GEORGIA POWER COMPANY

HATCH NUCLEAR PLANT

PROCEDURE

Determination of the Extent
Of Core Damage Under Accident Conditions
PROCEDURE TITLE

HNP-4848
PROCEDURE NUMBER

Lab
RESPONSIBLE SECTION

SAFETY RELATED (X)   NON-SAFETY RELATED (   )

REV.	DESCRIPTION	APPROVED DEPT. HEAD	APPROVED PLANT MANAGER	DATE
0	New Procedure	W H Rogers for RWZ	H away Nix	7/5/83
1	Pages 3 thru 6	RW Zavadoski	Tom Greene	10/14/83

HNP-9

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DETERMINATION OF THE EXTENT OF CORE DAMAGE UNDER ACCIDENT CONDITIONS

A. PURPOSE

To provide instructions for determining the extent of core damage under accident conditions.

B. REFERENCES

NEDO-22215 "Procedures for the Determination of the Extent of Core Damage Under Accident Conditions" by C. C. Lin

C. SAFETY

Observe good radiation protection practices when handling samples to minimize personnel exposure.

D. PROCEDURE

Obtain a reactor water sample and a drywell atmosphere sample by using the installed Post Accident Sampling System (PASS). Determine the corrected activity concentration in micro-curies per gm (uCi/gm) decay corrected back to time of reactor shutdown. This correction can be done by entering the time of the reactor shutdown into the computer for the sampling time.

Determine the corrected concentrations of the indicator isotopes I-131, Cs-137, Xe-133, and Kr-85. Multiply the concentrations of I-131 and Cs-137 that are in the reactor water by 1.22. Multiply the Xe-133 and Kr-85 in the drywell atmosphere sample by 0.786 for Unit I and 0.795 for Unit II. After multiplication, the resulting concentrations are the normalized concentrations and can be compared to the charts developed by General Electric and included in this procedure as Figures 1 through 4. Any damage to the fuel in the core can be determined directly from the graphs by reading percent of damage versus corrected concentration in uCi/gm or uCi/cc.

E. OTHER FACTORS

For further refinement of the core damage estimate, consult the reference in Section B. Some other factors that may be useful in determining core damage are summarized as follows.

1. Containment Radiation Levels

   Containment radiation level provides a measure of core damage, because it is an indication of the inventory of

airborne fission products (i.e., noble gases, a fraction of the halogens, and a much smaller fraction of the particulates) released from the fuel to the containment. Containment hydrogen levels, which are measurable by the PASS or the containment gas analyzers, provide a measure of the extent of metal-water reaction which, in turn, can be used to estimate the degree of clad damage.

2. Reactor Vessel Water Level

Another significant parameter for the estimation of core damage is reactor vessel water level. This parameter is used to establish if there has been an interruption of adequate core cooling. Significant periods of core uncovery, as evidenced by reactor vessel water level readings, would be an indicator of a situation where core damage is likely. Water level measurement would be particularly useful in distinguishing between bulk core damage situations caused by loss of adequate cooling to the entire core and localized core damage situations caused by a flow blockage in some portion of the core.

3. Main Steam Line Monitors

There are other parameters which may provide an indication that a core damage event has occurred. These are main steam line radiation level and reactor vessel pressure. The usefulness of main steam line radiation measurement is limited because the main steam line radiation monitors are downstream of the main steam isolation valves (MSIVs) and would be unavailable following vessel isolation.

4. Reactor Vessel Pressure Measurement

Reactor vessel pressure measurement would provide an ambiguous indication of core damage, because, although a high reactor vessel pressure may be indicative of a core damage event, there are many non-degraded core events which could also result in high reactor vessel pressure.

5. Detection of the Less Volatile Fission Products

There are other measurements besides radionuclide measurements which are obtainable using the PASS which would further aid in estimating core damage. Detection of such elements in the reactor coolant as Sr, Ba, La, and Ru is evidence of fuel melting. These indications could be factored into the final core damage estimate.

6. Metal-Water Reaction of Hydrogen in the Containment

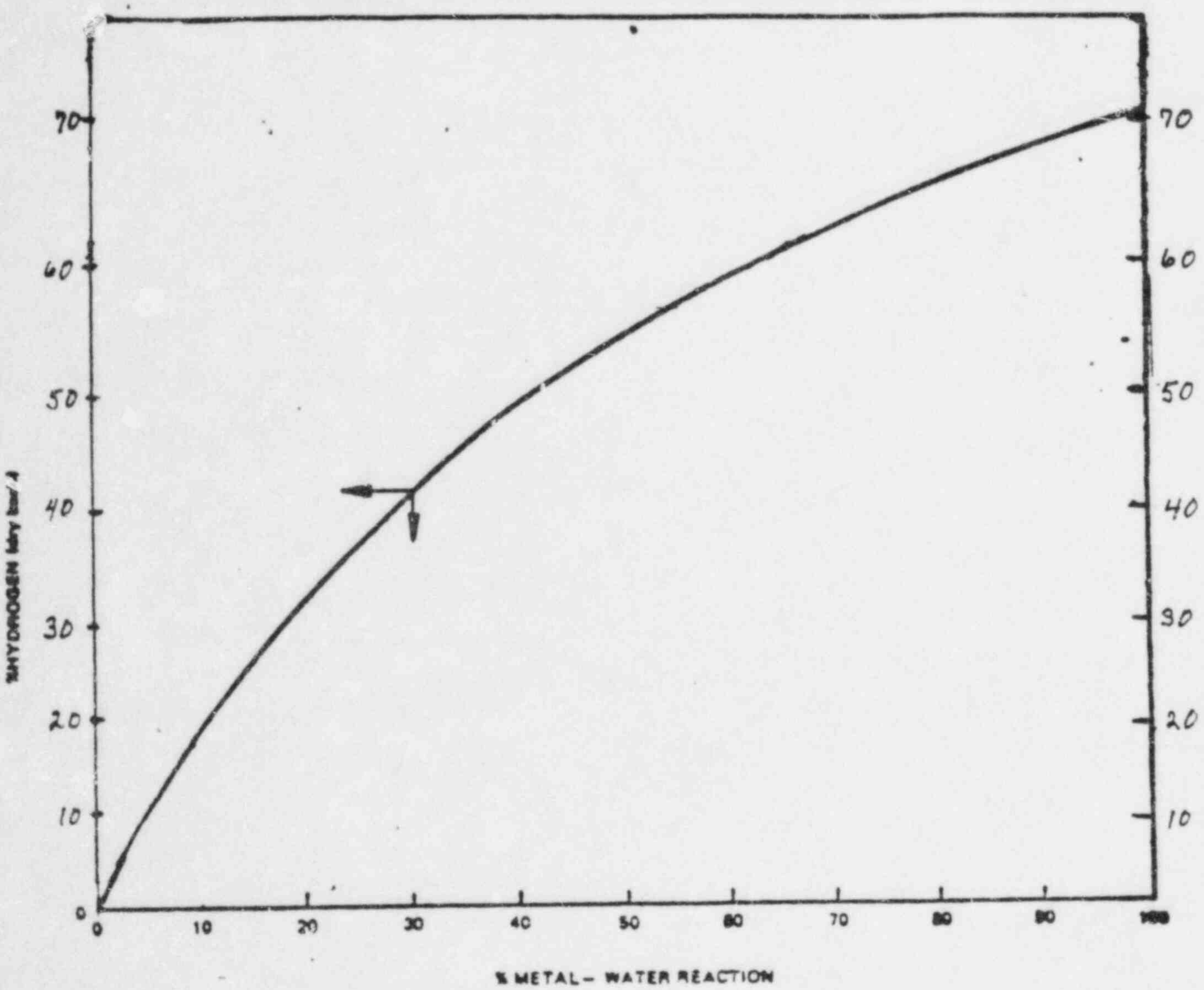
The extent of fuel clad damage as evidenced by the extent of metal-water reaction can be estimated by determination of the hydrogen concentration in the containment. That concentration is measurable by either the containment hydrogen monitor or by the post accident sampling system.

A correlation has been developed which relates containment hydrogen concentration to the percent metal-water reaction for Mark I type containments. That correlation is shown in the curve below. Steps 1 and 2 below indicate the method by which Plant Hatch can use the correlation to determine the extent of clad damage.

Step 1: Obtain containment hydrogen monitor reading, (H), in %.

Step 2: Using the curve below, determine the metal-water reaction for the reference plant, MW ref .

METAL-WATER REACTION OF HYDROGEN CURVE



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7. Containment Radiation Level Readings

An indication of the extend of core damage is the containment radiation level which is a measure of the inventory of fission products released to the containment. The purpose of this step is to present that correlation and provide a method whereby Plant Hatch can use the correlation to determine the degree of core damage.

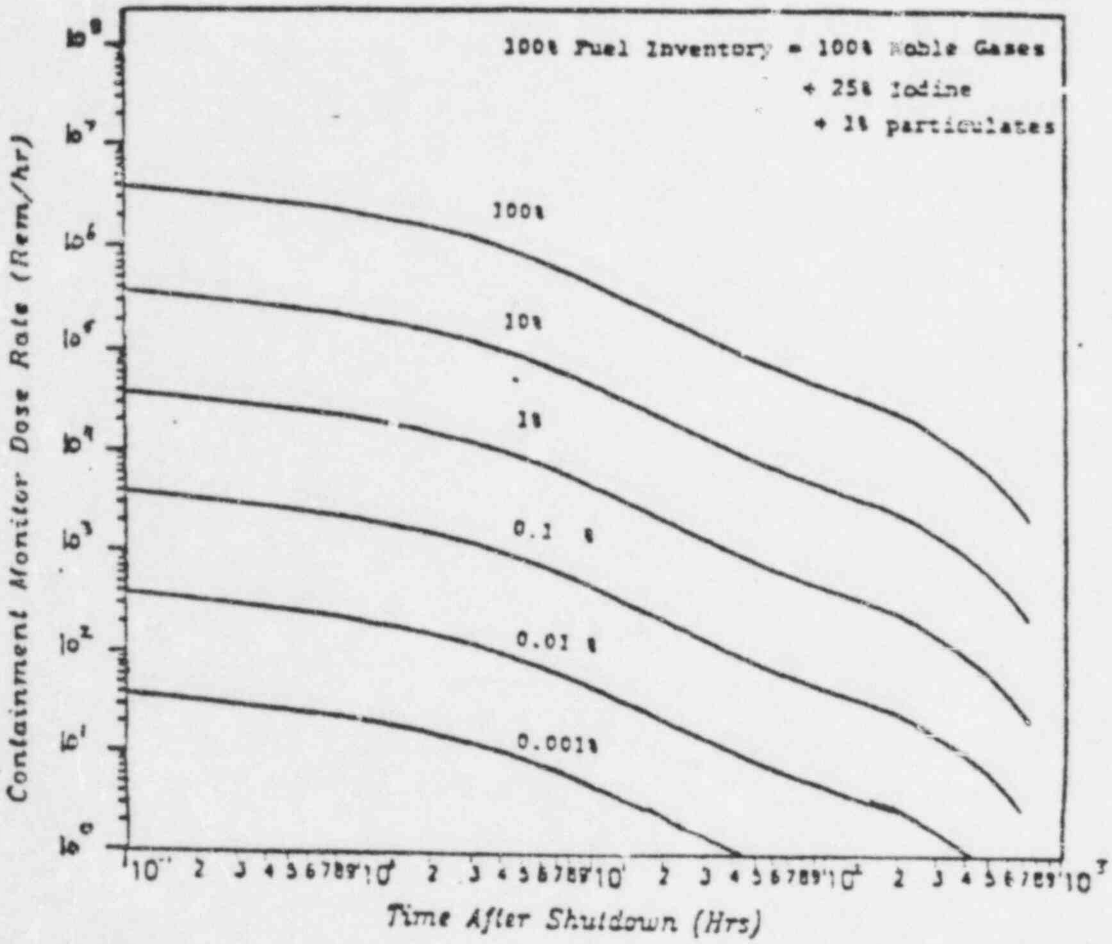
The procedure for determination of fraction of fuel inventory released to the containment is as follows:

Step 1: Obtain containment radiation monitor reading, (R), in Rem/hr.

Step 2: Determine elapsed time from plant shutdown to the containment radiation monitor reading (t) in hours.

Step 3: Using the curves below, determine the fuel inventory release of airborne radioactivity to the containment in percent.

PERCENT OF FUEL INVENTORY AIRBORNE IN THE CONTAINMENT CURVE



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8. Application of Other Significant Parameters to Core Damage Estimate

As noted previously, procedures have already been developed which provide an estimate of core damage based on radionuclide measurements. Based on these procedures, an initial assessment of core damage is made. Based on a clarification provided by the NRC, that assessment would appear in a matrix as follows:

Degree of Degradation	Minor (<10%)	Intermediate (10% - 50%)	Major (>50%)
No fuel damage	←----------	1	----------→
Cladding failure	2	3	4
Fuel Overheat	5	6	7
Fuel Melt	8	9	10

As recommended by the NRC, there are four general classes of damage and three degrees of damage within each of the classes except for the "no fuel damage" class. Consequently, there are a total of 10 possible damage assessment categories. For example, Category 3 would be descriptive of the condition where between 10 and 50 percent of the fuel cladding has failed. Note that the conditions of more than one category could exist simultaneously. The objective of the final core damage assessment procedure is to narrow down to the maximum extent possible those categories which apply to the actual inplant situation.

FIGURE 1

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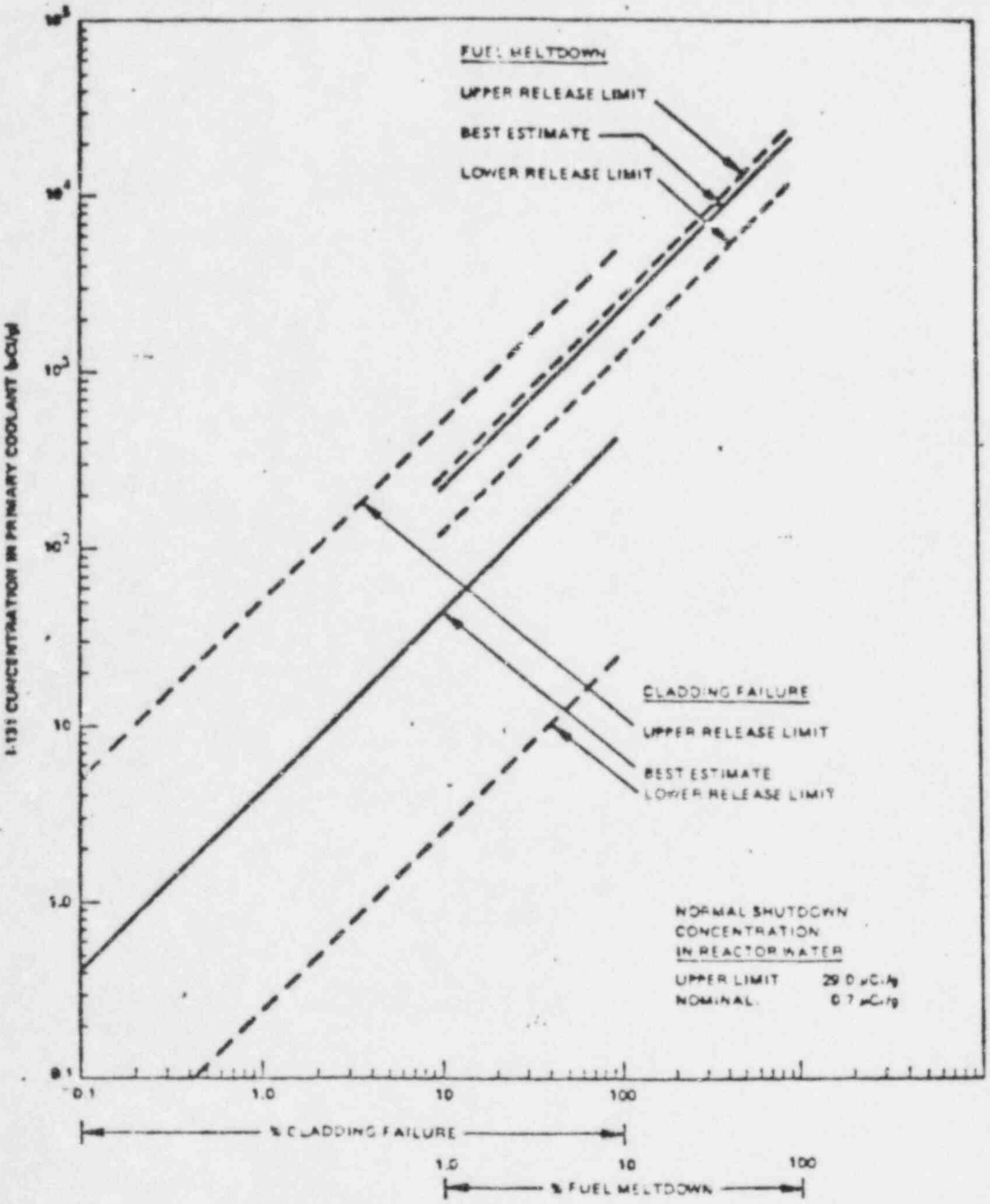

Figure 1: Relationship bewteen I-131 Concentration in the Primary Coolant (Reactor Water + Pool Water) and the Extent of Core Damage in Reference Plant

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FIGURE 2

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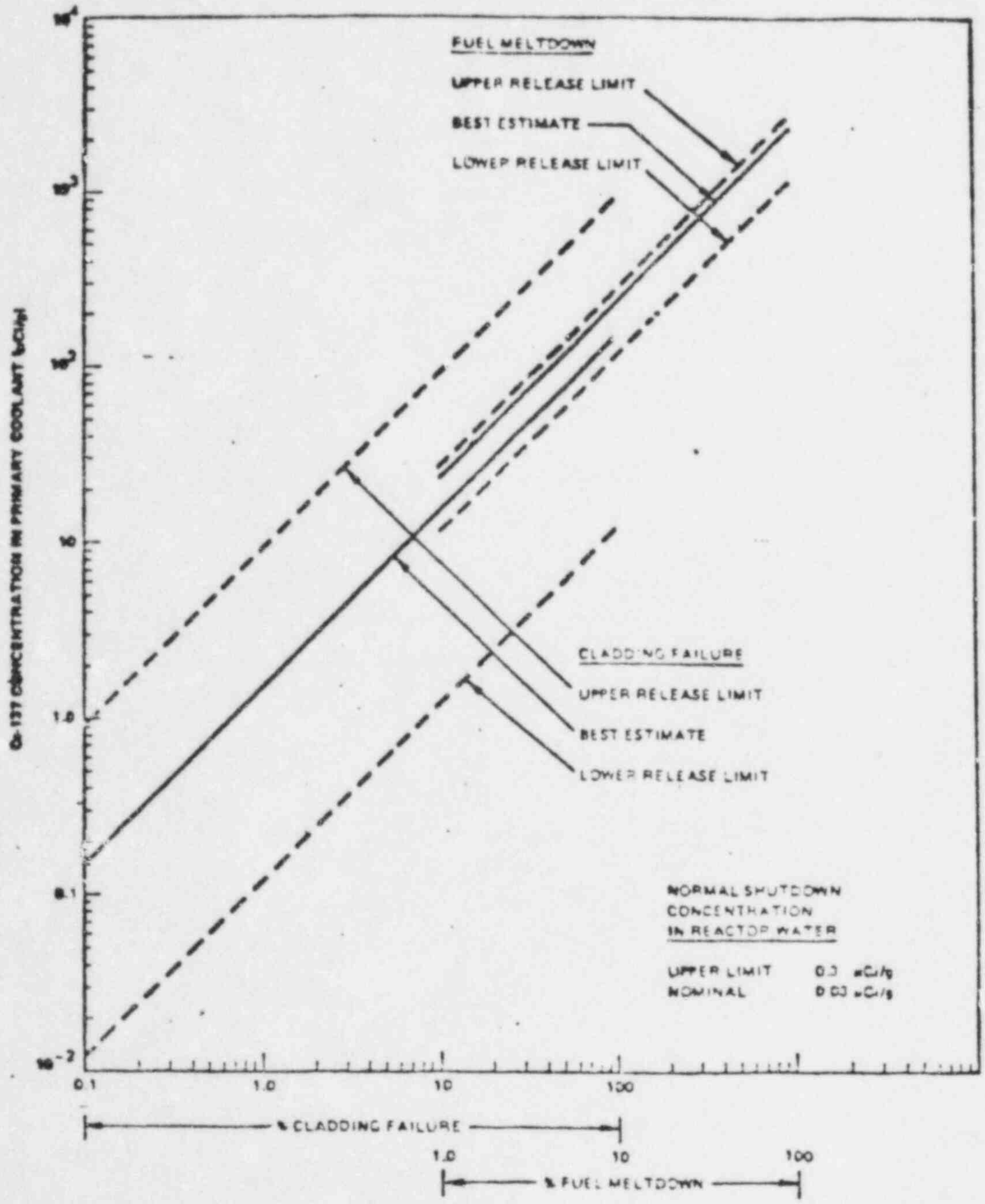

Figure 2: Relationship between Cs-137 Concentration in the Primary Coolant (Reactor Water + Pool Water) and the Extent of Core Damage in Reference Plant

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FIGURE 3

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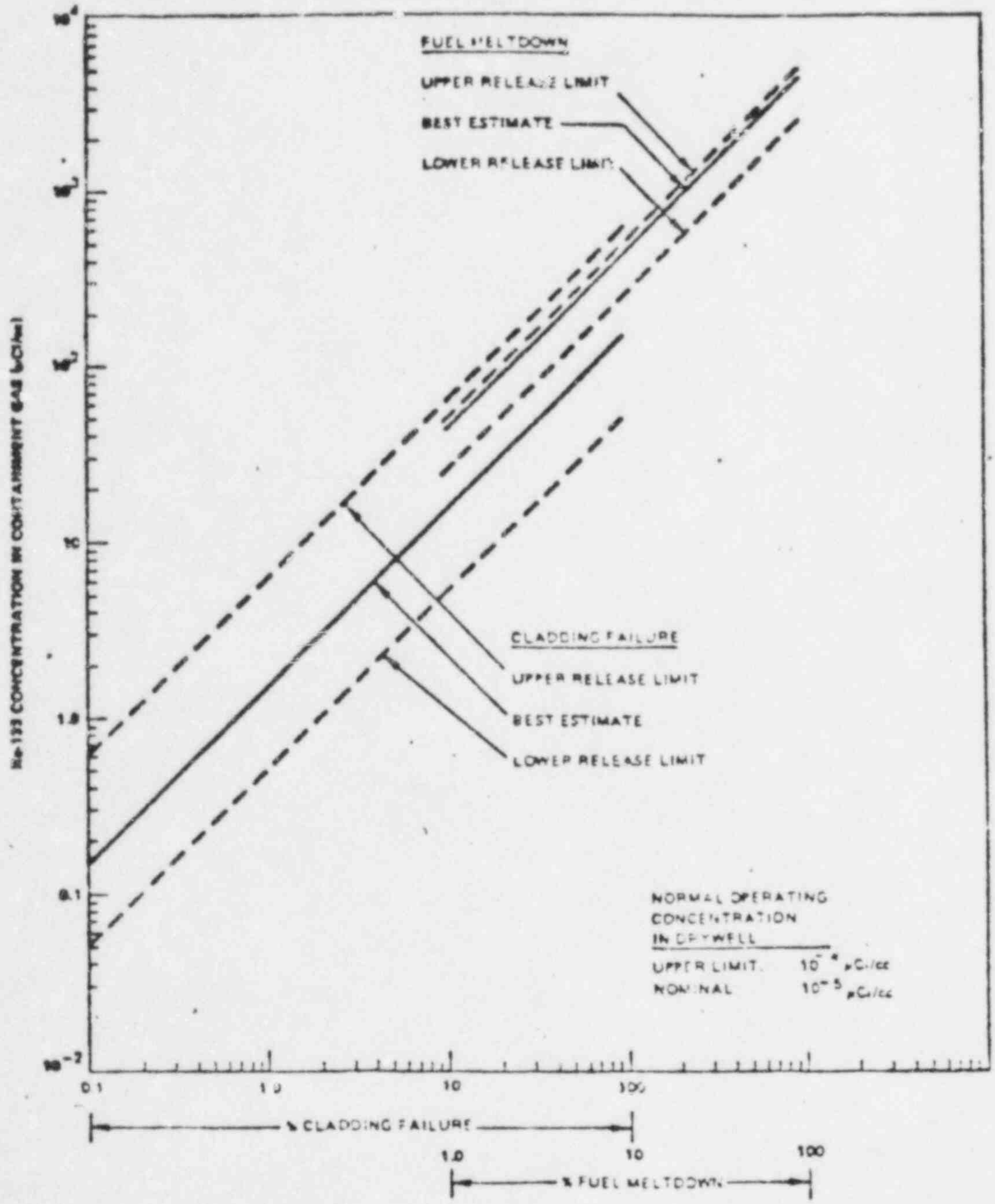

Figure 3: Relationship between Xe-133 Concentration in the Containment Gas (Drywell + Torus Gas) and the Extent of Core Damage in Reference Plant

FIGURE 4

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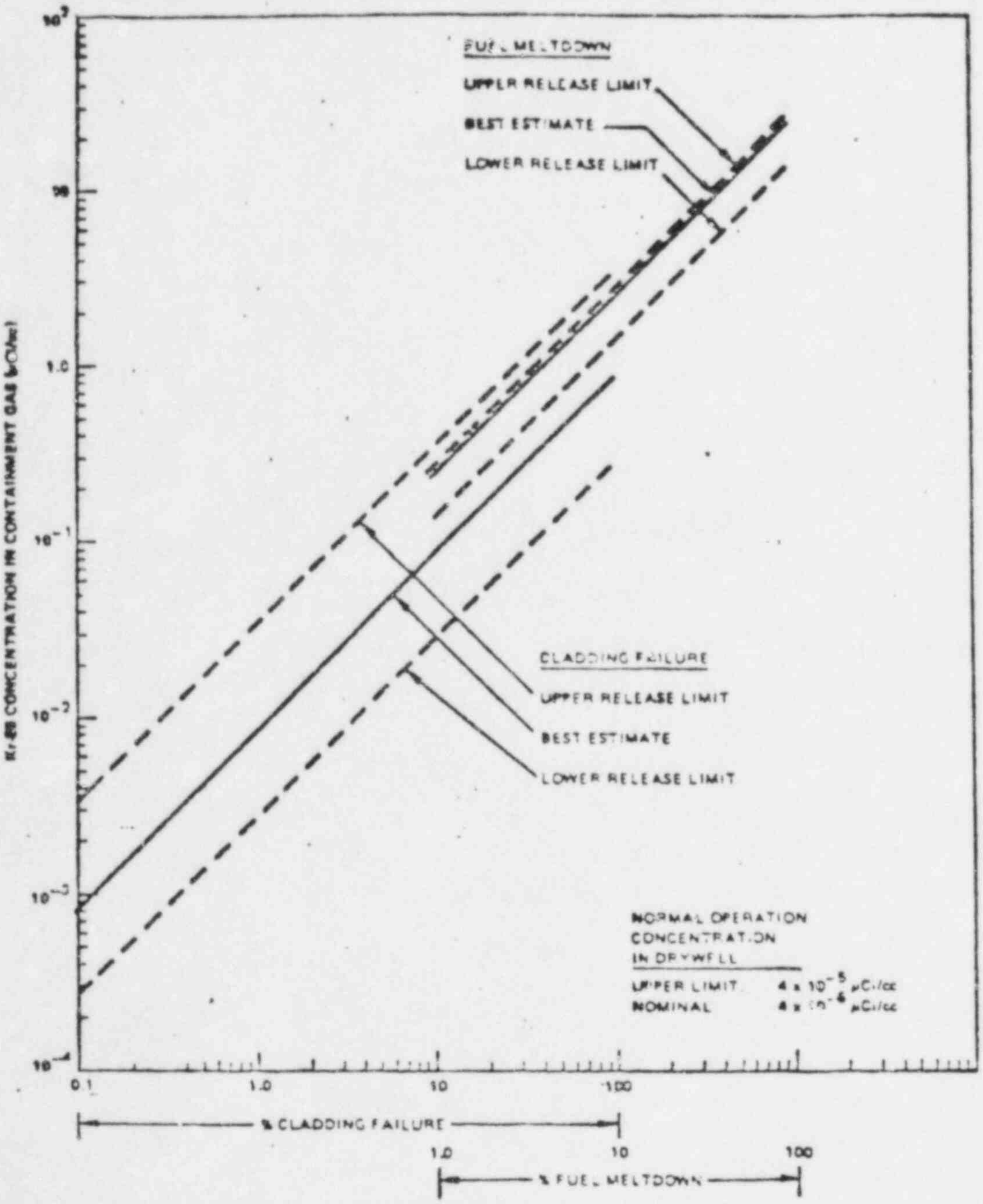

Figure 4: Relationship between Kr-85 Concentration in the Containment Gas (Drywell + Torus Gas) and the Extent of Core Damage in Reference Plant

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