

CALLAWAY PLANT
ENGINEERING DEPARTMENTAL PROCEDURE
EDP-ZZ-00005
ASSESSING CORE DAMAGE

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APPROVED BY W H Suggard DATE 5/17/84
DATE ISSUED _____

This procedure contains the following:

Pages	<u>1</u>	through	<u>4</u>
Attachments	<u>1</u>	through	<u>23</u>
Appendices	_____	through	_____
Checklist	_____	through	_____

ASSESSING CORE DAMAGE

1.0 PURPOSE AND SCOPE

- 1.1 This procedure provides a methodology for determining the extent of core damage following an accident using the Post Accident Sampling System (PASS). Preliminary estimates may also be made based on H₂ concentration in the containment, core exit thermocouple readings, reactor vessel water level, and containment radiation readings.

2.0 DEFINITIONS

- 2.1 Clad damage - Clad damage is characterized by the release of fission products which have accumulated in the gap between the clad and the fuel. The fission products which diffuse to this gap are the volatile ones such as the noble gases, the iodines, and the cesiums.
- 2.2 Fuel overheating - Fuel overheating is characterized by grain boundary release and diffusion from the UO₂ grains. This is estimated to be 20-40% of the noble gas, iodine and cesium inventories.
- 2.3 Fuel melt - Fuel melt leads to rapid release of many noble gases, halides and cesiums remaining in the fuel after overheating. Significant release of the strontium and barium - lanthanum groups distinguishes this condition.

3.0 NOTES AND PRECAUTIONS

- 3.1 This procedure may be copied so that it can be used more than once. Attachment 1 will have to be copied for each isotope to be used in the analysis.

- 3.2 During accident conditions, it is not known in what order that information will become available. Therefore, this procedure does not have to be completed in the order that it is written.
- 3.3 If hydrogen recombiners or the hydrogen purge system are operating, core damage estimates based on hydrogen in the containment may be inaccurate.
- 3.4 Use as many indications as possible to differentiate between the various core damage states. Because of overlapping values of release and potential simultaneous conditions of clad damage, overtemperature, and core melt, considerable judgement needs to be applied.
- 4.0 PROCEDURE
- 4.1 Obtain an estimate of core damage using containment hydrogen concentration, core exit thermocouple readings, reactor vessel water level, and the containment radiation monitor.
- 4.1.1 Hydrogen Concentration
- 4.1.1.1 Record containment hydrogen concentration.

- 4.1.1.2 From Attachment 9, obtain the % zirconium-water reaction and record here.

- 4.1.2 Core Exit Thermocouple Readings
- 4.1.2.1 From Attachment 8, estimate the core damage based on core exit thermocouple readings. Core damage: _____
- 4.1.3 Reactor Vessel Water Level

! 4.1.3.1 Record the duration of core uncoverly.

Duration: _____ minutes

! 4.1.3.2 From Attachment 8, estimate whether core
! damage has occurred based on core uncoverly.

Core damage: _____

4.1.4 Containment Radiation Monitor

4.1.4.1 Record the Containment Radiation Monitor
level R = _____ R/hr.

! 4.1.4.2 Record the 30-day average power (from
Attachment 2) P= _____%

4.1.4.3 Calculate the normalized dose rate

! Normalized Dose Rate = $3.66 \times 10^{-4} \times R \times \frac{100\%}{P} =$
_____ R/hr -Mwt

4.1.4.4 Record the time since the accident .
_____ hours.

4.1.4.5 Using Attachment 10, estimate the core
damage.

Core damage: _____

4.2 Estimation of core damage using PASS sample
results.

4.2.1 As sample results become available, complete
a copy of Attachment 1 for each isotope. If
an estimation of core damage was made in
4.1, then preference should be given to
those isotopes which are indicative of that
type of core damage. Attachment 3 provides
a list for this purpose.

4.2.2 Using the percentage of inventory released
and the fission product ratio from Attach-
ment 1, and using Attachment 8 and 11 to 23,
estimate the damage and record below.

CALCULATION OF PERCENT
OF CORE INVENTORY RELEASED

- 1.0 Isotope _____
- 1.1 Decay constant (from Attachment 3) $\lambda =$ _____
- 1.2 Half-life (from Attachment 3) $T_{1/2} =$ _____
- 2.0 Time and date of shutdown _____.

3.0 POWER CORRECTION FACTOR

- 3.1 Determine the power history using Attachment 2.
- 3.2 For steady-state power (except Cs-134), complete the appropriate section of 3.3. For transient power history (except Cs-134), complete the appropriate section of 3.4. For Cs-134, complete 3.5

3.3 STEADY STATE EXCEPT Cs-134

3.3.1 Half Life < 1 day

Power Correction Factor (PCF) =

$$\frac{\text{Steady state power percentage for prior 4 days}}{100} = \underline{\hspace{2cm}}$$

3.3.2 Half Life > 1 day

Power Correction Factor (PCF) =

$$\frac{\text{Steady state power percentage for prior 30 days}}{100} = \underline{\hspace{2cm}}$$

! 3.3.3 Half Life \geq 1 year

Power Correction Factor (PCF) = $\frac{\text{EFPD}}{\text{Total days of operation}} = \underline{\hspace{2cm}}$

! 3.4 TRANSIENT EXCEPT Cs-134

! 3.4.1 Total period of operation > 4 x T_{1/2}

Power Correction Factor (PCF) =
$$\frac{\sum_j [P_j (1 - e^{-\lambda t_j}) e^{-\lambda t^{\circ j}}]}{100} = \underline{\hspace{2cm}}$$

! where t_j = operating period in hours at power P_j where power does not vary more than ±10 percent power from time average value (P_j)
 P_j = percent power during operating period t_j
 t^{°j} = time between end of period j and time of reactor shutdown in hours.

! 3.4.2 Remaining transient cases

Power Correction Factor (PCF) =
$$\frac{\sum_j [P_j (1 - e^{-\lambda t_j}) e^{-\lambda t^{\circ j}}]}{100(1 - e^{-\lambda \sum_j t_j})} = \underline{\hspace{2cm}}$$

! 3.4.3 T_{1/2} ≥ 1 year

! Power Correction Factor (PCF) =
$$\frac{\text{EFPD}}{\text{Total days of operation}} = \underline{\hspace{2cm}}$$

! 3.5 POWER CORRECTION FACTOR FOR CS-134

Power Correction Factor (from Attachment 6) =
 (Use average power during entire period of operation from Attachment 2)

4.0 RCS ACTIVITY

4.1 Sample Data

4.1.1 Time and date of RCS sample

! 4.1.2 Time since shutdown t = (hours)

4.1.3 RCS volume (from Attachment 4) V = ft³

4.1.4 RCS temperature TI = °F.

4.1.5 RCS water density ratio (from Attachment 7) ρ_l/ρ_{stp} =

- 4.1.6 Sample result $C_m = \underline{\hspace{2cm}}$ $\mu\text{Ci/cc}$
- 4.1.7 Sample temperature $T_2 = \underline{\hspace{2cm}}$ $^{\circ}\text{F}$
- 4.1.8 Sample water density ratio (from Attachment 7)
 $\rho_2/\rho_{\text{stp}} = \underline{\hspace{2cm}}$

4.2 Decay correction of sample to time of reactor shutdown

4.2.1 $C_c = C_m e^{\lambda t} = \underline{\hspace{2cm}}$ $\mu\text{Ci/cc}$

! 4.3 Parent-Daughter Correction Factor Fr

! NOTE For isotopes which must have a
 ! parent-daughter correction
 ! factor applied, the parent
 ! isotopes are listed in Attach-
 ! ment 3. If no parent isotope
 ! is listed, then $Fr=1$. If 2
 ! isotopes are listed as parents,
 ! then a correction factor must
 ! be calculated for each parent
 ! (Fr_A and Fr_B).

! 4.3.1 Fr_A

! 4.3.1.1 Parent isotope A (from Attachment 3)
 ! $\underline{\hspace{2cm}}$

! 4.3.1.2 Parent isotope A decay constant (from Attach-
 ! ment 3) $\lambda_A = \underline{\hspace{2cm}}$

! 4.3.1.3 Parent isotope A 100% source inventory (from
 ! Attachment 3) $Q_A^0 = \underline{\hspace{2cm}}$

! 4.3.1.4 Daughter isotope 100% source inventory (from
 ! Attachment 3) $Q^0 = \underline{\hspace{2cm}}$

! 4.3.1.5 Decay Branching Factor (from Attachment 3) $K_A =$
 ! $\underline{\hspace{2cm}}$

! 4.3.1.6 $Fr_A = K_A \left(\frac{\lambda}{\lambda - \lambda_A} \right) Q_A^0 \left(e^{-\lambda_A t} - e^{-\lambda t} \right) = \underline{\hspace{2cm}}$

! 4.3.2 Fr_B ($Fr_B = 0$ if only one parent is listed in
 ! Attachment 3)

! 4.3.2.1 Parent isotope B (from Attachment 3) $\underline{\hspace{2cm}}$

! 4.3.2.2 Parent isotope B decay constant (from Attachment 3) $\lambda_B =$ _____

! 4.3.2.3 Parent isotope B 100% source inventory (from Attachment 3) $Q_B^0 =$ _____

! 4.3.2.4 Decay Branching Factor (from Attachment 3) $K_B =$ _____

! 4.3.2.5
$$Fr_B = K_B \left(\frac{\lambda}{\lambda - \lambda_B} \right) Q_B^0 \left(e^{-\lambda_B t} - e^{-\lambda t} \right) =$$

! 4.3.3
$$Fr = \frac{Q^0 e^{-\lambda t}}{Q^0 e^{-\lambda t} + Fr_A + Fr_B}$$

! 4.3.4 Corrected sample activity

! $C_F = C_C \times Fr =$ _____ $\mu\text{Ci/cc}$

! 4.4 Temperature correction of sample

! 4.4.1
$$C = C_F \times \frac{\rho_1 / \rho_{stp}}{\rho_2 / \rho_{stp}} =$$
 _____ $\mu\text{Ci/cc}$

! 4.5 RCS Activity A(RC)

! 4.5.1 $A(\text{RC}) = V \times C \times 2.83 \times 10^4 =$ _____ Ci

5.0 CONTAINMENT SUMP ACTIVITY

5.1 Sample Data

5.1.1 Time and date of containment sump sample _____

! 5.1.2 Time since shutdown $t =$ _____ (hours)

5.1.3 Containment sump volume (from Attachment 5)
 $V =$ _____ ft^3

5.1.4 Containment sump temperature $T_1 =$ _____ $^{\circ}\text{F}$

5.1.5 Containment sump water density ratio (from Attachment 7)

$\rho^1 / \rho_{stp} =$ _____

5.1.6 Sample result $C_m =$ _____ $\mu\text{Ci/cc}$

- 5.1.7 Sample temperature T2 = _____ °F
- 5.1.8 Sample water density ratio (from Attachment 7)
 ! $\rho_2/\rho_{stp} =$ _____
- 5.2 Decay correction of sample to time of reactor shutdown
- 5.2.1 $Cc = Cm \times e^{\lambda t} =$ _____ $\mu\text{Ci/cc}$
- ! 5.3 Parent-Daughter Correction Factor Fr
- ! NOTE For isotopes which must have a
 ! parent-daughter correction
 ! factor applied, the parent
 ! isotopes are listed in Attach-
 ! ment 3. If no parent isotope
 ! is listed, then Fr=1. If 2
 ! isotopes are listed as parents,
 ! then a correction factor must
 ! be calculated for each parent
 ! (Fr_A and Fr_B).
- ! 5.3.1 Fr_A
- ! 5.3.1.1 Parent isotope A (from Attachment 3)
 ! _____
- ! 5.3.1.2 Parent isotope A decay constant (from Attach-
 ! ment 3) $\lambda_A =$ _____
- ! 5.3.1.3 Parent isotope A 100% source inventory (from
 ! Attachment 3) $Q_A^0 =$ _____
- ! 5.3.1.4 Daughter isotope 100% source inventory (from
 ! Attachment 3) $Q^0 =$ _____
- ! 5.3.1.5 Decay Branching Factor (from Attachment 3) $K_A =$
 ! _____
- ! 5.3.1.6 $Fr_A = K_A \left(\frac{\lambda}{\lambda - \lambda_A} \right) Q_A^0 \left(e^{-\lambda_A t} - e^{-\lambda t} \right) =$ _____
- ! 5.3.2 Fr_B (Fr_B = 0 if only one parent is listed in
 ! Attachment 3)
- ! 5.3.2.1 Parent isotope B (from Attachment 3) _____
- ! 5.3.2.2 Parent isotope B decay constant (from Attach-
 ! ment 3) $\lambda_B =$ _____

! 5.3.2.3 Parent isotope B 100% source inventory (from Attachment 3) $Q_B^0 =$ _____

! 5.3.2.4 Decay Branching Factor (from Attachment 3) $K_B =$ _____

! 5.3.2.5 $Fr_B = K_B \left(\frac{\lambda}{\lambda - \lambda_B} \right) Q_B^0 \left(e^{-\lambda_B t} - e^{-\lambda t} \right) =$ _____

! 5.3.3 $Fr = \frac{Q^0 e^{-\lambda t}}{Q_e^{-\lambda t} + Fr_A + Fr_B}$

! 5.3.4 Corrected sample activity

! $C_F = C_C \times Fr =$ _____ $\mu\text{Ci/cc}$

! 5.4 Temperature correction of sample

! 5.4.1 $C = C_F \times \frac{\rho_1 / \rho_{stp}}{\rho_2 / \rho_{stp}} =$ _____ $\mu\text{Ci/cc}$

! 5.5 Containment Sump Activity A(CS)

! 5.5.1 $A(\text{CS}) = V \times C \times 2.83 \times 10^4$ _____ Ci

6.0 CONTAINMENT ATMOSPHERE ACTIVITY

6.1 Sample Data

6.1.1 Time and date of containment atmosphere sample _____

! 6.1.2 Time since shutdown $t =$ _____ (hours)

6.1.3 Containment atmosphere temperature $T1 =$ _____ $^{\circ}\text{F}$

6.1.4 Containment atmosphere pressure $P1 =$ _____ psia

6.1.5 Sample result $Cm =$ _____ $\mu\text{Ci/cc}$

6.1.6 Sample temperature $T2 =$ _____ $^{\circ}\text{F}$

6.1.7 Sample pressure $P2 =$ _____ psia

6.2 Decay correction of sample to time of reactor shutdown

6.2.1 $Cc = Cme^{\lambda t} = \text{_____} \mu\text{Ci/cc}$

! 6.3 Parent-Daughter Correction Factor Fr

! NOTE For isotopes which must have a
 ! parent-daughter correction
 ! factor applied, the parent
 ! isotopes are listed in Attach-
 ! ment 3. If no parent isotope
 ! is listed, then Fr=1. If 2
 ! isotopes are listed as parents,
 ! then a correction factor must
 ! be calculated for each parent
 ! (Fr_A and Fr_B).

! 6.3.1 Fr_A

! 6.3.1.1 Parent isotope A (from Attachment 3)
 ! _____

! 6.3.1.2 Parent isotope A decay constant (from Attach-
 ! ment 3) $\lambda_A = \text{_____}$

! 6.3.1.3 Parent isotope A 100% source inventory (from
 ! Attachment 3) $Q_A^0 = \text{_____}$

! 6.3.1.4 Daughter isotope 100% source inventory (from
 ! Attachment 3) $Q^0 = \text{_____}$

! 6.3.1.5 Decay Branching Factor (from Attachment 3) $K_A =$
 ! _____

! 6.3.1.6 $Fr_A = K_A \left(\frac{\lambda}{\lambda - \lambda_A} \right) Q_A^0 \left(e^{-\lambda_A t} - e^{-\lambda t} \right) = \text{_____}$

! 6.3.2 Fr_B ($Fr_B = 0$ if only one parent is listed in
 ! Attachment 3)

! 6.3.2.1 Parent isotope B (from Attachment 3) _____

! 6.3.2.2 Parent isotope B decay constant (from Attach-
 ! ment 3) $\lambda_B = \text{_____}$

! 6.3.2.3 Parent isotope B 100% source inventory (from
 ! Attachment 3) $Q_B^0 = \text{_____}$

! 6.3.2.4 Decay Branching Factor (from Attachment 3) $K_B = \text{_____}$

! 6.3.2.5 $Fr_B = K_B \left(\frac{\lambda}{\lambda - \lambda_B} \right) Q_B^0 \left(e^{-\lambda_B t} - e^{-\lambda t} \right) = \text{_____}$

! 6.3.3

$$Fr = \frac{Q^{\circ} e^{-\lambda t}}{Q_e^{-\lambda t} + Fr_A + Fr_B}$$

! 6.3.4 Corrected sample activity

! $C_F = C_C \times Fr = \underline{\hspace{2cm}} \text{ mCi/cc}$

! 6.4 Temperature and pressure correction of sample

! 6.4.1 $C = C_F \times \frac{P_1}{P_2} \times \frac{(T_2 + 460)}{(T_1 + 460)} = \underline{\hspace{2cm}} \text{ mCi/cc}$

! 6.5 Containment Atmosphere Activity A(CA)

! 6.5.1 $A(CA) = C \times 7.075 \times 10^4 = \underline{\hspace{2cm}} \text{ Ci}$

7.0 TOTAL ACTIVITY A

7.1 $A = A(RC) + A(CS) + A(CA) = \underline{\hspace{2cm}} \text{ Ci}$

8.0 INVENTORY AVAILABLE FOR RELEASE

8.1 Uncorrected inventory (from Attachment 3)

! $Q^{\circ} = \underline{\hspace{2cm}} \text{ Ci}$

8.2 Power Correction Factor (from section 3)

PCF =

! 8.3 Corrected inventory $Q_C^{\circ} = PCF \times Q^{\circ} = \underline{\hspace{2cm}} \text{ Ci}$

9.0 PERCENTAGE OF INVENTORY RELEASED

! 9.1 Percentage of inventory released = $\frac{A}{Q_C^{\circ}} \times 100\% = \underline{\hspace{2cm}} \%$

10.0 ACTIVITY RATIO

10.1 If the isotope is a noble gas, complete 10.2.
 If the isotope is an isotope of iodine, complete 10.3. Otherwise don't complete this section.

10.2 Noble gas ratio = $A/A(\text{Xe-133}) = \underline{\hspace{2cm}}$

! 10.3 Iodine ratio = $A/A(\text{I-131}) = \underline{\hspace{2cm}}$

POWER HISTORY

1.	<u>30-day power history</u>	
!	<u>Days Before Shutdown</u>	<u>Average Power(%)</u>
	1	_____
	2	_____
	3	_____
	4	_____
	5	_____
	6	_____
	7	_____
	8	_____
	9	_____
	10	_____
	11	_____
	12	_____
	13	_____
	14	_____
	15	_____
	16	_____
	17	_____
	18	_____
	19	_____
	20	_____
	21	_____
	22	_____
	23	_____
	24	_____
	25	_____
	26	_____
	27	_____
	28	_____
	29	_____
	30	_____
!	30-day average power	_____

2. Total number of days of operation D = _____

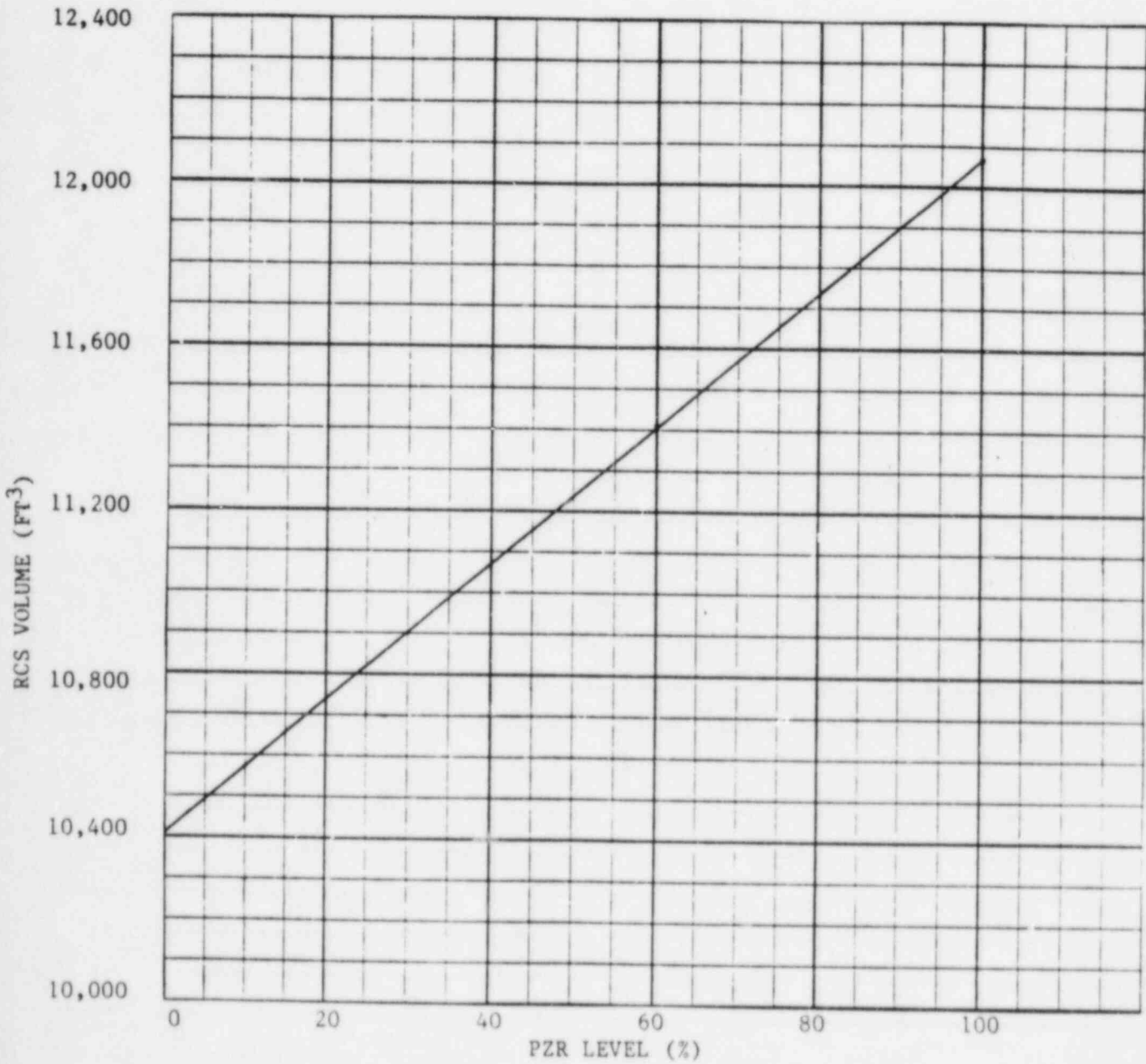
3. EFPD = _____

4. Average power during entire period of operation

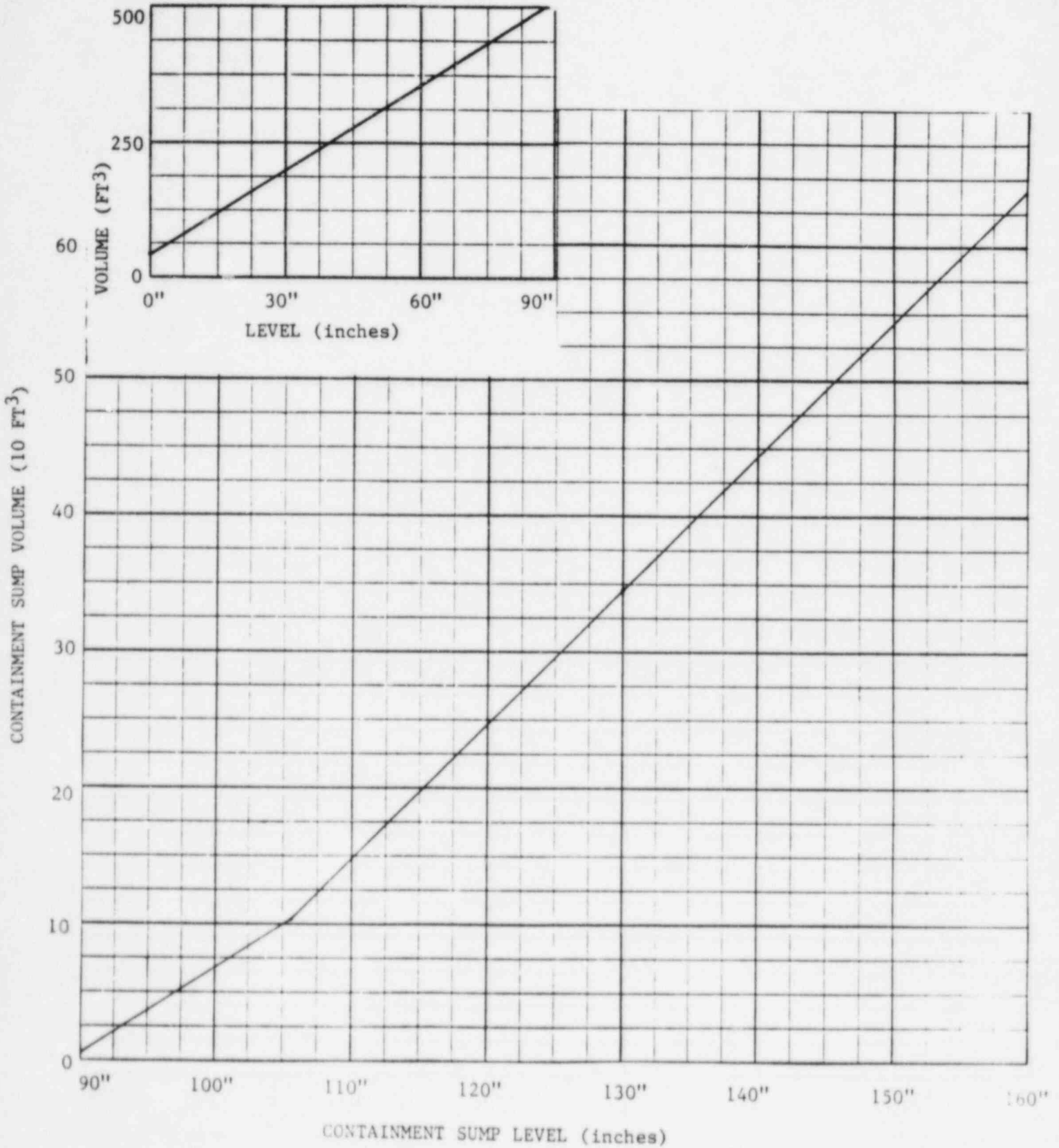
! $P = \frac{\text{EFPD}}{D} \times 100\% = \underline{\hspace{2cm}}$

NUCLIDE	T _{1/2}	λ	INVENTORY Q ⁰ (Curies)	PARENT	PARENT λ	PARENT INVENTORY (Curies)	BRANCHING DECAY FACTOR, K	CORE DAMAGE STATE
Kr-87	76m	.5472h ⁻¹	4.0E7					CLAD FAILURE
Rb-88	17.8m	2.336h ⁻¹	5.8E7	Kr-88	.248h ⁻¹	5.7E7	1.0	
Xe-131m	11.8d	2.45E-3h ⁻¹	6.3E5	I-131	3.59E-3h ⁻¹	9.8E7	.008	
Xe-133	5.27d	5.50E-3h ⁻¹	2.0E8	I-133	3.41E-2h ⁻¹	2.0E8	.976	
				Xe-133m	1.28E-2h ⁻¹	2.8E7	1.0	
I-131	8.05d	3.59E-3h ⁻¹	9.8E7					
I-132	2.26h	.3067h ⁻¹	1.4E8	Te-132	8.92E-3h ⁻¹	1.4E8	1.0	
I-133	20.3h	3.41E-2h ⁻¹	2.0E8					
I-135	6.68h	.104h ⁻¹	1.8E8					
CS-134	2y	3.96E-5h ⁻¹	2.3E7					
CS-137	30y	2.64E-6h ⁻¹	1.1E7					
Te-129	68.7m	.605h ⁻¹	3.3E7	Sb-129	.161h ⁻¹	3.2E7	.827	
				Te-129m	8.47E-4h ⁻¹	8.0E6	.680	
Te-132	77.7h	8.92E-3h ⁻¹	1.4E8					
Sr-89	52.7d	5.48E-4h ⁻¹	7.9E7					FUEL MELT
Ba-140	12.8d	2.25E-3h ⁻¹	1.7E8					
La-140	40.22h	1.72E-2h ⁻¹	1.8E8	Ba-140	2.25E-3h ⁻¹	1.7E8	1.0	
La-142	92.5m	.4496h ⁻¹	1.5E8	Ba-142	3.78h ⁻¹	1.6E8	1.0	
Pr-144	17.27m	2.408h ⁻¹	1.2E8	Ce-144	1.02E-4h ⁻¹	1.1E8	1.0	

RCS VOLUME

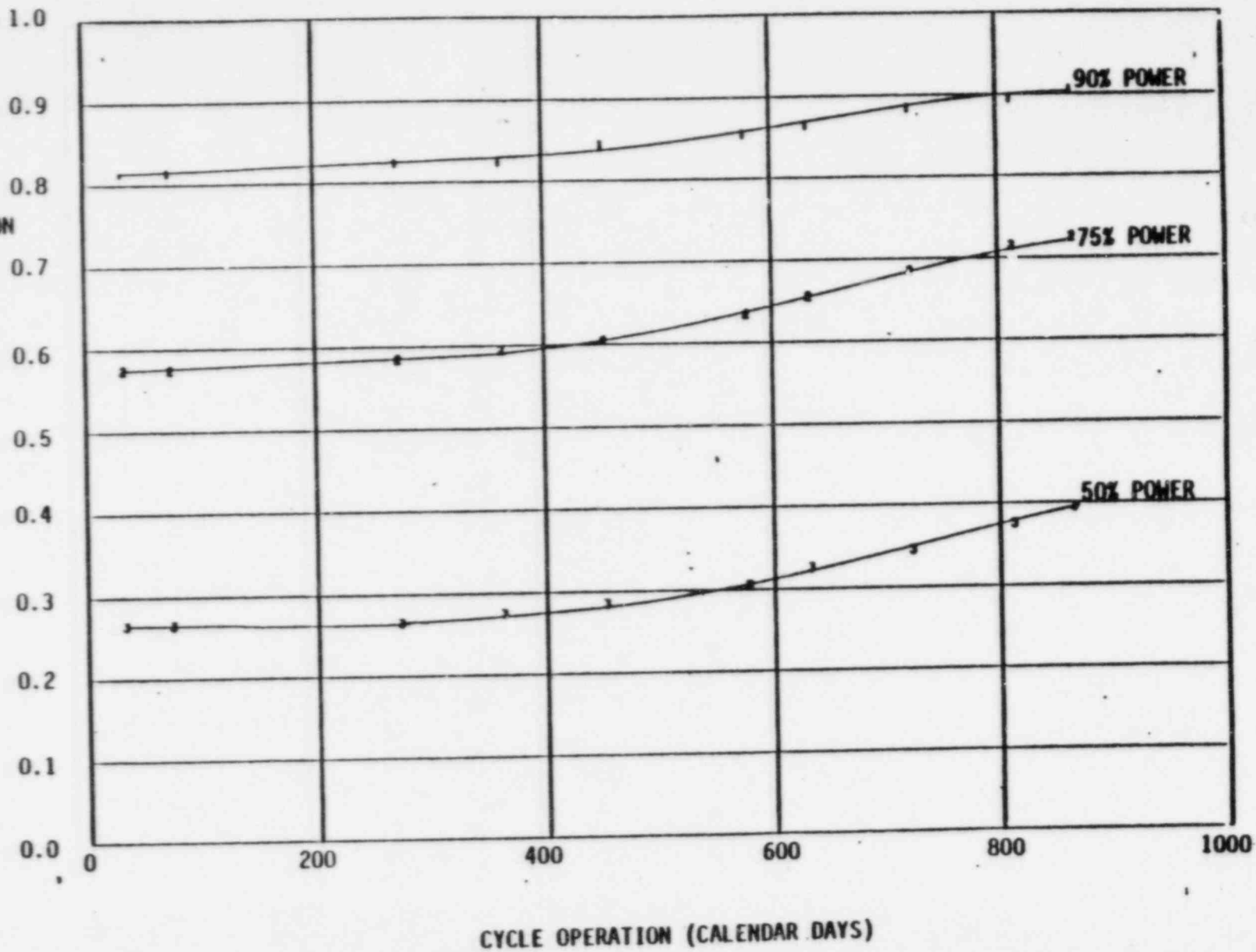


CONTAINMENT SUMP
VOLUME

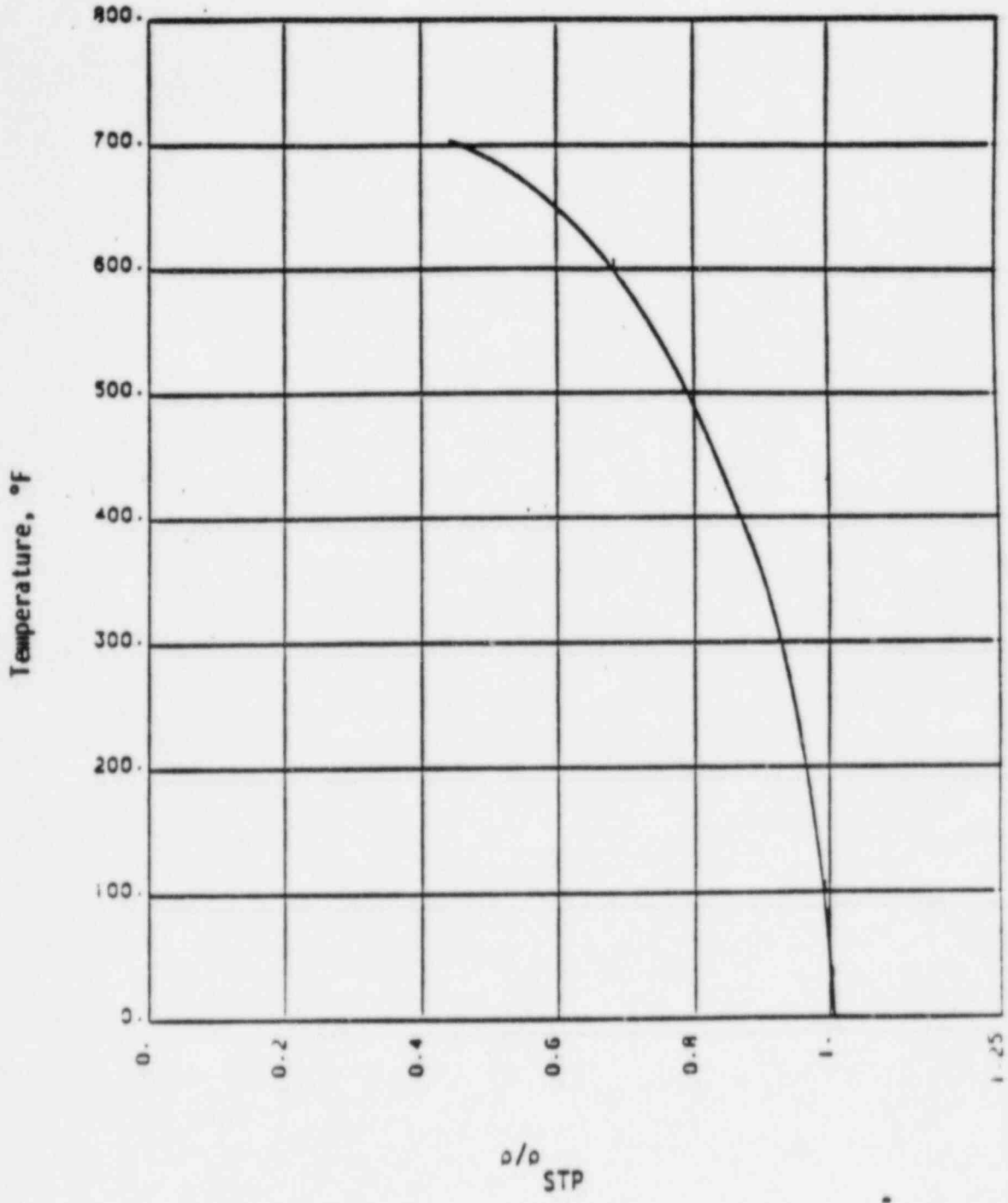


POWER CORRECTION
FACTOR

ATTACHMENT 6 Page 1 of 1



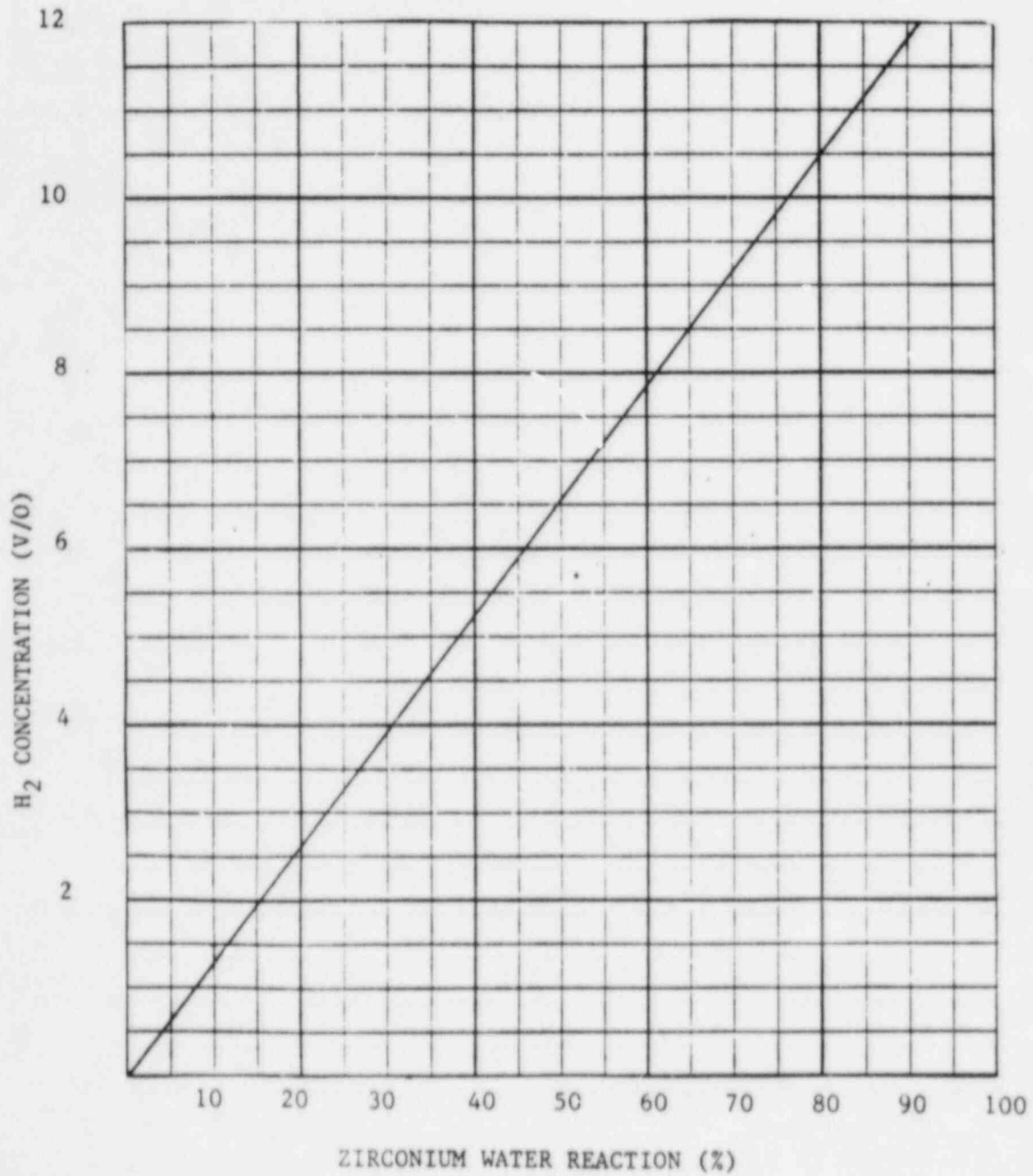
CYCLE OPERATION (CALENDAR DAYS)
POWER CORRECTION FACTOR FOR CS-134 BASED ON AVERAGE POWER DURING OPERATION

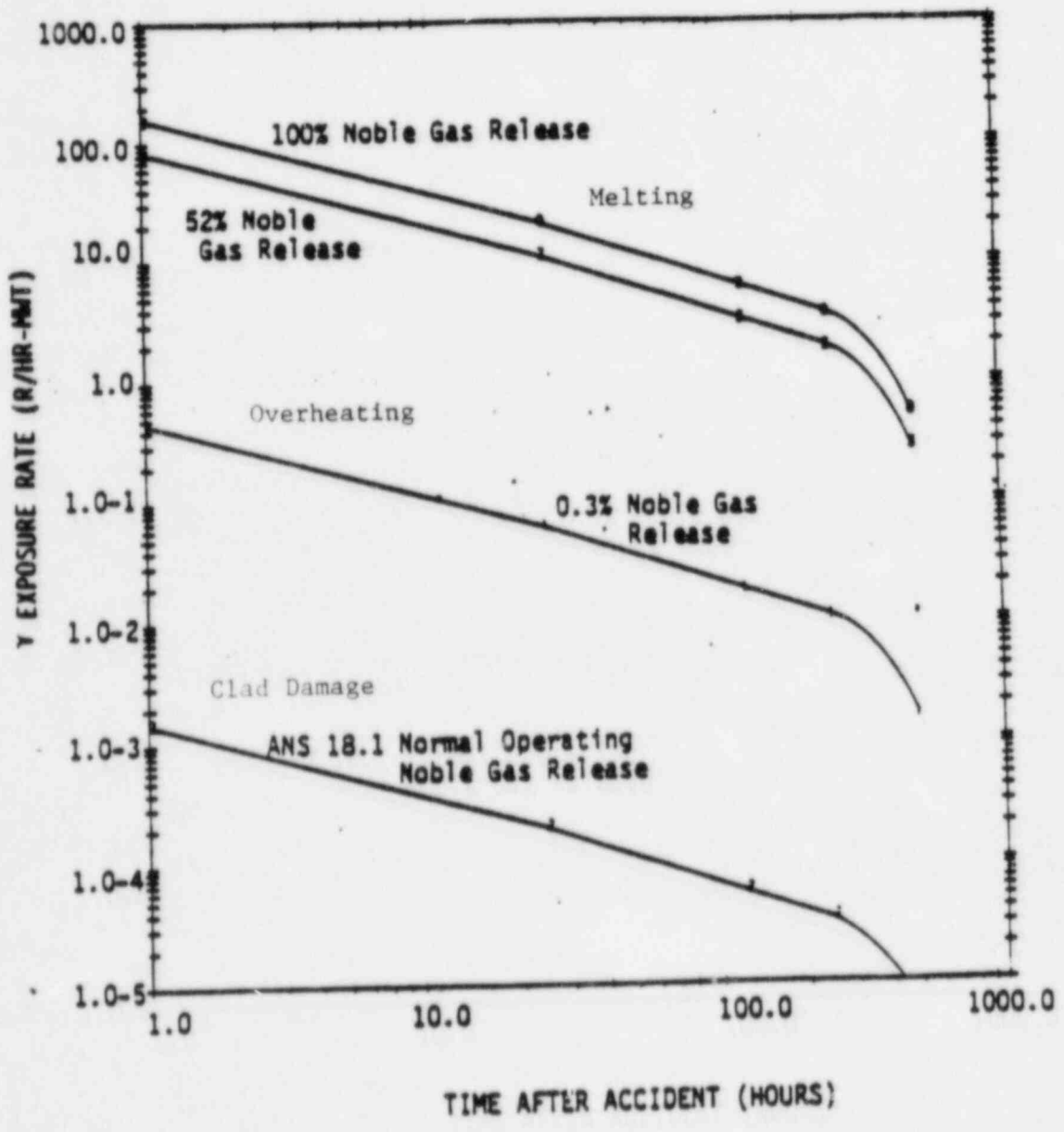


WATER DENSITY RATIO (TEMPERATURE VS. STP)

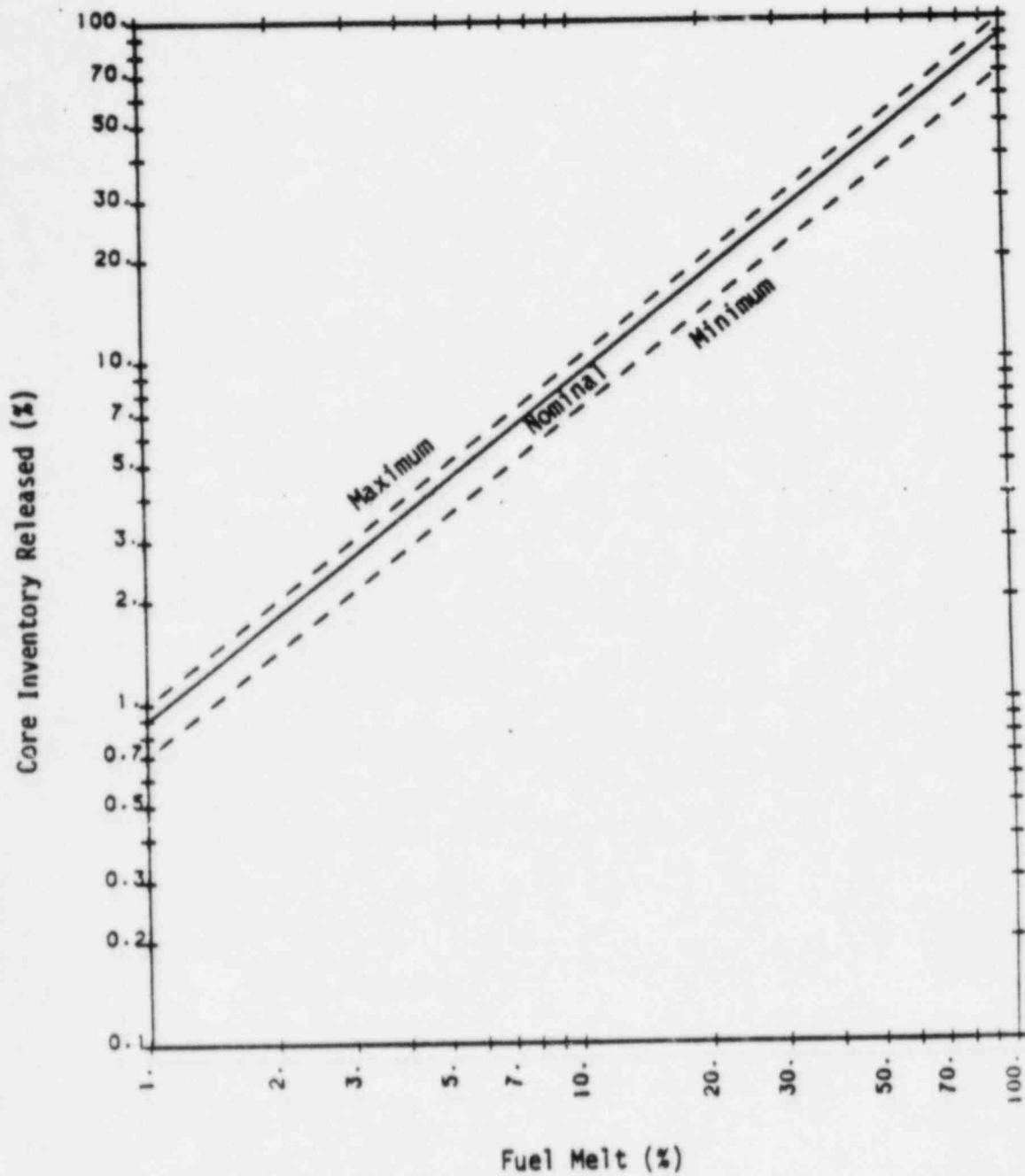
CORE DAMAGE	FISSION PRODUCT RATIO	CORE EXIT THERMOCOUPLE READINGS (°F)	CORE UNCOVERY INDICATION	H ₂ Monitor (VOL % H ₂)
No Clad Damage	Not Applicable	<750	None	Negligible
0-50% Clad Damage	Kr-87=0.022 I-133=0.71	750-1300	Core Uncovery	0-6
50-100% Clad Damage	Kr-87=0.022 I-133=0.71	1300-1650	Core Uncovery	6-11
0-50% Overtemperature	Kr-87=0.22 I-133=2.1	>1650	Core Uncovery	6-11
50-100% Overtemperature	Kr-87=0.22 I-133=2.1	>1650	Core Uncovery	6-11
0-50% Fuel Melt	Kr-87=0.22 I-133=2.1	>1650	Core Uncovery	6-11
50-100% Fuel Melt	Kr-87=0.22 I-133=2.1	>1650	Core Uncovery	6-11

H₂ CONCENTRATION VS. ZIRCONIUM-WATER REACTION

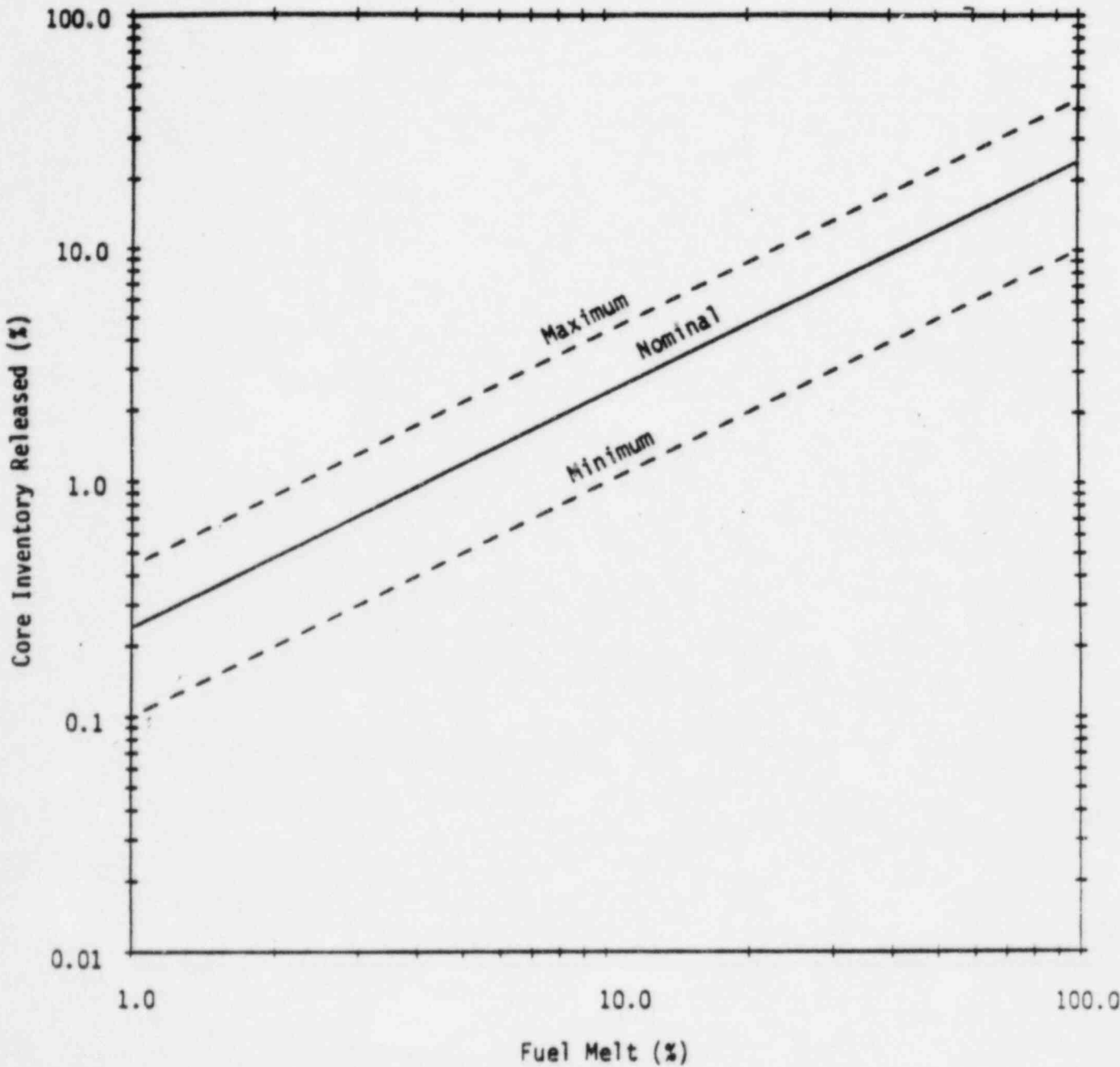




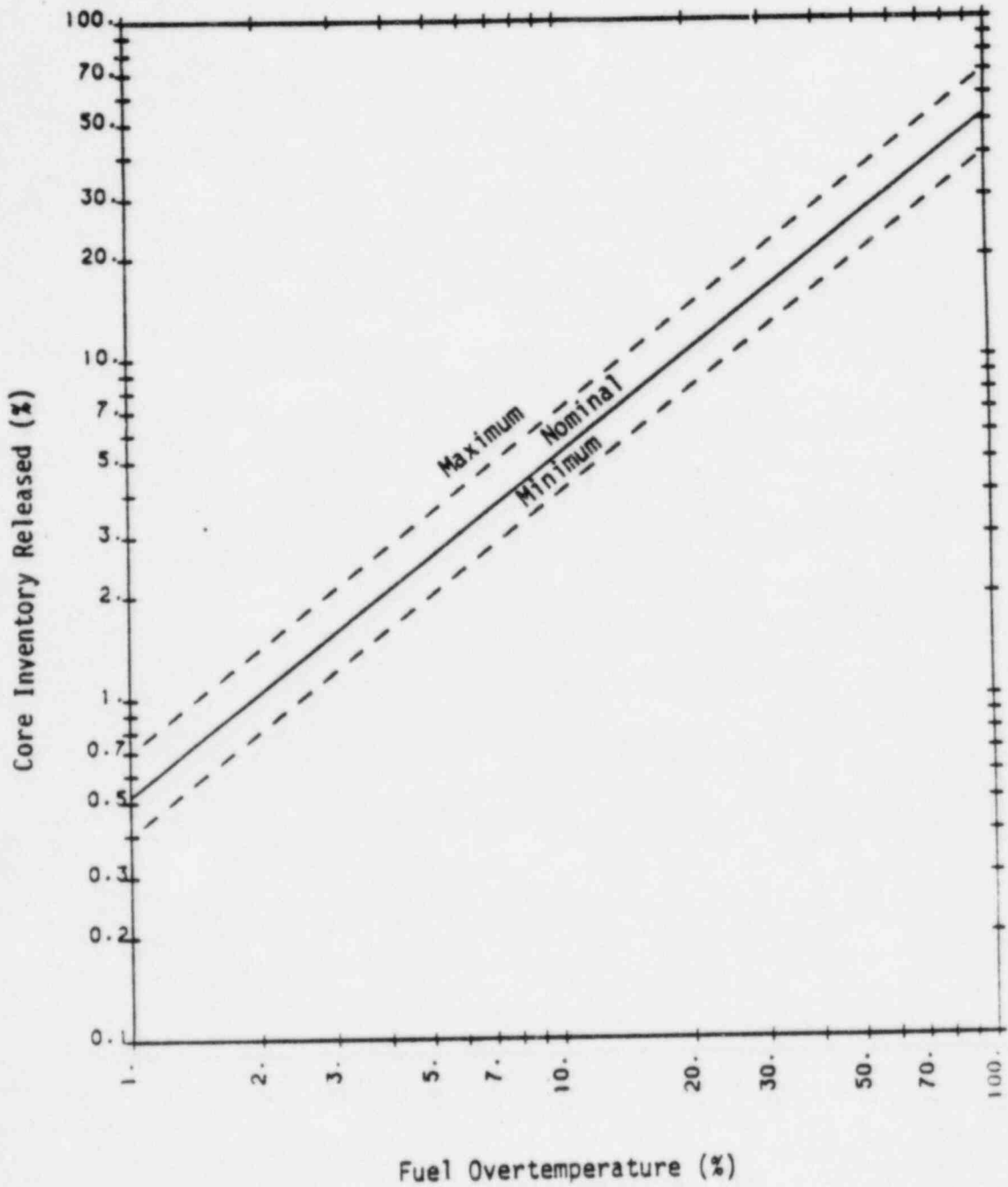
PERCENT NOBLE GASES IN CONTAINMENT



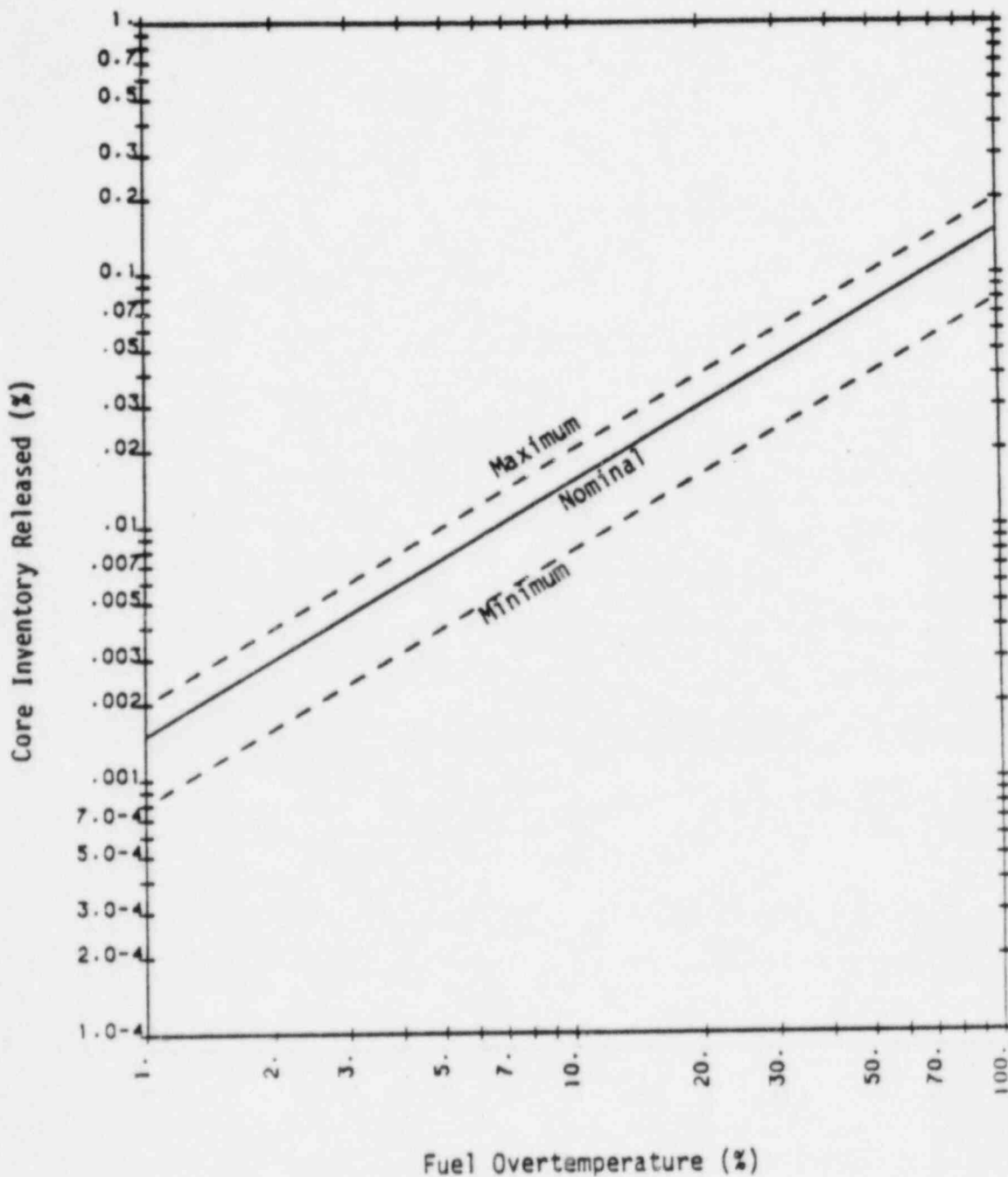
RELATIONSHIP OF % FUEL MELT WITH % CORE INVENTORY RELEASED OF XE, KR, I, CS, OR TE



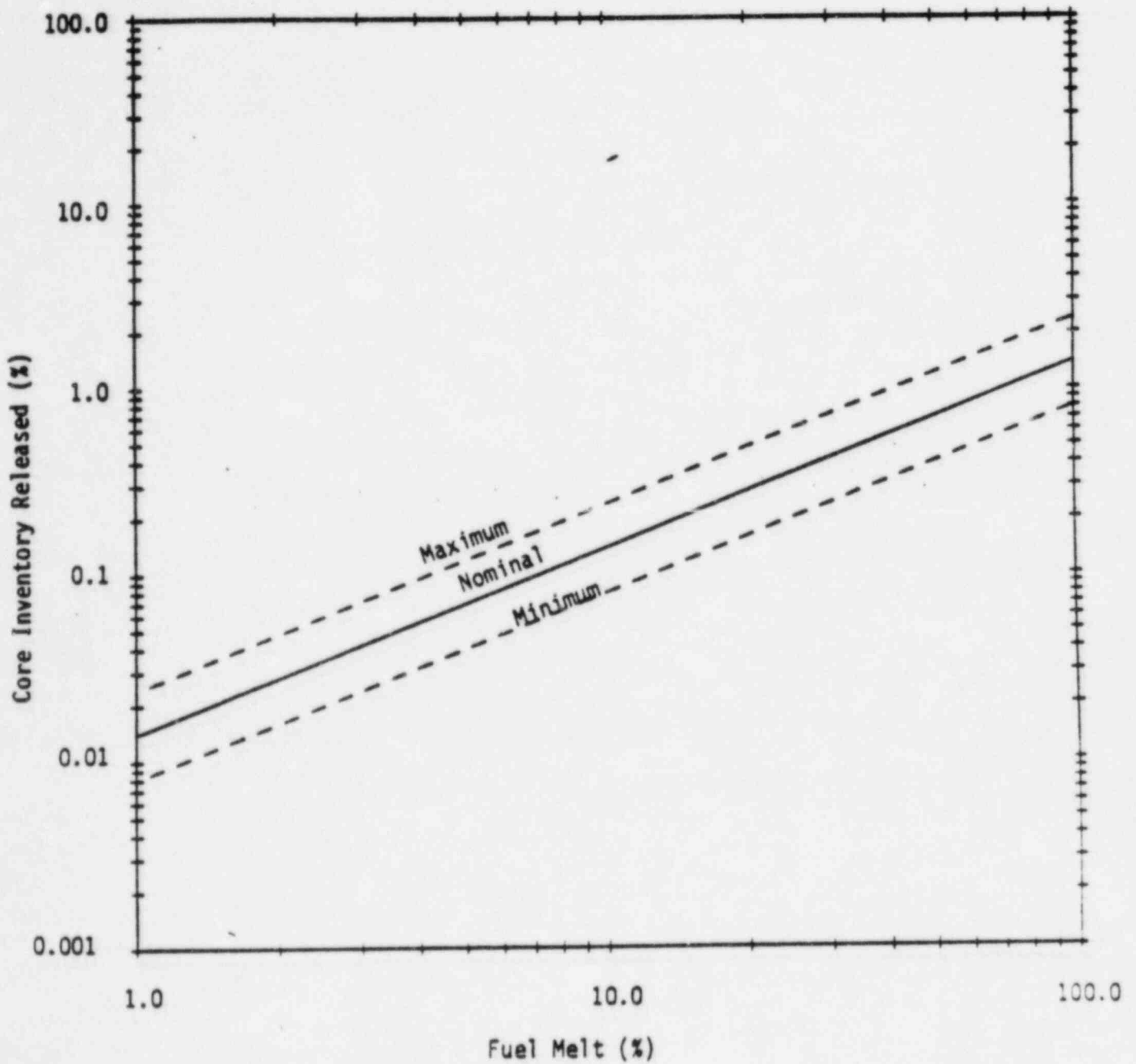
RELATIONSHIP OF % FUEL MELT WITH % CORE INVENTORY
RELEASED OF BA OR SR



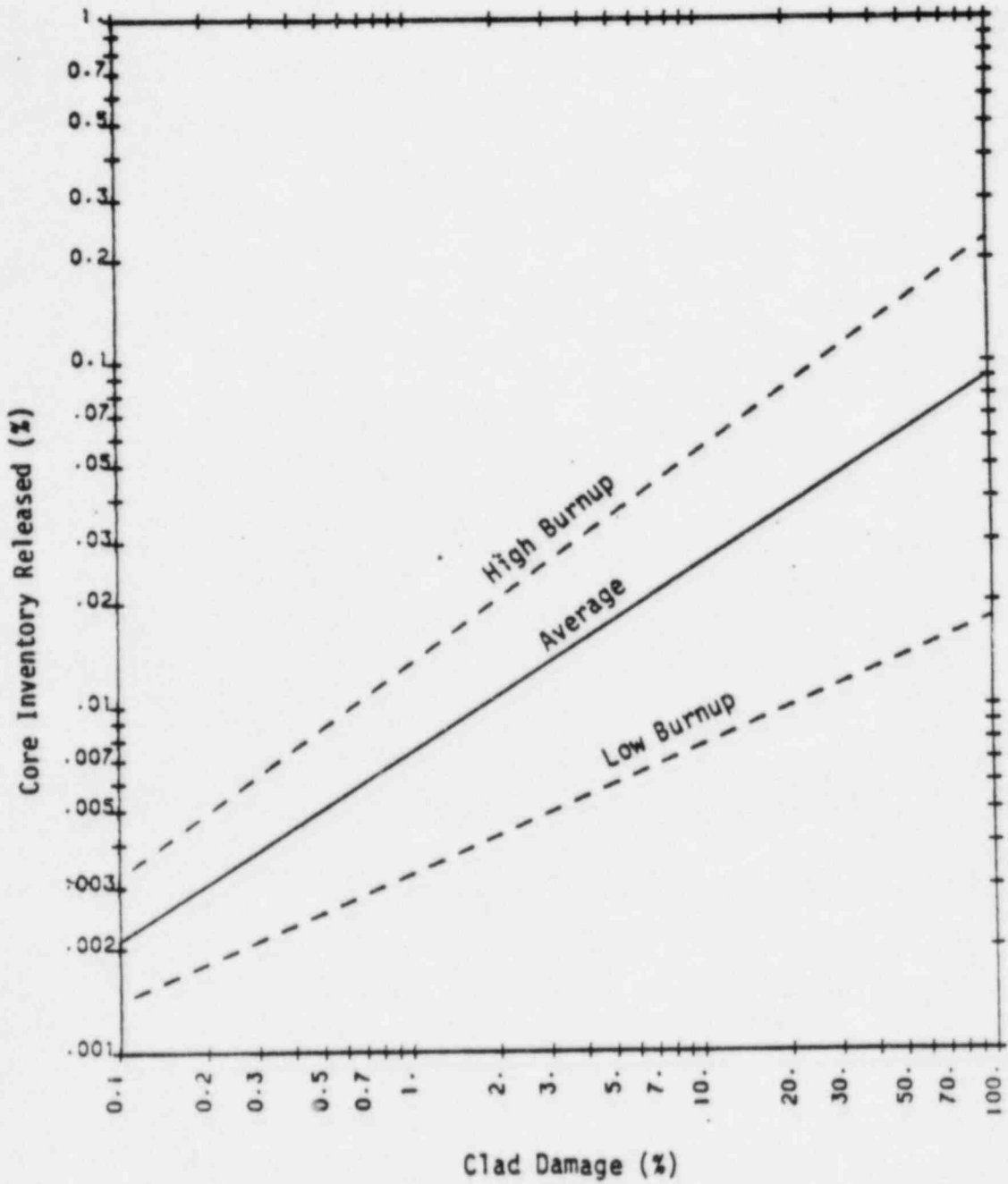
RELATIONSHIP OF % FUEL OVERTEMPERATURE WITH % CORE INVENTORY RELEASED OF XE, KR, I, OR CS



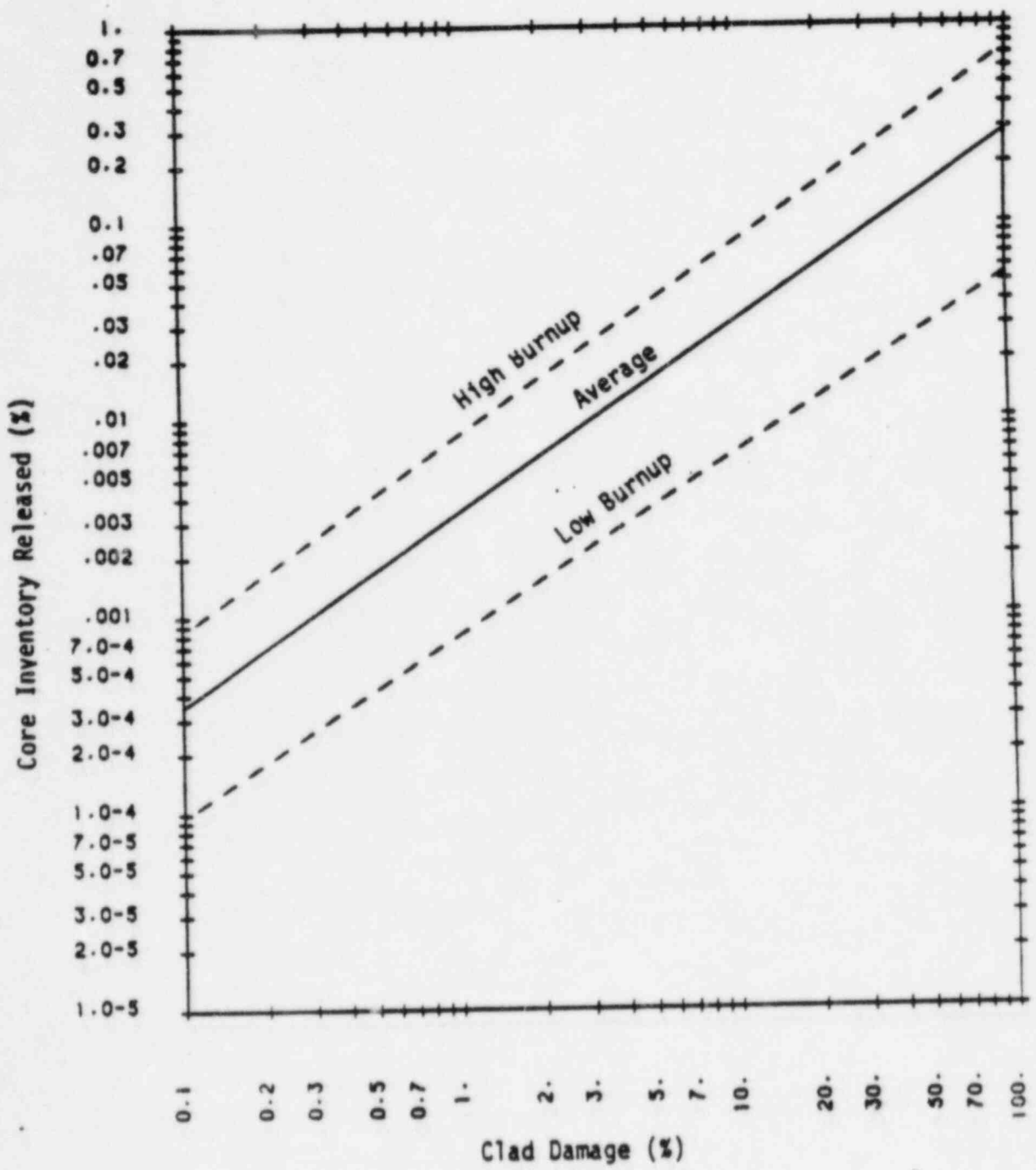
RELATIONSHIP OF % FUEL OVERTEMPERATURE WITH % CORE INVENTORY RELEASED OF BA OR SR



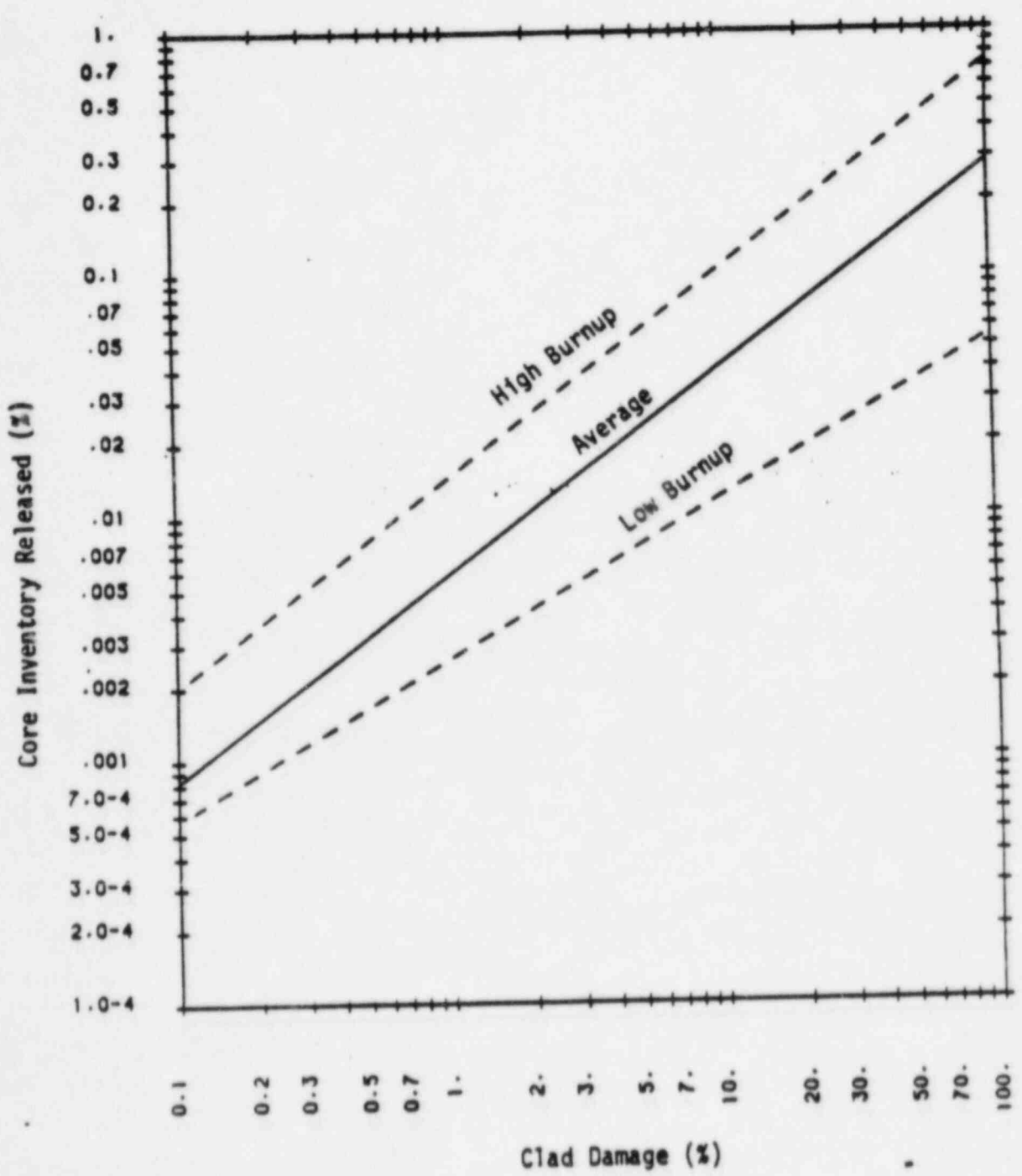
RELATIONSHIP OF % FUEL MELT WITH % CORE INVENTORY
RELEASED OF PR



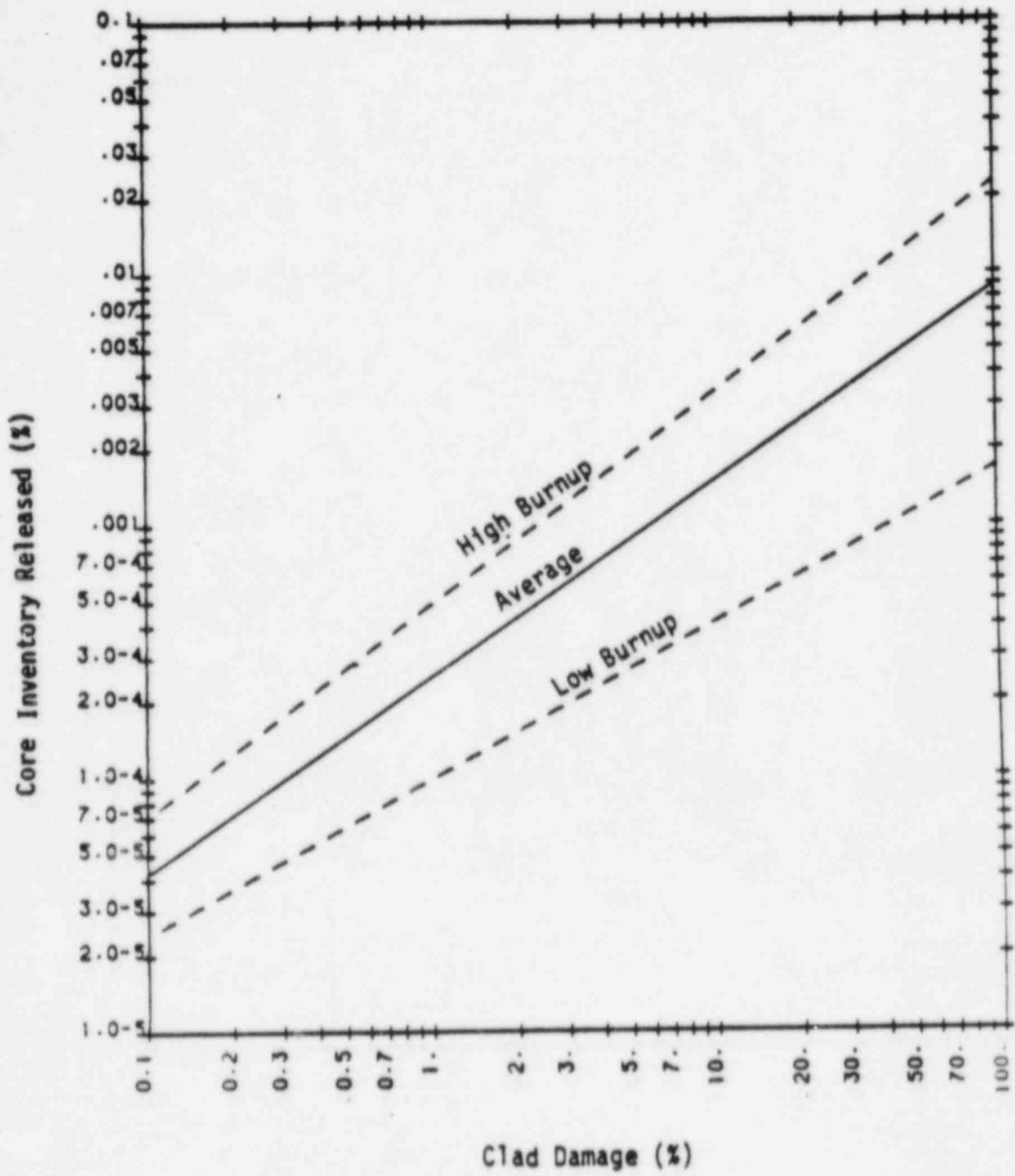
RELATIONSHIP OF % CLAD DAMAGE WITH % CORE INVENTORY RELEASED OF XE-133



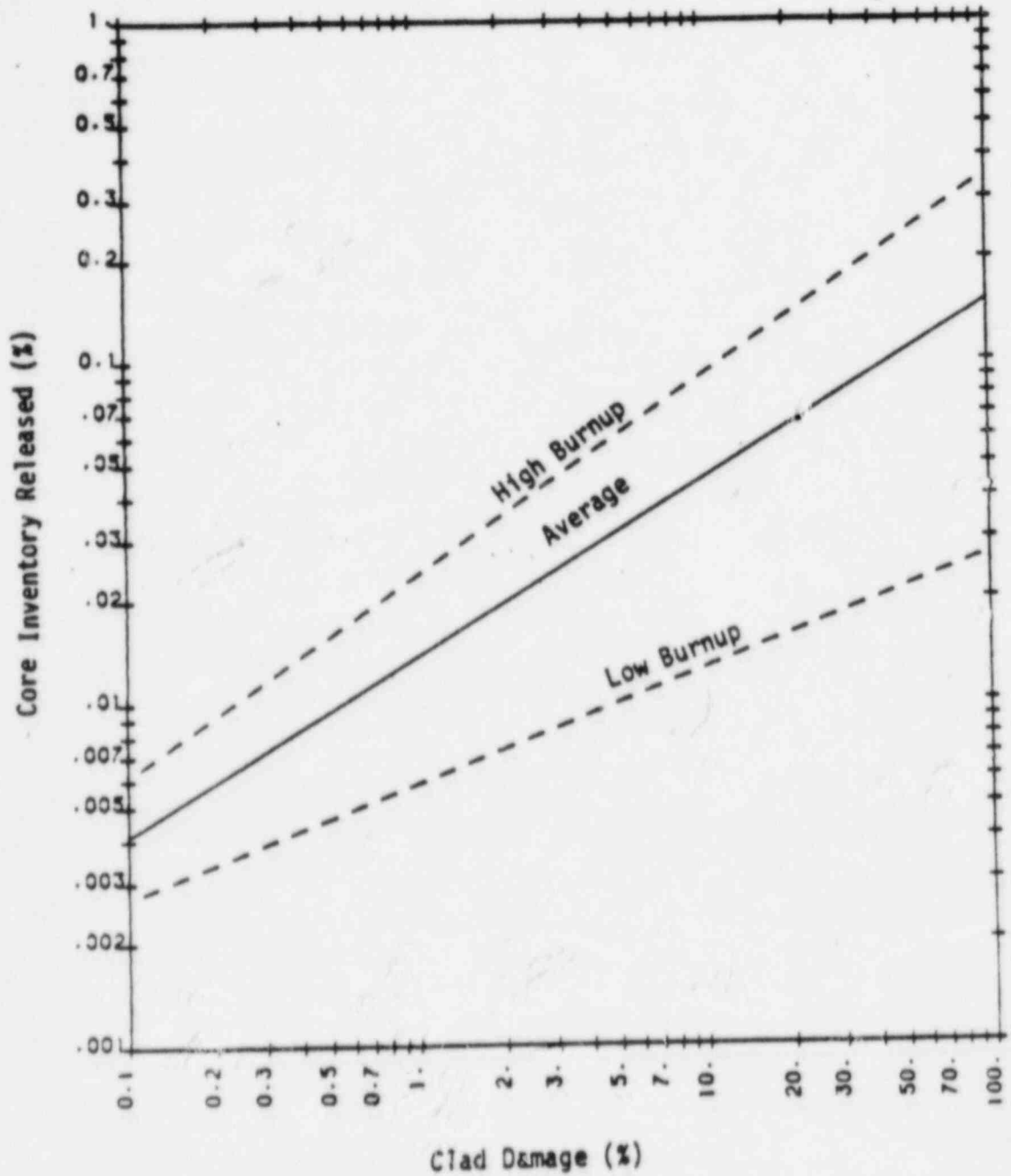
RELATIONSHIP OF % CLAD DAMAGE WITH % CORE INVENTORY RELEASED OF I-131



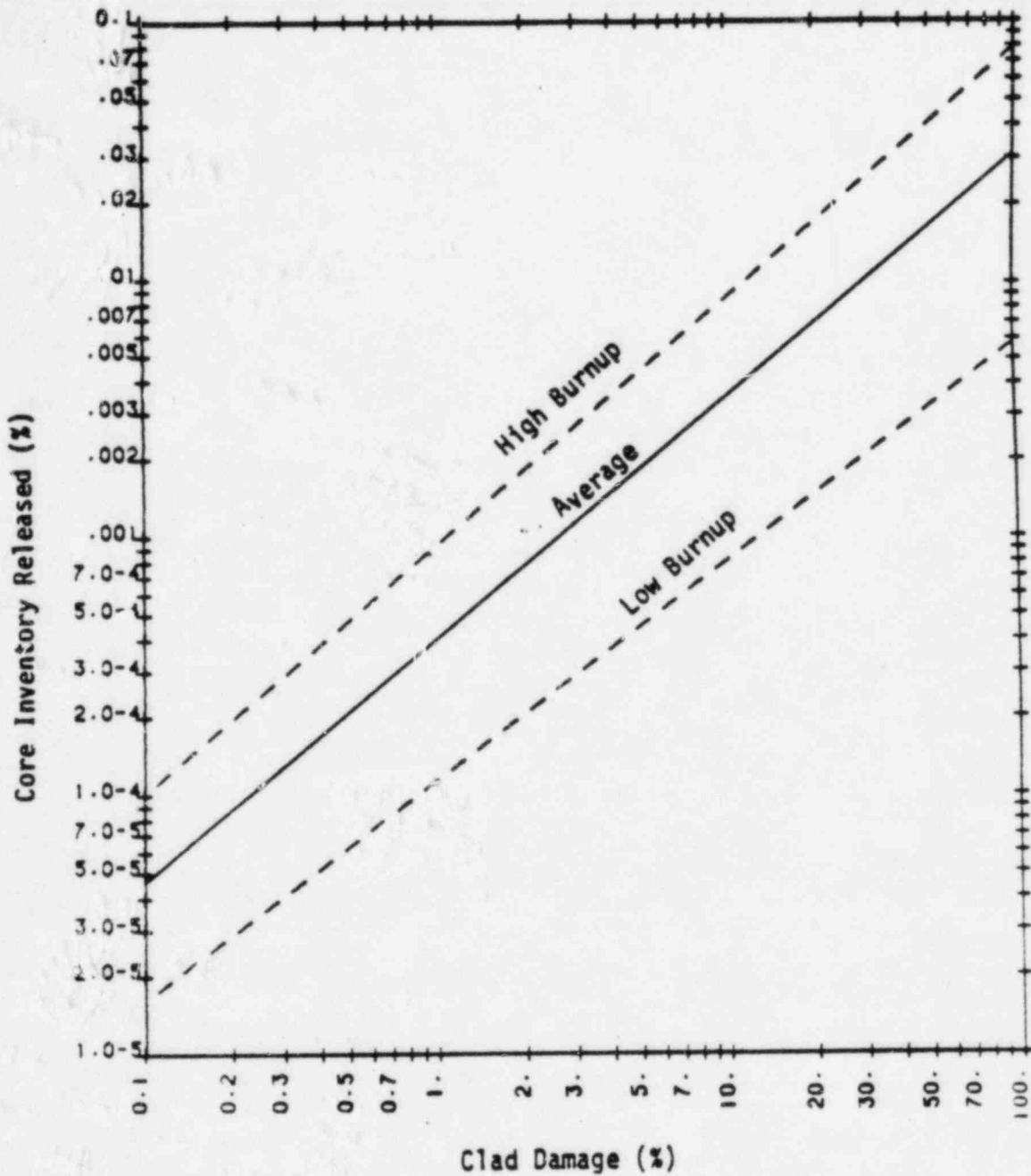
RELATIONSHIP OF % CLAD DAMAGE WITH % CORE INVENTORY
RELEASED OF I-131 WITH SPIKING



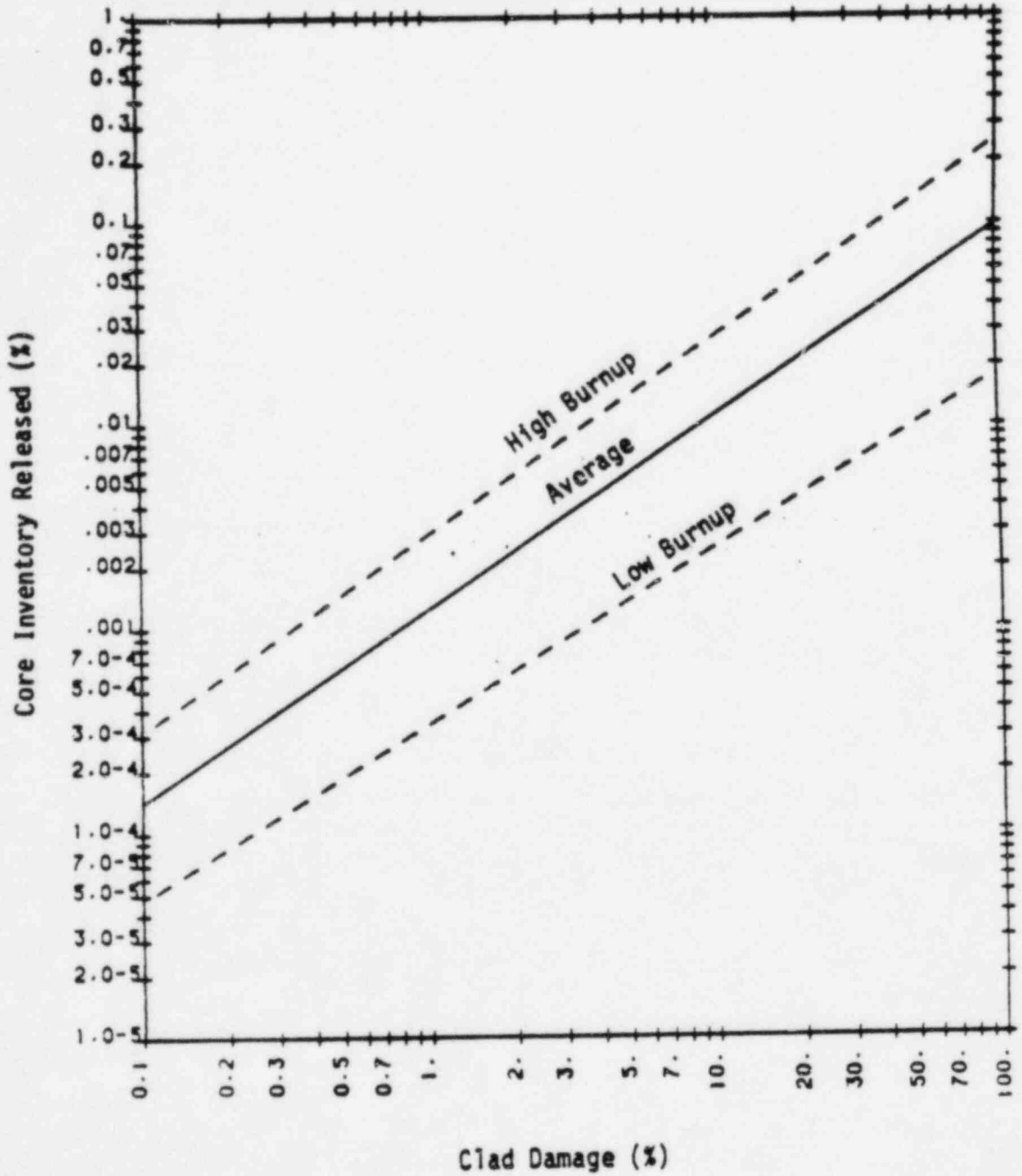
RELATIONSHIP OF % CLAD DAMAGE WITH % CORE INVENTORY
RELEASED OF KR-87



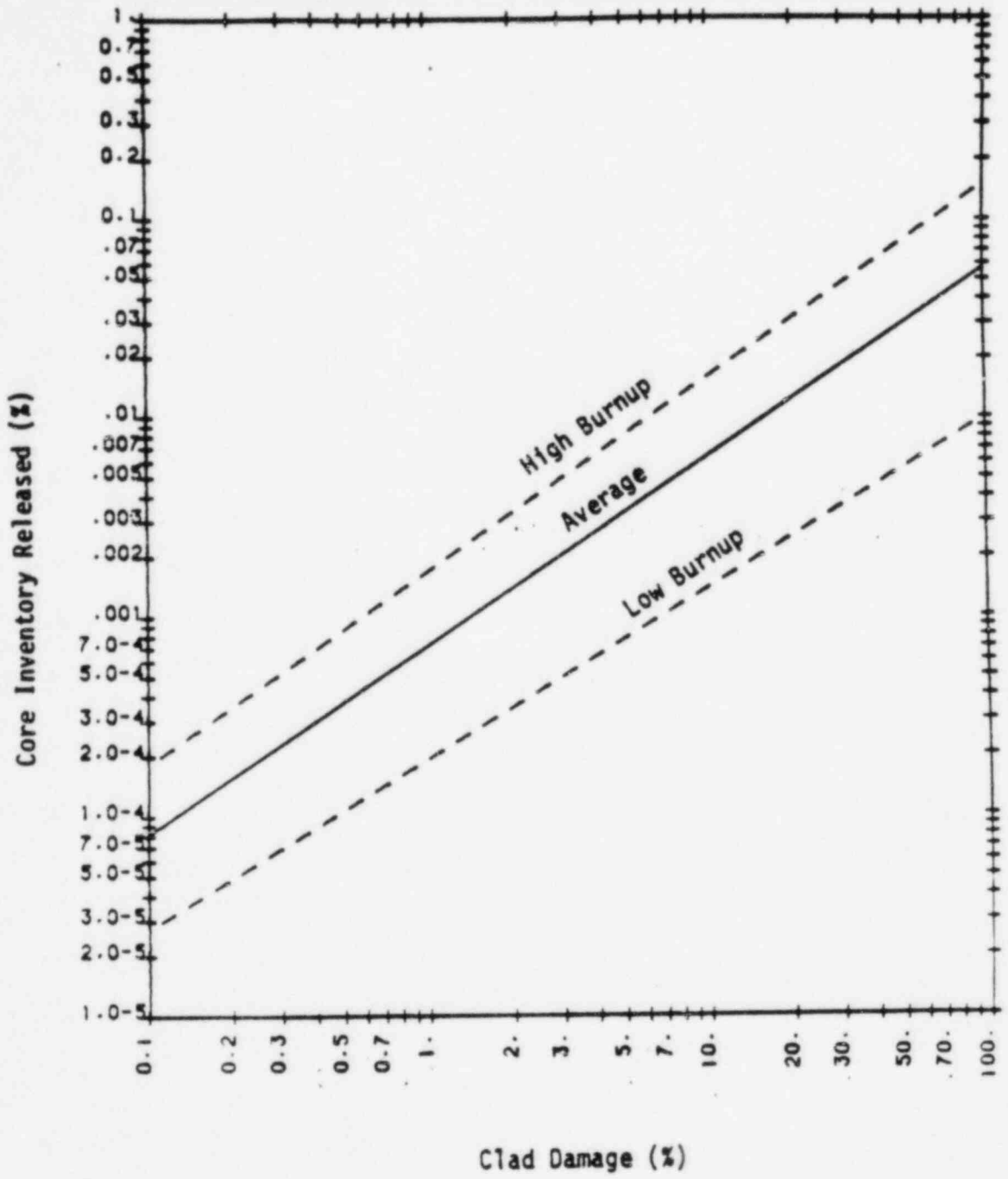
RELATIONSHIP OF % CLAD DAMAGE WITH % CORE INVENTORY
RELEASED OF XE-131M



RELATIONSHIP OF % CLAD DAMAGE WITH % CORE INVENTORY
RELEASED OF I-132



RELATIONSHIP OF % CLAD DAMAGE WITH % CORE INVENTORY RELEASED OF I-133



RELATIONSHIP OF % CLAD DAMAGE WITH % CORE INVENTORY RELEASED OF I-135