NS-TMA-2219

Westinghouse Electric Corporation

Water Reactor Divisions

PWR Systems Division

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Pittsburgh Pennsylvania 15230

March 14, 1980

Mr. John F. Stolz, Chief
Light Water Reactors Branch No. 1
Division of Project Management
U. S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland 20014

Dear Mr. Stolz:

Please find enclosed additional information for your use in your review of WCAP-9639. The enclosed information provides a response to question 12 of your letter of February 27. The response is in addition to the responses already transmitted to you via letter number NS-TMA-2211. These two submittals provide responses to all questions except question 11. Information on this question will be provided as soon as it becomes available.

Very truly yours,

for T. M. Anderson, Manager
Nuclear Safety Department

PJD/ls

Enclosure

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Question 12

The effect of using an equilibrium model representation of the reactor vessel upper head as regards transient analysis is described in the response to question 15.

During the design of the UHI system, bounding calculations were performed for both small and large breaks coincident with a Safe Shutdown Earthquake to demonstrate no loss of function would occur for structural components and that the plant could achieve a cold shutdown condition. These calculations included analyses for rupture of a UHI injection line as well as other potential small and large break locations and also considered the possibility of the upper head region containing a steam/water mixture rather than a solid system. In terms of the ASME Code definition of event classification, the presence of a steam/water mixture in the head during UHI injection was considered a faulted condition occurrence.

A telephone conversation was held on February 28, 1980, between Westinghouse personnel and the NRC Staff to clarify questions related to the "no loss of function" structural analyses performed for the reactor vessel closure head and the reactor internals upper assembly. The Staff expressed a desire to obtain a better understanding of the boundary conditions employed in the analyses in the following areas:

1. Component material employed and associated NVT fluence levels for the purpose of brittle fracture analysis.

2. Component temperatures at the time of UHI actuation.

3. Pressure in the vessel upper head region at the time of UHI actuation.

4. Temperatu[illegible] in the vessel upper head region at the time of UHI actuation and the temperature of the UHI fluid.

The following discussion is provided to address this information request:

The reactor vessel closure head flange and dome are fabricated from SA-508 Class 2 and SA-533 Gr. B Class 1 material respectively with a 0.158 inch minimum thickness 304 stainless cladding being in contact with the primary coolant. Westinghouse has performed a fracture evaluation of a vessel beltline region. This analysis is applicable and conservative for the subject transient on the UHI vessel heads for the following reasons:

1. The beltline region analyzed and the UHI head have comparable wall thicknesses.

2. The pressure and temperature conditions analyzed are more severe than the postulated UHI transients.

3. The fluence levels used in the end-of-life analysis are much higher in the beltline than at the head ($5.4x10^{19}$ neutrons/cm^2 for the beltline vs. $1x10^{14}$ neutrons/cm^2 for the head flange region).

This analysis shows that for the most severe transient postulated on the UHI head there is no crack initiation regardless of flaw size. Therefore, the transient of upper head injection into a steam filled closure head does not affect vessel integrity. All components of the reactor vessel upper internals assembly are constructed from 300 series stainless steel. The maximum NVT fluence level to which any of the upper internals assembly is exposed is $2.2x10^{20}$ neutrons/cm^2. This represents the fluence level for the upper core plate which is the component in closest proximity to the core. It should be noted that for 300 series stainless steel with the above mentioned fluence level, brittle fracture is not a concern.

The component metal temperatures present just prior to the UHI actuation event were based on the following:

1. Components exposed to only the vessel cold leg temperature fluid during normal full power operation are assumed to be uniformly at that temperature.

2. Components exposed to only the vessel hot leg temperature fluid during normal full power operation are assumed to be uniformly at that temperature.

3. Components exposed to the vessel cold leg temperature on one side and the hot leg temperature on the other side are assumed to possess the thermal gradients existing during normal full power operation.

The pressure in the vessel upper head region at the time the UHI system actuates is assumed to be 1250 $\pm$ 50 psia which represents the system set point and associated uncertainty. The pressure uncertainty is applied in a manner which results in a conservative analysis. It is assumed that the fluid and/or steam in the vessel upper head region is saturated at the time the UHI system actuates. Therefore, the temperature will be 572 $\pm$ 5°F. The temperature uncertainty is applied in a conservative fashion. The temperature of the UHI fluid is assumed to be 70°F.

Additional assurance of functional integrity was provided by ensuring that control rod trip signal is generated at a higher pressure level than the UHI actuation pressure. UHI flow into a partially voided upper head occurs only for break sizes of less than 8 inches and a spectrum of these breaks was evaluated in order to determine the margin between the time at which the rods are fully inserted and the UHI actuation time. Even after allowing for a 1.0 second trip delay time, the evaluation indicated that the rods are inserted for at least several seconds before the UHI actuation occurs. For example, during an 8 inch break, the control rods are inserted by 8.8 seconds into the transient but UHI actuation does not occur until 12.3 seconds into the transient. The magnitude of this margin increases significantly as the break size decreases.

The plots of requested system parameters for the breaks analyzed in WCAP 9639 are attached.

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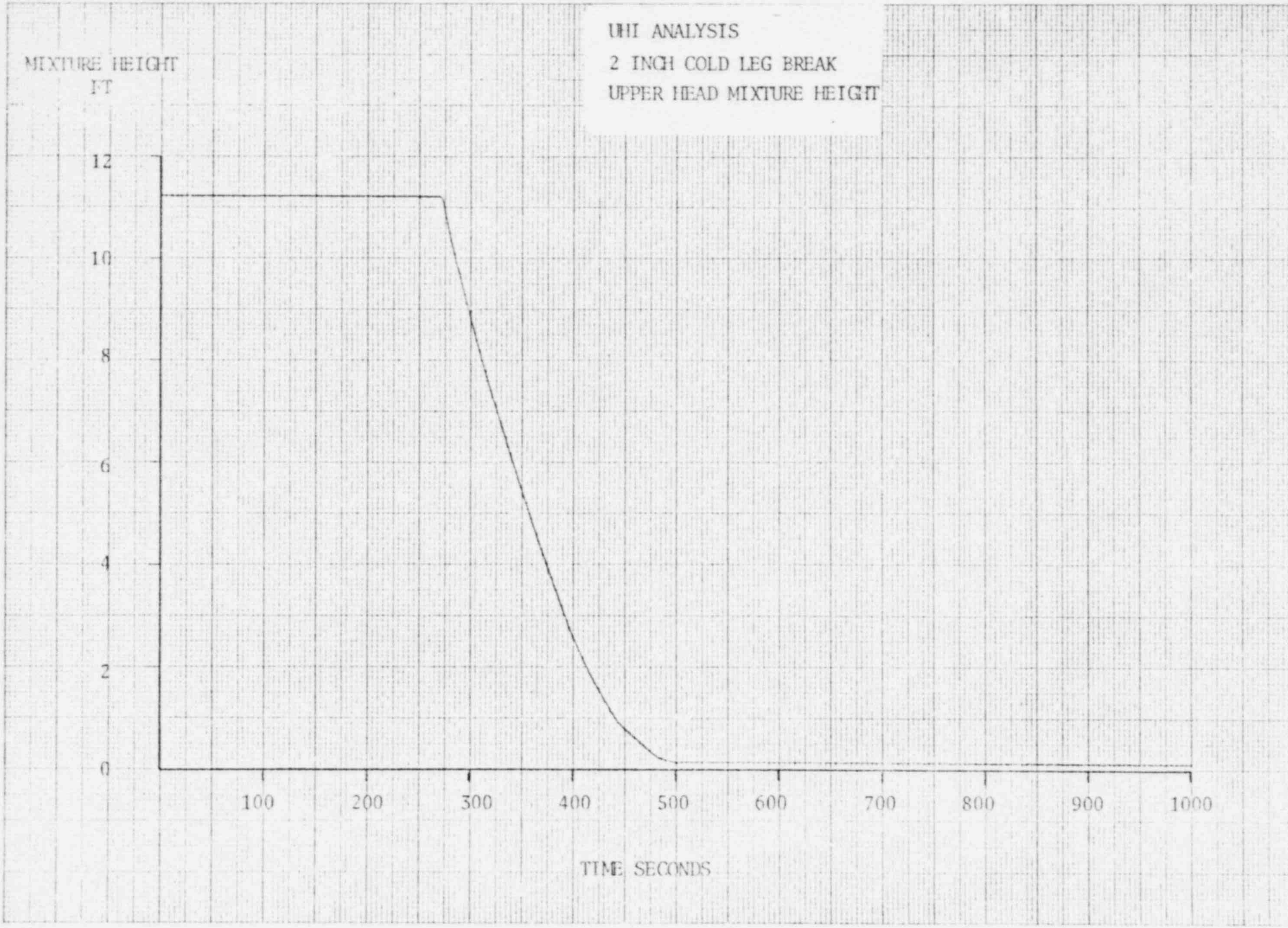

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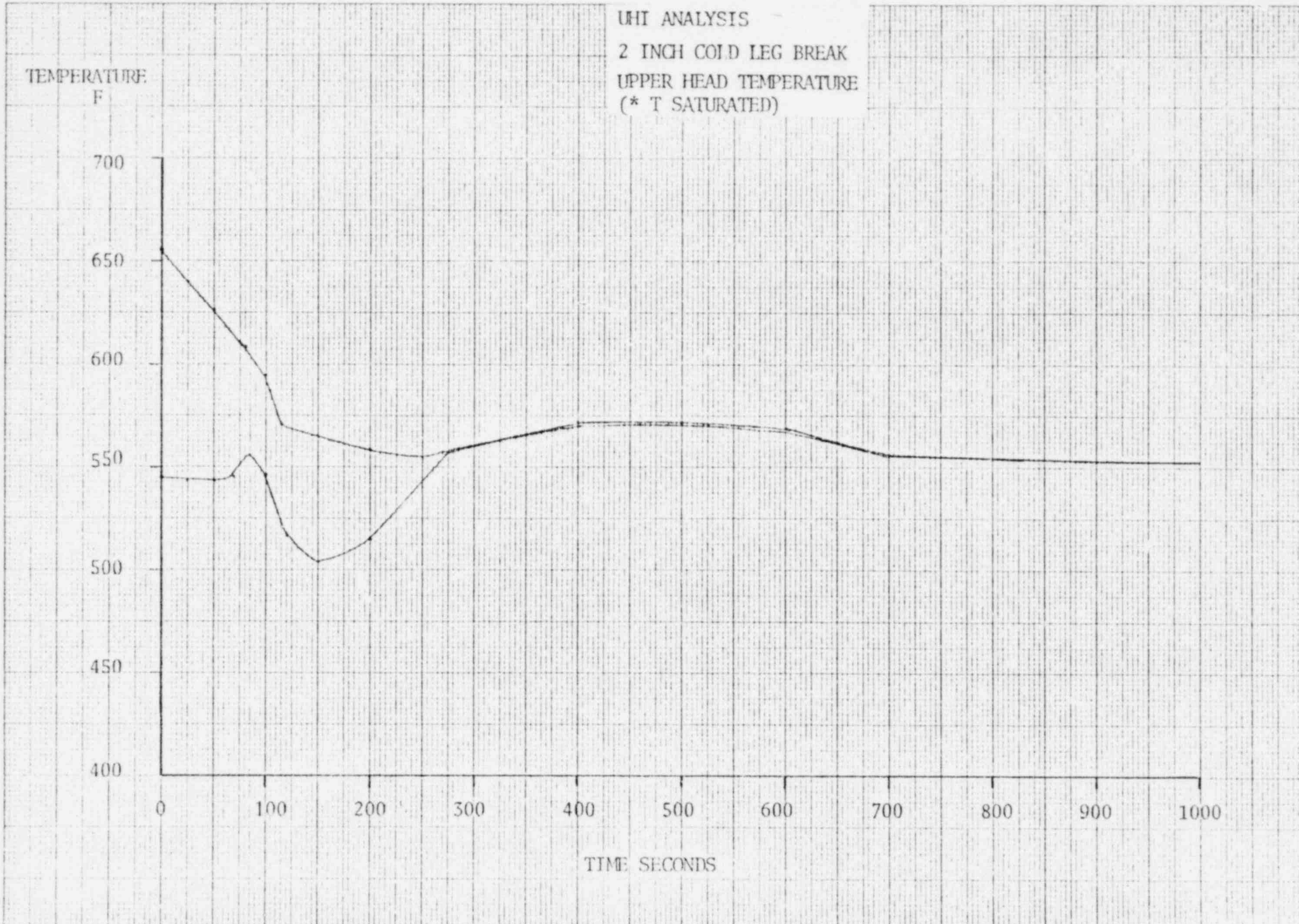

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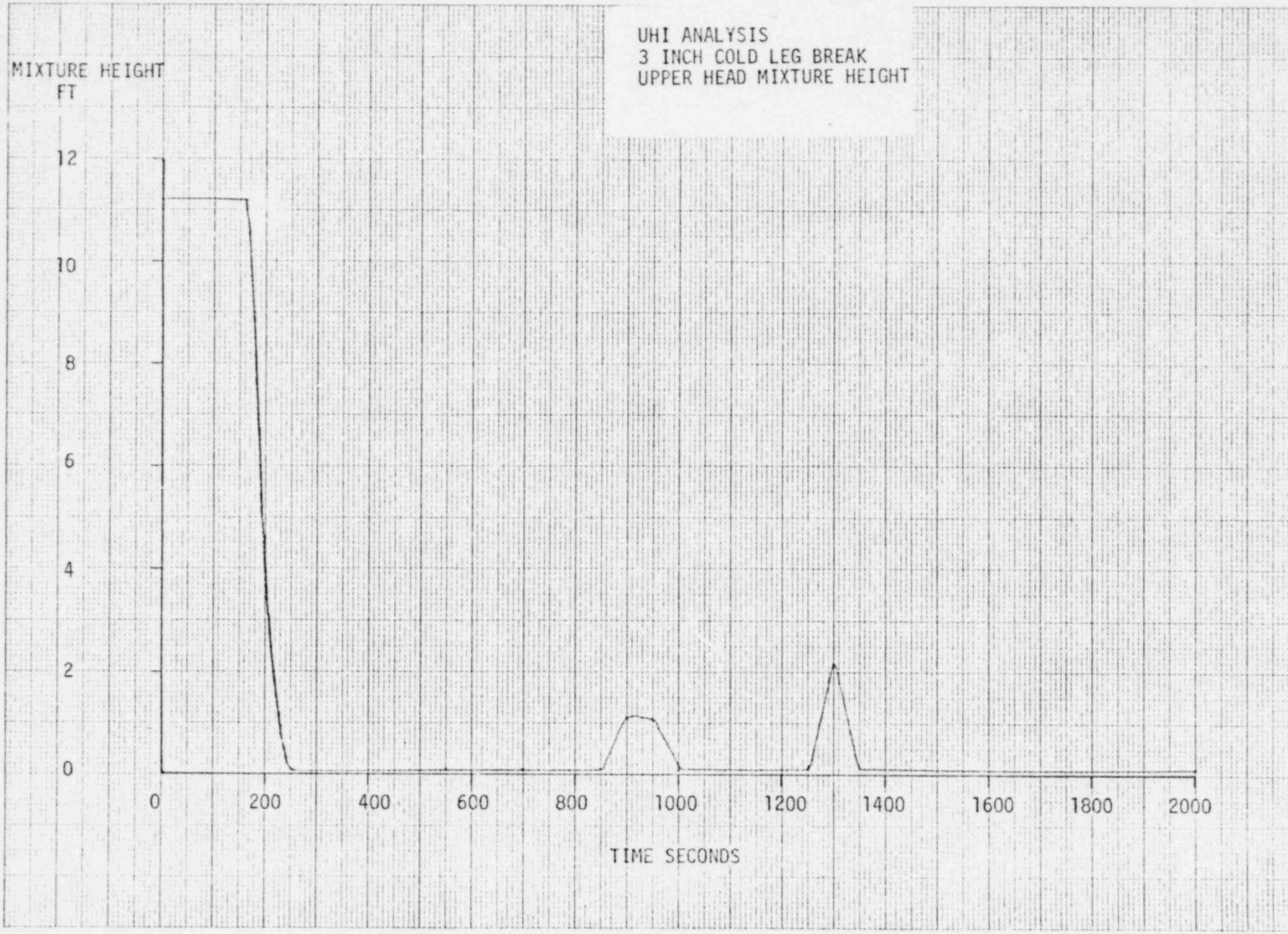

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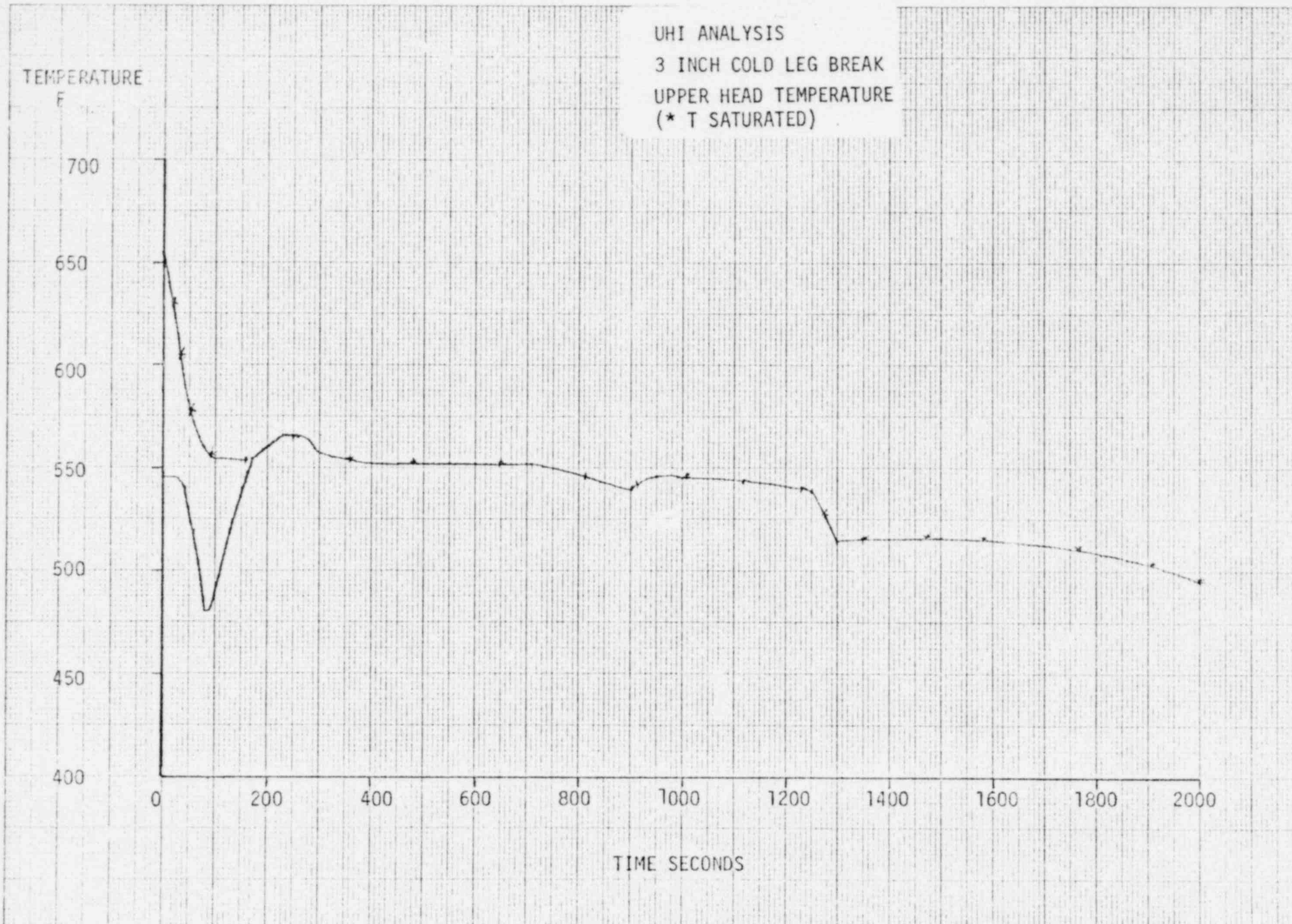

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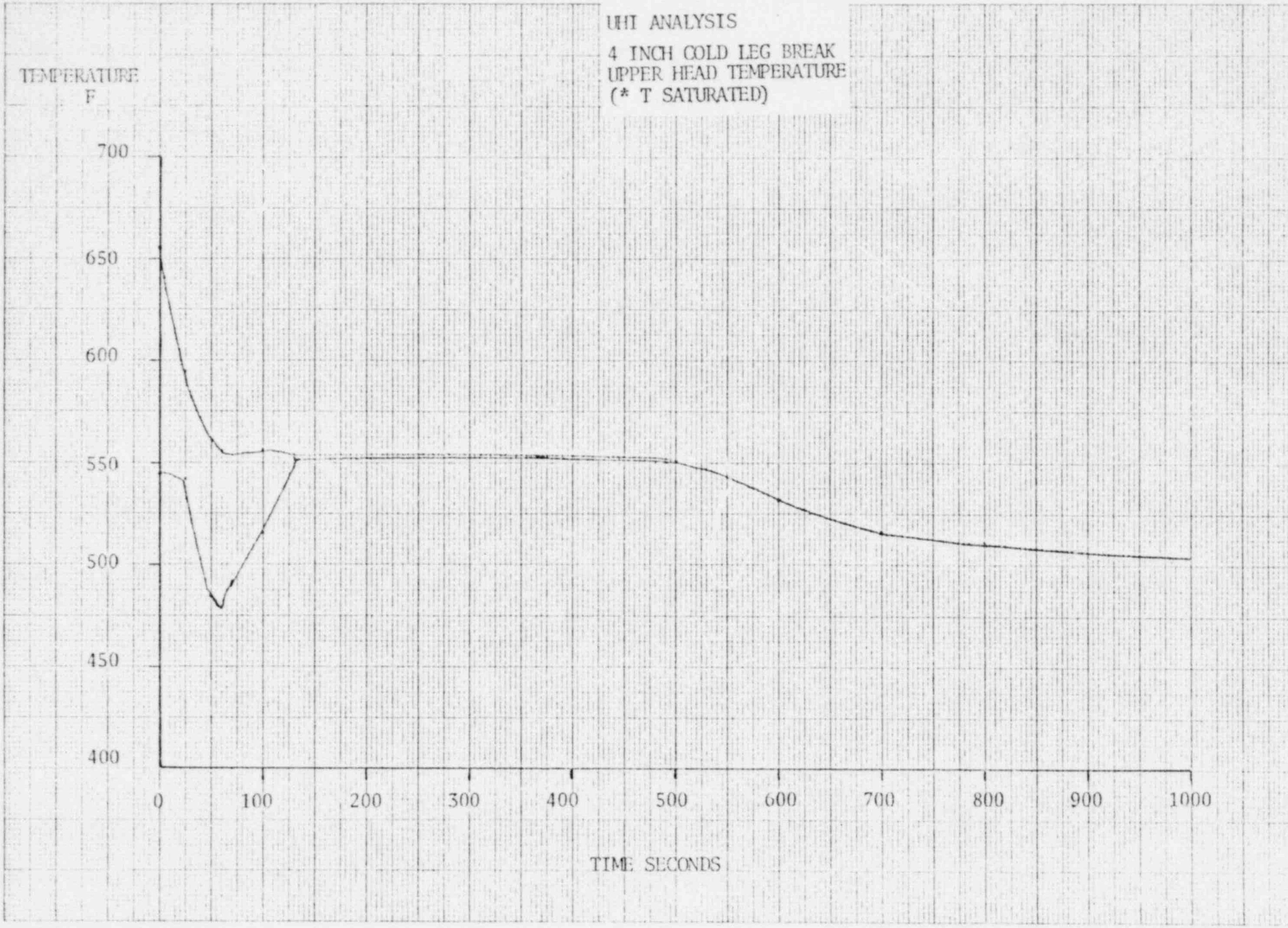

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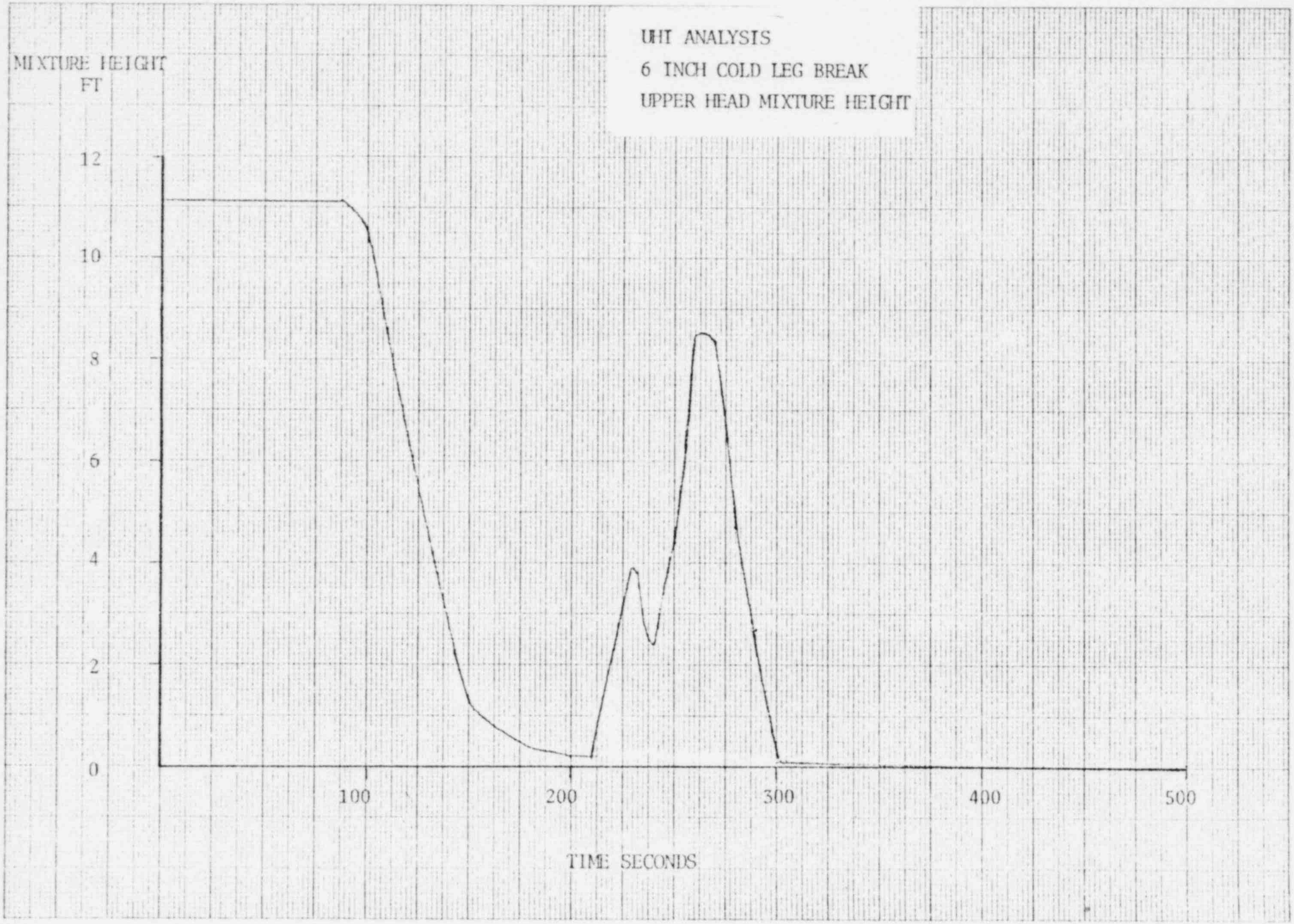

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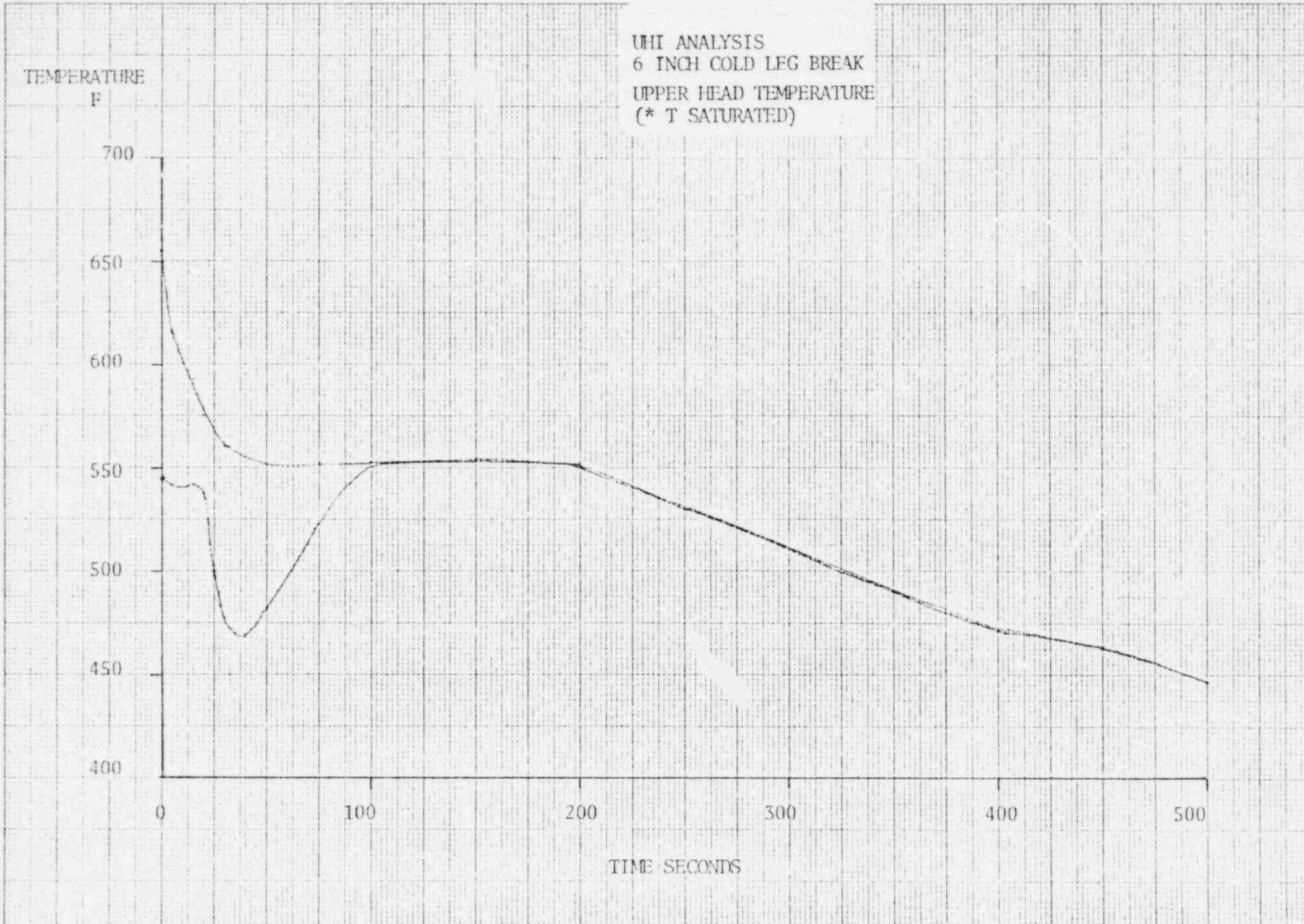

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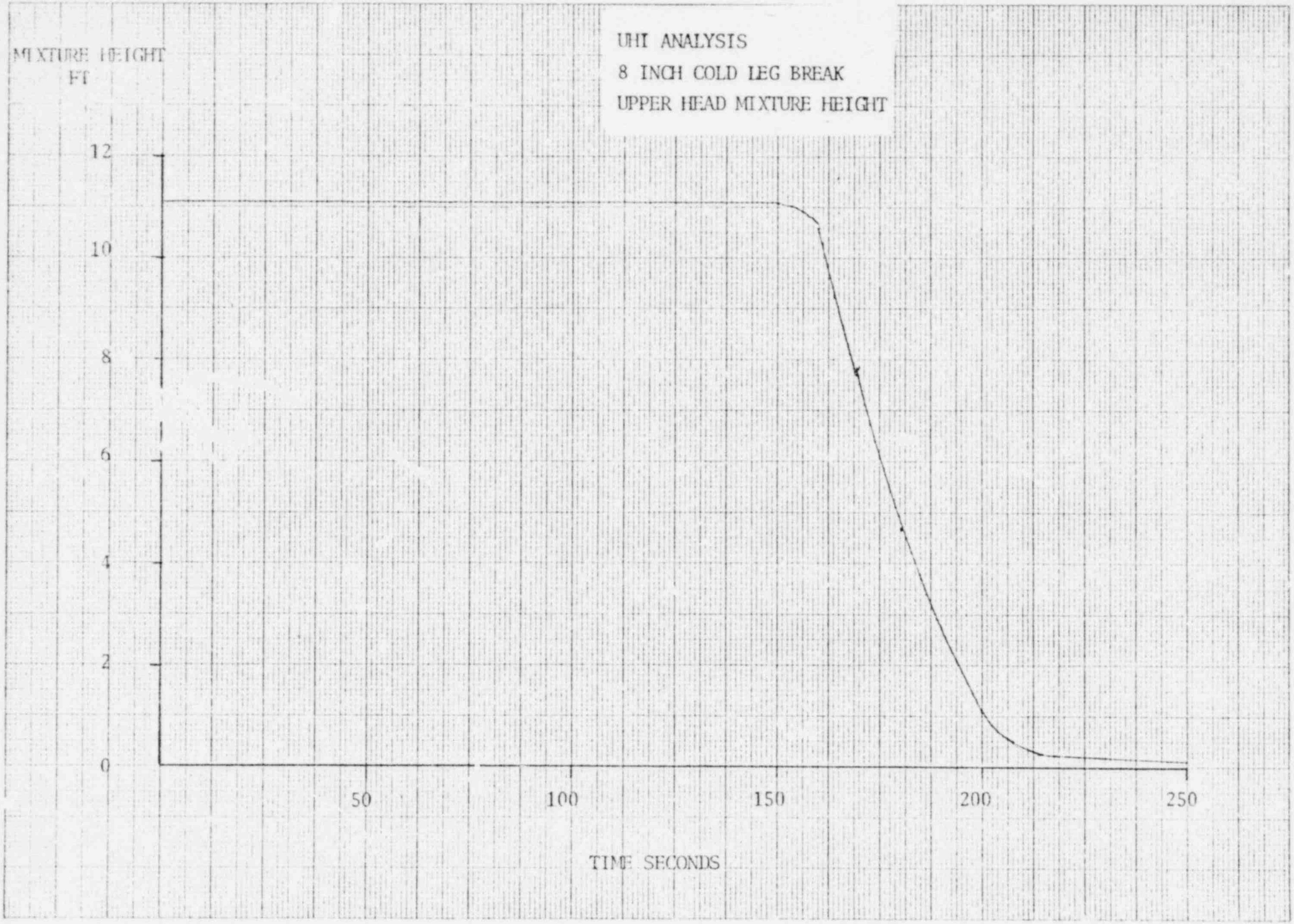

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