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Mr. Dennis L. Ziemann, Chief
Operating Reactors - Branch 2
Division of Operating Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Dresden and Quad-Cities Stations Supplement No. 1 to Dresden Station Special Report No. 39 and Quad-Cities Station Special Report No. 14, Analysis of Hydrogen Generation and Control in Primary Containment Following Postulated Loss of Coolant Accident, NRC Docket Nos. 50-237, 50-249, 50-254, and 50-265

Dear Mr. Ziemann:

Attached is Amendment No. 1 to the subject special reports. This amendment is seen on the attached pages 13, 14, 15, 21, and 22 and Figures IV.1, IV.2, IV.3, IV.4, IV.5, IV.6, IV.7, and IV.8.

Supplement No. 1 to Dresden Station Special Report No. 39 and Quad-Cities Station Special Report No. 14, "Combustible Gas Control System Design Report", has been based on a 0.23 mils thickness oxide penetration into an all 8 x 8 core. Additionally, the inventory of zirconium in the 8 x 8 has been increased by an additional ~20% to account for the possible higher than expected metal-water reaction results which were being performed at that time.

General Electric has completed the core wide metal-water calculations utilizing Method 1 described in NEDO-20566. Table 2 of Quad-Cities Station Special Report No. 15 and Dresden Station Special Report No. 40 will be updated to reflect the new calculations which resulted in 0.18% metal-water reaction. For the purposes of the combustible gas control design calculations, this number has been multiplied times 5; therefore, 0.90% was used as input to the calculations.

The 0.18% metal-water reaction has been calculated based on a fully 7 x 7 core; therefore, the zirconium inventory is based on a 7 x 7 core. The 8 x 8 core has not been utilized because a 7 x 7 core renders a more restrictive core wide metal-water reaction.

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A second core wide metal-water reaction calculation has been performed using Method 1 of NEDO-20566 except that the nodal power distribution curve which was considered typical for these plants when operating at 102% of licensed core power was used. This power distribution curve is based on the latest Appendix K MAPLHGR curves. The recalculation using the above assumptions gives a core wide metal-water reaction of 0.11%.

Attached is a curve (Figure 1) depicting the nodal power distribution for 16 operating state points of the CECo plants. Four data points were selected for each of the four plants using the criterion of highest operating power. The variation of MAPLHGR with exposure was obtained from the latest Appendix K analysis.

The curve is the average of the 16 data points. However, the highest powered bundles were operating at 80% of the Appendix K MAPLHGR's at the time the operating plants were at the highest power. Consequently, the curve was conservatively adjusted such that the highest powered bundles were operating at the Appendix K MAPLHGR's. All of the data points, even when adjusted to rated power conditions, show that the curve in the attached figure is a conservative representation of operating data.

It must be clearly noted that this calculation was not performed in accordance with the NRC approved methods. Also, the power distribution curve is based on past operating data and may not be representative of future conditions.

The above calculation is intended to provide the reviewing staff with another demonstration of the degree of conservatism present in the applicants design of the ACAD system.

The following pages contain the changes to the original report. These changes reflect the use of the 0.18% metal-water reaction in a 7 x 7 core and as it may be seen, the results are slightly less restrictive on the system than the original report.

Enclosed are one (1) signed original and 59 copies for your use. Please direct any questions to this office.

Very truly yours,

G. A. Abrell
Nuclear Licensing Administrator
Boiling Water Reactors

Enclosure

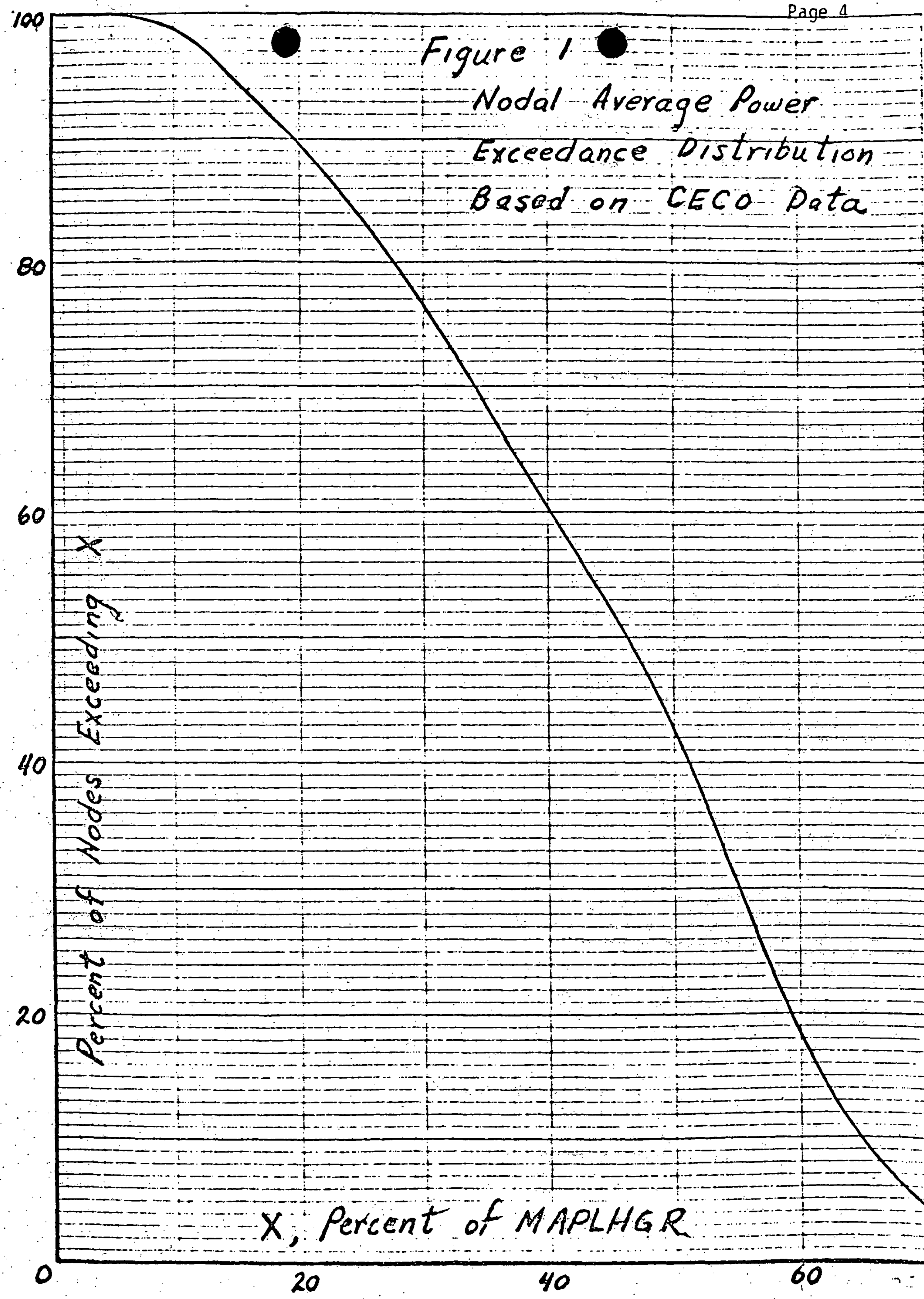

Figure 1
Nodal Average Power Exceedance Distribution Based on CECO Data

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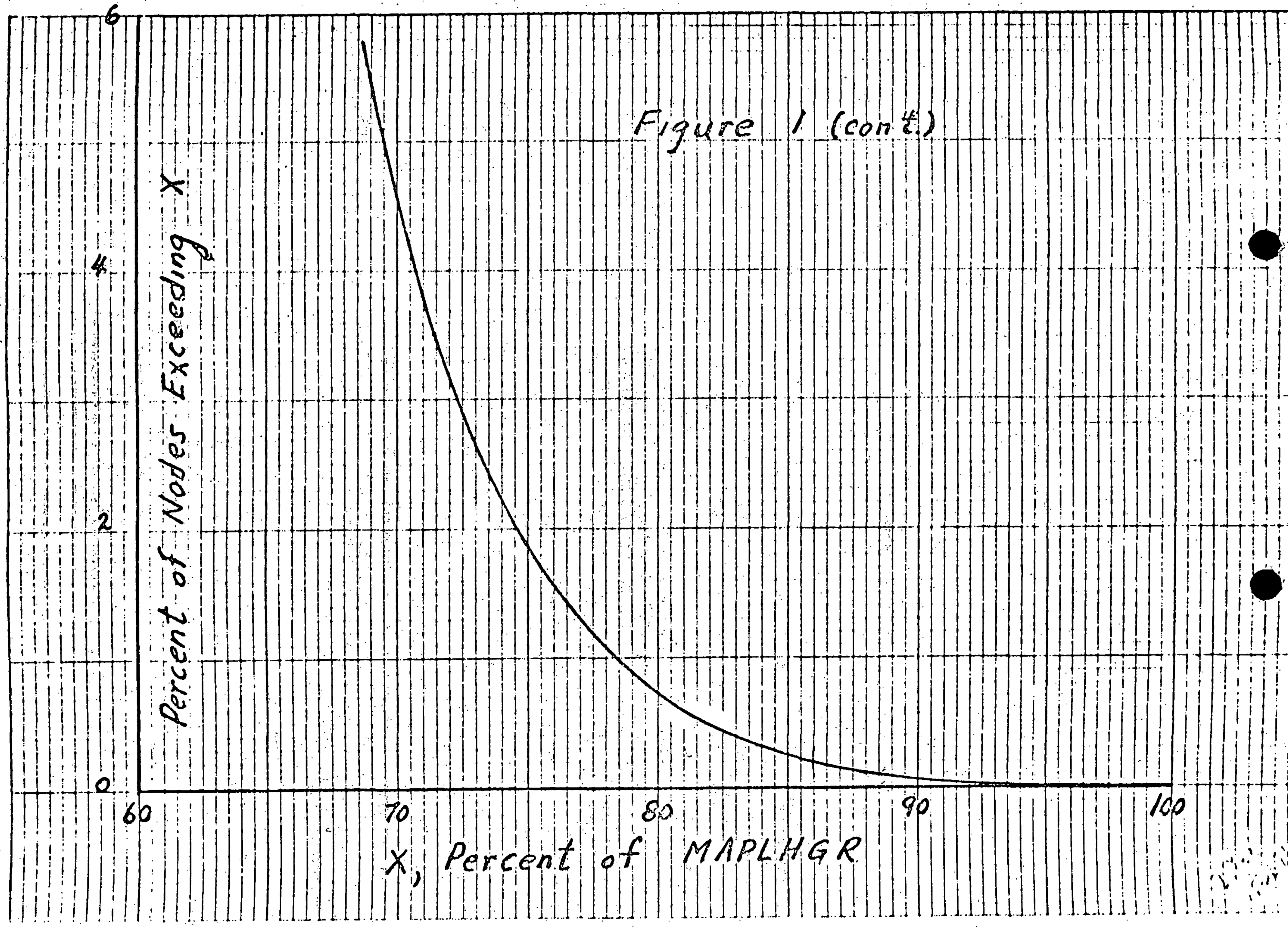

2.0 ANALYSIS

In reviewing the results of the forthcoming analysis it should be remembered that the assumed metal-water reaction for this analysis is based on a hypothetical situation and it cannot be related to any credible physical process during the already extremely improbable LOCA. Moreover, the entire design of the system as described in Section III is based on the unrealistic assumption that no water vapor is present in either the drywell or the wetwell and that neither of the two volumes leak during the entire course of the accident.

The analysis of the accident was conducted utilizing the EI proprietary code CONCEN. A full description of the code is contained in Appendix A to this report. Based on the assumptions contained in this section and in Appendix A, the analysis of hydrogen and oxygen production in the drywell and wetwell following the LOCA was conducted. Figure IV.1 shows the hydrogen concentration in the drywell as a function of time. Based on this analysis the ACAD system will not be required to be placed in operation until 135 minutes (2.25 hours) after the accident, when the hydrogen concentration reaches 3.5%. It should be noted that the hydrogen concentration continues to increase slowly until it reaches a peak of approximately 3.72 at about 600 minutes (10 hours) after the accident. After that time the concentration begins to drop. While the Dilution Air Injection Subsystem is in operation the pressures in the drywell and wetwell will gradually increase as is shown in Figures IV.2 and IV.3. As is shown, and it can be expected, the pressures in the drywell and wetwell will be nearly the same. This is due to the equalizing effect of the vents and vacuum breakers in case the air is injected into one volume at a time. If both of the volumes receive air at the same time the pressures in the two volumes will be equal due to a common connection, the air receiver. The hydrogen concentration history in the wetwell is shown in Figure IV.4. The lack of the initial metal-water reaction source is evident by the uniformly and slowly rising curve.

Am. 1

Am. 1

As was discussed earlier, the operation of the Dilution Air Injection Subsystem will gradually raise the pressures in the drywell and wetwell to a level approaching 50% of the design pressures of the two volumes. A value somewhat less than 50%, 43 psia, has been used in the analysis as the Pressure Bleed Sybsystem actuation pressure. This pressure will not be reached until 6430 minutes (107.17 hours) after the LOCA. The Pressure Bleed Sybsystem will reduce the pressures in the drywell and the wetwell by letting some of the contents of the wetwell and drywell to escape to the environment via the SBGT System. The resulting doses as a result of the system operation are discussed in Subsection 3.0. Am. 1 Am. 1

To provide an estimate of the margin of conservativeness inherent in the design of the ACAD system, an analysis utilizing the fact that water vapor will be present in the containment following a LOCA has been used. The water vapor content history assumption has been based upon the water vapor content history which has been utilized in the licensing of the nitrogen CAD system, for example, Amendment 50 to Browns Ferry Nuclear Plant Final Safety Analysis Report (Ref. 6) and Supplement 2 to Dresden Station Special Report No. 14, Quad Cities Station Special Report No. 7 (Ref. 7). The concentration of steam at anytime following the LOCA was obtained by calculating the ratio of the partial pressure of the water vapor to the total pressure of the containment. The partial pressure of the water vapor was obtained from standard steam tables as a function of temperature. The temperature history used was from the standard post-LOCA containment response analysis, assuming that sprays are operating, as presented in Subsection 14.6 of the Dresden and Quad Cities FSAR's (Refs. 8,9).

The results of this analysis shown in Figures IV.5 through IV.8 show that the ACAD System operation would not be required until 445 minutes (7.42 hours) after the accident, a factor of over 3 greater than the design case. Since the system would not be required to operate until much later than the design case, the required air injection rate would be 20% less than the design case. As a result of the slower air injection rate into the two volumes the pressure which requires the initiation of Am. 1

the Pressure Bleed Subsystem will not be reached until 6690 minutes (~111.3 hours) after the LOCA. This later release, of course, will result in considerably lower doses. Am. 1

To illustrate the effectiveness of the ACAD System operation the hydrogen concentration history in the drywell and wetwell is shown if no ACAD System was provided. By comparing Figures IV.1 and IV.9, and Figures IV.2 and IV.10 the effectiveness of the system is clearly demonstrated.

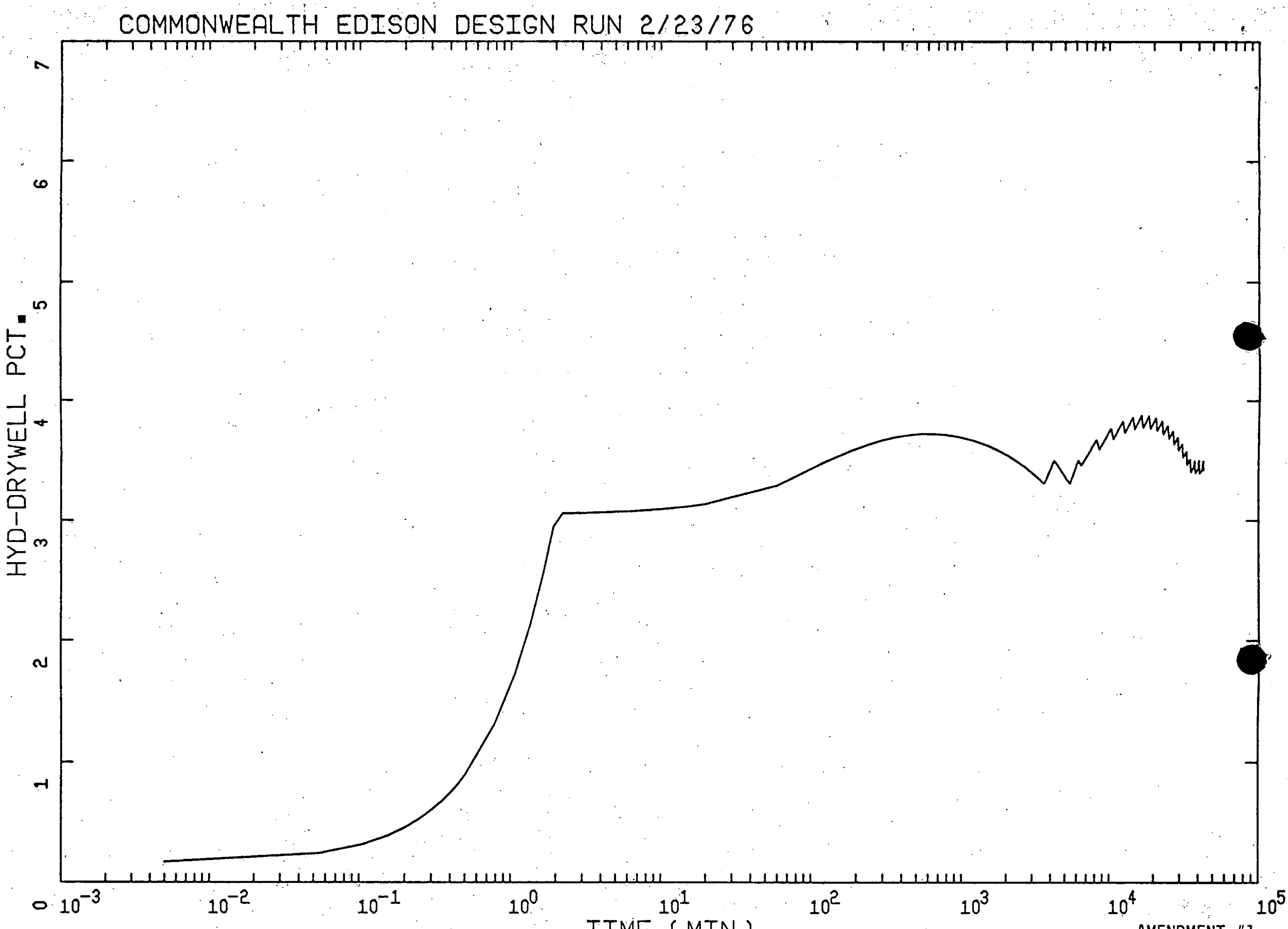

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Figure IV.1 Hydrogen Concentration in the Drywell Following a Loss-of-Coolant Accident, No Steam Dilution

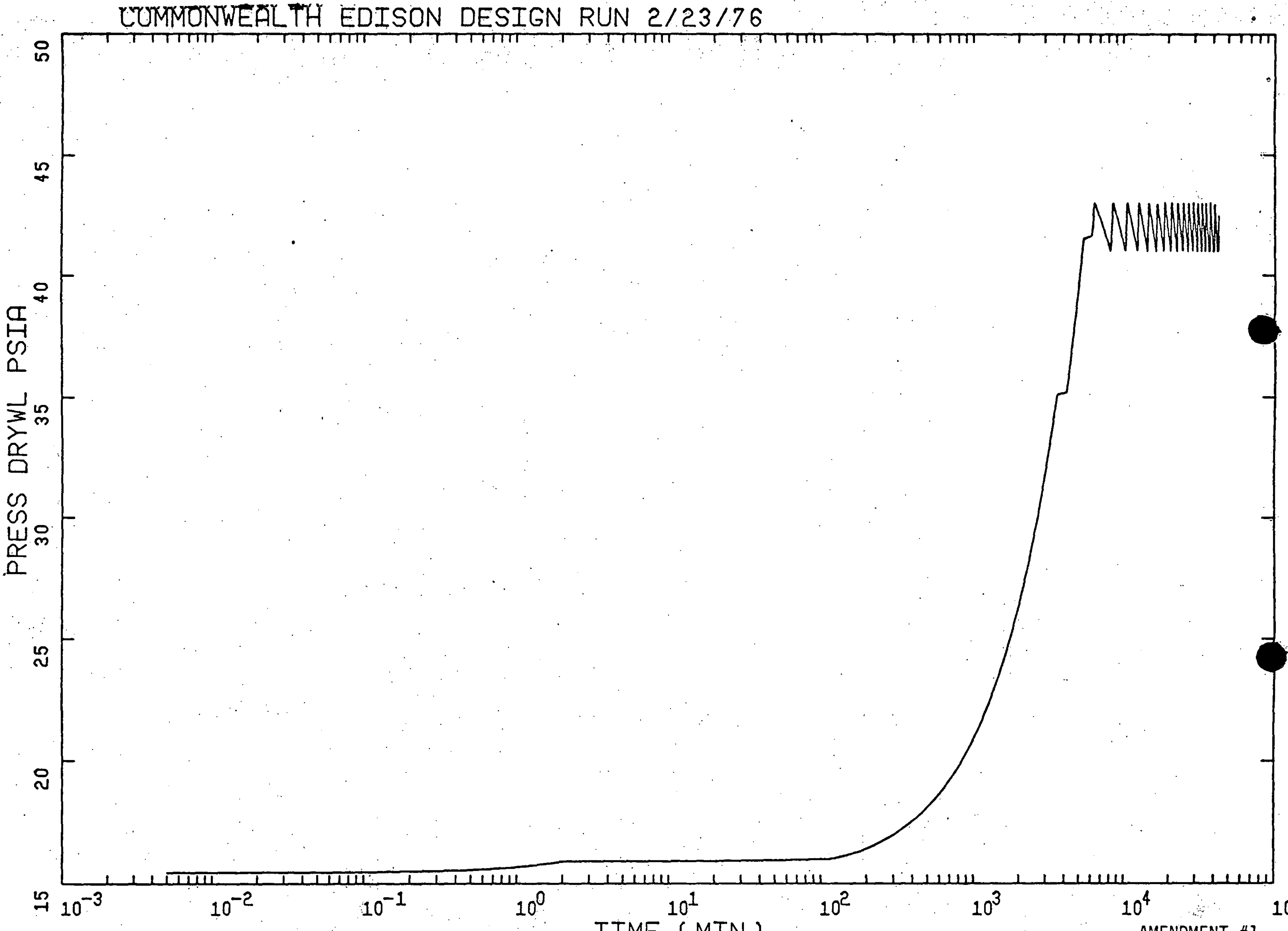

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Figure IV.2 Drywell Pressure History Following a Loss-of-Coolant Accident, No Steam Dilution

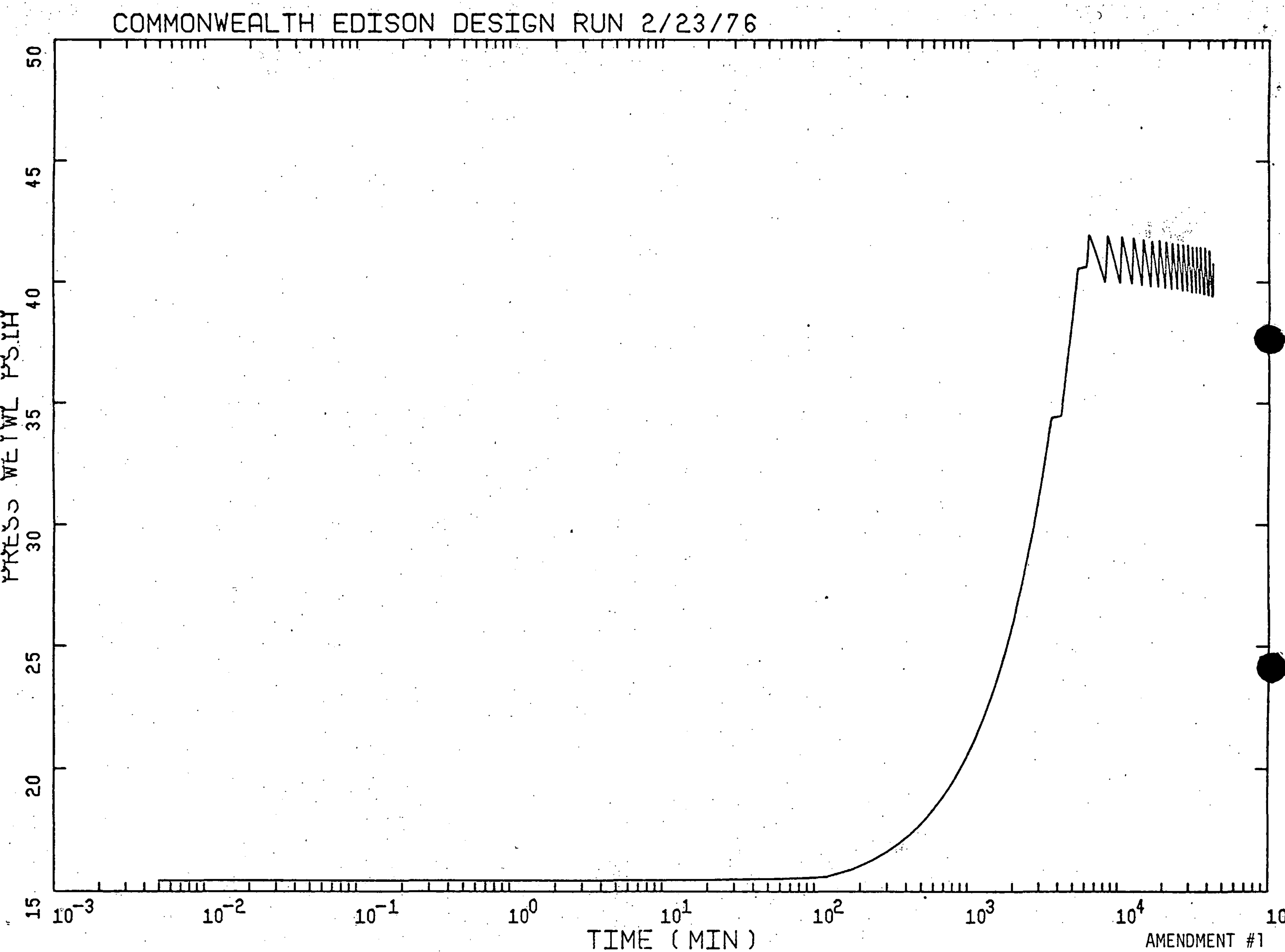

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Figure IV.3 Wetwell Pressure History Following a Loss-of-Coolant Accident, No Steam Dilution

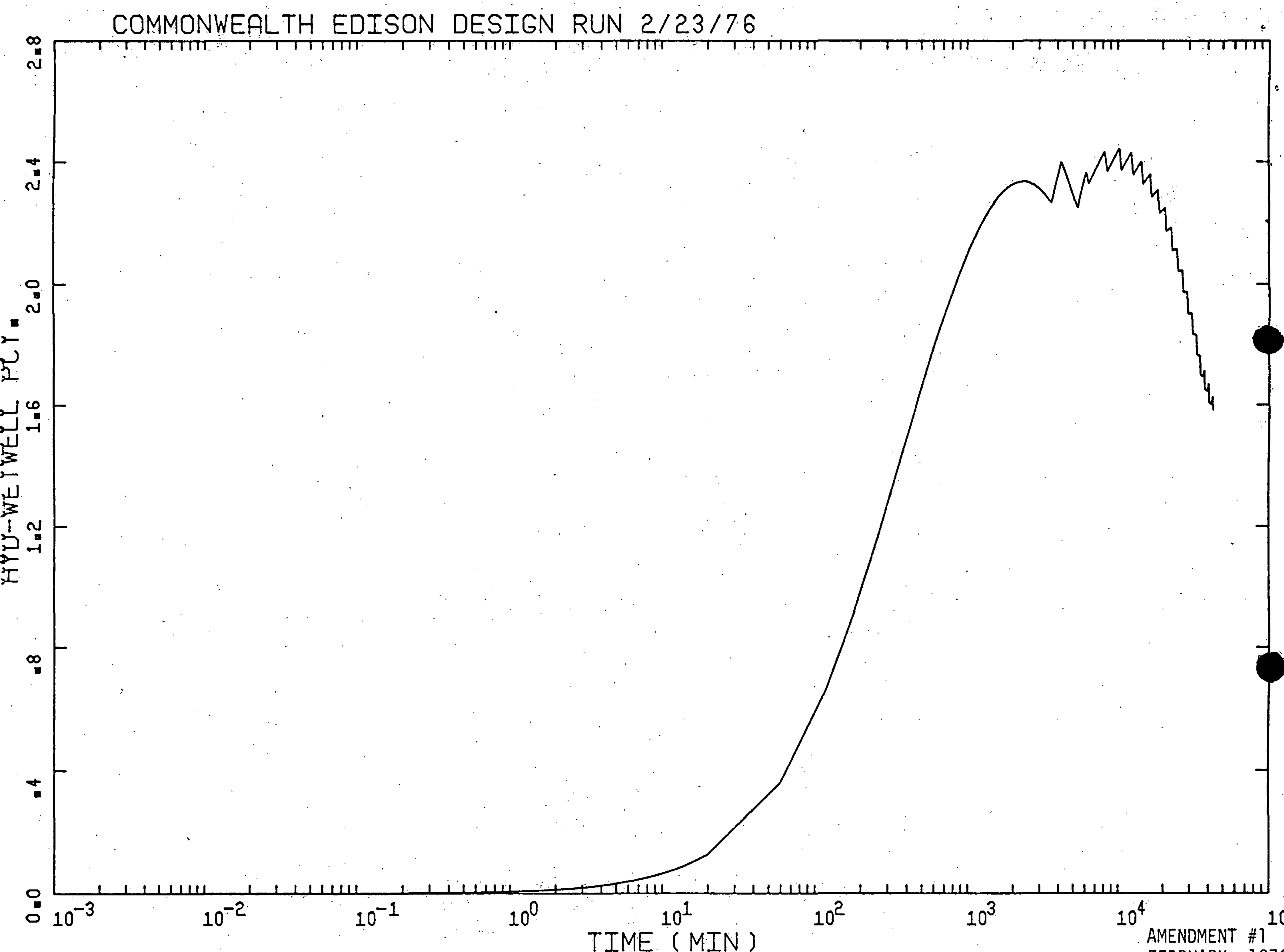

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Figure IV.4 Hydrogen Concentration in the Wetwell Following a Loss-of-Coolant Accident, No Steam Dilution

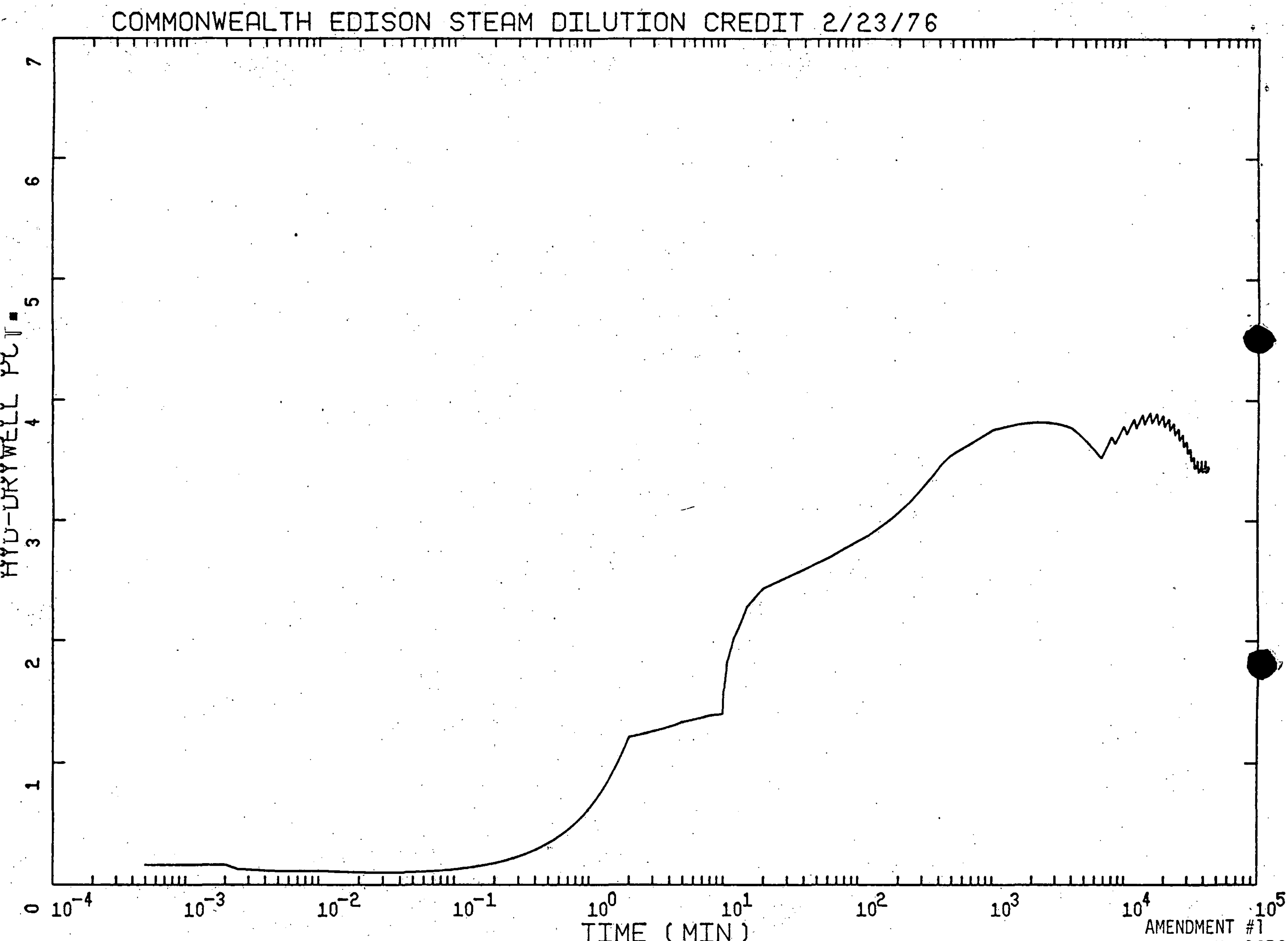

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Figure IV.5 Hydrogen Concentration in the Drywell Following a Loss-of-Coolant, Steam Dilution

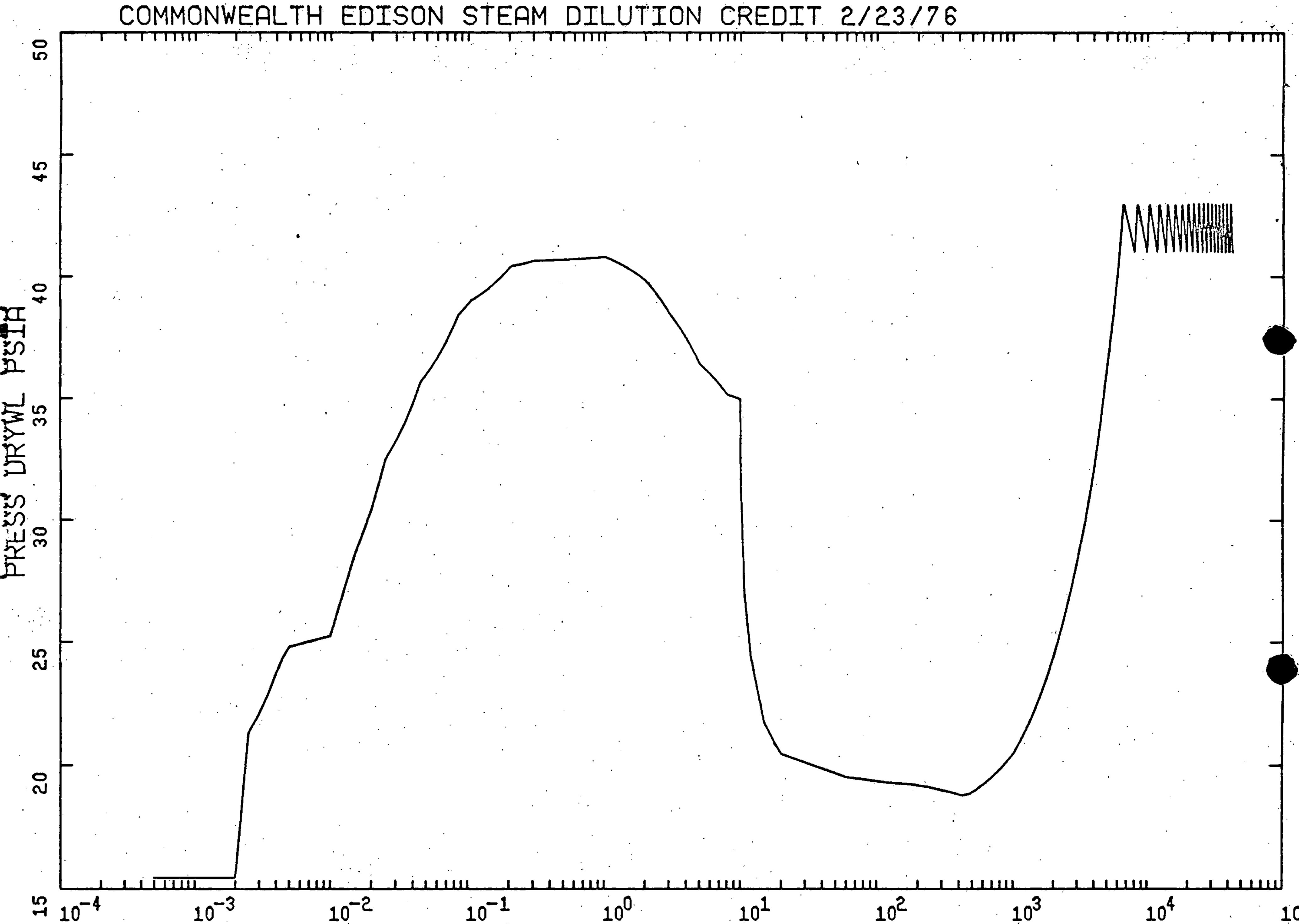

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Figure IV.6 Drywell Pressure History Following a Loss-of-Coolant Accident, Steam Dilution

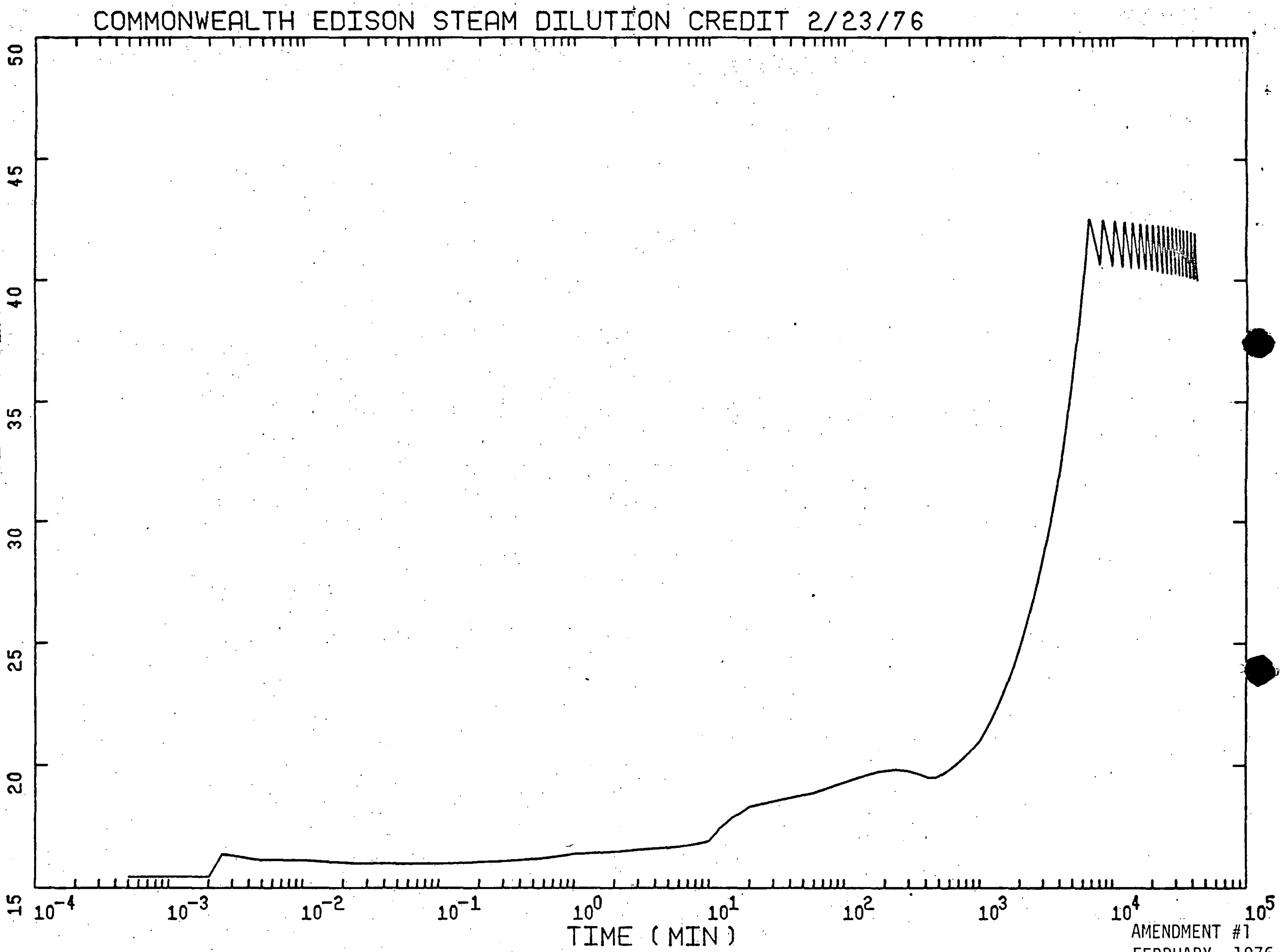

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Figure IV.7 Wetwell Pressure History Following a Loss-of-Coolant Accident, Steam Dilution

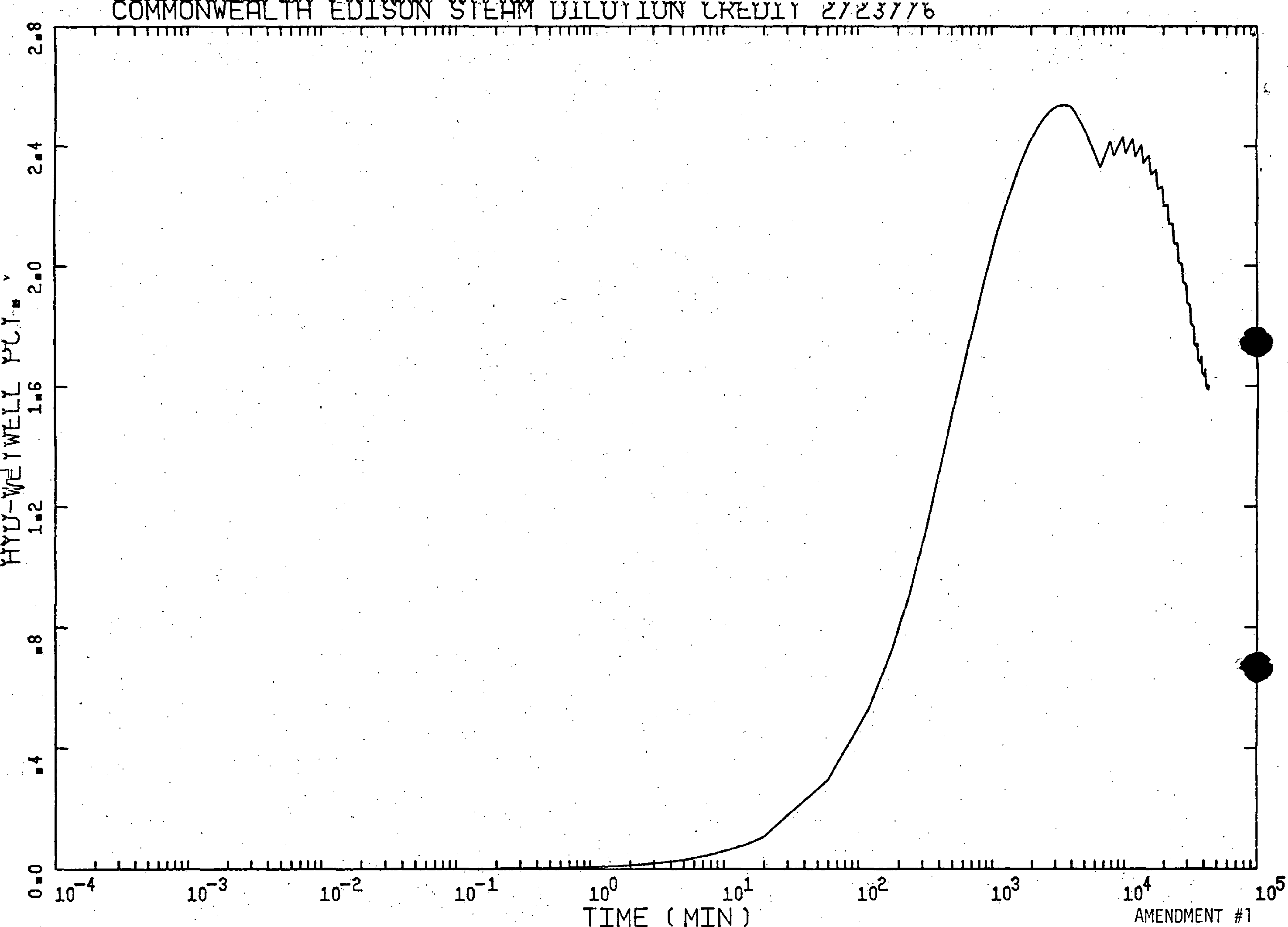

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Figure IV.8 Hydrogen Concentration in the Wetwell Following a Loss-of-Coolant Accident, Steam Dilution

TABLE IV. 1

INCREMENTAL 30 DAY LOW POPULATION ZONE DOSES RESULTING FROM ACAD SYSTEM OPERATION UTILIZING ACTUAL SITE METEOROLOGY

	QUAD CITIES, UNITS 1 & 2* 5% Probable Dose	DRESDEN STATION, UNITS 2 & 3 5% Probable Dose
Thyroid	4.47 rem	5.10 rem
Whole Body	0.052 rem	0.058 rem

Am.1

*NRC Staff LOCA doses:

	QUAD CITIES, UNITS 1 & 2	DRESDEN STATION, UNITS 2 & 3
Thyroid	108 rem	90 rem
Whole Body	3 rem	2 rem

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TABLE IV.2

INCREMENTAL 30 DAY LOW POPULATION ZONE DOSES RESULTING FROM ACAD SYSTEM OPERATION UTILIZING REGULATORY GUIDE 1.3 METEOROLOGY

	QUAD CITIES, UNITS 1 & 2*	DRESDEN STATION, UNITS 2 & 3*
	4-30 Days	4-30 Days
Thyroid	29.51 rem	17.03 rem
Whole Body	0.3232 rem	0.1865 rem

Am. 1

*NRC Staff LOCA doses:

	QUAD CITIES, UNITS 1 & 2	DRESDEN STATION, UNITS 2 & 3
Thyroid	108 rem	90 rem
Whole Body	3 rem	2 rem

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TABLE A.2

INPUT PARAMETERS FOR DRESDEN AND QUAD CITIES ACAD SYSTEM DESIGN

PARAMETER		NUMERICAL INPUT FOR CONCEN DRESDEN AND QUAD CITIES	
R1		22.0 scfm	
R2		90.0 scfm	
R2ON		0.0350	
R2POFF		0.0330	
R1POFF		43.0 psi	Am. 1
R1POFF		41.0 psi	
ENC1		430.22 moles	
ENSP1		318.52 moles	
TC		530.0 °R	
TSP		530.0 °R	
CCH1		0.00163	
CCO1		0.210	
CSH1		0.00	
CSO1		0.210	
VC		158236. ft^3	
VSP		117245. ft^3	
FILEFF	HALOGENS		
	ELEMENTAL	.90	
	PARTICULATE	.90	
	ORGANIC	.70	
	NOBLE GASES	0.0	
MZO		63679. lb_m	Am. 1
FMW		0.00900	
POW		2561 MWt	
GC		0.5	
GW		0.5	
FG		0.1	
FGB		0.01	
FI		0.5	

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