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HW--18094

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#9 300 File
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June 15, 1950

THIS DOCUMENT CONSISTS OF 11

To: J. B. Work

From: A. G. Blasewitz

FILTRATION EFFICIENCY OF THE T PLANT SAND FILTER

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BY AUTHORITY OF S.E. Gydensen
BY T. Stevens DATE 6-18-90
T. Davis 6-20-90
AM Eick 4-28-99

Summary:

The indicated decrease in the filtration efficiency of the T Plant sand filter was investigated. It was determined that the anomalous values were a direct result of the condensation of water in the ductwork seals and the sand filter. The consequent high humidity of the ventilation air downstream from the sand filter caused the deposition of water on the CWS monitoring filter. This increased the retention of gaseous I^{131} or volatile iodine compounds on the monitor. The recorded increase in contamination level at the downstream position was due to this factor and not a change in the removal efficiency of particulate matter. The humidity and efficiency data obtained during this study have revealed that on approximately April 15 all the condensed water vapor had been removed from the filter by evaporation, and coincident with this occurrence all operating characteristics of the unit returned to normal.

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Problem Background:

From the start of the T Plant sand filter operation, October 15, 1948, through November, 1949, the contamination removal efficiency of the unit had a normal operating range of 99.3 to 99.5%. These efficiencies were measured by periodic determinations of the contamination levels of the ventilation air upstream and downstream of the sand filter. CWS Type 6 filter paper was employed in these monitoring positions. In December, 1949, the filtration efficiency, as indicated by these monitors, experienced a significant drop. The recorded values ranged from 96 to 99%. This trend continued during the months of January and February.

Problem Analyses:

The monitoring equipment was thoroughly checked to determine whether erroneous flow measurements or air leakage into the sampling lines were contributing factors in the low values. When these results proved negative the decision was made to install additional sampling points in the downstream ventilation ductwork. The location of all the monitoring positions employed in the study is given schematically in Figure 1. The use of the two additional downstream monitoring positions established that the indication of lowered filtration efficiency was not due to contamination within the original sampling system, but rather to a measured increase in the contamination level downstream of the sand filter.

In late February, the continual collection of large quantities of water in the sand filter water seals at T Plant was brought to the attention of this group. A detailed report on this investigation has been issued under the heading "Restoration of Adequate Ventilation in 221-T Building", March 29, 1950, A. G. Blasewitz to J. B. Work. This study revealed that the ventilation air downstream of the sand filter was saturated with water vapor and that the first indication of water in the ventilation system occurred during the monitoring period of 11/27/49 thru 11/28. The first efficiency determination following this period (12/5) was in turn the first indication of a lowered contamination removal efficiency.

Decay curves were followed on upstream and downstream monitoring filters from both plant sand filters. The operating characteristics of the B Plant filter, which had remained normal in all respects, were used as a control basis throughout the investigation. Representative decay curves for the T and B Plant monitors are given in Figures II and III, respectively. These data demonstrated that a large fraction of the activity on the T Plant downstream monitors was due to a short-lived isotope such as I^{131}. The comparative gamma to beta plus gamma activities present on the T and B Plant downstream monitors (I^{131} having a high specific beta to gamma ratio) also suggested an abnormal concentration of radio-iodine on the T Plant downstream monitoring filters. The comparative gamma to beta plus gamma activities are given in Table I. All this information led to a consideration that the low recorded efficiencies were occasioned by the

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high humidity of the downstream ventilation air and consequent deposition of water on the CWS monitoring filter. This would result in an increased retention of gaseous I^{131} or volatile iodine compounds on the monitor and lead to an erroneous indication of lowered filtration efficiency. The sand filter, of course, is designed solely for the removal of particulate matter.

Accordingly, a complete fission product analysis was performed by the Analytical Section of the Technical Services Division on one set of T Plant monitoring filters. The results are given in Table II. These values further indicated that the filtration efficiency of the unit had remained unchanged for particulate matter and that the indicated increase in contamination level downstream from the filter was due to the high I^{131} concentration on the downstream monitor.

The described theory was further confirmed by the efficiency trend of the T Plant filter upon return to dry operation. The humidity recording equipment installed at T Plant has revealed that the water in the sand filter was removed by evaporation over the period of March 8 to April 15. Approximately 16,000 pounds of water were involved in this operation. The pressure drop across the bed has returned to the original value of 4.6 to 4.7 inches of water under two fan operation. (The pressure drop across the filter bed had increased approximately 0.3 of an inch of water during the period it was wetted.) Coincident with the return of dry operation the indicated filtration efficiency, based upon the original monitoring positions rose to a value of 99.3 to 99.6%. This is the normal operating range for the installation. These efficiency data are presented in Table III.

To further check the validity of the proposed mechanism, the operating characteristics of the T Plant monitors were simulated at B Plant. An upstream monitor and two parallel downstream monitors, were operated simulataneously. In two of the determinations both downstream monitors were operated normally. The efficiencies as calculated from both downstream positions were in excellent agreement and in the normal range (99.7 to 99.9%). Four runs were made wherein one of the downstream filters was maintained wet throughout the monitoring period. The efficiency based upon the dry filter remained unchanged, but in all instances the efficiency as determined by the moistened filter experienced a significant drop. An indicated efficiency as low as 97.1%, as compared with the dry filter value of 99.63%, was obtained. This indicated decrease is of the same order of magnitude as that experienced at T Plant. These results are presented in Table IV.

Conclusion:

The indicated decrease in the filtration efficiency of the T Plant sand filter was a direct result of the condensation of water in the ductwork

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water seals and the sand filter. The consequent high moisture content of the ventilation air downstream from the filter caused a humidification of the CWS monitoring filter. This in turn resulted in an increased retention of I^{131} on the monitor. It can be stated that the recorded low efficiencies were not true values. The contamination removal efficiency for particulate matter remained unchanged during this period and the increased level of contamination detected downstream from the filter was due to vapor phase radio iodine. Humidity and efficiency data have established that the ventilation ductwork and sand filter are now dry and that the operating characteristics of the filter are normal in all respects.

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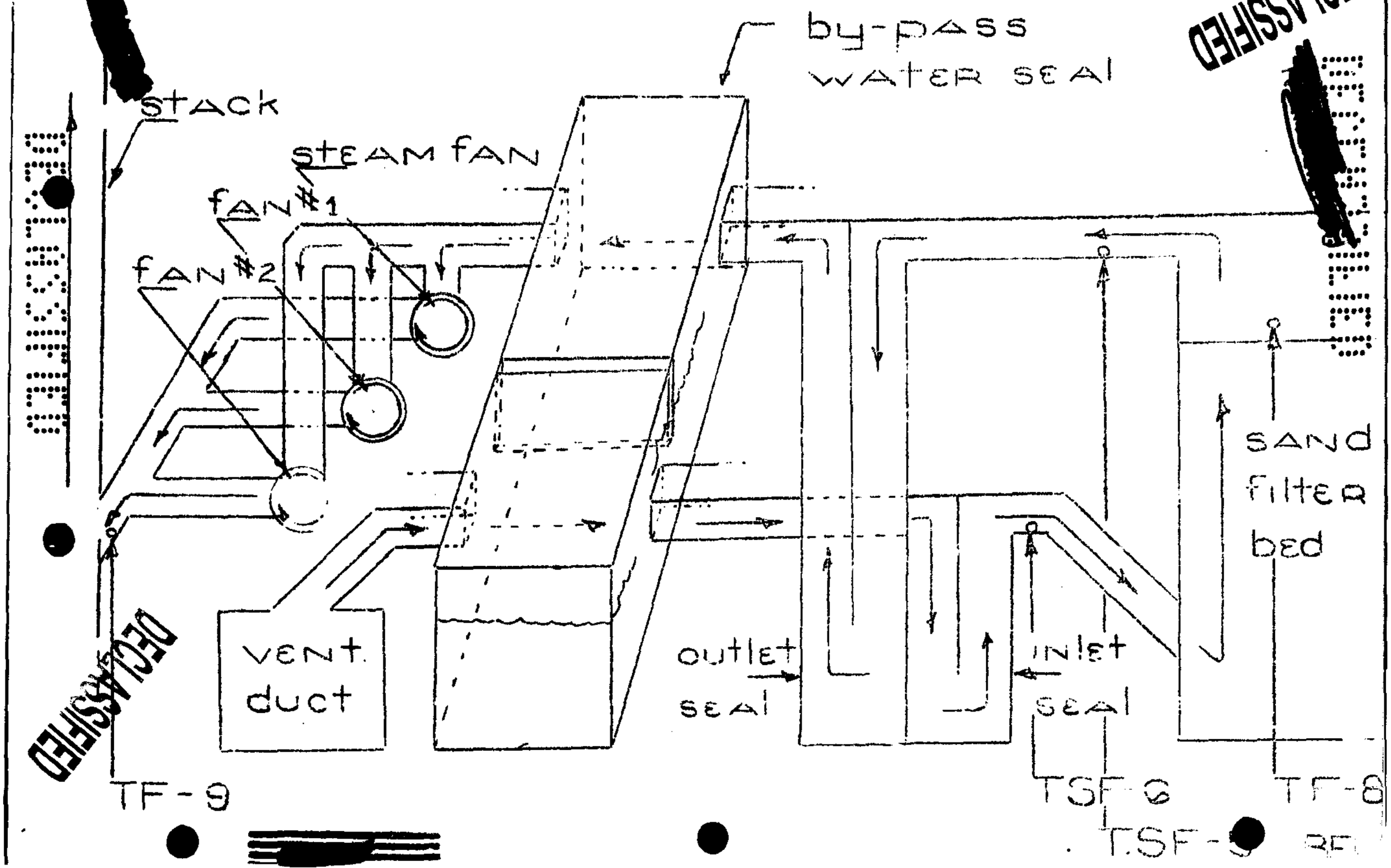
Figure I

T-Plant Ventilation Air Sampling Positions



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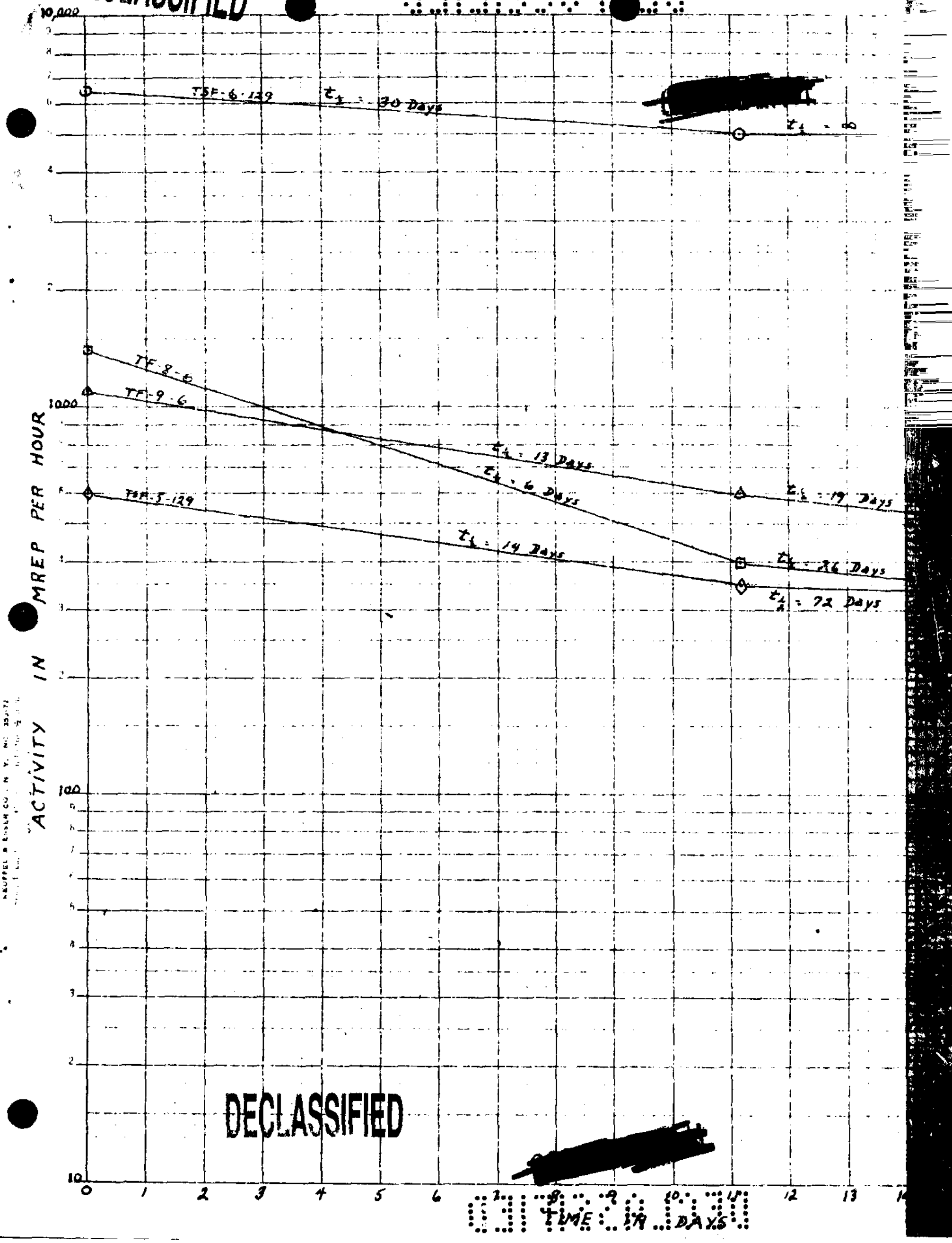

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FIGURE No. II

DECAY CURVES - WEST AREA

UPSTREAM MONITOR - TSF-6-129

DOWNSTREAM MONITORS- TSF-5-129

TF-8-6

TF-9-6

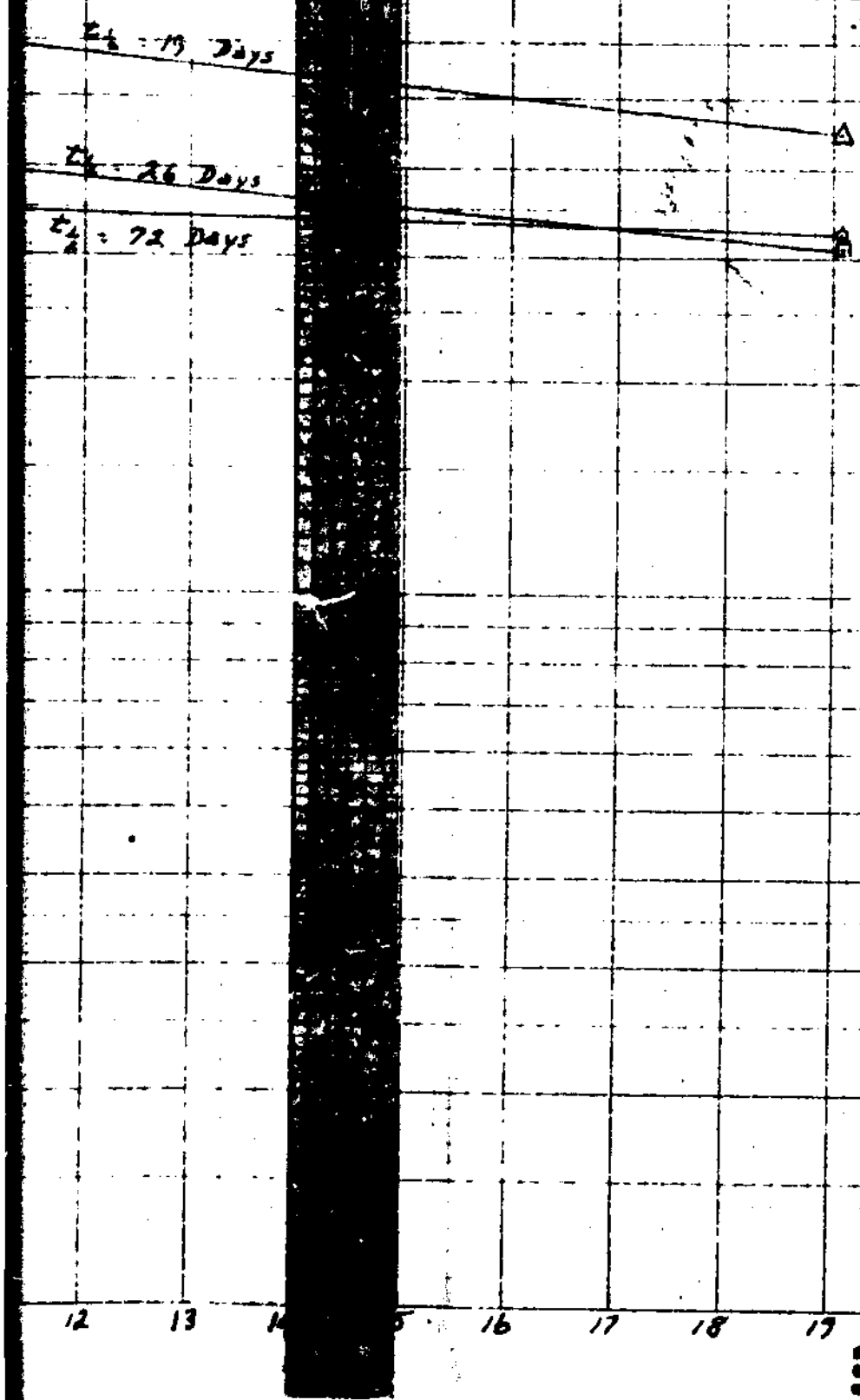

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FIG III

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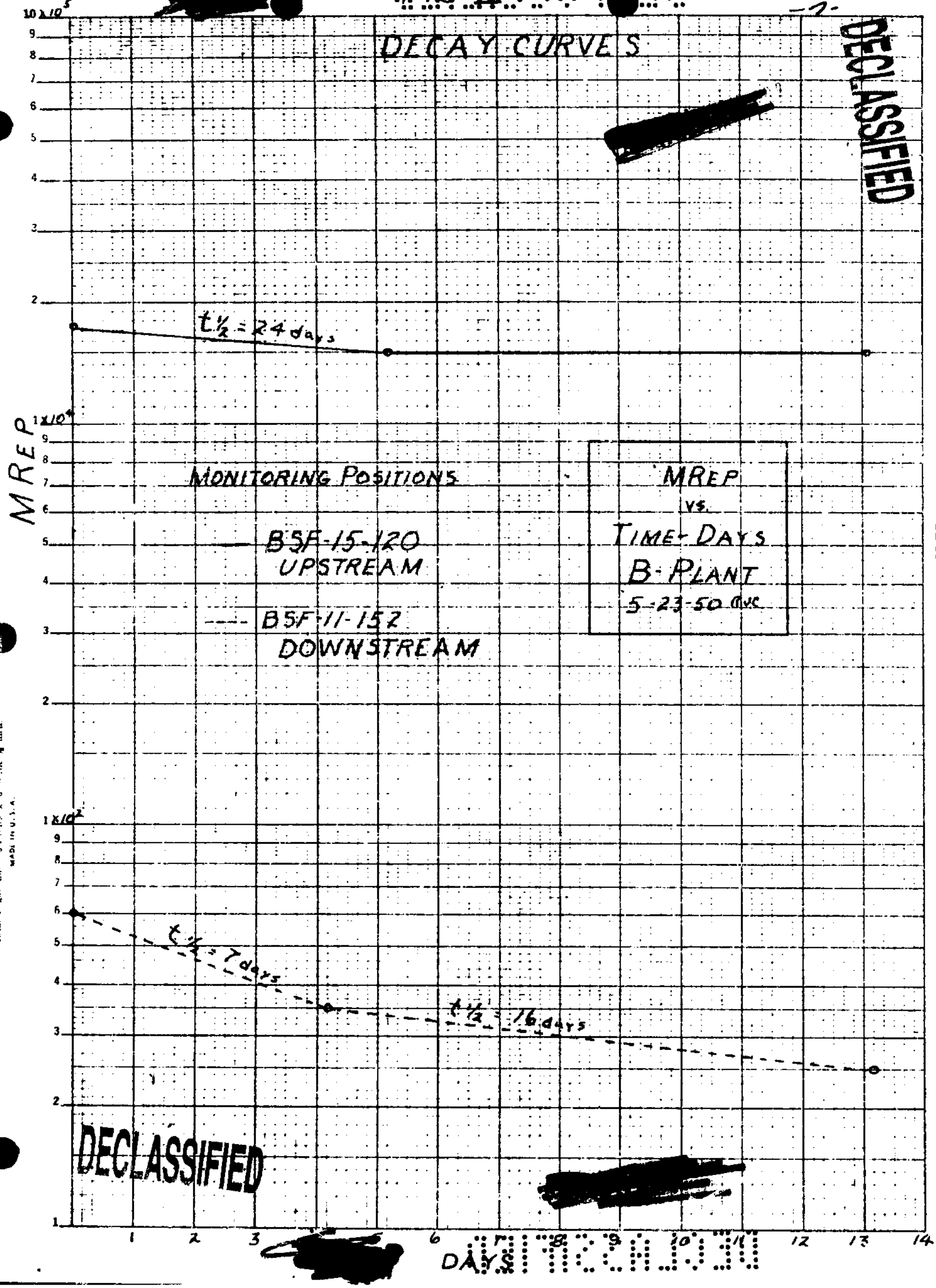

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TABLE I

Comparative Activities (Beta plus gamma to gamma) on the Sand Filter Monitors

	Ave. $\beta+\gamma/\gamma$ Ratio for Upstream Monitors		Ave. $\beta+\gamma/\gamma$ Ratio for Downstream Monitors			
	RF-15	TSF-6	BSF-11	TSF-5	TSF-8	TF-9
B Plant 5/49 - 11/49	63		84			
B Plant 12/49 - 4/15/50	58		71			
T Plant 5/49 - 11/49		62		75		
T Plant 12/49 - 4/15/50		66		110	330	250

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TABLE II

Upstream Filter TSF-6-133
Activity Reading (c.p.) 2550 mrep.
Flow - 1.0 cfm

Fission Product	Lab Analysis c/m	% of Total Beta Activity	% of Beta Activity on an I^{131} Free Basis
I^{131}	1,230,000	27.7	
Rare Earths other than Ce	1,420,000	32	44.2
Ce	928,000	20.9	28.9
Sr	456,000	10.2	14.2
Ru	408,000	9.2	12.7
Pu	344,000 d/m		
U	56		
Total c/m	4,442,000		
c/m Other than I^{131}	3,212,000		

Downstream Filter TF-8-10
Activity Reading (c.p.) 550 mrep
Flow - 5.75 cfm

I^{131}	783,000	85.6	
Rare Earths other Than Ce	65,500	7.2	49.4
Ce	35,800	3.9	27.1
Sr	16,500	1.8	12.5
Ru	14,500	1.5	11.0
Pu	36,700 d/m		
U	6		
Total c/m	915,300		
c/m Other than I^{131}	132,300		

Efficiencies

Total Beta (c.p.)	96.3
Total Beta (Lab analysis)	96.4
Beta other than I^{131} (Lab analysis	99.29

I^{131}	88.9
Rare earths except Ce	99.19
Ce	99.33
Sr	99.39
Ru	99.38

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TABLE III T Plant Sand Filter Efficiencies

Date	Average Efficiency	Individual Efficiencies
5/49 to 12/49	99.42	
12/49 to 4/15/50	98.0	96 to 99.1
4/18/50		98.37
4/20		99/51
4/21		99/26
4/21		99.41
4/25		99.34
5/3		99.49
5/5		85.45*
5/9		98.48*
5/11		99.08*
5/12		98.75*
5/14		98.94*
5/15		99.18
5/16		99.73
5/18		99.59
5/23		99.19

*Special caustic runs had deposited caustic in downstream line. This caused increased I^{131} retention. Lines were water flushed and dried to normal conditions on 5/15.

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TABLE IV

Run No.	B-191		B-195	
Upstream Monitor	BF-15-153		BF-15-157	
C.P. Reading mrep/hr	4000		19,500	
Flow (cfm)	0.97		1.0	
Downstream Monitor	BSF-11-187	BF-14-279	BSF-11-191	BF-14-283
C.P. Reading mrep/hr	35	25	160	140
Flow (cfm)	4.0	4.0	4.0	4.0
Condition of filter	Dry	Dry	Dry	Dry
Efficiency	99.79	99.85	99.79	99.82

Run No.	B-189		B-190		B-192		B-193	
Upstream Monitor	BF-15-151		BF-15-152		BF-15-154		BF-15-155	
C.P. Reading mrep/hr	335		450		5000		335	
Flow (cfm)	1.0		1.0		1.0		1.0	
Downstream Monitor	BSF-11-185	BF-14-277	BSF-11-186	BF-14-278	BSF-11-188	BF-14-280	BSF-11-189	BF-14-281
C.P. Reading mrep/hr	5	40	5	8	20	30	5	15
Flow (cfm)	4.1	4.1	4.0	4.0	4.0	4.0	4.0	4.0
Condition of filter	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Efficiency	99.63	97.1	99.73	99.56	99.90	99.85	99.63	98.9

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