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QUARTERLY HEALTH PHYSICS REPORT

Through December 31, 1959 (Deleted Version)

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SUMMARY

A resume of Health Physics activities for October, November, and December, 1959 is presented. Discussions and tabulations which summarize results of field surveys, bioassay, personnel monitoring, and environmental surveys are included.

The first extensive spread of contamination in the Waste Disposal Building occurred during this quarter.

The installation of the "HH" process in the "T" Building was completed. The process equipment was removed from the "HH" Building and disposed of. The building was decontaminated and turned over to an outside contractor for remodeling and outfitting for stable isotope work.

Two employes received a polonium-210 body burden in excess of the maximum permissible continuous concentration.

The remodeling of the R-145 - 147 area for plutonium-238 work continued during this quarter. When the 238 isotope work is moved into this new facility, many of the difficulties now being experienced should be eliminated or at least greatly minimized.

Except for one brief period in mid-November, contamination has been well controlled in this area.

The Tank Truck Unloading Station was rebuilt during this quarter. The new station has eliminated the continual difficulties we experienced with the old station.

The total quantity of tritium stacked from the various tritium operations has reached a significant figure. During the next quarter serious efforts will be directed towards the reduction of the quantity of tritium released in our stack effluents. Environmental monitoring has failed to detect any tritium in the air off-site.

FIELD SURVEYS

R. A. Guillet and J. M. Garner

STATISTICS

Air-monitoring samples (polonium)	5,343
Air-monitoring samples (plutonium)	2,560
Air-monitoring samples (other particulate)	2,630
Wipe samples	55,325
Routine and special surveys	5,851

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POLONIUM AREAS

A spread of contamination in the Waste Disposal Building on December 1, 1959, resulted from leaks at the packings of the influent tank agitators and from the circulation pumps. The contamination was tracked by personnel to most areas of the building before it was discovered. An extensive floor scrubbing job was required to clean up the building. The Maintenance Department corrected the leaks. No personnel exposures resulted.

The job of removing all process equipment and the complete decontamination of the "HH" Building was finished by the end of November. This building is now being extensively remodeled for stable isotope work by an outside contractor.

The major task of installing the hydrolysis process in the T-54, 56 area was also completed during this quarter.

During the period covered by this report, two employes were placed on the polonium urinalysis "hot" roster; that is, they received an internal deposition of polonium the quantity of which exceeded the maximum permissible. Both employes received a body burden while doing maintenance work in the high risk area. Neither of these employes submitted a urine specimen as required after risk area work. This omission resulted in the belated discovery that they had received a body burden and made it very difficult to determine the date (and job) on which they were exposed. As per the requirements of AEC Manual Chapter 0523 both cases were reported to the AEC. Both reports were entitled "Report of Internal Radiation Exposure Incident At Mound Laboratory"; the first was dated January 4, 1960, and the second was dated January 19, 1960. As a result of these late body burden determinations, a much more strict system for obtaining urine specimens from maintenance personnel will be devised. Neither employe will be permitted to work in any radiation risk area until his body burden is less than the permissible.

AIR SAMPLING. Air samples in the polonium areas are collected by the use of fixed position air samplers. These samplers, each located about five feet above floor level, pull air through HV-70 filter paper (Hollingsworth & Vose Company, East Walpole, Massachusetts) at a flow rate of 10 liters per minute. Samplers are usually run for a period of eight hours, giving a total volume of 4.8 cubic meters of air. After removal from the samplers, the filter paper discs are counted for alpha particle emission and the results are expressed in terms of polonium concentration.

Table I is a summary of the polonium air-sample program for this quarter.

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TABLE I

POLONIUM AIR SAMPLES

Sampling Location	Number of Samples	Per Cent Above 1,000 D/Min/M ³	Average D/Min/M ³
"T" Bldg. - Clean	239	0.0	5
Low-risk	2,338	2.3	410
High-risk	1,271	32.6	13,263*
Exhaust Systems	634	0.6	42
"H" Bldg. - Clean Laundry	62	0.0	18
Hot Laundry	124	0.0	33
Exhaust Systems	13	0.0	17
"WD" Bldg. - Low-risk	585	0.2	19
"HH" Bldg. - High-risk (October only)	15	86.6	18,630
Other - Low-risk	62	0.0	18

(*Increased average air concentration in this area due to installation of "HH" facility and subsequent operation of the process.)

Maximum Permissible Concentration - 1,000 D/Min/M³

WIPE SAMPLING. Past experience has indicated that, due to the nature of polonium and its compounds, it is more important to evaluate the possibility of contamination due to loose dust than to take direct readings. Therefore, in addition to direct readings, surfaces are wiped periodically over an area of approximately 40 square inches. Results of these wipe surveys are used to determine the possible exposure areas and to determine the amount and extent of decontamination work necessary. A wipe sample showing loose contamination in excess of 500 disintegrations per minute per 40 square inches is sufficient to require immediate cleaning of the area. Lower positive values indicate that decontamination work is necessary but it may be scheduled with other work.

Table II is a summary of the wipe sample data for the period covered by this report.

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TABLE II

POLONIUM WIPE SAMPLES

Area	Number of Wipes	Per Cent Above 500 D/Min/40 IN ²
"T" Bldg. (and Associated Bldgs.)	37,712	9.0
Laundry	684	4.5

PLUTONIUM AREAS

The plutonium neutron source group fabricated 49 neutron sources and 35 alpha sources during this quarter. Considerable survey work has been done in assisting the Neutron Source Group to produce special type alpha standards.

The work in the Plutonium Alloy Research Facility, R-159, has proceeded without any great contamination difficulties. One incident lead to the spread of contamination on the floor and on the flat hood surfaces. This incident resulted from poor procedure in removing material from a hood. The procedure has been revised to prevent recurrence of such incidents.

Several shipments of plutonium-238 nitrate solution have been received from the Savannah River plant and considerable work with plutonium-238 has been done during this quarter. The new facility for this work is still under construction in the R-145 - 147 area. Work with this isotope is presently being done in R-149 and R-120. The nitrate solutions yield considerable soft gamma radiation as well as hard gamma. Routine hand monitoring is being carried on for this work. The use of shielding, lead impregnated gloves, and some semi-remote handling equipment has kept personnel exposures low. The fluoridation step prior to metal reduction of large batches produces a high neutron flux. Controlling time and distance for the operators has kept neutron exposures well within limits. The preparation of plutonium oxide has at times lead to airborne contamination and surface contamination in both labs. Work with oxide requires the personnel to use respiratory protection as a precaution. Great care must be exercised in the use of pass boxes to hoods. Containment of contamination in the hoods is difficult. The hood systems in the new facility should minimize this problem very much.

AIR SAMPLING. Routine air samples in the plutonium areas are collected by the use of fixed position air samplers. In general, sampling locations are concentrated in the immediate area of the hoods by affixing the samplers on the front of the hoods. For complete lab coverage, other samplers are wall mounted. Normal elevation for all samplers is approximately five feet

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above floor level. The air is pulled through HV-70 filter paper at a flow rate of 25 liters per minute. Samplers are usually run for a period of eight hours, giving a total volume of 12 cubic meters of air. After removal from the samplers, the filter paper discs are counted for alpha particle emission and the results given in terms of plutonium concentration.

Table III is a summary of the plutonium air-sample program for this quarter.

TABLE III
CONCENTRATION OF PLUTONIUM IN AIR

Sampling Area	No. of Samples	Maximum*	Average*
"R" Bldg. - Cold Area	186	13.4	0.55
Low-risk	2,190	64.8	0.83
High-risk	90	789.4	33.32
Exhaust System	94	3.5	0.68

*Multiply all values by 10^{-12} to obtain $\mu\text{c}/\text{cc}$.

WIPE SAMPLING. In addition to making routine contamination surveys by direct monitoring with alpha survey meters, frequent wipe sample surveys are made throughout the plutonium areas. The surfaces of hoods, gloves, process equipment, benches, floors, etc., are wiped with paper discs over an area of approximately 40 square inches. Results of the wipe surveys are used to determine possible exposure areas. A wipe sample showing any loose plutonium contamination requires immediate cleaning of the area.

Table IV is a summary of the wipe sample data for the period covered by this report.

TABLE IV
PLUTONIUM WIPE SAMPLES

Area	No. of Wipes	Range	Range	Range	Range
		0-25 c/m	26-50 c/m	51-100 c/m	Over 100 c/m
"R" Bldg.	7,463	7,106	224	68	65

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TRITIUM AREAS

About the 16th of November, significant wipeable contamination was detected on the lab floor, hood gloves, and on the clothing of some of the operators. Area air monitors indicated the presence of airborne contamination. A thorough survey of the hoods revealed that hot trash in the lines had accumulated to the extent that the hood atmosphere became contaminated beyond the concentration which could be confined to the hoods. The contamination diffused through the gloves. After the hot trash was removed and the lab cleaned up, the air levels immediately returned to normal. Frequent trash removal from the lines and better "housekeeping" in the hoods since this time has kept this operation clean. One operator in this lab showed a urine concentration of 52 $\mu\text{c}/1$ as a result of the incident.

The R-105 tank truck unloading station was rebuilt during this quarter. The old station was dismantled and the area decontaminated. New equipment was installed and arranged so that all equipment is within a large hood. Ventilation to the area has been improved. A much improved air monitoring manifold was also installed and coupled to a T-289 monitor. This station is now operating very clean and has given us no contamination difficulties.

During this quarter, the salt recovery operation required very close survey. The processing of the titanium tritide materials of the Pinellas Plant has lead to several contamination spread incidents. This material is very difficult to contain in the hood system.

Over the past few months the quantity of tritium stacked to the environment from the various tritium operations has increased to a very significant figure. Definite plans have been drawn up to make systematic changes in

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The goal for which we are striving is a total monthly loss in the range of 5,000 curies. We consider that the problem demands attention only because of the total quantities discharged to the environment. See Table V below. Although the quantities discharged to date have been higher than we want, the average concentration of the stacked material has not exceeded the maximum discharge level. Routine off-site environmental monitoring to date has shown no detectable presence of tritium.

AIR SAMPLING. All air sampling in tritium areas (and the two effluent stacks) is accomplished by continuous air monitors. Each air monitor gives an instantaneous measurement of air contamination concentration and provides a strip chart record of air levels. Each monitor is fitted with an alarm to give an audible signal if a preset limit of air contamination is exceeded.

TABLE V
MONTHLY QUANTITIES OF STACKED TRITIUM

Stack	October	November	December
West	-	730	233
"B" Bldg.	14,816	10,977	15,485

Quantities are expressed in curies.

thermal column raffinate line was disconnected from the "B" Bldg. stack and tied into the west stack in December.) All other tritium facilities discharge their ventilation into the "B" Building stack. (The

WIPE SAMPLING. Routine wipe samples are taken throughout the tritium areas. Wipe samples are more sensitive than a sniffer instrument test. Wipe surveys are made to determine the effectiveness of contamination control programs and to schedule decontamination work. A wipe sample showing beta contamination in excess of 500 counts per minute per 40 square inches requires cleaning of the area.

Table VI is a summary of the wipe sample data for the period covered by this report.

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TABLE VI

TRITIUM WIPE SAMPLES

Area	Number of Samples	Number Above 500 C/Min
"R" Bldg.	1,830	207
Hot Facility	870	156

OTHER AREAS

Two sodium-24 sources were received from Oak Ridge during this quarter. Both sources were received and loaded into the geometry in T-247 without difficulty or undue exposure to the operating personnel.

Health Physics personnel requirements for this facility have been submitted to the Personnel Department.

PERSONNEL MONITORING

W. A. Bigler

BIOASSAY

Personnel working with radioactive isotopes or in areas containing radioactive materials are required to submit urine specimens. The urine specimens are analyzed quantitatively for the radioactive isotope to which the employe may have been exposed and the results are used to estimate the employe's body burden. An individual may be asked to submit urine samples, daily, weekly, monthly or quarterly, depending upon the frequency of contact with the radioactive material, the type of operations performed, the amount of radioactive material handled, and contamination concentrations in the area. An individual is placed on the "hot" roster if the concentration in his urine specimen exceeds the amount

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specified for the particular isotope for which the analysis was made. An individual on the "hot" roster is not permitted to work in any area in which he might receive additional exposure to radioactive materials.

POLONIUM URINALYSIS

During the period covered by this report, 972 urine specimens and 45 control samples were analyzed for polonium content. Personnel are placed on the "hot" roster when urine specimens show a polonium concentration greater than 580 disintegrations per minute per 24-hour sample. During this quarter two personnel were placed on the "hot" roster. Two employes remain on the "hot" roster at the end of this quarter.

PLUTONIUM URINALYSIS

Fifty-six 24-hour urine specimens were collected and analyzed for plutonium content. The maximum concentration in the samples analyzed was 2.12 disintegrations per minute. (Subsequent sampling of this employe showed that his urine count fell off to procedure background count after one month.) There is no one on the plutonium "hot" roster.

PROTACTINIUM URINALYSIS

One 24-hour urine specimen was analyzed for protactinium. The concentration in this sample was 0.30 disintegrations per minute.

THORIUM-232 URINALYSIS

One 24-hour urine specimen was analyzed for thorium-232. The concentration in this sample was 0.08 disintegrations per minute.

TRITIUM URINALYSIS

There were 834 spot urine specimens analyzed for tritium content. The maximum concentration in the samples analyzed was 52 $\mu\text{c}/\text{liter}$. One employe was removed from the "hot" roster in November. There is no one on the tritium "hot" roster as the quarter ends.

POCKET METERS

Total Number Read	11,304
Number of single readings	
(0-30 mr)	10,934
(30-100 mr)	317
(100-200 mr)	17
(over 200 mr)	36

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Number of paired readings	5,652
(0-30 mr)	5,623
(30-100 mr)	26
(100-200 mr)	2
(over 200 mr)	1

FILM METERS
Beta-Gamma

Regular*	Number processed	1,090
	Number of readings	
	(0-50 mrep)	1,070
	(50-150 mrep)	19
	(150-300 mrep)	1
	(300-600 mrep)	0
	(over 600 mrep)	0

Visitor	Number processed	568
	Number of readings	
	(0-50 mrep)	555
	(over 50 mrep)	13

Neutron *	Number processed	818
Regular & Visitor	Number of readings	
	(0-100 mrem)	798
	(100-300 mrem)	18
	(over 300 mrem)	2

*Most films were worn for a period of two weeks.

ENVIRONMENTAL SURVEYS

W. A. Bigler

AIR SAMPLING

Filter type air samples are collected as nearly downwind from Mound Laboratory as possible and are counted for alpha radiation. Of the 67 samples

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collected this period, 63 showed no alpha count above background. The highest sample result indicated a concentration of 4.96×10^{-13} $\mu\text{c}/\text{cc}$.

Off-area sites within a five mile radius of Mound Laboratory were monitored for tritium with a T-289 air monitor mounted in our off-site monitoring truck. No readings above background were found.

RIVER SURVEYS

The Great Miami River is monitored for the concentration of polonium in mud and water. Vegetation samples are collected along the river bank and at various other sites as well. Liquid wastes contaminated with isotopes other than polonium are small in volume and are treated and handled separately at Mound Laboratory. Polonium, therefore, is the major contaminant to be found in the liquid effluent.

Samples analyzed for polonium during the past quarter gave results which are summarized in Table VII.

TABLE VII

CONCENTRATION OF POLONIUM IN RIVER SURVEY SAMPLES

Sample	No. Collected	Maximum	Average
Mud	34	1.27×10^{-4} $\mu\text{c}/\text{gm}$	8.62×10^{-6} $\mu\text{c}/\text{gm}$
Water	63	1.86×10^{-6} $\mu\text{c}/\text{ml}$	6.59×10^{-8} $\mu\text{c}/\text{ml}$
Vegetation	67	5.41×10^{-6} $\mu\text{c}/\text{gm}$	7.13×10^{-7} $\mu\text{c}/\text{gm}$

The maximum mud sample and the maximum water sample were both collected where the plant effluent enters the Great Miami River. The maximum mud sample was collected on December 23, 1959, and the maximum water sample was collected on December 16, 1959. The maximum vegetation sample was collected at a point two miles north of Mound Laboratory on December 2, 1959.

LIQUID WASTE DISPOSAL

The quantity and activity content of the water discharged from the waste disposal plant to the Great Miami River is summarized in Table VIII.

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TABLE VIII

WASTE DISPOSAL DATA

	<u>Sept. 16 to Oct. 15</u>	<u>Oct. 16 to Nov. 15</u>	<u>Nov. 16 to Dec. 15</u>
Discharge Volume (in gallons)	873, 600	872, 200	592, 400
Total Alpha Activity (in millicuries)	13.5	8.9	22.1
Total Beta Activity (in millicuries)	16.1	42.2	36.9
Activity Density			
Alpha (in cts/min/ml)	4.3	2.5	6.1
Beta (in cts/min/ml)	5.1	13.1	10.2

SUMMARY OF PERSONNEL EXPOSURES FOR 1959 (AEC Manual Chapt. 0523)

I. Whole Body Radiation Exposures to External Penetrating Radiation

Range in rem	Number of Personnel
0 - 1	327
1 - 2	10
2 - 3	2
3 - 4	3
4 - 5	1
>5	0

II. Internal Deposition of Radioactive Material

We had one polonium-210 deposition case in which the average deposition exceeded one-half of the maximum permissible for a period greater than six months.

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PERSONNEL DISTRIBUTION

PERSONNEL (Average Employment for Quarter)

Supervisor	1
Assistant Health Supervisors	3
Instrument Operators	2
Health Surveyors	8
Chemist	1
Laboratory Technician	1
Laboratory Helpers	2
Custodial Supervisory Asst.	1
Decontamination Workers	<u>16</u>
Total	35

ALLOCATION OF TIME IN MAN-MONTHS

Administrative	3
Bioassay	10
Film, Pocket Meter, and T-Area Instrument Operation	5
Surveys - "T" Area	15
"G" Area (& Laundry Monitoring)	15
Instrument Operation	6
Custodial & Decontamination	
"T" Area	29
"G" Area	<u>22</u>
Total	105

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