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FLECHT SEASET Program

NRC/EPRI/Westinghouse Report No.4

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PWR FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TASK DATA REPORT

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NRC/EPRI/Westinghouse Report No. 4

PWR FLECHT SEASET
STEAM GENERATOR SEPARATE EFFECTS TASK
DATA REPORT

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ABSTRACT

This report presents data from the Steam Generator Separate Effects Task of the Full-Length Emergency Cooling Heat Transfer Separate Effects and Systems Effects Test Program (FLECHT SEASET). In this task a series of heat transfer tests were run on a model steam generator operating under simulated loss-of-coolant conditions. The model steam generator was made up of 32 full-length U-tubes instrumented with thermocouples to measure secondary fluid, tube wall, and primary steam temperatures. The separate effects tests measured steam generator bundle heat transfer with known boundary conditions to provide better understanding of the steam generator behavior in the systems effects tests. The test results presented in this report will be evaluated in a subsequent evaluation report.

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TABLE OF CONTENTS

TABLE OF CONTENTS (cont)

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 1

SUMMARY

As part of the Westinghouse/NRC/EPRI FLECHT SEASET reflood program, a series of separate effects tests were conducted on the FLECHT SET Phase B steam generator.[1] The purpose of these tests was to measure and to characterize the steam generator secondary side to primary side heat release under postulated inlet fluid conditions for a calculated hypothetical pressurized water reactor loss-of-coolant accident. This document presents the facility description and test results for this task in the FLECHT SEASET program.

In this test program, a special heat transfer facility was constructed such that the steam generator primary side inlet two-phase flow conditions could be varied in a parametric fashion. Sufficient instrumentation was placed in the steam generator and flow loop that heat transfer rates within the steam generator tube bundle could be calculated from the resulting data. In addition, a series of air/water tests were run using the FLECHT SET Phase B steam generator lower plenum to examine the radial flow distribution effects at the steam generator tubesheet and to help select the tube bundle instrumentation locations. The results of these tests will be used to develop a model or correlation which describes the FLECHT SEASET steam generator heat release characteristics; a separate report will present evaluation of the data.

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1. Conway, C. E., et al., "PWR FLECHT Separate Effects and Systems Effects Test (SEASET) Program Plan," NRC/EPRI/Westinghouse-1, December 1977.

SECTION 2

INTRODUCTION

2-1. TASK OBJECTIVES

The separate effects test described in the FLECHT SEASET Unblocked Bundle Task Plan Report[1] concentrated on the rod bundle heat transfer and thermal-hydraulic behavior. The systems effects tests focus on the entire simulated thermal-hydraulic response of a pressurized water reactor primary system during reflood. However, the bundle inlet flooding rate in systems effects tests is dependent on the transient hydraulic and heat transfer behavior of the whole loop, which includes the bundle and different system components.

Therefore, to understand the performance of the simulated primary system, the thermal-hydraulic behavior of the principal components of the system must be defined. The objective of the steam generator separate effects task is to determine the heat release rate from the larger FLECHT SET steam generator for various known inlet fluid conditions and secondary side conditions.[2] To meet this objective, separate experiments on the main components of the simulated primary system, notably the steam generator, are being performed before the integral systems tests. In this way, the thermal-hydraulic behavior of these important components will be better understood.

The first component examined in this task was the steam generator. The FLECHT SET Phase B tests indicated that, during the reflood portion of a postulated loss-of-coolant accident (LOCA), not all the incoming entrained liquid flow would be vaporized in the steam generators, and that droplets could be carried out of the

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1. Hochreiter, L. E., et al., "PWR FLECHT SEASET Unblocked Bundle, Forced and Gravity Reflood Task: Task Plan Report," NRC/EPRI/Westinghouse-3, March 1978.

2. Previous FLECHT SET Phase B tests utilized two scaled steam generators. The larger one represented three PWR reactor steam generators on the unbroken loops during a postulated loss-of-coolant accident, and the smaller one represented the steam generator in the remaining broken loop.

generator into the cold leg.[1] Carrying entrained liquid through the steam generators reduces the specific volume of the primary fluid. As the specific volume decreases, its density increases correspondingly, and a larger mass flow can be vented through the loops at the same loop pressure drop. Hence, the venting capacity of the primary system is increased, and steam binding effects are less severe. The increased venting capacity could result in larger core flooding rates and correspondingly increased core heat transfer and lower peak cladding temperatures.

To model steam generator behavior during reflood, detailed knowledge of how the steam generator releases its heat, where the heat is transferred, and how the secondary side fluid behaves during the reflood transient must be known. Because the steam generator and the primary system interact, the easiest way to examine the steam generator behavior is to isolate it and perform separate component tests. This is the approach used i, this experiment. Known inlet two-phase flows were injected into the generator; the resulting two-phase mixture leaving the steam generator was separated, collected, and measured. This permitted a primary fluid energy balance, which can be related to the secondary side energy release.

A number of secondary fluid thermocouples, tube wall thermocouples, and shell wall thermocouples were installed in the steam generator such that a secondary side heat release rate could be calculated. Selected tubes were instrumented with primary side steam probes and differential pressure transducers (probes) to measure superheat of steam and liquid accumulation in the entrance region of the tubes. The steam probe data allow an evaluation of thermodynamic nonequilibrium in the tubes, and the pressure drop transducers allow an evaluation of the mass storage in the entrance region of selected tubes.

Prior to the steam generator separate effects tests, a series of tests were run on the inlet plenum using air and water to simulate the two-phase steam mixture. The objective of these tests was to investigate the effect of the inlet plenum geometry

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1. Waring, J. P., and Hochreiter, L. E., "PWR FLECHT SET Phase B1 Evaluation Report," WCAP-8583, August 1975.

on the flow distribution at the entrance to the steam generator tube bundle. Two steam generator inlet plenum geometries were tested: one of the plenums duplicated the FLECHT SET inlet plenum, and the other plenum resembled the hemispherical shape of a plenum in a typical PWR with inverted U-tube steam generators.

2-2. PARAMETER RANGES AND REFERENCE CONDITIONS

Parameter ranges and reference conditions for the steam generator separate effects test were developed in section 4 of the Steam Generator Separate Effects Test Task Plan.[1] The parameter ranges and reference conditions are listed in table 2-1. It should be noted that all units in table 2-1 and throughout this report are given in metric units, followed by English units in parentheses.

2-3. DATA REQUIREMENTS

The task data requirements were developed in the steam generator separate effects test task plan.[1] The basic thermal-hydraulic parameters measured to meet the data requirements are summarized in table 2-2.

A series of bench tests were performed to aid in the design, selection, and placement of the steam generator instrumentation. Separate tests were performed to examine tube wall thermocouple mounting, ability to measure pressure drop in a two-phase flow using static probes with a continuous nitrogen purge flow, and the two-phase flow inlet distribution at the steam generator tubesheet. These tests were described in section 6 and appendix C of the task plan.[1] The results of these bench tests are presented in appendixes A and B.

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1. Hochreiter, L. E., et al., "PWR FLECHT SEASET Steam Generator Separate Effects Task: Task Plan Report," NRC/EPRI/Westinghouse-2, March 1978.

TABLE 2-1

PARAMETER RANGES AND REFERENCE CONDITIONS

Parameter	Reference Condition	Range
Primary side pressure	0.275 MPa[a] (40 psia)	0.138 to 0.414 MPa (20 to 60 psia)
Secondary side pressure	5.86 MPa (850 psia)	1.72 to 5.86 MPa (250 to 850 psia)
Primary side temperature	130.5^{o}C (267^{o}F)	109^{o}C to 145^{o}C (228^{o}F to 293^{o}F)
Secondary side temperature	274^{o}F (525^{o}F)	204^{o}C to 274^{o}C (400^{o}F to 525^{o}F)
Primary side mass velocity[b]	64.9 kg/sec/m^2 (13.3 lb/sec/ft^2)	64.9 to 129.9 kg/sec/m^2 (13.3 to 26.6 lb/sec/ft^2)
Inlet quality	0.80	0.10 to 1.0
Secondary side water level	100%	25% to 100%

a. Megapascals

b. Total steam plus water mass flow divided by hot leg flow area of 0.0035 m^2 (0.0375 ft^2)

TABLE 2-2

BASIC DATA OBTAINED IN THE STEAM GENERATOR SEPARATE EFFECTS TASK TO MEET DATA REQUIREMENTS FOR LOOP TEST

Desired Data	Measuring Device	Location
Steam generator secondary fluid temperatures	Fluid thermocouples	Various radial locations at several different levels on the secondary side of the steam generator
Steam generator tube wall temperatures	Wall thermocouples	Various locations on the steam generator tube walls
Steam generator primary side vapor temperatures	Steam probes (aspirating)	Within the steam generator tubes and inlet plenum
Water flow rate	Turbine meter	Mixer inlet line
Steam flow rate	Vortex meters	Mixer inlet line, steam separator outlet line
System pressure	Pressure transducers and transmitters	Steam generator secondary side, containment tank, and loop piping
Primary loop fluid temperatures	Thermocouples/ RTDs[a]	In loop piping
Pipe wall temperatures	Thermocouples	On piping, steam generator shell, plenum, and tanks

a. RTD - resistance temperature detector

TABLE 2-2 (cont)

BASIC DATA OBTAINED IN THE STEAM GENERATOR SEPARATE EFFECTS TASK TO MEET DATA REQUIREMENTS FOR LOOP TEST

Desired Data	Measuring Device	Location
System pressure drops	Differential pressure transducers and transmitters	Hot leg and inlet plenum, steam generator inlet tube, inlet to outlet plenum
Separator exit water mass rate	Differential pressure transducers	Steam separator collection tanks
Mass storage	Differential pressure transducer	Inlet plenum, water storage tanks
Secondary side fluid level	Differential pressure transducer	Secondary side of steam generator
Flow regimes	Photography	Steam generator inlet and outlet plenums

SECTION 3

TEST FACILITY DESCRIPTION

3-1. DESCRIPTION

Figure 3-1 is a detailed schematic diagram of the separate effects test loop. The major components in the loop are the boiler, water supply tank, steam/water mixer, steam generator, steam separator, and containment tank. The boiler and water supply tank supply steam and water to a mixing chamber, which generates a two-phase flow in the hot leg upstream of the steam generator. The test facility is designed to supply the steam generator with a steady-state two-phase mixture. The test loop and steam generator response are essentially steady-state except for the secondary water, which cools down slowly. Steam separators in the steam generator discharge flow path separate the two-phase effluent from the steam generator tube bundle to allow each component of the two-phase flow to be measured. A bypass line around the steam generator was provided to permit monitoring of the mixer effluent during shakedown testing, using the instrumentation downstream of the steam generator. An auxiliary steam line from the boiler to the hot leg was also provided to permit use of the boiler for loop heatup. A vent line off the bypass line allowed the two-phase mixture to be dumped to the atmosphere while test parameters were being stabilized prior to running a test.

The steam/water mixer consists of a liquid spray nozzle located inside the hot leg. The two-phase flow in the steam generator hot leg and lower plenum is generated by spraying saturated liquid into the steam. An alternate liquid injection point was provided inside the steam generator inlet plenum in four of the matrix tests. Here a spray nozzle was used to direct the liquid flow at the tubesheet. The same spray nozzle arrangement was utilized as in the air-water bench tests described in appendix B.

The FLECHT SET steam generator outlet plenum was modified by the addition of an integral steam separator in the plenum to minimize time delays and energy losses between the tube bundle exit and the liquid collection site. For most tests, the outlet plenum was used to collect the separated liquid. For tests where significant carryover was anticipated, the larger steam generator collection tank was utilized. Data were collected for a period of 31 minutes - 1 minute of pretest data, 25 minutes of test data, and 5 minutes of posttest data.

3-2. FACILITY LAYOUT AND COMPONENT DESCRIPTION

The loop shown schematically in figure 3-1 was built using as many of the FLECHT-SET test series loop components as possible. This included the steam generator, containment tank, and some connecting piping. The detailed piping layout drawings for the test loop are shown in appendix C.

The major loop components procured for this test included a water supply tank, a boiler for supplying steam, a close-coupled water collection tank at the steam generator outlet, a steam separator and collection tank, and the necessary loop valves and piping.

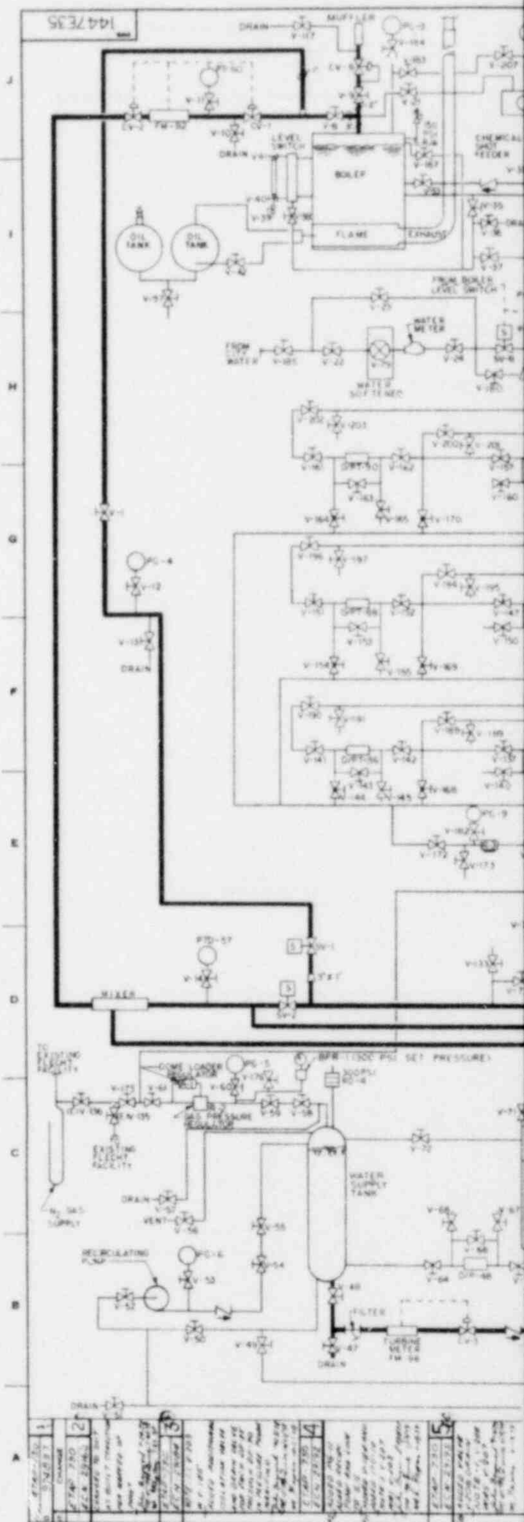
Facility components are described in the following paragraphs.

3-3. Boiler

The facility steam supply is a York-Shipley 1.23 Mw (125 bhp) steam boiler. The unit has a thermal output rating of 1.225 megawatts (4,184,000 Btu/hr) and an equivalent steam rating of 1956 kg/hr (4313 lb/hr) at 100°C (212°F). The boiler is of the package firetube type, equipped with a combination gas/oil burner, modulating fire capabilities, and automatic controls. Design and construction of the boiler is in accordance with the ASME Code, section I. Design pressure is 1.034 MPa (150 psig). The unit was operated at approximately 0.69 MPa (100 psig) for all tests. At this operating condition, outlet steam quality is rated as better than 99.5 percent.

3-4. Water Supply Tank

The water supply tank provides the water for the mixer section. The tank is constructed of 0.61-meter (24-inch) carbon steel pipe with elliptical head closures.


1447E35
MUFFLER
DRAIN
LEVEL SWITCH
BOILER
CHEMICAL FEEDER
OIL TANK
OIL TANK
FLAME
EXHAUST
FROM BOILER LEVEL SWITCH
WATER METER
WATER SOFTENER
FROM CITY WATER
MIXER
BPR (1300 PSI SET PRESSURE)
WATER SUPPLY TANK
RECIRCULATING PUMP
VENT
FILTER
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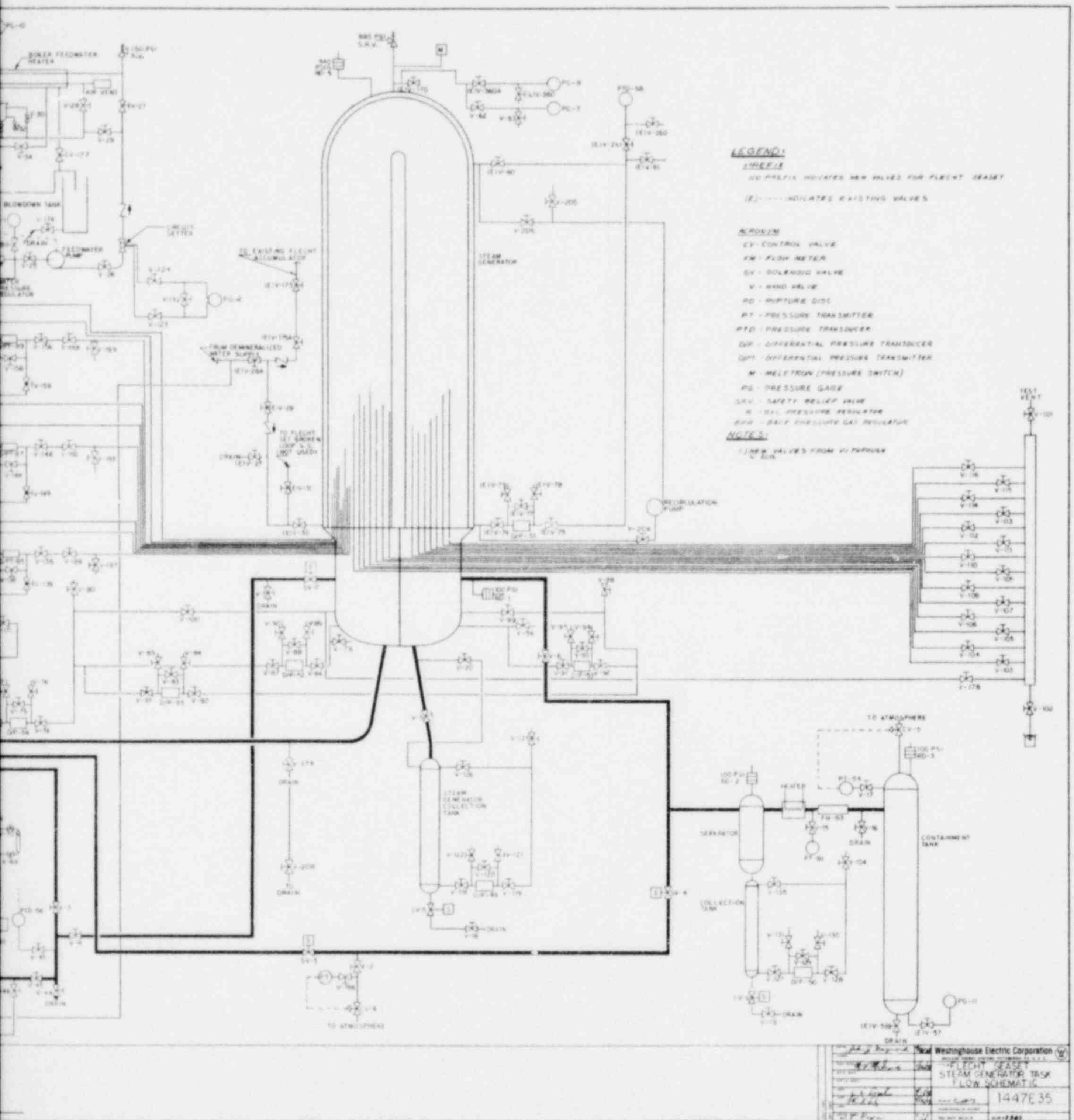

Figure 3-1. Detailed Schematic Diagram of Separate Effects Test Loop

The capacity is approximately 946 liters (250 gallons). Design and construction complies with section I of the ASME Code. The vessel is designed for 2.06 MPa (300 psi) at 343°C (650°F). Strip heaters on the tank wall, along with a mixing pump, are used to bring the water to the saturation temperature corresponding to the specified test pressure. A constant nitrogen gas overpressure supplies the driving head for injecting water into the mixer section.

3-5. Mixer

Water and steam are combined in the mixer section to produce the two-phase flows entering the steam generator. The mixer section is located in a horizontal run of hot leg piping upstream of the steam generator. Mixing is accomplished by spray nozzle injection (figure 3-2). The spray nozzles used are the type supplied by Spraying Systems Co.

Four different size nozzles were used in the mixer section over the course of the test series. The choice of nozzle size was based on matching the known nozzle pressure drop versus flow characteristics with the required liquid flow rate for a given test run. A minimum nozzle pressure drop was established to ensure a fully developed spray pattern from the nozzle. A maximum nozzle pressure drop was established to ensure that the pressure limits in the accumulator and piping upstream of the mixing nozzle would not be violated. Nozzle pressure drops ranged from 0.138 MPa (20 psi) to 0.345 MPa (50 psi) in the tests. Specific nozzles used in each test are identified in table 3-1.

To test the generator's response to uniform inlet flow conditions for four matrix tests, a right-angle spray nozzle was inserted through one of the generator inlet plenum window openings and directed at the tubesheet. A deflector screen was attached to the nozzle to provide a semicircular spray pattern consistent with the inlet plenum geometry.

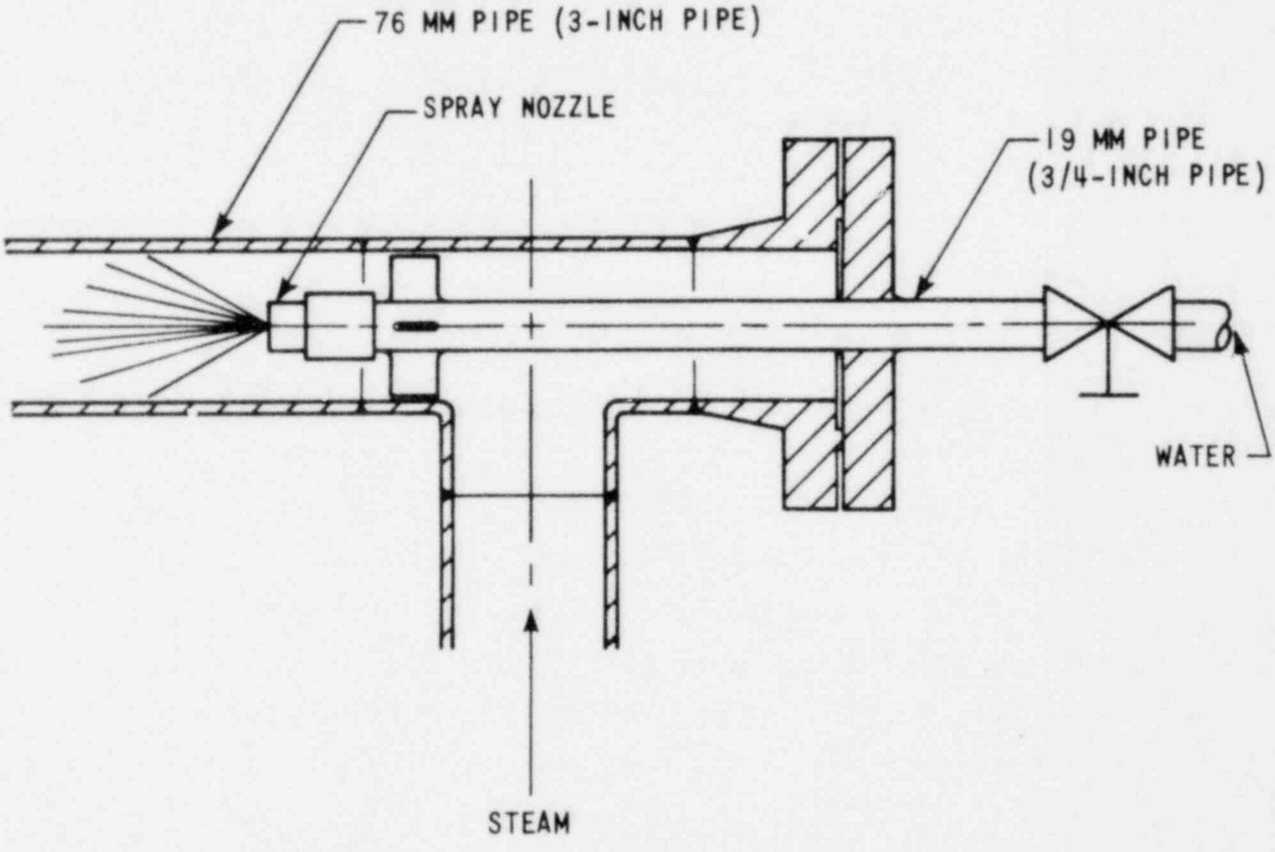

Figure 3-2. Diagram of Steam-Water Mixer Section

TABLE 3-1

LIQUID INJECTION SPRAY NOZZLES

Matrix Run No.	Spraying Systems Co. Nozzle Model No.
1,3,4,7,8,10,11,21	1/8 GGD 5
2	3/8 GD 9.5
5	3/8 GD 9.5
6	1/2 GGD 16
9	3/4 HD 4
12[a]	1/4 GGA 6.5
13[a]	1/4 GGA 6.5
14[a]	1/2 GGA 16
15[a]	1/2 GGA 16

a. Right-angle spray nozzles used in inlet plenum injection tests

3-6. Steam Generator

The steam generator used during the separate effects task is the large steam generator simulator used in the FLECHT-SET Phase B test program.[1] Figure 3-3 shows details of construction of the generator.

Certain modifications were made to the generator for the separate effects task. All but one of the stub tubes previously plugged for the FLECHT SET Phase B test series were opened. A total of 32 of 33 tubes were needed to preserve, as closely as possible, the flow area scaling relationship, because of the increased heater rod bundle flow area in the FLECHT SEASET systems effects test. The tube chosen for plugging was tube E (sheet 1); this tube would be most strongly affected by edge effects of the shell on the steam generator secondary side and edge effects of the inlet plenum on the primary side.

An instrumentation ring with multiple radial penetrations was added between the tubesheet flange and the lower plenum flange to bring out primary side instrumentation. Two sight glass nozzles were added to the discharge side of the lower plenum section for viewing and photographic study. An alternate 125-millimeter (5-inch) discharge nozzle was added to the lower plenum. This serves as an outlet for steam and also supports an internal baffle assembly. The baffle helps to separate any entrained liquid carried through the generator. The separated liquid drains through the old discharge nozzle to a new 3.05-meter-long (10-foot-long) collection tank made from 152-millimeter (6-inch) pipe. The baffle is illustrated in figure 3-4.

3-7. Steam Separator

A steam separator located downstream of the steam generator is used to separate any remaining entrained liquid so that an accurate single-phase steam flow measurement can be made by the vortex meter located downstream of the separator.

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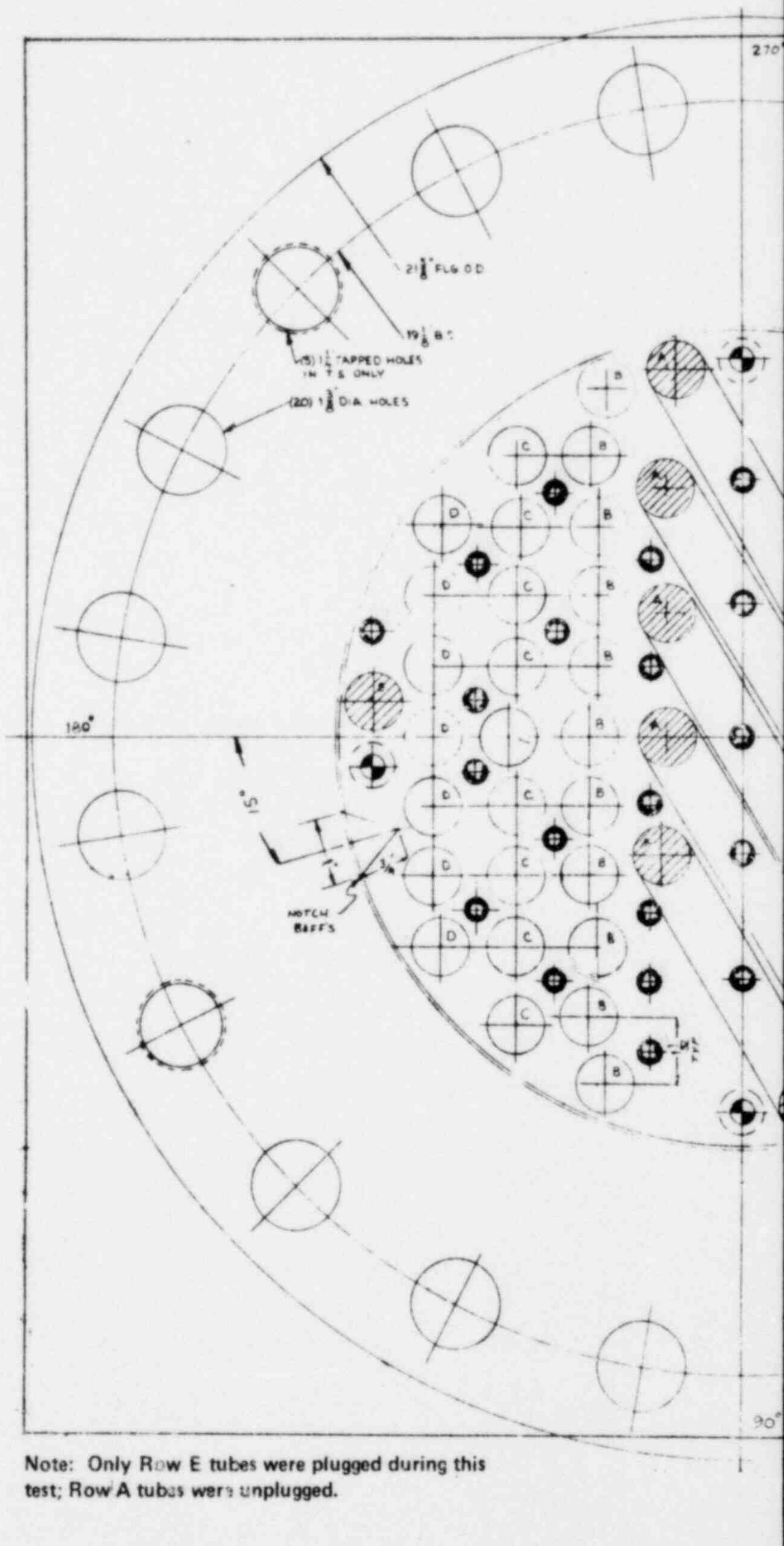
1. Waring, J. P., and Hochreiter, L. E., "PWR FLECHT SET Phase B1 Evaluation Report," WCAP-8583, August 1975.



Note: Only Row E tubes were plugged during this test; Row A tubes were unplugged.

POOR ORIGINAL

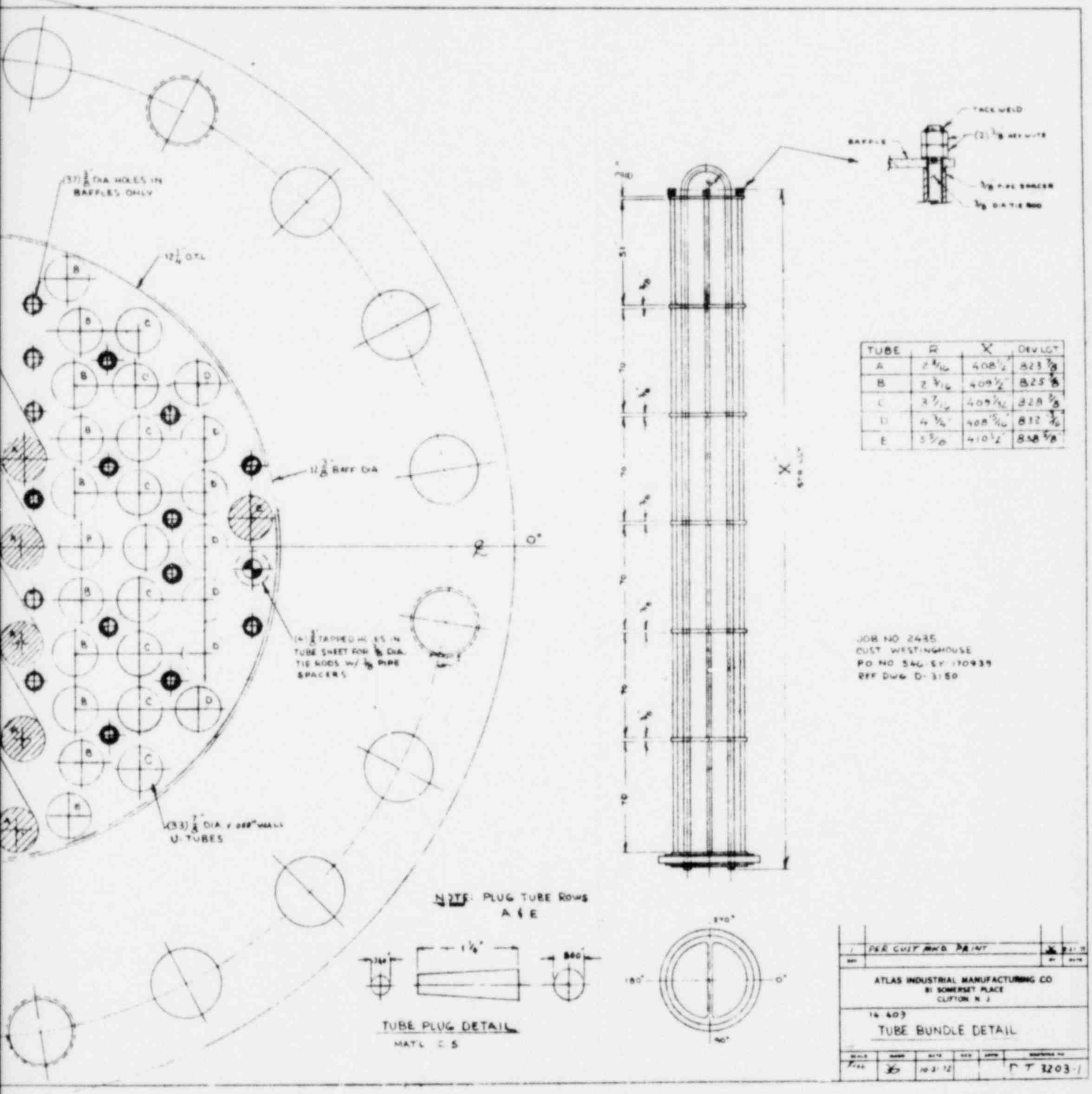
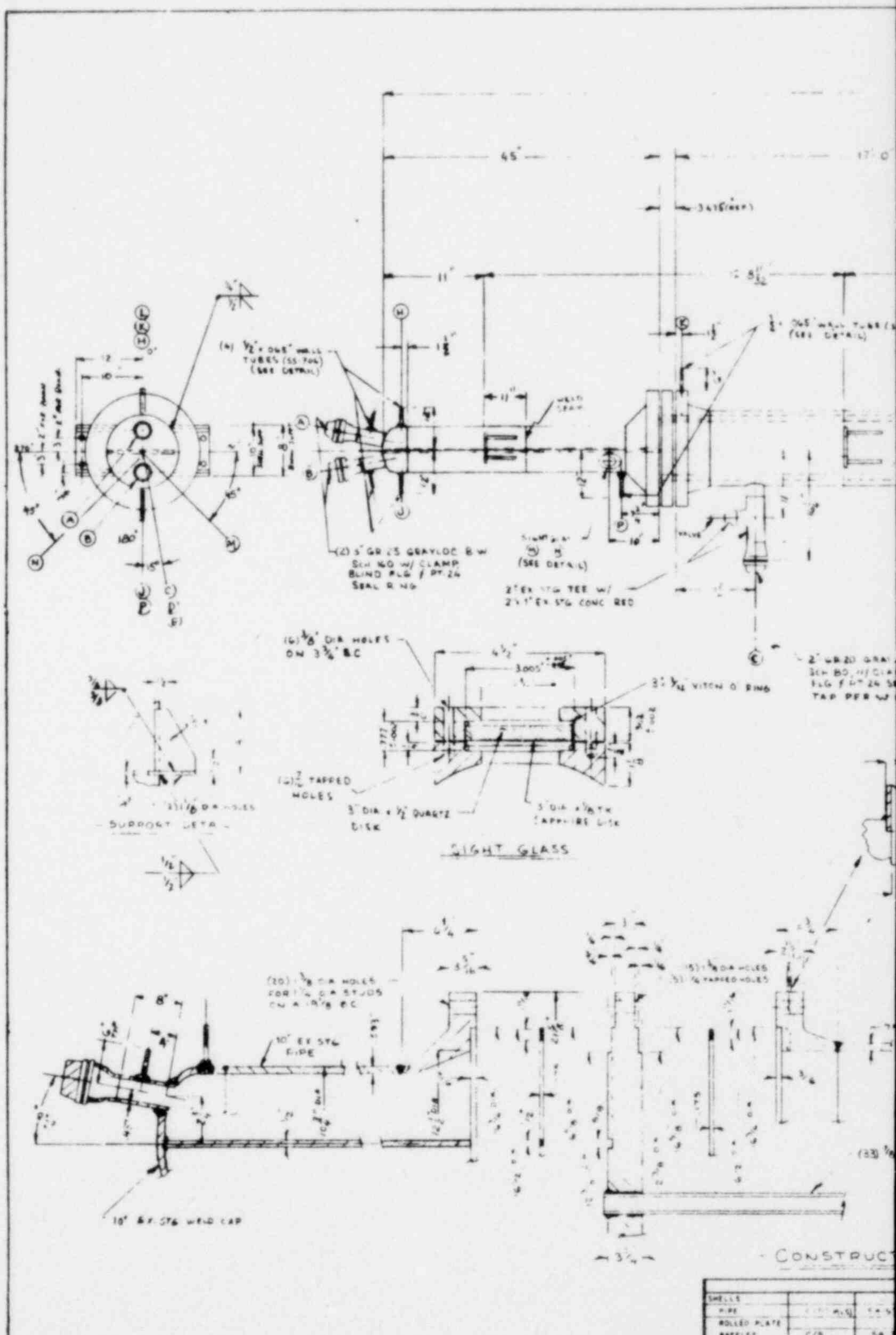


Figure 3-3. Constructions Details of Separate Effects Test Steam Generator (sheet 1 of 2)



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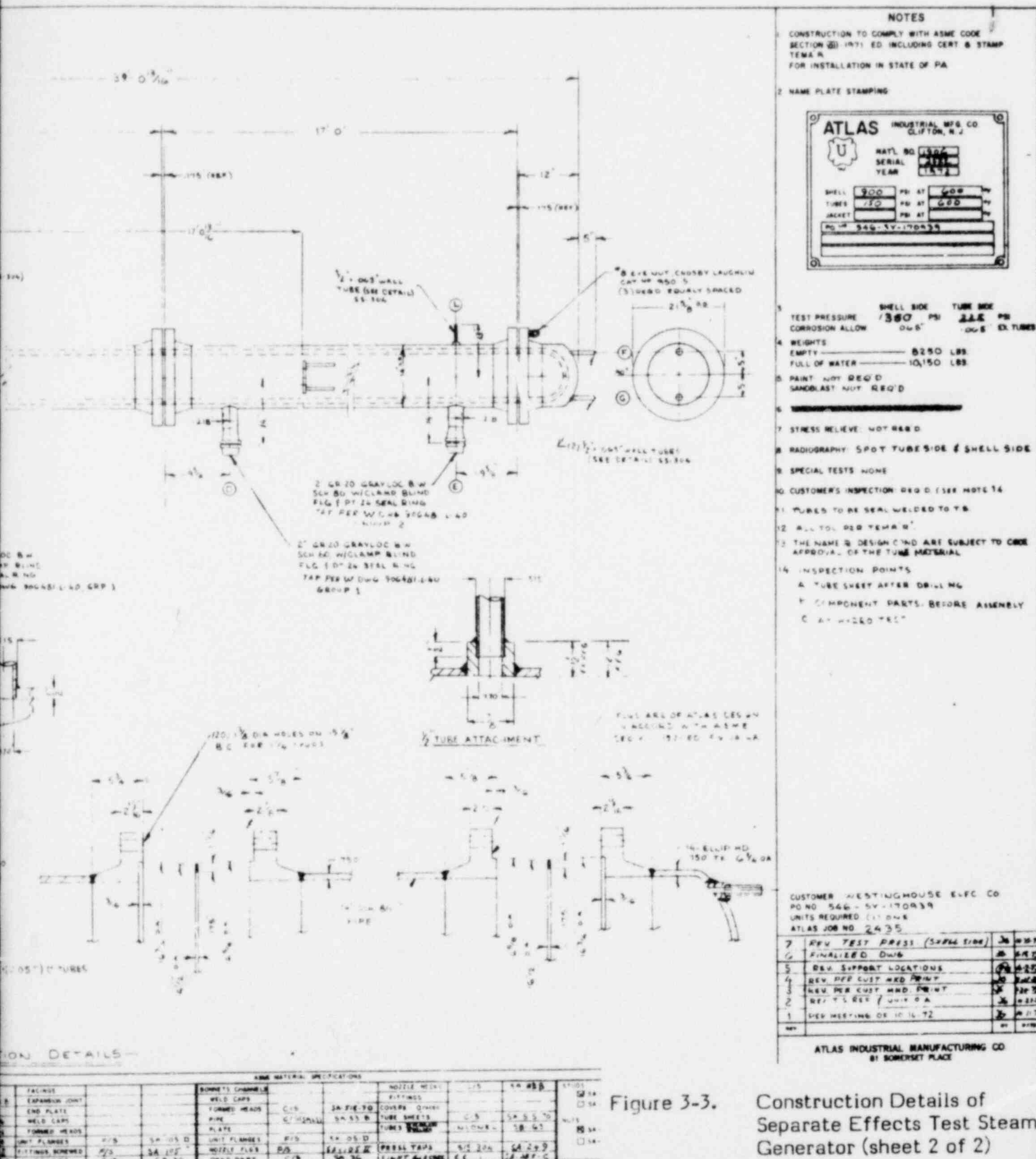

Figure 3-3. Construction Details of Separate Effects Test Steam Generator (sheet 2 of 2)

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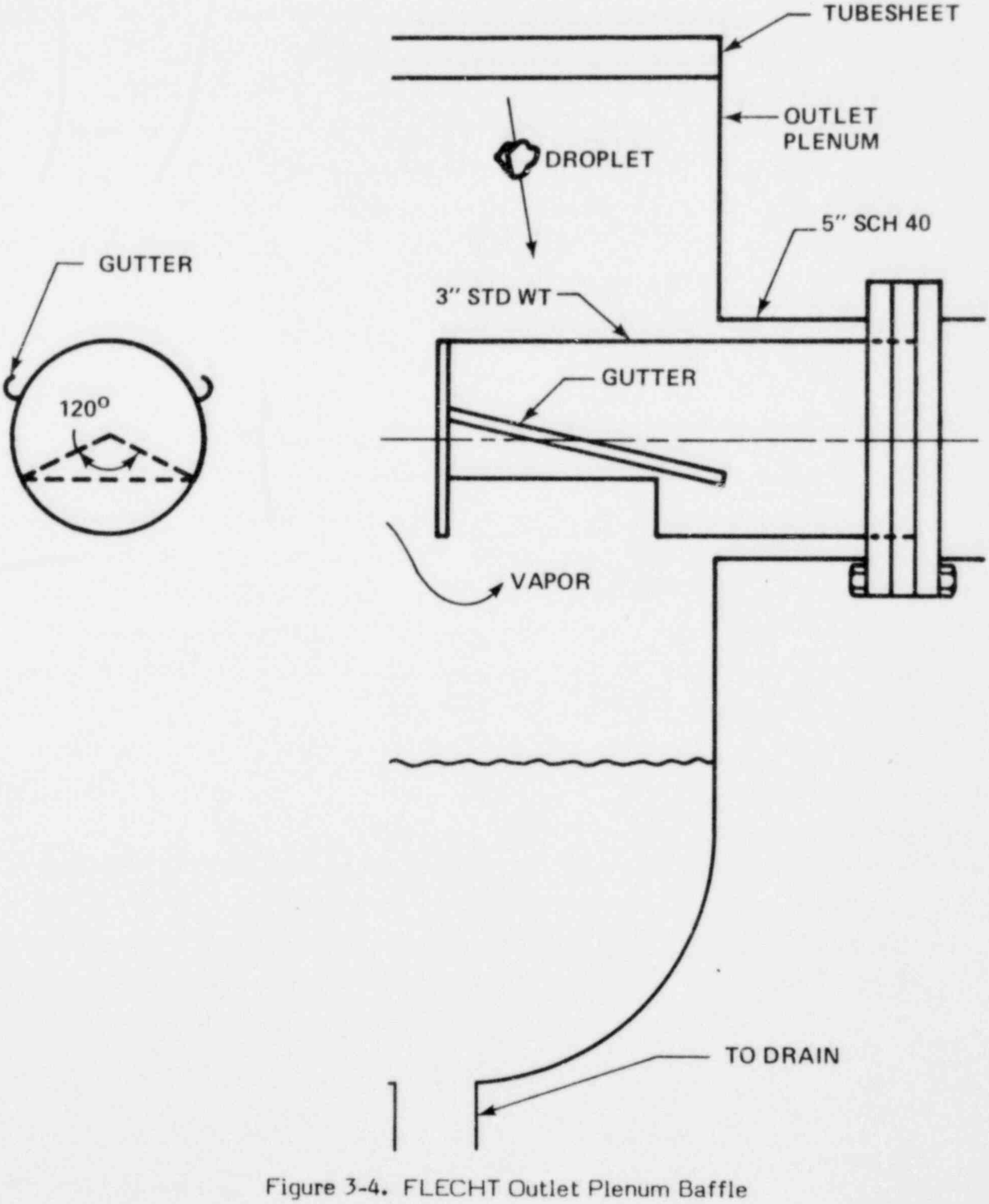

Figure 3-4. FLECHT Outlet Plenum Baffle

The separator uses centrifugal force to drive the heavier moisture against the walls of the vessel, where it drains to a 76.2-millimeter-diameter (3-inch-diameter) by 2.1-meter-long (7-foot-long) collection tank. The separator, manufactured by Wright-Austin, is a TS-type separator sized for 10.16-centimeter (4-inch) pipe. The pressure-retaining shell is made from 305-millimeter-diameter (12-inch-diameter) pipe with 102-millimeter (4-inch) flanged inlet and outlet steam connections. The unit is designed for 1.03 MPa (150 psi) at 260°C (500°F) in accordance with the ASME Code, section VIII. The manufacturer rates the separator as capable of removing 99 percent of all liquid and solid entrainment where the particle sizes exceed 10^{-5} meters (3.9×10^{-4} inches). Separator capacity varies with operating pressure. At 0.14 MPa (20 psia), the maximum recommended steam flow rate is 1134 kg/hr (2500 lb/hr), and at 0.41 MPa (60 psia), the capacity is 2132 kg/hr (4700 lb/hr). Up to half of the flow can be entrained water.

3-8. Containment Tank

The containment tank is the same vessel used in the FLECHT SET test program(1) to provide the containment backpressure simulation. The vessel is made from 0.61-metre-diameter (24-inch-diameter) pipe with elliptical head closures. Design and construction comply with the ASME Code, section I. The design rating is 0.7 MPa (100 psi) at 343°C (650°F). The tank has a volume of approximately 1703.3 liters (450 gallons). The containment tank serves as a convenient point at which to control system pressure. Its large volume helps to dampen any system pressure fluctuations in the test loop.

3-9. Loop Piping

The main loop steam piping from the boiler to the steam generator, including the bypass line, is fabricated primarily from 76-millimeter (3-inch) standard weight pipe and weld fittings. The FLECHT SET steam generator inlet piping geometry is maintained by using the inlet bend section of 76-millimeter (3-inch) schedule 160

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1. Blaisdell, J. A., Hochreiter, L. E., and Waring, J. P., "PWR FLECHT SET Phase A Report," WCAP-8238, December 1973.

piping from the FLECHT SET facility. A short section of pipe upstream of the steam separator and from the separator to the containment tank is 102-millimeter (4-inch) standard weight. Water injection piping from the water supply tank to the spray nozzle and any auxiliary steam piping is primarily field run and consists of 25.4-millimeter (1-inch) standard weight pipe and threaded fittings.

3-10. INSTRUMENTATION DESCRIPTION

Loop instrumentation (figure 3-5) is designed to measure mass and energy transport across the primary side inlet and primary side exit boundaries of the steam generator. Flow meters in the boiler steam line, liquid supply tank feed line, and steam separator exhaust line establish the mass flow rates of steam and liquid in these lines. The separator liquid flow rate is measured by the rate of change of liquid level in the liquid collection tanks. The energy content of the steam and liquid is calculated from measurements of the fluid temperature and pressure at the collection and flow measuring points. The difference between the steam generator primary side inlet quality and the primary side exit quality, for a given constant mass flow, represents the total energy exchange from the secondary to primary sides of the steam generator. Any steam generator exit vapor superheat is also considered in the overall energy balance.

Within the tube bundle, the heat transfer process is monitored by thermocouples in the secondary fluid and on the tube wall, and by steam probes inside the tubes. The steam generator bundle instrumentation locations are shown in figures 3-5 and 3-6. A summary of the bundle instrumentation is presented in table 3-2. The tube bundle instrumentation is specifically designed to measure a radial variation in heat transfer rate due to expected nonuniform two-phase flow in the inlet plenum.

The distribution of secondary fluid and tube wall thermocouples is skewed toward the bottom of the bundle, because prior FLECHT SET Phase B data showed that most secondary temperature variation occurred below the 0.61-meter (2-foot) elevation. The steam probe axial spacing is based on calculations of vapor temperature versus tube length from a model of the two-phase heat transfer process in the tubes.[1]

The tubes in the inlet side of the tube bundle are instrumented with differential pressure probes to monitor differential pressure over the zero- to 1.2-meter (4-foot) elevation. The differential pressure transducers have a range of zero to 6.9 kPa (zero to 1 psi), which is much larger than the calculated frictional or hydrostatic differential pressure within the tubes, assuming uniform conditions at the tube entrance. However, a larger than expected differential pressure develops in the tube entrance when mass accumulation occurs in a tube. The purpose of the differential pressure probes is to detect this mass accumulation when it occurs. To prevent spurious differential pressure signals due to liquid migration into the differential pressure probe, a continuous nitrogen purge flow is provided. The nitrogen flows from the differential pressure cell to the probe and prevents any liquid from entering the probe. The volumetric flow rate of the nitrogen flowing into the steam generator tubes, which is much less than 1 percent of the total flow rate, is neglected in the overall loop mass balance. The effect of the nitrogen purge on the heat transfer is minimal, because none of the tubes that are instrumented with thermocouples have differential pressure probes. Also, because of the low nitrogen purge flow and because the probe only perturbs a local zone within the total circumference of the tube, the heat transfer effect is minimal. The continuous purge concept was tested successfully in a single-tube bench test (appendix A).

The steam probes used to measure the primary side steam temperatures are aspirating-type probes inserted in selected steam generator tubes from the lower plenum. The probes are constructed of 2.4-millimeter-diameter (0.094-inch-diameter) outer tubing with a 0.6-millimeter-diameter (0.025-inch-diameter) inner sheathed thermocouple. The maximum reduction in steam generator tube flow area due to the steam probes is less than 10 percent, and the flow area reduction averaged over the total tube length is less than 2 percent. All steam probes in the

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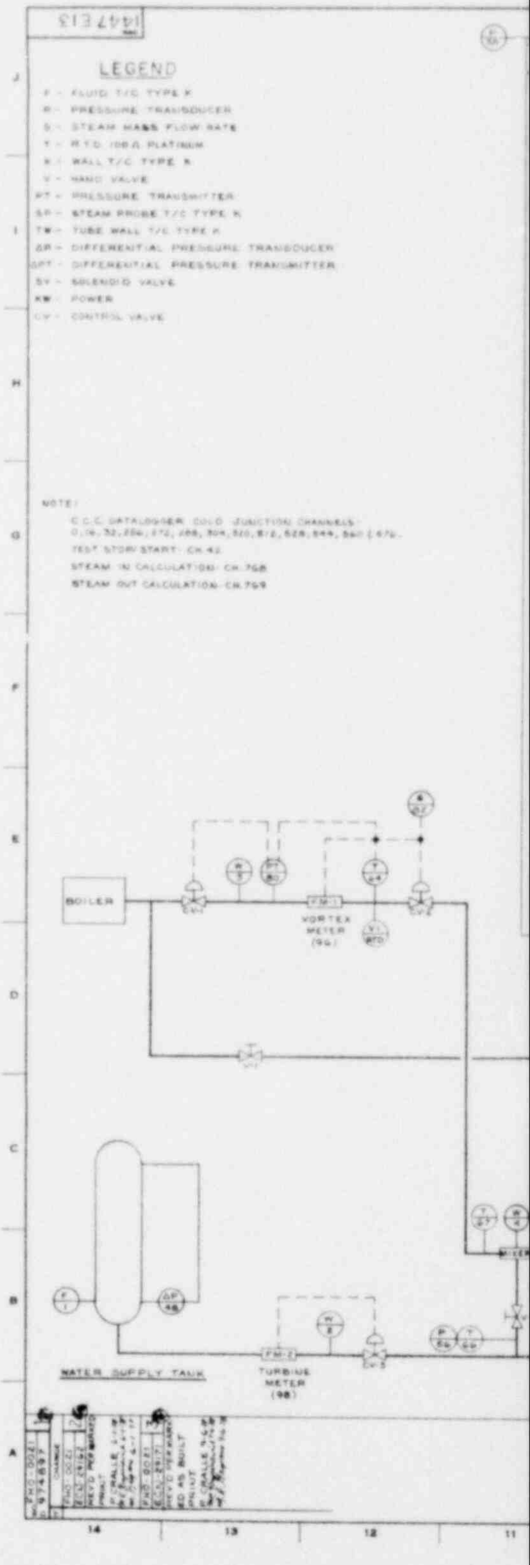
1. Hochreiter, L. E., et al., "PWR FLECHT SEASET Steam Generator Separate Effects Task: Task Plan Report," NRC/EPRI/Westinghouse-2, March 1978, figure 6-4 and appendix B.



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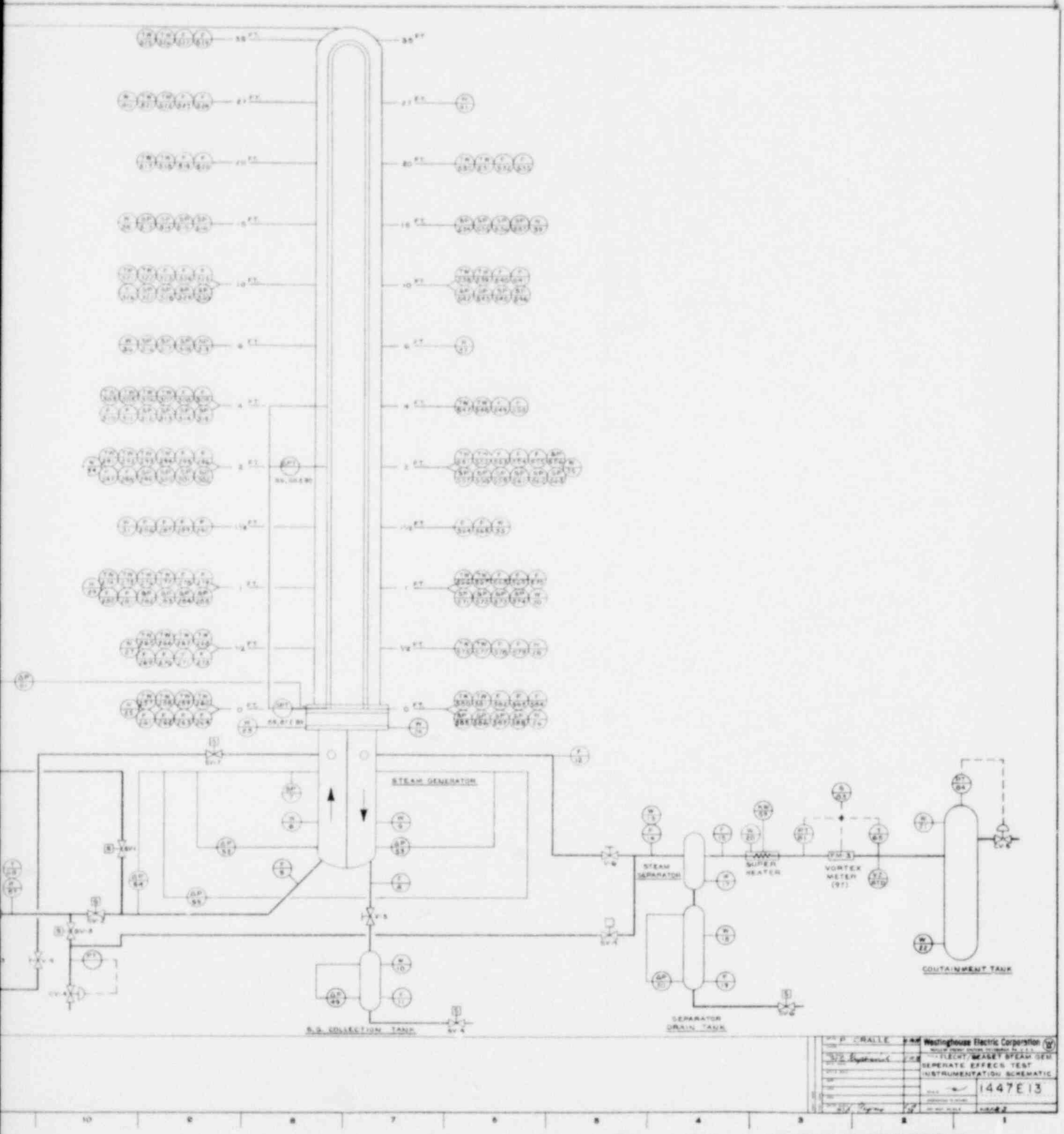
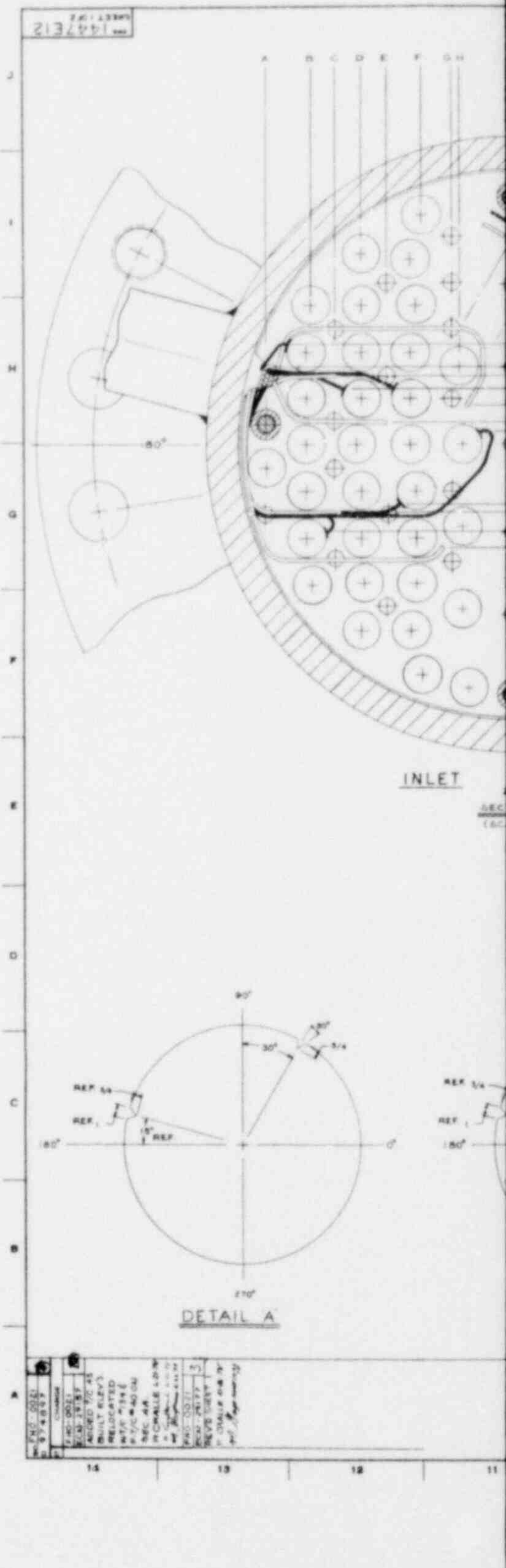


Figure 3-5. FLECHT SEASET Steam Generator Separate Effects Test Instrumentation Schematic Diagram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INLET
DETAIL 'A'
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180°
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REF.

15607-47

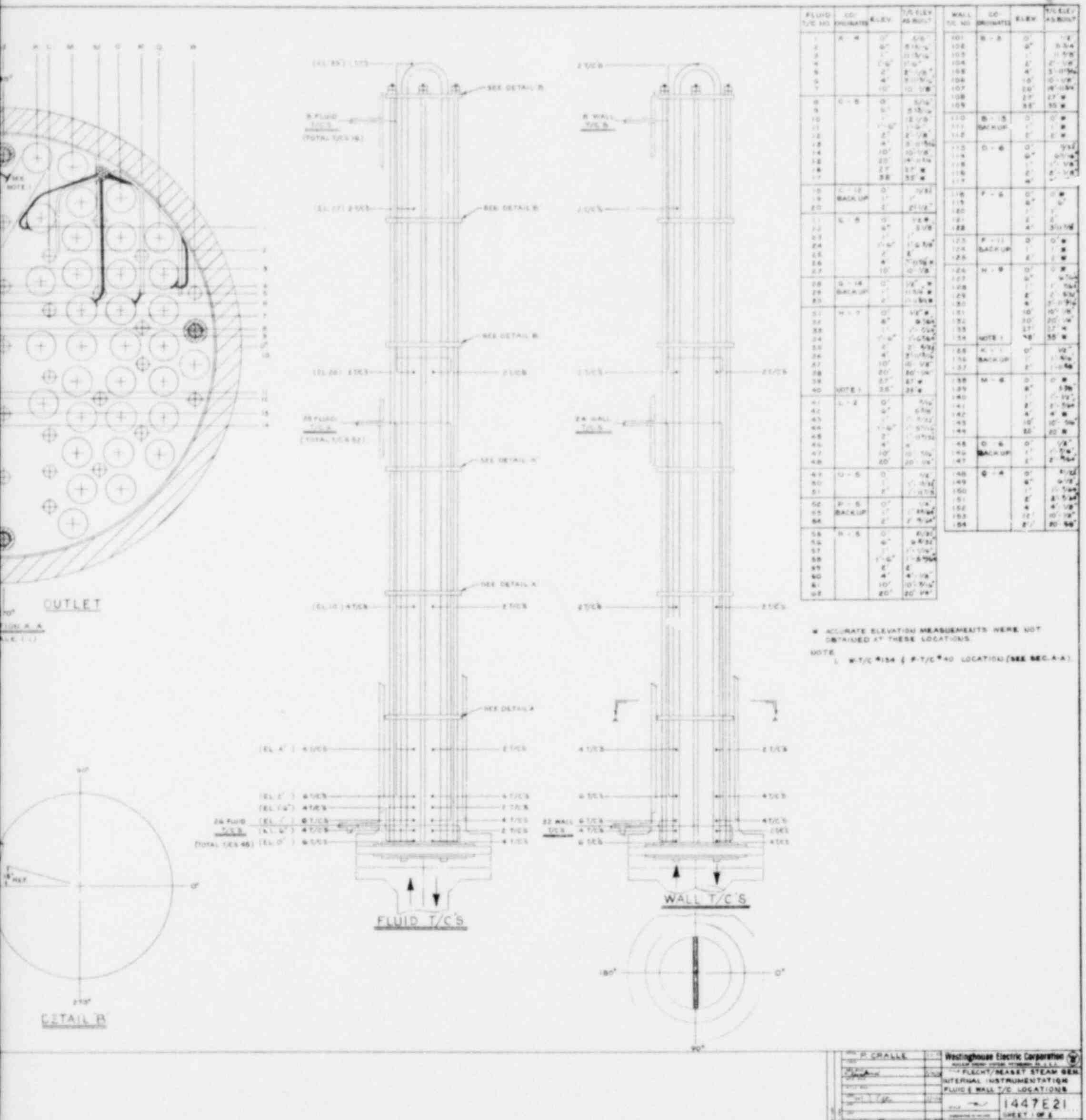
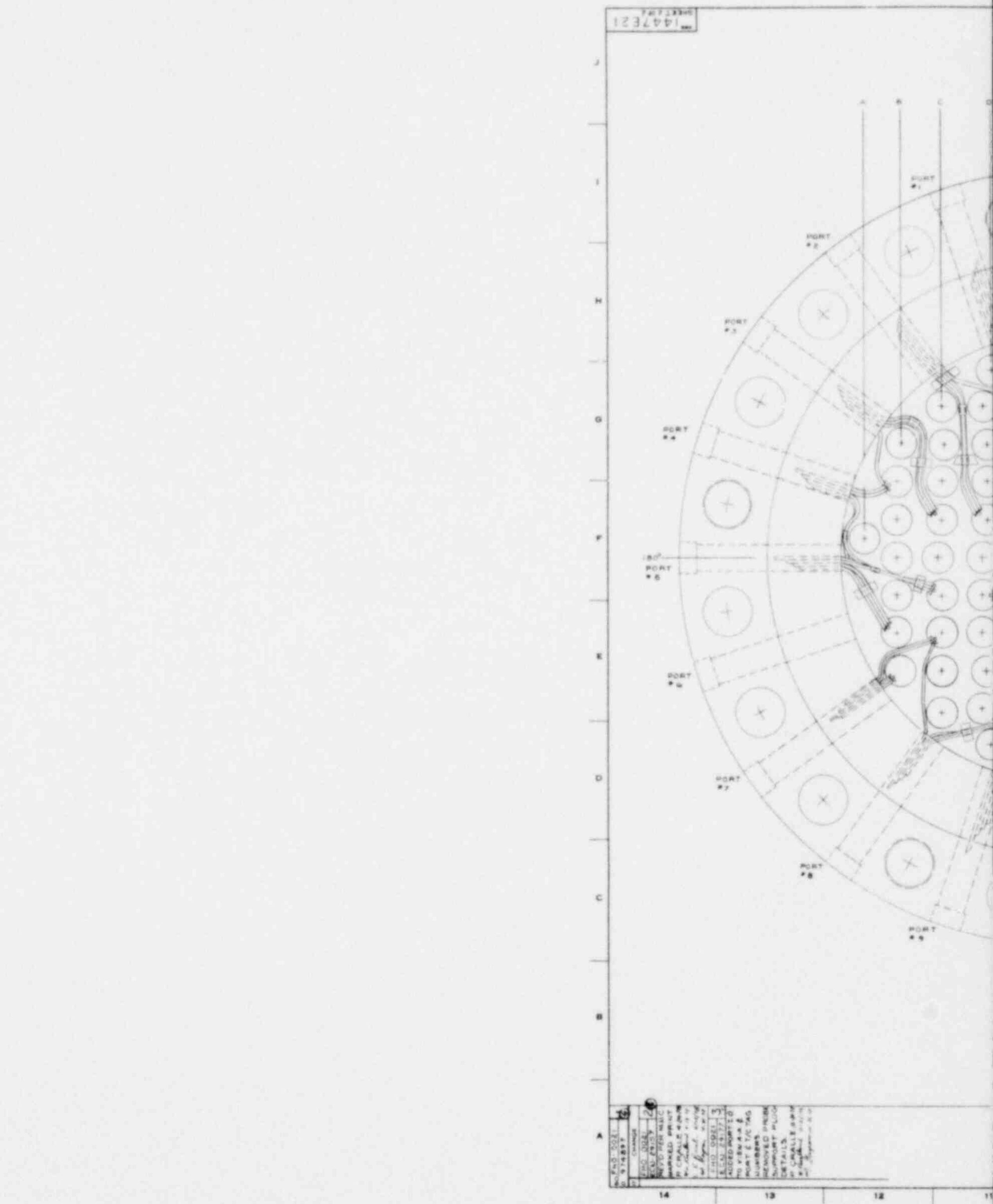


Figure 3-6. FLECHT SEASET Steam Generator Separate Effects Test Instrumentation Locations (sheet 1 of 2)

POOR ORIGINAL



POOR ORIGINAL

15607-48

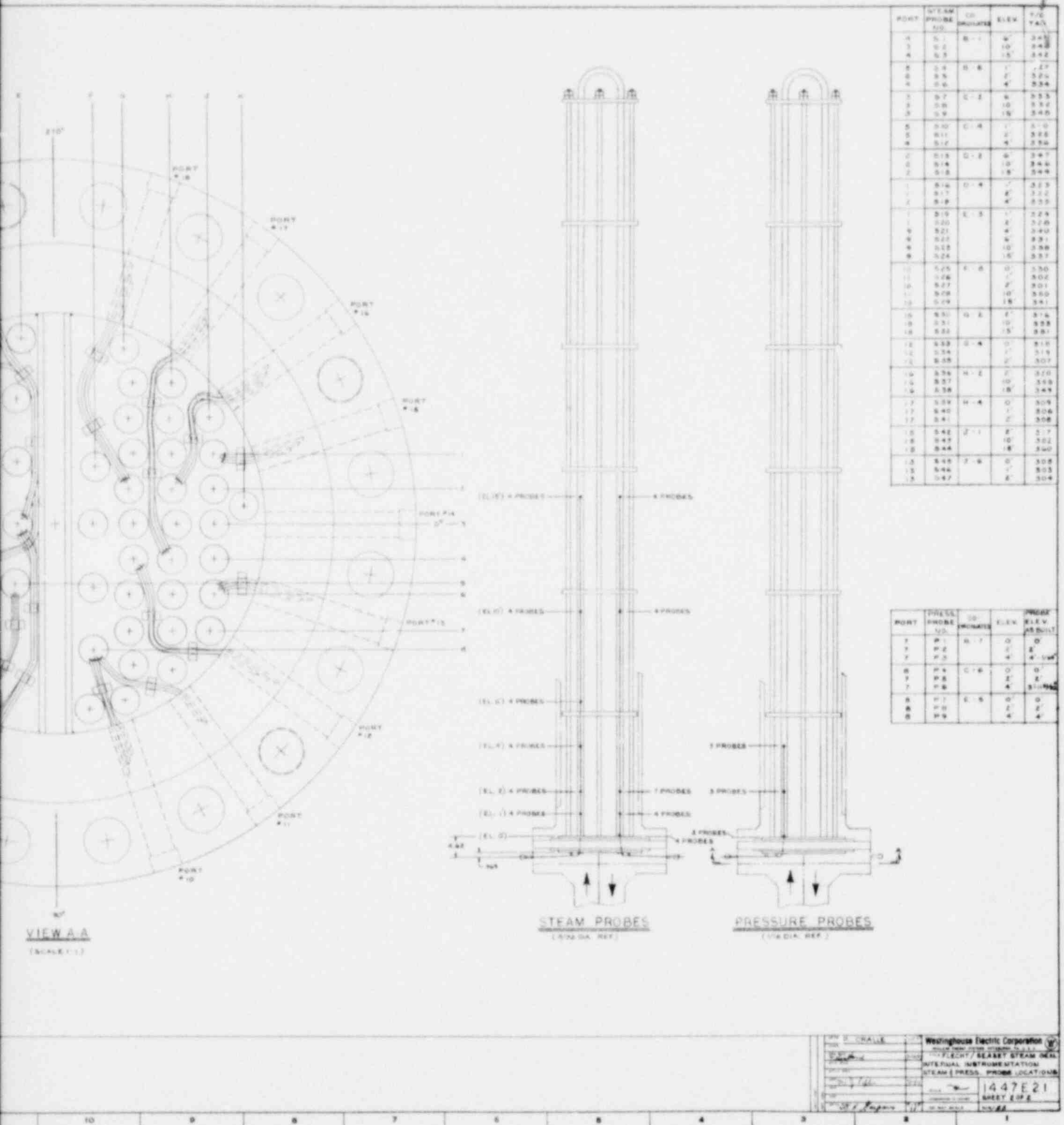


Figure 3-6. FLECHT SEASET Steam Generator Separate Effects Test Instrumentation Locations (sheet 2 of 2)

TABLE 3-2

AXIAL DISTRIBUTION OF TUBE WALL AND FLUID THERMOCOUPLES AND STEAM PROBES

Elevation in Meters (Feet)	Steam Generator Inlet				Steam Probes	Steam Generator Outlet				Steam Probes
	Tube Wall T/Cs		Fluid T/Cs			Tube Wall T/Cs		Fluid T/Cs		
	Primary	Backup	Primary	Backup	Primary	Primary	Backup	Primary	Backup	Primary
0	4	2	4	2	-	2	2	3	1	4
0.153 (0.5)	4	-	4	-	-	2	-	2	-	-
0.305 (1)	4	2	4	2	4	2	2	3	1	4
0.458 (1.5)	-	-	4	-	-	-	-	2	-	-
0.610 (2)	4	2	4	2	4	2	2	3	1	7
1.220 (4)	4	-	4	-	4	2	-	2	-	-
1.830 (6)	-	-	-	-	4	-	-	-	-	-
3.050 (10)	2	-	4	-	4	2	-	2	-	4
4.575 (15)	-	-	-	-	4	-	-	-	-	4
6.100 (20)	2	-	2	-	-	2	-	2	-	-

TABLE 3-2 (cont)

AXIAL DISTRIBUTION OF TUBE WALL AND FLUID THERMOCOUPLES AND STEAM PROBES

Elevation in Meters (Feet)	Steam Generator Inlet					Steam Generator Outlet				
	Tube Wall T/Cs		Fluid T/Cs		Steam Probes	Tube Wall T/Cs		Fluid T/Cs		Steam Probes
	Primary	Backup	Primary	Backup	Primary	Primary	Backup	Primary	Backup	Primary
8.235 (27)	2	-	2	-	-	-	-	-	-	-
10.675 (35)	2	-	2	-	-	-	-	-	-	-
Total[a]	28	6	34	6	24	14	6	19	3	23

a. Total tube wall T/Cs + fluid T/Cs = 116; total steam probes = 47 steam generator aspirate less than 3 percent of the total loop mass flow rate. Aspirated steam is condensed, collected, and accounted for in the overall loop mass and energy balance.

Photographic techniques were used to identify the two-phase flow regime in the steam generator inlet and outlet plenum. Droplet size and velocity information was obtained from high-speed movies and still photographs (appendix D). Movies and still photographs were taken in each of four different test runs. The movies were taken with two Redlake Hycam model 41-0004 high-speed cameras using a 25mm lens at an F-stop of 1.4. The light source was a 1000-watt incandescent lamp. The still photographs were taken with Nikon and Mamiya cameras synchronized with Vivitar model/283 flash units, which have a flash duration of 25 microseconds.

Motion pictures were taken for matrix runs 2, 5, 6, and 10. Two 400-foot rolls of film were exposed at the inlet plenum window at the beginning and at the end of the run. Four 400-foot rolls of film were exposed at the outlet plenum window at 1, 3, 5, and 7 minutes into the run. All film was shot at 2500 frames per second to allow tracking of individual drops in the plenums.

Still photographs were taken in matrix runs 3, 4, 9, and 11. Inlet plenum photos were taken at 1-minute intervals, starting at 1 minute into the test and terminating at 20 minutes. Outlet plenum photos were taken for 10 minutes at 30-second intervals, starting at 30 seconds into the test. High-intensity flash units were synchronized with the camera shutter to freeze the droplet action in the plenum.

3-11. DATA ACQUISITION

The first stage of the data processing sequence is the data acquisition system. The hardware is a microprocessor-based data logger which can record on either 21-column paper or digital magnetic tape. The paper readout feature is used to monitor loop heatup and the digital magnetic tape recorder stores data acquired during a test. Data are recorded in engineering units either from standard conversion tables for thermocouples and RTDs or from preprogrammed calibration files for the pressure and flow sensors. Input signals from the loop sensors are conditioned so that the input to the A/D converter is a zero- to 1-volt signal. These input conditioning cards are specialized for different types of sensors. Three A/D converters are used simultaneously to provide a system scan rate of 45 channels per second. With 212 channels, the data acquisition system is able to scan each channel every 6 seconds; this scan rate is acceptable for the slow transient response in this task. In addition to data collection on magnetic tape, three strip charts continuously recorded the signals from 12 test instruments. The strip chart recorders were used for operator indication of loop operation during the test and for recording the cycling of the power to the immersion heater located downstream of the loop separator. A channel list of the data recorded on the magnetic tape is shown in table 3-3, and a list of the data recorded continuously on the strip charts is shown in table 3-4.

After each test, the digital magnetic tape was processed on the existing FLECHT computer data acquisition system (a Digital Equipment Corporation PDP 11/20). A printout of all the data was made immediately following each test so that the test director could evaluate its reliability. A subroutine of the PDP 11/20 compiled specific data points so that the test director could determine if the test met the requirements of the test matrix. Finally, the PDP 11/20 produced a data tape which was processed by the CDC 7600 computer at the Westinghouse Nuclear Center in Monroeville, Pennsylvania. All of the data reduction and data analysis was carried out on the CDC 7600.

3-12. PARAMETER CONTROL SYSTEMS

The parameter control systems are described in the following paragraphs.

3-13. Parameter Control Method

Closed loop feedback control systems are provided to control the following five parameters in the primary loop:

- Steam pressure downstream of valve CV-1[1]
- Boiler steam mass flow rate

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1. See figure 3-7 for valve and component locations.

TABLE 3-3

STEAM GENERATOR SEPARATE EFFECTS TEST CHANNEL LIST

Channel	Data
1	Accumulator fluid T/C
2	Water injection line wall T/C
3	Steam line wall T/C
4	Mixer wall T/C
5	Steam generator inlet plenum fluid T/C
6	Steam generator inlet plenum wall T/C
7	Steam generator inlet plenum steam probe
8	Steam generator outlet plenum fluid T/C
9	Steam generator outlet plenum wall T/C
10	Steam generator collection tank wall T/C
11	Steam generator collection tank fluid T/C
12	Steam generator plenum exit fluid T/C
13	Steam separator entrance wall T/C
14	Steam separator entrance fluid T/C
15	Steam separator exit fluid T/C
17	Steam separator wall T/C
18	Steam separator drain tank wall T/C
19	Steam separator drain tank fluid T/C
20	Superheater wall T/C
21	Containment tank top wall T/C
22	Containment tank bottom wall T/C
23	Steam generator plenum flange inlet wall T/C
24	Steam generator plenum flange outlet wall T/C
25	Steam generator 0 ft inlet wall T/C
26	Steam generator 0 ft outlet wall T/C
27	Steam generator 0.5 ft inlet wall T/C
28	Steam generator 0.5 ft outlet wall T/C
29	Steam generator 1.0 ft inlet wall T/C
30	Steam generator 1.0 ft outlet wall T/C
31	Steam generator 1.5 ft inlet wall T/C
33	Steam generator 1.5 ft outlet wall T/C
34	Steam generator 2.0 ft inlet wall T/C
35	Steam generator 2.0 ft outlet wall T/C
36	Steam generator 6.0 ft inlet wall T/C
37	Steam generator 6.0 ft outlet wall T/C
38	Steam generator 15 ft inlet wall T/C
39	Steam generator 15 ft outlet wall T/C
40	Steam generator 27 ft inlet wall T/C
41	Steam generator 27 ft outlet wall T/C
42	Test start/stop
48	Accumulator level (psid)
49	Steam generator collection tank level (psid)
50	Steam separator drain tank level (psid)

TABLE 3-3 (cont)

STEAM GENERATOR SEPARATE EFFECTS TEST CHANNEL LIST

Channel	Data
51	Steam generator secondary level (psid)
52	Steam generator inlet plenum pressure (psid)
53	Steam generator outlet plenum pressure (psid)
54	Steam generator hot leg pressure (psid)
55	Steam generator plenum inlet/outlet pressure (psid)
56	Water injection line pressure (psig)
57	Mixer pressure (psig)
58	Steam generator secondary side pressure (psig x 10)
59	Superheater power (kw)
64	Steam supply fluid RTD
65	Steam exhaust fluid RTD
66	Water injection fluid RTD
67	Steam before mixer fluid RTD
68	Mixer fluid RTD
80	Steam supply pressure (psia)
81	Steam exhaust pressure (psia)
82	Steam supply flow (lbm/sec)
83	Steam exhaust flow (lbm/sec)
84	Containment tank pressure (psig)
85	Generator tube B-7[a], 0 - 2 ft pressure (psid)
86	Generator tube B-7, 2 - 4 ft pressure (psid)
87	Generator tube C-6, 0 - 2 ft pressure (psid)
88	Generator tube C-6, 2 - 4 ft pressure (psid)
89	Generator tube E-5, 0 - 2 ft pressure (psid)
90	Generator tube E-5, 2 - 4 ft pressure (psid)
96	Steam supply vortex meter (cfm)
97	Steam exhaust vortex meter (cfm)
98	Injection water flow turbine meter (gpm)
257	Generator 0 ft inlet tube B-6 wall T/C
258	Generator 0 ft inlet tube C-4 wall T/C
259	Generator 0 ft inlet tube D-4 wall T/C
260	Generator 0 ft inlet tube E-3 wall T/C
261	Generator 0 ft inlet secondary B-6 fluid T/C
262	Generator 0 ft inlet secondary C-4 fluid T/C
263	Generator 0 ft inlet secondary D-4 fluid T/C
264	Generator 0 ft inlet secondary E-3 fluid T/C
265	Generator 0.5 ft inlet tube B-6 wall T/C
266	Generator 0.5 ft inlet tube C-4 wall T/C
267	Generator 0.5 ft inlet tube D-4 wall T/C
268	Generator 0.5 ft inlet tube E-3 wall T/C
269	Generator 0.5 ft inlet secondary B-6 fluid T/C
270	Generator 0.5 ft inlet secondary C-4 fluid T/C
271	Generator 0.5 ft inlet secondary D-4 fluid T/C

a. This pressure transducer was not connected to the data acquisition system.

TABLE 3-3 (cont)

STEAM GENERATOR SEPARATE EFFECTS TEST CHANNEL LIST

Channel	Data
273	Generator 0.5 ft inlet secondary E-3 fluid T/C
274	Generator 1 ft inlet tube B-5 wall T/C
276	Generator 1 ft inlet tube D-4 wall T/C
277	Generator 1 ft inlet tube E-3 wall T/C
278	Generator 1 ft inlet secondary B-6 fluid T/C
279	Generator 1 ft inlet secondary C-4 fluid T/C
280	Generator 1 ft inlet secondary D-4 fluid T/C
281	Generator 1 ft inlet secondary E-3 fluid T/C
282	Generator 1 ft inlet primary B-6 steam probe
283	Generator 1 ft inlet primary C-4 steam probe
284	Generator 1 ft inlet primary D-4 steam probe
285	Generator 1 ft inlet primary E-3 steam probe
286	Generator 1.5 ft inlet secondary B-6 fluid T/C
287	Generator 1.5 ft inlet secondary C-4 fluid T/C
289	Generator 1.5 ft inlet secondary D-4 fluid T/C
290	Generator 1.5 ft inlet secondary E-3 fluid T/C
291	Generator 2 ft inlet tube B-6 wall T/C
292	Generator 2 ft inlet tube C-4 wall T/C
293	Generator 2 ft inlet tube D-4 wall T/C
294	Generator 2 ft inlet tube E-3 wall T/C
295	Generator 2 ft inlet secondary B-6 fluid T/C
296	Generator 2 ft inlet secondary C-4 fluid T/C
297	Generator 2 ft inlet secondary D-4 fluid T/C
298	Generator 2 ft inlet secondary E-3 fluid T/C
299	Generator 2 ft inlet primary B-6 steam probe
300	Generator 2 ft inlet primary C-4 steam probe
301	Generator 2 ft inlet primary D-4 steam probe
302	Generator 2 ft inlet primary E-3 steam probe
303	Generator 4 ft inlet tube B-6 wall T/C
305	Generator 4 ft inlet tube C-4 wall T/C
306	Generator 4 ft inlet tube D-4 wall T/C
307	Generator 4 ft inlet tube E-3 wall T/C
308	Generator 4 ft inlet secondary B-6 fluid T/C
309	Generator 4 ft inlet secondary C-4 fluid T/C
310	Generator 4 ft inlet secondary D-4 fluid T/C
311	Generator 4 ft inlet secondary E-3 fluid T/C
312	Generator 4 ft inlet primary B-6 steam probe
313	Generator 4 ft inlet primary C-4 steam probe
314	Generator 4 ft inlet primary D-4 steam probe
315	Generator 4 ft inlet primary E-3 steam probe
316	Generator 6 ft inlet primary B-1 steam probe
317	Generator 6 ft inlet primary C-2 steam probe
318	Generator 6 ft inlet primary D-2 steam probe

TABLE 3-3 (cont)

STEAM GENERATOR SEPARATE EFFECTS TEST CHANNEL LIST

Channel	Data
319	Generator 6 ft inlet primary E-3 steam probe
321	Generator 10 ft inlet tube B-6 wall T/C
322	Generator 10 ft inlet tube E-3 wall T/C
323	Generator 10 ft inlet secondary B-6 fluid T/C
324	Generator 10 ft inlet secondary C-4 fluid T/C
325	Generator 10 ft inlet secondary D-4 fluid T/C
326	Generator 10 ft inlet secondary E-3 fluid T/C
327	Generator 10 ft inlet primary B-1 steam probe
328	Generator 10 ft inlet primary C-2 steam probe
329	Generator 10 ft inlet primary D-2 steam probe
330	Generator 10 ft inlet primary E-3 steam probe
513	Generator 15 ft inlet primary B-1 steam probe
514	Generator 15 ft inlet primary C-2 steam probe
515	Generator 15 ft inlet primary D-2 steam probe
516	Generator 15 ft inlet primary E-3 steam probe
517	Generator 20 ft inlet tube B-6 wall T/C
518	Generator 20 ft inlet tube E-3 wall T/C
519	Generator 20 ft inlet secondary C-4 fluid T/C
520	Generator 20 ft inlet secondary E-3 fluid T/C
521	Generator 27 ft inlet tube B-6 wall T/C
522	Generator 27 ft inlet tube E-3 wall T/C
523	Generator 27 ft inlet secondary C-4 fluid T/C
524	Generator 27 ft inlet secondary E-3 fluid T/C
525	Generator 35 ft inlet tube B-6 wall T/C
526	Generator 35 ft inlet tube E-3 wall T/C
527	Generator 35 ft secondary C-4 fluid T/C
529	Generator 35 ft secondary E-3 fluid T/C
530	Generator 20 ft outlet tube G-4 wall T/C
531	Generator 20 ft outlet tube J-6 wall T/C
532	Generator 20 ft outlet secondary F-8 fluid T/C
533	Generator 20 ft outlet secondary J-6 fluid T/C
534	Generator 15 ft outlet primary F-8 steam probe
535	Generator 15 ft outlet primary G-2 steam probe
536	Generator 15 ft outlet primary H-2 steam probe
537	Generator 15 ft outlet primary J-1 steam probe
538	Generator 10 ft outlet tube G-4 wall T/C
539	Generator 10 ft outlet tube J-6 wall T/C
540	Generator 10 ft outlet secondary F-8 fluid T/C
541	Generator 10 ft outlet secondary J-6 fluid T/C
542	Generator 10 ft outlet primary F-8 steam probe
543	Generator 10 ft outlet primary G-2 steam probe
545	Generator 10 ft outlet primary H-2 steam probe
546	Generator 10 ft outlet primary J-1 steam probe

TABLE 3-3 (cont)

STEAM GENERATOR SEPARATE EFFECTS TEST CHANNEL LIST

Channel	Data
547	Generator 4 ft outlet tube G-4 wall T/C
548	Generator 4 ft outlet tube J-6 wall T/C
549	Generator 4 ft outlet secondary F-8 fluid T/C
550	Generator 4 ft outlet secondary J-6 fluid T/C
551	Generator 2 ft outlet tube G-4 wall T/C
552	Generator 2 ft outlet tube J-6 wall T/C
553	Generator 2 ft outlet secondary F-8 fluid T/C
554	Generator 2 ft outlet secondary G-4 fluid T/C
555	Generator 2 ft outlet secondary H-4 fluid T/C, Location J-6 for runs before run 21001
556	Generator 2 ft outlet primary F-8 steam probe
557	Generator 2 ft outlet primary G-2 steam probe
558	Generator 2 ft outlet primary G-4 steam probe
559	Generator 2 ft outlet primary H-2 steam probe
561	Generator 2 ft outlet primary H-4 steam probe
562	Generator 2 ft outlet primary J-1 steam probe
563	Generator 2 ft outlet primary J-6 steam probe
564	Generator 1.5 ft outlet secondary F-8 fluid T/C
565	Generator 1.5 ft outlet secondary J-6 fluid T/C
566	Generator 1 ft outlet tube H-4 wall T/C, Location G-4 for runs before run 21001
567	Generator 1 ft outlet tube J-6 wall T/C
568	Generator 1 ft outlet secondary F-8 fluid T/C
569	Generator 1 ft outlet secondary G-4 fluid T/C
570	Generator 1 ft outlet secondary H-4 fluid T/C, Location J-6 for runs before run 21001
571	Generator 1 ft outlet primary F-8 steam probe
572	Generator 1 ft outlet primary G-4 steam probe
573	Generator 1 ft outlet primary H-4 steam probe
574	Generator 1 ft outlet primary J-6 steam probe
575	Generator 0.5 ft outlet tube G-4 wall T/C
577	Generator 0.5 ft outlet tube J-6 wall T/C
578	Generator 0.5 ft outlet secondary F-8 fluid T/C
579	Generator 0.5 ft outlet secondary J-6 fluid T/C
580	Generator 0 ft outlet tube G-4 wall T/C
581	Generator 0 ft outlet tube J-6 wall T/C
582	Generator 0 ft outlet secondary F-8 fluid T/C
583	Generator 0 ft outlet secondary G-4 fluid T/C
584	Generator 0 ft outlet secondary J-6 fluid T/C
585	Generator 0 ft outlet primary F-8 steam probe
586	Generator 0 ft outlet primary G-4 steam probe
587	Generator 0 ft outlet primary H-4 steam probe
588	Generator 0 ft outlet primary J-6 steam probe
768	Steam supply mass flow (lbm/sec)
769	Steam exhaust mass flow (lbm/sec)

TABLE 3-4

STEAM GENERATOR SEPARATE EFFECTS TEST
CONTINUOUS STRIP CHART CHANNEL LIST

Channel	Data
82	Boiler mass flow rate
98	Liquid mass flow rate
83	Exhaust steam mass flow rate
53	Liquid level, outlet plenum
49	Liquid level, steam generator collection tank
50	Liquid level, loop separator collection tank
51	Liquid level, steam generator secondary
59	Power to loop superheater
57	Loop pressure at mixer
84	Containment tank pressure
48	Liquid level, liquid supply tank
--[a]	Bypass loop pressure

a. Recorded on strip chart but not on the data acquisition system.

- Liquid supply tank mass flow rate
- Bypass line loop pressure
- Containment tank pressure

The steam supply is controlled by valves CV-1 and CV-2. CV-1 provides a constant pressure supply, thus isolating the loop from fluctuations in boiler pressure. A pressure transmitter (channel 80) supplies feedback for controlling CV-1. CV-2 controls the inlet steam mass flow rate to the required fl rate specified in the test matrix. The steam mass flow is calculated from the vortex meter (channel 96) by multiplying the vortex meter signal by the steam density, which is determined from the steam temperature and pressure, recorded on channels 64 and 80.

The required liquid flow rate specified in the test matrix is maintained by control valve CV-3. The feedback control signal for the valve comes directly from the turbine meter (channel 98) in the feedline.

Two control valves (CV-4 and CV-5) are provided for loop pressure control. CV-4 controls pressure in the bypass line prior to the test initiation, when the steam generator isolation valves are closed. During the test, loop pressure is controlled by CV-5. Both valves are driven by controllers which have upstream pressure transmitters as sensors in the feedback control loop.

3-14. Controller Operation

The five air-operated control valves (CV-1 through CV-5) utilized on the Steam Generator Separate Effects Task test facility were each controlled with Fisher model TL-101 three-mode (proportional, reset, and rate) controllers. Each of the valve controller settings was adjusted during shakedown testing to provide the best process control at the reference run steady-state flow and pressure conditions; allowances were made for minor control parameter perturbations.

During heatup for a matrix test run and during an actual run, adjustments were made to the various valve controller proportional band, reset, and rate settings as deemed necessary to improve valve response or control. For example, the controller rate adjustment was normally kept at zero (its minimum value) on all valves, because of the tendency for its rate control action (valve response is proportional to the time rate of change of the process variable) to cause severe valve and control parameter cycling with even small abrupt changes in the process. However, the containment tank backpressure control valve, CV-5, controller rate setting was increased at the start of each test to help improve valve response when the loop solenoid valves were realigned from the bypass leg to the steam generator inlet. The rate setting on this valve controller was readjusted to zero after the initial containment pressure transient had been brought under control.

Proportional band adjustment was never made during the course of a test run, because of the sensitivity of this setting. Even minor adjustments would result in large changes to the desired process variable setpoint.

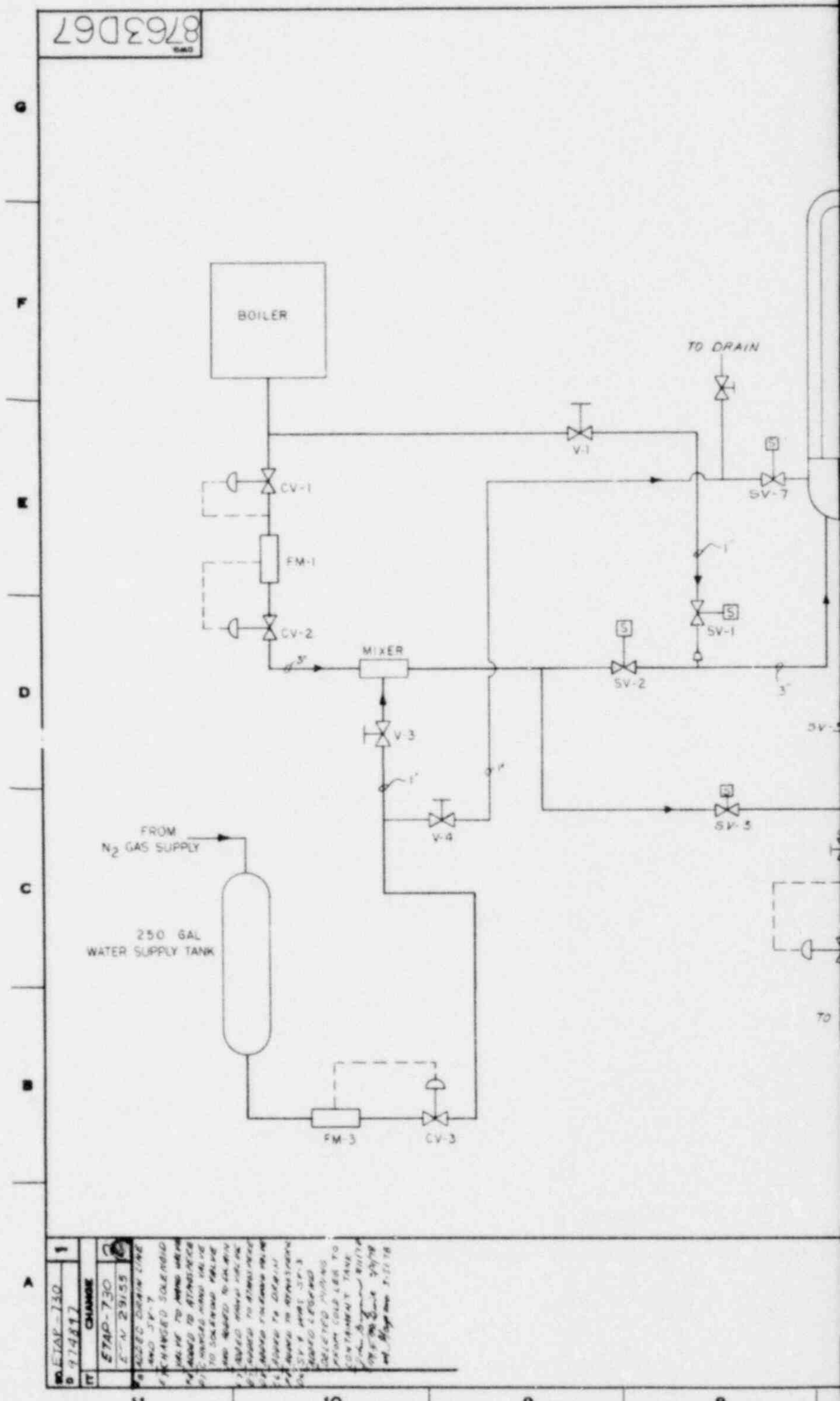
Controller reset adjustment was changed during the course of a test run to help minimize the time for the process variable to return to its setpoint.

Underadjustment of any of the above mentioned controller functions would lead to sluggish valve response; overadjustment could produce either limit cycling or other erratic behavior. During the loop shakedown test period, experience was gained in setting the controller adjustments to achieve stable parameter control. In the test program, no tests were invalidated because of controller behavior.

3-15. FACILITY OPERATION

To perform a steam generator separate effects experiment, the facility and the steam generator must be brought to the desired initial conditions. The steam generator secondary side was heated using electrical strip heaters on the steam generator shell and lower flanges. Previous FLECHT SET Phase B experiments(1) have shown that this method of heating produces a uniform temperature on the steam generator secondary side. In addition, a low-pressure recirculation pump was utilized to eliminate any stratified temperature distribution

1. Waring, J. P., and Hochreiter, L. E., "PWR FLECHT SET PHASE B1 Evaluation Report," WCAP-8583, August 1975.



POOR ORIGINAL

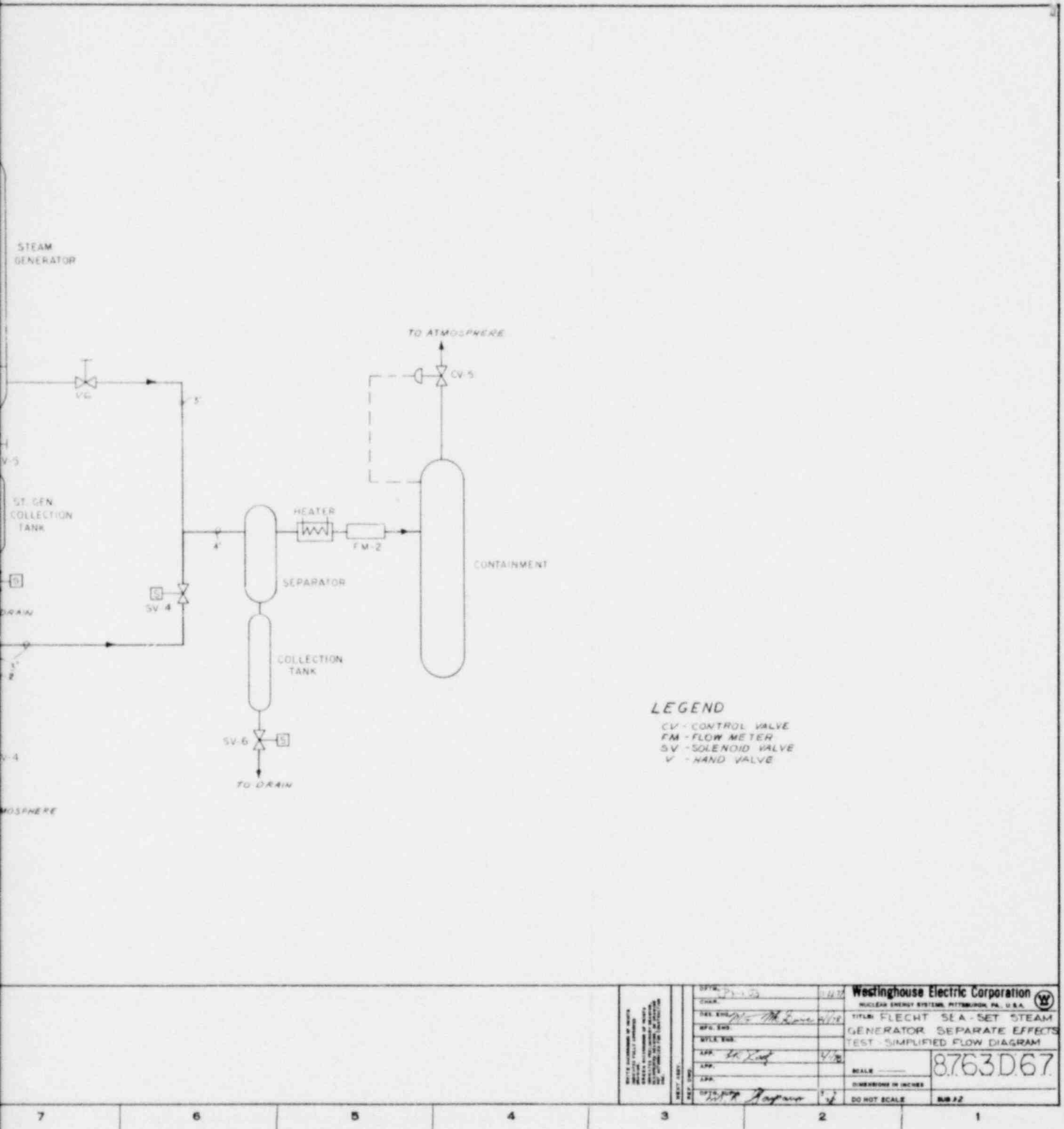


Figure 3-7. FLECHT SEASET Separate Effects Test Simplified Flow Diagram

which might be present from the preceding day's test. During heatup, the secondary side temperature was monitored, and the strip heaters at a given elevation were deenergized when that elevation reached the desired temperature.

The primary side piping was heated to the primary side saturation temperature using bleed steam from the boiler. While the system was being heated, the instrumentation channels were checked, flow meters and differential pressure transducer cells were zeroed, and solenoid valves were cycled. Once the system had been heated, the steam and liquid flows were adjusted to their desired values at the mixer, and the resulting two-phase flow was bypassed to the drain while these conditions were being established. When the desired inlet flow conditions had been established, the inlet two-phase flow was directed into the steam generator by proper alignment of the loop solenoid valves. Loop pressure and inlet flow were maintained constant by the control valves.

A pressure reducing valve, CV-1, was used to control the upstream pressure at the boiler vortex meter and to minimize system instabilities caused by boiler pressure fluctuations. The pressure drop of 0.28 to 0.52 MPa (40 to 75 psid) across CV-1 also helped to ensure a single-phase steam flow at the boiler vortex meter and the mixer. Steam flow control was accomplished with control valve CV-2; feedback to the valve was supplied by the boiler vortex meter.

Water flow to the mixer was controlled by valve CV-3. The turbine meter was used to measure the flow and provide feedback to the control valve.

Two-phase fluid leaving the generator primary side tubes went through a first stage of separation in the lower plenum section of the steam generator. An internal baffle assembly was used to separate the liquid, which was collected and measured in the outlet plenum or collection tank located below the plenum. The remaining steam passed through a commercial separator of the same type used in the FLECHT low flooding rate test series.[1] The separator removed any remaining

2. Lilly, G. P., et al., "PWR FLECHT Cosine Low Flooding Rate Test Series Evaluation Program," WCAP-8838, March 1977.

entrained liquid, which was then collected and measured in the separator drain tank. Each collection tank is equipped with a solenoid drain valve which could be activated to drain the tanks as needed during low-quality test runs.

Dry steam leaving the separator passed through the exhaust vortex flowmeter prior to entering the containment tank. An immersion heater, inserted upstream of the flowmeter, was used to ensure that single-phase flow was being measured by the meter. The exhaust valve (CV-5), located downstream of the containment tank, controlled the system backpressure. Control feedback to the valve was supplied by a pressure transmitter located on the containment tank.

The following is a simplified test operating procedure for water injection in the mixer section:

(1) Begin with all valves closed.

(2) Fill the steam generator and accumulator with water and heat up to desired conditions.

(3) Fire boiler. Open V-1, SV-1, V-5, V-6, and CV-5. Use steam to heat up steam generator primary side, separator, collection tank, containment, and interconnecting piping. Adjust backpressure with CV-5 and control steam flow with V-1.

(4) Open CV-1, CV-2, SV-3, and CV-4 and use boiler steam to heat up piping from boiler through mixer and steam generator bypass line. Control flow with CV-2 and backpressure with CV-4.

(5) When all loop components have reached desired conditions, set the desired test steam flow through the bypass line by using CV-1 to control FM-1 upstream pressure and CV-2 to control steam flow. Control bypass line backpressure with CV-4.

(6) Open V-3 and set water flow to mixer by appropriate adjustment of CV-3.

(7) To establish flow through the steam generator, close SV-1, SV-3, and CV-4 and open SV-2. Control backpressure with CV-5.

(8) To terminate the test, isolate the system by closing SV-2 and opening SV-3 and CV-4. Close CV-3 and shut down the boiler.

Appendix E contains the detailed test procedure used to run each test.

3-16. FACILITY TESTING

Shakedown testing of the test facility and instrumentation calibration are discussed in appendix F. A leak which was discovered across the steam generator lower plenum divider plate, and its subsequent repair and testing, are covered in appendix G.

SECTION 4

RUN CONDITIONS AND TEST RESULTS

4-1. TEST MATRIX AND RUN CONDITIONS

The test matrix of steam generator separate effects tests included runs 1 through 15 of the proposed test matrix in section 7.2 of the task plan(1) plus a single-phase steam and an isothermal (secondary temperature = primary temperature) test. Test runs 16 through 19 in the proposed test matrix could not be run because the required air/water tests with the spray nozzle in the inlet plenum duplicating the hemispherical plenum flow distribution were not successfully completed. The hemispherical plenum air/water flow distribution at the tubesheet was extremely nonuniform and it appeared to be highly unlikely that a nozzle mounted in the FLECHT inlet plenum could have reproduced the hemispherical plenum distribution. For this reason, tests 16 through 19, which would have used the inlet plenum nozzle to reproduce the hemispherical plenum distribution in the FLECHT steam generator, were not run. The test matrix for the steam generator separate effects test is shown in table 4-1. Table 4-2 presents the actual run conditions for each valid test, and summary test results. Summarized in table 4-2 are the time-averaged test boundary conditions (total inlet flow, quality, and loop pressure) and the test initial conditions (steam generator secondary liquid temperature and level). More detailed test run conditions are presented in appendix H.

Table 4-2 includes three runs (21001, 22415, and 23005) in which one of the controlled test parameters was outside of the allowable range for a valid test. Since the data from these tests are valid for the actual test run parameters, they can be thought of as a test at an off-nominal test condition. For this reason, they are included in the data report with results of the 17 valid runs at nominal test conditions.

The five-digit run number in table 4-2 contains a 2 as the first digit, signifying a steam generator matrix test; the second and third digits indicate the sequence number of the test; and the fourth and fifth digits are the test matrix run number. Test parameters for each matrix test are given in table 4-1.

1. Hochreiter, L. E., et al., "PWR FLECHT SEASET Steam Generator Separate Effects Task: Task Plan Report," NRC/EPRI/Westinghouse-2, March 1978.

TABLE 4-1

TEST MATRIX FOR STEAM GENERATOR SEPARATE EFFECTS TEST

Run No.	Run Description	Flow Rate [kg/sec (lb/sec)]	Primary Pressure [MPa (psia)]	Quality	SG Secondary Temperature [°C (°F)]	SG Secondary Level (%)
1	Reference run	0.23 (0.5)	0.28 (40)	0.80	274 (525)	100
2	Flow sensitivity	0.45 (1.0)	0.28 (40)	0.80	274 (525)	100
3	Pressure sensitivity	0.23 (0.5)	0.14 (20)	0.80	274 (525)	100
4	Pressure sensitivity	0.23 (0.5)	0.412 (60)	0.80	274 (525)	100
5	Quality sensitivity	0.23 (0.5)	0.28 (40)	0.50	274 (525)	100
6	Quality sensitivty	0.23 (0.5)	0.28 (40)	0.20	274 (525)	100
7	Secondary temperature sensitivity	0.23 (0.5)	0.28 (40)	0.80	204 (400)	100

TABLE 4-1 (cont)

TEST MATRIX FOR STEAM GENERATOR SEPARATE EFFECTS TEST

Run No.	Run Description	Flow Rate [kg/sec (lb/sec)]	Primary Pressure [MPa (psia)]	Quality	SG Secondary Temperature [°C (°F)]	SG Secondary Level (%)
8	Secondary level sensitivity	0.23 (0.5)	0.28 (40)	0.80	274 (525)	25
9	Postbundle quench	0.45 (1.0)	0.28 (40)	0.10	274 (525)	100
10	Replication of reference run	0.23 (0.5)	0.28 (40)	0.80	274 (525)	100
11	Replication of reference run	0.23 (0.5)	0.28 (40)	0.80	274 (525)	100
12[a]	Reference run	0.23 (0.5)	0.28 (40)	0.80	274 (525)	100
13[a]	Flow sensitivity	0.45 (1.0)	0.28 (40)	0.80	274 (525)	100
14[a]	Quality sensitivity	0.23 (0.5)	0.28 (40)	0.50	274 (525)	100

a. Runs with a liquid spray nozzle in the steam generator inlet plenum

TABLE 4-1 (cont)

TEST MATRIX FOR STEAM GENERATOR SEPARATE EFFECTS TEST

Run No.	Run Description	Flow Rate [kg/sec (lb/sec)]	Primary Pressure [MPa (psia)]	Quality	SG Secondary Temperature [°C (°F)]	SG Secondary Level (%)
15[a]	Quality sensitivity	0.23 (0.5)	0.28 (40)	0.20	274 (525)	100
16 to 19	Deleted from test matrix					
20	Single-phase steam	0.23 (0.5)	0.28 (40)	1.0	274 (525)	100
21	Isothermal	0.23 (0.5)	0.28 (40)	0.80	130 (267)	100

a. Runs with a liquid spray nozzle in the steam generator inlet plenum

Run No.	Time-Averaged Boundary Conditions			S
	Total Flow (lb/sec)	Quality	Pressure (psig)	Tempera (°F)
20904	0.494	0.798	45.7	525
21001	0.499	0.779	25.3	525
21121	0.488	0.801	25.4	267
21711	0.494	0.800	25.2	520
21806	0.500	0.200	25.3	520
21909	0.946	0.105	25.8	525
22010	0.503	0.801	25.3	525
22112	0.496	0.799	25.6	523
22213	0.991	0.797	25.3	524
22314	0.499	0.495	25.4	526
22415	0.614	0.345	25.3	524
22503	0.494	0.798	5.2	525
22608	0.495	0.796	25.3	525
22701	0.495	0.798	25.3	524
22920	0.493	1.00	25.1	523
23005	0.754	0.671	26.7	522
23207	0.504	0.801	25.2	400
23315	0.495	0.201	25.2	523
23402	0.989	0.799	25.3	523
23605	0.494	0.496	25.1	523

a. English units

b. Temperatures above 1 foot

c. Total from beginning to end of test. See appendix H

TABLE 4-2A[a]

RUN CONDITIONS AND TEST RESULTS

eam Generator Secondary Initial Conditions		Outlet Plenum Steam Temperature				Outlet Plenum Liquid Collected	Total Energy Transport[c]	Mass Balance Error
ture[b]	Level (ft)	T_{max} (^{o}F)	Time (sec)	T_{min} (^{o}F)	Time (sec)	(lb)	(Btux10^6)	(%)
	32.4	499	162	345	1584	7.26	0.142	-0.8
	32.5	498	79	325	1524	8.6	0.177	-3.1
	33.1	269	-	269	-	115.9	-	-
	32.4	498	103	333	1543	4.7	0.141	-0.2
	32.7	490	11	268	1691	143.8	0.406	1.5
	33.9	477	84	268	1560	790.5	0.415	-3.0
	33.6	499	150	333	1620	7.01	0.146	0.0
	34.0	500	90	333	1560	5.02	0.151	-1.3
	33.7	502	78	296	1560	2.0	0.321	-2.0
	34.2	498	85	289	1573	17.6	0.307	-0.8
	33.6	492	0	269	1632	146.0	0.430	-1.0
	33.6	498	12	319	1500	8.8	0.150	-1.1
	7.7	495	24	312	1482	10.1	0.161	-1.1
	33.0	500	18	334	1488	9.87	0.168	-1.1
	32.5	498	12	444	1494	0.0	0.068	-2.0
	33.3	497	12	289	1505	17.6	0.359	-2.1
	32.2	388	12	284	1488	5.71	0.132	-0.4
	32.3	494	12	267	1505	37.9	0.418	3.2
	32.1	500	12	301	1494	10.9	0.313	-1.6
	33.6	499	18	289	1476	22.2	0.321	-2.0

data summary sheets for the duration of each test.

	Time-Averaged Boundary Conditions			S
Run No.	Total Flow (kg/sec)	Quality	Pressure (MPa)	Temper (°C
20904	0.224	0.798	0.315	2
21001	0.226	0.779	0.174	2
21121	0.221	0.801	0.175	1
21711	0.224	0.800	0.174	2
21806	0.227	0.200	0.174	2
21909	0.429	0.105	0.178	2
22010	0.228	0.801	0.174	2
12112	0.225	0.799	0.176	2
22213	0.450	0.797	0.174	2
22314	0.226	0.495	0.175	2
22415	0.279	0.345	0.174	2
22503	0.224	0.798	0.036	2
22608	0.225	0.796	0.174	2
22701	0.225	0.798	0.174	2
22920	0.224	1.00	0.173	2
23005	0.342	0.671	0.184	2
23207	0.229	0.801	0.174	2
23315	0.225	0.201	0.174	2
23402	0.449	0.799	0.174	2
23605	0.224	0.496	0.173	2

a. Metric units
b. Temperatures above 30.5 cm
c. Total from beginning to end of test. See appendix I

TABLE 4-2B[a]

RUN CONDITIONS AND TEST RESULTS

team Generator Secondary Initial Conditions		Outlet Plenum Steam Temperature				Outlet Plenum Liquid Collected	Total Energy Transport[c]	Mass Balance Error
ture[b]	Level (m)	T_{max} (°C)	Time (sec)	T_{min} (°C)	Time (sec)	(kg)	(Mw-sec)	(%)
74	10.6	259	162	174	1584	3.29	150	-0.8
74	10.7	259	79	163	1524	3.90	187	-3.1
31	10.9	132	-	132	-	52.6	-	-
71	10.6	259	103	167	1543	2.13	149	-0.2
71	10.7	254	11	131	1691	65.2	429	1.5
74	11.1	247	84	131	1560	358.6	437	-3.0
74	11.0	259	150	167	1620	3.18	154	0.0
73	11.1	260	90	166	1560	2.28	159	-1.3
73	11.1	261	78	147	1560	.907	338	-2.0
74	11.2	259	85	143	1573	7.98	324	-0.8
73	11.0	256	0	132	1632	66.2	453	-1.0
74	11.0	259	12	159	1500	3.99	158	-1.1
74	2.5	257	24	156	1482	4.58	170	-1.1
73	10.8	260	18	168	1488	4.48	177	-1.1
73	10.7	259	12	229	1494	0.0	72	-2.0
72	10.9	258	12	143	1505	7.98	378	-2.1
04	10.6	198	12	140	1488	2.59	139	-0.4
73	10.6	257	12	131	1505	17.2	441	3.2
73	10.5	260	12	149	1494	4.94	330	-1.6
73	11.0	259	18	143	1476	10.1	338	-2.0

d data summary sheets for duration of each test.

4-2. TEST RESULTS

The summary test results in table 4-2 include the maximum and minimum steam temperature in the outlet plenum, the mass of liquid collected in the outlet plenum or collection tank, the total energy absorbed by the primary flow, and the mass balance error. More detailed test results are presented in appendix H.

The maximum and minimum outlet plenum steam temperature was measured by the fluid thermocouple (channel 12) in the plenum exit downstream from the moisture separator in the outlet plenum. The liquid collection was measured with a differential pressure cell in the outlet plenum or liquid collection tank, which collects the liquid separated out by the outlet plenum moisture separator.

The total energy transfer was calculated from the difference between the energy flow in the outlet and inlet plenums, integrated over the duration of the test. Energy flow was taken to be mass flow times enthalpy. Mass flow rates and enthalpy of the steam and liquid phases at the inlet and outlet plenums were derived from the measured data. The increase in energy flow from the inlet to outlet plenum was computed to get the rate of heat transfer in the tube bundle, and this rate was integrated over the test time to get the total reported in table 4-2.

The mass balance error reported in table 4-2 was calculated from the difference between the mass flow into the test loop and the mass flow out of the test loop plus the liquid collected in the liquid collection tanks. The amount of steam that was lost to the aspirating steam probes was condensed and collected in a bucket; it was accounted for in the mass balance. The hot leg was drained after the test, and the liquid drained from the hot leg was weighed and accounted for in the mass balance. A negative mass balance error implies that the mass flow out of the test loop was larger than the mass flow into the test loop.

In appendix I the expected mass balance error is calculated. The expected mass balance error was calculated from the instrument accuracy information supplied by the instrument vendor. The instrument accuracy data are stated in terms of the instrument output, such that the instrument error is assumed to always be less than a given range. To completely define the instrument error, the distribution of the error within the error band must be known. The assumption is made in appendix I that the error distribution is uniform (that is, all errors within the error range are equally likely), and that the error distribution is symmetrical about zero (that is, positive and negative errors are equally likely). A consequence of these assumptions is that the calculated mass balance error has a mean value of zero (in any given test, positive and negative errors are equally likely). The mass balance error calculated in appendix I is the standard deviation of the mass balance error distribution.

The average of the 19 mass balance errors in table 4-2 is -0.89 percent, with a standard deviation of 1.5 percent. The 95-percent confidence interval on the mean mass balance error is -0.12 to -1.64 percent. Since the confidence interval on the mean error does not contain zero, it is likely that some of the sources of error were not symmetrically distributed about zero but systematically perturbed the mass balance in the same direction in each test. Also, the standard deviation of the mass balance error (1.5 percent) is somewhat larger than the estimated error standard deviation of 0.7 percent in table I-4.

A systematic mass balance error can be caused by a systematic error in a flowmete the failure to account for mass entering or leaving the system. Two potential sourc mass flow into the bundle that are not accounted for are nitrogen from the continu purged differential pressure probes in three tubes in the tube bundle inlet region, an moisture carryover from the boiler. The nitrogen purge flow rate was regulated to value much smaller than 1 percent of the outlet plenum steam flow and can be safe neglected. Boiler carryover was detected during the shakedown test program, but chemical cleaning of the boiler was found to be an effective means of eliminating t carryover. Although the boiler was cleaned periodically, boiler carryover could hav contributed to the mass balance error.

In the error analysis in appendix I, estimates of the error in the overall primary side energy balance and in the local tube wall heat flux are calculated. A check on the primary side energy balance could have been made by comparing the change in stored energy in the bundle from beginning of test to end of test with the primary side energy balance, integrated over the test time. However, to compute the final bundle stored energy, the bundle temperature distribution must be known. During the tests, a large temperature gradient developed in the axial direction. The precise location of the gradient at the end of the test would have to be known to accurately calculate the residual bundle stored energy. Since, in most tests, this axial temperature gradient would be located above the 1.22-meter (4-foot) elevation, where most of the thermocouples were located, the check on the primary side energy balance was not calculated. From the appendix I error analysis, the primary side energy balance standard deviation is 3.3 percent.

The appendix I error analysis also estimates the error in the local tube wall heat flux measurement. Although no independent calculation can be made to check the tube wall heat flux measurement, the local tube wall heat flux integrated over the total bundle heat transfer area should agree with the primary side overall energy balance. In the test data reported in the summary sheets for each run in appendix H, this comparison is presented in the form of integrals over time from beginning of test to the time the 1.22-meter (4-foot) tube wall thermocouples quenched.

The local tube wall heat flux and primary side vapor temperature were used in a local energy balance within the tube to calculate the local nonequilibrium quality. Computer-generated tables of local quality at discrete times in the test run are presented in appendix H.

4-3. DATA REDUCTION HARDWARE

The initial data reduction stages, from the Consolidated Controls Corporation (CCC) data logger (which recorded the test data on magnetic tape during the test run) to the creation of a permanent retrievable data file on the CDC-7600 computer system at the Monroeville Nuclear Center (MNC), are illustrated in figure 4-1. The CCC data logger recorded the test data in engineering units by converting the bundle and loop instrument output voltage using preprogrammed calibration files. Each flowmeter, pressure sensor, and differential pressure transducer had unique calibration coefficients. The bundle and loop thermocouple data were converted to temperature units (^{o}F) using a common thermocouple calibration function and the five loop resistance temperature detectors (RTDs) were also converted to temperature units (^{o}F) using the same calibration function.

The CCC data logger can print the output of selected data channels directly in engineering units on a paper tape. This capability was used to monitor the warmup of loop components prior to a test run. All test data were recorded on the magnetic tape and processed as shown in figure 4-1.

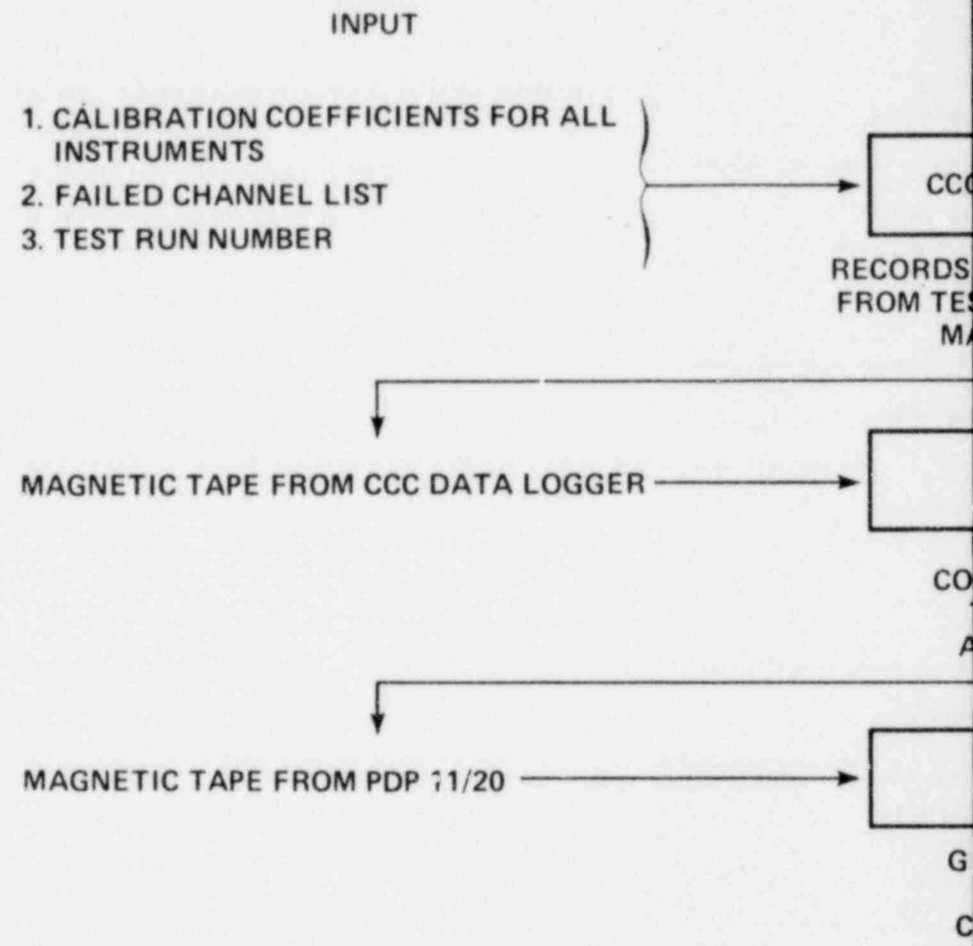
The information on the magnetic tape includes the test data during the test run, for a period of 1 minute immediately prior to the test, and for a 5-minute period immediately following the test, plus one scan of reference data. Reference data were taken on all pressure and flow instruments with the loop isolated; the test parameter used in the data reduction was the parameter change from this reference value. The reference data indicated only small differences in instrument output when the known input condition was zero. The order of magnitude of the reference data from each test was compared to that of the reference data from other tests. A large change in the reference value of an instrument between runs invalidated the data from that instrument.

The intermediate data reduction on the Digital Equipment Corporation PDP 11/20 at the test site provided a printout of all the test data, usually within 24 hours of a test run. This printout of all the data channels, along with the printout of a PDP 11/20 data validation program and the data recorded on the strip charts, was used for preliminary data validation. The PDP 11/20 also generated a magnetic tape copy of the data logger tape after converting the data format from hexadecimal to decimal notation.

The PDP 11/20 data tape was copied to a permanent retrievable data file using the CDC-7600 file manager system by a program called SGCATALOG. The SGCATALOG program applied one correction to the RTD data. In this correction, the five RTD data channels (channels 64 through 68) were converted from resistance to temperature units using individual calibration coefficients for each RTD rather than the one common RTD calibration coefficient used by the CCC data logger. The data tape generated by the SGCATALOG program was used for all test data reductions.

4-4. DATA REDUCTION SOFTWARE

The steam generator test data reduction software includes computer programs to (1) plot the test data versus time, (2) perform an overall mass and energy balance on the steam generator, (3) interpolate the tube bundle temperature data, and (4) calculate the local bundle heat flux and quality from the bundle temperatures. The data reduction is illustrated schematically in figure 4-2. The output file from each program except the SGPLOTS program is permanently stored in the CDC-7600 file manager system.


INPUT
1. CALIBRATION COEFFICIENTS FOR ALL INSTRUMENTS
2. FAILED CHANNEL LIST
3. TEST RUN NUMBER
CC
RECORDS
FROM TE
M
MAGNETIC TAPE FROM CCC DATA LOGGER
CO
A
MAGNETIC TAPE FROM PDP 11/20
G
C

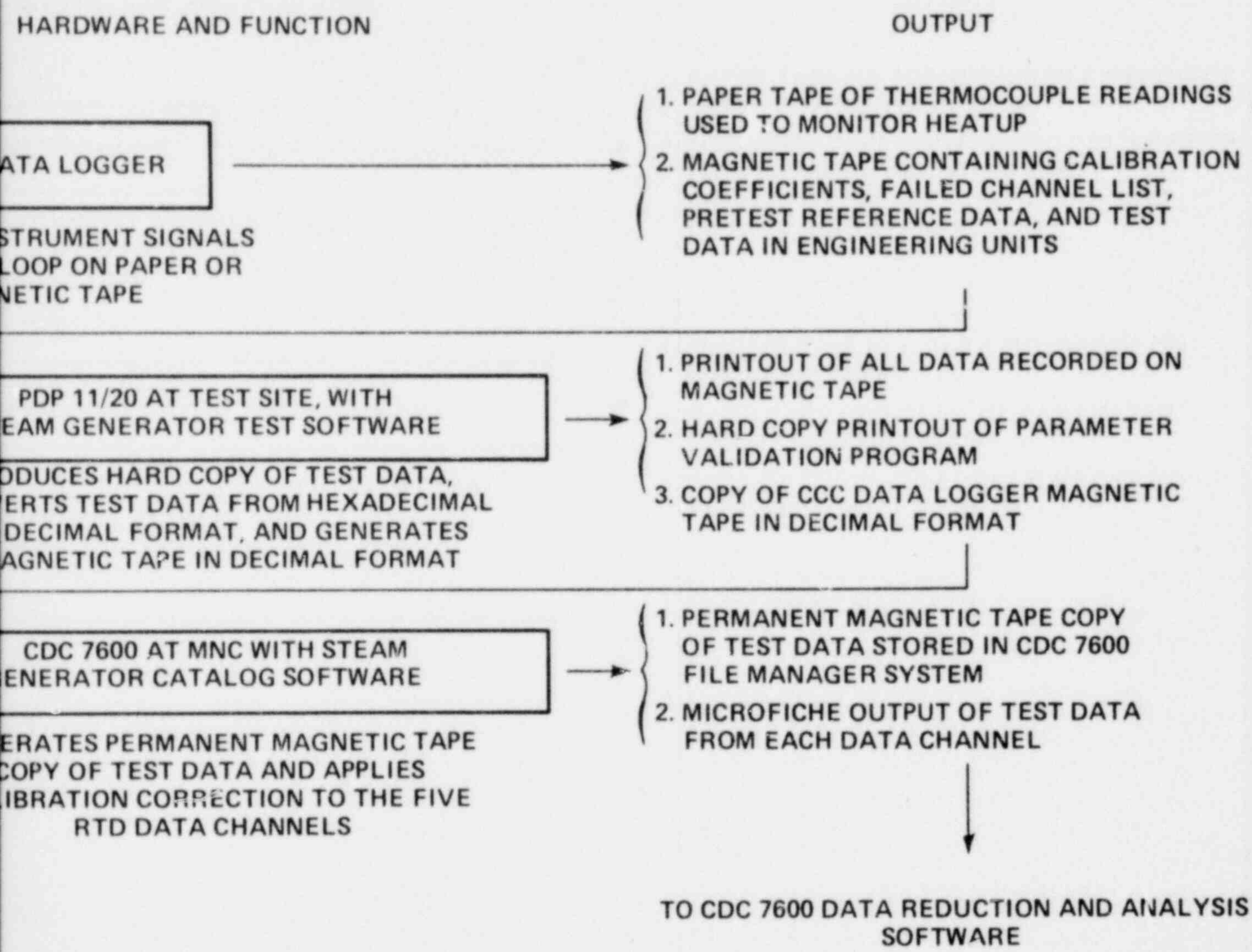


Figure 4-1. Steam Generator Tes' Data Reduction Hardware

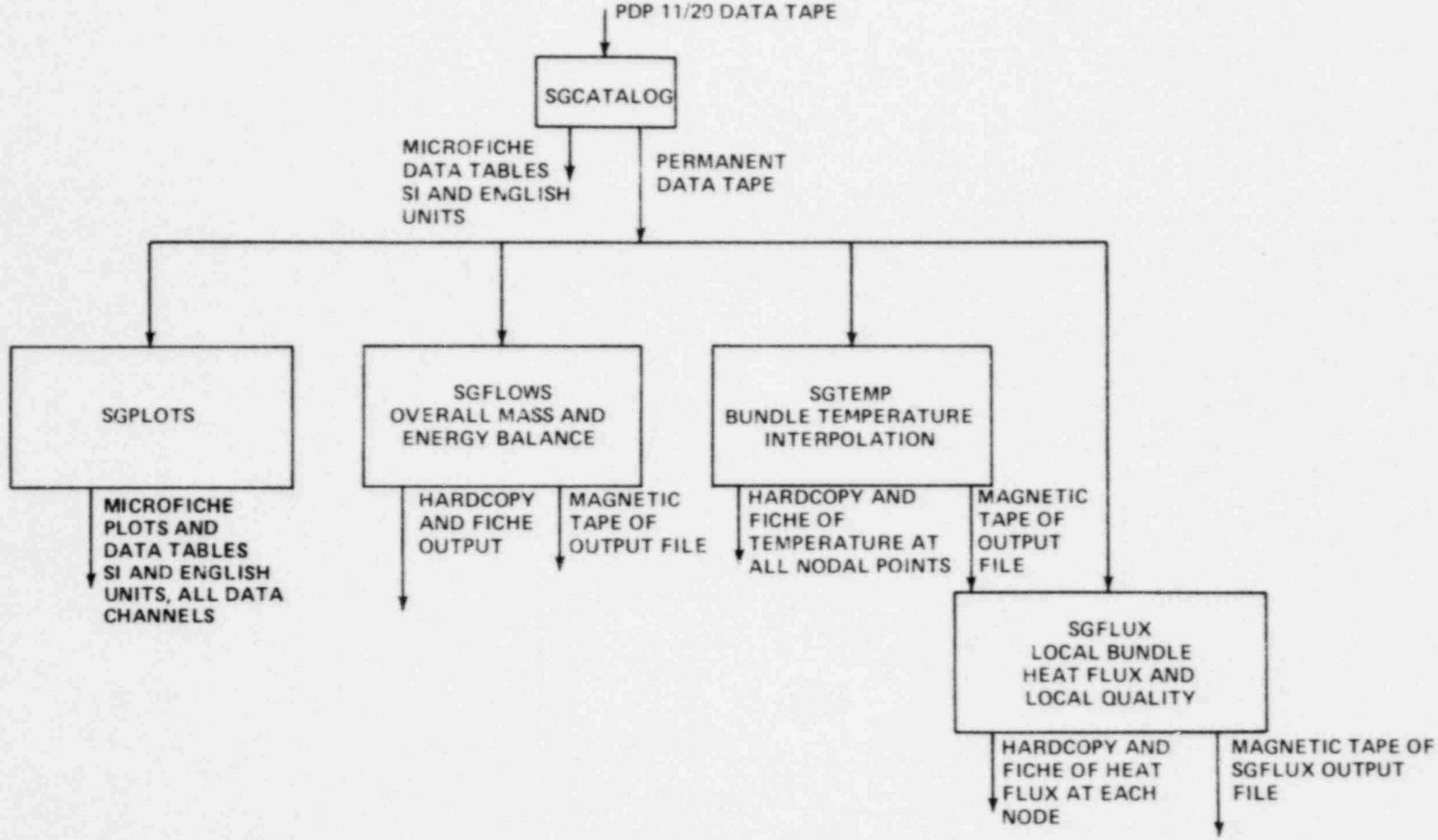


Figure 4-2. Steam Generator Test Data Reduction Software

The SGPLOTS program plots the data from each channel on microfiche. The plot time scale was adjusted to time=0 at the beginning of the test, with the pretest data included in a zone of negative time. The primary Y-axis units are SI; the equivalent English units are plotted on the right-hand Y-axis of the plot. The pressure and flow data were adjusted for the reference signal using the following equation:

plotted value = recorded value - reference value

The SGFLOWS program performs an overall mass and energy balance on the steam generator. Mass and energy flow at the inlet plenum tubesheet interface was calculated from the measured boiler and liquid supply tank flows and temperatures. Steam condensation or liquid evaporation at the steam/water mixer and liquid storage in the hot leg and inlet plenum were accounted for in calculating conditions at the inlet plenum tubesheet. Mass and energy flow at the outlet plenum tubesheet interface were calculated from measured steam flow and liquid accumulation in the outlet plenum and liquid separator collection tanks. Liquid evaporation in the superheater upstream from the containment tank flowmeter was counted as liquid in the outlet plenum. From the calculated mass and energy flow in the inlet and outlet plenums, the rate of loss of stored energy in the secondary side metal and fluid was calculated. The total loss in secondary side stored energy, calculated by integrating the above energy loss rate, was computed by SGFLOWS. The energy loss is reported in table 4-2.

The SGFLOWS program computes an overall loop mass balance by comparing the total mass flow into the loop to the total mass exhaust flow plus all liquid accumulation in the loop. This computer mass balance is not able to account for the steam that aspirates through the steam probes. A correction to the SGFLOWS mass balance that accounts for the steam probe steam was done by hand; the results of the calculation are presented in table 4-2. In this hand calculation, the liquid accumulation in the hot leg, inlet plenum, and tube bundle inlet was taken from the mass of liquid drained from the hot leg after the test rather than from the installed differential pressure cells.

The SGTEMPS data reduction program takes the measured bundle primary side steam probe and tube wall and secondary fluid temperatures, and interpolates the test data to determine the temperature at each nodal point in the bundle. From the four instrumented tubes with thermocouples at 12 axial elevations, the tube bundle was segregated into 116 nodes with the midpoint of each node located at a thermocouple location or an interpolated data location. The tube bundle nodalization is illustrated in figure 4-3. The SGTEMPS interpolation strategy uses Lagrangian interpolation for axial interpolations using three data points adjacent to the point being determined.

Before the Lagrangian interpolation, the independent variable (the distance from the tube inlet) was transformed to the log of the distance. This transformation made the intervals between instrumentation elevations more nearly uniform. With uniform intervals in the independent variable distance, the Lagrangian interpolation was less likely to generate an oscillation in the axial temperature profile.

For elevations with partial instrumentation, simple interpolation or extrapolation of the data at that elevation was used to estimate the temperature at the uninstrumented radial location. The program has two options to accommodate failed thermocouples. Data from any existing thermocouples can be transferred to the location of the failed thermocouple, or the failed thermocouple location can be added to the uninstrumented locations and the remaining data adjacent to the failed thermocouple interpolated to supply the missing data.

The data reduction program SGFLUX takes the bundle temperatures from the SGTEMPS program and calculates the local quality and heat flux, the heat flux integrated over the tube bundle heat transfer area, and the total heat transfer rate integrated over the time interval of the test. The local heat flux was calculated from the secondary side fluid and tube wall temperatures using a natural convection film coefficient from Eckert and Jackson:[1]

$$Nu_s = 0.021\,(Gr \cdot Pr)^{0.40} \qquad (4\text{-}1)$$

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1. Eckert, E. R. G., and Jackson, T. W., "Analysis of Turbulent Free-Convection Boundary Layer on Flat Plate," NACA-1015, 1951.

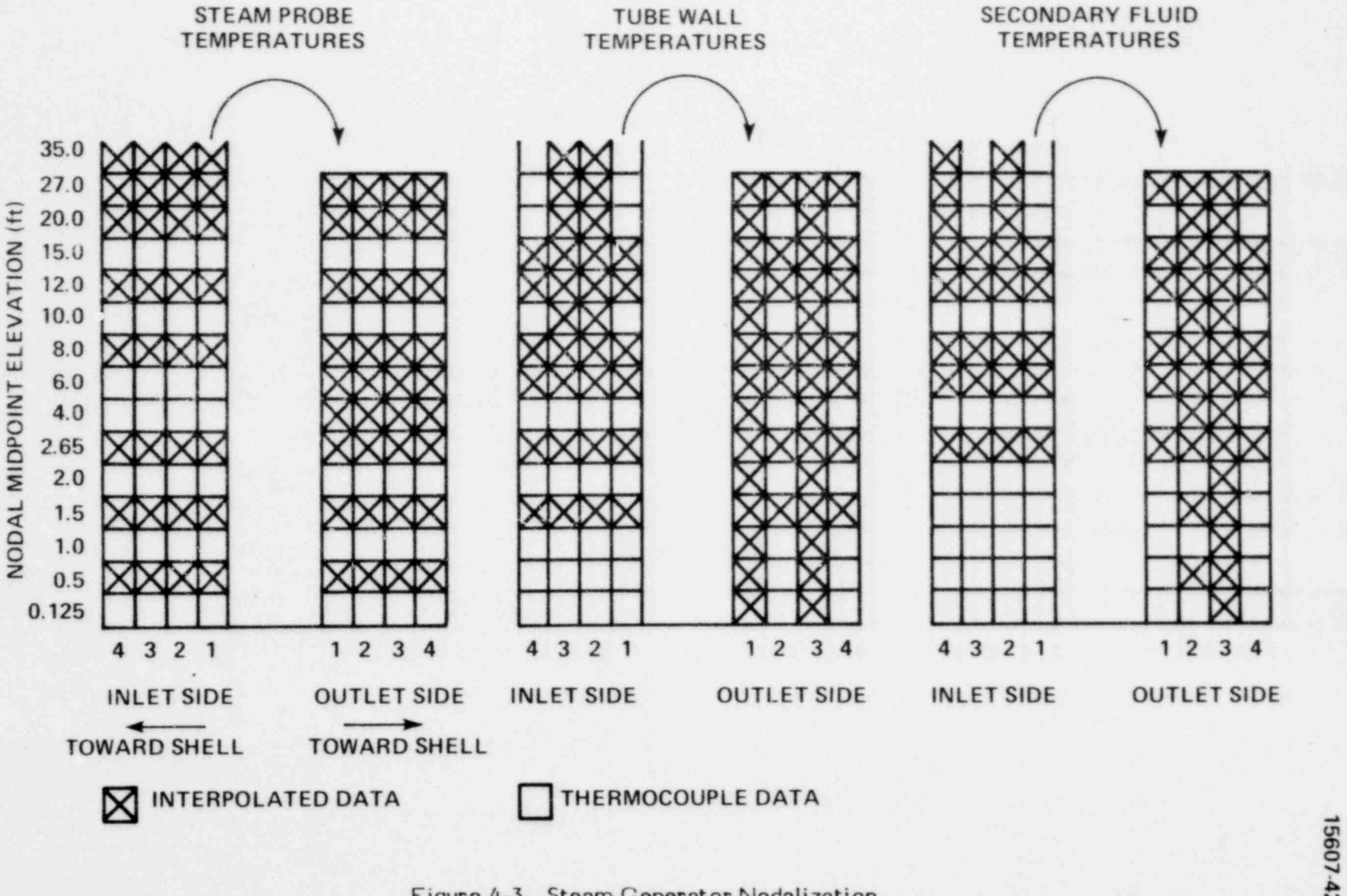

Figure 4-3. Steam Generator Nodalization

where

Nu_s	=	secondary side Nusselt number
Gr	=	secondary side Grashof number
Pr	=	secondary side Prandtl number

The Grashof number is defined as

$$Gr = \frac{\rho^2 g\beta (T_f - T_w) x^3}{\mu^2}$$

where

ρ	=	secondary fluid density
g	=	acceleration of gravity
β	=	volume coefficient of expansion
T_f	=	secondary fluid temperature
T_w	=	tube wall temperature
x	=	distance from the leading edge of the boundary layer
μ	=	secondary fluid viscosity

The parameter x in the Grashof number was computed by subtracting the nodal distance from the tube entrance from the distance from the tube entrance of the next tube sup ort plate farther away from the entrance. This definition of x assumes that the boundary layer for heat transfer begins at the tube support plate elevation and flows downward on the inlet side of the tube bundle (because of secondary cooling) and upward on the outlet side of the tube bundle (because of secondary heating). The determination of x is illustrated in figure 4-4.

In this calculation, the tube wall temperature was corrected by a linear function of the wall heat flux. The tube wall correction factor was determined from a series of single-phase liquid and steam heat transfer tests that were run during the shakedown test program. In these shakedown tests, the heat flux and tube wall temperature were calculated from the primary and secondary side fluid temperatures. The difference between the calculated and measured tube wall temperature was correlated with the calculated tube wall heat flux. A straight-line fit to these data was determined for each nodal location in the tube bundle. This linear function of the wall heat flux was subtracted from the

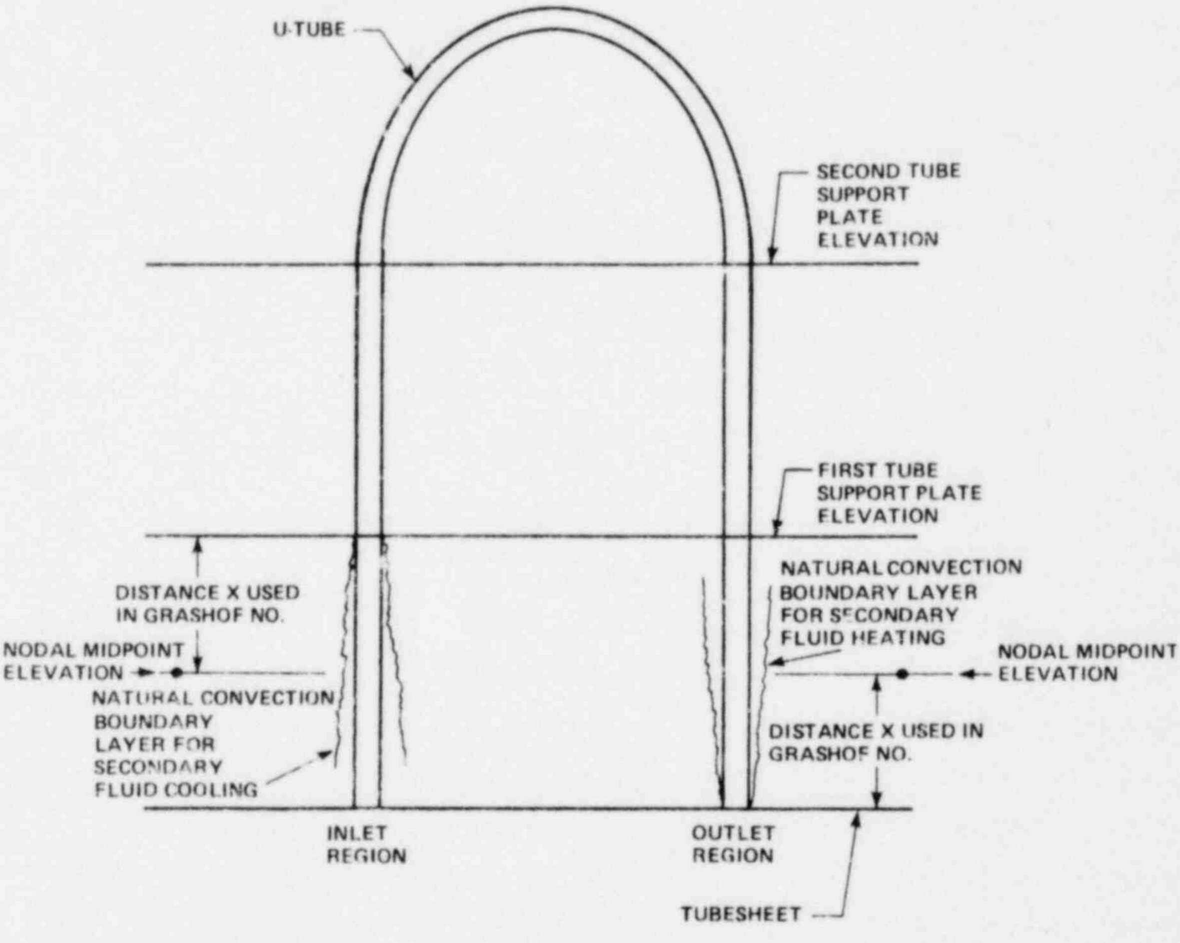

Figure 4-4. Illustration of Method Used to Determine Length in the Grashof Number

measured tube wall temperature to calculate the tube wall heat flux in the two-phase matrix tests. The uncertainty in this calculation includes the error due to thermocouple measurements (estimated in appendix I) plus additional uncertainty due to the tube wall temperature correction factor and the uncertainty due to the temperature interpolation to provide data at uninstrumented nodal locations. Although all of these uncertainties are not estimated in appendix I, the data presented in the summary sheets comparing the tube wall flux integrated over heat transfer area and time with the overall energy balance integrated over time permit an estimate of the time-averaged uncertainty in the tube wall heat flux calculation. These data are presented in the summary sheets for each run in appendix H. The comparison shows that the uncertainty is relatively small for the high-quality runs for the time interval before the tube quench reaches the 1.2-meter (4-foot) elevation. Beyond this time or for low quality tests, the uncertainty in measured wall heat flux can be large.

From the measured heat flux in the four instrumented tubes, the total bundle heat transfer rate was calculated by multiplying the instrumented tube heat transfer by a weighting factor, which represented the number of uninstrumented tubes assumed to respond like the instrumented tube. The weighting factors were determined from a series of air/water tests on the inlet plenum. These tests measured the flow distribution of air and water at the tubesheet.

In the air/water tests, the air and water volumetric flow rates were equated to the steam and water volumetric flow rates in the matrix tests. The weighting factor represents the number of tubes with inlet flow conditions close to the inlet flow of the instrumented tube. The weighting factors developed from the air/water tests are presented in appendix B.

In the SGFLUX program, the local tube wall heat flux in the two-phase matrix tests is calculated from the simultaneous solution of the following two equations:

$$Q_1 = h_s (T_f - T_w + \Delta T) \quad (4\text{-}2)$$

and

$$\Delta T = A Q_1 + B \quad (4\text{-}3)$$

where

Q_1 = tube wall heat flux (calculated)

h_s = turbulent free convection film coefficient (calculated from eq. 4-1)

T_f = secondary fluid temperature (measured)

T_w = tube wall temperature (measured)

ΔT = tube wall temperature correction (calculated)

A and B = coefficients in tube wall correction factor equation, determined from single-phase shakedown tests

The solution of equations (4-2) and (4-3) shows that for the case where 1/A is less than h_s, the value of Q_1 will be negative for positive values of $(T_f - T_w)$ and B. Since this solution is not correct, an alternate solution was used to calculate the heat flux if 1/A was less than h_s. In this case, the primary side flow regime is assumed to be dispersed flow with no liquid film on the walls. The primary side film coefficient was calculated from the Dittus-Boelter correlation. The overall heat transfer coefficient and local heat flux were then calculated from the following equations:

$$\frac{1}{U_{OVERALL}} = \frac{1}{h_s} + \frac{1}{h_t} + \frac{1}{h_p} \qquad (4\text{-}4)$$

$$Q_1 = U_{OVERALL}(T_f - T_p) \qquad (4\text{-}5)$$

where

$U_{OVERALL}$ = overall heat transfer coefficient

h_s = secondary side turbulent free convection film coefficient

h_t = tube wall equivalent heat transfer coefficient

h_p = primary side turbulent forced convection film coefficient

T_p = primary side temperature

Finally, the local heat flux as calculated by equations (4-2) and (4-3) was compared to an upper limit heat flux calculated from equations (4-4) and (4-5), with the assumption that the primary side film coefficient is infinite and that the primary side temperature is saturated. The local heat flux was taken to be the lesser of two values: the upper limit heat flux or the heat flux as calculated from equations (4-2) and (4-3).

The local tube wall heat flux, the primary steam temperature, and the individual tube inlet flow distribution data from the air/water test were combined to calculate local quality in the tubes. From a nodal energy balance on the primary side of a tube, the following equation is written:

$$Q_1 \cdot A_1 - M_w C_p \frac{dT_w}{dt} = W_g (H_o - H_i) + W_{fg} (H_o - H_f) \qquad (4\text{-}6)$$

where:

Q_1	=	measured nodal tube wall heat flux
A_1	=	tube wall nodal heat transfer area
M_w	=	tube wall nodal mass
C_p	=	tube wall heat capacity
dT_w/dt	=	rate of increase of tube wall temperature
W_g	=	primary side steam mass flow rate at the entrance to the node
H_o	=	steam enthalpy at the node exit
H_i	=	steam enthalpy at the node entrance
H_f	=	enthalpy of saturated liquid
W_{fg}	=	rate of liquid evaporation in the node

From the steam probe data, the primary steam enthalpy was determined. The rate of change of tube wall temperature was calculated from the tube wall thermocouple data and the tube wall heat flux was calculated from the measured secondary fluid and tube wall thermocouples. The individual tube inlet steam flow was derived from the air/water test data. The remaining unknown in equation (4-6) is W_{fg}, the rate of liquid evaporation in the node. By starting at the first nodal elevation, where the inlet steam mass flow rate was known from the air/water tests, equation (4-6) was used to compute the liquid evaporation in the node. From this calculation the inlet steam flow to the next node could be found and equation (4-6) could again be used to compute the liquid evaporation in the second node. The calculation was continued for all the calculational nodes. From the local nodal steam flow and the total tube mass flow (assumed to be constant), the local quality is found. Computer-generated tables of local tube wall heat flux and local quality are presented in appendix H. An uncertainty analysis on the local quality could in general be performed following the method described in appendix I. However, this analysis would require an estimate of the error introduced by applying the air/water test data to the steam water test, and an estimate of the error introduced by using interpolated steam probe temperature to determine local quality. An alternate method to evaluate the accuracy of the local quality calculation is to compare the calculated tube bundle exit quality with the measured outlet plenum quality, shown in the data plots in appendix H. In general, these local quality calculations indicate that the local quality is being underpredicted. The error is least in the high quality runs (x above 50%) and increases as the inlet quality decreases.

SECTION 5

CONCLUSIONS

The steam generator separate effects tests were successfully carried out, and the data obtained are expected to be useful for reflood model development and verification. In particular, the heat release rates in the steam generator tube bundle can be determined from the installed bundle thermocouples. A heat transfer calculational method using bundle thermocouples has been developed and will be used in subsequent systems effects tests to determine the bundle heat transfer. The tests also demonstrated that a small amount of liquid coexists with superheated steam in the primary side of the steam generator tube bundle, and can be collected in the outlet plenum.

APPENDIX A

INSTRUMENTATION BENCH TESTS

Two bench tests were run to demonstrate the adequacy of the tube bundle wall thermocouple installation method and the primary side tube inlet region differential pressure probe installation for measuring tube wall temperature and pressure drop.

In the tube wall thermocouple bench test (figure A-1), several thermocouple mounting concepts were tested. They varied from a purely mechanical spring-loaded mounting concept to a typical sheathed thermocouple mounted perpendicular to the tube wall, to a pad-type thermocouple tack-welded to the tube wall. These thermocouples were mounted to a short section of Inconel tube. Two thermocouples embedded in the tube wall served as references. In these tests the thermocouple that was silver-soldered perpendicular to the tube wall was consistently in closest agreement with the thermocouples buried in the tube wall.

A second series of bench tests were then run with thermocouples silver-soldered to the tube while the tube was in a mockup of a section of the 32-tube bundle. The purpose of this test was to verify that the existing dimensional clearance between the tubes was large enough to permit silver-soldering thermocouples to tubes in the tube bundle. After four thermocouples had been installed, the thermocouple response was measured in the bench test. The difference between the silver-soldered thermocouples and the thermocouple embedded in the tube wall, plotted against the tube wall heat flux, is shown in figure A-2. The heat flux was imposed on the tube by passing cold water $10^{o}C$ ($50^{o}F$) through the tube while it was immersed in a hot water bath approximately $82^{o}C$ ($180^{o}F$). After steady-state conditions had been reached, thermocouple output was recorded. Figure A-2 illustrates that the thermocouple bias varies linearly with heat flux and that each thermocouple response is different. The data trend in figure A-2 indicates that thermocouple installation may affect the thermocouple response and that an individual thermocouple calibration test should be run in the steam generator shakedown tests.

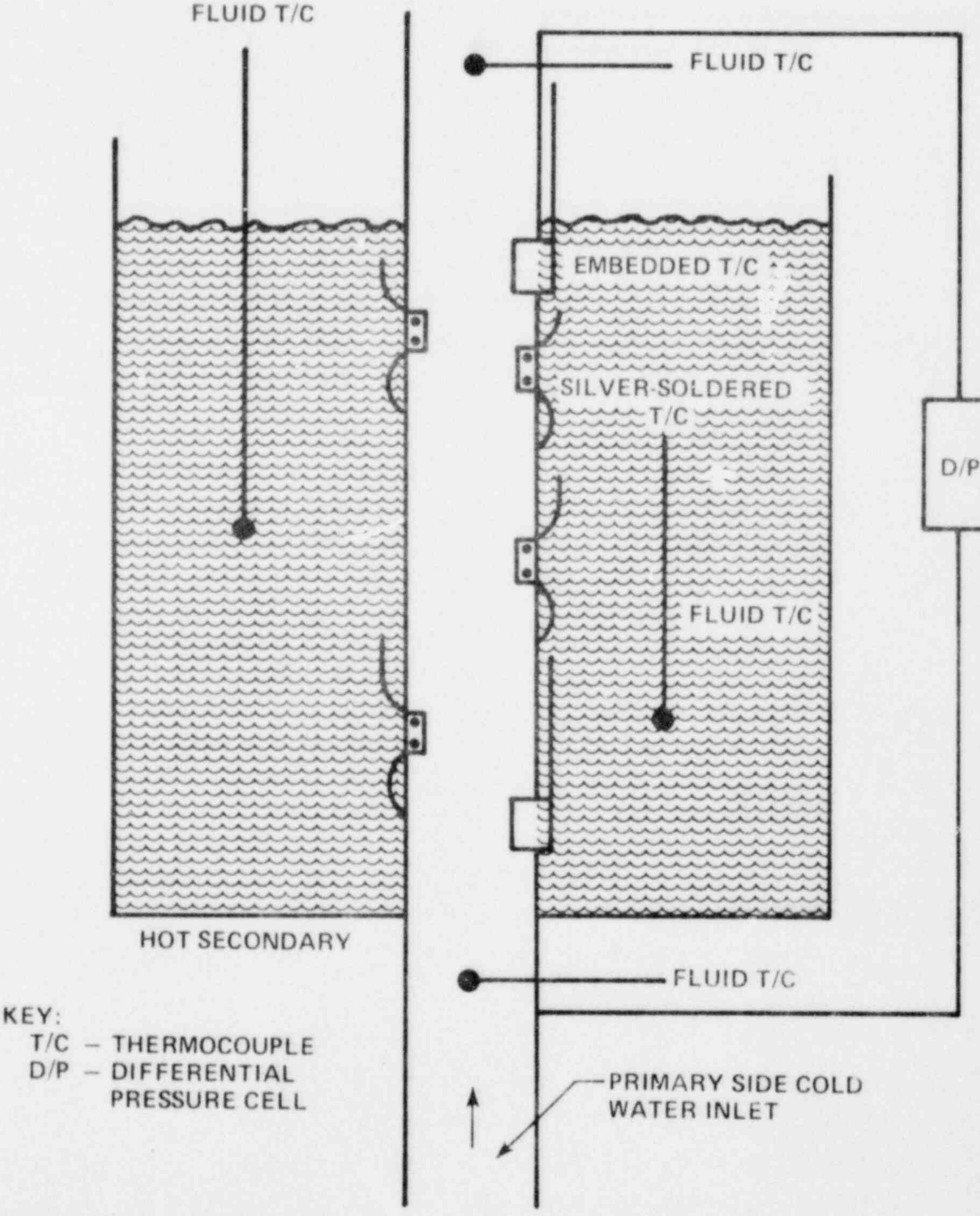

Figure A-1. Schematic Diagram of Thermocouple Bench Test

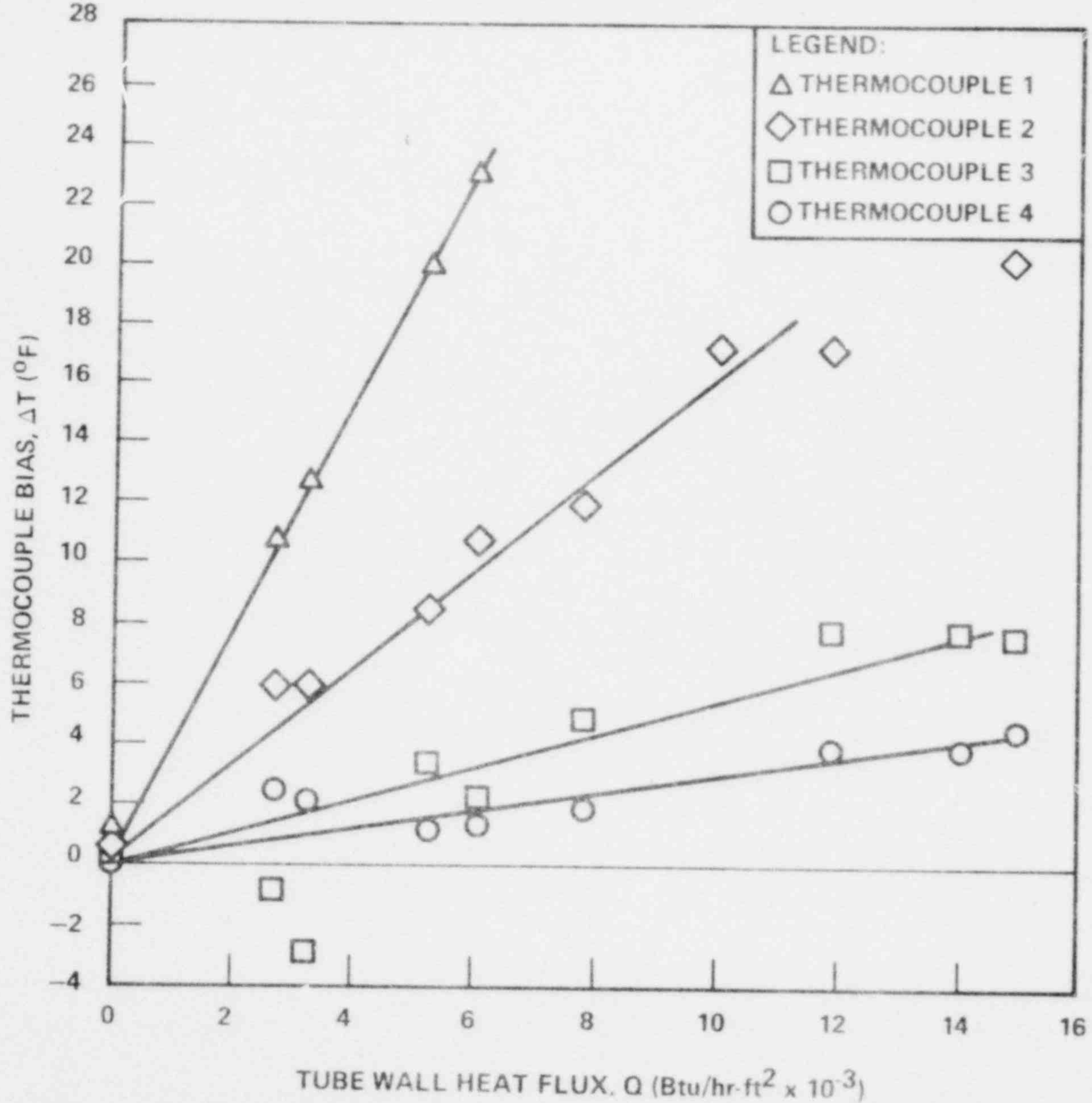

Figure A-2. Silver-Soldered Thermocouple Bias Versus Tube Wall Heat Flux

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The objective of the differential pressure probe bench test (figure A-3) was to demonstrate that such a probe inside the tube would function properly in a two-phase flow environment. In this test, the two-phase flow was simulated with air and water. The simulated steam generator tube was transparent to allow visual observation of the flow regime inside the tube. The concern was that the static pressure probe in the two-phase mixture could accumulate liquid, which would then cause an erroneous differential pressure signal.

A reference set of pressure taps was installed externally on the tube wall and connected to two differential pressure transducer cells. These reference differential pressure transducers had a water-solid external reference leg. The reference differential pressure was compared to differential pressure readings from the cells with sensing lines inside the tube. The internal differential pressure cell did not use a water solid reference leg, but used a nitrogen purge to ensure that the sensing lines did not accumulate water.

The results of the differer .ial pressure bench test (table A-1) show that the purge flow can keep the instrument lines free of liquid even for low void fractions, where the tube is essentially filled solid with water. Based on this test, it was concluded that the continuous purge of the differential pressure cel. probes would prevent liquid accumulation in the probes. The indicated differential pressure could then be used to calculate the void fraction in the tube.

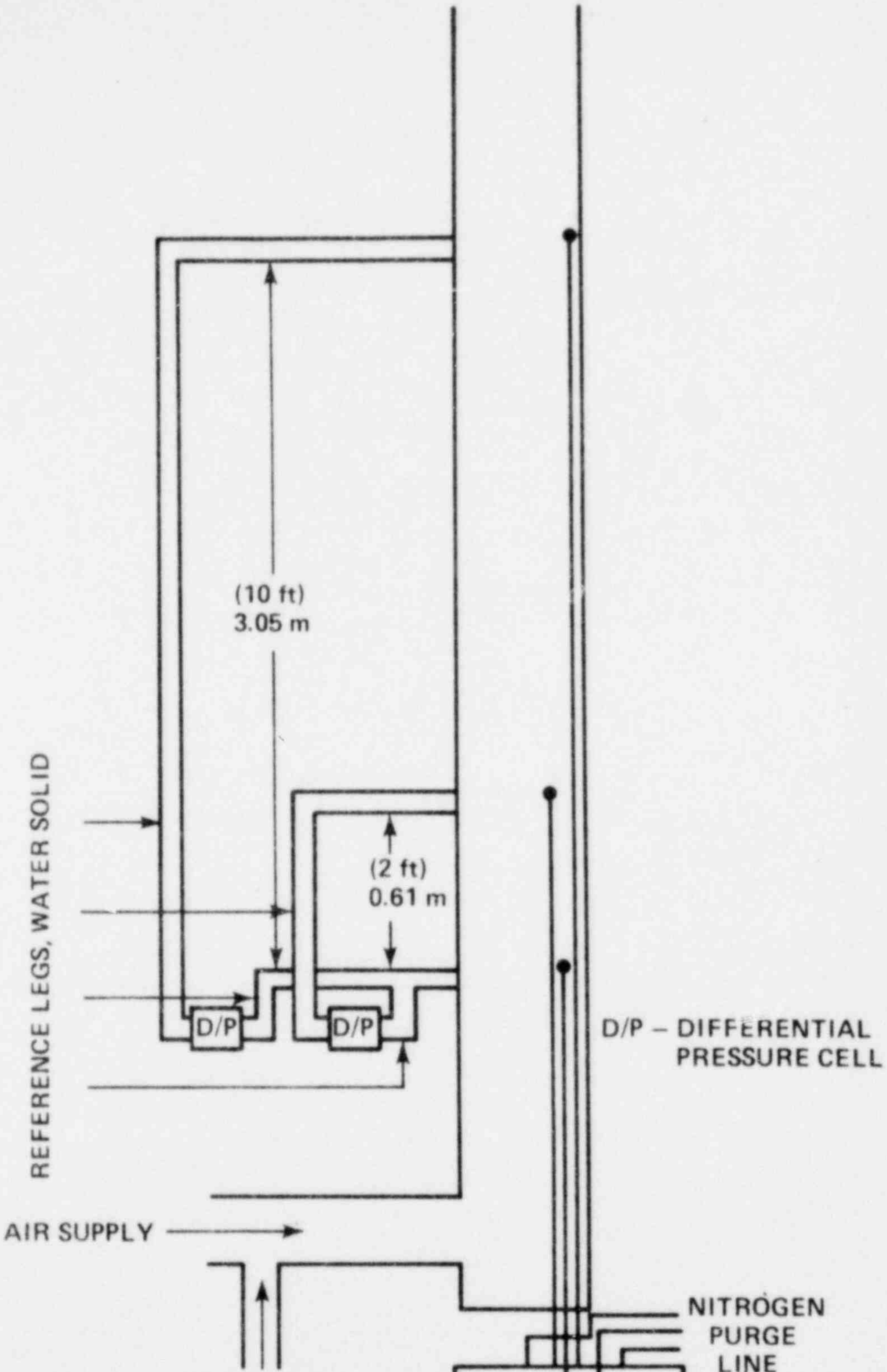

Figure A-3. Schematic Diagram of Steam Generator Tube Pressure Probe Bench Test

TABLE A-1

BENCH TEST OF DIFFERENTIAL PRESSURE PROBES WITH CONTINUOUS NITROGEN PURGE FLOW

Run	Differential Pressure [kPa (psi)]		Void Fraction in Tube[(a)]	Purge Flow Rate [m^3/sec (cfm)]
	External Reference Cell	Internal Probe		
1	0.21(0.03)	0.0 (0.0)	1.0	0.00002 (.05)
2	0.48(0.07)	0.55 (0.08)	0.92	0.00002 (0.05)
3	0.62(0.09)	0.76 (0.11)	0.90	0.00002 (0.05)
4	3.8(0.55)	4.3 (0.63)	0.33	0.00002 (0.05)
5	4.1(0.60)	4.7 (0.68)	0.31	0.00002 (0.05)
6	5.8(0.84)	6.1 (0.88)	0.03	0.000005 (0.01)

a. Based on external reference cell differential pressure

APPENDIX B

STEAM GENERATOR INLET PLENUM AIR/WATER FLOW DISTRIBUTION TEST

B-1. AIR/WATER INLET PLENUM TEST OBJECTIVES

The objectives of the air/water inlet plenum tests were as follows:

- To measure the radial variation in the liquid and air volumetric flow rates at the tubesheet of the FLECHT steam generator inlet plenum. The air and liquid volumetric flow rates simulated steam and liquid volumetric flow rates from the test matrix.

- To measure the radial variation in liquid and air flow rates as above, with the spray nozzle mounted inside the FLECHT inlet plenum. The purpose of the internal spray nozzle was to attempt to achieve a uniform liquid distribution at the tubesheet.

- To measure the radial variation in liquid and air flow rates as above, using an inlet plenum geometrically similar to a typical pressurized water reactor plant steam generator inlet plenum.

- To experimentally determine a configuration for the internal nozzle that reproduces the scaled plenum distribution above.

- To measure the single-phase air flow distribution at the tubesheet.

B-2. TEST DESIGN AND INSTRUMENTATION

The simulated tubesheet used in the air/water tests had a short section of tube with an orifice in the end of the tube to simulate the hydraulic resistance of a full-length tube. The standard isothermal frictional pressure drop and orifice pressure drop equations can be solved for orifice diameter in terms of the pipe parameters. The equation is

$$\frac{d_o}{d} = \left[\frac{1}{C^2 f L/D}\right]^{1/4}$$

where

d_o	=	orifice diameter
d	=	pipe diameter
C	=	orifice
f	=	friction factor in pipe
L/D	=	pipe length-to-diameter ratio

For the above calculation, a friction factor of 0.02 and an orifice flow coefficient of 0.69 were used. A typical orifice simulating a steam generator tube is shown in figure B-1.

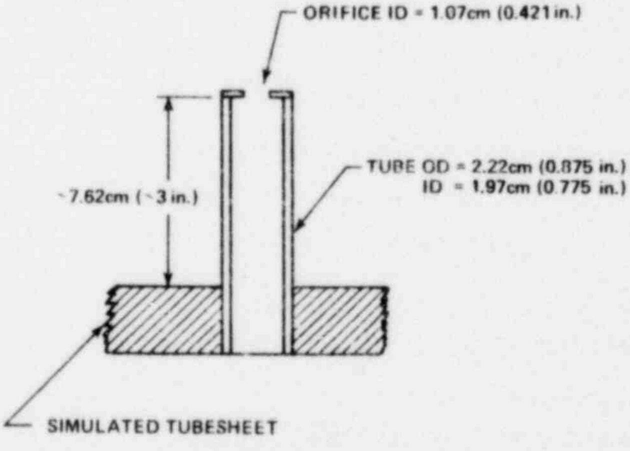

Figure B-1. Orifice Simulation of Steam Generator Tube Friction

During the air/water tests the air and liquid flow rates in the tube shown in figure B-1 were measured. For this measurement, the orifice shown in figure B-1 was removed, and the instrument shown in figure B-2 was connected to the tube. With this instrument and a Pitot tube, the air/water mixture in the tube was separated, and the flow rate of each component was measured. During a test, the instrument was moved from tube to tube sequentially to get the data necessary to map the

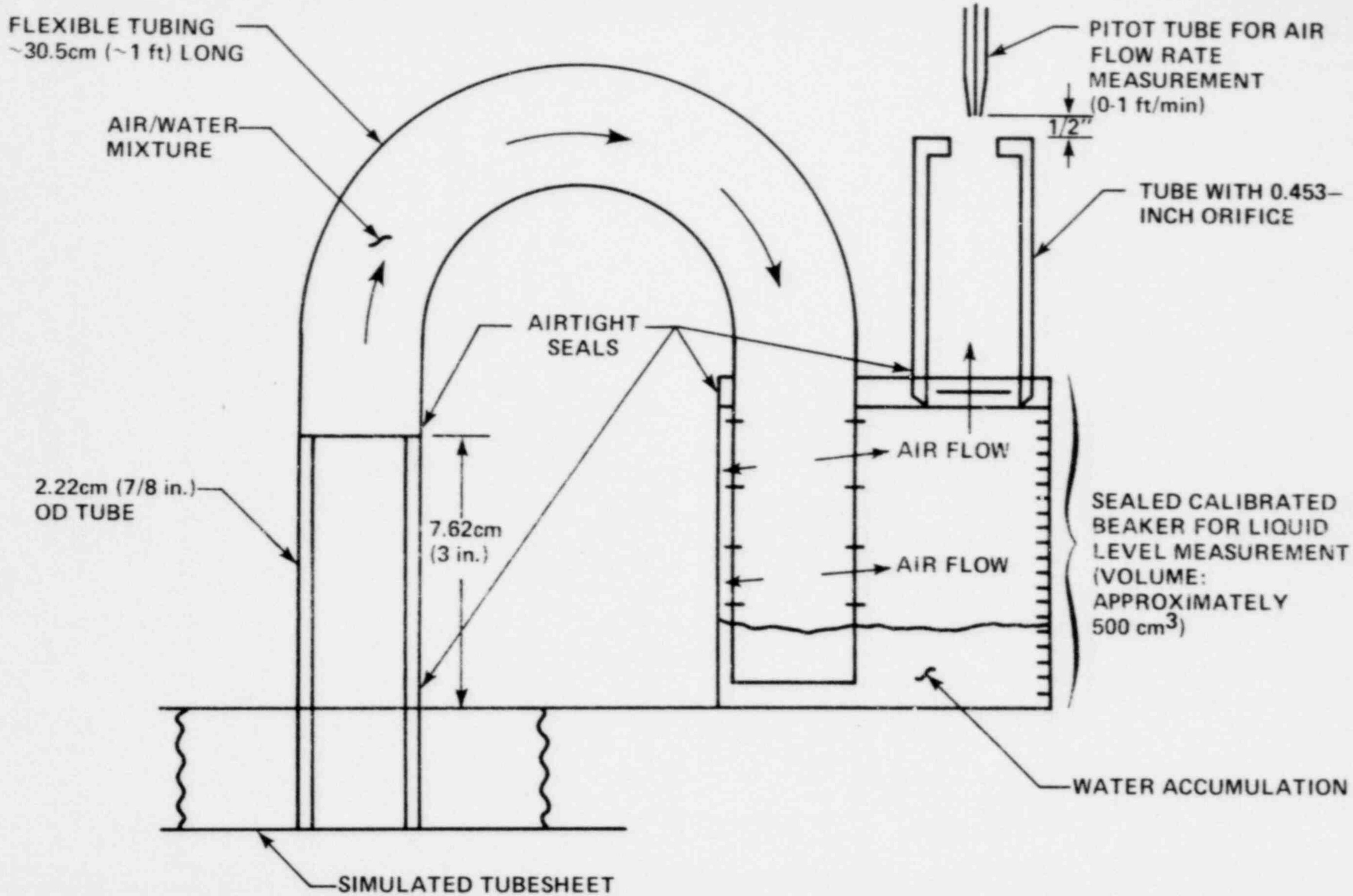

Figure B-2. Steam Generator Tube Air and Water Flow Rate Measurement

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flow distribution across the tubesheet. While the individual tube measurements were being made, the air and water flow to the inlet plenum was held constant. The orifice on the tube in the calibrated beaker was slightly larger than the orifices in the uninstrumented tubes to compensate for the added resistance of the instrument itself.

An overall loop schematic diagram for the air/water test is shown in figure B-3. The liquid flow rate was controlled with a throttling valve in the liquid supply line to control the pressure to the spray nozzle. The flow rate was measured with a direct-reading rotameter.

The air flow was supplied by the large air compressor and was regulated by bleeding a given amount of air from the compressor supply line. The air flow to the inlet plenum was measured with an orifice. The air flow to the plenum was regulated by adjusting valves V-2 and V-3 (figure B-3). Air and water flow rates required to simulate steam generator test conditions are shown in table B-1. Because of the compressor capacity limit, a maximum of only 330 cfm could be supplied to the inlet plenum.

B-3. TEST MATRIX

Tests with unique inlet plenum volumetric steam and liquid flow rates were selected for the air/water test from the test matrix in table 7-2 of the steam generator separate effects task plan.(1) The assumption behind the air/water tests was that the fluid conditions at the tubesheet would be duplicated in the air/water test if the volumetric flow rates of the air and water were the same as the volumetric flow rates of steam and water in the loop test.

In the air/water plenum test, the seven test conditions shown in table B-1 were run with the FLECHT inlet plenum. The hemispherical inlet plenum was tested with the conditions in runs 1, 2, 5, and 6. With the spray nozzle inside the inlet plenum, the run conditions from runs 1, 2, 5, and 6 were run with the spray nozzle designed

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1. Hochreiter, L. E., et al., "PWR FLECHT SEASET Steam Generator Separate Effects Task: Task Plan Report," NRC/EPRI/Westinghouse-2, March 1978.

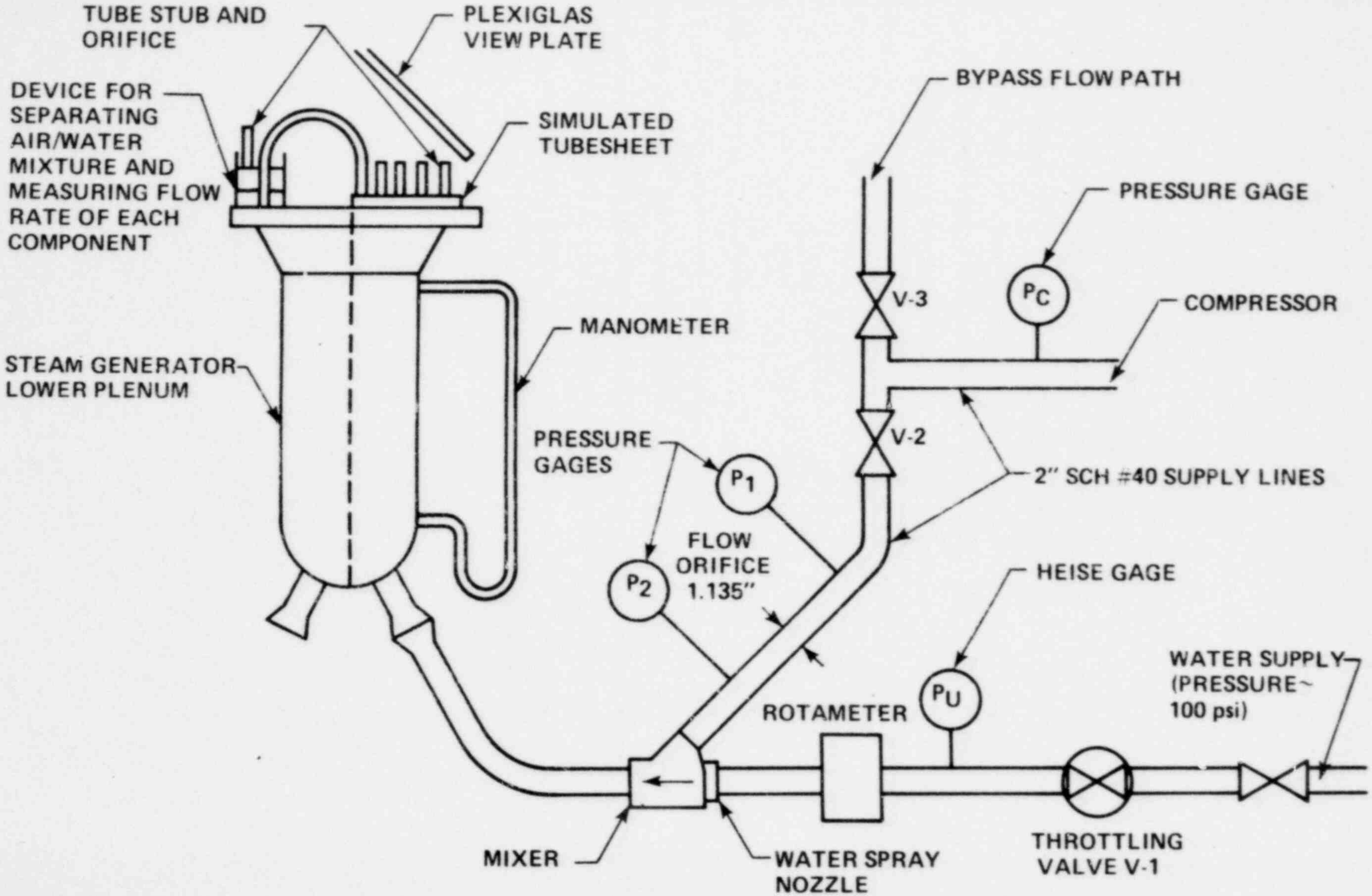

Figure B-3. Loop Schematic Diagram for Plenum Air/Water Test for a uniform inlet flow distribution. Also, several tests were run with air only to check the test loop, and several tests were repeated so that the random error in the data could be evaluated. Tests were also run with and without simulated steam probe and differential pressure probe instrumentation leads immediately below the tubesheet in the steam generator plenum.

Table B-2 summarizes the air/water tests run on the two inlet plenum geometries. Air and liquid volumetric flow rates from table B-1 provided the boundary conditions for the test (except for the compressor capacity limit noted above, which provided a maximum flow of 330 cfm). Also, because the test equipment was unable to function at the air flow required by runs 6 and 7, these tests were run at an air flow of 120 cfm. The geometry of the two plenums used in the test is illustrated in figure B-4.

B-4. TEST DATA

Test data consisted of the total liquid and air flow rates and the individual tube air and liquid flow rates. The liquid flow rate was read directly from the rotameter, and the air flow was calculated from the flow orifice pressure drop. The individual tube air and liquid flow rates were calculated from the Pitot tube measurement and the time for water level to change in the calibrated beaker shown in figure B-2. The total air flow rates and individual tube air flow rates were calculated from the following equations:

$$Q_{\text{total air}} = 343\,(Y)\,\sqrt{\Delta P \rho_1} \quad (1)$$

$$Q_{\text{tube } i} = 2.923\,\sqrt{\Delta H_i} \quad (2)$$

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1. Eq. 3-22 in Crane Technical Paper 410, with d_o = 1.135 in. and C = 0.65.

2. Eq. 3-21 in Crane Technical Paper 410, with d_o = 0.453 in. and C = 0.65.

Run No.	Description
1	Reference run
2	Flow sensitivity
3	Pressure sensitiv
4	Pressure sensitiv
5	Quality sensitivit
6	Quality sensitivit
7	Post bundle quen

TABLE B-1

STEAM GENERATOR SEPARATE EFFECTS TEST
STEAM AND LIQUID VOLUMETRIC FLOWRATES

	Pressure [MPa (psia)]	Quality	Total Flow [kg/sec (lb/sec)]	Liquid Flow		Steam Flow	
				[kg/sec (lb/sec)]	[m³/sec (gal/min)]	[kg/s (lb/sec)]	[m³/sec (cfm)]
	0.276 (40)	0.80	0.227 (0.5)	0.0454 (0.10)	0.000045 (0.72)	0.182 (0.40)	0.1189 (252)
	0.276 (40)	0.80	0.454 (1.0)	0.0908 (0.20)	0.000009 (1.44)	0.363 (0.80)	0.2378 (504)
ty	0.138 (20)	0.80	0.227 (0.5)	0.0454 (0.10)	0.000045 (0.72)	0.182 (0.40)	0.2275 (482)
ty	0.414 (60)	0.80	0.227 (0.5)	0.0454 (0.10)	0.000045 (0.72)	0.182 (0.40)	0.0812 (172)
y	0.276 (40)	0.50	0.227 (0.5)	0.114 (0.25)	0.00011 (1.8)	0.114 (0.25)	0.0746 (158)
y	0.276 (40)	0.20	0.227 (0.5)	0.182 (0.40)	0.00018 (2.9)	0.0454 (0.10)	0.0297 (63)
ch	0.276 (40)	0.10	0.454 (1.0)	0.409 (0.90)	0.00041 (6.5)	0.0454 (0.10)	0.0297 (63)

TABLE B-2

TEST MATRIX FOR STEAM GENERATOR INLET PLENUM AIR/WATER TESTS

Air/Water Test Matrix Run Number	Plenum Configuration	Test Conditions (Run No. From Table B-1)
01A	Scaled plenum without	Air only
02B	instrumentation leads	Air only
03C	Scaled plenum without	Run 1
04D	instrumentation leads	Run 2
05G		Run 5
06H		Run 6
07A	FLECHT plenum with	Air only
08B	instrumentation leads	Air only
09C		Run 1
10D		Run 2
11E	FLECHT plenum with	Run 3
12F	instrumentation leads	Run 4
13G		Run 5
14H		Run 6
15I		Run 7
16C	FLECHT plenum with	Run 1
17D	instrumentation leads,	Run 2
18D	with internal nozzle	Run 5
19H	for uniform flow distribution	Run 6

TABLE B-2 (cont)

TEST MATRIX FOR STEAM GENERATOR INLET PLENUM AIR/WATER TESTS

Air/Water Test Matrix Run Number	Plenum Configuration	Test Conditions (Run No. from Table B-1)
24A 25B	FLECHT plenum with instrumentation leads, with internal nozzle	Air only Air only
26C	FLECHT plenum without instrumentation leads	Run 1

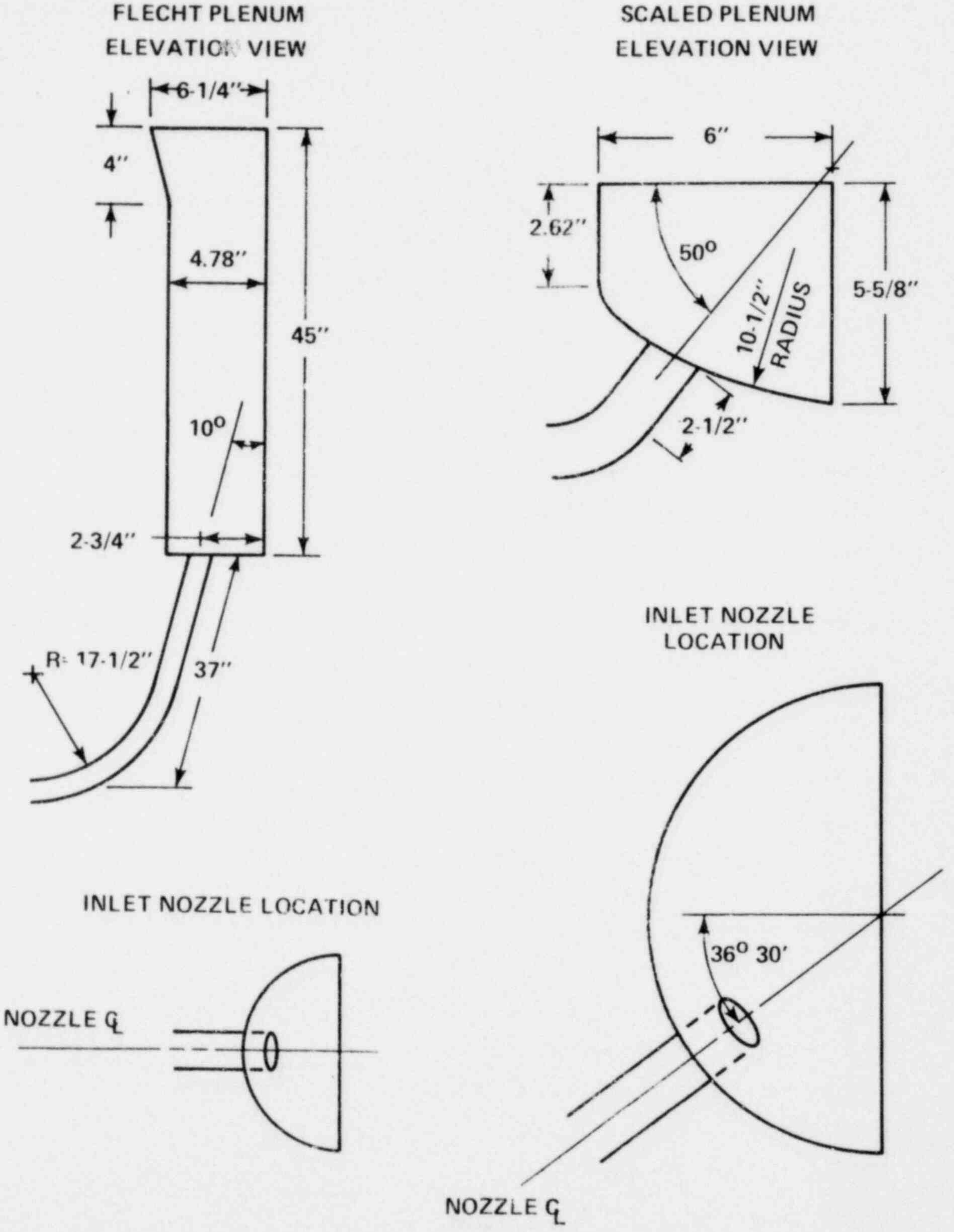

Figure B-4. Air/Water Test Inlet Plenum Geometries

where

$Q_{total\ air}$	=	total air flow rate to plenum at standard conditions [m^3/sec (cfm)]
$\Delta\rho$	=	flow orifice pressure drop [Pa(psi)]
ρ_1	=	mass density of air at upstream pressure tap [kg/cm^3 (lbm/ft^3)]
Y	=	compressible flow, net expansion factor[1]
$Q_{tube\ i}$	=	air flow from tube i [m^3/sec (cfm)]
ΔH_i	=	Pitot tube pressure head at tube i [Pa (in. H_2O)]

Table B-3 presents a summary of the loop data from each run together with the sum of the flow rates from each tube. The data in columns headed Sum of q_{tube} represent the sum of the tube flow, which can be compared to the total measured loop flow. Since the individual tube and total loop flow measurements are independent, this comparison is a consistency check on the data. The comparison shows that the air- and liquid-phase data agreement is generally within 10 percent for air flow rates above 0.071 m^3/sec (150 cfm); the difference between the two measurements increases as the air flow rate decreases below 0.071 m^3/sec (150 cfm). For this reason runs 6 and 7 (table B-1), which required a volumetric flow of air of 0.030 m^3/sec (63 cfm), were run at the higher air flow rate of approximately 0.057 m^3/sec (120 cfm).

Test data for the individual tube air and water flow rates are reported in figures B-5 through B-35. The data in these tables are normalized to the average tube flow rate reported in table B-3.

The data are presented on a drawing of the tube bundle with an arrow indicating the location of the lower plenum inlet nozzle. The number recorded in the circle representing each tube is the normalized air or liquid flow rate measured at that tube location.

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1. Crane Technical Paper 410, p A-21.

The run summary (table B-3) shows that the 04D run was repeated four times (runs 0804D, 1104D, 1304D, and 1604D). From these runs, the random error in the experiment was estimated by computing the overall variance in the normalized liquid flow. The results of the calculation were as follows:

	Normalized Liquid Flow Rate		
Data Sample	Overall Variance	Overall Standard Deviation	
		Absolute	Relative
All 32 tubes	0.048	0.22	22%
All tubes except A-9 and C-1	0.021	0.14	14%

The above table shows that two tubes in the bundle account for one-third of the total deviation; when these tubes are excluded the standard deviation in the liquid flowrate is 14 percent.

The air/water test data were used in the two-phase matrix test data reduction program SGFLUX. In this program the total bundle heat transfer was calculated from the four-instrumented-tube data by multiplying the instrumented tube heat flux by a weighting factor that represents the number of tubes with heat flux close to that of the measured tube. These weighting factors were developed from the air/water test data by assigning each uninstrumented tube to the instrumented tube with inlet flow parameters which most closely match the uninstrumented tube flow. For example, in run 1909C, which simulates the reference run, the instrumented tube locations had normalized liquid distributions of 1.77, 1.18, 0.75 and 0.68 for radial positions 1, 2, 3, and 4, respectively. In the air/water test, eight tubes had liquid fractions from 1.2 to 2.4, eight tubes had liquid fractions from 0.9 to 1.2, 12 tubes had liquid fractions from 0.68 to 0.9 and four tubes had liquid fractions below 0.68. The weighting factors from the air/water tests that were used in the SGFLUX program are presented in table B-4.

Test Run[a] Date	Test Type	Plenum[b]
0102B 7/25/78	Air only	HP
0201A 7/25/78	Air only	HP
0401A 7/27/78	Air only	HP
0502B 8/3/78	Air only	HP
0602B 8/3/78	Air only	HP
0703C 8/7/78	Air/water	HP
0804D 8/8/78	Air/water	HP
0905G 8/9/78	Air/water	HP
1006H 8/9/78	Air/water	HP
1104D 8/10/78	Air/water	HP
1206H 8/15/78	Air/water	HP
1304D 8/16/78	Air/water	HP
1403C 8/17/78	Air/water	HP
1505G 8/17/78	Air/water	HP
1604D 8/21/78	Air/water	HP
1726C	Air/water	FP

a. Test run ID = test sequence, as first two di
b. HP = scaled hemispherical plenum, FP = F
c. SI (metric) data are given in figures B-5 th
d. Total flow in all 32 tubes

TABLE B-3

AIR/WATER INLET PLENUM TEST RUN SUMMARY

Air Volumetric Flow Data[c]			Liquid Volumetric Flow Data[c]		
Measured Total Loop Flow (cfm)	Range of Measured q_{tube} Absolute (Normalized) (cfm)	Sum of q_{tube}[d] (cfm)	Measured Total Loop Flow (gal/min)	Range of Measured q_{tube} Absolute (Normalized) (cm^3/min)	Sum of q_{tube}[d] (gal/min)
330	9.63-12.05 (0.91-1.14)	339.42			
227	6.33-8.22 (0.89-1.15)	228.82			
227	6.23-8.34 (0.86-1.15)	233.05			
330	10.17-11.62 (0.96-1.10)	339.09			
330	9.50-12.19 (0.88-1.13)	346.72			
227	6.73-8.08 (0.96-1.15)	224.99	0.72	7-231 (0.08-2.51)	0.777
330	10.04-11.84 (0.96-1.13)	336.40	1.4	17-403 (0.13-3.04)	1.12
141	3.07-4.67 (0.81-1.24)	121.07	1.55	48-552 (0.26-2.95)	1.58
128	0-4.19 (0-1.33)	101.27	2.35	43-1048 (0.18-4.38)	2.02
330	9.96-11.73 (0.96-1.13)	333.06	1.4	30-408 (0.21-2.83)	1.219
121	0.3-3.92 (0-1.37)	91.86	2.9	43-825 (0.20-3.82)	1.829
327	9.69-11.47 (0.96-1.13)	323.74	1.54	12-5[illegible]7 (0.09-2.74)	1.188
247	7.19-8.65 (0.96-1.15)	240.19	0.69	2-1.94 (0.03-2.55)	0.642
157	3.52-5.30 (0.82-1.25)	137.27	1.85	47-593 (0.22-2.78)	1.802
335	10.04-11.67 (0.96-1.12)	333.44	1.54	20-513 (0.11-2.90)	1.495
250	7.25-7.51	236.34	0.72	21-171	0.723

nits, and test matrix run number as defined in table D-3
ECHT plenum
rough B-35.

Test Run[a] Date	Test Type	Plenum[b]
8/25/78		
1807A	Air/water	FP
8/30/78		
1909C	Air/water	FP
8/31/78		
2008B	Air only	FP
8/31/78		
2110D	Air/water	FP
9/1/78		
2211E	Air/water	FP
9/1/78		
2312F	Air/water	FP
9/5/78		
2413G	Air/water	FP
9/5/78		
2514H	Air/water	FP
9/6/78		
2615I	Air/water	FP
9/6/78		
2716C	Air/water	FP
9/8/78		
2824A	Air only	FP
9/13/78		
2925B	Air only	FP
9/13/78		
3017D	Air/water	FP
9/13/78		

a. Test run ID = test sequence, as first two c

b. HP = scaled hemispherical plenum, FP = F

c. SI (metric) data are given in figures B-5 t

d. Total flow in all 32 tubes

TABLE B-3 (cont)

AIR/WATER INLET PLENUM TEST RUN SUMMARY

Air Volumetric Flow Data(c)			Liquid Volumetric Flow Data(c)		
Measured Total Loop Flow (cfm)	Range of Measured q_{tube} Absolute (Normalized) (cfm)	Sum of q_{tube}(d) (cfm)	Measured Total Loop Flow (gal/min)	Range of Measured q_{tube} Absolute (Normalized) (cm^3/min)	Sum of q_{tube}(d) (gal/min)
	(0.98-1.02)			(0.25-2.01)	
252	8.03-8.17 (0.99-1.01)	259.54			
251	7.39-7.69 (0.97-1.01)	242.78	0.72	28-202 (0.32-232)	0.735
327	10.56-10.70 (0.99-1.01)	340.06			
330	9.95-10.52 (0.96-1.01)	332.32	1.45	94-470 (0.52-261)	1.518
329	10.23-10.52 (0.98-1.01)	333.51	0.72	38-247 (0.44-2.84)	0.733
175	4.12-5.25 (0.82-1.04)	161.69	0.72	21-160 (0.24-1.82)	0.742
161	4.50-5.41 (0.94-1.12)	153.97	1.8	83-353 (0.37-1.58)	1.888
123	3.27-3.39 (0.93-1.11)	113.06	2.9	86-645 (0.25-1.84)	2.967
124	3.05-4.44 (0.80-1.16)	122.34	6.5	222-1751 (0.27-2.13)	6.961
253	7.49-7.87 (0.96-1.01)	249.22	0.72	29-308 (0.34-358)	0.730
254	8.03-8.18 (0.99-1.01)	259.66			
328	10.62-10.72 1.00-1.00	341.59			
328	10.01-10.47 (0.97-1.02)	328.93	1.45	104-341 (0.58-1.91)	1.517

igits, and test matrix run number as defined in table D-3
LECHT plenum
rough B-35.

Test Run[(a)] Date	Test Type	Plenum[(b)]	
3117D 9/14/78	Air/water	FP	
3219H 9/14/78	Air/water	FP	
3316C 9/15/78	Air/water	FP	
3418G 9/15/78	Air/water	FP	
3517D 10/5/78	Air/water	FP	

a. Test run ID = test sequence, as first two digi

b. HP = scaled hemispherical plenum test, FP =

c. SI (metric) data are given in figures B-5 thro

d. Total flow in all 32 tubes

TABLE B-3 (cont)

AIR/WATER INLET PLENUM TEST RUN SUMMARY

Air Volumetric Flow Data(c)			Liquid Volumetric Flow Data(c)		
Measured Total Loop Flow (cfm)	Range of Measured q_{tube} Absolute (Normalized) (cfm)	Sum of q_{tube}(d) (cfm)	Measured Total Loop Flow (gal/min)	Range of Measured q_{tube} Absolute (Normalized) (cm^3/min)	Sum of q_{tube}(d) (gal/min)
328	9.88-10.36 (0.96-1.08)	329.60	1.45	85-447 (0.47-2.48)	1.518
122	2.67-3.64 (0.83-1.12)	103.95	2.9	78-635 (0.23-1.89)	2.844
253	7.61-7.91 (0.97-1.01)	249.82	0.72	41-211 (0.48-2.45)	0.730
170	4.48-5.37 (0.90-1.08)	158.68	1.7	74-475 (0.34-2.18)	1.841
331	9.83-10.39 (0.96-1.01)	327.91	1.45	78-375 (0.44-2.21)	1.511

ts, and test matrix run number as defined in table D-3
FLECHT plenum
ugh B-35.

AIR/WATER TEST WITH SCALED HEMISPHERICAL PLENUM

VALUES ARE AIR q (NORMALIZED)

$$\sum_{1}^{32} q_{tube} = 0.04335 \text{m}^3/\text{sec (91.86 cfm)}$$

$$\bar{q}_{tube} = 0.00135 \text{m}^3/\text{sec (2.87 cfm)}$$

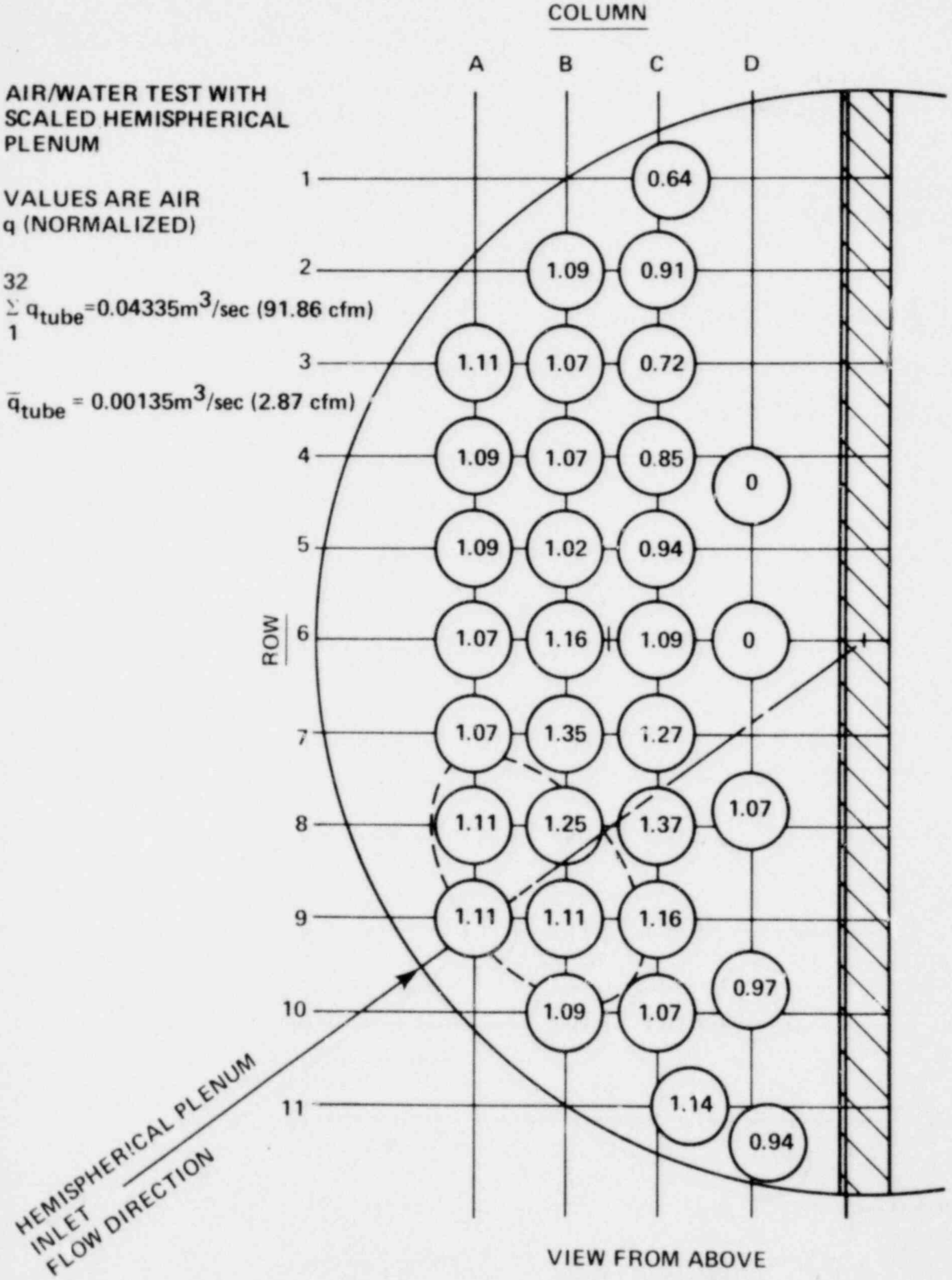


Figure B-5. Normalized Air Flow, Run 1206H

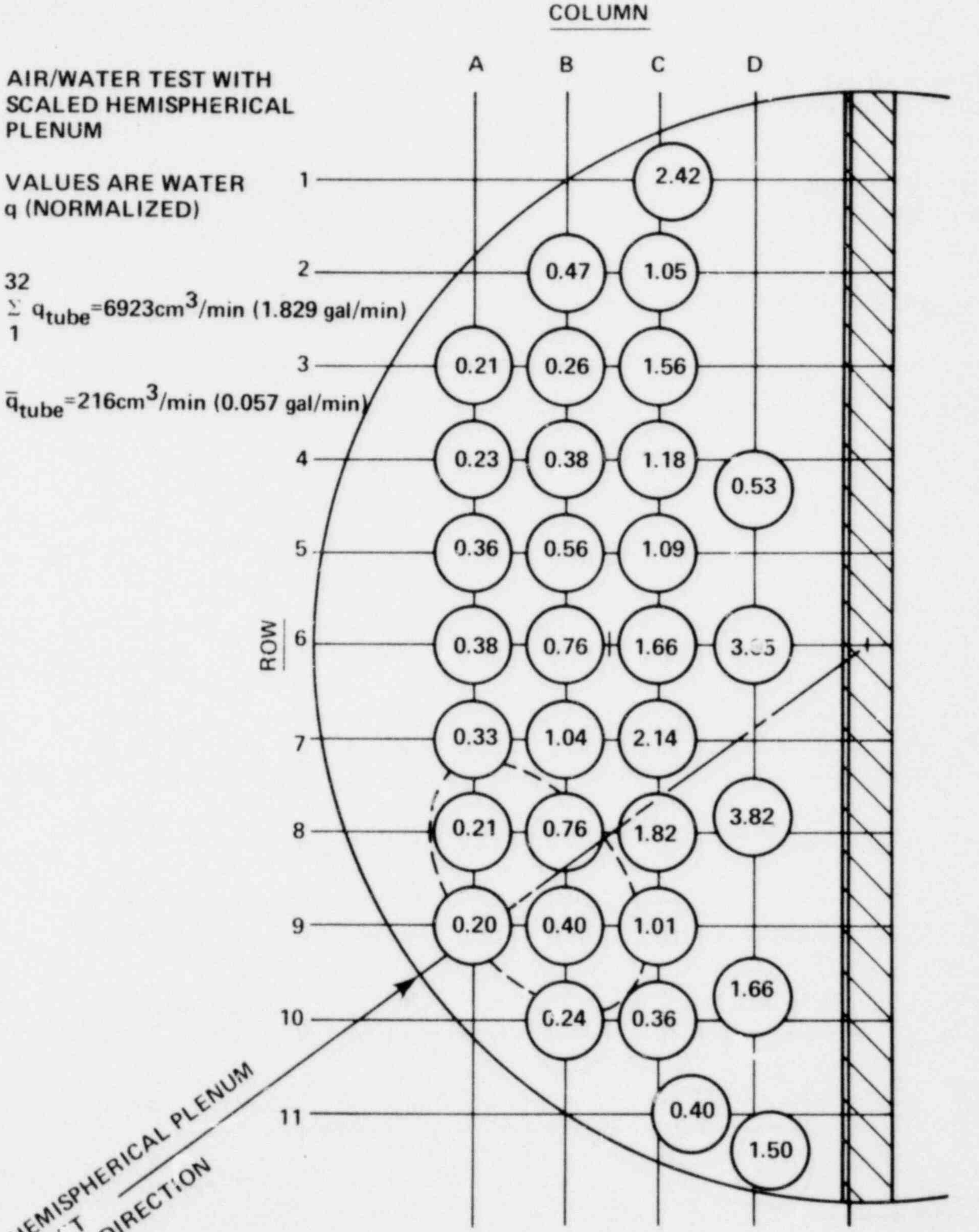


Figure B-6. Normalized Water Flow, Run 1206H

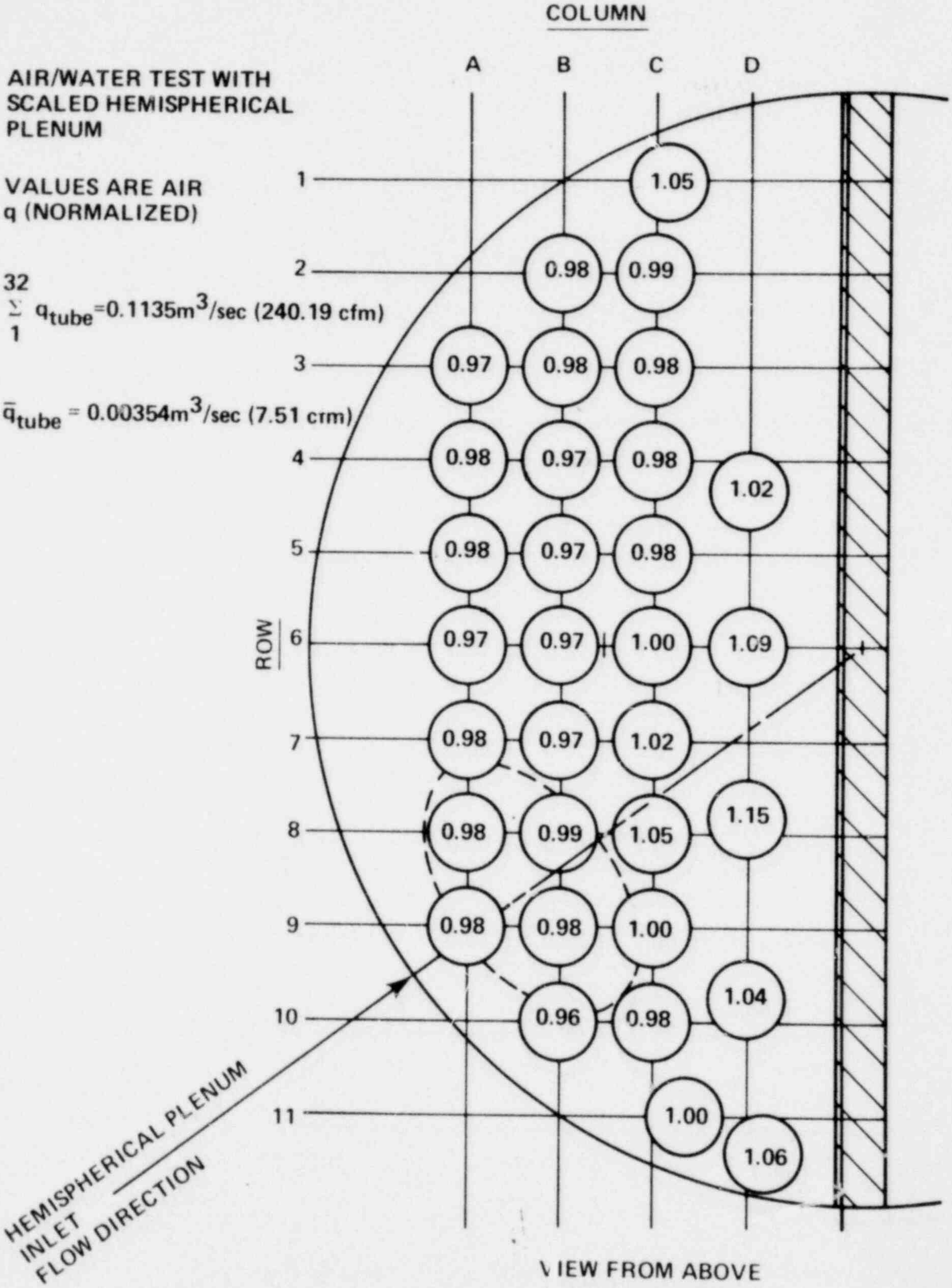


Figure B-7. Normalized Air Flow, Run 1403C

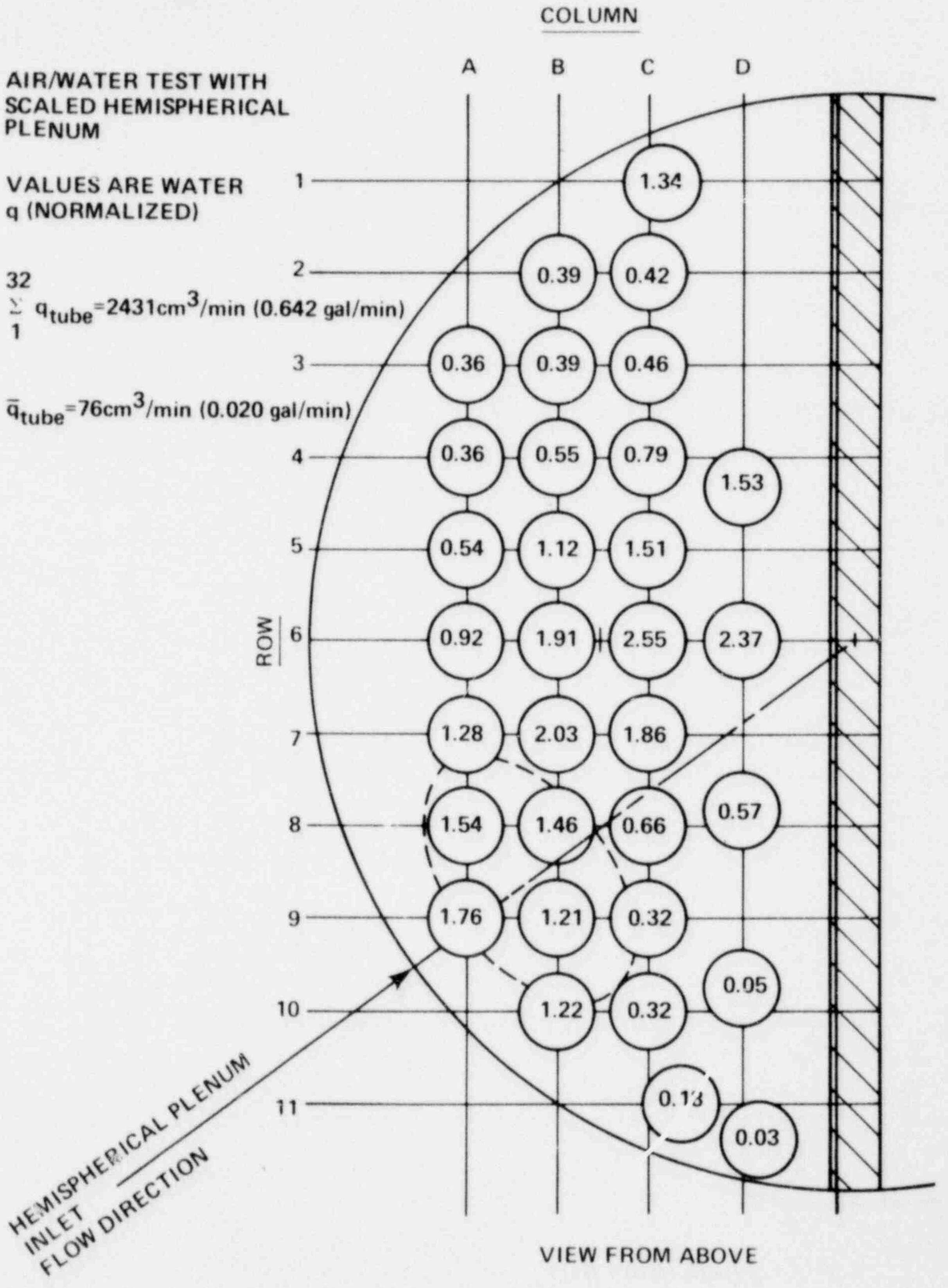


Figure B-8. Normalized Water Flow, Run 1403C

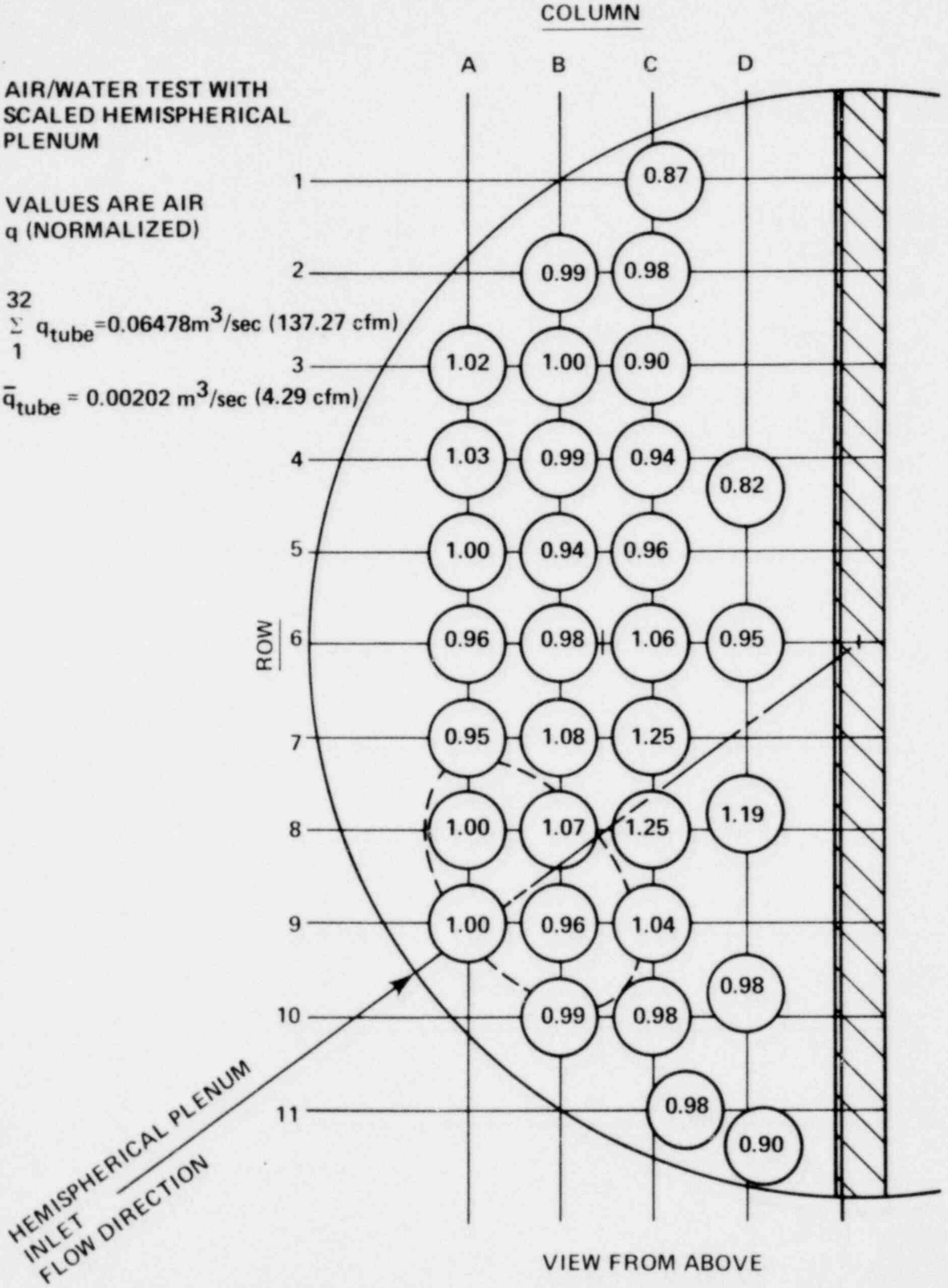


Figure B-9. Normalized Air Flow, Run 1505G

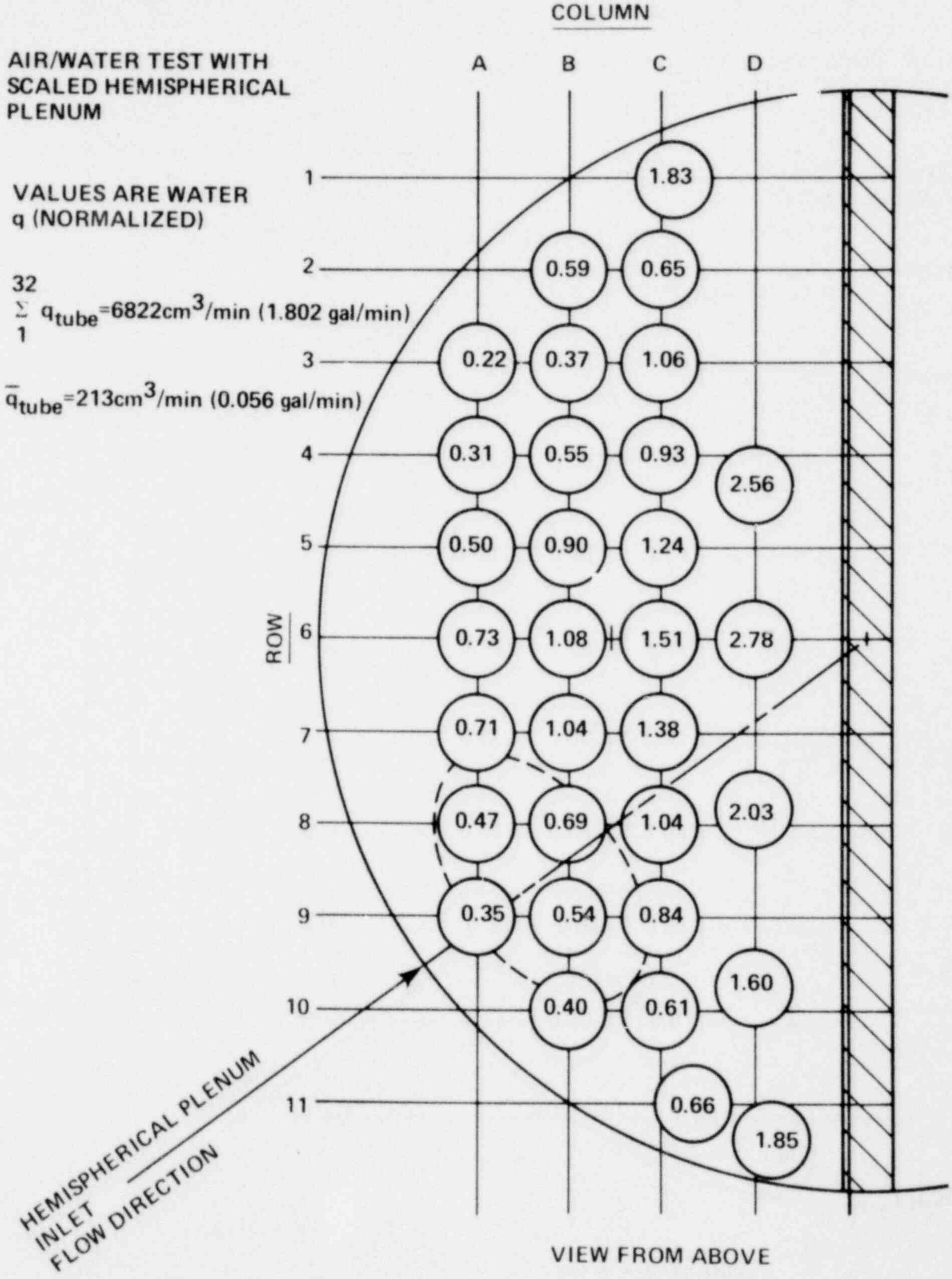


Figure B-10. Normalized Water Flow, Run 1505G

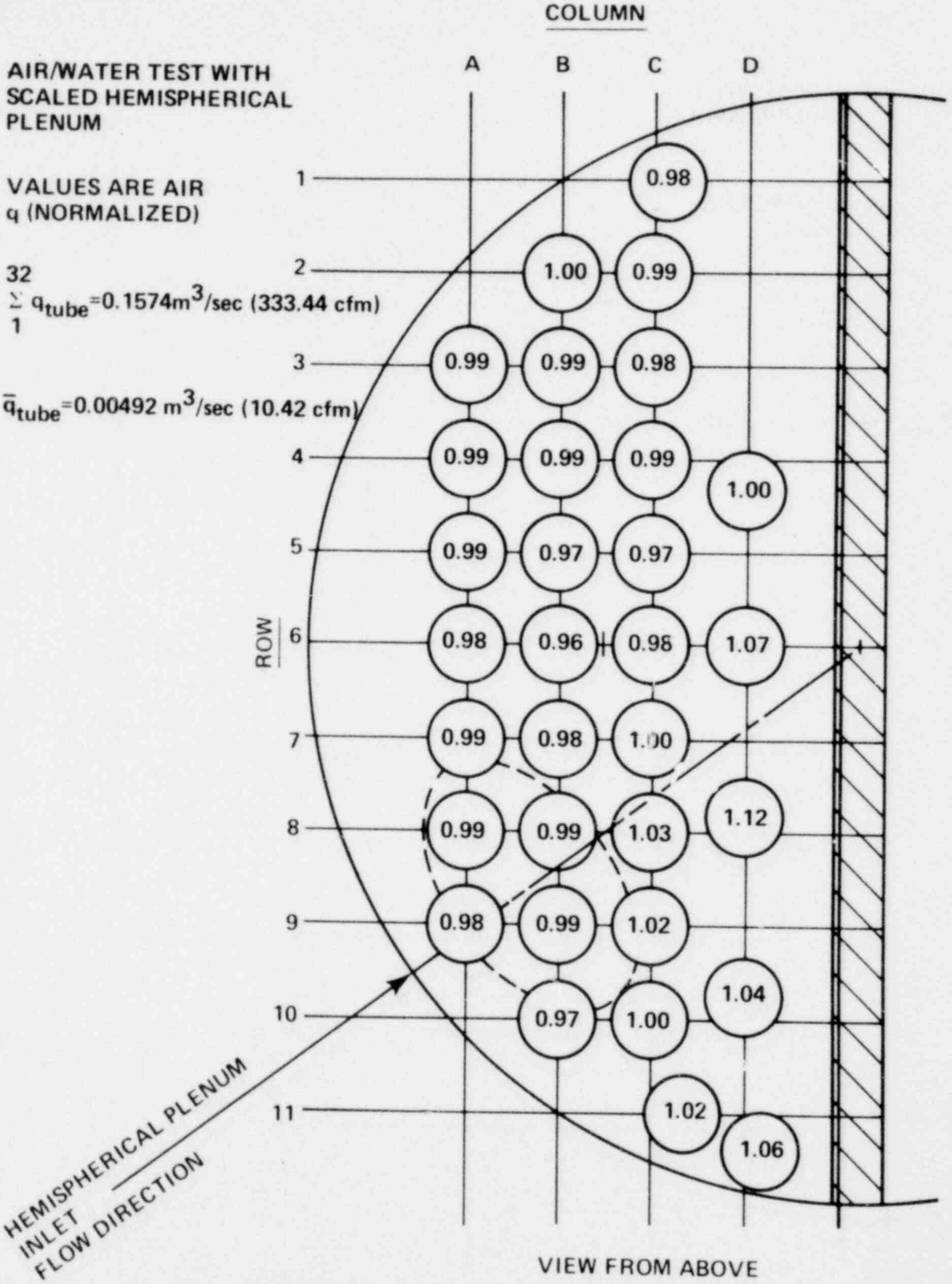


Figure B-11. Normalized Air Flow, Run 1604D

15607-10

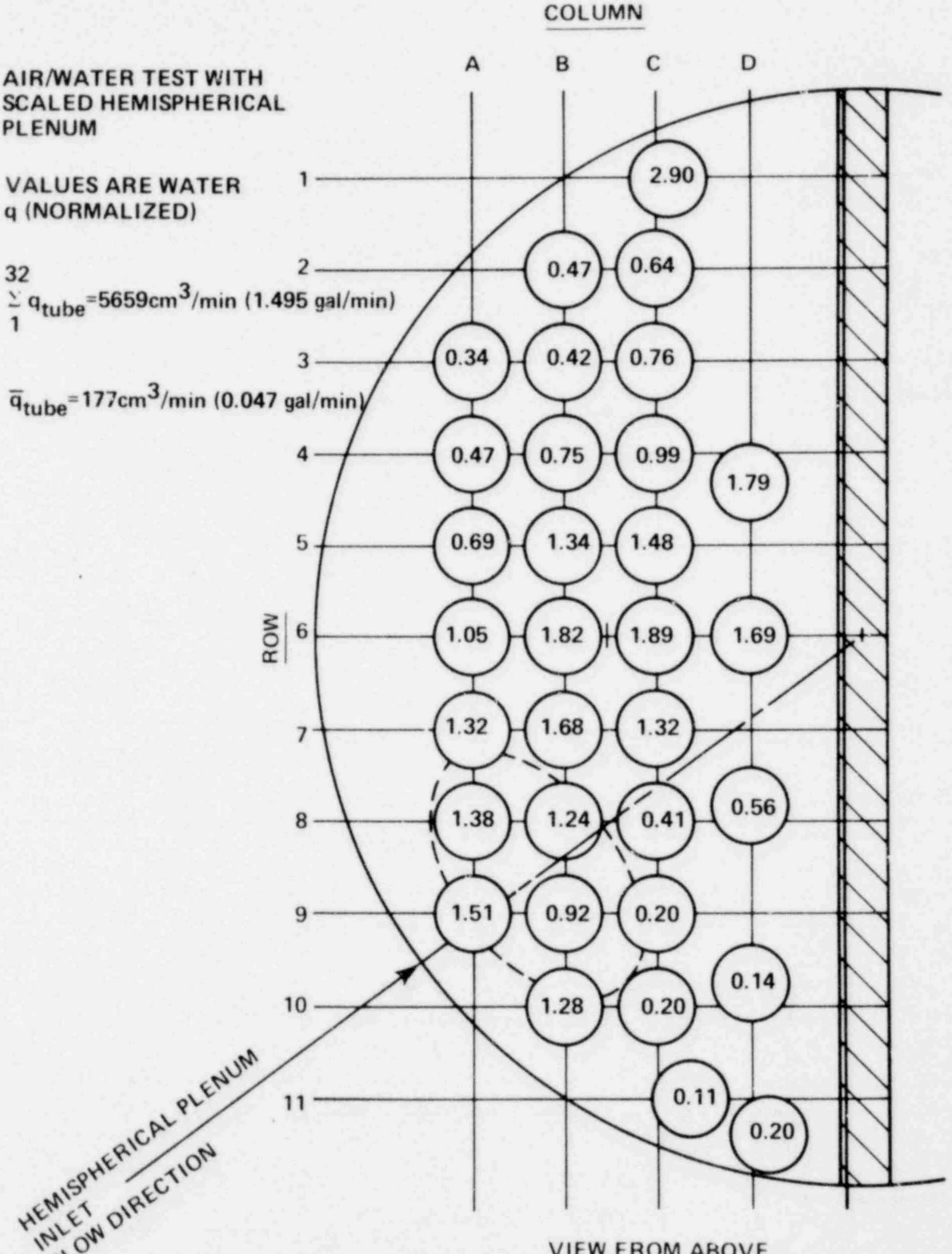


Figure B-12. Normalized Water Flow, Run 1604D

15607-11

AIR/WATER TEST WITH FLECHT PLENUM

VALUES ARE AIR q_{tube} (NORMALIZED)

$\sum_{1}^{32} q_{tube} = 0.1146 m^3/sec$ (242.78 cfm)

$\bar{q}_{tube} = 0.00358 m^3/sec$ (7.59 cfm)

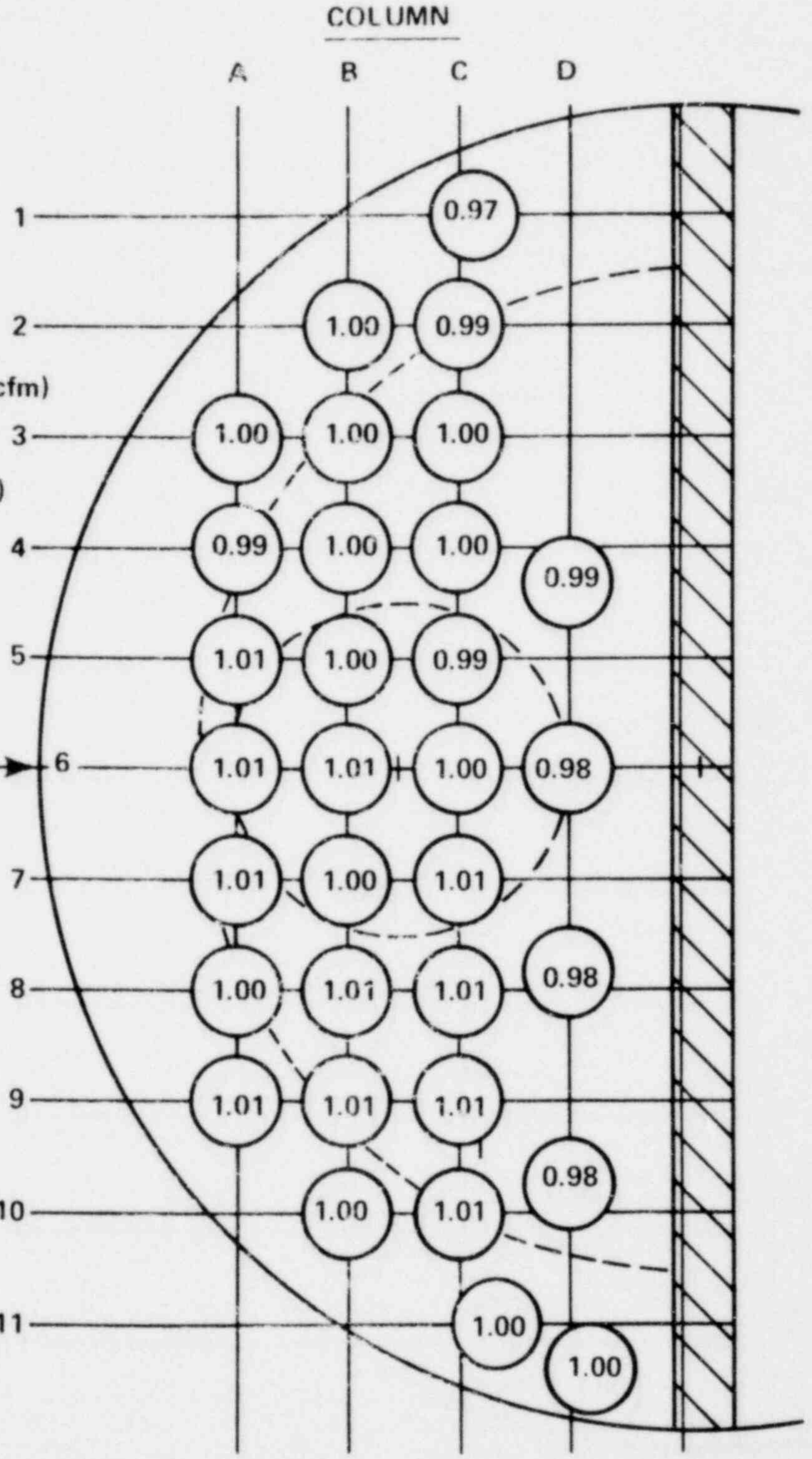


Figure B-13. Normalized Air Flow, Run 1909C

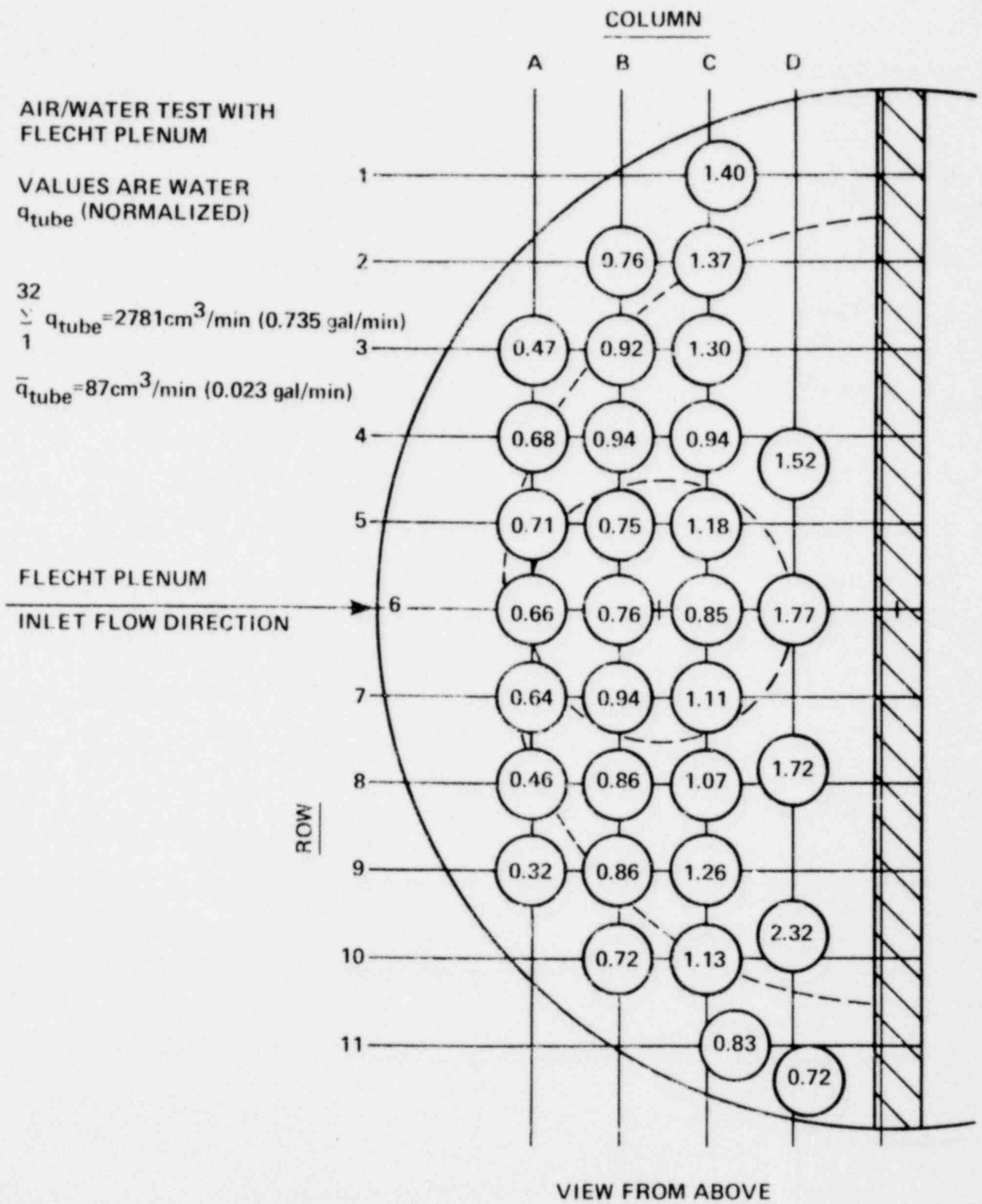


Figure B-14. Normalized Water Flow, Run 1909C

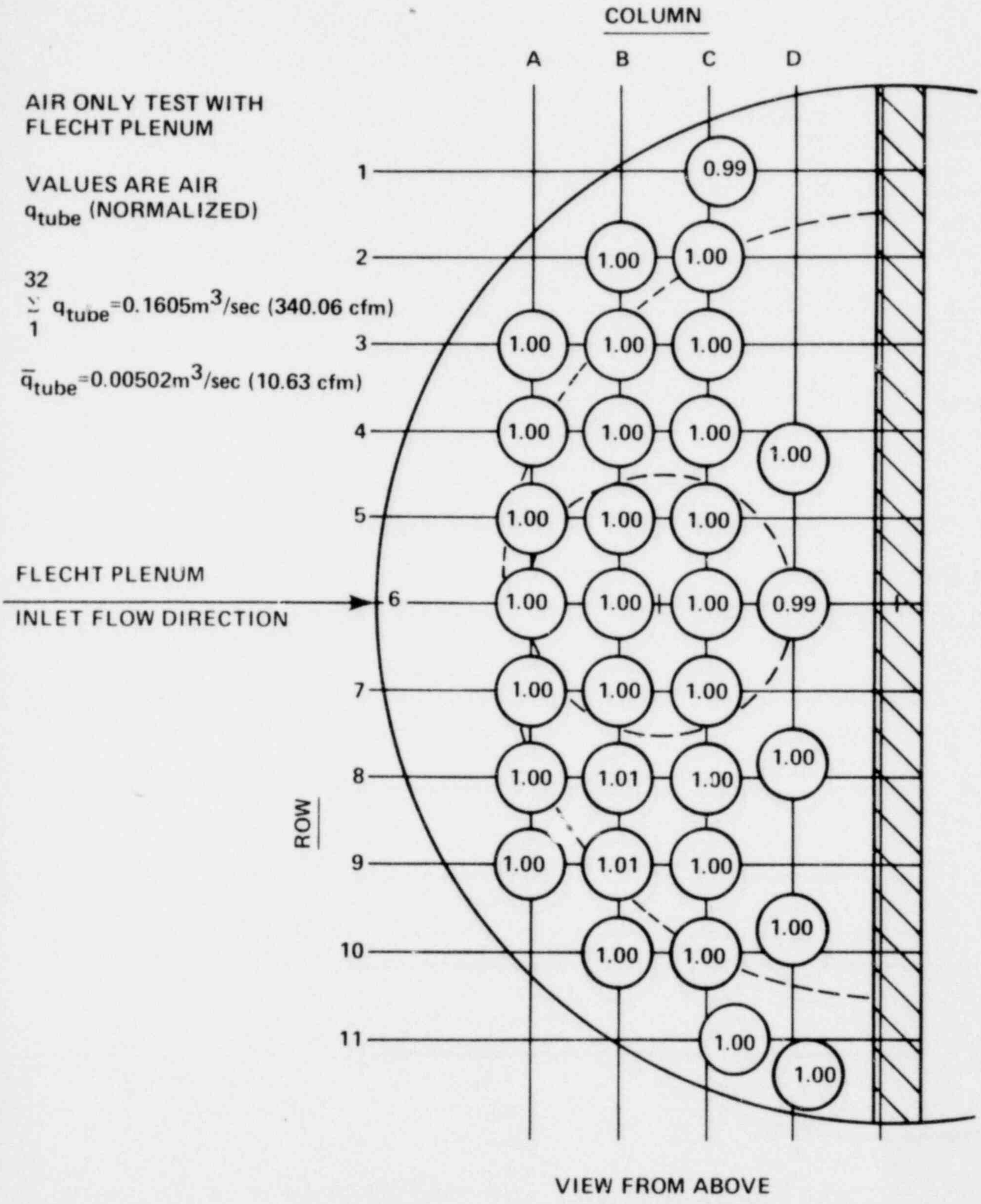


Figure B-15. Normalized Air Flow, Run 2008B

15607-14

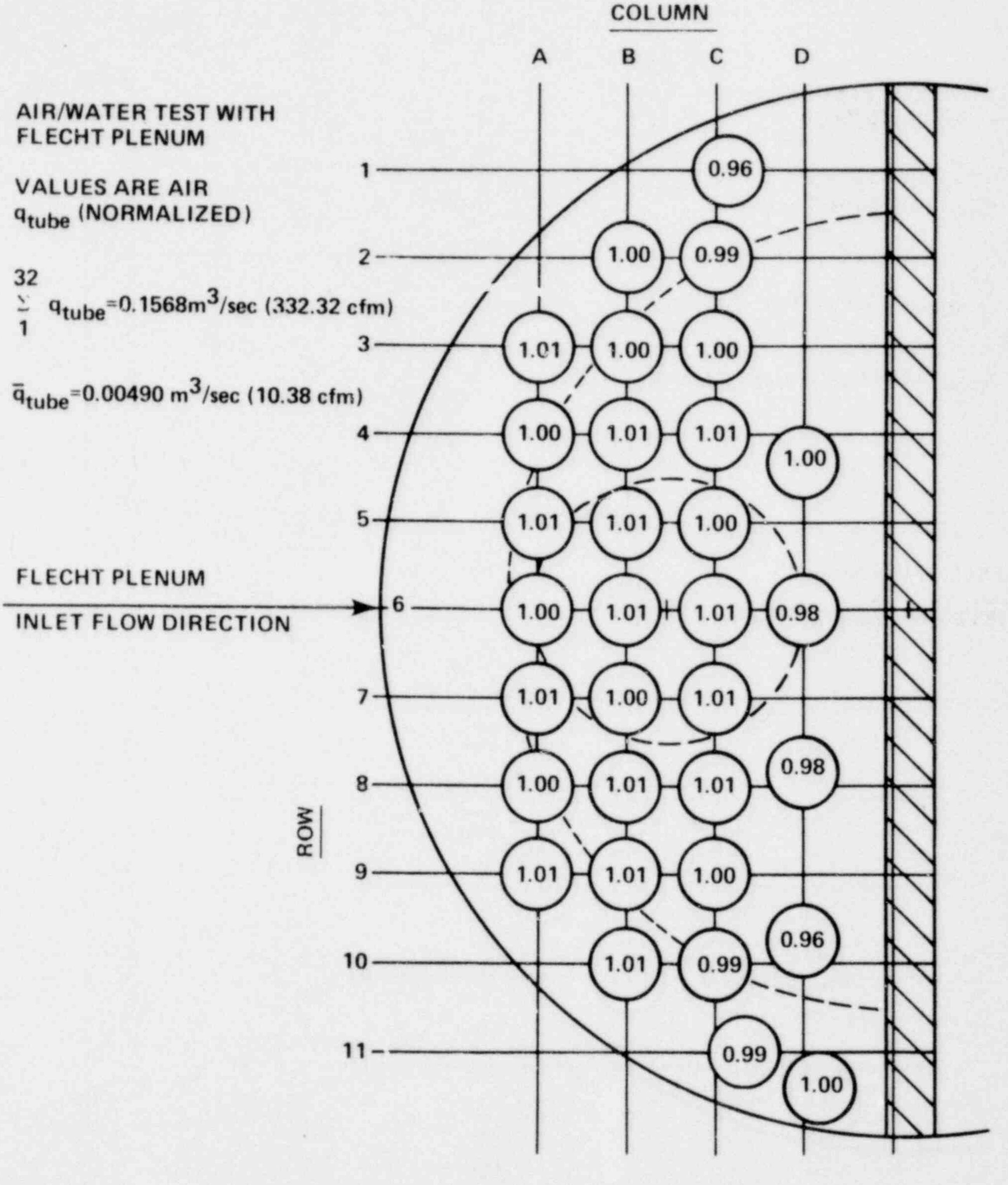


Figure B-16. Normalized Air Flow, Run 2110D

15607-15

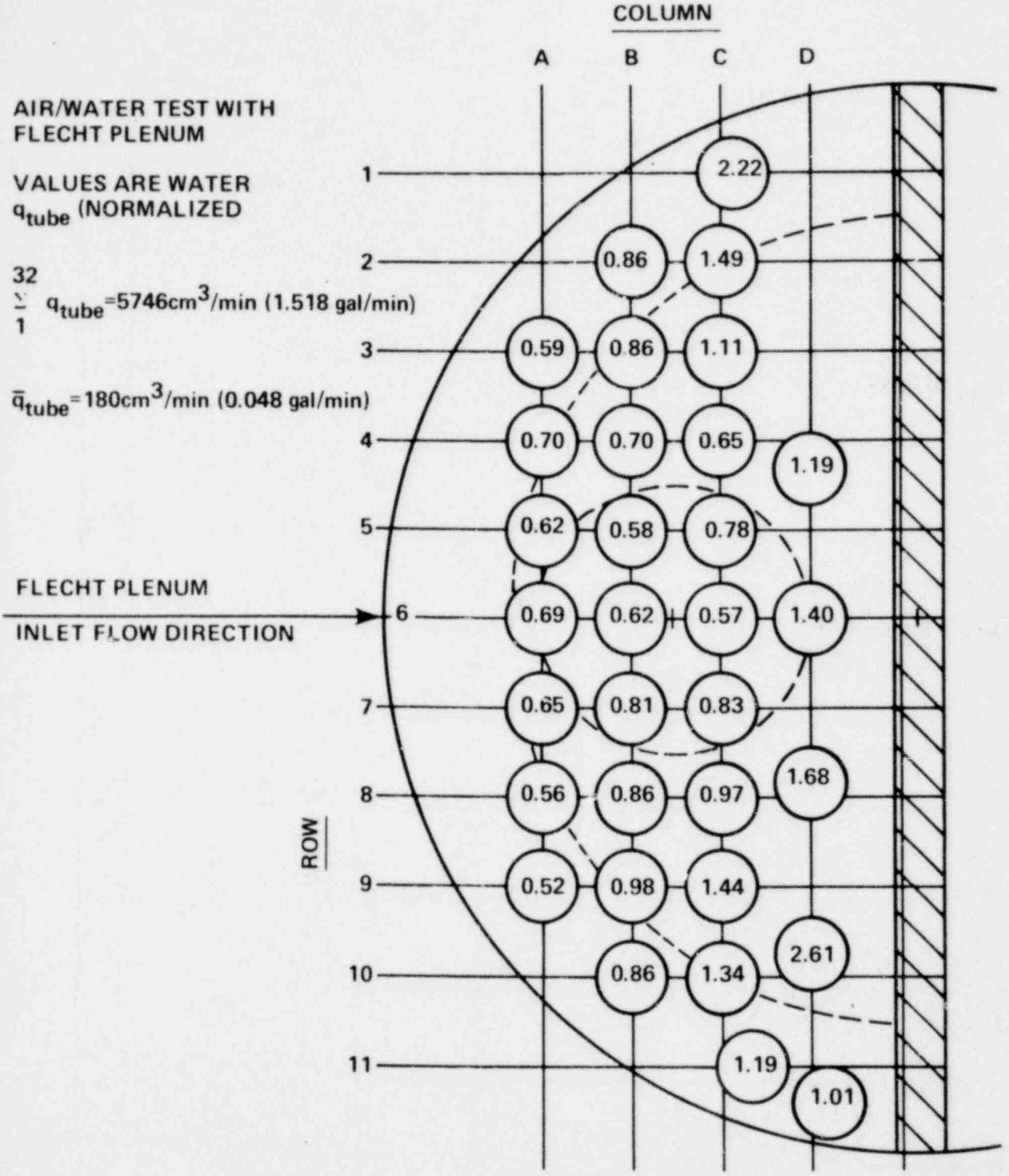


Figure B-17. Normalized Water Flow, Run 2110D

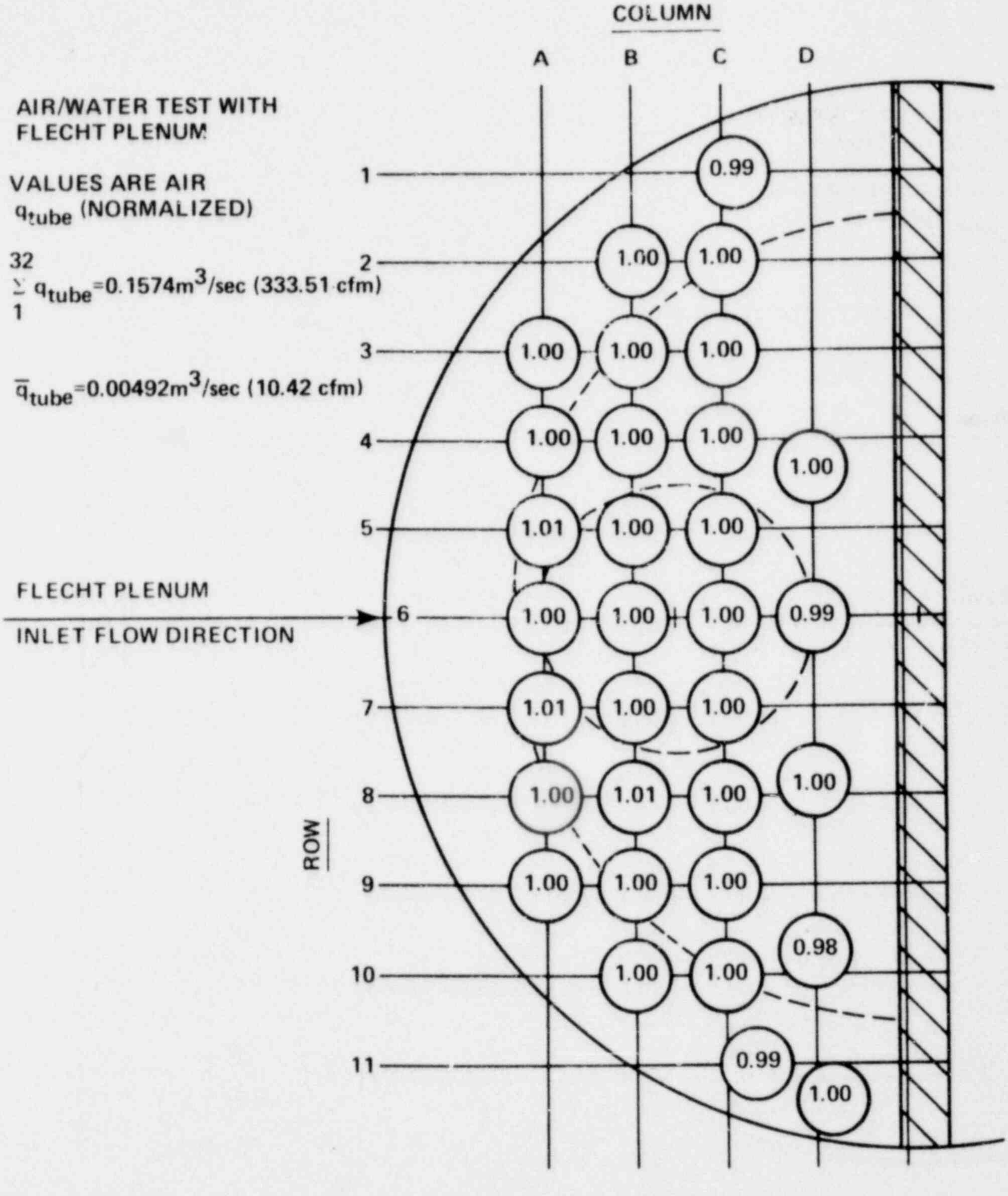


Figure B-18. Normalized Air Flow, Run 2211E

15607-17

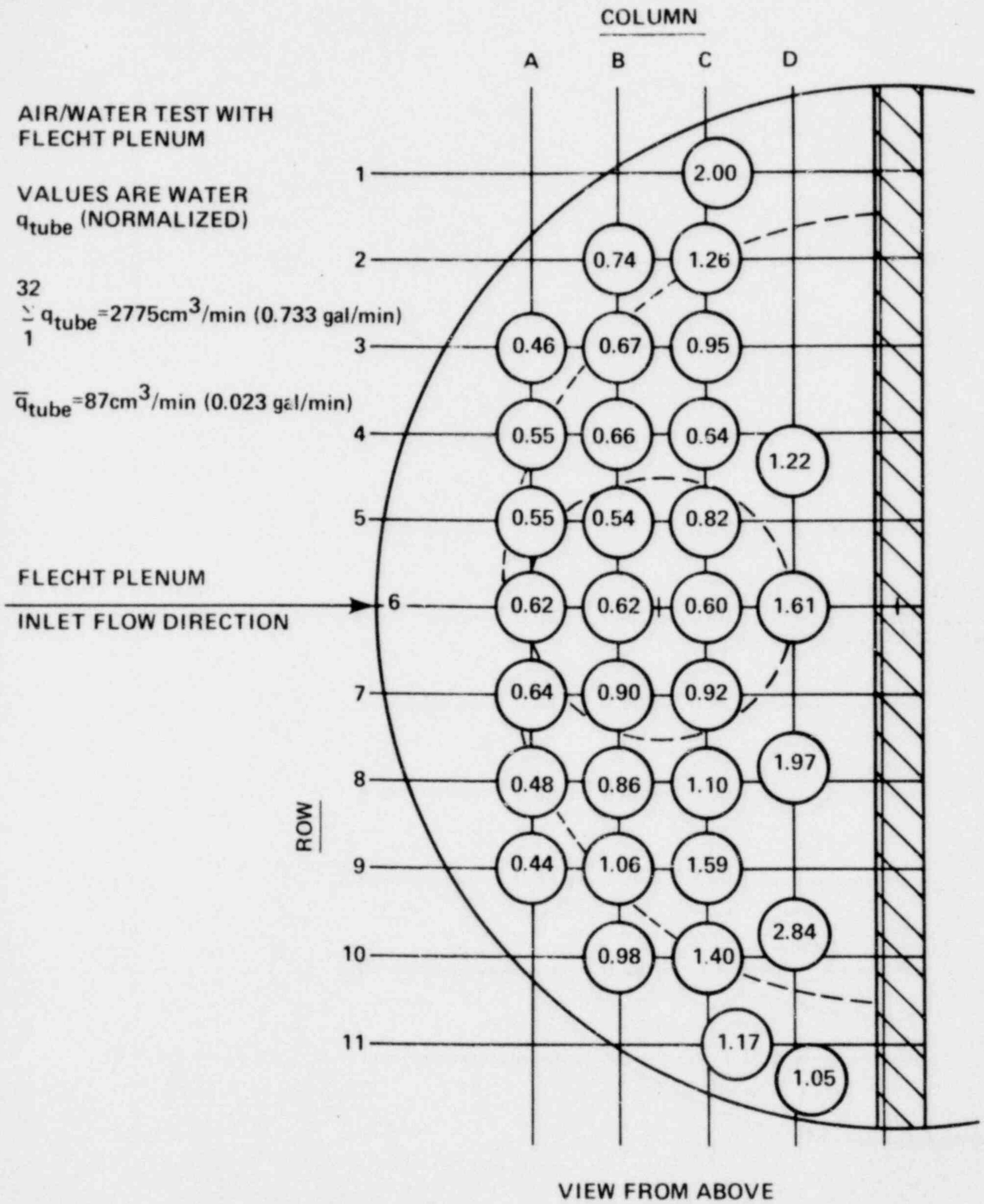


Figure B-19. Normalized Water Flow, Run 2211E

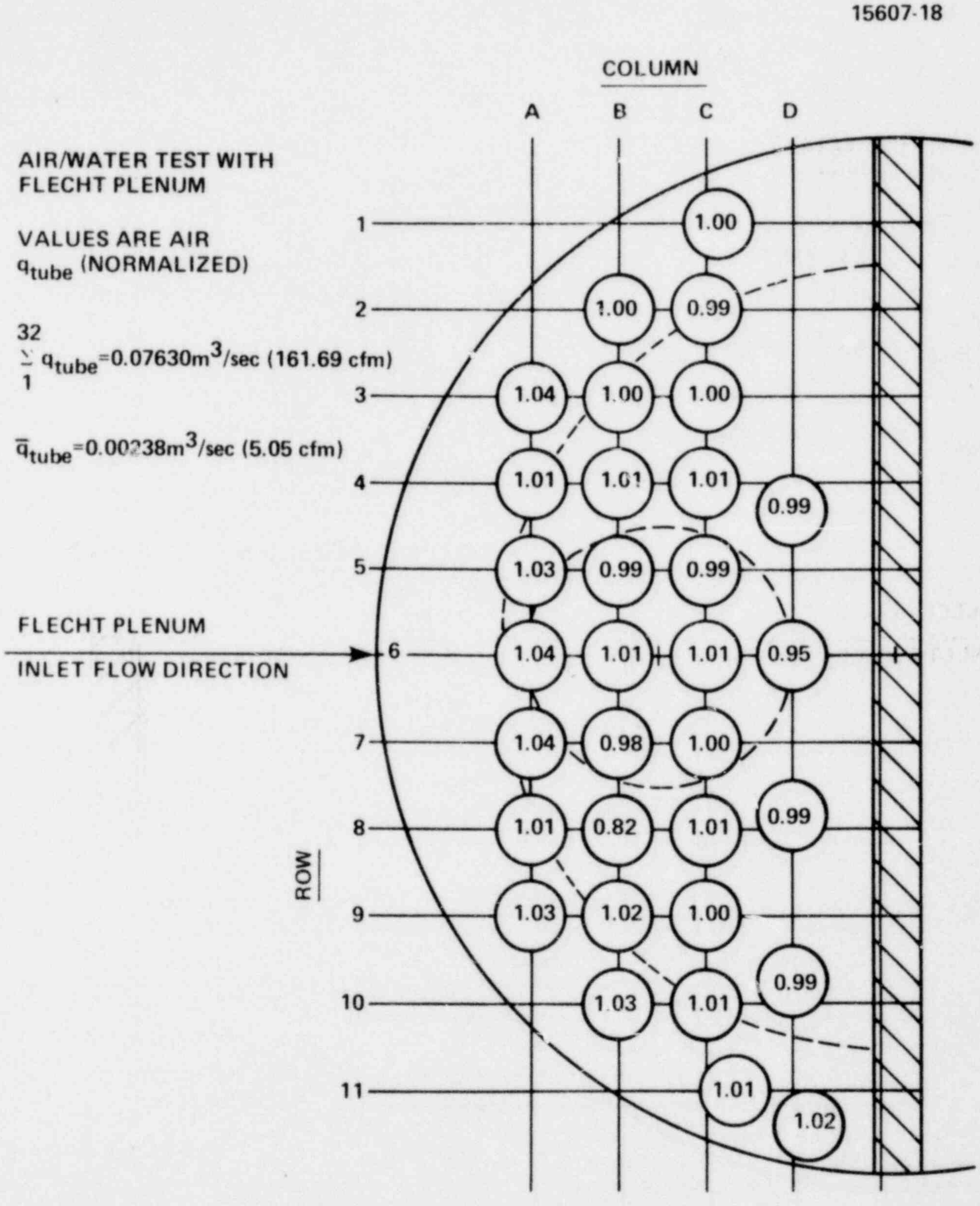


Figure B-20. Normalized Air Flow, Run [illegible]312F

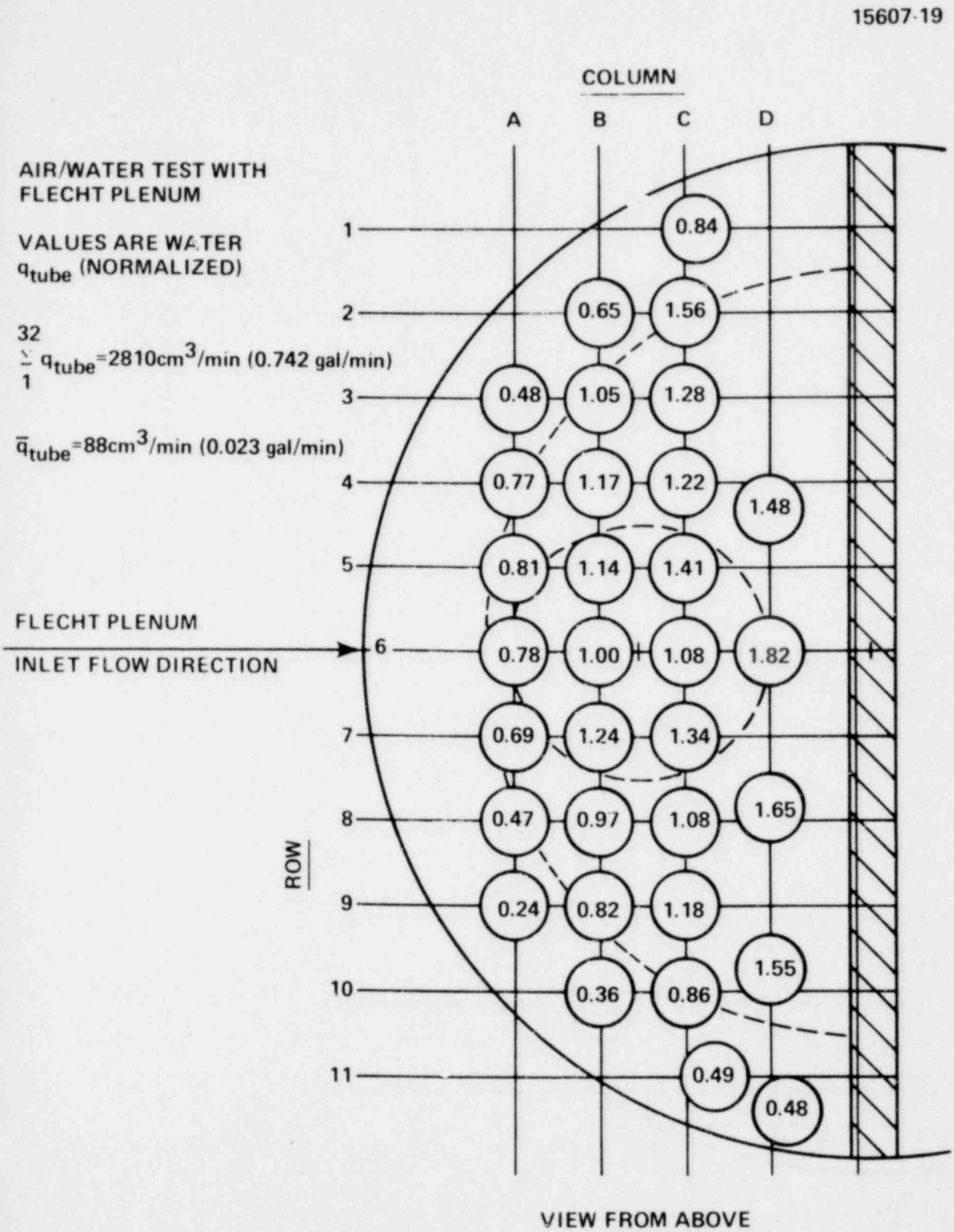


Figure B-21. Normalized Water Flow, Run 2312F

15607-20

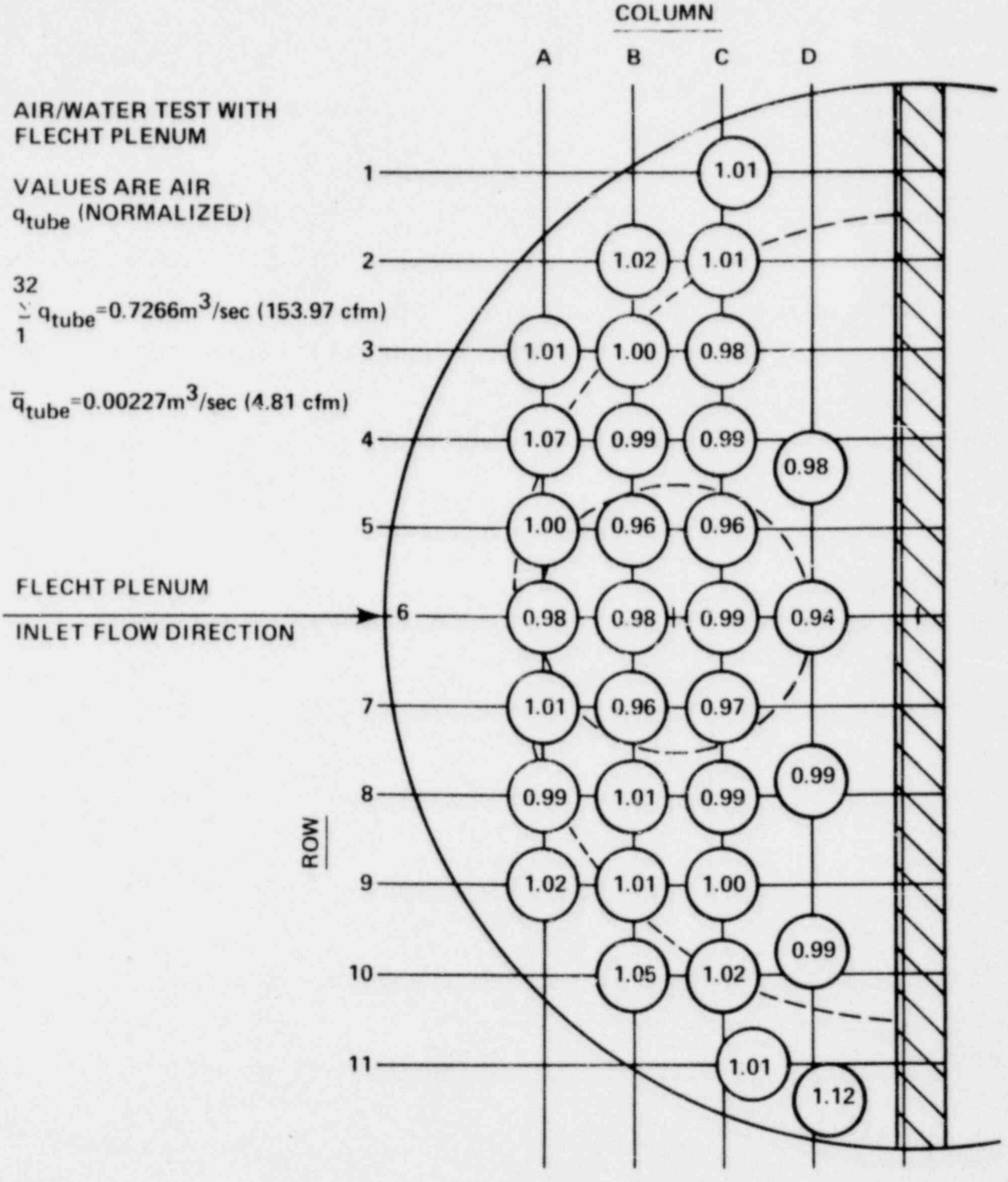


Figure B-22. Normalized Air Flow, Run 2413G

15607-21

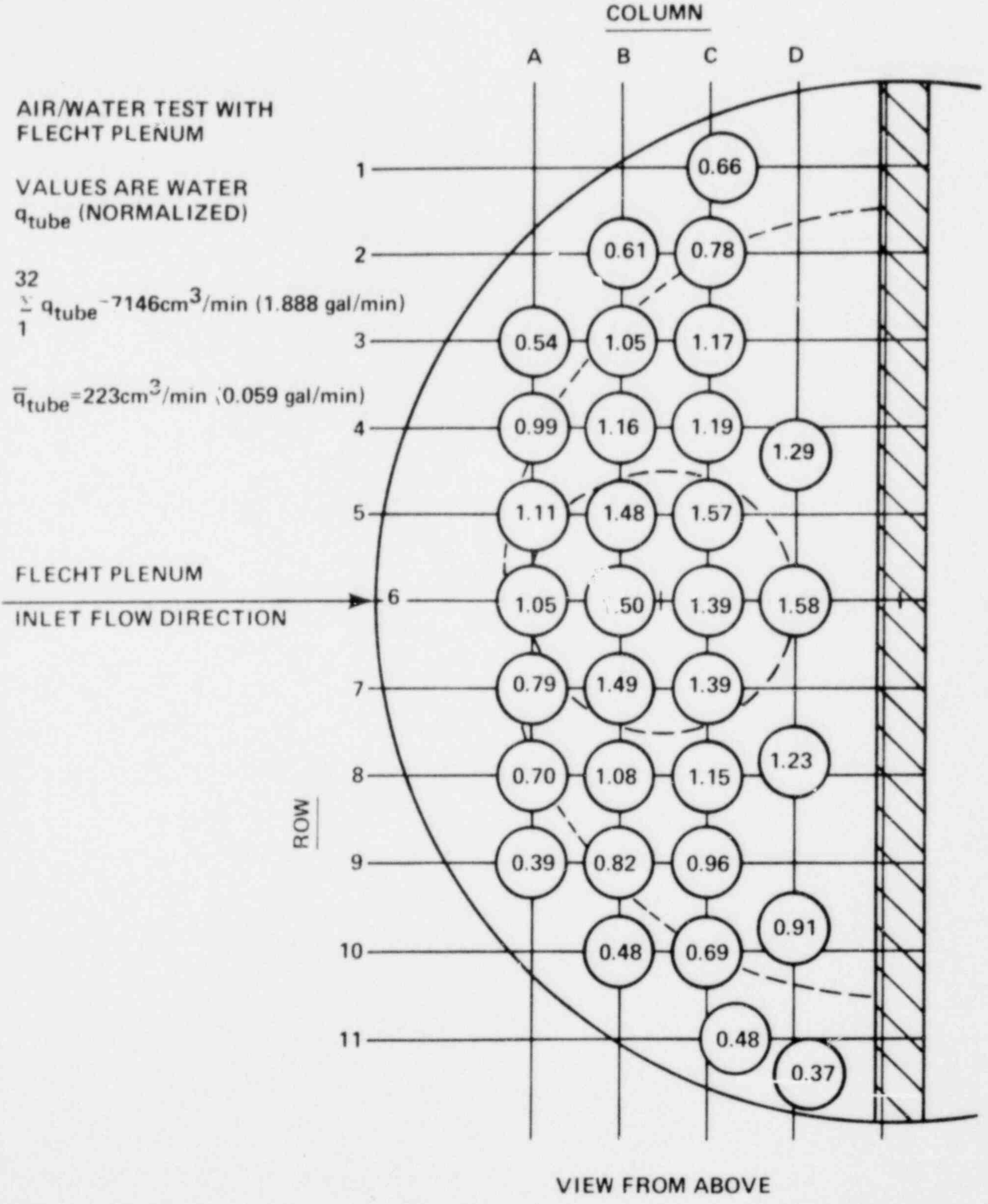


Figure B-23. Normalized Water Flow, Run 2413G

15607-22

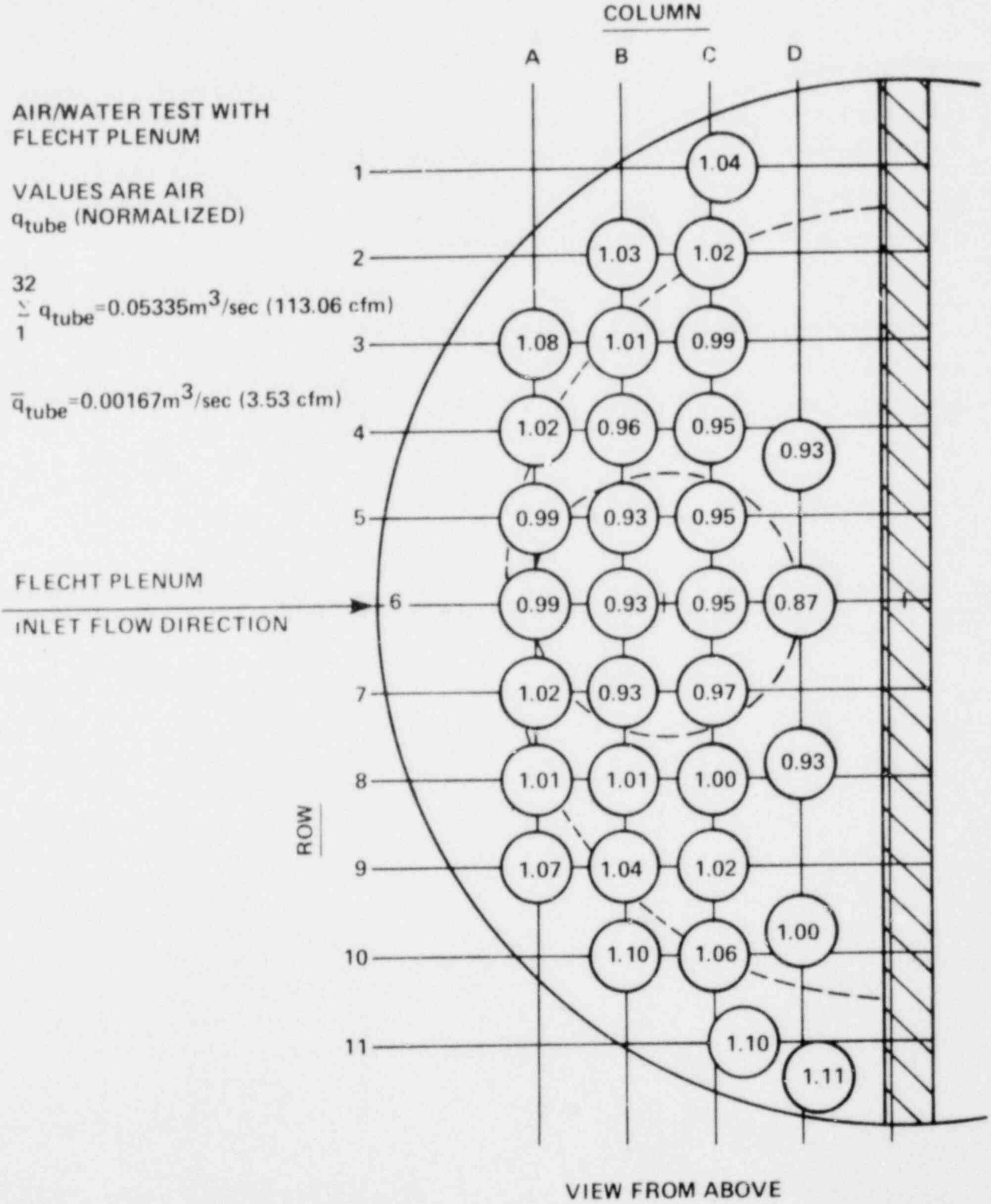


Figure B-24. Normalized Air Flow, Run 2514H

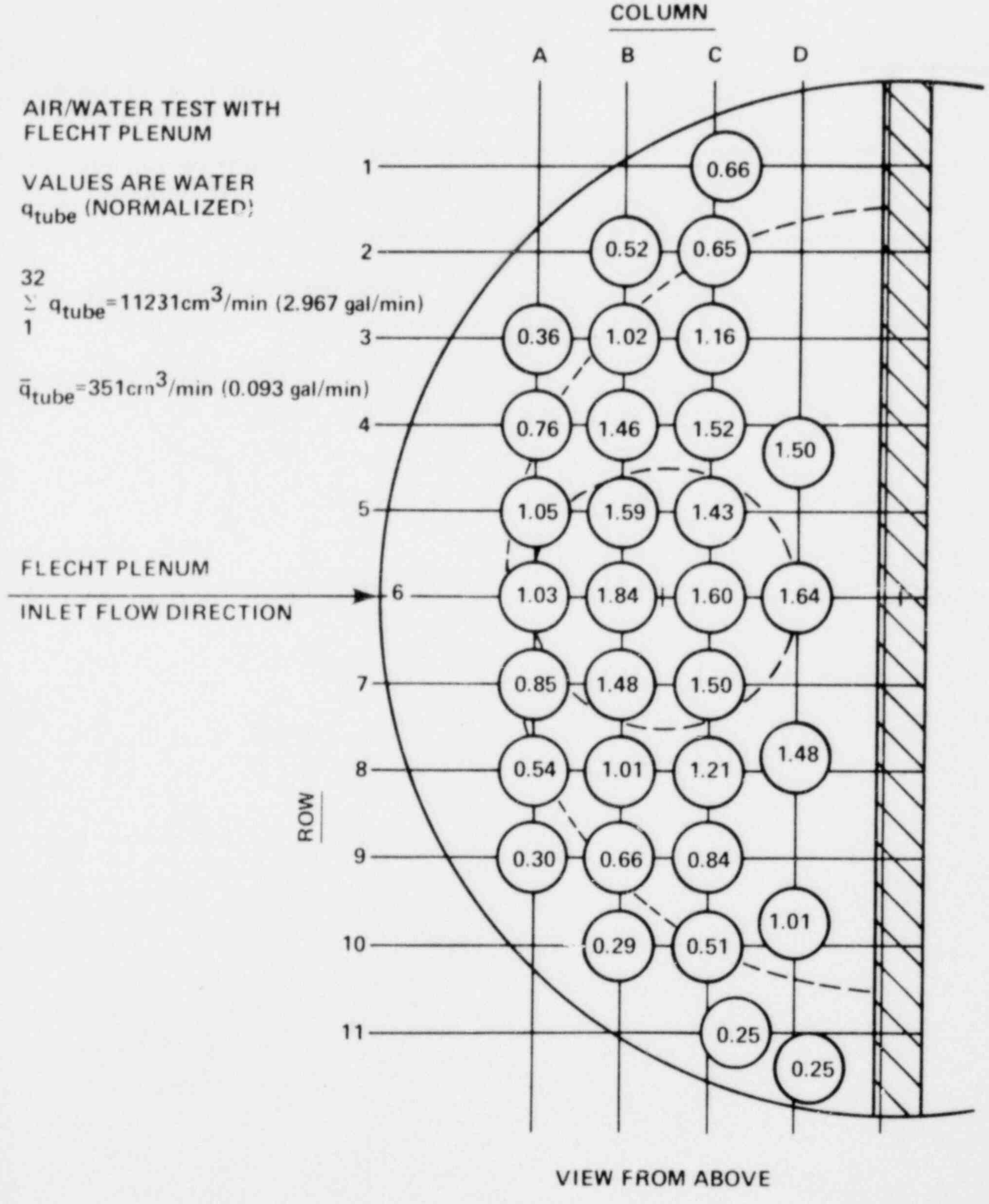


Figure B-25. Normalized Water Flow, Run 2514H

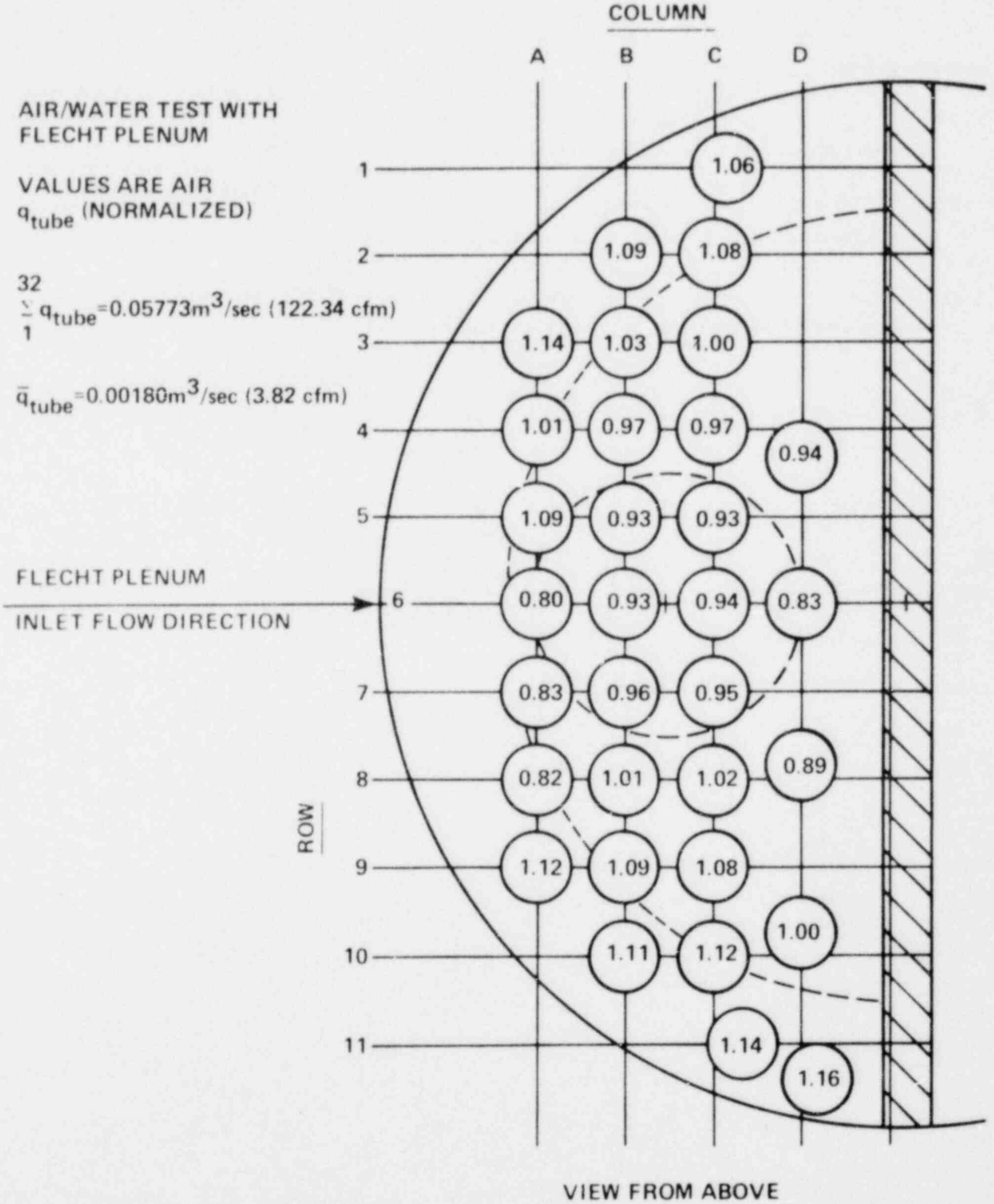


Figure B-26. Normalized Air Flow, Run 2615I

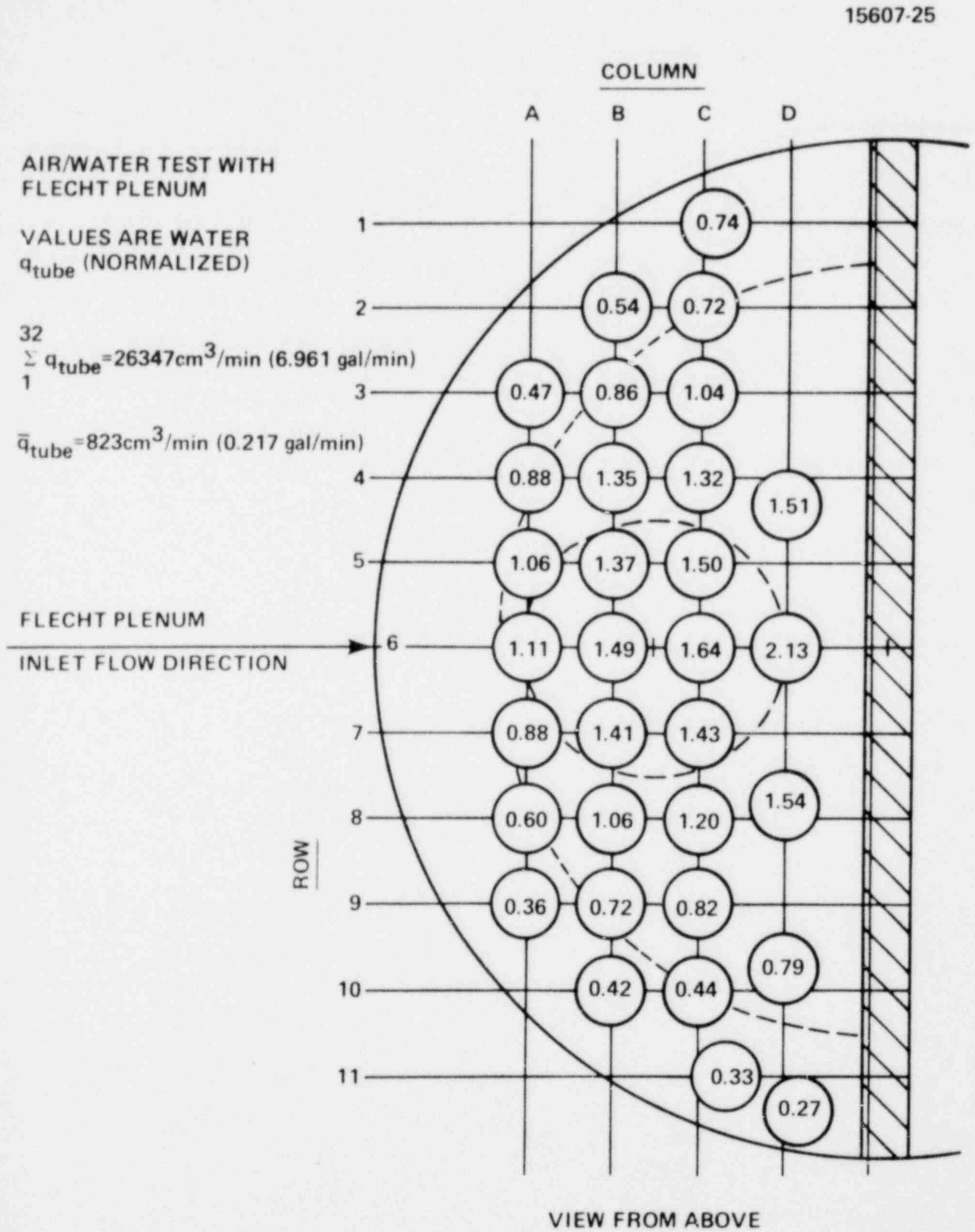


Figure B-27. Normalized Water Flow, Run 2615I

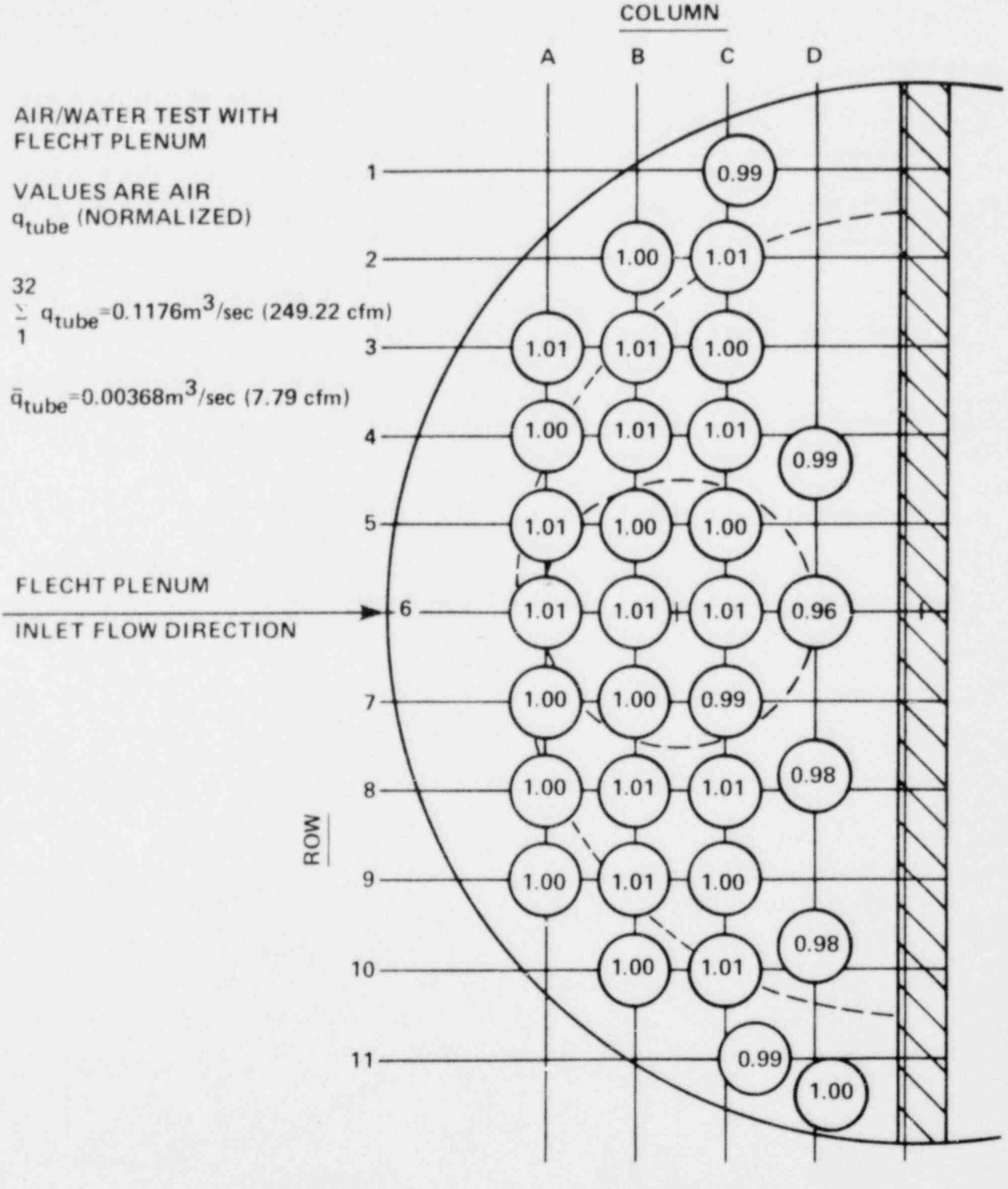


Figure B-28. Normalized Air Flow, Run 2716C

15607-27

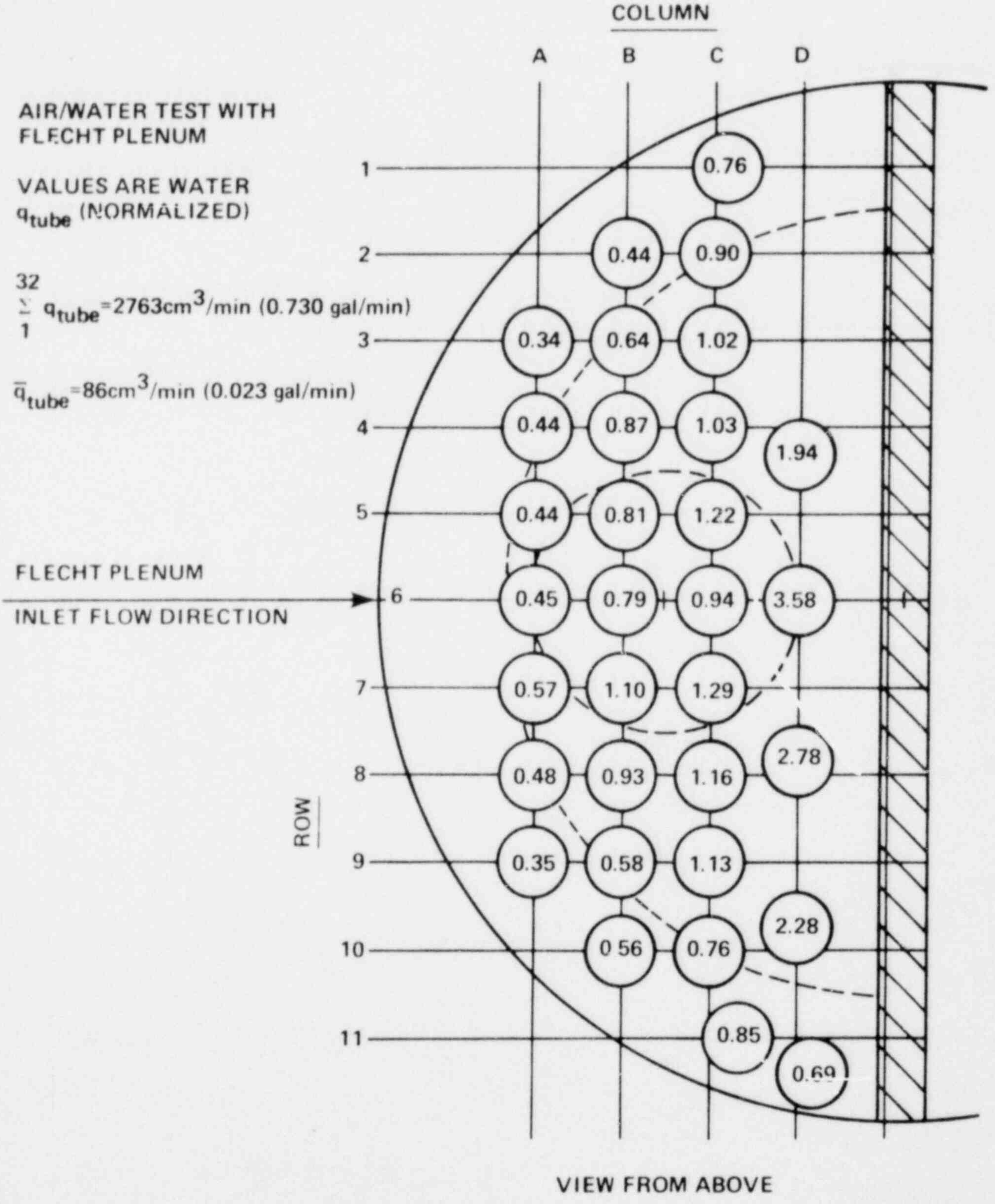


Figure B-29. Normalized Water Flow, Run 2716C

15607-28

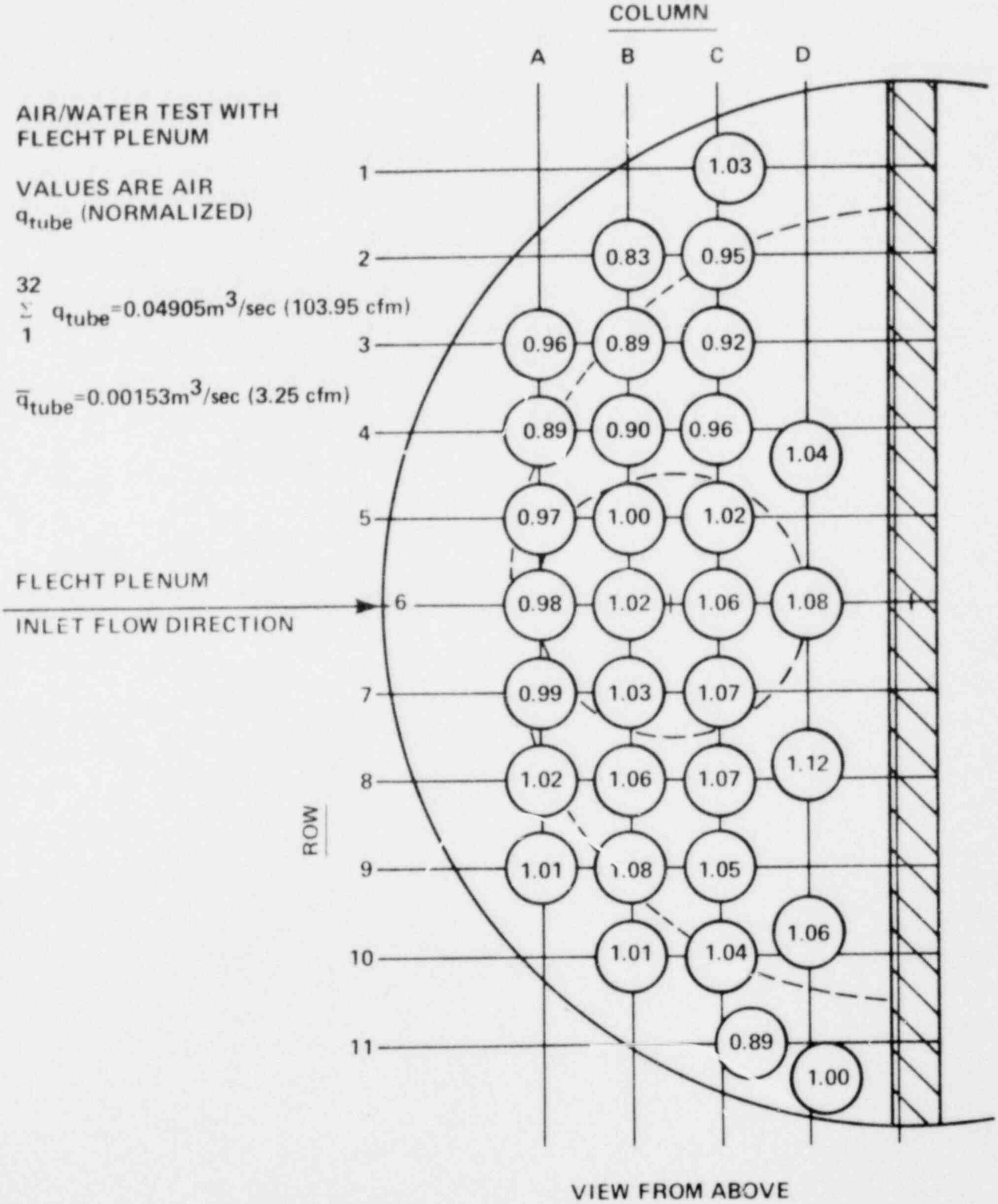


Figure B-30. Normalized Air Flow, Run 3219H

15607-29

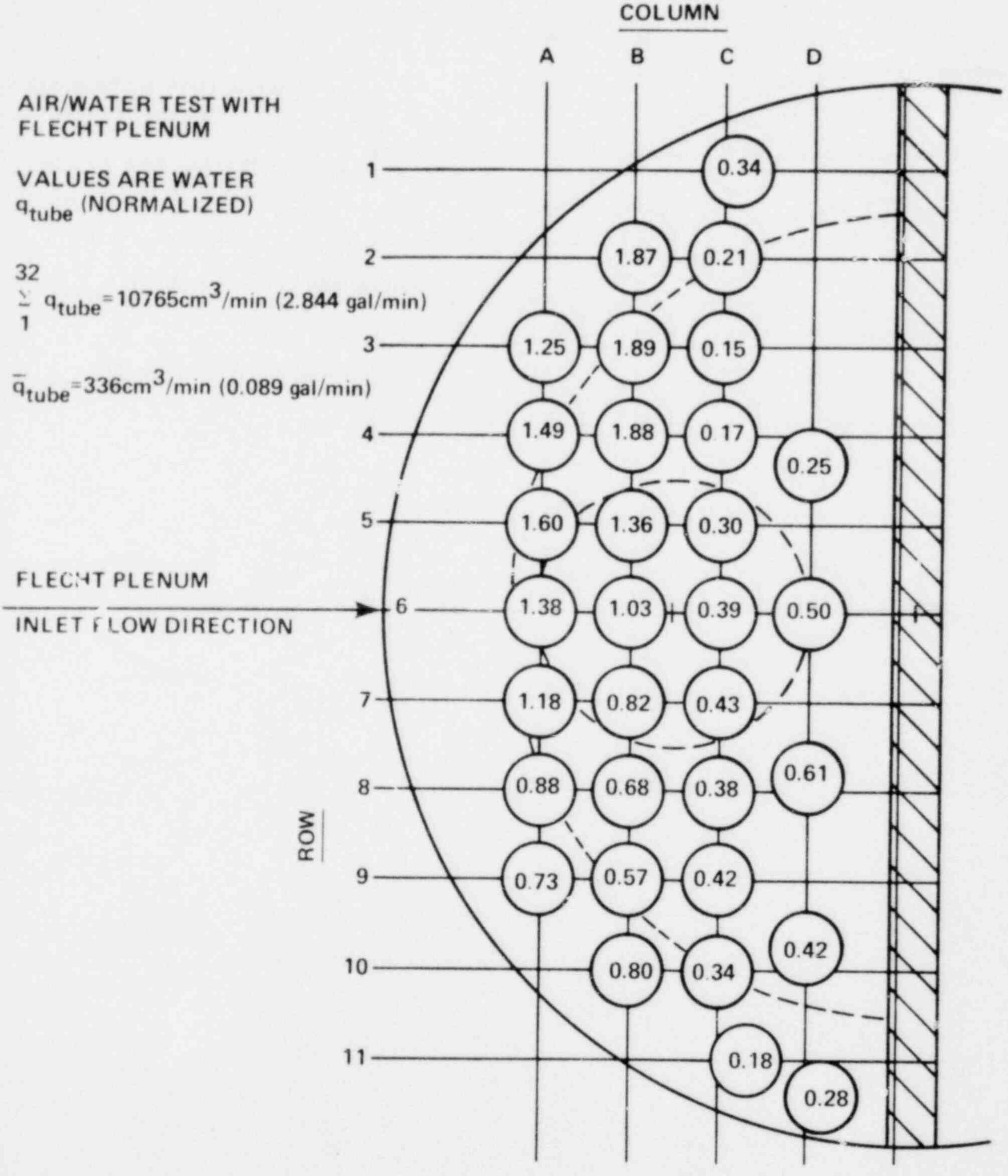


Figure B-31. Normalized Water Flow, Run 3219H

15607-30

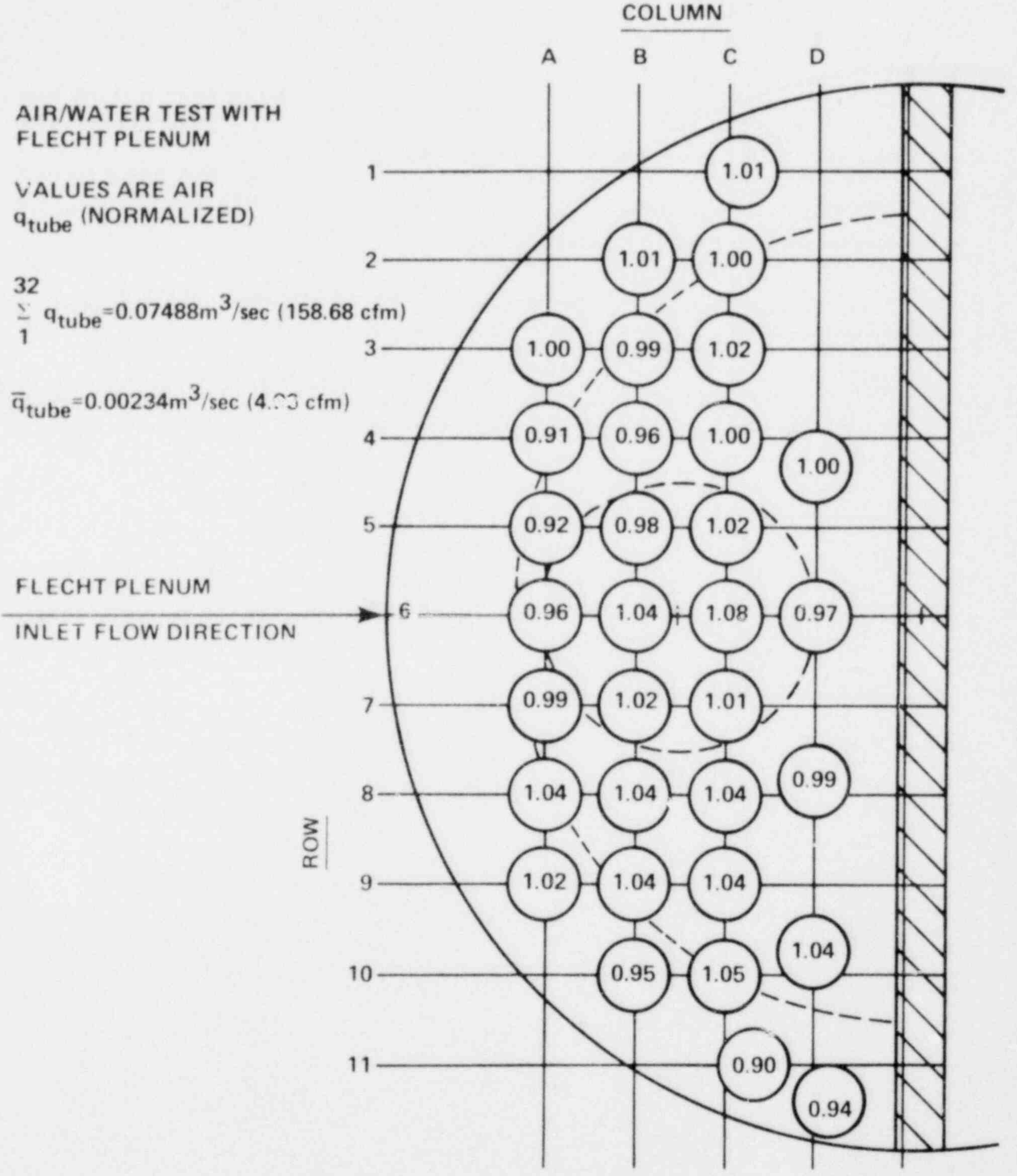


Figure B-32. Normalized Air Flow, Run 3418G

15607-31

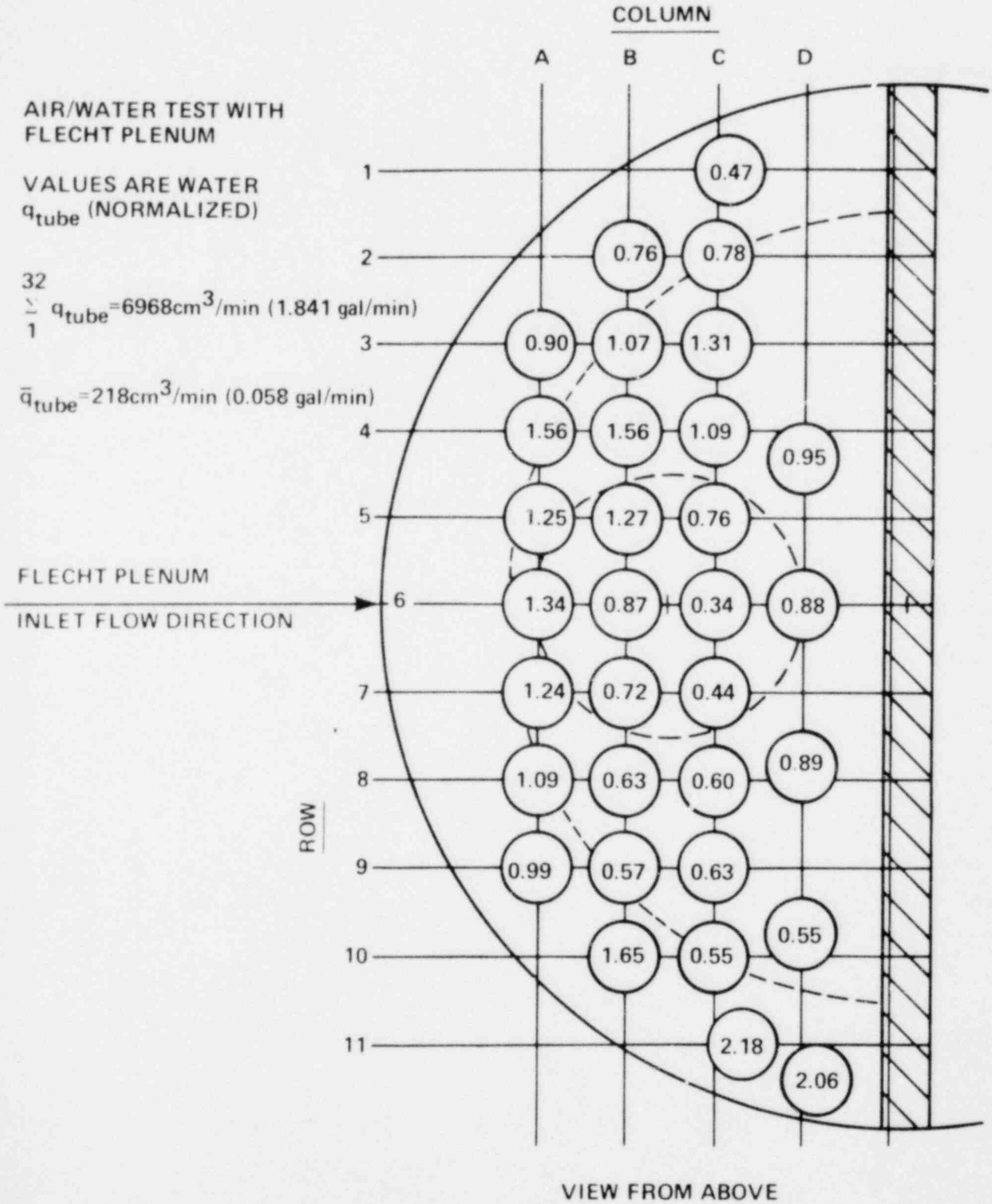


Figure B-33. Normalized Water Flow, Run 3418G

15607-32

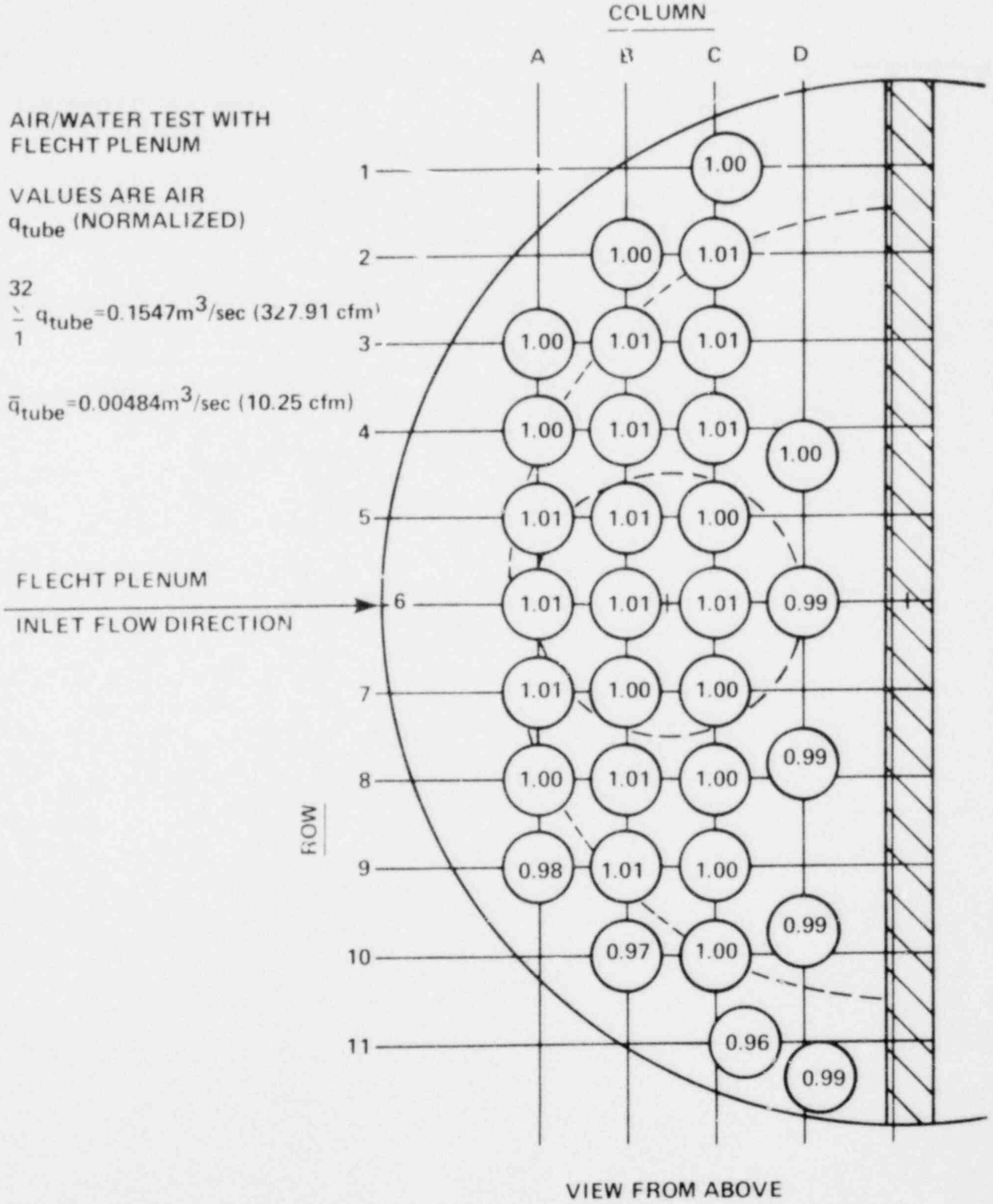


Figure B-34. Normalized Air Flow, Run 3517D

15607-33

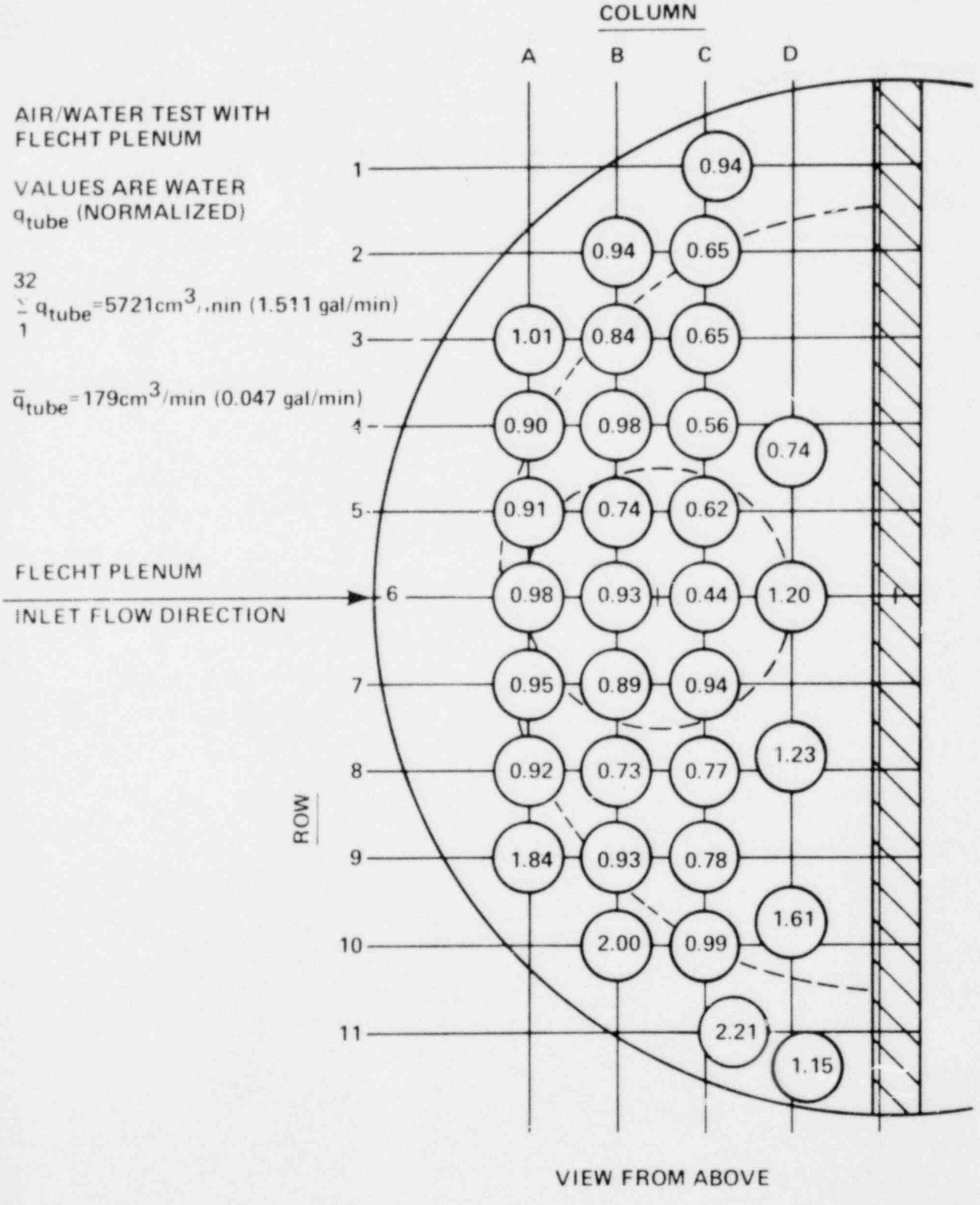


Figure B-35. Normalized Water Flow, Run 3517D

TABLE B-4

WEIGHTING FACTORS USED IN DATA REDUCTION PROGRAM SGFLUX

Matrix Test Run No.[(a)]	Air/Water Test Run No.[(b)]	Weighting Factor at Indicated Instrument Tube Location[(c)]			
		9-H	7-F	7-D	3-B
1,7,8,10,11	09C	8	8	12	4
2	10D	10	9	7	6
3	11E	9	10	7	6
4	12F	2	8	7	15
5	13G	1	2	6	23
6	14H	3	6	4	19
9	15I	1	7	5	19
12	16C	3	4	14	11
13	17D	6	5	7	14
14	18G	13	9	5	5
15	19H	10	5	7	10

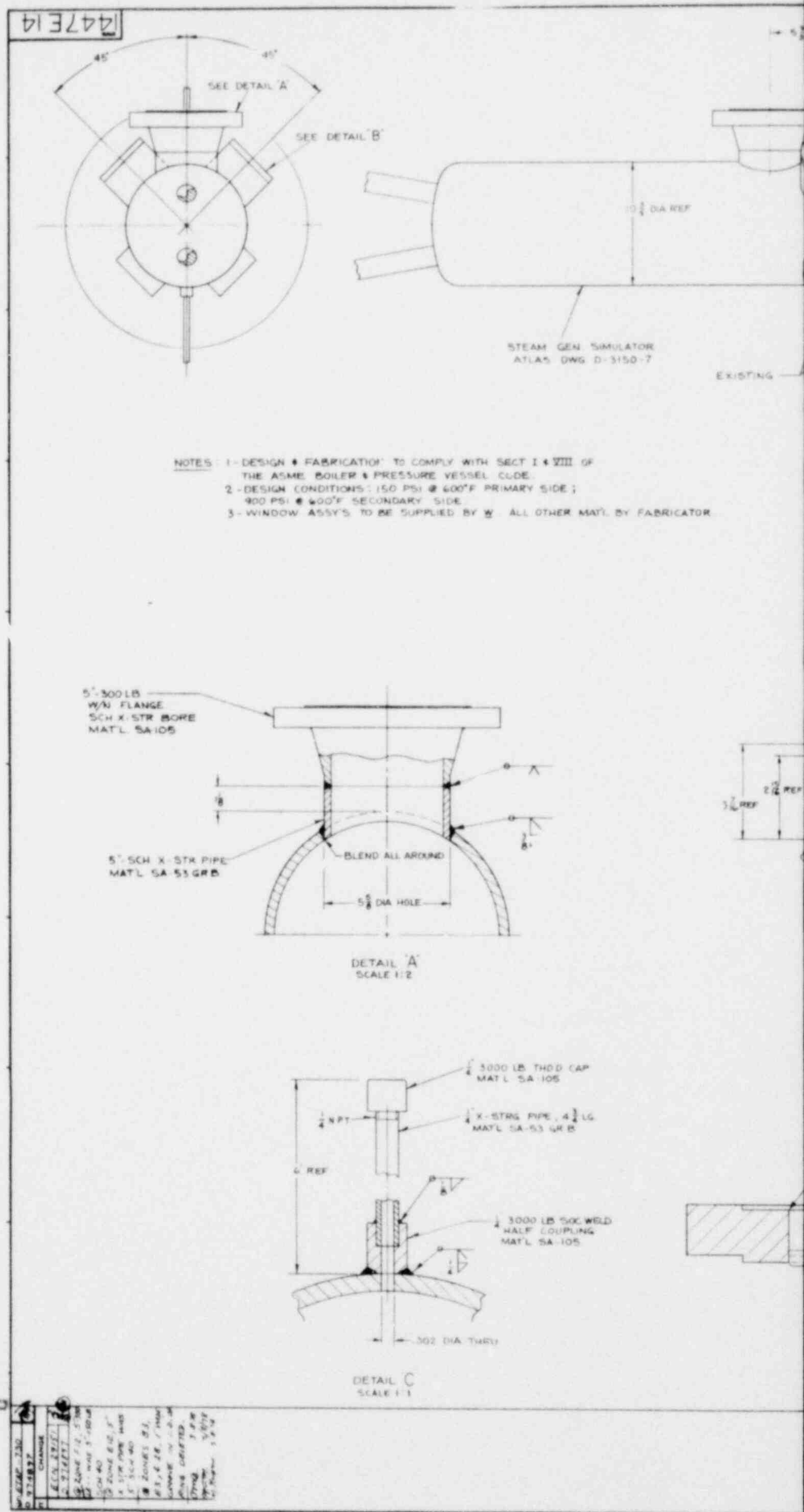
a. See table 4-1.
b. See table B-3.
c. Tube locations shown on Westinghouse drawing 1447E21 (appendix C)

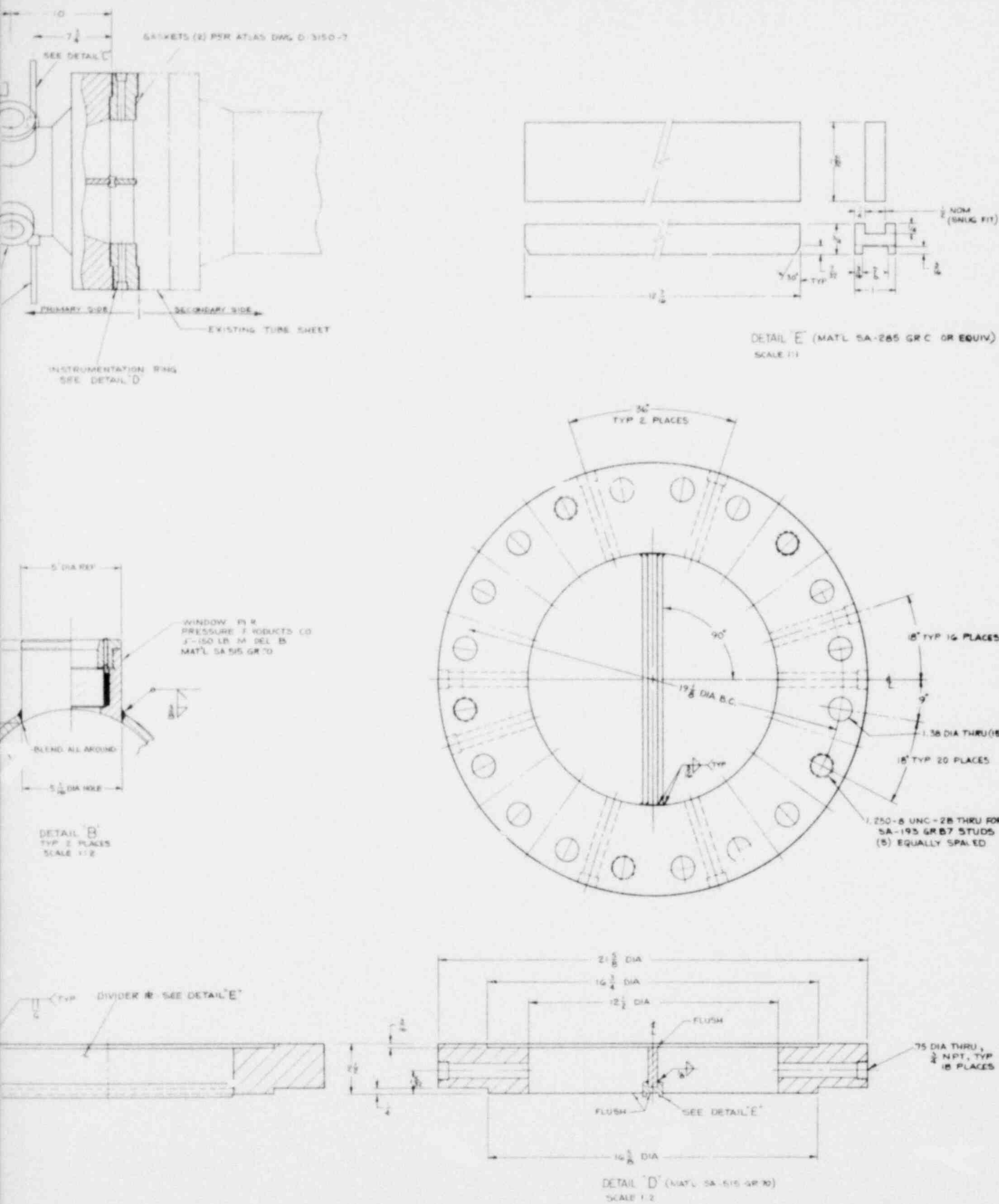
APPENDIX C

TEST FACILITY DRAWINGS

This appendix contains the following drawings of the test facility, as built:

-	1447E14, sub 2	FLECHT 14-Inch Steam Generator Lower Plenum Modifications
-	1453E15, sub 2 (3 sheets)	FLECHT SEASET Steam Generator Task Piping Layout
-	1463F31	FLECHT SEASET Steam Generator Test Water Supply Vessel
-	1447E32, sub 3 (3 sheets)	FLECHT SEASET Steam Generator Task Steam Piping Details
-	1453E14, sub 2	FLECHT SEASET Steam Generator Task Boiler Room Piping Layout
-	1447E21 (2 sheets)	FLECHT SEASET Steam Generator Internal Instrumentation Fluid and Wall T/C Locations


1247E14
45°
45°
SEE DETAIL 'A'
SEE DETAIL 'B'
10¾ DIA REF
STEAM GEN SIMULATOR
ATLAS DWG D-3150-7
EXISTING
NOTES: 1 - DESIGN & FABRICATION TO COMPLY WITH SECT I & VIII OF THE ASME BOILER & PRESSURE VESSEL CODE.
2 - DESIGN CONDITIONS: 150 PSI @ 600°F PRIMARY SIDE; 900 PSI @ 600°F SECONDARY SIDE.
3 - WINDOW ASSY'S TO BE SUPPLIED BY W. ALL OTHER MAT'L BY FABRICATOR.
5"-300 LB
W/N FLANGE
SCH X-STR BORE
MAT'L SA-105
5"-SCH X-STR PIPE
MAT'L SA-53 GR B
BLEND ALL AROUND
5⅝ DIA HOLE
DETAIL 'A'
SCALE 1:2
¼ 3000 LB THD'D CAP
MAT'L SA-105
¼ NPT
¼ X-STRG PIPE, 4¾ LG
MAT'L SA-53 GR B
4 REF
¼ 3000 LB SOC WELD
HALF COUPLING
MAT'L SA-105
.302 DIA THRU
DETAIL C
SCALE 1:1



UNLESS OTHERWISE SPECIFIED THE FOLLOWING TOLERANCES APPLY

SEE PROCESS SPECIFICATION NO. CAPS09128 FOR SUPPLEMENTARY MANUFACTURING INFORMATION

Westinghouse Electric Corporation

NUCLEAR ENERGY SYSTEMS PITTSBURGH PA U.S.A.

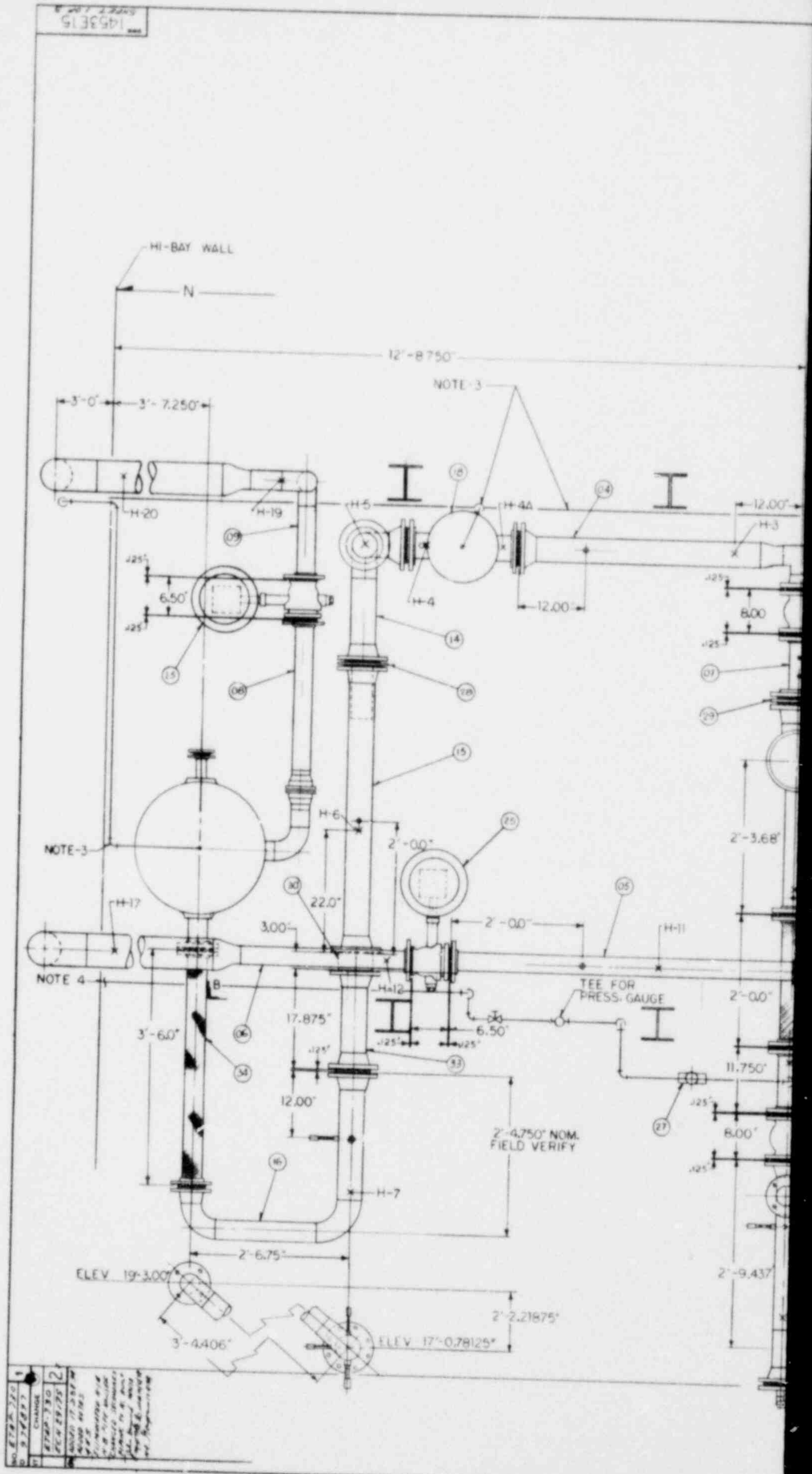
FLECHT

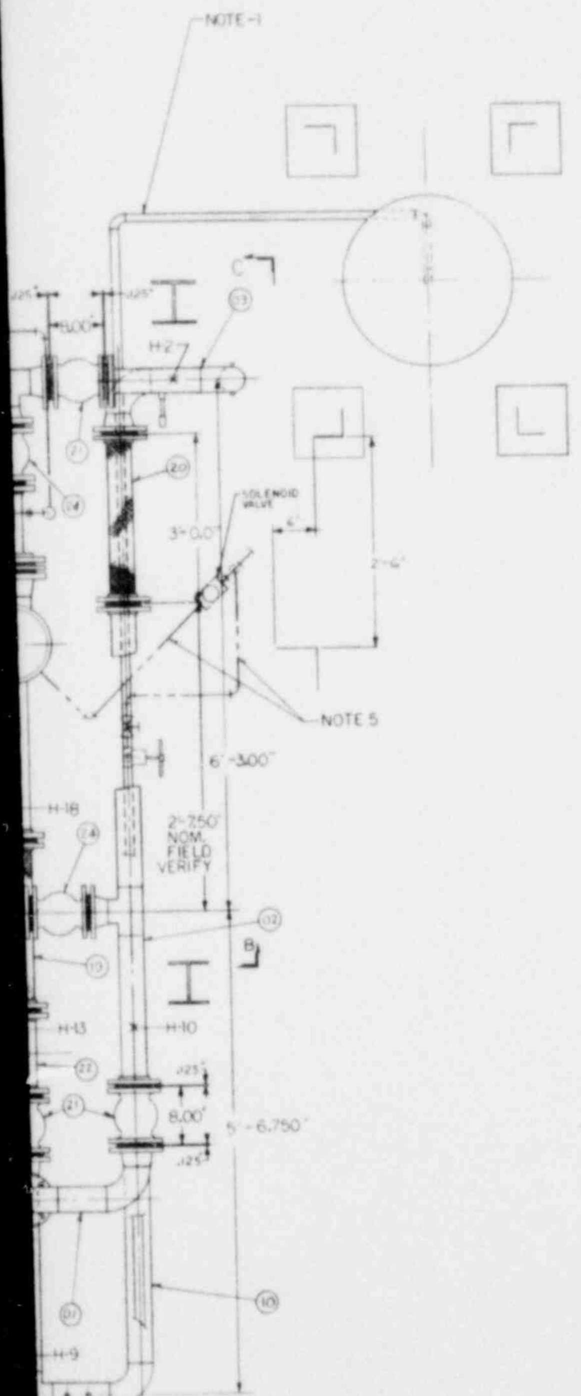
14" STEAM GENERATOR LOWER PLENUM MODIFICATIONS

SCALE 1:4

1442E14

POOR ORIGINAL


1453E15
HI-BAY WALL
N
12'-8.750"
NOTE-3
3'-0"
3'-7.250"
H-20
H-19
H-5
H-4A
H-4
H-3
12.00"
6.50"
8.00
NOTE-3
H-6
2'-0.0"
22.0"
3.00"
2'-0.0"
H-11
H-17
NOTE 4
H-12
TEE FOR PRESS. GAUGE
17.875"
3'-6.0"
6.50"
12.00"
2'-4.750" NOM. FIELD VERIFY
H-7
2'-6.75"
ELEV 19'-3.00"
3'-4.406"
2'-2.21875"
ELEV 17'-0.78125"
2'-3.68"
2'-0.0"
11.750"
8.00"
2'-9.437"



BILL OF MATERIAL

ITEM		PART NAME	PART NO.	MATERIAL	REQ. PER GROUP 01	02	03	04
01		PIPE SPOOL	1447E35G01		1			
02		PIPE SPOOL	1447E35G02		1			
03		PIPE SPOOL	1447E35G03		1			
04		PIPE SPOOL	1447E35G04		1			
05		PIPE SPOOL	1447E35G05		1			
06		PIPE SPOOL	1447E35G06		1			
07		PIPE SPOOL	1447E35G07		1			
08		PIPE SPOOL	1447E35G08		1			
09		PIPE SPOOL	1447E35G09		1			
10		PIPE SPOOL	1447E35G10		1			
11		PIPE SPOOL	1447E35G11		1			
12		PIPE SPOOL	1447E35G12		1			
13		PIPE SPOOL	1447E35G13		1			
14		PIPE SPOOL	1447E35G14		1			
15		PIPE SPOOL	1447E35G15		1			
16		PIPE SPOOL	1447E35G16		1			
17		PIPE SPOOL	1447E35G17		1			
18	Z	ENTRAINMENT SEPARATOR			1			
19	Y	3" 150# FLANGE FLEX HOSE			2			
20	Y	3" 150# FLANGE FLEX HOSE			1			
21	X	3" WIDER FLANGED BALL VALVE			3			
22		PIPE SPOOL	1447E35G022		1			
23		PIPE SPOOL	1447E35G023		1			
24	W	3" 150# FLANGED GATE VALVE			1			
25	V	3" V-100 BALL VALVE			2			
26	Y	1½" NPT FLEX HOSE			1			
27	U	1" SOLENOID VALVE (MODEL 1580)			1			
28	T	4" FLOW STRAIGHTENING VANE			1			
29		BAFFLE			1			
30	S	4" VORTEX FLOW METER			1			
31	S	3" VORTEX FLOW METER			1			
32	T	3" FLOW STRAIGHTENING VANE			1			
33		PIPE SPOOL	1447E35G024		1			
34	Y	3" 150# FLANGE FLEX HOSE			1			

NOTES:

Z - B.O. FR WRIGHT AUSTIN, DETROIT, MICHIGAN, 48207 4" ENTRAINMENT SEPARATOR TYPE T-S

Y - B.O. FR UNIVERSAL METAL HOSE CO., CHICAGO, ILLINOIS

X - B.O. FR WORCESTER CONTROLS, WEST BOYLSTON, MASSACHUSETTS

W - B.O. FR VOGT MACHINE CO., LOUISVILLE, KY, 40201

V - B.O. FR FISHER CONTROLS, MARSHALLTOWN, IOWA

U - B.O. FR ATKOMATIC VALVE CO., INDIANAPOLIS, INDIANA

T - B.O. FR DANIEL INDUSTRIES INC., HOUSTON TEXAS

S - B.O. FR NEPTUNE EASTECH, EDISON, N.J. 08817

NOTES:

1.) SEE DRAWING 1453E22 FOR WATER INJECTION SYSTEM PIPING DETAILS
2.) H-XX INDICATES HANGER LOCATION AND NUMBER, DETAILS TO BE SUPPLIED BY ENGINEERING
3.) FIELD ROUTED 1" RUPTURE DISC LINES
4.) SEE BOILER HOUSE PIPING LAYOUT DRAWING 1453E14 FOR CONTINUATION OF PIPING.
5.) PROPOSED FUTURE ALTERNATE INJECTION LINE PIPING.

Westinghouse Electric Corporation
NUCLEAR ENERGY SYSTEMS, PITTSBURGH, PA. U.S.A.

FLECHT SEASET STEAM GENERATOR TASK PIPING LAYOUT

SCALE 1½" = 1'-0"

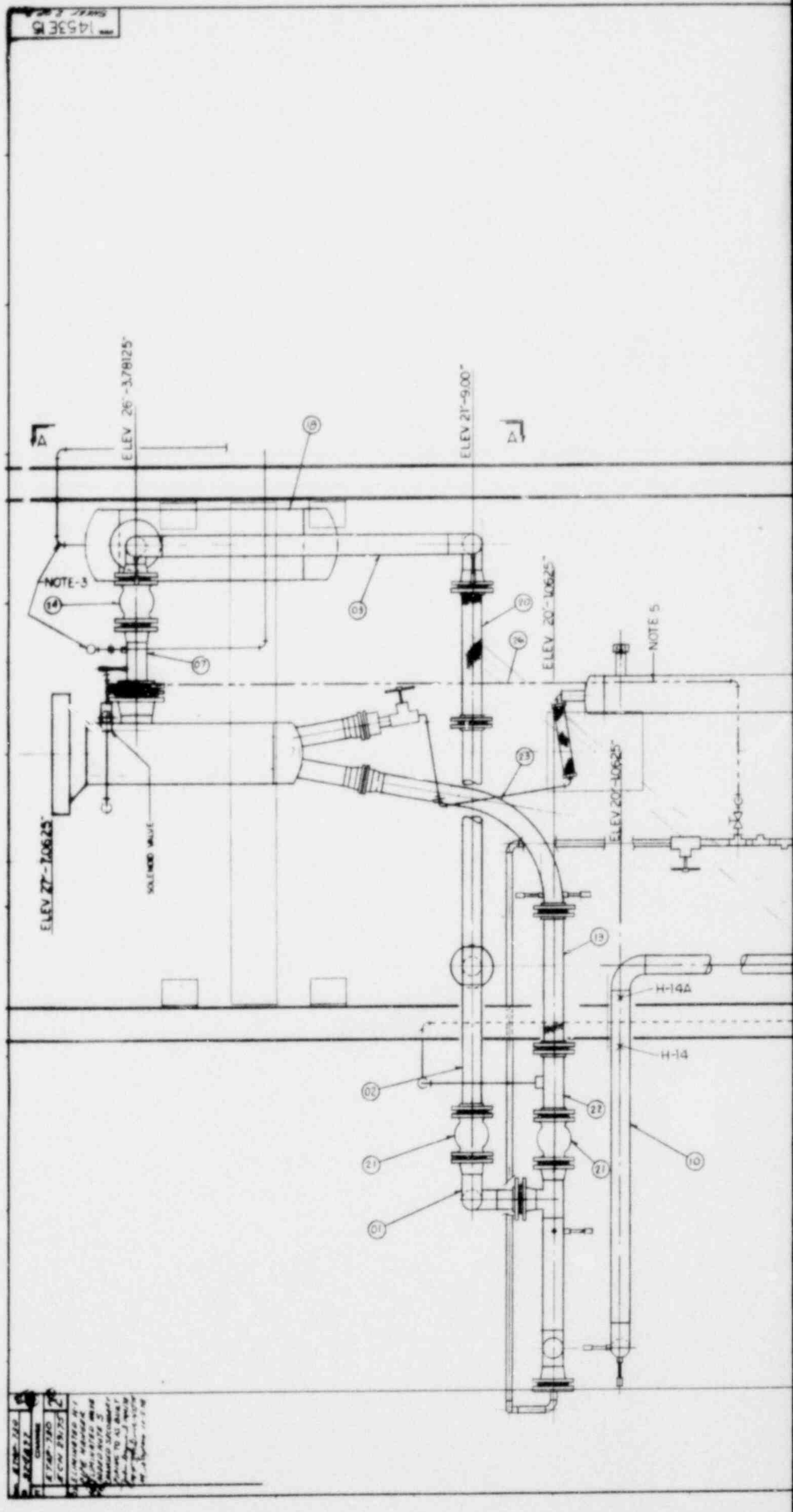
DIMENSIONS IN INCHES

DO NOT SCALE

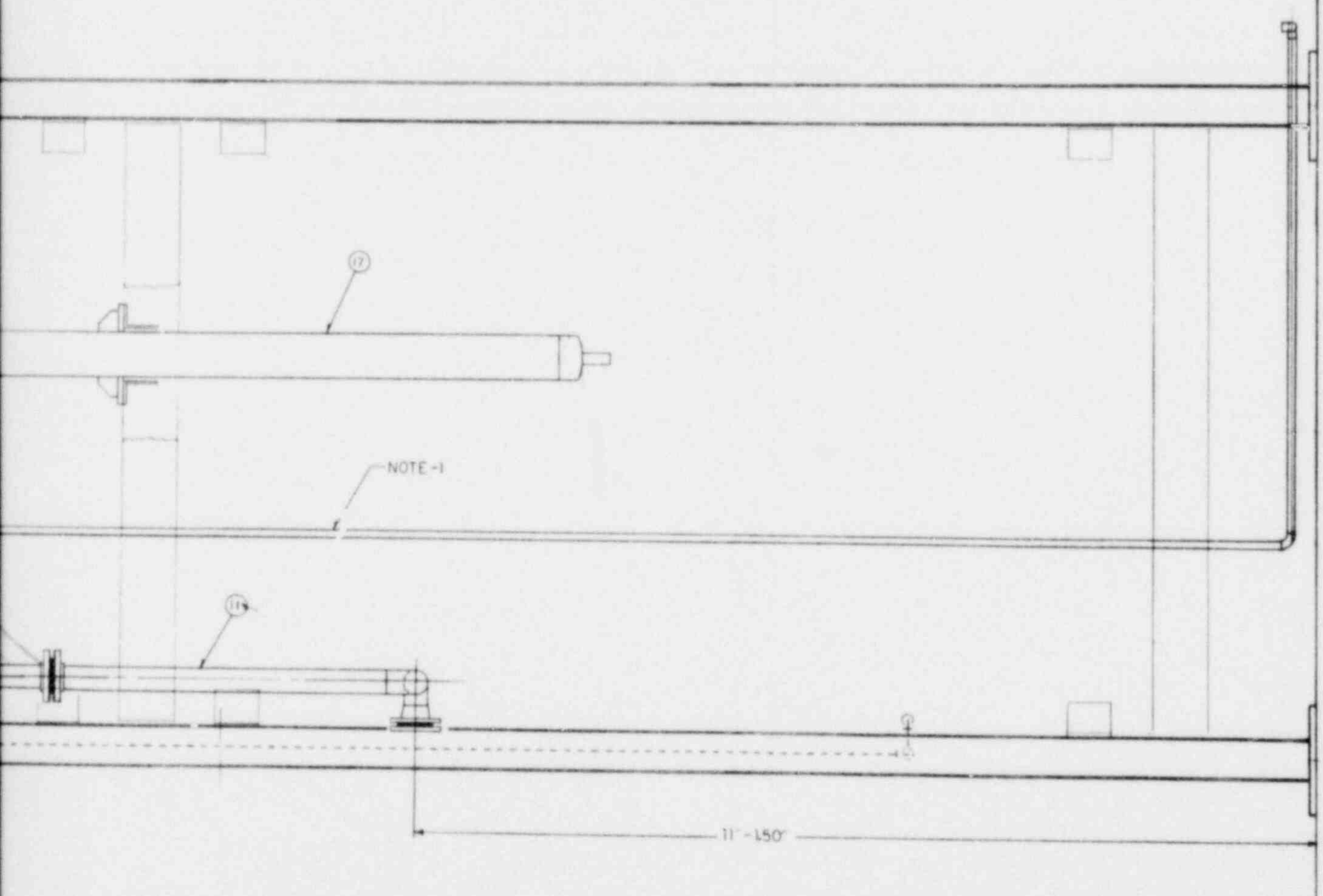
1453E15

SHEET 1 OF 3

POOR ORIGINAL



ELEV 26'-3.78125"
ELEV 21'-9.00"
ELEV 20'-10.625"
ELEV 20'-10.625"
ELEV 27'-7.0625"
NOTE-3
NOTE 5
SOLENOID VALVE
H-14A
H-14



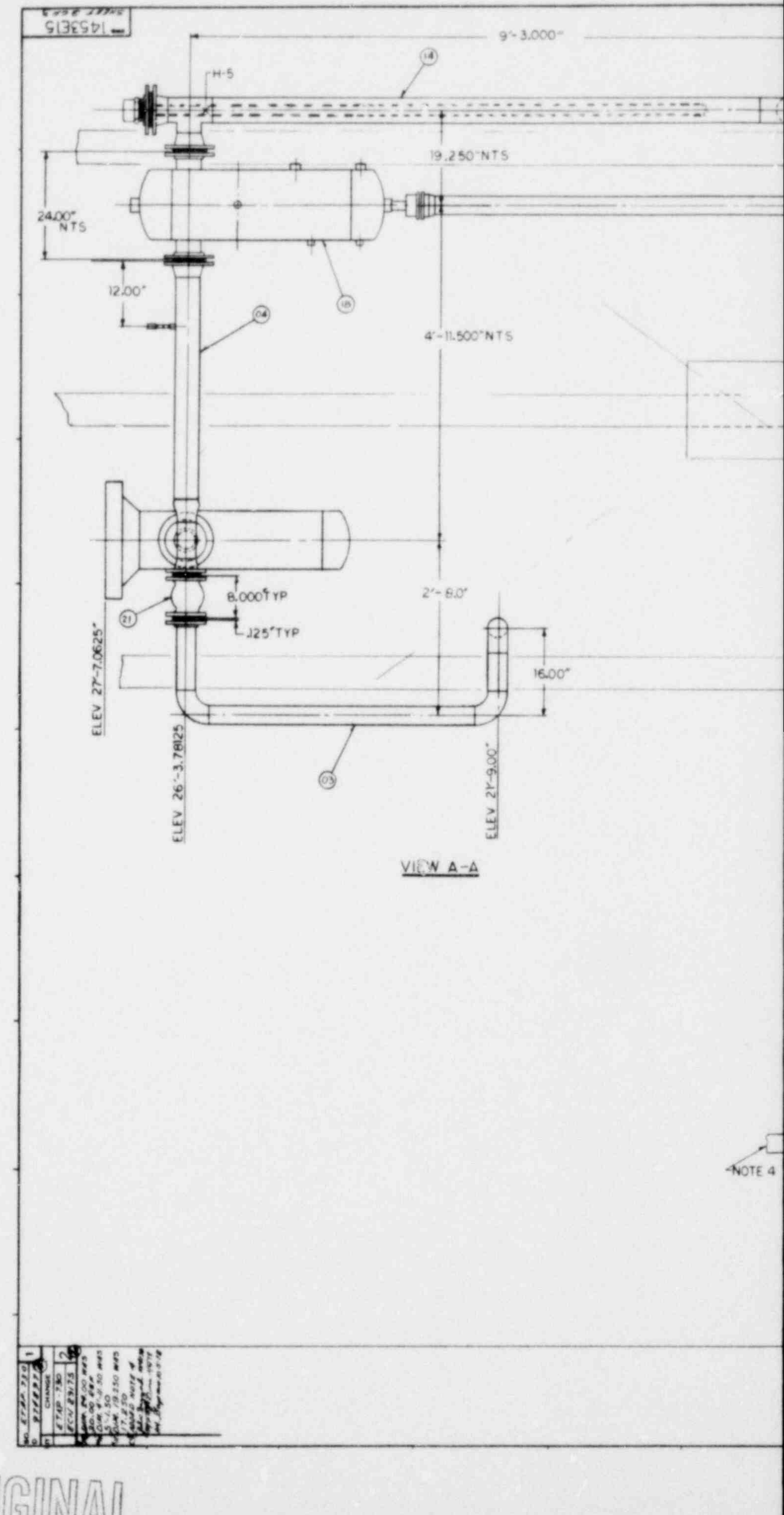
VIEW C-C

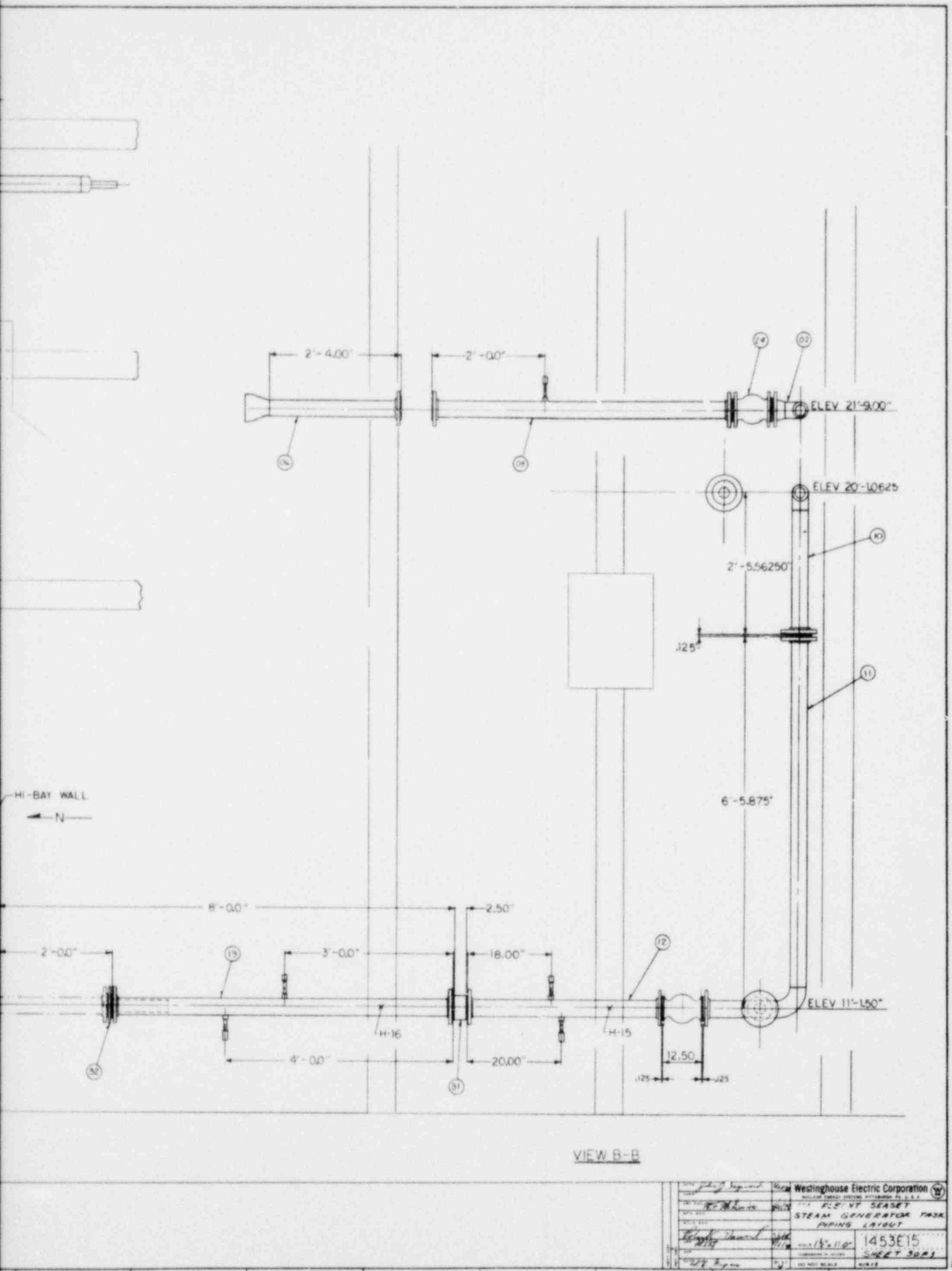
Westinghouse Electric Corporation
NUCLEAR ENERGY SYSTEMS PITTSBURGH, PA. U.S.A.

FLECHT SEASET
STEAM GENERATOR TASK
PIPING LAYOUT

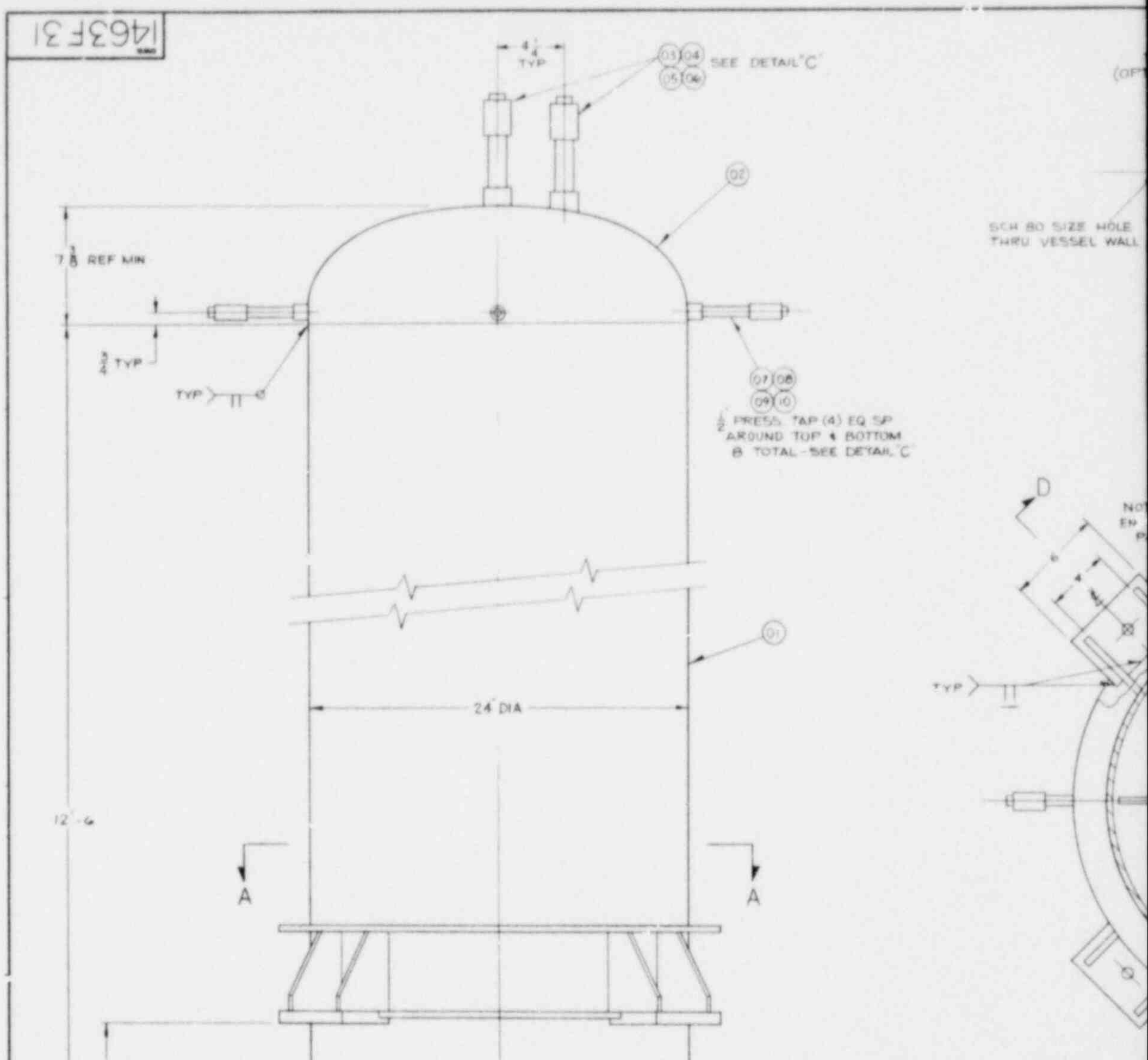
SCALE 1½" = 1'-0"
DIMENSIONS IN INCHES
DO NOT SCALE

1453E15
SHEET 2 OF 3

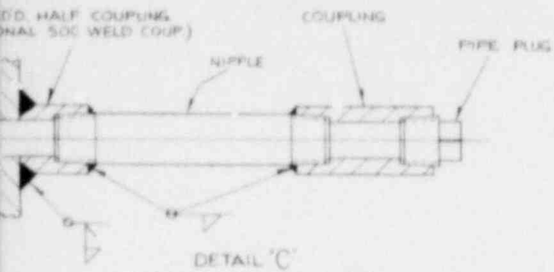

1453E15
9'-3.000"
H-5
19.250"NTS
24.00" NTS
12.00"
4'-11.500"NTS
8.000"TYP
.125"TYP
2'-8.0"
16.00"
ELEV 27'-7.0625"
ELEV 26'-3.78125
ELEV 21'-9.00"
VIEW A-A
NOTE 4



POOR ORIGINAL

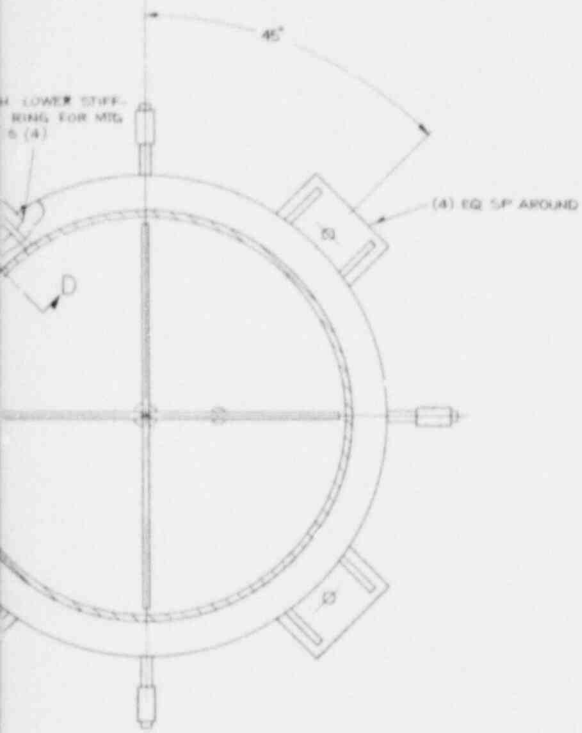


POOR ORIGINAL

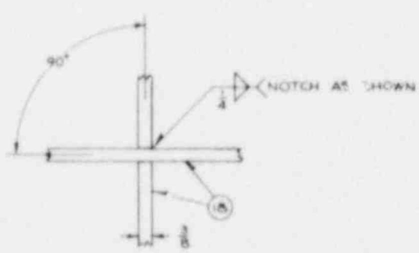


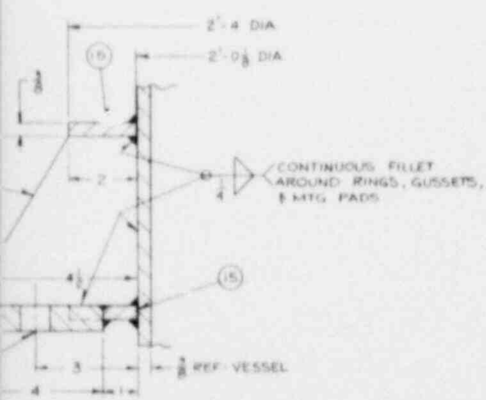
DETAIL 'C'
TYP PENETRATION ALL SIZES

BILL OF MATERIAL								
ITEM		PART NAME	PART NO.	MATERIAL	REQ. PER GROUP			
					01	02	03	04
01		VESSEL BODY 24" STD WT PIPE		SA-106 GR B	1			
02		ELLIPTICAL HEAD 24" ASME	3/8 THK	SA-285 GR C	2			
03		HALF COUP 1" NPT 3000 LB		SA-105	3			
04		NIPPLE 1" SCH 80 4" LG		SA-106 GR B	3			
05		COUPLING 1" NPT 3000 LB		SA-105	3			
06		PIPE PLUG 1" NPT SQ HD		SA-105	3			
07		HALF COUP 1/2 NPT 3000 LB		SA-105	8			
08		NIPPLE 1/2 SCH 80 4" LG		SA-106 GR B	8			
09		COUPLING 1/2 NPT 3000 LB		SA-105	8			
10		PIPE PLUG 1/2 NPT SQ HD		SA-105	8			
11		HALF COUP 1 1/2 NPT 3000 LB		SA-105	1			
12		NIPPLE 1 1/2 SCH 80 4" LG		SA-106 GR B	1			
13		COUPLING 1 1/2 NPT 3000 LB		SA-105	1			
14		PIPE PLUG 1 1/2 NPT SQ HD		SA-105	1			
15		STIFFENING RING		ASTM A 36	2			
16		GUSSET		↓	8			
17		MTG PAD		↓	4			
18		ANTI-SWIRL VANE		ASTM A 36	2			

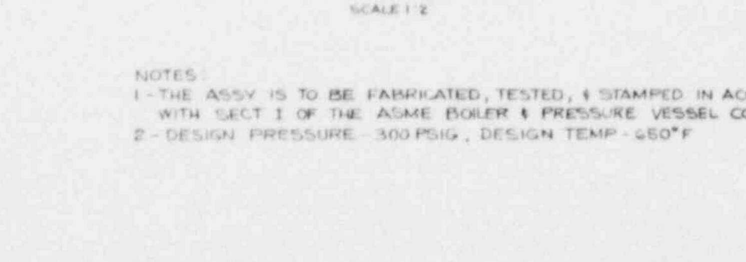


SECTION A-A





SECTION D-D
SCALE 1:2

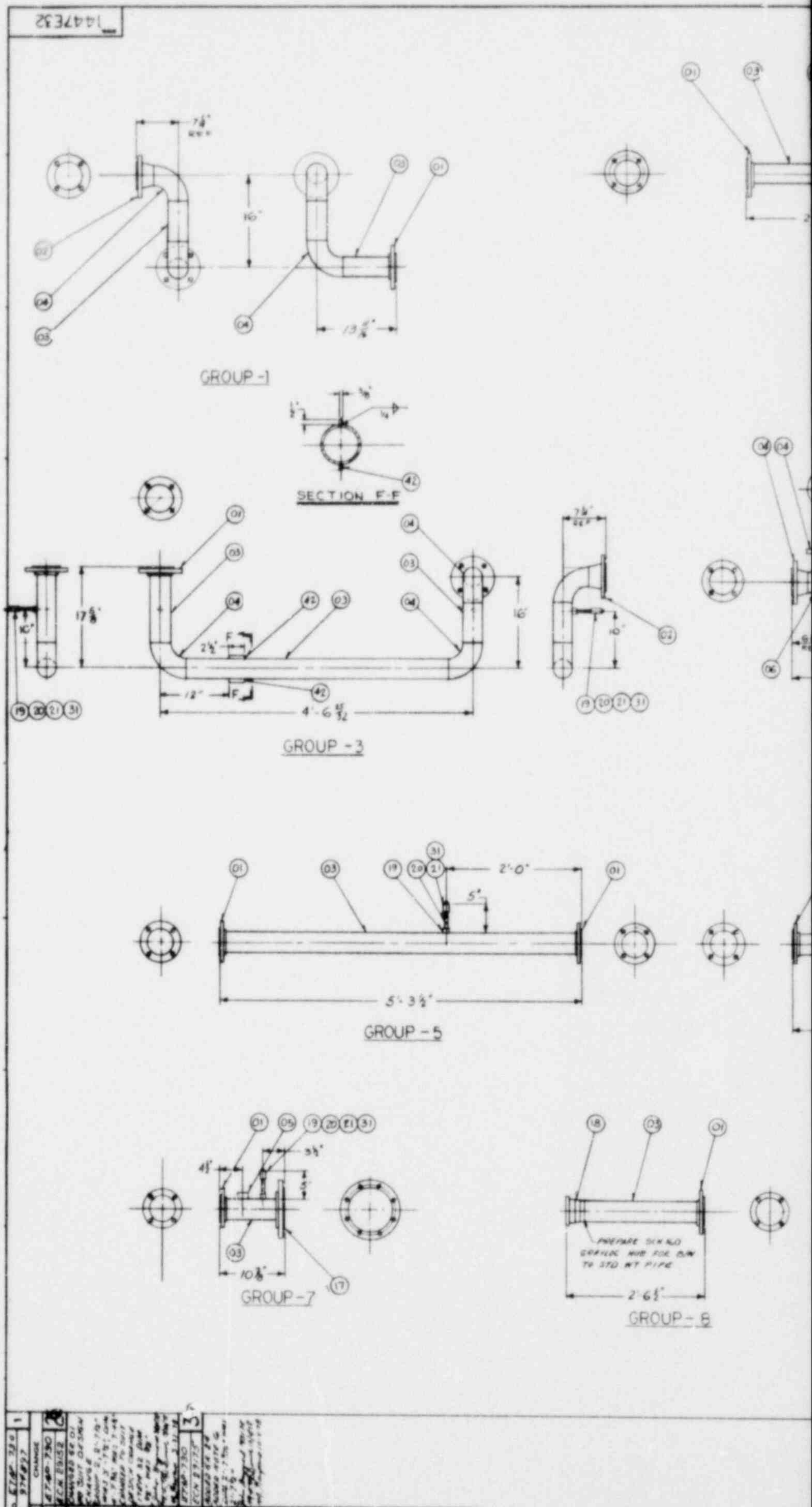


DETAIL B
SCALE 1:2

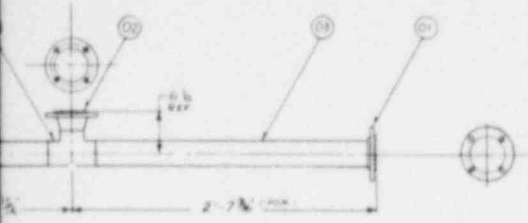
NOTES:
1 - THE ASSY IS TO BE FABRICATED, TESTED, & STAMPED IN ACCORDANCE WITH SECT I OF THE ASME BOILER & PRESSURE VESSEL CODE.
2 - DESIGN PRESSURE - 300 PSIG, DESIGN TEMP - 650°F

DR'N. Pmgh		Westinghouse Electric Corporation — NUCLEAR ENERGY SYSTEMS, PITTSBURGH, PA., U.S.A.	
CHKR.			
DES. ENG.		TITLE: FLECHT SEASET STEAM GEN TEST WATER SUPPLY VESSEL	
MFG. ENG.			
SPLS. ENG.			
APP.			1463F31
APP.		SCALE 1:4	
APP.		DIMENSIONS IN INCHES	
		DO NOT SCALE	SUB. 1

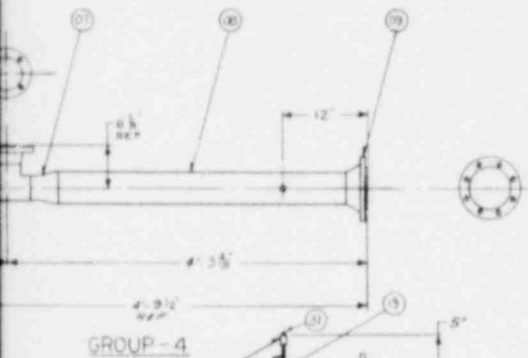
POOR ORIGINAL



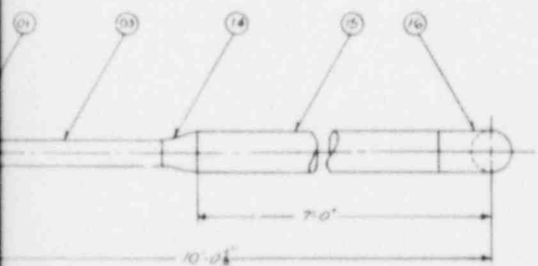
POOR ORIGINAL



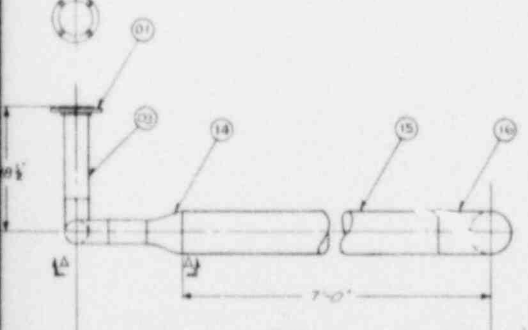
GROUP -2



GROUP - 4

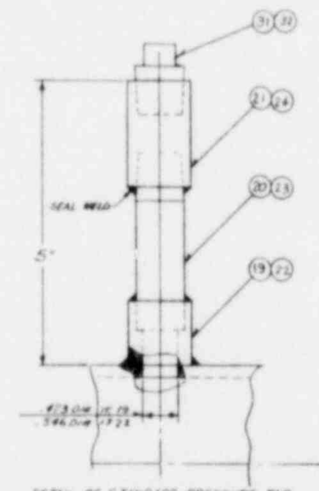


GROUP -6



GROUP -9

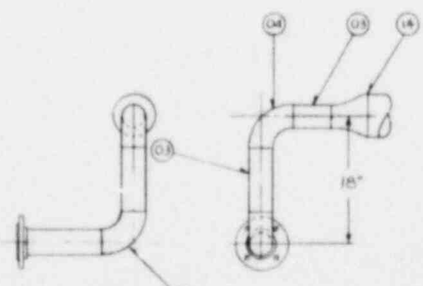
		BILL OF MATERIAL		
ITEM	PART NAME	DRAWING & GR OR ST	MATERIAL	REQ PER GROUP
01	FLANGE 3" 150 LB SLIP ON		SA-105	
02	FLANGE 3" 150 LB WELD NECK		SA-105	
03	PIPE 3" STD WT		SA-106 GR B	
04	ELBOWS 90° L.R. 3" STD WT		SA-234 WPB	
05	HALF COUPLING 1" NPT 3000 LB		SA-105	
06	TEE 3" STD WT B.W.		SA-234 WPB	
07	REDUCER CONC. 3 x 4 STD WT		SA-234 WPB	
08	PIPE 4" STD WT		SA-106 GR B	
09	FLANGE 4" 150 LB WELD NECK		SA-105	
10	FLANGE 3" 300 LB SLIP ON		SA-105	
11	TEE 4" STD WT B.W.		SA-234 WPB	
12	ELBOWS 90° L.R. 4" STD WT		SA-234 WPB	
13	ELBOW 90° RED 4" x 3" STD WT		SA-234 WPB	
14	REDUCER CONC. 7 x 5 STD WT		SA-234 WPB	
15	PIPE 5" STD WT		SA-106 GR B	
16	ELBOW 90° L.R. 5" STD WT		SA-234 WPB	
17	FLANGE 5" x 3" 300 LB S/O REDUCING		SA-105	
18	GRAYLOC 3" SCH 40 SA-226 BUTT WELD HUB		SA-105	
19	HALF COUPLING 3/4" 3000 LB SOC WELD		SA-105	
20	PIPE 3/4" SCH X STG		SA-106 GR B	
21	COUPLING 3/4" NPT 3000 LB		SA-105	
22	HALF COUPLING 1/2" 3000 LB SOC WELD		SA-105	
23	PIPE 1/2" SCH X STG		SA-106 GR B	
24	COUPLING 1/2" NPT 3000 LB		SA-105	
25	PIPE 6" STD WT		SA-106 GR B	
26	PIPE CAPS 6" STD WT B.W.		SA-234 WPB	
27	PIPE 1/2" X STG		SA-106 GR B	
28	PIPE CAP 1/2" NPT 3000 LB		SA-105	
29	PIPE 1" X STG		SA-106 GR B	
30	PIPE CAP 1" NPT 3000 LB		SA-105	
31	PIPE PLUG 3/4" NPT		SA-105	
32	PIPE PLUG 1/2" NPT		SA-105	
33	BASE PLATE		SA-36	
34	GUSSET		SA-36	
35	TEE RED 3" x 3" x 2" STD WT		SA-234 WPB	
36	PIPE 2" STD WT		SA-106 GR B	
37	REDUCER CONC. 2 x 3 STD WT		SA-234 WPB	
38	FLANGE 2" 300 LB W.N.		SA-105	
39	PIPE 3" X STG		SA-106 GR B	
40	LAP JOINT STUB END 3" X STG		SA-234 WPB	
41	FLANGE 3" 150 LB LAP JOINT		SA-105	
42	STOP		SA-36	



DETAIL OF STANDARD PRESSURE TAP

NOTES:

1. DESIGN CONDITIONS ALL GROUPS: 150 PSI @ 500°F
2. GROUP 14 FABRICATED OUTSIDE BY WEST ENGINEERING & SUPPLY CO., EL MONTE CALIF. PER ASME BOILER & PRESSURE VESSEL CODE, SEC I.
3. GROUP 17: DESIGN, FABRICATE & STAMP PER ASME BOILER & PRESSURE VESSEL CODE, SECTION VIII. SEE W SPECIFICATION FEES-018 FOR ADDITIONAL REQUIREMENTS.
4. GROUPS 1 THROUGH 13, 15, 16, 18 THROUGH 22: DESIGN, FABRICATE PER ASME BOILER AND PRESSURE VESSEL CODE, SECTION I (BOILER EXTERNAL PIPING). SEE W SPECIFICATION FEES-017, REV. 1 FOR ADDITIONAL REQUIREMENTS.
5. MODIFY EXISTING FABRICATION SUPPLIED BY WESTINGHOUSE BY CUTTING FLANGED END AND INSTALLING NEW 300 FLANGE & TWO PRESSURE TAP NOZZLES AS SHOWN.
6. GROUP 24 FABRICATED IN HOUSE PER POWER PIPING CODE ANSI B31.1-1977.



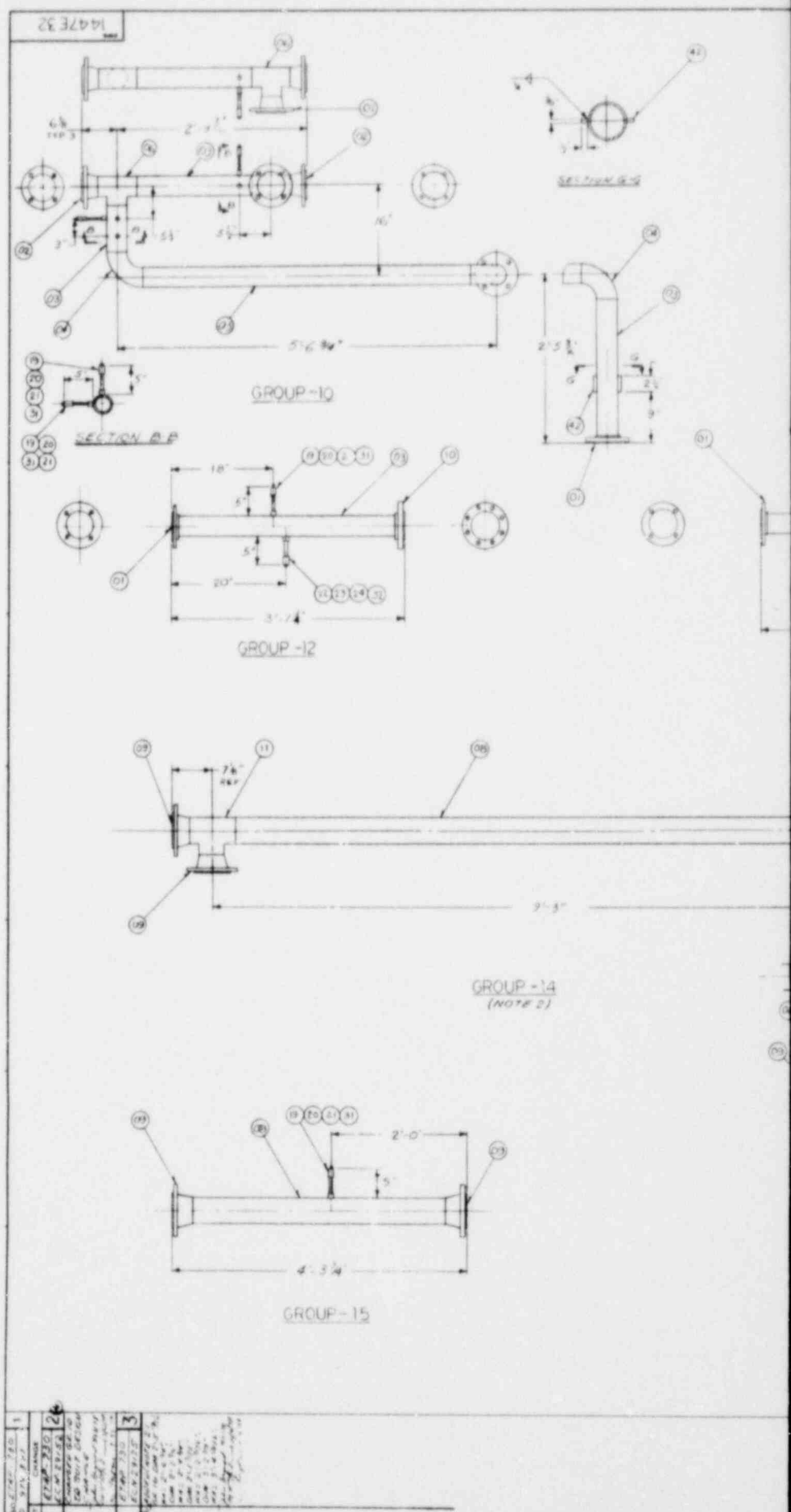
VIEW A-A

Westinghouse Electric Corporation
NUCLEAR ENERGY SYSTEMS PITTSBURGH PA U.S.A.

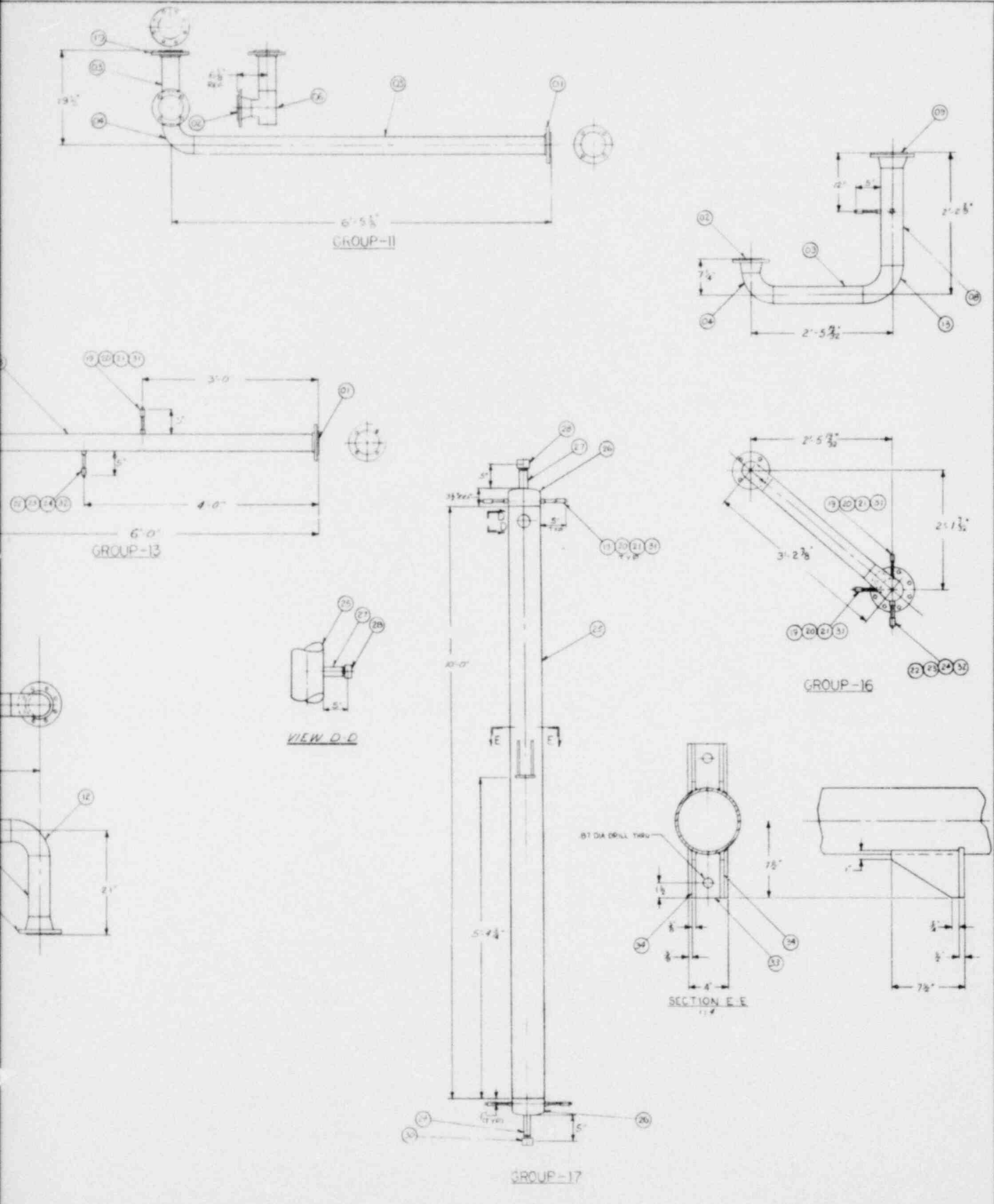
FLECHT SEASET
STEAM GENERATOR TASK
STEAM PIPING DETAILS

SCALE 1 1/2" - 1'-0"
DO NOT SCALE
1447E32
SHEET 1 OF 2

POOR ORIGINAL



POOR ORIGINAL



Westinghouse Electric Corporation
NUCLEAR ENERGY SYSTEMS PITTSBURGH PA U.S.A.

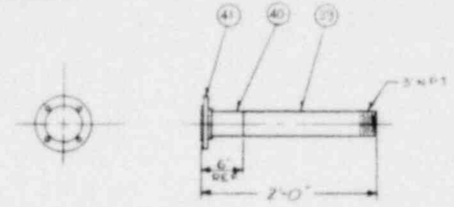
FLEX VT SEAJET
STEAM GENERATOR TANK
TRAIN PIPING DETAILS

1447E32
SHEET 5 OF 5

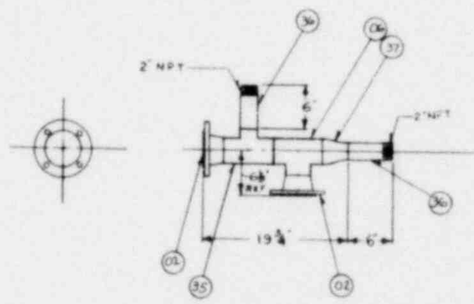
DO NOT SCALE

POOR ORIGINAL

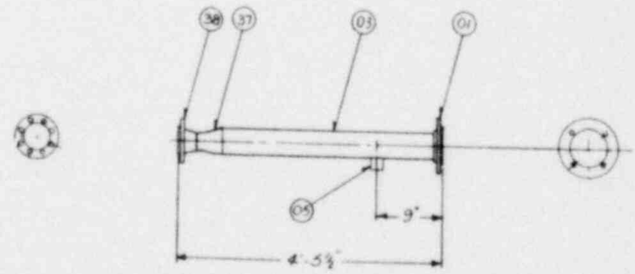
1447E32



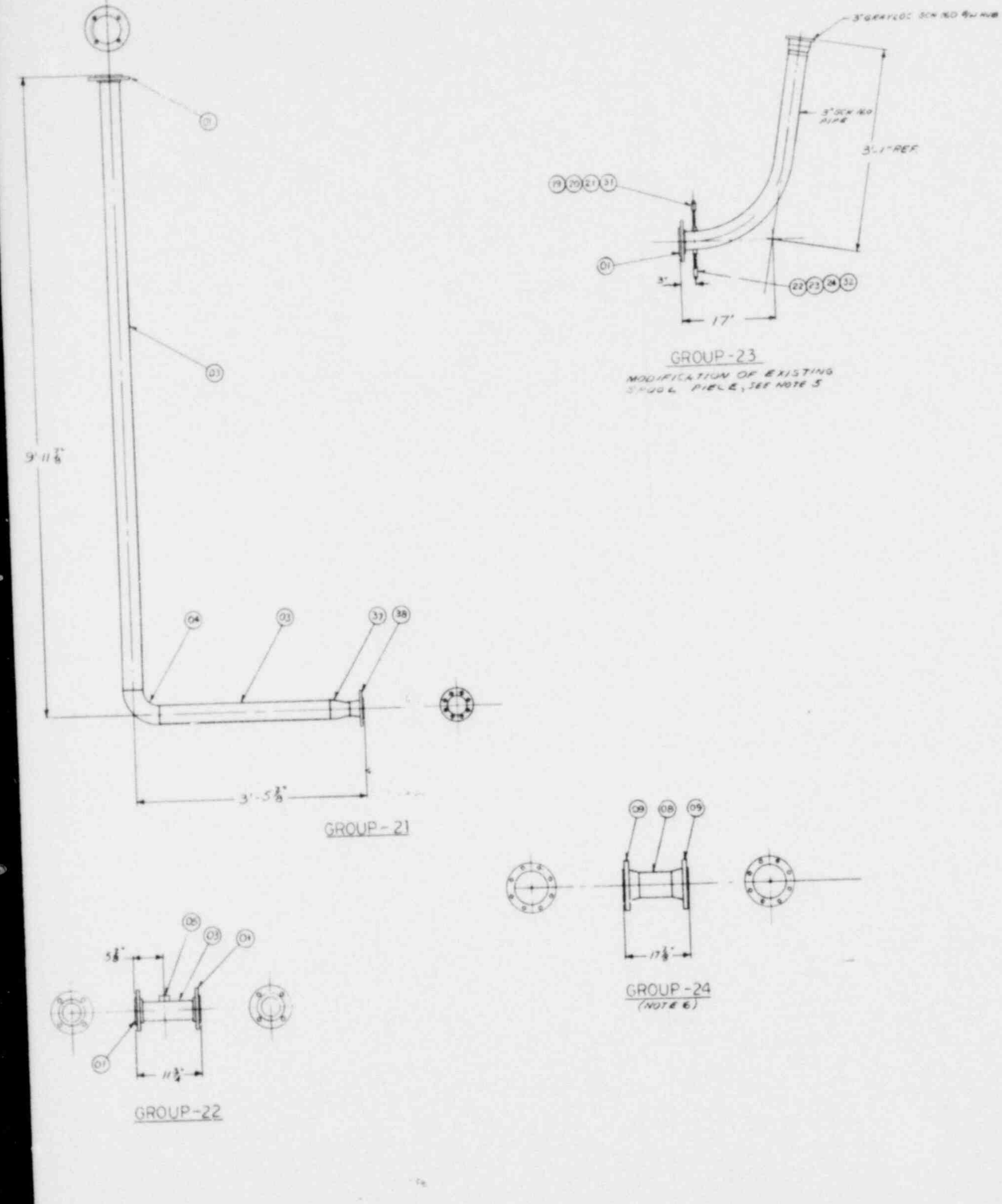
GROUP -18



GROUP - 19



GROUP -20



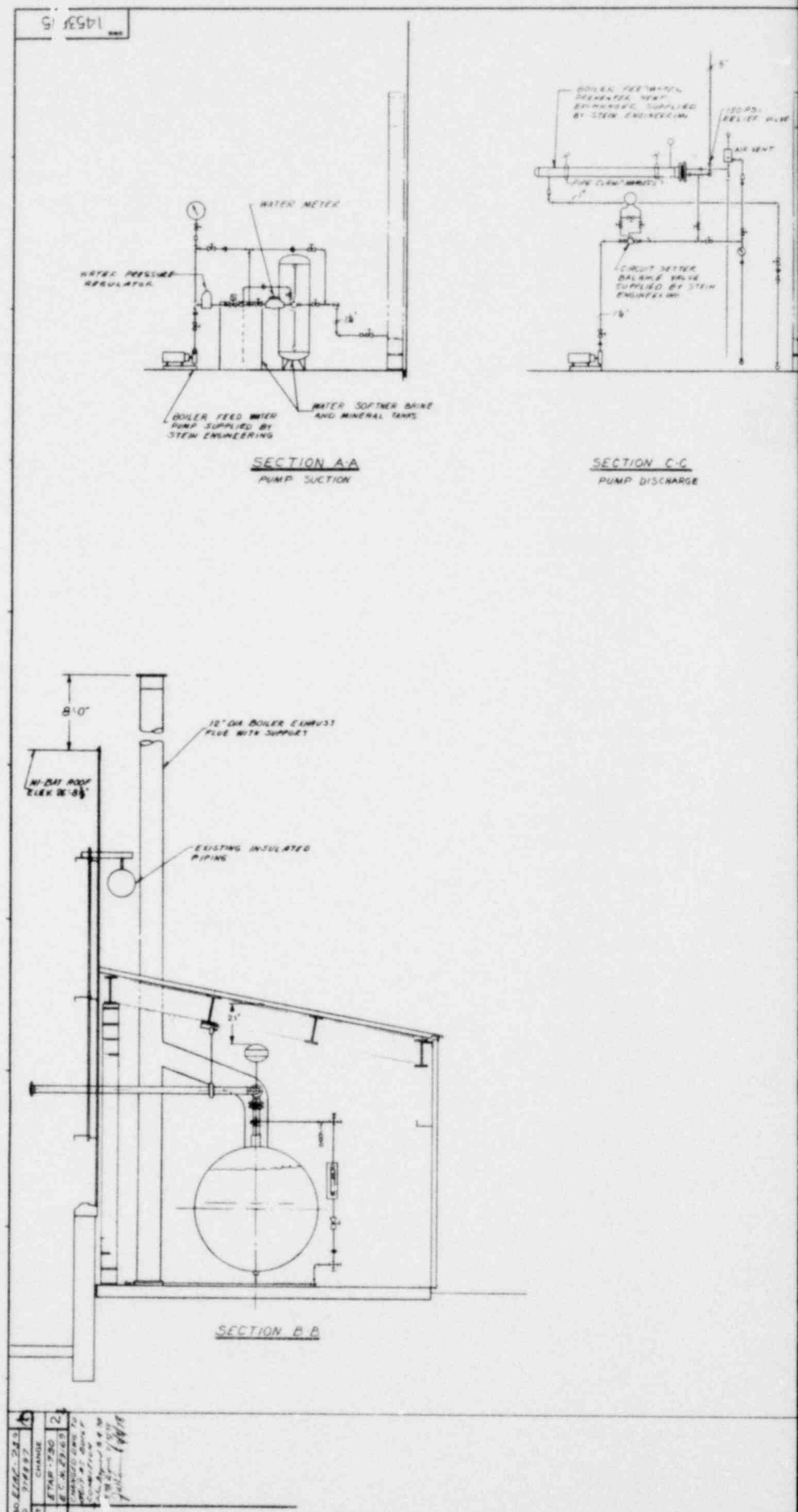
Westinghouse Electric Corporation
NUCLEAR ENERGY SYSTEMS PITTSBURGH PA U.S.A.

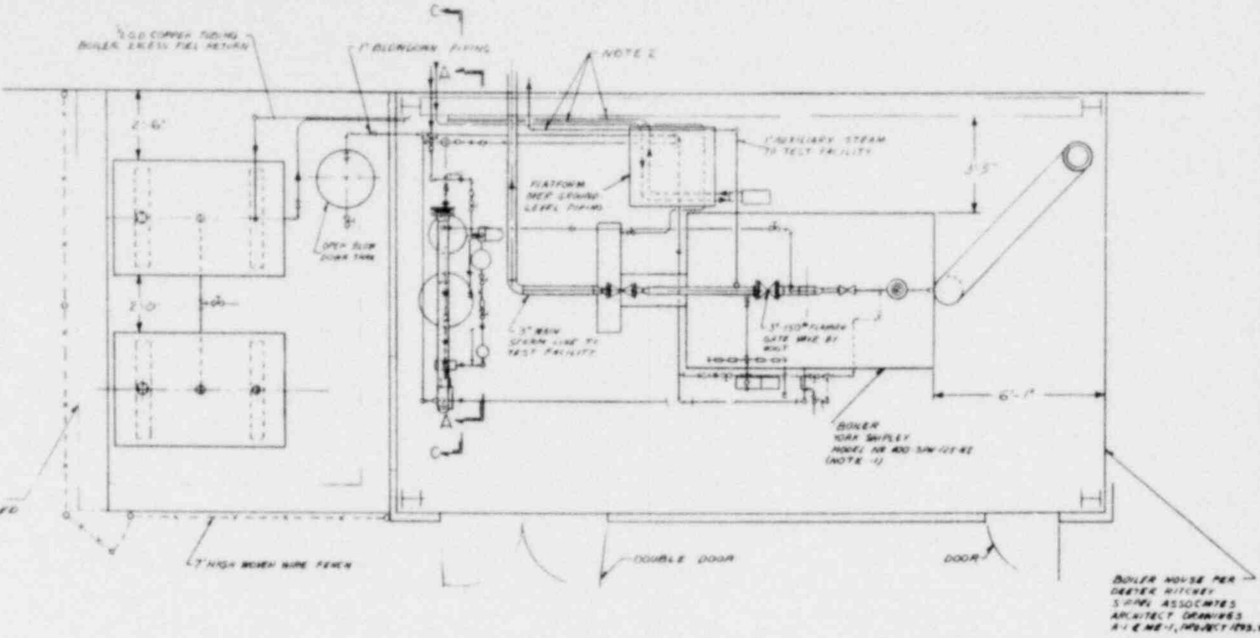
FLECHT SEASET
STEAM GENERATOR TASK
STEAM PIPING DETAILS

1447E32
SHEET 3 OF 3

DO NOT SCALE

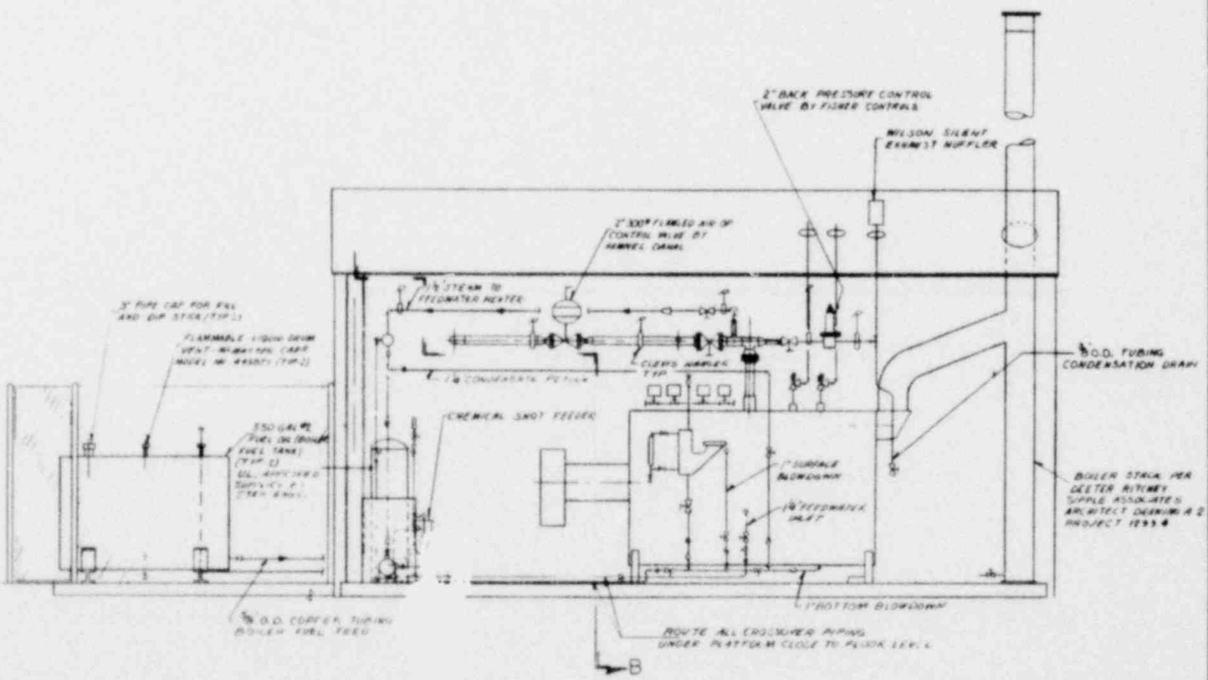
POOR ORIGINAL


WATER METER
WATER PRESSURE REGULATOR
BOILER FEED WATER PUMP SUPPLIED BY STEIN ENGINEERING
WATER SOFTNER BRINE AND MINERAL TANKS
SECTION A-A
PUMP SUCTION
BOILER FEEDWATER PREHEATER HEAT EXCHANGER SUPPLIED BY STEIN ENGINEERING
RELIEF VALVE
AIR VENT
CIRCUIT SETTER BALANCE VALVE SUPPLIED BY STEIN ENGINEERING
SECTION C-C
PUMP DISCHARGE
8'-0"
12" DIA BOILER EXHAUST FLUE WITH SUPPORT
HI-BAY ROOF
EXISTING INSULATED PIPING
SECTION B-B
CHANGE



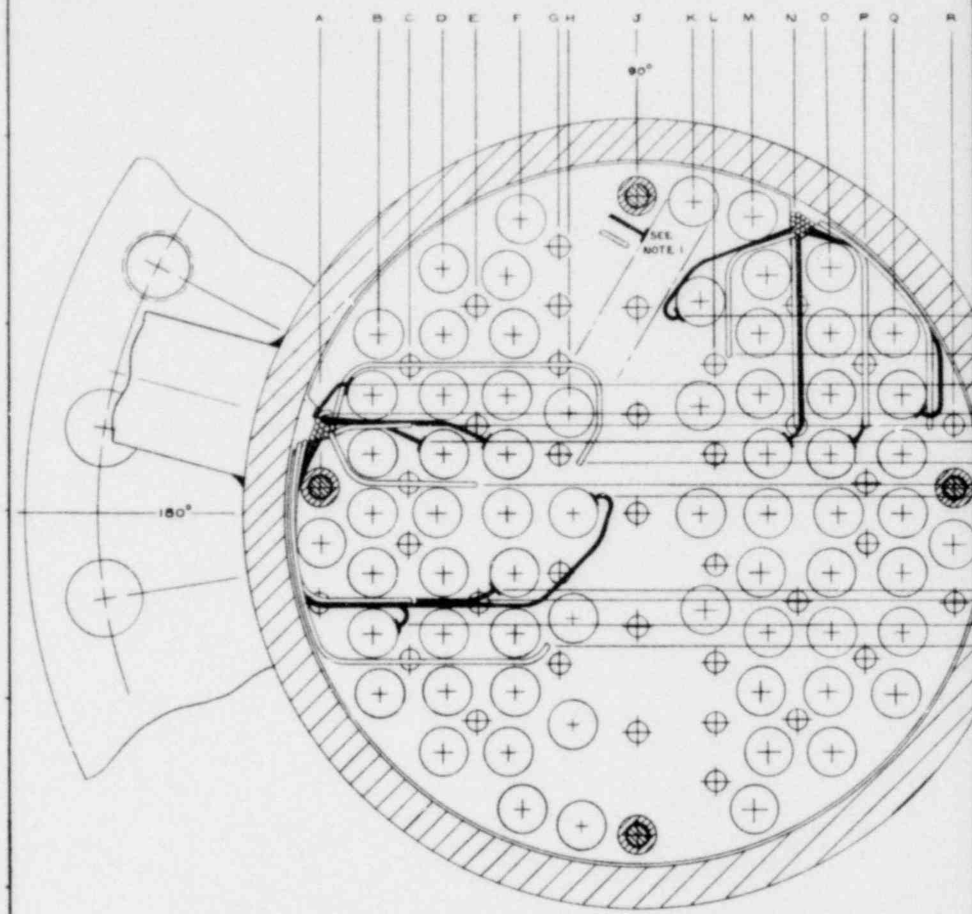
NOTES:

1. BOILER DESIGNED FABRICATED & STAMPED IN ACCORDANCE WITH ASME BOILER & PRESSURE VESSEL CODE, SECTION I.
2. LINES SHOWN OFFSET FOR CLARITY.

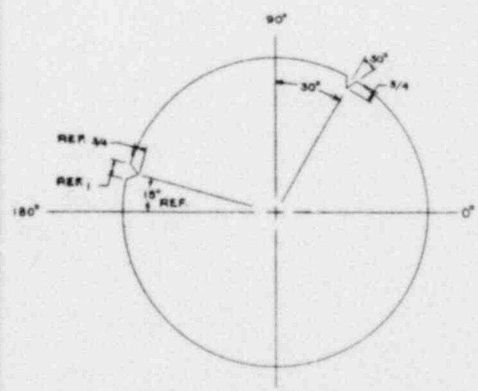


Westinghouse Electric Corporation	
FLECHT SEASET STEAM GENERATOR TASK BOILER ROOM PIPING LAYOUT	
DO NOT SCALE	1453E14

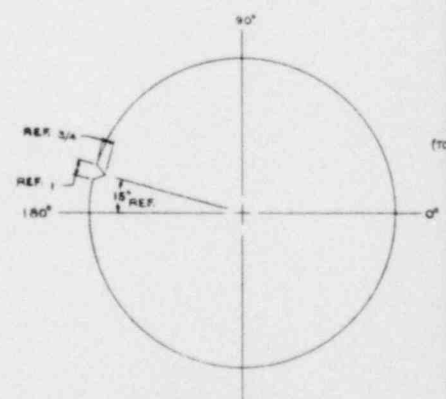
POOR ORIGINAL



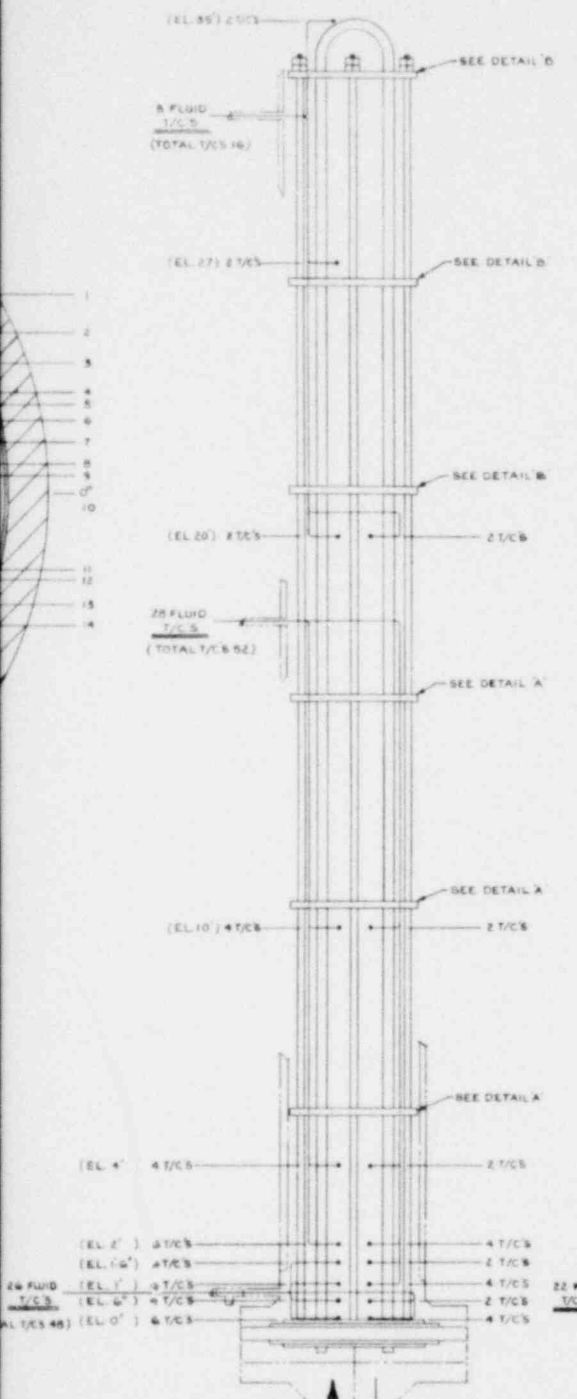
SECTION A-A
(SCALE 1:1)

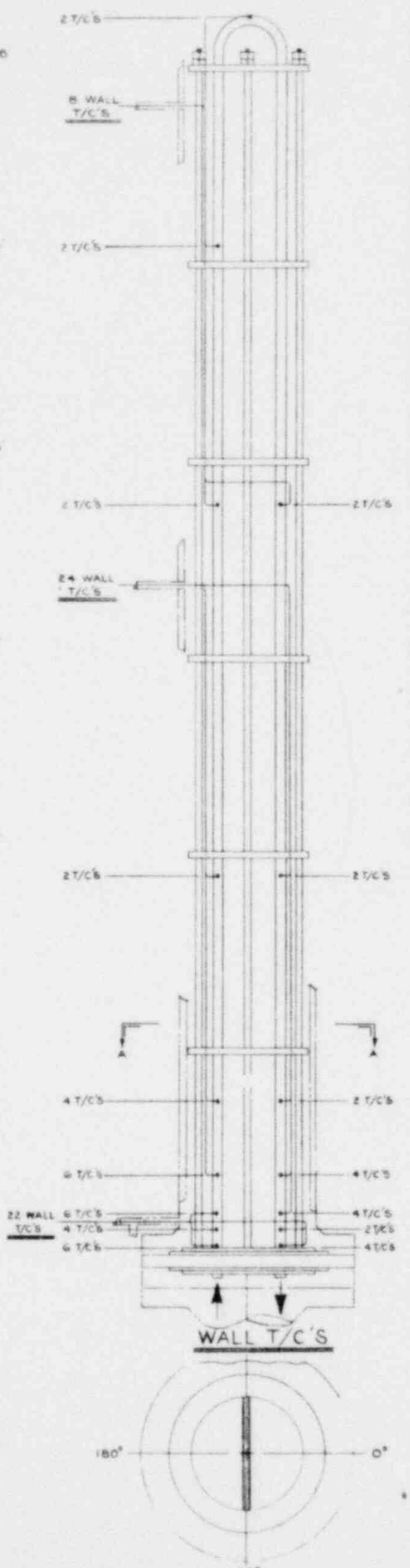


DETAIL 'A'



DETAIL 'B'





FLUID T/C NO.	CO-ORDINATES	ELEV.	T/C ELEV AS BUILT
1	A - 4	0'	3/8"
2		6"	5 13/16"
3		1'	11 13/16"
4		1'-6"	1'-6"
5		2'	2'-1/8"
6		4'	3'-11 15/16"
7		10'	10'-1/8"
8	C - 5	0'	5/16"
9		6"	5 13/16
10		1'	12 1/8"
11		1'-6"	1'-6"
12		2'	2'-1/8
13		4'	3'-11 15/16
14		10'	10-1/8
15		20'	19'-11 3/4
16		27'	27' *
17		35'	35' *
18	C - 12 BACK UP	0'	1/32"
19		1'	1'
20		2'	2'-1/2"
21	E - 8	0'	1/2" *
22		6"	5 1/8"
23		1'	1'
24		1'-6"	1'-6 3/8"
25		2'	2'
26		4'	3'-11 7/8 *
27		10'	10-1/8"
28	G - 14 BACKUP	0'	1/2" *
29		1'	11 3/4 *
30		2'	1'-11 3/4 *
31	H - 7	0'	1/2" *
32		6"	6 7/64
33		1'	1'-7/64
34		1'-6"	1'-6 7/64
35		2'	2'-5/32
36		4'	3'-11 13/16
37		10'	10'-1/8"
38		20'	20'-1/4"
39		27'	27' *
40	NOTE 1	35'	35' *
41	L - 2	0'	7/16"
42		6"	5 5/8"
43		1'	1'-9/32"
44		1'-6"	1'-5 11/16
45		2'	1'-11 15/32
46		4'	4'
47		10'	10'-7/16
48		20'	20'-1/4"
49	N - 5	0'	1/2"
50		1'	1'-13/32
51		2'	1'-11 7/8
52	P - 5 BACKUP	0'	1/4"
53		1'	1' 19/64"
54		2'	2' 9/64"
55	R - 5	0'	21/32"
56		6"	6 5/32"
57		1'	1'-1/16"
58		1'-6"	1'-5 49/64
59		2'	2'
60		4'	4'-1/8"
61		10'	10'-7/16"
62		20'	20'-1/4"

WALL T/C NO.	CO-ORDINATES	ELEV.	T/C ELEV AS BUILT
101	B - 3	0'	1/4"
102		6"	5 3/4
103		1'	11 7/8
104		2'	2'-1/8
105		4'	3'-11 15/16
106		10'	10'-1/8"
107		20'	19'-11 3/4
108		27'	27' *
109		35'	35' *
110	B - 13 BACKUP	0'	0' *
111		1'	1' *
112		2'	2' *
113	D - 6	0'	11/32
114		6"	6 11/16"
115		1'	1'-1/8"
116		2'	2'-1/8"
117		4'	3'-11 15/16
118	F - 6	0'	0' *
119		6"	6"
120		1'	1'
121		2'	2'
122		4'	3'-11 7/8
123	F - 11 BACKUP	0'	0' *
124		1'	1' *
125		2'	2' *
126	H - 9	0'	0' *
127		6"	6 7/64
128		1'	1'-7/64
129		2'	2'-5/32
130		4'	3'-11 15/16
131		10'	10'-1/8"
132		20'	20'-1/4"
133		27'	27' *
134	NOTE 1	35'	35' *
135	K - 1 BACK UP	0'	1/2"
136		1'	1'-5/16"
137		2'	1'-11 [illegible]
138	M - 6	0'	0' *
139		6"	5 7/8"
140		1'	1'-1/2"
141		2'	2'-7/64
142		4'	4' *
143		10'	10'-7/16"
144		20'	20' *
145	O - 6 BACK UP	0'	1/8"
146		1'	1'-7/16"
147		2'	2'-1/64"
148	Q - 4	0'	21/32
149		6"	6 1/8"
150		1'	1'-7/64
151		2'	2'-7/64
152		4'	4'-1/8"
153		10'	10'-1/2"
154		20'	20'-[illegible]

* ACCURATE ELEVATION MEASUREMENTS WERE NOT OBTAINED AT THESE LOCATIONS.

NOTE
1. W-T/C #134 & F-T/C #40 LOCATION (SEE SEC. A-A).

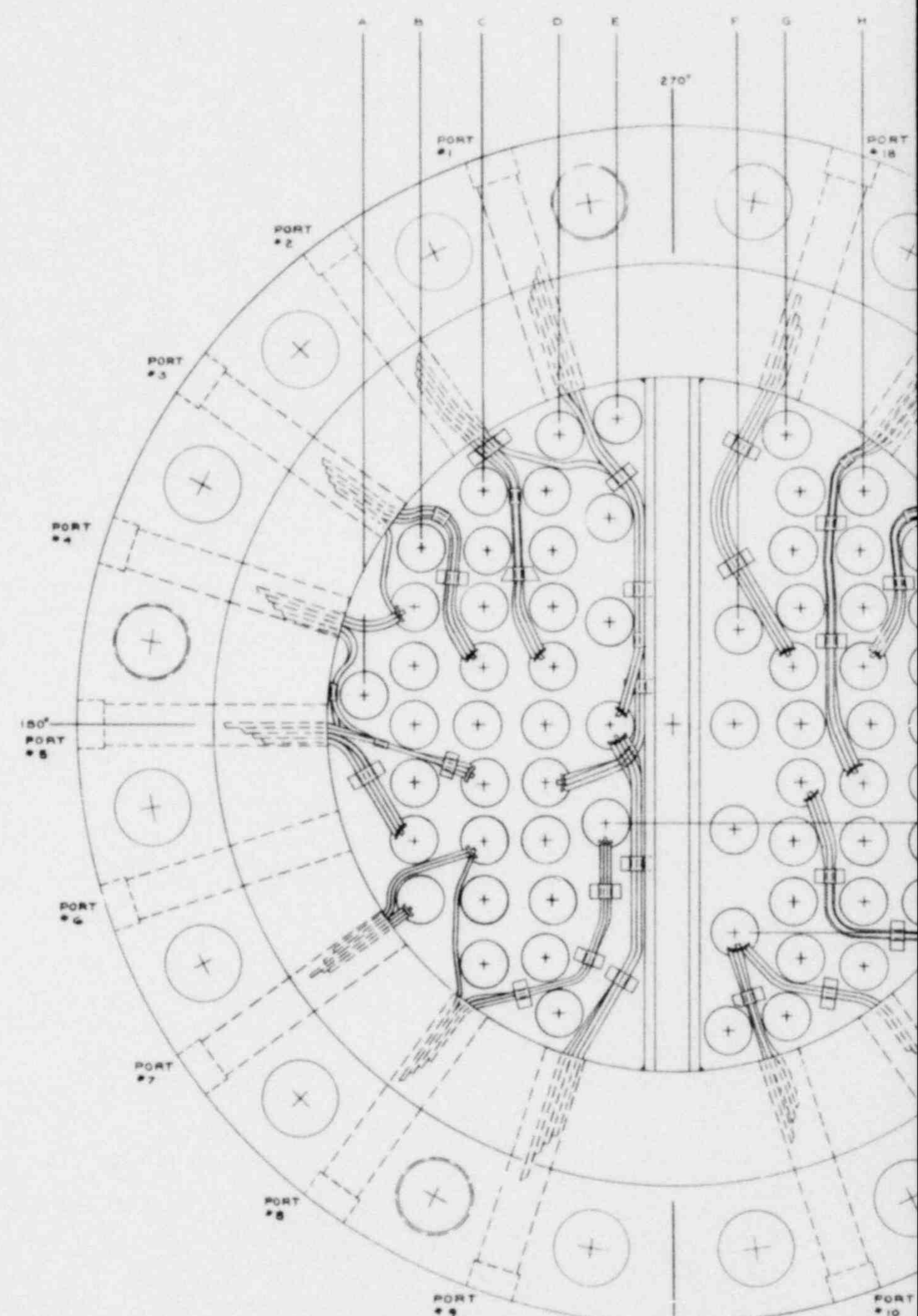
P. CRALLE

Westinghouse Electric Corporation
NUCLEAR ENERGY SYSTEMS PITTSBURGH PA. U.S.A.

FLECHT/SEASET STEAM GEN. INTERNAL INSTRUMENTATION FLUID & WALL T/C LOCATIONS

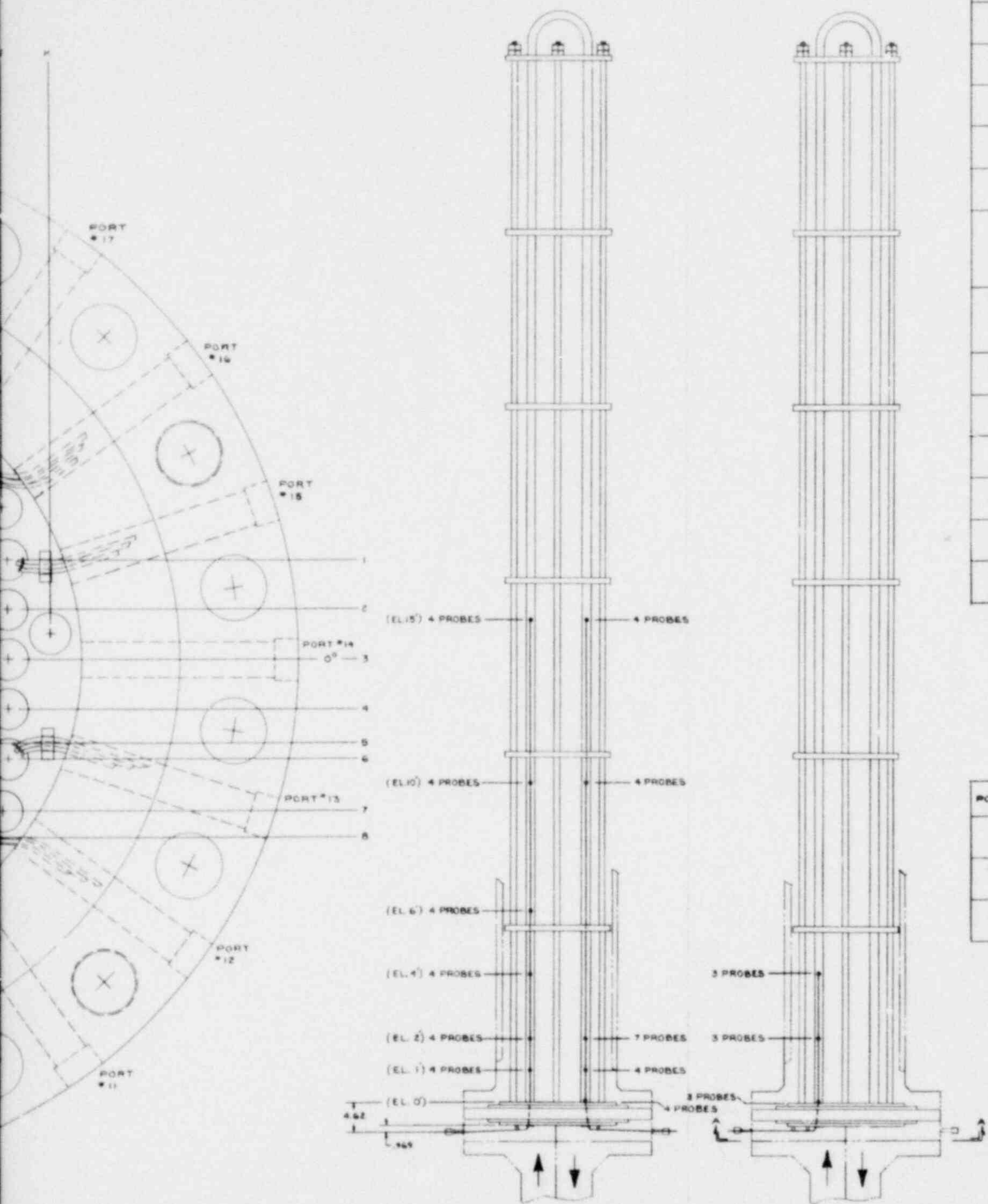
1447E21
SHEET 1 OF 2
DO NOT SCALE

POOR ORIGINAL



VIEW A-A
(SCALE 1:1)

POOR ORIGINAL



STEAM PROBES
(3/32 DIA. REF.)

PRESSURE PROBES
(1/16 DIA. REF.)

PORT	STEAM PROBE NO.	CO-ORDINATES	ELEV.	T/C TAG
4	S 1	B - 1	6'	345
3	S 2		10'	343
4	S 3		15'	342
5	S 4	B - 6	1'	327
5	S 5		2'	324
4	S 6		4'	334
3	S 7	C - 2	6'	333
3	S 8		10'	332
3	S 9		15'	348
5	S 10	C - 4	1'	310
5	S 11		2'	325
4	S 12		4'	336
2	S 13	D - 2	6'	347
2	S 14		10'	346
2	S 15		15'	344
1	S 16	D - 4	1'	323
1	S 17		2'	322
2	S 18		4'	335
1	S 19	E - 3	1'	329
1	S 20		2'	328
9	S 21		4'	340
9	S 22		6'	331
9	S 23		10'	338
9	S 24		15'	337
10	S 25	F - 8	0'	330
11	S 26		1'	302
10	S 27		2'	301
11	S 28		10'	350
10	S 29		15'	341
18	S 30	G - 2	2'	316
18	S 31		10'	353
18	S 32		15'	351
12	S 33	G - 4	0'	318
12	S 34		1'	319
12	S 35		2'	307
16	S 36	H - 2	2'	320
16	S 37		10'	358
16	S 38		15'	349
17	S 39	H - 4	0'	309
17	S 40		1'	306
17	S 41		2'	308
15	S 42	J - 1	2'	317
15	S 43		10'	352
15	S 44		15'	360
13	S 45	J - 6	0'	305
13	S 46		1'	303
13	S 47		2'	304

PORT	PRESS. PROBE NO.	CO-ORDINATES	ELEV.	PROBE ELEV. AS BUILT
7	P 1	B - 7	0'	0'
7	P 2		2'	2'
7	P 3		4'	4'-1/64"
8	P 4	C - 6	0'	0'
7	P 5		2'	2'
7	P 6		4'	3'-11 63/64"
8	P 7	E - 5	0'	0'
8	P 8		2'	2'
8	P 9		4'	4'

P. CRALLE

Westinghouse Electric Corporation
NUCLEAR ENERGY SYSTEMS PITTSBURGH PA U.S.A.

FLECHT/SEASET STEAM GEN.
INTERNAL INSTRUMENTATION
STEAM & PRESS. PROBE LOCATIONS

1447E21
SHEET 2 OF 2

DO NOT SCALE

APPENDIX D

PHOTOGRAPHIC STUDY RESULTS

D-1. INTRODUCTION

The steam generator inlet and outlet plenums were provided with two 2.5-inch-diameter view ports to allow visual observation of the flow regimes in the plenums. The inlet plenum ports are illustrated in figure 3-3, sheet 2. The outlet plenum ports are located in the same relative location in the plenum as the inlet plenum ports and were fabricated when the plenum was modified for the integral moisture separator. In selected runs, high-speed movies were taken of the flow in each plenum; in other runs, a still camera synchronized with a high-speed flash unit was used to take still pictures of the plenum flow.

The purpose of the photographic study was to determine droplet size and velocity and the flow regime in the plenums. The runs selected for photographic study are presented in table D-1.

D-2. EQUIPMENT DESCRIPTION

The high-speed cameras used in this test were Redlake Hycam Model 41-0004 cameras with 25mm lenses set at an F-stop of 1.4. The cameras were run at 2500 frames per second. One view port in each plenum was used to illuminate the flow with a 1000-watt light source. Digital timers were used to provide a record of the time after test initiation and mirrors were used to record the image of the timer on the film adjacent to the view port. The cameras were loaded with 400-foot rolls of film; during each test two inlet plenum rolls were shot and four outlet plenum rolls were shot. The inlet plenum movies were taken at the beginning and end of the test and the outlet plenum movies were taken at 2-minute intervals beginning at about 1 minute into the test.

The cameras used for the still photographs were a Nikon 35mm and a Mamiya RB-67 attached to Vivitar model 83 flash units. These flash units have a flash duration of 25 to 33 microseconds. The front lighting and timer setup was the same as that described above for the movies.

TABLE D-1

STEAM GENERATOR SEPARATE EFFECTS
TEST PHOTOGRAPHIC RUNS

Run No.	Nominal Boundary Conditions			Type of Photo
	Total Flow [kg/sec (lb/sec)]	Quality	Pressure [MPa (psia)]	
21711	0.227 (0.5)	0.80	0.276 (40)	Still photos
20703	0.227 (0.5)	0.80	0.138 (20)	Still photos
20904	0.227 (0.5)	0.80	0.414 (60)	Still photos
21909	0.454 (1.0)	0.10	0.276 (40)	Still photos
20610	0.227 (0.5)	0.80	0.276 (40)	High-speed movies[a]
21405	0.227 (0.5)	0.50	0.276 (40)	High-speed movies
21502	0.454 (1.0)	0.80	0.276 (40)	High-speed movies
21806	0.227 (0.5)	0.20	0.276 (40)	High-speed movies

a. Nominal framing rate = 2500 frames/second

D-3. RESULTS

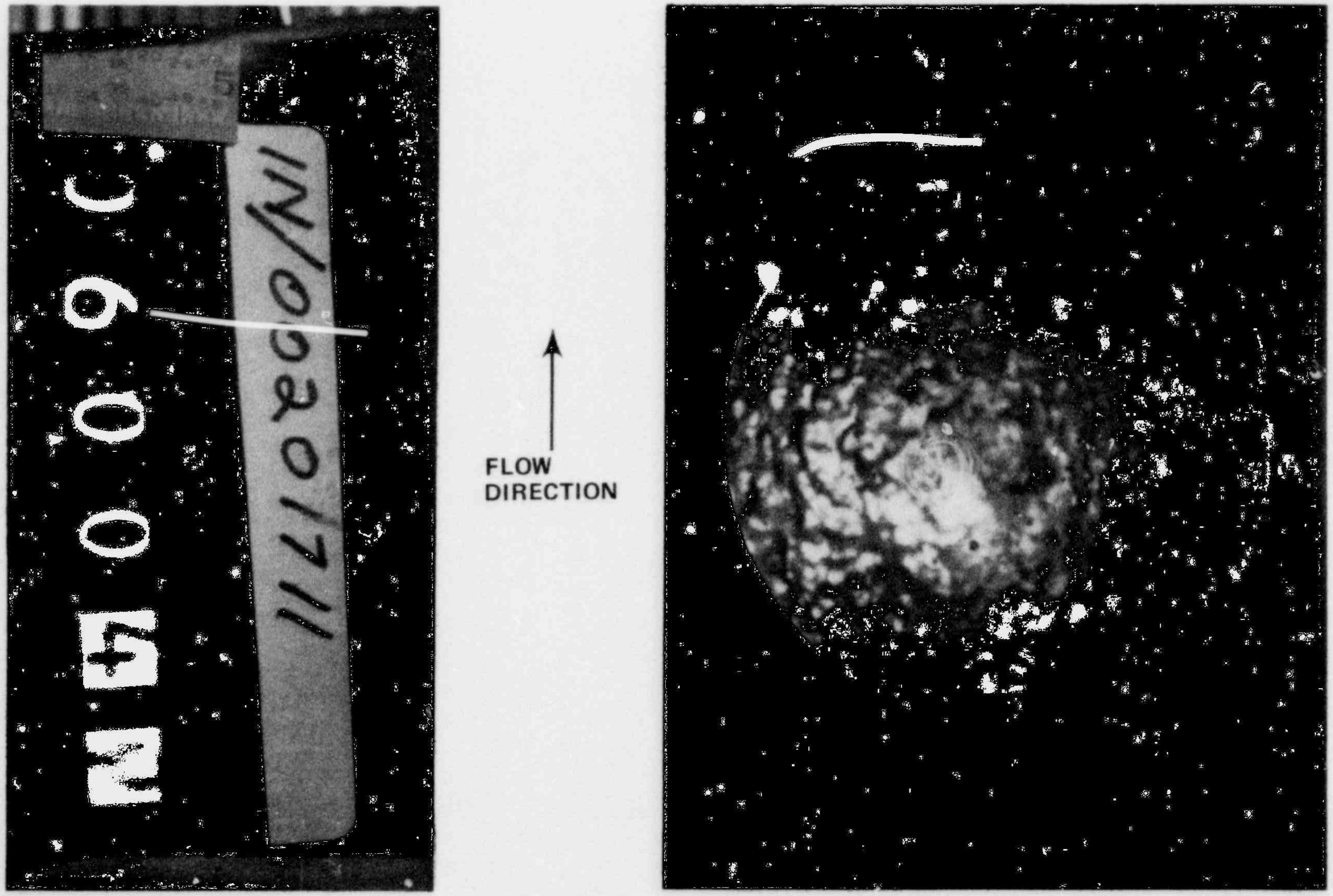
Examples of still photographs of the inlet plenum flow regime from each of the four runs in table D-1 are shown in figures D-1 through D-4. The maximum and minimum drop sizes were measured from the still photographs and are summarized in table D-2. The photographs from run 21909 indicate that, for this run condition, the liquid flow is primarily in the liquid film on the plenum wall, with relatively few entrained drops in the vapor core. The still photographs of the outlet plenum show no visible drops entrained in the flow.

The high-speed movies of the inlet plenum were analyzed for droplet velocity. The droplet velocity was determined by tracking the trajectory of a drop for a given number of frames and then dividing the distance traversed by the drop by the time the camera used to advance the film the given number of frames. From the movies, the drop size was also estimated by scaling the drop image to a known dimension in the picture. From all of the inlet plenum films, sample drops were tracked and the composite plot of drop velocity versus drop diameter shown in figure D-5 was constructed. In the inlet plenum, drops traveling in both directions were observed. Also shown in figure D-5 are three calculated terminal velocity characteristics,[1] assuming an asymptotic droplet drag coefficient of 0.44. The terminal velocity lines are different because the steam phase superficial velocity in each of the three tests is different. In figure D-5 the steam velocity is added to the droplet terminal velocity relative to the steam, to get the droplet absolute terminal velocity. The inlet plenum movies from run 21806 indicated that the flow regime changed from dispersed flow with entrained drops to a churn flow regime, with the liquid in a continuous liquid film on the plenum walls.

High-speed movies of the flow regime in the outlet plenum show entrained liquid drops in the superheated steam exhaust. However, the droplet density in the outlet plenum is much lower than the droplet density in the inlet plenum. A summary of drop size and velocity and the steam velocity in the tube bundle assuming complete liquid evaporation is given in table D-3.

---

1. Wallis, G. B., One-Dimensional Two-Phase Flow, McGraw-Hill, New York, 1969, equation 8.3.



15607-54

Figure D-1. Inlet Plenum Drops, Run 21711, Time = 600 Sec

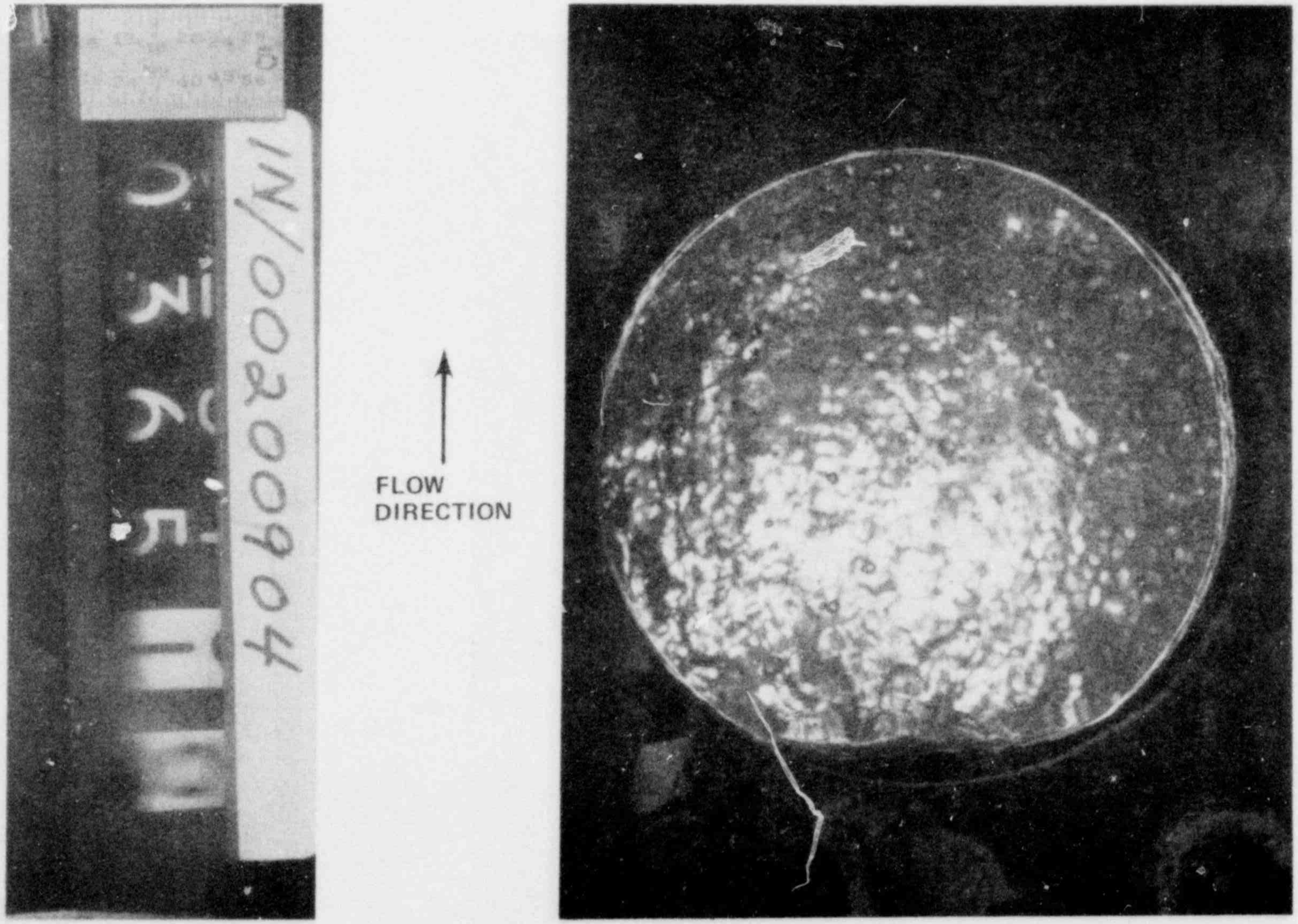
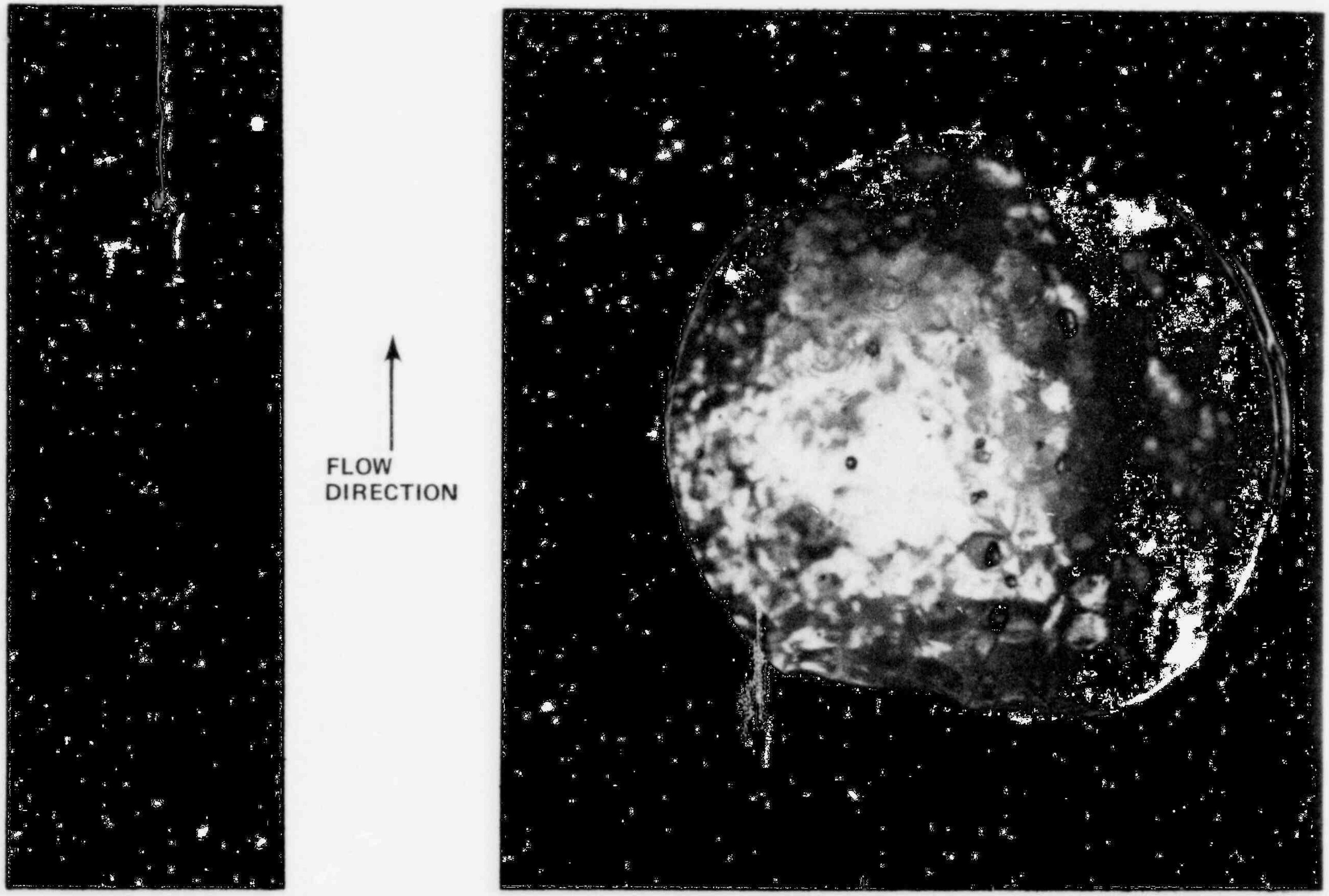


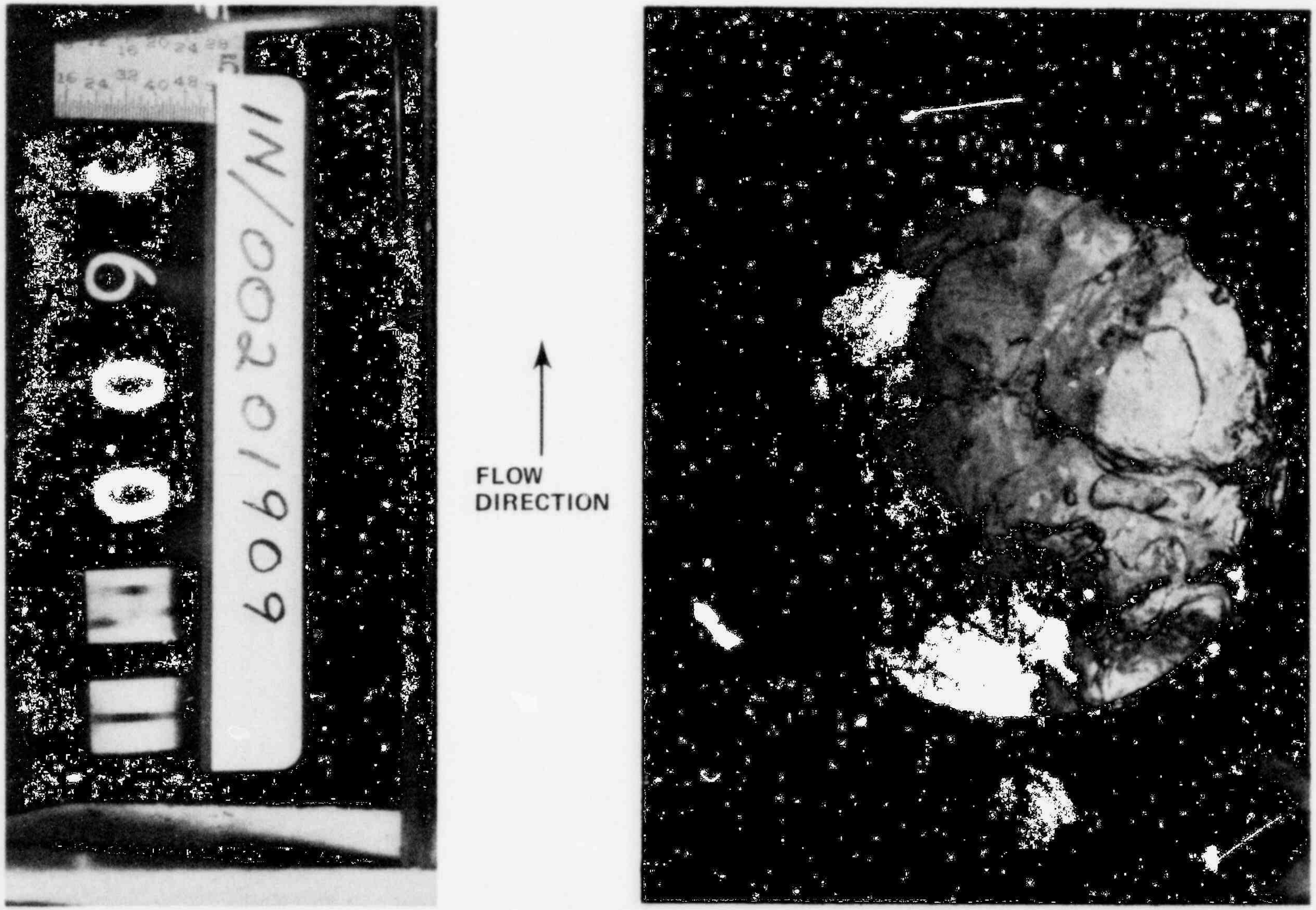
Figure D-3. Inlet Plenum Drops, Run 20904, Time = 365 Sec

15607-52



15607-53

Figure D-2. Inlet Plenum Drops, Run 20703, Time = 550 Sec



15607-55

Figure D-4. Inlet Plenum Drops, Run 21909, Time = 600 Sec

TABLE D-2

STEAM GENERATOR INLET PLENUM DROP SIZE RANGE FROM STILL PHOTOGRAPHS

Run	Minimum Drop Diameter [mm (in.)]	Maximum Drop Diameter [mm (in.)]
21711	0.25 (0.01)	1.8 (0.07)
20703	0.25 (0.01)	1.8 (0.07)
20904	0.25 (0.01)	2.0 (0.08)
21909	(a)	(a)

a. No visible drops in photograph

TABLE D-3

STEAM GENERATOR OUTLET PLENUM DROP SIZE AND VELOCITY FROM HIGH-SPEED MOVIES

Run No.	Drop Size Range [mm (in.)]		Velocity Range [m/sec (ft/sec)]		Steam Velocity in Tube Bundle[a] [m/sec (ft/sec)]
	Min	Max	Min	Max	
20610	1.3 (0.05)	3.6 (0.14)	0.61 (2)	2.4 (8)	15 (50)
21405	1.5 (0.06)	5.6 (0.22)	0.61 (2)	2.1 (7)	15 (50)
21502	1.3 (0.05)	2.8 (0.11)	1.8 (6)	4.0 (13)	30 (100)
21806	2.0 (0.08)	6.3 (0.25)	11 (35)	14 (45)	15 (50)

a. Assuming tube outlet quality = 1.00

15607-34

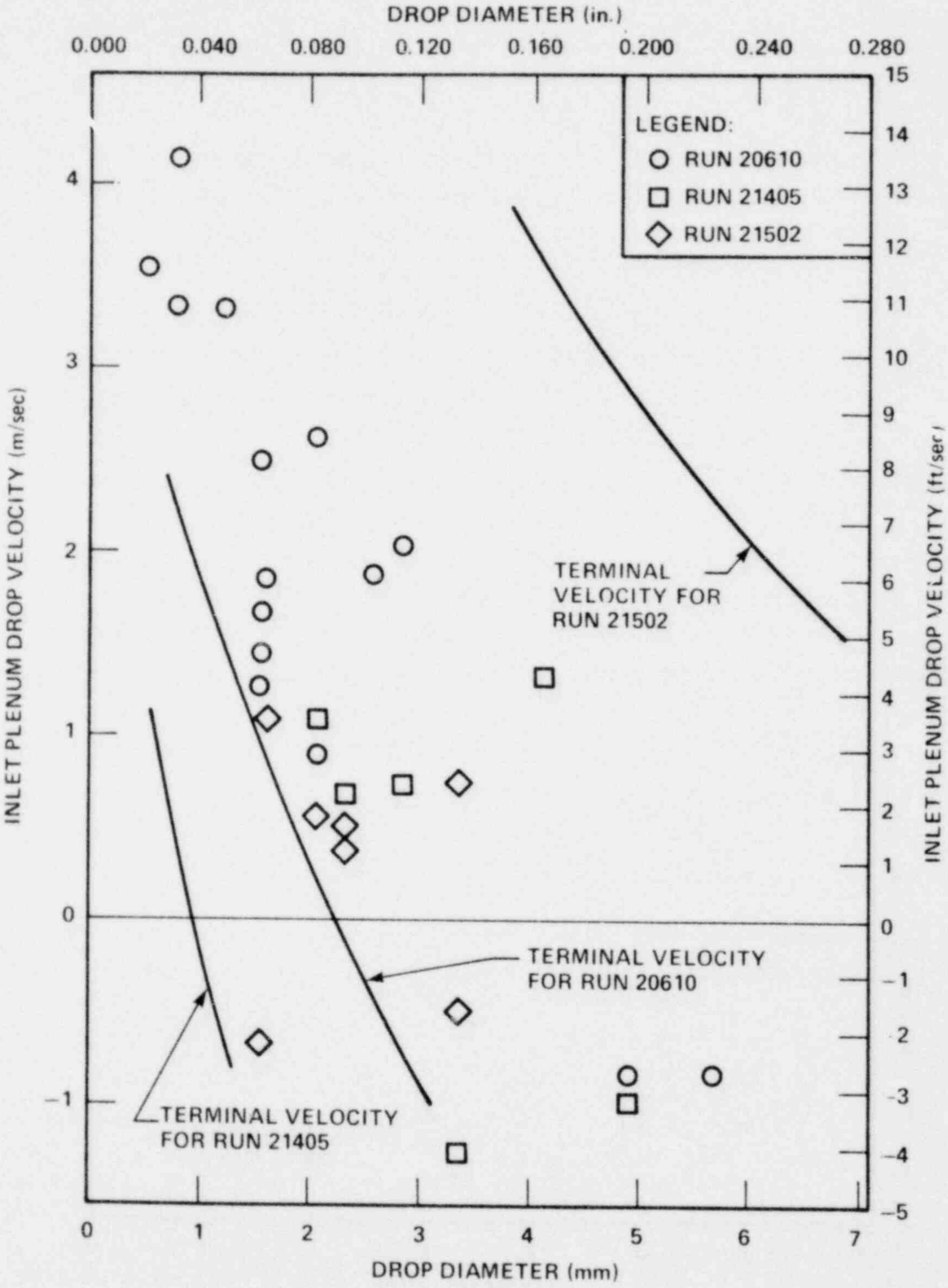


Figure D-5. Inlet Plenum Drop Velocity Versus Drop Size

D-4. CONCLUSIONS FROM PHOTOGRAPHIC STUDY

The flow regime in the inlet plenum is generally annular flow with dispersed drops entrained in the vapor core. However, as the inlet flow quality drops below 50 percent, the flow regime changes to a churn-type flow regime with the liquid in a continuous liquid film. For the runs with entrained liquid drops, a distribution of drop sizes exist and the drop velocity varies inversely with drop size. The trend qualitatively follows the terminal velocity predicted for a single drop. The still photographs of drops in the inlet plenum are the most accurate source for droplet diameter measurements; these photographs indicate that the drop diameters range from 1.02 to 2.03 mm (0.04 to 0.08 in.). From the high-speed movies of the inlet plenum drops, the drop size range varied from 0.51 to 5.6 mm (0.02 to 0.22 in.), with the drops above 4.1 mm (0.16 in.) falling away from the tubesheet.

The outlet plenum high-speed movies were used to measure drop velocities in the outlet plenum using the method described above for the inlet plenum. The results of the data reduction (table D-3) show that the measured drop velocities in runs 20610, 21405, and 21502 were less than the steam velocity in the tube bundle. Since the flow in the outlet side of the tube bundle is vertical downward flow, any entrained drop would reach a free fall velocity of approximately 15 m/sec (50 ft/sec) at the tube exit. The velocities for runs 20610, 21405, and 21502 were well below this lower limit and do not represent the velocity of drops entrained in the tube bundle. The droplet velocities from run 21806 are significantly higher and are representative of the velocity of an entrained drop in the tube bundle.

APPENDIX E

TEST PROCEDURE

The test procedure for the FLECHT SEASET Steam Generator Separate Effects Task is reproduced on the following pages.

FEP-073
Rev. 3
3-20-79

FACILITY ENGINEERING
FLECHT-SEASET STEAM GENERATOR TASK
(WATER INJECTION INTO MIXER SECTION)
TEST PROCEDURE

Prepared by: M. F. McGuire

M. F. McGuire, Engineer
Facility Engineering

APPROVED: L. R. Katz

L. R. Katz, Manager
Facility Engineering

FLECHT-SEASET Steam Generator Task
(Water Injection Into Mixer Section)
Test Procedure

NOTE: Refer to Drawings 1447E35, Sub. 4 and 1447E13, Sub. 3 for location of valves, components and instrumentation.

	Performed by	Date
0 Preliminary Setup		
1.1 Install appropriate spray nozzle in mixer section.	________	______
1.2 Position 192 gallon weight tank on scale at outlet of S/G and separator collection tank drains and fill with cold water just above drain outlets.	________	______
0 Initial Instrument & Valve Setup & Checkout		
2.1 Turn on instrument & control panel power.	________	______
2.2 Turn on strip chart recorders, set on standby. Turn on slow speed as required during heatup.	________	______
2.3 Turn on turbine meter electronics.	________	______
2.4 Check power supply voltages.	________	______
2.5 Turn on DAS	________	______
2.5.1 Reset DAS time & enter run number.	________	______
2.5.2 Clean mag tape heads.	________	______
2.5.3 Mount tape.	________	______
2.5.4 Check paper & ribbon.	________	______
2.5.5 Print out programming & enter any change per cognizant engineer's instructions.	________	______
2.5.6 Record programming on mag tape.	________	______
2.5.7 Scan all channels & check for defective ones, resolve any discrepancies.	________	______

	Performed by	Date
2.6 Check strip chart recorders paper & ink. Mark recorders with date, run number, chart speed and identify pens.		
2.7 Program DAS to monitor heatup at 15 minute scan intervals.		
2.8 Verify operation of facility air-operated control valves by opening & closing valves on manual & auto control mode:		
2.8.1 Check CV-1.		
2.8.2 Check CV-2.		
2.8.3 Check CV-3.		
2.8.4 Check CV-4.		
2.8.5 Check CV-5.		
2.9 Verify operation of facility solenoid valves operated from control panel by opening & closing valves:		
2.9.1 Check SV-1.		
2.9.2 Check SV-2.		
2.9.3 Check SV-3.		
2.9.4 Check SV-4.		
2.9.5 Check SV-5.		
2.9.6 Check SV-6.		
2.9.7 Check SV-7.		
3.0 <u>Filling & Heating up Steam Generator Shell Side</u>		
3.1 Close D/P-51 bypass (E) V-77.		
3.2 Open (E) V-74.		
3.3 Open (E) V-75.		
3.4 Close (E) V-78.		
3.5 Install tygon sight hose on vent valve (E) V-79 and open (E) V-79.		

		Performed by	Date
3.6	Open V-204.		
3.7	Open (E) V-81.		
3.8	Open (E) V-261.		
3.9	Close (E) V-260.		
3.10	Close (E) V-80.		
3.11	Open V-206.		
3.12	Close V-205.		
3.13	Open (E) V-170.		
3.14	Close drain valve (E) V-27.		
3.15	Open (E) V-28.		
3.16	Open (E) V-28A.		
3.17	Open (E) V-30.		
3.18	Turn on demineralized water pump & fill generator shell side to specified level. Use tygon sight tube attached to D/P-51 high side vent valve V-79 to determine level in generator while filling.		
3.19	Close (E) V-30 & turn off demineralized water pump.		
3.20	Close D/P-51 high side (E) V-74.		
3.21	Remove tygon sight hose from (E) V-79, leavel (E) V-79 open.		
3.22	Start S/G recirculation pump by plugging cord into 110 v outlet.		
3.23	Close (E) V-28.		
3.24	Close (E) V-28A.		
3.25	Turn on S/G heater breakers & turn on switch SW-14.		
3.26	Set steam generator heater sheath limits as follows:		

	Performed by	Date
3.26.1 Top Zone: 350°F		
3.26.2 Top Middle Zone: 350°F		
3.26.3 Bottom Middle Zone: 350°F		
3.26.4 Bottom Zone: 400°F		
3.27 Set S/G controller at 250°F.		
3.28 Heatup until temperature reaches 212°F and steam starts coming out vent line, then turn off S/G recirculation pump by pulling plug.		
3.29 Close pump suction side valve V-204.		
3.30 Close pump isolation valve V-206.		
3.31 Open pump line vent V-205.		
3.32 Close vessel vent (E) V-170.		
3.33 Change steam generator heater sheath limits to following values:		
3.33.1 Top Zone: 450°F		
3.33.2 Top Middle Zone: 475°F		
3.33.3 Bottom Middle Zone: 500°F		
3.33.4 Bottom Zone: 650°F		
3.34 Carefully increase controller setpoint and heatup S/G secondary side to a uniform temperature of 525°F (saturation pressure 833 psig) or as otherwise specified. Monitor pressure on PG-7 and internal fluid T/C's on DAS. Increase pressure at a maximum rate of 250 psi per hour.		

4.0 Filling & Heating Water Supply Tank

4.1 Open N_2 line valve (E) V-136.		
4.2 Close V-61.		

		Performed by	Date
4.3	Open tank vent valve V-56.		
4.4	Back off dome loader regulator R-1.		
4.5	Open V-175.		
4.6	Open PG-5 isolation valve V-60.		
4.7	If pressure indicates on PG-5 open V-176, vent, then close, otherwise close V-176.		
4.8	Close V-59.		
4.9	Close V-58.		
4.10	Check setting of BPR-1, should be 250 psi, if not, reset dome pressure.		
4.11	Close drain V-57.		
4.12	Open pump discharge valve V-54.		
4.13	Open V-55.		
4.14	Open V-52.		
4.15	Open V-50.		
4.16	Close drain V-51.		
4.17	Open V-48.		
4.18	Close V-47.		
4.19	Open CV-3, controller on manual mode.		
4.20	Open V-46.		
4.21	Close V-45.		
4.22	Close V-44.		
4.23	Open V-3.		
4.24	Close V-4.		
4 25	Open SV-7 (if installed).		
4.26	Close V-7 (if installed).		

	Performed by	Date
4.27 Align D/P 48 valves as follows for filling vessel:		
4.27.1 Close bypass V-66.		
4.27.2 Close vent V-68.		
4.27.3 Close vent V-67.		
4.27.4 Open V-64.		
4.27.5 Open V-65.		
4.27.6 Close V-69.		
4.27.7 Close V-70.		
4.27.8 Close V-71.		
4.27.9 Open V-72.		
4.28 Open demineralized water fill valve V-49 and fill water supply tank to 85% as indicated on strip chart recorder.		
4.29 Close V-49.		
4.30 Realign D/P 48 valves as follows for zero readings:		
4.30.1 Close V-64.		
4.30.2 Open V-68.		
4.30.3 Open V-71.		
4.30.4 Close V-72.		
4.31 Turn on water supply tank heater breaker.		
4.32 Turn on strip heaters, set limits for 650°F and controller for test specified temperature.		
4.33 Turn on recirculation pump.		
4.34 Monitor heatup on fluid T/C, channel 1.		
4.35 When fluid temperature reaches 212°F and steam comes out vent line (check discharge outside high bay), close vent valve V-56 and continue to heatup to test specified temperature.		

	Performed by	Date
5.0 Instrumentation Valve Alignment & Taking Zero Readings		
5.1 Boiler House		
5.1.1 Open PG-1 isolation valve V-181.		
5.1.2 Open PG-2 isolation valve V-123.		
5.1.3 Open PG-2 isolation valve V-124.		
5.1.4 Close bypass valve V-132.		
5.1.5 Open PG-3 isolation valve V-184.		
5.1.6 Open PG-10 isolation valves V-183 & V-207.		
5.2 Main Loop		
5.2.1 Open PT-80 isolation valve V-11.		
5.2.2 Open PG-4 isolation valve V-12.		
5.2.3 Open PTD-57 isolation valve V-14.		
5.2.4 Open bypass control valve CV-4 PT isolation valve V-166.		
5.2.5 Open PT-81 isolation valve V-15.		
5.2.6 Open PT-84 isolation valve V-17.		
5.2.7 S/G collection tank D/P-49:		
5.2.7.1 Close bypass valve V-120.		
5.2.7.2 Close vent valves V-121 & V-122.		
5.2.7.3 Open high & low side valves V-118 & V-119.		
5.2.7.4 Open V-126.		
5.2.7.5 Close V-125.		
5.2.8 Separator collection tank D/P-50:		
5.2.8.1 Close bypass valve V-129.		
5.2.8.2 Close vent valves V-130 & V-131.		

	Performed by	Date
5.2.8.3 Open high & low side valves V-127 & V-128.		
5.2.8.4 Open V-135.		
5.2.8.5 Close V-134.		
5.3 S/G Instruments		
5.3.1 DP-54:		
5.3.1.1 Close bypass V-75.		
5.3.1.2 Close vents V-76 & V-77.		
5.3.1.3 Open high & low side V-73 & V-74.		
5.3.1.4 Close vent V-133.		
5.3.2 D/P-55:		
5.3.2.1 Close bypass V-83.		
5.3.2.2 Close vents V-84 & V-85.		
5.3.2.3 Open high & low side V-81 & V-82.		
5.3.3 D/P-52:		
5.3.3.1 Close bypass V-88.		
5.3.3.2 Close vents V-89 & V-90.		
5.3.3.3 Open high & low side V-86 & V-87.		
5.3.3.4 Close vent V-80.		
5.3.3.5 Open V-100.		
5.3.3.6 Close vent V-78.		
5.3.4 D/P-53:		
5.3.4.1 Close bypass V-93.		
5.3.4.2 Close vents V-94 & V-95.		
5.3.4.3 Open high & low sides V-91 & V-92.		
5.3.4.4 Close vent V-96.		

	Performed by	Date
5.3.4.5 Open V-99.		
5.3.4.6 Close vent V-98.		
5.3.5 D/P-51: This was setup in Section 3.0.		
5.3.6 PTD-58: This was setup in Section 3.0.		
5.3.7 Close PG-8 isolation valve (E) V-360A.		
5.3.8 Close (E) V-360.		
5.3.9 Open PG-7 isolation valve V-62.		
5.3.10 Close V-63.		
5.4 Pressure Probe D/PT's		
5.4.1 Open D/PT-85 bypass V-138.		
5.4.2 Open D/PT-86 bypass V-143.		
5.4.3 Open D/PT-87 bypass V-148.		
5.4.4 Open D/PT-88 bypass V-153.		
5.4.5 Open D/PT-89 bypass V-158.		
5.4.6 Open D/PT-90 bypass V-163.		
5.5 Steam Probe Valves		
5.5.1 Open V-178.		
5.5.2 Open V-103 thru V-116.		
5.5.3 Open V-101, drain out condensate, then close.		
5.5.4 Open V-102, drain out condensate, then close.		
5.5.5 Close V-178.		
5.5.6 Close V-103 thru V-116.		
5.6 Water Supply System Instruments		
5.6.1 Open PG-5 isolation valve V-60.		
5.6.2 Open PG-6 isolation valve V-53.		
5.6.3 Open PTD-56 isolation valve V-43.		

Performed by Date

5.6.4 D/P-48: This was setup in Section 4.0

5.7 Turn off water supply tank pump (switch SW-8).

5.8 Take DAS printout of all facility transducer and transmitter zero readings, check with expected values and resolve any discrepancies.

5.9 Enter zero readings on DAS mag tape.

5.10 Turn on water supply tank pump (switch SW-8).

5.11 Realign D/P-48 valves for test as follows:

5.11.1 Close vent V-68.
5.11.2 Open bypass V-66.
5.11.3 Close vent V-71.
5.11.4 Open V-72.
5.11.5 Close bypass V-66.
5.11.6 Open high side V-64.

5.12 Realign S/G D/P-51 valves as follows:

5.12.1 Close vent (E) V-79.
5.12.2 Open bypass (E) V-77.
5.12.3 Close vent (E) V-81.
5.12.4 Open (E) V-80.
5.12.5 Close bypass (E) V-77.
5.12.6 Open high side (E) V-74.

6.0 Setting Pressure Probe D/PT Flows

6.1 Close D/PT's 85 thru 90 isolation valves V-186, V-188, V-190, V-192, V-194, V-196, V-198, V-200 and V-202.

6.2 Open tubing drain valves V-187, V-189, V-191, V-193, V-195, V-197, V-199, V-201, V-203, drain water from lines, then close drain valves.

6.3 Open isolation valves V-186, V-188, V-190, V-192, V-194, V-196, V-198, V-200 and V-202.

		Performed by	Date
6.4	Open D/PT-85 high & low side valves V-136 & V-137.		
6.5	Close bypass V-138.		
6.6	Close vent V-140.		
6.7	Open D/PT-86 high & low side valves V-142 & V-141.		
6.8	Close bypass V-143.		
6.9	Close vent V-145.		
6.10	Open D/PT-87 high & low side valves V-146 & V-147.		
6.11	Close bypass V-148.		
6.12	Close vent V-150.		
6.13	Open D/PT-88 high & low side valves V-152 & V-151.		
6.14	Close bypass V-153.		
6.15	Close vent V-155.		
6.16	Open D/PT-89 high & low side valves V-156 & V-157.		
6.17	Close bypass V-158.		
6.18	Close vent V-160.		
6.19	Open D/PT-90 high & low side valves V-162 & V-161.		
6.20	Close bypass V-163.		
6.21	Close vent V-165.		
6.22	Close metering valves V-139, V-168, V-144, V-149, V-169, V-154, V-159, V-170 & V-164.		
6.23	Close N_2 line isolation valve V-172.		
6.24	Close V-173.		
6.25	Close V-171.		
6.26	Vent R-3 dome pressure by backing out top bleed screw with Allen wrench.		
6.27	Open V-182, if pressure indicates on PG-9, open V-173, vent, then close V-173.		

		Performed by	Date
6.28	Open V-171.		
6.29	Set dome pressure on R-3 so that PG-9 reads 100 psi; crack open V-173 to insure R-3 is maintaining pressure, then close V-173.		
6.30	Open V-172.		
6.31	Position one operator at pressure probe manifold to align valves and another operator at DAS to monitor D/PT reading while setting N_2 flow through pressure probe lines. Both operators in communication via head sets.		
6.32	Display Ch-85 on DAS.		
6.33	Open D/PT-85 metering valve V-139 and adjust flow to 0.75 CFH.		
6.34	Open metering valve V-168 until D/P on Ch-85 is positive 0.1 ± .05 psi.		
6.35	Display Ch-86 on DAS.		
6.36	Open metering valve V-144 until D/P on CH-86 is positive 0.1 ± .05 psi.		
6.37	Repeat Steps 6.32 thru 6.36 for D/PT's 87 & 88 using their corresponding metering valves to adjust the D/P.		
6.38	Repeat Steps 6.32 thru 6.36 for D/PT's 89 & 90 using their corresponding metering valves to adjust the D/P.		
6.39	Recheck D/P readings on Ch's 85 thru 90 and make adjustments to appropriate metering valves to bring readings into specified tolerance.		
6.40	On back of this page of procedure, record pressure on PG-9 and flows through metering valves.		

7.0 Main Loop Valve Alignment & Boiler Startup

		Performed by	Date
7.1	Set CV-1 controller on auto mode and adjust setpoint to 6 psi above test specified containment pressure.		
7.2	Set CV-2 controller on manual mode and position valve full open.		

		Performed by	Date
7.3	Set CV-4 controller on auto mode and adjust setpoint to 5 psi above test specified containment pressure.		
7.4	Set CV-5 controller on auto mode and adjust setpoint to test specified containment pressure.		
7.5	Open SV-1.		
7.6	Close SV-2.		
7.7	Open SV-3.		
7.8	Close SV-4.		
7.9	Close SV-5.		
7.10	Close SV-6.		
7.11	Open V-1.		
7.12	Open drain valves V-10 & V-13, drain, then close.		
7.13	Position V-2 half open.		
7.14	Open drain V-179, crack open V-208.		
7.15	Open S/G collection tank valve V-5.		
7.16	Open S/G collection tank valve V-20.		
7.17	Open V-18.		
7.18	Open V-6 downstream of S/G.		
7.19	Open V-19.		
7.20	Open drain valve V-16, drain, then close.		
7.21	Close containment tank drain (E) V-58.		
7.22	Open (E) V-57.		
7.23	Open boiler steam isolation valve V-8.		

	Performed by	Date
7.24 Open CV-6 isolation valve V-9.		
7.25 Open drain valve V-117, drain any water in line, then close.		
7.26 Open feedwater heater inlet steam valve V-21.		
7.27 Check boiler oil supply tank levels; they should be at least 1/3 full prior to boiler startup for test run (tank capacity 550 gal/each).		
7.28 Open oil tank isolation valve V-42.		
7.29 Open city water valve V-185.		
7.30 Open V-22.		
7.31 Close water softener bypass V-23.		
7.32 Position softener solo valve V-79 to "run" position.		
7.33 Open V-24.		
7.34 Close V-180.		
7.35 Open V-25.		
7.36 Open V-26.		
7.37 Open V-27.		
7.38 Open V-28.		
7.39 Close bypass V-29.		
7.40 Open V-33.		
7.41 Close V-35.		
7.42 Close drain V-36.		
7.43 Close V-37.		
7.44 Open V-34.		
7.45 Open V-177.		
7.46 Close boiler level switch drain V-38.		
7.47 Open sight glass valve V-40.		

	Performed by	Date
7.48 Open sight glass valve V-41.		
7.49 Close sight glass drain V-39.		
7.50 Close chemical feeder valve V-30.		
7.51 Close feeder valve V-31.		
7.52 Remove chemical feeder top closure.		
7.53 Open V-32 drain any water, then close.		
7.54 Insert prescribed chemicals in feeder (see facility log book) and reinstall top cap.		
7.55 Open V-30.		
7.56 Open V-31.		
7.57 Verify breakers on wall supplying main power to boiler and feedwater pump are on.		
7.58 Verify high limit pressure trol setting: 125 psig.		
7.59 Verify operating limit pressure trol setting:		
Limit: 120 psig		
Differential: 10 psid		
7.60 Verify low fire hold pressure trol setting:		
Limit: 85 psig		
Differential: 0 psid		
7.61 Verify modulating pressure trol setting: 100 psig.		
7.62 Switch gas/oil selector switch to oil.		
NOTE: Start boiler approximately 2 hours before reaching specified steam generator secondary side temperature.		
7.63 Switch on/off switch to on, purge and ignition sequence should start. If purge and ignition sequence fails to start, proceed as follows:		
7.63.1 Push reset on primary water level control.		

	Performed by	Date
7.63.2 Push reset on high pressure cutout.		
7.63.3 Push reset on fireye (located inside boiler control wiring closure).		
7.63.4 Notify test director if none of the above activates the startup sequence.		
7.64 Monitor boiler heatup and close feedwater heater vent valve V-177 when a good steam flow is obtained in line going to blowdown tank.		
7.65 Position "Authorized Personnel Only" baracades across walkway between boiler house and FATS Loop Building.		
7.66 Adjust auxiliary steam line valve V-1 so that pressure on PG-4 is slightly above (1 to 2 psi) CV-5 setpoint. This will establish bleed flow necessary to heatup and pressurize main loop components. Monitor flow on FM-83 (Ch-83) and maintain flow under 0.12 lbm/sec.		
7.67 Turn on strip chart recorders and set on 20 in/hr. speed.		
7.68 Heatup loop piping and components to test specified temperature, monitor temperature on channels 3, 4, 6, 9, 10, 13, 18, 20, 21 and 22. Make adjustments to CV-1, V-1, CV-4 and CV-5 as required to obtain desired run conditions.		
7.69 Drain S/G and separator collection tanks and containment tank periodically during heatup to remove condensate.		

NOTE: Completely empty tanks and drain piping before test.

	Performed by	Date

8.0 Steam Probe Setup & Checkout

8.1 With containment tank at a minimum pressure of 5 psig, open steam probe manifold vent valve V-101. ________ ________

8.2 Open V-178, check for steam flow out V-101, then close. ________ ________

8.3 Repeat Step 8.2 for steam probe manifold valves V-103 through V-116. Note any valve which appears plugged. ________ ________

8.4 Close V-101. ________ ________

8.5 Fully open V-103 through V-116. ________ ________

8.6 Open V-178 three turns. ________ ________

8.7 Partially fill bucket with ice water, record weight ________ , and position next to steam probe manifold drain valve V-102. ________ ________

8.8 Position discharge line from V-102 into empty collection bucket. ________ ________

9.0 Establishing Steam Flow

9.1 With loop piping & components at specified conditions, adjust CV-2 controller setpoint to a position corresponding to approximately test specified steam flow. (Valve is still on manual control mode.) ________ ________

9.2 Set CV-2 valve position to half open by appropriate adjustment of manual valve positioning thumb wheel, at the same time, increase CV-1 setpoint until test specified flow is achieved as indicated on Ch-768. Adjust CV-2 setpoint so that it coincides with deviation indicator (red arrow). ________ ________

9.3 Switch CV-2 controller to auto mode and make adjustments to proportional band and reset to achieve stable control with desired flow. ________ ________

	Performed by	Date
9.4 Close V-9 in boiler house for specified steam flows 0.4 lb/sec. or higher.		

10.0 Pressurizing Water Supply Tank & Setting Water Flow

10.1 Turn off recirculation pump (SW-8).

10.2 Close V-46.

10.3 Open drain valve V-44, drain condensate until steam appears, then close V-44.

10.4 Open V-45.

10.5 Close CV-3 on manual mode.

10.6 Open N_2 valve V-61.

10.7 Adjust R-1 to obtain test specified water supply tank pressure.

10.8 Open V-59.

10.9 Close V-60 to avoid PG-5 indicator needle vibration while pressurizing.

10.10 Open V-58 and pressurize water supply tank.

10.11 Re-open V-60.

10.12 Set CV-3 controller setpoint to zero & switch valve to auto control setting.

10.13 Slowly increase CV-3 setpoint until flow reaches test specified value as indicated on CH-98. (NOTE: At flows around 0.7 gpm, it may take as long as 2 minutes for water to fill injection pipe to spray nozzle.)

11.0 Running Test

11.1 Set superheater limit to 600°F.

11.2 Set superheater controller to 400°F.

11.3 Turn on superheater breaker.

		Performed by	Date
11.4	Weigh S/G & separator collection tank drain tank and record pretest weight:______________	___________	_______
11.5	Set steam generator heater controller & limit setpoints to 0°F, turn off switch SW-14 & open heater breaker.	___________	_______
11.6	Set water supply tank heater controller & limit setpoints to 0°F & open heater breaker.	___________	_______
11.7	Setup DAS:		
	11.7.1 Program DAS for run.	___________	_______
	11.7.2 Enable mag tape in hex.	___________	_______
	11.7.3 Set single scan interval to 6 seconds.	___________	_______
	11.7.4 Set display to all channels.	___________	_______
	11.7.5 Disable paper printer.	___________	_______
11.8	Open steam probe drain valve V-102 as follows allowing steam to vent to <u>empty</u> collection bucket:		
	11.8.1 For test specified containment tank pressure of 5 psig, position V-102 full open.	___________	_______
	11.8.2 For test specified containment tank pressure of 25 psig, position V-102 two turns open.	___________	_______
	11.8.3 For test specified containment tank pressure of 45 psig, position V-102 1/3 turn open.	___________	_______
11.9	Check CV-5 setpoint & adjust to test specifed value for containment pressure.	___________	_______
11.10	Close drain V-208.	___________	_______
11.11	Start DAS & collect pre-run data for approximately one minute before starting test.	___________	_______
11.12	Reset turbine meter (SW-16) & vortex flow meter totalizers.	___________	_______

	Performed by	Date
11.13 To direct flow to steam generator, perform the following steps in sequence:		
11.13.1 Switch on event marker (SW-9).	______	______
11.13.2 Open SV-2 (wait for valve position indicator light to change before proceeding).	______	______
11.13.3 Close SV-3.	______	______
11.13.4 Close SV-1.	______	______
11.13.5 Switch steam probe drain line to ice bucket.	______	______
11.14 Close V-1.	______	______
11.15 Open S/G and/or separator collection tank drain valves SV-5 and SV-6 when level in respective tanks reaches 90% as indicated on strip chart recorder. Close valves when level drops to 25%. Drain only one tank at a time and record weight of water collected after each drain.	______	______
11.16 To terminate flow to steam generator, perform the following steps in sequence.		
11.16.1 Switch off event marker SW-9.	______	______
11.16.2 Open SV-3.	______	______
11.16.3 Close SV-2.	______	______
11.16.4 Close steam probe drain valve V-102.	______	______
11.17 Record turbine meter & vortex meter totalizer readings:	______	______

Turbine Meter: ____________

Inlet Steam Vortex Meter: ____________

Outlet Steam Vortex Meter: ____________

11.18 Set CV-3 controller on manual control mode and close valve.	______	______

	Performed by	Date
11.19 Allow DAS to run for 5 minutes after test termination, then stop DAS and change run number to all dashes.		
11.20 Record one final scan on mag tape.		
11.21 Turn strip chart recorders to standby.		
11.22 Set superheater controller & limit to 0°F and open heater breaker.		
11.23 Remove DAS mag tape and deliver to computer room for data reduction.		

12.0 Facility Shutdown

	Performed by	Date
12.1 Close water supply tank valve V-45.		
12.2 Fully open CV-3.		
12.3 Close N_2 line valve V-58.		
12.4 Remove dome pressure from R-2 by backing off R-1.		
12.5 Close V-61.		
12.6 Open V-176, vent, then close.		
12.7 Close V-59.		
12.8 Open water supply tank vent V-56 & depressurize tank.		
12.9 Reduce steam flow to approximately 0.14 lb/sec. (500 #/hr.) by reducing CV-2 setpoint (CV-1 setpoint may also require adjustment).		
12.10 In boiler house open V-9 & blowdown line valve V-37.		
12.11 Open level switch blowdown valve V-38 for 2 seconds, then close.		
12.12 Open boiler surface blowdown valve V-167 for 5 seconds, then close.		
12.13 Open boiler bottom blowdown valve V-35 for 10 seconds, then close.		
12.14 Carefully open sight glass blowdown valve V-39 for 2 seconds, then close.		

	Performed by	Date
12.15 Close V-37.		
12.16 Turn boiler on/off switch to off position.		
12.17 Close V-8.		
12.18 Switch CV-5 controller to manual mode and slowly open valve and depressurize containment tank.		
12.19 Switch CV-1 controller to manual mode and fully open valve.		
12.20 Switch CV-2 controller to manual mode and fully open valve.		
12.21 Switch CV-4 controller to manual mode and slowly open valve to depressurize piping back to boiler.		
12.22 Crack open V-8 to allow a small steam bleed and prevent a vacuum from forming when boiler cools down.		
12.23 Remove personnel barricades across walkway between boiler house and FATS Loop Building.		
12.24 Pressure Probe Manifold Depressurization:		
12.24.1 Open D/PT-85 through D/PT-90 bypass valves V-138, V-143, V-148, V-153, V-158 and V-163.		
12.24.2 Close D/PT-85 & 86 isolation valves V-186, V-188 & V-190.		
12.24.3 Close D/PT-87 & 88 isolation valves V-192, V-194 & V-196.		
12.24.4 Close D/PT-89 & 90 isolation valves V-198, V-200 & V-202.		
12.24.5 Close N_2 line valve V-171.		
12.24.6 Open vent valve V-173, vent off pressure in lines, then close V-173.		
12.24.7 Vent pressure off R-3 dome.		

		Performed by	Date
	12.24.8 Close V-173.	________	______
12.25	Record water weight in steam probe collection bucket: ________	________	______
12.26	Open SV-5, drain and record weight of water collected: ________	________	______
12.27	Open SV-6, drain and record weight of water collected: ________	________	______
12.28	Open V-179, drain and record weight of water left on inlet side of S/G: ________	________	______
12.29	Collect all heatup data and charts and give to cognizant engineer.	________	______
12.30	Turn off instrument panel power at end of day.	________	______
12.31	Crack open steam generator vent (E) V-170 to depressurize secondary side.	________	______

APPENDIX F

SHAKEDOWN TESTS

F-1. SHAKEDOWN TEST OBJECTIVES

After construction of the test loop was complete, a series of shakedown tests were run to verify that the instrumentation and loop components would perform as desired. In-place calibration checks were also run on the flowmeters and liquid collection tanks. The loop behavior with two-phase flow was checked by a series of tests with the steam generator isolated. In these tests the performance of the steam-water mixer was isolated and measured. A series of single-phase heat transfer tests were run which enabled a heat flux dependent correction factor to be calculated and applied to the measured tube wall temperatures in later two-phase flow heat transfer tests.

F-2. VERIFICATION TESTS

Verification tests are generally qualitative tests that confirm the correct functioning of the system. The data acquisition system wiring verification test consisted of applying a signal at the test instrument sensors and observing a response by the associated data channel in the data logger. The loop differential pressure cell responses were recorded with and without loop pressure to verify that the differential pressure cells' output did not change with loop pressure. The elevation of the thermocouples in the tube bundle was checked by filling the tube bundle with cold water to a known elevation and observing a response in the thermocouples at that elevation. The differential pressure probes in the inlet primary side of the tube bundle were checked by filling the tube bundle to the 0.6- and 1.2-meter (2- and 4-foot) elevations and recording the differential pressures from the six differential pressure transducers. In this test, the calculated void fraction in the tubes due to the nitrogen purge gas was 25 percent, the calculated differential pressure was 4.5 kPa (0.65 psi) and the measured differential pressure ranged from 4.1 to 4.8 kPa (0.60 to 0.70 psi). Because the measured differential pressure was in reasonable agreement with the known differential pressure, this test confirmed the satisfactory operation of the continuous purge in the tube bundle.

F-3 ONTROL AND CALIBRATION TESTS

Shakedown tests were run to verify the correct functioning of all automatic control circuits and all remote manually controlled components. The manually controlled components are the solenoid valves in the test loop which are controlled from the centrally located control station adjacent to the data logger and bank of strip chart recorders. The manually controlled solenoid valves were used to isolate the tube bundle prior to the test, to switch the flow to the bundle at test initiation, and to drain the liquid collection tanks during the test as required. Flow control valves are provided to regulate the boiler and water supply tank flow to the bundle, and pressure control valves regulate pressure at the containment tank, in the bypass line dump to atmosphere and upstream of the boiler flow control valve. Controls are provided on the electric resistance strip heaters on the water supply tank and the steam generator shell; these controls turn off the heaters when the wall temperature reaches a preset value.

The solenoid valve verification tests consisted of actuating the valves remotely at the control station and observing at the valve that the local valve position indicator agreed with the valve position indication at the control station. The flow and pressure control valve tests consisted of operating the loop in the bypass mode at matrix test conditions and observing on the continuous strip charts that the loop flow and pressure were stable. The liquid supply tank and the steam generator tube bundle were warmed up to test conditions using the strip heaters. A recirculation pump in the liquid supply tank prevented stratification and the warmup was monitored on channel 1. The warmup test demonstrated that the liquid supply tank heater controls would maintain the water at the desired temperature for the matrix tests.

The steam generator bundle strip heaters are controlled in four axial banks. To achieve a uniform temperature in the stagnant secondary water, the upper banks of heaters are set to control points below the desired temperature and the final stages of the heatup are achieved with power to the lowest bank only. In the warmup test on the steam generator, the desired temperature was 204^{o}C (400^{o}F) and the measured bundle temperatures were within a standard deviation of 0.9^{o}C (1.6^{o}F). This test confirmed the adequacy of the bundle warmup procedure to achieve an isothermal condition.

In-place calibration checks were run on the three flow meters in the test loop. The turbine meter calibration was checked by collecting and weighing the effluent from the turbine meter over a fixed time interval. The results of this test showed that the turbine meter average flow rate agreed with the calculated flow rate to within 0.75 percent.

The vortex meter calibrations were checked by running steam from the boiler through the loop bypassing the steam generator. Because the feedwater flow into the boiler was monitored with a water meter and all boiler steam flowed through both vortex meters, a calibration check of both vortex meters against the water meter was feasible. Results of this test are presented in table F-1. During the 0.414 MPa (60 psia) test, liquid accumulation was observed in the steam separator collection tank. The source of the liquid was believed to be boiler carryover. The calculated liquid flow rate was 7.7 g/sec (0.017 lb/sec). With this amount subtracted from the boiler feed flow rate, the differences in the 0.414 MPa (60 psia) test would be less than 1 percent. Following this test, the boiler carryover was investigated. After the boiler was chemically cleaned (based on the supplier's recommendation) to eliminate carryover, several tests were run to measure carryover, using the loop moisture separator to separate and collect entrained moisture in the boiler steam. The loop was lined up in the bypass mode with the steam generator bundle isolated. These tests were run at flow rates of 0.14 and 0.27 kg/sec (0.31 and 0.59 lb/sec). The measured carryover was less than 0.10 percent of the steam flow; thus the problem was assumed to have been eliminated by cleaning the boiler. During the matrix tests, carryover tests were repeated with no indication of significant carryover. After the carryover tests, the vortex meter calibration checks at 0.276 and 0.414 MPa (40 and 60 psia) were rerun. Results of these tests showed that at 0.276 MPa (40 psia) the vortex meters agreed with the boiler feedwater meter to within 0.75 percent; at 0.414 MPa (60 psia) the agreement was within 1.0 percent. Because the vortex meters could only be

TABLE F-1

VORTEX METER CALIBRATION CHECK

Loop Pressure [MPa (psia)]	Boiler Feed Flow Rate [kg/sec (lb/sec)]	Boiler Vortex Meter Flow Rate [kg/sec (lb/sec)]	Exhaust Vortex Meter Flow Rate [kg/sec (lb/sec)]	Difference (%)		
				Boiler Vortex - Feed Flow Meter	Exhaust Vortex - Feed Flow Meter	Exhaust Vortex - Boiler Vortex Meter
0.138(20)	0.175(0.385)	0.176(0.389)	0.185(0.407)	1	5.6	4.6
0.276(40)	0.177(0.391)	0.180(0.397)	0.183(0.404)	1.5	3.2	1.7
0.414(60)	0.210(0.463)	0.203(0.447)	0.201(0.443)	-4.5	-4.3	-1.0

compared to the boiler feedwater meter, this meter calibration was checked by collecting and weighing a fixed volume of feedwater. The boiler feedwater meter error was found to be less than 1 percent.

The four liquid collection and storage tanks in the test loop were calibrated by measuring the differential pressure in the tank with a known mass of water in the tank. From a plot of the water mass versus the differential pressure, the slope of the least-square fit straight line was calculated and used in the data reduction programs to calculate the mass of water in the tank. The equation used was

$$m_f = A_o \Delta P + M_o \qquad \text{(F-1)}$$

where

m_f = mass of liquid in the tank [kg (lb)]

A_o = least-square fit coefficient defined above

M_o = residual mass of liquid in the tank between the isolation valve and the lower tap on the differential pressure cell

ΔP = tank differential pressure [kPa (psi)]

The numerical values used in equation (F-1) are given in table F-2.

A shakedown test was run to measure the loop and tube bundle heat losses to ambient temperature. This test was run by heating up the loop and bundle to test conditions, and then isolating the loop and recording the rate of decrease of temperature with time. The heat loss was then calculated from the temperature loss and component heat capacity. The measured heat loss from the loop piping was less than 1.1 kw (1 Btu/sec) and the heat loss through the steam generator shell was less than 5.3 kw (5 Btu/sec). The loop heat loss represents less than 1 percent of the energy transfer to the fluid in the primary loop, and the bundle heat loss represents less than 2 percent of the stored energy initially in the steam generator. These heat loss terms were neglected in reduction of the data.

TABLE F-2

WATER COLLECTION AND STORAGE TANK DATA REDUCTION PARAMETERS[a]

Tank	A_0 [kg/kPa(lb/psi)]	M_0 [kg(lb)]
Water supply tank	27.98(425.9)	N/A
Steam generator collection tank	1.926(29.32)	0.830(1.83)
Steam generator outlet plenum	2.480(37.75)	2.41(5.31)[b] 1.50(3.3)[c]
Loop separator collection tank	0.5091(7.75)	1.44(3.18)

a. From equation (F-1)

b. Applicable when valve V-5 used for isolation

c. Applicable when valve V-20 used for isolation and pipe volume between V-5 and V-20 was prefilled with water

Three shakedown tests were run to demonstrate that the water injection nozzle was able to atomize the liquid sufficiently to enable the drops to become entrained in the steam and be carried to the loop separator, where the liquid could be separated and collected. Because the vortex meters were out of service during these tests, the boiler steam flow rate was controlled manually and was measured with the feedwater meter. The data were evaluated by comparing the liquid injection mass flow rate with the liquid collection mass flow rate. A summary of the test data is presented in table F-3. The data show that for the range of flow rates in the test, the liquid component of the two-phase primary side flow will be entrained and carried along with the steam and separated out by the loop moisture separator.

TABLE F-3

LIQUID INJECTION SHAKEDOWN TEST

Loop Presure [MPa(psia)]	Steam Flow [kg/sec(lb/sec)]	Liquid Injection Flow [kg/sec(lb/sec)]	Inlet Quality	Liquid Collection Rate [kg/sec(lb/sec)]
0.276(40)	0.19(0.42)	0.046(0.10)	0.81	0.047(0.10)
0.276(40)	0.12(0.26)	0.11(0.25)	0.51	0.12(0.26)
0.276(40)	0.05(0.12)	0.18(0.40)	0.23	0.19(0.41)

The final series of shakedown tests were run to calibrate the bundle thermocouples for the local heat flux measurement. In these tests, the primary side flow was single-phase steam or liquid. From the measured secondary fluid and primary side steam probe measurements, the local heat flux was calculated using equation (F-2):

$$q_{i,j} = U_{OVERALL} \; T_{fl_{i,j}} - T_{p_{i,j}} \qquad \text{(F-2)}$$

where

$q_{i,j}$ = local tube wall heat flux at location i,j (Btu/sec-ft^2)

$U_{OVERALL}$ = overall heat transfer coefficient at location i,j

$T_{fl_{i,j}}$ = measured or interpolated secondary fluid temperature at location i,j

$T_{p_{i,j}}$ = measured or interpolated steam probe temperature at location i,j

i = radial position index $1 \leq i \leq 4$

j = axial position index $1 \leq i \leq 29$

The overall heat transfer coefficient was calculated from

$$\frac{1}{U_{OVERALL}} = \frac{1}{h_s} + \frac{1}{h_p} \qquad \text{(F-3)}$$

where

h_s = natural convection secondary side film coefficient

h_p = forced convection primary side film coefficient

The secondary side film coefficient was calculated from the correlation given in appendix I, paragraph I-9, and the primary film coefficient was calculated from the Dittus-Boelter or Sieder-Tate turbulent flow correlations or the Sieder-Tate laminar flow correlation. The turbulent flow correlations were modified by including an entrance effect factor from Nusselt.(1) The calculated heat flux and secondary film coefficient and measured secondary fluid temperature were used to calculate the tube wall temperature:

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1. Nusselt, W., "Der Wärmeaustausch zwischen Wand and Wasser im Rohr," Forsch. Geb. Ingenieur-wes. 2, 309 (1931).

$$q_{i,j} = h_s (T_{fl_{i,j}} - T_{wc_{i,j}}) \qquad \text{(F-4)}$$

where

$T_{wc_{i,j}}$ = calculated tube wall temperature at location i,j

The tube wall correction factor could then be calculated and plotted against the local heat flux:

$$\Delta T = T_{w_{i,j}} - T_{wc_{i,j}} \qquad \text{(F-5)}$$

where

$\Delta T_{i,j}$ = temperature correction at location i,j for $q_{i,j}$

$T_{w_{i,j}}$ = measured or interpolated tube wall temperature at location i,j

Examples of the correction factor plotted versus local heat flux for four nodal positions in the tube bundle are shown in figures F-1 through F-4. Also shown on these figures is the linear tube wall temperature correction factor derived from the shakedown tests and used in calculating the local heat flux from the secondary fluid temperature and measured tube wall temperature. The tube wall temperature correction factor lines were generated by estimating the slope and intercept of the line that best fit the data. In cases where a consistent trend in the single-phase steam and single-phase liquid correction factor was not apparent, the line which best fit most of the data was chosen. In figures F-1 through F-4, the data point symbols 1, 2, 3, and the asterisks are the liquid-phase test data points and the data point symbol 4 is from the single-phase steam shakedown test run. Figures F-1 through F-4 illustrate the development of the correction factors for four specific nodal locations in the tube bundle. This same procedure was repeated for all 116 modes in the tube bundle; the results are given in table F-4.

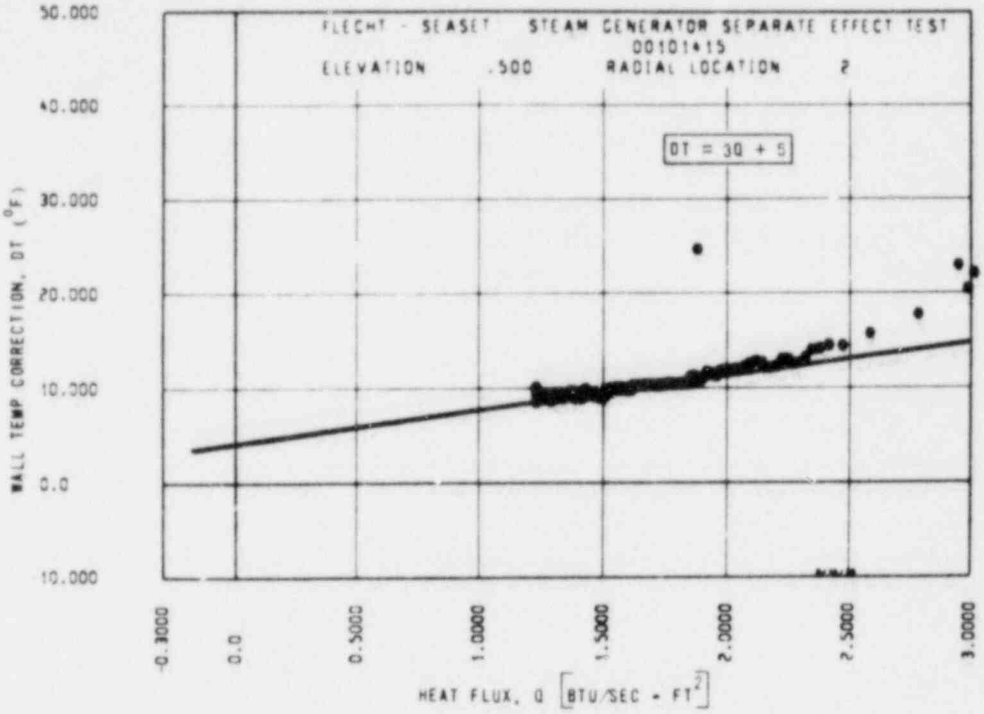


Figure F-1. Tube Wall Temperature Correction Factor for Node (1,2)

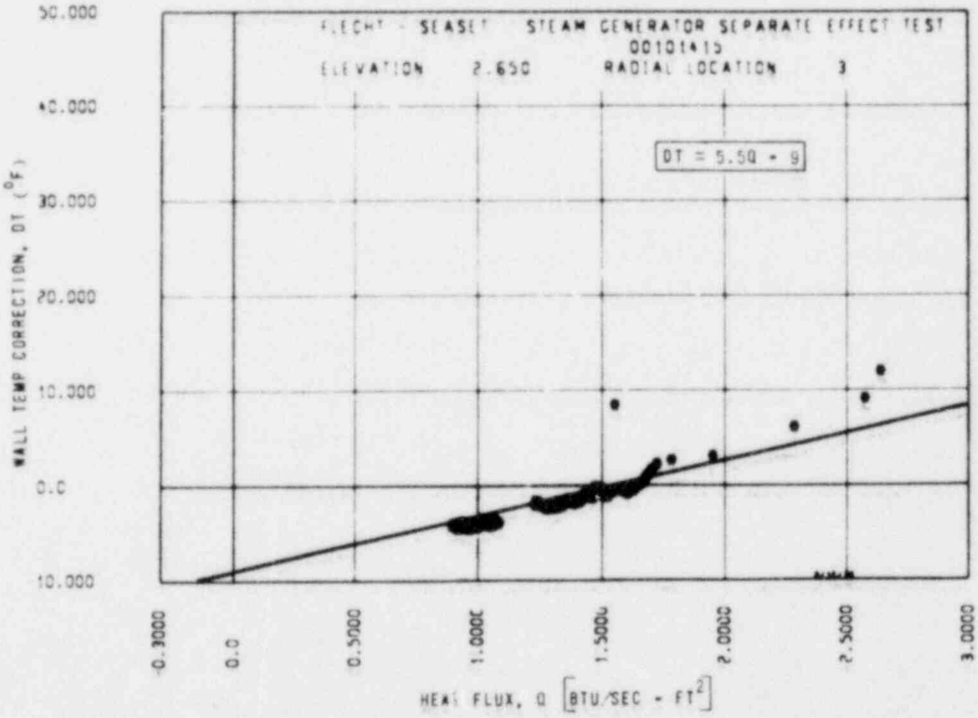


Figure F-2. Tube Wall Temperature Correction Factor for Node (4,5)

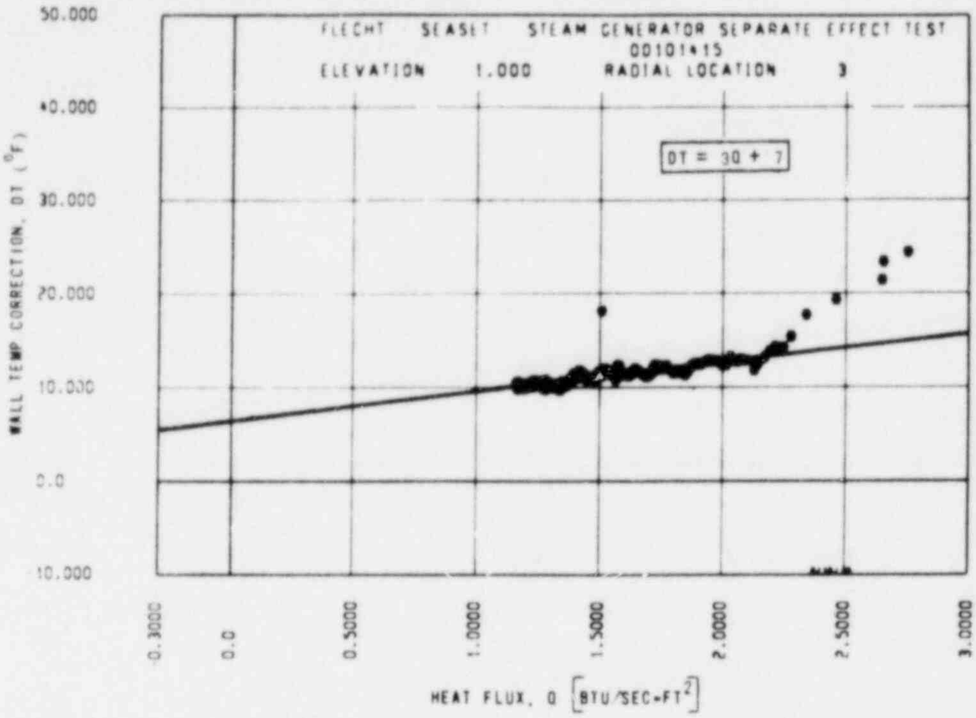


Figure F-3. Tube Wall Temperature Correction Factor for Node (6,3)

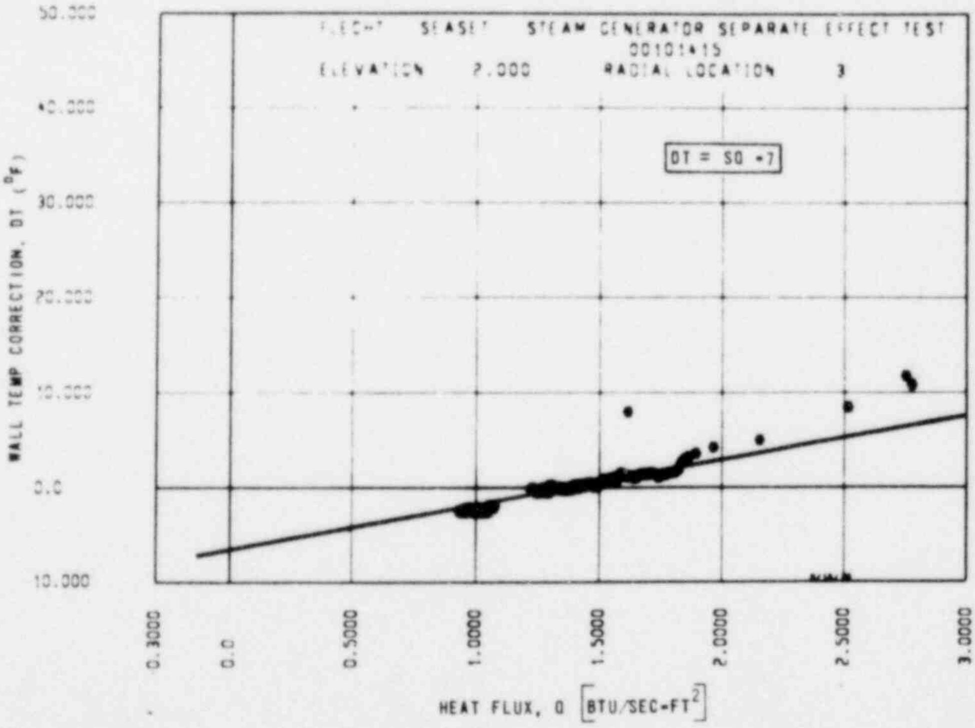


Figure F-4. Tube Wall Temperature Correction Factor for Node (7,1)

TABLE F-4

TUBE WALL TEMPERATURE CORRECTION FACTORS

Distance from Tube Entrance [m(ft)] (Index)	Radial Position (Index)	Slope[a] A	Intercept[a] B
0.038(0.125)	1	20	10
(1)	2	0	40
	3	2	0
	4	0	40
0.15(0.50)	1	5	5
(2)	2	3	5
	3	4	5
	4	2.5	5
0.30(1.0)	1	3	7.5
(3)	2	3.5	4
	3	3	7
	4	5	0
0.46(1.5)	1	6	2
(4)	2	5	5
	3	3	8
	4	6	2
0.61(2.0)	1	5	30
(5)	2	6	5
	3	5	-7
	4	0	0
0.802(2.63)	1	35	0
(6)	2	8	2
	3	5.5	-9
	4	0	0

a. $\Delta T_{ij} = (A_{i,j})(q_{i,j}) + B_{i,j}$

TABLE F-4 (cont)

TUBE WALL TEMPERATURE CORRECTION FACTORS

Distance from Tube Entrance [m(ft)] (Index)	Radial Position (Index)	Slope[a] A	Intercept[a] B
1.2(4.0)	1	4	-1
(7)	2	5	0
	3	5.5	0
	4	10	20
1.8(6.0)	1	0	0
(8)	2	0	3.3
	3	0	11
	4	0	20
2.4(8.0)	1	0	0
(9)	2	3.3	0
	3	17	0
	4	0	15
3.0(10)	1	10	0
(10)	2	10	0
	3	8	0
	4	10	0
3.7(12)	1	10	0
(11)	2	8	0
	3	0	0
	4	0	-5
4.6(15.0)	1	0	7
(12)	2	0	3
	3	0	0
	4	0	-3.3

a. $\Delta_{i,j} = (A_{i,j})(q_{i,j}) + B_{i,j}$

TABLE F-4 (cont)

TUBE WALL TEMPERATURE CORRECTION FACTORS

Distance from Tube Entrance [m(ft)] (Index)	Radial Position (Index)	Slope[(a)] A	Intercept[(a)] B
6.1(20)	1	7	2
(13)	2	6	2
	3	0	2
	4	0	0
8.2(27)	1	0	2
(14)	2	14	1
	3	0	0
	4	0	0
11(35)	1	0	0
(15)	2	0	0
	3	0	0
	4	0	0
13(43)	1	0	0
(16)	2	0	0
	3	0	0
	4	0	0
15(50)	1	0	0
(17)	2	0	0
	3	0	0
	4	0	0
17(55)	1	0	0
(18)	2	0	0
	3	0	0
	4	0	0

a. $\Delta T_{i,j} = (A_{i,j})(q_{i,j}) + B_{i,j}$

TABLE F-4 (cont)

TUBE WALL TEMPERATURE CORRECTION FACTORS

Distance from Tube Entrance [m(ft)] (Index)	Radial Position (Index)	Slope[(a)] A	Intercept[(a)] B
17.7(58)	1	20	0
(19)	2	20	0
	3	20	0
	4	12	0
18.2(60)	1	14	0
(20)	2	15	0
	3	10	0
	4	0	0
18.9(62)	1	25	0
(21)	2	0	0
	3	0	0
	4	0	0
19.5(64)	1	0	0
(22)	2	0	0
	3	0	0
	4	15	0
20.1(66)	1	0	0
(23)	2	0	0
	3	0	0
	4	6	0
20.54(67.38)	1	0	0
(24)	2	0	0
	3	0	0
	4	8	0

a. $\Delta T_{i,j} = (A_{i,j})(q_{i,j}) + B_{i,j}$

TABLE F-4 (cont)

TUBE WALL TEMPERATURE CORRECTION FACTORS

Distance from Tube Entrance [m(ft)] (Index)	Radial Position (Index)	Slope[a] A	Intercept[a] B
20.7(68)	1	10	2
(25)	2	9	1
	3	10	2
	4	10	2
20.9(68.5)	1	12	0
(26)	2	12	-1
	3	12	0
	4	15	0
21.0(69)	1	6	10
(27)	2	4	9
	3	5	10
	4	5	10
21.2(69.5)	1	20	2
(28)	2	22	1
	3	20	1
	4	20	1
21.30(69.88)	1	0	5
(29)	2	16	2
	3	0	0
	4	15	0

a. $\Delta T_{i,j} = (A_{i,j})(q_{i,j}) + B_{i,j}$

APPENDIX G

STEAM GENERATOR LOWER PLENUM DIVIDER PLATE AND GASKET SEAL PROBLEM

In November 1978, during facility shakedown testing, leakage was discovered across the steam generator lower plenum divider plate. The leak rate was considered of sufficient magnitude to necessitate repair. Inspection of the plenum through the view ports and 13 cm (5 in.) outlet nozzle showed leakage past the plenum divider plate to the instrument ring center partition seal and past the instrument ring center partition to the tubesheet seal.

Various techniques were tried to effect a seal. The problem was complicated by the fact that the gasket between the instrument ring and tubesheet could not be removed without completely disassembling and removing the primary side instrumentation. This would have involved a major reinstrumentation effort. A gasket seal was finally produced; however, it was then discovered that the 1.3 cm (0.5 in.) thick plenum divider plate was cracked across its width approximately half the distance between the top and bottom of the plenum. An in-place weld repair of the crack was not possible and an immediate and permanent repair would have involved extensive facility downtime. Instead, as a temporary solution to the problem, an epoxy compound was used to seal the crack.

Frequent leak checks were performed to monitor the leak rate and ensure that the leakage was maintained within acceptable limits. The leak check consisted of filling the inlet plenum and tube bundle with cold water to an elevation that approximated twice the nominal pressure drop seen across the generator during the FLECHT SET Phase B Test Series (approximately 14 kPa (2 psid). The leak rate was checked by timing the drop in level in a sight tube connected to the inlet plenum. This was then converted to a volumetric leak rate using the known flow area of the steam generator tubes. Table G-1 presents the results of the plenum divider plate leak rate checks performed during the course of the test series. A leak rate less than 1 percent of the lowest test-specified water injection rate [0.45 cm^3/sec (0.0072 gal/min)] was considered low enough not to affect test results.

TABLE G-1

STEAM GENERATOR LOWER PLENUM DIVIDER PLENUM
LEAK TEST RESULTS

Date	Head[(a)] [m(ft)]	Leak Rate [cm^3/sec(gal/min)]	Comments
12/14/78	3.35(11.0)	0.063 (0.0010)	First leak check after epoxy seal
1/04/79	1.2(4.0)	0.032 (0.0005)	
1/24/79	1.2(4.0)	0.15 (0.0024)	
2/07/79	1.2(4.0)	0.088 (0.0014)	First leak check after start of matrix testing
2/12/79	0.357(1.17)	0.00 (0.00)	Hot leak check at 131°C (267°F) for 15 minutes
2/19/79	1.50(4.92)	0.14 (0.0022)	
2/27/79	1.37(4.50)	0.063 (0.0010)	
3/12/79	1.27(4.17)	0.05 (0.0008)	
3/19/79	1.37(4.50)	0.10 (0.0016)	
3/29/79	1.5(5.0)	0.14 (0.0022)	
4/16/79	1.47(4.83)	0.43 (0.0068)	Increased leak rate warranted further investigation
4/17/79	1.45(4.75)	0.082 (0.0013)	Inspected divider plate, leak did not appear bad

a. Liquid heads were referenced from top of generator tubesheet. The location of the divider plate leak was approximately 71 cm (28 in.) below the top of the tubesheet.

TABLE G-1 (cont)

STEAM GENERATOR LOWER PLENUM DIVIDER PLENUM
LEAK TEST RESULTS

Date	Head[a] [m(ft)]	Leak Rate [cm^3/sec(gal/min)]	Comments
4/18/99 - 4/20/79			Matrix tests 00203315, 00203402, and 00203505 completed
4/23/79	1.2(4.0)	1.38 (0.0218)	Leak rate significant and confirmed by water collection in drain tank
4/24/79	1.42(4.67)	0.55 (0.0087)	Inspected divider plate, leakage visible
4/25/79	1.42(4.67)	0.00 (0.00)	Leak sealed with epoxy
4/27/79			Matrix test 00203605 performed
4/30/79	1.4(4.5)	0.0063 (0.0001)	Final leak check after matrix testing

a. Liquid heads were referenced from top of generator tubesheet. The location of the divider plate leak was approximately 71cm (28 in.) below the top of the tubesheet.

In addition to the cold leak tests, one hot leak test was performed on the divider plate near the beginning of matrix testing. Here the test loop was pressurized with steam to 0.276 MPa (40 psia) and the inlet plenum was filled with saturated water at 131°C (267°F) until the generator differential pressure reading (channel 55) showed 6.9 kPa (1 psi). No change in reading was apparent after 15 minutes, indicating no measurable leakage.

Leak rate checks performed on 4/16, 4/17, 4/23, and 4/24 (table G-1) showed deterioration of the divider plate seal with a tendency for the leak to be self-sealing. Deterioration of the seal from 4/16 to 4/24 was confirmed by a visual inspection of the divider plate. This was done with the help of a mirror and lights inserted through the steam generator 13 cm (5 in.) outlet nozzle.

Another epoxy seal repair was made on 4/25; a cold leak test performed subsequent to the repair showed no leakage. Matrix test no. 5 was repeated to assess the effect, if any, of the increased leakage after 4/16. No leakage effect could be determined from the test data and a final cold divider plate leak test performed after this matrix test indicated negligible leakage.

The reference run liquid injection flow rate was 0.49 cm^3/sec (0.78 gal/min). Except for the leak rates measured on 4/23 and 4/24, the measured leak rates ranged from zero leakage to 1 percent of the liquid injection flow rate. The typical leak rate was 0.3 percent of the liquid injection flow. Assuming that this leak rate was present during the reference run would account for approximately 0.2 kg (0.5 lb) of liquid in the outlet plenum. During the reference run, approximately 4.5 kg (10 lb) of liquid were collected in the outlet plenum. Therefore, the plenum leak was assumed to be negligible and to have had no significant effect on the test data.

APPENDIX H

DATA TABLES AND PLOTS

This section contains the data from the 20 tests in the steam generator separate effects test matrix described in paragraph 4-1. The reported data consist of summary sheets, computer plots of specific data channels, computer plots of quantities derived from the test data, and selected scans of the bundle thermocouples plotted in isometric form. The pages (after H-3) are numbered by test number.

The data summary sheet contains the run number, time-averaged test boundary conditions, initial bundle fluid temperature and level, three components of the overall mass balance, a list of failed bundle thermocouples, and the overall energy loss from the tube bundle and secondary fluid and bundle housing. The data in the summary sheet and plots are given in metric units, with English units in parentheses. The time-averaged test boundary conditions in section A of the summary sheet are averaged over the test time, reported as item A-7. The initial temperature represents the average of the secondary fluid thermocouples at the given elevation.

The mass balance components reported in the summary sheet include the amount of steam that left the test loop through the steam probes. This steam was not tracked by the data acquisition system. The purged steam was collected in an ice bath which was weighed after the test to determine its mass. After the loop was isolated at the end of the test, the hot leg was drained and the liquid collected and weighed. The outlet plenum liquid collection in the summary sheet was calculated from the differential pressure (ΔP) cell monitoring the liquid collection during the test. The liquid mass was calculated from the equation

$$\text{Collected liquid} = (A)(\Delta P) + M_o \qquad \text{(H-1)}$$

where

ΔP = differential pressure [kPa(psi)]

A = collection tank or outlet plenum cross section area [m^2 (in^2)]

M_o = initial mass of liquid below the lower ΔP cell pressure tap [kg(lb)]

The M_o term is necessary because the liquid collection tanks have a volume below the lower tap that must be filled before the ΔP cell responds to the mass accumulation. For this reason, the plots of ΔP versus time appear to be unresponsive until the M_o volume is filled. The rate of mass accumulation in this interval is equal to M_o divided by the time when the ΔP cell first responded.

The mass balance error reported in table 4-2 includes the terms in section C of the summary sheets. The computer-plotted mass balance shown in the data plots does not account for the steam lost through the aspirating steam probes. The computer-generated mass balance also calculates the liquid stored in the hot leg and inlet plenum from the installed ΔP cells rather than from the measurement of the liquid drained from the hot leg following the test.

The list of failed bundle thermocouples in the summary sheet is based on the thermocouple response after the test run, when the fluid temperature in the bundle was stratified. Bundle thermocouples which were significantly different from the majority of the thermocouples at the same elevation are flagged as failed thermocouples.

The summary sheet contains two measures of the overall energy exchange. One calculation is based on the primary loop parameters and the other is based on the local heat flux. In the steam generator data reduction program SGFLOWS, the change in energy flow (mass flow times enthalpy) from inlet to outlet plenum is calculated from the primary loop data. This rate is integrated over time to get the total energy exchange. In the second method, the bundle temperatures were used to calculate local heat flux and quality using the data reduction programs SGTEMPS and SGFLUX. The local heat flux is integrated over the tube bundle using the weighting factors described in paragraph 4-4 and the overall heat transfer rate is integrated over time to find the total energy exchange. The upper time limit on this integral is the approximate time of tube quench at the 1.2-meter (4-foot) elevation, because the bundle heat flux was found to be grossly in error for times beyond this time.

The following test data and derived data are included in the data package following the summary sheets:

- Boiler steam flow rate - channel 96
- Accumulator liquid flow rate - channel 98
- Containment steam flow rate - channel 97
- Outlet plenum differential pressure - channel 53
- Containment tank pressure - channel 84
- Mixer pressure - channel 57
- Hot leg differential pressure - channel 54
- Inlet plenum differential pressure - channel 52
- Inlet plenum steam probe temperature - channel 7
- Outlet plenum exit vapor temperature - channel 12
- Superheater power - channel 59
- Superheater exhaust fluid temperature - channel 65
- Mass balance - derived from SGFLOWS
- Secondary to primary heat flow rate - derived from SGFLOWS
- Inlet plenum quality - derived from SGFLOWS
- Outlet plenum quality - derived from SGFLOWS
- Plots of secondary fluid, tube wall, and primary steam temperature versus time for 1-, 4-, and 10-foot elevations in the inlet and outlet tube bundle regions for the first and fourth radial position - from SGTEMPS
- Isometric plots of the secondary fluid at four discrete test times - from SGTEMPS
- Fluid temperature versus distance above tubesheet for radial position no. 1 plotted on rectangular and semilogarithmic coordinates - from SGTEMPS
- Table of local heat flux and quality versus elevation and time - from SGFLUX

All of the plots show the parameter change with time, with time zero defined as the beginning of the test. The plots are presented in a dual metric/English unit system with the metric scale on the major Y-axis. The English unit scale is plotted with tick marks on the right-hand Y-axis of the plot. The major grid lines are subdivided into five subintervals with tick marks on the plot axes.

SUMMARY SHEET

RUN NO. 20904

DATE: 2/28/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.179 (0.395)
2. Water flow - [kg/sec (lb/sec)] - 0.045 (0.100)
3. Containment tank pressure [kPa (psig)] - 310 (45)
4. Steam temperature [^{o}C (^{o}F)] - 162 (324)
5. Water temperature [^{o}C (^{o}F)] - 138 (281)
6. Mixer pressure [kPa (psig)] - 331 (48)
7. Test time (sec) - 1440.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 9.8 (32.3)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	271 (520)
0.15 (0.50)	271 (520)
0.30 (1.00)	271 (520)
0.46 (1.50)	274 (525)
0.61 (2.00)	274 (525)
1.22 (4.00)	274 (525)
3.05 (10.00)	274 (525)
6.09 (20.00)	274 (525)
8.23 (27.00)	274 (525)
10.67 (35.00)	274 (525)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 4.30 (9.47)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 3.29 (7.26)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 0.82 (1.80)

D. FAILED BUNDLE T/Cs[1]

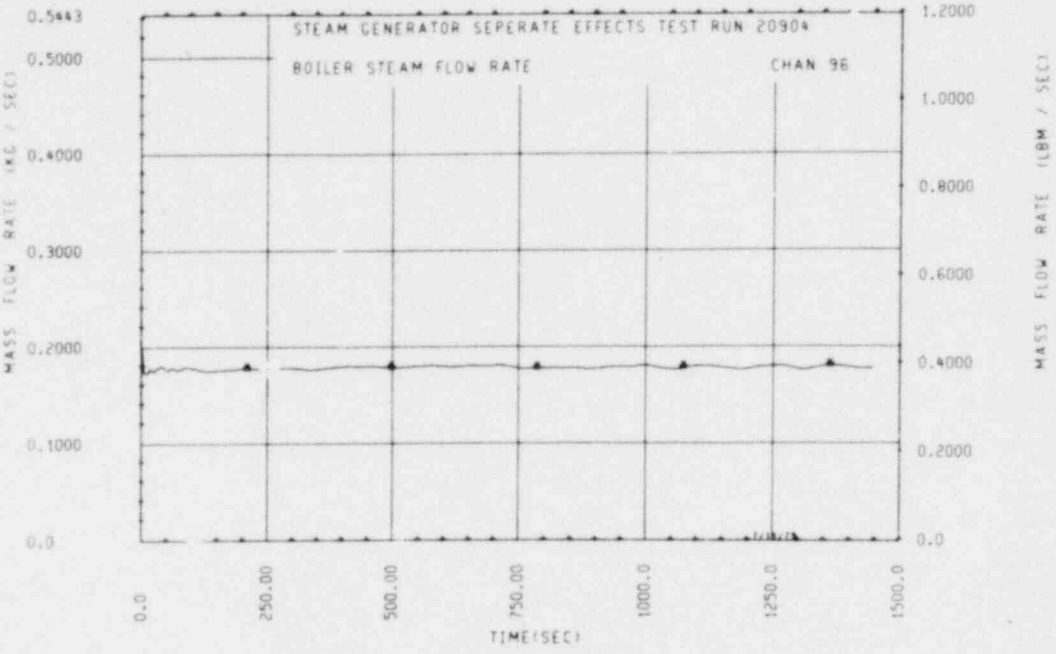
295, 305, 311, 321, 326, 549, 553, 555, 564, 565, 566, 568, 570

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

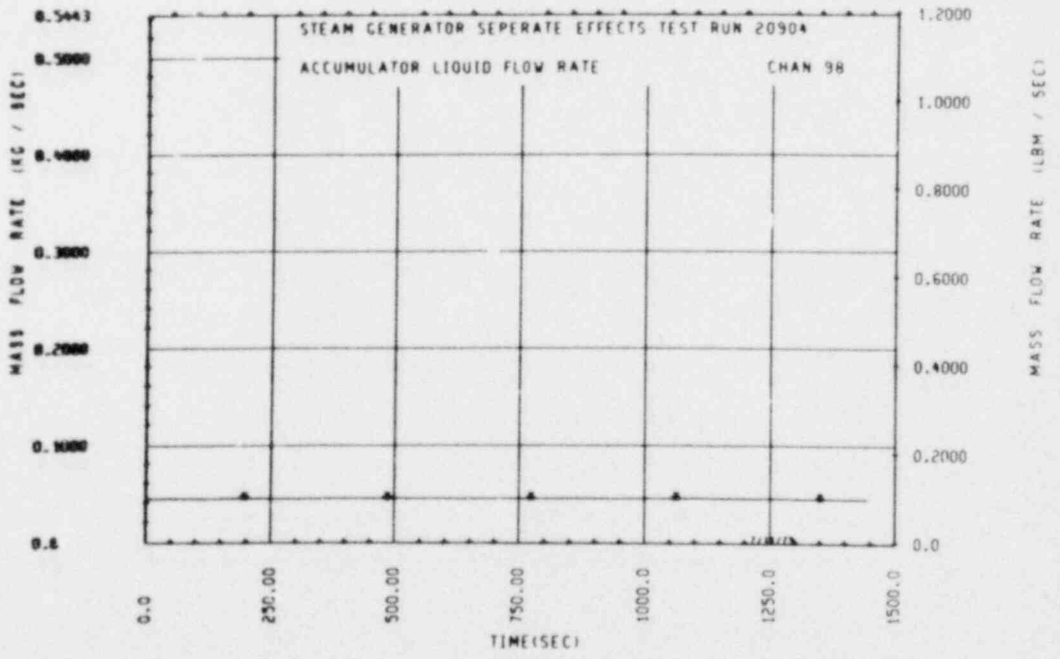
1. From primary side energy balance [kwsec(Btu)] - 0.581×10^5 (0.554×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da\,dt$) -[kwsec(Btu)] - 1.438×10^5 (0.561×10^5)
3. Integration to 600 sec

---

1. T/Cs are defined as failed based on resistance reading or T/C response.

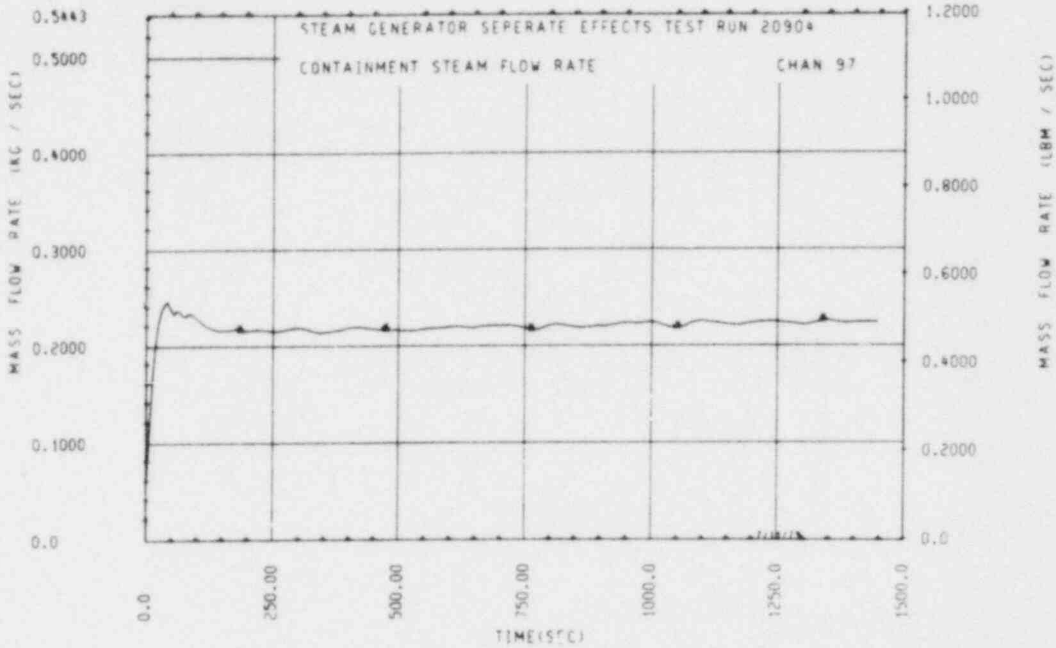


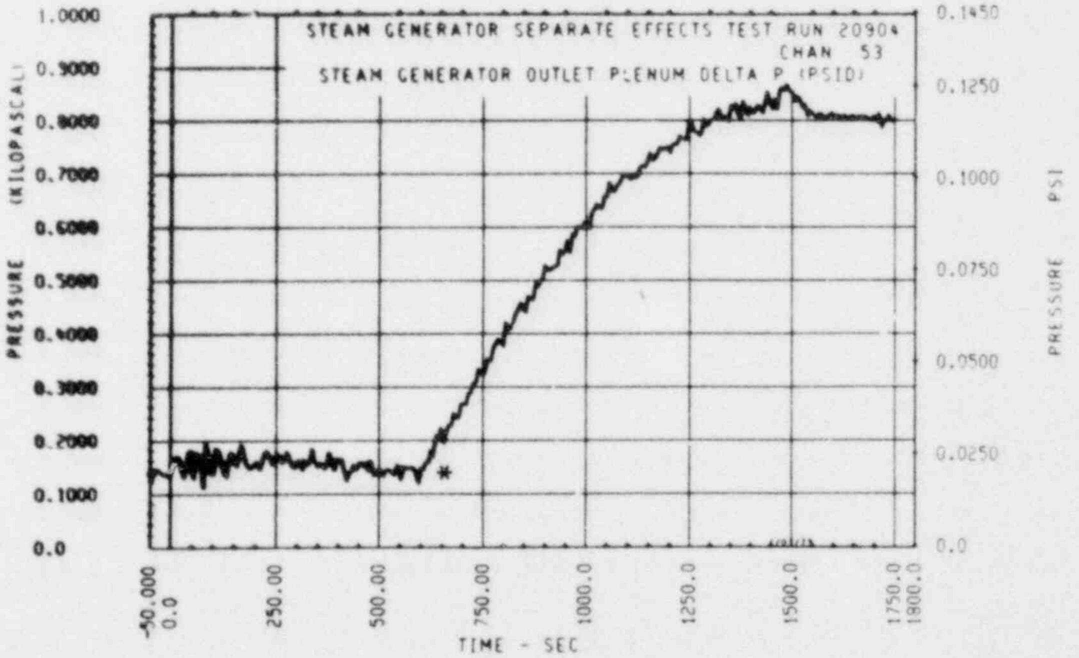
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 20904
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0



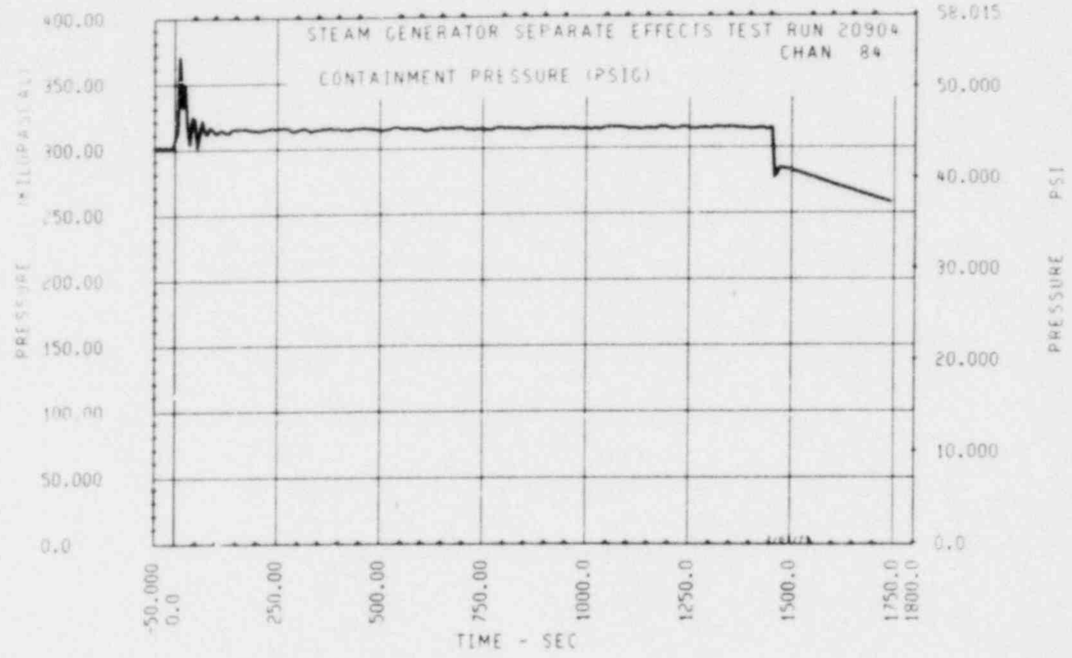
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 20904
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

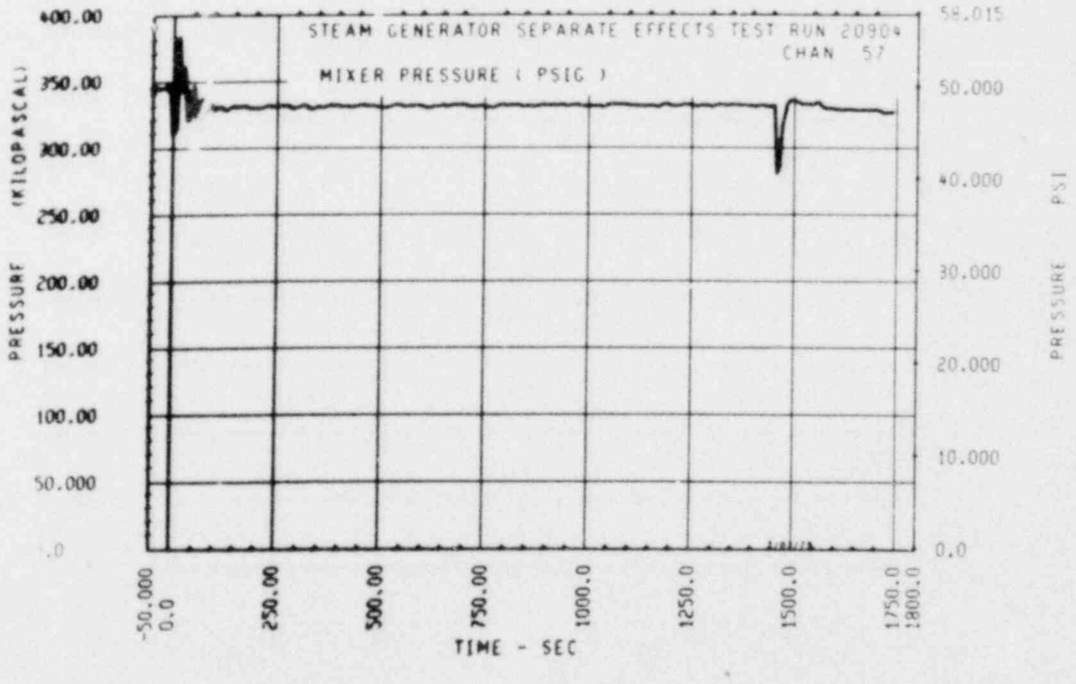
20904-3

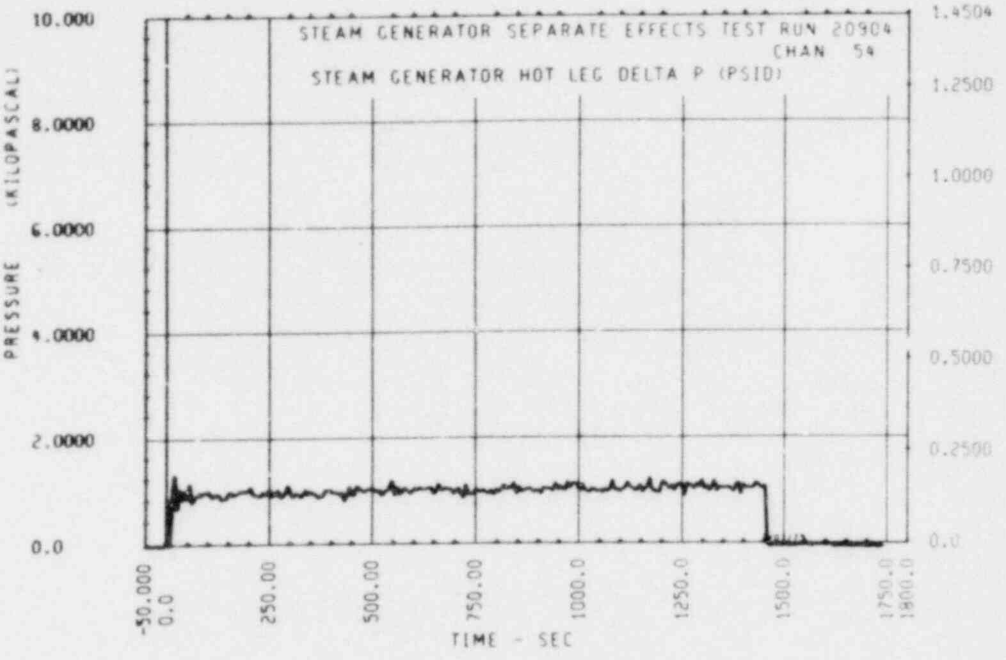


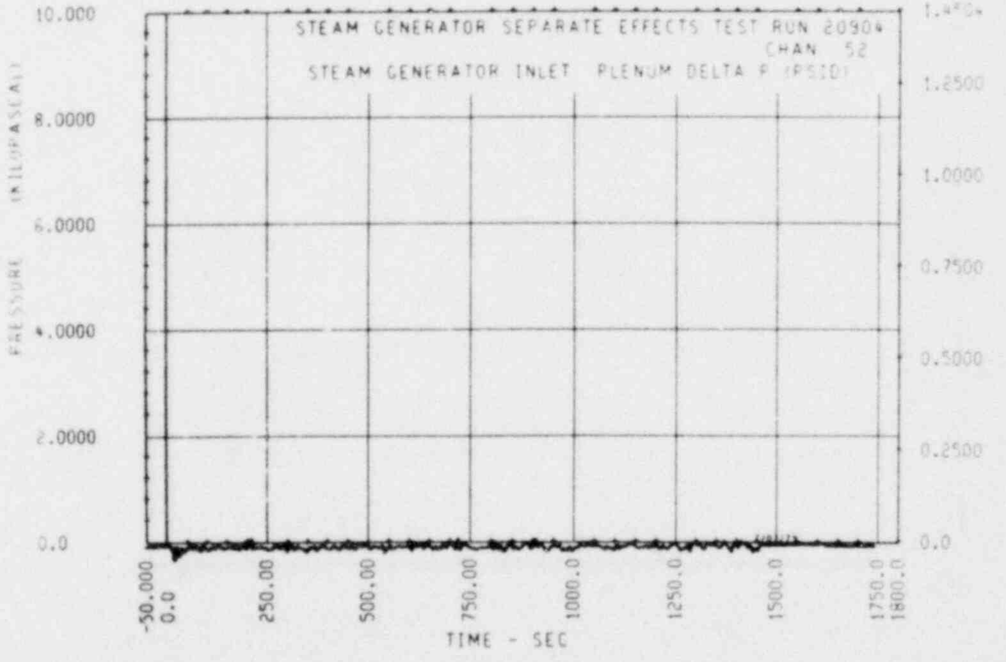


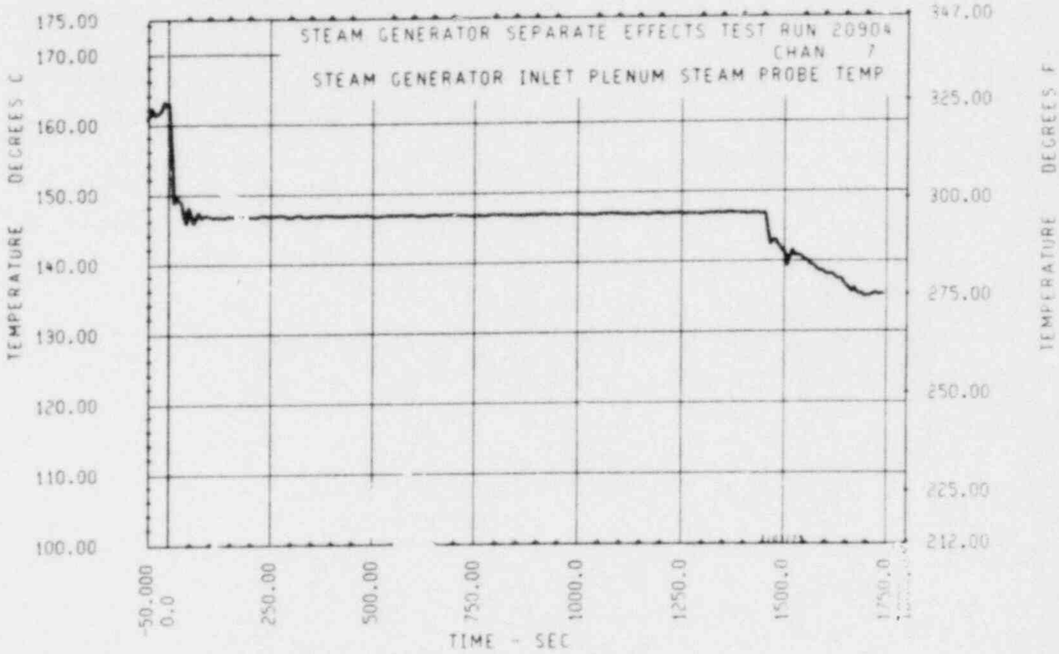
* Refer to Appendix H text for explanation of delayed response.

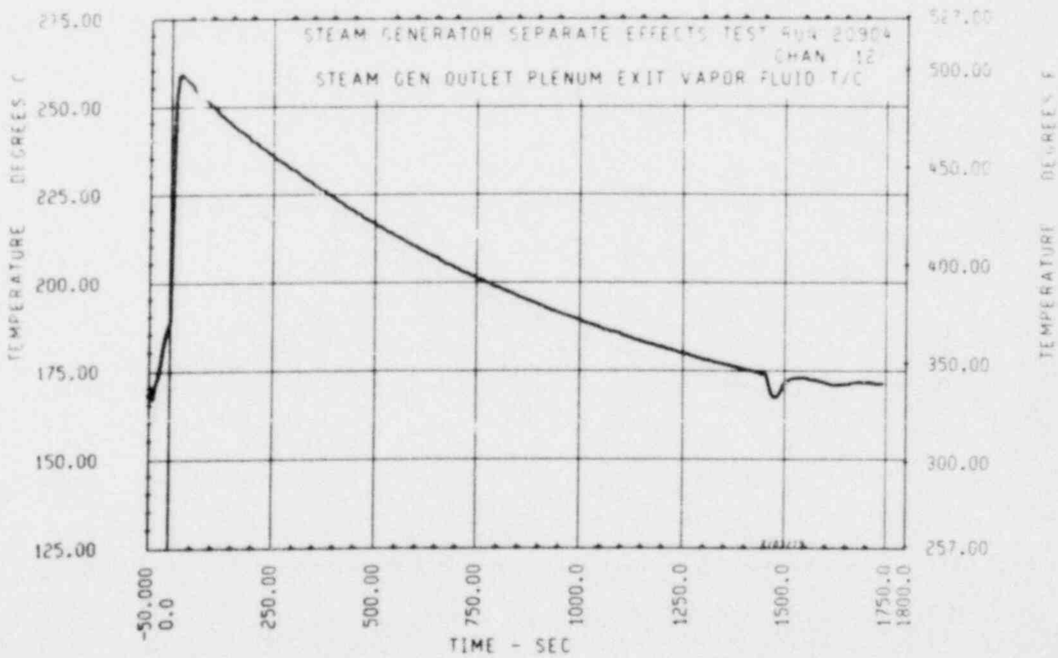

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 20904
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 20904
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

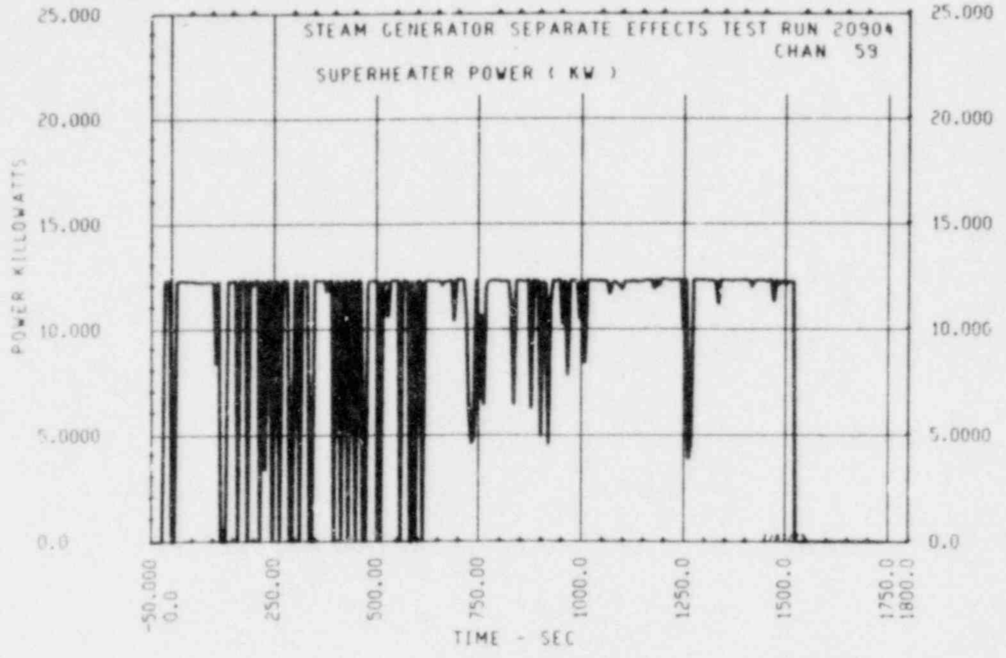

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 20904
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

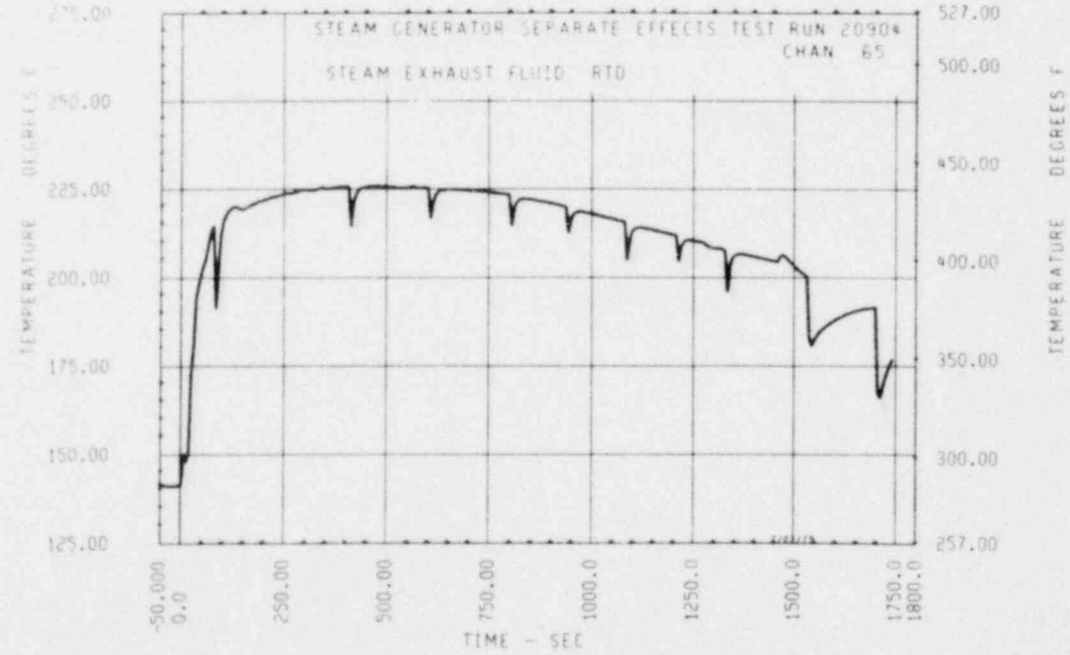

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 20904
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

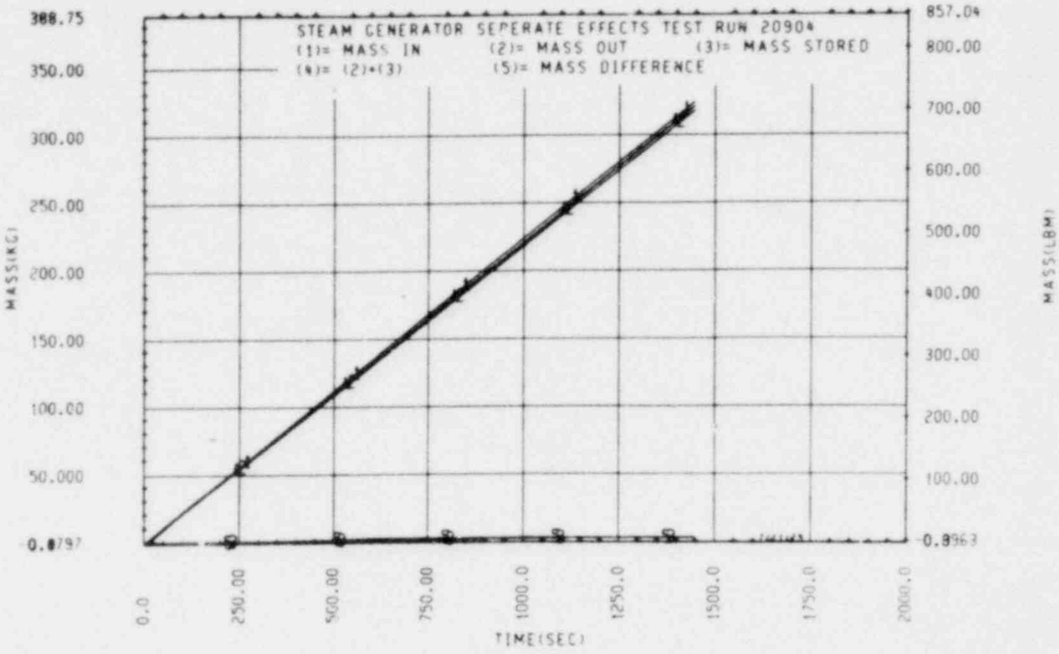

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 20904
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
175.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
347.00
325.00
300.00
275.00
250.00
225.00
212.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0

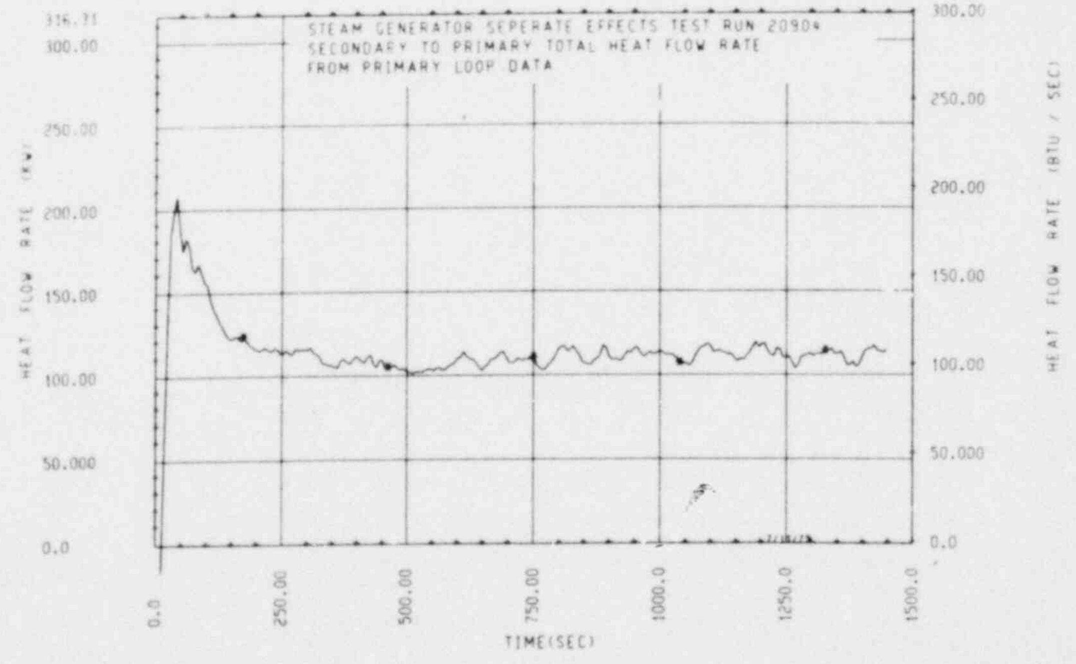

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 20904
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
250.00
225.00
200.00
175.00
150.00
125.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

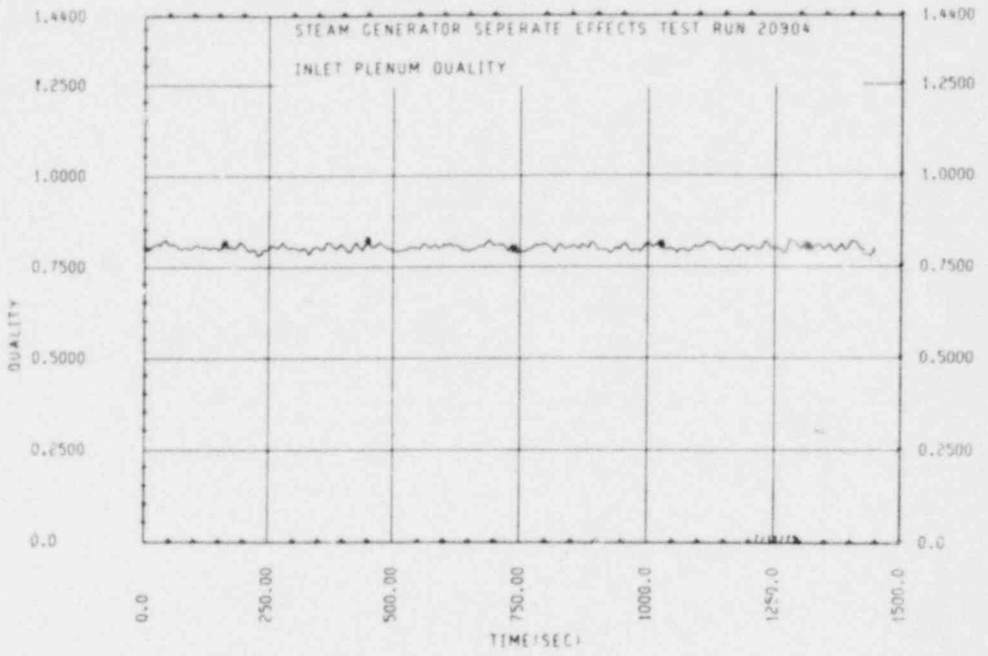
20904-7

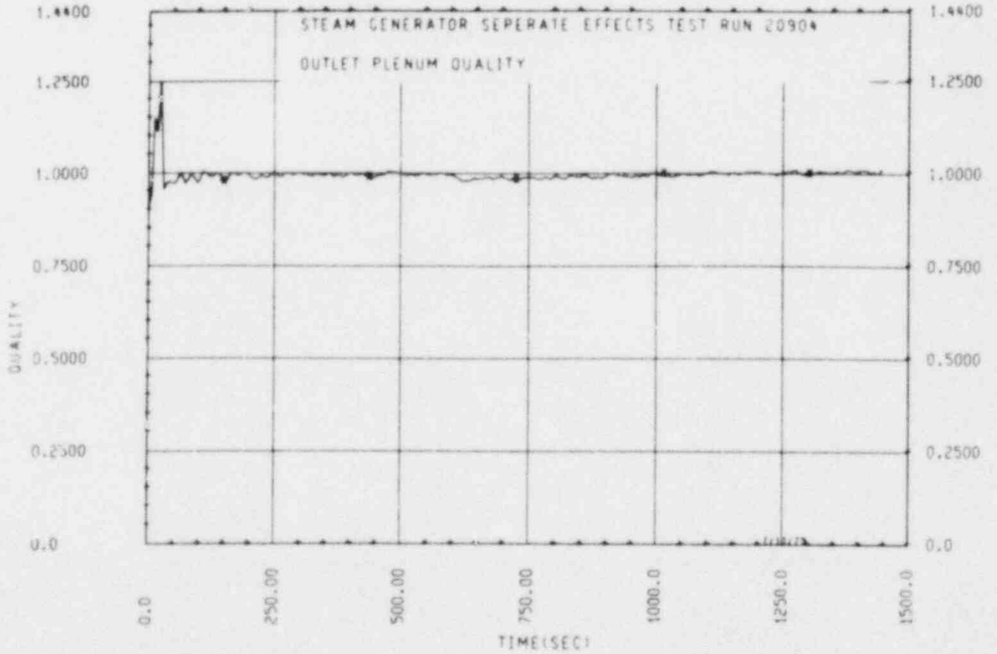

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 20904
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

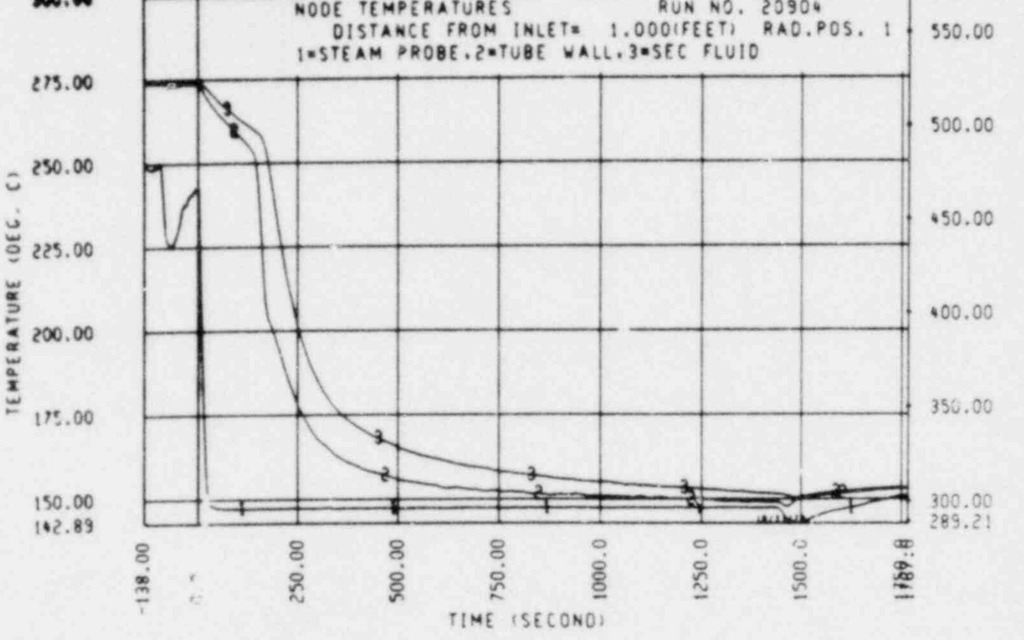

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 20904
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

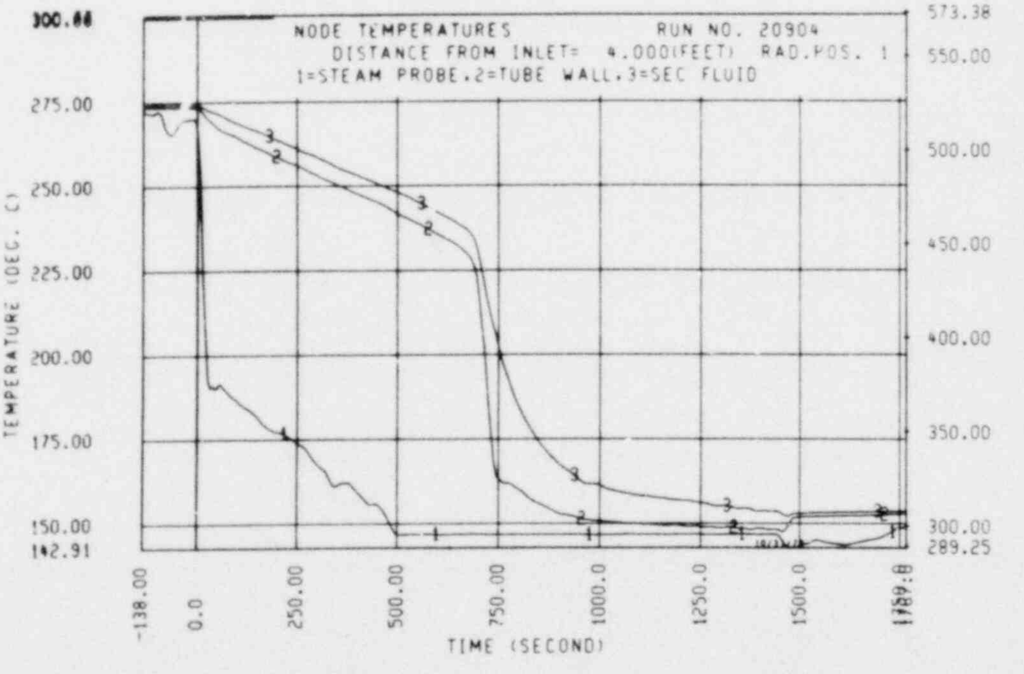

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 20904
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)
388.75
350.00
300.00
250.00
200.00
150.00
100.00
50.000
857.04
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
-0.8963
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
2000.0


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 20904
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)
300.00
250.00
200.00
150.00
100.00
50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

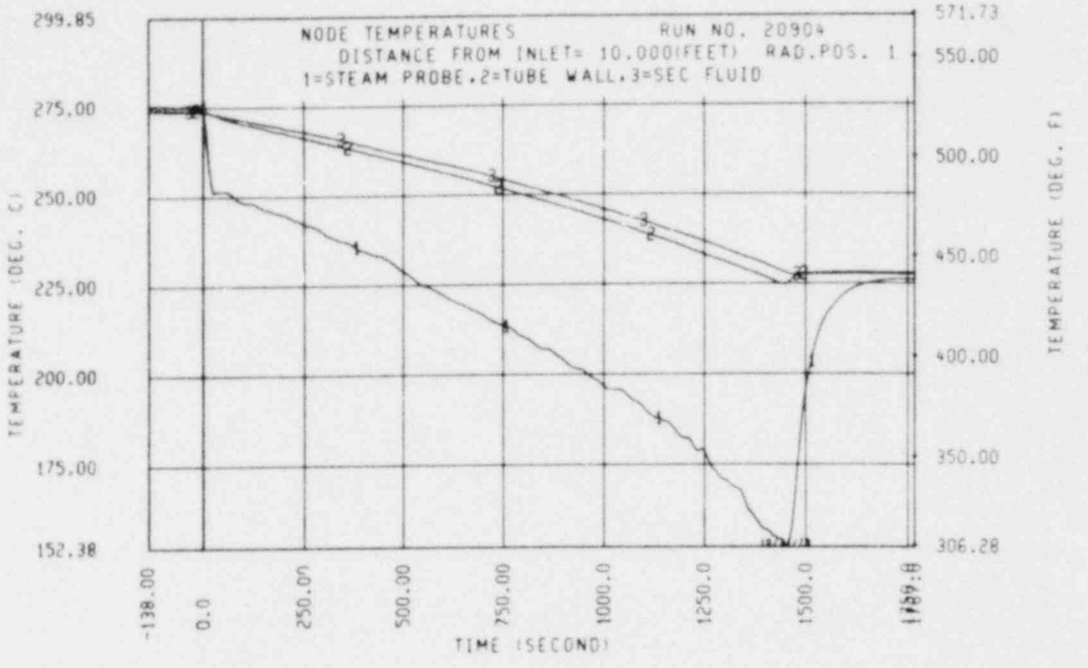

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 20904
INLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

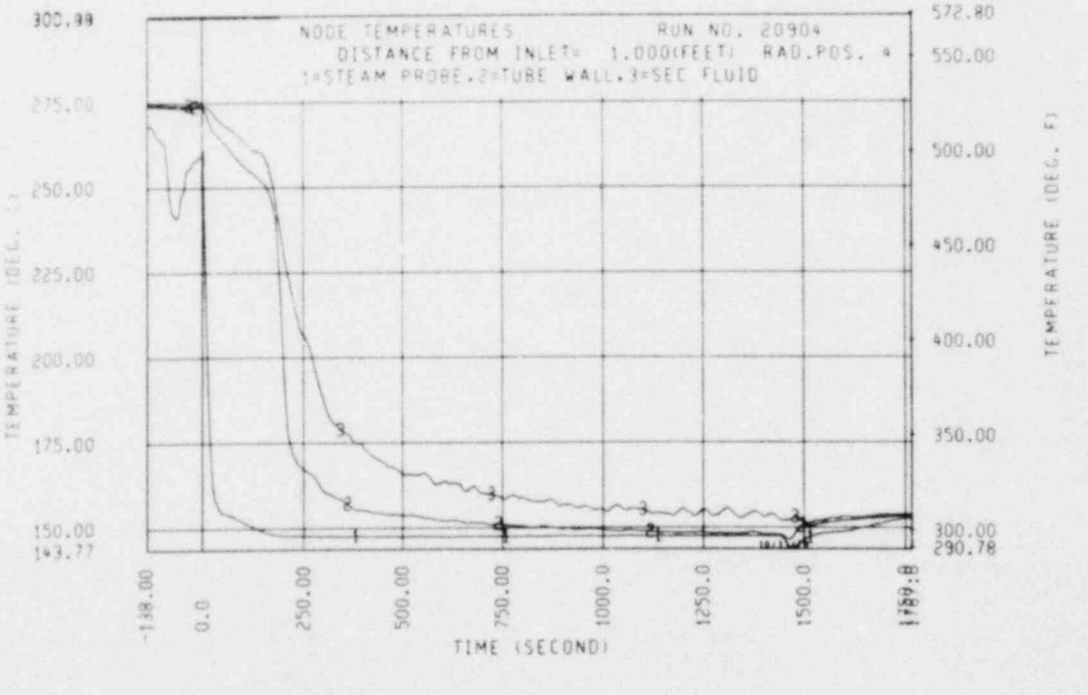

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 20904
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0


NODE TEMPERATURES RUN NO. 20904
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
300.00
275.00
250.00
225.00
200.00
175.00
150.00
142.89
TEMPERATURE (DEG. F)
572.74
550.00
500.00
450.00
400.00
350.00
300.00
289.21
-138.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1789.0
TIME (SECOND)

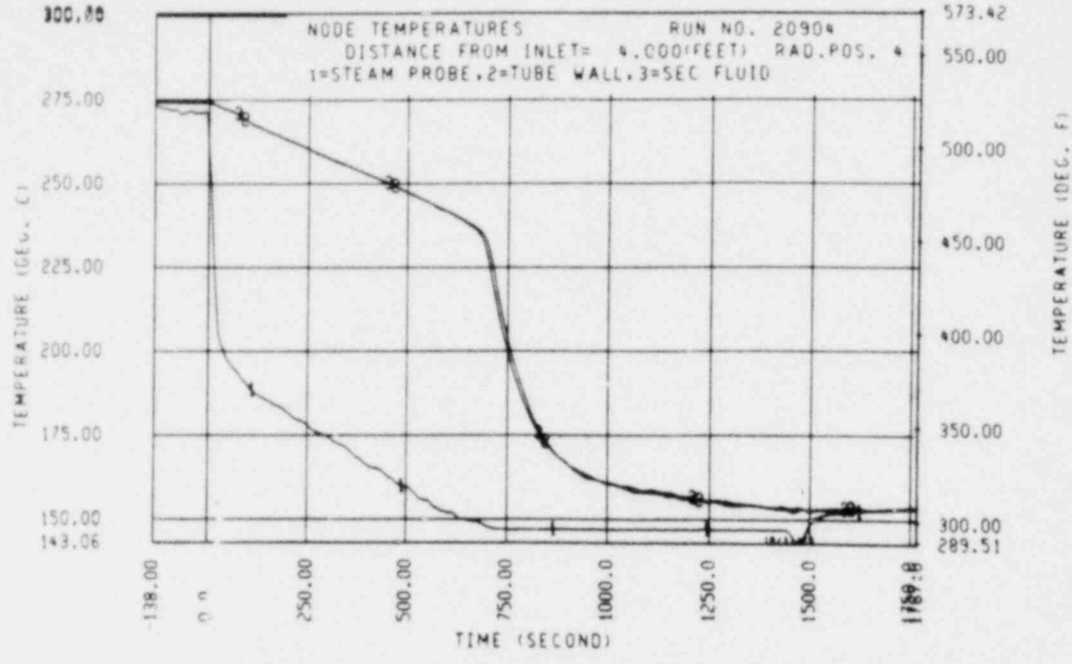

NODE TEMPERATURES RUN NO. 20904
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
300.00
275.00
250.00
225.00
200.00
175.00
150.00
142.91
TEMPERATURE (DEG. F)
573.38
550.00
500.00
450.00
400.00
350.00
300.00
289.25
-138.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1789.0
TIME (SECOND)

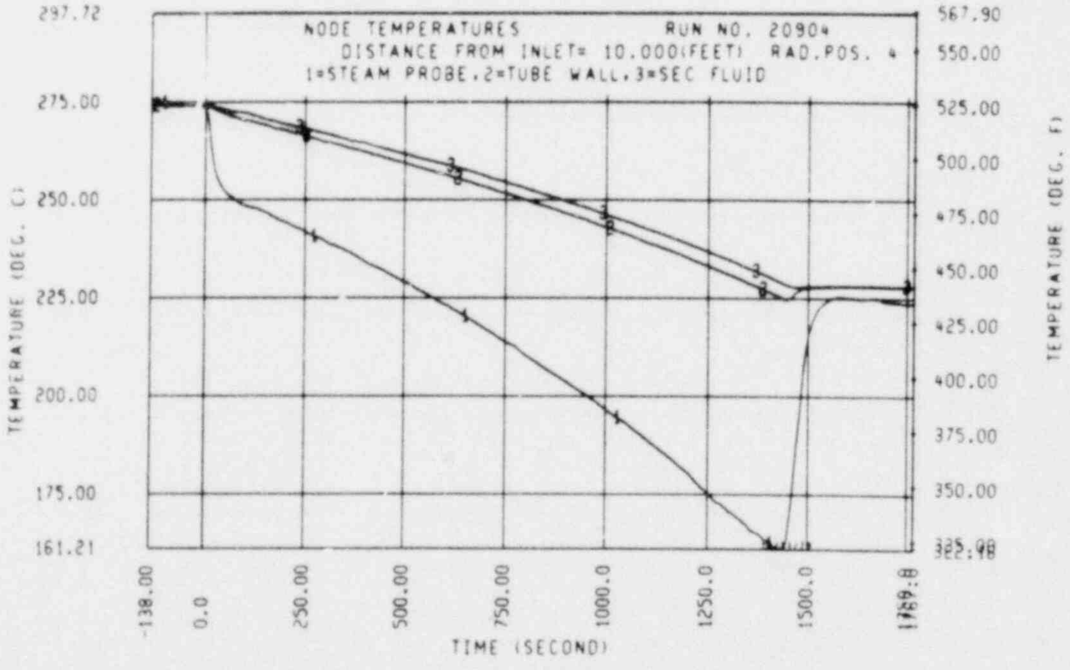
20904-11


NODE TEMPERATURES RUN NO. 20904
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
299.85
275.00
250.00
225.00
200.00
175.00
152.38
TEMPERATURE (DEG. F)
571.73
550.00
500.00
450.00
400.00
350.00
306.28
-138.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1759.8
TIME (SECOND)

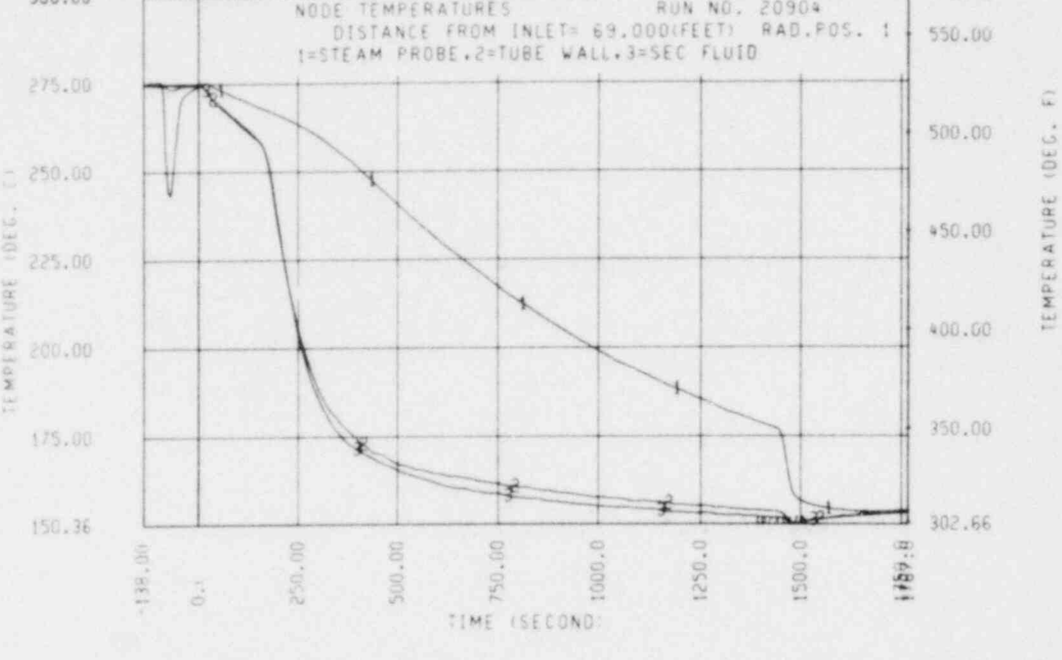

NODE TEMPERATURES RUN NO. 20904
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
300.88
275.00
250.00
225.00
200.00
175.00
150.00
143.77
TEMPERATURE (DEG. F)
572.80
550.00
500.00
450.00
400.00
350.00
300.00
290.78
-138.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1759.8
TIME (SECOND)

20904-12

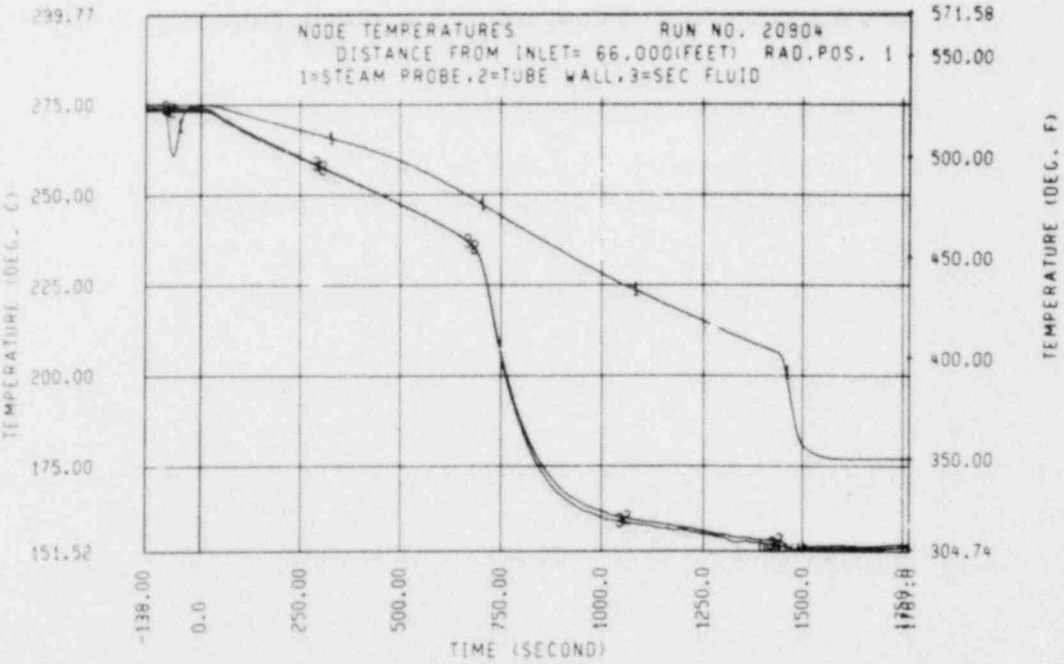

NODE TEMPERATURES RUN NO. 20904
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 20904
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

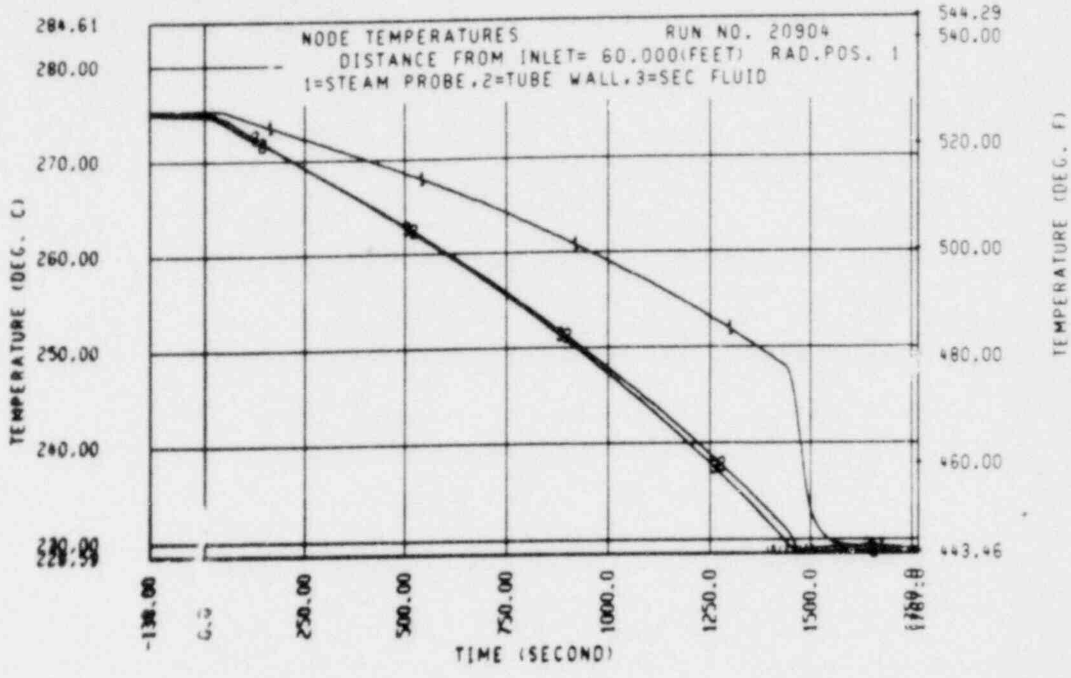
20904-13

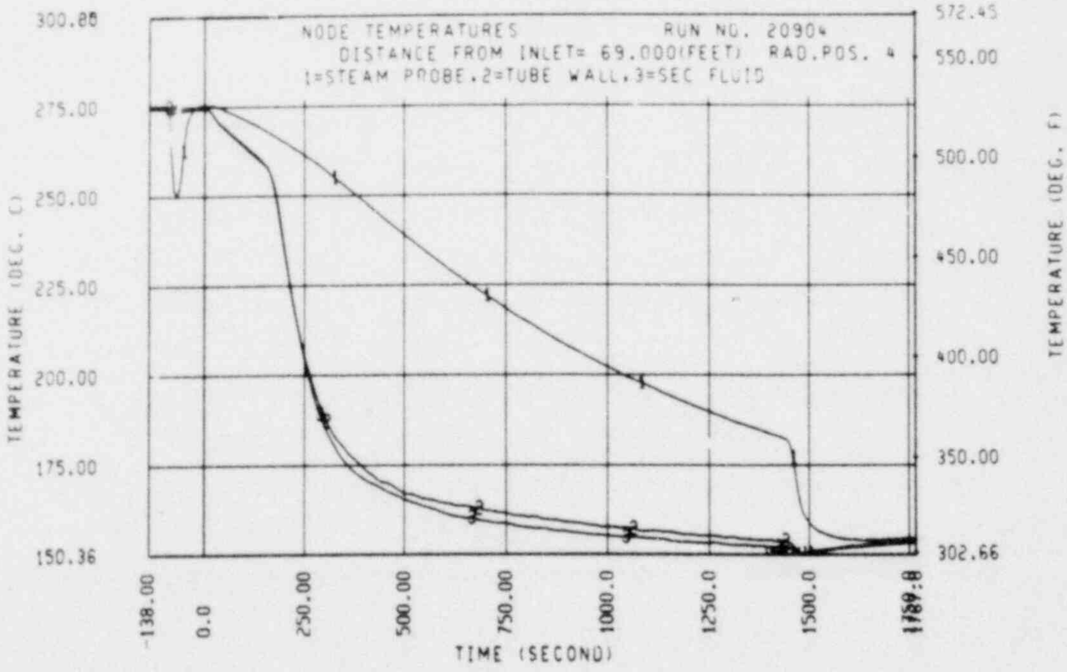


NODE TEMPERATURES RUN NO. 20904
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
300.80
275.00
250.00
225.00
200.00
175.00
150.36
572.45
550.00
500.00
450.00
400.00
350.00
302.66
-138.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1789.8

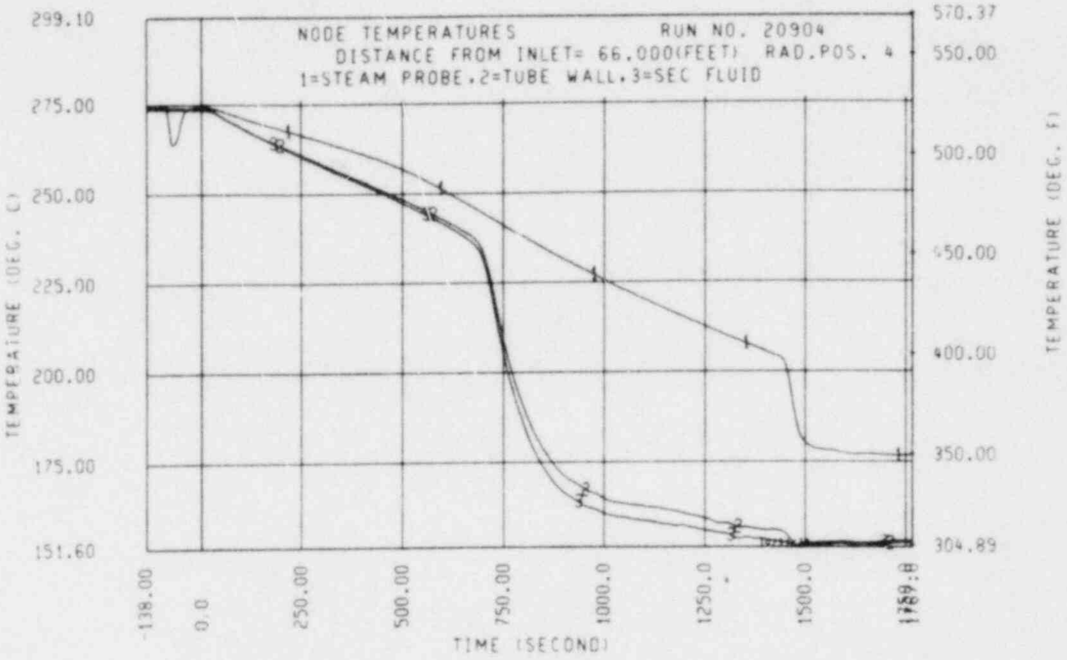


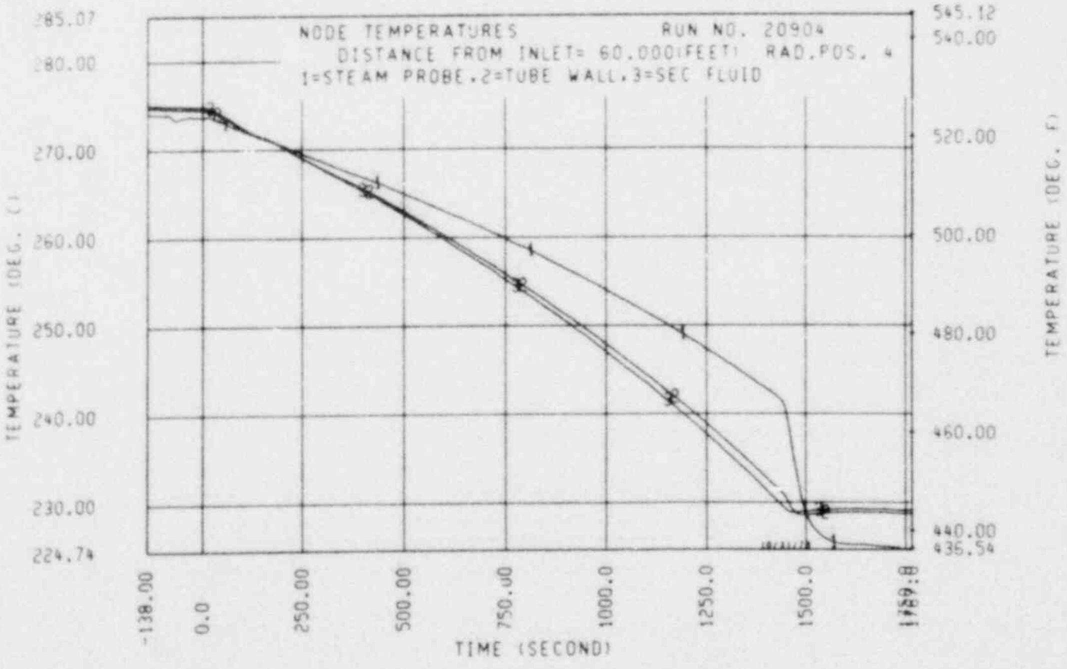
NODE TEMPERATURES RUN NO. 20904
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
299.77
275.00
250.00
225.00
200.00
175.00
151.52
571.58
550.00
500.00
450.00
400.00
350.00
304.74
-138.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1789.8


NODE TEMPERATURES RUN NO. 20904
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

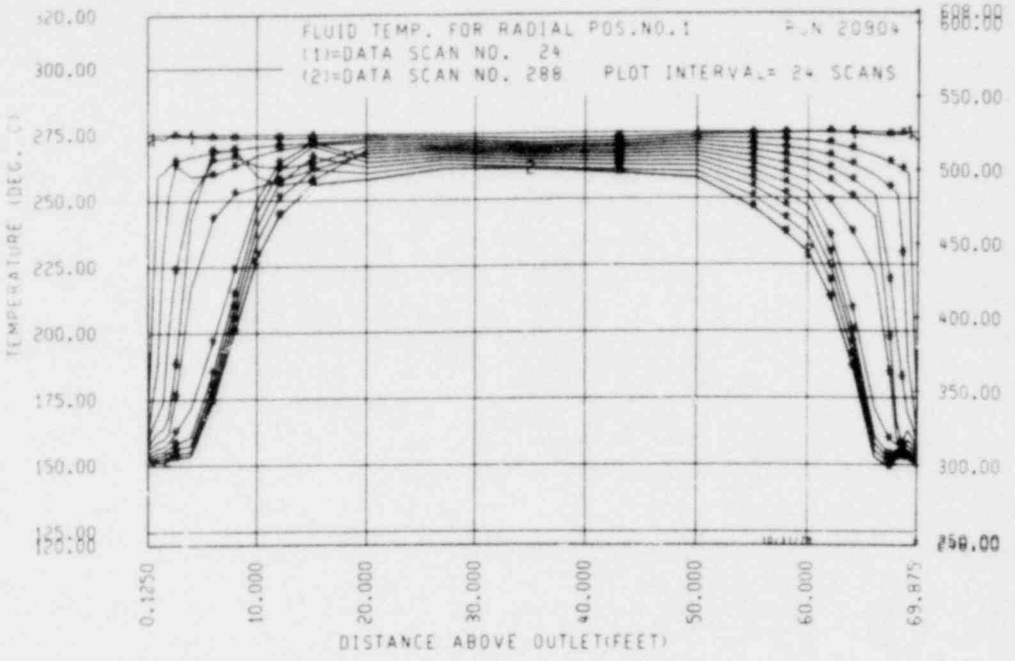

NODE TEMPERATURES RUN NO. 20904
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

20904-15

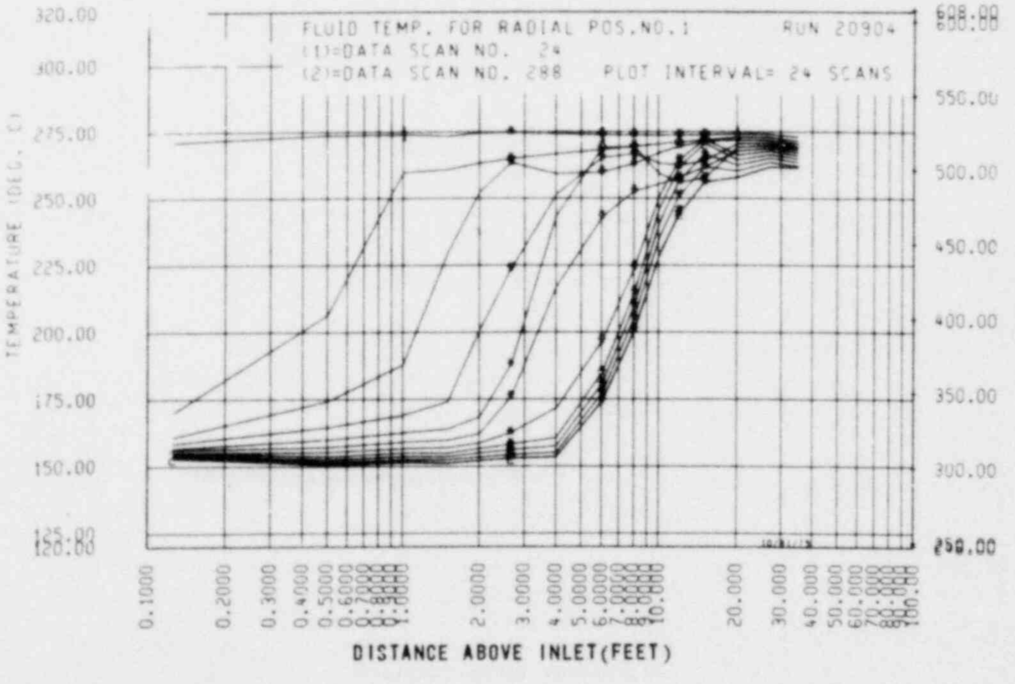

NODE TEMPERATURES RUN NO. 20904
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
299.10
275.00
250.00
225.00
200.00
175.00
151.60
TEMPERATURE (DEG. F)
570.37
550.00
500.00
450.00
400.00
350.00
304.89
-138.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1759.8
TIME (SECOND)


NODE TEMPERATURES RUN NO. 20904
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
285.07
280.00
270.00
260.00
250.00
240.00
230.00
224.74
TEMPERATURE (DEG. F)
545.12
540.00
520.00
500.00
480.00
460.00
440.00
436.54
-138.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1759.8
TIME (SECOND)

20904-16

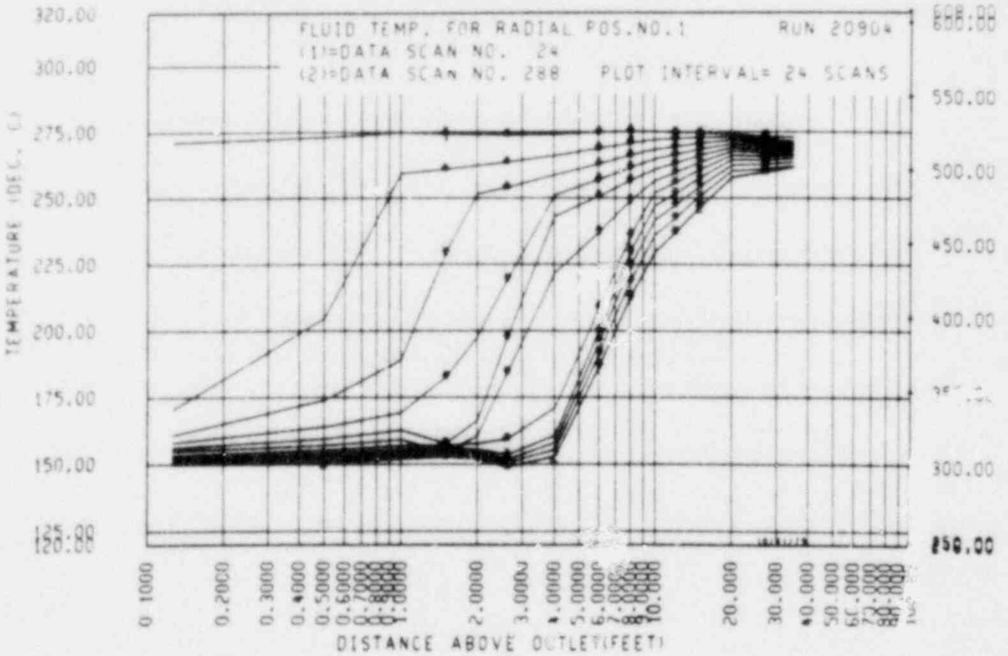


FLUID TEMP. FOR RADIAL POS.NO.1 RUN 20904
(1)=DATA SCAN NO. 24
(2)=DATA SCAN NO. 288 PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)



FLUID TEMP. FOR RADIAL POS.NO.1 RUN 20904
(1)=DATA SCAN NO. 24
(2)=DATA SCAN NO. 288 PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)

20904-17


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 20904
(1)=DATA SCAN NO. 24
(2)=DATA SCAN NO. 288
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
320.00
300.00
275.00
250.00
225.00
200.00
175.00
150.00
125.00
120.00
600.00
550.00
500.00
450.00
400.00
300.00
250.00
0.1000
0.2000
0.3000
0.4000
0.5000
0.6000
2.0000
3.0000
4.0000
5.0000
20.000
30.000
40.000
50.000
DISTANCE ABOVE OUTLET(FEET)

20904-18

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 20904

TIME = 60.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.9(.08)	83.2(7.33)	147.8(13.03)	112.9(9.94)	.636	.749	.795	.863
.2(.50)	24.6(2.17)	87.3(7.70)	31.0(2.74)	24.2(2.13)	.645	.787	.827	.886
.3(1.00)	15.9(1.40)	25.4(2.24)	21.1(1.86)	17.6(1.55)	.656	.819	.843	.895
.5(1.50)	10.8(.95)	13.8(1.21)	21.9(1.93)	20.4(1.80)	.651	.827	.857	.901
.6(2.00)	1.8(.16)	22.6(1.99)	2.5(.22)	7.3(.65)	.661	.835	.863	.905
.8(2.65)	1.8(.16)	25.6(2.26)	-1.7(-.15)	4.5(.40)	.656	.850	.858	.901
1.2(4.00)	7.2(.64)	6.9(.61)	6.0(.53)	1.5(.13)	.652	.855	.847	.889
1.8(6.00)	4.3(.38)	5.8(.51)	11.4(1.00)	9.5(.84)	.649	.842	.843	.883
2.4(8.00)	1.9(.17)	1.8(.16)	1.1(.10)	3.9(.34)	.644	.830	.841	.884
3.0(10.00)	.7(.06)	.7(.06)	1.3(.12)	1.6(.14)	.640	.825	.834	.878
3.7(12.00)	.1(.01)	.2(.02)	.7(.06)	-1.2(-.10)	.637	.821	.830	.872
4.6(15.00)	1.1(.09)	.5(.05)	.2(.02)	-.0(-.00)	.637	.817	.823	.866
6.1(20.00)	.1(.01)	.1(.01)	.4(.03)	.4(.04)	.637	.813	.818	.864
8.2(27.00)	.5(.05)	-.1(-.00)	-.2(-.02)	.3(.03)	.638	.811	.817	.865
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.641	.811	.818	.867
13.1(43.00)	-.4(-.03)	-.2(-.02)	.0(.00)	-.1(-.01)	.640	.811	.819	.868
15.2(50.00)	.2(.02)	-.1(-.01)	.0(.00)	-.1(-.00)	.640	.811	.820	.868
16.8(55.00)	.4(.04)	-.0(-.00)	.0(.00)	.0(.00)	.642	.811	.820	.868
17.7(58.00)	.4(.04)	-.0(-.00)	.1(.01)	.0(.00)	.643	.810	.821	.866
18.3(60.00)	.7(.06)	.0(.00)	.2(.01)	.1(.01)	.645	.810	.822	.869
18.9(62.00)	1.1(.10)	.1(.01)	.2(.01)	.1(.01)	.647	.810	.823	.870
19.5(64.00)	.2(.02)	.2(.02)	.1(.01)	.0(.00)	.649	.811	.824	.870
20.1(66.00)	.4(.03)	1.1(.09)	.4(.03)	-.0(-.00)	.650	.813	.824	.870
20.5(67.38)	-.1(-.01)	.2(.02)	-.1(-.03)	-.7(-.06)	.651	.815	.824	.870
20.7(68.00)	.4(.04)	.2(.01)	.4(.04)	.0(.00)	.651	.816	.824	.869
20.9(68.50)	-.6(-.06)	-.7(-.06)	-.6(-.05)	-1.3(-.12)	.651	.815	.824	.869
21.0(69.00)	-.2(-.01)	-.2(-.02)	-.2(-.02)	-.2(-.02)	.651	.815	.824	.868
21.2(69.50)	-1.1(-.10)	-2.9(-.26)	-1.5(-.14)	-.5(-.04)	.652	.814	.823	.869
21.3(69.87)	-26.7(-2.36)	-19.2(-1.69)	-12.6(-1.11)	-7.6(-.67)	.650	.811	.822	.868

20904-19

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 20904
TIME = 300.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.02)	15.6(1.37)	12.7(1.12)	17.1(1.51)	.639	.742	.776	.851
.2(.50)	45.9(4.04)	47.8(4.21)	48.1(4.24)	47.8(4.21)	.653	.758	.793	.868
.3(1.00)	68.7(6.05)	91.5(8.06)	83.4(7.35)	91.3(8.04)	.689	.796	.834	.911
.5(1.50)	128.6(11.34)	178.5(15.73)	91.0(8.02)	174.0(15.33)	.751	.877	.889	.991
.6(2.00)	1.6(.14)	30.9(2.72)	5.1(.45)	10.6(.93)	.791	.938	.918	1.046
.8(2.65)	1.8(.16)	.4(.03)	1.7(.15)	-2.3(-.21)	.788	.945	.917	1.042
1.2(4.00)	9.2(.81)	10.2(.90)	8.5(.75)	1.4(.12)	.787	.944	.914	1.026
1.8(6.00)	10.1(.89)	15.4(1.35)	20.2(1.78)	12.4(1.10)	.790	.948	.926	1.018
2.4(8.00)	6.0(.53)	9.6(.84)	1.1(.10)	10.8(.95)	.791	.954	.931	1.025
3.0(10.00)	3.2(.28)	3.2(.28)	3.7(.33)	3.6(.31)	.790	.952	.922	1.026
3.7(12.00)	.9(.08)	.4(.03)	1.0(.09)	-1.0(-.09)	.787	.946	.917	1.018
4.6(15.00)	.5(.05)	.7(.06)	.1(.01)	-.2(-.01)	.784	.941	.910	1.009
6.1(20.00)	1.0(.09)	1.1(.10)	.2(.02)	.8(.07)	.784	.939	.904	1.004
8.2(27.00)	.6(.05)	.1(.01)	-.2(-.02)	.3(.03)	.787	.938	.900	1.005
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.789	.937	.900	1.007
13.1(43.00)	-.3(-.03)	-.2(-.02)	.0(.00)	-.2(-.01)	.788	.936	.901	1.007
15.2(50.00)	.3(.03)	-.1(-.00)	.0(.00)	-.0(-.00)	.788	.935	.902	1.006
16.8(55.00)	.3(.02)	-.1(-.01)	-.0(-.00)	-.0(-.00)	.790	.935	.902	1.007
17.7(58.00)	.1(.01)	-.1(-.01)	-.0(-.00)	-.0(-.00)	.791	.935	.903	1.008
18.3(60.00)	-.0(-.00)	-.3(-.02)	-.1(-.01)	-.0(-.00)	.791	.935	.904	1.009
18.9(62.00)	-.1(-.00)	-.0(-.00)	-.0(-.00)	-.1(-.01)	.792	.936	.906	1.010
19.5(64.00)	-.0(-.00)	.1(.01)	.0(.00)	-.1(-.01)	.793	.938	.907	1.011
20.1(66.00)	.1(.01)	.9(.06)	.1(.01)	-.4(-.04)	.795	.941	.908	1.012
20.5(67.38)	-.4(-.04)	-.0(-.00)	-.4(-.04)	-1.5(-.13)	.797	.944	.909	1.011
20.7(68.00)	-.4(-.03)	-.5(-.04)	-.4(-.03)	-.9(-.08)	.797	.944	.909	1.011
20.9(68.50)	-3.0(-.27)	-3.4(-.30)	-3.0(-.27)	-4.6(-.41)	.797	.944	.909	1.012
21.0(69.00)	2.8(.24)	2.1(.18)	2.7(.23)	2.7(.23)	.800	.944	.911	1.014
21.2(69.50)	-15.6(-1.37)	-2.5(-.22)	-16.6(-1.47)	-13.7(-1.21)	.806	.949	.909	1.015
21.3(69.87)	-6.5(-.57)	-5.5(-.48)	-4.6(-.41)	-3.7(-.33)	.809	.952	.905	1.013

20904-20

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 20904

TIME = 600.0 SECONDS

UNITS - ELEVATION METER(FEET)

FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.01)	5.8(.51)	5.7(.50)	4.1(.36)	.638	.740	.774	.848
.2(.50)	16.3(1.44)	18.0(1.59)	17.0(1.50)	16.1(1.42)	.643	.745	.780	.853
.3(1.00)	20.4(1.80)	20.3(1.79)	18.8(1.65)	25.9(2.29)	.654	.756	.791	.866
.5(1.50)	21.5(1.89)	19.3(1.70)	23.6(2.08)	24.5(2.16)	.667	.768	.804	.882
.6(2.00)	28.6(2.52)	25.8(2.27)	21.5(1.89)	22.9(2.02)	.683	.781	.818	.897
.8(2.65)	.6(.05)	39.2(3.45)	19.0(1.67)	18.5(1.63)	.692	.806	.834	.912
1.2(4.00)	11.7(1.03)	14.0(1.23)	14.1(1.25)	1.3(.12)	.704	.836	.860	.914
1.8(6.00)	6.4(.56)	10.3(.91)	14.5(1.27)	11.6(1.02)	.715	.853	.886	.911
2.4(8.00)	3.9(.33)	5.5(.48)	1.7(.15)	6.8(.60)	.710	.851	.885	.912
3.0(10.00)	4.9(.43)	4.9(.43)	5.1(.45)	5.7(.50)	.703	.842	.870	.910
3.7(12.00)	5.6(.50)	4.0(.35)	3.3(.29)	2.6(.23)	.705	.838	.863	.907
4.6(15.00)	4.8(.42)	2.6(.23)	1.9(.16)	3.6(.32)	.716	.840	.860	.908
6.1(20.00)	1.7(.15)	1.8(.16)	.9(.08)	1.1(.10)	.727	.844	.857	.911
8.2(27.00)	.7(.06)	.2(.02)	-.2(-.01)	.4(.03)	.732	.844	.853	.911
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.732	.841	.853	.912
13.1(43.00)	-.4(-.03)	-.3(-.02)	.0(.00)	-.2(-.02)	.729	.839	.854	.913
15.2(50.00)	.2(.02)	-.1(-.01)	-.0(-.00)	-.0(-.00)	.729	.838	.854	.912
16.8(55.00)	.2(.02)	-.1(-.01)	-.0(-.00)	-.1(-.01)	.731	.839	.855	.913
17.7(58.00)	.0(.00)	-.1(-.01)	-.1(-.01)	-.1(-.01)	.733	.839	.856	.915
18.3(60.00)	-.1(-.01)	-.3(-.03)	-.2(-.02)	-.3(-.02)	.733	.840	.858	.917
18.9(62.00)	-.3(-.03)	-.0(-.00)	-.1(-.01)	-.4(-.03)	.735	.842	.861	.919
19.5(64.00)	-.1(-.01)	.1(.01)	-.0(-.00)	-.5(-.04)	.737	.846	.865	.921
20.1(66.00)	-.0(-.00)	.9(.08)	-.0(-.00)	-1.2(-.11)	.741	.852	.869	.923
20.5(67.38)	-2.7(-.24)	-2.0(-.17)	-2.7(-.24)	-5.8(-.51)	.743	.856	.872	.922
20.7(68.00)	-7.3(-.64)	-7.4(-.65)	-7.3(-.64)	-7.6(-.67)	.742	.856	.871	.920
20.9(68.50)	-8.6(-.76)	-9.8(-.87)	-8.6(-.76)	-11.6(-1.03)	.742	.853	.869	.919
21.0(69.00)	2.4(.21)	1.8(.16)	2.3(.20)	2.3(.20)	.747	.854	.871	.923
21.2(69.50)	-11.5(-1.01)	-10.7(-.94)	-9.6(-.84)	-7.8(-.69)	.753	.857	.872	.926
21.3(69.87)	-1.8(-.16)	-3.1(-.27)	-2.4(-.21)	-2.2(-.19)	.755	.859	.871	.924

20904-21

SUMMARY SHEET

RUN NO. 21001

DATE: 3/2/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.177 (0.390)
2. Water flow - [kg/sec (lb/sec)] - 0.050 (0.110)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{o}C (^{o}F)] - 160 (320)
5. Water temperature [^{o}C (^{o}F)] - 125 (257)
6. Mixer pressure [kPa (psig)] - 193 (28)
7. Test time (sec) - 1440.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 9.9 (32.5)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	260 (500)
0.15 (0.50)	271 (520)
0.30 (1.00)	274 (525)
0.46 (1.50)	274 (525)
0.61 (2.00)	274 (525)
1.22 (4.00)	274 (525)
3.05 (10.00)	274 (525)
6.09 (20.00)	274 (525)
8.23 (27.00)	274 (525)
10.67 (35.00)	274 (525)

SUMMARY SHEET (cont)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 3.13 (6.90)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 3.90 (8.60)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 1.12 (2.48)

D. FAILED BUNDLE T/Cs[1]

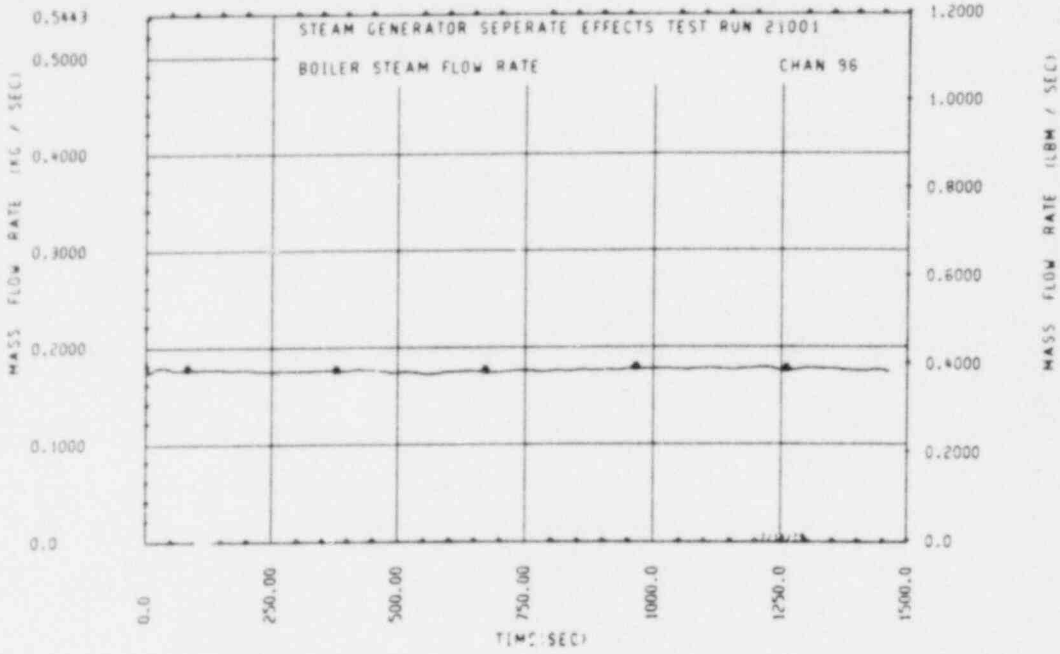
294, 295, 298, 311, 321, 326, 564, 565, 568

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

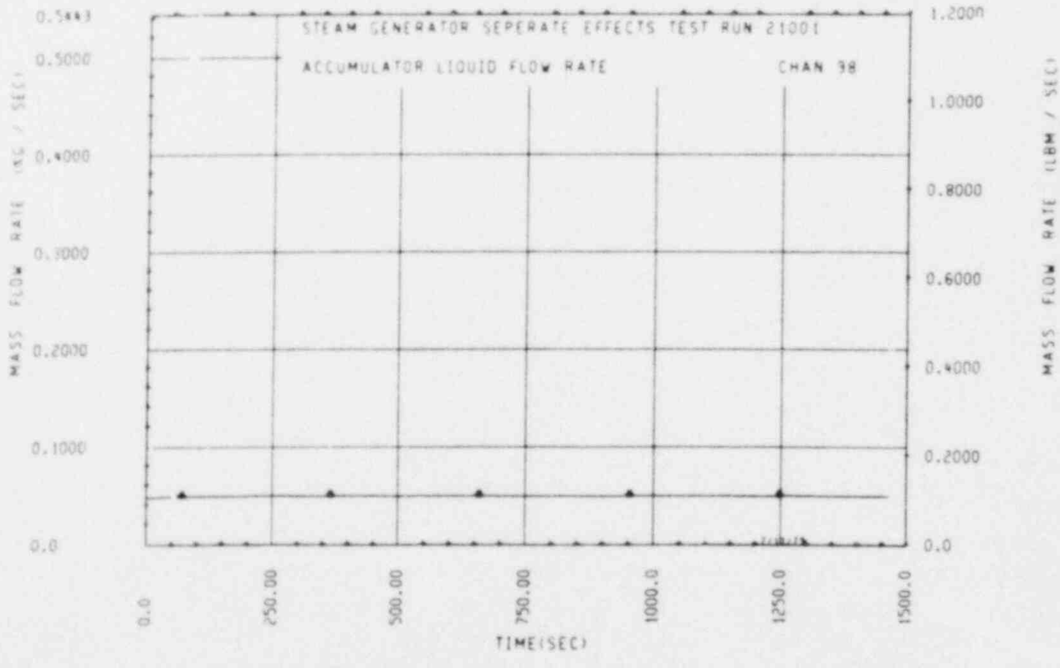
1. From primary side energy balance [kwsec(Btu)] - 0.752×10^5 (0.716×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da dt$) -[kwsec(Btu)] - 0.724×10^5 (0.690×10^5)
3. Integration to 600 sec

---

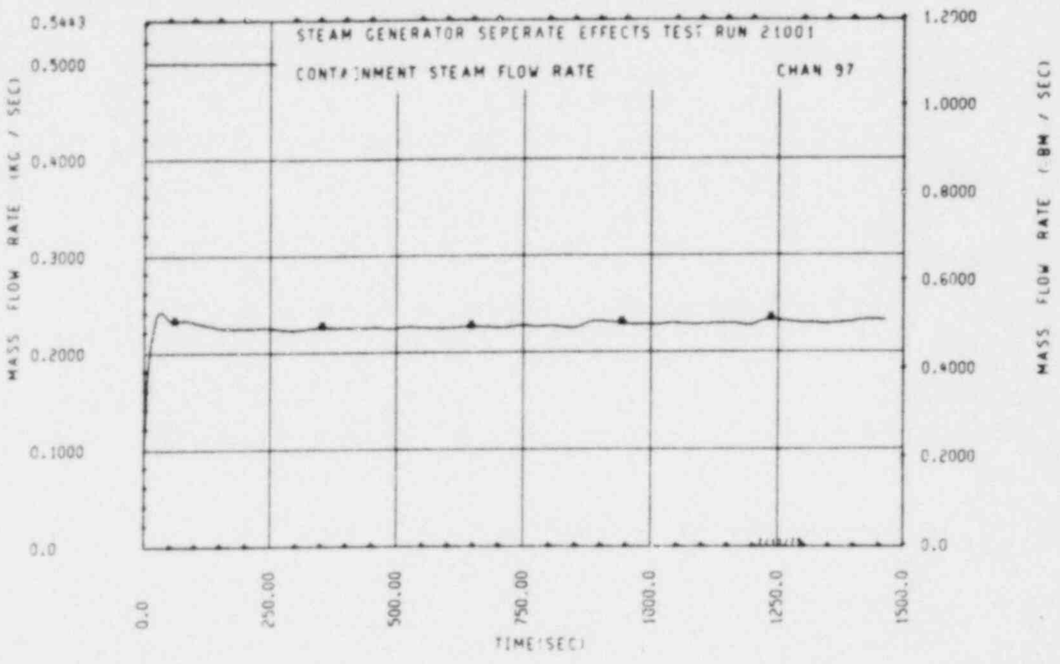
1. T/Cs are defined as failed based on resistance reading or T/C response.

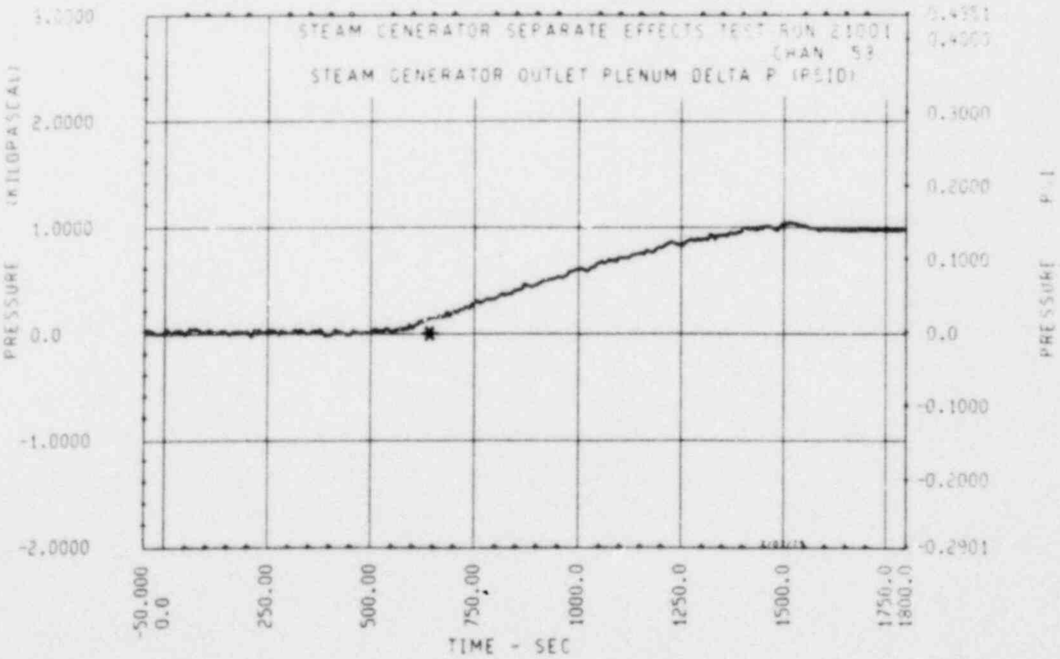


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21001
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)

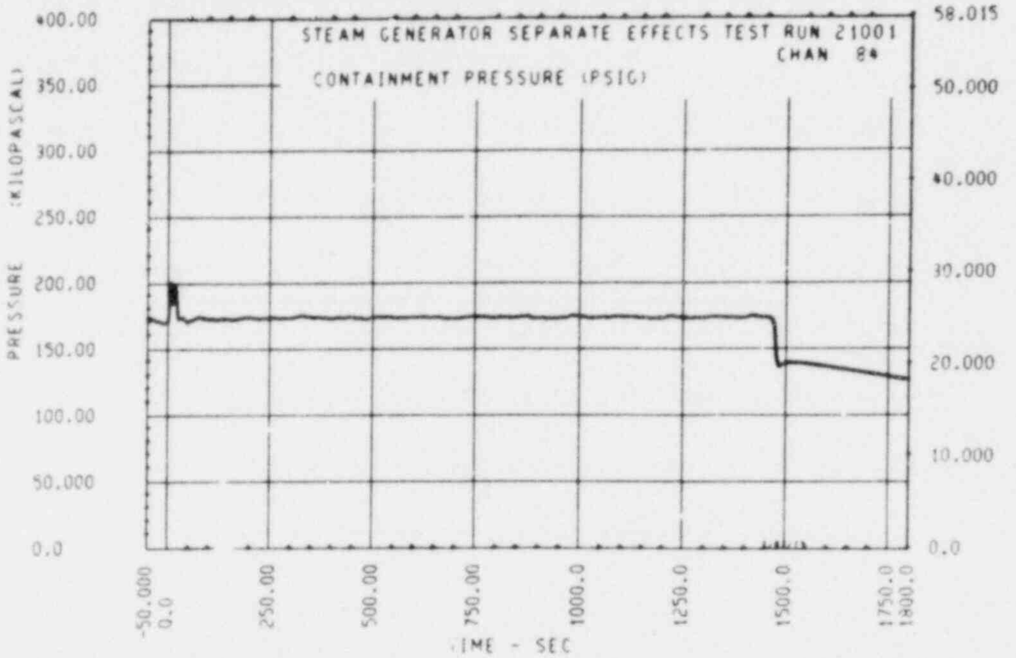


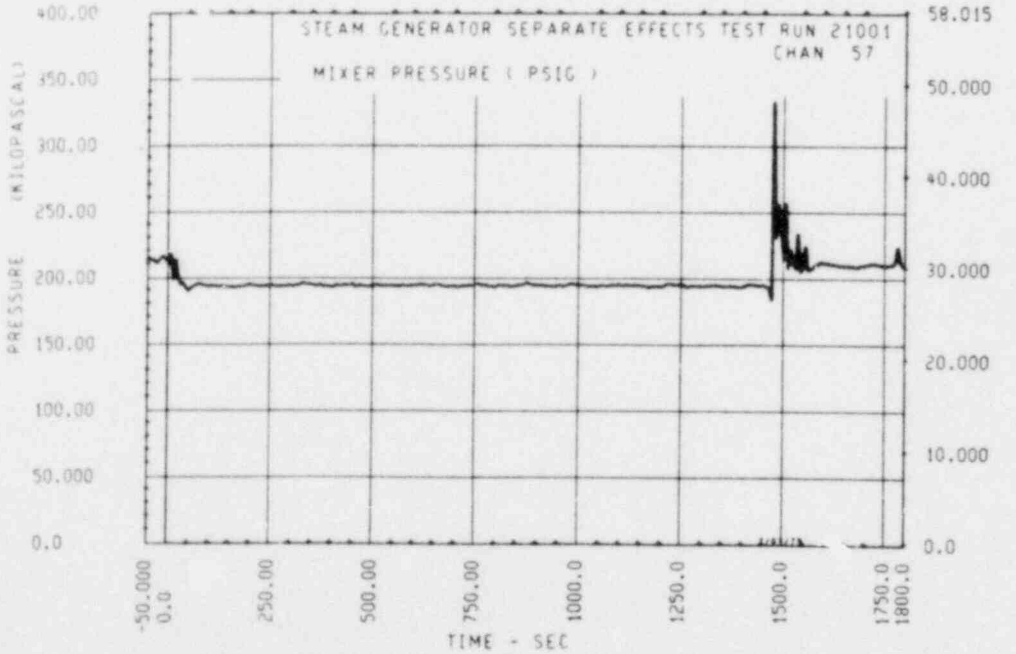
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21001
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)

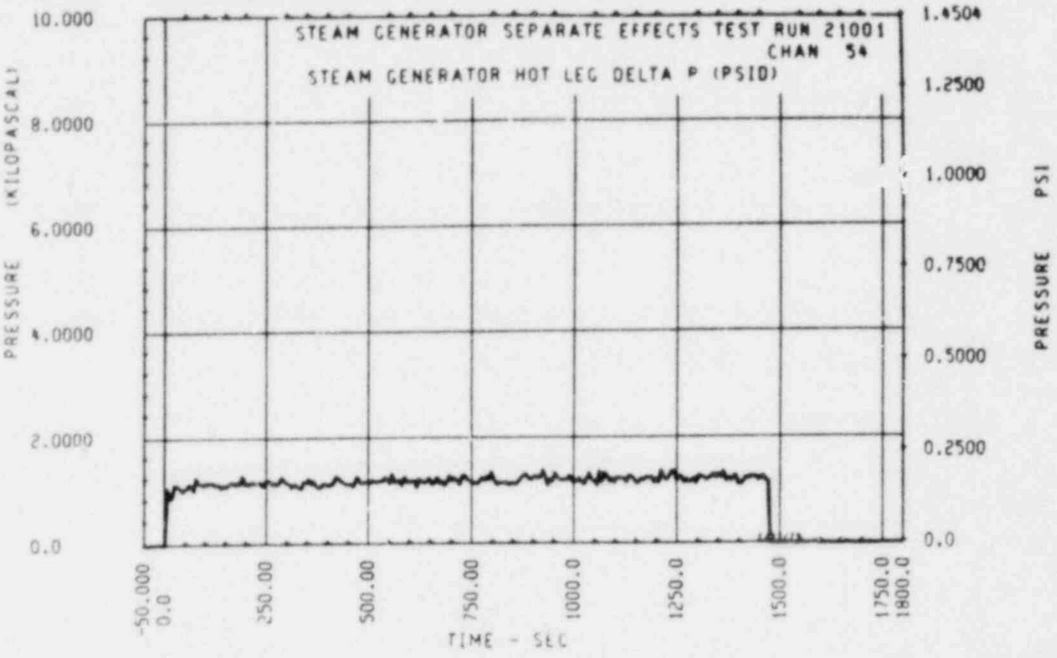


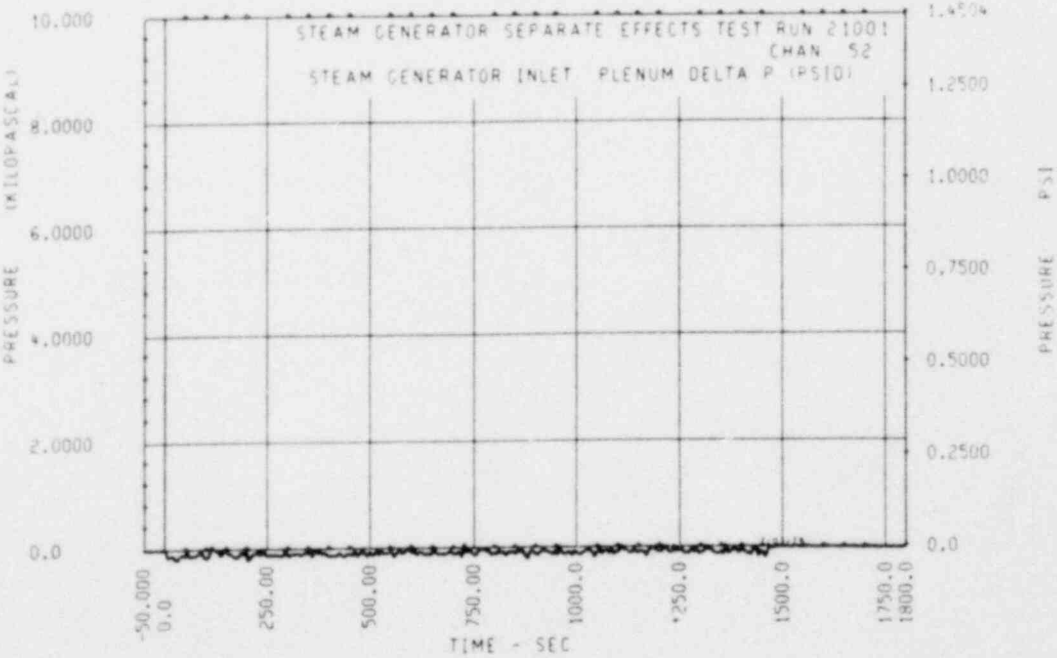


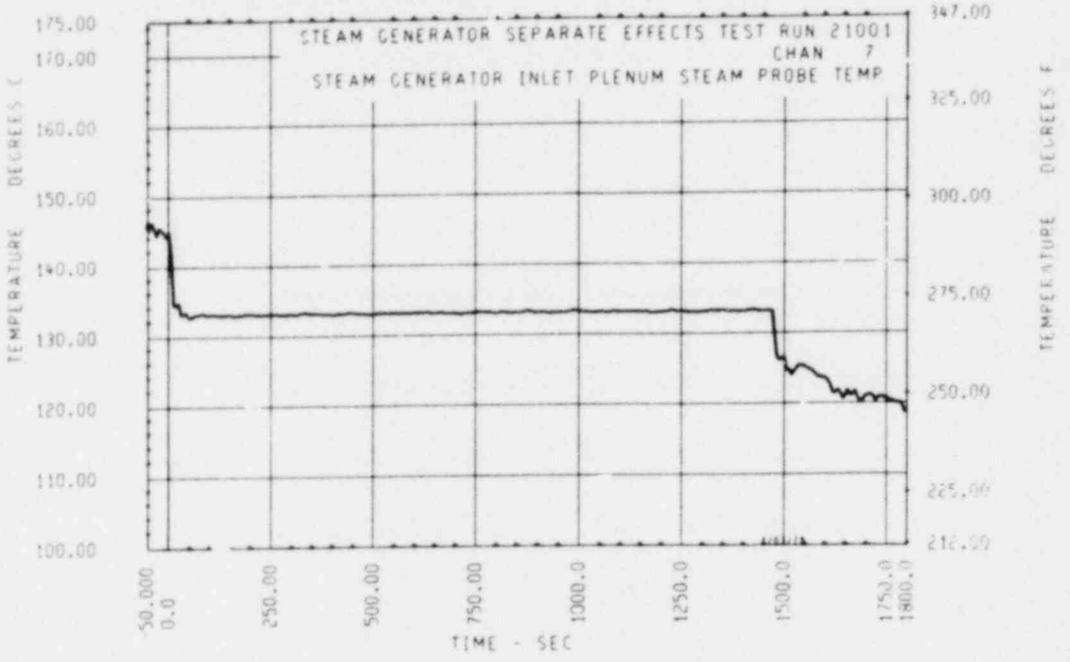
* Refer to Appendix H text for explanation of delayed response.

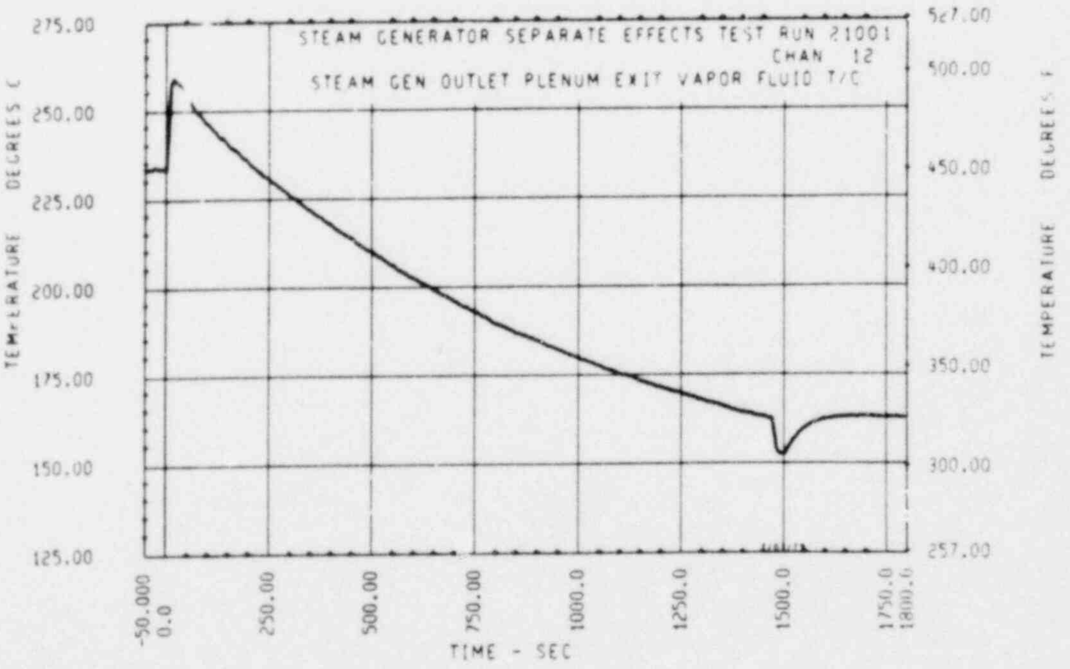

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21001
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21001
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

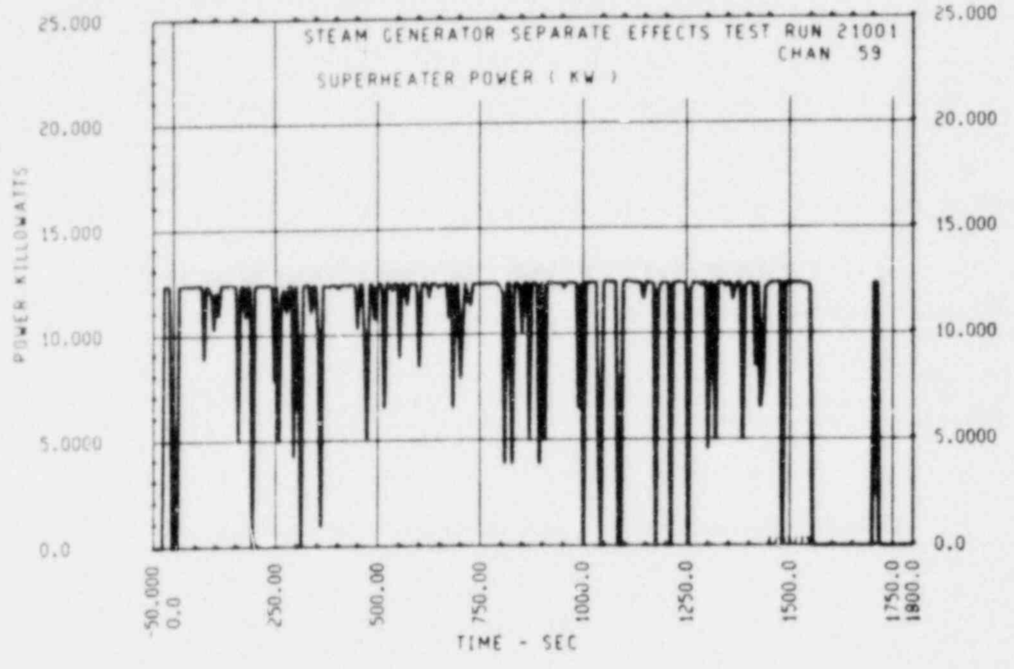

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21001
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
10.000
8.0000
6.0000
4.0000
2.0000
0.0
PRESSURE PSI
1.4504
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

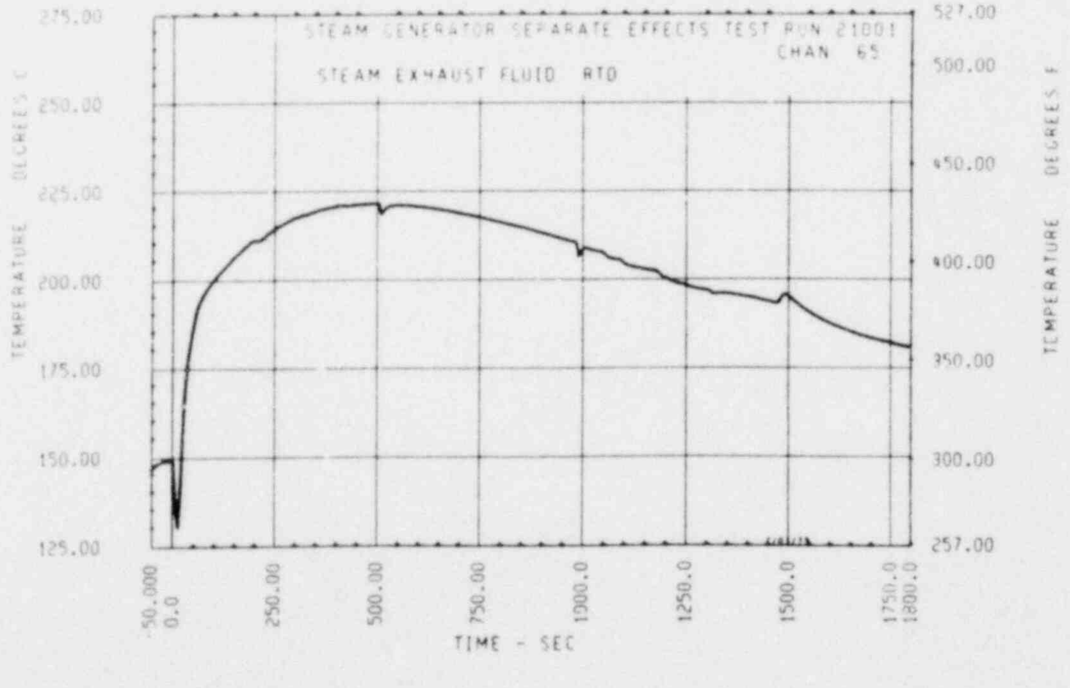

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21001
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
10.000
8.0000
6.0000
4.0000
2.0000
0.0
PRESSURE PSI
1.4504
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

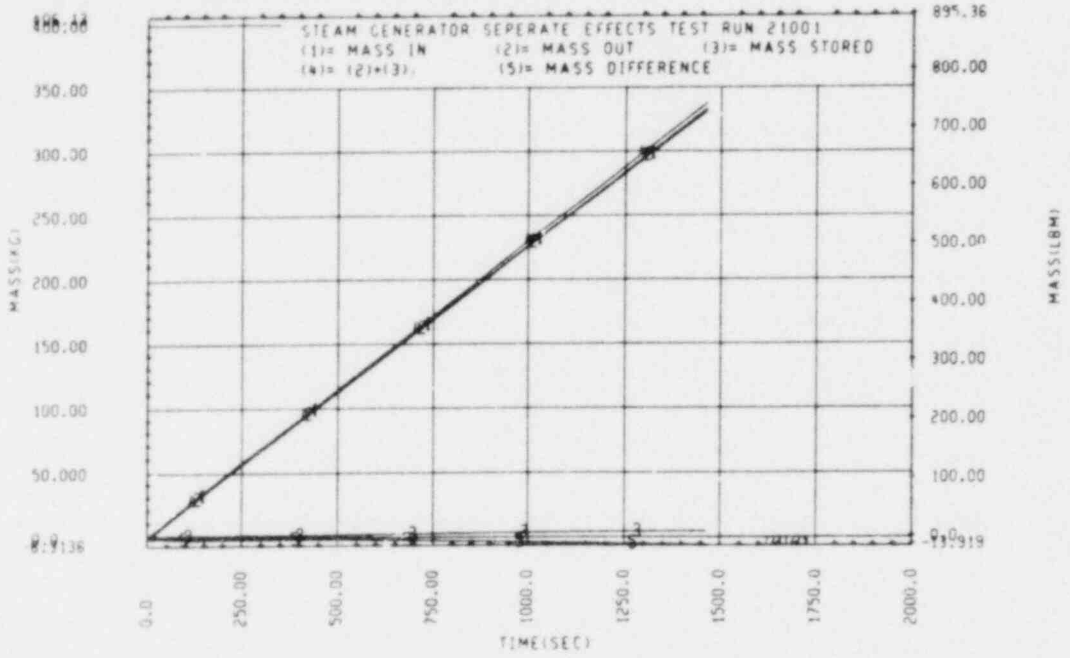

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21001
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
175.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
347.00
325.00
300.00
275.00
250.00
225.00
212.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

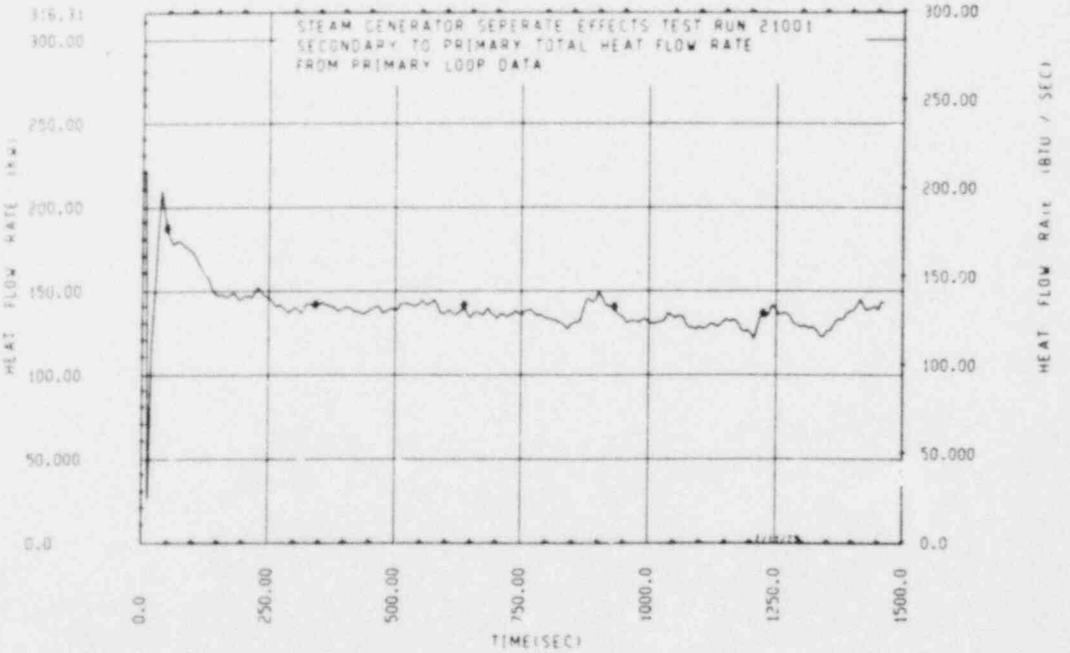

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21001
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

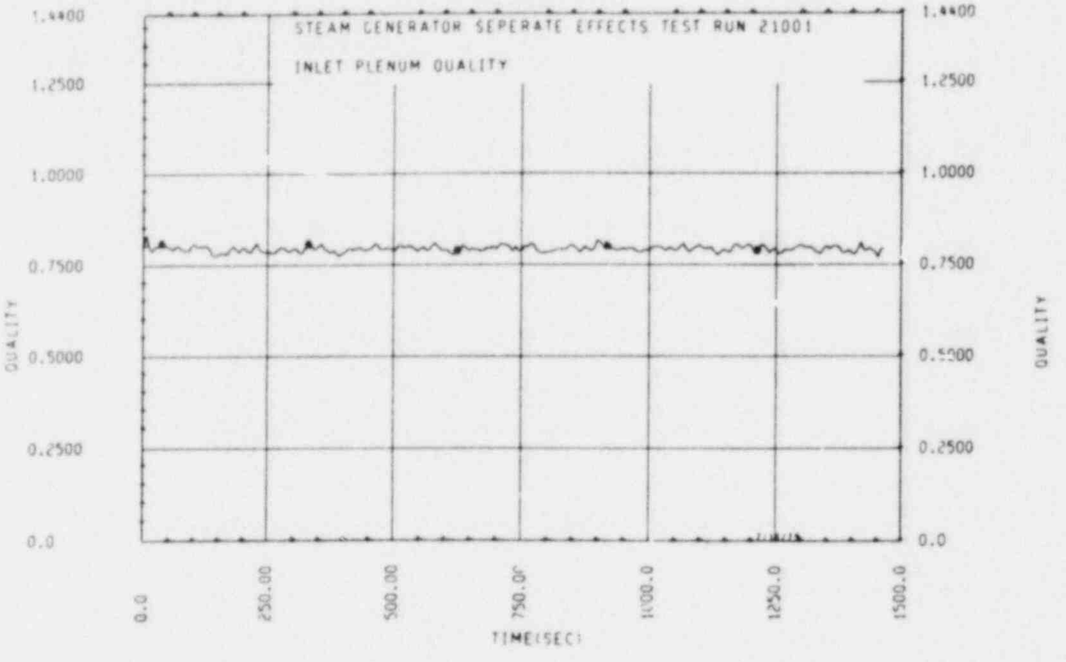
21001-7


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21001
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

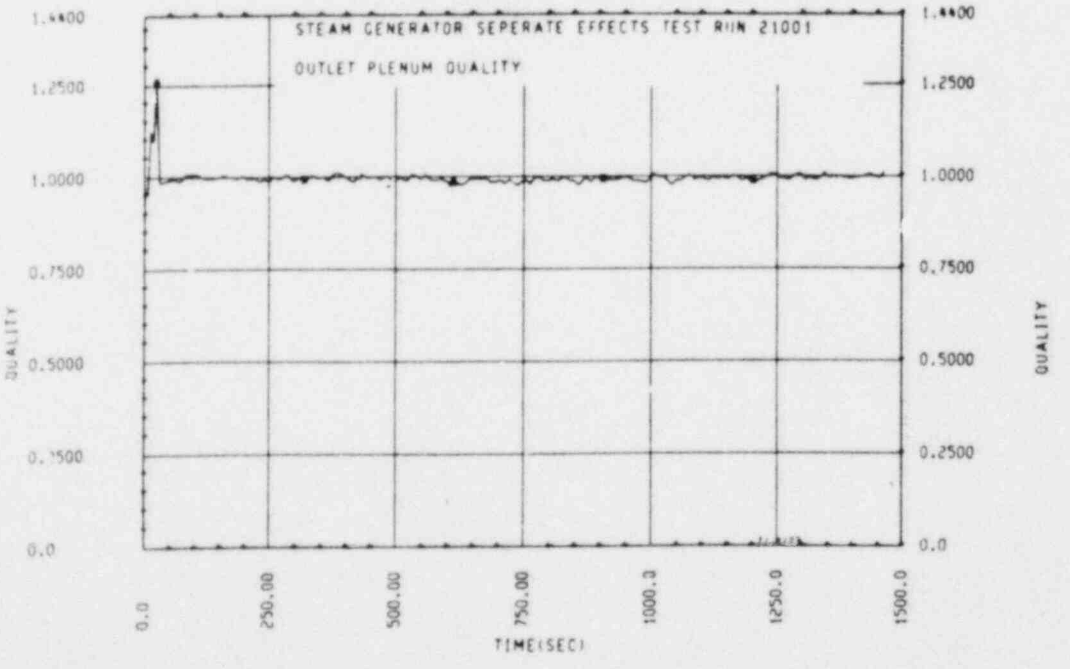

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21001
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
275.00
250.00
225.00
200.00
175.00
150.00
125.00
TEMPERATURE DEGREES F
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21001
(1)= MASS IN
(2)= MASS OUT
(3)= MASS STORED
(4)= (2)+(3)
(5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)

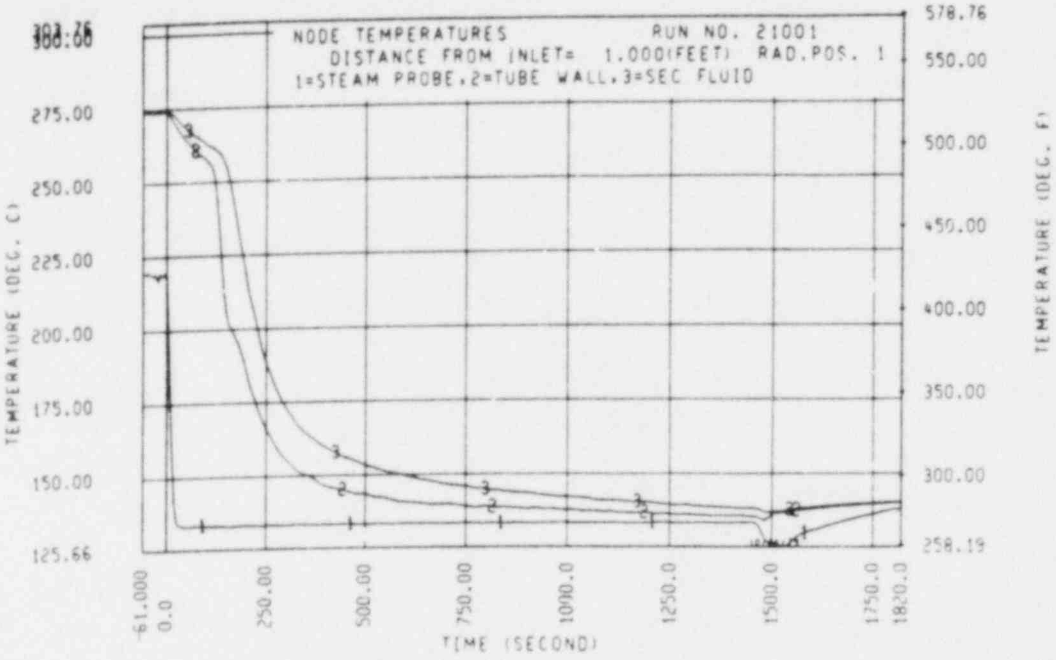

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21001
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)

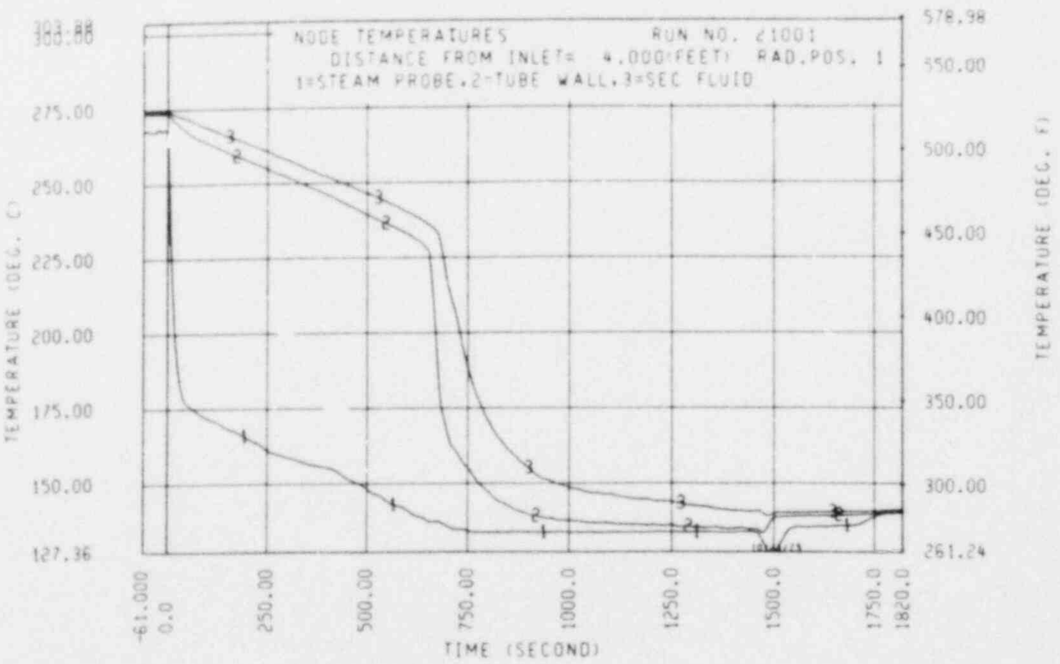


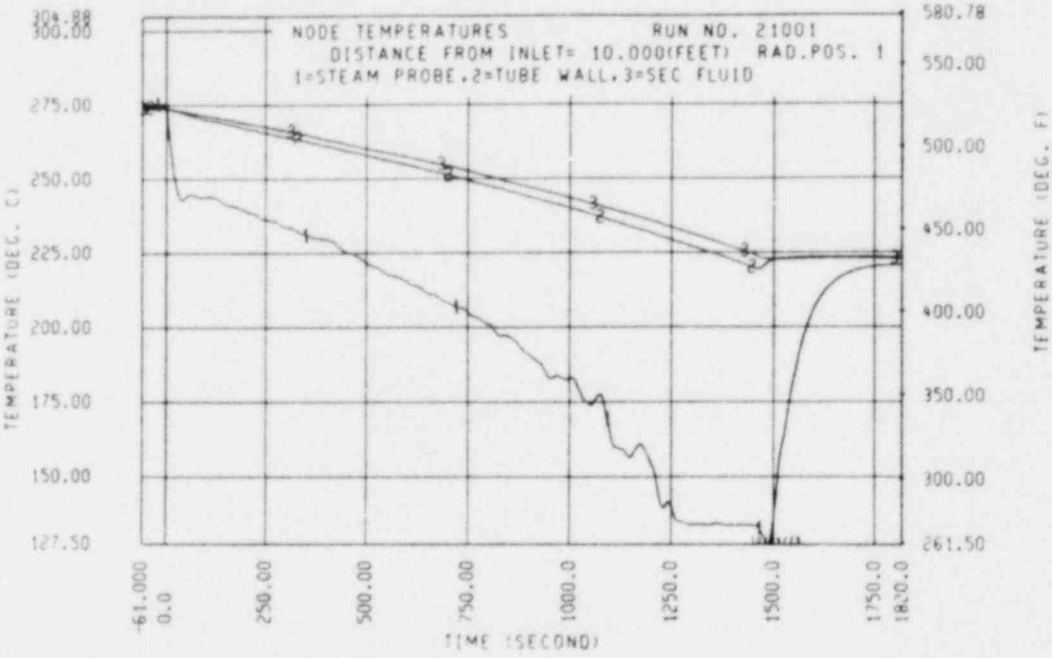
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21001
INLET PLENUM QUALITY
QUALITY
TIME(SEC)

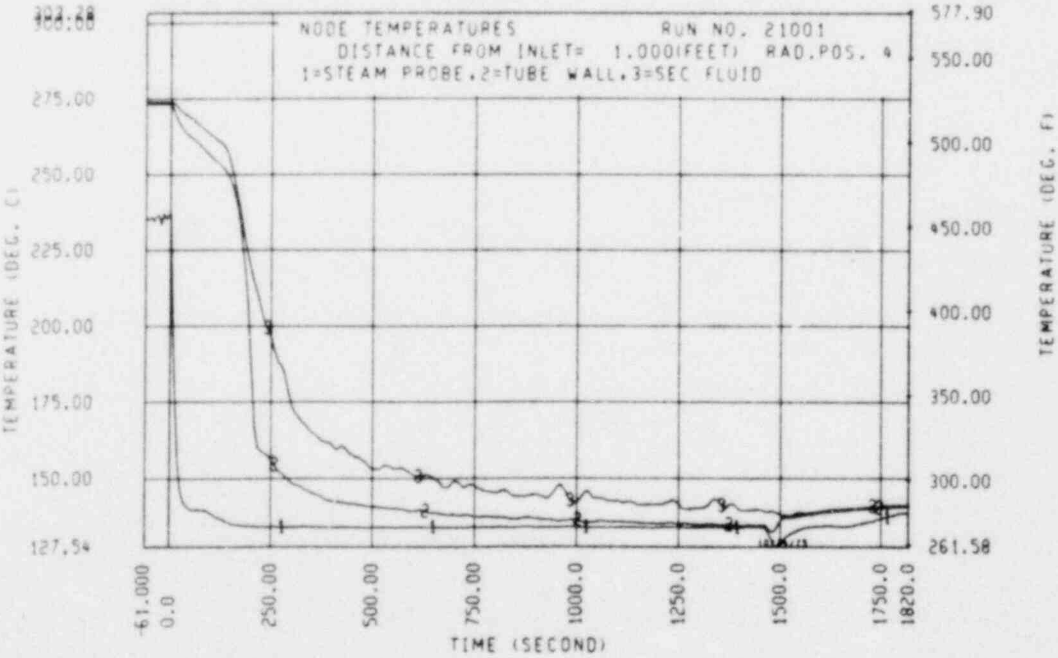


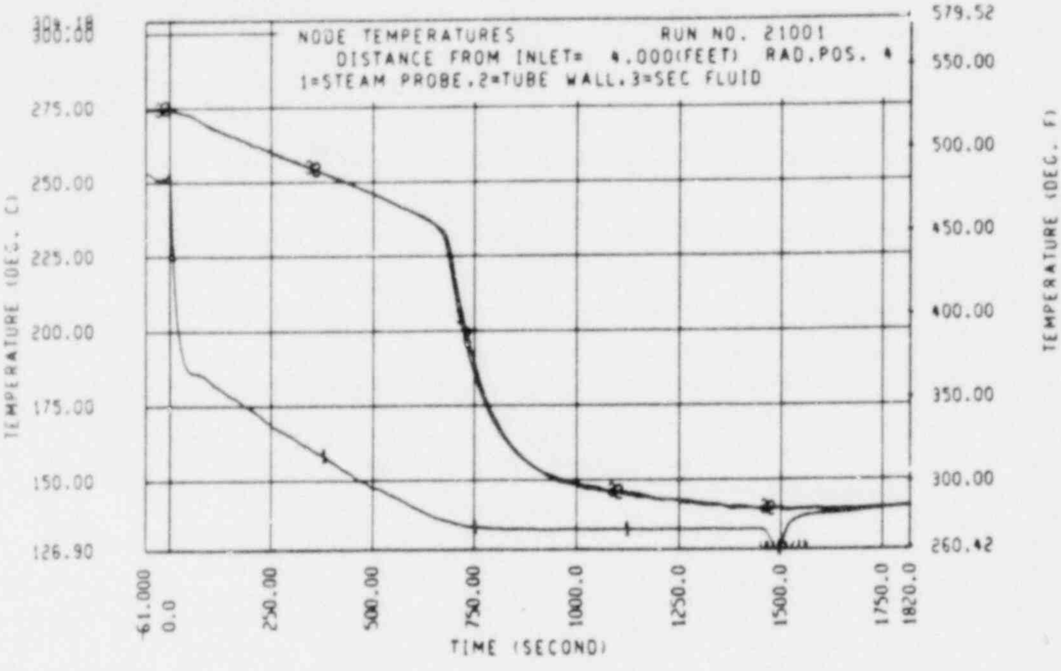
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21001
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)

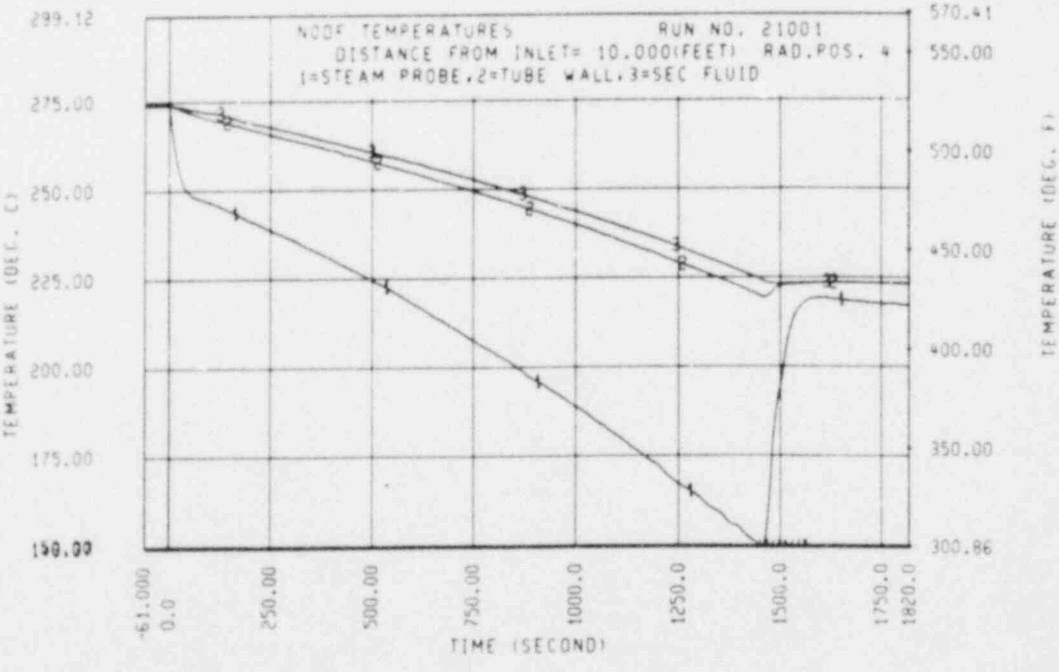

NODE TEMPERATURES RUN NO. 21001
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
303.76
300.00
275.00
250.00
225.00
200.00
175.00
150.00
125.66
TEMPERATURE (DEG. F)
578.76
550.00
500.00
450.00
400.00
350.00
300.00
258.19
-61.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1820.0
TIME (SECOND)

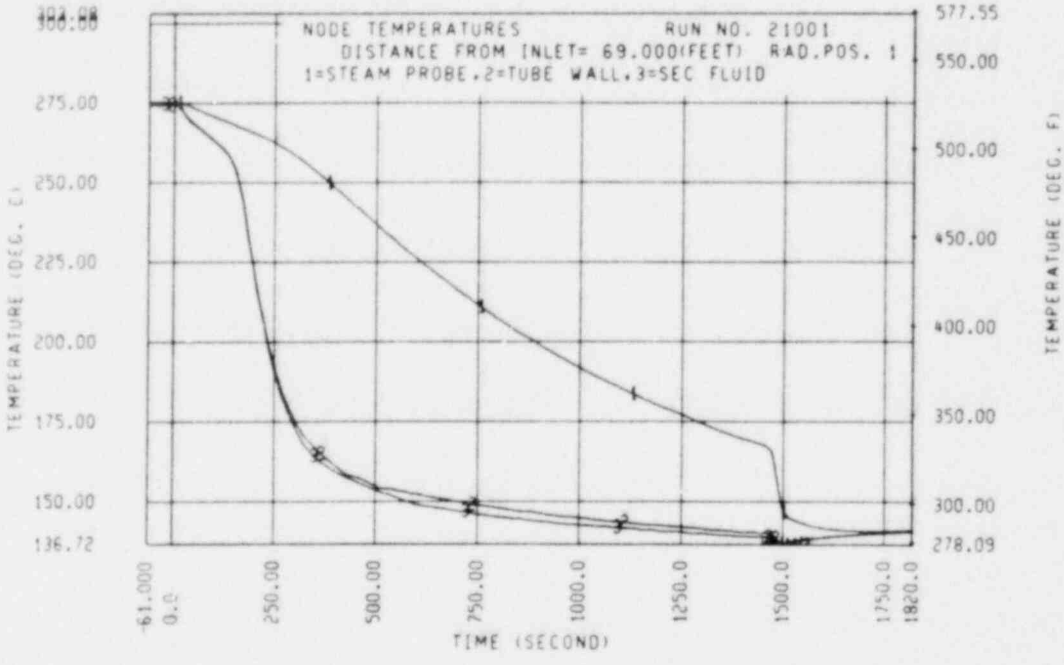

NODE TEMPERATURES RUN NO. 21001
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
303.88
300.00
275.00
250.00
225.00
200.00
175.00
150.00
127.36
TEMPERATURE (DEG. F)
578.98
550.00
500.00
450.00
400.00
350.00
300.00
261.24
-61.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1820.0
TIME (SECOND)

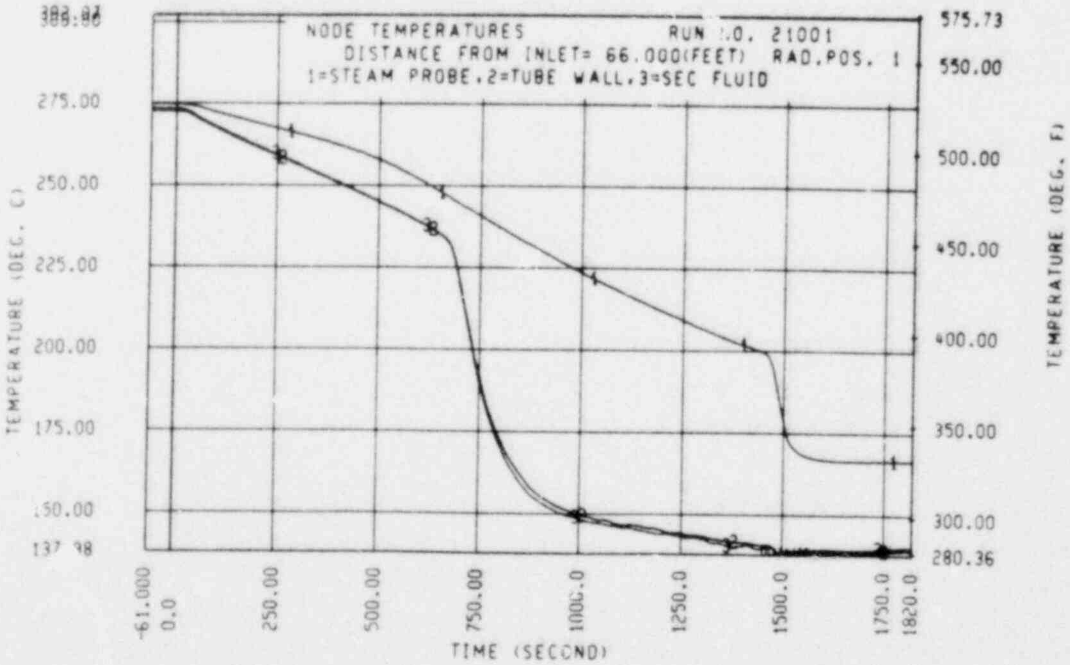

NODE TEMPERATURES
RUN NO. 21001
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
304.88
300.00
275.00
250.00
225.00
200.00
175.00
150.00
127.50
580.78
550.00
500.00
450.00
400.00
350.00
300.00
261.50
-61.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1820.0

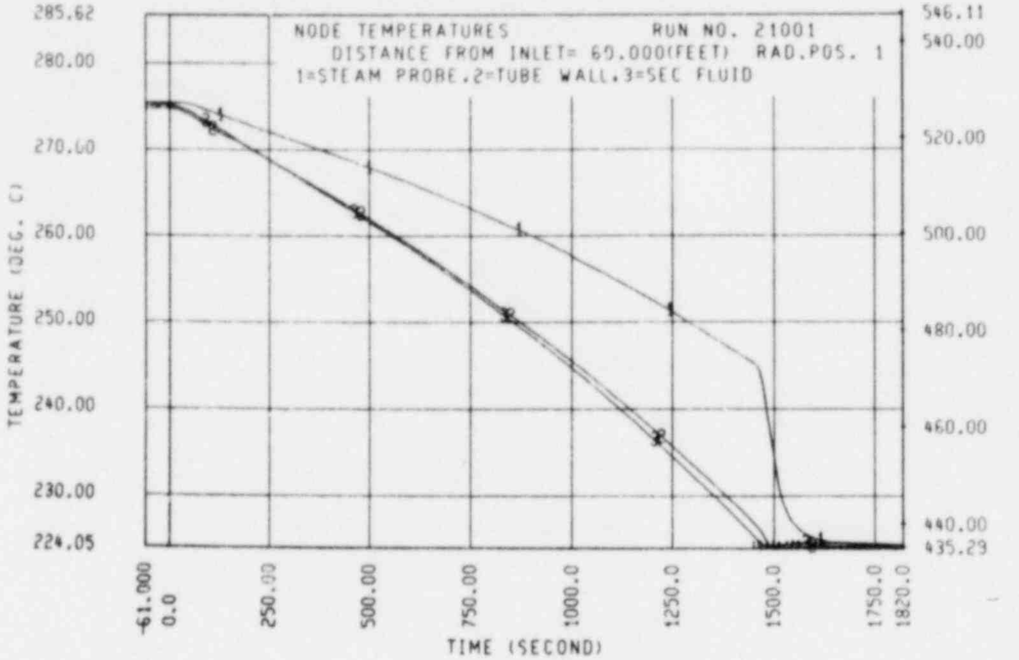

NODE TEMPERATURES
RUN NO. 21001
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
303.28
300.00
275.00
250.00
225.00
200.00
175.00
150.00
127.54
577.90
550.00
500.00
450.00
400.00
350.00
300.00
261.58
-61.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1820.0


NODE TEMPERATURES RUN NO. 21001
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

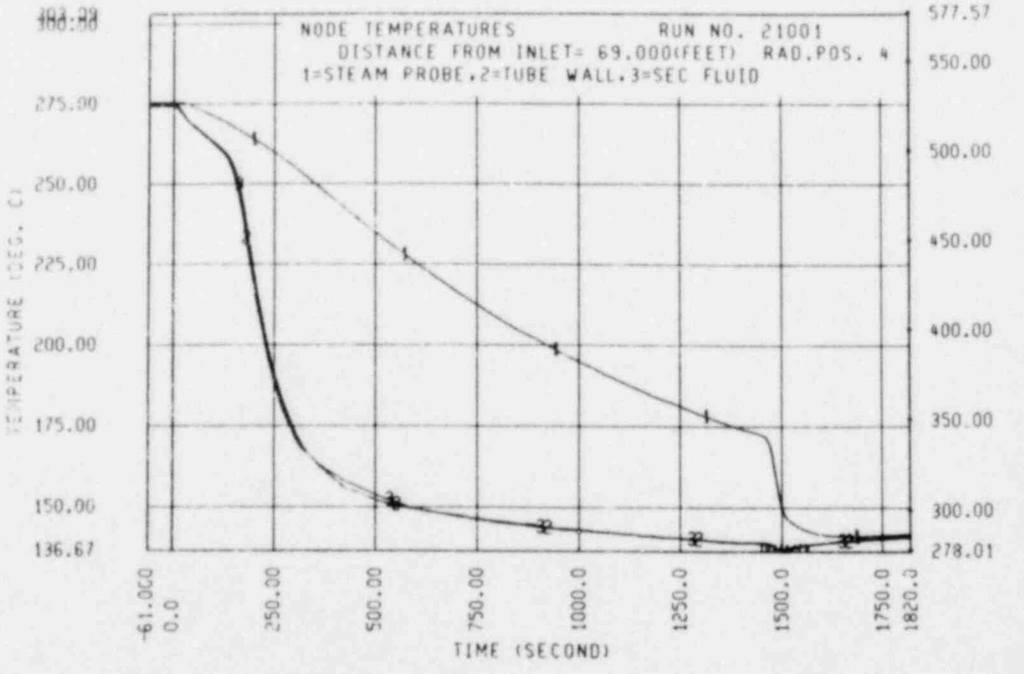

NODE TEMPERATURES RUN NO. 21001
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21001
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

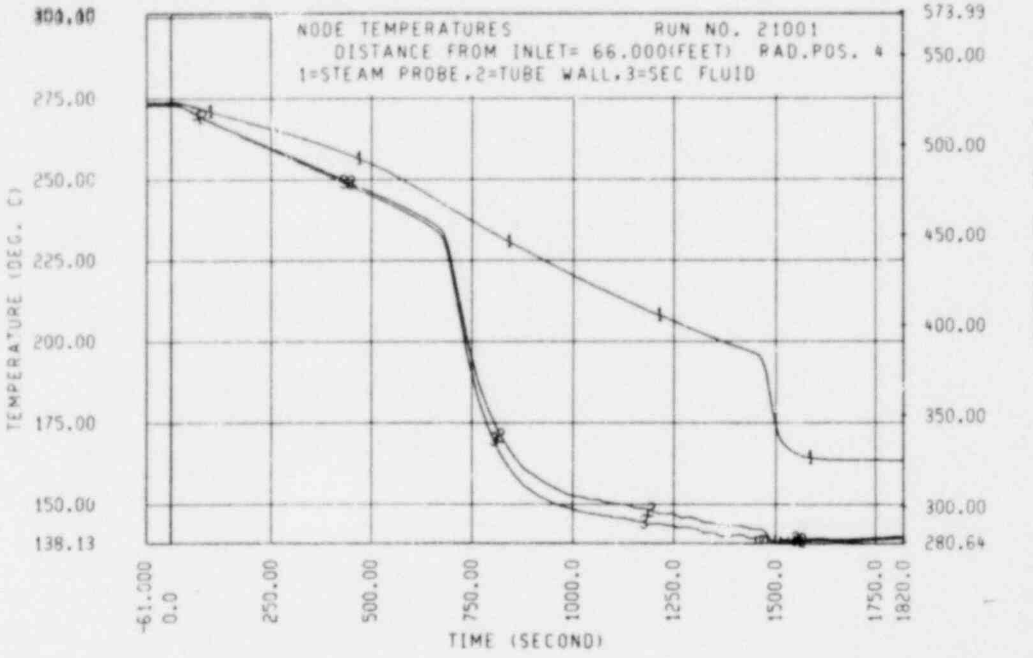

NODE TEMPERATURES RUN NO. 21001
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

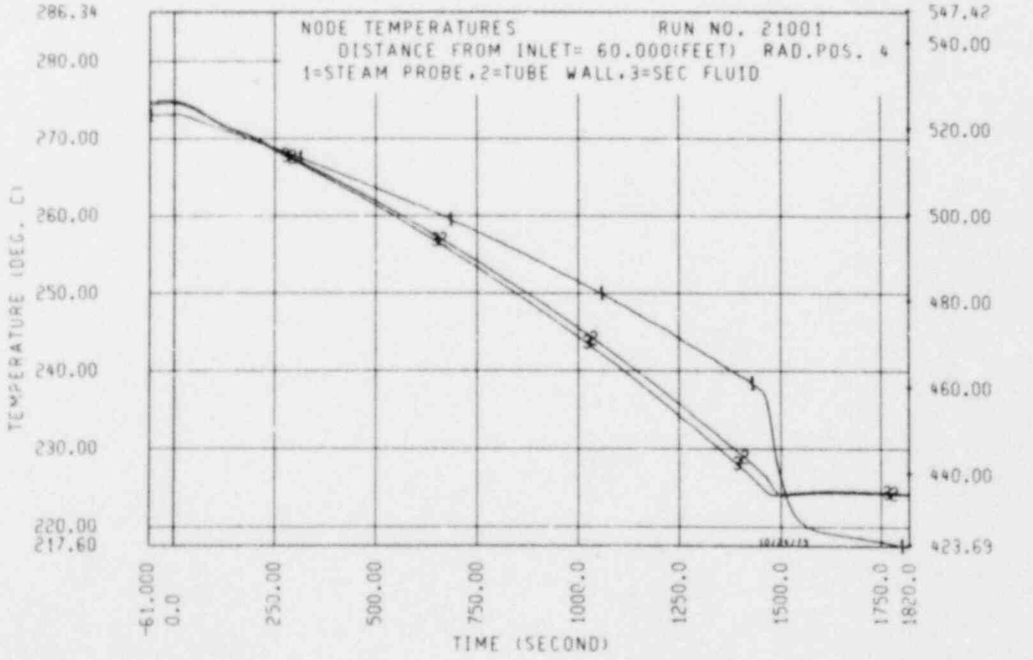


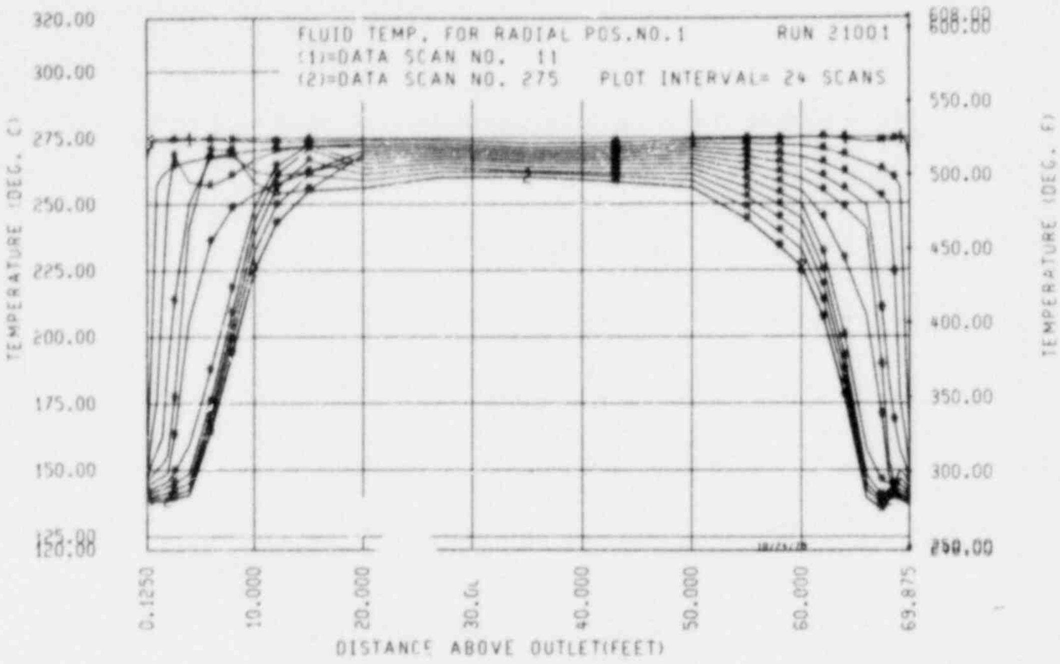
NODE TEMPERATURES
RUN NO. 21001
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

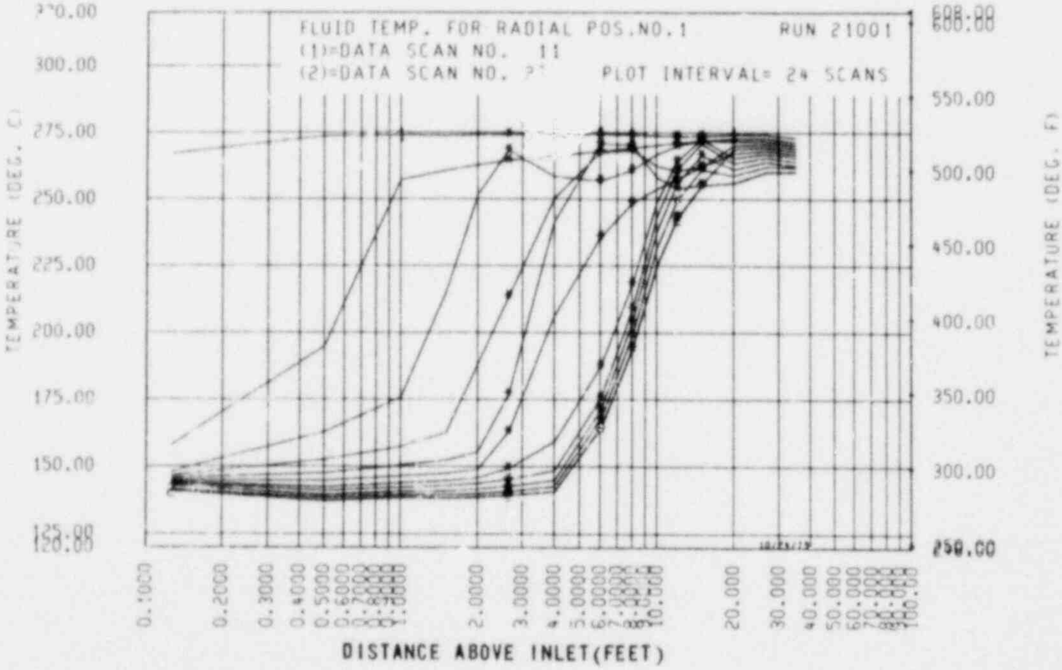


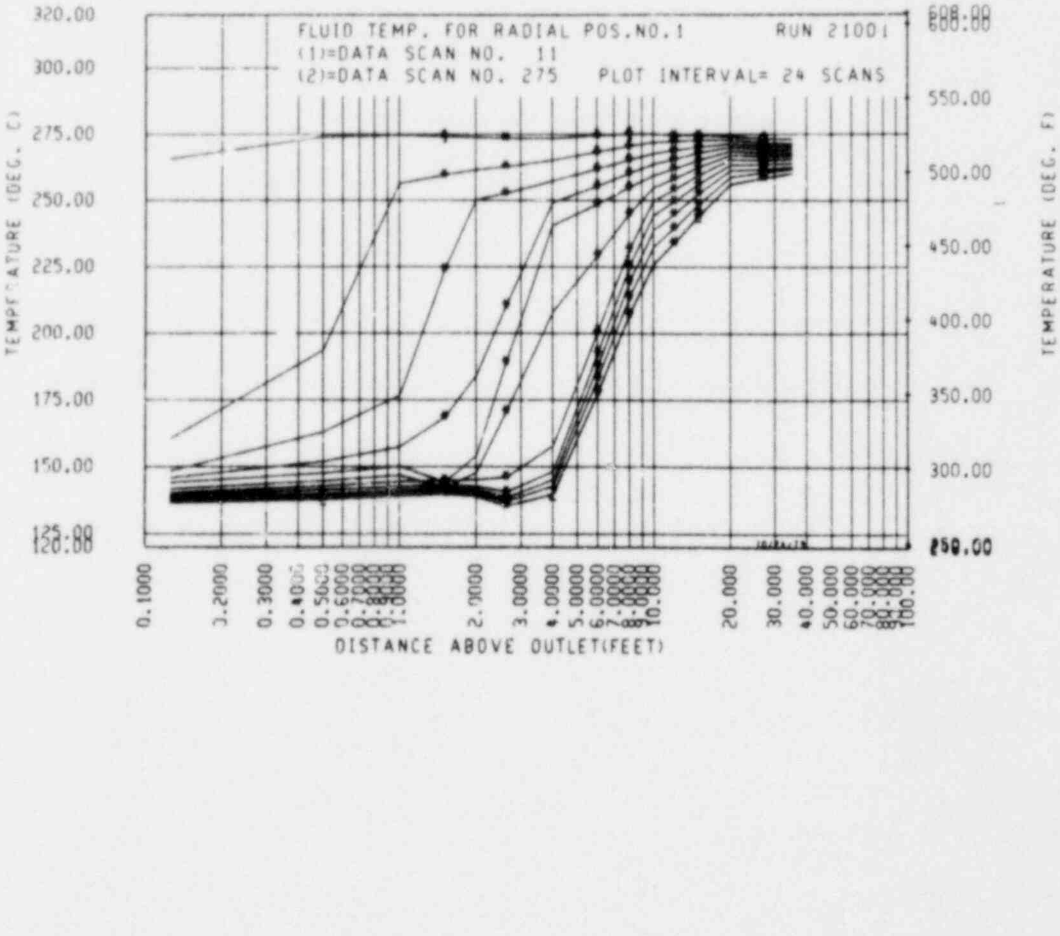
NODE TEMPERATURES
RUN NO. 21001
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21001
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21001
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 21001
(1)=DATA SCAN NO. 11
(2)=DATA SCAN NO. 275
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 21001
(1)=DATA SCAN NO. 11
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 21001
(1)=DATA SCAN NO. 11
(2)=DATA SCAN NO. 275
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

RUN 21001 FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

TIME = 66.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.8(.07)	63.8(5.63)	141.0(12.43)	96.4(8.49)	.628	.759	.861	.869
.2(.50)	192.3(16.94)	431.4(38.01)	67.5(5.94)	25.3(2.23)	.686	.900	.903	.890
.3(1.00)	18.7(1.64)	27.3(2.41)	25.0(2.21)	21.6(1.91)	.749	1.038	.931	.900
.5(1.50)	8.9(.78)	1.9(.17)	23.1(2.04)	23.2(2.04)	.754	1.043	.946	.908
.6(2.00)	1.8(.15)	21.4(1.88)	3.0(.27)	6.5(.57)	.753	1.046	.953	.911
.8(2.65)	1.8(.15)	43.3(3.81)	.6(.05)	3.4(.30)	.748	1.068	.954	.907
1.2(4.00)	8.5(.75)	6.8(.60)	18.6(1.64)	1.6(.14)	.743	1.077	.959	.892
1.8(6.00)	4.9(.43)	4.5(.40)	22.5(1.98)	8.1(.71)	.737	1.053	.968	.882
2.4(8.00)	2.1(.19)	1.2(.10)	1.0(.09)	2.9(.25)	.730	1.033	.967	.879
3.0(10.00)	.8(.07)	.8(.07)	1.5(.14)	1.9(.15)	.725	1.026	.962	.873
3.7(12.00)	.2(.01)	.7(.06)	.0(.00)	-1.1(-.10)	.720	1.021	.958	.866
4.6(15.00)	.9(.08)	1.2(.10)	-.5(-.04)	-.1(-.01)	.718	1.017	.948	.860
6.1(20.00)	.2(.01)	.1(.01)	.4(.04)	.5(.04)	.717	1.012	.939	.857
8.2(27.00)	.5(.04)	-.1(-.01)	-.2(-.02)	.3(.03)	.717	1.008	.937	.858
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.719	1.008	.938	.861
13.1(43.00)	-.4(-.04)	-.2(-.02)	.0(.00)	-.2(-.01)	.718	1.009	.940	.861
15.2(50.00)	.3(.03)	-.1(-.01)	.0(.00)	-.0(-.00)	.718	1.008	.940	.861
16.8(55.00)	.4(.04)	-.0(-.00)	.0(.00)	.0(.00)	.720	1.007	.940	.861
17.7(58.00)	.4(.03)	-.0(-.00)	.0(.00)	.0(.00)	.721	1.007	.941	.862
18.3(60.00)	.4(.04)	-.1(-.01)	.1(.01)	.1(.01)	.722	1.007	.943	.862
18.9(62.00)	.5(.04)	.0(.00)	.1(.01)	.1(.00)	.723	1.007	.944	.863
19.5(64.00)	.1(.01)	.2(.02)	.1(.01)	.0(.00)	.724	1.008	.944	.863
20.1(66.00)	.3(.03)	1.0(.09)	.3(.03)	-.0(-.00)	.726	1.010	.945	.863
20.5(67.38)	-.0(-.00)	.3(.03)	-.2(-.02)	-.6(-.05)	.727	1.012	.945	.863
20.7(68.00)	.5(.04)	-.1(-.01)	.1(.01)	.1(.00)	.727	1.013	.945	.863
20.9(68.50)	-.3(-.03)	-.3(-.03)	-.8(-.07)	-.6(-.05)	.727	1.012	.944	.862
21.0(69.00)	-.2(-.02)	-.2(-.02)	-.1(-.01)	-.2(-.02)	.728	1.011	.944	.862
21.2(69.50)	-1.2(-.11)	-3.8(-.33)	-2.4(-.21)	-1.8(-.16)	.730	1.011	.943	.862
21.3(69.87)	-25.0(-2.20)	-11.2(-.99)	-11.3(-1.00)	-7.3(-.64)	.728	1.009	.941	.861

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 21001

TIME = 306.0 SECONDS

UNITS - ELEVATION METER(FEET)

FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.02)	15.0(1.32)	15.5(1.37)	13.1(1.15)	.622	.747	.839	.854
.2(.50)	46.8(4.13)	49.4(4.36)	51.0(4.50)	50.0(4.41)	.636	.764	.857	.872
.3(1.00)	63.3(5.58)	87.8(7.74)	87.2(7.69)	80.1(7.05)	.669	.806	.899	.910
.5(1.50)	17.5(1.54)	75.2(6.62)	39.2(3.45)	73.6(6.48)	.693	.855	.937	.954
.6(2.00)	73.6(6.48)	31.3(2.76)	6.6(.58)	11.5(1.01)	.720	.887	.950	.976
.8(2.65)	1.5(.13)	10.7(.94)	-2.8(-.24)	2.7(.24)	.738	.899	.947	.975
1.2(4.00)	10.4(.92)	11.5(1.01)	6.9(.61)	1.5(.13)	.738	.902	.937	.962
1.8(6.00)	6.6(.58)	12.6(1.11)	13.9(1.23)	7.5(.66)	.739	.902	.934	.949
2.4(8.00)	3.9(.34)	7.5(.66)	1.0(.09)	5.8(.52)	.734	.903	.930	.944
3.0(10.00)	4.0(.35)	4.0(.35)	4.1(.36)	4.4(.39)	.731	.905	.923	.941
3.7(12.00)	3.6(.31)	1.6(.14)	2.2(.20)	.1(.01)	.731	.903	.921	.936
4.6(15.00)	3.8(.34)	1.2(.10)	.9(.08)	1.1(.09)	.738	.900	.917	.931
6.1(20.00)	1.4(.12)	1.3(.12)	.2(.02)	.9(.08)	.746	.899	.911	.929
8.2(27.00)	.6(.05)	.0(.00)	-.2(-.02)	.3(.02)	.750	.898	.907	.930
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.751	.897	.907	.931
13.1(43.00)	-.5(-.04)	-.3(-.02)	.0(.00)	-.2(-.01)	.748	.897	.909	.932
15.2(50.00)	.3(.02)	-.1(-.01)	.0(.00)	-.0(-.00)	.748	.896	.909	.932
16.8(55.00)	.2(.02)	-.1(-.01)	-.0(-.00)	-.0(-.00)	.749	.896	.910	.932
17.7(58.00)	.0(.00)	-.2(-.01)	-.1(-.01)	-.1(-.00)	.750	.895	.911	.933
18.3(60.00)	-.1(-.01)	-.4(-.04)	-.2(-.02)	-.1(-.01)	.751	.895	.912	.934
18.9(62.00)	-.1(-.01)	-.1(-.01)	-.1(-.01)	-.1(-.01)	.751	.896	.914	.935
19.5(64.00)	-.0(-.00)	.1(.01)	.0(.00)	-.2(-.02)	.753	.897	.915	.936
20.1(66.00)	.2(.01)	1.0(.09)	.2(.01)	-.5(-.04)	.755	.901	.916	.937
20.5(67.38)	-.4(-.04)	-.0(-.00)	-.5(-.05)	-1.7(-.15)	.756	.904	.917	.936
20.7(68.00)	-.4(-.03)	-.4(-.04)	-.7(-.06)	-1.3(-.11)	.757	.904	.917	.936
20.9(68.50)	-2.6(-.23)	-2.8(-.25)	-6.5(-.57)	-.7(-.06)	.757	.904	.916	.937
21.0(69.00)	2.7(.24)	2.1(.19)	.5(.04)	4.9(.43)	.760	.905	.916	.942
21.2(69.50)	-15.2(-1.34)	-2.7(-.24)	-18.8(-1.66)	-15.4(-1.36)	.766	.910	.915	.943
21.3(69.87)	-5.9(-.52)	-3.3(-.29)	-4.0(-.35)	-3.7(-.33)	.770	.914	.911	.940

21001-20

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 21001

TIME = 606.0 SECONDS

UNITS - ELEVATION METER(FEET)

FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1		2		3		4		LOCAL QUALITY 1	2	3	4
.0(.13)	.2(	.01)	5.9(	.52)	5.4(	.48)	4.7(	.41)	.624	.748	.839	.853
.2(.50)	16.3(	1.44)	18.5(	1.63)	18.0(	1.59)	16.3(	1.44)	.629	.754	.845	.859
.3(1.00)	21.5(	1.89)	22.1(	1.95)	20.2(	1.78)	25.4(	2.24)	.640	.766	.856	.871
.5(1.50)	23.4(	2.06)	21.1(	1.86)	23.4(	2.06)	27.7(	2.44)	.654	.779	.869	.888
.6(2.00)	27.7(	2.44)	25.5(	2.25)	23.0(	2.02)	23.6(	2.08)	.668	.793	.883	.903
.8(2.65)	[illegible](	.05)	33.3(	2.93)	22.8(	2.01)	18.3(	1.61)	.676	.816	.901	.917
1.2(4.00)	14.0(	1.23)	13.8(	1.22)	18.4(	1.62)	1.3(	.12)	.690	.841	.929	.918
1.8(6.00)	8.0(	.71)	10.9(	.96)	17.4(	1.54)	11.5(	1.02)	.707	.852	.955	.914
2.4(8.00)	4.7(	.41)	6.2(	.55)	1.6(	.14)	6.8(	.60)	.705	.852	.954	.914
3.0(10.00)	5.7(	.51)	5.7(	.51)	6.3(	.55)	6.7(	.59)	.697	.850	.941	.912
3.7(12.00)	6.2(	.54)	4.8(	.42)	3.7(	.33)	3.3(	.29)	.698	.850	.937	.910
4.6(15.00)	4.8(	.42)	2.9(	.25)	2.0(	.18)	4.3(	.37)	.709	.853	.933	.912
6.1(20.00)	1.8(	.15)	2.0(	.17)	1.0(	.09)	1.3(	.11)	.720	.856	.930	.916
8.2(27.00)	.6(	.05)	.1(	.01)	-.1(	-.01)	.4(	.03)	.723	.856	.926	.916
10.7(35.00)	0.0(	0.00)	0.0(	0.00)	0.0(	0.00)	0.0(	0.00)	.721	.854	.925	.917
13.1(43.00)	-.5(	-.05)	-.3(	-.03)	.0(	.00)	-.2(	-.02)	.718	.852	.926	.918
15.2(50.00)	.2(	.02)	-.1(	-.01)	-.0(	-.00)	-.0(	-.00)	.717	.851	.927	.917
16.8(55.00)	.1(	.01)	-.2(	-.02)	-.1(	-.01)	-.2(	-.01)	.719	.851	.927	.918
17.7(58.00)	-.0(	-.00)	-.3(	-.03)	-.2(	-.02)	-.2(	-.02)	.721	.851	.929	.919
18.3(60.00)	-.4(	-.03)	-.8(	-.07)	-.5(	-.05)	-.5(	-.04)	.721	.851	.930	.921
18.9(62.00)	-.7(	-.05)	-.2(	-.01)	-.3(	-.03)	-.6(	-.05)	.722	.853	.933	.923
19.5(64.00)	-.1(	-.01)	.1(	.01)	-.1(	-.01)	-.7(	-.06)	.725	.857	.938	.926
20.1(66.00)	-.0(	-.00)	.9(	.08)	-.0(	-.00)	-1.4(	-.12)	.729	.864	.943	.928
20.5(67.38)	-2.9(	-.25)	-2.3(	-.20)	-3.1(	-.27)	-5.9(	-.52)	.731	.868	.946	.927
20.7(68.00)	-7.5(	-.66)	-8.3(	-.73)	-8.4(	-.74)	-7.3(	-.65)	.730	.867	.945	.925
20.9(68.50)	-8.6(	-.78)	-10.7(	-.94)	-11.7(	-1.03)	-6.9(	-.60)	.730	.864	.942	.926
21.0(69.00)	2.0(	.19)	1.4(	.13)	.7(	.06)	-1.7(	-.15)	.735	.865	.943	.930
21.2(69.50)	-10.5(	-.93)	-11.4(	-1.01)	-9.2(	-.81)	-7.1(	-.62)	.741	.868	.945	.932
21.3(69.87)	-1.7(	-.15)	-1.1(	-.10)	-2.0(	-.17)	-2.5(	-.22)	.744	.870	.944	.931

21001-21

SUMMARY SHEET

RUN NO. 21121

DATE: 3/5/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.177 (0.391)
2. Water flow - [kg/sec (lb/sec)] - 0.044 (0.097)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{o}C (^{o}F)] - 155 (311)
5. Water temperature [^{o}C (^{o}F)] - 124 (255)
6. Mixer pressure [kPa (psig)] - 193 (28)
7. Test time (sec) - 1156

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.1 (33.1)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	131 (267)
0.15 (0.50)	131 (267)
0.30 (1.00)	131 (267)
0.46 (1.50)	131 (267)
0.61 (2.00)	131 (267)
1.22 (4.00)	131 (267)
3.05 (10.00)	132 (267)
6.09 (20.00)	131 (269)
8.23 (27.00)	131 (267)
10.67 (35.00)	131 (268)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 10.3 (22.6)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 52.6 (115.9)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 2.9 (6.4)

D. FAILED BUNDLE T/Cs[1]

311, 326, 553, 568

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

NA

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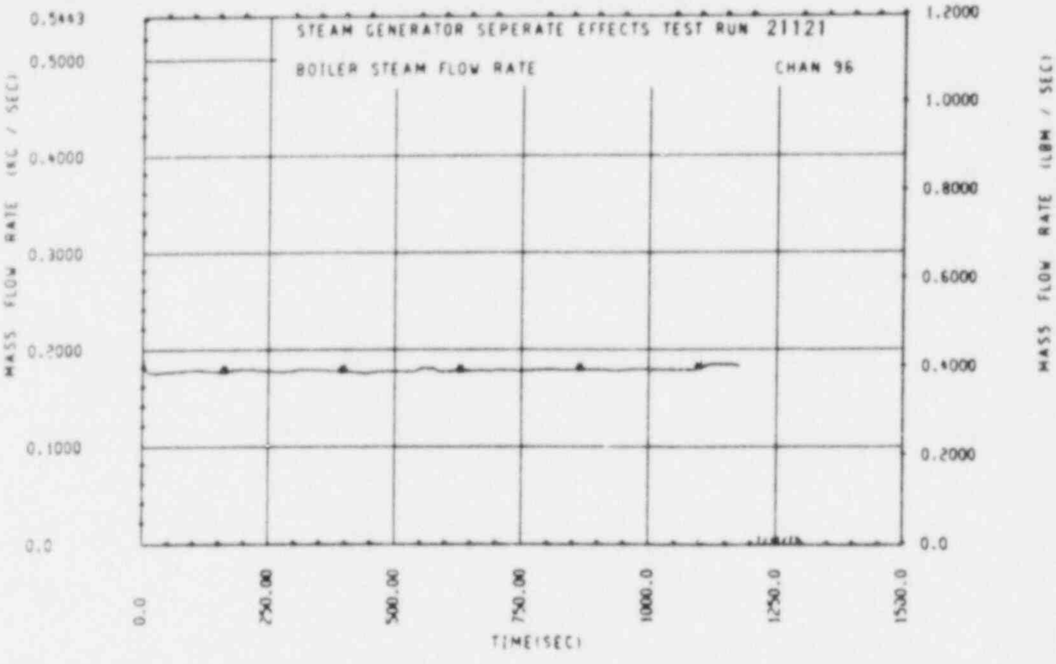
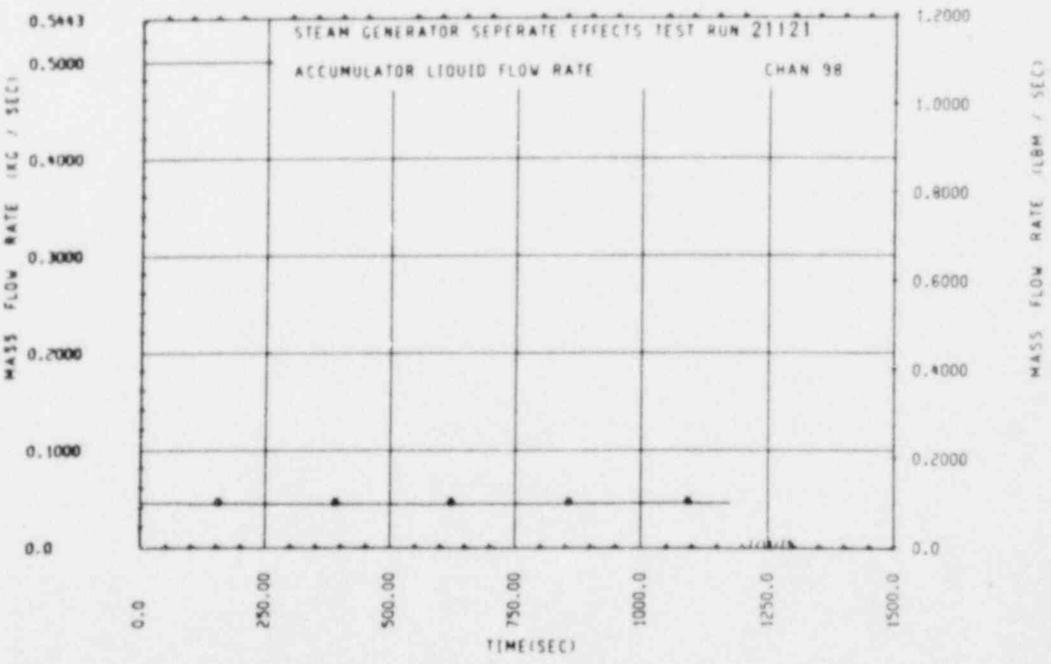
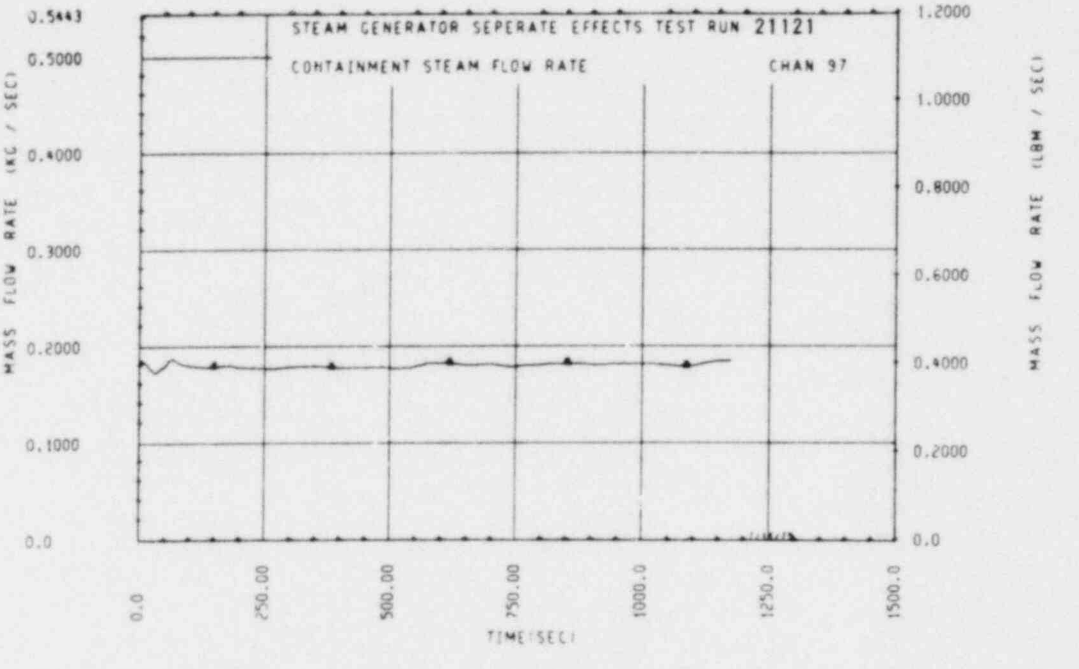
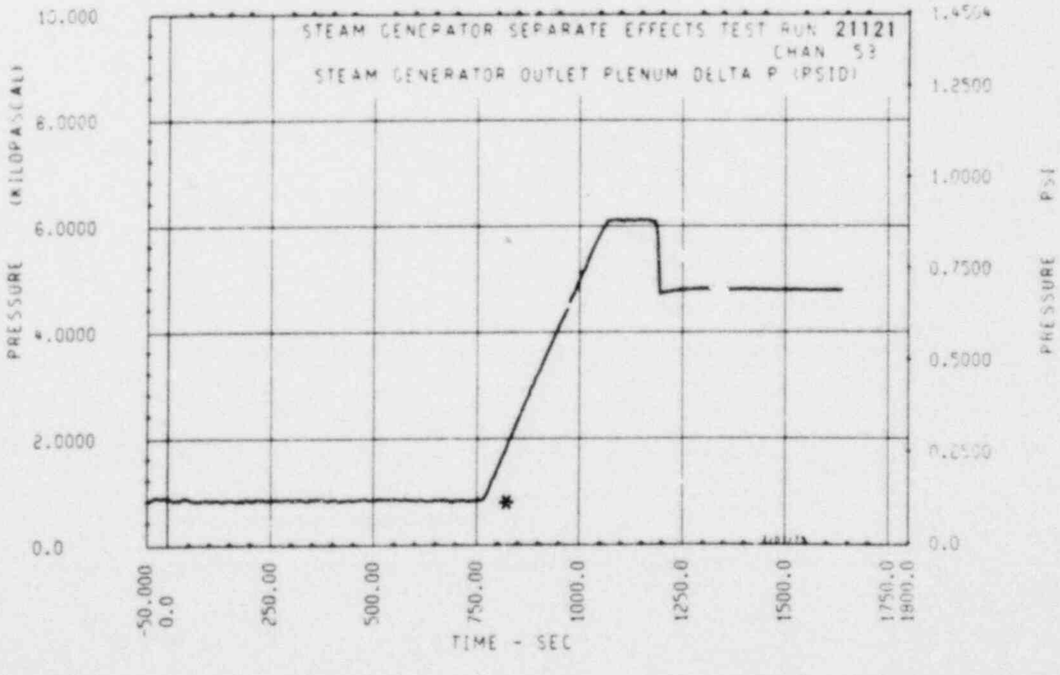
1. T/Cs are defined as failed based on resistance reading or T/C response.

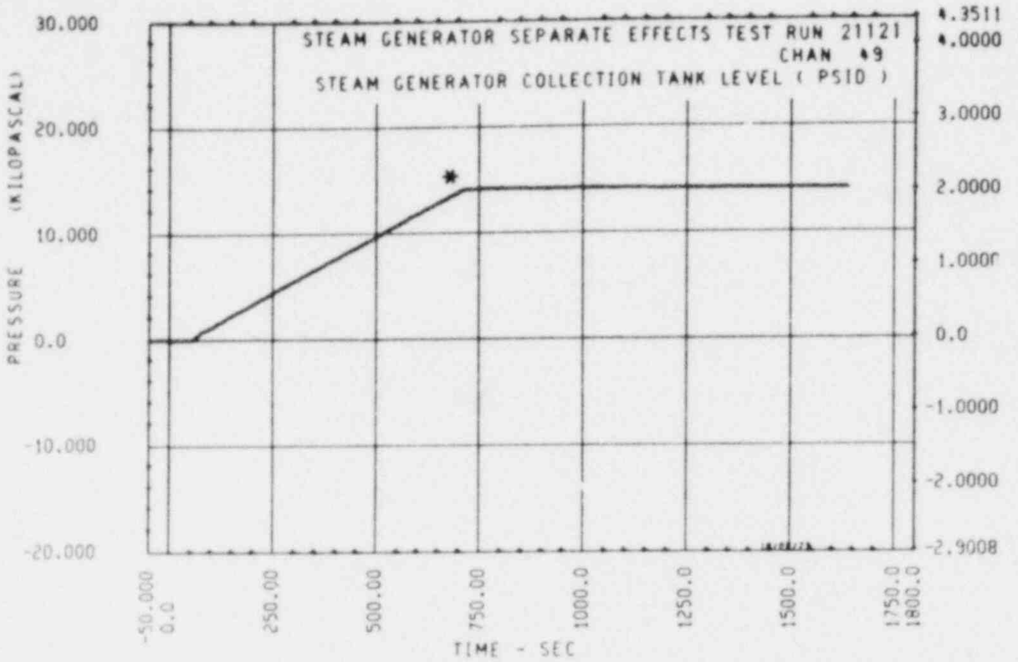

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21121
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21121
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

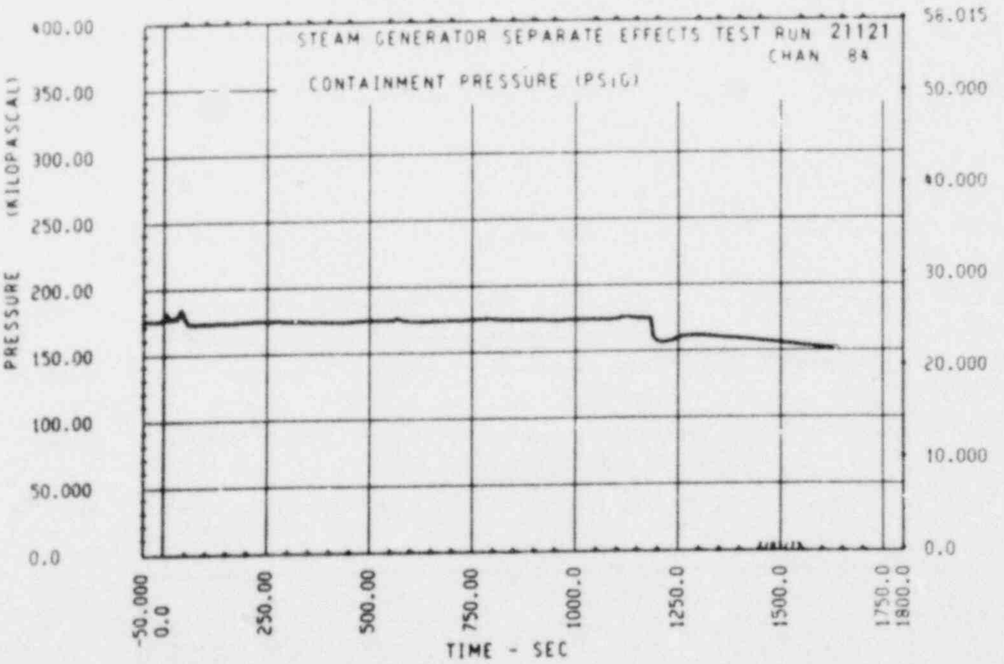


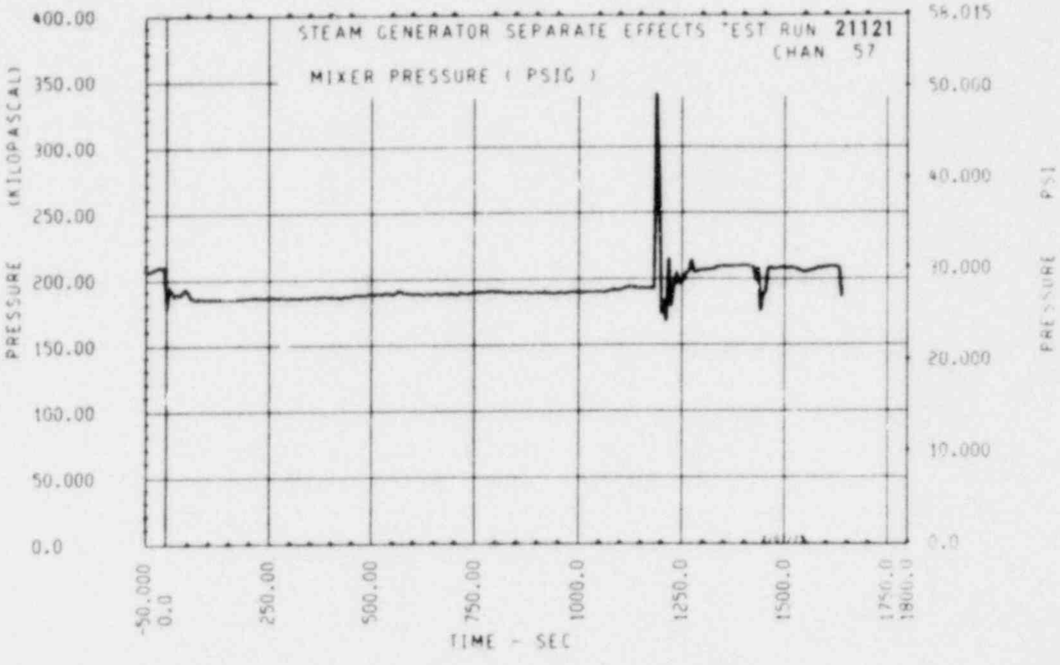


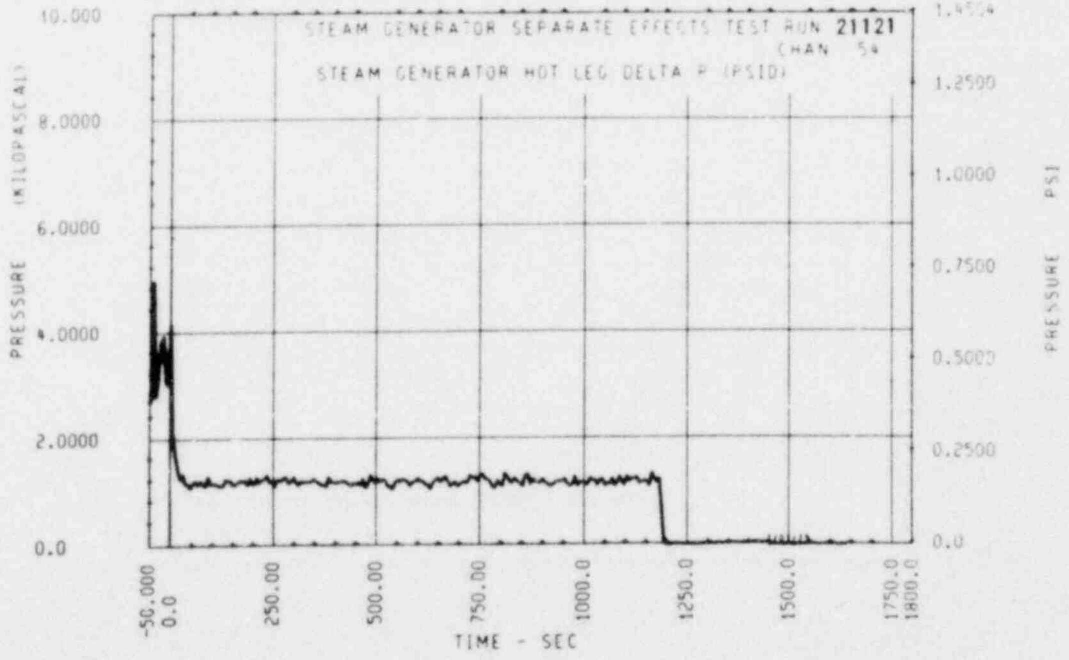
* Refer to Appendix H text for explanation of delayed response.

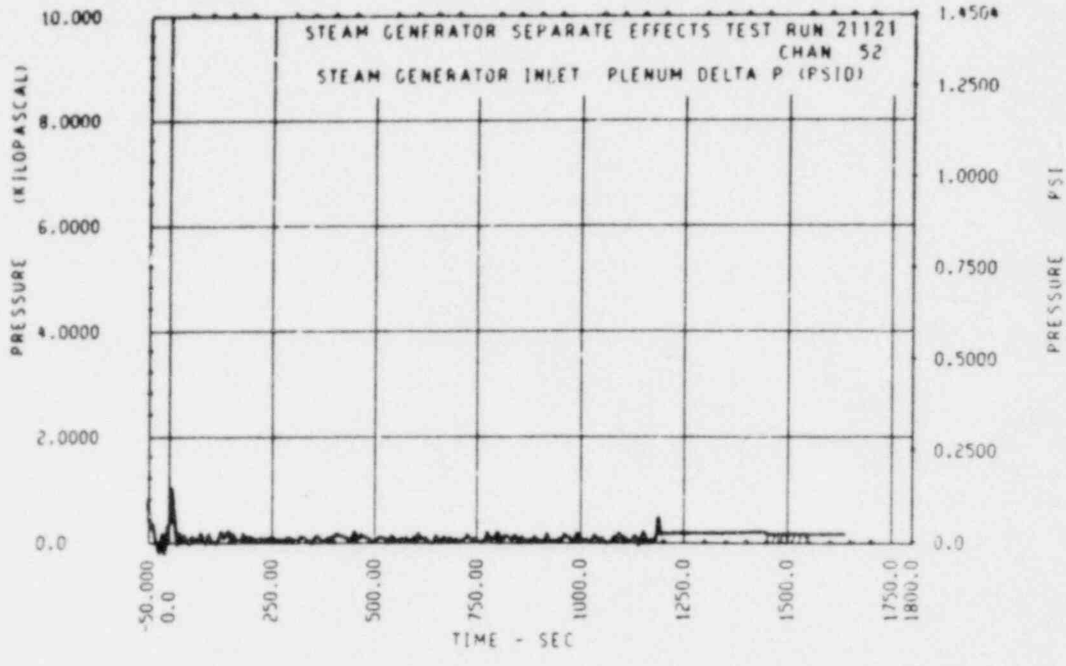


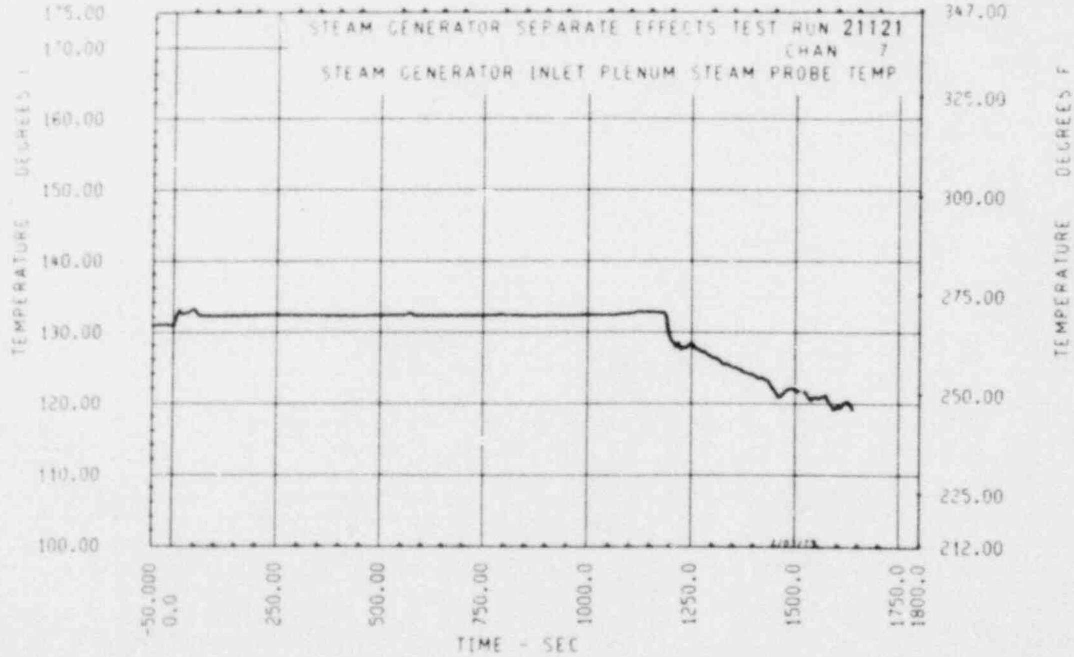
* Refer to Appendix H text for explanation of delayed response.

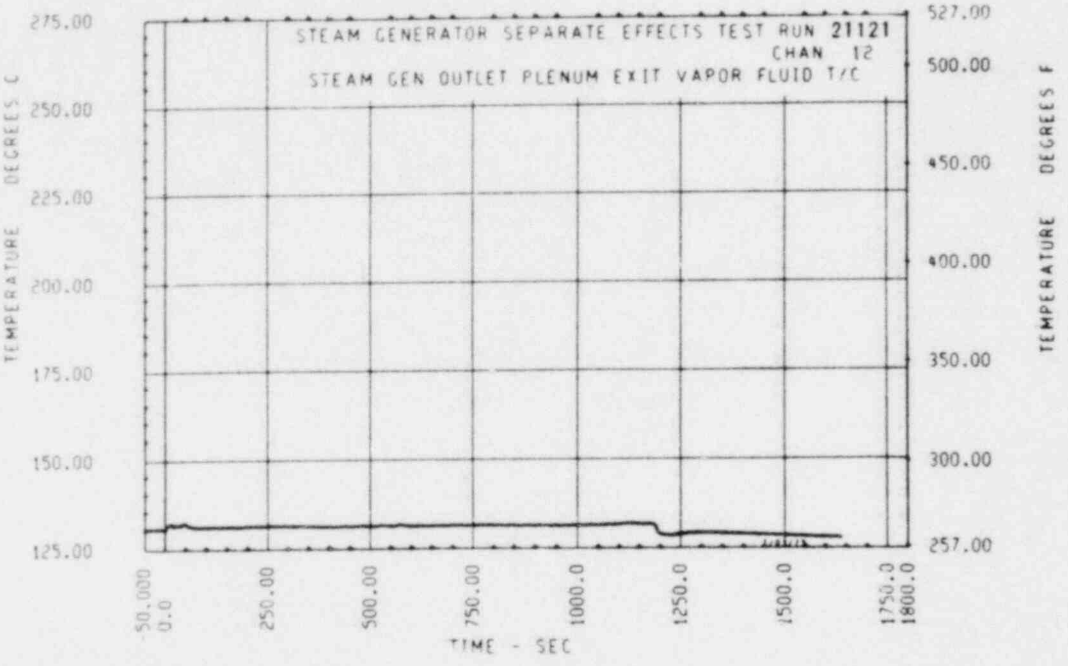


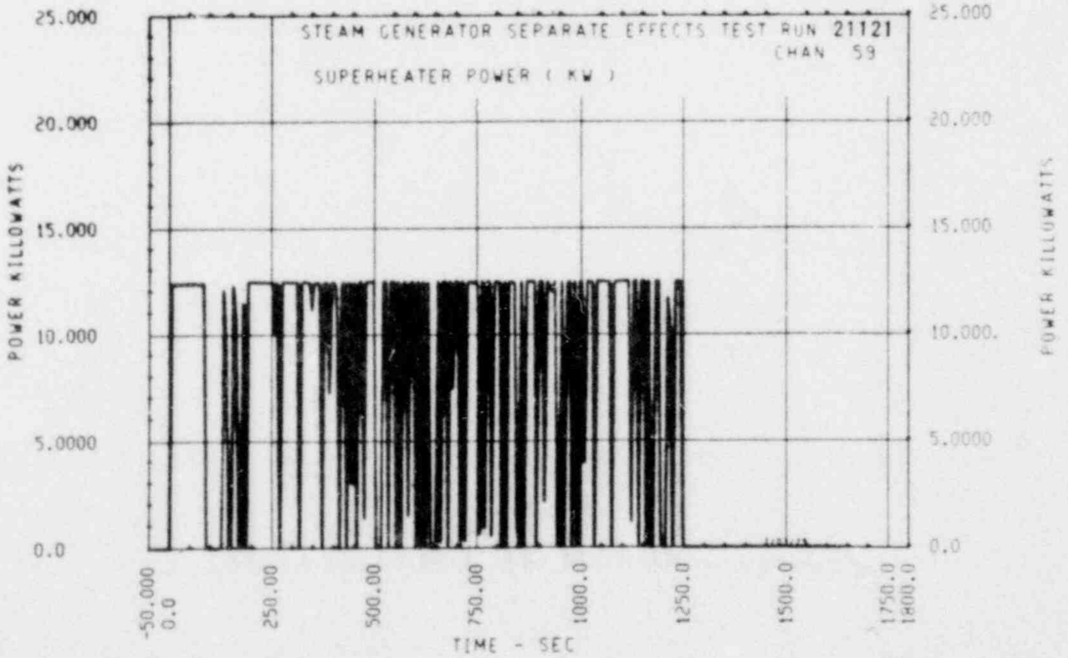

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21121
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

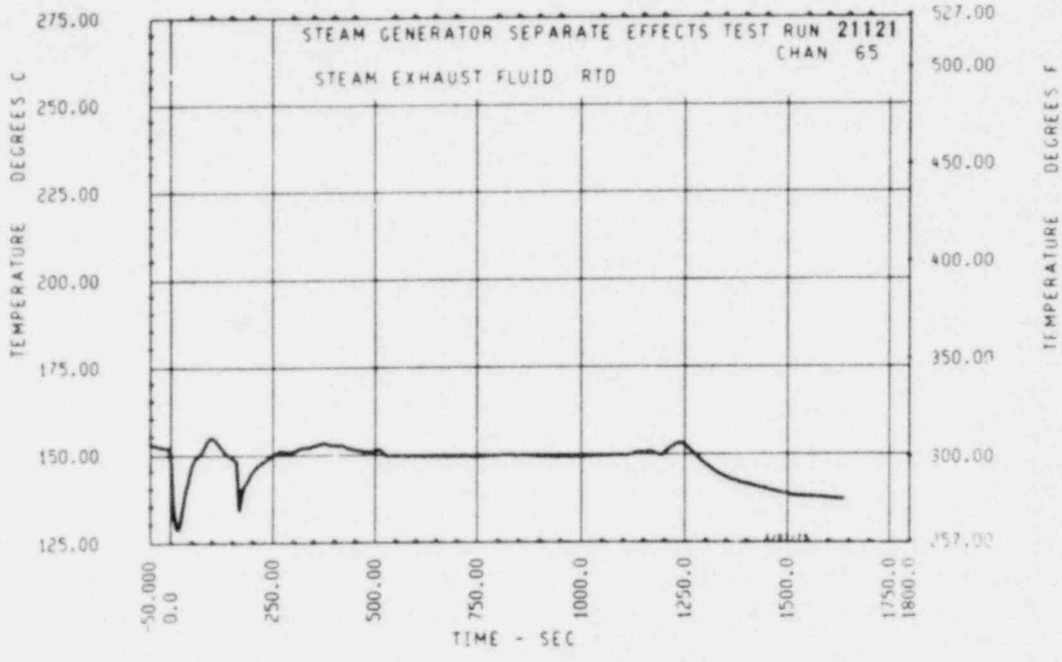

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21121
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
10.000
8.0000
6.0000
4.0000
2.0000
0.0
1.4504
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

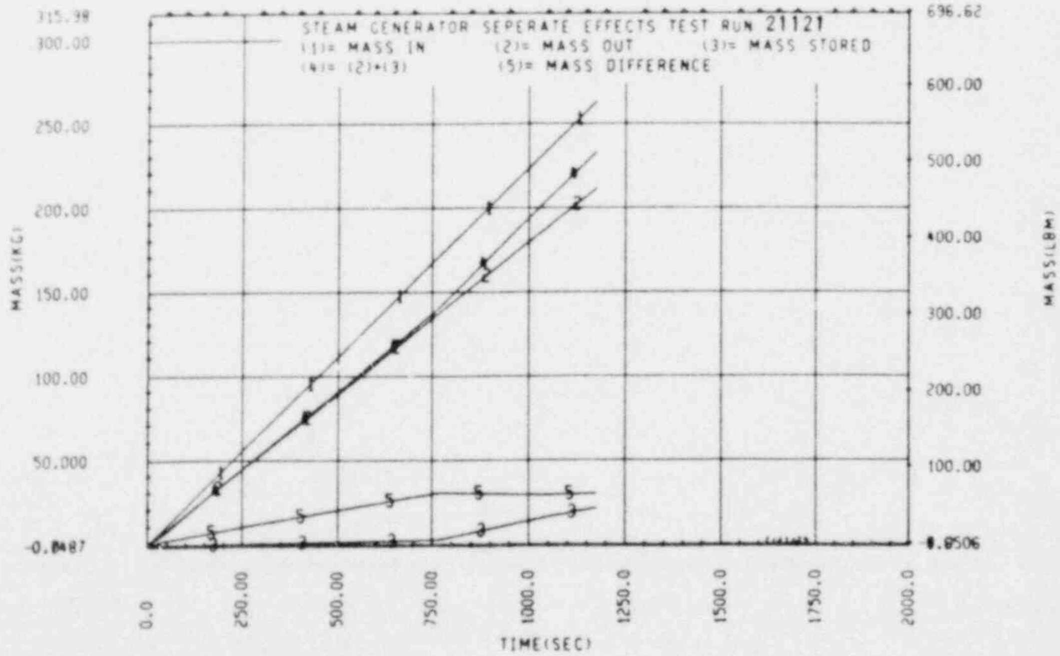

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21121
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
10.000
8.0000
6.0000
4.0000
2.0000
0.0
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

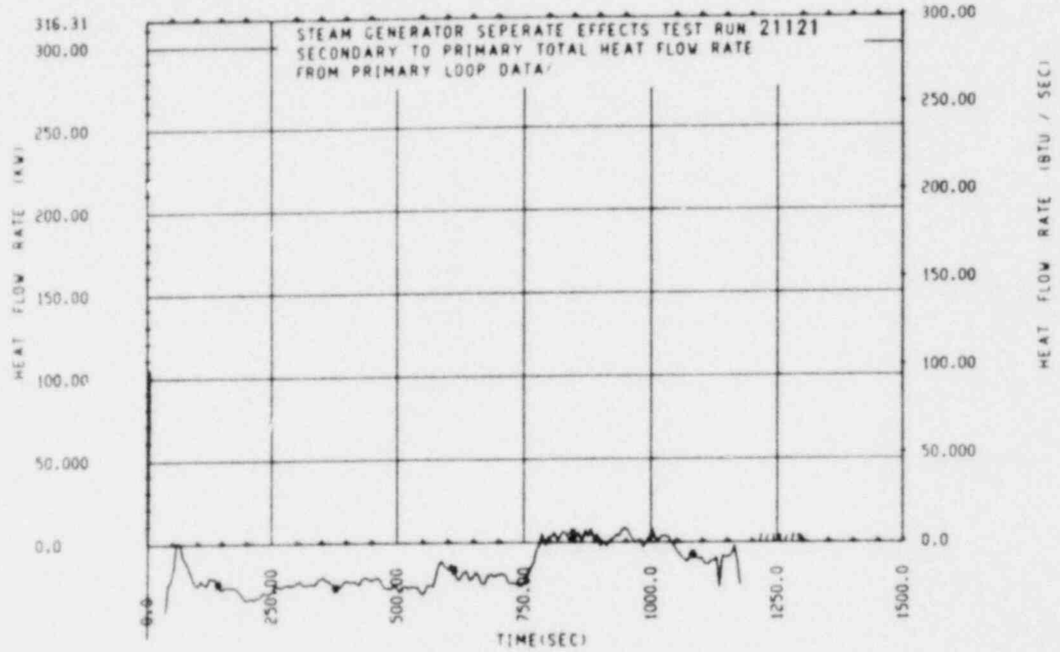

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21121
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE
TEMPERATURE DEGREES F
TIME - SEC
160.00
150.00
140.00
130.00
120.00
110.00
100.00
347.00
300.00
275.00
250.00
225.00
212.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

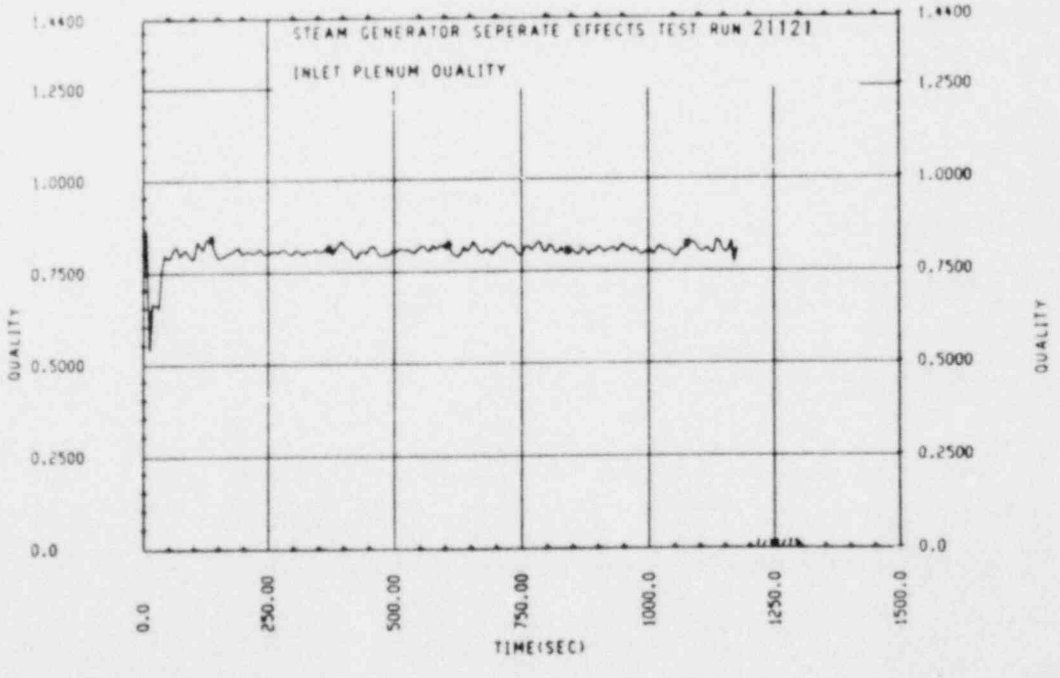

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21121
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
275.00
250.00
225.00
200.00
175.00
150.00
125.00
TEMPERATURE DEGREES F
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

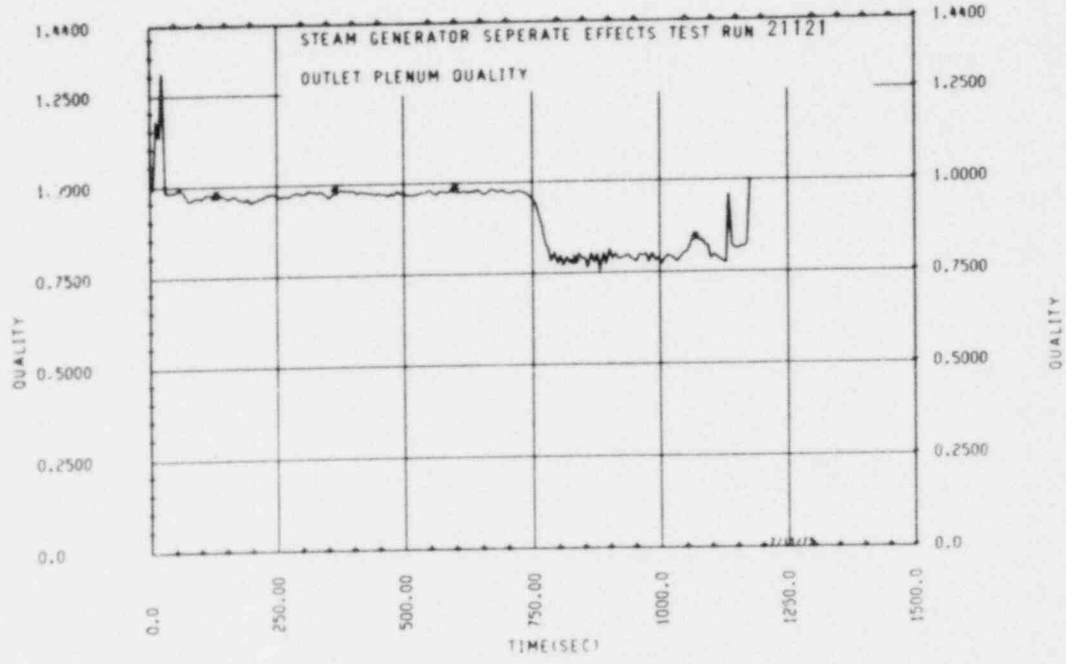

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21121
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

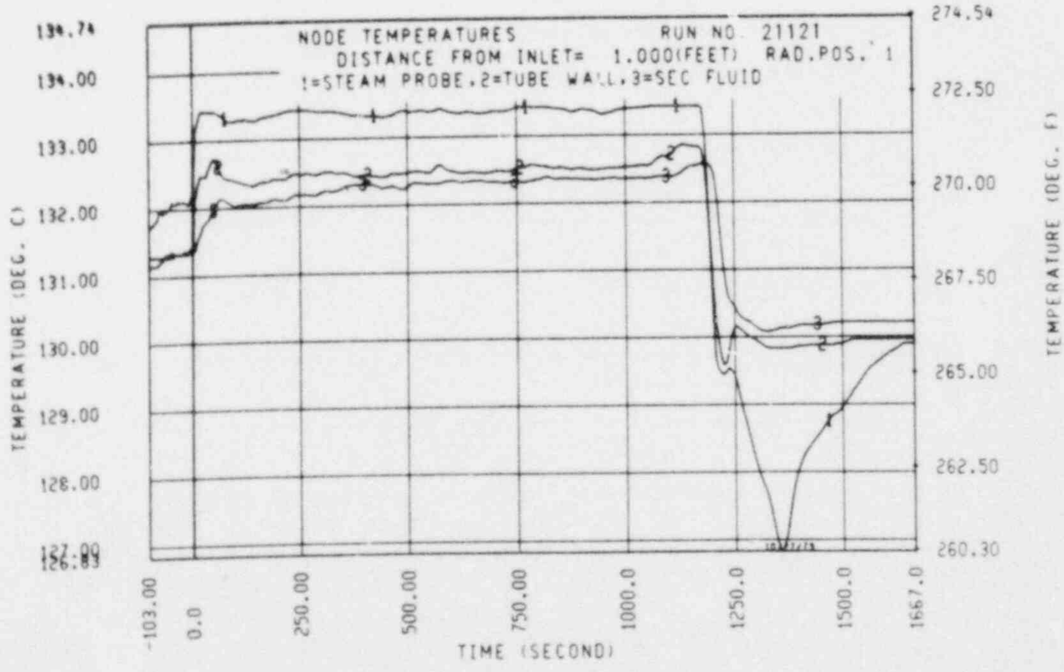

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21121
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

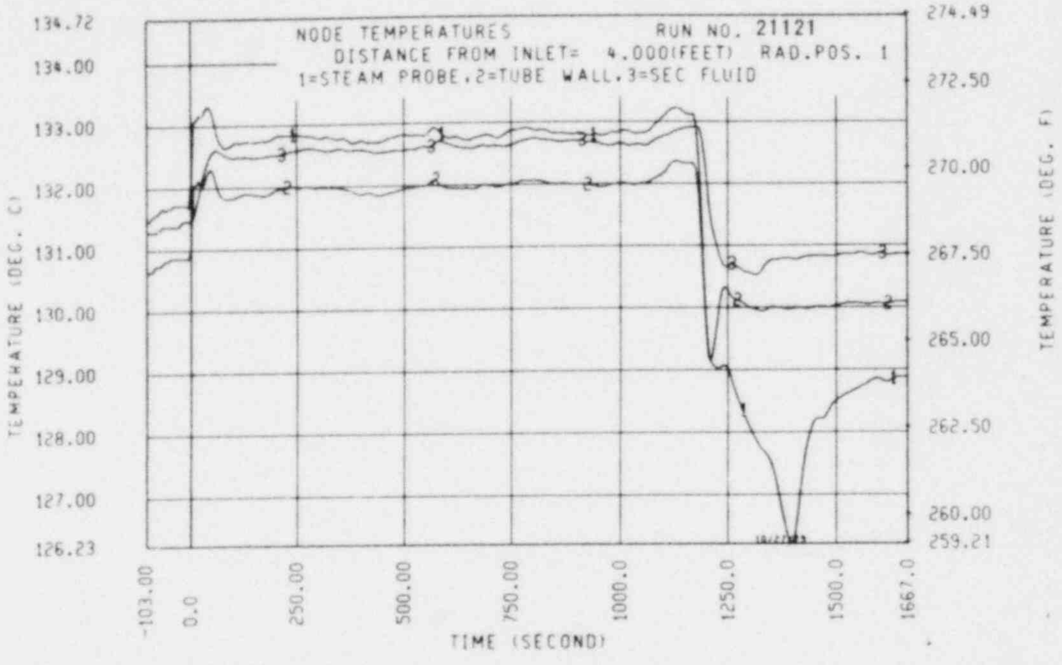

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21121
(1)= MASS IN
(2)= MASS OUT
(3)= MASS STORED
(4)= (2)+(3)
(5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)

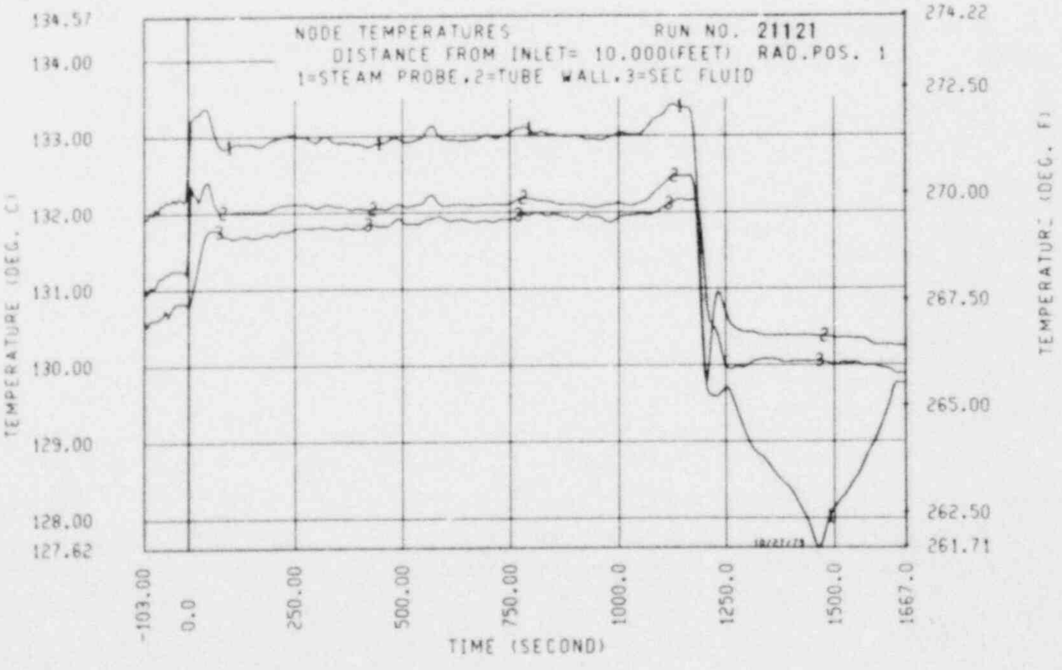

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21121
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA/
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
316.31
300.00
250.00
200.00
150.00
100.00
50.000
0.0
TIME(SEC)
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

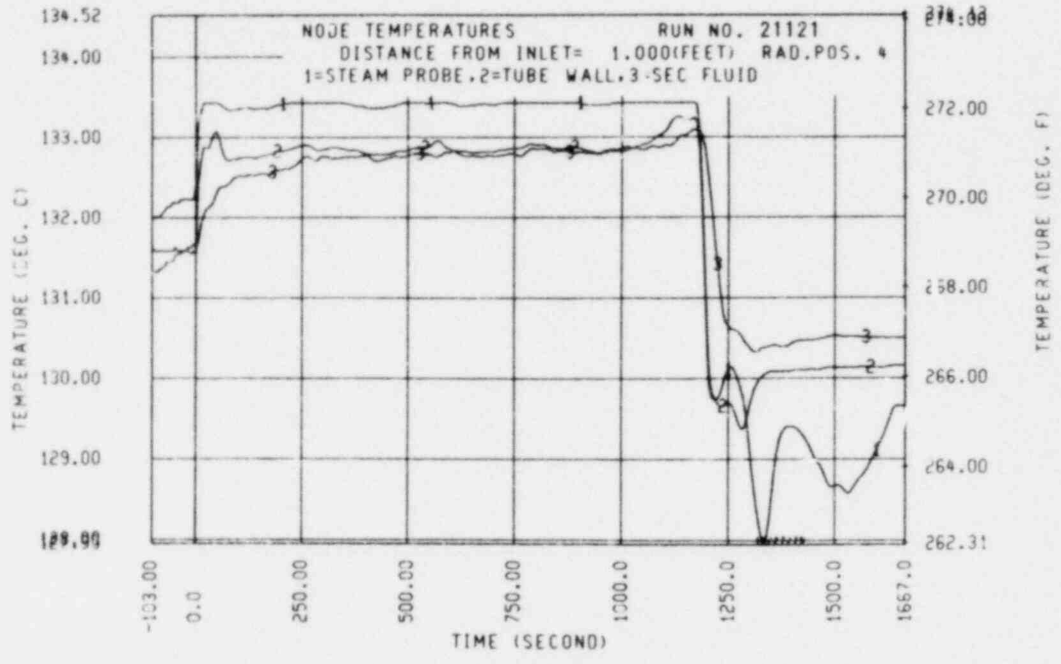

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21121
INLET PLENUM QUALITY
QUALITY
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
TIME(SEC)
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

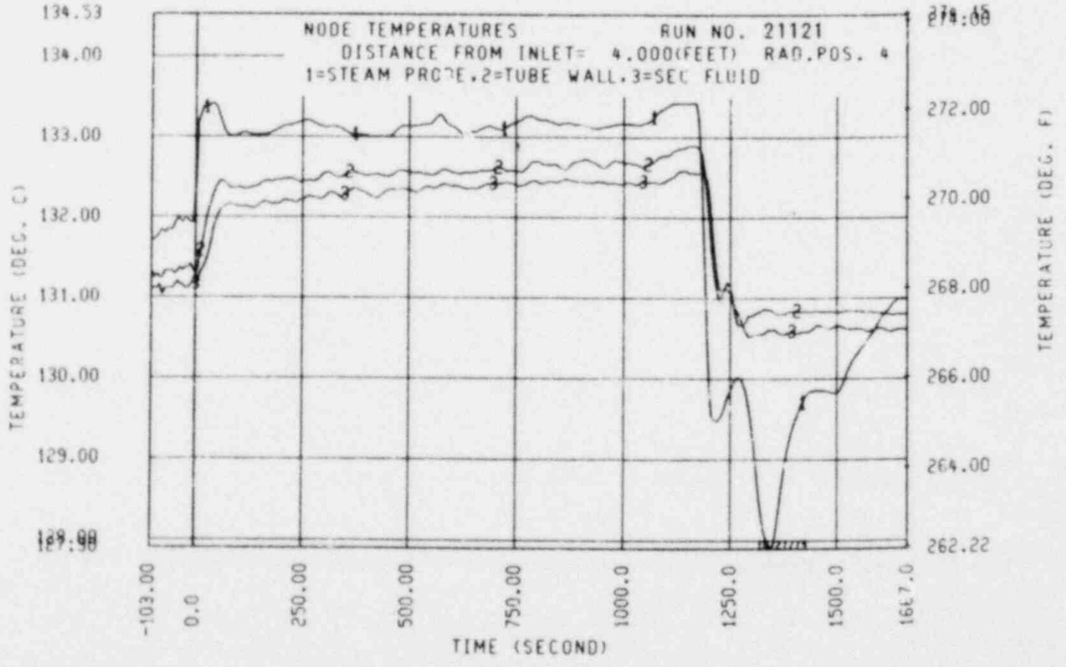

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21121
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

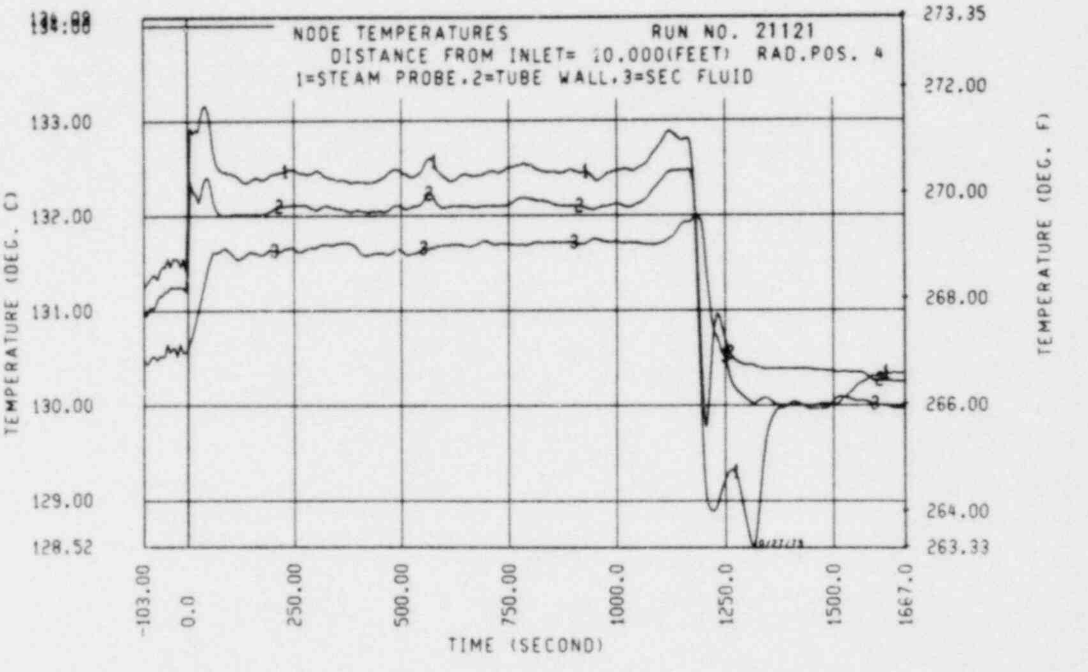

NODE TEMPERATURES RUN NO. 21121
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
134.74
134.00
133.00
132.00
131.00
130.00
129.00
128.00
126.83
274.54
272.50
270.00
267.50
265.00
262.50
260.30
-103.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1667.0

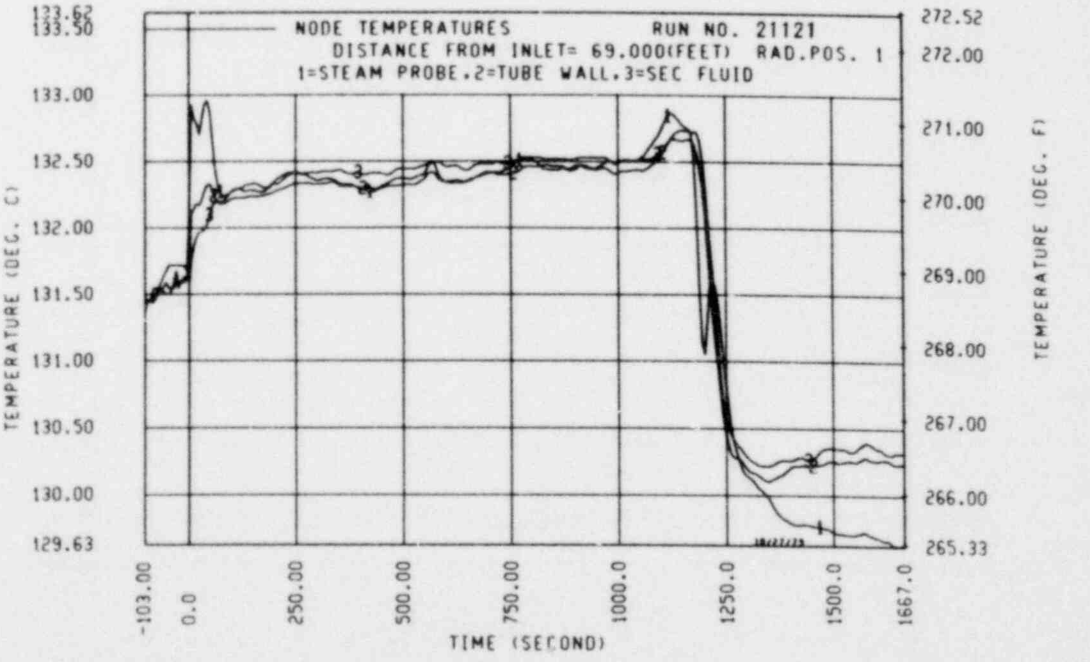

NODE TEMPERATURES RUN NO. 21121
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

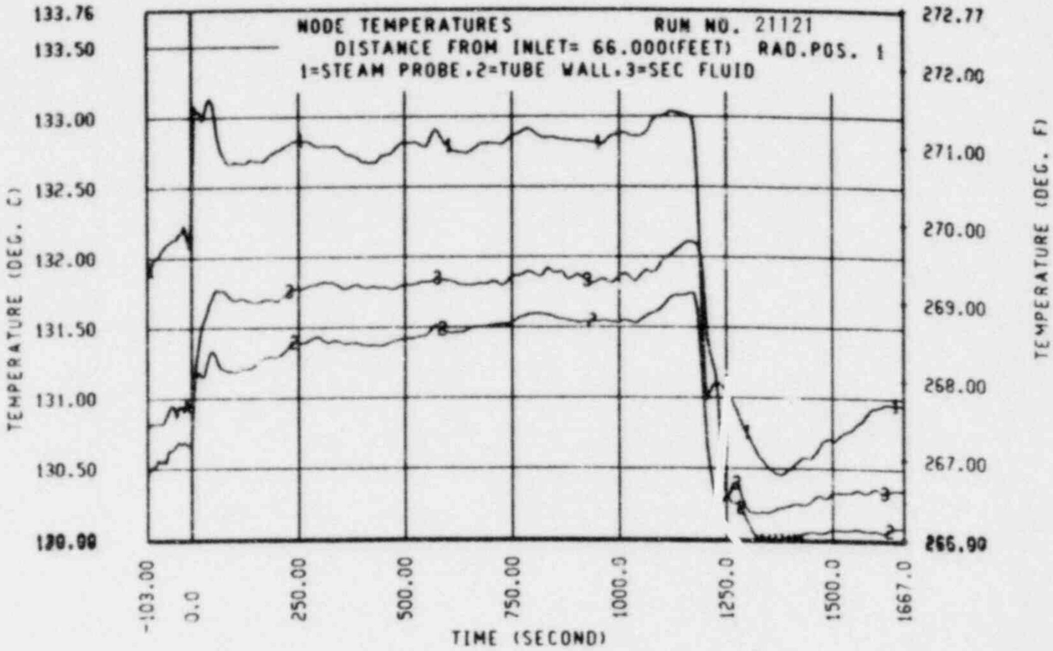

NODE TEMPERATURES RUN NO. 21121
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

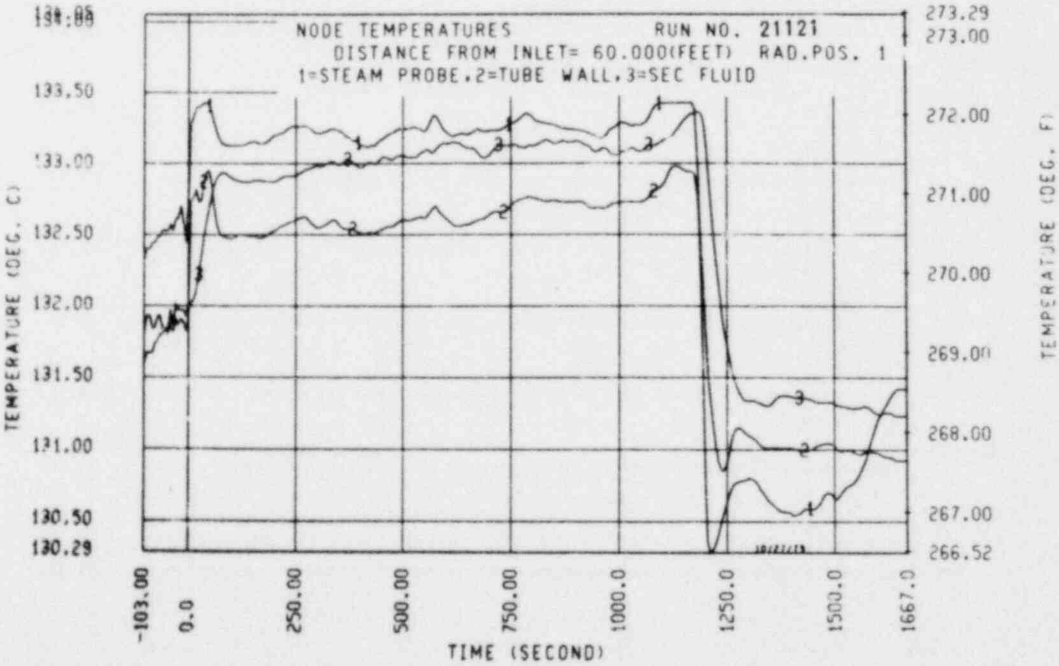

NODE TEMPERATURES RUN NO. 21121
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

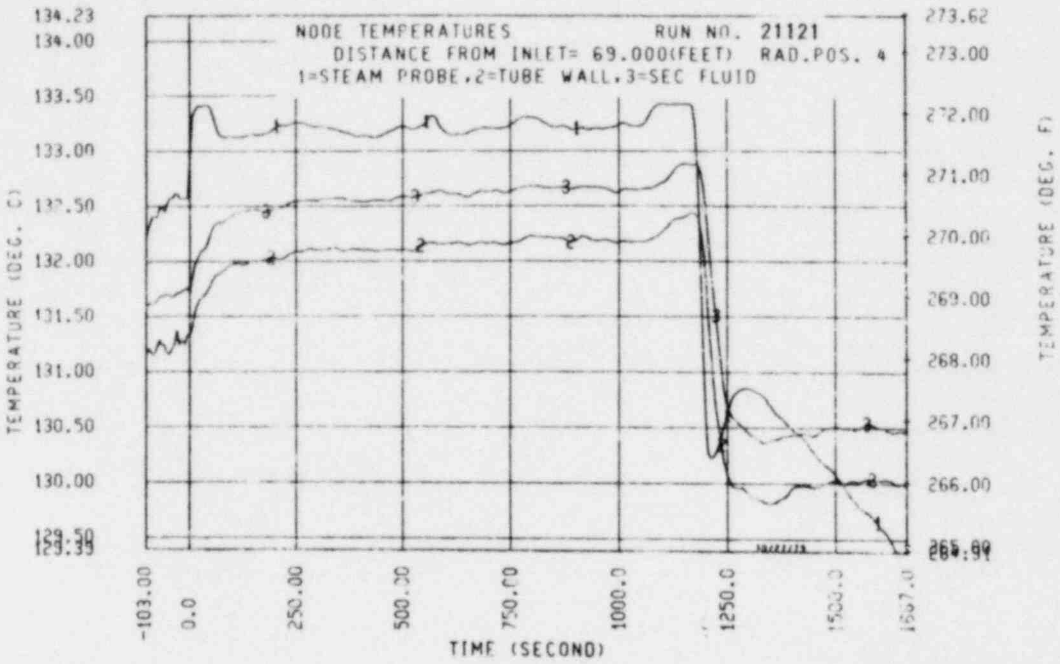

NODE TEMPERATURES RUN NO. 21121
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

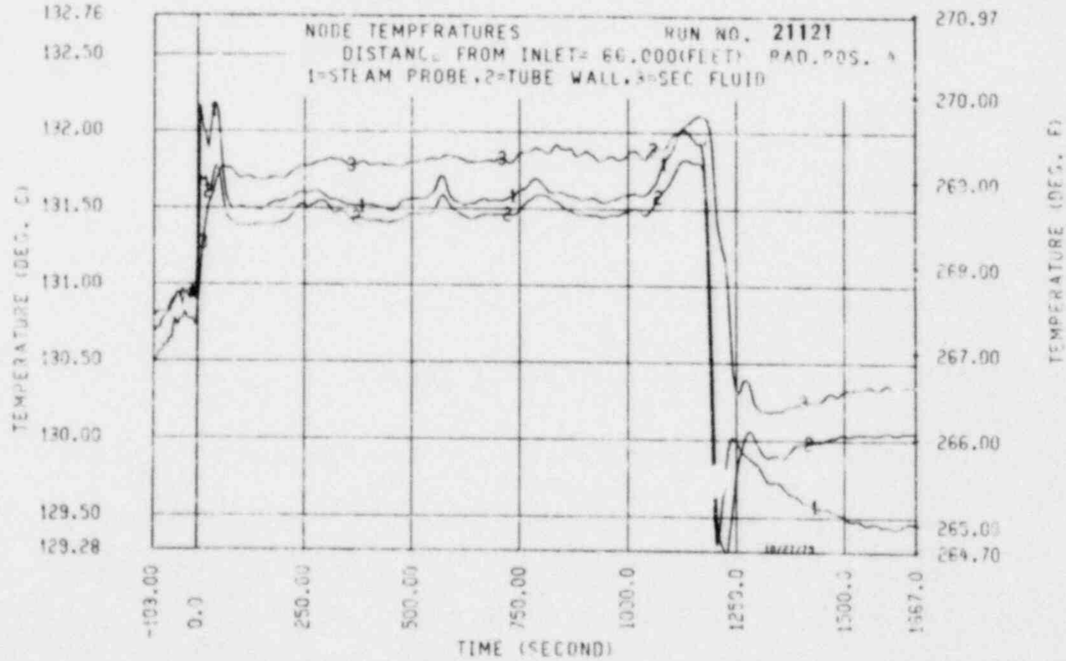

NODE TEMPERATURES
RUN NO. 21121
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
133.00
132.00
131.00
130.00
129.00
128.52
273.35
272.00
270.00
268.00
266.00
264.00
263.33
TEMPERATURE (DEG. F)
-103.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1667.0
TIME (SECOND)

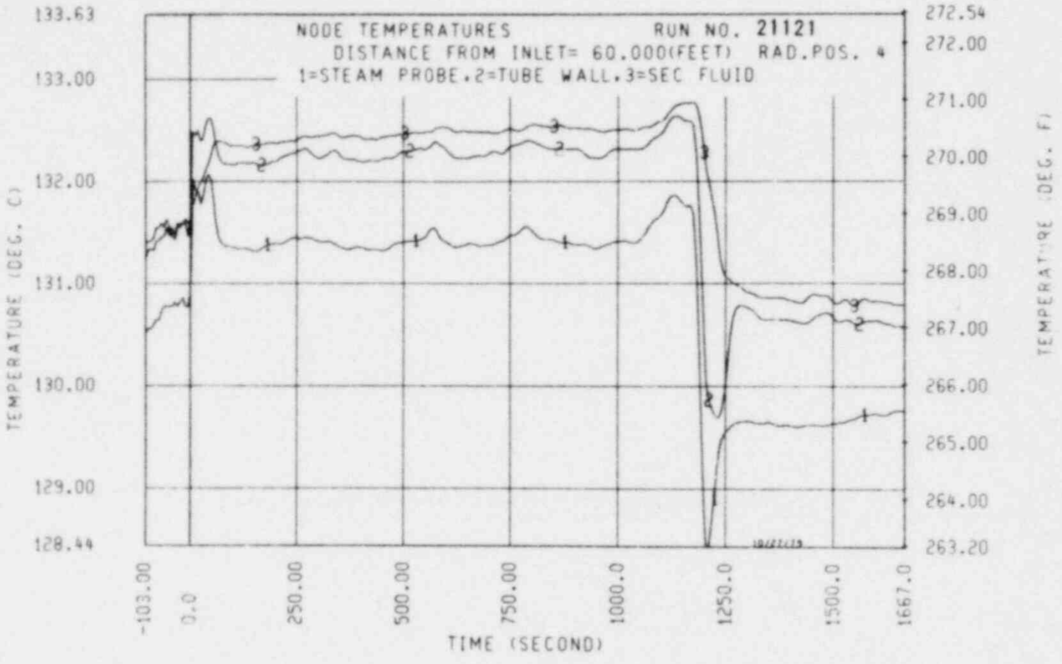

NODE TEMPERATURES
RUN NO. 21121
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
133.62
133.50
133.00
132.50
132.00
131.50
131.00
130.50
130.00
129.63
272.52
272.00
271.00
270.00
269.00
268.00
267.00
266.00
265.33
TEMPERATURE (DEG. F)
-103.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1667.0
TIME (SECOND)

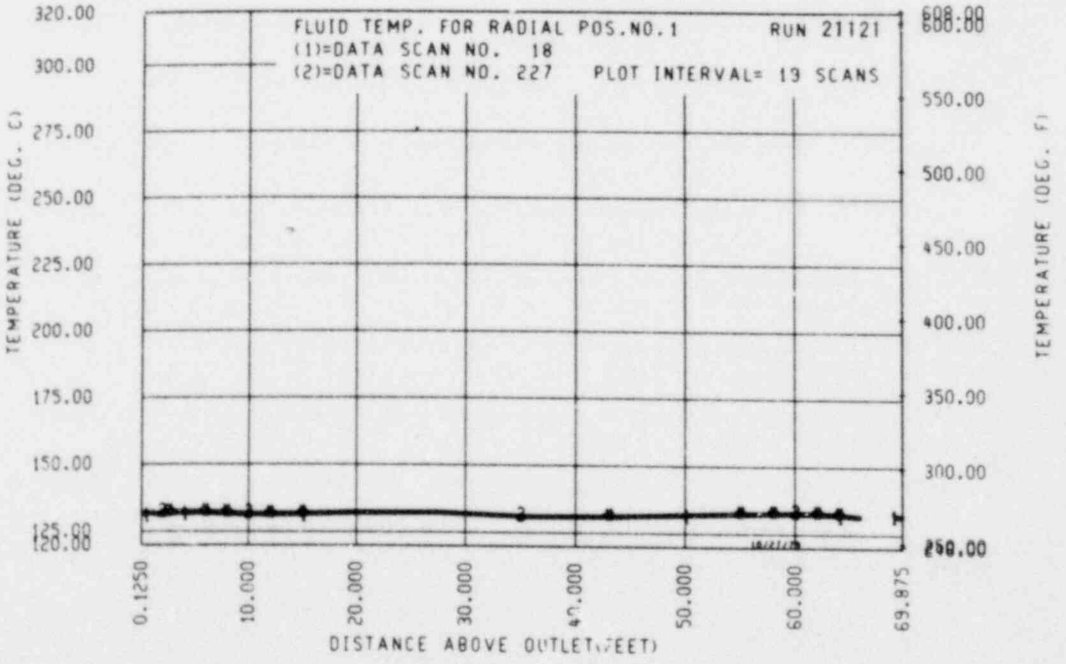

NODE TEMPERATURES RUN NO. 21121
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

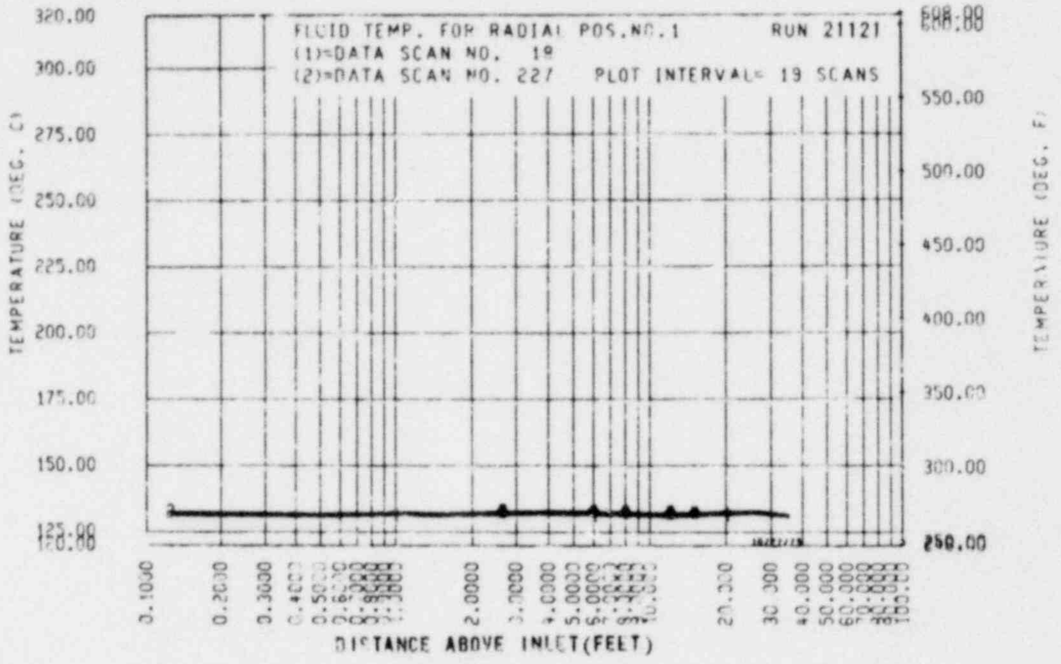

NODE TEMPERATURES RUN NO. 21121
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

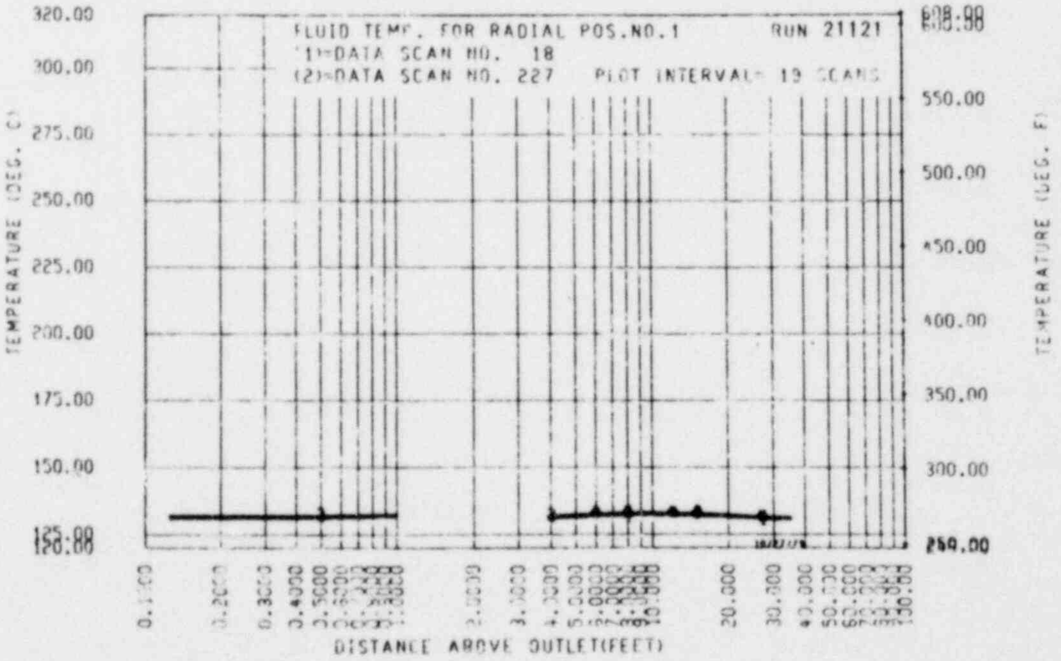

NODE TEMPERATURES
RUN NO. 21121
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES
RUN NO. 21121
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21121
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


FLUID TEMP. FOR RADIAL POS.NO.1 RUN 21121
(1)=DATA SCAN NO. 18
(2)=DATA SCAN NO. 227 PLOT INTERVAL= 19 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 21121
(1)=DATA SCAN NO. 18
(2)=DATA SCAN NO. 227
PLOT INTERVAL= 19 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 21121
(1)=DATA SCAN NO. 18
(2)=DATA SCAN NO. 227
PLOT INTERVAL= 19 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

SUMMARY SHEET

RUN NO. 21711

DATE: 3/14/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.179 (0.395)
2. Water flow - [kg/sec (lb/sec)] - 0.045 (0.099)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{o}C (^{o}F)] - 157 (315)
5. Water temperature [^{o}C (^{o}F)] - 124 (256)
6. Mixer pressure [kPa (psig)] - 193 (28)
7. Test time (sec) - 1439.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 9.9 (32.4)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	260 (500)
0.15 (0.50)	266 (510)
0.30 (1.00)	274 (525)
0.46 (1.50)	271 (520)
0.61 (2.00)	271 (520)
1.22 (4.00)	271 (520)
3.05 (10.00)	271 (520)
6.09 (20.00)	271 (520)
8.23 (27.00)	271 (520)
10.67 (35.00)	271 (520)

SUMMARY SHEET (cont)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 4.04 (8.91)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 2.15 (4.74)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 1.33 (2.94)

D. FAILED BUNDLE T/Cs[(1)]

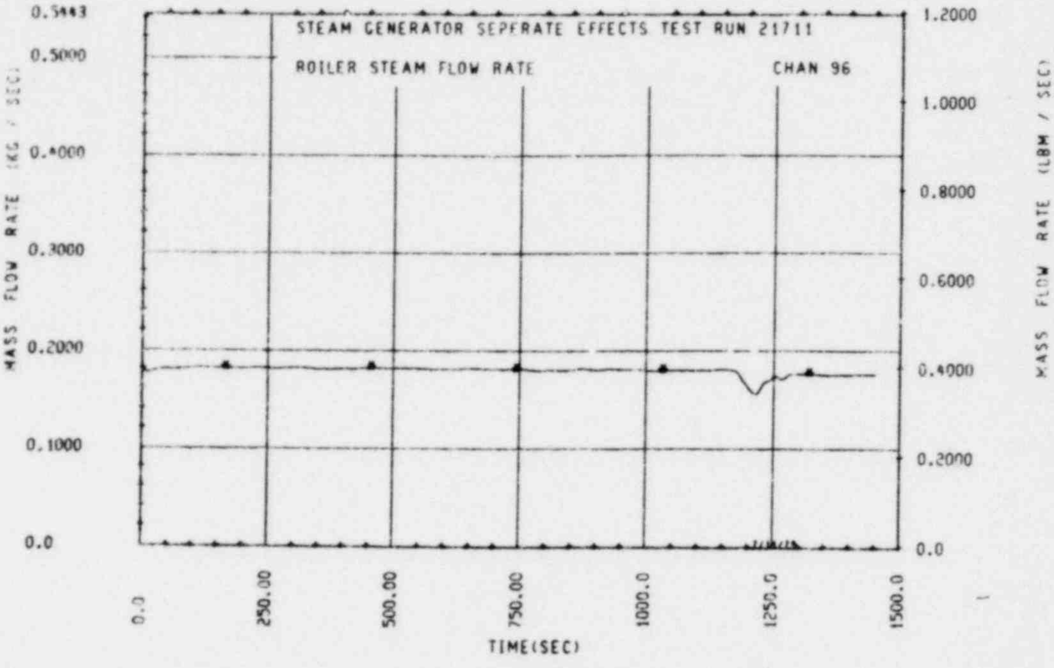
294, 295, 298, 305, 309, 310, 311, 321, 326, 549, 553, 564, 565, 568

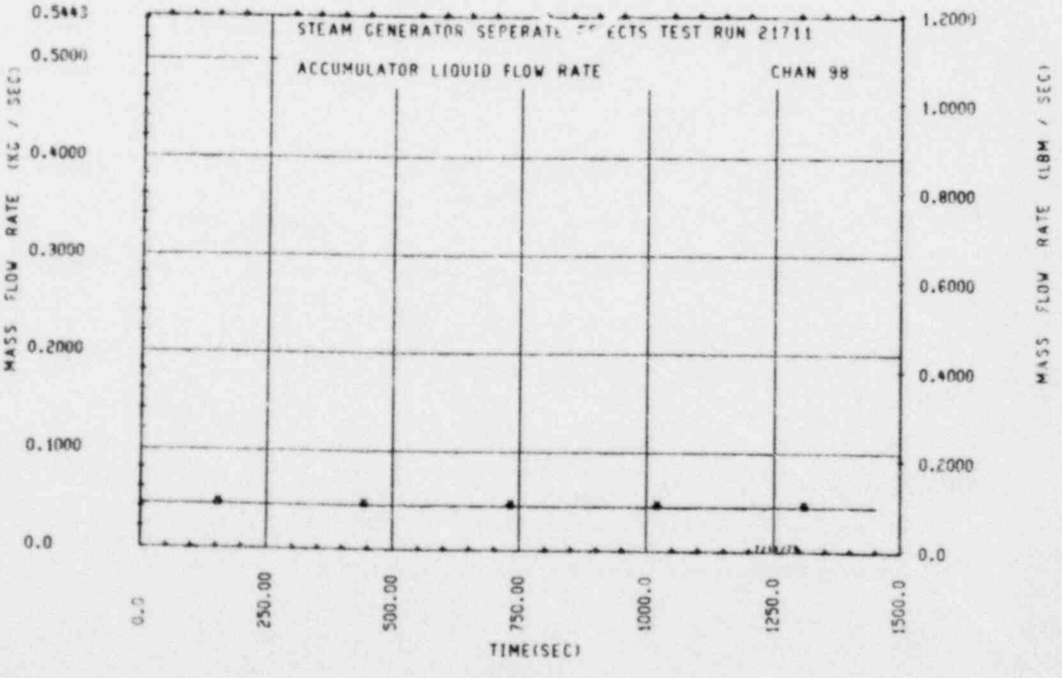
E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

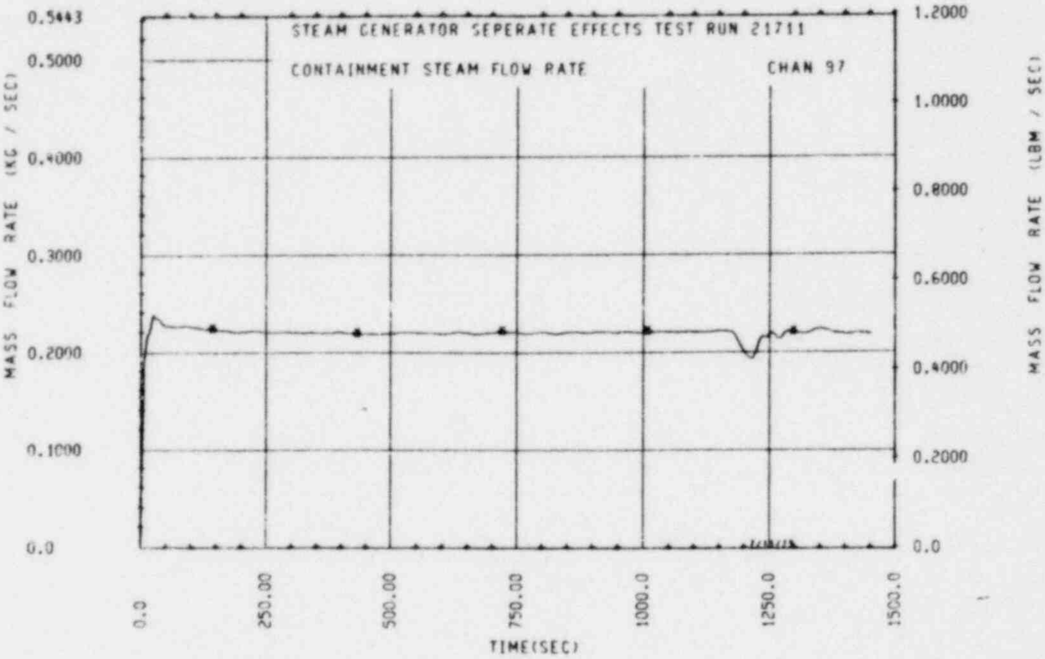
1. From primary side energy balance [kwsec(Btu)] - 0.594×10^5 (0.566×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, dadt$) - [kwsec(Btu)] - 0.678×10^5 (0.646×10^5)
3. Integration to 600 sec

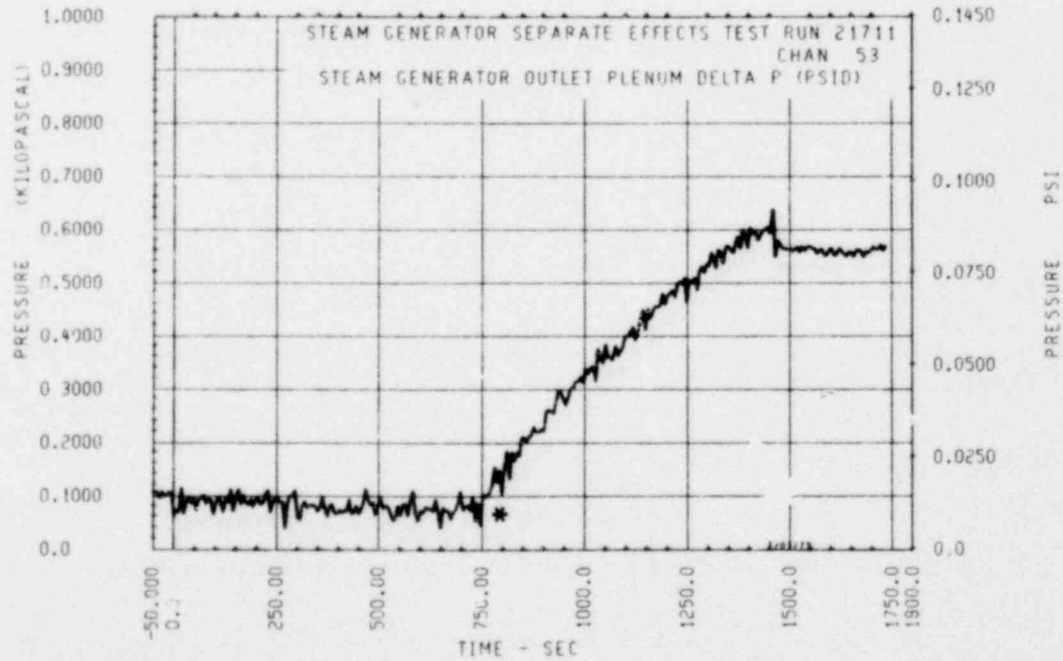
---

1. T/Cs are defined as failed based on resistance reading or T/C response.

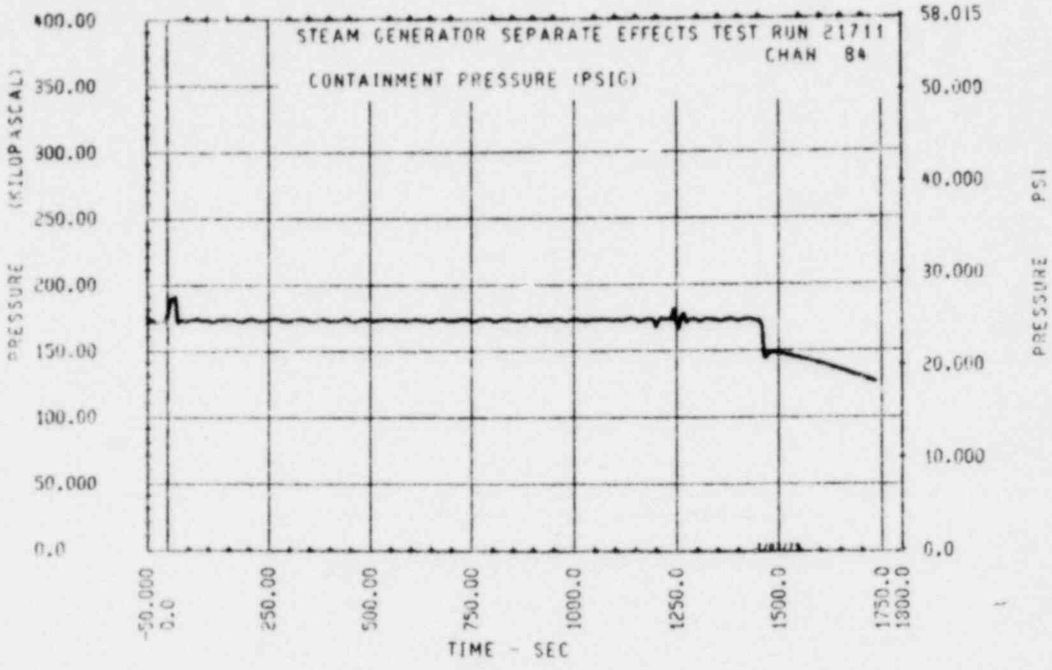

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21711
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
MASS FLOW RATE (LBM / SEC)
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21711
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
MASS FLOW RATE (LBM / SEC)
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)

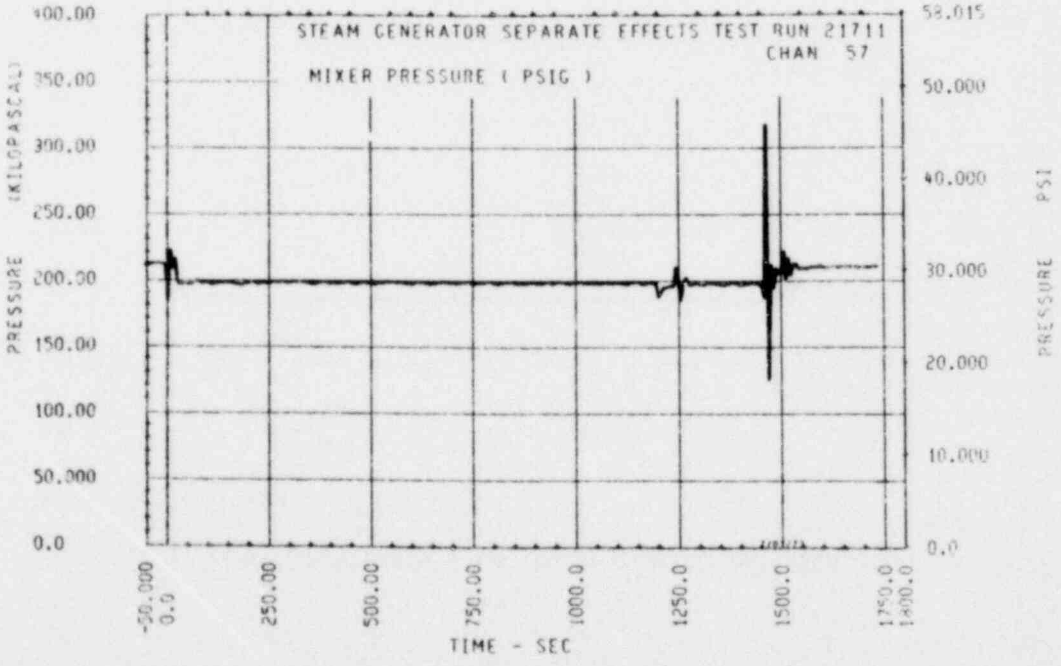




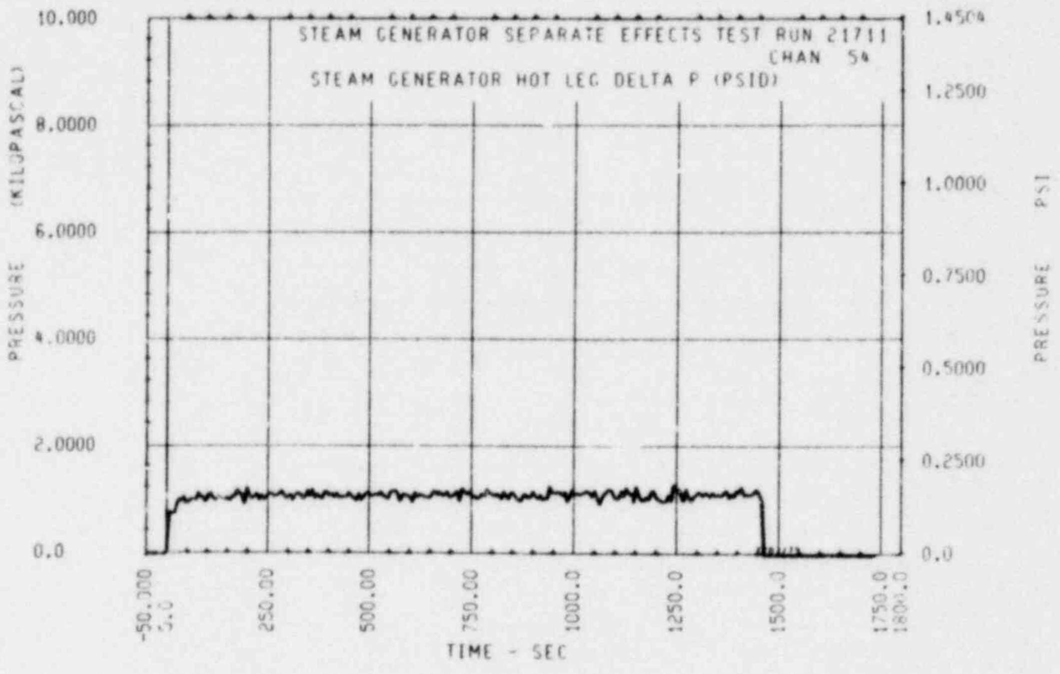
* Refer to Appendix H text for explanation of delayed response.

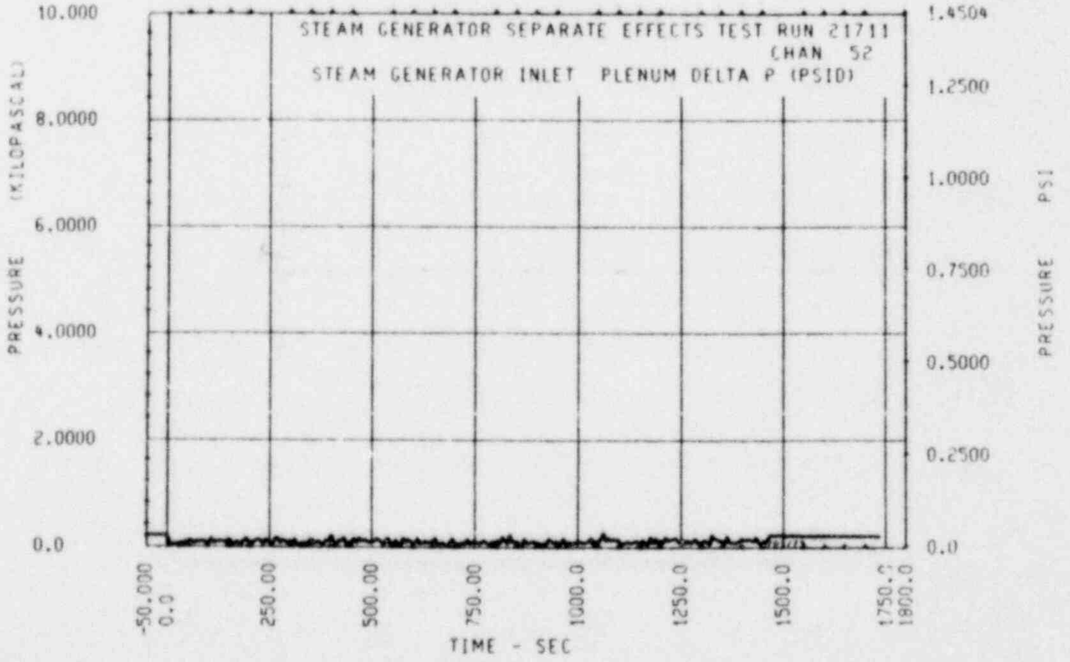


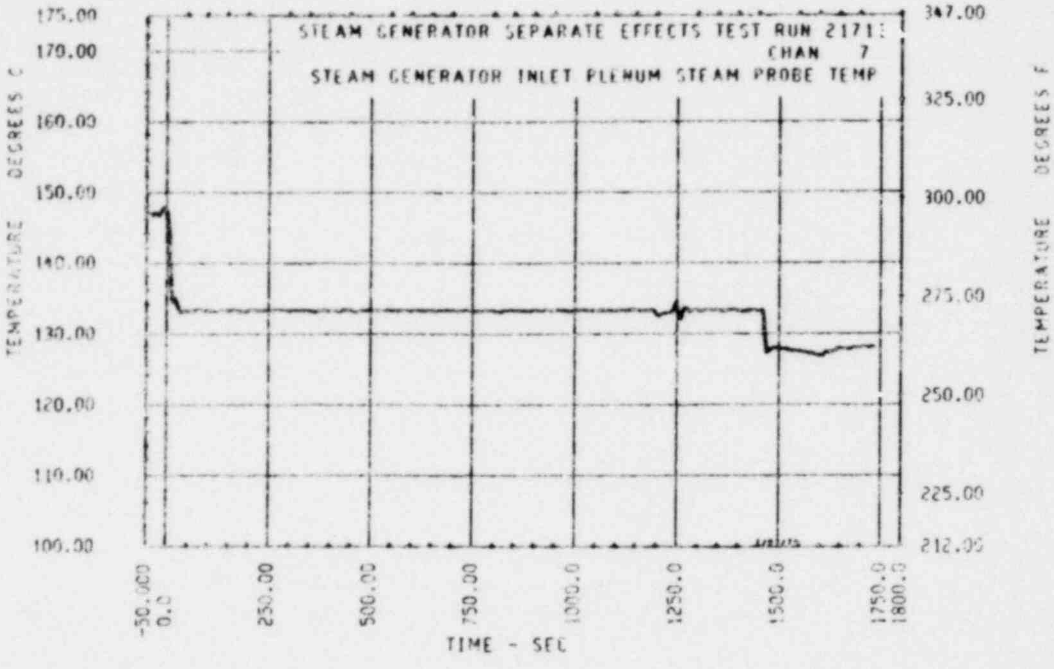
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21711
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

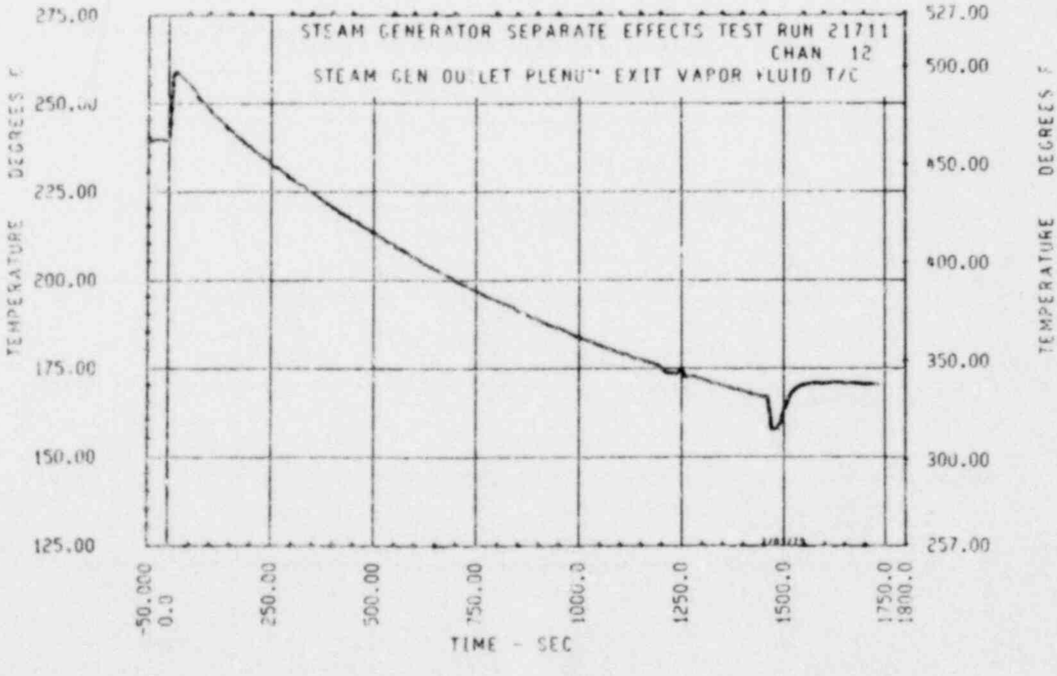


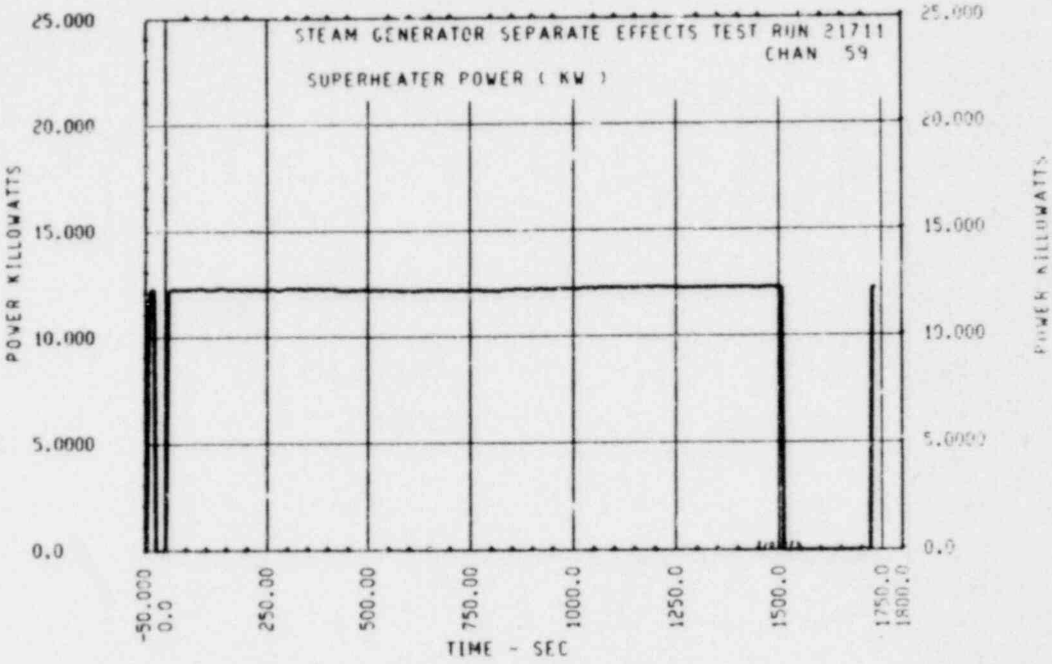
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21711
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21711
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

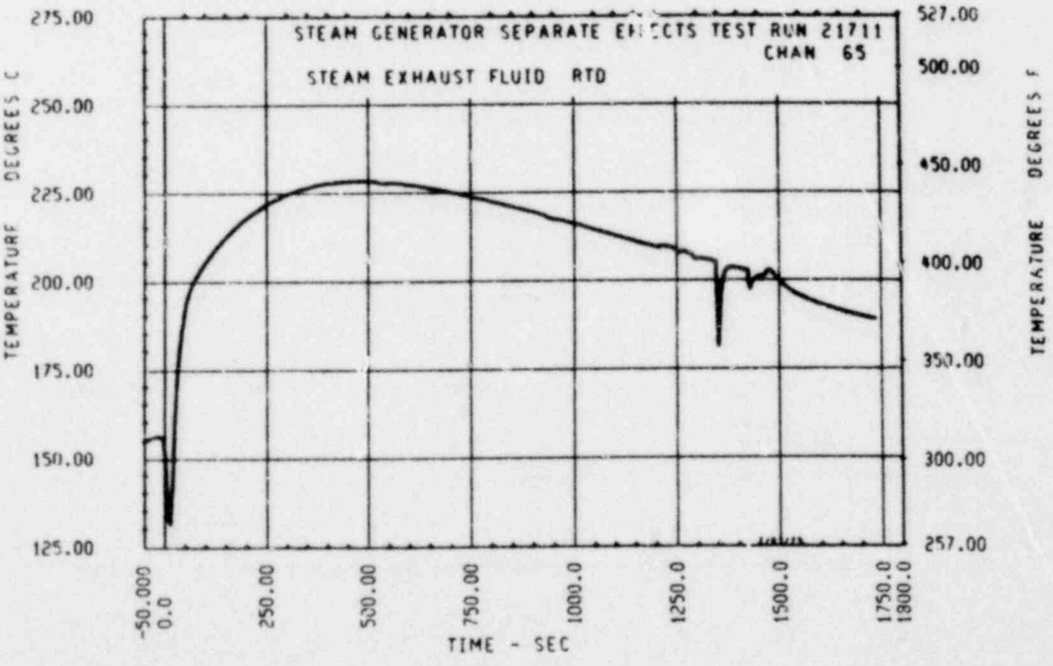

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21711
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21711
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

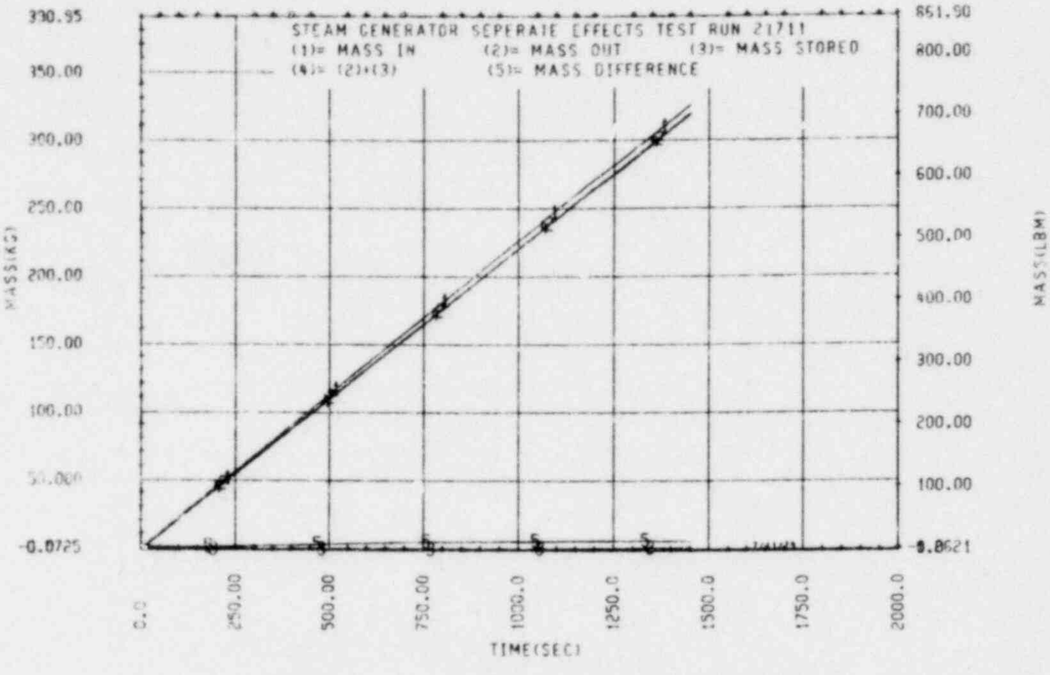

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21711
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

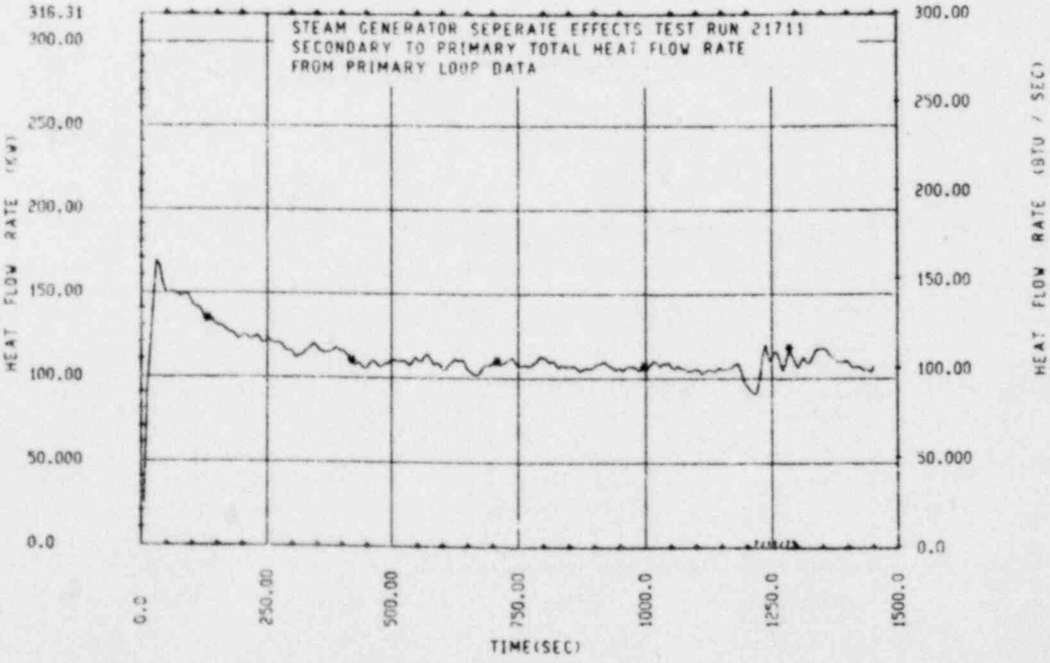


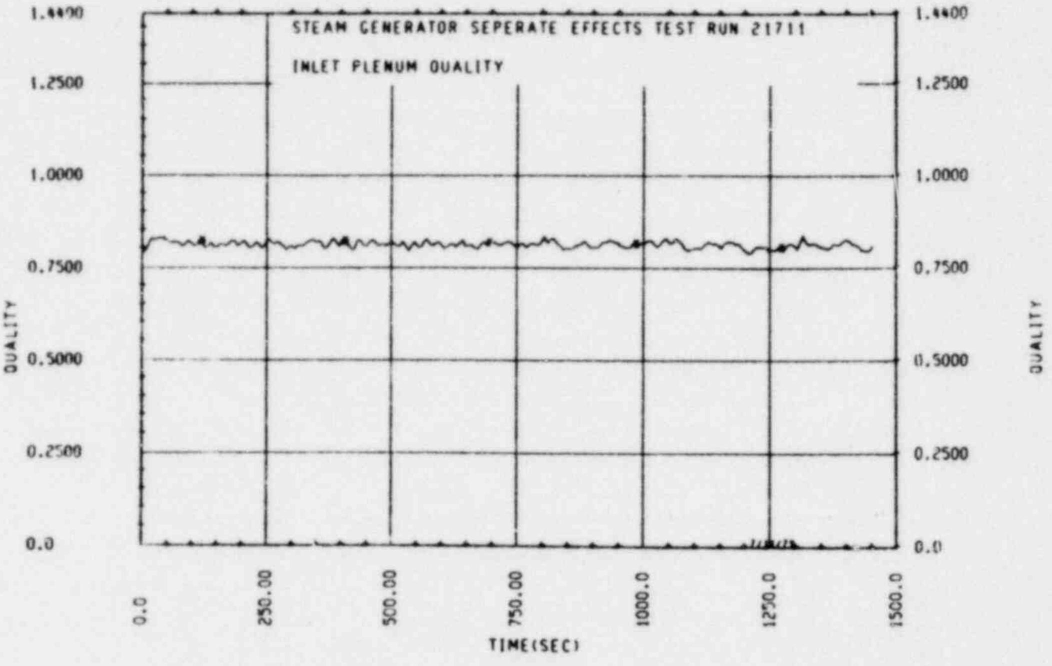
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21711
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

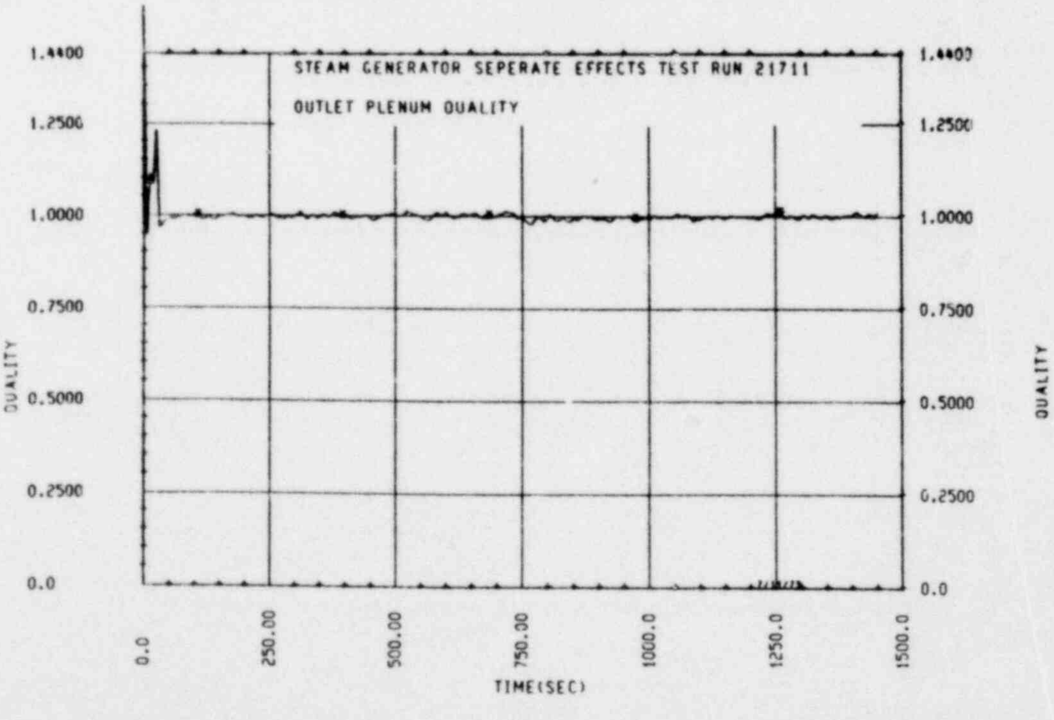


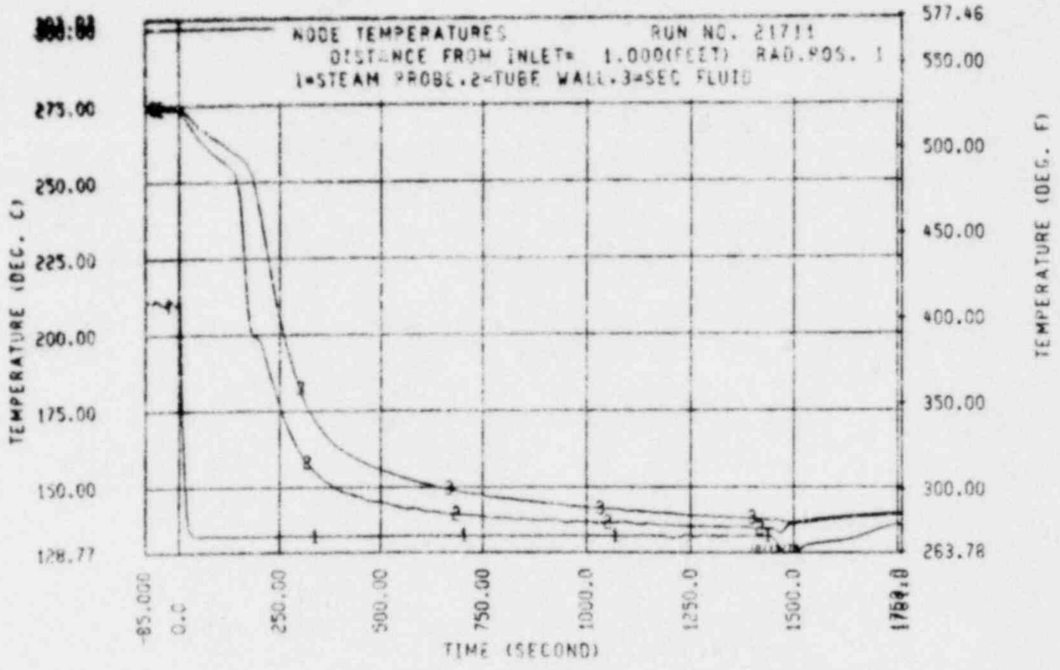
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21711
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
275.00
250.00
225.00
200.00
175.00
150.00
125.00
TEMPERATURE DEGREES F
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

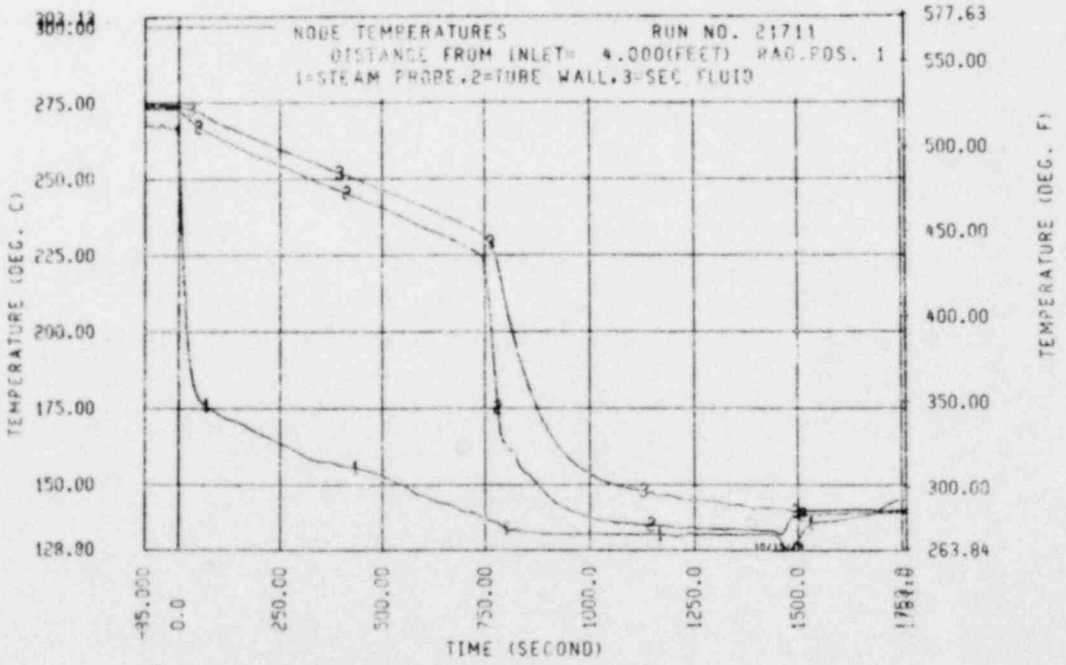

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21711
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)

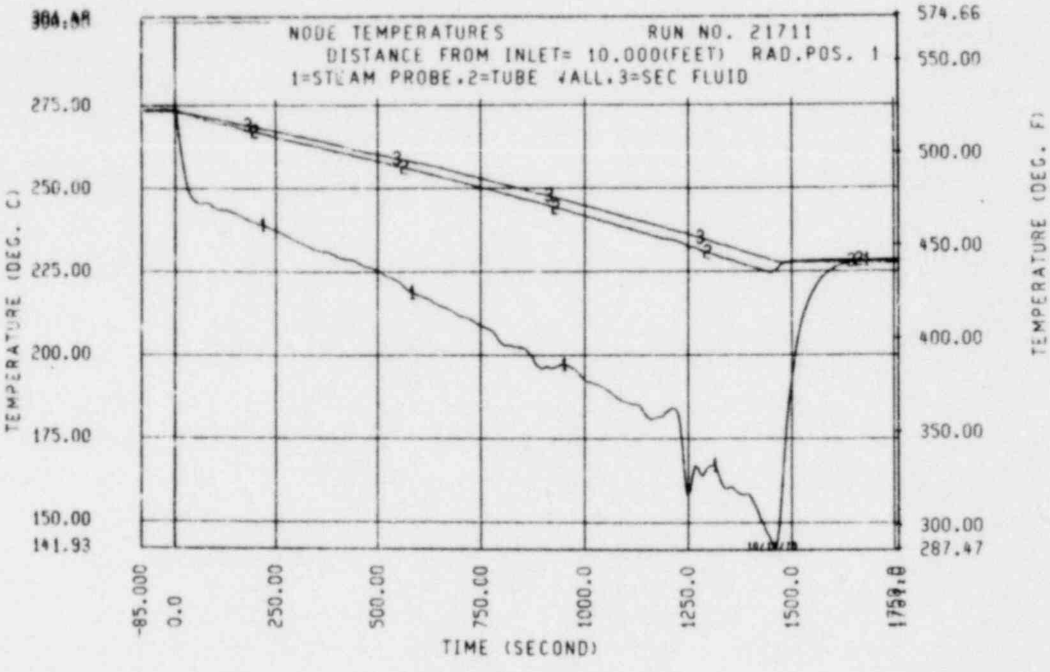

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21711
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21711
INLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

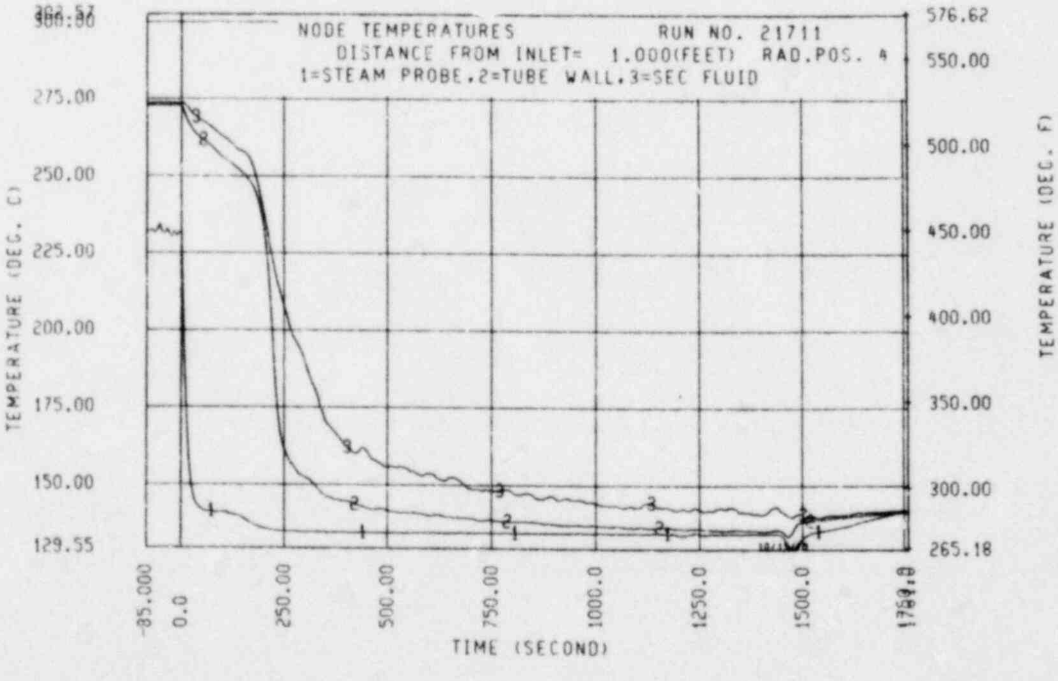

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21711
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0


NODE TEMPERATURES RUN NO. 21711
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21711
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

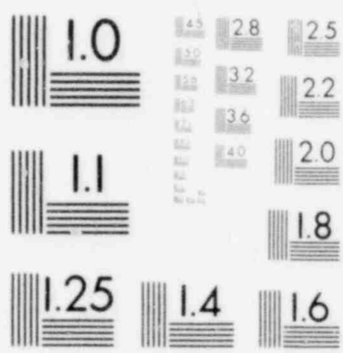


NODE TEMPERATURES RUN NO. 21711
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)



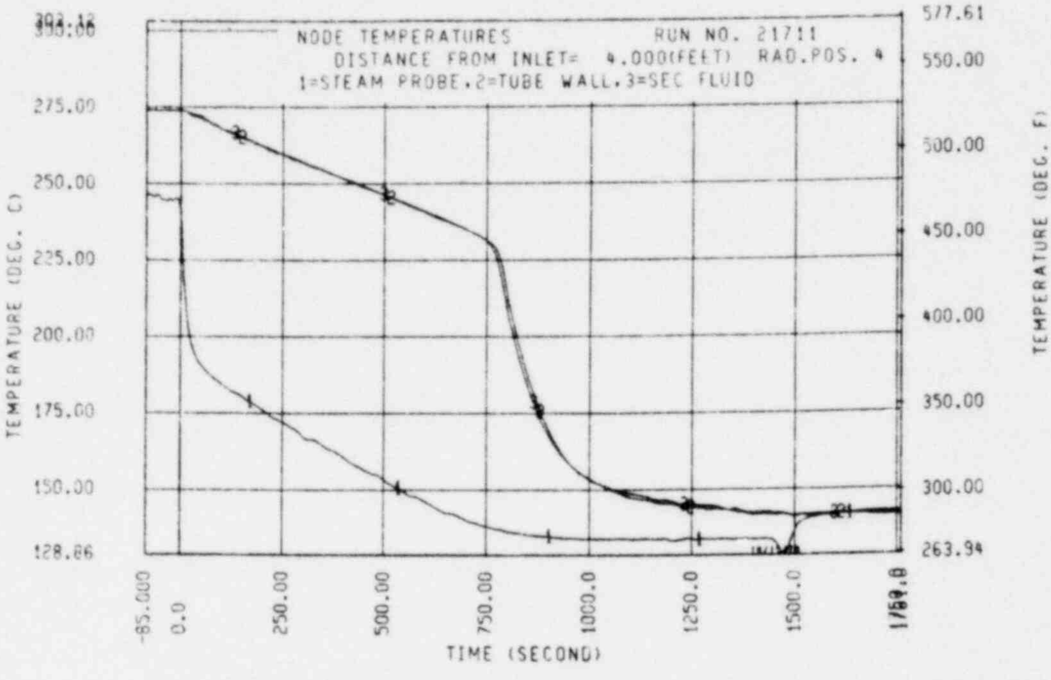
NODE TEMPERATURES RUN NO. 21711
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

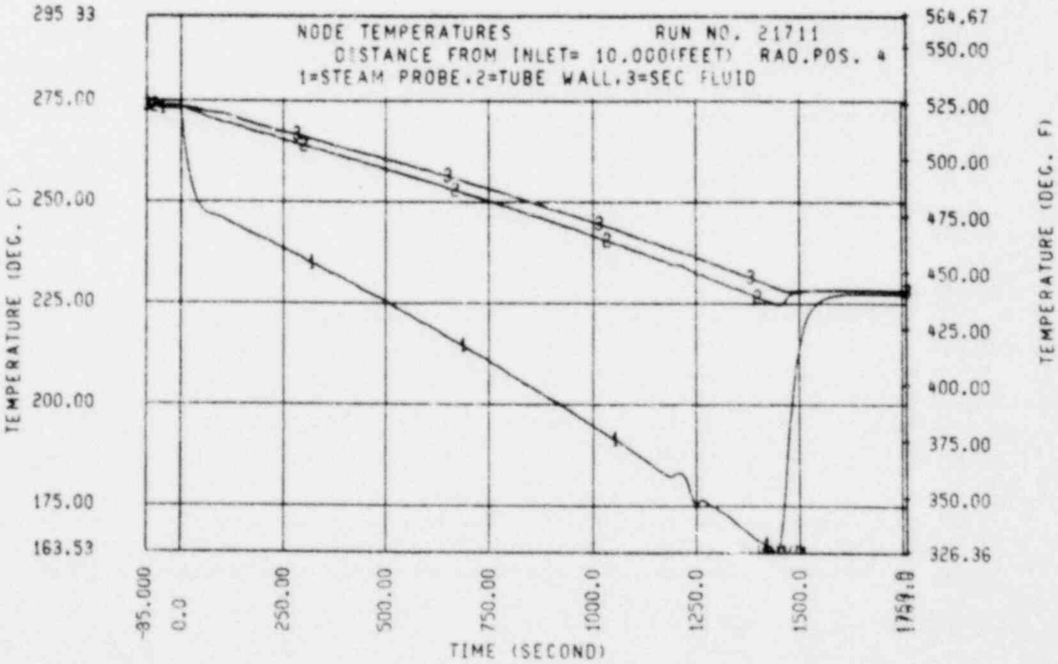
IMAGE EVALUATION
TEST TARGET (MT-3)

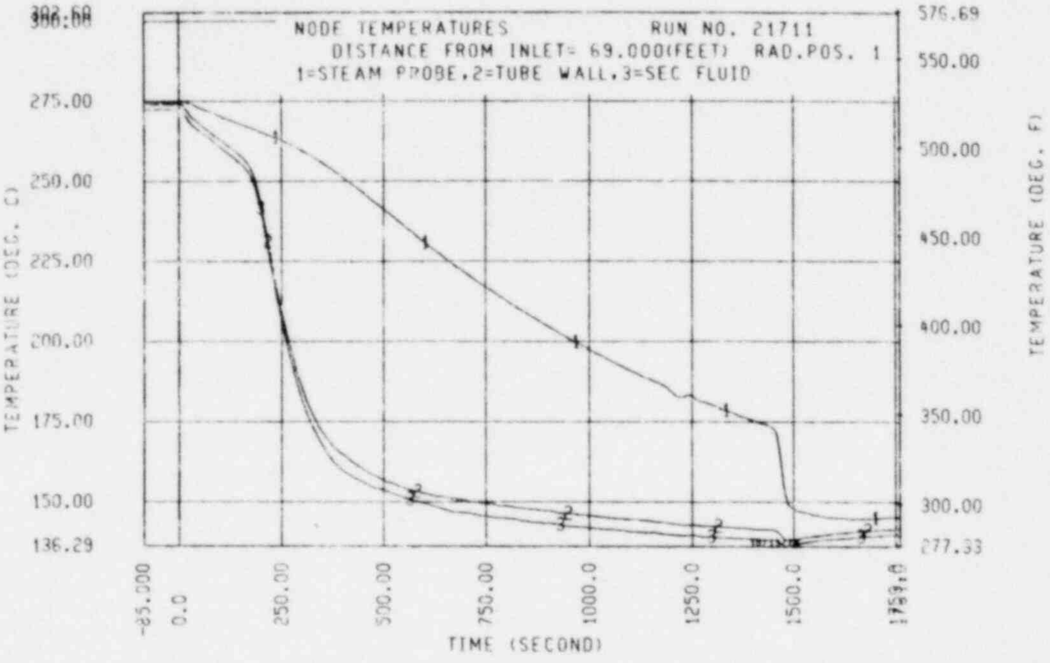


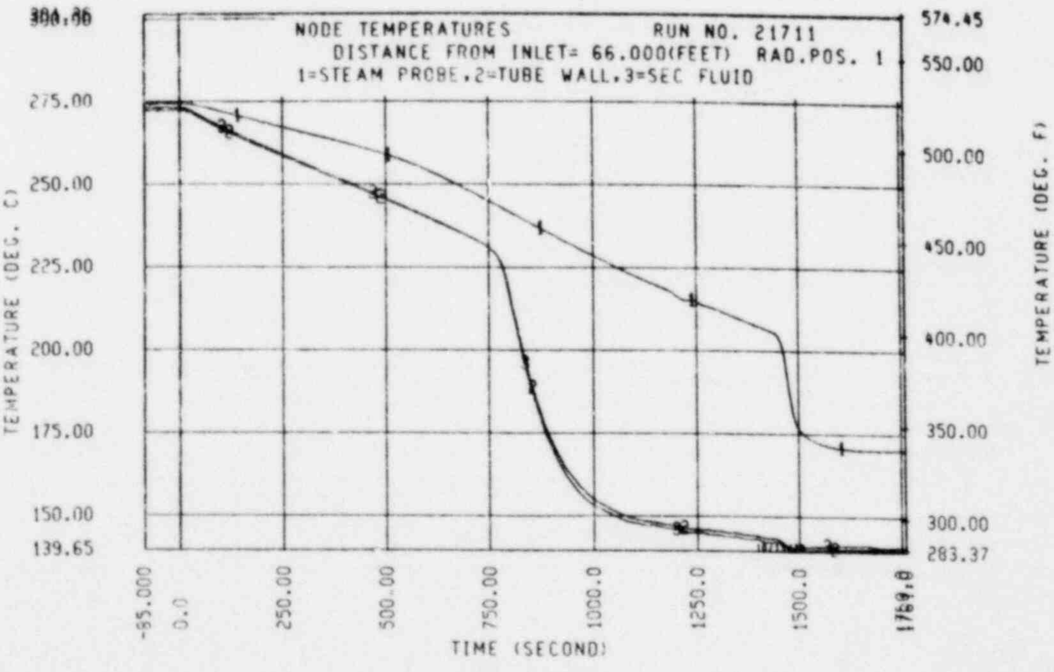
6″

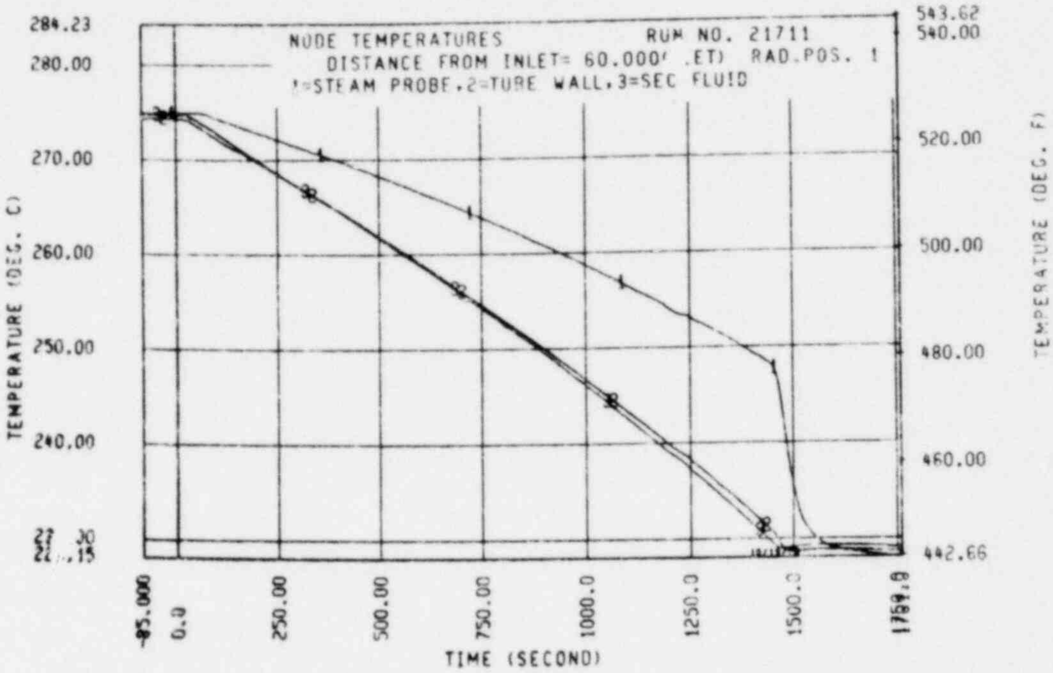
MICROCOPY RESOLUTION TEST CHART

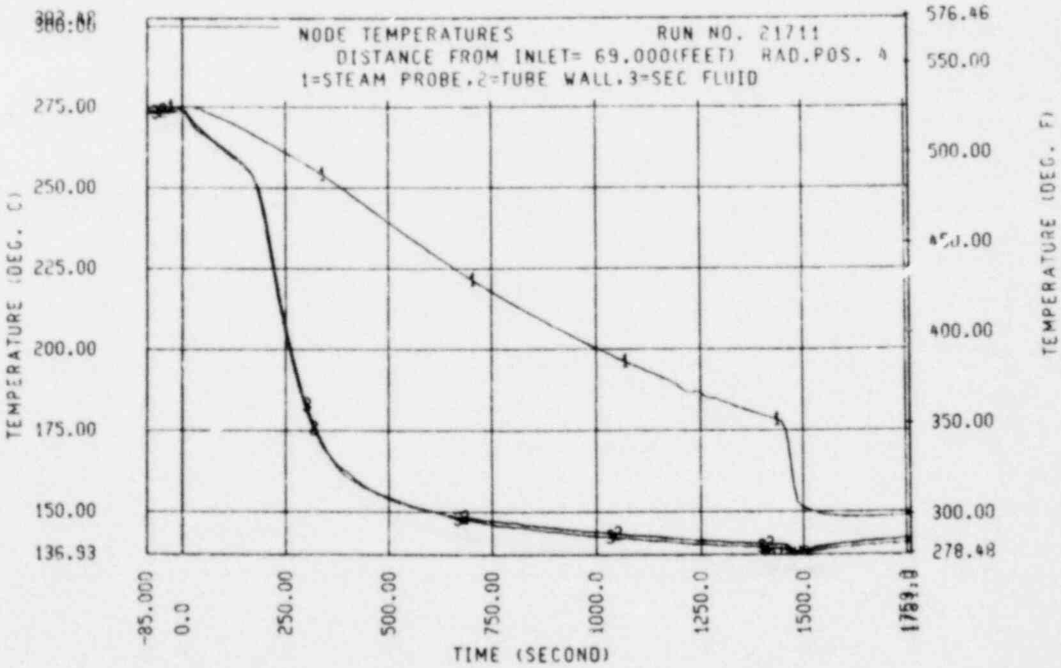

NODE TEMPERATURES RUN NO. 21711
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

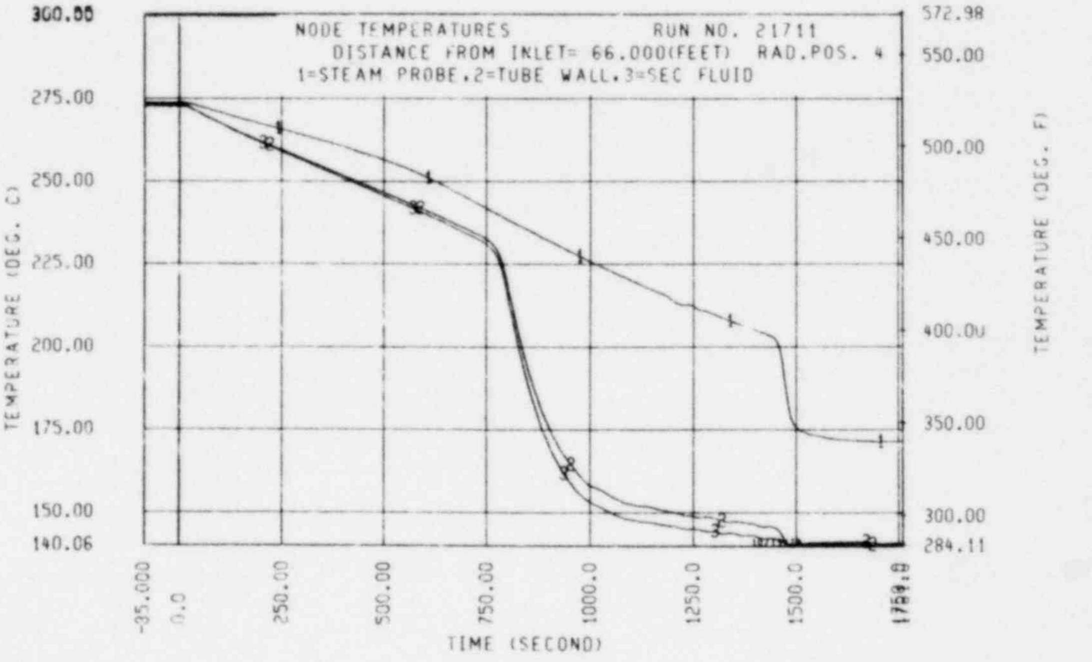

NODE TEMPERATURES RUN NO. 21711
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21711
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

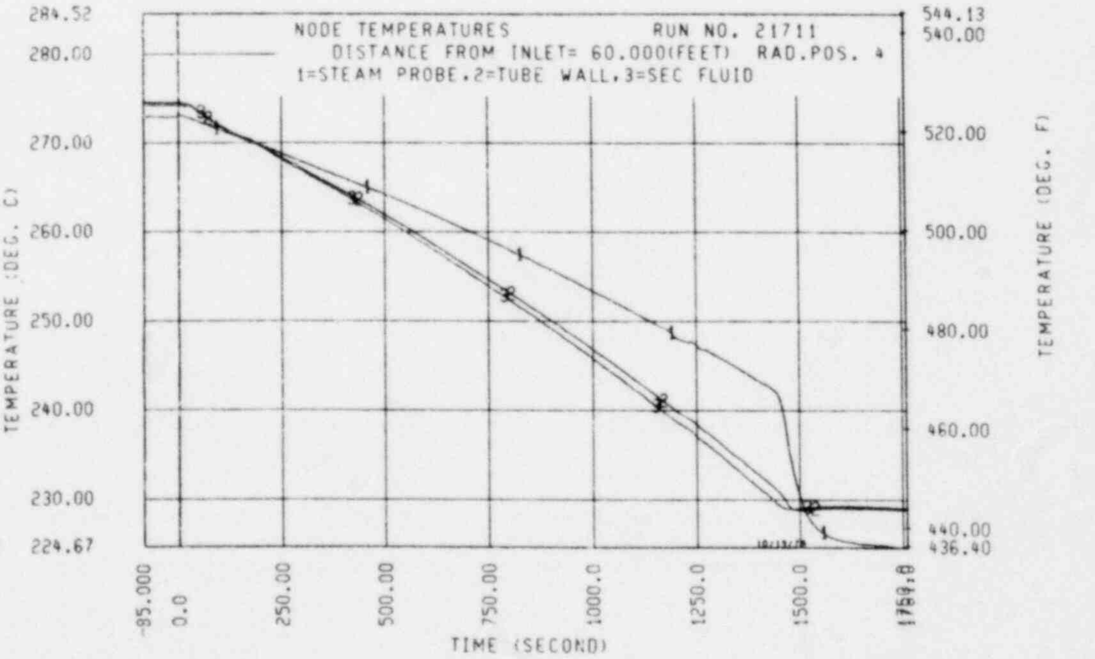

NODE TEMPERATURES RUN NO. 21711
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21711
DISTANCE FROM INLET= 60.000(.ET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

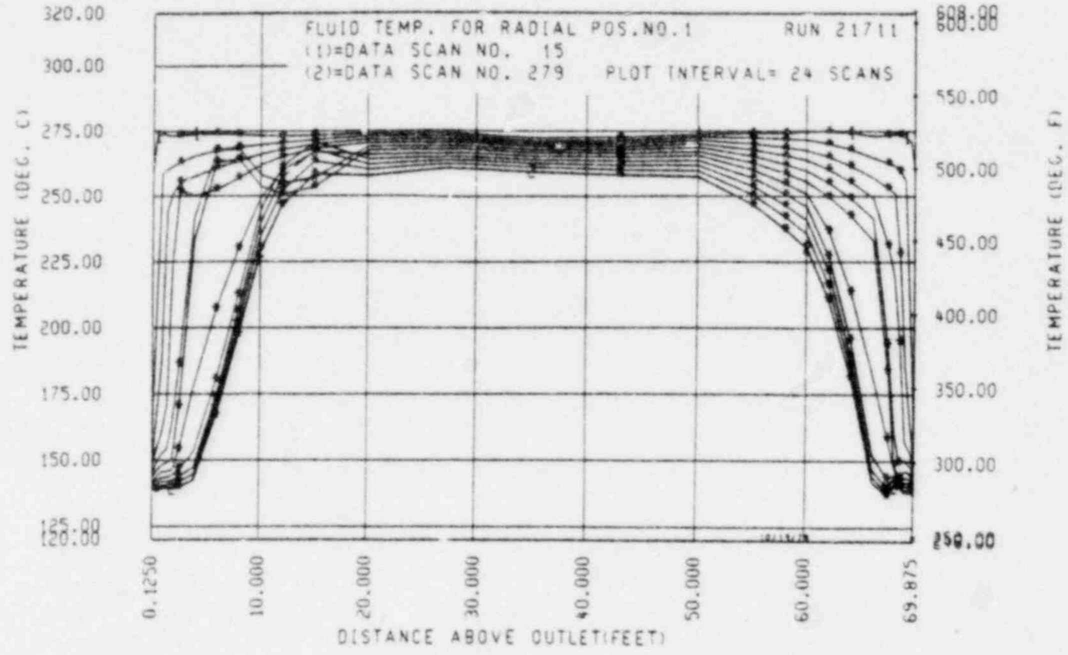

NODE TEMPERATURES RUN NO. 21711
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)



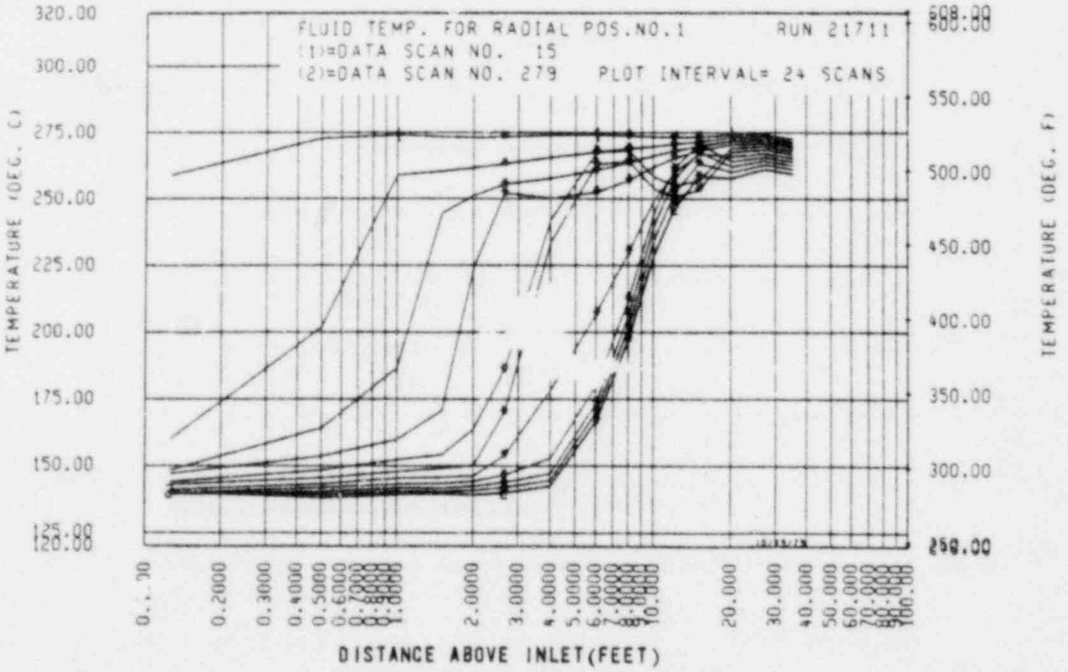
NODE TEMPERATURES RUN NO. 21711
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)



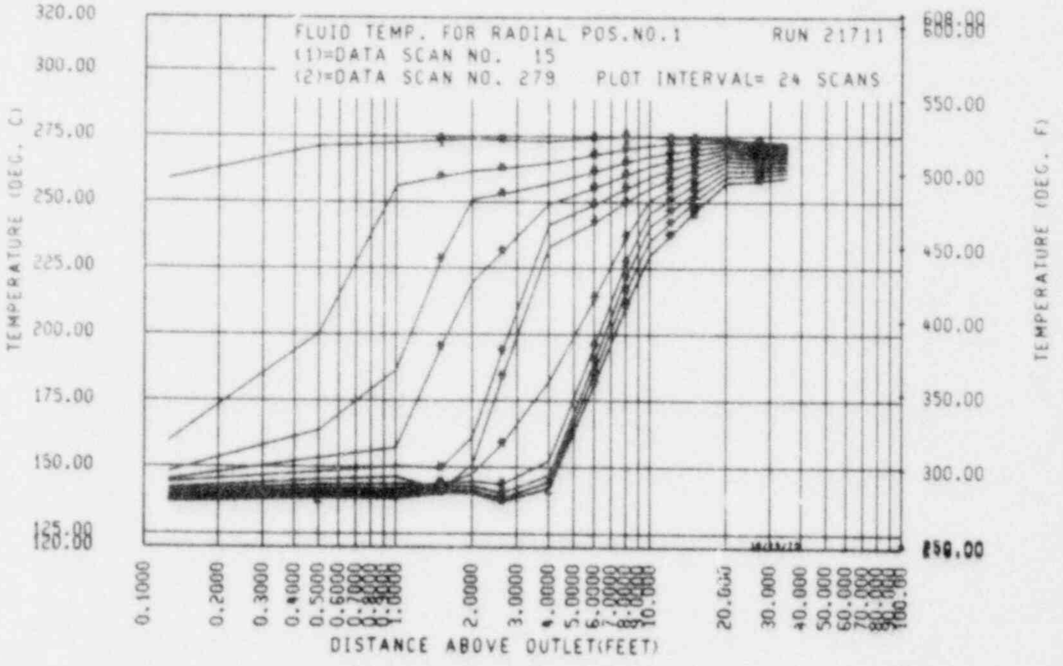
NODE TEMPERATURES RUN NO. 21711
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)



FLUID TEMP. FOR RADIAL POS.NO.1 RUN 21711
(1)=DATA SCAN NO. 15
(2)=DATA SCAN NO. 279 PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)



FLUID TEMP. FOR RADIAL POS.NO.1 RUN 21711
(1)=DATA SCAN NO. 15
(2)=DATA SCAN NO. 279 PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)



FLUID TEMP. FOR RADIAL POS.NO.1
RUN 21711
(1)=DATA SCAN NO. 15
(2)=DATA SCAN NO. 279
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

21711-18

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 21711

TIME = 60.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.9(.08)	81.4(7.17)	160.1(14.11)	12.8(1.12)	.657	.785	.880	.871
.2(.50)	17.8(1.57)	27.8(2.45)	27.5(2.43)	26.1(2.30)	.663	.806	.912	.879
.3(1.00)	18.3(1.61)	23.4(2.06)	18.8(1.66)	20.7(1.82)	.673	.820	.926	.888
.5(1.50)	14.0(1.23)	17.7(1.56)	21.3(1.88)	22.8(2.01)	.679	.829	.938	.895
.6(2.00)	1.8(.16)	19.0(1.67)	2.7(.24)	7.5(.66)	.681	.837	.944	.898
.8(2.65)	1.8(.16)	18.0(1.59)	-1.4(-.13)	4.6(.41)	.676	.847	.941	.894
1.2(4.00)	9.3(.82)	8.3(.73)	5.8(.51)	1.6(.14)	.673	.849	.927	.881
1.8(6.00)	6.5(.57)	7.7(.68)	11.0(.97)	7.8(.69)	.673	.838	.912	.871
2.4(8.00)	2.9(.25)	2.9(.25)	1.0(.09)	2.3(.20)	.670	.830	.903	.868
3.0(10.00)	.7(.06)	.7(.06)	1.7(.15)	1.7(.15)	.666	.828	.898	.862
3.7(12.00)	-.0(-.00)	.0(.00)	.9(.08)	-1.2(-.11)	.662	.824	.895	.856
4.6(15.00)	1.9(.16)	.6(.05)	.3(.03)	-.1(-.00)	.663	.820	.889	.849
6.1(20.00)	1.0(.09)	1.0(.09)	.4(.03)	.7(.06)	.666	.818	.884	.847
8.2(27.00)	.6(.05)	-.1(-.00)	-.2(-.02)	.4(.03)	.670	.818	.882	.850
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.673	.818	.882	.852
13.1(43.00)	-.6(-.05)	-.3(-.03)	.1(.00)	-.2(-.02)	.671	.818	.883	.852
15.2(50.00)	.4(.04)	-.1(-.01)	.0(.00)	-.0(-.00)	.676	.816	.884	.852
16.8(55.00)	.7(.06)	-.0(-.00)	.1(.01)	.0(.00)	.673	.816	.884	.852
17.7(58.00)	.6(.05)	-.0(-.00)	.1(.01)	.0(.00)	.675	.816	.885	.852
18.3(60.00)	.8(.07)	.0(.00)	.2(.02)	.1(.01)	.676	.815	.887	.853
18.9(62.00)	1.2(.10)	.1(.01)	.2(.02)	.1(.01)	.679	.816	.888	.854
19.5(64.00)	.2(.02)	.3(.03)	.2(.02)	.0(.00)	.681	.817	.889	.854
20.1(66.00)	.5(.04)	1.4(.12)	.5(.04)	-.0(-.00)	.682	.820	.890	.854
20.5(67.38)	.3(.02)	1.0(.09)	-.2(-.02)	-.4(-.03)	.684	.822	.890	.854
20.7(68.00)	-.1(-.01)	1.4(.12)	-.1(-.01)	.3(.03)	.684	.823	.889	.854
20.9(68.50)	-.5(-.04)	-.4(-.03)	-1.4(-.13)	-1.0(-.09)	.684	.823	.889	.853
21.0(69.00)	4.0(.35)	3.1(.27)	-.2(-.02)	-.3(-.02)	.685	.823	.888	.853
21.2(69.50)	-.9(-.08)	-3.6(-.31)	-1.6(-.14)	-.7(-.06)	.688	.823	.888	.853
21.3(69.87)	-28.7(-2.53)	-16.5(-1.46)	-12.8(-1.13)	-6.5(-.58)	.686	.821	.886	.853

21711-19

POOR ORIGINAL

POOR ORIGINAL

21711-20

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 21711
TIME = 300.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.02)	18.0(1.58)	13.5(1.19)	12.2(1.07)	.657	.775	.858	.872
.2(.50)	49.1(4.33)	53.3(4.70)	54.7(4.82)	55.8(4.91)	.671	.793	.876	.891
.3(1.00)	79.9(7.02)	121.8(10.73)	114.8(10.12)	142.1(12.52)	.713	.846	.927	.948
.5(1.50)	1.4(.12)	1.5(.13)	329.4(29.02)	1.5(.13)	.741	.883	1.060	.987
.6(2.00)	1.6(.14)	24.0(2.11)	6.5(.57)	12.0(1.05)	.741	.890	1.160	.986
.8(2.65)	1.7(.15)	-96.3(-8.49)	-65.3(-5.75)	-23.9(-2.10)	.738	.851	1.127	.973
1.2(4.00)	10.0(.88)	8.6(.76)	5.9(.52)	1.5(.14)	.737	.803	1.084	.948
1.8(6.00)	20.6(1.82)	25.8(2.28)	30.8(2.72)	28.8(2.54)	.753	.817	1.094	.960
2.4(8.00)	12.2(1.08)	19.1(1.68)	1.1(.10)	20.7(1.82)	.774	.849	1.106	.996
3.0(10.00)	3.1(.27)	3.1(.27)	4.0(.35)	4.2(.37)	.779	.864	1.097	1.009
3.7(12.00)	-.6(-.05)	-.9(-.08)	.0(.00)	-1.7(-.15)	.774	.860	1.091	1.002
4.6(15.00)	2.2(.20)	-.1(-.01)	-.8(-.07)	-.7(-.06)	.772	.851	1.079	.990
6.1(20.00)	1.4(.13)	1.4(.12)	.2(.02)	.9(.08)	.776	.847	1.068	.984
8.2(27.00)	.6(.06)	.6(.05)	-.2(-.02)	.6(.05)	.781	.850	1.063	.985
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.782	.852	1.064	.989
13.1(43.00)	-.6(-.06)	-.4(-.03)	.0(.00)	-.2(-.02)	.780	.851	1.065	.989
15.2(50.00)	.4(.03)	-.1(-.01)	.0(.00)	-.0(-.00)	.779	.850	1.066	.988
16.8(55.00)	.4(.03)	-.1(-.01)	-.0(-.00)	-.0(-.00)	.781	.850	1.066	.989
17.7(58.00)	.1(.01)	-.1(-.01)	-.0(-.00)	-.0(-.00)	.783	.850	1.068	.990
18.3(60.00)	-.0(-.00)	-.2(-.02)	-.1(-.01)	-.1(-.01)	.783	.850	1.069	.991
18.9(62.00)	-.0(-.00)	.0(.00)	-.0(-.00)	-.1(-.01)	.784	.851	1.071	.992
19.5(64.00)	.0(.00)	.2(.02)	.0(.00)	-.2(-.02)	.785	.852	1.073	.993
20.1(66.00)	.3(.02)	1.5(.13)	.3(.02)	-.5(-.04)	.788	.857	1.075	.993
20.5(67.38)	-.0(-.00)	.5(.04)	-.5(-.04)	-1.1(-.09)	.789	.860	1.076	.993
20.7(68.00)	.5(.04)	-.3(-.03)	-.8(-.07)	-.2(-.02)	.790	.861	1.076	.993
20.9(68.50)	-2.2(-.19)	-2.4(-.21)	-6.8(-.60)	-.3(-.02)	.791	.860	1.074	.995
21.0(69.00)	2.1(.18)	1.3(.12)	.6(.05)	4.5(.39)	.794	.861	1.074	.999
21.2(69.50)	-19.0(-1.68)	-2.9(-.25)	-20.0(-1.76)	-18.7(-1.65)	.796	.864	1.072	.999
21.3(69.87)	-6.6(-.58)	-4.3(-.38)	-4.5(-.40)	-3.8(-.33)	.800	.867	1.069	.995

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 21711
TIME = 600.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX PAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.1(.01)	6.3(.55)	6.6(.58)	5.3(.46)	.655	.771	.856	.869
.2(.50)	17.7(1.56)	19.0(1.68)	21.5(1.89)	19.2(1.69)	.666	.778	.863	.875
.3(1.00)	23.7(2.09)	24.0(2.11)	23.3(2.05)	31.4(2.76)	.672	.791	.876	.890
.5(1.50)	26.0(2.29)	21.0(1.85)	29.6(2.61)	32.5(2.87)	.687	.805	.892	.910
.6(2.00)	42.3(3.73)	39.2(3.45)	38.2(3.37)	34.4(3.03)	.708	.823	.912	.930
.8(2.65)	.6(.05)	75.9(6.68)	35.0(3.09)	29.3(2.58)	.719	.869	.938	.951
1.2(4.00)	12.6(1.11)	10.9(.96)	7.4(.65)	1.4(.12)	.728	.908	.954	.955
1.8(6.00)	2.9(.25)	4.6(.40)	1.1(.10)	11.0(.97)	.735	.906	.945	.949
2.4(8.00)	1.6(.14)	1.9(.17)	.8(.07)	7.1(.63)	.723	.893	.926	.948
3.0(10.00)	5.0(.44)	5.0(.44)	5.7(.51)	6.3(.56)	.714	.885	.916	.946
3.7(12.00)	9.8(.87)	7.3(.64)	5.8(.51)	3.8(.33)	.720	.888	.915	.945
4.6(15.00)	6.6(.58)	4.3(.38)	4.1(.37)	5.0(.44)	.739	.896	.919	.949
6.1(20.00)	1.9(.16)	2.0(.17)	.9(.08)	1.3(.11)	.754	.902	.920	.954
8.2(27.00)	.6(.06)	.1(.01)	-.2(-.01)	.5(.04)	.758	.902	.917	.954
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.757	.900	.916	.956
13.1(43.00)	-.7(-.06)	-.4(-.04)	.0(.00)	-.2(-.02)	.754	.898	.918	.956
15.2(50.00)	.2(.02)	-.2(-.01)	-.0(-.00)	-.1(-.00)	.752	.897	.918	.956
16.8(55.00)	.2(.02)	-.1(-.01)	-.1(-.01)	-.1(-.01)	.755	.897	.919	.956
17.7(58.00)	.0(.00)	-.1(-.01)	-.1(-.01)	-.2(-.02)	.756	.897	.920	.958
18.3(60.00)	-.1(-.01)	-.3(-.03)	-.3(-.03)	-.4(-.03)	.757	.898	.922	.960
18.9(62.00)	-.2(-.02)	-.0(-.00)	-.1(-.01)	-.5(-.04)	.758	.900	.925	.961
19.5(64.00)	-.0(-.00)	.2(.02)	-.0(-.00)	-.5(-.05)	.761	.904	.929	.964
20.1(66.00)	.1(.01)	1.3(.12)	.1(.01)	-1.1(-.10)	.765	.911	.933	.965
20.5(67.38)	-3.6(-.31)	-2.7(-.23)	-3.7(-.32)	-8.0(-.71)	.766	.915	.935	.963
20.7(68.00)	-11.3(-1.00)	-10.8(-.95)	-11.8(-1.04)	-12.0(-1.06)	.764	.913	.932	.959
20.9(68.50)	-11.8(-1.04)	-13.1(-1.15)	-12.6(-1.11)	-11.0(-.97)	.762	.909	.929	.957
21.0(69.00)	2.1(.19)	1.5(.13)	1.9(.17)	-1.8(-.16)	.766	.908	.930	.961
21.2(69.50)	-16.3(-1.44)	-22.9(-2.01)	-14.8(-1.31)	-11.0(-.97)	.771	.909	.930	.962
21.3(69.87)	-2.7(-.24)	-2.9(-.26)	-2.9(-.25)	-3.3(-.29)	.773	.908	.928	.960

SUMMARY SHEET

RUN NO. 21806

DATE: 3/15/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.045 (0.100)
2. Water flow - [kg/sec (lb/sec)] - 0.181 (0.400)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{o}C (^{o}F)] - 148 (299)
5. Water temperature [^{o}C (^{o}F)] - 128 (262)
6. Mixer pressure [kPa (psig)] - 200 (29)
7. Test time (sec) - 1679.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.0 (32.7)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	260 (500)
0.15 (0.50)	266 (510)
0.30 (1.00)	268 (515)
0.46 (1.50)	271 (520)
0.61 (2.00)	271 (520)
1.22 (4.00)	271 (520)
3.05 (10.00)	271 (520)
6.09 (20.00)	271 (520)
8.23 (27.00)	271 (520)
10.67 (35.00)	271 (520)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 13.09 (28.85)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - NA
   (b) SG collection tank [kg (lb)] - 65.23 (143.8)
3. Posttest drain from hot leg [kg (lb)] - 17.33 (38.21)

D. FAILED BUNDLE T/Cs[1]

310, 311, 326, 553, 564, 565, 568

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

1. From primary side energy balance [kwsec(Btu)] - 0.752×10^5 (0.716×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da\,dt$) -[kwsec(Btu)] - 0.378×10^5 (0.360×10^5)
3. Integration to 300 sec

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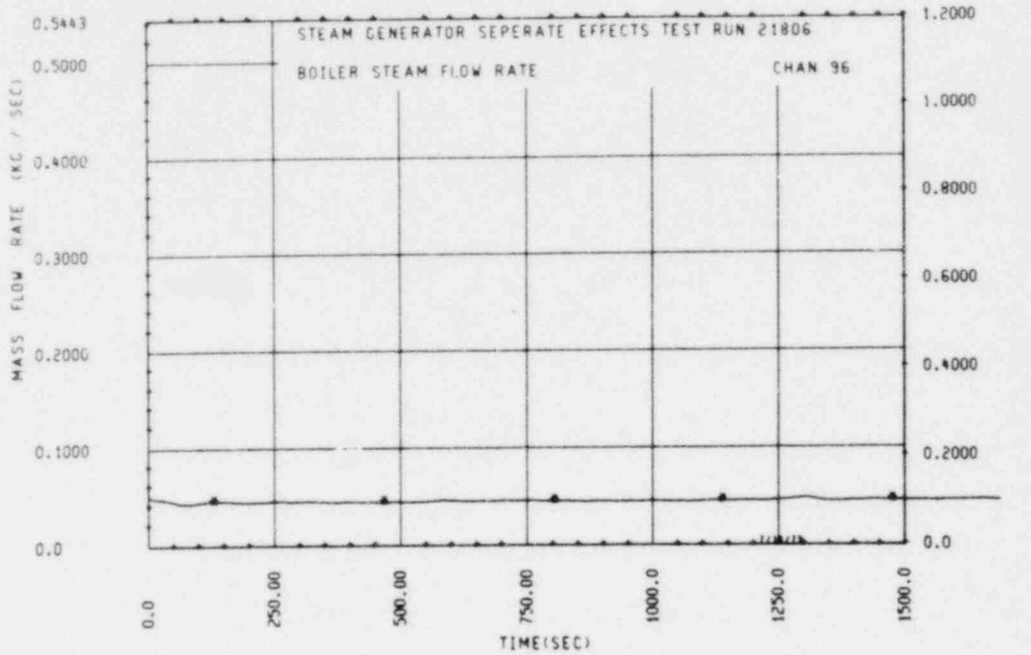
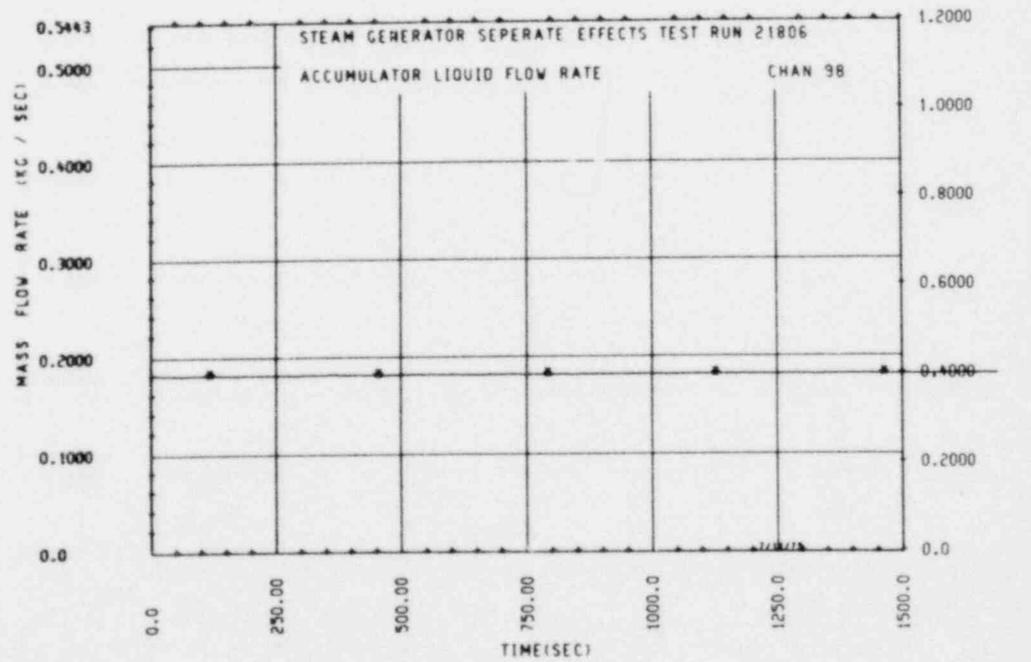
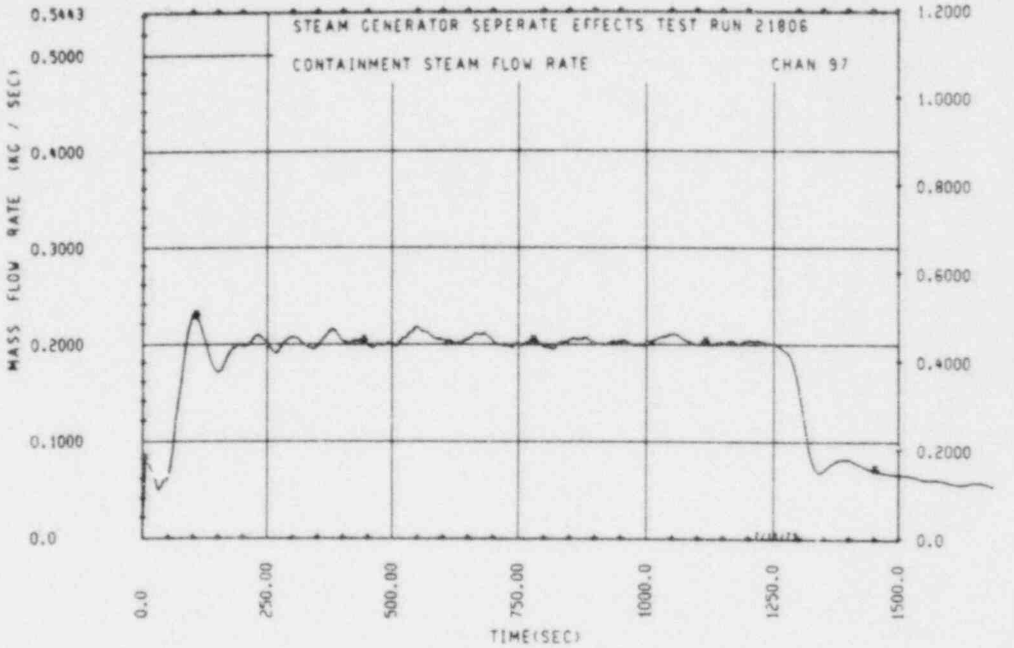
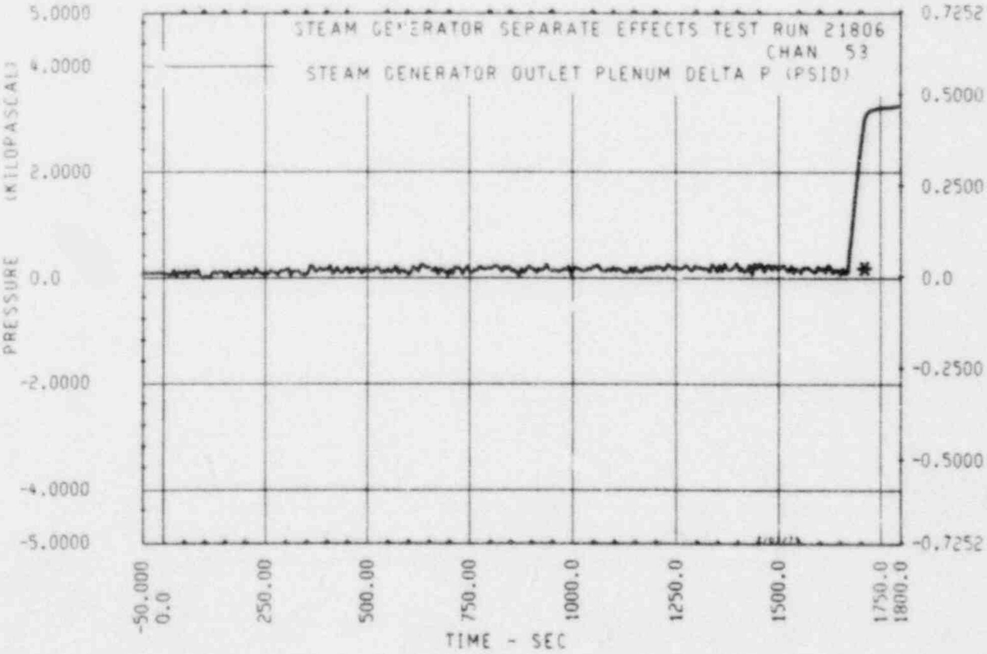
1. T/Cs are defined as failed based on resistance reading or T/C response.

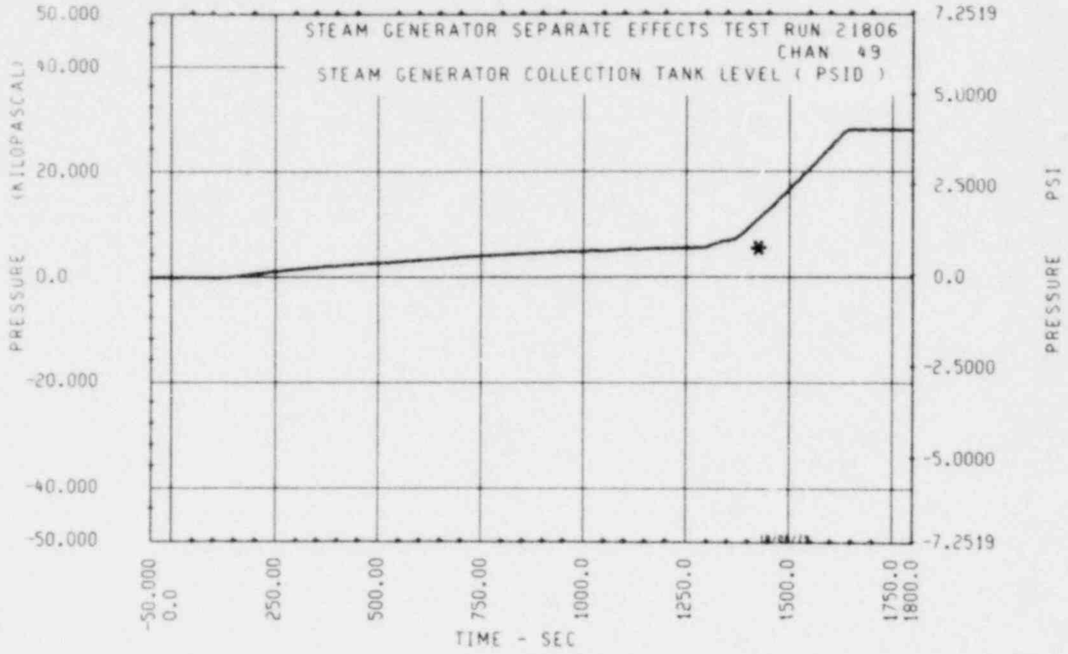

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21806
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21806
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

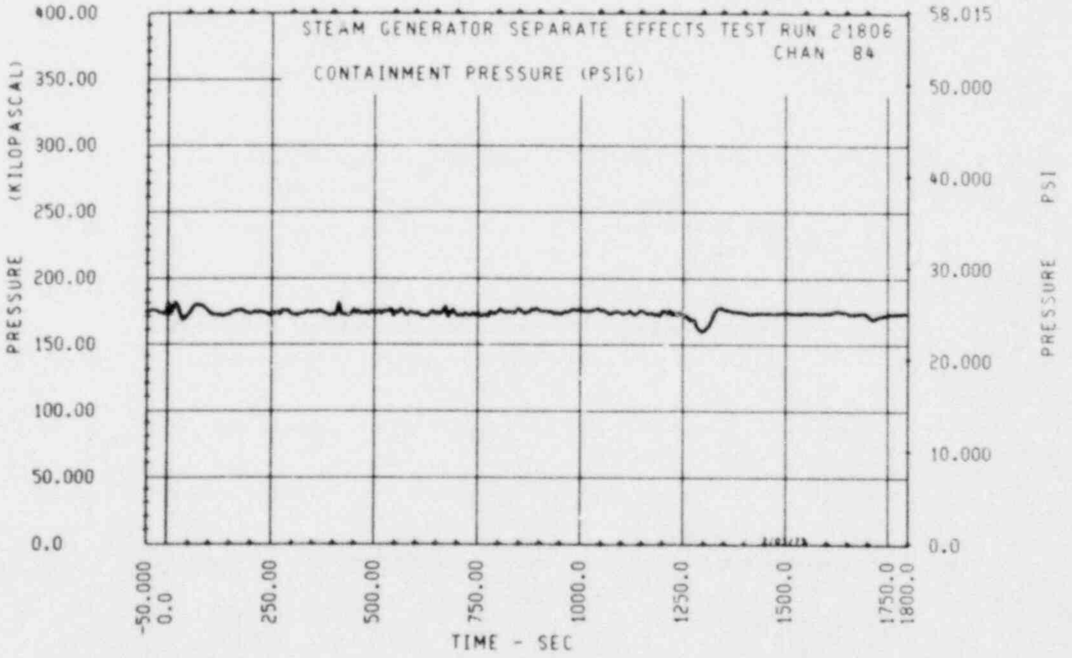


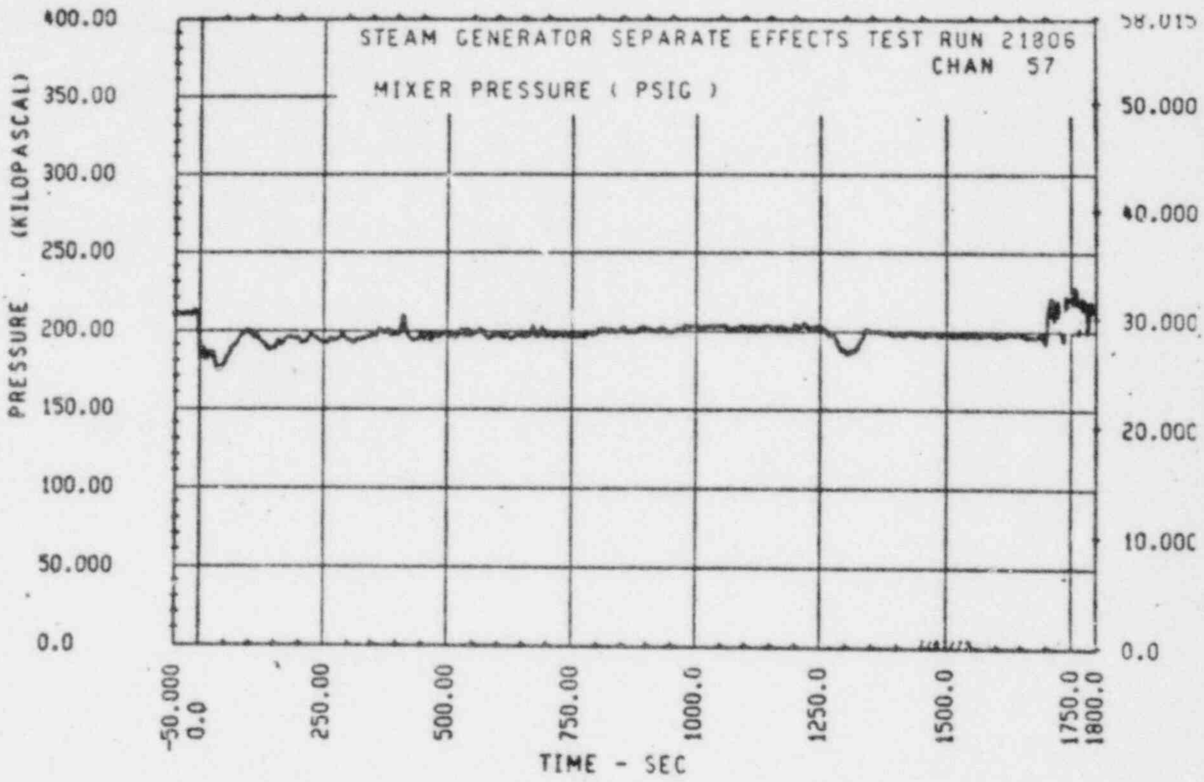


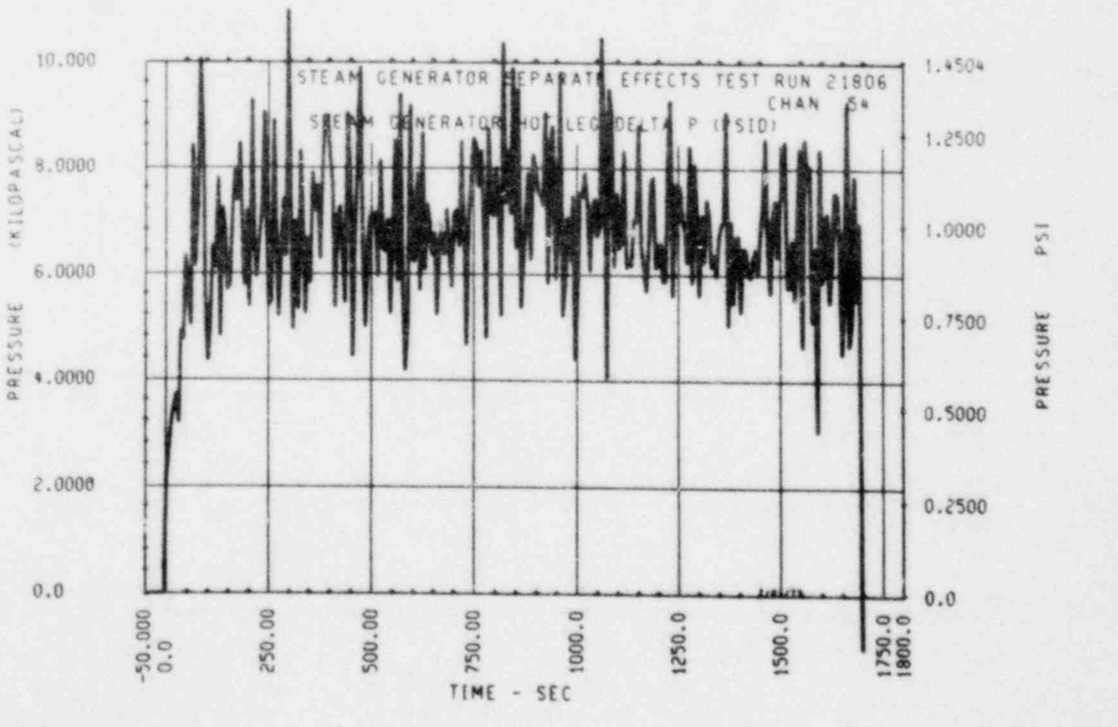
* Refer to Appendix H text for explanation of delayed response.

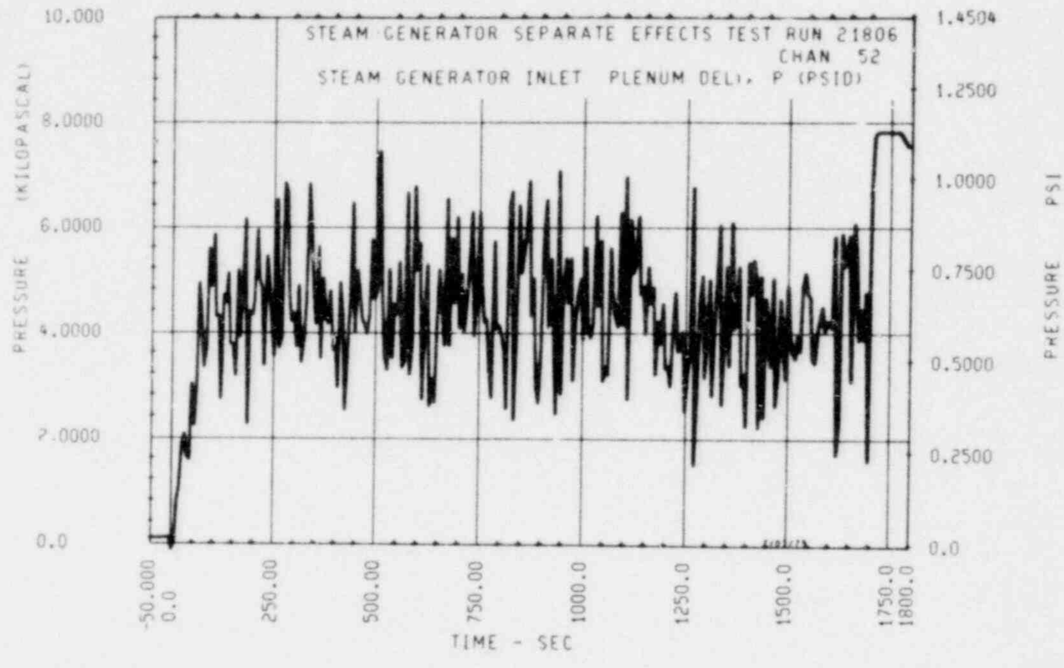


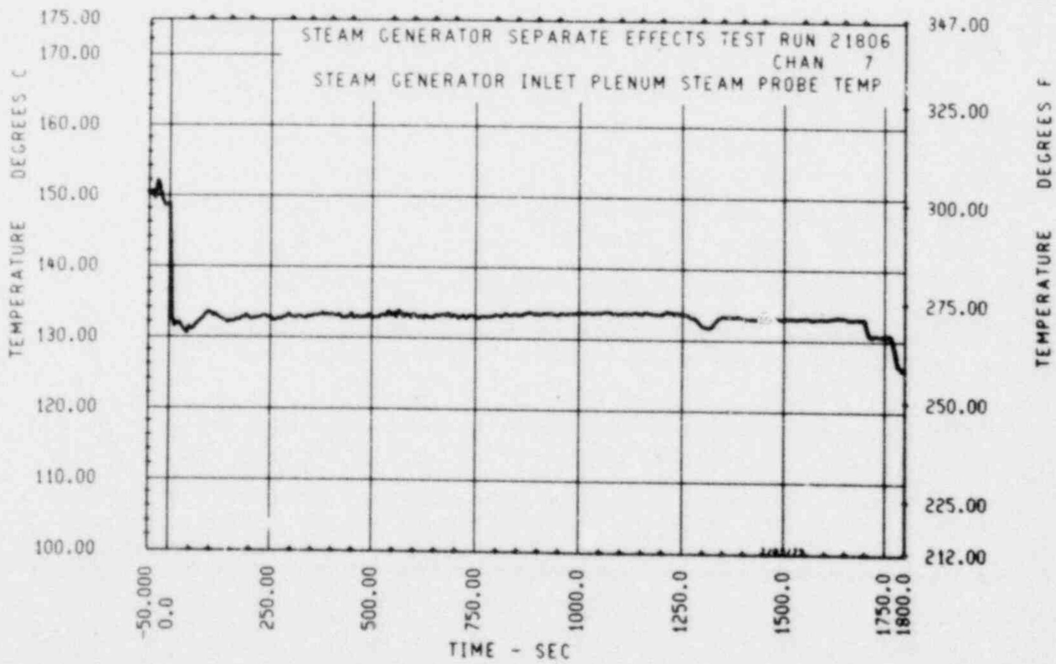
* Refer to Appendix H text for explanation of delayed response.



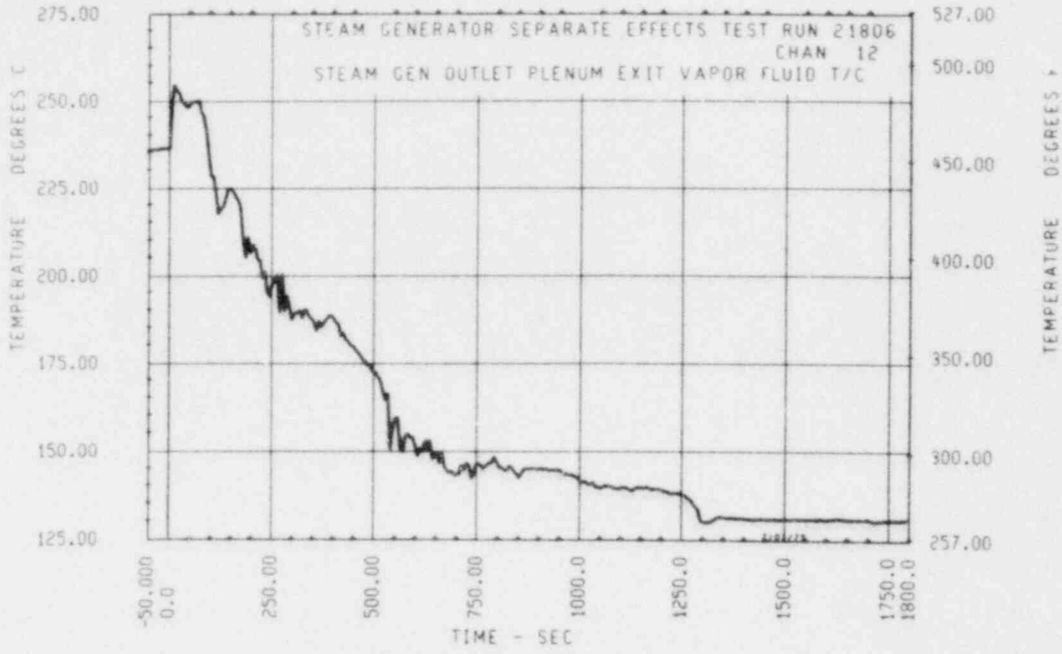

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21806
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

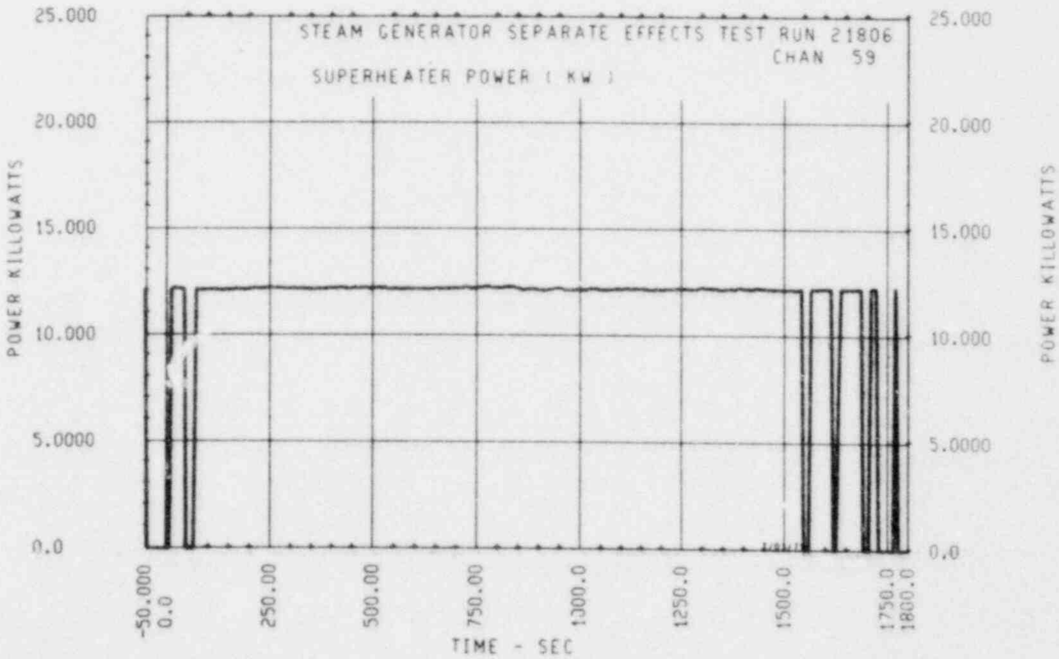

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21806
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
10.000
8.0000
6.0000
4.0000
2.0000
0.0
1.4504
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
PRESSURE PSI
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

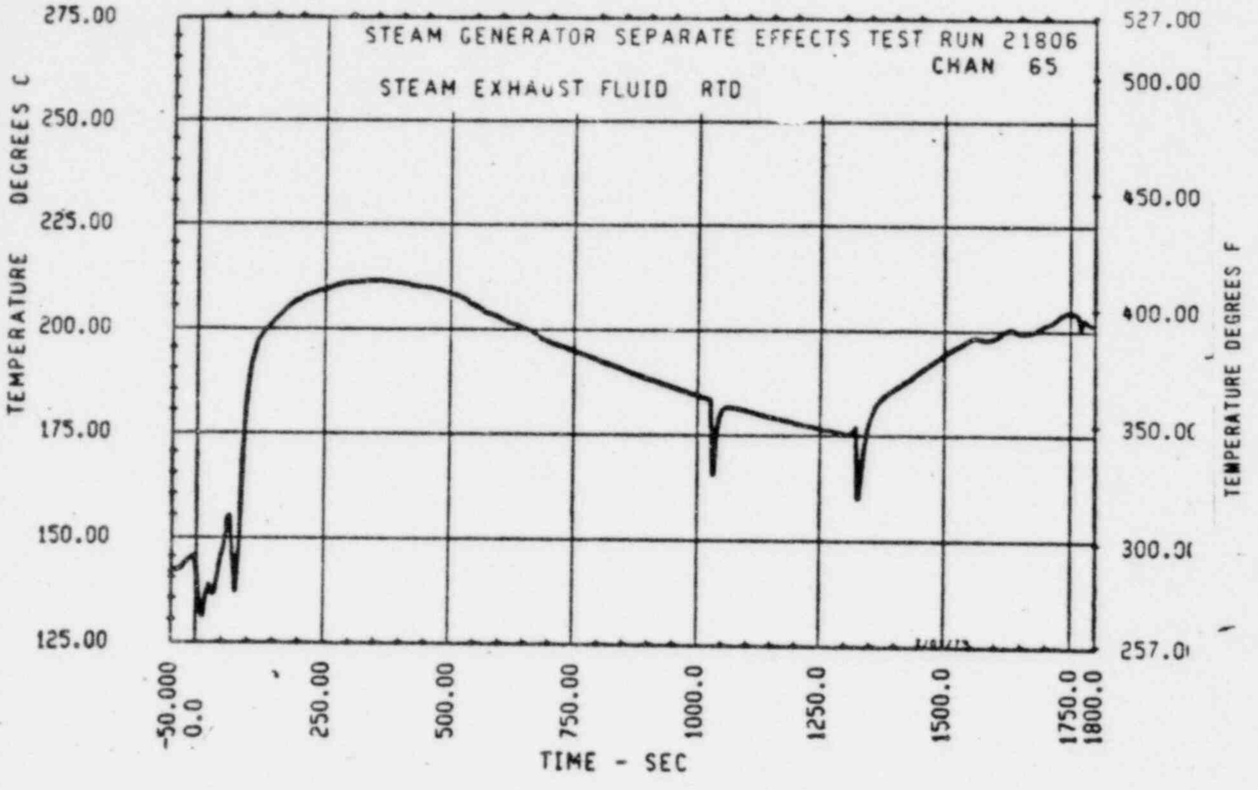

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21806
CHAN 52
STEAM GENERATOR INLET PLENUM DEL). P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
10.000
8.0000
6.0000
4.0000
2.0000
0.0
1.4504
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

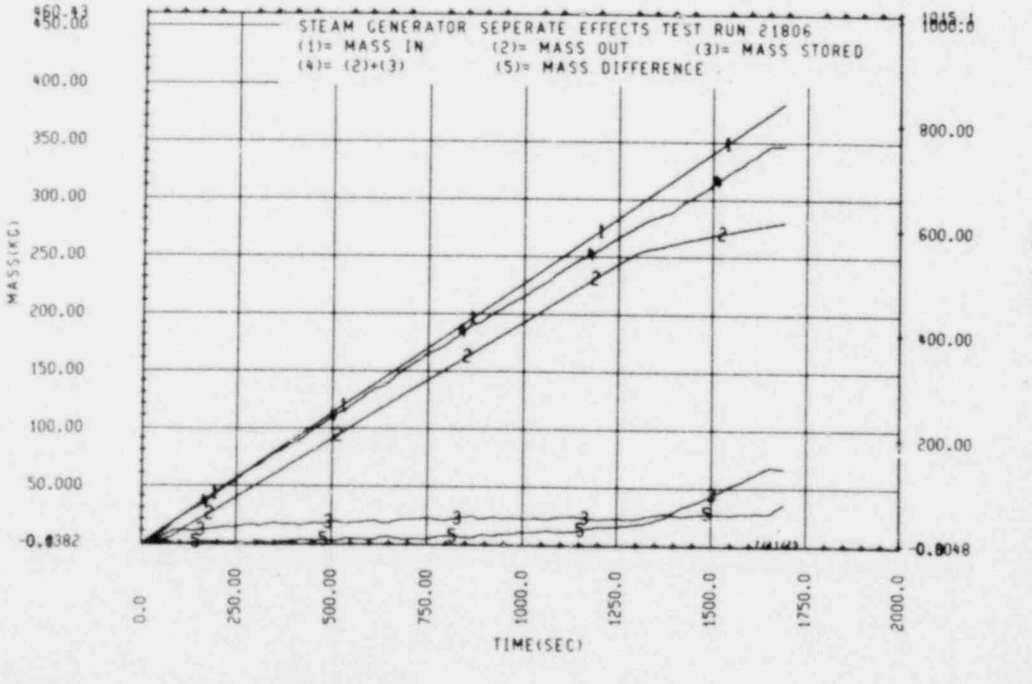

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21806
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
175.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
347.00
325.00
300.00
275.00
250.00
225.00
212.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

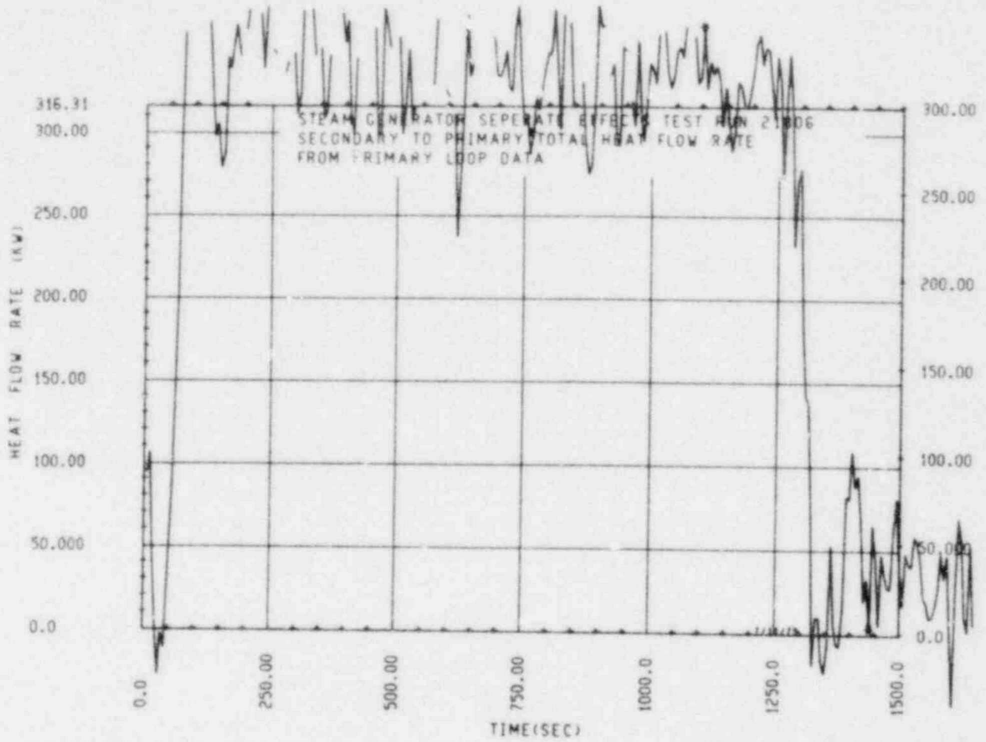
21806-7

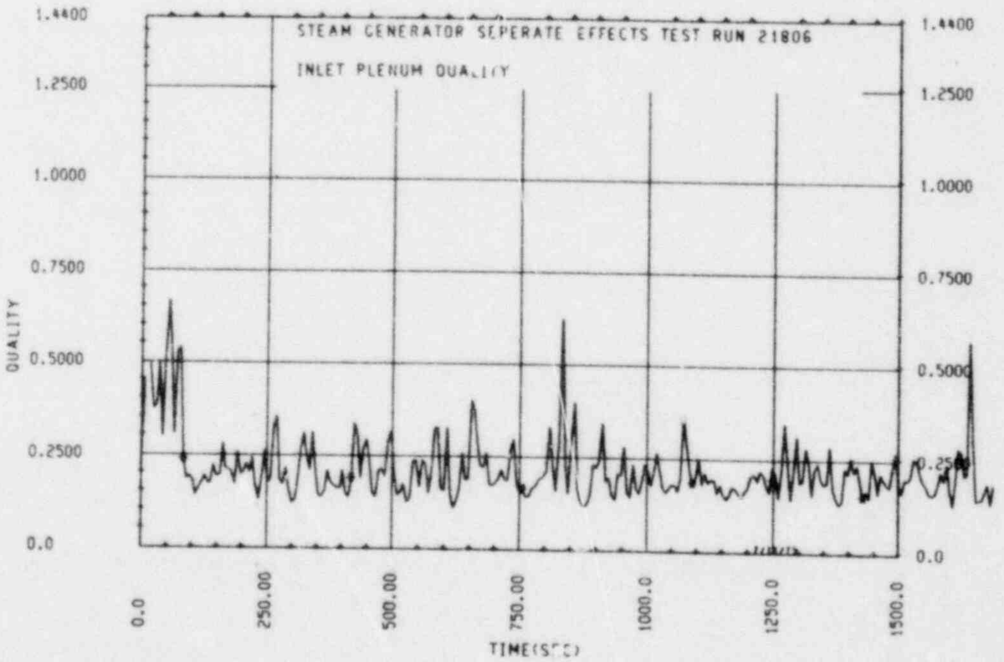

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21806
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

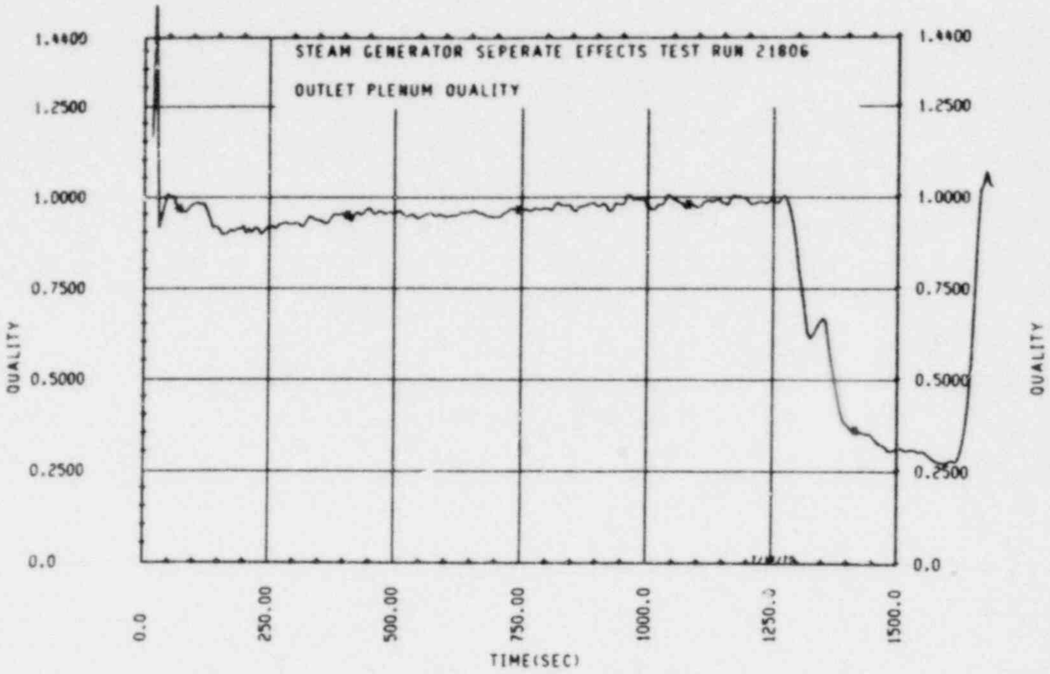

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21806
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
TIME - SEC
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

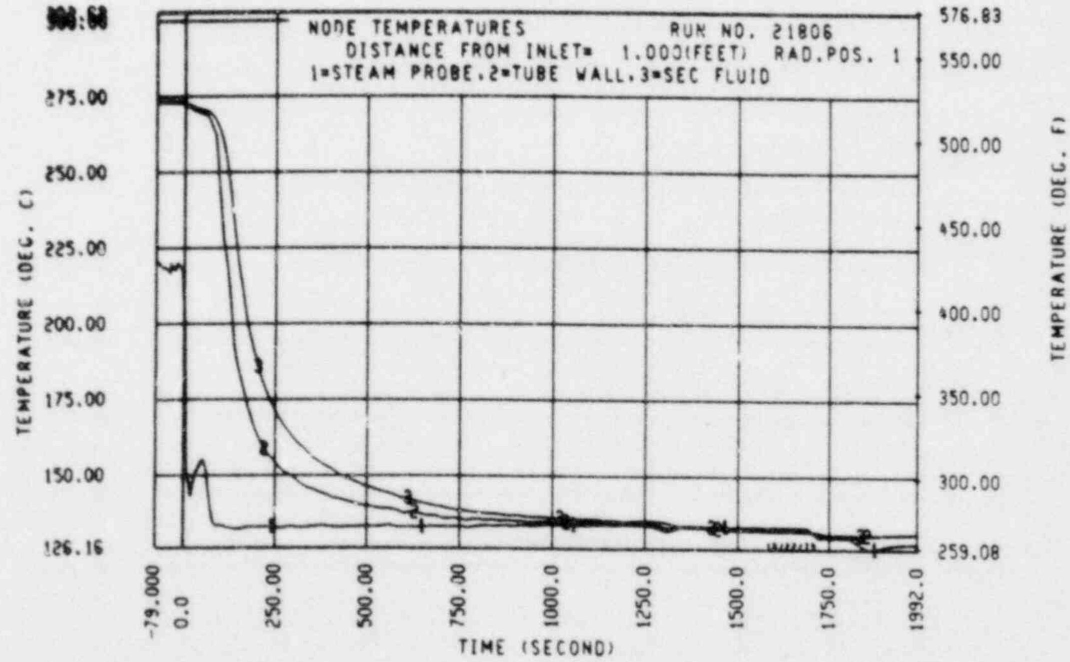

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21806
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

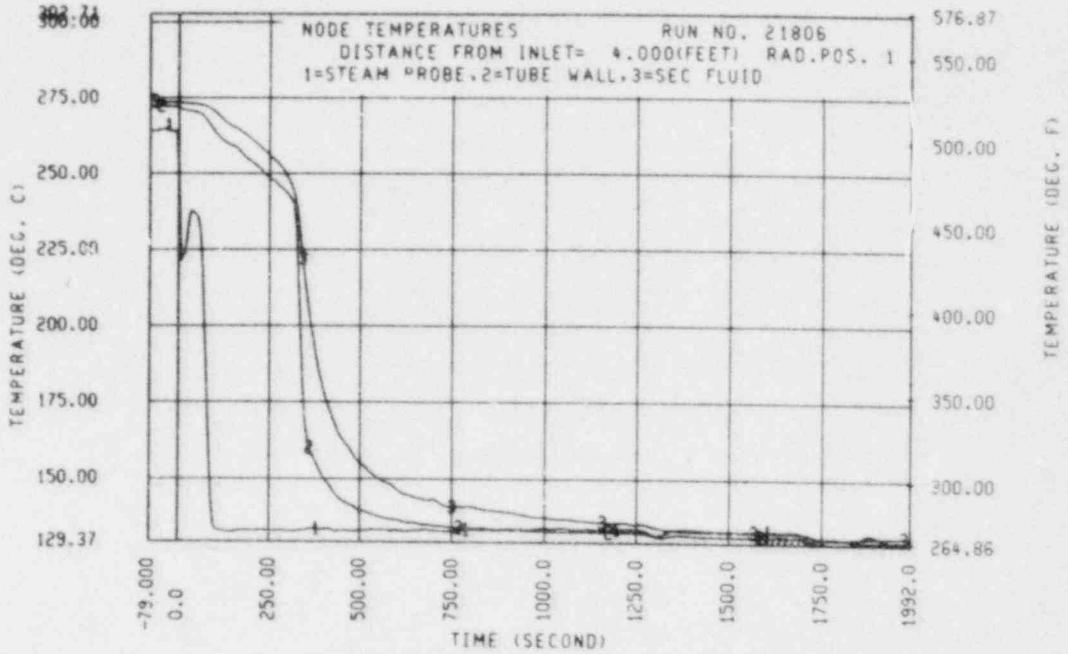

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21806
(1)= MASS IN
(2)= MASS OUT
(3)= MASS STORED
(4)= (2)+(3)
(5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)

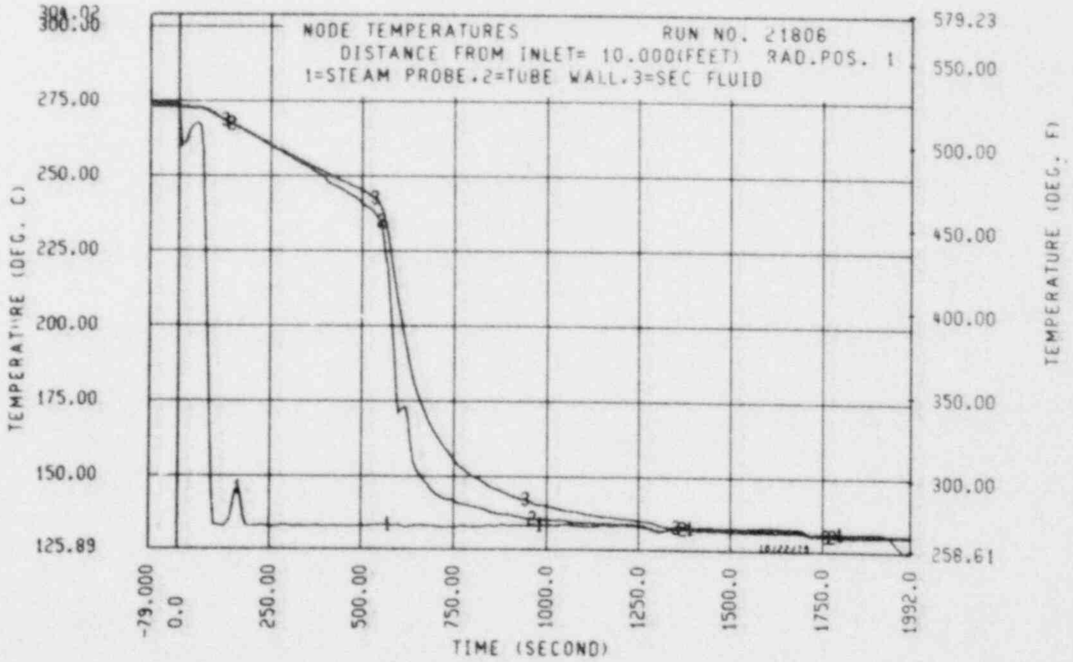

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21806
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)
316.31
300.00
250.00
200.00
150.00
100.00
50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

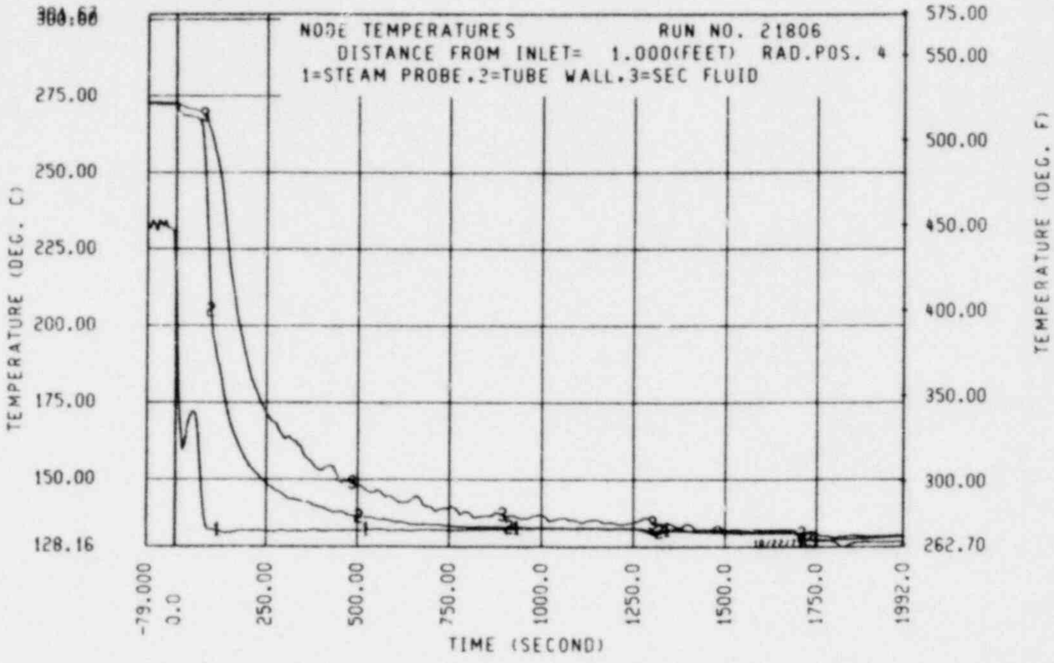

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21806
INLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

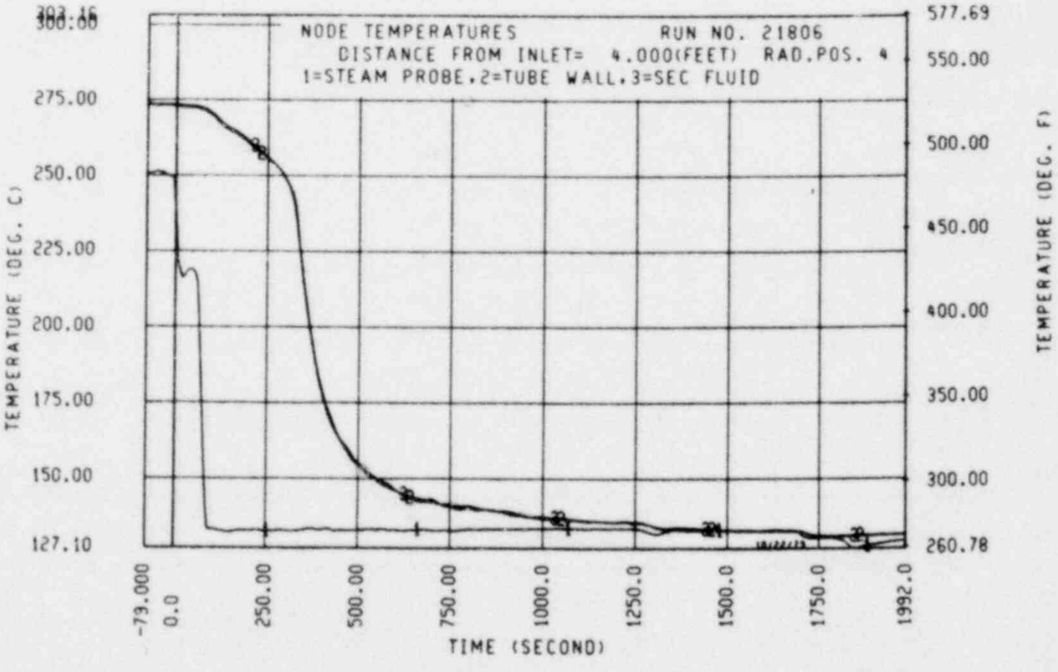

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21806
OUTLET PLENUM QUALITY
QUALITY
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
250.00
500.00
750.00
1000.0
1500.0
TIME(SEC)

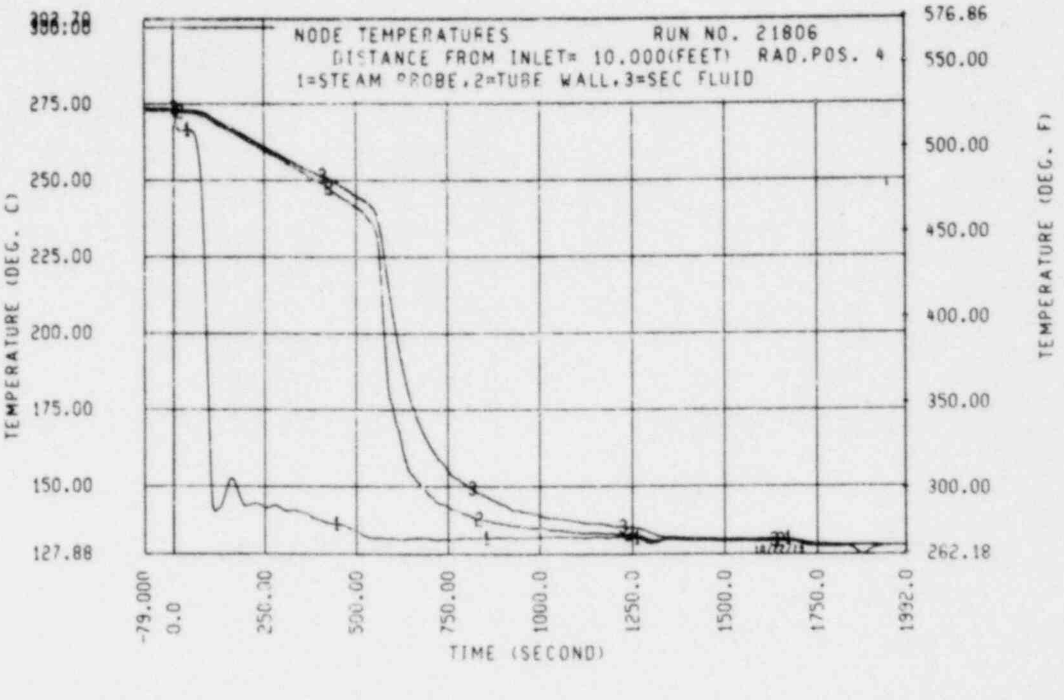

NODE TEMPERATURES
RUN NO. 21806
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
275.00
250.00
225.00
200.00
175.00
150.00
126.16
576.83
550.00
500.00
450.00
400.00
350.00
300.00
259.08
-79.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1992.0
TIME (SECOND)

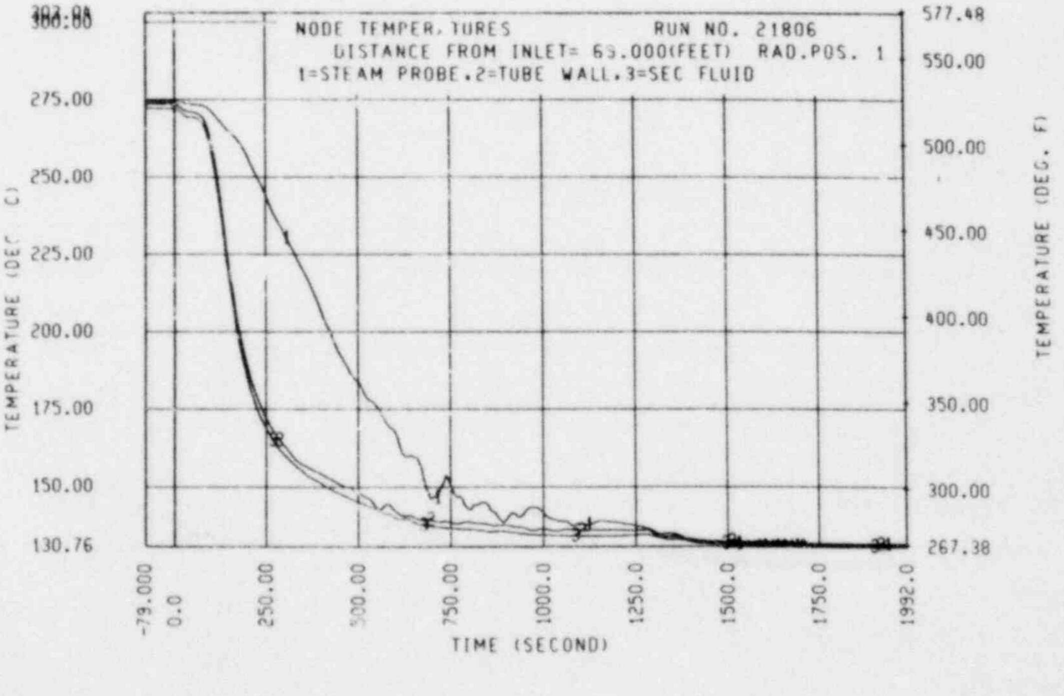

NODE TEMPERATURES RUN NO. 21806
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

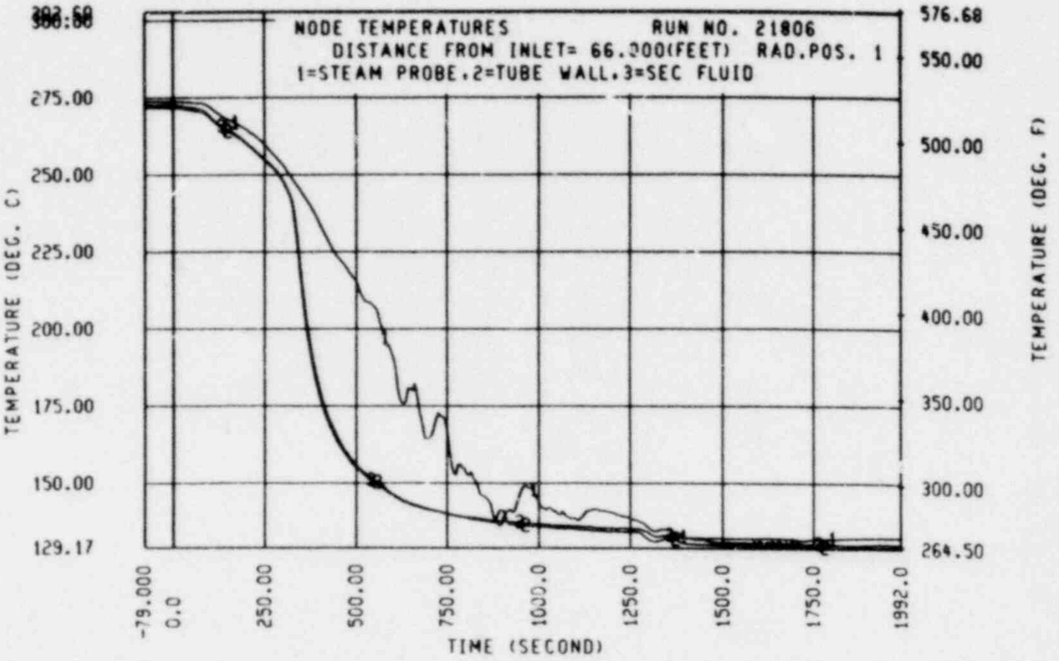

NODE TEMPERATURES RUN NO. 21806
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21806
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

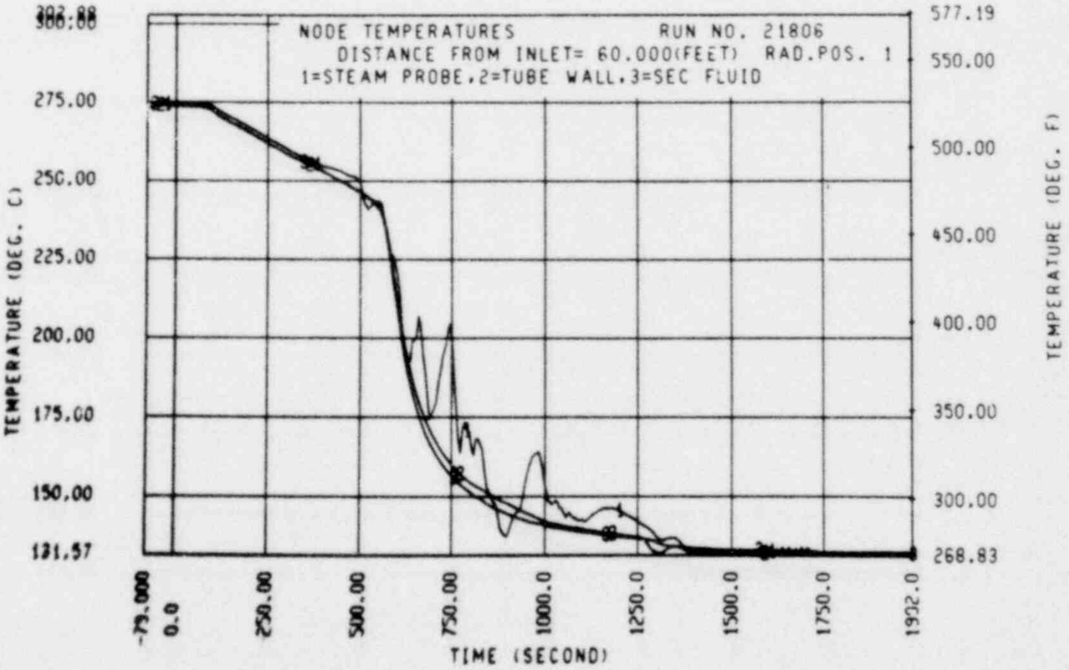

NODE TEMPERATURES RUN NO. 21806
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21806
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21806
DISTANCE FROM INLET= 65.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

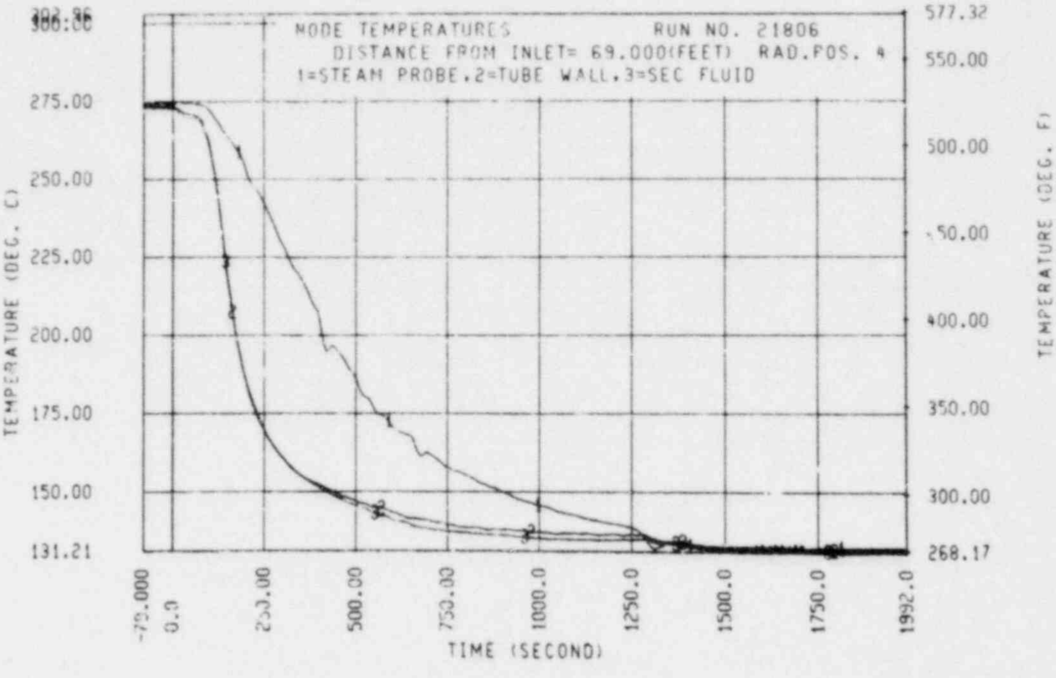


NODE TEMPERATURES RUN NO. 21806
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
302.60
300.00
275.00
250.00
225.00
200.00
175.00
150.00
129.17
TEMPERATURE (DEG. F)
576.68
550.00
500.00
450.00
400.00
350.00
300.00
264.50
-79.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1992.0
TIME (SECOND)

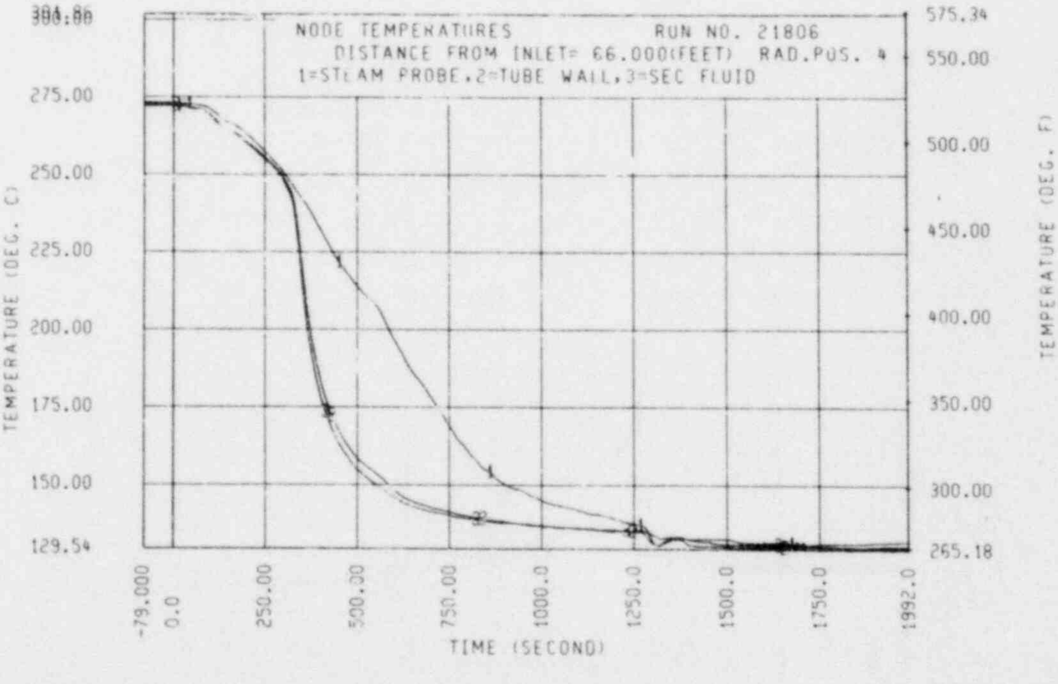


NODE TEMPERATURES RUN NO. 21806
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
302.88
300.00
275.00
250.00
225.00
200.00
175.00
150.00
131.57
TEMPERATURE (DEG. F)
577.19
550.00
500.00
450.00
400.00
350.00
300.00
268.83
-79.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1992.0
TIME (SECOND)

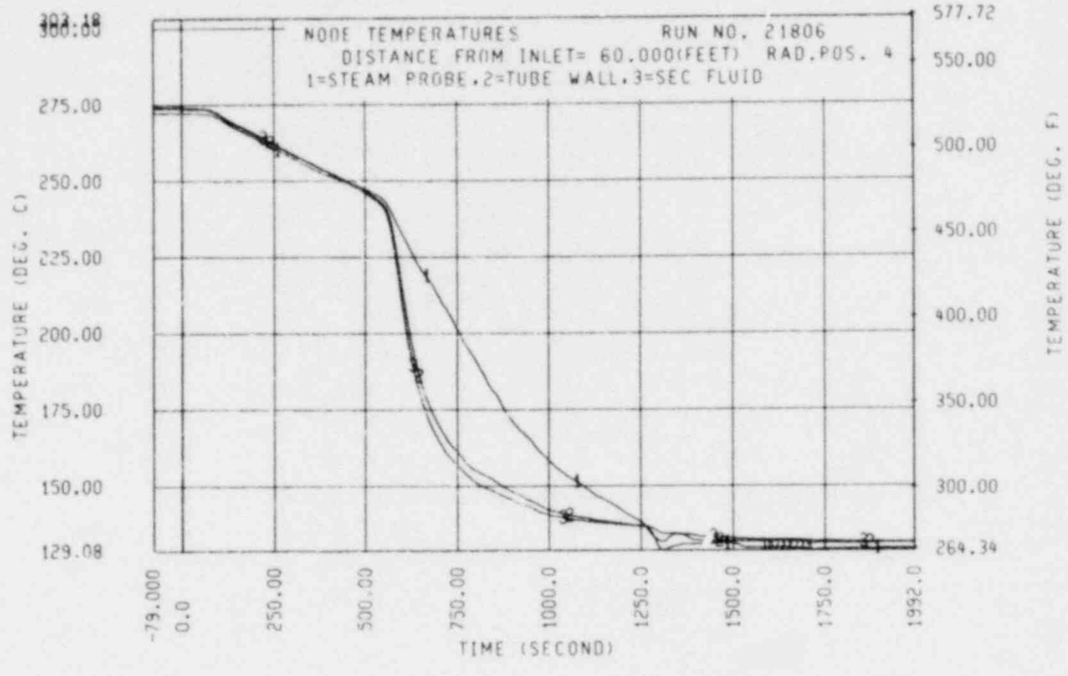
21806-15

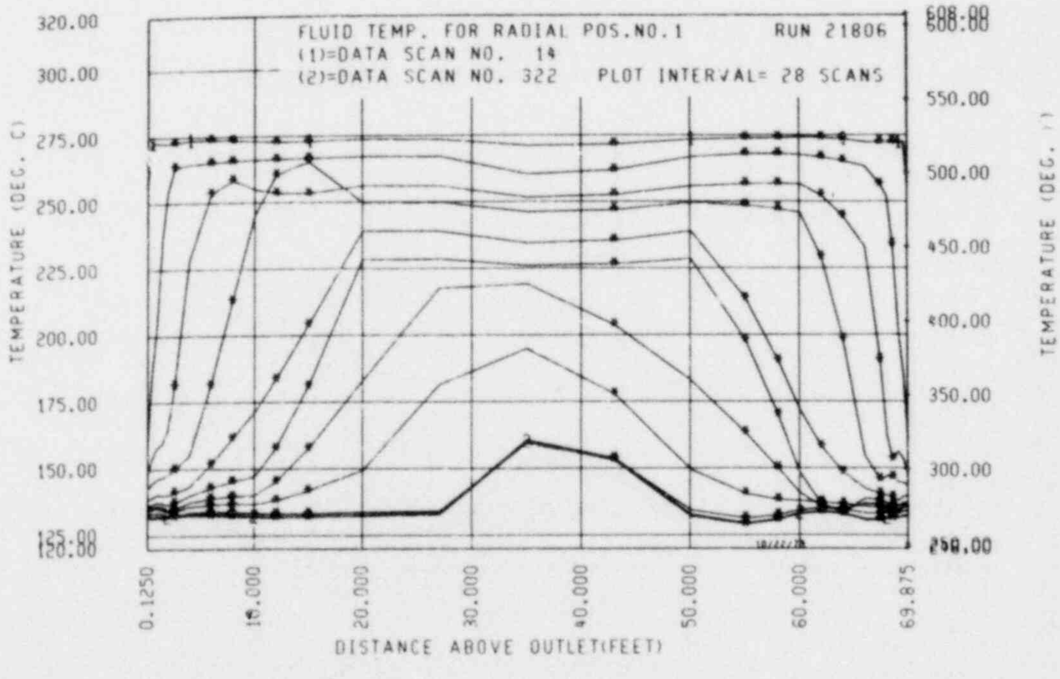


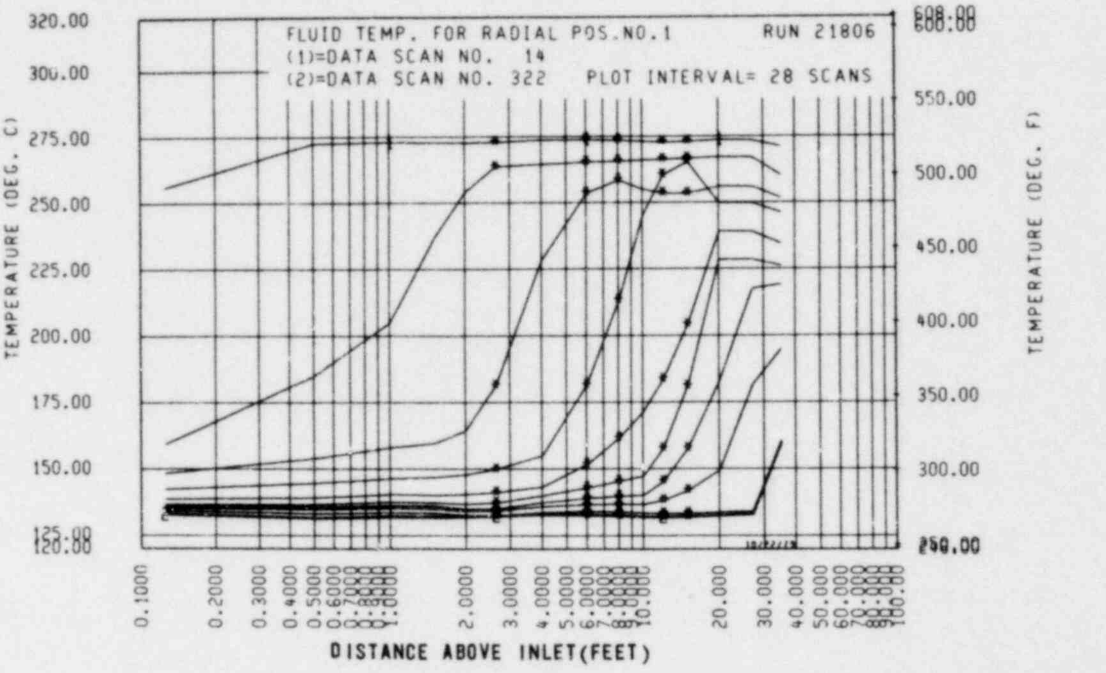
NODE TEMPERATURES
RUN NO. 21806
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

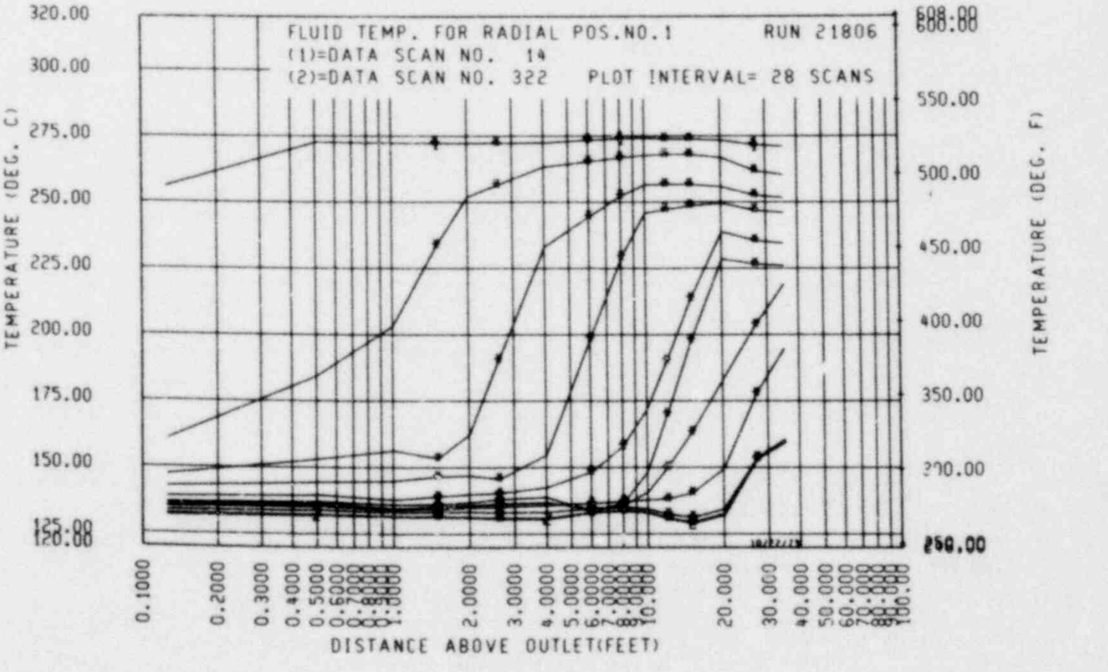


NODE TEMPERATURES
RUN NO. 21806
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21806
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


FLUID TEMP. FOR RADIAL POS.NO.1 RUN 21806
(1)=DATA SCAN NO. 14
(2)=DATA SCAN NO. 322 PLOT INTERVAL= 28 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1 RUN 21806
(1)=DATA SCAN NO. 14
(2)=DATA SCAN NO. 322 PLOT INTERVAL= 28 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1 RUN 21806
(1)=DATA SCAN NO. 14
(2)=DATA SCAN NO. 322 PLOT INTERVAL= 28 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 21806

TIME = 60.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.5(.05)	43.1(3.80)	31.0(2.73)	25.4(2.23)	.021	.027	.025	.413
.2(.50)	4.5(.40)	7.0(.61)	8.9(.78)	11.0(.97)	.022	.036	.033	.414
.3(1.00)	6.9(.61)	9.7(.85)	12.0(1.06)	5.1(.45)	.025	.040	.039	.414
.5(1.50)	4.1(.36)	7.0(.61)	13.2(1.17)	8.7(.77)	.028	.045	.046	.417
.6(2.00)	.6(.05)	9.1(.80)	-2.8(-.25)	3.1(.27)	.029	.049	.048	.420
.8(2.65)	.5(.04)	7.9(.70)	-4.7(-.42)	2.0(.18)	.029	.054	.045	.417
1.2(4.00)	3.6(.31)	3.4(.30)	2.7(.24)	.5(.04)	.032	.060	.045	.409
1.8(6.00)	2.7(.24)	4.2(.37)	9.1(.80)	6.2(.54)	.039	.067	.057	.405
2.4(8.00)	.9(.08)	1.0(.08)	5.0(.44)	5.3(.46)	.043	.072	.072	.412
3.0(10.00)	-.1(-.01)	.1(.01)	.5(.05)	.8(.07)	.043	.073	.077	.415
3.7(12.00)	-1.0(-.09)	-.1(-.01)	.2(.02)	-1.7(-.15)	.042	.073	.078	.413
4.6(15.00)	2.2(.20)	.6(.06)	-.0(-.00)	-.7(-.06)	.046	.074	.078	.409
6.1(20.00)	.0(.00)	-.0(-.00)	.4(.04)	.5(.05)	.051	.075	.079	.409
8.2(27.00)	.5(.05)	-.0(-.00)	-.2(-.02)	.5(.04)	.053	.075	.079	.412
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.055	.076	.079	.415
13.1(43.00)	-.5(-.04)	-.2(-.02)	.1(.01)	-.2(-.02)	.054	.075	.080	.415
15.2(50.00)	.5(.04)	.0(.00)	.1(.01)	-.0(-.00)	.053	.075	.081	.415
16.8(55.00)	.6(.05)	.1(.01)	.1(.01)	.0(.00)	.056	.075	.082	.415
17.7(58.00)	.3(.03)	.1(.01)	.1(.01)	.1(.00)	.058	.076	.082	.415
18.3(60.00)	.2(.02)	.1(.01)	.1(.01)	.1(.01)	.058	.076	.082	.415
18.9(62.00)	.3(.02)	.1(.01)	.1(.01)	.1(.01)	.059	.076	.083	.416
19.5(64.00)	.1(.01)	.2(.02)	.2(.01)	.1(.01)	.060	.076	.083	.416
20.1(66.00)	.5(.05)	1.0(.09)	.5(.05)	.2(.01)	.060	.078	.084	.416
20.5(67.38)	.1(.01)	.5(.04)	-.2(-.02)	-.4(-.04)	.061	.079	.084	.416
20.7(68.00)	.5(.04)	.5(.04)	.0(.00)	.1(.01)	.061	.080	.084	.416
20.9(68.50)	-.9(-.08)	-.8(-.07)	-1.1(-.10)	-1.9(-.17)	.061	.079	.084	.415
21.0(69.00)	4.1(.36)	3.2(.28)	-.0(-.00)	3.5(.31)	.062	.080	.084	.415
21.2(69.50)	.5(.04)	-.2(-.02)	.1(.01)	.1(.01)	.063	.081	.084	.417
21.3(69.87)	-1.1(-.10)	.0(.00)	-.9(-.08)	-.0(-.00)	.063	.081	.084	.417

21806-19

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 21806
TIME = 179.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.1(.01)	31.5(2.77)	29.0(2.55)	19.4(1.71)	.020	.025	.025	.413
.2(.50)	92.7(8.17)	99.6(8.77)	103.7(9.14)	106.6(9.40)	.049	.060	.061	.448
.3(1.00)	138.6(12.21)	175.1(15.43)	5.7(.50)	169.7(14.95)	.119	.143	.094	.532
.5(1.50)	.4(.04)	.4(.04)	156.0(13.75)	.4(.03)	.161	.197	.143	.585
.6(2.00)	.5(.05)	.5(.05)	.5(.05)	208.1(18.33)	.162	.197	.191	.649
.8(2.65)	.6(.05)	.6(.05)	.6(.05)	163.8(14.43)	.163	.198	.191	.788
1.2(4.00)	16.9(1.49)	10.6(.93)	9.1(.80)	.6(.05)	.184	.212	.203	.864
1.8(6.00)	-16.2(-1.43)	-3.3(-.29)	-8.8(-.77)	5.9(.52)	.185	.219	.204	.870
2.4(8.00)	-13.0(-1.14)	-6.7(-.59)	.6(.05)	4.1(.36)	.148	.204	.193	.876
3.0(10.00)	.1(.01)	.2(.02)	.9(.08)	1.2(.11)	.131	.192	.193	.871
3.7(12.00)	19.9(1.76)	5.2(.46)	8.3(.73)	2.3(.20)	.152	.194	.199	.852
4.6(15.00)	11.6(1.02)	4.9(.43)	8.5(.75)	4.5(.40)	.196	.207	.219	.831
6.1(20.00)	-.1(-.01)	-.1(-.01)	.4(.04)	.4(.04)	.217	.215	.234	.821
8.2(27.00)	.5(.04)	-.1(-.01)	-.2(-.02)	.2(.02)	.221	.216	.237	.823
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.229	.222	.242	.833
13.1(43.00)	-.1(-.01)	-.0(-.00)	2.0(.18)	-1.9(-.16)	.235	.228	.257	.8[illegible]
15.2(50.00)	.4(.04)	.1(.01)	.1(.01)	-.0(-.00)	.239	.232	.270	.827
16.8(55.00)	.5(.04)	.1(.01)	-.0(-.00)	.2(.02)	.243	.233	.271	.828
17.7(58.00)	.3(.03)	.1(.01)	.0(.00)	.1(.01)	.244	.234	.272	.830
18.3(60.00)	.2(.02)	.1(.01)	.1(.01)	.1(.01)	.245	.234	.273	.831
18.9(62.00)	.2(.01)	.1(.01)	.2(.01)	.0(.00)	.246	.235	.274	.832
19.5(64.00)	.1(.01)	.2(.02)	.1(.01)	-.0(-.00)	.247	.236	.274	.832
20.1(66.00)	.2(.02)	.9(.08)	.2(.02)	-.2(-.02)	.248	.238	.275	.832
20.5(67.38)	-1.1(-.10)	-.6(-.05)	-.8(-.07)	-2.5(-.22)	.248	.239	.275	.831
20.7(68.00)	-2.8(-.25)	-2.8(-.24)	-1.8(-.15)	-3.3(-.29)	.247	.238	.274	.829
20.9(68.50)	-7.1(-.63)	-7.7(-.68)	-7.8(-.69)	-3.6(-.31)	.245	.236	.272	.829
21.0(69.00)	2.4(.22)	1.6(.14)	1.1(.10)	-.6(-.06)	.244	.235	.271	.831
21.2(69.50)	-8.9(-.78)	-13.5(-1.20)	-9.1(-.80)	-7.1(-.63)	.245	.233	.270	.832
21.3(69.87)	-8.2(-.72)	-2.1(-.18)	-4.5(-.40)	-3.9(-.34)	.244	.230	.268	.831

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 21806
TIME = 239.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.1(.01)	23.2(2.04)	21.0(1.85)	23.1(2.04)	.020	.024	.024	.412
.2(.50)	54.2(4.78)	60.7(5.35)	63.9(5.63)	56.8(5.00)	.037	.046	.046	.433
.3(1.00)	69.3(6.11)	88.0(7.75)	3.6(.32)	84.8(7.48)	.074	.091	.066	.476
.5(1.50)	95.2(8.39)	100.1(8.82)	28.0(2.47)	104.0(9.16)	.124	.147	.076	.534
.6(2.00)	159.5(14.06)	146.4(12.90)	160.3(14.13)	121.5(10.71)	.201	.222	.133	.603
.8(2.65)	.4(.03)	.4(.03)	.4(.03)	105.8(9.32)	.249	.267	.182	.688
1.2(4.00)	16.4(1.45)	14.9(1.31)	10.1(.89)	.6(.05)	.276	.285	.195	.737
1.8(6.00)	-2.5(-.22)	.2(.02)	5.1(.45)	10.9(.96)	.287	.303	.213	.750
2.4(8.00)	-3.4(-.30)	-3.0(-.27)	.6(.05)	6.0(.53)	.280	.298	.220	.768
3.0(10.00)	.2(.02)	.4(.03)	1.0(.09)	1.4(.13)	.276	.293	.221	.768
3.7(12.00)	4.0(.35)	3.1(.28)	2.5(.22)	-.9(-.08)	.279	.298	.222	.750
4.6(15.00)	5.9(.52)	3.5(.30)	2.1(.19)	.3(.02)	.294	.314	.222	.720
6.1(20.00)	.5(.04)	.6(.05)	.4(.03)	.4(.04)	.306	.329	.222	.700
8.2(27.00)	.5(.04)	.6(.05)	-.2(-.02)	.2(.02)	.306	.328	.224	.704
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.300	.319	.230	.724
13.1(43.00)	-.1(-.01)	.1(.01)	-.2(-.02)	1.4(.12)	.293	.317	.238	.750
15.2(50.00)	.5(.04)	.1(.01)	.1(.01)	-.0(-.00)	.295	.323	.242	.763
16.8(55.00)	.5(.04)	.1(.01)	.2(.02)	-.1(-.01)	.300	.327	.244	.762
17.7(58.00)	.3(.02)	.1(.01)	.1(.01)	.0(.00)	.303	.329	.246	.762
18.3(60.00)	.2(.01)	.1(.01)	.1(.01)	.1(.01)	.304	.329	.247	.763
18.9(62.00)	.1(.01)	.2(.01)	.1(.01)	.1(.01)	.304	.330	.248	.765
19.5(64.00)	.0(.00)	.3(.02)	.1(.00)	-.0(-.00)	.305	.331	.248	.766
20.1(66.00)	.2(.01)	1.1(.10)	.2(.01)	-.6(-.05)	.306	.334	.249	.766
20.5(67.38)	-3.8(-.34)	-3.1(-.27)	-3.3(-.29)	-8.2(-.72)	.306	.335	.249	.763
20.7(68.00)	-15.4(-1.35)	-14.3(-1.26)	-12.0(-1.06)	-14.8(-1.30)	.301	.336	.245	.756
20.9(68.50)	-17.3(-1.52)	-19.0(-1.68)	-15.2(-1.34)	-17.2(-1.51)	.293	.322	.238	.751
21.0(69.00)	2.1(.19)	1.4(.12)	1.8(.16)	-.7(-.06)	.291	.319	.236	.751
21.2(69.50)	-12.0(-1.06)	-23.0(-2.02)	-13.6(-1.20)	-11.8(-1.04)	.292	.316	.234	.751
21.3(69.87)	-5.2(-.46)	-2.2(-.19)	-3.4(-.30)	-2.5(-.22)	.290	.311	.230	.748

21806-21

POOR ORIGINAL

SUMMARY SHEET

RUN NO. 21909

DATE: 3/16/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.045 (0.100)
2. Water flow - [kg/sec (lb/sec)] - 0.384 (0.847)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{o}C (^{o}F)] - 154 (309)
5. Water temperature [^{o}C (^{o}F)] - 129 (264)
6. Mixer pressure [kPa (psig)] - 207 (30)
7. Test time (sec) - 870.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.4 (34.0)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	249 (480)
0.15 (0.50)	266 (510)
0.30 (1.00)	274 (525)
0.46 (1.50)	274 (525)
0.61 (2.00)	274 (525)
1.22 (4.00)	274 (525)
3.05 (10.00)	274 (525)
6.09 (20.00)	274 (525)
8.23 (27.00)	274 (525)
10.67 (35.00)	274 (525)

SUMMARY SHEET (cont)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 15.5 (34.2)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - NA
   (b) SG collection tank [kg (lb)] - 358.6 (790.5)
3. Posttest drain from hot leg [kg (lb)] - 12.2 (27.0)

D. FAILED BUNDLE T/Cs[1]

310, 311, 326, 553, 564, 565, 568

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

1. From primary side energy balance [kwsec(Btu)] - 1.27×10^5 (1.21×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da dt$) - [kwsec(Btu)] - ($0.525 \times 10^5$ (0.5×10^5)
3. Integration to 180 sec

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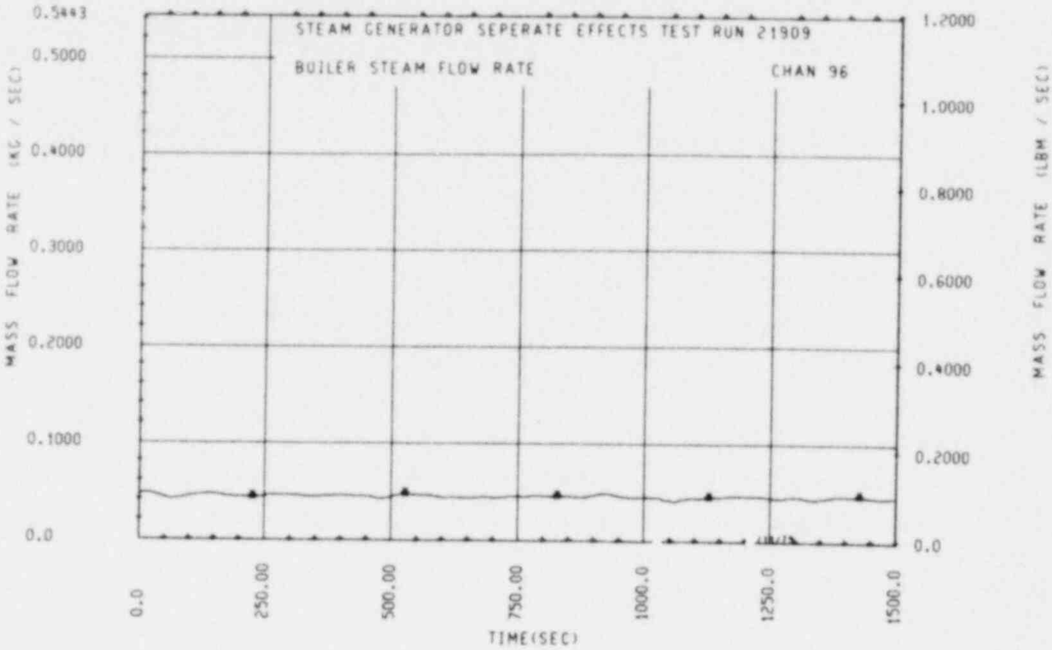
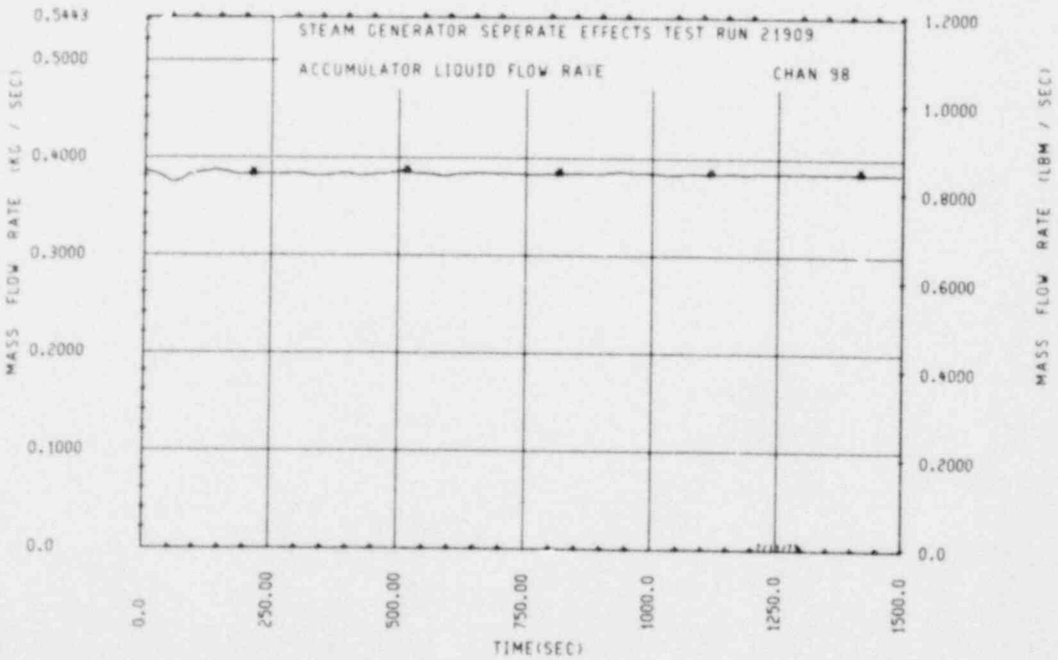
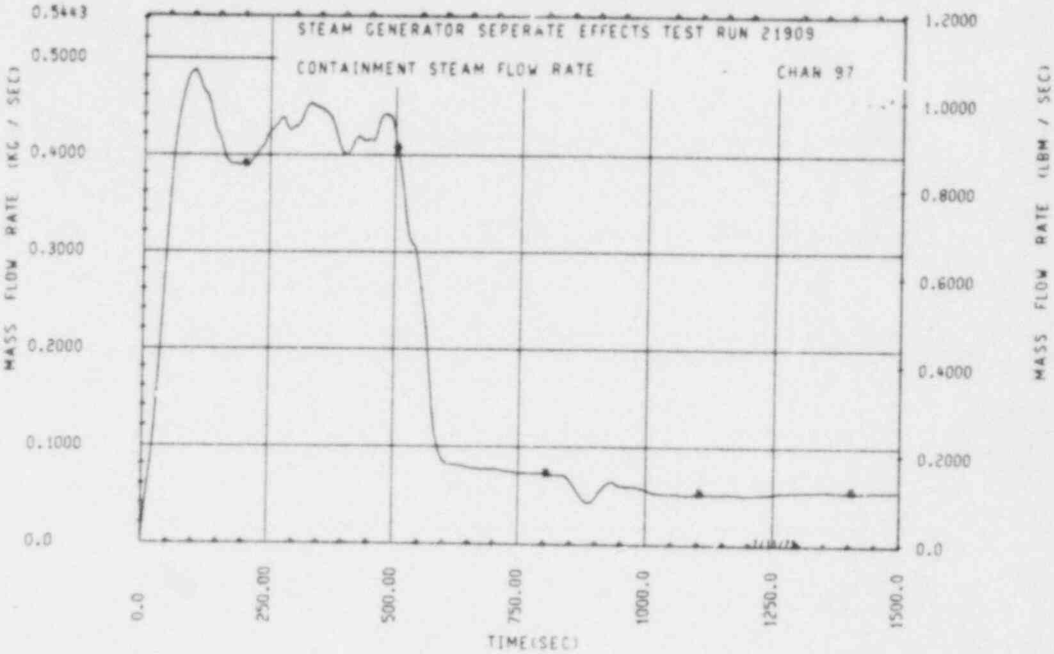
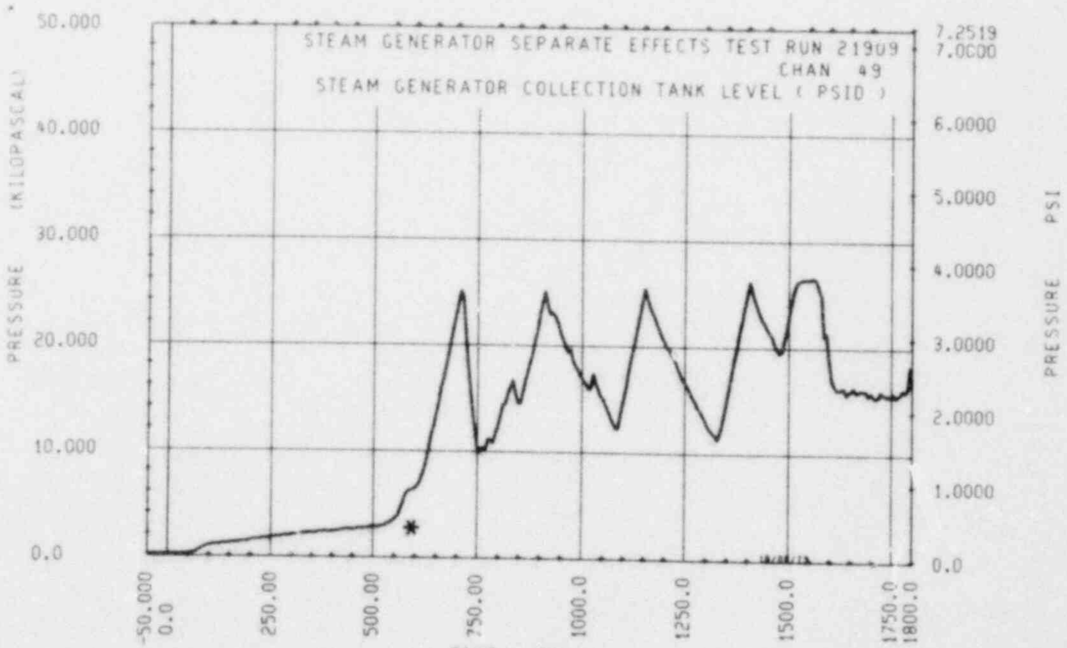
1. T/Cs are defined as failed based on resistance reading or T/C response.

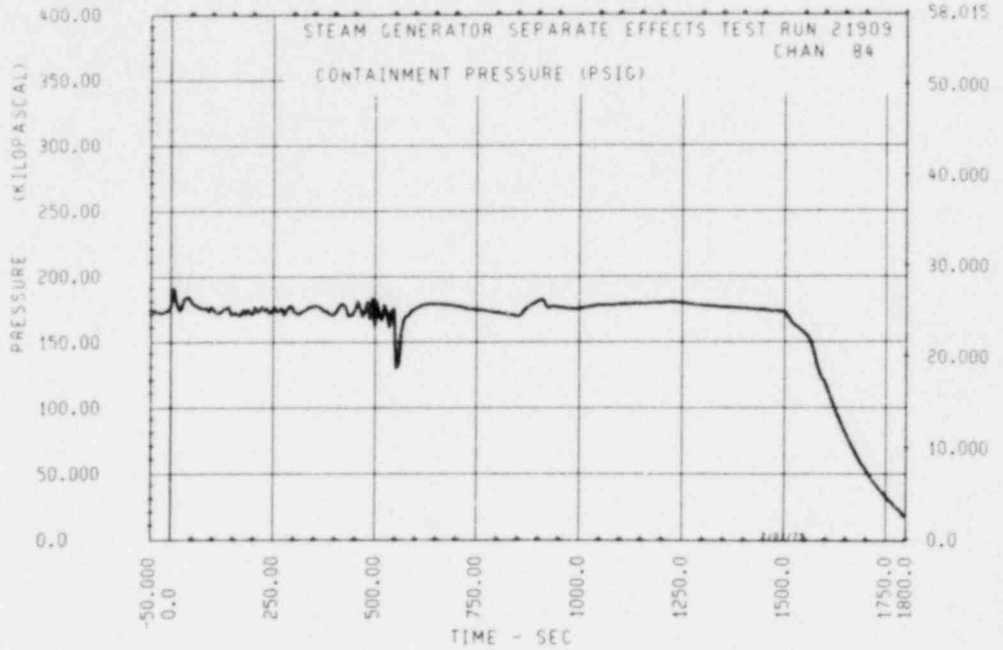

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21909
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
MASS FLOW RATE (LBM / SEC)
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21909
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
MASS FLOW RATE (LBM / SEC)
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)

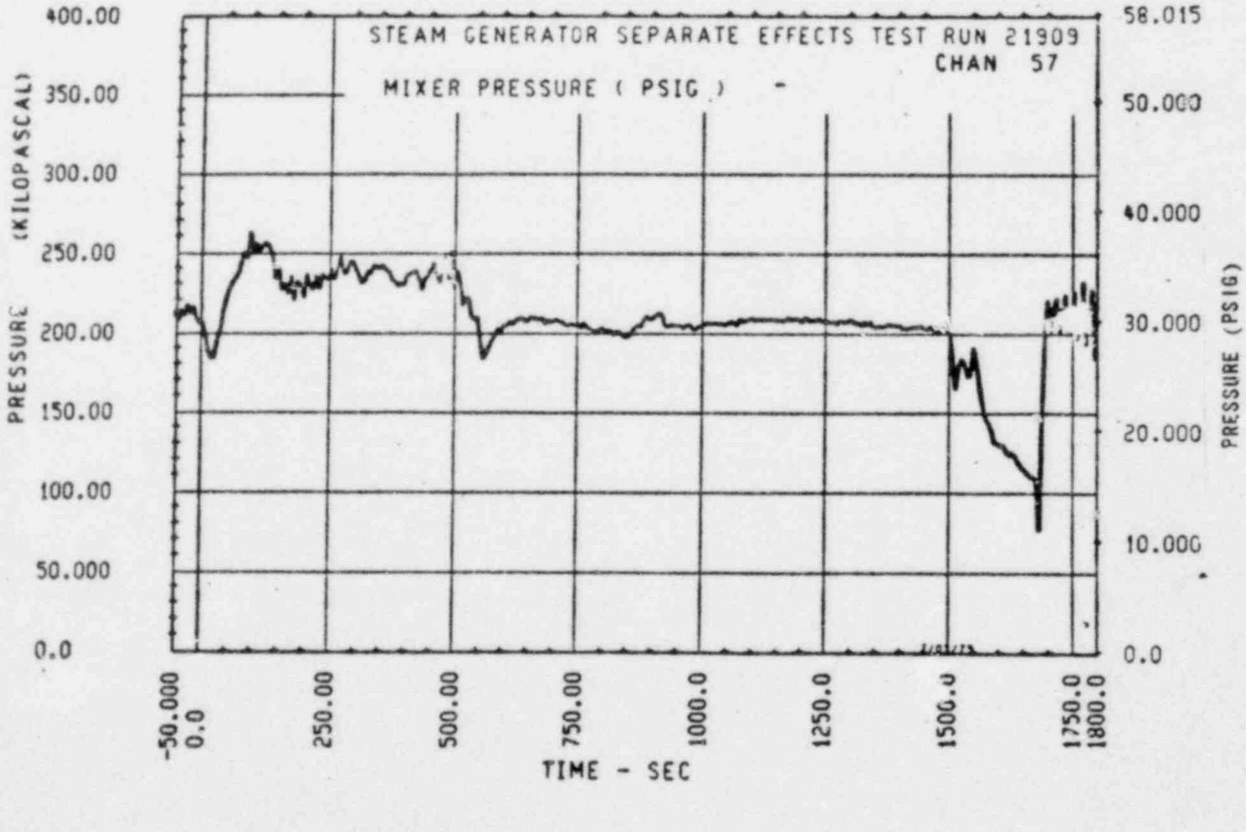




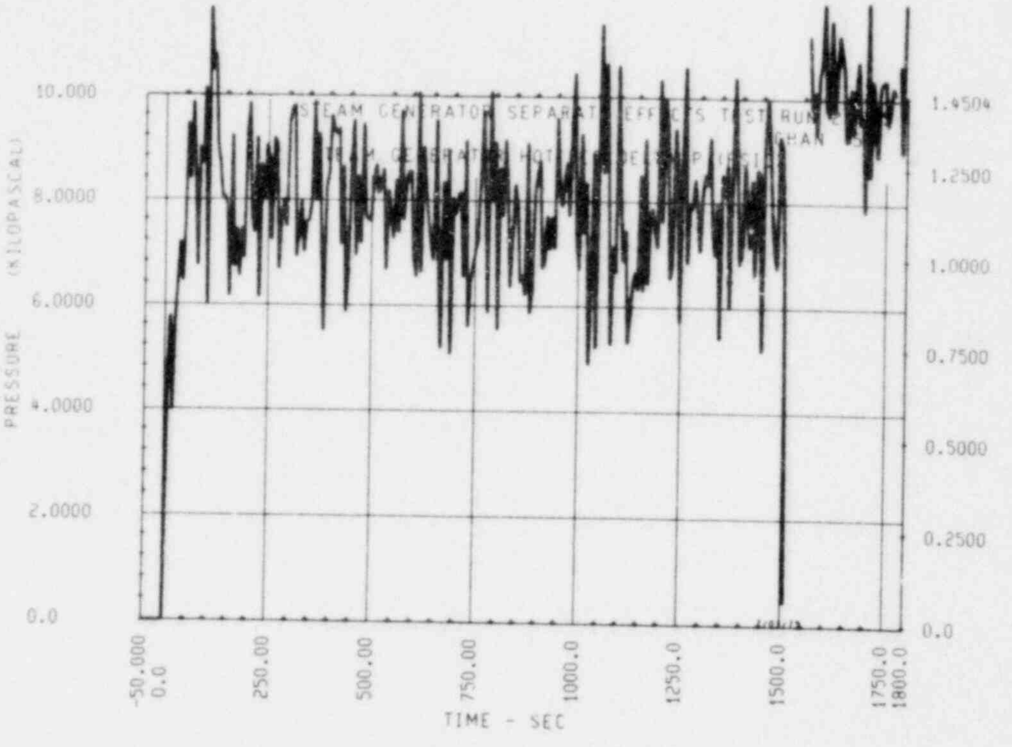
* Refer to Appendix H text for explanation of delayed response.

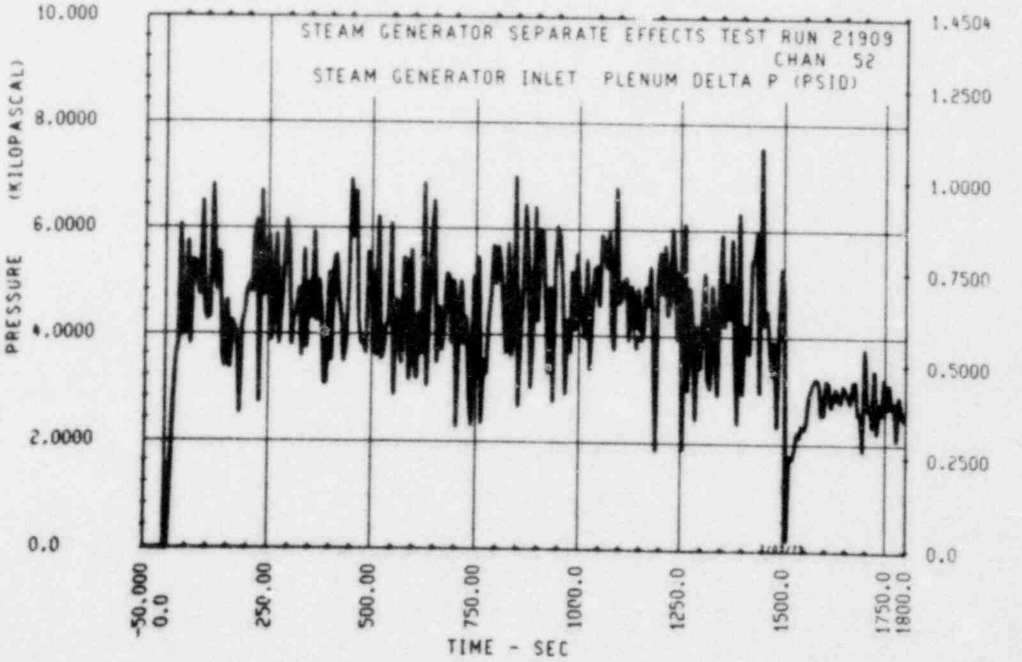


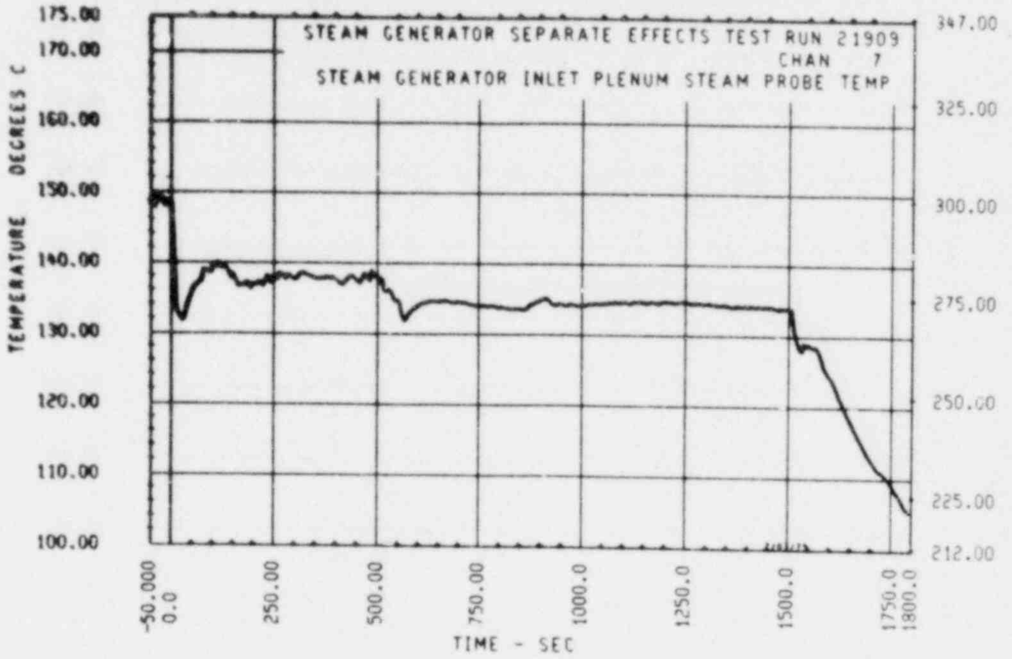
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21909
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

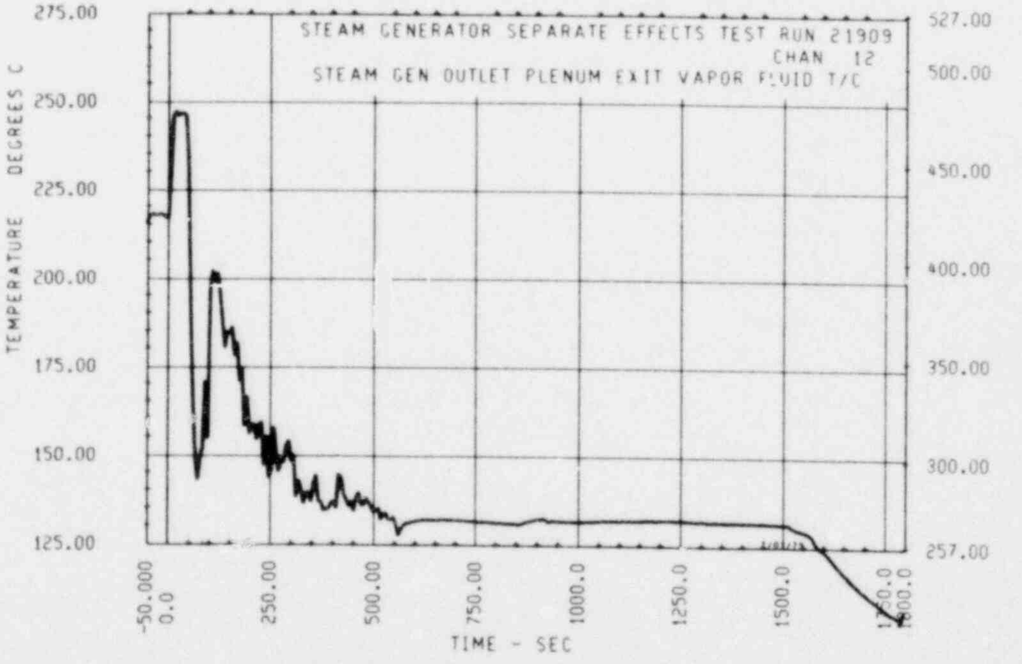


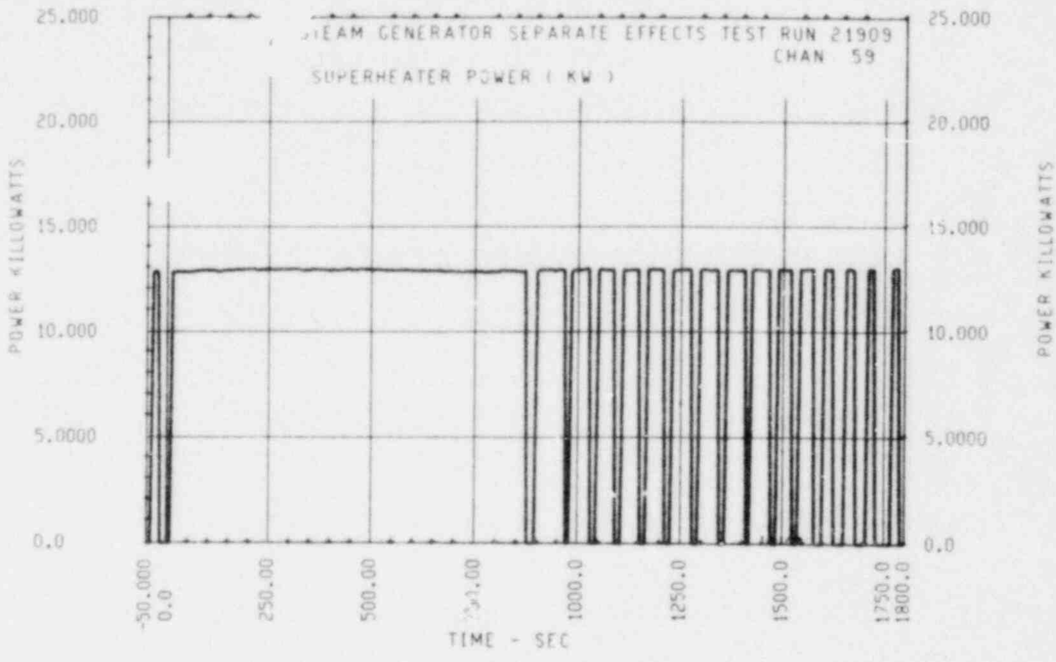
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21909
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE (PSIG)
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0


STEAM GENERATOR SEPARATE EFFECTS TEST RUN
CHAN
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

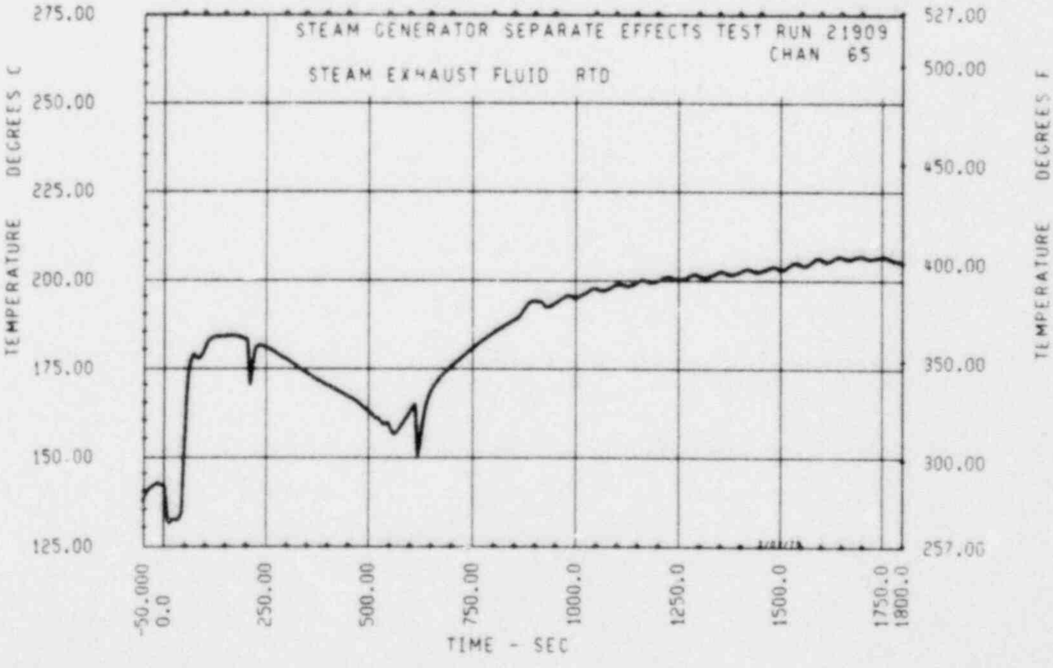

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21909
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21909
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
175.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
347.00
325.00
300.00
275.00
250.00
225.00
212.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

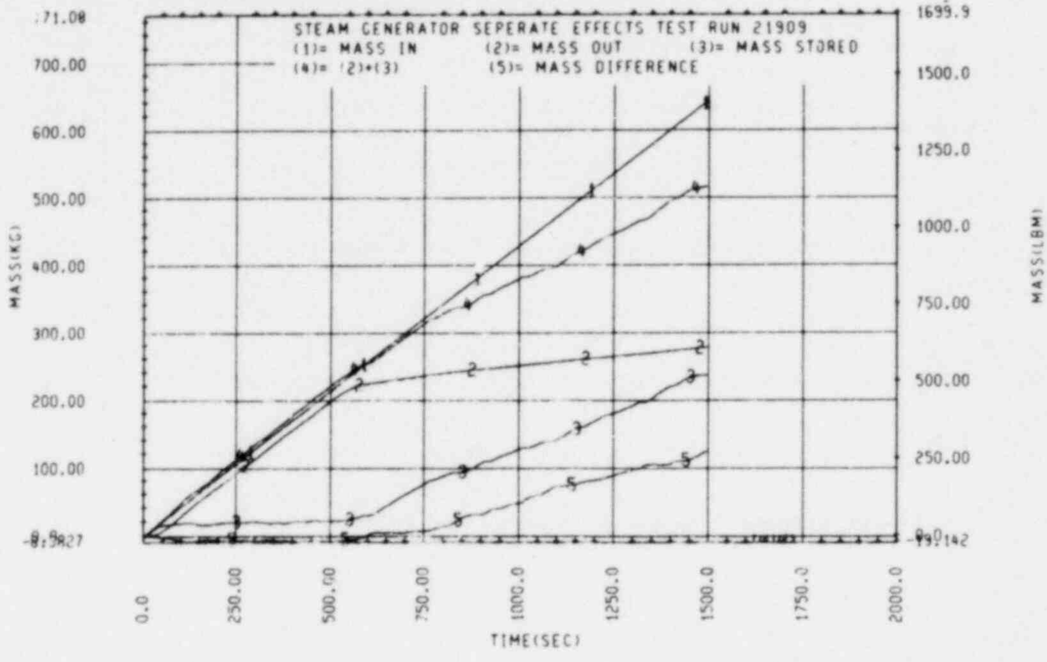

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21909
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1800.0

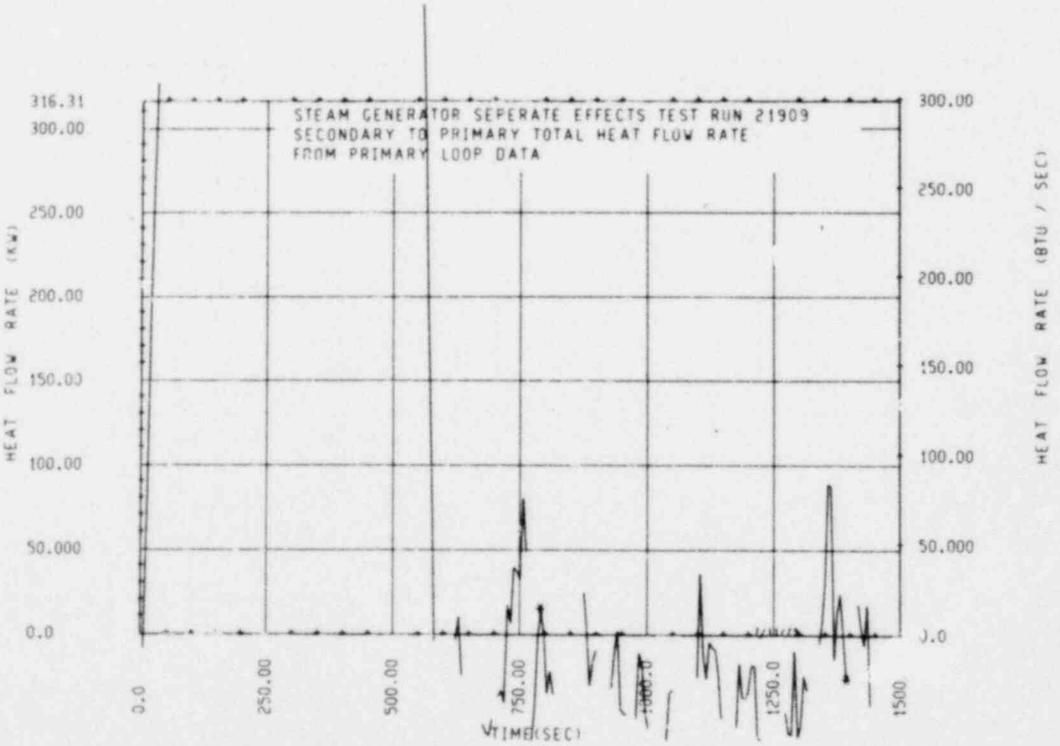


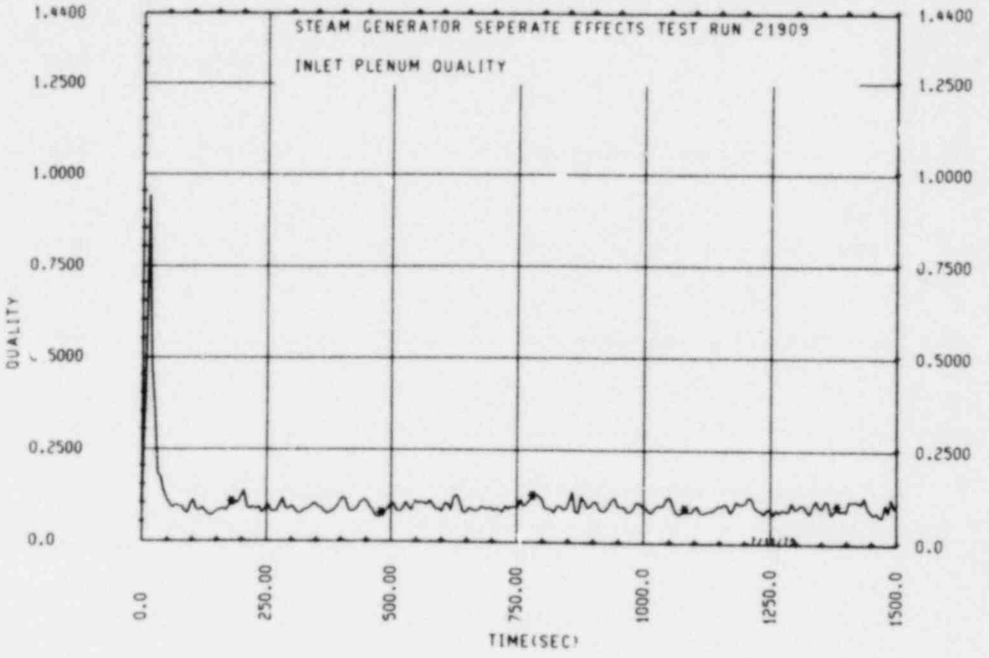
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21909
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

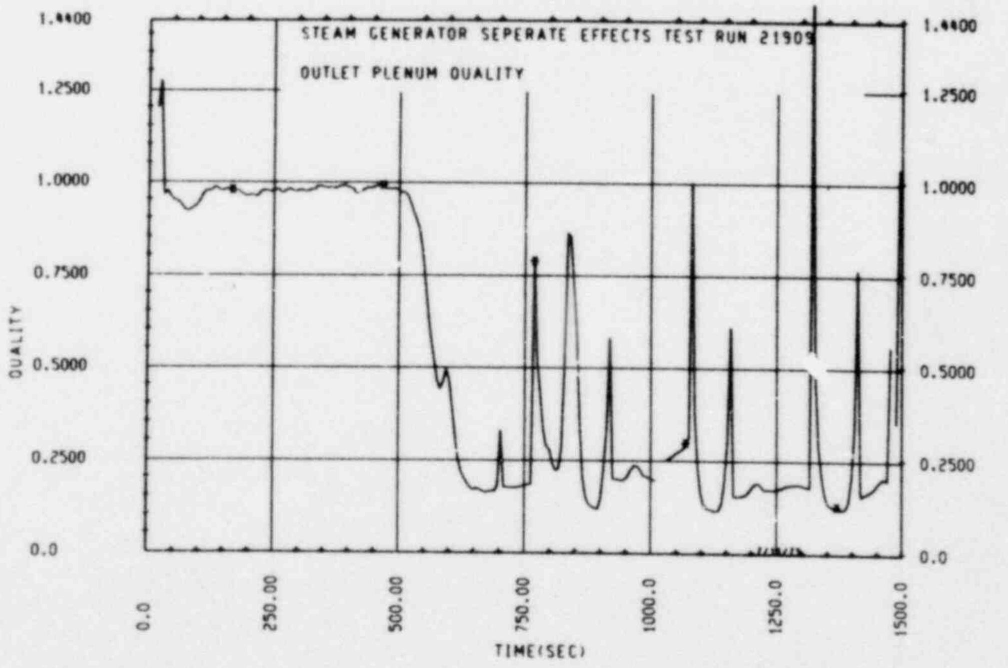


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 21909
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

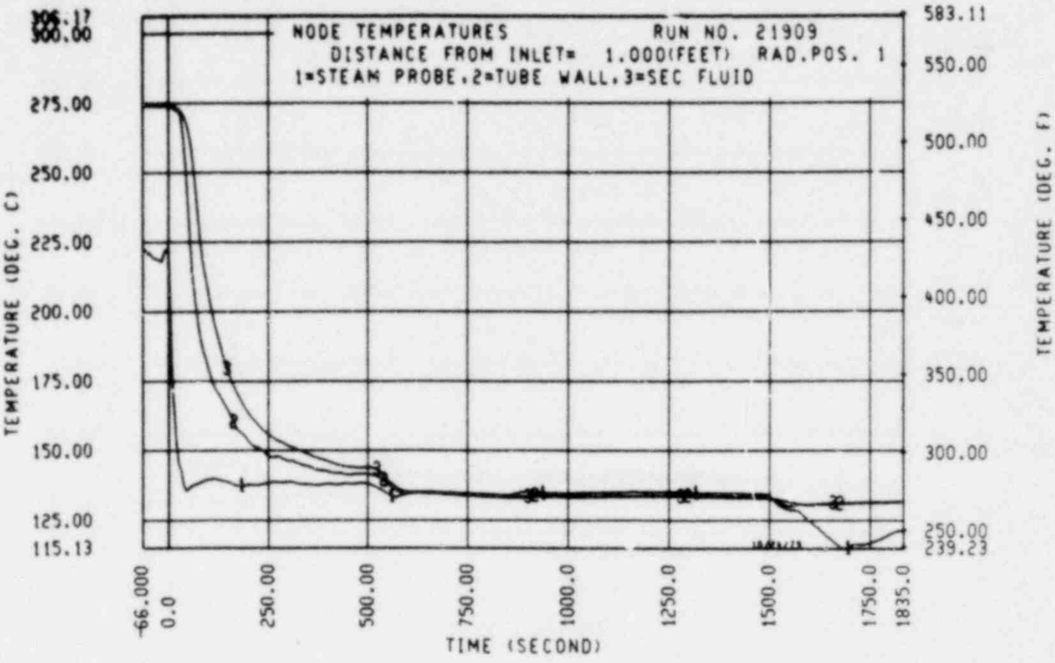

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21909
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21909
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)

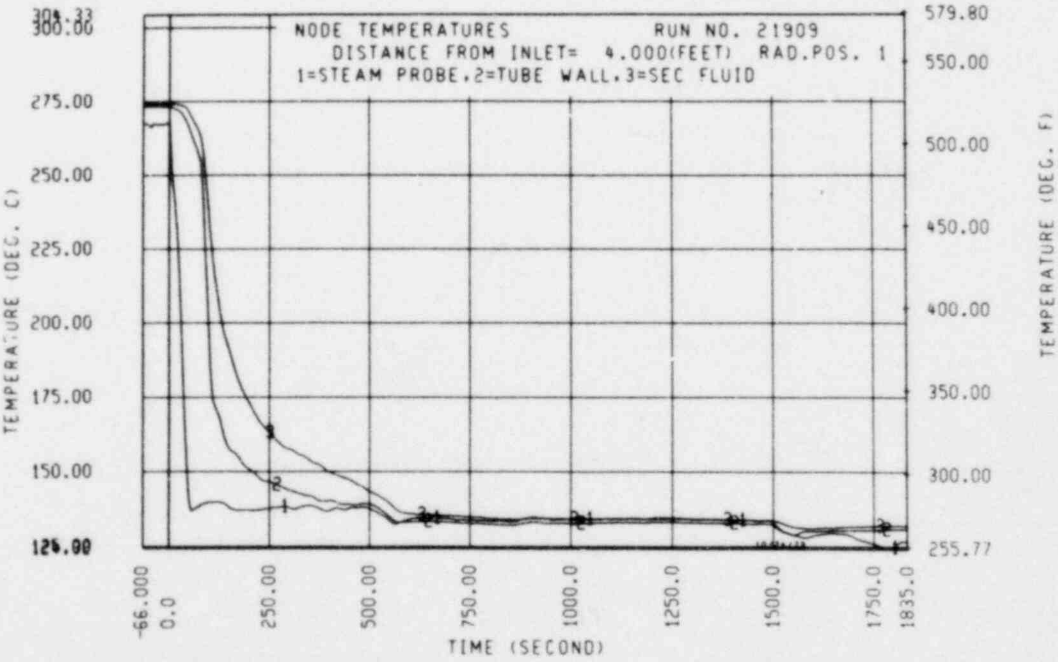

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21909
INLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 21909
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

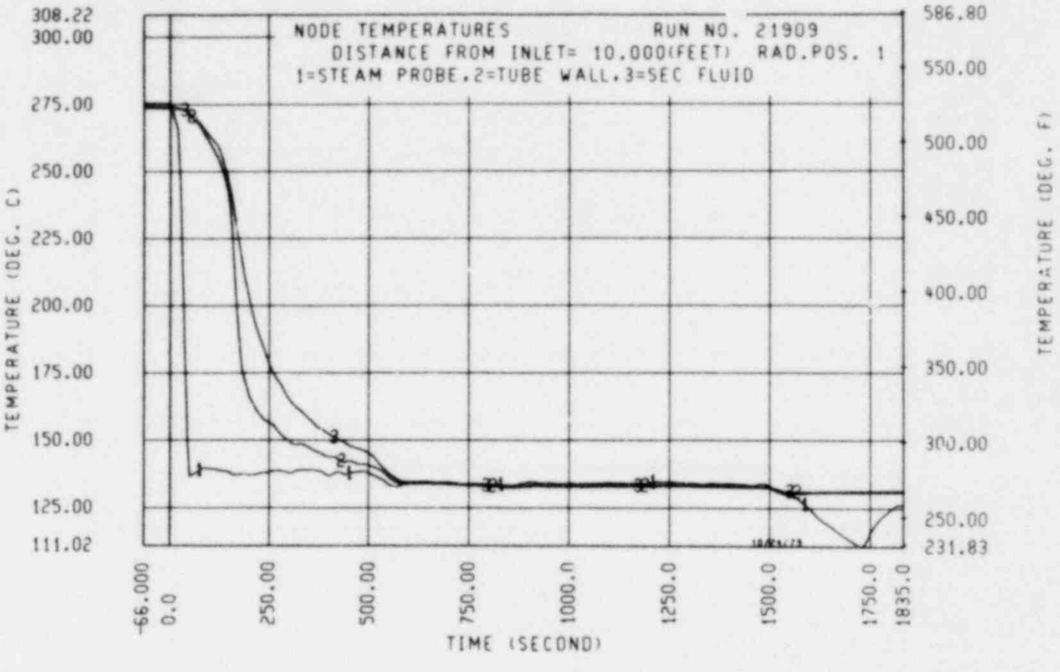
21909-10

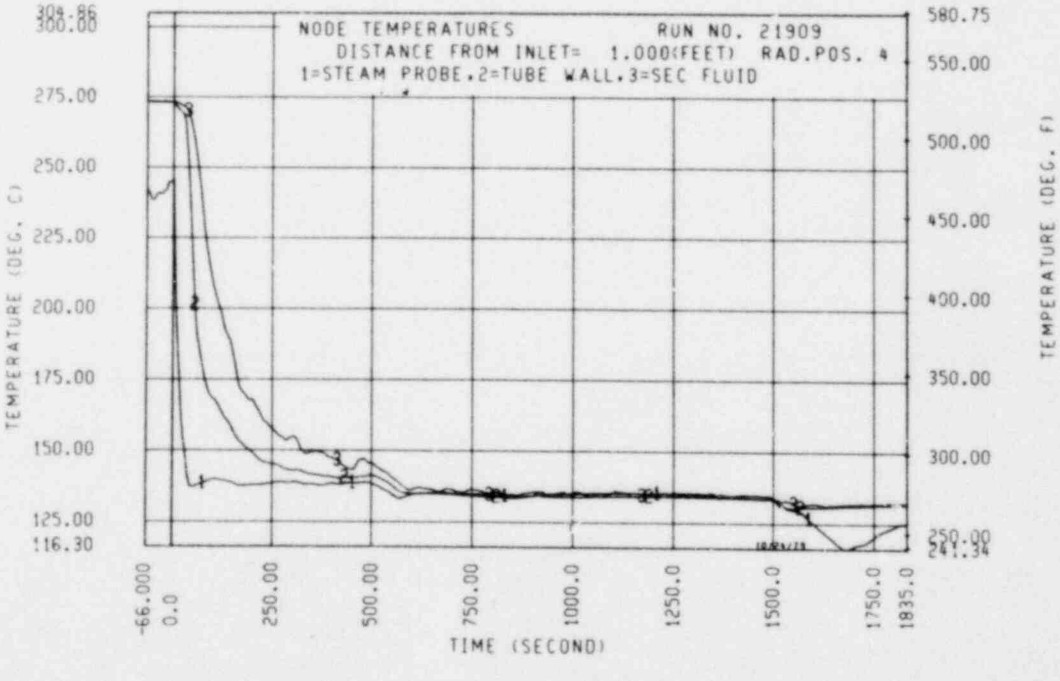


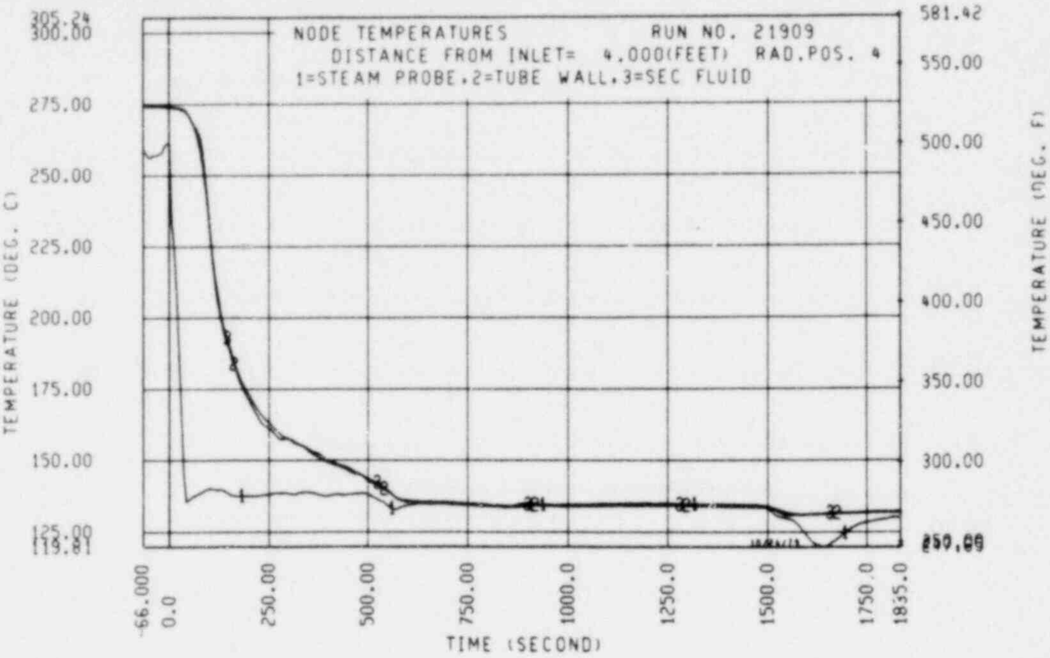
NODE TEMPERATURES RUN NO. 21909
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

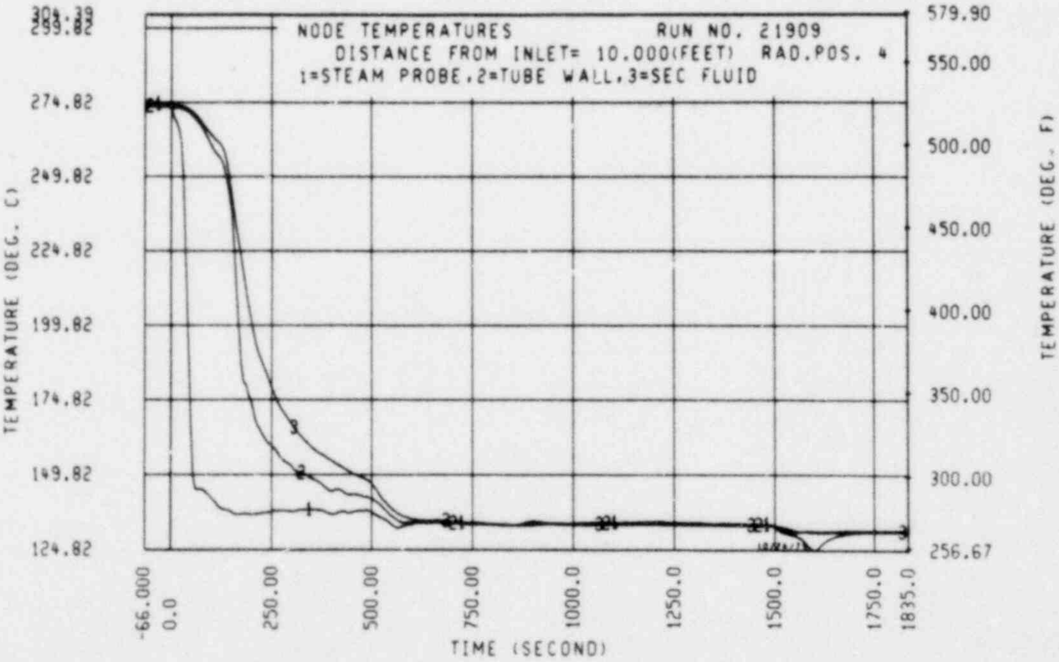


NODE TEMPERATURES RUN NO. 21909
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

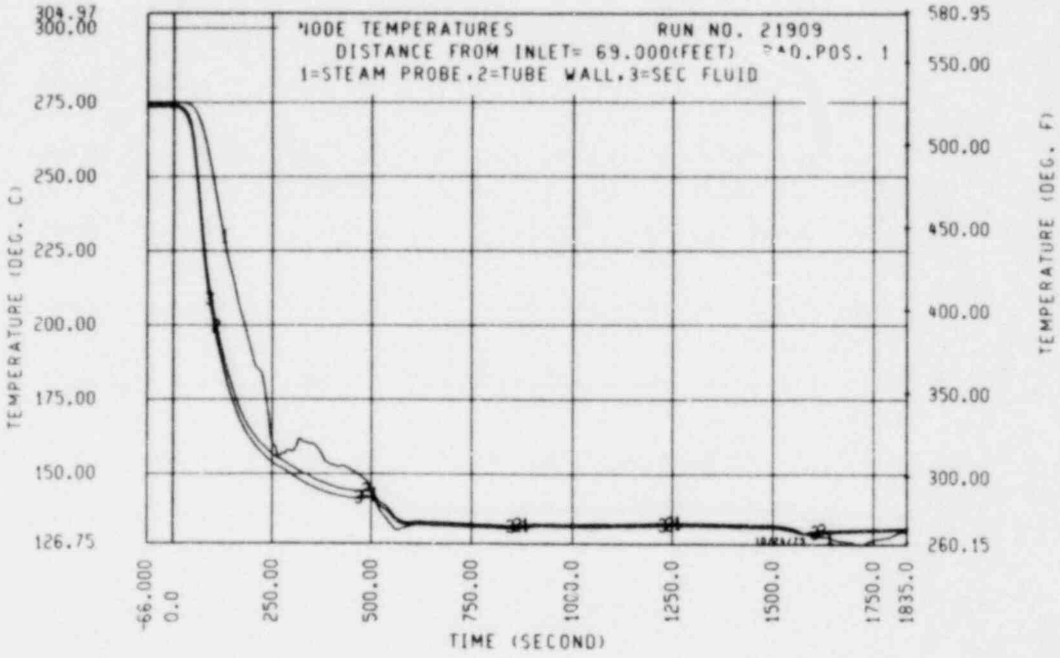

NODE TEMPERATURES RUN NO. 21909
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
308.22
300.00
275.00
250.00
225.00
200.00
175.00
150.00
125.00
111.02
TEMPERATURE (DEG. F)
586.80
550.00
500.00
450.00
400.00
350.00
300.00
250.00
231.83
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1835.0
TIME (SECOND)

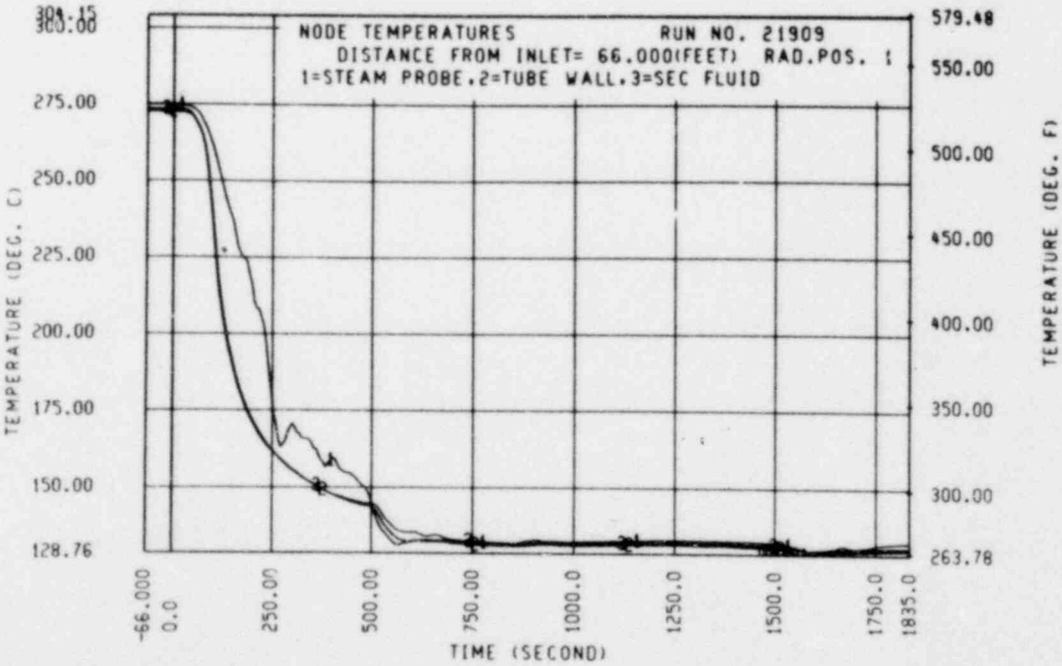

NODE TEMPERATURES RUN NO. 21909
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
304.86
300.00
275.00
250.00
225.00
200.00
175.00
150.00
125.00
116.30
TEMPERATURE (DEG. F)
580.75
550.00
500.00
450.00
400.00
350.00
300.00
250.00
241.34
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1835.0
TIME (SECOND)

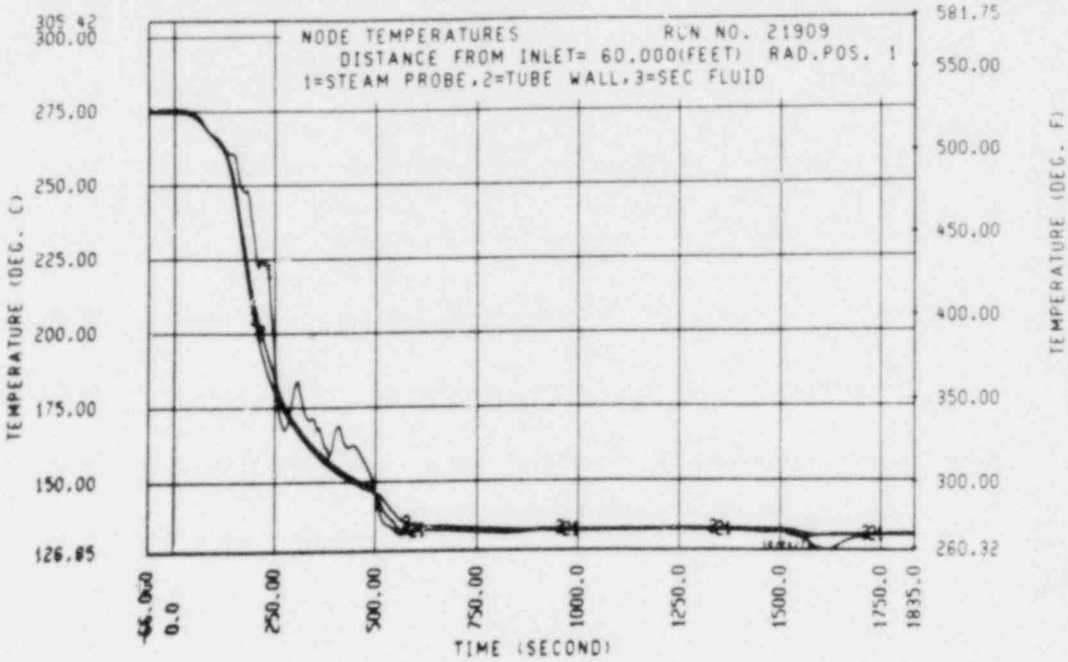

NODE TEMPERATURES RUN NO. 21909
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
305.24
300.00
275.00
250.00
225.00
200.00
175.00
150.00
125.00
119.81
581.42
550.00
500.00
450.00
400.00
350.00
300.00
250.00
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1835.0

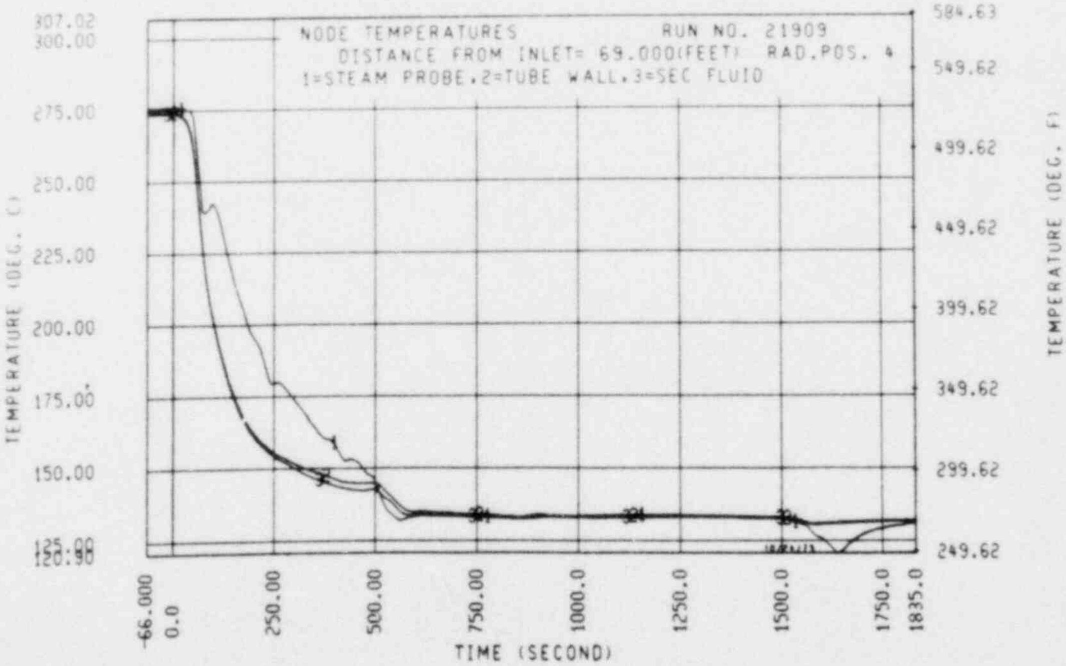

NODE TEMPERATURES RUN NO. 21909
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
304.39
299.82
274.82
249.82
224.82
199.82
174.82
149.82
124.82
579.90
550.00
500.00
450.00
400.00
350.00
300.00
256.67
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1835.0

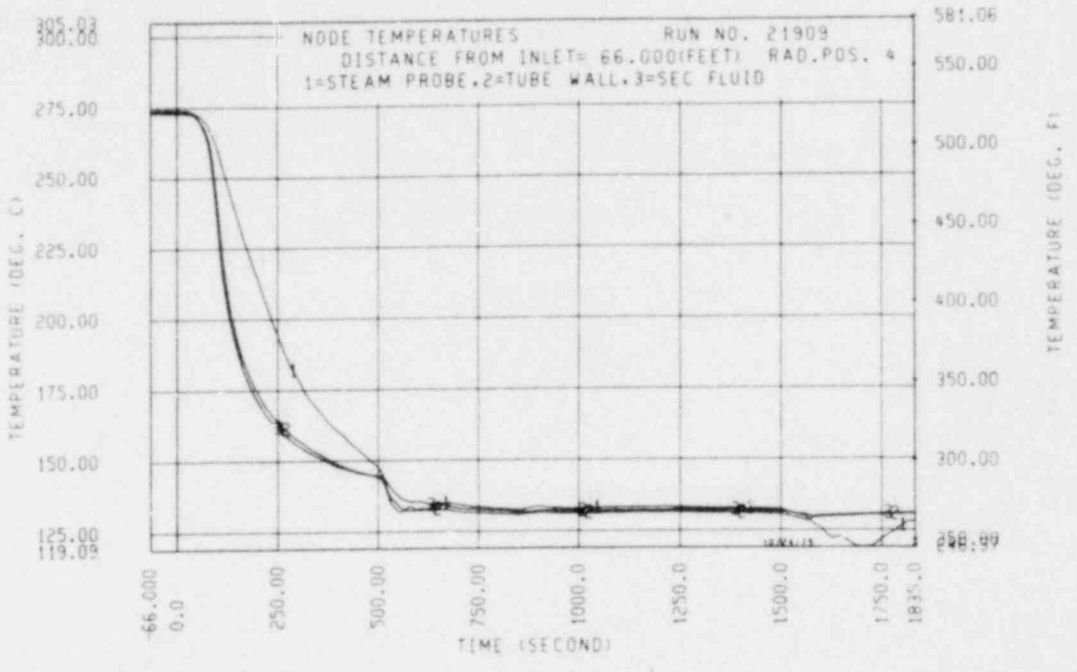
21909-13

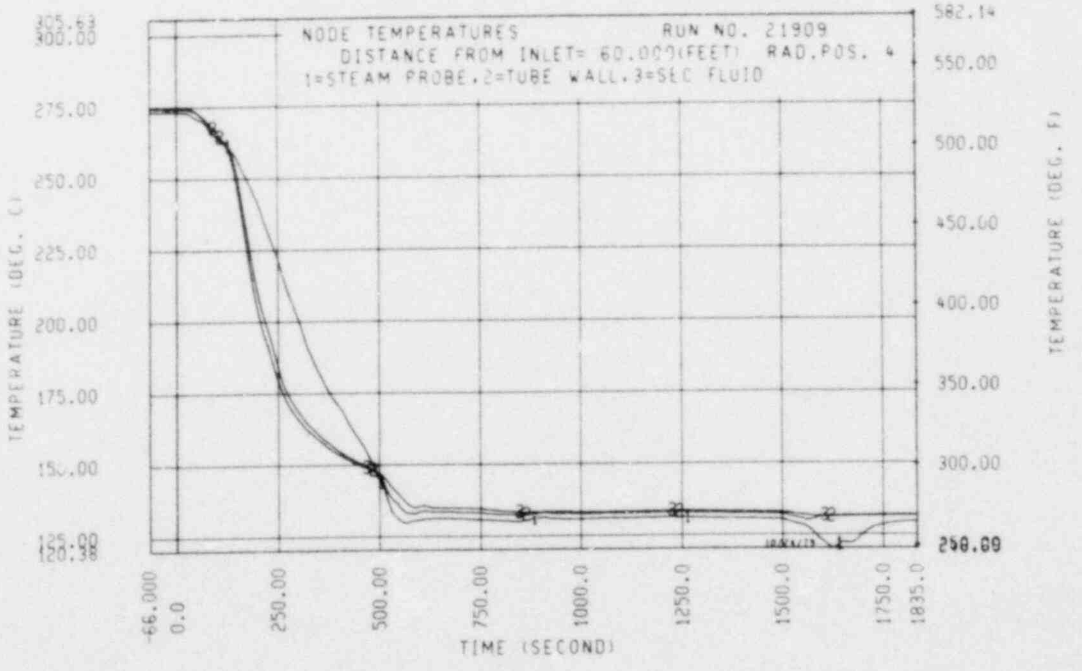

NODE TEMPERATURES RUN NO. 21909
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

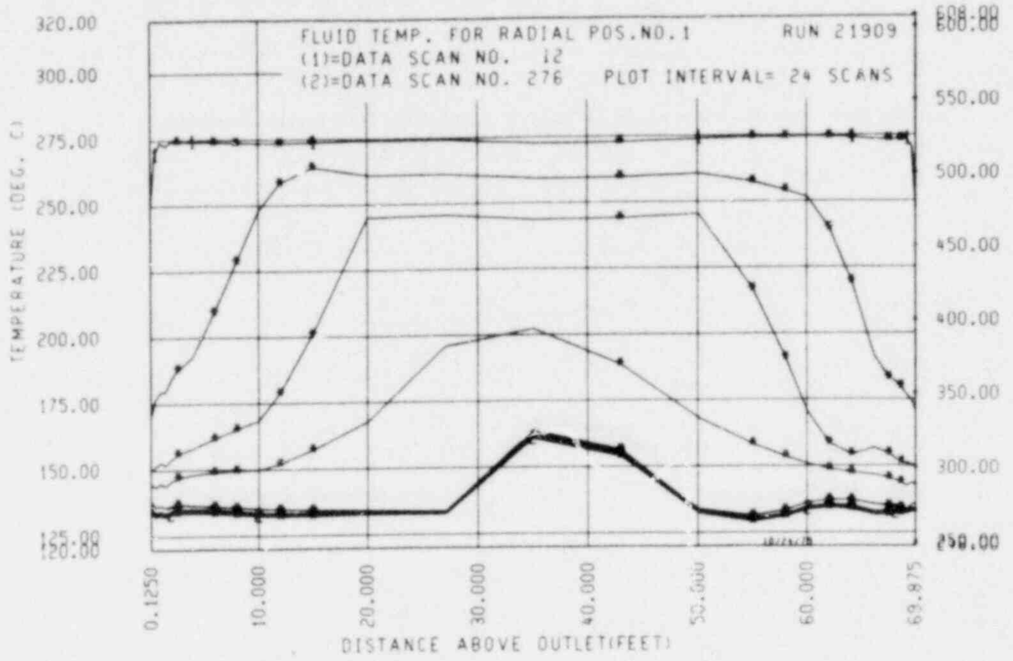

NODE TEMPERATURES RUN NO. 21909
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

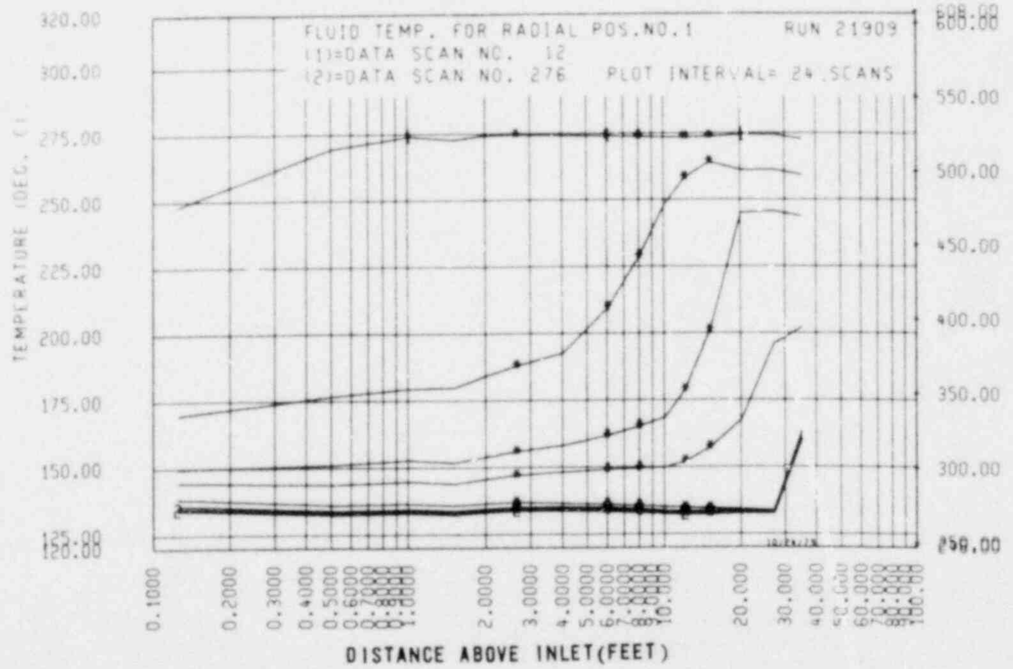

NODE TEMPERATURES RUN NO. 21909
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21909
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

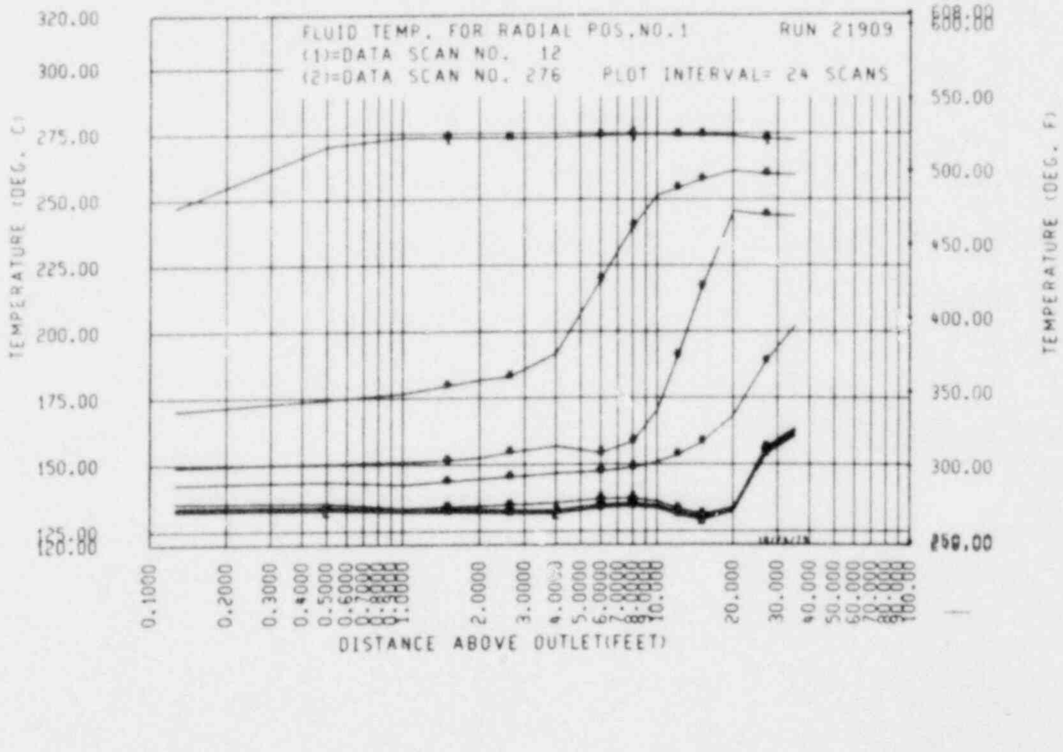

NODE TEMPERATURES RUN NO. 21909
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 21909
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 21909
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 21909
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)

21909-17


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 21909
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

21909-18

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 21909
TIME = 36.9 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD PTS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.5(.04)	102.3(9.01)	145.6(12.83)	79.7(7.03)	.012	.012	.012	.216
.2(.50)	57.4(5.06)	48.3(4.25)	51.6(4.55)	50.3(4.43)	.012	.012	.012	.216
.3(1.00)	32.7(2.88)	175.1(15.43)	7.8(.69)	111.6(9.83)	.012	.012	.012	.216
.5(1.50)	6.9(.60)	188.7(16.62)	63.1(5.56)	189.9(16.73)	.012	.012	.012	.216
.6(2.00)	.7(.06)	96.9(8.53)	299.2(26.36)	56.4(4.97)	.012	.012	.012	.216
.8(2.65)	.7(.06)	43.1(3.79)	353.4(31.14)	42.6(3.75)	.012	.012	.012	.216
1.2(4.00)	5.1(.45)	3.9(.35)	19.9(1.75)	.7(.06)	.012	.012	.012	.216
1.8(6.00)	5.9(.52)	1.9(.17)	12.7(1.12)	11.7(1.03)	.012	.012	.012	.216
2.4(8.00)	2.5(.22)	.3(.03)	5.0(.44)	7.2(.64)	.012	.012	.012	.216
3.0(10.00)	-.0(-.00)	.1(.01)	.7(.06)	.8(.07)	.012	.012	.012	.216
3.7(12.00)	-2.1(-.19)	.1(.01)	.3(.03)	-.8(-.07)	.012	.012	.012	.216
4.6(15.00)	2.3(.20)	.2(.02)	.1(.01)	.9(.08)	.012	.012	.012	.216
6.1(20.00)	.0(.00)	.2(.02)	.3(.03)	.7(.06)	.012	.012	.012	.216
8.2(27.00)	.4(.04)	.2(.02)	-.2(-.02)	.3(.03)	.012	.012	.012	.216
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.012	.012	.012	.216
13.1(43.00)	-.4(-.04)	-.2(-.02)	.2(.02)	-.5(-.05)	.012	.012	.012	.216
15.2(50.00)	.6(.05)	.2(.02)	.2(.02)	-.0(-.00)	.012	.012	.012	.216
16.8(55.00)	.6(.05)	.2(.02)	.2(.01)	.1(.01)	.012	.012	.012	.216
17.7(58.00)	.3(.03)	.1(.01)	.1(.01)	.1(.01)	.012	.012	.012	.216
18.3(60.00)	.1(.01)	.3(.03)	.1(.01)	.1(.01)	.012	.012	.012	.216
18.9(62.00)	.1(.01)	.1(.01)	.1(.01)	.1(.01)	.012	.012	.012	.216
19.5(64.00)	.1(.01)	.2(.02)	.2(.01)	.1(.01)	.012	.012	.012	.216
20.1(66.00)	.6(.05)	1.1(.10)	.6(.05)	.2(.02)	.012	.012	.012	.216
20.5(67.38)	.0(.00)	.4(.03)	-.2(-.02)	-.5(-.04)	.012	.012	.012	.216
20.7(68.00)	.5(.04)	-.2(-.02)	-.2(-.02)	-.0(-.00)	.012	.012	.012	.216
20.9(68.50)	-1.0(-.09)	-1.0(-.09)	-2.5(-.22)	-2.1(-.18)	.012	.012	.012	.216
21.0(69.00)	4.0(.35)	3.2(.28)	3.8(.34)	-.1(-.01)	.012	.012	.012	.216
21.2(69.50)	-.3(-.03)	-.7(-.06)	-1.1(-.10)	-1.6(-.14)	.012	.012	.012	.216
21.3(69.87)	-13.5(-1.19)	-6.0(-.53)	-6.2(-.55)	-1.8(-.16)	.012	.012	.012	.216

21909-19

POOR ORIGINAL

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 21909
TIME = 72.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.02)	82.1(7.23)	92.3(8.13)	88.0(7.75)	.011	.011	.011	.199
.2(.50)	.4(.03)	234.9(20.69)	239.8(21.13)	244.5(21.54)	.011	.011	.011	.199
.3(1.00)	277.6(24.46)	204.3(23.98)	4.2(.37)	.4(.04)	.011	.011	.011	.199
.5(1.50)	233.1(20.54)	.5(.04)	110.4(9.72)	.5(.04)	.011	.011	.011	.199
.6(2.00)	.5(.04)	.5(.04)	.5(.04)	301.0(26.52)	.011	.011	.011	.199
.8(2.65)	.5(.05)	.5(.05)	.5(.05)	234.9(20.70)	.011	.011	.011	.199
1.2(4.00)	18.9(1.66)	321.3(28.31)	165.1(14.55)	.6(.05)	.011	.011	.011	.199
1.8(6.00)	24.2(2.13)	89.1(7.84)	15.7(1.38)	-1.2(-.10)	.011	.011	.011	.199
2.4(8.00)	12.2(1.08)	57.7(5.09)	-.1(-.00)	-.4(-.04)	.011	.011	.011	.199
3.0(10.00)	1.1(.10)	1.3(.12)	2.3(.20)	2.3(.20)	.011	.011	.011	.199
3.7(12.00)	-4.2(-.37)	-23.5(-2.07)	2.9(.26)	6.2(.55)	.011	.011	.011	.199
4.6(15.00)	1.5(.13)	-5.7(-.50)	2.1(.18)	9.0(.79)	.011	.011	.011	.199
6.1(20.00)	.6(.05)	.9(.08)	.3(.02)	.7(.06)	.011	.011	.011	.199
8.2(27.00)	.5(.05)	.6(.05)	-.2(-.02)	.2(.02)	.011	.011	.011	.199
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.011	.011	.011	.199
13.1(43.00)	.1(.01)	1.0(.09)	14.8(1.30)	-6.5(-.57)	.011	.011	.011	.199
15.2(50.00)	.7(.06)	.3(.03)	.3(.02)	-.0(-.00)	.011	.011	.011	.199
16.8(55.00)	.5(.04)	.1(.01)	-.7(-.06)	.6(.06)	.011	.011	.011	.199
17.7(58.00)	.2(.02)	.3(.03)	-.3(-.03)	.4(.03)	.011	.011	.011	.199
18.3(60.00)	.1(.01)	.3(.03)	.1(.01)	.1(.01)	.011	.011	.011	.199
18.9(62.00)	.0(.00)	.1(.01)	.2(.02)	-.1(-.01)	.011	.011	.011	.199
19.5(64.00)	-.0(-.00)	.2(.02)	.1(.01)	-.3(-.03)	.011	.011	.011	.199
20.1(66.00)	.6(.06)	1.1(.10)	.0(.00)	-1.4(-.13)	.011	.011	.011	.199
20.5(67.38)	-2.9(-.26)	-2.3(-.19)	-3.7(-.33)	-8.1(-.72)	.011	.011	.011	.199
20.7(68.00)	-11.7(-1.03)	-11.3(-.97)	-16.9(-1.49)	-14.1(-1.25)	.011	.011	.011	.199
20.9(68.50)	-17.7(-1.56)	-20.2(-1.78)	-37.8(-3.33)	-17.6(-1.55)	.011	.011	.011	.199
21.0(69.00)	2.8(.24)	1.9(.16)	-1.6(-.14)	-.1(-.01)	.011	.011	.011	.199
21.2(69.50)	-.5(-.04)	-.4(-.04)	-.1(-.01)	-.2(-.02)	.011	.011	.011	.199
21.3(69.87)	-14.8(-1.30)	-8.7(-.77)	-7.6(-.67)	-4.3(-.39)	.011	.011	.011	.199

21909-20

POOR ORIGINAL

SUMMARY SHEET

RUN NO. 22010

DATE: 3/22/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.182 (0.402)
2. Water flow - [kg/sec (lb/sec)] - 0.045 (0.100)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{o}C (^{o}F)] - 154 (309)
5. Water temperature [^{o}C (^{o}F)]- 125 (257)
6. Mixer pressure [kPa (psig)] - 193 (28)
7. Test time (sec) - 1440.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.2 (33.6)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	257 (495)
0.15 (0.50)	271 (520)
0.30 (1.00)	274 (525)
0.46 (1.50)	274 (525)
0.61 (2.00)	274 (525)
1.22 (4.00)	274 (525)
3.05 (10.00)	274 (525)
6.09 (20.00)	274 (525)
8.23 (27.00)	273 (524)
10.67 (35.00)	273 (524)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 4.01 (8.84)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 3.18 (7.01)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 1.09 (2.40)

D. FAILED BUNDLE T/Cs[1]

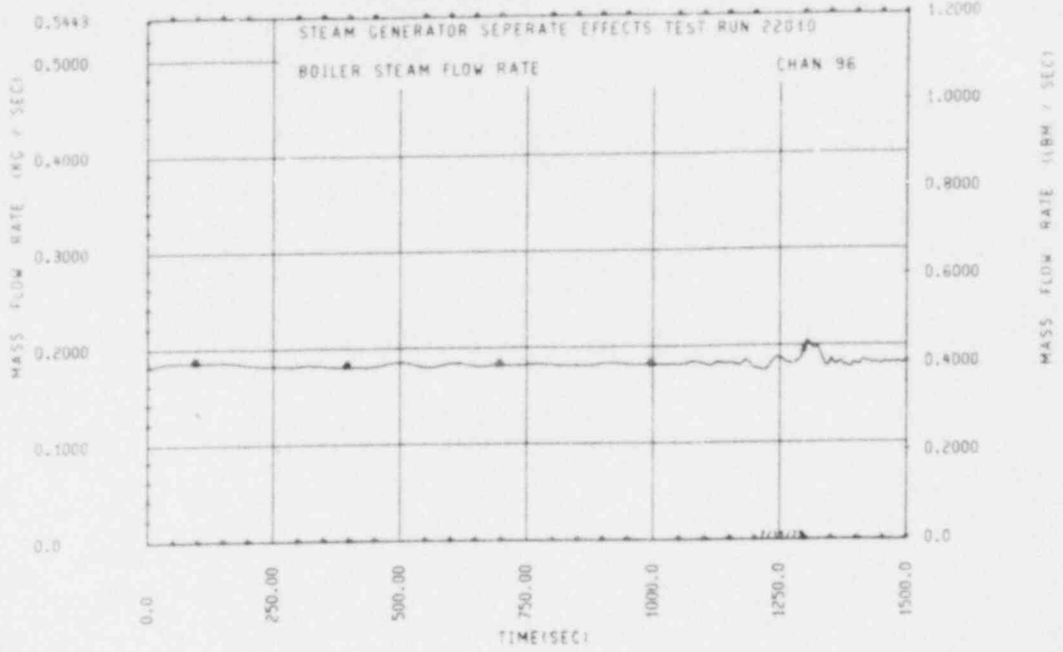
294, 295, 305, 309, 310, 311, 326, 532, 553, 564, 565, 568, 569

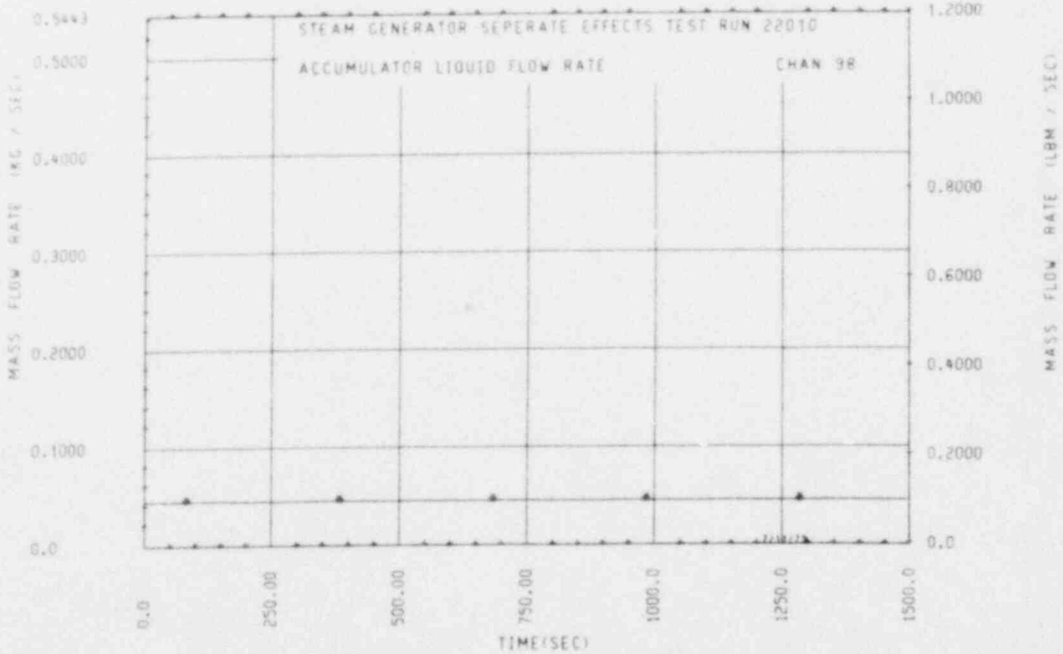
E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

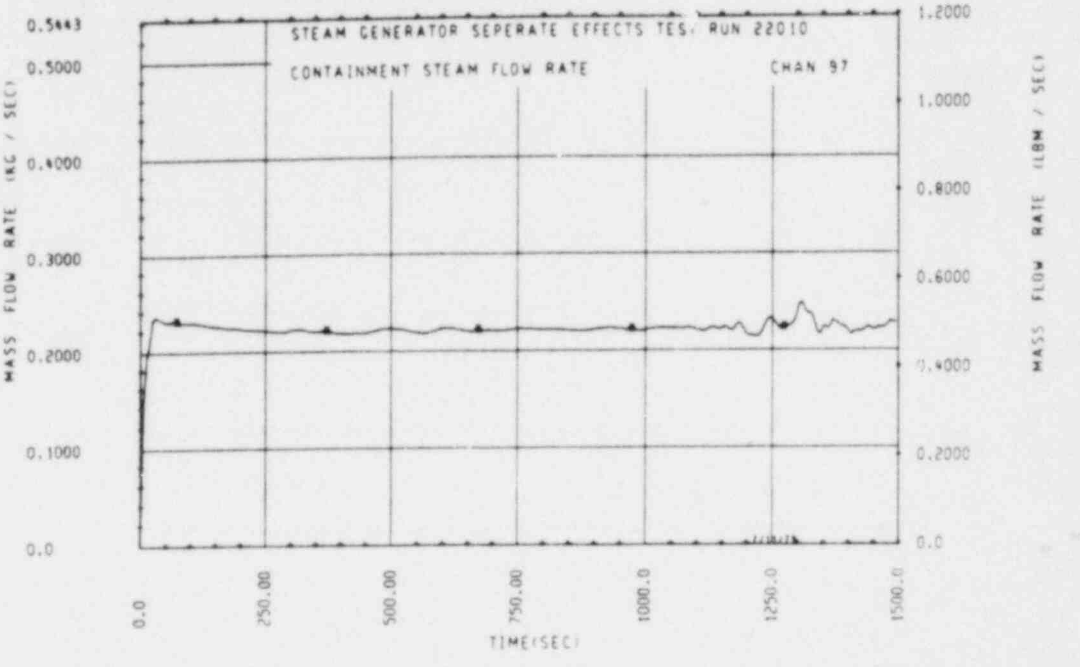
1. From primary side energy balance [kwsec(Btu)] - 0.627×10^5 (0.597×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da\,dt$) -[kwsec(Btu)] - 0.613×10^5 (0.584×10^5)
3. Integration to 600 sec

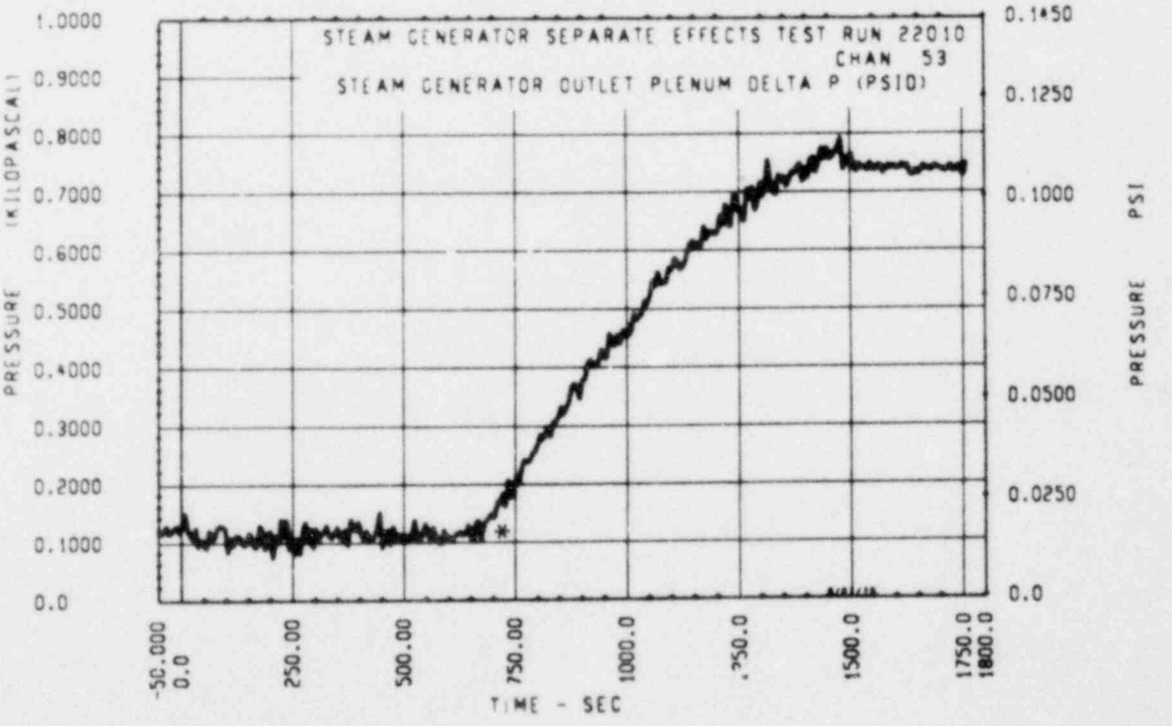
---

1. T/Cs are defined as failed based on resistance reading or T/C response.

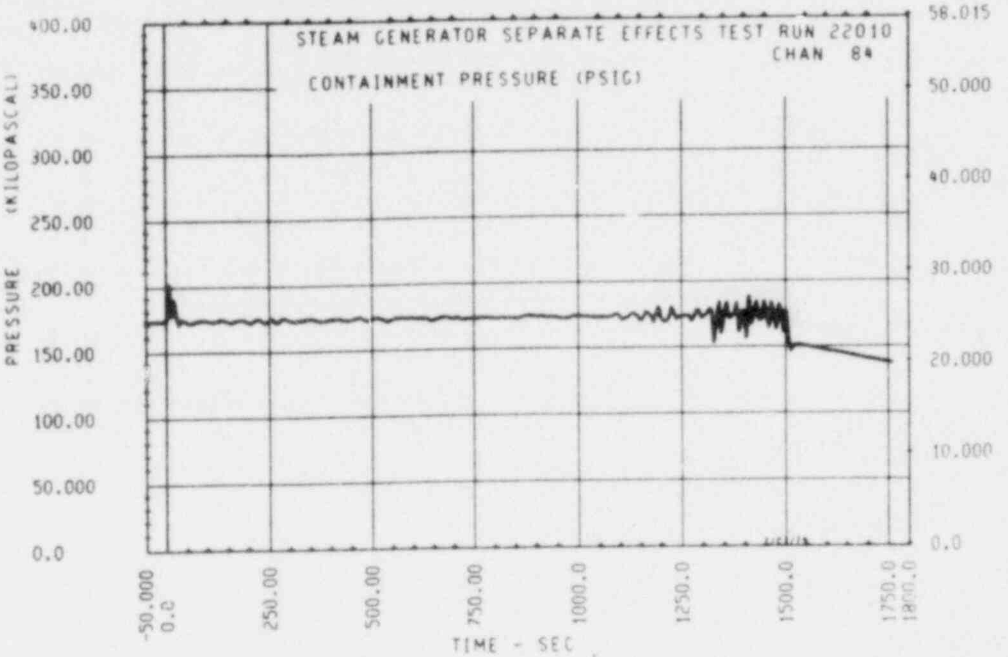

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22010
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

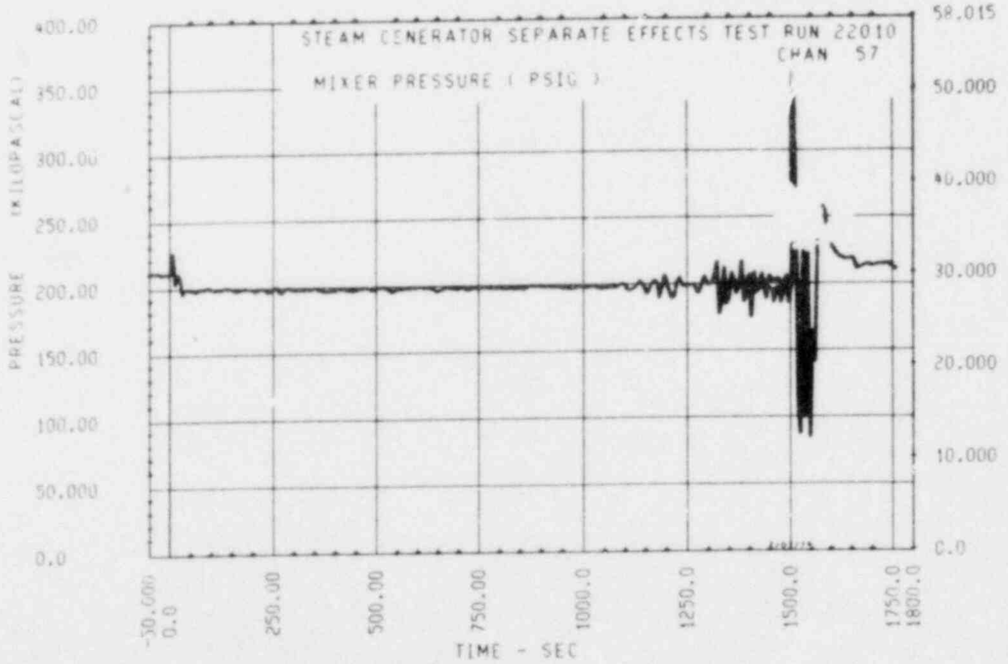

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22010
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

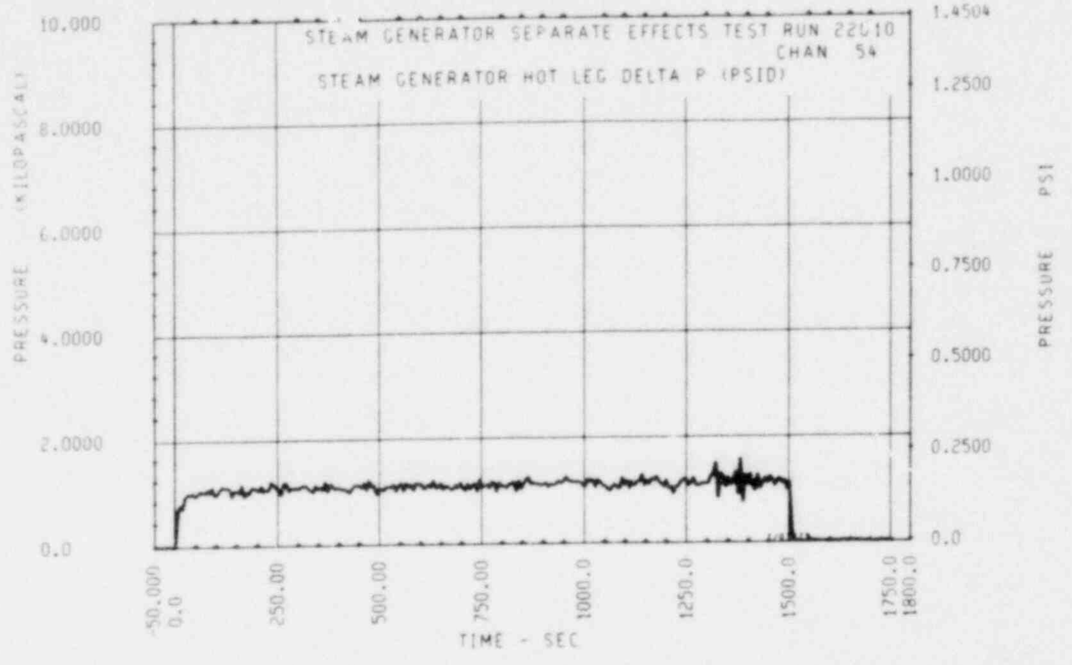




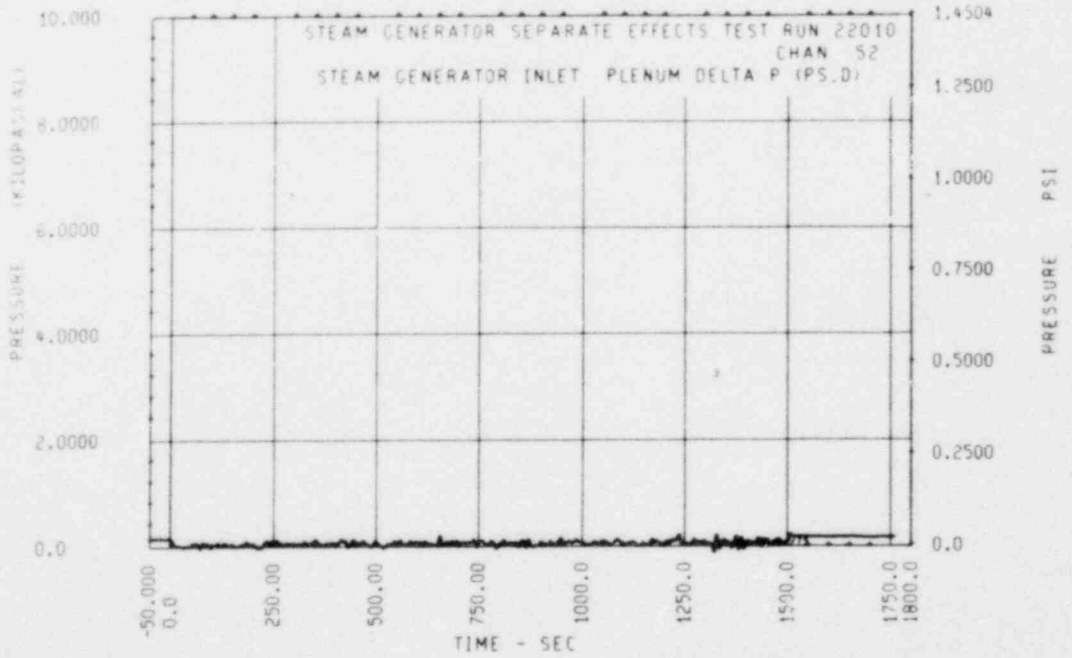
* Refer to Appendix H text for explanation of delayed response.


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22010
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

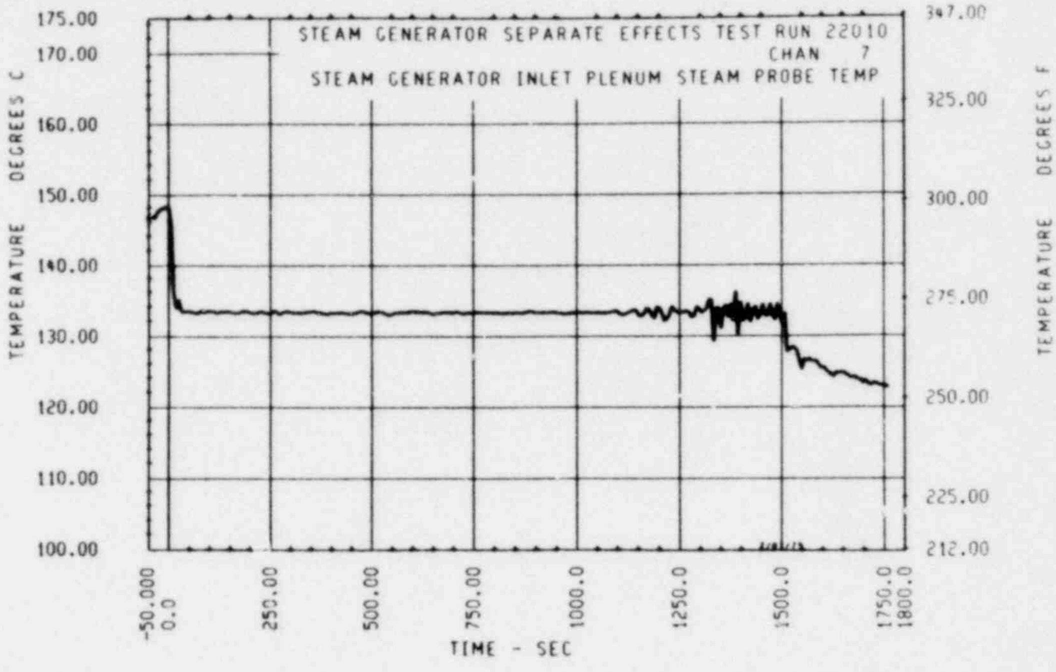

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22010
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

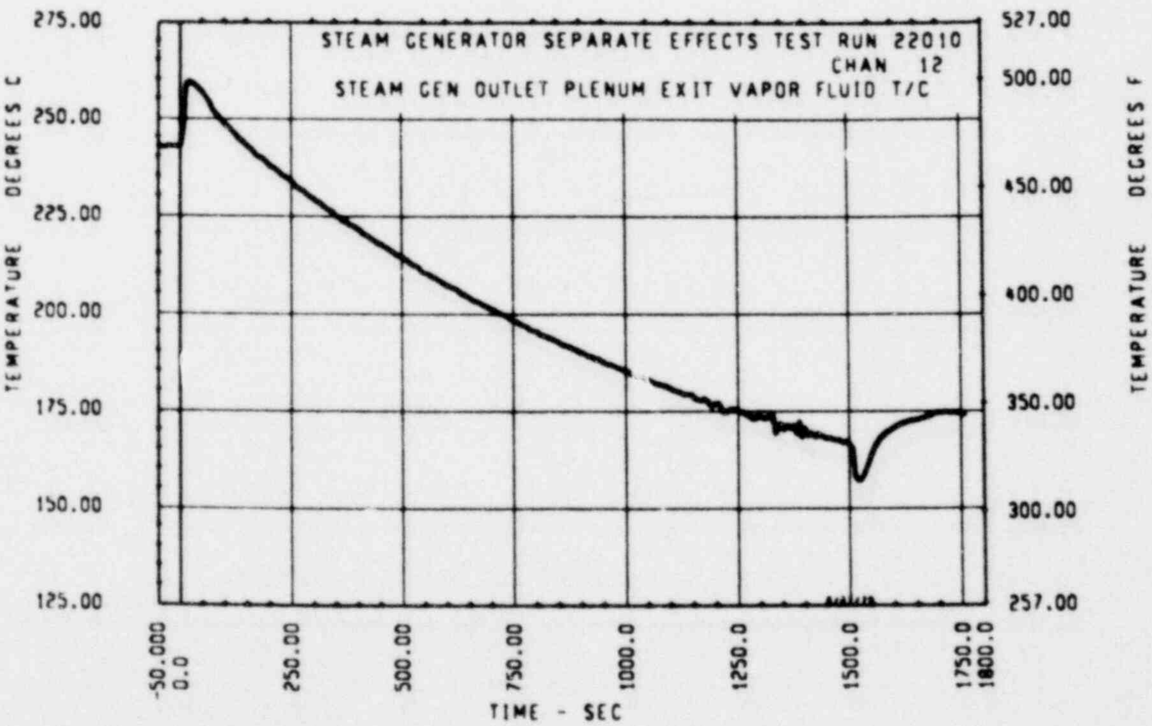


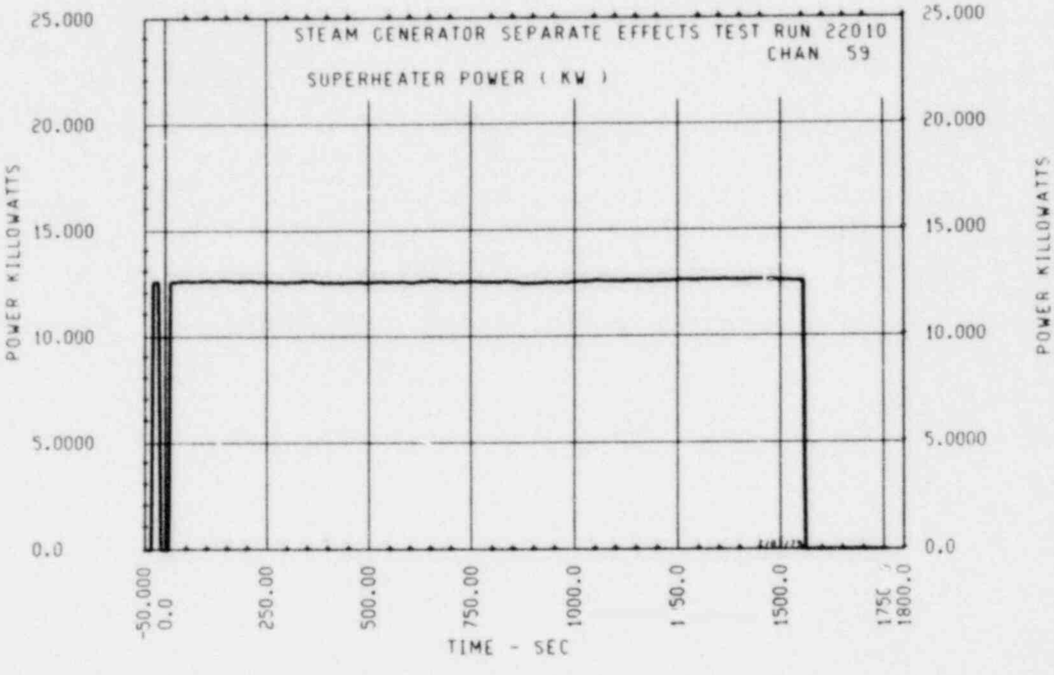
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22010
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

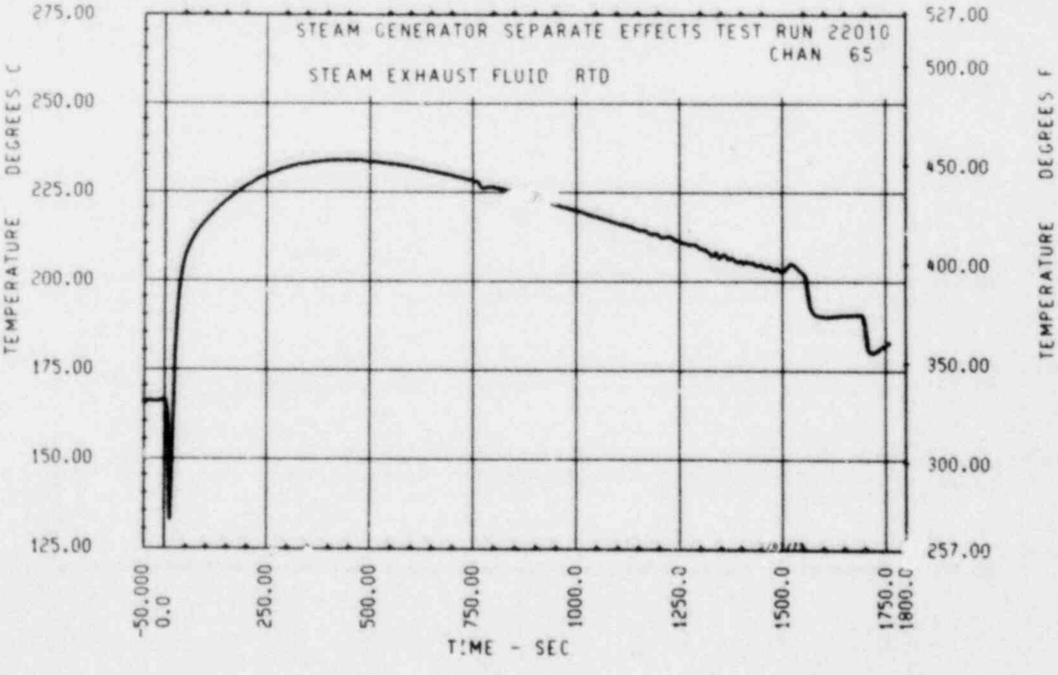


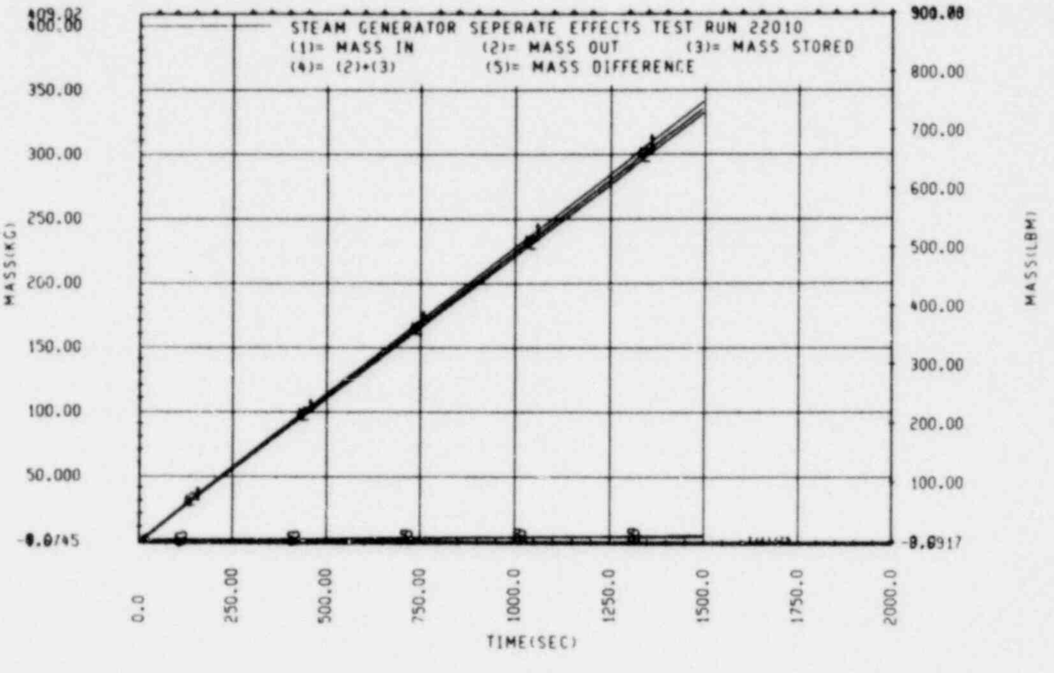
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22010
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

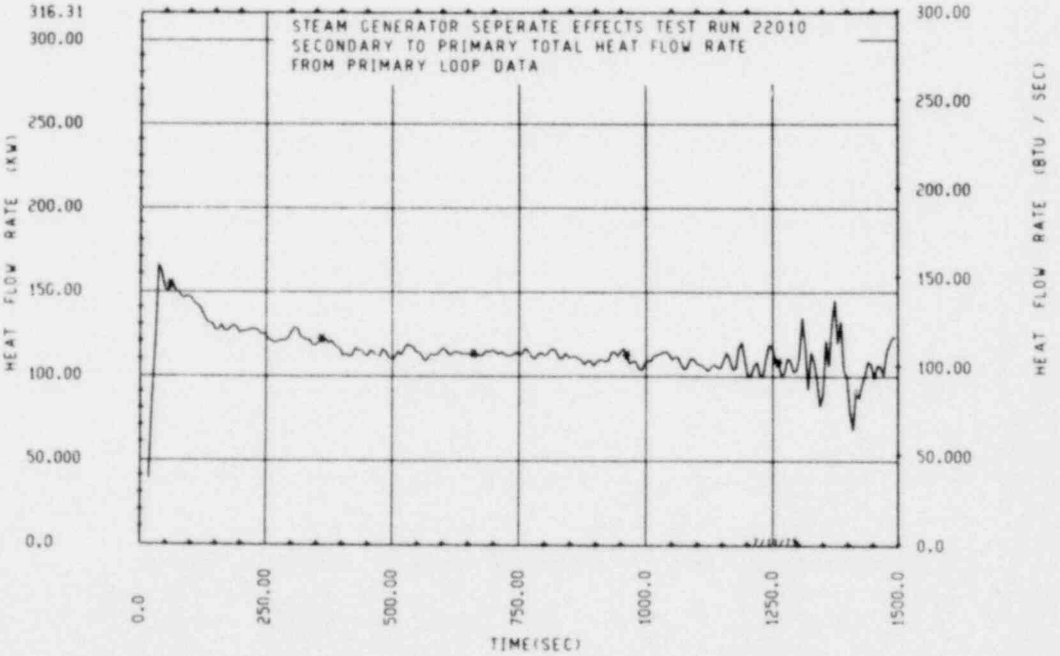

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22010
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
175.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
347.00
325.00
300.00
275.00
250.00
225.00
212.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

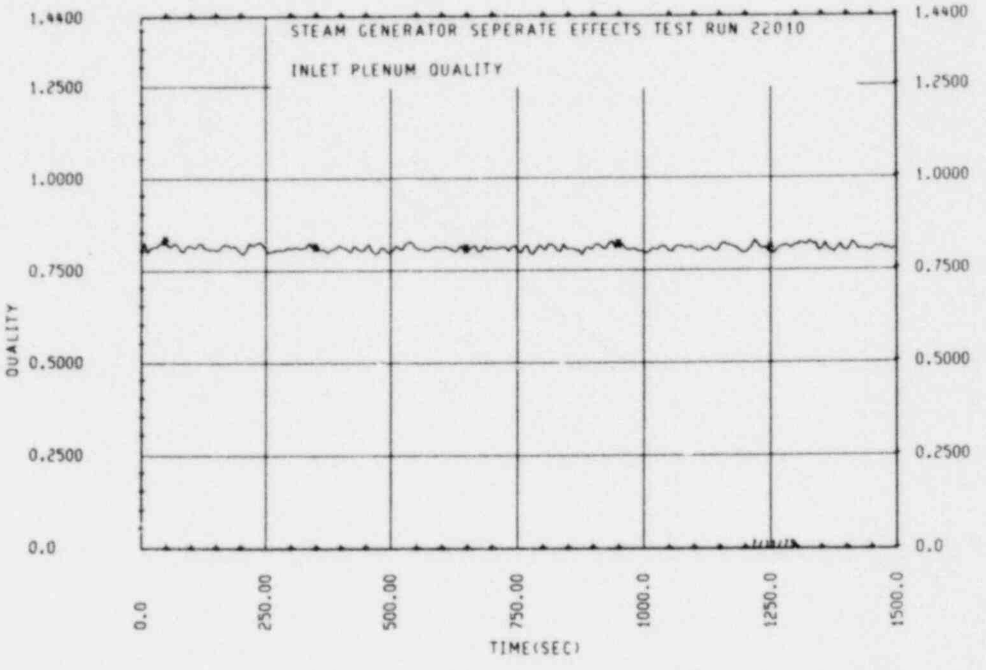

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22010
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

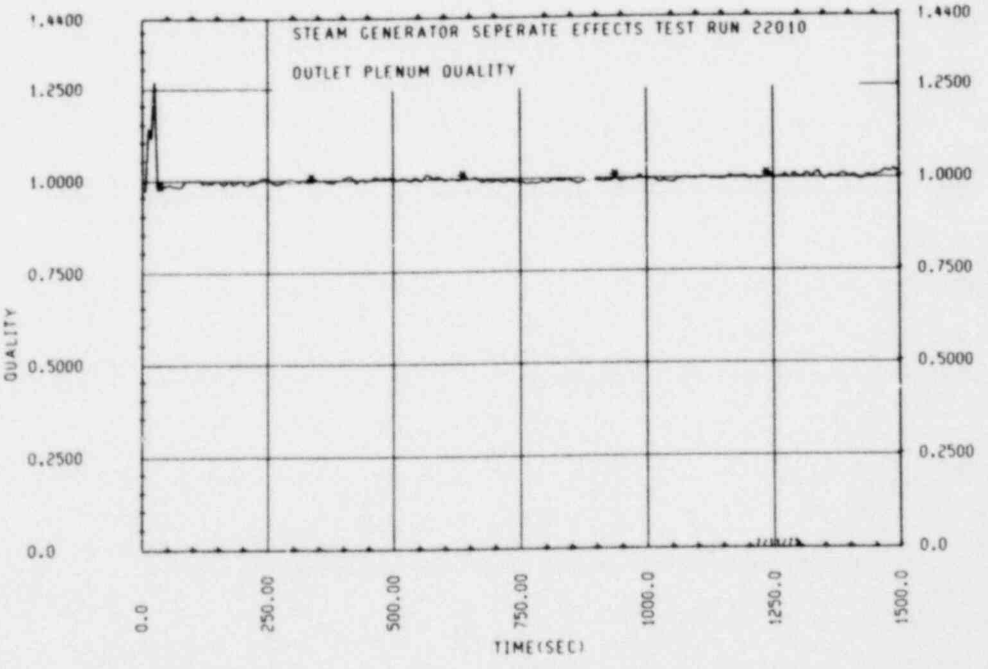

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22010
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
TIME - SEC

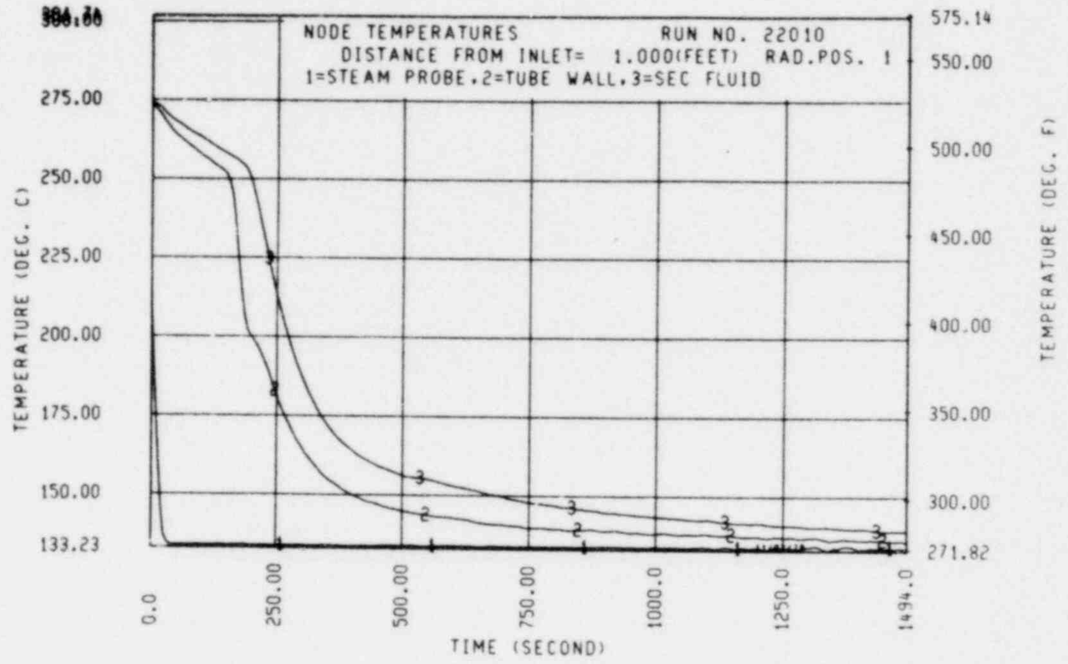

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22010
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22010
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)
350.00
300.00
250.00
200.00
150.00
100.00
50.000
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
2000.0

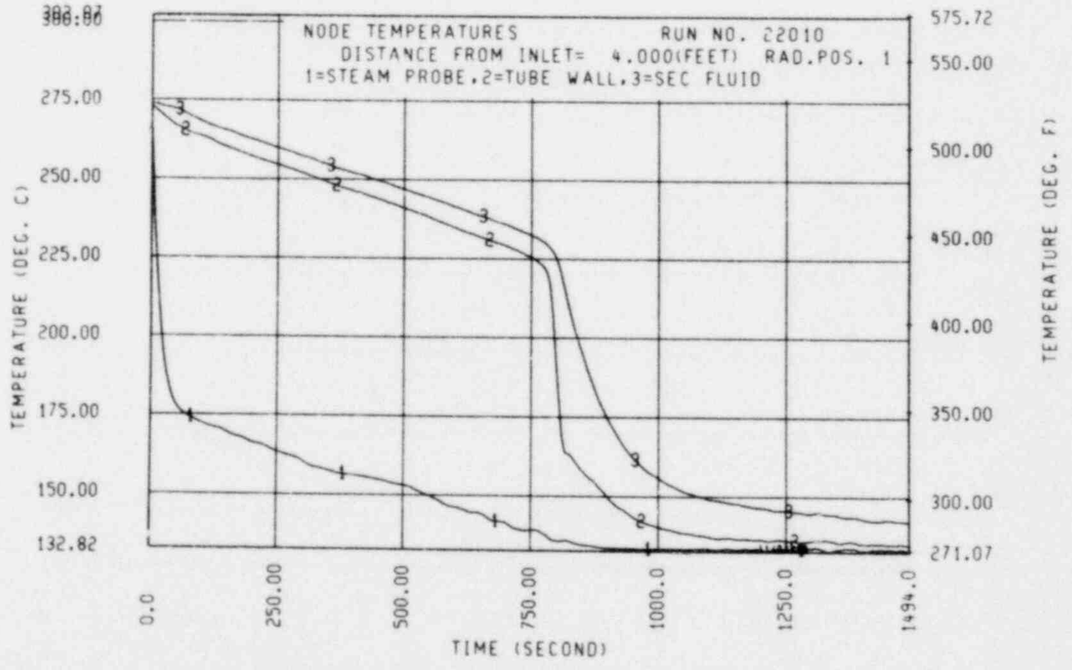

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22010
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)
316.31
300.00
250.00
200.00
150.00
100.00
50.000
0.0
300.00
250.00
200.00
150.00
100.00
50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22010
INLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

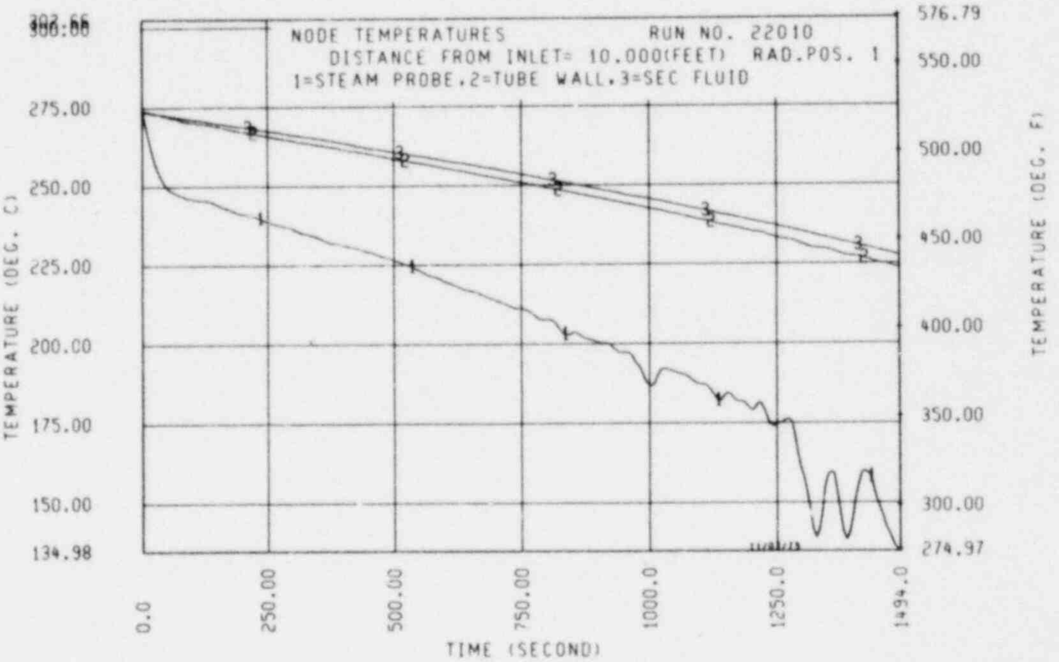

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22010
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

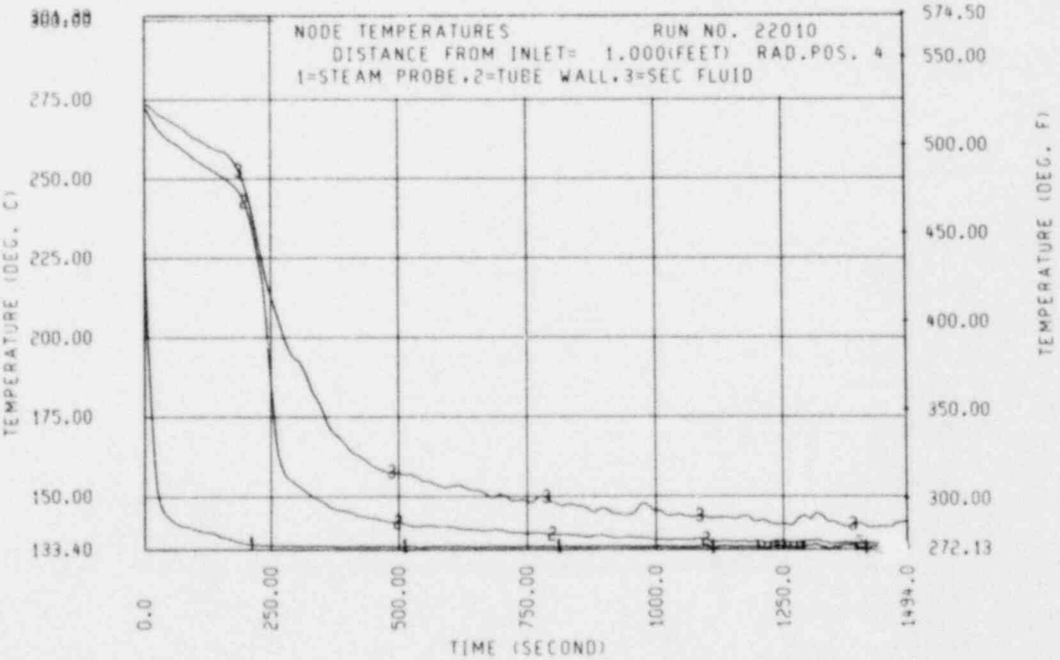


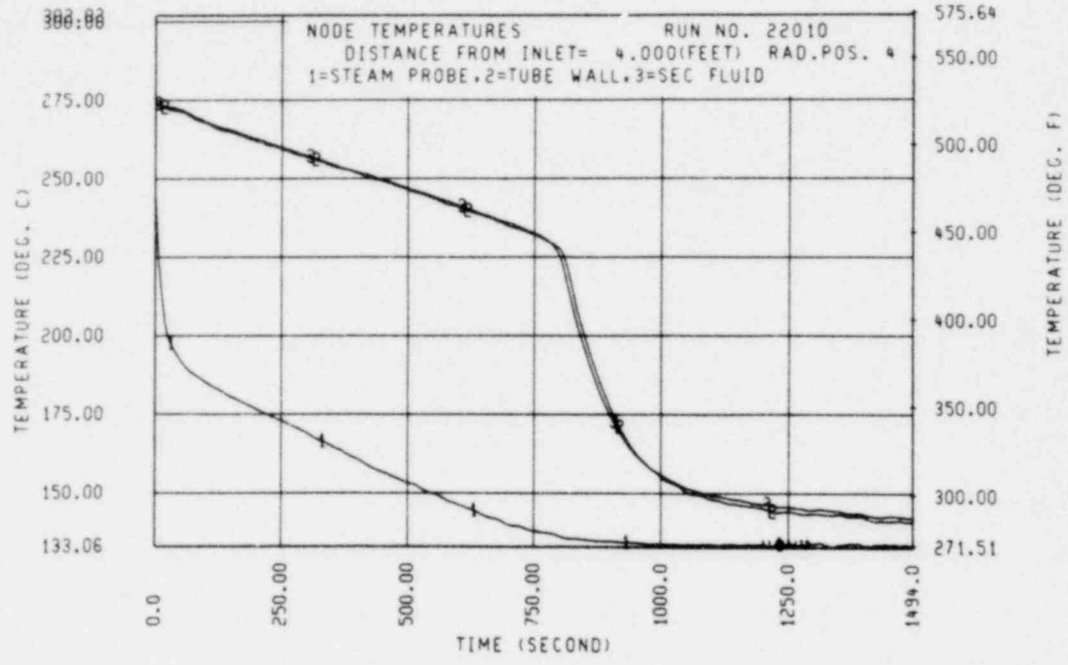
NODE TEMPERATURES RUN NO. 22010
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
133.23
575.14
550.00
500.00
450.00
400.00
350.00
300.00
271.82
0.0
250.00
500.00
750.00
1000.0
1250.0
1494.0

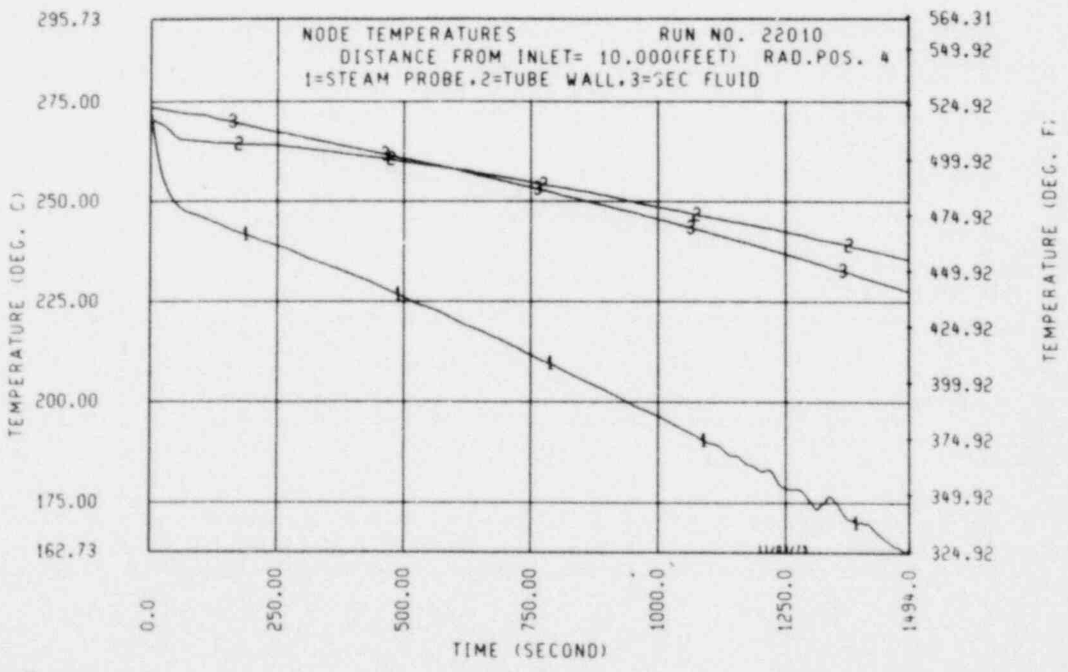


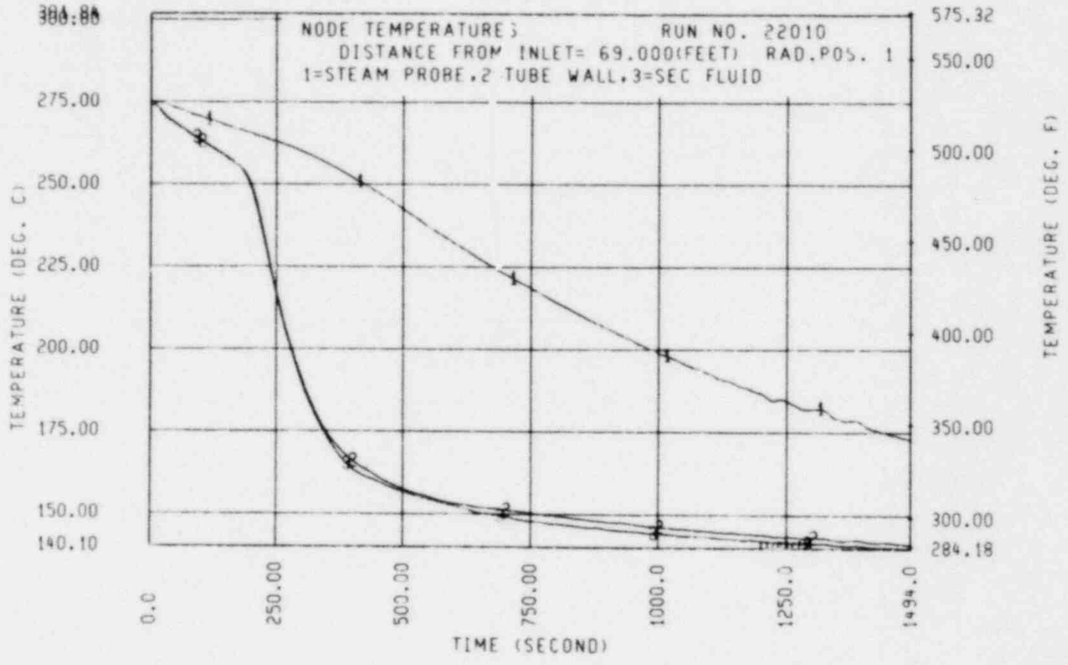
NODE TEMPERATURES RUN NO. 22010
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
132.82
575.72
550.00
500.00
450.00
400.00
350.00
300.00
271.07
0.0
250.00
500.00
750.00
1000.0
1250.0
1494.0

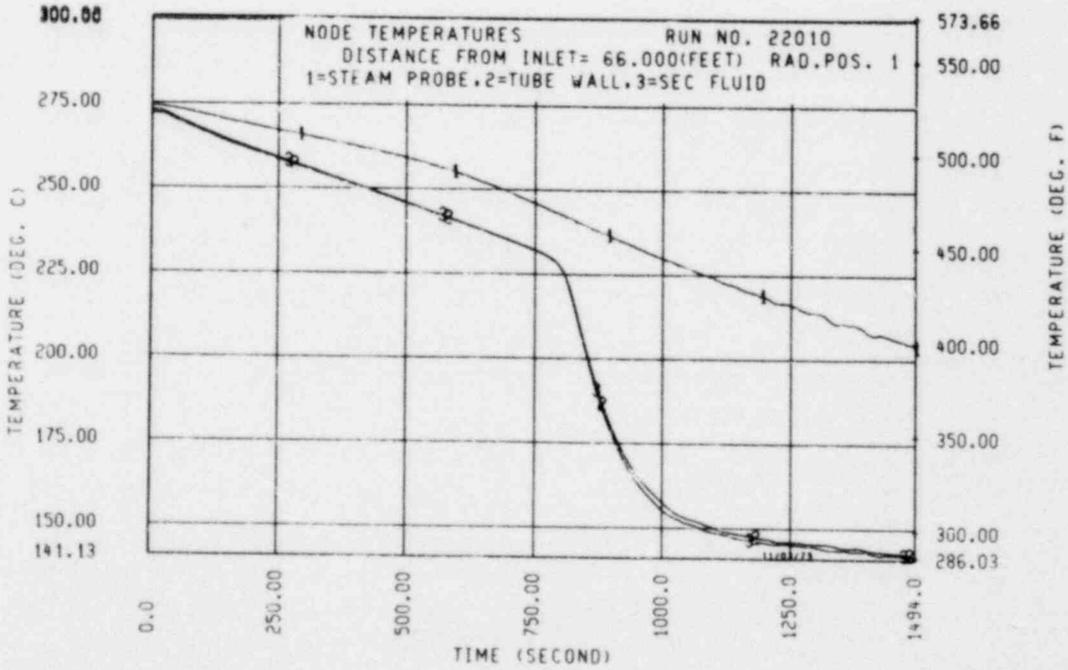

NODE TEMPERATURES
RUN NO. 22010
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
134.98
576.79
550.00
500.00
450.00
400.00
350.00
300.00
274.97
0.0
250.00
500.00
750.00
1000.0
1250.0
1494.0

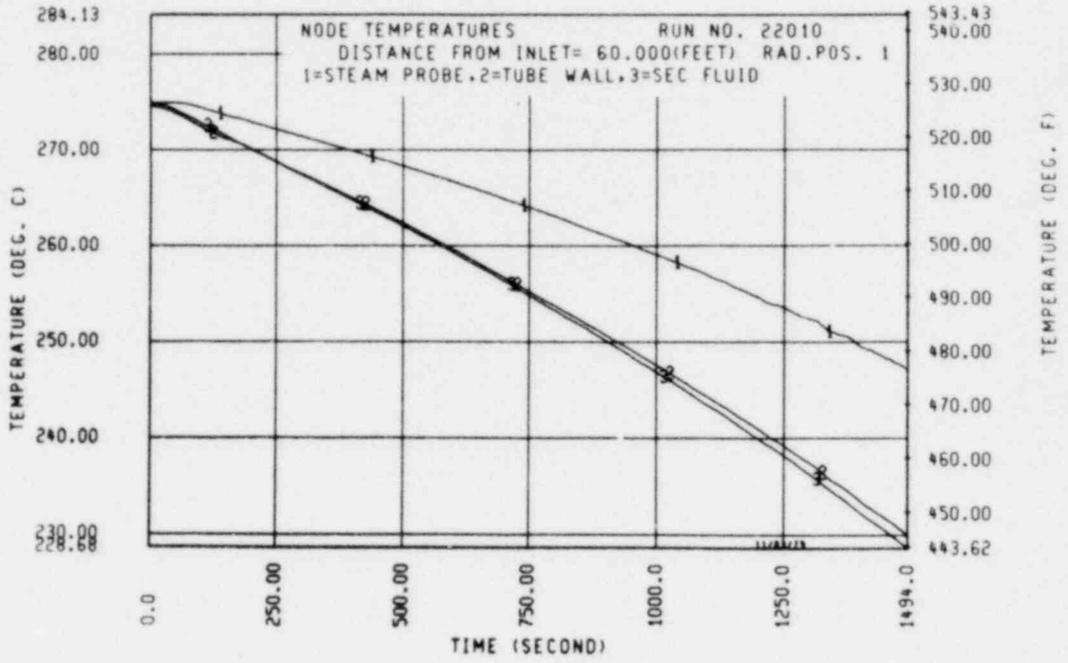

NODE TEMPERATURES
RUN NO. 22010
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
133.40
574.50
550.00
500.00
450.00
400.00
350.00
300.00
272.13
0.0
250.00
500.00
750.00
1000.0
1250.0
1494.0

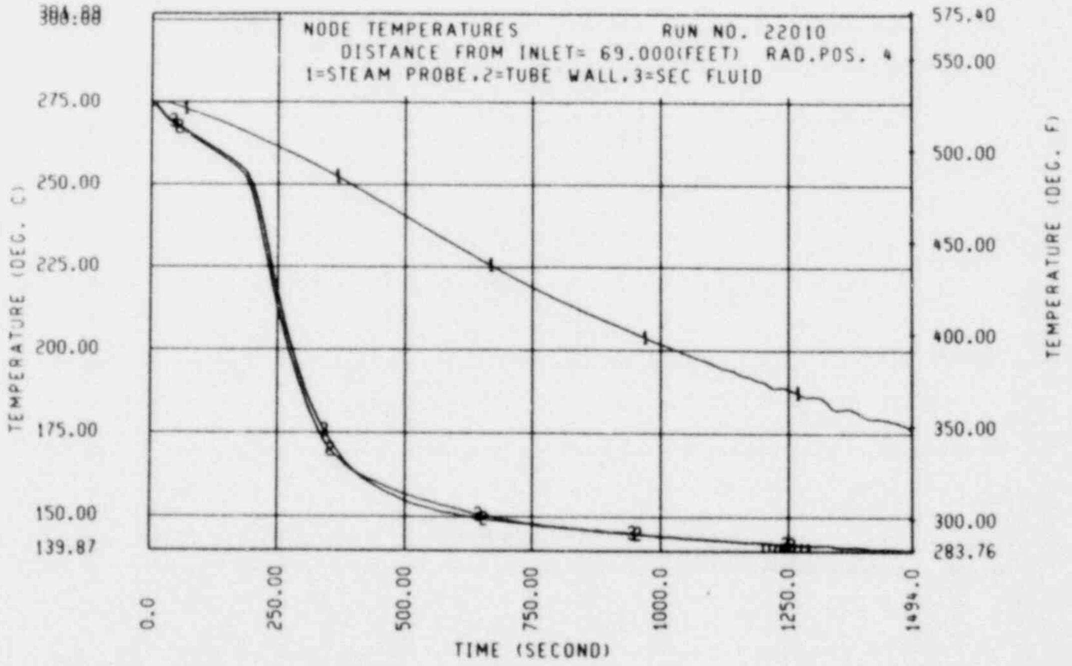

NODE TEMPERATURES
RUN NO. 22010
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
133.06
575.64
550.00
500.00
450.00
400.00
350.00
300.00
271.51
0.0
250.00
500.00
750.00
1000.0
1250.0
1494.0

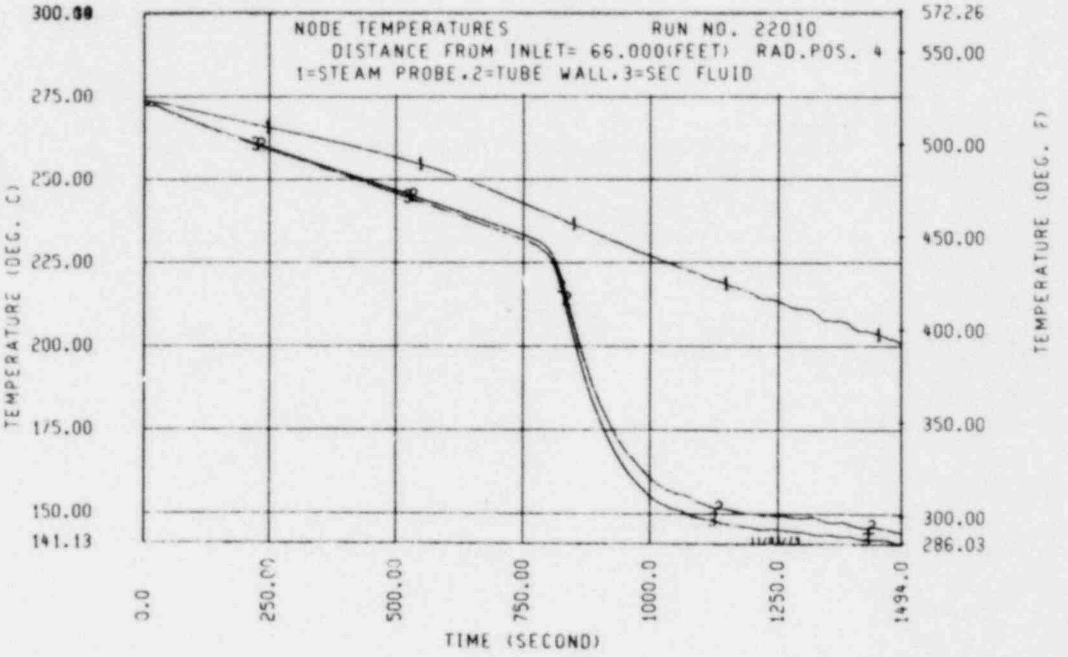

NODE TEMPERATURES
RUN NO. 22010
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
295.73
275.00
250.00
225.00
200.00
175.00
162.73
564.31
549.92
524.92
499.92
474.92
449.92
424.92
399.92
374.92
349.92
324.92
0.0
250.00
500.00
750.00
1000.0
1250.0
1494.0

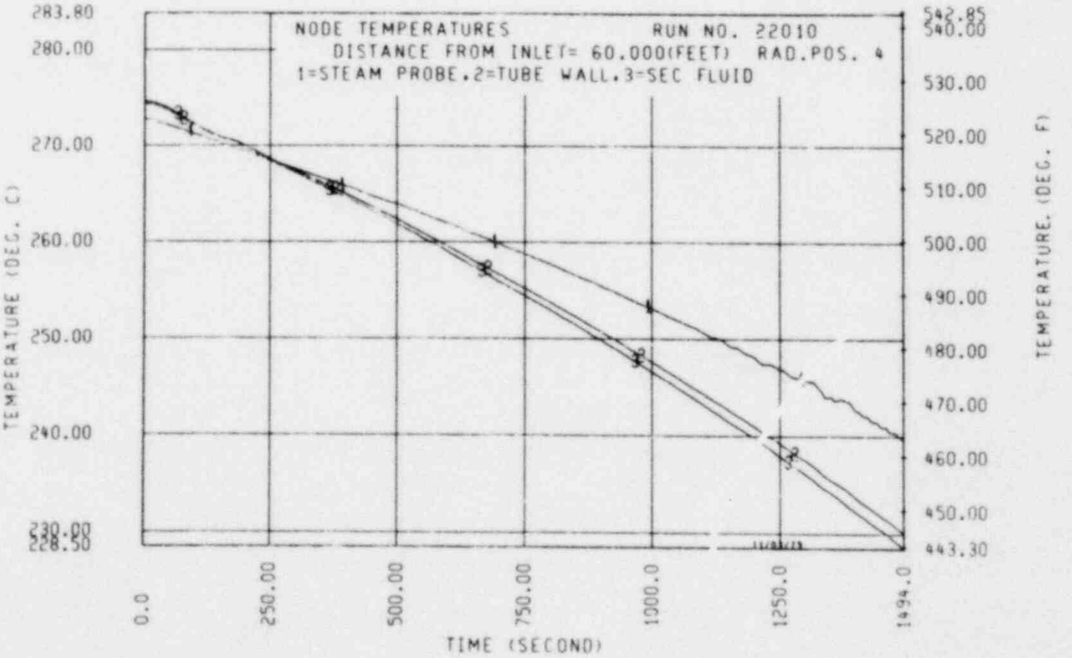

NODE TEMPERATURES RUN NO. 22010
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

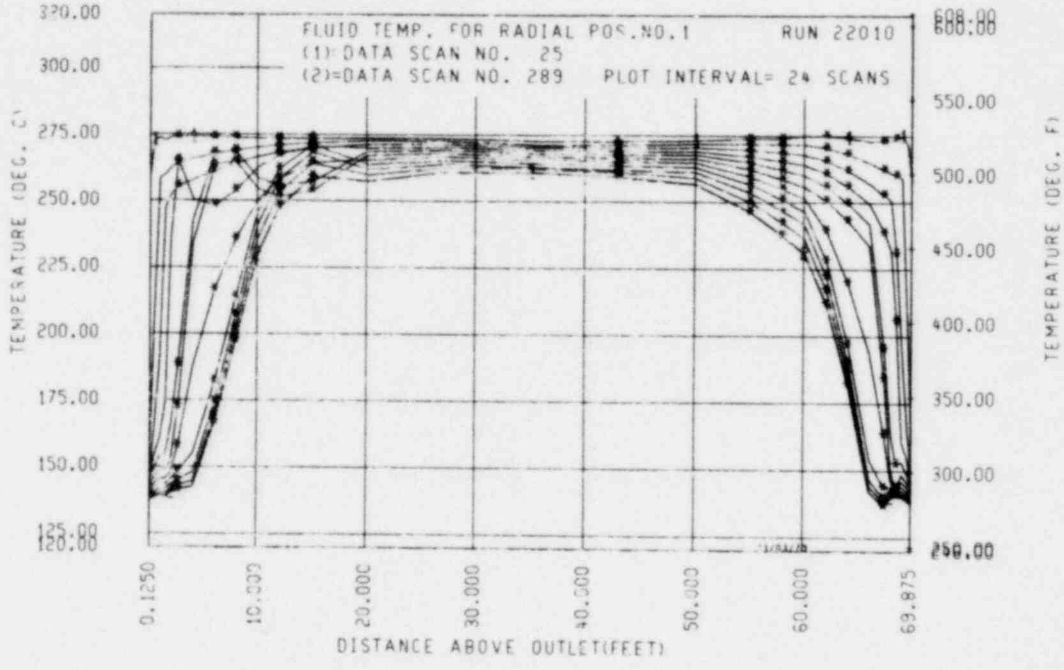

NODE TEMPERATURES RUN NO. 22010
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

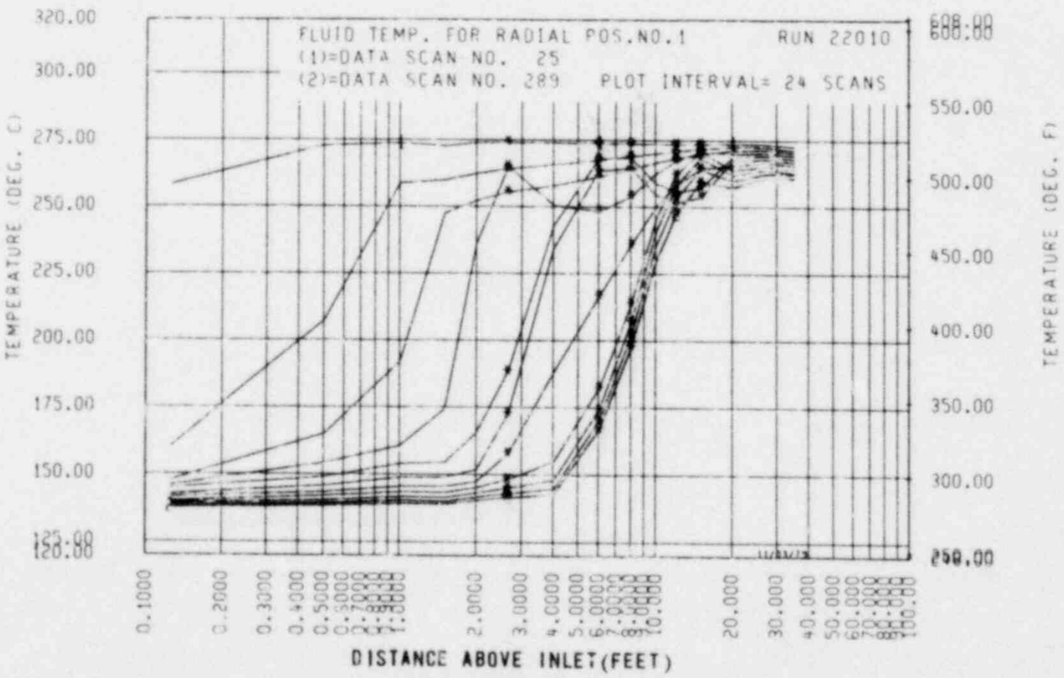

NODE TEMPERATURES
RUN NO. 22010
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

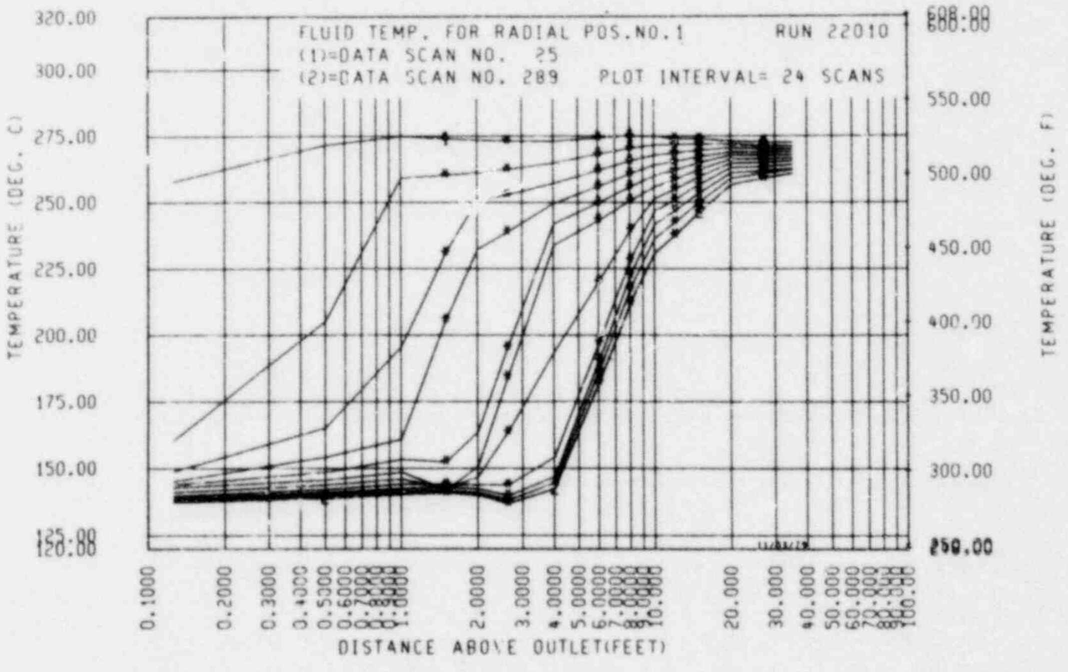

NODE TEMPERATURES
RUN NO. 22010
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22010
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
300.00
275.00
250.00
225.00
200.00
175.00
150.00
141.13
572.26
550.00
500.00
450.00
400.00
350.00
300.00
286.03
0.0
250.00
500.00
750.00
1000.0
1250.0
1494.0


NODE TEMPERATURES RUN NO. 22010
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
283.80
280.00
270.00
260.00
250.00
240.00
230.00
228.50
542.85
540.00
530.00
520.00
510.00
500.00
490.00
480.00
470.00
460.00
450.00
443.30
0.0
250.00
500.00
750.00
1000.0
1250.0
1494.0


FLUID TEMP. FOR RADIAL POS.NO.1 RUN 22010
(1)=DATA SCAN NO. 25
(2)=DATA SCAN NO. 289 PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1 RUN 22010
(1)=DATA SCAN NO. 25
(2)=DATA SCAN NO. 289 PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)



FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22010
(1)=DATA SCAN NO. 25
(2)=DATA SCAN NO. 289
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22010

TIME = 120.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1		2		3		4		LOCAL QUALITY 1	2	3	4
.0(.13)	.7(	.06)	33.3	2.93)	51.2(	4.51)	30.0(	2.64)	.794	.857	.907	.913
.2(.50)	1.9(	.17)	239.3(	21.09)	281.3(	24.79)	24.8(	2.18)	.795	.906	.969	.921
.3(1.00)	23.2(	2.05)	32.2(	2.84)	2.5(	.22)	25.1(	2.21)	.798	.957	1.027	.926
.5(1.50)	-4.8(	-.42)	-2.7(	-.24)	-5.1(	-.45)	8.1(	.71)	.799	.960	1.026	.926
.6(2.00)	2.6(	.23)	22.8(	2.01)	7.5(	.66)	10.2(	.90)	.796	.962	1.026	.923
.8(2.65)	2.7(	.24)	70.5(	6.21)	28.9(	2.55)	10.1(	.89)	.791	.983	1.034	.920
1.2(4.00)	7.4(	.65)	7.1(	.62)	5.1(	.45)	2.4(	.21)	.779	.990	1.027	.909
1.8(6.00)	2.0(	.17)	4.9(	.43)	4.3(	.38)	6.0(	.53)	.763	.964	.995	.895
2.4(8.00)	.8(	.07)	3.5(	.31)	1.5(	.13)	14.3(	1.26)	.749	.946	.973	.894
3.0(10.00)	1.2(	.11)	10.2(	.90)	11.2(	.99)	40.4(	3.56)	.740	.947	.972	.923
3.7(12.00)	1.8(	.16)	14.3(	1.26)	8.6(	.76)	9.5(	.84)	.736	.958	.980	.951
4.6(15.00)	3.5(	.31)	5.4(	.48)	5.4(	.48)	7.2(	.64)	.738	.968	.986	.963
6.1(20.00)	1.0(	.09)	.9(	.08)	.4(	.04)	.6(	.06)	.741	.969	.986	.969
8.2(27.00)	.3(	.02)	-.1(	-.01)	-.4(	-.03)	.4(	.03)	.741	.966	.982	.966
10.7(35.00)	0.0(	0.00)	0.0(	0.00)	0.0(	0.00)	0.0(	0.00)	.740	.966	.982	.969
13.1(43.00)	-.5(	-.05)	-.3(	-.02)	.0(	.00)	-.1(	-.01)	.738	.966	.982	.970
15.2(50.00)	-.1(	-.01)	-.3(	-.03)	-.1(	-.01)	.0(	.00)	.736	.964	.982	.969
16.8(55.00)	.0(	.00)	-.3(	-.02)	-.1(	-.01)	.0(	.00)	.736	.962	.981	.969
17.7(58.00)	.1(	.01)	-.2(	-.02)	-.0(	-.00)	.0(	.00)	.736	.961	.982	.969
18.3(60.00)	.4(	.04)	-.3(	-.03)	.0(	.00)	.0(	.00)	.736	.961	.983	.970
18.9(62.00)	1.0(	.09)	-.0(	-.00)	.1(	.01)	.0(	.00)	.737	.961	.984	.971
19.5(64.00)	.2(	.02)	.2(	.02)	.1(	.01)	-.0(	-.00)	.739	.962	.985	.971
20.1(66.00)	.4(	.03)	1.2(	.10)	.4(	.03)	-.1(	-.01)	.740	.964	.985	.971
20.5(67.38)	-.0(	-.00)	.4(	.03)	-.5(	-.05)	-.9(	-.08)	.741	.966	.985	.971
20.7(68.00)	.5(	.04)	-.2(	-.02)	-1.0(	-.09)	-.3(	-.03)	.741	.966	.985	.970
20.9(68.50)	-.2(	-.02)	-.3(	-.03)	-2.4(	-.21)	-.8(	-.07)	.741	.966	.984	.970
21.0(69.00)	-.3(	-.03)	-.4(	-.04)	-.4(	-.04)	-.4(	-.04)	.742	.965	.983	.970
21.2(69.50)	-9.7(	-.86)	-2.0(	-.18)	-7.5(	-.66)	-15.4(	-1.35)	.745	.966	.982	.968
21.3(69.87)	-17.0(	-1.50)	-7.3(	-.64)	-8.6(	-.75)	-6.6(	-.59)	.747	.966	.981	.966

22010-19

POOR ORIGINAL

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22010

TIME = 300.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.3(.02)	17.0(1.49)	14.8(1.30)	11.7(1.03)	.794	.855	.903	.912
.2(.50)	50.8(4.47)	55.0(4.85)	57.6(5.08)	58.3(5.14)	.803	.867	.916	.926
.3(1.00)	102.6(9.04)	143.7(12.66)	7.1(.62)	155.1(13.67)	.830	.905	.929	.967
.5(1.50)	2.2(.20)	2.3(.20)	201.4(17.75)	2.3(.20)	.849	.933	.972	.995
.6(2.00)	2.4(.21)	23.9(2.11)	7.4(.65)	11.9(1.05)	.849	.937	1.013	.993
.8(2.65)	2.5(.22)	-107.9(-9.50)	-16.6(-1.46)	-26.8(-2.36)	.845	.907	1.005	.980
1.2(4.00)	9.4(.83)	8.1(.71)	5.7(.50)	2.3(.20)	.836	.865	.984	.957
1.8(6.00)	20.7(1.83)	26.3(2.31)	22.1(1.95)	31.6(2.79)	.834	.863	.976	.961
2.4(8.00)	12.4(1.09)	20.5(1.81)	1.6(.14)	23.2(2.05)	.838	.877	.972	.984
3.0(10.00)	3.1(.27)	4.9(.43)	6.1(.54)	6.6(.58)	.835	.885	.965	.992
3.7(12.00)	-.7(-.06)	-.1(-.01)	1.9(.17)	-1.5(-.13)	.828	.881	.962	.985
4.6(15.00)	2.2(.19)	.2(.02)	.3(.03)	-.8(-.07)	.825	.874	.955	.975
6.1(20.00)	1.1(.09)	.9(.08)	.4(.04)	.6(.05)	.824	.868	.948	.967
8.2(27.00)	.4(.04)	-.0(-.00)	-.4(-.04)	.3(.03)	.823	.865	.943	.966
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.822	.864	.942	.966
13.1(43.00)	-.5(-.05)	-.3(-.02)	-.0(-.00)	-.1(-.01)	.820	.863	.943	.967
15.2(50.00)	-.1(-.01)	-.3(-.03)	-.1(-.01)	-.0(-.00)	.818	.861	.942	.966
16.8(55.00)	-.1(-.01)	-.3(-.03)	-.2(-.01)	-.0(-.00)	.818	.860	.942	.966
17.7(58.00)	-.0(-.00)	-.2(-.02)	-.1(-.01)	-.0(-.00)	.818	.860	.942	.967
18.3(60.00)	-.1(-.01)	-.4(-.03)	-.2(-.01)	-.1(-.01)	.818	.859	.944	.968
18.9(62.00)	-.0(-.00)	-.0(-.00)	-.0(-.00)	-.2(-.01)	.819	.860	.945	.970
19.5(64.00)	.0(.00)	.2(.01)	.0(.00)	-.2(-.02)	.820	.862	.947	.970
20.1(66.00)	.2(.02)	1.1(.10)	.2(.02)	-.5(-.04)	.822	.864	.946	.971
20.5(67.38)	-.2(-.02)	.1(.01)	-.7(-.06)	-1.4(-.13)	.824	.867	.948	.970
20.7(68.00)	.2(.01)	-.0(-.00)	-1.3(-.12)	-.8(-.07)	.824	.867	.946	.970
20.9(68.50)	-1.2(-.10)	-1.4(-.12)	-7.6(-.67)	-.1(-.01)	.825	.867	.947	.972
21.0(69.00)	2.7(.24)	2.3(.20)	.7(.06)	8.3(.73)	.828	.868	.947	.976
21.2(69.50)	-18.3(-1.61)	-16.5(-1.45)	-15.3(-1.35)	-14.5(-1.28)	.835	.869	.946	.976
21.3(69.67)	-7.2(-.63)	-4.0(-.36)	-4.8(-.42)	-4.8(-.42)	.840	.859	.945	.976

22010-20

POOR ORIGINAL

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22010
TIME = 480.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.3(.02)	10.2(.90)	9.8(.86)	14.8(1.31)	.794	.854	.903	.911
.2(.50)	25.0(2.20)	27.9(2.46)	29.9(2.64)	27.6(2.44)	.798	.860	.910	.916
.3(1.00)	35.4(3.12)	36.6(3.22)	.5(.04)	39.5(3.48)	.809	.873	.916	.932
.5(1.50)	22.7(2.00)	20.7(1.82)	.5(.05)	45.5(4.01)	.820	.884	.916	.950
.6(2.00)	175.2(15.44)	159.6(14.06)	174.0(15.33)	139.0(12.25)	.855	.919	.951	.987
.8(2.65)	1.9(.17)	1.9(.17)	1.9(.17)	156.0(13.74)	.883	.946	.964	1.056
1.2(4.00)	10.3(.91)	10.3(.91)	6.7(.59)	2.2(.19)	.878	.943	.976	1.090
1.8(6.00)	-17.5(-1.54)	-6.7(-.59)	-14.3(-1.26)	-10.8(-.95)	.853	.921	.945	1.057
2.4(8.00)	-11.2(-.99)	-8.9(-.79)	1.9(.17)	-5.9(-.52)	.814	.889	.913	1.022
3.0(10.00)	3.5(.31)	1.9(.17)	3.5(.31)	.8(.07)	.794	.871	.903	1.000
3.7(12.00)	.9(.08)	16.4(1.44)	13.7(1.21)	6.7(.59)	.787	.874	.905	.994
4.6(15.00)	16.6(1.46)	8.7(.76)	13.5(1.19)	10.5(.92)	.803	.889	.925	1.004
6.1(20.00)	1.5(.13)	1.5(.13)	.6(.05)	.9(.08)	.821	.894	.936	1.012
8.2(27.00)	.5(.04)	.0(.00)	-.3(-.03)	.4(.03)	.821	.891	.931	1.010
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.819	.889	.930	1.010
13.1(43.00)	-.6(-.05)	-.3(-.03)	-.0(-.00)	-.1(-.01)	.816	.887	.930	1.011
15.2(50.00)	-.2(-.02)	-.5(-.04)	-.2(-.02)	-.0(-.00)	.814	.885	.929	1.010
16.8(55.00)	-.1(-.01)	-.4(-.04)	-.3(-.02)	-.1(-.01)	.814	.884	.929	1.010
17.7(58.00)	-.1(-.01)	-.3(-.03)	-.2(-.02)	-.1(-.01)	.814	.884	.930	1.012
18.3(60.00)	-.2(-.02)	-.4(-.04)	-.3(-.03)	-.3(-.02)	.815	.884	.931	1.014
18.9(62.00)	-.2(-.01)	-.0(-.00)	-.1(-.01)	-.3(-.03)	.816	.885	.933	1.015
19.5(64.00)	-.0(-.00)	.2(.01)	-.0(-.00)	-.4(-.03)	.817	.887	.935	1.017
20.1(66.00)	.1(.01)	1.1(.10)	.1(.01)	-.9(-.08)	.820	.891	.938	1.017
20.5(67.38)	-4.5(-.40)	-3.9(-.35)	-.9(-.08)	-6.6(-.58)	.821	.893	.939	1.016
20.7(68.00)	-20.4(-1.79)	-20.1(-1.77)	-1.8(-.16)	-10.9(-.96)	.818	.890	.939	1.014
20.9(68.50)	-15.3(-1.35)	-18.4(-1.62)	-5.1(-.45)	-7.4(-.65)	.815	.884	.940	1.014
21.0(69.00)	2.4(.21)	2.0(.18)	1.8(.15)	4.6(.40)	.819	.884	.943	1.020
21.2(69.50)	-20.9(-1.84)	-3.8(-.33)	-20.5(-1.80)	-17.4(-1.53)	.826	.890	.944	1.022
21.3(69.87)	-4.5(-.40)	-4.1(-.36)	-3.4(-.30)	-2.1(-.19)	.830	.894	.942	1.020

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22010

TIME = 720.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.02)	5.3(.47)	5.4(.48)	3.3(.29)	.793	.853	.902	.910
.2(.50)	13.1(1.15)	16.7(1.47)	16.2(1.43)	14.3(1.26)	.795	.857	.905	.913
.3(1.00)	19.9(1.75)	19.4(1.71)	.3(.02)	20.8(1.83)	.801	.864	.909	.920
.5(1.50)	19.7(1.73)	16.8(1.48)	14.9(1.32)	22.5(1.99)	.808	.871	.912	.929
.6(2.00)	25.8(2.27)	20.7(1.82)	17.9(1.57)	21.7(1.91)	.816	.879	.918	.939
.8(2.65)	.8(.07)	26.3(2.32)	19.7(1.74)	17.9(1.58)	.820	.890	.926	.947
1.2(4.00)	12.2(1.07)	11.4(1.00)	7.7(.68)	2.0(.17)	.825	.900	.935	.946
1.8(6.00)	6.1(.54)	8.5(.75)	5.5(.48)	11.3(.99)	.826	.896	.929	.938
2.4(8.00)	3.7(.33)	2.9(.26)	.3(.03)	6.7(.59)	.815	.886	.911	.930
3.0(10.00)	5.6(.49)	.8(.07)	1.3(.12)	-1.3(-.12)	.800	.871	.892	.916
3.7(12.00)	7.4(.65)	.2(.02)	1.7(.15)	-1.2(-.11)	.794	.860	.880	.901
4.6(15.00)	5.5(.48)	.7(.06)	1.3(.12)	-.5(-.04)	.799	.851	.872	.888
6.1(20.00)	2.1(.19)	2.3(.20)	1.1(.10)	1.5(.13)	.803	.846	.865	.880
8.2(27.00)	.6(.06)	.2(.02)	-.2(-.02)	.4(.04)	.803	.844	.860	.878
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.799	.841	.858	.878
13.1(43.00)	-.6(-.05)	-.3(-.03)	-.0(-.00)	-.1(-.01)	.795	.839	.859	.876
15.2(50.00)	-.1(-.01)	-.3(-.03)	-.1(-.01)	-.0(-.00)	.794	.837	.858	.878
16.8(55.00)	-.1(-.01)	-.4(-.03)	-.3(-.02)	-.1(-.01)	.794	.837	.858	.876
17.7(58.00)	-.1(-.01)	-.4(-.03)	-.3(-.03)	-.3(-.02)	.795	.837	.859	.880
18.3(60.00)	-.3(-.02)	-.8(-.07)	-.5(-.05)	-.5(-.05)	.796	.837	.861	.882
18.9(62.00)	-.3(-.03)	-.1(-.01)	-.3(-.02)	-.6(-.06)	.798	.840	.864	.884
19.5(64.00)	-.0(-.00)	.1(.01)	-.1(-.01)	-.7(-.06)	.802	.844	.869	.887
20.1(66.00)	-.0(-.00)	1.0(.09)	-.0(-.00)	-1.5(-.13)	.807	.851	.874	.889
20.5(67.38)	-1.6(-.14)	-1.0(-.08)	-2.9(-.26)	-4.3(-.38)	.810	.856	.878	.890
20.7(68.00)	-3.2(-.29)	-3.7(-.32)	-7.6(-.67)	-4.6(-.41)	.812	.858	.878	.890
20.9(68.50)	-4.5(-.40)	-5.5(-.49)	-11.2(-.98)	-3.9(-.35)	.816	.858	.877	.894
21.0(69.00)	2.4(.21)	1.8(.16)	.5(.04)	-2.5(-.22)	.823	.860	.879	.899
21.2(69.50)	-12.9(-1.14)	-10.0(-.88)	-11.4(-1.00)	-12.5(-1.10)	.830	.864	.880	.901
21.3(69.87)	-1.4(-.13)	-1.9(-.17)	-1.7(-.15)	-.7(-.06)	.835	.867	.879	.899

22010-22

SUMMARY SHEET

RUN NO. 22112

DATE: 3/26/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.181 (0.398)
2. Water flow - [kg/sec (lb/sec)] - 0.045 (0.100)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{o}C (^{o}F)] - 156 (313)
5. Water temperature [^{o}C (^{o}F)] - 124 (256)
6. Mixer pressure [kPa (psig)] - 200 (29)
7. Test time (sec) - 1440.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.4 (34.0)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	261 (501)
0.15 (0.50)	260 (518)
0.30 (1.00)	274 (525)
0.46 (1.50)	272 (522)
0.61 (2.00)	272 (522)
1.22 (4.00)	-
3.05 (10.00)	274 (525)
6.09 (20.00)	273 (524)
8.23 (27.00)	-
10.67 (35.00)	273 (523)

SUMMARY SHEET (cont)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 4.93 (10.87)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 2.28 (5.02)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 1.78 (3.92)

D. FAILED BUNDLE T/Cs[1]

294, 295, 305, 309, 310, 311, 326, 332, 549, 553, 564, 565, 568, 569

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

1. From primary side energy balance [kwsec(Btu)] - 0.657×10^5 (0.625×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da dt$) - [kwsec(Btu)] - 0.627×10^5 (0.597×10^5)
3. Integration to 600 sec

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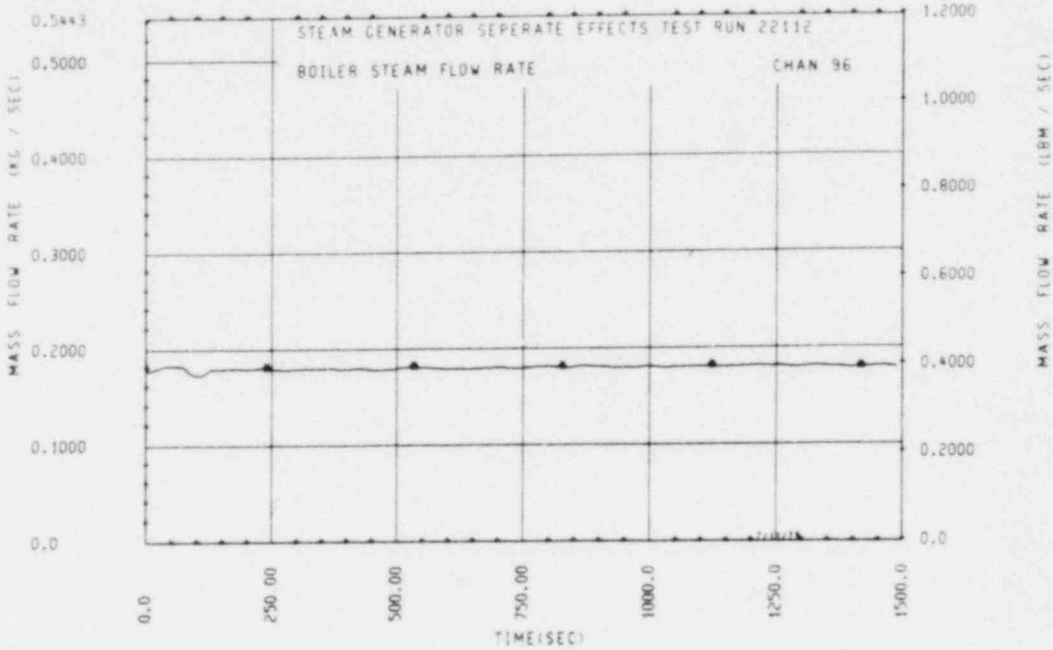
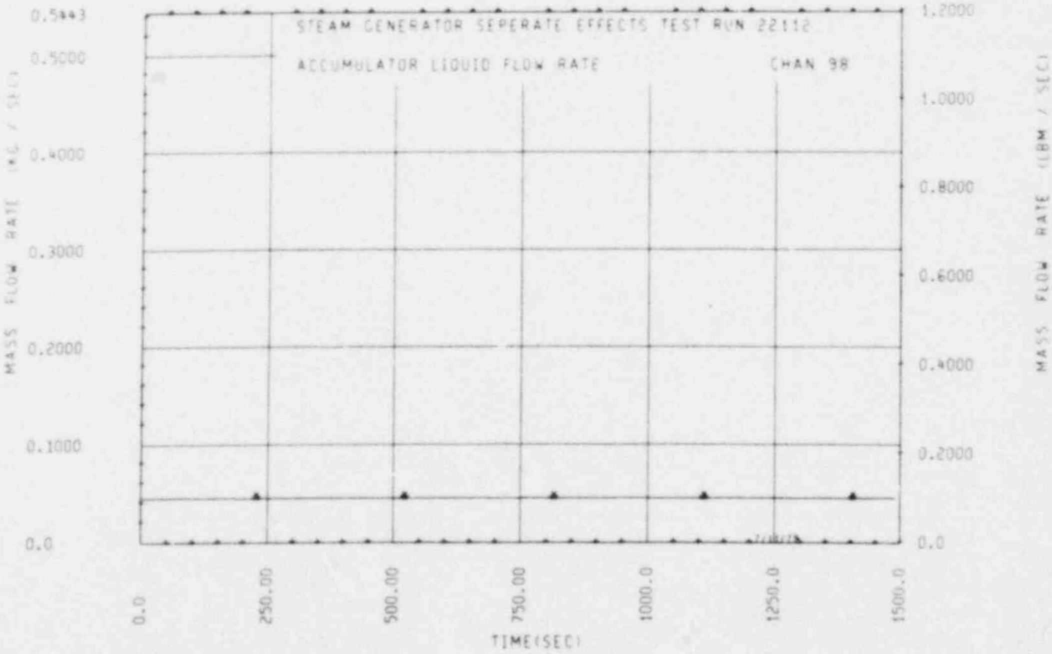
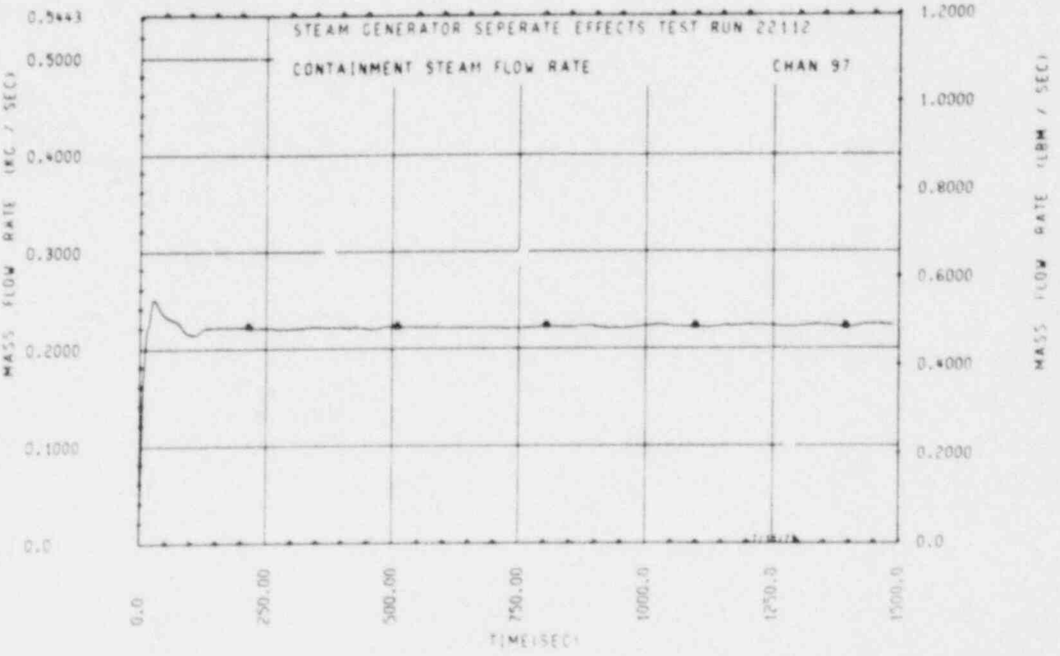
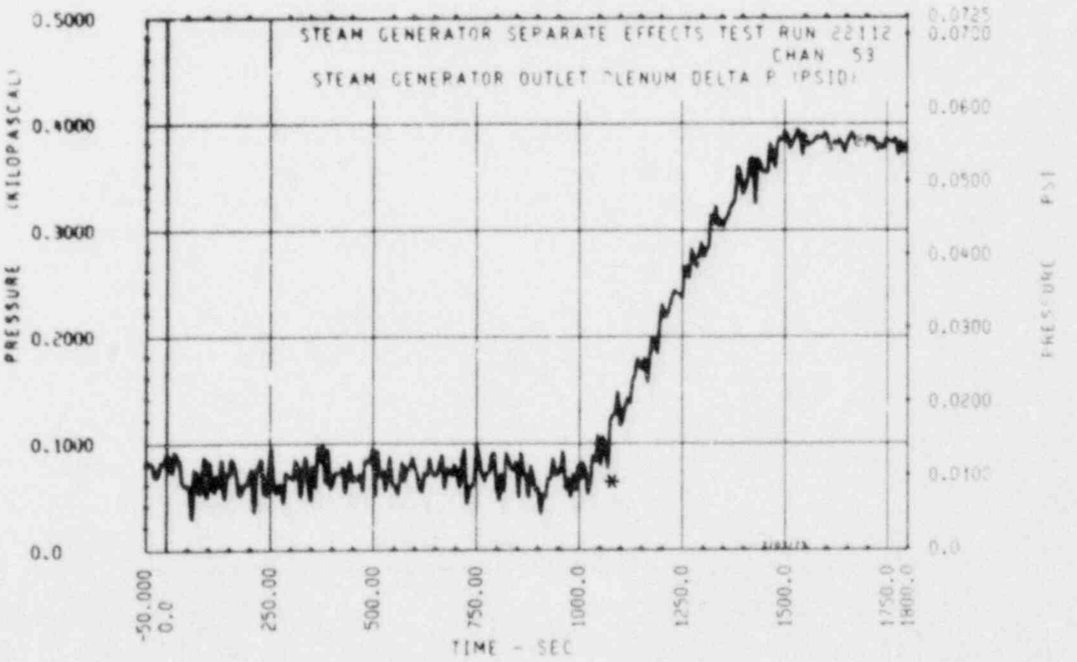
1. T/Cs are defined as failed based on resistance reading or T/C response.

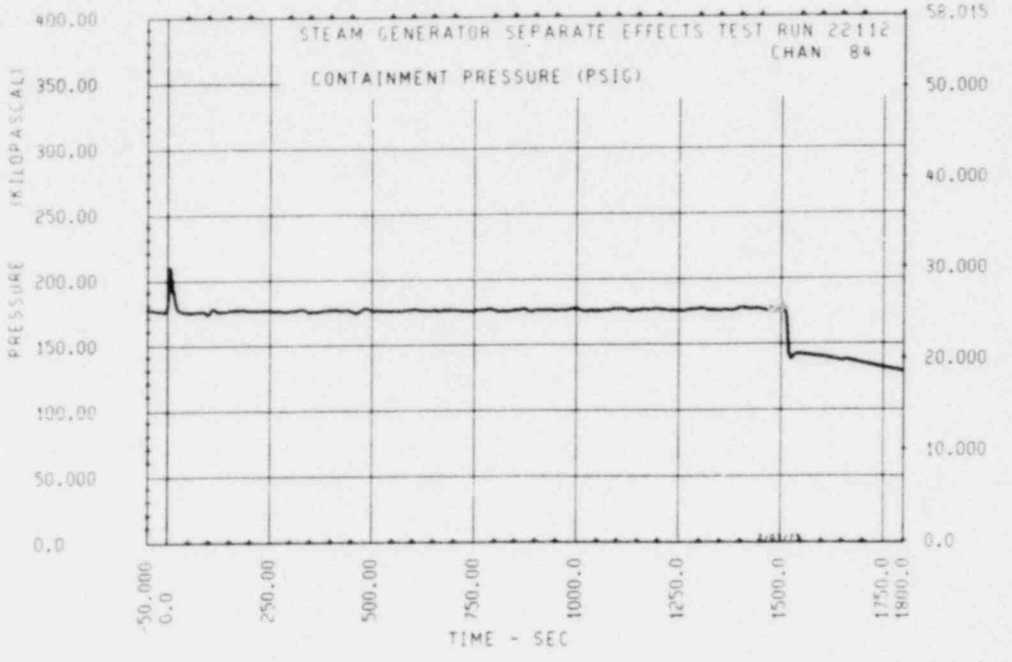

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22112
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

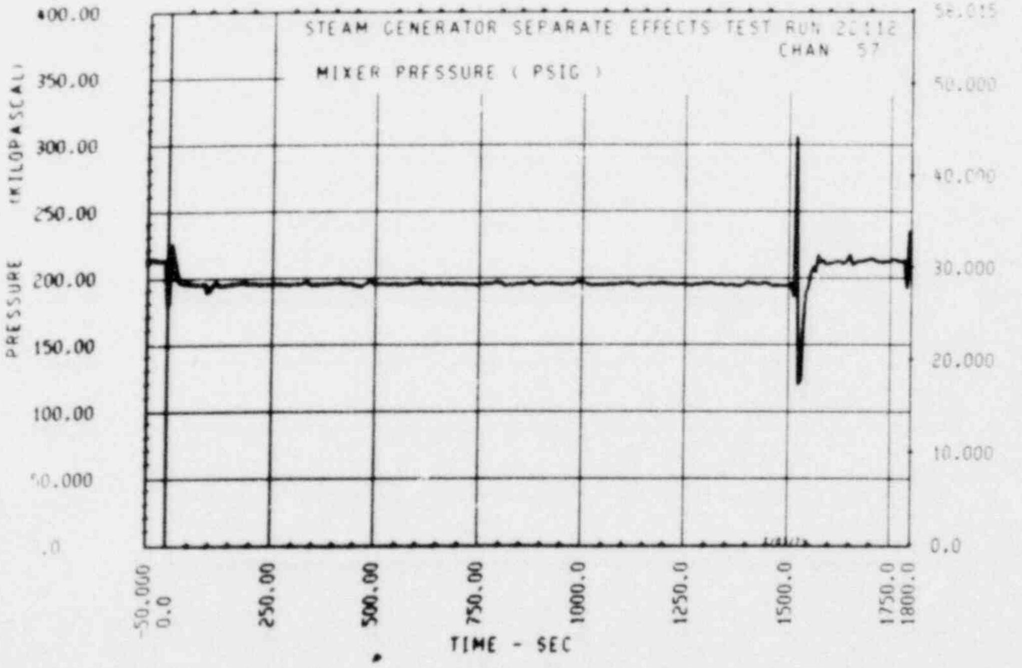

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22112
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

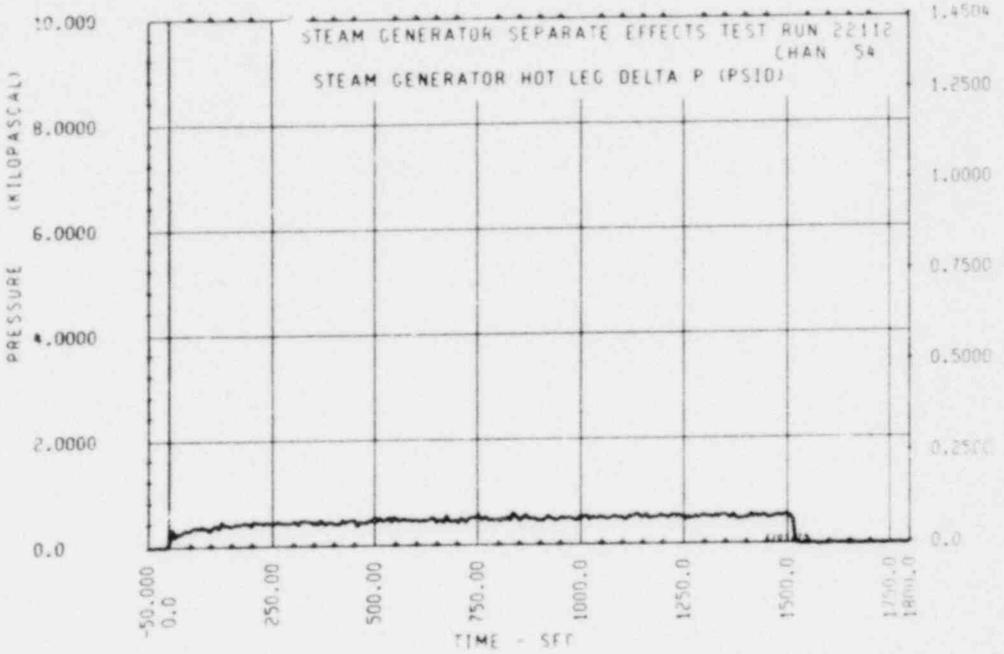




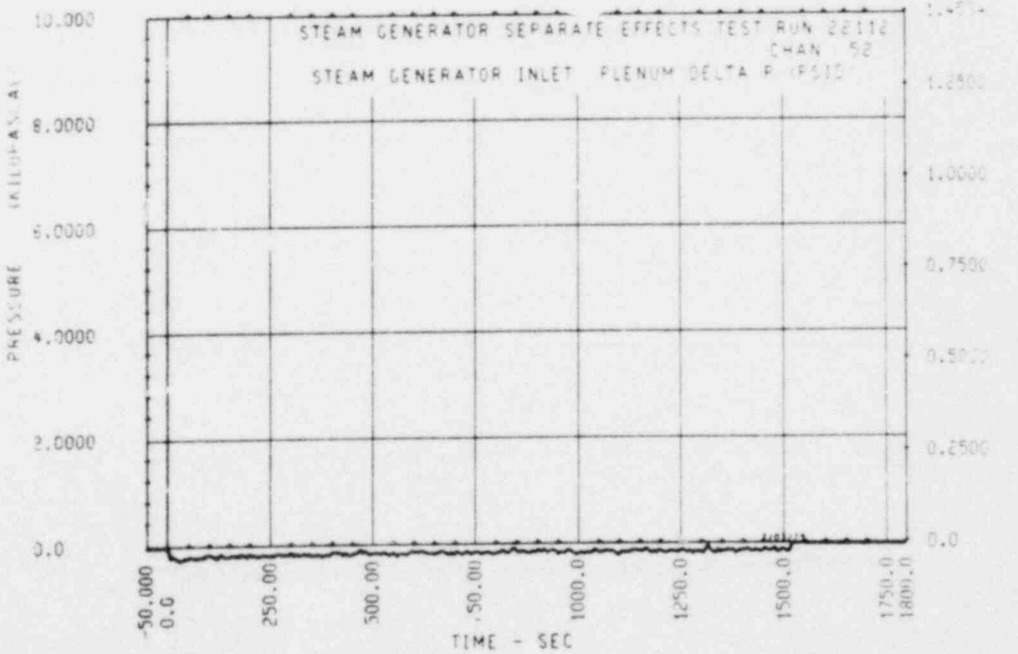
* Refer to Appendix H text for explanation of delayed response.


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22112
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

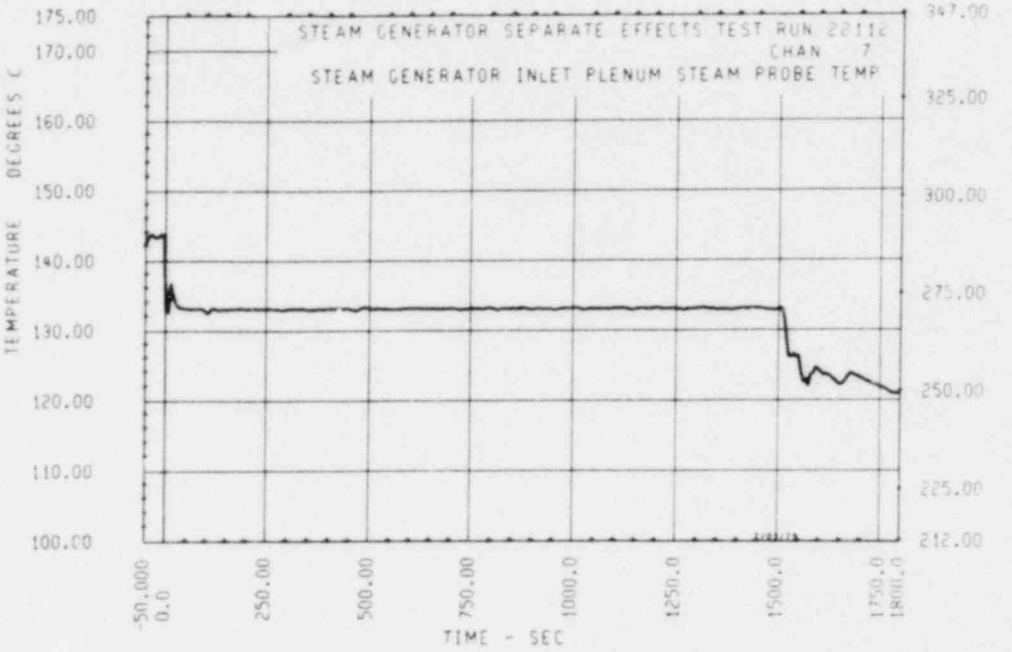

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22112
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

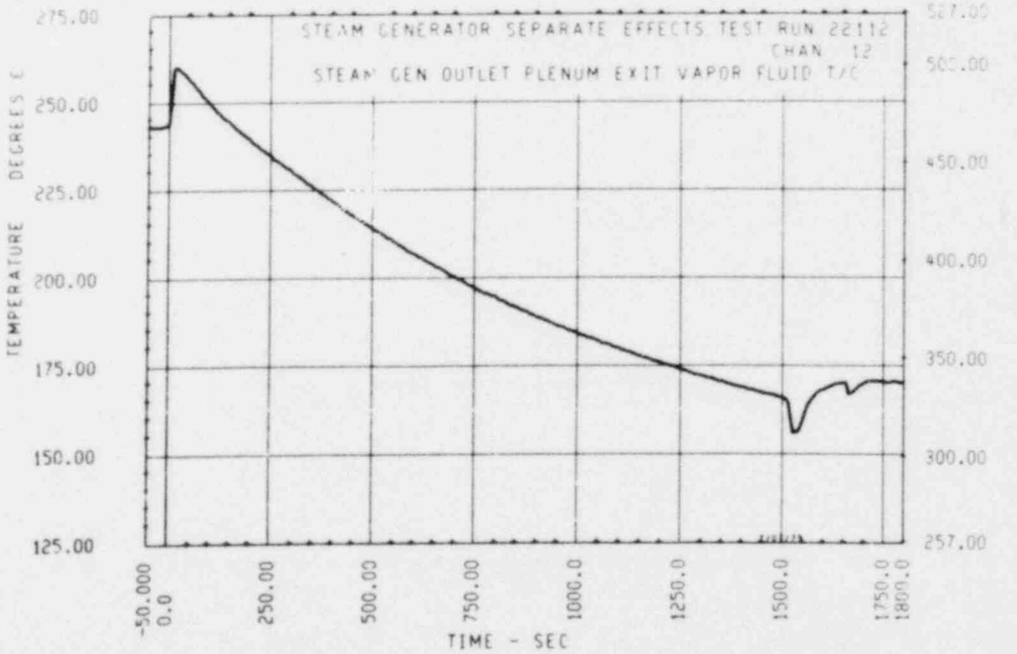


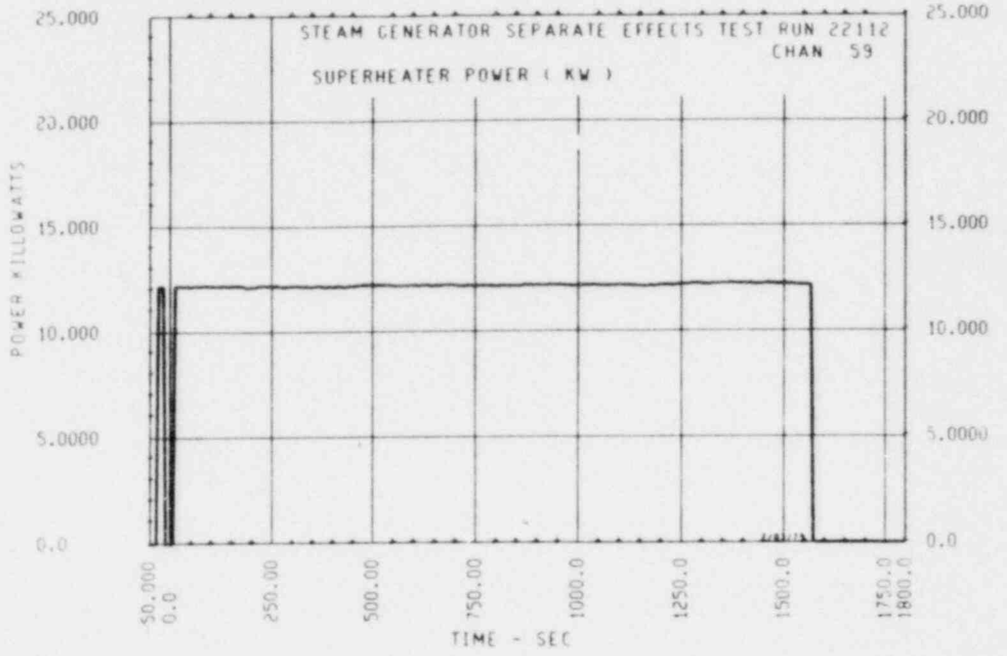
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22112
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

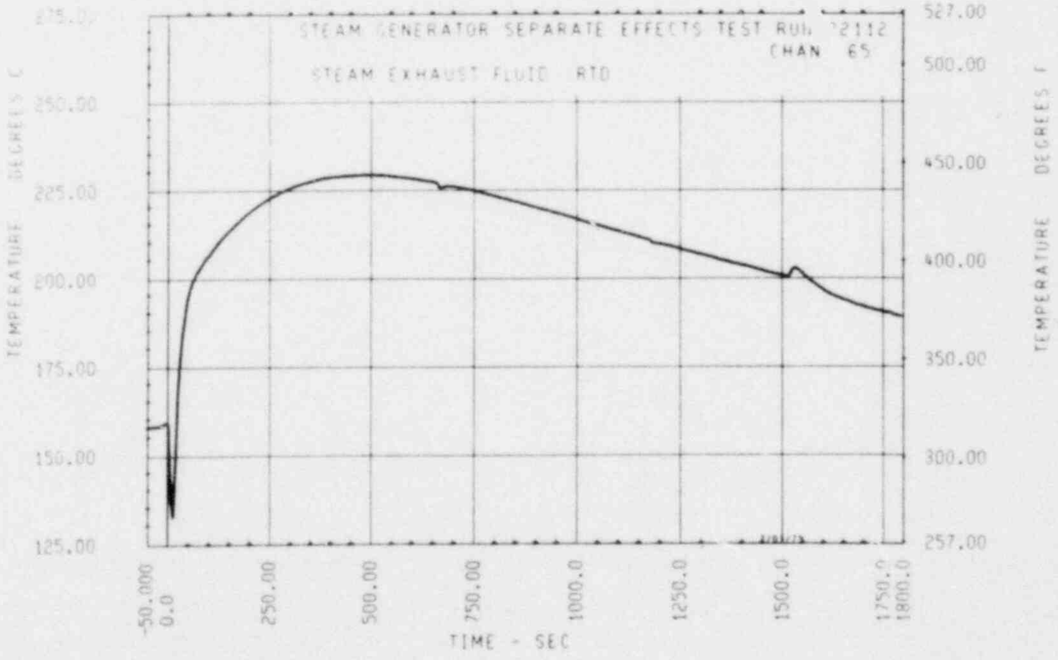


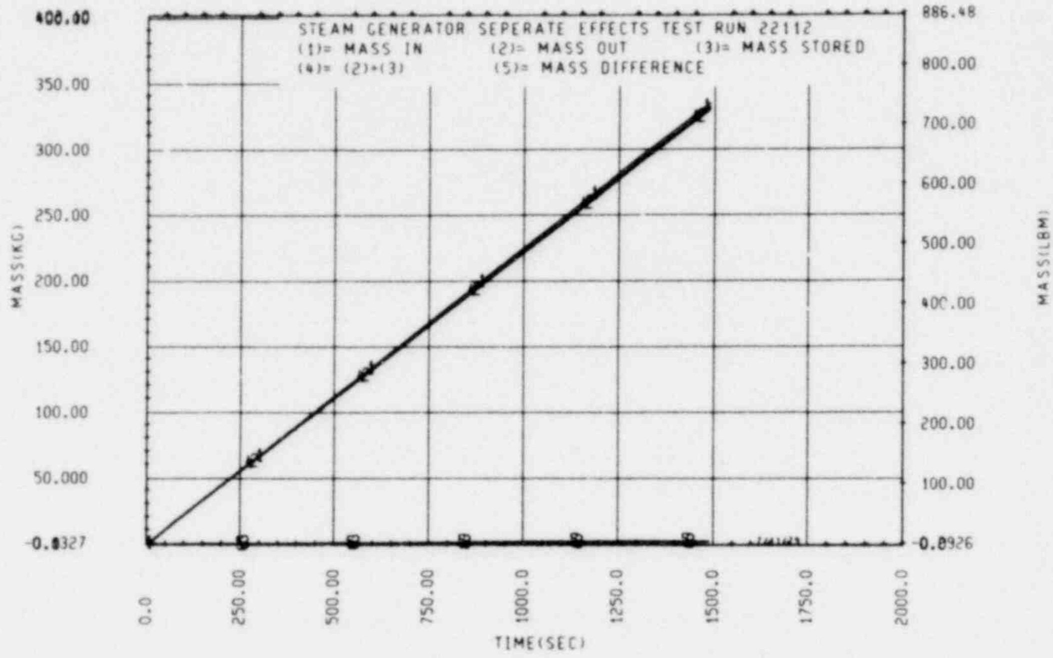
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22112
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22112
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
175.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
347.00
325.00
300.00
275.00
250.00
225.00
212.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

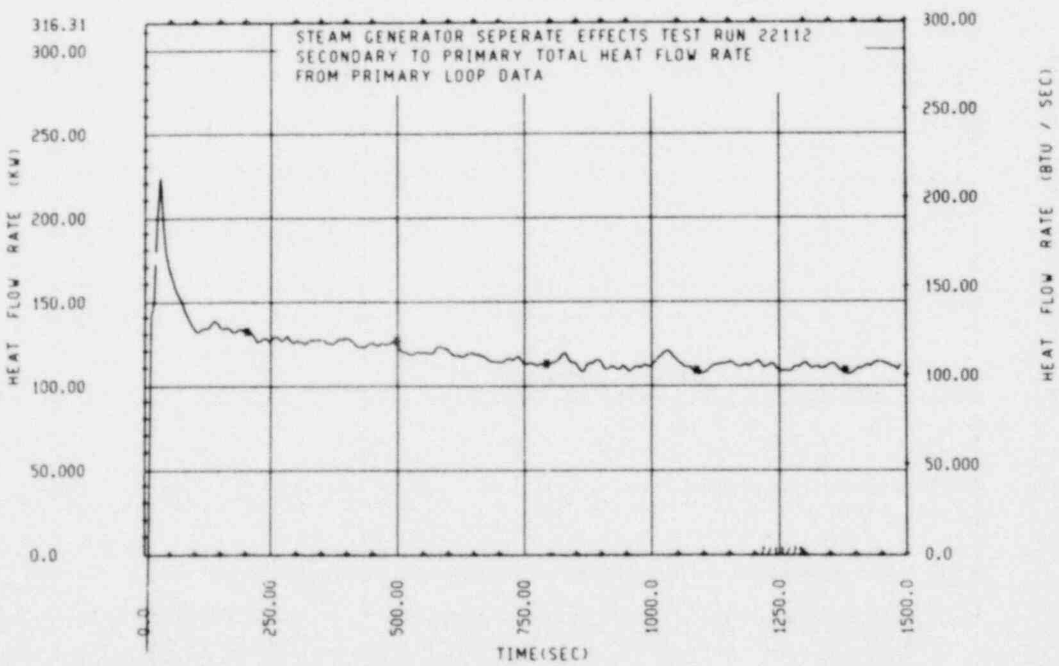

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22112
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22112
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
TIME - SEC

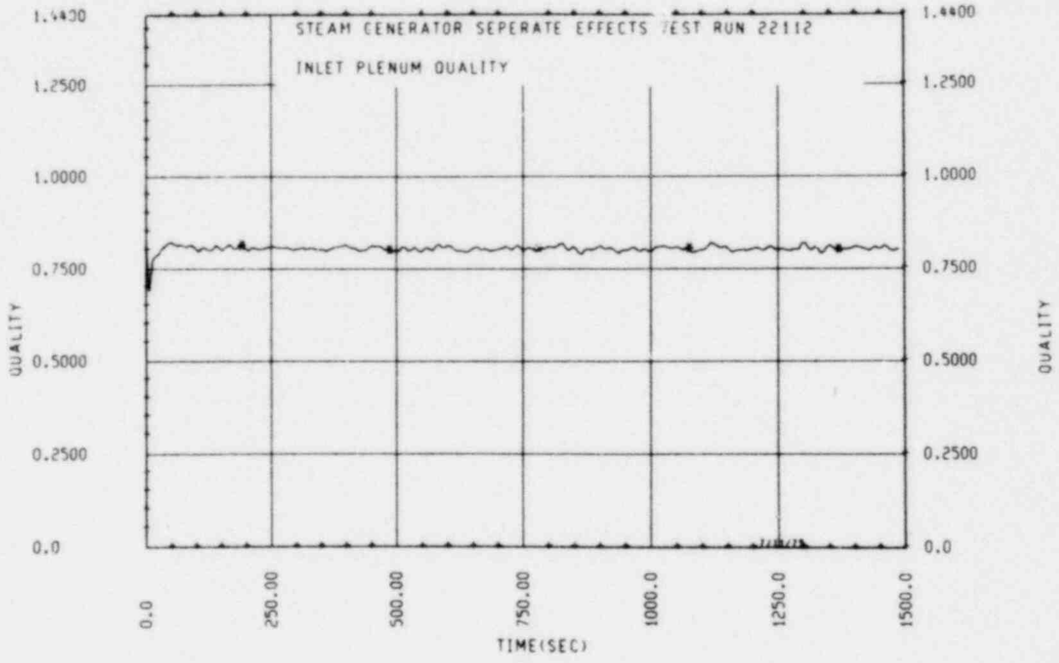

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22112
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC



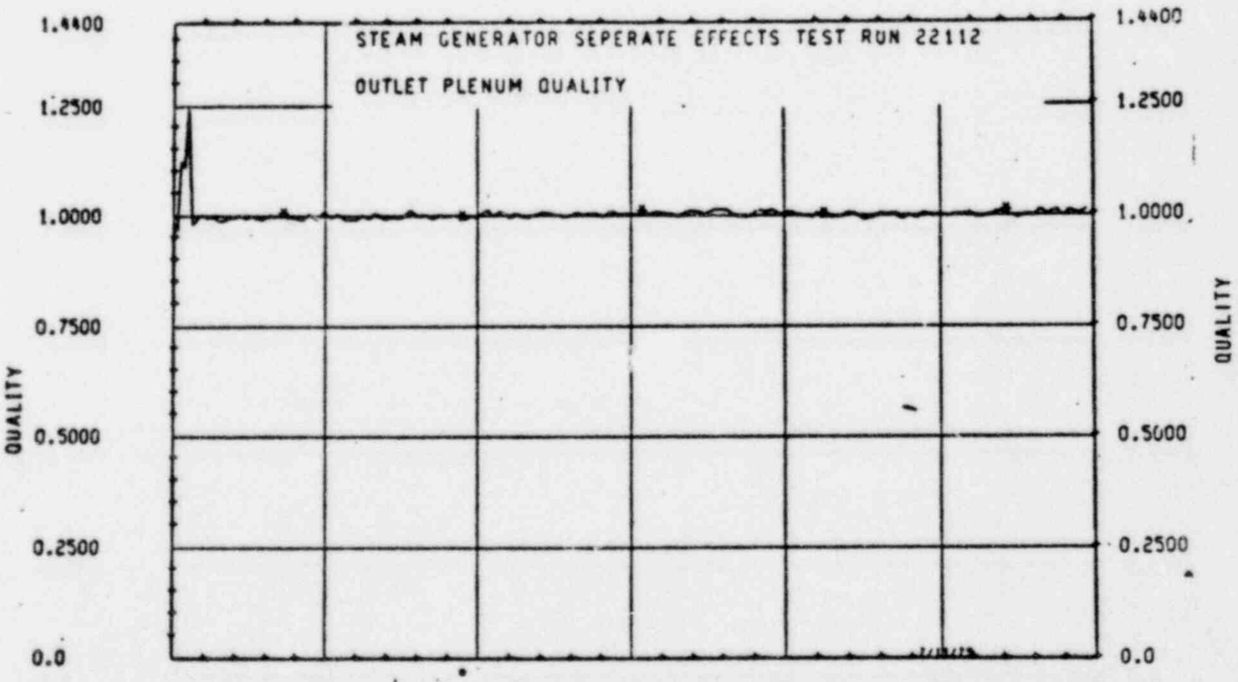
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22112
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)



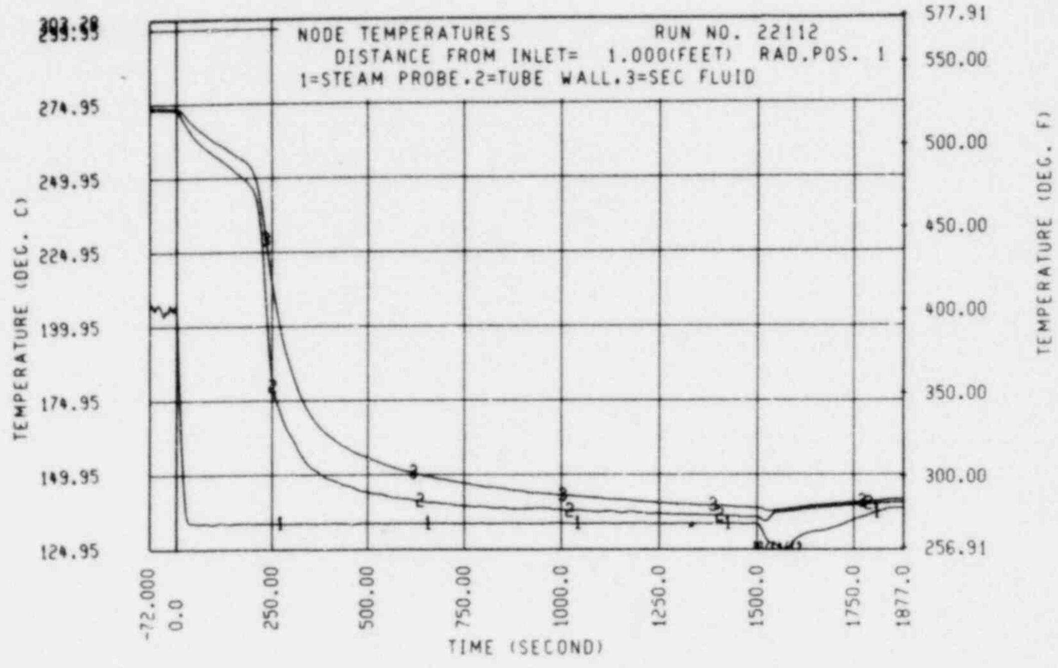
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22112
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)

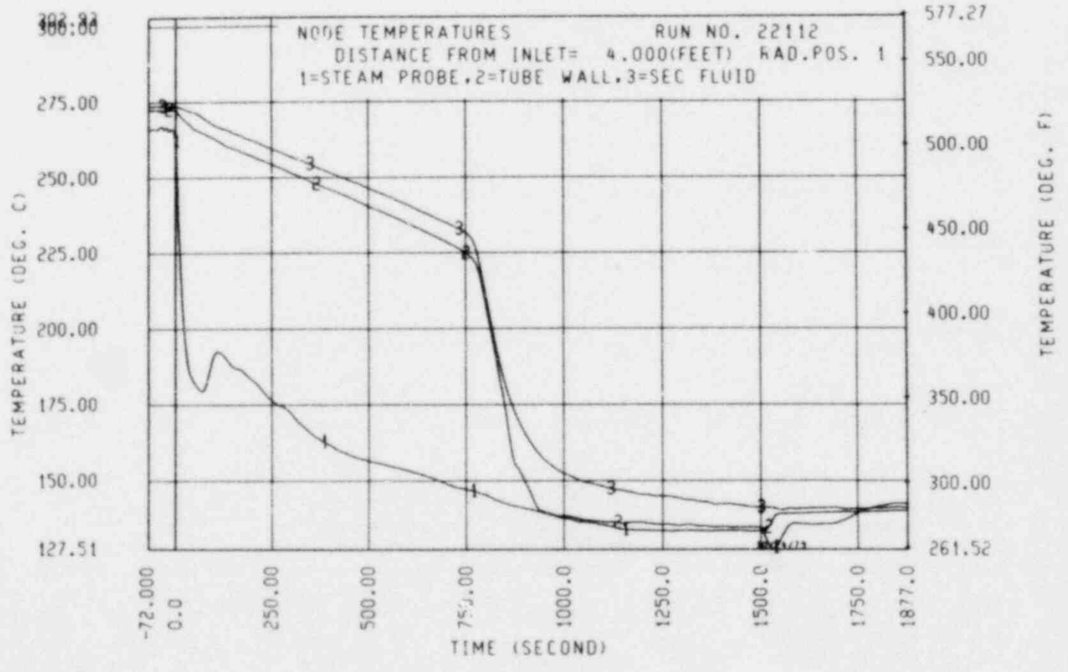


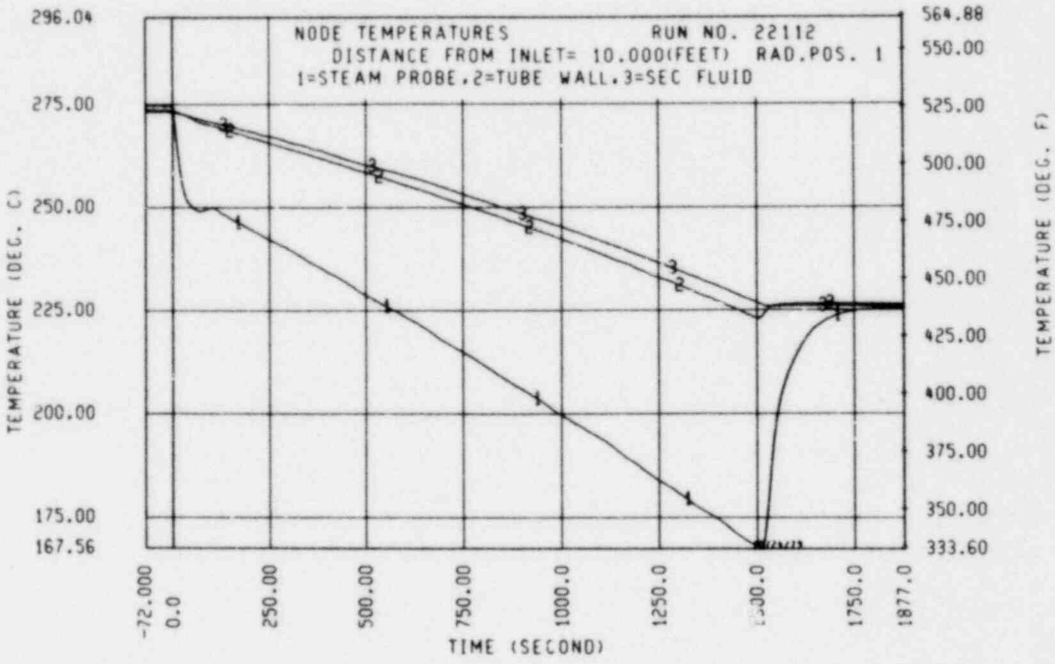
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22112
INLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

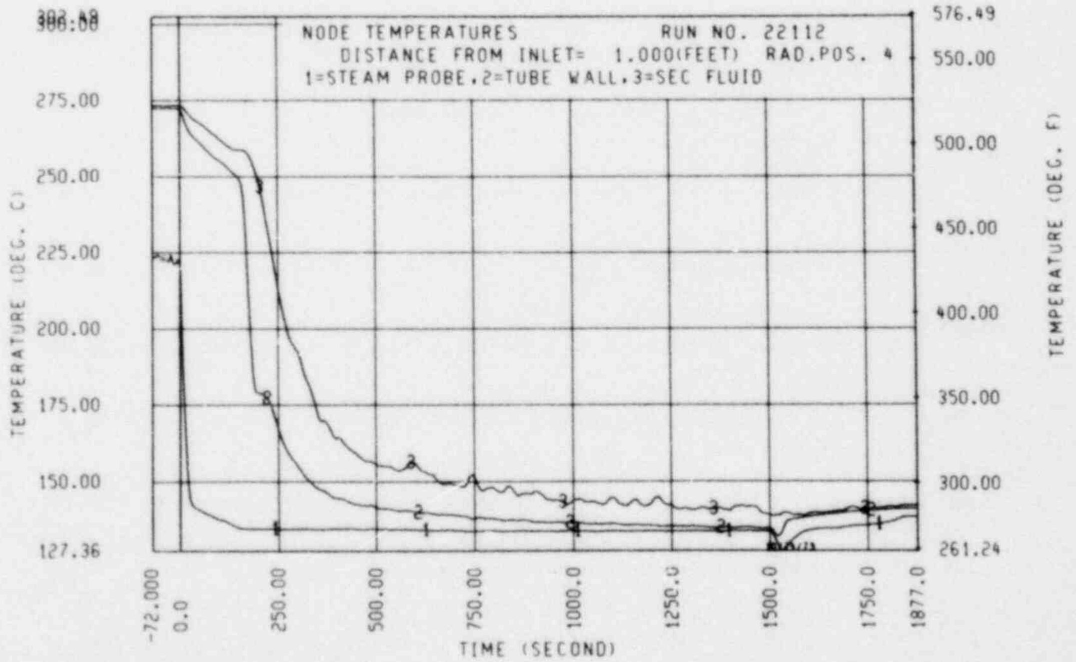


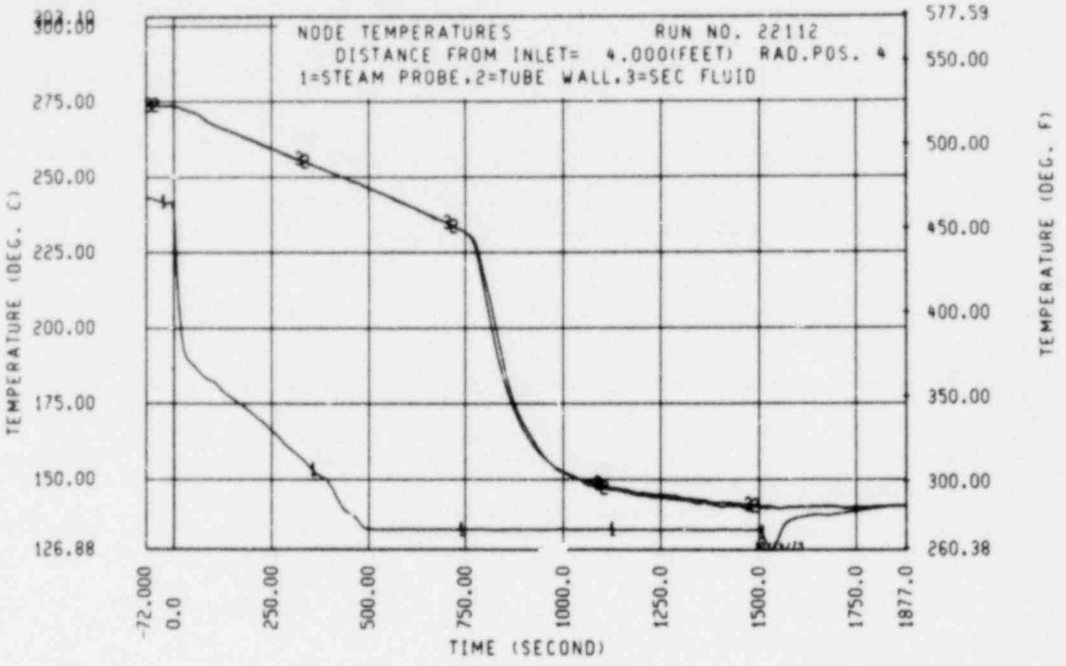
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22112
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

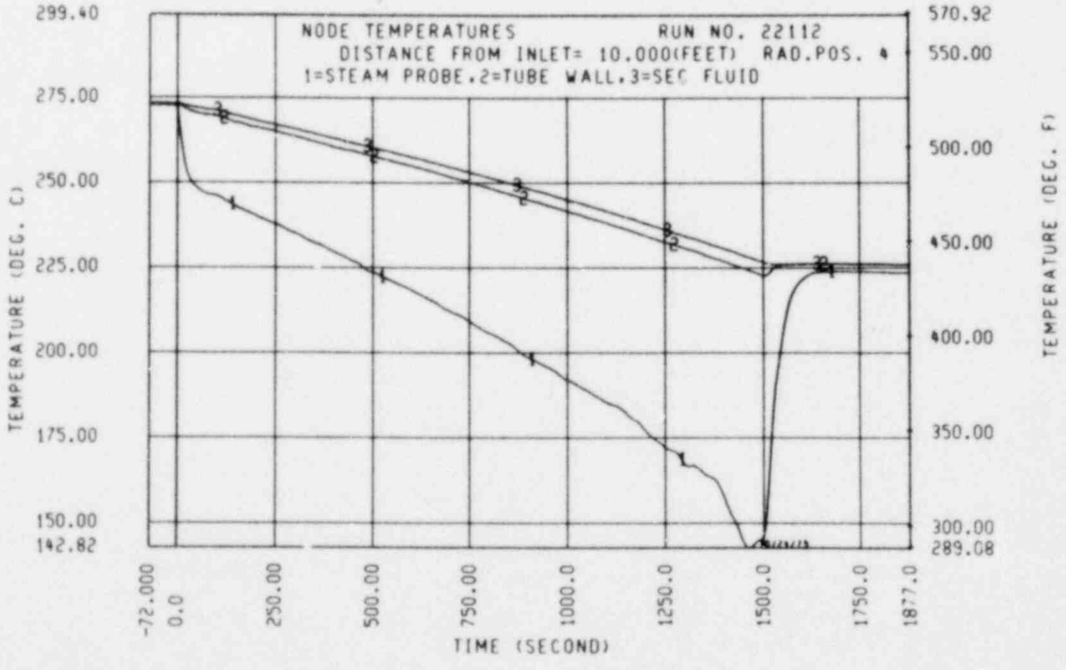

NODE TEMPERATURES
RUN NO. 22112
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
274.95
249.95
224.95
199.95
174.95
149.95
124.95
577.91
550.00
500.00
450.00
400.00
350.00
300.00
256.91
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1877.0


NODE TEMPERATURES
RUN NO. 22112
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
127.51
577.27
550.00
500.00
450.00
400.00
350.00
300.00
261.52
-72.000
0.0
250.00
500.00
1000.0
1250.0
1500.0
1750.0
1877.0

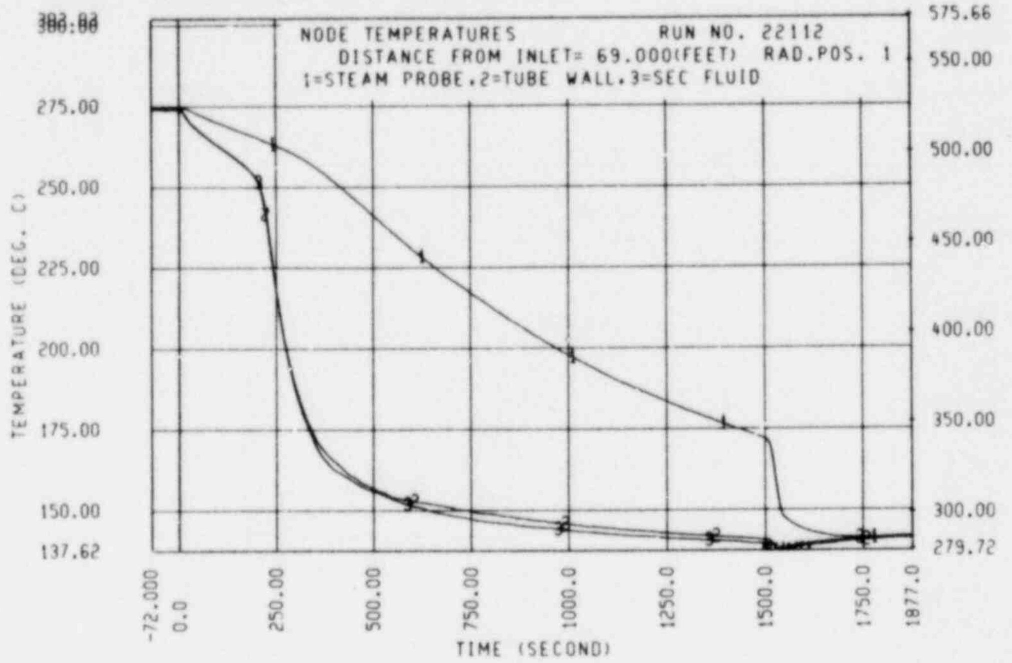

NODE TEMPERATURES
RUN NO. 22112
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
296.04
275.00
250.00
225.00
200.00
175.00
167.56
564.88
550.00
525.00
500.00
475.00
450.00
425.00
400.00
375.00
350.00
333.60
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1750.0
1877.0


NODE TEMPERATURES
RUN NO. 22112
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
127.36
576.49
550.00
500.00
450.00
400.00
350.00
300.00
261.24
-72.000
0.0
250.00
500.00
750.00
1000.0
1500.0
1750.0
1877.0

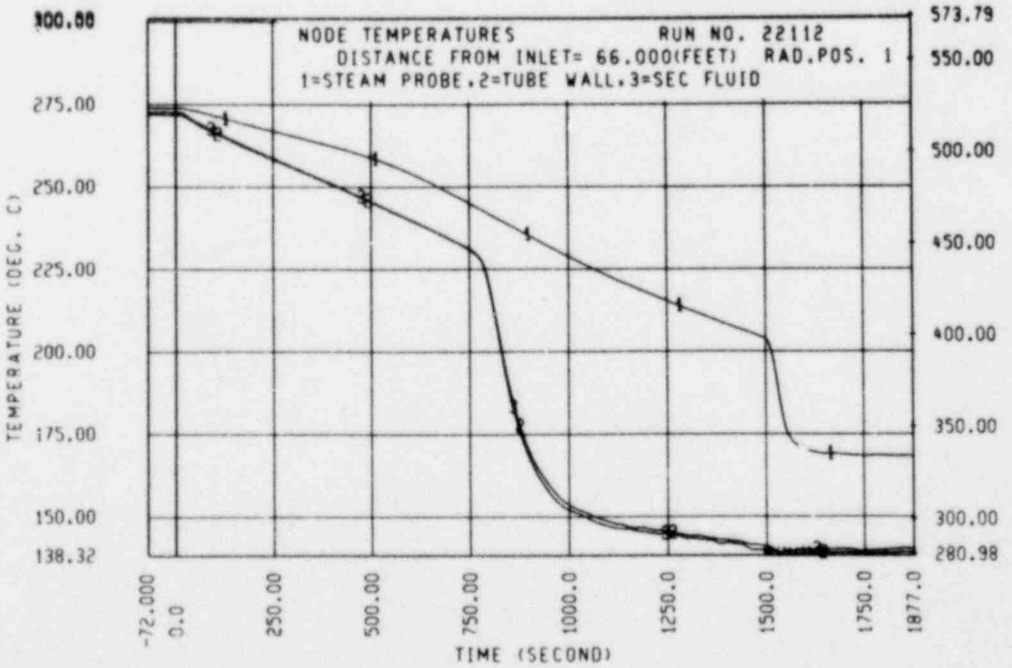

NODE TEMPERATURES RUN NO. 22112
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22112
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

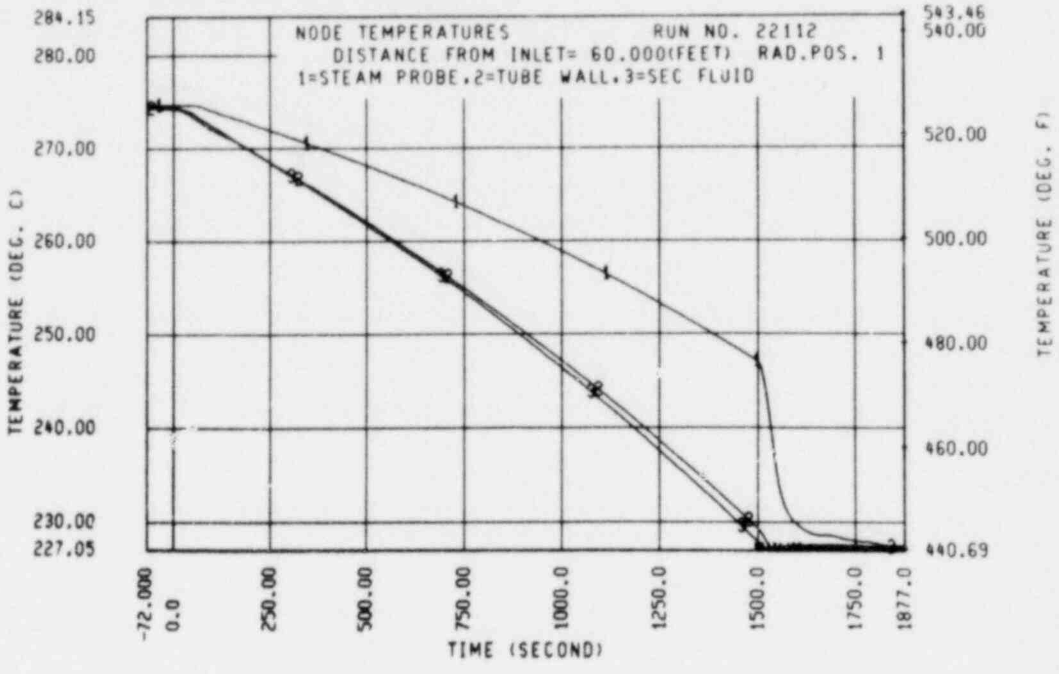
22112-13

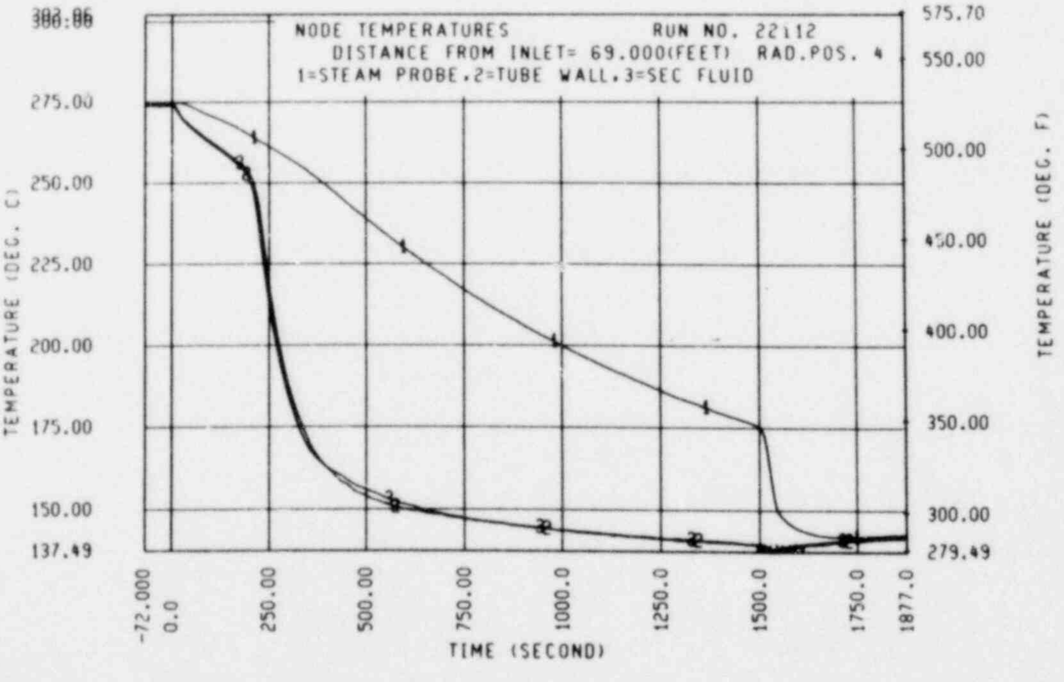


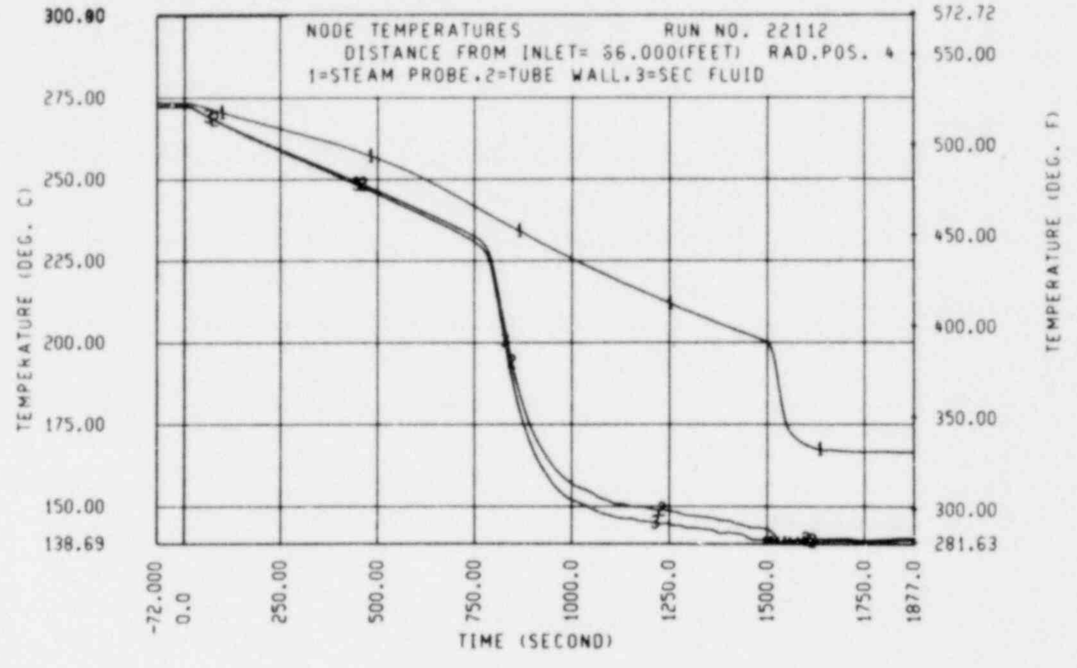
NODE TEMPERATURES RUN NO. 22112
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
137.62
575.66
550.00
500.00
450.00
400.00
350.00
300.00
279.72
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1877.0

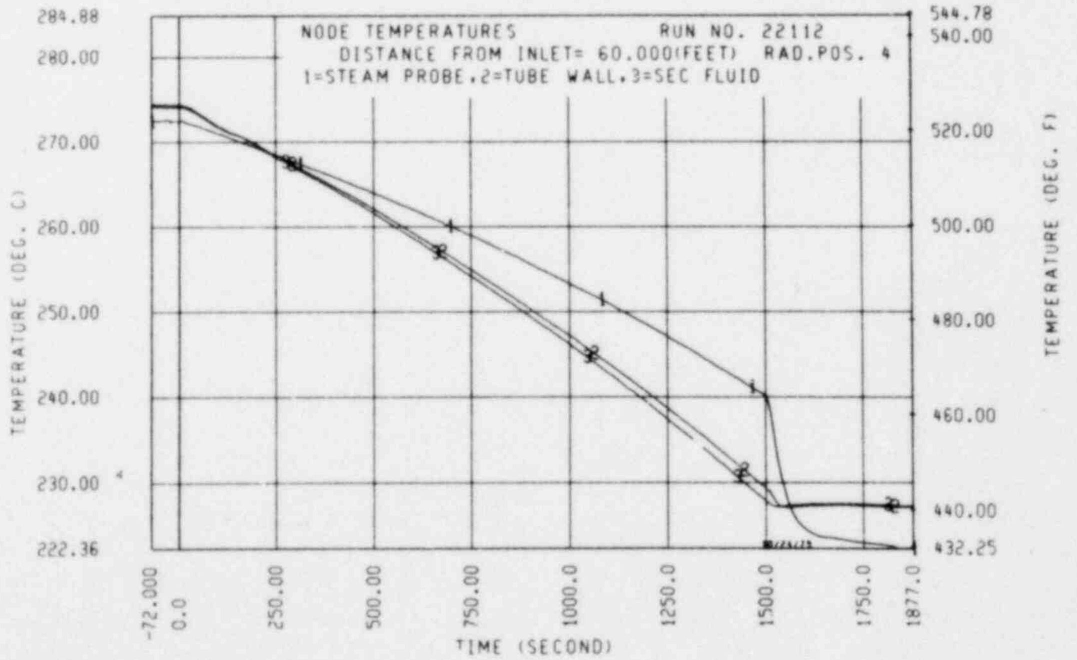


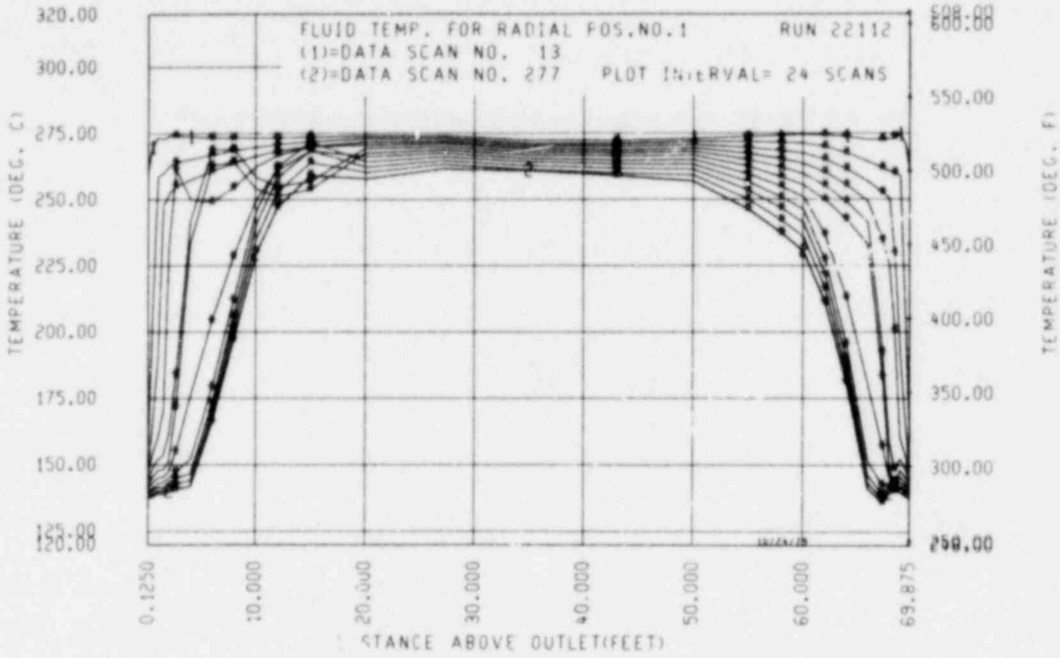
NODE TEMPERATURES RUN NO. 22112
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
300.00
275.00
250.00
225.00
200.00
175.00
150.00
138.32
573.79
550.00
500.00
450.00
400.00
350.00
300.00
280.98
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1877.0

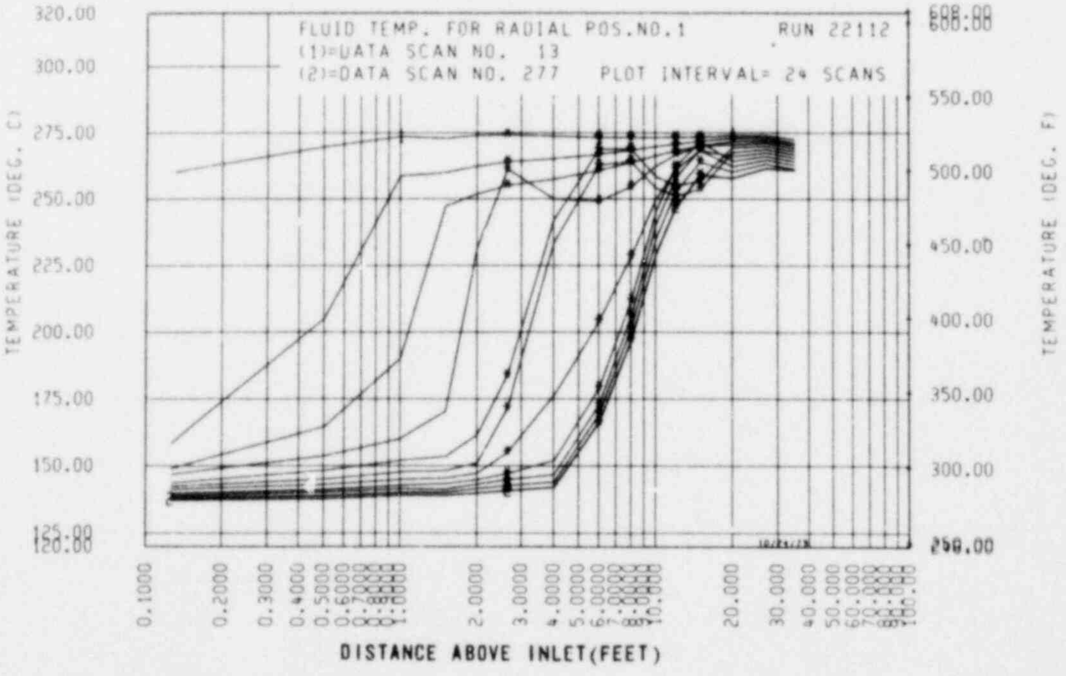

NODE TEMPERATURES
RUN NO. 22112
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
284.15
280.00
270.00
260.00
250.00
240.00
230.00
227.05
543.46
540.00
520.00
500.00
480.00
460.00
440.69
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1877.0

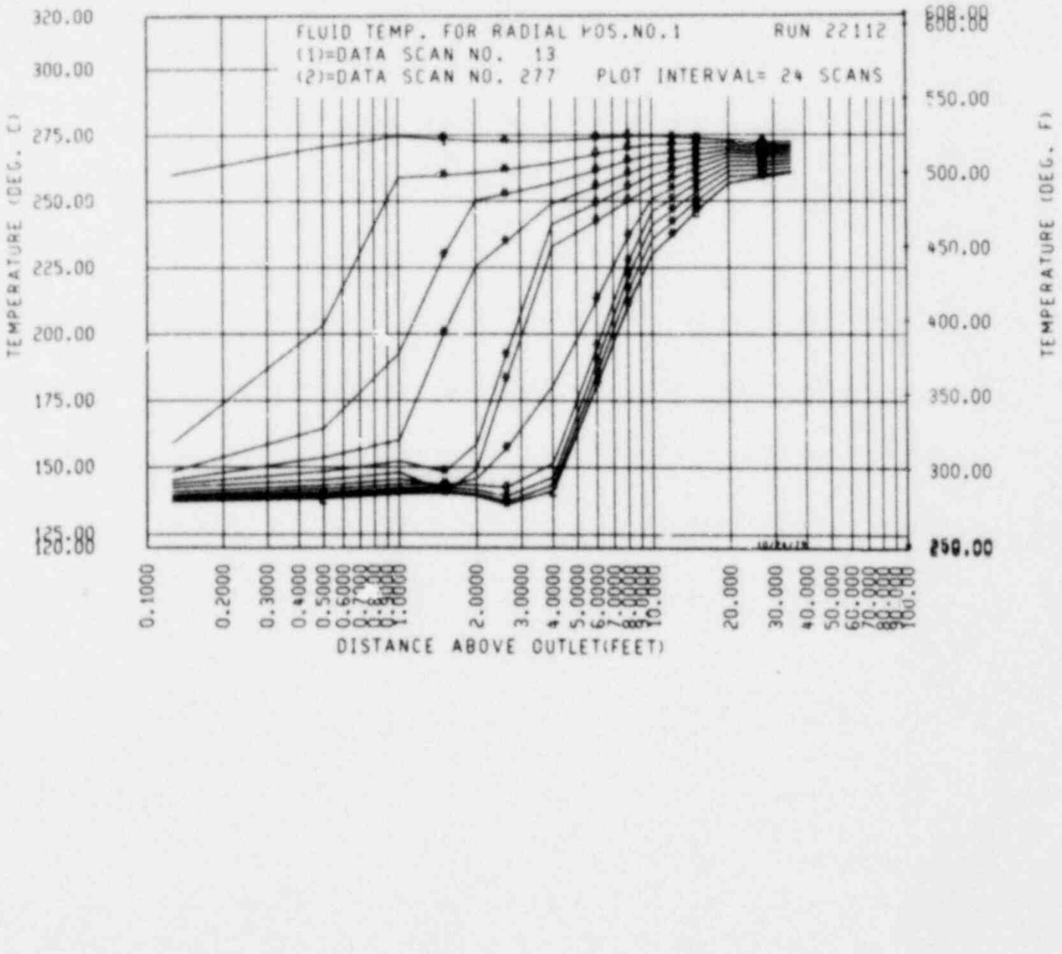

NODE TEMPERATURES
RUN NO. 22112
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
137.49
575.70
550.00
500.00
450.00
400.00
350.00
300.00
279.49
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1877.0


NODE TEMPERATURES RUN NO. 22112
DISTANCE FROM INLET= 56.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22112
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22112
(1)=DATA SCAN NO. 13
(2)=DATA SCAN NO. 277
PLOT INtERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)
0.1250
10.000
20.000
30.000
40.000
50.000
60.000
69.875


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22112
(1)=DATA SCAN NO. 13
(2)=DATA SCAN NO. 277
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)



FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22112
(1)=DATA SCAN NO. 13
(2)=DATA SCAN NO. 277
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22112

TIME = 114.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.4(.04)	31.8(2.80)	41.3(3.64)	23.9(2.11)	.282	.759	.843	.915
.2(.50)	23.0(2.03)	251.1(22.12)	323.3(28.49)	339.6(29.9[illegible])	.290	.844	.952	1.026
.3(1.00)	19.5(1.72)	27.2(2.39)	1.6(.14)	24.6(2.16)	.302	.930	1.055	1.137
.5(1.50)	5.8(.51)	-3.2(-.28)	-1.0(-.09)	-.7(-.07)	.306	.934	1.054	1.138
.6(2.00)	1.7(.15)	19.0(1.67)	5.1(.45)	10.2(.90)	.305	.935	1.055	1.135
.8(2.65)	1.6(.15)	56.0(4.93)	18.6(1.64)	14.1(1.24)	.303	.963	1.062	1.135
1.2(4.00)	7.4(.65)	5.9(.52)	4.1(.37)	1.4(.13)	.307	.976	1.054	1.120
1.8(6.00)	3.5(.30)	3.2(.28)	2.3(.20)	11.4(1.01)	.314	.953	1.020	1.107
2.4(8.00)	1.5(.13)	.7(.06)	.1(.01)	6.4(.56)	.314	.935	.995	1.108
3.0(10.00)	.9(.08)	1.3(.11)	2.2(.20)	2.7(.23)	.313	.929	.989	1.103
3.7(12.00)	.6(.05)	1.7(.15)	2.6(.23)	.0(.00)	.313	.928	.989	1.097
4.6(15.00)	2.1(.19)	2.0(.17)	1.7(.15)	1.3(.11)	.317	.928	.988	1.093
6.1(20.00)	1.0(.09)	.9(.08)	.4(.04)	.5(.05)	.324	.929	.986	1.091
8.2(27.00)	.7(.06)	-.1(-.01)	-.4(-.03)	.5(.04)	.330	.929	.984	1.092
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.333	.929	.983	1.095
13.1(43.00)	-.8(-.07)	-.4(-.03)	.0(.00)	-.1(-.01)	.330	.929	.984	1.096
15.2(50.00)	-.0(-.00)	-.2(-.01)	-.0(-.00)	.1(.01)	.327	.927	.985	1.096
16.8(55.00)	.1(.01)	-.1(-.01)	-.0(-.00)	.1(.01)	.327	.926	.985	1.097
17.7(58.00)	.2(.01)	-.1(-.01)	.0(.00)	.1(.01)	.328	.926	.986	1.098
18.3(60.00)	.3(.03)	-.2(-.02)	.0(.00)	.0(.00)	.329	.925	.988	1.099
18.9(62.00)	.5(.05)	.0(.00)	.1(.01)	.0(.00)	.330	.926	.989	1.100
19.5(64.00)	.1(.01)	.2(.02)	.1(.01)	-.0(-.00)	.331	.927	.990	1.101
20.1(66.00)	.3(.03)	1.1(.10)	.3(.03)	-.1(-.01)	.332	.930	.991	1.100
20.5(67.36)	-.0(-.00)	.4(.03)	-.2(-.02)	-.7(-.06)	.333	.932	.991	1.100
20.7(68.00)	.5(.04)	-.2(-.01)	.0(.00)	.0(.00)	.333	.933	.991	1.100
20.9(68.50)	-.2(-.02)	-.2(-.02)	-1.2(-.11)	-.5(-.04)	.334	.932	.990	1.100
21.0(69.00)	-.2(-.02)	-.3(-.02)	-.2(-.02)	-.3(-.02)	.334	.932	.989	1.100
21.2(69.50)	-1.7(-.15)	1.2(.10)	-1.6(-.14)	-13.7(-1.21)	.336	.933	.989	1.097
21.3(69.87)	-16.7(-1.47)	-8.4(-.74)	-8.4(-.74)	-5.5(-.48)	.335	.933	.989	1.094

22112-19

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22112

TIME = 294.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.02)	16.1(1.42)	12.6(1.11)	8.7(.76)	.286	.760	.841	.914
.2(.50)	52.0(4.58)	55.4(4.88)	56.8(5.01)	57.7(5.08)	.332	.760	.863	.932
.3(1.00)	112.0(9.87)	142.3(12.54)	4.1(.36)	153.5(13.52)	.352	.840	.874	.947
.5(1.50)	1.5(.13)	1.5(.13)	208.2(18.34)	1.5(.13)	.386	.883	.944	1.045
.6(2.00)	1.5(.14)	21.2(1.87)	7.0(.62)	14.2(1.25)	.384	.880	1.009	1.049
.8(2.65)	1.6(.14)	-149.1(-13.14)	-18.4(-1.62)	-23.5(-2.07)	.382	.822	.999	1.037
1.2(4.00)	9.0(.79)	7.0(.62)	5.1(.45)	1.5(.14)	.387	.746	.977	1.006
1.8(6.00)	21.3(1.88)	26.0(2.29)	21.4(1.88)	28.5(2.51)	.413	.761	.976	1.014
2.4(8.00)	12.6(1.11)	19.9(1.76)	1.0(.09)	20.4(1.80)	.444	.797	.980	1.040
3.0(10.00)	2.7(.24)	3.6(.32)	4.8(.42)	4.0(.35)	.455	.815	.975	1.060
3.7(12.00)	-1.2(-.10)	-.7(-.06)	1.4(.12)	-1.7(-.15)	.453	.813	.973	1.052
4.6(15.00)	2.1(.19)	-.0(-.00)	.2(.01)	-.7(-.06)	.454	.806	.966	1.039
6.1(20.00)	1.2(.11)	1.2(.11)	.1(.01)	.8(.07)	.450	.803	.959	1.032
8.2(27.00)	.7(.06)	-.0(-.00)	-.5(-.04)	.4(.04)	.466	.804	.953	1.033
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.459	.803	.952	1.035
13.1(43.00)	-.9(-.08)	-.4(-.04)	.0(.00)	-.1(-.01)	.455	.802	.954	1.036
15.2(50.00)	-.0(-.00)	-.2(-.02)	-.0(-.00)	.2(.01)	.452	.800	.954	1.037
16.8(55.00)	.0(.00)	-.2(-.01)	-.0(-.00)	.1(.01)	.462	.799	.954	1.038
17.7(58.00)	-.0(-.00)	-.2(-.01)	-.1(-.01)	-.0(-.00)	.463	.799	.956	1.039
18.3(60.00)	-.1(-.01)	-.3(-.03)	-.2(-.01)	-.1(-.01)	.453	.799	.957	1.041
18.9(62.00)	-.1(-.01)	-.0(-.00)	-.1(-.01)	-.2(-.02)	.453	.800	.959	1.042
19.5(64.00)	.0(.00)	.1(.01)	.0(.00)	-.2(-.02)	.454	.801	.960	1.043
20.1(66.00)	.1(.01)	1.0(.09)	.1(.01)	-.5(-.04)	.456	.805	.962	1.043
20.5(67.38)	-.2(-.01)	.1(.01)	-.5(-.04)	-1.3(-.11)	.457	.807	.962	1.042
20.7(68.00)	.3(.02)	.1(.01)	-.6(-.05)	-.5(-.04)	.457	.806	.962	1.042
20.9(68.50)	-1.0(-.09)	-1.1(-.10)	-6.3(-.56)	.0(.00)	.457	.808	.961	1.044
21.0(69.00)	2.7(.24)	2.2(.20)	.7(.06)	8.8(.77)	.470	.809	.960	1.049
21.2(69.50)	-18.4(-1.62)	-24.8(-2.19)	-19.5(-1.72)	-21.8(-1.92)	.470	.806	.957	1.049
21.3(69.67)	-7.2(-.63)	-4.7(-.41)	-4.7(-.42)	-3.9(-.34)	.459	.802	.953	1.044

22112-20

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22112

TIME = 594.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.1(.01)	7.3(.64)	7.3(.64)	4.6(.41)	.287	.759	.841	.913
.2(.50)	17.2(1.52)	21.0(1.85)	21.6(1.90)	18.4(1.62)	.292	.767	.848	.919
.3(1.00)	24.4(2.15)	23.0(2.02)	.2(.02)	38.3(3.38)	.305	.780	.855	.937
.5(1.50)	26.0(2.29)	21.6(1.90)	12.9(1.14)	31.4(2.77)	.320	.793	.859	.958
.6(2.00)	41.2(3.63)	38.0(3.35)	37.5(3.30)	33.2(2.92)	.341	.811	.874	.979
.8(2.65)	.6(.05)	71.2(6.27)	50.2(4.42)	28.4(2.50)	.352	.854	.909	1.002
1.2(4.00)	10.7(.94)	9.5(.84)	6.3(.56)	1.4(.12)	.350	.836	.931	1.008
1.8(6.00)	2.0(.17)	3.9(.34)	5.0(.44)	10.9(.96)	.368	.880	.922	.999
2.4(8.00)	1.1(.10)	1.7(.15)	-.6(-.06)	7.1(.63)	.354	.867	.904	.995
3.0(10.00)	4.4(.39)	5.2(.46)	5.4(.48)	5.3(.46)	.354	.853	.894	.990
3.7(12.00)	9.6(.85)	8.0(.70)	6.4(.57)	3.2(.28)	.376	.869	.896	.986
4.6(15.00)	6.8(.60)	4.6(.40)	4.9(.43)	4.5(.40)	.398	.879	.903	.988
6.1(20.00)	2.3(.20)	2.0(.18)	.8(.07)	1.2(.11)	.418	.887	.906	.991
8.2(27.00)	1.0(.08)	.1(.00)	-.4(-.04)	.5(.04)	.427	.857	.901	.991
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.431	.886	.900	.993
13.1(43.00)	-.8(-.07)	-.4(-.03)	.1(.01)	-.0(-.00)	.427	.885	.902	.995
15.2(50.00)	.1(.01)	-.1(-.01)	.1(.01)	.5(.04)	.425	.883	.903	.996
16.8(55.00)	.1(.01)	-.2(-.01)	-.0(-.00)	.2(.01)	.426	.883	.903	.999
17.7(58.00)	-.0(-.00)	-.2(-.02)	-.1(-.01)	-.0(-.00)	.426	.884	.905	1.001
18.3(60.00)	-.3(-.03)	-.5(-.05)	-.4(-.04)	-.4(-.03)	.427	.884	.907	1.004
18.9(62.00)	-.6(-.05)	-.1(-.01)	-.2(-.02)	-.6(-.05)	.427	.886	.910	1.005
19.5(64.00)	-.1(-.01)	.1(.01)	-.1(-.01)	-.6(-.06)	.428	.889	.913	1.007
20.1(66.00)	.0(.00)	1.1(.09)	.0(.00)	-1.1(-.10)	.430	.895	.917	1.009
20.5(67.38)	-3.9(-.34)	-3.1(-.27)	-3.9(-.35)	-8.4(-.74)	.430	.899	.918	1.006
20.7(68.00)	-12.4(-1.09)	-12.1(-1.07)	-12.7(-1.12)	-12.7(-1.12)	.426	.896	.915	1.002
20.9(68.50)	-10.5(-.93)	-11.9(-1.05)	-14.7(-1.29)	-9.3(-.82)	.422	.892	.911	1.001
21.0(69.00)	2.4(.22)	2.0(.18)	1.2(.11)	4.2(.37)	.423	.892	.911	1.007
21.2(69.50)	-15.5(-1.36)	-15.2(-1.34)	-14.6(-1.29)	-15.6(-1.38)	.425	.894	.911	1.009
21.3(69.87)	-2.8(-.25)	-2.9(-.25)	-2.5(-.22)	-1.3(-.12)	.424	.895	.909	1.005

22112-21

POOR ORIGINAL

SUMMARY SHEET

RUN NO. 22213

DATE: 3/27/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.358 (0.790)
2. Water flow - [kg/sec (lb/sec)] - 0.091 (0.201)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature[^{o}C (^{o}F)] - 165 (329)
5. Water temperature [^{o}C (^{o}F)] - 127 (261)
6. Mixer pressure[kPa (psig)] - 241 (35)
7. Test time (sec) - 1440.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.3 (33.7)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	268 (515)
0.15 (0.50)	272 (522)
0.30 (1.00)	274 (525)
0.46 (1.50)	272 (522)
0.61 (2.00)	272 (522)
1.22 (4.00)	-
3.05 (10.00)	274 (525)
6.09 (20.00)	273 (524)
8.23 (27.00)	-
10.67 (35.00)	273 (523)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 5.68 (12.52)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 0.9 (2.0)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 0.20 (0.44)

D. FAILED BUNDLE T/Cs[1]

294, 295, 305, 309, 310, 311, 326, 532, 549, 553, 564, 565, 568, 569

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

1. From primary side energy balance [kwsec(Btu)] - 0.748×10^5 (0.712×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da\,dt$) - [kwsec(Btu)] - 0.485×10^5 (0.462×10^5)
3. Integration to 300 sec

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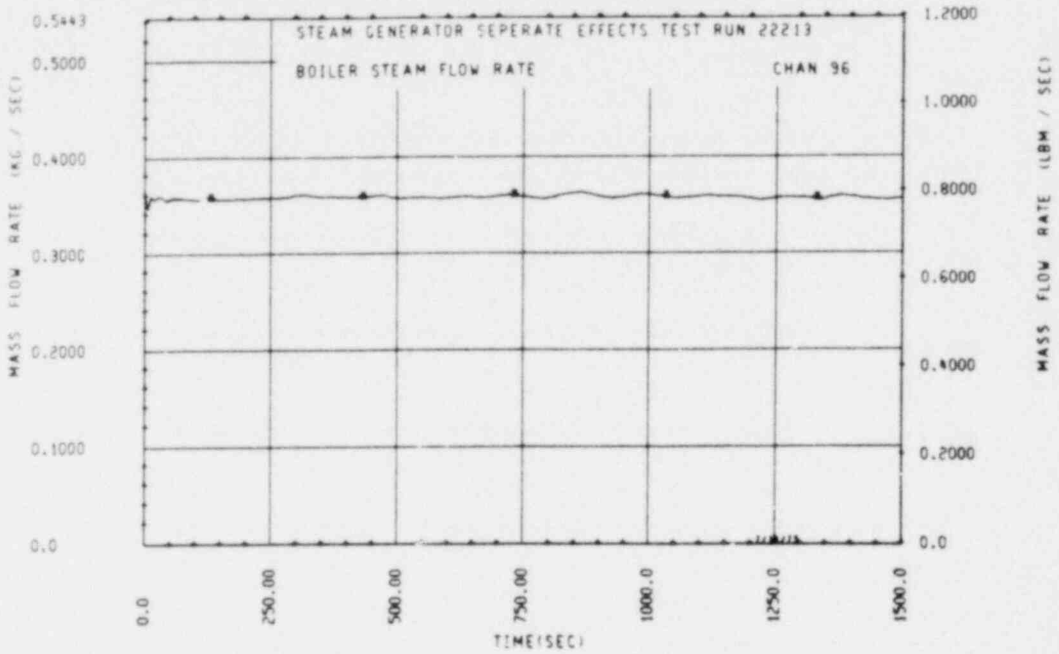
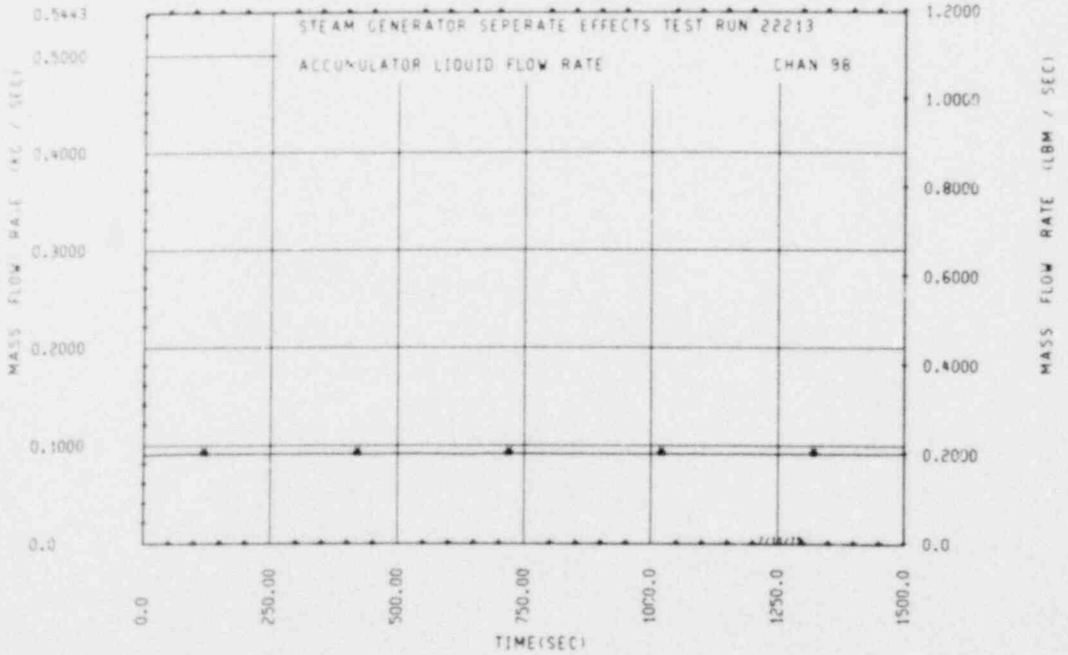
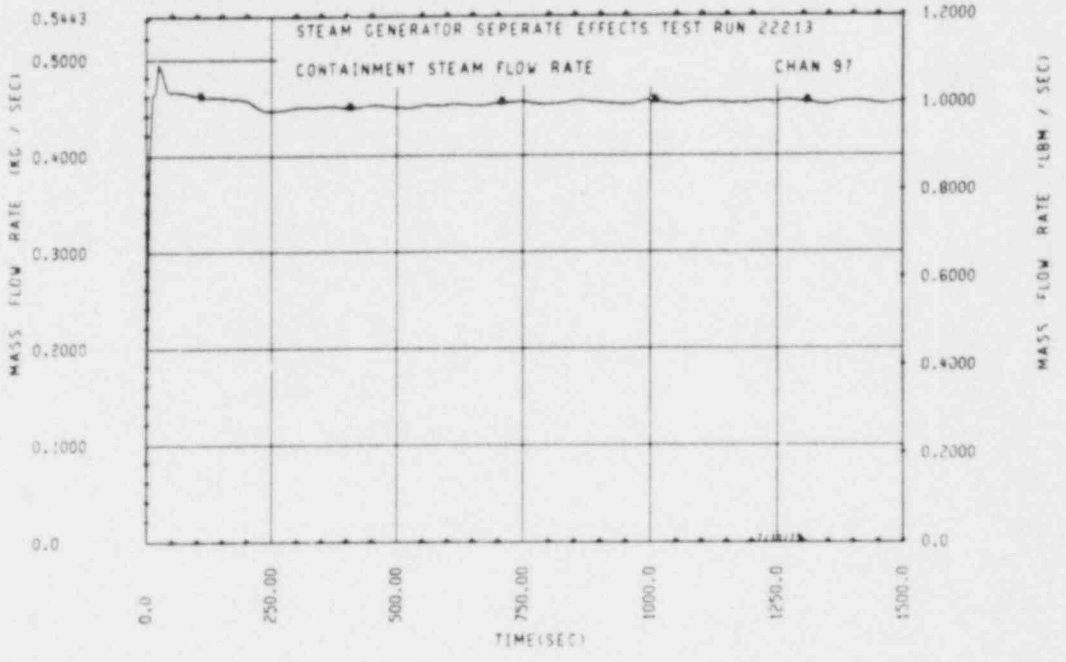
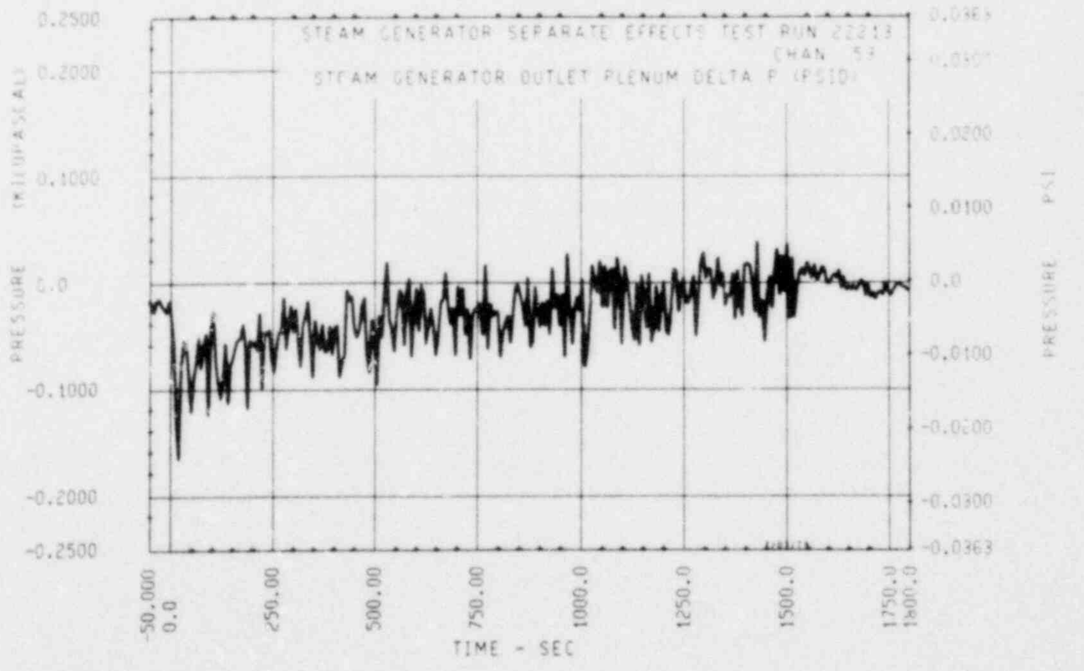
1. T/Cs are defined as failed based on resistance reading or T/C response.


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22213
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)

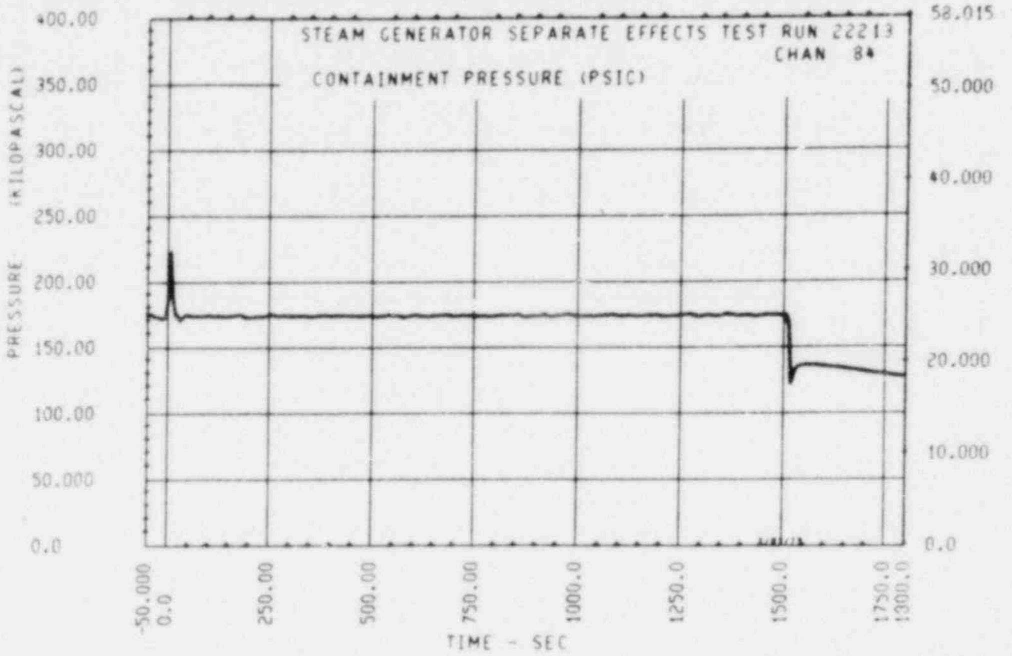

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22213
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)

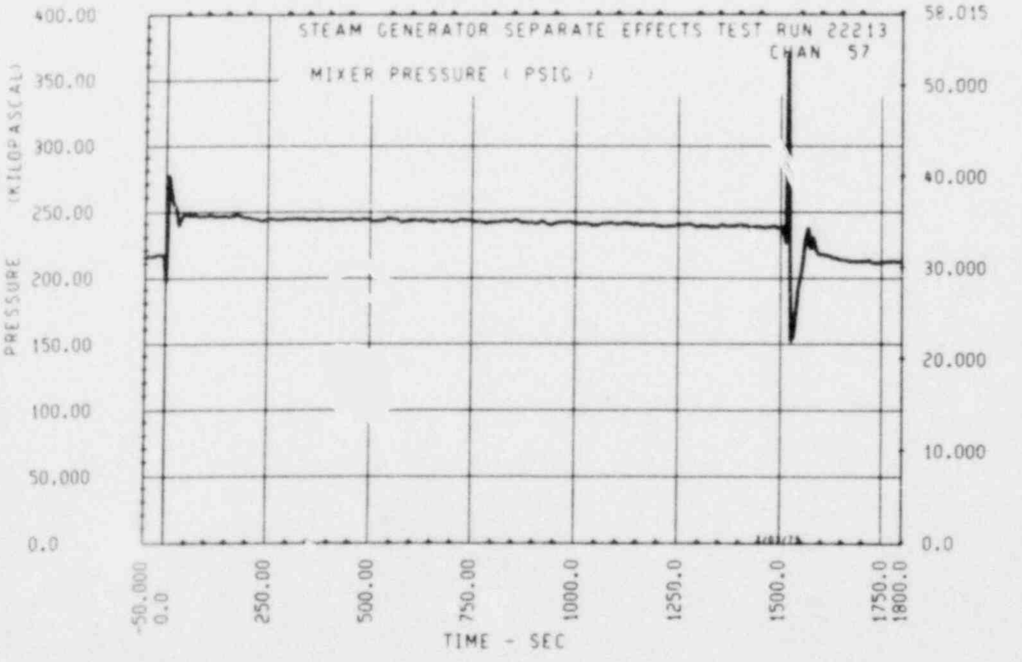


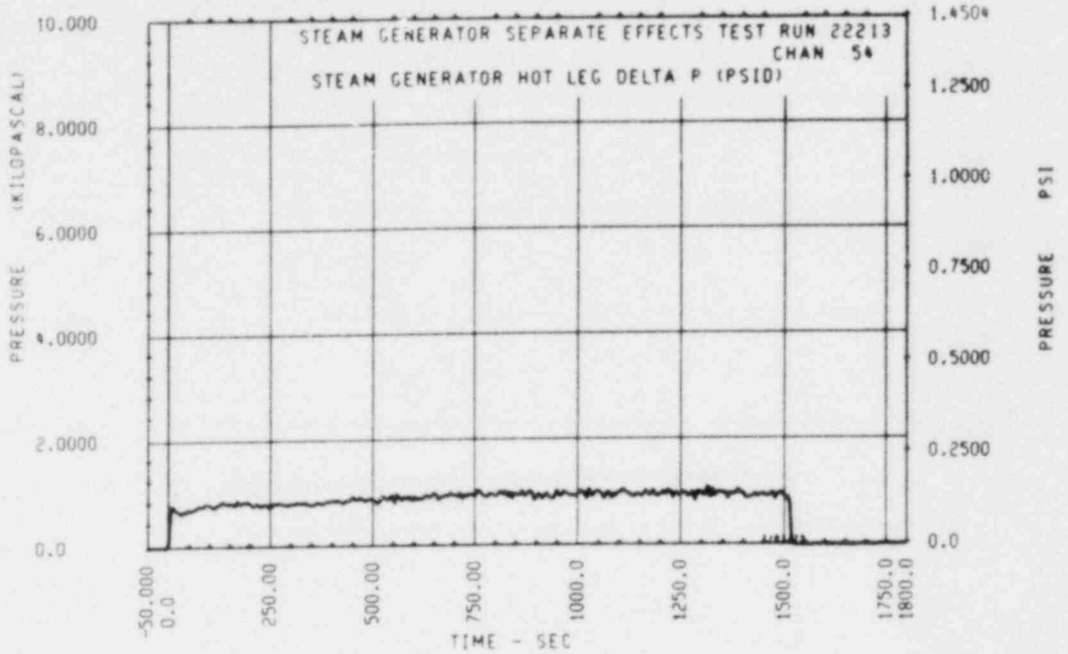
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22213
CONTAINMENT STEAM FLOW RATE
CHAN 97
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)

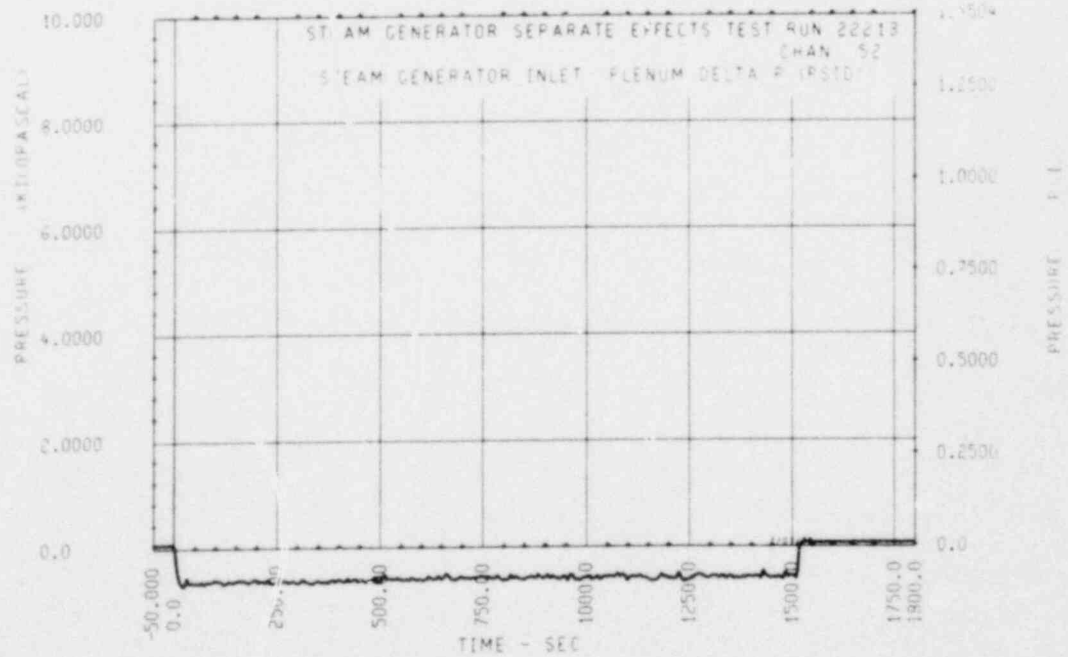


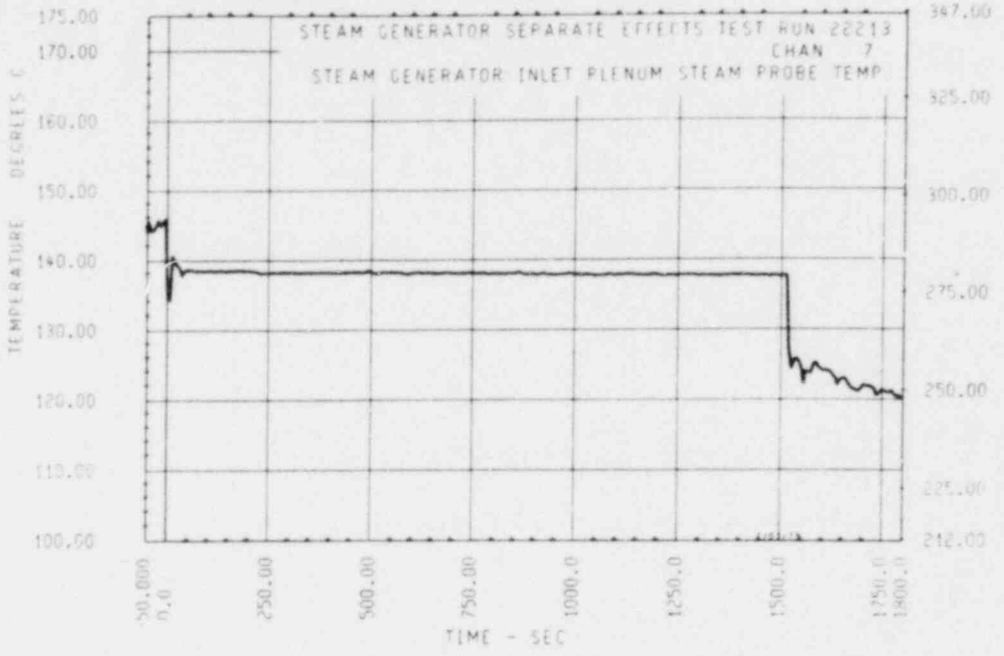
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22213
CHAN 53
STEAM GENERATOR OUTLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22213
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
-50.000
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

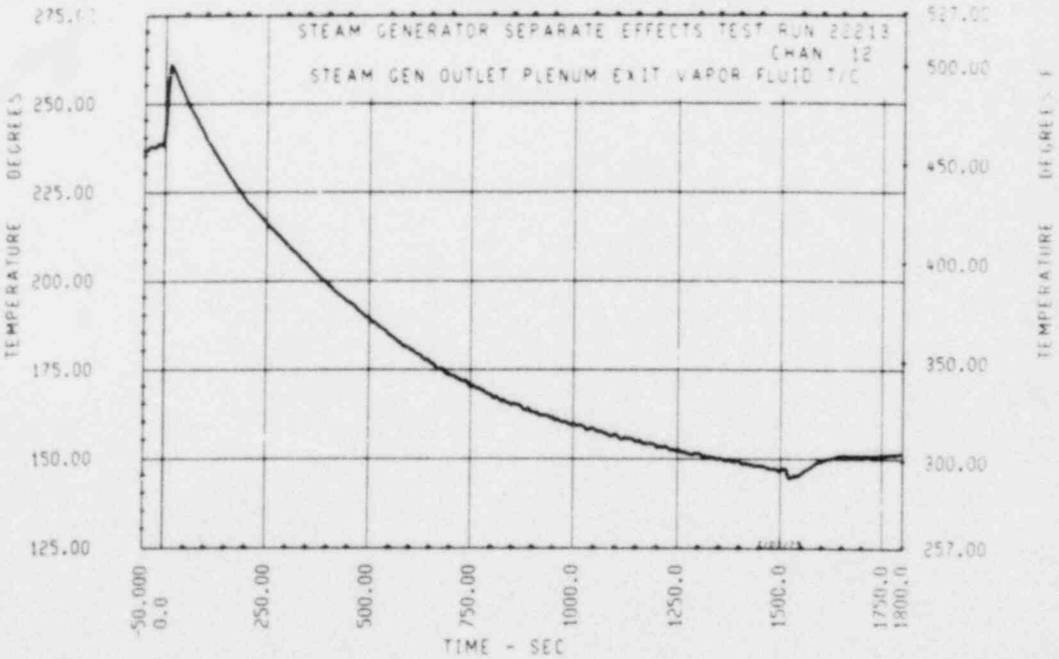

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22213
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
-50.000
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22213
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

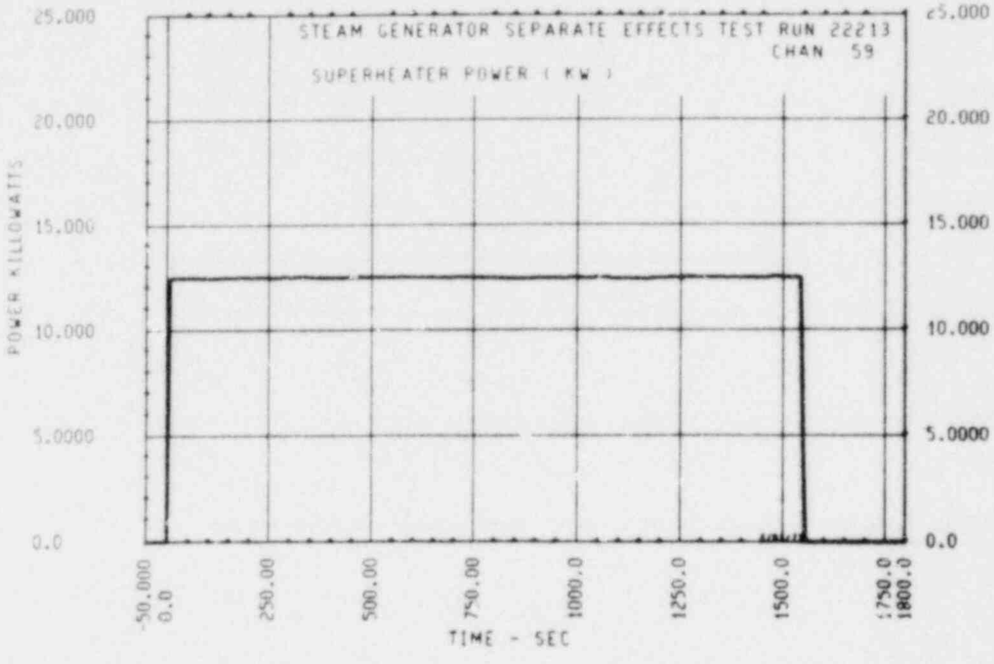

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22213
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
TIME - SEC

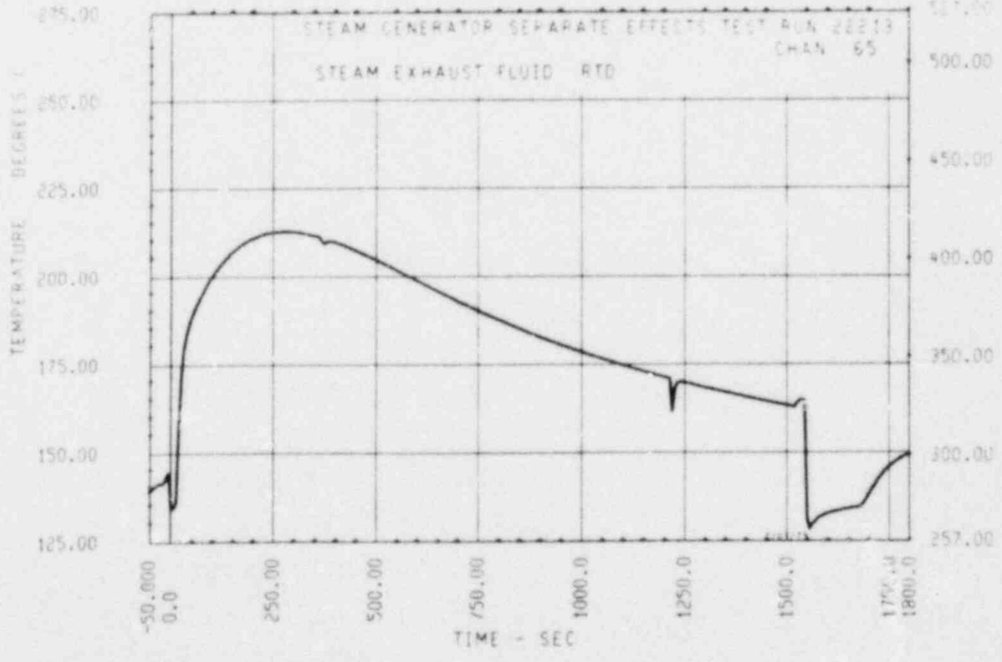


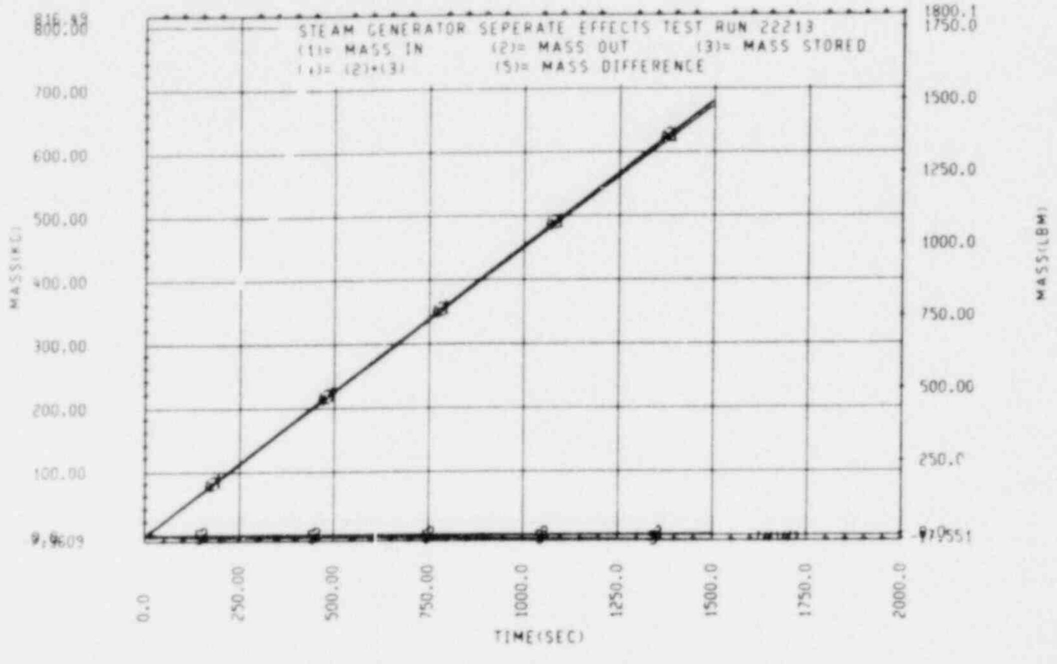
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22213
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

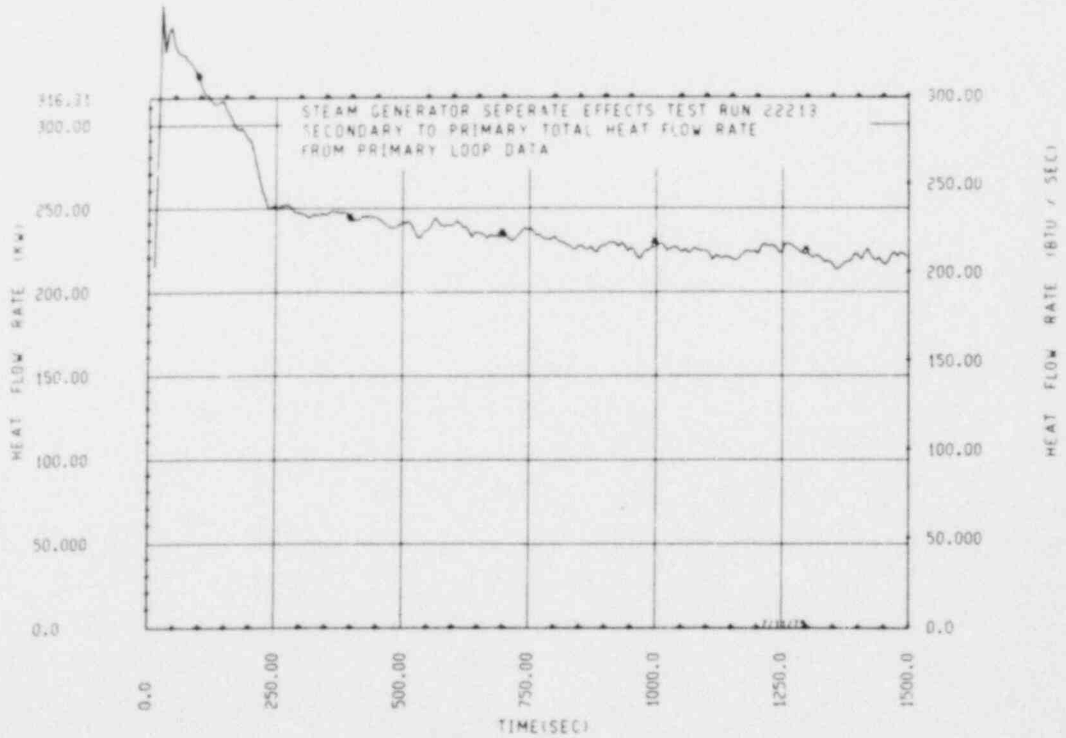


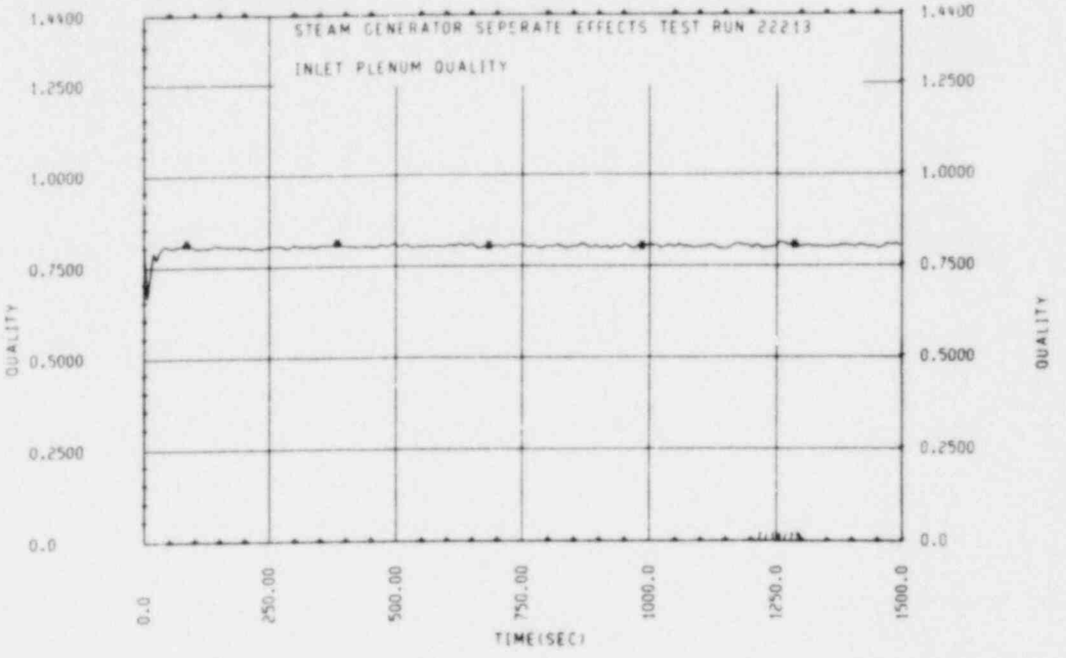
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22213
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES
TEMPERATURE DEGREES F
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22213
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

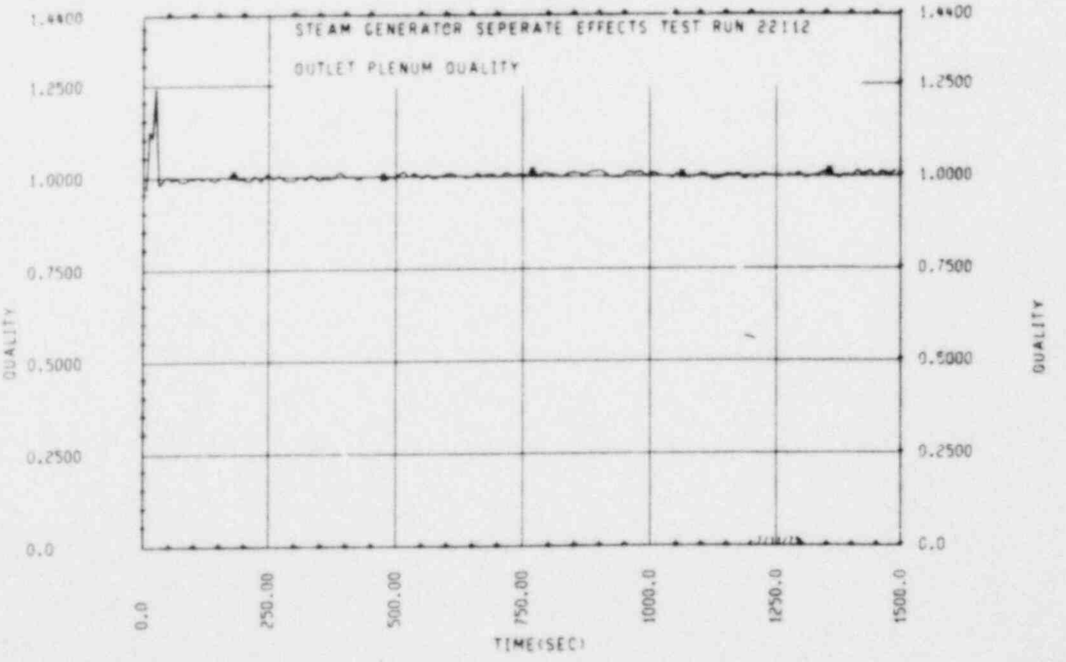

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22213
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
250.00
225.00
200.00
175.00
150.00
125.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1800.0
TIME - SEC


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22213
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)

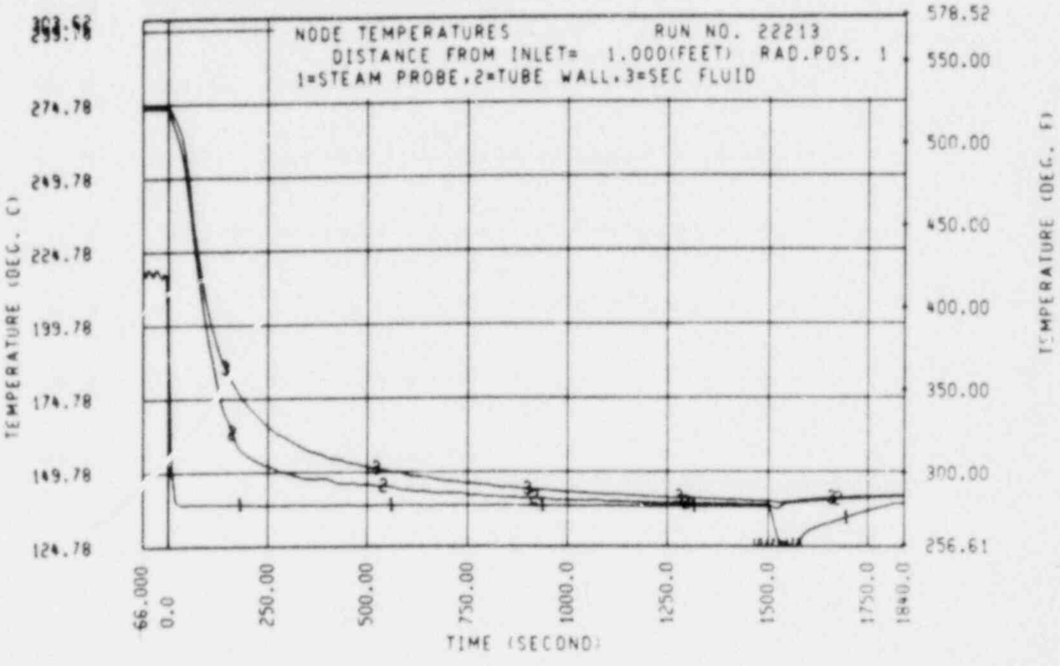

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22213
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)

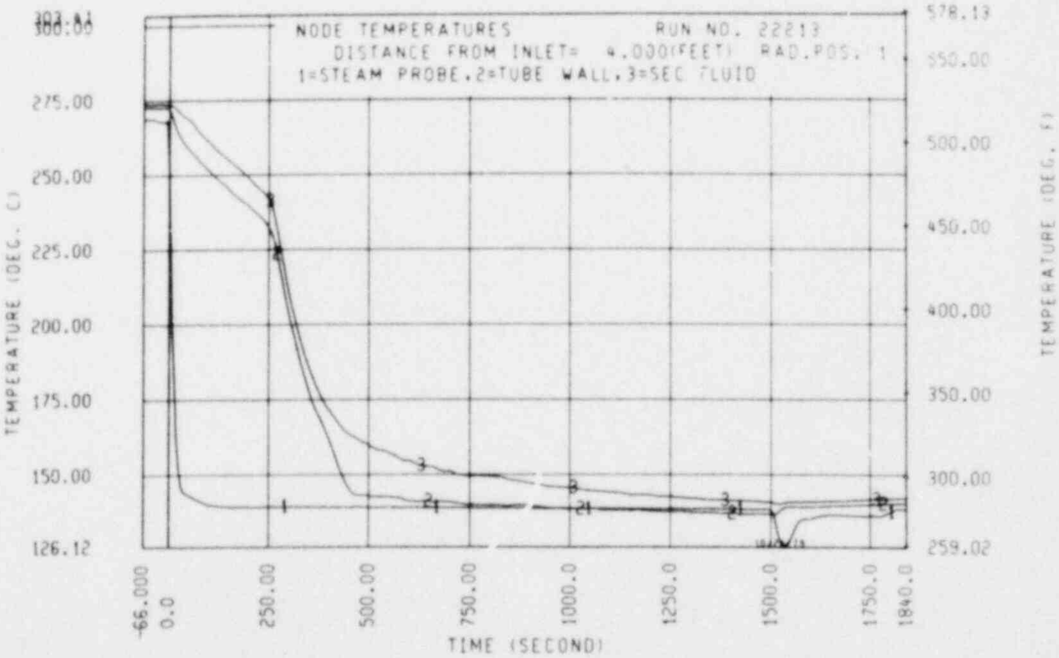


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22213
INLET PLENUM QUALITY
QUALITY
TIME(SEC)

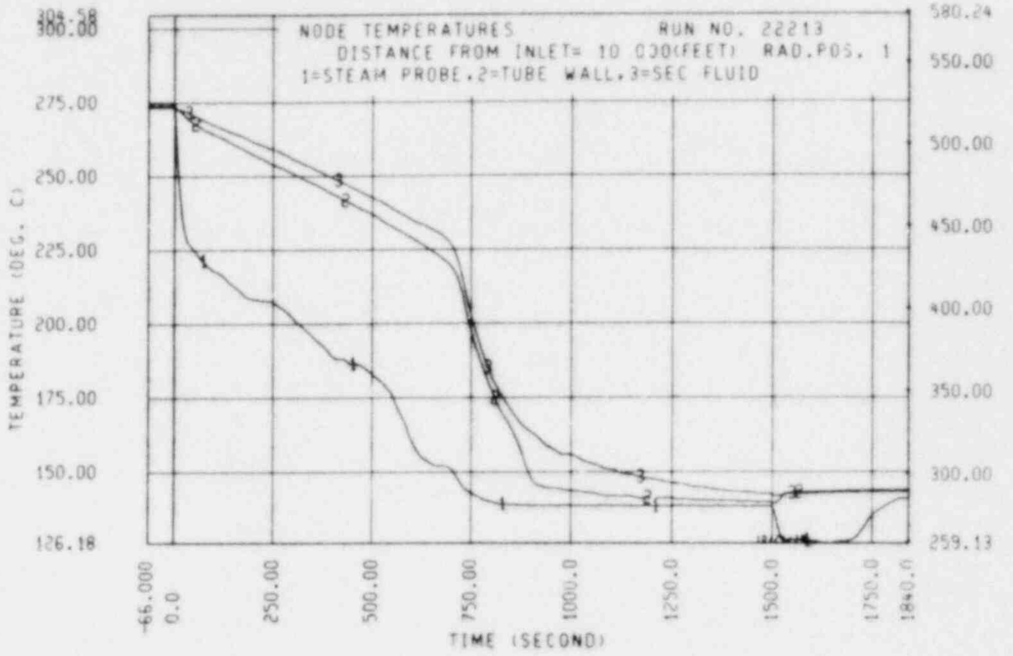


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22112
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)

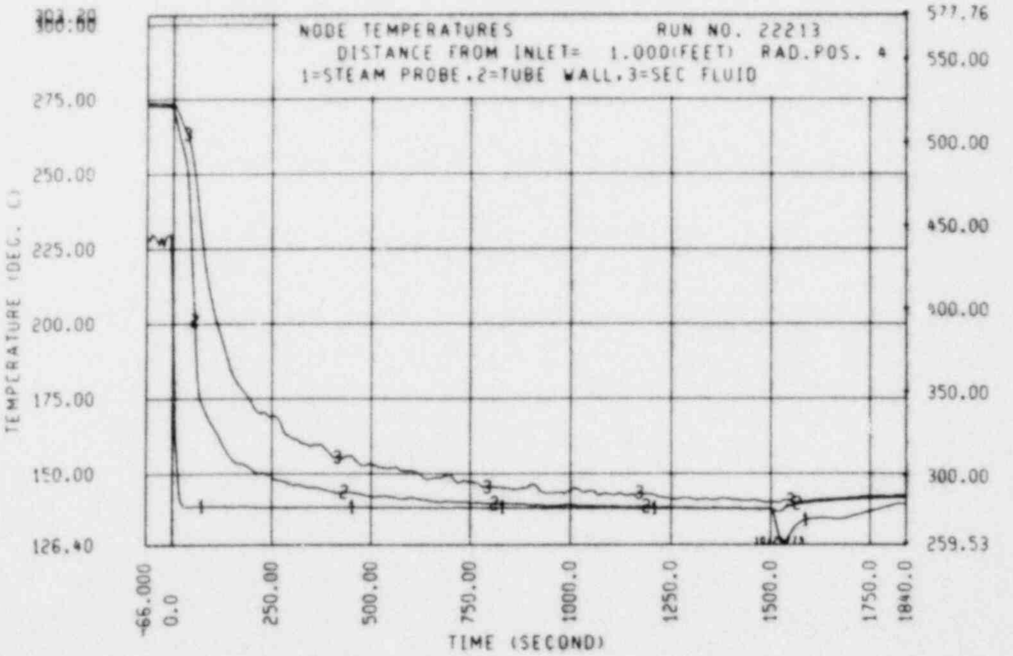

NODE TEMPERATURES RUN NO. 22213
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
274.78
249.78
224.78
199.78
174.78
149.78
124.78
578.52
550.00
500.00
450.00
400.00
350.00
300.00
256.61
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1840.0


NODE TEMPERATURES RUN NO. 22213
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
126.12
578.13
550.00
500.00
450.00
400.00
350.00
300.00
259.02
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1840.0

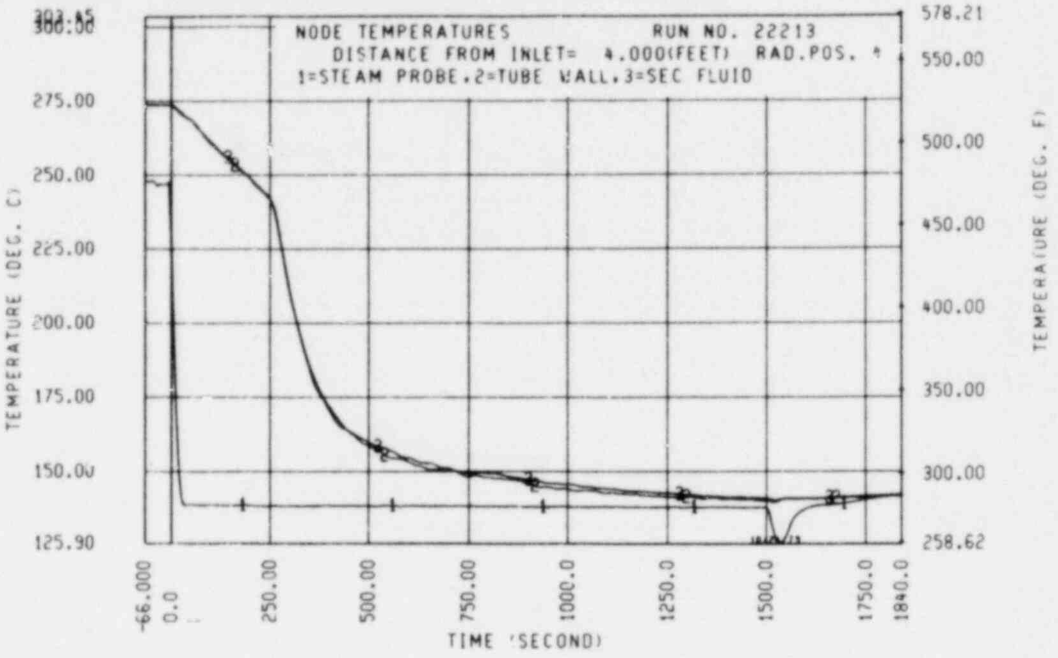
22213-11

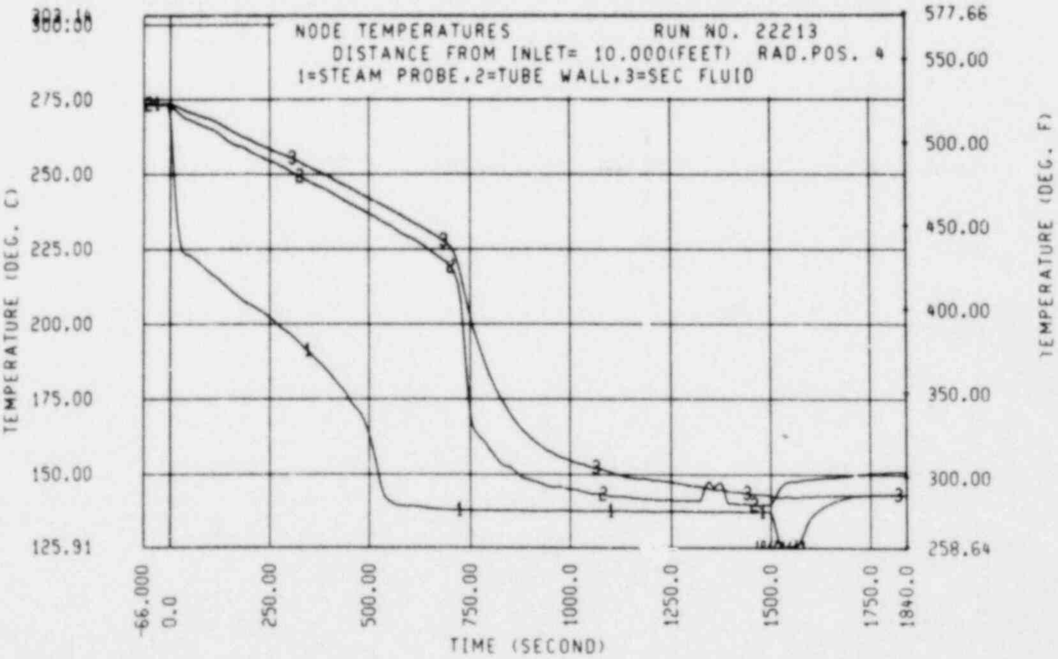


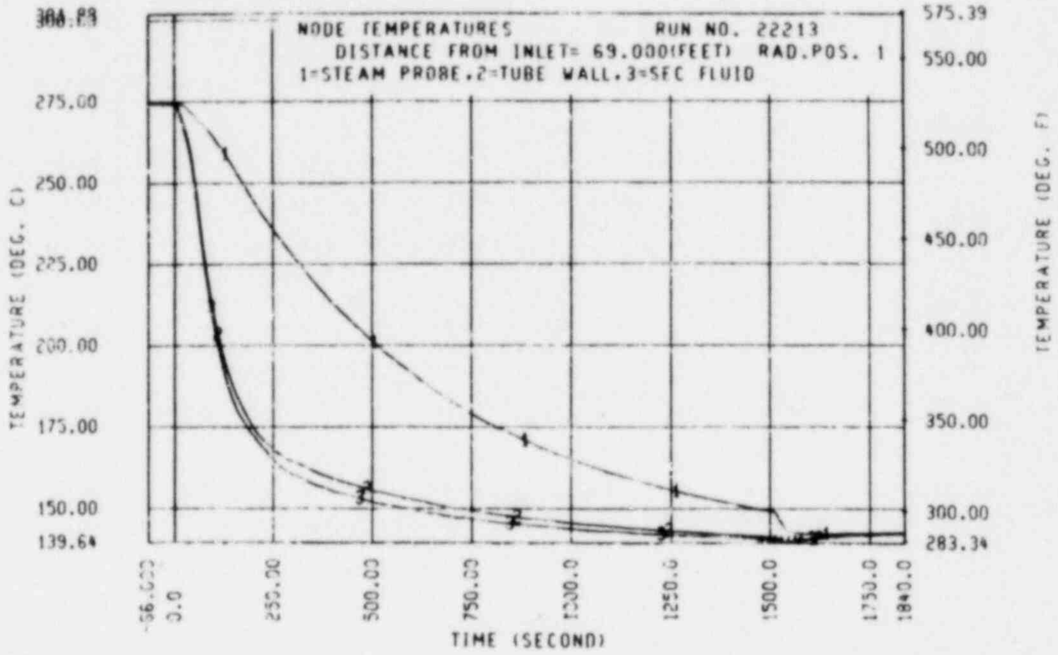
NODE TEMPERATURES RUN NO. 22213
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

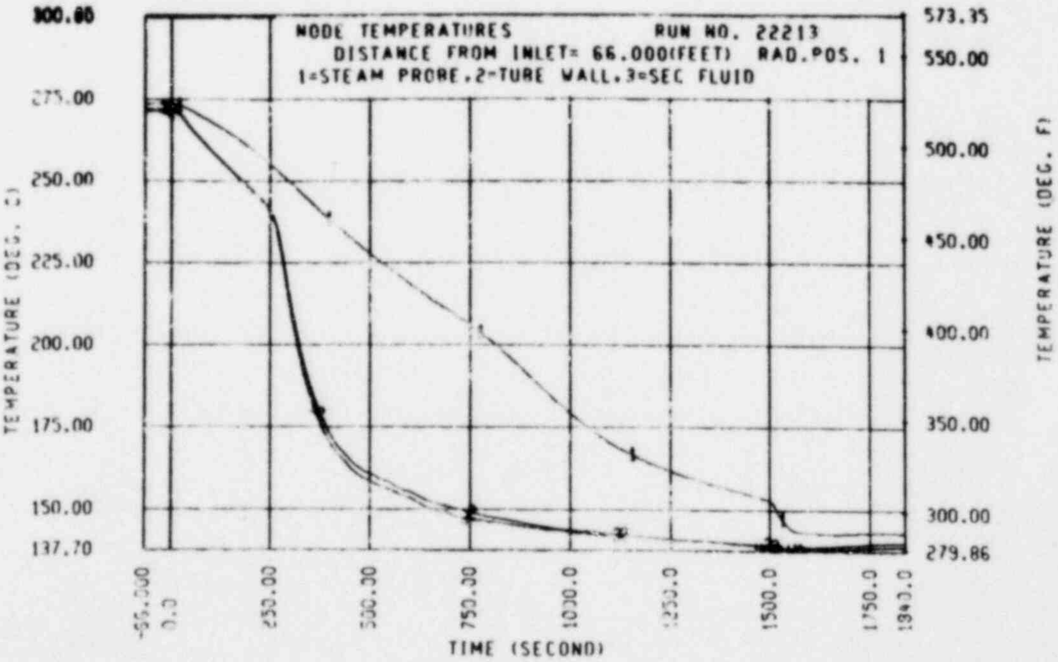


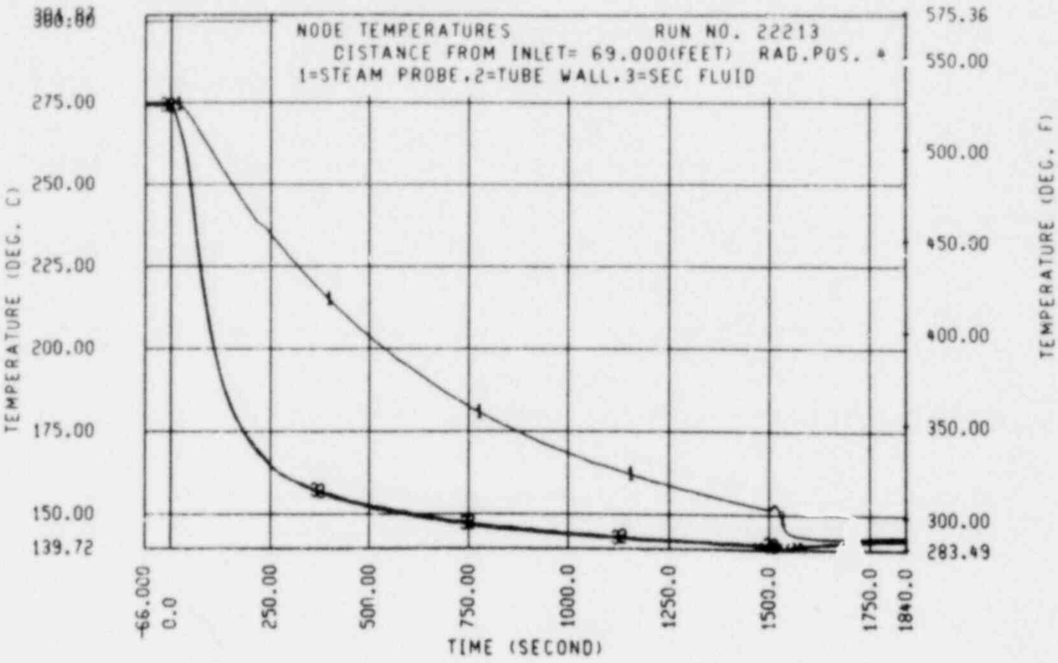
NODE TEMPERATURES RUN NO. 22213
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22213
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

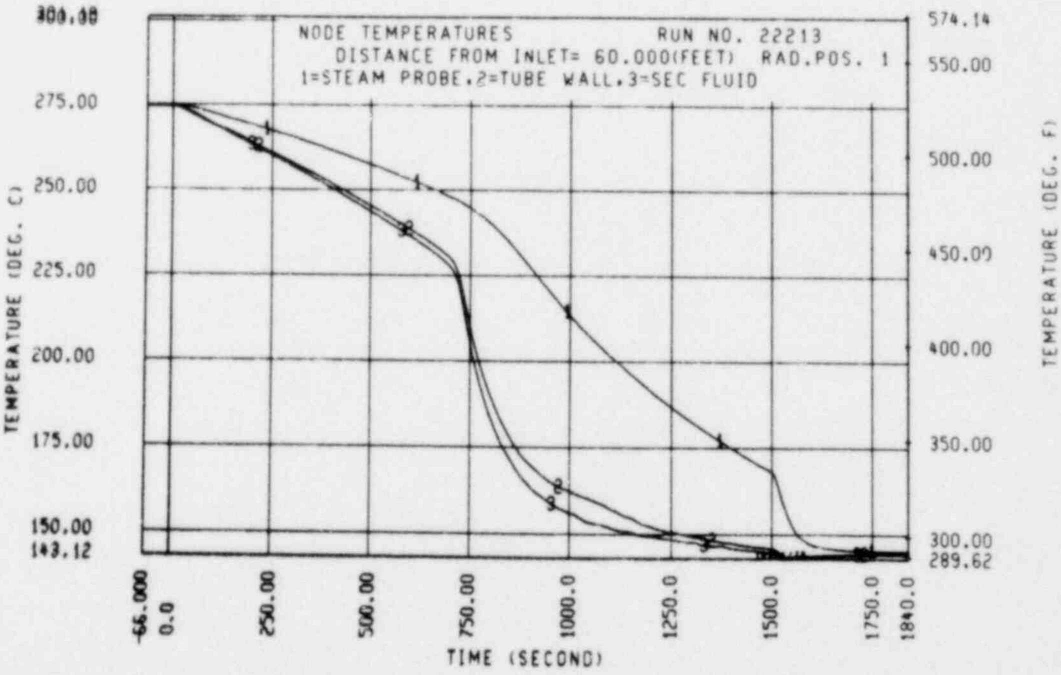

NODE TEMPERATURES RUN NO. 22213
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22213
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

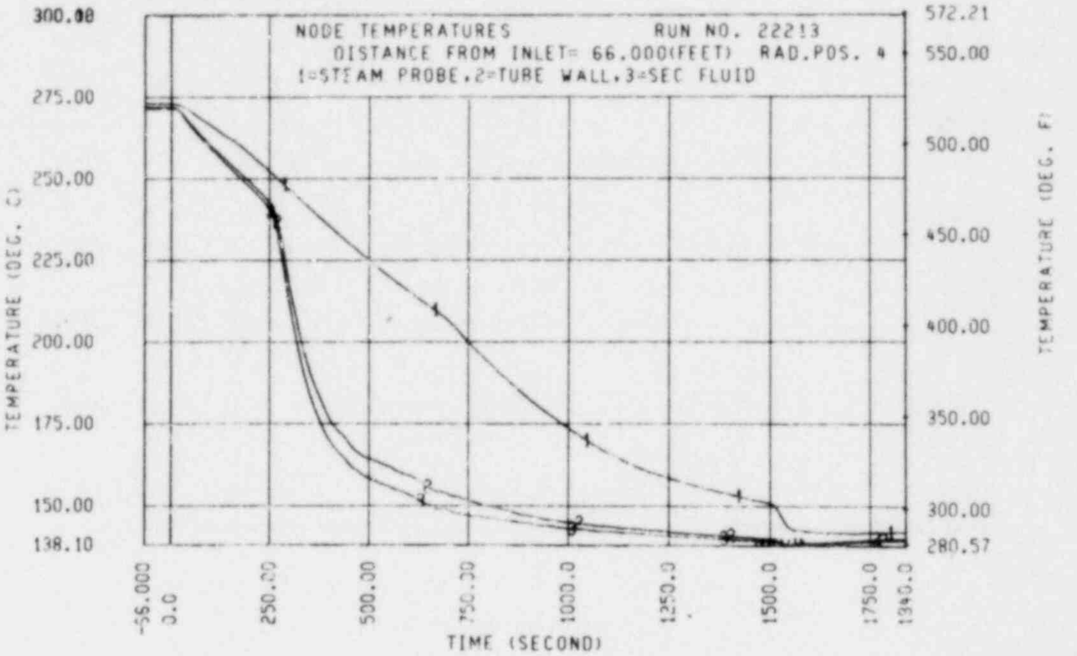

NODE TEMPERATURES RUN NO. 22213
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

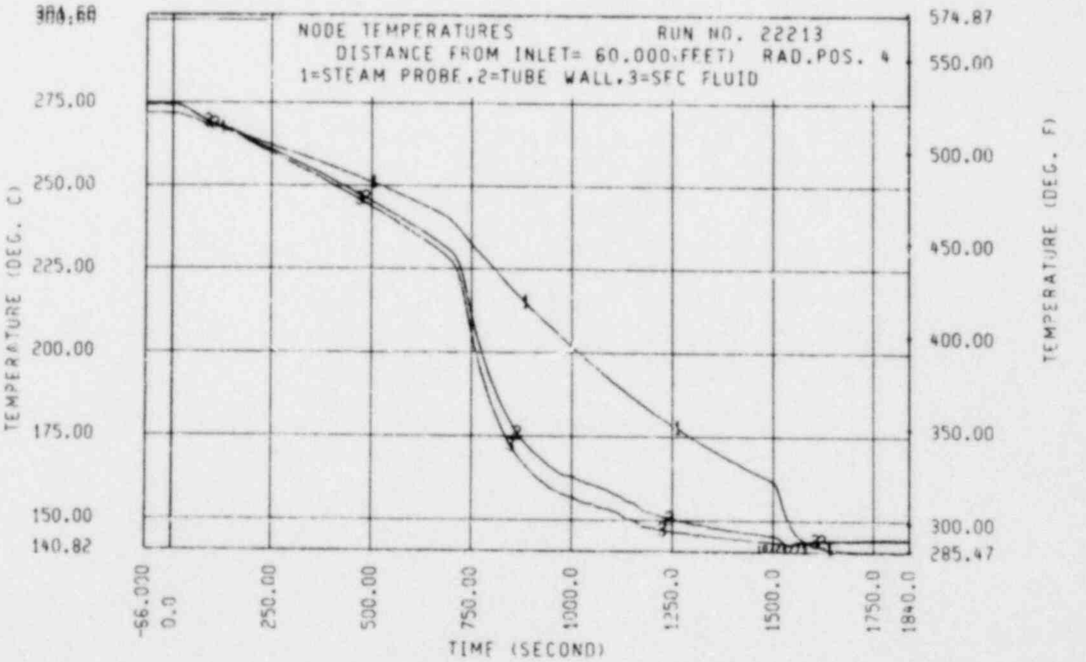


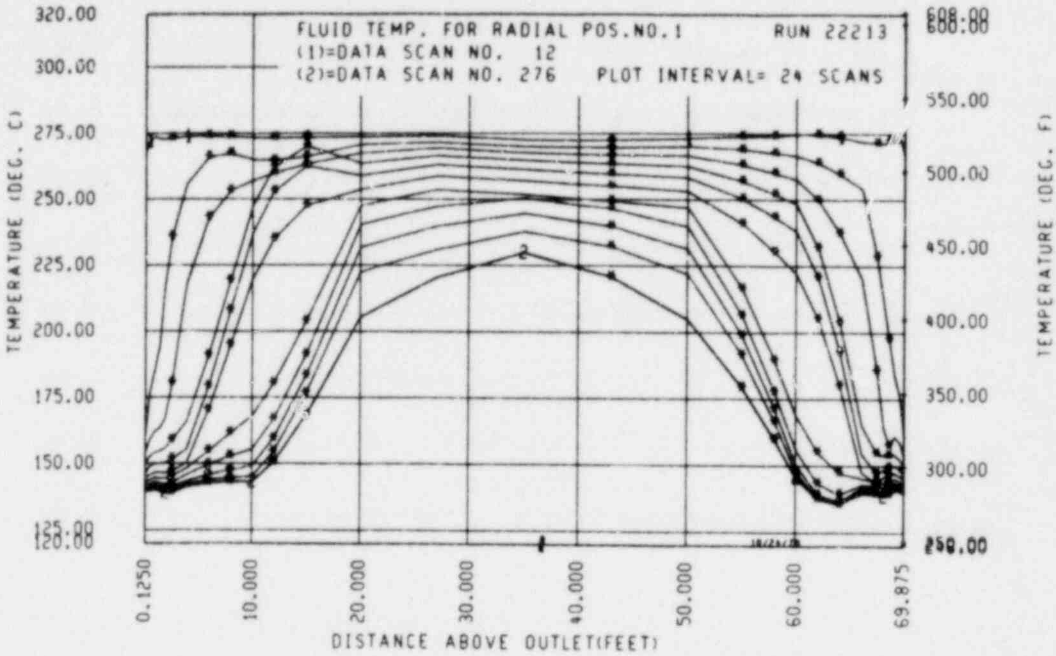
NODE TEMPERATURES RUN NO. 22213
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

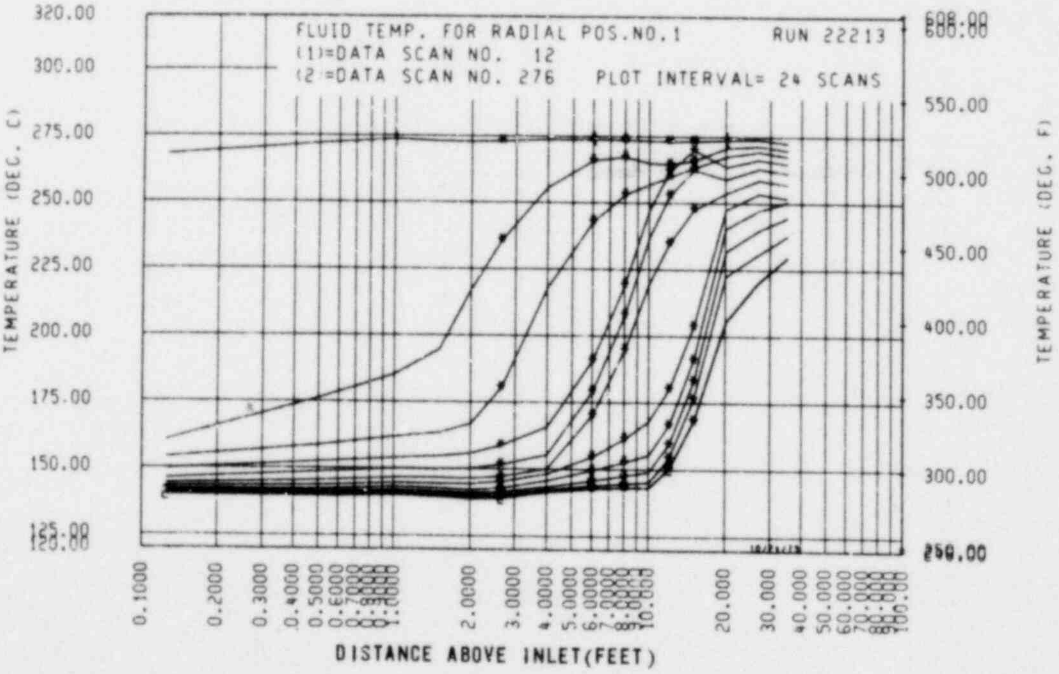


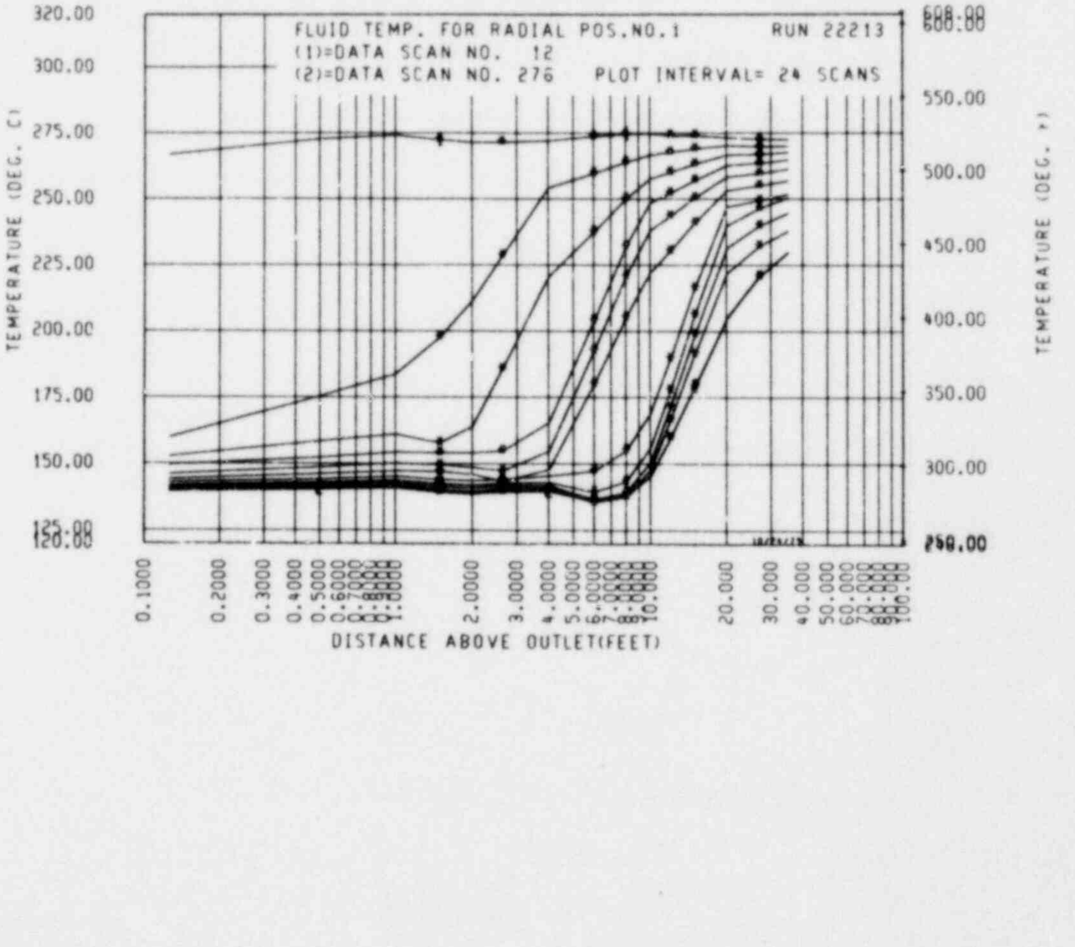
NODE TEMPERATURES RUN NO. 22213
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22213
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22213
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22213
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22213
(1)=DATA SCAN NO. 12
(2 =DATA SCAN NO. 276
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22213
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

22213-18

RUN 22213 FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

TIME = 114.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.6(.05)	37.1(3.27)	33.0(2.91)	24.1(2.12)	.761	.879	.855	.822
.2(.50)	93.3(8.22)	102.5(9.03)	106.1(9.35)	103.2(9.09)	.775	.898	.874	.840
.3(1.00)	39.1(3.45)	163.9(14.44)	4.4(.39)	152.6(13.45)	.796	.939	.891	.879
.5(1.50)	106.4(9.39)	110.1(9.70)	71.5(6.30)	1.7(.15)	.818	.981	.903	.904
.6(2.00)	2.6(.23)	26.7(2.35)	2.6(.22)	220.2(19.40)	.834	1.002	.914	.939
.8(2.65)	3.0(.26)	3.3(.29)	2.9(.26)	202.4(17.83)	.836	1.005	.916	1.021
1.2(4.00)	24.3(2.14)	13.5(1.19)	11.8(1.04)	2.8(.25)	.852	1.011	.924	1.070
1.8(6.00)	-8.1(-.71)	16.8(1.48)	-18.5(-1.63)	-3.7(-.33)	.856	1.020	.913	1.060
2.4(8.00)	-5.5(-.49)	11.4(1.00)	2.9(.26)	.4(.04)	.824	1.012	.881	1.029
3.0(10.00)	8.3(.73)	6.0(.53)	7.7(.68)	8.9(.79)	.798	.992	.860	1.000
3.7(12.00)	1.5(.13)	2.2(.20)	20.1(1.77)	11.8(1.04)	.788	.979	.859	.991
4.6(15.00)	16.9(1.49)	1.3(.11)	18.9(1.67)	13.8(1.22)	.803	.974	.882	1.005
6.1(20.00)	2.1(.19)	1.9(.17)	.7(.06)	1.2(.11)	.822	.973	.896	1.016
8.2(27.00)	1.2(.10)	1.0(.09)	-.2(-.02)	.8(.07)	.822	.971	.890	1.013
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.819	.967	.885	1.011
13.1(43.00)	-.5(-.04)	-.3(-.02)	.1(.01)	.0(.00)	.815	.963	.884	1.009
15.2(50.00)	.2(.01)	-.1(-.01)	.2(.01)	.6(.06)	.815	.963	.885	1.011
16.8(55.00)	.2(.02)	-.2(-.02)	.0(.00)	.4(.04)	.816	.964	.886	1.014
17.7(58.00)	.1(.01)	-.3(-.03)	-.0(-.00)	.1(.01)	.817	.964	.888	1.016
18.3(60.00)	.0(.00)	-.9(-.08)	-.2(-.01)	-.1(-.00)	.818	.964	.890	1.018
18.9(62.00)	-.0(-.00)	-.2(-.02)	-.1(-.01)	-.3(-.02)	.818	.964	.891	1.019
19.5(64.00)	-.0(-.00)	.1(.01)	-.0(-.00)	-.4(-.04)	.820	.966	.892	1.019
20.1(66.00)	.0(.00)	1.0(.09)	.0(.00)	-1.1(-.10)	.822	.969	.893	1.019
20.5(67.38)	-4.0(-.35)	-3.2(-.28)	-1.9(-.17)	-7.6(-.67)	.822	.971	.893	1.017
20.7(68.00)	-19.5(-1.71)	-18.1(-1.60)	-5.7(-.50)	-13.7(-1.21)	.820	.968	.892	1.014
20.9(68.50)	-23.4(-2.06)	-27.1(-2.38)	-20.1(-1.77)	-13.1(-1.15)	.815	.962	.889	1.013
21.0(69.00)	2.4(.21)	1.6(.14)	-3.2(-.28)	-2.9(-.26)	.814	.959	.887	1.014
21.2(69.50)	-3.5(-.31)	-4.0(-.35)	-3.9(-.35)	-3.5(-.31)	.819	.962	.888	1.016
21.3(69.97)	-11.6(-1.02)	-11.3(-.99)	-7.6(-.67)	-6.9(-.61)	.822	.964	.888	1.016

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22213
TIME = 234.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.4(.04)	18.3(1.61)	14.9(1.31)	15.3(1.35)	.762	.878	.854	.822
.2(.50)	39.7(3.50)	42.9(3.78)	46.1(4.06)	40.2(3.55)	.768	.886	.862	.829
.3(1.00)	49.0(4.32)	52.4(4.62)	.7(.06)	61.3(5.40)	.781	.900	.869	.845
.5(1.50)	54.7(4.82)	53.0(4.67)	23.4(2.06)	62.1(5.47)	.797	.916	.873	.865
.6(2.00)	72.5(6.39)	67.4(5.94)	75.3(6.64)	61.8(5.44)	.816	.935	.888	.884
.8(2.65)	1.4(.12)	99.7(8.78)	117.2(10.32)	50.4(4.44)	.828	.968	.927	.905
1.2(4.00)	20.9(1.84)	16.8(1.48)	11.8(1.04)	2.5(.22)	.841	1.000	.962	.918
1.8(6.00)	5.4(.47)	7.1(.62)	5.0(.44)	8.6(.76)	.852	1.008	.966	.918
2.4(8.00)	4.2(.37)	5.1(.45)	-.0(-.00)	6.8(.60)	.838	.994	.947	.907
3.0(10.00)	18.1(1.60)	17.0(1.49)	15.3(1.35)	12.1(1.07)	.826	.980	.929	.892
3.7(12.00)	1.3(.12)	24.9(2.20)	13.7(1.20)	8.3(.73)	.822	.986	.928	.887
4.6(15.00)	11.3(1.00)	7.9(.70)	10.2(.90)	9.1(.81)	.828	.998	.936	.890
6.1(20.00)	3.1(.27)	2.8(.25)	1.3(.11)	1.7(.15)	.839	1.001	.940	.893
8.2(27.00)	1.7(.15)	2.2(.19)	-.1(-.01)	1.3(.12)	.841	1.001	.933	.891
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.837	.998	.927	.890
13.1(43.00)	-.7(-.06)	-.4(-.04)	.0(.00)	-.0(-.00)	.832	.994	.925	.889
15.2(50.00)	.0(.00)	-.3(-.03)	.0(.00)	.4(.03)	.832	.994	.925	.890
16.8(55.00)	-.0(-.00)	-.4(-.04)	-.1(-.01)	.1(.01)	.834	.995	.927	.893
17.7(58.00)	-.2(-.02)	-.7(-.06)	-.4(-.03)	-.1(-.01)	.835	.995	.930	.895
18.3(60.00)	-1.0(-.09)	-1.9(-.16)	-1.0(-.09)	-.6(-.05)	.835	.995	.931	.897
18.9(62.00)	-2.7(-.24)	-.4(-.04)	-.6(-.05)	-.9(-.08)	.835	.996	.934	.898
19.5(64.00)	-.2(-.02)	-.0(-.00)	-.3(-.02)	-1.2(-.10)	.836	.999	.937	.900
20.1(66.00)	-.2(-.02)	.7(.06)	-.2(-.02)	-2.4(-.21)	.840	1.005	.940	.900
20.5(67.39)	-6.2(-.55)	-5.2(-.45)	-5.4(-.48)	-14.0(-1.24)	.841	1.009	.941	.898
20.7(68.00)	-25.2(-2.22)	-22.9(-2.02)	-20.3(-1.79)	-24.0(-2.11)	.839	1.006	.939	.893
20.9(68.50)	-22.3(-1.97)	-24.7(-2.18)	-25.9(-2.29)	-22.4(-1.98)	.835	1.001	.934	.891
21.0(69.00)	2.6(.23)	1.9(.17)	-.3(-.03)	-3.0(-.26)	.838	.999	.933	.892
21.2(69.50)	-2.9(-.26)	-3.6(-.32)	-3.5(-.31)	-3.1(-.27)	.844	1.004	.935	.895
21.3(69.87)	-5.5(-.49)	-7.1(-.63)	-4.7(-.42)	-4.5(-.40)	.848	1.007	.936	.895

22213-20

SUMMARY SHEET

RUN NO. 22314

DATE: 3/28/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.112 (0.248)
2. Water flow - [kg/sec (lb/sec)] - 0.114 (0.252)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{o}C (^{o}F)] - 155 (311)
5. Water temperature [^{o}C (^{o}F)] - 127 (260)
6. Mixer pressure [kPa (psig)] - 193 (28)
7. Test time (sec) - 1499.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.4 (34.3)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	257 (495)
0.15 (0.50)	271 (520)
0.30 (1.00)	273 (523)
0.46 (1.50)	273 (524)
0.61 (2.00)	276 (528)
1.22 (4.00)	276 (528)
3.05 (10.00)	273 (524)
6.09 (20.00)	273 (524)
8.23 (27.00)	272 (522)
10.67 (35.00)	273 (523)

SUMMARY SHEET (cont)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 7.49 (16.51)
2. Liquid collection
   (a) Outlet plenum[kg (lb)] - 7.98 (17.6)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 9.71 (21.4)

D. FAILED BUNDLE T/Cs[1]

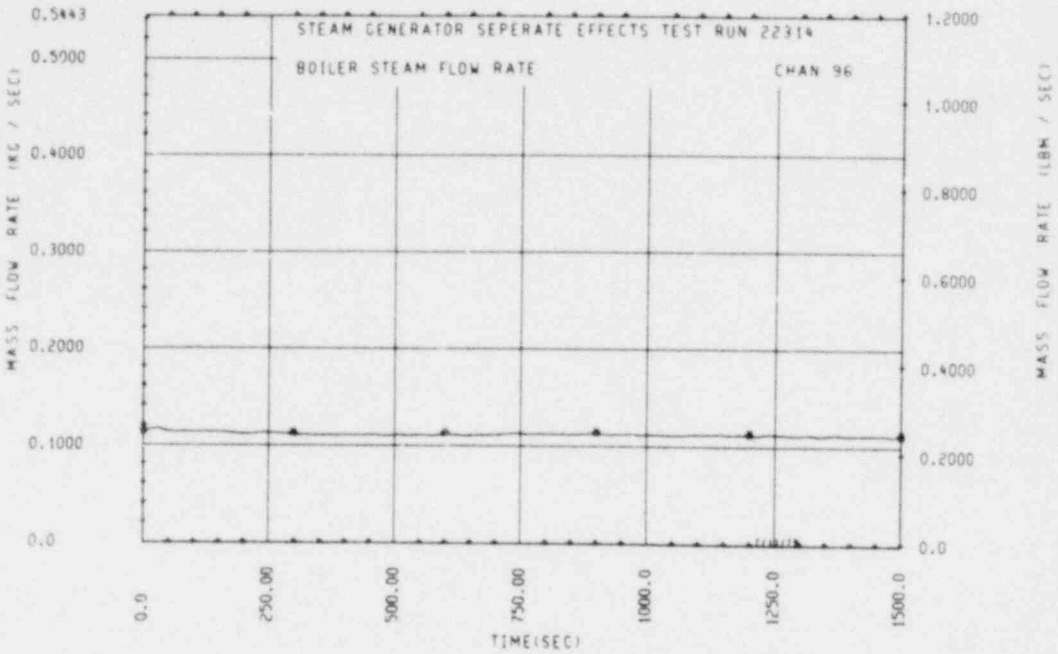
294, 295, 305, 309, 310, 311, 326, 532, 549, 553, 564, 565, 568, 569

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

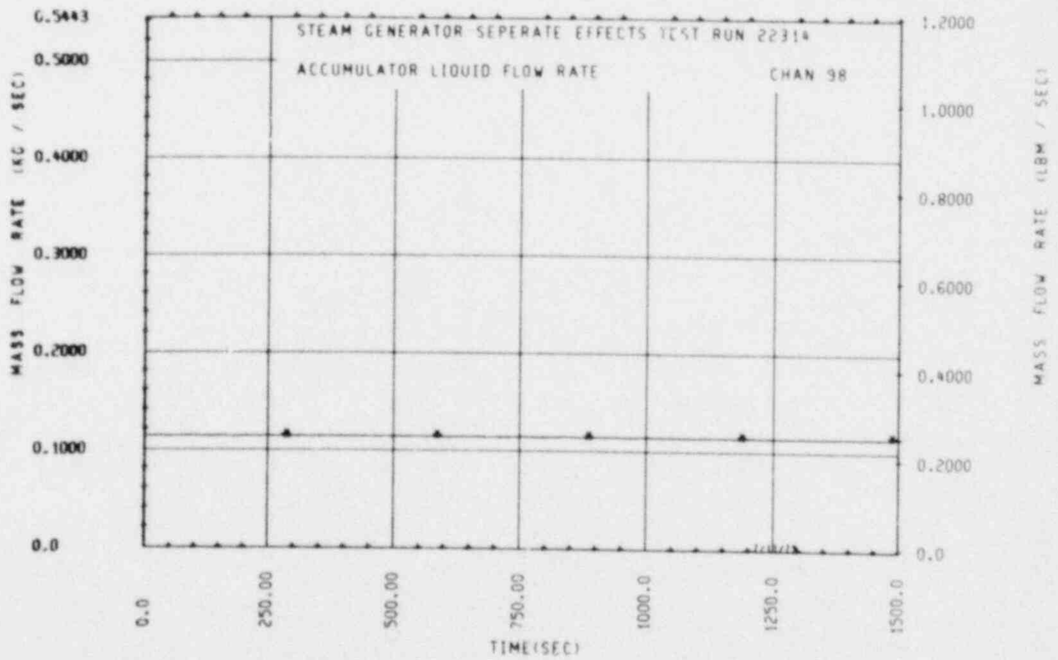
1. From primar ide energy balance [kwsec(Btu)] - 0.549×10^5 (0.523×10^5)
2. From lo .l heat flux ($\int_0^t \int_0^{HTA} \Phi \, da dt$) -[kwsec(Btu)] - 0.385×10^5 (0.367×10^5)
3. Integration to 300 sec

---

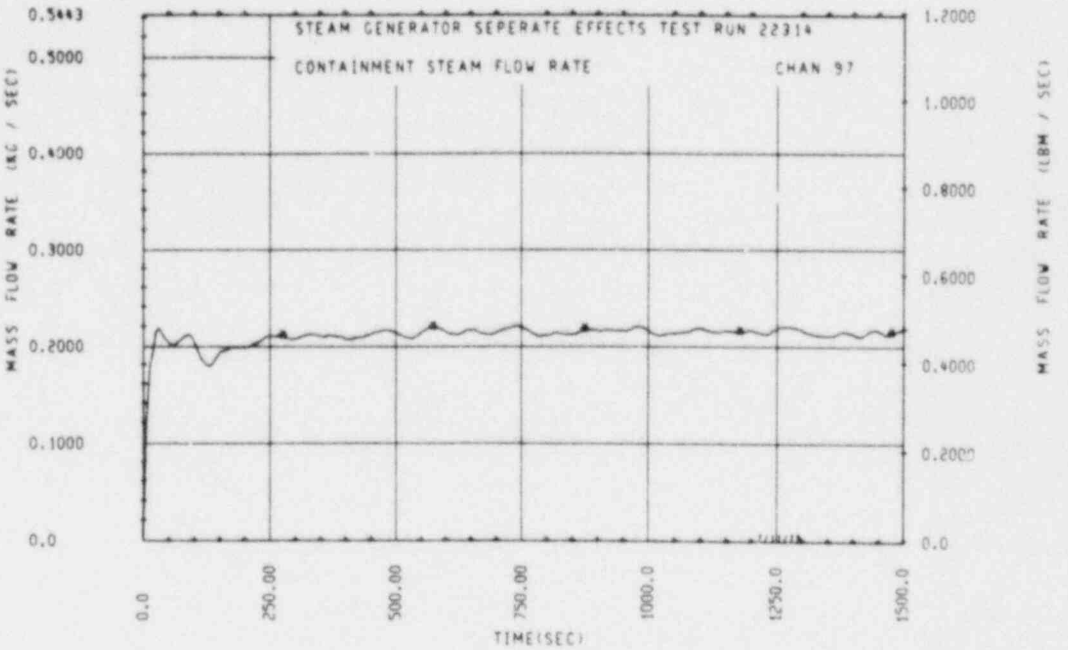
1. T/Cs are defined as failed based on resistance reading or T/C response.

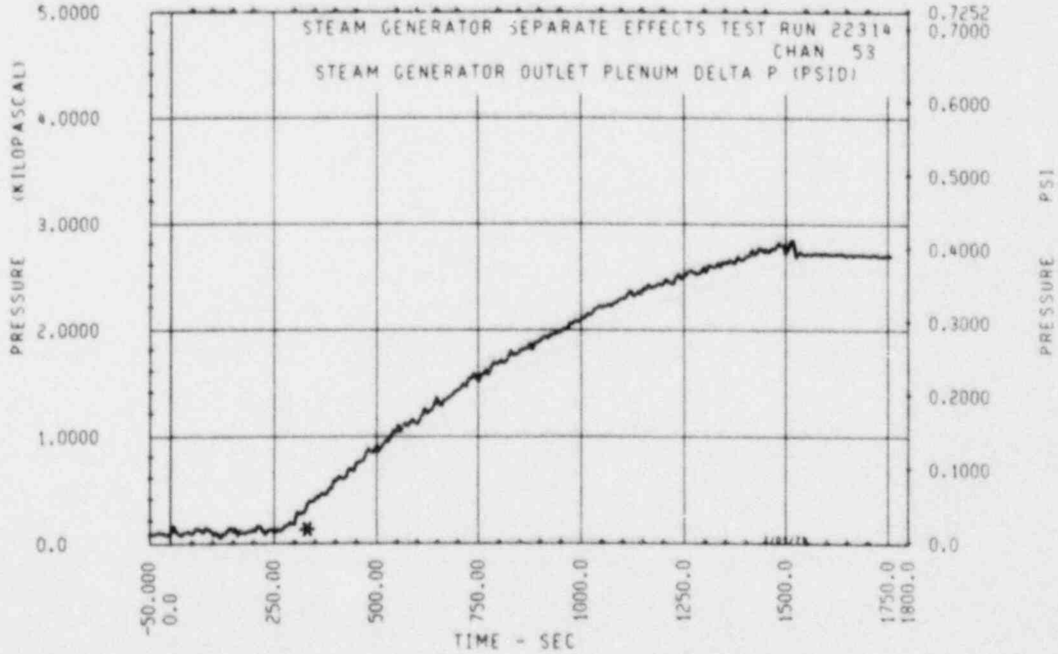


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22314
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
MASS FLOW RATE (LBM / SEC)
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)

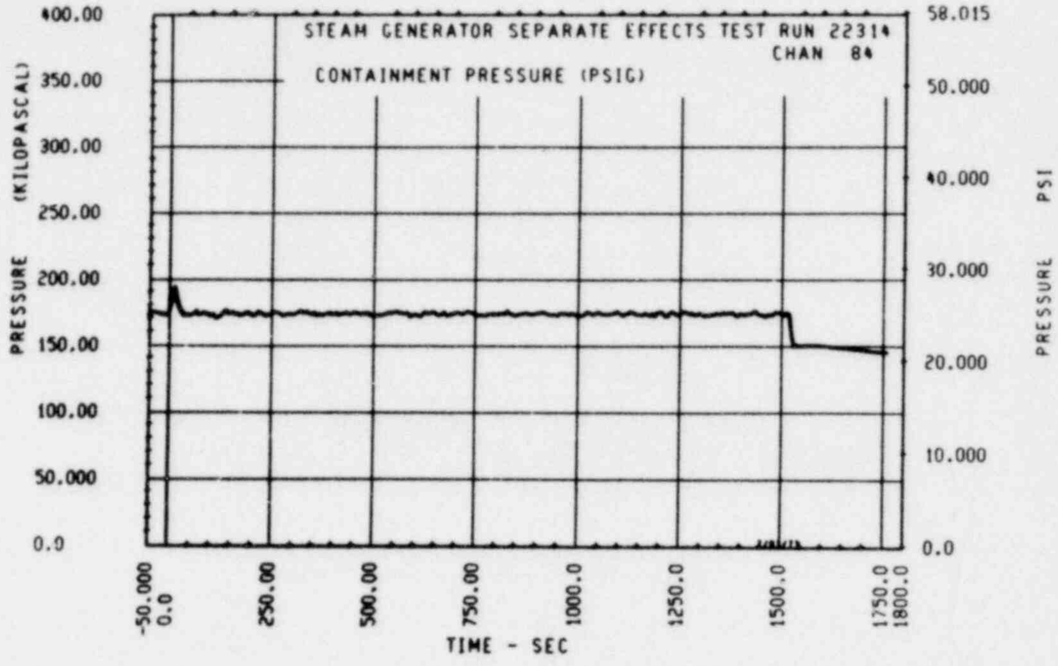


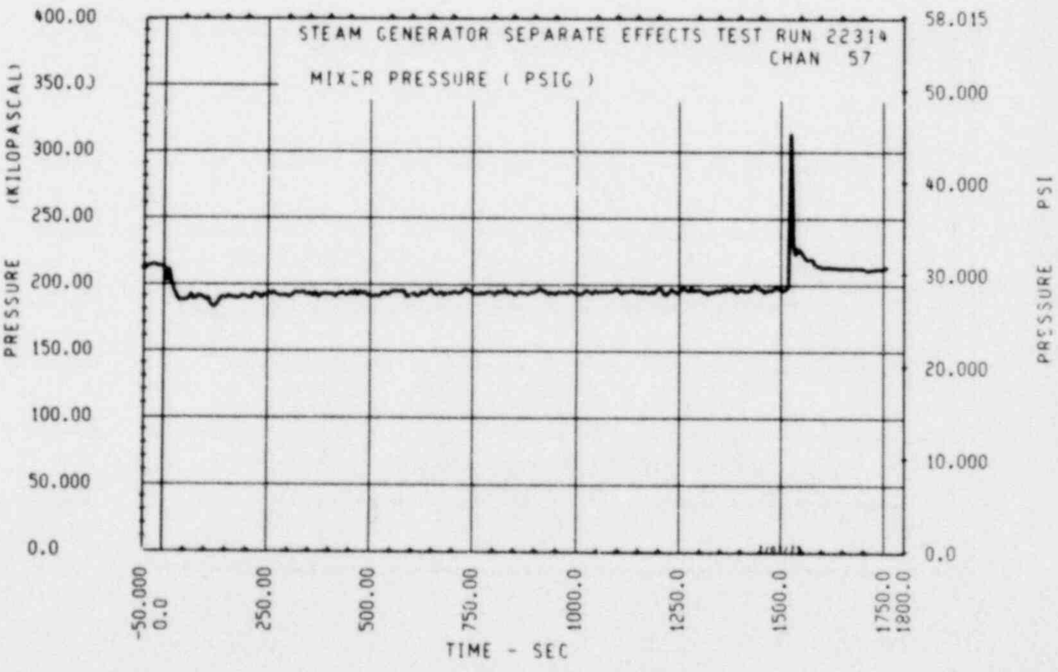
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22314
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
MASS FLOW RATE (LBM / SEC)
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)

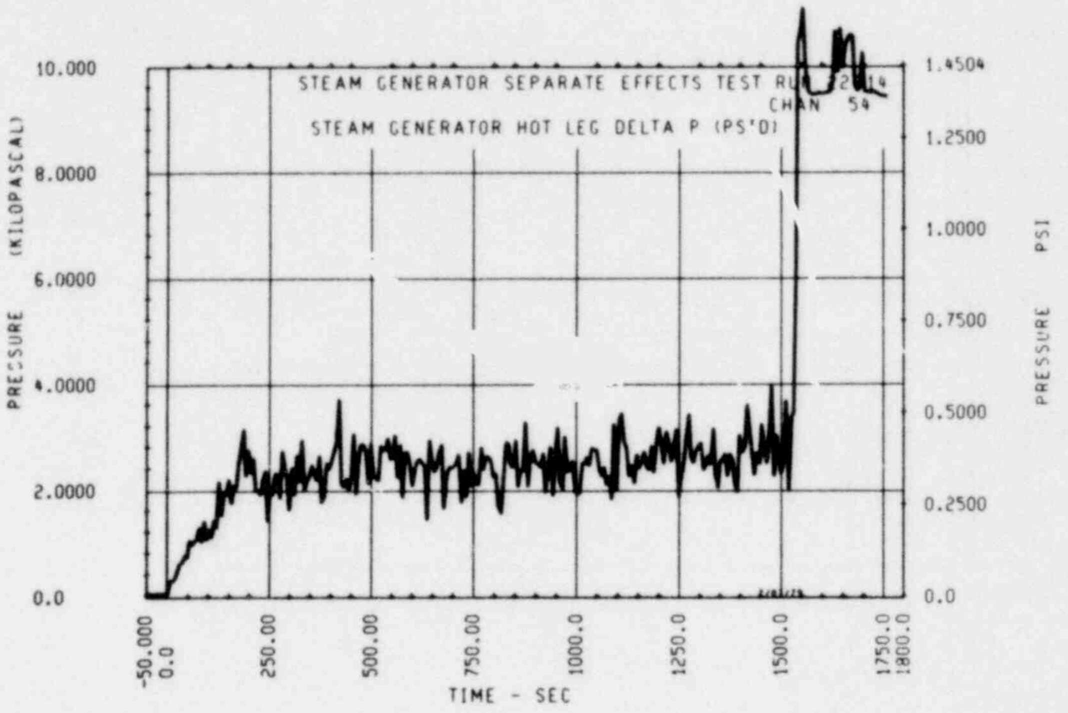


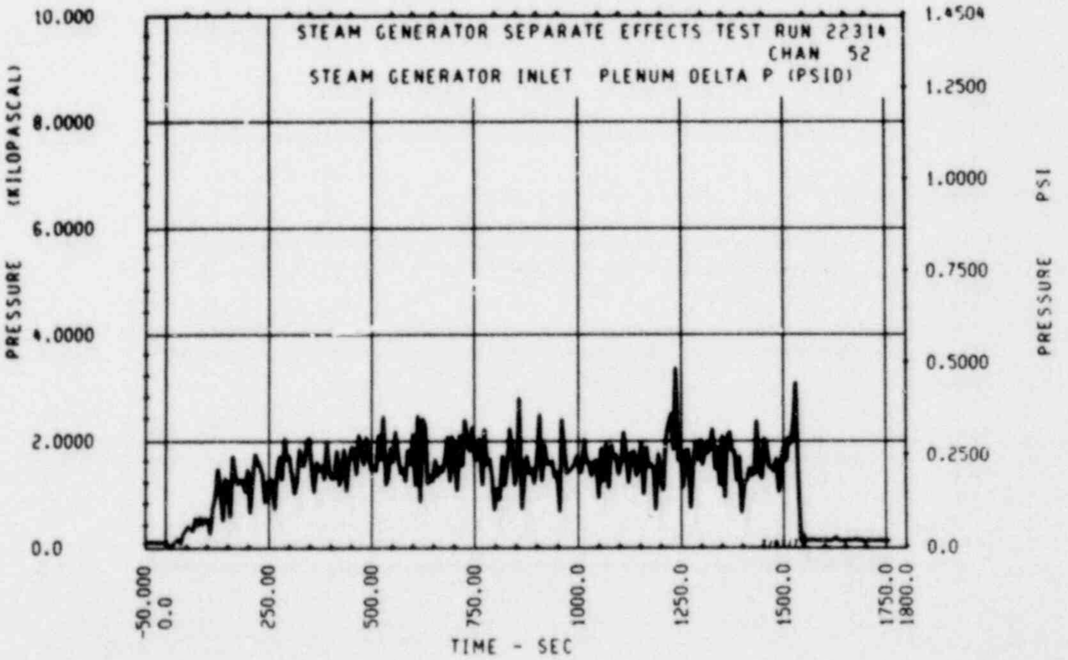


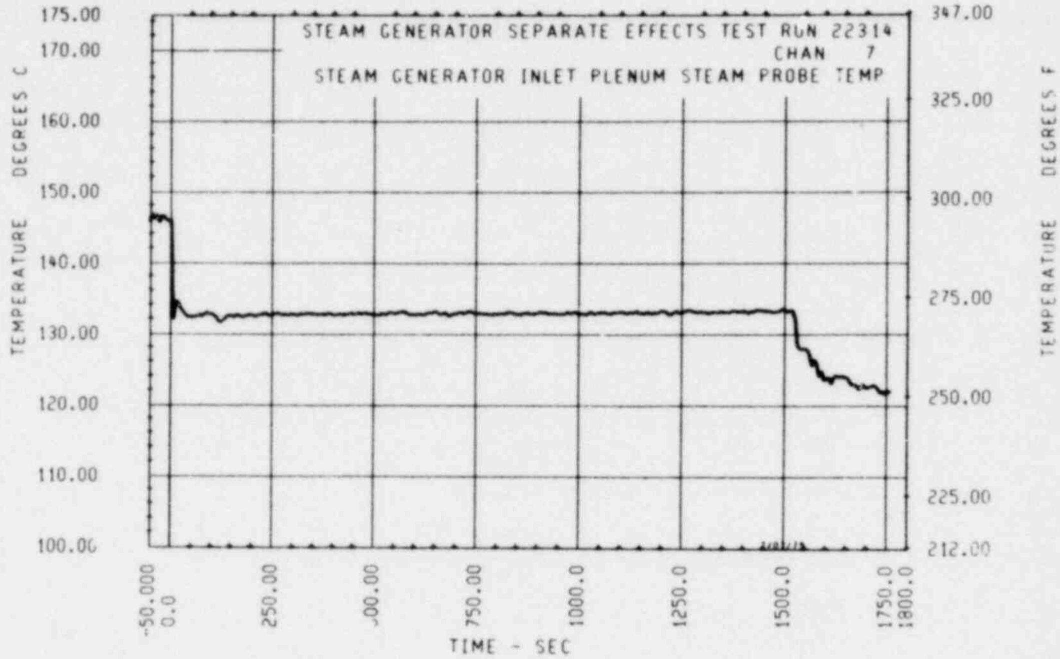
* Refer to Appendix H text for explanation of delayed response.

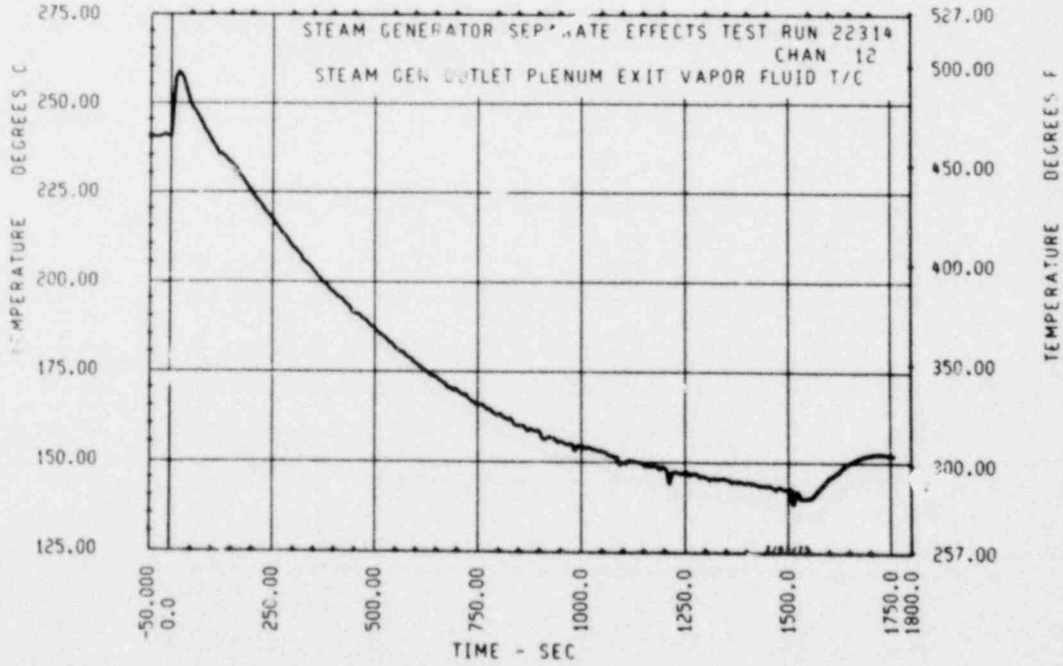

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22314
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
-50.000
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

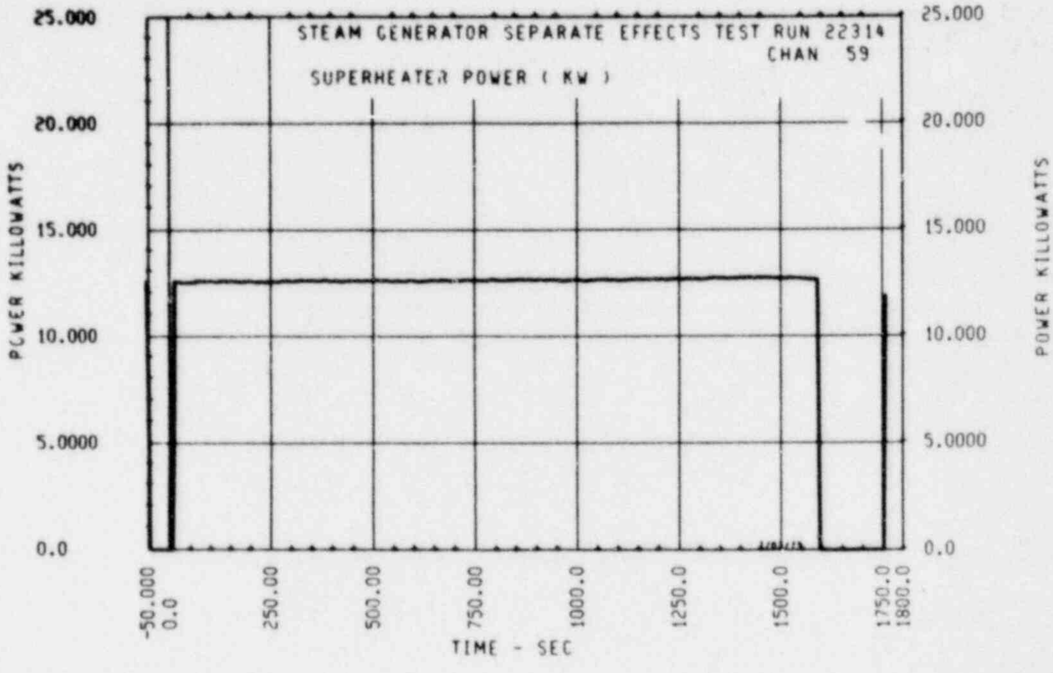

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22314
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
-50.000
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22314
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

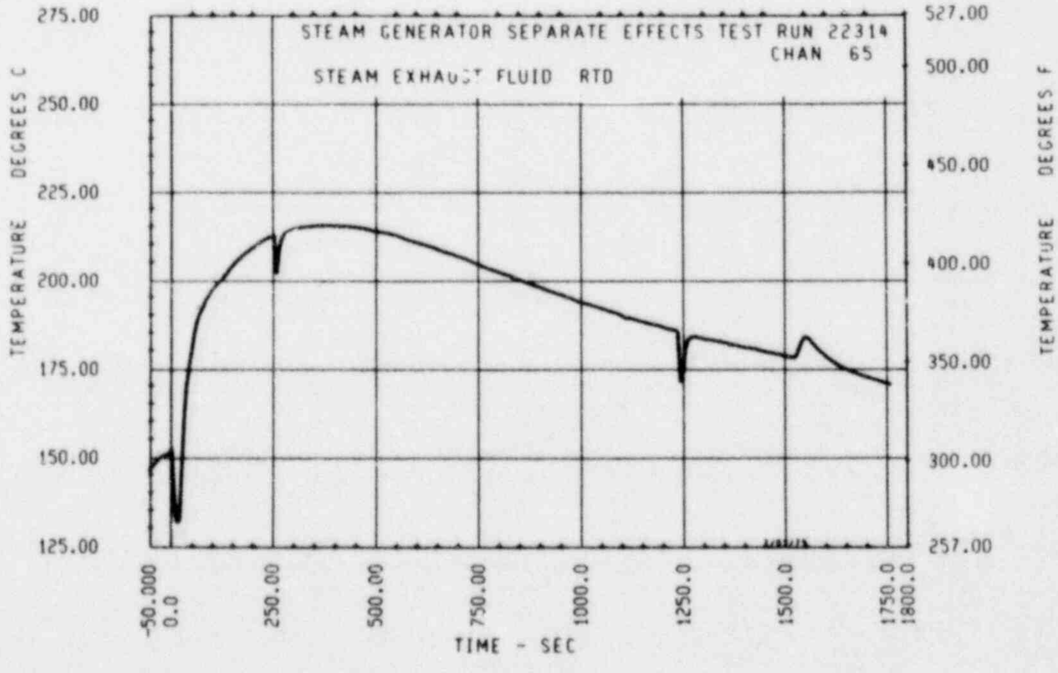

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22314
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22314
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
175.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
347.00
325.00
300.00
275.00
250.00
225.00
212.00
-50.000
0.0
250.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

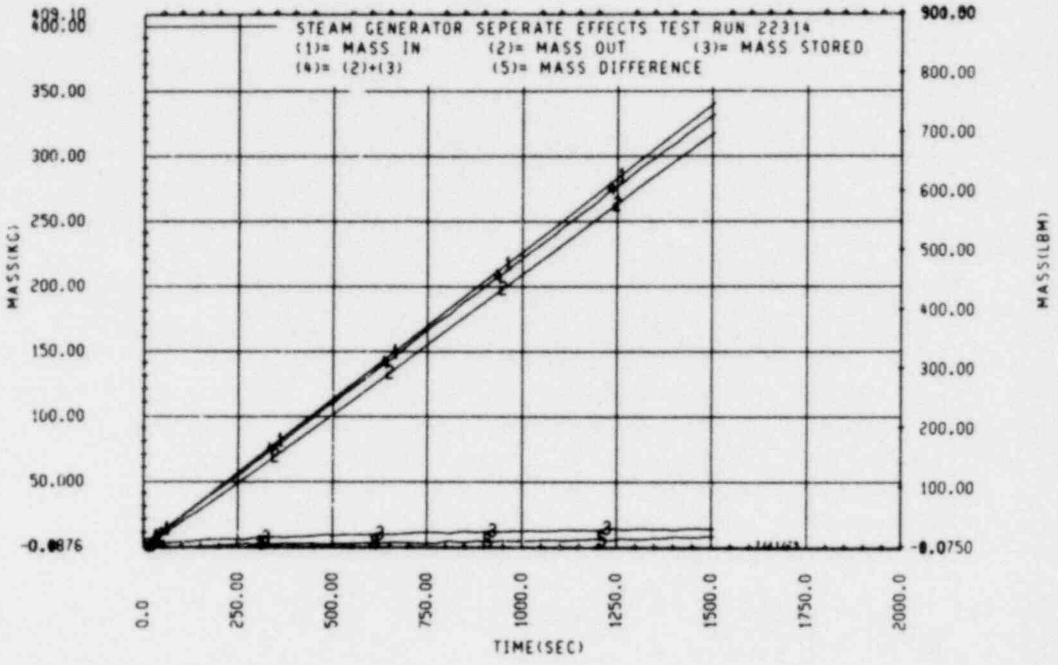

CHAN 12
TEMPERATURE DEGREES F
TIME - SEC
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0



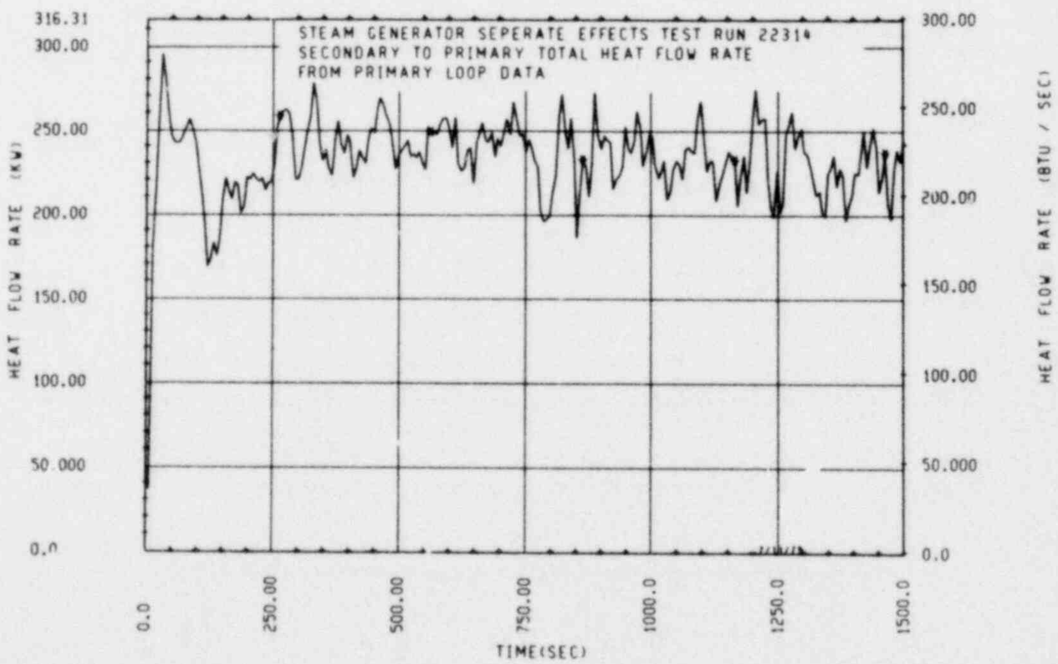
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22314
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC



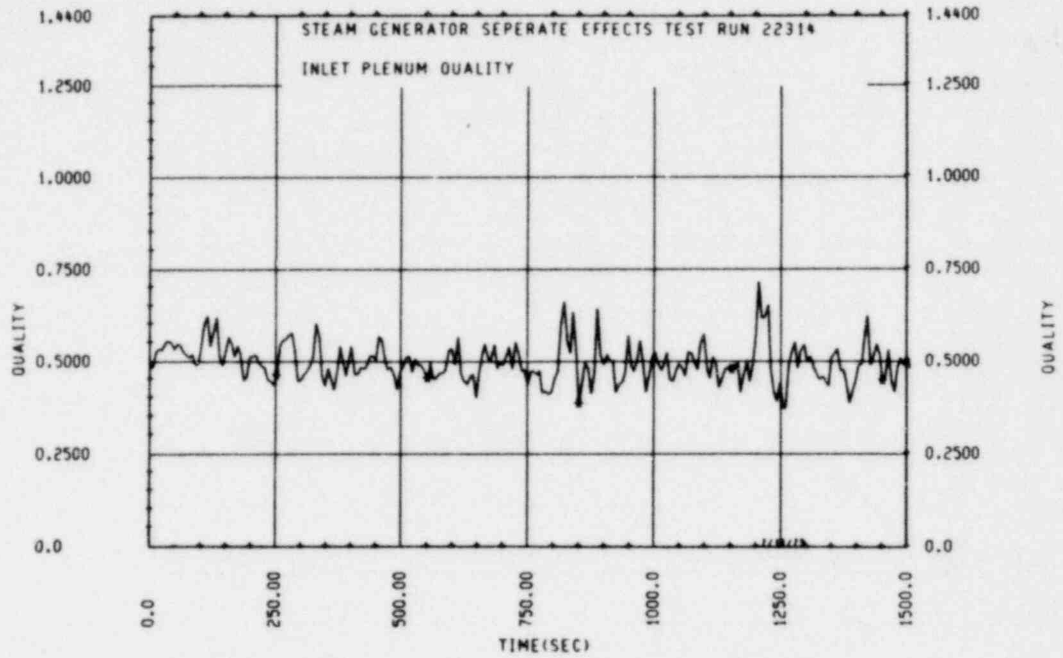
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22314
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

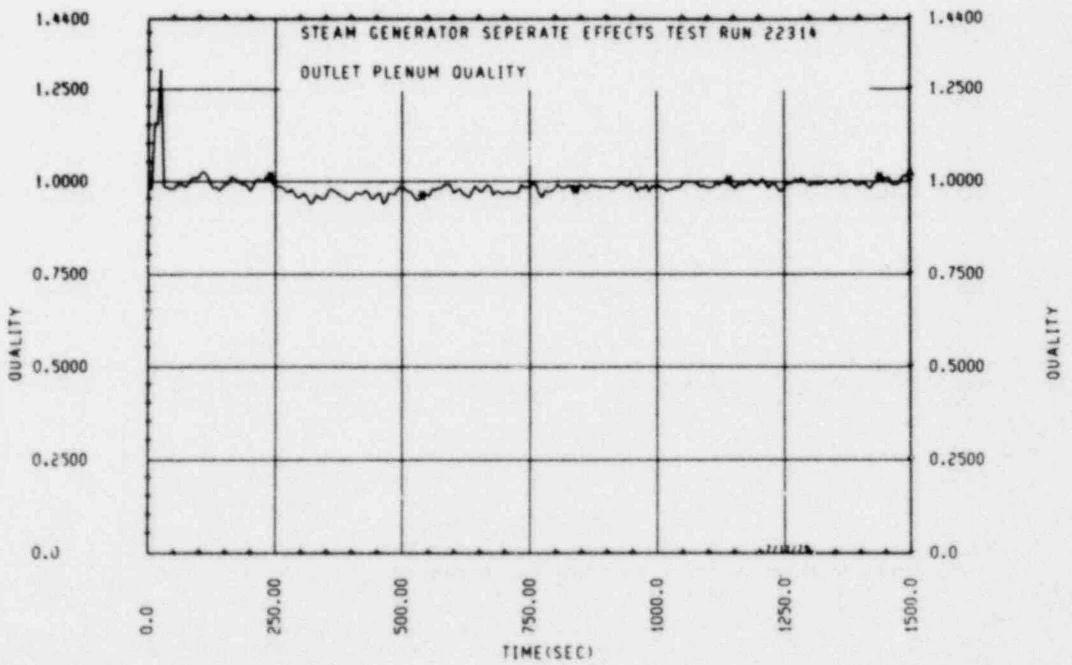


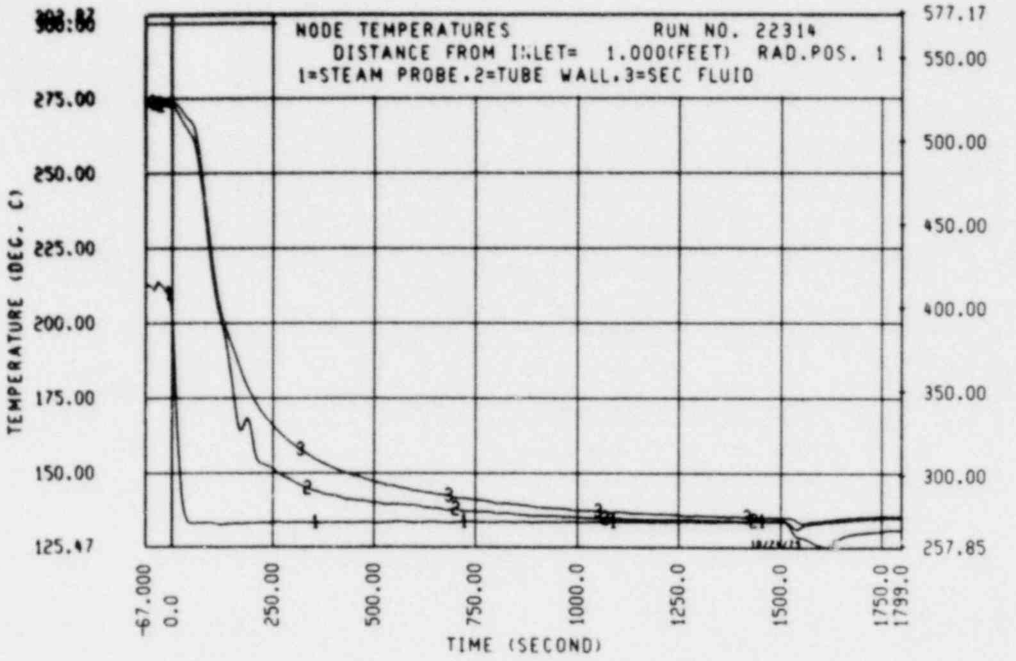
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22314
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)

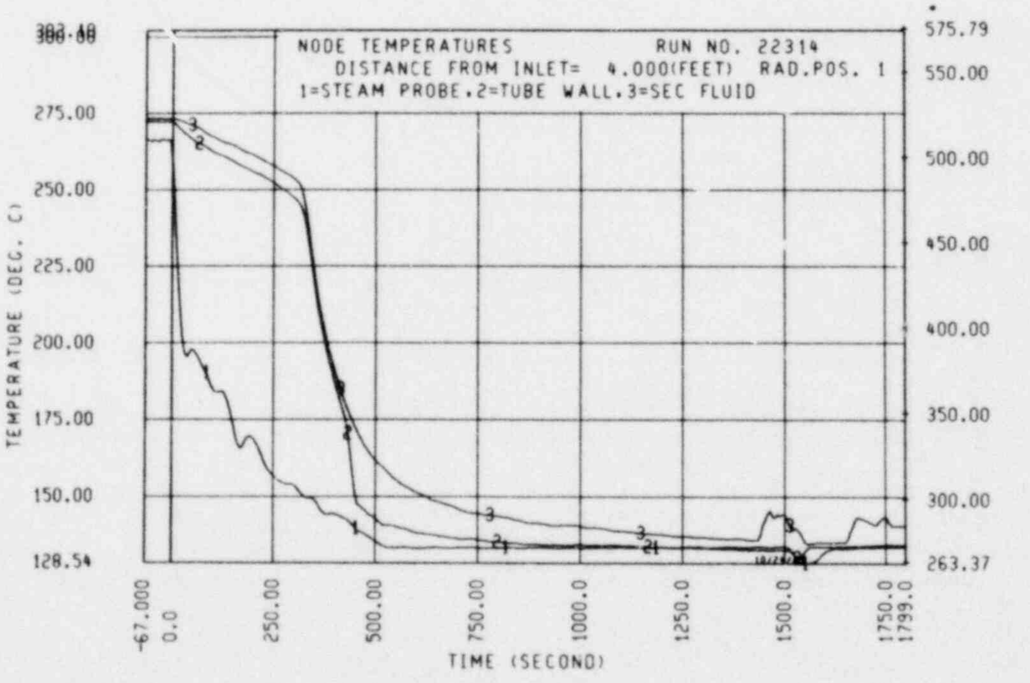


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22314
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)

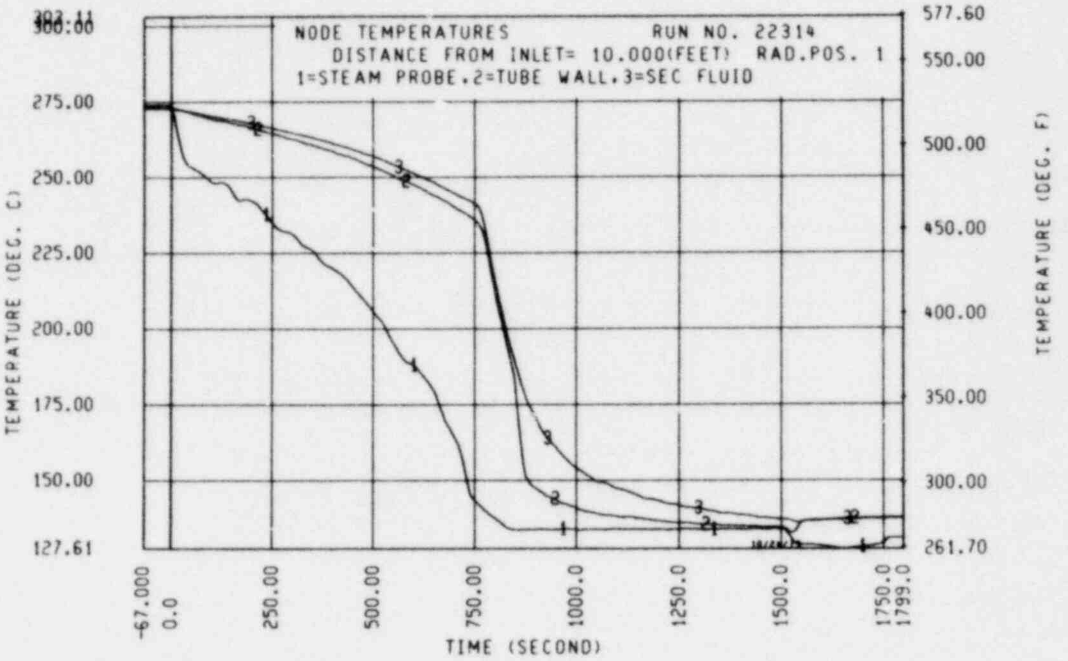

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22314
INLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

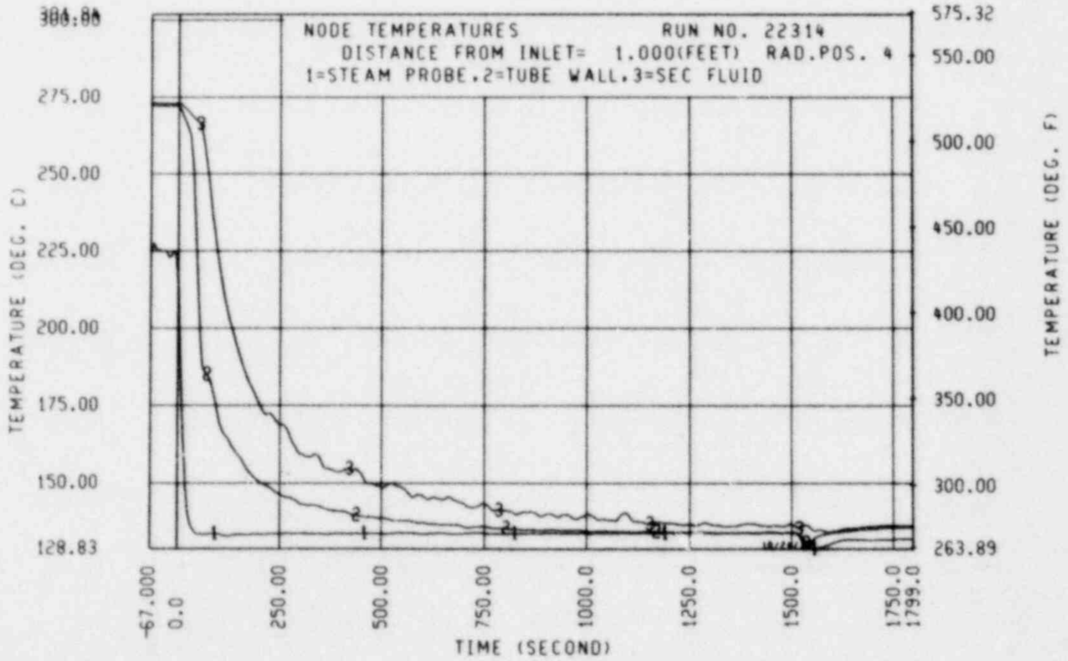

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22314
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0


NODE TEMPERATURES RUN NO. 22314
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

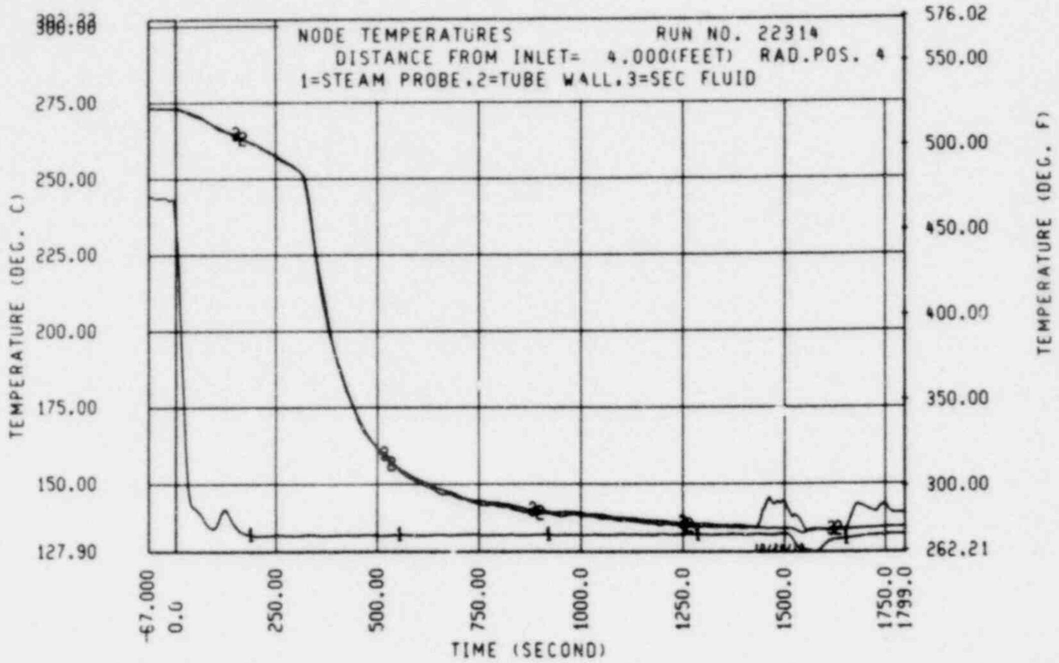

NODE TEMPERATURES RUN NO. 22314
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

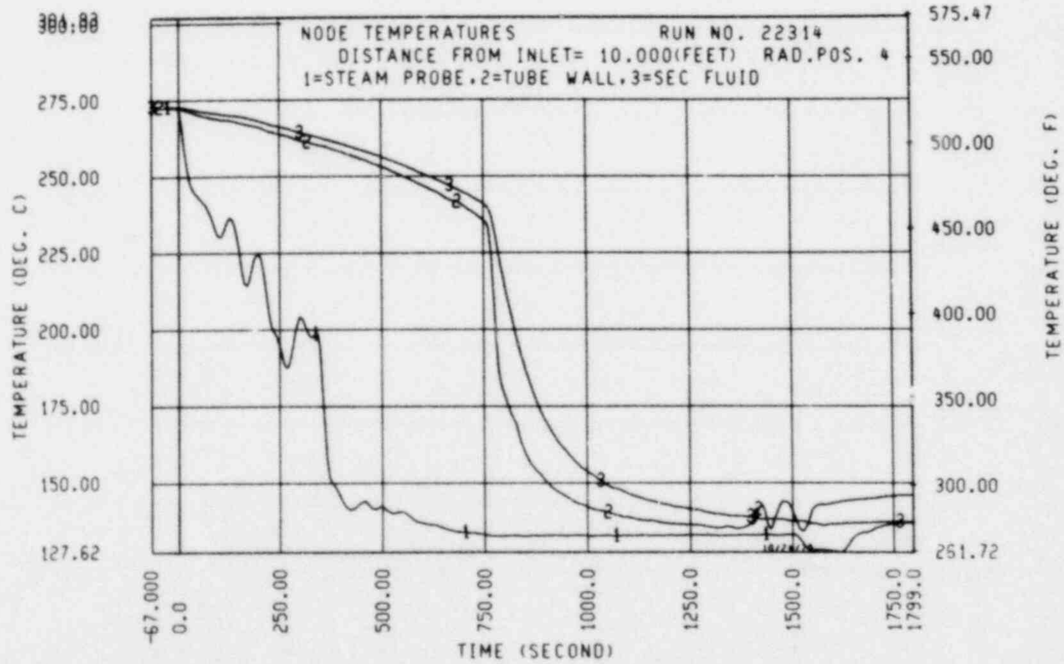
22314-11

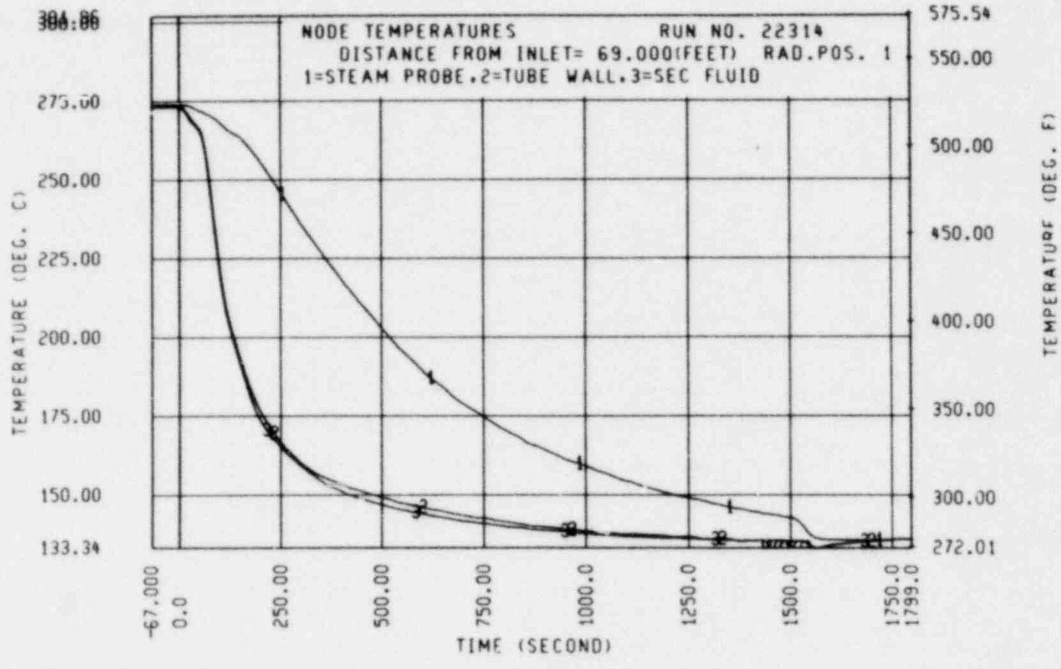

NODE TEMPERATURES
RUN NO. 22314
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
127.61
TEMPERATURE (DEG. F)
577.60
550.00
500.00
450.00
400.00
350.00
300.00
261.70
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1799.0
TIME (SECOND)

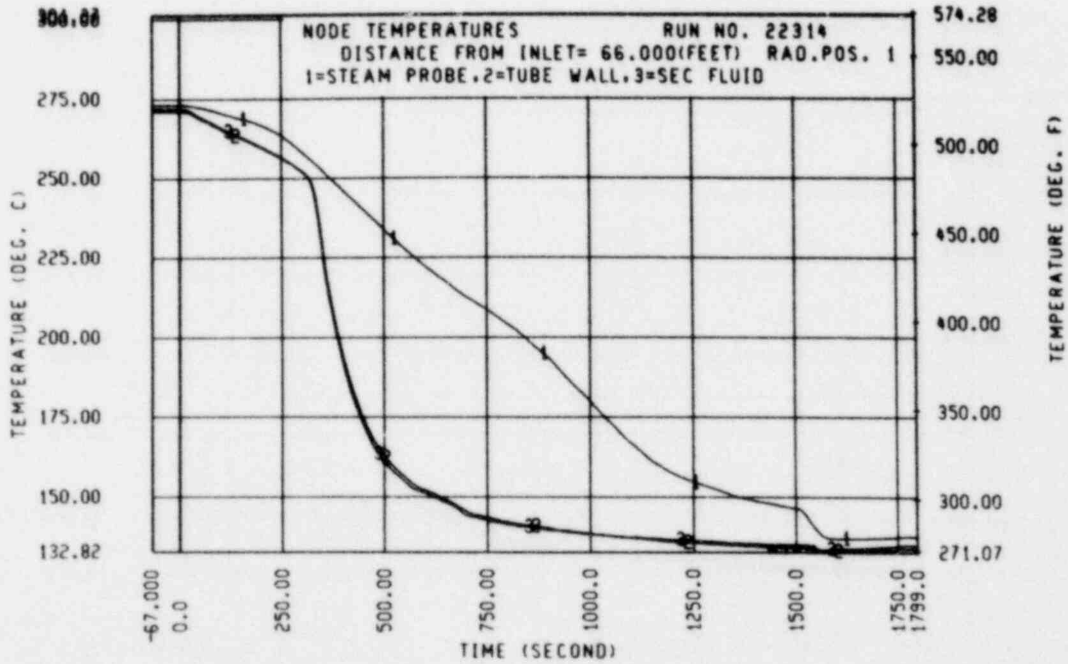

NODE TEMPERATURES
RUN NO. 22314
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
128.83
TEMPERATURE (DEG. F)
575.32
550.00
500.00
450.00
400.00
350.00
300.00
263.89
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1799.0
TIME (SECOND)

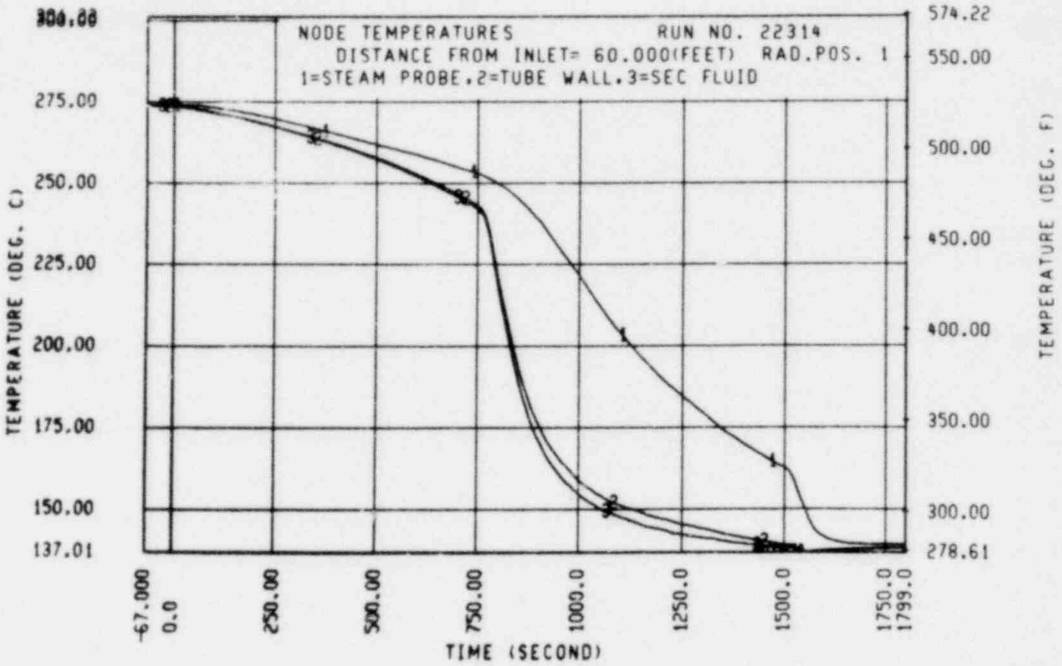
22314-12

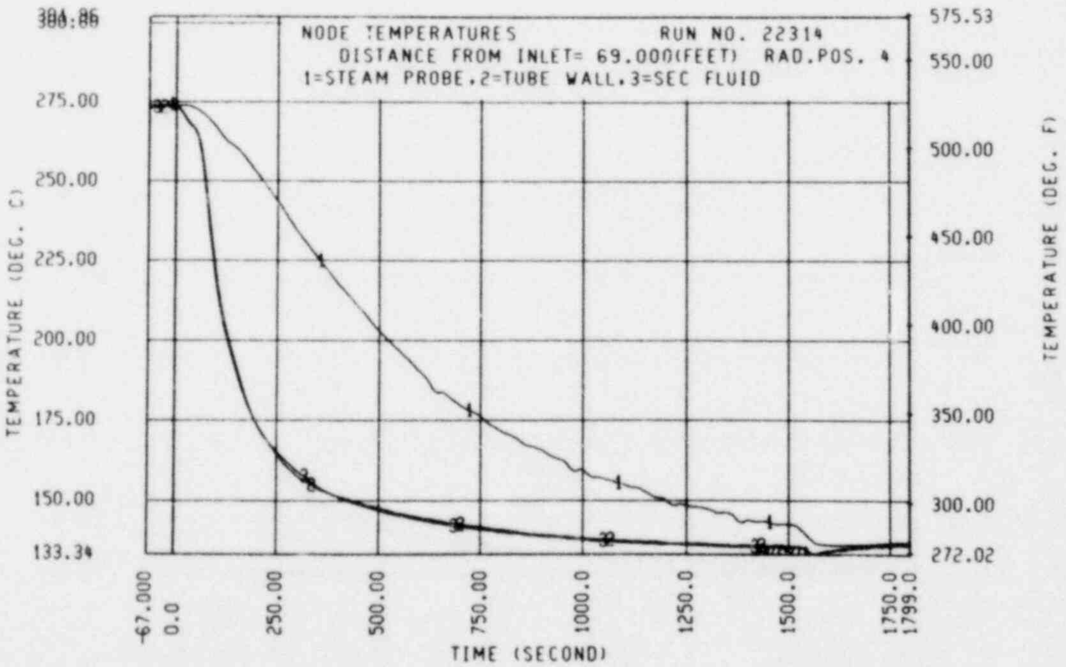

NODE TEMPERATURES RUN NO. 22314
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

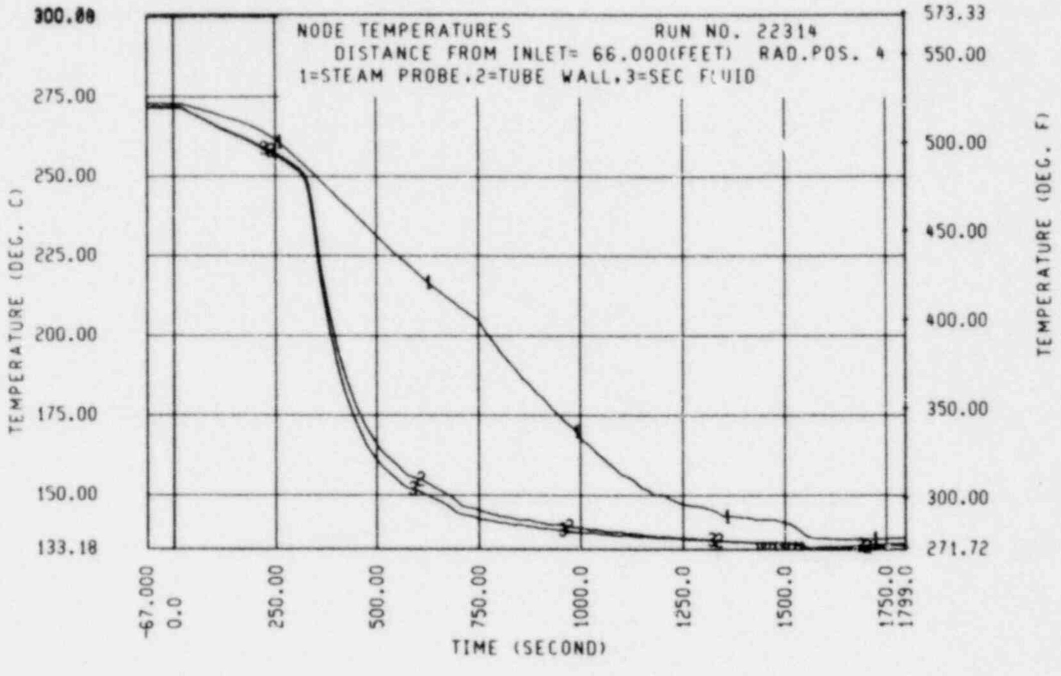

NODE TEMPERATURES RUN NO. 22314
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

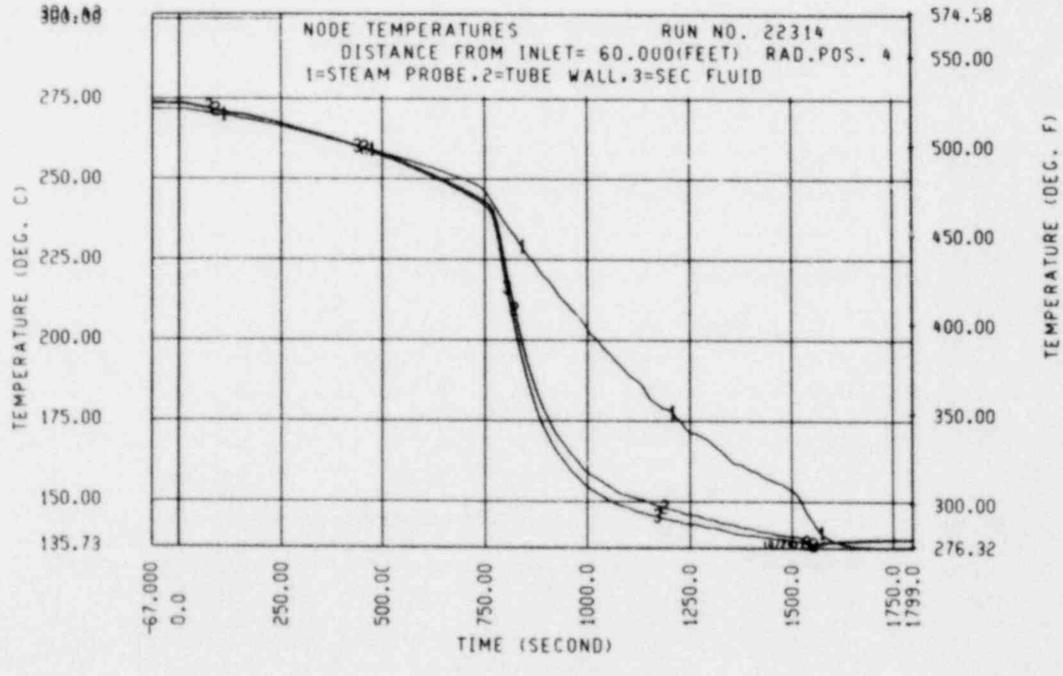

NODE TEMPERATURES RUN NO. 22314
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22314
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

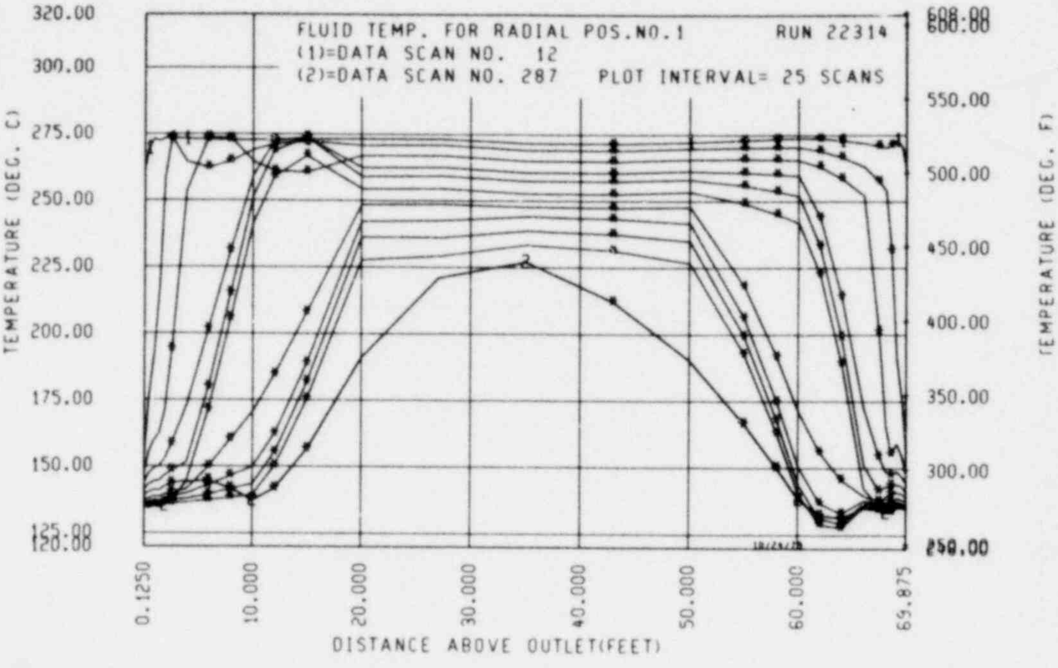

NODE TEMPERATURES RUN NO. 22314
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

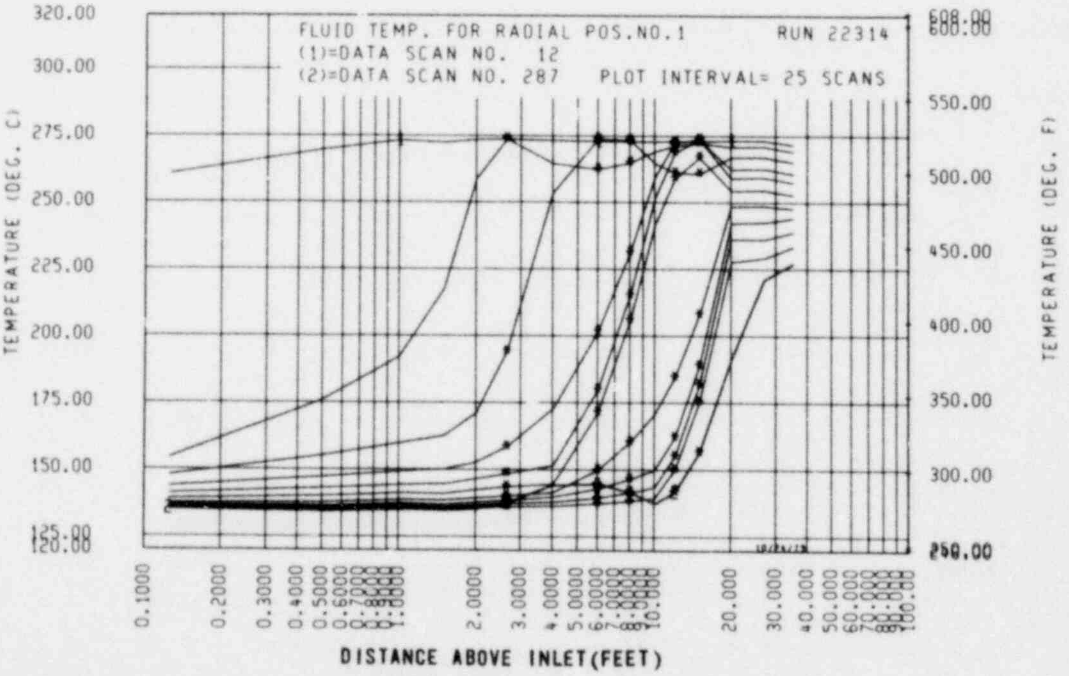

NODE TEMPERATURES RUN NO. 22314
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22314
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
300.00
275.00
250.00
225.00
200.00
175.00
150.00
133.18
573.33
550.00
500.00
450.00
400.00
350.00
300.00
271.72
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1799.0

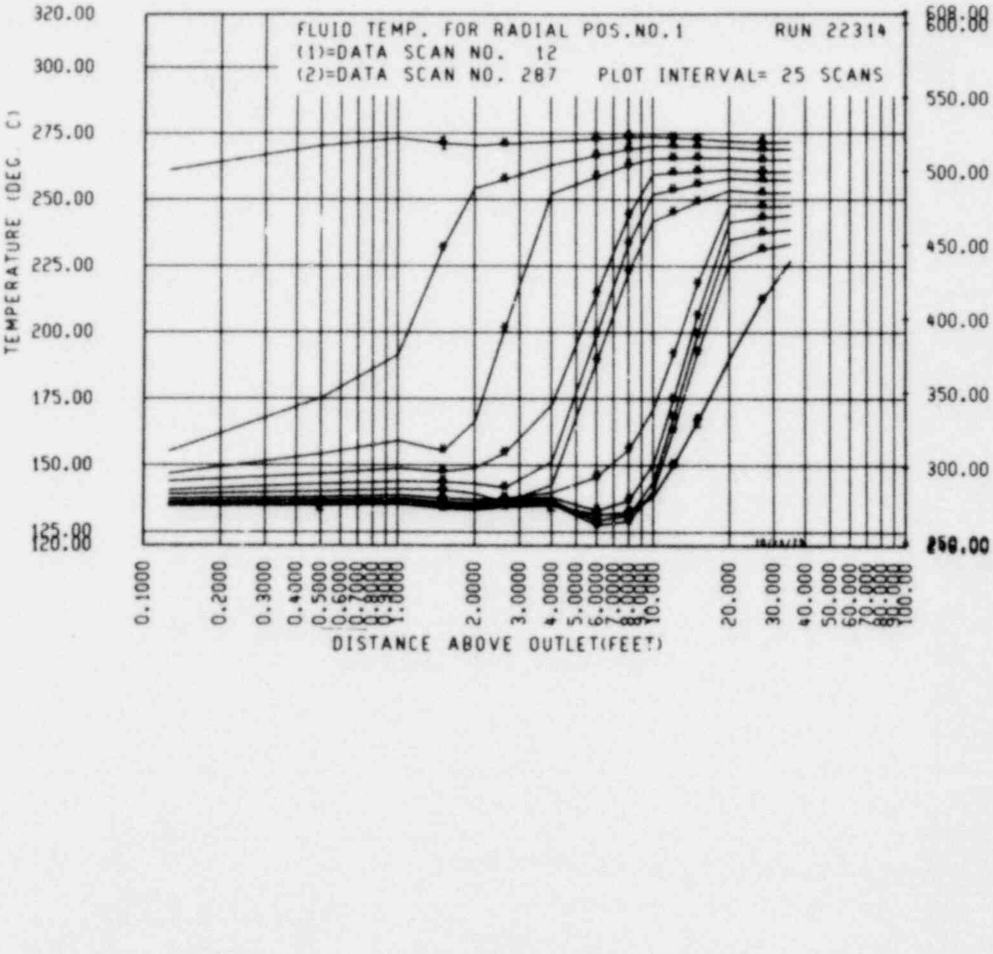

NODE TEMPERATURES RUN NO. 22314
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
300.00
275.00
250.00
225.00
200.00
175.00
150.00
135.73
574.58
550.00
500.00
450.00
400.00
350.00
300.00
276.32
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1799.0

22314-16


FLUID TEMP. FOR RADIAL POS.NO.1 RUN 22314
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 287 PLOT INTERVAL= 25 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1 RUN 22314
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 287 PLOT INTERVAL= 25 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)

22314-17



FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22314
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 287 PLOT INTERVAL= 25 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

22314-18

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22314

TIME = 78.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.3(.03)	49.1(4.33)	55.7(4.91)	34.2(3.01)	.565	.632	.377	.228
.2(.50)	21.2(1.87)	201.9(17.79)	207.9(18.32)	214.0(18.85)	.574	.700	.449	.298
.3(1.00)	10.0(.88)	367.1(32.35)	2.7(.23)	1.0(.09)	.580	.872	.513	.384
.5(1.50)	67.7(5.97)	1.2(.11)	17.5(1.54)	1.2(.11)	.597	.983	.520	.365
.6(2.00)	97.3(8.57)	21.7(1.91)	43.6(3.84)	12.7(1.12)	.639	.988	.538	.369
.8(2.65)	1.2(.11)	-7.4(-.66)	49.7(4.38)	-11.3(-1.00)	.661	.988	.575	.368
1.2(4.00)	7.3(.64)	7.4(.65)	4.6(.40)	1.2(.11)	.658	.973	.597	.362
1.8(6.00)	3.6(.32)	15.1(1.33)	4.9(.43)	20.4(1.80)	.656	.961	.593	.380
2.4(8.00)	1.4(.13)	8.8(.77)	-1.4(-.12)	14.8(1.31)	.651	.963	.581	.409
3.0(10.00)	.6(.05)	1.3(.11)	2.1(.19)	2.6(.23)	.645	.967	.570	.417
3.7(12.00)	.1(.01)	-.5(-.04)	3.2(.28)	-1.7(-.15)	.641	.964	.569	.411
4.6(15.00)	.6(.05)	.5(.04)	2.4(.21)	-.8(-.07)	.640	.956	.570	.405
6.1(20.00)	.1(.01)	.0(.00)	.4(.04)	.3(.03)	.640	.950	.572	.403
8.2(27.00)	.6(.05)	-.1(-.00)	-.2(-.02)	.6(.05)	.642	.949	.571	.407
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.646	.950	.572	.410
13.1(43.00)	-.8(-.07)	-.3(-.03)	.0(.00)	-.1(-.01)	.644	.951	.574	.410
15.2(50.00)	-.0(-.00)	-.1(-.01)	-.0(-.00)	.1(.00)	.641	.950	.575	.411
16.8(55.00)	.1(.01)	-.1(-.01)	-.0(-.00)	.1(.01)	.642	.950	.576	.412
17.7(58.00)	.1(.01)	-.1(-.00)	.0(.00)	.1(.01)	.642	.950	.577	.413
18.3(60.00)	.2(.02)	-.1(-.01)	.0(.00)	.1(.01)	.643	.950	.578	.413
18.9(62.00)	.4(.04)	.0(.00)	.1(.01)	.0(.00)	.644	.950	.578	.414
19.5(64.00)	.1(.01)	.2(.01)	.1(.01)	-.0(-.00)	.645	.951	.579	.414
20.1(66.00)	.3(.03)	1.0(.09)	.3(.03)	-.1(-.01)	.646	.953	.580	.414
20.5(67.38)	-.9(-.08)	-.3(-.03)	-.9(-.08)	-2.6(-.23)	.647	.955	.580	.413
20.7(68.00)	-2.3(-.20)	-1.9(-.16)	-2.4(-.21)	-3.8(-.34)	.646	.955	.578	.411
20.9(68.50)	-4.4(-.39)	-4.4(-.39)	-10.1(-.89)	-2.5(-.22)	.645	.953	.575	.409
21.0(69.00)	3.5(.31)	2.8(.25)	1.6(.14)	6.9(.61)	.646	.952	.573	.411
21.2(69.50)	-14.9(-1.31)	-1.4(-.13)	-22.1(-1.95)	-1.4(-.12)	.647	.955	.568	.414
21.3(69.87)	-15.0(-1.32)	-5.6(-.50)	-7.2(-.64)	-4.3(-.38)	.645	.956	.562	.414

22314-19

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22314
TIME = 258.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.1(.01)	16.9(1.49)	15.5(1.37)	14.4(1.27)	.563	.626	.370	.224
.2(.50)	39.0(3.43)	42.7(3.76)	46.0(4.05)	40.6(3.53)	.575	.641	.387	.239
.3(1.00)	46.9(4.13)	60.7(5.35)	.3(.02)	71.5(6.30)	.601	.672	.401	.273
.5(1.50)	64.0(5.64)	67.8(5.97)	23.0(2.03)	63.3(5.58)	.635	.711	.408	.315
.6(2.00)	107.9(9.51)	103.1(9.09)	112.1(9.88)	83.6(7.37)	.586	.764	.449	.360
.8(2.65)	.7(.06)	.7(.06)	171.8(15.13)	79.0(6.96)	.716	.795	.562	.421
1.2(4.00)	10.2(.90)	15.9(1.40)	8.4(.74)	1.1(.10)	.717	.804	.651	.459
1.8(6.00)	-.2(-.02)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.711	.797	.661	.458
2.4(8.00)	-.3(-.03)	-.2(-.01)	.2(.02)	7.7(.68)	.694	.775	.653	.458
3.0(10.00)	2.8(.25)	3.6(.32)	4.0(.35)	4.9(.43)	.684	.768	.654	.461
3.7(12.00)	9.8(.86)	8.5(.75)	4.3(.38)	.1(.01)	.690	.775	.647	.456
4.6(15.00)	7.0(.62)	4.8(.43)	2.9(.25)	.7(.06)	.712	.738	.633	.447
6.1(20.00)	.1(.01)	.1(.01)	.4(.03)	.3(.03)	.724	.792	.622	.442
8.2(27.00)	.7(.06)	.6(.05)	-.2(-.02)	.7(.06)	.726	.792	.620	.446
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.730	.797	.623	.452
13.1(43.00)	-.8(-.07)	-.3(-.03)	.0(.00)	-.1(-.01)	.728	.799	.626	.454
15.2(50.00)	.0(.00)	-.1(-.01)	.0(.00)	.1(.01)	.726	.799	.627	.455
16.8(55.00)	.1(.00)	-.1(-.01)	-.0(-.00)	.1(.01)	.727	.799	.628	.456
17.7(58.00)	.0(.00)	-.1(-.01)	-.0(-.00)	.0(.00)	.728	.799	.629	.457
18.3(60.00)	-.0(-.00)	-.2(-.02)	-.1(-.01)	-.0(-.00)	.728	.799	.630	.458
18.9(62.00)	-.0(-.00)	-.0(-.00)	-.0(-.00)	-.1(-.01)	.728	.799	.631	.458
19.5(64.00)	.0(.00)	.1(.01)	.0(.00)	-.2(-.02)	.730	.801	.633	.459
20.1(66.00)	.1(.01)	1.0(.09)	.1(.01)	-.6(-.05)	.733	.805	.635	.459
20.5(67.39)	-4.8(-.42)	-4.0(-.35)	-3.7(-.33)	-9.7(-.85)	.733	.807	.635	.455
20.7(68.00)	-19.2(-1.70)	-17.8(-1.57)	-13.2(-1.16)	-17.5(-1.55)	.727	.802	.631	.448
20.9(68.50)	-15.4(-1.35)	-17.0(-1.50)	-15.1(-1.33)	-14.6(-1.29)	.721	.794	.625	.441
21.0(69.00)	2.6(.23)	2.1(.19)	1.8(.16)	-1.5(-.13)	.723	.793	.624	.440
21.2(69.50)	-13.6(-1.20)	-1.6(-.14)	-15.5(-1.38)	-12.5(-1.10)	.729	.799	.623	.438
21.3(69.87)	-4.5(-.40)	-3.8(-.33)	-3.5(-.31)	-2.9(-.26)	.732	.803	.619	.435

SUMMARY SHEET

RUN NO. 22415

DATE: 3/30/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.097 (0.213)
2. Water flow - [kg/sec (lb/sec)] - 0.182 (0.402)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{o}C (^{o}F)] - 149 (300)
5. Water temperature [^{o}C (^{o}F)]- 124 (256)
6. Mixer pressure [kPa (psig)] - 200 (29)
7. Test time (sec) - 1626.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.3 (33.8)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	257 (494)
0.15 (0.50)	266 (510)
0.30 (1.00)	273 (524)
0.46 (1.50)	273 (523)
0.61 (2.00)	274 (525)
1.22 (4.00)	275 (527)
3.05 (10.00)	273 (524)
6.09 (20.00)	273 (523)
8.23 (27.00)	272 (522)
10.67 (35.00)	272 (522)

SUMMARY SHEET (cont)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 12.4 (27.3)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - NA
   (b) SG collection tank [kg (lb)] - 66.2 (146.0)
3. Posttest drain from hot leg [kg (lb)] - 18.0 (39.6)

D. FAILED BUNDLE T/Cs[1]

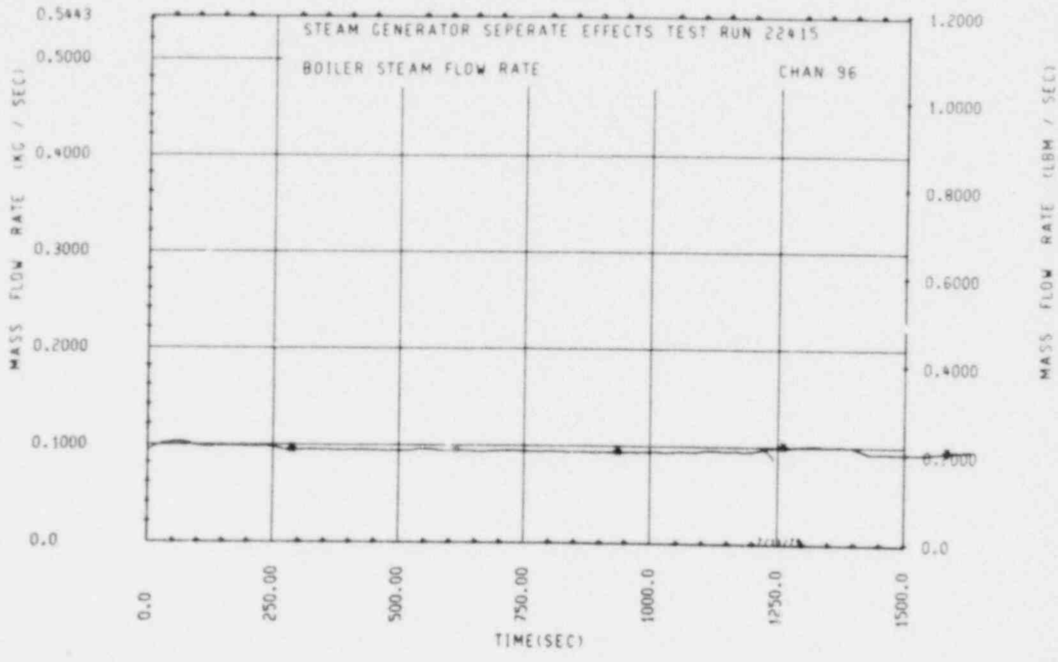
294, 295, 305, 308, 309, 310, 311, 326, 532, 549, 553, 564, 565, 568, 569

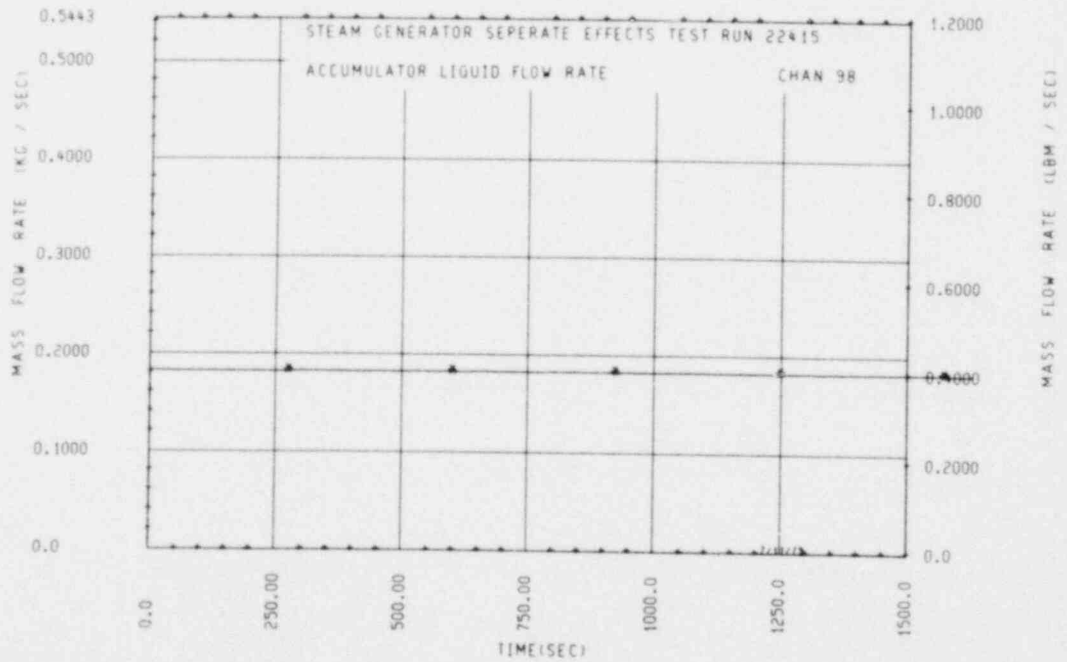
E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

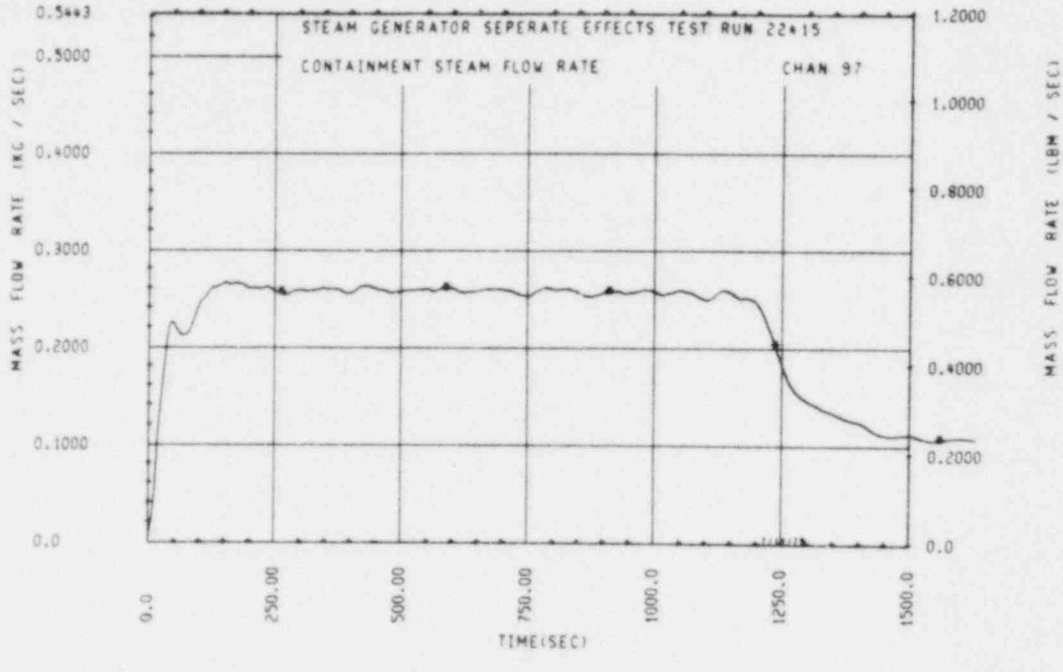
1. From primary side energy balance [kwsec(Btu)] - 1.01×10^5 (0.964×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da\,dt$) - [kwsec(Btu)] - 0.500×10^5 (0.476×10^5)
3. Integration to 300 sec

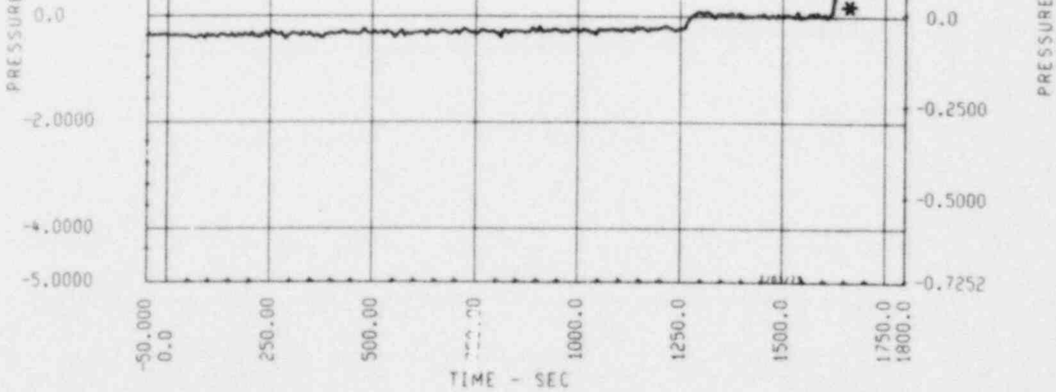
---

1. T/Cs are defined as failed based on resistance reading or T/C response.

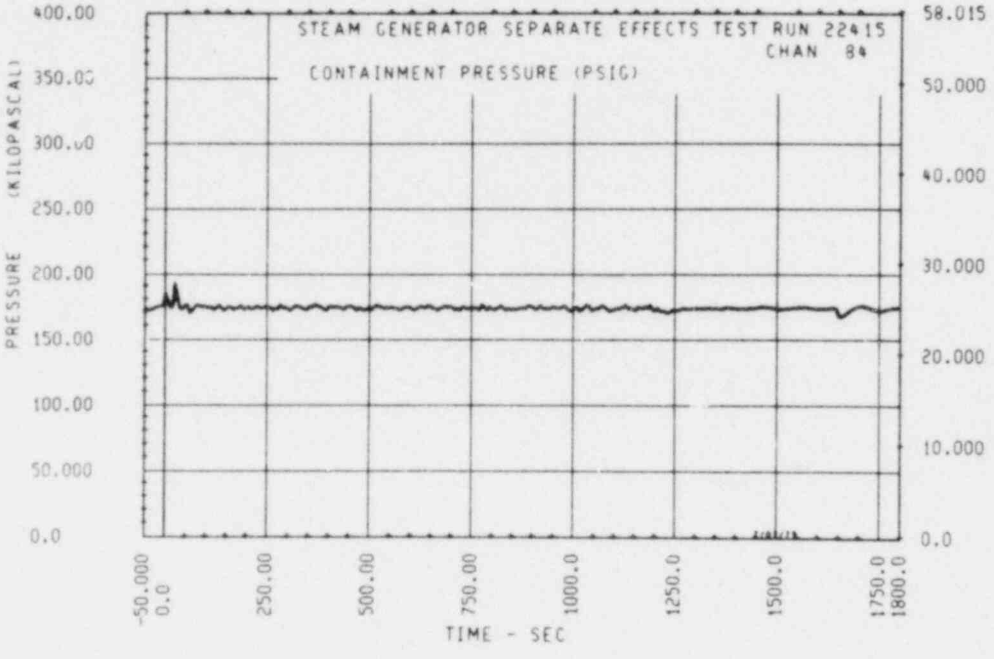

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22415
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22415
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

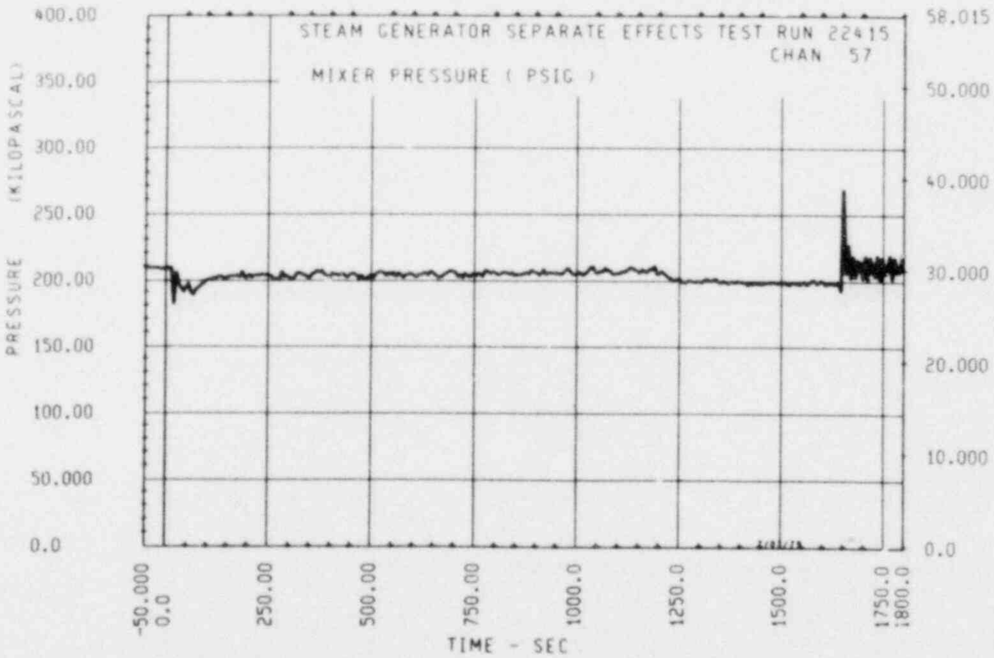




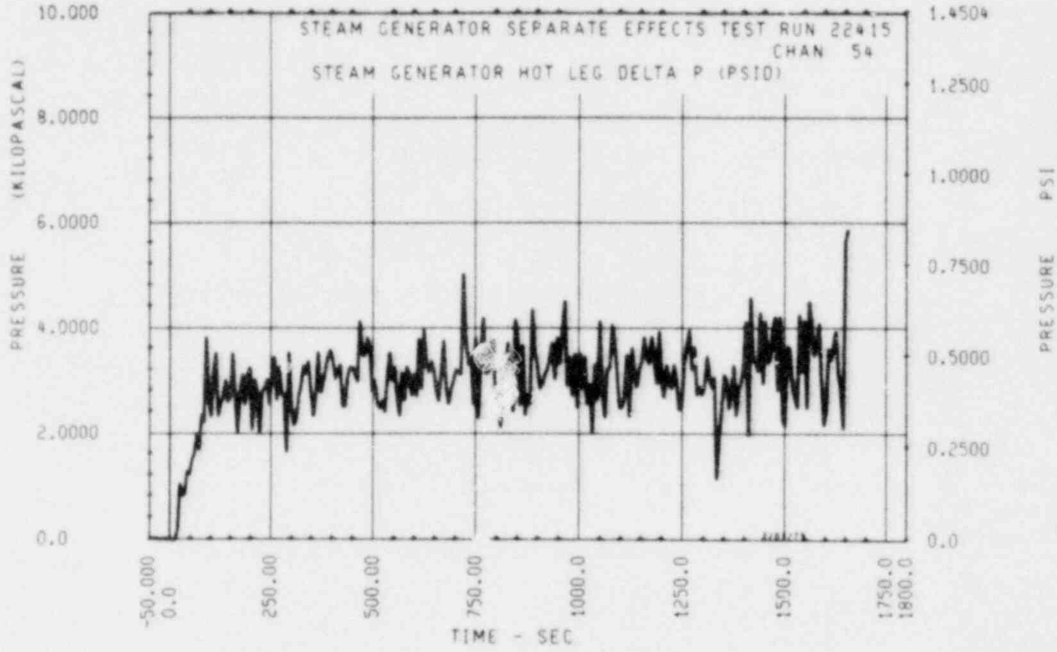
* Refer to Appendix H text for explanation of delayed response.

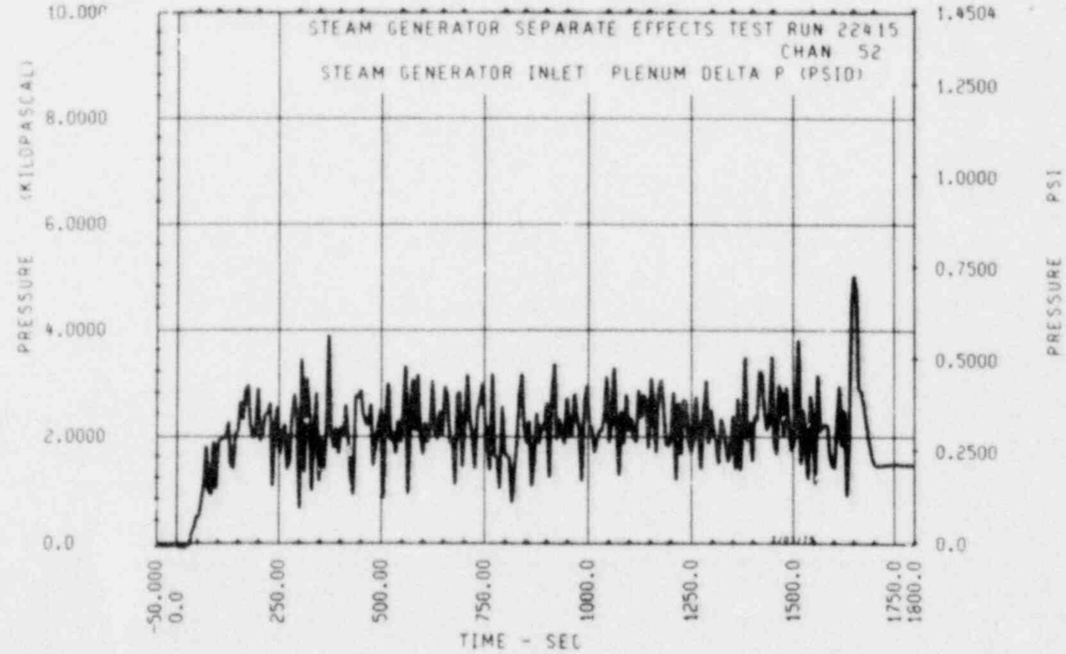


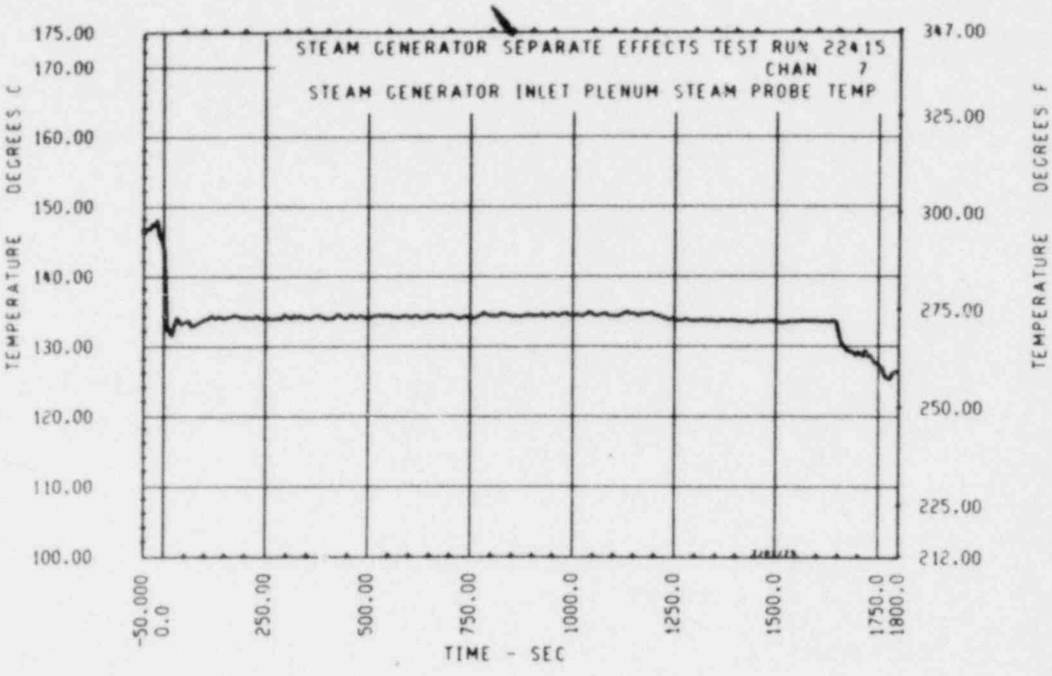
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22415
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC



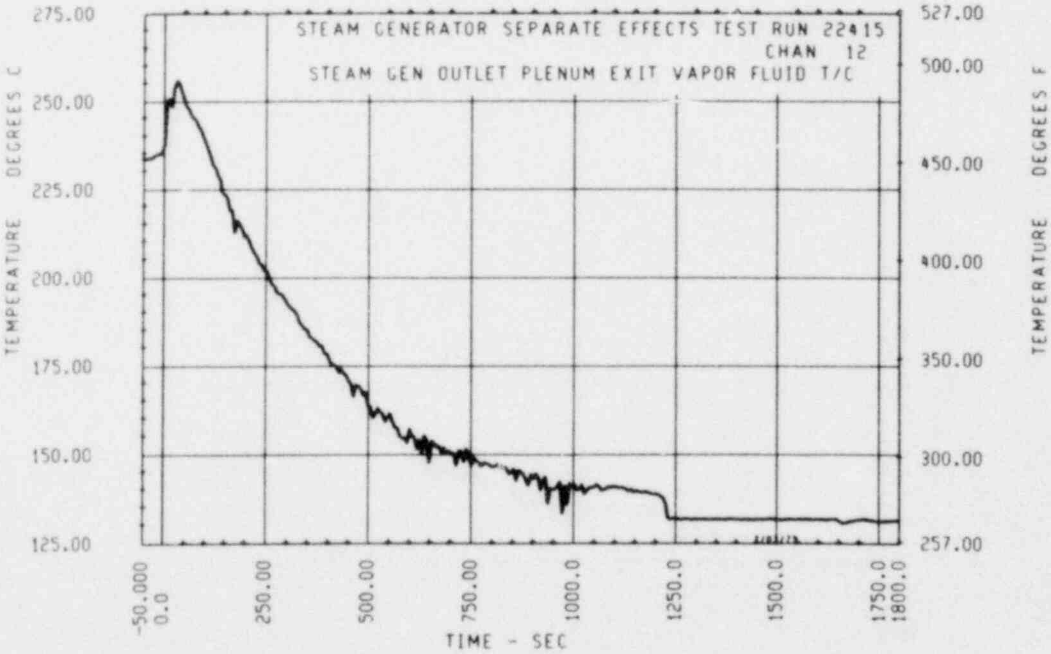
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22415
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22415
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
10.000
8.0000
6.0000
4.0000
2.0000
0.0
1.4504
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22415
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
8.0000
6.0000
4.0000
2.0000
0.0
1.4504
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

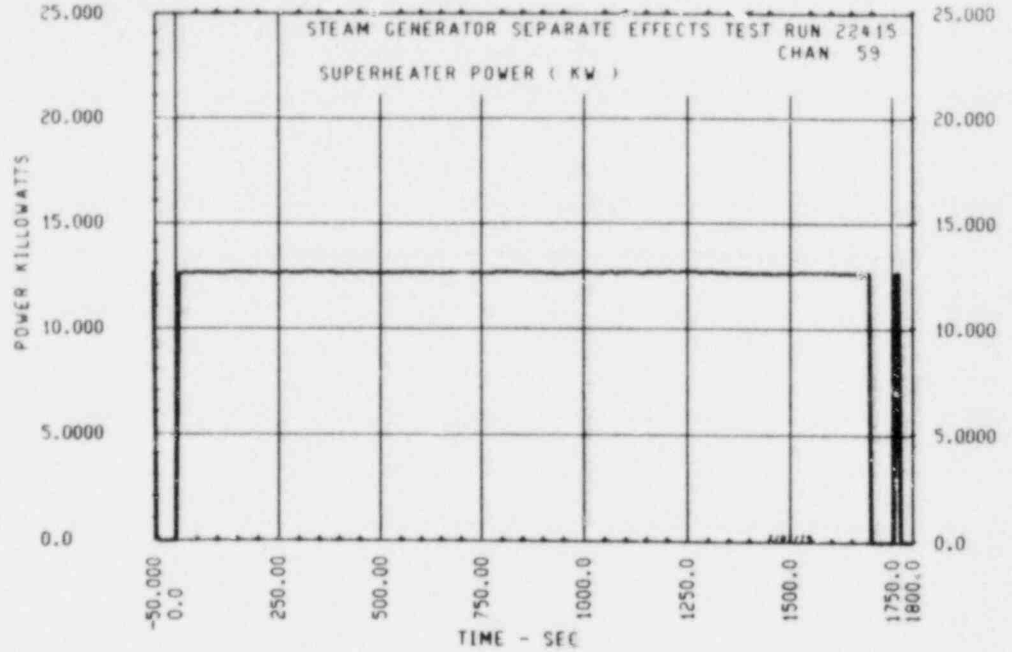


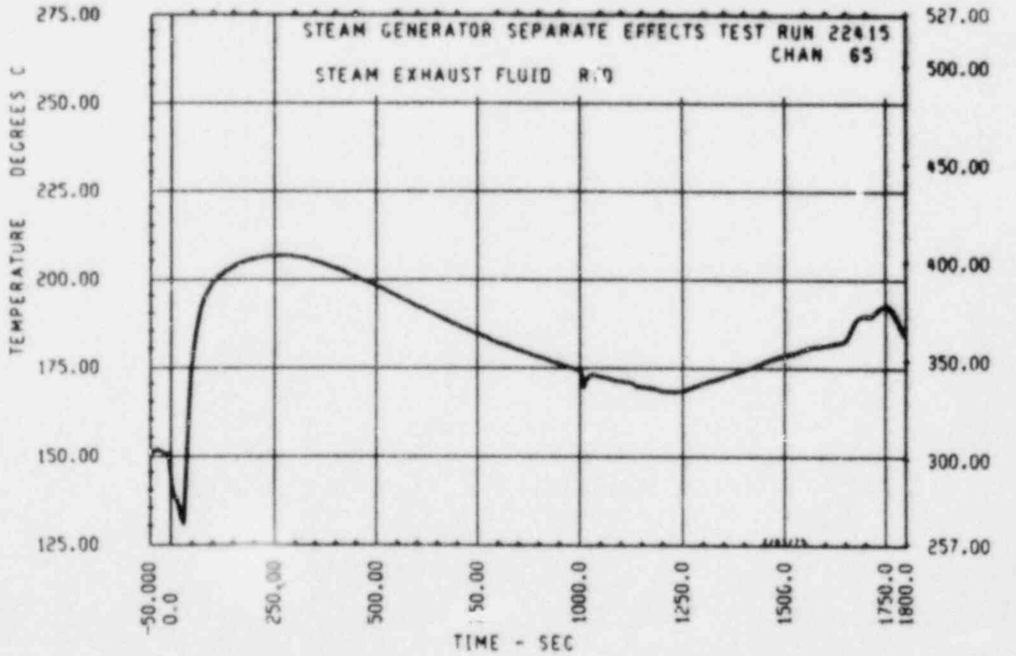
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22415
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

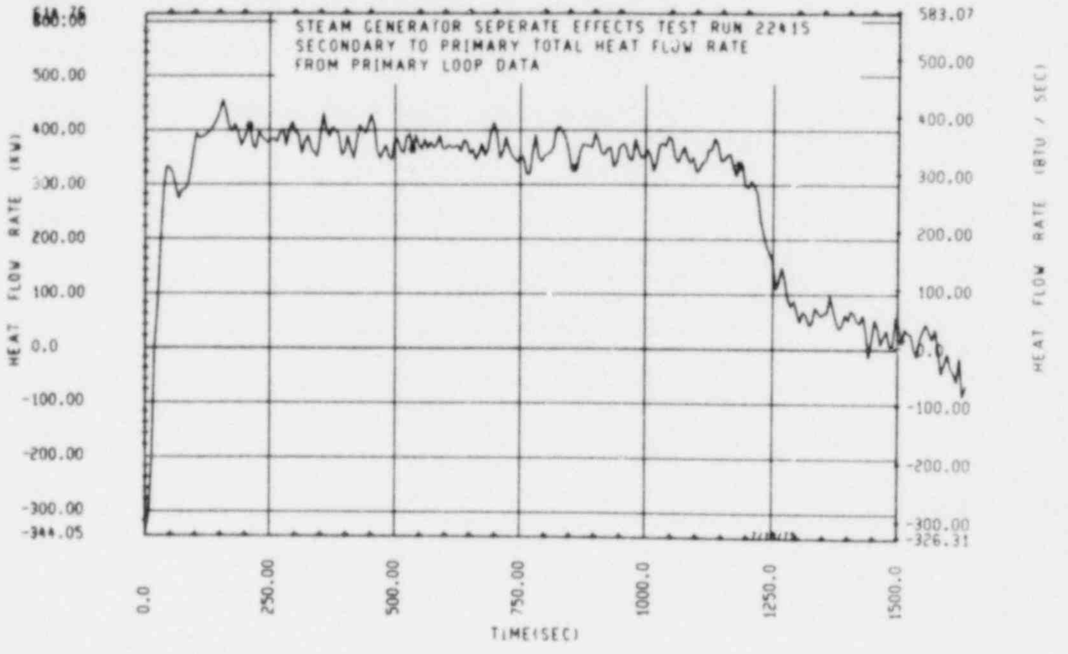


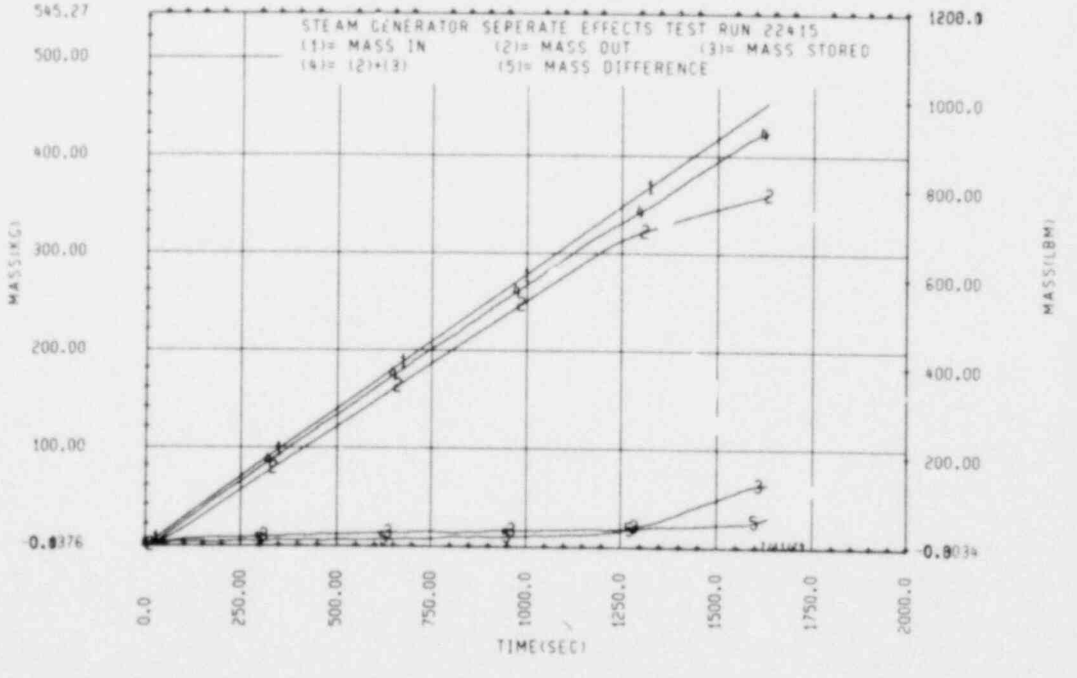
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22415
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

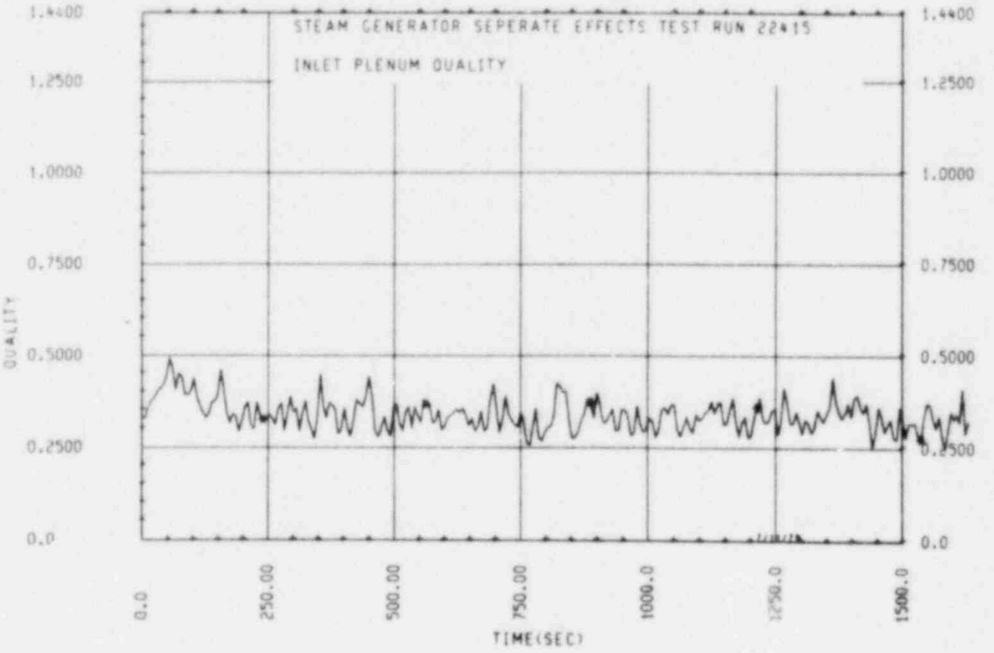
22415-7


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22415
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

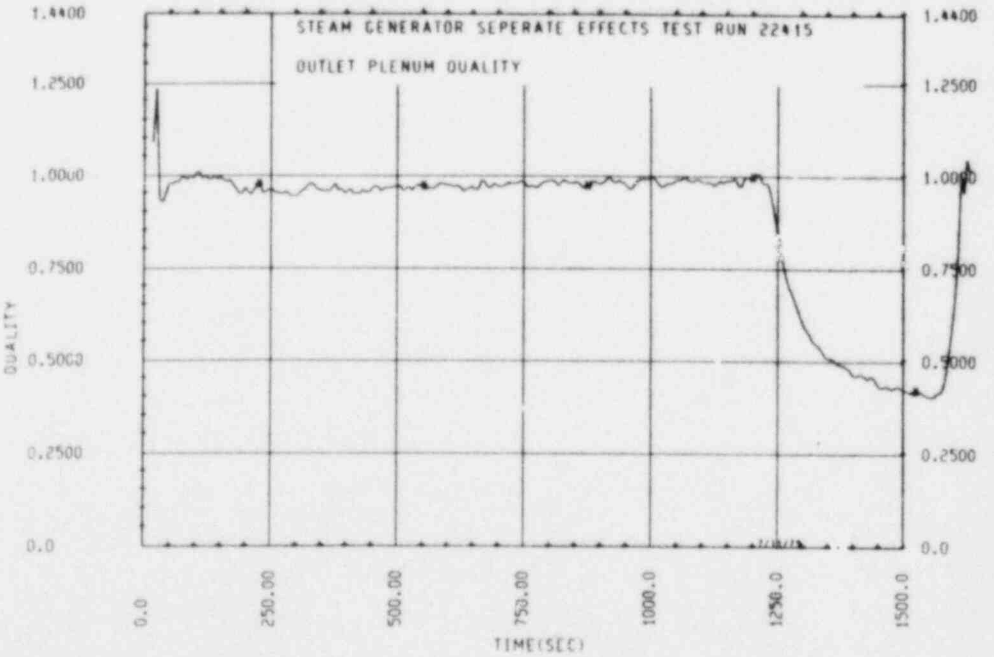

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22415
CHAN 65
STEAM EXHAUST FLUID
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
500.00
1000.0
1250.0
1750.0
1800.0
TIME - SEC


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22415
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)
500.00
400.00
300.00
200.00
100.00
0.0
-100.00
-200.00
-300.00
-344.05
583.07
-326.31
250.00
500.00
750.00
1000.0
1250.0
1500.0


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22415
(1)= MASS IN
(2)= MASS OUT
(3)= MASS STORED
(4)= (2)+(3)
(5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)
545.27
500.00
400.00
300.00
200.00
100.00
1200.0
1000.0
800.00
600.00
400.00
200.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
2000.0

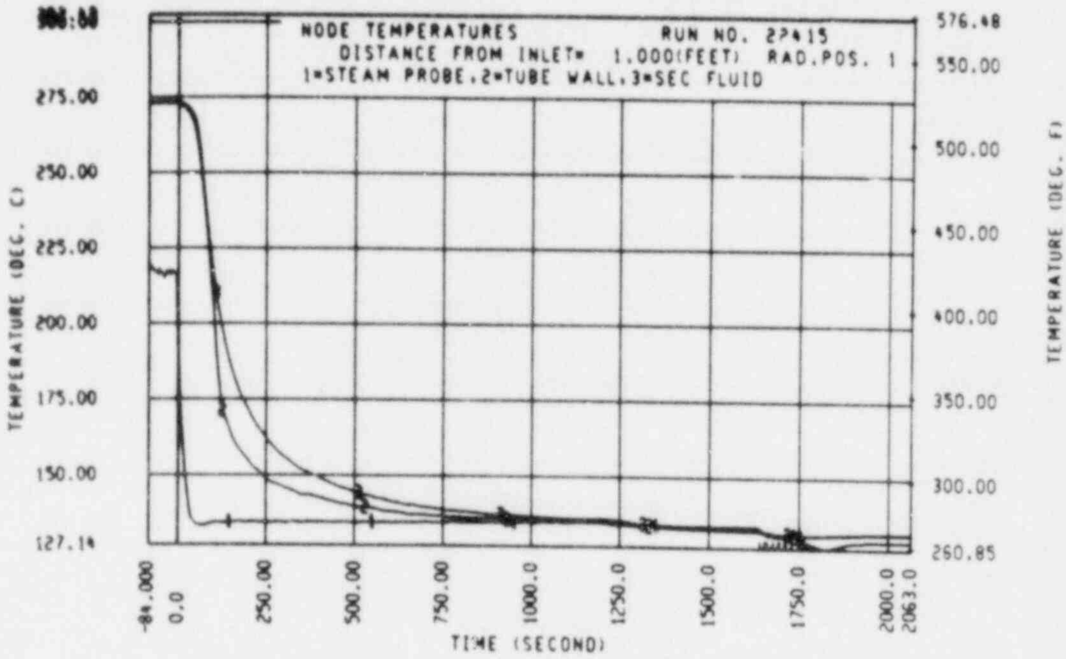


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22415
INLET PLENUM QUALITY
QUALITY
TIME(SEC)

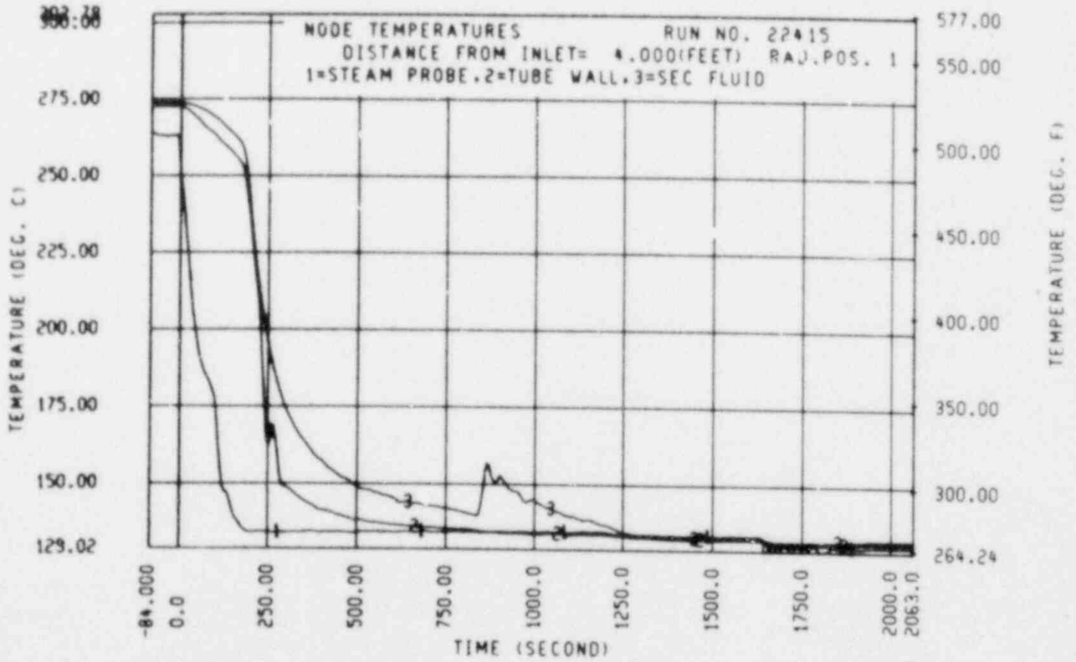


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22415
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)

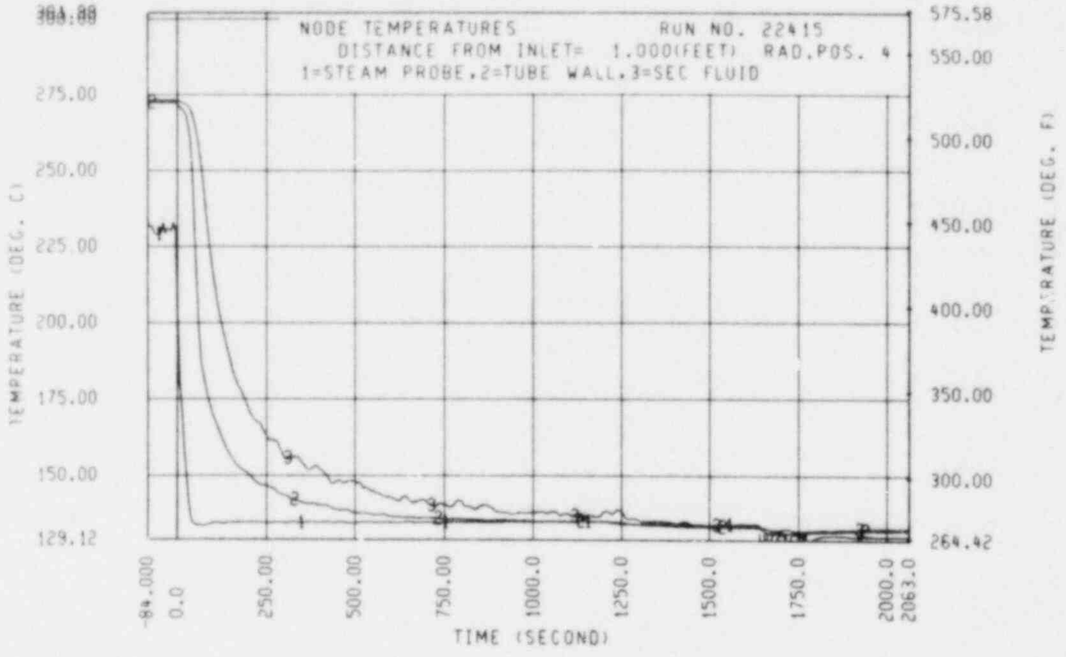
22415-10

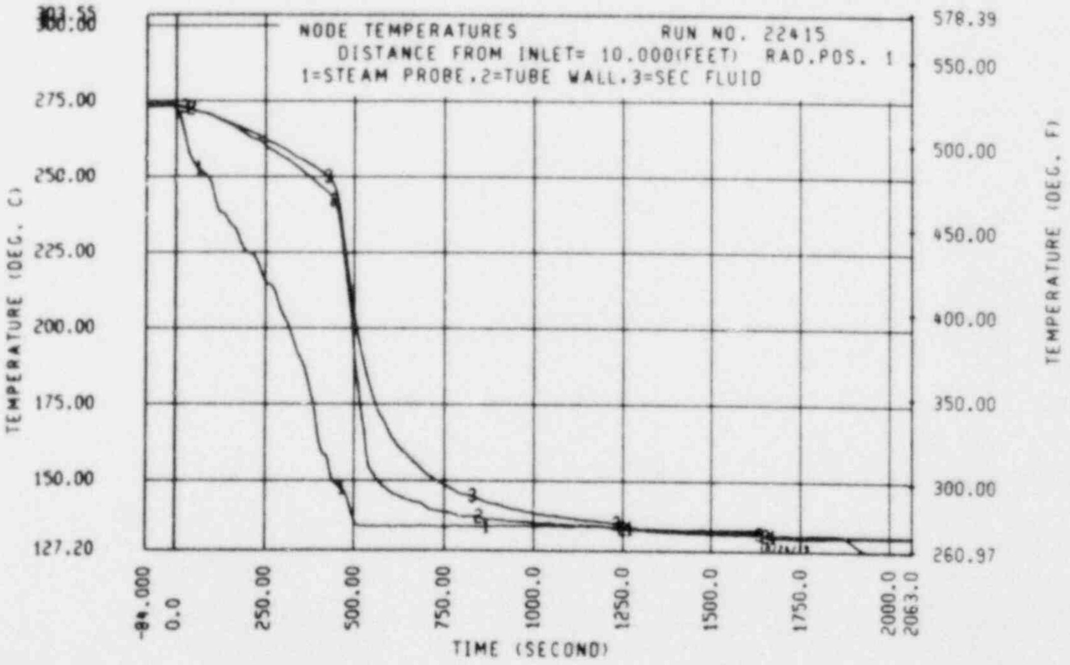


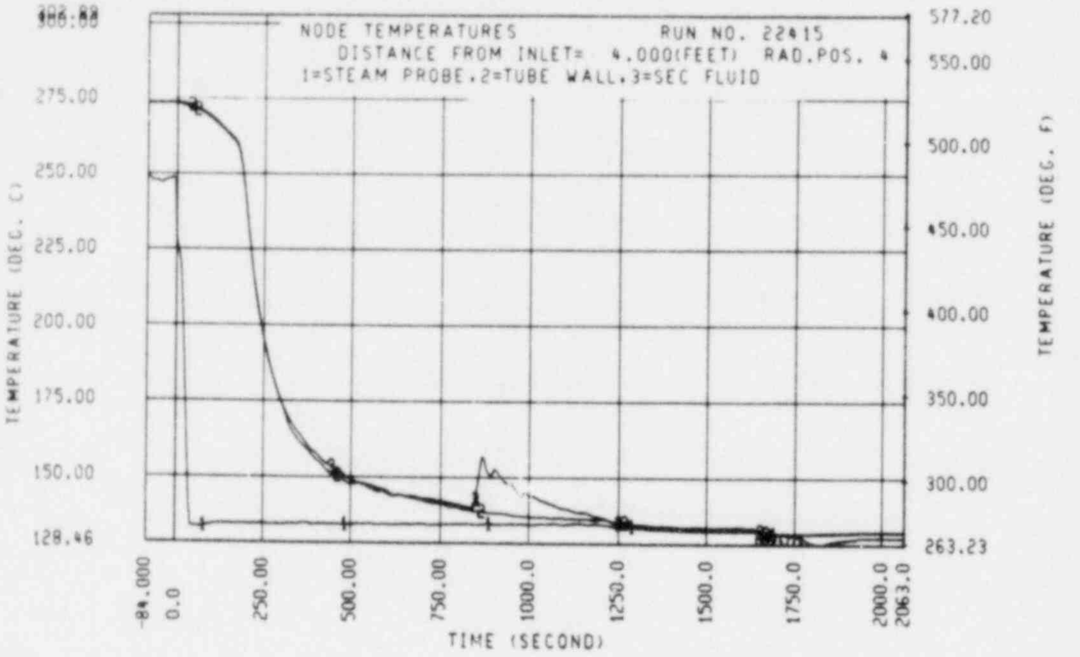
NODE TEMPERATURES RUN NO. 22415
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
127.14
TEMPERATURE (DEG. F)
576.48
550.00
500.00
450.00
400.00
350.00
300.00
260.85
TIME (SECOND)
-84.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
2000.0
2063.0

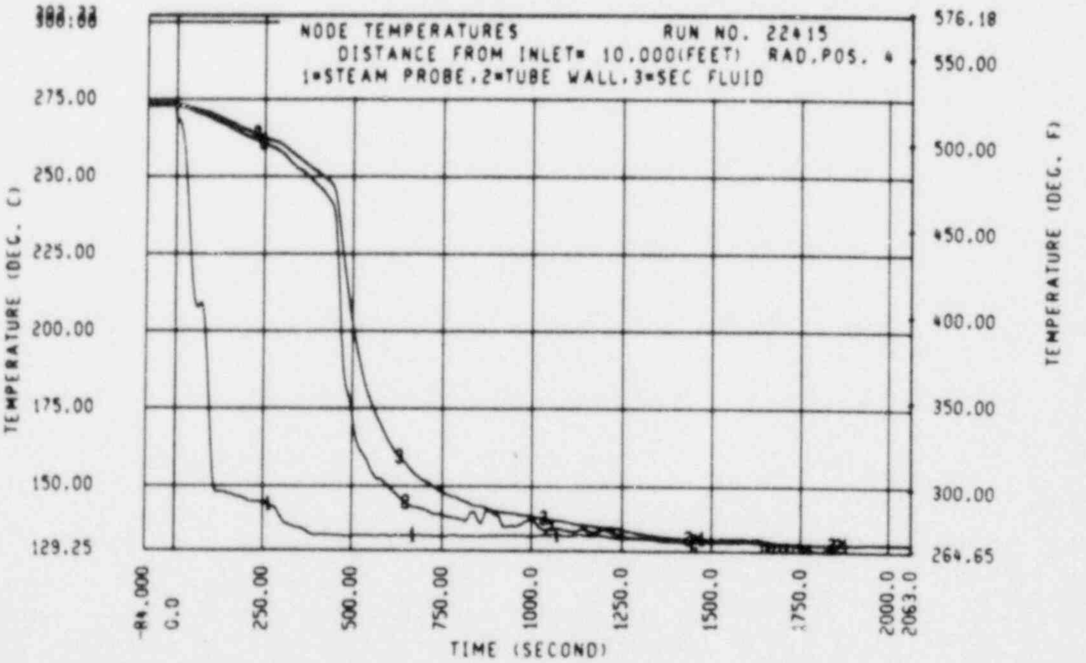


NODE TEMPERATURES RUN NO. 22415
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
129.02
TEMPERATURE (DEG. F)
577.00
550.00
500.00
450.00
400.00
350.00
300.00
264.24
TIME (SECOND)
-84.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
2000.0
2063.0

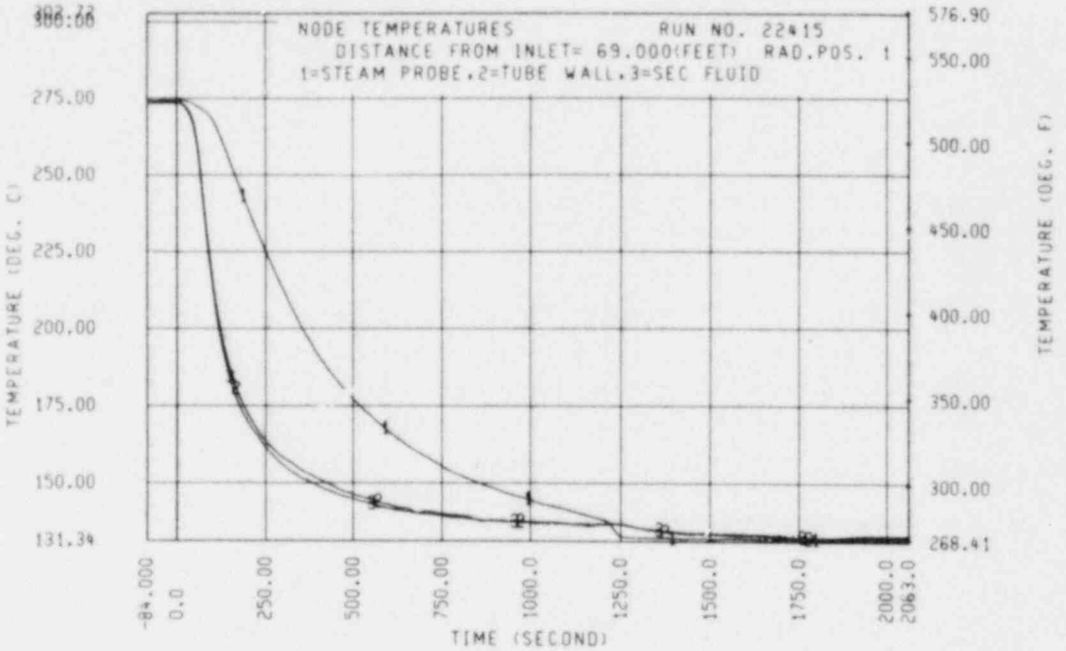

NODE TEMPERATURES RUN NO. 22415
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

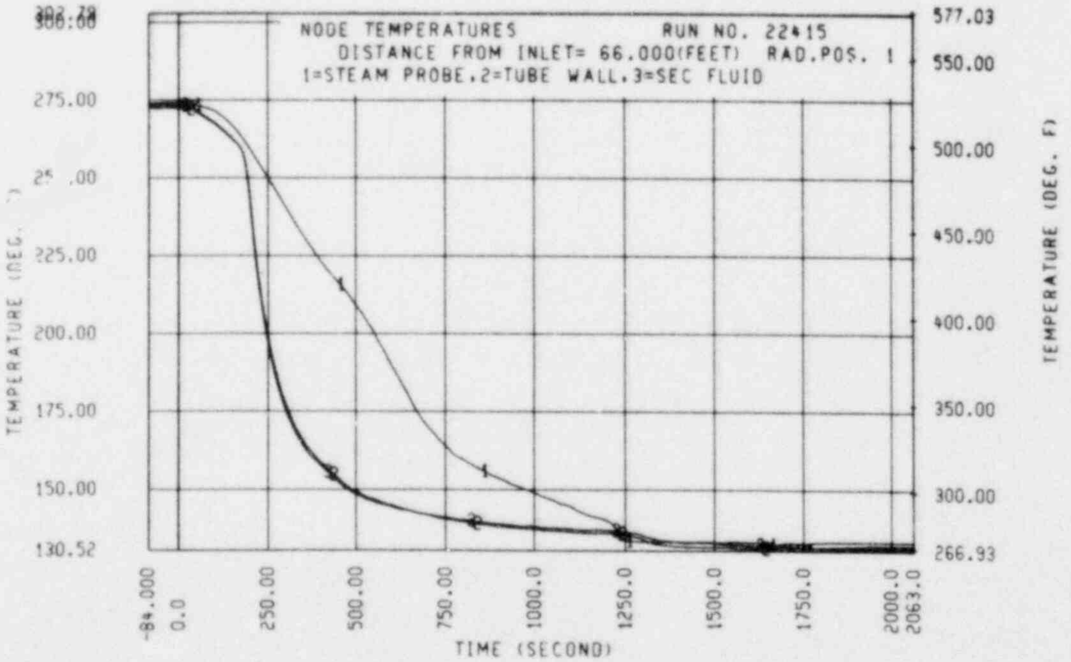

NODE TEMPERATURES RUN NO. 22415
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

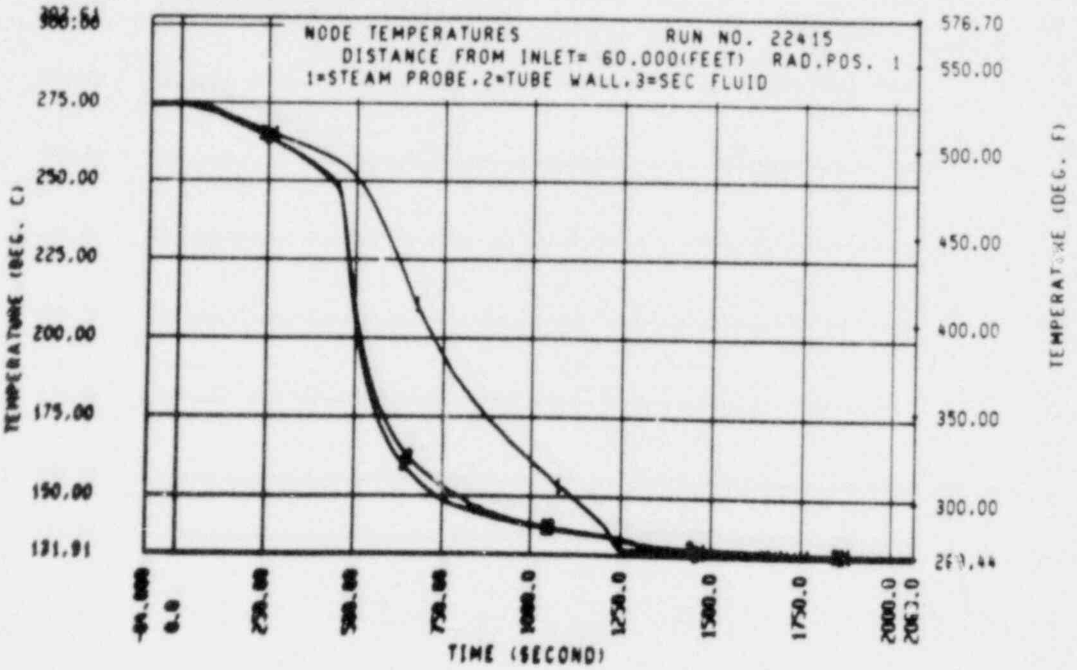

NODE TEMPERATURES RUN NO. 22415
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

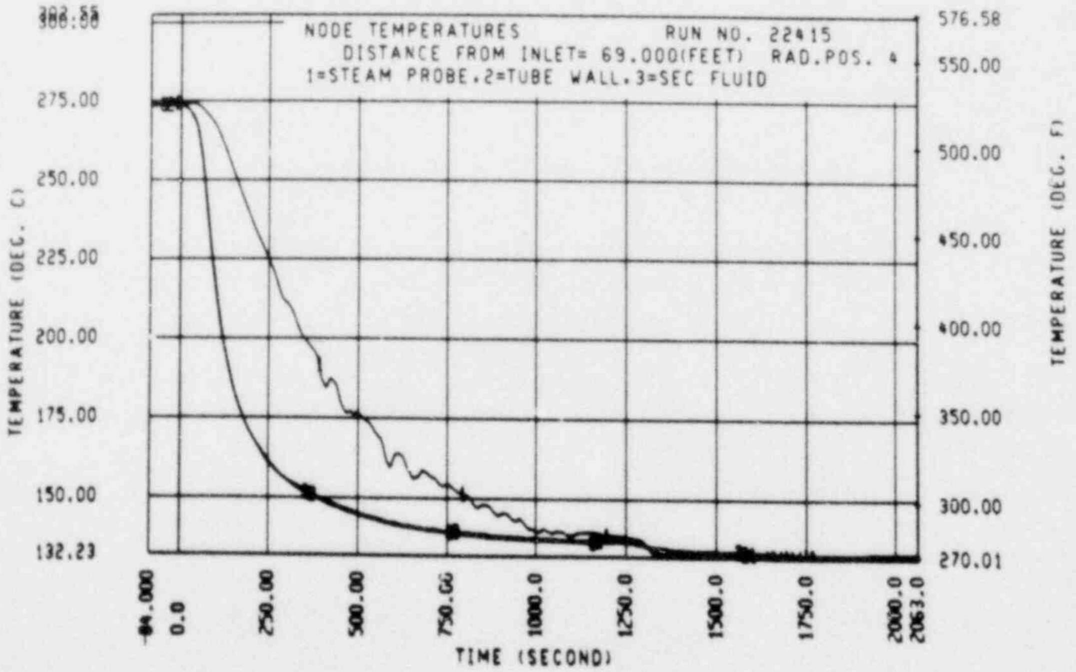

NODE TEMPERATURES RUN NO. 22415
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

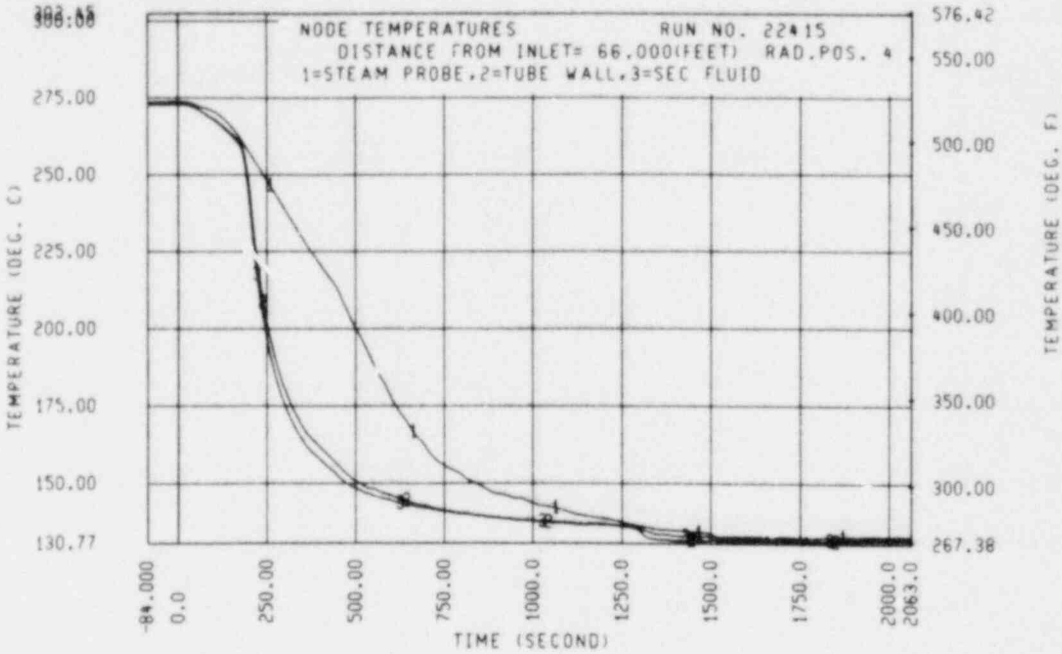
22415-13


NODE TEMPERATURES RUN NO. 22415
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

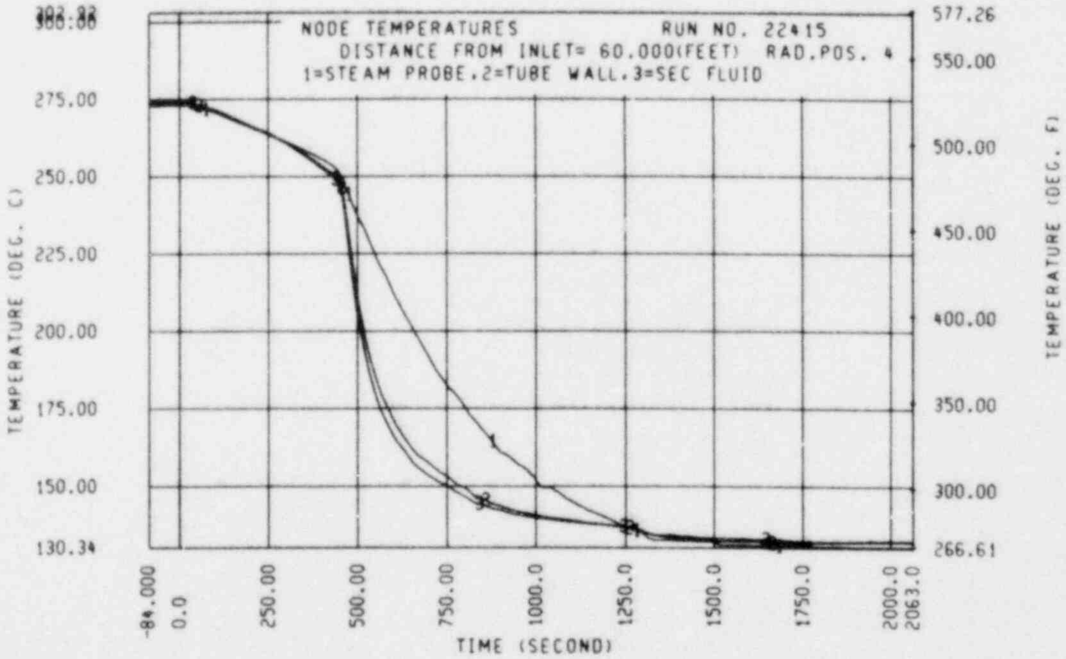

NODE TEMPERATURES RUN NO. 22415
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES
RUN NO. 22415
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
576.70
550.00
500.00
450.00
400.00
350.00
300.00
250.0
500.0
1250.0
1500.0
1750.0
2000.0

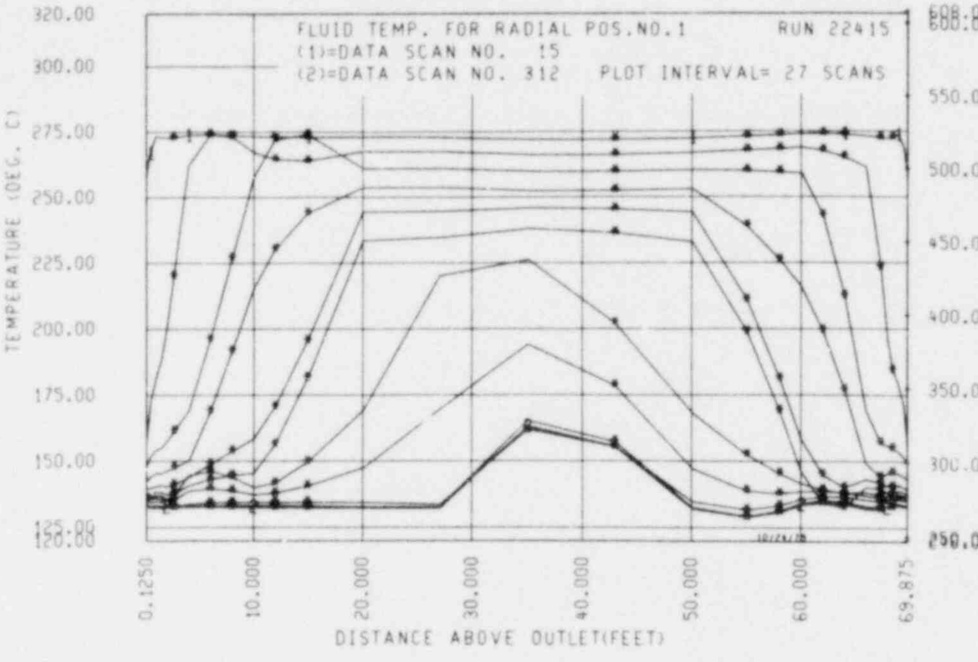

NODE TEMPERATURES
RUN NO. 22415
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
132.23
576.58
550.00
500.00
450.00
400.00
350.00
300.00
270.01
-84.000
0.0
250.00
500.00
1000.0
1250.0
1500.0
1750.0
2000.0
2063.0

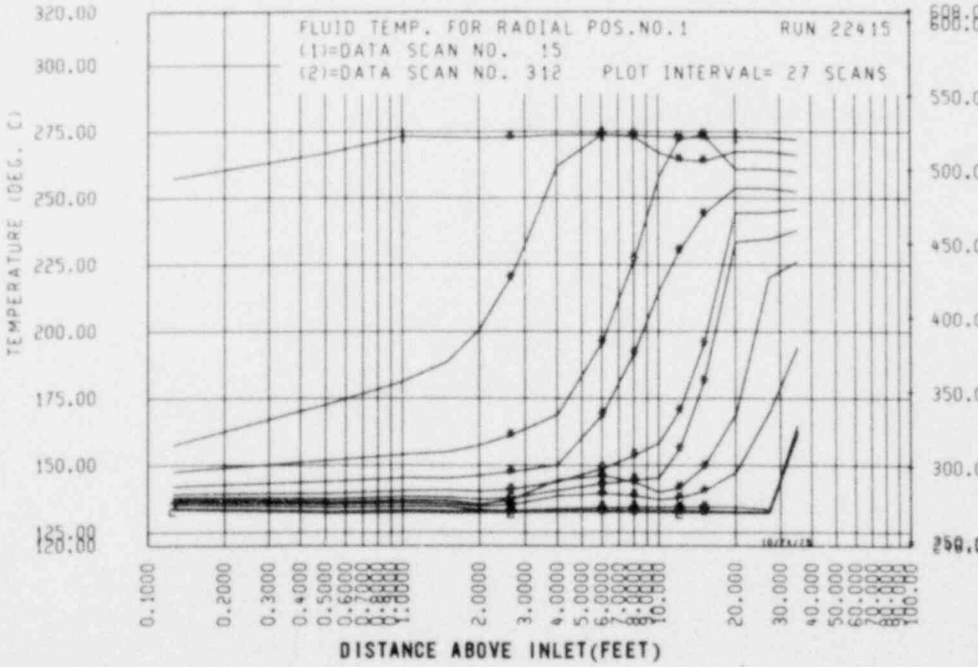


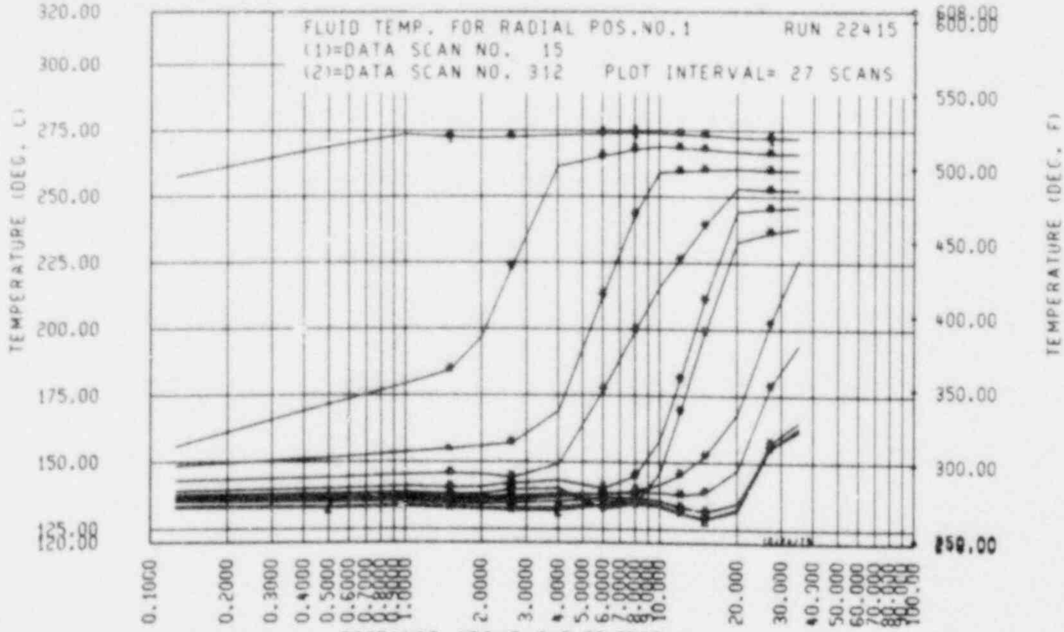
NODE TEMPERATURES
RUN NO. 22415
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)



NODE TEMPERATURES
RUN NO. 22415
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22415
(1)=DATA SCAN NO. 15
(2)=DATA SCAN NO. 312
PLOT INTERVAL= 27 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22415
(1)=DATA SCAN NO. 15
(2)=DATA SCAN NO. 312
PLOT INTERVAL= 27 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)



FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22415
(1)=DATA SCAN NO. 15
(2)=DATA SCAN NO. 312
PLOT INTERVAL= 27 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

RUN 22415

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

TIME = 102.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.1(.01)	44.1(3.89)	38.5(3.39)	24.1(2.13)	.623	.783	.027	.025
.2(.50)	126.1(11.11)	141.3(12.45)	142.9(12.59)	150.7(13.28)	.660	.829	.076	.074
.3(1.00)	51.0(4.50)	246.5(21.72)	5.4(.48)	.4(.03)	.711	.940	.121	.120
.5(1.50)	.5(.04)	.5(.05)	195.3(17.21)	.5(.04)	.722	1.011	.182	.120
.6(2.00)	.6(.05)	265.0(23.35)	.6(.05)	314.9(27.75)	.719	1.088	.241	.216
.8(2.65)	.7(.06)	107.9(9.51)	.7(.06)	234.6(20.67)	.715	1.209	.242	.417
1.2(4.00)	11.7(1.03)	10.2(.90)	7.5(.66)	.6(.05)	.715	1.245	.252	.525
1.8(6.00)	-11.6(-1.02)	4.9(.44)	.2(.02)	8.8(.78)	.696	1.216	.261	.534
2.4(8.00)	-3.7(-.77)	1.1(.10)	.6(.06)	5.9(.52)	.659	1.187	.259	.546
3.0(10.00)	.1(.01)	.7(.06)	1.2(.10)	1.8(.15)	.641	1.175	.257	.545
3.7(12.00)	11.3(.99)	.5(.05)	5.6(.49)	1.8(.16)	.648	1.169	.258	.536
4.6(15.00)	9.3(.82)	1.0(.09)	5.4(.47)	3.5(.31)	.677	1.165	.268	.529
6.1(20.00)	.0(.00)	.0(.00)	.4(.03)	.3(.02)	.694	1.161	.276	.526
8.2(27.00)	.3(.03)	-.0(-.00)	-.1(-.01)	.4(.04)	.697	1.159	.277	.528
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.705	1.168	.286	.541
13.1(43.00)	-.4(-.03)	-.0(-.00)	.1(.01)	.2(.02)	.714	1.181	.300	.557
15.2(50.00)	-.2(-.02)	-.3(-.03)	-.2(-.02)	-.1(-.01)	.717	1.185	.306	.564
16.8(55.00)	-.0(-.00)	-.4(-.03)	-.2(-.01)	-.0(-.00)	.717	1.183	.306	.564
17.7(58.00)	.1(.01)	-.3(-.02)	-.0(-.00)	.0(.00)	.717	1.182	.306	.565
18.3(60.00)	.4(.03)	-.4(-.03)	.0(.00)	.1(.01)	.718	1.181	.306	.565
18.9(62.00)	.8(.07)	-.0(-.00)	.1(.01)	.1(.01)	.719	1.181	.307	.566
19.5(64.00)	.2(.01)	.2(.01)	.1(.01)	.0(.00)	.721	1.182	.307	.566
20.1(66.00)	.3(.02)	1.0(.09)	.3(.02)	-.1(-.01)	.722	1.184	.308	.566
20.5(67.38)	-2.0(-.18)	-1.3(-.11)	-2.2(-.19)	-5.1(-.45)	.722	1.185	.308	.564
20.7(68.00)	-7.8(-.68)	-6.7(-.59)	-9.1(-.80)	-10.2(-.90)	.720	1.184	.305	.560
20.9(68.50)	-9.9(-.88)	-10.4(-.92)	-20.6(-1.82)	-7.7(-.68)	.716	1.180	.297	.556
21.0(69.00)	3.3(.29)	2.5(.22)	.3(.02)	5.4(.47)	.717	1.179	.292	.557
21.2(69.50)	-15.8(-1.39)	-.9(-.08)	-22.4(-1.97)	-19.7(-1.73)	.720	1.183	.287	.555
21.3(69.87)	-12.5(-1.10)	-7.4(-.65)	-6.9(-.61)	-4.8(-.42)	.720	1.186	.281	.550

22415-19

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22415

TIME = 222.0 SECONDS

UNITS - ELEVATION METER(FEET)

FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.1(.01)	17.9(1.59)	21.1(1.86)	16.8(1.49)	.617	.775	.024	.024
.2(.50)	44.4(3.91)	46.9(4.13)	48.8(4.30)	43.3(3.91)	.630	.791	.042	.039
.3(1.00)	51.1(4.50)	62.1(5.47)	.1(.01)	63.4(5.59)	.658	.823	.057	.071
.5(1.50)	62.9(5.54)	62.7(5.53)	21.6(1.90)	67.0(5.91)	.692	.860	.064	.111
.6(2.00)	78.3(6.90)	73.1(6.44)	62.7(5.53)	49.9(4.40)	.734	.900	.089	.146
.8(2.65)	.2(.02)	.2(.02)	96.9(8.54)	36.9(3.25)	.757	.921	.152	.178
1.2(4.00)	5.4(.48)	190.1(16.75)	55.5(4.89)	.4(.03)	.761	1.140	.266	.198
1.8(6.00)	-2.1(-.18)	134.2(11.82)	29.2(2.57)	9.6(.85)	.753	1.498	.373	.216
2.4(8.00)	-1.3(-.12)	100.9(8.89)	.6(.05)	6.6(.58)	.733	1.726	.412	.239
3.0(10.00)	2.7(.24)	3.3(.29)	3.0(.27)	3.6(.31)	.718	1.797	.416	.250
3.7(12.00)	14.6(1.28)	-33.7(-2.97)	.4(.04)	2.3(.20)	.726	1.734	.414	.251
4.6(15.00)	8.5(.75)	-3.6(-.32)	-.2(-.01)	3.6(.32)	.751	1.671	.399	.249
6.1(20.00)	1.0(.09)	.1(.01)	.3(.03)	.3(.03)	.765	1.649	.384	.247
8.2(27.00)	.4(.03)	.0(.00)	-.2(-.02)	.4(.04)	.769	1.642	.378	.250
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.772	1.641	.379	.257
13.1(43.00)	-.3(-.03)	-.2(-.02)	.0(.00)	-.1(-.01)	.774	1.642	.382	.262
15.2(50.00)	-.1(-.01)	-.3(-.02)	-.1(-.01)	-.0(-.00)	.774	1.643	.385	.264
16.8(55.00)	-.0(-.00)	-.3(-.03)	-.1(-.01)	.0(.00)	.775	1.642	.385	.265
17.7(58.00)	-.0(-.00)	-.3(-.03)	-.1(-.01)	.0(.00)	.775	1.642	.386	.266
18.3(60.00)	.0(.00)	-.6(-.05)	-.1(-.01)	.0(.00)	.776	1.641	.387	.266
18.9(62.00)	-.3(-.02)	-.1(-.01)	-.2(-.02)	-.6(-.05)	.777	1.644	.388	.267
19.5(64.00)	-.4(-.03)	.1(.01)	-.4(-.04)	-2.9(-.25)	.781	1.652	.391	.266
20.1(66.00)	-1.8(-.16)	1.1(.09)	-1.8(-.16)	-12.1(-1.06)	.786	1.666	.394	.254
20.5(67.39)	-5.7(-.50)	-3.3(-.29)	-6.5(-.57)	-17.5(-1.55)	.788	1.676	.393	.237
20.7(68.00)	-16.2(-1.42)	-15.1(-1.33)	-20.6(-1.82)	-18.1(-1.60)	.784	1.675	.386	.226
20.9(68.50)	-13.9(-1.22)	-16.8(-1.48)	-21.9(-1.93)	-14.6(-1.29)	.779	1.670	.376	.218
21.0(69.00)	2.7(.24)	2.1(.19)	1.4(.12)	-.6(-.05)	.782	1.671	.372	.215
21.2(69.50)	-16.3(-1.43)	-.7(-.06)	-16.8(-1.48)	-14.6(-1.29)	.786	1.681	.370	.212
21.3(69.87)	-5.2(-.45)	-4.2(-.37)	-3.9(-.35)	-3.5(-.31)	.786	1.688	.366	.208

SUMMARY SHEET

RUN NO. 22503

DATE: 4/2/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.178 (0.393)
2. Water flow - [kg/sec (lb/sec)] - 0.045 (0.100)
3. Containment tank pressure [kPa (psig)] - 34 (5)
4. Steam temperature [^oC (^oF)] - 154 (310)
5. Water temperature [^oC (^oF)]- 102 (216)
6. Mixer pressure [kPa (psig)] - 69 (10)
7. Test time (sec) - 1440.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.2 (33.6)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^oC (^oF)]
0.00 (0.00)	257 (494)
0.15 (0.50)	270 (518)
0.30 (1.00)	275 (527)
0.46 (1.50)	273 (523)
0.61 (2.00)	273 (524)
1.22 (4.00)	-
3.05 (10.00)	274 (526)
6.09 (20.00)	274 (525)
8.23 (27.00)	-
10.67 (35.00)	273 (524)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 3.51 (7.74)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 3.98 (8.78)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg[kg (lb)] - 0.703 (1.55)

D. FAILED BUNDLE T/Cs[1]

294, 295, 305, 308, 309, 310, 311, 326, 532, 549, 553, 555, 564, 565, 568, 569

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

1. From primary side energy balance [kwsec(Btu)] - 1.02×10^5 (0.969×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da\,dt$) - [kwsec(Btu)] - 0.967×10^5 (0.921×10^5)
3. Integration to 900 sec

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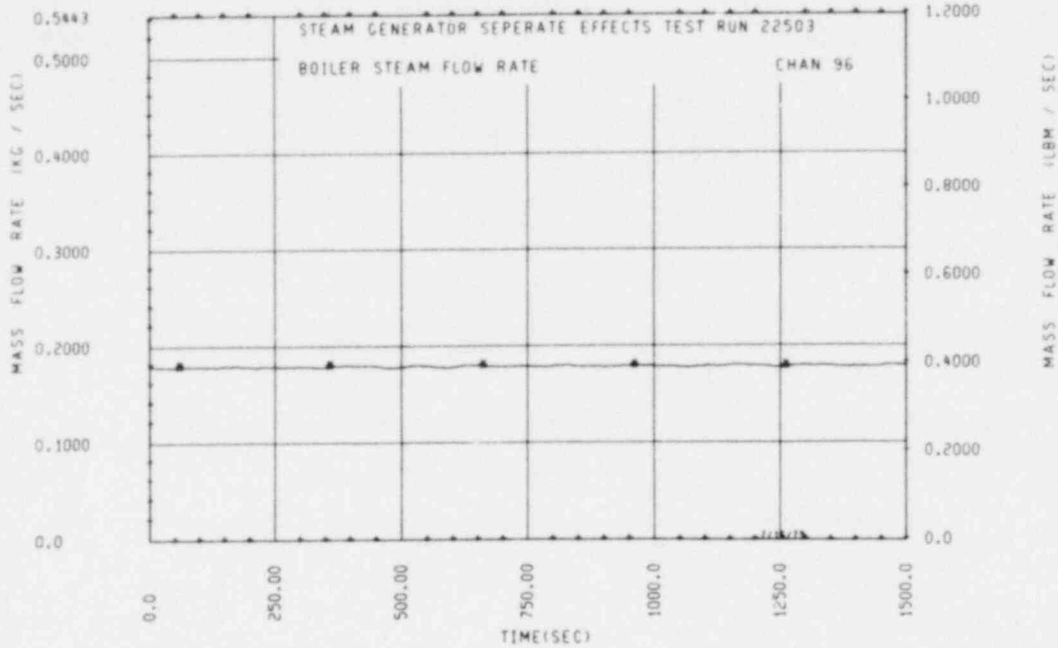
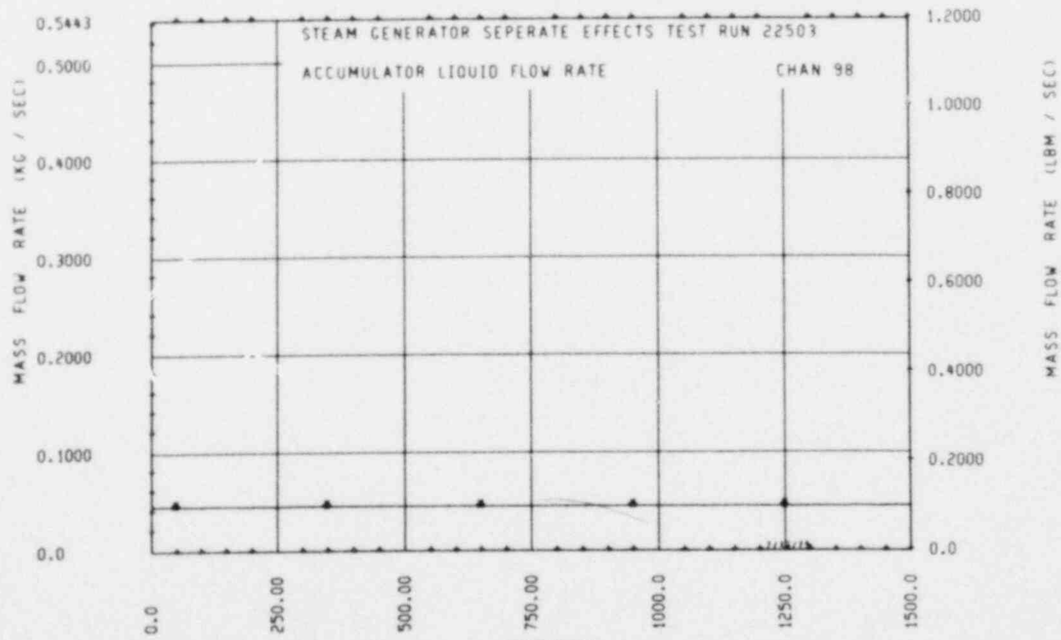
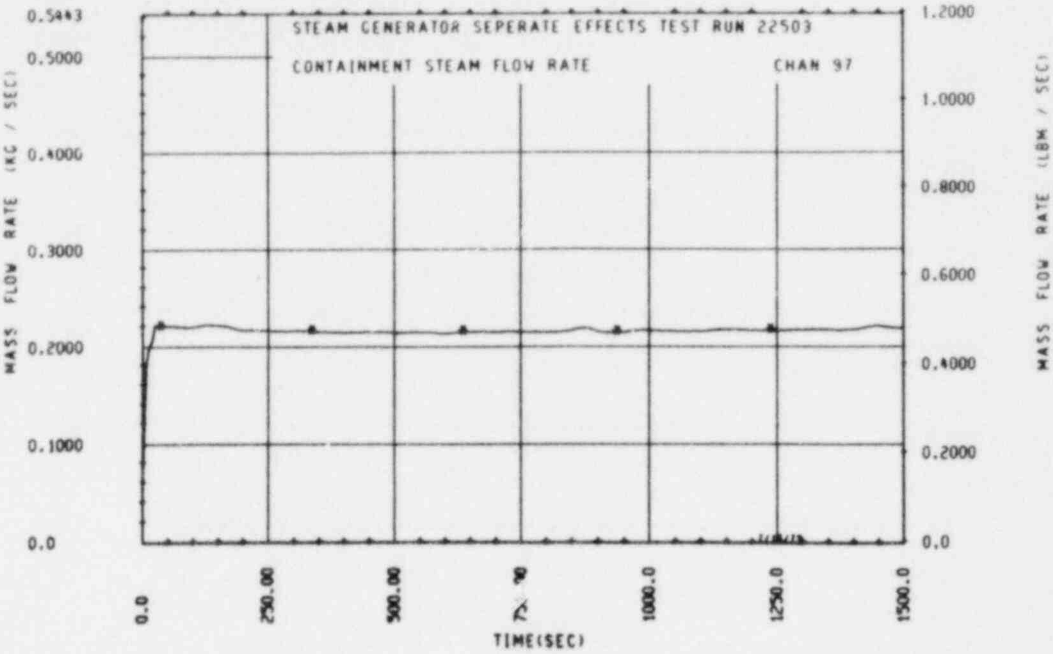
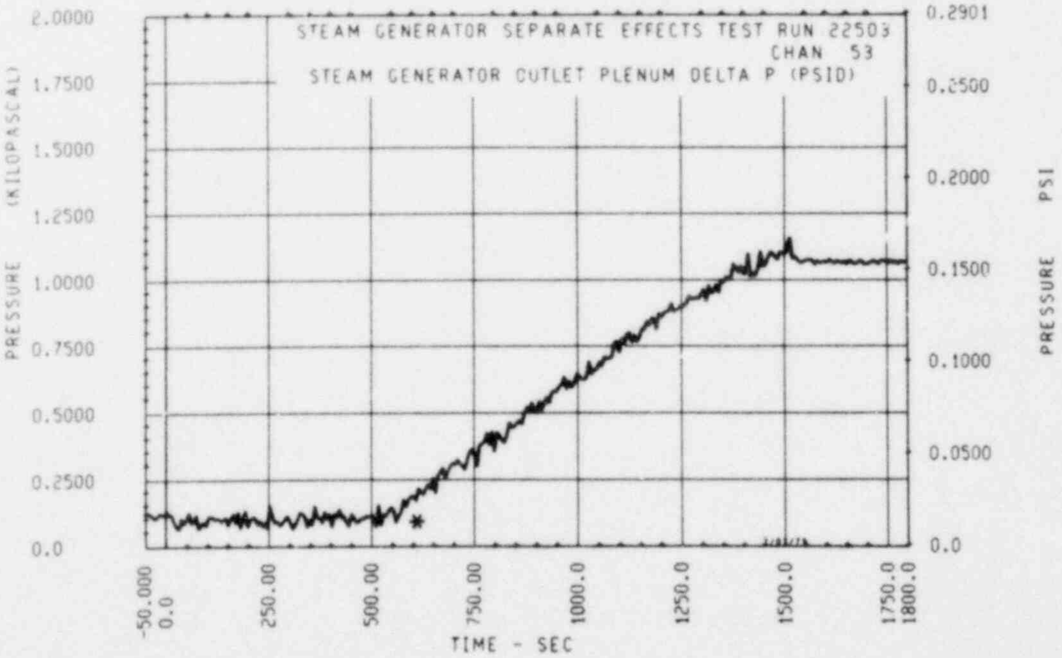
1. T/Cs are defined as failed based on resistance reading or T/C response.

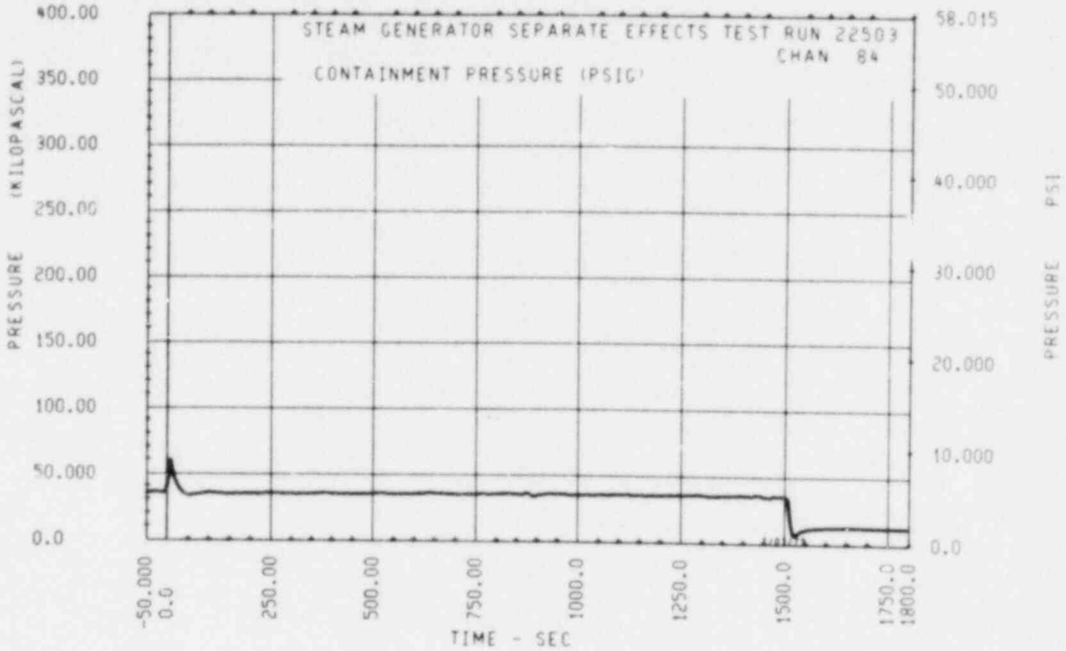

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22503
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

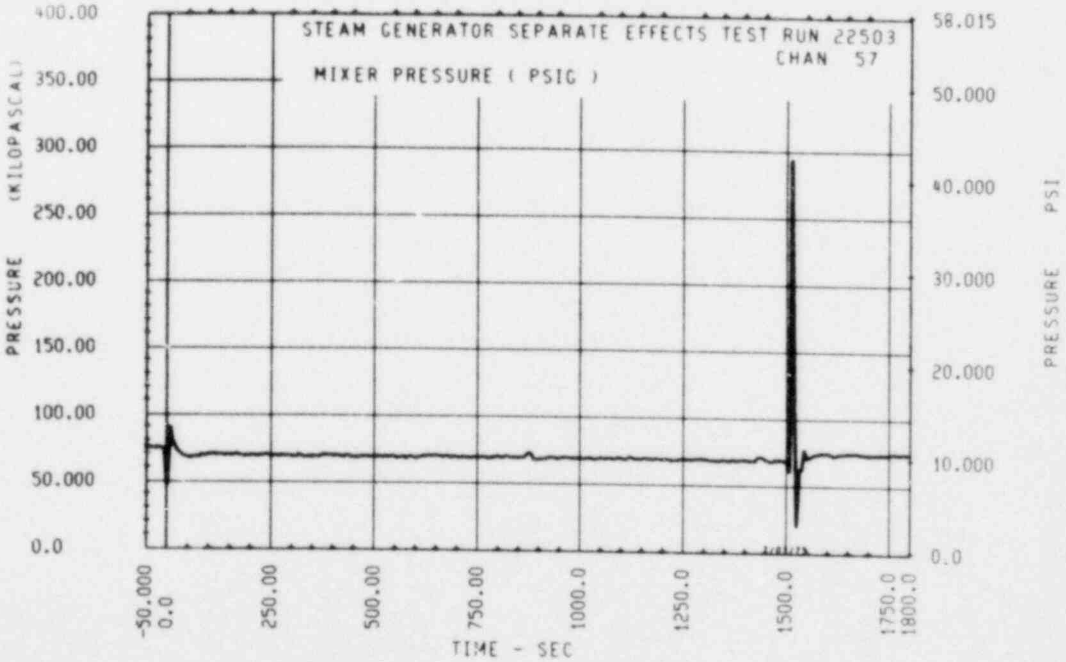

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22503
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

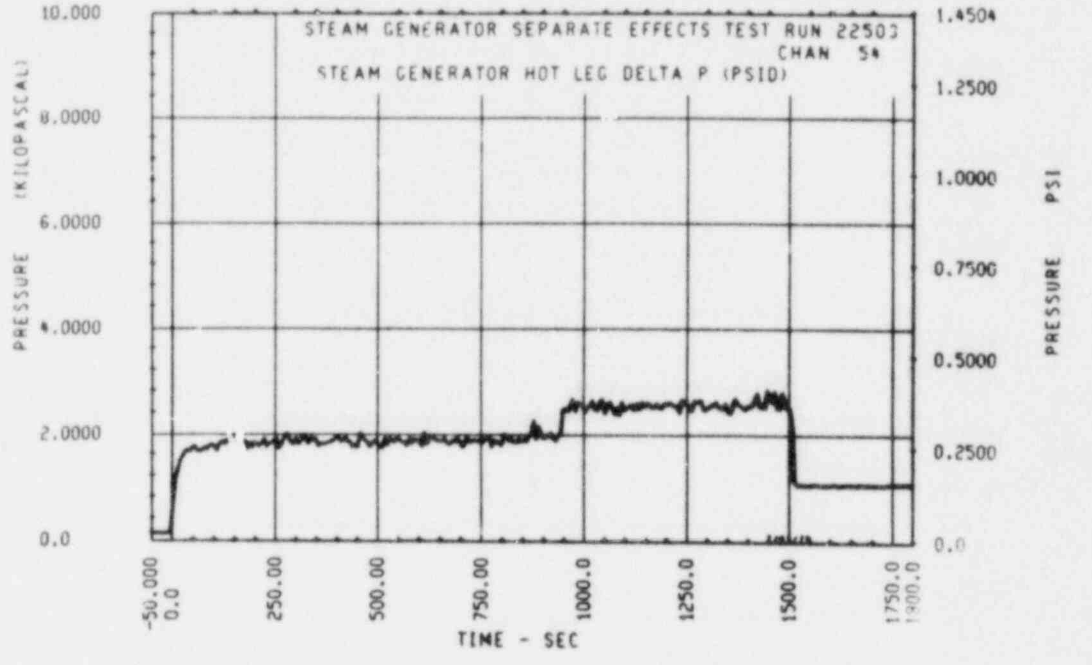


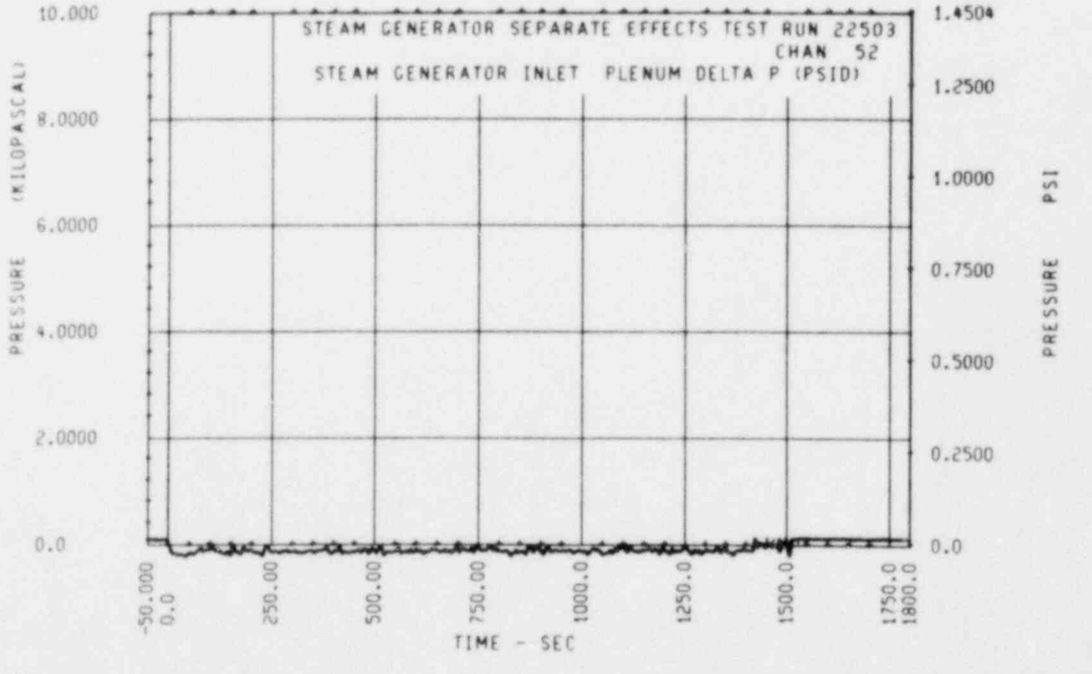


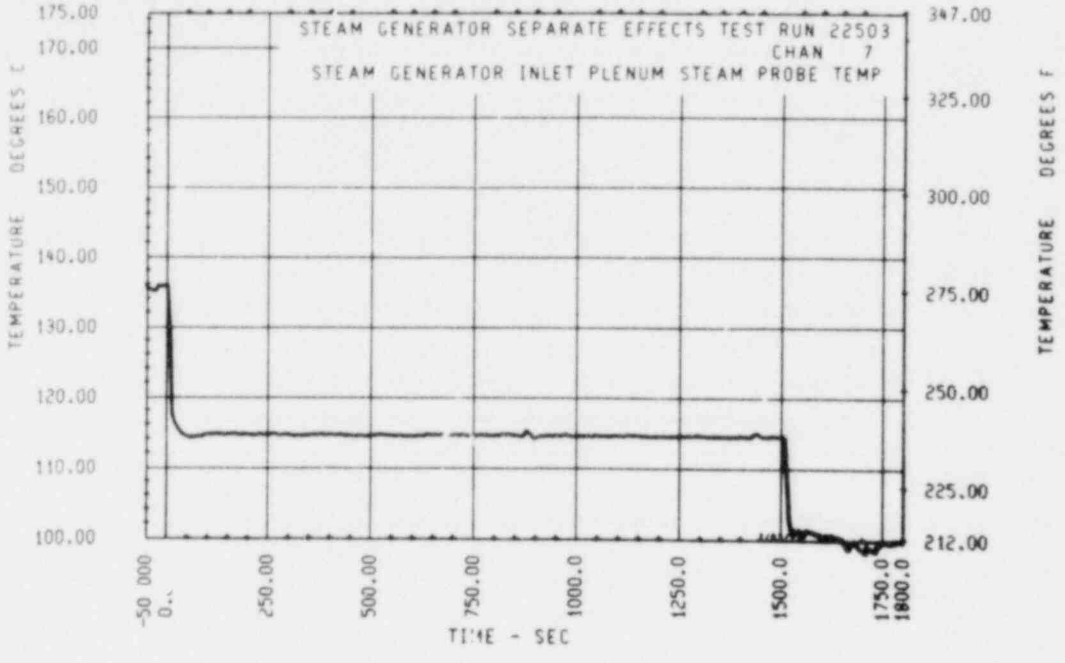
* Refer to Appendix H text for explanation of delayed response.

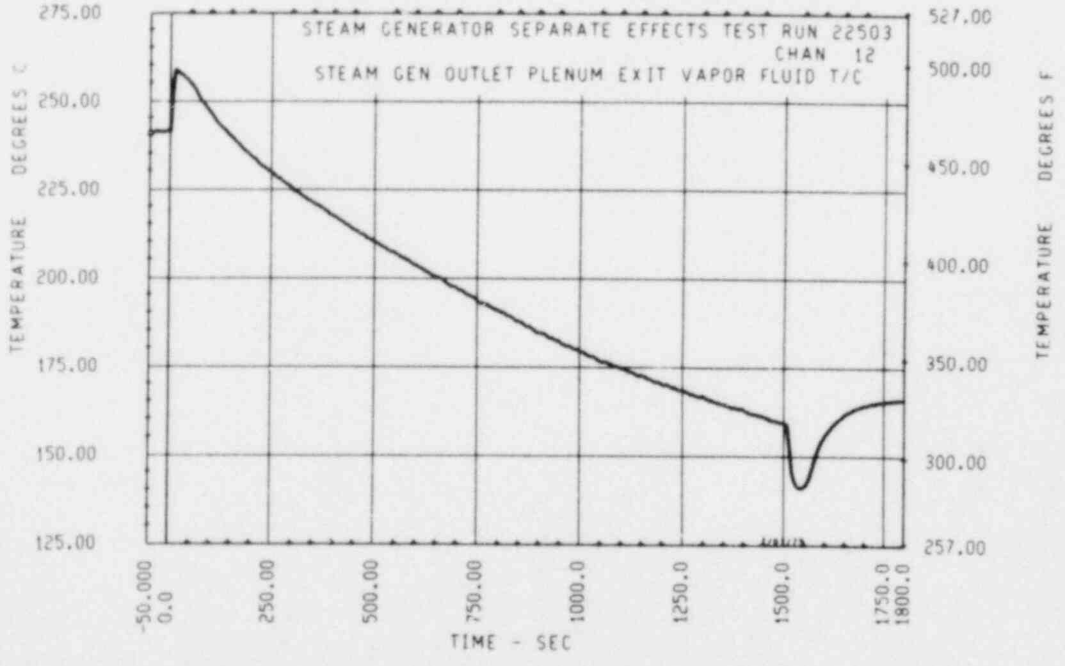

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22503
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22503
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

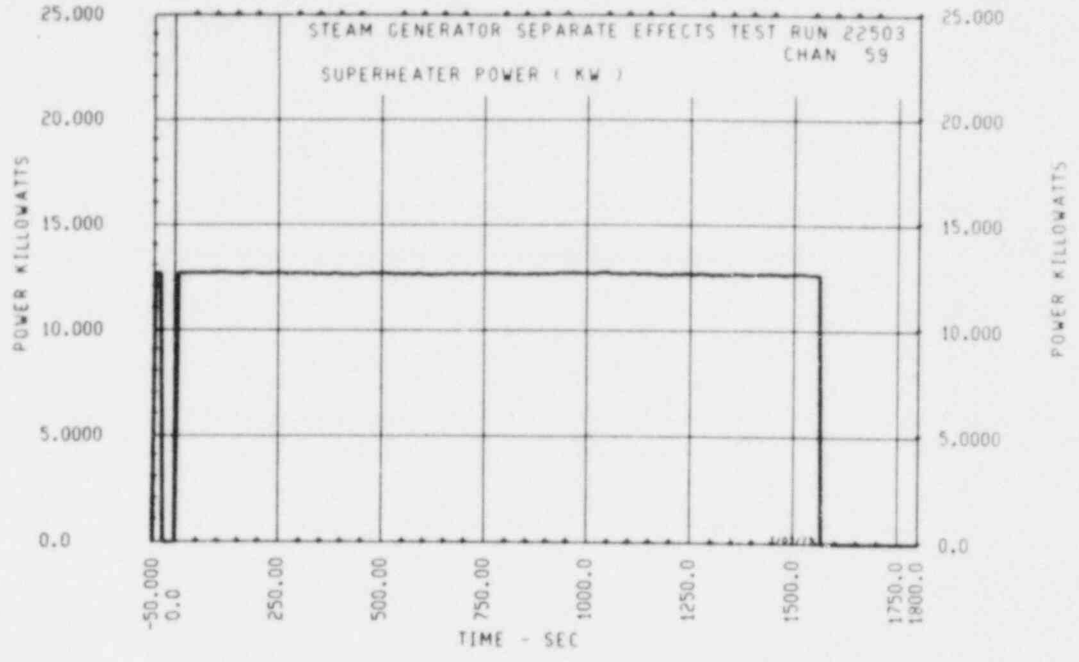

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22503
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

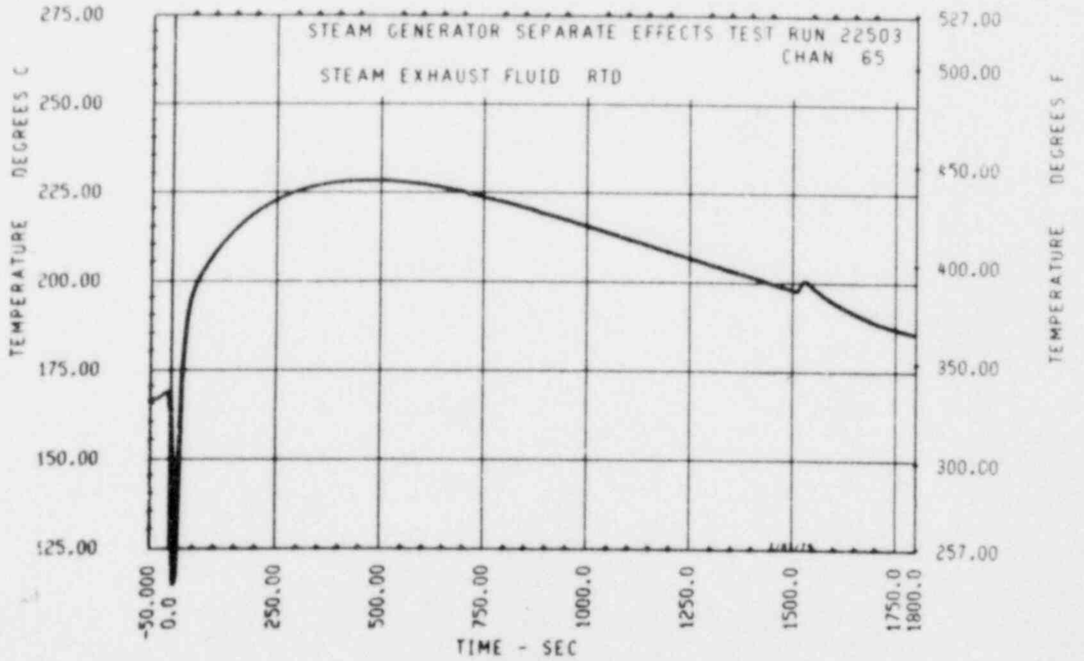

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22503
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

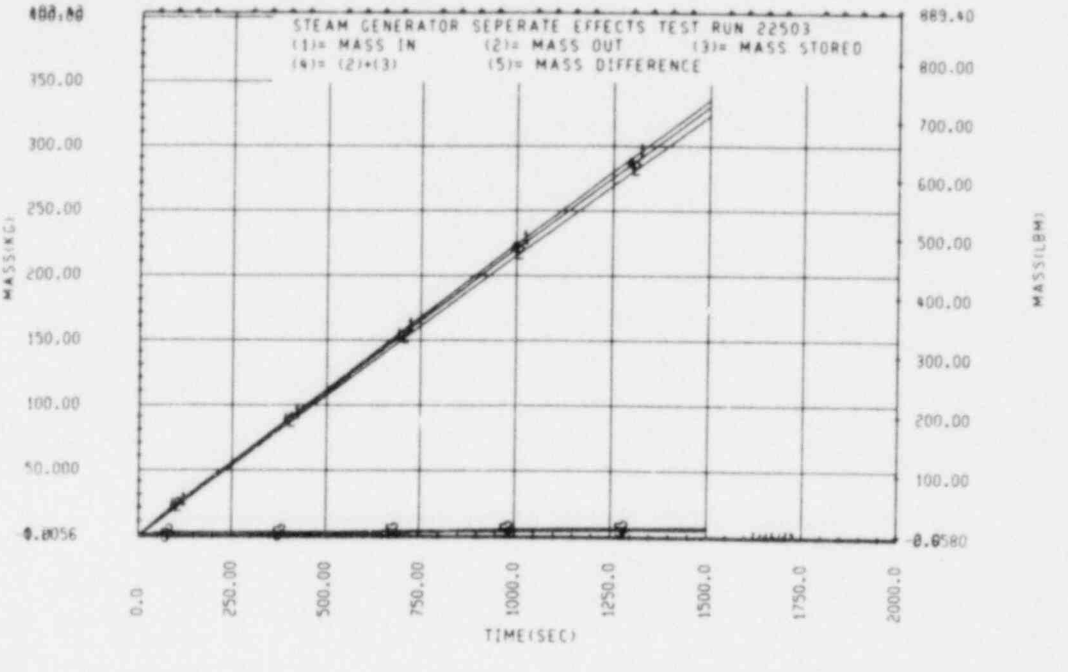

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22503
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
175.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
347.00
325.00
300.00
275.00
250.00
225.00
212.00
-50.000
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

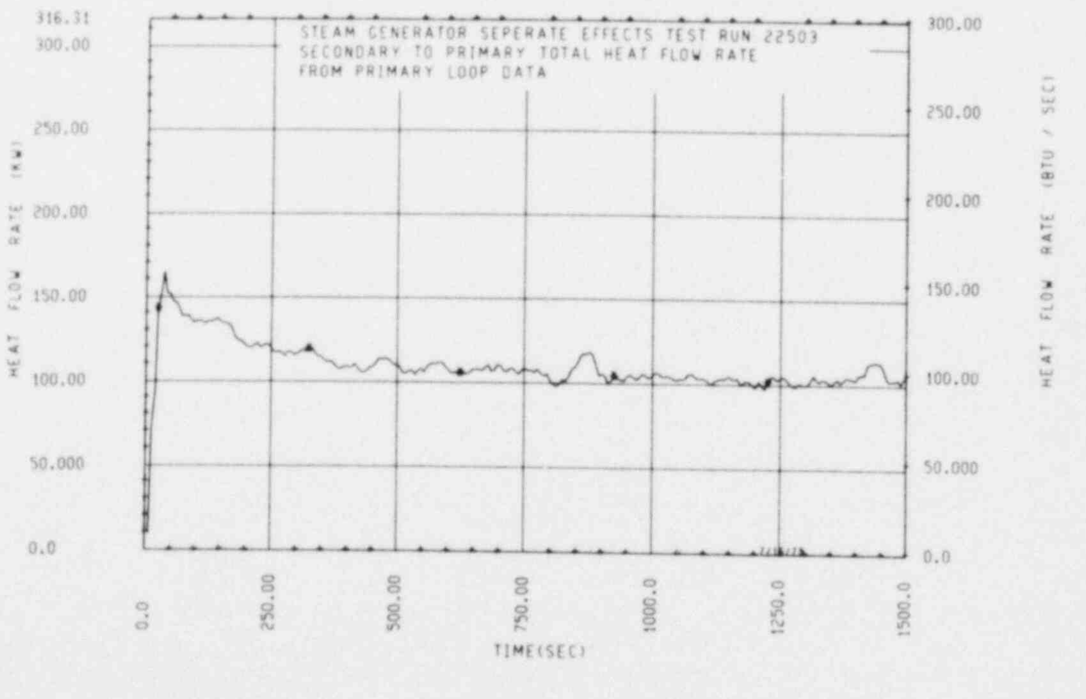

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22503
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

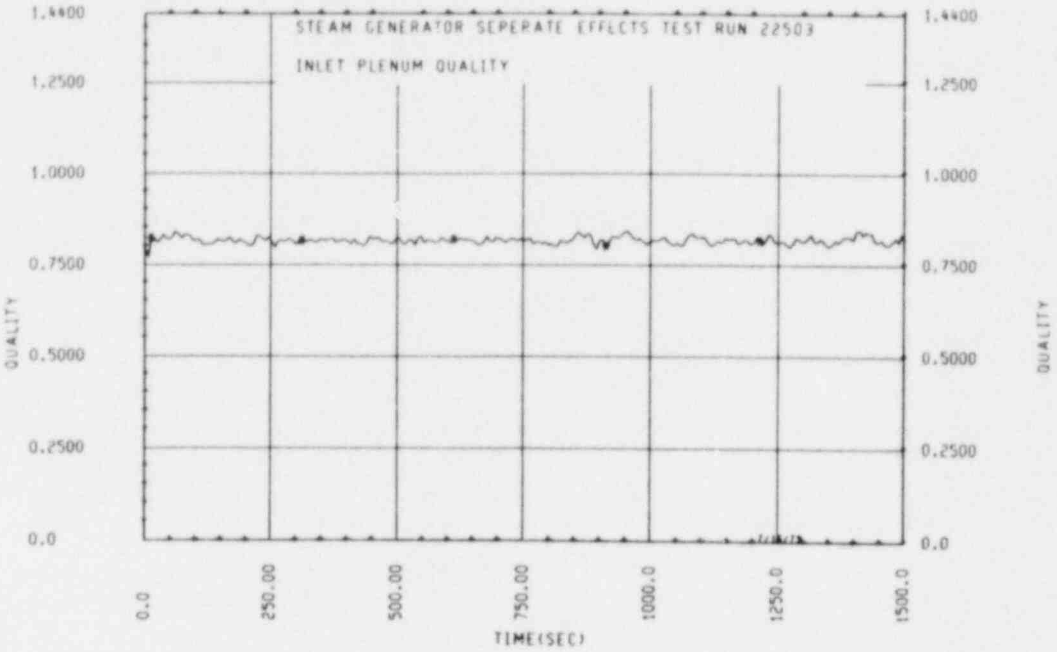
22503-7

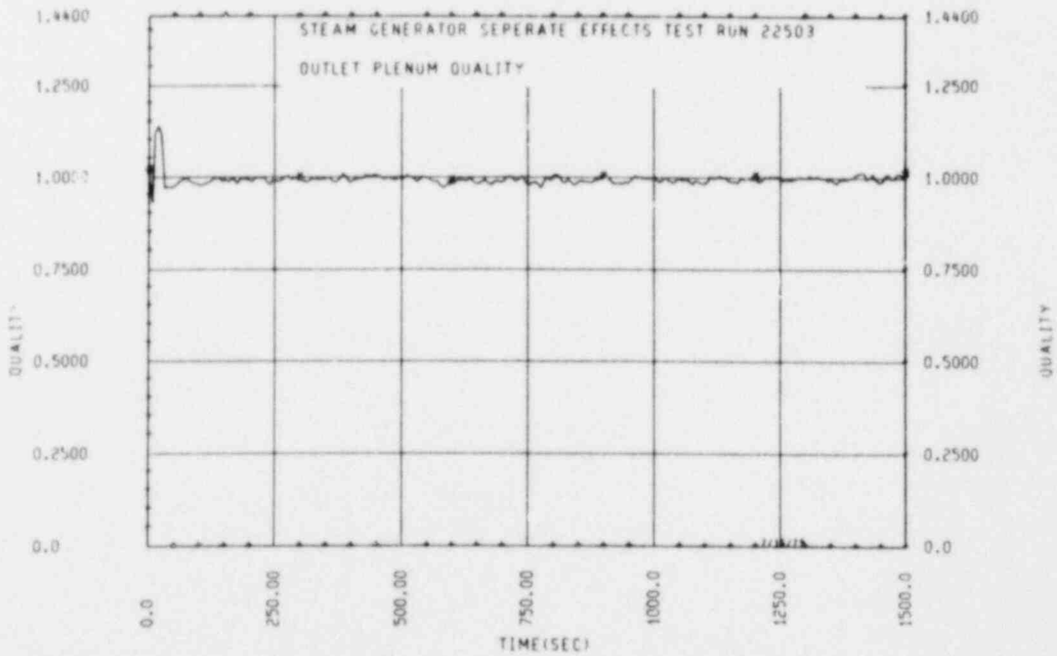

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22503
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

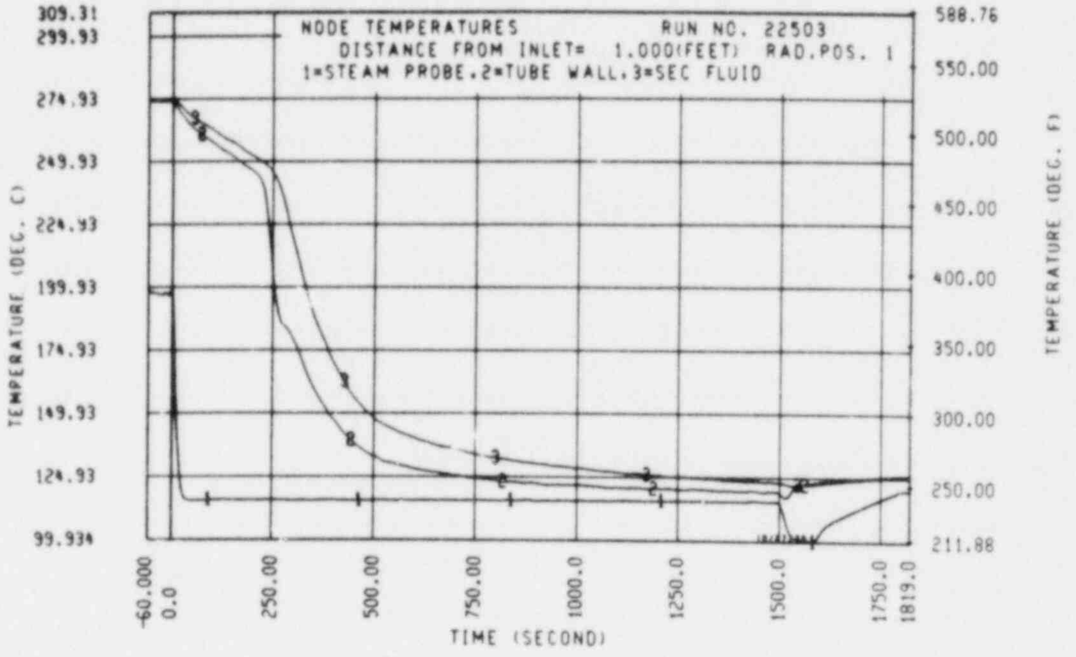

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22503
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
275.00
250.00
225.00
200.00
175.00
150.00
125.00
TEMPERATURE DEGREES F
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22503
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
-0.0056
889.40
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
-0.0580
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
2000.0

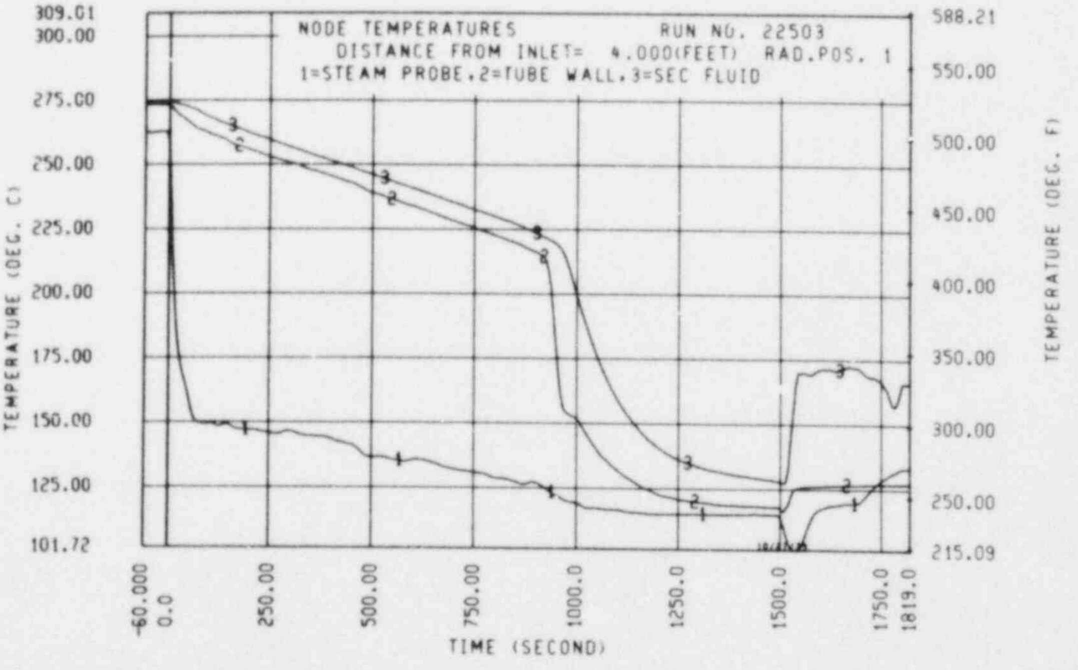

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22503
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)
316.31
300.00
250.00
200.00
150.00
100.00
50.000
0.0
300.00
250.00
200.00
150.00
100.00
50.000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22503
INLET PLENUM QUALITY
QUALITY
TIME(SEC)

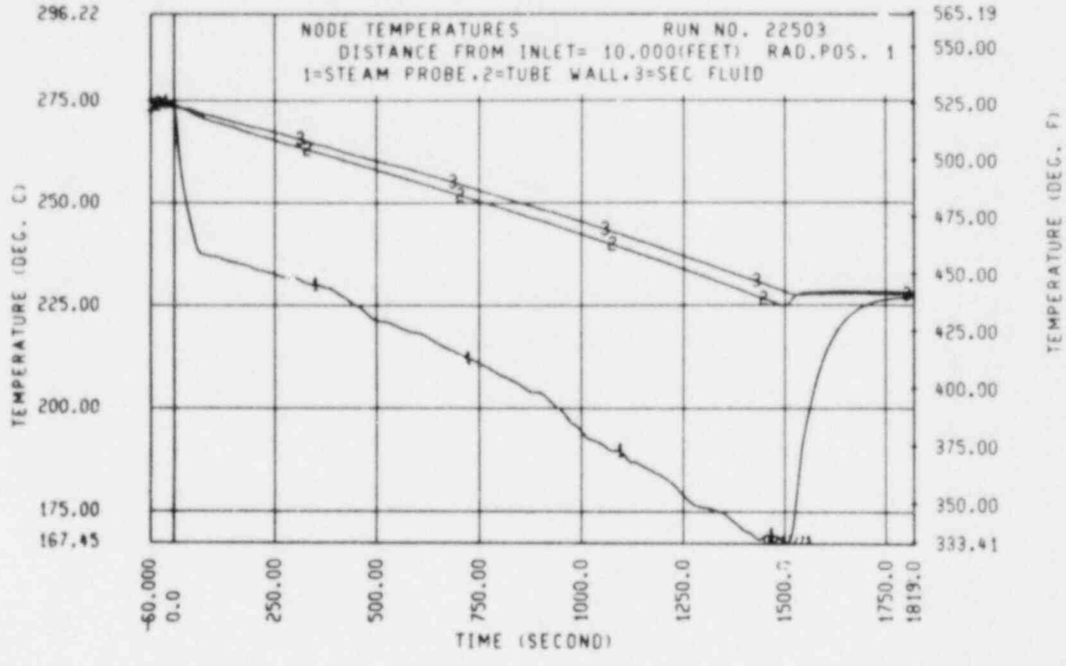

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22503
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)

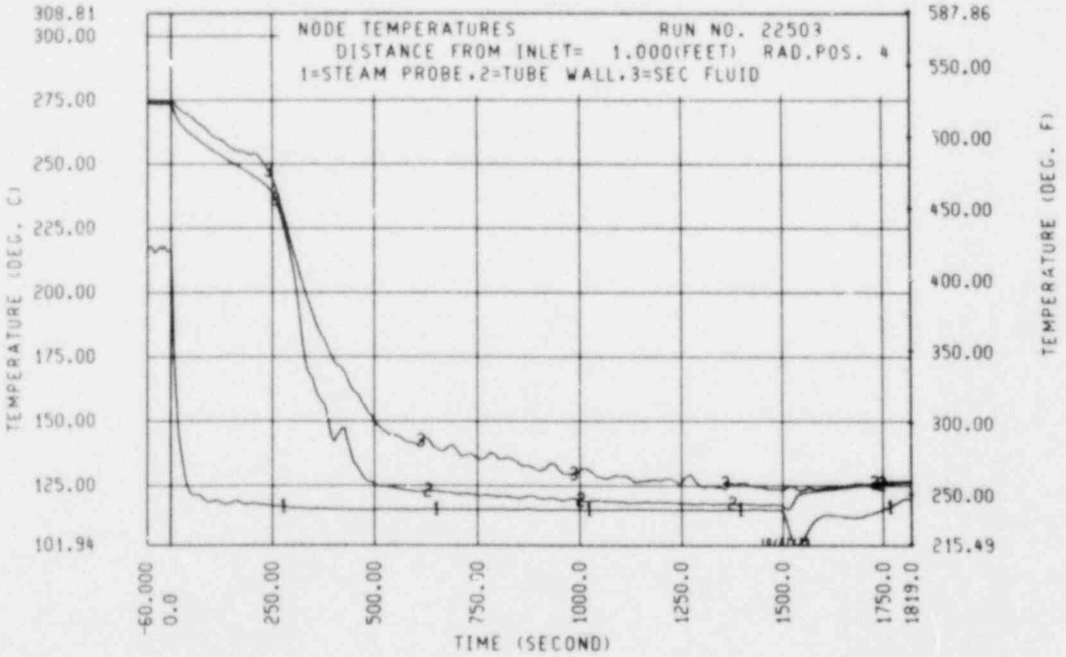


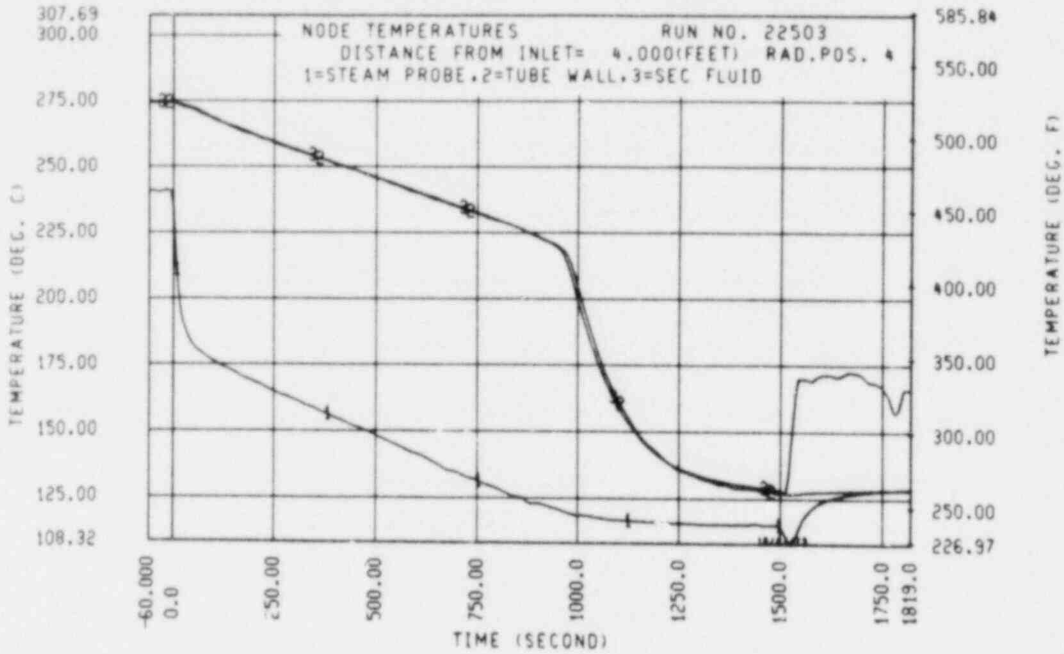
NODE TEMPERATURES RUN NO. 22503
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

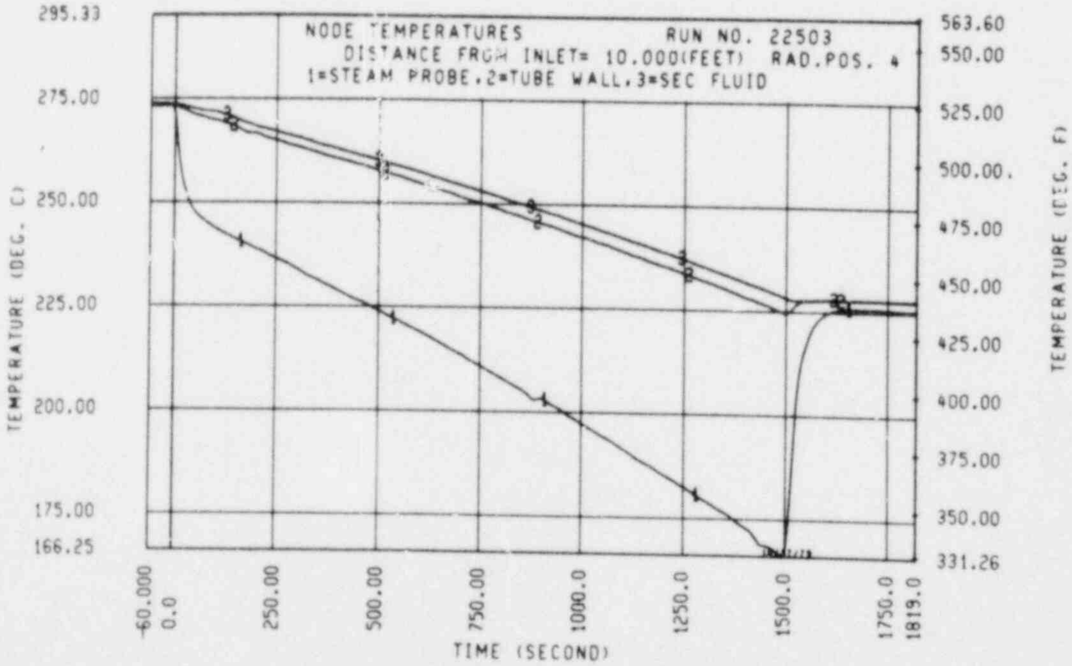


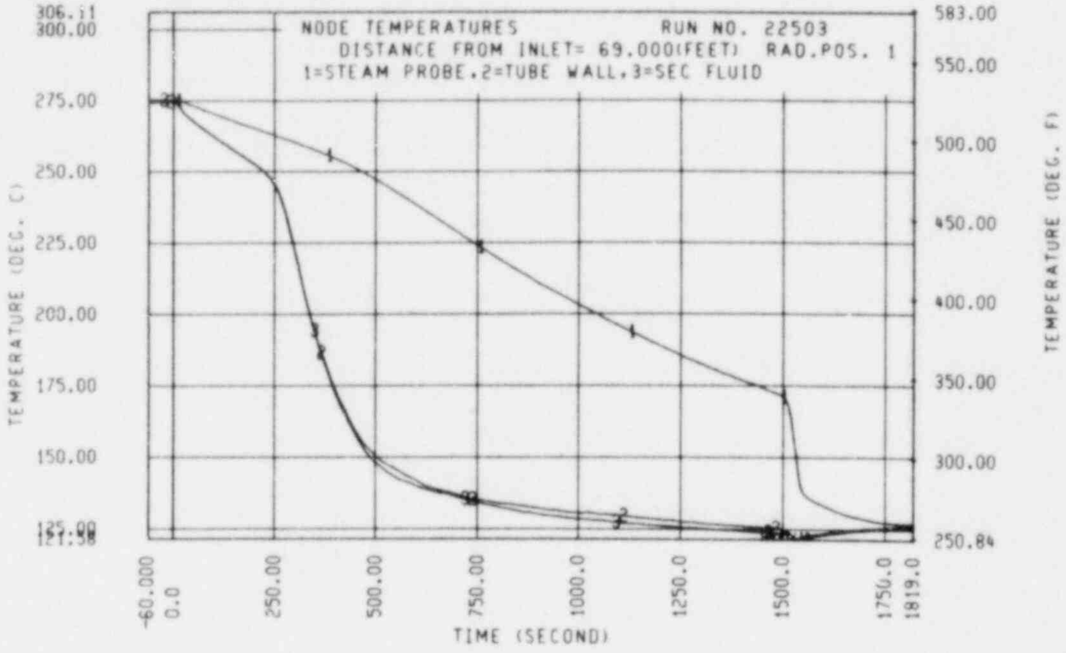
NODE TEMPERATURES RUN NO. 22503
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

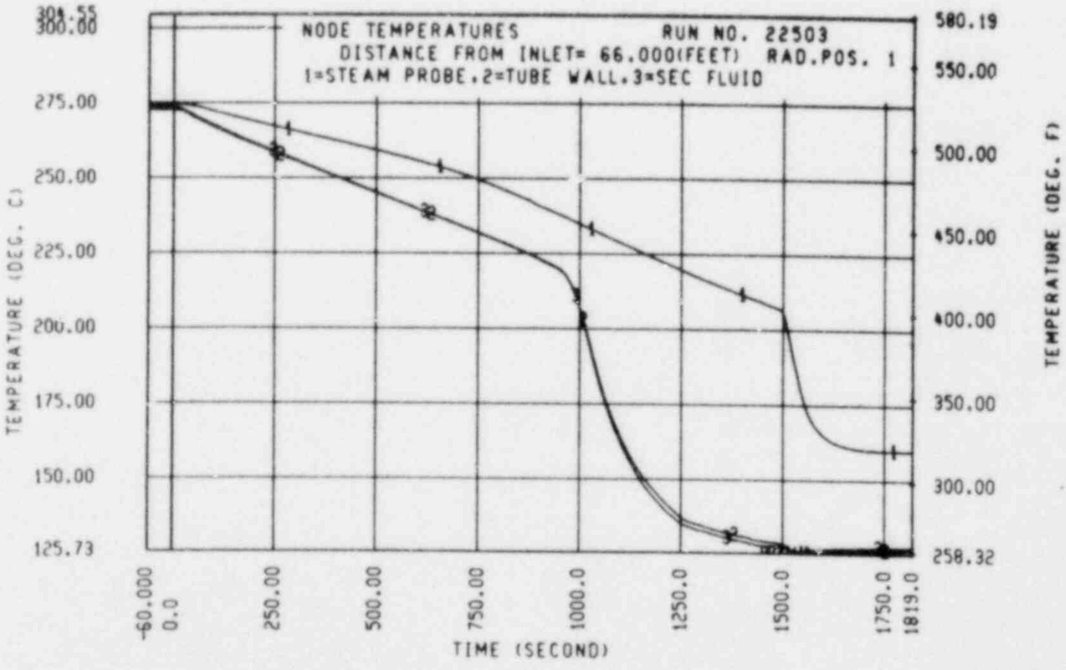

NODE TEMPERATURES RUN NO. 22503
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
296.22
275.00
250.00
225.00
200.00
175.00
167.45
565.19
550.00
525.00
500.00
475.00
450.00
425.00
400.00
375.00
350.00
333.41
-60.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1819.0

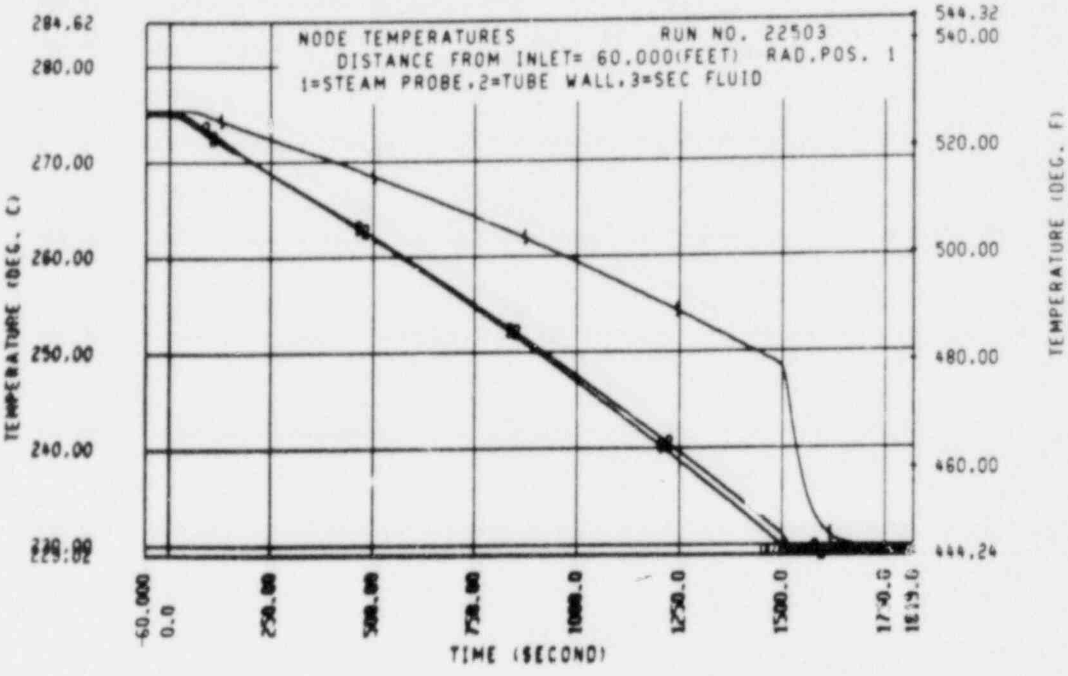

NODE TEMPERATURES RUN NO. 22503
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
308.81
300.00
275.00
250.00
225.00
200.00
175.00
150.00
125.00
101.94
587.86
550.00
500.00
450.00
400.00
350.00
300.00
250.00
215.49
-60.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1819.0

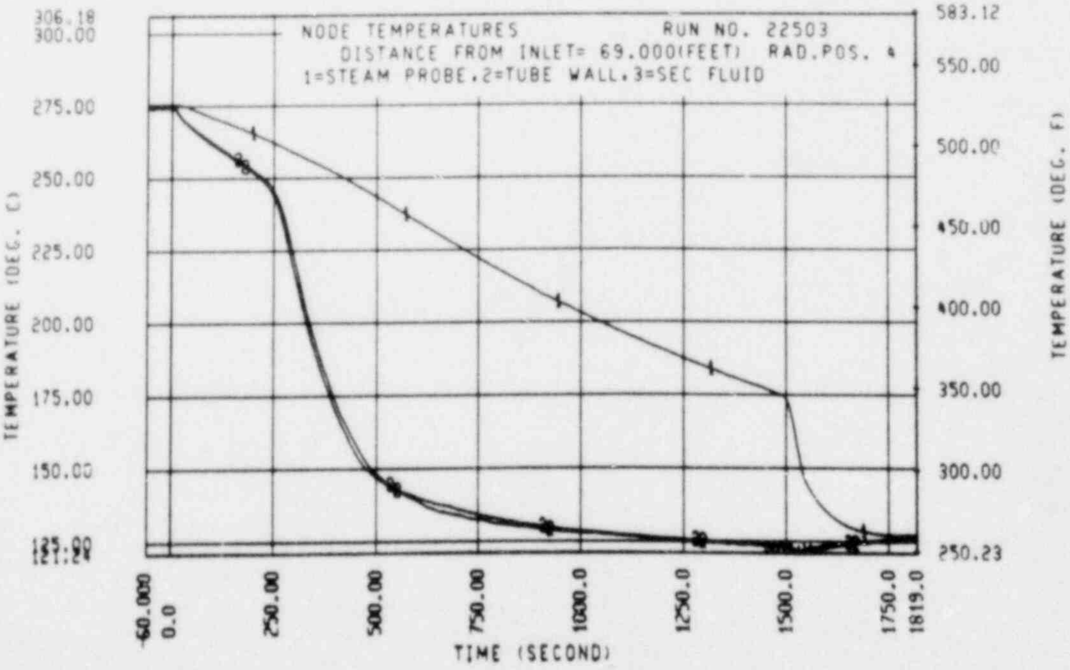

NODE TEMPERATURES
RUN NO. 22503
DISTANCE FROM INLET= 4.000(FEET)
RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
307.69
300.00
275.00
250.00
225.00
200.00
175.00
150.00
125.00
108.32
TEMPERATURE (DEG. F)
585.84
550.00
500.00
450.00
400.00
350.00
300.00
250.00
226.97
-60.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1819.0
TIME (SECOND)

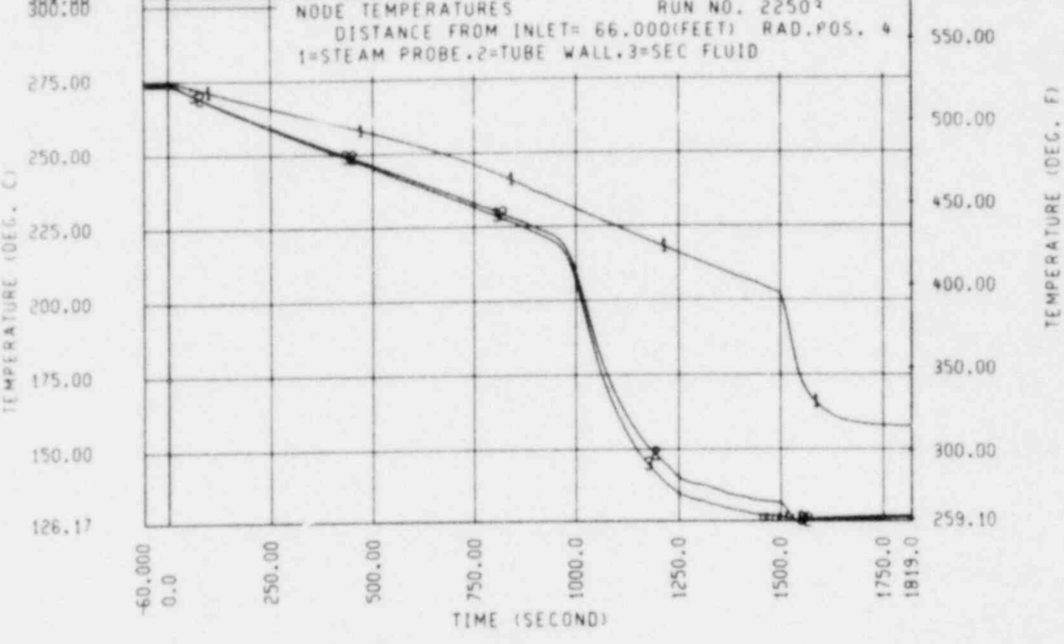

NODE TEMPERATURES
RUN NO. 22503
DISTANCE FROM INLET= 10.000(FEET)
RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
295.33
275.00
250.00
225.00
200.00
175.00
166.25
TEMPERATURE (DEG. F)
563.60
550.00
525.00
500.00
475.00
450.00
425.00
400.00
375.00
350.00
331.26
-60.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1819.0
TIME (SECOND)

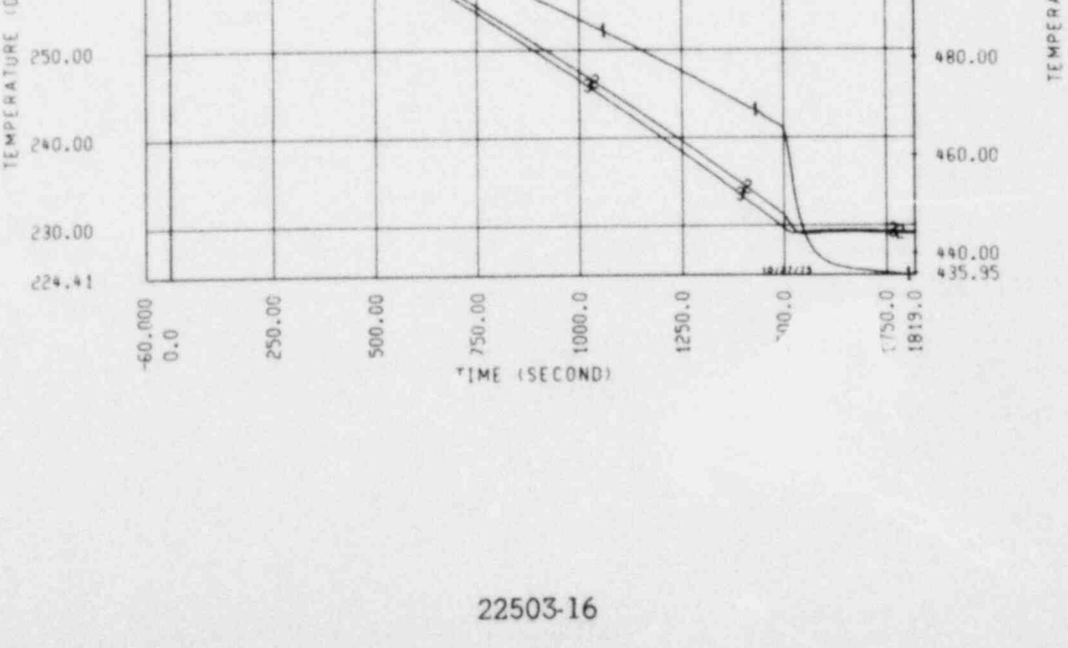

NODE TEMPERATURES RUN NO. 22503
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

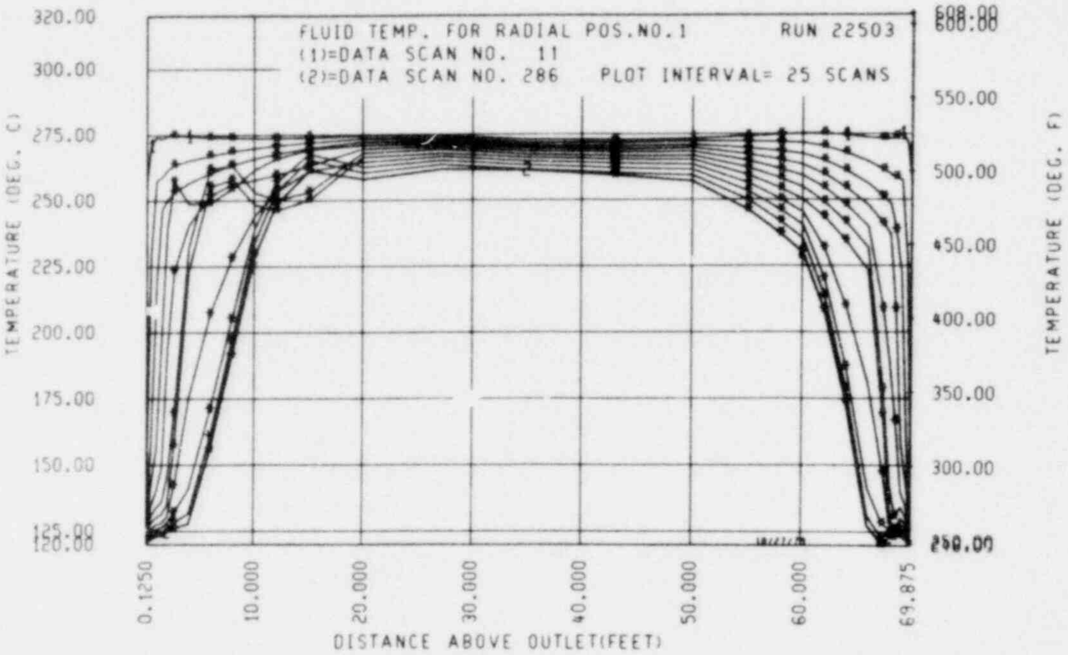

NODE TEMPERATURES RUN NO. 22503
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

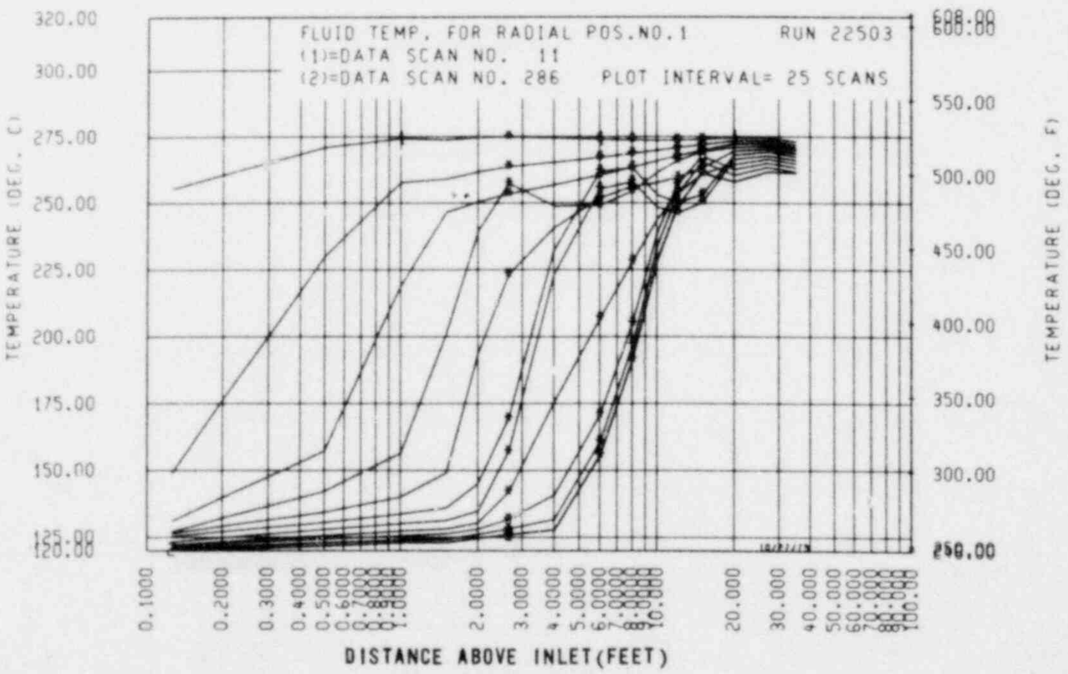

NODE TEMPERATURES RUN NO. 22503
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22503
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

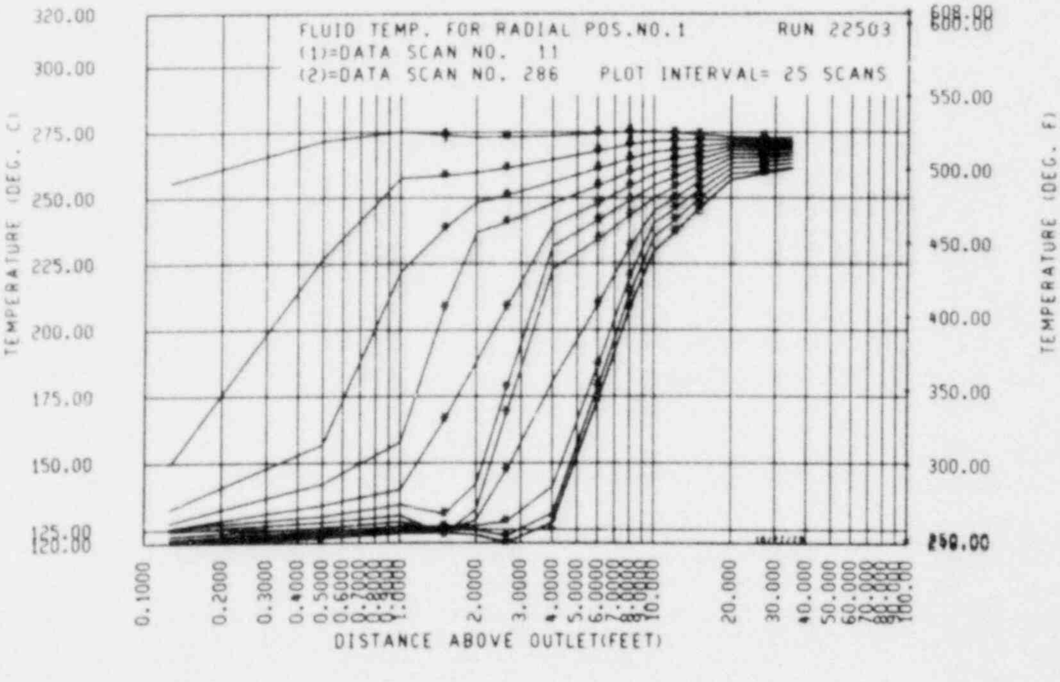

NODE TEMPERATURES
RUN NO. 22503
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES
RUN NO. 22503
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22503
(1)=DATA SCAN NO. 11
(2)=DATA SCAN NO. 286
PLOT INTERVAL= 25 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22503
(1)=DATA SCAN NO. 11
(2)=DATA SCAN NO. 286
PLOT INTERVAL= 25 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)

22503-17


FLUID TEMP. FOR RADIAL POS.NO.1 RUN 22503
(1)=DATA SCAN NO. 11
(2)=DATA SCAN NO. 286 PLOT INTERVAL= 25 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22503

TIME = 120.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX [illegible] - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.5(.04)	51.9(4.57)	83.3(7.37)	5.6(.50)	.681	.846	.965	.892
.2(.50)	61.3(5.40)	4[illegible].4(39.96)	339.3(29.90)	23.7(2.09)	.700	.990	1.019	.900
.3(1.00)	21.3(1.88)	29.2(2.57)	1.6(.14)	18.5(1.63)	.724	1.133	1.121	.910
.5(1.50)	14.7(1.29)	-3.4(-.30)	1.6(.14)	24.5(2.16)	.733	1.137	1.122	.918
.6(2.00)	1.6(.14)	22.1(1.25)	9.3(.82)	10.9(.96)	.735	1.139	1.124	.924
.8(2.65)	1.7(.15)	71.2(6.27)	16.1(1.42)	7.7(.68)	.732	1.173	1.125	.921
1.2(4.00)	12.1(1.06)	7.6(.67)	6.3(.55)	1.6(.14)	.734	1.197	1.111	.904
1.8(6.00)	7.3(.64)	4.1(.36)	6.8(.60)	9.4(.83)	.738	1.182	1.087	.892
2.4(8.00)	3.5(.31)	1.2(.11)	3.2(.28)	2.1(.19)	.732	1.161	1.073	.888
3.0(10.00)	1.7(.15)	1.9(.17)	3.2(.29)	3.7(.33)	.722	1.144	1.067	.882
3.7(12.00)	.6(.05)	2.4(.21)	2.8(.25)	-.0(-.00)	.716	1.134	1.065	.878
4.6(15.00)	1.5(.13)	2.3(.20)	1.7(.15)	1.0(.09)	.715	1.128	1.063	.873
6.1(20.00)	1.3(.12)	1.2(.10)	.2(.02)	.7(.06)	.719	1.124	1.058	.872
8.2(27.00)	.3(.02)	-.1(-.01)	-.2(-.01)	.5(.04)	.722	1.120	1.055	.874
10.7(35.00)	0.0(0.00)	0.0(0.00)	[illegible]	[illegible]	.722	1.120	1.055	.877
13.1(43.00)	-1.0(-.09)	-.5(-.04)	.0(.00)	-.2(-.01)	.717	1.119	1.056	.877
15.2(50.00)	-.1(-.01)	-.3(-.03)	-.1(-.01)	.0(.00)	.713	1.116	1.056	.877
16.8(55.00)	.1(.01)	-.2(-.02)	-.0(-.00)	.1(.01)	.713	1.115	1.056	.877
17.7(58.00)	.3(.02)	-.1(-.01)	.0(.00)	.0(.00)	.714	1.114	1.057	.878
18.3(60.00)	.6(.05)	-.2(-.02)	.1(.00)	.0(.00)	.715	1.114	1.059	.879
18.9(62.00)	1.2(.11)	.3(.00)	.1(.01)	.0(.00)	.717	1.115	1.060	.880
19.5(64.00)	.2(.02)	.2(.02)	.1(.01)	-.0(-.00)	.720	1.116	1.061	.881
20.1(66.00)	.3(.02)	1.1(.10)	.3(.03)	-.1(-.01)	.721	1.119	1.062	.881
20.5(67.38)	-.3(-.02)	.1(.01)	-.3(-.02)	-1.3(-.11)	.722	1.121	1.062	.880
20.7(68.00)	-.1(-.00)	-.1(-.01)	-.1(-.00)	-.8(-.07)	.722	1.122	1.062	.879
20.9(68.50)	-1.1(-.09)	-1.1(-.10)	-1.7(-.15)	-1.3(-.11)	.722	1.121	1.061	.879
21.0(69.00)	-.3(-.02)	-.3(-.03)	3.3(.29)	-.3(-.03)	.723	1.120	1.062	.879
21.2(69.50)	.3(.02)	-.7(-.07)	-.5(-.04)	-2.1(-.19)	.727	1.121	1.063	.879
21.3(69.87)	-25.8(-2.27)	-13.5(-1.19)	-11.7(-1.03)	[illegible](-.41)	.728	1.120	1.062	.879

22503-19

POOR ORIGINAL

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22503
TIME = 420.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX ROD ROW - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.1(.01)	12.5(1.10)	10.6(.93)	9.1(.80)	.681	.840	.895	.893
.2(.50)	44.8(3.94)	45.6(4.02)	48.8(4.30)	49.3(4.34)	.694	.855	.911	.910
.3(1.00)	81.9(7.21)	116.5(10.26)	4.1(.36)	112.2(9.88)	.732	.903	.926	.956
.5(1.50)	1.1(.10)	1.2(.10)	103.1(9.08)	1.2(.10)	.758	.938	.958	.985
.6(2.00)	[illegible]	25.1(2.21)	9.9(.87)	12.8(1.13)	.778	.945	.991	.985
.8(2.65)	1.5(.13)	-49.9(-4.39)	-3.9(-.34)	-7.3(-.64)	.796	.926	.987	.978
1.2(4.00)	11.1(.98)	8.9(.78)	6.5(.57)	1.4(.13)	.794	.896	.971	.960
1.8(6.00)	18.2(1.60)	23.5(2.07)	17.4(1.53)	19.2(1.70)	.806	.904	.968	.961
2.4(8.00)	10.8(.95)	17.4(1.53)	1.1(.09)	14.8(1.30)	.820	.928	.966	.979
3.0(10.00)	3.6(.31)	4.0(.35)	5.8(.51)	4.3(.38)	.821	.940	.962	.983
3.7(12.00)	-.9(-.08)	-.1(-.01)	2.7(.24)	-1.2(-.11)	.815	.936	.960	.975
4.6(15.00)	[illegible]	.4(.04)	1.1(.10)	-.5(-.04)	.814	.928	.956	.963
6.1(20.00)	1.4(.12)	1.5(.14)	.7(.06)	1.0(.09)	.817	.925	.951	.957
8.2(27.00)	.5(.05)	.7(.06)	-.1(-.01)	.6(.06)	.819	.927	.948	.958
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.819	.928	.946	.961
13.1(43.00)	-1.1(-.10)	-.6(-.05)	-.0(-.00)	-.2(-.02)	.814	.926	.950	.962
15.2(50.00)	-.1(-.01)	-.4(-.04)	-.1(-.01)	.0(.00)	.810	.923	.949	.961
16.8(55.00)	-.0(-.00)	-.3(-.03)	-.2(-.02)	-.0(-.00)	.810	.921	.949	.962
17.7(58.00)	-.3(-.03)	-.2(-.02)	-.2(-.01)	-.1(-.01)	.810	.921	.950	.963
18.3(60.00)	-.1(-.01)	-.3(-.03)	-.2(-.02)	-.2(-.02)	.811	.921	.952	.965
18.9(62.00)	-.0(-.00)	-.0(-.00)	-.1(-.01)	-.3(-.03)	.812	.922	.953	.966
19.5(64.00)	.0(.00)	.1(.01)	-.0(-.00)	-.4(-.03)	.814	.925	.955	.967
20.1(66.00)	.1(.01)	1.0(.09)	.1(.01)	-.7(-.07)	.817	.929	.958	.967
20.5(67.38)	-.7(-.07)	-.1(-.01)	-.7(-.06)	-2.4(-.21)	.818	.932	.959	.967
20.7(68.00)	-1.2(-.11)	-1.1(-.10)	-1.2(-.11)	-2.2(-.19)	.819	.933	.959	.966
20.9(68.50)	-2.7(-.24)	-2.9(-.26)	-7.6(-.67)	-.5(-.05)	.819	.932	.957	.968
21.0(69.00)	2.6(.23)	2.1(.19)	.0(.00)	7.4(.65)	.823	.933	.957	.973
21.2(69.50)	-14.9(-1.31)	-17.9(-1.58)	-14.4(-1.27)	-13.7(-1.20)	.830	.934	.956	.975
21.3(69.87)	-7.6(-.67)	-5.3(-.47)	-5.0(-.44)	-3.6(-.32)	.834	.933	.954	.973

22503-20

POOR ORIGINAL

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22503
TIME = 840.? SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX ROD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.1(.01)	4.9(.43)	4.6(.40)	4.2(.37)	.681	.839	.894	.892
.2(.50)	14.8(1.30)	15.7(1.39)	15.7(1.39)	15.2(1.34)	.686	.843	.899	.897
.3(1.00)	19.0(1.67)	20.5(1.80)	.2(.01)	29.1(2.56)	.696	.854	.904	.910
.5(1.50)	21.5(1.89)	17.4(1.53)	9.3(.82)	27.1(2.38)	.708	.866	.907	.927
.6(2.00)	29.9(2.63)	24.7(2.18)	12.2(1.07)	28.1(2.48)	.723	.879	.913	.943
.8(2.65)	.5(.04)	33.8(2.98)	15.3(1.35)	23.1(2.04)	.730	.900	.922	.960
1.2(4.00)	11.8([illegible])	11.2(.99)	7.6(.67)	1.2(.10)	.740	.919	.928	.962
1.8(6.00)	6.5(.57)	8.3(.73)	8.8(.77)	10.9(.96)	.752	.920	.925	.956
2.4(8.00)	3.8(.33)	4.7(.41)	1.5(.13)	6.9(.61)	.747	.913	.914	.955
3.0(10.00)	5.5(.49)	6.0(.53)	7.5(.66)	6.5(.58)	.739	.910	.918	.950
3.7(12.00)	7.3(.64)	6.5(.57)	5.9(.52)	3.8(.33)	.741	.913	.910	.946
4.6(15.00)	5.6(.49)	3.9(.33)	4.0(.36)	4.9(.43)	.754	.917	.913	.948
6.1(20.00)	2.5(.22)	2.6(.23)	1.4(.13)	1.6(.14)	.766	.921	.914	.951
8.2(27.00)	.7(.06)	.9(.07)	-.0(-.00)	.7(.06)	.771	.924	.911	.952
10.7(35.00)	[illegible]	[illegible]	0.0([illegible])	[illegible](0.00)	.770	.924	.910	.954
13.1(43.00)	-1.1(-.10)	-.6(-.05)	-.0([illegible])	-.2(-.02)	.764	.922	.912	.955
15.2(50.00)	-.2(-.01)	-.4(-.04)	-.2(-.01)	.0(.00)	.759	.919	.912	.955
16.8(55.00)	-.1(-.01)	-.4(-.04)	-.3(-.02)	-.1(-.01)	.760	.918	.912	.956
17.7(58.00)	-.1(-.01)	-.4(-.04)	-.4(-.03)	-.3(-.02)	.762	.918	.913	.958
18.3(60.00)	-.4(-.03)	-.2(-.08)	-.8(-.06)	-.6(-.05)	.763	.918	.915	.961
18.9(62.00)	-.5(-.04)	-.1(-.01)	-.3(-.03)	-.8(-.07)	.764	.920	.919	.963
19.5(64.00)	-.1(-.01)	.1(.01)	-.1(-.01)	-.9(-.08)	.768	.925	.924	.966
20.1(66.00)	-.0(-.00)	1.0(.09)	-.0(-.00)	-1.7(-.15)	.773	.933	.930	.968
20.5(67.38)	-3.6(-.32)	-2.5(-.22)	-3.6(-.32)	[illegible](-.70)	.775	.939	.933	.966
20.7(68.00)	[illegible]	-9.0(-.79)	-9.5(-.84)	-10.3(-.91)	.774	.938	.932	.963
20.9(68.50)	-9.4([illegible])	-9.1(-.80)	-11.5(-1.02)	-7.3(-.64)	.774	.936	.929	.964
21.0(69.00)	2.2(.20)	1.9(.16)	.6(.05)	-1.9(-.17)	.779	.937	.931	.969
21.2(69.50)	-10.6(-.94)	-16.9(-1.49)	-11.7(-1.03)	-10.2(-.90)	.797	.940	.931	.971
21.3(69.87)	-2.7(-.24)	-3.1(-.27)	-3.0(-.26)	-3.5(-.31)	.77[illegible]	.941	.930	.969

22503-21

POOR ORIGINAL

SUMMARY SHEET

RUN NO. 22608

DATE: 4/3/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.179 (0.395)
2. Water flow - [kg/sec (lb/sec)] - 0.046 (0.101)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [°C (°F)] - 155 (311)
5. Water temperature [°C (°F)] - 123 (254)
6. Mixer pressure [kPa (psig)] - 193 (28)
7. Test time (sec) - 1440.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 2.3 (7.7)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [°C (°F)]
0.00 (0.00)	294 (481)
0.15 (0.50)	264 (507)
0.30 (1.00)	275 (527)
0.46 (1.50)	273 (523)
0.61 (2.00)	273 (524)
1.22 (4.00)	-
3.05 (10.00)	274 (526)
6.09 (20.00)	274 (526)
8.23 (27.00)	-
10.67 (35.00)	274 (526)

SUMMARY SHEET (cont)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 4.07 (8.98)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 4.60 (10.14)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 1.42 (3.14)

D. FAILED BUNDLE T/Cs[1]

294, 295, 305, 308, 309, 310, 311, 549, 553, 555, 564, 565, 568, 569

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

1. From primary side energy balance [kwsec(Btu)] - 1.10×10^5 (1.04×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, dadt$) - [kwsec(Btu)] - 0.897×10^5 (0.854×10^5)
3. Integration to 900 sec

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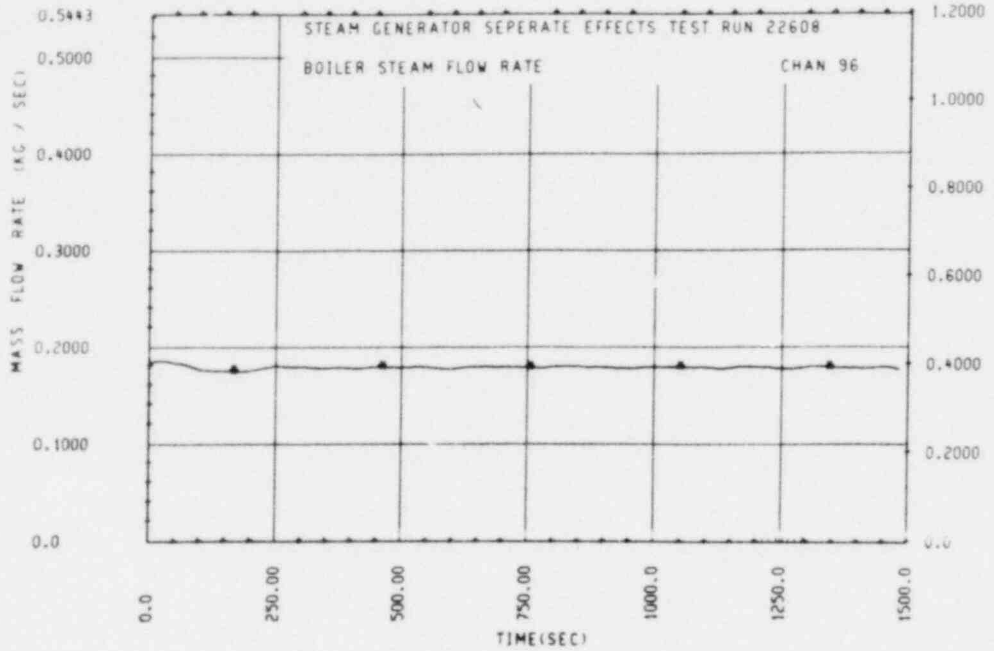
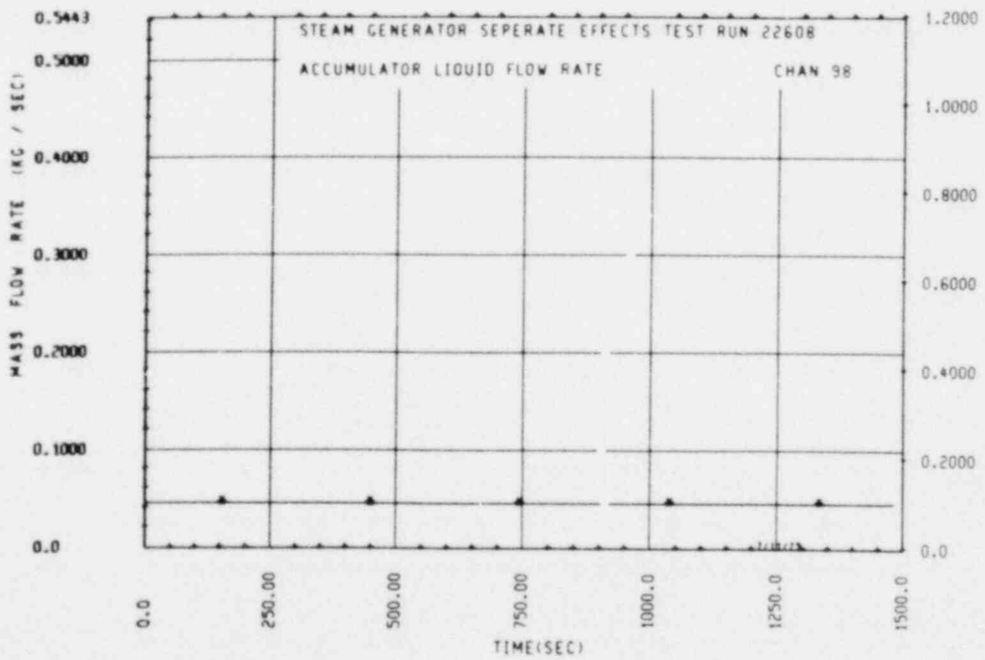
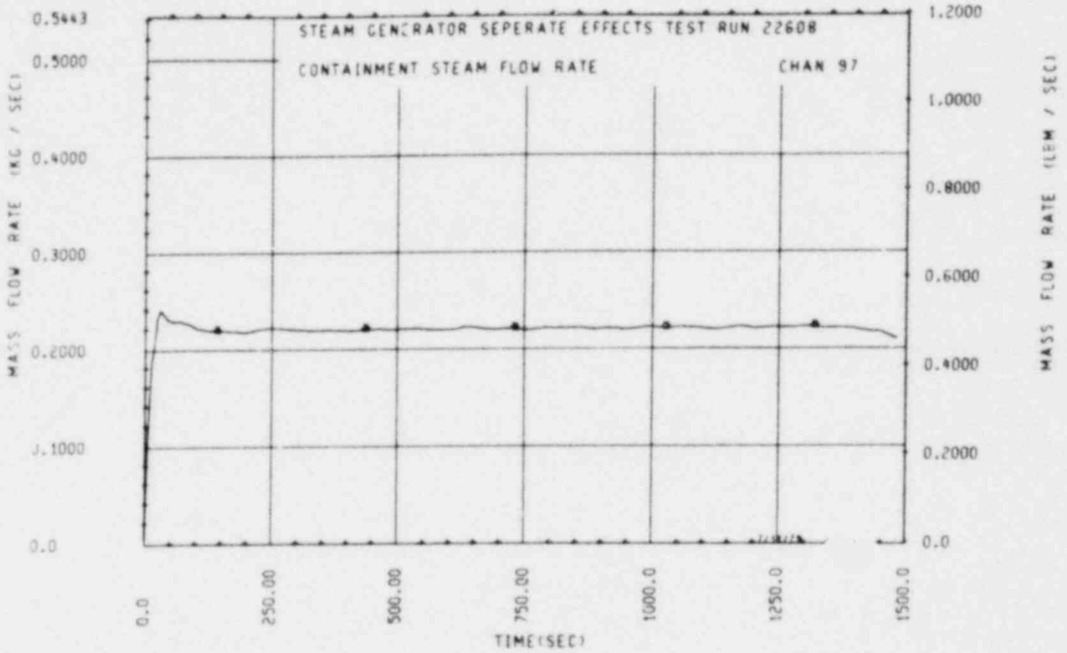
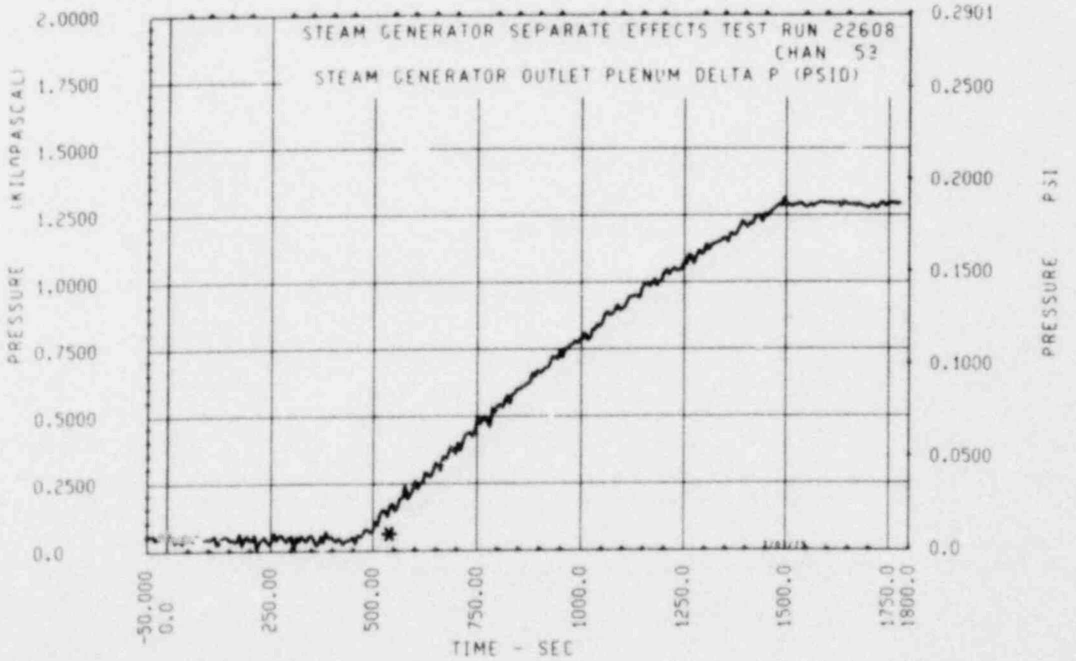
1. T/Cs are defined as failed based on resistance reading or T/C response.

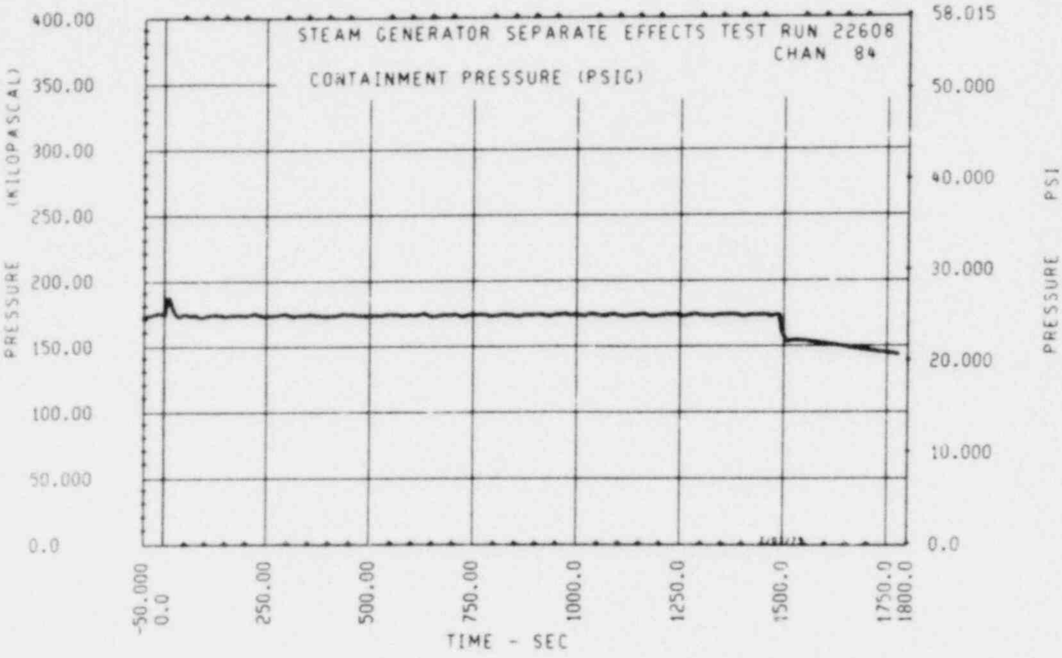

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22608
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

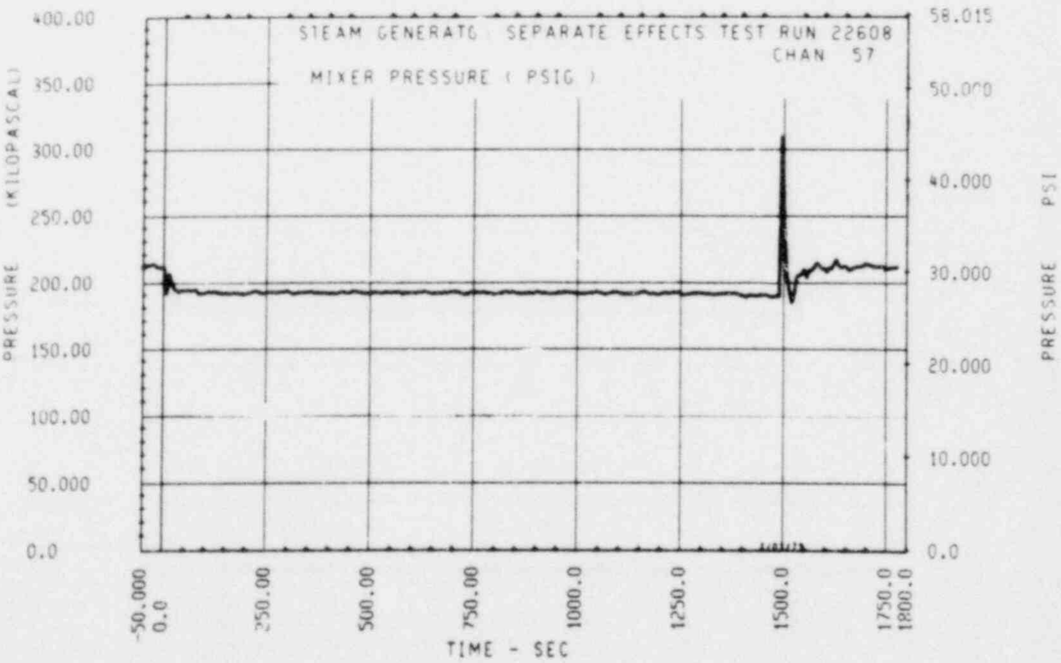

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22608
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

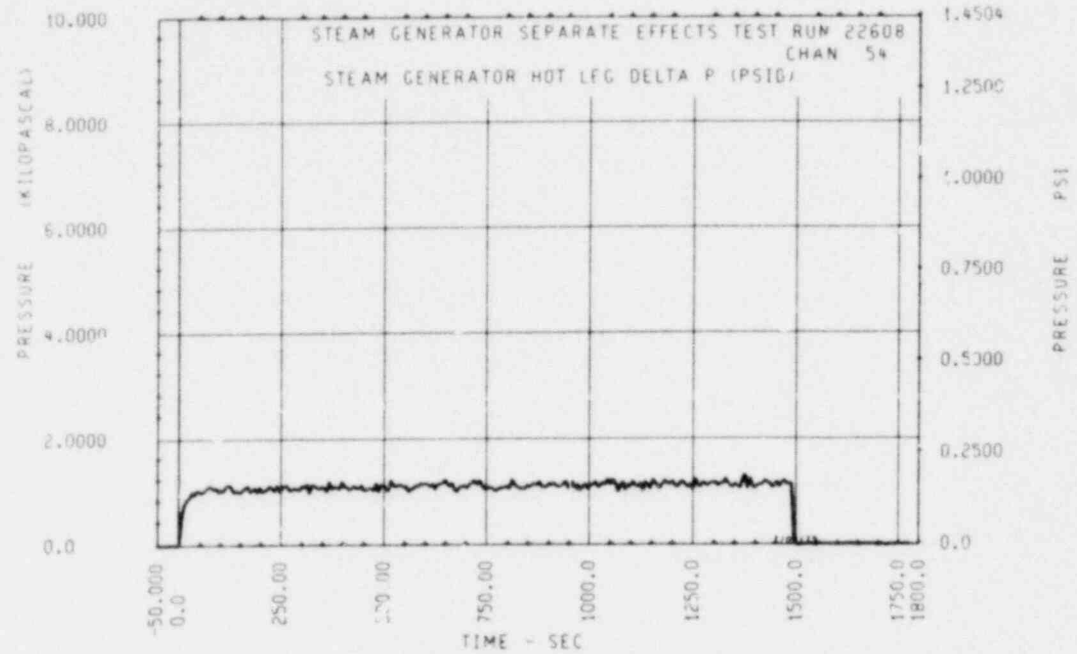


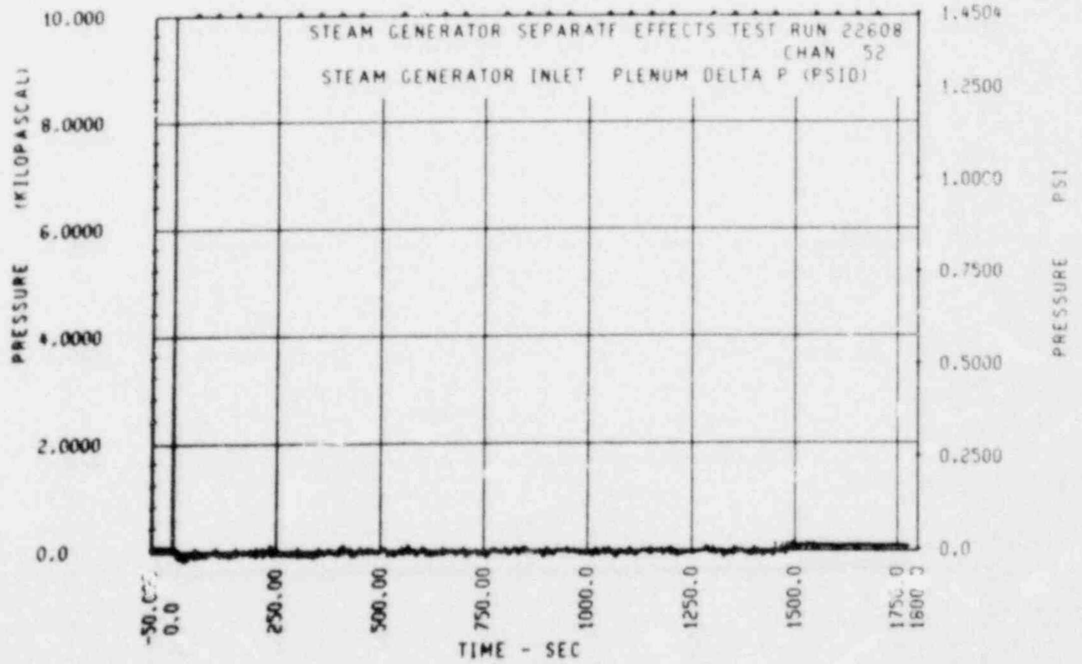


* Refer to Appendix H text for explanation of delayed response.

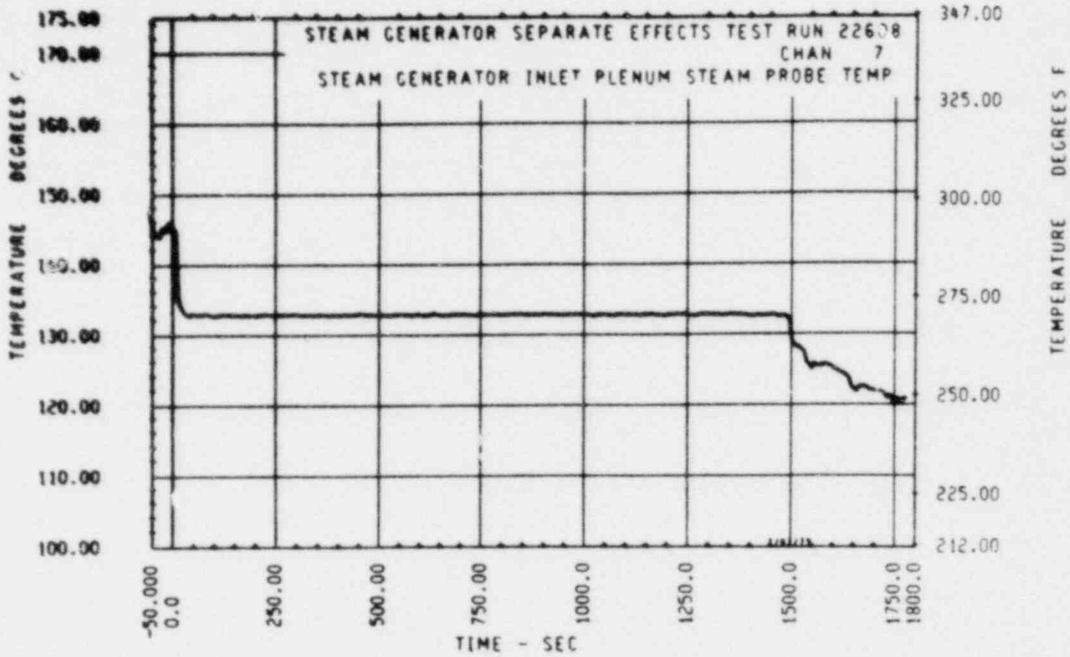

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22608
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

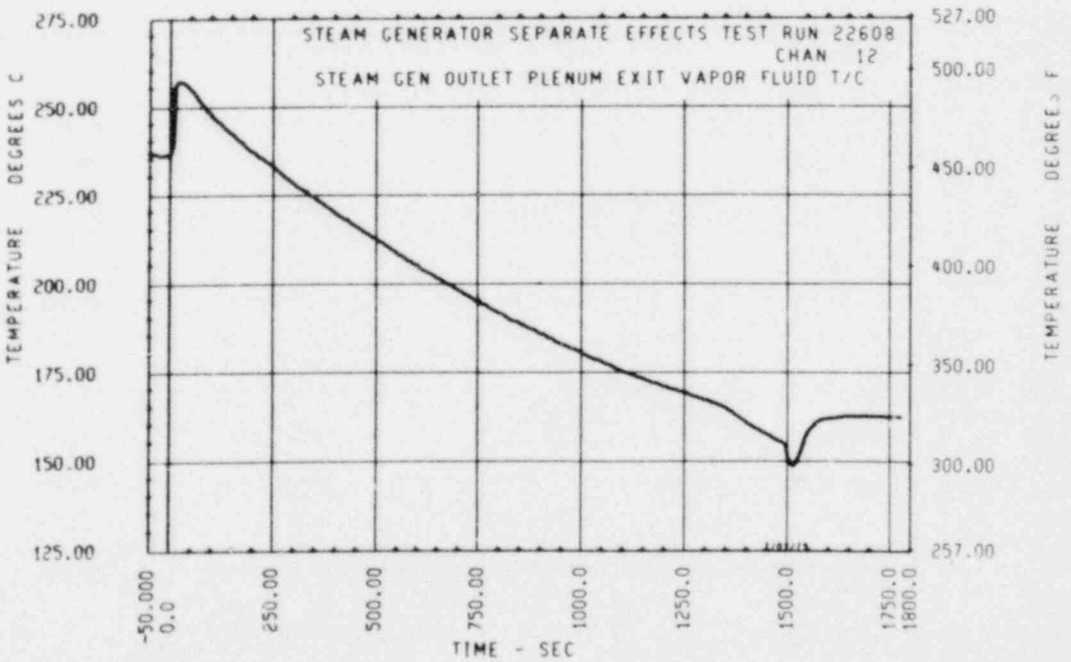

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22608
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

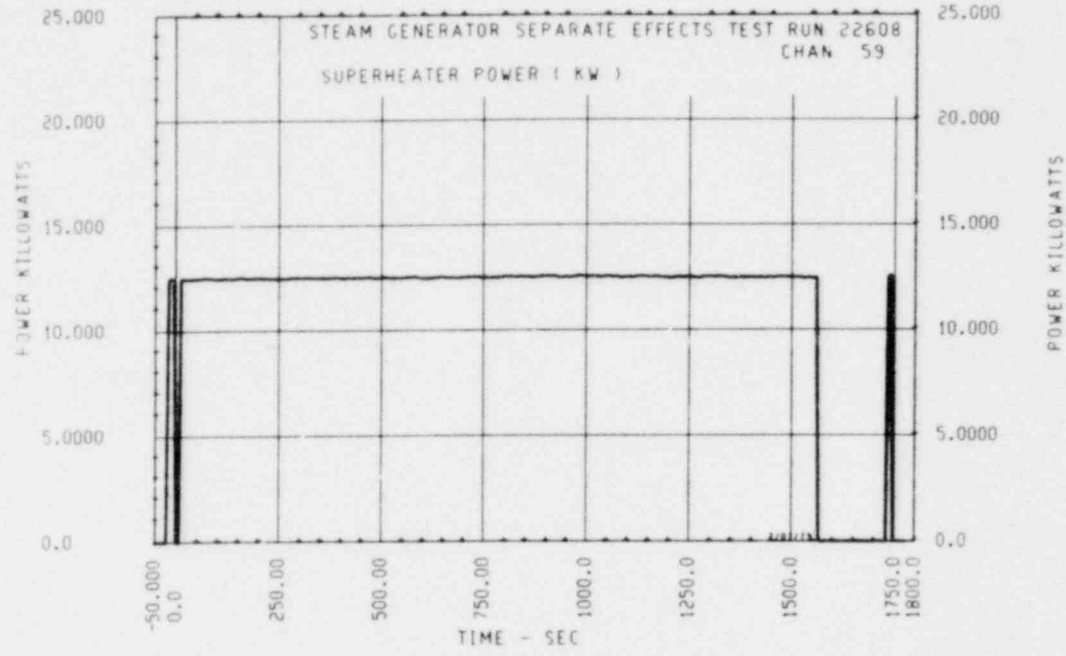

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22608
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
10.000
8.0000
6.0000
2.0000
0.0
1.4504
1.2500
0.7500
0.2500
-50.000
250.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

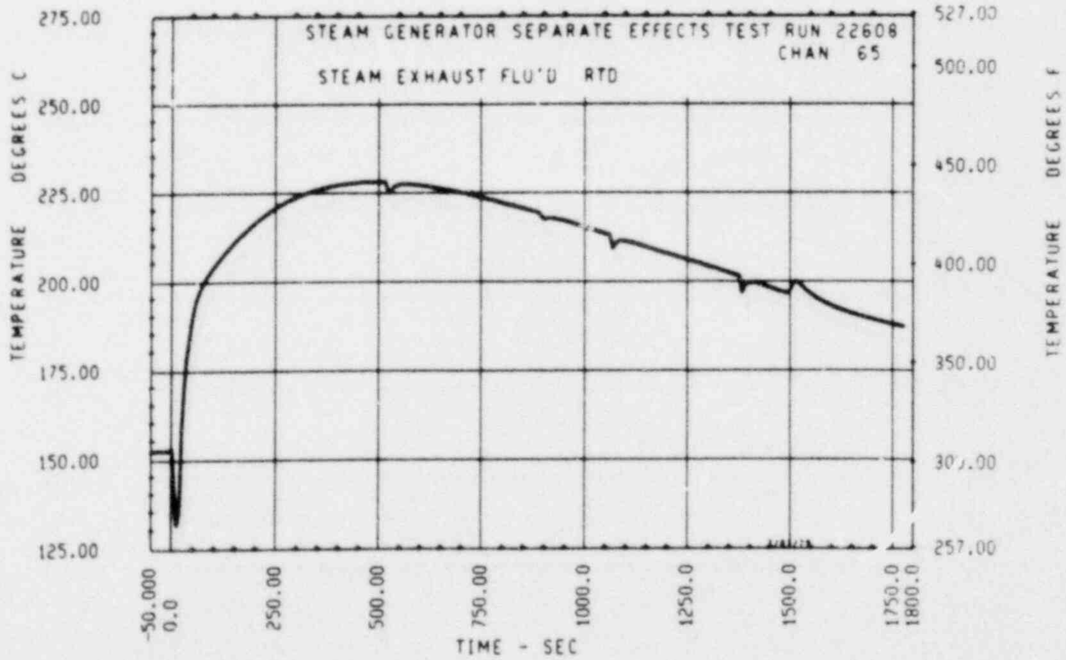

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22608
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
10.000
8.0000
6.0000
4.0000
2.0000
0.0
1.4504
1.2500
0.7500
0.5000
0.2500
250.00
500.00
750.00
1000.0
1250.0
1500.0

22608-6

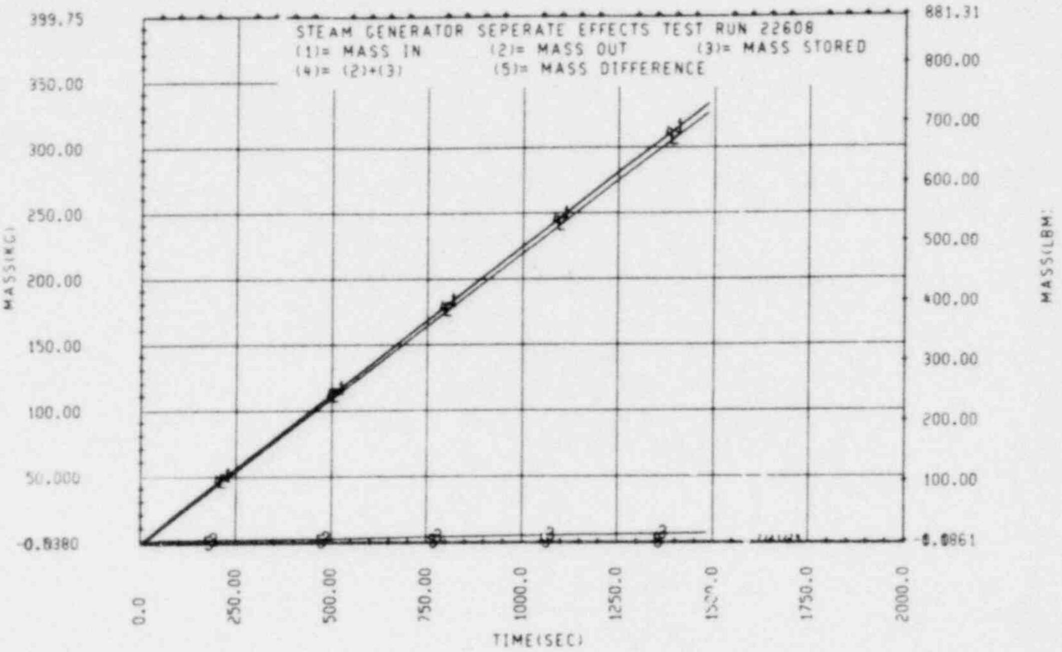

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22608
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
175.00
170.00
160.00
150.00
130.00
120.00
110.00
100.00
347.00
325.00
300.00
275.00
250.00
225.00
212.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

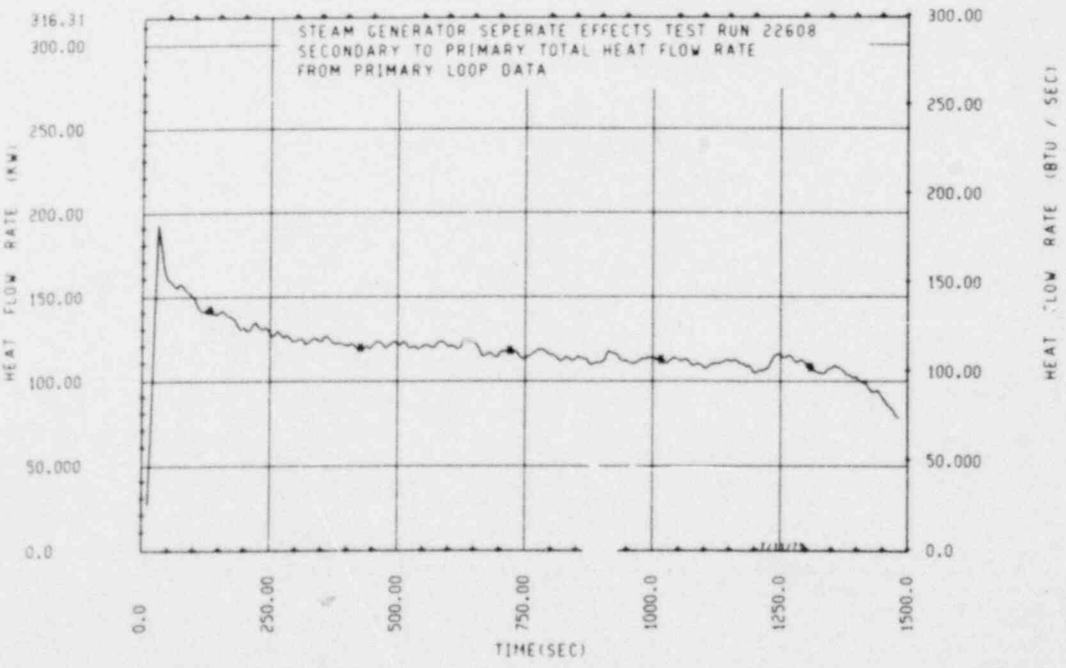

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22608
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TIME - SEC
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22608
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

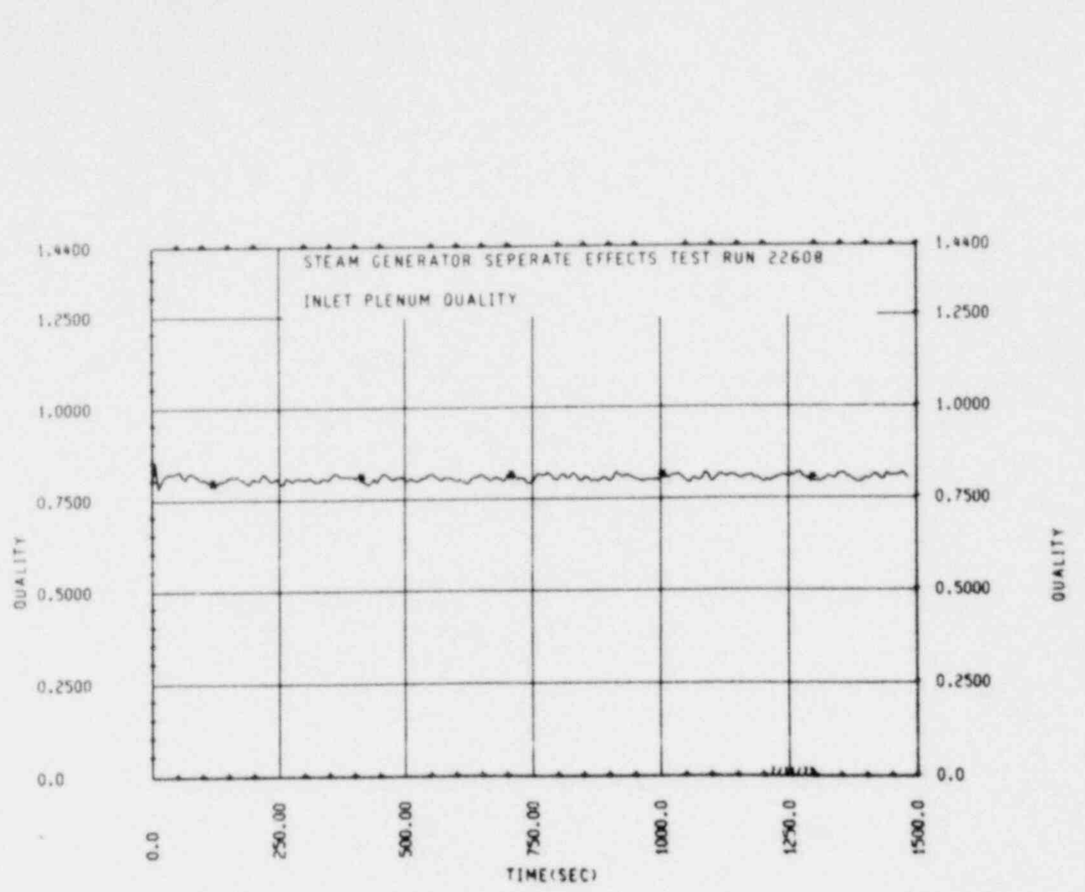

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22608
CHAN 65
STEAM EXHAUST FLU'D RTD
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
275.00
250.00
225.00
200.00
175.00
150.00
125.00
500.00
450.00
400.00
350.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

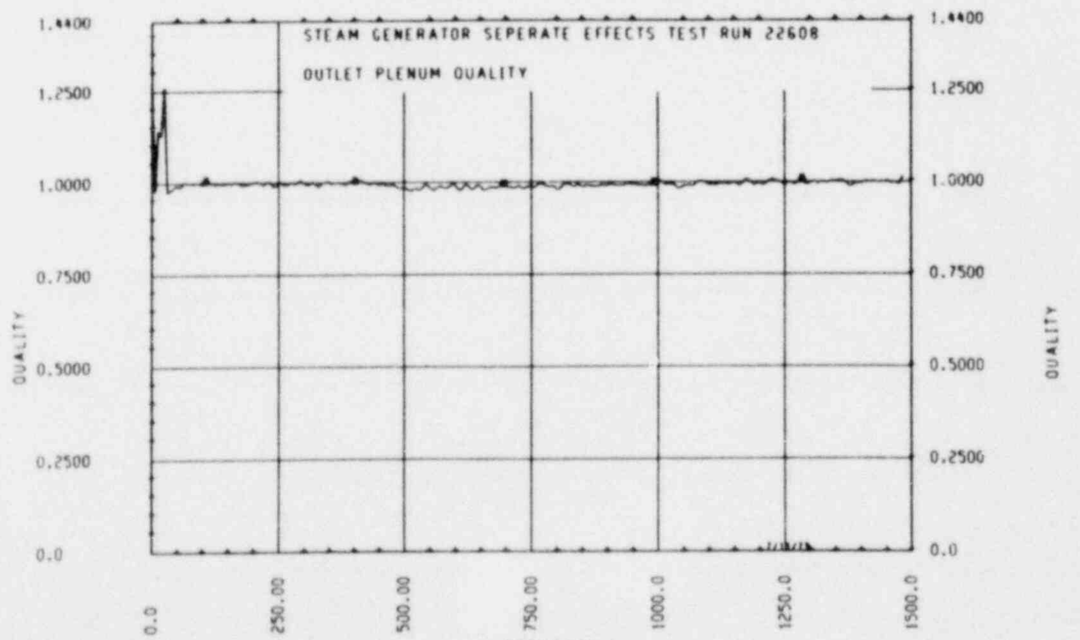
22608-8

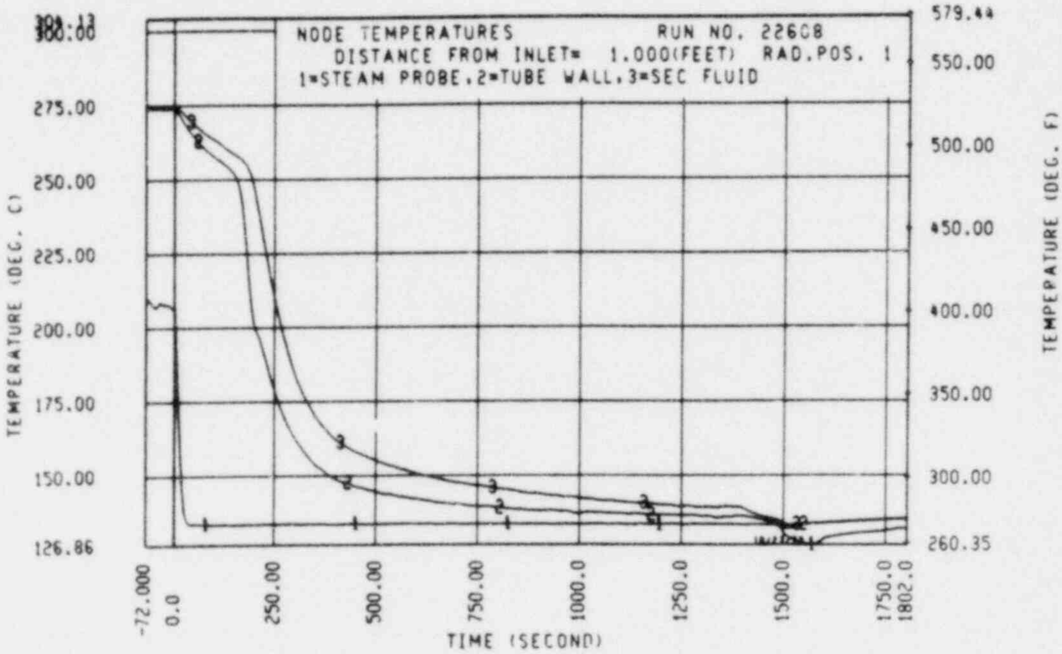

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22608
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)

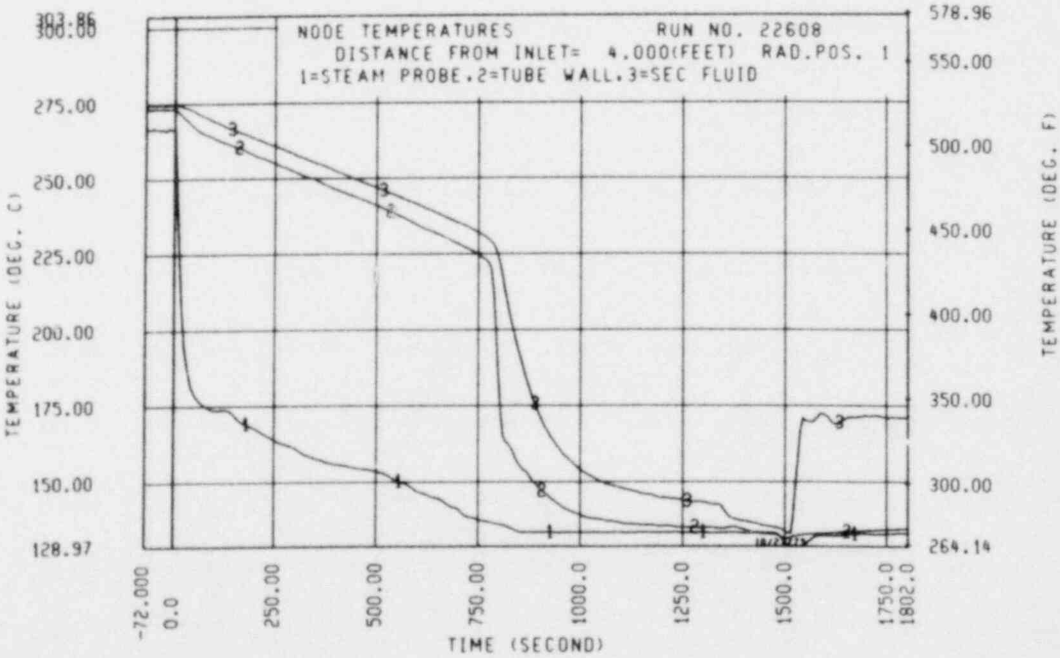

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22608
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)

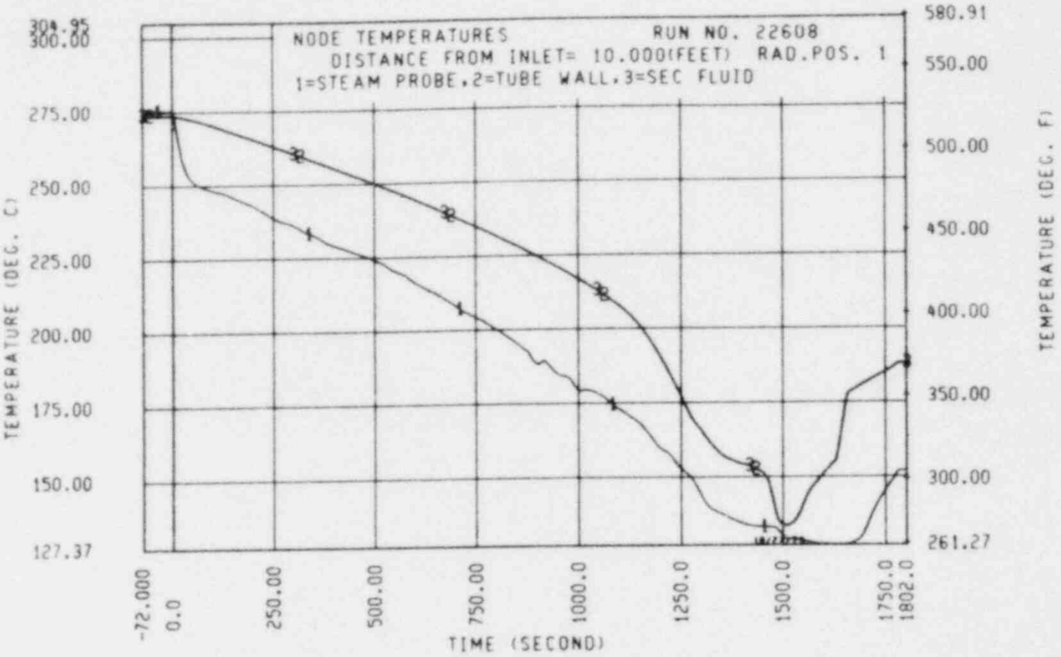
22608-9

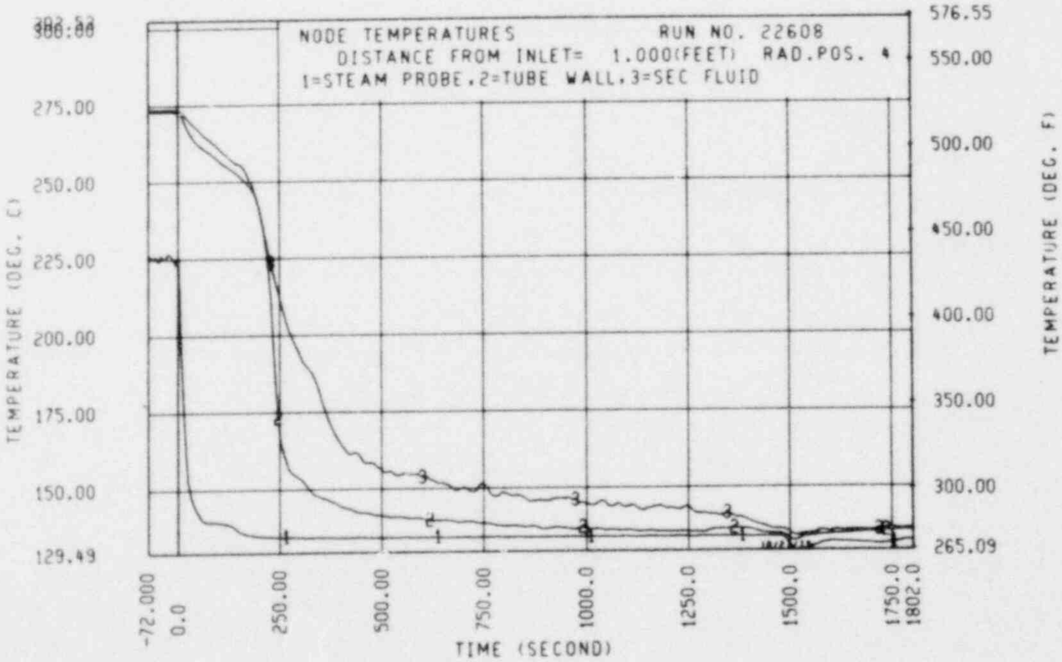

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22608
INLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22608
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

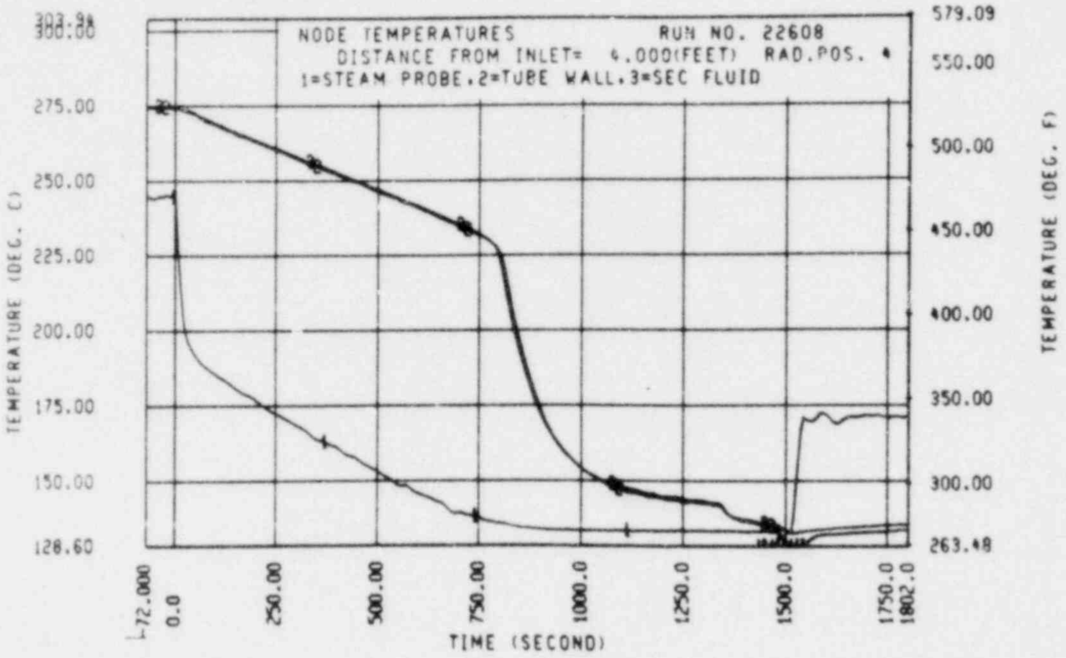

NODE TEMPERATURES RUN NO. 22608
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
126.86
579.44
550.00
500.00
450.00
400.00
350.00
300.00
260.35
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1802.0


NODE TEMPERATURES RUN NO. 22608
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
303.86
300.00
275.00
250.00
225.00
200.00
175.00
150.00
128.97
578.96
550.00
500.00
450.00
400.00
350.00
300.00
264.14
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1802.0

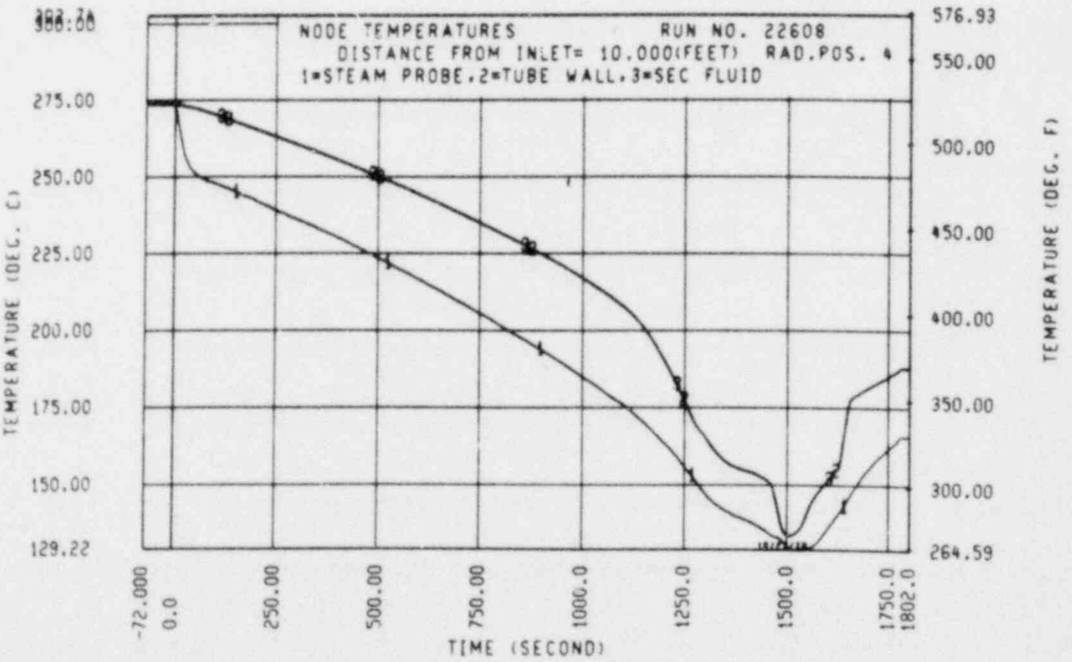

NODE TEMPERATURES RUN NO. 22608
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22608
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

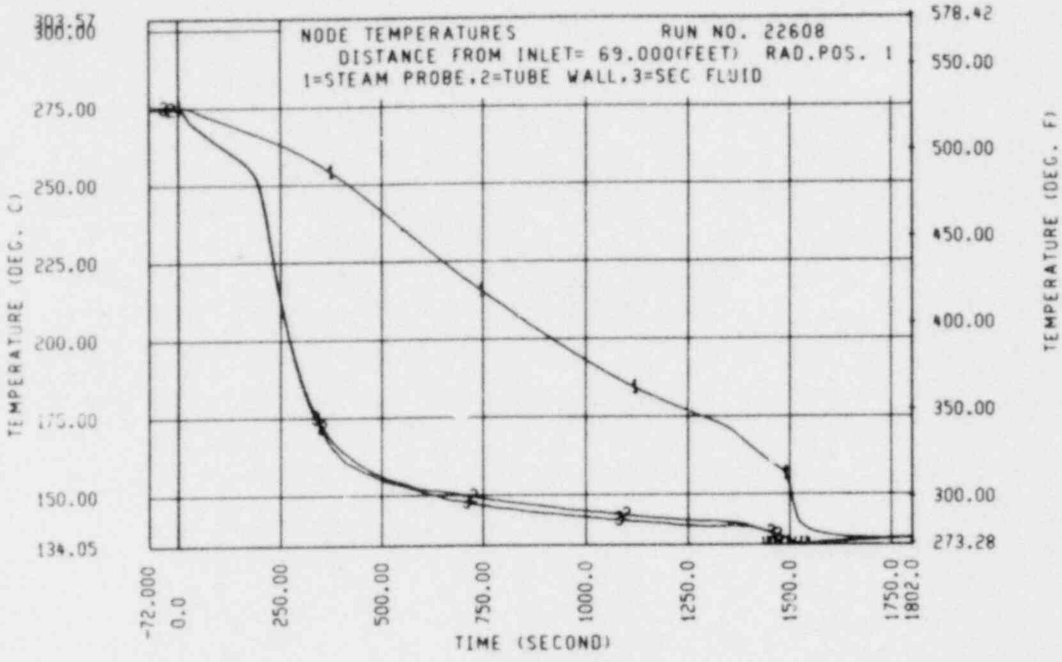
22608-12

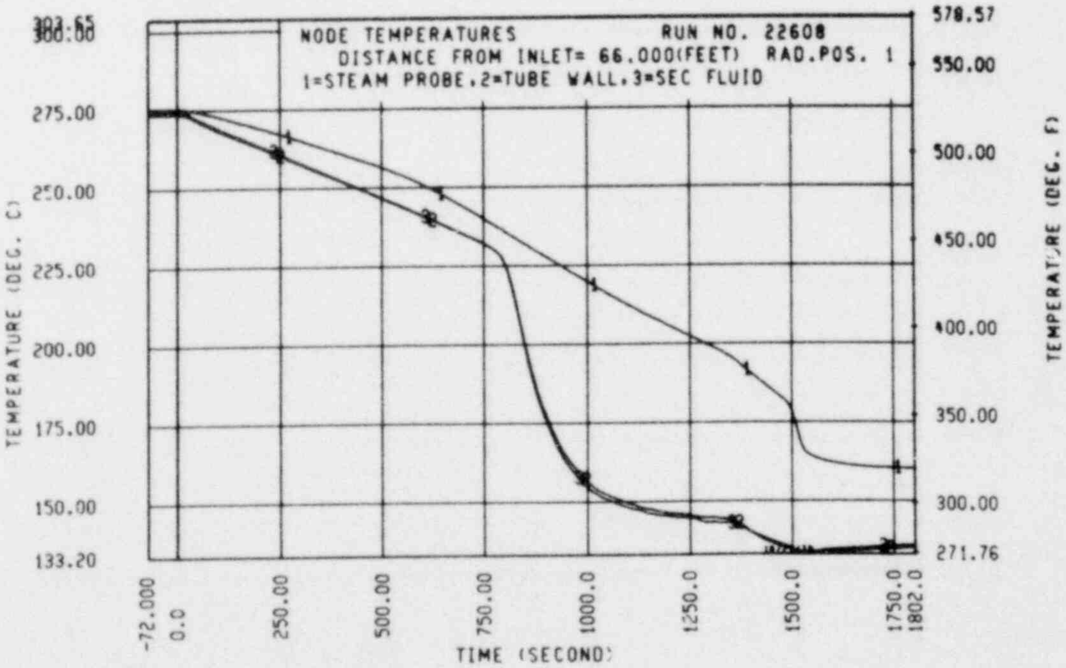


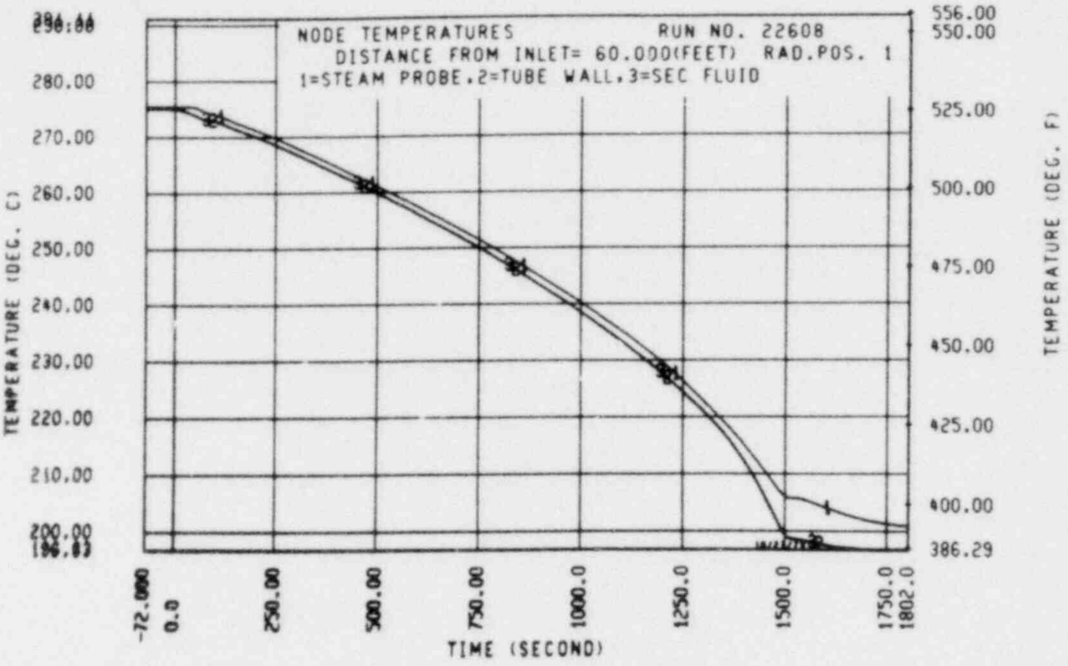
NODE TEMPERATURES RUN NO. 22608
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
303.98
300.00
275.00
250.00
225.00
200.00
175.00
150.00
128.60
TEMPERATURE (DEG. F)
579.09
550.00
500.00
450.00
400.00
350.00
300.00
263.48
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1802.0
TIME (SECOND)



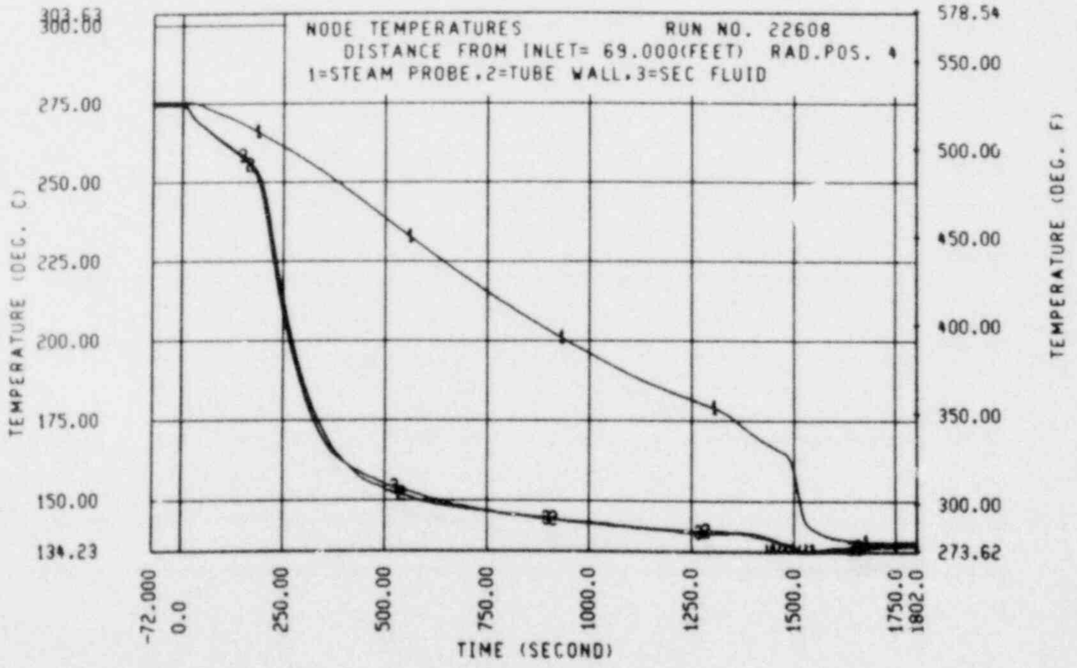
NODE TEMPERATURES RUN NO. 22608
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
300.00
275.00
250.00
225.00
200.00
175.00
150.00
129.22
TEMPERATURE (DEG. F)
576.93
550.00
500.00
450.00
400.00
350.00
300.00
264.59
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1802.0
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22608
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22608
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

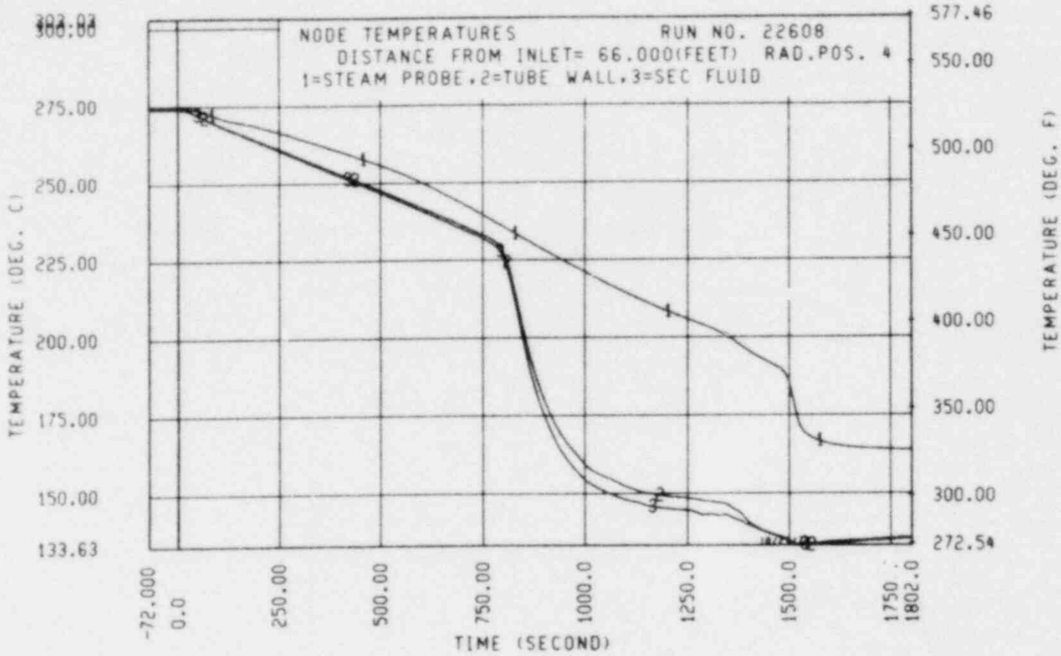


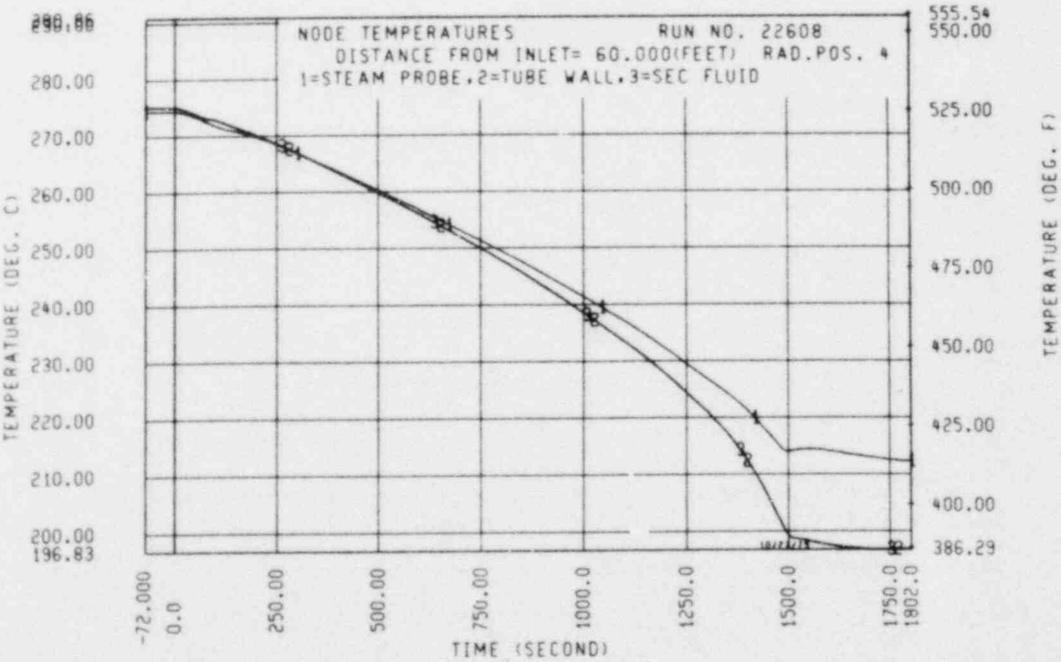
NODE TEMPERATURES RUN NO. 22608
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
280.00
270.00
260.00
250.00
240.00
230.00
220.00
210.00
200.00
TEMPERATURE (DEG. F)
556.00
550.00
525.00
500.00
475.00
450.00
425.00
400.00
386.29
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1802.0
TIME (SECOND)

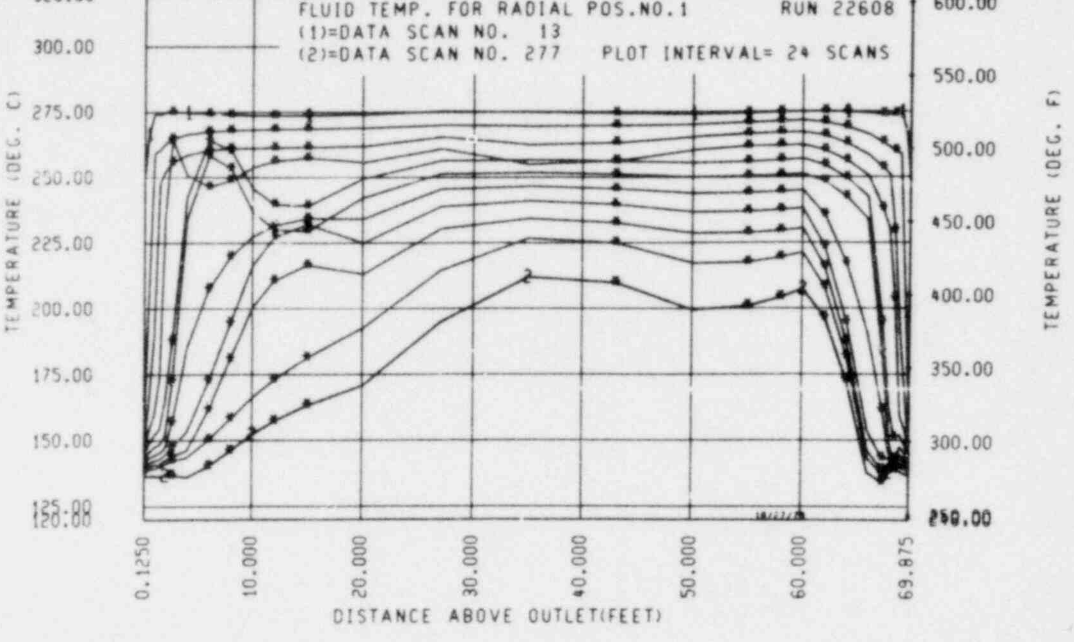


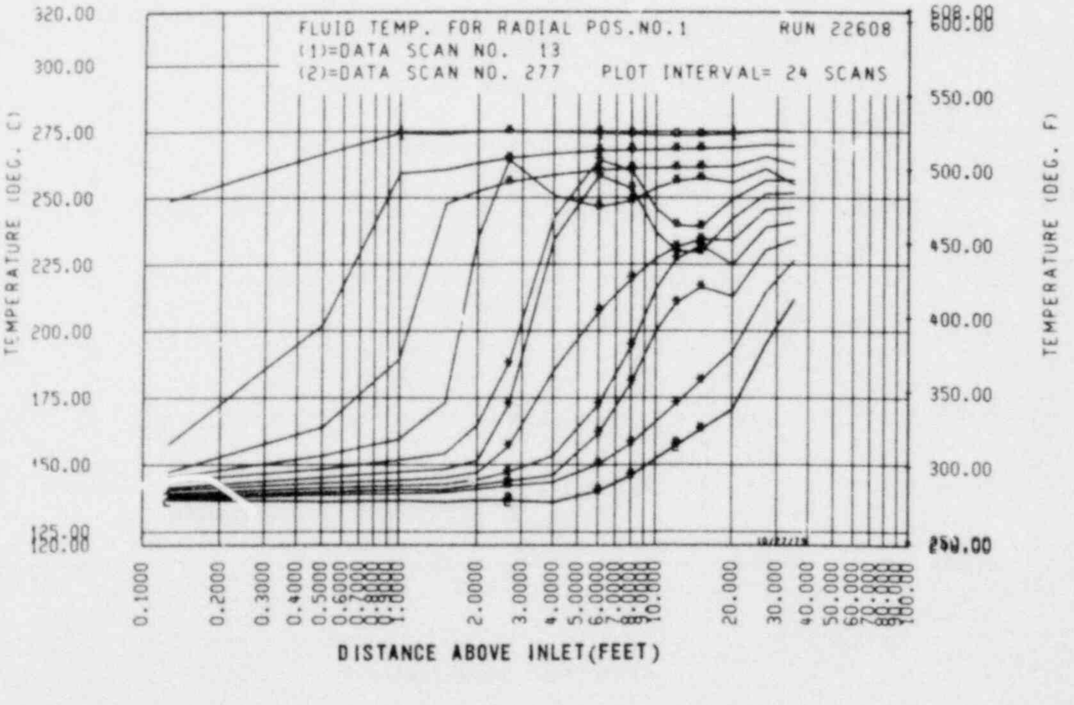
NODE TEMPERATURES RUN NO. 22608
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
303.63
300.00
275.00
250.00
225.00
200.00
175.00
150.00
134.23
TEMPERATURE (DEG. F)
578.54
550.00
500.00
450.00
400.00
350.00
300.00
273.62
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1802.0
TIME (SECOND)

22608-15

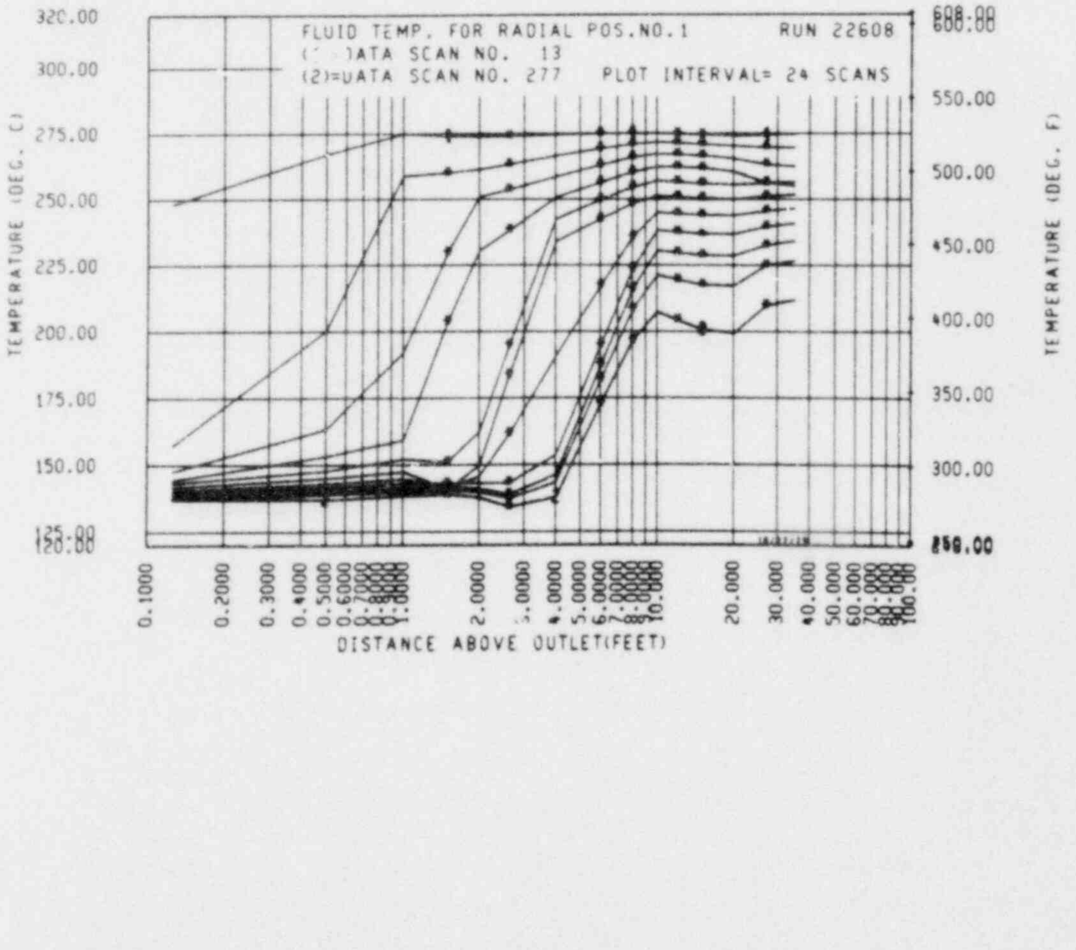

NODE TEMPERATURES RUN NO. 22608
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22608
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22608
(1)=DATA SCAN NO. 13
(2)=DATA SCAN NO. 277
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22608
(1)=DATA SCAN NO. 13
(2)=DATA SCAN NO. 277
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)

22608-17



FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22608
(2)=DATA SCAN NO. 277
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22608
TIME = 120.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.4(.04)	29.3(2.58)	42.0(3.70)	24.2(2.13)	.643	.765	.855	.866
.2(.50)	1.2(.10)	210.5(18.55)	222.5(19.60)	60.2(5.31)	.644	.835	.931	.888
.3(1.00)	23.3(2.05)	33.0(2.91)	4.6(.41)	7.8(.69)	.650	.911	1.001	.905
.5(1.50)	-3.5(-.31)	-4.8(-.43)	-2.1(-.19)	1.4(.12)	.654	.917	1.010	.901
.6(2.00)	1.7(.15)	19.0(1.68)	8.9(.78)	11.1(.98)	.651	.919	1.001	.899
.8(2.65)	1.7(.15)	62.4(5.50)	29.1(2.57)	13.3(1.17)	.646	.951	1.014	.900
1.2(4.00)	10.5(.93)	7.1(.63)	6.0(.53)	1.6(.14)	.646	.971	1.015	.892
1.8(6.00)	3.4(.30)	3.3(.29)	3.6(.31)	11.2(.99)	.644	.949	.989	.887
2.4(8.00)	.8(.07)	.2(.02)	-2.0(-.18)	7.0(.61)	.635	.928	.964	.892
3.0(10.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.628	.919	.953	.887
3.7(12.00)	-.4(-.04)	-.1(-.01)	.2(.02)	-1.7(-.15)	.623	.914	.947	.878
4.6(15.00)	2.1(.18)	.6(.05)	.3(.03)	-.7(-.06)	.624	.909	.941	.870
6.1(20.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.628	.905	.935	.865
8.2(27.00)	.3(.03)	-.1(-.01)	-.2(-.01)	.4(.03)	.630	.904	.935	.868
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.635	.908	.940	.874
13.1(43.00)	-.0(-.00)	-.0(-.00)	.0(.00)	-.0(-.00)	.638	.912	.944	.878
15.2(50.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.639	.913	.945	.878
16.8(55.00)	.0(.00)	.0(.00)	-.0(-.00)	.0(.00)	.639	.913	.945	.878
17.7(58.00)	.0(.00)	.0(.00)	-.0(-.00)	.0(.00)	.639	.912	.945	.879
18.3(60.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.639	.912	.946	.879
18.9(62.00)	.1(.00)	.1(.01)	.0(.00)	-.0(-.00)	.639	.913	.947	.880
19.5(64.00)	.1(.01)	.3(.02)	.1(.01)	-.0(-.00)	.640	.914	.948	.880
20.1(66.00)	.4(.04)	1.3(.11)	.4(.04)	-.1(-.01)	.641	.916	.948	.880
20.5(67.38)	-.4(-.04)	.0(.00)	-.4(-.04)	-1.6(-.14)	.642	.918	.949	.880
20.7(68.00)	-.6(-.05)	-.5(-.05)	-.6(-.05)	-1.6(-.14)	.642	.918	.948	.878
20.9(68.50)	-1.7(-.15)	-1.8(-.15)	-2.2(-.20)	-2.3(-.20)	.642	.918	.947	.877
21.0(69.00)	-.3(-.02)	-.3(-.03)	-.3(-.03)	-.3(-.03)	.642	.917	.947	.877
21.2(69.50)	-5.6(-.49)	-2.5(-.22)	-6.7(-.59)	-16.2(-1.42)	.645	.918	.946	.874
21.3(69.87)	-17.0(-1.50)	-8.2(-.72)	-8.3(-.73)	-4.7(-.42)	.646	.917	.944	.870

22608-19

POOR ORIGINAL

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22608
TIME = 420.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.01)	10.9(.96)	9.0(.79)	11.4(1.01)	.646	.765	.851	.866
.2(.50)	29.6(2.61)	33.9(2.99)	33.6(2.96)	32.8(2.89)	.655	.777	.863	.877
.3(1.00)	40.0(3.53)	52.4(4.62)	.4(.03)	50.7(4.47)	.676	.803	.873	.902
.5(1.50)	-10.5(-.93)	25.1(2.21)	-41.9(-3.70)	-30.1(-2.65)	.685	.827	.860	.908
.6(2.00)	222.4(19.60)	1.4(.12)	7.0(.61)	12.9(1.13)	.749	.835	.849	.901
.8(2.65)	1.8(.16)	1.9(.16)	88.3(7.78)	31.2(2.75)	.815	.834	.888	.915
1.2(4.00)	10.7(.94)	6.4(.56)	5.8(.51)	1.5(.13)	.816	.829	.920	.915
1.8(6.00)	-3.6(-.32)	-24.0(-2.12)	4.6(.41)	10.5(.92)	.804	.784	.907	.907
2.4(8.00)	-3.9(-.34)	-28.1(-2.47)	.8(.07)	6.4(.57)	.778	.765	.893	.908
3.0(10.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.760	.664	.883	.901
3.7(12.00)	2.9(.26)	19.8(1.74)	.9(.08)	-1.3(-.12)	.756	.682	.876	.891
4.6(15.00)	5.5(.48)	11.1(.98)	1.1(.10)	.0(.00)	.768	.726	.873	.884
6.1(20.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.779	.748	.870	.880
8.2(27.00)	2.7(.24)	4.2(.37)	.1(.01)	1.6(.14)	.791	.766	.870	.886
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.805	.789	.875	.898
13.1(43.00)	-.1(-.01)	-.1(-.01)	-.0(-.00)	-.1(-.01)	.808	.792	.880	.901
15.2(50.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.808	.792	.880	.901
16.8(55.00)	.0(.00)	.0(.00)	.0(.00)	.0(.00)	.807	.792	.879	.900
17.7(58.00)	.0(.00)	.0(.00)	.0(.00)	.0(.00)	.807	.792	.880	.900
18.3(60.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.807	.792	.881	.901
18.9(62.00)	.0(.00)	.1(.01)	.0(.00)	-.0(-.00)	.808	.792	.882	.902
19.5(64.00)	.0(.00)	.2(.02)	.0(.00)	-.2(-.01)	.809	.794	.883	.902
20.1(66.00)	.1(.01)	1.1(.09)	.1(.01)	-.7(-.06)	.811	.797	.884	.903
20.5(67.38)	-1.9(-.17)	-1.1(-.10)	-1.9(-.17)	-4.8(-.42)	.811	.799	.884	.901
20.7(68.00)	-6.2(-.55)	-5.7(-.50)	-6.2(-.55)	-7.5(-.66)	.810	.798	.883	.898
20.9(68.50)	-7.9(-.70)	-8.6(-.76)	-12.7(-1.12)	-6.4(-.57)	.808	.794	.879	.897
21.0(69.00)	2.5(.22)	2.0(.17)	.6(.05)	-2.3(-.20)	.811	.795	.879	.900
21.2(69.50)	-12.3(-1.09)	-2.6(-.23)	-14.5(-1.28)	-10.5(-.92)	.819	.799	.879	.900
21.3(69.87)	-4.6(-.41)	-4.0(-.36)	-3.6(-.32)	-2.7(-.24)	.824	.803	.876	.898

22608-20

POOR ORIGINAL

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22608
TIME = 720.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX PAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.1(.01)	5.5(.49)	3.8(.34)	3.3(.29)	.647	.766	.851	.865
.2(.50)	13.1(1.16)	15.0(1.32)	14.7(1.29)	14.5(1.28)	.651	.771	.856	.869
.3(1.00)	17.7(1.56)	19.8(1.74)	.2(.02)	22.0(1.94)	.660	.781	.860	.880
.5(1.50)	19.6(1.73)	16.8(1.48)	12.9(1.14)	26.8(2.36)	.672	.793	.864	.896
.6(2.00)	26.4(2.33)	20.6(1.82)	17.2(1.52)	21.2(1.87)	.686	.804	.873	.911
.8(2.65)	.5(.04)	27.4(2.41)	20.2(1.78)	16.3(1.44)	.693	.823	.888	.924
1.2(4.00)	13.7(1.21)	10.2(.90)	7.9(.70)	1.3(.11)	.708	.842	.902	.925
1.8(6.00)	5.2(.46)	6.6(.58)	4.1(.36)	11.2(.99)	.723	.847	.900	.922
2.4(8.00)	1.3(.11)	1.3(.12)	-.5(-.05)	6.8(.60)	.715	.839	.885	.924
3.0(10.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.699	.826	.868	.916
3.7(12.00)	-.6(-.06)	-.5(-.04)	.1(.01)	-1.4(-.12)	.688	.817	.858	.905
4.6(15.00)	2.0(.17)	.6(.05)	.1(.01)	-.3(-.03)	.688	.812	.852	.895
6.1(20.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.691	.808	.846	.889
8.2(27.00)	8.9(.78)	.2(.02)	2.0(.18)	5.3(.47)	.729	.806	.852	.910
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.765	.805	.861	.933
13.1(43.00)	-.6(-.06)	-.4(-.04)	-.2(-.02)	-.5(-.04)	.762	.804	.861	.931
15.2(50.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.762	.804	.862	.931
16.8(55.00)	.0(.00)	.0(.00)	.0(.00)	.0(.00)	.764	.807	.864	.933
17.7(58.00)	.0(.00)	.0(.00)	.0(.00)	.0(.00)	.765	.807	.866	.934
18.3(60.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.765	.808	.867	.935
18.9(62.00)	-.0(-.00)	.0(.00)	-.0(-.00)	-.1(-.01)	.767	.809	.869	.937
19.5(64.00)	-.0(-.00)	.1(.01)	-.0(-.00)	-.3(-.02)	.769	.812	.873	.939
20.1(66.00)	-.0(-.00)	.7(.06)	-.0(-.00)	-1.1(-.10)	.773	.817	.877	.942
20.5(67.38)	-3.1(-.27)	-2.3(-.21)	-3.1(-.27)	-6.5(-.57)	.774	.820	.879	.941
20.7(68.00)	-8.1(-.72)	-7.9(-.69)	-8.1(-.72)	-8.7(-.77)	.773	.819	.878	.939
20.9(68.50)	-8.3(-.74)	-9.2(-.81)	-11.3(-1.00)	-7.5(-.66)	.773	.817	.875	.939
21.0(69.00)	2.4(.21)	1.8(.16)	.6(.06)	-1.6(-.14)	.778	.818	.876	.944
21.2(69.50)	-7.7(-.68)	-9.6(-.85)	-7.4(-.66)	-5.9(-.52)	.786	.821	.878	.946
21.3(69.87)	-1.7(-.15)	-2.3(-.20)	-2.2(-.19)	-2.1(-.19)	.789	.822	.877	.945

22608-21

POOR ORIGINAL

SUMMARY SHEET

RUN NO. 22701

DATE: 4/4/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.179 (0.395)
2. Water flow - [kg/sec (lb/sec)] - 0.045 (0.100)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{o}C (^{o}F)] - 155 (311)
5. Water temperature [^{o}C (^{o}F)] - 122 (251)
6. Mixer pressure [kPa (psig)] - 193 (28)
7. Test time (sec) - 1439.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.1 (33.1)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	262 (504)
0.15 (0.50)	271 (520)
0.30 (1.00)	274 (526)
0.46 (1.50)	273 (523)
0.61 (2.00)	273 (524)
1.22 (4.00)	-
3.05 (10.00)	274 (525)
6.09 (20.00)	273 (524)
8.23 (27.00)	-
10.67 (35.00)	273 (524)

SUMMARY SHEET (cont)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 3.19 (7.04)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 4.48 (9.87)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 1.29 (2.85)

D. FAILED BUNDLE T/Cs[1]

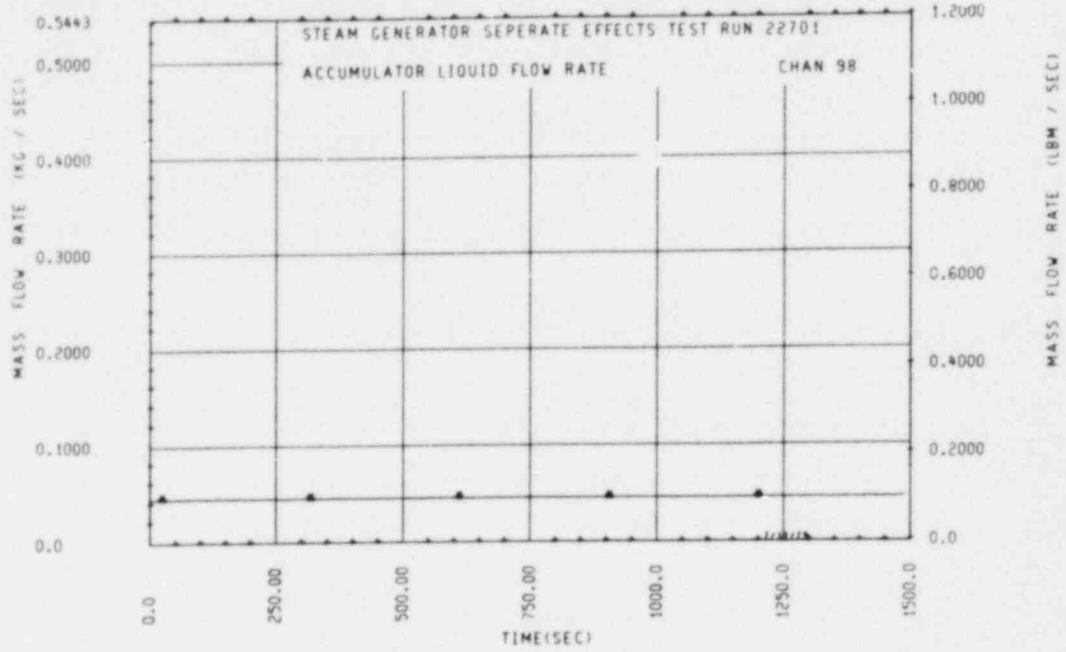
294, 295, 298, 305, 309, 310, 311, 321, 326, 532, 549, 553, 555, 564, 565, 568, 569

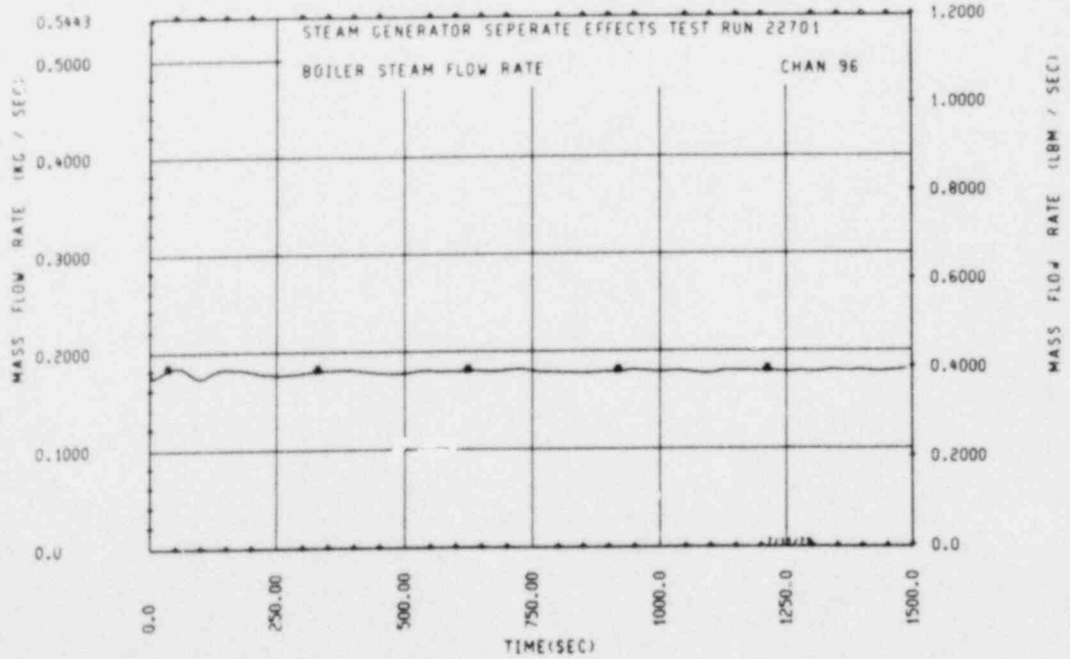
E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

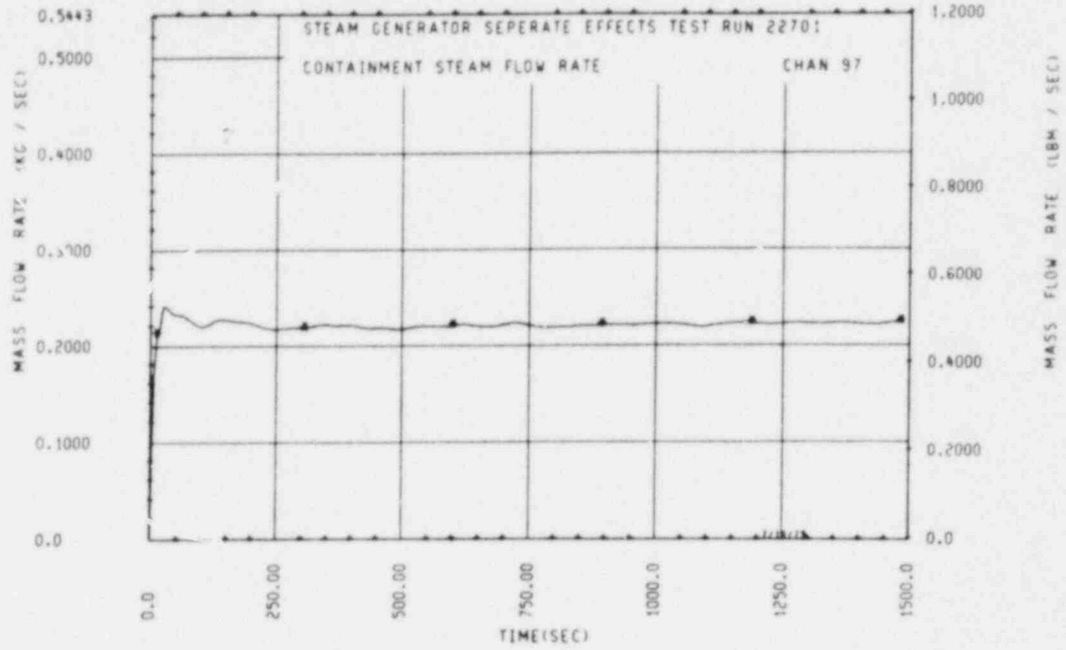
1. From primary side energy balance [kwsec(Btu)] - 13×10^5 (1.08×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da\,dt$) - [kwsec(Btu)] - 0.960×10^5 (0.914×10^5)
3. Integration to 900 sec

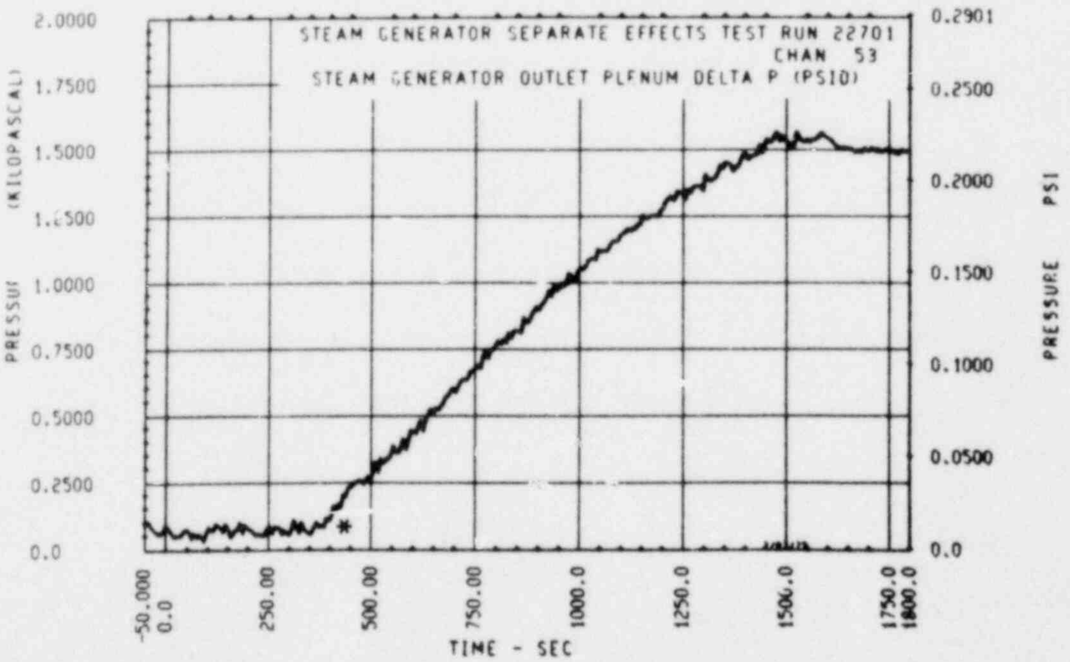
---

1. T/Cs are defined as failed based on resistance reading or T/C response.

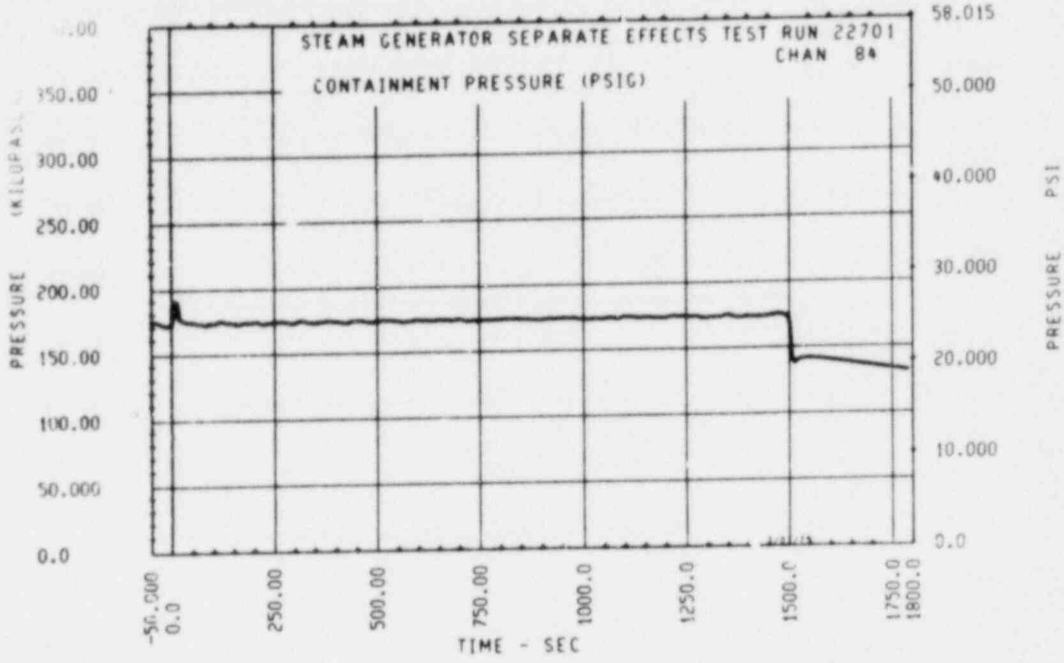

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22701
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

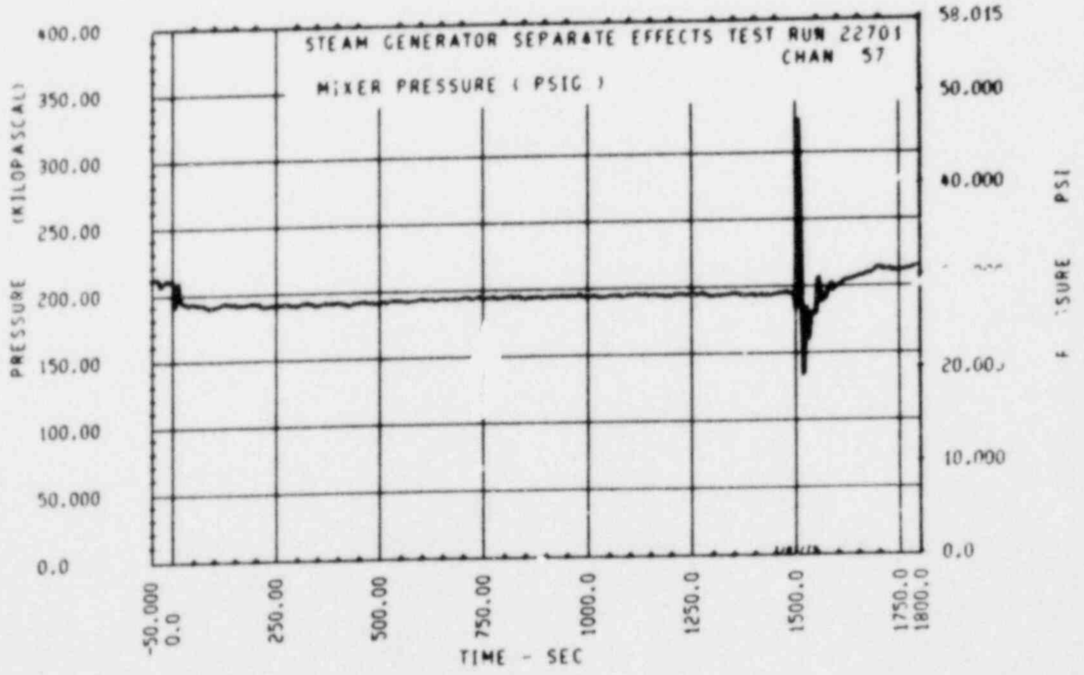

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22701
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

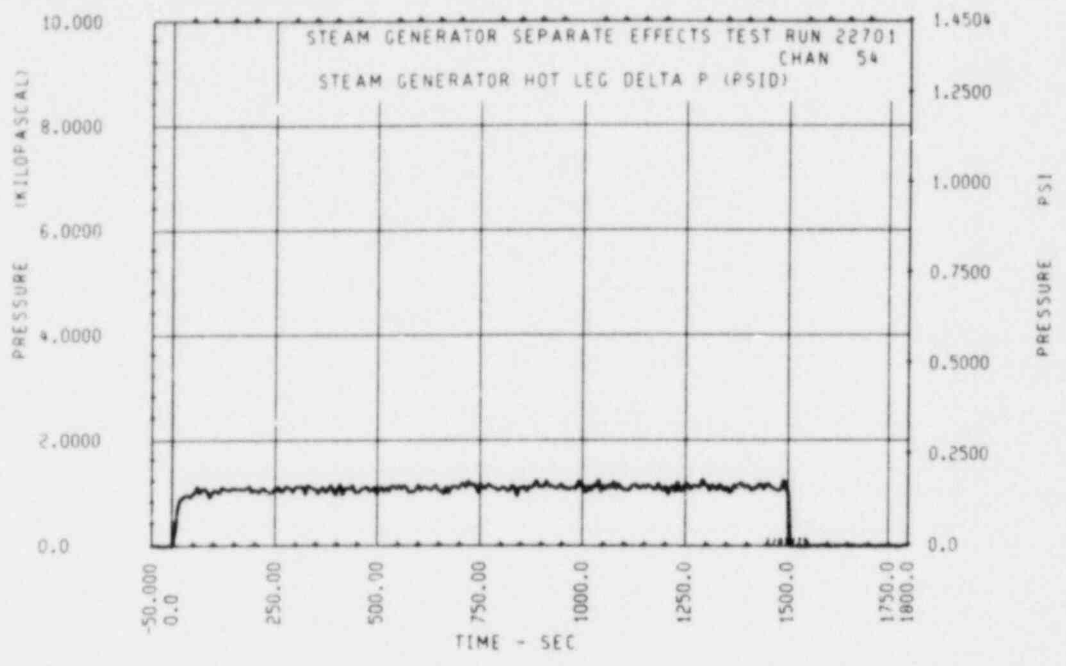




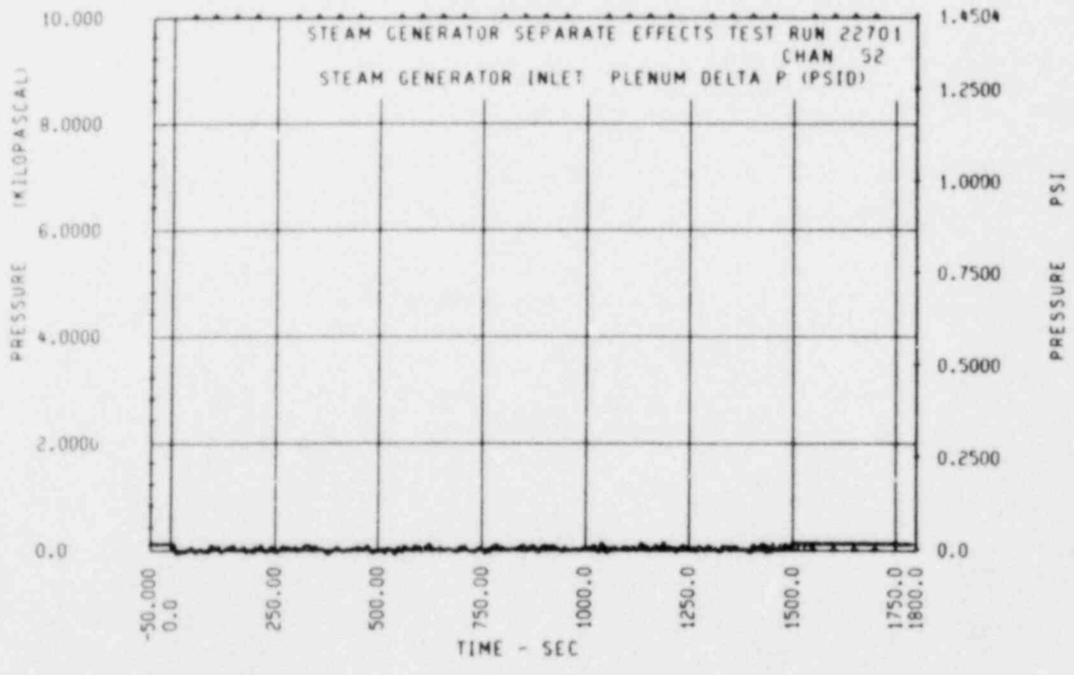
* Refer to Appendix H text for explanation of delayed response.


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22701
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

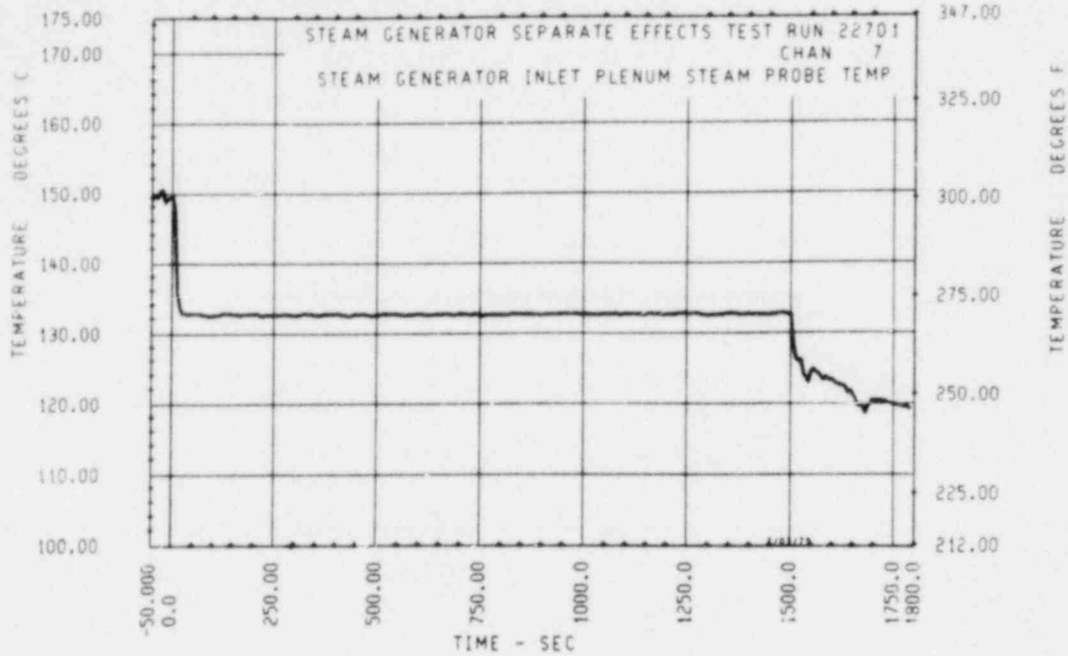

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22701
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
TIME - SEC

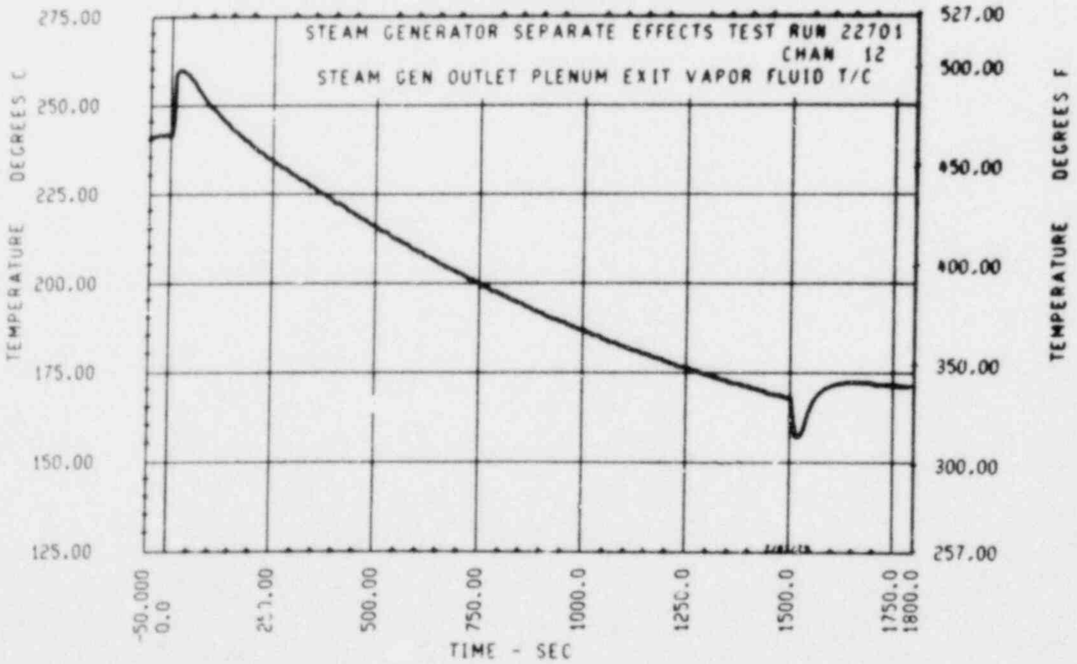


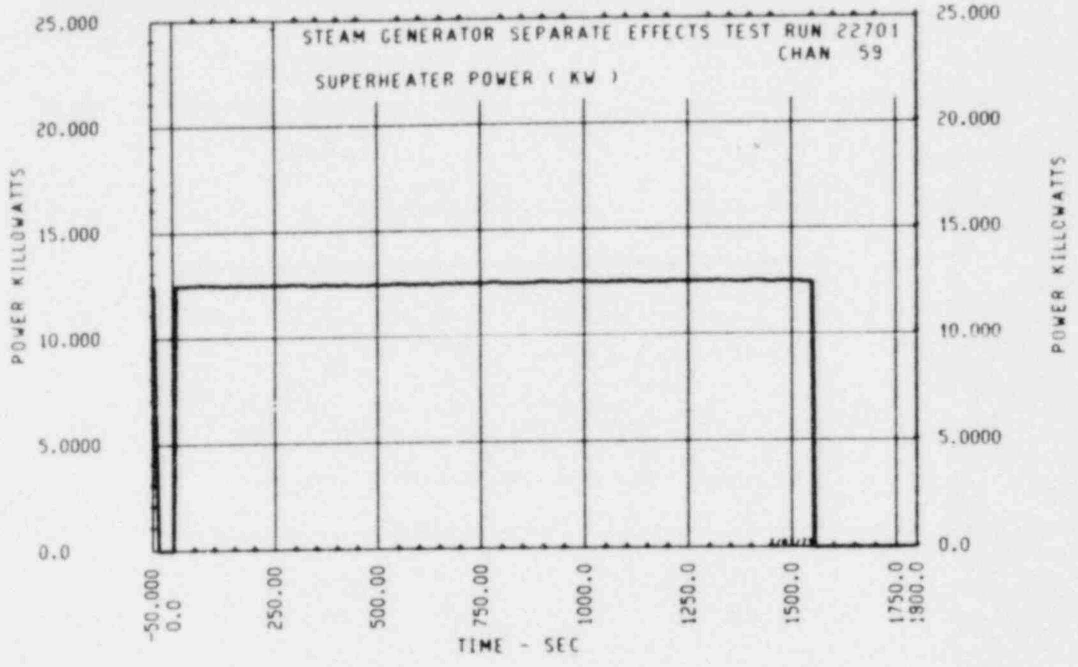
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22701
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

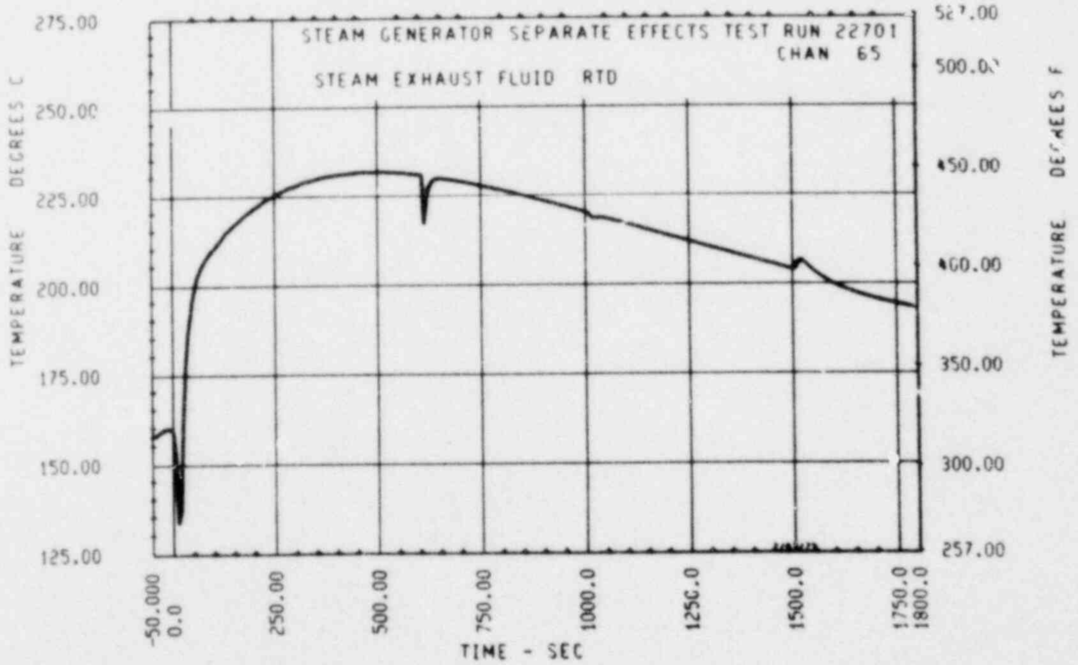


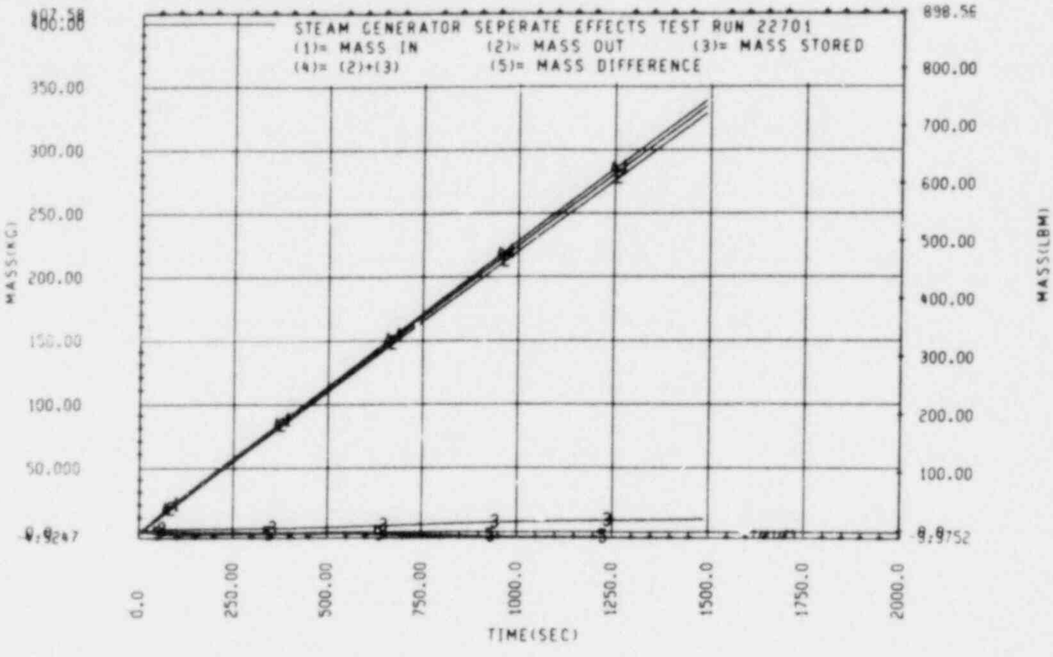
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22701
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

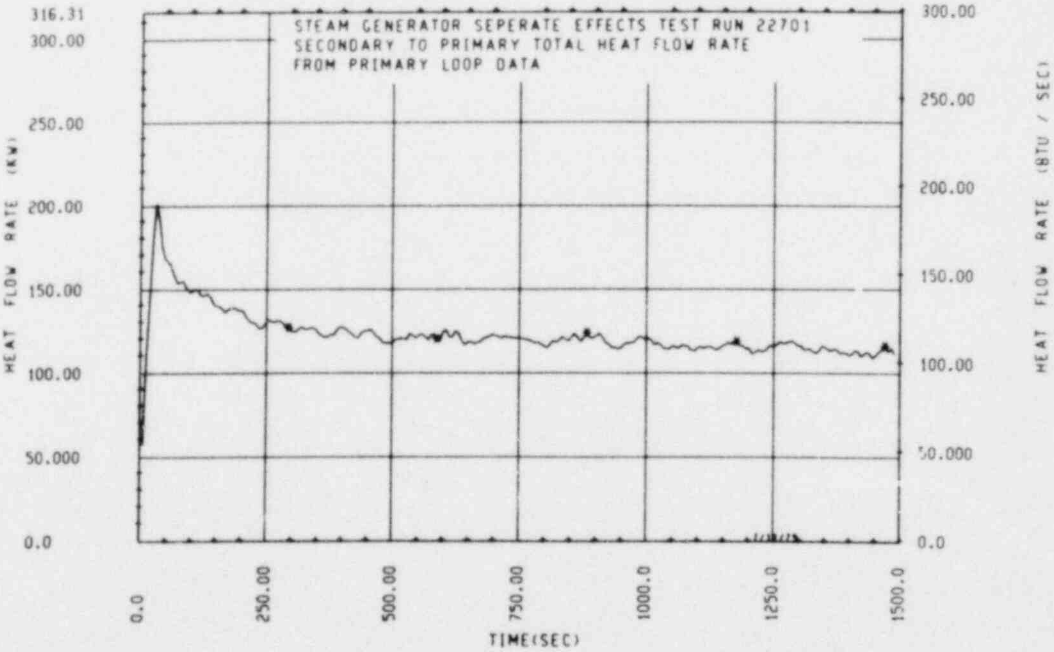

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22701
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
175.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
347.00
325.00
300.00
275.00
250.00
225.00
212.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

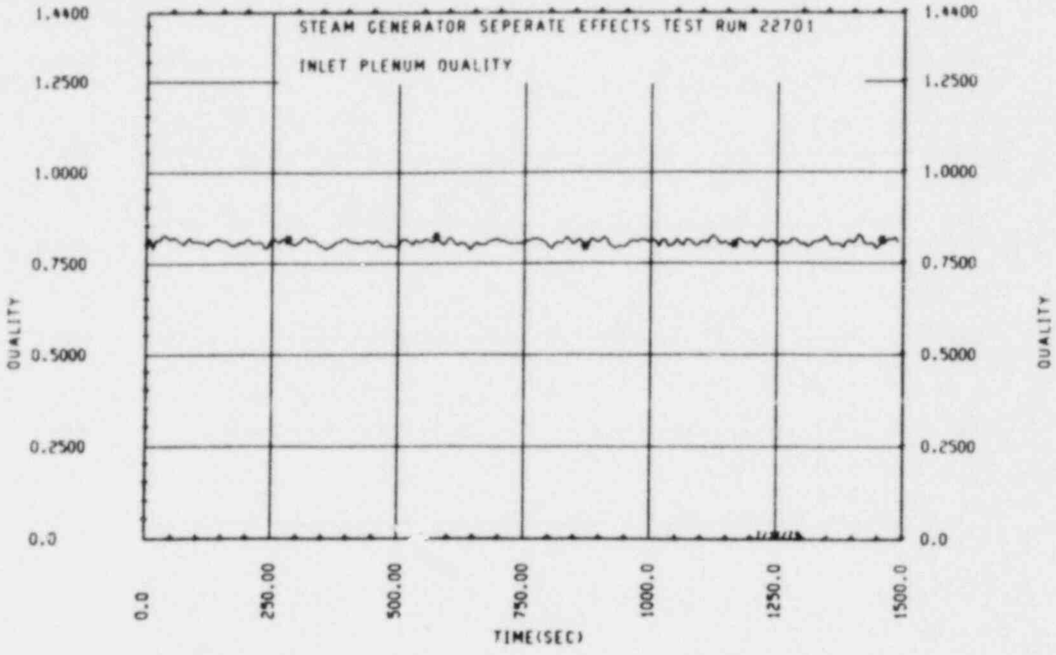

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22701
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

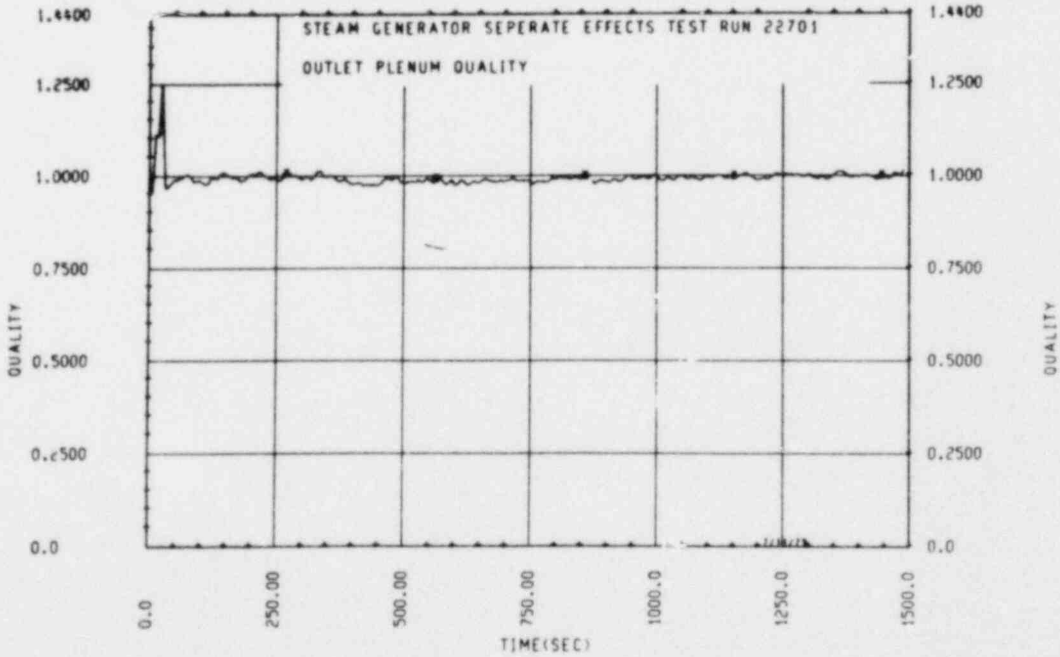

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22701
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1900.0
TIME - SEC

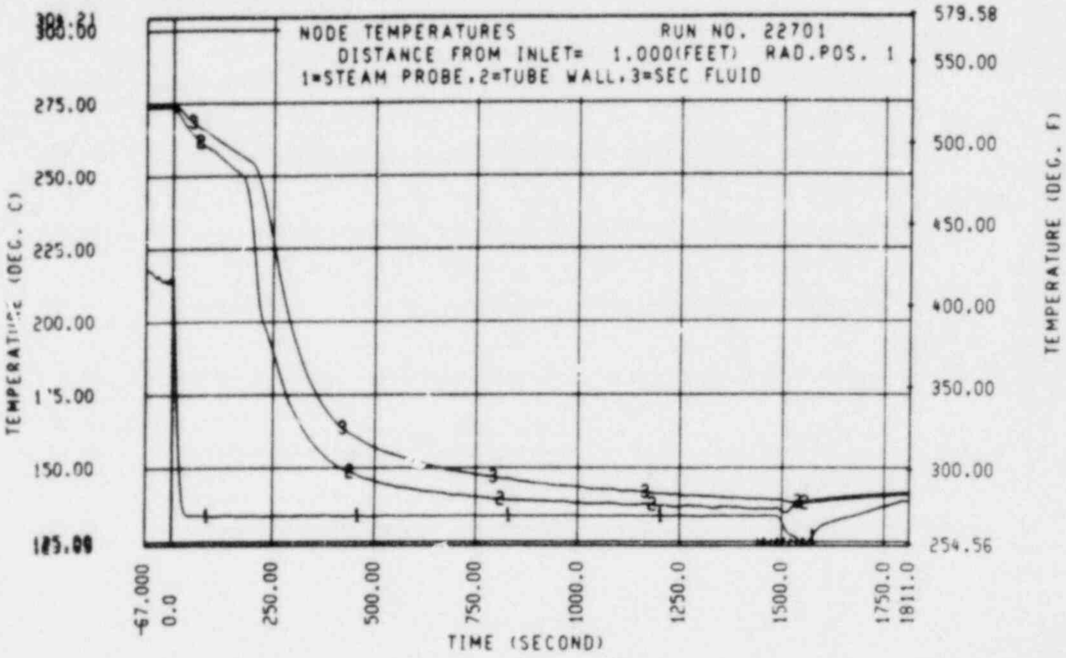

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22701
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
275.00
250.00
225.00
200.00
175.00
150.00
125.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1500.0
1750.0
1800.0
TIME - SEC

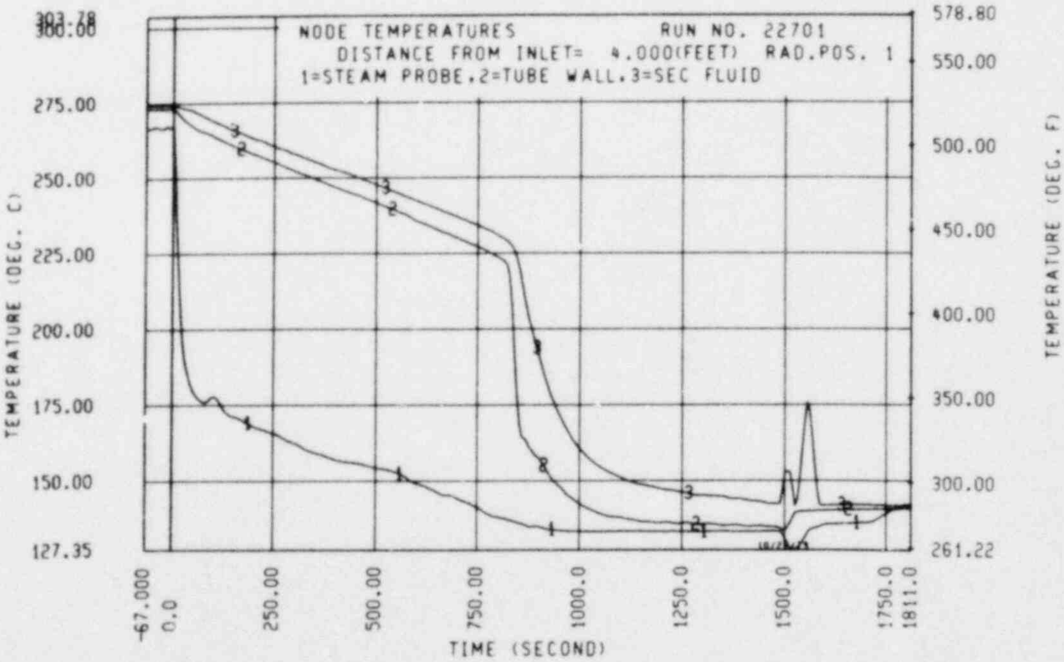

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22701
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22701
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)

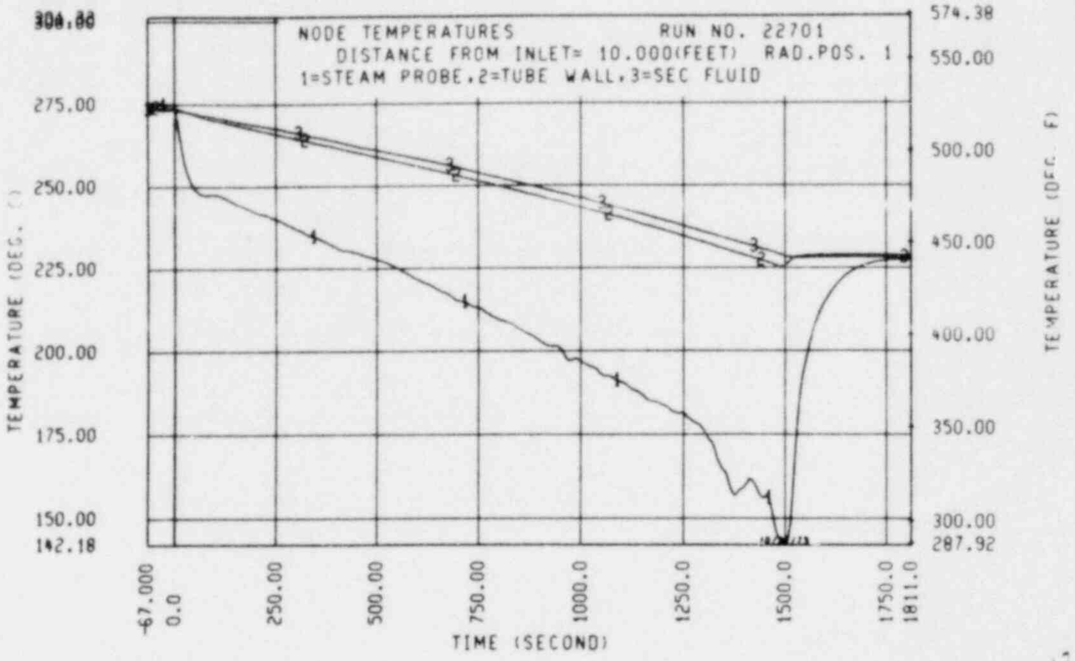

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22701
INLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

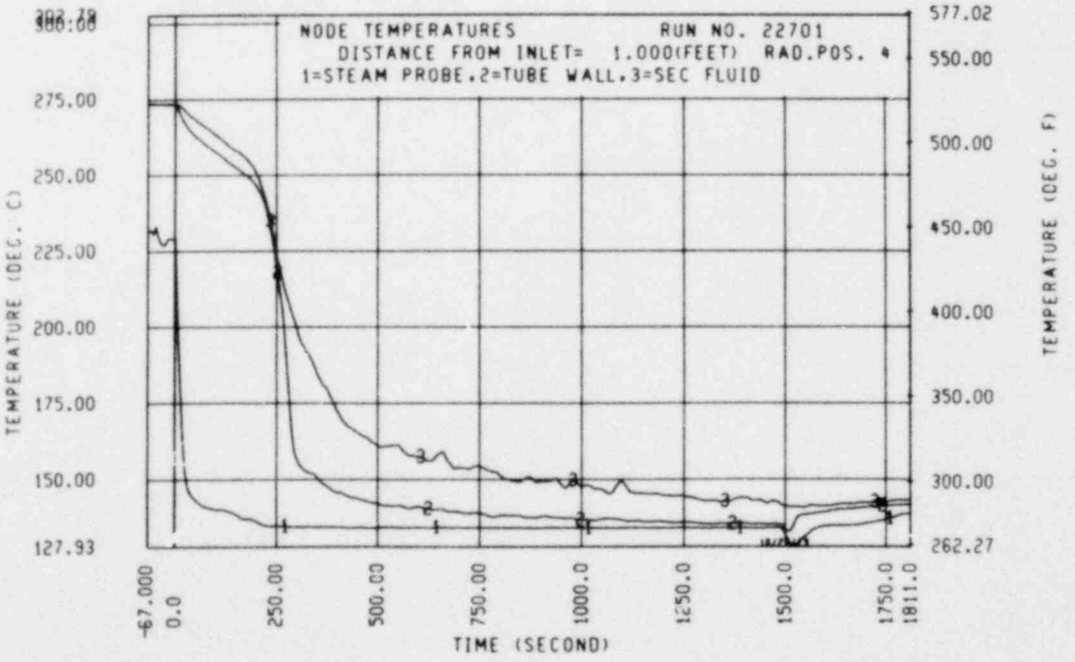

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22701
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

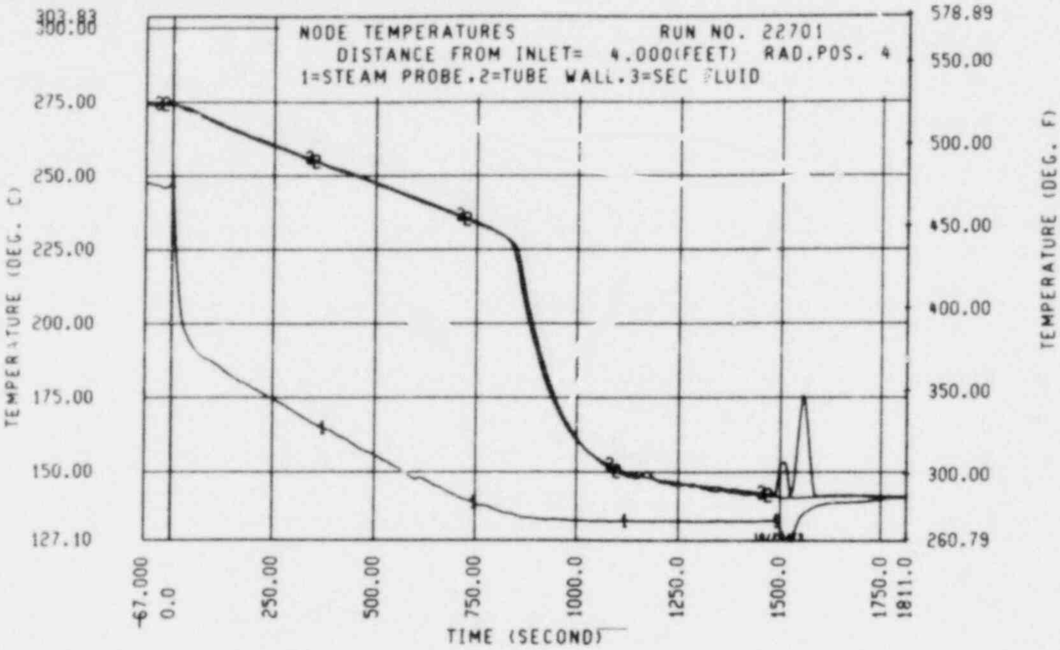

NODE TEMPERATURES RUN NO. 22701
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

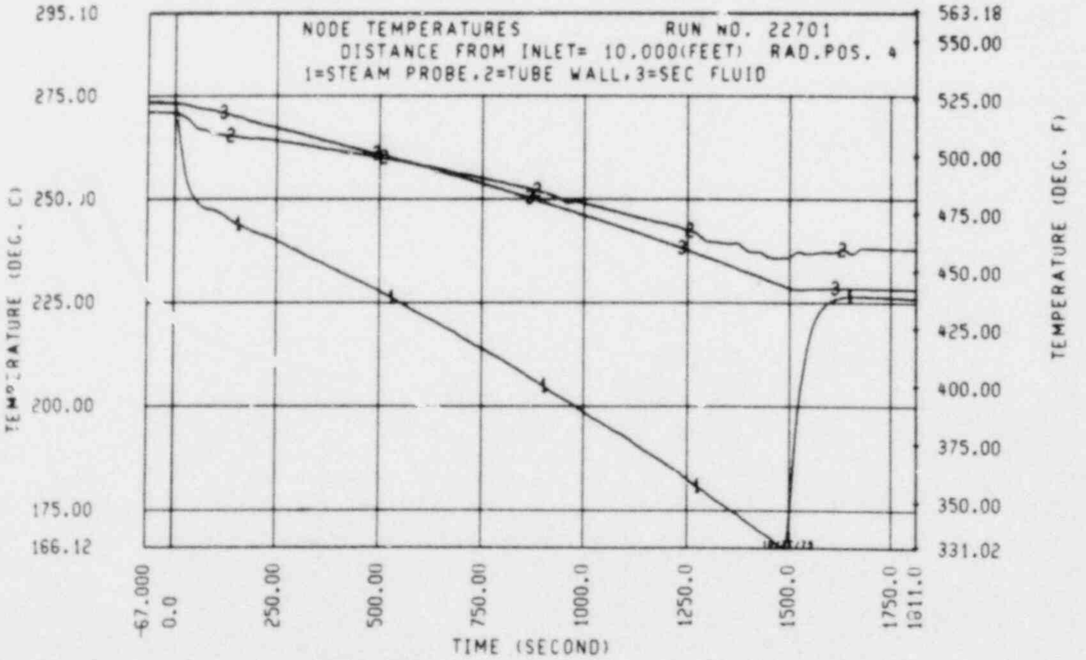

NODE TEMPERATURES RUN NO. 22701
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

22701-11

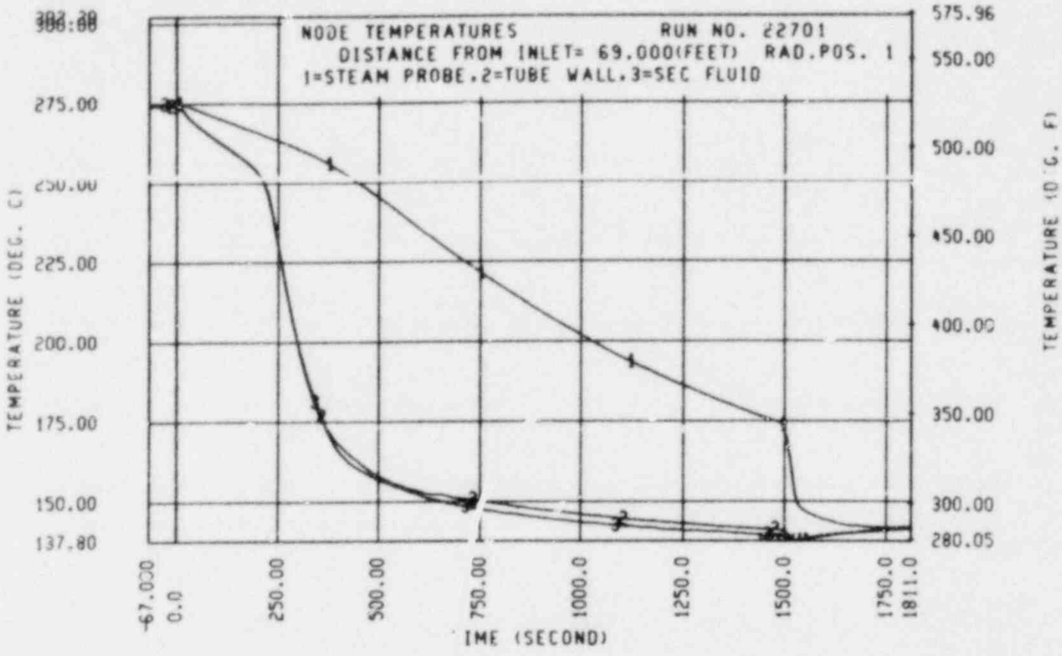

NODE TEMPERATURES RUN NO. 22701
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22701
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

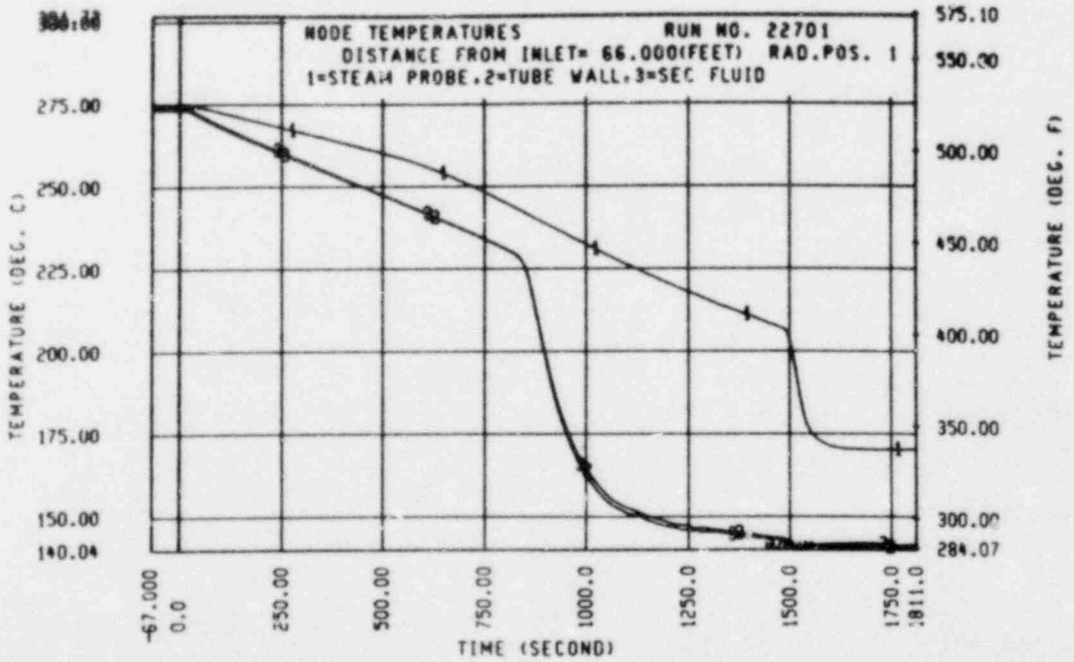

NODE TEMPERATURES RUN NO. 22701
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22701
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

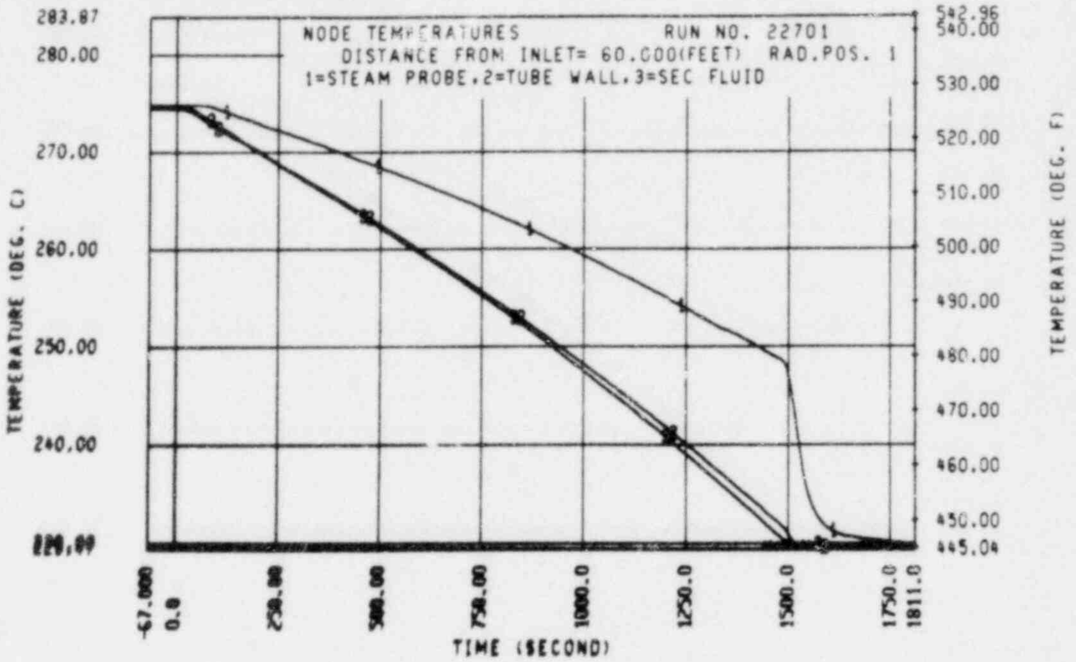
22701-13

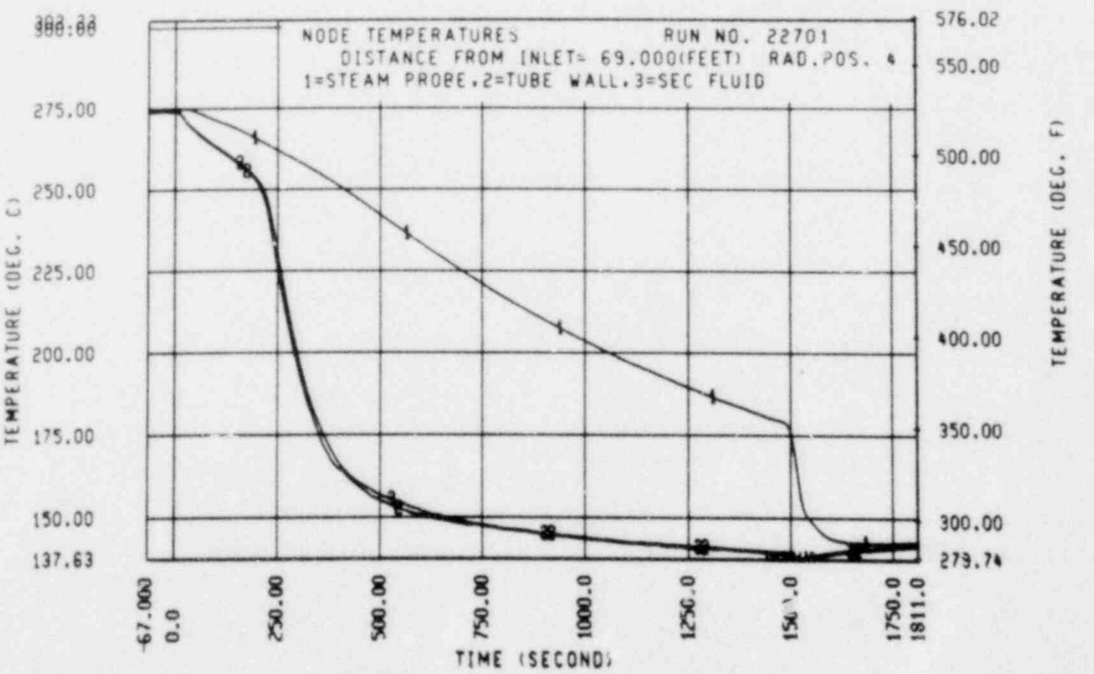


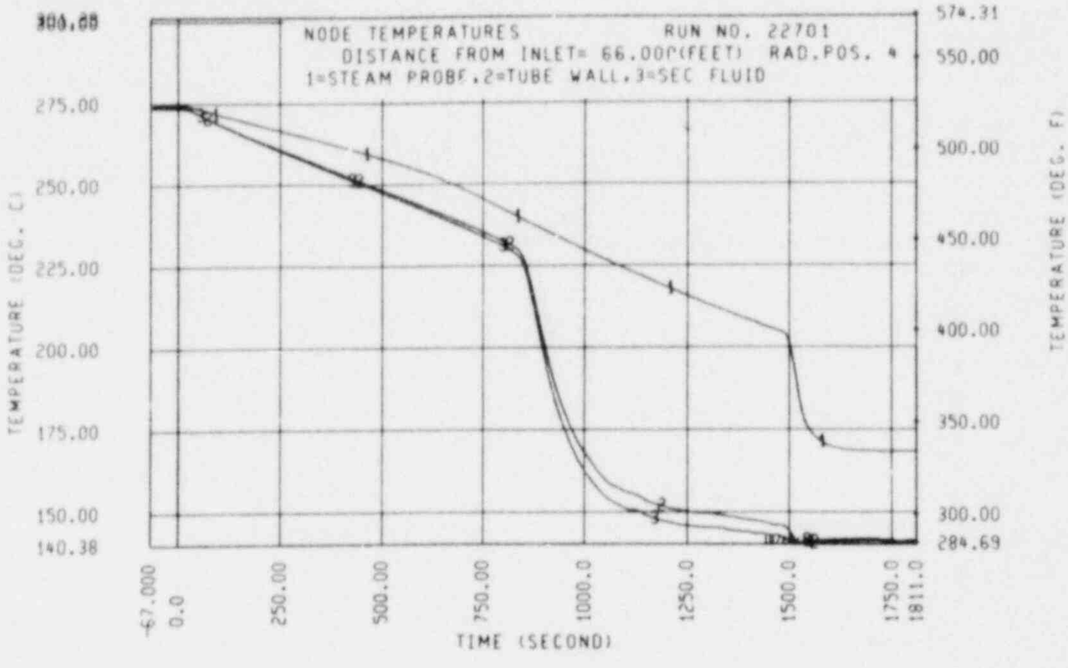
NODE TEMPERATURES RUN NO. 22701
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
137.80
TEMPERATURE (DEG. F)
575.96
550.00
500.00
450.00
400.00
350.00
300.00
280.05
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1811.0
TIME (SECOND)



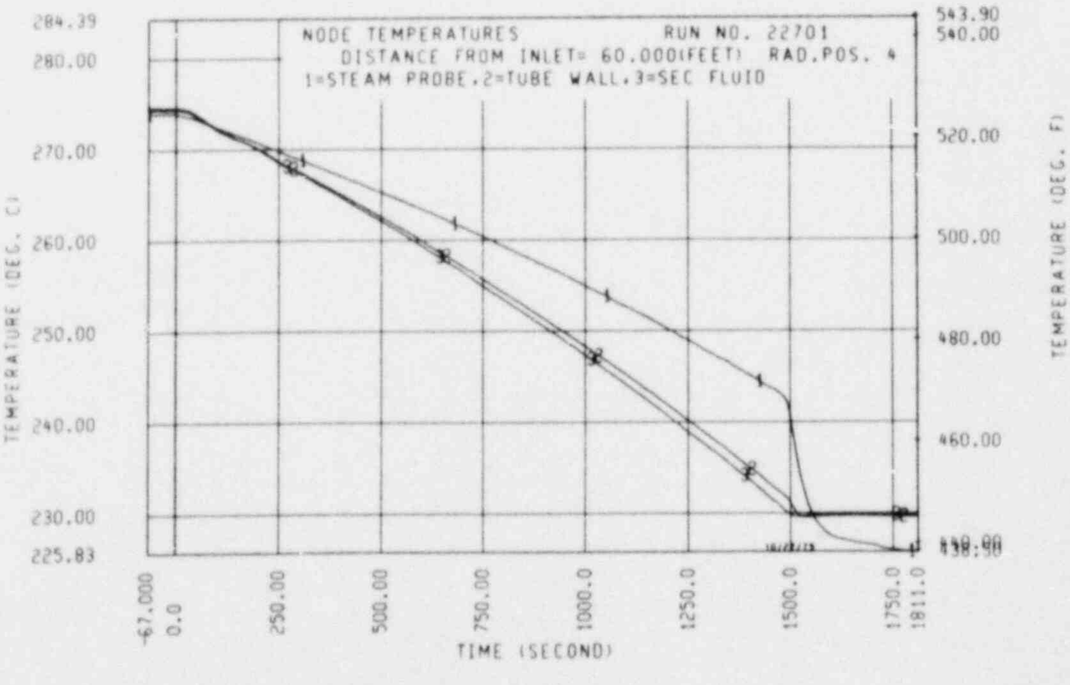
NODE TEMPERATURES RUN NO. 22701
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
140.04
TEMPERATURE (DEG. F)
575.10
550.00
500.00
450.00
400.00
350.00
300.00
284.07
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1811.0
TIME (SECOND)


NODE TEMPERATURES RUN NO. 22701
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

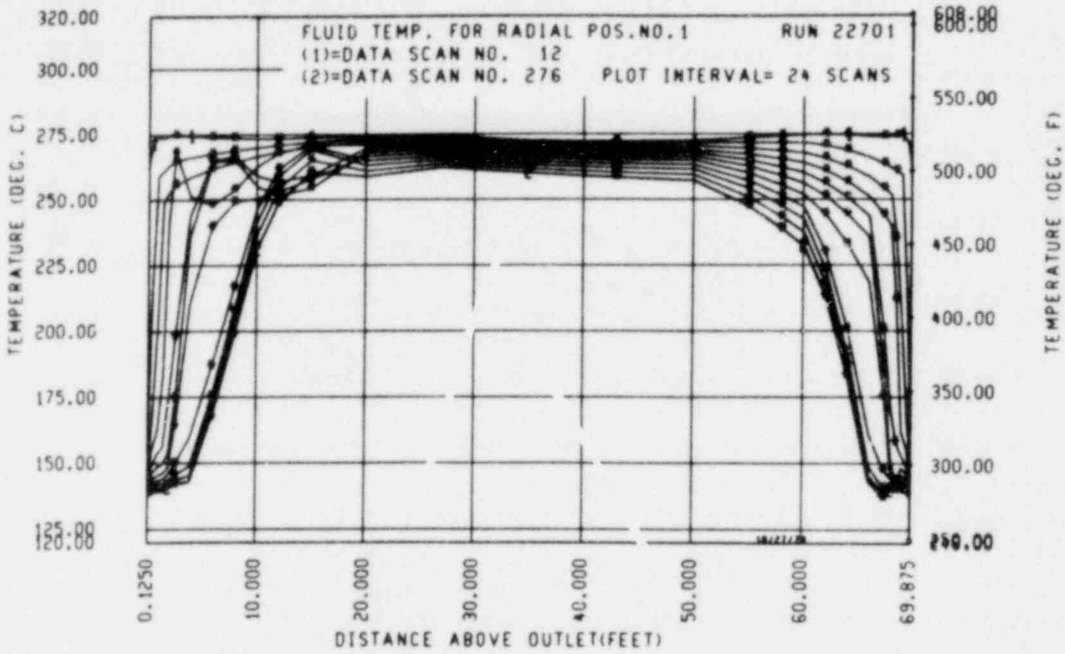

NODE TEMPERATURES RUN NO. 22701
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

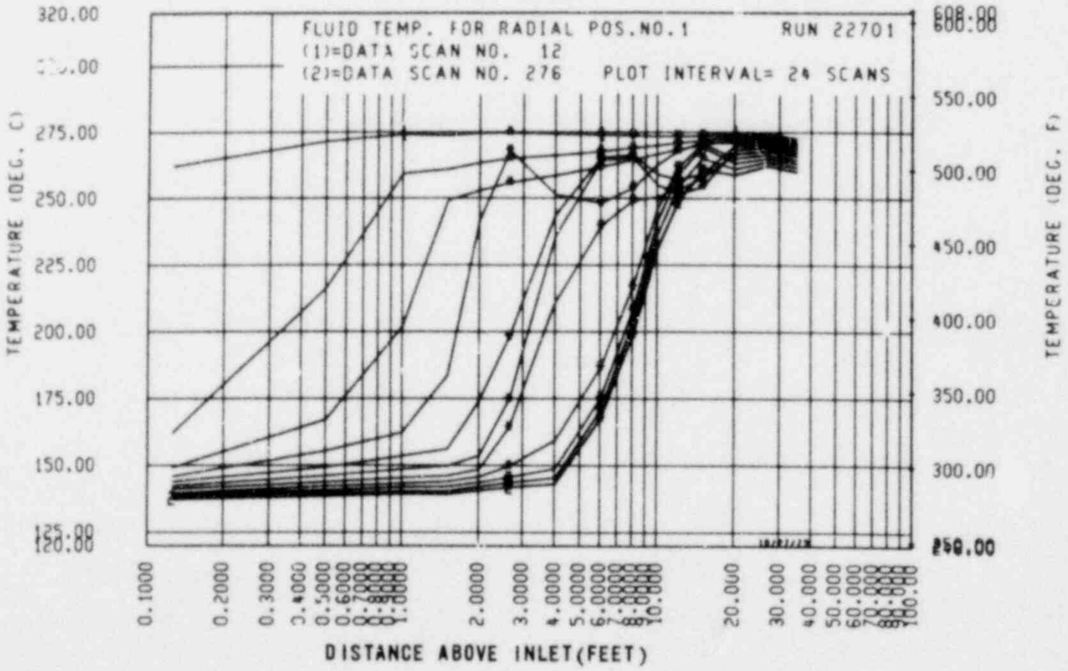


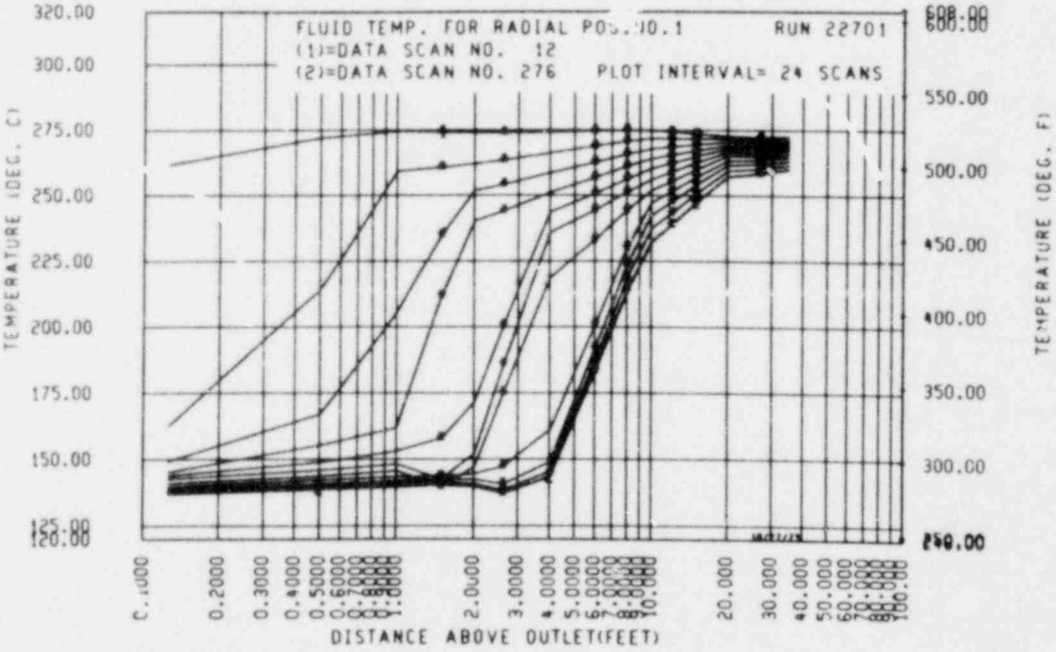
NODE TEMPERATURES RUN NO. 22701
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
140.38
574.31
550.00
500.00
450.00
400.00
350.00
300.00
284.69
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1811.0



NODE TEMPERATURES RUN NO. 22701
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
284.39
280.00
270.00
260.00
250.00
240.00
230.00
225.83
543.90
540.00
520.00
500.00
480.00
460.00
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1811.0


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22701
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22701
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)


FLUID TEMP. FOR RADIAL POS. NO.1
RUN 22701
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

22701-19

RUN 22701
TIME = 120.0 SECONDS

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.5(.04)	34.8(3.06)	56.1(4.95)	30.6(2.69)	.646	.769	.859	.868
.2(.50)	1.4(.12)	282.0(24.84)	290.8(25.63)	13.3(1.17)	.647	.863	.958	.876
.3(1.00)	22.6(1.99)	32.2(2.83)	5.1(.45)	16.1(1.42)	.653	.959	1.050	.881
.5(1.50)	-.5(-.05)	-2.6(-.23)	1.7(.15)	12.5(1.10)	.657	.965	1.050	.883
.6(2.00)	1.7(.15)	18.8(1.65)	7.8(.69)	11.2(.99)	.655	.967	1.051	.885
.8(2.65)	1.7(.15)	54.5(4.80)	20.9(1.84)	10.1(.89)	.650	.996	1.060	.885
1.2(4.00)	9.0(.79)	6.2(.55)	5.2(.46)	1.6(.14)	.648	1.011	1.056	.875
1.8(6.00)	3.3(.29)	3.4(.30)	3.2(.28)	10.0(.88)	.644	.986	1.027	.869
2.4(8.00)	1.4(.12)	.8(.07)	.3(.03)	5.1(.45)	.636	.965	1.004	.871
3.0(10.00)	1.1(.10)	1.1(.10)	2.2(.20)	1.7(.15)	.631	.959	.998	.867
3.7(12.00)	1.1(.09)	1.5(.13)	2.5(.22)	-.9(-.08)	.629	.956	.997	.861
4.6(15.00)	2.9(.25)	2.0(.17)	1.8(.16)	.4(.03)	.633	.955	.995	.855
6.1(20.00)	1.4(.13)	1.3(.12)	.4(.04)	.8(.07)	.641	.957	.993	.854
8.2(27.00)	0.0(0.00)	-.1(-.00)	-.1(-.01)	.6(.05)	.644	.958	.991	.858
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.644	.958	.992	.861
13.1(43.00)	-1.6(-.14)	-.8(-.07)	-.1(-.01)	-.5(-.05)	.638	.955	.992	.860
15.2(50.00)	-.4(-.03)	-.5(-.05)	-.4(-.03)	-.2(-.02)	.630	.951	.991	.857
16.8(55.00)	-.0(-.00)	-.3(-.03)	-.2(-.02)	-.1(-.01)	.629	.948	.989	.856
17.7(58.00)	.1(.01)	-.2(-.01)	-.0(-.00)	.0(.00)	.629	.948	.990	.856
18.3(60.00)	.3(.03)	-.1(-.01)	.0(.00)	.0(.00)	.630	.947	.991	.857
18.9(62.00)	.8(.07)	.1(.00)	.1(.01)	.0(.00)	.631	.948	.992	.857
19.5(64.00)	.2(.02)	.3(.02)	.1(.01)	.0(.00)	.633	.949	.993	.858
20.1(66.00)	.4(.03)	1.3(.11)	.4(.03)	-.1(-.01)	.634	.952	.994	.858
20.5(67.38)	-.1(-.01)	.2(.02)	-.1(-.01)	-1.0(-.09)	.635	.954	.994	.858
20.7(68.00)	.2(.02)	.1(.01)	.2(.02)	-.4(-.04)	.636	.954	.994	.858
20.9(68.50)	-.8(-.07)	-.8(-.07)	-1.2(-.11)	-1.1(-.10)	.636	.954	.994	.857
21.0(69.00)	-.2(-.02)	-.3(-.03)	-.3(-.02)	-.3(-.02)	.637	.954	.994	.857
21.2(69.50)	-1.4(-.12)	.0(.00)	-2.1(-.18)	-8.1(-.72)	.640	.955	.994	.856
21.3(69.87)	-16.9(-1.49)	-12.8(-1.13)	-8.9(-.79)	-4.9(-.43)	.641	.954	.993	.854

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22701

TIME = 480.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.01)	9.4(.83)	10.7(.94)	12.2(1.09)	.646	.765	.852	.866
.2(.50)	27.9(2.45)	30.3(2.67)	30.9(2.72)	29.6(2.60)	.654	.776	.863	.876
.3(1.00)	36.4(3.21)	42.7(3.76)	.3(.03)	56.6(4.99)	.674	.798	.872	.902
.5(1.50)	-13.9(-1.22)	13.5(1.19)	-49.2(-4.33)	-41.4(-3.65)	.681	.816	.857	.907
.6(2.00)	175.1(15.43)	1.2(.11)	23.4(2.06)	7.7(.69)	.731	.820	.849	.896
.8(2.65)	1.6(.14)	1.6(.14)	178.7(15.75)	24.7(2.19)	.782	.819	.936	.905
1.2(4.00)	10.9(.96)	8.3(.73)	6.1(.54)	1.4(.13)	.784	.817	1.011	.904
1.8(6.00)	-1.7(-.15)	-17.4(-1.53)	3.8(.33)	10.8(.95)	.776	.784	.994	.896
2.4(8.00)	-1.4(-.12)	-18.5(-1.63)	1.0(.09)	6.7(.59)	.755	.724	.975	.896
3.0(10.00)	3.3(.29)	3.3(.29)	4.8(.42)	2.8(.25)	.743	.697	.966	.892
3.7(12.00)	18.0(1.59)	43.1(3.80)	7.7(.68)	.9(.09)	.759	.743	.971	.886
4.6(15.00)	9.5(.83)	14.5(1.28)	6.5(.58)	2.4(.22)	.795	.817	.986	.885
6.1(20.00)	2.1(.18)	2.0(.18)	1.0(.09)	1.1(.10)	.818	.848	.995	.887
8.2(27.00)	.3(.02)	.6(.05)	-.1(-.01)	.7(.06)	.822	.852	.993	.889
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.821	.853	.993	.892
13.1(43.00)	-1.7(-.15)	-.9(-.08)	-.1(-.01)	-.6(-.05)	.814	.850	.995	.891
15.2(50.00)	-.5(-.04)	-.7(-.06)	-.5(-.04)	-.3(-.03)	.806	.844	.993	.888
16.8(55.00)	-.2(-.02)	-.5(-.04)	-.4(-.04)	-.2(-.02)	.804	.842	.991	.887
17.7(58.00)	-.2(-.01)	-.3(-.02)	-.3(-.03)	-.2(-.02)	.805	.841	.991	.888
18.3(60.00)	-.3(-.02)	-.3(-.02)	-.3(-.02)	-.3(-.02)	.805	.841	.993	.889
18.9(62.00)	-.2(-.01)	.0(.00)	-.1(-.01)	-.3(-.02)	.806	.842	.994	.890
19.5(64.00)	-.0(-.00)	.2(.02)	.0(.00)	-.3(-.03)	.808	.845	.997	.891
20.1(66.00)	.1(.01)	1.2([illegible])	.1(.01)	-.8(-.07)	.810	.849	.999	.892
20.5(67.38)	-4.1(-.35)	-3.4(-.30)	-4.1(-.37)	-9.3(-.82)	.811	.851	1.000	.889
20.7(68.00)	-20.0(-1.75)	-19.1(-1.68)	-20.0(-1.76)	-19.5(-1.72)	.805	.846	.994	.881
20.9(68.50)	-15.9(-1.40)	-18.7(-1.65)	-24.1(-2.13)	-13.6(-1.20)	.798	.837	.984	.875
21.0(69.00)	2.5(.22)	2.1(.18)	1.0(.09)	4.9(.43)	.799	.834	.981	.878
21.2(69.50)	-13.1(-1.15)	-2.6(-.23)	-16.2(-1.43)	-12.7(-1.12)	.807	.840	.981	.879
21.3(69.87)	-4.3(-.38)	-6.1(-.53)	-3.9(-.34)	-3.1(-.27)	.811	.843	.979	.877

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22701

TIME = 720.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1		2		3		4		LOCAL QUALITY 1	2	3	4
.0(.13)	.1(	.01)	5.1(	.45)	3.9(	.34)	3.4(	.30)	.649	.767	.852	.866
.2(.50)	15.1(	1.33)	17.4(	1.54)	16.3(	1.44)	15.8(	1.40)	.654	.773	.858	.871
.3(1.00)	19.6(	1.73)	20.6(	1.81)	.2(	.02)	32.9(	2.90)	.664	.784	.862	.885
.5(1.50)	21.6(	1.90)	18.3(	1.61)	16.4(	1.44)	27.6(	2.43)	.677	.796	.867	.904
.6(2.00)	30.2(	2.66)	23.7(	2.08)	22.8(	2.01)	25.6(	[illegible]	.692	.809	.879	.921
.8(2.65)	.5(	.05)	30.7(	2.71)	25.7(	2.26)	20.6(	[illegible]	.700	.830	.898	.937
1.2(4.00)	13.1(	1.15)	10.1(	.89)	7.4(	.66)	1.3(	.12)	.711	.849	.912	.938
1.8(6.00)	5.6(	.49)	7.9(	.69)	5.1(	.45)	11.4(	1.01)	.723	.852	.909	.934
2.4(8.00)	3.2(	.28)	4.3(	.38)	2.8(	.25)	6.9(	.60)	.717	.847	.895	.934
3.0(10.00)	5.1(	.45)	5.1(	.45)	5.6(	.49)	4.4(	.38)	.710	.843	.888	.929
3.7(12.00)	7.2(	.63)	5.3(	.47)	5.3(	.47)	2.0(	.17)	.712	.845	.887	.923
4.6(15.00)	5.6(	.49)	3.4(	.30)	3.9(	.35)	3.2(	[illegible]	.726	.848	.890	.921
6.1(20.00)	2.4(	.21)	2.5(	.22)	1.5(	.13)	1.3(	.12)	.740	.854	.892	.921
8.2(27.00)	.5(	.05)	.7(	.06)	-.1(	-.01)	.7(	.06)	.745	.858	.891	.923
10.7(35.00)	0.0(	0.00)	0.0(	0.00)	0.0(	0.00)	0.0(	0.00)	.744	.859	.890	.925
13.1(43.00)	-1.7(	-.15)	-.8(	-.07)	-.1(	-.01)	-.6(	-.05)	.736	.855	.891	.925
15.2(50.00)	-.4(	-.04)	-.6(	-.05)	-.4(	-.04)	-.3(	-.03)	.728	.851	.890	.922
16.8(55.00)	-.2(	-.02)	-.4(	-.04)	-.5(	-.04)	-.3(	-.03)	.728	.849	.888	.921
17.7(58.00)	-.2(	-.02)	-.3(	-.03)	-.4(	-.04)	-.3(	-.03)	.728	.849	.889	.922
18.3(60.00)	-.4(	-.03)	-.5(	-.05)	-.5(	-.04)	-.5(	-.04)	.729	.849	.890	.924
18.9(62.00)	-.4(	-.04)	-.0(	-.00)	-.2(	-.02)	-.6(	-.05)	.730	.851	.893	.926
19.5(64.00)	-.1(	-.01)	.1(	.01)	-.1(	-.01)	-.7(	-.06)	.733	.855	.897	.928
20.1(66.00)	-.0(	-.00)	1.0(	.09)	-.0(	-.00)	-1.6(	-.14)	.737	.862	.903	.930
20.5(67.38)	-2.9(	-.26)	-2.1(	-.19)	-2.9(	-.26)	-6.2(	-.55)	.739	.867	.906	.929
20.7(68.00)	-7.6(	-.67)	-7.8(	-.69)	-7.6(	-.67)	-7.7(	-.68)	.738	.866	.905	.927
20.9(68.50)	-8.1(	-.72)	-9.5(	-.83)	-11.4(	-1.01)	-6.5(	-.57)	.738	.864	.903	.928
21.0(69.00)	2.3(	.21)	1.8(	.16)	.3(	.02)	-1.8(	-.16)	.743	.865	.904	.933
21.2(69.50)	-9.1(	-.80)	-12.0(	-1.06)	-8.9(	-.78)	-7.1(	-.63)	.750	.868	.905	.935
21.3(69.87)	-1.7(	-.15)	-3.3(	-.29)	-2.6(	-.23)	-3.4(	-.30)	.754	.869	.904	.933

22701-21

SUMMARY SHEET

RUN NO. 22920

DATE: 4/6/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.225 (0.495)
2. Water flow - [kg/sec (lb/sec)] - -0.0005 (-0.001)
3. Containment tank pressure [kPa (psig)] - 174.4 (25.3)
4. Steam temperature [^{o}C (^{o}F)] - 157 (314.0)
5. Water temperature [^{o}C (^{o}F)] - 31 (87.8)
6. Mixer pressure [kPa (psig)] - 196.5 (28.5)
7. Test time (sec) - 1440.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.2 (33.4)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	263 (506)
0.15 (0.50)	272 (522)
0.30 (1.00)	274 (526)
0.46 (1.50)	273 (523)
0.61 (2.00)	272 (521)
1.22 (4.00)	-
3.05 (10.00)	274 (525)
6.09 (20.00)	273 (524)
8.23 (27.00)	-
10.67 (35.00)	273 (524)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 3.27 (7.2)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 0.0 (0.0)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 0.0 (0.0)

D. FAILED BUNDLE T/Cs[1]

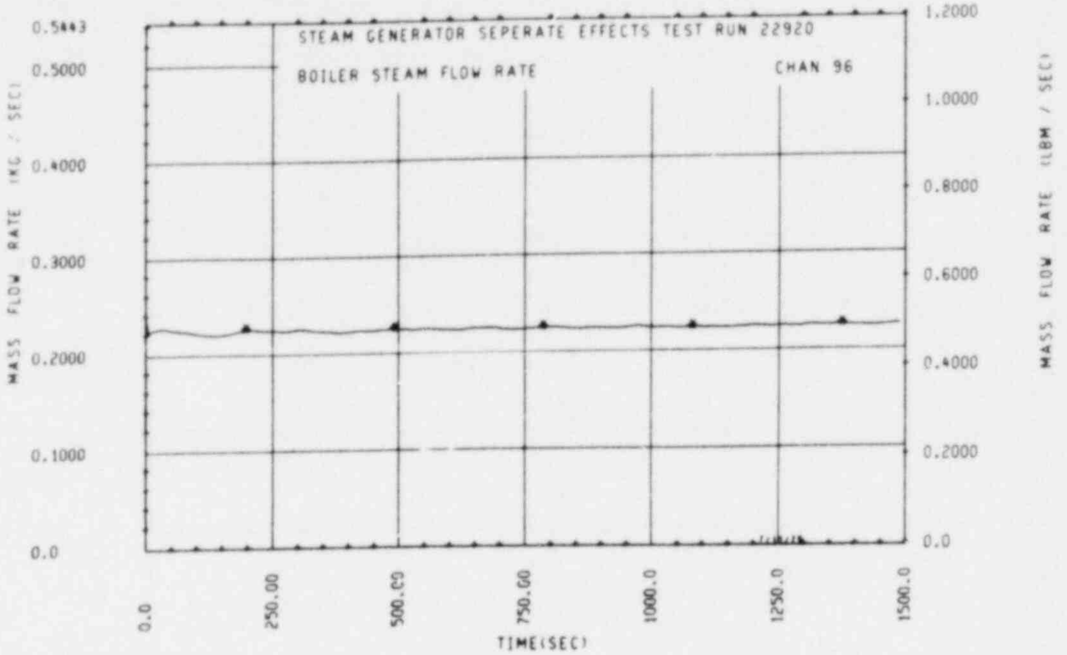
294, 295, 305, 308, 309, 310, 311, 326, 532, 549, 553, 555, 564, 565, 568, 569

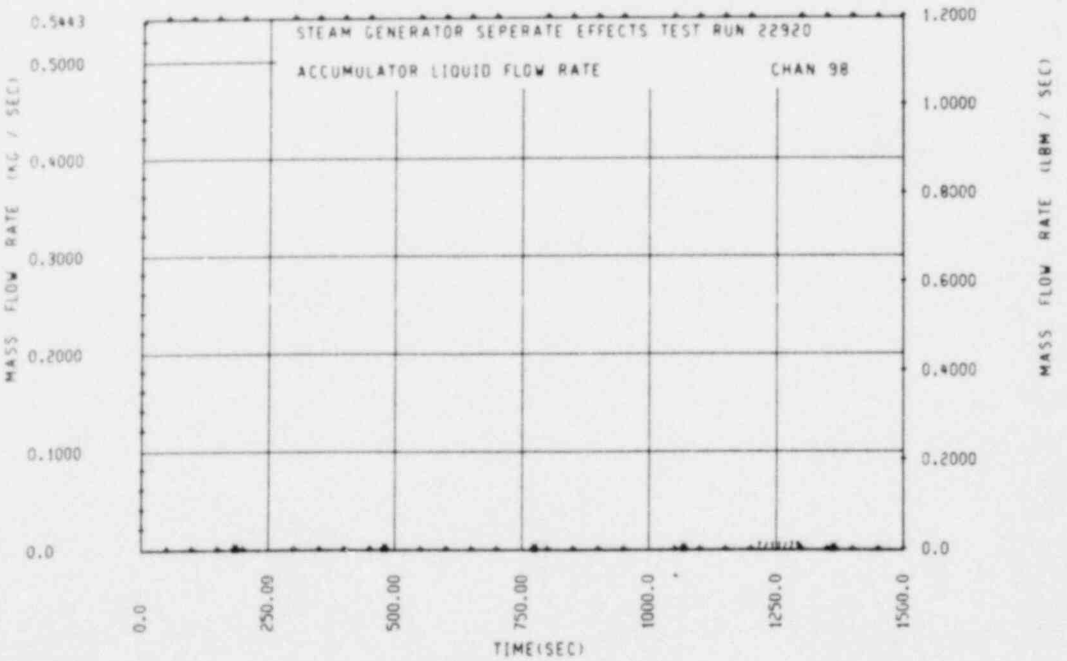
E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

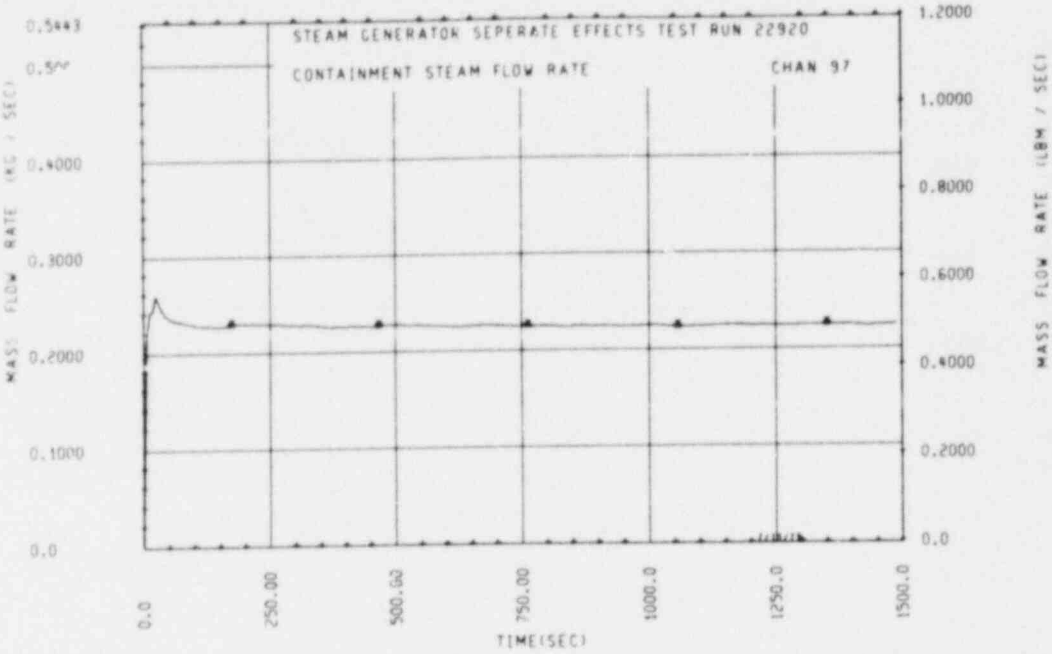
1. From primary side energy balance [kwsec(Btu)] - 0.484×10^5 (0.461×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da\,dt$) -[kwsec(Btu)] - 0.402×10^5 (0.383×10^5)
3. Integration to 900 sec

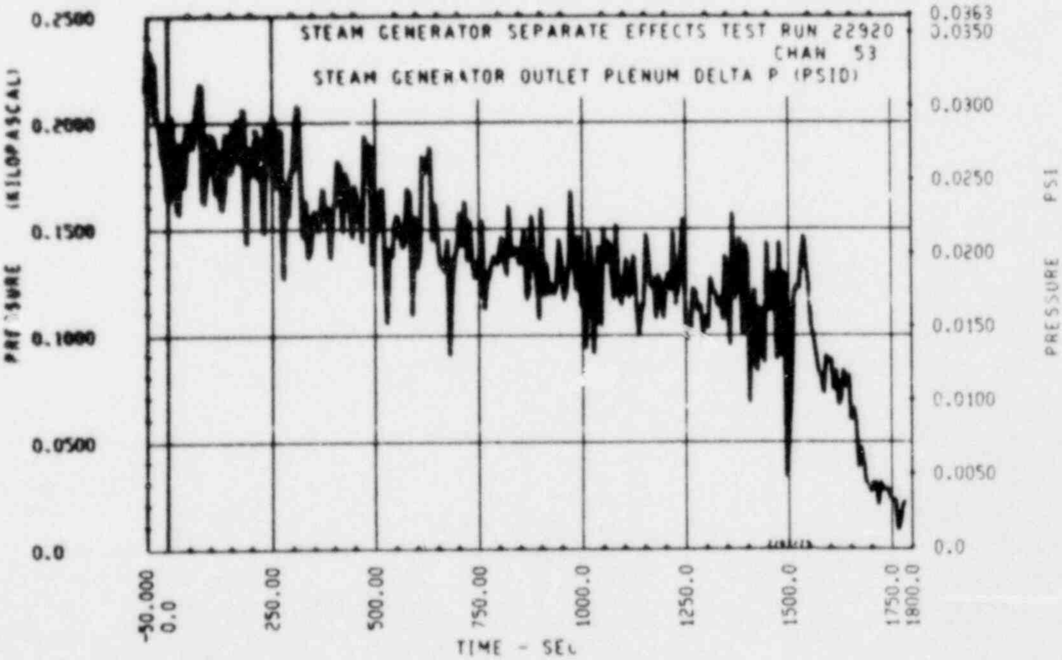
---

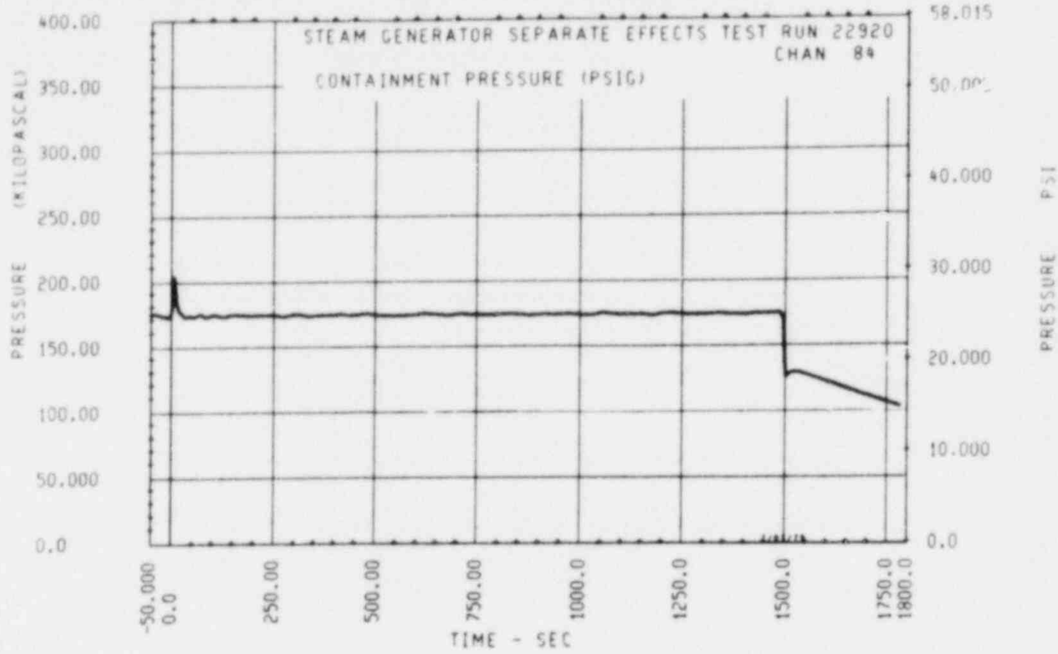
1. T/Cs are defined as failed based on resistance reading or T/C response.

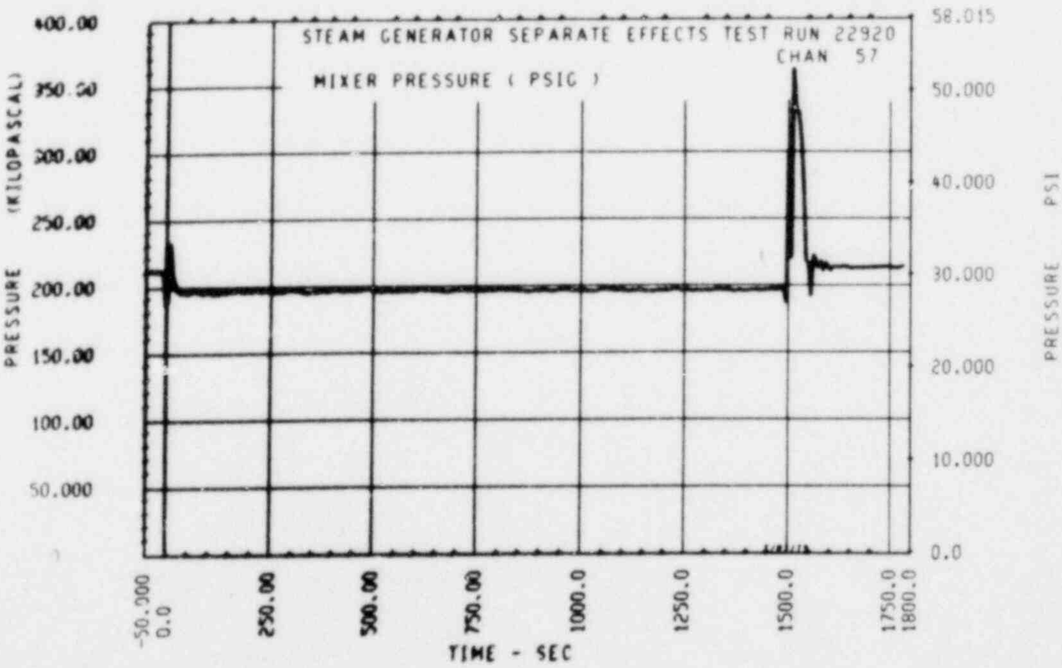

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22920
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

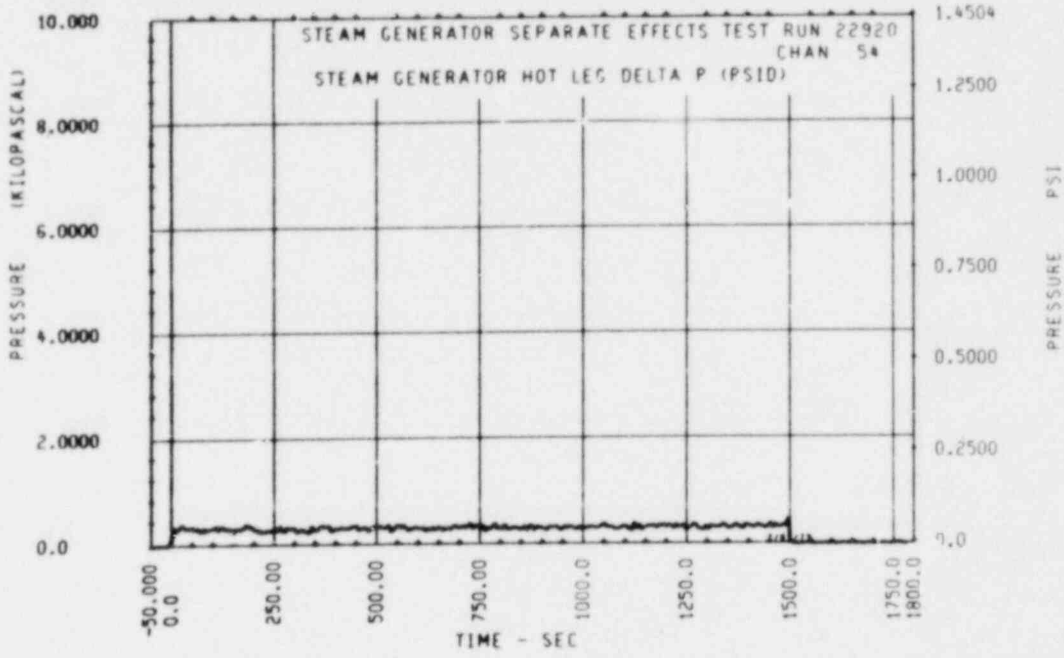

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22920
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

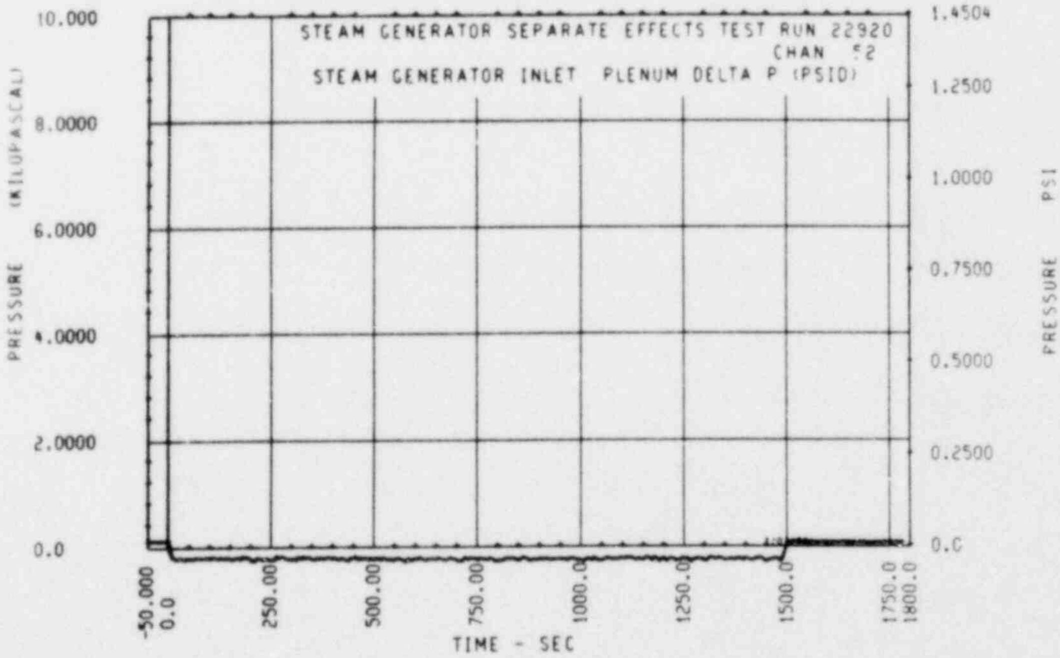

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22920
CONTAINMENT STEAM FLOW RATE
CHAN 97
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)

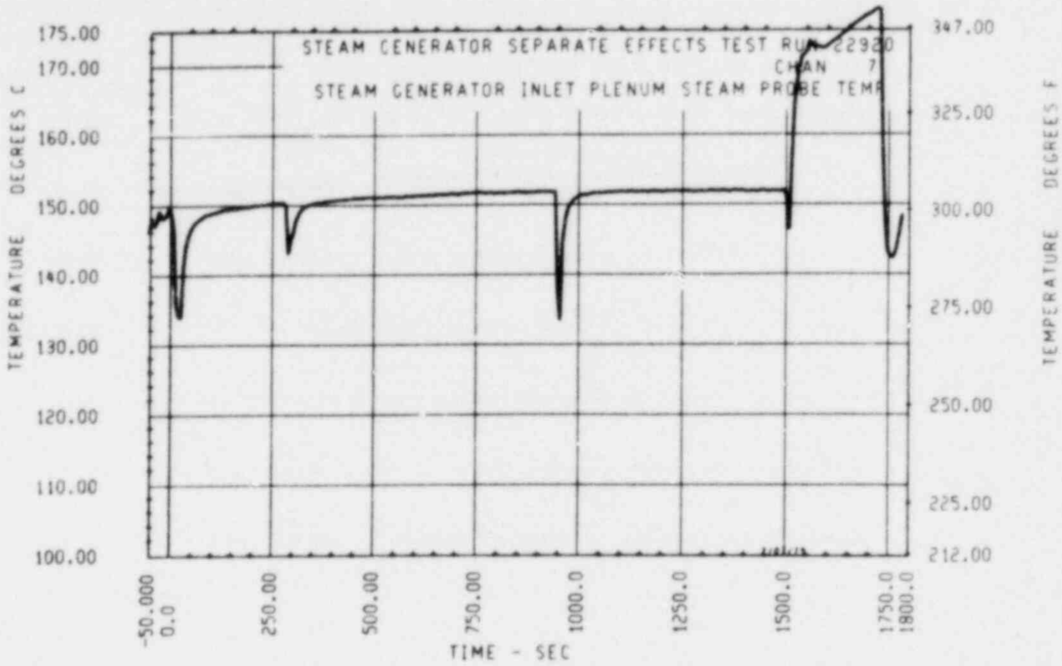

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22920
CHAN 53
STEAM GENERATOR OUTLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

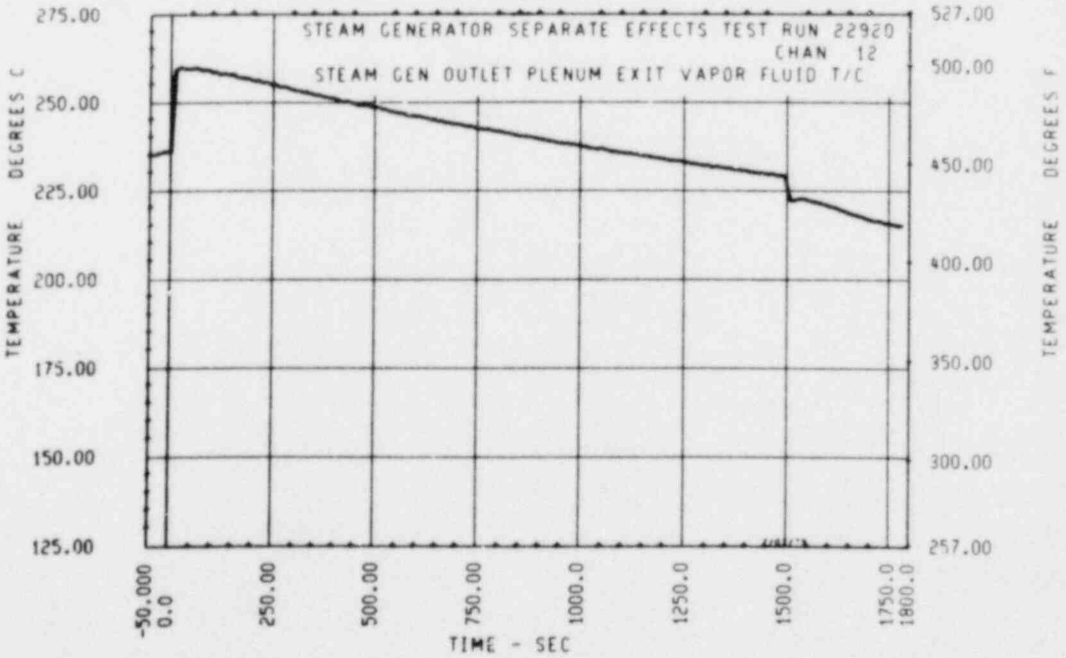

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22920
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

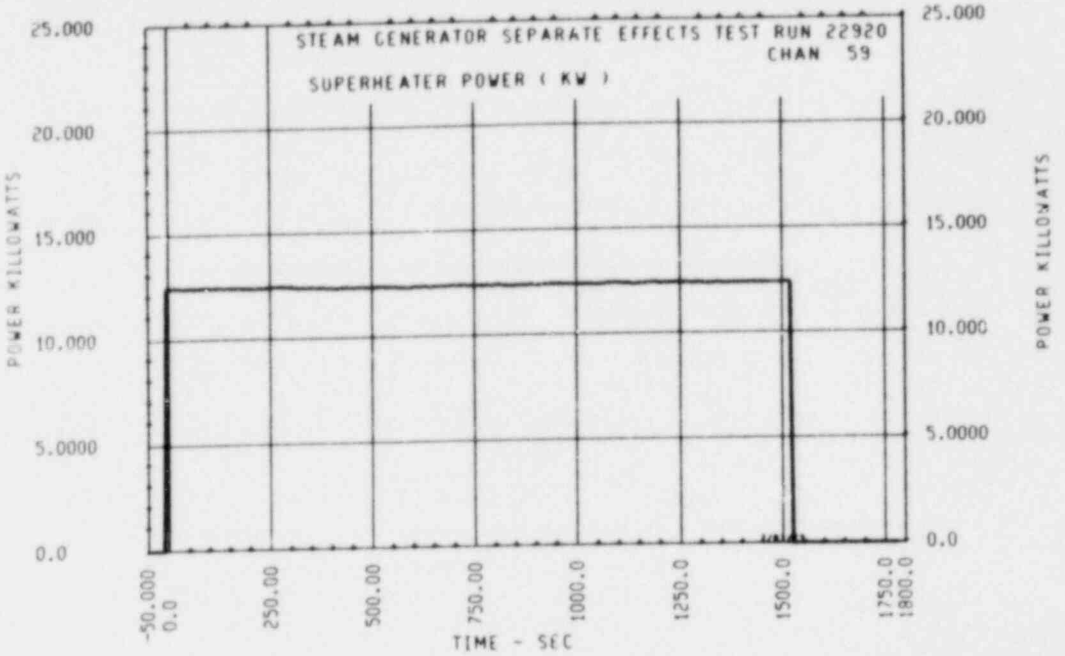

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22920
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

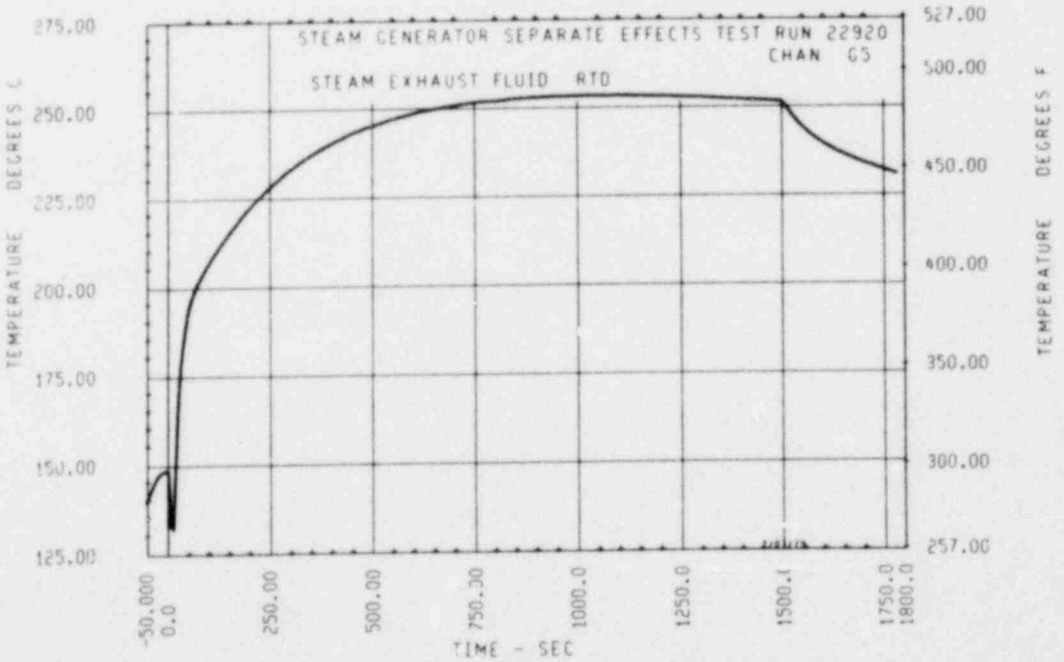

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22920
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
10.000
8.0000
6.0000
4.0000
2.0000
0.0
1.4504
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

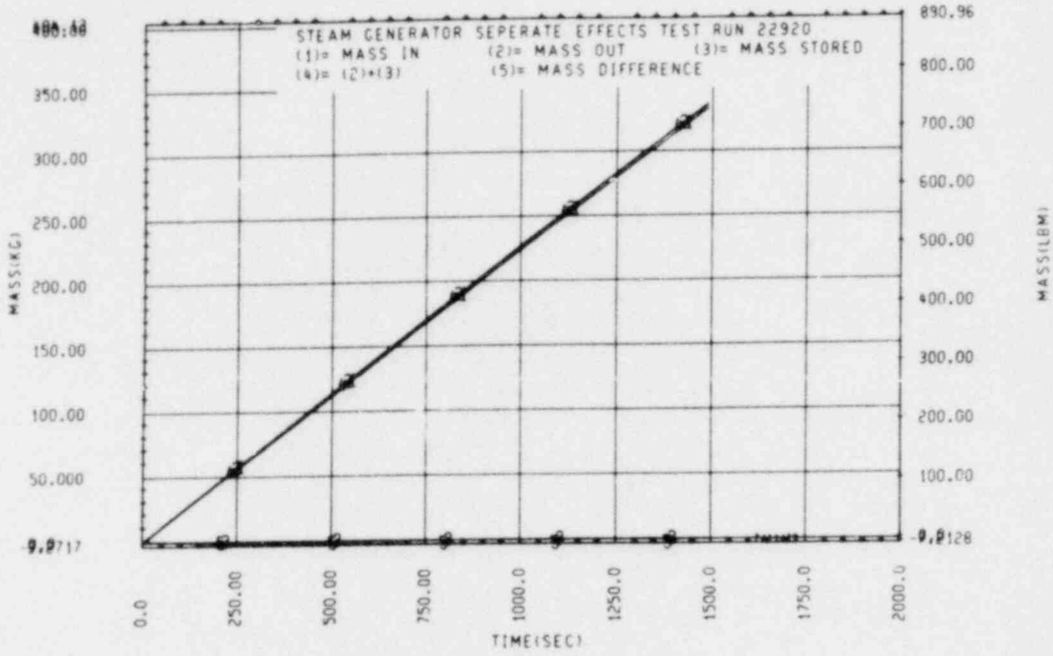

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22920
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
10.000
8.0000
6.0000
4.0000
2.0000
0.0
1.4504
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22920
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

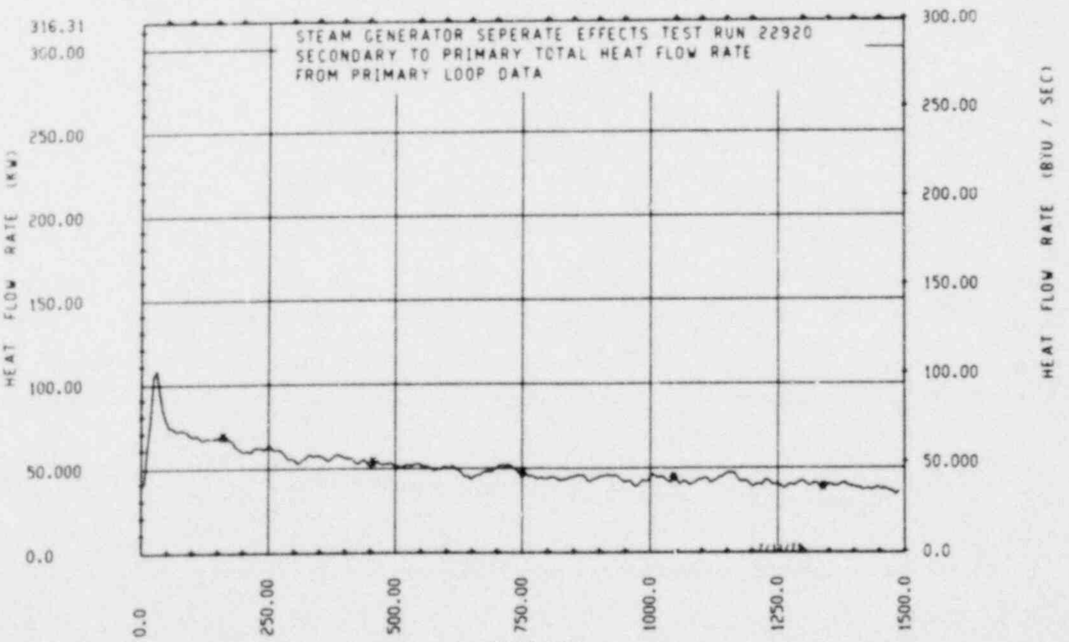

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22920
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22920
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

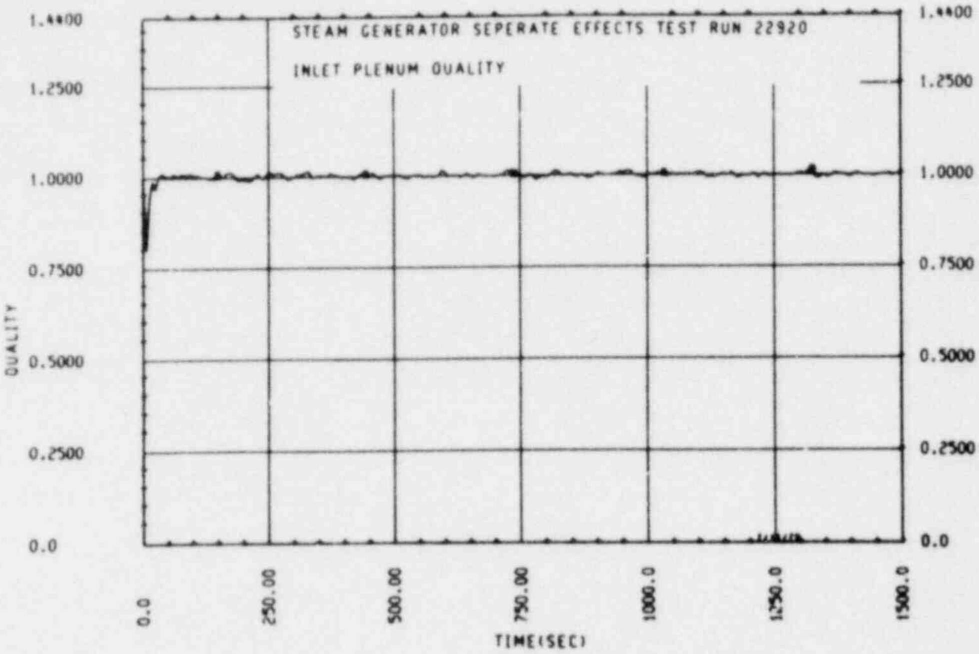

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 22920
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
275.00
250.00
225.00
200.00
175.00
150.00
125.00
TEMPERATURE DEGREES F
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

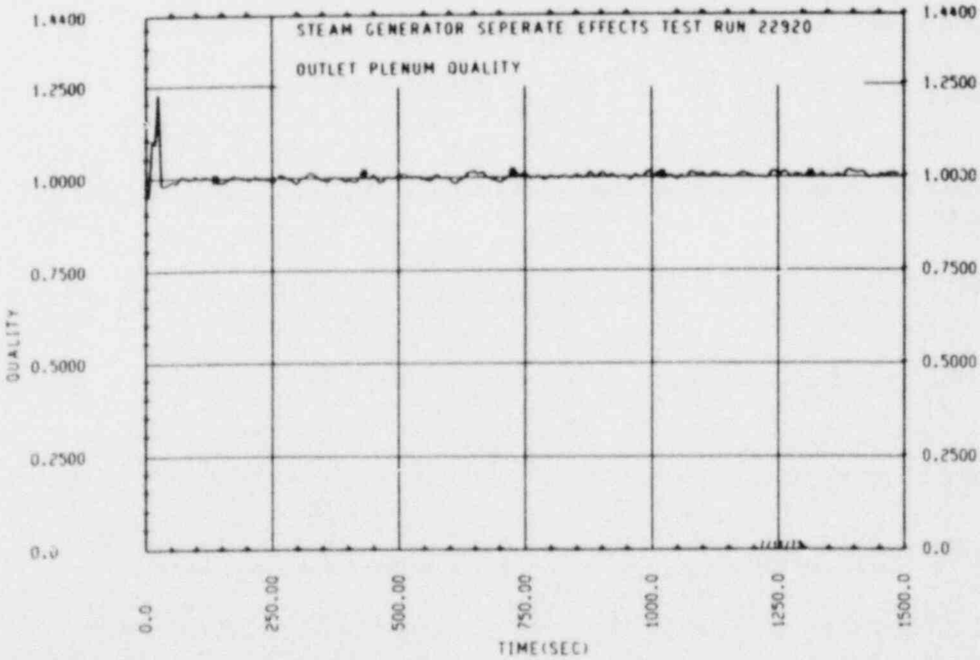


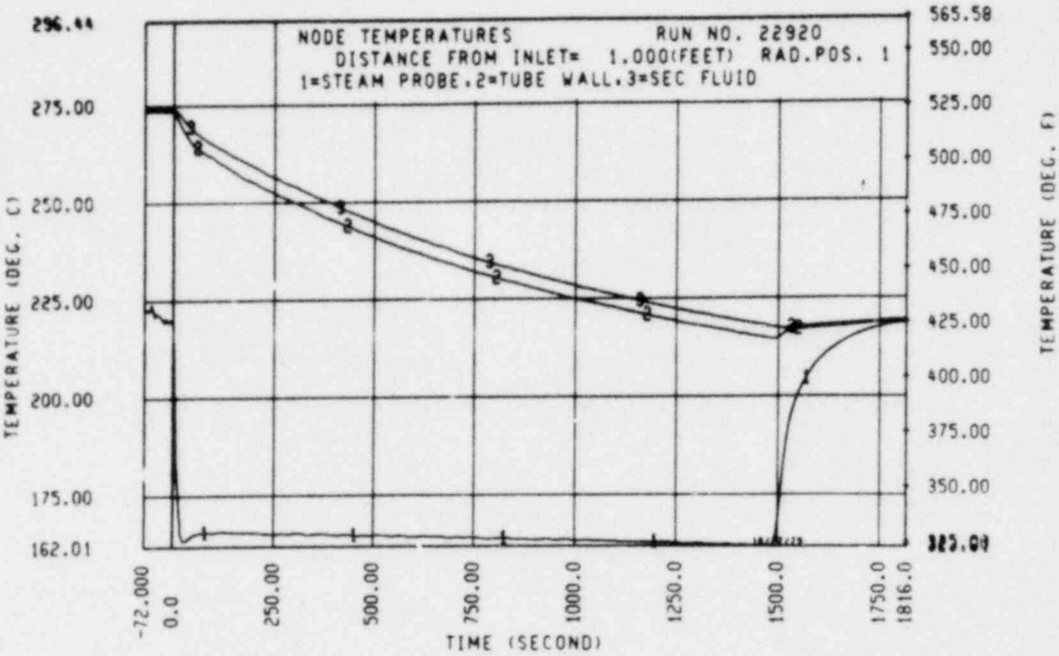
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22920
(1)= MASS IN
(2)= MASS OUT
(3)= MASS STORED
(4)= (2)+(3)
(5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)



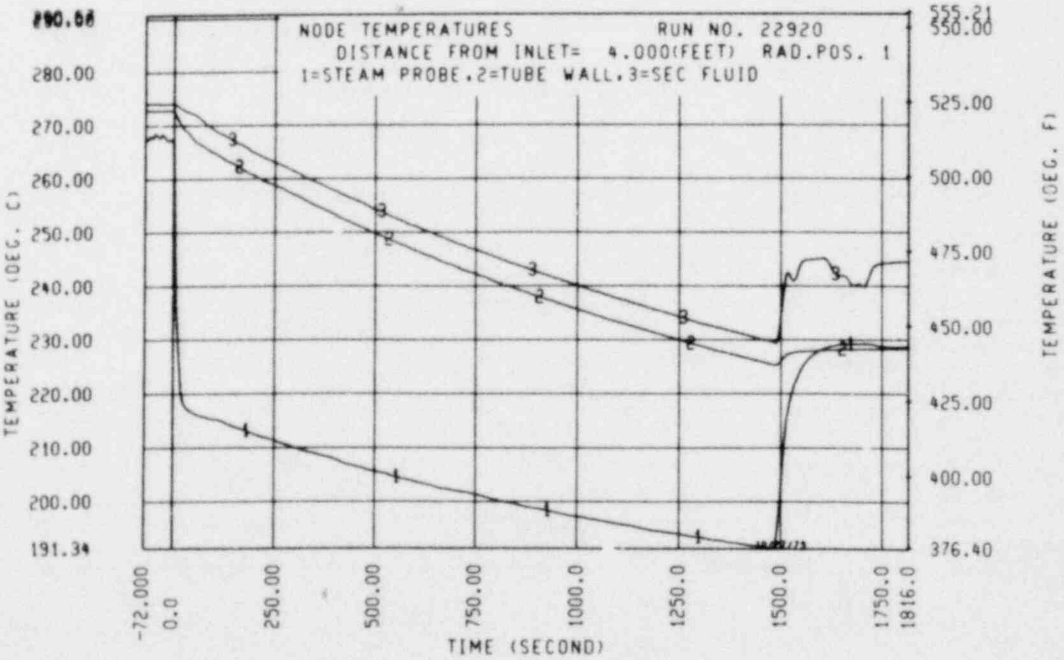
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22920
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22920
INLET PLENUM QUALITY
QUALITY
TIME(SEC)

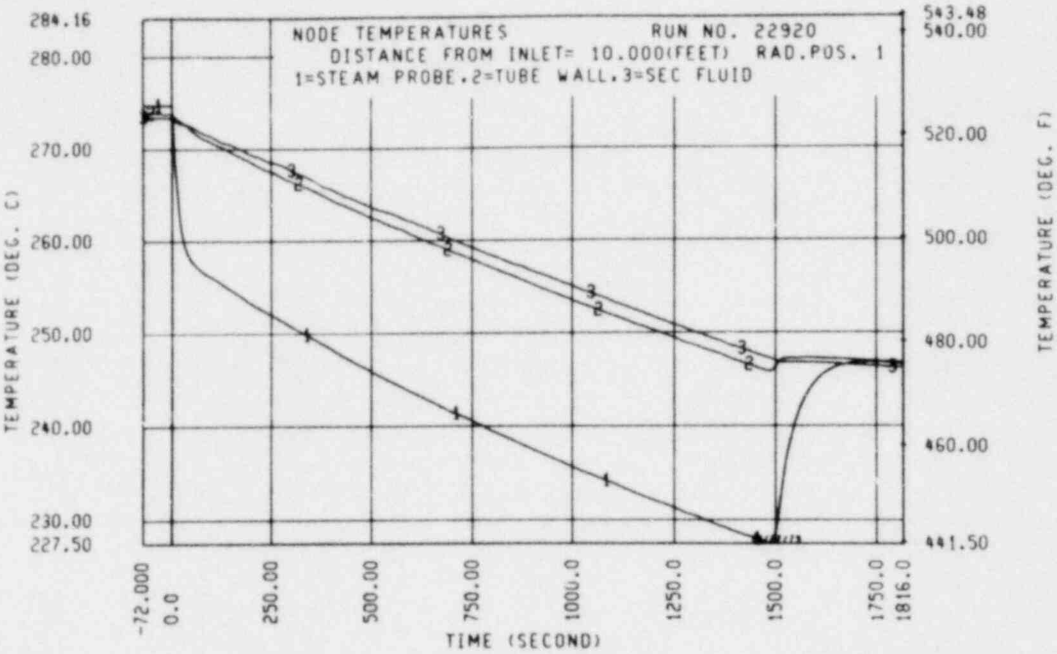

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 22920
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)

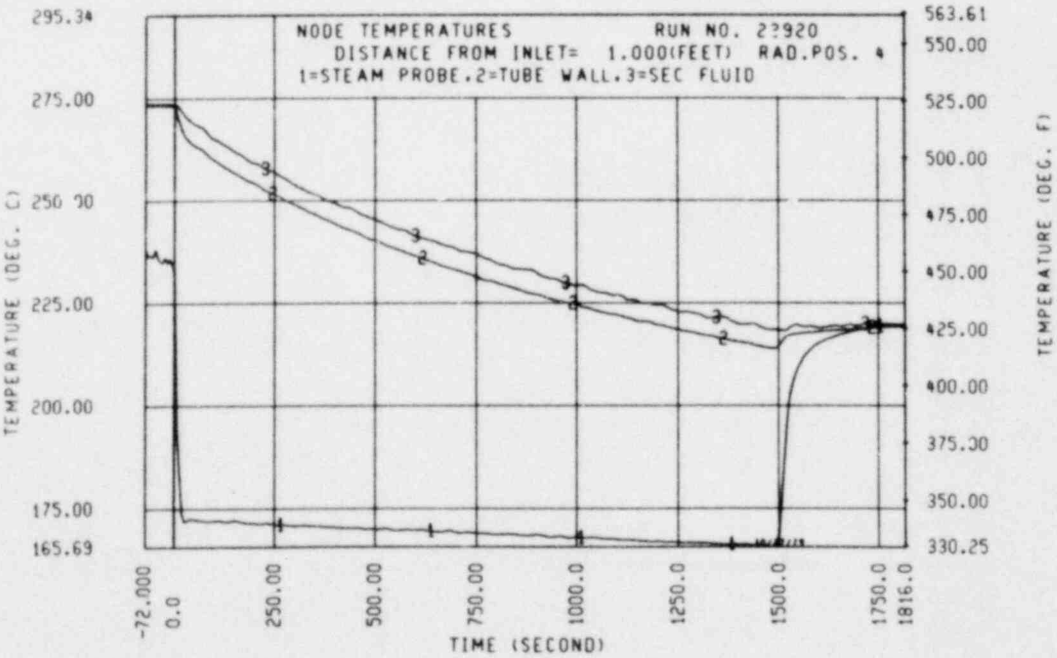


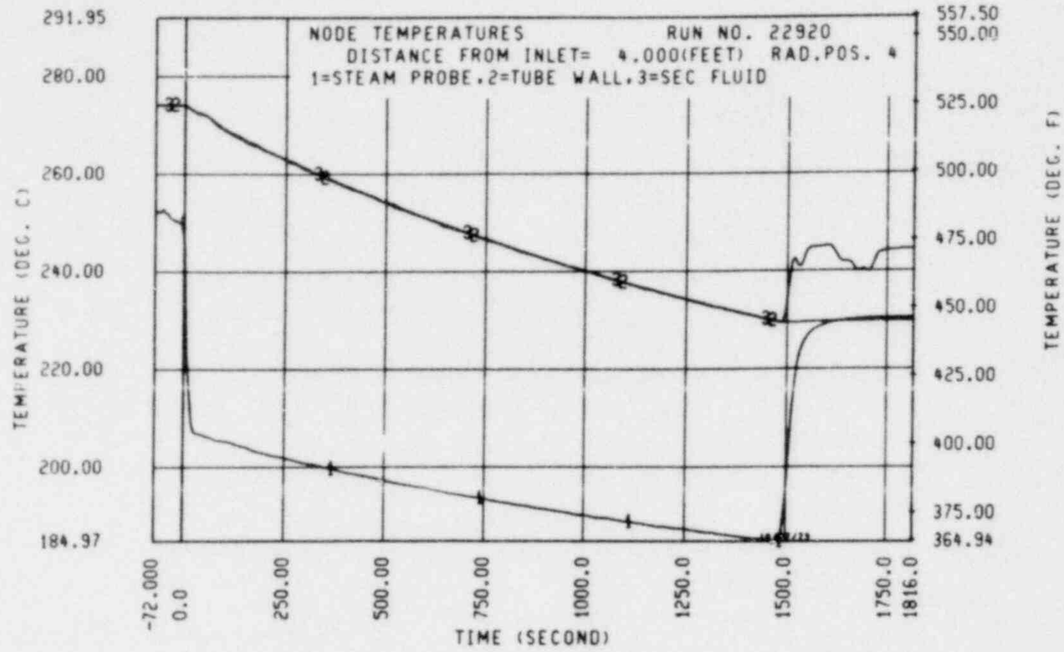
NODE TEMPERATURES RUN NO. 22920
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

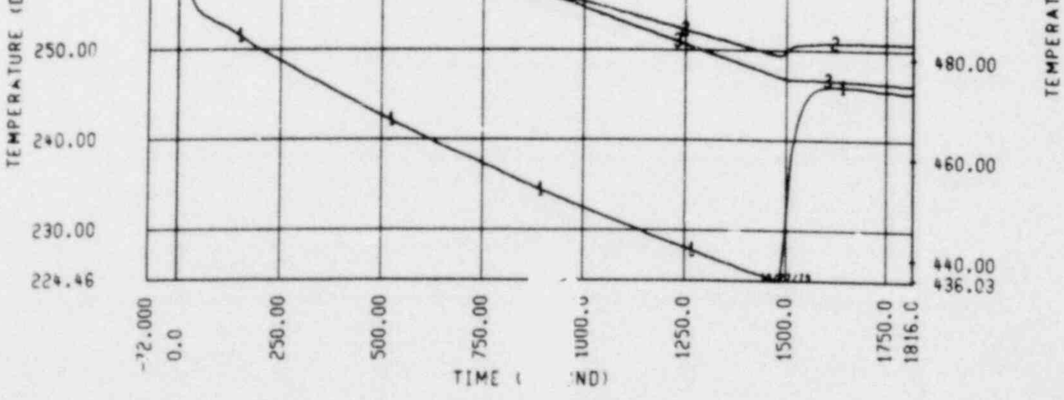


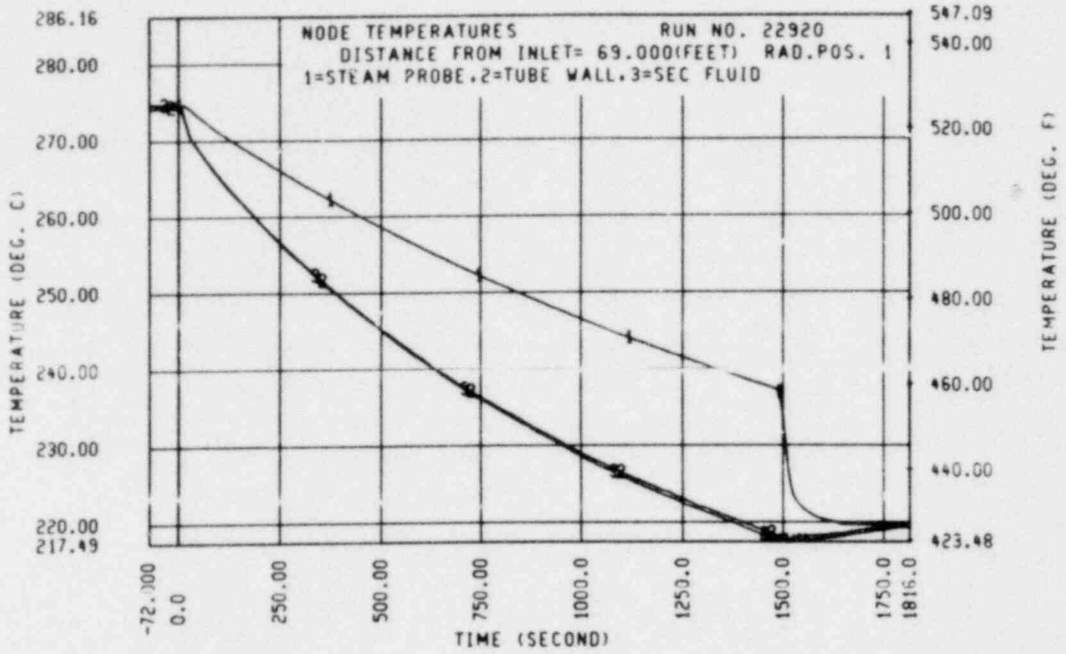
NODE TEMPERATURES RUN NO. 22920
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

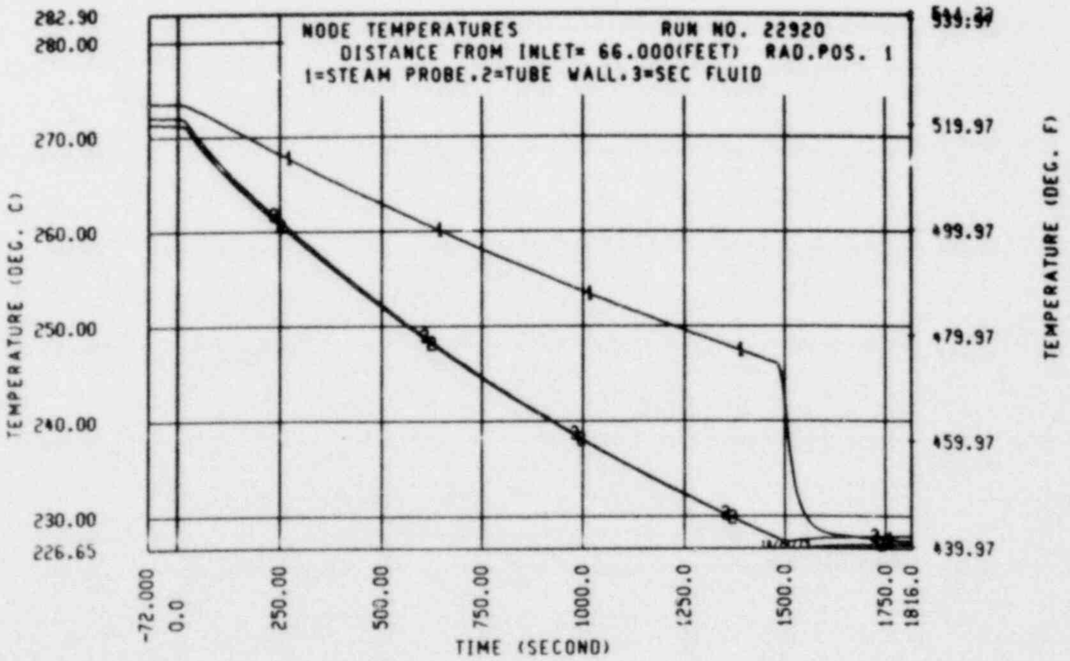

NODE TEMPERATURES
RUN NO. 22920
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
284.16
280.00
270.00
260.00
250.00
240.00
230.00
227.50
543.48
540.00
520.00
500.00
480.00
460.00
441.50
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1816.0


NODE TEMPERATURES
RUN NO. 22920
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
295.34
275.00
250.00
225.00
200.00
175.00
165.69
563.61
550.00
525.00
500.00
475.00
450.00
425.00
400.00
375.00
350.00
330.25
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1816.0

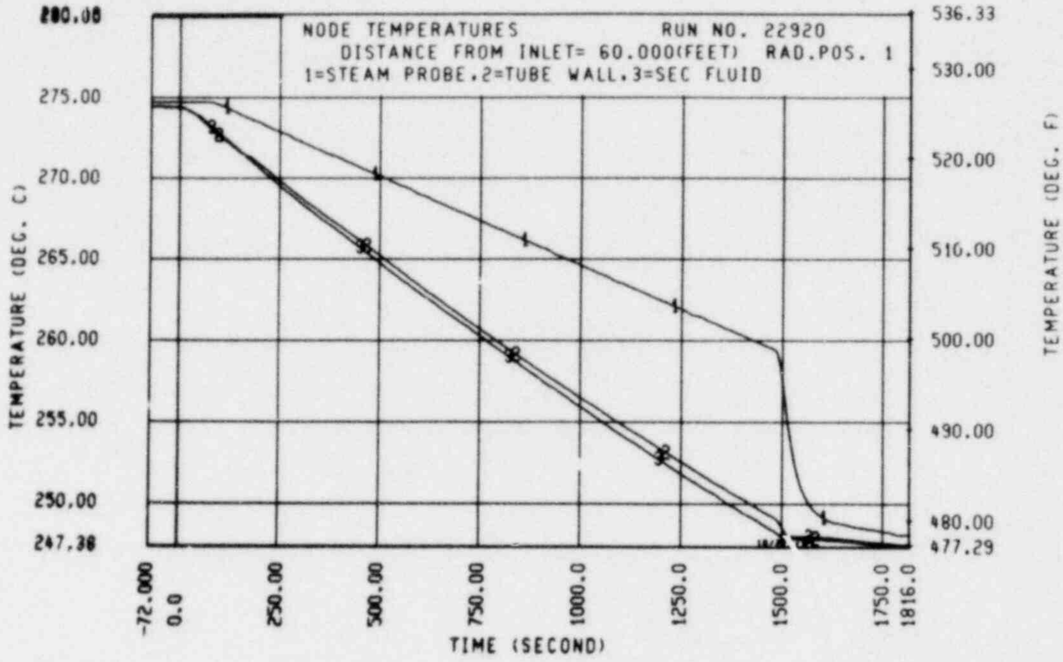

NODE TEMPERATURES RUN NO. 22920
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

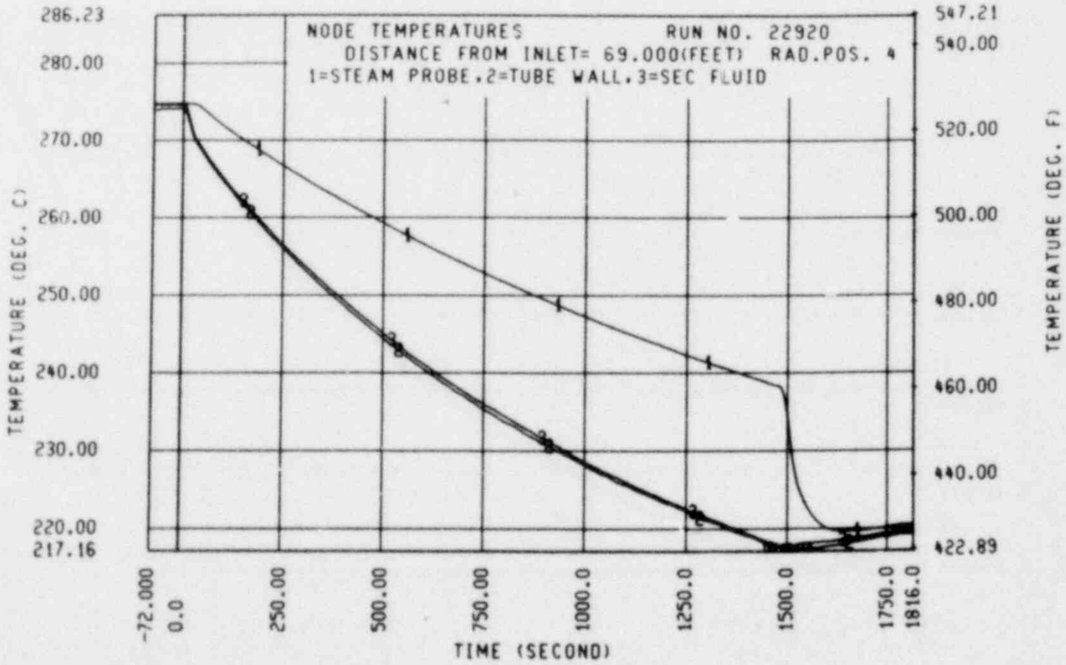

NODE TEMPERATURES RUN NO. 22920
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)

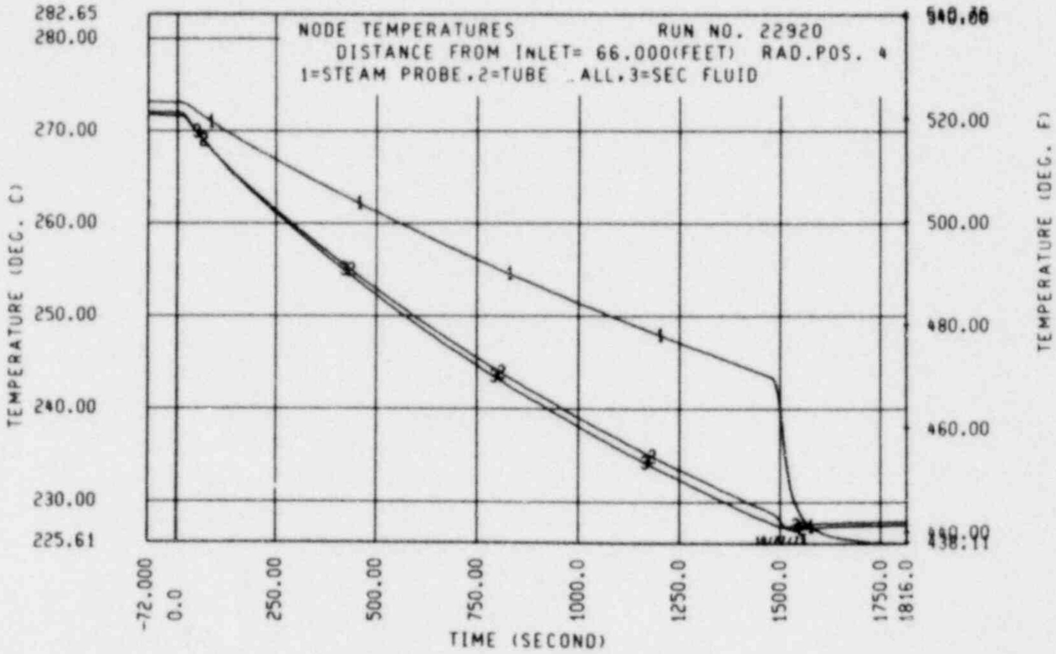

NODE TEMPERATURES RUN NO. 22920
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
286.16
280.00
270.00
260.00
250.00
240.00
230.00
220.00
217.49
547.09
540.00
520.00
500.00
480.00
460.00
440.00
423.48
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1816.0


NODE TEMPERATURES RUN NO. 22920
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
282.90
280.00
270.00
260.00
250.00
240.00
230.00
226.65
519.97
499.97
479.97
459.97
439.97
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1816.0

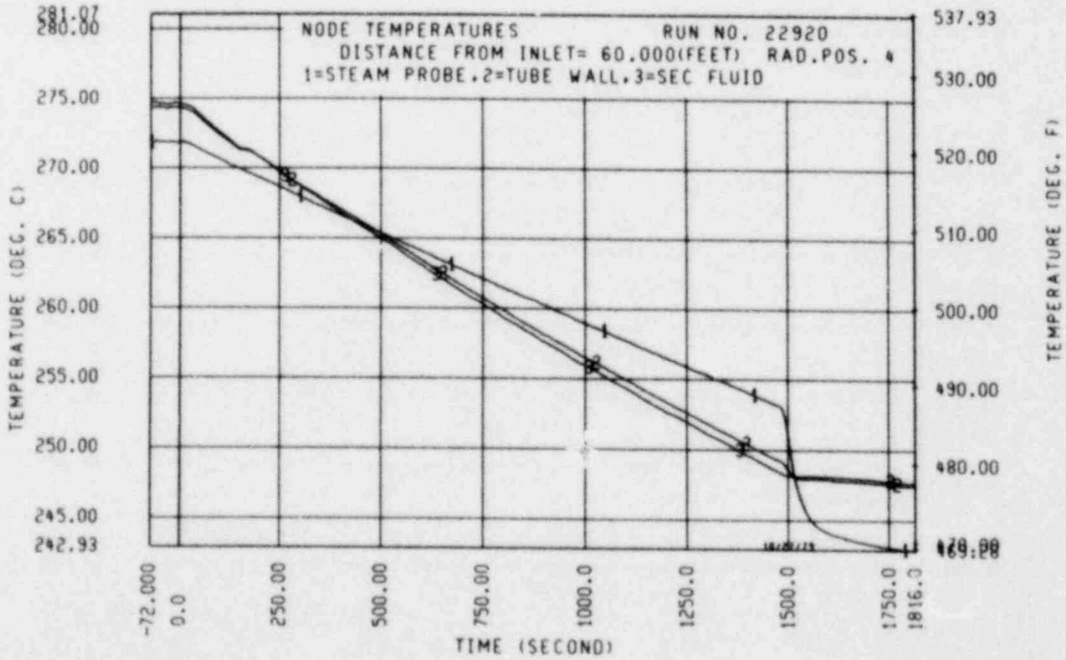
22920-14


NODE TEMPERATURES RUN NO. 22920
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
280.00
275.00
270.00
265.00
260.00
255.00
250.00
247.38
TEMPERATURE (DEG. F)
536.33
530.00
520.00
510.00
500.00
490.00
480.00
477.29
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1816.0
TIME (SECOND)

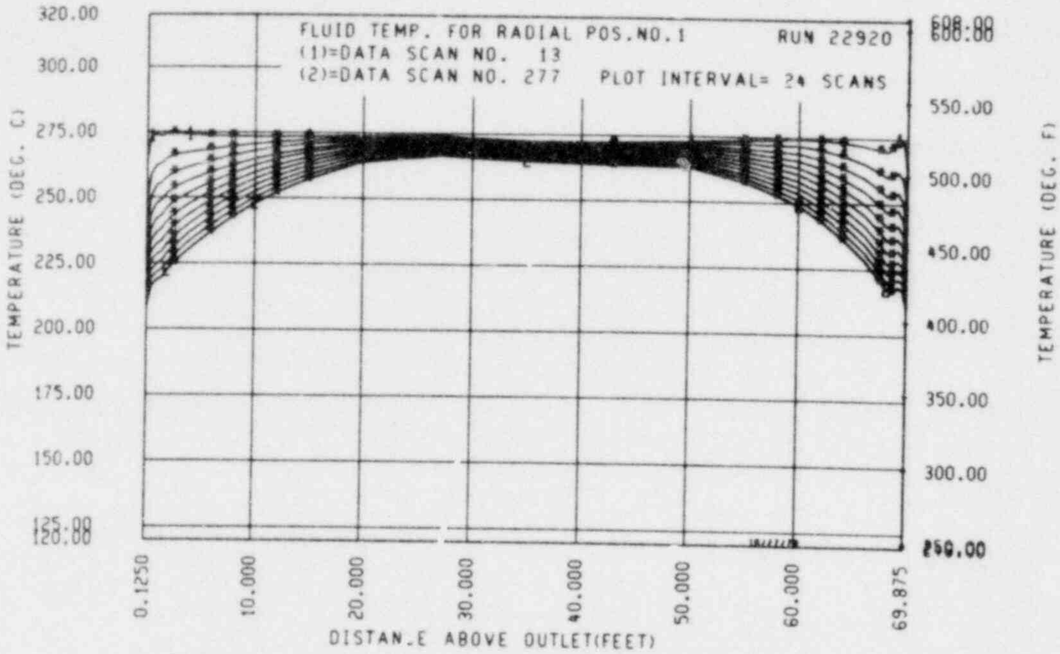

NODE TEMPERATURES RUN NO. 22920
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
286.23
280.00
270.00
260.00
250.00
240.00
230.00
220.00
217.16
TEMPERATURE (DEG. F)
547.21
540.00
520.00
500.00
480.00
460.00
440.00
422.89
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1816.0
TIME (SECOND)

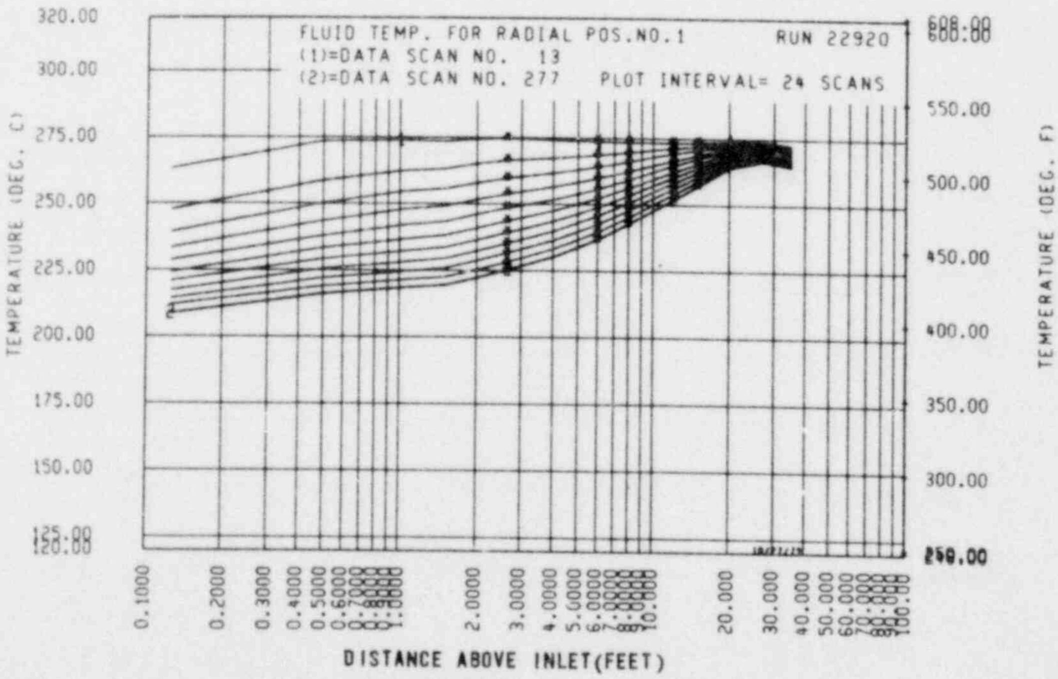


NODE TEMPERATURES RUN NO. 22920
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
282.65
280.00
270.00
260.00
250.00
240.00
230.00
225.61
540.00
520.00
500.00
480.00
460.00
438.11
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1816.0

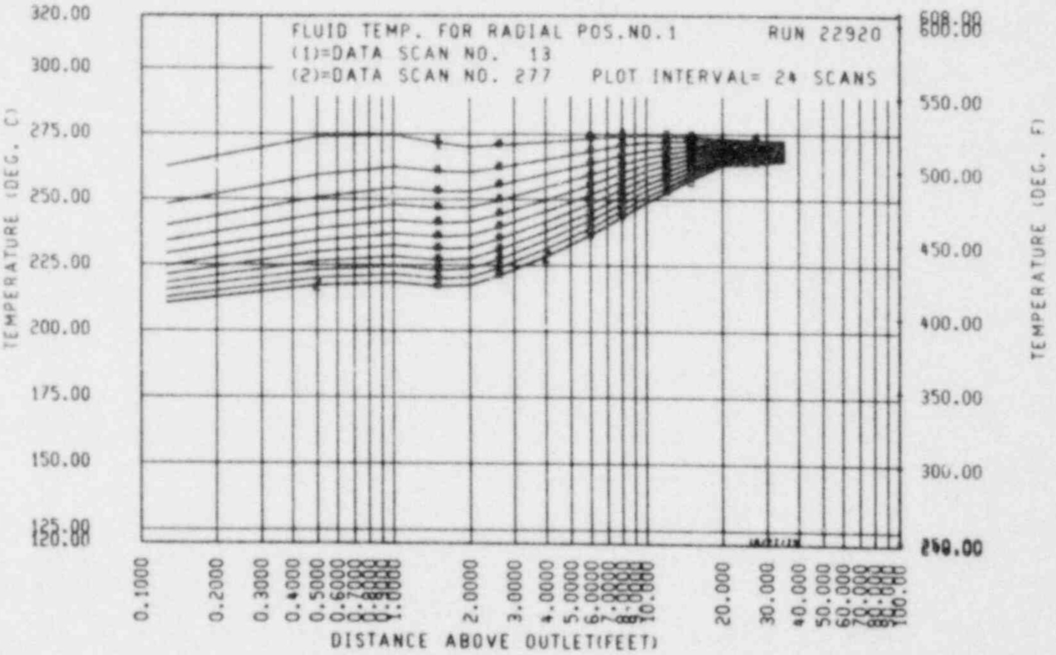


NODE TEMPERATURES RUN NO. 22920
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
281.07
280.00
275.00
270.00
265.00
260.00
255.00
250.00
245.00
242.93
537.93
530.00
520.00
510.00
500.00
490.00
480.00
469.28
-72.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1816.0


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22920
(1)=DATA SCAN NO. 13
(2)=DATA SCAN NO. 277
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTAN.E ABOVE OUTLET(FEET)
320.00
300.00
275.00
250.00
225.00
200.00
175.00
150.00
125.00
120.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
0.1250
10.000
20.000
30.000
40.000
50.000
60.000
69.875


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22920
(1)=DATA SCAN NO. 13
(2)=DATA SCAN NO. 277
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)
320.00
300.00
275.00
250.00
225.00
200.00
175.00
150.00
125.00
120.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
0.1000
0.2000
0.3000
0.4000
0.5000
2.0000
3.0000
4.0000
5.0000
6.0000
20.000
30.000
40.000
50.000

22920-17


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 22920
(1)=DATA SCAN NO. 13
(2)=DATA SCAN NO. 277
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22920
TIME = 60.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	2.4(.21)	14.8(1.30)	14.3(1.26)	27.3(2.41)	1.001	1.002	1.003	1.001
.2(.50)	13.1(1.15)	18.0(1.59)	20.0(1.76)	21.1(1.86)	1.000	1.001	1.008	1.000
.3(1.00)	14.9(1.31)	19.1(1.68)	2.6(.23)	16.2(1.43)	.995	1.001	1.003	.997
.5(1.50)	10.9(.96)	13.1(1.16)	12.6(1.11)	20.7(1.83)	.988	1.000	.993	.998
.6(2.00)	2.5(.22)	14.5(1.28)	-.1(-.01)	8.2(.72)	.981	.999	.985	.999
.8(2.65)	2.3(.21)	13.5(1.19)	-2.4(-.21)	5.3(.47)	.974	.998	.976	.996
1.2(4.00)	8.7(.76)	6.9(.61)	4.8(.42)	1.8(.16)	.969	.992	.967	.986
1.8(6.00)	5.4(.48)	8.0(.70)	11.5(1.01)	7.5(.66)	.966	.986	.963	.977
2.4(8.00)	2.2(.20)	4.5(.39)	1.2(.10)	8.3(.73)	.961	.964	.960	.977
3.0(10.00)	.4(.03)	3.7(.33)	5.0(.44)	9.9(.87)	.955	.982	.958	.982
3.7(12.00)	.4(.03)	2.7(.24)	3.2(.28)	2.2(.19)	.950	.983	.959	.986
4.6(15.00)	2.1(.19)	1.8(.16)	1.5(.13)	2.3(.20)	.950	.983	.959	.986
6.1(20.00)	.1(.01)	.1(.01)	.4(.04)	.3(.03)	.951	.982	.958	.986
8.2(27.00)	.3(.03)	-.0(-.00)	-.2(-.02)	.5(.05)	.951	.980	.957	.987
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.951	.979	.957	.989
13.1(43.00)	-1.0(-.08)	-.3(-.03)	.0(.00)	-.2(-.02)	.948	.978	.957	.989
15.2(50.00)	-.0(-.00)	-.0(-.00)	-.0(-.00)	.0(.00)	.944	.977	.956	.987
16.8(55.00)	.1(.01)	-.0(-.00)	.0(.00)	.1(.01)	.944	.976	.957	.988
17.7(58.00)	.1(.01)	.0(.00)	.0(.00)	.1(.01)	.944	.976	.958	.989
18.3(60.00)	.1(.01)	.0(.00)	.1(.01)	.1(.01)	.944	.976	.959	.990
18.9(62.00)	.2(.02)	.1(.01)	.1(.01)	.1(.01)	.945	.976	.960	.990
19.5(64.00)	.1(.01)	.3(.02)	.1(.01)	.0(.00)	.946	.977	.961	.990
20.1(66.00)	.5(.04)	1.2(.11)	.5(.04)	-.1(-.01)	.947	.979	.961	.990
20.5(67.38)	-.9(-.08)	-.3(-.02)	-.9(-.08)	-.3(-.03)	.948	.981	.960	.989
20.7(68.00)	-.3(-.03)	-.3(-.02)	-.3(-.02)	-.4(-.04)	.948	.981	.960	.988
20.9(68.50)	-.3(-.02)	-.3(-.02)	-.3(-.03)	-.4(-.03)	.947	.980	.959	.988
21.0(69.00)	-.2(-.02)	-.3(-.02)	-.2(-.02)	-.3(-.02)	.947	.979	.958	.988
21.2(69.50)	-.3(-.02)	-.4(-.04)	-.4(-.03)	-.4(-.03)	.948	.979	.958	.988
21.3(69.87)	-2.3(-.21)	-.7(-.06)	-1.8(-.16)	-.5(-.05)	.948	.979	.958	.988

22920-19

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22920
TIME = 540.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	1.7(.15)	16.0(1.41)	13.0(1.15)	26.2(2.31)	1.002	1.002	1.003	1.002
.2(.50)	8.3(.73)	16.2(1.42)	15.3(1.35)	16.3(1.44)	1.000	1.003	1.007	1.001
.3(1.00)	14.0(1.24)	16.5(1.46)	2.0(.18)	12.5(1.10)	.997	1.004	1.004	.999
.5(1.50)	11.0(.97)	11.4(1.00)	26.2(2.31)	15.4(1.36)	.993	1.004	1.000	1.000
.6(2.00)	1.9(.17)	13.3(1.17)	.6(.06)	8.3(.73)	.988	1.004	.997	1.002
.8(2.65)	1.8(.16)	11.6(1.03)	-3.7(-.33)	6.2(.54)	.981	1.004	.989	1.000
1.2(4.00)	6.5(.58)	4.6(.41)	3.6(.32)	1.7(.15)	.977	.998	.981	.993
1.8(6.00)	4.5(.40)	5.6(.49)	10.7(.94)	9.1(.80)	.973	.990	.977	.987
2.4(8.00)	2.5(.22)	2.6(.23)	1.1(.10)	3.4(.30)	.968	.985	.973	.984
3.0(10.00)	1.7(.15)	2.1(.19)	3.4(.30)	2.1(.19)	.961	.980	.969	.978
3.7(12.00)	1.1(.10)	1.8(.16)	2.2(.20)	-.7(-.06)	.957	.977	.967	.972
4.6(15.00)	2.3(.21)	1.8(.16)	1.2(.10)	.4(.04)	.957	.976	.964	.966
6.1(20.00)	.3(.03)	1.2(.10)	.6(.05)	.7(.06)	.957	.975	.960	.962
8.2(27.00)	.4(.03)	.1(.01)	-.2(-.02)	.5(.04)	.956	.974	.957	.961
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.955	.972	.956	.962
13.1(43.00)	-1.1(-.10)	-.4(-.03)	.0(.00)	-.3(-.03)	.950	.971	.957	.962
15.2(50.00)	-.1(-.01)	-.1(-.01)	-.1(-.01)	-.1(-.01)	.946	.970	.957	.960
16.8(55.00)	-.0(-.00)	-.1(-.00)	-.1(-.01)	-.1(-.01)	.947	.970	.957	.961
17.7(58.00)	-.2(-.02)	-.2(-.02)	-.1(-.01)	-.1(-.01)	.947	.970	.958	.962
18.3(60.00)	-.3(-.02)	-.2(-.02)	-.0(-.00)	-.1(-.01)	.947	.970	.960	.964
18.9(62.00)	-.3(-.03)	-.0(-.00)	-.1(-.01)	-.2(-.02)	.948	.971	.962	.966
19.5(64.00)	-.0(-.00)	.1(.01)	-.0(-.00)	-.2(-.02)	.950	.973	.964	.966
20.1(66.00)	.1(.01)	1.0(.09)	.1(.01)	-.4(-.04)	.952	.977	.966	.967
20.5(67.38)	-1.3(-.11)	-.5(-.05)	-1.3(-.11)	-.7(-.06)	.954	.980	.966	.966
20.7(68.00)	-.7(-.06)	-.6(-.06)	-.6(-.06)	-.8(-.07)	.955	.981	.966	.966
20.9(68.50)	-.7(-.06)	-.7(-.06)	-.7(-.06)	-.8(-.07)	.955	.980	.965	.966
21.0(69.00)	-.6(-.05)	-.7(-.06)	-.7(-.06)	-.6(-.06)	.955	.979	.965	.967
21.2(69.50)	-.6(-.06)	-.9(-.08)	-.8(-.07)	-.8(-.07)	.957	.979	.965	.968
21.3(69.87)	-2.0(-.17)	-1.0(-.09)	-1.7(-.15)	-.9(-.08)	.959	.980	.965	.968

22920-20

RUN 22920 FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

TIME = 1020.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	LOCAL FLUX 2	LOCAL FLUX 3	LOCAL FLUX 4	LOCAL QUALITY 1	LOCAL QUALITY 2	LOCAL QUALITY 3	LOCAL QUALITY 4
.0(.13)	1.5(.13)	17.9(1.57)	10.2(.90)	25.1(2.21)	1.002	1.002	1.002	1.002
.2(.50)	7.2(.63)	14.1(1.24)	13.6(1.20)	12.5(1.10)	1.000	1.004	1.006	1.001
.3(1.00)	11.6(1.02)	14.4(1.27)	1.7(.15)	12.7(1.12)	.997	1.004	1.003	.999
.5(1.50)	8.1(.72)	9.3(.82)	27.4(2.41)	12.3(1.08)	.993	1.005	1.001	1.001
.6(2.00)	1.5(.13)	10.4(.91)	-.5(-.04)	6.8(.60)	.989	1.005	.999	1.002
.8(2.65)	1.5(.13)	8.7(.76)	-3.9(-.35)	4.9(.44)	.984	1.004	.993	1.001
1.2(4.00)	6.2(.54)	4.0(.35)	3.2(.28)	1.3(.11)	.980	.998	.985	.994
1.8(6.00)	4.8(.42)	4.8(.42)	10.1(.89)	9.9(.87)	.978	.991	.982	.990
2.4(8.00)	2.8(.24)	1.5(.13)	1.1(.09)	6.4(.57)	.973	.985	.978	.991
3.0(10.00)	2.0(.18)	.4(.03)	1.1(.10)	.9(.08)	.967	.977	.972	.987
3.7(12.00)	1.5(.13)	.1(.01)	.6(.05)	-1.3(-.11)	.963	.971	.966	.978
4.6(15.00)	2.7(.24)	.6(.05)	.3(.03)	-.8(-.07)	.963	.966	.959	.968
6.1(20.00)	1.1(.10)	1.7(.15)	1.1(.09)	1.2(.10)	.964	.963	.954	.962
8.2(27.00)	.7(.06)	.9(.08)	-.1(-.00)	.8(.07)	.964	.965	.951	.962
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.963	.964	.950	.963
13.1(43.00)	-1.2(-.11)	-.4(-.04)	-.0(-.00)	-.4(-.04)	.958	.962	.950	.962
15.2(50.00)	-.1(-.01)	-.1(-.01)	-.1(-.01)	-.2(-.01)	.954	.961	.950	.961
16.8(55.00)	-.1(-.01)	-.2(-.01)	-.3(-.02)	-.2(-.02)	.955	.961	.950	.962
17.7(58.00)	-.3(-.03)	-.3(-.03)	-.2(-.02)	-.2(-.02)	.955	.962	.952	.964
18.3(60.00)	-.4(-.04)	-.4(-.04)	-.2(-.02)	-.4(-.03)	.956	.962	.954	.966
18.9(62.00)	-.5(-.04)	-.1(-.01)	-.2(-.02)	-.4(-.04)	.957	.964	.957	.968
19.5(64.00)	-.1(-.01)	.1(.01)	-.1(-.01)	-.3(-.03)	.960	.967	.960	.969
20.1(66.00)	.0(.00)	.9(.08)	.0(.00)	-.6(-.05)	.964	.972	.962	.970
20.5(67.38)	-1.8(-.16)	-.9(-.08)	-1.8(-.16)	-.8(-.07)	.966	.976	.963	.970
20.7(68.00)	-.9(-.08)	-.8(-.07)	-.8(-.07)	-1.0(-.09)	.967	.976	.963	.970
20.9(68.50)	-.9(-.08)	-.9(-.08)	-.9(-.08)	-.9(-.08)	.967	.976	.963	.971
21.0(69.00)	-.7(-.06)	-.9(-.08)	-.8(-.07)	-.8(-.07)	.968	.975	.962	.972
21.2(69.50)	-.7(-.06)	-.9(-.08)	-.9(-.08)	-.8(-.07)	.970	.975	.963	.973
21.3(69.87)	-1.6(-.14)	-1.0(-.09)	-1.6(-.14)	-.9(-.08)	.973	.977	.963	.973

22920-21

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 22920
TIME = 1500.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	1.3(.12)	20.2(1.78)	5.9(.52)	24.5(2.16)	1.001	1.003	1.002	1.002
.2(.50)	3.3(.29)	7.2(.63)	8.2(.72)	7.2(.63)	.996	1.002	1.002	.999
.3(1.00)	8.6(.76)	11.6(1.02)	1.4(.12)	7.2(.63)	.987	.998	.997	.993
.5(1.50)	5.0(.44)	7.4(.65)	10.0(.88)	7.9(.69)	.979	.994	.990	.989
.6(2.00)	1.0(.08)	7.7(.68)	-2.2(-.19)	4.8(.42)	.972	.991	.983	.986
.8(2.65)	.9(.08)	10.8(.95)	-2.9(-.25)	5.9(.52)	.966	.990	.975	.984
1.2(4.00)	19.7(1.74)	18.1(1.60)	18.5(1.63)	1.3(.11)	.979	1.001	.982	.980
1.8(6.00)	15.9(1.41)	15.8(1.39)	24.0(2.11)	21.7(1.91)	1.005	1.020	1.008	.990
2.4(8.00)	6.9(.61)	5.1(.45)	1.1(.10)	5.4(.48)	1.016	1.026	1.019	1.003
3.0(10.00)	.4(.04)	.7(.06)	.8(.07)	.6(.05)	1.012	1.023	1.012	.996
3.7(12.00)	.5(.04)	.6(.05)	-2.8(-.25)	-10.8(-.95)	1.005	1.016	1.003	.980
4.6(15.00)	1.9(.17)	-1.5(-.13)	-2.7(-.24)	-6.6(-.58)	1.002	1.008	.988	.955
6.1(20.00)	.9(.08)	1.5(.13)	.9(.08)	1.0(.08)	1.001	1.002	.976	.941
8.2(27.00)	.7(.06)	.7(.06)	-.1(-.01)	.6(.06)	.999	1.002	.972	.941
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.997	.999	.969	.938
13.1(43.00)	-1.2(-.11)	-.4(-.04)	-.0(-.00)	-.4(-.03)	.991	.995	.969	.934
15.2(50.00)	-.1(-.01)	-.1(-.01)	-.1(-.01)	-.2(-.01)	.988	.995	.969	.934
16.8(55.00)	-.1(-.01)	-.1(-.01)	-.2(-.02)	-.2(-.01)	.989	.997	.971	.936
17.7(58.00)	-.3(-.03)	-.3(-.03)	-.2(-.02)	-.2(-.02)	.991	.998	.974	.940
18.3(60.00)	-.4(-.04)	-.4(-.04)	-.2(-.02)	-.3(-.02)	.993	1.000	.977	.943
18.9(62.00)	-.5(-.04)	-.0(-.00)	-.1(-.01)	-.3(-.02)	.996	1.002	.981	.946
19.5(64.00)	-.0(-.00)	.1(.01)	-.0(-.00)	-.3(-.02)	1.000	1.007	.986	.949
20.1(66.00)	.1(.01)	1.0(.08)	.1(.01)	-.5(-.04)	1.005	1.013	.990	.951
20.5(67.38)	-1.1(-.10)	-.5(-.04)	-1.1(-.10)	-.7(-.06)	1.009	1.018	.993	.952
20.7(68.00)	-.7(-.06)	-.8(-.07)	-.6(-.06)	-.9(-.08)	1.011	1.020	.993	.952
20.9(68.50)	-.7(-.06)	-.7(-.06)	-.7(-.06)	-.8(-.07)	1.011	1.020	.993	.953
21.0(69.00)	-.6(-.05)	-.6(-.05)	-.7(-.06)	-.6(-.05)	1.012	1.020	.992	.954
21.2(69.50)	-.5(-.04)	-.7(-.06)	-.7(-.06)	-.7(-.06)	1.014	1.021	.991	.954
21.3(69.87)	-.5(-.04)	-.8(-.07)	-.8(-.07)	-.7(-.06)	1.017	1.022	.992	.953

SUMMARY SHEET

RUN NO. 23005

DATE:

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.230 (0.507)
2. Water flow - [kg/sec (lb/sec)] - 0.112 (0.248)
3. Containment tank pressure [kPa (psig)] - 179 (26)
4. Steam temperature [°C (°F)] - 154 (309)
5. Water temperature [°C (°F)] - 126 (258)
6. Mixer pressure [kPa (psig)] - 214 (31)
7. Test time (sec) - 1445.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.1 (33.2)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [°C (°F)]
0.00 (0.00)	256 (493)
0.15 (0.50)	271 (520)
0.30 (1.00)	274 (526)
0.46 (1.50)	273 (523)
0.61 (2.00)	272 (521)
1.22 (4.00)	-
3.05 (10.00)	273 (524)
6.09 (20.00)	272 (522)
8.23 (27.00)	-
10.67 (35.00)	273 (523)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 5.48 (12.08)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 8.01 (17.65)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 1.80 (3.96)

D. FAILED BUNDLE T/Cs[1]

294, 295, 305, 308, 309, 310, 311, 321, 326, 518, 520, 521, 532, 549, 553, 555, 564, 565, 568, 569

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TC PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

1. From primary side energy balance [kwsec(Btu)] - 0.511×10^5 (0.487×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da dt$) - [kwsec(Btu)] - 0.240×10^5 (0.229×10^5)
3. Integration to 180 sec

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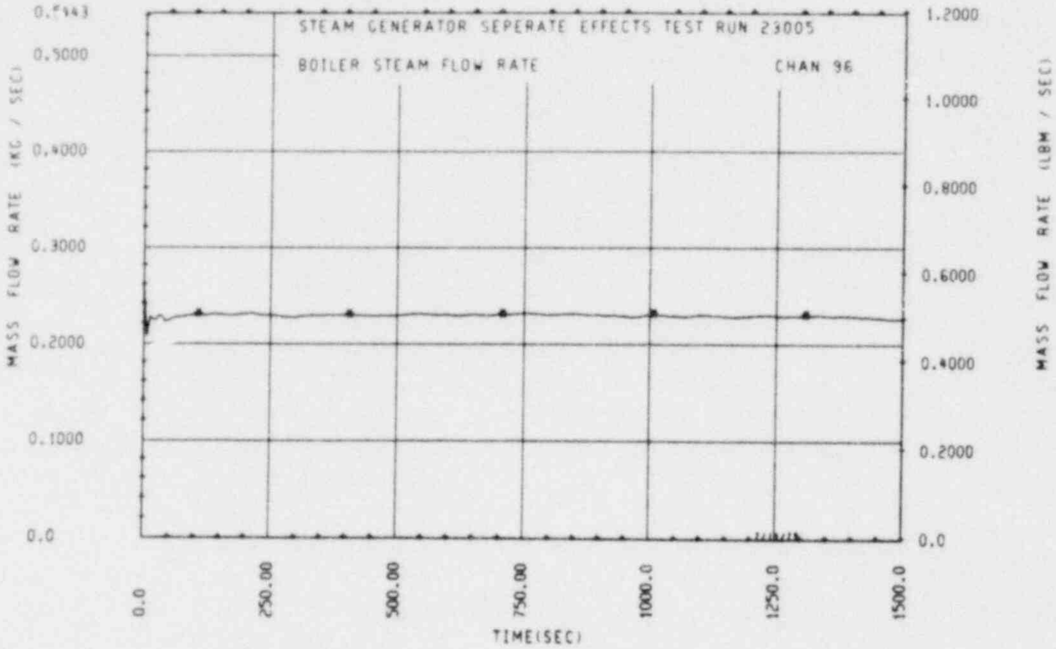
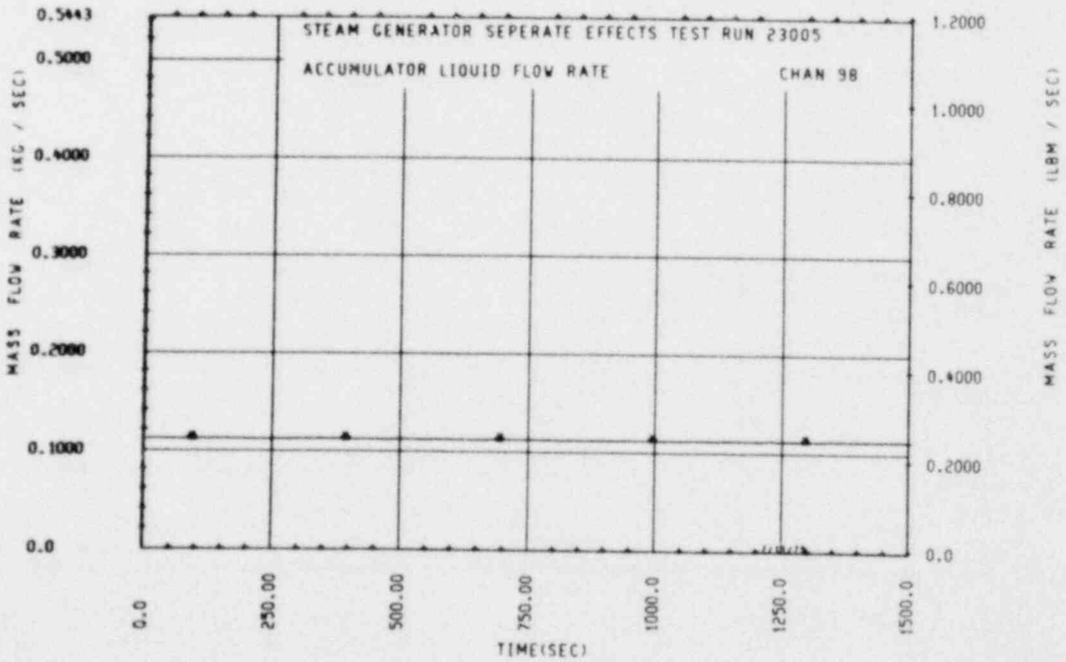
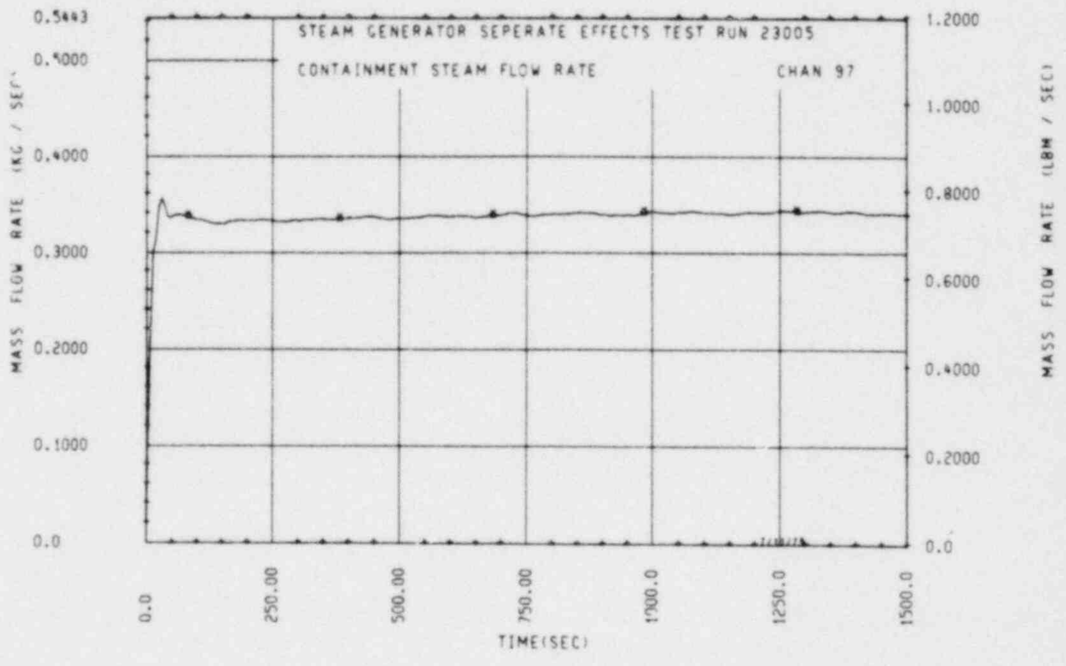
1. T/Cs are defined as failed based on resistance reading or T/C response.

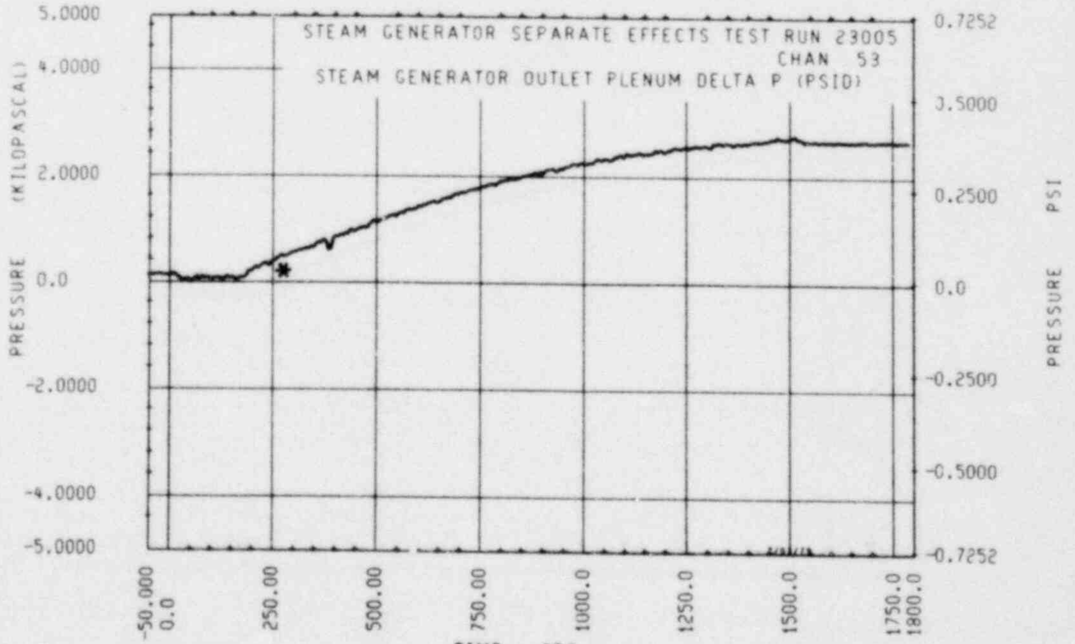


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23005
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

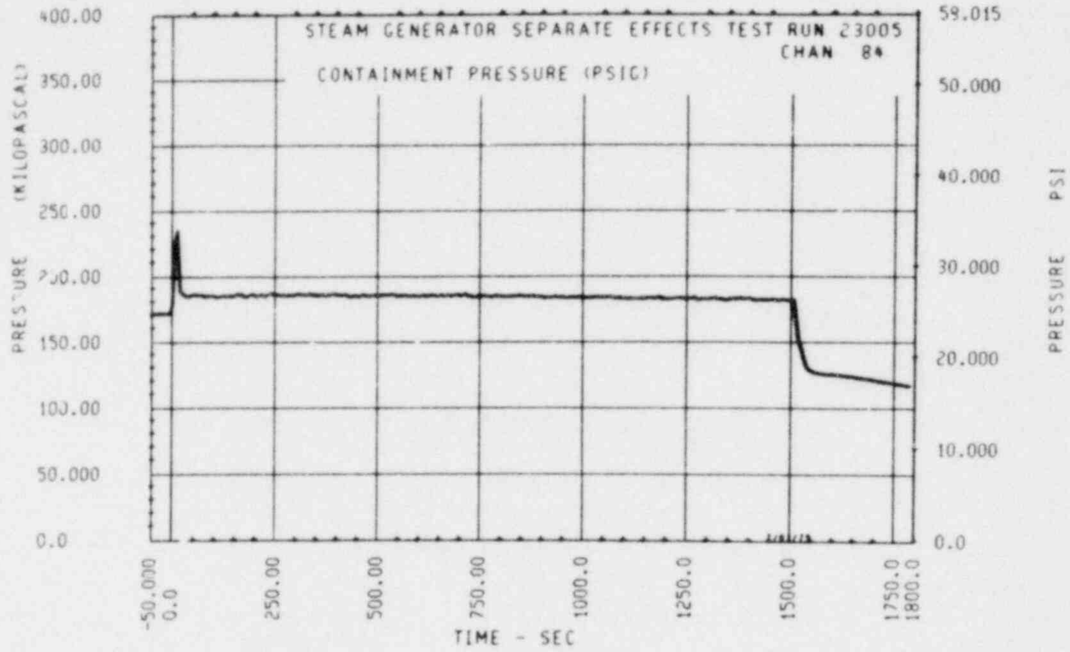


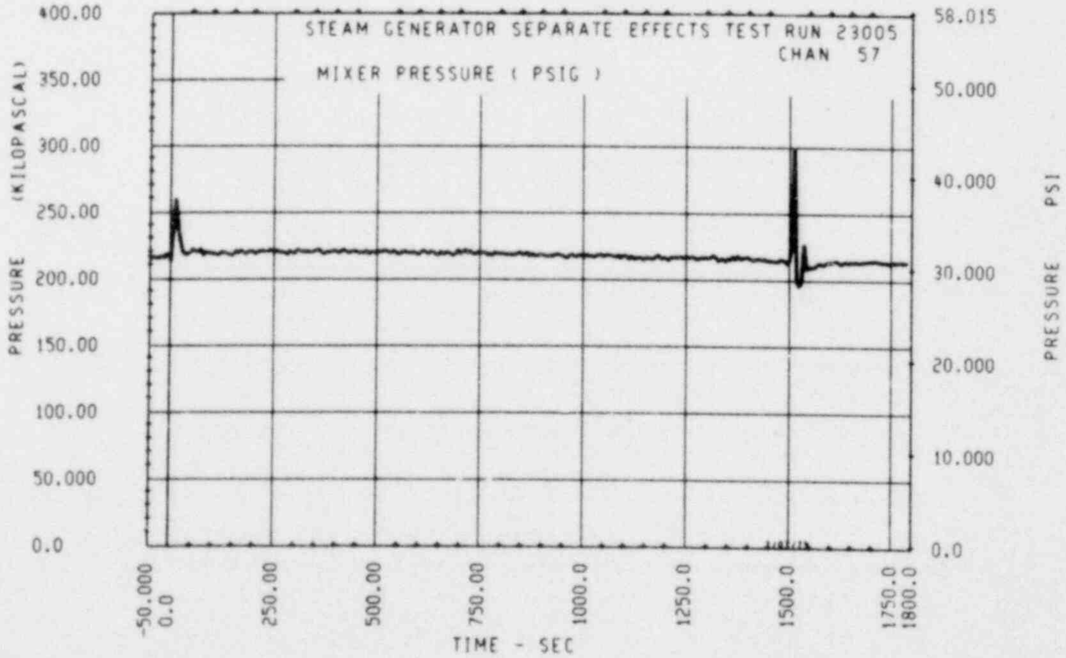
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23005
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

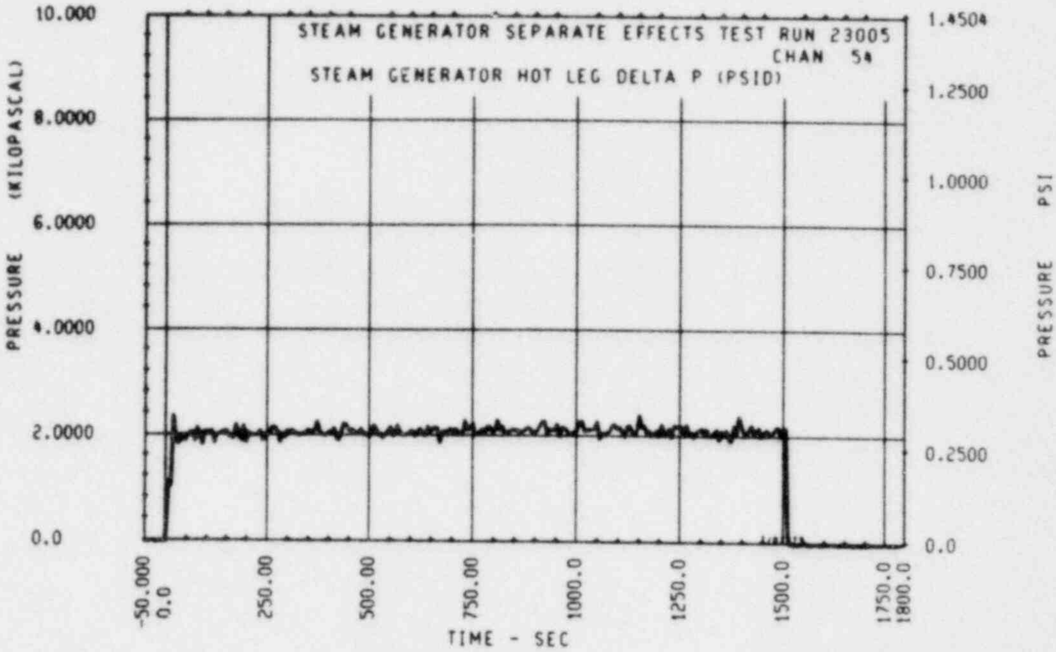


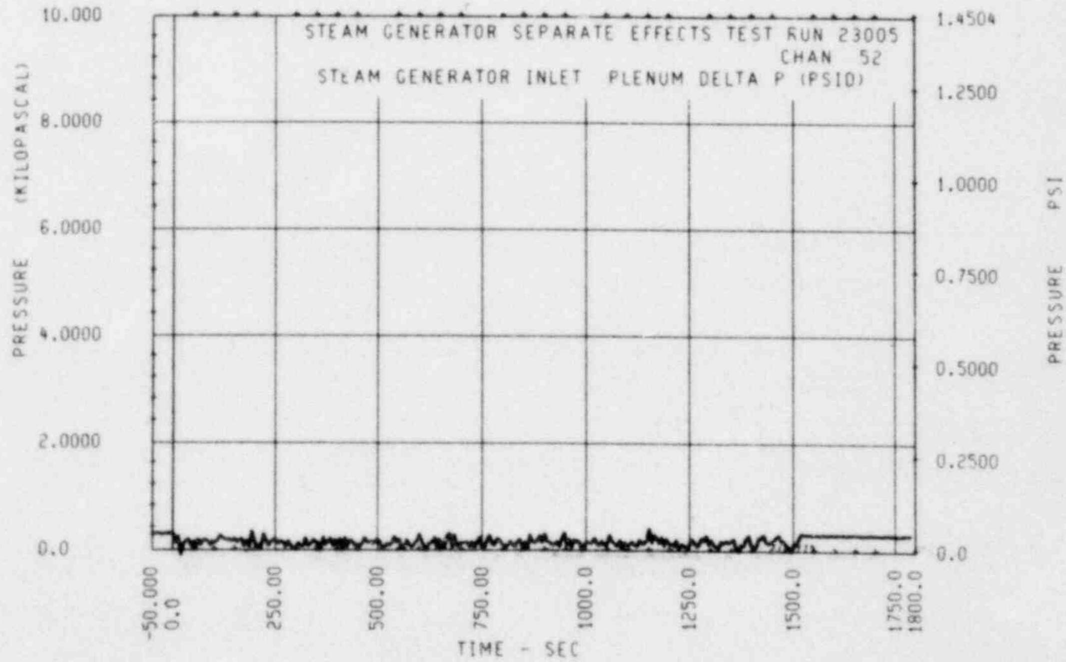


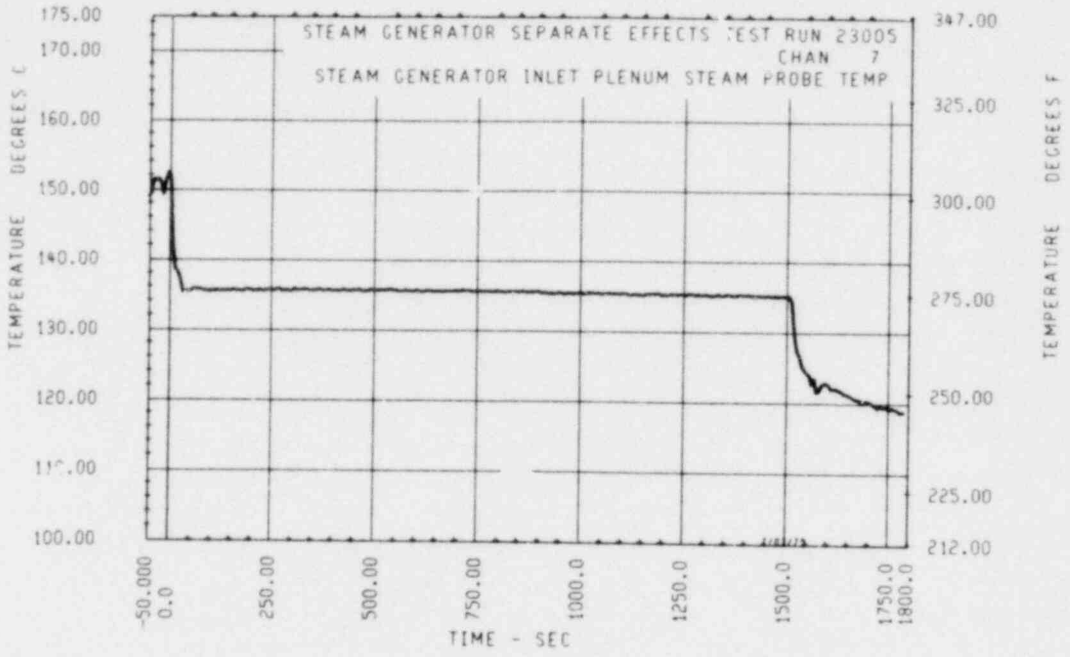
* Refer to Appendix H text for explanation of delayed response.

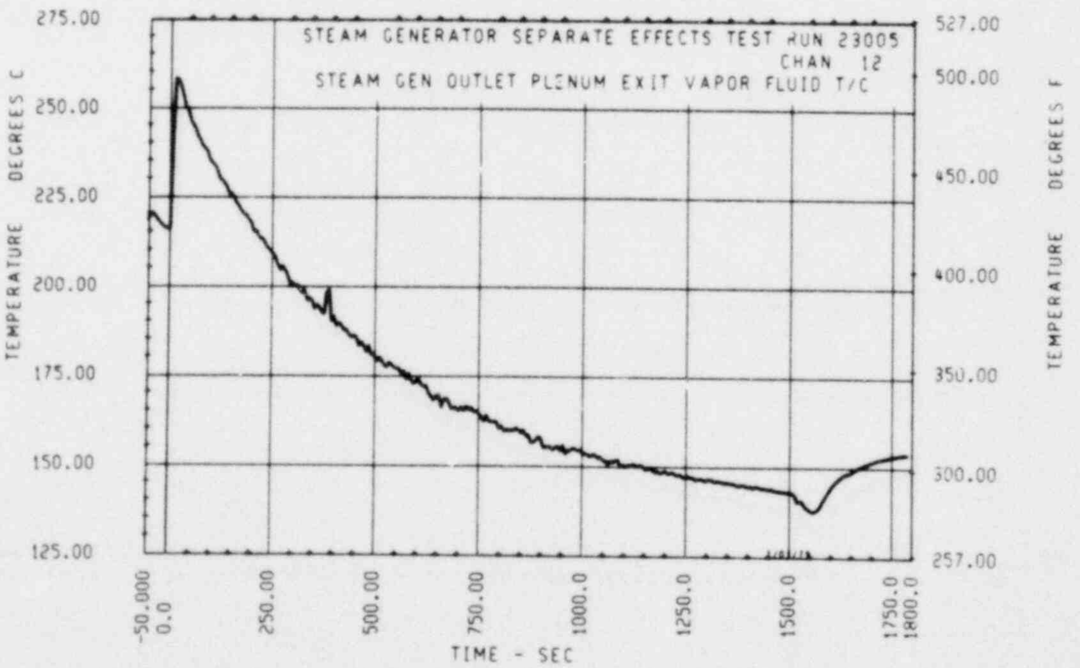

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23005
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23005
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

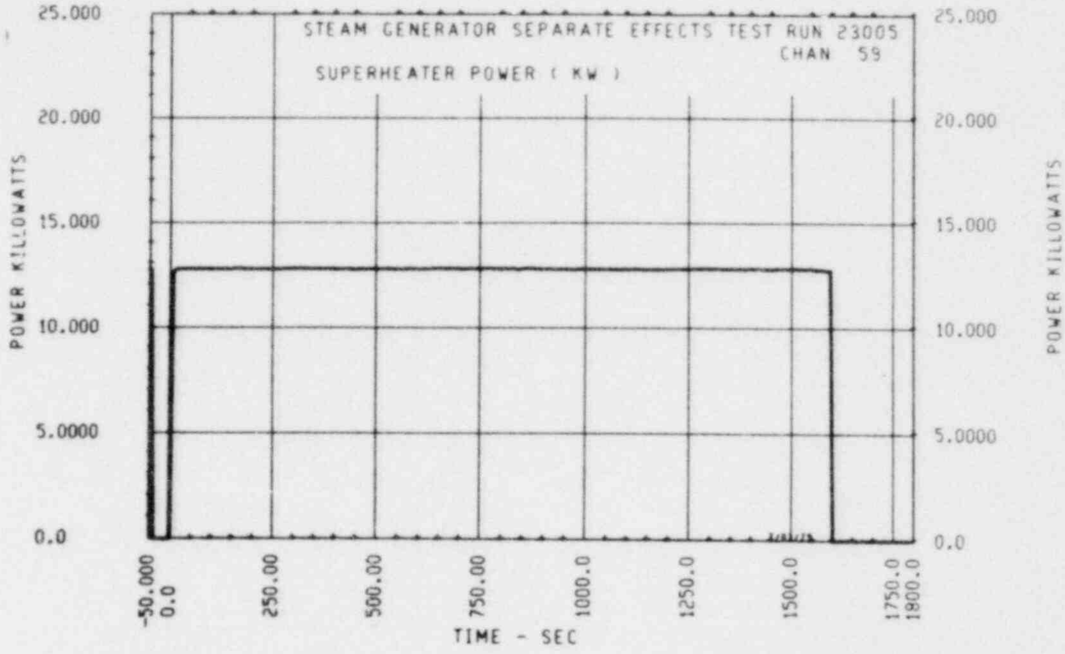

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23005
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23005
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

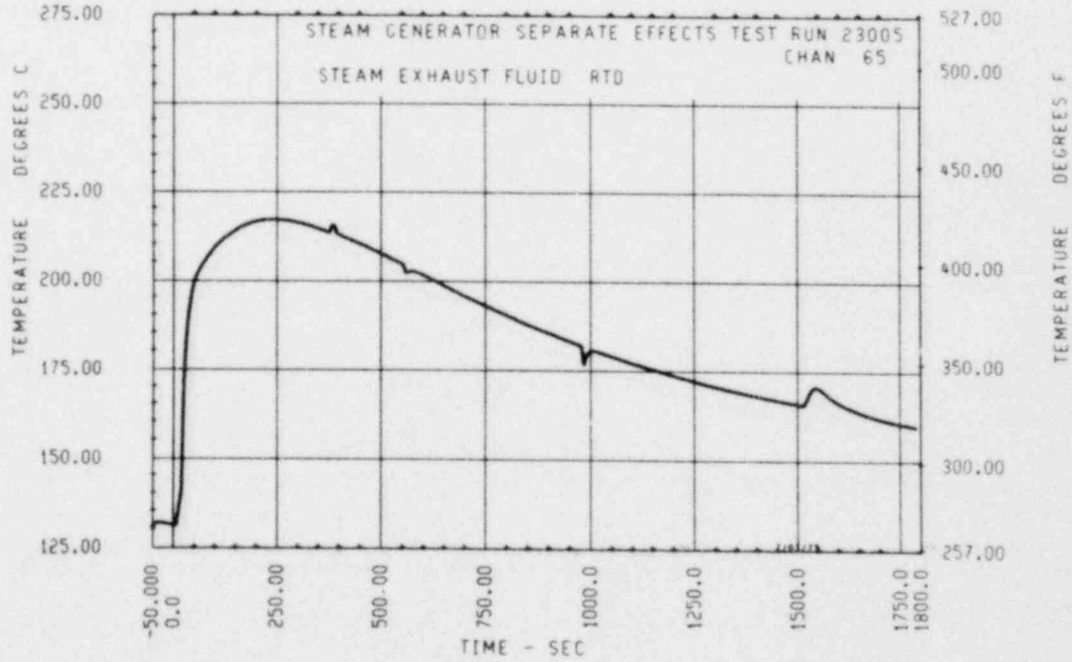

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23005
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23005
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

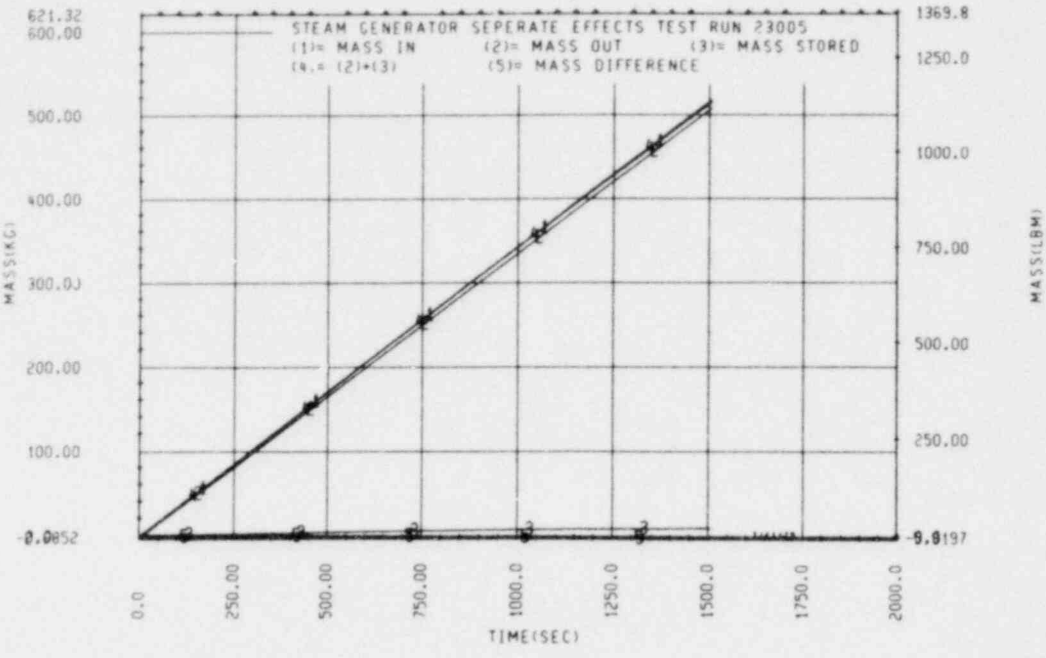
23005-7

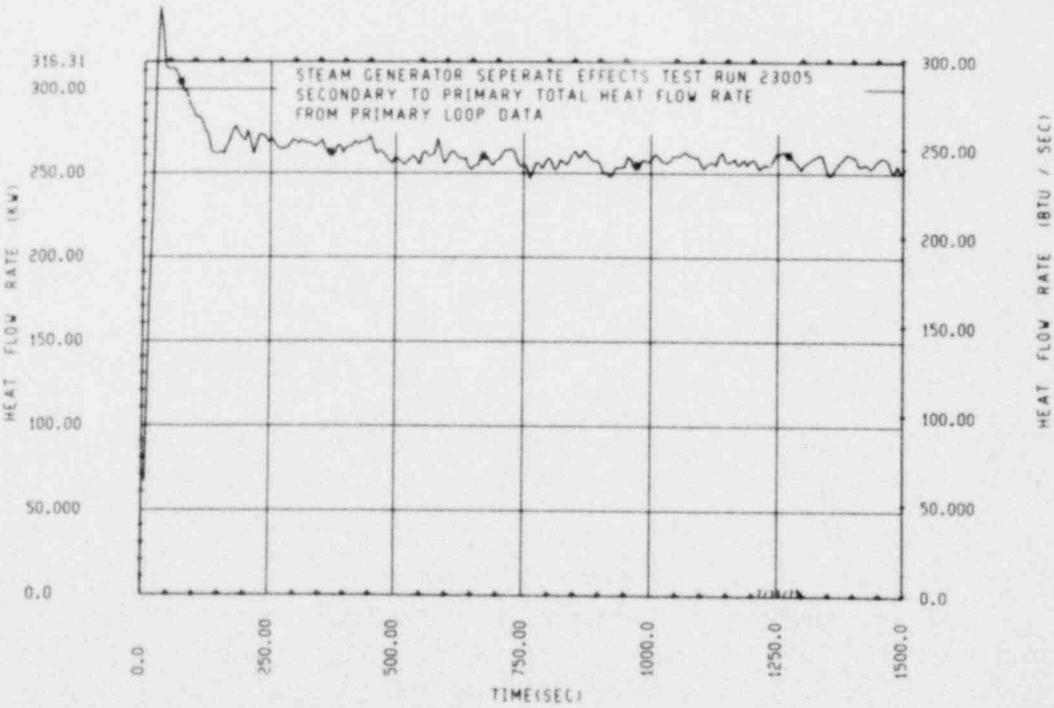


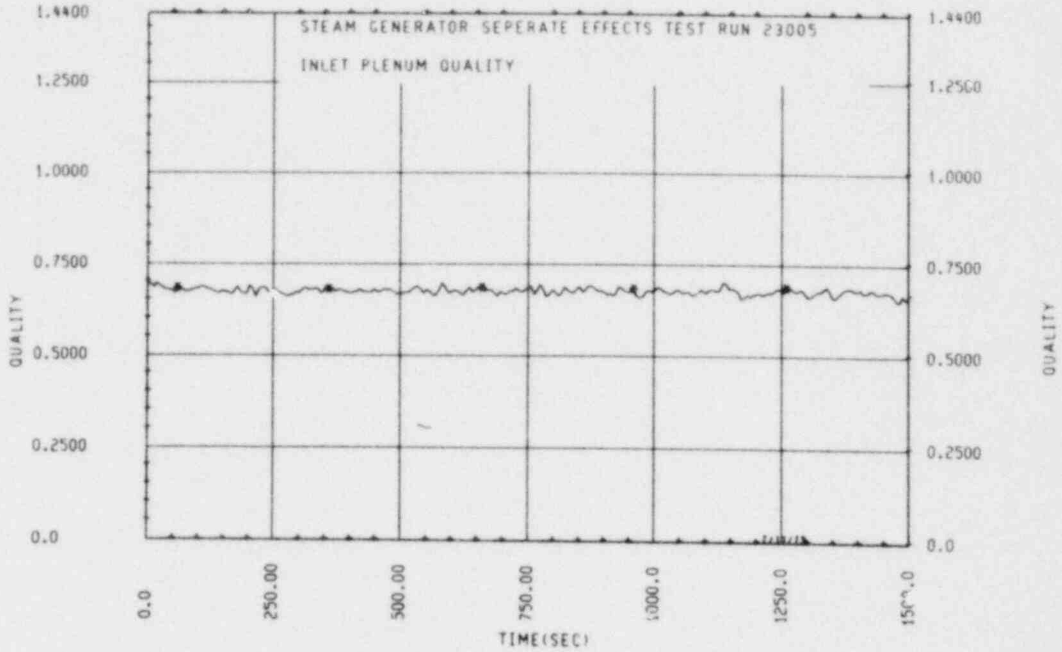
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23005
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

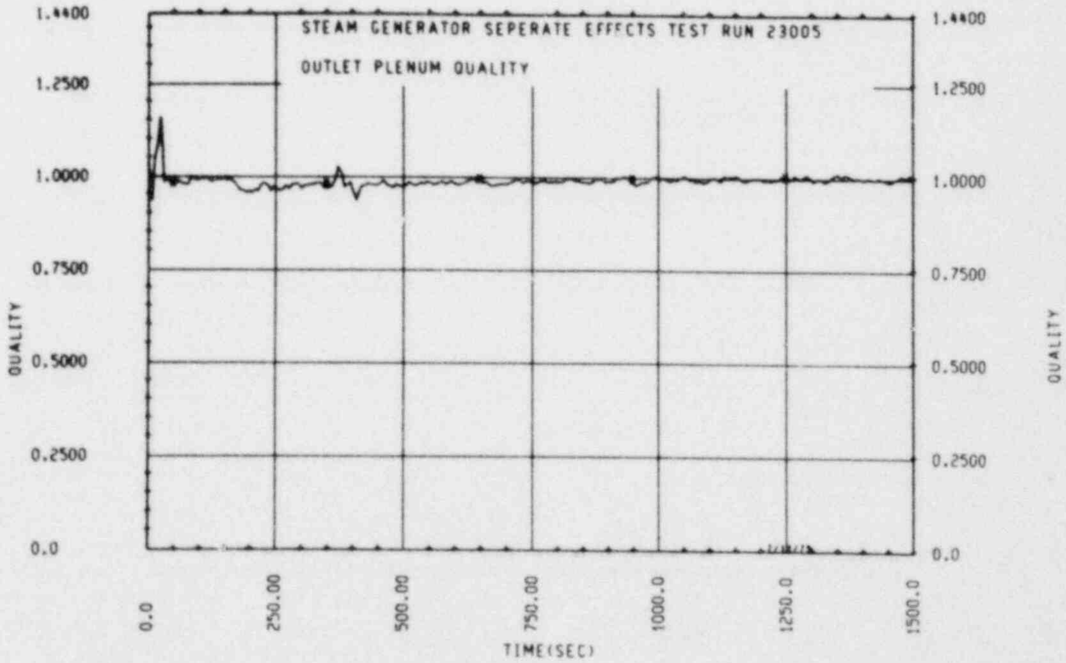


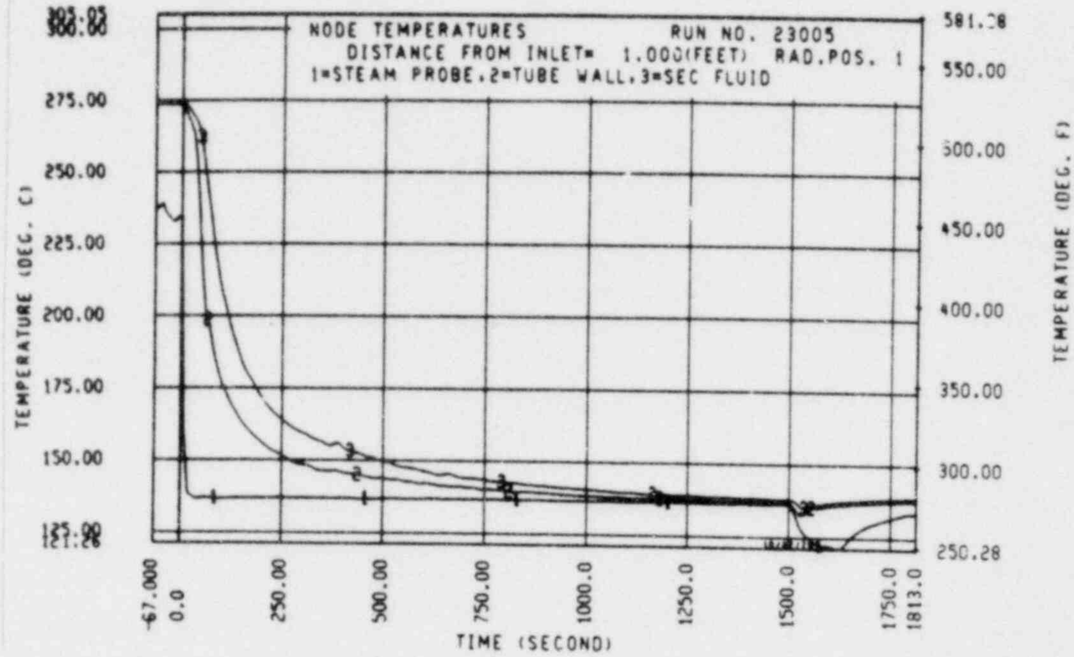
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23005
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

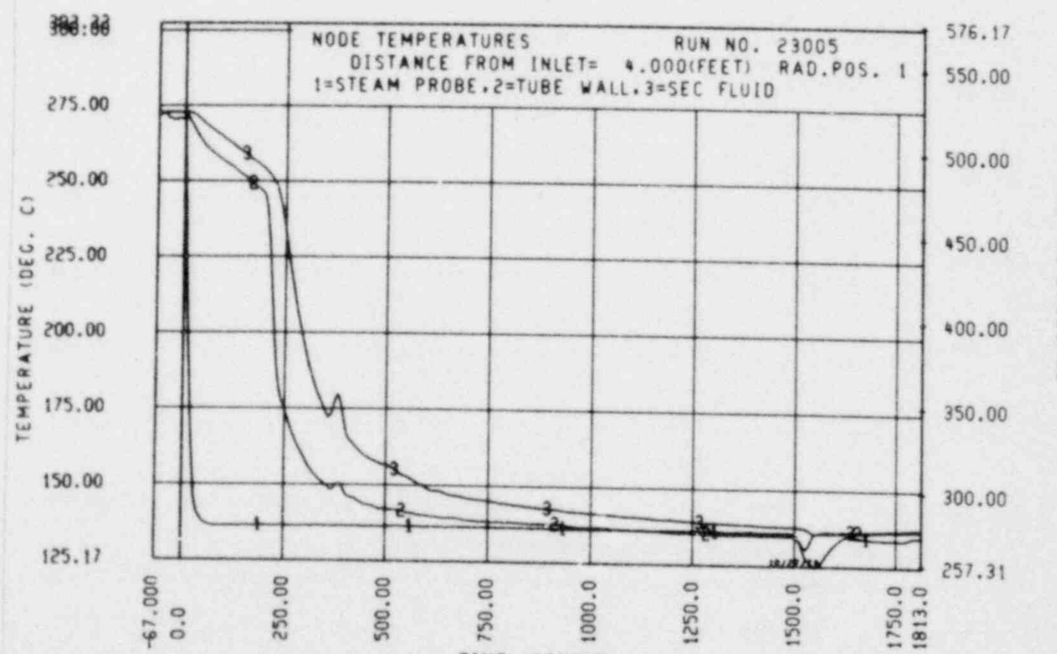

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23005
(1)= MASS IN
(2)= MASS OUT
(3)= MASS STORED
(4.= (2)+(3)
(5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)
621.32
600.00
500.00
400.00
300.00
200.00
100.00
-0.0852
1369.8
1250.0
1000.0
750.00
500.00
250.00
-0.0197
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
2000.0

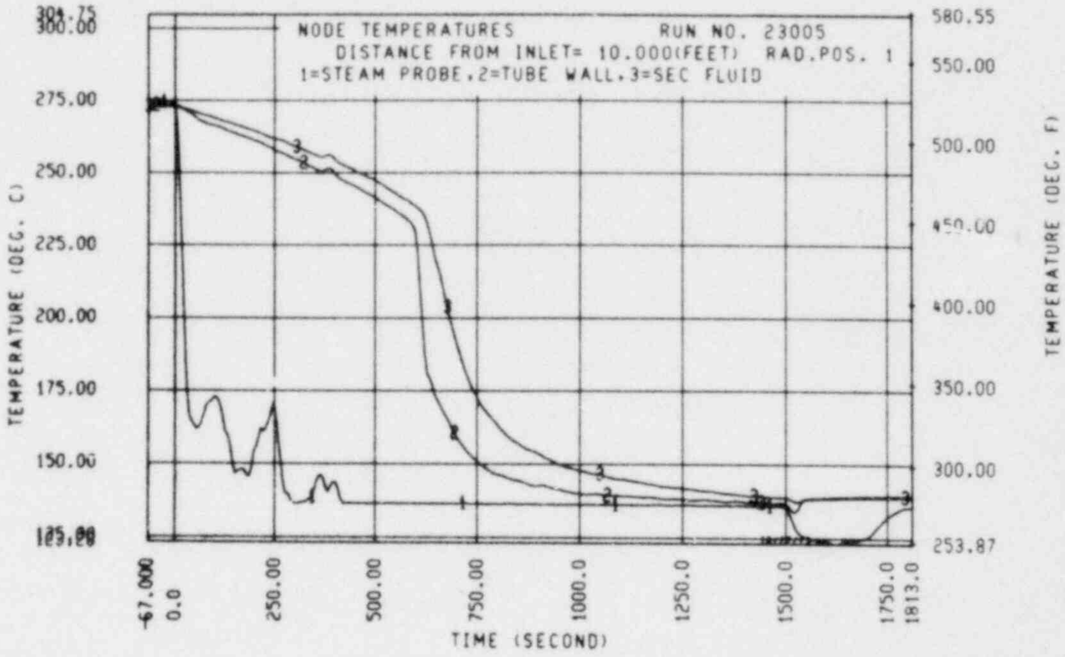

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23005
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)
316.31
300.00
250.00
200.00
150.00
100.00
50.000
0.0
300.00
250.00
200.00
150.00
100.00
50.000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

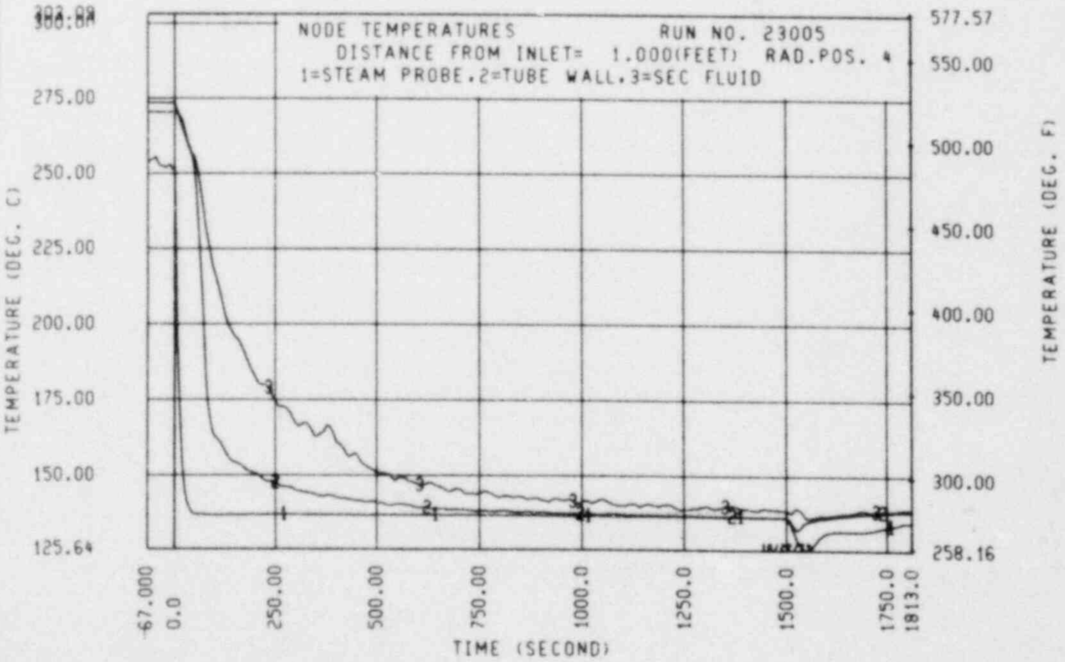

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23005
INLET PLENUM QUALITY
QUALITY
TIME(SEC)
0.0
0.2500
0.5000
0.7500
1.0000
1.2500
1.4400
250.00
500.00
750.00
1000.0
1250.0

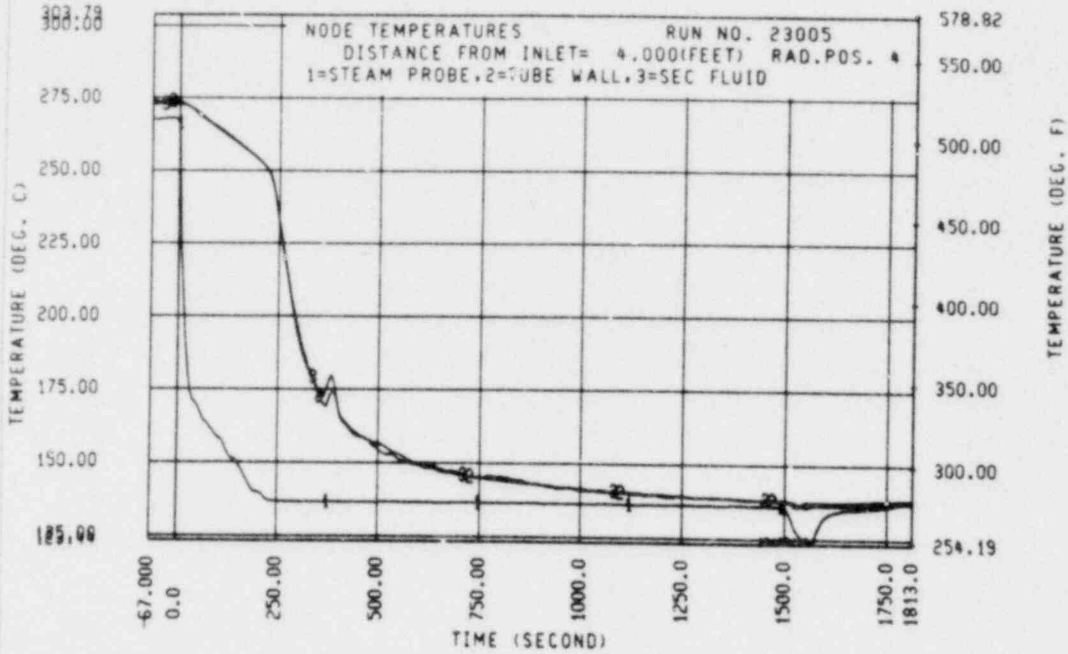

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23005
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)
0.0
0.2500
0.5000
0.7500
1.0000
1.2500
1.4400
250.00
500.00
750.00
1000.0
1250.0
1500.0

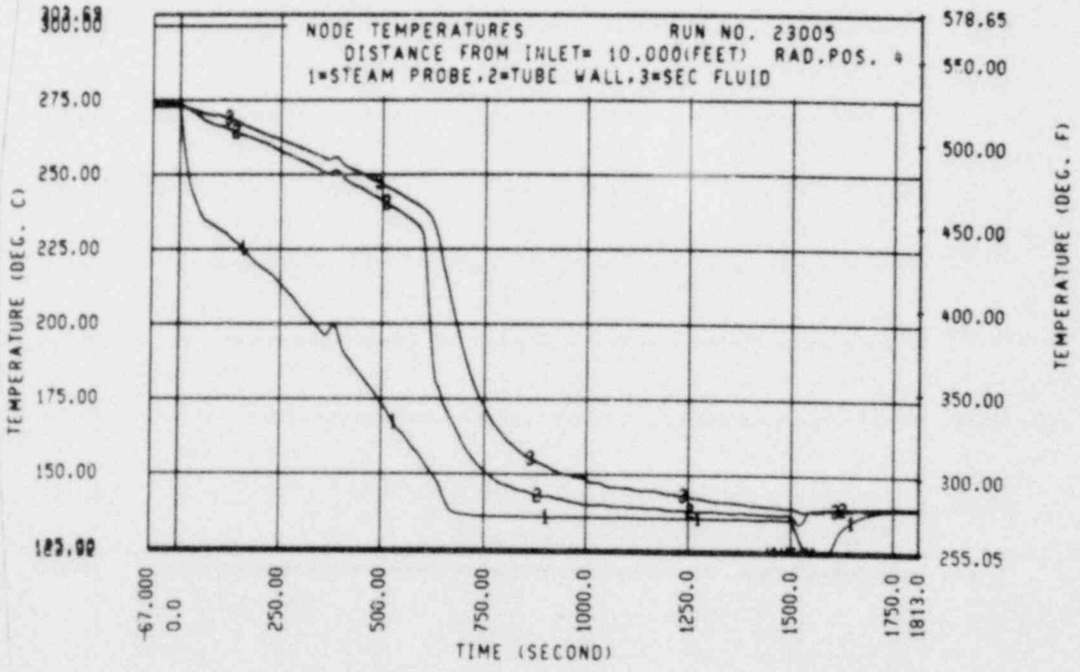

NODE TEMPERATURES RUN NO. 23005
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

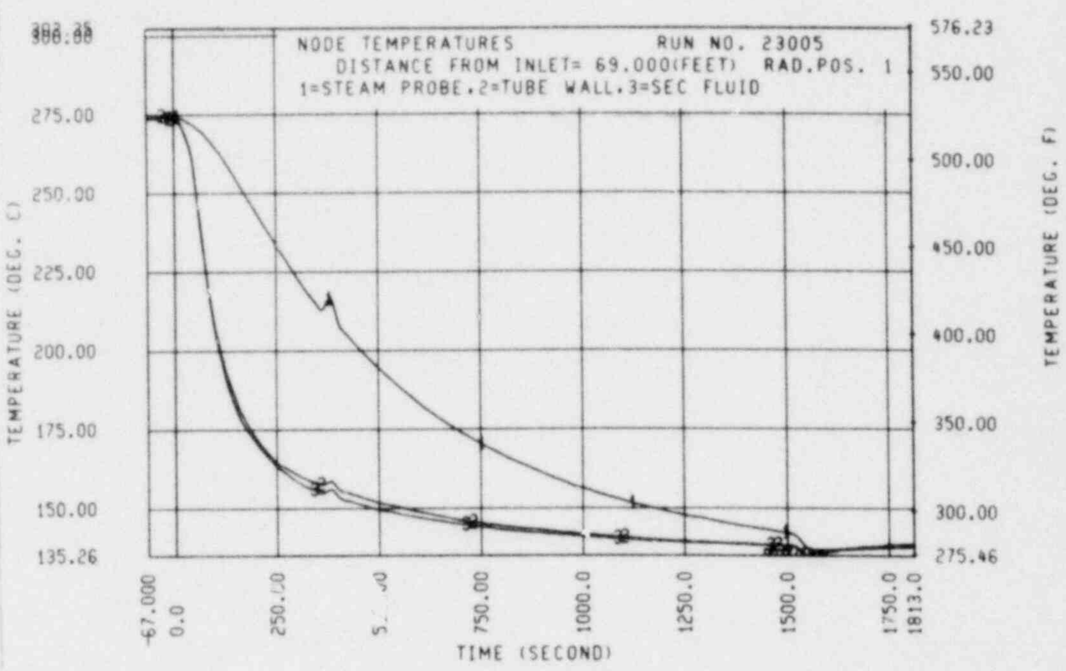

NODE TEMPERATURES RUN NO. 23005
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

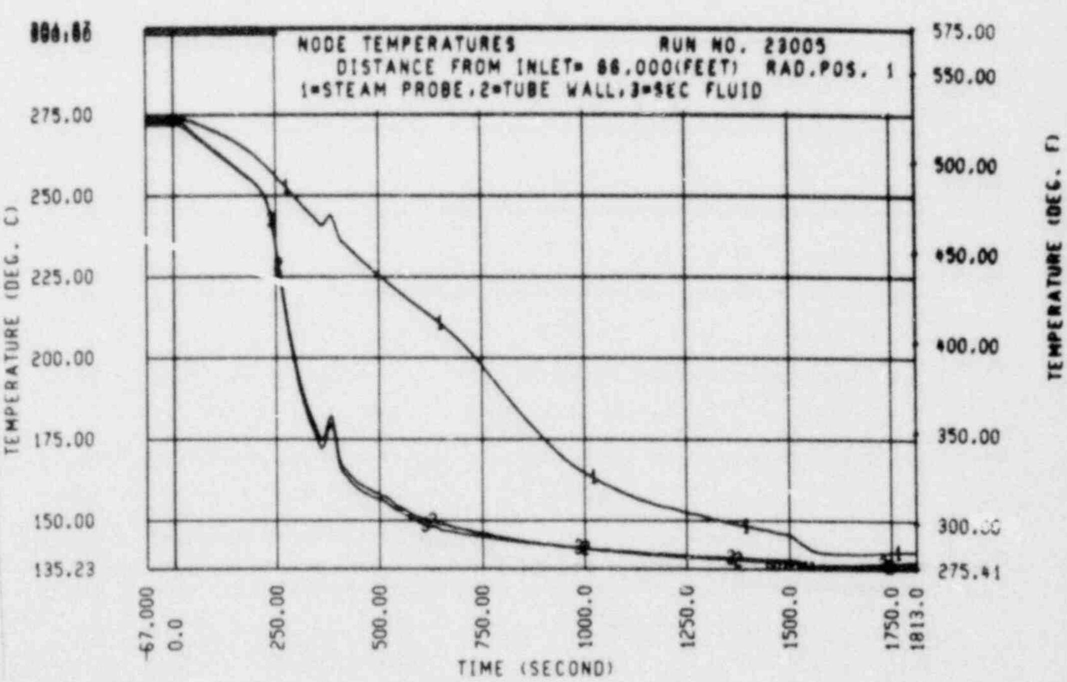

NODE TEMPERATURES RUN NO. 23005
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

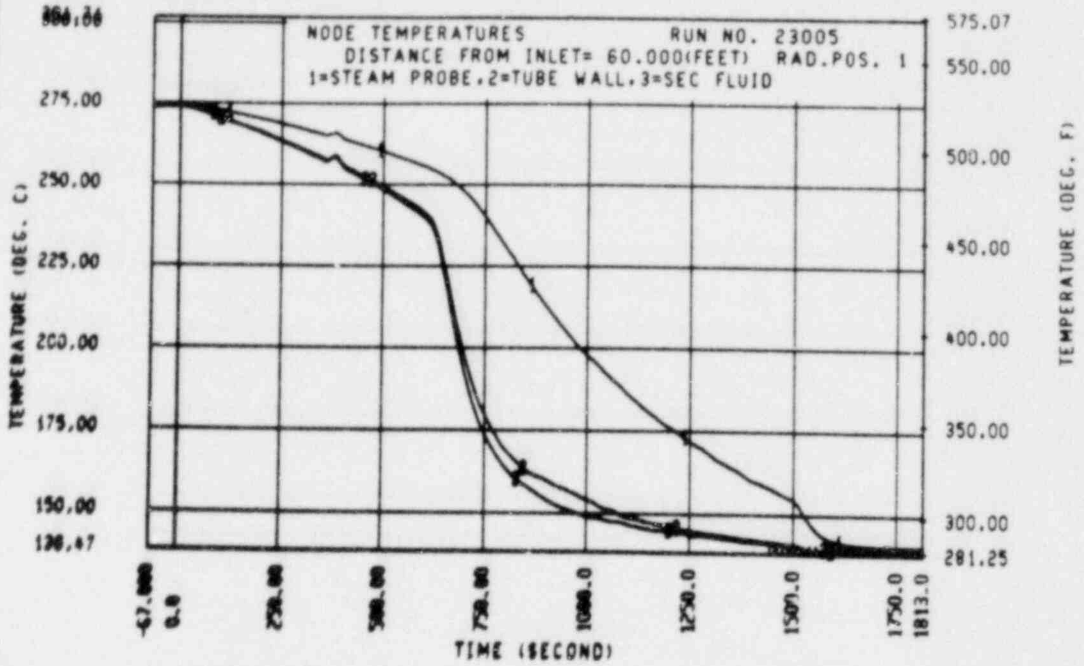

NODE TEMPERATURES RUN NO. 23005
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 23005
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

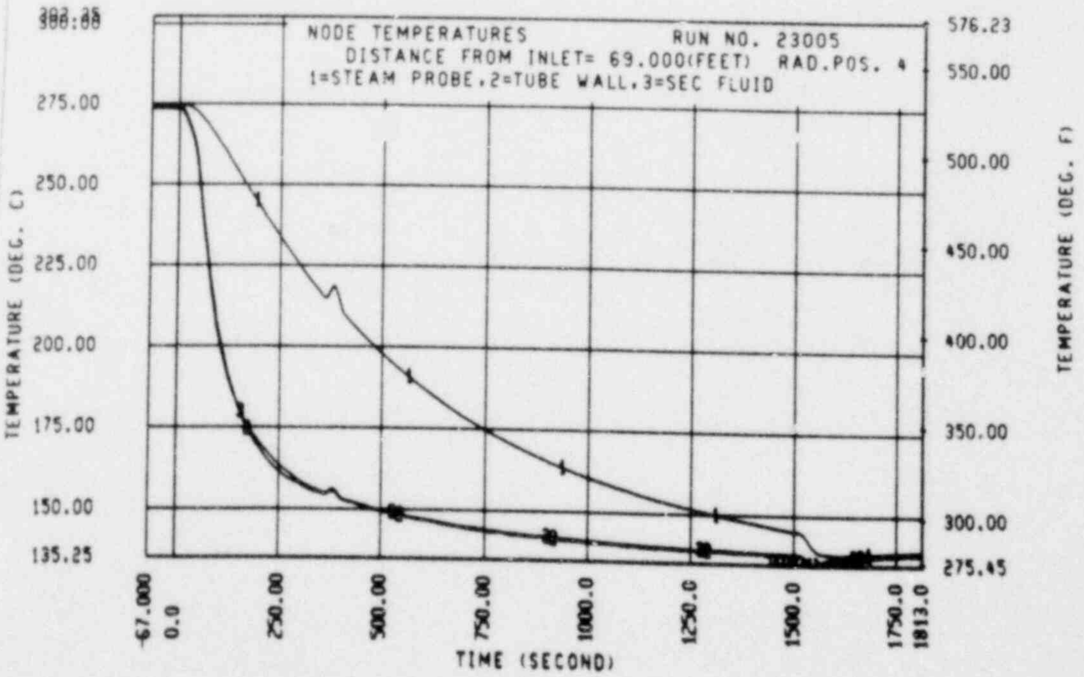

NODE TEMPERATURES RUN NO. 23005
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 23005
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

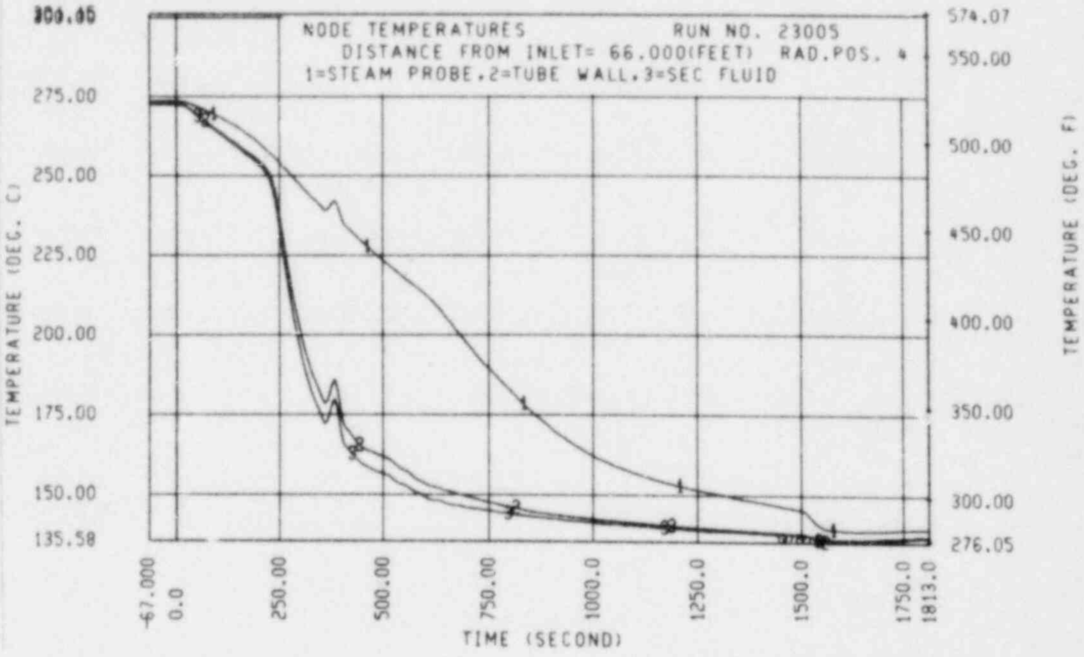

NODE TEMPERATURES RUN NO. 23005
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)



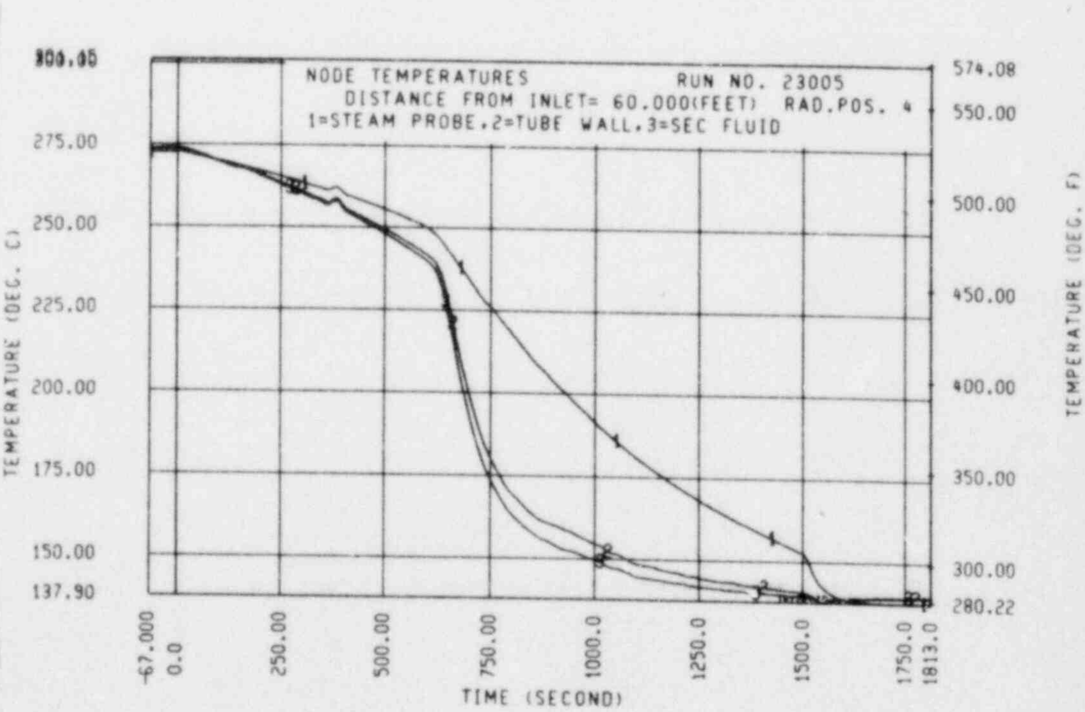
NODE TEMPERATURES RUN NO. 23005
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
TEMPERATURE (DEG. F)
575.07
550.00
500.00
450.00
400.00
350.00
300.00
281.25
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1813.0
TIME (SECOND)



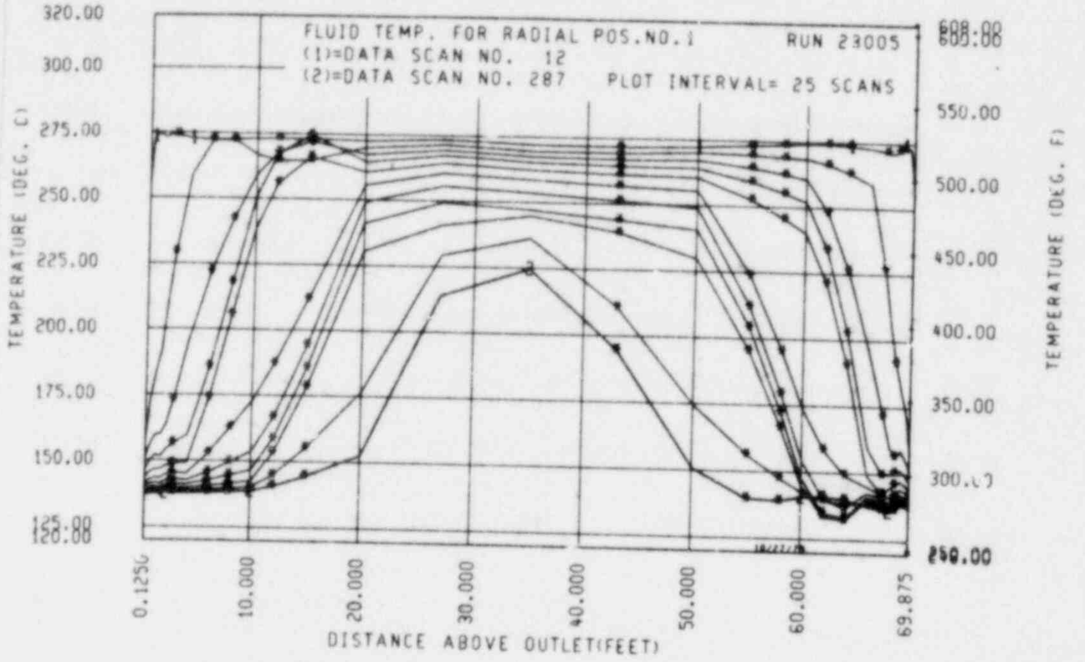
NODE TEMPERATURES RUN NO. 23005
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
135.25
TEMPERATURE (DEG. F)
576.23
550.00
500.00
450.00
400.00
350.00
300.00
275.45
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1813.0
TIME (SECOND)



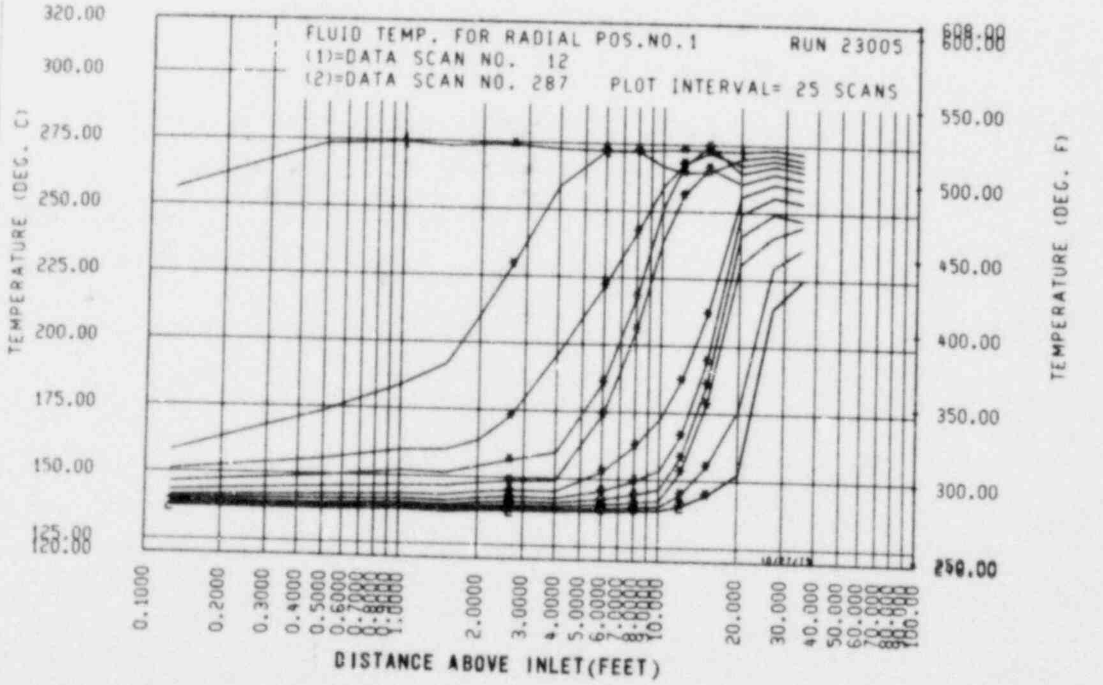
NODE TEMPERATURES RUN NO. 23005
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
300.05
275.00
250.00
225.00
200.00
175.00
150.00
135.58
TEMPERATURE (DEG. F)
574.07
550.00
500.00
450.00
400.00
350.00
300.00
276.05
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1813.0
TIME (SECOND)



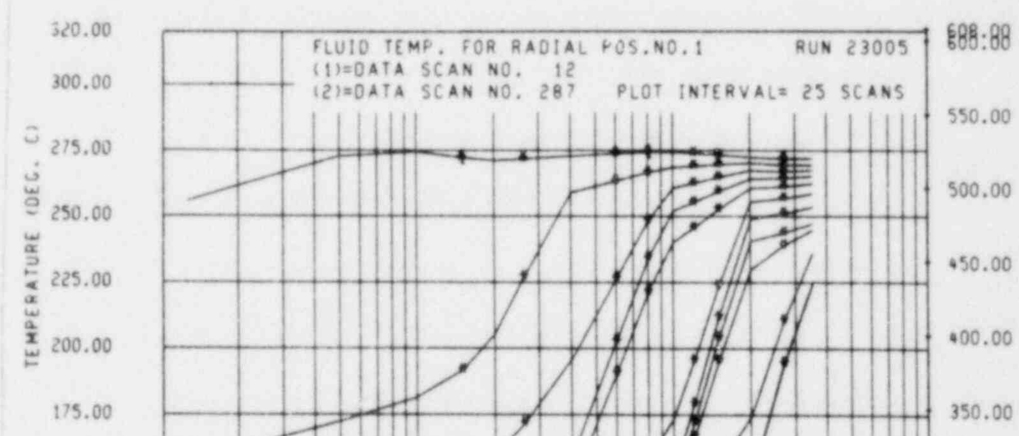
NODE TEMPERATURES RUN NO. 23005
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
300.05
275.00
250.00
225.00
200.00
175.00
150.00
137.90
TEMPERATURE (DEG. F)
574.08
550.00
500.00
450.00
400.00
350.00
300.00
280.22
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1813.0
TIME (SECOND)



FLUID TEMP. FOR RADIAL POS.NO.1
RUN 23005
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 287
PLOT INTERVAL= 25 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)



FLUID TEMP. FOR RADIAL POS.NO.1
RUN 23005
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 287
PLOT INTERVAL= 25 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)



FLUID TEMP. FOR RADIAL POS.NO.1
RUN 23005
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 287
PLOT INTERVAL= 25 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

23005-18

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 23005

TIME = 59.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.4(.04)	68.9(6.07)	76.4(6.73)	42.9(3.78)	.213	.228	.275	.515
.2(.50)	208.7(18.39)	226.2(19.93)	227.6(20.06)	238.6(21.03)	.278	.310	.358	.596
.3(1.00)	357.4(31.49)	393.9(34.71)	1.0(.09)	98.0(8.64)	.456	.504	.430	.702
.5(1.50)	1.2(.10)	1.2(.10)	34.3(3.03)	56.4(4.97)	.558	.628	.441	.751
.6(2.00)	129.4(11.40)	35.4(3.12)	98.7(6.70)	14.6(1.29)	.609	.640	.483	.772
.8(2.65)	1.2(.11)	-32.7(-2.89)	110.2(9.71)	8.0(.70)	.650	.635	.506	.776
1.2(4.00)	16.7(1.47)	8.5(.75)	7.1(.62)	1.2(.10)	.672	.621	.619	.766
1.8(6.00)	18.2(1.60)	21.1(1.86)	5.0(.44)	11.0(.97)	.715	.638	.616	.762
2.4(8.00)	10.2(.90)	15.3(1.35)	-1.7(-.15)	4.5(.39)	.745	.667	.604	.766
3.0(10.00)	4.3(.38)	4.3(.38)	5.2(.46)	4.4(.39)	.751	.681	.599	.764
3.7(12.00)	.2(.01)	.0(.00)	6.4(.57)	.5(.04)	.736	.681	.606	.761
4.6(15.00)	2.3(.20)	.5(.05)	4.7(.42)	1.1(.10)	.718	.675	.619	.757
6.1(20.00)	-.1(-.01)	.1(.01)	.4(.03)	-.0(-.00)	.704	.670	.626	.754
8.2(27.00)	.1(.01)	.1(.01)	-.8(-.07)	-.3(-.03)	.701	.668	.621	.751
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.704	.670	.619	.751
13.1(43.00)	-1.2(-.11)	-.2(-.02)	.1(.00)	-.3(-.02)	.701	.671	.621	.752
15.2(50.00)	-.0(-.00)	.1(.01)	-.0(-.00)	-.1(-.01)	.696	.671	.622	.751
16.8(55.00)	.2(.02)	.1(.00)	.0(.00)	-.0(-.00)	.697	.672	.623	.751
17.7(58.00)	.3(.03)	-.0(-.00)	.0(.00)	.0(.00)	.698	.672	.624	.752
18.3(60.00)	.7(.06)	-.1(-.01)	.1(.01)	.1(.01)	.700	.672	.625	.753
18.9(62.00)	1.2(.11)	.0(.00)	.1(.01)	.0(.00)	.702	.673	.626	.753
19.5(64.00)	.2(.01)	.2(.01)	.1(.01)	-.0(-.00)	.705	.674	.627	.754
20.1(66.00)	.2(.02)	1.1(.10)	.2(.02)	-.3(-.03)	.706	.676	.627	.754
20.5(67.38)	-1.5(-.13)	-.6(-.05)	-1.5(-.13)	-4.3(-.37)	.706	.678	.627	.752
20.7(68.00)	-4.7(-.41)	-3.6(-.32)	-4.7(-.41)	-7.1(-.63)	.705	.677	.625	.746
20.9(68.50)	-6.2(-.55)	-6.1(-.53)	-13.1(-1.16)	-4.1(-.36)	.702	.674	.620	.745
21.0(69.00)	3.3(.29)	2.7(.24)	1.9(.16)	8.2(.72)	.703	.673	.617	.747
21.2(69.50)	-1.1(-.09)	-1.3(-.11)	-1.3(-.11)	-1.2(-.11)	.708	.675	.618	.751
21.3(69.87)	-16.8(-1.48)	-14.5(-1.28)	-9.6(-.84)	-8.0(-.70)	.709	.674	.617	.750

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 23005

TIME = 179.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.02)	23.4(2.06)	20.4(1.80)	24.0(2.12)	.215	.223	.269	.516
.2(.50)	56.4(4.97)	59.3(5.22)	62.5(5.50)	60.3(5.32)	.232	.245	.291	.536
.3(1.00)	69.5(6.13)	84.5(7.45)	4.3(.38)	132.3(11.66)	.271	.290	.312	.597
.5(1.50)	84.7(7.46)	90.2(7.95)	29.2(2.57)	95.2(8.39)	.320	.345	.322	.668
.6(2.00)	125.9(11.10)	119.2(10.50)	130.6(11.50)	101.4(8.93)	.385	.410	.372	.729
.8(2.65)	.7(.06)	.7(.06)	184.3(16.24)	84.8(7.47)	.425	.448	.499	.798
1.2(4.00)	18.1(1.60)	16.9(1.49)	10.6(.93)	1.1(.09)	.448	.466	.594	.832
1.8(6.00)	-.0(-.00)	1.1(.10)	2.2(.19)	4.8(.42)	.471	.480	.596	.822
2.4(8.00)	-.1(-.00)	.2(.02)	1.3(.12)	9.0(.79)	.469	.473	.586	.818
3.0(10.00)	7.8(.69)	7.8(.69)	8.9(.78)	8.1(.71)	.474	.471	.586	.820
3.7(12.00)	31.8(2.80)	16.5(1.45)	8.0(.71)	1.3(.12)	.539	.492	.598	.819
4.6(15.00)	10.0(.89)	6.6(.58)	5.5(.49)	1.4(.13)	.549	.520	.613	.815
6.1(20.00)	-.1(-.01)	.2(.02)	.5(.05)	.1(.01)	.554	.533	.620	.811
8.2(27.00)	.5(.05)	.2(.02)	-.7(-.07)	-.2(-.02)	.552	.526	.615	.806
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.557	.529	.612	.805
13.1(43.00)	-1.4(-.12)	-.3(-.03)	.0(.00)	-.3(-.03)	.553	.528	.614	.806
15.2(50.00)	-.1(-.01)	.0(.00)	-.1(-.01)	-.2(-.02)	.547	.526	.615	.804
16.8(55.00)	-.0(-.00)	-.0(-.00)	-.1(-.01)	-.2(-.02)	.548	.529	.615	.804
17.7(58.00)	-.0(-.00)	-.1(-.01)	-.2(-.01)	-.1(-.01)	.548	.529	.615	.805
18.3(60.00)	-.2(-.02)	-.6(-.05)	-.3(-.02)	-.1(-.01)	.546	.529	.616	.806
18.9(62.00)	-.3(-.03)	-.1(-.01)	-.1(-.01)	-.2(-.02)	.548	.529	.617	.806
19.5(64.00)	-.0(-.00)	.1(.01)	-.0(-.00)	-.3(-.03)	.549	.530	.619	.807
20.1(66.00)	.1(.01)	1.2(.10)	.1(.01)	-1.0(-.09)	.551	.534	.621	.808
20.5(67.38)	-7.0(-.61)	-6.0(-.53)	-7.0(-.61)	-16.9(-1.49)	.550	.534	.619	.801
20.7(68.00)	-36.4(-3.21)	-31.6(-2.79)	-36.4(-3.21)	-36.9(-3.25)	.536	.524	.607	.785
20.9(68.50)	-29.8(-2.62)	-32.7(-2.89)	-41.3(-3.64)	-37.4(-3.30)	.522	.506	.587	.767
21.0(69.00)	2.8(.24)	2.2(.19)	.3(.03)	-1.4(-.13)	.518	.499	.573	.761
21.2(69.50)	-27.5(-2.42)	-1.6(-.14)	-34.5(-3.04)	-30.0(-2.64)	.516	.502	.569	.755
21.3(69.87)	-7.1(-.62)	-7.2(-.64)	-5.3(-.46)	-4.6(-.41)	.511	.503	.560	.747

23005-20

SUMMARY SHEET

RUN NO. 23207

DATE: 4/11/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.183 (0.403)
2. Water flow - [kg/sec (lb/sec)] - 0.045 (0.100)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{o}C (^{o}F)] - 151 (304)
5. Water temperature [^{o}C (^{o}F)] - 122 (251)
6. Mixer pressure [kPa (psig)] - 186 (27)
7. Test time (sec) - 1446.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 11.1 (36.4)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	193 (380)
0.15 (0.50)	199 (390)
0.30 (1.00)	204 (400)
0.46 (1.50)	204 (400)
0.61 (2.00)	204 (400)
1.22 (4.00)	204 (400)
3.05 (10.00)	204 (400)
6.09 (20.00)	204 (400)
8.23 (27.00)	204 (400)
10.67 (35.00)	204 (400)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 4.41 (9.72)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 2.59 (5.71)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 1.52 (3.36)

D. FAILED BUNDLE T/Cs[1]

294, 295, 298, 305, 308, 309, 310, 311, 321, 326, 518, 520, 521, 532, 549, 553, 555, 564, 565, 568, 569

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

1. From primary side energy balance [kwsec(Btu)] - 0.328×10^5 (0.312×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da\,dt$) - [kwsec(Btu)] - 0.226×10^5 (0.215×10^5)
3. Integration to 300 sec

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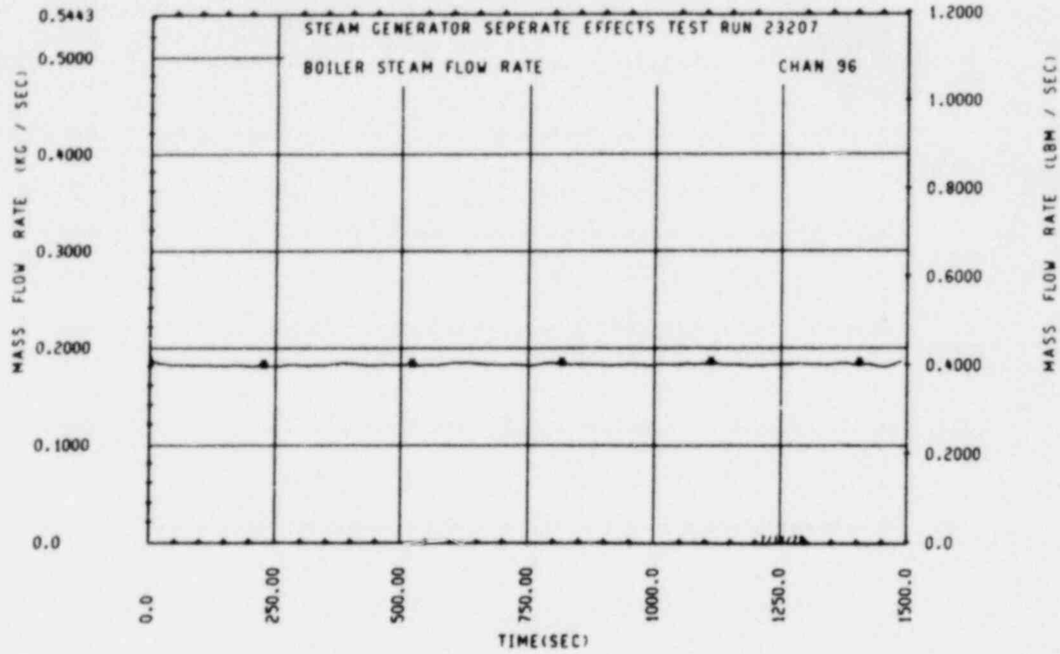
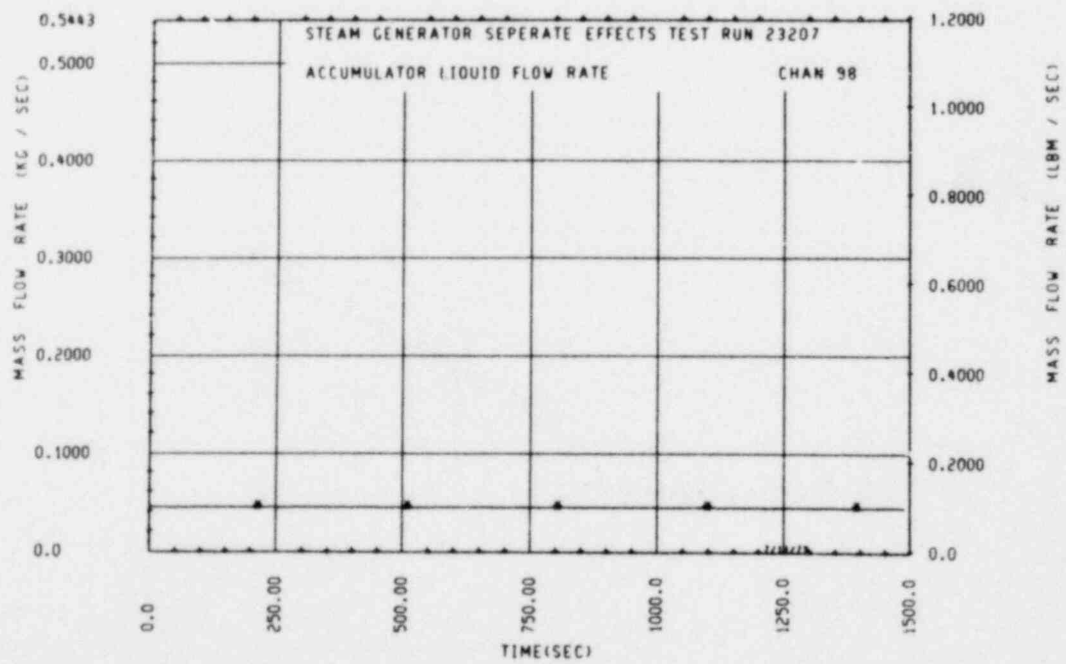
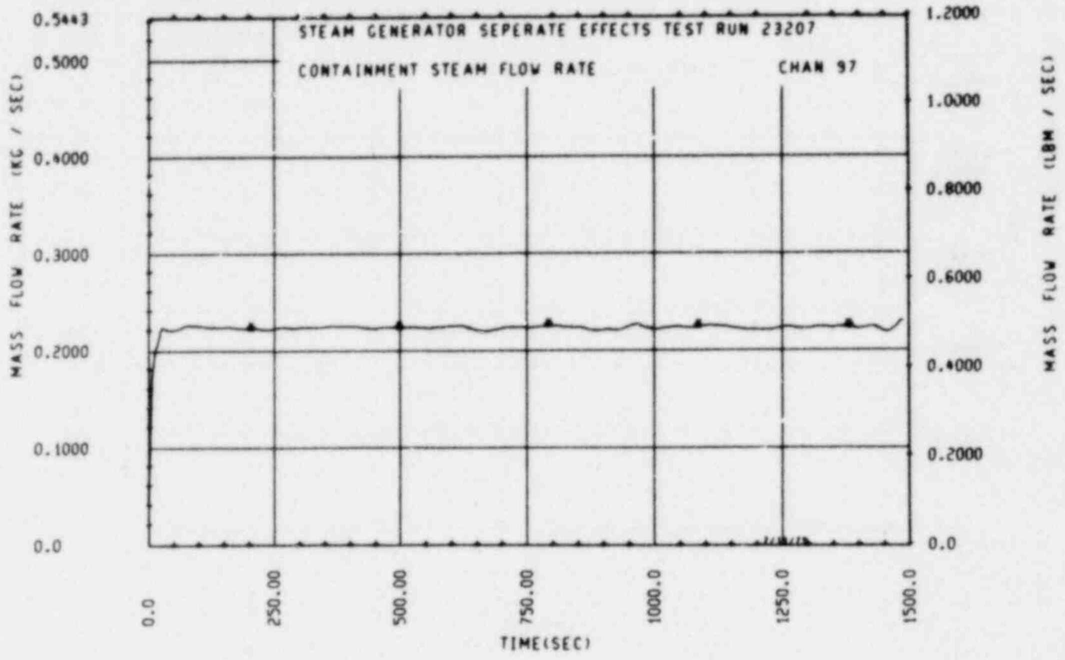
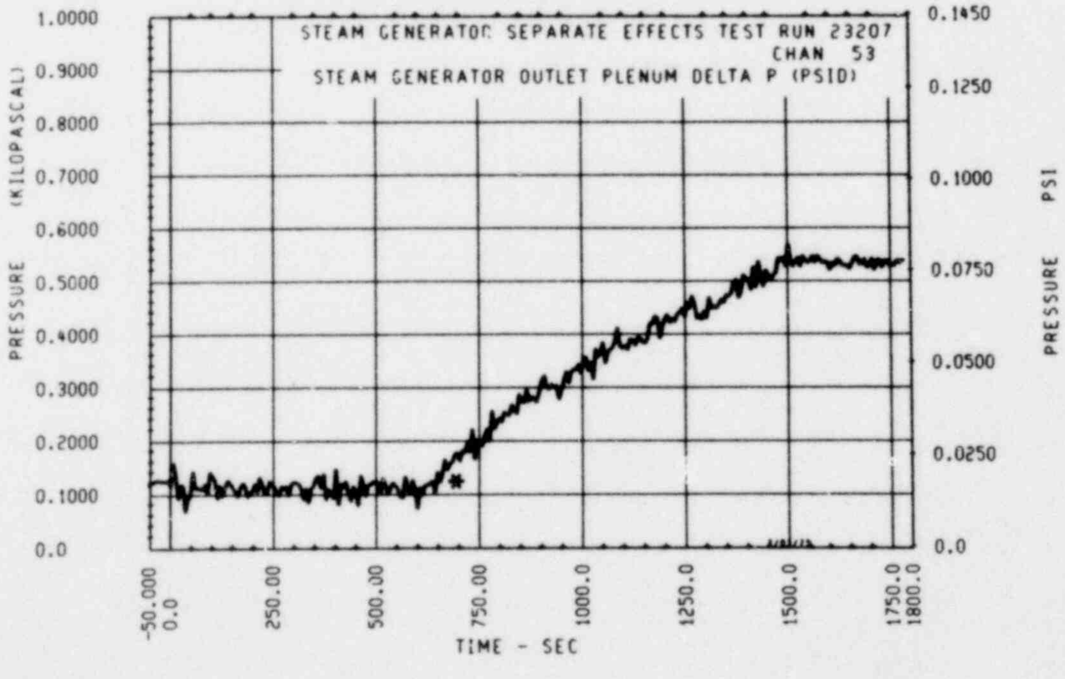
1. T/Cs are defined as failed based on resistance reading or T/C response.

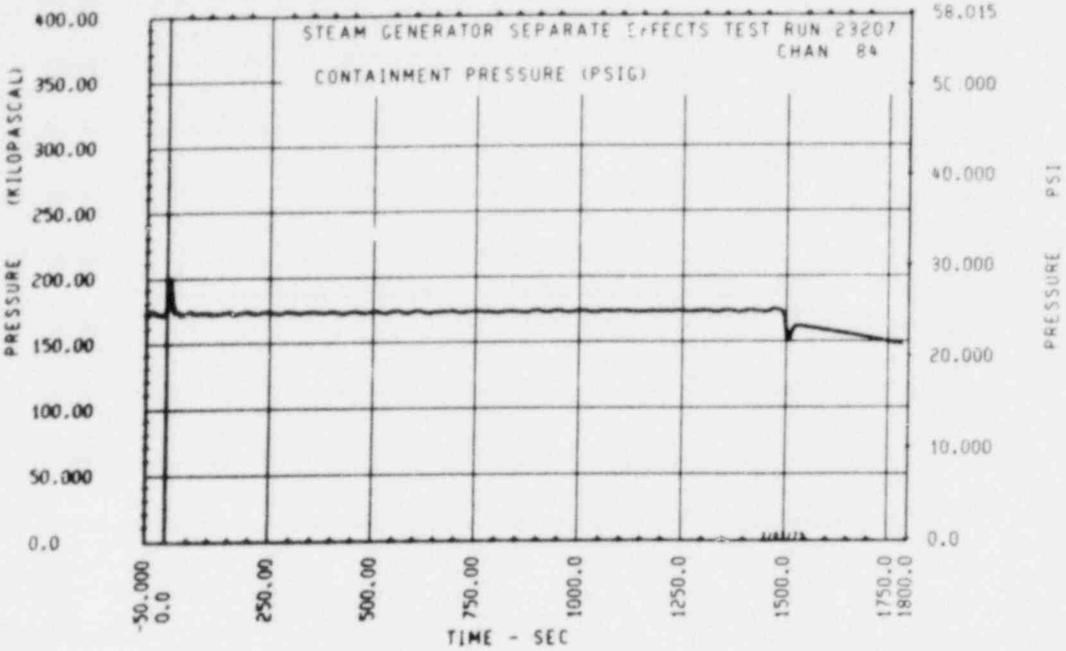

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23207
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

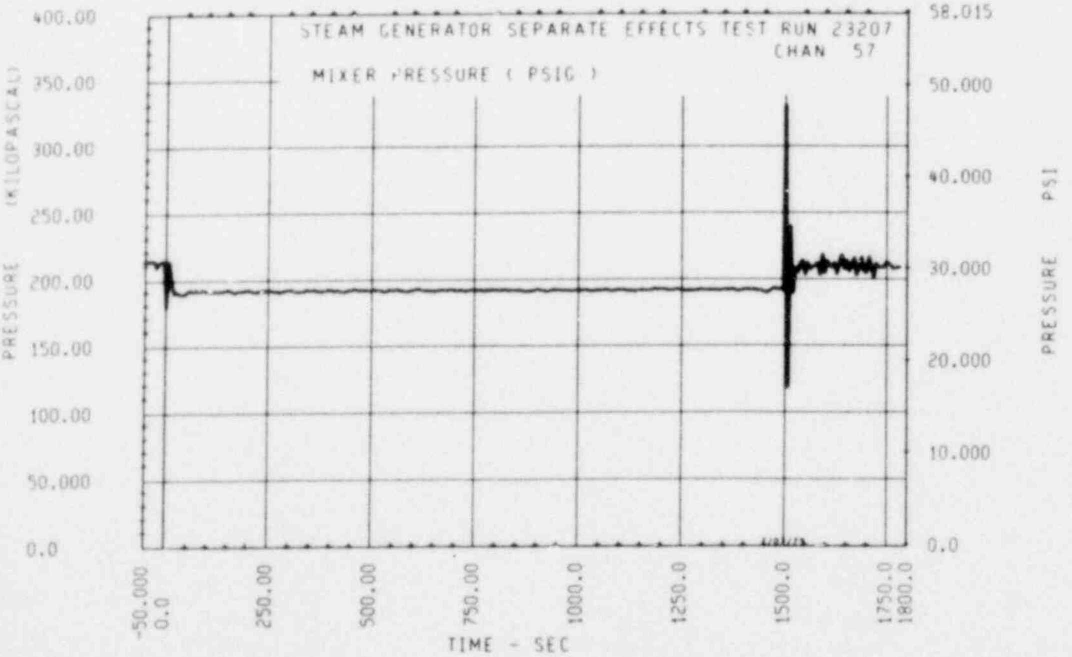

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23207
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

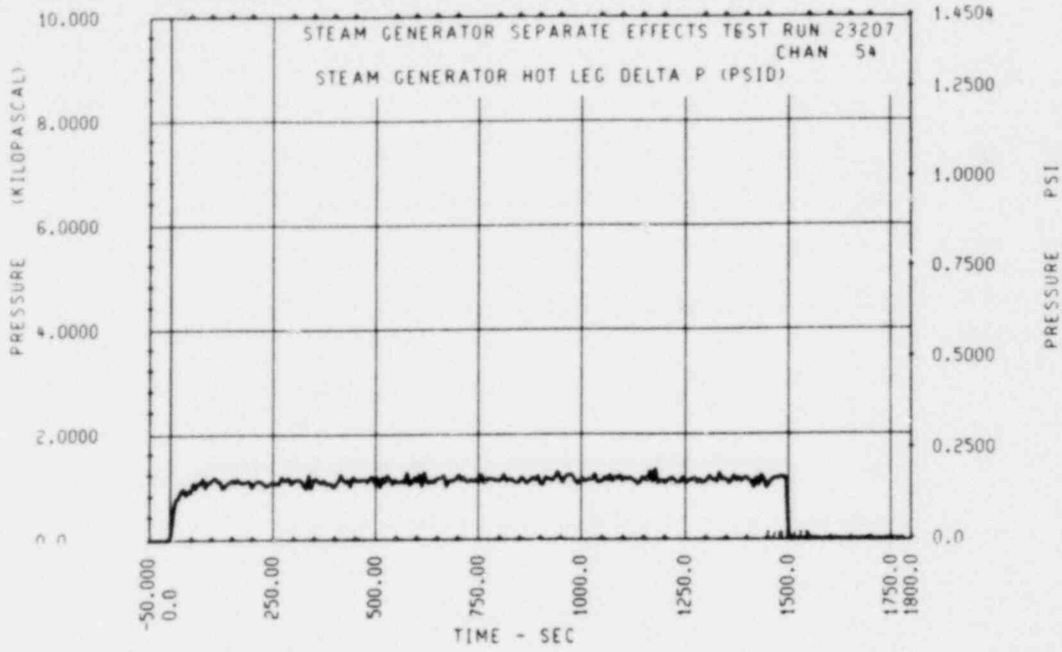


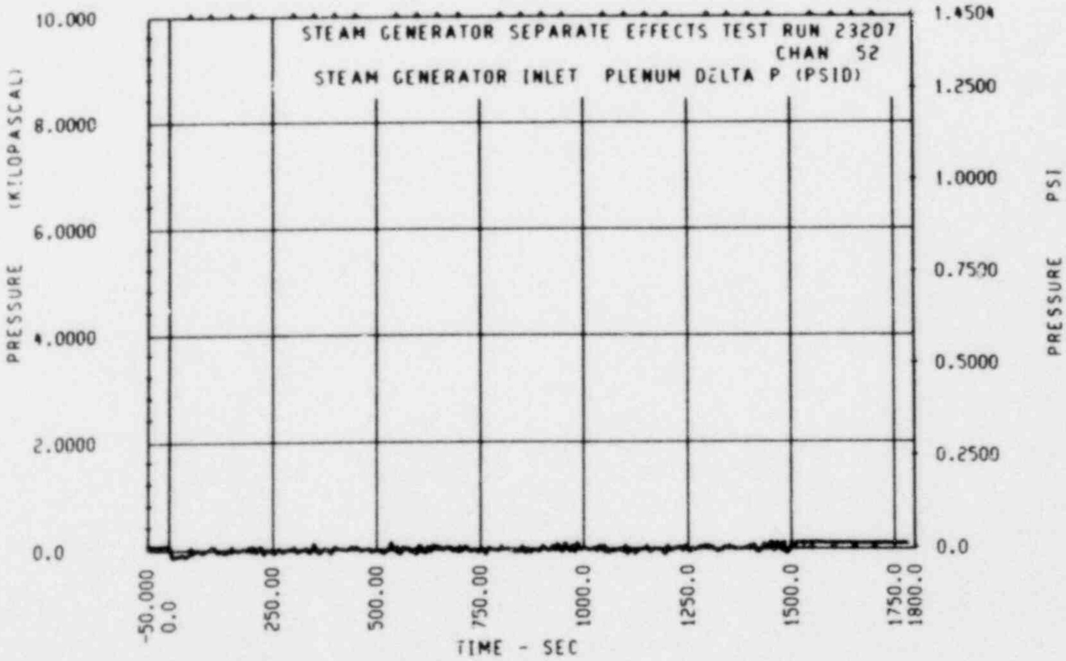


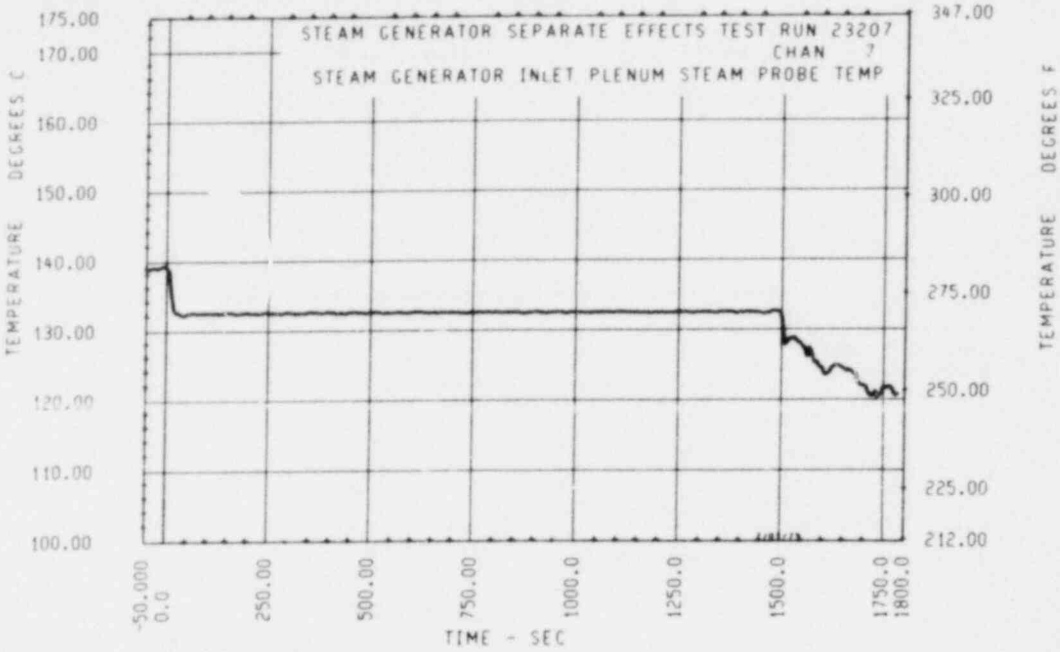
* Refer to Appendix H text for explanation of delayed response.

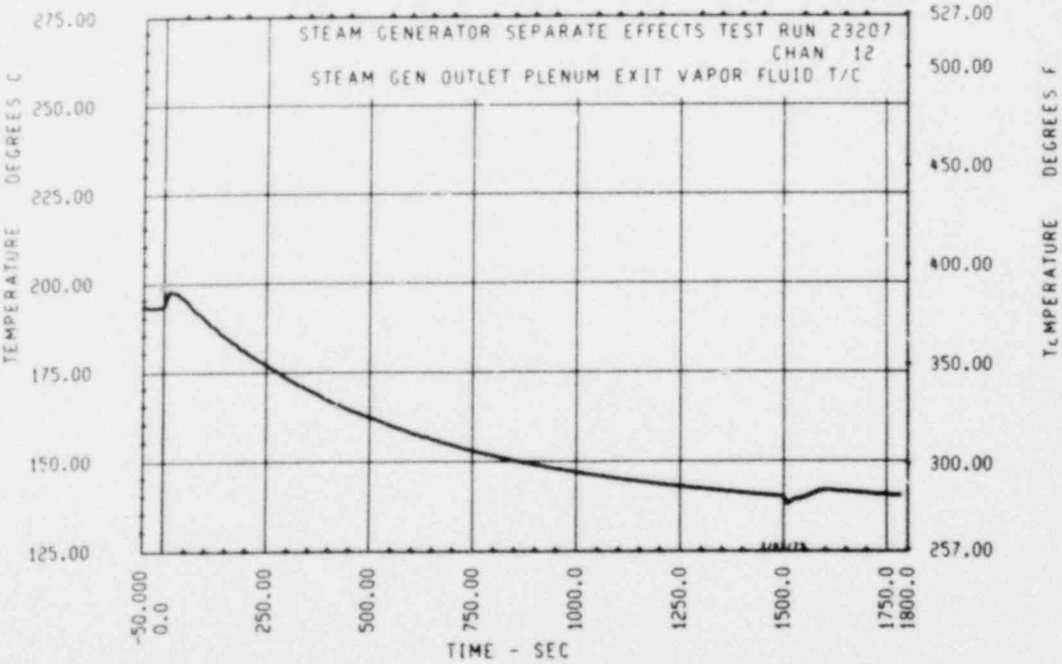

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23207
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23207
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

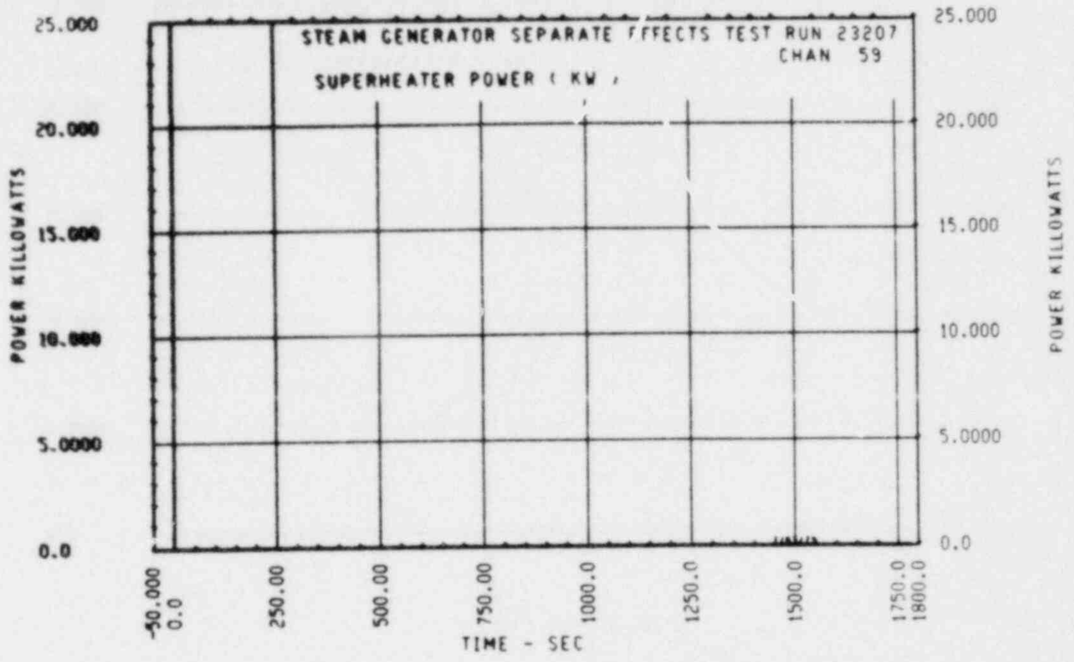

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23207
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

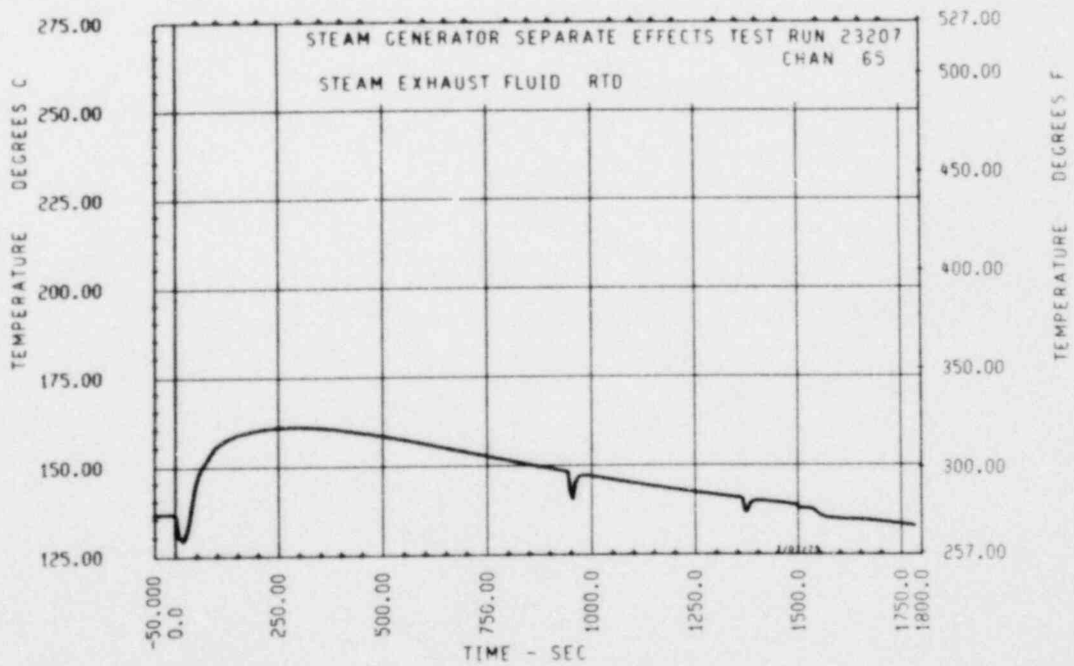

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23207
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

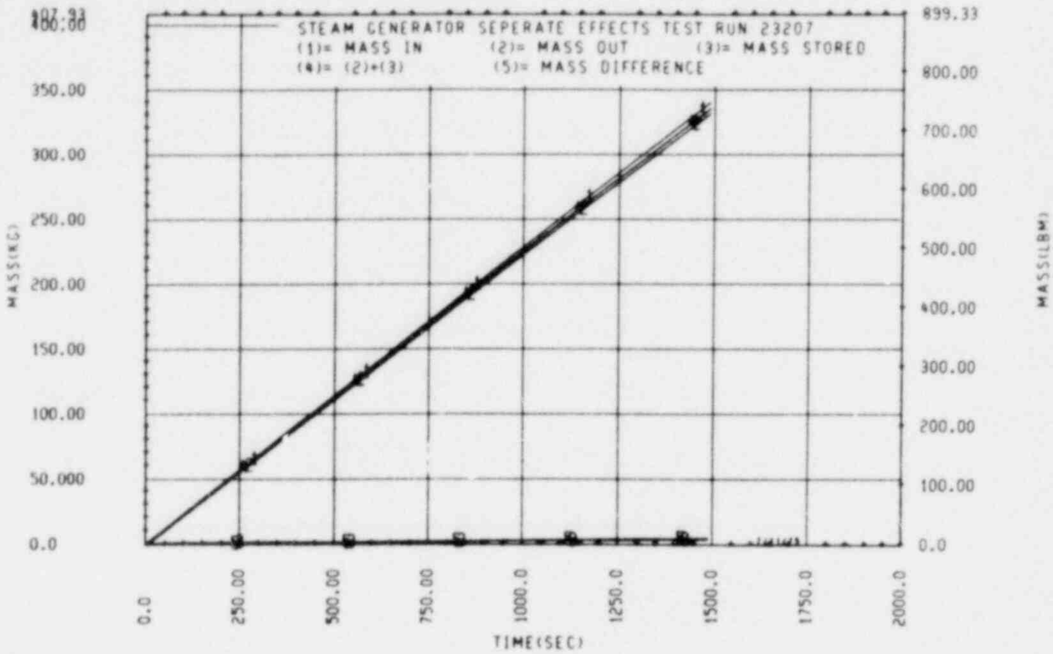

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23207
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23207
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

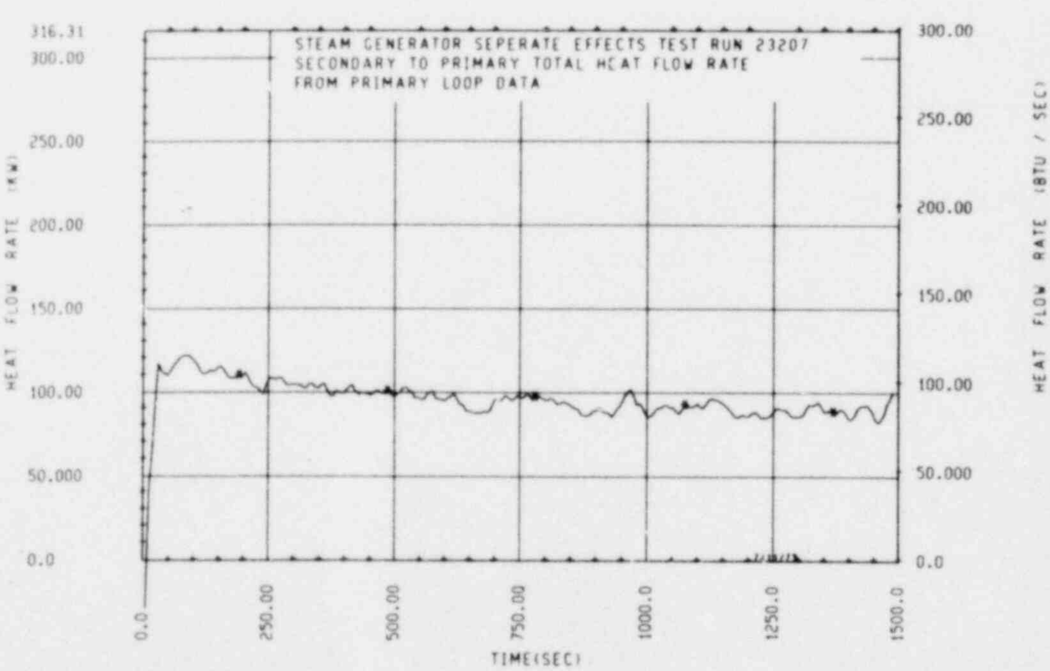
23207-7


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23207
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

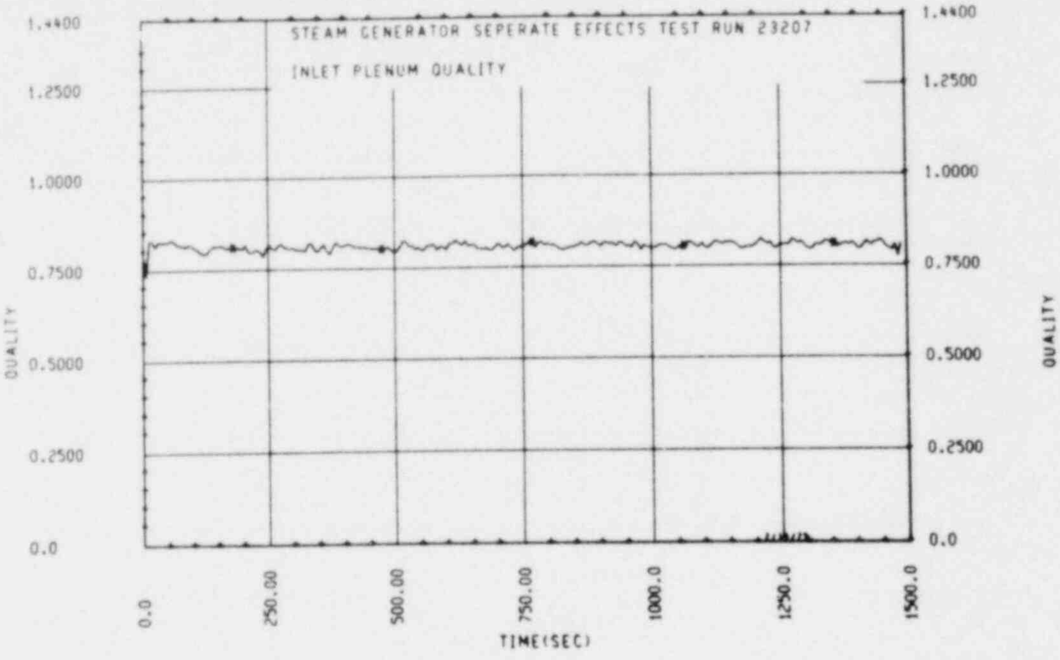

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23207
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
275.00
250.00
225.00
200.00
175.00
150.00
125.00
TEMPERATURE DEGREES F
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC



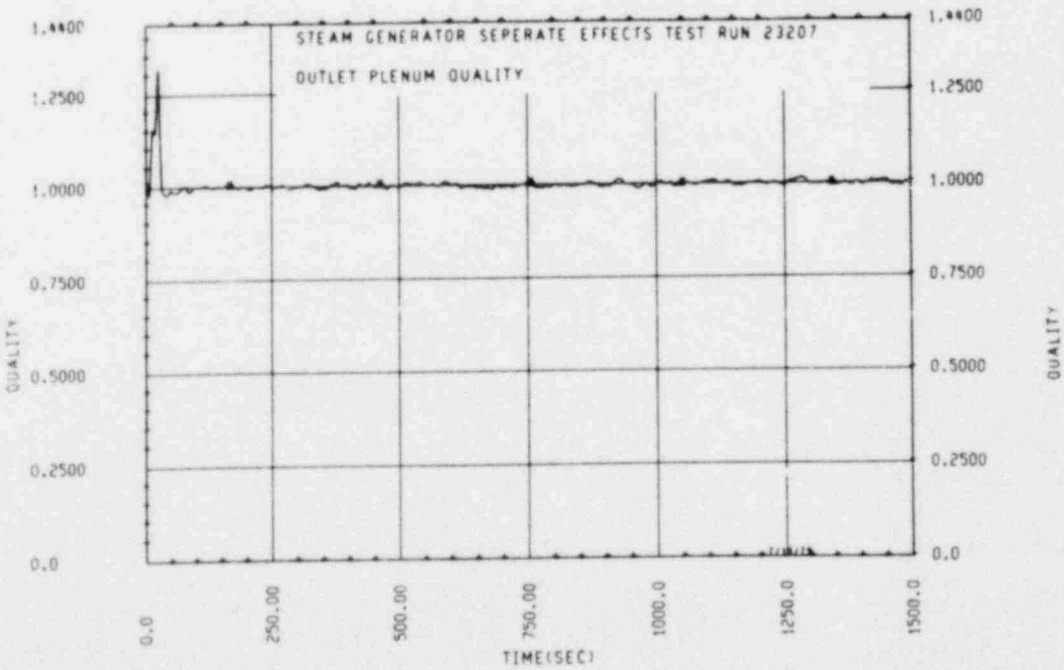
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23207
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)
407.93
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
899.33
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
2000.0



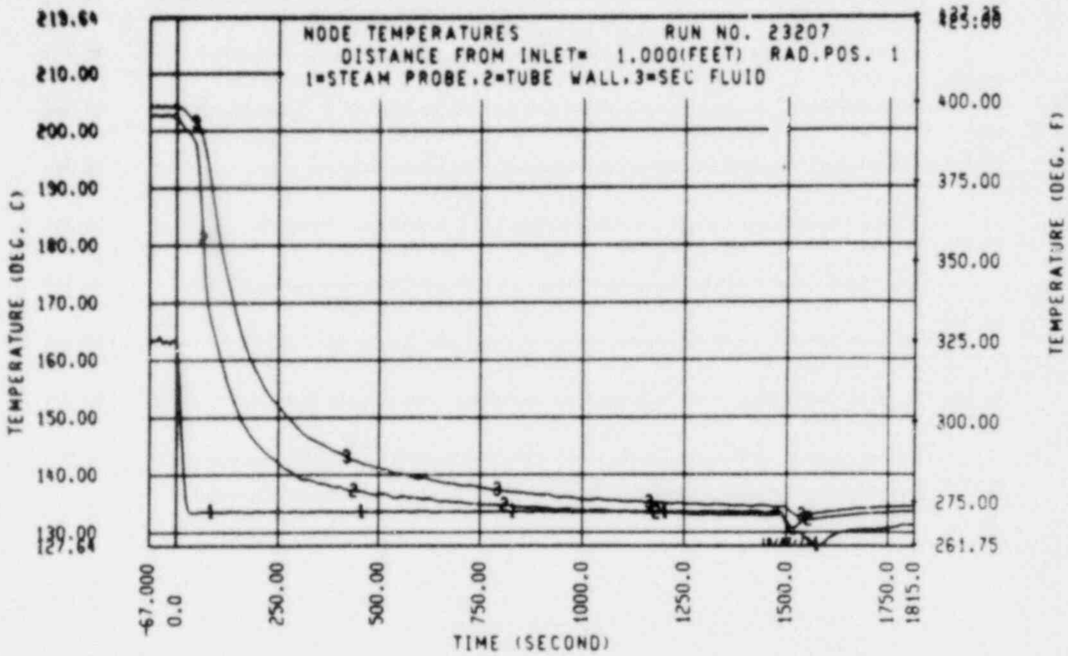
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23207
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)
316.31
300.00
250.00
200.00
150.00
100.00
50.000
0.0
300.00
250.00
200.00
150.00
100.00
50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

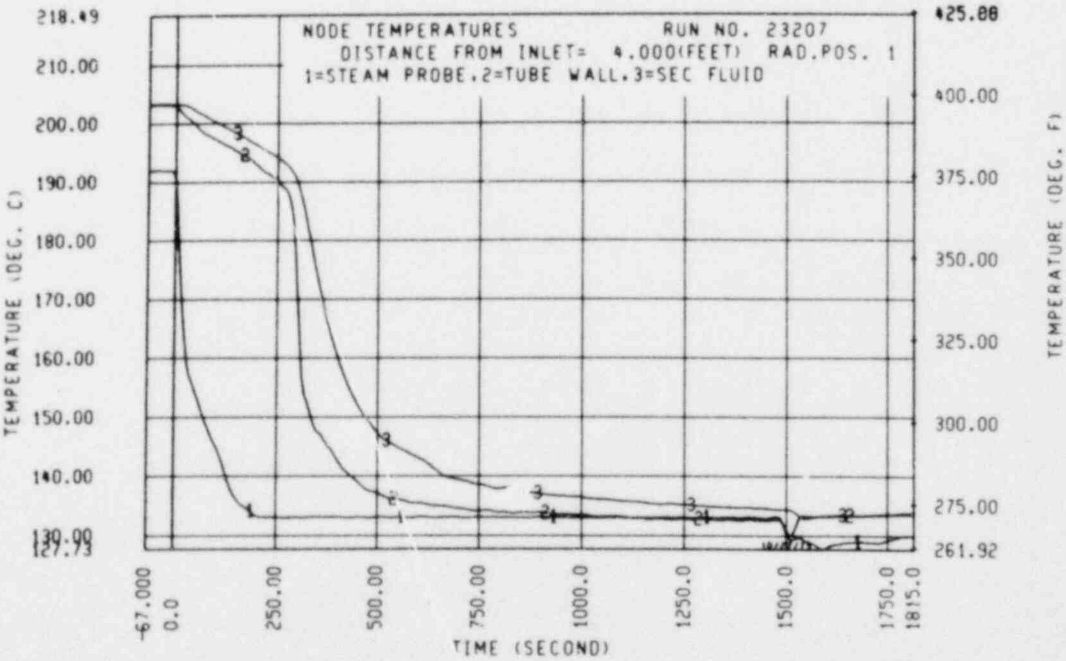


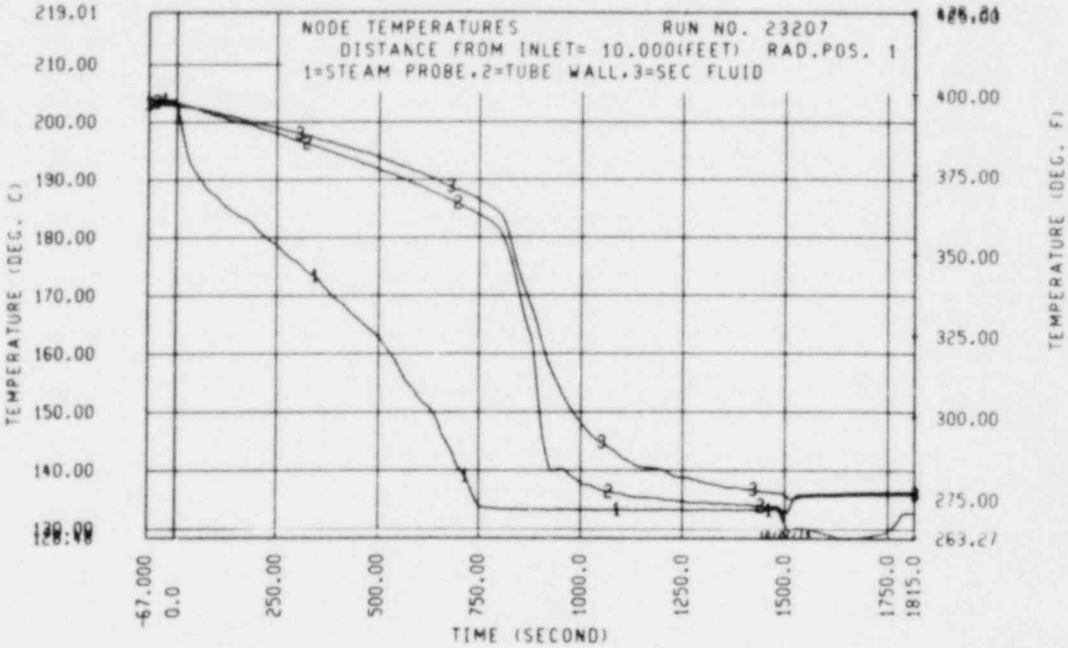
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23207
INLET PLENUM QUALITY
QUALITY
TIME(SEC)

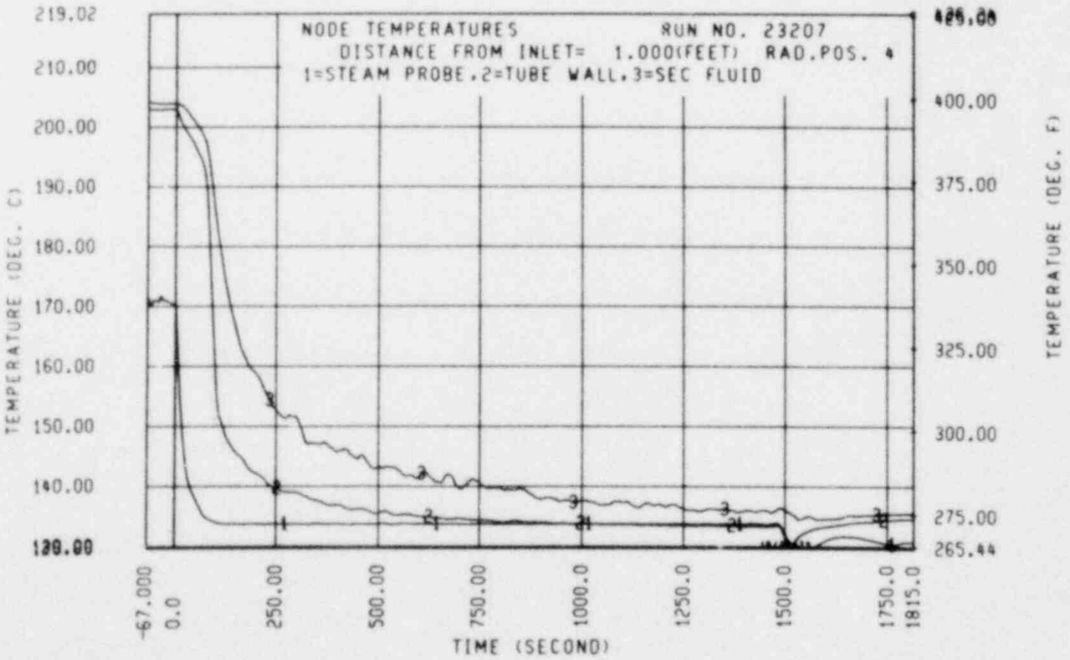


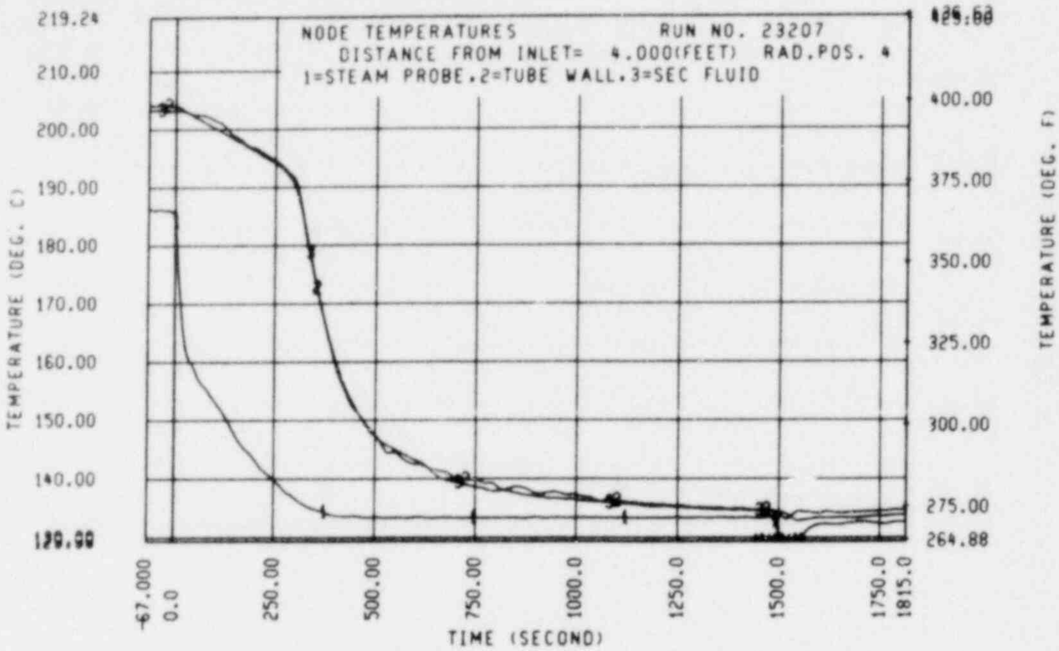
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23207
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)


NODE TEMPERATURES RUN NO. 23207
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

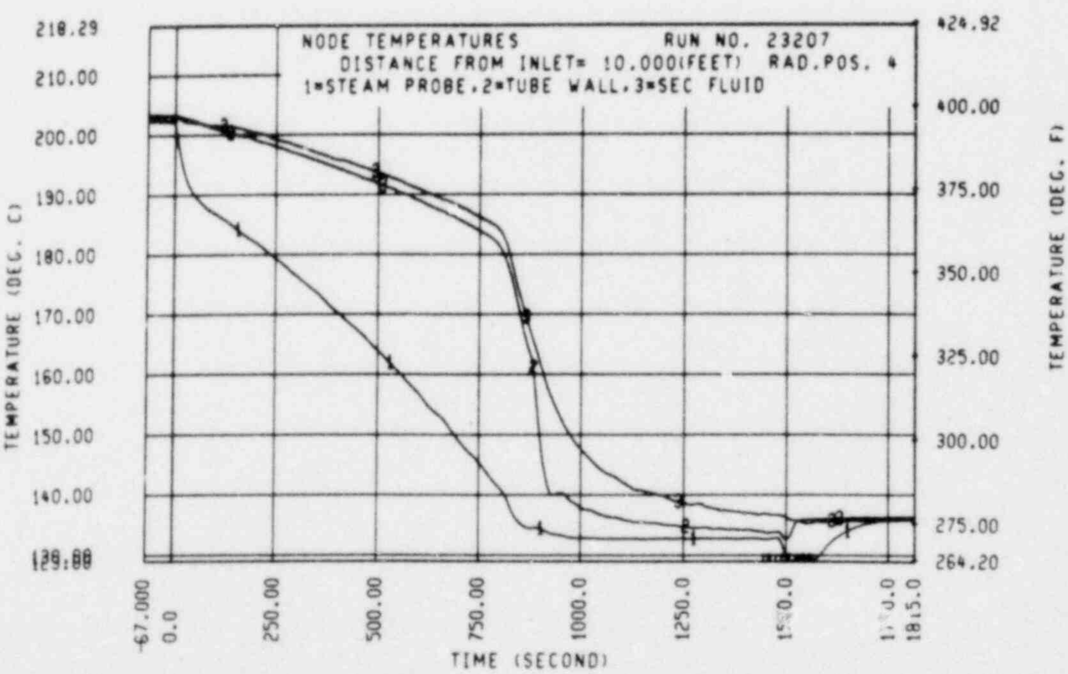

NODE TEMPERATURES RUN NO. 23207
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 23207
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
219.01
210.00
200.00
190.00
180.00
170.00
160.00
150.00
140.00
400.00
375.00
350.00
325.00
300.00
275.00
263.27
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1815.0


NODE TEMPERATURES RUN NO. 23207
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
219.02
210.00
200.00
190.00
180.00
170.00
160.00
150.00
140.00
400.00
375.00
350.00
325.00
300.00
275.00
265.44
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1815.0

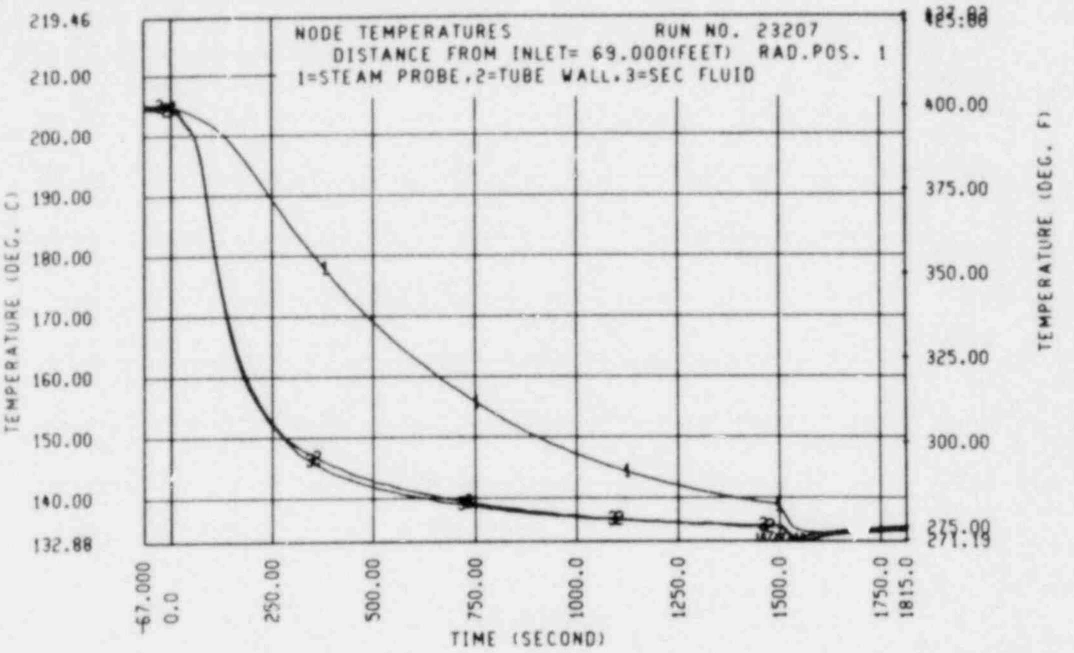


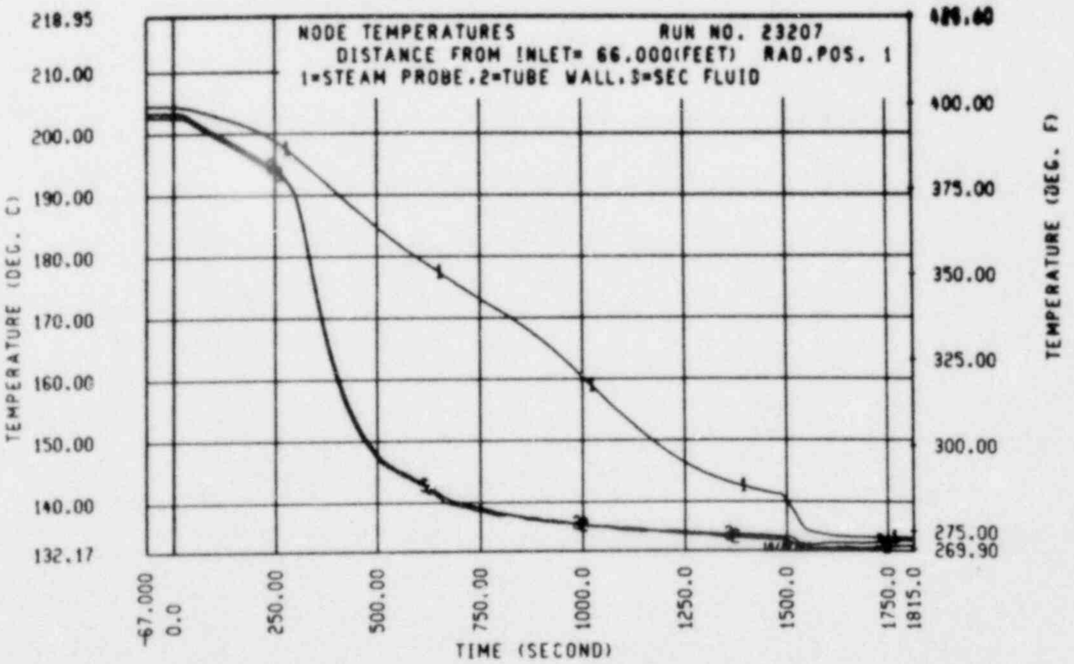
NODE TEMPERATURES RUN NO. 23207
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

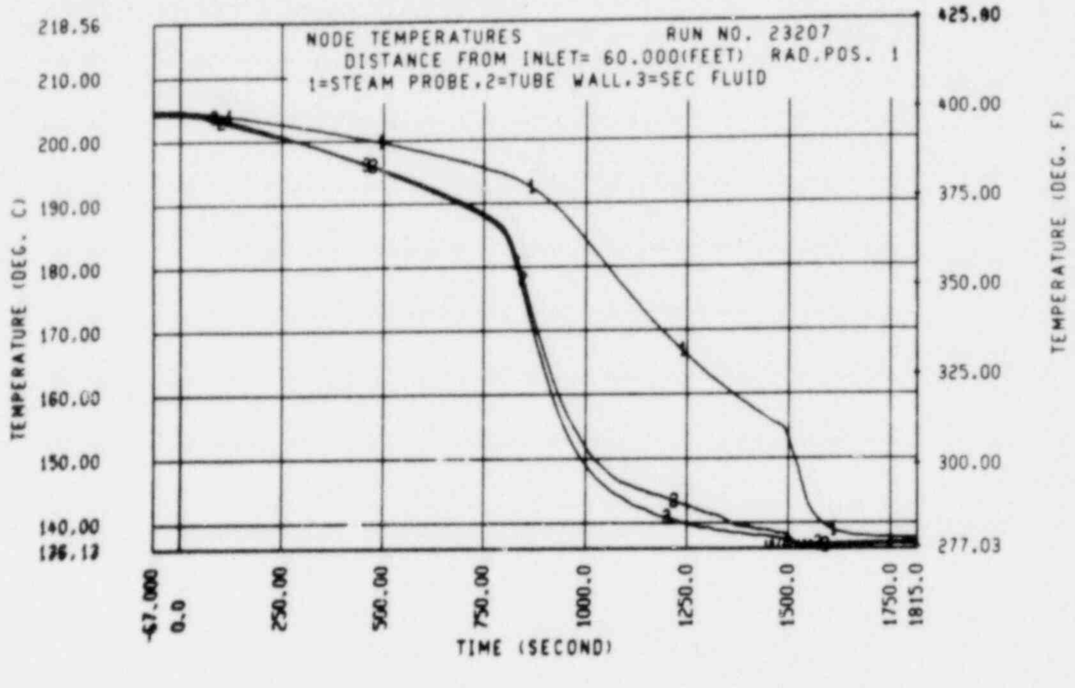


NODE TEMPERATURES RUN NO. 23207
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

23207-13


NODE TEMPERATURES RUN NO. 23207
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 23207
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 23207
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
218.56
210.00
200.00
190.00
180.00
170.00
160.00
150.00
140.00
136.13
425.00
400.00
375.00
350.00
325.00
300.00
277.03
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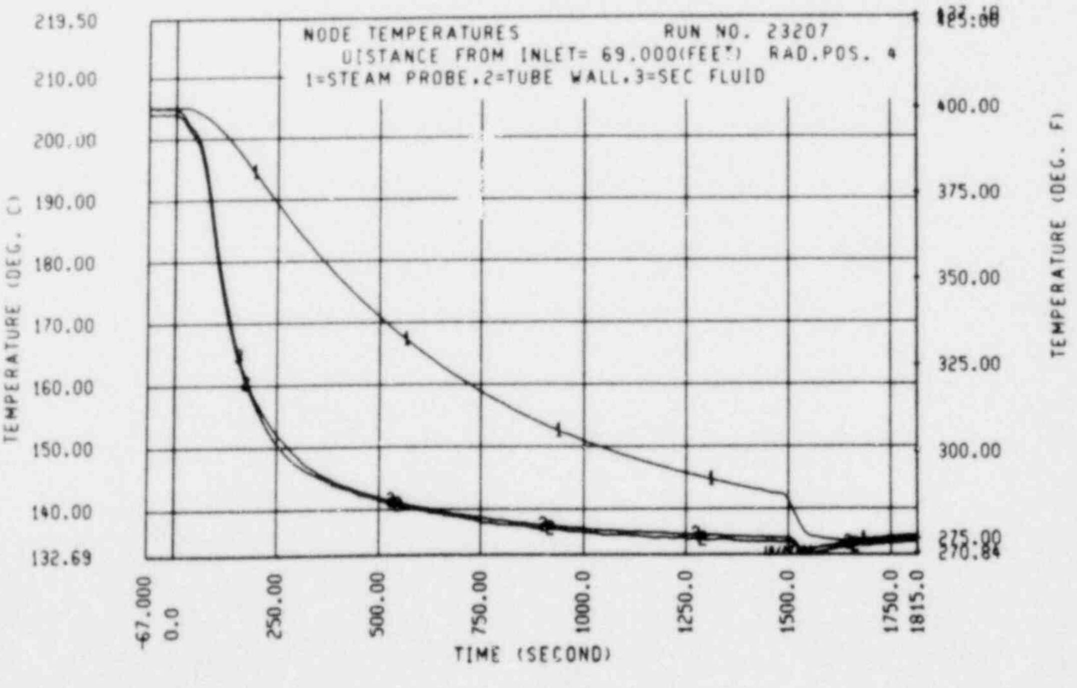
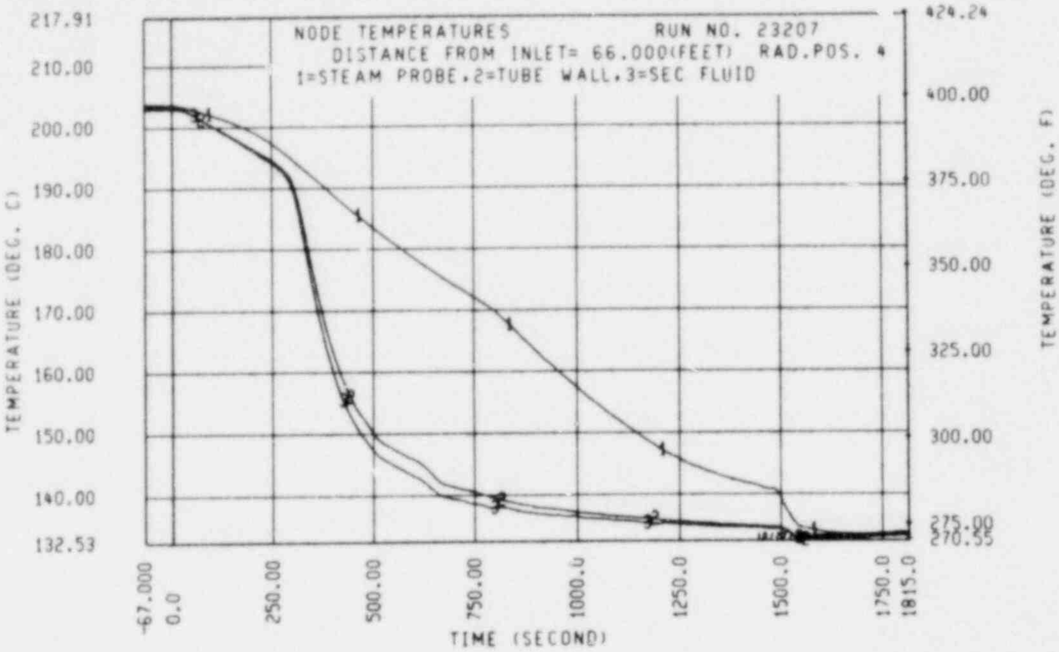
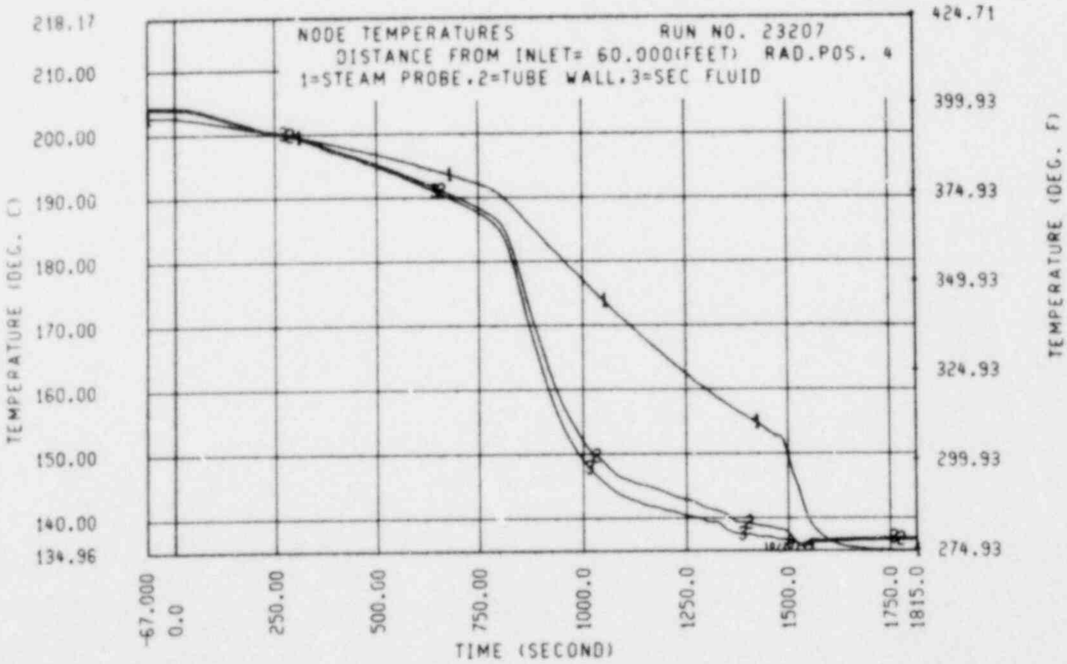
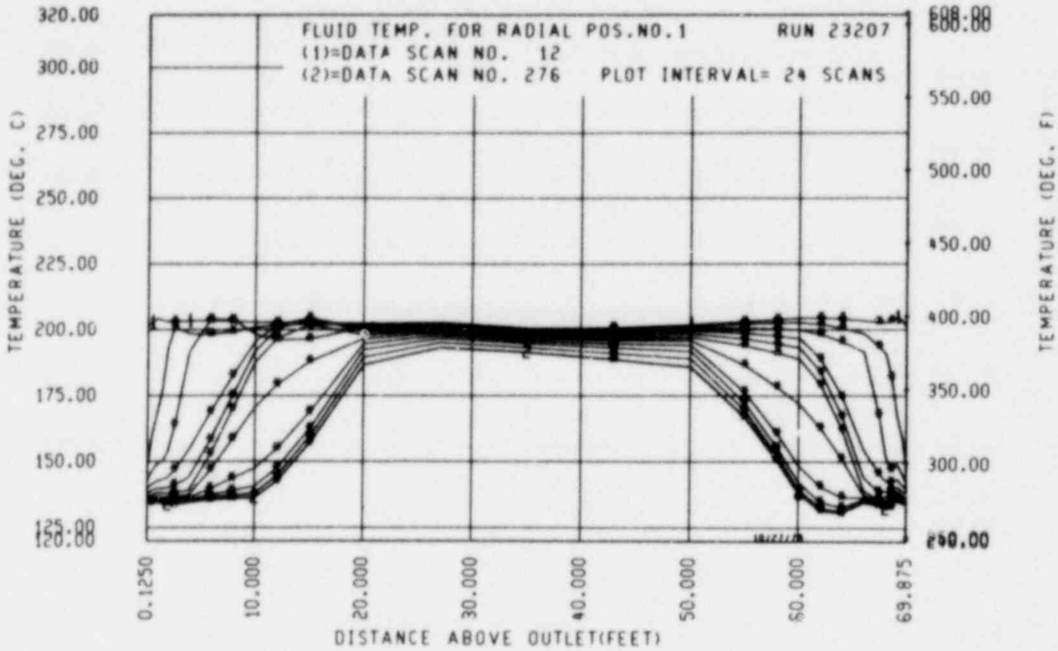
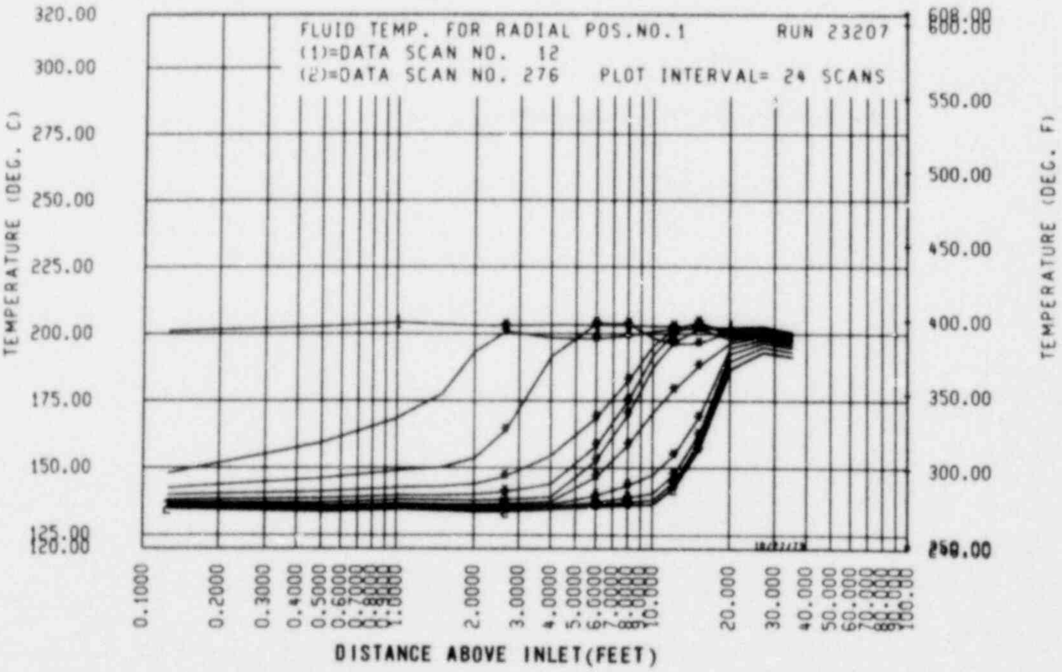
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1815.0

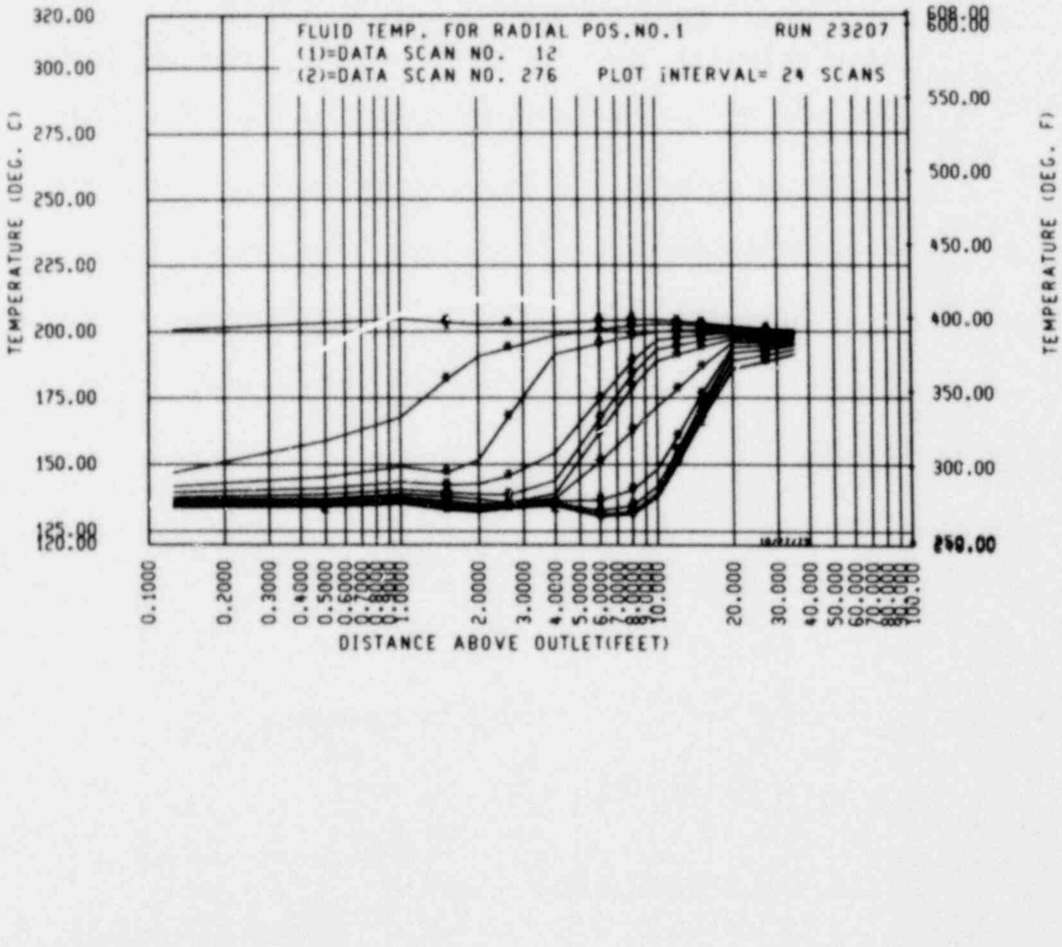

NODE TEMPERATURES RUN NO. 23207
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
219.50
210.00
200.00
190.00
180.00
170.00
160.00
150.00
140.00
132.69
400.00
375.00
350.00
325.00
300.00
275.00
270.84
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1815.0


NODE TEMPERATURES RUN NO. 23207
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
217.91
210.00
200.00
190.00
180.00
170.00
160.00
150.00
140.00
132.53
TEMPERATURE (DEG. F)
424.24
400.00
375.00
350.00
325.00
300.00
275.00
270.55
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1815.0
TIME (SECOND)


NODE TEMPERATURES RUN NO. 23207
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
218.17
210.00
200.00
190.00
180.00
170.00
160.00
150.00
140.00
134.96
TEMPERATURE (DEG. F)
424.71
399.93
374.93
349.93
324.93
299.93
274.93
-67.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1815.0
TIME (SECOND)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 23207
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276 PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 23207
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276 PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)



FLUID TEMP. FOR RADIAL POS.NO.1
RUN 23207
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

23207-18

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 23207
TIME = 120.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX PAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.02)	18.1(1.59)	18.1(1.60)	9.8(.86)	.647	.768	.854	.866
.2(.50)	52.9(4.66)	56.9(5.01)	59.6(5.25)	60.5(5.33)	.663	.788	.875	.886
.3(1.00)	75.5(6.66)	98.7(8.69)	.5(.05)	93.2(8.22)	.703	.835	.893	.933
.5(1.50)	105.4(9.29)	129.5(11.41)	2.4(.21)	78.7(6.93)	.759	.906	.893	.984
.6(2.00)	104.2(9.18)	145.3(12.80)	1.9(.17)	7.7(.68)	.823	.991	.894	1.008
.8(2.65)	.9(.08)	.9(.08)	4.8(.42)	.1(.01)	.854	1.034	.895	1.007
1.2(4.00)	2.8(.25)	2.7(.24)	1.2(.10)	.7(.06)	.851	1.029	.891	.999
1.8(6.00)	.2(.02)	-4.9(-.43)	3.6(.32)	8.2(.72)	.842	1.010	.883	.997
2.4(8.00)	.0(.00)	-6.2(-.55)	-.2(-.02)	3.9(.34)	.831	.984	.876	1.001
3.0(10.00)	.3(.02)	.3(.02)	.9(.08)	.5(.05)	.824	.969	.871	.998
3.7(12.00)	.7(.06)	5.0(.44)	1.6(.14)	-1.3(-.11)	.821	.971	.869	.992
4.6(15.00)	2.6(.23)	4.8(.42)	1.3(.12)	-.4(-.04)	.825	.984	.870	.985
6.1(20.00)	.7(.07)	.7(.06)	.6(.06)	.1(.01)	.831	.994	.871	.981
8.2(27.00)	.6(.05)	.1(.01)	-1.0(-.09)	-.3(-.02)	.834	.994	.866	.979
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.837	.995	.863	.978
13.1(43.00)	-1.0(-.08)	-.2(-.02)	.1(.01)	-.2(-.01)	.833	.994	.864	.978
15.2(50.00)	-.0(-.00)	-.3(-.03)	-.0(-.00)	-.0(-.00)	.828	.993	.864	.977
16.8(55.00)	.1(.01)	-.0(-.00)	-.0(-.00)	.0(.00)	.828	.993	.864	.977
17.7(58.00)	.2(.02)	-.0(-.00)	.0(.00)	.0(.00)	.829	.992	.865	.978
18.3(60.00)	.4(.04)	-.1(-.01)	.1(.01)	.1(.01)	.829	.992	.866	.978
18.9(62.00)	.6(.05)	.0(.00)	.1(.01)	.0(.00)	.831	.992	.867	.979
19.5(64.00)	.2(.01)	.2(.01)	.1(.01)	.0(.00)	.832	.993	.867	.979
20.1(66.00)	.3(.03)	.9(.08)	.3(.03)	-.0(-.00)	.833	.995	.868	.979
20.5(67.38)	-.1(-.00)	.2(.02)	-.0(-.00)	-.6(-.05)	.834	.997	.868	.978
20.7(68.00)	.3(.03)	.1(.01)	.3(.03)	-.1(-.01)	.835	.997	.867	.978
20.9(68.50)	-.5(-.05)	-.5(-.05)	-1.6(-.14)	-.1(-.01)	.835	.997	.867	.978
21.0(69.00)	-.5(-.05)	-.6(-.05)	2.5(.22)	5.0(.44)	.836	.997	.868	.981
21.2(69.50)	-1.4(-.13)	-2.6(-.23)	-2.4(-.22)	-2.9(-.26)	.839	.997	.869	.983
21.3(69.87)	-4.7(-.42)	-1.6(-.14)	-3.0(-.27)	-2.2(-.19)	.841	.998	.868	.982

23207-19

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 23207

TIME = 24[illegible] SECONDS

UNITS - ELEVATION METER(FEET)

FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX PAD POS - 1	LOCAL FLUX 2	LOCAL FLUX 3	LOCAL FLUX 4	LOCAL QUALITY 1	2	3	4
.0(.13)	.1(.01)	7.4(.66)	7.2(.64)	8.3(.73)	.647	.766	.852	.866
.2(.50)	17.8(1.57)	20.6(1.82)	23.6(2.08)	20.8(1.84)	.653	.773	.860	.873
.3(1.00)	28.0(2.47)	31.3(2.76)	.2(.02)	32.2(2.83)	.666	.789	.867	.889
.5(1.50)	31.7(2.80)	31.1(2.74)	16.8(1.48)	37.2(3.28)	.685	.808	.872	.911
.6(2.00)	48.2(4.25)	44.7(3.94)	44.9(3.95)	37.9(3.34)	.710	.832	.891	.934
.8(2.65)	.5(.04)	59.4(5.23)	50.5(4.45)	30.0(2.64)	.725	.873	.928	.958
1.2(4.00)	4.1(.36)	4.7(.41)	2.5(.22)	.7(.06)	.728	.901	.950	.966
1.8(6.00)	-.6(-.05)	.9(.07)	2.2(.19)	4.8(.42)	.724	.897	.944	.962
2.4(8.00)	-.6(-.05)	-.4(-.04)	.1(.01)	4.1(.36)	.712	.885	.934	.959
3.0(10.00)	.7(.06)	.7(.06)	1.5(.13)	1.0(.09)	.703	.878	.926	.956
3.7(12.00)	2.8(.25)	2.1(.19)	2.1(.18)	-1.2(-.10)	.702	.876	.924	.949
4.6(15.00)	4.5(.40)	2.5(.22)	1.6(.14)	-.4(-.03)	.713	.879	.925	.942
6.1(20.00)	1.0(.09)	1.0(.09)	.8(.07)	.3(.02)	.724	.884	.926	.938
8.2(27.00)	.6(.06)	.0(.00)	-1.2(-.10)	-.3(-.03)	.729	.8[illegible]4	.921	.935
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.731	.884	.916	.934
13.1(43.00)	-1.0(-.08)	-.2(-.02)	.1(.01)	-.2(-.02)	.726	.883	.917	.934
15.2(50.00)	-.0(-.00)	.0(.00)	-.0(-.00)	-.0(-.00)	.722	.882	.917	.933
16.8(55.00)	.1(.01)	-.0(-.00)	-.0(-.00)	.0(.00)	.722	.882	.917	.933
17.7(58.00)	.1(.01)	-.1(-.01)	-.0(-.00)	.0(.00)	.723	.882	.918	.933
18.3(60.00)	.1(.01)	-.3(-.02)	-.0(-.00)	.0(.00)	.723	.882	.919	.934
18.9(62.00)	.1(.01)	-.1(-.01)	.0(.00)	-.0(-.00)	.724	.882	.921	.935
19.5(64.00)	.1(.01)	.1(.01)	.0(.00)	-.0(-.00)	.725	.883	.922	.936
20.1(66.00)	.2(.02)	.9(.08)	.2(.02)	-.2(-.02)	.727	.886	.923	.936
20.5(67.38)	-1.6(-.15)	-1.1(-.10)	-1.6(-.14)	-3.3(-.29)	.727	.888	.923	.935
20.7(68.00)	-4.4(-.39)	-4.5(-.39)	-4.4(-.39)	-4.9(-.43)	.726	.887	.922	.933
20.9(68.50)	-4.3(-.38)	-4.9(-.43)	-6.1(-.54)	-3.5(-.31)	.725	.885	.920	.933
21.0(69.00)	-.7(-.06)	-.8(-.07)	2.3(.20)	4.2(.37)	.727	.884	.920	.936
21.2(69.50)	-2.8(-.25)	-3.8(-.33)	-3.5(-.31)	-3.5(-.31)	.730	.886	.922	.938
21.3(69.87)	-1.6(-.14)	-1.5(-.13)	-1.9(-.17)	-1.9(-.17)	.732	.887	.922	.938

23207-20

SUMMARY SHEET

RUN NO. 23315

DATE: 4/18/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.046 (0.101)
2. Water flow - [kg/sec (lb/sec)] - 0.180 (0.396)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{o}C (^{o}F)] - 152 (305)
5. Water temperature [^{o}C (^{o}F)]- 127 (261)
6. Mixer pressure [kPa (psig)] - 200 (29)
7. Test time (sec) - 1446.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 9.8 (32.2)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{o}C (^{o}F)]
0.00 (0.00)	255 (491)
0.15 (0.50)	264 (507)
0.30 (1.00)	274 (525)
0.46 (1.50)	272 (522)
0.61 (2.00)	272 (522)
1.22 (4.00)	-
3.05 (10.00)	273 (524)
6.09 (20.00)	272 (522)
8.23 (27.00)	-
10.67 (35.00)	272 (522)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 14.38 (31.71)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - NA
   (b) SG collection tank [kg (lb)] - 17.19 (37.89)
3. Posttest drain from hot leg [kg (lb)] - 16.8 (37.0)

D. FAILED BUNDLE T/Cs[1]

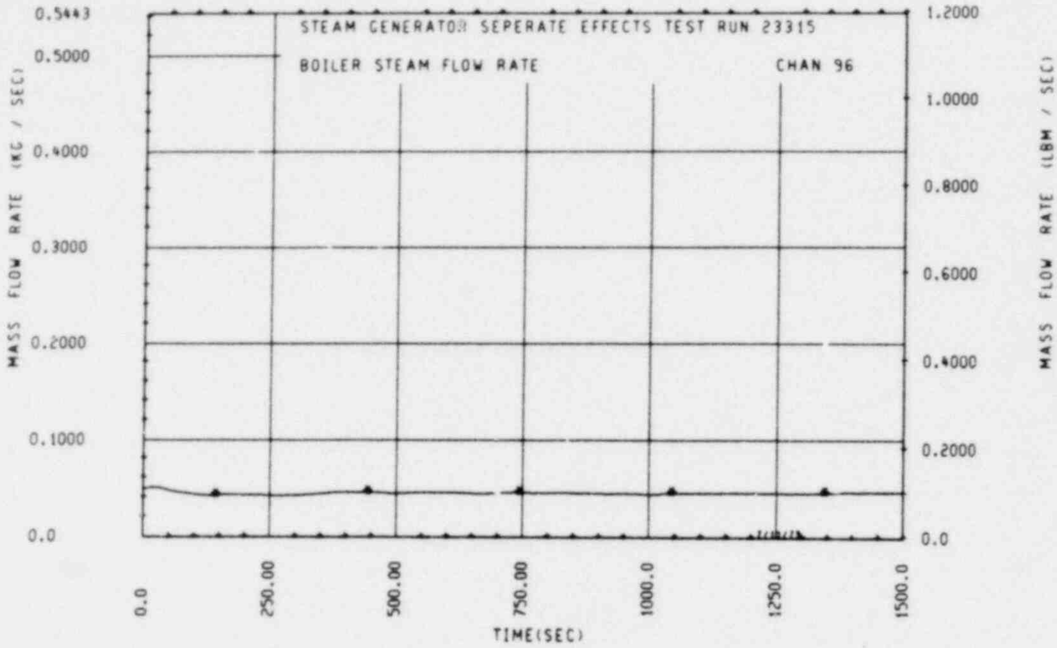
294, 295, 298, 305, 308, 309, 310, 311, 321, 326, 518, 520, 521, 532, 549, 553, 555, 564, 565, 568, 569

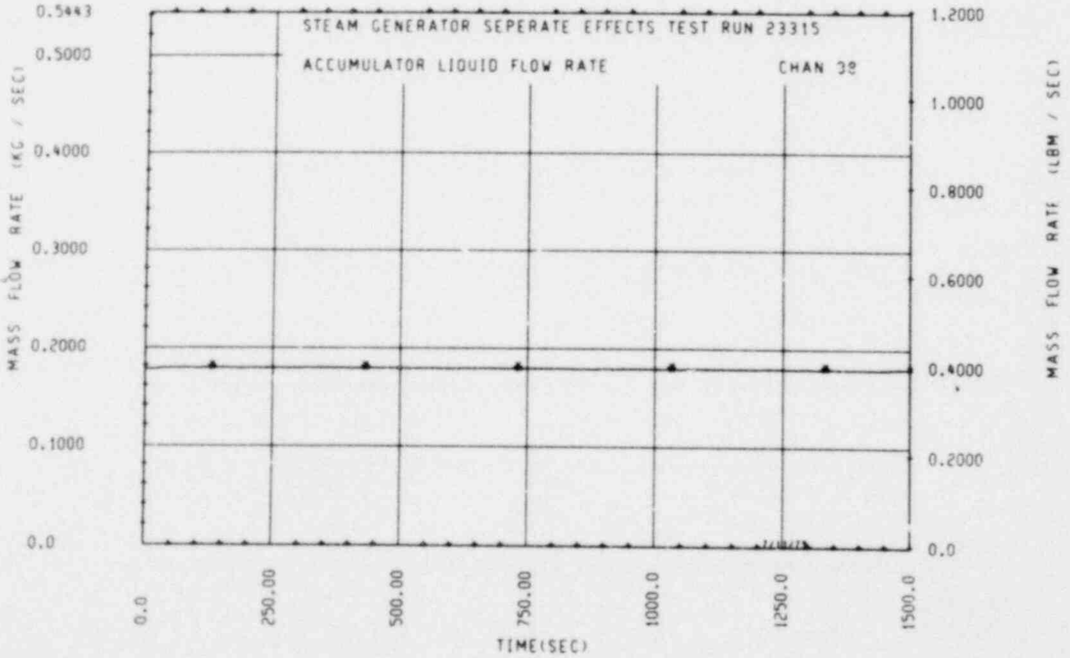
E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

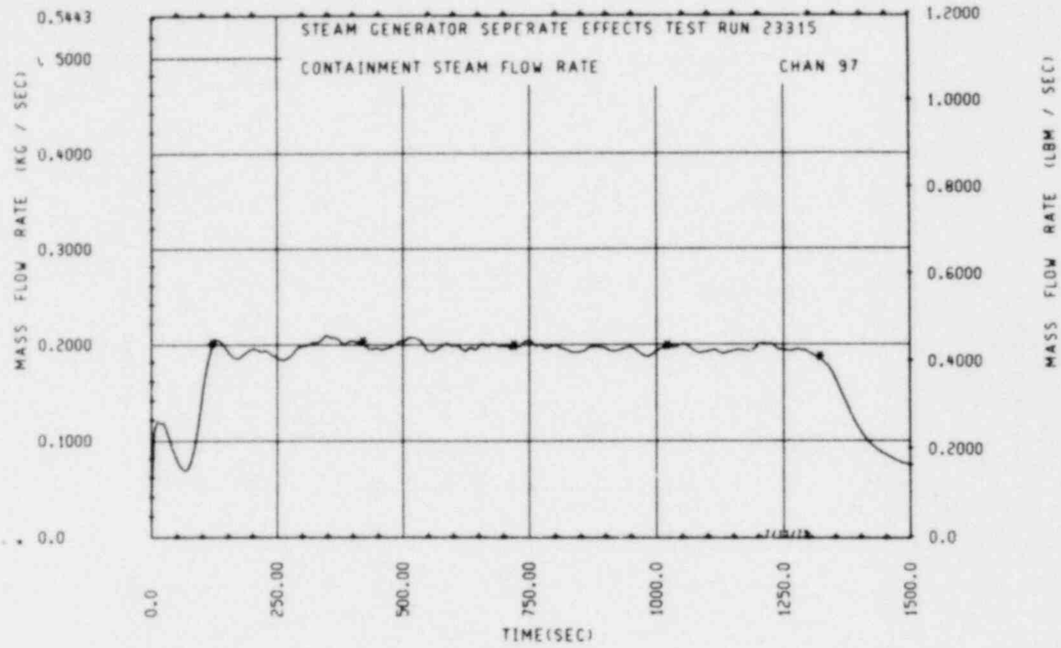
1. From primary side energy balance [kwsec(Btu)] - 0.838×10^5 (0.798×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da\, dt$) - [kwsec(Btu)] - 0.328×10^5 (0.312×10^5)
3. Integration to 300 sec

---

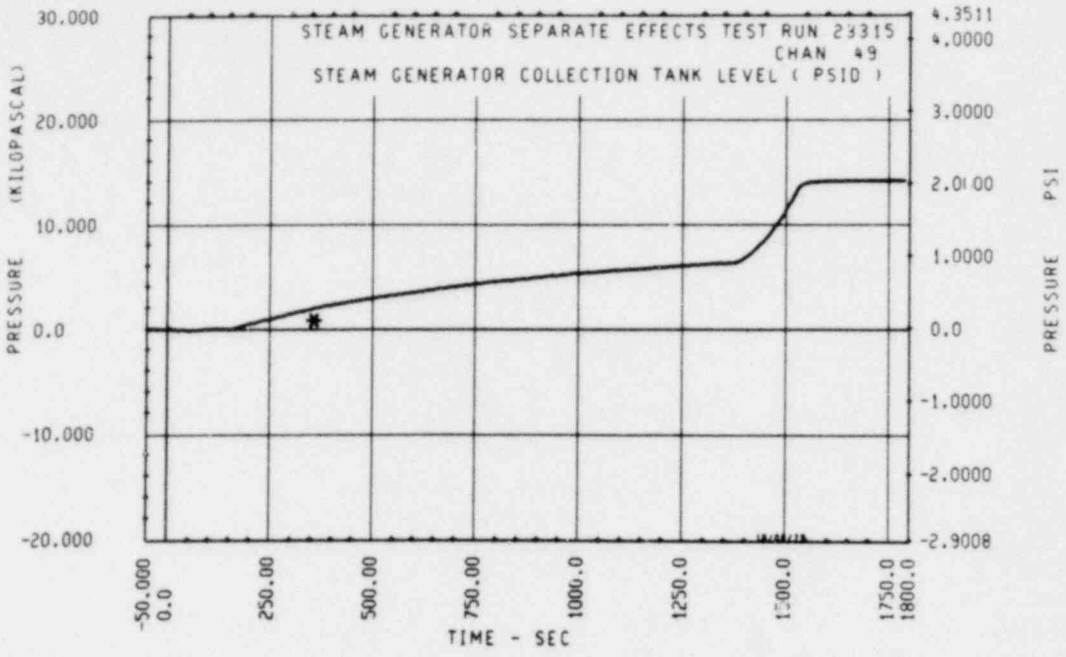
1. T/Cs are defined as failed based on resistance reading or T/C response.


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23315
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

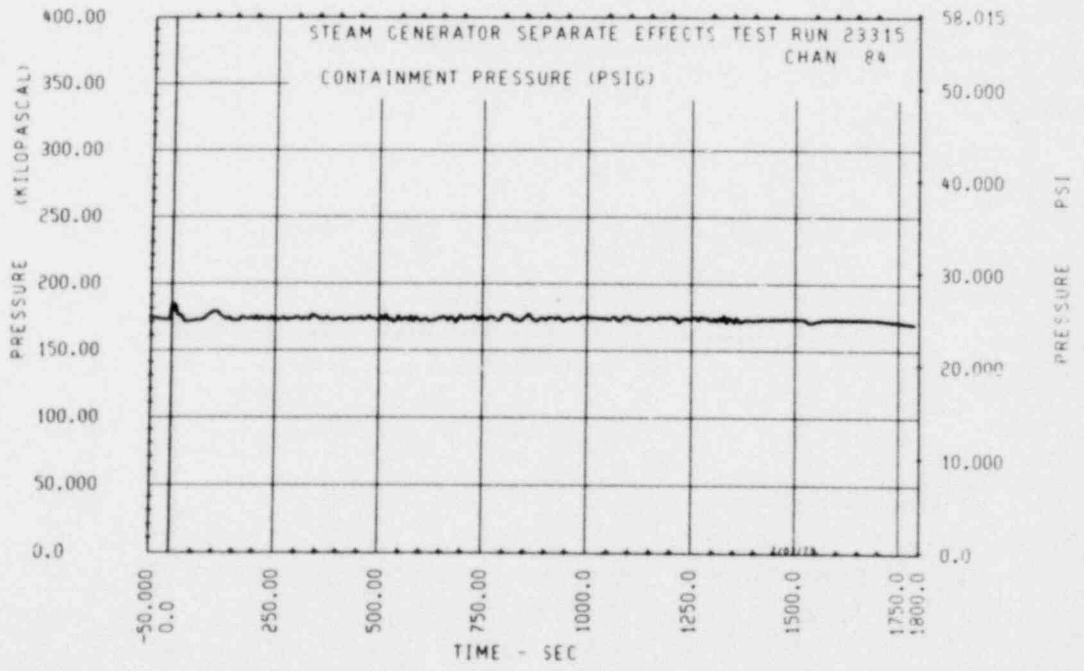

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23315
ACCUMULATOR LIQUID FLOW RATE
CHAN 38
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

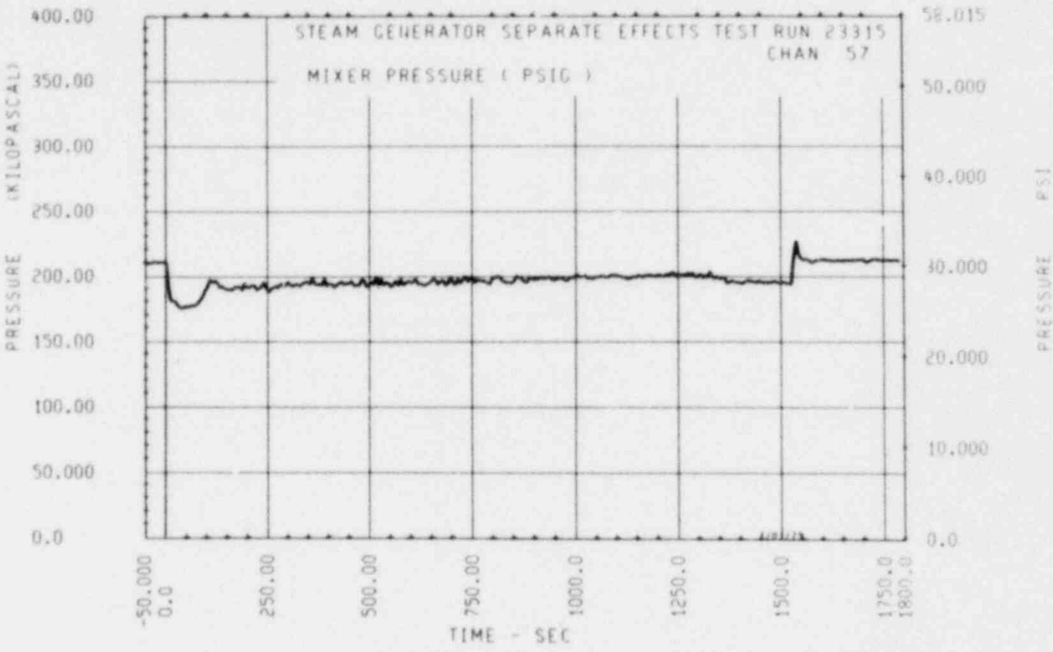

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23315
CONTAINMENT STEAM FLOW RATE
CHAN 97
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)

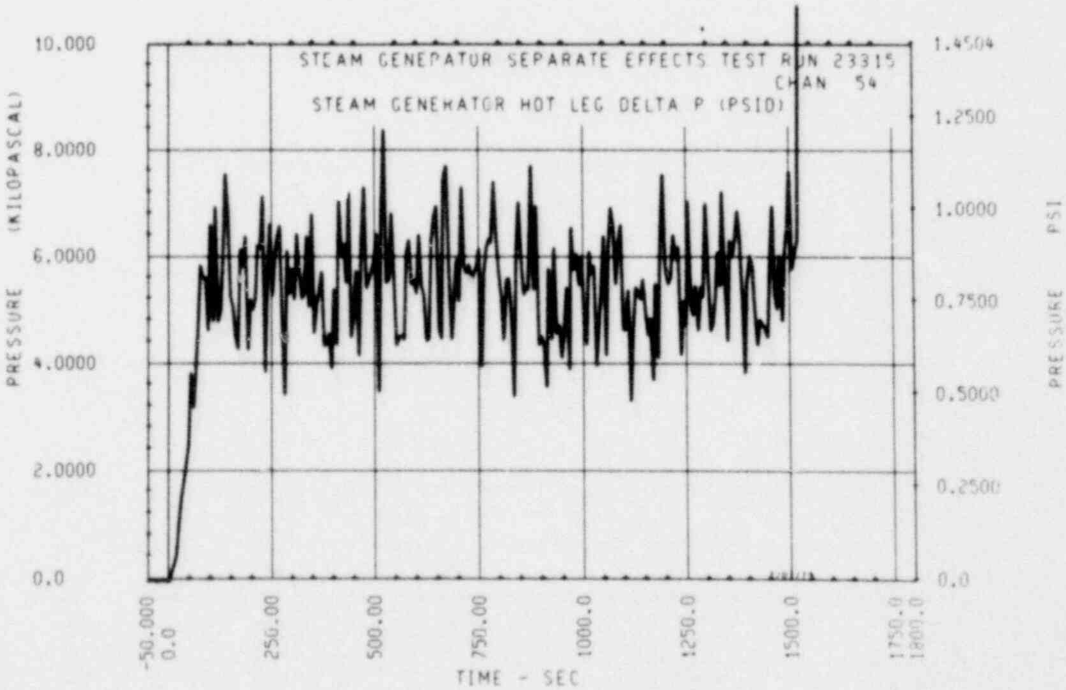
23315-4

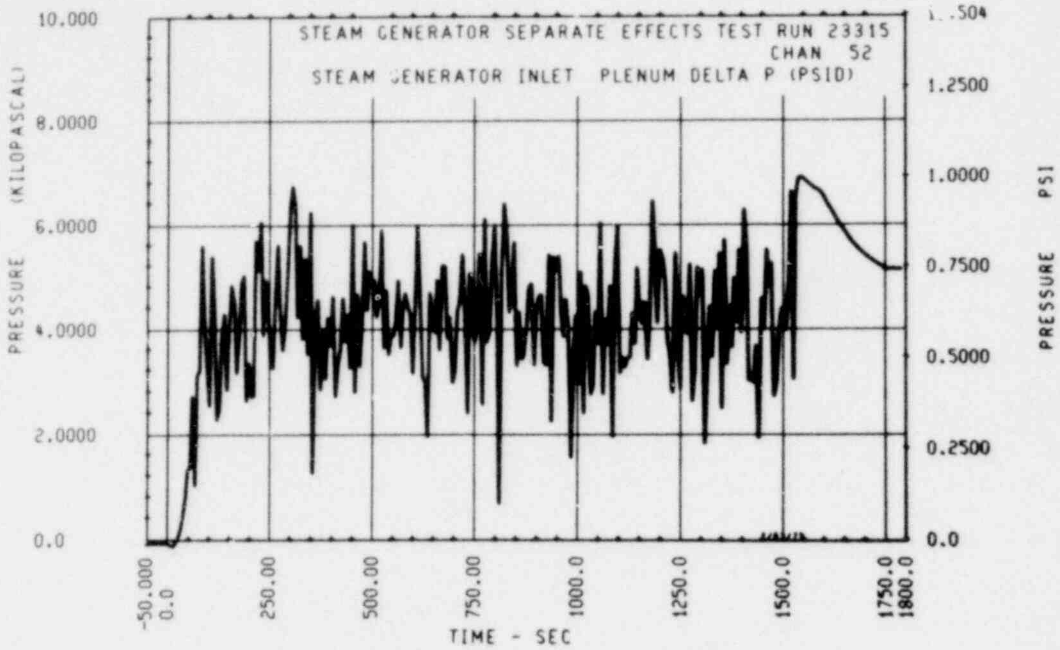


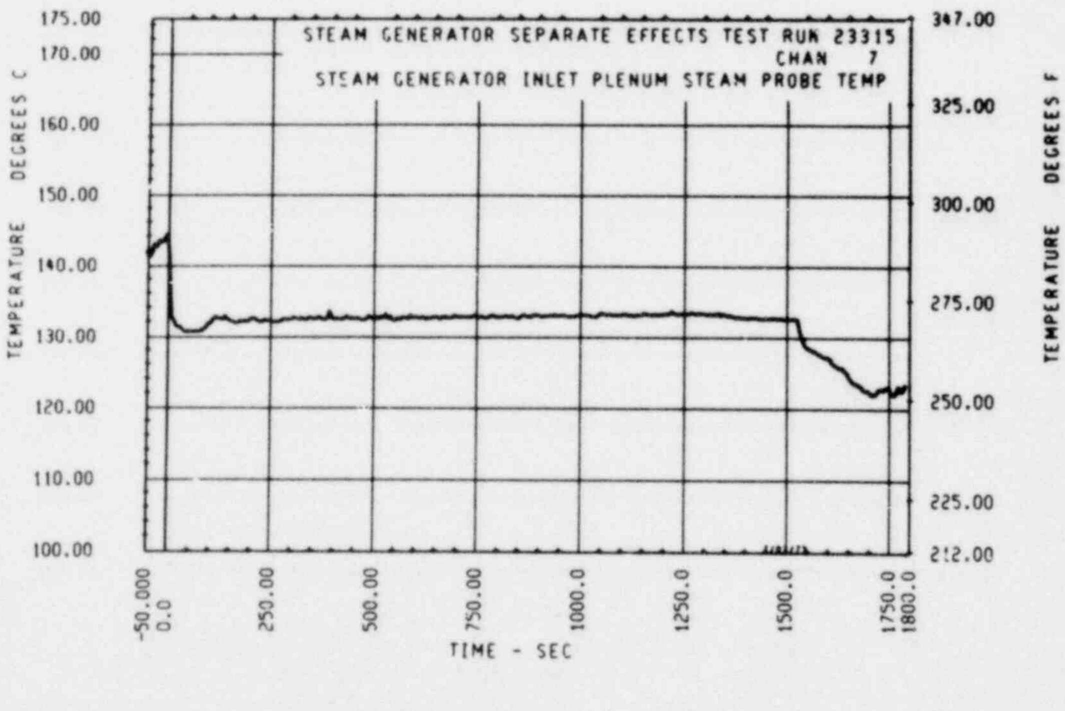
* Refer to Appendix H text for explanation of delayed response.

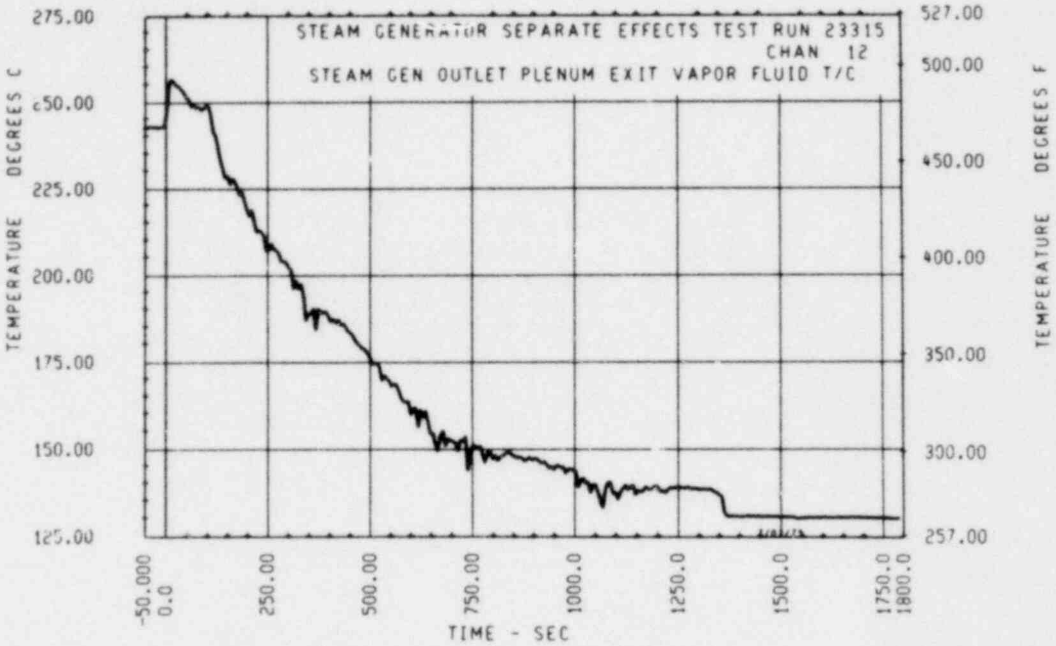


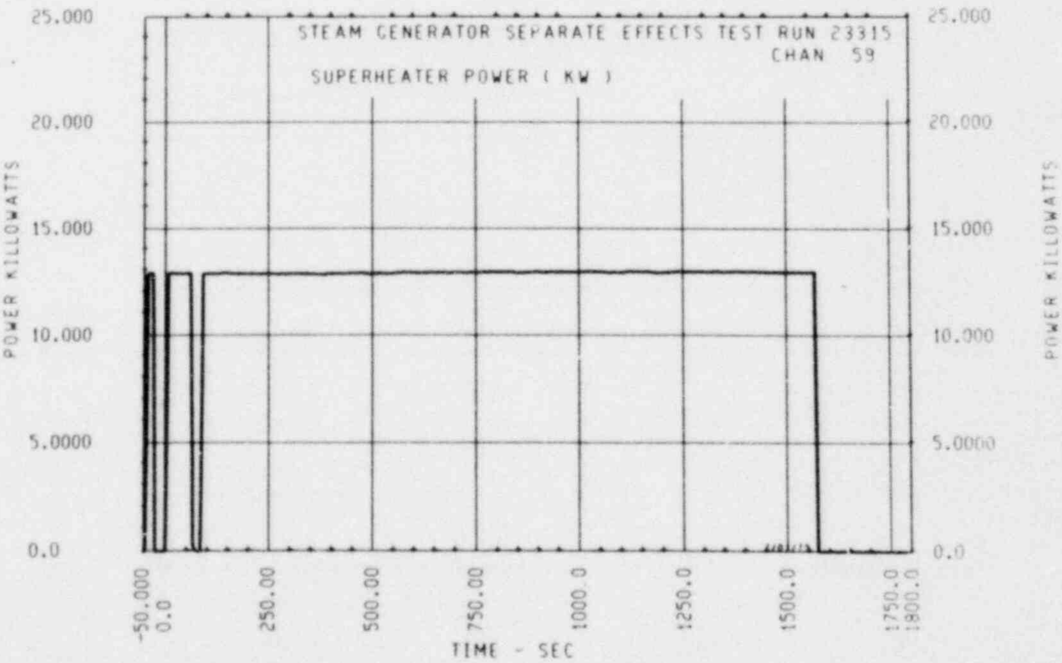

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23315
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
-50.000
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

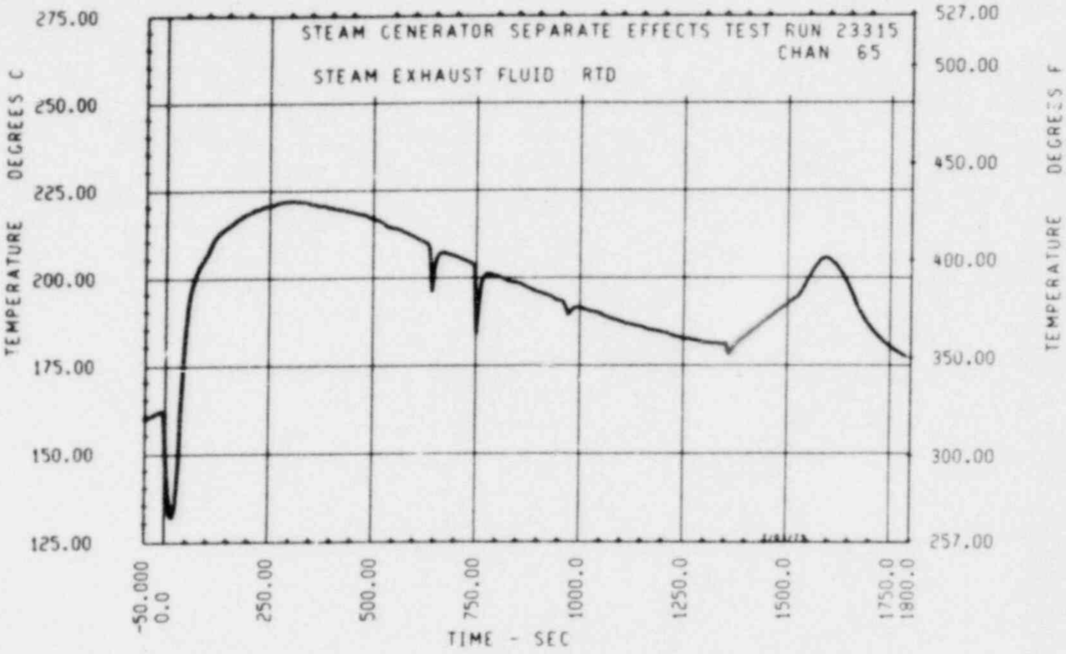

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23315
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
10.000
8.0000
6.0000
4.0000
2.0000
0.0
1.4504
1.2500
1.0000
0.7500
0.5000
0.2500
-50.000
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

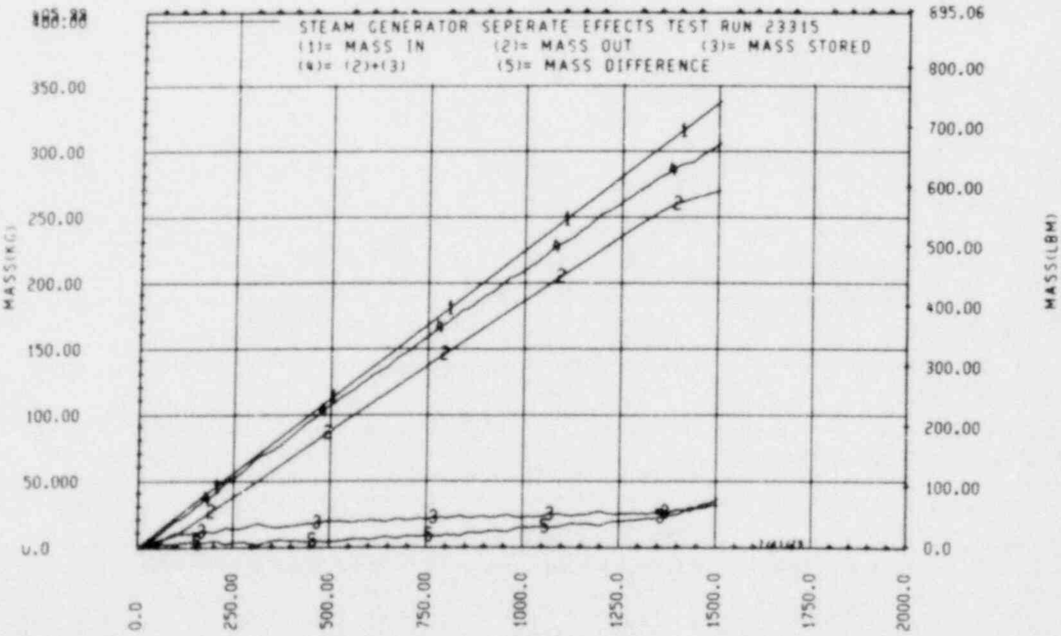

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23315
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

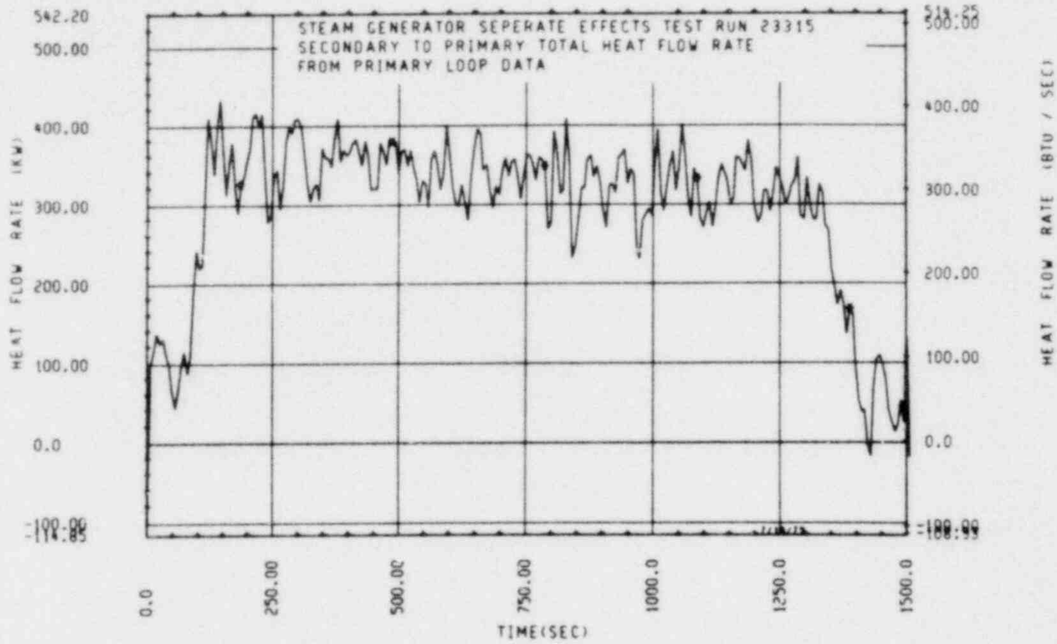

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23315
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

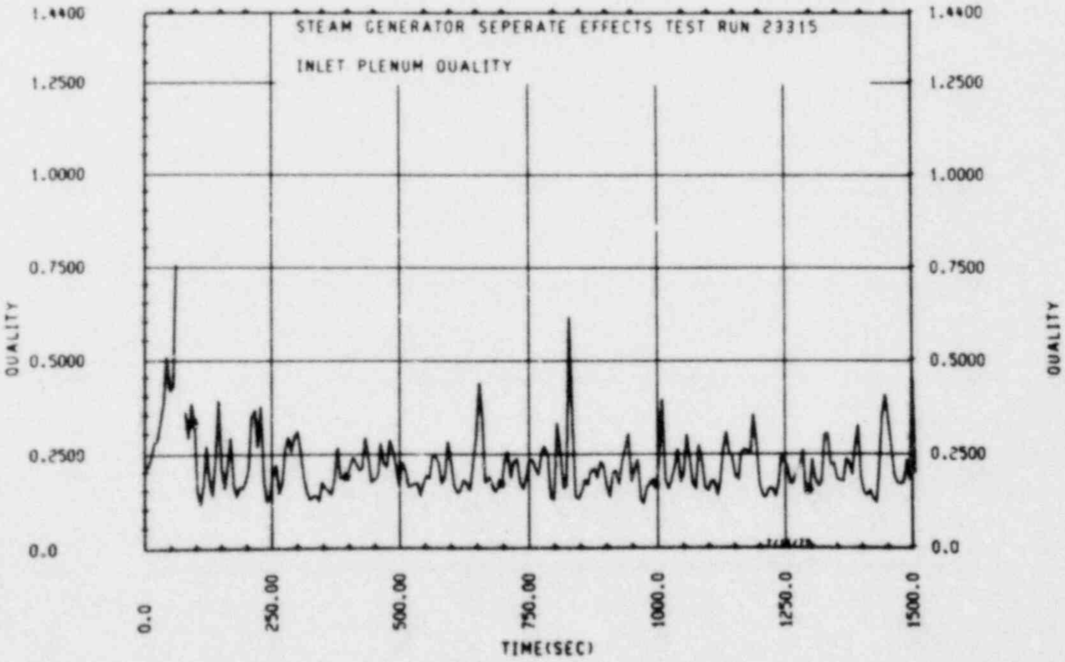

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23315
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23315
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
TIME - SEC

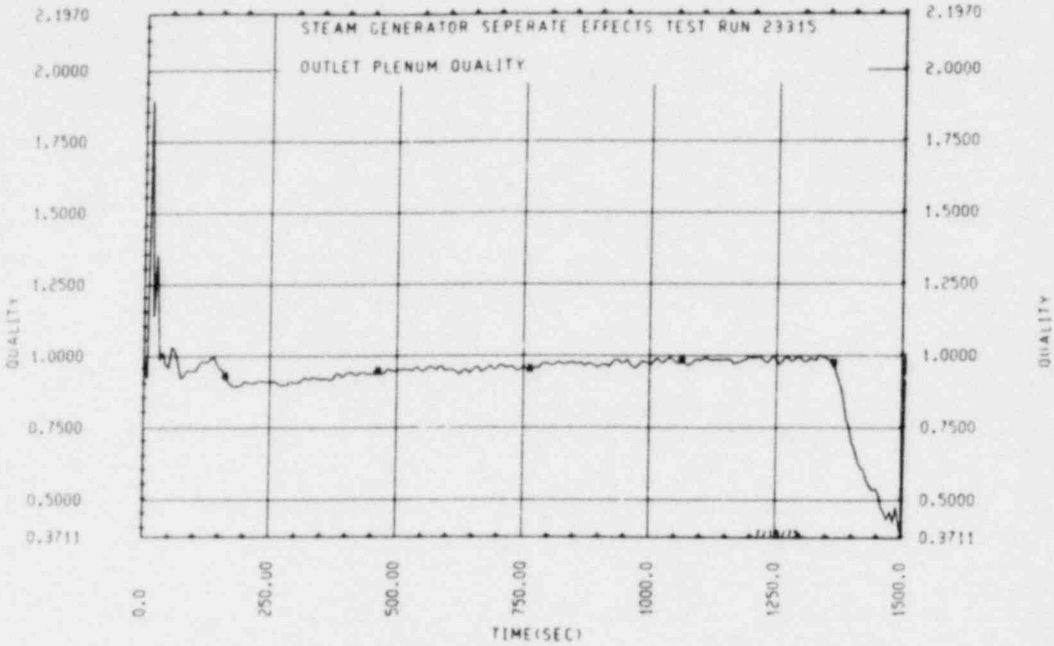

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23315
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23315
(1)= MASS IN
(2)= MASS OUT
(3)= MASS STORED
(4)= (2)+(3)
(5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)

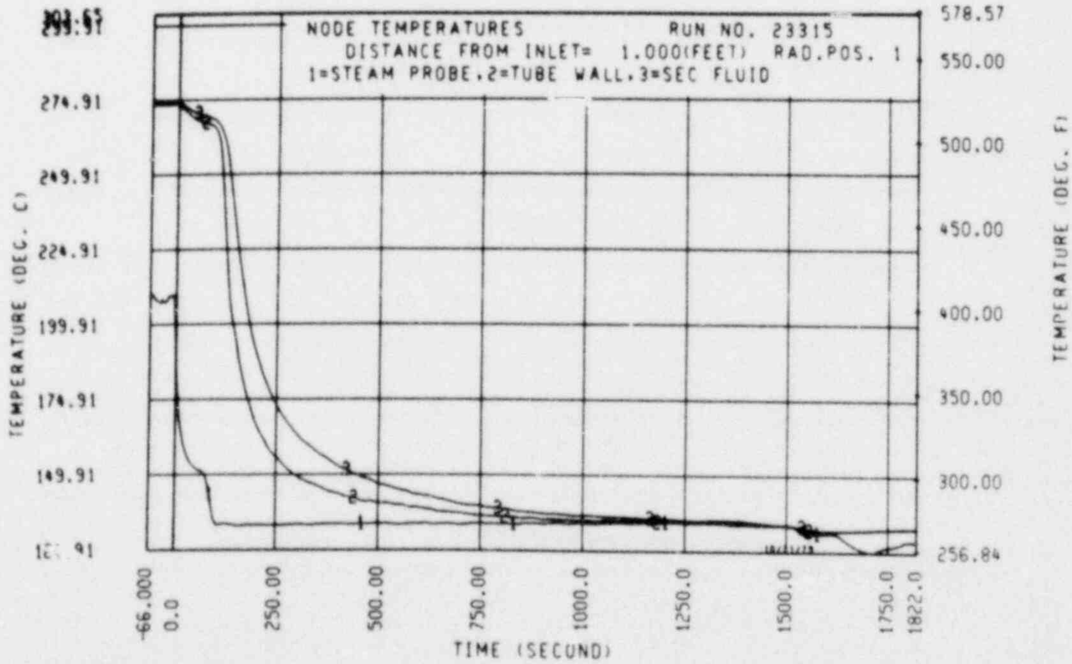

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23315
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23315
INLET PLENUM QUALITY
QUALITY
TIME(SEC)

23315-10

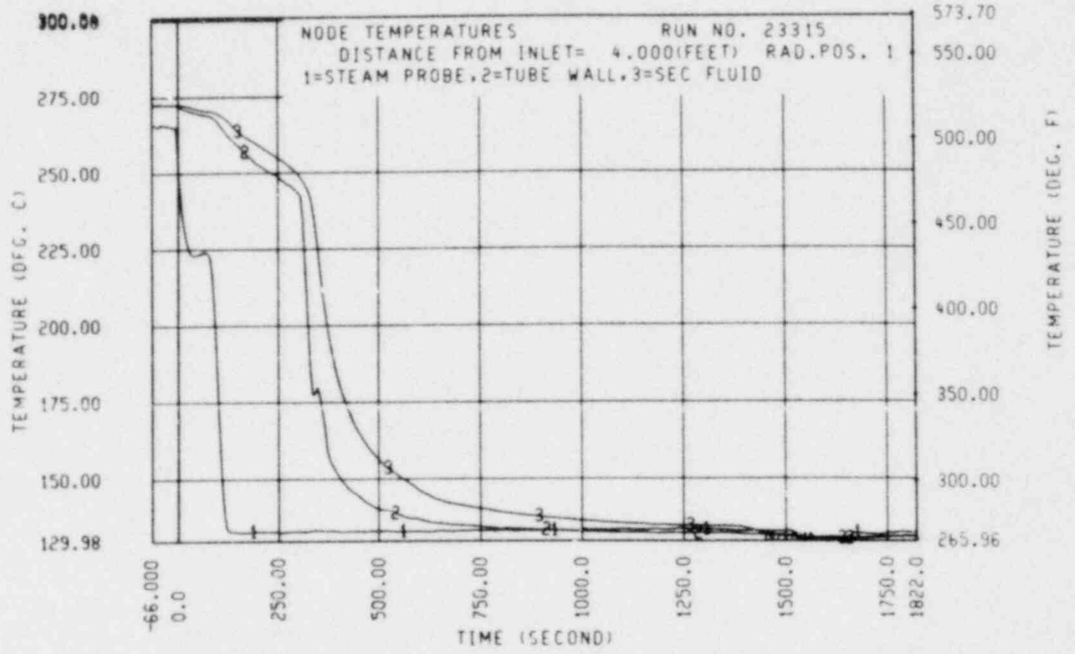


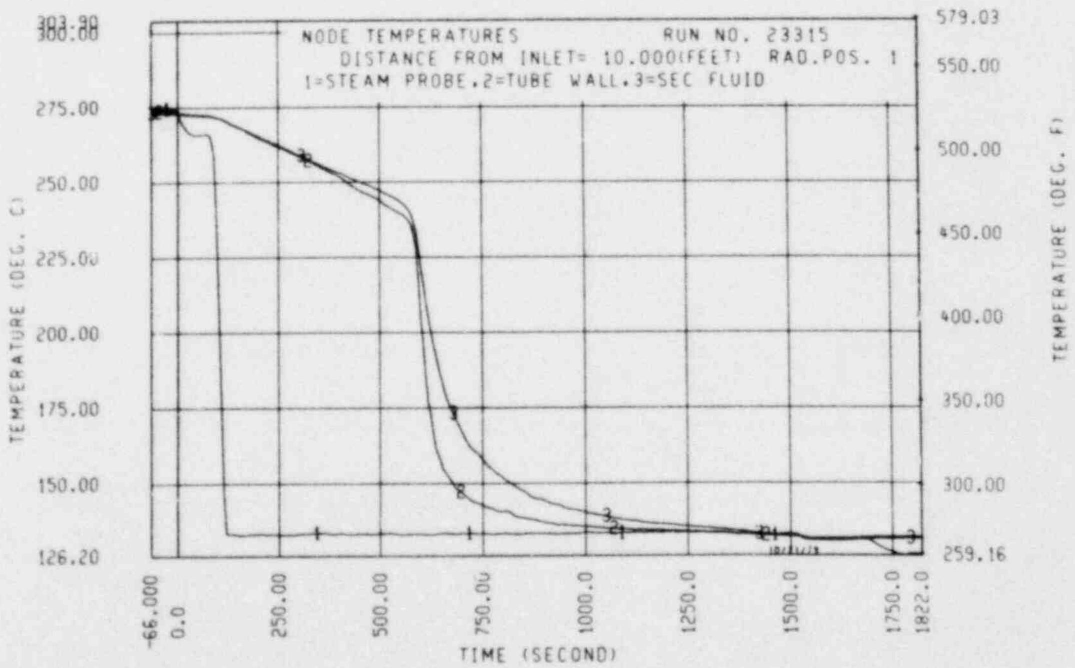
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23315
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)
2.1970
2.0000
1.7500
1.5000
1.2500
1.0000
0.7500
0.5000
0.3711
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0



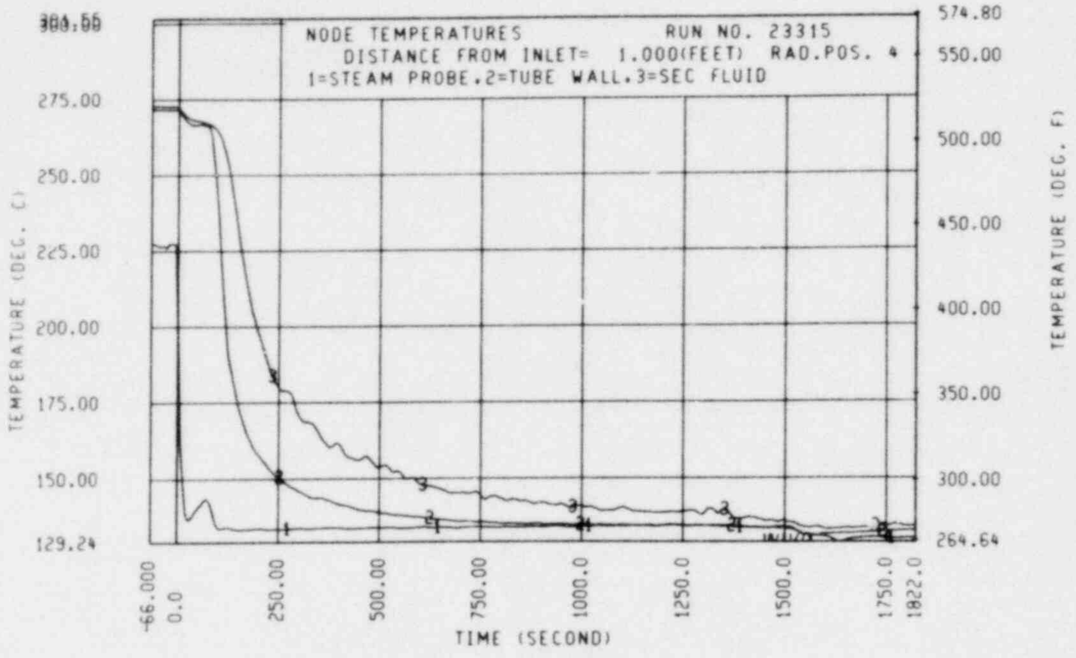
NODE TEMPERATURES RUN NO. 23315
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
274.91
249.91
224.91
199.91
174.91
149.91
578.57
550.00
500.00
450.00
400.00
350.00
300.00
256.84
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1822.0

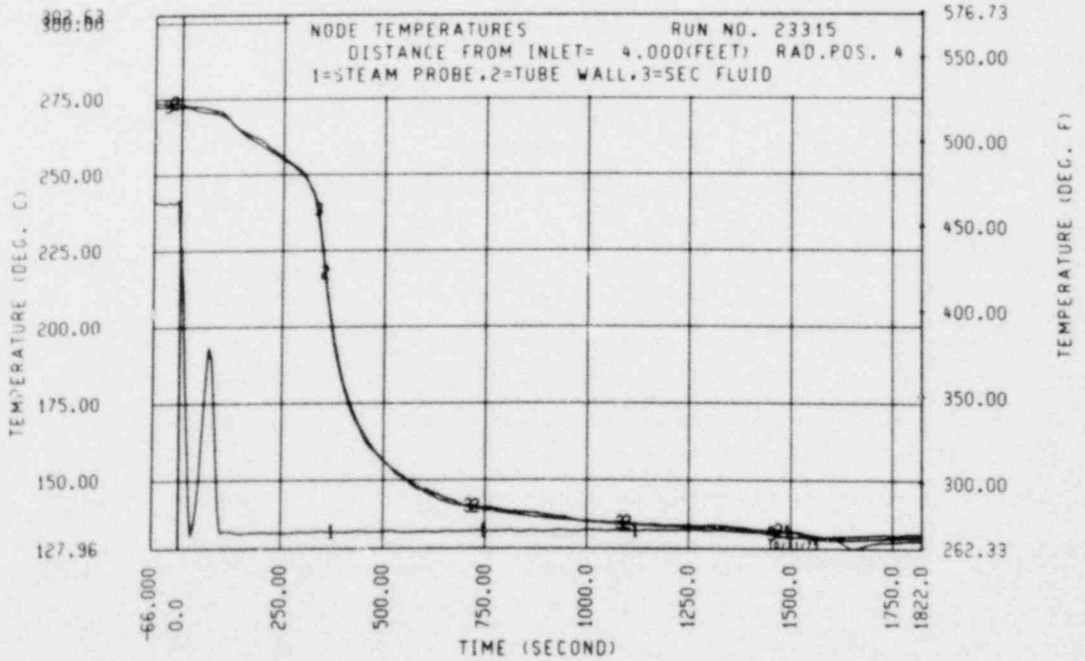
23315-11


NODE TEMPERATURES RUN NO. 23315
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

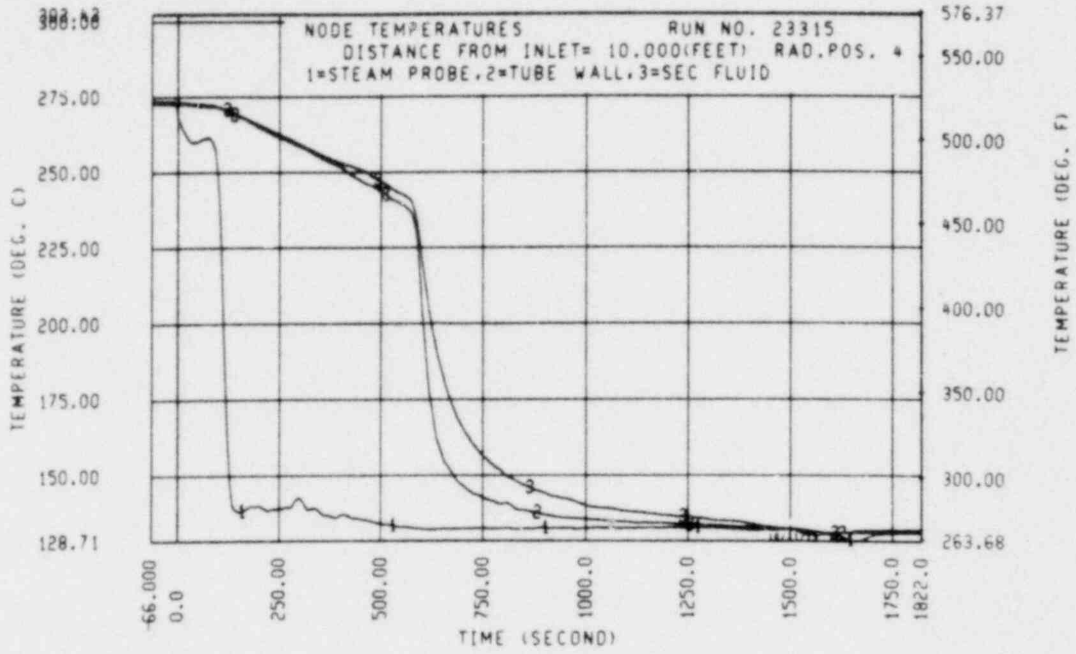

NODE TEMPERATURES RUN NO. 23315
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

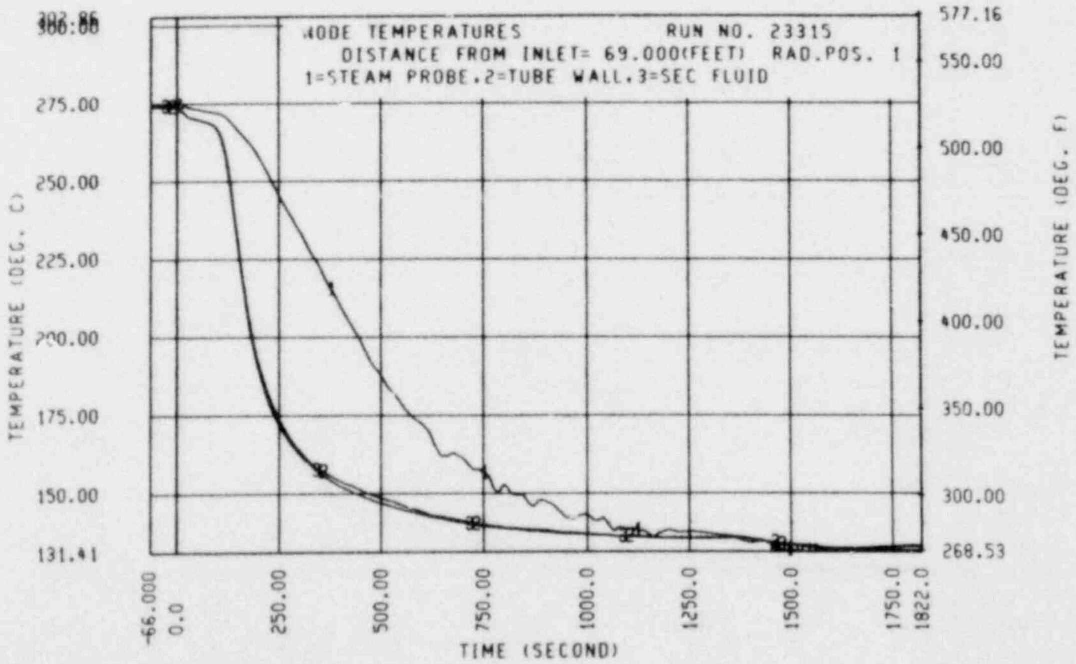
23315-12


NODE TEMPERATURES RUN NO. 23315
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

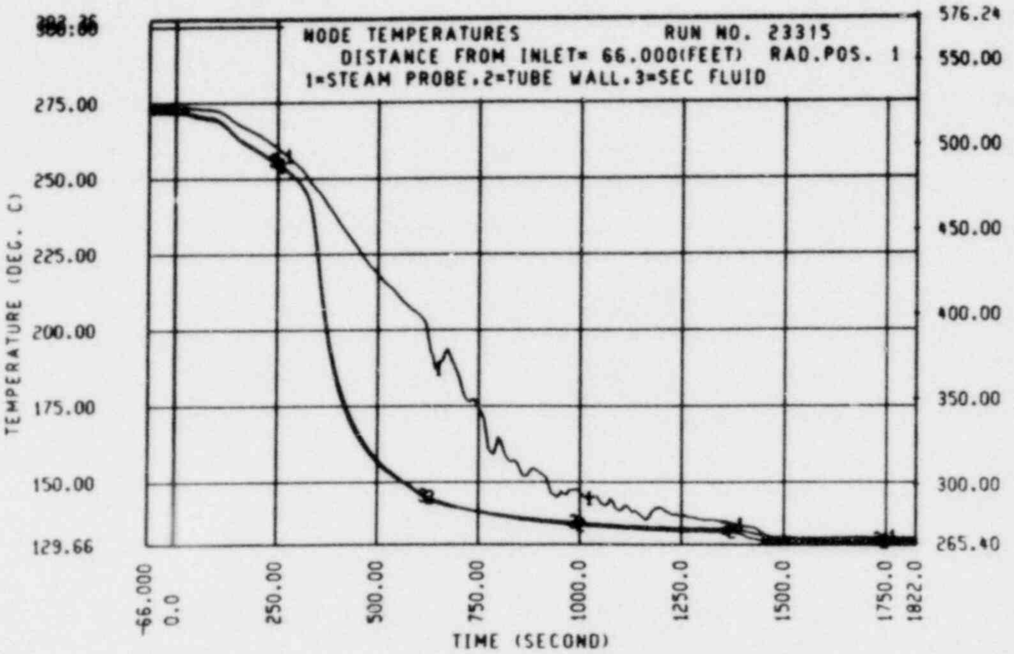

NODE TEMPERATURES RUN NO. 23315
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

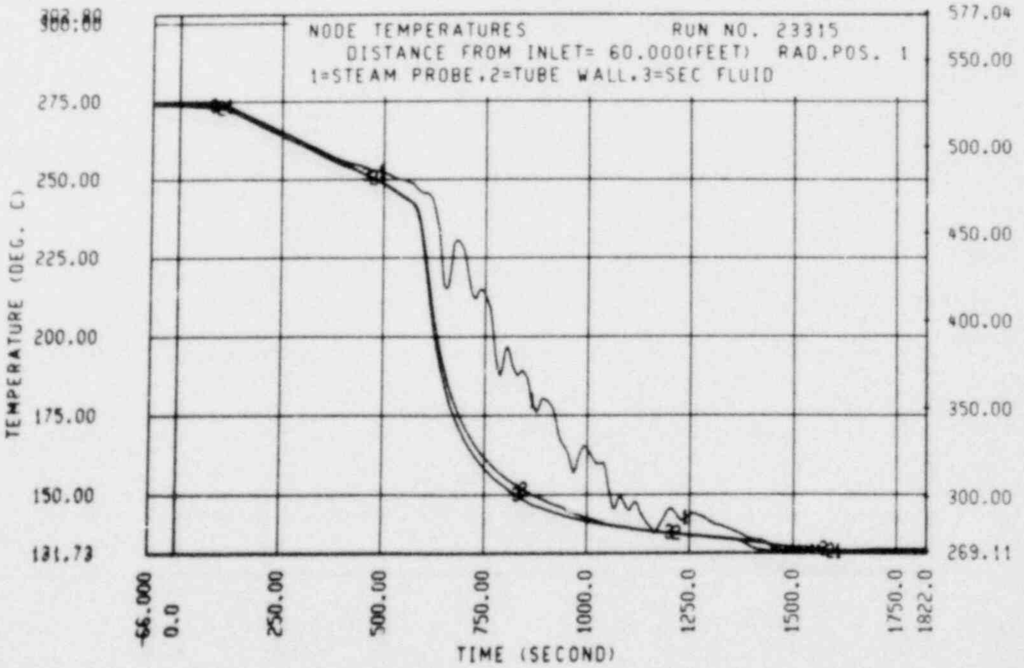
23315-13

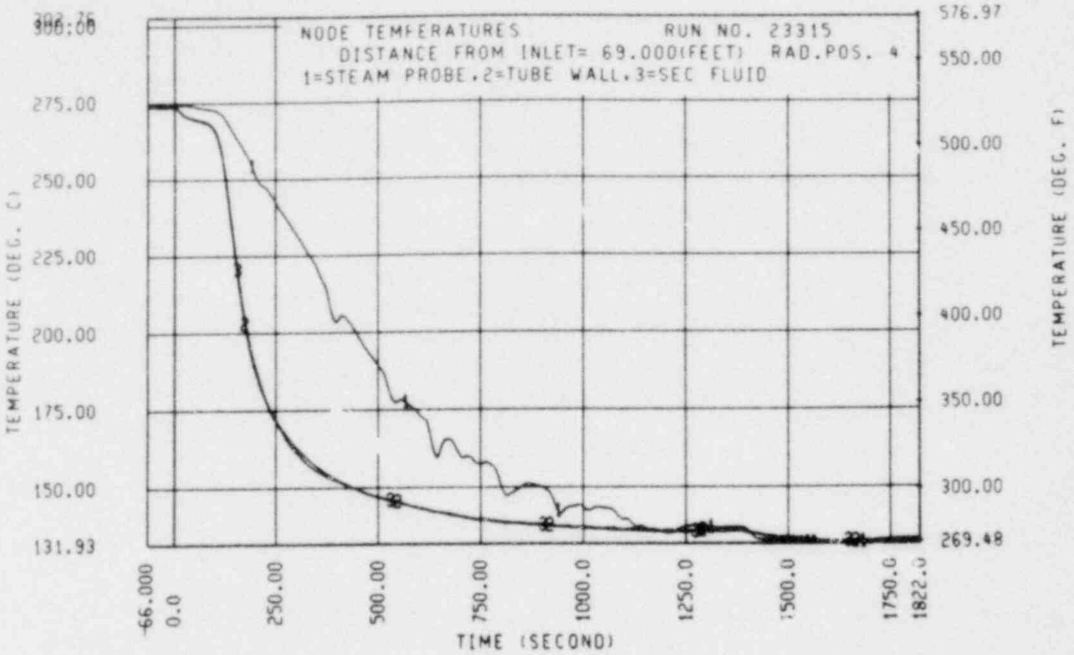

NODE TEMPERATURES RUN NO. 23315
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

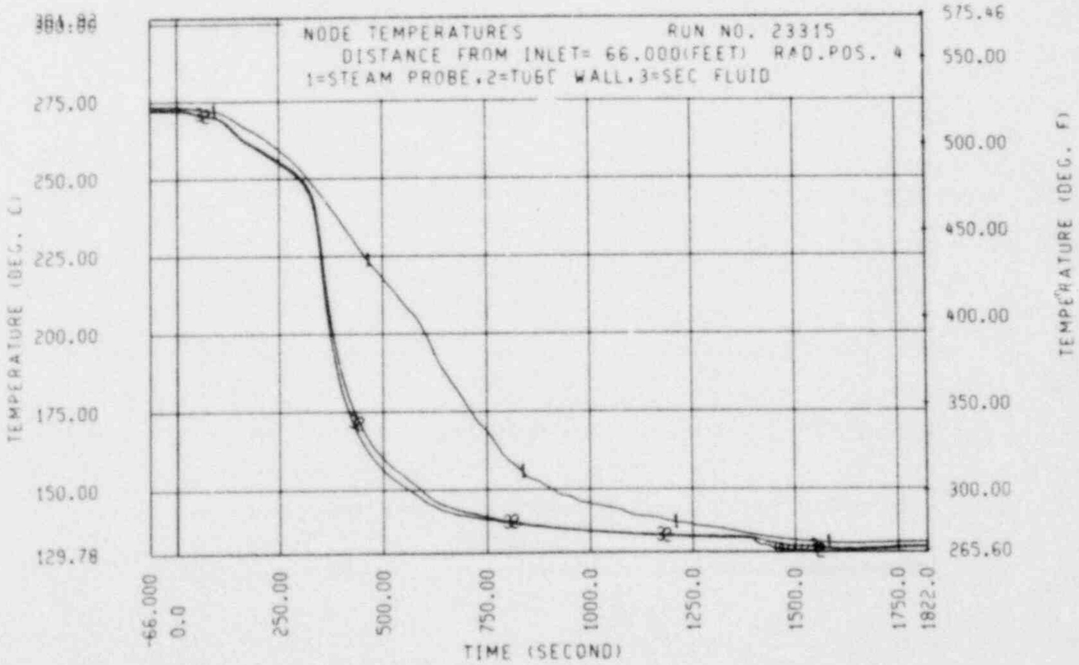

NODE TEMPERATURES RUN NO. 23315
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

23315-14

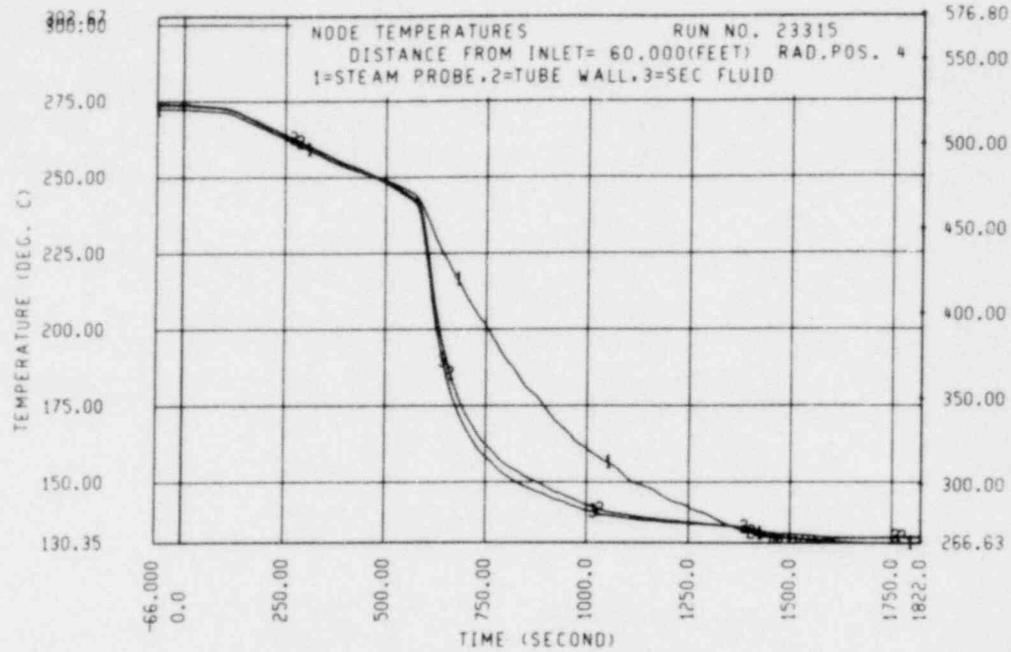

NODE TEMPERATURES RUN NO. 23315
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

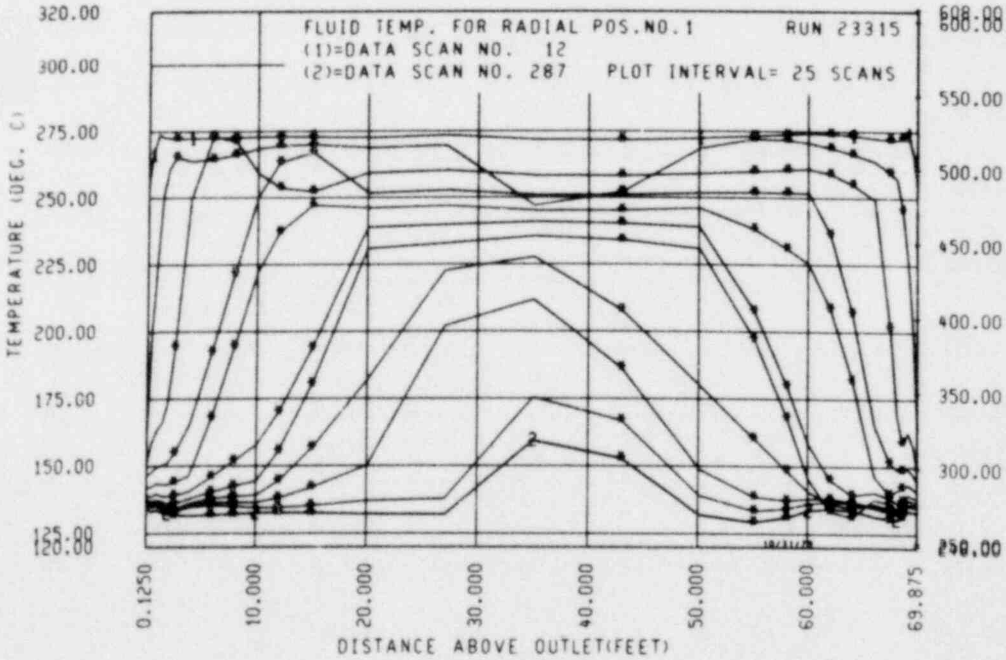

NODE TEMPERATURES RUN NO. 23315
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE, 2=TUBE WALL, 3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

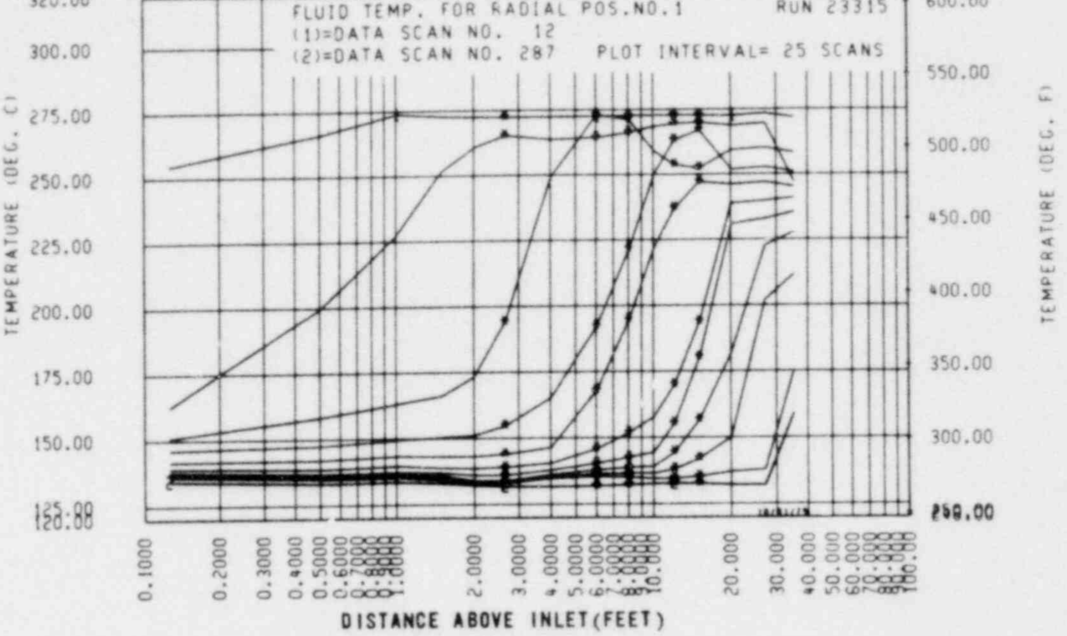

NODE TEMPERATURES RUN NO. 23315
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

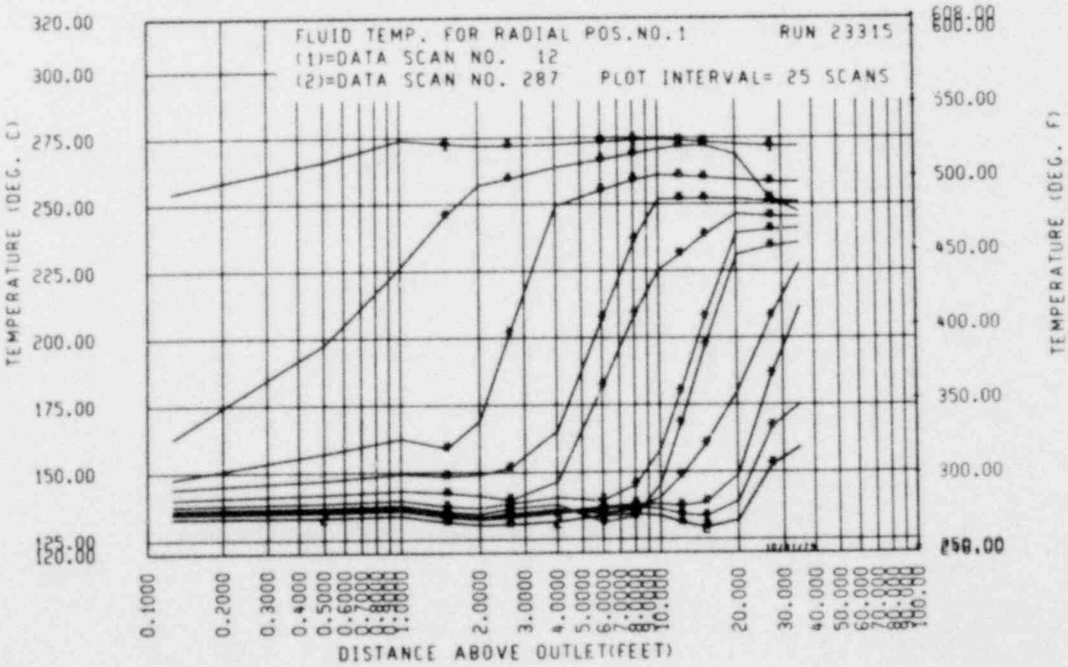

NODE TEMPERATURES RUN NO. 23315
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

23315-16


NODE TEMPERATURES RUN NO. 23315
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
130.35
576.80
550.00
500.00
450.00
400.00
350.00
300.00
266.63
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1822.0


FLUID TEMP. FOR RADIAL POS.NO.1 RUN 23315
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 287 PLOT INTERVAL= 25 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)
320.00
300.00
275.00
250.00
225.00
200.00
175.00
150.00
125.00
120.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
0.1250
10.000
20.000
30.000
40.000
50.000
60.000
69.875


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 23315
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 287
PLOT INTERVAL= 25 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 23315
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 287
PLOT INTERVAL= 25 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 23315

TIME = 60.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1		LOCAL FLUX 2		LOCAL FLUX 3		LOCAL FLUX 4		LOCAL QUALITY 1	LOCAL QUALITY 2	LOCAL QUALITY 3	LOCAL QUALITY 4
.0(.13)	.3(	.03)	16.8(	1.48)	137.9(	12.15)	51.7(	4.55)	.604	.766	.041	.028
.2(.50)	7.2(	.64)	1.2(	.11)	11.1(	.98)	12.3(	1.08)	.603	.770	.065	.039
.3(1.00)	9.8(	.86)	8.3(	.73)	.6(	.05)	.8(	.07)	.599	.770	.069	.043
.5(1.50)	3.1(	.28)	.6(	.05)	6.7(	.59)	9.2(	.81)	.592	.766	.071	.046
.6(2.00)	.5(	.05)	8.9(	.78)	-.8(	-.07)	4.9(	.43)	.585	.763	.072	.051
.8(2.65)	.5(	.04)	7.2(	.64)	-3.1(	-.27)	3.1(	.27)	.578	.760	.070	.053
1.2(4.00)	.8(	.07)	-.0(	-.00)	-.0(	-.00)	.6(	.05)	.569	.744	.067	.054
1.8(6.00)	.2(	.01)	.8(	.07)	5.0(	.44)	11.7(	1.03)	.560	.719	.070	.065
2.4(8.00)	-.1(	-.01)	-.8(	-.07)	-2.4(	-.21)	7.2(	.63)	.553	.705	.072	.084
3.0(10.00)	-.2(	-.02)	-.2(	-.02)	.1(	.01)	-.5(	-.04)	.549	.699	.069	.091
3.7(12.00)	-.3(	-.03)	-.0(	-.00)	.6(	.05)	-1.2(	-.11)	.546	.697	.069	.089
4.6(15.00)	1.7(	.15)	.7(	.06)	.6(	.05)	-.8(	-.07)	.549	.696	.071	.086
6.1(20.00)	-.0(	-.00)	-.0(	-.00)	.5(	.05)	.1(	.01)	.552	.696	.073	.084
8.2(27.00)	.5(	.04)	.2(	.02)	-.9(	-.08)	-.3(	-.02)	.554	.696	.072	.083
10.7(35.00)	0.0(	0.00)	0.0(	0.00)	0.0(	0.00)	0.0(	0.00)	.557	.698	.068	.082
13.1(43.00)	-1.1(	-.09)	-.3(	-.02)	.0(	.00)	-.2(	-.02)	.552	.697	.069	.082
15.2(50.00)	-.2(	-.02)	-.1(	-.01)	-.2(	-.02)	-.2(	-.02)	.547	.695	.068	.080
16.8(55.00)	.0(	.00)	-.0(	-.00)	-.1(	-.01)	-.1(	-.01)	.547	.695	.068	.079
17.7(58.00)	.1(	.01)	-.0(	-.00)	.0(	.00)	.0(	.00)	.547	.695	.068	.079
18.3(60.00)	.4(	.04)	.0(	.00)	.1(	.01)	.1(	.01)	.547	.695	.068	.079
18.9(62.00)	1.0(	.09)	.1(	.01)	.2(	.02)	.1(	.01)	.549	.695	.069	.080
19.5(64.00)	.2(	.02)	.2(	.02)	.2(	.02)	.1(	.01)	.551	.696	.069	.080
20.1(66.00)	.4(	.04)	1.0(	.09)	.4(	.04)	.1(	.00)	.552	.698	.070	.080
20.5(67.38)	-.0(	-.00)	.3(	.02)	-.0(	-.00)	-.5(	-.04)	.553	.699	.070	.080
20.7(68.00)	.5(	.04)	-.0(	-.00)	.5(	.04)	.1(	.01)	.553	.699	.070	.080
20.9(68.50)	-.4(	-.03)	-.3(	-.03)	-.5(	-.04)	-.7(	-.06)	.553	.699	.070	.080
21.0(69.00)	-.0(	-.00)	-.0(	-.00)	-.0(	-.00)	-.0(	-.00)	.553	.698	.070	.080
21.2(69.50)	-.0(	-.00)	.1(	.01)	-.1(	-.01)	0.0(	0.00)	.555	.699	.070	.080
21.3(69.87)	-32.4(	-2.86)	-15.9(	-1.40)	-12.2(	-1.08)	-.8(	-.07)	.553	.697	.069	.080

23315-19

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 23315

TIME = 120.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.01)	45.6(4.01)	58.0(5.11)	54.5(4.80)	.604	.770	.029	.028
.2(.50)	.5(.04)	300.7(26.49)	.5(.04)	339.4(29.91)	.604	[illegible]	.038	.141
.3(1.00)	234.2(20.64)	420.5(37.05)	8.1(.72)	.5(.05)	.677	1.092	.041	.245
.5(1.50)	.6(.05)	.6(.05)	104.7(9.23)	.6(.05)	.751	1.222	.076	.246
.6(2.00)	.6(.05)	35.9(3.16)	.6(.05)	295.8(26.07)	.752	1.234	.108	.338
.8(2.65)	.6(.05)	-9.7(-.86)	.6(.05)	202.6(17.85)	.753	1.240	.110	.523
1.2(4.00)	7.4(.66)	2.6(.23)	3.0(.26)	.6(.05)	.762	1.238	.115	.618
1.8(6.00)	-9.4(-.83)	9.0(.79)	.8(.07)	10.0(.88)	.760	1.252	.120	.629
2.4(8.00)	-6.8(-.60)	4.0(.35)	.6(.05)	6.3(.56)	.739	1.267	.121	.642
3.0(10.00)	.1(.00)	.1(.00)	.6(.05)	.1(.01)	.726	1.264	.122	.637
3.7(12.00)	7.6(.67)	-1.4(-.12)	4.1(.36)	-.7(-.06)	.717	1.243	.125	.620
4.6(15.00)	7.9(.70)	.4(.03)	4.3(.38)	1.0(.09)	.713	1.211	.135	.601
6.1(20.00)	-.0(-.00)	.4(.04)	.5(.04)	.1(.00)	.707	1.184	.143	.591
8.2(27.00)	.4(.04)	.2(.02)	-.8(-.07)	-.3(-.02)	.709	1.169	.144	.593
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.749	1.180	.167	.615
13.1(43.00)	.2(.02)	.5(.04)	1.3(.11)	.1(.01)	.805	1.213	.214	.646
15.2(50.00)	-.2(-.02)	-.1(-.01)	-.2(-.02)	-.3(-.02)	.825	1.229	.237	.656
16.8(55.00)	-.1(-.01)	-.1(-.01)	-.2(-.02)	-.2(-.02)	.820	1.227	.235	.652
17.7(58.00)	.1(.00)	-.0(-.00)	-.0(-.00)	-.0(-.00)	.818	1.225	.235	.651
18.3(60.00)	.6(.05)	.1(.01)	.2(.02)	.1(.01)	.819	1.226	.235	.652
18.9(62.00)	1.9(.17)	.2(.02)	.2(.02)	.1(.01)	.823	1.226	.236	.653
19.5(64.00)	.2(.02)	.3(.03)	.2(.01)	-.0(-.00)	.826	1.228	.237	.653
20.1(66.00)	.2(.02)	1.0(.08)	.2(.02)	-.2(-.02)	.828	1.230	.238	.653
20.5(67.38)	-.8(-.07)	-.2(-.02)	-.8(-.07)	-2.3(-.20)	.828	1.232	.238	.652
20.7(68.00)	-1.4(-.13)	-1.2(-.11)	-1.4(-.13)	-2.6(-.23)	.828	1.232	.237	.650
20.9(68.50)	-3.1(-.27)	-3.2(-.28)	-5.5(-.49)	-2.6(-.23)	.827	1.230	.235	.649
21.0(69.00)	-.2(-.01)	2.8(.24)	3.4(.30)	-.2(-.01)	.827	1.230	.235	.649
21.2(69.50)	-23.0(-2.03)	-.4(-.04)	-.4(-.04)	-.4(-.04)	.826	1.232	.236	.650
21.3(69.87)	-17.8(-1.57)	-10.6(-.94)	-8.8(-.77)	-4.4(-.39)	.822	1.233	.235	.650

23315-20

RUN 23315 FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

TIME = 180.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.1(.01)	29.4(2.59)	27.9(2.46)	27.8(2.45)	.604	.767	.024	.024
.2(.50)	102.5(9.03)	84.6(7.45)	106.3(9.36)	115.6(10.18)	.635	.797	.061	.064
.3(1.00)	145.4(12.81)	194.4(17.13)	.3(.03)	.3(.03)	.712	.883	.094	.099
.5(1.50)	.4(.03)	240.9(21.23)	90.0(7.93)	.4(.03)	.757	1.018	.122	.100
.6(2.00)	.5(.05)	.5(.05)	.5(.05)	322.1(28.38)	.758	1.093	.150	.199
.8(2.65)	.6(.05)	.6(.05)	.6(.05)	267.6(23.58)	.758	1.094	.150	.421
1.2(4.00)	10.8(.95)	4.1(.36)	3.5(.31)	.6(.05)	.772	1.099	.155	.544
1.8(6.00)	-25.7(-2.27)	.4(.04)	-21.1(-1.86)	-8.6(-.76)	.754	1.102	.133	.534
2.4(8.00)	-18.2(-1.61)	-1.6(-.14)	.6(.05)	-4.3(-.38)	.750	1.093	.108	.517
3.0(10.00)	.2(.02)	.2(.02)	1.0(.09)	.4(.03)	.673	1.082	.110	.507
3.7(12.00)	.6(.05)	1.8(.16)	12.0(1.06)	4.8(.43)	.655	1.077	.122	.499
4.6(15.00)	15.4(1.35)	2.6(.23)	13.0(1.15)	8.1(.71)	.661	1.079	.161	.501
6.1(20.00)	-.1(-.01)	.5(.05)	.6(.05)	.1(.01)	.674	1.077	.183	.506
8.2(27.00)	.3(.03)	.2(.01)	-.3(-.07)	-.3(-.02)	.678	1.057	.189	.507
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.686	1.025	.188	.510
13.1(43.00)	-.6(-.05)	-.2(-.02)	6.2(.55)	-7.1(-.63)	.683	1.003	.214	.479
15.2(50.00)	-.2(-.02)	-.1(-.01)	-.2(-.02)	-.3(-.03)	.676	1.001	.240	.447
16.8(55.00)	-.1(-.00)	-.1(-.01)	-.8(-.07)	.2(.02)	.673	1.004	.239	.448
17.7(58.00)	.0(.00)	-.0(-.00)	-.3(-.03)	.2(.02)	.672	1.006	.238	.449
18.3(60.00)	.1(.01)	-.0(-.00)	.0(.00)	.1(.01)	.673	1.007	.238	.450
18.9(62.00)	.2(.02)	.1(.01)	.2(.02)	-.0(-.00)	.674	1.008	.239	.451
19.5(64.00)	.1(.01)	.2(.02)	.2(.02)	-.1(-.00)	.675	1.009	.240	.451
20.1(66.00)	.2(.02)	1.0(.09)	.2(.02)	-.2(-.02)	.677	1.011	.241	.451
20.5(67.38)	-1.4(-.13)	-.8(-.07)	-1.5(-.13)	-3.7(-.32)	.677	1.012	.241	.450
20.7(68.00)	-4.4(-.39)	-3.9(-.34)	-4.4(-.39)	-5.9(-.52)	.676	1.011	.239	.447
20.9(68.50)	-6.1(-.54)	-6.4(-.57)	-11.8(-1.04)	-3.9(-.35)	.674	1.009	.235	.446
21.0(69.00)	3.1(.27)	2.5(.22)	1.0(.09)	5.5(.48)	.676	1.010	.232	.448
21.2(69.50)	-7.1(-.63)	-16.2(-1.43)	-9.5(-.84)	-8.7(-.77)	.681	1.010	.231	.449
21.3(69.87)	-7.9(-.69)	-4.2(-.37)	-4.1(-.36)	-.8(-.07)	.684	1.010	.228	.447

23315-21

SUMMARY SHEET

RUN NO. 23402

DATE: 4/19/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.358 (0.790)
2. Water flow - [kg/sec (lb/sec)] - 0.090 (0.199)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^oC (^oF)] - 163 (325)
5. Water temperature [^oC (^oF)] - 126 (258)
6. Mixer pressure [kPa (psig)] - 234 (34)
7. Test time (sec) - 1446.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 9.8 (32.1)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^oC (^oF)]
0.00 (0.00)	257 (494)
0.15 (0.50)	271 (519)
0.30 (1.00)	274 (525)
0.46 (1.50)	272 (522)
0.61 (2.00)	273 (523)
1.22 (4.00)	-
3.05 (10.00)	273 (524)
6.09 (20.00)	273 (523)
8.23 (27.00)	-
10.67 (35.00)	273 (523)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 4.87 (10.73)
2. [illegible]uid collection
   (a) Outlet plenum [kg (lb)] - 4.92 (10.85)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 0.649 (1.43)

D. FAILED BUNDLE T/Cs[1]

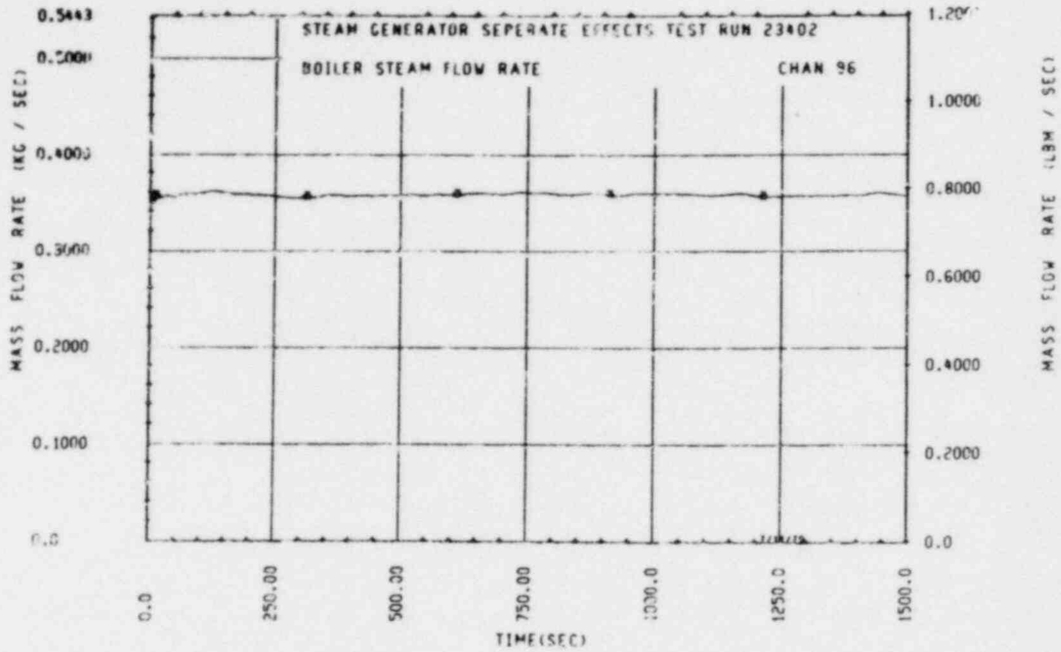
287, 294, 295, 298, 305, 308, 309, 310, 311, 326, 518, 520, 521, 532, 549, 553, 555, 564, 565, 568, 569

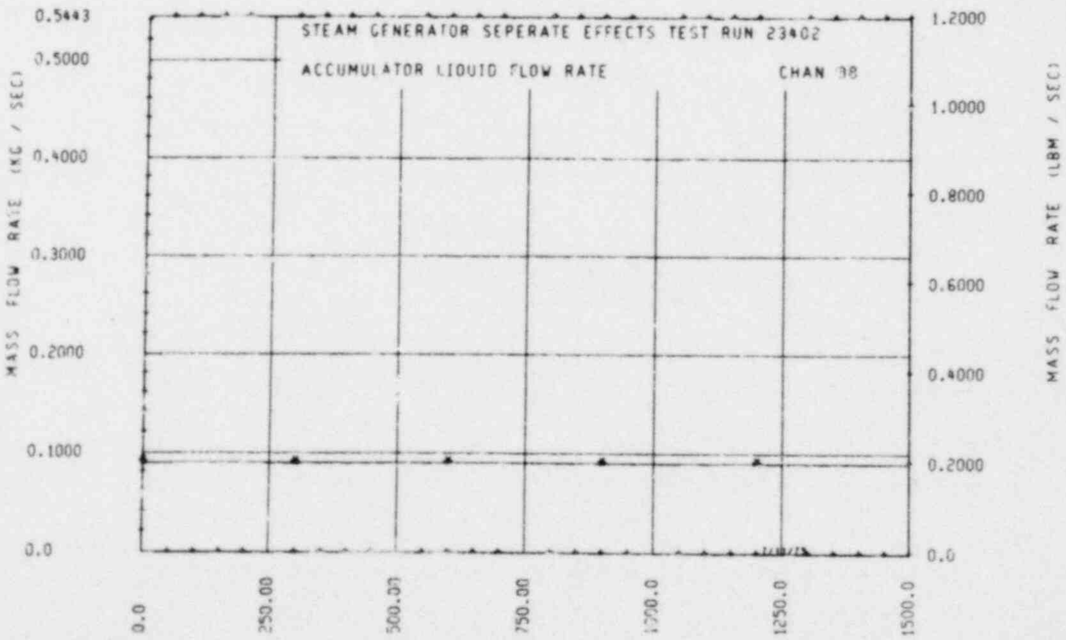
E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

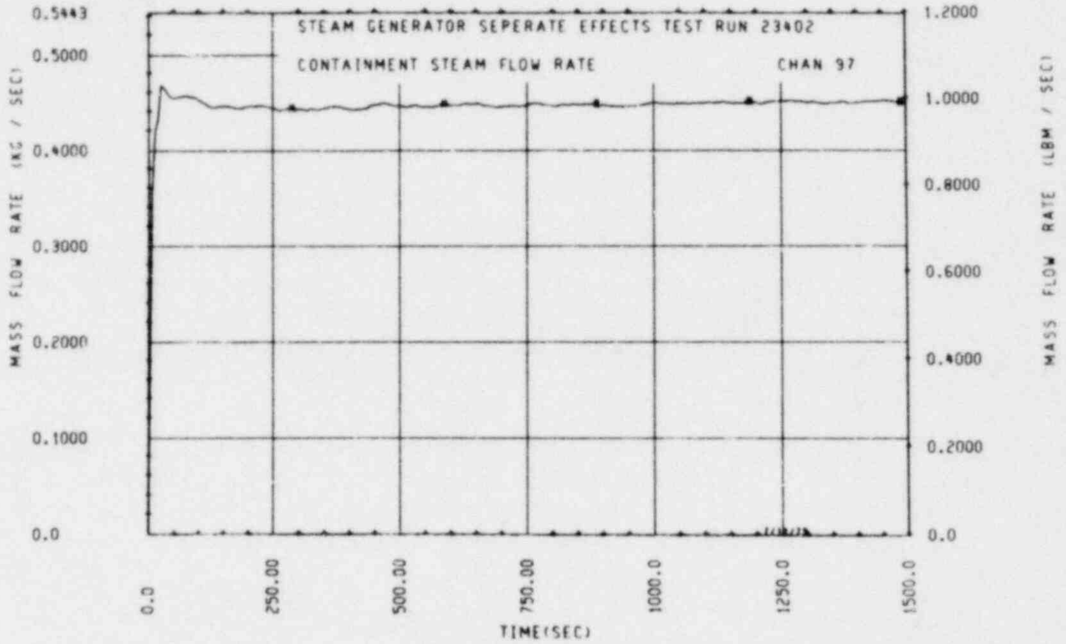
1. From primary side energy balance [kwsec(Btu)] - 0.787×10^5 (0.75×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da dt$) - [kwsec(Btu)] - 0.497×10^5 (0.473×10^5)
3. Integration to 300 sec

---

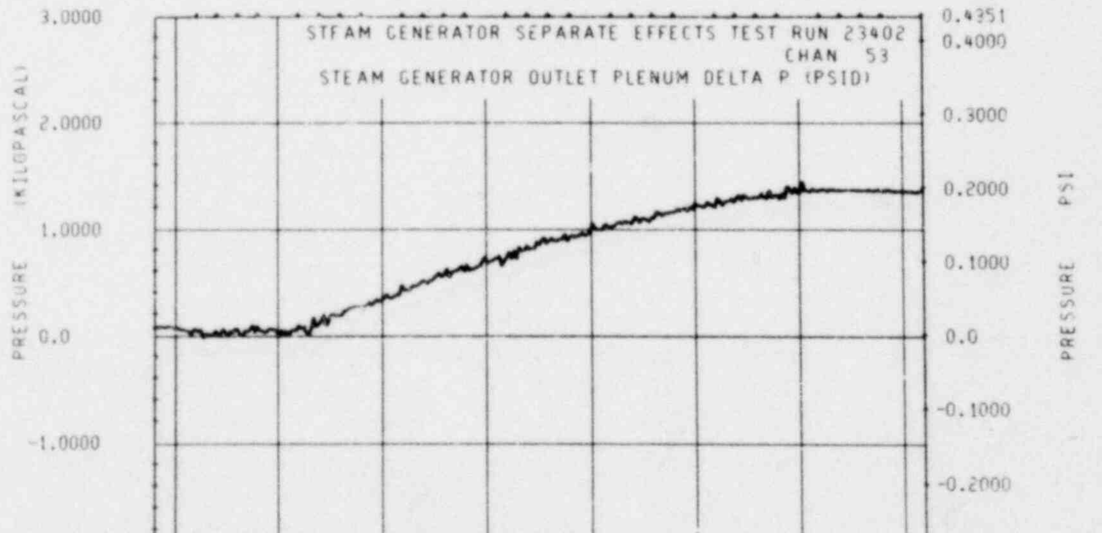
1. T/Cs are defined as failed based on resistance reading or T/C response.


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23402
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)

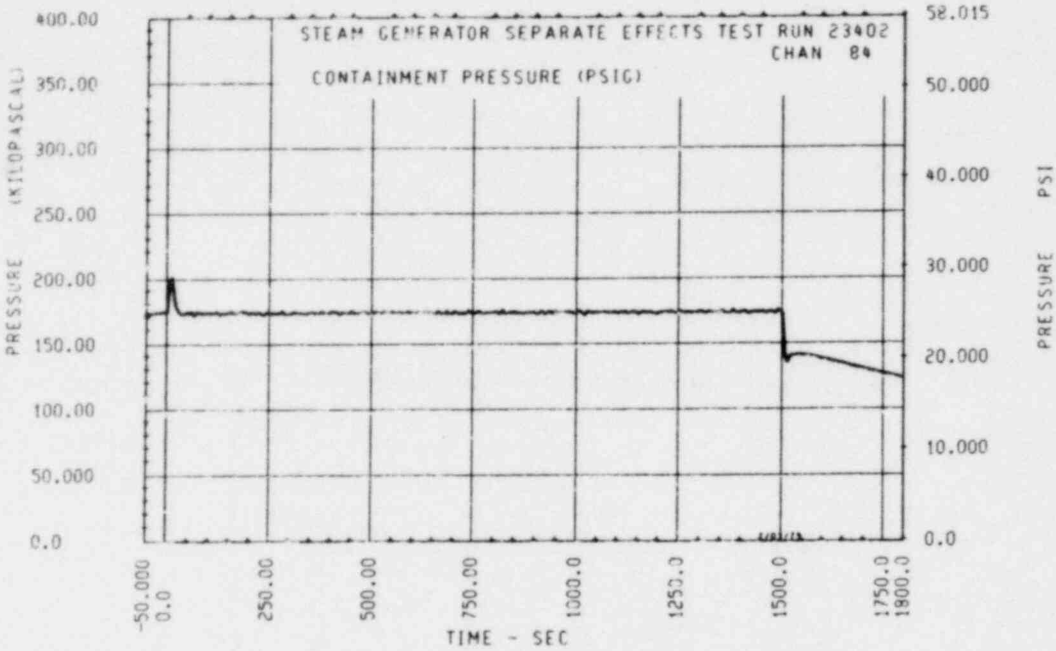

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23402
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)

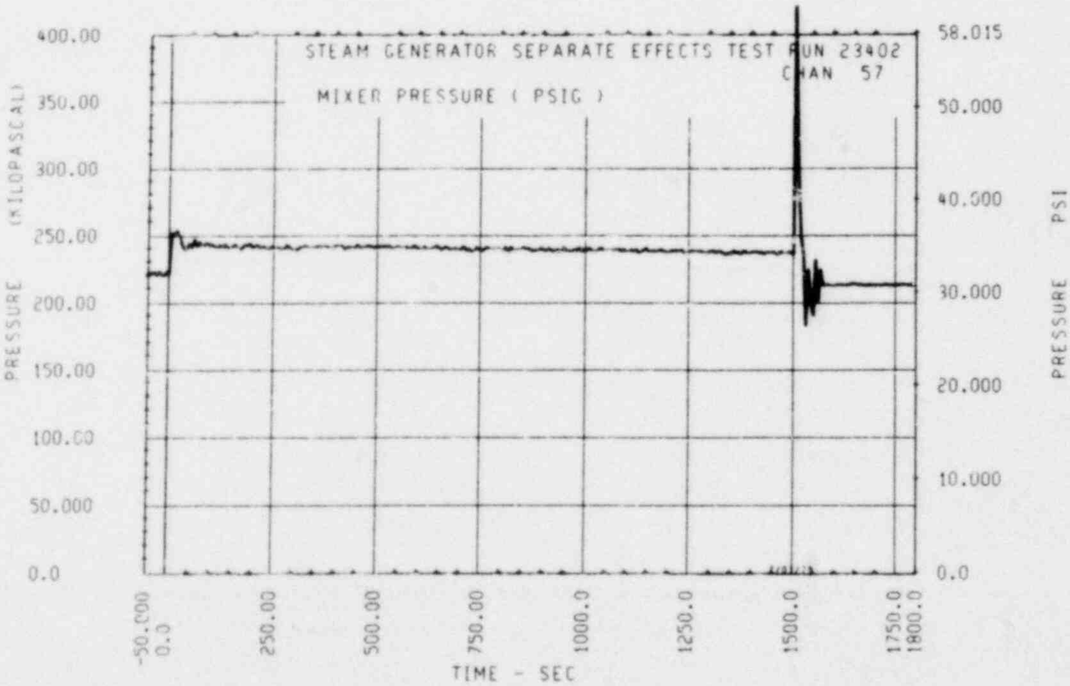


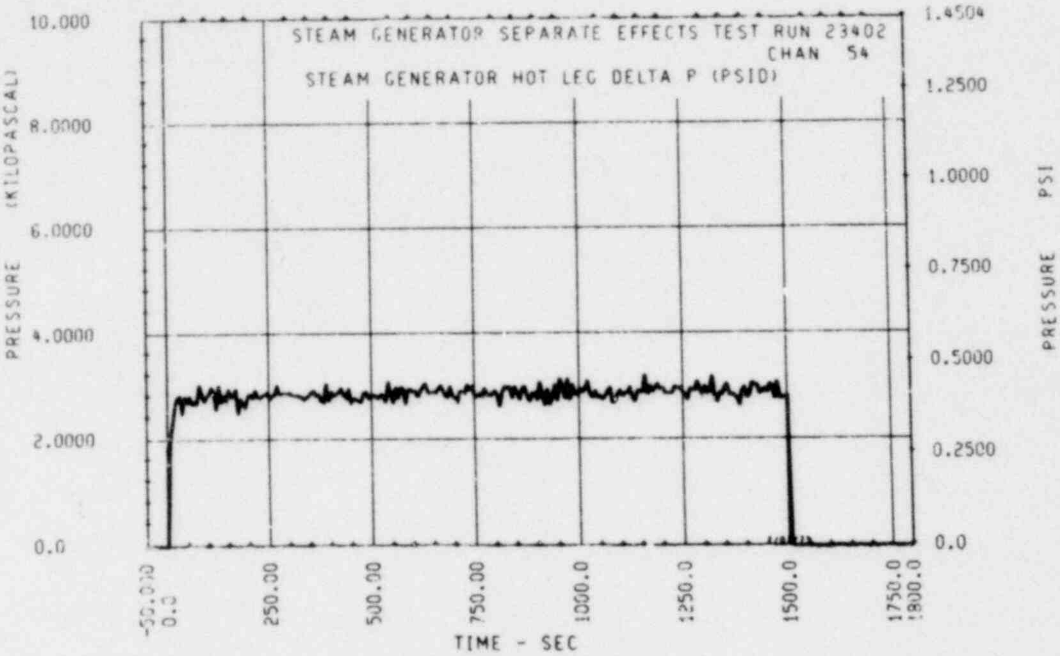
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23402
CONTAINMENT STEAM FLOW RATE
CHAN 97
MASS FLOW RATE (KG / SEC)
MASS FLOW RATE (LBM / SEC)
TIME(SEC)

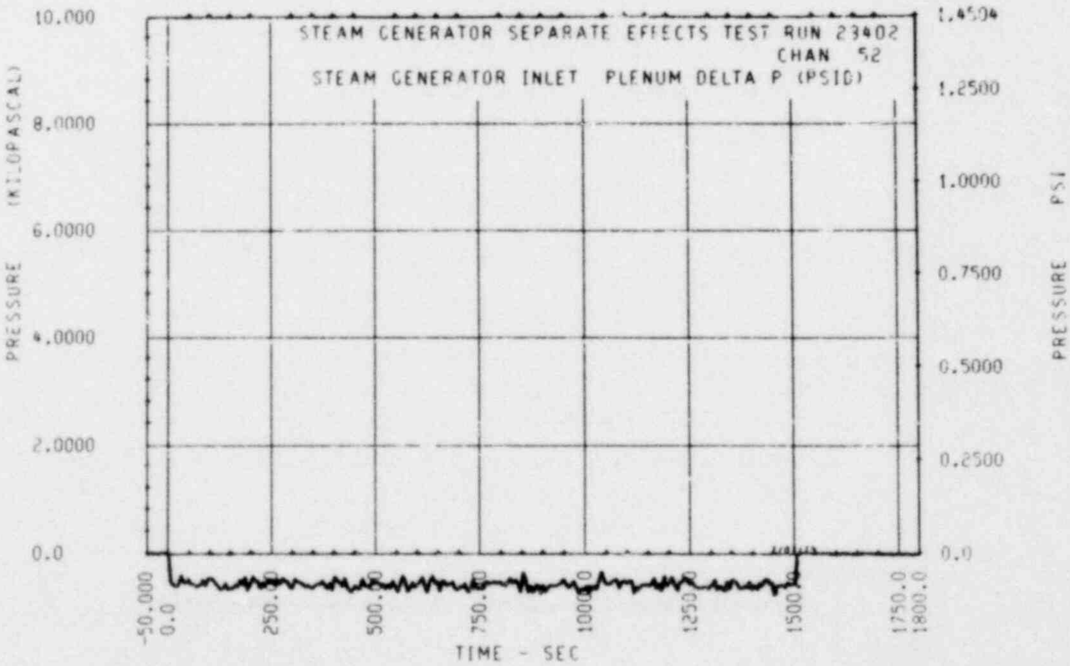


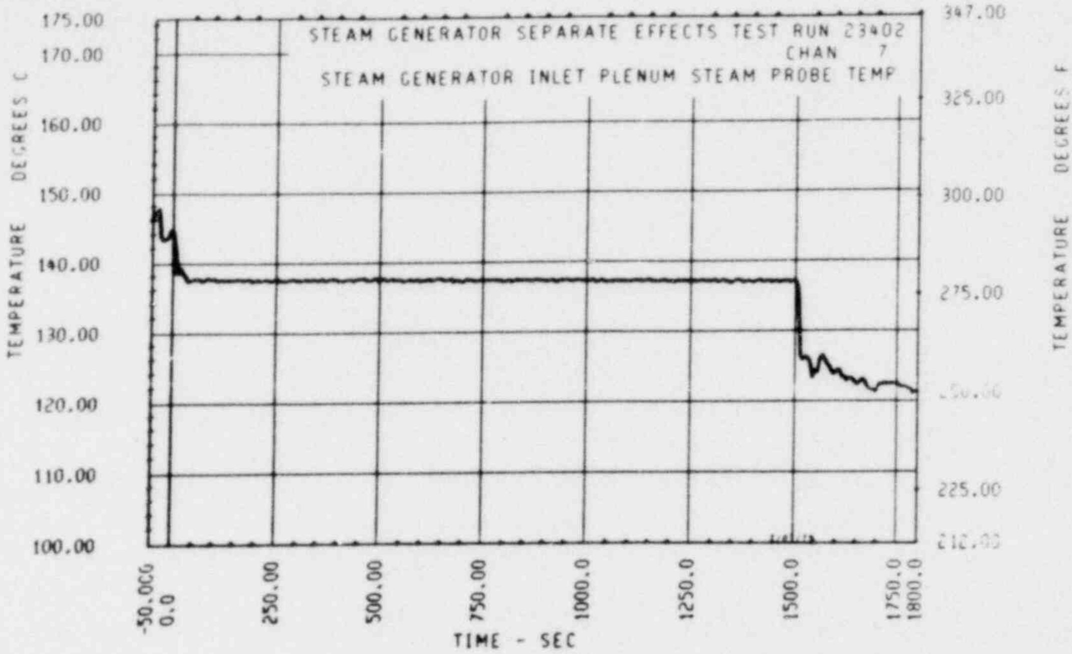
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23402
CHAN 53
STEAM GENERATOR OUTLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

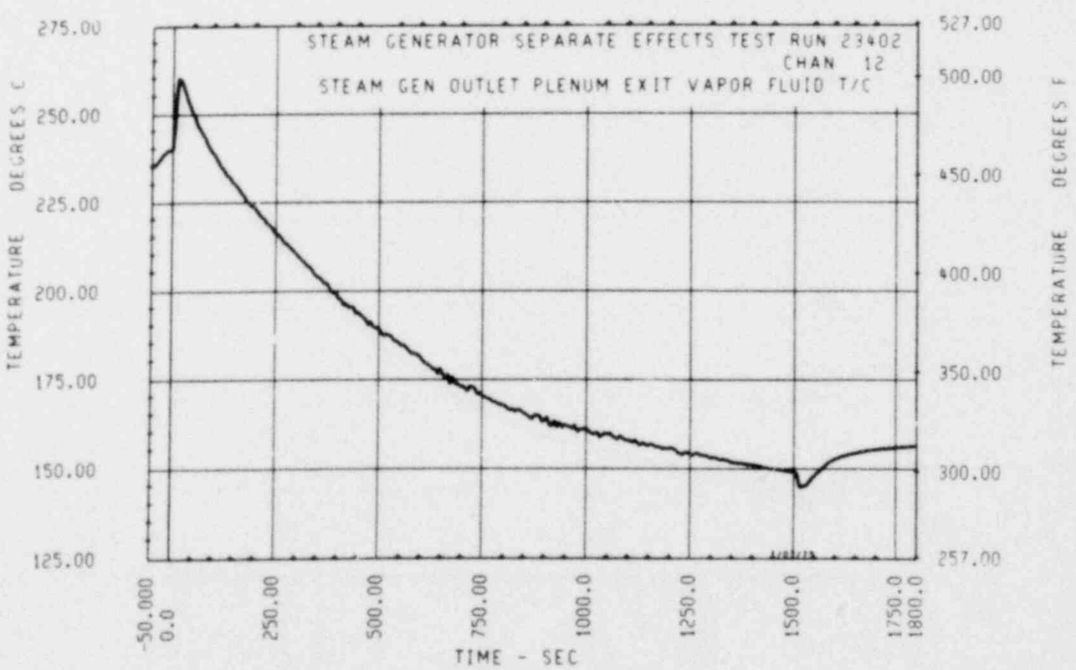

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23402
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.000
0.0
58.015
50.000
40.000
30.000
20.000
10.000
-50.000
250.00
500.00
750.00
1000.0
1500.0
1750.0
1800.0

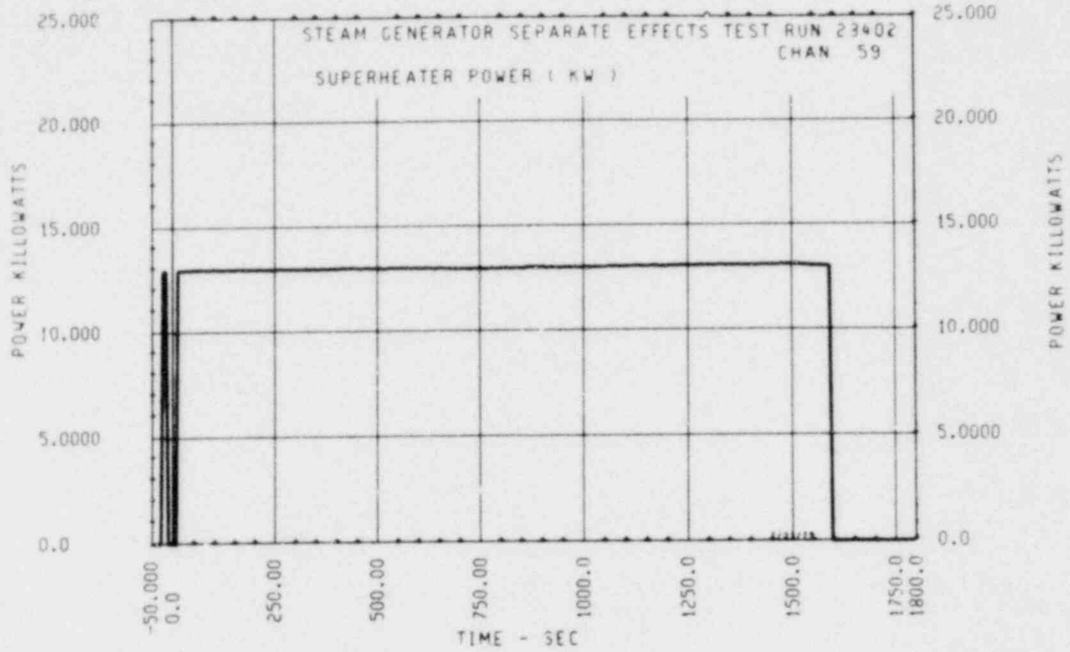

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23402
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC
400.00
350.00
300.00
250.00
200.00
150.00
50.000
0.0
58.015
50.000
30.000
20.000
10.000
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

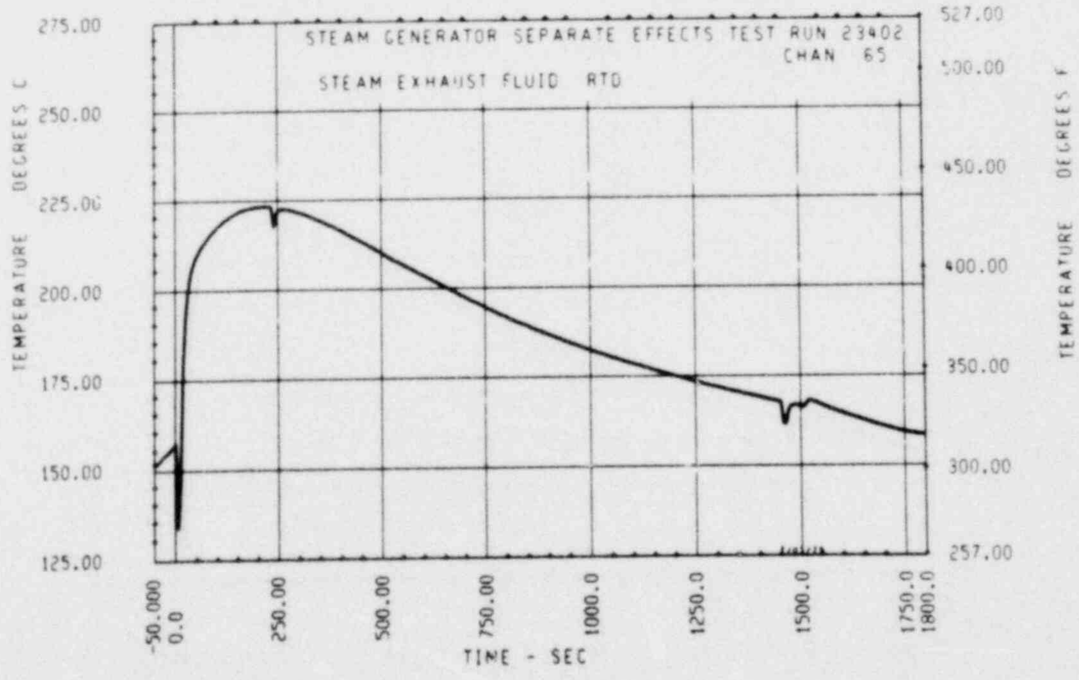

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23402
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
10.000
8.0000
6.0000
4.0000
2.0000
0.0
PRESSURE PSI
1.4504
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

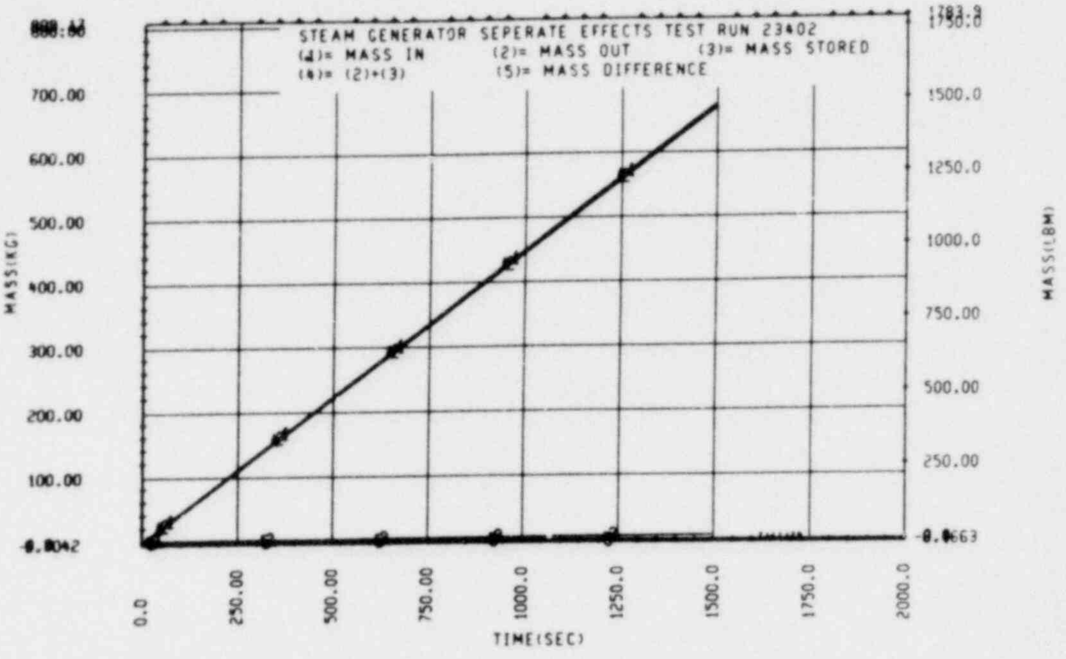

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23402
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
10.000
8.0000
6.0000
4.0000
2.0000
0.0
PRESSURE PSI
1.4504
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
-50.000
0.0
1750.0
1800.0
TIME - SEC

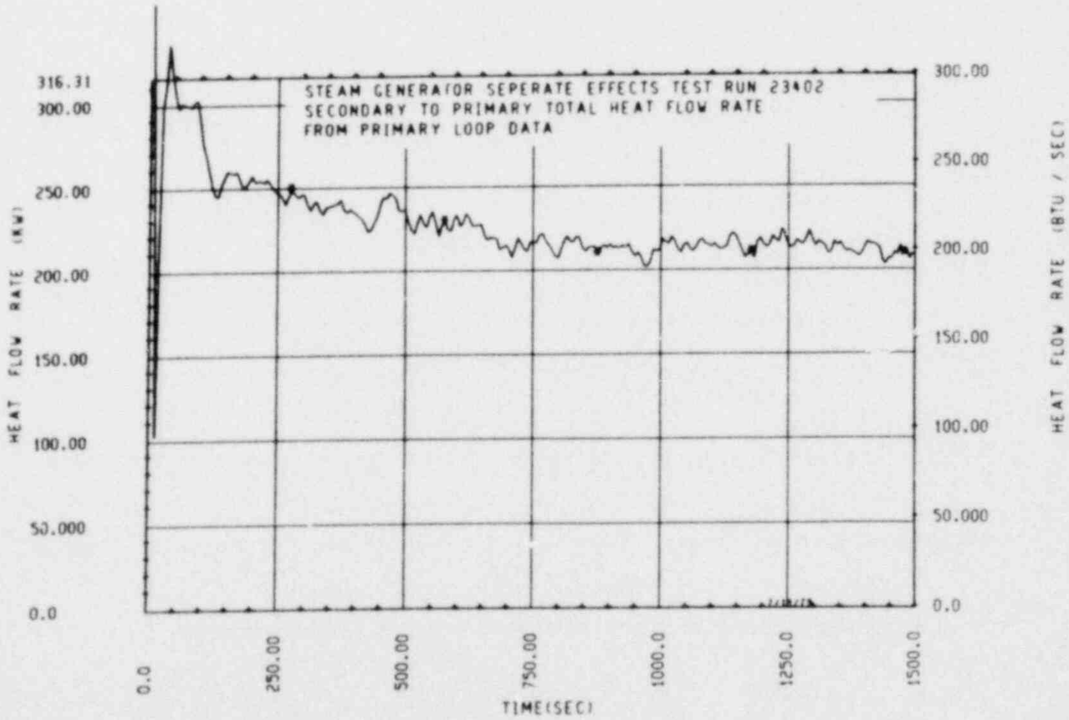

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23402
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
175.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
347.00
325.00
300.00
275.00
225.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

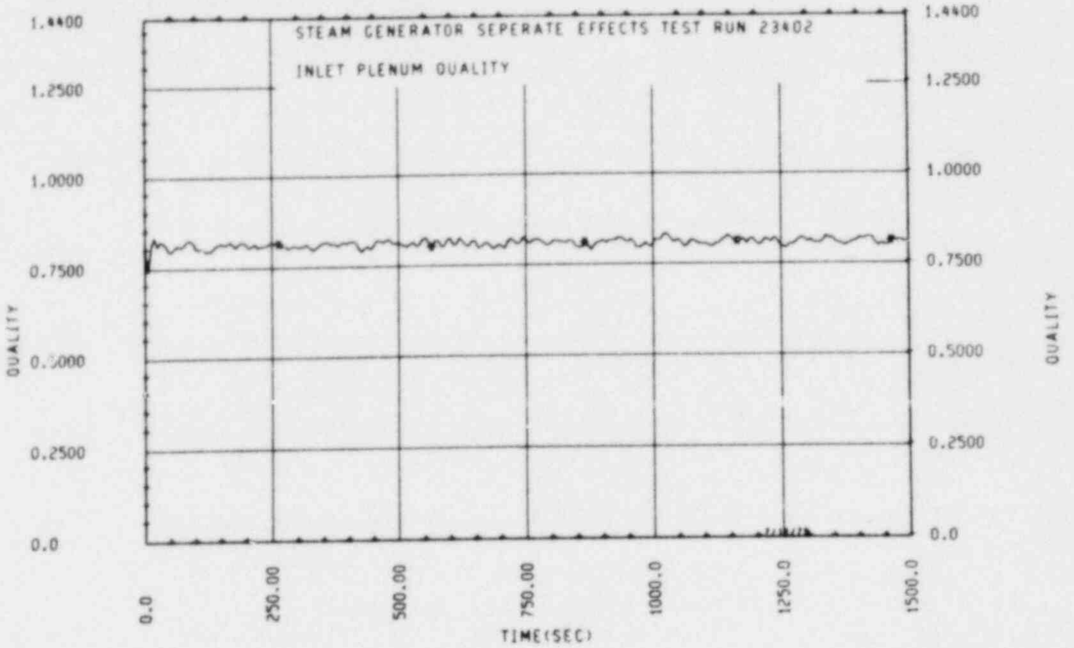

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23402
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0

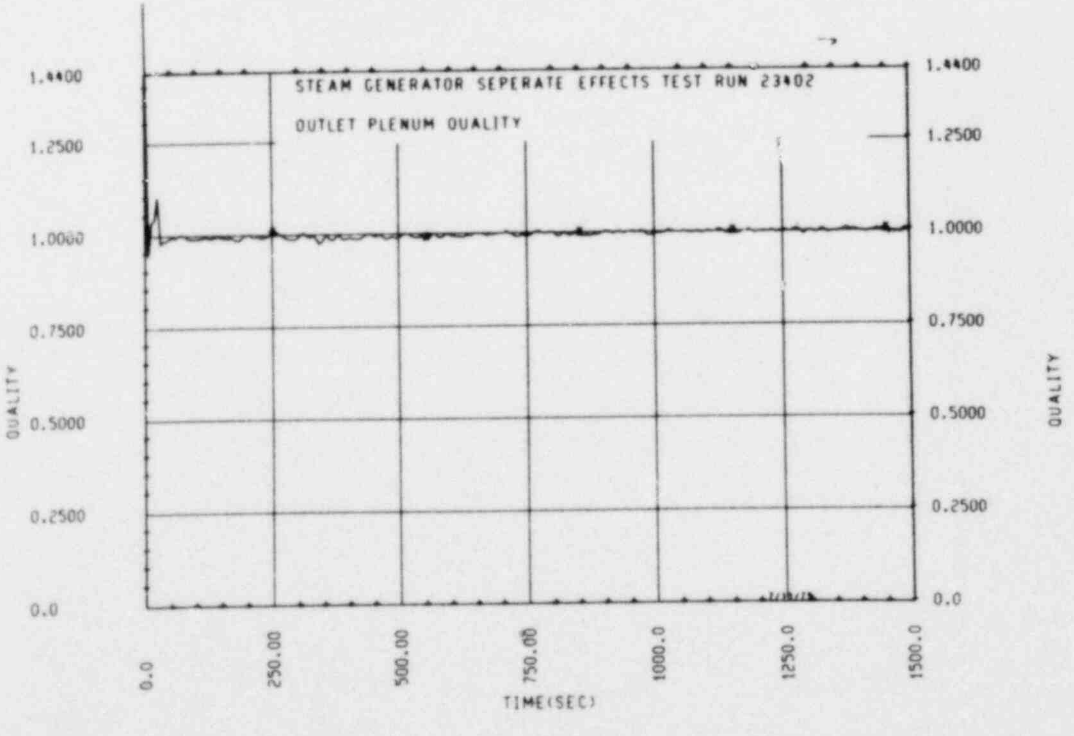

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23402
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

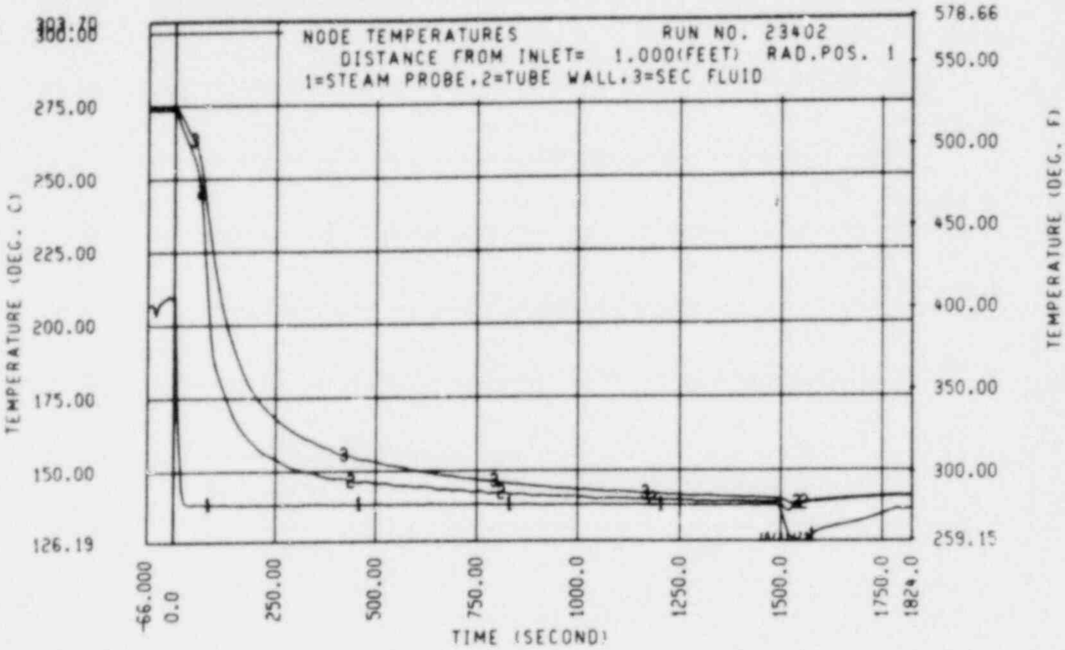

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23402
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
275.00
250.00
225.00
200.00
175.00
150.00
125.00
TEMPERATURE DEGREES F
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

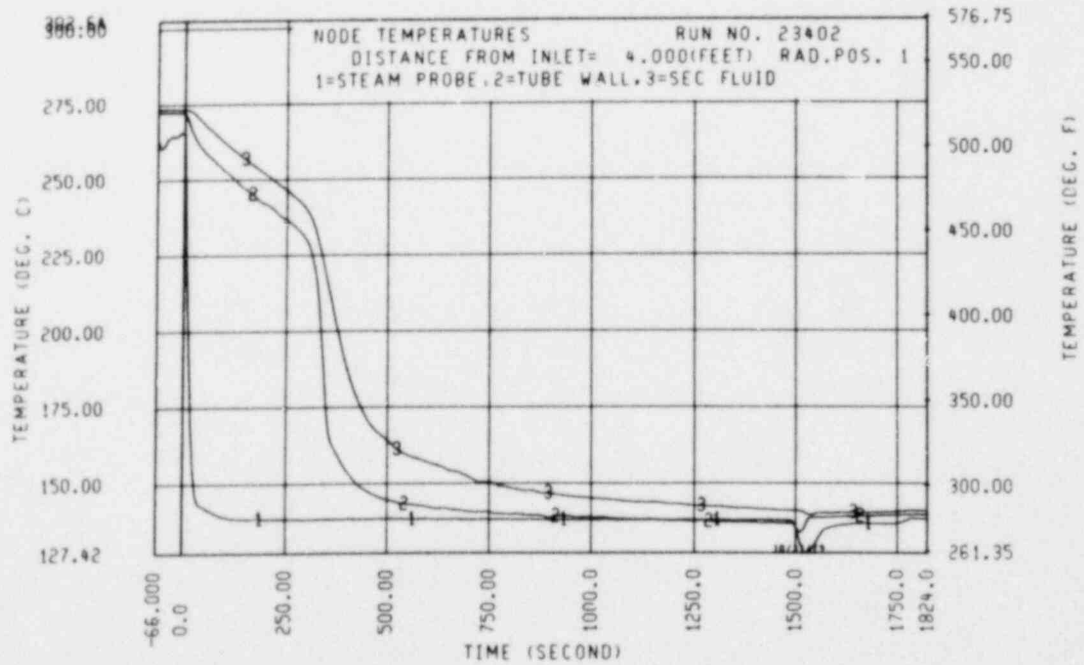

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23402
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23402
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)

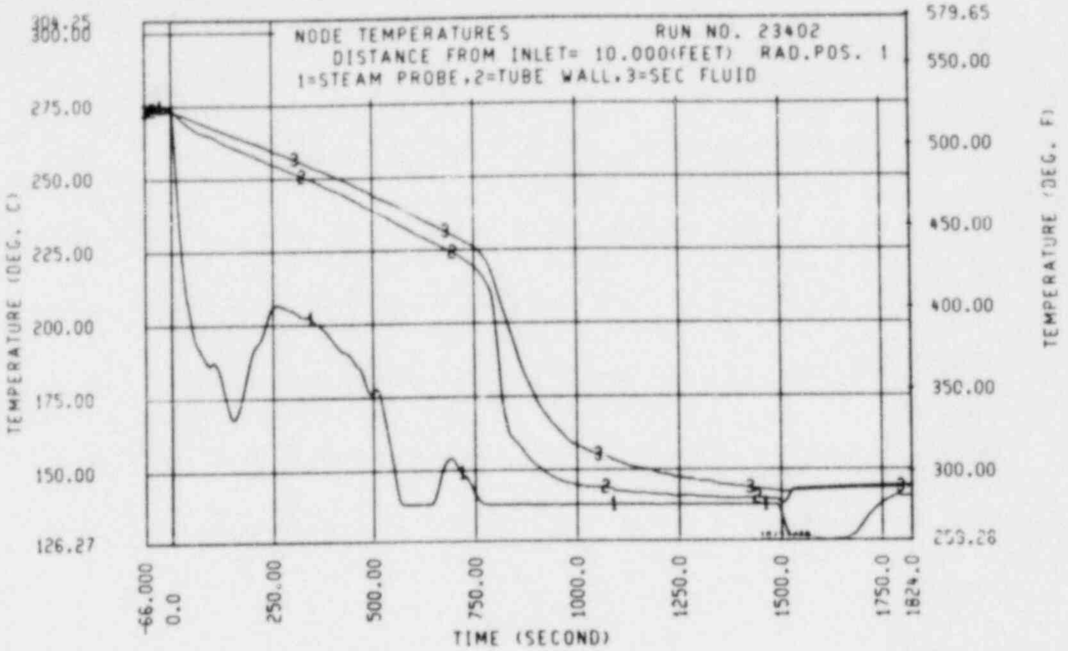

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23402
INLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

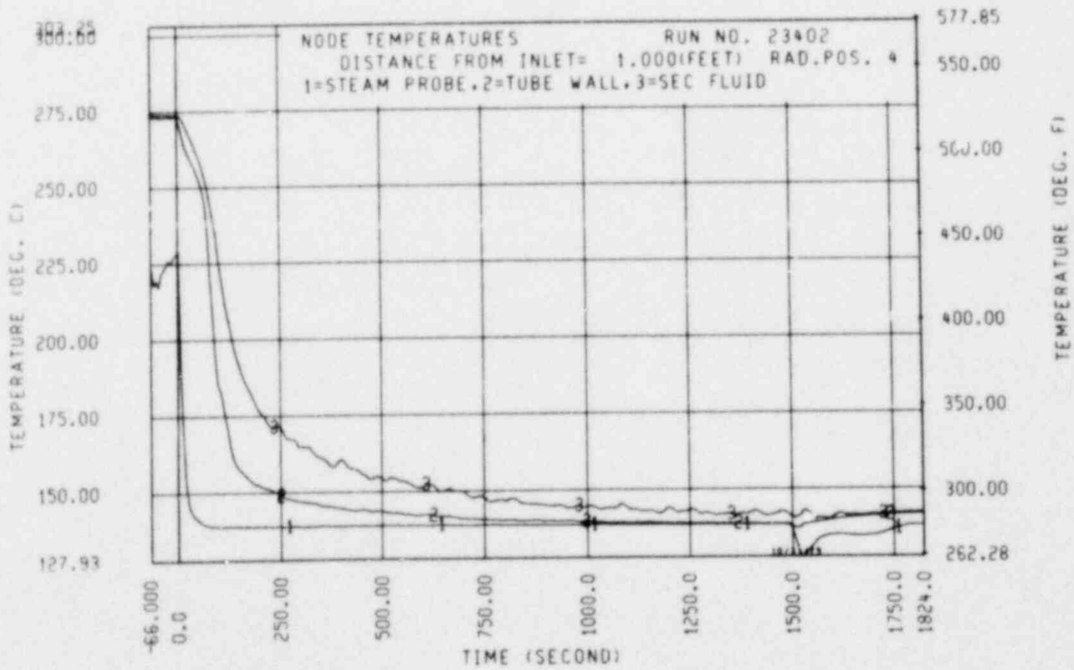

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23402
OUTLET PLENUM QUALITY
QUALITY
TIME(SEC)
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

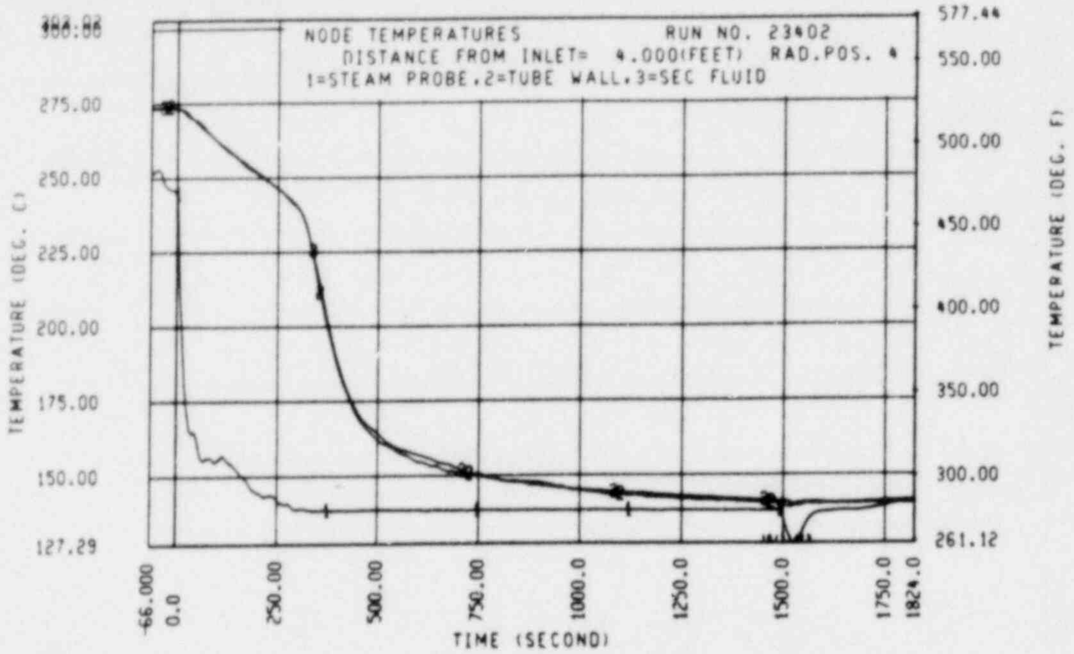

NODE TEMPERATURES RUN NO. 23402
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
300.00
275.00
250.00
225.00
200.00
175.00
150.00
126.19
578.66
550.00
500.00
450.00
400.00
350.00
300.00
259.15
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1824.0


NODE TEMPERATURES RUN NO. 23402
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
300.00
275.00
250.00
225.00
200.00
175.00
150.00
127.42
576.75
550.00
500.00
450.00
400.00
350.00
300.00
261.35
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1824.0

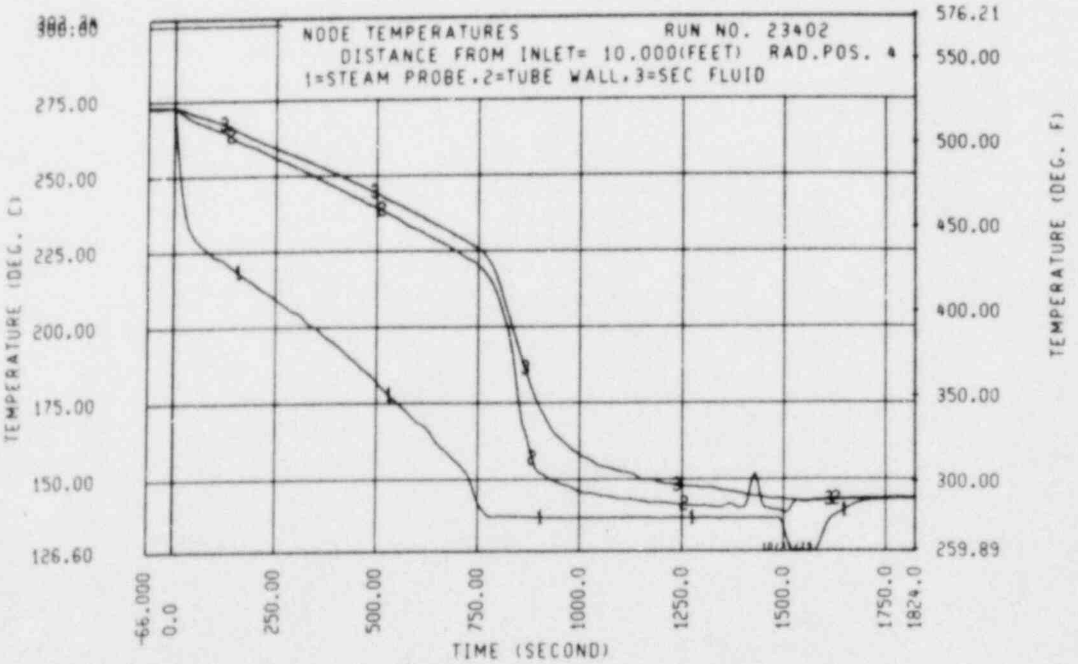
23402-11


NODE TEMPERATURES RUN NO. 23402
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

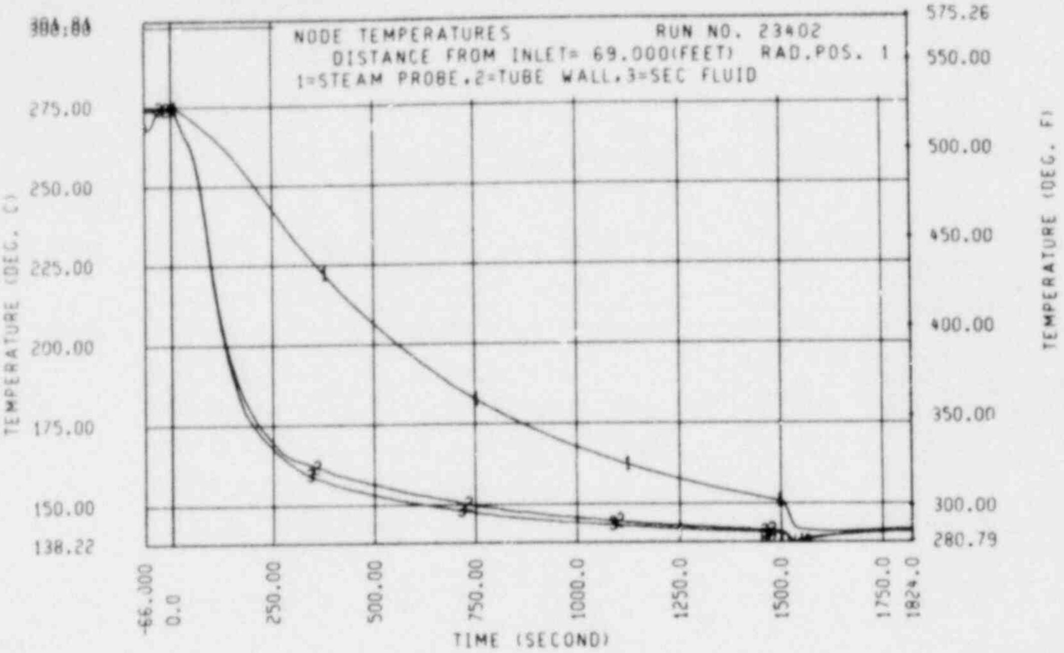

NODE TEMPERATURES RUN NO. 23402
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)



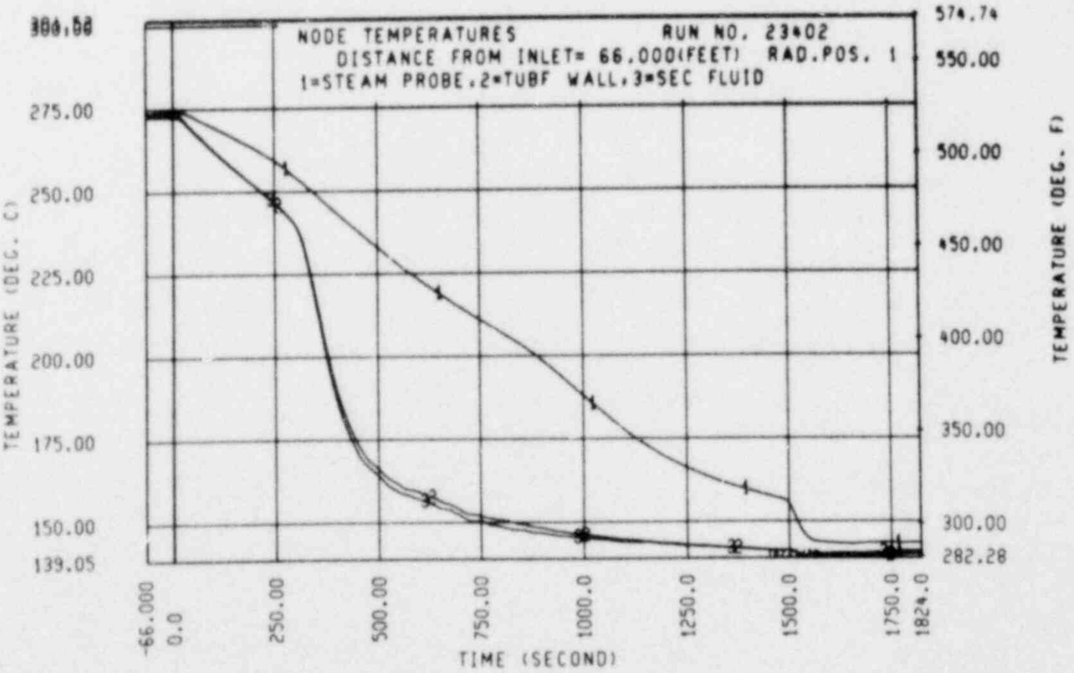
NODE TEMPERATURES RUN NO. 23402
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)



NODE TEMPERATURES RUN NO. 23402
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

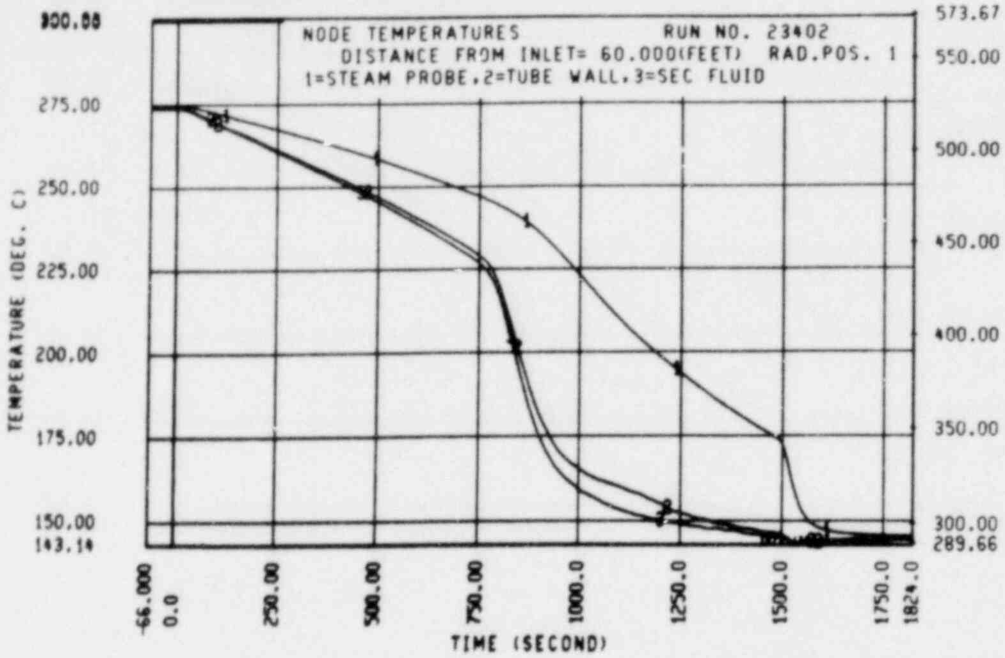


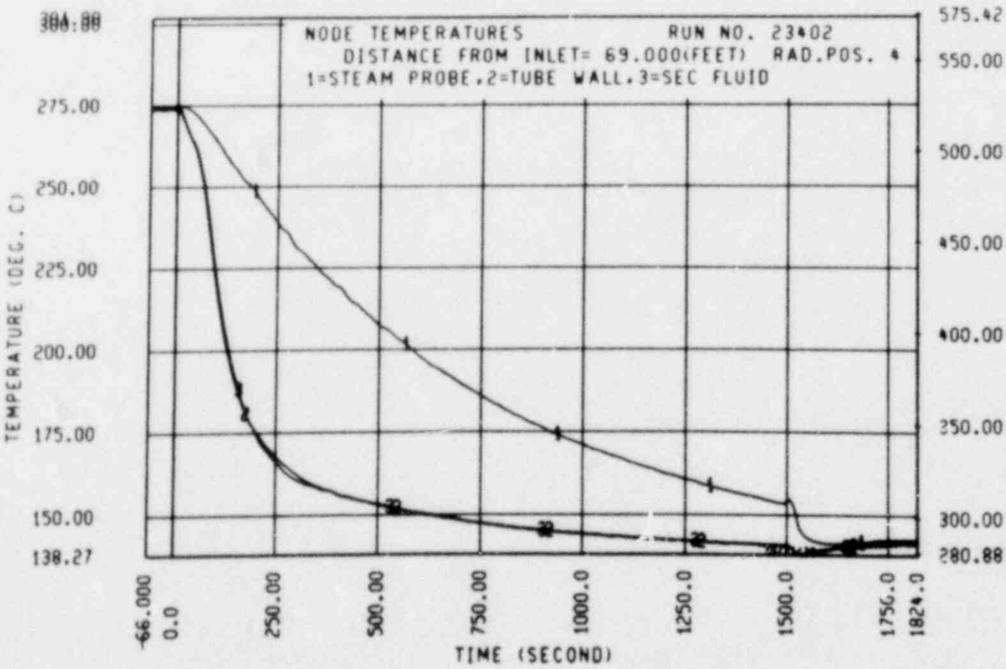
NODE TEMPERATURES RUN NO. 23402
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
138.22
TEMPERATURE (DEG. F)
575.26
550.00
500.00
450.00
400.00
350.00
300.00
280.79
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1824.0
TIME (SECOND)



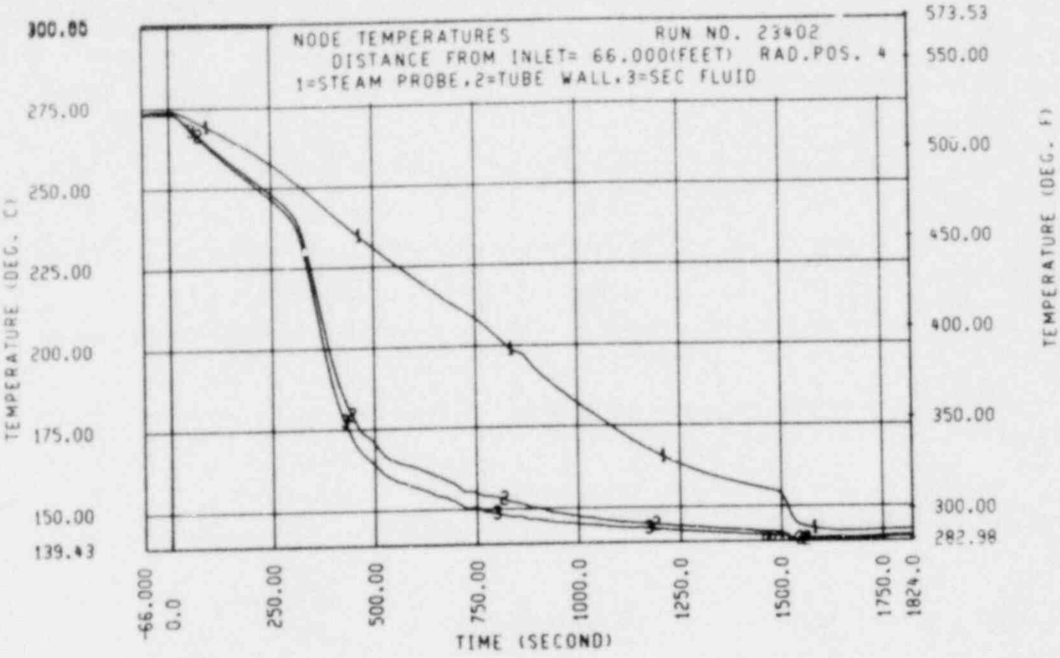
NODE TEMPERATURES RUN NO. 23402
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBF WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
139.05
TEMPERATURE (DEG. F)
574.74
550.00
500.00
450.00
400.00
350.00
300.00
282.28
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1824.0
TIME (SECOND)

23402-14

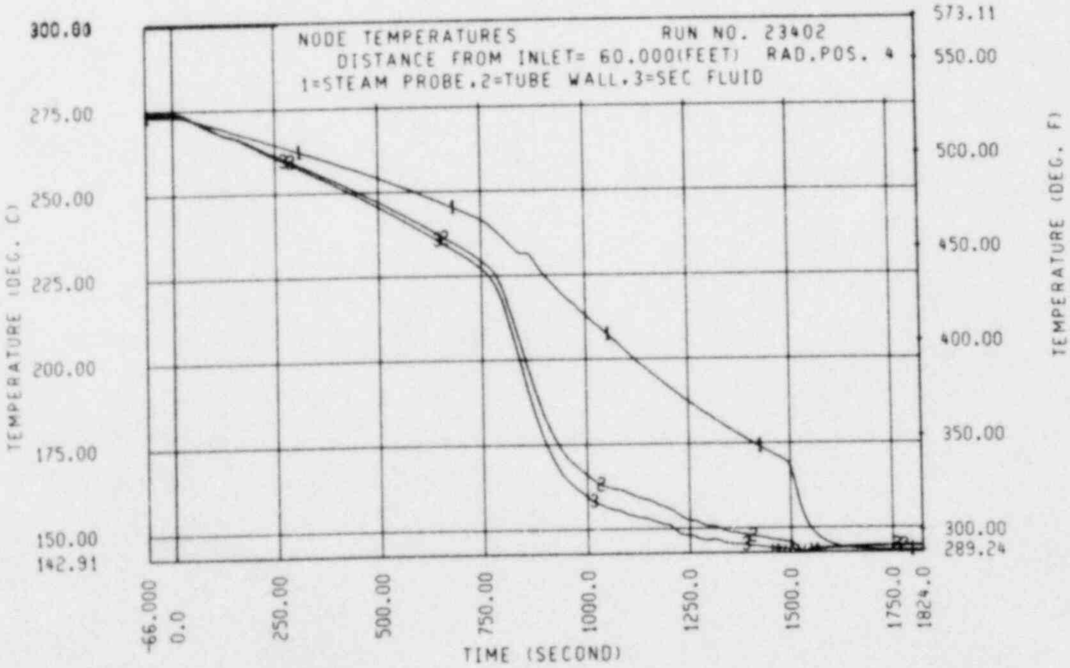

NODE TEMPERATURES RUN NO. 23402
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
143.14
TEMPERATURE (DEG. F)
573.67
550.00
500.00
450.00
400.00
350.00
300.00
289.66
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1824.0
TIME (SECOND)


NODE TEMPERATURES RUN NO. 23402
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
138.27
TEMPERATURE (DEG. F)
575.42
550.00
500.00
450.00
400.00
350.00
300.00
280.88
-66.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1756.0
1824.0
TIME (SECOND)

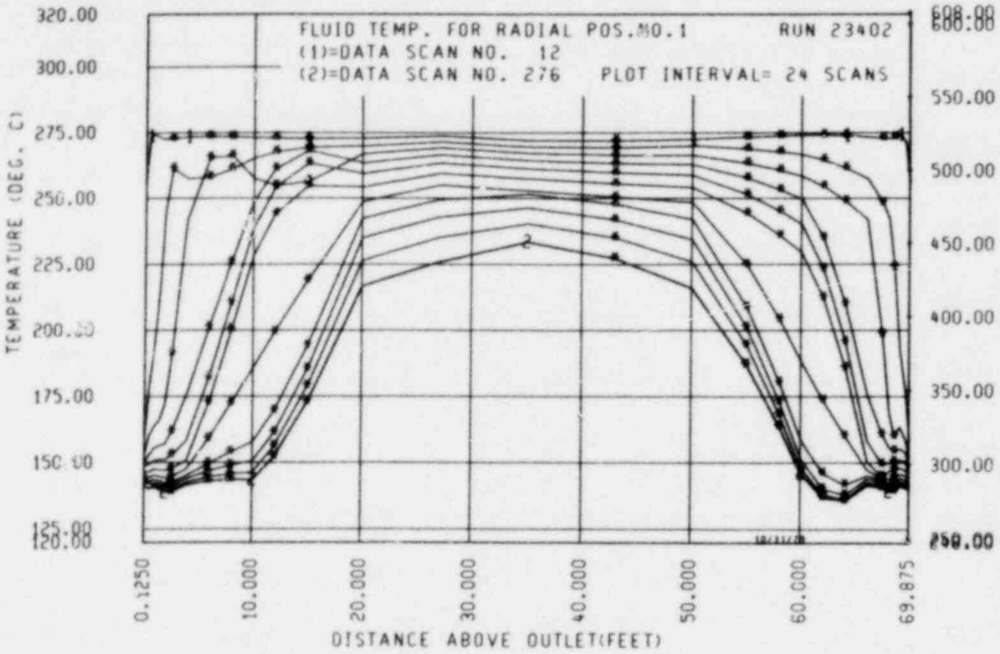
23402-15



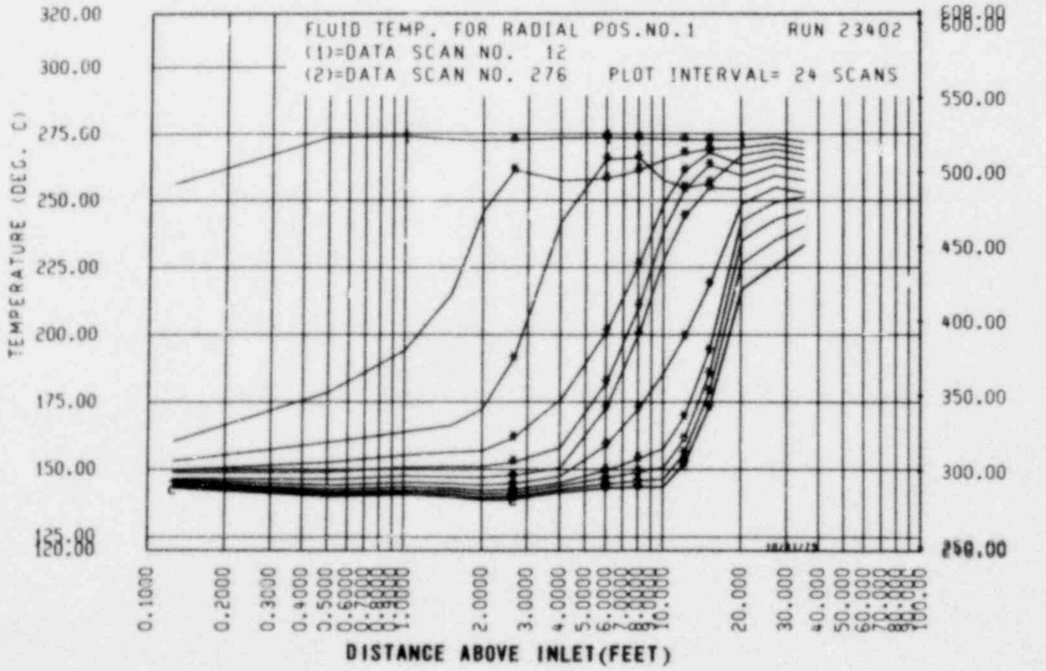
NODE TEMPERATURES RUN NO. 23402
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)



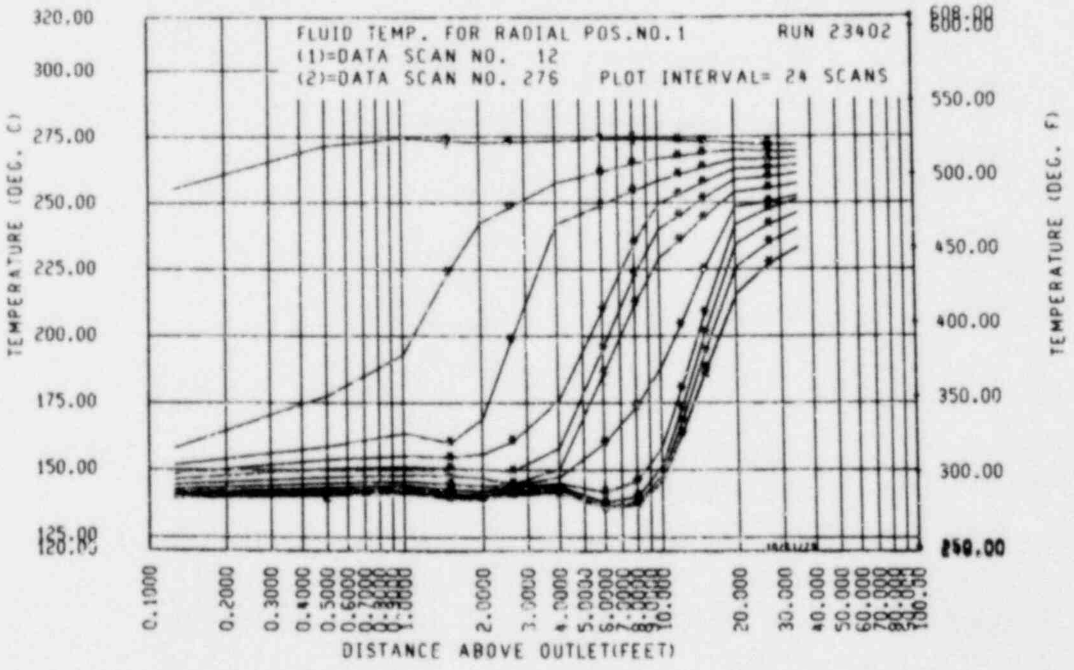
NODE TEMPERATURES RUN NO. 23402
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)



FLUID TEMP. FOR RADIAL POS.NO.1 RUN 23402
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276 PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)
320.00
300.00
275.00
250.00
225.00
200.00
175.00
150.00
125.00
120.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
0.1250
10.000
20.000
30.000
40.000
50.000
60.000
69.875



FLUID TEMP. FOR RADIAL POS.NO.1 RUN 23402
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276 PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)
320.00
300.00
275.00
250.00
225.00
200.00
175.00
150.00
125.00
120.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
250.00
0.1000
0.2000
0.3000
0.4000
0.5000
2.0000
3.0000
4.0000
5.0000
20.000
30.000
40.000
50.000



FLUID TEMP. FOR RADIAL POS.NO.1
RUN 23402
(1)=DATA SCAN NO. 12
(2)=DATA SCAN NO. 276
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

23402-19

RUN 23402
TIME = 120.0 SECONDS

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.6(.05)	33.3(2.93)	33.4(2.94)	27.1(2.39)	.726	.851	.890	.866
.2(.50)	95.2(8.39)	100.1(8.82)	109.0(9.61)	111.9(9.86)	.741	.868	.909	.884
.3(1.00)	157.3(13.86)	196.9(17.35)	4.2(.37)	182.0(16.03)	.779	.913	.926	.929
.5(1.50)	2.3(.21)	250.3(22.06)	56.3(4.96)	2.4(.21)	.804	.982	.935	.958
.6(2.00)	153.8(13.55)	28.1(2.47)	228.0(20.09)	19.8(1.75)	.828	1.024	.978	.961
.8(2.65)	3.0(.27)	-10.8(-.95)	294.7(25.96)	-.4(-.04)	.852	1.025	1.077	.960
1.2(4.00)	24.0(2.12)	11.2(.99)	11.1(.97)	2.8(.25)	.858	1.024	1.137	.958
1.8(6.00)	18.8(1.66)	21.2(1.87)	4.5(.40)	13.3(1.17)	.891	1.029	1.122	.964
2.4(8.00)	11.3(1.00)	15.7(1.38)	-6.7(-.59)	11.8(1.04)	.896	1.025	1.096	.956
3.0(10.00)	10.8(.95)	6.1(.54)	8.3(.74)	5.7(.50)	.889	1.010	1.077	.933
3.7(12.00)	6.1(.54)	1.0(.09)	10.3(.91)	-.2(-.02)	.880	.998	1.074	.915
4.6(15.00)	3.6(.32)	.6(.05)	8.4(.74)	.3(.03)	.855	.991	1.079	.938
6.1(20.00)	2.1(.18)	2.0(.17)	1.5(.13)	.6(.06)	.853	.988	1.081	.905
8.2(27.00)	1.0(.09)	.3(.02)	-.7(-.06)	-.1(-.01)	.852	.986	1.075	.901
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.855	.983	1.071	.896
13.1(43.00)	-1.3(-.11)	-.5(-.04)	.0(.00)	-.2(-.02)	.854	.977	1.071	.894
15.2(50.00)	-.1(-.01)	-.2(-.02)	-.1(-.01)	-.0(-.00)	.851	.976	1.071	.894
16.8(55.00)	.0(.00)	-.2(-.02)	-.1(-.01)	.0(.00)	.851	.978	1.071	.895
17.7(58.00)	.1(.01)	-.2(-.02)	-.0(-.00)	.0(.00)	.851	.978	1.072	.896
18.3(60.00)	.1(.01)	-.4(-.04)	-.0(-.00)	.0(.00)	.852	.979	1.074	.897
18.9(62.00)	.2(.01)	-.0(-.00)	.0(.00)	-.0(-.00)	.853	.980	1.075	.898
19.5(64.00)	.0(.00)	.1(.01)	.0(.00)	-.2(-.02)	.854	.981	1.076	.899
20.1(66.00)	.1(.01)	1.1(.10)	.1(.01)	-.9(-.08)	.855	.982	1.077	.899
20.5(67.38)	-1.7(-.15)	-.7(-.06)	-1.6(-.14)	-4.7(-.41)	.856	.984	1.078	.898
20.7(68.00)	-4.8(-.42)	-4.1(-.36)	-4.8(-.42)	-6.5(-.56)	.856	.983	1.077	.897
20.9(68.50)	-6.6(-.58)	-7.0(-.61)	-14.9(-1.31)	-3.0(-.27)	.855	.982	1.075	.897
21.0(69.00)	3.2(.28)	2.5(.22)	-.3(-.03)	7.7(.68)	.857	.982	1.074	.900
21.2(69.50)	-3.7(-.32)	-4.1(-.36)	-4.1(-.35)	-3.8(-.33)	.862	.985	1.076	.903
21.3(69.87)	-12.0(-1.06)	-14.9(-1.31)	-8.3(-.73)	-7.7(-.68)	.866	.986	1.076	.903

23402-20

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 23402
TIME = 240.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.5(.04)	16.4(1.44)	20.0(1.77)	22.9(2.02)	.726	.849	.889	.865
.2(.50)	39.9(3.51)	40.1(3.53)	46.1(4.06)	42.4(3.73)	.732	.856	.897	.873
.3(1.00)	50.1(4.42)	60.1(5.29)	.7(.06)	68.2(6.01)	.746	.871	.904	.890
.5(1.50)	63.5(5.59)	64.3(5.67)	23.9(2.11)	70.3(6.20)	.753	.890	.907	.911
.6(2.00)	101.0(8.90)	92.0(8.10)	102.6(9.04)	87.0(7.66)	.789	.914	.927	.930
.8(2.65)	1.6(.14)	1.6(.14)	152.6(13.44)	75.4(6.64)	.805	.926	.978	.965
1.2(4.00)	25.0(2.20)	15.1(1.33)	12.3(1.08)	2.5(.22)	.821	.936	1.013	.983
1.8(6.00)	2.8(.24)	3.0(.27)	3.3(.29)	7.1(.63)	.832	.939	1.003	.962
2.4(8.00)	2.1(.18)	1.9(.17)	2.7(.24)	6.0(.53)	.816	.920	.983	.967
3.0(10.00)	17.4(1.54)	13.6(1.20)	15.2(1.34)	8.4(.74)	.804	.903	.974	.945
3.7(12.00)	1.5(.13)	25.8(2.28)	16.1(1.42)	7.1(.63)	.800	.909	.979	.935
4.6(15.00)	12.9(1.14)	8.8(.77)	13.2(1.16)	8.4(.74)	.807	.925	.992	.939
6.1(20.00)	3.6(.32)	3.4(.30)	2.4(.21)	1.3(.12)	.820	.933	1.000	.942
8.2(27.00)	1.3(.11)	.6(.05)	-.6(-.05)	-.0(-.00)	.821	.932	.995	.938
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.817	.927	.990	.933
13.1(43.00)	-1.4(-.12)	-.6(-.05)	-.0(-.00)	-.2(-.02)	.812	.923	.989	.931
15.2(50.00)	-.2(-.02)	-.4(-.03)	-.2(-.02)	-.0(-.00)	.810	.922	.989	.932
16.8(55.00)	-.1(-.01)	-.4(-.03)	-.3(-.03)	-.1(-.01)	.811	.923	.990	.933
17.7(58.00)	-.2(-.02)	-.3(-.03)	-.4(-.03)	-.2(-.02)	.812	.924	.992	.935
18.3(60.00)	-.7(-.06)	-.7(-.06)	-.6(-.05)	-.4(-.04)	.812	.925	.993	.936
18.9(62.00)	-1.2(-.11)	-.1(-.01)	-.3(-.03)	-.6(-.05)	.812	.927	.995	.937
19.5(64.00)	-.1(-.01)	.1(.01)	-.1(-.01)	-.8(-.07)	.813	.929	.997	.936
20.1(66.00)	-.1(-.01)	1.0(.09)	-.1(-.01)	-2.0(-.17)	.816	.932	1.000	.939
20.5(67.36)	-7.3(-.64)	-6.3(-.56)	-7.3(-.65)	-17.7(-1.56)	.816	.933	1.001	.936
20.7(68.00)	-36.1(-3.18)	-32.5(-2.86)	-36.1(-3.18)	-35.3(-3.11)	.811	.926	.996	.929
20.9(68.50)	-29.3(-2.58)	-33.3(-2.94)	-42.0(-3.70)	-32.0(-2.82)	.805	.920	.987	.924
21.0(69.00)	2.7(.24)	2.1(.18)	-.5(-.04)	4.9(.43)	.807	.916	.984	.925
21.2(69.50)	-3.3(-.29)	-3.9(-.35)	-3.8(-.34)	-30.6(-2.70)	.813	.923	.987	.926
21.3(69.87)	-6.2(-.55)	-10.3(-.91)	-5.7(-.50)	-6.3(-.56)	.817	.926	.988	.922

SUMMARY SHEET

RUN NO. 23605

DATE: 4/27/79

A. TIME-AVERAGED RUN CONDITIONS

1. Boiler steam flow [kg/sec (lb/sec)] - 0.111 (0.245)
2. Water flow - [kg/sec (lb/sec)] - 0.113 (0.249)
3. Containment tank pressure [kPa (psig)] - 172 (25)
4. Steam temperature [^{0}C (^{0}F)] - 152 (306)
5. Water temperature [^{0}C (^{0}F)]- 126 (258)
6. Mixer pressure [kPa (psig)] - 193 (28)
7. Test time (sec) - 1446.0

B. INITIAL SECONDARY LIQUID LEVEL AND TEMPERATURE

1. Level [m(ft)] - 10.1 (33.3)
2. Initial temperature

Elevation [m(ft)]	Initial Temperature [^{0}C (^{0}F)]
0.00 (0.00)	257 (494)
0.15 (0.50)	266 (510)
0.30 (1.00)	274 (526)
0.46 (1.50)	273 (523)
0.61 (2.00)	272 (521)
1.22 (4.00)	-
3.05 (10.00)	274 (525)
6.09 (20.00)	273 (524)
8.23 (27.00)	-
10.67 (35.00)	273 (524)

C. MASS BALANCE COMPONENTS

1. Steam probe purge steam [kg (lb)] - 6.75 (14.88)
2. Liquid collection
   (a) Outlet plenum [kg (lb)] - 10.06 (22.18)
   (b) SG collection tank [kg (lb)] - NA
3. Posttest drain from hot leg [kg (lb)] - 9.07 (20.0)

D. FAILED BUNDLE T/Cs(1)

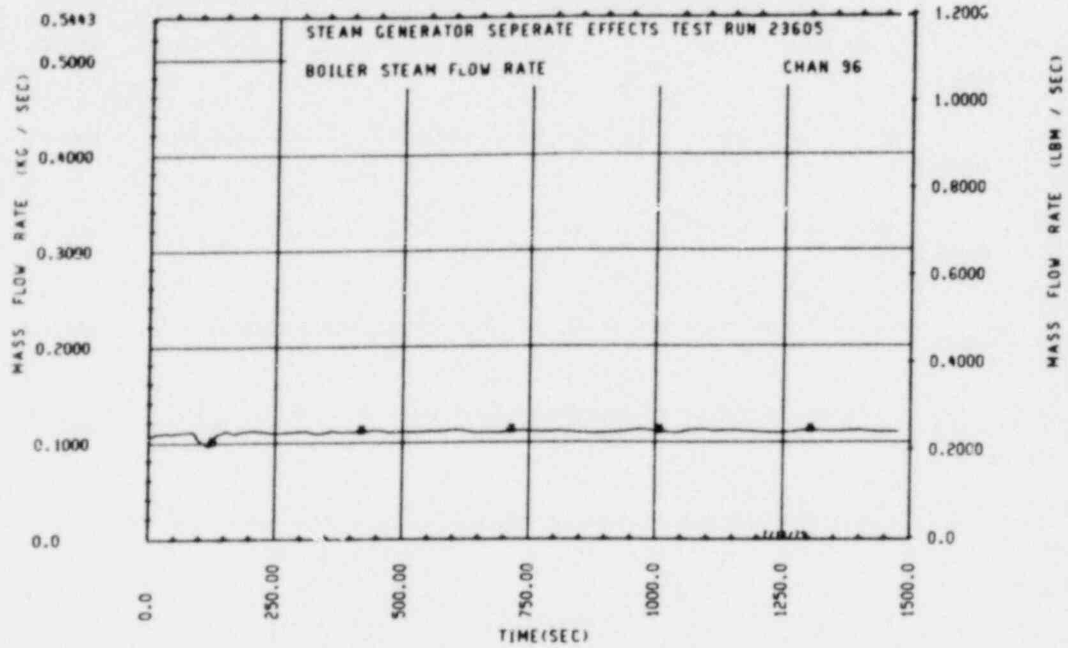
287, 294, 295, 298, 305, 308, 309, 310, 311, 326, 517, 518, 520, 521, 524, 531, 532, 533, 549, 553, 555, 564, 565, 568, 569, 570

E. OVERALL ENERGY EXCHANGE FROM SECONDARY TO PRIMARY FROM BEGINNING OF TEST TO 1.2-METER (4-FOOT) QUENCH TIME

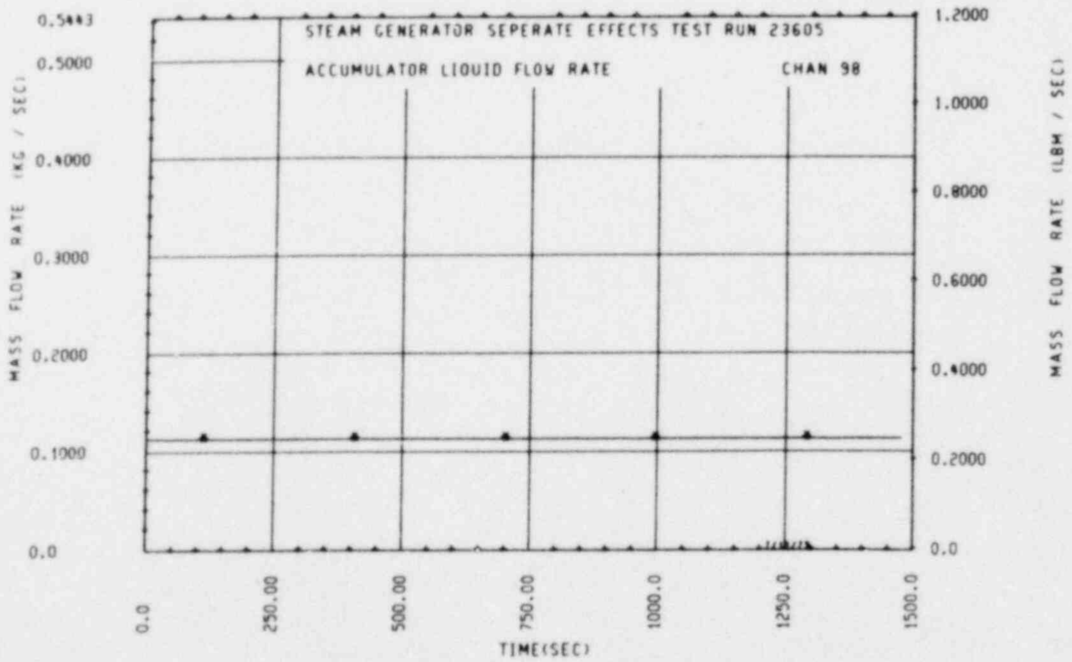
1. From primary side energy balance [kwsec(Btu)] - 0.719×10^5 (0.685×10^5)
2. From local heat flux ($\int_0^t \int_0^{HTA} \Phi \, da\,dt$) - [kwsec(Btu)]- 0.378×10^5 (0.360×10^5)
3. Integration to 300 sec

---

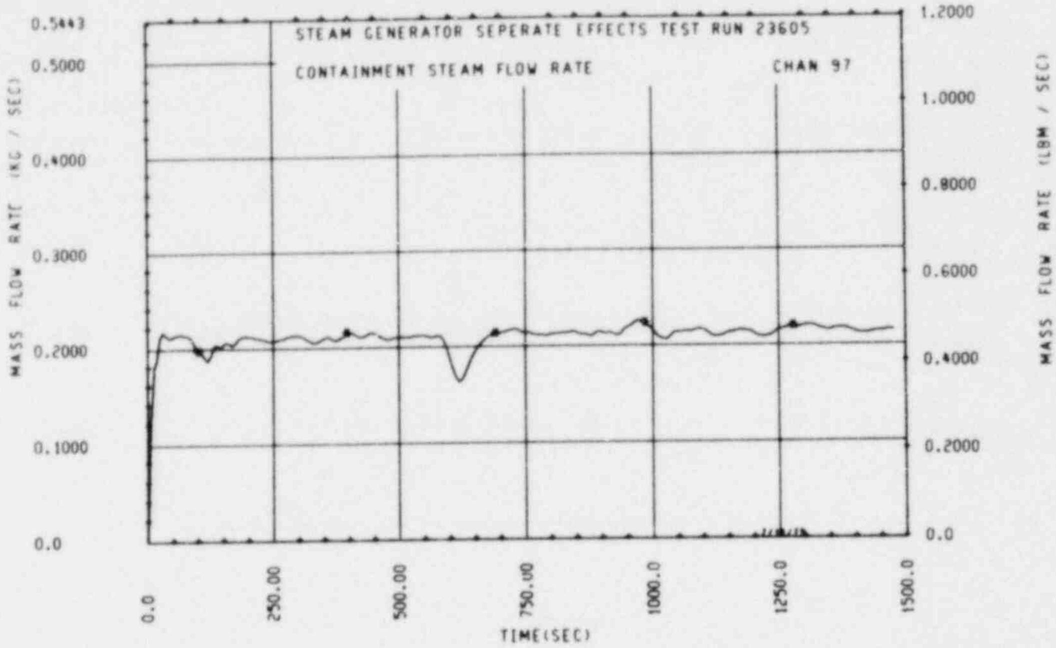
1. T/Cs are defined as failed based on resistance reading or T/C response.

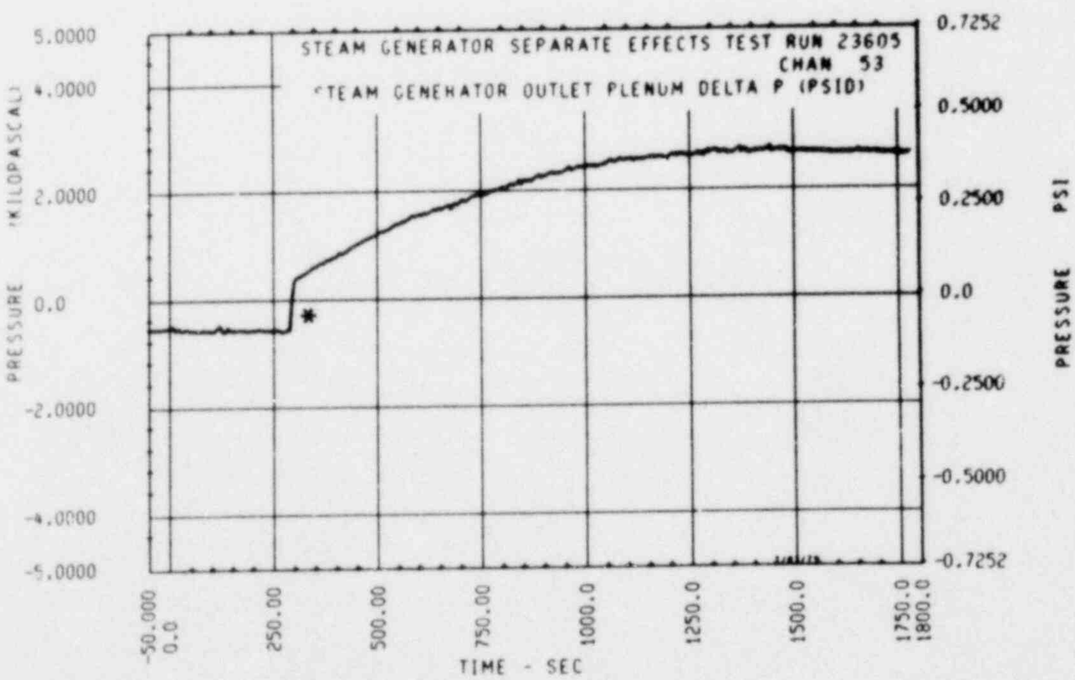


STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23605
BOILER STEAM FLOW RATE
CHAN 96
MASS FLOW RATE (KG / SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
MASS FLOW RATE (LBM / SEC)
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)

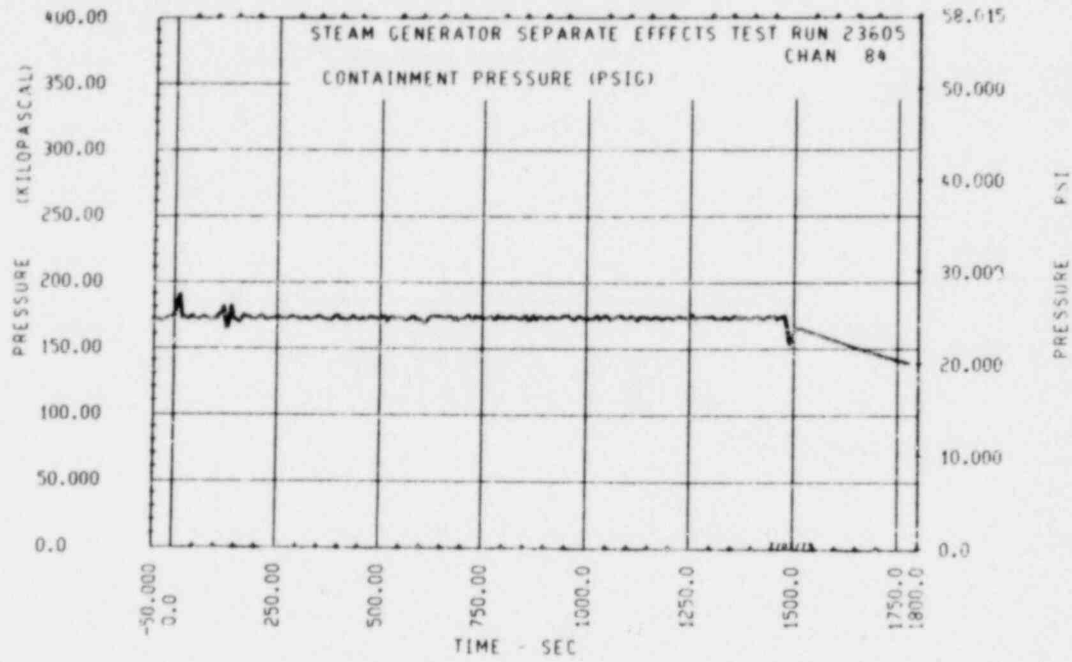


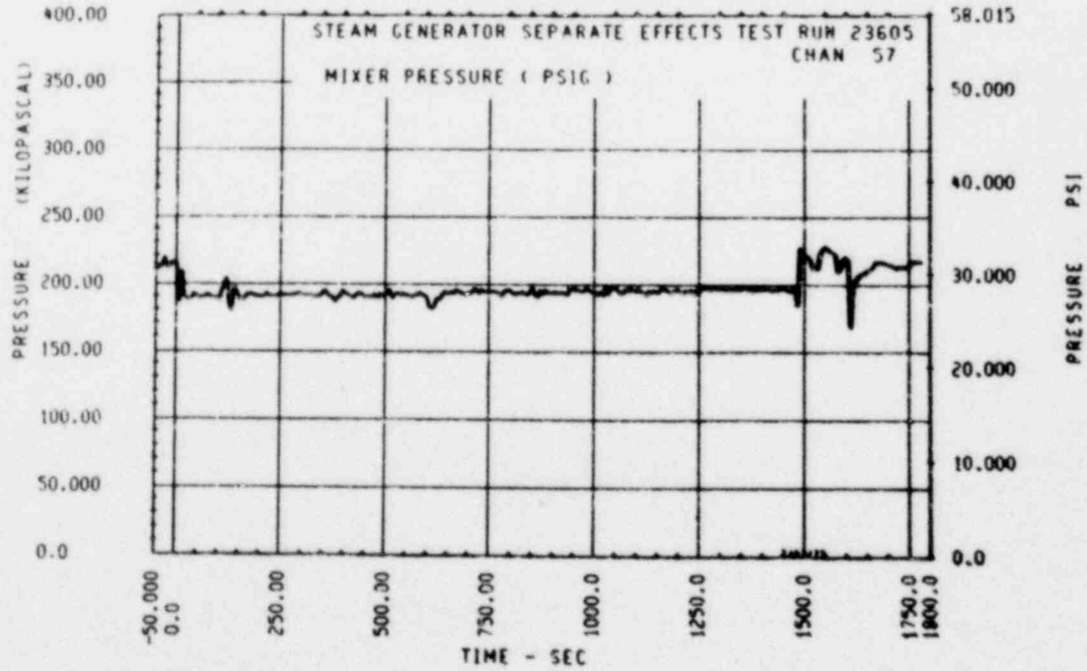
STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23605
ACCUMULATOR LIQUID FLOW RATE
CHAN 98
MASS FLOW RATE (KG / SEC)
0.5443
0.5000
0.4000
0.3000
0.2000
0.1000
0.0
MASS FLOW RATE (LBM / SEC)
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)

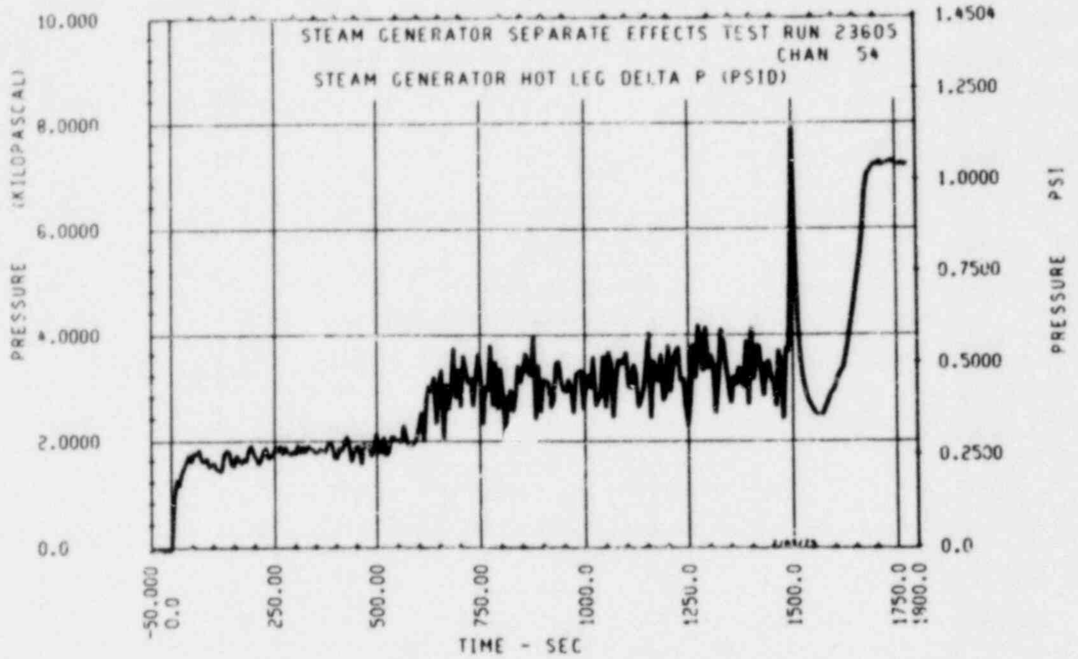


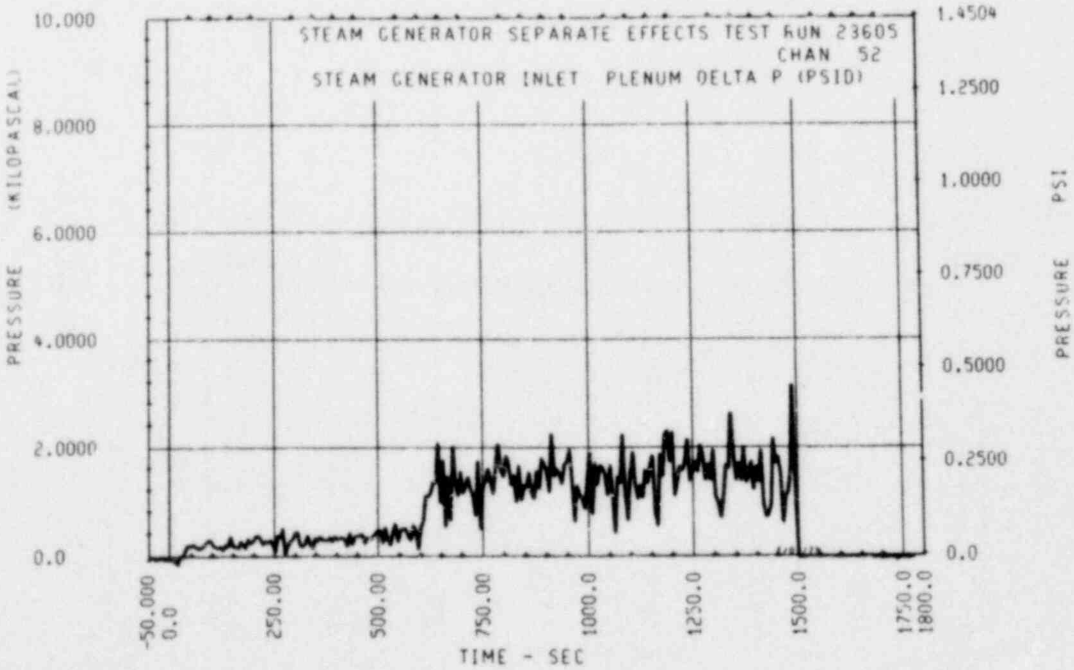


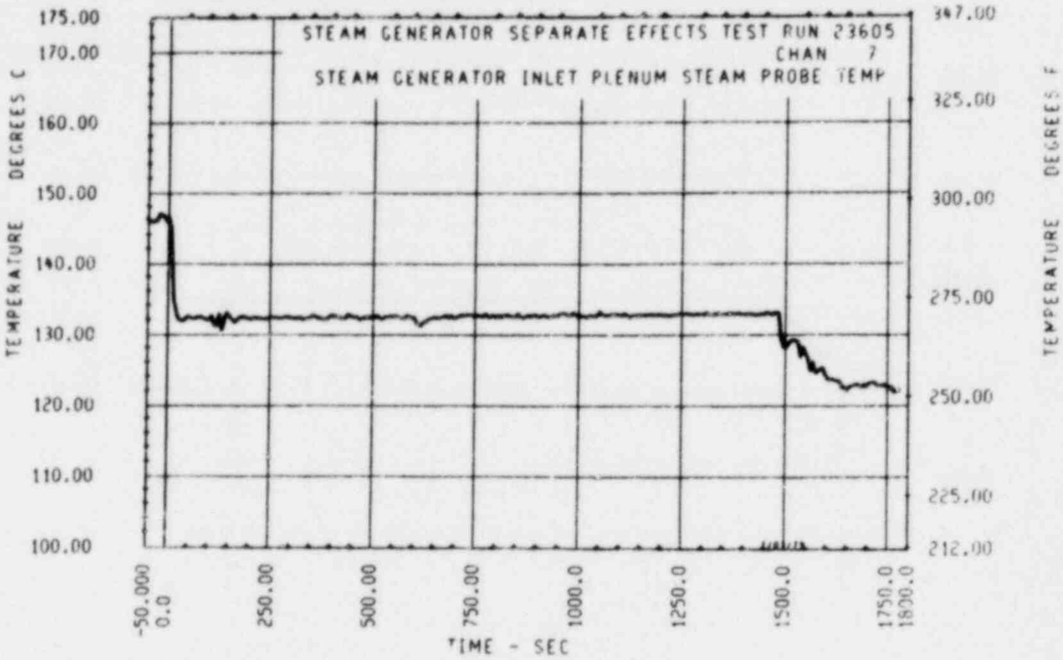
* Refer to Appendix H text for explanation of delayed response.


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23605
CHAN 84
CONTAINMENT PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

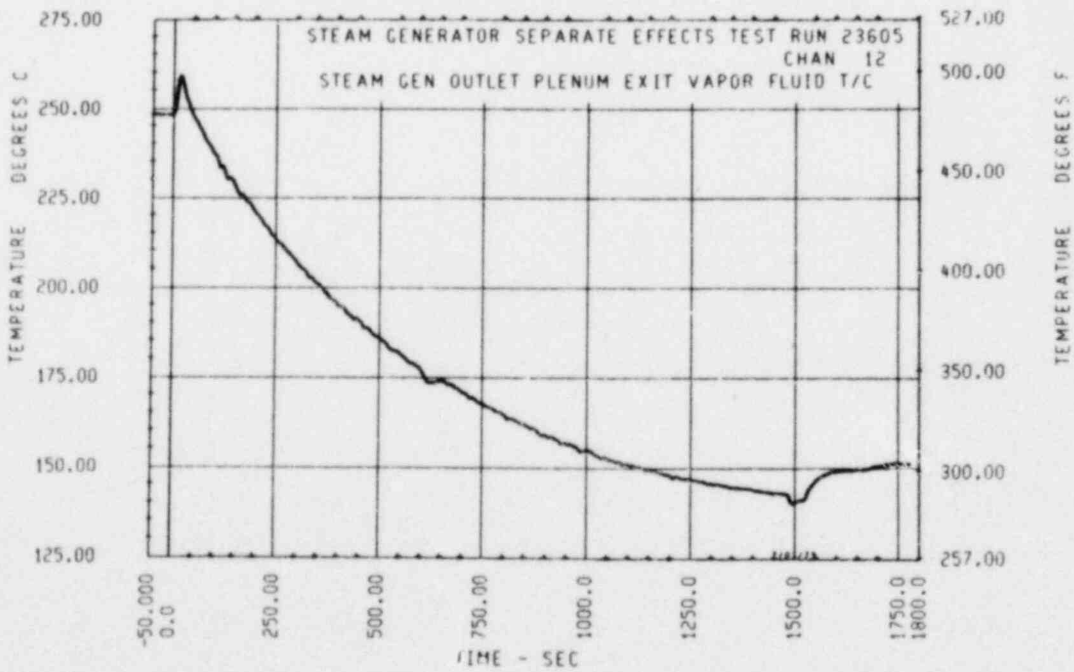

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23605
CHAN 57
MIXER PRESSURE (PSIG)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23605
CHAN 54
STEAM GENERATOR HOT LEG DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

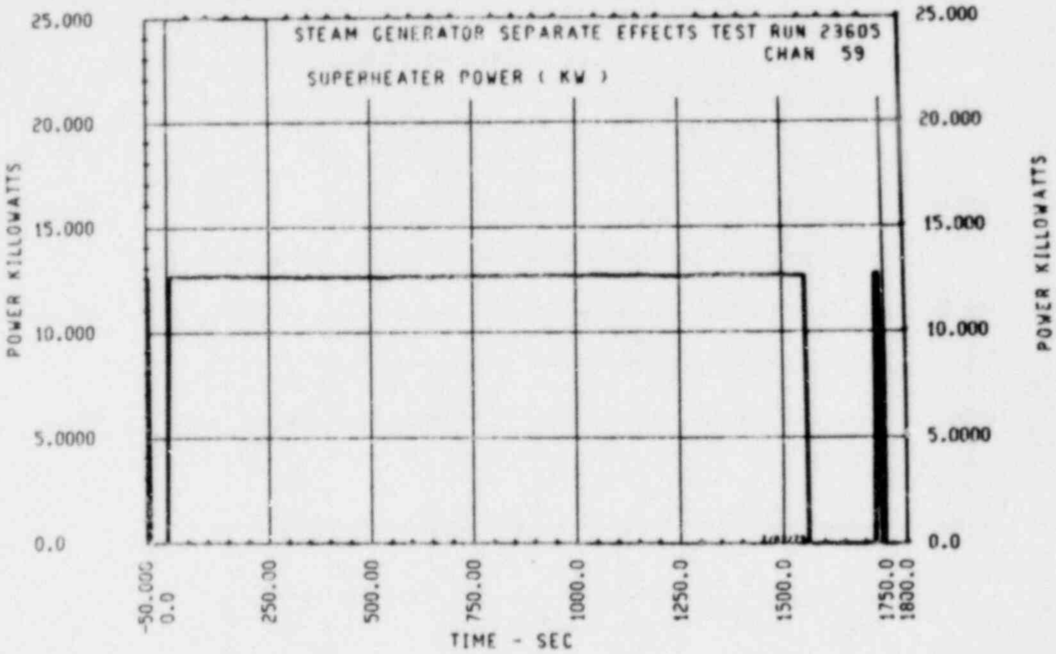

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23605
CHAN 52
STEAM GENERATOR INLET PLENUM DELTA P (PSID)
PRESSURE (KILOPASCAL)
PRESSURE PSI
TIME - SEC

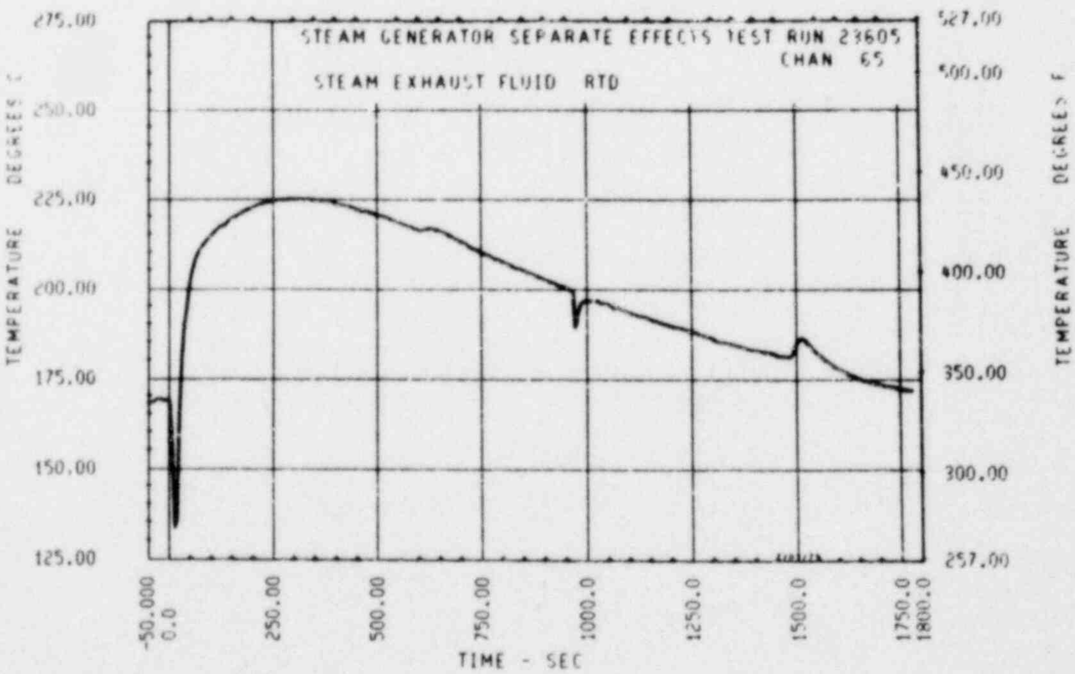


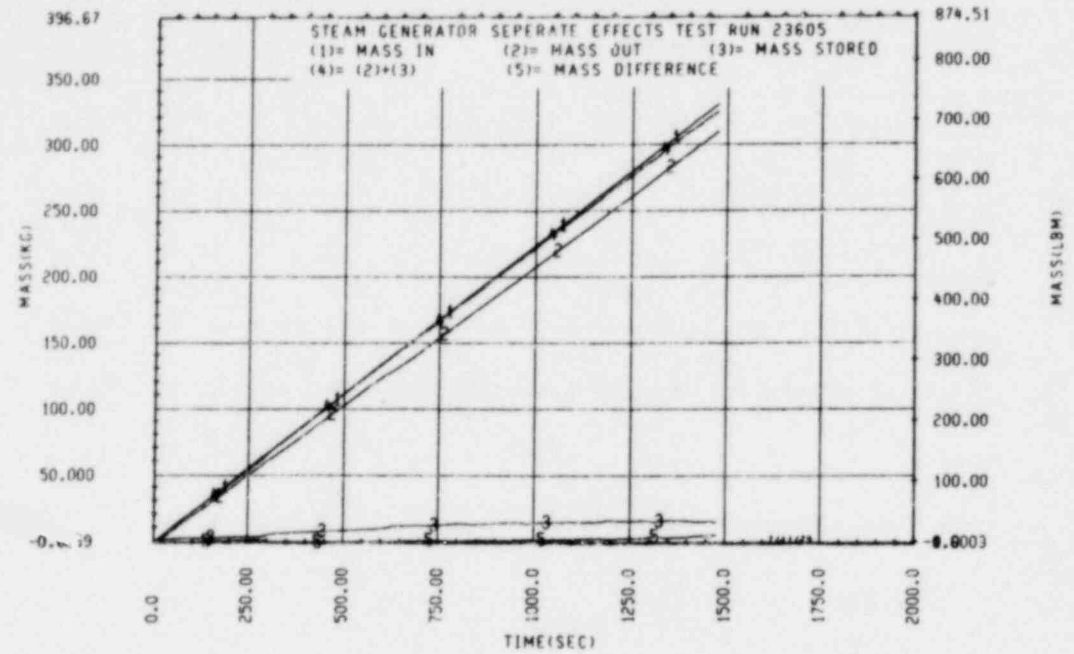
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23605
CHAN 7
STEAM GENERATOR INLET PLENUM STEAM PROBE TEMP
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

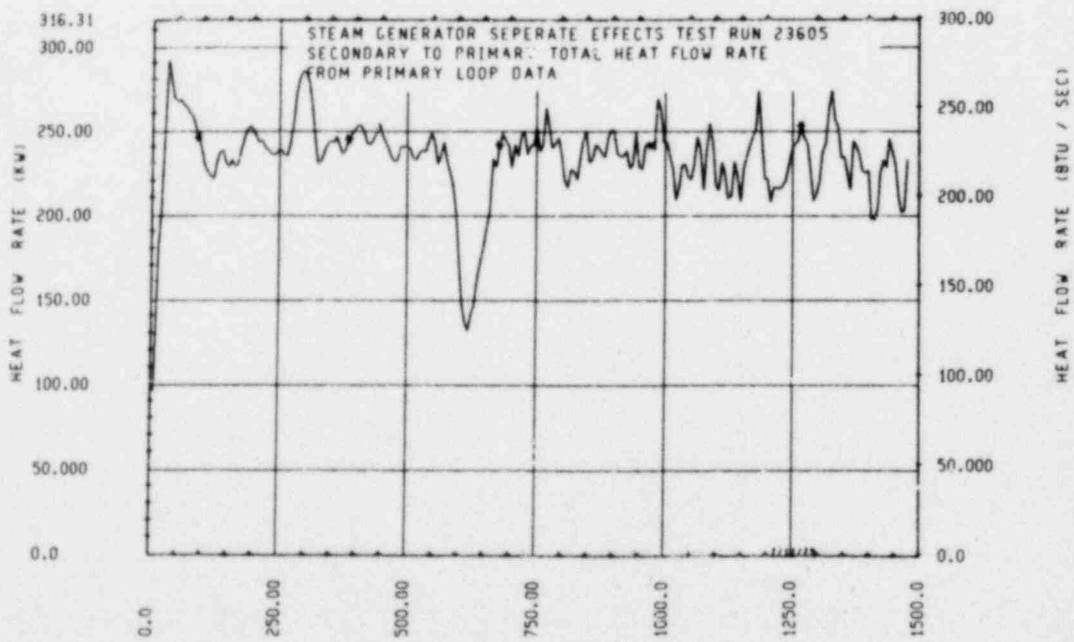


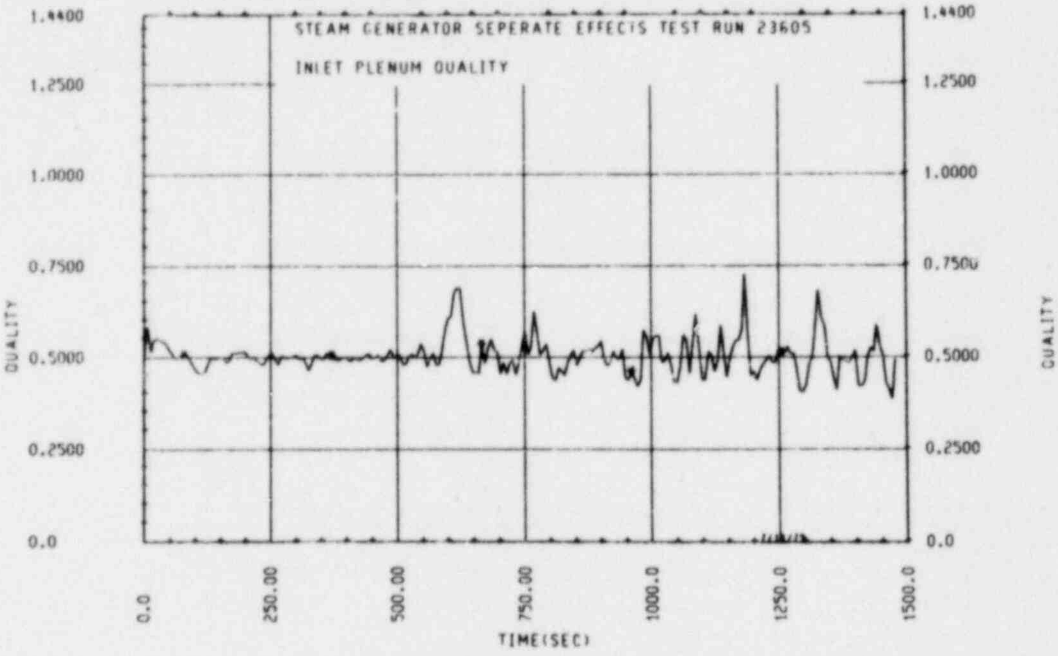
STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23605
CHAN 12
STEAM GEN OUTLET PLENUM EXIT VAPOR FLUID T/C
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
TIME - SEC

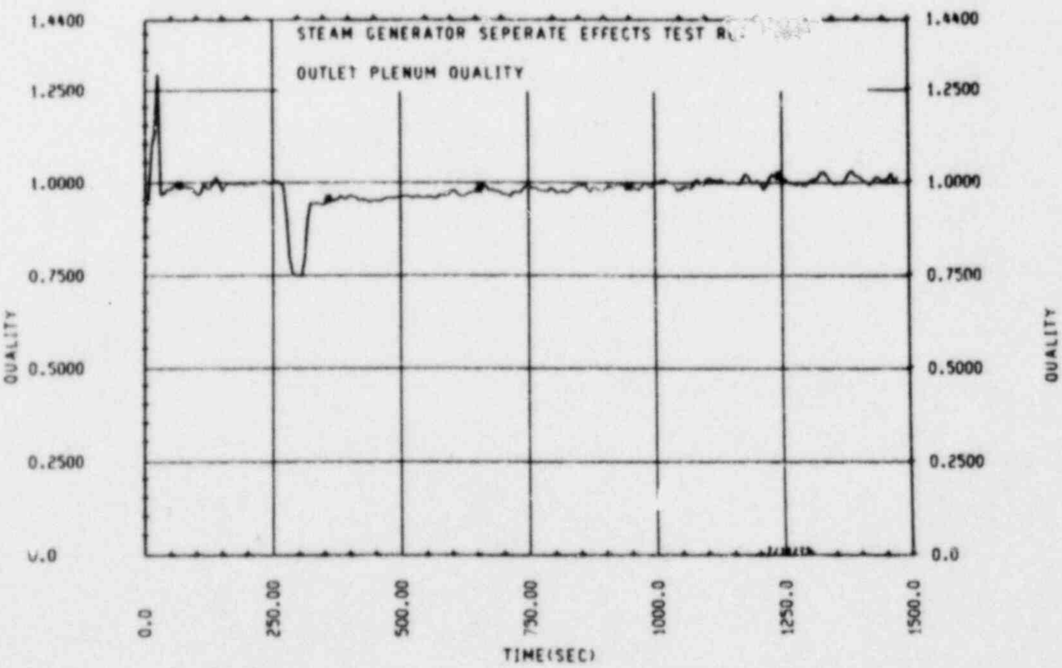

STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23605
CHAN 59
SUPERHEATER POWER (KW)
POWER KILLOWATTS
25.000
20.000
15.000
10.000
5.0000
0.0
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC


STEAM GENERATOR SEPARATE EFFECTS TEST RUN 23605
CHAN 65
STEAM EXHAUST FLUID RTD
TEMPERATURE DEGREES C
TEMPERATURE DEGREES F
275.00
250.00
225.00
200.00
175.00
150.00
125.00
527.00
500.00
450.00
400.00
350.00
300.00
257.00
-50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1800.0
TIME - SEC

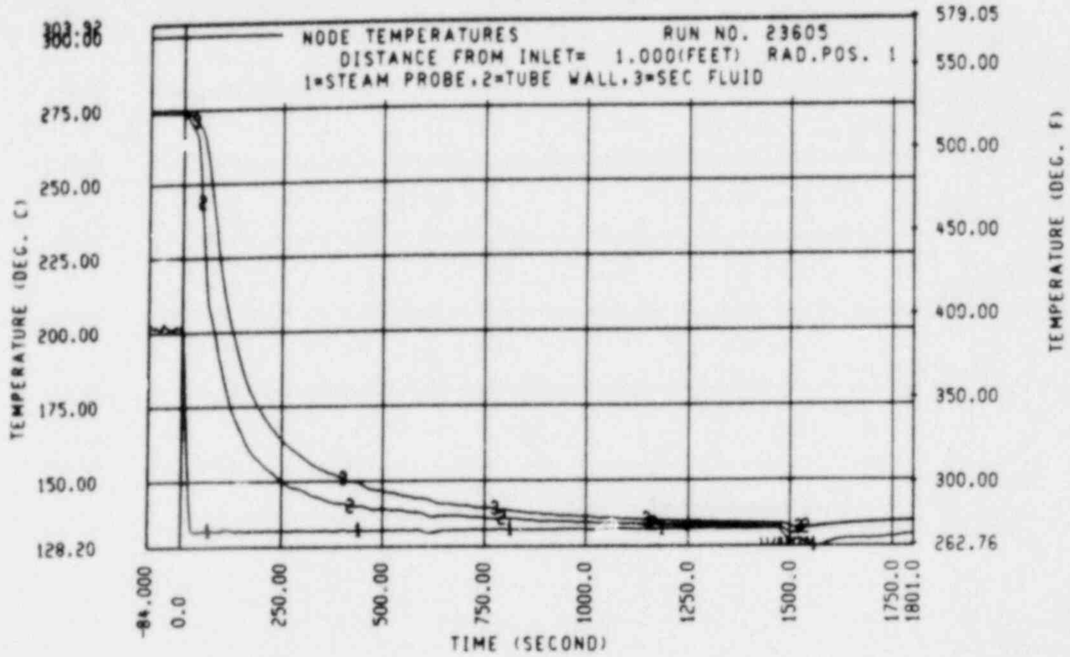

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23605
(1)= MASS IN (2)= MASS OUT (3)= MASS STORED
(4)= (2)+(3) (5)= MASS DIFFERENCE
MASS(KG)
MASS(LBM)
TIME(SEC)
396.67
350.00
300.00
250.00
200.00
150.00
100.00
50.000
874.51
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.0003
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
2000.0

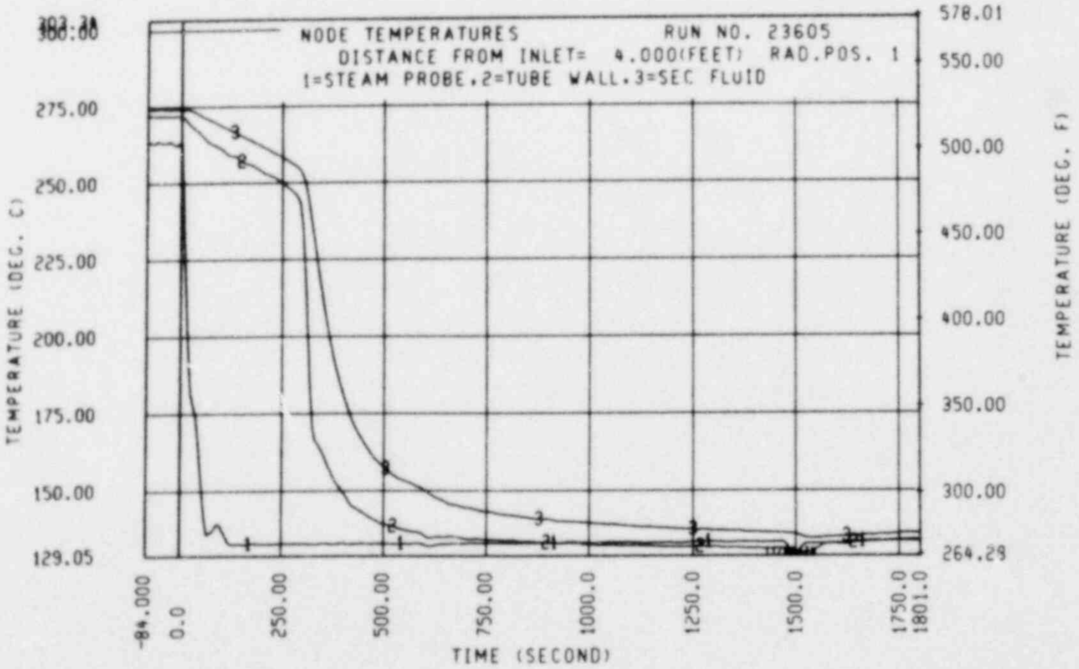

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23605
SECONDARY TO PRIMARY TOTAL HEAT FLOW RATE
FROM PRIMARY LOOP DATA
HEAT FLOW RATE (KW)
HEAT FLOW RATE (BTU / SEC)
TIME(SEC)
316.31
300.00
250.00
200.00
150.00
100.00
50.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0

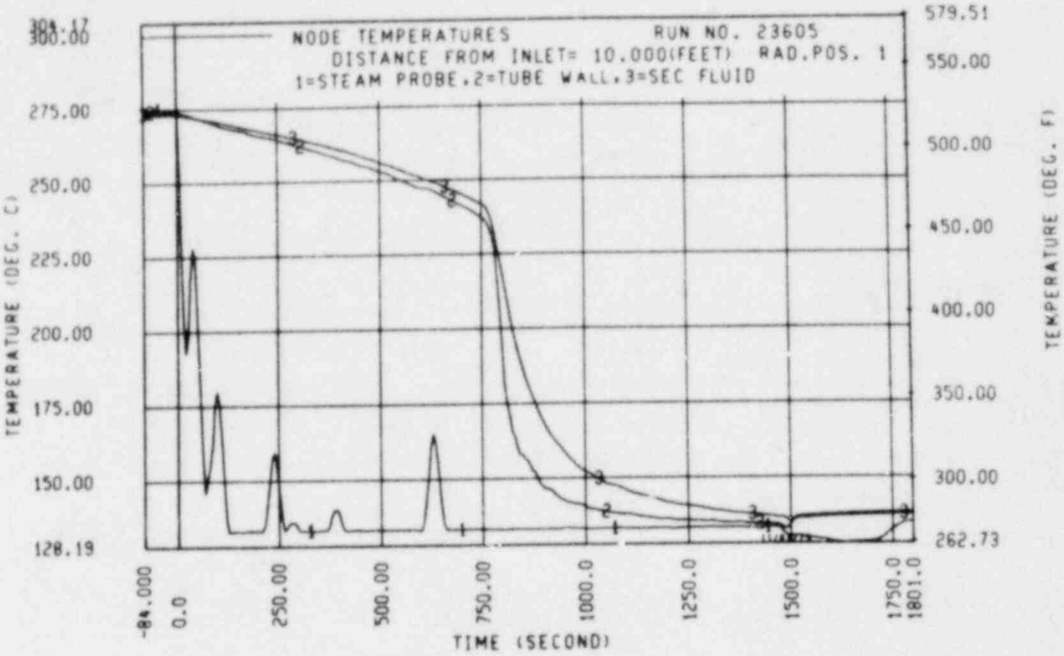

STEAM GENERATOR SEPERATE EFFECTS TEST RUN 23605
INLET PLENUM QUALITY
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
QUALITY
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)

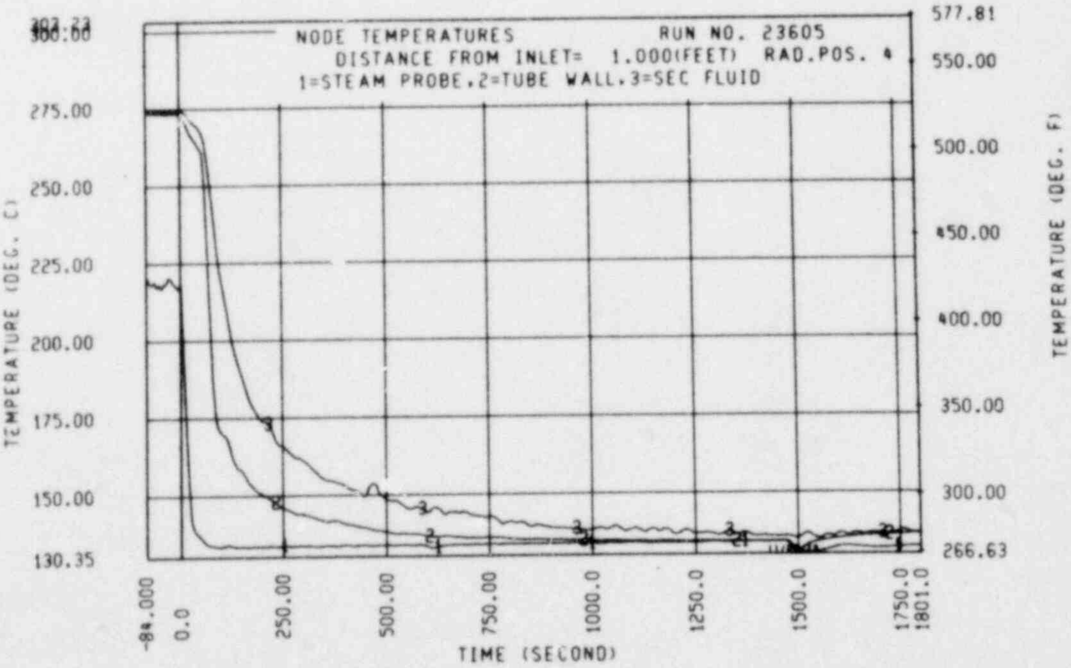

STEAM GENERATOR SEPERATE EFFECTS TEST R
OUTLET PLENUM QUALITY
1.4400
1.2500
1.0000
0.7500
0.5000
0.2500
0.0
QUALITY
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
TIME(SEC)

23605-10

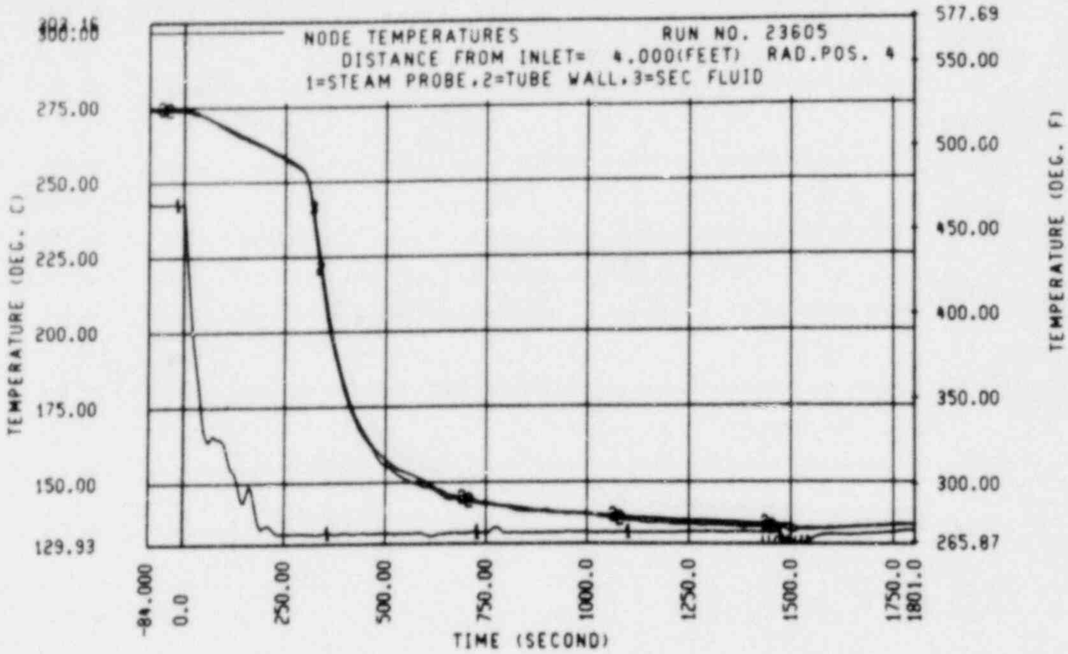

NODE TEMPERATURES
RUN NO. 23605
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
128.20
579.05
550.00
500.00
450.00
400.00
350.00
300.00
262.76
-84.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1801.0

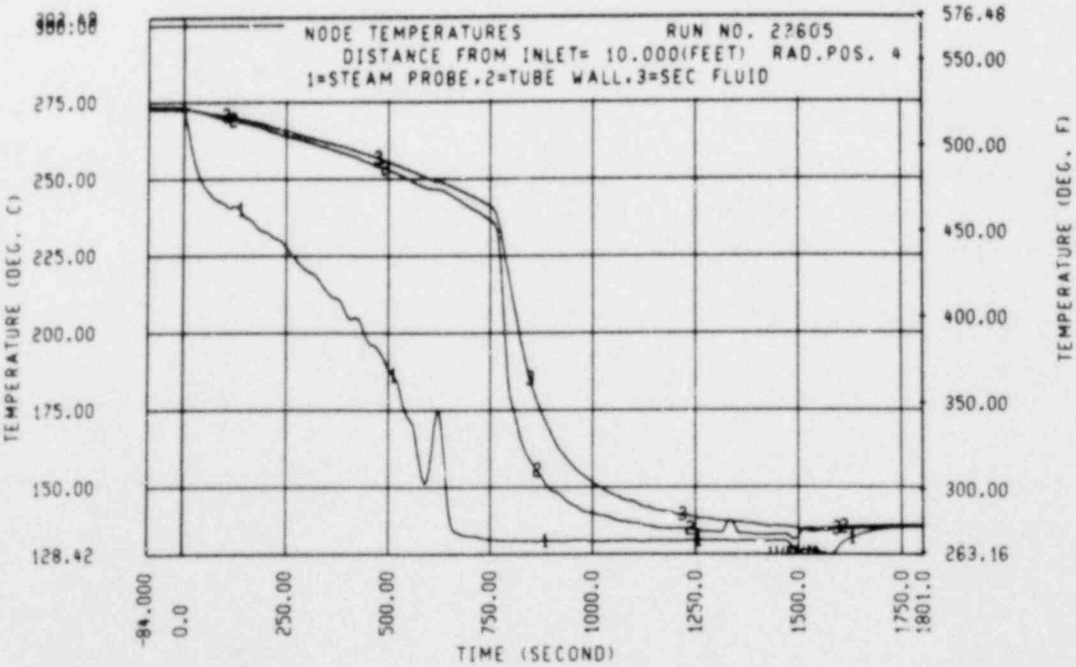

NODE TEMPERATURES
RUN NO. 23605
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)
275.00
250.00
225.00
200.00
175.00
150.00
129.05
578.01
550.00
500.00
450.00
400.00
350.00
300.00
264.29
-84.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1801.0

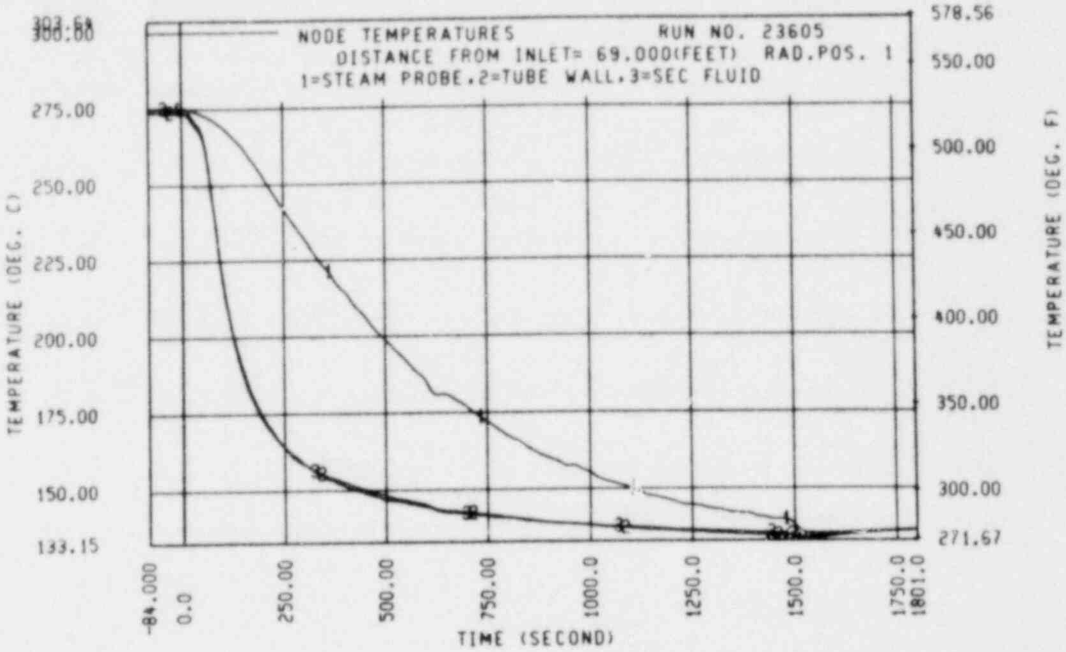

NODE TEMPERATURES
RUN NO. 23605
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

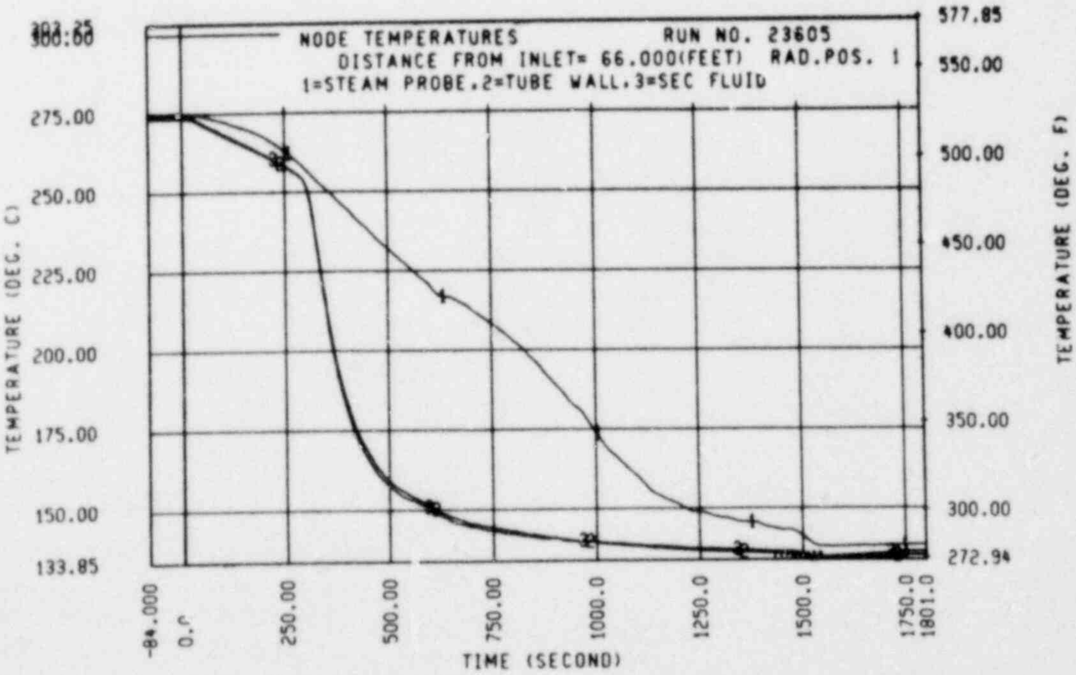

NODE TEMPERATURES
RUN NO. 23605
DISTANCE FROM INLET= 1.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

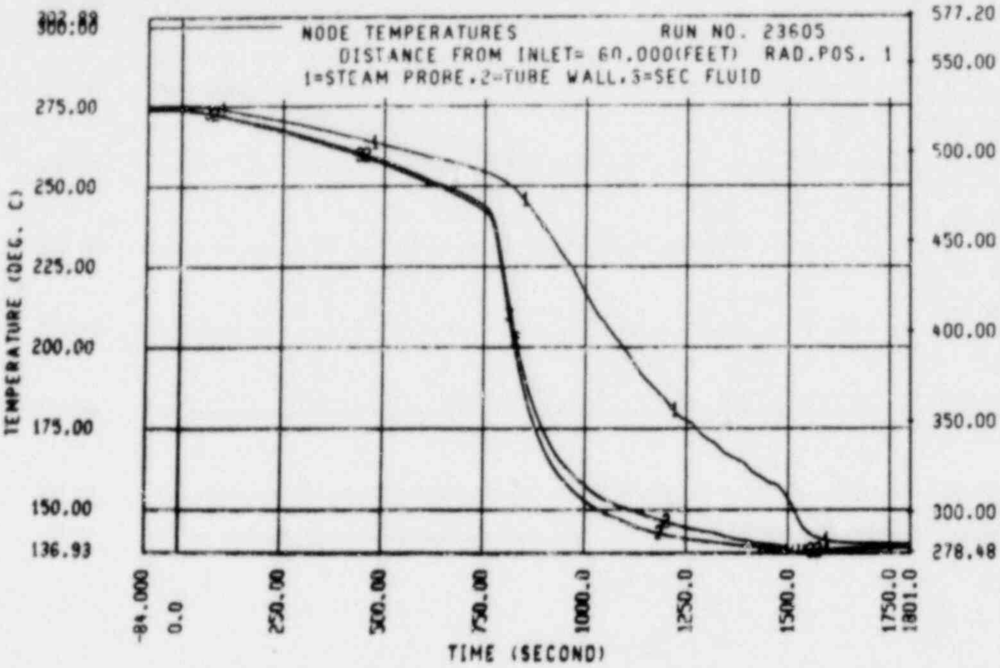
23605-12

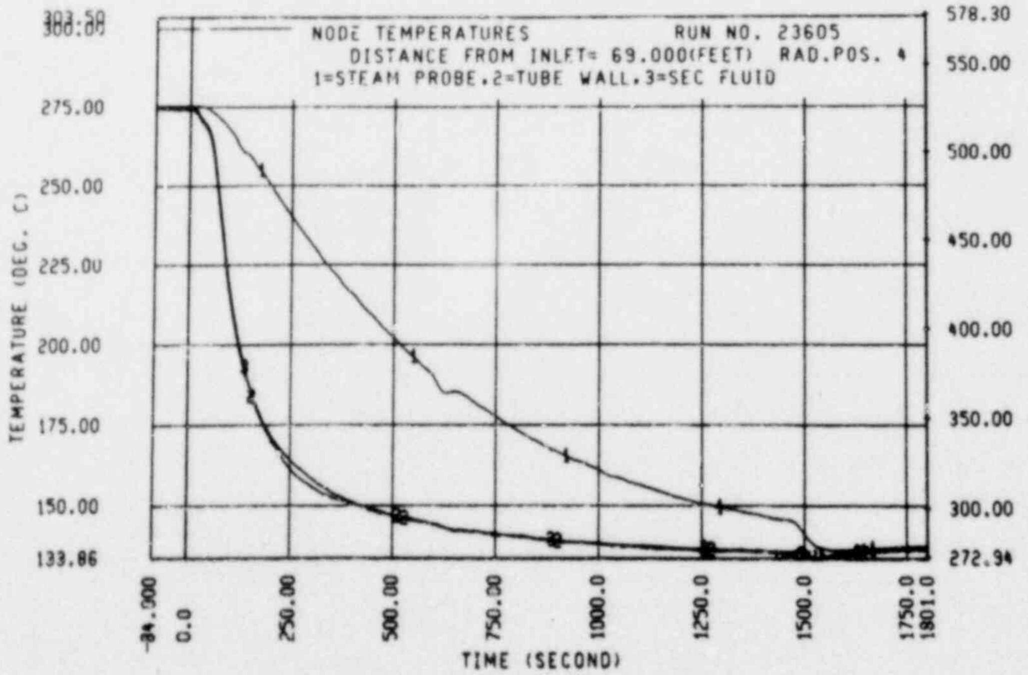

NODE TEMPERATURES RUN NO. 23605
DISTANCE FROM INLET= 4.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

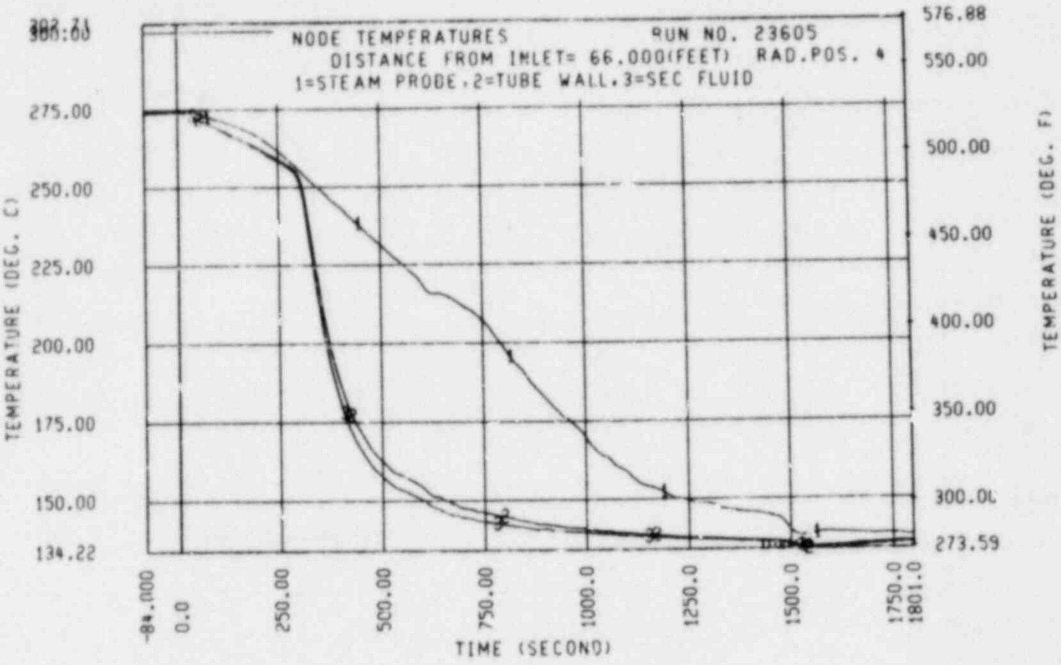

NODE TEMPERATURES RUN NO. 23605
DISTANCE FROM INLET= 10.000(FEET) RAD.POS. 4
1=STEAM PROBE.2=TUBE WALL.3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

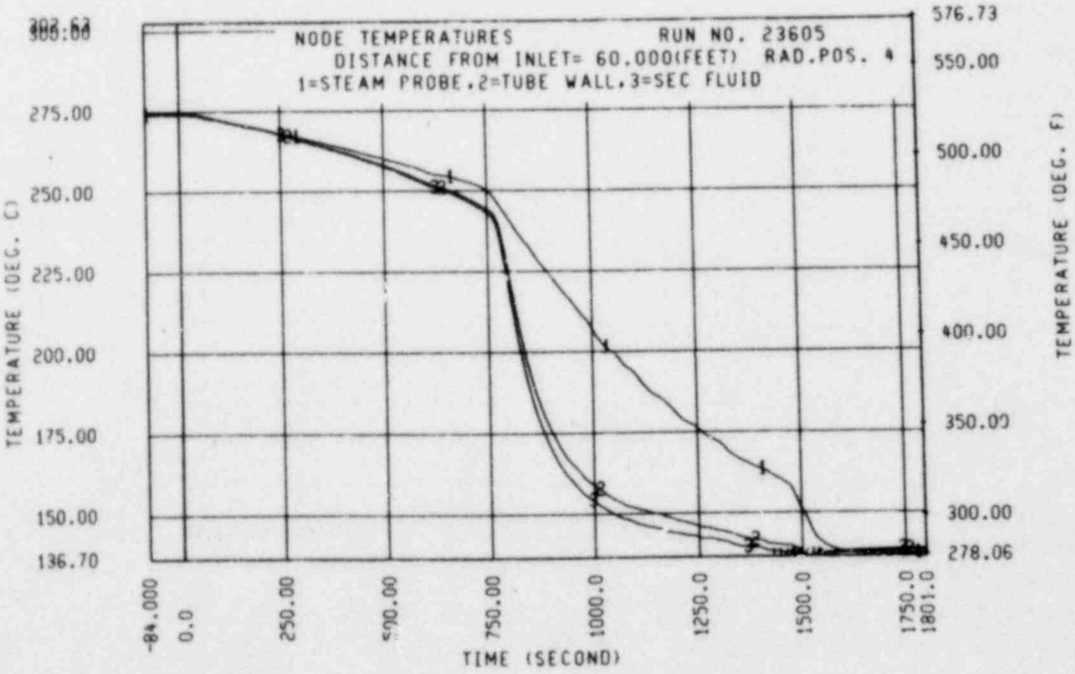

NODE TEMPERATURES RUN NO. 23605
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

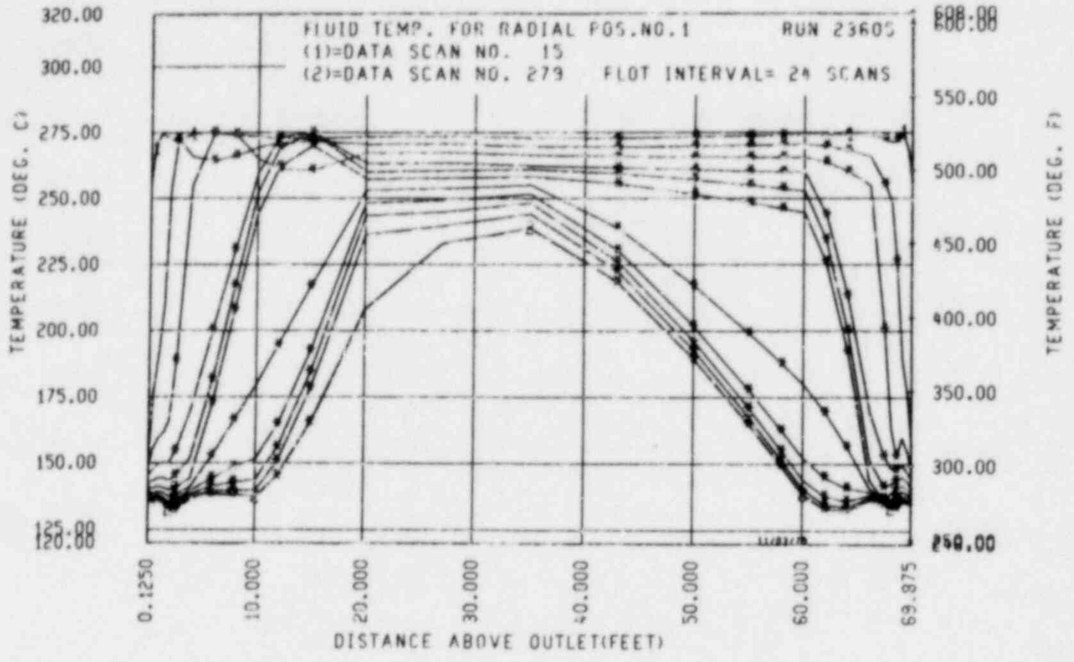

NODE TEMPERATURES RUN NO. 23605
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

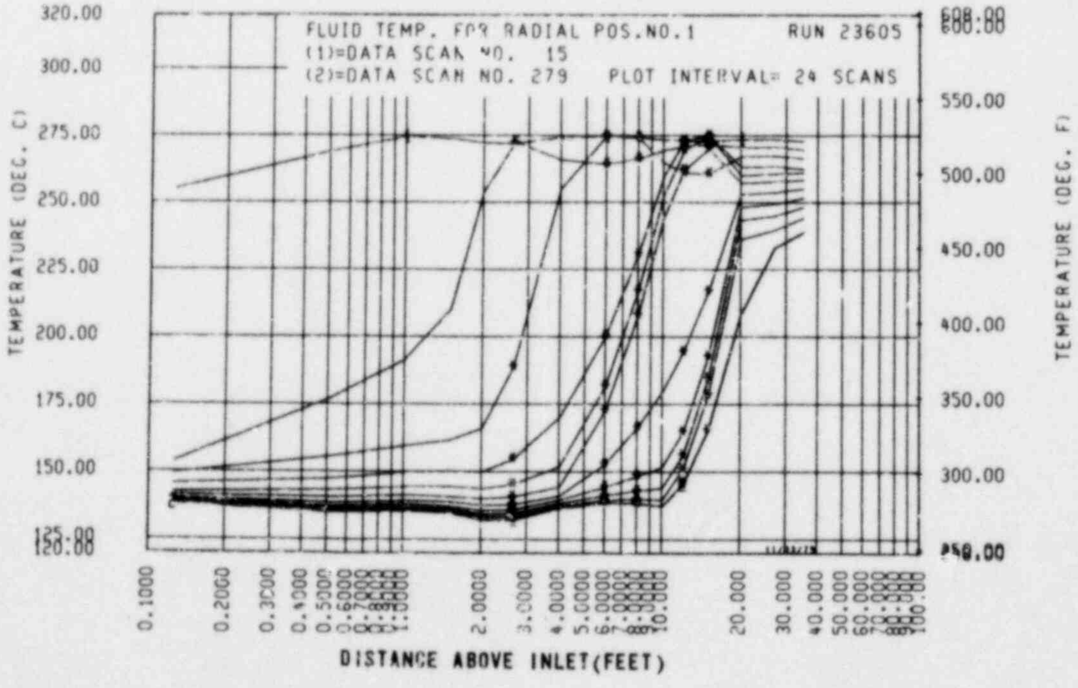

NODE TEMPERATURES
RUN NO. 23605
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 1
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)

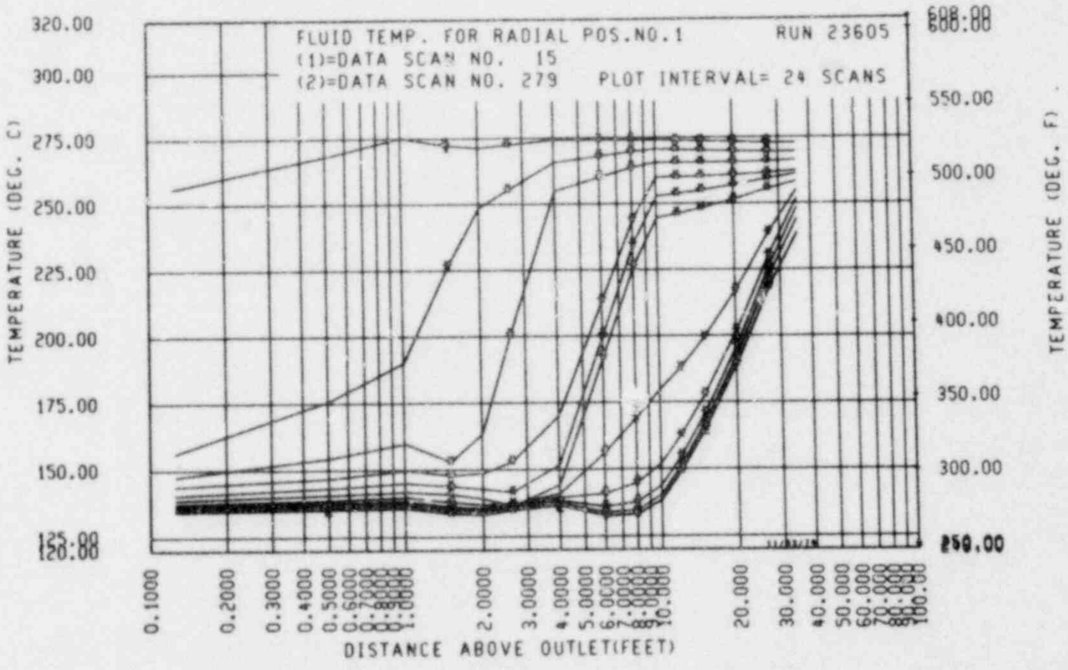

NODE TEMPERATURES
RUN NO. 23605
DISTANCE FROM INLET= 69.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
TIME (SECOND)


NODE TEMPERATURES RUN NO. 23605
DISTANCE FROM INLET= 66.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
134.22
TEMPERATURE (DEG. F)
576.88
550.00
500.00
450.00
400.00
350.00
300.00
273.59
-84.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1801.0
TIME (SECOND)


NODE TEMPERATURES RUN NO. 23605
DISTANCE FROM INLET= 60.000(FEET) RAD.POS. 4
1=STEAM PROBE,2=TUBE WALL,3=SEC FLUID
TEMPERATURE (DEG. C)
275.00
250.00
225.00
200.00
175.00
150.00
136.70
TEMPERATURE (DEG. F)
576.73
550.00
500.00
450.00
400.00
350.00
300.00
278.06
-84.000
0.0
250.00
500.00
750.00
1000.0
1250.0
1500.0
1750.0
1801.0
TIME (SECOND)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 23605
(1)=DATA SCAN NO. 15
(2)=DATA SCAN NO. 279
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)


FLUID TEMP. FOR RADIAL POS.NO.1
RUN 23605
(1)=DATA SCAN NO. 15
(2)=DATA SCAN NO. 279
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE INLET(FEET)



FLUID TEMP. FOR RADIAL POS.NO.1
RUN 23605
(1)=DATA SCAN NO. 15
(2)=DATA SCAN NO. 279
PLOT INTERVAL= 24 SCANS
TEMPERATURE (DEG. C)
TEMPERATURE (DEG. F)
DISTANCE ABOVE OUTLET(FEET)

23605-18

RUN 23605 FLECHT SEASET STEAM GENERATUR SEPARATE EFFECTS TEST SERIES

TIME = 102.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.02)	38.1(3.36)	39.0(3.43)	42.6(3.75)	.212	.223	.266	.514
.2(.50)	146.5(12.91)	124.3(10.95)	147.3(12.98)	149.9(13.20)	.257	.267	.319	.566
.3(1.00)	207.0(18.24)	257.1(22.65)	2.4(.21)	.8(.07)	.366	.385	.356	.613
.5(1.50)	1.0(.09)	1.1(.10)	1.0(.09)	1.0(.09)	.431	.465	.367	.614
.6(2.00)	1.2(.10)	237.4(20.92)	1.2(.10)	14.6(1.29)	.432	.534	.368	.615
.8(2.65)	1.2(.11)	22.6([illegible])	1.2(.11)	-4.1(-.36)	.432	.623	.369	.617
1.2(4.00)	17.5(1.54)	9.2(.81)	8.6(.76)	1.2(.11)	.453	.644	.380	.603
1.8(6.00)	19.8(1.74)	8.8(.78)	19.2(1.69)	16.3(1.44)	.495	.661	.409	.606
2.4(8.00)	9.9(.87)	3.8(.33)	1.2(.10)	11.2(.98)	.525	.659	.422	.624
3.0(10.00)	1.2(.11)	1.2(.11)	2.8(.25)	1.1(.10)	.529	.644	.414	.628
3.7(12.00)	-4.6(-.41)	.1(.01)	.4(.03)	-1.4(-.12)	.513	.631	.408	.621
4.6(15.00)	1.1(.10)	.7(.06)	-.8(-.07)	-1.5(-.13)	.494	.625	.401	.612
6.1(20.00)	-5.6(-.50)	-.2(-.01)	-1.9(-.17)	-1.7(-.15)	.465	.626	.389	.598
8.2(27.00)	.3(.03)	-.5(-.04)	-.7(-.06)	-.7(-.06)	.453	.625	.379	.589
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.454	.624	.377	.588
13.1(43.00)	-1.4(-.12)	-.3(-.03)	.1(.01)	-.1(-.01)	.449	.624	.380	.589
15.2(50.00)	-.7(-.06)	-.2(-.01)	.1(.01)	-.1(-.01)	.442	.623	.381	.589
16.8(55.00)	-.3(-.03)	-.0(-.00)	.1(.01)	-.0(-.00)	.439	.623	.382	.589
17.7(58.00)	-.1(-.01)	.0(.00)	.1(.00)	.0(.00)	.438	.624	.383	.589
18.3(60.00)	-.0(-.00)	.2(.02)	.1(.01)	.1(.01)	.438	.624	.383	.590
18.9(62.00)	.1(.01)	.3(.03)	.1(.01)	.1(.01)	.439	.625	.384	.590
19.5(64.00)	.1(.01)	.3(.03)	.1(.01)	.0(.00)	.439	.626	.385	.591
20.1(66.00)	.3(.03)	1.1(.10)	.3(.03)	-.1(-.01)	.440	.628	.385	.591
20.5(67.38)	-2.2(-.19)	-1.3(-.12)	-2.2(-.19)	-5.8(-.51)	.440	.629	.385	.589
20.7(68.00)	-9.2(-.81)	-7.1(-.62)	-9.2(-.81)	-12.5(-1.10)	.437	.627	.382	.583
20.9(68.50)	-8.6(-.76)	-8.3(-.73)	-15.2(-1.34)	-7.8(-.69)	.433	.623	.375	.578
21.0(69.00)	-1.1(-.10)	-1.2(-.11)	2.4(.21)	7.3(.65)	.432	.621	.372	.580
21.2(69.50)	-6.7(-.59)	-4.9(-.43)	-7.7(-.68)	-13.1(-1.15)	.434	.622	.372	.580
21.3(69.87)	-7.5(-.66)	-1.3(-.11)	-3.8(-.33)	-2.5(-.22)	.434	.623	.370	.577

23605-19

POOR ORIGINAL

FLECHT SEASET STEAM GENERATOR SEPARATE EFFECTS TEST SERIES

RUN 23605
TIME = 222.0 SECONDS

UNITS - ELEVATION METER(FEET)
FLUX KILOWATT/METER**2 (BTU/SEC-FT**2)

ELEVATION	LOCAL FLUX RAD POS - 1	2	3	4	LOCAL QUALITY 1	2	3	4
.0(.13)	.2(.02)	20.9(1.84)	18.4(1.62)	25.9(2.28)	.214	.222	.267	.514
.2(.50)	52.7(4.64)	39.3(3.46)	55.3(4.88)	46.6(4.10)	.230	.237	.287	.532
.3(1.00)	53.0(4.67)	70.6(6.22)	2.0(.18)	78.1(6.88)	.252	.271	.304	.570
.5(1.50)	51.2(4.51)	76.8(6.77)	-4.4(-.39)	73.8(6.50)	.295	.316	.304	.617
.6(2.00)	102.9(9.06)	109.2(9.62)	-1.9(-.16)	90.7(7.99)	.342	.374	.302	.658
.8(2.65)	.7(.06)	.7(.06)	4.4(.38)	84.5(7.45)	.375	.408	.304	.735
1.2(4.00)	18.4(1.62)	13.4(1.18)	10.4(.92)	1.1(.10)	.394	.425	.319	.767
1.8(6.00)	-.5(-.04)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.420	.439	.331	.747
2.4(8.00)	-1.0(-.09)	-.2(-.02)	.3(.03)	5.9(.52)	.417	.431	.330	.732
3.0(10.00)	2.5(.22)	2.6(.23)	5.0(.44)	2.1(.19)	.414	.422	.332	.727
3.7(12.00)	22.7(2.00)	11.6(1.02)	7.2(.64)	-.2(-.02)	.432	.429	.337	.720
4.6(15.00)	15.7(1.38)	10.9(.96)	10.1(.89)	3.8(.33)	.474	.457	.355	.721
6.1(20.00)	59.7(5.26)	43.3(3.82)	18.0(1.58)	14.4(1.27)	.610	.615	.427	.772
8.2(27.00)	.3(.02)	-.6(-.05)	-.7(-.06)	-.7(-.06)	.856	.754	.483	.815
10.7(35.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	.891	.755	.433	.815
13.1(43.00)	-1.7(-.15)	-.5(-.05)	.0(.00)	-.3(-.03)	.856	.755	.435	.817
15.2(50.00)	-1.4(-.13)	-.6(-.05)	-.1(-.01)	-.4(-.03)	.875	.752	.486	.816
16.8(55.00)	-1.0(-.09)	-.2(-.02)	-.1(-.01)	-.2(-.02)	.858	.750	.485	.814
17.7(58.00)	-.7(-.07)	-.0(-.00)	-.1(-.01)	-.1(-.01)	.855	.750	.486	.814
18.3(60.00)	-.8(-.07)	.2(.02)	-.1(-.01)	-.0(-.00)	.854	.752	.485	.815
18.9(62.00)	-.4(-.03)	.3(.03)	-.0(-.00)	-.0(-.00)	.858	.753	.487	.816
19.5(64.00)	-.0(-.00)	.3(.03)	.0(.00)	-.1(-.01)	.854	.755	.488	.817
20.1(66.00)	.1(.01)	1.0(.09)	.1(.01)	-.6(-.05)	.857	.758	.490	.818
20.5(67.36)	-6.5(-.58)	-5.9(-.52)	-6.6(-.58)	-15.2(-1.34)	.856	.756	.488	.812
20.7(68.00)	-31.3(-2.61)	-28.3(-2.50)	-31.8(-2.81)	-32.0(-2.82)	.856	.749	.478	.799
20.9(68.50)	-22.0(-1.94)	-24.3(-2.14)	-27.4(-2.41)	-28.6(-2.52)	.845	.736	.453	.766
21.0(69.00)	-1.5(-.13)	-1.7(-.15)	2.5(.22)	4.8(.42)	.845	.732	.458	.785
21.2(69.50)	-7.7(-.68)	-14.5(-1.28)	-10.0(-.88)	-10.3(-.91)	.834	.732	.456	.786
21.3(69.87)	-3.4(-.30)	-.6(-.05)	-2.5(-.22)	-2.4(-.2[illegible])	.859	.732	.456	.786

23605-20

POOR ORIGINAL

APPENDIX I

ERROR ANALYSIS

I-1. INSTRUMENT ERRORS

The data collected by the data acquistion system (DAS) had inherent inaccuracies due to component errors. This error analysis quantifies the error associated with each data channel. The component errors used were derived from manufacturers' published specifications or, in the case of thermocouples, from industry standards. These component errors arise from three categories of instruments: sensor, conditioning, and readout. The sensor is the device that converts a physical property (temperature, pressure, flow) to an electrical signal. The conditioning device, if required, matches the sensor output to the input requirements of the readout device. The readout device measures the electrical signal and records the value of the physical property measured by the sensor. The errors introduced by the interconnecting wires, which are essentially an order of magnitude smaller than the component errors, have been neglected.

Each sensor was calibrated to meet or exceed the manufacturers' specifications, but in all cases the manufacturers' numbers were used; statistically these are valid over the calibration time interval of 6 months.

Sensor, conditioning, and readout errors as well as the combined error for each data channel are listed in table I-1. All component errors are listed in engineering units for each particular channel and are, as specified by the manufacturer, a percentage of the full-scale range of the component. The error specified by the manufacturer is taken to be the maximum uncertainty for this instrument. The accuracy for each channel is listed in two ways. The maximum possible error is the sum total of all the component errors. This calculation does not take into account the randomness or cancellation of errors. A more realistic assessment of error is the standard deviation, σ, computed with the following equation:[1]

$$\sigma^2 = \sum_{i=1}^{n} \frac{E_i^2}{3} \qquad \text{(I-1)}$$

1. Hogg, R. V., and Craig, A. T., Introduction to Mathematical Statistics, 4th ed., MacMillan, New Jersey, 1978, section 1.10.

TABLE I-1

INSTRUMENT ERRORS [(a)]

Channel Number	Sensor Error	Conditioning Error	Readout Error	Standard Deviation of Data Path[(b)] (1σ)	Data Path Maximum Error
1-15, 17-31 33-41, 257-271, 273-287, 289-303, 305-319, 321-330, 513-527, 529-543, 545-559, 561-575, 577-588	$\pm$ 4^{o}F	N/A	$\pm$ 2^{o}F	$\pm$ 3^{o}F	$\pm$ 6^{o}F
42	N/A	N/A	N/A	N/A	N/A
48	$\pm$0.05 psi	$\pm$0.019 psi	$\pm$0.004 psi	$\pm$0.031 psi	$\pm$0.073 psi
49	$\pm$0.05 psi	$\pm$0.018 psi	$\pm$0.005 psi	$\pm$0.031 psi	$\pm$0.073 psi
50	$\pm$0.025 psi	$\pm$0.010 psi	$\pm$0.003 psi	$\pm$0.016 psi	$\pm$0.038 psi
51	$\pm$0.0.10 psi	$\pm$0.04 psi	$\pm$0.007 psi	$\pm$0.062 psi	$\pm$0.147 psi
52	$\pm$0.0125 psi	$\pm$0.005 psi	$\pm$0.0009 psi	$\pm$0.0078 psi	$\pm$0.0184 psi
53	$\pm$0.0125 psi	$\pm$0.005 psi	$\pm$0.0008 psi	$\pm$0.0078 psi	$\pm$0.0183 psi
54	$\pm$0.025 psi	$\pm$0.01 psi	$\pm$0.002 psi	$\pm$0.016 psi	$\pm$0.037 psi
55	$\pm$0.025 psi	$\pm$0.01 psi	$\pm$0.003 psi	$\pm$0.016 psi	$\pm$0.038 psi
56	$\pm$.1.5 psi	$\pm$0.6 psi	$\pm$0.11 psi	$\pm$0.93 psi	$\pm$2.21 psi
57	$\pm$.1.0 psi	$\pm$0.40 psi	$\pm$0.06 psi	$\pm$0.62 psi	$\pm$1.46 psi
58	$\pm$7.5 psi	$\pm$5.99 psi	$\pm$0.6 psi	$\pm$5.55 psi	$\pm$14.09 psi
59	$\pm$0.467 kw	N/A	$\pm$0.008 kw	$\pm$0.27 kw	$\pm$0.475 kw
64 - 68	$\pm$0.3^{o}F	N/A	$\pm$1.3^{o}F	$\pm$0.8^{o}F	$\pm$1.6^{o}F

a. SI (metric) data are given in the text.

b. Calculated by equation (I-1)

TABLE I-1 (cont)

INSTRUMENT ERRORS [a]

Channel Number	Sensor Error	Conditioning Error	Readout Error	Standard Deviation of Data Path[b] (1σ)	Data Path Maximum Error
80	±0.5 psi	N/A	±0.18 psi	±0.31 psi	±0.68 psi
81	±0.5 psi	N/A	±0.17 psi	±0.31 psi	±0.67 psi
82	±0.009 lb/sec	±0.044 lb/sec	±0.002 lb/sec	±0.026 lb/sec	±0.055 lb/sec
83	±0.009 lb/sec	±0.044lb/sec	±0.002 lb/sec	±0.026 lb/sec	±0.055 lb/sec
84	±0.5 psi	N/A	±0.18 psi	±0.53 psi	±0.68 psi
85 - 90	±0.0054 psi	N/A	±0.0019 psi	±0.0033 psi	±0.0073 psi
96	±1.2 cfm	N/A	±1.1 cfm	±0.9 cfm	±2.3 cfm
97	±2.8 cfm	N/A	±2.3 cfm	±1.7 cfm	±5.1 cfm
98	±0.03 gal/min	N/A	±0.022 gal/min	±0.021 gal/min	±0.052 gal/min
768	N/A	N/A	N/A	±0.004 lb/sec	±0.015 lb/sec
769	N/A	N/A	N/A	±0.004 lb/sec	±0.015 lb/sec

a. SI (metric) data are given in the text.
b. Calculated by equation (I-1)

where

σ	=	data path standard deviation
E_i	=	component i maximum error
n	=	number of sources of error

The errors for each type of component are discussed in the following paragraphs.

I-2. Sensor Errors

All thermocouples recorded on the DAS were type K (chromel-alumel) premium grade in a stainless steel sheath. The maximum thermocouple error for temperatures between -18°C and 276°C (0°F and 530°F) was $\pm$ 2.2°C ($\pm$ 4°F).

Resistance temperature detectors (RTDs) were used to measure the primary loop temperatures. Each RTD was calibrated; the maximum error was $\pm$ 0.17°C ($\pm$ 0.3°F).

Pressure and differential pressure (level) measurements were made with strain gage transducers and transmitters. The output of the transducers was in millivolts; transmitters supplied 4 to 20 milliampere output signals. The manufacturers' specifications for the pressure transducers and transmitters were $\pm$ 0.5 percent of the full-scale range.

The superheater power was measured by a watt transducer and stepdown current and potential transformers. The error for the watt transducer output was the combined error for the three components. The additive treatment of the individual errors is justified because the watt transducer multiplies the current and voltage signals to form the transducer output. The full-scale errors were $\pm$ 0.6 percent for the potential transformer, $\pm$ 0.5 percent for the current transformer, and $\pm$ 0.25 percent for the watt transducer. The combined (maximum) error amounts to $\pm$ 0.467 kilowatts for the watt transducer.

The steam flow in cubic feet per minute was measured by vortex meters, which had an error of $\pm$ 0.25 percent of full scale. The accuracy of these meters, like that of orifice meters, is dependent on the long-term stability provided by internal physical dimensions. The water flow was measured by a turbine meter with an error of $\pm$ 0.25 percent of full scale.

I-3. Conditioning Errors

The Consolidated Controls Corporation data logger requires no external signal conditioning to measure the sensors employed. For this error analysis, effective signal conditioning errors have been assessed for pressure and differential pressure transducers and steam mass flow meters.

The output of the pressure transducer is dependent upon the power supply voltage; this error was considered a signal conditioning error. The uncertainty of the supply voltage, due to the nature of the power control system, was converted to a corresponding uncertainty in the range of the transducer.

The steam mass flow was measured by the vortex meter, pressure transmitter, and fluid RTD. These three signals were processed by a Waugh flow computer, which took the cubic feet per minute measurement from the vortex meter and compensated for the temperature and pressure measurements according to standard steam tables. Because of the nonlinearity of the steam tables over the range of test conditions and the limitation of the compensating circuits, the flow computers were calibrated for maximum accuracy at 0.292 MPa (40 psia) conditions, the conditions at which most of the tests were run. The accuracy degraded as the pressure rose or fell to 0.414 or 0.138 MPa (60 or 20 psia).

I-4. Readout Errors

All signals were measured and recorded on the data logger. The input signals were multiplexed to three independent analog/digital converters, the digital values were converted to engineering units, and then the engineering value was recorded. The readout error accounts for these three transitions.

The thermocouple readout error was a combination of $\pm$ 0.14°C ($\pm$0.3°F) conformance to the curve and $\pm$ 0.05 percent of 2520°F full scale. This results in a $\pm$ 1.1°C ($\pm$ 2°F) error.

The RTD readout error was $\pm$ 0.10 percent of 880°F on linearity and $\pm$0.05 percent of 880°F on repeatability. The combined error was 0.73°C ($\pm$1.3°F), assuming that the multiplexer calibration matches each RTD sensor. To take advantage of the RTDs' accuracy, the DAS multiplexer was calibrated to the sensor ideal calibration curve and the recorded value was corrected using the individual sensor calibration data. The correction, performed by the CATALOG program, used the calibration data to calculate the RTD resistance measured by the DAS and then compute the temperature corresponding to that resistance for that particular RTD.

The pressure transducers were measured by a thermocouple multiplexer calibrated for 32 millivolts full scale. The error was $\pm$ 0.03 percent of full scale $\pm$ 1 count. The pressure transmitters and steam mass computers were measured by an industrial transmitter multiplexer. The error for this transmitter multiplexer was $\pm$ 0.15 percent of full scale $\pm$ 1 count.

The turbine meter and steam flow vortex meters were measured and recorded on a frequency multiplexer with individual adjustments for zero and span. The error was $\pm$ 0.2 percent of full scale $\pm$ 1 count.

The steam mass flow rate was computed by the data logger from recorded data of volumetric flow rate, pressure, and temperature. The following equation was used:

$$\text{mass flow rate} = \frac{(K)\ (\text{volumetric flow rate})\ (\text{pressure})}{\text{absolute temperature}} \qquad \text{(I-2)}$$

where K is a conversion constant determined from steam table data using the conditions of the test matrix. The average K-value chosen had a standard deviation of 0.2 percent. The most probable error is computed by summing the variances of the four terms on the right-hand side of equation (I-2) and taking the square root of the combined variance.

I-5. Combined Errors

The combined error calculations for each type of instrument are detailed below and summarized in table I-1.

- Thermocouple data (DAS channels 1 - 15, 17 - 31, 33 - 41, 257 - 271, 273 - 287, 289 - 303, 305 - 319, 321 - 330, 513 - 527, 529 - 543, 545 - 559, 561 - 575, 577 - 588)

  Sensor error: premium grade type K error between 0 and 530^{o}F = $\pm$ 2.2^{o}C (4^{o}F).
  Readout error: CCC data logger T/C conformance error = $\pm$ 0.17^{o}C ($\pm$ 0.3^{o}F); plus $\pm$ 0.05% of 2520^{o}F full scale = 0.69^{o}C (1.26^{o}F); combined readout error = $\pm$ 0.86^{o}C ($\pm$ 1.6^{o}F) ≈ $\pm$ 2^{o}F (one degree resolution on recorded data).

- RTD data (DAS channels 64 - 68)

  Sensor error: 100-ohm platinum RTD error $\pm$ 0.14^{o}C ($\pm$ 0.25^{o}F) ≈ 0.2^{o}C ($\pm$ 0.3^{o}F).
  Readout error: $\pm$ 0.10% full scale (880^{o}F) linearity plus $\pm$ 0.05% full scale (880^{o}F) repeatability = 0.15% full scale = 0.73^{o}C ($\pm$ 1.3^{o}F).

  This calculation assumes that the individual RTD calibration data were used to correct each reading.

- Millivolt reading (DAS channel 42)

  This error does not apply to data analysis. This data channel was used to document when the test started and stopped; therefore, these data are event readings and an absolute value reading is not relevant.

- Strain gage transducers (DAS channels 48 - 58)

Sensor error:

Range ± 10 psid error = ± 0.5% full scale (one direction) = ± 0.34 kPa (± 0.05 psi).
Range ± 5 psid error = ± 0.5% full scale (one direction) = ± 0.17 kPa (± 0.025 psi).
Range ± 2.5 psid error = ± 0.5% full scale (one direction) = ± 0.086 kPa (± 0.0125 psi).
Range ± 20 psid error = ± 0.5% full scale (one direction) = ± 0.69 kPa (± 0.10 psi).
Range 0 - 300 psi error = ± 0.5% full scale = ± 10.3 kPa (± 1.5 psi).
Range 0 - 200 psi error = ± 0.5% full scale = ± 6.9 kPa (± 1.0 psi).
Range 0 - 1500 psi error = ± 0.5% full scale = ± 51 kPa (± 7.5 psi).

Conditioning error: The output of the transducer is a direct function of the power supply voltage, nominally 3 millivolts output for each volt of excitation. The power supply error, ± 0.2 percent, was converted to an output millivolt error and then to an error in psi. This psi error was calculated for each transducer and was dependent on the transducer's power supply and the slope of the calibration curve.

Readout error: The CCC data logger error in reading the millivolts out of the transducer was ± 0.03 percent of full scale ± 1 count. The full-scale value used was the programmed A-value which was derived from individual transducer calibrations.

- Superheater power (DAS channel 59)

Sensor error:

Watt transducer error = ± 0.25% full scale (34.6 kw) = ± 0.0865 kw.
Potential transformer error = ± 0.6% full scale.
Current transformer = ± 0.5% full scale.
Combined sensor error = ± 1.35% full scale (34.6 kw) = ± 0.467 kw.

Readout error: CCC data logger error = ± 0.03% full scale (A = 22.83) ± 1 count = ± 0.008 kw.

- Industrial transmitters (DAS channels 80 - 90)

Sensor error:
Range 0 - 100 psi, error = ± 0.5% full scale = ± 3.4 kPa (± 0.5 psi).[1]
Range 0 - 30 in. H_2O (0 - 1.083 psi), error = ± 0.5% full scale = ± 0.037 kPa (± 0.0054 psi).[2]

Conditioning error: This error is included in the sensor error when the supply voltage is above the minimum required voltage for its load resistance.

Readout error: The CCC data logger error for industrial transmitters was ± 0.15 percent of full scale ± 1 count.

- Flowmeters (DAS channels 96 - 98)

Sensor error: The accuracy of the vortex meters and turbine meter was ± 0.25 percent of full scale.[3]

Readout error: The CCC data logger error was ± 0.2 percent of full scale ± 1 count.

- Steam mass flow calculation (DAS channels 768 and 769)

The combined error for DAS channels 768 and 769 is the same as the readout error for these channels.

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1. Channels 80 and 81
2. Channels 85 through 90
3. Channel 96 full scale = 496 cfm
   Channel 97 full scale = 1100 cfm
   Channel 98 full scale = 10.32 gpm

The calculations for each channel are shown below:

Channel 768

Most probable error

Ch 96	± 0.9 cfm	=	± 0.18% full scale (496 cfm)
Ch 80	± 0.31 psi	=	± 0.28% full scale (110 psi)
Ch 64	± 0.8°F	=	± 0.06% full scale (1340°R)
	K	=	± 0.2%
			± 0.39% full scale

± 0.39% of 1.1 = ± 0.0018 kg/sec (± 0.004 lb/sec)

Maximum error

Ch 96	± 2.3 cfm	=	± 0.46% full scale (496 cfm)
Ch 80	± 0.68 psi	=	± 0.62% full scale (110 psi)
Ch 64	± 1.6°F	=	± 0.12% full scale (1340°R)
	K	=	± 0.2%
			1.4% full scale

± 1.4% of 1.1 = ± 0.0068 kg/sec (±0 .015 lb/sec)

Channel 769

Most probable error

Ch 97	± 1.7 cfm	=	± 0.15% full scale (1100 cfm)
Ch 81	± 0.31 psi	=	± 0.28% full scale (110 psi)
Ch 65	± 0.8°F	=	± 0.06% full scale (1340°R)
	K	=	± 0.2%
			± 0.38% full scale

± 0.38% of 1.1 = ± 0.0018 kg/sec (± 0.004 lb/sec)

Maximum error

Ch 97	± 5.1 cfm	=	± 0.46% full scale (1100 cfm)
Ch 81	± 0.67 psi	=	± 0.61% full scale (110 psi)
Ch 65	± 1.6°F	=	± 0.12% full scale (1340°R)
	K	=	± 0.2%
			± 1.39% full scale

± 1.39% of 1.1 = ± 0.0068 kg/sec (± 0.015 lb/sec)

- Flow controller mass flow computation (DAS channels 82 and 83)

Error calculations for each channel are shown below:

Channel 82

Sensor error:

Ch 96	$\pm$ 1.2 cfm	=	$\pm$ 0.25% full scale
Ch 80	$\pm$ 0.5 psi	=	$\pm$ 0.50% full scale
RTD	$\pm$ 0.3^{o}F	=	$\pm$ 0.03% full scale
			$\pm$ 0.78% full scale

$\pm$ 0.78% of 1.1 = $\pm$ 0.0041 kg/sec ($\pm$ 0.009 lb/sec)

Conditioning error: $\pm$ 4.0% worst case over the range of test conditions, as determined by an in-house calibration; $\pm$ 4.0% of 1.1 = $\pm$ 0.020 kg/sec ($\pm$ 0.044 lb/sec).

Readout error: CCC data logger error = $\pm$ 0.15% full scale; $\pm$ 0.15% of 1.1 = $\pm$ 0.0009 kg/sec ($\pm$ 0.002 lb/sec).

Channel 83

Sensor error:

Ch 97	$\pm$ 2.8 cfm	=	$\pm$ 0.25% full scale
Ch 81	$\pm$ 0.5 psi	=	$\pm$ 0.50% full scale
RTD	$\pm$ 0.3^{o}F	=	$\pm$ 0.03% full scale
			$\pm$ 0.78% full scale

$\pm$ 0.78% of 1.1 = $\pm$ 0.0041 kg/sec ($\pm$ 0.009 lb/sec)

Conditioning error: $\pm$ 4.0% of 1.1 = $\pm$ 0.020 kg/sec ($\pm$ 0.044 lb/sec).

Readout error: $\pm$ 0.15% of 1.1 = $\pm$ 0.0009 kg/sec ($\pm$ 0.002 lb/sec).

I-2. COMBINED EXPERIMENTAL ERROR

In the following paragraphs the instrument errors discussed above are combined with other errors in the experiment and the total experimental error is estimated. Additional sources of error include random noise in the instruments and errors due to simplifying assumptions made in the data reduction. The error in the reference test run (run no. 22701) is also evaluated, and the error in the overall mass balance, the overall heat transfer rate, and the local heat flux are estimated.

I-3. Error Due to Random Noise

The amount of noise in the test data was estimated from a sample of test data, by selecting a period of about 2 minutes (20 data scans) where the overall data change was small. In this interval it was assumed that the total data variation was due to random noise in the experiment. The results of this study on several data channels from the reference test are presented in table I-2. A comparison of tables I-2 and I-1 shows that the data error due to noise is of the same order or less than the error due to instrument accuracy. Because this component of the total error was small and tended to cancel itself when quantities were integrated over time, this component was neglected when the errors were combined.

I-4. Error Due to Simplifying Assumptions in Data Reduction

Liquid accumulation in the test loop was measured by differential pressure cells, which recorded a change in static pressure over a given elevation in the test loop. Frictional and momentum pressure drop components were neglected. To estimate the magnitude of these pressure drop components, the following calculations were made using reference test parameters. The frictional pressure drop in the hot leg and the pressure change due to the momentum change in the inlet plenum were calculated for single-phase steam. Table I-3 shows the results of the calculation. The error estimates in table I-3 show that the simplifying assumptions made in the data reduction did not introduce significant errors into the reduced data.

TABLE I-2

ESTIMATE OF EXPERIMENTAL ERROR DUE TO RANDOM NOISE

Data Channel	Parameter	Data Sample Size	Data Average[a]	Standard Deviation[a]
53	Outlet plenum delta pressure	20	0.008 psi	0.003 psi
54	Hot leg and inlet plenum delta pressure	20	0.154 psi	0.005 psi
52	Inlet plenum delta pressure	20	0.0 psi	0.006 psi
64	Boiler steam temperature	20	310.8°F	0.67°F
65	Containment tank steam temperature	20	448.9°F	0.19°F
66	Injection water temperature	20	251.3°F	0.05°F
80	Boiler steam pressure	20	61.4 psia	0.08 psi
81	Exhaust steam pressure	20	40.35 psia	0.08 psi
96	Boiler steam flow	20	174.3 cfm	0.80 cfm
97	Exhaust steam flow	20	391.5 cfm	2.32 cfm
98	Injection water flow	20	0.771 gal/min	0.001 gal/min
257	Bundle tube wall temperature	20	275.2°F	0.36°F
279	Bundle secondary fluid temperature	20	291.7°F	1.29°F

a. To convert to SI (metric) units, multiply psi by 6.89 (k Pa), divide (°F-32) by 1.8 (°C), multiply cfm by 4.72×10^{-4} (m^3/sec), and multiply gpm by 6.3×10^{-5} (m^3/sec).

TABLE I-3

ESTIMATE OF DATA REDUCTION ERROR DUE TO SIMPLIFYING ASSUMPTIONS

Parameter Neglected	Magnitude	Derived Quantity Error	Relative Error in Derived Quality
Frictional pressure drop in hot leg	0.69 k Pa (0.1 psid)	0.23 kg (0.5 lb) of liquid accumulated in hot leg	3.9% of all stored liquid
Inlet plenum pressure change due to momentum change	0.0028 k Pa (+0.004 psid)	0.059 kg (0.13 lb) of liquid accumulated in inlet plenum	1% of all stored liquid
Nitrogen purge from D/P probes into the steam/generator tubes	85 cm^3/sec (0.18 cfm)	0.001 m/sec (0.0003 lb/sec) exhaust steam flow	<0.1% of exhaust mass flow
Heat capacity of hot leg and steam generator plenums	$10^{o}C$ ($50^{o}F$)	4.7×10^6 J (4.5×10^3 Btu)	3% of total energy exchanged

A small amount of nitrogen was used in the differential pressure probes in the inlet section of three tubes to prevent liquid from entering the probe. This nitrogen flowed into the tubes and was eventually detected by the containment tank vortex meter along with the steam. The nitrogen effect on the vortex meter was negligible, as shown in table I-3.

In the primary side energy balance, the heat capacity of the hot leg and the steam generator plenums was neglected. Because the loop was preheated prior to a test, the error associated with neglecting the loop heat capacity was proportional to the change in loop temperature during the test. The energy change is shown in table I-3. Neglecting this term in the energy balance did not result in a significant error in the reduced data.

I-5. Error Due to Equipment and Instrument Performance Limits

During the steam generator shakedown tests, moisture carryover from the boiler was detected. The magnitude of the carryover was approximately 1 percent of the total flow; the flowmeter data indicated that the boiler vortex meter detected the steam component of the flow but not the entrained liquid. The effect of boiler carryover on the overall mass balance would be to cause a systematic negative mass balance error (mass out of test loop is greater than mass into test loop), because the entrained liquid would be counted as separated liquid in the outlet plenum or steam in the exhaust vortex meter. The boiler carryover was corrected by chemically cleaning the boiler. Periodically during the test program, the chemical cleaning was repeated and tests to detect carryover were run. Based on these tests, it was concluded that moisture carryover from the boiler did not contribute significantly to the experimental error. Results from the shakedown tests are reported in appendix F.

The response of the tube inlet differential pressure (D/P) cells was significantly different from the response expected based on earlier bench tests using the same nitrogen purge technique. This unexpected result was common to all matrix tests except for run 21121. This run was the only matrix test with zero heat flux.

The response of channel 85 on run 21121 indicates the presence of a small amount of liquid in the 0 to 0.61 m (0 to 2 ft) entrance region of the tube during the test. After loop isolation, the D/P cell returned to a value very close to the initial D/P cell value, prior to the test. This is the expected D/P cell response. However, in the test runs with heat transfer, illustrated by channel 85 D/P from run 22701 in figure B-1, the final D/P after loop isolation was significantly different from the initial D/P. The change in the D/P probe from beginning of test to end of test in rur 22701 was that initially the probe temperature inside the tube is equal to the initial secondary temperature of 274°C (525°F) but at the end of the test, the entrance zone of the tube had quenched and the probe temperature was T_{sat}, 131°C (267°F). Since the change in probe temperature is the only difference between the two runs shown in figure I-1, it is concluded that the probe temperature change in run 22701 caused the peculiar response of channel 85 in run 22701 and in all runs where the probes changed temperature during the test.

The probe temperature change caused a temperature change in the purge nitrogen, which resulted in a pressure drop change in the purge line between the D/P cell and pressure probe. Regulator valves upstream of the D/P cell maintained a constant mass flow of nitrogen in the instrument sensing lines.

I-6. COMPOSITE EXPERIMENTAL ERROR

To compute the total error in a derived quantity, the assumption is made that the individual components of the error are stochastically independent. Then the variance of each error component can be weighted by an appropriate weighting factor and summed to estimate the variance in the derived quantity.[1] The appropriate weighting factors are the coefficients in a first-order multivariable Taylor series expansion of the derived quantity in terms of the independent variables. For example, if

$$M = F[x_1 \, x_2 \, x_3 \cdots x_n] \qquad \text{(I-3)}$$

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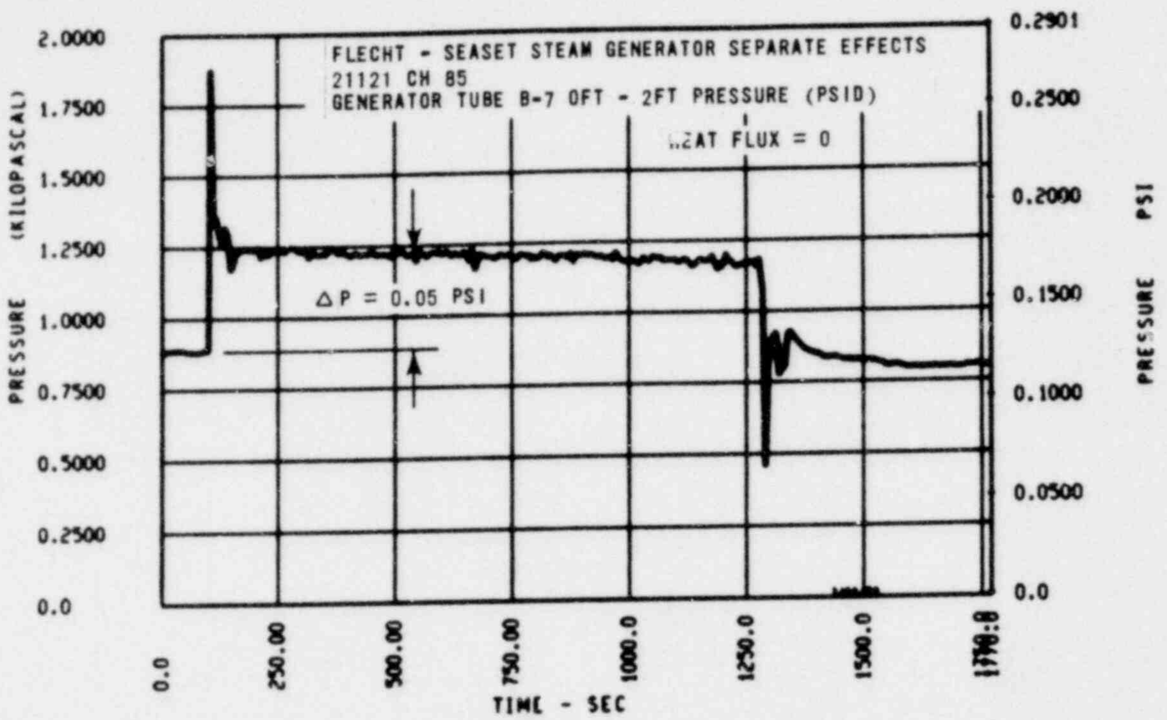
1. Hogg, R. V., and Craig, A. T., Introduction to Mathematical Statistics, 4th ed., Macmillan, New Jersey, 1978, p 168, theorem 4.



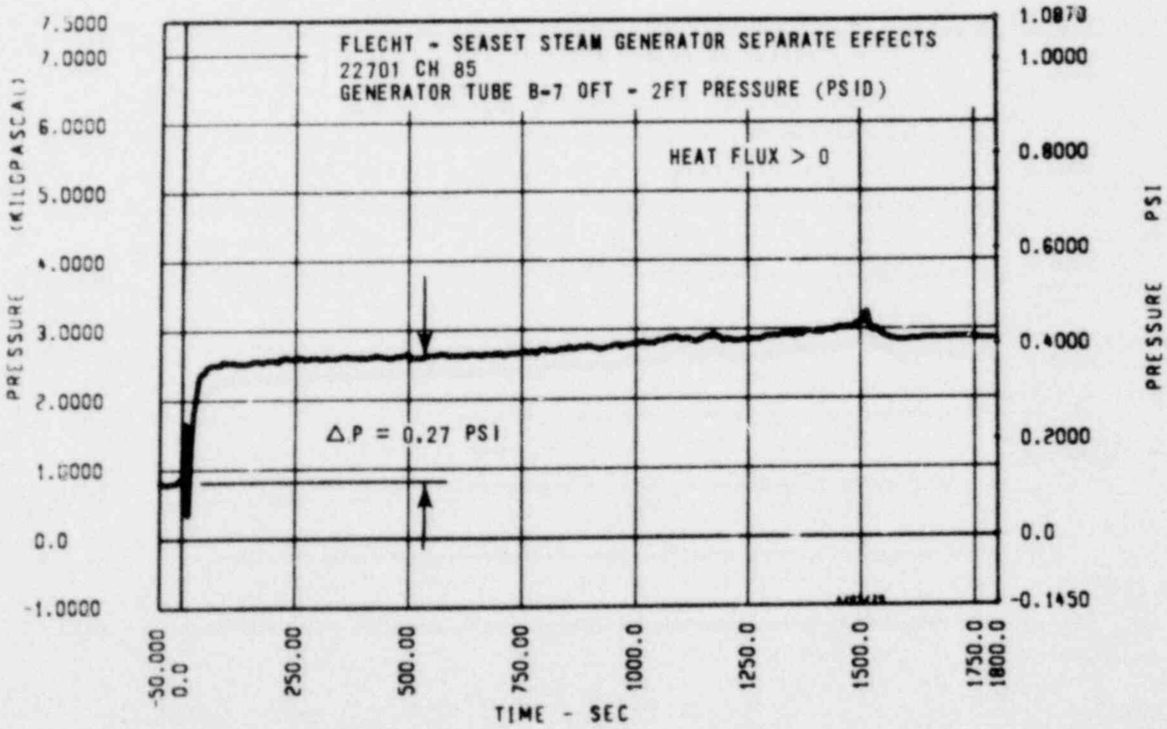


Figure I-1. Channel 85 Response With and Without Heat Flux and

$$dM = \frac{\partial F}{\partial x_1} dx_1 + \frac{\partial F}{\partial x_2} dx_2 ---- \frac{\partial F}{\partial x_n} dx_n \tag{I-4}$$

where

M	=	derived quantity
dM	=	small change in M
x_i	=	independent variable i
dx_i	=	small change in x_i
$\frac{\partial F}{\partial x_i}$	=	change in M relative to a change in x_i
n	=	number of independent variables

Then

$$\sigma_M^2 = \sum_{i=1}^{n} \left[\frac{\partial F}{\partial x_i}\right]^2 \sigma_{x_i}^2 \tag{I-5}$$

where

σ^2_M = variance in M

$\sigma^2_{x_i}$ = variance in x_i

I-7. Overall Mass Balance Error

The overall mass balance error was derived from the overall mass balance equation:

$$E_M = E_{MASS\text{-}IN} - E_{MASS\text{-}OUT} + E_{MASS\text{-}STORED} \tag{I-6}$$

where

E_M	=	total mass balance error
$E_{MASS\text{-}IN}$	=	injection mass
$E_{MASS\text{-}OUT}$	=	exhaust mass
$E_{MASS\text{-}STORED}$	=	mass in liquid accumulation tanks

The mass-in and mass-out terms are derived from the flowmeter signals integrated over the test time and the mass storage is derived from the weights of liquid collected from the hot leg drain and steam probe ice bath, and from the outlet plenum differential pressure cell output. The flowmeters all recorded volumetric flow, which was multiplied by the appropriate density derived from measured loop temperatures and pressure. In the equation (I-6), the mass-in and mass-out terms are products of a volumetric flow rate integrated over time and multiplied by the fluid density. The density is dependent on two measured parameters; therefore the equation for E_{MASS} analogous to equation (I-5) was derived as follows:

$$MASS = \rho \int_0^t q \; dt \qquad \text{(I-7)}$$

$$d(MASS) = \rho \, dQ + Q \, d\rho \; (T,P) \qquad \text{(I-8)}$$

$$d(MASS) = \rho \; dQ + Q \left[\frac{\partial \rho}{\partial T}\bigg|_P dT + \frac{\partial \rho}{\partial P}\bigg|_T dP \right] \qquad \text{(I-9)}$$

where

$Q = \int_0^t q \; dt = qt$

q = volumetric flow rate

ρ = fluid density

P = fluid pressure

T = fluid temperature

t = time from beginning of test

$dQ = t(dq)$

The coefficients were evaluated at nominal loop conditions.

Equation (I-9) can be substituted into equation (I-6) with the differential terms replaced by the variance to get an equation analogous to equation (I-5). The resulting overall mass balance error variance is

$$\sigma^2_{\substack{MASS\\BAL}} = \sum_i Q_i^2 \left(\frac{\partial \rho}{\partial T}\right)^2_{P_i} \sigma^2_{T_i} + Q_i^2 \left(\frac{\partial \rho}{\partial P}\right)^2_{T_i} \sigma^2_{P_i} + (\rho_i t)^2 \sigma^2_{Q_i}$$

$$+ \left[(-A_{OP})^2 \sigma^2_{53} + \sigma^2_{SP} + \sigma^2_{HL+IP} \right] \qquad \text{(I-10)}$$

where

Q_i	=	qt from flowmeter i
i	=	boiler vortex meter, injection liquid turbine meter, or containment tank vortex meter
t	=	test time (min)
$\sigma^2_{Q_i}$	=	instrument variance in flowmeter i
T_i	=	temperature at flowmeter i
$\sigma^2_{T_i}$	=	variance in T_i
$\sigma^2_{P_i}$	=	variance in P_i

$\partial\rho/\partial T$ and $\partial\rho/\partial P$ = change in density due to a change in T_i or P_i

σ^2_{53} = variance in channel 53 (outlet plenum D/P cell)

σ^2_{SP} = variance in measured weight of steam probe condensed steam

$\sigma^2_{HL + IP}$ = variance in measured liquid drained from the hot leg following the test

In this estimate of the mass balance error, it was assumed that no additional error was introduced by integrating the flowmeter signals over time and that the variance in measured weights of steam probe condensed steam and hot leg drained liquid was negligible. The water weights were measured on a laboratory-grade balance beam scale calibrated in grams.

The results of a numerical evaluation of equation (I-10) are presented in table I-4. Over 95 percent of the mass balance variance comes from the flowmeter variance. The results of the overall mass balance error analysis show that the overall mass balance standard deviation is less than 1 percent of the injected mass. Each instrument error distribution was assumed to have a mean of zero and a standard deviation as given in table I-1. The combined mass balance error also has a mean of zero and the standard deviation expressed in equation (I-10). The actual statistical reduction of mass balance errors in table 4-2 shows that the average error is -0.9 percent and the error standard deviation is 1.5 percent. These parameters suggest that a small systematic error may have been present in the tests and that the random error may be somewhat larger than the estimate from equation (I-10) (1.5 percent versus 0.7 percent).

TABLE I-4

COMBINED EXPERIMENTAL ERROR IN OVERALL MASS BALANCE AND PRIMARY SIDE ENERGY BALANCE

Derived Quantity	Overall Variance	Standard Deviation	
		Absolute	Relative
Overall mass balance	24.8 lb^2 from equation (I-10)	4.98 lb	0.7%[(a)]
Overall primary side energy balance	31.5 x 10^6 Btu^2 from equation (I-10)	5.6 x 10^3 Btu	3.3%[(b)]

a. Relative to total mass injected into bundle during test, 0.5 lb/sec, times 1500 seconds, or 750 lb

b. Relative to total energy exchange, 0.168 x 10^6 Btu, as calculated by SGFLOWS (see table 4-1)

I-8. Overall Primary Side Energy Balance Error

The method outlined in paragraph I-6 was used to estimate the error in the overall primary side energy balance. The starting point is the following equation:

$$\text{Energy change} = \text{Energy out}_{\substack{\text{outlet}\\ \text{plenum}}} - \text{Energy in}_{\substack{\text{inlet}\\ \text{plenum}}} \qquad \text{(I-11)}$$

or

$$E_P = \int_o^t \left(W_g H_g + W_f H_f \right) dt_{OP} - \int_o^t \left(W_g H_g + W_P H_P \right) dt_{IP} \qquad \text{(I-12)}$$

where

W	=	mass flow rate (lb/sec)
H	=	enthalpy (Btu/lb)
t	=	time interval of test
E	=	energy increase in primary fluid

Subscript	g	= vapor phase
	f	= liquid phase
	OP	= outlet plenum
	IP	= inlet plenum
	P	= primary loop

Each term in equation (I-12) is a flow times enthalpy product which can be differentiated into a group of five terms because of the dependence of enthalpy and density on temperature and pressure:

$$d(WH) = WdH + HdW \qquad \text{(I-13)}$$

but

$$W = \rho Q \tag{I-14}$$

$$dW = \rho dQ + Q d\rho \tag{I-15}$$

and

$$dH = \left.\frac{\partial H}{\partial P}\right|_T dP + \left.\frac{\partial H}{\partial T}\right|_P dT \tag{I-16}$$

Therefore,

$$d(WH) = WdH + H(\rho dQ + Qd\rho) \tag{I-17}$$

and

$$d(WH) = W\left(\left.\frac{\partial H}{\partial P}\right|_T dP + \left.\frac{\partial H}{\partial T}\right|_P dT\right) + H\left(\rho\, dQ + Qd\rho\right) \tag{I-18}$$

Since

$$d\rho = \left.\frac{\partial \rho}{\partial P}\right|_T dP + \left.\frac{\partial \rho}{\partial T}\right|_P dT \tag{I-19}$$

$$\begin{aligned} d(WH) = {} & W\left(\left.\frac{\partial H}{\partial P}\right|_T dP + \left.\frac{\partial H}{\partial T}\right|_P dT\right) + H\rho dQ \\ & + HQ\left(\left.\frac{\partial \rho}{\partial P}\right|_T dp + \left.\frac{\partial \rho}{\partial T}\right|_P dT\right) \end{aligned} \tag{I-20}$$

where

ρ = density kg/m^3 (lb/ft^3)

Q = volumetric flow rate m^3/sec (gal/min)

T = temperature ^oC (^oF)

P = pressure Pa (psia)

IMAGE EVALUATION
TEST TARGET (MT-3)

6"

MICROCOPY RESOLUTION TEST CHART

The equation for the variance of E_P can now be written using equation (I-5). In abbreviated form,

$$\sigma^2_{E_P} = \sum_{i=1}^{4} \left\{ W_i^2 \left[\left(\frac{\partial H}{\partial P}\right)_T^2 \sigma_P^2 + \left(\frac{\partial H}{\partial T}\right)_P^2 \sigma_T^2 \right]_i + H\rho_i^2 \sigma_i^2 \, {}^2_{Q_i} + \left[\left(\frac{\partial \rho}{\partial P}\right)_T^2 \sigma_P^2 + \right. \right.$$

$$\left. \left. \left(\frac{\partial \rho}{\partial T}\right)_P^2 \sigma_T^2 \right] H_i Q_i \right\} t^2 \qquad \text{(I-21)}$$

where

i =	1	=	inlet plenum vapor
	2	=	inlet plenum liquid
	3	=	outlet plenum vapor
	4	=	inlet plenum liquid

In the derivation of the overall mass balance error, it was shown that the third term in the above equation is over 20 times larger than the fourth plus fifth terms; therefore, these two terms are neglected in the numerical evaluation of equation (I-21). The results of the calculation are presented in table I-4. In equation (I-21), for the vapor phase terms the variance in flow ($\sigma_{Q_i}{}^2$) is equal to the vortex meter variance. The liquid phase terms include variance due to storage of the liquid phase in the hot leg and plenums. Although there are 20 terms in equation I-21, over 95 percent of the total variance comes from the flow variance terms ($H_i \rho_i \sigma_{Q_i}{}^2$). Based on the above calculations, the estimated error in the primary side energy balance is of the order of 3 percent. From the reference test data reduction code SGFLOWS, a sample of 20 consecutive scans of data was chosen randomly and the standard deviation in the overall primary side energy balance was found to be approximately 2 percent.

I-9. Local Heat Flux Error

The local heat flux is calculated in the SGFLUX data reduction program using an equation of the form

$$q_{LOCAL} = h_s (T_f - T_w) \tag{I-22}$$

where

q_{LOCAL}	=	local heat flux [w/m^2 $Btu/sec\text{-}ft^2$]
h_s	=	free convection film coefficient between secondary fluid and tube wall
T_f	=	secondary fluid temperature
T_w	=	corrected tube wall temperature

Using the method described in paragraph I-6 to combine instrument variance and the following equations for h_s and the Grashof Number, the standard deviation of the local heat flux was calculated

$$Nu_s = 0.021 \left[(Gr)\,(Pr) \right]^{0.4} \tag{I-23}$$

and

$$Gr = \frac{g^{B} \rho^2 X^3}{\mu^2} (T_f - T_w)$$

$$Nu_s = \frac{h_s X}{K_f}$$

where

Pr	=	secondary fluid Prandtl number
Gr	=	Grashof number in secondary fluid
Nu_s	=	Nusselt number in secondary fluid

The equation derived for the local heat flux variance is

$$\sigma^2_{q_{LOCAL}} = (1.4\, h_s)^2 \left(\sigma^2_{T_f} + \sigma^2_{T_w} \right) \qquad \text{(I-24)}$$

In this derivation, the variance in the tube wall correction factor is neglected.

Equation (I-24) was evaluated for the assumed three-tier temperature and heat flux profile given in table I-5. The design bundle thermocouple standard deviation of 1.7°C (3°F) (table I-1) is used and the results are presented in table I-6. The same calculation was repeated using a calculated bundle thermocouple standard deviation of 0.9°C (1.6°F) based on isothermal bundle data taken during the shakedown test program. Results of this calculation are given in table I-7. These results show that the relative error in local heat flux is relatively small in the zones of high heat flux. For heat fluxes above 1.1×10^5 w/m^2 (10 Btu/sec-ft^2) the local heat flux error is estimated to be less than 6 percent. However, over much of the tube bundle, the local heat flux can be small and the corresponding relative error in the local heat flux may be large. Since most of the bundle heat transfer will occur in zones of higher heat flux where the errors are smaller, the overall uncertainty in the tube bundle heat flux is reasonable, as shown by the calculation in table I-7 based on best-estimate thermocouple standard deviation.

The error in the overall heat flux is estimated in paragraph I-10.

I-10. OVERALL HEAT TRANSFER ERROR BASED ON INTEGRATED LOCAL HEAT FLUX

The SGFLUX program integrates the local heat flux over the bundle heat tranfer area to get the total heat transfer rate in the tube bundle. The calculation is:

$$q_{TOTAL} = \sum_{i=1}^{N} q^{i}_{LOCAL} A_i \qquad \text{(I-25)}$$

where

q_{TOTAL} = overall bundle heat transfer

i = index on tube bundle computational nodes. ($1 \leq i \leq 116$)

A_i = Heat transfer Area of bundle node i

Following the above method of summing variance, the variance in q_{TOTAL} is

$$\sigma^2 q_{TOTAL} = \sum_{i=1}^{N} (A_i)^2 \sigma^2 (q_{LOCAL\ i}) \qquad \text{(I-26)}$$

This equation is evaluated using the assumed heat flux distribution in table I-5 and local heat flux variance in tables I-6 and I-7.

The results in tables I-6 and I-7 for the overall heat transfer relative standard deviation indicate that the expected error in the reduced data for the overall bundle heat transfer should be less than 25 percent. Thus, comparisons can be made between the overall primary and secondary heat transfer and the bundle thermocouples can be used to measure the bundle heat transfer. However, the above estimate of the overall heat transfer combined experimental error does not account for errors due to temperature interpolation. In several of the calculational nodes in the tube bundle at least one of the temperatures and in many nodes all of the temperatures used in the heat flux calculations are interpolated from measured temperatures at other nodal locations. As the tube quench front progresses to elevations above the zone of maximum instrumentation 1.2 m (4 ft) elevation, large errors due to interpolation may exist.

ASSUMED T

Heat Trans Regime[(a)]	Tube Bundle Region	Film Coeffic [w/m^2-^{o}C (Btu/sec-ft^2
Nucleate boiling	0-2 ft elevation	4088(0.20)
Two-phase forced convection	2-10 ft elevation	2044 (0.10
Liquid deficient	10 ft elevation to tube exit	1022(0.05)

a. Likely primary side heat transfer regime required to
b. Secondary fluid to tube wall temperature difference

TABLE I-5

EMPERATURE AND HEAT FLUX DISTRIBUTION FOR OVERALL HEAT TRANSFER VARIANCE CALCULATION

ient [°F)]	Assumed Temperature Difference(b) [°C(°F)]	Local Heat Flux [w/m^2(Btu/sec-ft^2)]	Heat Transfer Area [m^2(ft^2)]	Total Heat Transfer [w(Btu/sec)]
	28(50)	1.1 x 10^5(10)	1.37(14.7)	1.55 x 10^5(147)
)	5.6(10)	1.1 x 10^4(1.0)	5.46(58.8)	6.2 x 10^4(59)
	1.1(2)	1.1 x 10^3(0.1)	41.0(441)	4.6 x 10^4(44)
			TOTAL	2.63 x 10^5(250)

) sustain temperature difference in column 4.

TABLE I-6

COMBINED ERROR IN HEAT FLUX ASSUMING DESIGN BUNDLE THERMOCOUPLE VARIANCE[(a)]

Local Heat Flux[(b)]	Overall Variance	Standard Deviation	
		Absolute	Relative
Nucleate boiling regime	1.41[(c)]	1.3×10^4 w/m^2 (1.19 Btu/sec-ft^2)	11.9%
Film boiling regime	0.35[(c)]	0.65×10^4 w/m^2 (0.59 Btu/sec-ft^2)	59%
Liquid deficient regime	0.088[(c)]	0.33×10^4 w/m^2 (0.296 Btu/sec-ft^2)	296%
Overall heat transfer, assuming distribution in table I-5	0.186×10^5[(d)]	110 kw (136 Btu/sec)	55%[(e)]

a. Design thermocouple standard deviation = 3°F, from table I-1
b. From data in table I-5
c. From equation (I-24)
d. From equation (I-26)
e. Percent of total heat transfer, from table I-5

TABLE I-7

COMBINED ERROR IN HEAT FLUX ASSUMING BEST-ESTIMATE BUNDLE THERMOCOUPLE VARIANCE[a]

Local Heat Flux[b]	Overall Variance	Standard Deviation	
		Absolute	Relative
Nucleate boiling regime	0.40[c]	0.71×10^4 w/m^2 (0.63 Btu/sec-ft^2)	6.3%
Film boiling regime	0.10[c]	0.36×10^4 w/m^2 (0.32 Btu/sec-ft^2)	32%
Liquid deficient regime	0.025[c]	0.18×10^4 w/m^2 (0.16 Btu/sec-ft^2)	160%
Overall heat transfer, assuming distribution in table I-5	0.529×10^4[d]	76 kw (72.4 Btu/sec)	29%[e]

a. Best-estimate thermocouple standard deviation = 1.6°F (from isothermal bundle data)
b. From data in table I-5
c. From equation (I-24)
d. From equation (I-26)
e. Percent of total heat transfer, from table I-5

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