents details of the Primary Containment Integrated Leak Rate Test (PCILRT) successfully performed on December 8, 1993 at LaSalle County Nuclear Power Station, Unit 2. The test was performed in accordance with 10CFR50, Appendix J and the LaSalle County Station Unit 2 Technical Specifications. LaSalle County Station Unit 2 is a BWR 5, Mark II containment, located in Marseilles, Illinois. LaSalle County Station Unit 2 received its operating license in June 19, 1984.

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 total primary containment integrated leakage rate was found to be 0.3164 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 0.28486 wt%/day plus the leakage rate of all non-vented penetrations which is 0.0315 wt%/day. The total 95% upper confidence limit leakage rate was found to be 0.3479 wt%/day. This value is the sum of the measured 95% upper confidence limit of 0.3164 wt%/day plus the leakage rate of all non-vented penetrations which is 0.0315 wt%/day.

The total "as-found" containment leakage rate was found to be 0.4273 wt%/day which is also within the 0.476 wt%/day (.75 La) acceptance criteria. This value is the sum of the "as-left" leak rate (0.3164 wt%/day), the non-vented penetrations (0.0315 wt%/day), and the back correction leak rate (0.0794 wt%/day) which takes into account the improvements made to type B and C pathways during the outage.

The Induced phased leak rate test result was found to be 0.7996 wt%/day. This value should compare with the sum of the measured leak rate phase of 0.2849 wt%/day and the induced leakage rate of 0.638 wt%/day (387.0 SCFH), the difference of which being within the ± 0.159 wt%/day (0.25 La) tolerance band. The actual test data results show a difference of 0.1232 wt%/day which is within the acceptance criterion.

The next primary containment integrated leak rate test is to be performed during the sixth Unit 2 refuel outage which also happens to be the 10 year refuel outage. The outage is currently scheduled to begin February 1995.

SECTION A - TEST PREPARATIONS

A.1 Type A Test Procedure

The PCILRT was performed in accordance with Procedure LTS-300-4, Revision 18, dated December 1, 1993. This procedure was written to comply with 10CFR50 Appendix J, ANSI N45.4-1972, and LaSalle County Unit 2 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 utilized in the PCILRT. Table Two lists the physical locations of the temperature and humidity sensors within the primary containment. Instrument calibrations were performed using NIST traceable standards and LTS-300-4 was used to perform required In-Situ's prior to testing.

A Graftel, Inc Smart Sensor Instrumentation System was used in the performance of this test. The Smart Sensors allow for the measurement of temperature and relative humidity during an ILRT without the aid of a data acquisition system. Each sensor contains its own CPU, memory, signal conditioner, and RS-485 bus interface. All calibration constants are contained in each sensors nonvolatile memory.

Up to 124 sensors may be connected to a communications port at the same time. For this test, 40 sensors were connected. Each sensor responds only to its own unique address. Cable runs may be up to 10,000 feet long. For this test, cable runs were between 250 and 350 feet long. Since the output of each sensor is a digital signal, cable lengths have no effect on instrument calibration.

The sensors were connected in 4 strings with each string containing both temperature and relative humidity sensors. Although the sensors are physically connected in series, they are electrically connected in parallel. This ensures that the failure of any one sensor will not affect other sensors. The strings connect to a standard serial communications port of an IBM compatible personal computer.

a. Temperature

30 temperature sensors (thermistors) were suspended to prevent direct thermal influences from any metal surfaces. Sensors were also kept away from any direct air flows.

Graftel, Inc. Model 9202 temperature sensors were used to provide the containment temperatures. The model 9202 sensor is designed for the measurement of dry bulb temperatures during an ILRT. The sensors utilize superstable precision thermistors. The thermistors are glass hermetic encapsulated and subject to 100% individual inprogress screening.

Each thermistor is mated to a signal conditioning circuitry, A/D converter, CPU, EEPROMS, and RS-485 network interface. An isolation circuit is used to isolate each sensor from the network. This provides extra assurance that the failure of a single sensor will not result in a failure of the entire string of sensors.

b. **Pressure**

Two precision Paroscientific 760-100A pressure transmitters were utilized. Each transmitter had a local digital readout in addition to a Binary Coded Decimal output to the 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 instrument consists of a Paroscientific pressure transducer an a digital interface board. The digital board has a microprocessor-controlled counter and a RS-232 serial port. The microprocessor operating program is stored in permanent memory (EPROM). User controllable parameters are stored in writable memory (EEPROM). The computer interacts with the pressure transmitter by way of the RS-232 interface.

The microprocessor monitors incoming commands from the computer. When a sampling command is received, the microprocessor selects the appropriate frequency signal source and makes a period measurement using a 124.5 MHz timebase counter. The counter integration time is user selectable. Some commands require measurements of both temperature and pressure signals. In that case, the temperature period is measured first, followed by the pressure period. When the period measurement is completed, the microprocessor makes the appropriate calculations and loads the data onto the RS-232 bus.

Each precision pressure transmitter was calibrated over the range of 0 psia to 100 psia in approximately 10 psia increments using calibration standards as stipulated in Pre-Cal Services, Inc. procedure ICP-14.

c. **Vapor Pressure**

Ten relative humidity sensors were used to determine the partial pressure due to water vapor in the containment. The humidity sensors were installed throughout the drywell and suppression chamber. The sensors were placed in locations where the chance of the dewcell becoming damaged was slight.

The humidity sensors used were Graftel, Inc. Model 9203 Relative Humidity Sensors. These sensors utilize a temperature compensated bulk polymer chip. They have an equivalent accuracy of 2°F dew temperature and are unaffected by most commonly present chemical vapors.

Each relative humidity sensor is mated to signal conditioning circuitry, A/D converter, CPU, EEPROMs and RS-485 network interface. An RS-485 isolation circuit is used to isolate each sensor from the network. This provides extra assurance that the failure of any one sensor will not result in the failure if the entire string of sensors.

d. **Flow**

A rotameter flowmeter, Fischer-Porter, calibrated to within ± 1.0% by Fischer-Porter, was used for flow measurements during the induced leakage phase of the ILRT. The rotameter was connected to a primary containment penetration via ½" polyflow tubing and the unrestricted output was vented to atmosphere.

A.3 Type A Test Measurement

Data from temperature and relative humidity sensors as well as the pressure transmitters was collected by an IBM compatible personal computer. Electrical penetration E-20 was used to allow signals to travel back and forth between the inside and the outside of the drywell. The computer would ask a specific sensor for its current data. The sensor would in turn send the current data via the RS-485 cable to repeater outside the drywell. The signal from the repeater then gets sent through a converter to a switching box that switches between the temperature/humidity sensors and the pressure transmitters. Output from the A/B switching box is then sent directly to the computer via the serial interface where data is readable by the computer and the test engineer. All necessary calculations are performed and displayed and the data is stored to disk for retrieval at a later date.

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 the existing PCILRT pressurization line. For ease of handling, a flexible 4" pipe was used outside of the reactor building.

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

TABLE 1
(SHEET 1 OF 3)

INSTRUMENT SPECIFICATIONS

INSTRUMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	RANGE	ACCURACY	REPEATABILITY
THERMISOR 1	GRAFTEL	9202	0392010-33	50°F - 130°F	0.5°F	0.01°
THERMISOR 2	GRAFTEL	9202	0392010-07	50°F - 130°F	0.5°F	0.01°
THERMISOR 3	GRAFTEL	9202	0392010-31	50°F - 130°F	0.5°F	0.01°
THERMISOR 4	GRAFTEL	9202	0392010-03	50°F - 130°F	0.5°F	0.01°
THERMISOR 5	GRAFTEL	9202	0392010-25	50°F - 130°F	0.5°F	0.01°
THERMISOR 6	GRAFTEL	9202	0392010-09	50°F - 130°F	0.5°F	0.01°
THERMISOR 7	GRAFTEL	9202	0392010-10	50°F - 130°F	0.5°F	0.01°
THERMISOR 8	GRAFTEL	9202	0392010-21	50°F - 130°F	0.5°F	0.01°
THERMISOR 9	GRAFTEL	9202	0392010-24	50°F - 130°F	0.5°F	0.01°
THERMISOR 10	GRAFTEL	9202	0392010-12	50°F - 130°F	0.5°F	0.01°
THERMISOR 11	GRAFTEL	9202	0392010-05	50°F - 130°F	0.5°F	0.01°
THERMISOR 12	GRAFTEL	9202	0392010-17	50°F - 130°F	0.5°F	0.01°
THERMISOR 13	GRAFTEL	9202	0392010-06	50°F - 130°F	0.5°F	0.01°
THERMISOR 14	GRAFTEL	9202	0392010-16	50°F - 130°F	0.5°F	0.01°
THERMISOR 15	GRAFTEL	9202	0392010-14	50°F - 130°F	0.5°F	0.01°
THERMISOR 16	GRAFTEL	9202	0392010-15	50°F - 130°F	0.5°F	0.01°
THERMISOR 17	GRAFTEL	9202	0392010-01	50°F - 130°F	0.5°F	0.01°
THERMISOR 18	GRAFTEL	9202	0392010-27	50°F - 130°F	0.5°F	0.01°
THERMISOR 19	GRAFTEL	9202	0392010-19	50°F - 130°F	0.5°F	0.01°
THERMISOR 20	GRAFTEL	9202	0392010-18	50°F - 130°F	0.5°F	0.01°

TABLE 1
(SHEET 2 OF 3)

INSTRUMENT SPECIFICATIONS

INSTRUMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	RANGE	ACCURACY	REPEATABILITY
THERMISOR 21	GRAFTEL	9202	0392010-22	50°F - 130°F	0.5°F	0.01°
THERMISOR 22	GRAFTEL	9202	0392010-04	50°F - 130°F	0.5°F	0.01°
THERMISOR 23	GRAFTEL	9202	0392010-02	50°F - 130°F	0.5°F	0.01°
THERMISOR 24	GRAFTEL	9202	0392010-11	50°F - 130°F	0.5°F	0.01°
THERMISOR 25	GRAFTEL	9202	0392010-13	50°F - 130°F	0.5°F	0.01°
THERMISOR 26	GRAFTEL	9202	0392010-30	50°F - 130°F	0.5°F	0.01°
THERMISOR 27	GRAFTEL	9202	0392010-28	50°F - 130°F	0.5°F	0.01°
THERMISOR 28	GRAFTEL	9202	0392010-29	50°F - 130°F	0.5°F	0.01°
THERMISOR 29	GRAFTEL	9202	0392010-26	50°F - 130°F	0.5°F	0.01°
THERMISOR 30	GRAFTEL	9202	0392010-32	50°F - 130°F	0.5°F	0.01°
RH SENSOR 1	GRAFTEL	9203	0392010-42	20 - 100% RH	2°F DEW TEMP EQUIVALENT	0.2%
RH SENSOR 2	GRAFTEL	9203	0392010-39	20 - 100% RH	2°F DEW TEMP EQUIVALENT	0.2%
RH SENSOR 3	GRAFTEL	9203	0392010-45	20 - 100% RH	2°F DEW TEMP EQUIVALENT	0.2%
RH SENSOR 4	GRAFTEL	9203	0392010-37	20 - 100% RH	2°F DEW TEMP EQUIVALENT	0.2%
RH SENSOR 5	GRAFTEL	9203	0392010-35	20 - 100% RH	2°F DEW TEMP EQUIVALENT	0.2%
RH SENSOR 6	GRAFTEL	9203	0392010-36	20 - 100% RH	2°F DEW TEMP EQUIVALENT	0.2%
RH SENSOR 7	GRAFTEL	9203	0392010-41	20 - 100% RH	2°F DEW TEMP EQUIVALENT	0.2%
RH SENSOR 8	GRAFTEL	9203	0392010-48	20 - 100% RH	2°F DEW TEMP EQUIVALENT	0.2%
RH SENSOR 9	GRAFTEL	9203	0392010-40	20 - 100% RH	2°F DEW TEMP EQUIVALENT	0.2%
RH SENSOR 10	GRAFTEL	9203	0392010-38	20 - 100% RH	2°F DEW TEMP EQUIVALENT	0.2%

TABLE 1
(SHEET 3 OF 3)

INSTRUMENT SPECIFICATIONS

INSTRUMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	RANGE	ACCURACY	REPEATABILITY
PRESSURE	~~VOLUMETRICS~~ PAROSCIENTIFIC	760-100A	47111	0 - 100 psia	0.01% OF FULL SCALE	0.02% OF FULL SCALE
PRESSURE	~~VOLUMETRICS~~ PAROSCIENTIFIC	760-100A	46847	0 - 100 psia	0.01% OF FULL SCALE	0.02% OF FULL SCALE
FLOW METER	FISCHER-PORTER	10A1755 S	8511A0113A7	60 - 870 SCFH	± 1.0% OF FULL SCALE	N/A
FLOW METER	FISCHER-PORTER	10A1755 S	8511A0113A7	60 - 870 SCFH	± 1.0% OF FULL SCALE	N/A
PRESSURE	DRUCK	DPI601	6012773211	0 - 50 psia	± 0.025 psia	N/A

TABLE 2A
(SHEET 1 OF 3)

ILRT SENSOR PHYSICAL LOCATIONS

TEMPERATURE SENSORS

CHANNEL NUMBER	ELEVATION	LOCATION AZIMUTH	RADIUS	SUBVOLUME
CHANNEL NUMBER	ELEVATION	LOCATION AZIMUTH	RADIUS	SUBVOLUME
1	724'	276°	39'-8"	8
2	758'	270°	25'	5
3	762'	0°	25'	4
4	777'	270°	31'	4
5	791'	270°	16'	3
6	808'	270°	20'	2
7	808'	225°	12'	2
8	826'	180°	10'	1
9	708'	195°	39'-8"	8
10	730'	270°	16'	6
11	743'	180°	5'	7
12	754'	180°	31'	5
13	772'	180°	20'	4
14	785'	180°	24'	3
15	804'	45°	12'	2
16	730'	90°	7'	6
17	743'	0°	5'	7
18	724'	75-43°	21'-10"	8
19	708'	19-30°	39'-8"	8
20	749'	0°	17'	5
21	785'	0°	28'	3

TABLE 2A
(SHEET 2 OF 3)

ILRT SENSOR PHYSICAL LOCATIONS

TEMPERATURE SENSORS

CHANNEL NUMBER	ELEVATION	LOCATION AZIMUTH	RADIUS	SUBVOLUME
22	811'	0°	16'	2
23	724'	95-30°	40'	8
24	708'	75-43°	22'-10"	8
25	750'	90°	20'	5
26	767'	90°	36'	4
27	791'	90°	21'	3
28	797'	90°	25'	2
29	815'	180°	14'	2
30	822'	0°	14'	1

TABLE 2A
(SHEET 3 OF 3)

ILRT SENSOR PHYSICAL LOCATIONS

RH SENSORS

CHANNEL NUMBER	ELEVATION	LOCATION AZIMUTH	RADIUS	SUBVOLUME
1	763'	0°	30'	4
2	803'	270°	21'	2
3	708'	232-10°	40'-3"	8
4	746'	270°	5'	7
5	773'	180°	20'	4
6	724'	75-43°	22'-4"	8
7	749'	0°	17'	5
8	791'	0°	21'	3
9	812'	180°	14'	2
10	825'	0°	5'	1

FIGURE 1

ILRT SENSOR DEVICE INTERCONNECTION

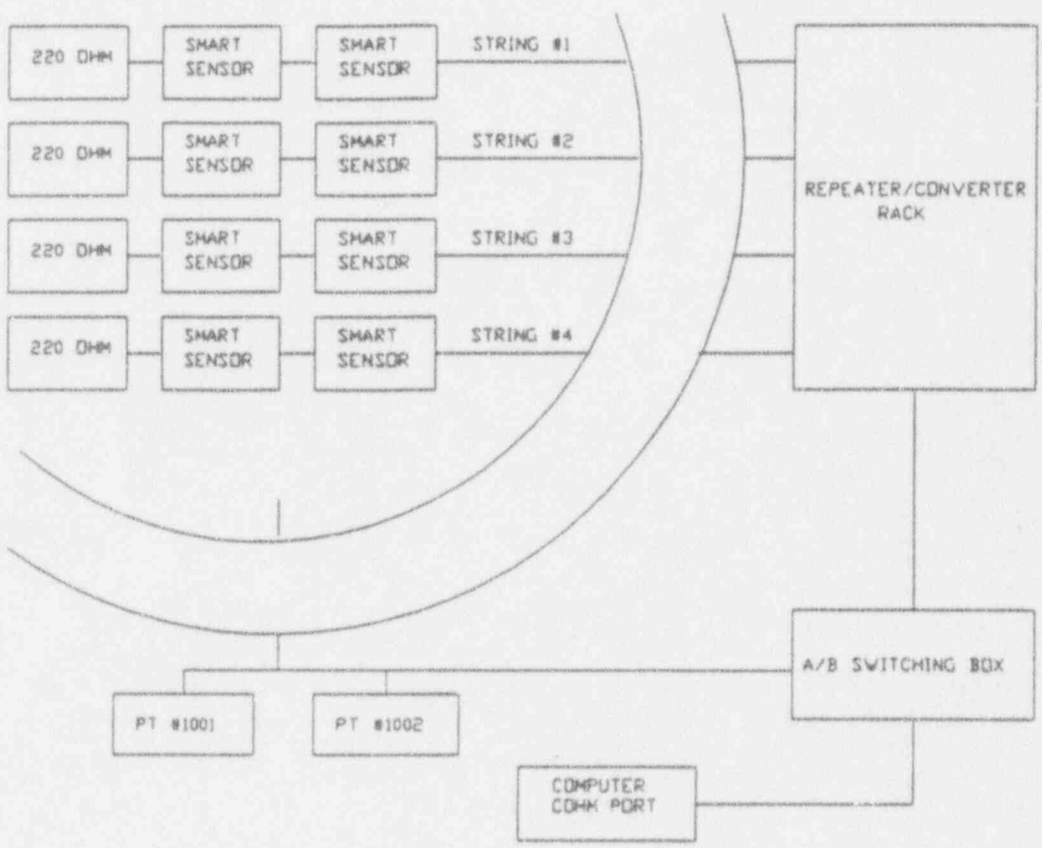


TABLE 2B
(SHEET 1 OF 2)

SUBVOLUME LOCATIONS AND VOLUMES

SUBVOLUME	LOCATION	VOLUME ft3	SUBVOLUME (wt. factor)
1	Drywell Head Area Above 817'-6"	7745	.01963
2	Annulus Between Rx Vessel and Shield and Between Elev. 817'-6" and 796'-6"	25,483	.06458
3	Between Elev. 796'-6" and 777'-1"	36,786	.09321
4	Between Elev. 777'-11" and 759'-6"	55,595	.14088
5	Between Elev. 759'-6" and 734'-0"	95,910	.24303
6	Sump Area	3427	.00868
7	CRD Area	4592	.01164
8	Suppression Pool	165,100	.41836
TOTAL		394,638	1.0000

TABLE 2B
(SHEET 2 OF 2)

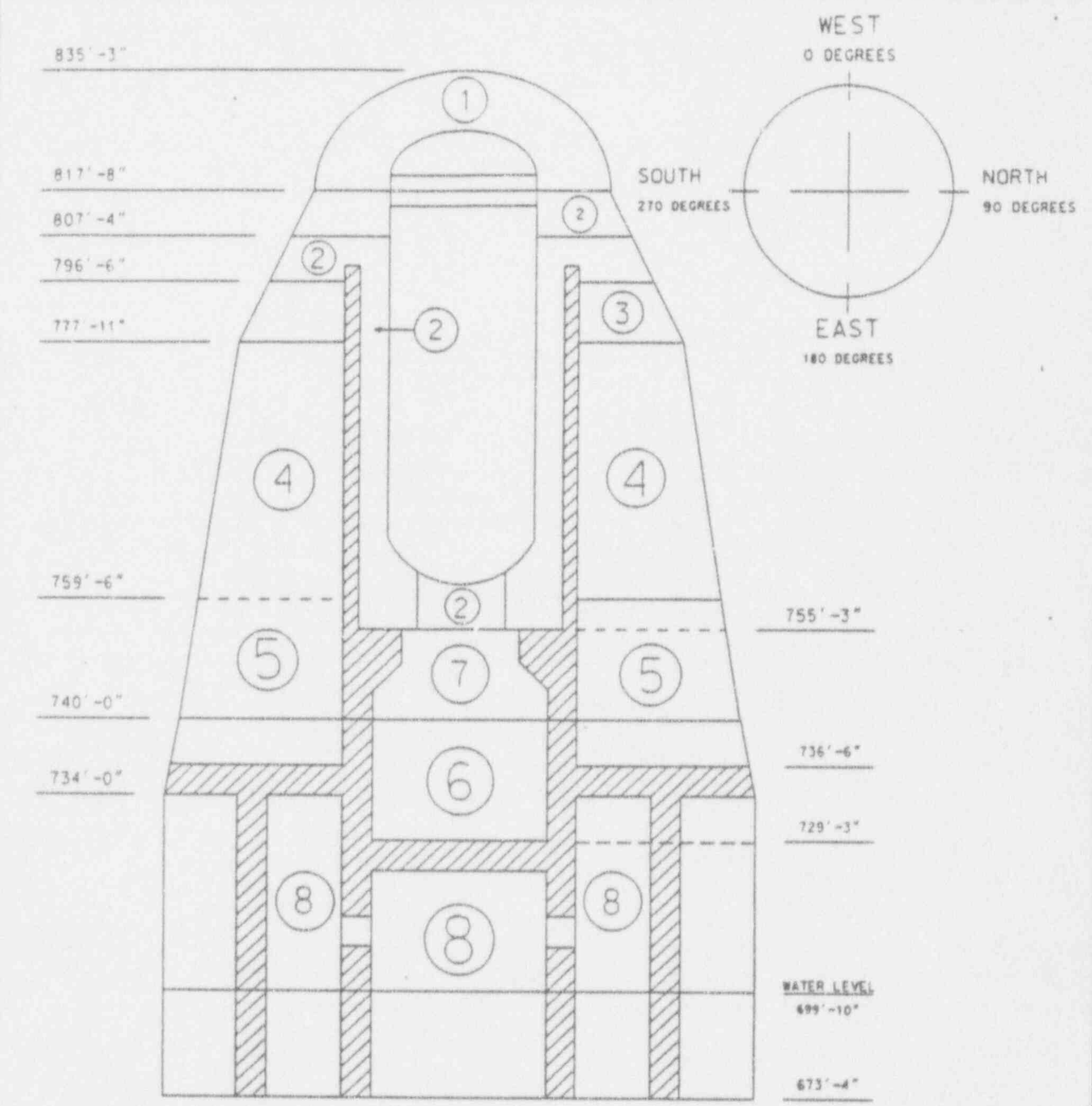
SUBVOLUME LOCATIONS AND VOLUMES

SUBVOLUME	NUMBER OF TEMPERATURE SENSORS IN SUBVOLUME	TEMPERATURE SENSOR VOLUME ft 3	TEMPERATURE SENSOR (wt. factor)
1	2	3,872.50	.009815
2	6	4,247.17	.010763
3	4	9,196.50	.023303
4	4	13,898.75	.03522
5	4	23,977.50	.060758
6	2	1,713.50	.00434
7	2	2,296.0	.00582
8	6	27,516.67	.069727
TOTAL	30	394,638	1.00000

SUBVOLUME	NUMBER OF RH SENSORS IN SUBVOLUME	RH SENSORS VOLUME ft 3	RH SENSORS (wt. factor)
1	1	7,745.0	.020497
2	2	12,741.5	.033157
3	1	36,786.0	.094077
4	2	27,797.5	.071307
5	1	95,910.0	.243897
6	0	0	0
7	1	4,592.0	.012507
8	2	82,550.0	.210047
TOTAL	10	394,638	1.00000

FIGURE 2

ILRT SENSOR PHYSICAL LOCATIONS



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 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 detectibility 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 Instrument Selection Guide (ISG) calculation is normally done per the guidelines of ANS 56.8 to determine system accuracy uncertainty. Commonwealth Edison Co. utilizes a standard ILRT instrumentation system which meets and exceeds the minimum criteria set forth in ANS 56.8.

Appendix C, page 114, specifies instrumentation requirements for Commonwealth Edison Co. standard ILRT instrumentation system. Because the instrumentation system specifications and minimum number of sensors criteria are met, then the ANS 56.8 ISG acceptance criteria is always satisfied. The ISG calculation for the instrument specifications yields an ISG of 0.02%/day based on minimum instrument numbers.

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

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 December 8, 1993 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.

C.2 Test Pressurization Chronology

DATE	TIME	EVENT
12/07/93	1700	Primary Containment pressurization initiated. Atmospheric pressure is 14.32 psia.
12/07/93	1715	Received reactor SCRAM and PCIS Groups 6 (partial), 7, and 9 at 1.69 psig.
12/07/93	2130	Found leakage at the Drywell Personnel Access Hatch inner door equalization valve.
12/07/93	2143	Drywell Personnel Access Hatch inner door equalization valve is open and outer door is closed.
12/07/93	2325	Pressurization completed with Drywell pressure at 55.6356 psia and Reactor Building atmospheric pressure at 14.268 psia and Valve 2E12-F017A is closed. Drywell Presonnel Access Hatch inner door open at this time.

C.3 Temperature Stabilization Chronology

DATE	TIME	EVENT
12/07/93	2329	Started containment stabilization phase.
12/08/93	0205	The pressurization line is vented per union connection at 0SA040.
12/08/93	0329	Stabilization criteria met for mass-plot and BN-Top-1 test methods at data set 160.

C.4 Measured Leak Rate Phase

DATE	TIME	EVENT
12/08/93	0343	Declare start of ILRT measured leak rate phase at data set 167.
12/08/93	0405	Operations notified that test phase has begun and that no adjustments are to be made to Shut Down Cooling and B RHR is not to be filled and vented with CY without the consent of the test director.
12/08/93	0957	ILRT measured leak rate phase completed satisfactory at data set 204 with a duration of 6.25 hours. Results: * Calculated Leak Rate: 0.284863 wt%/day * 95% Upper Confidence Limit: 0.316442 wt%/day * Total 95% Upper Confidence Limit including non-vented penetrations: 0.347942 wt%/day.

C.5 Induced Leak Rate Phase

DATE	TIME	EVENT
12/08/93	1037	Stared 1 hour Induced Test stabilization phase at data set 208 with an induced leak rate of 387.0 SCFH or 0.638 wt%/day.
12/08/93	1147	Started Induced Leak Rate Test at data set 215.

DATE	TIME	EVENT
12/08/93	1527	Induced Leak Rate Test phase is completed satisfactorily at data set 237 with a duration of 3.67 hours. Results: * Induced Leakage: 0.638 wt%/day * Induced Calculated Leak Rate: 0.7996 wt%/day. Results within ± 0.159 wt%/day acceptance criteria as the difference between the induced leak rate and the calculated leak rate is 0.1232 wt%/day.
12/08/93	1534	Isolated Induced Test rig.

C.6 **Depressurization Phase**

DATE	TIME	EVENT
12/08/93	1750	Commenced containment depressurization by manually opening 2VQ035.
12/08/93	2350	Suspended containment depressurization at 17.96 psia in preparation for the Drywell Floor Bypass Test.
12/09/93	0150	Gags removed from vacuum breakers, returned to closed position.
12/09/93	0250	Commenced depressurizing suppression chamber to atmospheric pressure.
12/09/93	0630	Drywell depressurized to 15.88 psia, suppression chamber depressurized to 0 psig.
12/09/93	0743	Drywell Floor Bypass Test stabilization period started.
12/09/93	0813	Started 1 hour 1.5 psi Drywell Floor Bypass Test.
12/09/93	0913	Completed Drywell Floor Bypass Test, done satisfactory.
12/09/93	0926	Commenced Drywell depressurization.
12/09/93	0935	Drywell depressurized to atmosphere.
12/09/93	1100	Performed Drywell Post Test 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 3 through 30.

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 31 through 58.

MEASURED LEAK RATE

PHASE

DATA SETS 167 - 204

TABLE 3

Total Time Leak Rate Analysis

LaSalle
2

RDG	TIME (MINUTES)	MEASURED LEAK (WT %/DAY)	CALCULATED LEAK (WT %/DAY)	UCL LEAK (WT %/DAY)
167	0.00	-	-	-
168	10.02	0.232721	-	-
169	15.18	0.212241	0.212241	-
170	25.88	0.243869	0.241635	0.441336
171	35.88	0.251774	0.252345	0.324873
172	45.90	0.288423	0.279433	0.335900
173	55.90	0.254037	0.273394	0.337899
174	65.90	0.236688	0.261328	0.332094
175	75.92	0.256392	0.262182	0.323493
176	85.92	0.272271	0.268697	0.323060
177	95.92	0.270755	0.272455	0.321526
178	105.93	0.274696	0.276251	0.321217
179	115.93	0.265965	0.276286	0.319090
180	125.93	0.276898	0.279234	0.319289
181	135.95	0.290432	0.284911	0.322884
182	145.95	0.287832	0.288613	0.324568
183	155.95	0.272727	0.287993	0.323940
184	165.97	0.280093	0.289011	0.323891
185	175.97	0.285895	0.290958	0.324558
186	185.97	0.288264	0.292961	0.325400
187	195.98	0.284564	0.293882	0.325648
188	205.98	0.282515	0.294230	0.325655
189	215.98	0.284589	0.294826	0.325778
190	232.70	0.279869	0.295712	0.327094
191	243.42	0.275327	0.294375	0.326435
192	253.42	0.278784	0.293657	0.325716
193	263.43	0.274762	0.292432	0.324826
194	273.43	0.281987	0.292415	0.324385
195	283.43	0.279223	0.292006	0.323770
196	293.45	0.277208	0.291370	0.323063
197	303.45	0.275307	0.290553	0.322275
198	313.45	0.276216	0.289932	0.321547
199	323.47	0.274925	0.289215	0.320775
200	333.47	0.273178	0.288360	0.319936
201	343.47	0.272203	0.287473	0.319069
202	353.48	0.274522	0.286920	0.318335
203	363.48	0.268703	0.285792	0.317366
204	373.48	0.269689	0.284863	0.316442

FIGURE 3

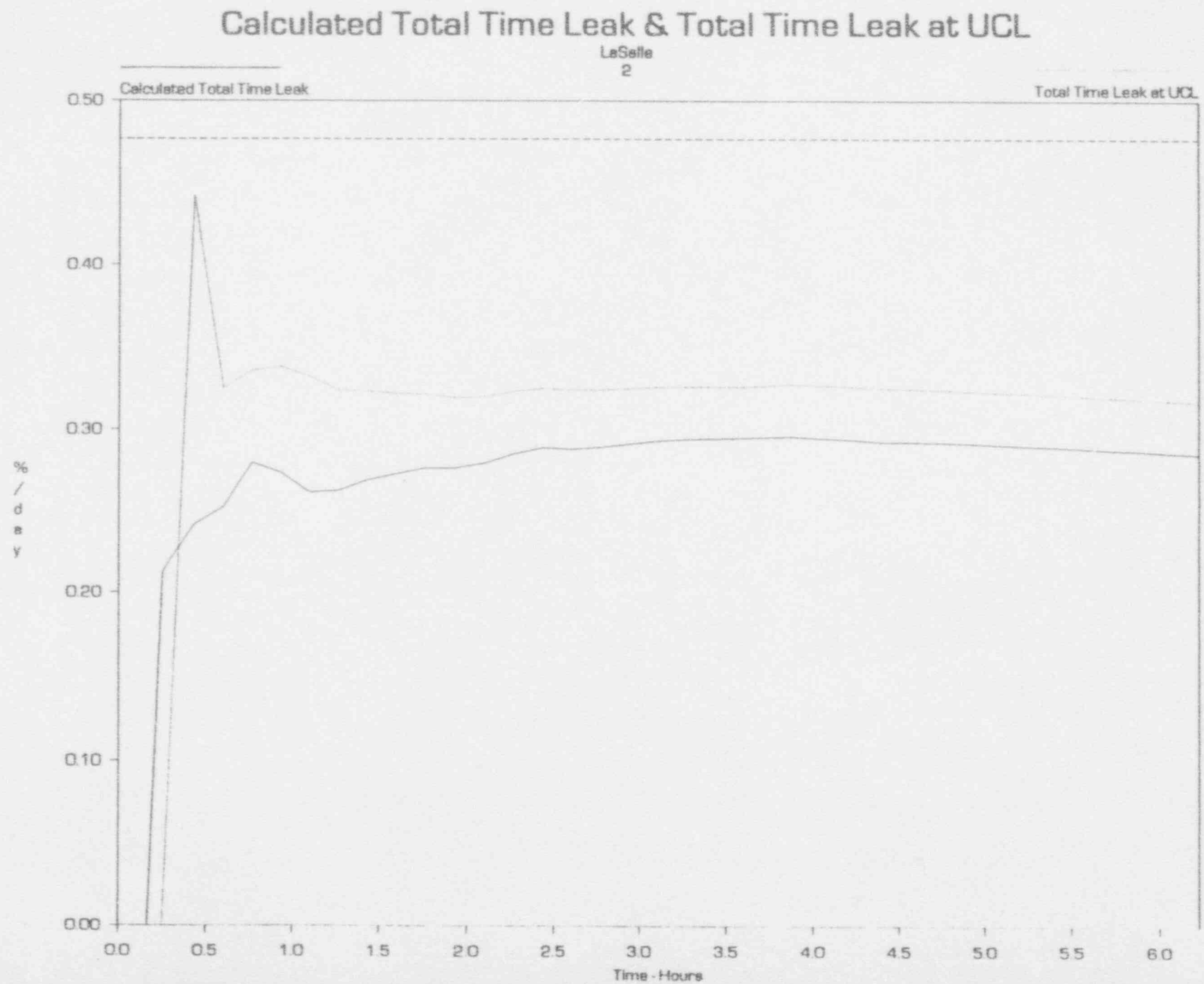

Calculated Total Time Leak & Total Time Leak at UCL
LaSalle
2
Calculated Total Time Leak
Total Time Leak at UCL
0.50
0.40
0.30
0.20
0.10
0.00
% / d a y
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 4

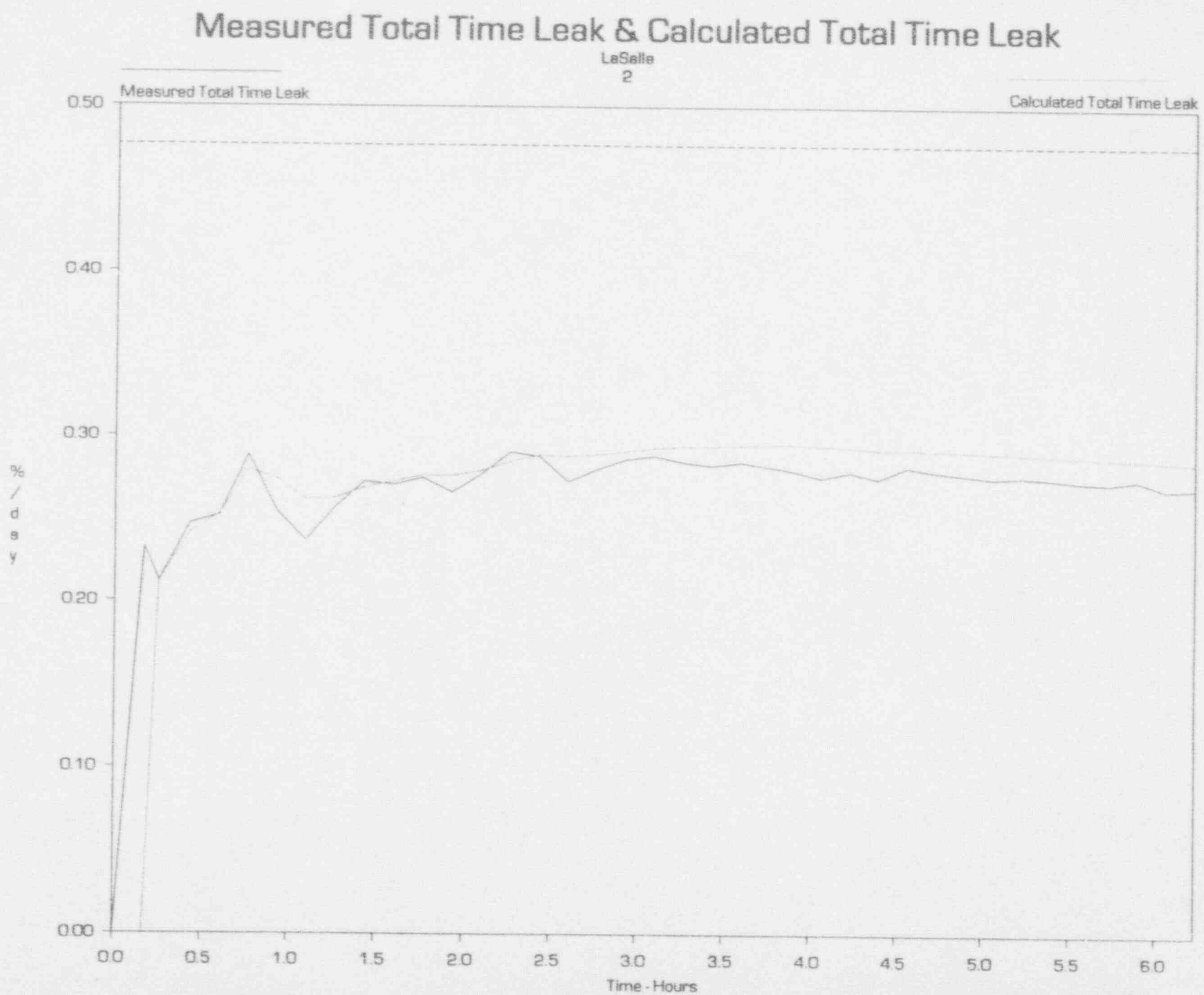
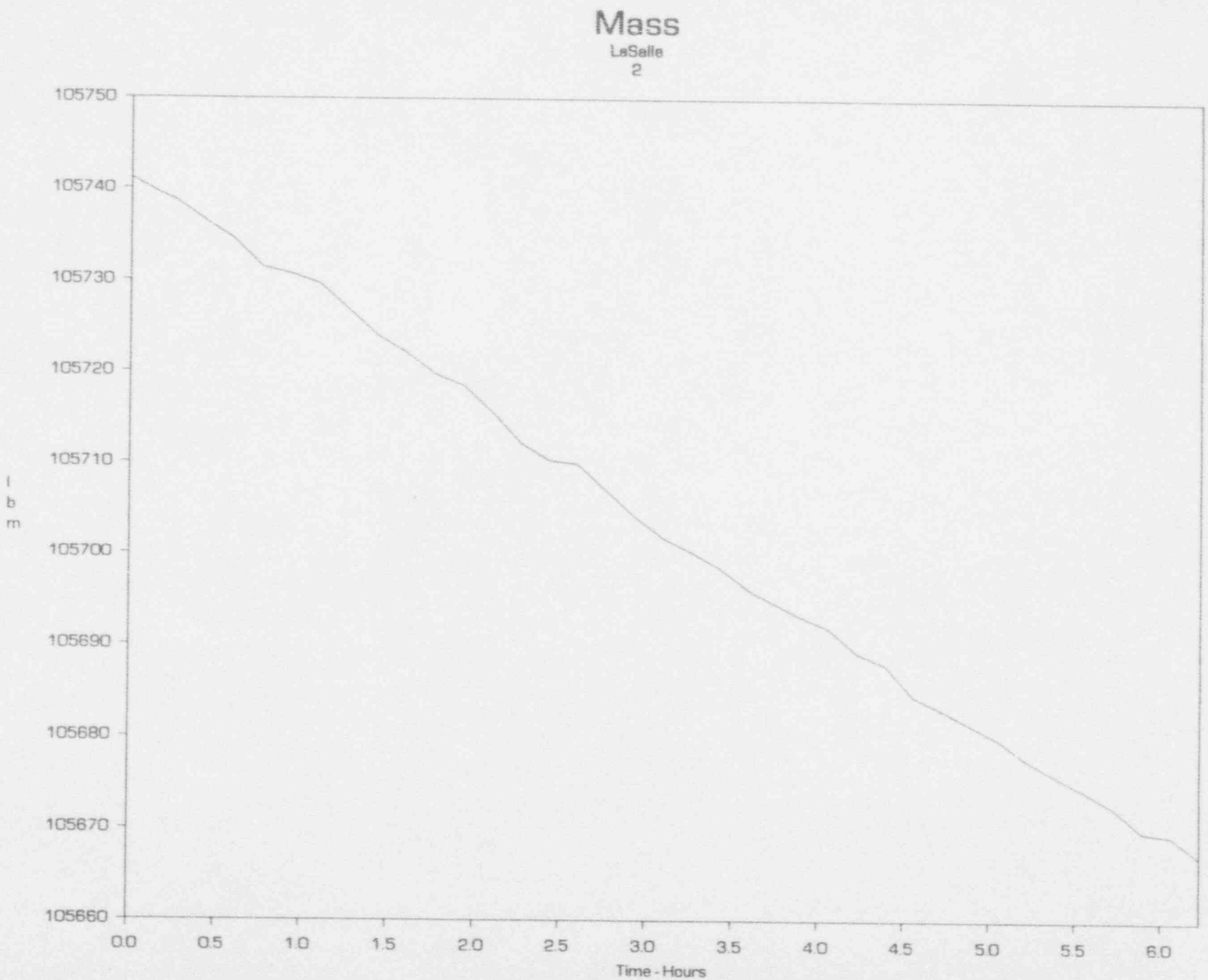
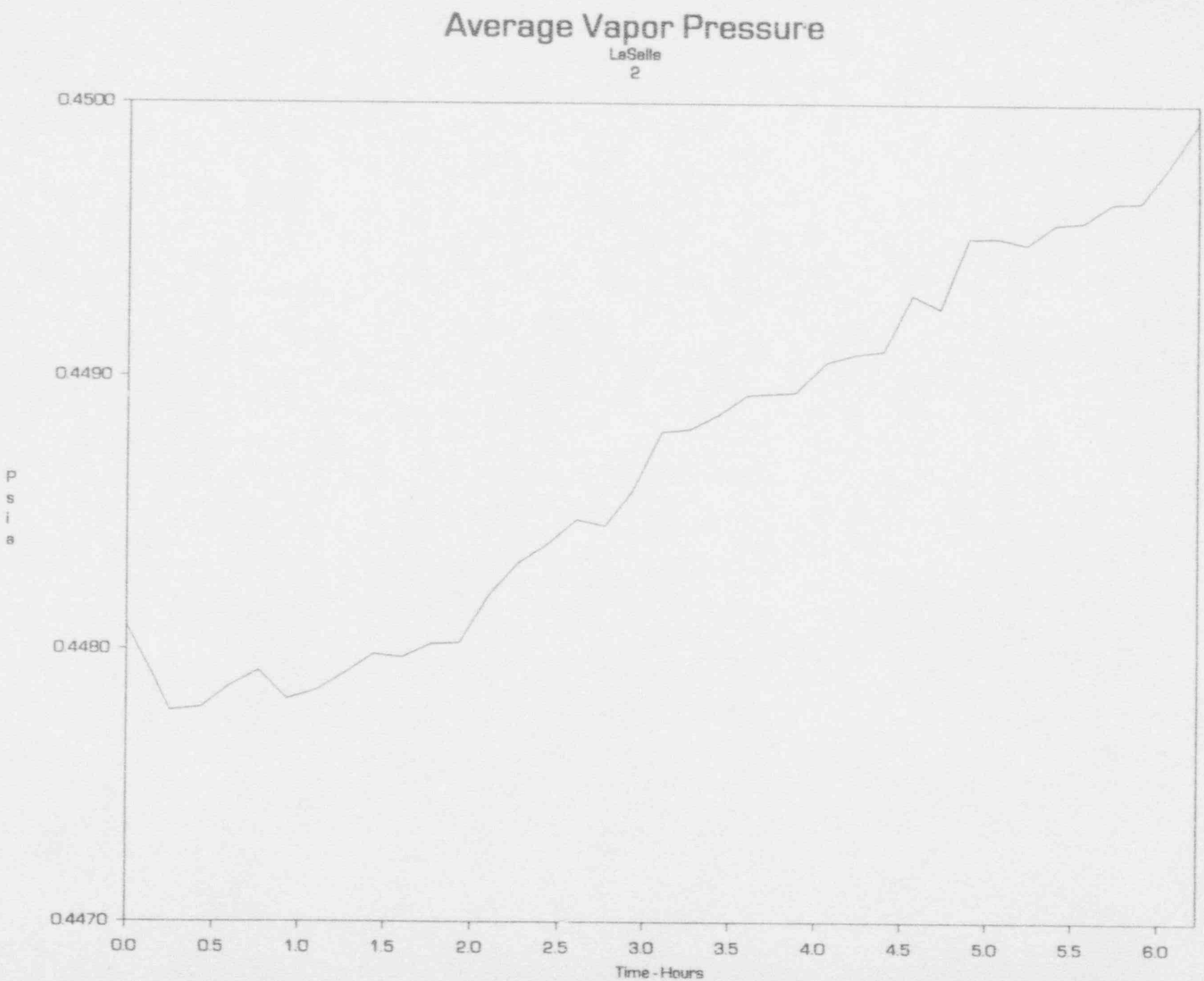

Measured Total Time Leak & Calculated Total Time Leak
LaSalle
2
Measured Total Time Leak
Calculated Total Time Leak
0.50
0.40
0.30
0.20
0.10
0.00
% / d a y
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 5



Mass
LaSalle
2
105750
105740
105730
105720
105710
105700
105690
105680
105670
105660
lbm
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 6



Average Vapor Pressure
LaSalle
2
0.4500
0.4490
0.4480
0.4470
Psia
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 7

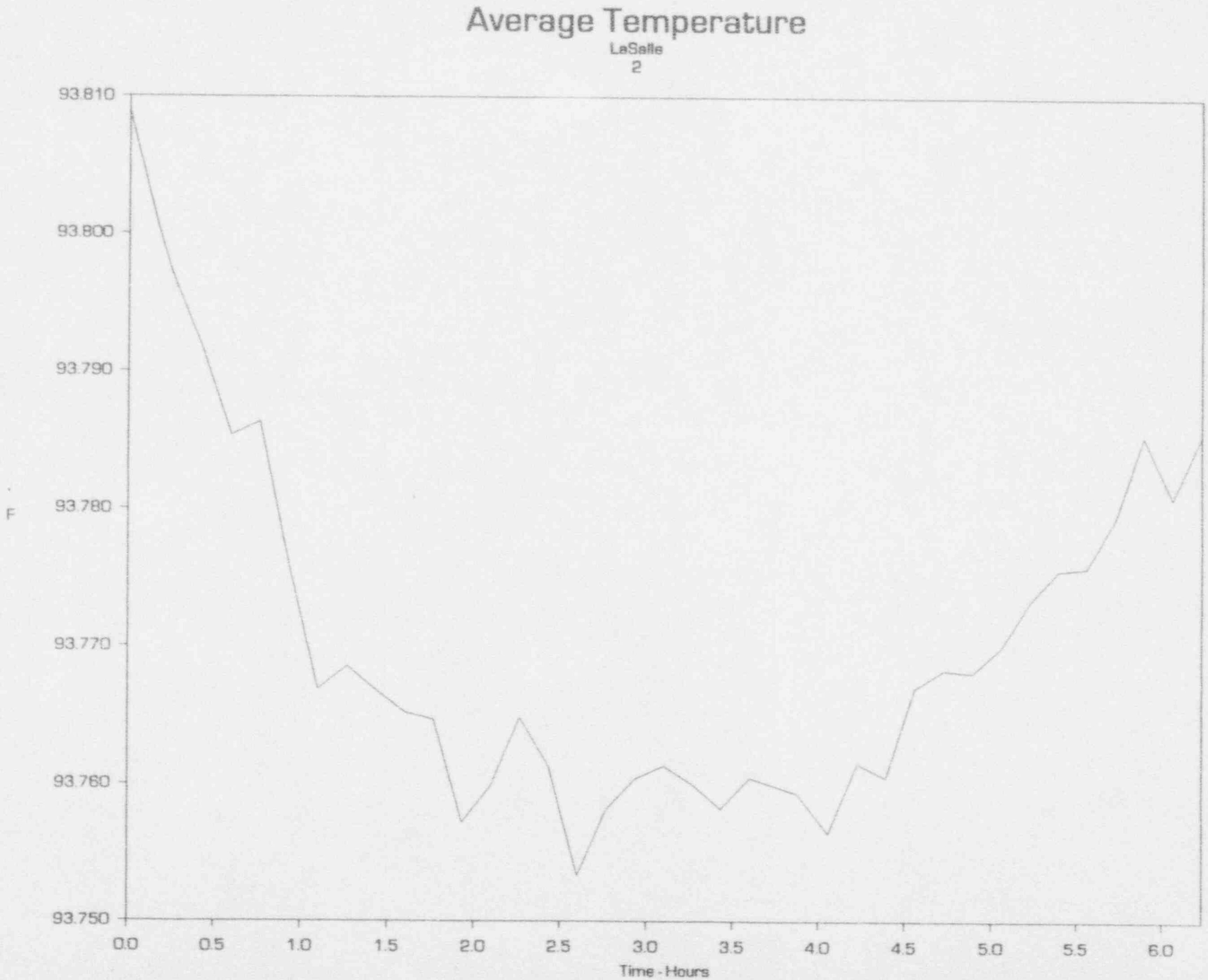

Average Temperature
LaSalle
2
93.810
93.800
93.790
93.780
93.770
93.760
93.750
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 8

Average Dew Point
LaSalle
2

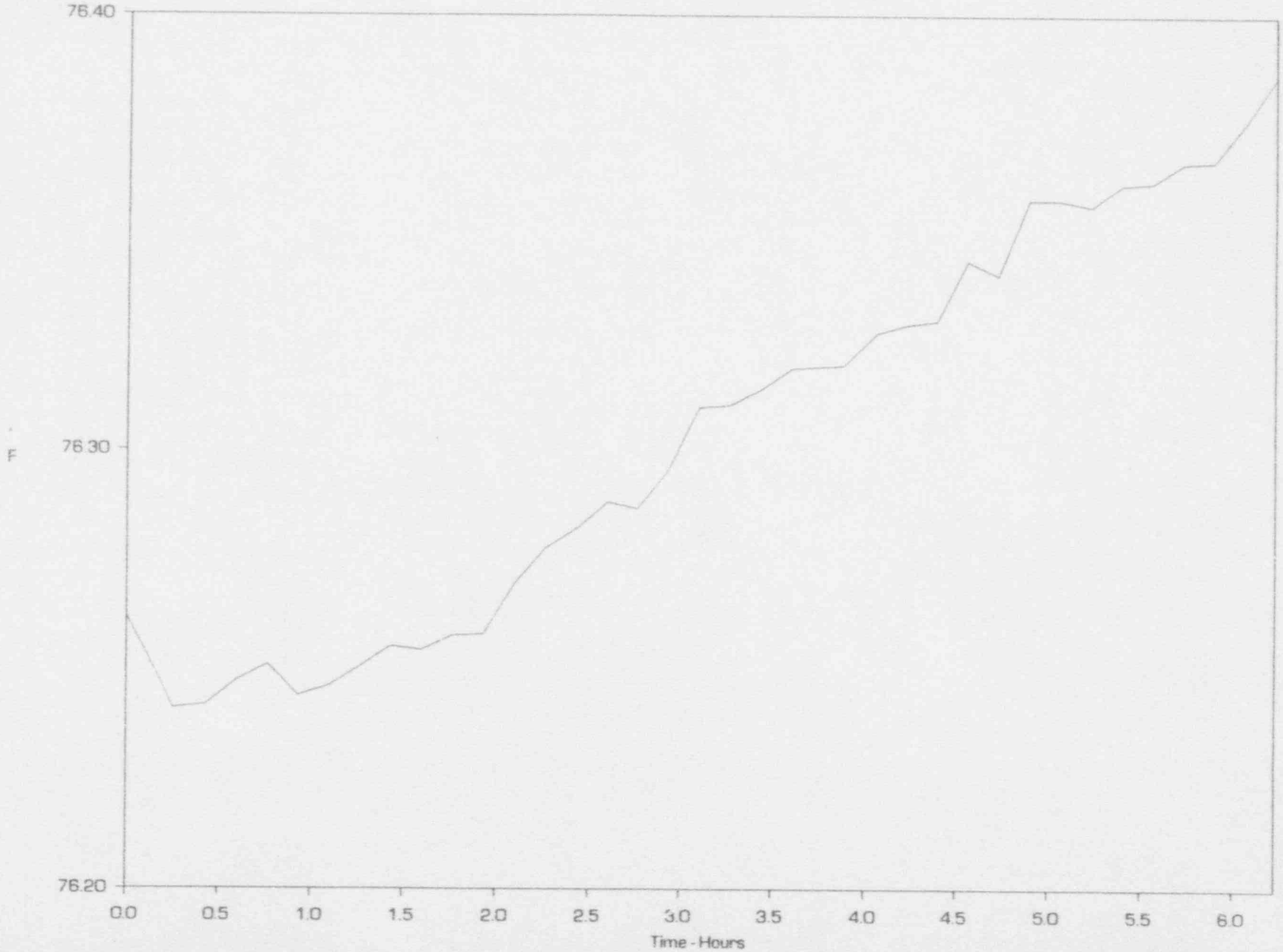


FIGURE 9

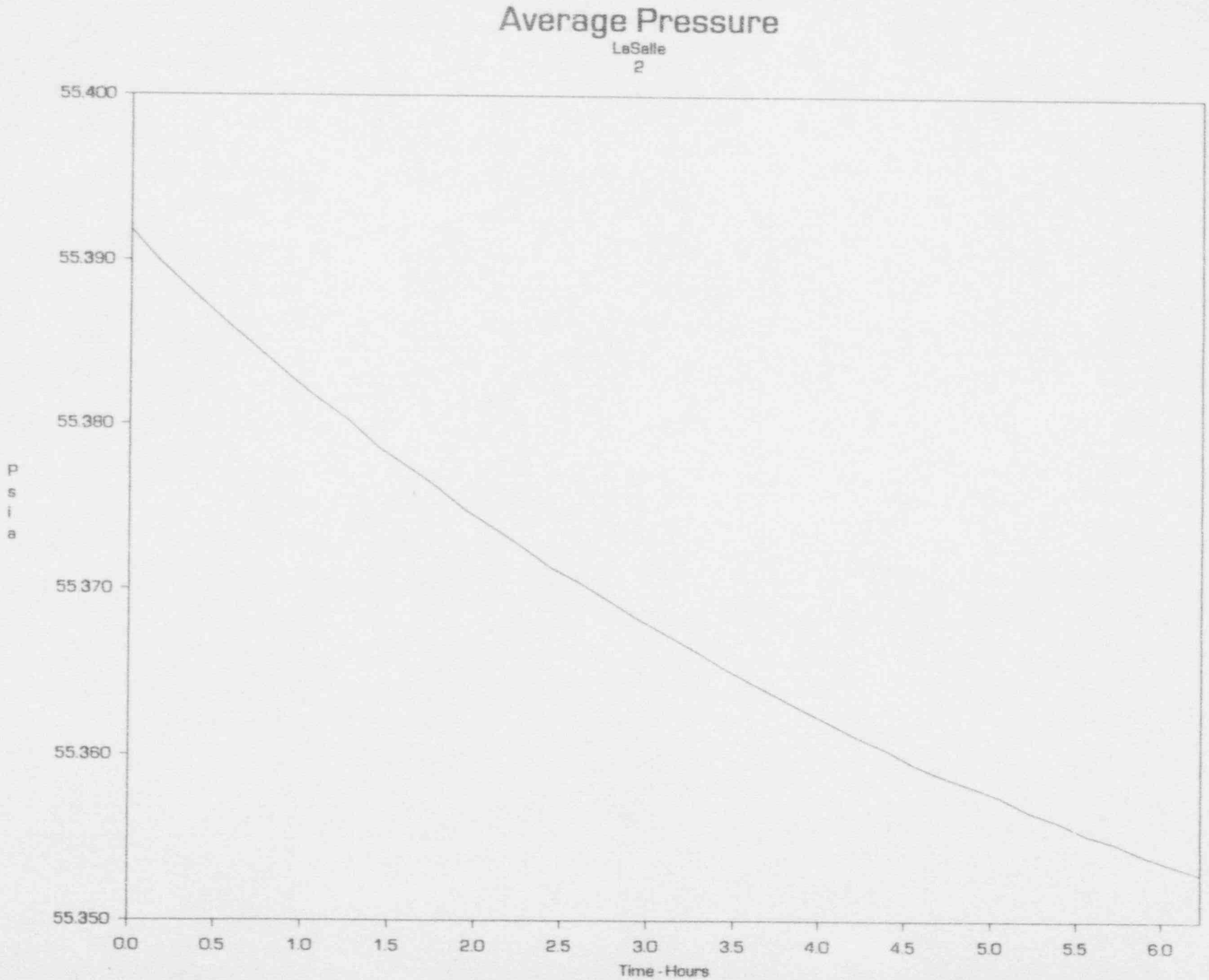
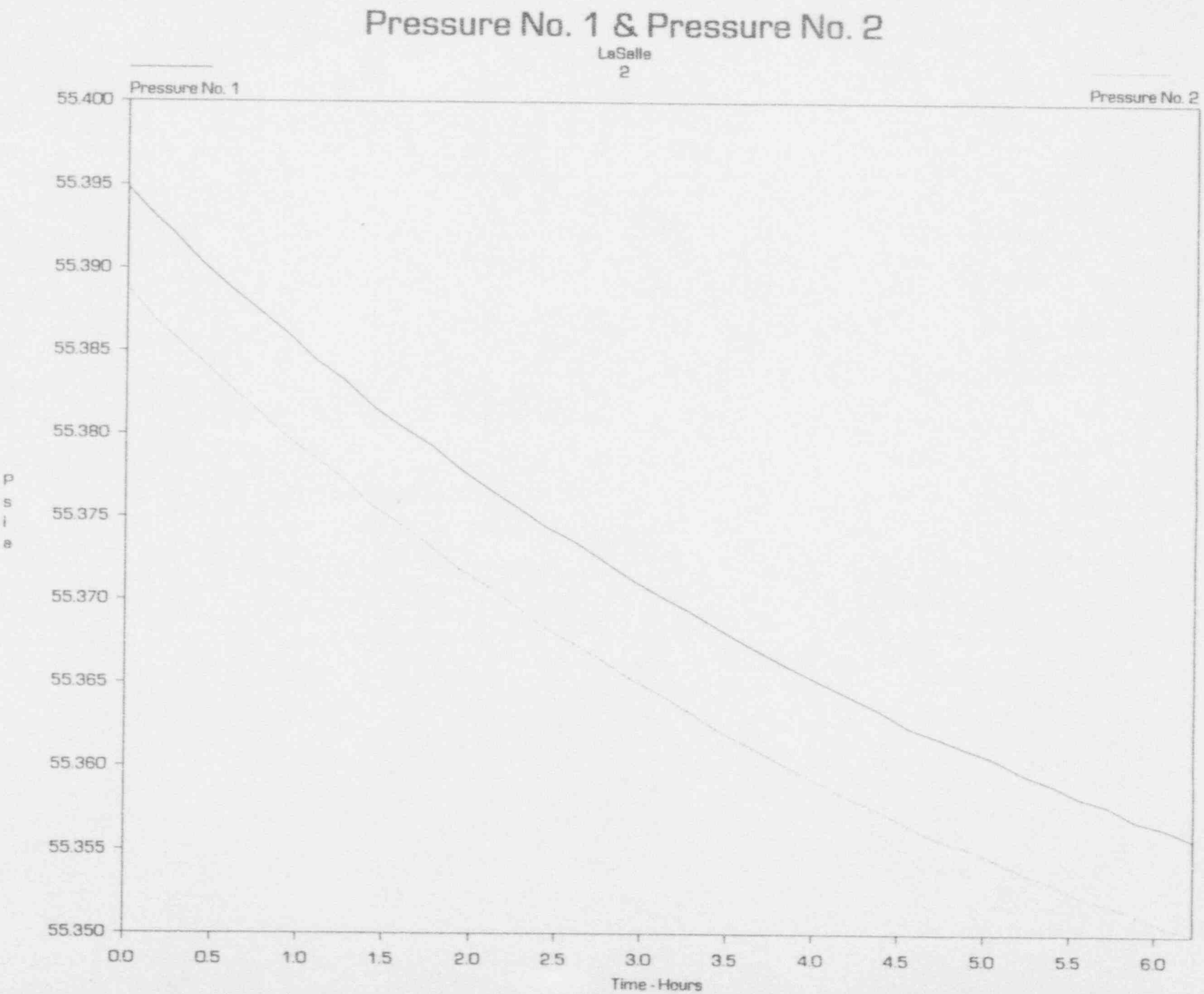

Average Pressure
LaSalle
2
55.400
55.390
55.380
55.370
55.360
55.350
Psia
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 10



Pressure No. 1 & Pressure No. 2
LaSalle
2
Pressure No. 1
Pressure No. 2
55.400
55.395
55.390
55.385
55.380
55.375
55.370
55.365
55.360
55.355
55.350
P s i a
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 11

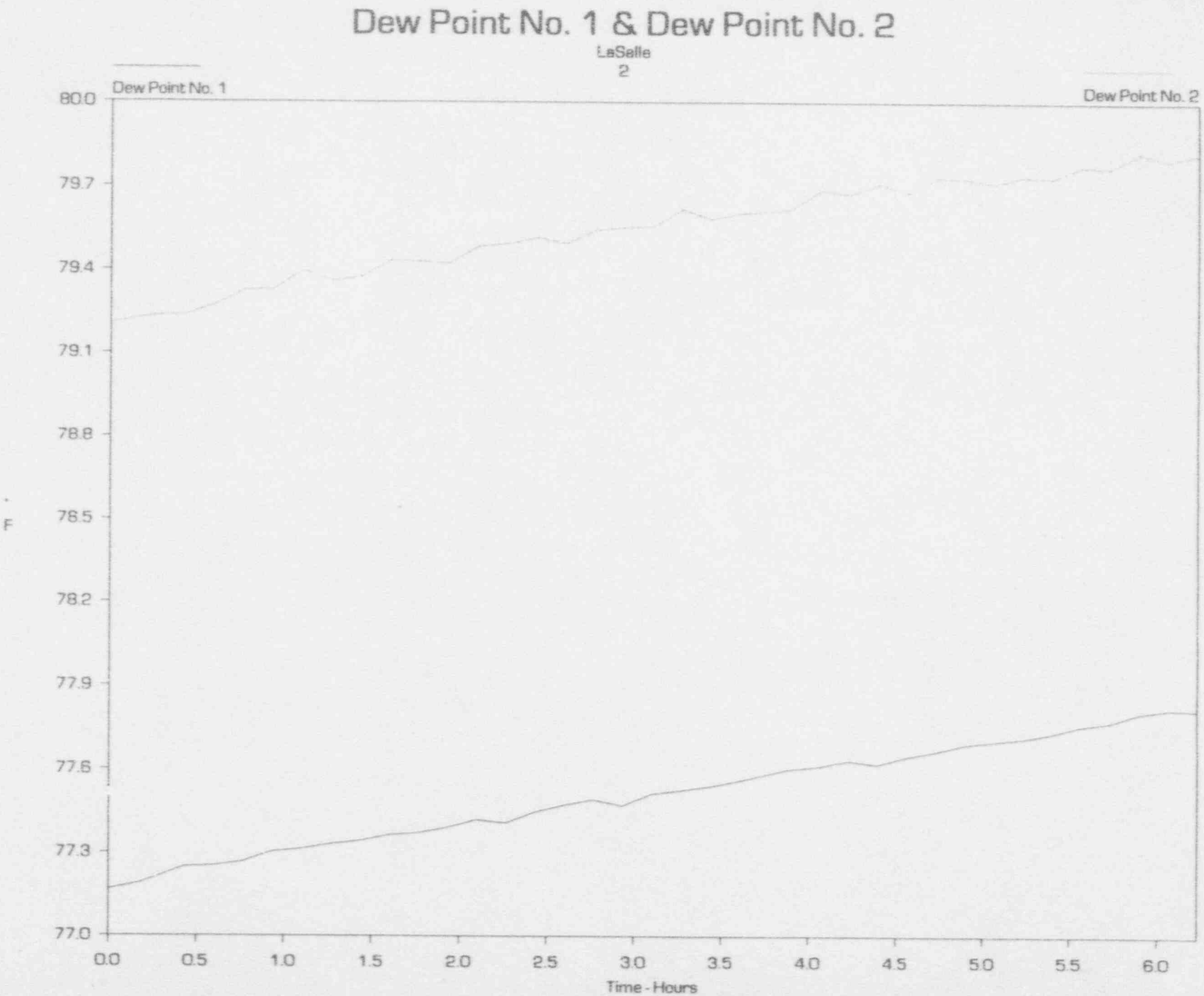

Dew Point No. 1 & Dew Point No. 2
LaSalle
2
Dew Point No. 1
Dew Point No. 2
80.0
79.7
79.4
79.1
78.8
78.5
78.2
77.9
77.6
77.3
77.0
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 12

Dew Point No. 3 & Dew Point No. 4

LaSalle
2

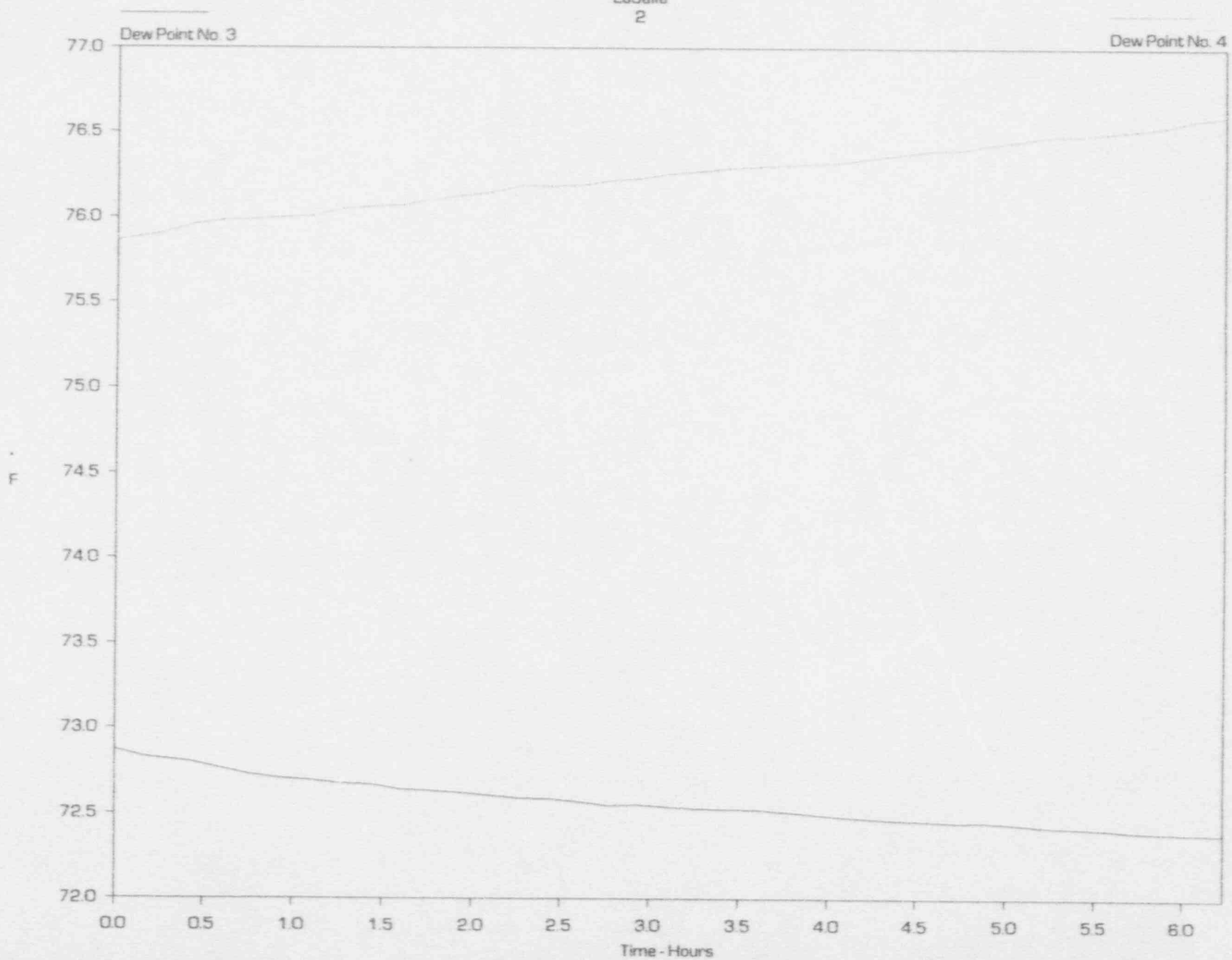


FIGURE 13

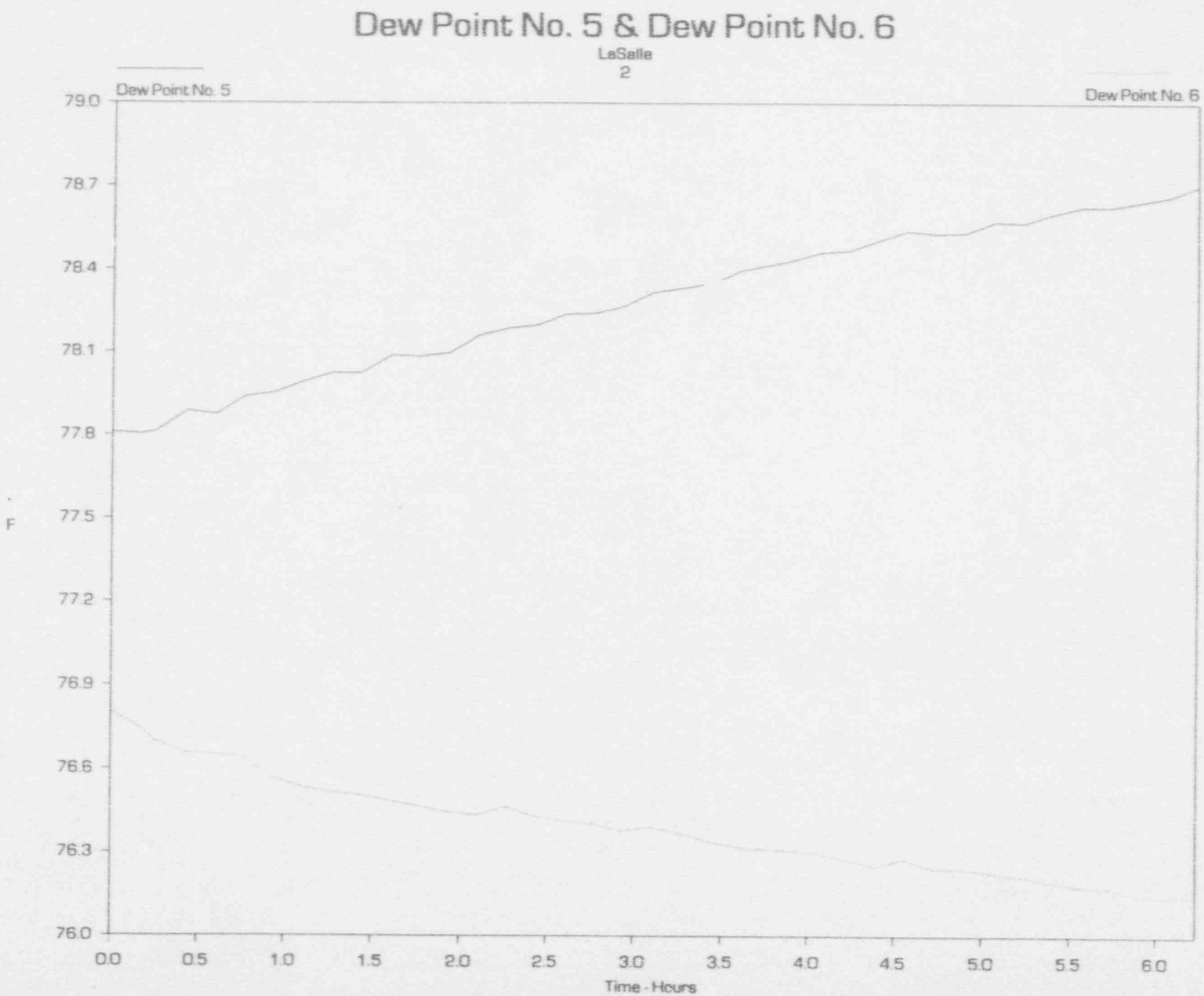

Dew Point No. 5 & Dew Point No. 6
LaSalle
2
Dew Point No. 5
Dew Point No. 6
79.0
78.7
78.4
78.1
77.8
77.5
77.2
76.9
76.6
76.3
76.0
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 14

Dew Point No. 7 & Dew Point No. 8

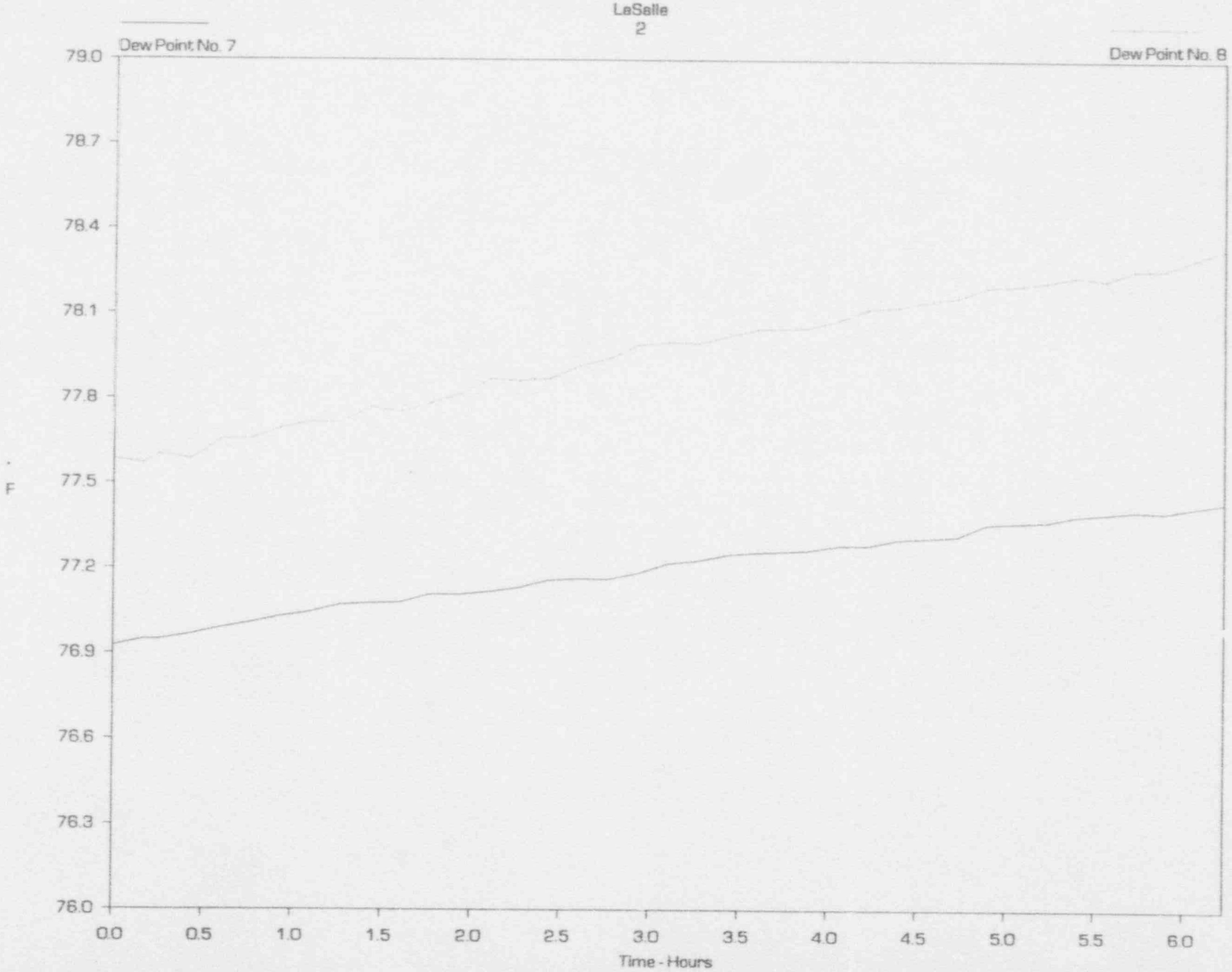
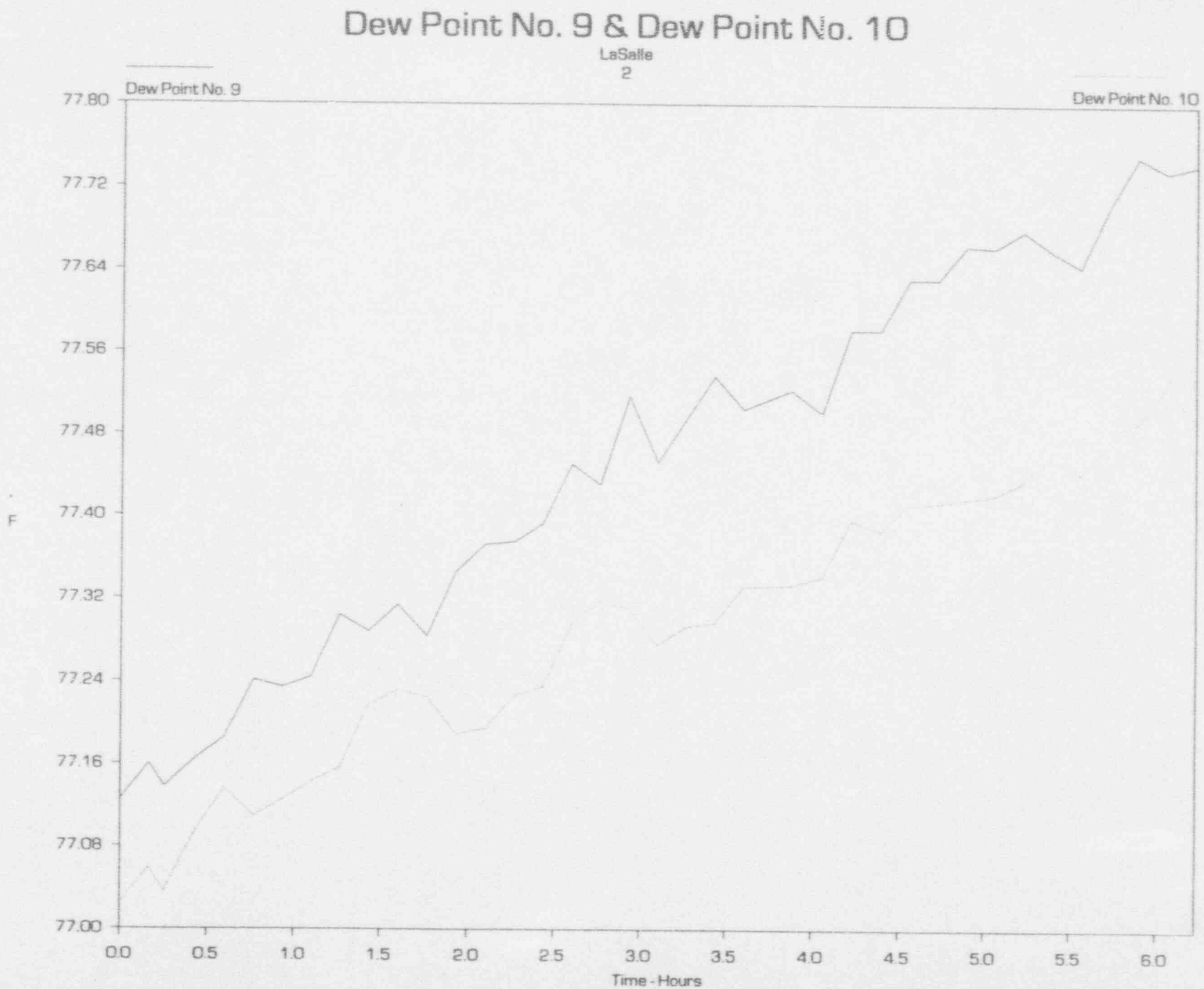
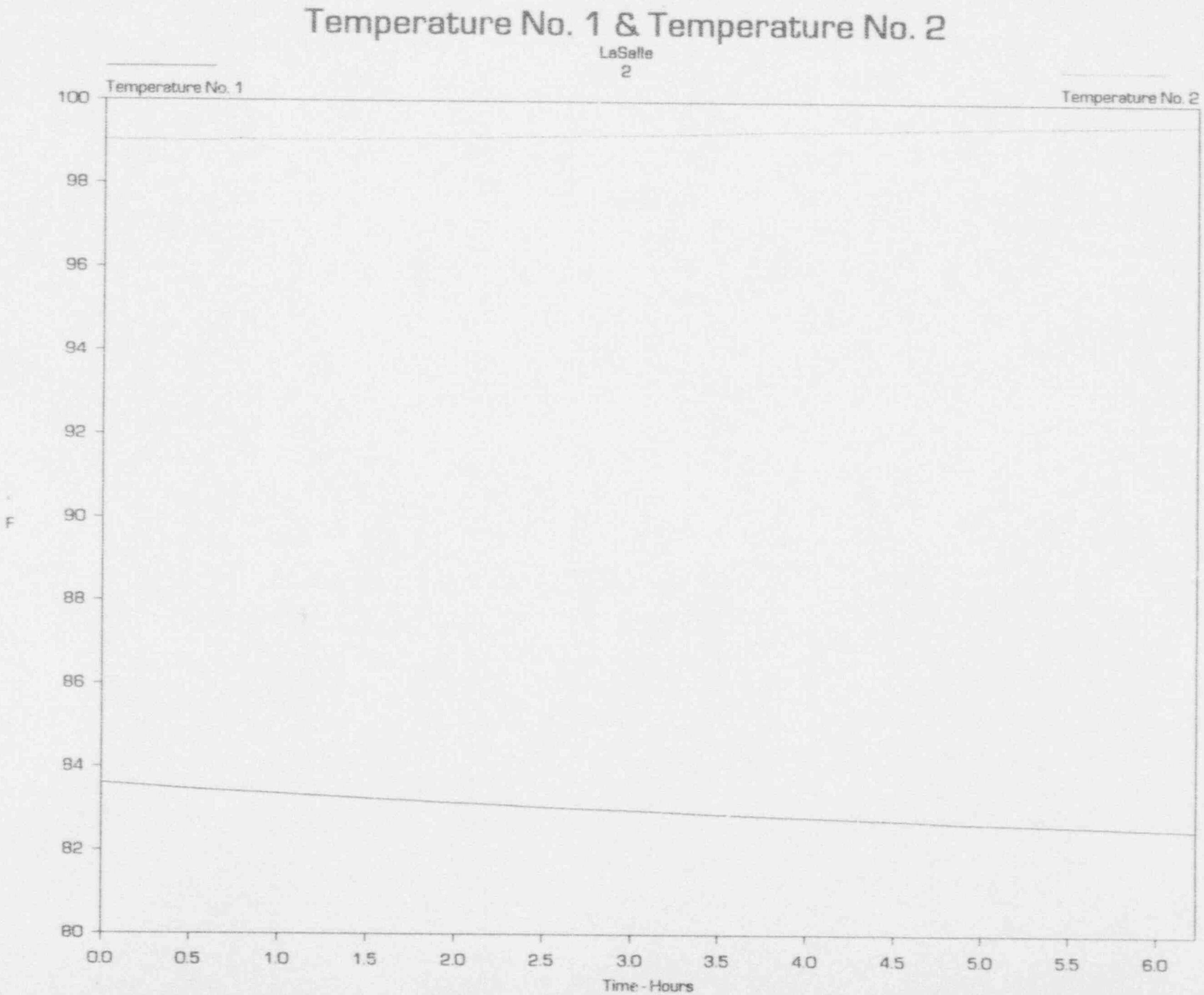


FIGURE 15



Dew Point No. 9 & Dew Point No. 10
LaSalle
2
Dew Point No. 9
Dew Point No. 10
77.80
77.72
77.64
77.56
77.48
77.40
77.32
77.24
77.16
77.08
77.00
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 16



Temperature No. 1 & Temperature No. 2
LaSalle
2
Temperature No. 1
Temperature No. 2
100
98
96
94
92
90
88
86
84
82
80
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 17

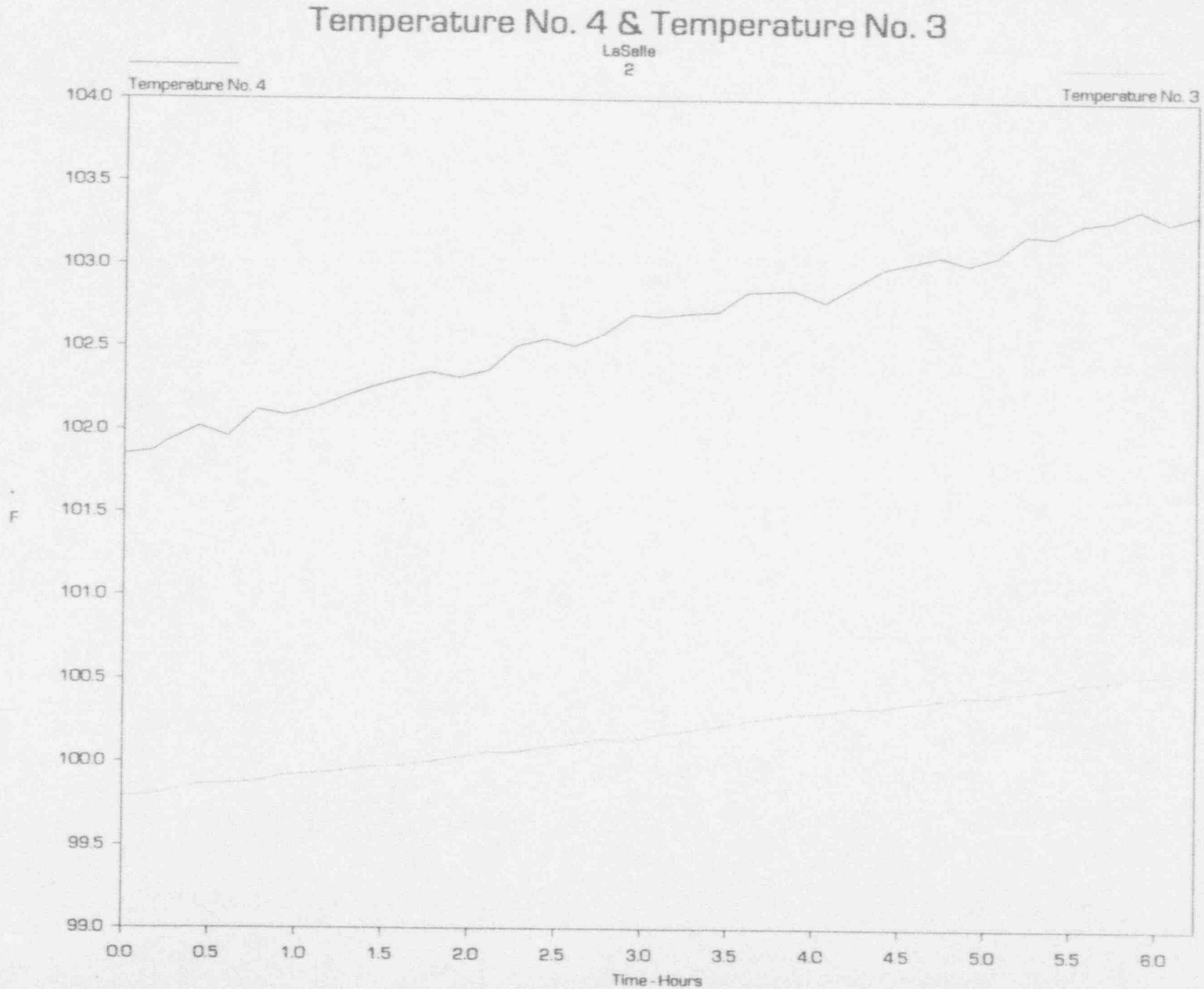

Temperature No. 4 & Temperature No. 3
LaSalle
2
Temperature No. 4
Temperature No. 3
104.0
103.5
103.0
102.5
102.0
101.5
101.0
100.5
100.0
99.5
99.0
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 18

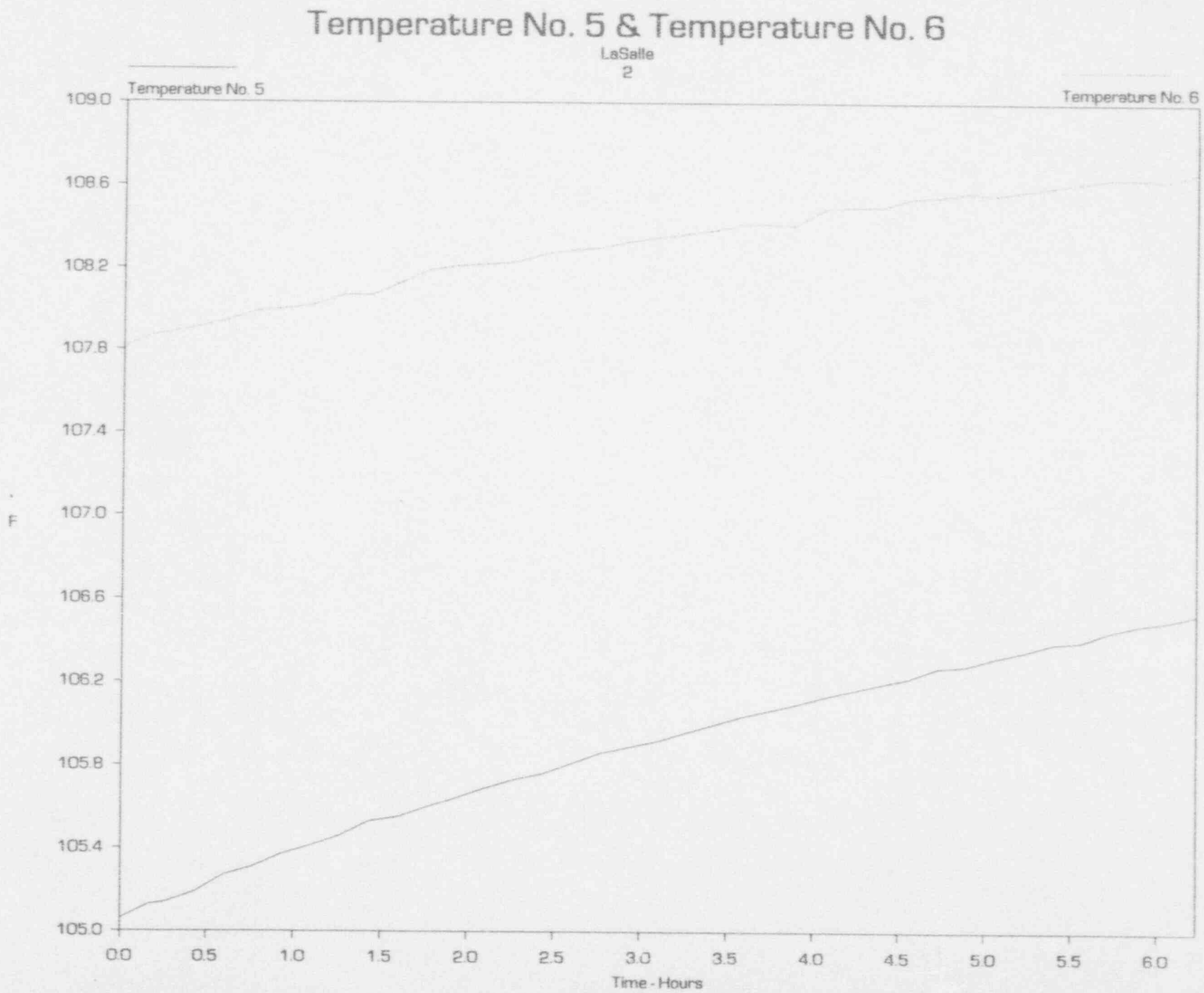

Temperature No. 5 & Temperature No. 6
LaSalle
2
Temperature No. 5
Temperature No. 6
109.0
108.6
108.2
107.8
107.4
107.0
106.6
106.2
105.8
105.4
105.0
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 19

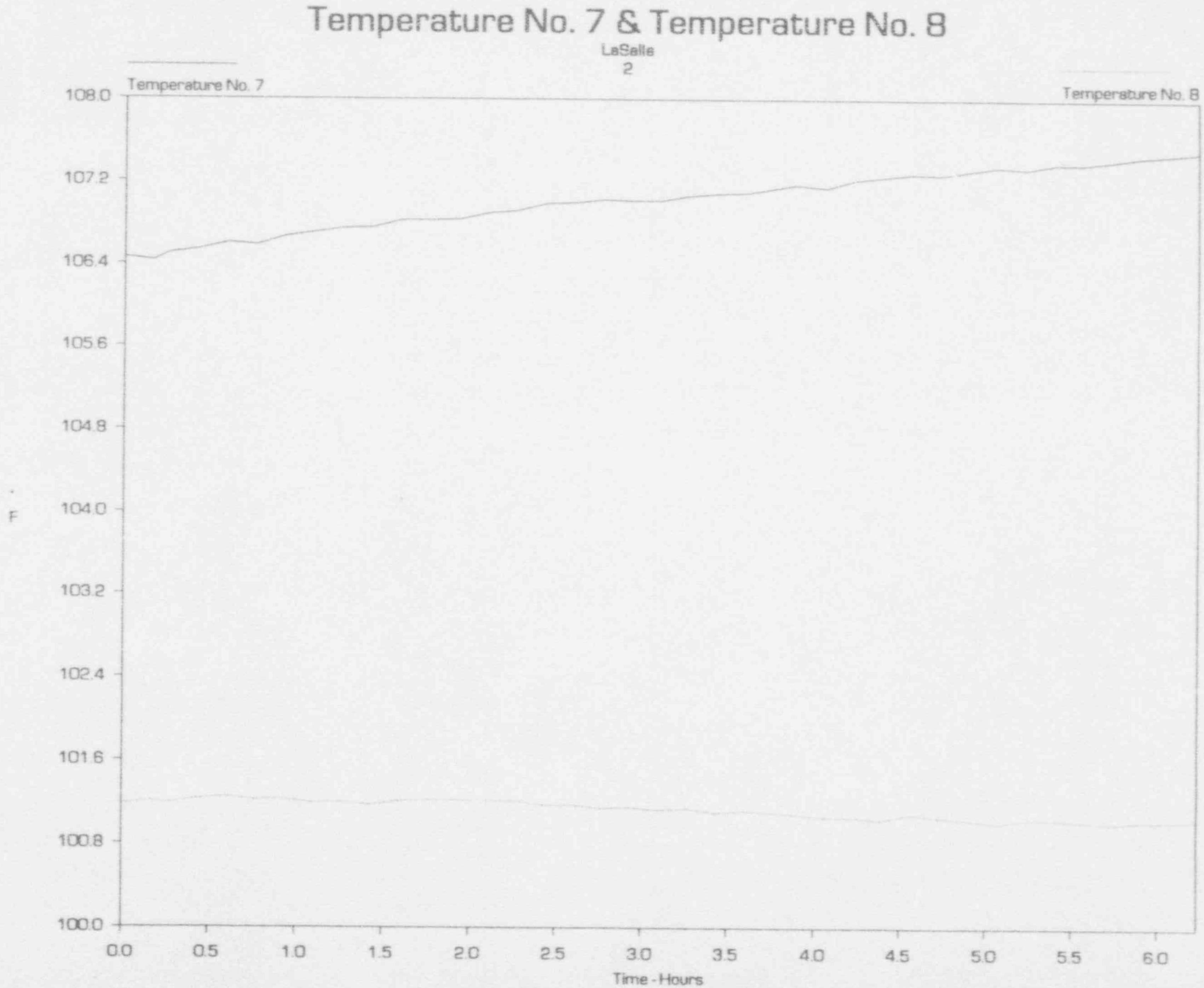

Temperature No. 7 & Temperature No. 8
LaSalle
2
Temperature No. 7
Temperature No. 8
108.0
107.2
106.4
105.6
104.8
104.0
103.2
102.4
101.6
100.8
100.0
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 20

Temperature No. 9 & Temperature No. 10

LaSalle
2

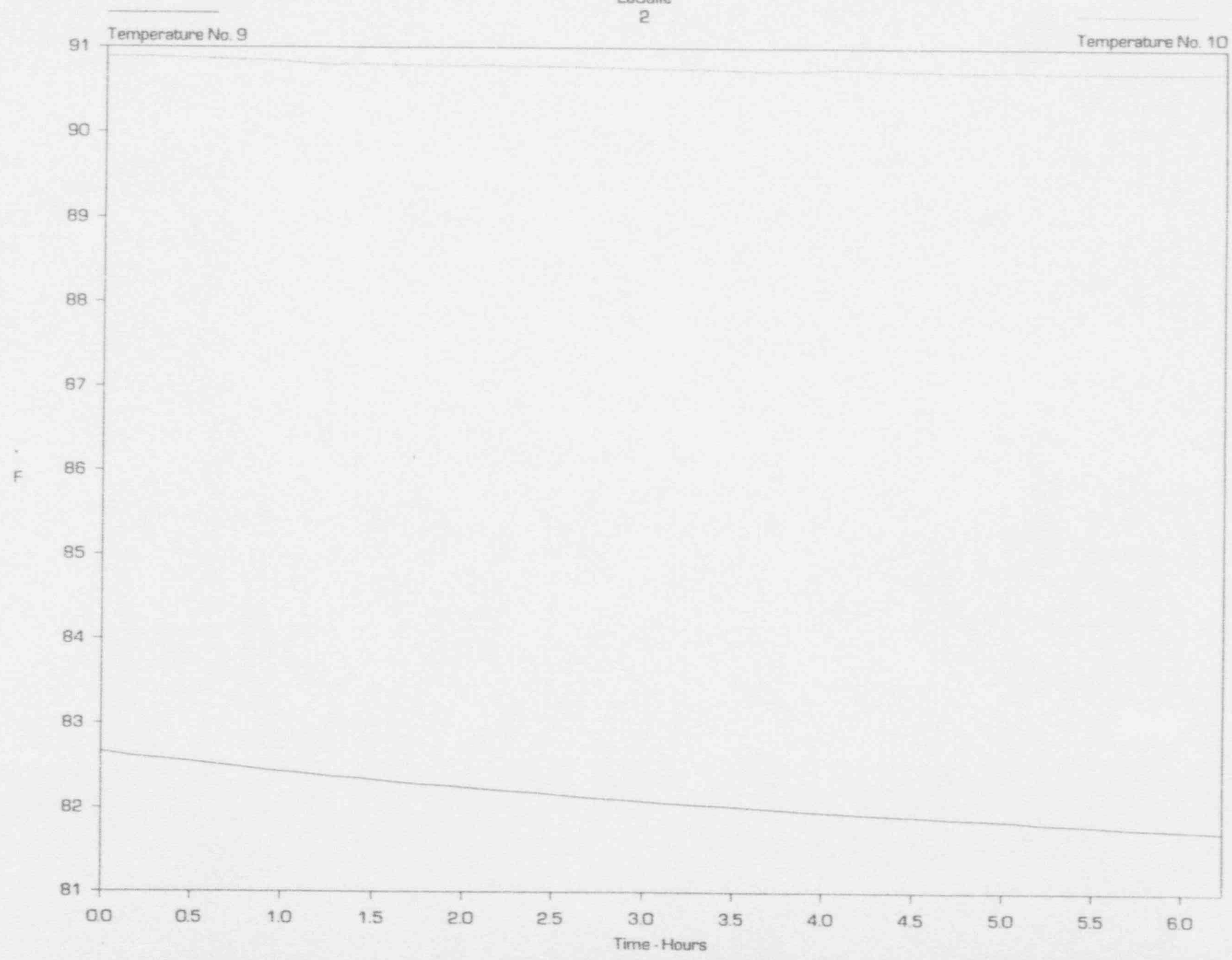
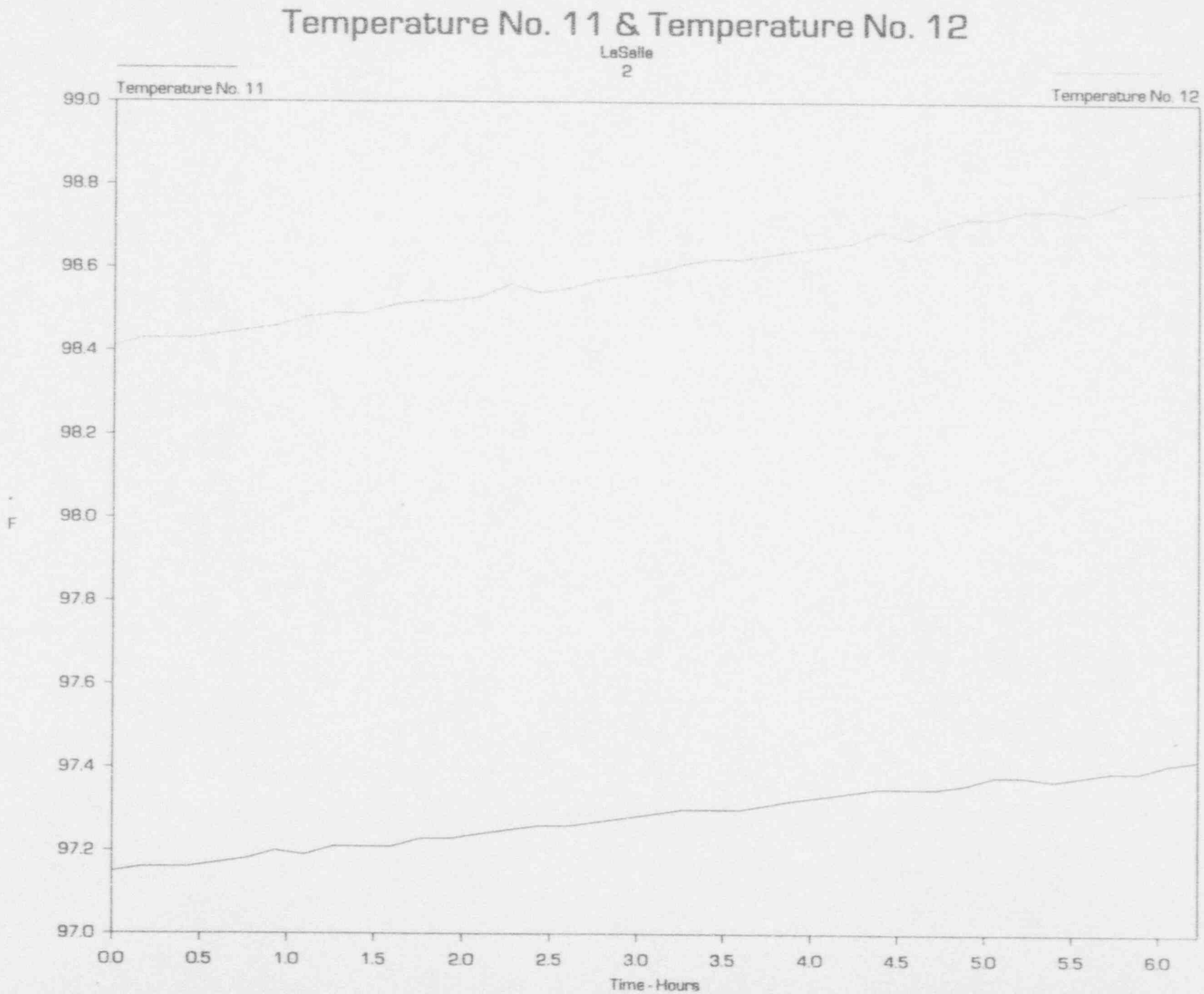


FIGURE 21



Temperature No. 11 & Temperature No. 12
LaSalle
2
Temperature No. 11
Temperature No. 12
99.0
98.8
98.6
98.4
98.2
98.0
97.8
97.6
97.4
97.2
97.0
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 22

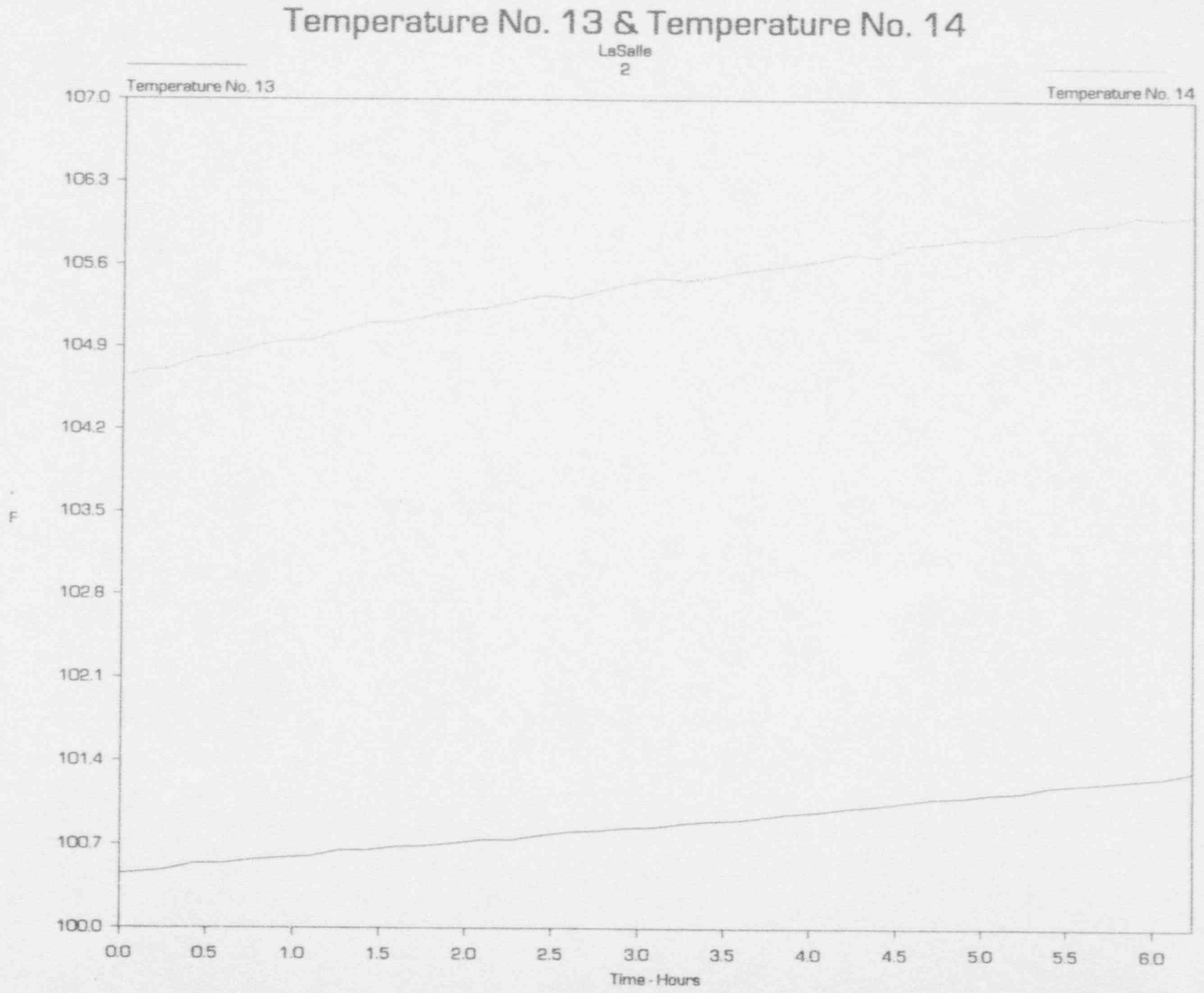

Temperature No. 13 & Temperature No. 14
LaSalle
2
Temperature No. 13
Temperature No. 14
107.0
106.3
105.6
104.9
104.2
103.5
102.8
102.1
101.4
100.7
100.0
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 23

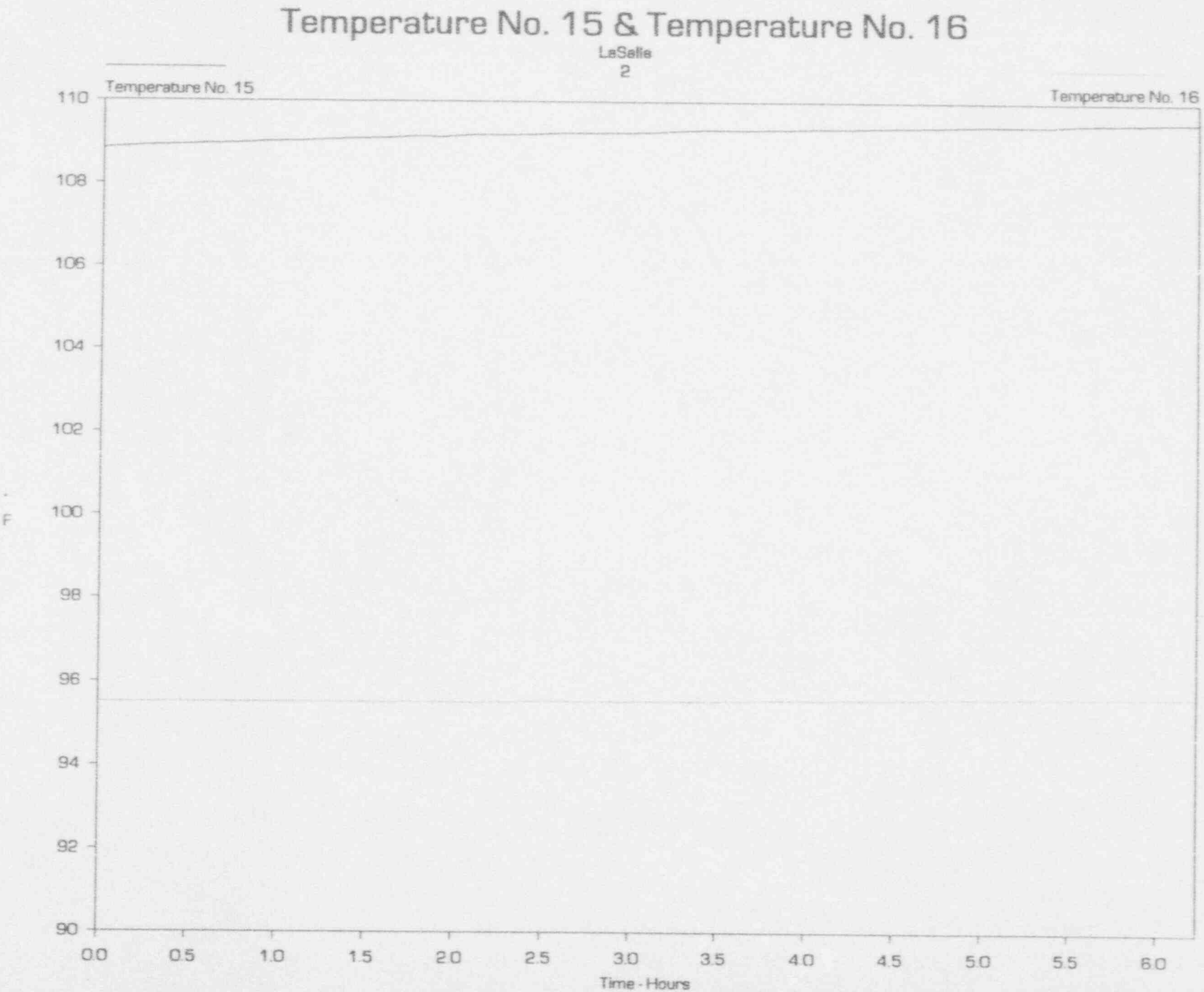

Temperature No. 15 & Temperature No. 16
LaSalle
2
Temperature No. 15
Temperature No. 16
110
108
106
104
102
100
98
96
94
92
90
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 24

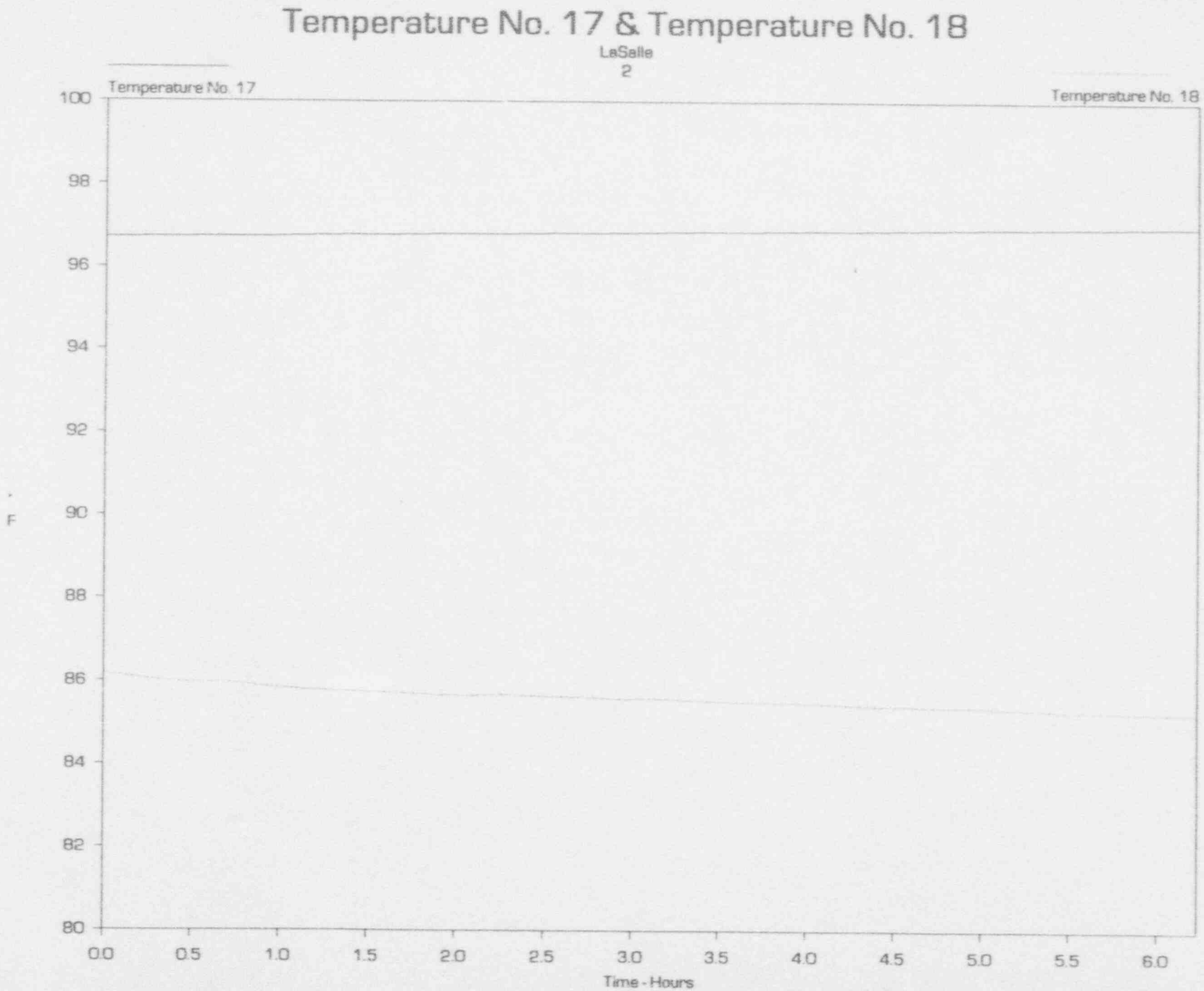

Temperature No. 17 & Temperature No. 18
LaSalle
2
Temperature No. 17
Temperature No. 18
100
98
96
94
92
90
88
86
84
82
80
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 25

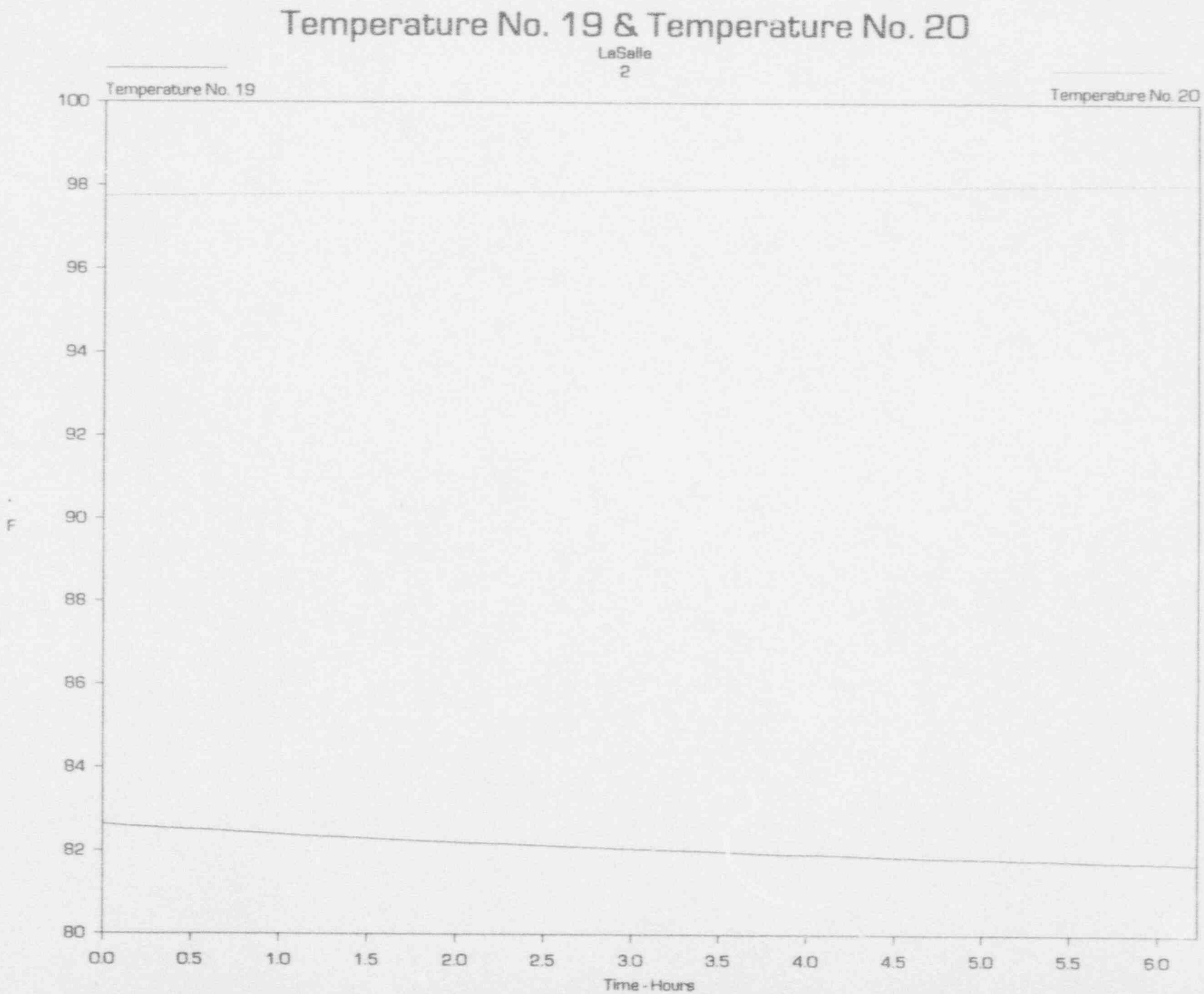
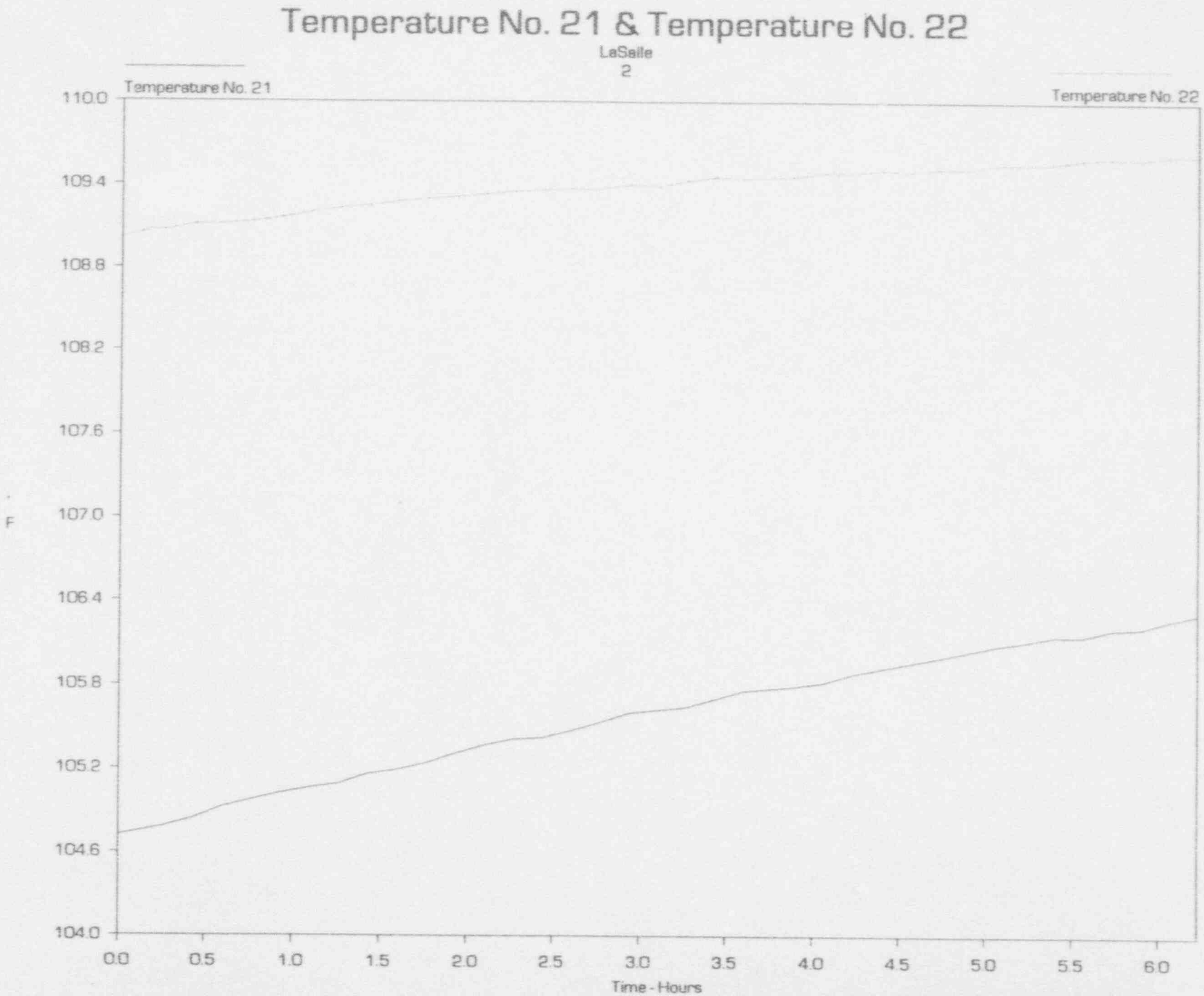

Temperature No. 19 & Temperature No. 20
LaSalle
2
Temperature No. 19
Temperature No. 20
100
98
96
94
92
90
88
86
84
82
80
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 26



Temperature No. 21 & Temperature No. 22
LaSalle
2
Temperature No. 21
Temperature No. 22
110.0
109.4
108.8
108.2
107.6
107.0
106.4
105.8
105.2
104.6
104.0
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 27

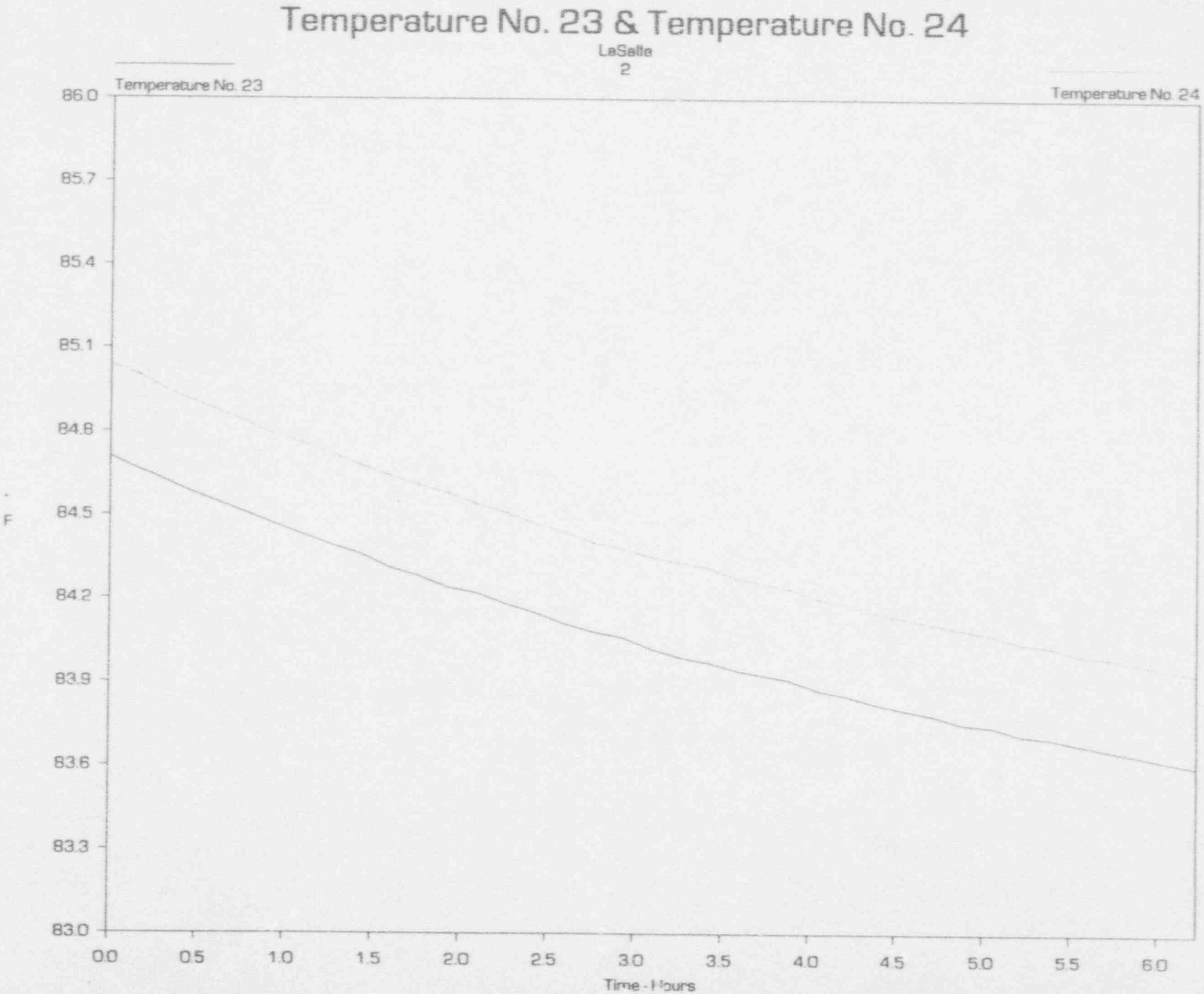
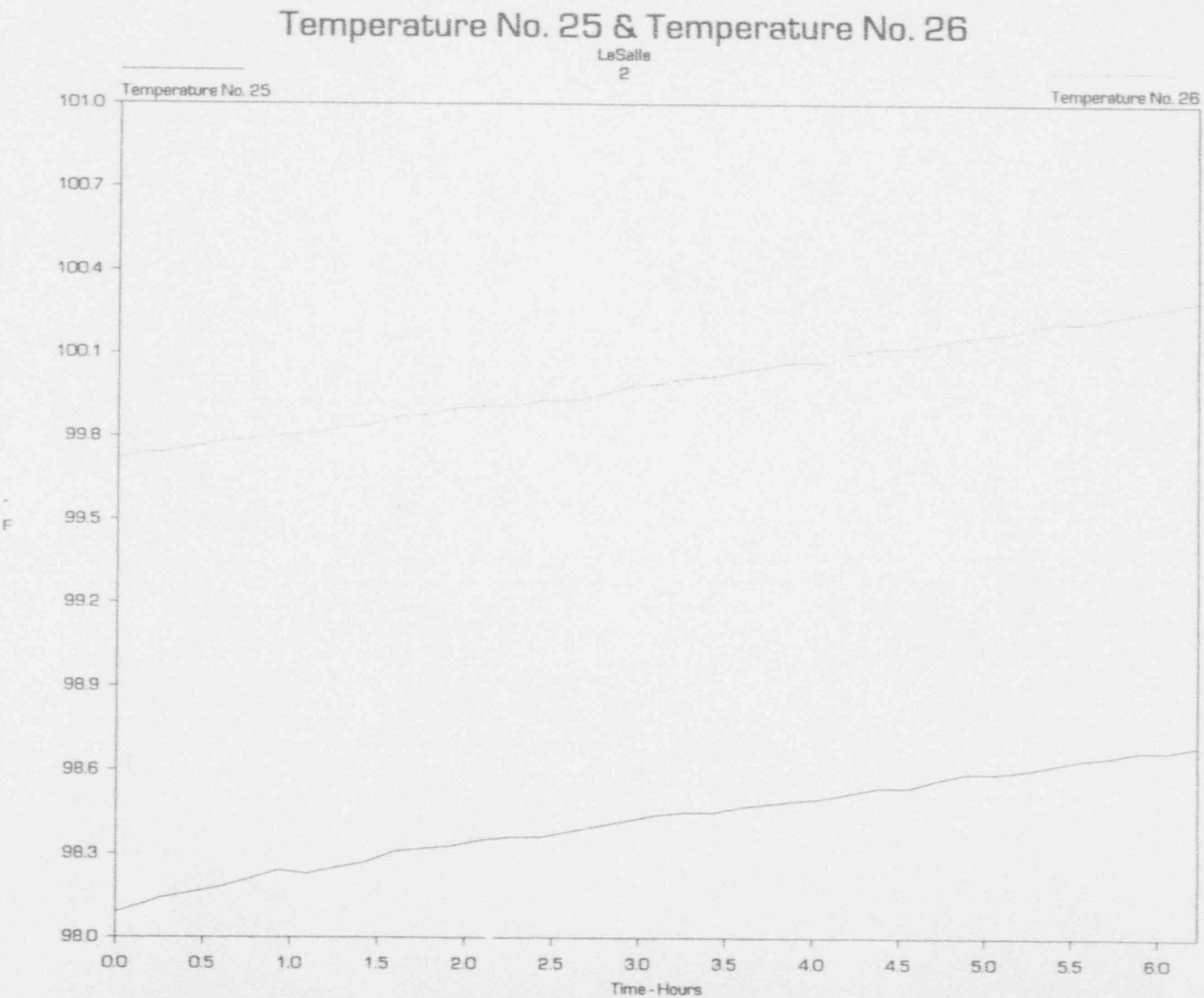

Temperature No. 23 & Temperature No. 24
LaSalle
2
Temperature No. 23
Temperature No. 24
86.0
85.7
85.4
85.1
84.8
84.5
84.2
83.9
83.6
83.3
83.0
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 28



Temperature No. 25 & Temperature No. 26
LaSalle
2
Temperature No. 25
Temperature No. 26
101.0
100.7
100.4
100.1
99.8
99.5
99.2
98.9
98.6
98.3
98.0
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

FIGURE 29

Temperature No. 27 & Temperature No. 28

LaSelle
2

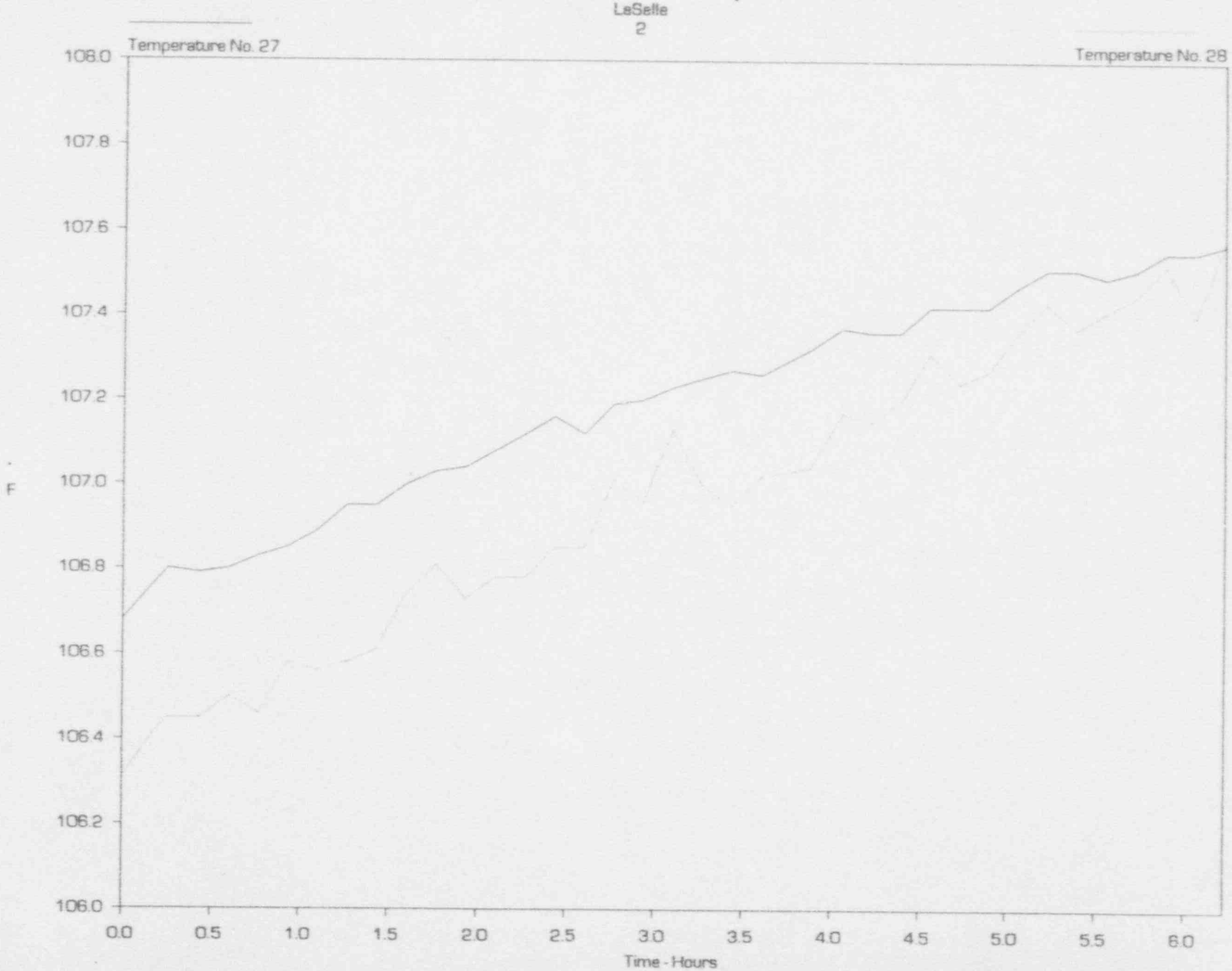
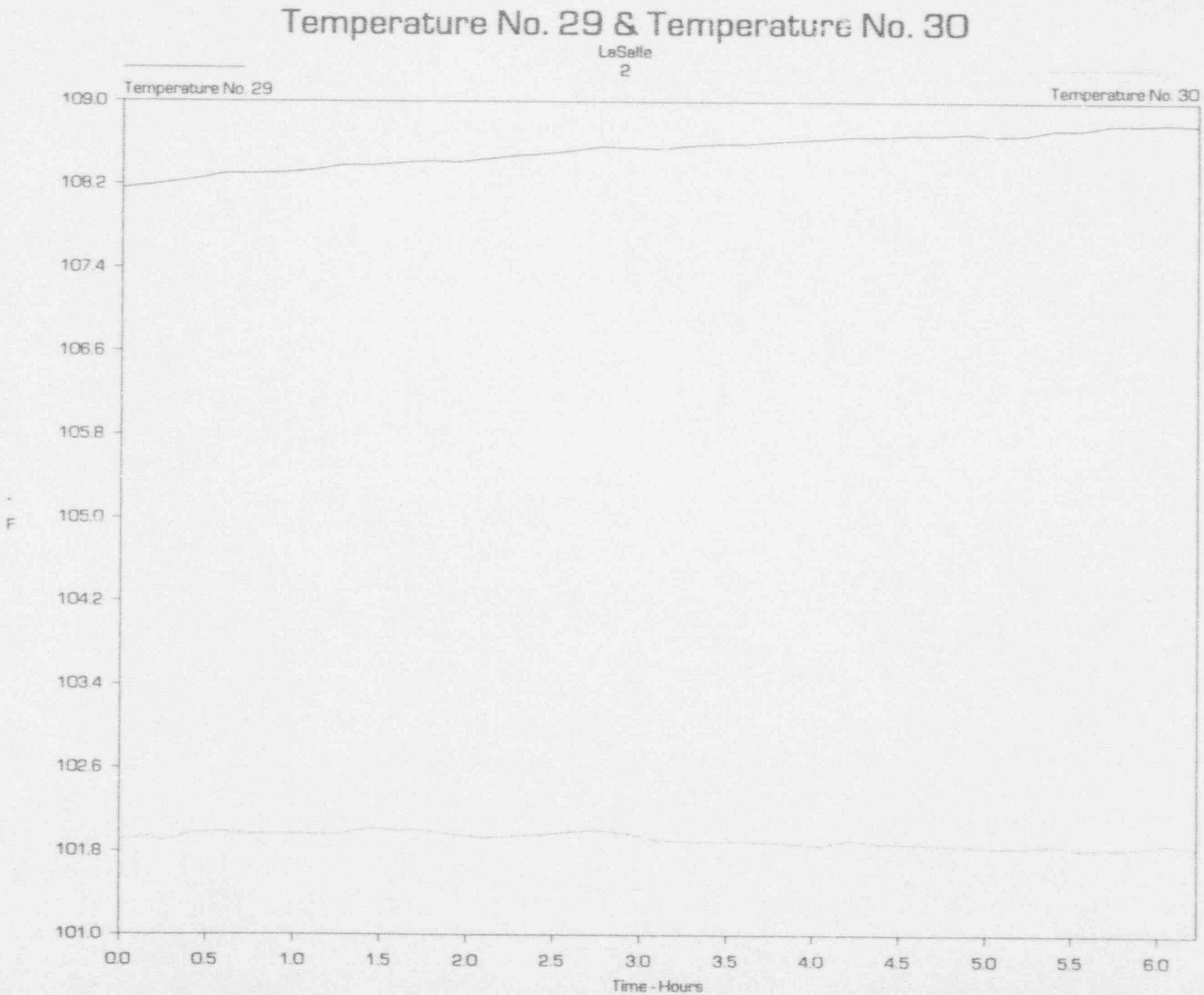


FIGURE 30


Temperature No. 29 & Temperature No. 30
LaSalle
2
Temperature No. 29
Temperature No. 30
109.0
108.2
107.4
106.6
105.8
105.0
104.2
103.4
102.6
101.8
101.0
F
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
Time - Hours

INDUCED LEAK RATE

PHASE

DATA SETS 215 - 237

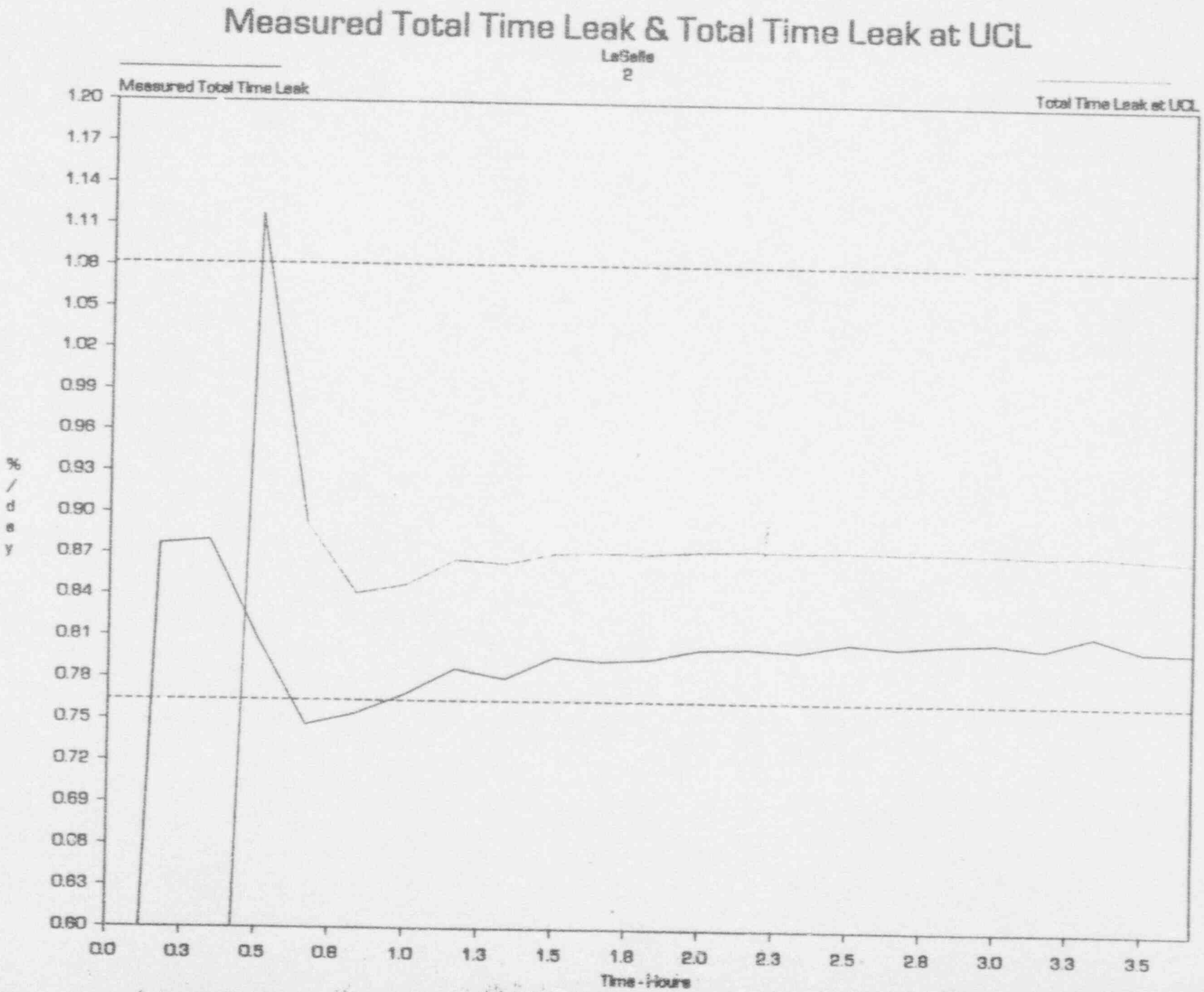
TABLE 4

Total Time Leak Rate Analysis

LaSalle
2

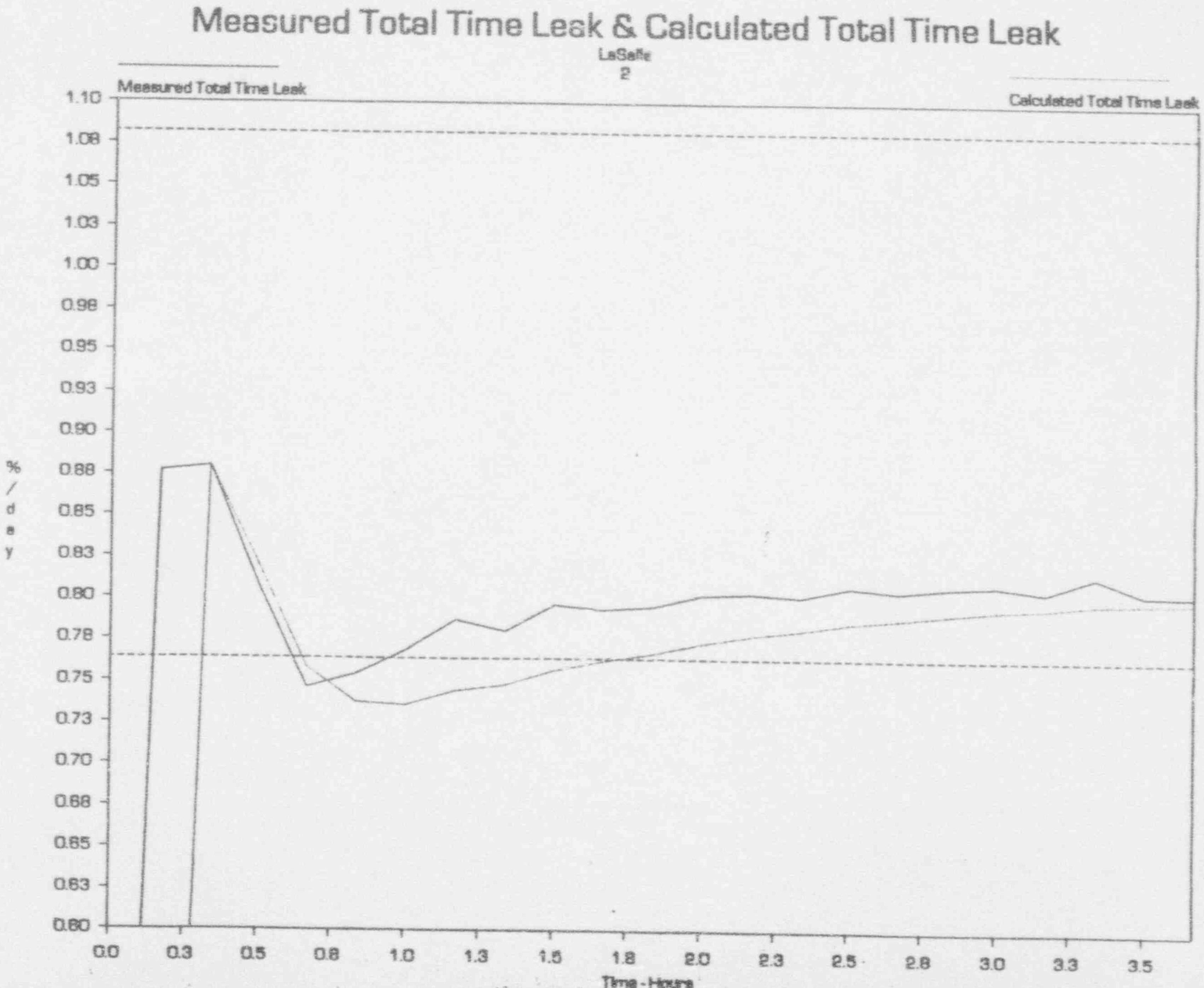
RDG	TIME (MINUTES)	MEASURED LEAK (WT %/DAY)	CALCULATED LEAK (WT %/DAY)	UCL LEAK (WT %/DAY)
215	0.00	-	-	-
216	10.00	0.876778	-	-
217	20.02	0.879801	0.879801	-
218	30.02	0.807866	0.820378	1.117033
219	40.02	0.746149	0.758100	0.891611
220	50.03	0.754391	0.737308	0.840920
221	60.03	0.768613	0.735697	0.847677
222	70.05	0.786986	0.744522	0.866157
223	80.05	0.780202	0.748038	0.863656
224	90.07	0.795807	0.756824	0.871354
225	100.08	0.793150	0.762369	0.871787
226	110.10	0.795022	0.767213	0.871592
227	120.10	0.802180	0.773101	0.873705
228	130.10	0.803330	0.778004	0.874642
229	140.12	0.801286	0.781358	0.873784
230	150.12	0.807423	0.785554	0.874660
231	160.12	0.804651	0.788322	0.873920
232	170.13	0.807451	0.791201	0.873734
233	180.13	0.808824	0.793869	0.873590
234	190.13	0.804956	0.795342	0.872234
235	200.15	0.814686	0.798394	0.873163
236	210.15	0.804127	0.799101	0.871410
237	220.15	0.803771	0.799648	0.869702

FIGURE 31



Measured Total Time Leak & Total Time Leak at UCL
LaSalle
2
Measured Total Time Leak
Total Time Leak at UCL
1.20
1.17
1.14
1.11
1.08
1.05
1.02
0.99
0.96
0.93
0.90
0.87
0.84
0.81
0.78
0.75
0.72
0.69
0.66
0.63
0.60
%/day
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 32



Measured Total Time Leak & Calculated Total Time Leak
LaSalle
2
Measured Total Time Leak
Calculated Total Time Leak
1.10
1.08
1.05
1.03
1.00
0.98
0.95
0.93
0.90
0.88
0.85
0.83
0.80
0.78
0.75
0.73
0.70
0.68
0.65
0.63
0.60
% / d a y
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 33

Mass
LaSalle
2

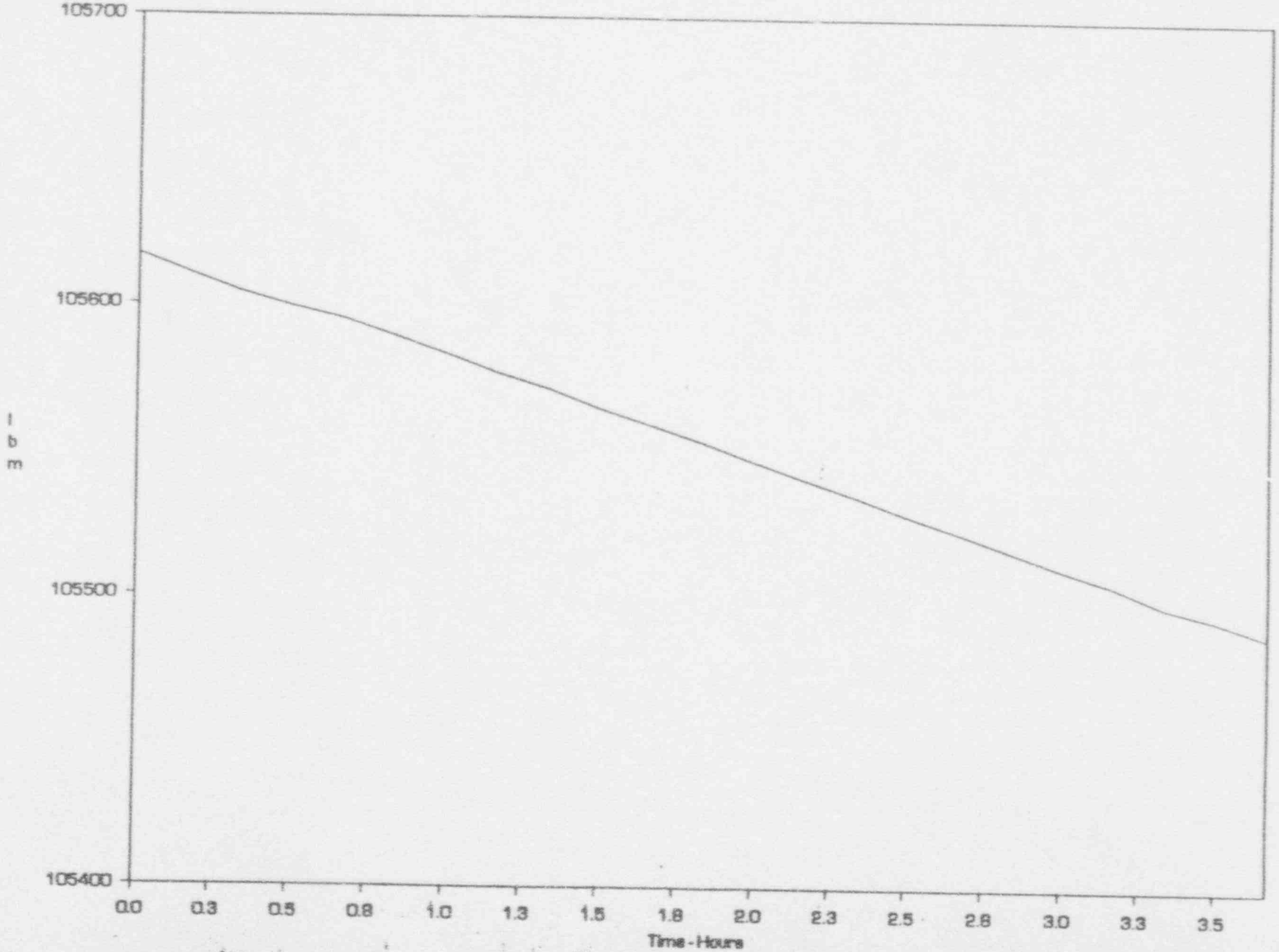


FIGURE 34

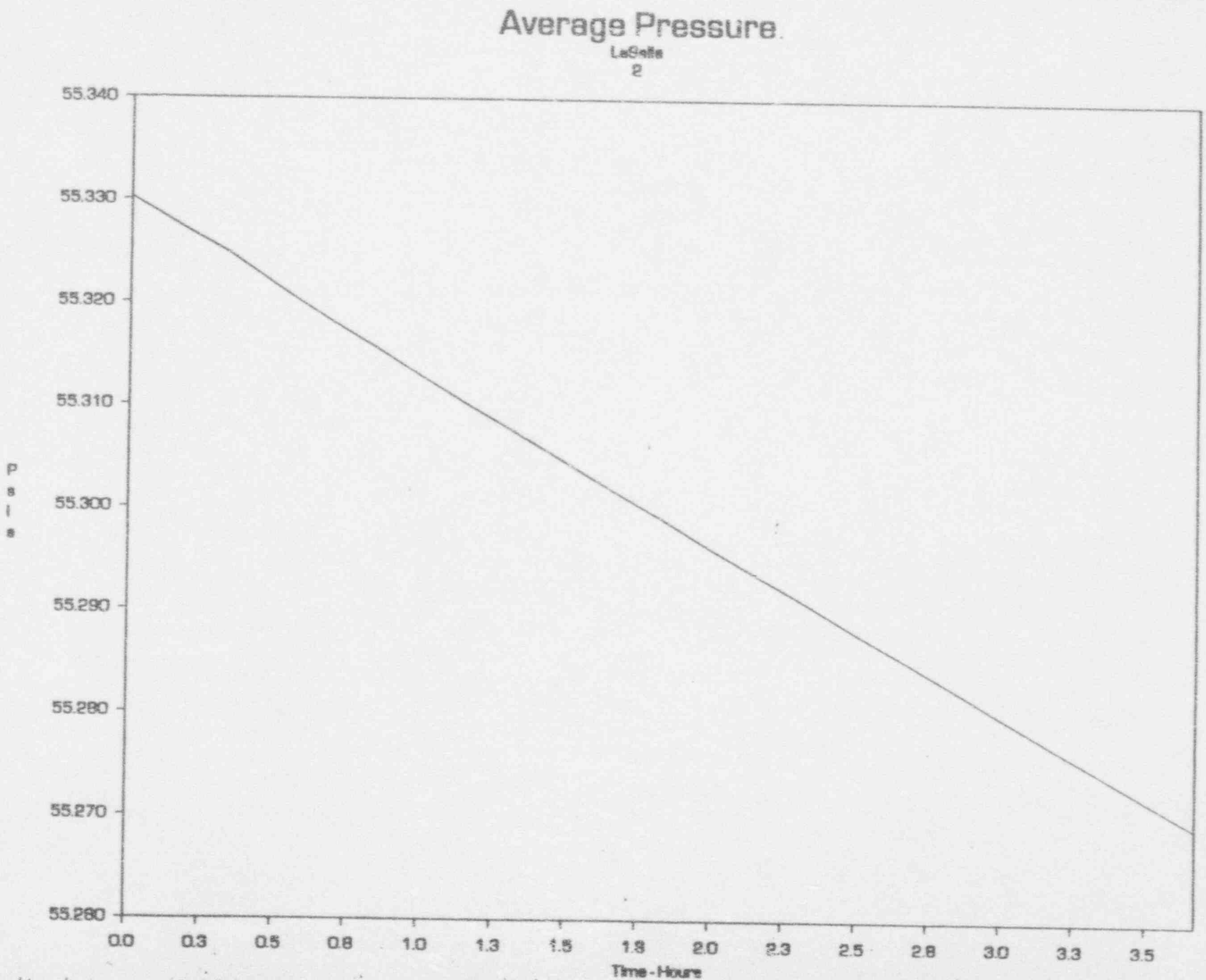


FIGURE 35

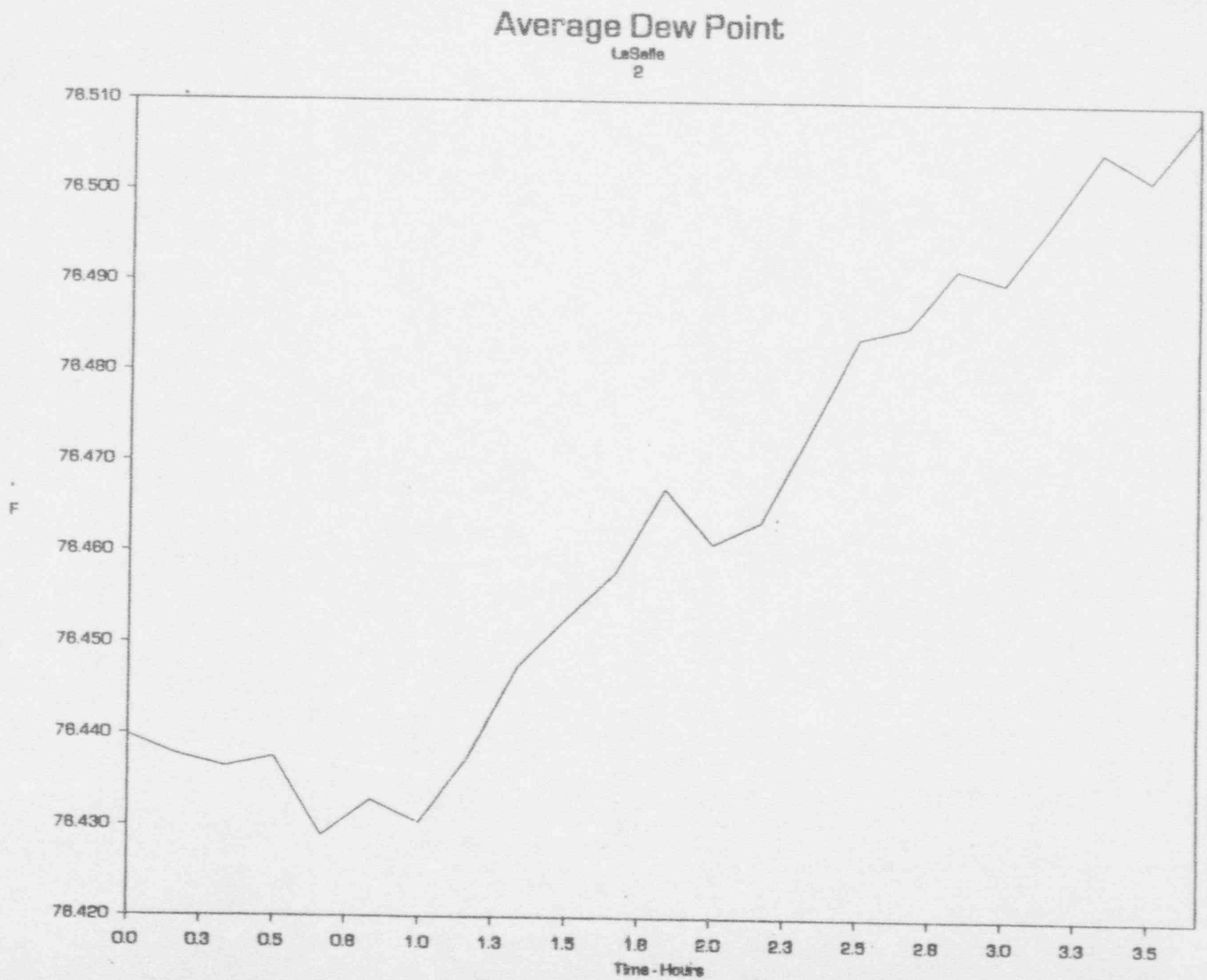
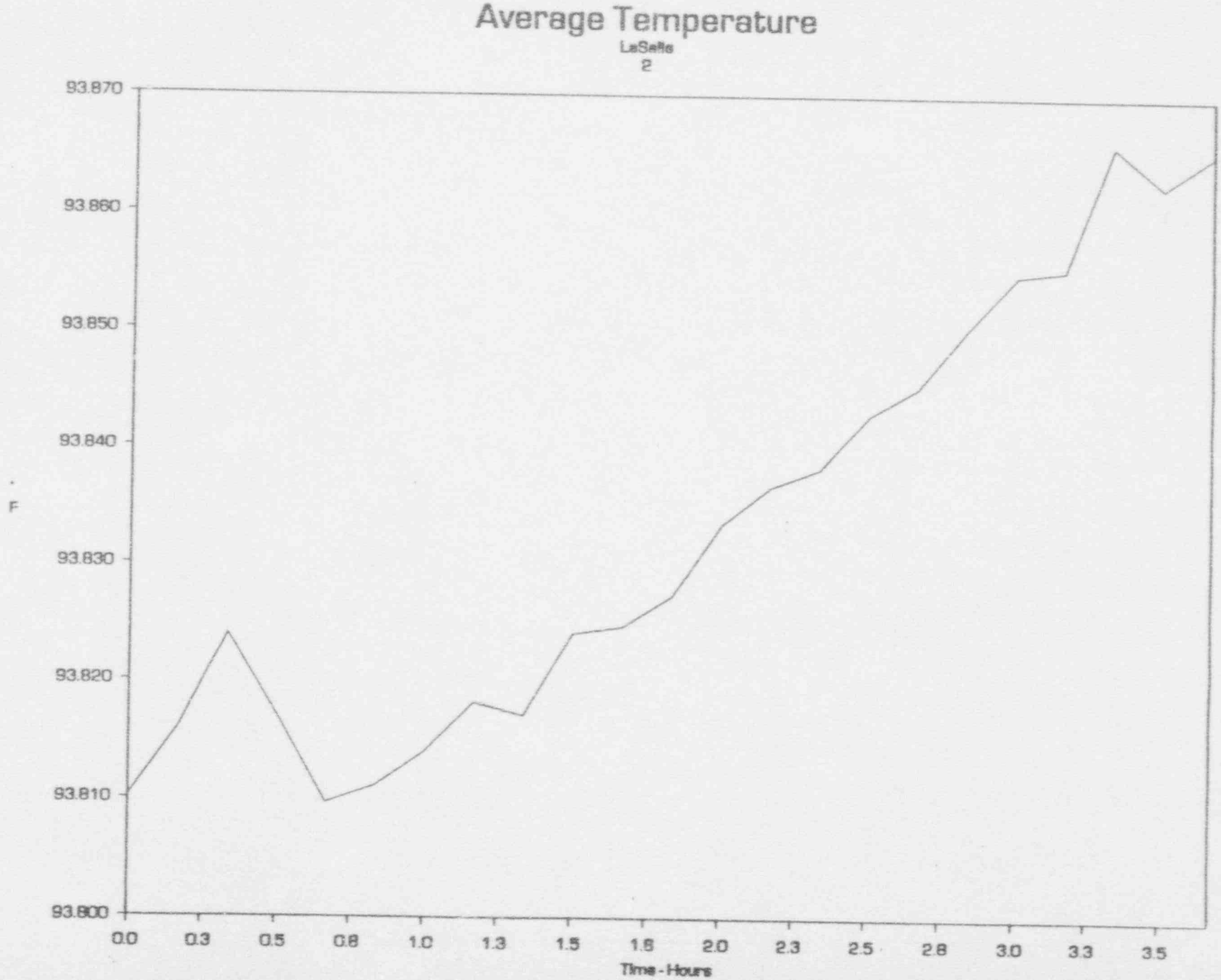
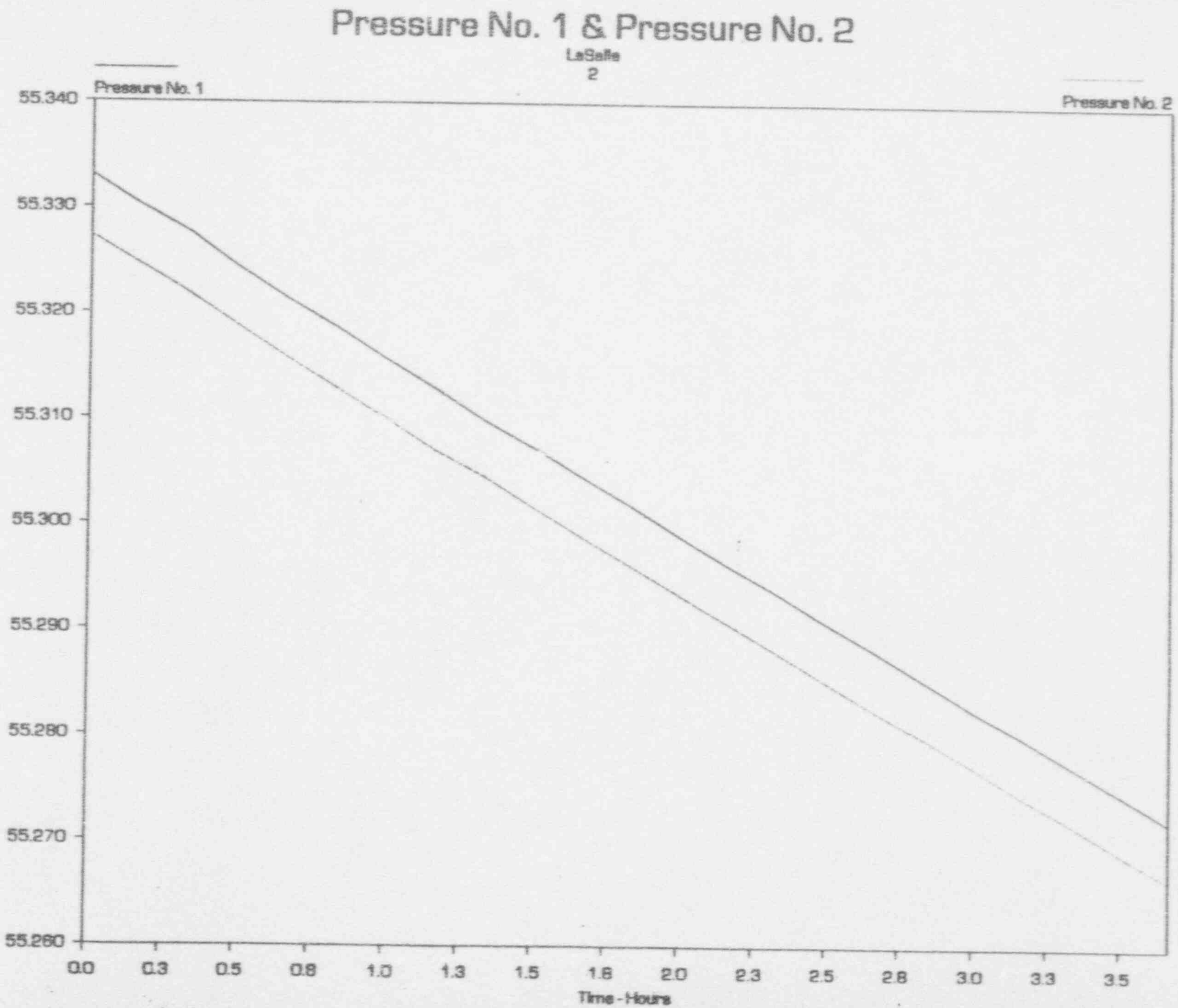

Average Dew Point
LaSalle
2
F
78.510
78.500
78.490
78.480
78.470
78.460
78.450
78.440
78.430
78.420
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 36



Average Temperature
LaSalle
2
93.870
93.860
93.850
93.840
93.830
93.820
93.810
93.800
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 37



Pressure No. 1 & Pressure No. 2
LaSalle
2
Pressure No. 1
Pressure No. 2
55.340
55.330
55.320
55.310
55.300
55.290
55.280
55.270
55.260
P
s
i
a
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 39

Dew Point No. 1 & Dew Point No. 2

LaSalle
2

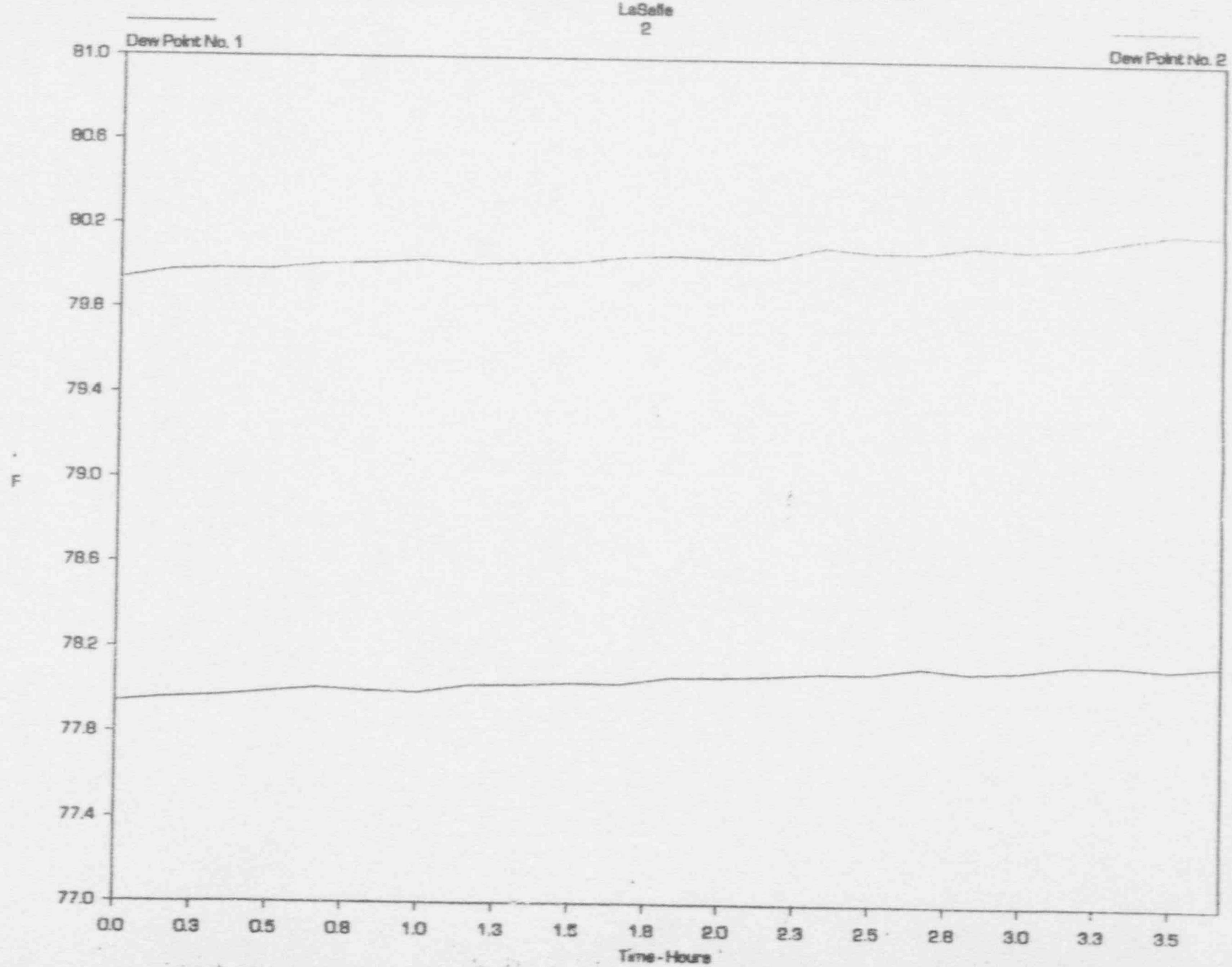


FIGURE 40

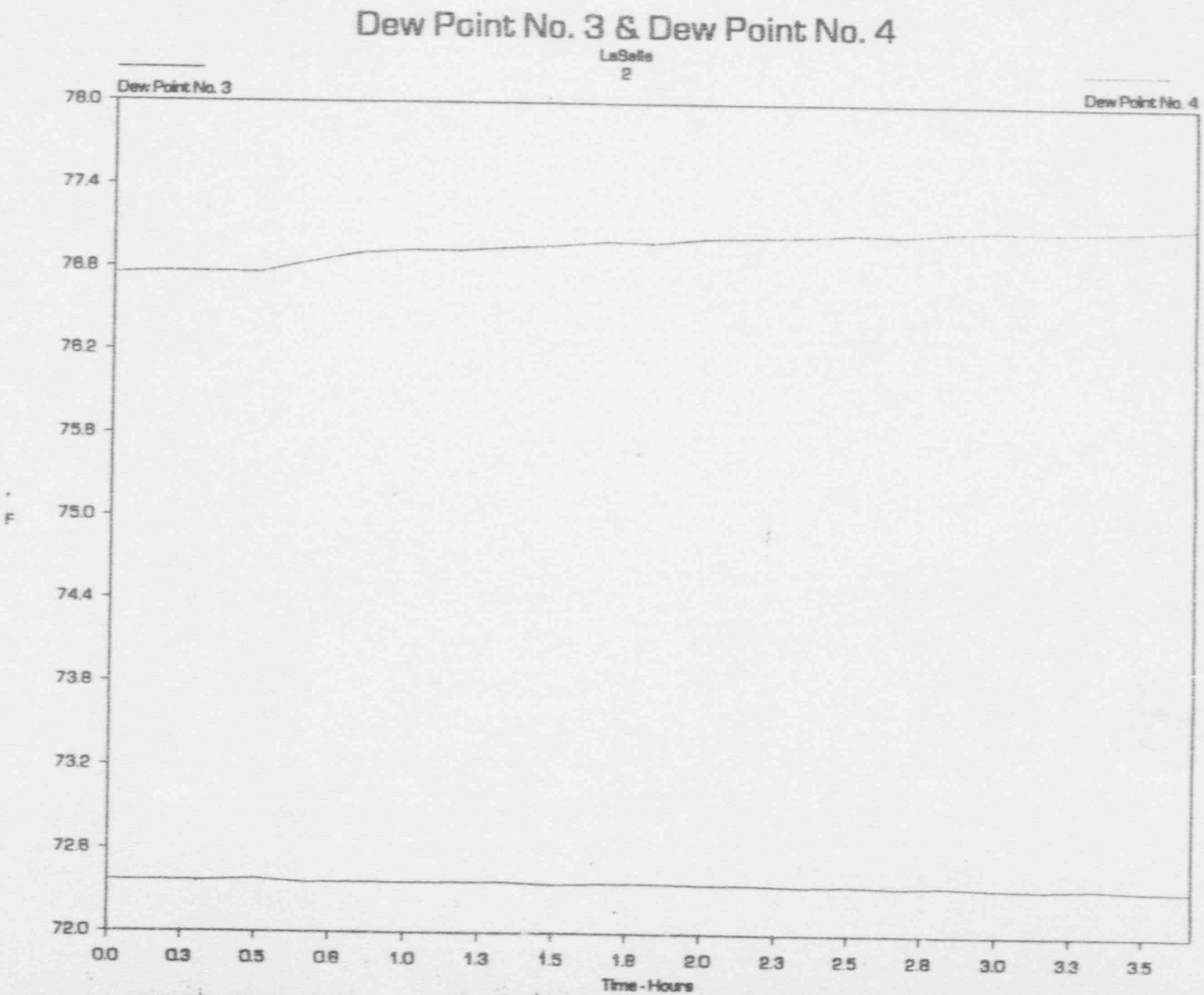
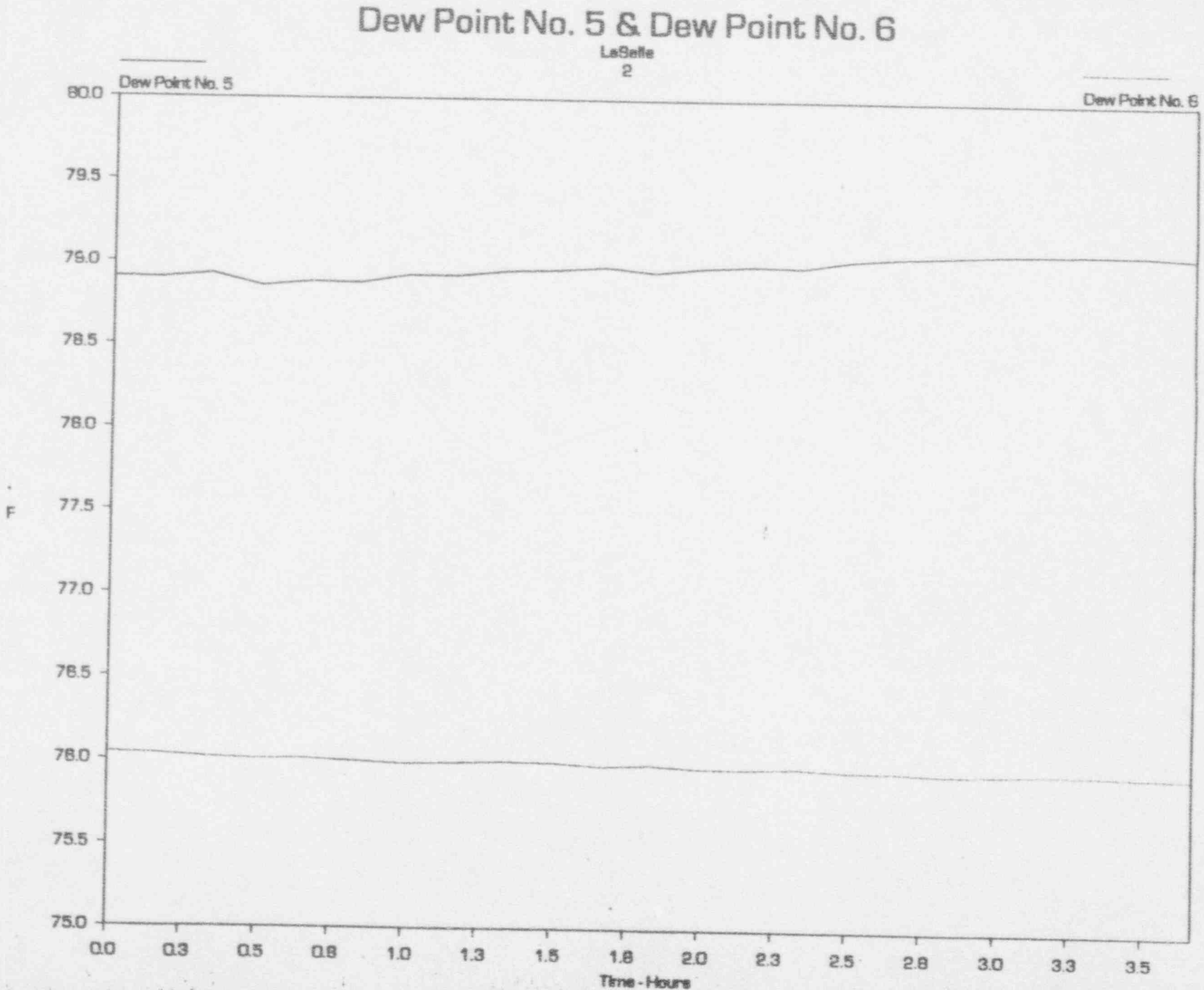
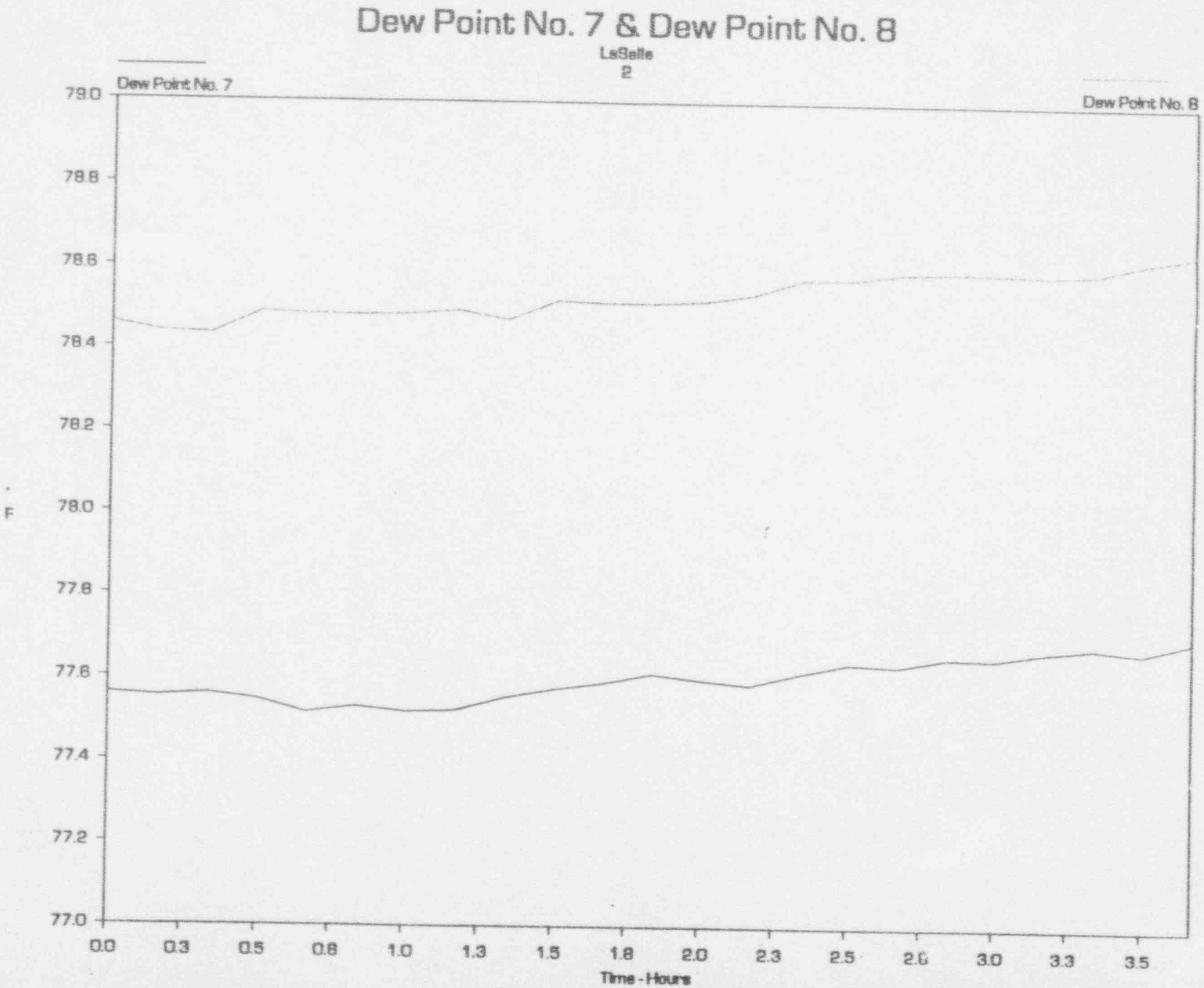

Dew Point No. 3 & Dew Point No. 4
LaSalle
2
Dew Point No. 3
Dew Point No. 4
78.0
77.4
76.8
76.2
75.6
75.0
74.4
73.8
73.2
72.6
72.0
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 41



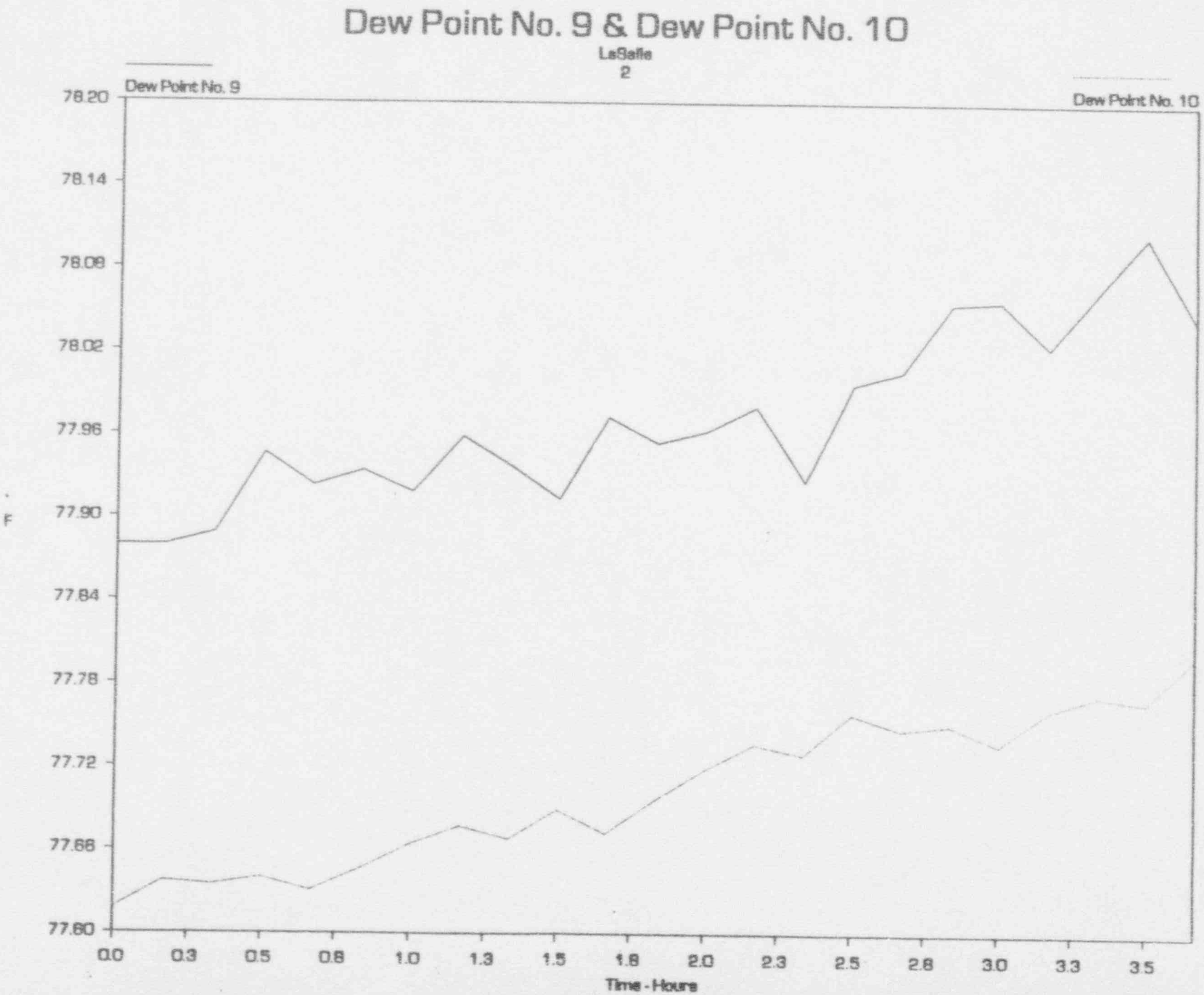
Dew Point No. 5 & Dew Point No. 6
LaSalle
2
Dew Point No. 5
Dew Point No. 6
80.0
79.5
79.0
78.5
78.0
77.5
77.0
76.5
76.0
75.5
75.0
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 42



Dew Point No. 7 & Dew Point No. 8
LaSalle
2
Dew Point No. 7
Dew Point No. 8
79.0
78.8
78.6
78.4
78.2
78.0
77.8
77.6
77.4
77.2
77.0
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 43



Dew Point No. 9 & Dew Point No. 10
LaSalle
2
Dew Point No. 9
Dew Point No. 10
78.20
78.14
78.08
78.02
77.96
77.90
77.84
77.78
77.72
77.66
77.60
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 44

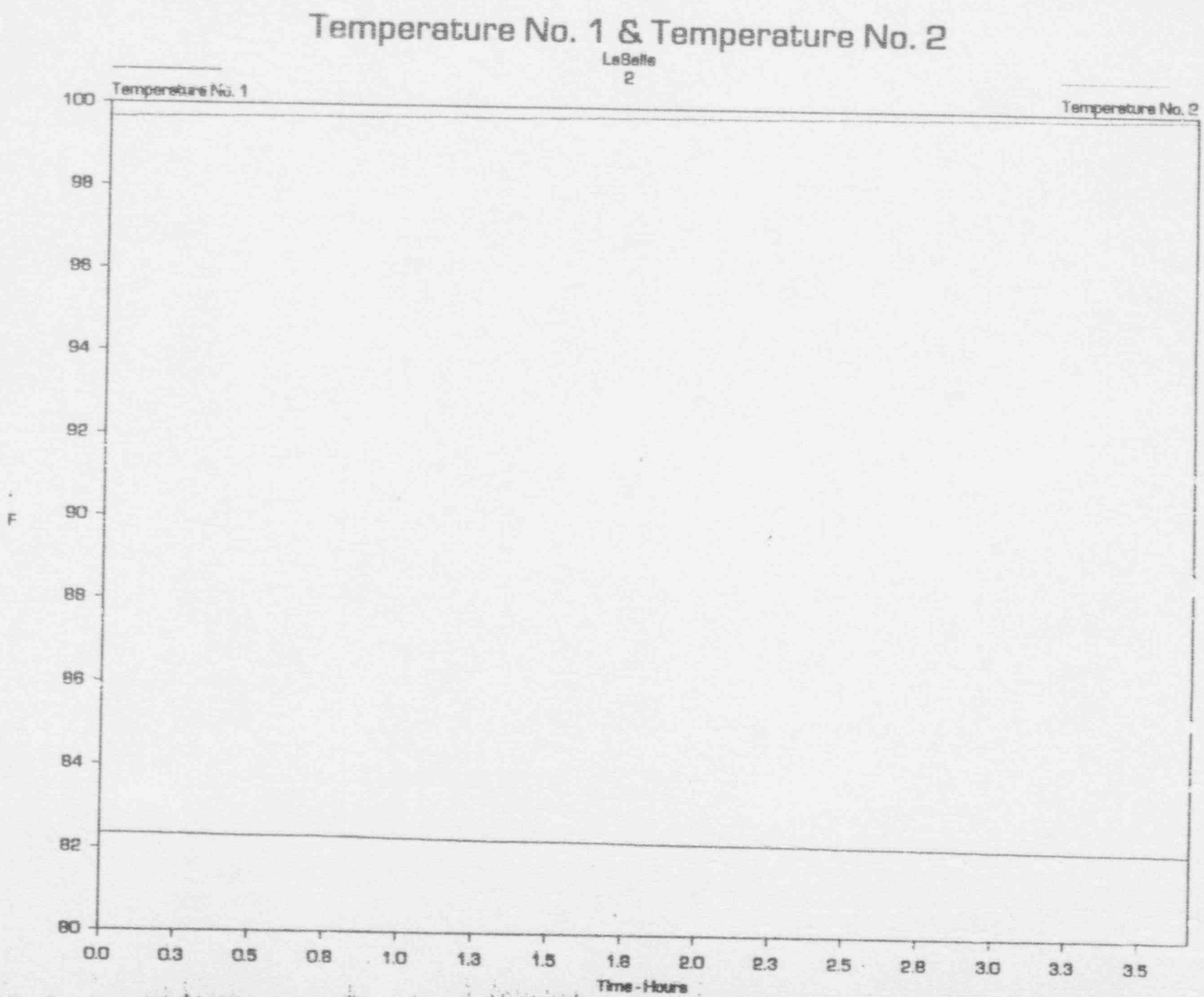
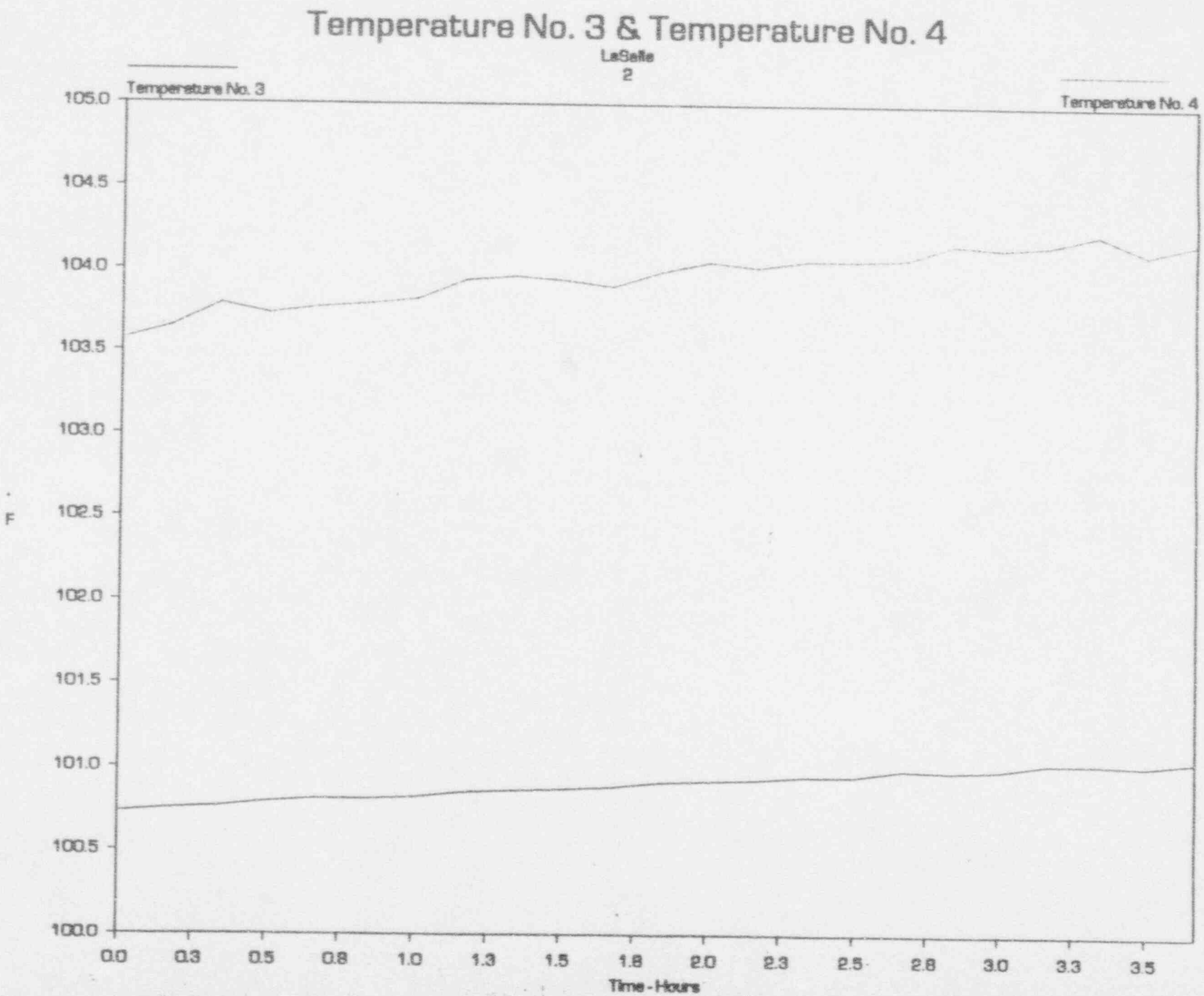

Temperature No. 1 & Temperature No. 2
LaSalle
2
Temperature No. 1
Temperature No. 2
100
98
96
94
92
90
88
86
84
82
80
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 45



Temperature No. 3 & Temperature No. 4
LaSalle
2
Temperature No. 3
Temperature No. 4
105.0
104.5
104.0
103.5
103.0
102.5
102.0
101.5
101.0
100.5
100.0
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 46

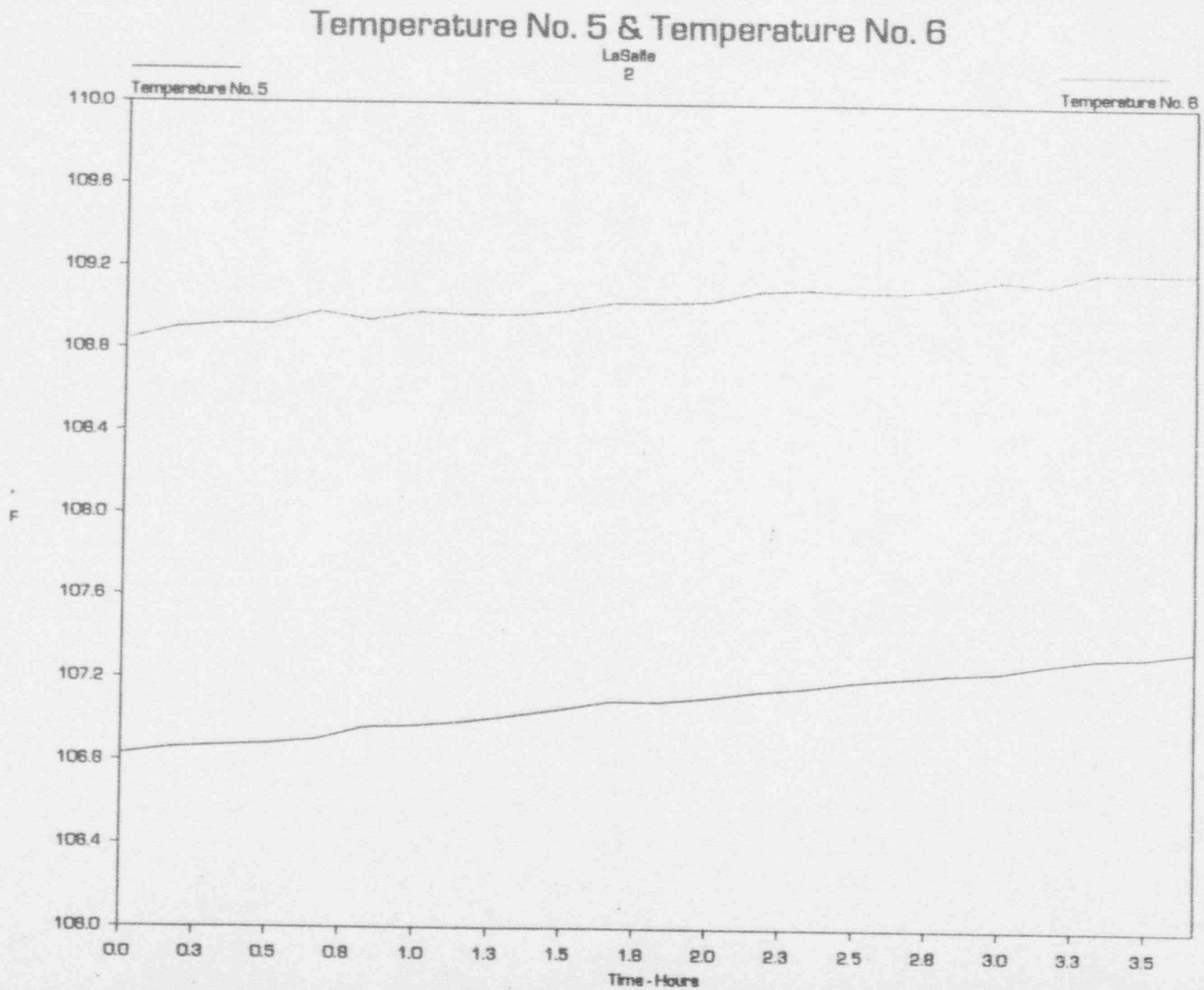

Temperature No. 5 & Temperature No. 6
LaSalle
2
Temperature No. 5
Temperature No. 6
110.0
109.6
109.2
108.8
108.4
108.0
107.6
107.2
106.8
106.4
106.0
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 47

Temperature No. 7 & Temperature No. 8

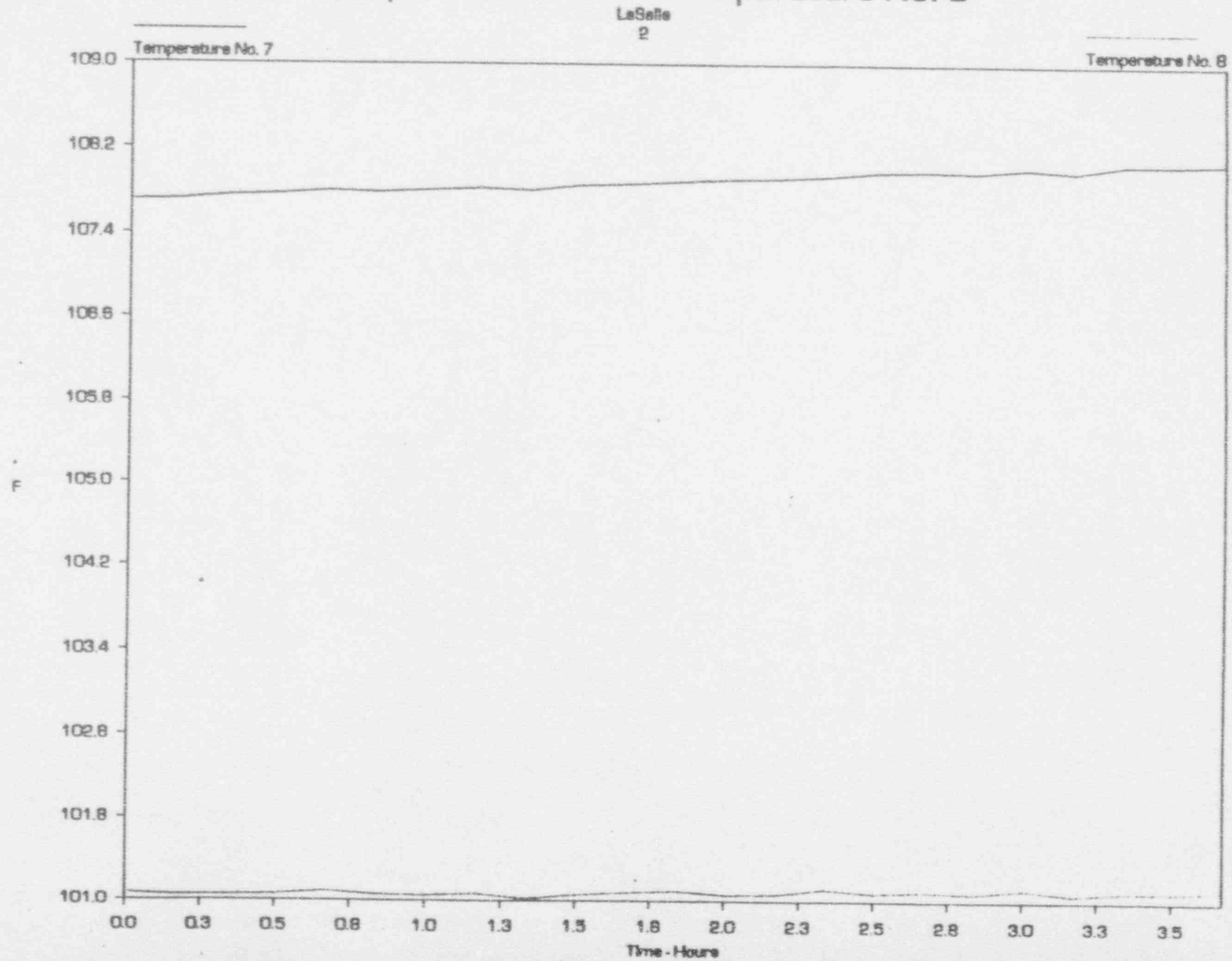


FIGURE 48

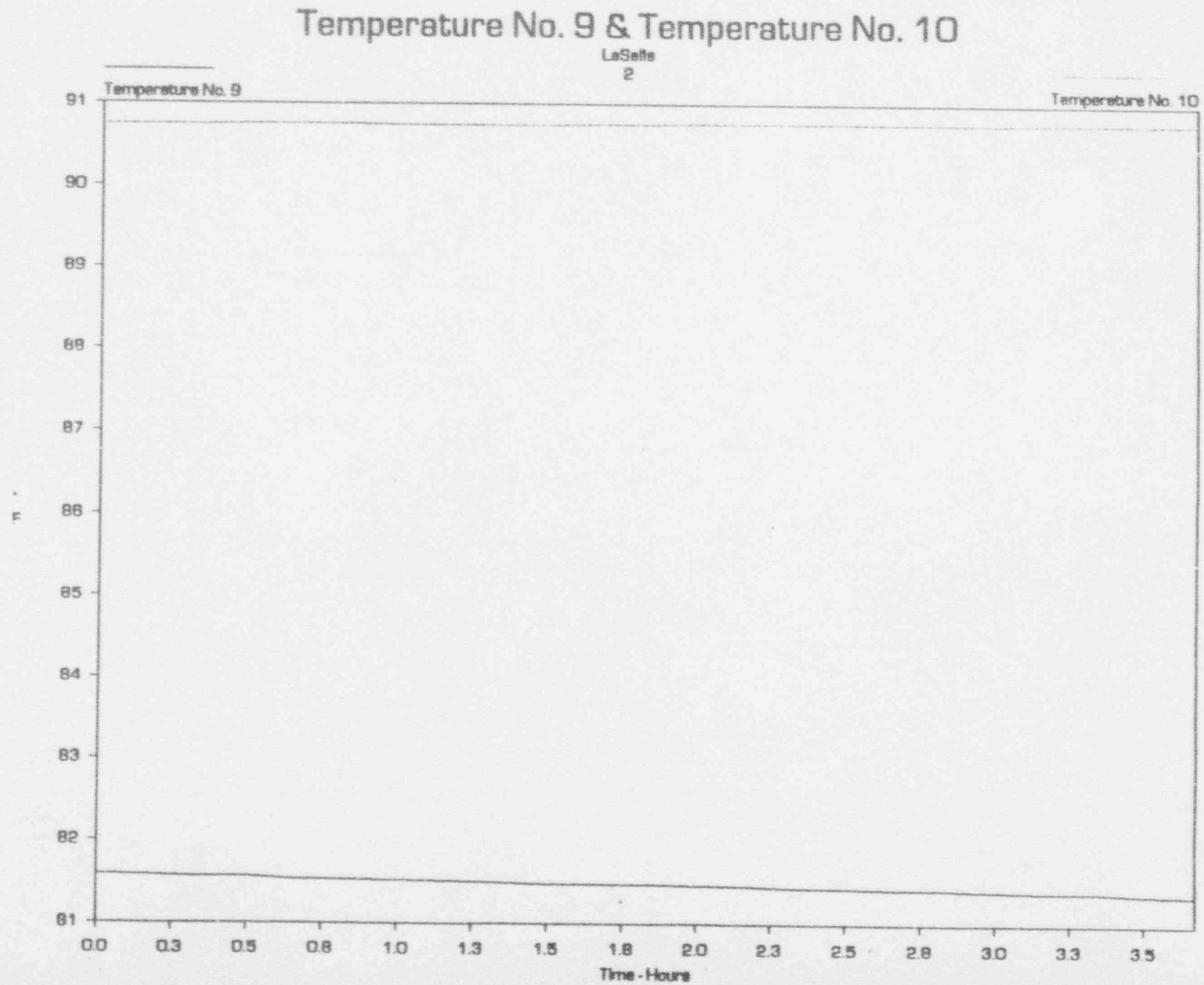
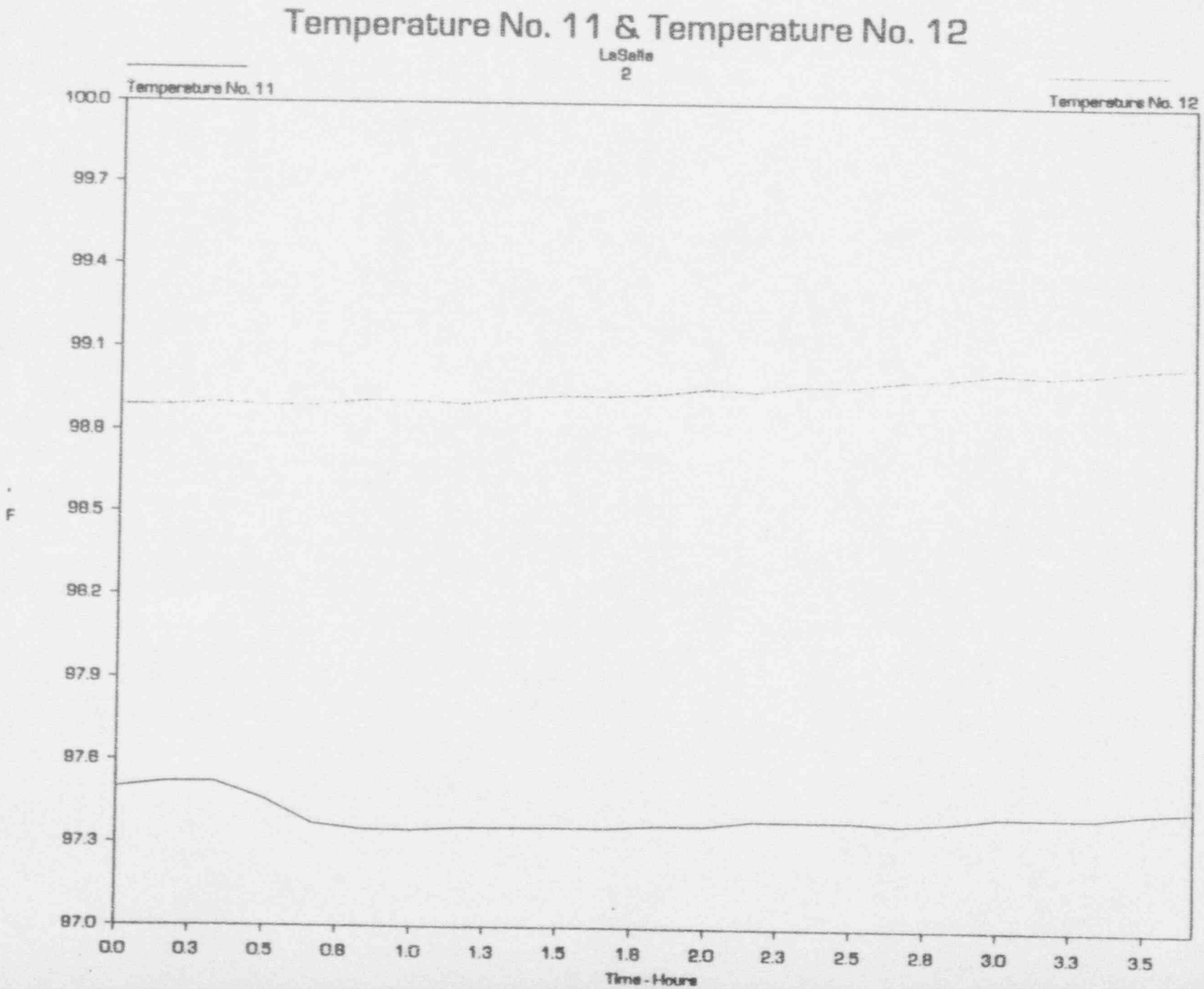

Temperature No. 9 & Temperature No. 10
LaSalle
2
Temperature No. 9
Temperature No. 10
91
90
89
88
87
86
85
84
83
82
81
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 49



Temperature No. 11 & Temperature No. 12
LaSalle
2
Temperature No. 11
Temperature No. 12
100.0
99.7
99.4
99.1
98.8
98.5
98.2
97.9
97.6
97.3
97.0
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 50

Temperature No. 13 & Temperature No. 14

LaSalle
2

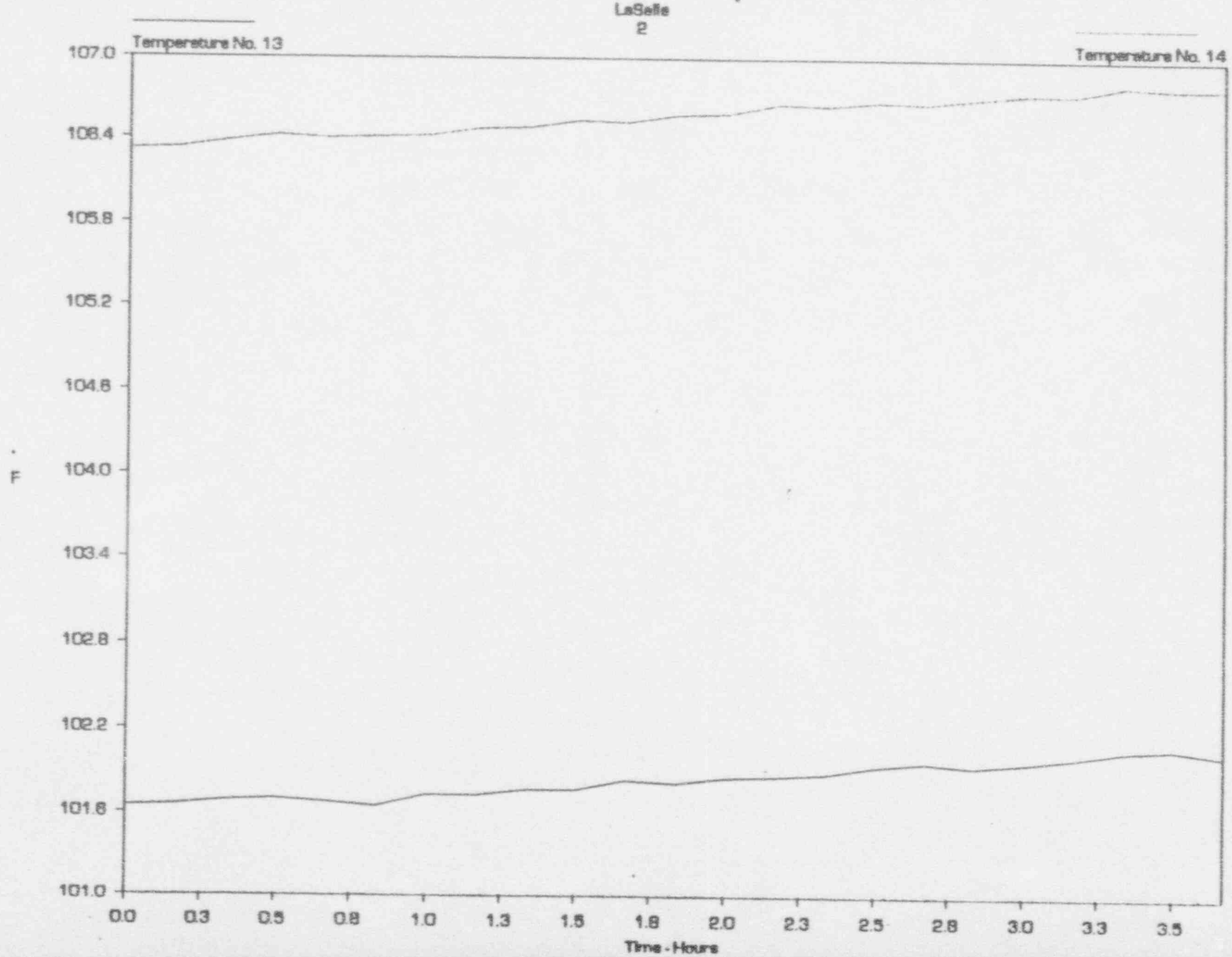


FIGURE 51

Temperature No. 15 & Temperature No. 16

LaSalle
2

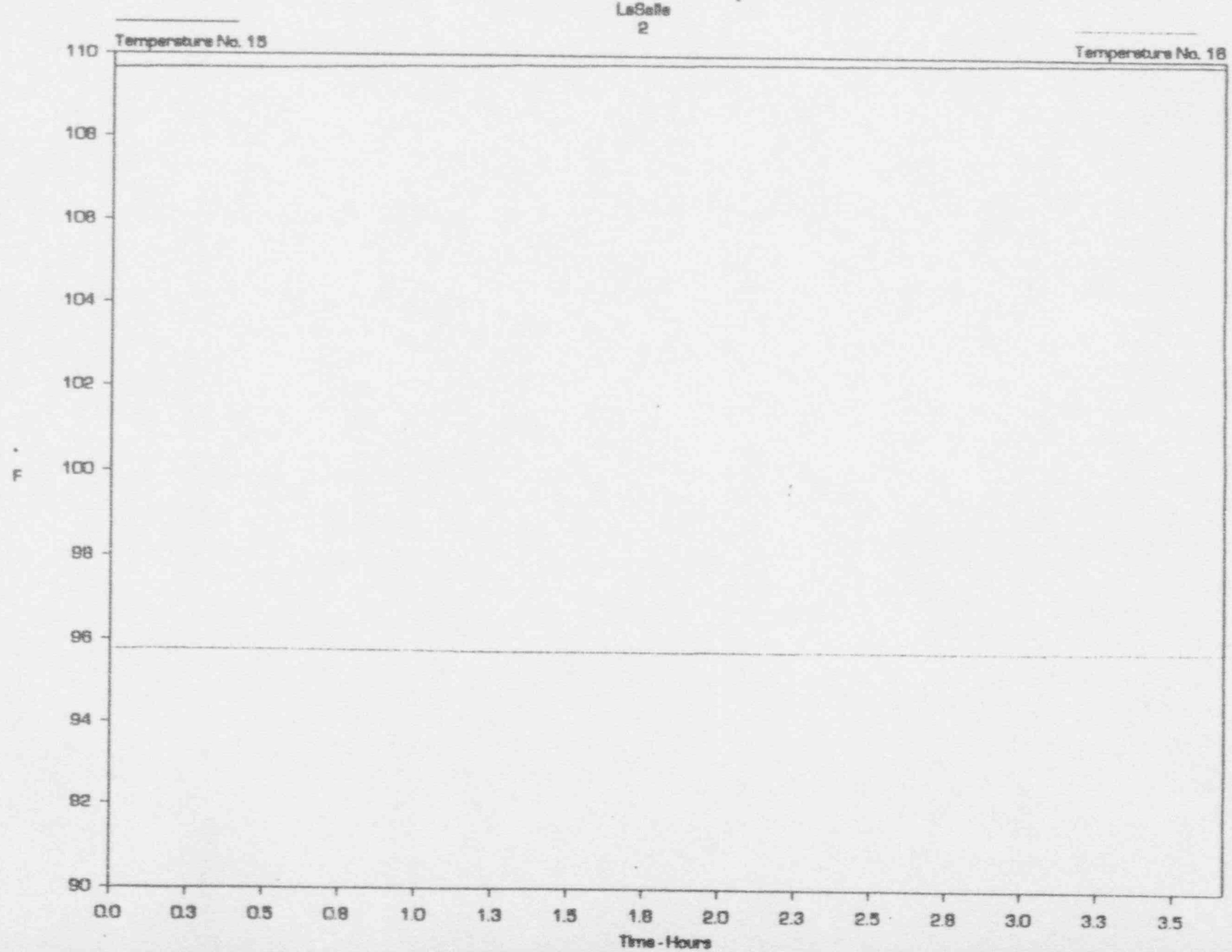


FIGURE 52

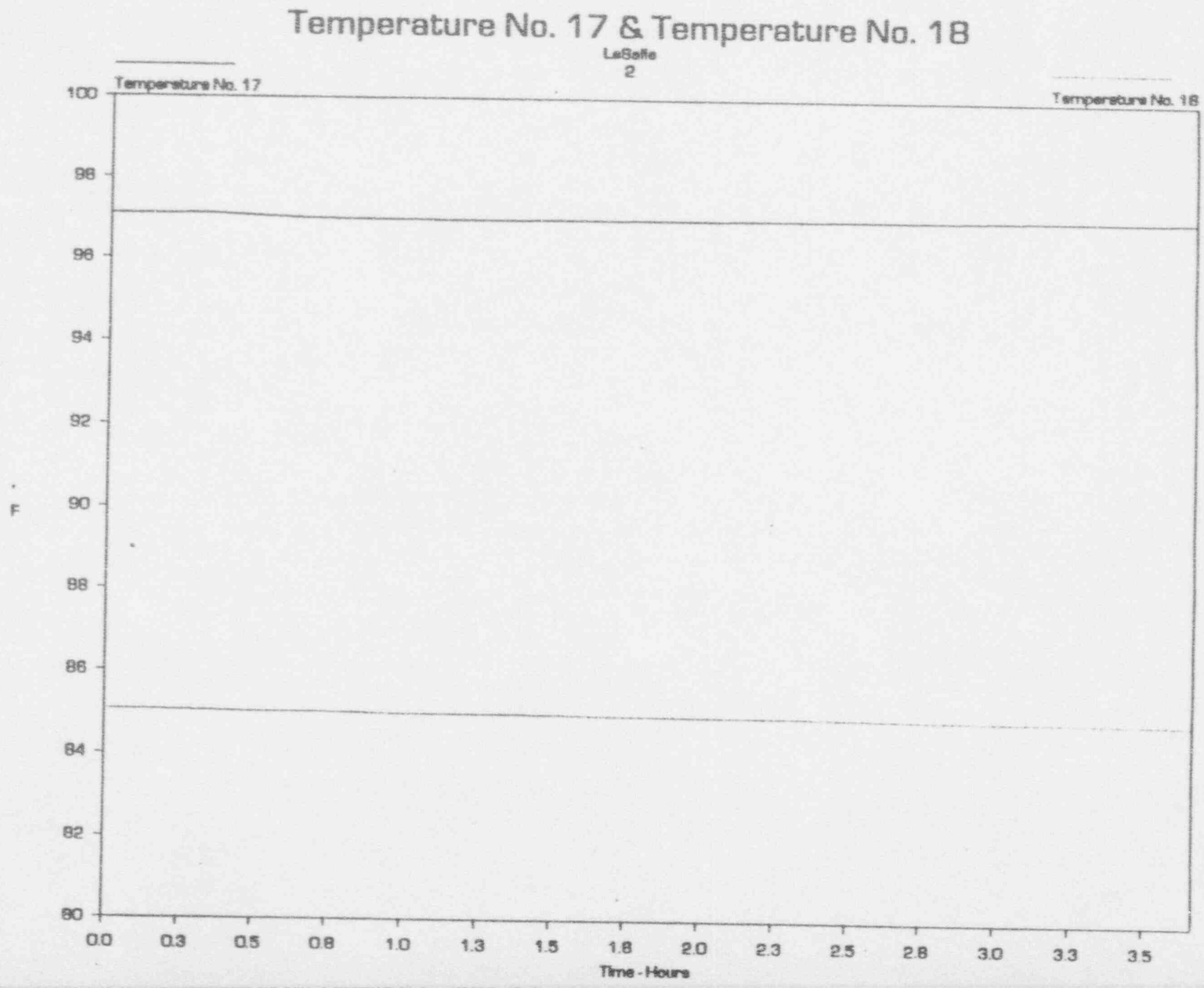

Temperature No. 17 & Temperature No. 18
LaSalle
2
Temperature No. 17
Temperature No. 18
100
98
96
94
92
90
88
86
84
82
80
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 53

Temperature No. 19 & Temperature No. 20

LaSalle
2

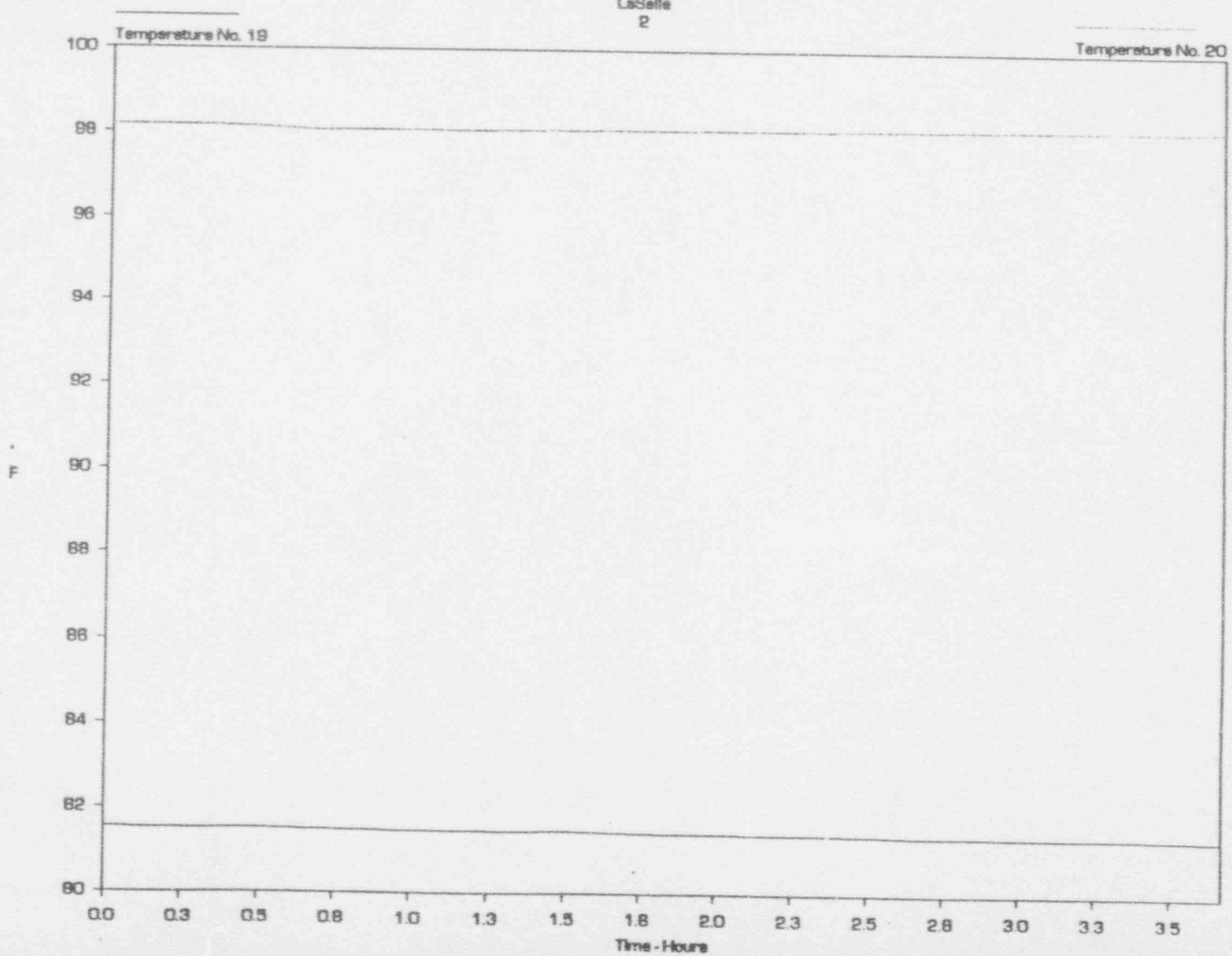


FIGURE 54

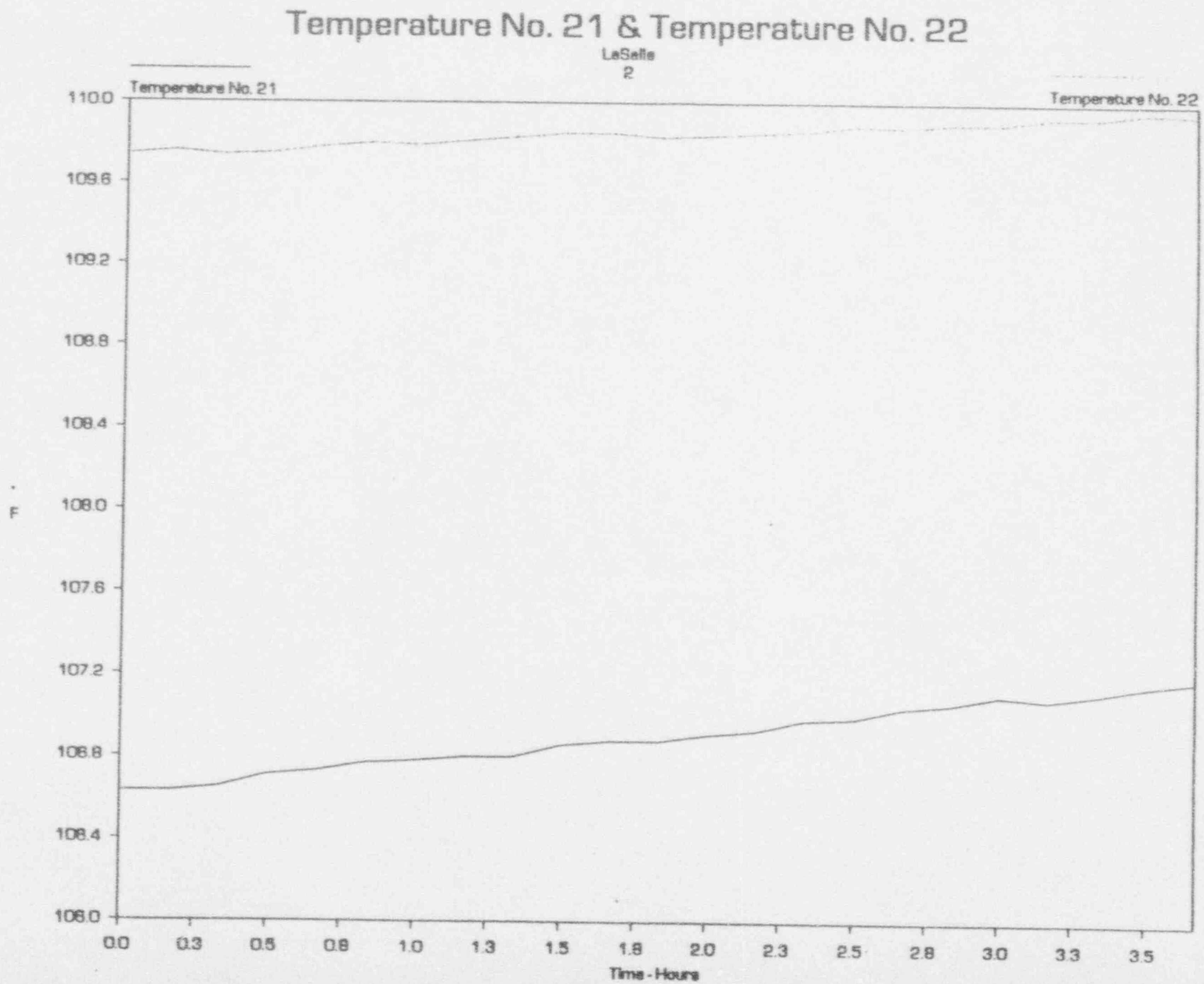

Temperature No. 21 & Temperature No. 22
LaSalle
2
Temperature No. 21
Temperature No. 22
110.0
109.6
109.2
108.8
108.4
108.0
107.6
107.2
106.8
106.4
106.0
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 55

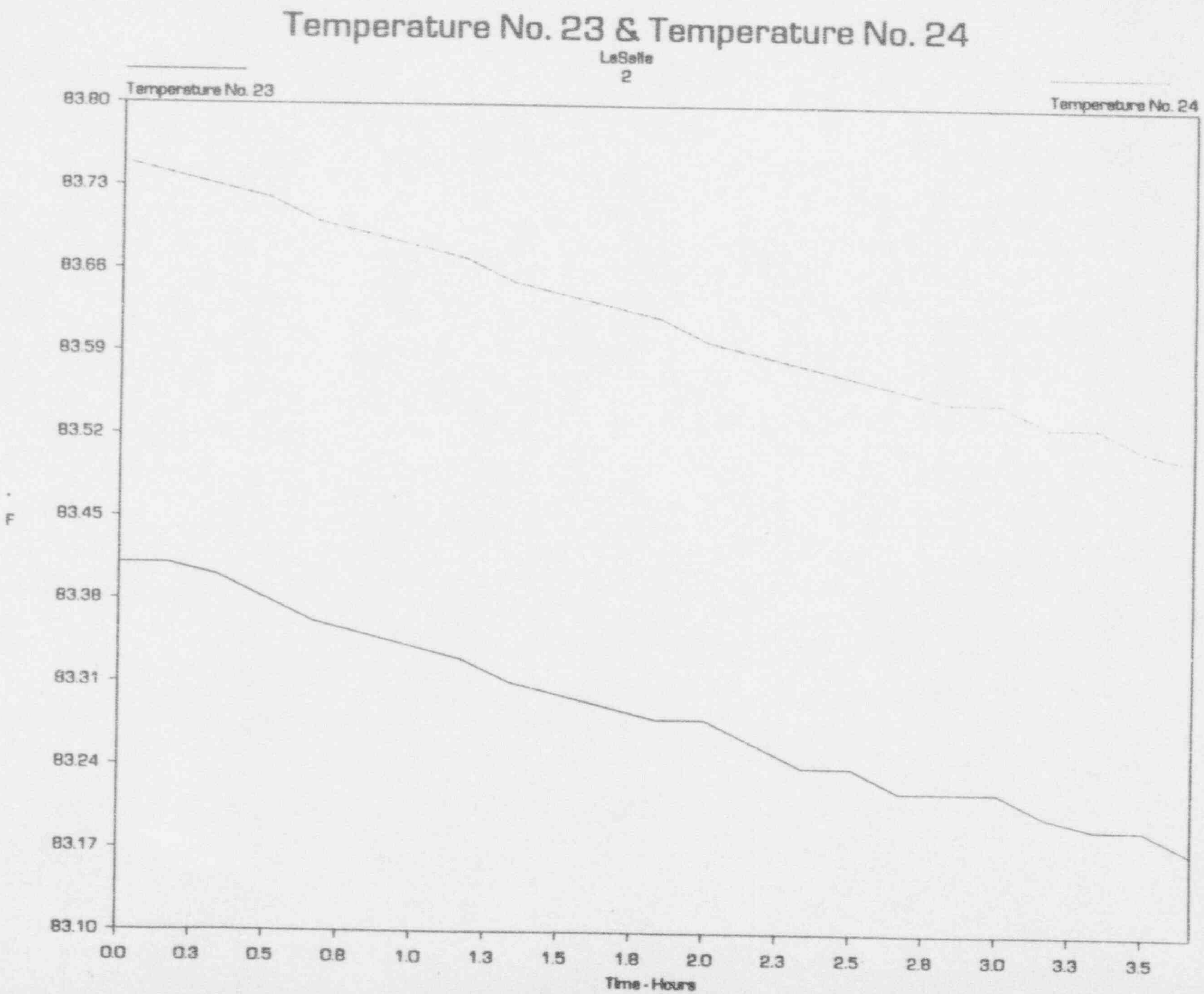

Temperature No. 23 & Temperature No. 24
LaSalle
2
Temperature No. 23
Temperature No. 24
83.80
83.73
83.66
83.59
83.52
83.45
83.38
83.31
83.24
83.17
83.10
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 56

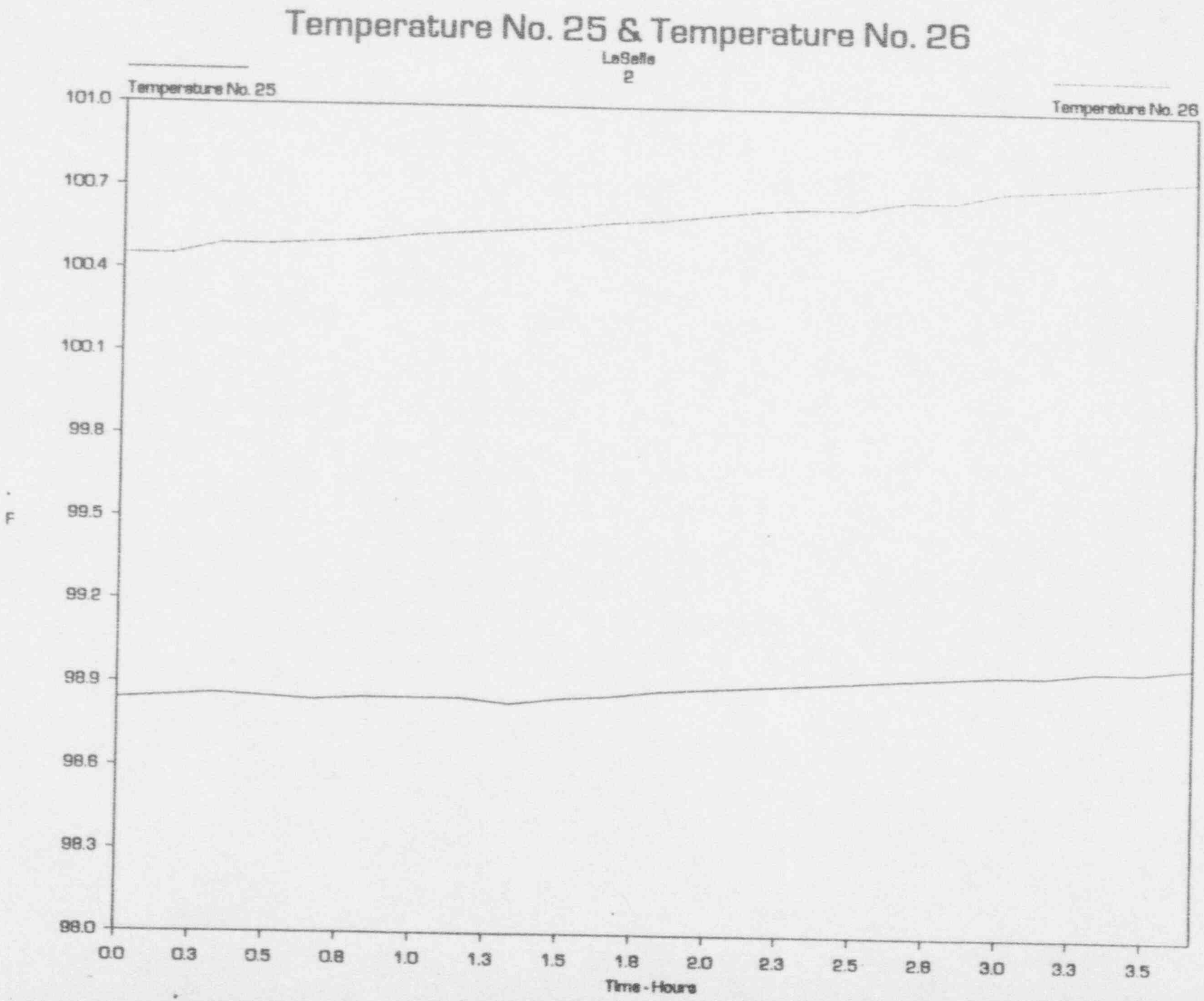
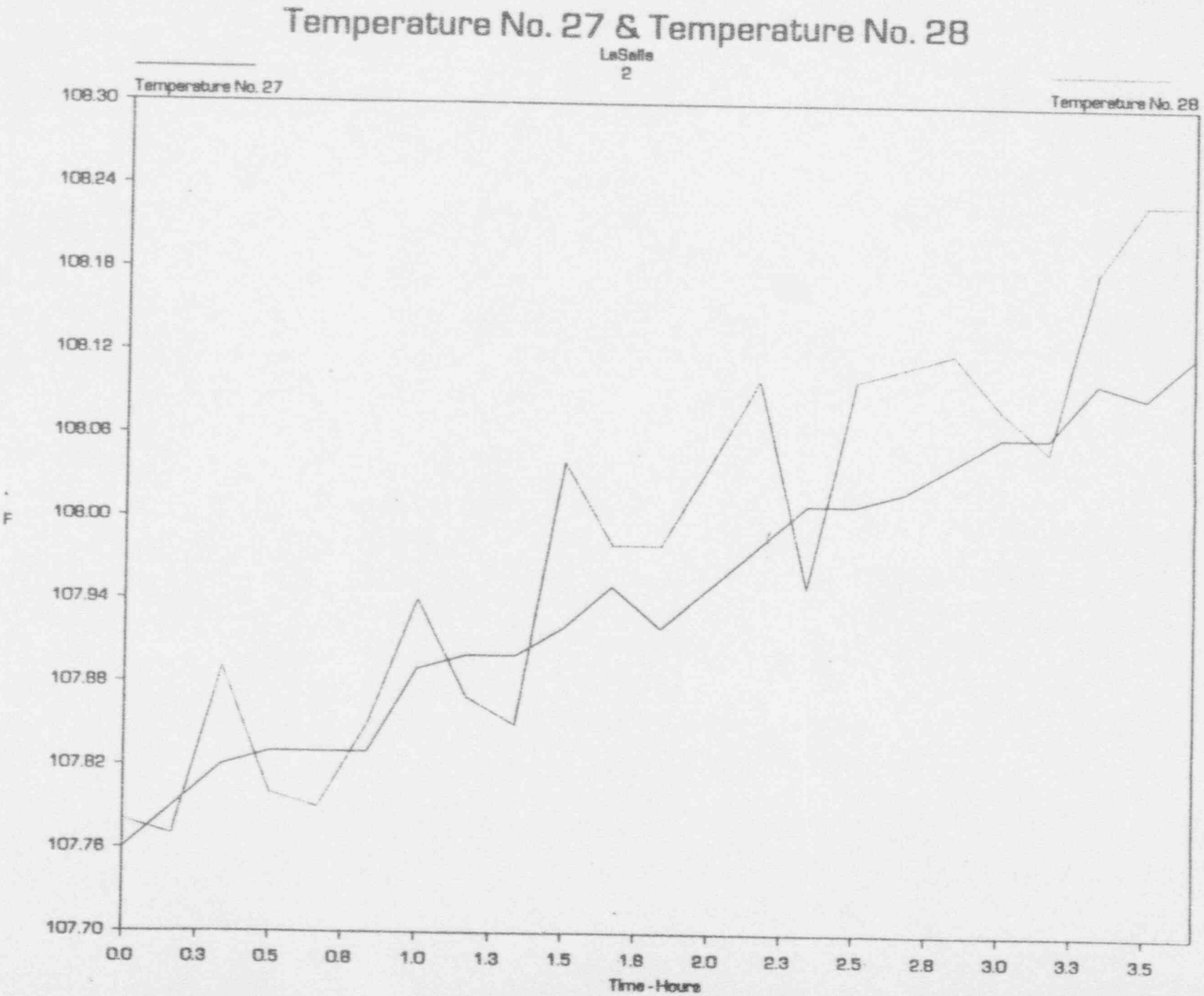

Temperature No. 25 & Temperature No. 26
LaSalle
2
Temperature No. 25
Temperature No. 26
101.0
100.7
100.4
100.1
99.8
99.5
99.2
98.9
98.6
98.3
98.0
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 57

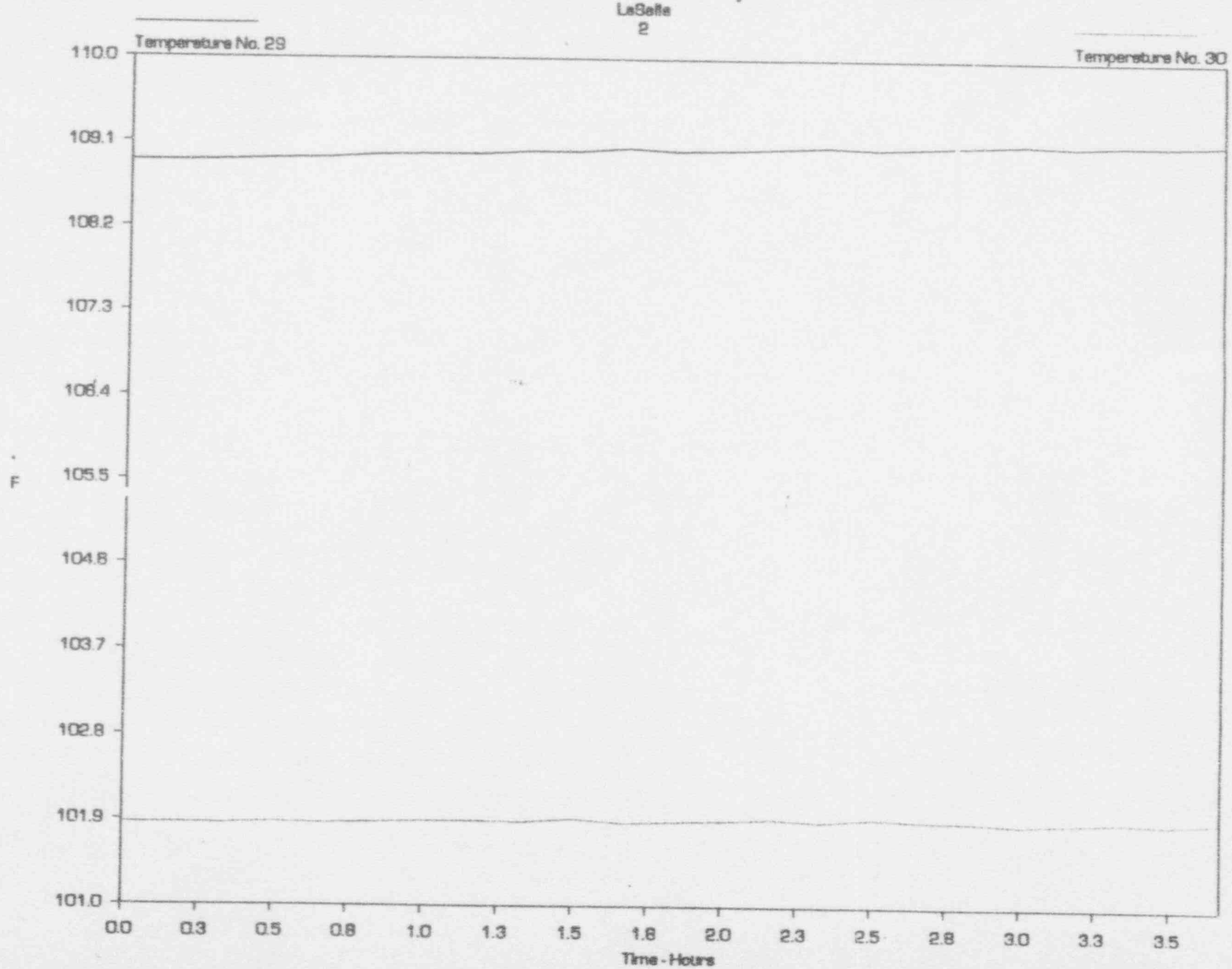


Temperature No. 27 & Temperature No. 28
LaSalle
2
Temperature No. 27
Temperature No. 28
108.30
108.24
108.18
108.12
108.06
108.00
107.94
107.88
107.82
107.76
107.70
F
0.0
0.3
0.5
0.8
1.0
1.3
1.5
1.8
2.0
2.3
2.5
2.8
3.0
3.3
3.5
Time - Hours

FIGURE 58

Temperature No. 29 & Temperature No. 30

LaSalle 2



SECTION E - TEST CALCULATIONS

Calculations for the test were based on LaSalle County Station 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 County Station short duration test using BN-TOP-1, Rev. 1, a number of editorial error and ambiguous statements in the topical report were identified. Corrections to these errors have been incorporated into the calculations for BN-TOP-1, Rev 1, found in LTS-300-4 and in the calculations found in Appendix C. 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 INTERPRETATIONS

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	0.269689	0.476
Calculated Leak Rate	0.284863	0.476
Upper 95% Confidence Limit Leak Rate	0.316442	0.476

F.2 Induced Phase Test Results

A leak of 387.0 SCFH (0.638 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 Leak Rate (L_o)	0.638
Calculated Leak Rate Prior To Verification Test (L_1)	0.284863
Induced Calculated Leak Rate During Verification Test (L_c)	0.799648

Acceptance Criterion:

$$| L_c - (L_1 + L_o) | \leq 0.159 \text{ wt\%/day}$$

$$| L_c - (L_1 + L_o) | = 0.1232 \text{ wt\%/day}$$

F.3 Leak Rate Compensation For Non-Vented Penetrations

The Primary Containment Integrated 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	0.45
M-25	PCCW "A" Supply	0.69
M-26	PCCW "B" Supply	0.35
M-27	PCCW "A" Return	6.08
M-28	PCCW "B" Return	0.0
M-30	RWCU Suction	0.0
M-36	Recirc Loop Sample	0.0
M-96	Drywell Equip. Drain Sump	0.19
M-98	Drywell Floor Drain Sump	2.55
M-97	Drywell Equip. Drain Sump Cooling	0.0
M-22	Inboard MSIV Drain	0.19
M-7	RHR Shutdown Cooling Suction	0.37
M-15	Steam To RCIC	0.37
ECCS/RCIC	Worst Division	6.84
M-HG	Unit 2 H_2 Recombiner Skid	1.03
M-34	StandBy Liquid Control	0.0
I-7	CRD to RVWLIS Backfill	0.0
I-8	CRD to RVWLIS Backfill	0.0
I-4A	CRD to RVWLIS Backfill	0.0
I-5	CRD to RVWLIS Backfill	0.0
	TOTAL	19.11 SCFH

This yields the following Non-Vented Penetration Penalty:

TOTAL(SCFH) x 1.6473×10^{-3}

Non-Vented Penetration Penalty = 0.0315 wt%/day

F.4 Change In Drywell Sump Level

During the time that the drywell was closed for the PCILRT to the time it was re-opened for post test inspection (approximately 36 hours), the drywell floor sump levels did not change as verified by the pre and post ILRT sump level measurements. The drywell equipment drain sump did increase 4.5" (approximately 1.3×10^{-2}% total containment volume) during this period. The small change in drywell equipment sump volume, (over the 36 hour period when the drywell was closed), produced negligible effects during the 6 hours that the test was performed. Therefore, changes in drywell sump levels were not used in calculating the final containment leakage rate.

F.5 Evaluation Of Instrument Failures

There were no instrument failures or sensors rejected during the test.

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	0.316442 wt%/day
Penalty For Non-Vented Penetrations	0.0315 wt%/day
Calculated Adjusted Leakage	0.0794 wt%/day
TOTAL	0.42734 wt%/day

The total "As Found" containment leakage rate was below the maximum allowable leakage rate of 0.75 La (0.476 wt%/day). Thus, the "As Found" Containment Integrated Leakage is satisfactory.

TABLE 5

(SHEET 1 OF 5)

CALCULATED ADJUSTED LEAKAGE

PENETRATION / VALVE(s)	TEST VOLUME	MINIMUM PATHWAY AS-FOUND (SCFH)	MINIMUM PATHWAY AS-LEFT (SCFH)	ADJUSTED LOCAL LEAK RATE (SCFH)
M-22 2B21-F016, 2B21-F019	INBOARD MSIV DRAIN	3.86	0.19	# 3.67
M-21 2VQ035, 2VQ068	DRYWELL PURGE	1.26	0.00	# 1.26
M-5 2B21-F010A, 2B21-F032A	"A" FEEDWATER TO REACTOR	4.43	3.00	@ 1.43
M-6 2B21-F010B, 2B21-F032B	"B" FEEDWATER TO REACTOR	0.00	0.00	@ 0.00
M-9B 2RF012, 2RF013	DRYWELL FLOOR DRAIN SUMP	25.14	5.10	* 20.04
M-108, M-104 2PC001A	DRYWELL VACUUM BREAKER	0.00	0.37	$ 0.00
M-30 2G33-F001, 2G33-F004	RWCU SUCTION	0.37	0.00	@ 0.37
M-101 2E51-F080, 2E51-F086	RCIC TURBINE EXHAUST VACUUM BREAKER	0.00	0.37	# 0.00
M-25 2VP063A, 2VP113A	PCCW "A" SUPPLY	0.00	0.69	# 0.00
M-27 2VP053A, 2VP114A	PCCW "A" RETURN	0.42	6.08	* 0.00

TABLE 5

(SHEET 2 OF 5)

CALCULATED ADJUSTED LEAKAGE

PENETRATION / VALVE(s)	TEST VOLUME	MINIMUM PATHWAY		ADJUSTED LOCAL
		AS-FOUND (SCFH)	AS-LEFT (SCFH)	LEAK RATE (SCFH)
M-28 2VP053B, 2VP114B	PCCW "B" RETURN	0.00	0.00	# 0.00
M-53 2HG001A, 2HG002A	COMBUSTIBLE GAS CONTROL "A" SUCTION	0.42	0.55	# 0.00
M-104 2HG005A, 2HG006A	COMBUSTIBLE GAS CONTROL "A" RETURN	0.20	0.00	* 0.20
M-33 2HG001B, 2HG002B	COMBUSTIBLE GAS CONTROL "B" SUCTION	0.37	0.15	# 0.22
M-106 2HG005B, 2HG006B	COMBUSTIBLE GAS CONTROL "B" RETURN	0.00	0.00	* 0.00
M-15 2E51-F008, 2E51-F063, 2E51-F076, 2E51-F064, 2E51-F091, 2E51-F357	RCIC STEAM SUPPLY	17.46	0.37	+ 17.09
M-29 2E12-F023, 2E51-F013	RHR/RCIC HEAD SPRAY	0.00	0.37	$ 0.00
M-17 2WR040, 2WR180	RBCWW RETURN	0.00	0.45	@ 0.00
M-54 2IN074, 2IN075		1.35	0.19	# 1.16

TABLE 5

(SHEET 3 OF 5)

CALCULATED ADJUSTED LEAKAGE

PENETRATION / VALVE(s)	TEST VOLUME	MINIMUM PATHWAY		ADJUSTED LOCAL LEAK RATE (SCFH)
		AS-FOUND (SCFH)	AS-LEFT (SCFH)	
M-11 2E22-F004	HPCS INJECTION	0.00	0.42	$ 0.00
M-7 2E12-F008, 2E12-F009	RHR SHUT DOWN COOLING SUCTION	0.37	0.37	@ 0.00
M-34 2C41-F004A, 2C41-F004B, 2C41-F007	SBLC INJECTION	0.00	0.0C	@ 0.00
M-81 2E51-F069, 2E51-F028	RCIC VACUUM PUMP DISCHARGE	0.72	0.00	* 0.72
M-76 2E51-F068, 2E51-F040	RCIC TURBINE EXHAUST	0.58	0.71	# 0.00
M-18 2E12-F016A, 2E12-F017A	RHR "A" DRYWELL SPRAY	0.88	0.19	# 0.69
M-20 2VQ047, 2VQ048	DRYWELL INERTING MAKEUP	0.42	0.19	# 0.23
M-19 2E12-F016B, 2E12-F017B	RHR "B" DRYWELL SPRAY	0.00	0.95	# 0.00
M-14 2E12-F042B	RHR "B" LPCI INJECTION	0.00	0.93	$ 0.00

TABLE 5

(SHEET 4 OF 5)

CALCULATED ADJUSTED LEAKAGE

PENETRATION / VALVE(s)	TEST VOLUME	MINIMUM PATHWAY		ADJUSTED LOCAL	
		AS-FOUND (SCFH)	AS-LEFT (SCFH)	LEAK RATE (SCFH)	
M-9 2E12-F053B	RHR "B" SHUT DOWN COOLING RETURN	0.00	0.37	$	0.00
M-10 2E21-F005	LPCS INJECTION	0.46	0.37	$	0.09
M-12 2E12-F042C	LPCI "C" INJECTION	0.00	5.54	$	0.00
I-11, I-36, I-45 2CM022A, 2CM024A, 2CM025A	"A" POST LOCA CONTAINMENT MONITORING	1.53	9.30	*	0.00
I-50, I-35, I-47 2CM021B, 2CM023B, 2CM026B	"B" POST LOCA CONTAINMENT MONITORING	0.00	1.40	*	0.00
M-107, M-103 2PC002A	DRYWELL VACUUM BREAKER	3.46	2.43	$	1.03
				TOTAL =	48.20

CALCULATED ADJUSTED LEAKAGE RATE = TOTAL (SCFH) x (1.6473 x 10^-3) [wt%/day]

CALCULATED ADJUSTED LEAKAGE RATE = 0.079400 [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-leakage in either case is 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

Presented herein are the results of local leak rate tests conducted on all penetrations, double-gasketed seals, and isolation valves during the Unit 2 Refuel Outage, L2R05 (fifth). 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.

L2R05

LLRT RESULTS

TABLE 6

(SHEET 1 OF 10)

L2R05 LLRT RESULTS

PENETRATION	DESCRIPTION	VALVE(s)/COMPONENT	AS- FOUND				AS- LEFT			
			DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-22	INBOARD MSIV DRAIN	2B21-F016, 2B21-F019	9/5/93	7.72	3.860	7.720	11/29/93	0.37	0.185	0.370
M-66	SUPPRESSION CHAMBER VENT	2VQ026, 2VQ043, 2VQ027	9/10/93	8.28	4.140	8.280	9/10/93	8.28	4.140	8.280
M-20	DRYWELL VENT	2VQ029, 2VQ030, 2VQ042	9/10/93	3.50	1.750	3.500	9/10/93	3.50	1.750	3.500
M-67	SUPPRESSION CHAMBER PURGE	2VQ031, 2VQ032, 2VQ040	9/10/93	15.67	7.835	15.670	9/10/93	5.99	2.995	5.990
M-21	DRYWELL PURGE	2VQ034, 2VQ035, 2VQ036 2VQ068	9/10/93	2.51	1.255	2.510	11/21/93	0.00	0.000	0.000
I-36	SUPPRESSION CHAMBER CONTINUOUS AIR MONITOR	2CM027, 2CM028	9/17/93	0.00	0.000	0.000	9/17/93	0.00	0.000	0.000
I-11	DRYWELL CONTINUOUS AIR MONITORING	2CM029, 2CM030	9/17/93	0.00	0.000	0.000	9/17/93	0.00	0.000	0.000
I-11	PC AIR SAMPLE	2CM031, 2CM032	9/18/93	0.00	0.000	0.000	9/18/93	0.00	0.000	0.000
I-45	SAMPLE RETURN TO SUPPRESSION CHAMBER	2CM033, 2CM034	9/18/93	0.00	0.000	0.000	9/18/93	0.00	0.000	0.000
M-5	A FEEDWATER	2B21-F010A	9/10/93	INFINITE			11/3/93	3.00		
		2B21-F032A	9/11/93	4.43	4.430	INFINITE	11/3/93	6.47	3.000	6.470
		2B21-F065A	9/11/93	0.00			9/11/93	0.00		
M-6	B FEEDWATER and RWCU RETURN	2B21-F010B	9/7/93	0.00			9/7/93	0.00		
		2B21-F032B	9/7/93	13.34	0.000	INFINITE	10/29/93	2.60	0.000	2.600
		2B21-F065B	9/8/93	0.55			10/29/93	1.57		
		2G33-F040	9/9/93	INFINITE			10/29/93	1.39		

TABLE 6

(SHEET 2 OF 10)

L2R05 LLRT RESULTS

PENETRATION	DESCRIPTION	VALVE(s)/COMPONENT	AS-FOUND DATE	AS-FOUND TOTAL	AS-FOUND MINIMUM PATHWAY	AS-FOUND MAXIMUM PATHWAY	AS-LEFT DATE	AS-LEFT TOTAL	AS-LEFT MINIMUM PATHWAY	AS-LEFT MAXIMUM PATHWAY
M-54	DRYWELL PNEUMATIC SUCTION	2IN001A, 2IN001B	9/8/93	0.00	0.000	0.000	9/8/93	0.00	0.000	0.000
M-36	RECIRC LOOP SAMPLE	2B33-F019	9/7/93	0.00	0.000	0.000	9/7/93	0.00	0.000	0.000
		2B33-F020	9/7/93	0.00			9/7/93	0.00		
M-98	DRYWELL FLOOR DRAIN SUMP	2RF012, 2RF013	9/20/93	107.66	25.140	107.660	11/27/93	5.10	2.550	5.100
M-111	DRYWELL PERSONNEL ACCESS HATCH	DRYWELL PERSONNEL ACCESS HATCH	9/3/93	2.40	2.400	2.400	12/1/93	2.12	2.120	2.120
M-112	DRYWELL EQUIPMENT HATCH	DRYWELL EQUIPMENT HATCH	9/4/93	0.00	0.000	0.000	12/4/93	0.00	0.000	0.000
M-113	SUPPRESSION POOL EMERGENCY ACCESS HATCH #1	SUPPRESSION POOL EMERGENCY ACCESS HATCH #1	9/4/93	0.00	0.000	0.000	11/26/93	0.00	0.000	0.000
M-114	SUPPRESSION POOL EMERGENCY ACCESS HATCH #2	SUPPRESSION POOL EMERGENCY ACCESS HATCH #2	9/4/93	0.00	0.000	0.000	11/26/93	0.00	0.000	0.000
M-115	CRD REMOVAL HATCH	CRD REMOVAL HATCH	9/4/93	0.00	0.000	0.000	11/18/93	0.00	0.000	0.000
N/A	DRYWELL HEAD	DRYWELL HEAD	9/5/93	0.00	0.000	0.000	12/3/93	0.00	0.000	0.000
M-42	E TIP PENETRATION FLANGE	E TIP PENETRATION FLANGE	9/5/93	0.00	0.000	0.000	9/5/93	0.00	0.000	0.000
M-43	D TIP PENETRATION FLANGE	D TIP PENETRATION FLANGE	9/5/93	0.00	0.000	0.000	9/5/93	0.00	0.000	0.000
M-44	C TIP PENETRATION FLANGE	C TIP PENETRATION FLANGE	9/5/93	0.00	0.000	0.000	9/5/93	0.00	0.000	0.000

TABLE 6

(SHEET 3 OF 10)

L2R05 LLRT RESULTS

PENETRATION	DESCRIPTION	VALVE(s)/COMPONENT	AS- FOUND				AS- LEFT			
			DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-45	B TIP PENETRATION FLANGE	B TIP PENETRATION FLANGE	9/5/93	0.00	0.000	0.000	9/5/93	0.00	0.000	0.000
M-46	A TIP PENETRATION FLANGE	A TIP PENETRATION FLANGE	9/5/93	0.00	0.000	0.000	9/5/93	0.00	0.000	0.000
M-108/M-104	DW TO SP A VACUUM BREAKER	2PC001A OUTBOARD FLANGE O-RING SEAL	9/2/93	0.00	0.000	0.000	11/27/93	0.00	0.000	0.000
M-108/M-104	DW TO SP A VACUUM BREAKER	2PC001A INBOARD FLANGE O-RING SEAL	9/2/93	0.00	0.000	0.000	11/27/93	0.37	0.370	0.370
M-108/M-104	DW TO SP A VACUUM BREAKER	2PC001A ACTUATOR O-RING	9/2/93	0.00	0.000	0.000	11/27/93	0.00	0.000	0.000
M-108/M-1[illegible]	D[illegible]O SP A VACUUM BREAKER	2PC001A ACTUATOR SEAL	9/2/93	0.00	0.000	0.000	11/27/93	0.00	0.000	0.000
M-106/M-110	DW TO SP B VACUUM BREAKER	2PC001B OUTBOARD FLANGE O-RING SEAL	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-106/M-110	DW TO SP B VACUUM BREAKER	2PC001B INBOARD FLANGE O-RING SEAL	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-106/M-110	DW TO SP B VACUUM BREAKER	2PC001B ACTUATOR O-RING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-106/M-110	DW TO SP B VACUUM BREAKER	2PC001B ACTUATOR SEAL	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-103/M-107	DW TO SP C VACUUM BREAKER	2PC001C OUTBOARD FLANGE O-RING SEAL	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-103/M-107	DW TO SP C VACUUM BREAKER	2PC001C INBOARD FLANGE O-RING SEAL	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000

TABLE 6

(SHEET 4 OF 10)

L2R05 LLRT RESULTS

PENETRATION	DESCRIPTION	VALVE(s)/COMPONENT	AS- FOUND				AS- LEFT			
			DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-103/M-107	DW TO SP C VACUUM BREAKER	2PC001C ACTUATOR O-RING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-103/M-107	DW TO SP C VACUUM BREAKER	2PC001C ACTUATOR SEAL	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-105/M-109	DW TO SP D VACUUM BREAKER	2PC001D OUTBOARD FLANGE O-RING SEAL	9/2/93	0.00	0.000	0.000	9/20/93	0.00	0.000	0.000
M-105/M-109	DW TO SP D VACUUM BREAKER	2PC001D INBOARD FLANGE O-RING SEAL	9/2/93	0.00	0.000	0.000	9/20/93	0.00	0.000	0.000
M-105/M-109	DW TO SP D VACUUM BREAKER	2PC001D ACTUATOR O-RING	9/2/93	0.00	0.000	0.000	9/20/93	0.00	0.000	0.000
M-105/M-109	DW TO SP D VACUUM BREAKER	2PC001D ACTUATOR SEAL	9/2/93	0.00	0.000	0.000	9/20/93	0.00	0.000	0.000
M-20	DRYWELL VENT	2VQ030 INNER FLANGE O-RING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-82	HPCS SPARE PENETRATION	HPCS SPARE FLANGE	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-66	SUPPRESSION POOL VENT	2VQ027 INNER FLANGE O-RING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-67	SUPPRESSION CHAMBER PURGE	2VQ031 INNER FLANGE O-RING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-21	DRYWELL PURGE	2VQ034 INNER FLANGE O-RING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-20	DRYWELL VENT	2VQ030 VALVE STEM PACKING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000

TABLE 6

(SHEET 5 OF 10)

L2R05 LLRT RESULTS

PENETRATION	DESCRIPTION	VALVE(s)/COMPONENT	AS- FOUND				AS- LEFT			
			DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-66	SUPPRESSION CHAMBER VENT	2VQ027 VALVE STEM PACKING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-67	SUPPRESSION CHAMBER PURGE	2VQ031 VALVE STEM PACKING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-38	SA TO DRYWELL	SA FLANGE O-RINGS	9/2/93	0.00	0.000	0.000	12/4/93	0.00	0.000	0.000
M-37	MC TO DRYWELL	MC FLANGE O-RINGS	9/2/93	0.00	0.000	0.000	12/4/93	0.00	0.000	0.000
M-21	DRYWELL PURGE	2VQ034 VALVE STEM PACKING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-103	C VACUUM BREAKER LINE	2PC003C INNER FLANGE O-RING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-104	A VACUUM BREAKER LINE	2PC003A INNER FLANGE O-RING	9/2/93	0.00	0.000	0.000	12/4/93	0.00	0.000	0.000
M-105	D VACUUM BREAKER LINE	2PC003D INNER FLANGE O-RING	9/3/93	0.00	0.000	0.000	9/3/93	0.00	0.000	0.000
M-106	B VACUUM BREAKER LINE	2PC003B INNER FLANGE O-RING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-107	C VACUUM BREAKER LINE	2PC002C INNER FLANGE O-RING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-108	A VACUUM BREAKER LINE	2PC002A INNER FLANGE O-RING	9/2/93	0.00	0.000	0.000	11/27/93	0.00	0.000	0.000
M-109	D VACUUM BREAKER LINE	2PC002D INNER FLANGE O-RING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-110	B VACUUM BREAKER LINE	2PC002B INNER FLANGE O-RING	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000

TABLE 6

(SHEET 6 OF 10)

L2R05 LLRT RESULTS

PENETRATION	DESCRIPTION	VALVE(s)/COMPONENT	AS- FOUND				AS- LEFT			
			DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-97	DW EQUIPMENT DRAIN SUMP COOLING	2RE026, 2RE029	9/20/93	0.00	0.000	0.000	9/20/93	0.00	0.000	0.000
E-21	ELECTRICAL PENETRATION 770' - 2°	N/A	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
E-23	ELECTRICAL PENETRATION 775' - 137°	N/A	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
E-26	ELECTRICAL PENETRATION 774' - 225°	N/A	9/2/93	0.00	0.000	0.000	9/2/93	0.00	0.000	0.000
M-96	DRYWELL EQUIPMENT DRAIN SUMP	2RE024, 2RE025	11/11/93	19.40	9.700	19.400	11/11/93	0.38	0.190	0.380
M-30	RWCU SUCTION	2G33-F001	9/30/93	0.37	0.370	0.370	10/20/93	0.00	0.000	0.000
		2G33-F004	9/30/93	0.37			10/20/93	0.00		
M-101	RCIC TURBINE EXHAUST VACUUM BREAKER	2E51-F080, 2E51-F086	9/6/93	0.00	0.000	0.000	12/1/93	0.37	0.185	0.370
N/A	ELECTRICAL PENETRATION	PRESSURIZATION SYSTEM	9/13/93	0.57	0.567	0.567	9/13/93	0.57	0.567	0.567
M-25	PCCW A SUPPLY	2VP063A, 2VP113A	9/22/93	0.00	0.000	0.000	10/26/93	1.38	0.690	1.380
M-26	PCCW B SUPPLY	2VP063B, 2VP113B	9/10/93	0.69	0.345	0.690	9/10/93	0.69	0.345	0.690
M-27	PCCW A RETURN	2VP053A, 2VP114A	9/22/93	0.83	0.415	0.830	11/10/93	12.16	6.080	12.160
M-28	PCCW B RETURN	2VP053B, 2VP114B	9/10/93	0.00	0.000	0.000	11/24/93	0.00	0.000	0.000
M-47	TIP INDEX PURGE AIR SUPPLY	2IN031	9/9/93	0.00	0.000	0.000	9/9/93	0.00	0.000	0.000

TABLE 6

(SHEET 7 OF 10)

L2R05 LLRT RESULTS

PENETRATION	DESCRIPTION	VALVE(s)/COMPONENT	AS- FOUND DATE	AS- FOUND TOTAL	AS- FOUND MINIMUM PATHWAY	AS- FOUND MAXIMUM PATHWAY	AS- LEFT DATE	AS- LEFT TOTAL	AS- LEFT MINIMUM PATHWAY	AS- LEFT MAXIMUM PATHWAY
M-54	DRYWELL PNEUMATIC DISCHARGE TO DRYWELL	2IN017	9/8/93	0.79	0.000	0.790	9/8/93	0.79	0.000	0.790
		2IN018	9/8/93	0.00			9/8/93	0.00		
M-53	COMBUSTIBLE GAS CONTROL A SUCTION	2HG001A, 2HG002A	9/9/93	0.83	0.415	0.830	12/3/93	1.11	0.555	1.110
M-104	COMBUSTIBLE GAS CONTROL A RETURN	2HG005A, 2HG006A	9/9/93	21.16	10.580	21.160	11/23/93	6.01	3.010	6.010
M-33	COMBUSTIBLE GAS CONTROL B SUCTION	2HG001B, 2HG002B	9/9/93	0.74	0.370	0.740	12/3/93	0.37	0.185	0.370
M-106	COMBUSTIBLE GAS CONTROL B RETURN	2HG005B, 2HG006B	9/9/93	0.00	0.000	0.000	11/23/93	0.00	0.000	0.000
M-15	STEAM TO RCIC	2E51-F063, 2E51-F076, 2E51-F064, 2E51-F008, 2E51-F091, 2E51-F357	9/6/93	34.92	17.460	34.920	11/17/93	0.74	0.370	0.740
M-38	SA TO DRYWELL	2SA042, 2SA046	12/4/93	0.00	0.000	0.000	12/4/93	0.00	0.000	0.000
M-37	MC TO DRYWELL	2MC027, 2MC033	12/4/93	0.00	0.000	0.000	12/4/93	0.00	0.000	0.000
M-29	RHR/RCIC HEAD SPRAY	2E12-F023, 2E51-F013	9/17/93	0.00	0.000	0.000	9/17/93	0.00	0.370	0.370
							11/27/93	0.37		
M-59	CYCLED CONDENSATE TO REFUELING BELLOWS	2FC113	11/24/93	0.00	0.000	0.550	11/24/93	0.00	0.000	0.550
		2FC114	11/24/93	0.55			11/24/93	0.55		
M-65	REACTOR WELL DRAIN	2FC115	9/21/93	0.00	0.000	0.000	9/21/93	0.00	0.000	0.000
		2FC086	9/21/93	0.00			9/21/93	0.00		
M-16	RBCCW SUPPLY	2WR029	9/10/93	0.00	0.000	0.000	9/10/93	0.00	0.000	0.000
		2WR179	9/10/93	0.00			9/10/93	0.00		

TABLE 6

(SHEET 8 OF 10)

L2R05 LLRT RESULTS

PENETRATION	DESCRIPTION	VALVE(s)/COMPONENT	AS- FOUND				AS- LEFT			
			DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-17	RBCCW RETURN	2WR040	9/10/93	0.00	0.000	0.510	10/15/93	0.45	0.450	0.560
		2WR180	9/11/93	0.51			10/15/93	0.56		
I-4F	DRYWELL HUMIDITY MONITOR A SUCTION	2CM017A, 2CM018A	9/18/93	0.00	0.000	0.000	9/18/93	0.00	0.000	0.000
I-5F	DRYWELL HUMIDITY MONITOR B SUCTION	2CM017B, 2CM018B	9/18/93	0.00	0.000	0.000	9/18/93	0.00	0.000	0.000
I-45	DRYWELL HUMIDITY MONITOR A DISCHARGE	2CM019A, 2CM020A	9/18/93	0.37	0.185	0.370	9/18/93	0.37	0.185	0.370
I-45	DRYWELL HUMIDITY MONITOR B DISCHARGE	2CM019B, 2CM020B	9/18/93	0.37	0.185	0.370	9/18/93	0.37	0.185	0.370
M-54	DRYWELL PNEUMATIC DRYER PURGE	2IN074, 2IN075	9/8/93	2.69	1.345	2.690	10/22/93	0.37	0.185	0.370
M-11	HPCS INJECTION	2E22-F004	9/9/93	0.00	0.000	0.000	10/16/93	0.42	0.420	0.420
M-7	RHR SHUTDOWN COOLING SUCTION	2E12-F008	9/22/93	0.37	0.370	0.370	9/22/93	0.37	0.370	5.130
		2E12-F009	9/22/93	0.37			10/19/93	5.13		
M-34	SBLC INJECTION LINE	2C41-F004A/B	2/26/92	0.00	0.000	0.000	10/16/93	0.00	0.000	0.000
		2C41-F007	10/16/93	0.00			10/16/93	0.00		
M-81	RCIC VACUUM PUMP DISCHARGE	2E51-F069, 2E51-F028	9/6/93	1.44	0.718	1.436	12/1/93	0.47	0.234	0.468
M-76	RCIC TURBINE EXHAUST	2E51-F068, 2E51-F040	9/6/93	1.16	0.580	1.160	12/2/93	1.42	0.710	1.420
M-20	DRYWELL INERTING MAKEUP	2VQ047, 2VQ048	9/10/93	0.83	0.415	0.830	11/20/93	0.37	0.185	0.370

TABLE ∘

(SHEET 9 OF 10)

L2R05 LLRT RESULTS

PENETRATION	DESCRIPTION	VALVE(s)/COMPONENT	AS- FOUND				AS- LEFT			
			DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY	DATE	TOTAL	MINIMUM PATHWAY	MAXIMUM PATHWAY
M-66	SUPPRESSION POOL INERTING MAKEUP	2VQ050, 2VQ051	9/10/93	0.00	0.000	0.000	9/10/93	0.00	0.000	0.000
M-46	A TIP PENETRATION	TIP BALL VALVE A	9/13/93	0.37	0.370	0.370	9/13/93	0.37	0.370	0.370
M-45	B TIP PENETRATION	TIP BALL VALVE B	9/13/93	0.37	0.370	0.370	9/13/93	0.37	0.370	0.370
M-44	C TIP PENETRATION	TIP BALL VALVE C	9/13/93	0.37	0.370	0.370	9/13/93	0.37	0.370	0.370
M-43	D TIP PENETRATION	TIP BALL VALVE D	9/13/93	0.00	0.000	0.000	9/13/93	0.00	0.000	0.000
M-42	E TIP PENETRATION	TIP BALL VALVE E	9/13/93	0.56	0.560	0.560	9/13/93	0.56	0.560	0.560
M-18	RHR A DRYWELL SPRAY	2E12-F016A, 2E12-F017A	9/14/93	1.76	0.880	1.760	10/19/93	0.37	0.185	0.370
M-19	RHR B DRYWELL SPRAY	2E12-F016B, 2E12-F017B	9/23/93	0.00	0.000	0.000	11/13/93	1.29	0.645	1.290
M-13	RHR A LPCI INJECTION	2E12-F042A	9/14/93	0.83	0.830	0.830	9/14/93	0.83	0.830	0.830
M-14	RHR B LPCI INJECTION	2E12-F042B	9/23/93	0.00	0.000	0.000	11/5/93	0.93	0.930	0.930
M-8	A RHR SHUTDOWN COOLING RETURN	2E12-F053A	9/13/93	4.43	4.430	4.430	9/13/93	4.43	4.430	4.430
M-9	B RHR SHUTDOWN COOLING RETURN	2E12-F053B	9/23/93	0.00	0.000	0.000	11/5/93	0.37	0.370	0.370
M-10	LPCS INJECTION	2E12-F005	9/10/93	0.46	0.460	0.460	9/28/93	0.37	0.370	0.370
M-12	RHR C LPCI INJECTION	2E12-F042C	10/6/93	0.00	0.000	0.000	11/19/93	5.54	5.540	5.540
M-77	RCIC TEST RETURN TO SUPPRESSION POOL	2E51-F362, 2E51-F363	9/18/93	0.00	0.000	0.000	9/18/93	0.00	0.000	0.000

TABLE 6

(SHEET 10 OF 10)

L2R05 LLRT RESULTS

PENETRATION	DESCRIPTION	VALVE(s)/COMPONENT	AS- FOUND DATE	AS- FOUND TOTAL	AS- FOUND MINIMUM PATHWAY	AS- FOUND MAXIMUM PATHWAY	AS- LEFT DATE	AS- LEFT TOTAL	AS- LEFT MINIMUM PATHWAY	AS- LEFT MAXIMUM PATHWAY
I-11/I-36/ I-45	A POST LOCA CONTAINMENT MONITORING	2CM022A, 2CM024A, 2CM025A	9/18/93	1.53	1.530	1.530	11/27/93	9.30	9.300	9.300
I-50/I-35/ I-47	B POST LOCA CONTAINMENT MONITORING	2CM021B, 2CM023B, 2CM026B	9/18/93	0.00	0.000	0.000	11/27/93	1.40	1.400	1.400
I-4A	RVWLIS CRD BACKFILL PANEL 2C11-P004	2C11-F422G	N/A	N/A	N/A	N/A	11/25/93	0.00	0.000	0.000
		2C11-F423G	N/A	N/A			11/25/93	0.00		
I-5A	RVWLIS CRD BACKFILL PANEL 2C11-P003	2C11-F422B	N/A	N/A	N/A	N/A	11/20/93	0.00	0.000	0.000
		2C11-F423B	N/A	N/A			11/20/93	0.00		
I-7	RVWLIS CRD BACKFILL PANEL 2C11-P002	2C11-F422D	N/A	N/A	N/A	N/A	11/20/93	0.00	0.000	0.000
		2C11-F423D	N/A	N/A			11/20/93	0.00		
I-8A	RVWLIS CRD BACKFILL PANEL 2C11-P005	2C11-F422F	N/A	N/A	N/A	N/A	11/20/93	0.00	0.000	0.000
		2C11-F423F	N/A	N/A			11/20/93	0.00		
			TOTAL	infinite	104.630	infinite	TOTAL	96.265	58.251	96.265

APPENDIX B

L2R05 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 Technical Specification limit of 231.4 SCFH using the Minimum Pathway Methodology. The Technical Specification limit was exceeded using the Maximum Pathway Methodology due to large leakage from the RWCU return isolation valve (2G33-F040) and the "A" Feedwater inboard check valve (2B21-F010A). Both components resulted in infinite leakage. Failed components were 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	2.967	2.967	3.057	-------
Type C	101.663	INFINITE	93.208	-------
Total	104.63	INFINITE	96.265	231.4

MAIN STEAM ISOLATION VALVES (TESTED AT 25 PSIG)

The As-Found leak rate for the Main Steam Isolation Valves did not exceed Technical Specification limits.

STEAM LINE	As-Found Leak Rate (SCFH)	As-Left Leak Rate (SCFH)	Tech Spec Limit (SCFH)
A	29.35	29.35	------
B	15.54	15.54	------
C	7.79	7.79	------
D	8.56	2.09	------
Total	61.24	54.77	100.00

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/Thermistor temps in subvolume #i

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

Where

N = The number of RTDs/Thermistors 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

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

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.

C. 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

CALCULATION OF CONTAINMENT DRY AIR MASS

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.

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

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 $32 \leq D_i \leq 80°F$

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

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 $115 \leq D_i \leq 155°F$

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

CALCULATION OF CONTAINMENT DRY AIR MASS

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.

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

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

CALCULATION OF CONTAINMENT DRY AIR MASS

For $0.50683 \leq Pv_c \leq 1.4711$ psia

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

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

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.

CALCULATION OF CONTAINMENT DRY AIR MASS

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)

$$P_d = P - Pv_c$$

J. Total Containment Dry Air Mass, (M)

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

where

R = Perfect gas constant of air, 53.35 $lb_f - ft/lb_m - {}^\circ R$

V_c = Total containment free volume.

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:

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

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

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

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

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 (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.

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

BN-TOP-1 METHOD TEST CALCULATIONS

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:

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

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

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%.

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 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.

BN-TOP-1 METHOD TEST CALCULATIONS

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

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

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

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

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

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

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

BN-TOP-1 METHOD TEST CALCULATIONS

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:

$$\text{Confidence limits} = L \pm T\sigma \qquad [12]$$

or

$$UCL = Li + T\sigma \qquad [13]$$

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.

DATA REJECTION CRITERIA

1. If a sensor, in the opinion of the ILRT Test Engineer, is out of range, it will be ignored (i.e., set=0) and the total number of operable RTD's/Thermistors or Dewcells in the containment 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 a loss of temperature or humidity sensor occur, the bad sensor will be locked out. The volume fraction of the locked out sensor will be assigned to a substitute instrument (as many as five substitutes) which is located in similar temperature location based on temperature survey and/or temperature distribution prior to instrument failure. The volume fraction of the locked out sensor will be set equal to zero. Data from the locked out sensor will continue to be monitored and displayed. However, the data from the locked out sensor will not be used in the ILRT calculations. Document on Attachment Z data sheet and in Events Log, (Attachment C).

NOTE

If all RTD's/Thermistors in Subvolume 8 are lost, then STOP the test and repair the RTD's/Thermistors, or if the air in Subvolume 8 can be shown to be near saturation, use Subvolume 8 Average Dewcell Temperature.

If all dewcells in Subvolume 8 are lost and the air in Subvolume 8 can be shown to be near saturation, use Subvolume 8 Average RTD/Thermistor Temperature. Also, it the average RTD/Thermistor temperature over the last 6 data sets is within 0.5° F of a specific RTD/Thermistor, the specific RTD/Thermistor may be chosen as the dewcell.

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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 recalculated with bad element(s) deleted.

DATA REJECTION DATA SHEET

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.

ILRT TEST INSTRUMENTATION REQUIREMENTS

10CFR50, Appendix J specifies that all Type A tests be conducted in accordance with the provisions of the American National Standard, N45.4-1972. Section 6.4 of that standard requires that the combined precision of all instruments used to perform a Type A test be such that the accuracy of the collected data is consistent with the magnitude of the specified leakage rate.

The Instrument Selection Guide (ISG) formulation defined in Appendix G of the 1987 Standard, ANSI/ANS-56.8, is an acceptable means of determining the ability of the Type A Test Instrumentation System to measure the integrated leakage rate of a Primary Reactor Containment System. This rather long formulation is labor intensive to calculate, either by hand or by computer.

Section 5.4 of Commonwealth Edison NO Directive, NOD-TS.13, specifies that all Commonwealth Edison plants shall use a standardized instrumentation system for Type A testing. The following is a list of the resolutions, repeatabilities, and sensitivities which may be expected when the standardized system is used. Also listed are the recommended minimum numbers of each type of sensor:

ILRT INSTRUMENTATION SYSTEM SPECIFICATIONS

Pressure Transmitters:	Resolution	0.0001 psi
	Repeatability	0.001 psi
	Sensitivity	0.0001 psi
	Minimum Number	1
Temperature Channels:	Resolution	0.01 °F
	Repeatability	0.02 °F
	Sensitivity	0.01 °F
	Minimum Number	15
Dew Temperature Channels:	Resolution	0.01 °F
	Repeatability	0.1 °F
	Sensitivity	0.1 °F
	Minimum Number	5

Instrument Parameter Definitions From ANSI/ANS 56.8 - 1987

Repeatability: The capability of the measurement system to reproduce a given reading from a constant source.

Resolution: The least unit discernible on the display mechanism.

Sensitivity: The capability of a measurement system to respond to change in the measured parameter.