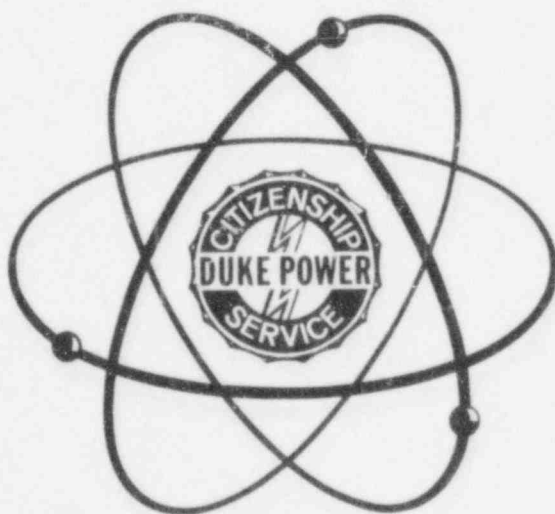


# **DUKE POWER COMPANY CATAWBA NUCLEAR STATION UNIT 2**

## **REACTOR CONTAINMENT BUILDING INTEGRATED LEAK RATE TEST**



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DUKE POWER COMPANY  
CATAWBA NUCLEAR STATION  
UNIT 2  
REACTOR CONTAINMENT BUILDING  
INTEGRATED LEAK RATE TEST  
(PREOPERATIONAL)

CONDUCTED JUNE 29 - JULY 11, 1985

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I. DEFINITION OF SYMBOLS AND ABBREVIATIONS

ILRT	Integrated Leak Rate Test
E	Repeatability error
e	Absolute error
$\Sigma$	Measurement system error
$^{\circ}\text{F}$	Temperature, degrees Fahrenheit
FOM	Figure of Merit
$L_a$	0.20% by weight of the containment air per 24 hours at $P_a$ , 14.68 psig
$L_{am}$	Measured overall integrated containment leakage rate. It is $\leq 0.75 L_a$
$L_t$	Maximum allowable reduced pressure (7.34 psig) test leak rate. Determined during the preoperational test and is equal to $L_a$ ( $L_{tm}/L_{am}$ ) with $L_{tm}/L_{am} \leq 0.7$
$L_{tm}$	Measured overall integrated containment leakage rate during reduced pressure test. It is $\leq 0.75 L_t$
LR	Total observed leak rate during the ILRT.
LR(95%)	95% upper confidence level of observed leak rate of the containment vessel
$L_{aux}$	Leak rate of all penetrations, valves, flanges which cannot be exposed to test pressure.
$L_c$	Total observed leak rate during the supplemental test
$L_o$	The known leakage rate superimposed on the containment during the supplemental test.
LLRT	Local leak rate test
P	Pressure
$P_a$	Design accident pressure
psia	absolute pressure
psig	Gauge pressure

°R	Temperature, degrees Rankine
SIT	Structural integrity test
T	Temperature
T <sub>dp</sub>	Dew point temperature
t	Time
V	Containment volume, cubic feet

## II. INTRODUCTION

The purpose of this report is to provide adequate information so that an objective review of the test can be performed. This will ensure that the test results reflect truly the leakage characteristic of the as-built containment. In conformance with the Appendix J of 10CFR50 and associated ANSI standards, the absolute method and mass-plot techniques, which require monitoring the containment vessel temperature and pressure to determine the change in containment vessel air mass caused by leakage, are used as the framework for selecting test equipment, developing test computer programs and test procedures.

The Catawba Unit 2 Containment System consists of a containment vessel and a separate reactor building enclosing an annulus. The following containment vessel specifications are used as base data for the containment leak rate test.

- Containment Net Free Volume	1,216,173 ft <sup>3</sup> (no ice loaded)
- Design pressure	15 PSIG
- Calculated Peak Accident Pressure	14.68 PSIG
- Test Pressure	<u>&gt;</u> 14.68 PSIG for Full Pressure Test
- Test Temperature	Ambient

51 Resistance Temperature Detectors, 3 Dewpoint hygrometers and 3 pressure sensors are installed at predetermined locations in the containment vessel to determine the weighted averages of containment vessel temperature, vapor pressure and pressure. The Catawba containment vessel leak rate test utilizes a fully automatic Data Acquisition System. All raw test data is scanned, printed and recorded on Cassette tape automatically to minimize uncontrolled random errors. Assigned engineers of Duke Power Company were responsible for drafting and conducting the test. Two 12-hour shift crews which consisted of one shift coordinator, one shift engineer, and two technicians were utilized to maintain 24 hour test activity.

Pressurization for the Catawba Unit 2 ILRT was accomplished by 3 diesel driven portable air compressors/dryers rented from Atlas-Copco. Two compressors were rated at 900 cfm @ 120 psig and one was rated for 1200 cfm @ 120 psig. These compressors supplied air directly to Upper and Lower Containment and to the Ice Condenser through a 40°F dewpoint dryer. When the test was completed, the containment vessel was depressurized through the containment hydrogen sample and purge system in the annulus and the containment air release and addition system in the Auxiliary Building. The release rate can be controlled if the air is contaminated. Section IX, Figures 2 and 3 show the pressurization and depressurization path used in this test.

### III. TEST PURPOSE

The purpose of the Preoperational Containment Integrated Leak Rate Test is to determine the leak rate of the containment vessel under controlled test conditions; to verify that there were no unidentified openings in the containment vessel due to incomplete construction; and to evaluate the possibility of accurately measuring the containment leak rate in a shorter period of time and/or at a reduced pressure.

The containment vessel was preconditioned to provide test conditions which satisfy the following:

- The vessel is under a calculated accident pressure of 14.68 psig for the Full Pressure Test.
- Air temperature and pressure are stable to avoid biasing the leakage characteristics.
- The containment vessel and all penetrations are lined up as close as possible to the predicted post-accident condition; i.e., those portions of the fluid system that are part of the reactor coolant pressure boundary and are opened directly to the containment atmosphere under post-accident conditions and become an extension of the boundary of the containment shall be opened or vented to the containment atmosphere prior to and during the test.

The test utilized highly accurate sensors and an automatic data system to assure the accuracy and quality of the test data.

Statistical and error propagation analyses are performed on the test data to ensure that the test results are reliable and accurate.

IV. SUMMARY

The Containment Vessel Integrated Leak Rate and Structural Integrity Test was initiated on 6/29/85 and completed on 7/9/85. It was conducted in compliance with the Catawba FSAR and Title 10, Code of Federal Regulations, Part 50, Appendix J, which states that the containment vessel is subject to a test to assure that an acceptable upper limit of leakage of radioactive material is not exceeded under design accident basis.

The vessel was initially pressurized up to 16.618 psig (110.8% of design pressure) and held for 10 minutes for the Structural Integrity Test. Pressure was then reduced to  $\leq 85\%$  of  $P_T$  and held for  $\geq 24$  hours to allow for outgassing. Pressure was then increased to  $\geq 7.34$  psig and the reduced pressure test was begun at 0215 on 7/2/85 after a  $> 4$  hour temperature stabilization period. After obtaining 22 hours worth of what appeared to be acceptable results, the data acquisition equipment began to fail. Values were reading correctly on the digital display, but were being randomly changed as they were relayed to the data logger. Due to this problem and the fact that a half-pressure test was not required, the half pressure test was aborted and efforts concentrated on repairing the equipment.

Pressure was then increased to  $\geq 14.68$  psig and the full pressure ILRT was begun at 0415 on 7/6/85 after a  $> 4$  hour temperature stabilization period. The data was recorded manually from the digital output display and edited if necessary, on the computer. The test was evaluated as acceptable at 0745 on 7/8/85 using 27.5 hours of test data with the following results:

$$\begin{aligned} LR &= 0.1202962\%/Day \\ LR(95\%) &= 0.1255774\%/Day \end{aligned}$$

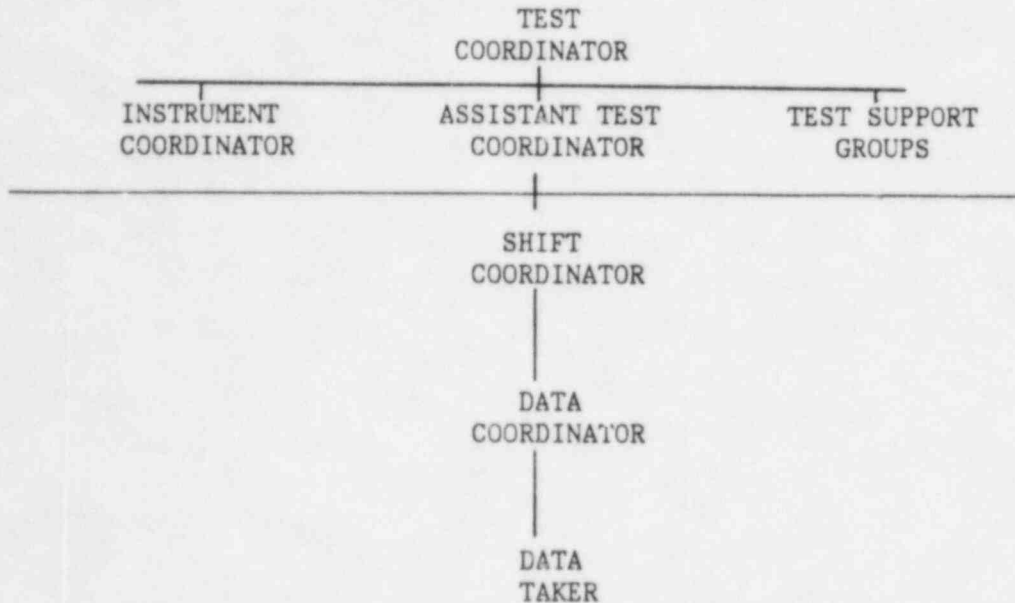
The 95% UCL was less than the acceptance criteria of 0.15%/day.

The supplemental verification test began at 0735 on 7/8/85 and was determined acceptable at 1835 on 7/8/85 with an observed leak rate of 0.3018148%/day.

This test was conducted per test procedure TP/2/A/1200/06, Containment Initial Integrated Leak Rate Test and Structural Integrity Test.

V. TEST ORGANIZATION

In order to assure that the test is conducted in a safe and efficient manner, assigned personnel are organized as shown and their responsibility defined.



Test Coordinator: His lead responsibility is to provide overall planning and efficient execution of the test. He is also to provide same support to his 12 hour shift.

Assistant Test Coordinator: His lead responsibility is to assume test coordinator responsibilities during his 12 hour shift.

Instrumentation Coordinator: His responsibility is to provide test equipment maintenance support to Test Coordinator.

Test Support Groups: Their responsibilities are to furnish technical support to Test personnel as required in conducting the ILRT, solving test problems, and minimizing schedule delays.

Shift Coordinator: Assume general responsibility for ILRT execution on a shift basis.

Data Coordinator: His lead responsibility is to process and edit raw data.

Data Taker: Record data accurately at correct intervals.



## VI. TEST BACKGROUND INFORMATION

- A. Test Method: The absolute method of leakage rate testing is used for the Catawba test. This requires the determination and calculation of air losses by the containment vessel leakage over a stated period of time by the means of direct pressure, temperature and dewpoint observations during the period of the test. Sensors are properly located to provide an average value of the containment vessel temperature and pressure. The effect of the partial pressure of water vapor is measured and compensated.

Upon completion of the 24 hour leak rate test, a test is performed to verify the accuracy of the leak rate test. This requires superimposing a controlled and measurable leak on the containment vessel and the composite leakage of both the containment vessel and the superimposed leak is measured. The difference between the result of the leakage measurement obtained prior to the introduction of the superimposed leak and that of the composite leak determines the accuracy of the leak rate test.

The test environment is simulated as close to that of designed accident basis as possible. All portions of the fluid systems that are postulated as opening directly to the containment or outside atmosphere under post-accident conditions are opened or vented during the test except systems required to maintain the plant in safe conditions during the test.

The test pressure is the calculated design basis accident pressure of 14.68 psig for the full pressure test.

- B. Calculation Technique: Mass of the containment vessel air volume is calculated by the Ideal Gas Law for 24 consecutive hours and plotted against time. The leak rate is obtained by a linear least square fit to the mass plot graph. The 95% confidence upper limit of the leak rate is calculated by applying the Student T Distribution Test on the leak rate test result. This upper limit is compared with the acceptance criteria to determine the completion of the test. See also Appendix A.
- C. Test Activity Flow Chart: Figure 1, Containment Pressure versus Time provides an overall look of the test activities. This provides information for test planning and test execution.
- D. Test Acceptance Criteria And Test Results

1.a. Structural Integrity Test Acceptance Criteria:

The Containment Structural Integrity Test is acceptable if a pressure of at least 16.5 psig is maintained for 10 minutes without any apparent changes in appearance of or other abnormal degradation of the containment vessel surfaces.



The Reactor Building Structural Integrity Test is acceptable if a visual inspection detects no abnormal degradation or changes in appearance.

1.b. Structural Integrity Test Results:

No apparent changes in appearance or abnormal degradation of the containment vessel surfaces were detected after a > 10 minute hold at 16.618 psig.

The Reactor Building Inspection detected no abnormal degradation or changes in appearance.

2.a Hot Penetrations Leakage Test Acceptance Criteria:

The hot penetration soap bubble test detects no leakage for those penetrations listed in the test procedure per Tech Spec 4.6.1.2.e.

2.b Hot Penetrations Leakage Test Results:

No leakage was detected for those penetrations listed in the test procedure.

3.a. Full Pressure Test Acceptance Criteria:

The measured overall integrated containment leakage rate ( $L_{am}$ ) is less than or equal to  $0.75 L_a$  with the test pressure  $\geq 14.68$  psig.  $L_{am} \leq 0.75 L_a$  where  $L_a = 0.20$  percent by weight of the containment air per 24 hours @  $P_a$  (14.68 psig)  $L_{am} \leq 0.15\%/Day$ .

Also,  $L_{am} = LR(95\%) + L_{aux}$

where  $LR(95\%) = 95\%$  Upper Confidence Level of observed leak rate of the Containment Vessel

and  $L_{aux} =$  Leak rate of all penetrations, valves, flanges which cannot be exposed to test pressure due to system operation.

The difference between the supplemental verification test and the total observed leak rate is within  $0.25 L_a$ :

$$|(L_c - L_o) - LR| \leq 0.25 L_a$$

Where  $L_c =$  Total observed leak rate during supplemental test

$L_o =$  The known leakage rate superimposed on the containment during the supplemental test

The quantity of air bled from containment during the supplemental test must be equivalent to 75 to 125% of the leakage rate  $L_a$ .

$$0.75 L_a \leq L_o \leq 1.25 L_a$$

3.b Full Pressure Test Results:

24-Hour Test Result (0415, 7/6/85 to 0744, 7/7/85)

LR = 0.1202962 %/Day

LR(95%) = 0.1255774 %/Day

The following penetrations were not exposed to test pressure due to system alignment required by ILRT. They were Type C tested and the leakage added to  $L_{aux}$ .

<u>Penetration #</u>	<u>System</u>	<u>Reason</u>
M204	VQ	Flowpath for turbine flowmeter during imposed leak rate test.
M346	VY	Relief valve for containment connected to this penetration.
CNIP-2MI5	MI	ILRT Pressure sensing line.
CNIP-2MI6	MI	ILRT Pressure sensing line.
CNIP-2MI7	MI	ILRT Pressure sensing line.

The following penetrations were not exposed to test pressure due to an exemption from venting and draining in Supplement 3 to the Catawba SER. These penetrations contain a "reverse" check valve for overpressurization protection and process containment isolation valves receiving seal injection water. Therefore the reverse check valve is Type C tested and the results added to  $L_{aux}$ .

<u>Penetration #</u>	<u>System</u>
M256 (2NV90 only)	NV
M230 (2RN485 only)	RN
M308 (2RN430 only)	RN
M221 (2WL868 only)	WL
M345 (2WL806 only)	WL
M359 (2WLA22 only)	WL
M374 (2WL321 only)	WL

The following penetrations were not exposed to test pressure due to following reasons:

<u>Penetration #</u>	<u>System</u>	<u>Reason</u>
CNIP-2NS10	NS	Pressure transmitter 2NSPT5260 was an exception to turnover and was not installed prior to ILRT. The transmitter was Type C tested after ILRT and the results added to L <sub>aux</sub> .
M240	RN	This penetration has the outside isolation valve supplied by NW. The inside check unit is type C tested. However, it was noticed to be leaking excessively prior to beginning the 24 hour leak rate test and so the penetration was isolated. Maintenance was performed on 2RN438 and valve internals were rebuilt/replaced. A Type C test was performed on 2RN438 and results were added to L <sub>aux</sub> .
M321 (2KC279 only)	KC	Exempted from venting and draining since both containment isolation valves receive seal injection water. A reverse check valve bypasses this inside containment isolation valve. This check valve is Type C tested and results added to L <sub>aux</sub> .  The NRC was notified that this penetration would be exempted from venting and draining for Type A testing per letter from H. B. Tucker to Harold R. Denton, dated July 30, 1985, File No.: CN-801.01.
Upper Air Lock Emerg. Air Penetration	IAE	Pressurization fixture was installed on penetration to allow entry into containment during inspections. Type B test results were added to L <sub>aux</sub> .

<u>Penetration</u>	<u>System</u>	<u>Leakage</u> <u>(sccm) x 2.1476x10<sup>-8</sup></u>		<u>%/Day</u> <u>sccm</u>	<u>Leakage</u> <u>= %/Day</u>
M308	RN	1	x 2.1476x10 <sup>-8</sup>		= 2.1476x10 <sup>-8</sup>
M221	WL	1	x 2.1476x10 <sup>-8</sup>		= 2.1476x10 <sup>-8</sup>
M345	WL	1.8	x 2.1476x10 <sup>-8</sup>		= 3.8657x10 <sup>-8</sup>
M359	WL	1.6	x 2.1476x10 <sup>-8</sup>		= 3.4362x10 <sup>-8</sup>
M374	WL	49.4	x 2.1476x10 <sup>-8</sup>		= 1.0609x10 <sup>-6</sup>
M240	RN	13	x 2.1476x10 <sup>-8</sup>		= 2.7919x10 <sup>-7</sup>
M321	KC	1	x 2.1476x10 <sup>-8</sup>		= 2.1476x10 <sup>-8</sup>
CNIP-2NS10	NS	1.8	X 2.1476x10 <sup>-8</sup>		= 3.8657x10 <sup>-8</sup>
Upper Air Lock Emerg. Air Penetration	IAE	3.16	x 2.1476x10 <sup>-8</sup>		= 6.7864x10 <sup>-8</sup>

$$\text{Total } L_{\text{aux}} = 3.3279 \times 10^{-6} \text{ \%/Day}$$

Therefore,

$$\begin{aligned}
 L_{\text{am}} &= LR(95\%) + L_{\text{aux}} \\
 &= 0.1255774\text{ \%/Day} + \underline{3.3279 \times 10^{-6}} \text{ \%/Day} \\
 &= \underline{0.1255807} \text{ \%/Day}
 \end{aligned}$$

Which is within Acceptable Criteria of  $\leq 0.15\text{ \%/Day}$

## Supplemental Verification Test Results:

$$L_c = 0.3018148\%/Day$$

$$L_o = 0.200003\%/Day$$

$$LR = 0.1202962\%/Day$$

$$|(L_c - L_o) - LR| \leq 0.25 L_a$$

$$|(0.3018148 - 0.200003) - 0.1202962| \leq 0.050\%/Day$$

$$0.0185 \leq 0.050\%/Day$$

which is within Acceptance Criteria

$$0.75 L_a \leq L_o \leq 1.25 L_a$$

$$0.75 (0.20) \leq 0.200003 \leq 1.25 (0.20)$$

$$0.15\%/Day \leq 0.200003\%/Day \leq 0.25\%/Day$$

Which is within Acceptance Criteria.

E. RESULTS OF TYPE B AND C LEAK RATE TESTS

<u>Test</u>		<u>Final Conservative Test Results</u>	
PT/2/A/4200/01C, Isolation		2006.6	sccm
Valve Leak Rate Test	=	$4.3411 \times 10^{-5}$	%/Day
PT/2/A/4200/41A, Containment		3395.8	sccm
Purge Isolation Valve Leak Rate Test	=	$7.293 \times 10^{-5}$	%/Day
PT/2/A/4200/41B, VQ Penetration		80.0	sccm
Leak Rate Test	=	$1.7181 \times 10^{-6}$	%/Day
PT/2/A/4200/01D, Fuel Transfer		1.0	sccm
Tube Leak Rate Test	=	$2.1476 \times 10^{-8}$	%/Day
TP/2/A/1200/18, Upper Cont.		1683	sccm
Personnel Lock Leak Rate Test	=	$3.6144 \times 10^{-5}$	%/Day
TP/2/A/1200/19, Lower Cont.		1861	sccm
Personnel Lock Leak Rate Test	=	$3.997 \times 10^{-5}$	%/Day
PT/2/A/4200/01H, Equipment Hatch		14.5	sccm
Leak Rate Test	=	$3.1140 \times 10^{-7}$	%/Day
PT/2/A/4200/01B, Electrical		271.4	sccm
Penetration Leak Rate Test	=	$5.8286 \times 10^{-6}$	%/Day
PT/2/A/4200/01P, NF Penetration		4.2	sccm
Leak Rate Test	=	$9.020 \times 10^{-8}$	%/Day
PT/2/A/4200/01R, M301 Penetration		2.8	sccm
Leak Rate Test	=	$6.013280 \times 10^{-8}$	%/Day



Output: Visual display plus 0-5 VDC signal for recording

The Data Acquisition Facility is a Leeds and Northrup Catalog Number 70072-409-4999-6-000000-0600-00-001-301-099 Digital Data Surveillance Facility with the following features:

- Numation Numeric Display
- Scanner/Programmer
- Digital Printer
- Digital Clock
- Cassette Tape Recorder

Section IX, Figure 4 shows the test instrumentation set-up.

#### B. Computer Program

To provide on-line data analysis, a computer program is developed using formulas and methods specified in Appendix A. The Leak Rate Test Program (LRT) reads instrument readings from a magnetic tape cassette taken from the data recorder on the Digital Data Surveillance Facility (DDSF). The raw data from the tape is calibrated using quadratic curve fits. This calibrated data is then checked for validity. Using the mass plot analysis method, the calibrated verified data is processed to yield a normalized weight which is the ratio of the mass of air in the containment at the present time to that which was initially present when the test began. Linear regression and confidence interval calculations are then performed to determine whether the results have coveredaged sufficiently to yield an accurate indication of the actual containment leak rate.

Using the terminal procedures detailed in the user documentation, the test administrator can run the program from any teletype-compatible terminal device having magnetic tape cassette capability. The program is designed for interactive processing so that at each step the user will be queried as to how he wishes the work to be accomplished. Instrument parameters and readings can be entered into the computer system either automatically from cassette or manually from the terminal keyboard. If any errors are detected in the data, then the user will have the option of correcting the specific error on the computer instead of re-entering all of the data.

All data stored in the computer is protected by a password selected at the beginning of the test and must be specified each time the program is run to gain access to the data. This provides some measure of protection against inadvertent intrusion during the conduct of the test. At the conclusion of the test all of the stored data, from raw instrument readings through intermediate results to the final results, will be copied to an archival storage medium to satisfy long-term retention requirements of regulatory agencies. The archives can be placed on active storage at any time to verify calculations or generate reports.



C. Instrument Error Analysis

(Equations used in the section can be found in ANS N274, Draft Revision 3, November 15, 1978)

Symbols:

FOM = Instrument Figure of Merit (%/day)  
 t = Test duration (hrs)  
 P = Test pressure (PSIA) (use 14.68 psig for Full Pressure Test, 7.34 psig for Reduced Pressure Test)  
 $P_v$  = Vapor pressure at test time (PSIA)  
 T = Cont. weighted average absolute test temp. (°F) (Assume 76.63°F)  
 e = Error associated with measurement of change  
 E = Sensor error (Sensitivity)  
 $\Sigma$  = Measurement system error excluding sensor

## 1. Pressure:

No. of sensors = 3  
 Range 0 - 40 PSIA

Sensor Error ( $E_p$ ) =  $\pm 0.008\%FS = 0.0032$  PSIA

Measurement system repeatability error ( $\Sigma_p$ ) =  $\pm 0.002\%FS = 0.0008$  PSIA

$$e_p = \pm \frac{[(E_p)^2 + (\Sigma_p)^2]^{\frac{1}{2}}}{(3)^{\frac{1}{2}}} = \pm 0.0019044 \text{ PSIA}$$

## 2. Vapor Pressure:

No. of sensors = 3  
 Range -40°F to 120°F

Sensor Error E =  $\pm 0.40^\circ F$  or  $\pm .001268$  PSIA\*

Measurement System Error ( $\Sigma$ ) =  $\pm 0.05^\circ F$  or  $\pm .0001585$  PSIA\*

$$e_{p_v} = \frac{[(.001268)^2 + (.0001585)^2]^{\frac{1}{2}}}{(3)^{\frac{1}{2}}} = \pm .0007378 \text{ PSIA}$$

\*At dewpoint of 36°F, the rate of vapor pressure change per 1°F is .00317 PSIA/°F

## 3. Temperature

No. of Sensor = 52\*

Sensor Error =  $\pm 0.40^{\circ}\text{F}$  or  $\pm 0.40^{\circ}\text{R}$ Measurement System Error =  $\pm .15^{\circ}\text{F}$  or  $\pm .15^{\circ}\text{R}$ 

$$e_T = \pm \frac{[(.4^{\circ}\text{R})^2 + (.15^{\circ}\text{R})^2]^{\frac{1}{2}}}{(52)^{\frac{1}{2}}} = \pm .0592420^{\circ}\text{R}$$

\*Although only 51 were used during the test due to one RTD giving an open signal.

## 4. FOM (Figure of Merit)

$$\begin{aligned} \text{FOM} &= \pm \frac{2400}{t} \left[ \left( \frac{2 e_p}{p} \right)^2 + 2 \left( \frac{e_{PV}}{p} \right)^2 + 2 \left( \frac{e_T}{T} \right)^2 \right]^{1/2} \\ &= \pm \frac{2400}{24} \left[ 2 \left( \frac{.0019044}{29.376} \right)^2 + 2 \left( \frac{.0007378}{29.376} \right)^2 + 2 \left( \frac{.0592420}{536.3} \right)^2 \right]^{1/2} \\ &= \pm .0184585\% \text{ per day for Full Pressure Test} \\ &\quad (\text{Note that value is } \leq 0.25L_a = 0.05) \end{aligned}$$

These FOM values indicate that test instrument repeatability is adequate to provide a precision measurement of maximum allowable leak rate for both Full and Reduced Pressure Leakage Tests.

Random errors on test results were analyzed under 95% confidence analysis and incorporated into the test results for acceptance verification.

The test also underwent the required accuracy test at the end of the 24 hour ILRT and met the Acceptance Criteria (See test results).

VIII. CONCLUSION

With all conservative factors built in the test results analysis, the following conclusions were made on the Catawba Unit 2 ILRT:

1. Catawba Unit 2 Containment Vessel is capable of safely containing fission products under designed accident conditions.
2. With a properly controlled test environment, test acceptance could be attained much earlier than the 24 hour minimum required time for a 24-hour test.
3. No unidentified opening in the Catawba Unit 2 Containment vessel exists due to incomplete construction.

IX. ILRT FIGURES

1. Containment Pressure vs Time
2. RTD Locations and Pressurization/Depressurization Paths
3. Pressurization System
4. Test Instrumentation System

Containment Pressure Vs. Time

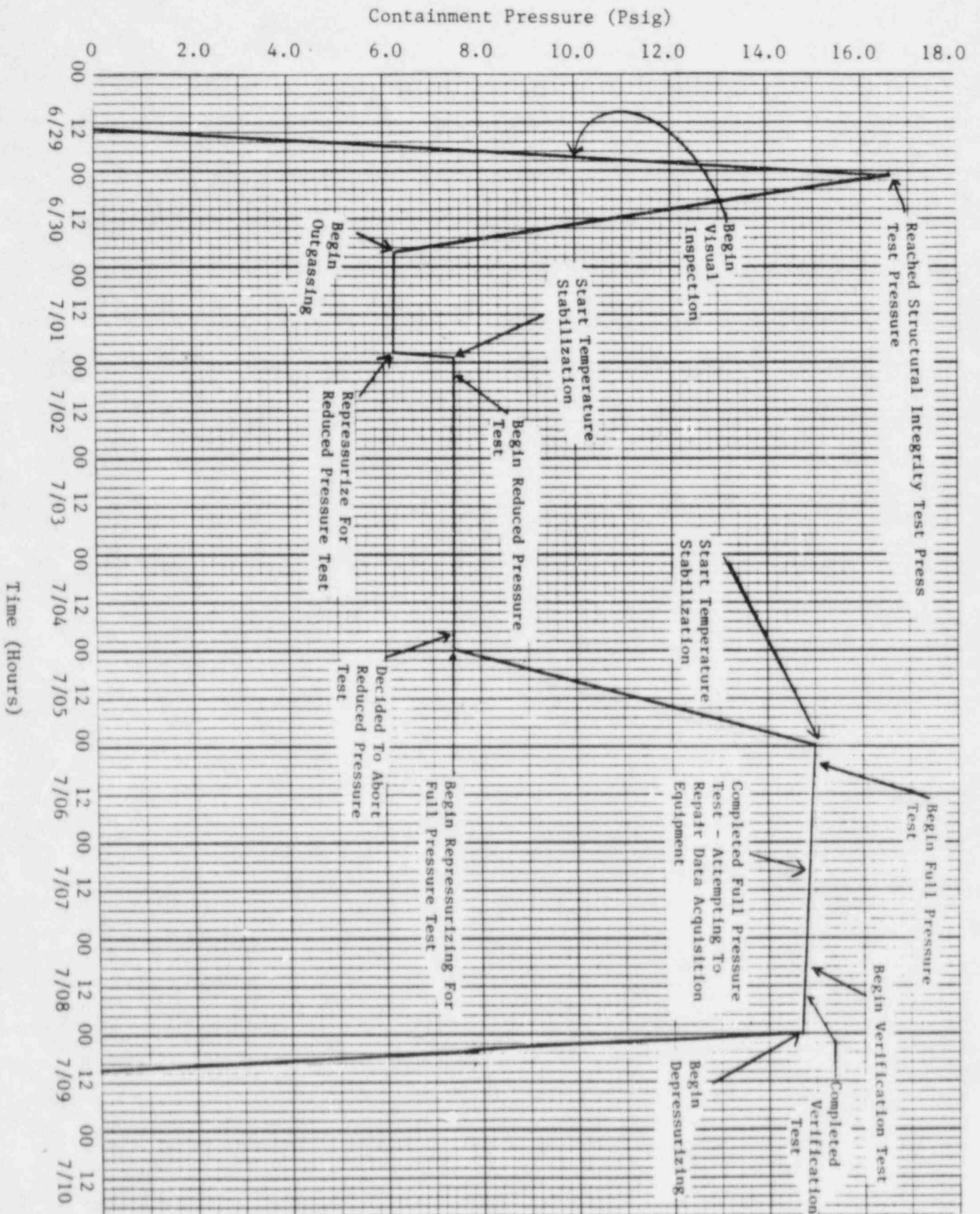


FIGURE 2

RTD Locations and Pressurization/Depressurization Paths

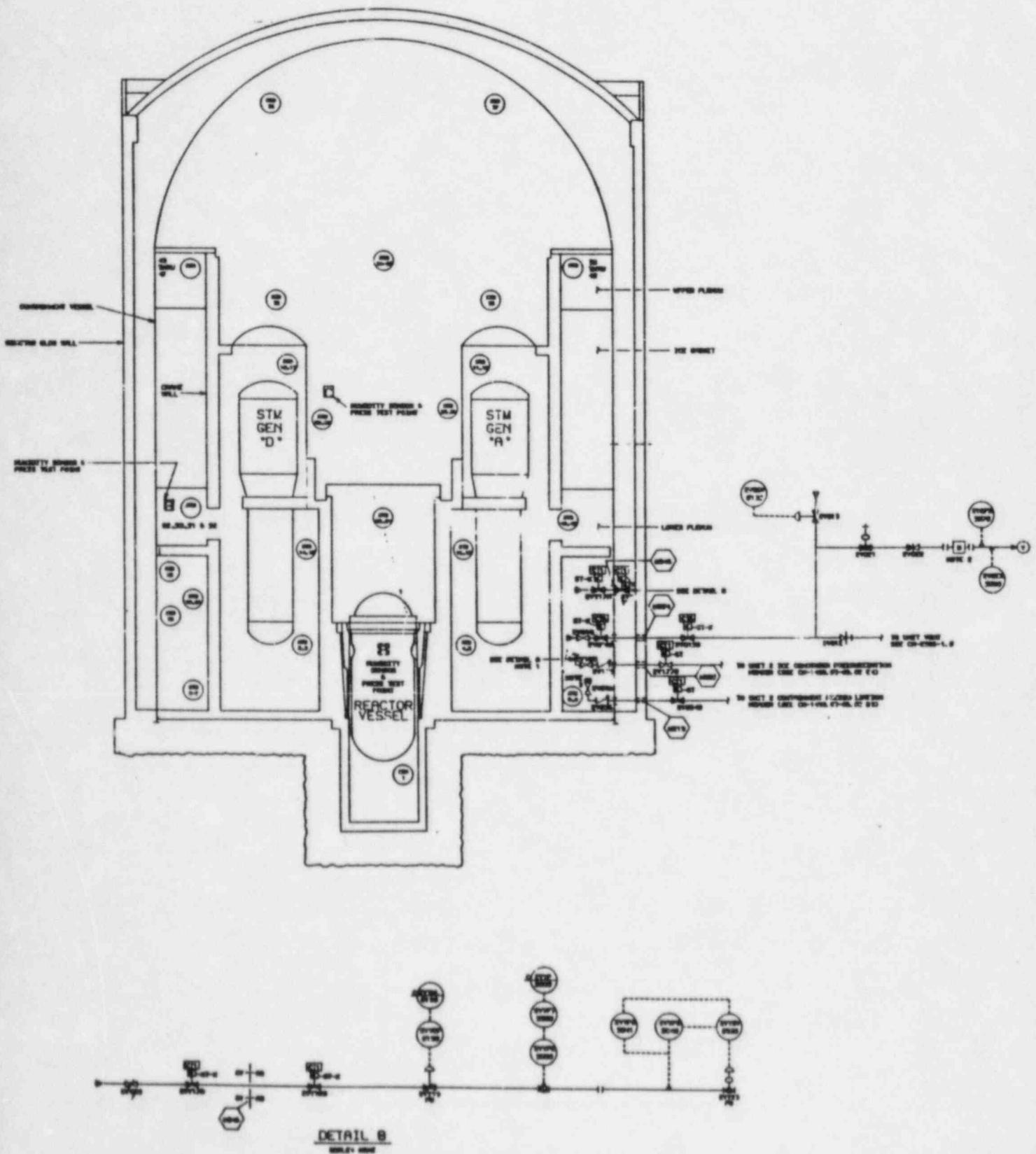
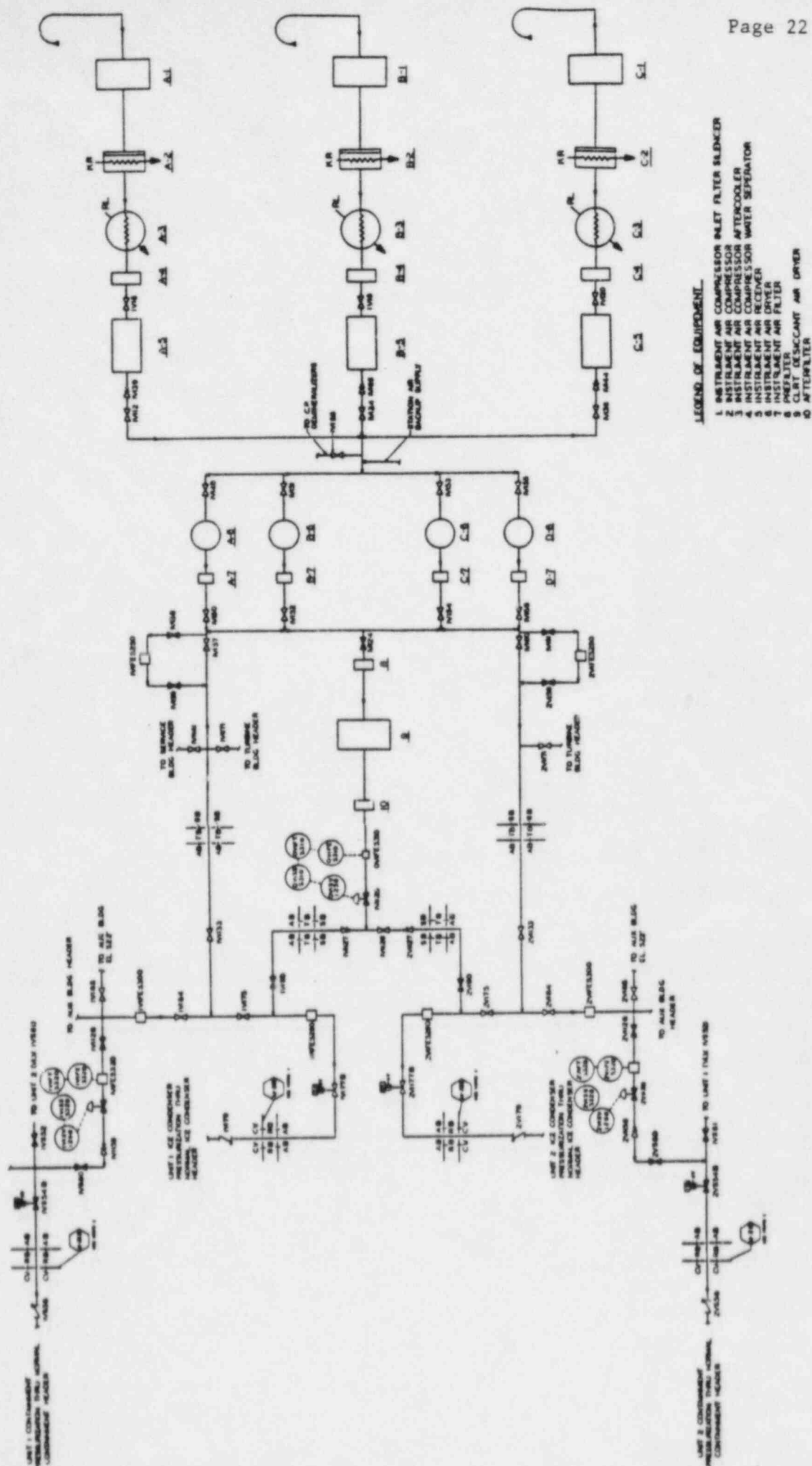


FIGURE 3

Pressurization System



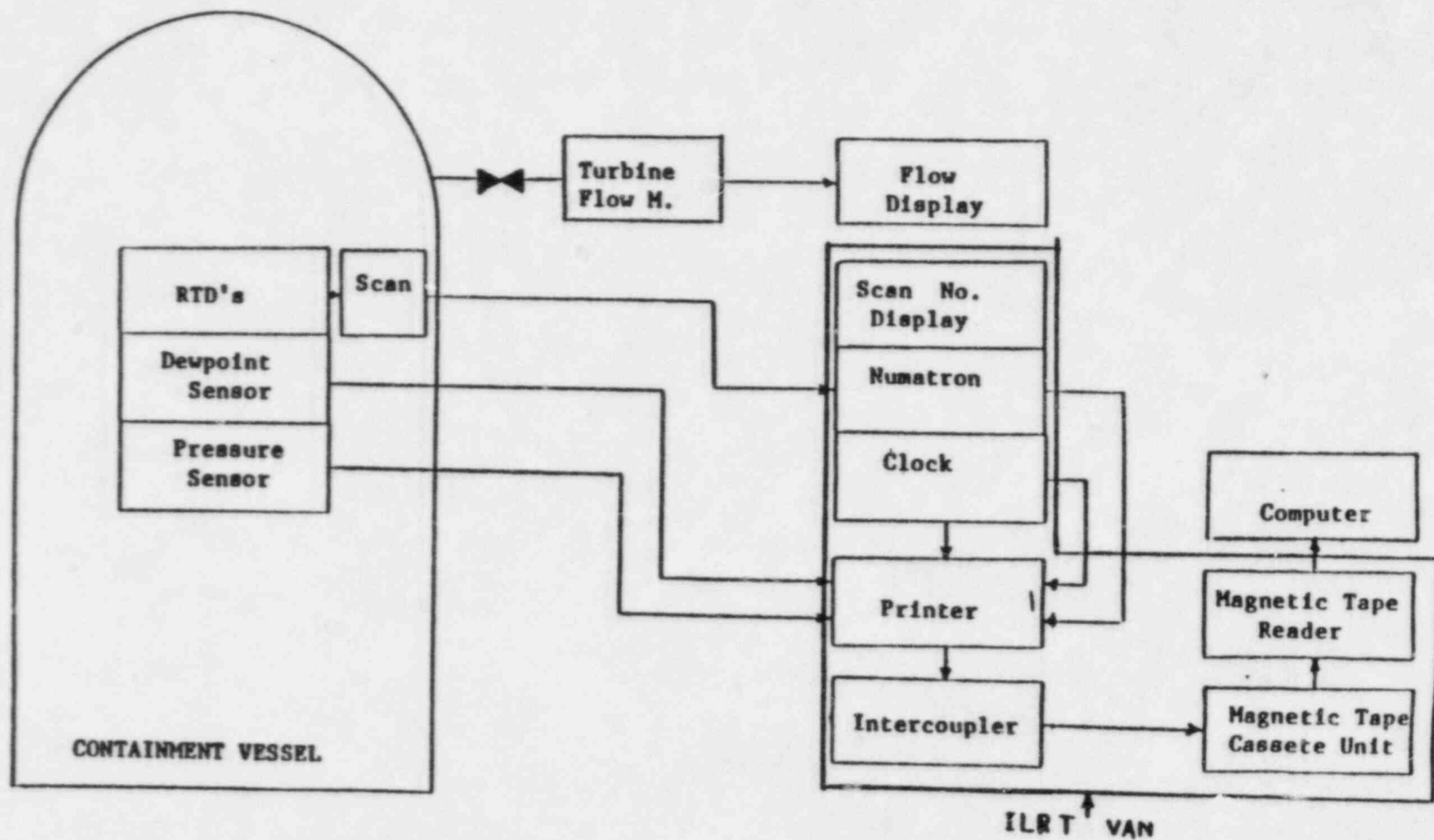


FIGURE 4  
Test Instrumentation System



X. RTD LOCATIONSLOWER CONTAINMENT (CONTAINMENT VOLUME FRACTION = 0.2612)

RTD #	GENERAL LOCATION	COMPARTMENT VOLUME FRACTION
1	Wall mounted in incore inst. area	0.0528
2	S.G. D lower support structure el. 570'	0.0530
3	S.G. A lower support structure el. 570'	0.0530
4	S.G. B lower support structure el. 570'	0.0530
5	S.G. C lower support structure el. 570'	0.0530
6	Wall mounted in tunnel area	0.0327
7	Wall mounted in tunnel area	0.0327
8	Wall mounted in tunnel area	0.0327
9	Wall mounted in tunnel area	0.0327
10	On top of S.G. 2D	0.0530
11	On top of S.G. 2C	0.0530
12	On top of S.G. 2B	0.0530
13	On top of S.G. 2A	0.0530
14	On top of NC Pump 2D	0.0530
15	On top of NC Pump 2A	0.0530
16	On top of NC Pump 2B	0.0530
17	On top of NC Pump 2C	0.0530
18	In Accumulator Room 2D	0.0120
19	In Accumulator Room 2C	0.0101
20	In Accumulator Room 2B	0.0116
21	In Accumulator Room 2A	0.0116

RTD #	GENERAL LOCATION	CONTAINMENT VOLUME FRACTION
25	Column mounted in incore instrumentation area	0.0533
26	Column mounted near lower containment vent	0.0419
27	Column mounted near lower containment vent	0.0399

UPPER CONTAINMENT (CONTAINMENT VOLUME FRACTION = 0.5734)

RTD #	GENERAL LOCATION	COMPARTMENT VOLUME FRACTION
28	On concrete housing for S.G. 2D	0.0590
29	On concrete housing for S.G. 2A	0.0590
30	On concrete housing for S.G. 2B	0.0590
31	On concrete housing for S.G. 2C	0.0590
32	On wall between S.G. 2A & 2D	0.1150
33	On wall between S.G. 2B & 2C	0.1150
34	On wall below crane track el. 665'	0.1100
35	On wall below crane track el. 665'	0.1100
36	On cont. spray piping 31'6" of center el. 707'	0.0950
37	On cont. spray piping 31'6" of center el. 707'	0.0950
22	Wall mounted in room with air return fans	0.0200
23	Mounted on ladder support in reactor cavity	0.0590
24	Mounted on ladder support in reactor internals storage area	0.0450

ICE CONDENSER (CONTAINMENT VOLUME FRACTION = 0.1654)

RTD #	GENERAL LOCATION	COMPARTMENT VOLUME FRACTION
38-43	Evenly spaced around the upper plenum area el. 669'	0.0538 Each
44-47	Evenly spaced around the upper plenum area	0.0539 Each
48-49	Evenly spaced around the lower plenum area el. 600'	0.0882 Each
50	Lower plenum area el. 600'	0.1385
52	Lower plenum area el. 600'	0.1384

## APPENDICES

## APPENDIX A

### DERIVATIONS AND FORMULAS FOR CATAWBA CONTAINMENT LEAK RATE COMPUTATIONS

This appendix presents derivations of formulas used to develop the Catawba leak rate computer program.

## DEFINITION OF SYMBOLS

- $P$  = Absolute pressure in the Containment Vessel (PSFA)  
 $T$  = Weighted average absolute temperature of the Containment Vessel air compartment ( $^{\circ}\text{R}$ )  
 $W_i$  = Normalized mass of containment vessel air at  $i$  data point (dimension less)  
 $P_v$  = Partial pressure of water vapor (PSFA)  
 $t_{th}$  = time (min)  
 $V_k$  = Assigned volume fraction of  $k$  sensor (Fraction of volume)  
 $T_k$  = Recorded temperature of  $k$  sensor ( $^{\circ}\text{R}$ )  
 $W_i$  = Estimated value of  $W_i$  in the least square fit calculation  
 $b$  = Slope of the least square fit line (fraction/min.)  
 $LR(95\%)$  = 95% confidence value of LR  
 $LR$  = Measured containment leakage rate (%/day)  
 $a$  = y intercept of the least square fit line (dimensionless)  
 $S^2_{W_i}$  = the variance of  $W_i$

$S^2_b$  = the variance of  $b$   
 $b$

## SUBSCRIPTS

- $u$  = upper containment compartment  
 $L$  = lower containment compartment  
 $I$  = Ice Condenser compartment  
 $v$  = vapor  
 $l_{th}$  = data point at start of test  
 $i_{th}$  =  $i$  data point ( $i = 1$  to  $N$ )  
 $N_{th}$  = Final data point of a given set  
 $k$  =  $k$  sensor

## MASS PLOT CALCULATION AND STATISTICAL TREATMENT OF LEAK RATE DATA

Normalized Containment Vessel Air Mass

The air mass of the Containment Vessel is calculated using ideal gas law compensated for partial water vapor pressure. Air mass of 3 compartments (lower, upper, Ice) are determined separately and combined to yield the whole Containment Vessel to simplify the calculation. Normalization of  $W_i$  is applied by taking the ratio of the  $i_{th}$  value and that of the initial value.

The values 0.5734, 0.2612, 0.1654 are the assigned volume fraction for upper containment, lower containment and Ice Condenser

The average temperature  $T$  at each compartment is calculated as the sum of the volume weighted recorded temperatures.

$$W_i = \frac{0.5734 \left( \frac{P-P}{T} v \right)_u^i + 0.2612 \left( \frac{P-P}{T} v \right)_L^i + 0.1654 \left( \frac{P-P}{T} v \right)_I^i}{0.5734 \left( \frac{P-P}{T} v \right)_u^1 + 0.2612 \left( \frac{P-P}{T} v \right)_L^1 + 0.1654 \left( \frac{P-P}{T} v \right)_I^1}$$

$$T = \frac{\sum T V}{\sum k} \quad \begin{array}{l} k = 1 \text{ to } 21, 25 \text{ to } 27 \text{ for lower} \\ \text{containment} \\ k = 22 \text{ to } 24, 28 \text{ to } 37 \text{ for upper} \\ \text{containment} \\ k = 39 \text{ to } 52 \text{ for ice condenser} \end{array}$$

See Section X for volume fraction of each sensor.

#### Leakage Rate of the Containment Vessel

The graph of  $W_i$  versus time is least square fitted to yield an estimated straight line. The rate of the containment vessel air mass loss (or the containment vessel leak rate) is the slope  $b$  of the least square fitted line  $W_i$ :

$$\hat{W}_i = bt_i + a$$

The value of  $a$  and  $b$  can be determined by taking the first partial derivation of the sum of square of deviation  $Q$  ( $Q = \sum (W_i - \hat{W}_i)^2$ ) with respect to  $a$  and  $b$  and minimize them:

$$\frac{\delta Q}{\delta a} = \frac{\delta \left[ \sum (W_i - \hat{W}_i)^2 \right]}{\delta a} = 0 \quad \begin{array}{l} \hat{W}_i = bt_i + a \\ W_i - \hat{W}_i = W_i - bt_i - a \end{array}$$

$$\frac{\delta \left[ \sum_i (W_i - \hat{W}_i)^2 \right]}{\delta a} = 2 \sum (W_i - bt_i - a) = 0$$

$$\sum (W_i - bt_i - a) = 0$$

$$Na + b\sum t_i = \sum W_i \quad (1)$$

$$\frac{\delta Q}{\delta b} = \frac{\delta \left[ \sum_i (W_i - \hat{W}_i)^2 \right]}{\delta b} = 0$$

$$\hat{W}_i = bt_i + a$$

$$W_i - \hat{W}_i = W_i - bt_i - a$$

$$\frac{\delta \left[ \sum_i (W_i - \hat{W}_i)^2 \right]}{\delta b} = 2 \sum -t_i (W_i - bt_i - a) = 0$$

$$\sum -t_i (W_i - bt_i - a) = 0 \quad (2)$$

$$a\sum t_i + b\sum t_i^2 = \sum t_i W_i \quad (3)$$

with (1) and (3), a and b can be solved by matrix:

$$Na + (\sum t_i) b = \sum W_i \quad (1)$$

$$(\sum t_i) a + (\sum t_i^2) b = \sum t_i W_i \quad (3)$$

$$N \quad \sum W_i$$

$$b = \frac{\sum t_i \quad \sum t_i \quad W_i}{N \quad \sum t_i \quad \sum t_i^2} = \frac{N \sum t_i W_i - (\sum W_i) (\sum t_i)}{N \sum t_i^2 - (\sum t_i)^2} \quad (4)$$



$$a = \frac{\sum w_i \sum t_i}{N \sum t_i^2} = \frac{\sum w_i \sum t_i^2 - \sum t_i \sum t_i w_i}{N \sum t_i^2 - (\sum t_i)^2} \quad (5)$$

$$LR = -b \text{ 144000\% per day}$$

(\*unless otherwise specified, all summation will be from  $i = 1$  to  $i = N$ )

It is important to emphasize here that the slope  $b$  or leak rate is formulated on the following assumptions:

- the deviation of  $W_i$  from the true value are distributed according to the gas distribution function
- only the  $W_i$  contains random error, not the  $t_i$

### The Confidence Limit of the Slope of the Least Square Line

As indicated in the error analysis, the random error is a major contribution which deviates the test result from the true value. Due to the random characteristics of this error, only statistical treatment can possibly evaluate the error effect on the test result. In order to choose a proper statistical treatment, it is important to identify the characteristics of the observed data. In the previous derivation, it is found that LR is the outcome of the calculation from the observed temperature and pressure in the Containment Vessel using the ideal gas law and curve fitting method. It is now obvious that the observed data is a continuous measurement which is completely different from the discrete measurement. The latter requires discrete statistical treatment ( $\chi^2$  CHI SQUARE), while the former requires continuous statistical treatment (The t test).

The t test provides information which indicates how much the calculated leak rate deviated from the true value and at what probability.

In other words:

$$L_{(TRUE)} = LR \pm \text{"Deviation"} \text{ (percent of probability)}$$

For t test method "deviation" is defined as:

$$\text{Deviation} = t S_b$$

- t is a tabulated value which corresponds to the number of Data sets taken and the required probability (in this case 95% is chosen on popular basis).
- $S_b$  is the standard deviation of the variance of the containment air weight.

Equation (4) indicates that  $b = f(W_i)$  and by definition of variance:

$$S_b^2 = \sum \left( \frac{\delta b}{\delta W_i} \right)^2 S_w^2 \quad (5)$$

where  $S_w^2$  is the variance of  $W_i$ :

$$S_w^2 = \frac{\sum_i (W_i - a - bt_i)^2}{N-2} \quad (6)$$

The  $(N-2)$  is chosen here instead of  $N$  because the least square line  $W_i$  is restricted by value of  $b$  and  $a$ . The freedom to evaluate the variance of  $W_i$  is reduced by 2 even though  $N$  data is recorded.

$$\frac{\delta b}{\delta W_i} = \frac{\delta \frac{\left( N \sum_i t_i W_i - (\sum_i W_i) (\sum_i t_i) \right)}{N \sum_i t_i^2 - (\sum_i t_i)^2}}{\delta W_i}$$

$$\text{let } c = N \sum_i t_i^2 - (\sum_i t_i)^2$$

$$\begin{aligned} \frac{\delta b}{\delta W_i} &= \frac{\delta \frac{\left( N \sum_i t_i W_i - (\sum_i W_i) (\sum_i t_i) \right)}{c}}{\delta W_i} \\ &= \frac{1}{c} \delta \frac{\left( N \sum_i t_i W_i - (\sum_i W_i) (\sum_i t_i) \right)}{\delta W_i} \\ &= \frac{1}{c} (N t_i - \sum_i t_i) \end{aligned}$$

$$\left( \frac{\delta b}{\delta W_i} \right)^2 = \frac{1}{c^2} \left( N t_i - \sum_i t_i \right)^2 \quad (7)$$

Substitute (7) to (5)

$$\begin{aligned} S_b^2 &= \frac{S^2}{c^2} \sum_i (N t_i - \sum_i t_i)^2 \\ &= \frac{S^2}{c^2} \sum_i (N^2 t_i^2 - 2 N t_i \sum_i t_i + (\sum_i t_i)^2) \\ &= \frac{S^2}{c^2} (N^2 \sum_i t_i^2 - 2 N \sum_i t_i \sum_i t_i + N (\sum_i t_i)^2) \end{aligned}$$

$$= \frac{S^2}{c^2} (N \sum_i t_i^2 - N(\sum_i t_i)^2) \quad (8)$$

Substitute  $c = N \sum_i t_i^2 - (\sum_i t_i)^2$  to (8):

$$S_b^2 = \frac{NS^2W}{c} = S^2 \frac{c}{w/f}$$

$$\frac{c}{N} = \frac{N \sum_i t_i^2 - \sum_i t_i^2}{N} = \sum_i t_i^2 - \frac{\sum_i t_i^2}{N}$$

$$S_b^2 = \frac{S^2W}{\sum_i t_i^2 - \frac{\sum_i t_i^2}{N}}$$

The identity provides:

$$\sum_i (t_i - \bar{t})^2 = \sum_i t_i^2 - \frac{(\sum_i t_i)^2}{N} = \sum_i t_i^2 - \bar{t} \sum_i t_i$$

$$S_b^2 = \frac{S^2}{\sum_i t_i^2 - \frac{\sum_i t_i^2}{N}} = \frac{S^2}{\sum_i (t_i - \bar{t})^2} = \frac{S^2}{\sum_i t_i^2 - \bar{t} \sum_i t_i} \quad (9)$$

Summarization:

The following are the essential equations used in developing ILRT computer program:

$$W_i = \frac{0.5734 \left( \frac{P-P}{T} \right)_u^i + 0.2612 \left( \frac{P-P}{T} \right)_L^i + 0.1654 \left( \frac{P-P}{T} \right)_I^i}{0.5734 \left( \frac{P-P}{T} \right)_u^1 + 0.2612 \left( \frac{P-P}{T} \right)_L^1 + 0.1654 \left( \frac{P-P}{T} \right)_I^1}$$

$$T = \sum_k T_k V_k$$

$$W_i = bt_i + a$$

$$b = \frac{N \sum t_i W_i - (\sum W_i) (\sum t_i)}{N \sum t_i^2 - (\sum t_i)^2}$$

$$a = \frac{\sum W_i (\sum t_i^2) - (\sum t_i) (\sum t_i W_i)}{N \sum t_i^2 - (\sum t_i)^2}$$

$$LR = -b$$

$$LR(95\%) = LR \pm tS_b$$

t value corresponds to  $f = N-2$  and 0.975

$$S_W^2 = \frac{\sum (W_i - a - bt_i)^2}{N-2}$$

$$S_b = \left[ \frac{S_W^2}{\sum t_i^2 - \bar{t} \sum t_i} \right]^{\frac{1}{2}}$$

## APPENDIX B

### RAW AND PROCESSED DATA

# INITIALIZATION DATA

LOWER CONTAINMENT  
26 INSTRUMENT POINTS, 26.1% BLOC VOLUME

**VOLUME**

**BIDD**

**NYS**

**HEN**

**KEN**

**CON**

**SKU**

**SHU**

**LON**

**NOB**

UPPER CUTAASENT

[illegible]





FULL PRESSURE TEST CALIBRATED DATA

# LEAK RATE INSTRUMENT CALIBRATED DATA

POINTS:	1	2	3	4	5	6	7	8	9	10
425 RADING	187	178	170	162	154	146	138	130	122	114
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
426 RADING	187	178	170	162	154	146	138	130	122	114
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
427 RADING	187	178	170	162	154	146	138	130	122	114
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
428 RADING	187	178	170	162	154	146	138	130	122	114
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
429 RADING	187	178	170	162	154	146	138	130	122	114
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
430 RADING	187	178	170	162	154	146	138	130	122	114
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100
BANK	100	100	100	100	100	100	100	100	100	100













## LEAK RATE INSTRUMENT CALIBRATED DATA

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POYNTER

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## 7

*[The page contains extremely faint, illegible markings that appear to be bleed-through from the reverse side.]*



# LEAK RATE INSTRUMENT CALIBRATED DATA

POINTS:

1 2 3 4 5 6 7 8 9 10

479 READING AT

BANK	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
BANK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BANK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BANK	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459

480 READING AT

BANK	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
BANK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BANK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BANK	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459

481 READING AT

BANK	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
BANK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BANK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BANK	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459

482 READING AT

BANK	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
BANK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BANK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BANK	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459

483 READING AT

BANK	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
BANK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BANK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BANK	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459

484 READING AT

BANK	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000
BANK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BANK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BANK	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459	29.3459

10/26

**POINTS:**

[illegible]





**POINTS:**

13/26

[illegible]





# LEAK RATE INSTRUMENT CALIBRATED DATA

POINTS:	1	2	3	4	5	6	7	8	9	10
READING	187	187	187	187	187	187	187	187	187	187
INSTRUMENT	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
DATE	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
TIME	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
LOCATION	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
OPERATOR	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
REMARKS	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
1	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
3	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
5	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
6	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
7	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
8	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
9	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
10	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000

# LEAK RATE INSTRUMENT CALIBRATED DATA

POINTS:	1	2	3	4	5	6	7	8	9	10
READING	187	187	187	187	187	187	187	187	187	187
1	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
2	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
3	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
4	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
5	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
6	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
7	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
8	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
9	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000
10	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000	00000000







# LEAK RATE INSTRUMENT CALIBRATED DATA

POINTS	1	2	3	4	5	6	7	8	9	10
1	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
2	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
3	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
4	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
5	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
6	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
7	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
8	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
9	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
10	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000



# LEAK RATE INSTRUMENT CALIBRATED DATA

POINTS	1	2	3	4	5	6	7	8	9	10
POINT 1	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
POINT 2	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
POINT 3	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
POINT 4	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
POINT 5	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
POINT 6	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
POINT 7	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
POINT 8	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
POINT 9	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
POINT 10	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000

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# LEAK RATE INSTRUMENT CALIBRATED DATA

POINTS	1	2	3	4	5	6	7	8	9	10
1	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
2	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
3	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
4	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
5	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
6	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
7	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
8	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
9	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
10	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000



FULL PRESSURE TEST 24 HOUR RESULTS

# RESULTS OF CONTAINMENT MASS PLOT ANALYSIS (g/DAY)

TIME	MINIMUM	OBSERVED	MAXIMUM
1	0.00	0.00	0.00
2	0.00	0.00	0.00
3	0.00	0.00	0.00
4	0.00	0.00	0.00
5	0.00	0.00	0.00
6	0.00	0.00	0.00
7	0.00	0.00	0.00
8	0.00	0.00	0.00
9	0.00	0.00	0.00
10	0.00	0.00	0.00
11	0.00	0.00	0.00
12	0.00	0.00	0.00
13	0.00	0.00	0.00
14	0.00	0.00	0.00
15	0.00	0.00	0.00
16	0.00	0.00	0.00
17	0.00	0.00	0.00
18	0.00	0.00	0.00
19	0.00	0.00	0.00
20	0.00	0.00	0.00
21	0.00	0.00	0.00
22	0.00	0.00	0.00
23	0.00	0.00	0.00
24	0.00	0.00	0.00
25	0.00	0.00	0.00
26	0.00	0.00	0.00
27	0.00	0.00	0.00
28	0.00	0.00	0.00
29	0.00	0.00	0.00
30	0.00	0.00	0.00
31	0.00	0.00	0.00
32	0.00	0.00	0.00
33	0.00	0.00	0.00
34	0.00	0.00	0.00
35	0.00	0.00	0.00
36	0.00	0.00	0.00
37	0.00	0.00	0.00
38	0.00	0.00	0.00
39	0.00	0.00	0.00
40	0.00	0.00	0.00
41	0.00	0.00	0.00
42	0.00	0.00	0.00
43	0.00	0.00	0.00
44	0.00	0.00	0.00
45	0.00	0.00	0.00
46	0.00	0.00	0.00
47	0.00	0.00	0.00
48	0.00	0.00	0.00
49	0.00	0.00	0.00
50	0.00	0.00	0.00
51	0.00	0.00	0.00
52	0.00	0.00	0.00
53	0.00	0.00	0.00
54	0.00	0.00	0.00
55	0.00	0.00	0.00
56	0.00	0.00	0.00
57	0.00	0.00	0.00
58	0.00	0.00	0.00
59	0.00	0.00	0.00
60	0.00	0.00	0.00
61	0.00	0.00	0.00
62	0.00	0.00	0.00
63	0.00	0.00	0.00
64	0.00	0.00	0.00
65	0.00	0.00	0.00
66	0.00	0.00	0.00
67	0.00	0.00	0.00
68	0.00	0.00	0.00
69	0.00	0.00	0.00
70	0.00	0.00	0.00
71	0.00	0.00	0.00
72	0.00	0.00	0.00
73	0.00	0.00	0.00
74	0.00	0.00	0.00
75	0.00	0.00	0.00
76	0.00	0.00	0.00
77	0.00	0.00	0.00
78	0.00	0.00	0.00
79	0.00	0.00	0.00
80	0.00	0.00	0.00
81	0.00	0.00	0.00
82	0.00	0.00	0.00
83	0.00	0.00	0.00
84	0.00	0.00	0.00
85	0.00	0.00	0.00
86	0.00	0.00	0.00
87	0.00	0.00	0.00
88	0.00	0.00	0.00
89	0.00	0.00	0.00
90	0.00	0.00	0.00
91	0.00	0.00	0.00
92	0.00	0.00	0.00
93	0.00	0.00	0.00
94	0.00	0.00	0.00
95	0.00	0.00	0.00
96	0.00	0.00	0.00
97	0.00	0.00	0.00
98	0.00	0.00	0.00
99	0.00	0.00	0.00
100	0.00	0.00	0.00

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# RESULTS OF CONTAINMENT MASS PLOT ANALYSIS(9/DAY)

NO	TIME	MINIMUM	MAXIMUM
1	0000	0.00	0.00
2	0005	0.00	0.00
3	0010	0.00	0.00
4	0015	0.00	0.00
5	0020	0.00	0.00
6	0025	0.00	0.00
7	0030	0.00	0.00
8	0035	0.00	0.00
9	0040	0.00	0.00
10	0045	0.00	0.00
11	0050	0.00	0.00
12	0055	0.00	0.00
13	0100	0.00	0.00
14	0105	0.00	0.00
15	0110	0.00	0.00
16	0115	0.00	0.00
17	0120	0.00	0.00
18	0125	0.00	0.00
19	0130	0.00	0.00
20	0135	0.00	0.00
21	0140	0.00	0.00
22	0145	0.00	0.00
23	0150	0.00	0.00
24	0155	0.00	0.00
25	0200	0.00	0.00
26	0205	0.00	0.00
27	0210	0.00	0.00
28	0215	0.00	0.00
29	0220	0.00	0.00
30	0225	0.00	0.00
31	0230	0.00	0.00
32	0235	0.00	0.00
33	0240	0.00	0.00
34	0245	0.00	0.00
35	0250	0.00	0.00
36	0255	0.00	0.00
37	0300	0.00	0.00
38	0305	0.00	0.00
39	0310	0.00	0.00
40	0315	0.00	0.00
41	0320	0.00	0.00
42	0325	0.00	0.00
43	0330	0.00	0.00
44	0335	0.00	0.00
45	0340	0.00	0.00
46	0345	0.00	0.00
47	0350	0.00	0.00
48	0355	0.00	0.00
49	0400	0.00	0.00
50	0405	0.00	0.00
51	0410	0.00	0.00
52	0415	0.00	0.00
53	0420	0.00	0.00
54	0425	0.00	0.00
55	0430	0.00	0.00
56	0435	0.00	0.00
57	0440	0.00	0.00
58	0445	0.00	0.00
59	0450	0.00	0.00
60	0455	0.00	0.00
61	0500	0.00	0.00
62	0505	0.00	0.00
63	0510	0.00	0.00
64	0515	0.00	0.00
65	0520	0.00	0.00
66	0525	0.00	0.00
67	0530	0.00	0.00
68	0535	0.00	0.00
69	0540	0.00	0.00
70	0545	0.00	0.00
71	0550	0.00	0.00
72	0555	0.00	0.00
73	0600	0.00	0.00
74	0605	0.00	0.00
75	0610	0.00	0.00
76	0615	0.00	0.00
77	0620	0.00	0.00
78	0625	0.00	0.00
79	0630	0.00	0.00
80	0635	0.00	0.00
81	0640	0.00	0.00
82	0645	0.00	0.00
83	0650	0.00	0.00
84	0655	0.00	0.00
85	0700	0.00	0.00
86	0705	0.00	0.00
87	0710	0.00	0.00
88	0715	0.00	0.00
89	0720	0.00	0.00
90	0725	0.00	0.00
91	0730	0.00	0.00
92	0735	0.00	0.00
93	0740	0.00	0.00
94	0745	0.00	0.00
95	0750	0.00	0.00
96	0755	0.00	0.00
97	0800	0.00	0.00
98	0805	0.00	0.00
99	0810	0.00	0.00
100	0815	0.00	0.00

The image shows a document page with a grid of vertical lines and horizontal lines, resembling a ledger or a form. The page is heavily obscured by vertical black bars, likely representing redacted information or a scanning artifact. The text is mostly illegible due to the redaction.





## 0.1460N/DAY LEAKAGE OBSERVED AFTER 577 READINGS

LOG	TIME	WORK	EXP	DEV/LEAK	QSS	LEAK RATE	LEAK RATE
1	00:00	0000	0000	0000	0000	0000	0000
2	00:05	0005	0005	0005	0005	0005	0005
3	00:10	0010	0010	0010	0010	0010	0010
4	00:15	0015	0015	0015	0015	0015	0015
5	00:20	0020	0020	0020	0020	0020	0020
6	00:25	0025	0025	0025	0025	0025	0025
7	00:30	0030	0030	0030	0030	0030	0030
8	00:35	0035	0035	0035	0035	0035	0035
9	00:40	0040	0040	0040	0040	0040	0040
10	00:45	0045	0045	0045	0045	0045	0045
11	00:50	0050	0050	0050	0050	0050	0050
12	00:55	0055	0055	0055	0055	0055	0055
13	01:00	0100	0100	0100	0100	0100	0100
14	01:05	0105	0105	0105	0105	0105	0105
15	01:10	0110	0110	0110	0110	0110	0110
16	01:15	0115	0115	0115	0115	0115	0115
17	01:20	0120	0120	0120	0120	0120	0120
18	01:25	0125	0125	0125	0125	0125	0125
19	01:30	0130	0130	0130	0130	0130	0130
20	01:35	0135	0135	0135	0135	0135	0135
21	01:40	0140	0140	0140	0140	0140	0140
22	01:45	0145	0145	0145	0145	0145	0145
23	01:50	0150	0150	0150	0150	0150	0150
24	01:55	0155	0155	0155	0155	0155	0155
25	02:00	0200	0200	0200	0200	0200	0200
26	02:05	0205	0205	0205	0205	0205	0205
27	02:10	0210	0210	0210	0210	0210	0210
28	02:15	0215	0215	0215	0215	0215	0215
29	02:20	0220	0220	0220	0220	0220	0220
30	02:25	0225	0225	0225	0225	0225	0225
31	02:30	0230	0230	0230	0230	0230	0230
32	02:35	0235	0235	0235	0235	0235	0235
33	02:40	0240	0240	0240	0240	0240	0240
34	02:45	0245	0245	0245	0245	0245	0245
35	02:50	0250	0250	0250	0250	0250	0250
36	02:55	0255	0255	0255	0255	0255	0255
37	03:00	0300	0300	0300	0300	0300	0300
38	03:05	0305	0305	0305	0305	0305	0305
39	03:10	0310	0310	0310	0310	0310	0310
40	03:15	0315	0315	0315	0315	0315	0315
41	03:20	0320	0320	0320	0320	0320	0320
42	03:25	0325	0325	0325	0325	0325	0325
43	03:30	0330	0330	0330	0330	0330	0330
44	03:35	0335	0335	0335	0335	0335	0335
45	03:40	0340	0340	0340	0340	0340	0340
46	03:45	0345	0345	0345	0345	0345	0345
47	03:50	0350	0350	0350	0350	0350	0350
48	03:55	0355	0355	0355	0355	0355	0355
49	04:00	0400	0400	0400	0400	0400	0400
50	04:05	0405	0405	0405	0405	0405	0405
51	04:10	0410	0410	0410	0410	0410	0410
52	04:15	0415	0415	0415	0415	0415	0415
53							

## 0.1000/DAY LEAKAGE OBSERVED AFTER 577 READINGS

**Abstract**

LEAK DATE

LEAK RATE

NEW/LEARN

EXP WGT

42A 000

TIME

ROC

6/15

7/



# LEAK RATE NORMALIZED AIR WEIGHTS

TIME	ELAPSED	TOTAL CONTAINMENT	LOWER CONTAINMENT	UPPER CONTAINMENT	ICE CAPTURE
000	000	000	000	000	000
001	001	001	001	001	001
002	002	002	002	002	002
003	003	003	003	003	003
004	004	004	004	004	004
005	005	005	005	005	005
006	006	006	006	006	006
007	007	007	007	007	007
008	008	008	008	008	008
009	009	009	009	009	009
010	010	010	010	010	010
011	011	011	011	011	011
012	012	012	012	012	012
013	013	013	013	013	013
014	014	014	014	014	014
015	015	015	015	015	015
016	016	016	016	016	016
017	017	017	017	017	017
018	018	018	018	018	018
019	019	019	019	019	019
020	020	020	020	020	020
021	021	021	021	021	021
022	022	022	022	022	022
023	023	023	023	023	023
024	024	024	024	024	024
025	025	025	025	025	025
026	026	026	026	026	026
027	027	027	027	027	027
028	028	028	028	028	028
029	029	029	029	029	029
030	030	030	030	030	030
031	031	031	031	031	031
032	032	032	032	032	032
033	033	033	033	033	033
034	034	034	034	034	034
035	035	035	035	035	035
036	036	036	036	036	036
037	037	037	037	037	037
038	038	038	038	038	038
039	039	039	039	039	039
040	040	040	040	040	040
041	041	041	041	041	041
042	042	042	042	042	042
043	043	043	043	043	043
044	044	044	044	044	044
045	045	045	045	045	045
046	046	046	046	046	046
047	047	047	047	047	047
048	048	048	048	048	048
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051	051	051	051	051	051
052	052	052	052	052	052
053	053	053	053	053	053
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058	058	058	058	058	058
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076	076	076	076	076	076
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087	087	087	087	087	087
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091	091	091	091	091	091
092	092	092	092	092	092
093	093	093	093	093	093
094	094	094	094	094	094
095	095	095	095	095	095
096	096	096	096	096	096
097	097	097	097	097	097
098	098	098	098	098	098
099	099	099	099	099	099
100	100	100	100	100	100

# LEAK RATE NORMALIZED AIR WEIGHTS

ROD	TIME	ELAPSED	TOTAL CONTAINMENT	LOWER CONTAINMENT	LOWER CONTAINMENT	LOWER CONTAINMENT
				26.13	27.38	28.53
				BLOC VOLUME	BLOC VOLUME	BLOC VOLUME
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0	0	0
25	0	0	0	0	0	0
26	0	0	0	0	0	0
27	0	0	0	0	0	0
28	0	0	0	0	0	0
29	0	0	0	0	0	0
30	0	0	0	0	0	0
31	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0	0	0	0	0
34	0	0	0	0	0	0
35	0	0	0	0	0	0
36	0	0	0	0	0	0
37	0	0	0	0	0	0
38	0	0	0	0	0	0
39	0	0	0	0	0	0
40	0	0	0	0	0	0
41	0	0	0	0	0	0
42	0	0	0	0	0	0
43	0	0	0	0	0	0
44	0	0	0	0	0	0
45	0	0	0	0	0	0
46	0	0	0	0	0	0
47	0	0	0	0	0	0
48	0	0	0	0	0	0
49	0	0	0	0	0	0
50	0	0	0	0	0	0
51	0	0	0	0	0	0
52	0	0	0	0	0	0
53	0	0	0	0	0	0
54	0	0	0	0	0	0
55	0	0	0	0	0	0
56	0	0	0	0	0	0
57	0	0	0	0	0	0
58	0	0	0	0	0	0
59	0	0	0	0	0	0
60	0	0	0	0	0	0
61	0	0	0	0	0	0
62	0	0	0	0	0	0
63	0	0	0	0	0	0
64	0	0	0	0	0	0
65	0	0	0	0	0	0
66	0	0	0	0	0	0
67	0	0	0	0	0	0
68	0	0	0	0	0	0
69	0	0	0	0	0	0
70	0	0	0	0	0	0
71	0	0	0	0	0	0
72	0	0	0	0	0	0
73	0	0	0	0	0	0
74	0	0	0	0	0	0
75	0	0	0	0	0	0
76	0	0	0	0	0	0
77	0	0	0	0	0	0
78	0	0	0	0	0	0
79	0	0	0	0	0	0
80	0	0	0	0	0	0
81	0	0	0	0	0	0
82	0	0	0	0	0	0
83	0	0	0	0	0	0
84	0	0	0	0	0	0
85	0	0	0	0	0	0
86	0	0	0	0	0	0
87	0	0	0	0	0	0
88	0	0	0	0	0	0
89	0	0	0	0	0	0
90	0	0	0	0	0	0
91	0	0	0	0	0	0
92	0	0	0	0	0	0
93	0	0	0	0	0	0
94	0	0	0	0	0	0
95	0	0	0	0	0	0
96	0	0	0	0	0	0
97	0	0	0	0	0	0
98	0	0	0	0	0	0
99	0	0	0	0	0	0
100	0	0	0	0	0	0



# WEIGHTED COMPARTMENT AVERAGES BY READING

UPPER CONTAINER

THE COMPARTMENT

LOWER CONTAINER

UPPER CONTAINER

THE COMPARTMENT

LOWER CONTAINER

UPPER CONTAINER

THE COMPARTMENT

LOWER CONTAINER

UPPER CONTAINER

THE COMPARTMENT

LOWER CONTAINER

## WEIGHTED COMPARTMENT AVERAGES BY READING

LOWER CONTAINMENT

WFOO CONTINUUM

ICE CONDENSER

*[The page contains several columns of extremely faint, illegible text, likely bleed-through from the reverse side.]*

[illegible]

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
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1. The first column contains the names of the authors, such as "J. A. Smith", "J. B. Jones", etc.  
 2. The second column contains the titles of the papers, such as "On the Theory of...", "The Effect of...".  
 3. The third column contains the page numbers, such as "1-10", "11-20", etc.  
 4. The fourth column contains the volume numbers, such as "Vol. 1", "Vol. 2", etc.  
 5. The fifth column contains the issue numbers, such as "No. 1", "No. 2", etc.  
 6. The sixth column contains the years, such as "1910", "1911", etc.  
 7. The seventh column contains the names of the publishers, such as "John Wiley & Sons", "McGraw-Hill", etc.  
 8. The eighth column contains the names of the libraries, such as "Library of Congress", "British Museum", etc.  
 9. The ninth column contains the names of the institutions, such as "University of Cambridge", "University of Oxford", etc.  
 10. The tenth column contains the names of the countries, such as "United States", "Great Britain", etc.

1. The first part of the document is a title page. It contains the title of the document, the author's name, and the date of the document. The title is "The History of the City of New York from 1624 to 1789". The author is "John Smith". The date is "1789".

2014年12月10日

100





THE COMPANY

NUMBER 6

OWER\_CGHTA

**TOTAL CONFINEMENT**

ELAPSED

TIME

## WDC

13/15

## LEAK RATE CALCULATED AIR WEIGHTS

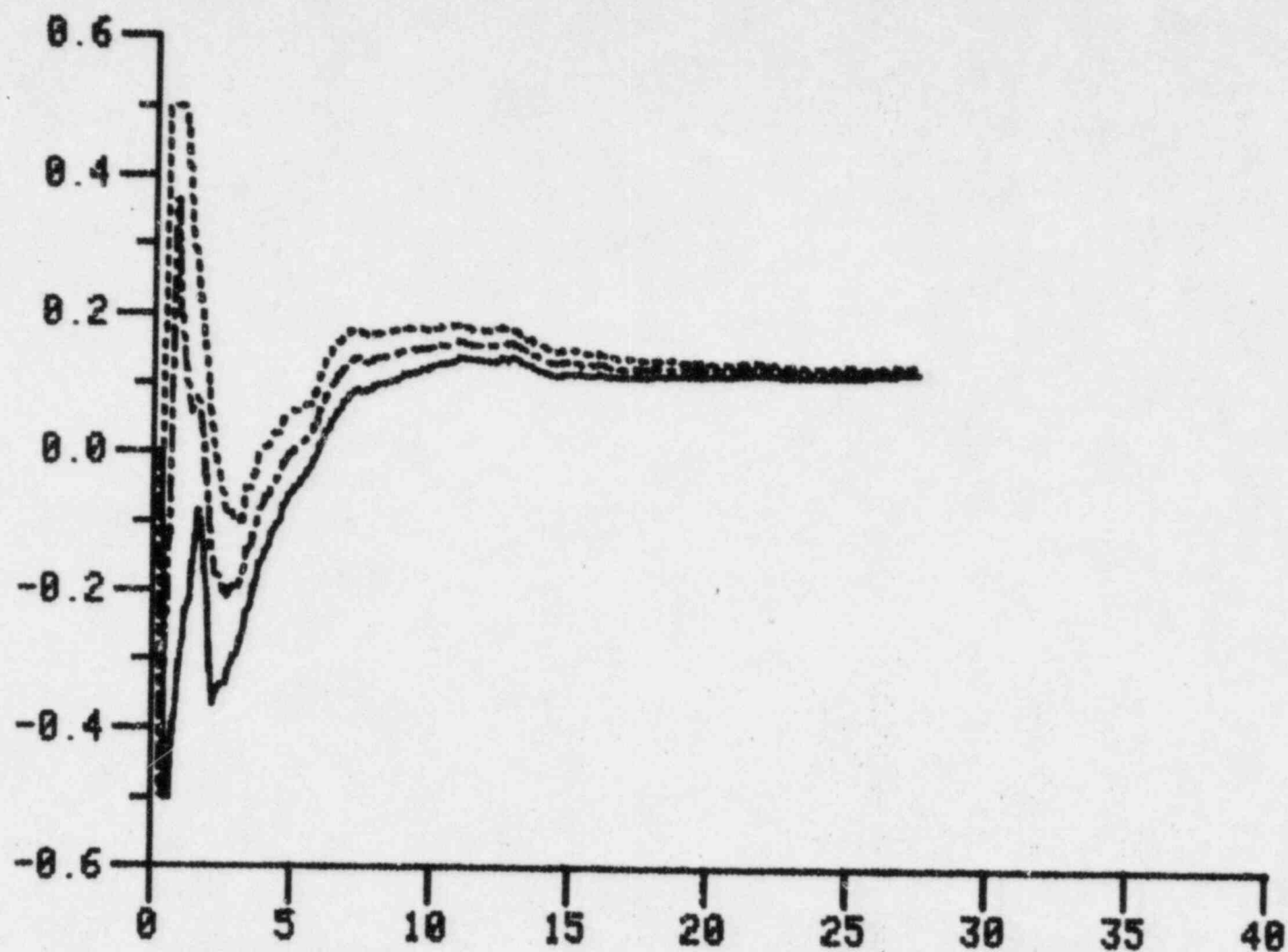
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LEAK RATE CALCULATED AIR WEIGHTS

[illegible]

DUKE POWER COMPANY, CATAWBA 2  
MASS PLOT ANALYSIS (MIN, OBS, MAX)



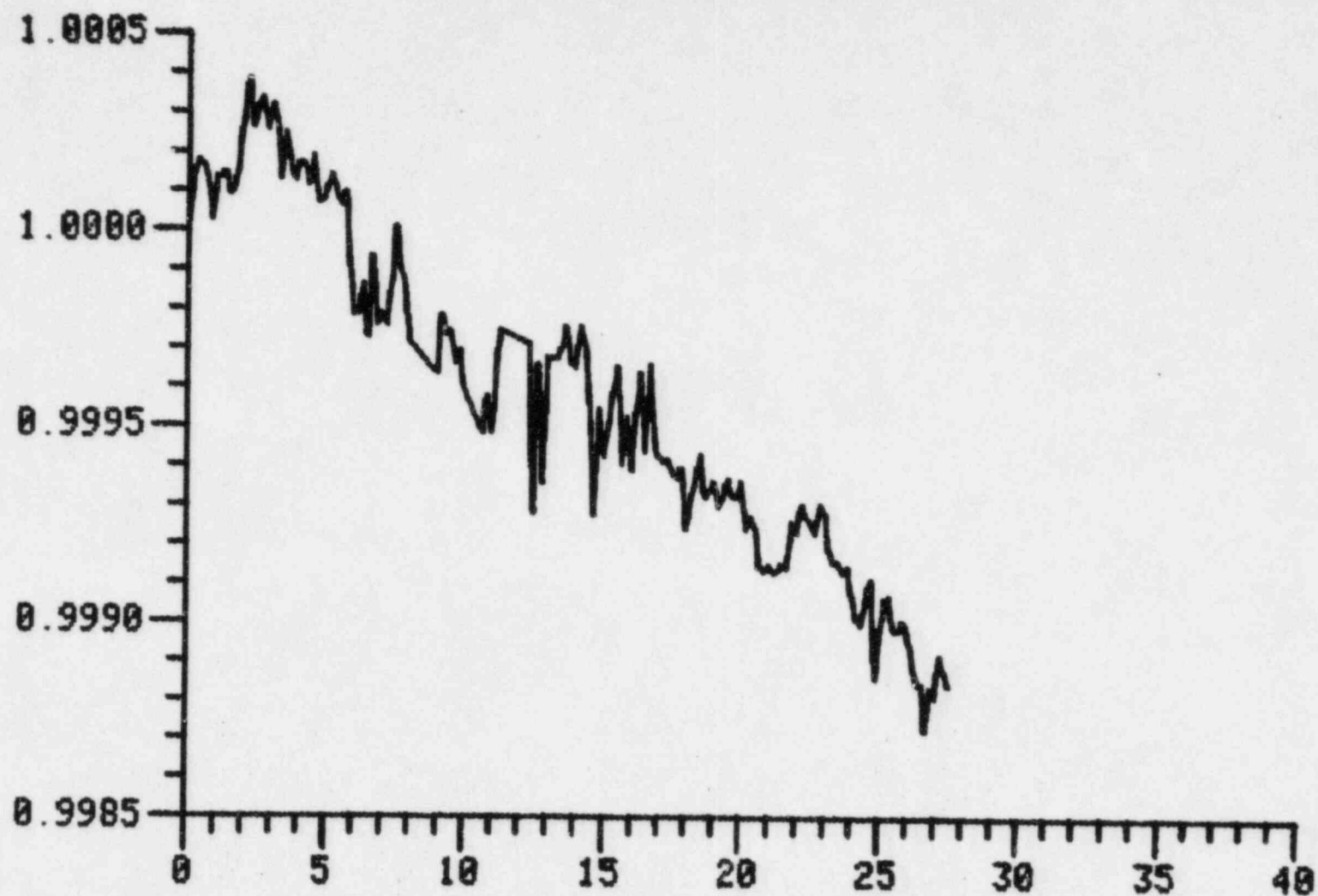
85187: 415 THRU 85188: 744

MIN - SOLID LINE

MAX - DASH LINE

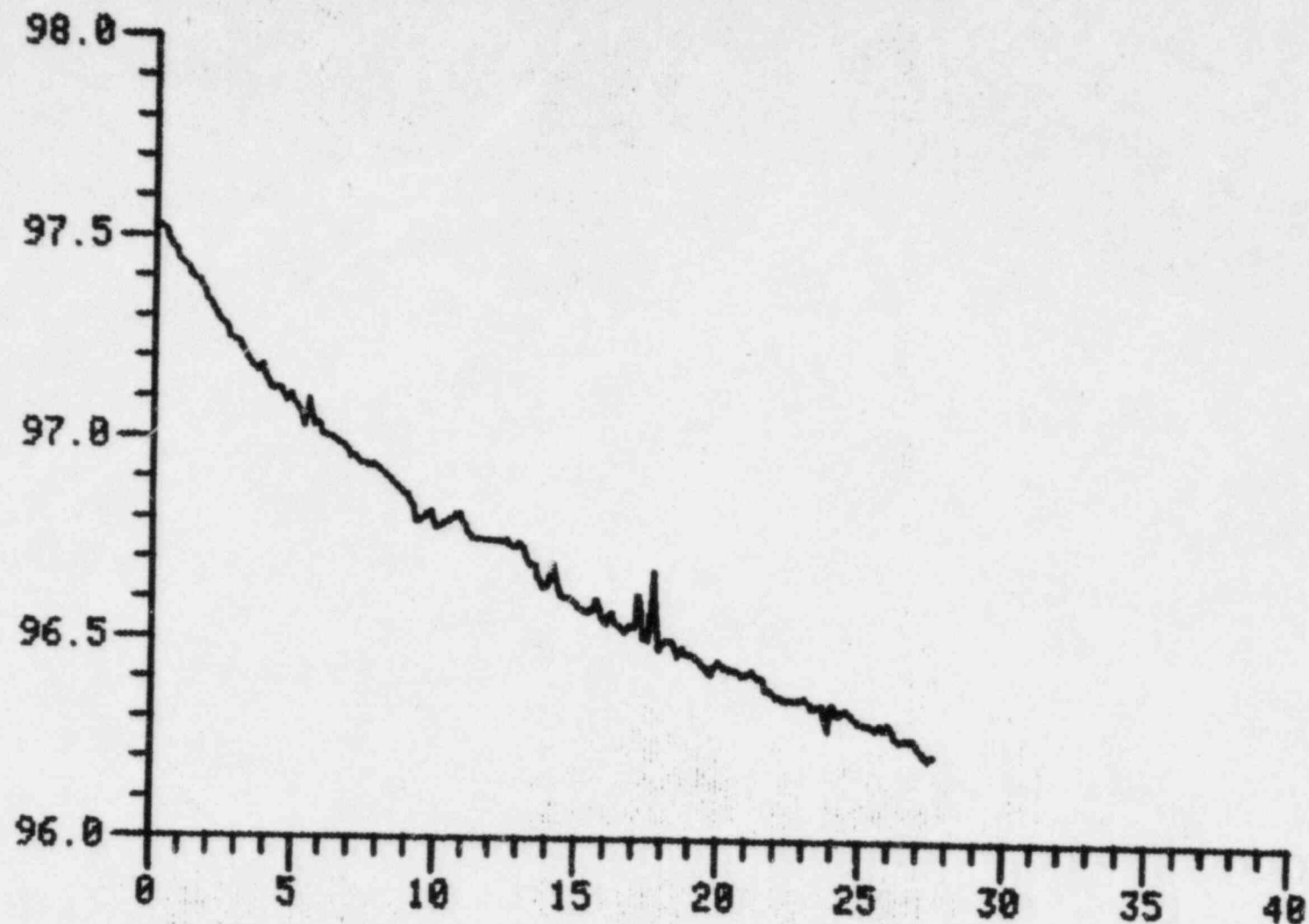
OBS - DOT/DASH LINE

DUKE POWER COMPANY, CATAWBA 2  
NORMALIZED AIR MASS



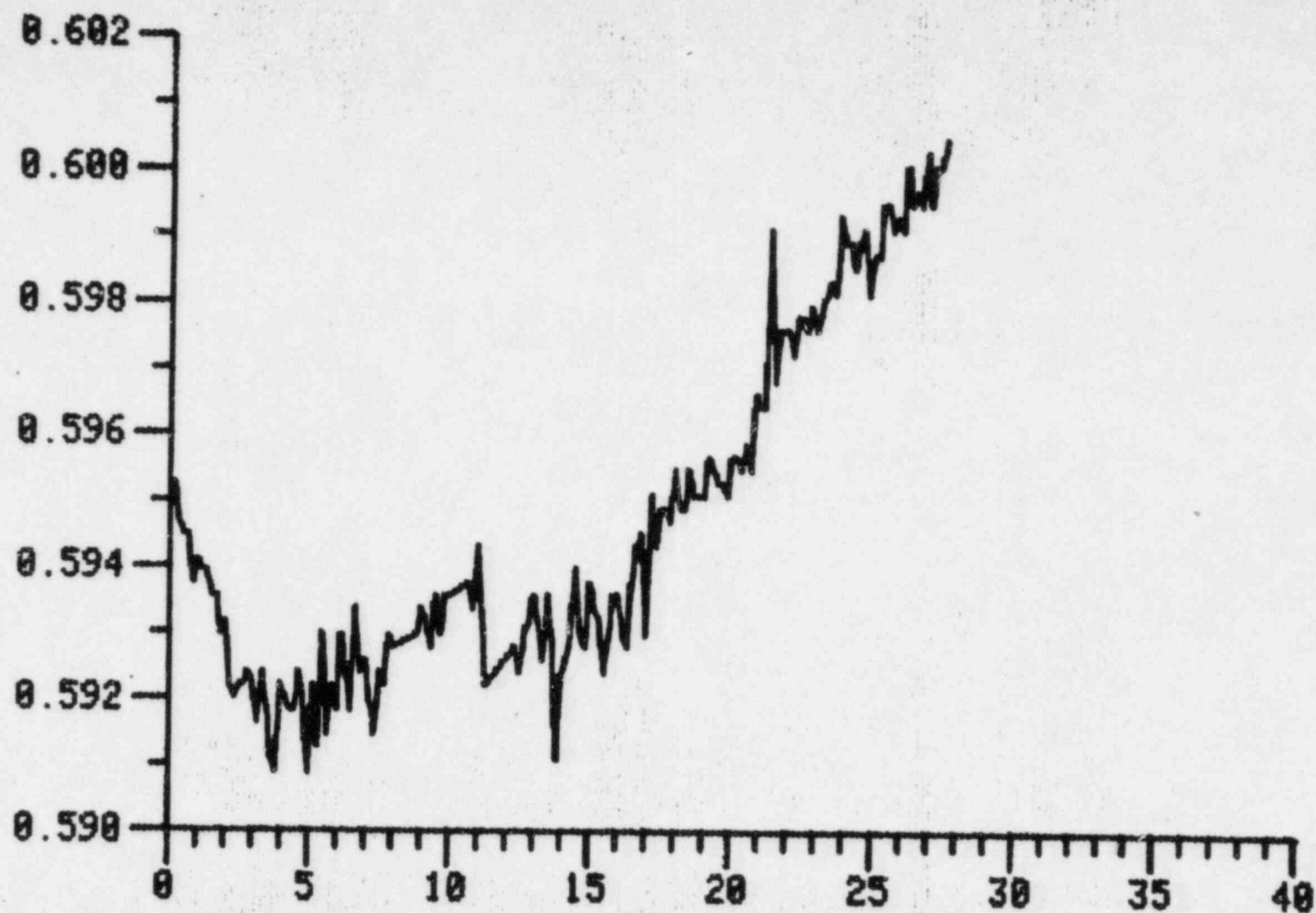
85187: 415 THRU 85188: 744

DUKE POWER COMPANY, CATAWBA 2  
LOWER CONTAINMENT TEMPERATURE



85187: 415 THRU 85188: 744

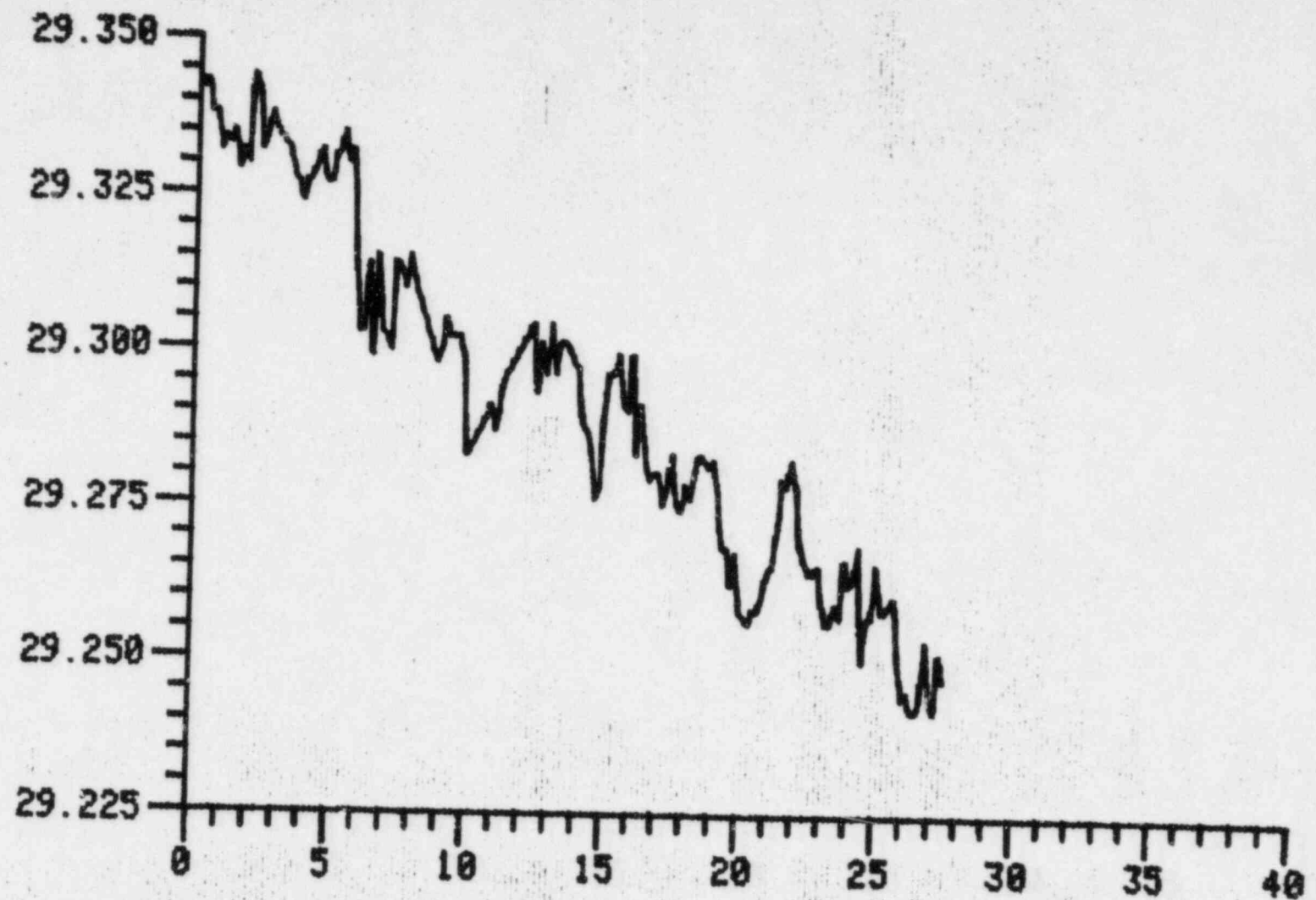
DUKE POWER COMPANY, CATANBA 2  
LOWER CONTAINMENT VAPOR PRESSURE



85187: 415 THRU 85188: 744

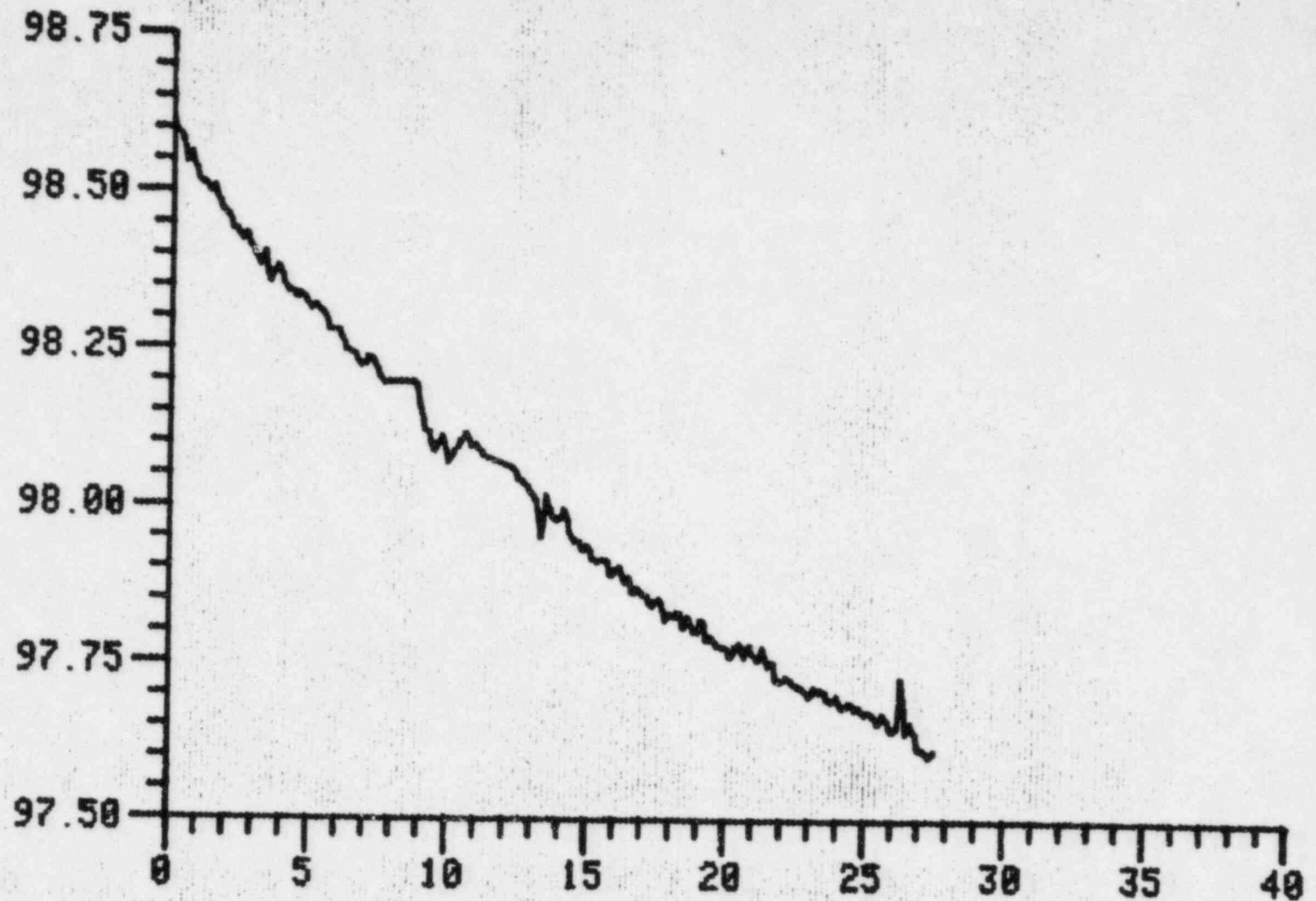


DUKE POWER COMPANY, CATAWBA 2  
LOWER CONTAINMENT PRESSURE



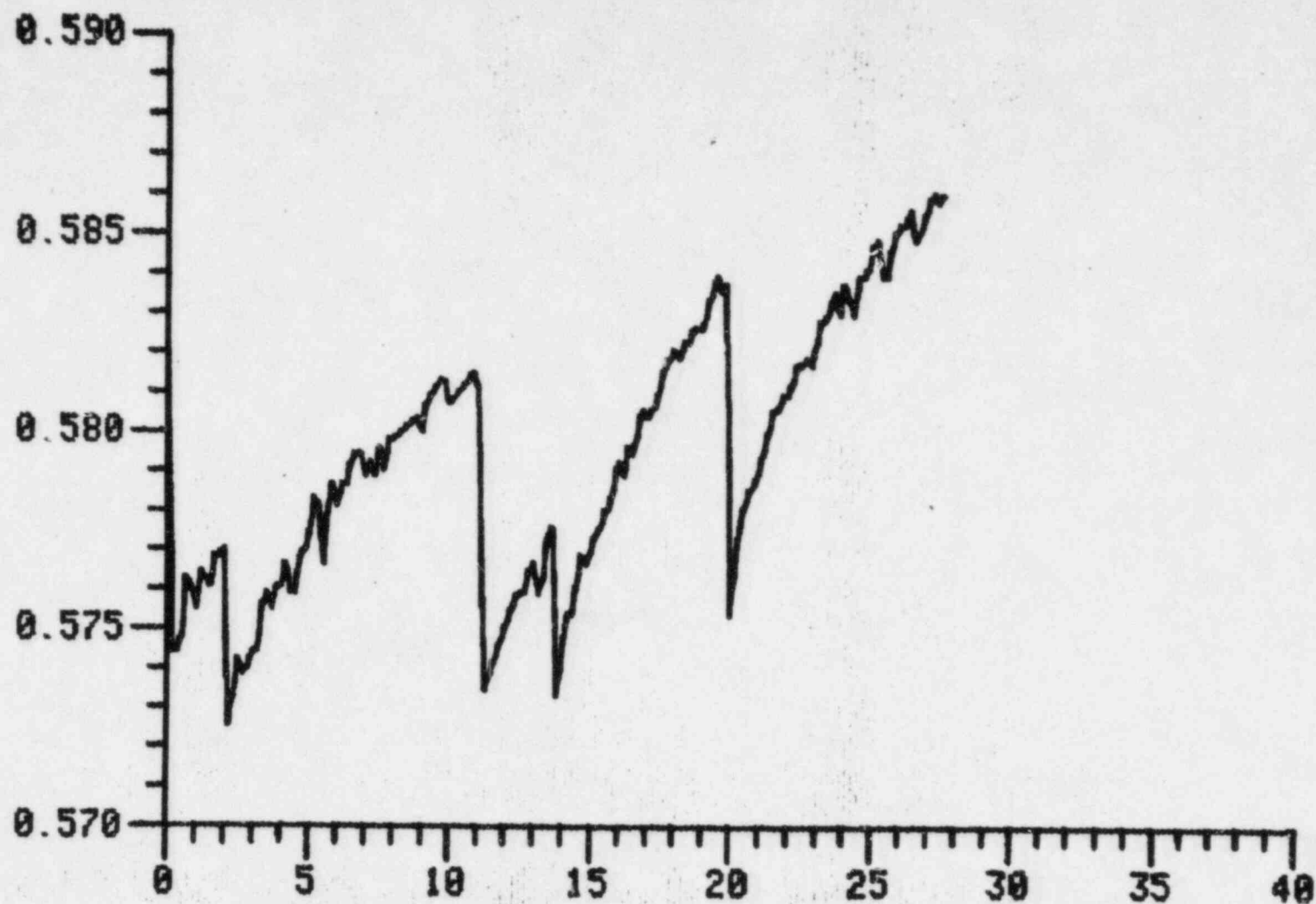
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DUKE POWER COMPANY, CATANBA 2  
UPPER CONTAINMENT TEMPERATURE



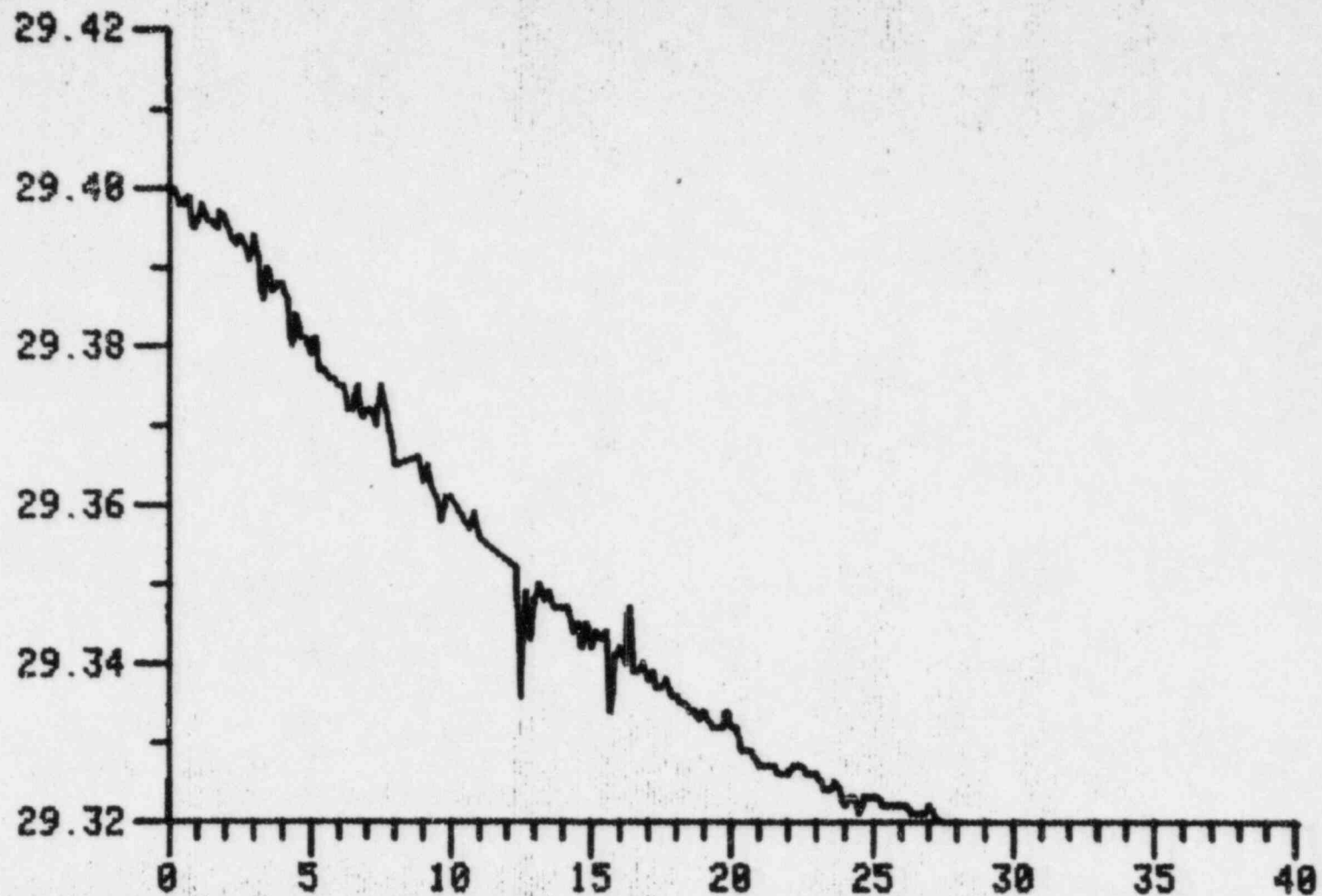
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DUKE POWER COMPANY, CATANBA 2  
UPPER CONTAINMENT VAPOR PRESSURE



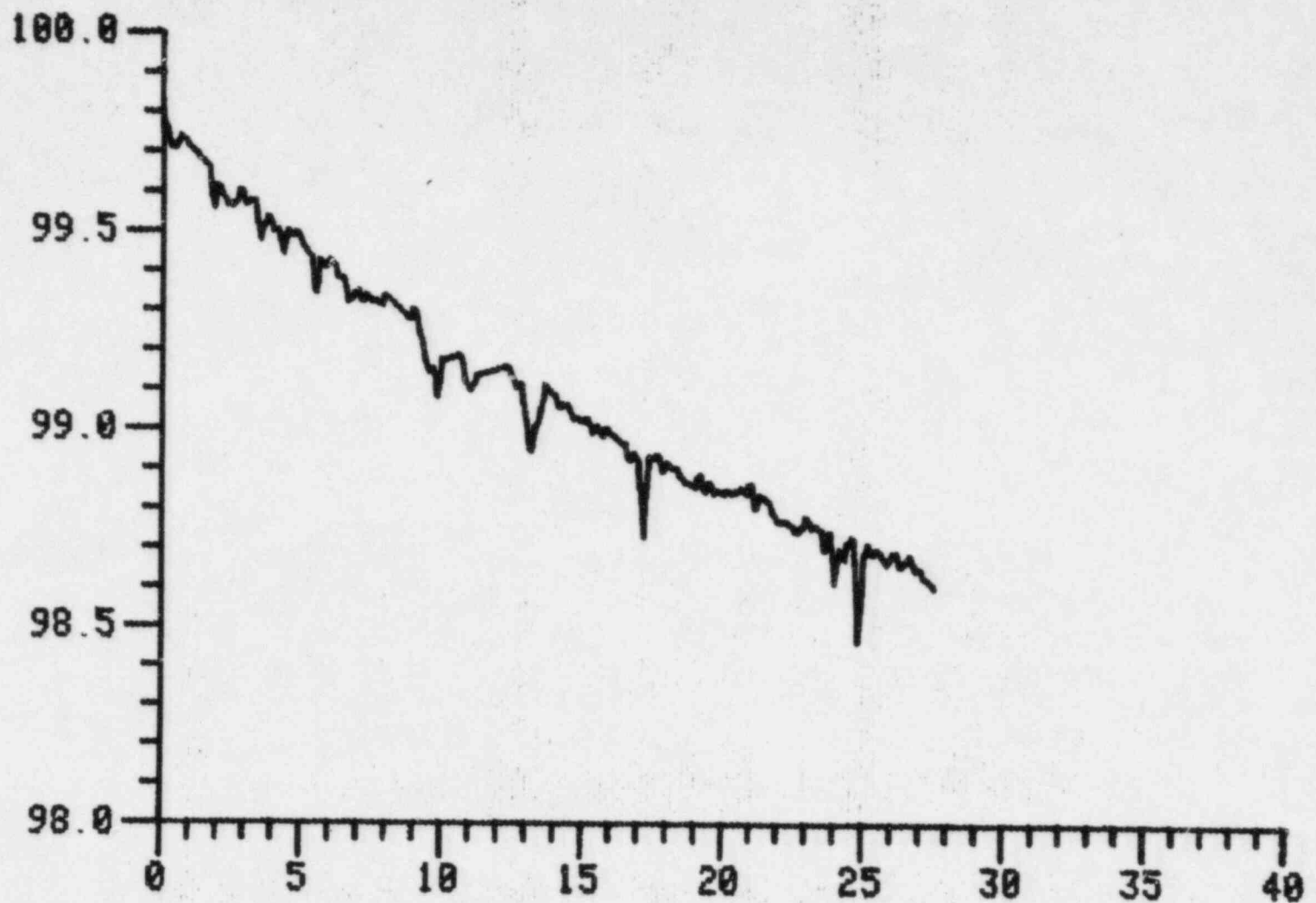
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DUKE POWER COMPANY, CATANBA 2  
UPPER CONTAINMENT PRESSURE



85187: 415 THRU 85188: 744

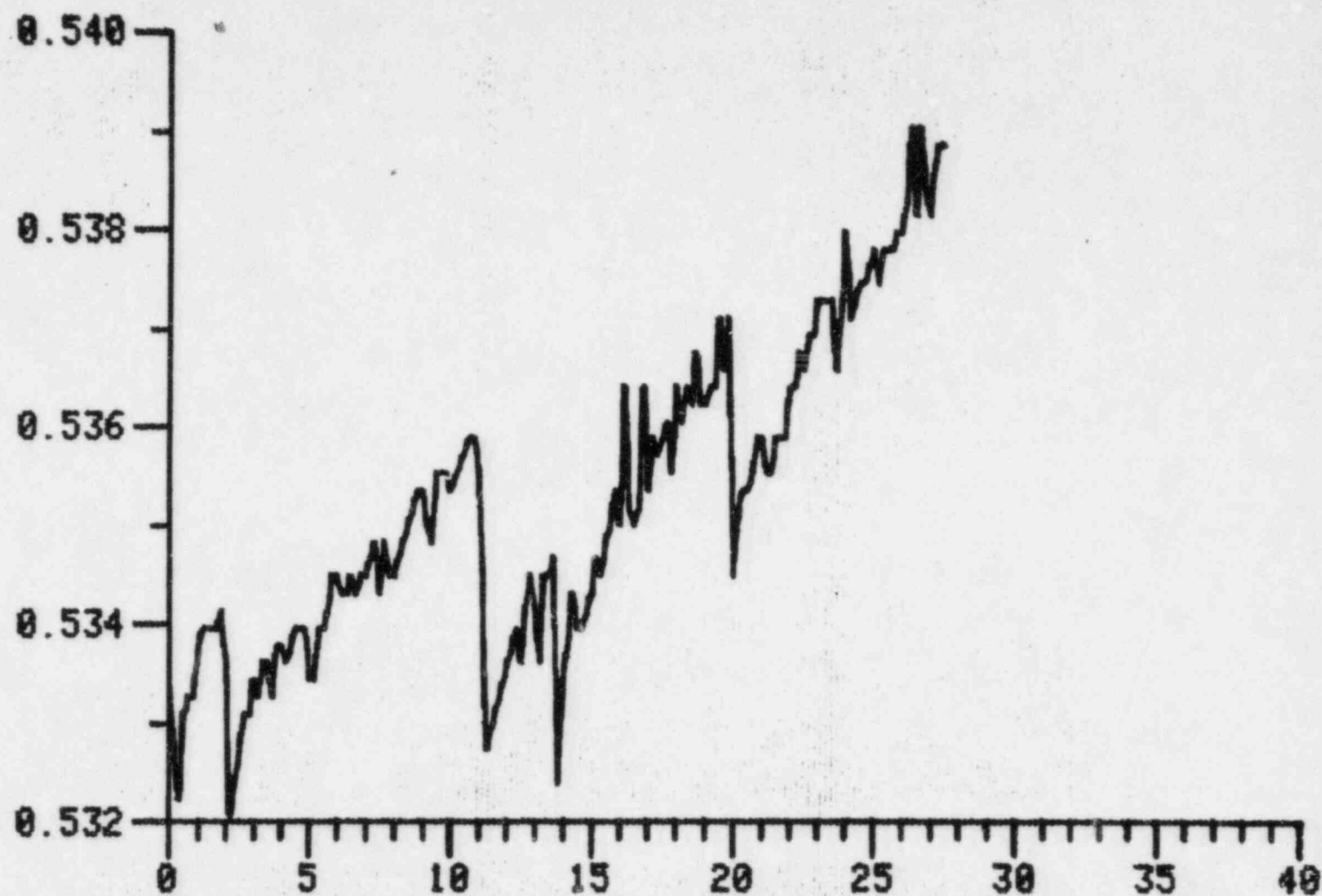
DUKE POWER COMPANY, CATAWBA 2  
ICE CONDENSER TEMPERATURE



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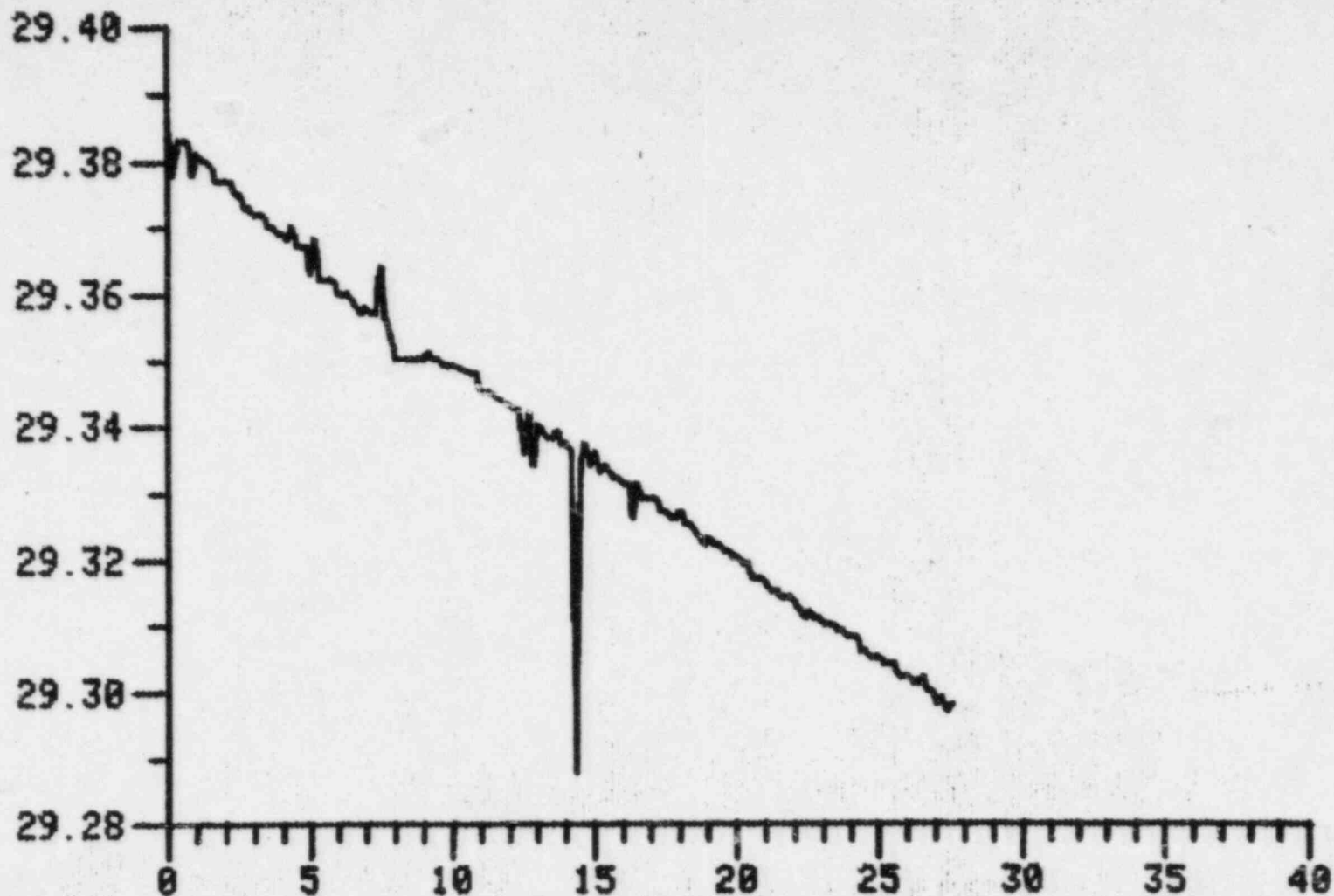


DUKE POWER COMPANY, CATAWBA 2  
ICE CONDENSER VAPOR PRESSURE



85187: 415 THRU 85188: 744

DUKE POWER COMPANY, CATANBA 2  
ICE CONDENSER PRESSURE



85187: 415 THRU 85188: 744

11/11

FULL PRESSURE VERIFICATION TEST CALIBRATED DATA

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**POINTS:**

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The image shows a vertical strip of a document, likely a page from a book or a document with a repeating pattern. The text is arranged in a vertical column, with a central vertical line running through the middle. The text is in a serif font, and the overall appearance is that of a high-contrast, black-and-white scan of a document page.

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*[The page contains dense vertical columns of Chinese text, which are mostly illegible due to extreme blurring.]*

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 2191-2192 1000  
 2192-2

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## LEAK RATE INSTRUMENT CALIBRATED DATA

[illegible]





**POINTS:**

9/12

10/12



CONTINUED

11/12





FULL PRESSURE VERIFICATION TEST RESULTS

[illegible]

MINIMUM  
OBSERVED  
TIME  
REG

# LEAK RATE ANALYSIS

0.3018%/DAY LEAKAGE OBSERVED AFTER 686 READINGS  
LEAK RATE "BANDWIDTH" MIN IS 0.2703% MAX IS 0.3703

LEAK RATE  
LIMIT  
VIOL

LEAK RATE

OBS

DEV/LEAK

EXP MGT

NORM MGT

TIME

RDC

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## 0.3155%/DAY LEAKAGE OBSERVED AFTER 606 READINGS

0.3155%/DAY LEAKAGE OBSERVED AFTER 66 READINGS

BEAR RATE \*BANDWIDTH\* MIN IS 0.97015 MAX IS 0.9703

WDG	TIME	NORM WGT	EXP WGT	DEV/LEAK	OBS LEAK RATE	LEAK RATE LIMIT VIOL.
7A	08:00:14.34	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000

[illegible]

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[illegible][illegible]

**679**

Category	Value
1. Total	100.00
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$$M_{\text{eff}} = M_0 + \frac{\lambda}{2} \left( \frac{1}{\mu} - \frac{1}{\nu} \right) \left( \frac{1}{\mu} + \frac{1}{\nu} \right) \left( \frac{1}{\mu} - \frac{1}{\nu} \right)$$

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*Journal of Interpersonal Violence* 28(1) 10-26  
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1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

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## LEAK RATE NORMALIZED AIR WEIGHTS

[illegible]

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# WEIGHTED COMPARTMENT AVERAGES BY READING

## LOWER CONTAINMENT

RDG	AVG	PSIA	AVG	TEMP	VAP	PSIA	AVG	PSIA	AVG	TEMP	VAP	PSIA	AVG	PSIA
680	680	680	680	680	680	680	680	680	680	680	680	680	680	680
677	677	677	677	677	677	677	677	677	677	677	677	677	677	677
676	676	676	676	676	676	676	676	676	676	676	676	676	676	676
677	677	677	677	677	677	677	677	677	677	677	677	677	677	677
680	680	680	680	680	680	680	680	680	680	680	680	680	680	680
688	688	688	688	688	688	688	688	688	688	688	688	688	688	688
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684	684	684	684	684	684	684	684	684	684	684	684	684	684	684
685	685	685	685	685	685	685	685	685	685	685	685	685	685	685
686	686	686	686	686	686	686	686	686	686	686	686	686	686	686

## LEAK RATE CALCULATED AIR WEIGHTS

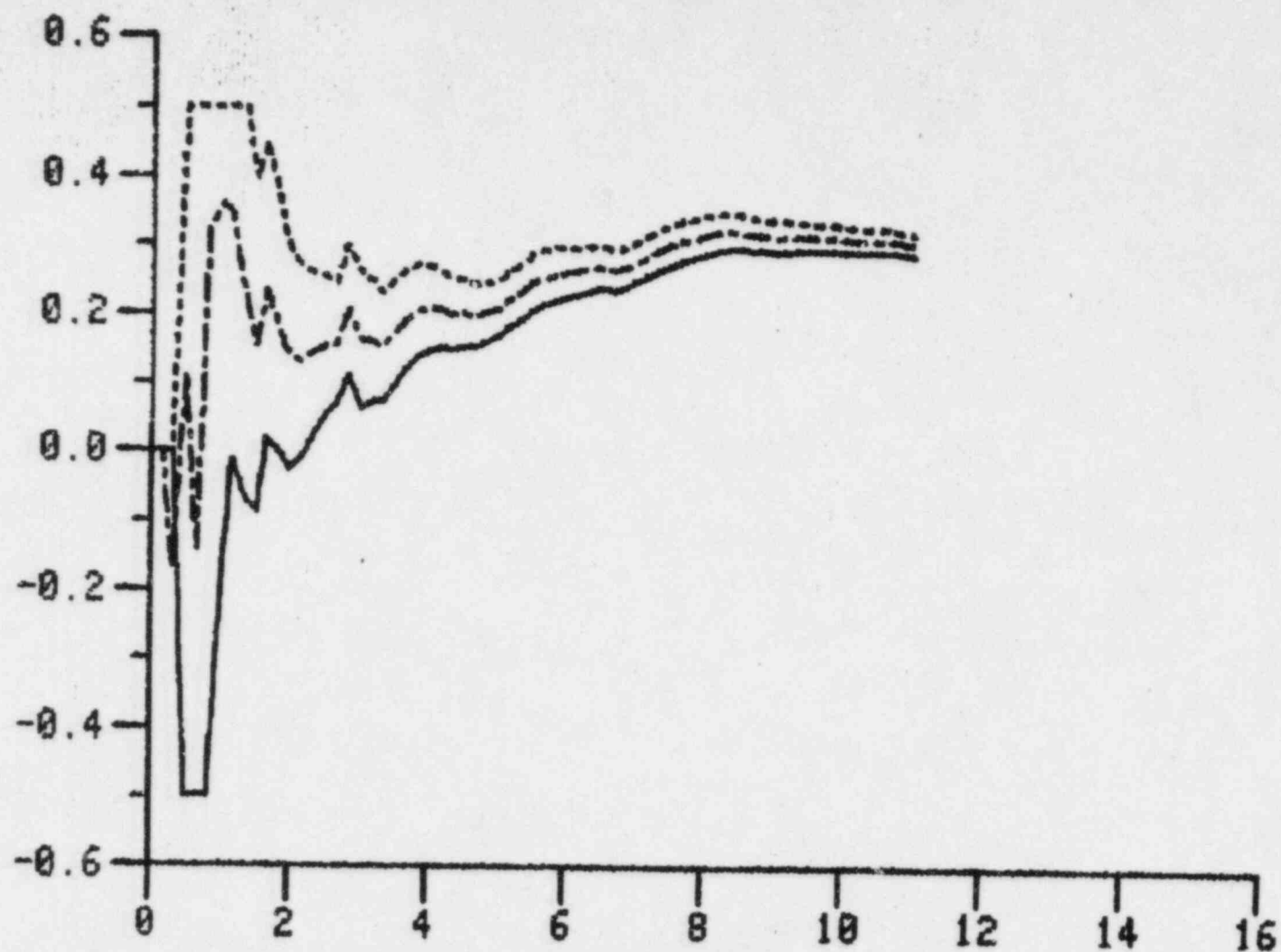
[illegible]



LEAK RATE CALCULATED AIR WEIGHTS

[illegible]

DUKE POWER COMPANY, CATAWBA 2  
MASS PLOT ANALYSIS (MIN, OBS, MAX)



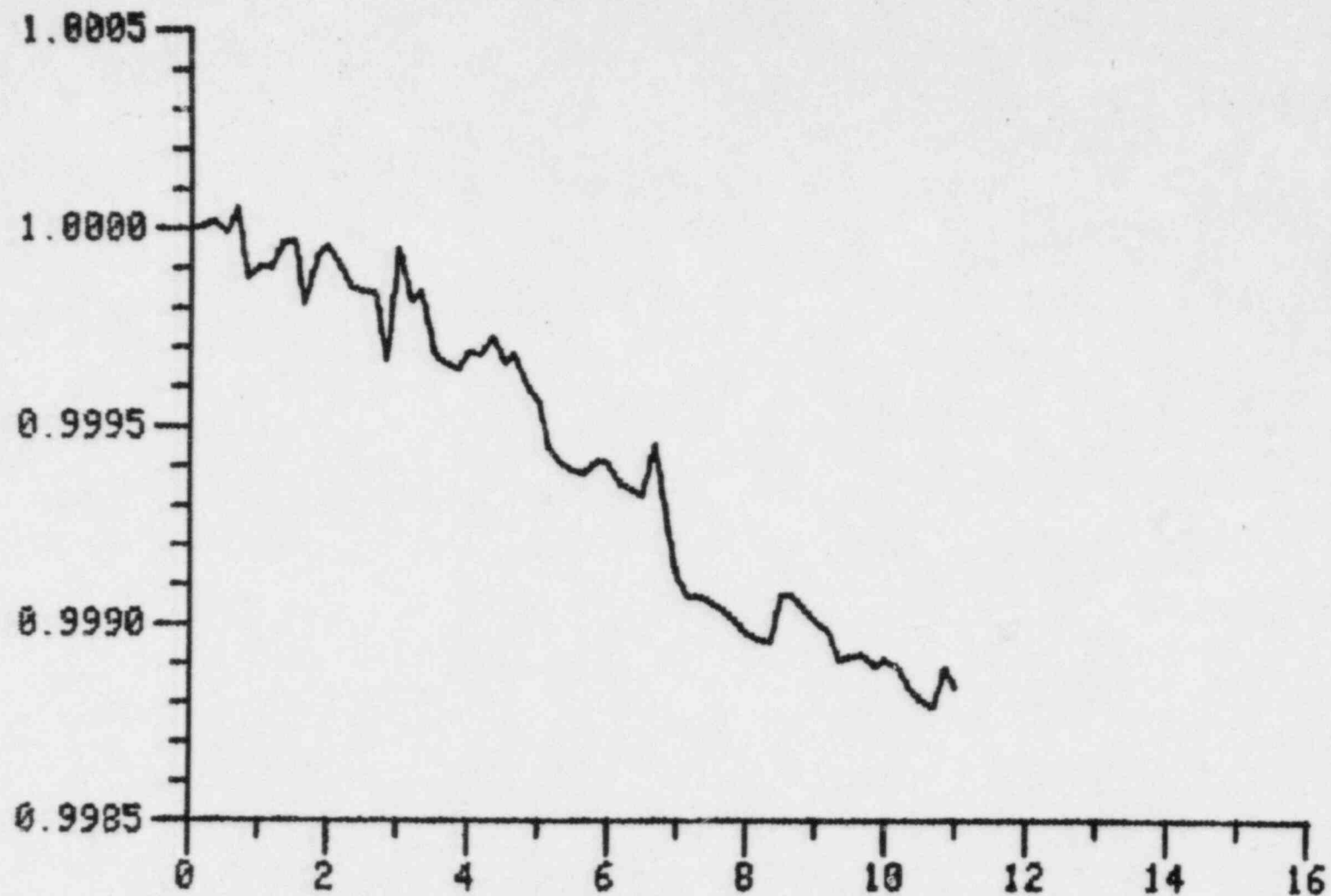
85189: 735 THRU 85189:1834

MIN - SOLID LINE

MAX - DASH LINE

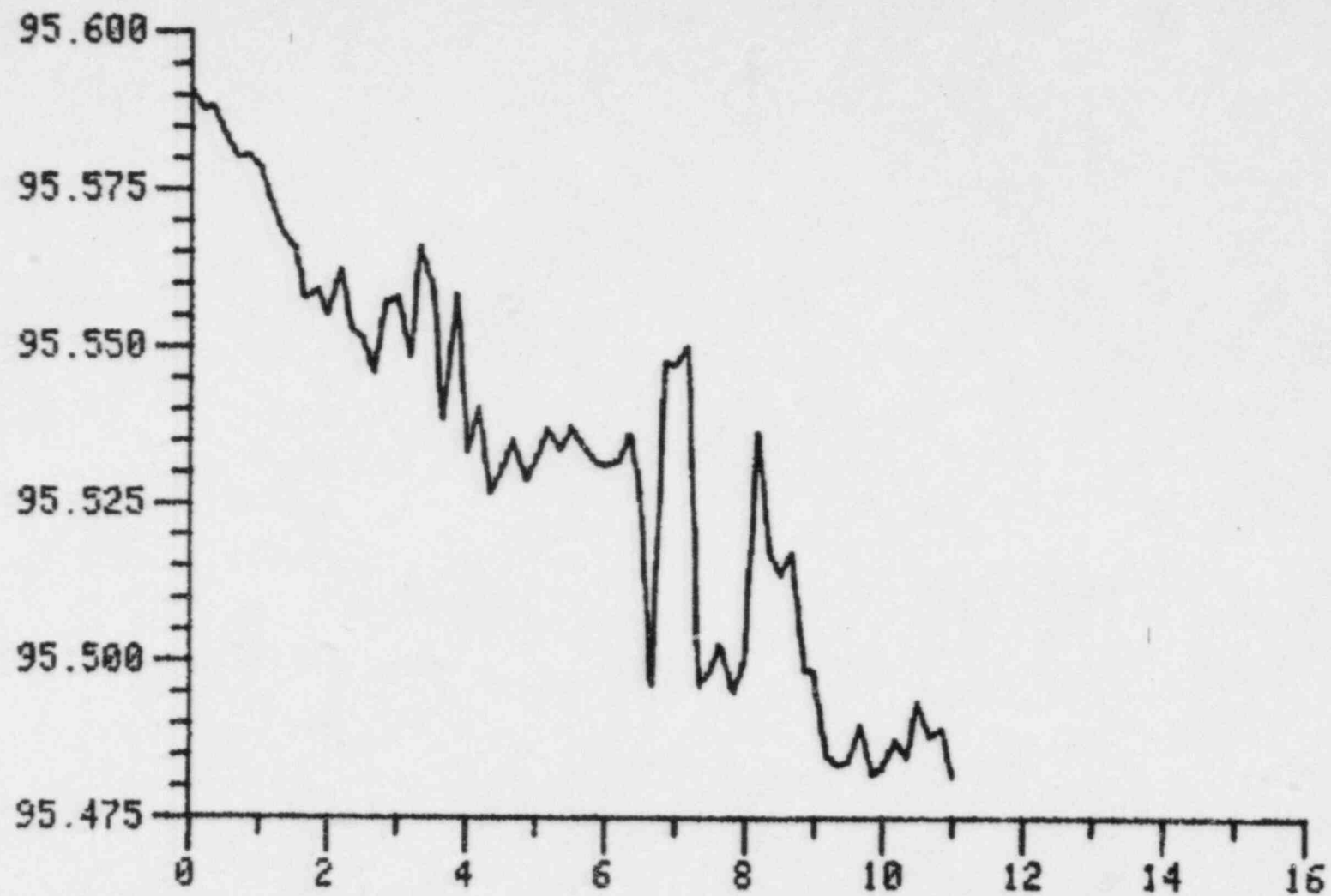
OBS - DOT/DASH LINE

DUKE POWER COMPANY, CATAWBA 2  
NORMALIZED AIR MASS



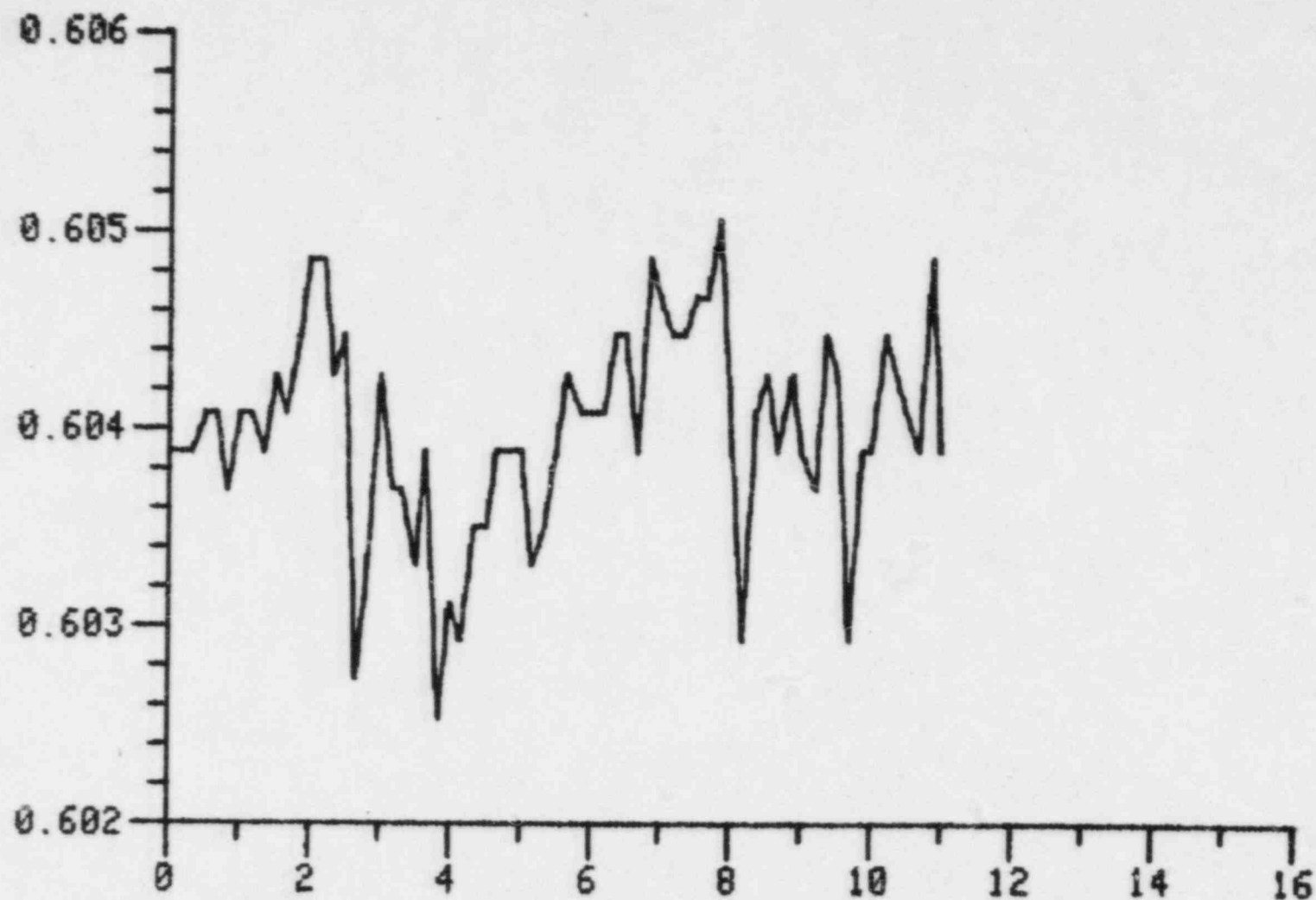
85189: 735 THRU 85189:1834

DUKE POWER COMPANY, CATAWBA 2  
LOWER CONTAINMENT TEMPERATURE



85189: 735 THRU 85189:1834

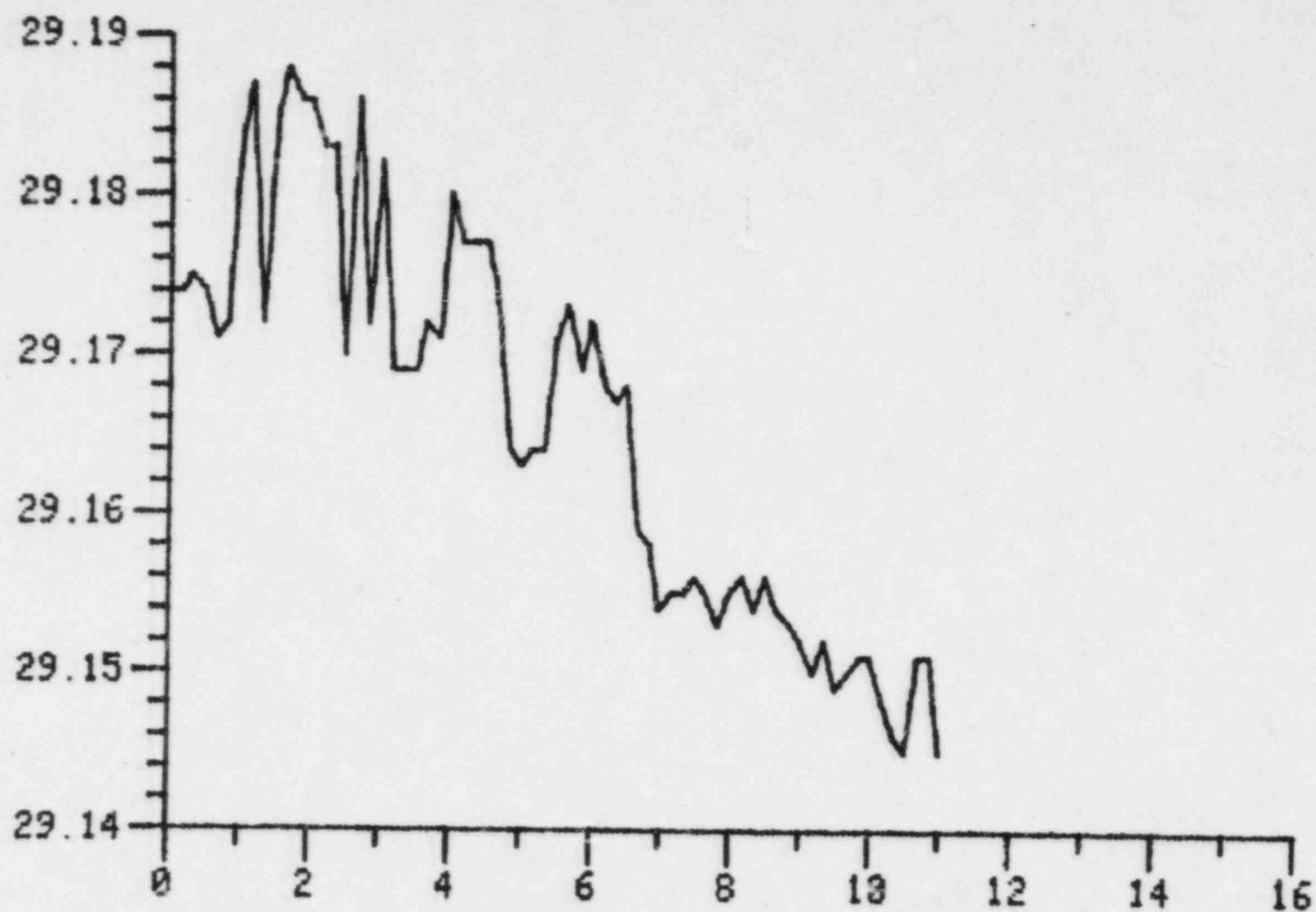
DUKE POWER COMPANY, CATAWBA 2  
LOWER CONTAINMENT VAPOR PRESSURE



85189: 735 THRU 85189:1834

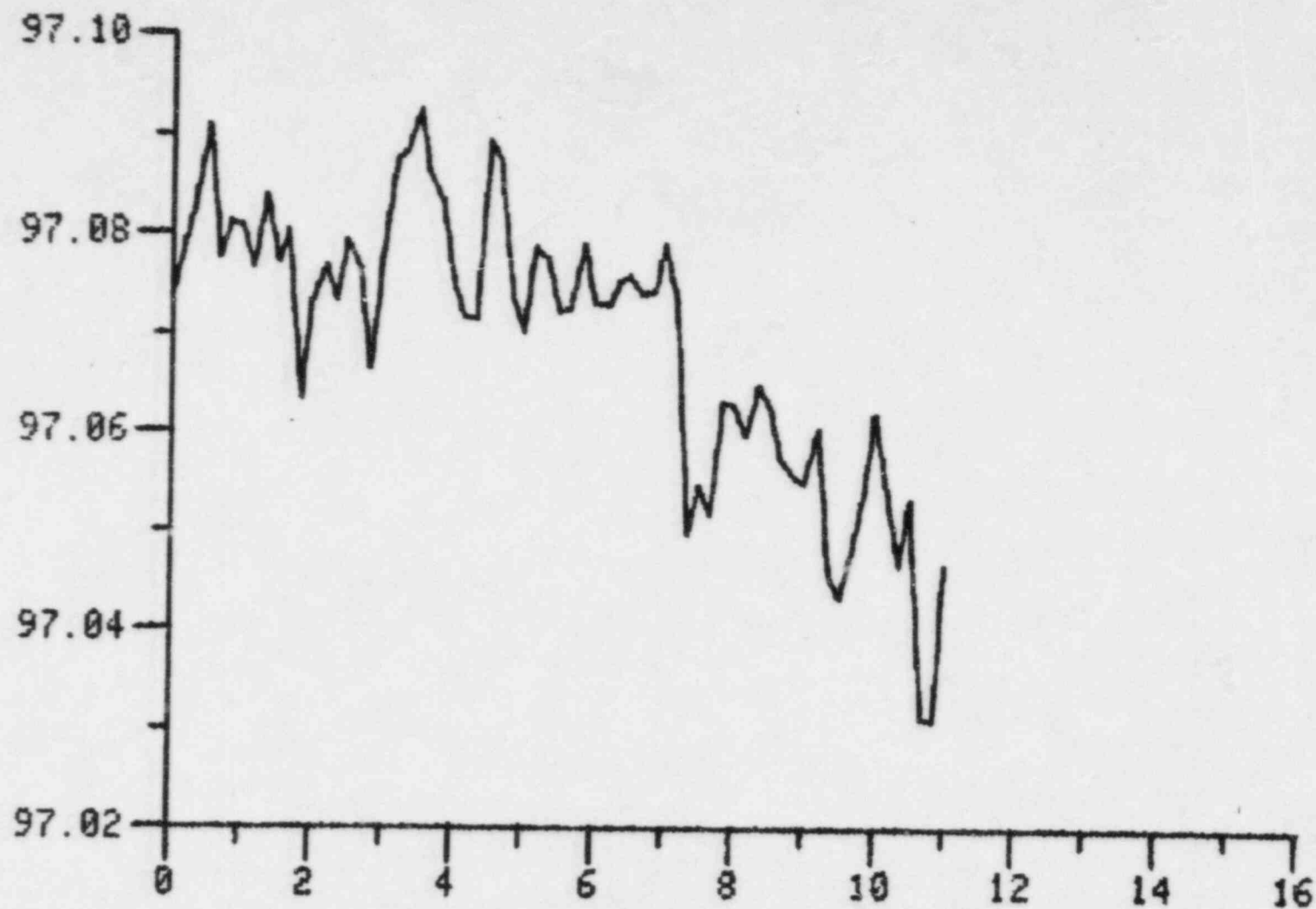


DUKE POWER COMPANY, CATAWBA 2  
LOWER CONTAINMENT PRESSURE



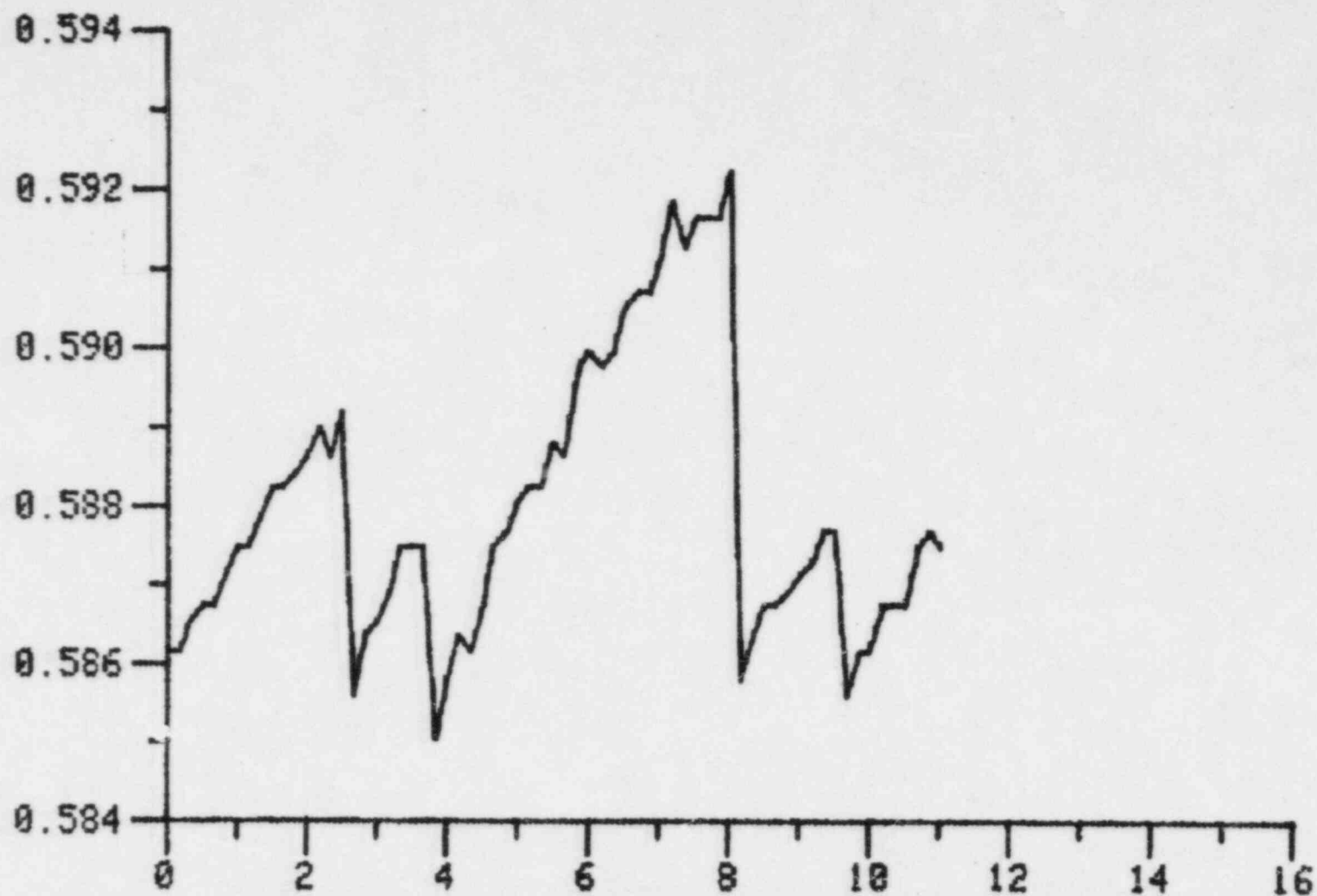
85189: 735 THRU 85189:1834

DUKE POWER COMPANY, CATAWBA 2  
UPPER CONTAINMENT TEMPERATURE



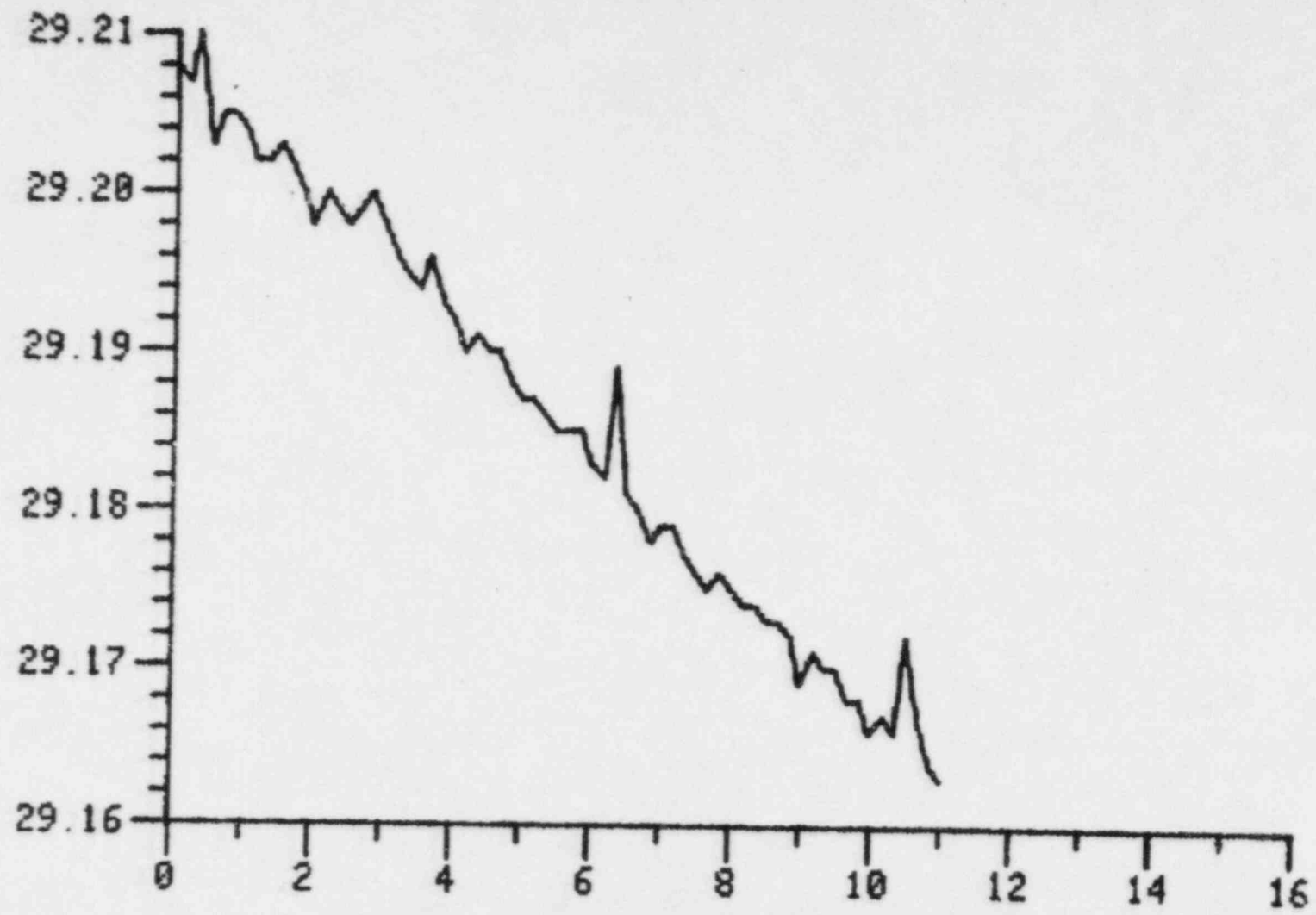
85189: 735 THRU 85189:1834

DUKE POWER COMPANY, CATAWBA 2  
UPPER CONTAINMENT VAPOR PRESSURE



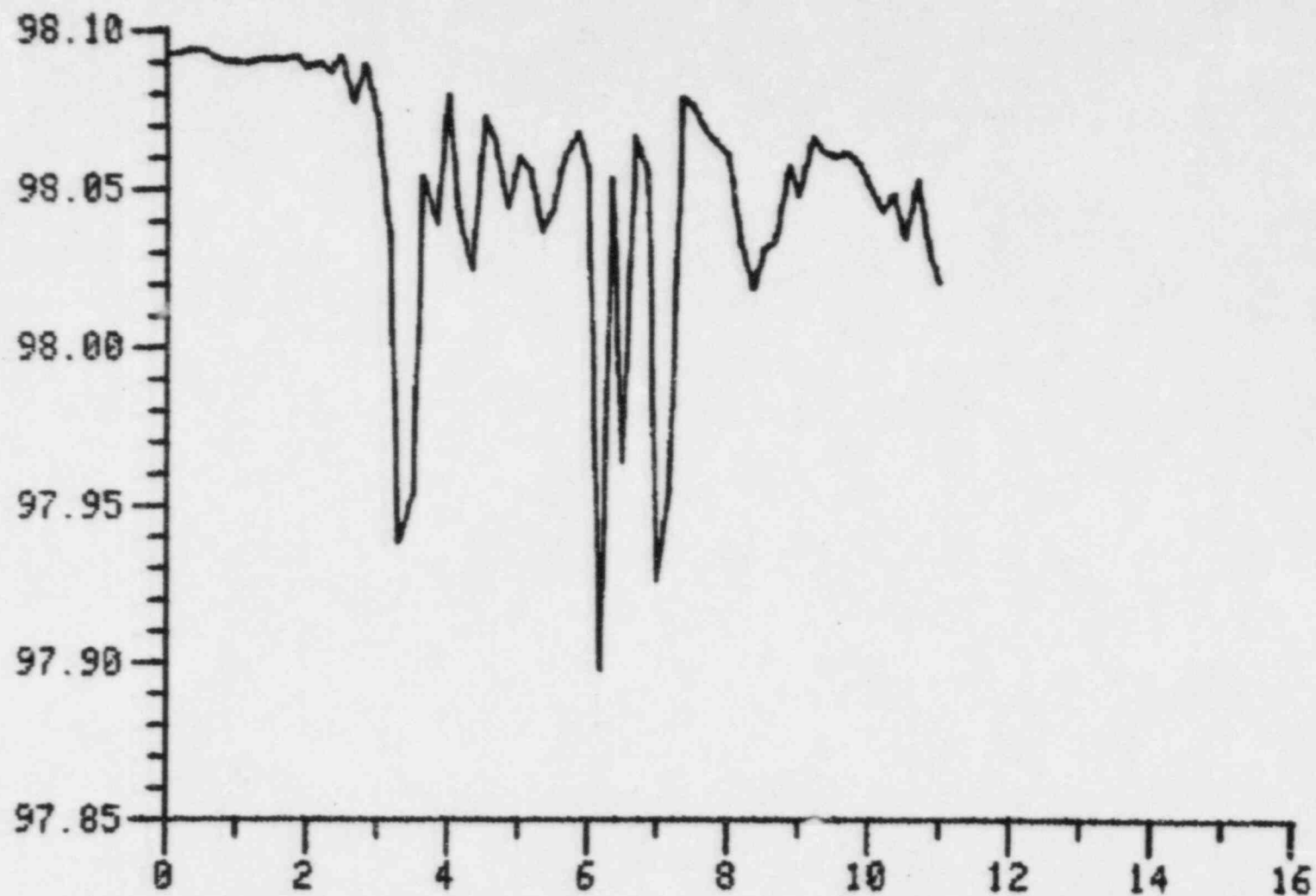
85189: 735 THRU 85189:1834

DUKE POWER COMPANY, CATAWBA 2  
UPPER CONTAINMENT PRESSURE



85189: 735 THRU 85189:1834

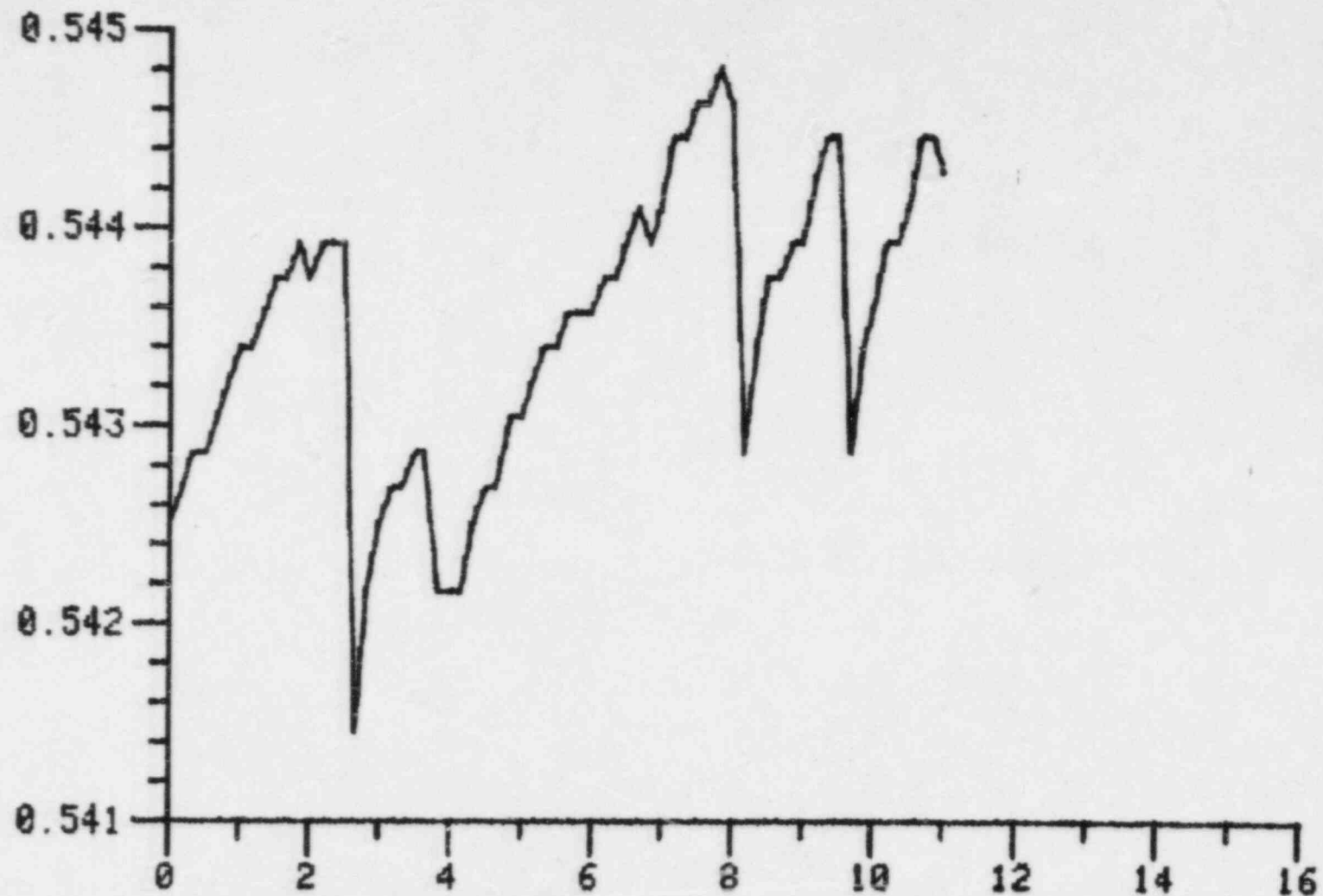
DUKE POWER COMPANY, CATAWBA 2  
ICE CONDENSER TEMPERATURE



85189: 735 THRU 85189:1834

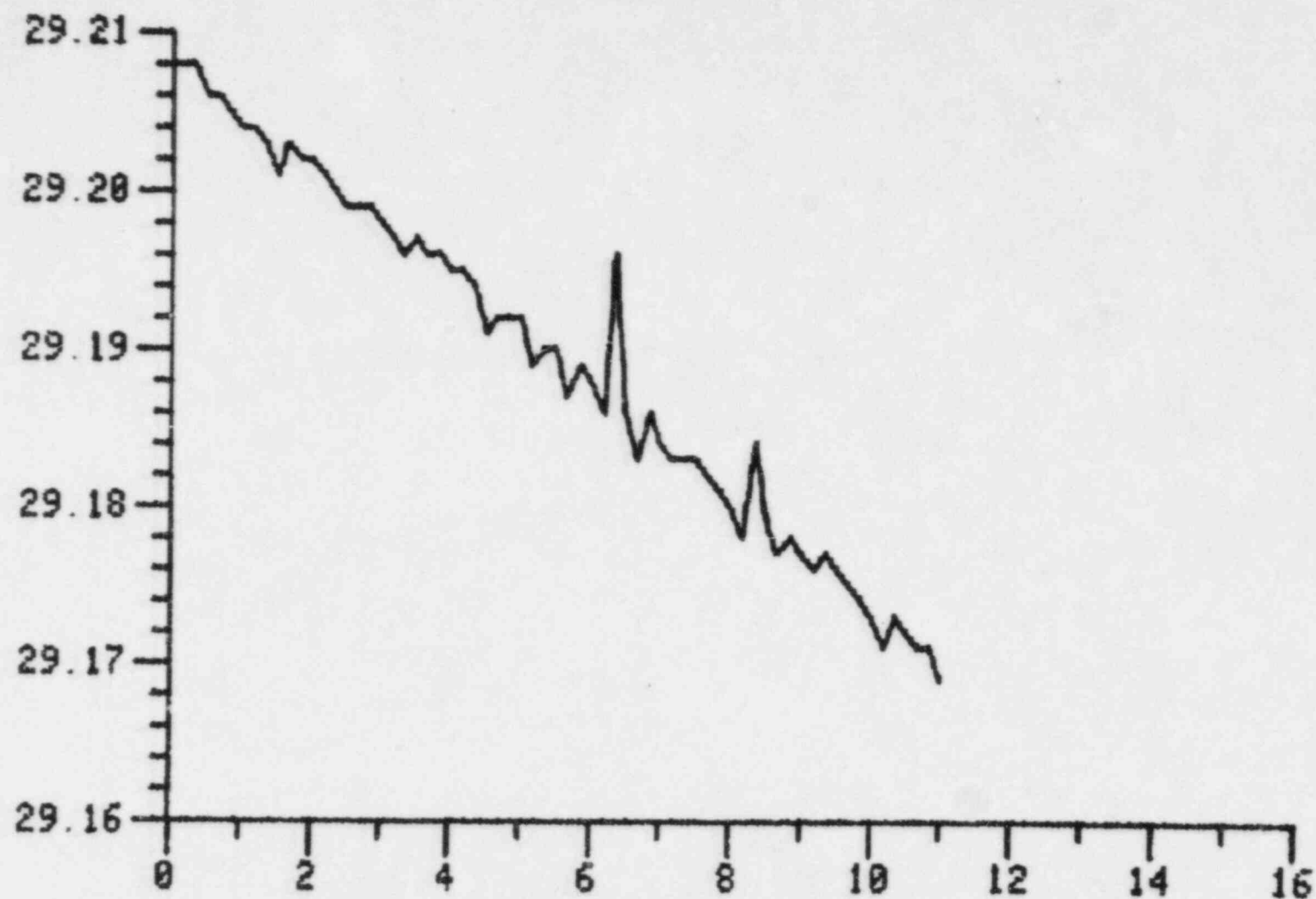


DUKE POWER COMPANY, CATAWBA 2  
ICE CONDENSER VAPOR PRESSURE



85189: 735 THRU 85189:1834

DUKE POWER COMPANY, CATAWBA 2  
ICE CONDENSER PRESSURE



85189: 735 THRU 85189:1834

APPENDIX C

TEST LOG

## SUMMARY OF MAJOR ACTIVITIES DURING ILRT

<u>Date/Time</u>	<u>Comments</u>
May 9, 1985	Design Engineering completed pre-ILRT inspections.
June 8, 1985	Began valve alignments for ILRT.
June 21, 1985	Completed set up of rental compressors.
June 26, 1985	Ran and checked out rental compressors. Checked out O.K.
June 27, 1985	Began venting of Mechanical Penetration bellows to the annulus.
June 29, 1985/1400	Began pressurization of Containment for Structural Integrity Test.
June 29, 1985/2130	Entered Containment for visual inspection.
June 30, 1985/0100	Reached SIT pressure of 16.618 psig. Started 10 minute hold period.
June 30, 1985/0330	Personnel entered Containment to perform Post SIT inspection.
June 30, 1985/0815	Personnel exited Containment after performing Post SIT inspection.
June 30, 1985/2030	Reached $.85P_T$ . Began 24-hour outgassing period.
July 1, 1985/2045	Began repressurization to $P_T$ .
July 1, 1985/2200	Began 4 hour hold period for temperature stabilization.
July 2, 1985/0215	Began Reduced Pressure Test.
July 4, 1985/2000	Decided to abort Reduced Pressure Test due to unacceptable readings and problems with data acquisition equipment.
July 4, 1985/2330	Began pressurizing to Pa. Due to problems with data acquisition equipment, readings were taken manually to verify correctness.
July 5, 1985/2345	Began 4 hour hold period for temperature stabilization.
July 6, 1985/0415	Began Full Pressure Test.

<u>Date/Time</u>	<u>Comments</u>
July 7, 1985/0715	Satisfactorily completed Full Pressure Test. Allowed General Office Personnel to work on data acquisition equipment.
July 8, 1985/0735	Data acquisition equipment now working better - continued to take manual readings and started the Supplemental Verification Test.
July 8, 1985/1835	Completed Supplemental Verification Test.
July 8, 1985/2100	Began depressurization of containment after checking results of ILRT.
July 9, 1985/0715	Completed depressurization of Containment.