TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

August 5, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

In the Matter of the) Docket No. 50-259
Tennessee Valley Authority)

As discussed with your staff and committed to in my letter to you dated August 4, 1983, we are submitting information regarding planned weld overlays for the Browns Ferry Nuclear Plant unit 1. Included is information regarding piping stresses and predicted crack growths. We are currently applying overlays with the dimensions given in the enclosure.

In a meeting with your staff on July 6, 1983 there was discussion of ten recirculation welds for which no weld overlay was planned. Our position with regard to those ten welds will be submitted in the near future.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills, Manager
Nuclear Licensing

Subscribed and sworn to before
me this 5th day of Aug. 1983.

Bryant M. Lowery
Notary Public
My Commission Expires 4/8/86

Enclosure
cc: See page 2

A001
1/1

cc (Enclosure):
U.S. Nuclear Regulatory Commission
Region II
ATTN: James P. O'Reilly, Regional Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30303

Mr. R. J. Clark
Browns Ferry Project Manager
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland 20814

Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

ENCLOSURE
DETAILS REGARDING PLANNED WELD OVERLAYS
BROWNS FERRY NUCLEAR PLANT UNIT 1

Basis of Overlay Sizing

The weld overlay sizes were developed using the following bases:

1. The welds to be overlaid were identified by TVA.
2. The ultrasonically determined crack depths were doubled.
3. All cracks were 360° at maximum depth.
4. The design minimum overlay thicknesses were used.
5. The lesser of measured or nominal pipe thicknesses was used.
6. The pipe stresses provided by TVA were used.
7. Paragraph IWB-3640, 'Acceptance Criteria for Austenitic Steel Piping,' was used. When the applied stress ratio was below that required, the methods inherent in IWB-3640 were used to extend the table.

Crack Growth Methodology

The residual stress distribution for each overlay design was determined by grouping the 26 weld overlays into 7 enveloping categories. The categorization precedure considered pipe diameter, crack depth, overlay thickness, overlay length, and steady-state-applied stress. The seven categories are:

1. End caps.
2. Twenty-eight-inch pipe with deep cracks and large overlay.
3. Twenty-eight-inch pipe with standard overlay.
4. Twelve-inch pipe with mini overlay.
5. Twelve-inch pipe with high applied stress and standard overlay.
6. Twenty- and twenty-four-inch pipe with standard overlay.
7. Twenty-four inch pipe with large overlay.

The details of the categorization are presented in Tables 1 and 2.

For each category, a post weld overlay residual stress distribution was obtained. For categories 1, 4, and 5, the distributions were obtained from previous NUTECH analyses. For categories 2, 3, 6, and 7, new residual stress profiles were calculated.

Both a straight pipe-to-pipe joint and a pipe-to-fitting joint with a 30° taper were considered. The taper was found to have a negligible effect on the residual stress profile. The residual stress profiles were then combined with the enveloping applied stress profiles and the stress intensity factor as a function of crack depth. Figures 1, 3, 5, 7, 9, 11, and 13 are plots of the stress intensity factor for categories 1 through 7, respectively. The predicted crack growth was then calculated assuming:

1. The initial crack size was 360° with a depth equal to two times the ultrasonically determined crack depth.

2. Two crack growth laws were used:

   (a) NUTECH-recommended crack growth law:

   $$\frac{da}{dT} = 4.116 \times 10^{-12} K^{4.615}$$

   a = crack depth (inches)
   T = time (hours)
   K = stress intensity factor (KSI $\sqrt{\text{inches}}$)

   (b) EPRI bounding crack growth law:

   $$\frac{da}{dT} = 1.2 \times 10^{6} e^{0.11X}$$

Results

The results are plotted in figures 2, 4, 6, 8, 10, 12, and 14 for categories 1 through 7, respectively. These figures show that for all cases the predicted crack size will remain below the allowable crack size for several fuel cycles.

TVA is currently applying overlays with dimensions as presented in Table 1. We believe these overlay designs are adequate for startup and operation of unit 1 because they:

1. Provide more than an adequate margin for flaw sizing error;
2. Provide joints that can be reasonably baseline examined;
3. Will have minimum impact on the system stresses; and
4. Provide the required safety margin for a minimum of 80 months.

TABLE 1

OVERLAY DESIGNS

Weld No.	Pipe Diameter	Crack Depth	Overlay Thickness	Overlay Length	Steady State Stress	Category
KR-1-37	22in.	35%	.200in.	4.5in.	6,099*psi	1
KR-1-15	22	27	.200	4.5	6,099*	1
KR-1-3	28	43	.35	7.0	8,411	2
GR-1-3	28	35	.25	7.0	8,145	3
GR-1-58	28	45	.35	7.0	7,845	2
GR-1-54	28	45	.35	7.0	8,384	2
GR-1-60	28	36	.25	7.0	7,725	3
KR-1-18	12	35	.125	2.5	15,110	4
KR-1-21	12	35	.125	2.5	12,461	4
KR-1-22	12	35	.125	2.5	11,754	4
KR-1-16	12	35	.125	2.5	13,283	4
GR-1-41	12	12	.200	4.5	35,244	5
GR-1-46	12	20	.125	2.5	12,593	4
D-RHR-1-17	24	31	.200	4.5	13,224	6
D-RHR-1-18	24	20	.200	4.5	15,058	6'
D-RHR-1-15	24	30	.200	4.5	9,461	6
DS-RHR-1-9	20	29	.200	4.5	13,829	6
DS-RHR-1-8B	24	41	.200	4.5	13,427	6
DS-RHR-1-11	20	24	.200	4.5	12,633	6
DS-RHR-1-10	20	30	.200	4.5	12,057	6
DS-RHR-1-5	24	31	.200	4.5	11,879	6
D-RHR-1-5	24	36	.25	7.0	11,599	7
DS-RHR-1-4	24	30	.200	4.5	14,071	6
D-RHR-1-20	20	43	.200	4.5	12,450	6
D-RHR-1-8	24	25	.200	4.5	11,396	6
DS-RHR1-4A	24	44	.25	7.0	13,617	7

* Pressure stress only - assumed equal to that for weld number KR-1-34

TABLE 2

OVERLAY CATEGORIZATION

Category	Source of Weld Residual Stress	Applied Stress	Initial Crack Size*	Pipe Diameter	Pipe Thickness	Overlay Thickness	Overlay Length
1	Reference 3	6,099psi	70%	22"	1.031	.2"	4.5"
2	Computer Run	8,411	90	28.51	1.322	.35	7.0
3	Computer Run	8,145	72	28.15	1.138	.25	7.0
4	Reference 4	15,110	70	12.75	.789	.125	2.5
5	Reference 5	35,344**	24	12.75	.579	.20	4.5
6	Computer Run	15,058***	86	20.	1.031	.20	4.5
7	Computer Run	13,617	88	20.	1.031	.25	7.0

* The measured U.T. depth was multiplied by 2.0 for use in the crack growth analysis. The tabulated crack sizes are in percent of unrepaired pipe thickness.

** Crack growth evaluation performed using 26,270 psi = $35,344 \frac{.579}{.579 + .200}$.

*** Crack growth evaluation performed using 12,612 psi = $15,058 \frac{1.031}{1.031 + .200}$.

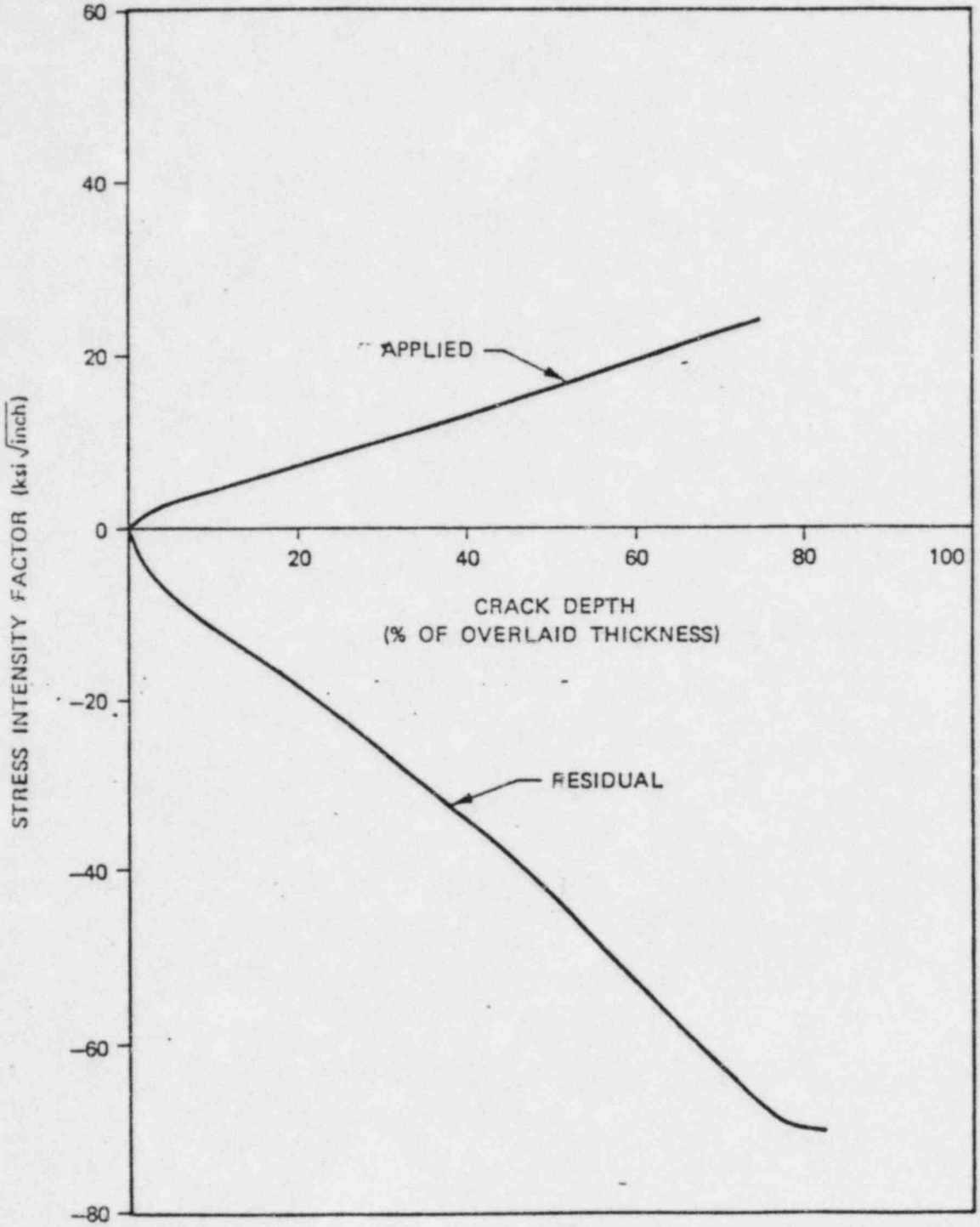

Figure 1

STRESS INTENSITY FACTOR FOR CATEGORY 1

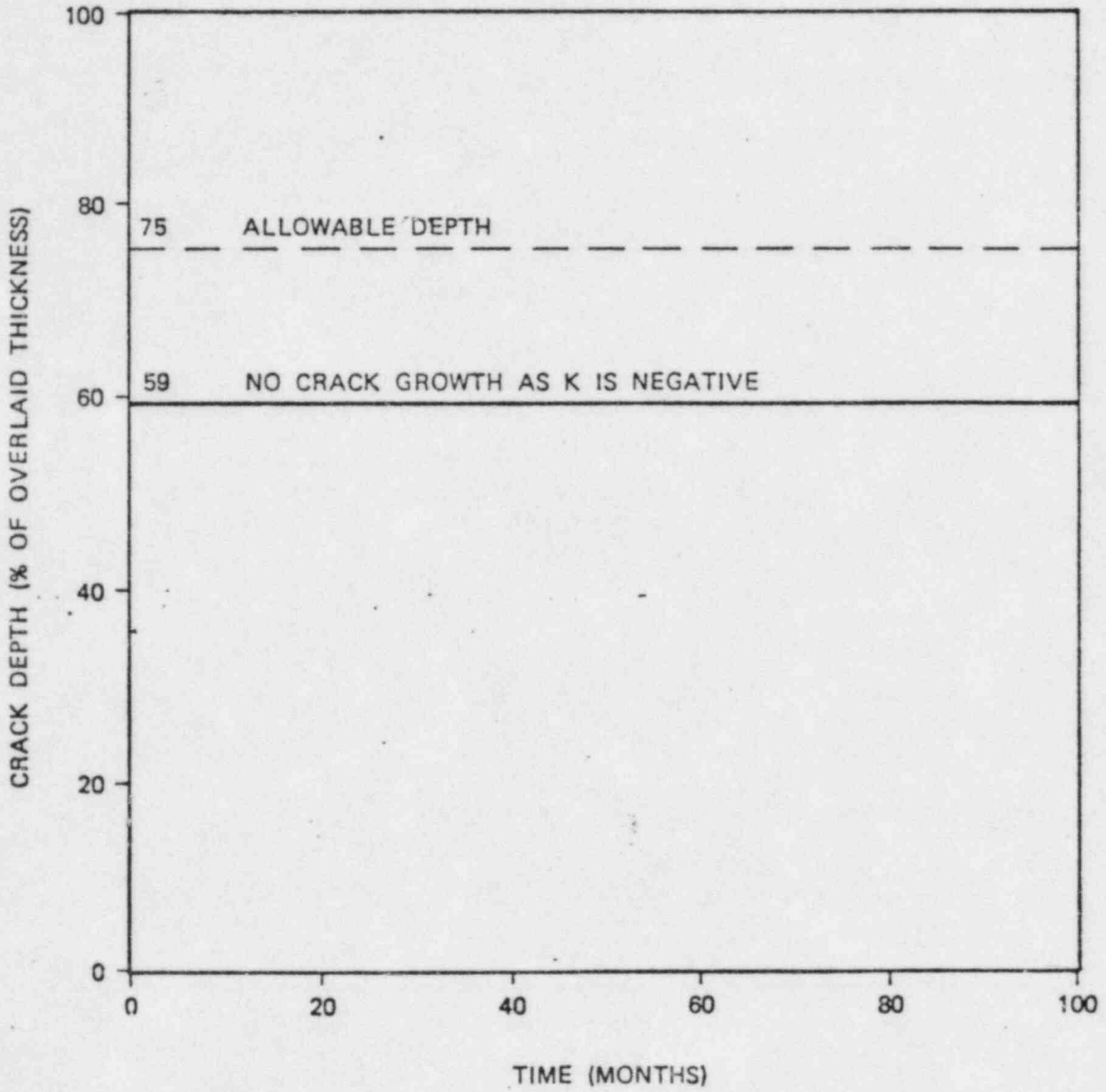

Figure 2

CRACK GROWTH FOR CATEGORY 1

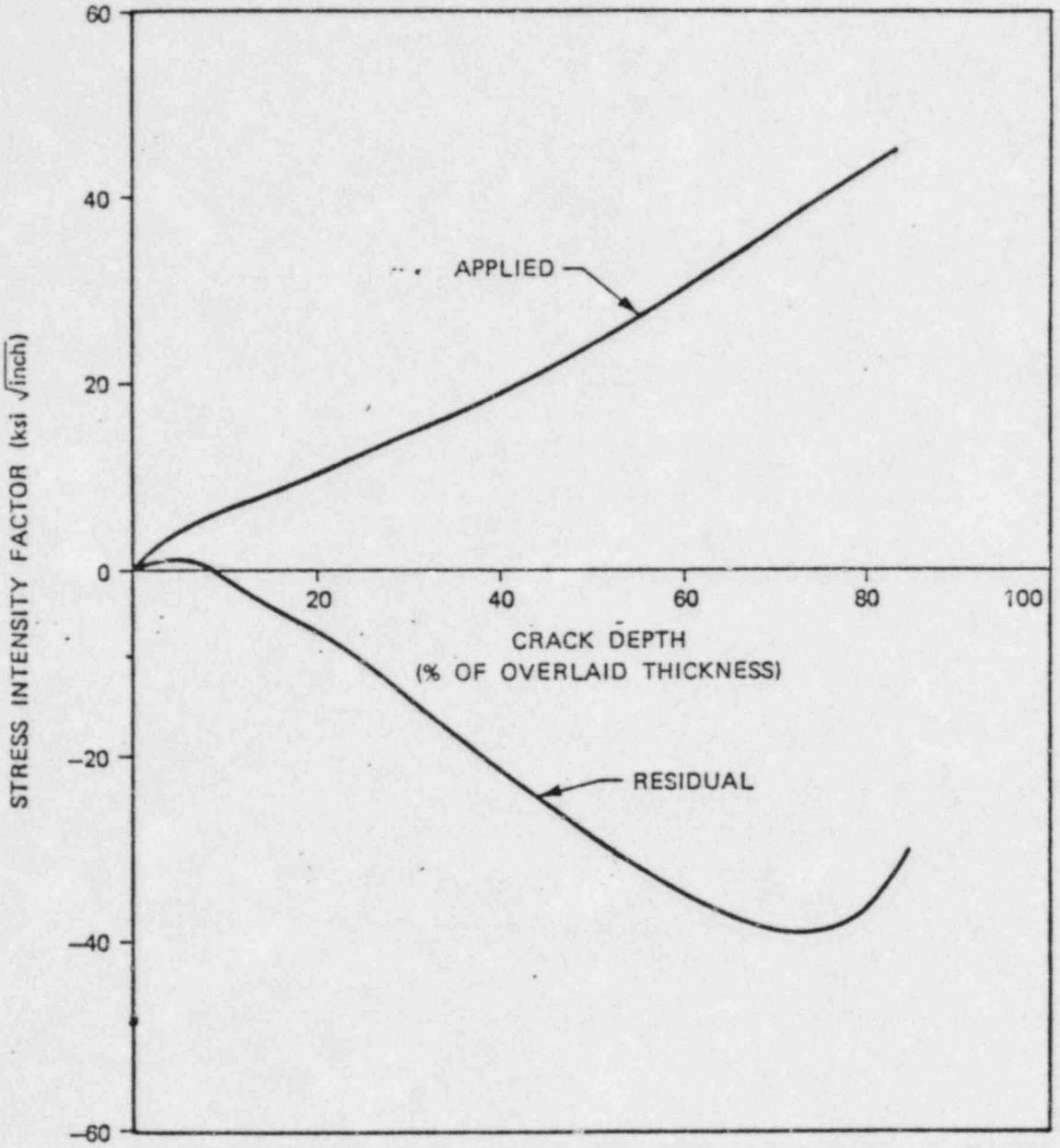

Figure 3

STRESS INTENSITY FACTOR FOR CATEGORY 2

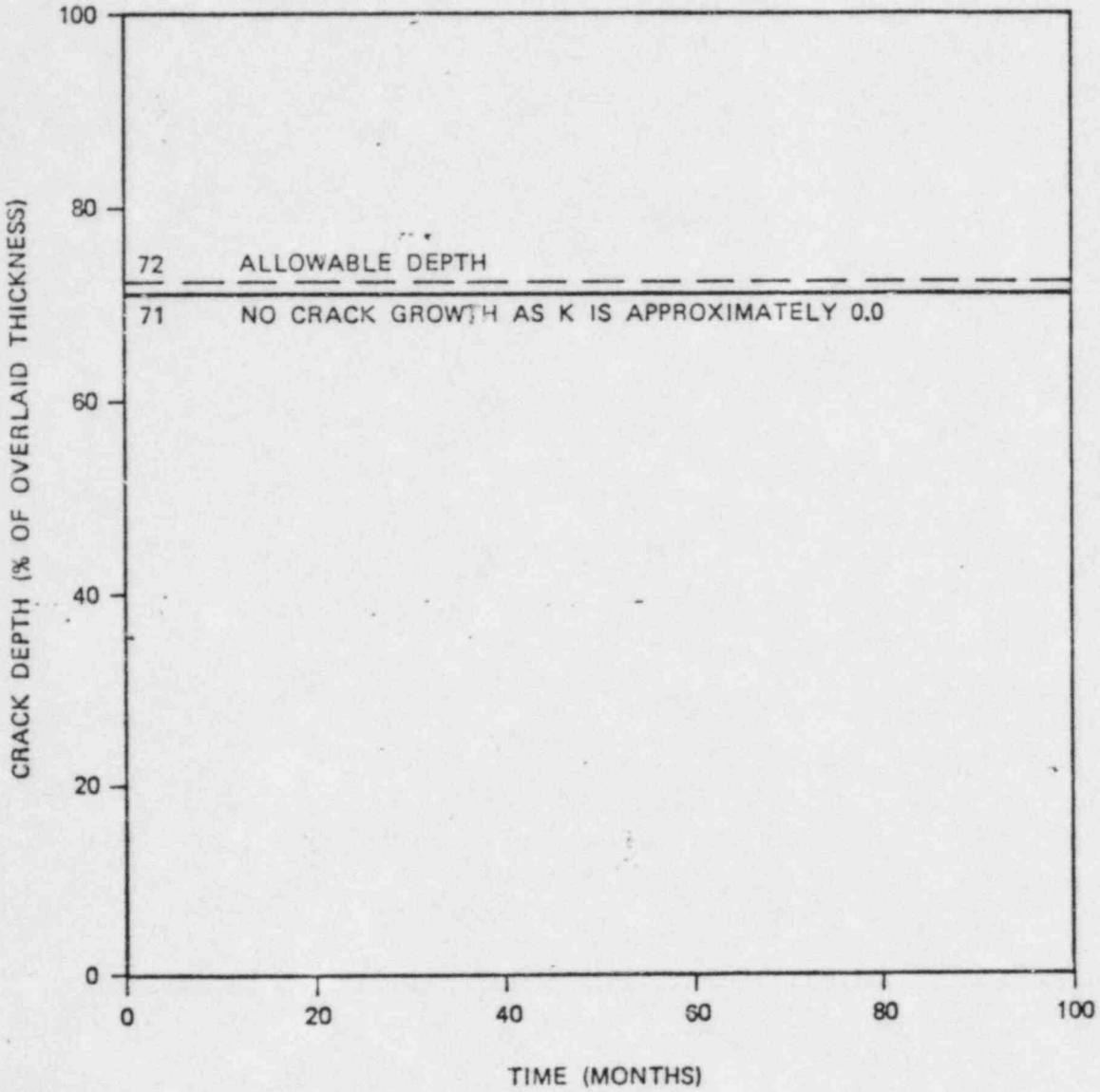

Figure 4

CRACK GROWTH FOR CATEGORY 2

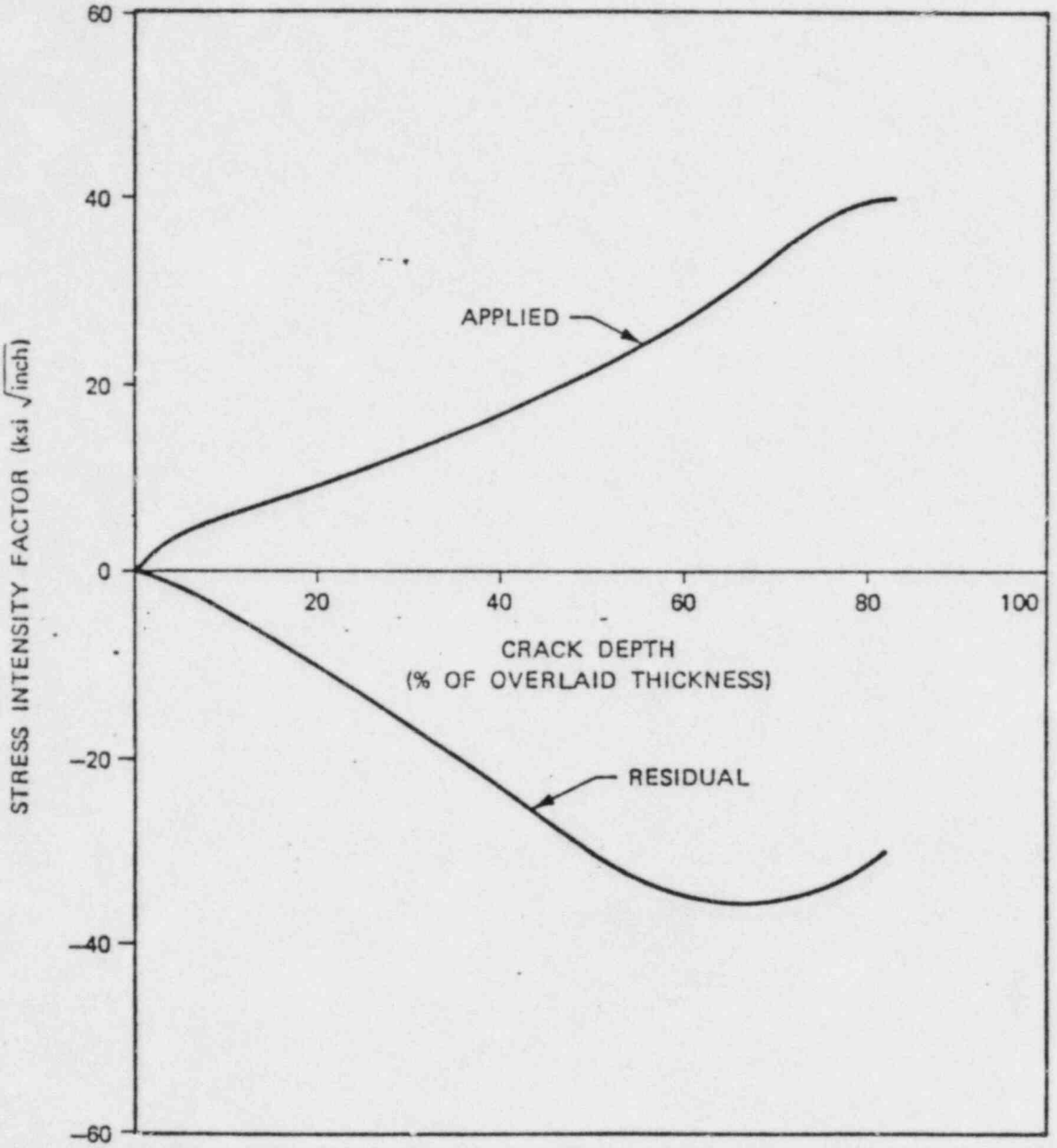

Figure 5

STRESS INTENSITY FACTOR FOR CATEGORY 3

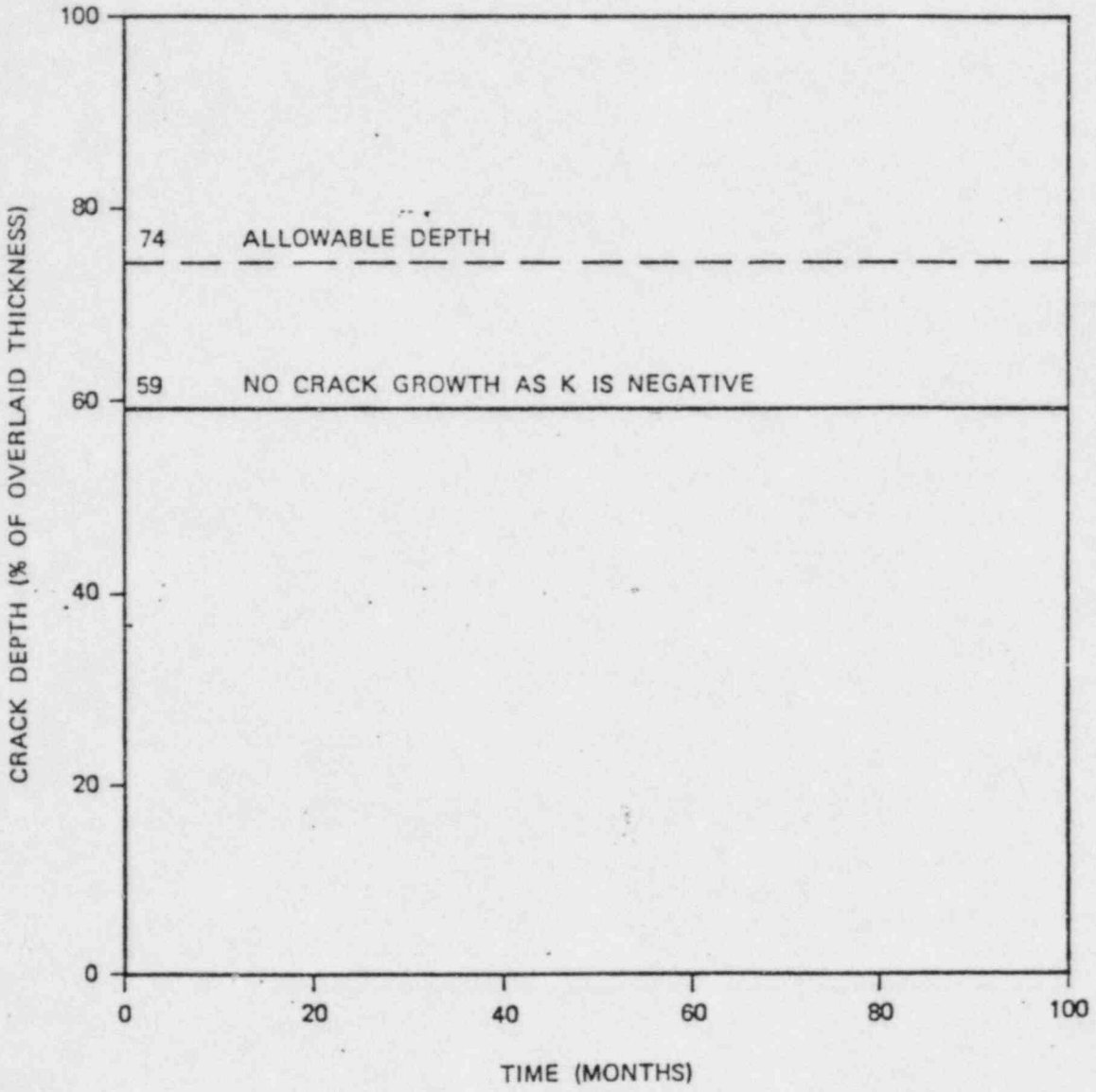

Figure 6

CRACK GROWTH FOR CATEGORY 3

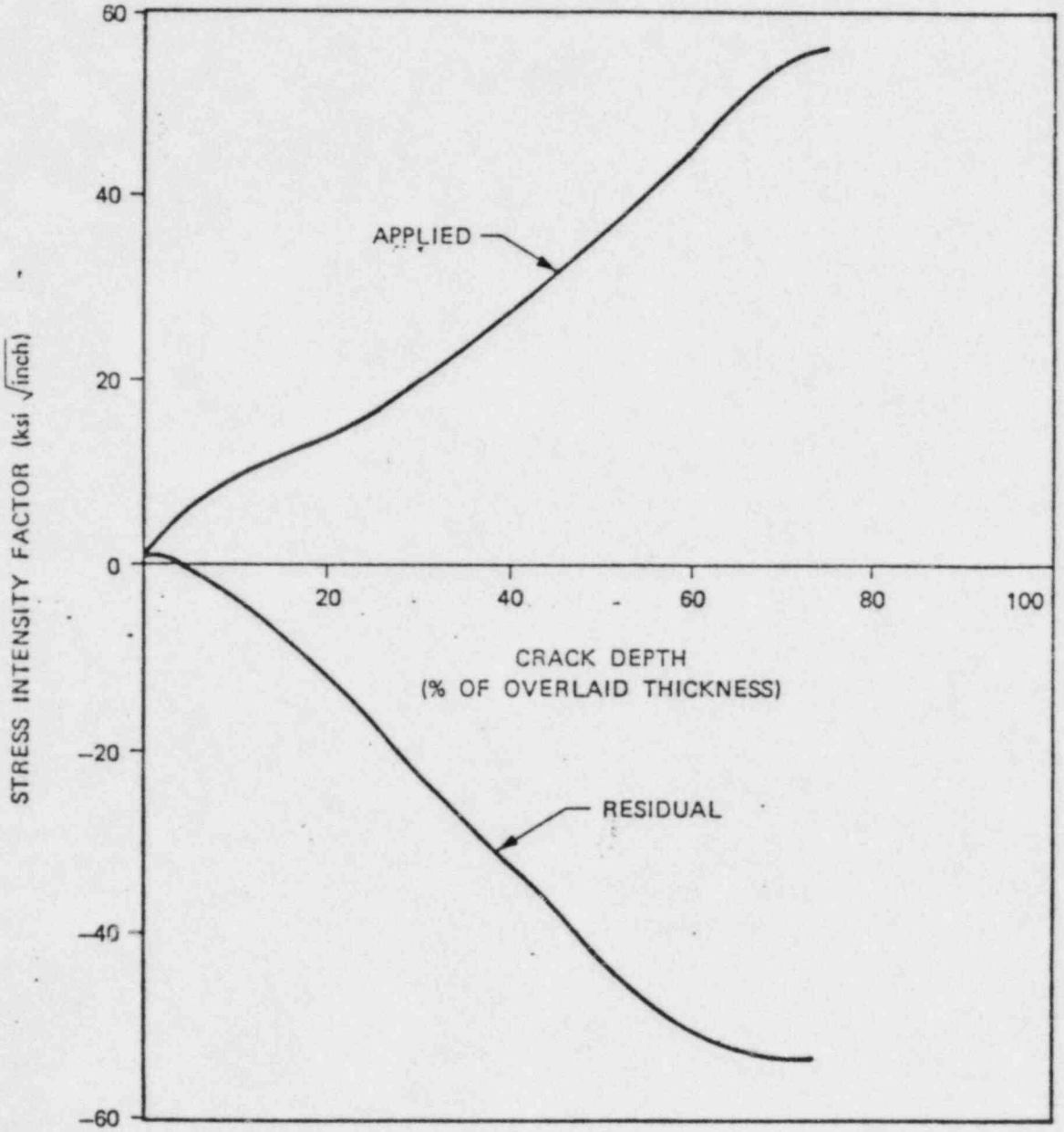

Figure 7

STRESS INTENSITY FACTOR FOR CATEGORY 4

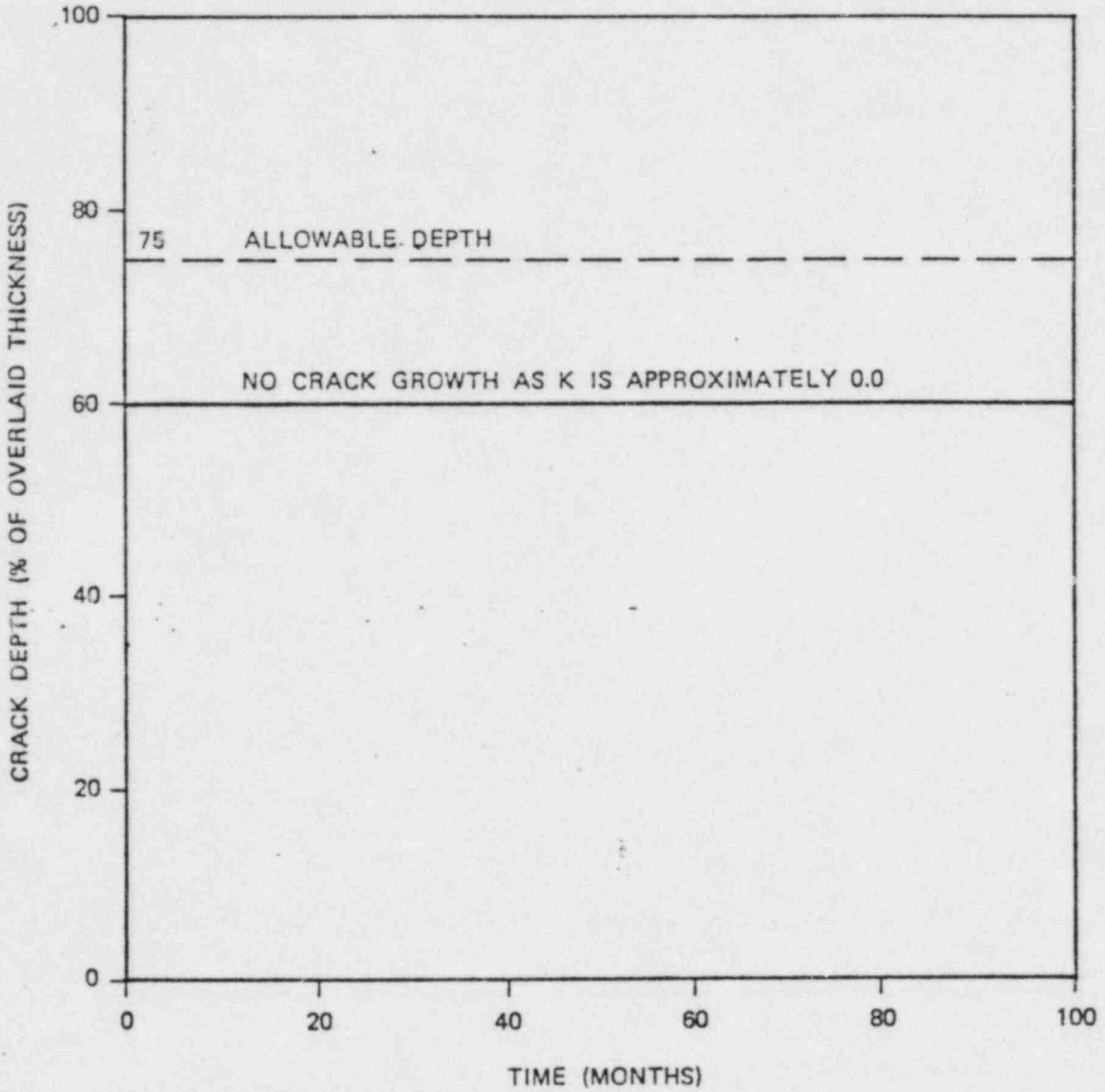

Figure 8

CRACK GROWTH FOR CATEGORY 4

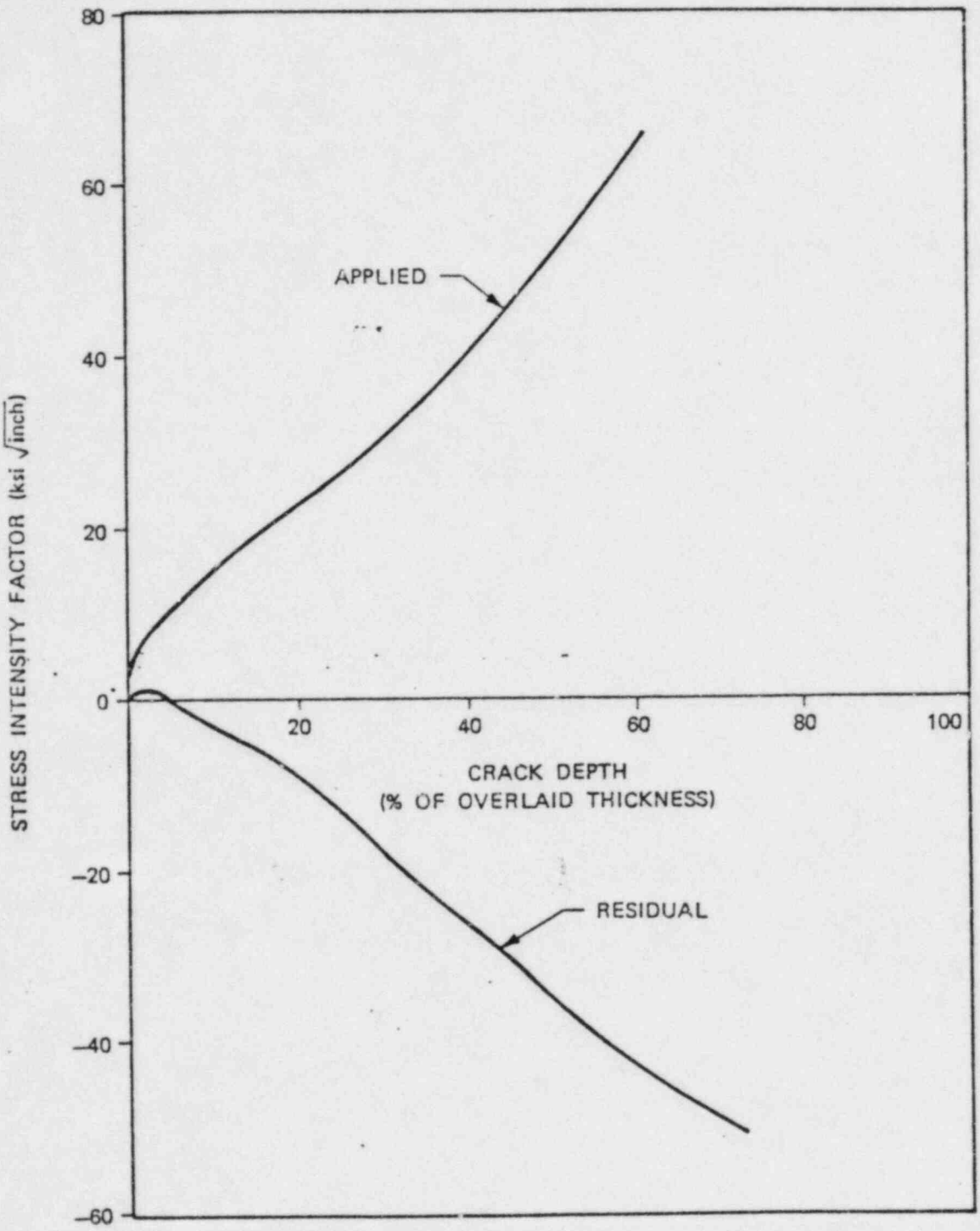

Figure 9

STRESS INTENSITY FACTOR FOR CATEGORY 5

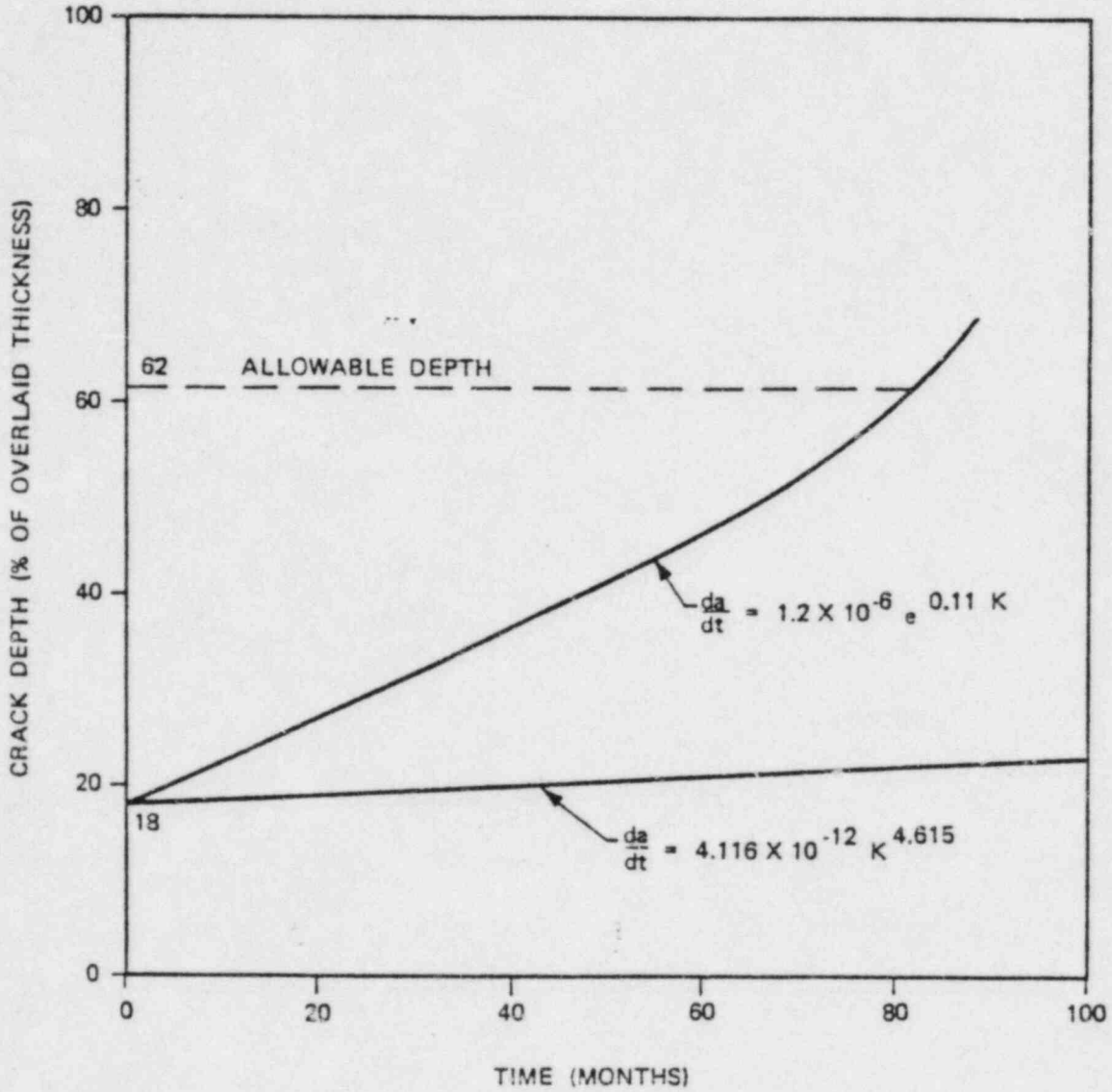

Figure 10

CRACK GROWTH FOR CATEGORY E

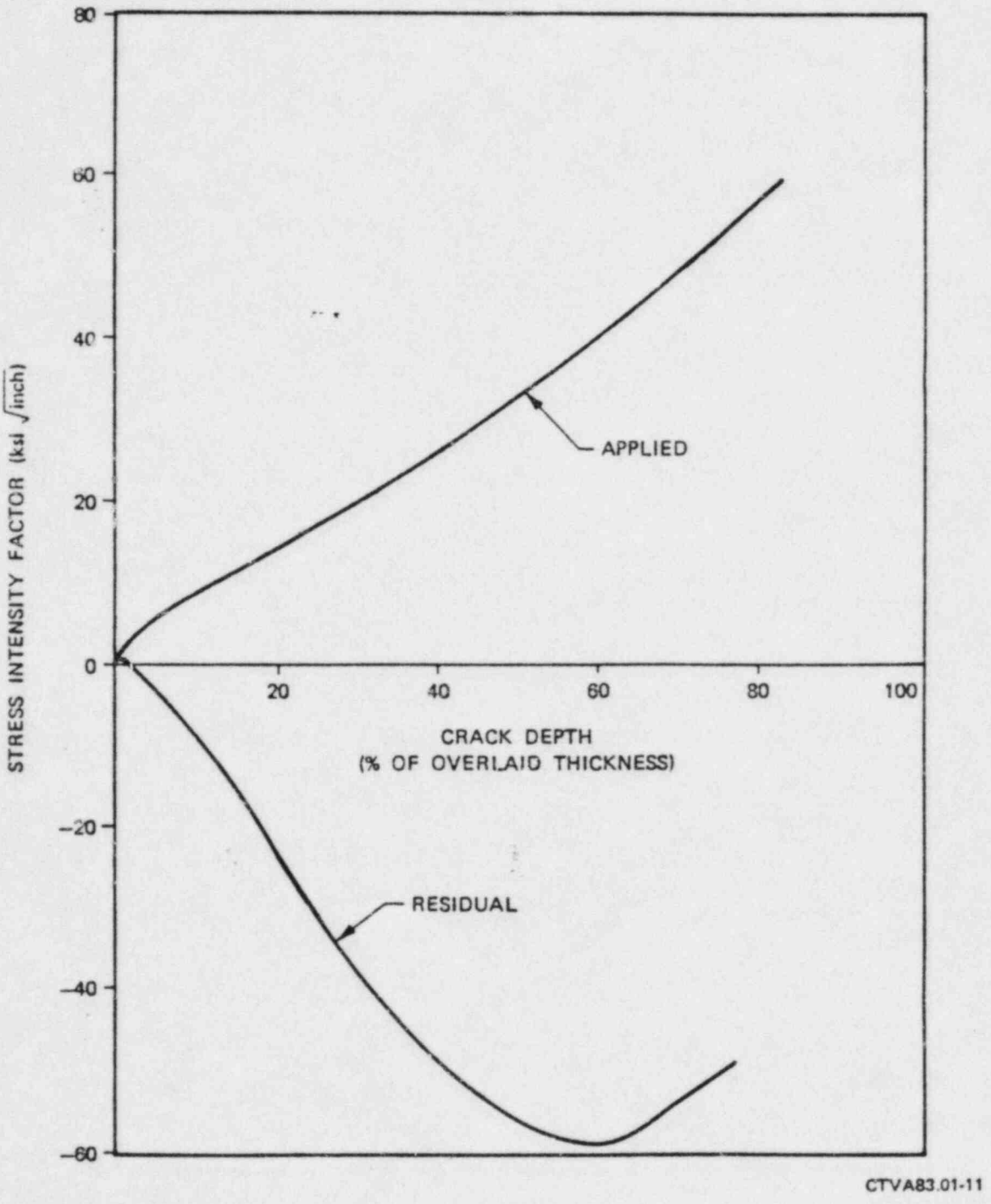

Figure 11

STRESS INTENSITY FACTOR FOR CATEGORY 6

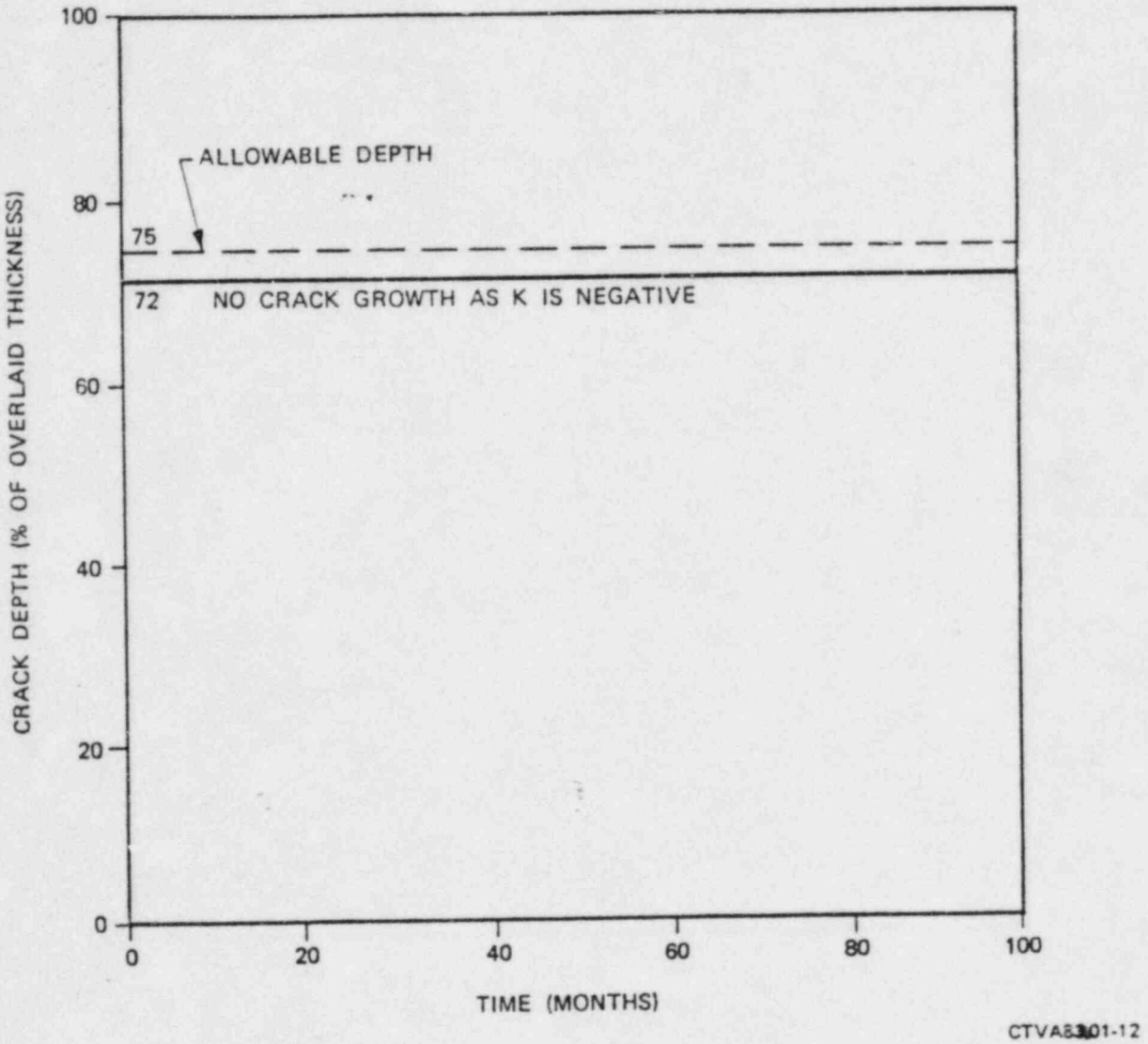

Figure 12

CRACK GROWTH FOR CATEGORY 6

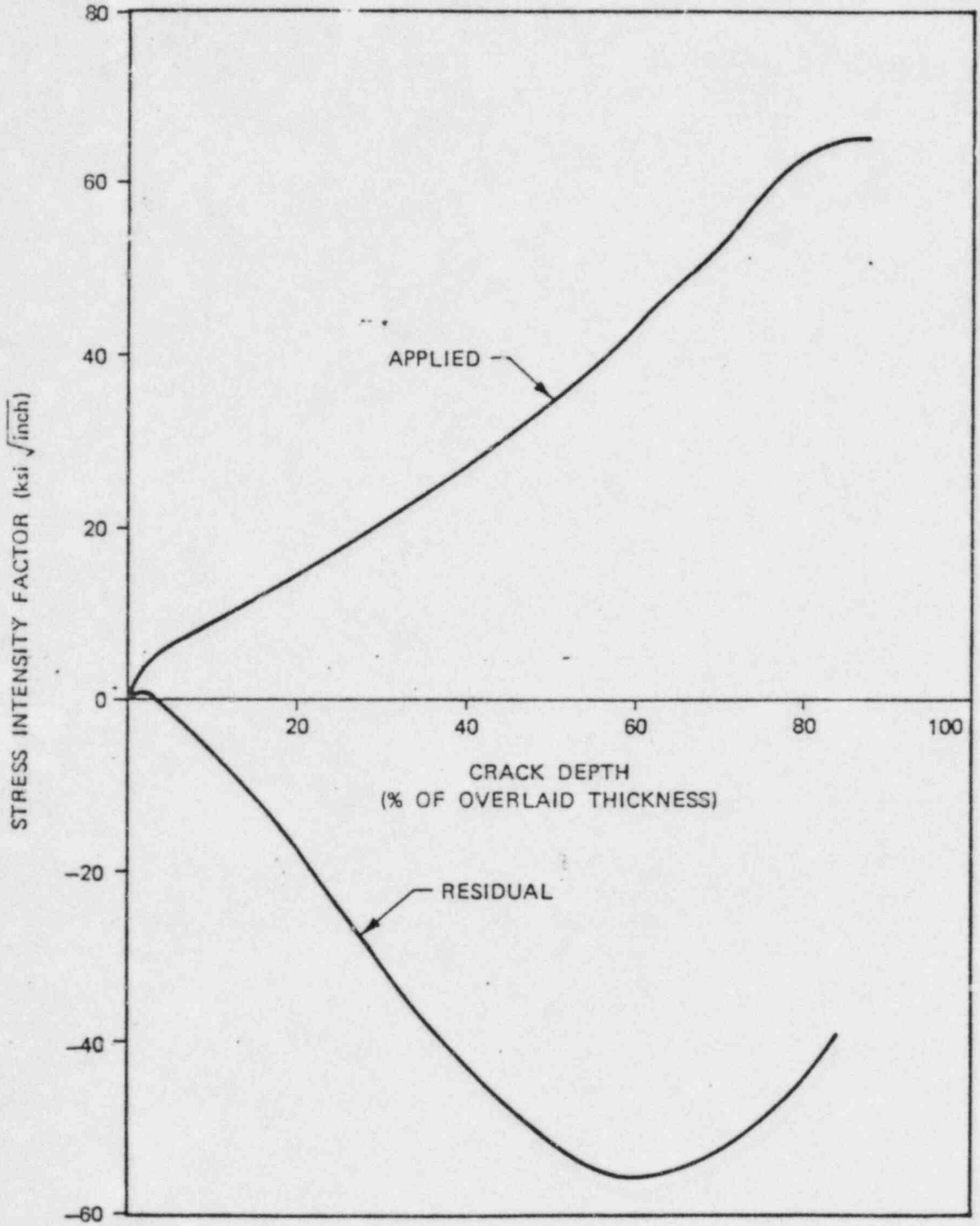

Figure 13

STRESS INTENSITY FACTOR FOR CATEGORY 7

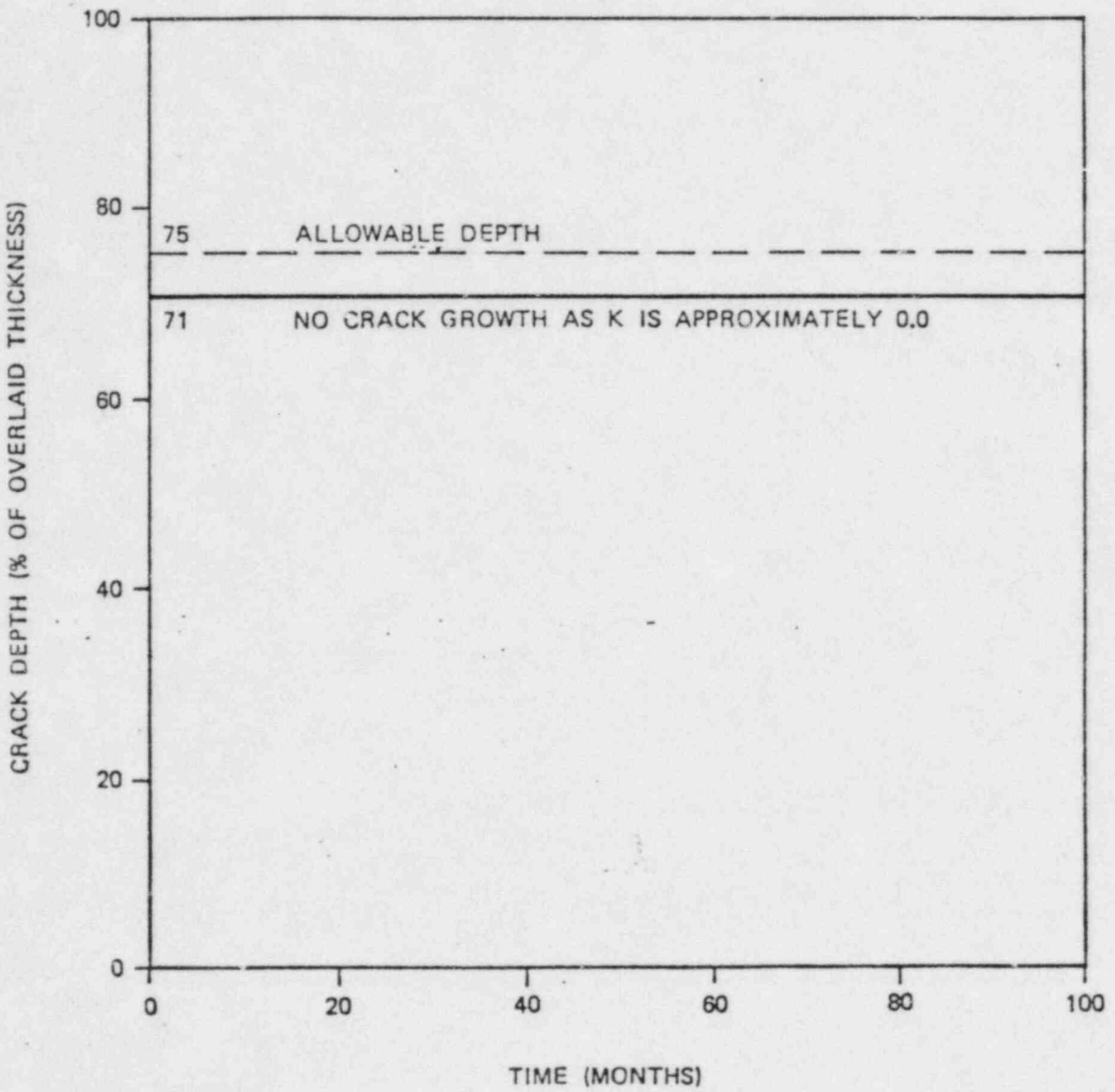

Figure 14

CRACK GROWTH FOR CATEGORY 7