

A NATIONAL SURVEY
ON
NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)
IN PETROLEUM PRODUCING AND GAS PROCESSING FACILITIES

SUBMITTED BY

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PREFACE
NATURALLY OCCURRING RADIOACTIVE MATERIALS
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The presence of naturally occurring radioactive materials (NORM) in oil and gas producing operations has been recognized since the early 1930s when slightly elevated radium levels were detected in Russian oil fields. Over the years, scientists have studied various aspects of low level radiation from NORM associated with oil and gas production. Recently, in 1981, scale produced on large platforms located in the North Sea was found to contain NORM at measurable levels. In the United States, the issue of NORM in mineral scale deposits gained industry and government attention in 1986. During routine work on a well in Mississippi, barium sulfate scale deposited in production tubing was found to contain measurable quantities of NORM. Industry responded by 1) notifying appropriate state agencies and the Mid-Continent Oil & Gas Association, 2) initiating field surveys to locate the occurrence of NORM, 3) informing other oil and gas operators, employees, and contractors, 4) initiating training programs, and 5) reviewing operating practices.

The Mid-Continent Oil & Gas Association in Mississippi was established as a clearing house for information on NORM, initially coordinating field survey activities and outlining field handling guidelines. The American Petroleum Institute began coordinating action on the NORM issue at the national level beginning in late 1986. The following API-sponsored report by Dr. Gordon Otto of the University of Houston defines the general occurrence of NORM in the United States based on a statistical analysis of gamma measurements taken external to certain petroleum producing and gas processing equipment. While not exhaustive, the data base is large and indicates that NORM is not everywhere in the "oil patch," and is generally limited to certain geographical areas. In fact, since much of the data were collected at sites which were suspected of some radioactivity, the magnitude of occurrence is likely to be overstated.

Health, safety and environmental impact issues associated with NORM occurrence, while not addressed in Dr. Otto's report, are met by industry through the use of traditional industrial hygiene practices and work procedures since most oil and gas NORM resides inside of closed steel vessels and pipes. Additionally, the quantity of NORM at any given work location is generally very small, and radiation levels are low when compared with background levels. NORM exists on the inner surfaces of some oil and gas equipment, generally in the following forms:

- Radium 226 and Radium 228 - co-precipitated in some mineral scales.
- Lead 210 films in gas processing equipment, primarily propane and ethane pumps.
- Radon gas co-produced with natural gas.

The exposure to NORM of most concern in oil and gas operations is by ingestion and inhalation which is prevented utilizing work procedures routinely used for protection of other risks. Exposure to NORM is only one of several risks which must be dealt with in oil and gas producing operations. Equipment which may contain small quantities of NORM also contains large quantities of hydrocarbons which may in turn contain carbon dioxide and/or hydrogen sulfide. Because of the existence of these materials in the oilfield, industrial hygiene practices aimed at protecting against their hazards have long been in place and include:

- Purging of vessels prior to entry.
- Use of respirators and breathing apparatus while working inside of vessels.
- Use of masks while performing grinding and chipping operations.
- Utilization of protective clothing, including gloves, and the prohibition of eating, smoking, or chewing around open equipment.

NORM is widely dispersed in the earth's crust, and some industries, of necessity, concentrate NORM pursuant to the primary function. This occurs in the mining of uranium and certain other minerals...the production of some fertilizers...and in other very legitimate commercial undertakings. NORM derived from producing oil and gas is not generally concentrated; it is of very low specific activity; and oil and gas well locations are typically widespread, thus, a natural dispersion of oilfield NORM is maintained. The small quantities of NORM produced at only a few relatively remote sites constitutes no appreciable addition to natural radiation background levels. The following report by Dr. Otto presents information on the geographical occurrence of oilfield NORM, relating it to natural radiation background levels, and points toward further understanding of why there are no known NORM environmental, health, or safety concerns associated with oil and gas production sites.

R. D. Baker

for

J. C. Martin

Chairman - API Committee on NORM

A National Survey on
Naturally Occurring Radioactive Materials (NORM)
In Petroleum Producing and Gas Processing Facilities

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* State summaries contain figures, tables and appendices similar to the total U.S. information and state measurement data is provided for counties, parishes, etc.

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I. Introduction

The data summarized in this report is a compilation of over 36,000 individual observations submitted by a number of participating petroleum companies using similar equipment and collection protocols (see Section VIII). The purpose of the study was 1) to identify the geographic areas of producing and gas processing facilities (gas plants) which have the greatest occurrence of NORM and 2) to identify items of equipment at these facilities which have the highest NORM activity levels.

Results are first reported on a national basis so that the general patterns in background levels and the excess radioactivity over background for both types of facilities can be seen in geographic perspective. NORM activity levels are reported in this study in micro-rem/hr. In addition to geographic studies at the county, state and national level of aggregation, there are also summaries by item of equipment for each state and the total U.S.

II. Summary of Results

Section VI - National Summary contains figures, tables and appendices for the total U.S. This study consists of 36,890 observations collected in twenty states and two offshore areas. The geographical distribution of the survey points is shown in Figure 1 and includes both oil/gas producing equipment (33,042 readings) and gas processing equipment (3,848 readings). Figures 1A and 1B illustrate survey distribution for gas processing and oil/gas producing equipment respectively. The size of the data base is impressive. However, results must be used with some caution in evaluating state or local environmental conditions for reasons described in Section III.

Figure 2 illustrates median background levels and Figures 3 and 4 illustrate median activity levels over background for gas processing and oil/gas production facilities respectively. The 5th, 25th, 75th and 95th percentile points of the nationally aggregated data were used to define five categories for tabulation and mapping of both the background levels and the differences over background. In developing these categories, offshore data was deleted from the background compilation due to the abnormally low background provided by the marine environment. Likewise, equipment observations which were not above background were deleted from the differences compilation due to the large number of "zero" values. This is discussed further in Section IV. The median values for background and differences are shown on the next page for the five categories. These values are reported in the National Summary and were used to classify equipment, counties and states in the State Summaries.

Category	Definition (National)	Background MR/hr	Differences MR/hr
1	Lowest 5%	0.00 - 2.33	0.00 - 0.80
2	Next 20%	2.34 - 4.99	0.81 - 1.99
3	Middle 50%	5.00 - 9.00	2.00 - 33.00
4	Next 20%	9.01 - 14.00	33.01 - 245.00
5	Highest 5%	over 14.00	over 245.00

NORM activity levels showed wide variability, both geographically and between items of equipment in the same geographic area. As shown on Figure 2, lower background levels tend to occur offshore and near the coast. The Midwest and Rocky Mountain areas tend to have higher background levels. Background levels are not related to the equipment readings. Several areas of Colorado, Wyoming and Utah, for example, had high background levels and very few equipment readings above background. This can be seen by comparing the background levels shown in Figure 2 with the difference over background levels in Figures 3 and 4.

The geographic areas with the highest equipment readings are the entire gulf coast crescent (Florida panhandle to Brownsville, Texas), the northeast Texas crescent, southeast Illinois and a few counties in southern Kansas. These are shown in Figures 3 and 4 for gas processing and production facilities, respectively. The eastern gulf coast from Mississippi to the Florida panhandle has the highest consistent NORM activity levels surveyed in the entire United States.

Table 1 illustrates NORM activity levels over background for approximately 15 different types of equipment for both gas processing and production facilities. NORM activity levels tend to be higher in specific types of equipment. Gas processing facilities having the highest levels are reflux pumps, propane pumps and tanks, other pumps and product lines. Water handling equipment in the production facilities category exhibits the greatest NORM activity levels. Details on equipment types are provided in the national summary in the report.

When located in the same area, the gas processing equipment noted above tends to have higher activity levels than the water handling equipment in the producing facilities. This can be seen in the state summaries by comparing the median readings for the two types of facilities in the same county.

III. The Data

The data were supplied by a number of major petroleum companies from readings made on their own equipment under a common protocol using a similar type of scintillation detector. Calibration was done in accordance with the manufacturer's specifications by all participants. Thus this data base represents the most comprehensive and consistent set of NORM data available for petroleum operations. However, much of the data were collected at sites which were suspected of exhibiting some degree of radioactivity. Hence, the data is not typical of a randomly chosen site and tends to overstate the magnitude of NORM occurrence.

The data were not collected in statistically designed sampling plans and hence there is no scientific basis for extrapolating the results to unsurveyed areas of petroleum production/gas processing. The number of observations from gas processing and producing equipment for a given geographic area may not be proportional to the actual amount of operational equipment in the area. In addition to the lack of proportionality between equipment types, there is dis-proportionality in the representation among counties in the same state and between the states themselves. Many counties with oil and gas operations have no data reported and many others have only a single observation. The entire states of Kentucky and Nebraska have 21 and 30 observations respectively. All of the Nebraska data comes from a single county on its southern border and the Kentucky data is all from two counties on the western border with Illinois.

Readers should consider the sample size which is reported along with the NORM statistics. The reliability of statistical results are also related to the sample sizes collected. In many cases seemingly large NORM readings (relative to other such readings) for a county or item of equipment in a state may be the result of a single observation or a small group of observations taken at the same location.

IV. Additional Considerations

Since the survey was not conducted under statistically controlled conditions, interpretation of the results become difficult when the data are aggregated across dis-similar areas with different sample sizes and different potential for NORM activity levels in the equipment. In particular, a large number of low readings from benign areas may "average out" and thus minimize the influence of a smaller number of high readings.

One approach to this problem is to examine two different sets of statistics: 1) using all of the observations and 2) the tabulation of only those which are above background. The latter approach filters out the large number of "zero" values (relative to difference over background) which constitute 64.3% of the gas processing data and 56.9% of the production data. The first approach focuses on the overall result and the second focuses on conditions in only those cases where NORM was found to be present. The first approach tends to understate the median activity levels and the second tends to overstate the occurrence of NORM and activity levels if viewed as the "average" case.

The national summaries were prepared using both approaches. Table 1 and Appendix 1 show the summary by equipment types for all observations and Table 2 and Appendix 2 show the results for the non-zero differences only. Table 2 is more useful for identifying the items of equipment which are most likely to have higher NORM activity levels.

Table 3 constructs an "incidence" measure for each state which is an alternative statistical method of comparing NORM occurrence by providing a ranking in terms of both frequency of occurrence and intensity of activity levels. This index is the product of the percentage of above-background readings times the median value of the above-background observations. From Table 3 we see that Alabama/Florida and Mississippi have a much higher incidence measure than any other states with Illinois not too far behind. The Texas coast, Alaska and Kentucky form the next grouping.

V. Glossary

The data was collected using abbreviations for the equipment types surveyed. The glossary of abbreviations used is given below.

A. Gas Processing Equipment (GP)

1. BOTTOMS PUMP - Pumps transferring liquids from the bottoms of towers.
2. COMPRESSOR - Compressors and associated equipment. This includes compressors located on the lease.
3. CRYO UNIT - All equipment associated with the cryogenic process.
4. DEHYDRATOR - Dehydration equipment to include Glycol, EG and TEC systems, etc.
5. FRAC TOWER - All process towers and columns.
6. INLET SCRUBBER - Inlet scrubbers, separators, fwko etc.. This includes those located on the lease.
7. METER - All metering equipment to include meters, meter runs, screens, strainers, filters, etc..
8. OPUMP - All other pumps.
9. OTANK - All other tanks.
10. OTHER - All other gas processing equipment, including pig launcher and receiver.
11. PPUMP - Propane pump.
12. PTANK - Propane tank.
13. PRODUCT LINE - All product lines.
14. REFLUX PUMP - All reflux pumps.
15. REFRIGERATION - All equipment associated with the propane refrigeration system.
16. SWEETENER - All gas sweetening equipment to include amine systems, etc..

B. Production Facilities (PROD)

1. FLINE - Flow lines to include all valves and elbows.
2. H/T - Heater treater.
3. MANIFOLD - Manifold/header piping, valves and chokes, etc.
4. OTHER - All other measurements on in service equipment.
5. PUMP - All pumps.
6. SEP - Separators to include production separators, fwko, gunbarrels, etc..
7. STANK - Stock tanks.
8. SUMP - Sumps to include pits, pigtraps, ponds, etc.
9. VRU - Vapor recovery units.
10. WINJ - Injection wellhead.
11. WOTHER - Other wellheads.
12. WPROD - Production wellhead.
13. WLINE - Water lines to include all valves and elbows.
14. WTANK - Water tanks.

VI. National Summary

Overview

I. Differences in Equipment (all observations)

The equipment with the most pronounced differences over background based on Median ranking are listed below in descending order. The difference is the excess of the reading over background using all observations:

Equipment	Median Difference	75 th Percentile
1. Reflux Pumps (GP)	52.7 μ R/hr	242.0 μ R/hr
2. Propane Pumps (GP)	19.0	70.0
3. Propane Tanks (GP)	9.0	45.8

II. Differences in Equipment (observations in excess of background)

A second way of looking at the data is to exclude all values which were at or below background and focus on what happens when NORM is detected.

The equipment with the most pronounced differences over background based on Median ranking are listed below in descending order. The difference is the excess of the reading over background using only those observations in excess of background:

Equipment	Over	Median Difference	75 th Percentile
1. Reflux Pumps (GP)	86.4	76.0 μ R/hr	291.0 μ R/hr
2. Flow Line (Prod)	24.0	42.0	112.0
3. Pump (GP)	66.7	38.0	73.0
4. Product Line (GP)	56.1	35.0	110.5
5. Water Line (Prod)	51.6	34.6	100.0
6. Propane Pumps (GP)	74.7	31.0	97.5
7. Other Pump (GP)	49.1	27.8	96.3
8. Propane Tanks (GP)	72.6	25.0	65.7
9. Injection Well (Prod)	49.0	20.0	56.3

III. Overall Summary

1. Nationwide (all Obsns)

ITEM	No	5 th Pct. (low)	25 th Pct. (-----)	Median mid-range	75 th Pct. (-----)	95 th Pct. (high)
a. Background*	33970	2.3	5.0	7.0	9.0	14.0
b. Max Reading	36890	1.5	6.0	9.0	13.0	110.0
c. Difference	36890	0.0	0.0	0.0	4.0	104.6

* On-shore backgrounds only. Based on these numbers, back-

grounds for each county were classified if their median values were below 2.34 (very low), between 2.34 and 5.99 (low), between 5.99 and 9.99 (mid-range), between 9.99 and 14.99 (high) and above 14.99 (very high).

2. Nationwide (observations over background only)

ITEM	No	5 th Pct. (low)	25 th Pct. (----- mid-range -----)	Median	75 th Pct. (-----)	95 th Pct. (high)
Difference	15639	0.8	2.8	6.8	33.8	245.8

This distribution was used to classify all difference readings (by county or equipment) as very low (< 0.8), low (0.8 - 1.99), mid-range (2.0-33.0), high (33.01 - 245) and very high (above 245).

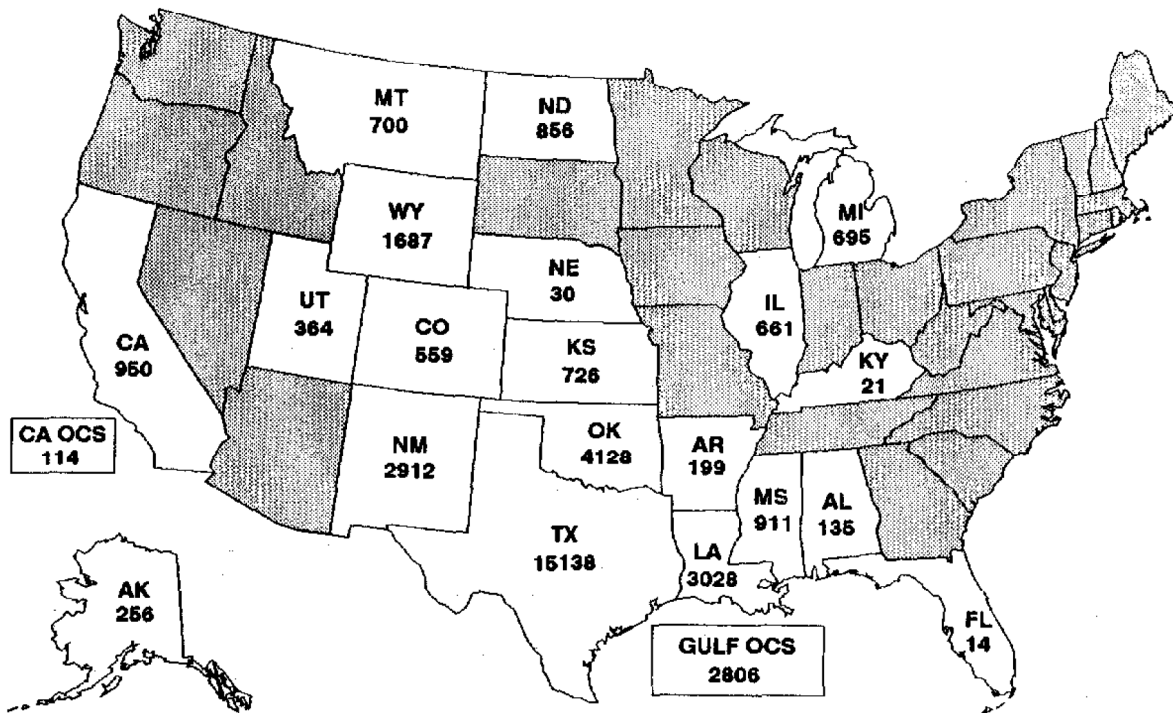
3. Facility

ITEM	No	5 th Pct. (low)	25 th Pct. (----- mid-range -----)	Median	75 th Pct. (-----)	95 th Pct. (high)
Difference (All observations)						
Gas Processing	3864	0.8	0.8	0.8	3.8	95.8
Production	33826	0.8	0.8	0.8	4.8	185.8

Difference (Observations in excess of background)						
Gas Processing	1379	0.8	2.8	9.8	46.8	261.9
Production	14250	0.8	2.8	6.8	31.8	245.8

NOTE: All data are measured in micro-rems/hr

FIGURE 1 - STATES/AREAS REPRESENTED IN SURVEY

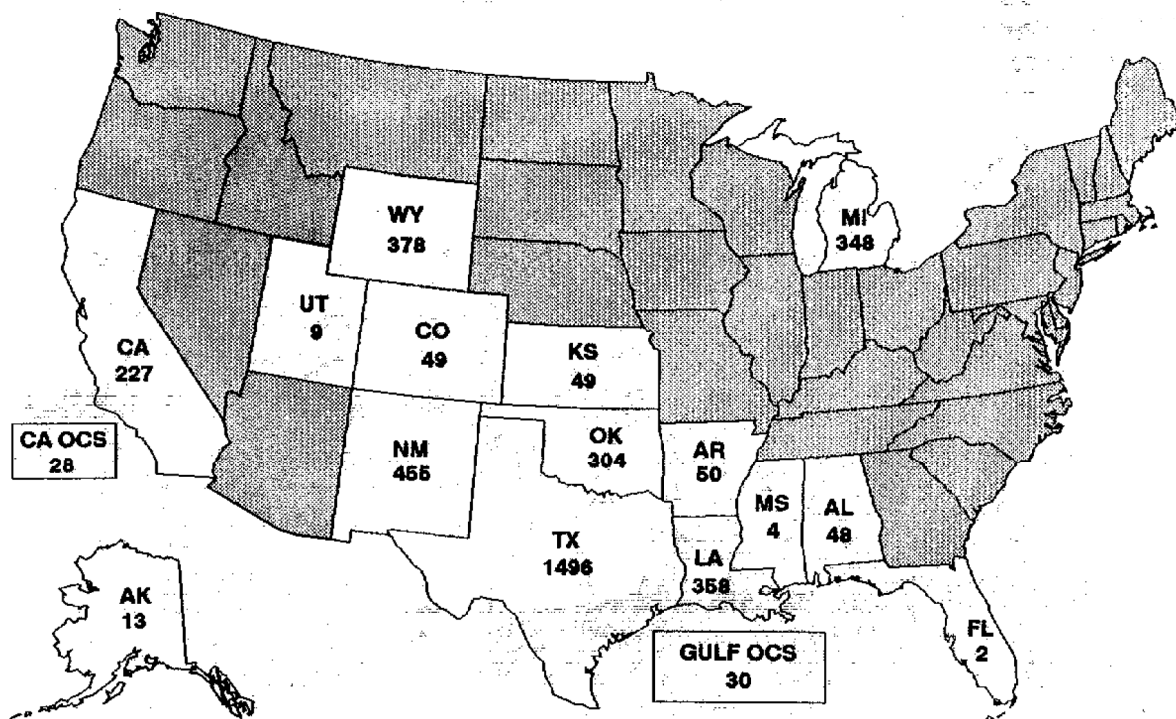


'MT' = STATE
'700' = NO. DATA PTS.

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TOTAL MEASUREMENTS
PRODUCING EQPT. 33,042
GAS PROCESSING 3,848
36,890

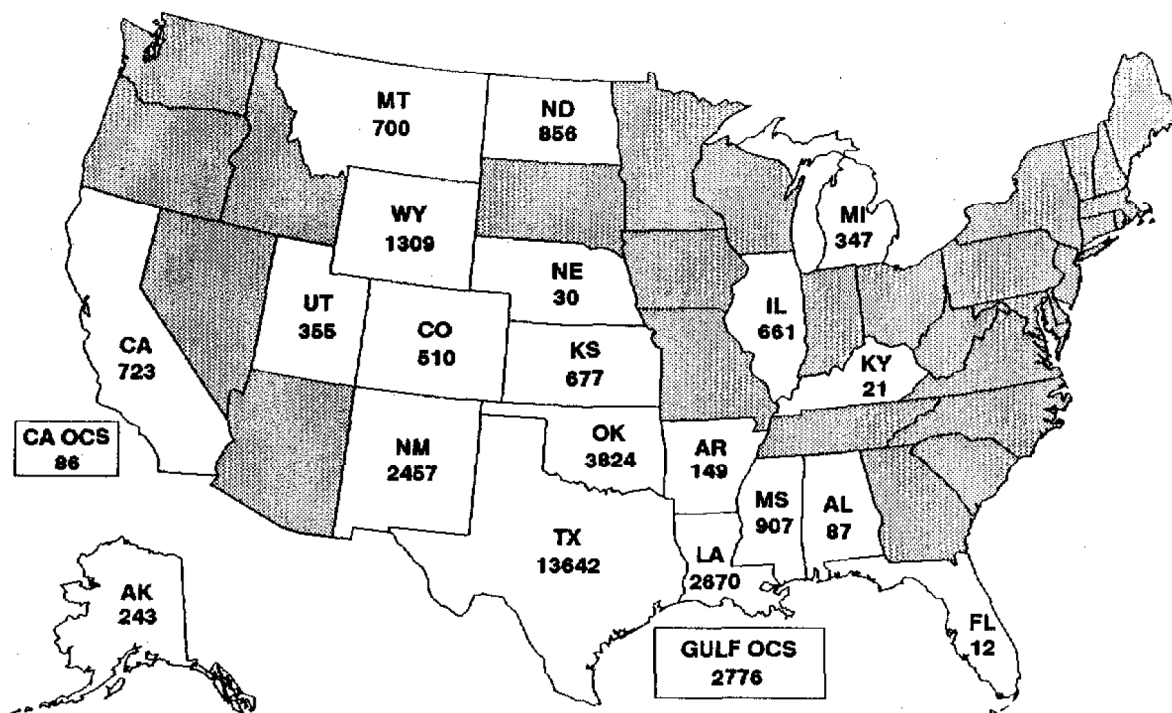
FIGURE 1A - GAS PROCESSING MEASUREMENTS



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'NM' = STATE
'455' = NO. DATA PTS.

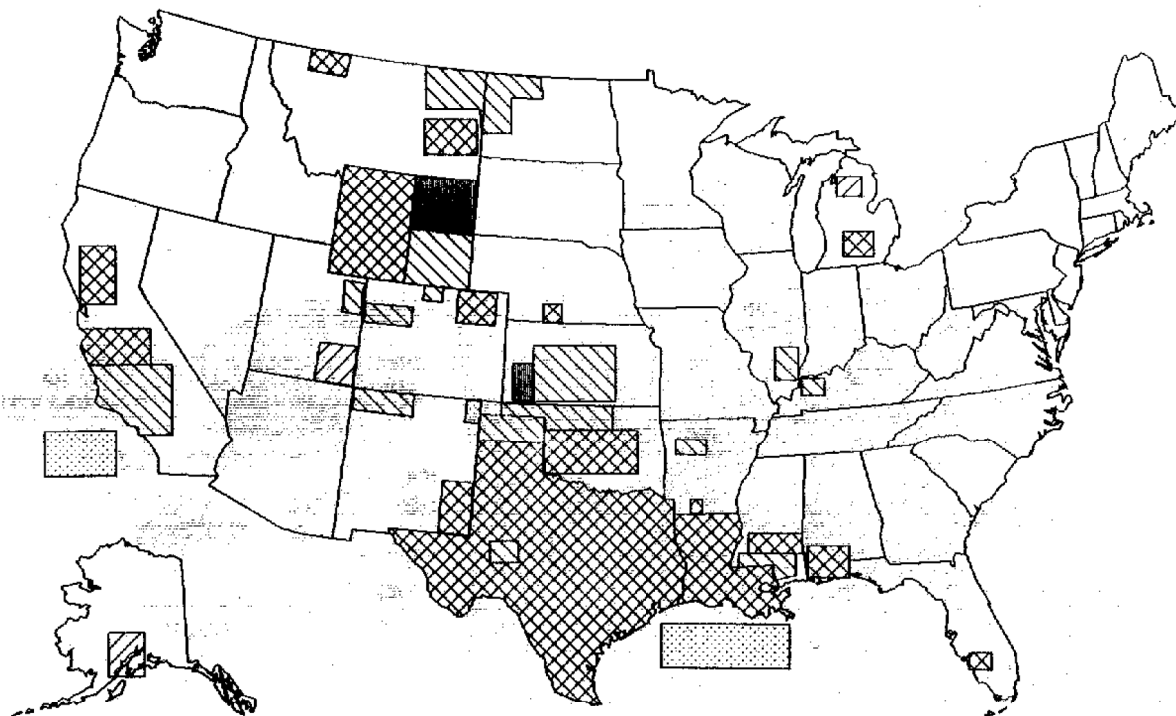
FIGURE 1B - PRODUCTION FACILITY MEASUREMENTS



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'MT' = STATE
'700' = NO. DATA PTS.

FIGURE 2 - MEDIAN BACKGROUND LEVELS



MICRO-REMS/HR



NO DATA



0 - 2.33



2.34 - 4.99



5.0 - 9.0



9.01 - 14.0

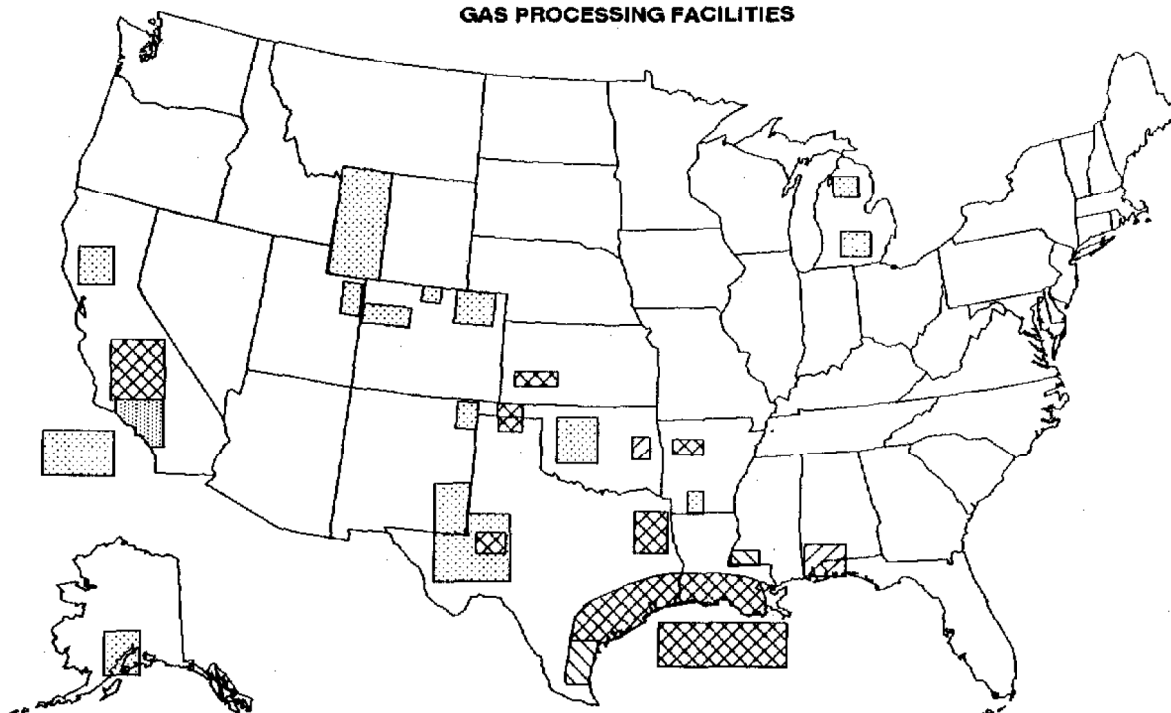


OVER 14.0

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FIGURE 3 - MEDIAN OF DIFFERENCE OVER BACKGROUND

GAS PROCESSING FACILITIES



MICRO-REMS/HR

NO DATA

2 - 33

BELOW .8

33.01 - 245

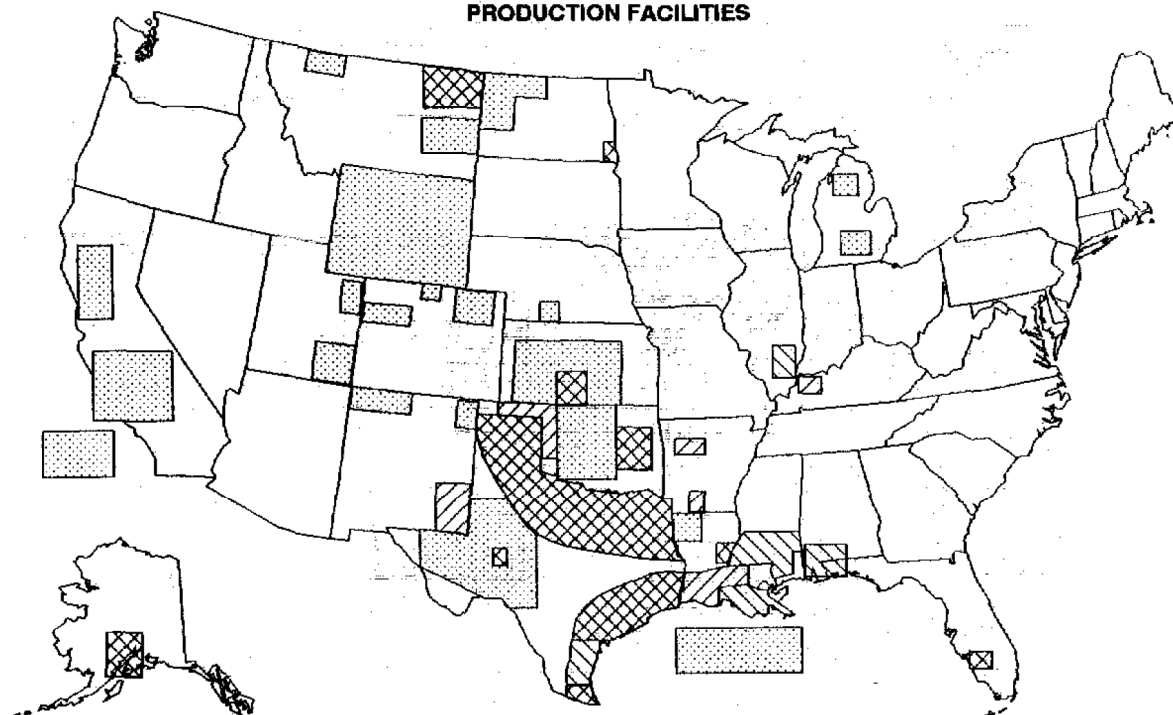
.8 - 1.99

OVER 245

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FIGURE 4 - MEDIAN OF DIFFERENCE OVER BACKGROUND

PRODUCTION FACILITIES



MICRO-REMS/HR		NO DATA		BELOW .8		.8 - 1.99
		2 - 33		33.01 - 245		OVER 245

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Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

FACILITY: Gas Processing

FACILITY: Production

-13-

Table 2

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

National Summary
(Observations in excess of background)

FACILITY: Gas Processing

Obsns	Equipment		Median Difference	75 th Percentile
119	COMPRESSOR	*	2.0	3.0
72	DEHYDRATOR	**	3.0	6.7
30	SWEETENER	**	3.4	19.5
156	INLET SCRUBBER	**	5.0	19.0
32	METER	***	5.5	51.0
20	CRYO UNIT	***	6.0	21.9
140	OTANK	***	6.0	30.0
165	OTHER	****	7.0	23.0
123	FRAC TOWER	*****	9.5	33.3
56	REFRIGERATION	*****	16.0	68.0
30	BOTTOMS PUMP	*****	17.0	45.3
90	PTANK	*****	25.0	65.0
114	OPUMP	*****	27.7	96.3
53	PPUMP	*****	31.0	97.5
82	PRODUCT LINE	*****	35.0	110.5
2	PUMP	*****	38.0	73.0
95	REFLUX PUMP	*****	76.0	291.0
1379				
		10 20 30 40 50 60 70 80		
		Median of Difference Over Background		

FACILITY: Production

5	WOTHER	*	2.0	3.0
777	WPROD	*	2.3	7.9
72	METER	**	3.0	5.0
424	PUMP	**	3.0	14.0
1007	OTHER	**	4.0	15.0
2696	STANK	**	4.0	14.0
895	MANIFOLD	***	6.0	55.0
253	SUMP	***	7.0	26.5
3816	SEP	****	7.0	40.0
1495	H/T	****	8.0	47.0
2140	WTANK	****	8.0	35.0
25	VRU	*****	17.0	207.5
50	WINJ	*****	20.0	56.3
176	WLINE	*****	34.6	100.0
419	PLINE	*****	42.0	112.0
14250				
		10 20 30 40 50 60 70 80		
		Median Of Difference Over Background		

Table 3

NORM Incidence by State

(All Facilities)

State Name	All Observations		Obsns. Above Background		Incidence Measure
	No. of Obsns.	Median Difference	% of Total	Median Difference	
Alaska	256	6.0	76.2	10.0	7.62
Alabama/FI	149	20.0	69.8	58.5	40.83
Arkansas	199	1.0	61.3	2.0	1.23
California	950	0.0	34.2	10.0	3.42
Colorado	559	0.0	18.8	8.5	1.60
Illinois	661	17.0	91.8	23.0	21.12
Kansas	726	0.0	45.5	10.5	4.77
Kentucky	21	3.0	57.1	12.0	6.86
Lousiana	3,028	0.0	43.7	11.8	5.15
Michigan	695	0.0	19.4	2.6	0.51
Mississippi	911	20.0	76.1	46.0	35.01
Montana	700	0.0	12.3	37.0	4.55
North Dakota	856	0.0	19.7	9.0	1.77
Nebraska	30	0.0	20.0	5.4	1.00
New Mexico	2,912	0.0	40.1	4.0	1.60
Oklahoma	4,128	0.0	43.7	4.0	1.75
Texas (all)	15,138	0.0	41.4	5.0	2.07
* Coastal	2,567	1.0	54.3	15.0	8.15
* Northern	4,927	1.0	52.4	4.0	2.10
* Western	7,278	0.0	29.9	5.7	1.68
Utah	364	0.0	19.5	5.0	0.98
Wyoming	1,687	0.0	16.8	2.3	0.39
Offshore	2,920	0.5	62.3	3.2	1.99
* Gulf	2,806	0.5	63.4	3.2	2.03
* California	114	0.0	33.3	3.46	1.15

Note: The Texas total includes 366 observations which could not be classified by Region because the county name was not reported.

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

National Summary (All Observations)

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
-----------	----	---------	---------	---------	------	--------	------

Gas Processing Facilities

COMPRESSOR	648	1.401	490.0	0	0.000	0.00	0.000
CRYO UNIT	50	70.292	2985.0	0	0.000	0.00	2.525
DEHYDRATOR	244	4.693	529.0	0	0.000	0.00	1.000
FRAC TOWER	272	16.676	395.0	0	0.000	0.00	6.000
INLET SCRUBBER	593	7.479	701.0	0	0.000	0.00	0.450
METER	101	19.497	695.0	0	0.000	0.00	1.050
OPUMP	232	55.608	1391.0	0	0.000	0.00	25.500
OTANK	423	9.574	383.0	0	0.000	0.00	2.000
OTHER	430	11.800	995.0	0	0.000	0.00	4.000
REFRIGERATION	143	18.823	595.0	0	0.000	0.00	4.000
SWEETENER	234	2.942	220.5	0	0.000	0.00	0.000
PUMP	3	25.333	73.0	0	0.000	3.00	73.000
PRODUCT LINE	146	54.130	1000.0	0	0.000	3.25	46.500
BOTTOMS PUMP	40	25.130	220.0	0	0.125	7.00	28.000
PTANK	124	37.633	600.0	0	0.000	9.00	45.000
PPUMP	71	86.303	1041.0	0	0.000	19.00	70.000
REFLUX PUMP	110	225.262	2985.0	0	2.000	52.65	242.000

Production Facilities

FLINE	1748	21.5717	2991.0	0	0	0.0	0.00
MANIFOLD	2537	23.3713	2995.0	0	0	0.0	2.00
METER	306	2.2288	92.0	0	0	0.0	0.00
OTHER	2397	18.9506	3785.0	0	0	0.0	3.00
PUMP	1393	8.7212	906.0	0	0	0.0	1.00
SEP	7007	31.2279	4491.0	0	0	0.0	7.00
STANK	7005	10.5057	2475.0	0	0	0.0	2.00
VRU	115	36.6696	1207.0	0	0	0.0	0.00
WINJ	102	32.2451	886.0	0	0	0.0	20.00
WOTHER	24	0.5292	5.5	0	0	0.0	0.00
WPROD	2324	9.8176	1487.0	0	0	0.0	1.00
H/T	2962	43.4679	3490.0	0	0	0.3	8.00
SUMP	454	25.3998	793.0	0	0	1.0	9.25
WLINE	341	74.8135	2790.0	0	0	1.0	39.00
WTANK	3431	35.4036	3786.0	0	0	2.0	14.00

Appendix 2

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

National Summary (Observations in excess of Background)

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
<u>Gas Processing Facilities</u>							
COMPRESSOR	119	7.631	490.0	0.3	1.000	2.00	3.000
DEHYDRATOR	72	15.904	529.0	0.3	1.350	3.00	6.650
SWEETENER	30	22.947	220.5	0.2	1.000	3.45	19.500
INLET SCRUBBER	156	28.431	701.0	0.1	1.000	5.00	19.000
METER	32	61.537	695.0	0.3	1.150	5.50	51.000
CRYO UNIT	20	175.730	2985.0	1.0	2.000	6.00	21.925
OTANK	140	28.927	383.0	0.2	2.000	6.00	30.000
OTHER	165	30.752	995.0	0.3	2.900	7.00	23.000
FRAC TOWER	123	36.876	395.0	0.2	1.500	9.50	33.200
REFRIGERATION	56	48.066	595.0	0.1	2.000	16.00	68.750
BOTTOMS PUMP	30	33.507	220.0	0.5	3.000	17.00	45.250
PTANK	90	51.850	680.0	0.5	7.325	25.00	65.750
OPUMP	114	113.168	1391.0	0.4	6.825	27.75	96.250
PPUMP	53	115.613	1041.0	0.1	9.500	31.00	97.500
PRODUCT LINE	82	96.391	1080.0	0.1	13.750	35.00	110.500
PUMP	2	38.000	73.0	3.0	3.000	38.00	73.000
REFLUX PUMP	95	260.829	2985.0	0.2	15.800	76.00	291.000

Production Facilities

WOTHER	5	2.540	5.5	1.2	1.6	2.0	3.75
WPROD	777	29.364	1487.0	0.1	1.0	2.3	7.90
METER	72	9.472	92.0	1.0	1.0	3.0	5.75
PUMP	424	28.652	986.0	0.1	1.0	3.0	14.00
OTHER	1007	45.109	3785.0	0.1	1.0	4.0	15.00
STANK	2696	27.297	2475.0	0.1	2.0	4.0	14.00
MANIFOLD	895	66.249	2995.0	0.1	1.0	6.0	55.00
SUMP	253	45.579	793.0	0.1	3.0	7.0	26.50
SEP	3816	64.543	4491.0	0.1	2.0	7.8	40.00
H/T	1495	86.122	3490.0	0.1	2.0	8.0	47.00
WTANK	2140	56.761	3786.0	0.1	3.0	8.0	35.00
VRU	25	168.680	1287.0	0.2	2.0	17.0	207.50
WINJ	50	65.780	886.0	1.0	4.0	20.0	56.25
WLINE	176	144.951	2790.0	0.2	6.0	34.6	100.00
PLINE	419	89.994	2991.0	0.1	7.0	42.0	112.00

VII. State Summaries

Overview

The state summaries are each organized in the same order to give the following information:

- A. Summary Statistics for the state (one page)
- B. State Maps showing the counties in the survey.
A separate map has been made for Background Levels (Figure 1), Difference Over Background for Gas Processing Facilities (Figure 2), and Difference Over Background for Production Facilities (Figure 3).

In each figure the counties are summarized into the following categories according to their median values:

Category	Definition (National)	Background μ R/hr	Difference μ R/hr
1	- Lowest 5 %	0.00 - 2.33	0.00 - 0.80
2	- Next 20 %	2.34 - 4.99	0.80 - 1.99
3	- Middle 50 %	5.00 - 9.00	2.00 - 33.00
4	- Next 20 %	9.01 - 14.00	33.01 - 245.00
5	- Highest 5 %	over 14.00	over 245.00

A Background map was prepared for every state. If the difference over background was the same in every county the Difference Over Background map was deleted.

- C. Tables in Bar Chart form showing the median values for equipment, county, and background ranked in increasing order. The differences over background for equipment and county are reported separately for Gas Processing and Production Facilities.
- D. Appendices 1,2, and 3 give the detail data shown in the tables, plus a few other statistics.

SUMMARY

(Alabama and Florida)

I. All significant differences were equipment specific.

The equipment with the most pronounced differences over background based on Median ranking are listed below in descending order. The difference is the excess of the reading over background. These items were located in Escambia county Alabama and its adjacent neighbor, Santa Rosa county Florida.

	Equipment	Median Difference	75 th Percentile
1.	Separator (Prod)	121 μ R/hr	220.0 μ R/hr
2.	Other Pumps (GP)	100	145.0
3.	Reflux Pumps (GP)	65	120.0
4.	Flow Lines (Prod)	50	184.5
5.	Water Line (prod)	35	125.0

II. Santa Rosa (Fl) and Mobile county had low background readings while Monroe county had a high background level. All of the others were mid-range.

III. Overall Summary

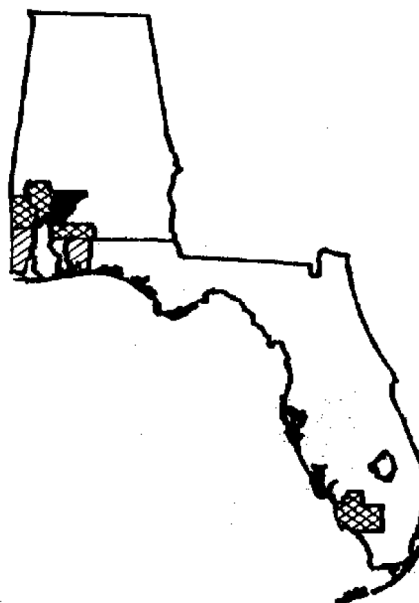
ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
1. Statewide					
a. Background	149	5.0	15.0	15.0	15
b. Max Reading	149	30.0	110.0	220.0	625
c. Difference	149	20.0	106.0	205.0	621
2. Facility					
a. Background					
Gas Processing	50	15.0	15.0	15.0	15
Production	99	5.0	15.0	15.0	15
b. Max Reading					
Gas Processing	50	15.0	35.0	100.5	150
Production	99	50.0	150.0	250.0	625
c. Difference					
Gas Processing	50	0.0	24.6	94.6	145
Production	99	42.0	147.0	245.0	621

NOTES: 1) All data are measured in micro-rams/hr

2) The apparent differences between facilities are due to the specific items of equipment listed in Section I above.

FIGURE 1 — MEDIAN BACKGROUND LEVELS

ALABAMA-FLORIDA



MICRO-REMS/HR

NO DATA
5.0 - 9.0

0 - 2.33
9.01 - 14.0

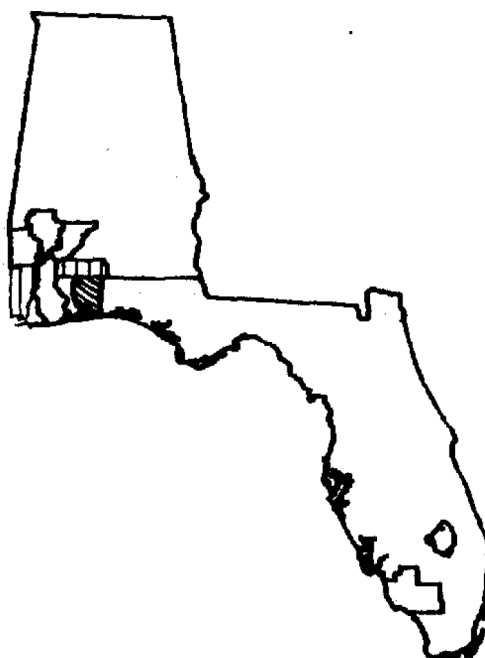
2.34 - 4.99
OVER 14.0

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FIGURE 2 — DIFFERENCE OVER BACKGROUND

ALABAMA-FLORIDA

GAS PROCESSING FACILITIES



MICRO-REMS/HR

NO DATA
2 - 33

BELOW .8
33.01 - 245

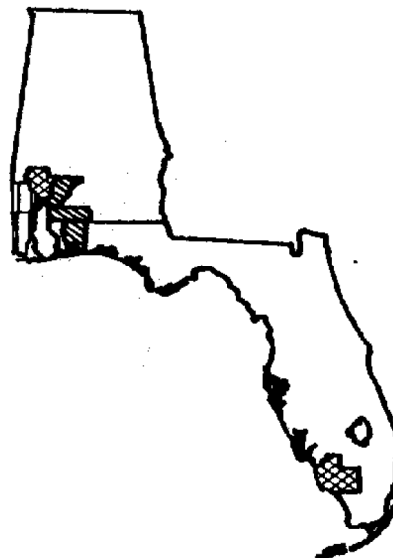
.8 - 1.99
OVER 245

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FIGURE 3 — DIFFERENCE OVER BACKGROUND

ALABAMA-FLORIDA

PRODUCTION FACILITIES



MICRO-REMS/HR

NO DATA
2 - 33

BELOW .8
33.01 - 245

.8 - 1.99
OVER 245

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Table 1

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Alabama and Florida

FACILITY: Gas Processing

Obsns	Equipment	Median Difference	75 th Percentile
1	BOTTOMS PUMP	0.0	0.0
1	COMPRESSOR	0.0	0.0
2	CRYO UNIT	0.0	0.0
2	DEHYDRATOR	0.0	0.0
3	FRAC TOWER	0.0	45.0
21	INLET SCRUBBER	0.0	22.2
1	METER	0.0	0.0
5	OTANK	0.0	24.6
1	REFRIGERATION	0.0	0.0
1	SWEETENER	0.0	0.0
6	OTHER	8.4	98.5
1	PRODUCT LINE	20.0	20.0
3	REFLUX PUMP	65.0	120.0
2	OPUMP	100.0	145.0
50		10 20 30 40 50 60 70 80 90 100	

Median of Difference Over Background

FACILITY: Production

2	WINJ	0.0	0.0
1	WOTHER	0.0	0.0
5	MANIFOLD	5.0	44.0
9	OTHER	7.0	37.5
4	WPROD	7.5	25.0
10	WTANK	10.0	72.0
11	H/T	13.0	145.0
4	STANK	19.5	112.0
3	WLINE	35.0	125.0
9	FLINE	50.0	184.5
41	SEP	121.0	220.0
99		10 20 30 40 50 60 70 80 90 100 110 120	

Median of Difference Over Background

Table 2

Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Alabama and Florida

FACILITY: Gas Processing

Obsns	County		Median Difference	75 th Percentile
19	MOBILE		0.0	13.2
29	ESCAMBIA		0.0	50.0
2	SANTA ROSA	*****	106.0	121.0
		-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----		
		10 20 30 40 50 60 70 80 90 100 110		

Median of Difference Over Background

FACILITY: Production

15	MOBILE		0.0	13.0
3	WASHINGTON		0.0	0.0
6	COLLIER	*****	31.5	79.8
2	CLARKE	*****	32.0	47.0
12	MONROE	*****	40.0	120.0
55	ESCAMBIA	*****	71.0	196.0
6	SANTA ROSA	*****	107.0	228.2
		-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----		
		10 20 30 40 50 60 70 80 90 100 110		

Median of Difference Over Background

Note: Santa Rosa is in the Florida Panhandle and Collier is in the southern tip of Florida (Naples). All other counties are in Alabama.

Table 3

Median Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Alabama and Florida

Obs	County		Median	75 th Percentile
8	SANTA ROSA	*****	3.0	4.0
34	MOBILE	*****	4.5	7.5
84	ESCAMBIA	*****	5.0	15.0
3	WASHINGTON	*****	7.5	7.5
2	CLARKE	*****	8.0	8.0
6	COLLIER	*****	8.0	10.0
12	MONROE	*****	15.0	15.0
		-----+-----+-----+-----+-----+-----+-----+-----+-----+		
		2 4 6 8 10 12 14 16 18		

Median of Background Readings

Note: Santa Rosa is in the Florida Panhandle and Collier is in the southern tip of Florida (Naples). All other counties are in Alabama.

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Alabama and Florida

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
<u>Gas Processing Facilities</u>							
BOTTOMS PUMP	1	0.000	0.0	0	0.00	0.0	0.0
COMPRESSOR	1	0.000	0.0	0	0.00	0.0	0.0
CRYO UNIT	2	0.000	0.0	0	0.00	0.0	0.0
DEHYDRATOR	2	0.000	0.0	0	0.00	0.0	0.0
FRAC TOWER	3	15.000	45.0	0	0.00	0.0	45.0
INLET SCRUBBER	21	18.133	95.0	0	0.00	0.0	22.2
METER	1	0.000	0.0	0	0.00	0.0	0.0
OTANK	5	9.820	27.8	0	0.00	0.0	24.5
REFRIGERATION	1	0.000	0.0	0	0.00	0.0	0.0
SWEETENER	1	0.000	0.0	0	0.00	0.0	0.0
OTHER	6	38.633	121.0	0	2.25	8.4	98.5
PRODUCT LINE	1	20.000	20.0	20	20.00	20.0	20.0
REFLUX PUMP	3	61.667	120.0	0	0.00	65.0	120.0
OPUMP	2	100.000	145.0	55	55.00	100.0	145.0
<u>Production Facilities</u>							
WINJ	2	0.000	0	0	0.00	0.0	0
WOTHER	1	0.000	0	0	0.00	0.0	0
MANIFOLD	5	19.600	46	0	2.50	5.0	44
OTHER	9	24.111	10	0	3.50	7.0	37.5
WPROD	4	11.250	30	0	1.25	7.5	25
WTANK	10	32.100	105	0	0.00	10.0	72
STANK	4	45.250	142	0	4.25	19.5	112
WLINE	3	53.333	125	0	0.00	35.0	125
H/T	11	65.364	275	0	0.00	13.0	145
FLINE	9	88.222	245	0	15.00	50.0	184.5
SEP	41	164.488	621	0	42.00	121.0	220

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

Alabama and Florida

FACILITY	COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
GP	MOBILE	19	6.405	27.0	0	0.00	0.0	13.20
GP	ESCAMBIA	29	26.828	145.0	0	0.00	0.0	50.00
GP	SANTA ROSA	2	106.000	121.0	91	91.00	106.0	121.00
PROD	MOBILE	15	31.667	275.0	0	0.00	0.0	13.00
PROD	WASHINGTON	3	0.000	0.0	0	0.00	0.0	0.00
PROD	COLLIER	6	51.333	193.0	5	5.00	31.5	79.75
PROD	CLARKE	2	32.000	47.0	17	17.00	32.0	47.00
PROD	MONROE	12	64.167	205.0	0	6.25	40.0	120.00
PROD	ESCAMBIA	55	123.764	621.0	0	16.00	71.0	196.00
PROD	SANTA ROSA	6	142.500	397.0	30	39.00	107.0	228.25

Note: Santa Rosa is in the Florida Panhandle and Collier is in the southern tip of Florida (Naples). All other counties are in Alabama.

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

Alabama and Florida

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
SANTA ROSA	8	4.1250	10.0	3.0	3.00	3.0	4.0
MOBILE	34	7.0735	15.0	4.5	4.50	4.5	7.5
ESCAMBIA	84	8.4286	15.0	3.0	4.00	5.0	15.0
WASHINGTON	3	7.5000	7.5	7.5	7.50	7.5	7.5
CLARKE	2	8.0000	8.0	8.0	8.00	8.0	8.0
COLLIER	6	8.8333	13.0	7.0	7.75	8.0	10.0
MONROE	12	15.0000	15.0	15.0	15.00	15.0	15.0

Note: Santa Rosa is in the Florida Panhandle and Collier is in the southern tip of Florida (Naples). All other counties are in Alabama.

SUMMARY

(Alaska)

I. There were no significant differences over background in any of the items of equipment.

II. Offshore areas had low background readings and Anchorage county was very low.

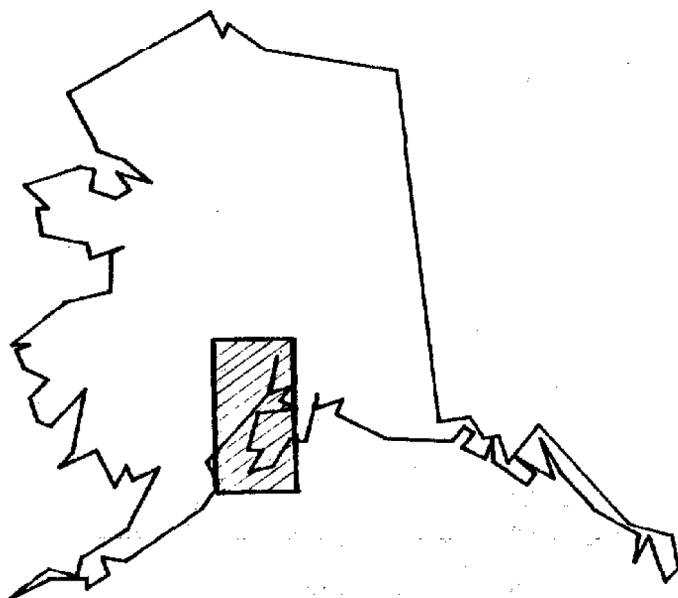
III. Overall Summary

ITEM	No	Median	75 th Pct.	98 th Pct.	Max Value
1. Statewide					
a. Background	256	4.0	4.0	5.0	6
b. Max Reading	256	9.5	29.0	84.5	706
c. Difference	256	6.0	25.0	80.9	701
2. Facility					
a. Background					
Gas Processing	13	4.0	4.5	6.0	6
Production	243	4.0	4.0	5.0	6
b. Max Reading					
Gas Processing	13	5.0	8.5	428.	706
Production	243	10.0	30.0	85.8	500
c. Difference					
Gas Processing	13	0.0	4.0	423.5	701
Production	243	6.0	26.0	81.8	495

NOTE: All data are measured in micro-rems/hr

FIGURE 1 - MEDIAN BACKGROUND LEVELS

ALASKA



MICRO-REMS/HR



NO DATA

5.0 - 9.0



0 - 2.33

9.01 - 14.0



2.34 - 4.99

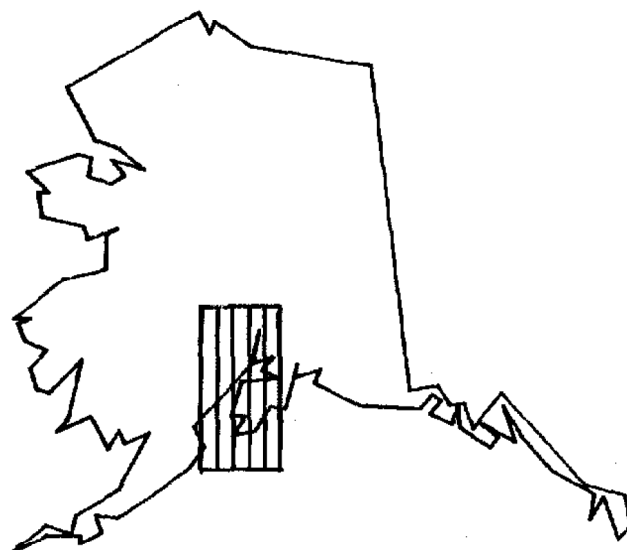
OVER 14.0

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FIGURE 2 – DIFFERENCE OVER BACKGROUND

ALASKA

GAS PROCESSING FACILITIES



MICRO-REMS/HR

NO DATA
2 - 33

BELOW .8
33.01 - 245

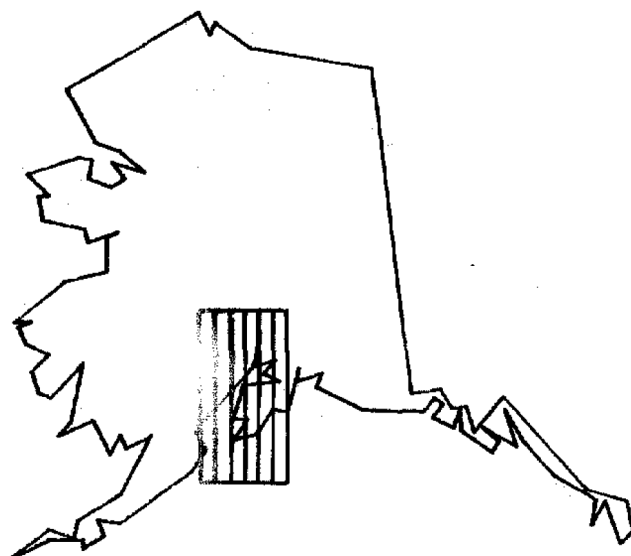
.8 - 1.99
OVER 245

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FIGURE 3 - DIFFERENCE OVER BACKGROUND

ALASKA

PRODUCTION FACILITIES



MICRO-REMS/HR

NO DATA
2 - 33

BELOW .6
33.01 - 245

.6 - 1.99
OVER 245

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Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

FACILITY: Gas Processing

Median of Difference Over Background

Median of Difference Over Background

Table 2

Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Alaska

FACILITY: Gas Processing

Obsns	County		Median Difference	75 th Percentile
2	ANCHORAGE		0.0	0
7	UNREPORTED		0.0	1
4	OFFSHORE	*****	4.0	7
		-----+-----+-----+-----+-----+-----+-----+-----+-----+		
		2 4 6 8 10 12 14 16 18 20		
Median of Difference Over Background				

FACILITY: Production

21	ANCHORAGE		0.0	0
147	UNREPORTED	*****	6.0	24
75	OFFSHORE	*****	13.0	42
		-----+-----+-----+-----+-----+-----+-----+-----+-----+		
		2 4 6 8 10 12 14 16 18 20		
Median of Difference Over Background				

Table 3

Median Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Alaska

Obs	County		Median	75 th Percentile
23	ANCHORAGE	**	1.0	1.0
154	OFFSHORE	*****	4.0	4.0
79	UNREPORTED	*****	4.0	5.0
-----+-----+-----+-----+-----+-----+-----+-----+-----+				
		2 4 6 8 10 12 14 16 18 20		
MEDIAN OF BKGRND				

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Alaska

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
-----------	----	---------	---------	---------	------	--------	------

Gas Processing Facilities

OTHER	1	0.0000	0	0	0	0	0.00
COMPRESSOR	4	0.2500	1	0	0	0	0.75
PRODUCT LINE	1	1.0000	1	1	1	1	1.00
INLET SCRUBBER	7	102.286	701	0	0	1	7.00

Production Facilities

METER	1	0.0000	0	0	0.00	0.0	0.00
WPROD	8	0.2500	1	0	0.00	0.0	0.75
WLINE	11	2.6364	14	0	0.00	0.0	5.00
WINJ	2	1.0000	1	1	1.00	1.0	1.00
VRU	3	1.3333	2	0	0.00	2.0	2.00
OTHER	34	4.0588	25	0	0.75	2.0	5.00
WTANK	8	6.1250	16	0	0.00	3.5	13.00
STANK	12	7.4167	36	0	0.00	4.5	8.00
SUMP	24	11.3750	92	0	1.00	5.5	13.00
MANIFOLD	30	25.9667	159	0	2.50	7.0	42.00
SEP	34	53.2059	307	0	3.00	18.5	54.00
PUMP	7	18.0000	54	0	0.00	10.0	28.00
H/T	44	55.2727	495	0	6.00	18.0	67.50
PLINE	25	51.4000	191	0	1.50	31.0	83.00

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

Alaska

FACILITY	COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
GP	ANCHORAGE	2	0.000	0	0	0.00	0	0
GP	UNREPORTED	7	100.429	701	0	0.00	0	1
GP	OFFSHORE	4	3.750	7	0	0.25	4	7
PROD	ANCHORAGE	21	0.048	1	0	0.00	0	0
PROD	UNREPORTED	147	31.272	495	0	1.00	6	24
PROD	OFFSHORE	75	32.253	287	0	4.00	13	42

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

Alaska

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
ANCHORAGE	23	1.00000	1	1	1	1	1
OFFSHORE	79	2.97468	4	1	1	4	4
UNREPORTED	154	4.17532	6	2	4	4	5

SUMMARY

(Arkansas)

I. There were no significant differences between items of equipment.

II. Columbia and Logan counties had mid-range background levels and Franklin and Pope counties had high background levels.

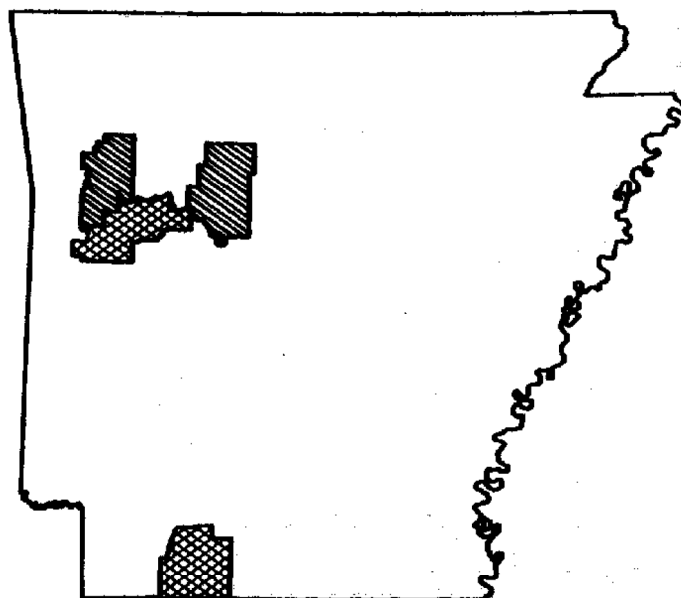
III. Overall Summary

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
1. Statewide					
a. Background	199	9.0	10.0	12.0	13
b. Max Reading	199	11.0	12.0	14.0	300
c. Difference	199	1.0	2.0	3.4	292
2. Facility					
a. Background					
Gas Processing	50	7.0	9.0	10.9	13
Production	149	9.0	10.0	12.0	13
b. Max Reading					
Gas Processing	50	8.5	11.3	19.5	300
Production	149	11.0	12.0	14.0	90
c. Difference					
Gas Processing	50	0.0	2.0	12.3	292
Production	149	1.0	2.0	3.0	81

NOTE: All data are measured in micro-rem/hr

FIGURE 1 - MEDIAN BACKGROUND LEVELS

ARKANSAS



MICRO-REMS/HR



NO DATA

5.0 - 9.0



0 - 2.33

2.34 - 4.99



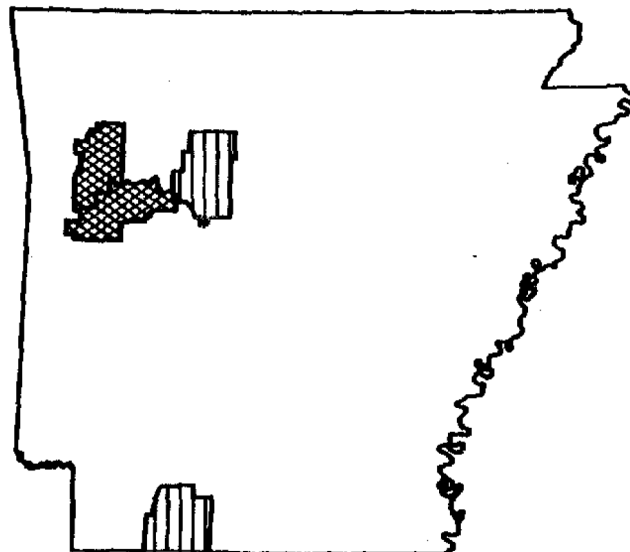
OVER 14.0

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 2 - DIFFERENCE OVER BACKGROUND

ARKANSAS

GAS PROCESSING FACILITIES



MICRO-REMS/HR

NO DATA
2 - 33

BELOW .8
33.01 - 245

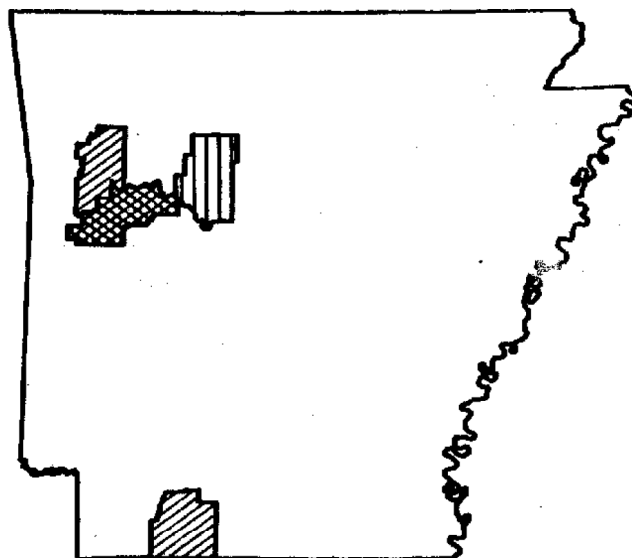
.8 - 1.99
OVER 245

AMERICAN PETROLEUM INSTITUTE
NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 3 - DIFFERENCE OVER BACKGROUND

ARKANSAS

PRODUCTION FACILITIES



MICRO-REMS/HR



NO DATA
2 - 39



BELOW .8
33.01 - 245



.8 - 1.99
OVER 245

AMERICAN PETROLEUM INSTITUTE
NATURALLY OCCURRING RADIOACTIVITY SURVEY

Table 1

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Arkansas

FACILITY: Gas Processing

Obsns	Equipment	Median Difference	75th Percentile
4	METER	0.00	23.6
21	OTHER	0.00	1.8
4	SWEETENER	0.00	0.6
3	DEHYDRATOR	1.00	2.0
6	OTANK	1.35	10.3
12	COMPRESSOR	1.50	2.8

50			

Median of Difference Over Background

FACILITY: Production

4	OTHER	0.00	0.8
10	STANK	0.00	1.6
2	WOTHER	0.00	0.0
35	H/T	1.00	2.0
13	SEP	1.00	2.0
41	WPROD	1.00	2.0
42	WTANK	2.00	3.0
2	PUMP	3.00	3.5

149			

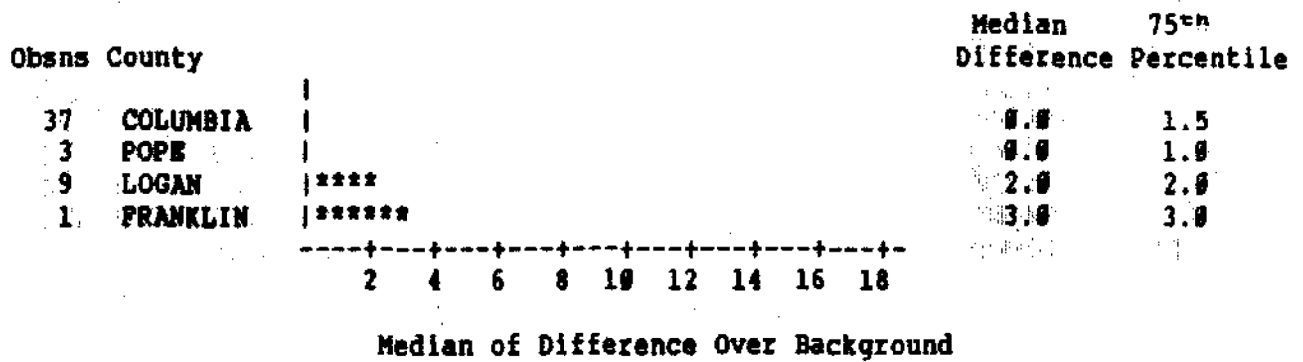
Median of Difference Over Background

Table 2

Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Arkansas

FACILITY: Gas Processing



FACILITY: Production

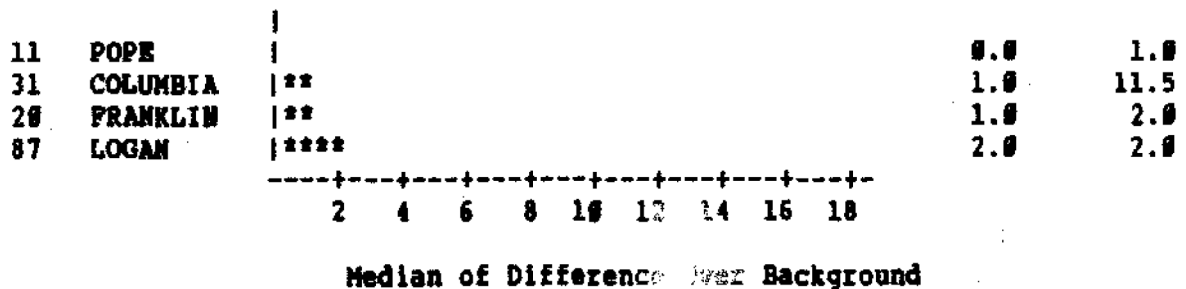


Table 3
 Median Background by County
 Sequenced by Increasing Median Difference
 (Micro-Rems/Hr)

Arkansas

Obs	County		Median	75 th Percentile
68	COLUMBIA	*****	7.75	8.5
96	LOGAN	*****	9.00	9.8
21	FRANKLIN	*****	12.00	12.0
14	POPE	*****	12.00	13.0
		-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+		
		2 4 6 8 10 12 14 16 18 20		
MEDIAN OF BKGRND				

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Arkansas

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
<u>Gas Processing Facilities</u>							
SWEETENER	4	0.0500	0.2	0	0	0.00	0.150
OTHER	21	15.6000	292.0	0	0	0.00	1.750
METER	4	7.8750	31.5	0	0	0.00	23.625
DEHYDRATOR	3	1.0000	2.0	0	0	1.00	2.000
OTANK	6	5.2833	23.0	0	0	1.35	10.250
COMPRESSOR	12	1.4167	3.0	0	0	1.50	2.750

Production Facilities

WOTHER	2	0.00000	0.0	0.0	0.0	0	0.000
OTHER	4	0.25000	1.0	0.0	0.0	0	0.750
STANK	10	0.60000	2.0	0.0	0.0	0	1.625
H/T	35	3.54286	81.0	0.0	0.0	1	2.000
SEP	13	1.19231	3.5	0.0	0.0	1	2.000
WPROD	41	1.21951	4.0	0.0	0.0	1	2.000
WTANK	42	6.67857	61.5	0.0	0.0	2	3.000
PUMP	2	3.00000	3.5	2.5	2.5	3	3.500

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

Arkansas

PROD	COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
GP	POPE	3	0.3333	1	0	0.0	0	1.0
GP	COLUMBIA	37	10.5946	292	0	0.0	0	1.5
GP	LOGAN	9	1.6667	3	0	0.5	2	2.5
GP	FRANKLIN	1	3.0000	3	3	3.0	3	3.0
PROD	POPE	11	0.2727	1	0	0.0	0	1.0
PROD	FRANKLIN	20	1.2000	3	0	0.0	1	2.0
PROD	COLUMBIA	31	10.8387	81	0	0.0	1	11.5
PROD	LOGAN	87	1.3793	4	0	0.0	2	2.0

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

Arkansas

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
COLUMBIA	68	7.0000	9	2.5	5.50	7.75	8.50
LOGAN	96	9.2500	11	7.0	9.00	9.00	9.75
FRANKLIN	21	11.0000	13	9.0	9.50	12.00	12.00
POPE	14	12.0714	13	11.0	11.75	12.00	13.00

SUMMARY

(California)

I. All significant differences were equipment specific.

The equipment with the most pronounced differences over background based on Median ranking are listed below in descending order. The difference is the excess of the reading over background:

Equipment	Median Difference	75 th Percentile
1. Reflux Pumps (GP)	138 μ R/hr	492.5 μ R/hr
2. Propane Pumps (GP)	87	152.0
3. Propane Tanks (GP)	61.5	98.8
4. Bottoms Pump (GP)	34.0	52.0

II. Orange county had a low median background, Los Angeles, Santa Barbara, Kern, and Ventura had high median background readings. All others were mid-range.

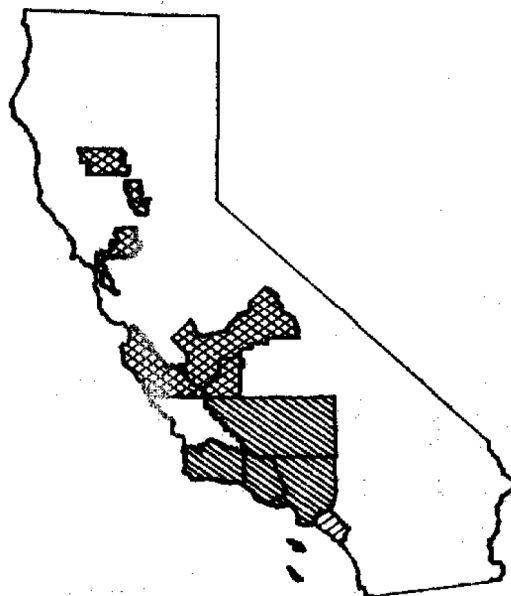
III. Overall Summary

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
1. Statewide					
a. Background	950	10.0	13.0	15.0	30
b. Max Reading	950	11.0	18.0	54.0	1,300
c. Difference	950	0.0	4.0	41.0	1,290
2. Facility					
a. Background					
Gas Processing	227	14.0	15.0	15.0	20
Production	723	9.0	12.0	16.2	30
b. Max Reading					
Gas Processing	227	15.0	60.0	129.2	1,000
Production	723	10.0	13.0	24.0	1,300
c. Difference					
Gas Processing	227	4.0	46.0	116.2	980
Production	723	0.0	2.0	10.0	1,290

NOTES: 1) All data are measured in micro-rem/hr

2) The apparent differences between facilities are due to the specific items of equipment listed in Section I above.

FIGURE 1 — MEDIAN BACKGROUND LEVELS
CALIFORNIA



MICRO-REMS/HR



NO DATA

5.0 - 9.0



0 - 2.33

9.01 - 14.0



2.34 - 4.99

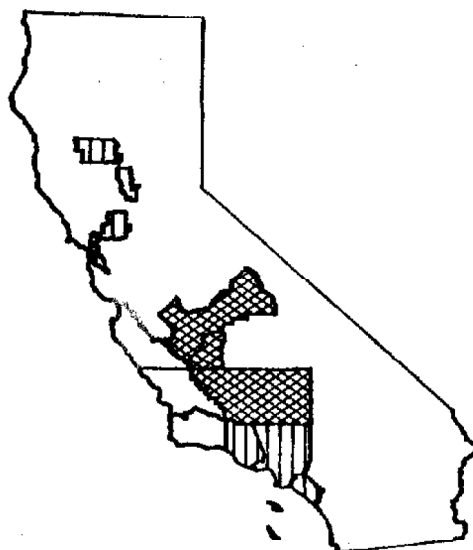
OVER 14.0

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 2 — DIFFERENCE OVER BACKGROUND

CALIFORNIA

GAS PROCESSING FACILITIES



MICRO-REMS/HR

NO DATA
2 - 33

BELOW .8
33.01 - 245

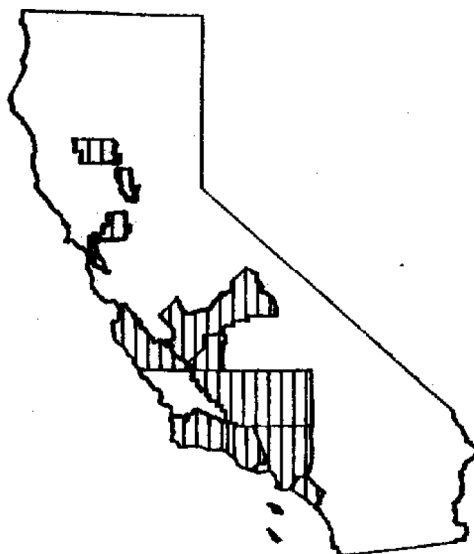
.8 - 1.99
OVER 245

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 3 - DIFFERENCE OVER BACKGROUND

CALIFORNIA

PRODUCTION FACILITIES



MICRO-REMS/HR



NO DATA
2 - 33



BELOW .8
33.01 - 245



.8 - 1.99
OVER 245

AMERICAN PETROLEUM INSTITUTE
NATURALLY OCCURRING RADIOACTIVITY SURVEY

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

FACILITY: Gas Processing

Median of Difference

Median of Difference

Table 2

Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

California

FACILITY: Gas Processing

Obsns	County		Median Difference	75 th Percentile
15	GLENN		0.0	0.0
2	LOS ANGELES		0.0	0.0
3	ORANGE		0.0	12.0
3	SOLANO		0.0	0.0
110	VENTURA		0.0	39.5
10	FRESNO/KING	*****	5.0	5.0
77	KERN	*****	27.0	65.0
7	UNREPORTED	*****	48.0	78.0

-----+-----+-----+-----+-----+-----+-----+-----+-----+-----
 5 10 15 20 25 30 35 40 45
 Median of Difference Over Background

FACILITY: Production

61	FRESNO		0.0	0.0
6	FRESNO/KING		0.0	0.0
82	GLENN		0.0	0.0
315	KERN		0.0	5.0
94	LOS ANGELES		0.0	0.0
12	MONTEREY		0.0	2.0
29	ORANGE		0.0	1.5
2	SANTA BARB.		0.0	0.0
22	SOLANO		0.0	0.0
8	SUTTER		0.0	0.0
36	UNREPORTED		0.0	9.8
56	VENTURA		0.0	2.0

-----+-----+-----+-----+-----+-----+-----+-----+-----+-----
 5 10 15 20 25 30 35 40 45
 Median of Difference Over Background

California

2 4 6 8 10 12 14 16

-55-

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

California

Equipment	No	AVG	Maximum	Minimum	PCT25	Median	PCT75
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Gas Processing Facilities

COMPRESSOR	24	0.500	12	0	0.00	0.0	0.00
INLET SCRUBBER	32	18.531	527	0	0.00	0.0	0.00
OTANK	30	17.474	193	0	0.00	0.0	5.00
OTHER	11	4.273	38	0	0.00	0.0	2.00
SWEETENER	4	26.250	95	0	0.50	5.0	73.25
REFRIGERATION	13	16.154	55	0	0.00	7.0	28.00
OPUMP	2	11.000	18	4	4.00	11.0	18.00
CRYO UNIT	1	13.000	13	13	13.00	13.0	13.00
DEHYDRATOR	10	73.200	529	0	0.75	13.0	55.75
PRODUCT LINE	26	46.800	277	0	0.00	15.0	73.50
METER	6	25.500	51	0	0.00	25.5	51.00
FRAC TOWER	13	51.846	226	0	6.50	27.0	62.00
BOTTOMS PUMP	3	32.000	52	10	10.00	34.0	52.00
PTANK	30	72.267	216	0	31.00	61.5	98.75
PPUMP	2	87.000	152	22	22.00	87.0	152.00
REFLUX PUMP	12	249.833	980	0	39.50	138.0	492.50

Production Facilities

H/T	58	1.793	32	0	0	0	0.00
MANIFOLD	35	37.629	1290	0	0	0	3.00
OTHER	86	4.988	52	0	0	0	6.00
PUMP	40	12.250	213	0	0	0	0.00
SEP	121	5.884	430	0	0	0	0.00
STANK	131	4.443	147	0	0	0	0.00
SUMP	10	1.600	6	0	0	0	5.00
WINJ	7	0.714	4	0	0	0	1.00
WOTHER	3	0.667	2	0	0	0	2.00
WPROD	67	2.075	63	0	0	0	0.00
WTANK	100	3.111	85	0	0	0	2.00
WLINE	16	20.687	143	0	0	2	28.25
FLINE	20	42.300	213	0	0	3	85.75
VRU	21	199.429	1287	0	0	25	249.50

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

California

FACILITY	COUNTY	NO	AVG	LARGEST	LOWEST	PCT25	MED	PCT75
GP	GLENN	15	0.0000	0	0	0	0	0.00
GP	LOS ANGELES	2	0.0000	0	0	0	0	0.00
GP	ORANGE	3	4.0000	12	0	0	0	12.00
GP	SOLANO	3	0.0000	0	0	0	0	0.00
GP	VENTURA	110	35.6182	529	0	0	0	39.50
GP	FRESNO/KING	10	3.0000	5	0	0	5	5.00
GP	KERN	77	72.4935	980	0	1	27	65.00
GP	UNREPORTED	7	48.0000	93	0	13	40	78.00
PROD	FRESNO	61	1.1148	17	0	0	0	0.00
PROD	FRESNO/KING	6	0.0000	0	0	0	0	0.00
PROD	GLENN	82	0.0610	4	0	0	0	0.00
PROD	KERN	315	27.3587	1290	0	0	0	5.00
PROD	LOS ANGELES	94	0.9043	40	0	0	0	0.00
PROD	MONTEREY	12	4.2500	29	0	0	0	2.75
PROD	ORANGE	29	2.5862	22	0	0	0	1.50
PROD	SANTA BARBARA	2	0.0000	0	0	0	0	0.00
PROD	SOLANO	22	0.1010	2	0	0	0	0.00
PROD	SUTTER	8	0.3750	2	0	0	0	0.75
PROD	UNREPORTED	36	12.4167	143	0	0	0	9.75
PROD	VENTURA	56	2.5179	42	0	0	0	2.00

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

California

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
ORANGE	32	5.0312	8	3	3	3.0	8.00
FRESNO/KING	16	5.7500	7	5	5	5.0	7.00
GLENN	97	4.7526	5	2	5	5.0	5.00
SUTTER	8	5.6250	7	4	5	5.5	6.75
MONTEREY	12	6.4167	7	6	6	6.0	7.00
SOLANO	25	7.0000	7	7	7	7.0	7.00
FRESNO	61	9.6557	15	7	9	9.0	10.00
LOS ANGELES	96	9.3054	12	5	10	10.0	10.00
SANTA BARBARA	2	10.0000	10	10	10	10.0	10.00
KERN	392	11.6327	30	5	7	12.0	15.00
UNREPORTED	43	12.0000	12	12	12	12.0	12.00
VENTURA	166	12.3193	15	5	10	13.0	15.00

SUMMARY

(Colorado)

- I. There were no significant differences in readings among items of equipment or between facility types.
- II. Adams and Weld counties had mid-range background levels while Jackson, Washington, and Rio Blanco counties were in the high category.

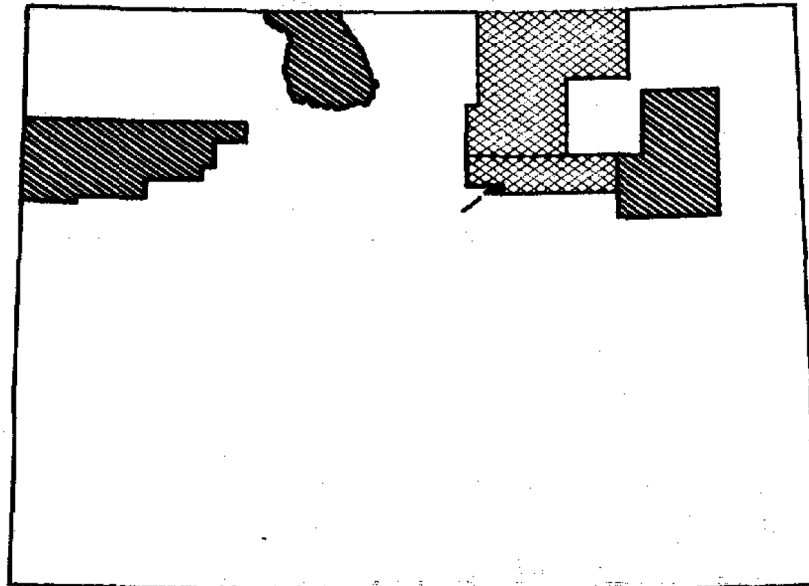
III. Overall Summary

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
1. Statewide					
a. Background	559	12.0	13.0	16.0	17
b. Max Reading	559	12.0	16.0	20.0	280
c. Difference	559	0.0	0.0	8.0	263
2. Facility					
a. Background					
Gas Processing	49	6.5	8.0	10.0	11
Production	510	12.0	14.0	16.0	17
b. Max Reading					
Gas Processing	49	8.0	13.0	60.0	225
Production	510	13.0	16.0	20.0	280
c. Difference					
Gas Processing	49	0.0	7.3	53.5	221
Production	510	0.0	0.0	7.0	263

NOTES: 1) All data are measured in micro-rams/hr

FIGURE 1 - MEDIAN BACKGROUND LEVELS

COLORADO



MICRO-REMS/HR



NO DATA



5.0 - 9.0



0 - 2.33



9.01 - 14.0



2.34 - 4.99



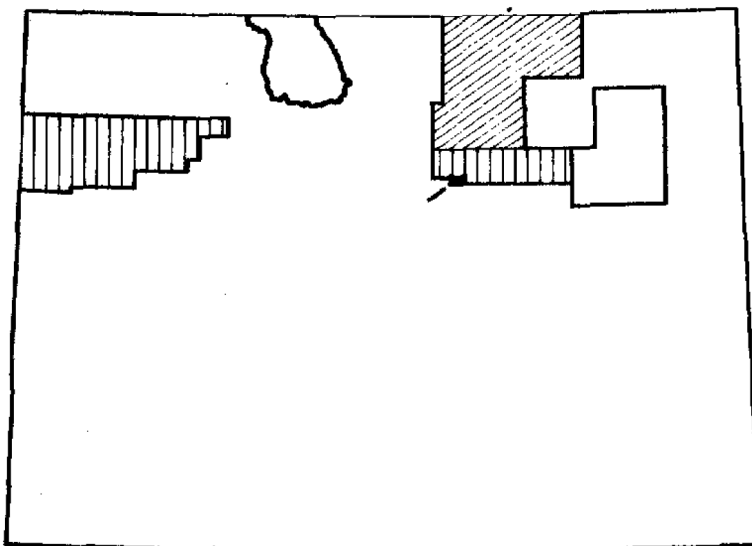
OVER 14.0

AMERICAN PETROLEUM INSTITUTE
NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 2 – DIFFERENCE OVER BACKGROUND

COLORADO

GAS PROCESSING FACILITIES



MICRO-REMS/HR



NO DATA
2 - 33



BELOW .6
33.01 - 245



.6 - 1.99
OVER 245

AMERICAN PETROLEUM INSTITUTE
NATURALLY OCCURRING RADIOACTIVITY SURVEY

Table 1

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Colorado

FACILITY: Gas Processing

Obsns	Equipment		Median Difference	75 th Percentile
4	DEHYDRATOR		0.0	0.0
3	FRAC TOWER		0.0	0.0
16	INLET SCRUBBER		0.0	2.9
1	PTANK		0.0	0.0
4	REFRIGERATION		0.0	1.1
4	OTANK	*	1.5	25.6
8	PRODUCT LINE	***	6.0	21.9
3	SWEETENER	*****	13.0	220.5
2	OTHER	*****	16.0	32.0
4	OPUMP	*****	31.5	64.0

-----+-----+-----+-----+-----+-----
10 20 30 40 50 60

Median of Difference Over Background

FACILITY: Production

29	H/T		0.0	2.5
178	MANIFOLD		0.0	0.0
20	METER		0.0	0.0
19	OTHER		0.0	4.0
15	PUMP		0.0	0.0
121	SEP		0.0	7.0
52	STANK		0.0	0.0
1	SUMP		0.0	0.0
4	WLINE		0.0	0.0
4	WPROD		0.0	0.0
34	WTANK		0.0	0.0
35	WINJ	*	1.5	3.0
2				

-----+-----+-----+-----+-----+-----
10 20 30 40 50 60

Median of Difference Over Background

Table 2

Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Colorado

FACILITY: Gas Processing

Obsns	County		Median Difference	75 th Percentile
5	RIO BLANCO		0.00	0.0
16	ADAMS	***	0.75	12.13
28	WELD	****	1.00	7.88
		-----+-----+-----+-----+-----+-----+-----		
		1 2 3 4 5 6 7		
Median of Difference Over Background				

FACILITY: Production

108	JACKSON		0.00	0.0
353	RIO BLANCO		0.00	0.0
11	WASHINGTON		0.00	0.0
38	WELD		0.00	2.5
		-----+-----+-----+-----+-----+-----+-----		
		1 4 2 3 4 5 6 7		
Median of Difference Over Background				

Table 3

Median Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Colorado

Obs	County		Median	75 th Percentile
66	WELD	*****	7.5	9.0
16	ADAMS	*****	8.0	8.0
108	JACKSON	*****	12.0	13.0
11	WASHINGTON	*****	12.0	12.0
258	RIO BLANCO	*****	13.0	15.0
---		-----+-----+-----+-----+-----+-----+-----+-----		
559		0 2 4 6 8 10 12 14 16		
Median of Background Reading				

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Colorado

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
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Gas Processing Facilities

DEHYDRATOR	4	0.0000	0.0	0.0	0.00	0.0	0.000
FRAC TOWER	3	0.0000	0.0	0.0	0.00	0.0	0.000
INLET SCRUBBER	16	11.4687	168.5	0.0	0.00	0.0	2.875
PTANK	1	0.0000	0.0	0.0	0.00	0.0	0.000
REFRIGERATION	4	0.3750	1.5	0.0	0.00	0.0	1.125
OTANK	4	9.1250	33.5	0.0	0.25	1.5	25.625
PRODUCT LINE	8	14.1875	58.5	0.0	1.12	6.0	21.875
SWEETENER	3	78.0000	220.5	0.5	0.50	13.0	220.500
OTHER	2	16.0000	32.0	0.0	0.00	16.0	32.000
OPUMP	4	33.5000	68.5	2.5	4.25	31.5	64.750

Production Facilities

H/T	29	3.37931	28	0	0	0.0	2.5
MANIFOLD	178	0.19101	15	0	0	0.0	0.0
METER	20	0.00000	0	0	0	0.0	0.0
OTHER	19	6.89474	78	0	0	0.0	4.0
PUMP	15	2.33333	29	0	0	0.0	0.0
SEP	121	8.40496	263	0	0	0.0	7.0
STANK	52	0.42308	13	0	0	0.0	0.0
SUMP	1	0.00000	0	0	0	0.0	0.0
WLINE	4	0.00000	0	0	0	0.0	0.0
WPROD	34	1.20500	24	0	0	0.0	0.0
WTANK	35	1.88571	27	0	0	0.0	0.0
WINJ	2	1.50000	3	0	0	1.5	3.0

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

Colorado

FACILITY	COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
GP	RIO BLANCO	5	0.0000	0.0	0	0	0.00	0.000
GP	ADAMS	16	18.5625	220.5	0	0	0.75	12.125
GP	WELD	28	15.6429	168.5	0	0	1.00	7.875
PROD	JACKSON	108	0.4537	28.0	0	0	0.00	0.000
PROD	RIO BLANCO	353	3.7139	263.0	0	0	0.00	0.000
PROD	WASHINGTON	11	0.0000	0.0	0	0	0.00	0.000
PROD	WELD	30	2.2895	13.0	0	0	0.00	2.500

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

Colorado

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
WELD	66	8.4742	13	6.5	6.500	7.5	9
ADAMS	16	7.1250	8	4.5	5.375	8.0	8
JACKSON	108	11.8981	15	6.0	11.000	12.0	13
WASHINGTON	11	12.0000	14	10.0	12.000	12.0	12
RIO BLANCO	358	12.8966	17	8.0	12.000	13.0	15

SUMMARY

(Illinois)

I. All significant differences were equipment specific.

The equipment with the most pronounced differences over background based on Median ranking are listed below in descending order. The difference is the excess of the reading over background:

Equipment	Median Difference	75 th Percentile
1. Heater Treater(1) (Prod)	176 μ R/hr	176.0 μ R/hr
2. Flow Line (Prod)	124	259.3
3. Separator (Prod)	61	161.0
4. Water Line (1) (Prod)	60	60.0
5. Pump (Prod)	50	80.0

II. Fayette county has a high background level and Gallatin county has a very high background level.

III. The high equipment readings for Gallatin county were due to some very high readings for a few water and storage tanks, one of which was an outlier value. There were only twenty-four total observations for that county so it is pre-mature to declare it to be a hot-spot. It is, however, suspect.

IV. Overall Summary (All data were on Production facilities)

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
Statewide					
a. Background	661	7.0	10.0	15.0	50
b. Max Reading	661	24.0	100.0	237.0	2,500
c. Difference	661	17.0	90.5	211.6	2,475

NOTE: All data are measured in micro-rams/hr

FIGURE 1 — MEDIAN BACKGROUND LEVELS

ILLINOIS



MICRO-REMS/HR



NO DATA

5.0 - 9.0



0 - 2.33

9.01 - 14.0



2.34 - 4.99

OVER 14.0

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FIGURE 2 - MEDIAN DIFFERENCE OVER BACKGROUND

ILLINOIS

PRODUCTION FACILITIES



MICRO-REMS/HR



NO DATA
2 - 33



BELOW .8
33.01 - 245



.8 - 1.99
OVER 245

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

Table 1

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Illinois

FACILITY: Production

Obsns	Equipment		Median Difference	75 th Percentile
18	SUMP	*	5.5	24.3
80	OTHER	*	6.0	13.0
303	STANK	**	11.0	51.0
34	WTANK	**	12.0	126.0
3	PUMP	*****	50.0	80.0
1	WLINE	*****	60.0	60.0
213	SEP	*****	63.0	161.0
8	FLINE	*****	124.0	259.3
1	H/T	*****	176.0	176.0
-----+-----+-----+-----+-----+-----+-----+-----+-----				
20 40 60 80 100 120 140 160				

Median of Difference Over Background

Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

FACILITY: Production

Median of Difference Over Background

Median Background by County
Sequenced by Increasing Median Difference
(Micro-Rms/Hz)

Median of Background Reading

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Illinois

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
<u>Production Facilities</u>							
SUMP	18	15.944	71	0	4.5	5.5	24.25
OTHER	80	13.050	186	0	2.0	6.0	13.00
STANK	303	64.422	2475	0	3.0	11.0	51.00
WTANK	34	100.294	575	0	4.0	12.0	126.75
PUMP	3	43.333	80	0	0.0	50.0	80.00
WLINE	1	60.000	60	60	60.0	60.0	60.00
SEP	213	120.944	1075	0	15.0	63.0	161.00
FLINE	8	163.500	389	42	79.0	124.0	259.25
H/T	1	176.000	176	176	176.0	176.0	176.00

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

Illinois

FACILITY	COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
PROD	UNREPORTED	497	55.686	893	0	3.0	14.0	56.00
PROD	FAYETTE	140	119.064	975	0	7.0	49.5	162.25
PROD	GALLATIN	24	297.792	2475	0	16.5	142.5	234.75

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

Illinois

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
UNREPORTED	497	6.5965	12	4	4	7	8
FAYETTE	140	15.6000	50	9	11	13	16
GALLATIN	24	18.2500	25	9	15	16	25

SUMMARY

(Kansas)

I. All significant differences were equipment specific.

The equipment with the most pronounced differences over background based on Median ranking are listed below in descending order. The difference is the excess of the reading over background:

	Equipment	Median Difference	75 th Percentile
1.	Reflux Pumps (GP)	205 μ R/hr	636.3 μ R/hr
2.	Product Line (GP)	170	330.0
3.	Propane Tanks (GP)	85	680.8
4.	Propane Pump (GP)	70	70.0
5.	Flow Line (PROD)	64	191.3

II. Kiowa, Sheridan, Ellsworth, and Edwards counties had mid-range background levels. All the others were classified as high except for Haskell, Stevens, Finney and Grant which were very high.

III. Overall Summary

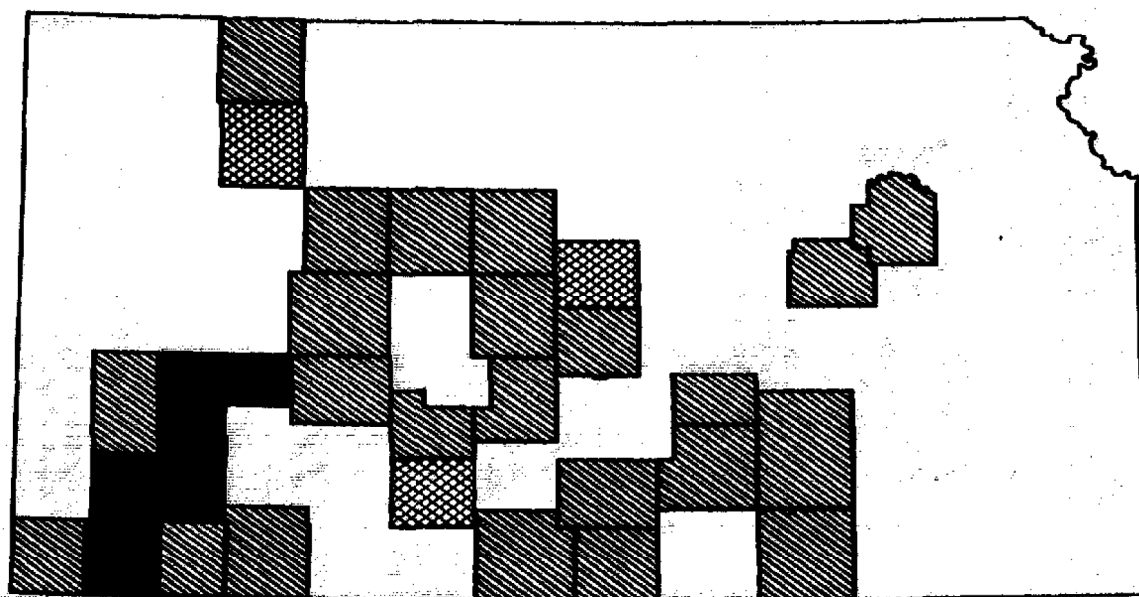
ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
1. Statewide					
a. Background	726	11.0	14.0	20.0	70
b. Max Reading	726	13.0	23.0	110.0	1,500
c. Difference	726	0.0	7.0	96.3	1,487
2. Facility					
a. Background					
Gas Processing	49	20.0	20.0	20.0	20
Production	677	11.0	13.0	17.0	70
b. Max Reading					
Gas Processing	49	50.0	205.0	350.0	1,100
Production	677	13.0	20.0	80.0	1,500
c. Difference					
Gas Processing	49	30.0	185.0	330.0	1,000
Production	677	0.0	4.5	66.4	1,487

NOTES: 1) All data are measured in micro-rem/hr

2) The apparent differences between facilities are due to the specific items of equipment listed in Section I above.

FIGURE 1 — MEDIAN BACKGROUND LEVELS

KANSAS



MICRO-REMS/HR

NO DATA
5.0 - 9.0

0 - 2.33
9.01 - 14.0

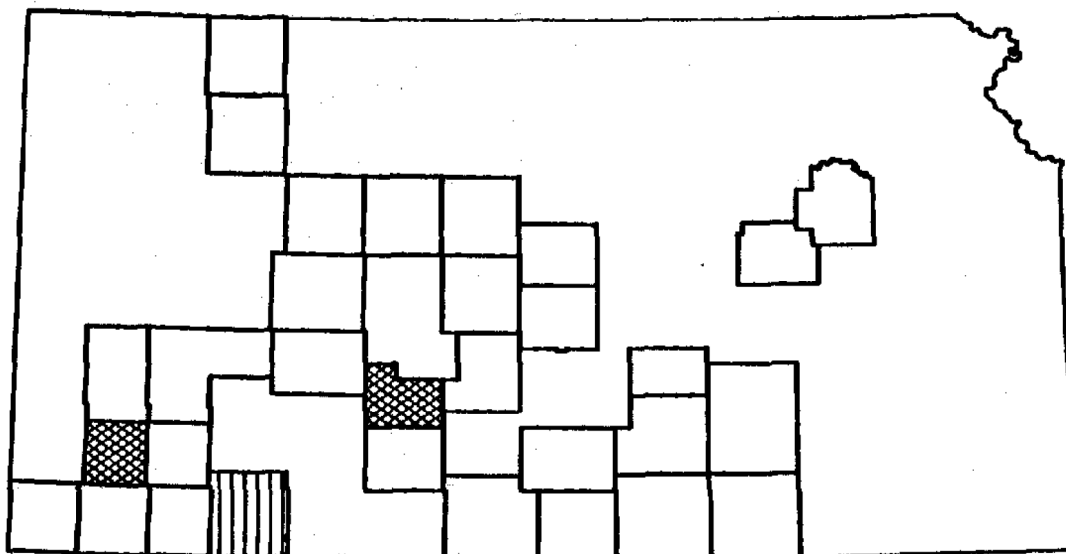
2.34 - 4.99
OVER 14.0

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FIGURE 2 – DIFFERENCE OVER BACKGROUND

KANSAS

GAS PROCESSING FACILITIES



MICRO-REMS/HR

NO DATA
2 - 33

BELOW .8
33.01 - 245

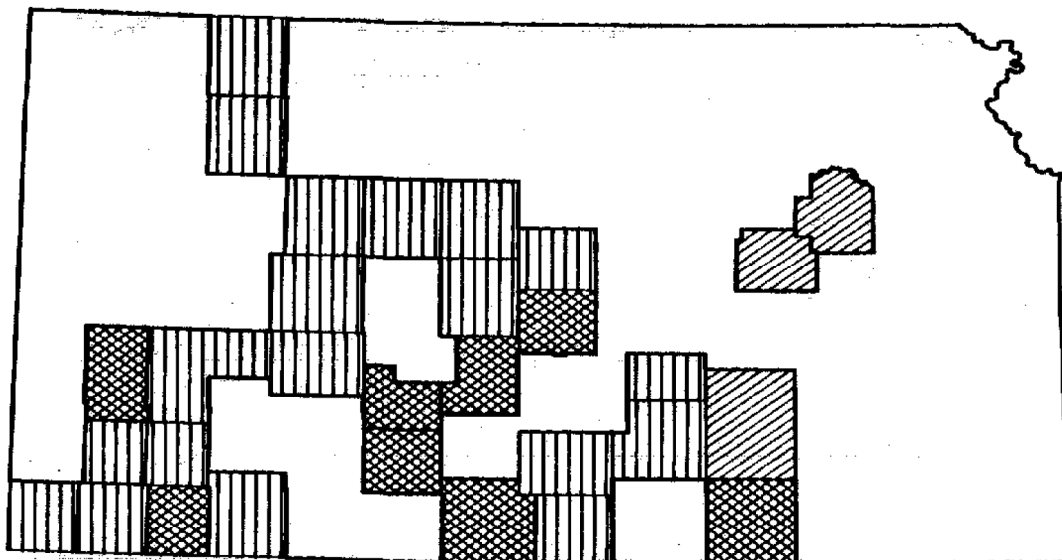
.8 - 1.99
OVER 245

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 3 – DIFFERENCE OVER BACKGROUND

KANSAS

PRODUCTION FACILITIES



MICRO-REMS/HR

NO DATA
2 - 39

BELOW .8
33.01 - 245

.8 - 1.99
OVER 245

AMERICAN PETROLEUM INSTITUTE
NATURALLY OCCURRING RADIOACTIVITY SURVEY

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

FACILITY: Gas Processing

Median of Difference Over Background

Median of Difference Over Background

Table 2

Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Kansas

FACILITY: Gas Processing

Obsns	County		Median Difference	75 th Percentile
1	MEADE		0.0	0.0
1	EDWARDS	***	6.0	6.0
47	GRANT	*****	30.0	190.0
-----+-----+-----+-----+-----+-----+----- 10 20 30 40 50 60				

Median of Difference Over Background

FACILITY: Production

1	KINGMAN		0.0	0.0
29	BARTON		0.0	7.5
10	DECATUR		0.0	0.5
41	ELLIS		0.0	1.0
37	ELLSWORTH		0.0	1.0
3	FINNEY		0.0	0.0
15	HARPER		0.0	6.0
11	HARVEY		0.0	13.0
16	HASKELL		0.0	0.5
42	HODGEMAN		0.0	0.0
18	MEADE		0.0	3.3
6	MORTON		0.0	1.0
21	NESS		0.0	0.0
49	RUSSELL		0.0	0.0
37	SEDGWICK		0.0	10.5
10	SHERIDAN		0.0	1.5
12	TREGO		0.0	30.5
18	STEVENS		0.0	0.6
44	MORRIS		0.5	1.0
89	BUTLER	*	1.0	70.5
6	WABAUNSEE	*	1.0	3.0
59	BARBER	*	2.0	34.0
2	COWLEY	*	2.0	2.0
5	RICE	**	3.0	103.0
8	KIOWA	**	3.5	8.0
62	STAFFORD	**	3.5	57.3
13	SEWARD	***	5.0	60.5
11	EDWARDS	***	6.0	6.0
2	KEARNY	*****	12.0	19.0
-----+-----+-----+-----+-----+-----+----- 10 20 30 40 50 60				

Median of Difference Over Background

Table 3

Median Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Kansas

Obs	County		75 th	
			Median	Percentile
8	KIOWA	*****	7.0	7.0
10	SHERIDAN	*****	7.5	12.0
37	ELLSWORTH	*****	8.0	8.5
12	EDWARDS	*****	9.0	11.0
10	DECATUR	*****	9.5	10.3
1	KINGMAN	*****	10.0	10.0
29	BARTON	*****	10.0	11.5
41	ELLIS	*****	10.0	11.0
15	HARPER	*****	10.0	13.0
13	SEWARD	*****	10.0	13.0
2	COWLEY	*****	11.0	11.0
11	HARVEY	*****	11.0	11.0
2	KEARNY	*****	11.0	11.0
19	MEADE	*****	11.0	11.0
6	MORTON	*****	11.0	11.0
5	RICE	*****	11.0	17.5
49	RUSSELL	*****	11.0	12.0
6	WABAUNSEE	*****	11.0	11.0
49	BARBER	*****	12.0	13.0
44	MORRIS	*****	12.0	13.0
21	NESS	*****	12.0	13.0
37	SEDGWICK	*****	12.0	13.0
62	STAFFORD	*****	12.0	16.0
12	TREGO	*****	13.0	17.0
42	HODGEMAN	*****	13.5	14.0
89	BUTLER	*****	14.0	22.0
16	HASKELL	*****	15.0	16.9
3	FINNEY	*****	17.5	17.5
18	STEVENS	*****	17.5	20.0
47	GRANT	*****	20.0	20.0

-----+-----+-----+-----+-----+-----+-----+-----+-----+
2 4 6 8 10 12 14 16 18 20

Median of Background Reading

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Kansas

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
-----------	----	---------	---------	---------	------	--------	------

Gas Processing Facilities

COMPRESSOR	2	3.000	6	0.0	0.00	3	6.00
OPUMP	1	5.000	5	5.0	5.00	5	5.00
OTANK	5	13.000	30	0.0	2.50	5	27.50
FRAC TOWER	17	48.676	255	0.0	0.00	20	42.50
DEHYDRATOR	1	30.000	30	30.0	30.00	30	30.00
PPUMP	1	70.000	70	70.0	70.00	70	70.00
PTANK	3	255.833	600	2.5	2.50	85	600.00
PRODUCT LINE	15	230.000	1000	10.0	75.00	170	330.00
REFLUX PUMP	4	297.500	700	0.0	51.25	205	636.25

Production Facilities

MANIFOLD	10	6.3000	63	0	0.00	0.0	0.00
METER	16	0.0625	1	0	0.00	0.0	0.00
OTHER	25	1.3600	31	0	0.00	0.0	0.00
PTANK	16	3.2500	49	0	0.00	0.0	0.00
SEP	84	13.2262	378	0	0.00	0.0	1.00
WLINE	3	0.3333	1	0	0.00	0.0	1.00
STANK	226	17.8142	1198	0	0.00	0.0	2.05
PUMP	47	8.4255	106	0	0.00	0.0	1.00
SUMP	8	0.7500	4	0	0.00	0.0	1.50
WPROD	79	26.2215	1487	0	0.00	0.0	2.00
H/T	47	32.2660	500	0	0.00	1.0	6.00
WINJ	7	14.5714	48	0	0.00	2.0	37.00
WTANK	97	88.2732	785	0	2.00	19.0	110.00
FLINE	12	93.5000	286	0	0.00	64.0	191.25

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

Kansas

FACILITY	COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
GP	MEADE	1	0.000	0	0	0	0.0	0.000
GP	EDWARDS	1	6.000	6	6	6	6.0	6.000
GP	GRANT	47	136.277	1080	0	5	30.0	190.000
PROD	KINGMAN	1	0.000	0	0	0	0.0	0.000
PROD	FINNEY	3	0.000	0	0	0	0.0	0.000
PROD	HODGEMAN	42	1.357	31	0	0	0.0	0.000
PROD	NESS	21	3.095	63	0	0	0.0	0.000
PROD	RUSSELL	49	1.898	32	0	0	0.0	0.000
PROD	DECATUR	10	0.700	5	0	0	0.0	0.500
PROD	HASKELL	16	2.094	22	0	0	0.0	0.500
PROD	STEVENS	10	1.167	16	0	0	0.0	0.625
PROD	ELLIS	41	6.488	128	0	0	0.0	1.000
PROD	ELLSWORTH	37	1.108	21	0	0	0.0	1.000
PROD	MORTON	6	0.333	1	0	0	0.0	1.000
PROD	SHERIDAN	10	5.400	48	0	0	0.0	1.500
PROD	MEADE	18	72.667	785	0	0	0.0	3.250
PROD	HARPER	15	2.800	12	0	0	0.0	6.000
PROD	BARTON	29	28.931	588	0	0	0.0	7.500
PROD	HARVEY	11	11.818	70	0	0	0.0	13.000
PROD	SEDGWICK	37	70.000	1198	0	0	0.0	18.500
PROD	TREGO	12	15.417	53	0	0	0.0	30.500
PROD	MORRIS	44	0.500	1	0	0	0.5	1.000
PROD	WABAUNSEE	6	2.333	9	1	1	1.0	3.000
PROD	BUTLER	89	70.596	1487	0	0	1.0	70.500
PROD	COWLEY	2	2.000	2	2	2	2.0	2.000
PROD	BARBER	59	52.339	467	0	0	2.0	34.000
PROD	RICE	5	41.800	197	0	0	3.0	103.000
PROD	KIOWA	0	6.000	17	2	3	3.5	8.000
PROD	STAFFORD	62	50.210	500	0	0	3.5	57.250
PROD	SEWARD	13	36.385	202	0	0	5.0	60.500
PROD	EDWARDS	11	4.818	21	0	0	6.0	6.000
PROD	KEARNY	2	12.000	19	5	5	12.0	19.000

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

Kansas

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
KIOWA	8	7.0000	7.0	7.0	7.00	7.0	7.000
SHERIDAN	10	8.2000	13.0	4.0	4.75	7.5	12.000
ELLSWORTH	37	7.6757	13.0	4.0	7.00	8.0	8.500
EDWARDS	12	9.7500	12.0	9.0	9.00	9.0	11.000
DECATUR	10	8.9000	11.0	5.0	8.00	9.5	10.250
ELLIS	41	9.8049	12.0	7.0	8.00	10.0	11.000
BARTON	29	10.3793	15.0	8.0	9.00	10.0	11.500
HARPER	15	9.9333	14.0	4.0	7.00	10.0	13.000
SEWARD	13	11.7692	22.0	8.0	10.00	10.0	13.000
KINGMAN	1	10.0000	10.0	10.0	10.00	10.0	10.000
COWLEY	2	11.0000	11.0	11.0	11.00	11.0	11.000
HARVEY	11	11.0000	11.0	11.0	11.00	11.0	11.000
KEARNY	2	11.0000	11.0	11.0	11.00	11.0	11.000
MEADE	19	11.3158	15.0	10.0	11.00	11.0	11.000
MORTON	6	11.0000	11.0	11.0	11.00	11.0	11.000
WABAUNSEE	6	11.0000	11.0	11.0	11.00	11.0	11.000
RUSSELL	49	10.7143	14.0	7.0	9.00	11.0	12.000
RICE	5	12.8000	22.0	9.0	9.00	11.0	17.500
BARBER	59	12.3559	23.0	5.0	10.00	12.0	13.000
MORRIS	44	11.9091	13.0	11.0	11.00	12.0	13.000
NESS	21	11.9048	15.0	7.0	12.00	12.0	13.000
SEDGWICK	37	11.7560	16.0	8.0	10.00	12.0	13.000
STAFFORD	62	27.9839	500.0	6.0	10.00	12.0	16.000
HODGEMAN	42	12.4524	15.0	9.0	9.00	13.5	14.000
BUTLER	89	14.9888	23.0	6.0	10.50	14.0	22.000
HASKELL	16	15.5312	20.0	13.0	15.00	15.0	16.875
FINNEY	3	17.5000	17.5	17.5	17.50	17.5	17.500
STEVENS	18	17.2222	20.0	12.5	15.00	17.5	20.000
GRANT	47	20.0000	20.0	20.0	20.00	20.0	20.000

SUMMARY

(Kentucky)

I. All significant differences were equipment specific.

The equipment with the most pronounced differences over background based on Median ranking are listed below in descending order. The difference is the excess of the reading over background:

Equipment		Median Difference	75 th Percentile
Water Tank	(Prod)	178 μ R/hr	340.0 μ R/hr

II. There were no significant differences in background readings from county to county. Henderson county, however, with a median background of 9 μ R/hr was at the top end of the mid-range class and Union county with 10 μ R/hr was at the low end of the high classification.

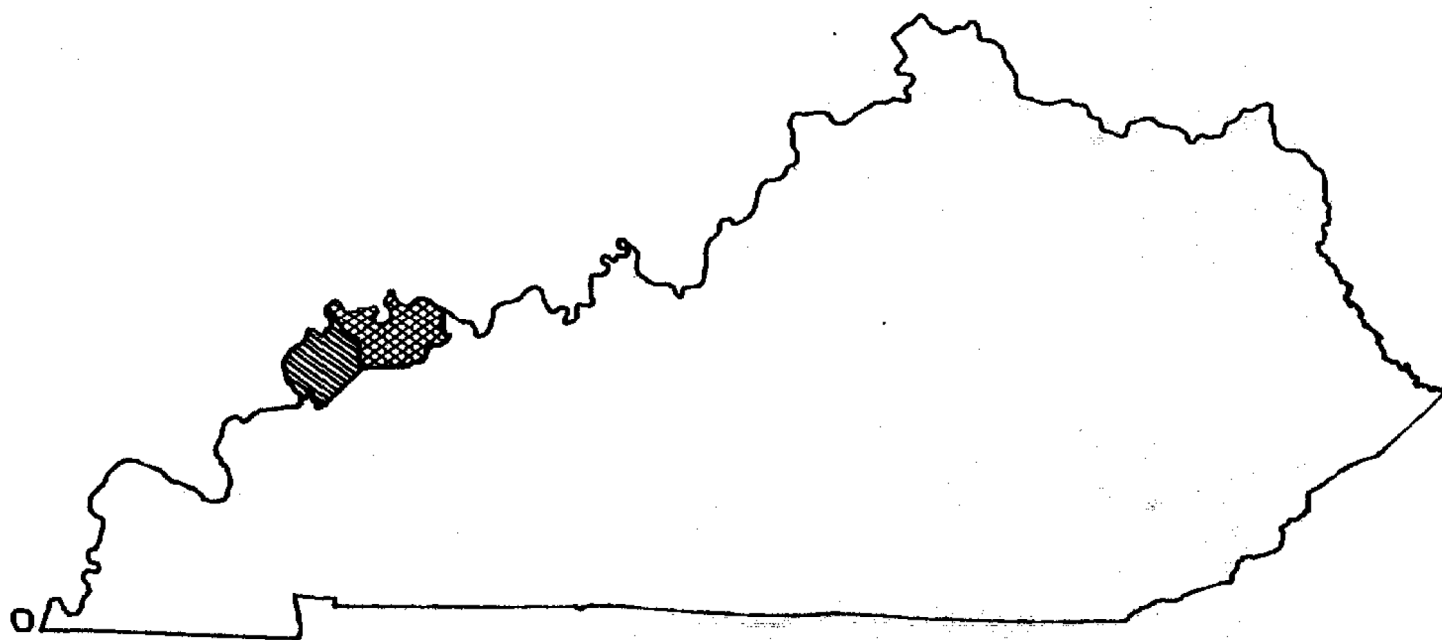
III. Overall Summary (All data were from Production Facilities)

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
Statewide					
a. Background	21	10.0	12.5	14.6	15
b. Max Reading	21	15.0	23.0	67.0	350
c. Difference	21	3.0	15.0	59.0	340

NOTE: All data are measured in micro-rem/hr

FIGURE 1 — MEDIAN BACKGROUND LEVELS

KENTUCKY



MICRO-REMS/HR



NO DATA

5.0 - 9.0



0 - 2.33

9.01 - 14.0



2.34 - 4.99

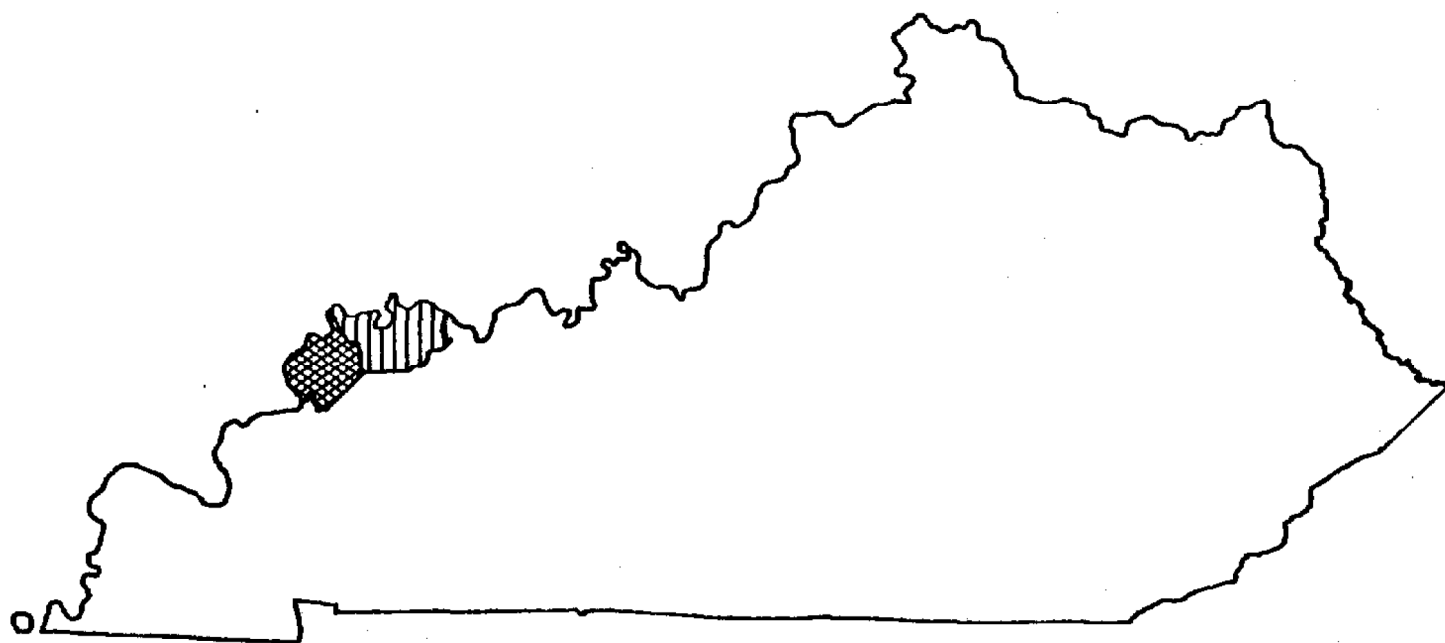
OVER 14.0

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FIGURE 2 — MEDIAN DIFFERENCE OVER BACKGROUND

KENTUCKY

PRODUCTION FACILITIES



MICRO-REMS/HR

NO DATA
2 - 33

BELOW .8
33.01 - 245

.8 - 1.99
OVER 245

AMERICAN PETROLEUM INSTITUTE
NATURALLY OCCURRING RADIOACTIVITY SURVEY

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

FACILITY: Production

Median of Difference Over Background

**Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)**

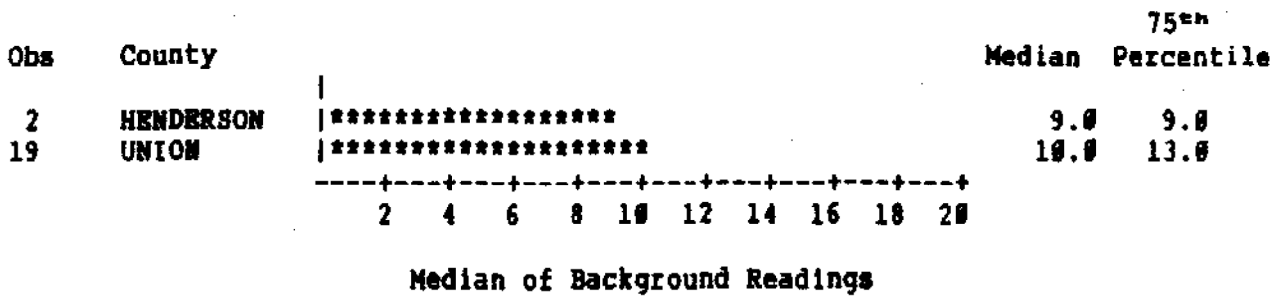
FACILITY: Production

Median of Difference Over Background

Table 3

**Median Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)**

Kentucky



Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Kentucky

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
<u>Production Facilities</u>							
OTHER	14	2.871	18	8	8.88	8	3.58
SUMP	1	8.888	8	8	8.88	8	8.88
SEP	4	35.888	62	14	14.75	32	58.25
WTANK	2	178.888	348	16	16.88	178	348.88

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

Kentucky

FACILITY	COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
PROD	HENDERSON	2	0.0000	0	0	0	0	0
PROD	UNION	19	28.0526	340	0	0	5	16

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

Kentucky

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
HENDERSON	2	9.0000	9	9	9	9	9
UNION	19	10.3684	15	7	8	10	13

SUMMARY

(Louisiana)

I. All significant differences were equipment specific.

The equipment with the most pronounced differences over background based on Median ranking are listed below in descending order. The difference is the excess of the reading over background:

Equipment	Median Difference	75 th Percentile
Water Line (Prod)	45.2	143.9

II. There were significant differences in background readings from parish to parish. Specifically, Cameron, and St. Landry were low. The remainder were mid-range except for Bossier, Caddo, Ascension, Lafayette, Red River, St. Helen, East and West Baton Rouge, and Pointe Coupee which were high and Iberville which was very high.

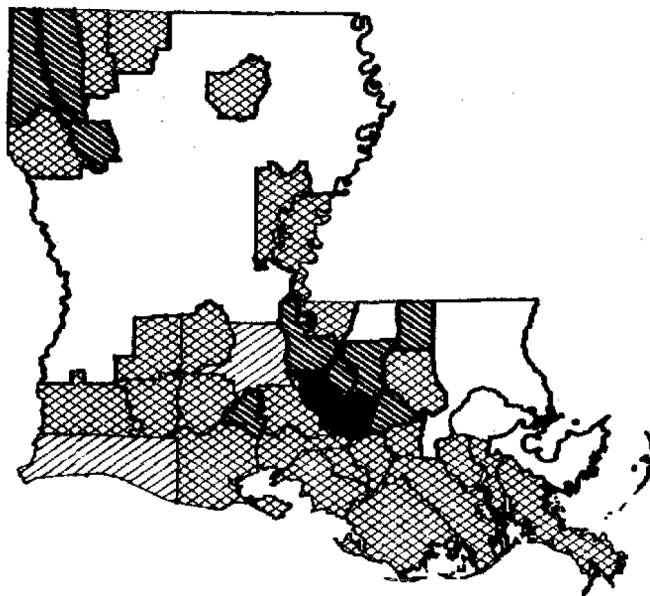
III. Overall Summary

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
1. Statewide					
a. Background	3,028	6.5	9.0	10.0	24.4
b. Max Reading	3,028	9.0	15.0	75.0	3,000.0
c. Difference	3,028	0.0	7.8	69.1	2,991.0
2. Facility					
a. Background					
Gas Processing	358	3.5	5.0	7.0	13.0
Production	2,670	7.0	9.5	10.3	24.4
b. Max Reading					
Gas Processing	358	5.0	8.0	18.7	500
Production	2,670	9.5	16.0	80.0	3,000
c. Difference					
Gas Processing	358	0.0	2.2	14.0	491
Production	2,670	0.0	9.0	74.9	2,991

NOTE: All data are measured in micro-rem/hr

FIGURE 1 — MEDIAN BACKGROUND LEVELS

LOUISIANA



MICRO-REMS/HR

NO DATA
5.0 - 9.0

0 - 2.33
9.01 - 14.0

2.34 - 4.99
OVER 14.0

AMERICAN PETROLEUM INSTITUTE
NATURALLY OCCURRING RADIOACTIVITY SURVEY

Median Difference Over Background by Parish
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

FACILITY: Production

-98-

Table 3

Median Background by Parish
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Louisiana

Obs	Parish		Median	75 th Percentile
383	CAMERON	*****	3.5	6.0
5	ST. LANDRY	*****	3.5	5.8
8	ASSUMPTION	*****	5.0	6.0
84	CALCASIEU	*****	5.0	7.0
67	IBERIA	*****	5.0	9.0
27	PLAQUEMINES	*****	5.0	8.0
204	ST. MARTIN	*****	5.0	7.0
60	ST. MARY	*****	5.0	10.0
158	TERREBONNE	*****	5.0	8.5
66	UNREPORTED	*****	5.0	7.3
336	VERMILION	*****	5.0	6.1
388	EVANGELINE	*****	6.0	7.0
85	CLAIBORNE	*****	7.0	7.0
36	JEFFERSON DAVIS	*****	7.0	7.0
138	LAFOURCHE	*****	7.0	8.0
6	OUACHITA	*****	7.0	7.0
35	ALLEN	*****	7.5	7.5
15	WEBSTER	*****	7.5	7.5
224	ACADIA	*****	8.0	11.0
2	CATAHOULA	*****	8.0	9.0
26	DESOTO	*****	8.0	10.0
2	ST JAMES	*****	8.0	8.0
4	CONCORDIA	*****	9.0	10.0
12	JEFFERSON	*****	9.0	10.0
121	LIVINGSTON	*****	9.0	9.0
34	ST. CHARLES	*****	9.0	9.0
1	WEST FELICIANA	*****	9.0	9.0
8	BOSSIER	*****	9.5	9.5
178	CADDO	*****	9.5	10.0
3	ASCENSION	*****	10.0	10.0
2	LAFAYETTE	*****	10.0	10.0
10	RED RIVER	*****	10.0	10.0
2	ST HELEN	*****	10.0	10.0
99	E. BATON ROUGE	*****	10.3	10.3
112	PT. COUPEE	*****	11.5	12.5
35	W. BATON ROUGE	*****	11.8	13.0
43	IBERVILLE	*****	15.5	24.4
-----+-----				
		2 4 6 8 10 12 14 16 18		
		Median of Background Reading		

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Louisiana

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
<u>Gas Processing Facilities</u>							
COMPRESSOR	39	4.3462	95.0	0.0	0.00	0.00	2.000
CRYO UNIT	5	5.4800	24.9	0.0	0.00	0.00	13.700
DEHYDRATOR	38	2.2816	36.8	0.0	0.00	0.00	1.350
INLET SCRUBBER	92	12.1848	491.0	0.0	0.00	0.00	1.000
METER	10	0.2600	1.1	0.0	0.00	0.00	0.625
OTHER	31	10.6548	261.9	0.0	0.00	0.00	3.000
PRODUCT LINE	7	3.0571	21.3	0.0	0.00	0.00	0.100
REFRIGERATION	10	0.5100	2.7	0.0	0.00	0.00	1.150
SWEETENER	19	0.6000	3.9	0.0	0.00	0.00	0.900
OTANK	14	5.2250	117.0	0.0	0.00	0.35	5.900
REFLUX PUMP	17	54.5824	400.3	0.0	0.00	0.50	19.050
BOTTOMS PUMP	5	6.8400	20.3	0.0	0.25	1.00	15.950
PPUMP	5	4.0200	11.0	0.0	0.45	3.60	7.800
PTANK	5	10.2200	33.6	0.5	1.75	5.00	21.300
OPUMP	18	43.6222	217.0	0.0	0.00	6.15	74.500
FRAC TOWER	13	18.9769	110.0	0.0	0.85	6.50	29.650
<u>Production Facilities</u>							
METER	5	12.400	49.0	0	0.0	0.0	31.000
OTHER	388	12.182	688.0	0	0.0	0.0	1.000
PUMP	114	2.352	90.0	0	0.0	0.0	0.000
SEP	760	42.954	2991.0	0	0.0	0.0	18.075
STANK	452	11.658	590.0	0	0.0	0.0	3.000
VRU	7	0.000	0.0	0	0.0	0.0	0.000
WOTHER	7	0.286	2.0	0	0.0	0.0	0.000
WPROD	73	9.433	194.0	0	0.0	0.0	5.000
WTANK	235	17.466	475.0	0	0.0	0.0	6.500
SUMP	72	6.653	69.0	0	0.0	1.0	6.000
H/T	322	56.722	1496.0	0	0.0	2.0	46.500
MANIFOLD	136	95.021	1444.0	0	0.0	3.5	90.000
FLINE	74	99.423	2991.0	0	0.0	8.0	72.000
WINJ	7	11.571	34.2	0	0.0	8.4	29.400
WLINE	18	180.983	1594.0	0	7.6	45.2	143.025

Appendix 2

Statistical Data on Median Difference over Background By Facility and Parish (Micro-Rems/Hr)

Lousiana

FACILITY	PARISH	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
GP	CALCASIEU	1	0.000	0.0	0	0.00	0.00	0.00
GP	CAMERON	172	8.911	400.3	0	0.00	0.00	2.25
GP	EVANGELINE	49	2.265	95.0	0	0.00	0.00	0.00
GP	IBERVILLE	2	0.000	0.0	0	0.00	0.00	0.00
GP	ST. MARTIN	7	21.857	104.0	0	0.00	0.00	49.00
GP	VERMILION	74	4.470	261.9	0	0.00	0.00	0.50
GP	JEFFERSON DAVIS	5	1.000	2.0	0	0.00	1.00	2.00
GP	IBERIA	6	31.500	121.0	1	1.00	3.50	74.50
GP	ACADIA	19	39.316	217.0	0	0.00	3.00	59.00
GP	UNREPORTED	13	6.385	18.0	0	2.00	5.00	9.50
GP	TERREBONNE	2	8.000	12.0	8	8.00	10.00	12.00
GP	LAFOURCHE	4	131.500	491.0	4	4.25	15.50	374.75
GP	ST. MARY	3	75.333	117.0	47	47.00	62.00	117.00
GP	ST. CHARLES	1	147.000	147.0	147	147.00	147.00	147.00
PROD	ALLEN	35	0.257	3.5	0	0.00	0.00	0.00
PROD	BOSSIER	8	3.188	25.5	0	0.00	0.00	0.00
PROD	CADDO	178	1.677	75.0	0	0.00	0.00	0.00
PROD	CALCASIEU	83	2.443	58.0	0	0.00	0.00	2.00
PROD	CLAIBORNE	85	1.400	50.5	0	0.00	0.00	0.00
PROD	DESOTO	26	1.365	17.5	0	0.00	0.00	0.00
PROD	E. BATON ROUGE	99	4.910	104.7	0	0.00	0.00	3.00
PROD	EVANGELINE	339	4.248	264.5	0	0.00	0.00	0.00
PROD	JEFFERSON DAVIS	31	9.194	226.0	0	0.00	0.00	2.50
PROD	LAFAYETTE	2	0.000	0.0	0	0.00	0.00	0.00
PROD	LIVINGSTON	121	0.242	21.0	0	0.00	0.00	0.00
PROD	PT. COUPEE	112	3.621	137.5	0	0.00	0.00	0.00
PROD	OUACHITA	6	0.000	0.0	0	0.00	0.00	0.00
PROD	RED RIVER	10	2.300	15.0	0	0.00	0.00	2.75
PROD	ST HELEN	2	0.000	0.0	0	0.00	0.00	0.00
PROD	ST. CHARLES	33	10.167	146.0	0	0.00	0.00	7.00
PROD	ST. LANDRY	5	1.400	7.0	0	0.00	0.00	3.50
PROD	VERMILION	262	21.164	321.3	0	0.00	0.00	9.00
PROD	W. BATON ROUGE	35	0.100	3.5	0	0.00	0.00	0.00
PROD	WEBSTER	15	0.333	3.0	0	0.00	0.00	0.00
PROD	UNREPORTED	53	29.436	425.0	0	0.00	0.00	19.00
PROD	WEST FELICIANA	1	0.000	0.0	0	0.00	0.00	0.00
PROD	IBERVILLE	41	10.707	144.0	0	0.00	0.10	4.05
PROD	CAMERON	211	9.599	194.0	0	0.00	1.00	5.00
PROD	ACADIA	205	68.190	2991.0	0	0.00	4.00	38.00

SUMMARY

(Michigan)

- I. There were no significant differences between items of equipment.
- II. There were significant differences in background readings from county to county. Specifically, Antrim, Crawford, Grand Traverse, and Kalkaska counties were very low while Calhoun, Eaton, and Ingham were mid-range.

III. Overall Summary

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
1. Statewide					
a. Background	695	5.0	6.0	7.0	10
b. Max Reading	695	5.0	7.0	10.0	3,500
c. Difference	695	0.0	0.0	2.4	3,490
2. Facility					
a. Background					
Gas Processing	348	6.0	7.0	7.0	10
Production	347	4.8	6.0	7.0	10
b. Max Reading					
Gas Processing	348	6.0	7.0	8.0	131
Production	347	5.0	7.0	19.2	3,500
c. Difference					
Gas Processing	348	0.0	0.0	1.0	127
Production	347	0.0	0.0	14.0	3,490

NOTE: All data are measured in micro-rem/hr

FIGURE 1 - MEDIAN BACKGROUND LEVELS

MICHIGAN



MICRO-REMS/HR



NO DATA



5.0 - 9.0



0 - 2.33



9.01 - 14.0



2.34 - 4.99



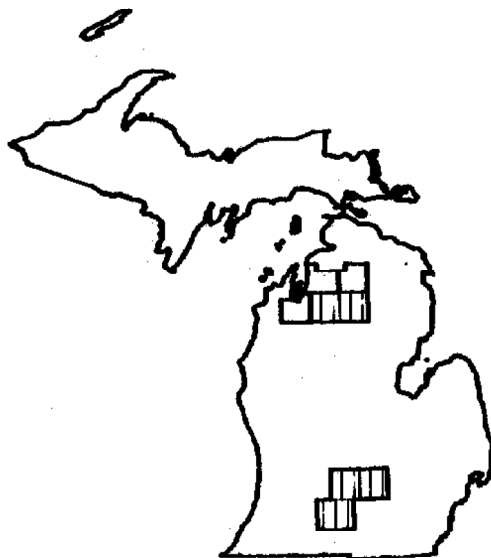
OVER 14.0

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 2 - DIFFERENCE OVER BACKGROUND

MICHIGAN

GAS PROCESSING FACILITIES



MICRO-REMS/HR



NO DATA
2 - 33



BELOW .8
33.01 - 245



.8 - 1.99
OVER 245

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 3 – DIFFERENCE OVER BACKGROUND

MICHIGAN

PRODUCTION FACILITIES



MICRO-REMS/HR

NO DATA
2 - 33

BELOW .8
33.01 - 245

.8 - 1.99
OVER 245

AMERICAN PETROLEUM INSTITUTE
NATURALLY OCCURRING RADIOACTIVITY SURVEY

Table 1

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Michigan

FACILITY: Gas Processing

Obsns	Equipment	Median Difference	75 th Percentile
3	BOTTOMS PUMP	0.0	1.0
18	COMPRESSOR	0.0	0.0
13	DEHYDRATOR	0.0	0.0
39	INLET SCRUBBER	0.0	0.0
22	METER	0.0	0.0
58	OPUMP	0.0	0.0
97	OTANK	0.0	0.0
52	OTHER	0.0	0.0
28	PRODUCT LINE	0.0	0.0
5	PPUMP	0.1	6.4
5	FRAC TOWER	0.3	0.8
11	PTANK	26.0	46.0
5	REFRIGERATION	26.0	82.5

-----+-----+-----+-----+-----+-----+
10 20 30 40 50 60

Median of Difference Over Background

FACILITY= Production

10	FLINE	0.0	0.0
31	H/T	0.0	11.0
19	MANIFOLD	0.0	0.0
3	METER	0.0	0.0
89	OTHER	0.0	0.0
26	PUMP	0.0	0.0
39	SEP	0.0	0.1
58	STANK	0.0	11.3
10	SUMP	0.0	24.8
17	VRU	0.0	0.0
1	WINJ	0.0	0.0
2	WLINE	0.0	0.0
3	WOTHER	0.0	0.0
11	WPROD	0.0	0.0
28	WTANK	0.65	13.8

-----+-----+-----+-----+-----+-----+
10 20 30 40 50 60

Median of Difference Over Background

Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

FACILITY: Gas Processing

Median of Difference Over Background

10	ANTRIM		0.0	0.8
157	CALHOUN		0.0	0.0
18	CRAWFORD		0.0	0.0
5	EATON		0.0	0.0
26	GRAND TRAVERSE		0.0	0.0
36	INGHAM		0.0	0.0
49	KALKASKA		0.0	0.1
10	OTSEGO		0.0	0.0
36	UNREPORTED	*****	14.0	25.0
-----+---+---+---+---+---+---+---+---+---+---				
3 6 9 12 15 18 21 24 27 30 33				

-109-

Median Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Obs	County	Median	Percentile
10	ANTRIM	0.3	0.3
19	CRAWFORD	0.4	0.4
26	GRAND TRAVERSE	0.4	0.4
82	KALKASKA	0.4	0.4
10	OTSEGO	0.8	0.8
49	UNREPORTED	4.0	4.0
226	CALHOUN	5.0	6.0
48	EATON	6.0	7.0
225	INGHAM	6.0	7.0

Median of Background Reading

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Michigan

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
<u>Gas Processing Facilities</u>							
BOTTOMS PUMP	3	0.3333	1.0	0	0.00	0.0	1.00
COMPRESSOR	18	0.1667	1.0	0	0.00	0.0	0.00
DEHYDRATOR	13	0.0846	1.1	0	0.00	0.0	0.00
INLET SCRUBBER	39	0.0795	1.0	0	0.00	0.0	0.00
METER	22	0.0909	1.0	0	0.00	0.0	0.00
OPUMP	58	1.3069	41.0	0	0.00	0.0	0.00
OTANK	97	0.1856	6.0	0	0.00	0.0	0.00
OTHER	52	0.0962	1.0	0	0.00	0.0	0.00
PRODUCT LINE	20	1.3500	25.0	0	0.00	0.0	0.00
PPUMP	5	2.5600	9.6	0	0.00	0.1	6.35
FRAC TOWER	5	0.4000	1.1	0	0.10	0.3	0.75
PTANK	11	33.6091	96.0	0	2.10	26.0	46.00
REFRIGERATION	5	38.2200	127.0	0	0.05	26.0	82.50

Production Facilities

FLINE	10	0.100	1.0	0	0	0.00	0.00
H/T	31	136.042	3490.0	0	0	0.00	11.00
MANIFOLD	19	0.037	0.5	0	0	0.00	0.00
METER	3	0.000	0.0	0	0	0.00	0.00
OTHER	89	0.031	1.0	0	0	0.00	0.00
PUMP	26	0.000	0.0	0	0	0.00	0.00
SEP	39	117.392	2991.0	0	0	0.00	0.10
STANK	58	38.102	744.0	0	0	0.00	11.25
SUMP	10	9.500	30.0	0	0	0.00	24.75
VRU	17	0.941	16.0	0	0	0.00	0.00
WINJ	1	0.000	0.0	0	0	0.00	0.00
WLINE	2	0.000	0.0	0	0	0.00	0.00
WOTHER	3	0.000	0.0	0	0	0.00	0.00
WPROD	11	0.091	1.0	0	0	0.00	0.00
WTANK	28	8.564	91.0	0	0	0.65	13.75

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

Michigan

FACILITY	COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
GP	CALHOUN	69	0.4058	25.0	0	0.0	0.0	0.000
GP	CRAWFORD	1	0.0000	0.0	0	0.0	0.0	0.000
GP	EATON	43	0.1860	1.0	0	0.0	0.0	0.000
GP	INGHAM	189	0.3175	41.0	0	0.0	0.0	0.000
GP	KALKASKA	33	1.5939	14.6	0	0.0	0.1	1.350
GP	UNREPORTED	13	43.3077	127.0	6	18.5	35.0	71.000
PROD	ANTRIM	10	0.2700	0.9	0	0.0	0.0	0.000
PROD	CALHOUN	157	59.0382	3490.0	0	0.0	0.0	0.000
PROD	CRAWFORD	18	0.1444	2.4	0	0.0	0.0	0.000
PROD	EATON	5	0.0000	0.0	0	0.0	0.0	0.000
PROD	GRAND TRAVERSE	26	0.0385	0.6	0	0.0	0.0	0.000
PROD	INGHAM	36	0.4722	16.0	0	0.0	0.0	0.000
PROD	KALKASKA	49	0.1245	2.5	0	0.0	0.0	0.100
PROD	OTSEGO	10	0.0400	0.3	0	0.0	0.0	0.025
PROD	UNREPORTED	36	57.3056	896.0	0	6.5	14.0	25.000

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

Michigan

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
ANTRIM	10	0.30000	0.3	0.3	0.3	0.3	0.3
CRAWFORD	19	0.40000	0.4	0.4	0.4	0.4	0.4
GRAND TRAVERSE	26	0.36154	0.4	0.3	0.3	0.4	0.4
KALKASKA	82	0.35488	0.4	0.3	0.3	0.4	0.4
OTSEGO	10	0.80000	0.8	0.8	0.8	0.8	0.8
UNREPORTED	49	3.64286	4.0	1.5	4.0	4.0	4.0
CALHOUN	226	5.68496	10.0	3.0	5.0	5.0	6.0
EATON	48	6.02083	9.0	4.0	5.0	6.0	7.0
INGHAM	225	6.11422	10.0	3.0	5.0	6.0	7.0

SUMMARY

(Mississippi)

I. All significant differences were equipment specific.

The equipment with the most pronounced differences over background based on Median ranking are listed below in descending order. The difference is the excess of the reading over background:

Equipment			Median Difference	75 th Percentile
1.	Flow Line	(Prod)	106 μ R/hr	133.0 μ R/hr
2.	Water Line	(Prod)	105	135.0
3.	Heater Treater	(Prod)	74	307.5
4.	Injection Well	(Prod)	45	90.0
5.	Inlet Scrubber	(GP)	38	38.0
6.	Separator	(Prod)	36	136.0
7.	Manifold	(Prod)	33	96.0

II. Jefferson, Jefferson Davis, Smith, and Lincoln counties had low background levels. The remaining ones were mid-range except for Wayne, Lamar, Perry, and Waltham which were high.

III. Overall Summary

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
1. Statewide					
a. Background	911	5.0	8.0	15.0	22
b. Max Reading	911	25.0	120.0	400.0	4,500
c. Difference	911	20.0	115.0	395.8	4,491
2. Facility					
a. Background					
Gas Processing	4	6.0	7.0	7.0	7
Production	907	5.0	8.0	15.0	22
b. Max Reading					
Gas Processing	4	6.0	35.5	45.0	45
Production	907	25.0	120.0	402.0	4,500
c. Difference					
Gas Processing	4	0.0	28.5	38.0	38
Production	911	20.0	115.0	398.0	4,491

NOTES: 1) All data are measured in micro-rems/hr

2) The apparent differences between facilities are due to the specific items of equipment listed in Section I above.

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

Michigan

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
ANTRIM	18	0.30000	0.3	0.3	0.3	0.3	0.3
CRAWFORD	19	0.40000	0.4	0.4	0.4	0.4	0.4
GRAND TRAVERSE	26	0.36154	0.4	0.3	0.3	0.4	0.4
KALKASKA	82	0.35488	0.4	0.3	0.3	0.4	0.4
OTSEGO	18	0.80000	0.8	0.8	0.8	0.8	0.8
UNREPORTED	49	3.64286	4.0	1.5	4.0	4.0	4.0
CALHOUN	226	5.68496	10.0	3.0	5.0	5.0	6.0
EATON	48	6.02083	9.0	4.0	5.0	6.0	7.0
INGHAM	225	6.11422	10.0	3.0	5.0	6.0	7.0

SUMMARY

(Mississippi)

I. All significant differences were equipment specific.

The equipment with the most pronounced differences over background based on Median ranking are listed below in descending order. The difference is the excess of the reading over background:

Equipment	Median Difference	75 th Percentile
1. Flow Line (Prod)	186 μ R/hr	133.0 μ R/hr
2. Water Line (Prod)	105	135.0
3. Heater Treater (Prod)	74	387.5
4. Injection Well (Prod)	45	90.0
5. Inlet Scrubber (GP)	38	38.0
6. Separator (Prod)	36	136.0
7. Manifold (Prod)	33	96.0

II. Jefferson, Jefferson Davis, Smith, and Lincoln counties had low background levels. The remaining ones were mid-range except for Wayne, Lamar, Perry, and Waltham which were high.

III. Overall Summary

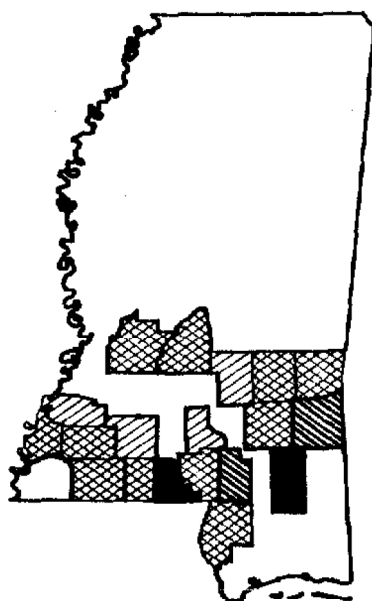
ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
1. Statewide					
a. Background	911	5.0	8.0	15.0	22
b. Max Reading	911	25.0	120.0	400.0	4,500
c. Difference	911	20.0	115.0	395.0	4,491
2. Facility					
a. Background					
Gas Processing	4	6.0	7.0	7.0	7
Production	907	5.0	8.0	15.0	22
b. Max Reading					
Gas Processing	4	6.0	35.5	45.0	45
Production	907	25.0	120.0	402.0	4,500
c. Difference					
Gas Processing	4	0.0	28.5	38.0	38
Production	911	20.0	115.0	398.0	4,491

NOTES: 1) All data are measured in micro-rems/hr

2) The apparent differences between facilities are due to the specific items of equipment listed in Section I above.

FIGURE 1 - MEDIAN BACKGROUND LEVELS

MISSISSIPPI



MICRO-REMS/HR



NO DATA



5.0 - 9.0



0 - 2.33



9.01 - 14.0



2.34 - 4.99



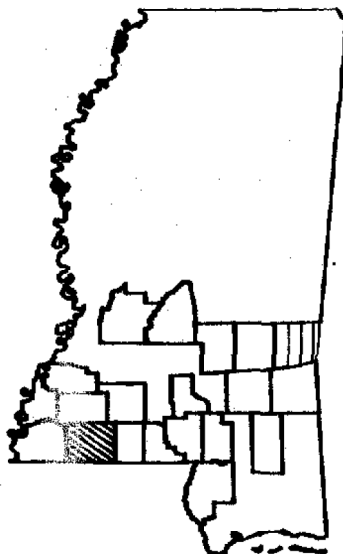
OVER 14.0

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FIGURE 2 — DIFFERENCE OVER BACKGROUND

MISSISSIPPI

GAS PROCESSING FACILITIES



MICRO-REMS/HR



NO DATA
2 - 33



BELOW .8
33.01 - 245

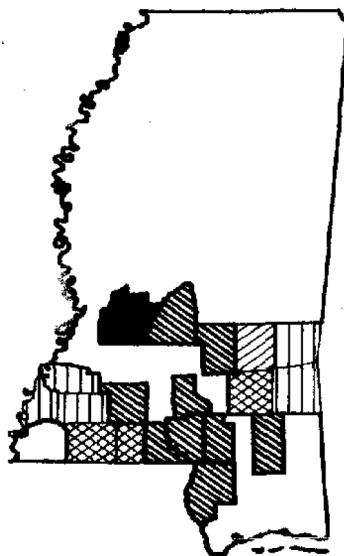


.8 - 1.99
OVER 245

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 3 — DIFFERENCE OVER BACKGROUND

MISSISSIPPI
PRODUCTION FACILITIES



MICRO-REMS/HR



NO DATA
2 - 33



BELOW .8
33.01 - 245



.8 - 1.99
OVER 245

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

Table 1

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Mississippi

FACILITY: Gas Processing

Obsns	Equipment	Median Difference	75 th Percentile
3	COMPRESSOR	0.0	0.0
1	INLET SCRUBBER	38.0	38.0
4			

Median of Difference Over Background

FACILITY: Production

13	PUMP	0.0	42.5
101	STANK	0.0	20.1
1	SUMP	0.0	0.0
92	OTHER	5.0	33.8
124	WPROD	12.5	76.0
143	WTANK	23.0	145.0
72	MANIFOLD	33.0	96.0
168	SEP	36.0	136.0
10	WINJ	45.0	90.0
158	H/T	74.0	387.5
12	WLINE	105.0	135.0
13	FLINE	106.0	133.0

Median of Difference Over Background

Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

FACILITY: Gas Processing

Obsns County		Median Difference	75 th Percentile
3	CLARKE	8.0	0
1	AMITE	38.0	38

Median of Difference Over Background

18	ADAMS			0	0.3
97	CLARKE			0	0.0
23	FRANKLIN			0	0.5
23	JEFFERSON			0	9.4
64	WAYNE			0	28.9
83	JASPER			1	16.0
1	PIKE	*		10	10.0
2	AMITE	***		23	28.0
232	JONES	****		29	135.8
5	PERRY	*****		35	70.0
152	MARION	*****		45	141.0
11	JEFFERSON DAVIS	*****		56	106.0
4	PEARL RIVER	*****		56	391.3
12	LINCOLN	*****		60	970.0
94	SMITH	*****		95	195.0
11	WALTHALL	*****		115	185.0
16	LAMAR	*****		140	624.5
14	RANKIN	*****		201	1095.0
45	HINDS	*****		345	995.0
		-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+			
		30 60 90 120 150 180 210 240 270 300 330			
Median of Difference Over Background					

Mississippi

- 120 -

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Mississippi

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
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Gas Processing Facilities

COMPRESSOR	3	0	0	0	0	0	0
INLET SCRUBBER	1	38	38	38	38	38	38

Production Facilities

PUMP	13	35.385	235	0.0	0.000	0.0	42.50
STANK	101	37.671	585	0.0	0.000	0.0	20.10
SUMP	1	0.000	0	0.0	0.000	0.0	0.00
OTHER	92	47.449	595	0.0	0.000	5.0	33.75
WPROD	124	83.242	1196	0.0	3.000	12.5	76.00
WTANK	143	140.731	1995	0.0	0.000	23.0	145.00
MANIFOLD	72	177.033	2995	0.0	14.000	33.0	96.00
SEP	168	229.172	4491	0.0	9.250	36.0	136.00
WINJ	10	69.000	245	0.0	20.000	45.0	90.00
H/T	150	312.908	2995	0.0	1.875	74.0	387.50
WLINE	12	102.325	245	1.7	47.500	105.0	135.00
FLINE	13	140.077	843	0.0	12.500	106.0	133.00

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

Mississippi

FACILITY	COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
GP	CLARKE	3	0.000	0.0	0	0.00	0.0	0.00
GP	AMITE	1	38.000	38.0	38	38.00	38.0	38.00
PROD	ADAMS	18	1.250	10.5	0	0.00	0.0	0.25
PROD	CLARKE	97	0.809	21.0	0	0.00	0.0	0.00
PROD	FRANKLIN	23	0.357	2.0	0	0.00	0.0	0.50
PROD	JEFFERSON	23	10.013	125.5	0	0.00	0.0	9.40
PROD	WAYNE	64	85.102	1590.0	0	0.00	0.0	28.87
PROD	JASPER	83	35.663	585.0	0	0.00	1.0	16.00
PROD	PIKE	1	10.000	10.0	10	10.00	10.0	10.00
PROD	AMITE	2	23.000	28.0	18	18.00	23.0	28.00
PROD	JONES	232	140.267	2292.0	0	7.00	29.0	135.75
PROD	PERRY	5	35.000	85.0	0	0.00	35.0	70.00
PROD	MARION	152	175.309	4491.0	0	9.00	45.0	141.00
PROD	JEFFERSON DAVIS	11	68.182	116.0	10	26.00	56.0	106.00
PROD	PEARL RIVER	4	158.250	495.0	25	27.00	56.5	391.25
PROD	LINCOLN	12	602.833	2996.0	14	20.25	60.0	970.00
PROD	SMITH	94	188.968	1995.0	1	25.50	95.0	195.00
PROD	WALTHALL	11	245.000	1385.0	45	95.00	115.0	185.00
PROD	LAMAR	16	363.125	1887.0	15	55.25	140.5	624.50
PROD	RANKIN	14	819.000	3396.0	25	88.50	201.0	1095.00
PROD	HINDS	45	645.400	2995.0	15	95.00	345.0	995.00

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

Mississippi

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
JEFFERSON	23	9.0652	17.9	3.5	3.5	3.5	17.9
JEFFERSON DAVIS	11	7.1818	11.0	4.0	4.0	4.0	11.0
SMITH	94	4.3617	5.0	4.0	4.0	4.0	5.0
LINCOLN	12	4.5000	5.0	4.0	4.0	4.5	5.0
CLARKE	100	6.9500	15.0	3.0	3.0	5.0	9.0
HINDS	45	4.6889	5.0	4.0	4.0	5.0	5.0
JASPER	83	6.9759	15.0	4.0	5.0	5.0	8.0
JONES	232	5.1250	15.0	4.0	4.0	5.0	5.0
MARION	152	6.9737	15.0	4.0	5.0	5.0	9.0
PEARL RIVER	4	5.0000	5.0	5.0	5.0	5.0	5.0
PIKE	1	5.0000	5.0	5.0	5.0	5.0	5.0
RANKIN	14	4.5714	5.0	4.0	4.0	5.0	5.0
FRANKLIN	23	5.5000	5.5	5.5	5.5	5.5	5.5
AMITE	3	7.0000	7.0	7.0	7.0	7.0	7.0
ADAMS	18	8.4167	8.5	7.0	8.5	8.5	8.5
WAYNE	64	11.7141	22.2	3.5	3.5	11.0	15.8
LAMAR	16	11.2500	13.0	6.0	10.0	11.5	13.0
PERRY	5	15.0000	15.0	15.0	15.0	15.0	15.0
WALTHALL	11	15.0000	15.0	15.0	15.0	15.0	15.0

SUMMARY

(Montana)

- I. All of the reported readings in Montana were from Production Facilities. All significant differences were due to Water Tank readings in Sheridan county. This item of equipment is noted below:

Equipment	Median Difference	75 th Percentile
Water Tank (Prodn)	92 μ R/hr	212 μ R/hr

- II. All counties had mid-range background levels except Roosevelt which was high.

III. Overall Summary (Production Facilities)

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
Statewide					
a. Background	700	7.0	8.0	10.0	12
b. Max Reading	700	8.0	9.0	15.0	625
c. Difference	700	0.0	0.0	5.9	615

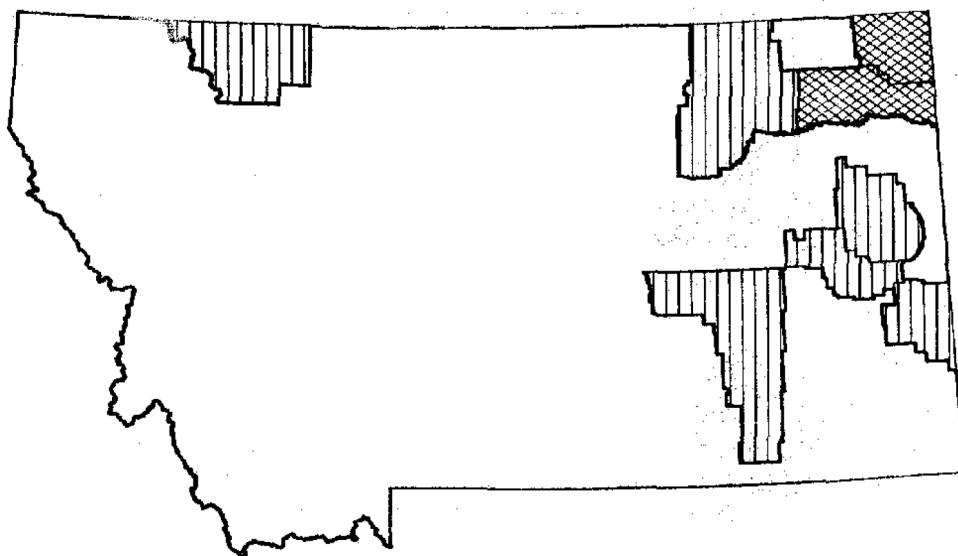
NOTE: All data are measured in micro-rem/hr

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 2 - MEDIAN DIFFERENCE OVER BACKGROUND

MONTANA

PRODUCTION FACILITIES



MICRO-REMS/HR



NO DATA

2 - 99



BELOW .8

99.01 - 245



.8 - 1.99

OVER 245

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

**Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)**

FACILITY: Production

Median of Difference over Background

**Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)**

FACILITY: Production

-128-

Table 3
Median Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Montana

Obsns	County		Median	75th Percentile
53	DAWSON	*****	7.0	8.0
348	FALLON	*****	7.0	8.0
57	PRAIRIE	*****	7.0	7.0
89	SHERIDAN	*****	8.0	10.0
10	GLACIER	*****	9.0	9.0
30	ROSEBUD	*****	9.0	9.0
103	VALLEY	*****	9.0	9.0
10	ROOSEVELT	*****	11.0	12.0
		-----+-----+-----+-----+-----+-----+-----+-----+-----+		
		2 4 6 8 10 12 14 16 18		
Median of Background Reading				

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Montana

Equipment	No	Average	Maximum	Minimum	PCT25	Median	PCT75
H/T	71	47.761	615	0	0.00	0.0	0.0
MANIFOLD	5	0.000	0	0	0.00	0.0	0.0
METER	1	0.000	0	0	0.00	0.0	0.0
OTHER	5	22.400	112	0	0.00	0.0	56.0
SEP	401	0.031	10	0	0.00	0.0	0.0
STANK	53	5.189	35	0	0.00	0.0	6.0
WPROD	17	1.000	10	0	0.00	0.0	0.0
SUMP	0	27.125	92	0	1.25	3.0	75.0
PUMP	11	24.091	92	0	0.00	12.0	42.0
WINJ	2	10.000	36	0	0.00	18.0	36.0
WLINE	3	40.667	92	2	2.00	20.0	92.0
FLINE	4	53.750	152	6	11.25	28.5	121.5
WTANK	39	120.436	370	0	0.00	92.0	212.0

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

Montana

FACILITY	COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
PROD	DAWSON	53	0.2453	10	0	0.00	0	0.00
PROD	FALLOW	348	0.0000	0	0	0.00	0	0.00
PROD	GLACIER	10	0.0000	0	0	0.00	0	0.00
PROD	PRAIRIE	57	0.0351	1	0	0.00	0	0.00
PROD	ROSEBUD	30	0.0333	1	0	0.00	0	0.00
PROD	VALLEY	103	0.0777	5	0	0.00	0	0.00
PROD	ROOSEVELT	10	72.9000	228	0	1.75	21	164.25
PROD	SHERIDAN	89	96.7303	615	0	2.00	30	127.50

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

Montana

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
DAWSON	53	7.5094	9	7	7	7	8
FALLON	348	7.3247	12	7	7	7	8
PRAIRIE	57	7.0351	9	7	7	7	7
SHERIDAN	89	8.4944	10	7	8	8	10
GLACIER	10	9.0000	9	9	9	9	9
ROSEBUD	30	9.1000	10	9	9	9	9
VALLEY	103	8.7767	10	8	8	9	9
ROOSEVELT	10	11.0000	12	10	10	11	12

SUMMARY

(Nebraska)

I. There were no significant differences between items of equipment. All readings were quite low.

II. All data came from Red Willow county which had a mid-range background level.

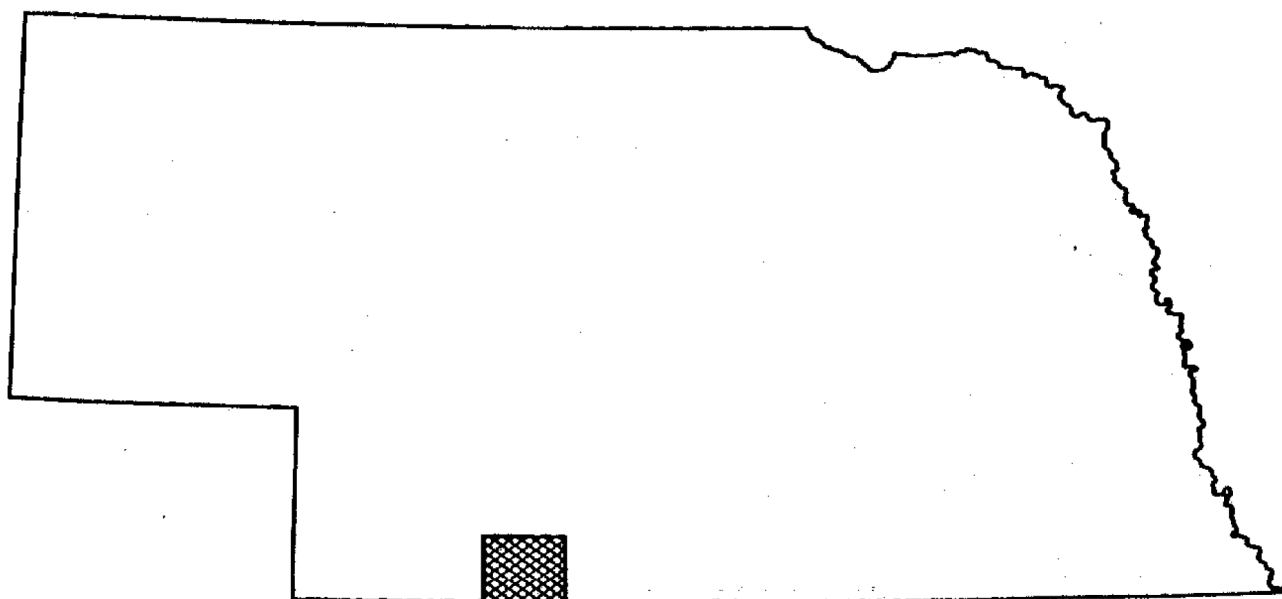
III. Overall Summary (There were no Gas Processing data)

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
Statewide (Red Willow County)					
a. Background	30	6.3	6.5	6.5	6.5
b. Max Reading	30	6.3	6.5	12.2	20.0
c. Difference	30	0.0	0.0	5.7	13.5

NOTE: All data are measured in micro-rem/hr

FIGURE 1 — MEDIAN BACKGROUND LEVELS

NEBRASKA



MICRO-RMS/HR



NO DATA

5.0 - 9.0



0 - 2.99

9.01 - 14.0



2.34 - 4.99

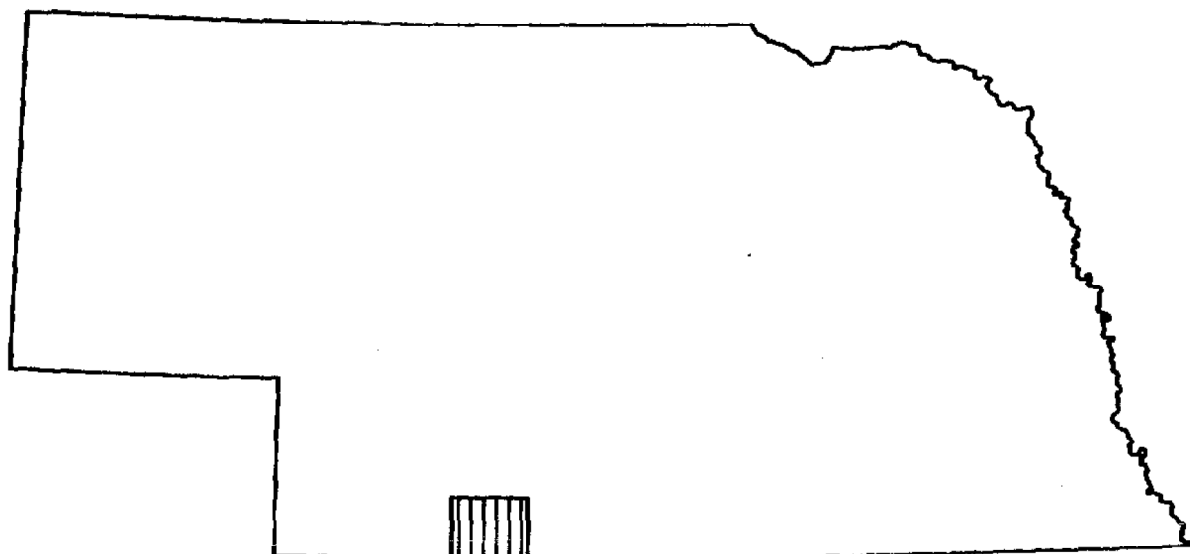
OVER 14.0

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FIGURE 2 — MEDIAN DIFFERENCE OVER BACKGROUND

NEBRASKA

PRODUCTION FACILITIES



MICRO-RENS/HR

NO DATA
2 - 33

BELOW .8
33.01 - 245

.8 - 1.99
OVER 245

AMERICAN PETROLEUM INSTITUTE
NATURALLY OCCURRING RADIOACTIVITY SURVEY

Table 1

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Nebraska

FACILITY: Production

Obsns	Equipment	Median Difference	75 th Percentile
3	MANIFOLD	0.0	0.0
1	OTHER	0.0	0.0
6	PUMP	0.0	0.0
13	SEP	0.0	5.4
2	STANK	0.0	0.0
2	WLINE	0.0	0.0
3	WTANK	0.0	0.0
30			

10 20 30 40 50 60

Median of Difference Over Background

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Nebraska

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
<u>Production Facilities</u>							
MANIFOLD	3	0.00000	0.0	0	0	0	0.0
OTHER	1	0.00000	0.0	0	0	0	0.0
PUMP	6	0.00000	0.0	0	0	0	0.0
SEP	13	2.98462	13.5	0	0	0	5.4
STANK	2	0.00000	0.0	0	0	0	0.0
WLINE	2	0.00000	0.0	0	0	0	0.0
WTANK	3	0.00000	0.0	0	0	0	0.0

SUMMARY

(New Mexico)

I. All significant differences were equipment specific.

The equipment with the most pronounced differences over background based on Median ranking are listed below in descending order. The difference is the excess of the reading over background:

Equipment	Median Difference	75 th Percentile
Product line (1) (GP)	693 μ R/hr	693 μ R/hr

II. Union county had a very low background level, Lea, Chaves and Eddy were mid-range, and San Juan and Rio Arriba were high.

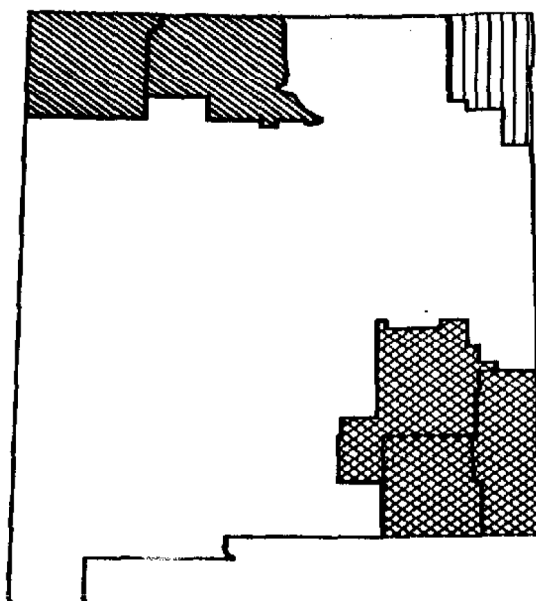
III. Overall Summary

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
1. Statewide					
a. Background	2,912	5.0	7.0	10.0	27
b. Max Reading	2,912	7.0	11.0	21.0	850
c. Difference	2,912	0.0	3.0	15.0	843
2. Facility					
a. Background					
Gas Processing	455	1.5	7.0	7.0	7
Production	2,457	5.0	8.0	11.0	27
b. Max Reading					
Gas Processing	455	3.5	7.0	30.0	750
Production	2,457	7.0	12.0	20.0	850
c. Difference					
Gas Processing	455	0.0	0.3	25.0	743
Production	2,457	0.0	3.0	15.0	843

NOTES: 1) All data are measured in micro-rams/hr

FIGURE 1 - MEDIAN BACKGROUND LEVELS

NEW MEXICO



MICRO-REMS/HR



NO DATA

5.0 - 9.0



0 - 2.33

9.01 - 14.0



2.34 - 4.99

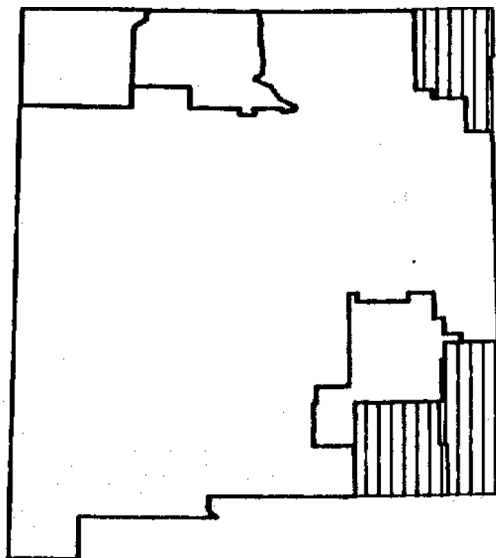
OVER 14.0

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 2 - DIFFERENCE OVER BACKGROUND

NEW MEXICO

GAS PROCESSING FACILITIES



MICRO-REMS/HR

NO DATA
2 - 33

BELOW .8
33.01 - 245

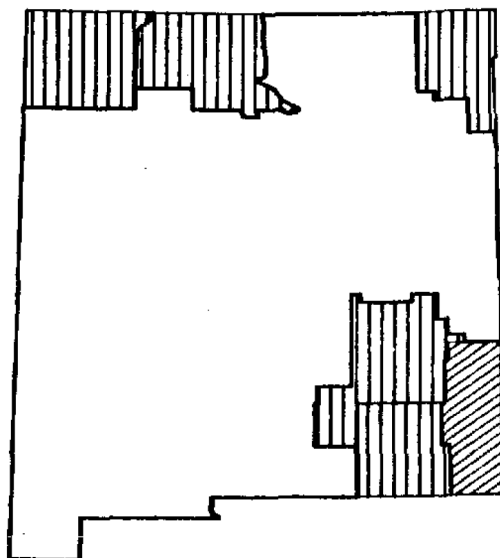
.8 - 1.99
OVER 245

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 3 — DIFFERENCE OVER BACKGROUND

NEW MEXICO

PRODUCTION FACILITIES



MICRO-REMS/HR

NO DATA
2 - 33

BELOW .8
33.01 - 245

.8 - 1.99
OVER 245

AMERICAN PETROLEUM INSTITUTE
NATURALLY OCCURRING RADIOACTIVITY SURVEY

Table 1

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

New Mexico

FACILITY: Gas Processing

Obsns	Equipment	Median Difference	75 th Percentile
221	COMPRESSOR	0.0	0.0
7	DEHYDRATOR	0.0	0.0
39	FRAC TOWER	0.0	1.0
24	INLET SCRUBBER	0.0	4.5
31	OTANK	0.0	2.0
22	OTHER	0.0	3.5
11	PPUMP	0.0	38.0
19	SWEETENER	0.0	0.0
7	CRYO UNIT	2.0	85.0
3	PUMP	3.0	73.0
18	REFRIGERATION	4.0	75.0
17	PTANK	5.0	23.5
15	OPUMP	5.0	53.0
9	METER	7.0	174.0
11	BOTTOMS PUMP	21.0	65.0
1	PRODUCT LINE	693.0	693.0
455			

Median of Difference Over Background

Facility: Production

256	PLINE	0.0	0.0
88	MANIFOLD	0.0	1.0
13	METER	0.0	0.0
58	OTHER	0.0	1.0
15	PUMP	0.0	5.0
577	SEP	0.0	4.0
691	STANK	0.0	3.0
5	VRU	0.0	1.5
63	WLINE	0.0	0.0
155	WPROD	0.0	0.0
2	WINJ	1.5	3.0
290	H/T	2.0	9.3
36	SUMP	2.0	88.3
200	WTANK	2.0	13.0
2457			

Median of Difference Over Background

Table 2

Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

New Mexico

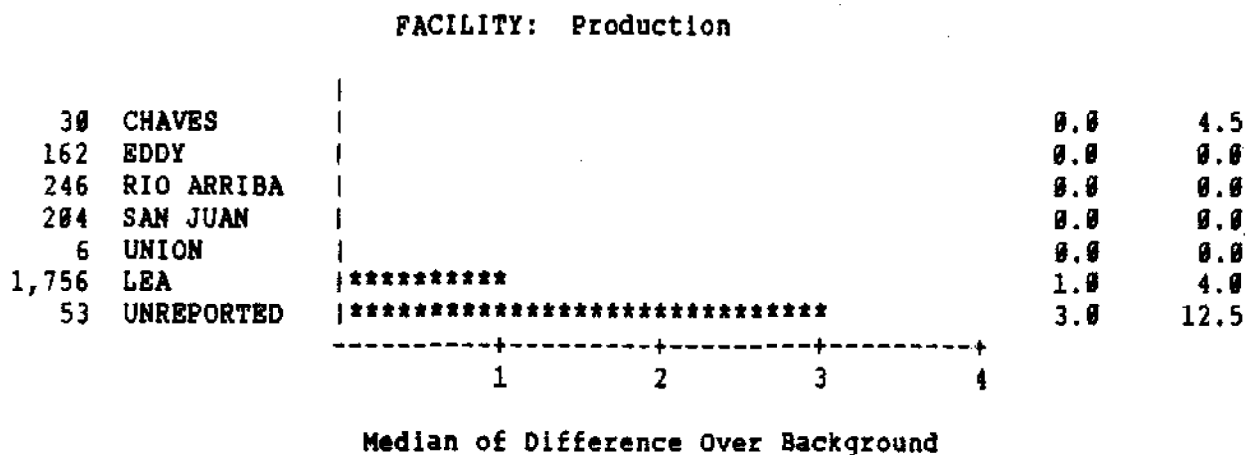
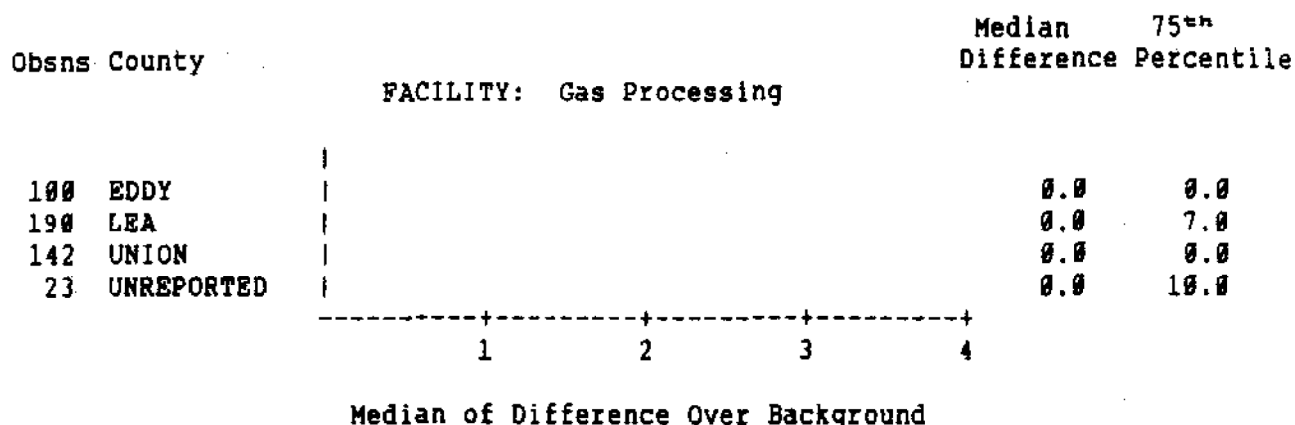


Table 3

Median Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

New Mexico

Obs	County		Median	Percentile
148	UNION	***	1.5	1.5
1,946	LEA	*****	5.0	6.0
76	UNREPORTED	*****	5.0	7.0
30	CHAVES	*****	6.0	7.0
262	EDDY	*****	6.0	8.0
204	SAN JUAN	*****	10.0	10.0
246	RIO ARRIBA	*****	13.0	13.0
		-----+-----+-----+-----+-----+-----+-----+-----		
		2 4 6 8 10 12 14		
Median of Background Reading				

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

New Mexico

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
<u>Gas Processing Facilities</u>							
COMPRESSOR	221	0.025	1.5	0	0	0	0.00
DEHYDRATOR	7	0.043	0.3	0	0	0	0.00
FRAC TOWER	39	6.782	115.0	0	0	0	1.00
INLET SCRUBBER	24	5.167	63.5	0	0	0	4.50
OTANK	31	23.355	383.0	0	0	0	2.00
OTHER	22	11.773	153.0	0	0	0	3.25
PPUMP	11	25.136	135.0	0	0	0	38.00
SWEETENER	19	3.158	50.0	0	0	0	0.00
CRYO UNIT	7	41.857	195.0	0	0	2	85.00
PUMP	3	25.333	73.0	0	0	3	73.00
REFRIGERATION	18	66.250	595.0	0	0	4	75.00
PTANK	17	22.735	215.0	0	0	5	23.50
OPUMP	15	115.933	743.0	0	0	5	53.00
METER	9	119.444	695.0	0	0	7	174.00
BOTTOMS PUMP	11	48.636	220.0	1	3	21	65.00
PRODUCT LINE	1	693.000	693.0	693	693	693	693.00

Production Facilities

FLINE	256	1.0742	239	0	0	0.0	0.00
MANIFOLD	88	2.7727	95	0	0	0.0	1.00
METER	13	0.0000	0	0	0	0.0	0.00
OTHER	58	11.4828	210	0	0	0.0	1.00
PUMP	15	7.8667	95	0	0	0.0	5.00
SEP	577	12.9726	582	0	0	0.0	4.00
STANK	691	8.2438	790	0	0	0.0	3.00
SUMP	36	65.3894	593	0	0	0.0	88.25
VRU	5	0.6000	3	0	0	0.0	1.50
WLINE	63	4.4921	78	0	0	0.0	0.00
WPROD	155	0.7613	20	0	0	0.0	0.00
WINJ	2	1.5000	3	0	0	1.5	3.00
H/T	290	21.1238	843	0	0	2.0	9.25
WTANK	208	18.9308	792	0	0	2.0	13.00

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

New Mexico

FACILITY	COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
GP	EDDY	100	2.1750	98.5	0	0	0.0	0.0
GP	LEA	190	34.4474	743.0	0	0	0.0	7.0
GP	UNION	142	0.0444	1.5	0	0	0.0	0.0
GP	UNREPORTED	23	40.6522	383.0	0	0	0.0	10.0
PROD	CHAVES	30	22.2667	370.0	0	0	0.0	4.5
PROD	EDDY	162	12.4938	444.0	0	0	0.0	0.0
PROD	RIO ARriba	246	0.1098	3.0	0	0	0.0	0.0
PROD	SAN JUAN	204	10.0049	790.0	0	0	0.0	0.0
PROD	UNION	6	0.0000	0.0	0	0	0.0	0.0
PROD	LEA	1756	11.6379	843.0	0	0	1.0	4.0
PROD	UNREPORTED	53	39.8679	545.0	0	0	3.0	12.5

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

New Mexico

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
UNION	148	1.3587	1.8	1.0	1.000	1.5	1.5
LEA	1946	5.6828	18.0	2.0	5.000	5.0	6.0
UNREPORTED	76	5.8158	8.0	5.0	5.000	5.0	7.0
CHAVES	30	6.8667	13.0	5.0	6.000	6.0	7.0
EDDY	262	5.8153	10.0	1.5	1.500	6.0	8.0
SAN JUAN	204	8.1382	14.0	3.3	4.575	10.0	10.0
RIO ARriba	246	12.2435	27.0	3.0	11.000	13.0	13.0

SUMMARY

(North Dakota)

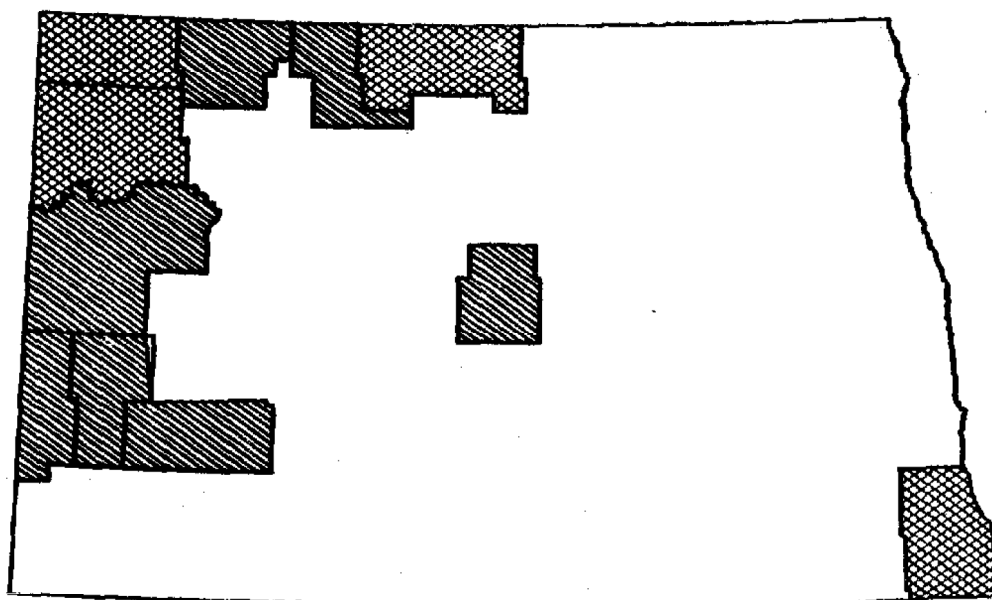
- I. North Dakota reported no Gas Processing equipment. There are no significant differences between types of equipment.
- II. Williams, Bottineau, Divide, and Richland counties had mid-range background levels while the remainder were high.
- III. Overall Summary (Production Facilities)

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
Statewide					
a. Background	856	10.0	12.0	13.0	15
b. Max Reading	856	10.0	12.0	19.3	400
c. Difference	856	0.0	0.0	8.3	389

NOTE: All data are measured in micro-rem/hr

FIGURE 1 - MEDIAN BACKGROUND LEVELS

NORTH DAKOTA



MICRO-REMS/HR



NO DATA

5.0 - 9.0



0 - 2.33

9.01 - 14.0



2.34 - 4.99

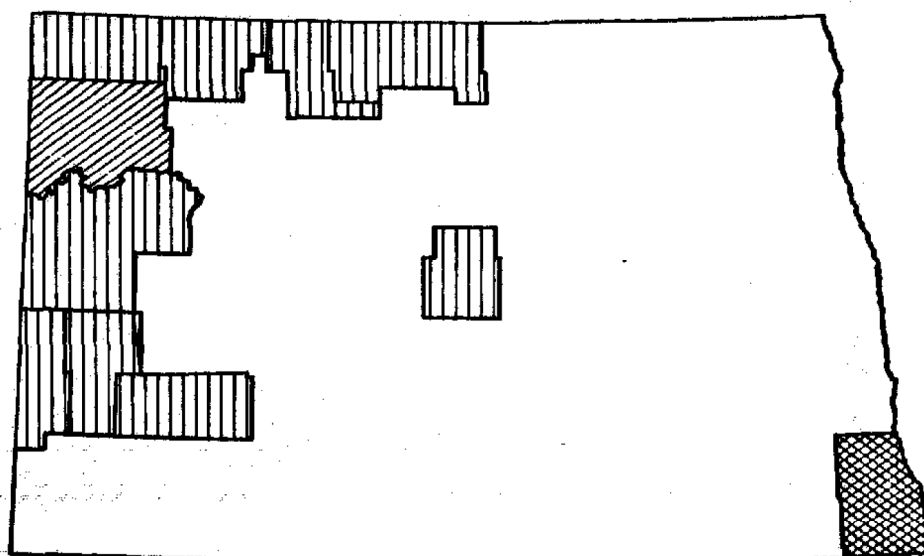
OVER 14.0

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NATURALLY OCCURRING RADIOACTIVITY SURVEY

FIGURE 2 - MEDIAN DIFFERENCE OVER BACKGROUND

NORTH DAKOTA

PRODUCTION FACILITIES



MICRO-REMS/HR

NO DATA
2 - 33

BELOW .8
33.01 - 245

.8 - 1.99
OVER 245

AMERICAN PETROLEUM INSTITUTE
NATURALLY OCCURRING RADIOACTIVITY SURVEY

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

FACILITY: Production

-151-

Table 2

Median Difference Over Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

North Dakota

FACILITY: Production

Obsns County		Median Difference	75 th Percentile
218	BILLINGS	0.0	0.0
57	BOTTINEAU	0.0	0.0
27	BURKE	0.0	5.0
134	DIVIDE	0.0	2.0
14	GOLDEN VALLEY	0.0	4.3
259	MCKENZIE	0.0	0.0
8	RENVILLE	0.0	0.0
11	SHERIDAN	0.0	2.0
78	STARK	0.0	0.0
19	WILLIAMS	1.0	7.0
39	RICHLAND	4.0	21.0

Median of Difference

Table 3

Median Background by County
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

North Dakota

Obs	County	Facility: Production	75 th	
			Median	Percentile
19	WILLIAMS	*****	5.0	10.0
57	BOTTINEAU	*****	8.0	9.0
134	DIVIDE	*****	9.0	9.5
39	RICHLAND	*****	9.0	9.0
218	BILLINGS	*****	10.0	10.0
27	BURKE	*****	10.0	10.0
8	RENVILLE	*****	10.0	10.0
14	GOLDEN VALLEY	*****	11.0	11.0
259	MCKENZIE	*****	11.0	12.0
11	SHERIDAN	*****	11.0	12.0
70	STARK	*****	13.0	13.0
-----+-----+-----+-----+-----+-----+-----+-----+				
856		2 4 6 8 10 12 14 16		

Median of Background

Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

North Dakota

Equipment	No	AVG	Maximum	Minimum	PCT25	Median	PCT75
<u>Production Facilities</u>							
FLINE	2	0.0000	0	0	0.0	0	0.0
H/T	108	17.2685	389	0	0.0	0	1.8
MANIFOLD	21	0.0952	2	0	0.0	0	0.0
METER	5	0.0000	0	0	0.0	0	0.0
OTHER	24	4.4583	56	0	0.0	0	0.0
PUMP	32	2.0312	36	0	0.0	0	0.0
SEP	108	0.2593	15	0	0.0	0	0.0
STANK	327	1.4954	161	0	0.0	0	0.0
WINJ	1	0.0000	0	0	0.0	0	0.0
WPROD	62	1.3226	68	0	0.0	0	0.0
WTANK	156	17.7564	229	0	0.0	1	18.5
WLINE	5	14.2000	52	0	3.0	6	29.5
SUMP	5	9.2000	16	0	1.5	13	15.0

Gas Processing

None

Appendix 2

Statistical Data on Median Difference over Background By Facility and County (Micro-Rems/Hr)

North Dakota

FACILITY	COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
PROD	BILLINGS	218	0.6835	36	0	0	0	0.00
PROD	BOTTINEAU	57	2.3860	68	0	0	0	0.00
PROD	BURKE	27	3.1052	20	0	0	0	5.00
PROD	DIVIDE	134	15.3881	311	0	0	0	2.00
PROD	GOLDEN VALLEY	14	4.2857	31	0	0	0	4.25
PROD	MCKENZIE	259	5.5676	389	0	0	0	0.00
PROD	RENVILLE	8	0.0000	0	0	0	0	0.00
PROD	SHERIDAN	11	1.0000	6	0	0	0	2.00
PROD	STARK	70	3.6143	52	0	0	0	0.00
PROD	WILLIAMS	19	4.7368	25	0	0	1	7.00
PROD	RICHLAND	39	31.6923	221	0	0	4	21.00

Appendix 3

Statistical Data on Background by County (Micro-Rems/Hr)

North Dakota

COUNTY	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
WILLIAMS	19	7.3684	10	5	5	5	10.0
BOTTINEAU	57	8.4035	9	8	8	8	9.0
DIVIDE	134	8.6269	13	2	7	9	9.5
RICHLAND	39	9.2051	11	9	9	9	9.0
BILLINGS	218	10.7156	14	9	10	10	10.0
BURKE	27	9.8148	10	9	10	10	10.0
RENVILLE	8	10.0000	10	10	10	10	10.0
GOLDEN VALLEY	14	11.0000	11	11	11	11	11.0
MCKENZIE	259	10.9228	13	8	10	11	12.0
SHERIDAN	11	11.2727	12	11	11	11	12.0
STARK	70	12.5000	15	9	12	13	13.0

SUMMARY

(Offshore)

I. All significant differences were equipment specific.

The equipment with the most pronounced differences over background based on Median ranking is listed below. The difference is the excess of the reading over background:

Equipment	Median Difference	75 th Percentile
Injection Well (Prod)	95 μ R/hr	97.0 μ R/hr

II. There were no significant differences in background readings between the Gulf of Mexico (1 μ R/Hr) and California (2 μ R/Hr). The Alaska offshore data (4 μ R/Hr) were reported with the rest of Alaska since there were few observations and there was no difference between onshore and offshore in that state.

III. Overall Summary

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
1. Overall					
a. Background	2920	1.0	2.0	2.0	10
b. Max Reading	2920	2.0	8.9	40.0	1,000
c. Difference	2920	0.5	7.0	39.0	995
2. Facility					
a. Background					
Gas Processing	58	2.0	2.0	5.0	5
Production	2,862	1.0	2.0	2.0	10
b. Max Reading					
Gas Processing	58	3.0	15.0	25.5	70
Production	2,862	2.0	8.1	42.7	1,000
c. Difference					
Gas Processing	58	1.0	13.3	24.4	68
Production	2,862	0.5	7.0	41.3	995

NOTE: All data are measured in micro-rem/hr

Table 1

Difference of Maximum Reading over Background by Equipment
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Offshore

FACILITY: Gas Processing

Obsns	Equipment		Median Difference	75 th Percentile
12	COMPRESSOR		0.00	0.0
35	INLET SCRUBBER		1.00	14.0
4	DEHYDRATOR	*	2.50	11.8
1	METER	***	5.00	5.0
1	OTANK	*****	10.00	10.0
3	OPUMP	*****	15.00	55.0
2	OTHER	*****	15.00	20.0
58		10 20 30 40 50 60 70 80 90		
Median of Difference Over Background				

FACILITY: Production

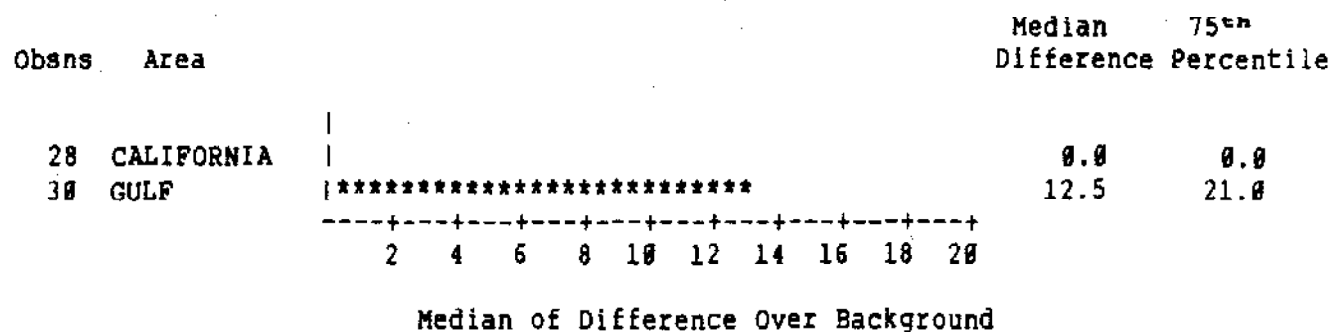
513	WPROD		0.00	0.3
519	MANIFOLD		0.30	8.2
93	PUMP		0.30	8.4
368	OTHER		0.35	2.9
6	WOTHER		0.60	2.9
1	VRU		0.80	0.8
90	H/T		1.00	10.3
725	SEP	*	1.00	8.0
17	WLINE	*	2.10	10.6
131	FLINE	*	3.00	22.0
168	STANK	*	3.20	19.0
76	WTANK	***	6.10	18.7
73	SUMP	****	8.00	50.0
8	METER	*****	21.00	38.8
2	WINJ	*****	95.00	97.0
2860		10 20 30 40 50 60 70 80 90		
Median of Difference Over Background				

Table 2

Median Difference Over Background by Area
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Offshore

FACILITY: Gas Processing



FACILITY: Production

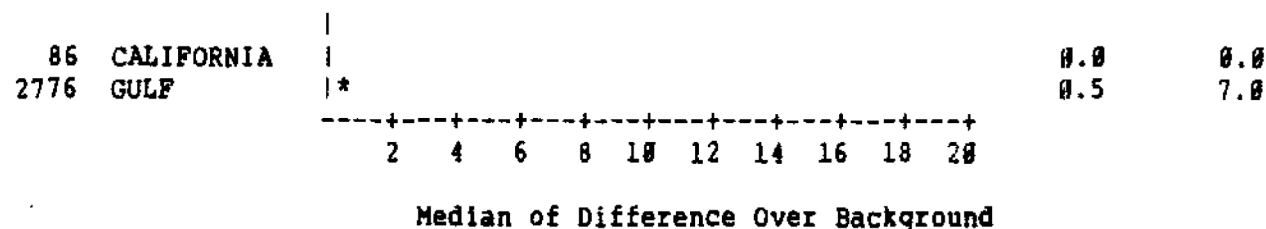
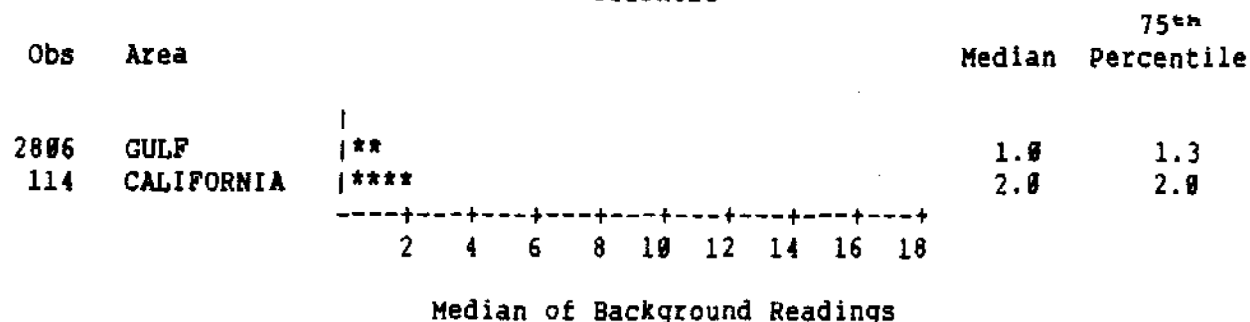


Table 3

Median Background by Area
Sequenced by Increasing Median Difference
(Micro-Rems/Hr)

Offshore



Appendix 1

Statistical Data by Facility and Equipment Difference Over Background (Micro-Rems/Hr)

Offshore

Equipment	No	Average	Maximum	Minimum	25 %	Median	75 %
<u>Gas Processing Facilities</u>							
COMPRESSOR	12	0.5833	7	0	0	0.0	0.00
INLET SCRUBBER	35	9.8000	68	0	0	1.0	14.00
DEHYDRATOR	4	4.7500	14	0	0	2.5	11.75
METER	1	5.0000	5	5	5	5.0	5.00
OTANK	1	10.0000	10	10	10	10.0	10.00
OPUMP	3	28.3333	55	15	15	15.0	55.00
OTHER	2	15.0000	20	10	10	15.0	20.00
<u>Production</u>							
WPROD	513	3.7164	495.0	0.0	0.00	0.0	0.300
MANIFOLD	591	24.5440	598.0	0.0	0.00	0.3	8.200
PUMP	93	7.8183	88.0	0.0	0.00	0.3	8.350
OTHER	368	19.2701	995.0	0.0	0.00	0.3	2.875
WOTHER	6	1.4500	5.5	0.0	0.00	0.6	2.875
VRU	1	0.8000	0.8	0.8	0.80	0.8	0.800
H/T	90	29.4578	595.0	0.0	0.00	1.0	10.250
SEP	725	21.5276	748.0	0.0	0.00	1.0	8.000
WLINE	17	32.9765	397.0	0.0	0.05	2.1	6.150
FLINE	131	27.8008	473.0	0.0	0.00	3.0	22.000
STANK	168	29.8440	748.0	0.0	0.43	3.2	19.000
WTANK	76	13.1013	128.2	0.0	1.80	6.1	18.725
SUMP	73	54.1192	793.0	0.0	0.75	8.0	50.000
METER	8	23.5000	44.0	4.0	9.25	21.0	38.750
WINJ	2	95.0000	97.0	93.0	93.00	95.0	97.000

Appendix 2

Statistical Data on Median Difference over Background By Facility and Area (Micro-Rems/Hr)

Offshore

FACILITY	AREA	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
GP	CALIFORNIA	28	0.1429	1	0	0	0.0	0
GP	GULF	30	16.5000	68	0	5	13.0	20
PROD	CALIFORNIA	86	3.5000	48	0	0	0.0	3
PROD	GULF	2776	20.4281	995	0	0	0.5	7

Appendix 3

Statistical Data on Background by Area (Micro-Rems/Hr)

Offshore

AREA	NO	AVERAGE	MAXIMUM	MINIMUM	PCT25	MED	PCT75
GULF	2806	1.2721	10	0	0.7	1	1.3
CALIFORNIA	114	2.0000	2	2	2.0	2	2.0

SUMMARY

(Oklahoma)

I. There were no significant differences among the different items of equipment.

II. Background levels were mid-range in all counties except Grant, Haskell, Kingfisher, McClain, Pittsburg, Beaver, Dewey, Oklahoma, Tulsa, Woods, Garfield, and Woodward which were high, and Kay and Payne which were very high.

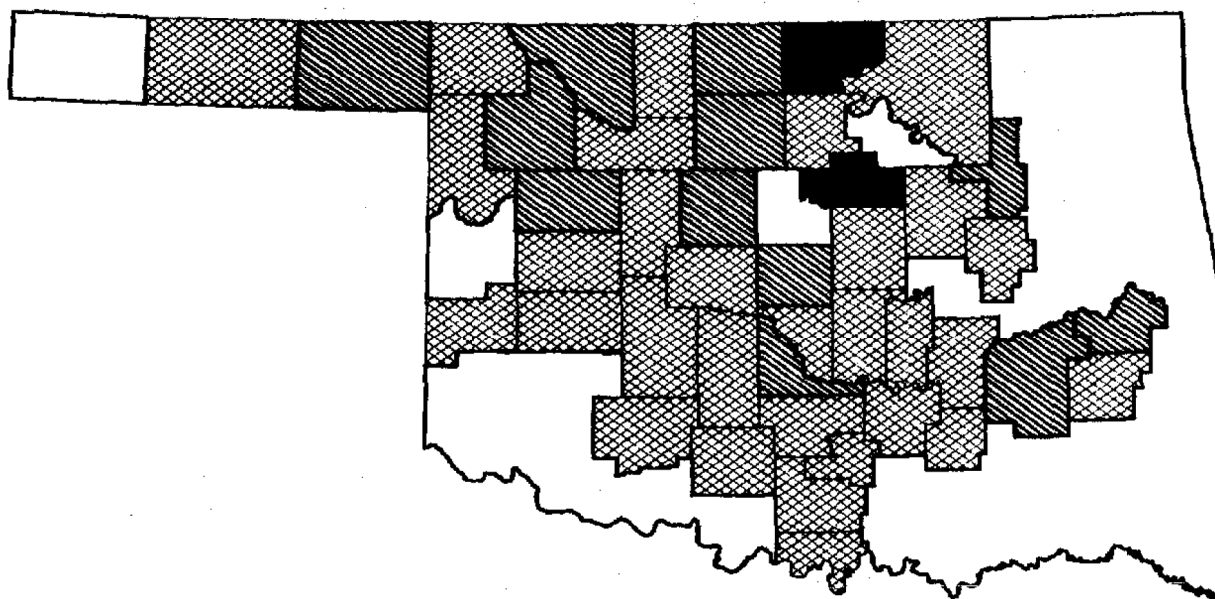
III. Overall Summary

ITEM	No	Median	75 th Pct.	90 th Pct.	Max Value
1. Statewide					
a. Background	4,128	9.0	10.0	12.0	25
b. Max Reading	4,128	10.0	13.0	42.0	3,800
c. Difference	4,128	0.0	3.0	33.1	3,786
2. Facility					
a. Background					
Gas Processing	304	10.0	11.0	12.5	14
Production	3,824	9.0	10.0	12.0	25
b. Max Reading					
Gas Processing	304	10.0	12.5	15.0	550
Production	3,824	10.0	13.0	48.0	3,800
c. Difference					
Gas Processing	304	0.0	1.0	8.3	539
Production	3,824	0.0	3.0	38.0	3,786

NOTE: All data are measured in micro-rems/hr

FIGURE 1 – MEDIAN BACKGROUND LEVELS

OKLAHOMA



MICRO-REMS/HR



NO DATA



5.0 - 9.0



0 - 2.33



9.01 - 14.0



2.34 - 4.99



OVER 14.0

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