ATTACHMENT 3
ST-HL-AE-3157
PAGE 1 OF 10

3. The reactor is assumed to be at hot zero power. This assumption is more conservative than that of a lower initial system temperature. The higher initial system temperature yields a larger fuel-water heat transfer coefficient, larger specific heats, and a less negative (smaller absolute magnitude) Doppler coefficient, all of which tend to reduce the Doppler feedback effect thereby increasing the neutron flux peak. The initial effective multiplication factor is assumed to be 1.0 since this results in the worst nuclear power transient.

4. Two reactor coolant pumps are assumed to be in operation. This lowest initial flow minimizes the initial margin to DNB. 57

5. Reactor trip is assumed to be initiated by power range high neutron flux (low setting). The most adverse combination of instrument and setpoint errors, as well as delays for trip signal actuation and RCCA release, is taken into account. A 10 percent increase is assumed for the power range flux trip setpoint raising it from the nominal value of 25 percent to 35 percent. Since the rise in the neutron flux is so rapid, the effect of errors in the trip setpoint on the actual time at which the rods are released is negligible. In addition, the reactor trip insertion characteristic is based on the assumption that the highest worth RCCA is stuck in its fully withdrawn position. The RCCA insertion time to dashpot entry of ~~2.2~~ 2.8 seconds is assumed.* ~~This is a conservative insertion time under the reduced flow conditions that exist when only two reactor coolant pumps are assumed to be in operation. See Section 15.0.5 for additional RCCA insertion characteristics.~~ 57

ADD *AS DISCUSSED IN SECTION 15.0.5.

DELETE

6. The maximum positive reactivity insertion rate assumed is greater than that for the simultaneous withdrawal of the combination of the two sequential control banks having the greatest combined worth at maximum speed (45 in/min). Control rod drive mechanism (CRDM) design is discussed in Section 4.6.

7. The most limiting axial and radial power shapes, associated with having the two highest combined worth banks in their high worth position, are assumed in the departure from nucleate boiling (DNB) analysis.

8. The initial power level was assumed to be below the power level expected for any shutdown condition (10^{-9} of nominal power). The combination of highest reactivity insertion rate and lowest initial power produces the highest peak heat flux.

A block diagram summarizing various protection sequences for safety actions required to mitigate the consequences of this event is provided in Figure 15.0-15. 2 Q211.6

Plant systems and equipment which are available to mitigate the effects of the accident are discussed in Section 15.0.8 and listed in Table 15.0-6. No single active failure in any of these systems or equipment will adversely affect the consequences of the accident.

<u>Results</u>

Figures 15.4-1 through 15.4-3 show the transient behavior for the uncontrolled RCCA bank withdrawal, with the accident terminated by reactor trip at 35 percent of nominal power. The reactivity insertion rate used is greater than that calculated for the two highest worth sequential control banks, both assumed to be in their highest incremental worth region.

NUCLEAR POWER

DELETE

Figures 15.4-1 shows the neutron flux transient. The neutron flux does not overshoot the nominal full power value.

The energy release and the fuel temperature increases are relatively small. The thermal flux response, of interest for DNB considerations, is shown on Figure 15.4-2. The beneficial effect of the inherent thermal lag in the fuel is evidenced by a heat flux much less than the full power nominal value. There is a large margin to DNB during the transient since the rod surface heat flux remains below the design value, and there is a high degree of subcooling at all times in the core. Figure 15.4-3 shows the response of the hot spot fuel and cladding temperature. The hot spot fuel average temperature increases to a value below the nominal full power hot spot value. The minimum DNBR at all times remains above 1.30. DELETE 18

ADD THE SAFETY ANALYSIS LIMIT VALUE

The calculated sequence of events for this accident is shown in Table 15.4-1. With the reactor tripped, the plant returns to a stable condition. The plant may subsequently be cooled down further by following normal plant shutdown procedures.

15.4.1.3 Radiological Consequences. There are no radiological consequences associated with an uncontrolled RCCA bank withdrawal from a subcritical or low power startup condition event since radioactivity is contained within the fuel rods and RCS within design limits.

15.4.1.4 Conclusions. In the event of a RCCA withdrawal accident from the subcritical condition, the core and the RCS are not adversely affected, since the combination of thermal power and the coolant temperature result in a DNBR which is well above the limiting value of 1.30. Thus, the DNB design basis as described in Section 4.4 is met. DELETE 18

ADD SAFETY ANALYSIS LIMIT VALUE

15.4.2 Uncontrolled Rod Cluster Control Assembly Bank Withdrawal at Power

15.4.2.1 Identification of Causes and Accident Description. Uncontrolled RCCA bank withdrawal at power results in an increase in the core heat flux. Since the heat extraction from the steam generators lags behind the core power generation until the steam generator pressure reaches the relief or safety valve setpoint, there is a net increase in the reactor coolant temperature. Unless terminated by manual or automatic action, the power mismatch and resultant coolant temperature rise could eventually result in DNB. Therefore, in order to avert damage to the fuel clad, the Reactor Trip System (RTS) is designed to terminate any such transient before the DNBR falls below 1.30. 43

This event is classified as an ANS Condition II incident (an incident of moderate frequency) as defined in Section 15.0.1.

The automatic features of the RTS which prevent core damage following the postulated accident include the following: 43

1. Power range neutron flux instrumentation actuates a reactor trip if two out of four channels exceed an overpower setpoint.

2. Reactor trip is actuated if any two out of four ΔT channels exceed an overtemperature ΔT setpoint. This setpoint is automatically varied with axial power imbalance, coolant temperature and pressure to protect against DNB.

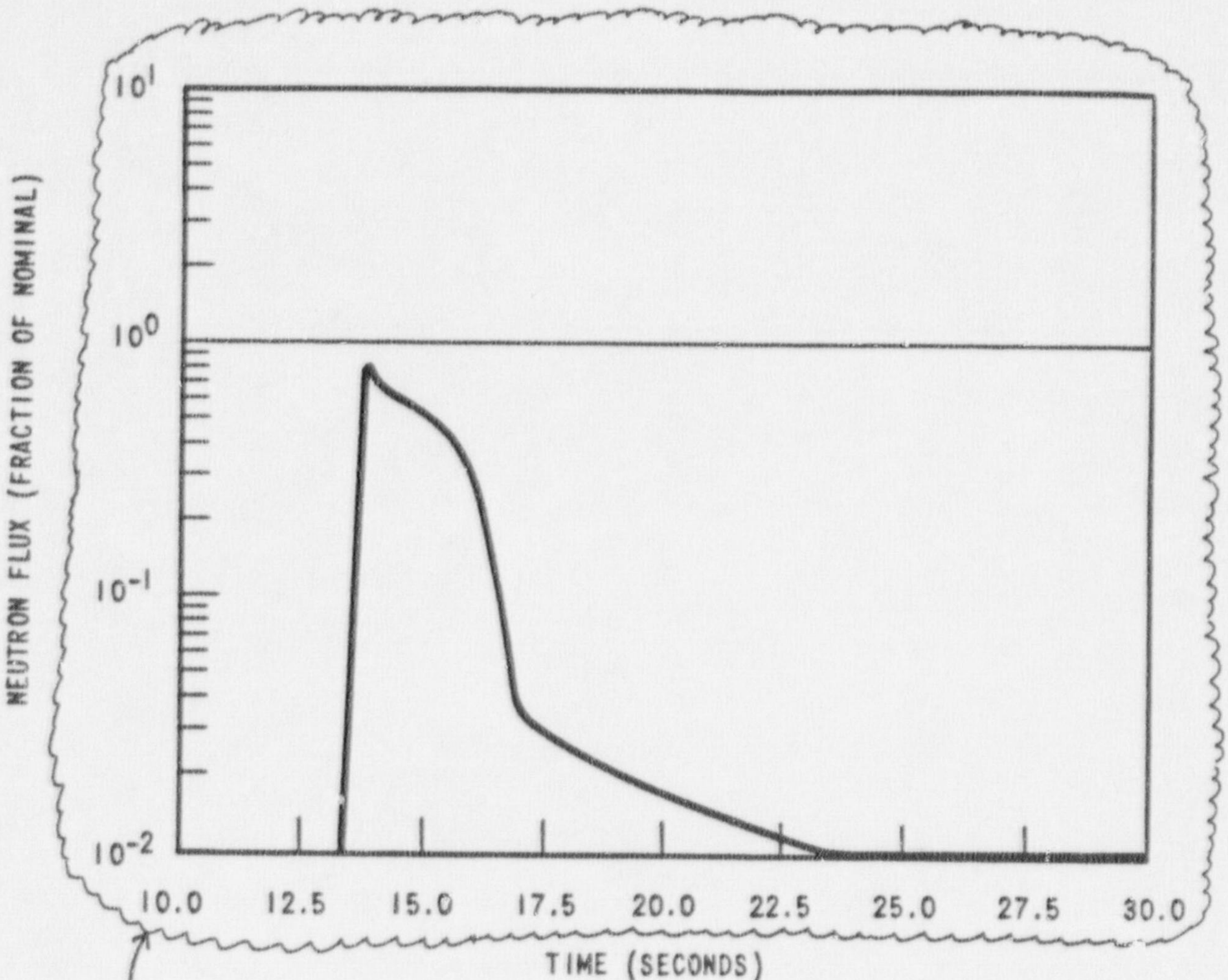
ATTACHMENT 3
ST-HL-AE-3157
PAGE 3 OF 10

Table 15.4-1

TIME SEQUENCE OF EVENTS FOR INCIDENTS WHICH CAUSE REACTIVITY AND POWER DISTRIBUTION ANOMALIES

Accident	Event	Time (sec.)	REPLACE WITH NEW VALUES	
Uncontrolled Rod Cluster Control Assembly Bank Withdrawal from a Subcritical or Low Power Startup Condition	Initiation of uncontrolled rod withdrawal from 10^{-9} of nominal power	0.0		
	Power range high neutron flux low setpoint reached	13.7	10.4	
	Peak nuclear power occurs	13.8	10.5	
	Rods begin to fall into core	14.2	10.9	
	Minimum DNBR occurs	15.6	13.0	
MOVE	Peak average clad temperature occurs	15.6	13.4	
	Peak heat flux occurs	15.6	13.0	
	Peak average fuel temperature occurs	15.8	13.6	
Uncontrolled RCCA Bank Withdrawal at Power				
1. Case A	Initiation of uncontrolled RCCA withdrawal at a high reactivity insertion rate (70 pcm/sec)	0		
	Power range high neutron flux high trip point reached	1.7		
	Rods begin to fall into core	2.2		57
	Minimum DNBR occurs	3.2		

12.106-66

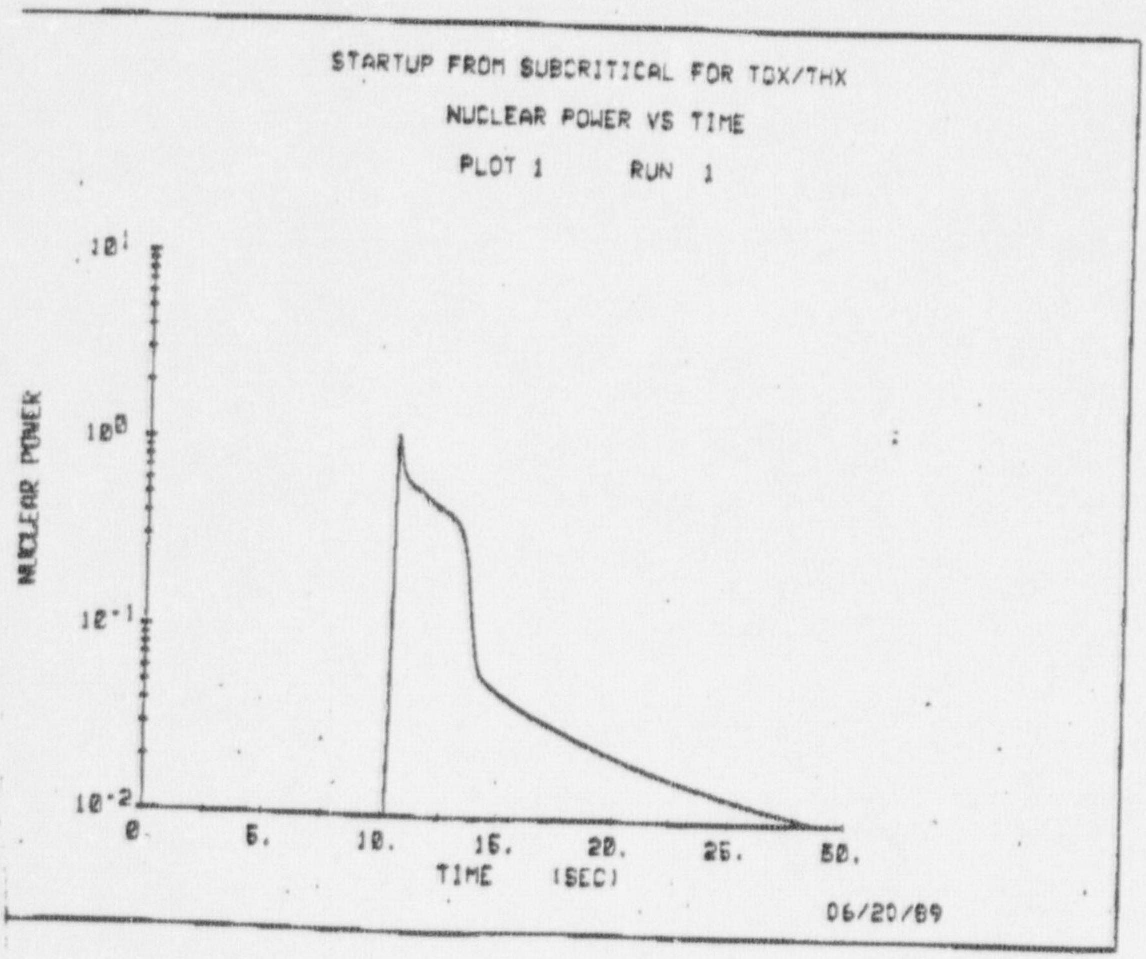


DELETE AND REPLACE WITH NEW FIGURE

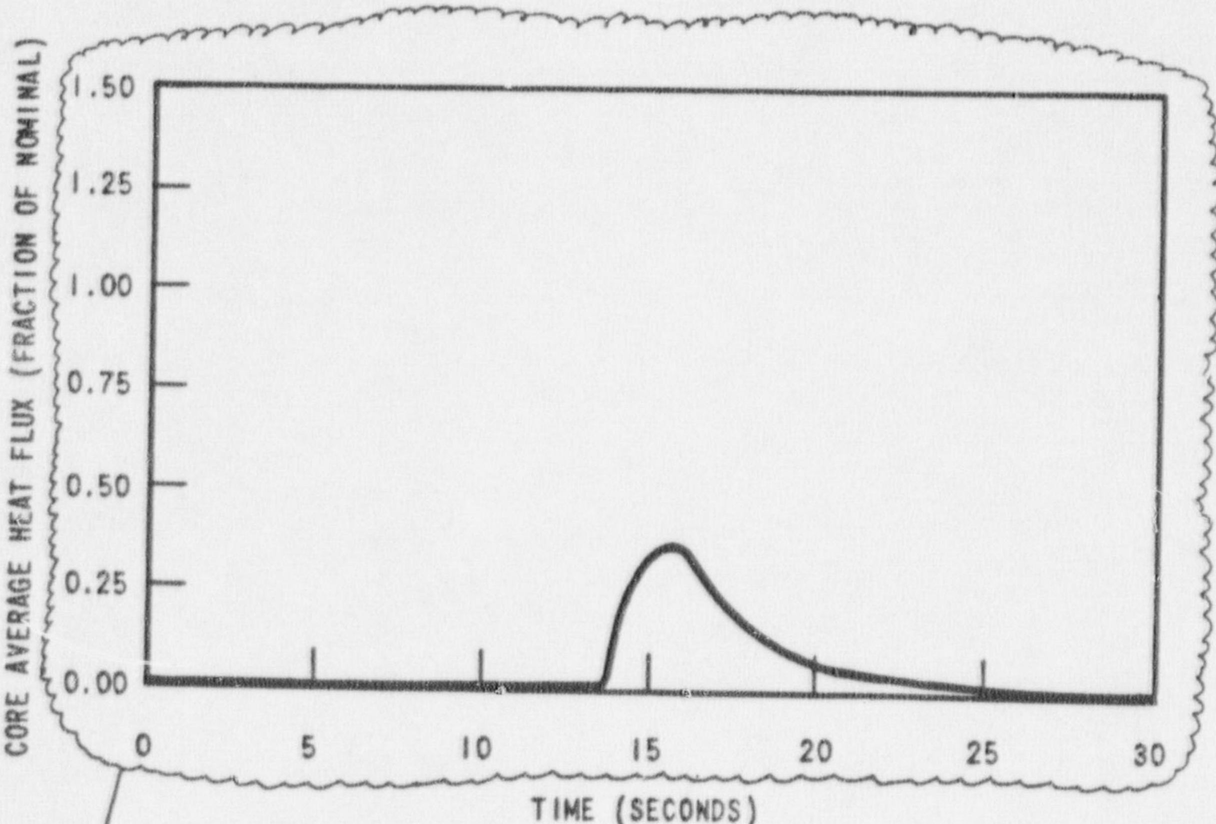
SOUTH TEXAS PROJECT
UNITS 1 & 2

Neutron Flux Transient for Uncontrolled Rod Withdrawal from a Subcritical Condition

Figure 15.4-1


STARTUP FROM SUBCRITICAL FOR TDX/THX
NUCLEAR POWER VS TIME
PLOT 1 RUN 1
NUCLEAR POWER
10^1
10^0
10^-1
10^-2
0.
5.
10.
15.
20.
25.
30.
TIME (SEC)
06/20/89

ATTACHMENT 3
ST-HL-AE-3157
PAGE 6 OF 10

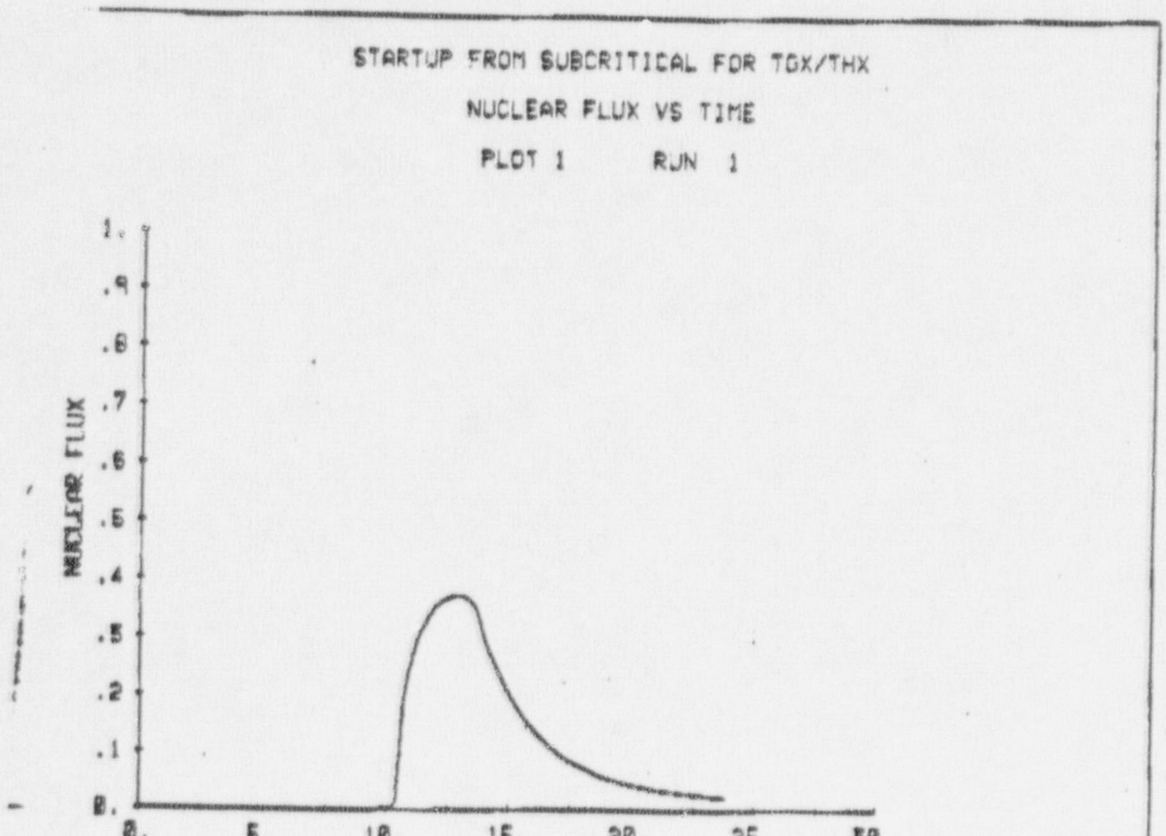


DELETE AND REPLACE WITH NEW FIGURE

SOUTH TEXAS PROJECT
UNITS 1 & 2

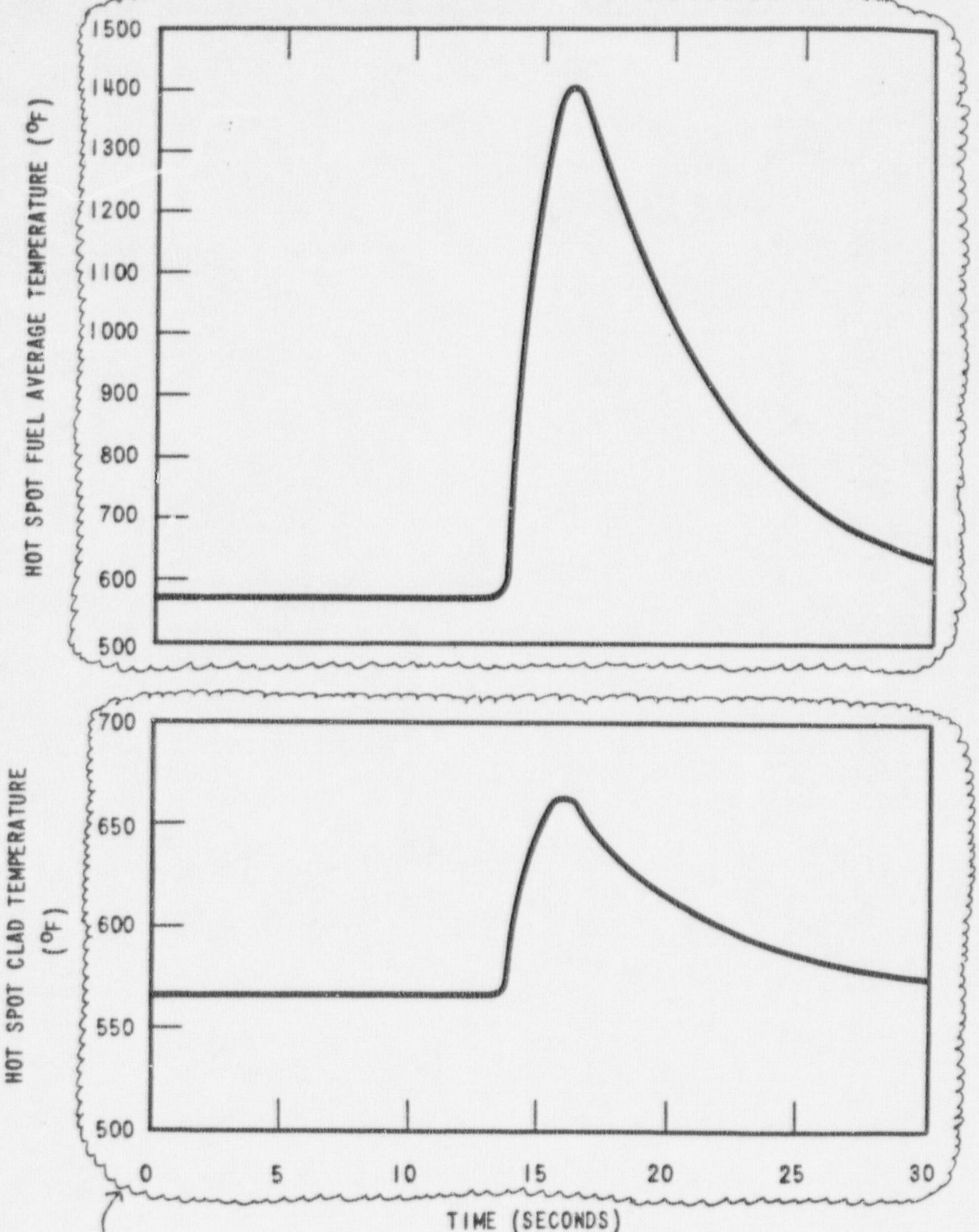
Thermal Flux Transient for Uncontrolled Rod Withdrawal from a Subcritical Condition

Figure 15.4-2


STARTUP FROM SUBCRITICAL FOR TGX/THX
NUCLEAR FLUX VS TIME
PLOT 1 RUN 1
NUCLEAR FLUX
1.
.9
.8
.7
.6
.5
.4
.3
.2
.1
0.
0.
5.
10.
15.
20.
25.
30.
TIME (SEC)
06/20/89

DELETE AND REPLACE WITH FIGURE 15.4-3 A

12,106-68

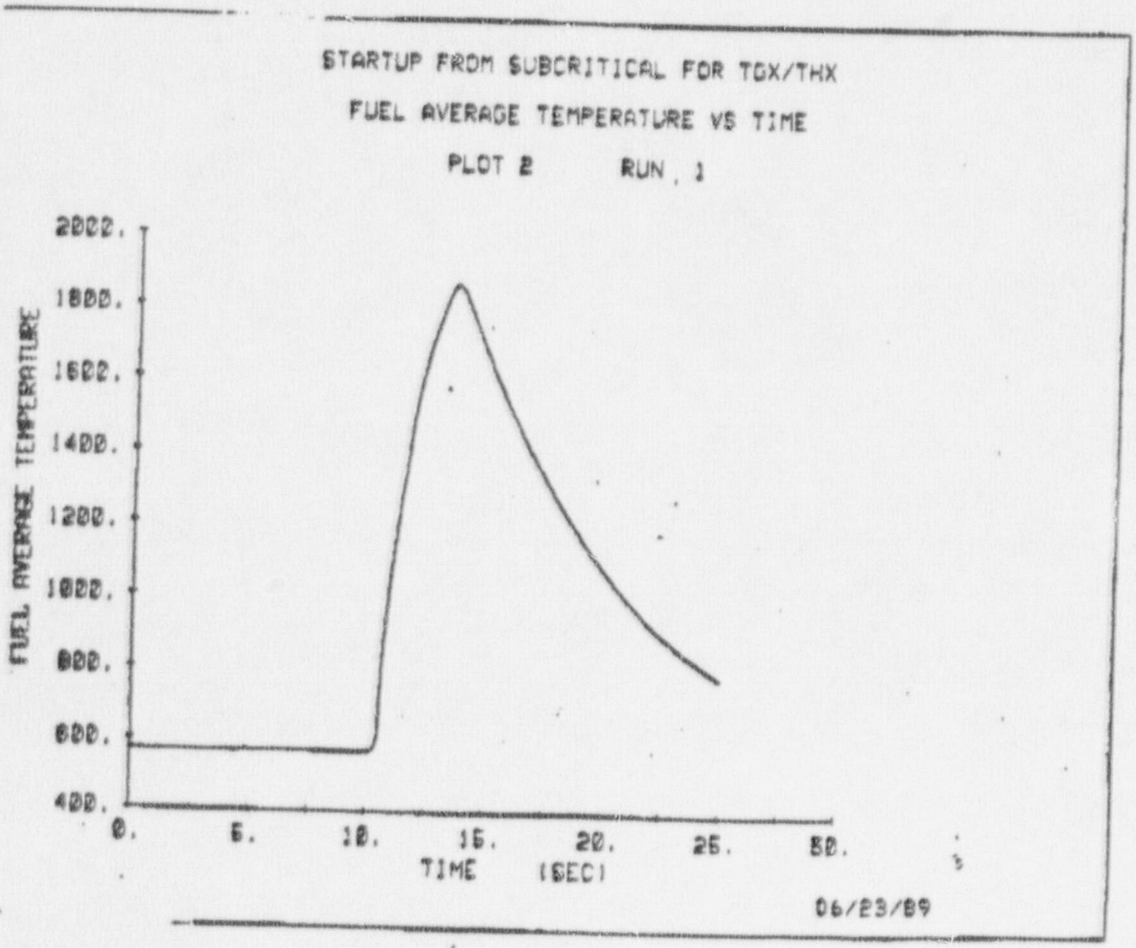


DELETE AND REPLACE WITH FIGURE 15.4-3 B

SOUTH TEXAS PROJECT
UNITS 1 & 2

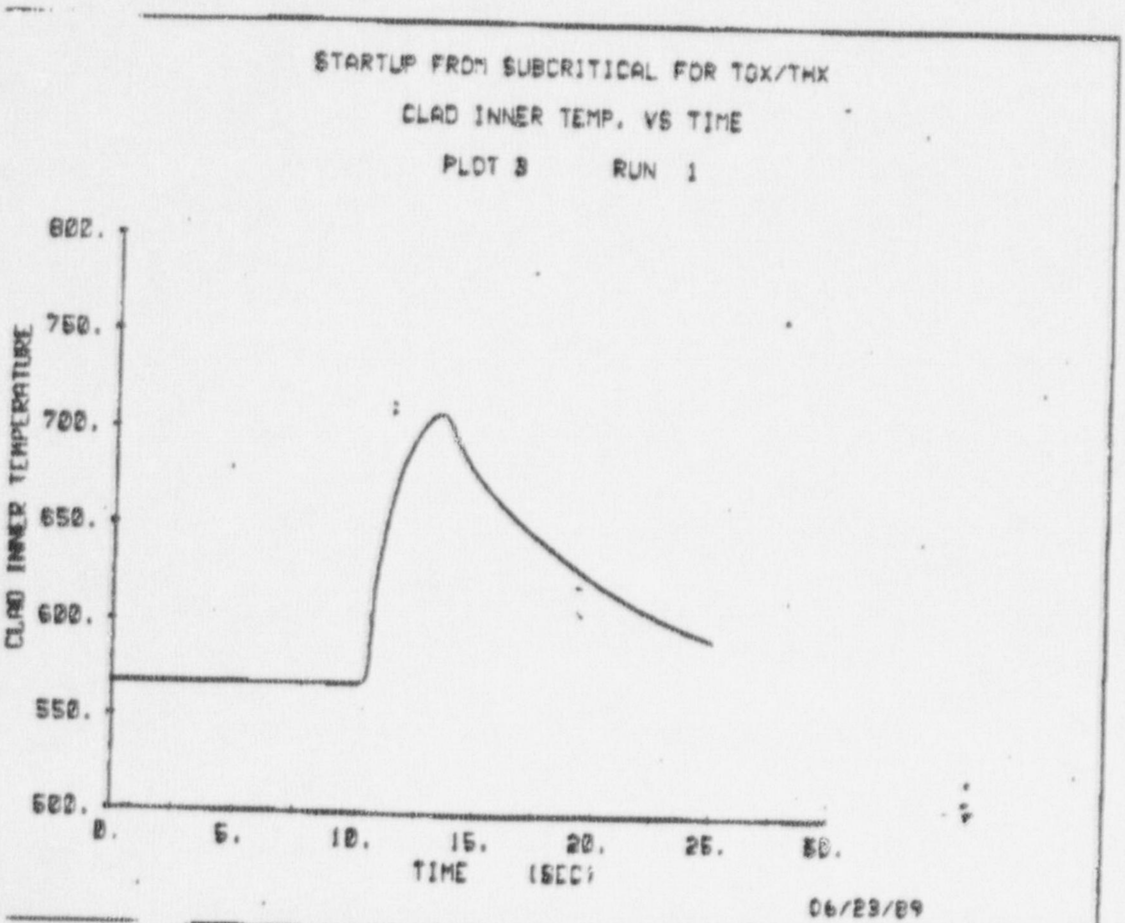
Fuel and Clad Temperature Transients for Uncontrolled Rod Withdrawal from a Subcritical Condition

Figure 15.4-3


STARTUP FROM SUBCRITICAL FOR TDX/THX
FUEL AVERAGE TEMPERATURE VS TIME
PLOT 2 RUN 1
FUEL AVERAGE TEMPERATURE
2000.
1800.
1600.
1400.
1200.
1000.
800.
600.
400.
0.
5.
10.
15.
20.
25.
30.
TIME (SEC)
06/23/89

15.4-3 A

ATTACHMENT 3
ST-HL-AE-3157
PAGE 10 OF 10



15.4-3 B