SUGGESTED SAMPLING LOCATIONS

SCENARIO	SAMPLING LOCATIONS(S)	SAMPLE PROCEDURES(S)	COMMENTS
Small break LOCA			
Rx Power >1%	RCS Hot Leg Loop 1 1(2)PS9351 A or Loop 3 1(2)PS9351B	BZP 380-12/ Diluted R/C and BZP 380-15/ R/C Stripped Gas	
	Alternate Point RCS Pressurizer 1(2)PS9350B and	Same as Hot Leg Sampling Procedures	
	Containment Atmosphere	BZP 380-18 BCP 800-7	If Containment atmosphere process monitor 1(2)RE-PR011 indication is increased or is increasing.
Rx Power <1%	RCS Hot Leg Loop 1 1(2)PS9351A Loop 3 1(2)PS9351B	Same as Hot Leg Sampling procedures	If PCS pressurized and RC pumps running.
	RHR 1(2)PS9353A 1(2)PS9353B	Same as Hot Leg Sampling Procedures	If RCS on RHR
	Alternate point RCS Pressurizer 1(2)PS9350B	Same as Hot Leg Sampling Procedures	

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SCENARIO	SAMPLING LOCATIONS(S)	SAMPLE PROCEDURES(S)	COMMENTS
Large break LOCA			
Rx Power >1%	Containment sump 1(2)PS156	NONE	
	and		
	Containment Atmosphere	BZP 380-18 BCP 800-7	
	and		
	RCS Hot Leg Loop 1 1(2)PS9351A or Loop 2 1(2)PS9351B	BZP 380-12/ Diluted R/C and BXP 380-15 R/C Stripped Gas	If Containment Sump is providing cooling to core, do not include hot leg sample activity in damage assessment calculations.
Rx Power <1%	Containment Atmosphere	BZP 380-18 BCP 800-7	
	and		
	Containment Sump 1(2)PS156	NONE	Provided Containment Sump supplying core cooling
	or		
	RHR System 1(2)PS9353A or 1(2)PS9353B		Provided RHR taking suction from Containment Sump.
	or		
	RCS Hot Leg Loop 1 1(2)PS9351A or Loop 2 1(2)PS9351B	BZP 380-12, Diluted R/C BZP 380-15 R/C Stripped Gas 1B	

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SCENARIO	SAMPLING LOCATIONS(S)	SAMPLE PROCEDURES(S)	COMMENTS
Steam Line Break	RCS Hot Leg 1(2)PS9351A 1(2)PS9351B or Alternate Point	BZP 380-12/Diluted R/C and BZP 380-15 R/C Stripped Gas	
	RCS Pressurizer 1(2)PS9350B and	Same as above	
	Containment Atmosphere	BZP 380-18 BCP 800-7	If Containment atmosphere process monitor 1(2)RE-PR011 has increased or is increasing.
Steam Generator Tube Rupture	RCS Hot Leg 1(2)PS9351A 1(2)PS9351B	BZP 380-12 Diluted R/C and BZP 380-15 R/C Stripped Gas	
	Steam generator blowdown	NONE	
	Main Steam	NONE	
	Containment Atmosphere	BZP 380-18 BZP 800-7	If Containment atmosphere process monitor 1(2)RE-PR011 has increased or is increasing.

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SCENARIO	SAMPLING LOCATIONS(S)	SAMPLE PROCEDURES(S)	COMMENTS
Indication of Significant Containment Sump Inventory	Containment Sump 1(2)PS156 and	None	When coupled with excessive RCS leakage.
	Containment Atmosphere	BZP 380-18 BCP 800-7	If Containment atmosphere process monitor 1(2)RE-PR011 indications have increased or are increasing.
Containment Bldg Radiation Monitor Alarm	Containment Atmosphere and	BZP 380-18 BCP 800-7	When coupled with reactor cooling anomalies or excessive RCS leakage
	Containment Sump	NONE	When coupled with reactor cooling anomalies or excessive RCS leakage.
Safety Injection Actuated	RCS Hot Leg Loop 1 1(2)PS9351A or Loop 2 1(2)PS9351B	BZP 380-12/ Diluted R/C and BZP 380-15/ R/C Stripped Gas	
	Alternate point RCS Pressurizer 1(2)PS9350B	Same as Hot Leg Sampling Procedures	
Indication of High Radiaton Level inRCS	RCS Hot Leg Loop 1 1(2)PS9351A or Loop 3 1(2)PS9351B	BZP 380-12/ Diluted R/C and BZP 380-15/ R/C Stripped Gas	
	Alternate Point RCS Pressurizer 1(2)PS9350B	Same as Hot Leg Sampling procedures	

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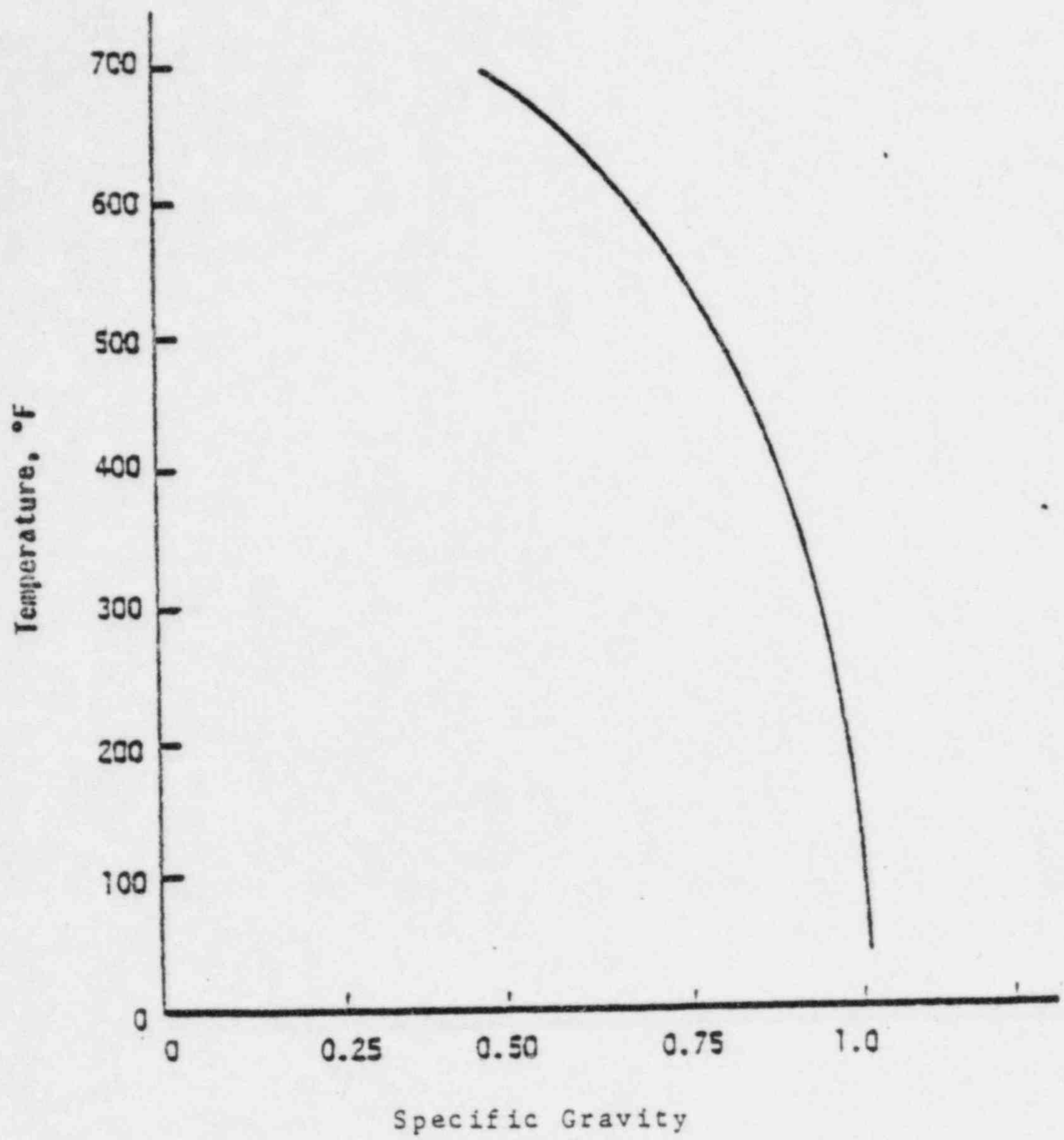

SPECIFIC GRAVITY OF WATER VS TEMPERATURE

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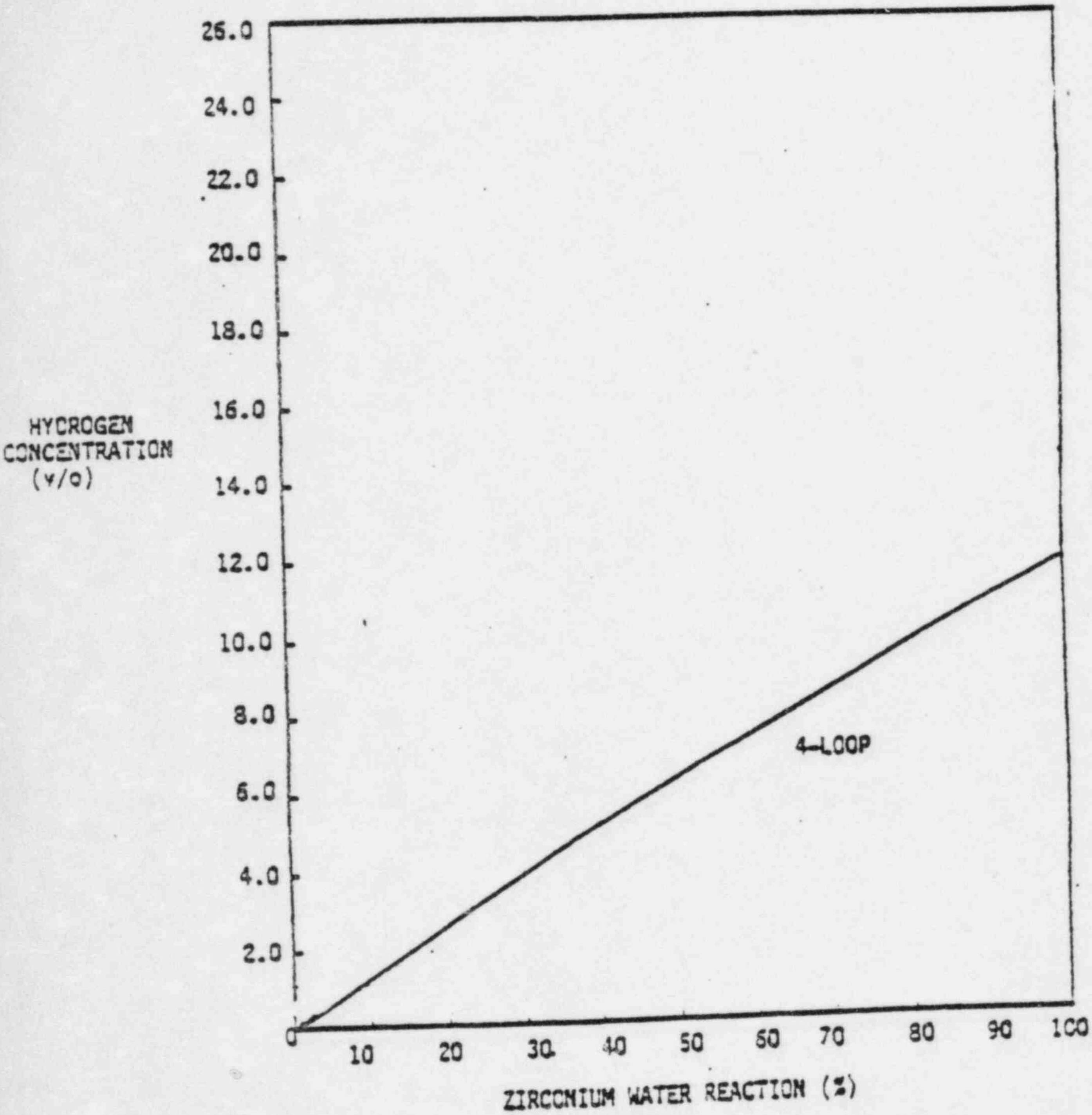

CONTAINMENT HYDROGEN CONCENTRATION BASED ON ZIRCONIUM WATER REACTION

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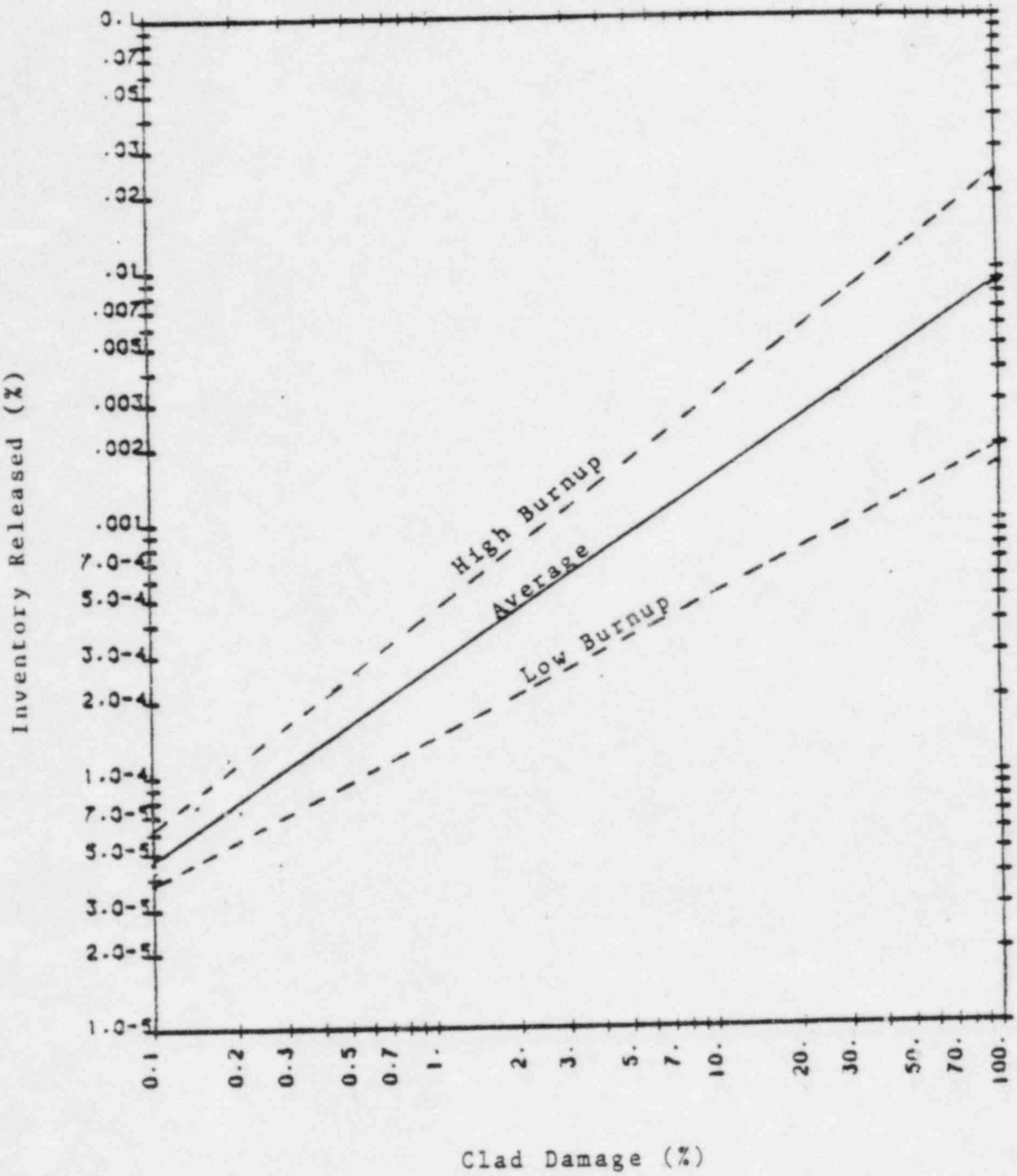

RELATIONSHIP OF % CLAD DAMAGE WITH % INVENTORY RELEASED OF KR-87

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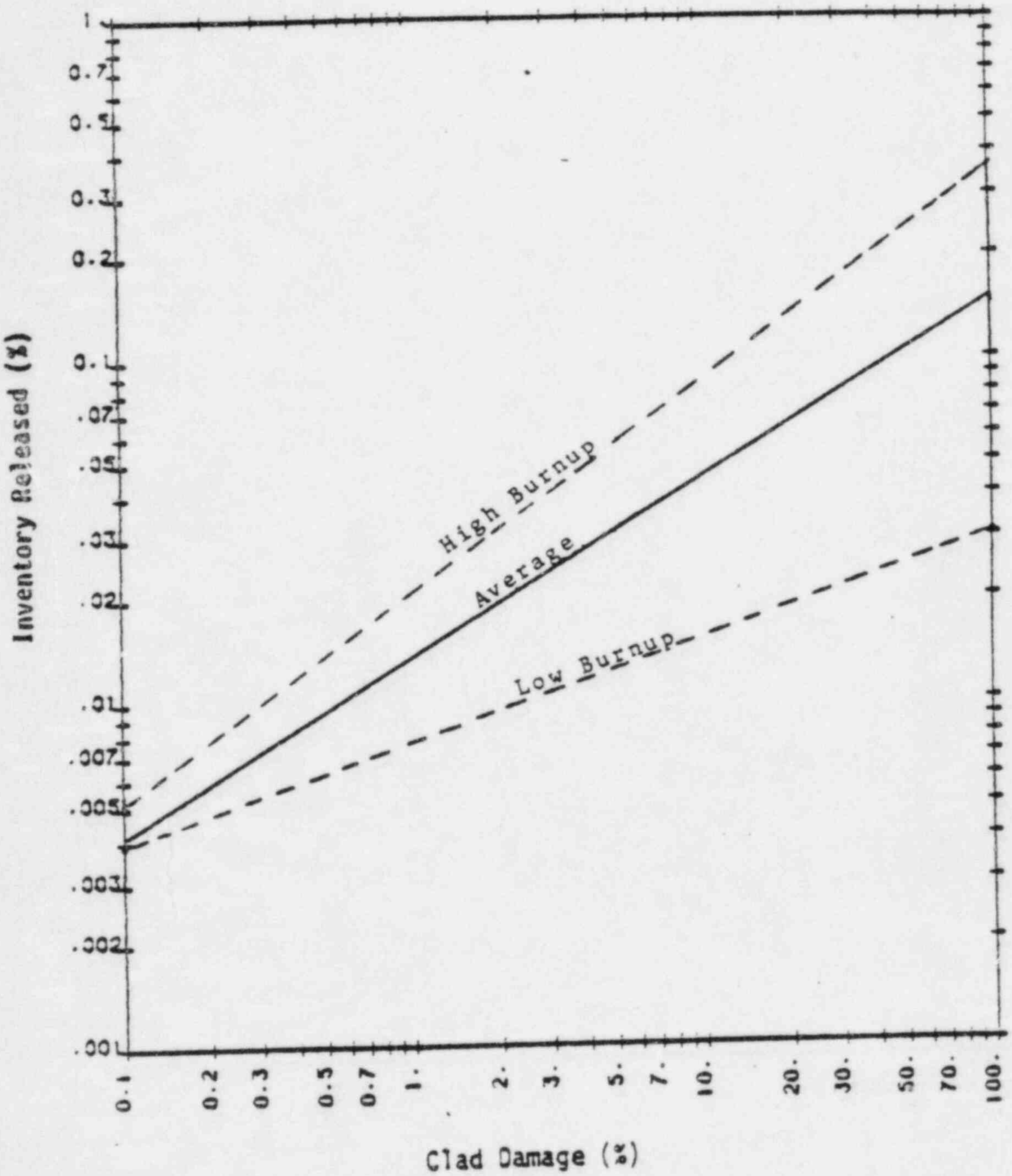

RELATIONSHIP OF % CLAD DAMAGE WITH % INVENTORY RELEASED OF XE-131M

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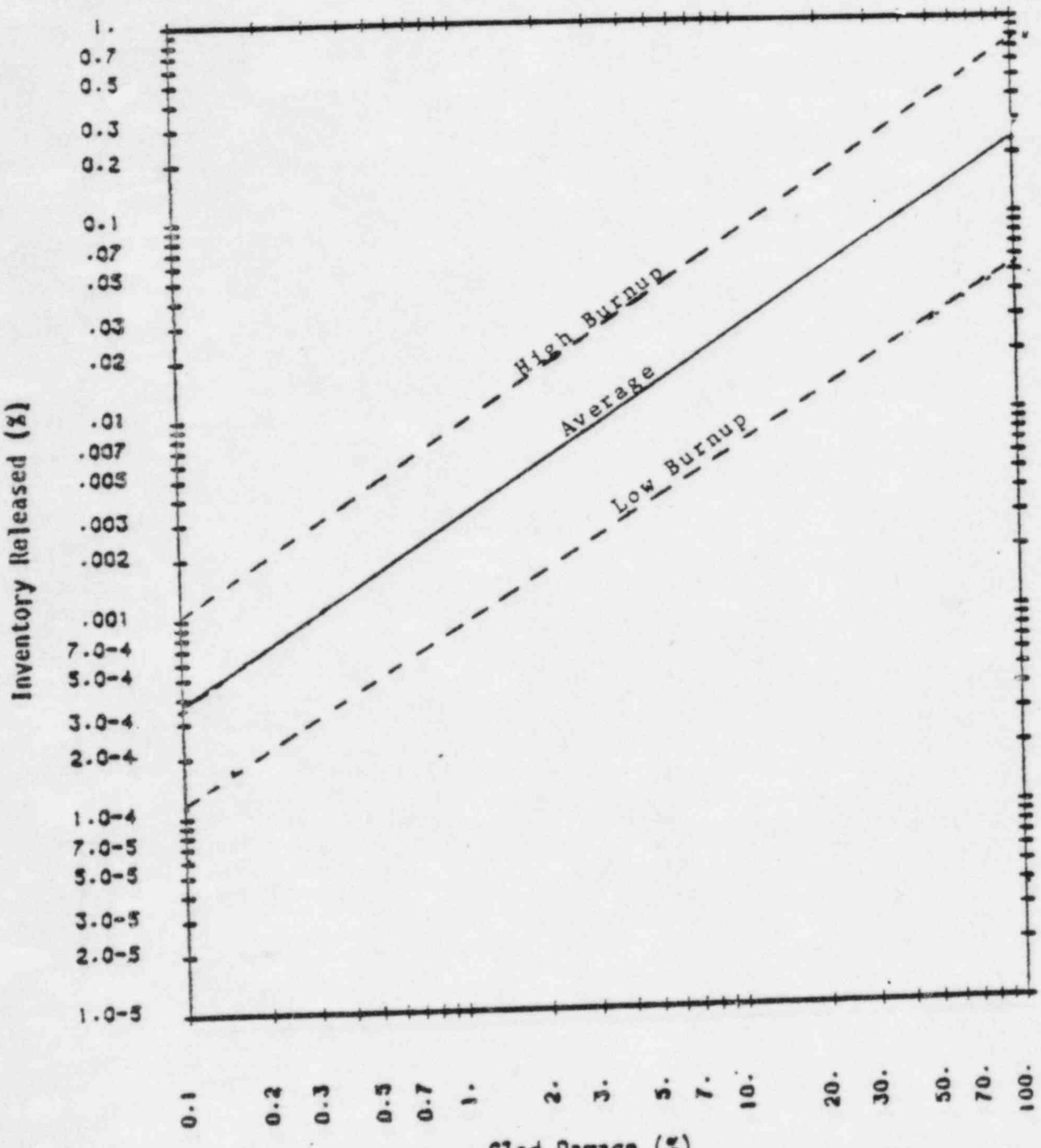

RELATIONSHIP OF % CLAD DAMAGE WITH % INVENTORY RELEASED OF I-131

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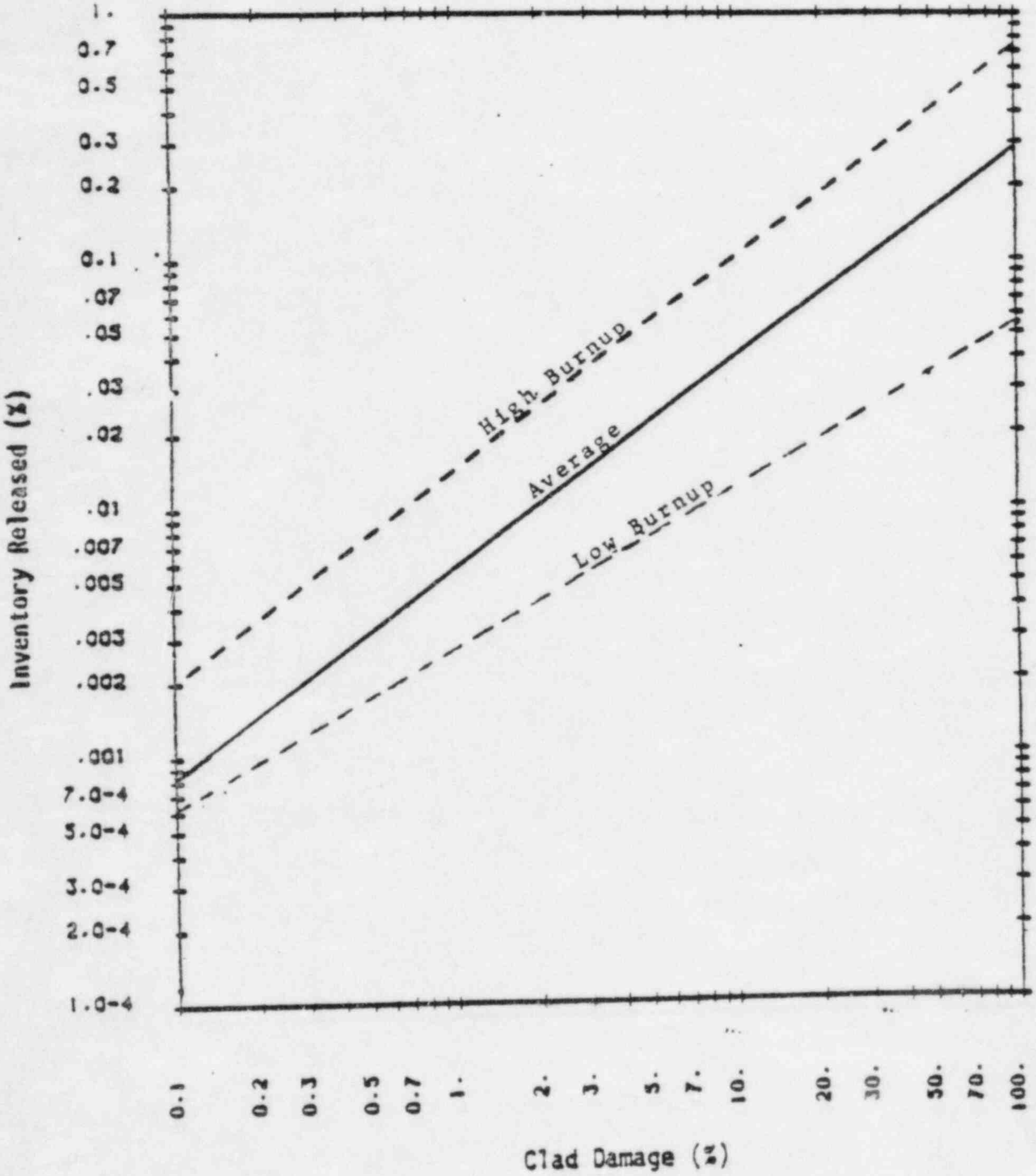

RELATIONSHIP OF % CLAD DAMAGE WITH % INVENTORY RELEASED OF I-131 WITH SPIKING

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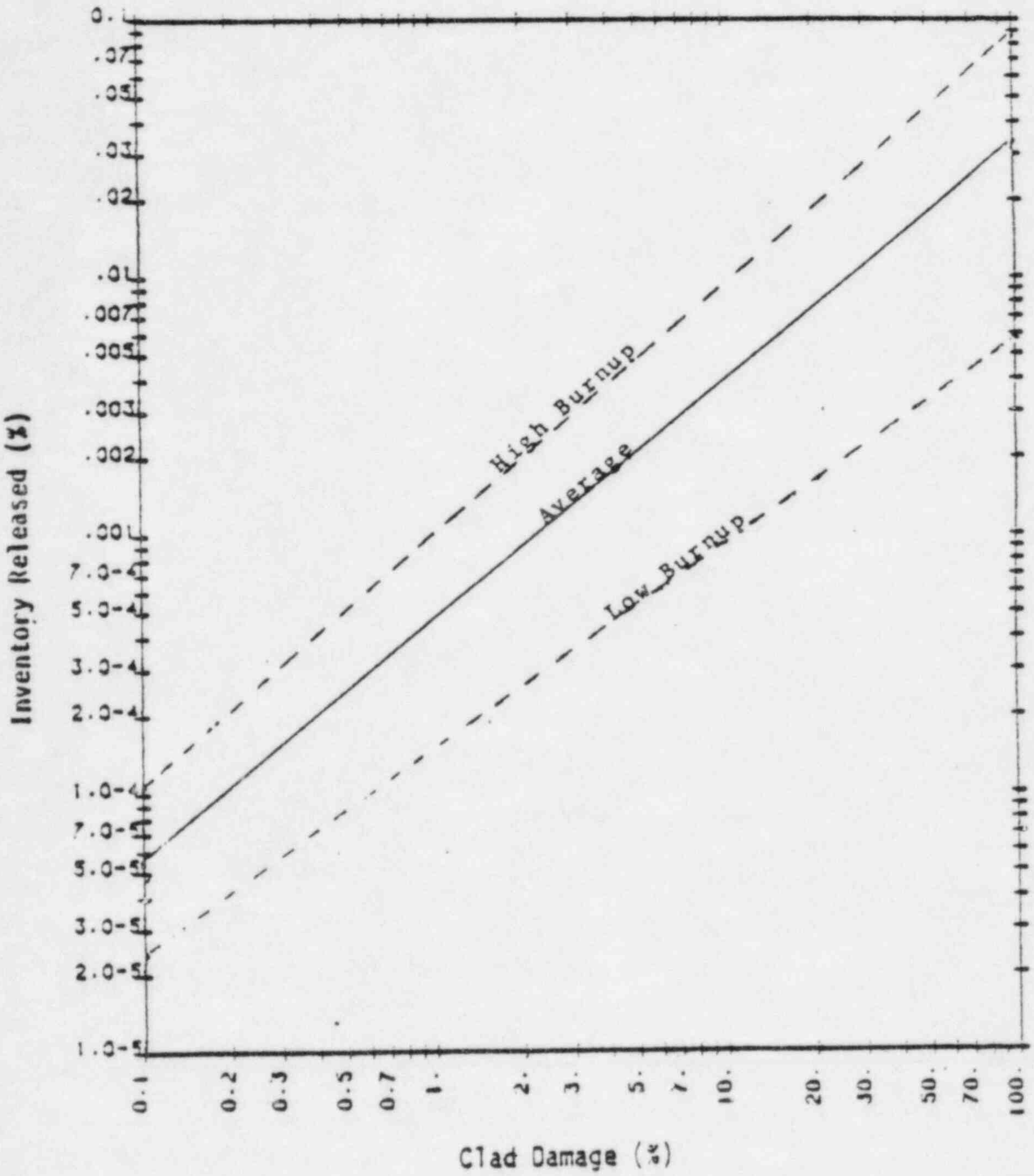

RELATIONSHIP OF % CLAD DAMAGE WITH % INVENTORY RELEASED OF I-132

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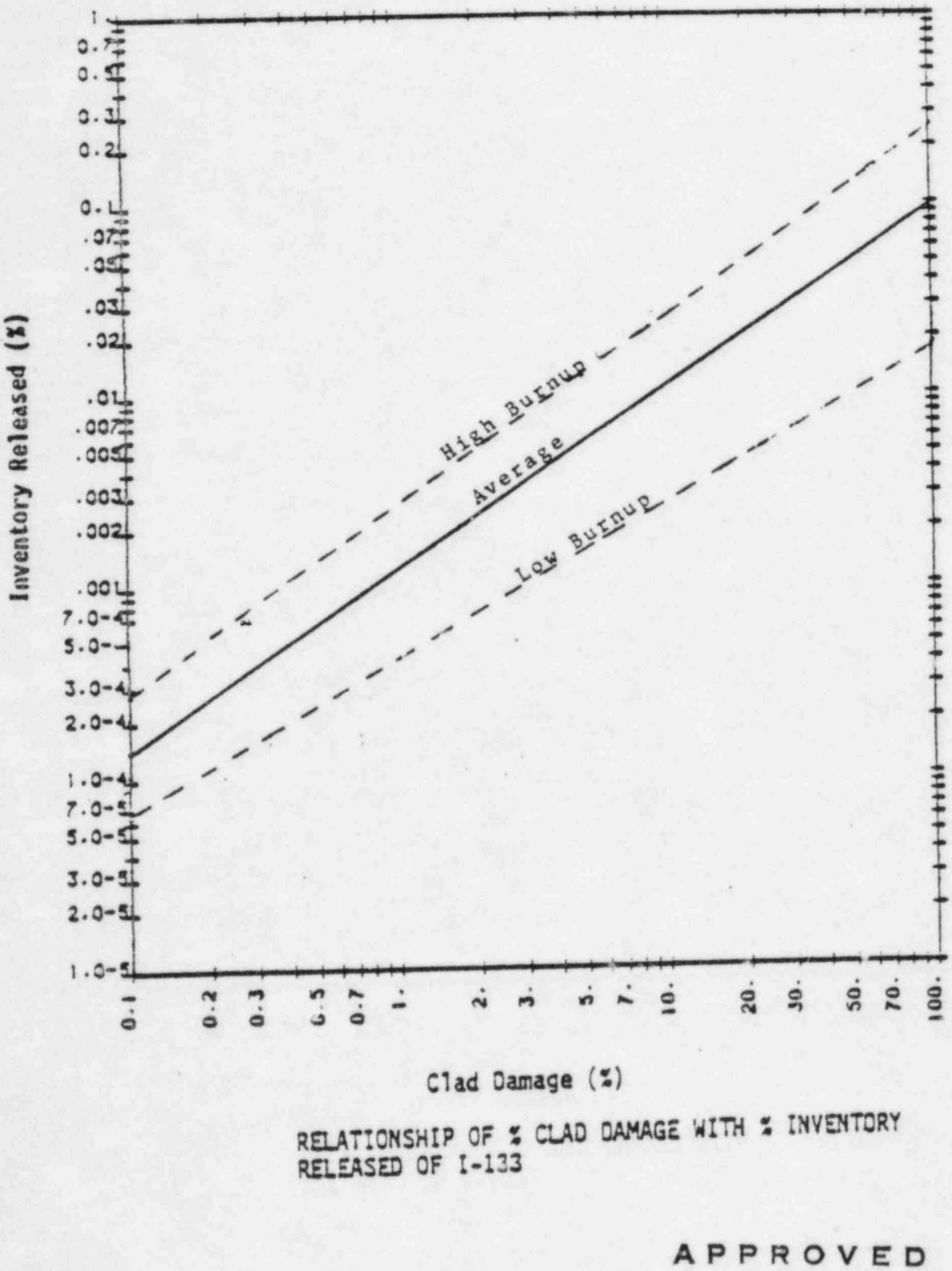

RELATIONSHIP OF % CLAD DAMAGE WITH % INVENTORY RELEASED OF I-133

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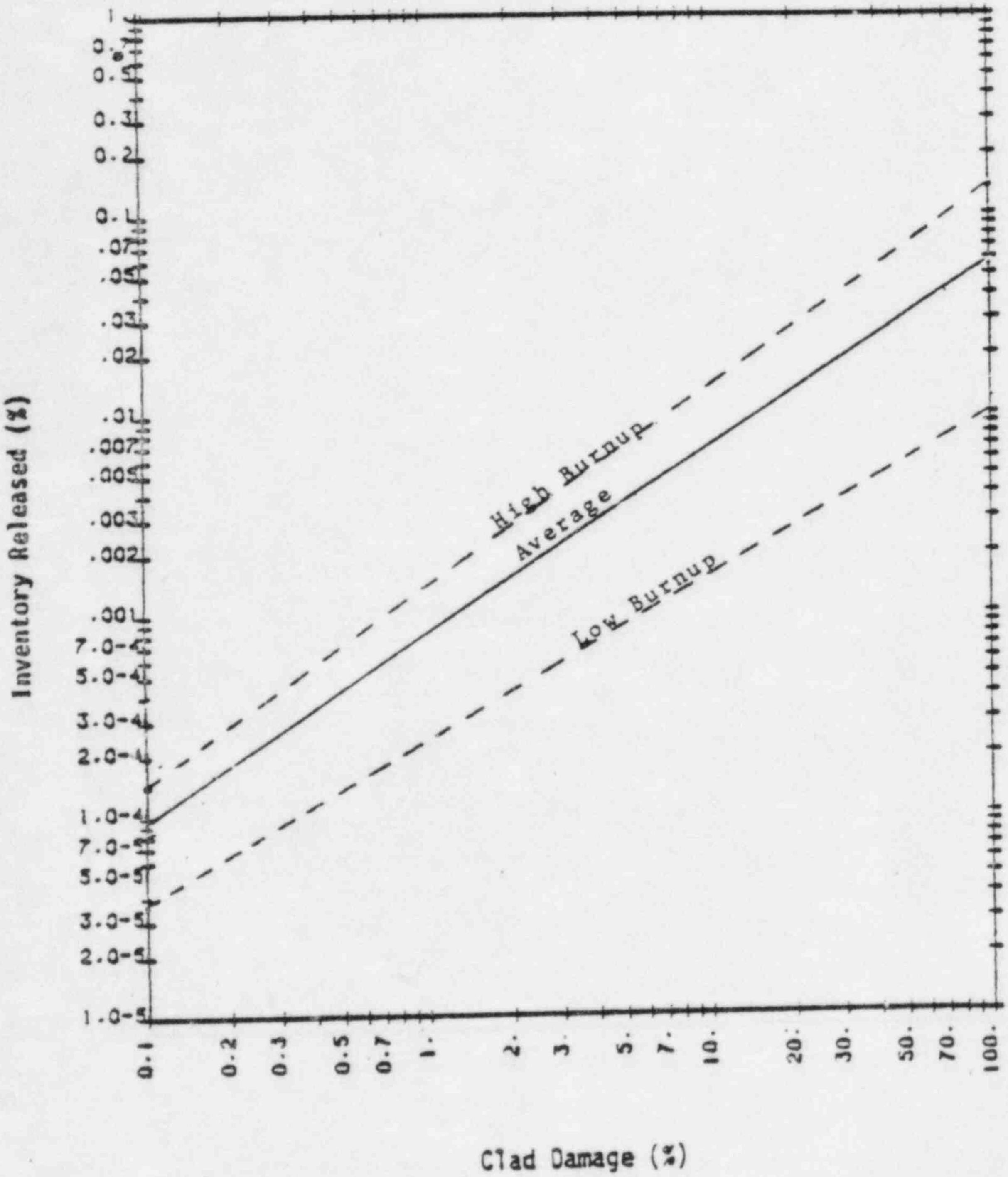

RELATIONSHIP OF % CLAD DAMAGE WITH % INVENTORY RELEASED OF I-135

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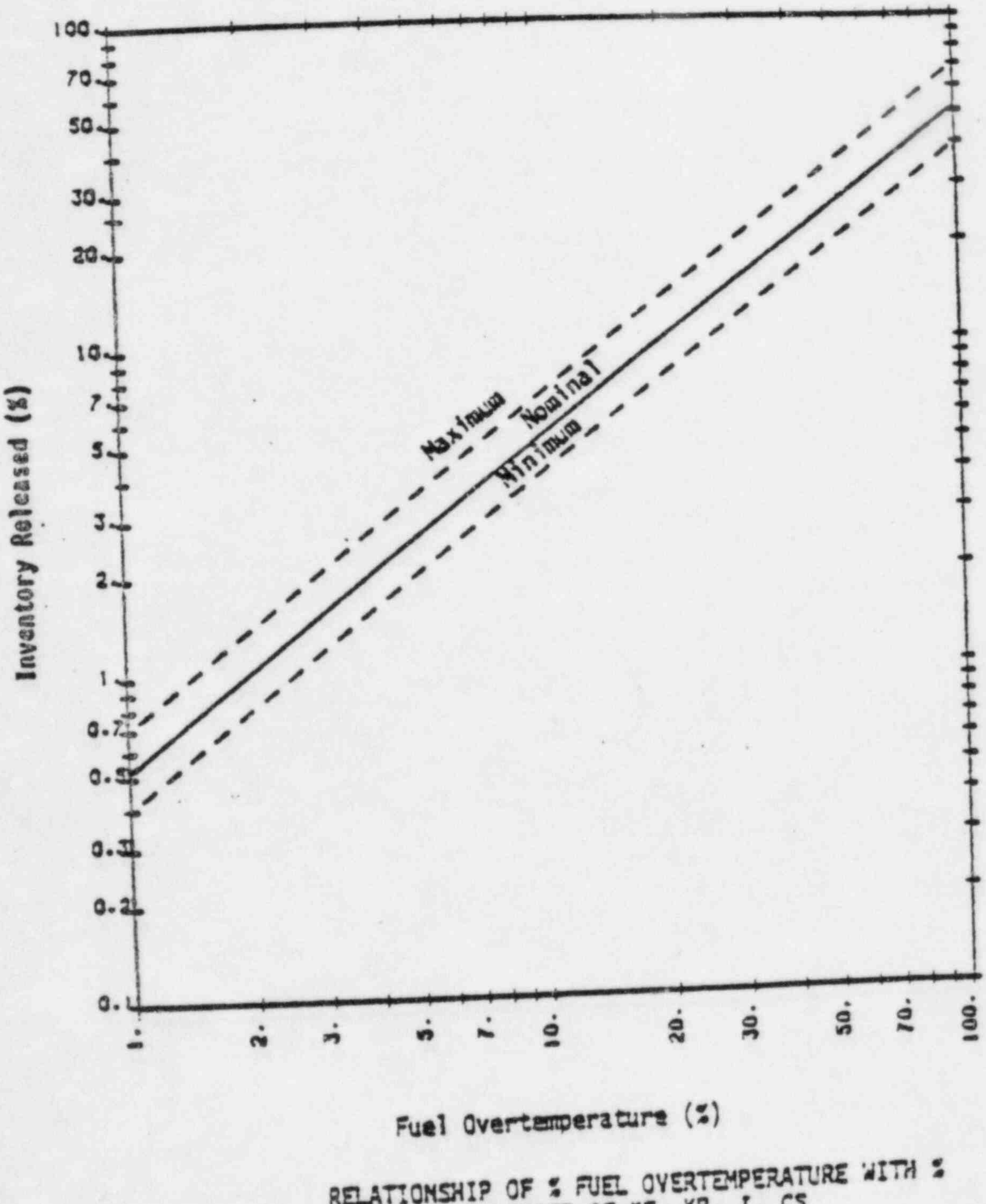

RELATIONSHIP OF % FUEL OVERTEMPERATURE WITH %
INVENTORY RELEASED OF XE, KR, I, CS

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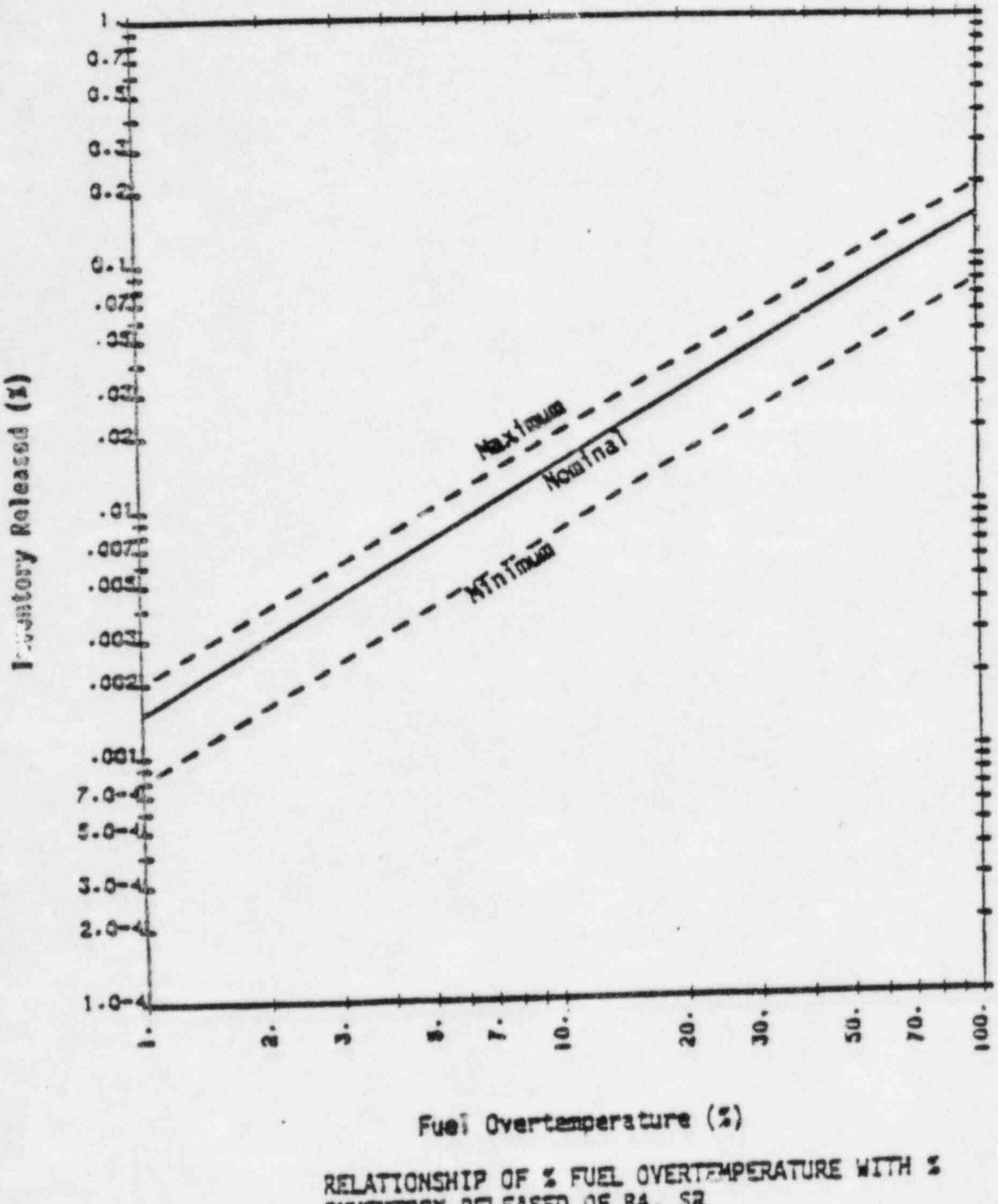

RELATIONSHIP OF % FUEL OVERTEMPERATURE WITH % INVENTORY RELEASED OF BA, SR

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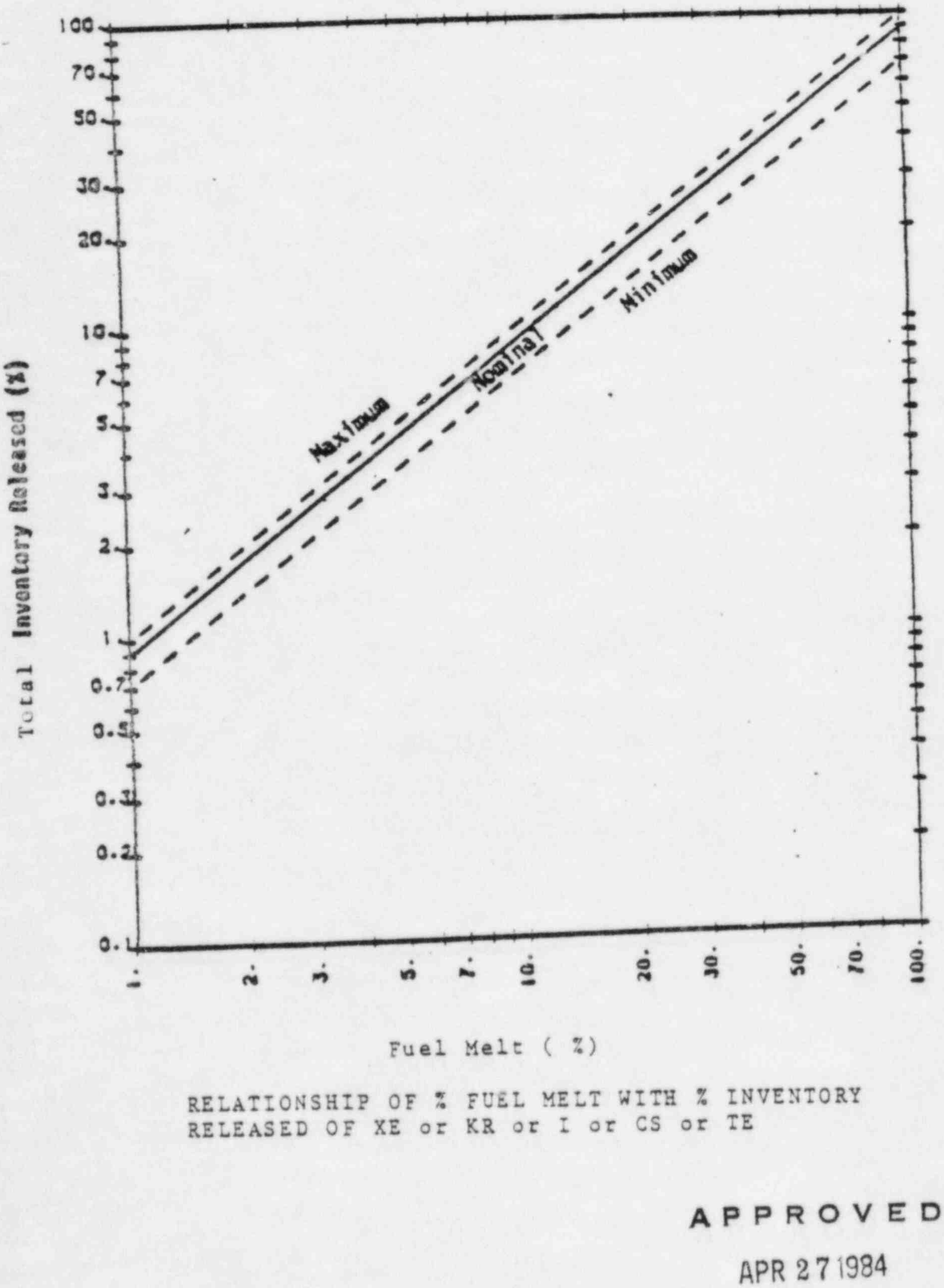

RELATIONSHIP OF % FUEL MELT WITH % INVENTORY
RELEASED OF XE or KR or I or CS or TE

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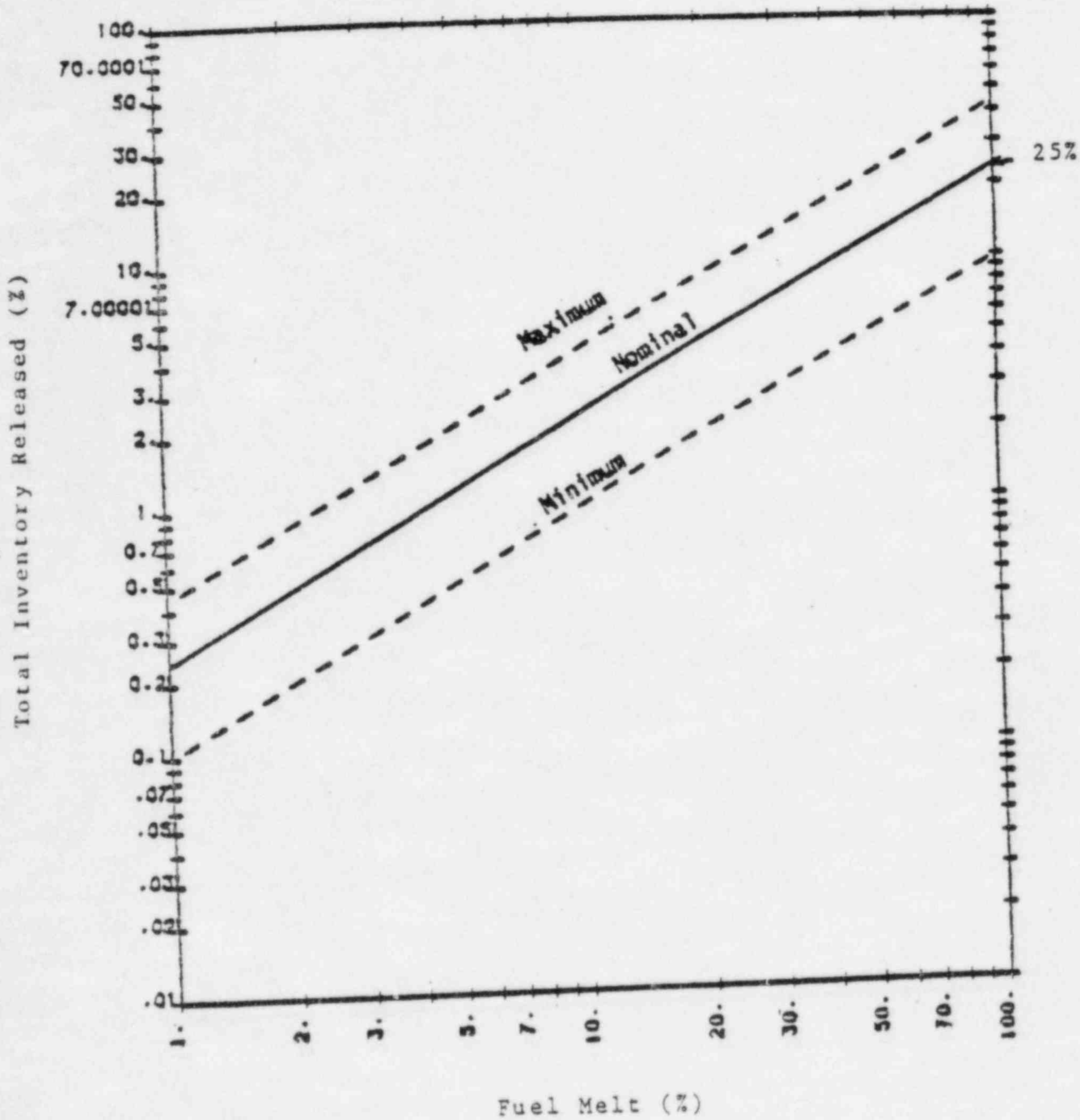

RELATIONSHIP OF % FUEL MELT WITH % INVENTORY RELEASED OF BA or SR

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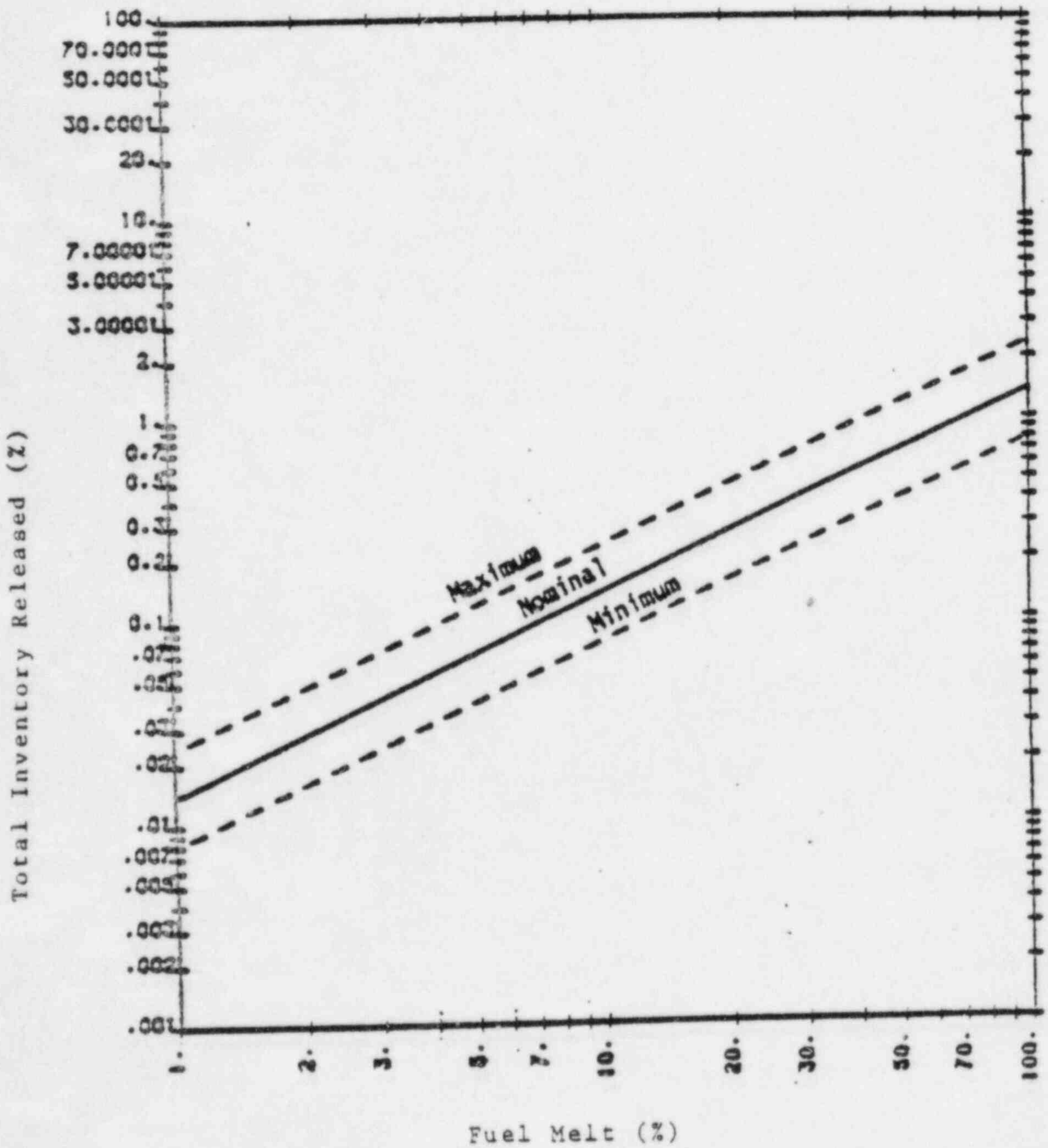

RELATIONSHIP OF % FUEL MELT WITH % INVENTORY RELEASED OF PR

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CHARACTERISTICS OF CATEGORIES OF FUEL DAMAGE

CORE DAMAGE CATEGORY	PERCENT AND TYPE OF FISSION PRODUCTS RELEASED	FISSION PRODUCT RATIO	CONTAINMENT HIGH RANGE ARE MONITOR, R/hr*	CORE EXIT THERMOCCUPLE READINGS (DEG F)	CORE UNCOVERED (YES/NO)	HYDROGEN MONITOR 1(2) AI PS 343 or 344 (VOL % H_2)
No Clad Damage	Kr-87<1X10-3 Xe-133<1X10-3 I-131<1X10-3 I-133<1X10-3	Kr-87=0.022 I-133=0.71	----	<750	No Uncovery	Negligible
0-50% Clad Damage	Kr-87 10^{-3}-0.1 Xe-133 10^{-3}-0.1 I-131 10^{-3}-0.3 I-133 10^{-3}-0.1	Kr-87=0.022 I-133=0.71	0-97	750-1300	Core Uncovery	<6%
50-100% Clad Damage	Kr-87 0.1-0.2 Xe-133 0.1-0.2 I-131 0.3-0.5 I-133 0.1-0.2	Kr-87=0.022 I-133=0.71	97-194	1300-1650	Core Uncovery	6%-11%
0-50% Fuel Pellet Overtemperature	Xe, Kr, Cs, I 1-20 Sr, Ba 0-0.4	Kr-87=0.22 I-133=2.1	194-25,000	>1,650	Core Uncovery	6%-11%
50-100% Fuel Pellet Overtemperature	Xe,Kr,Cs,I 20-40 Sr, Ba 0.4-0.8	Kr-87=0.22 I-133=2.1	2.5E4-5.0E4	>1,650	Core Uncovery	6%-11%
0-50% Fuel Melt	Xe, Kr, Cs, I 40-70 Sr, Ba 0.2-0.8 Pr, Rb, 0.1-0.8	Kr-87=0.22 I-133=2.1	5.0E4-8.5E4	>1,650	Core Uncovery	6%-11%
50-100% Fuel Melt	Xe, Kr, Cs, I, Te >70 Sr, Ba >24 Pr, Rb >0.8 ,	Kr-87=0.22 I-133=2.1	>8.5E4	>1,650	Core Uncovery	6%-11%

*10 hours after shutdown.

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SELECTED NUCLIDES FOR CORE DAMAGE ASSESSMENT

Core Damage State	Nuclide	Half-Life*	Predominant Gammas (Kev) Yield (%)*
Clad Failure	Kr-85m**	4.4 h	150(74), 305(13)
	Kr-87	76 m	403(84), 2570(35)
	Kr-88**	2.8 h	191(35), 850(23), 2400(35)
	Xe-131m	11.8 d	164(2)
	Xe-133	5.27 d	81(37)
	Xe-133m**	2.26 d	233(14)
	Xe-135**	9.14 h	250(91)
	I-131	8.05 d	364(82)
	I-132	2.26 h	773(89), 955(22), 1400(14)
	I-133	20.3 h	530(90)
	I-135	6.68 h	1140(37), 1280(34), 1460(12), 1720(19)
	Rb-88	17.8 m	898(13), 1863(21)
Fuel Overheat	Cs-134	2 yr	605(98), 796(99)
	Cs-137	30 yr	662(85)
	Te-129	68.7 m	455(15)
	Te-132	77.7 h	230(90)
Fuel Melt	Sr-89	52.7 d	
	Sr-90**	28 yr	
	Ba-140	12.8 d	537(34)
	La-140	40.22 h	487(40), 815(19), 1596(96)
	La-142	92.5 m	650(48), 1910(9), 2410(15), 2550(11)
	Pr-144	17.27 m	695(1.5)

* Values obtained from Table of Isotopes, Lederer, Hollander, and Perlman, Sixth Edition.

** These nuclides are marginal with respect to selection criteria for candidate nuclides; they have been included on the possibility that they may be detected and thus utilized in a manner analogous to the candidate nuclides.

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ISOTOPIC ACTIVITY RATIOS OF FUEL PELLET AND GAP

Nuclide	Fuel Pellet Activity Ratio	Gap Activity Ratio
Kr-85m	0.11	0.022
Kr-87	0.22	0.022
Kr-88	0.29	0.045
Xe-131m	0.004	0.004
Xe-133	1.0	1.0
Xe-133m	0.14	0.096
Xe-135	0.19	0.051
I-131	1.0	1.0
I-132	1.5	0.17
I-133	2.1	0.71
I-135	1.9	0.39

Where:

$$\text{Noble Gas Ratio} = \frac{\text{Total Activity of Noble Gas Isotope Released}}{\text{Total Activity of Xe 133 Released}}$$

$$\text{Iodine Ratio} = \frac{\text{Total Activity of Iodine Isotope Released}}{\text{Total Activity of I 131 Released}}$$

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CALCULATION OF INGROWTH AND DECAY CORRECTION FACTORS

Kr-85 ⟶ $e^{0.157t}$

Kr-87 ⟶ $e^{0.547t}$

Kr-88 ⟶ $e^{0.247t}$

Xe-131M ⟶ $\frac{1}{-2.62e^{-(3.54E-3)t} + 3.62e^{-(2.45E-3)t}}$

Xe-133 ⟶ $\frac{1}{-0.185e^{-(3.41E-2)t} -0.10e^{-(1.28E-2)t} +1.285e^{-(5.48E-3)t}}$

Xe-133M ⟶ $\frac{1}{-0.1e^{-(3.41E-2)t} +1.1e^{-(1.28E-2)t}}$

Xe-135 ⟶ $\frac{1}{-9.26e^{-(1.04E-1)t} -0.033e^{-(2.66)t} +10.293e^{-(7.58E-2)t}}$

I-131 ⟶ $e^{0.00359t}$

I-132 ⟶ $\frac{1}{0.103e^{-(8.91E-3)t} +0.897e^{-(0.307)t}}$

I-133 ⟶ $e^{0.0341t}$

I-135 ⟶ $e^{0.104t}$

Cs-134 ⟶ 1

Te-129 ⟶ $\frac{1}{1.09e^{-(0.161)t} +0.16e^{-(8.47E-4)t} -0.25e^{-(0.605)t}}$

Te-132 ⟶ $e^{0.00892t}$

Ba-140 ⟶ $e^{0.00225t}$

La-140 ⟶ $\frac{1}{1.09e^{-(2.25E-3)t} -0.09e^{-(1.72E-2)t}}$

La-142 ⟶ $\frac{1}{-0.14e^{-(3.78)t} +1.14e^{-(0.449)t}}$

Pr-144 ⟶ $\frac{1}{0.91e^{-(1.04e-4)t} +0.09e^{-(2.4)t}}$

Where:

t = the number of hours between reactor shutdown and time of sample count (frcm column 2 of BZP 380-T4, pages 1 and 2).

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NORMAL OPERATING ACTIVITY*

Nuclide	Specific Activity in Reactor Coolant (uCi/gm)
KR 85m	1.1 (-1)
KR 87	6.0 (-2)
KR 88	2.0 (-1)
Xe 131m	1.1 (-1)
Xe 133	1.8 (+1)
Xe 133m	2.2 (-1)
Xe 135	3.5 (-1)
I 131	2.7 (-1)
I 132	1.0 (-1)
I 133	3.8 (-1)
I 135	1.9 (-1)

* Values obtained from ANS 18.1

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IODINE 131 ACTIVITY RELEASED DUE TO SPIKING PHENOMENA

Range of Average SA	Total I-131 Available for Release, Curies
0.5 < SA < 1.0	3400
0.1 < SA < 0.5	380
0.05 < SA < 0.1	200
0.01 < SA < 0.05	200
0.005 < SA < 0.01	100
0.001 < SA < 0.005	100
SA < 0.001	2

Range of Average SA for 90/90 Upper Confidence Level	Maximum I-131 Available for Release, Curies (90% probability of not exceeding indicated curies
0.5 < SA < 1.0	6500
0.1 < SA < 0.5	950
0.05 < SA < 0.1	650
0.01 < SA < 0.05	650
0.005 < SA < 0.01	300
0.001 < SA < 0.005	300
SA < 0.001	10

Where SA = the normal operaing I 131 specific activity (μci/gm) in the reactor coolant.

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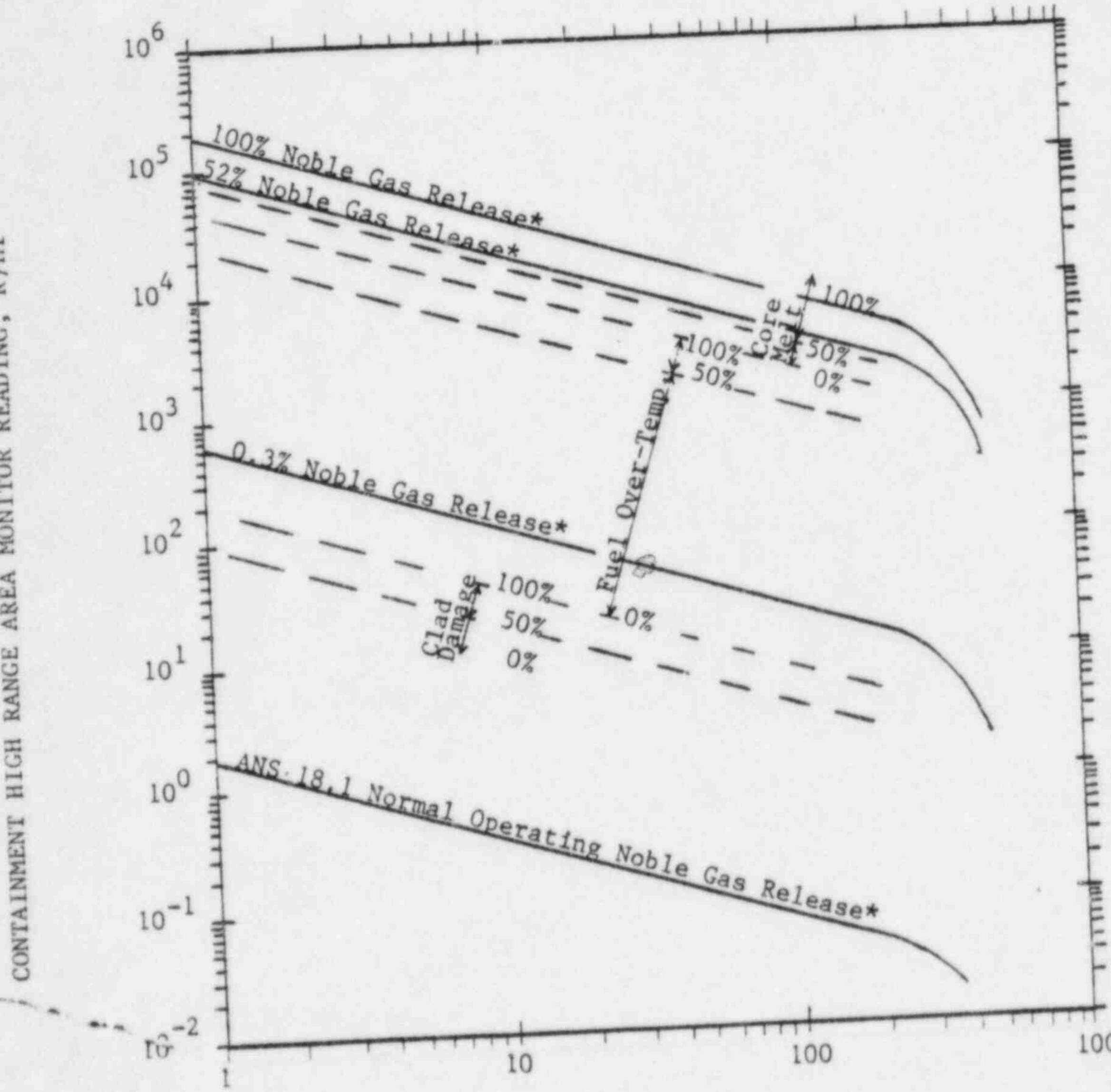
PERCENT OF NOBLE GASES IN CONTAINMENT



* Specific to Byron Nuclear Generating Station only

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FINAL