[illegible]

[illegible] Sandia Laboratories, [illegible] New Mexico [illegible]

[illegible]

[illegible] rapid heating [illegible] characteristic of a super- [illegible] the ultimate [illegible] expanding [illegible] sensitive function [illegible] fission product gas [illegible] disruption and dispersal [illegible] earlier than would [illegible] vapor pressure [illegible] Although [illegible] sensitivity increases [illegible] at very high reactivity insertion rates, the effect deserves investigation because of its potential importance in accident mitigation and analysis.

[illegible] which still contains fis- [illegible] assumed to exist, in large [illegible] density [illegible] very small intragranular bubbles. Large [illegible] gas may move to the grain boundaries during rapid heating as a [illegible] migration of small bubbles [illegible] temperature or stress gra- [illegible] During this process the bubbles may coalesce, but will not relax to equi- [illegible] with the lattice if the flux of vacancies from grain boundaries is insuf- [illegible]. The flux of vacancies is driven by the bubble excess pressure but it [illegible] that even for transients with a timescale of one or a few seconds equilib- [illegible] may not be attained.[3,4] In such cases large overpressures will be available [illegible] heating [illegible] will [illegible] equilibrium [illegible]

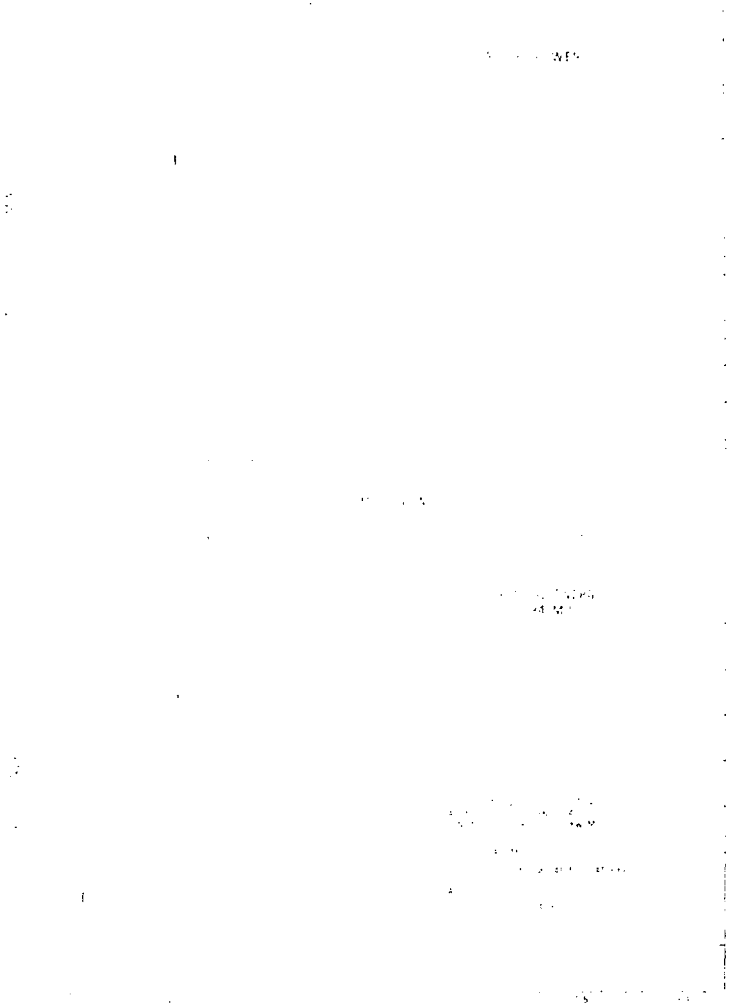
[illegible]

[illegible]

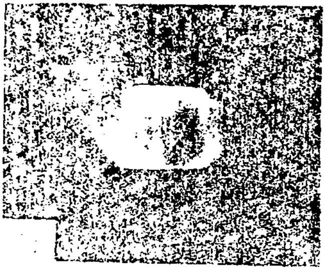
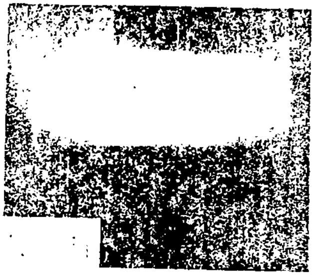
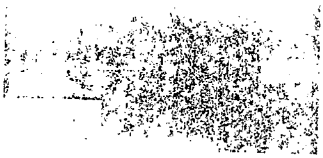
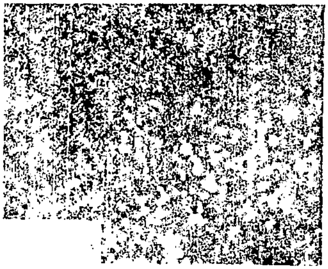
[illegible]

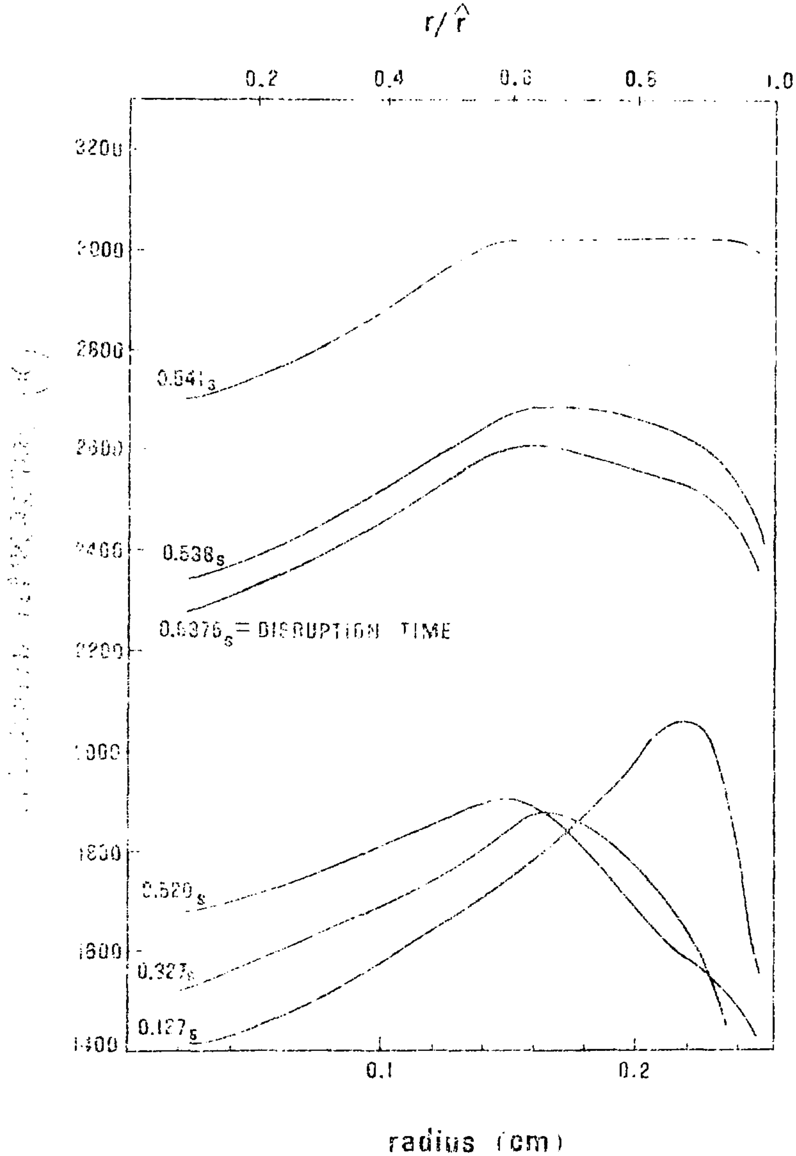
[illegible] with [illegible] disruption. [illegible] pellet and [illegible] between the [illegible] axial [illegible] while the [illegible] is [illegible] the highest temperatures at the axial end occurred [illegible] temperatures decreasing by about 200F [illegible] Figure 3 shows fuel temperature [illegible] for the axial end.

[illegible] temperature distributions [illegible] at two times. [illegible] of course, yield temperatures [illegible] expansion [illegible] unreasonable to assume [illegible] fuel to [illegible] remained in the [illegible] regions of the expanding [illegible] first millisecond or two. [illegible] maximum fuel temperature in [illegible] extrapolated back to the disruption time, a value of 2700K is [illegible].



[illegible] 1. Reactor Power and Energy Density History in FD 1.6.



Radial temperature history at the axial extremity of the fuel pellet.

[illegible] using the [illegible] heat transfer program, [illegible] temperature [illegible] region time of 2660K. [illegible] experimental [illegible] are no more than about [illegible] determination [illegible] the hypothesis that [illegible] fuel [illegible] fuel melting point.

[illegible]

[illegible] intragranular [illegible] transient intragranular [illegible] swelling) has been [illegible] gas release and swelling in [illegible] experiment series. [illegible] limitation [illegible] code [illegible] with [illegible] fuel creep at [illegible] release of gas bubbles [illegible] intergranular [illegible] of [illegible] will be incorporated. [illegible] specific aspects of [illegible] swelling are not [illegible] intragranular bubble [illegible].

[illegible] using TIGRS [illegible] somewhat [illegible] intragranular [illegible] the grain boundaries. The [illegible] small release [illegible] by assumptions concerning [illegible] size and concentrations within the experimental range [illegible] distribution of grain sizes about the mean [illegible] used in the [illegible] can perturb the answer by a [illegible] either direction.

[illegible] not grain boundary bubbles have time to come to equilibrium [illegible] pressure, [illegible] may not saturate [illegible] the conditions of the experiment, roughly 2% release [illegible] grain boundary coverage [illegible] areal fraction at equilibrium [illegible] smaller size bubbles remaining at overpressures [illegible] that [illegible] disruptive [illegible] loss of grain boundary adhesion, although [illegible] the [illegible] calculation.

[illegible] boundary bubble equilibration [illegible] may be made in the [illegible][10] and [illegible][11] [illegible] is assumed to [illegible] fast along the grain boundary. The rate of increase [illegible] given by:

$$[illegible]$$

[illegible] for areal coverage fraction [illegible] pressure, Ω the vacancy volume [illegible] of the width w of the [illegible] grain boundary [illegible] DiMelfi and Dietrich[1] [illegible] value of [illegible] exp [illegible] m²/s for this product.

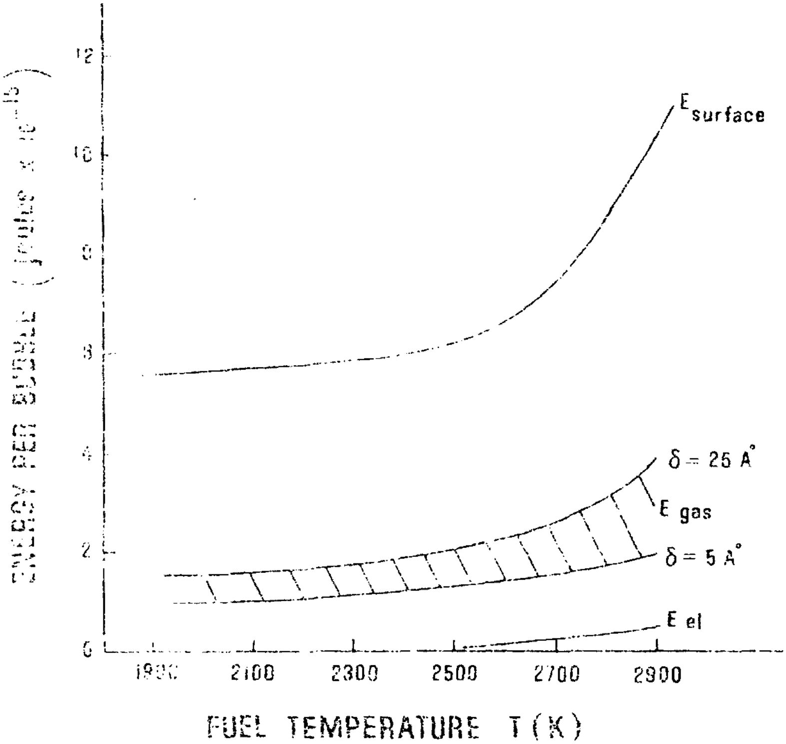
[illegible] calculated to exist in the transient (r ~ 7 nm, P ~ 1.5 × 10⁹ N/m²) [illegible] it will remain true that the excess bubble pressure approximately [illegible] bubble gas pressure. Then, using a reduced Van der Waals equation-of-state [illegible] average [illegible] vacan- [illegible] vibration [illegible] leading to a [illegible] direction.

[illegible] emanating from [illegible] similarly [illegible] limitation on [illegible] pressures. At dis- [illegible] to be a little over [illegible] required per bubble to [illegible] three times larger [illegible] gas into the (idealized) [illegible] above the [illegible] order of magnitude smaller [illegible] relationships have been used, [illegible]

[illegible]

[illegible] tension, [illegible] the bubble pressure, [illegible] $x\ 10^{?}$ [illegible] tenth the [illegible] temperature, [illegible] the number of [illegible] atoms per bubble, [illegible] taken to be [illegible] cracks would make little [illegible]

[illegible] particularly with respect to [illegible] possible [illegible] energy requirement for [illegible] such rapid transients.



[illegible] 4. [illegible] of energy requirements and availability for [illegible] proposed in [illegible] .6.

[illegible]

[illegible] ... ries, Albuquerque, [illegible]

[illegible] ... Proceedings ... Specialists Meeting on [illegible] ... Harwell (July 1977). [illegible]

[illegible] ... Behavior in [illegible] ... Nuclear Engineering ... 1975); also, "A [illegible] ... Behavior [illegible] ... Divi- [illegible] ... July 197[illegible].

[illegible] ... private communication of work [illegible]

[illegible] Structures [illegible]," Proceed- [illegible] Berkeley, CA August [illegible]

[illegible] the [illegible] [illegible]

[illegible] Physical [illegible], Nuclear [illegible]

[illegible] SAND [illegible], Sandia [illegible], Albuquerque [illegible]

[illegible] Phil. Mag. [illegible]

[illegible] 196[illegible]

[illegible] documentary [illegible]

[illegible]