AUG 17 1971

ATTACHMENT 3

50-245

R. S. Boyd, Assistant Director for BWRs, DRL

AIRBORNE PARTICULATE ACTIVITY FROM MILLSTONE OPERATION

Enclosed is our preliminary evaluation of available information concerning the offsite concentrations of airborne particulate activity associated with recent Millstone Unit 1 operation. The reported particulate level of 1×10^{-7} uc/cc at Groton on August 9, 1971 is considerably in excess of the value of 4×10^{-9} uc/cc which we would expect at that distance for the indicated stack release rate and meteorological conditions. This opinion is shared by our meteorological consultant, Dr. Van der Hoven. Although the single measurement should not be disregarded, we consider it unlikely that continuous operation with unfavorable fuel performance (i.e. 100,000 uc/sec) would result in annual average particulate concentrations anywhere offsite in excess of about 10^{-9} uc/cc.

We recommend that the licensee be requested to submit a report describing the anomalous stack release rates during the startup, the meteorological conditions, and projected offsite concentrations. Also, the licensee should be requested to sample for short lived particulate activity along the plume axis under varying meteorological conditions. Such measurements, including coolant activity and short-term stack monitoring, would be especially appropriate during the next startup. This information would provide a basis for determining whether changes in present calculational methods and assumptions were warranted.

We understand GE is obtaining additional information on the multichannel analysis performed at Groton and is making independent measurements of stack releases and environmental levels. In the meanwhile, we have asked GE to review the particulate model assumptions described in the Dresden 2/3 application.

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Enclosure:
Preliminary Evaluation

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PRELIMINARY EVALUATION OF REPORT OF HIGH ACTIVITY NEAR THE MILLSTONE POINT SITE

by THE RADIOLOGICAL SAFETY BRANCH
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The following analysis of releases and meteorological conditions at the Millstone site is provided for use in evaluating the reported high activity concentrations at the Electric Boat Company facility, Groton, Connecticut, on August 9, 1971.

A. Meteorology

The actual meteorology during the period in question was obtained through I. Van der Hoven of NOAA on August 10, 1971 and is indicated below for Groton.

Time	Direction (From)	Speed (Knots)
1200	220°	8
1300	220°	10
1400	230°	10
1500	240°	12

Conditions were reported as no clouds but hazy. Van der Hoven estimated Pasquill type B or C, unstable conditions with a X/Q at 5 miles of about 2×10^{-7} sec/m^3. Data obtained from New Haven was similar, being characterized by winds from 240° at about 12 knots. It thus seems unlikely that an inversion was experienced at the site. It should be noted that the direction to the Millstone site is about 230° from the Electric Boat Company facility.

We have estimated the downwind X/Q for these meteorological conditions as a function of distance using Pasquill C conditions (Figure 1). From this, the X/Q at Groton (2.2×10^{-7} sec/m^3) can be directly read by assuming that (1) the plume centerline passed directly over the Groton Facility, and (2) a ground level sampling point was used. The peak value of X/Q (2.8×10^{-6} sec/m^3) occurs at 1200 meters as indicated on Figure 1.

A comparison of the expected worst short term meteorology and the annual average meteorology with the meteorology estimated for August 9, 1971, is given below in the terms of X/Q (sec/m^3)

	Maximum Offsite	5 Mi
Worst hour	6.2×10^{-5} (Site Boundary)	5.5 x
Worst day	1.5×10^{-5} (Site Boundary)	1.9 x
Annual average	5×10^{-8}	1.4 x
Early afternoon, Aug.9, 1971 (assuming constant wind direction)	2.8×10^{-6} (1200 meters)	2 x 10

Particulates

Particulates are anticipated to build up in the plume as the noble gases decay and yield daughter products. The particulate curie content of the plume reaches a maximum value between 0.25 and 1 hour after the release. (Figure 3). At 0.5 hours after release the particulates comprise about 15% of the curie content of the plume. (Figure 2).

The primary particulates are formed as follows:

Xe - 138 (17 min) ⟶ Cs - 138 (32 min)

Kr - 88 (2.77 hr) ⟶ Rb - 88 (17.8 min)

If the plant off-gas filter (assumed to be 99.9% efficient) were absent, the concentration of particulates (at one-half hour after release) would increase by only a factor of about three since most of the particulate activity is generated after the plume leaves the stack.

C. Measurements at Groton

On the basis of conversations with CO headquarters and Region 1, we understand that high particulate activity was detected at the Electric Boat Company in Groton about 1:30 pm and that a gross beta count after a high volume air sample at 1:40 pm gave a calculated concentration of 10^{-7} uc/cc. Also, a multichannel (gamma) analysis after a high volume air sample indicated a calculated activity of 7×10^{-8} uc/cc. It has been assumed that this consisted of particulate activity only, since the count would be made on the basis of material collected on a filter paper. Since particulates normally would make up about 20% of the total curie content of a plume from a BWR reactor at 1/2 hour after release, this implies that about 4×10^{-7} uc/cc of noble gas activity was present. This is 4 times MPC for the noble gases and 3.3 times MPC for the particulates. (The stack release rates are set on an annual average concentration and measured concentrations may vary widely from day to day but this is a greater variation than would be expected at a distance of 5 miles.)

D. Dose Calculations

The table below indicates the concentrations (in MPC's) which can be expected at Groton for various meteorological conditions for particulates only for a stack release rate of 125,000 uc/sec.

	5 Miles MPC's (Decay time)	
Worst Hour	4.1	(1.25 hr)
Worst Day	1.5	(0.75 hr)
Annual Average	0.01	(0.5 hr)
Early Afternoon, Aug. 9, 1971 (assuming constant wind direction)	0.14 1/	(0.5 hr)

1/ This is our calculated expected value. The reported measurement was 3.3 MPC; 24 times higher than the calculated value.

The approximate corresponding hourly dose rate can be calculated by noting that the permissible annual average offsite concentrations of 3×10^{-8} uc/cc is assumed to correspond to 500 mr per year or 0.056 mr/hr and that the dose at other points is proportional to the concentration. A correction must be made to account for the fact that the actual MPC for noble gases is 10^{-7} uc/ci and only the particulate MPC is 3×10^{-8} uc/cc (the 3×10^{-8} uc/cc figure is used in calculating a tech. spec. release limit to avoid determining the particulate fraction).

The approximate dose rates are listed below for a stack emission rate of 125,000 uc/sec. 1/

	Maximum Offsite (mr/hr)	5 Miles (mr/hr)
Worst Hour	4.6 (site boundary)	0.42
Worst Day	1.1 (site boundary)	0.16
Annual Average	0.0037	0.0012
Early afternoon, Aug 9, 1971 (assuming constant wind direction)	0.2 (1200 meters)	0.017

1/ Dose rates for the case of release at the tech. spec. annual average limit of 800,000 uc/sec would be 6.4 times higher.

The 0.017 mr/hr at 5 miles given in the table above is our calcu expected dose rate. The dose inferred from the Groton particula measurement (assuming our calculation of the particulate fracti is correct) would be 0.41 mr/hr; 24 times our calculated dose ra and 0.98 times the worst we would ever expect at Groton for a pe of 1 hour.

E. Interpretation

There are several possible causes for the apparent high readin at Groton, none of which have enough supporting information to draw any preliminary conclusions of cause. The possible cause can be characterized as (1) plant analysis (2) errors in the Groton measurement and (3) errors in our assumptions on noble gas isotope ratios (leading to the formation of higher particu levels) or in our meteorological models.

1. Plant-Related Anomalies

High releases would have to result from unmonitored or bad monitored plant effluent releases. Possible sources of error include stack monitor calibration and bypass of the monitor and/or filters. Failure to run stack dilution fan or release from the turbine would be possible but unlikely sources in view of the presently known plant operating sequence on August 9, 1971. The causes of a high activity release are another problem but could be related to a buil of long-lived gases during shutdown in the coolant or stea system. (Release of fuel particles to the coolant during shutdown is another area which could be investigated).

As noted previously, if our assumptions on the noble gas mixture are correct, then the particulate activity could not increase by more than a factor of about 3 (at 1/2 hour decay) as a result of complete bypass of the filters.

2. Groton Measurement Uncertainties

A source of activity other than the reactor is a possibili but could be eliminated if the multichannel analysis at Groton was found to correlate with the Millstone stack an An error in instrument calibration or calculation of parti activity is possible but less likely at this point since measurement procedures have presumably been checked by Gr personnel. A misunderstanding of the significance of the measurement is possible in that they might know enough to back-calculated a total cloud dose from knowledge of the particulate concentration (unlikely).

3. Assumption and Model Uncertainties

Inadequate information on the actual meteorological conditio is a more likely source of error than those noted above. We have measurements from Alleghany Airlines at Groton airport and some corroborating data from the Weather Bureau at New Haven. Our consultant, Dr. I. Van der Hoven is doubtful th the weather conditions were unfavorable. A Pasquill type D is the worst he would postulate which would lead to doses a factor of about 4 higher than calculated but leaves a facto of 8 unaccounted for. If inadequate knowledge of meteorolo is the cause of the discrepancy it raises the question of o ability to predict offsite concentrations. (Van der Hoven maintains we should be able to predict concentrations at th distance within a factor of 2 given the general meteorologi parameters). It should be pointed out that the "worst off measurement could not simultaneously increase by the same f as any discrepancy in the dose at 5 miles, since to experie high concentrations close-in would require good mixing of t elevated release which would lead to lower concentrations a 5 miles. We expect that the "worst offsite" conditions wou not change substantially even if poor meteorology were the cause of the apparent high concentration at Groton. (A cha in the man-rem calculational techniques could be the result of such a finding, however).

Another possible assumption error is in the mix of noble ga assumed to generate the particulate activity. This could not result in more than a factor of about 5 increase in particulate activity and is easily dismissed if examination of plant records confirms a normal operating mixture.

SAMPLE CALCULATION OF DOSE RATE

a. $$\frac{\text{(Release rate)} \quad \text{(Particulate contribution)} \left(\frac{X}{Q}\right) \text{(Dose rate per MPC)}}{\text{Particulate MPC}}$$

$$\frac{(125{,}000 \text{ uc/sec}) \left(\frac{0.17 \text{ ci partic.}}{1 \text{ ci initial release}}\right) \left(2 \times 10^{-7} \frac{\text{sec}}{\text{m}^3}\right) \left(0.056 \text{ mr/hr}\right.}{\left(\frac{3 \times 10^{-8} \text{ uc/cc}}{\text{MPC}}\right) \left(10^6 \frac{\text{cc}}{\text{m}^3}\right) \left.\text{MPC}\right)}$$

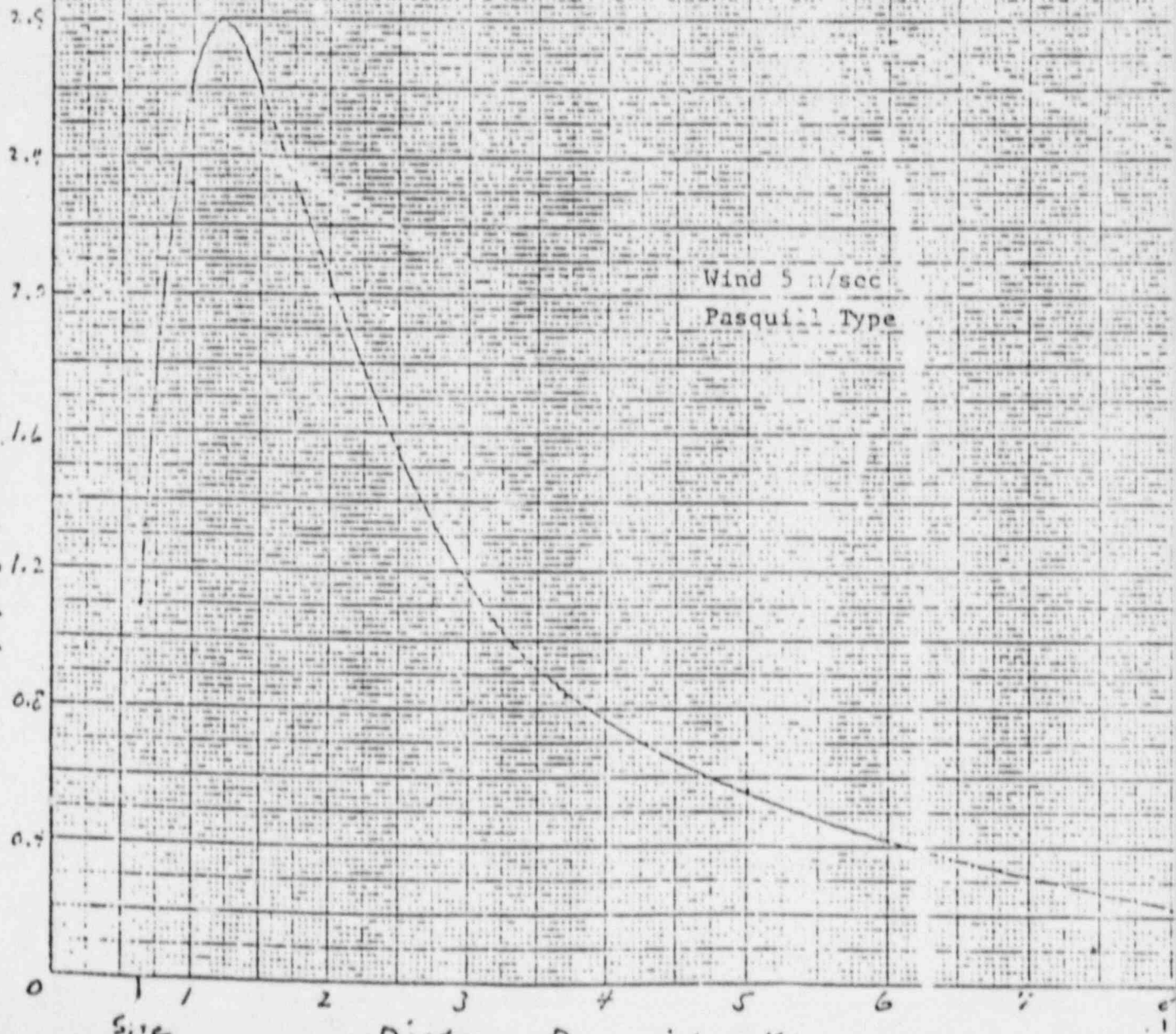
b. $$\frac{\text{(Release Rate} \quad \text{(Noble Gas Contribution)} \left(\frac{X}{Q}\right) \quad \text{(Dose rate per MPC)}}{\text{Noble Gas MPC}}$$

$$\frac{(125{,}000) \quad (0.67) \quad (2 \times 10^{-7}) \quad (0.056)}{(10^{-1}) \quad (10^{6})} = 0.0094$$

c. Total = Partic. + Nobles = 0.0077 + 0.0094 = 0.017 mr/hr

Figure 1

Diffusion Estimates for early afternoon August 9, 1971,
at Millstone



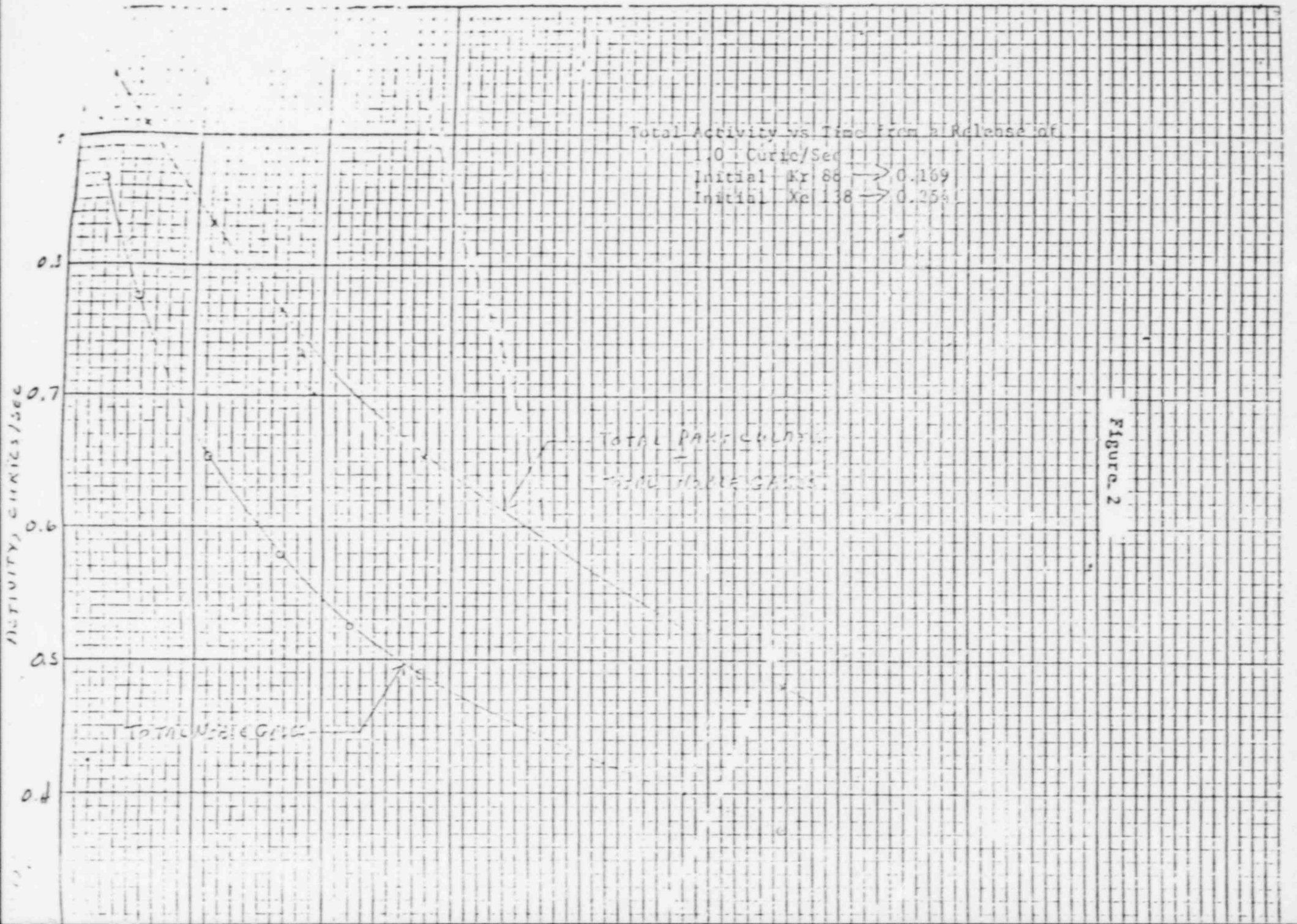
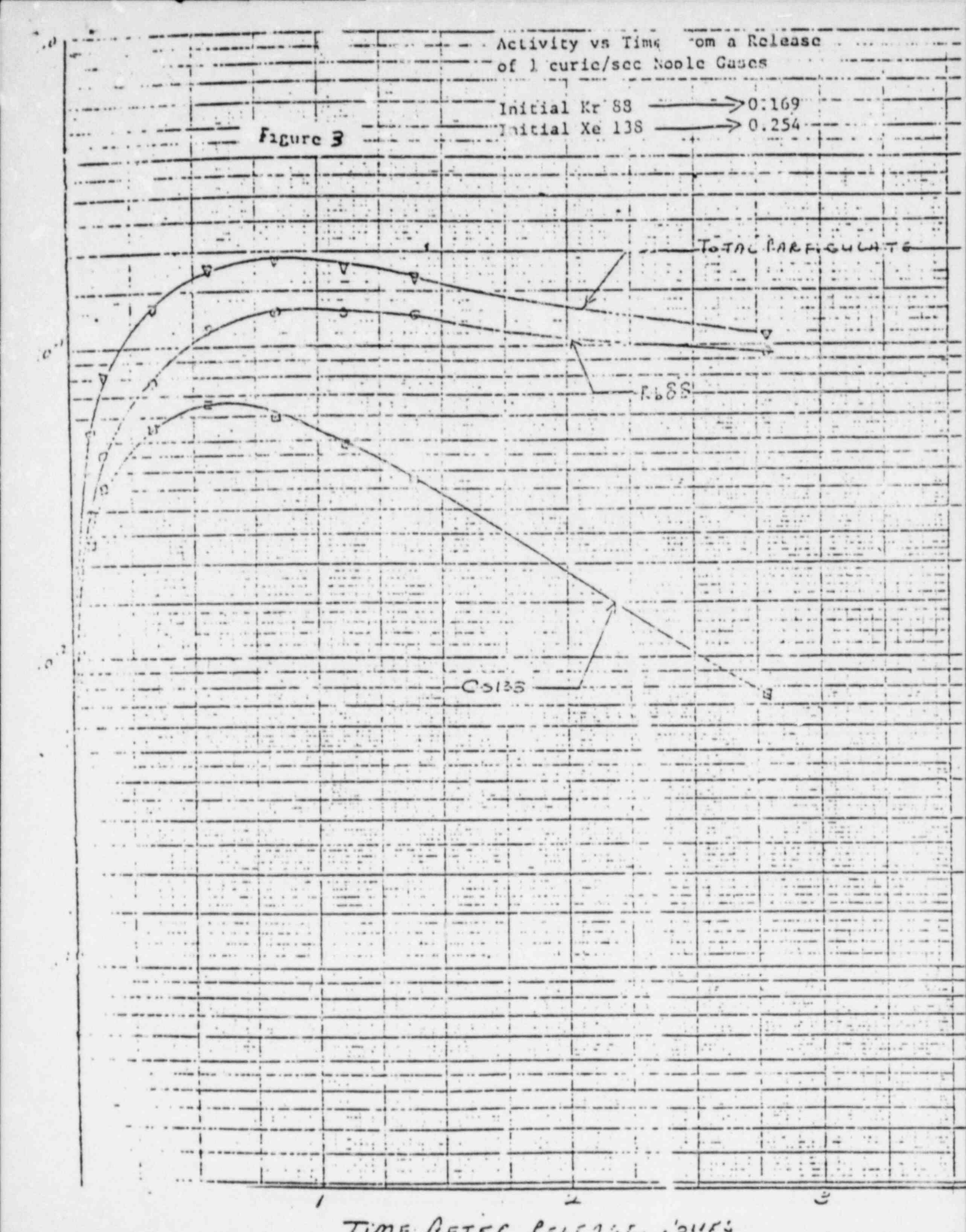

Total Activity vs Time From a Release of
1.0 Curie/Sec
Initial Kr 88 → 0.169
Initial Xe 138 → 0.256
0.8
0.7
0.6
0.5
0.4
ACTIVITY, CURIES/SEC
TOTAL PARTICULATE
TOTAL NOBLE GASES

Figure 2


Activity vs Time from a Release
of 1 curie/sec Noble Gases
Initial Kr 88 → 0.169
Initial Xe 138 → 0.254
Figure 3
TOTAL PARTICULATE
I-135
CS135
TIME AFTER RELEASE, HOURS