ATTACHMENT

SUPPLEMENTARY INFORMATION

TO WCAP-9561 ADDENDUM 1

1. PRESSURE

During the reflood portion of the transient, the BART code assumes a constant pressure as shown in Figure 1. This pressure of 16 psia is below the lower limit of the approved pressure band which is 20 psia. Using a pressure outside the approved band makes it necessary to demonstrate that the BART calculations are still conservative.

In the FLECHT Skewed Test Series, tests 13404 and 13609 have identical conditions except for system pressure. The pressure in test 13404 was 40 psia and the pressure in test 13609 was 20 psia. The clad temperatures in the data and the BART calculations of the tests will be examined to show that lowering the pressure retains the conservatism in BART. Figure 2 shows the clad temperature transients at the 6 foot, 8 foot, and 10 foot elevations for both the test data and the BART calculations. The peak clad temperatures are listed in the following table.

Elevation (feet)	Data Test 13609 20 psia PCT (°F)	Data Test 13404 40 psia PCT (°F)	BART Test 13609 20 psia PCT (°F)	BART Test 13404 40 psia PCT (°F)
6	1591	1569	1614	1608
8	1731	1788	1829	1882
10	1715	1851	2000	2088

In these tests, BART conservatively overpredicts the clad temperatures. Figure 3 compares the BART predicted cladding temperatures to the measured cladding temperatures. This figure shows that reducing the pressure does not adversely affect the conservatism in BART. Thus, the consequences of using 16 psia instead of 20 psia are that the BART calculations would still be conservative.

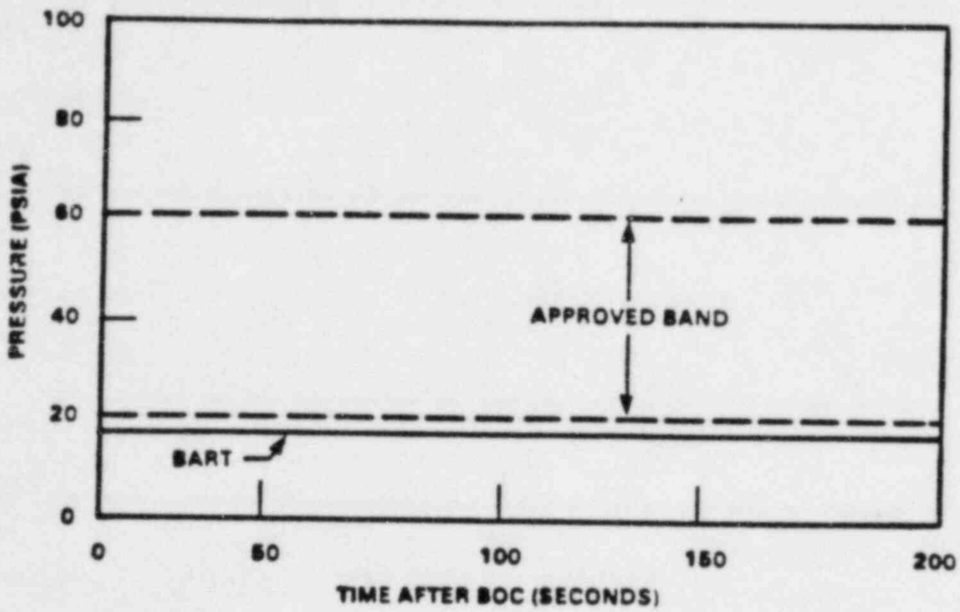
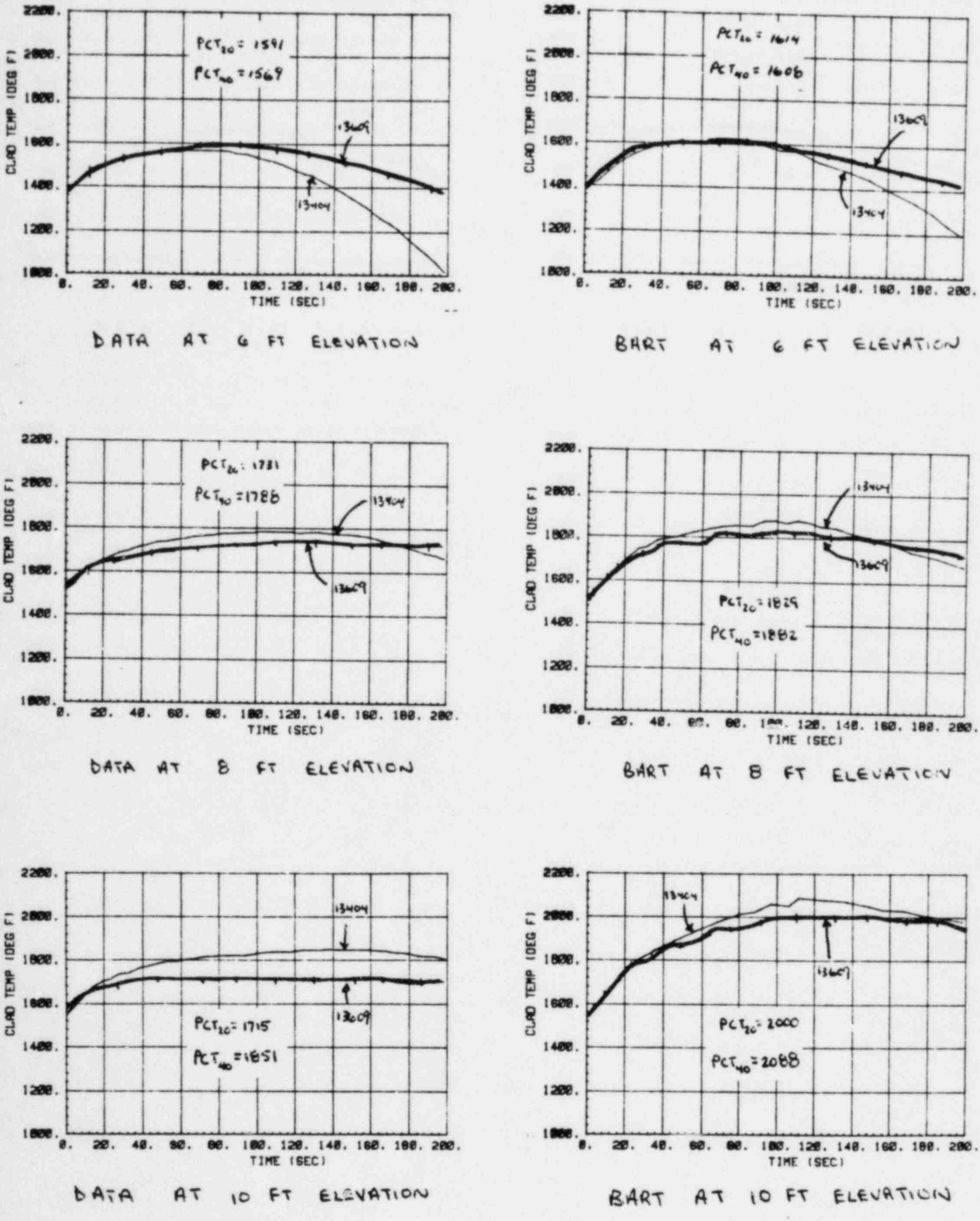


Figure 1 BART Pressure Compared to Approved Band

Figure 2 Clad Temperature Transients in Tests 13404 and 13609



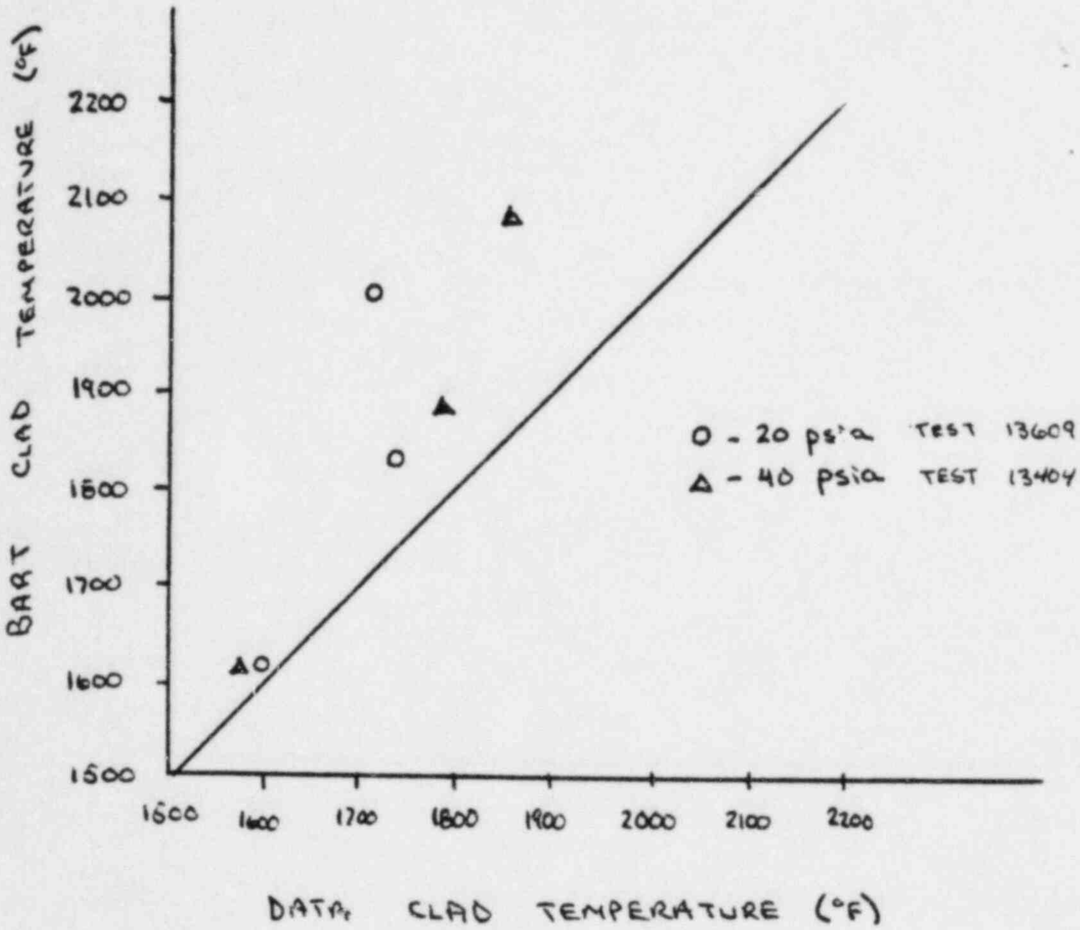


Figure 3 BART vs. DATA Clad Temperature

2. INITIAL PEAK ROD TEMPERATURE

The initial peak rod temperature concerns only the maximum of the average rod temperature at BOC. Typical initial temperatures of the cladding are shown in Figure 4. The magnitude of the peak average rod temperature may vary depending on the break being analyzed. However, these variations may only slightly exceed or fall below the approved range.

A number of tests and BART predictions of the tests will be used to demonstrate that BART is conservative over a wide range of initial peak temperature. The sets of experimental data included:

A. FLECHT-SEASET 161 Rod Tests:	30817
	31203
	31805
	32235
	32333
B. G-2 Tests:	538
	561
C. FLECHT Cosine Power Tests:	4831
	5132
	5342
	6638
	7934

Comparisons between BART and the data will be made using the cladding temperature rise ratio, A.

$$A = \frac{(T_{PEAK} - T_{INITIAL})_{BART}}{(T_{PEAK} - T_{INITIAL})_{DATA}}$$

If this ratio is greater than 1, BART conservatively overpredicts the cladding temperature rise. Figure 5 plots this ratio as a function of initial temperature. The points on the figure can be correlated in the form of a straight line using a least squares fit. The resulting correlation is:

$$A = 1.323 - 0.0001348 * T_{INITIAL}$$

The small coefficient of $T_{INITIAL}$ indicates that the conservatism in BART is not very sensitive to initial temperature. This correlation can be used to determine the upper limit of $T_{INITIAL}$ for which A is greater than 1. The calculated upper limit of $T_{INITIAL}$ is 2396°F. Thus, for initial temperatures lower than 2396°F, BART conservatively overpredicts the cladding temperature rise.

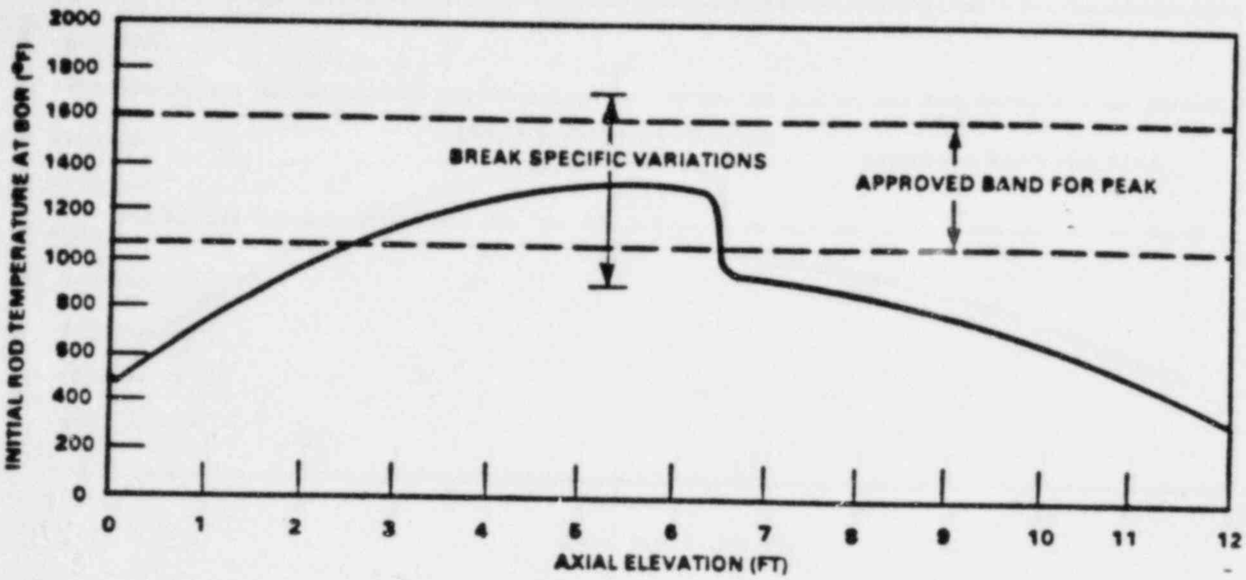


Figure 4 Initial Rod Temperatures Compared to Approved Band

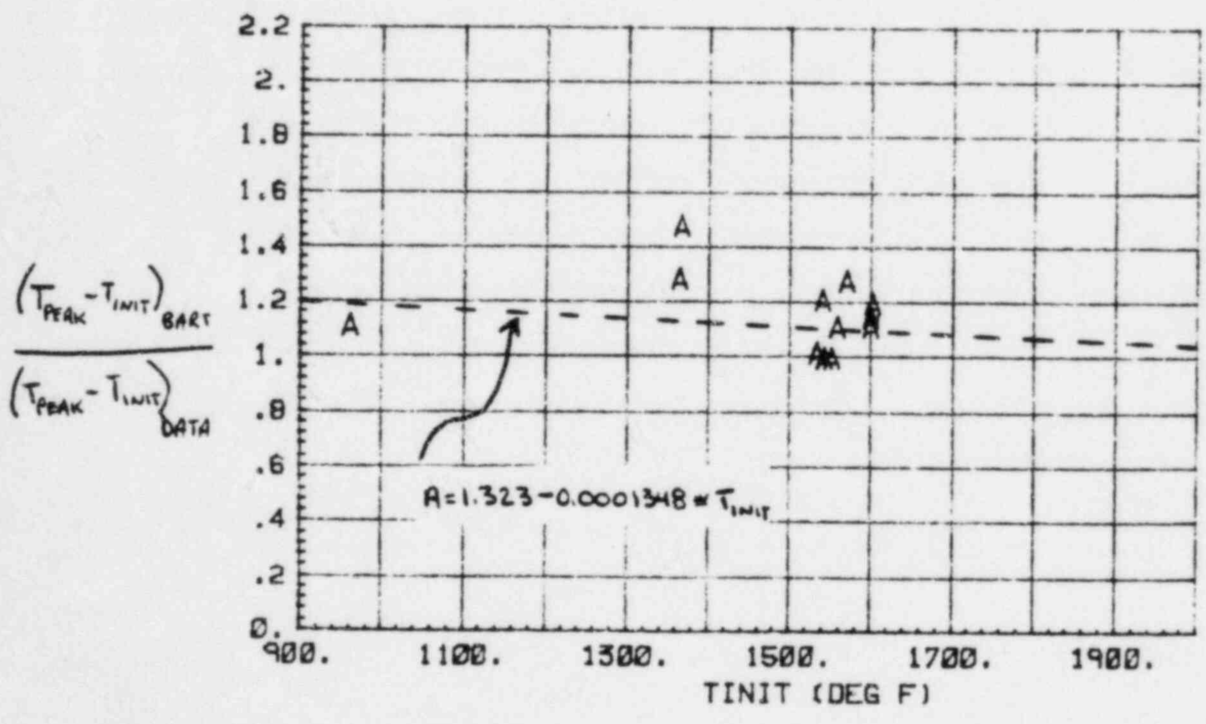


Figure 5 Cladding Temperature Rise Ratio as a Function of Initial Temperature

3. REFLOOD RATE

BART has been approved for transients in which the core reflood rate varies between 0.6 in./sec and 1.5 in./sec. The core reflood rate for a sample UHI transient is compared to the approved band in Figure 6. This comparison shows that using BART for UHI applications remains within the NRC limits on core reflood rates except f r a spike where the reflood rate drops to 0.5 in./sec.

Heat transfer coefficients in BART are calculated using the mass flow rate through the core. The core mass flow rate through the core is approximately proportional to the product of the flooding rate, liquid density, and mass entrainment. When the reflood rate spiked down to 0.5 in./sec the mass entrainment fraction concurrently increased. The mass flow rate through the core remained essentially the same even though the flooding rate spiked down. This can be seen in Figures 7 and 8. Thus, the calculated heat transfer coefficient would not be significantly affected by the downward spike in flooding rate.

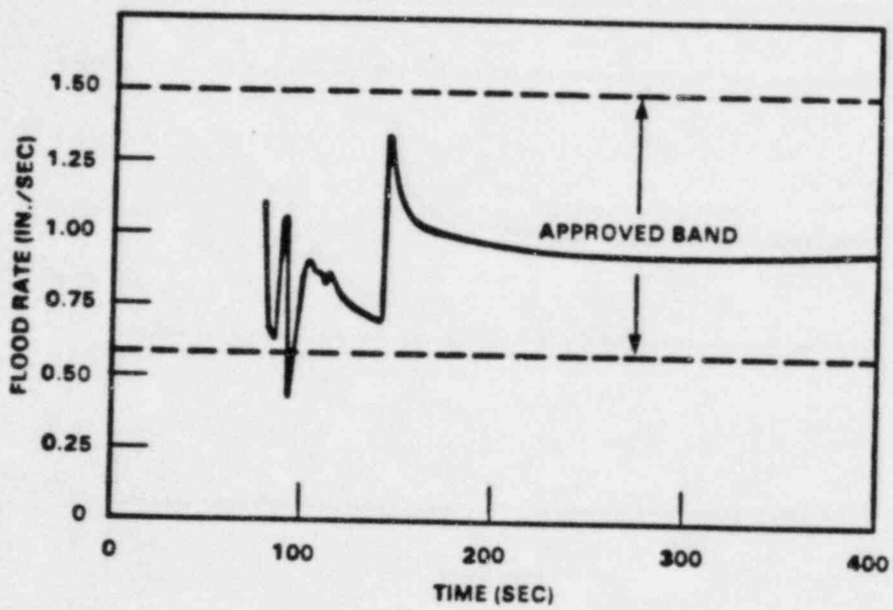


Figure 6 Reflood Rate Compared to Approved Band

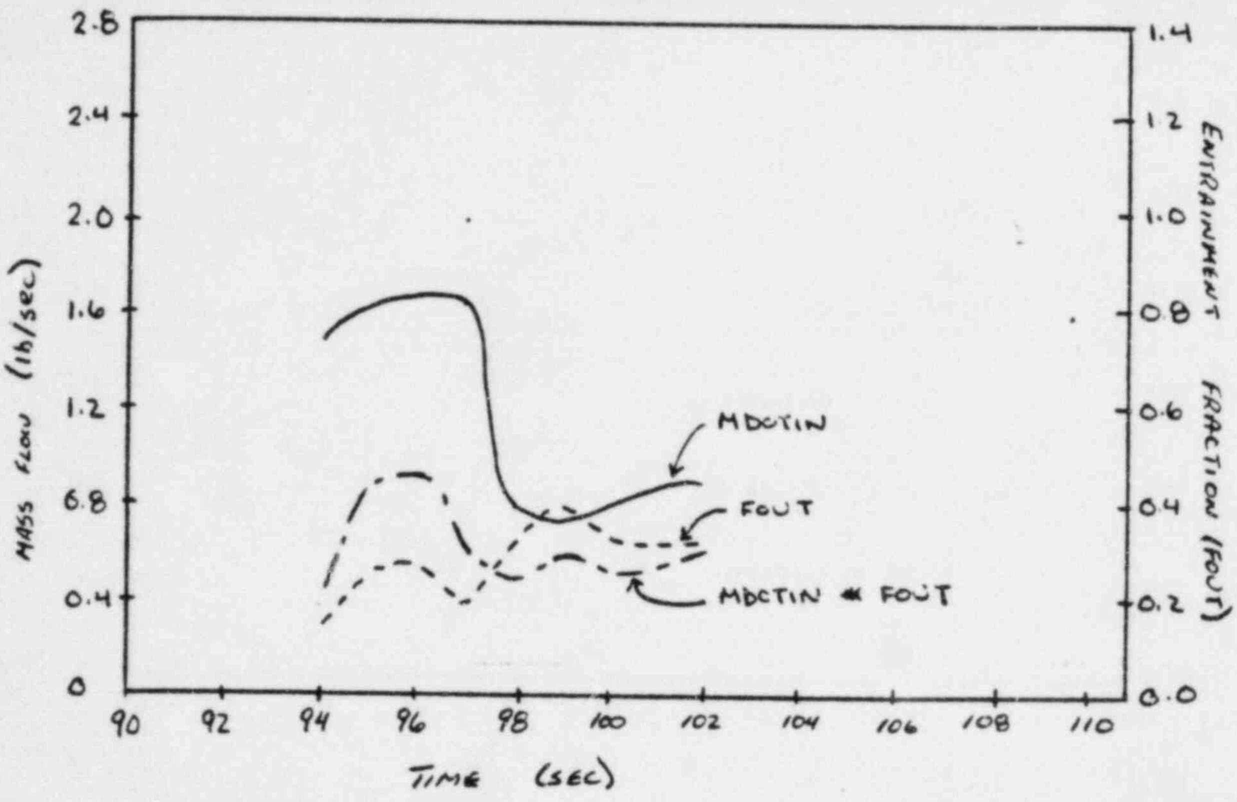


Figure 7 Core Flow Rate

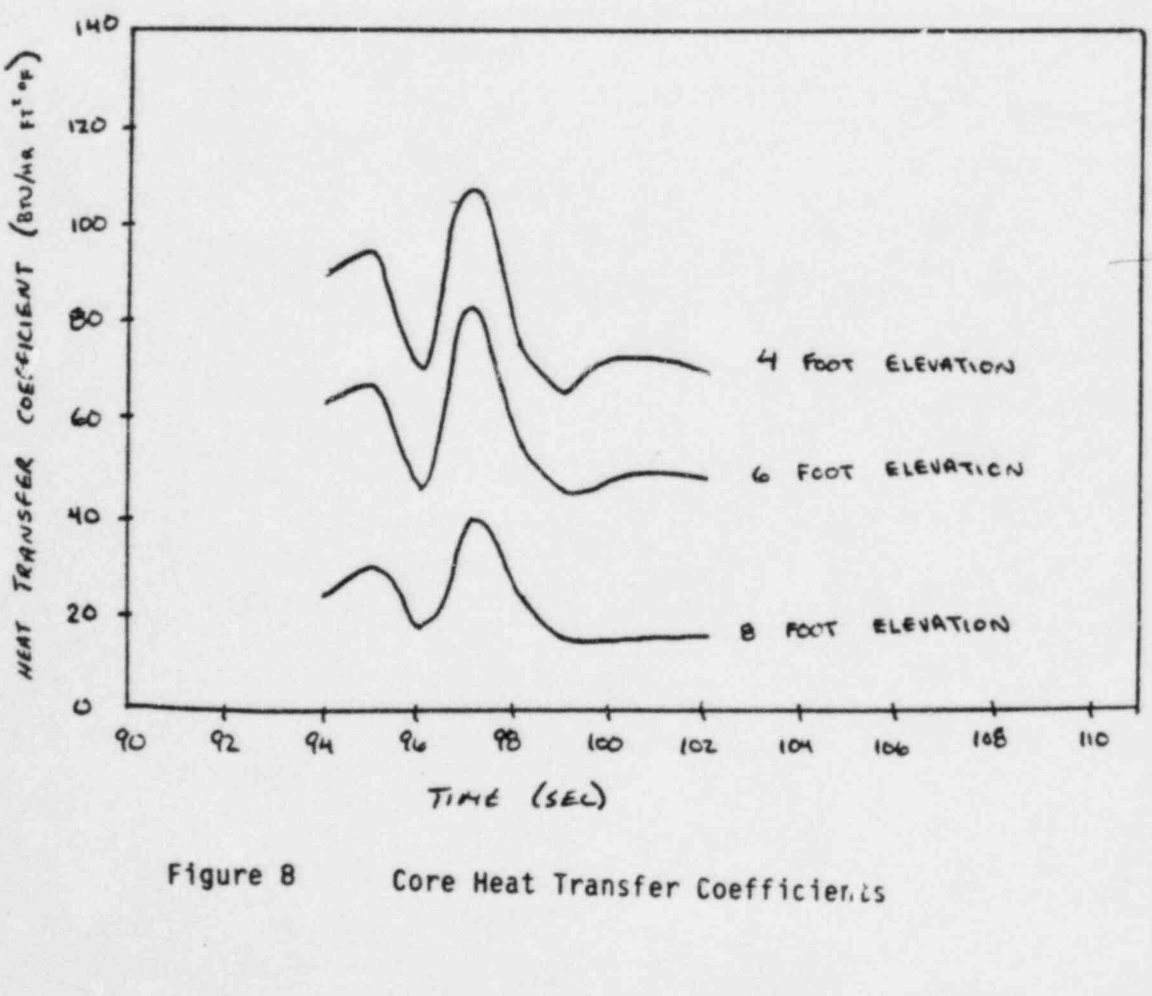


Figure 8 Core Heat Transfer Coefficients