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DPST-83-508TL

June 17, 1983

J. T. GRANAGHAN, MANAGER
SAVANNAH RIVER PLANT

ATTENTION: L. M. PAPOUCHADO, SUPERINTENDENT
SEPARATIONS TECHNOLOGY DEPARTMENT

STUDY OF PERSONNEL CONTAMINATIONS
IN 200 AREA FACILITIES

The attached memorandum by M. A. Wagner and D. H. Stoddard documents the frequency of personnel assimilations and contaminations in 200 Area facilities. The study (conducted for SRL's use in 200 Area Safety Analyses) is being transmitted to aid in your ongoing program to reduce and eliminate these incidents.

One surprising result deserves particular attention - A-Line in F Area had the highest frequency of uptakes from 1970 through 1981 for all 200 Area facilities. This resulted from a large number of relatively low-level uranium assimilations that occurred in 1975. During this period, Construction employees were restoring the building after an explosion and fire. These assimilations were discovered through routine bioassays and were not attributable to any specific incident. With significant A-Line construction activity planned for the next several years via upgrade projects, the potential hazard from uranium assimilation should be emphasized with all involved personnel.

H. D. HARMON
ACTINIDE TECHNOLOGY DIVISION

HDH:jmb
Att.

TECHNICAL DIVISION
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May 18, 1983

MEMORANDUM

TO: H. D. HARMON

FROM: M. A. WAGNER* AND D. H. STODDARD
ACTINIDE TECHNOLOGY DIVISION

A STATISTICAL ANALYSIS OF PERSONNEL CONTAMINATIONS IN 200 AREA FACILITIES

INTRODUCTION

This study determined the frequency statistics of personnel contaminations in 200 Area facilities. These statistics are utilized in probability calculations for contamination risks, and are part of an effort to provide reliable information for use in safety studies. Data for this analysis were obtained from the 200 Area and the Tritium Area Fault Tree Data Banks and were analyzed with the aid of the STATPAC computer code.[1,2]

SUMMARY

Analyses were performed on confirmed uptakes and on nasal, skin, and clothing contamination incidents in 200 Area facilities to obtain frequency statistics. The mean frequencies are as follows:

* Co-op student, Tennessee Tech.

MEAN FREQUENCY OF PERSONNEL CONTAMINATIONS
(Events per Year)

Facility	Uptakes				Nasal Contam.	Skin Contam.	Clothing Contam.
	Inhalation	Injection	Absorption	Ingestion			
F Canyon	0.8	0.0	0.0	0.0	1.5	8.3	15.9
JB-Line	3.7	0.1	0.0	0.0	8.7	24.3	36.5
Laboratory 772-F	3.2	0.1	0.0	0.0	2.4	3.4	3.1
235-F	0.7	0.0	0.0	0.0	2.9	8.1	30.4
A-Line	14.0	0.0	0.0	0.0	0.0	0.2	0.0
Burial Ground	0.2	0.0	0.0	0.0	0.0	0.7	0.5
F Area Waste	0.1	0.0	0.0	0.0	0.8	1.7	1.8
MPPF	0.4	0.0	0.0	0.0	0.3	0.3	0.0
F Area Outside Facilities	0.0	0.0	0.0	0.0	0.2	0.3	0.3
H Canyon	3.1	0.1	0.0	0.0	2.4	15.2	19.2
HB-Line	6.4	0.2	0.1	0.0	4.9	11.1	36.5
H Area Waste	0.4	0.0	0.0	0.0	0.2	3.5	7.6
RBOF	0.0	0.0	0.0	0.0	0.5	0.2	0.8
H Area Outside Facilities	0.0	0.0	0.1	0.0	0.3	0.3	1.7
Tritium 232-H	1.1	0.1	0.8	0.0	-	-	-
Tritium 234-H, 236-H	2.4	0.0	1.9	0.0	-	-	-
Tritium 237-H, 238-H	0.1	0.0	0.0	0.0	-	-	-

DISCUSSION

This analysis was performed to determine the frequency statistics for personnel contaminations in the 200 Area facilities. The frequencies for confirmed uptakes and for nasal, skin, and clothing contaminations were analyzed, where enough data were available to give meaningful results. This statistical study concerns incidents from 1970 through 1981 for 200 Area uptakes (excluding tritium); 1976 through 1981 for 200 Area nasal, skin, and clothing contaminations; and 1970 through 1982 for all tritium contamination incidents.

Data were obtained from the 200 Area and Tritium Area Fault Tree Data Banks, which are collections of incidents in those areas dating back to plant startup. The initial effort in this study was to update the data banks with assimilation information obtained from Health Protection Exposure Records for the years 1970 through 1981. Nearly 300 entries containing bioassay results were added to the 200 Area Fault Tree Data Bank, while 59 were added to the Tritium Data Bank. After integrating with existing material, the HP Exposure Records were found to have contributed 150 new incidents to the 200 Area bank and 26 new incidents to the tritium bank, primarily for 1970-1975 for which Health Protection log book data were not available.

The STATPAC computer code was utilized in performing the computations. After sorting specified incidents for each facility, STATPAC was used to calculate the arithmetic mean and median times between occurrences. The program also fitted the data to five different distributions: the normal, log-normal, exponential, Weibull, and log-uniform. A mean, median, and chi-square statistic were calculated for each distribution. STATPAC also plotted the probability density functions for each distribution and presented a trend plot of each contamination type for each facility.

Table 1 presents the results of the STATPAC analysis. It was determined that at least twelve incidents were required for STATPAC to work effectively. The best fit distribution was determined by comparison with the statistical mean and median value to the arithmetic mean and median.

With few exceptions, all uptakes in the 200 Area facilities were by inhalation. Within the indicated time spans, there was one uptake by injection in both JB-Line and 772-F, two uptakes by injection and one uptake by absorption in HB-line, and one uptake by injection in H Canyon. In H Area, the only uptake for the outside facilities was by absorption. These numbers are included in the values in Table 1. In the Building 232-H tritium facility, there was one uptake by injection in addition to the other uptakes.

The facility that had the highest frequency of both nasal and skin contaminations (based on data from 1976 through 1981) was JB-Line, while the highest frequency of clothing contaminations during the same period was in Building 235-F. The highest frequency of uptakes (based on data from 1970 through 1981) was in A-line. Most of these were relatively small uranium assimilations not attributable to any incident. Forty-seven percent of the uptakes in A-Line occurred during a two-month period in the spring of 1975, when construction employees were restoring the building after an explosion and fire. As Table 1 also shows, A-line had the lowest frequency of nasal, skin, and clothing contaminations for any non-tritium facility. Since the assimilations were discovered through routine bioassays, it would have been too late to have detected any nasal contaminations, if they had indeed existed.

Figure 1 is a typical probability density function. The height of each small block indicates the frequency of incidents during the time interval represented on the X axis. The distribution curve is the best fit to the observed data.

Figures 2 through 8 are trend plots which show the number of incidents for the represented years and indicate an increasing or decreasing trend for that facility. Trend plots for other facility and contamination situations are not representative due to a lack of data points.

REFERENCES

1. W. S. Durant, W. D. Galloway, P. M. Allen, and R. Lee. **200 Area Fault Tree Data Bank - 1982 Status Report.** DPST-83-235 (January 24, 1983).

2. D. H. Stoddard, H. R. Haynes, and W. D. Galloway. **Tritium Area Fault Tree Data Bank - 1982 Status Report.** DPST-82-875 (September 28, 1982).

TABLE 1

STATPAC Analysis Results

Facility	Contamination Type	No. of Incidents	Best Fit Distribution	Mean Time Between Occurrences (Days)	Median Time Between Occurrences (Days)	Years Included
F Canyon	Uptake	9	-	486	-	1970-1981
	Nasal	9	-	243	-	1976-1981
	Skin	42	Weibull	44	20	1976-1981
	Clothing	76	Weibull	23	5	1976-1981
JB-Line	Uptake	36	Weibull	98	47	1970-1981
	Nasal	41	Weibull	42	17	1976-1981
	Skin	114	Weibull	15	7	1976-1981
	Clothing	230	Log-Normal	10	4	1976-1981
Laboratory 772-F	Uptake	37	Weibull	115	41	1970-1981
	Nasal	12	Weibull	155	107	1976-1981
	Skin	18	Weibull	106	74	1976-1981
	Clothing	20	Weibull	116	40	1976-1981
235-F	Uptake	8	-	547	-	1970-1981
	Nasal	12	Weibull	125	20	1976-1981
	Skin	42	Weibull	45	8	1976-1981
	Clothing	259	Log-Normal	12	4	1976-1981
A-Line	Uptake	74	Weibull	26	6	1970-1981
	Nasal	0	-	-	-	1976-1981
	Skin	1	-	2190	-	1976-1981
	Clothing	0	-	-	-	1976-1981
Burial Ground	Uptake	2	-	2190	-	1970-1981
	Nasal	0	-	-	-	1976-1981
	Skin	4	-	547	-	1976-1981
	Clothing	3	-	730	-	1976-1981
F Area Waste	Uptake	1	-	4380	-	1970-1981
	Nasal	5	-	438	-	1976-1981
	Skin	10	-	219	-	1976-1981
	Clothing	11	-	199	-	1976-1981
MPPF	Uptake	5	-	876	-	1970-1981
	Nasal	2	-	1095	-	1976-1981
	Skin	2	-	1095	-	1976-1981
	Clothing	0	-	-	-	1976-1981

* Arithmetic mean values are shown where insufficient data were available to permit a STATPAC analysis.

TABLE 1 (Contd)

Facility	Contamination Type	No. of Incidents	Best Fit Distribution	Mean Time Between Occurrences (Days)	Median Time Between Occurrences (Days)	Years Included
F Area Outside Facilities	Uptake	0	-	-	-	1970-1981
	Nasal	1	-	2190	-	1976-1981
	Skin	2	-	1095	-	1976-1981
	Clothing	2	-	1095	-	1976-1981
H Canyon	Uptake	38	Weibull	116	14	1970-1981
	Nasal	10	-	151	35	1976-1981
	Skin	81	Weibull	24	8	1976-1981
	Clothing	102	Weibull	19	6	1976-1981
HB-Line	Uptake	65	Weibull	57	21	1970-1981
	Nasal	22	Exponential	74	51	1976-1981
	Skin	55	Exponential	33	23	1976-1981
	Clothing	190	Weibull	10	5	1976-1981
H Area Waste	Uptake	5	-	876	-	1970-1981
	Nasal	1	-	2190	-	1976-1981
	Skin	24	Weibull	105	14	1976-1981
	Clothing	45	Weibull	48	10	1976-1981
RBOF	Uptake	0	-	-	-	1970-1981
	Nasal	3	-	730	-	1976-1981
	Skin	1	-	2190	-	1976-1981
	Clothing	5	-	438	-	1976-1981
H Area Outside Facilities	Uptake	1	-	4380	-	1970-1981
	Nasal	2	-	1095	-	1976-1981
	Skin	2	-	1095	-	1976-1981
	Clothing	10	-	219	84	1976-1981
Tritium 232-H	Uptake/Inhal.	15	Weibull	319	34	1970-1982
	Uptake/Absorp.	10	-	474	312	1970-1982
	Personnel	0	-	-	-	1970-1982
Tritium 234-H, 236-H	Uptake/Inhal.	21	Exponential	153	106	1970-1982
	Uptake/Absorp.	24	Weibull	190	72	1970-1982
	Personnel	3	-	1581	-	1970-1982
Tritium 237-H, 238-H	Uptake/Inhal.	1	-	4745	-	1970-1982
	Uptake/Absorp.	0	-	-	-	1970-1982
	Personnel	0	-	-	-	1970-1982

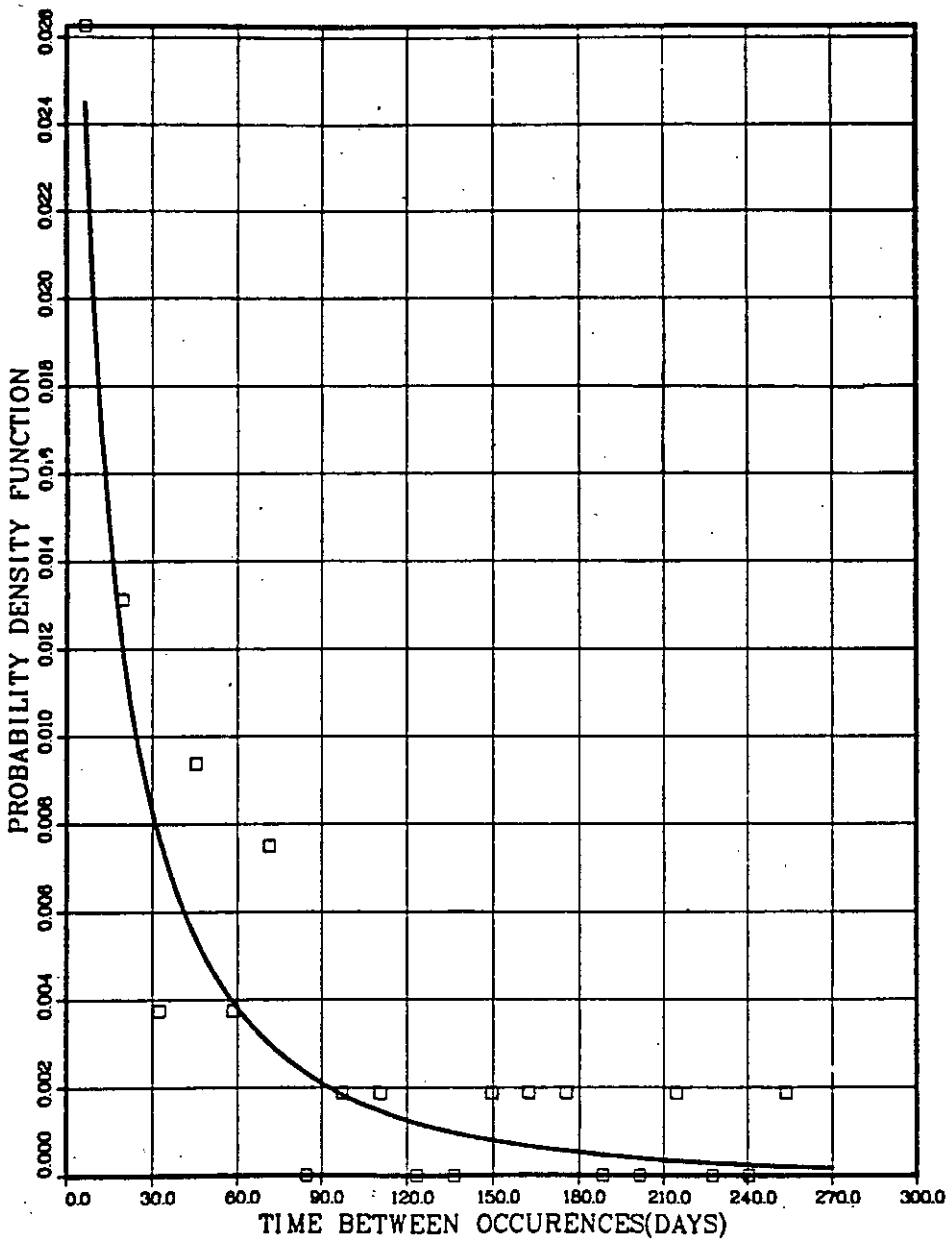

FIGURE 1. Probability Density Function for Skin Contaminations in F-Canyon

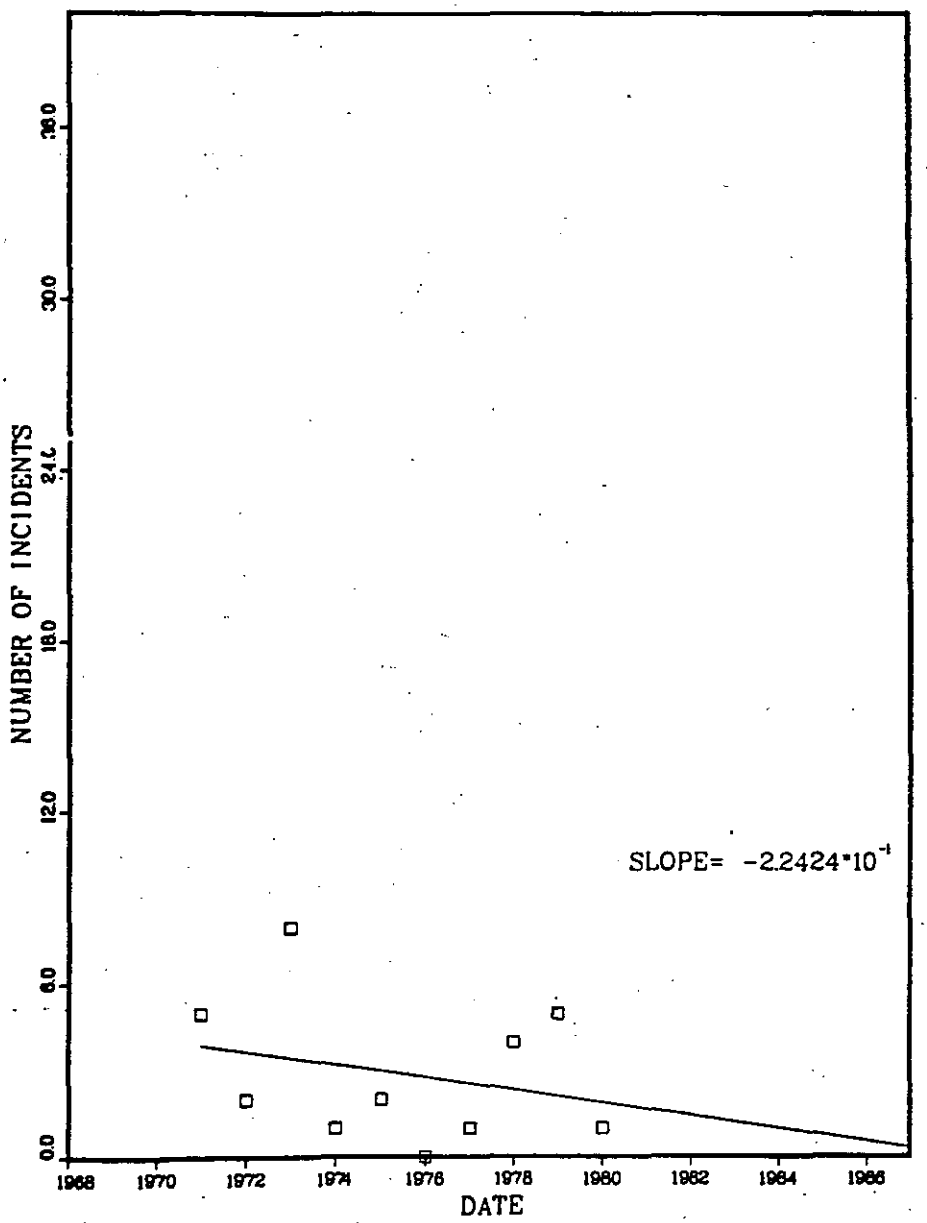

FIGURE 2. Trend Plot of Uptakes by Inhalation for JB-Line

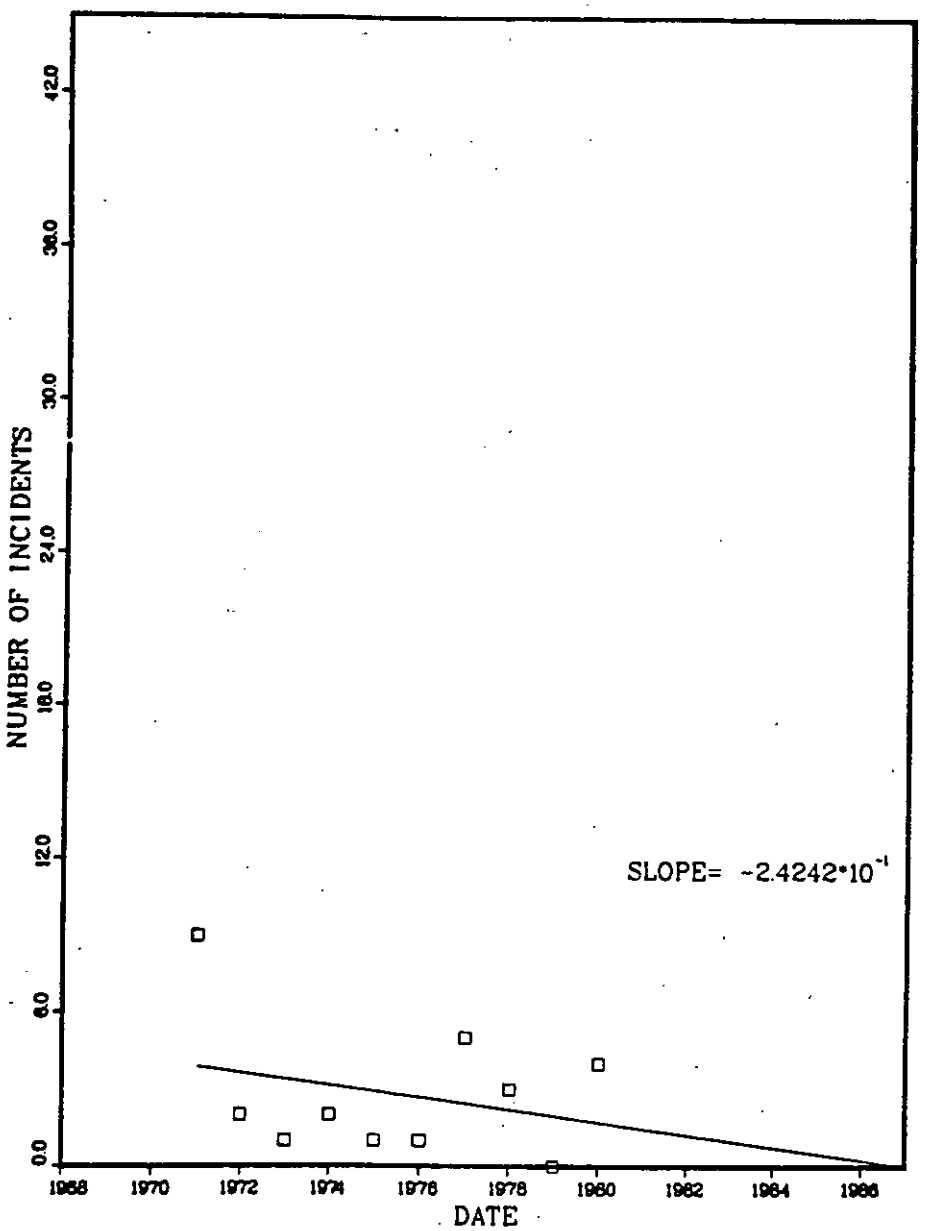

FIGURE 3. Trend Plot of Uptakes by Inhalation for 772-F

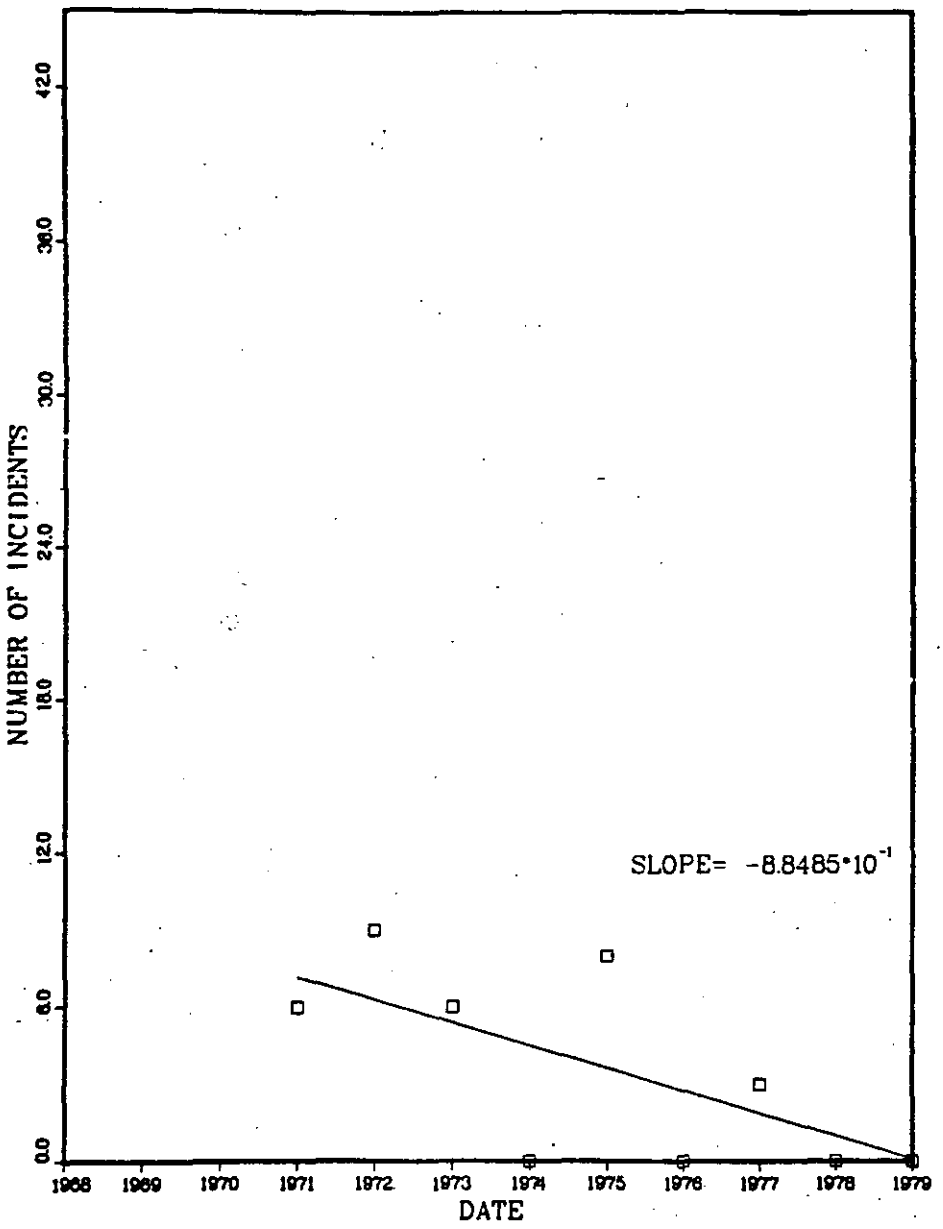

FIGURE 4. Trend Plot of Uptakes by Inhalation for H-Canyon

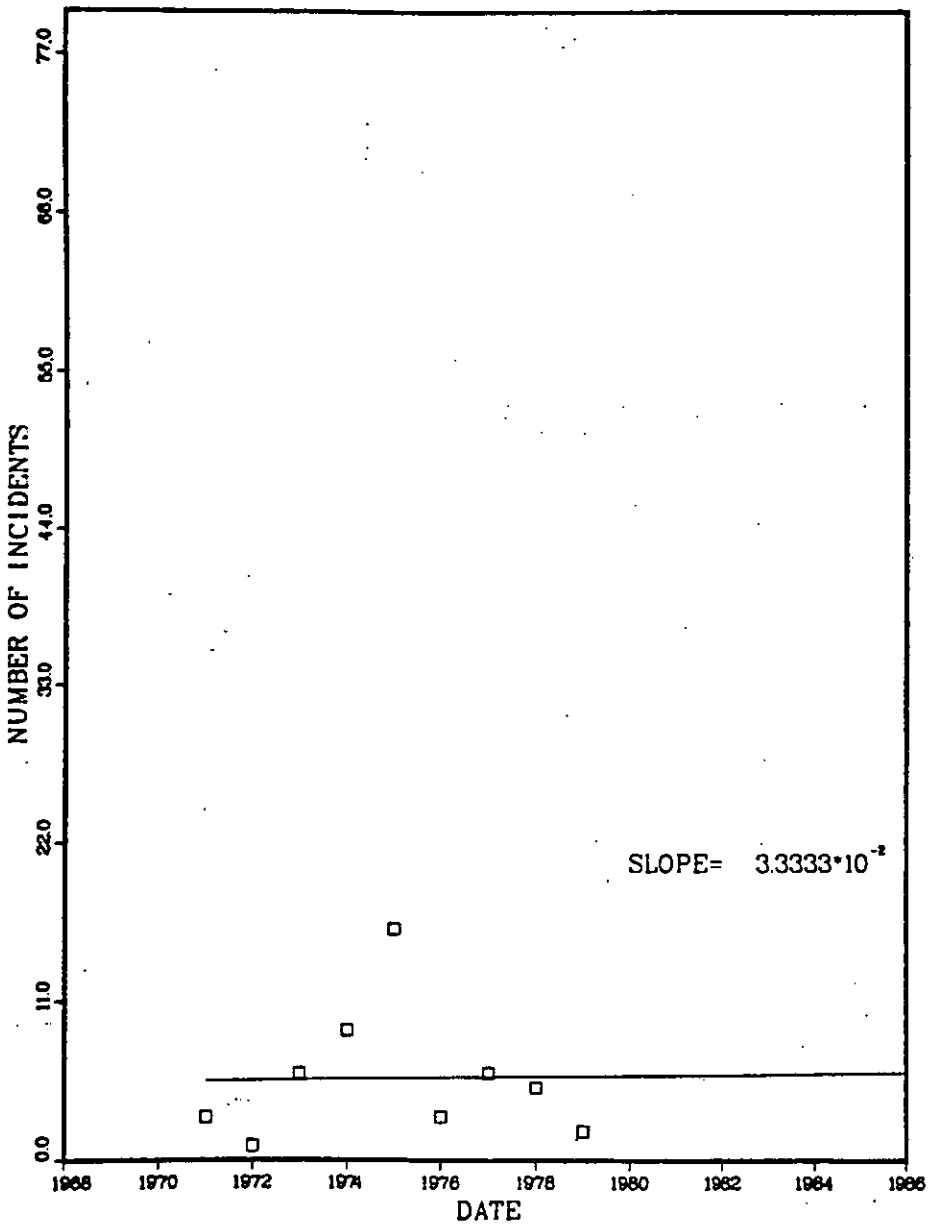

FIGURE 5. Trend Plot of Uptakes by Inhalation for HB-Line

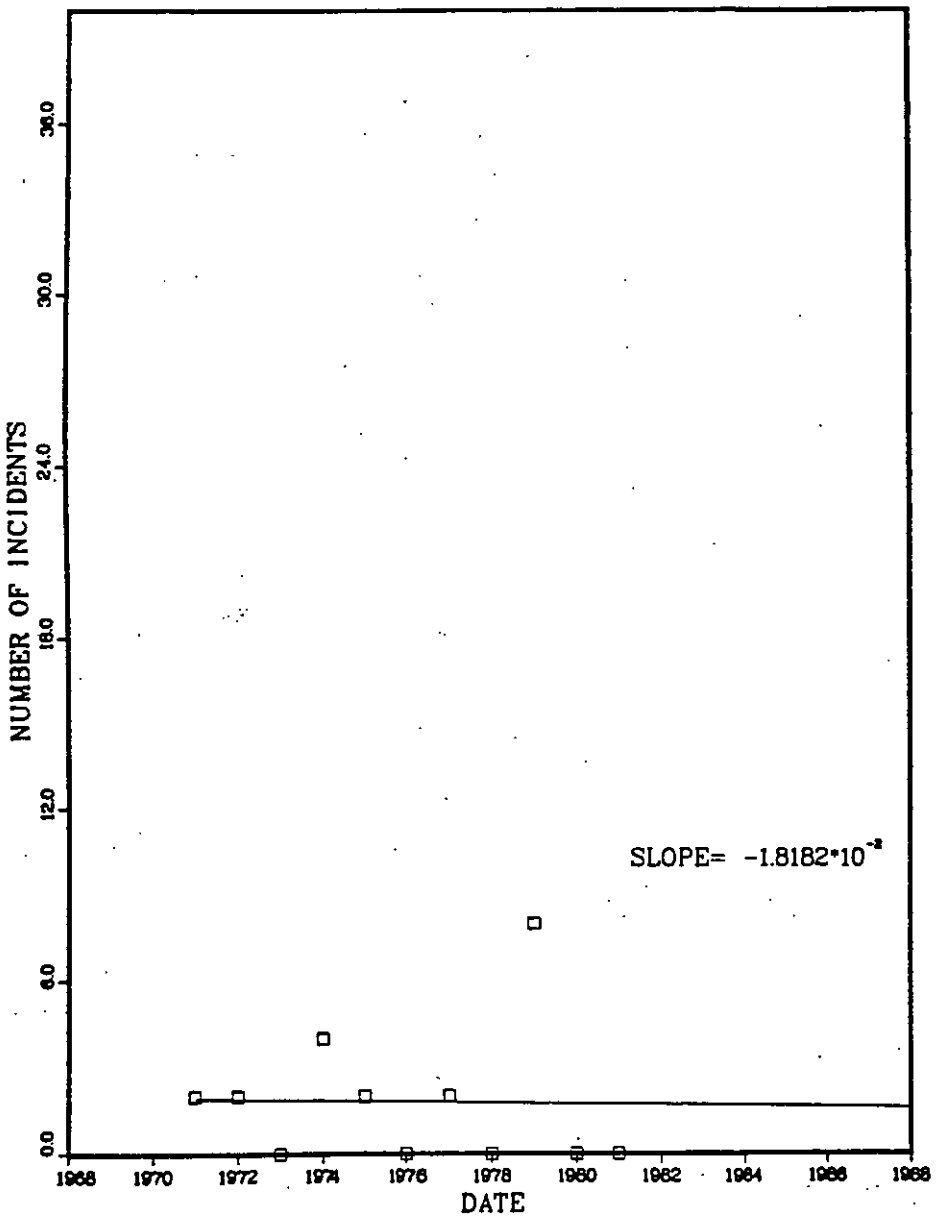

FIGURE 6. Trend Plot of Uptakes by Absorption for 234-H and 236-H (Tritium)

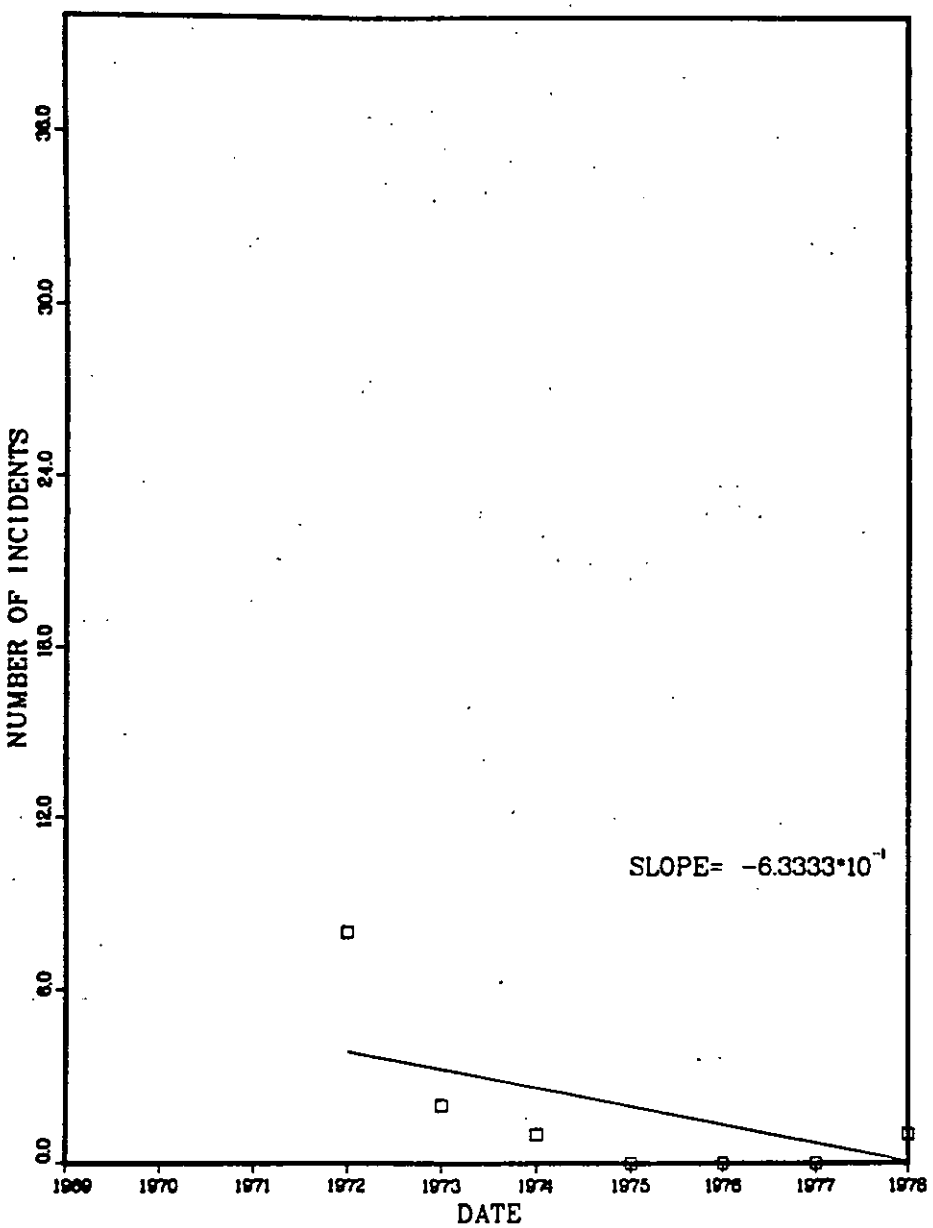

FIGURE 7. Trend Plot of Uptakes by Inhalation for 232-H (Tritium)

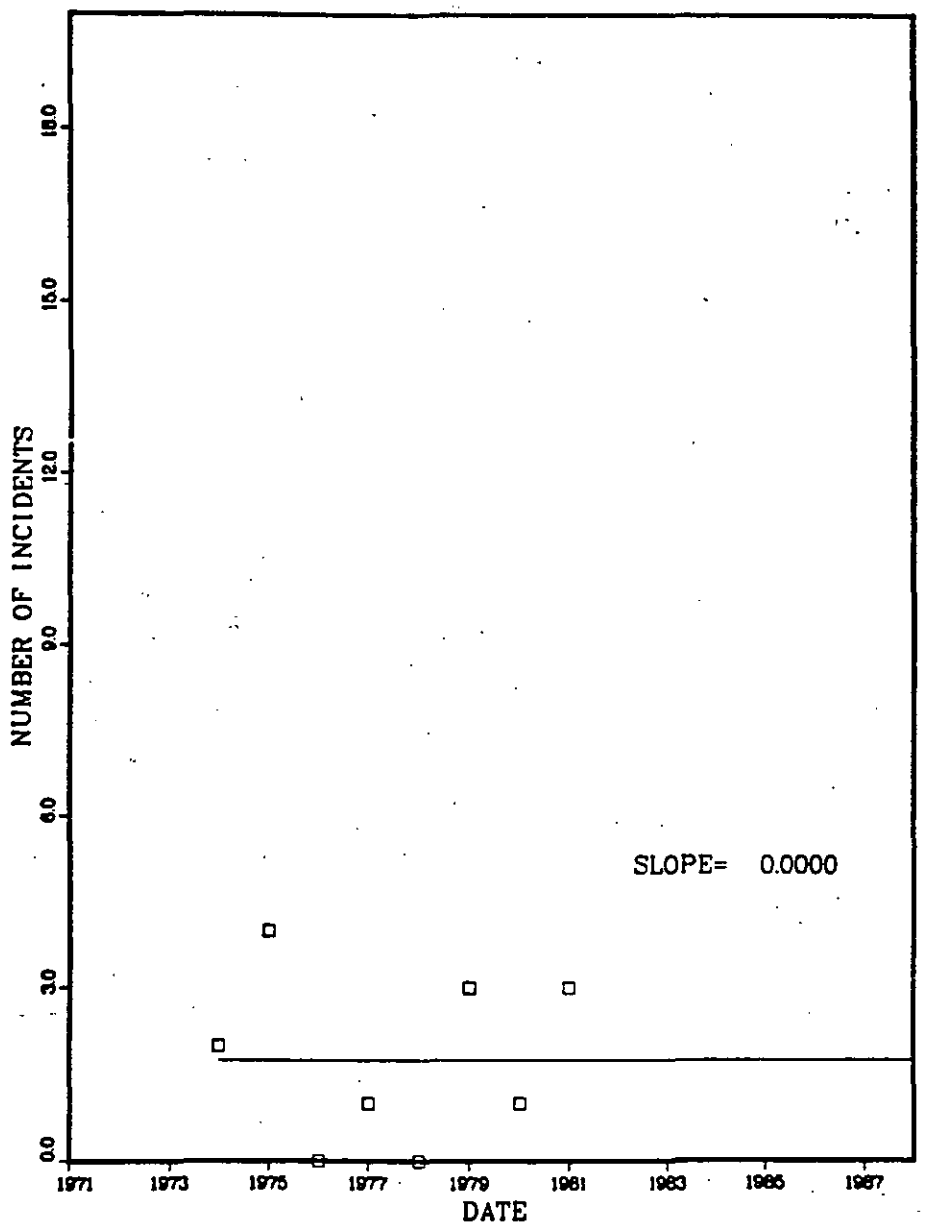

FIGURE 8. Trend Plot of Uptakes by Inhalation for 234-H and 236-H (Tritium)

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DPST-83-508

A STATISTICAL ANALYSIS OF PERSONNEL CONTAMINATIONS IN 200 AREA FACILITIES (U)

by

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Letter (DPST-83-508TL) H. D. Harmon to J. T. Granaghan dated 6/17/83

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