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RECIP.NAME RECIPIENT AFFILIATION
* Office of Nuclear Reactor Regulation

SUBJECT: Responds to 781129 ltr re containment purge issue.Forwards C-E ECCS performance evaluation,assessment of radiological release from containment & discussion of containment purge isolation instrumentation & control circuit designs.

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FLORIDA POWER & LIGHT COMPANY

December 13, 1979
L-79-347

Office of Nuclear Reactor Regulation
Attention: Mr. R. W. Reid, Chief
Operating Reactors Branch #4
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Reid:

Re: St. Lucie Unit 1
Docket No. 50-335
Containment Purge

References: (1) NRC letter dated September 27,1979 from Darrell G. Eisenhut to All Light Water Reactors

(2) NRC letter dated October 23, 1979 from R. W. Reid to R. E. Uhrig (applicable to Docket No. 50-335)

In response to your letter of November 29, 1978, several analyses/evaluations have been performed in an effort to resolve the containment purge issue. A description of this effort, which is responsive to references (1) and (2), is given below.

In order to bound the worst case purge mass release, two different purge valve closure scenarios were examined. The first assumed no single failure, i.e., complete operability of all six purge valves and an arbitrarily slow valve closure time of ten seconds. This yielded a calculated mass loss of 5224 pounds of air from the containment. The second case conservatively assumed the worst single failure (a complete containment isolation signal train failure), a Technical Specification purge valve closure time of five seconds, and a delayed purge valve closure initiation time of 2.3 seconds. This case resulted in a calculated air mass loss of 5104 pounds.

Attachment 1 represents Combustion Engineering's Emergency Core Cooling System (ECCS) performance evaluation documenting the effect of containment purging using the higher mass release scenario. This evaluation clearly shows that the impact of purging on ECCS performance is small with only a 26°F increase in peak clad temperature.

An assessment of the radiological release from containment through the closing purge valves is presented in Attachment 2. The results clearly indicate that any potential dose increase is small and well within the limits of 10 CFR 100.

Attachment 3 discusses the containment purge and isolation instrumentation and control circuit designs. It demonstrates that the appropriate separation and single failure criteria are satisfied.

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Finally, in order to demonstrate purge valve integrity under postulated accident transients, FPL (through Ebasco Services, Incorporated) has contracted with the valve manufacturer (Henry Pratt Company) to perform the necessary analyses. The results of the analyses are anticipated by June 1980. However, for the interim period, FPL, in consultation with Henry Pratt Company, has determined that satisfactory operability under accident transient conditions is expected when purge valve opening is limited. A plant change/modification is being processed to implement a purge valve modification restricting the valve opening to a maximum of 50 degrees.

In addition, the containment purge system was previously evaluated with respect to I & E Bulletins 79-01 and 79-01A. The FPL response concerning the qualification of class 1E electrical equipment was sent to you on July 2, 1979 (L-79-181). As indicated then, the investigation for data identified problems relating to qualification documentation for AVCO solenoid valves and NAMCO limit switches, which have an application on the containment purge supply and exhaust valves. Despite the lack of initial test data, the construction of the valves and materials utilized therein can withstand the initial seconds of the containment environment following a LOCA. The use of NAMCO switches on the purge valves does not affect the ability of the valves to close. In spite of a potential lack of position indication of the valves in containment, those purge valves that are not located in the post-containment environment will show actual position. However, in order to provide additional safety margin and to ensure long term solenoid valve operation and purge valve position indication, FPL has ordered replacement solenoid valves and limit switches which are post-LOCA qualified. These will be installed at the first available opportunity following their receipt.

In conclusion, Florida Power & Light Company plans to operate the containment purge system in compliance with our letter of May 25, 1979, which contained a commitment to limit containment purging at St. Lucie Unit 1 to 90 hours/year in operational modes 1 and 2, until such time as the 50 degree modification is implemented. The effect of purging on ECCS performance and radiological dose has been shown to be minimal. The results of the valve integrity evaluation, to be performed by the valve vendor, are expected to be available by June, 1980.

We will continue to keep you informed of our progress in this matter.

Very truly yours,

Robert E Uhrig

Robert E. Uhrig
Vice President
Advanced Systems & Technology

REU/MAS/cph

Attachments

cc: J. P. O'Reilly, Region II
Harold Reis, Esquire

St. Lucie Unit 1, Cycle III
ECCS Performance Evaluation With and Without Containment Purging

1.0 INTRODUCTION AND SUMMARY

The ECCS performance calculations for St. Lucie Unit 1 presented herein demonstrate appropriate conformance with 10CFR50.46 which presents the Acceptance Criteria for Emergency Core Cooling Systems for Light Water Cooled Reactors(1). This evaluation report documents the results of two separate ECCS performance analyses for St. Lucie Unit 1.

A one break analysis using Core Cycle 3 specific data was performed to demonstrate acceptable ECCS performance at a Peak Linear Heat Generation Rate (PLHGR) of 14.8 kw/ft for St. Lucie Unit 1, Cycle 3. Reference 10 presented an ECCS evaluation for Cycle 3 which by demonstrating that the Cycle 2 ECCS performance analysis(4,5) was bounding for Cycle 3 justified a Cycle 3 PLHGR of 14.8 kw/ft. Reference 10 did not, however, contain a Cycle 3 specific analysis. A penalty of 0.12 kw/ft was imposed limiting Cycle 3 to a PLHGR of 14.68 kw/ft pending a Cycle 3 analysis. The results of such an analysis are documented in this report and justify operation of Cycle 3 at a PLHGR of 14.8 kw/ft.

In response to Reference 2 a second one break analysis was performed, also using Cycle 3 specific data, to determine the effect on ECCS performance of containment purging. The results of this analysis demonstrates that the ECCS performance for St. Lucie Unit 1, Cycle 3 is acceptable at a PLHGR of 14.8 kw/ft for a LOCA initiated during containment purging.

2.0 METHOD OF ANALYSIS

The analyses were performed using the approved C-E large break evaluation model(3). The break size and type, 0.8 DES/PD*, is the same as

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*0.8 x Double-Ended Slot Break in the Reactor Coolant Pump Discharge Leg was analyzed for the St. Lucie Unit 1 Cycle 2 ECCS performance evaluation(4,5). Both analyses used St. Lucie Unit 1 Cycle 3 specific data for input. The major differences in the input data between Cycle 2 and Cycle 3 are:

1. A conservative approach was employed to generate the initial fuel stored energy. This approach resulted in a 16°F increase (over the Cycle 2 value) in the hot spot fuel average temperature for Cycle 3.

2. The radial power distribution used in the thermal rod-to-rod radiation model is less limiting for Cycle 3.

Table 1 compares the important system parameters for both core cycles.

The analysis without containment purging used the exact same methodology as employed for the Cycle 2 analysis(4,5). Because the two input data changes only affect the clad temperature (STRIKIN-II)(6) and hence the core wide clad oxidation (COMZIRC)(9) calculations, the blowdown (CEFLASH-4A)(7) and refill/reflood (COMPERC-II)(8) calculations employed in this analysis are the same as documented in References 4 and 5.

The analysis with containment purging employed the same methodology and input data as described above. The effect of the mass loss through the purge system was modeled by reducing the initial containment pressure. Separate COMPERC-II, STRIKIN-II, and COMZIRC calculations were then performed. CEFLASH-4A results are not affected by changes in initial containment pressure since break flow remains critical throughout the blowdown period.

Reference 11 documents the amount of air lost from the containment via the purge lines (one intake and one exhaust). The containment pressure transient from the Cycle 2 analysis(5) was used to determine the flow rate. The purge system isolation valves were assumed to start closing at 0.8 seconds and be fully closed at 10.8 seconds following the break. Figure 1 presents the total flow rate versus time for both lines. The flow rate is based on the conservative assumption that only air was flowing through the purge lines.

In the calculation of the containment pressure, the total air mass expelled was determined by integrating the flow rate versus time function. This mass of air (5224 lbm) was then subtracted from the initial containment air mass and a new initial pressure determined. This method exaggerates the effect of purging on the containment pressure for the first ten seconds. Since the containment pressure is not an important parameter until after 20 seconds into the transient (after blowdown is over), the difference as determined by peak clad temperature, of removing the total mass expelled at the beginning versus removing it over a 10.8 second period is only slightly conservative.

3.0 RESULTS

Times of interest and significant results are summarized in Table 2. The results for both analyses are presented graphically in the figures listed in Table 3.

As stated in Section 2.0, these analyses used data specific to St. Lucie Unit 1, Cycle 3. The analysis without purging therefore can be compared to the Cycle 2 ECCS analysis(4,5) to show the effect of Cycle 2 to Cycle 3 data changes. The resulting Peak Clad Temperature (PCT) of 1872°F for Cycle 3 is over 150°F lower than the Cycle 2 PCT (2035°F) and demonstrates acceptable ECCS performance for core Cycle 3 at a PLHGR of 14.8 kw/ft.

The analysis with containment purging resulted in a PCT of 1898°F, demonstrating that a PLHGR of 14.8 kw/ft is also acceptable in terms of ECCS performance if the LOCA occurs during purging operation. The 26°F difference in PCT (1898°F - 1872°F) between the two analyses shows that the impact of containment purging on ECCS performance is small for St. Lucie Unit 1, Cycle 3.

REFERENCES

1. Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Cooled Nuclear Power Reactors, Federal Register, Vol. 39, No. 3, Friday, January 4, 1974.

2. Letter, from R. W. Reid (NRC) to R. E. Uhrig (FP&L), Subject: "Containment Purging During Normal Plant Operation", Docket No. 50-335, 11/29/78.

3. CENPD-132, "Calculative Methods for the CE Large Break LOCA Evaluation Model", August 1974 (Proprietary).

   CENPD-132, Supplement 1, "Updated Calculative Methods for the CE Large Break LOCA Evaluation Model", December 1974 (Proprietary).

   CENPD-132, Supplement 2, "Calculational Methods for the CE Large Break LOCA Evaluation Model", July 1975, (Proprietary).

4. Transmittal of F-LOCA-78-005 (R.E.Uhrig to V.Stello, March 22, 1978)

5. Transmittal of F-LOCA-78-017 (R.E.Uhrig to V.Stello, March 22, 1978)

6. CENPD-135, "STRIKIN-II, A Cylindrical Geometry Fuel Rod Heat Transfer Program, April 1974 (Proprietary).

   CENPD-135, Supplement 2, "STRIKIN-II, A Cylindrical Geometry Fuel Rod Heat Transfer Program (Modification)", February 1975 (Proprietary).

   CENPD-135, Supplement 4, "STRIKIN-II, A Cylindrical Geometry Fuel Rod Heat Transfer Program", August 1976 (Proprietary).

   CENPD-135, Supplement 5, "STRIKIN-II, A Cylindrical Geometry Fuel Rod Heat Transfer Program", August 1976 (Proprietary).

7. CENPD-133, "CEFLASH-4A, A FORTRAN-IV Digital Computer Program for Reactor Blowdown Analysis", April 1974 (Proprietary).

CENPD-133, Supplement 2, "CEFLASH-4A, A FORTRAN-IV Digital Computer Program for Reactor Blowdown Analysis (Modification)", December 1974 (Proprietary).

8. CENPD-134, "COMPERC-II, A Program for Emergency Refill-Reflood of the Core", April 1974 (Proprietary).

9. CENPD-134, Supplement 1, "COMPERC-II, A Program for Emergency Refill-Reflood of the Core (Modification)", December 1974 (Proprietary).

10. Transmittal of F-LOCA-79-002 (FPL letter L-79-45, February 22, 1979)

11. Letter, NSS-1-79-01, from L. J. Sas (Ebasco) to A. S. Jameson (CE), 6/4/79.

Table 1

St. Lucie Unit 1

General System Parameters

Quantity	Value		
	Cycle III	Cycle II	
Reactor Power Level (102% of Nominal)	2611	2611	MWt
Average Linear Heat Rate	6.0956	6.2126	kw/ft
Moderator Temperature Coefficient at Initial Density	$+0.2\times10^{-4}$	$+0.2\times10^{-4}$	Δρ/°F
System Flow Rate (Total)	139.44×10^{6}	139.44×10^{6}	lbs/hr
Core Flow Rate	134.6×10^{6}	134.6×10^{6}	lbs/hr
Initial System Pressure	2250	2250	psia
Core Inlet Temperature	548	548	°F
Core Outlet Temperature	598	598	°F
Active Core Height	11.39	11.39	ft
Fuel Rod OD	0.44	0.44	in
Number of Cold Legs	4	4	
Number of Hot Legs	2	2	
Cold Leg Diameter	30	30	in
Hot Leg Diameter	42	42	in
Safety Injection Tank Pressure	215	215	psia
Safety Injection Tank Gas/Water Volume	930/1090	930/1090	ft^3
Peak Linear Heat Generation Rate (PLHGR)	14.8	14.8	kw/ft
Gap Conductance at PLHGR	1525	1552	BTU/hr-
Fuel Centerline Temperature at PLHGR	3512	3484	°F
Fuel Average Temperature at PLHGR	2197	2181	°F
Hot Rod Gas Pressure	1031	1048	psia
Hot Rod Burnup	820	820	MWD/MT

Table 2

St. Lucie Unit II
Summary of Analytical Results

Times of Interest
(seconds)

	Hot Rod Rupture	SI Tanks On	Start of Reflood	SI Tanks Empty
Without Purge	55.5	17.6	35.8	63.3
With Purge	52.8	17.6	35.8	63.2

Results

	PCT (°F)	Local Zirc (%)	Core Wide Zirc (%)
Without Purge	1872	6.81	<0.515
With Purge	1898	7.24	<0.649

Table 3

St. Lucie Unit II
Analysis Plots

Variable	Figure Number
Containment Pressure*	2
Mass Added to Core During Reflood*	3
Peak Clad Temperature*	4
Rupture Node Peak Clad Temperature*	5
Local Clad Oxidation*	6
Hot Spot Gap Conductance*	7
Hot Spot Heat Transfer Coefficient*	8
Hot Rod Internal Gas Pressure	9
Clad Temperature, Centerline Fuel Temperature, Average Fuel Temperature, and Coolant Temperature for Hottest Node (without purging)	10
Clad Temperature, Centerline Fuel Temperature, Average Fuel Temperature, and Coolant Temperature for Hottest Node (with purging)	11

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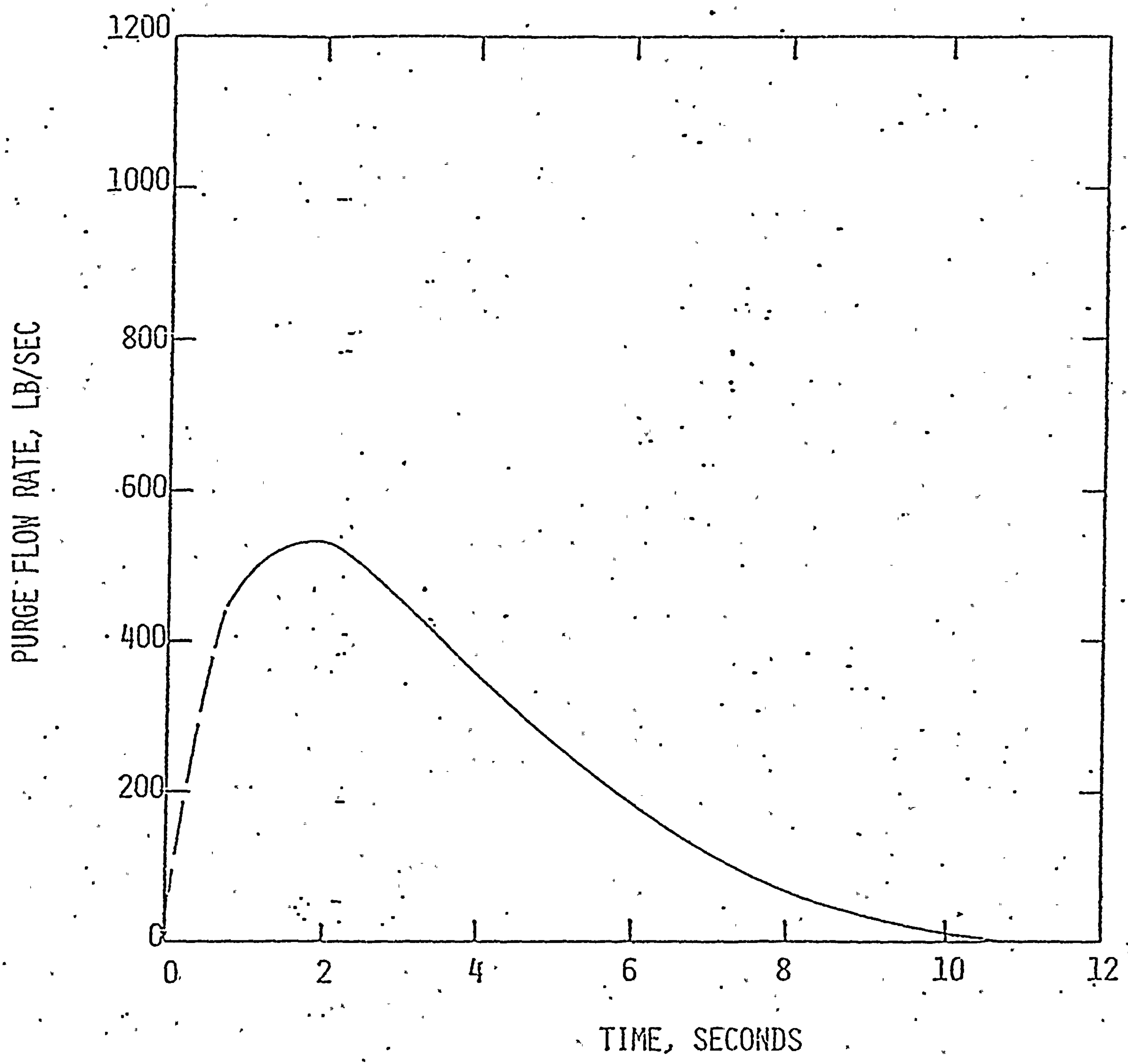
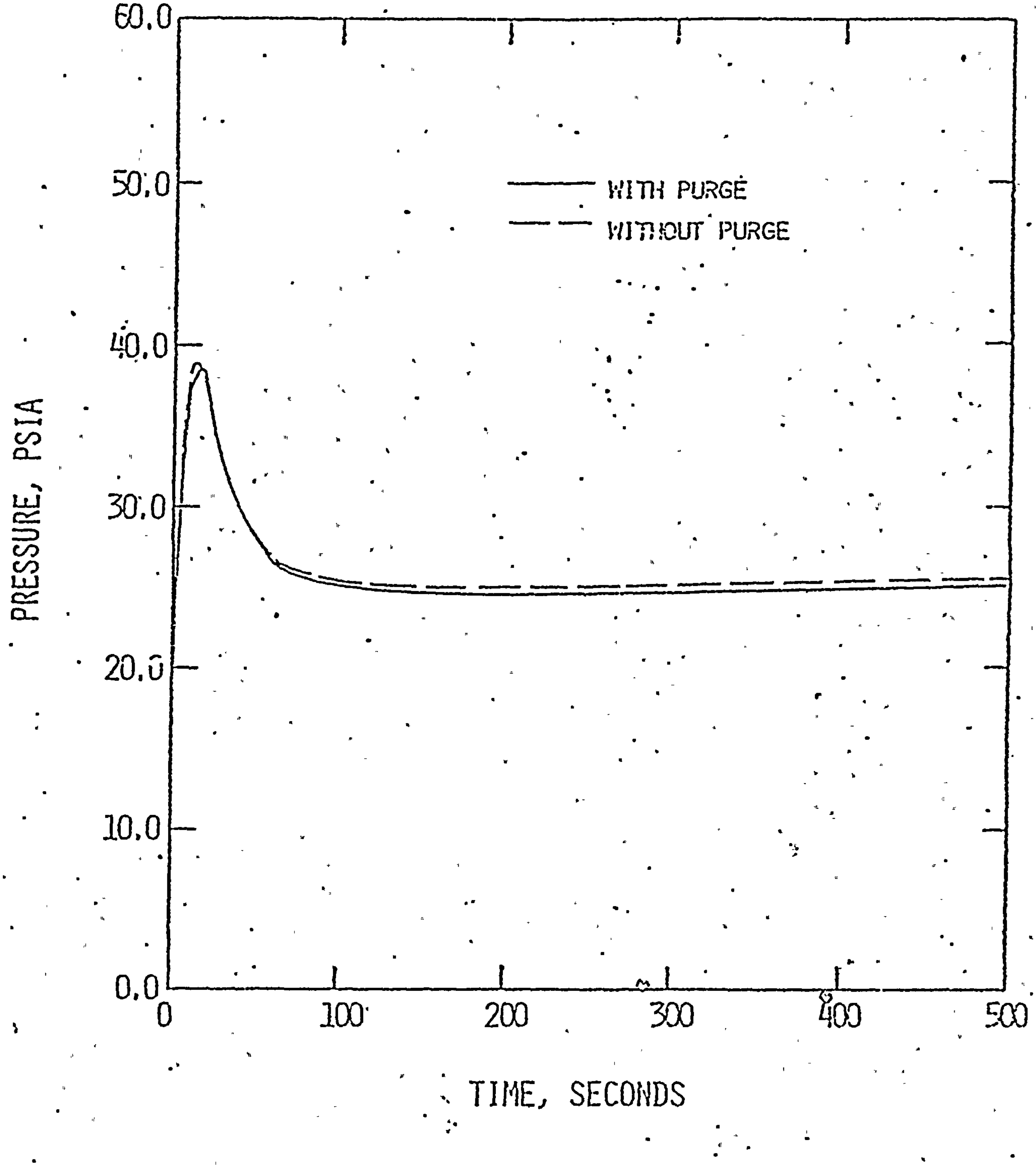
*Figure presents results for both analyses.

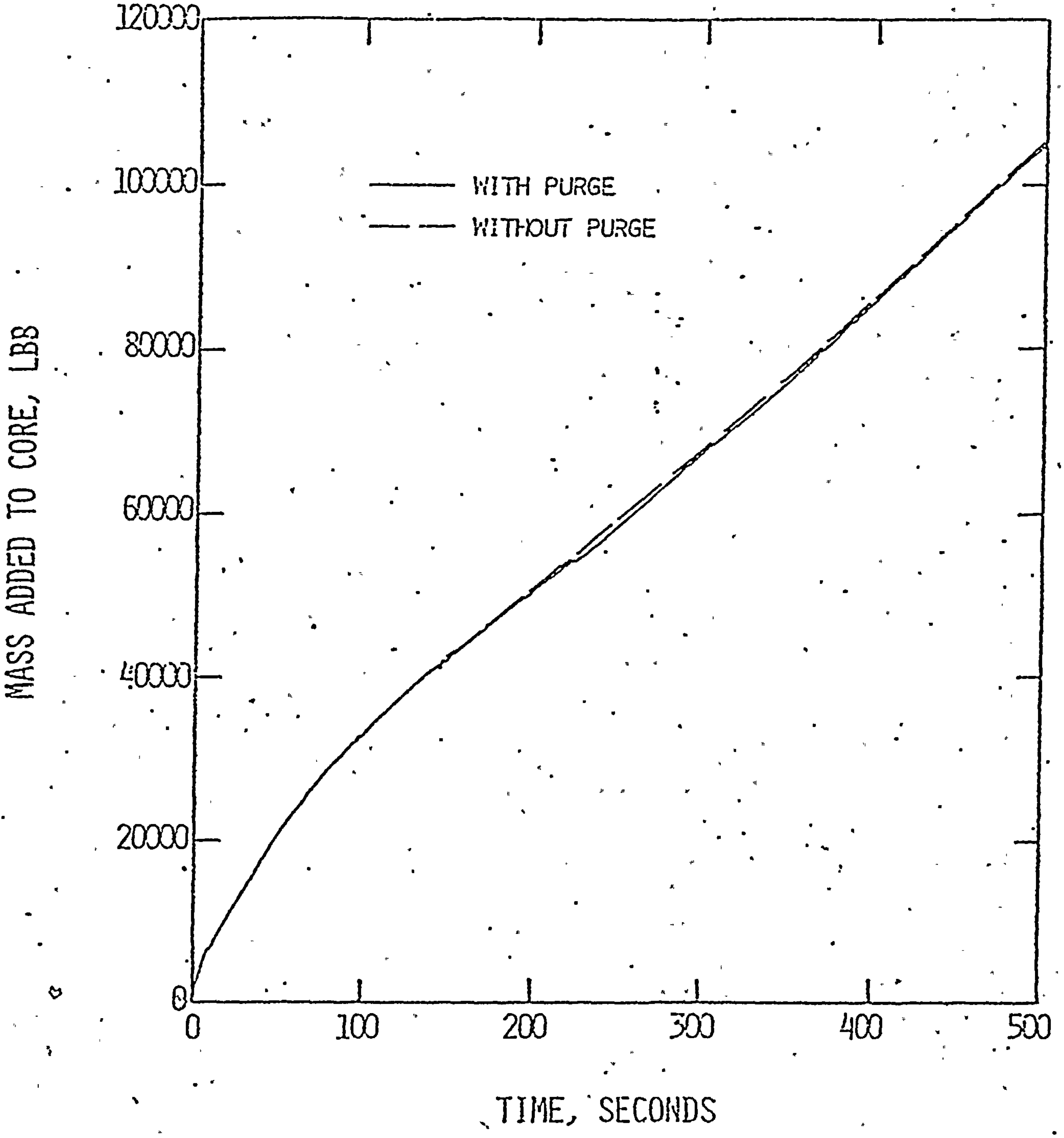


Florida P&L Co. St. Lucie Plant Unit Number 1	PURGE LINE FLOW RATE	Figure 1



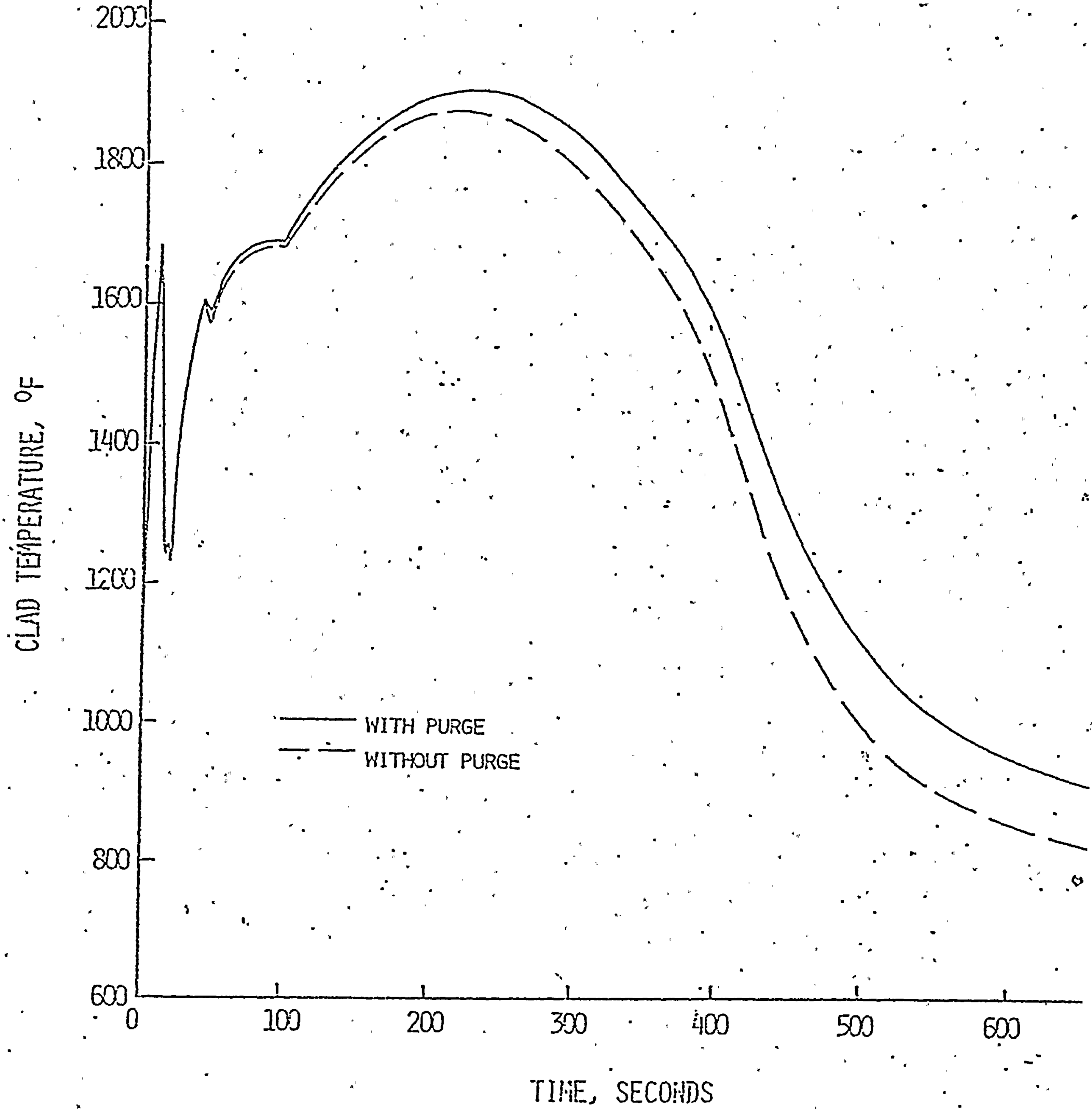
CYCLE 3

Florida P & L Co. St. Lucie Plant Unit Number 1	CONTAINMENT PRESSURE	Figure 2



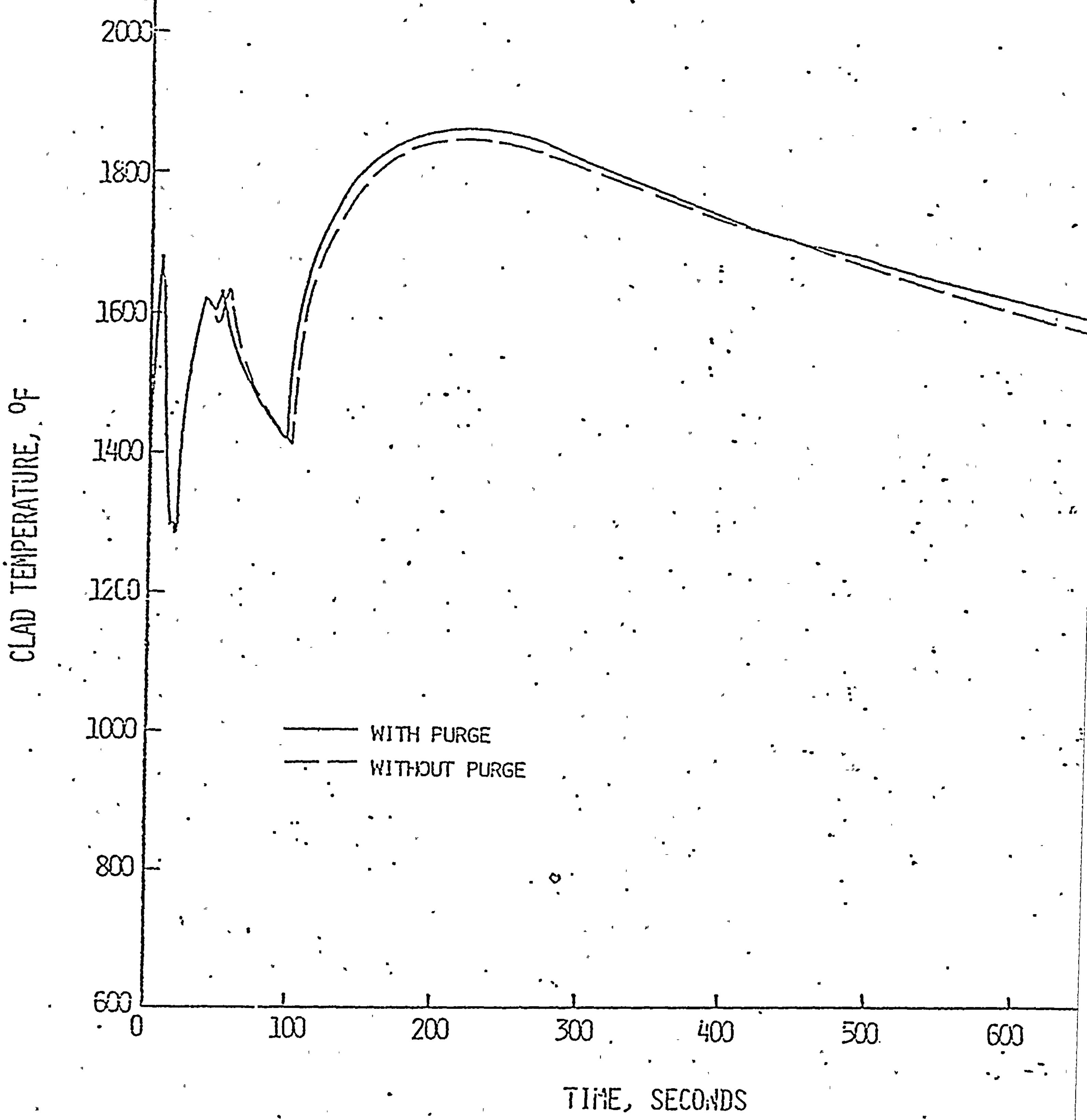
CYCLE 3

Florida P&L Co. St. Lucie Plant Unit Number 1	MASS ADDED TO CORE DURING REFLOOD	Figure N 3



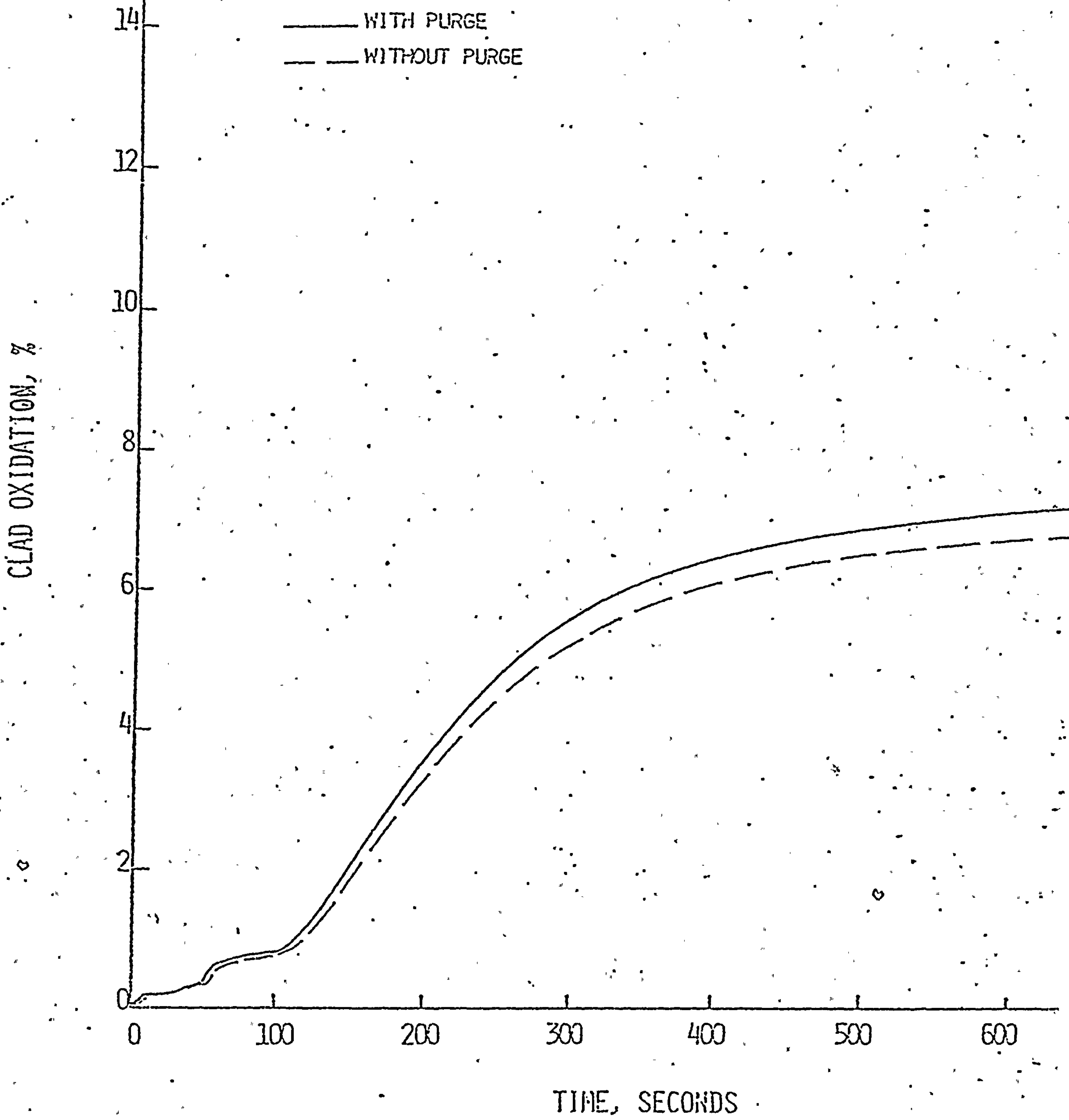
Florida P&L Co. St. Lucie Plant Unit Number 1	PEAK CLAD TEMPERATURE	Figure 4

CYCLE 3



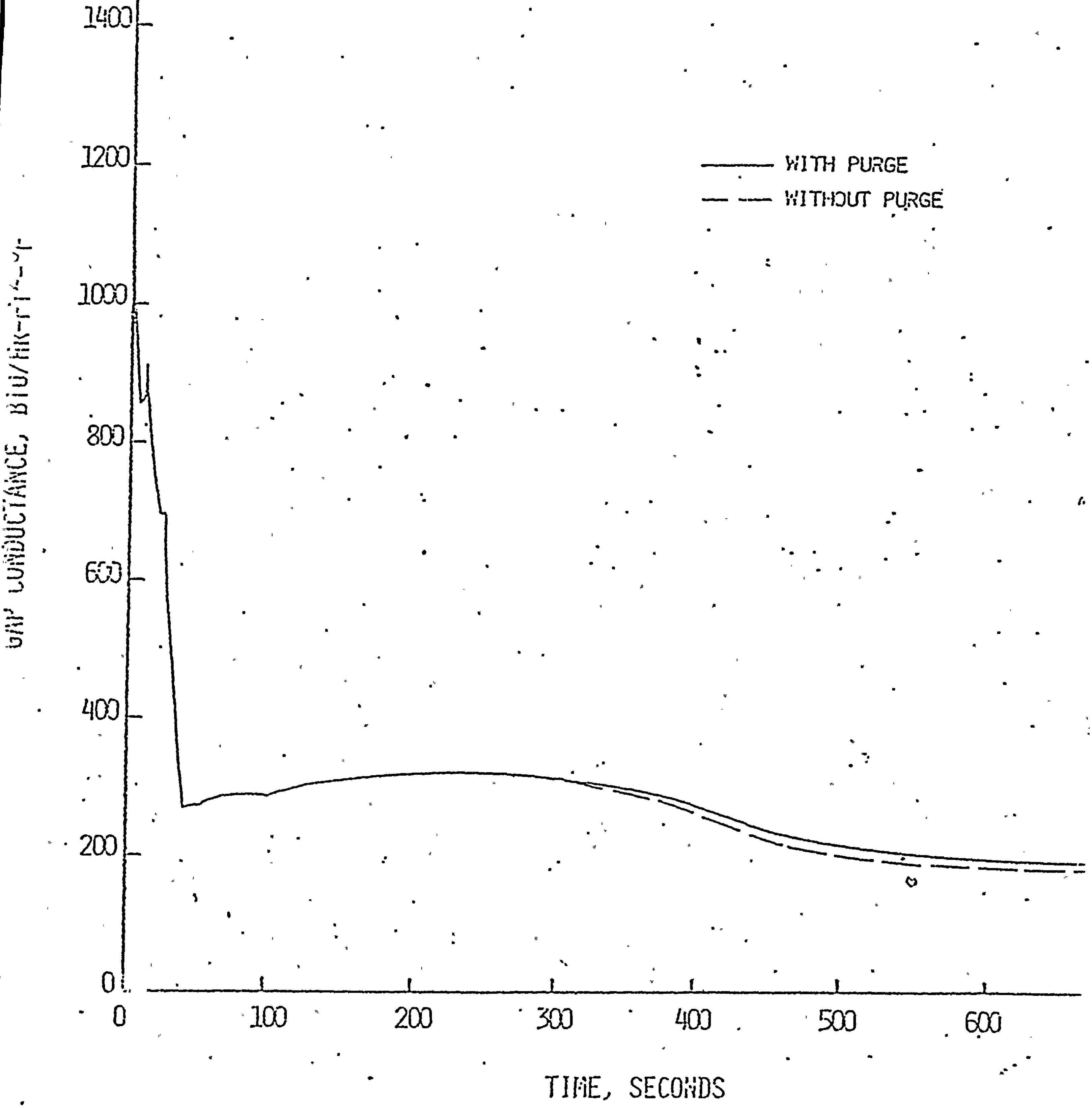
Florida P&L Co. St. Lucie Plant Unit Number 1	PEAK CLAD TEMPERATURE, RUPTURE ZONE	Figure 5

CYCLE 3



Florida P&L Co. St. Lucie Plant Unit Number 1	LOCAL CLAD OXIDATION	Figure 6

CYCLE 3

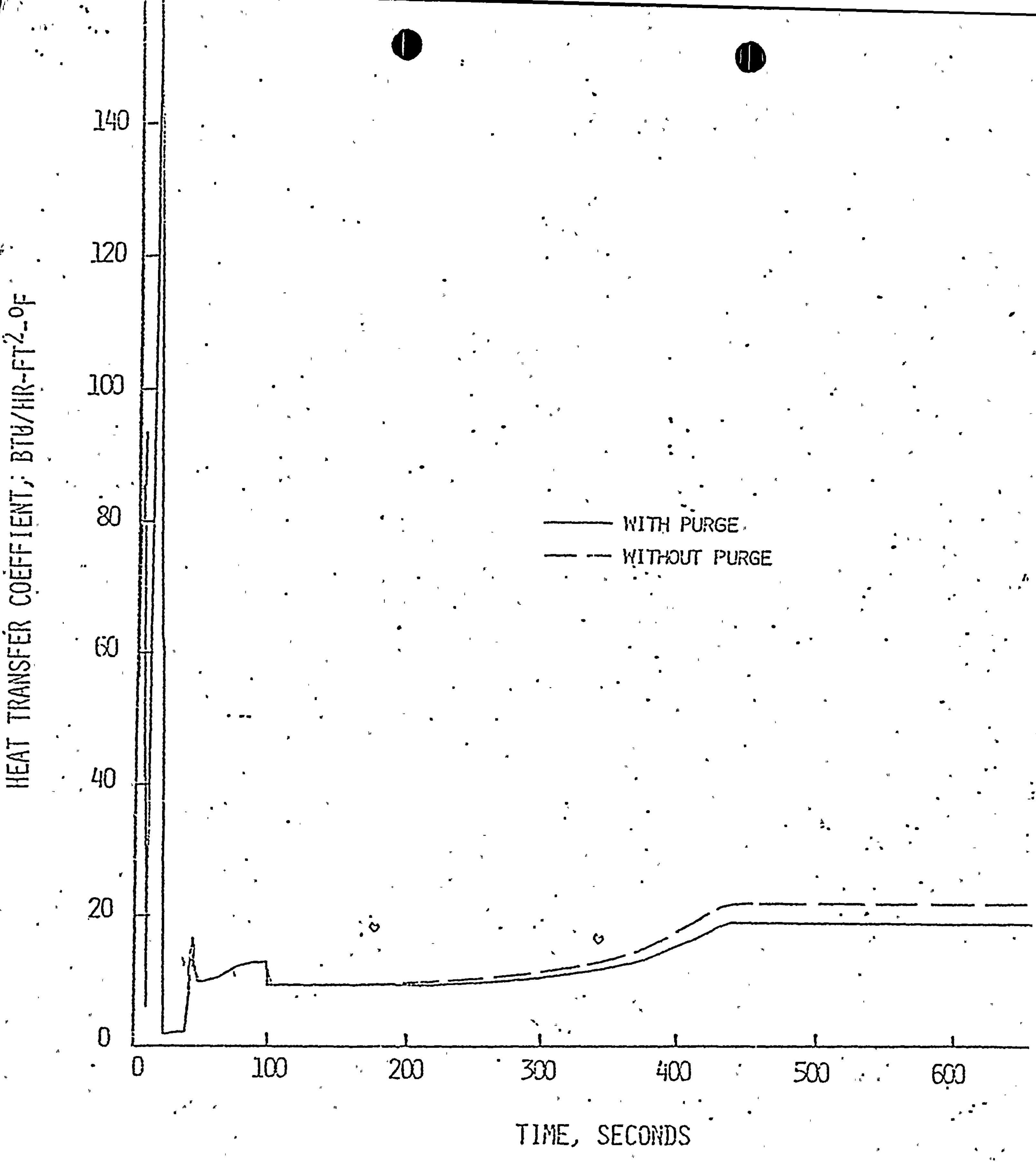


Florida P&L Co.
St. Lucie Plant
Unit Number 1

HOT SPOT GAP CONDUCTANCE

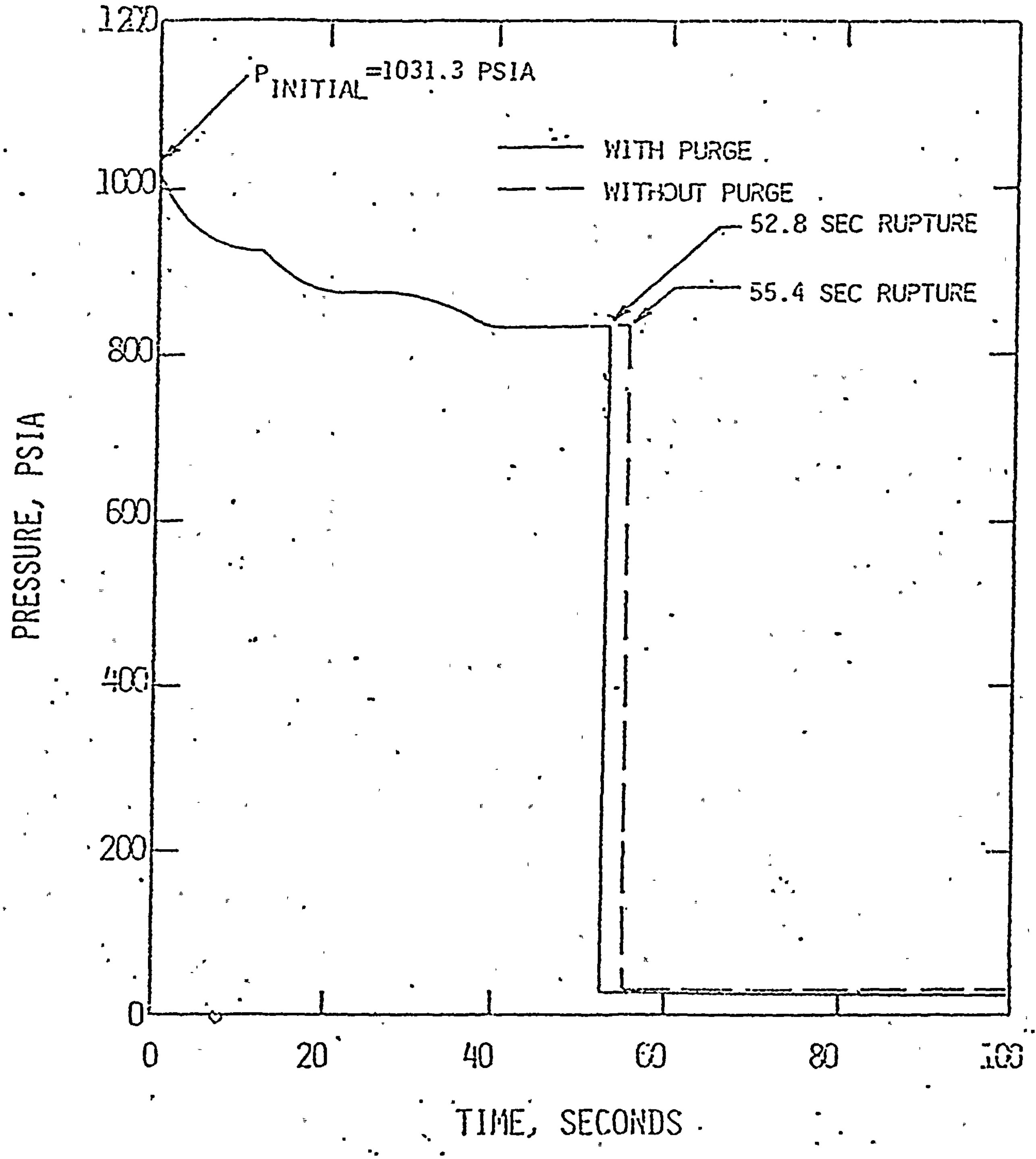
Figure N
7

CYCLE 3



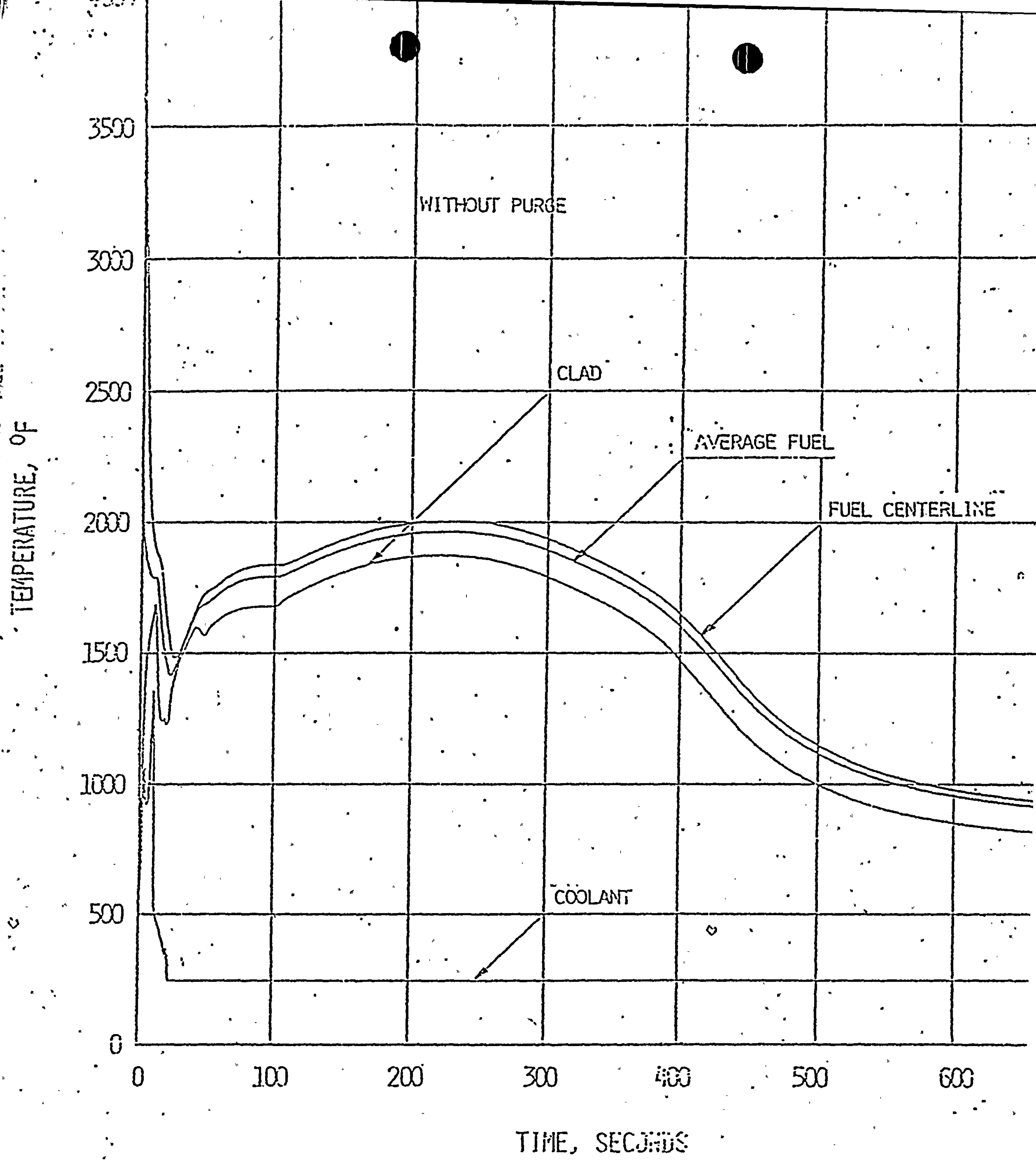
Florida P&L Co. St. Lucie Plant Unit Number 1	HOT SPOT HEAT TRANSFER COEFFICIENT	Figure 8

CYCLE 3



CYCLE 3

Florida P&L Co. St. Lucie Plant Unit Number 1	HOT ROD INTERNAL GAS PRESSURE	Figure 9

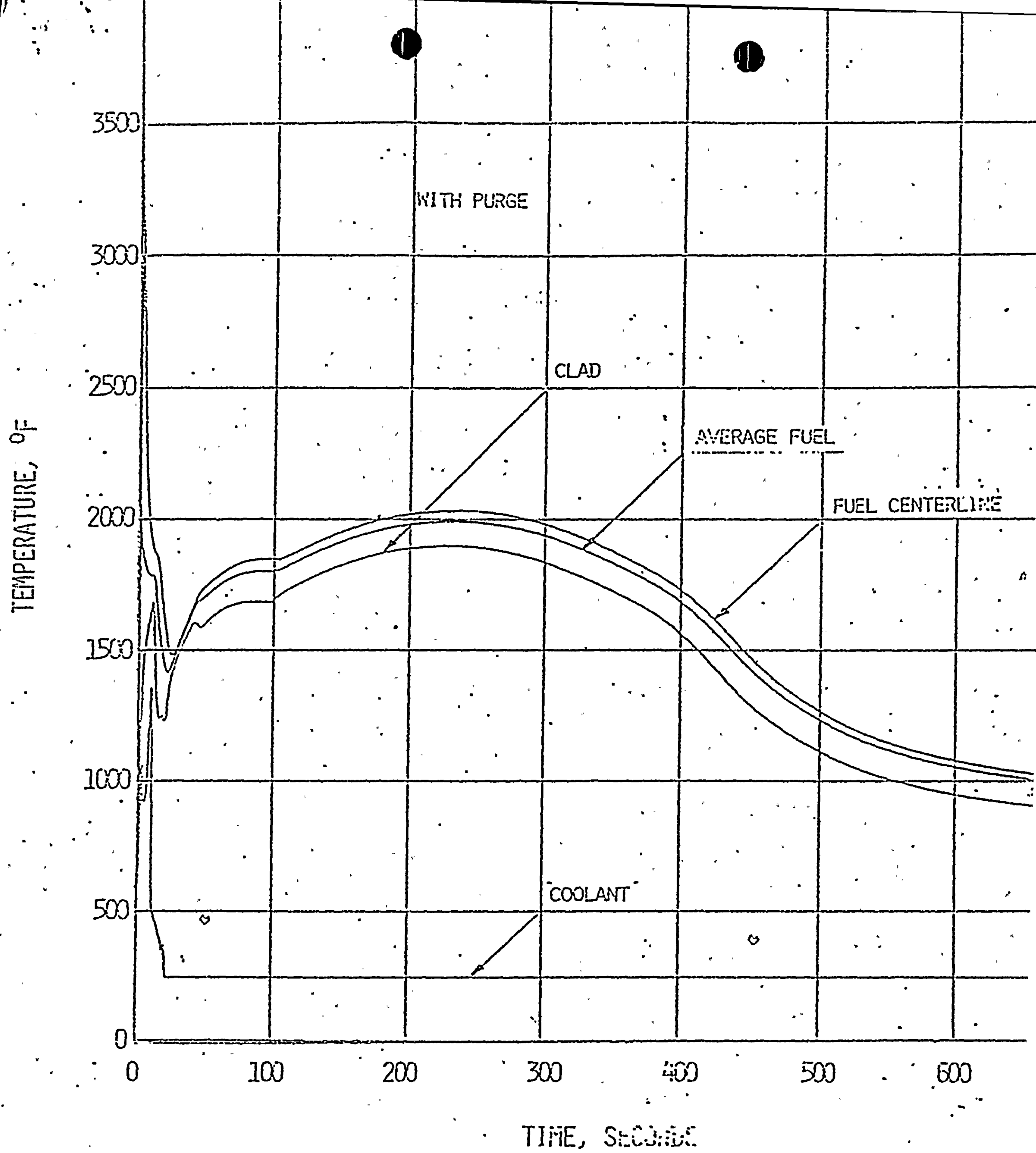


Florida P&L Co.
St. Lucie Plant
Unit Number 1

CLAD TEMPERATURE, CENTERLINE FUEL TEMPERATURE, AVERAGE FUEL TEMPERATURE AND COOLANT TEMPERATURE FOR HOTTEST NODE

Figure
10

CYCLE 3



Florida P & L Co. St. Lucie Plant Unit Number 1	CLAD TEMPERATURE, CENTERLINE FUEL TEMPERATURE, AVERAGE FUEL TEMPERATURE AND COOLANT TEMPERATURE FOR HOTTEST NODE	Figure 11

CYCLE 3

ATTACHMENT 2

St. Lucie Unit 1
Post LOCA Radiological Assessment
With Containment Purging

The radiological doses due to a postulated Loss of Coolant Accident (LOCA) have been previously established and documented in the FSAR (Appendix 6B). At that time it was assumed that no containment purging was occurring at the onset of the accident.

This assessment includes the dose increment due to the operation of the purge system. The assumptions used in the evaluation of the dose increment are as follows:

1. Purge valve closure is completed in 7.3 seconds from the onset of the LOCA;
2. No fuel failure is assumed to occur during the time interval of valve closure, i.e., 7.3 seconds;
3. The primary coolant iodine activity corresponds to the maximum limit of 60 μci/gm, dose equivalent;
4. 100% of the blowdown from the FSAR worst case break (1.0 x DES/Ps)* flashes to steam. All the iodine in the flashed steam is assumed to become airborne;
5. The flow through the purge valves is base on air considering the worst case scenario resulting in a 5104 pound mass loss;
6. All other relative assumptions are in accordance with the FSAR.

The results of the evaluation are presented below:

Offsite Thyroid Dose (REM)

Location	LOCA	Increment due to Purging	Total
Site Boundary (EAB) (0-2 hours)	66.0	12.8	78.8
Low Population Zone (LPZ) (30 days)	150.0	6.1	156.1

	Offsite Whole Body Dose (REM)		
Site Boundary (EAB) (0-2hours)	4.0	0.08	4.08
Low Population Zone (LPZ) (30 days)	5.5	0.04	5.54

As clearly indicated, the anticipated doses attributable to a LOCA occurring during purging operation is well within the limits of 10 CFR 100 in the most conservative sense. A realistic anticipated iodine dose equivalent is less than 1 µci/gm which would result in an offsite dose increment due to purging of orders of magnitude less than shown above.

*Double Ended Slot Break at the Pump Section (9.82 ft.^{2}).

ATTACHMENT 3

St. Lucie Unit 1
Containment Purge and Isolation
Instrumentation and Control Circuit Design

The containment purge valves are situated in two separate flow paths (FCV-25-1, -2,-3 and FCV-25-4,-5,-6). These valves are closed upon an engineered safety features actuation systems (ESFAS) initiation of containment isolation signal (CIS) through de-energization of the control solenoids associated with each valve.

The ESFAS is designed in accordance with IEEE 279 - 1971 as discussed in FSAR Section 7.3.1.4 and 7.3.2.3. The ESFAS provides two (2) independent (physically and electrically isolated) actuation paths to initiate and complete containment isolation. These are CIS 'A' and CIS 'B'. CIS 'A' de-energizes the solenoids thereby causing them to vent and close valves FCV-25-1,-3,-5 while CIS 'B' de-energizes the solenoids causing valves FCV-25-2,-4,-6 to close in a similar fashion. Operation of either 'A' or 'B' train will effect the isolation of both containment purge paths.

In addition, the review of the design of the safety actuation signal circuits that incorporate a manual override feature, previously reported to the NRC via our submittal of January 5, 1979, confirmed that existing physical features are provided to facilitate adequate administrative controls. Overriding one safety actuation signal does not cause the bypass of any other safety actuation signal.

STATE OF FLORIDA)
) ss.
COUNTY OF DADE)

Robert E. Uhrig, being first duly sworn, deposes and says:

That he is a Vice President of Florida Power & Light Company, the Licensee herein;

That he has executed the foregoing document; that the statements made in this said document are true and correct to the best of his knowledge, information, and belief, and that he is authorized to execute the document on behalf of said Licensee.

Robert E Uhrig

Robert E. Uhrig

Subscribed and sworn to before me this

13 day of December, 1979

Theresa M. Miranda

NOTARY PUBLIC, in and for the county of Dade, State of Florida

Notary Public, State of Florida at Large
My Commission Expires May 5, 1981
Bonded thru Maynard Bonding Agency

My commission expires: ____________________