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RADIOLOGICAL SCIENCES DEPARTMENT
MONTHLY SECTION REPORTS
JULY 1956

By: M. L. Mickelson
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August 6, 1956

Due to film deterioration, portions of this document may be illegible. PNL-6-91 [redacted]

General Electric Company
Hanford Atomic Products Operation

RADIOLOGICAL SCIENCES DEPARTMENT

MONTHLY SECTION REPORTS

JULY 1956

Department General

The department month-end force of 436* included 36 supervisors, 103 engineers and scientists, 26 clerical and 271 other personnel. Twenty-five additions to the roll and thirteen deletions represented the most active employment month for the department this year and resulted in a net gain of twelve over the previous month-end force.

Suggestions submitted for evaluation during the month were about equivalent to the pattern established from previous experience.

The cost vs budget experience for the department at fiscal year-end was essentially as predicted in last month's report. The Biology and Medicine Program expenditures came within about one per cent of the financial plan whereas the protection of plant and personnel function experienced an overrun of about two per cent. The overrun was largely caused by the strike among construction workers earlier this spring.

Invention reports submitted during the month of July included:

Inventor	Title
None	None

Training

The AEC Radiological Physics Fellowship Program proceeded without incident.

Communications

Previously postponed activity on a sound slide film has been resumed. The subject for this first attempt at devising training aids of this nature is the "Bragg-Gray Principle."

Civil and Plant Emergency Defense

Basic dose-rate patterns were calculated and drawn to scale from information supplied for the nation-wide civil defense exercise "Operation Alert-1956."

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*Does not include tech. grad. and technician trainees and temporary summer employees assigned to the department.

[redacted]

Other Services

The one member on loan to the Naval Radiological Defense Laboratory continued in his assignment at the Pacific Proving Ground.

M. L. Mickelson

Manager,
Radiological Administration
and Communications Section

ML Mickelson.kss

RADIOLOGICAL ENGINEERING SECTION
MONTHLY REPORT JULY 1956

Department Construction Projects

Approval of the project proposal for the "Shielded Personnel Monitoring Station" (CG-658) has not yet been received from AEC-Washington.

Construction on the "Improved Calibration Facility" (CG-671) was 40% complete by the end of the month. The two calibration wells were drilled and the shielding lead poured. The high range trolley was dismantled and re-installed in the south room. Construction work was 1% complete on the "Office Addition - 141-M Bldg." (IR-204).

One well remains to be drilled on project AECP-1[illegible]. U.S. Geological Survey drilling crews are also currently drilling and developing research wells north of 200-East Area.

The project proposal for a "Radio-telemetering Network" was approved by Radiological Sciences and Engineering and has been forwarded to the Financial Department for final General Electric approval.

The project proposal for "Geological and Hydrological Well Drilling - FY-57" was approved by Radiological Sciences. A high spot cost estimate was made for the preliminary scope for a "Radiological Engineering Test Facility". Based on the use of a Butler type prefabricated metal building and a slightly reduced scope, it is estimated that the facility can be constructed for a cost approaching the $95,000 originally budgeted.

The Engineering Department was requested to prepare a project proposal for a "High Level Exposure Facility Addition - 141-H Bldg." at the Experimental Animal Farm. This item was originally budgeted as "Animal Farm Waste System Improvements".

Use of Project Lands by Outside Agencies

Methods of work performance and the extent of work by Fixed Price Contractor forces on "Additional Waste Disposal Facilities - BC Area Phase II" were discussed with representatives of the Engineering Department and the locations, depth and amount of casing perforation were specified for test wells to monitor the additional trenches.

Separations Areas Projects

Plans for the modification of the 241-WR facility for the utilization of UO_3 plant recovered acid at Redox and Purex following completion of the Metal Recovery Program were discussed with representatives of the Engineering Department.

Radiological Engineering Consultation

Further discussions were held to determine the desirability of preparing a shelf design for the faulty 100-K west outfall line. Since the time needed to prepare the detailed design would normally be shorter than that required to procure pipe for the structure it was decided that at present funds for a study of the system preparation of the scope criteria, and preliminary design only would be requested.

Dose rates and radioactive gas build-up on the front elevator and their effects on operational charging at 105-C building were reviewed with members of Design Section and Reactor Section.

Ventilation flow diagrams for project CG-654 were reviewed with esign Section.

Miscellaneous Radiological Engineering Consultation

Assistance in radiation protection for the thorium refining development program of the U. S. Bureau of Mines Northwest Electrodevelopment Laboratory at Albany, Oregon was terminated as of June 30, 1956. The assistance began in September 1954. Total costs billed to the National Lead Company of Ohio, sponsor of the development program by the HAPO were about $1370. These costs were for renovation and routine servicing and shipping of portable radiation survey instruments, coordination time, four visits to the Laboratory, and three burials of waste in 300-North burial trenches. Valuable knowledge and experience was gained by HAPO in handling, radiation survey and air sampling of thorium metal and compounds. The Methods Unit, Biophysics Section developed an extremely sensitive bioassay procedure for thorium which is being adopted throughout the U. S. The procedure can be modified for accurate analysis of air samples, necessary for radiation protection in large-scale handling of thorium.

The outside consultants hired to review the testing project for crib design and site selection methods, sponsored by the Utilities and Services Design and Development Unit, visited Hanford July 9-11, 1956. At a meeting with one of them the requirements for radioisotope adsorption and liquid infiltration were discussed.

Waste Disposal - Reactor Areas

The Experimental Animal Farm requested and received permission to send to the river the liquid excreta from five pigs dosed with Pu^{239} in November and December, 1955. The pigs urine before dilution with other sewer liquids, reactor effluent and river water is less than 2% of MPC for drinking water. Permission to permit the solid portion of the excreta to be used as fertilizer in 100-F area will be considered when adequate information is obtained to permit an evaluation of the hazard.

Waste Disposal - Separations Areas

As in June, the presence of Co^{60} in TBP scavenged supernates in excess of the recommend crib disposal limit (4×10^{-5} µc/cc) has resulted in tank retention of all wastes scavenged in July. Additional soil testing of scavenged waste supernates confirmed earlier test results which indicated insignificant soil adsorption of the complexed cobalt.

Construction work on Phase I of Project CA-688 which provides three trenches west of the 216-BC crib site to receive scavenged supernates high in Co^{60} on a specific retention basis, is now underway with a beneficial use date of August 15, 1956. It has been decided to construct six trenches in lieu of cribs under Phase II of the project, since a solution to the cobalt problem is not expected prior to the time the these disposal facilities will be required.

The Purex Plant 216-A-8 crib receiving tank farm condensate and condenser cooling water overflowed onto the ground at the northeast end of the crib on July 8, 1956. Overflow continued at a rate estimated at 35 gpm until July 16, 1956, when the condenser cooling water flow was lowered from 1000 gpm to 500 gpm. The overflow

was caused by increased water input to the tank farm condenser to maintain tank vacuum while an automatic control was out of service. This continuous input of 1000 gpm exceeded the crib infiltration capacity. Evidence of algae, organic scum, and raw water silt found in the A-8 sampler pit indicates that these may possibly have contributed to the overflow by decreasing the infiltration capacity of the crib. No contamination was detected in samples of the overflow liquid.

Laboratory soil adsorption tests are in progress by Earth Sciences to determine if Purex coating removal wastes, and spent carbonate wastes from organic treatment are suitable for ground disposal.

Columbia River Studies

A critical review was begun of present and past Columbia River hydrological studies and radiological surveys. The primary purpose of this review was to correlate hydrological characteristics of the Columbia and the downstream distribution of gross beta activity resulting from disposal reactor cooling water. Analysis of presently available data has established relationships between rate of flow in the river and mean travel times from the 107 basins discharge points and various downstream locations.

Attention is currently directed toward establishing a reliable radioactivity "budget" in the river. The mechanism of the decrease in gross beta activity of the river water by stream purification processes is also under investigation.

The data for the correlation of variables affecting the concentration of radioisotopes discharged by reactor cooling waters to the Columbia has been placed on IBM cards. Minor additions of data are to be made prior to proceeding with an analysis by the "702". The programming of the study for the 702 has not been completed by the Procedures and Computing Section, hence the study has been delayed.

During the month the Corps of Engineering, U. S. Army, held a series of five public hearings throughout the Pacific Northwest on plans for further development of the resources of the Columbia and its tributaries. Flood control, navigation, and hydroelectric power projects were recommended as well as the conservation of fish and wildlife and other natural resources. Flood control and hydroelectric power projects in the Columbia River basin will tend to stabilize river flows past the Hanford reservation. Navigation through the Hanford reservation is not recommended at this time by the Corps of Engineers. It is reasonable to predict, however, with the completion of Priest Rapids and Wanapum dams navigation interests will work for a river channel through the Hanford area.

The federal water pollution law was amended by Congress and approved by the President on July 9, 1956. The law continues the past policy of cooperation by the Public Health Service with federal, state, and other governmental agencies. The law provides for intervention by the PHS and Department of Health, Education, and Welfare in matters of pollution of surface and underground waters especially those which are interstate in character. Remedial action is primarily a state function, however, the Secretary of the Department of Health, Education, and Welfare may request the Attorney General to bring suit on behalf of the U.S. to secure abatement of pollution and the court has jurisdiction to enter a judgment and issue orders of enforcement.

The law declares the intent of Congress that an operation such as Hanford, insofar as practicable and consistent with the interest of the U. S., cooperate with the Departme of Health, Education, and Welfare and with any state or interstate agency having jurisdiction over waters, such as the Columbia, into which any matter is discharged, i preventing or controlling pollution of such waters. The Columbia River Advisory Grou is composed presently of pollution control officials of Washington, Oregon, and the F

An informal conference was held on July 13 with some members of the CRAG. They reported that sphaerotilus growth is now present in both the Columbia and Willamette rivers. Mills on the Willamette have started to impound their wastes and hence the growth of this organism should cease. The CRAG has asked for our consultation on this problem.

Radiological Disaster Studies

Data on the population distribution and industries in the vicinity are being gathered for the report on disaster probability and consequences following the reactor modification program.

Internal Exposure Studies

A review of the bioassay data for an individual exposed in 1952 was made. Since the results were available only for the last year, firm conclusions were not possible but the data indicated that the body burden was probably between 0.02 and 0.055 μc depending upon the rate of movement from the plutonium deposited in the wound.

The studies of the transfer of plutonium from that portion retained in the lung for long periods of time were continued. The basic data used were the results of urinary and fecal excretion rates and blood concentrations from humans acutely exposed to plutonium aerosols. The slower decline in the rate of urinary excretion than is predicted by Langham's equation was attributed to a transfer of the plutonium from the bloodstream thus resulting in a chronic administration to the blood. The rate of turnover, and the quantity initially present in the lung is obtained by fitting the calculated curves to the urinary excretion rates. Comparison of fecal rates to those expected indicates that after the initial rapid turnover due to clearance of the upper respiratory tract, only about 10% of the removal from the lung can be accounted for by direct elimination into the GI tract. Table 1 presents the estimated values for rate of removal from the lung by transfer to the blood stream and of ciliary action in two cases.

Table 1
COMPARISON OF ELIMINATION RATES FROM THE LUNG

Time Since Exposure Days	Estimated Lung Elimination Rate By Ciliary Action d/m/day	Solubilization d/m/day
Case I		
1	16,000	11
3	9	11
9	5	11
15	0.7	11
40	1.4	11
71	3.1	10
280	0.7	8.4
281	0.6	8.4
Case II		
1	3300	550
4	280	550
464	4.3	55
465	7.0	55

Since the concentration in the blood should be higher for the continued administration from the lung than in the case of a single administration, equations were derived for estimating the blood concentration and the results compared with thesamples available. These comparisons are given in Table 2.

Table 2
BLOOD VALUES

Time Since Exposure Days	Quantity in Blood	
	Calculated(a) d/m	Measured(b) d/m
Case II		
140	230	210
220	160	190
Case III		
872	7.7	16
955	6.4	7

(a) from quantity and rate of turnover estimated from urine results.

(b) assuming 5000 ml of blood in body

The agreement obtained indicates that the caluclation gives a reasonable interpretation. The time of turnover from the lung is also of interest in the estimation of lung dose. For these cases, the best values of the half-life in the lung range up to about two years.

Automatic Reactor Effluent Monitor

Problems related to the continuous separation of As^{76} from the stream to be monitored for P^{32} were given additional study. The original concept provided an open reaction vessel following the cation exchange bed. In this vessel hydrocloric acid and sodium thiosulfate would be added intermittently, the solution being maintaine near boiling. The reaction products would have then been pumped at a constant rate through the CuS bed. Difficulties with this system tried were (1) intermittent addition of reagents on the cycle tried did not achieve retention of As^{76} on the CuS; (2) colloidal sulfur resulting from the reaction would soon make check valves in the pump inoperative; (3) the placement of the pump between reaction vessel and CuS bed required interconnecting lines in which the solution cooled materially before reaching the CuS.

Consideration was given to a completely pressurized system in which the pump would have been placed before the ion column, the reaction vessel pressurized and connected to the CuS bed. This system made controlled addition of reagents more difficult; however, a scheme was worked out worthy of a trial. The potential failure of the system from overheating the reaction vessel was also apparent, and some relief valve system would be required.

The advantages of the open vessel system could be retained and the pump and lines eliminated if vacuum could be employed to draw the reaction products through the CuS bed. The product receiver would require provision for breaking the vacuum to permit sample delivery. It would also be necessary to regulate the vacuum to operate only when the liquid level were above a minimum height over the CuS. A relay system was assembled to actuate solenoid valves which will achieve these requirements. The receiver is opened to atmospheric when the liquid level drops to a given height above the CuS. As the liquid level then rises to a height determined by sensing probes, the receiver is cut off from atmospheric pressure and the vacuum draws the sample to the receiver.

The success of continuous operation of this system will be determined largely by the rate at which the colloidal sulfur plugs the CuS bed. This will be evaluated.

Continuous addition of reagent in the cc per hour range should be achieved by a constant head device, capillary feed tubes and very small flow rate meters presently on order. Motor-driven syringe feeds were investigated. These, though useful, are generally complex, and lacking in capacity, unless some provision is made for rapid reloading.

Data were obtained on the relative efficiency of the proportional counter for counting P^{32}. It was determined that counting P^{32} beta particles through the 0.010" aluminum cup bottom was a few percent less efficient than counting the same source with the counter over the cup (3/4" high). Other advantages of placing the beta counter over rather than under the sample cup are better window protection, greater ease in used cup disposal, and better counter accessibility.

In the shield recently designed and made available, a background count of about 40 c/m was achieved, a reduction of a factor of two.

The table structure and cup positioning mechanisms, were developed to the point of releasing drawings for shop fabrication.

A dual channel count rate meter was fabricated from the design used in slug rupture monitoring. This equipment will be used in making Compton corrections for Na in Mn^{56} and Np^{239} measurements.

The master programmer is being fabricated for the 107 effluent monitor. Basically, this consists of two recycling timers (Industrial Timer Corp.) which are coupled or driven from a single drive motor and two stepping relays which control the electronic gear.

A housing for the photomultiplier, crystal and preamplifier is being designed. This housing will enclose the crystal, photomultiplier and preamp and will provide necessary protection to these components.

The reversible decade counters were received and tested. Three units completed in decade will add or subtract counts according to proper switching signals. Application of these counters may result in a method of making background corrections, Compton corrections, or absorber corrections as in the case of As^{76} absorber determination.

L. C. Schwendiman
Radiological Engineering Section
for P. E. McMurray

MONTHLY REPORT - RADIOLOGICAL RECORDS AND STANDARDS SECTION - JULY 1956

GENERAL

The force increased fourteen, primarily attributable to staffing the Radiation Monitoring Unit for intensified work on Project CG-558.

All statistics for this report may be found at the end of the report in a condensed appendix.

RADIATION MONITORING

The demand for radiation monitoring service was normal during the month. High radiation fields were encountered in A cell of the 201-C Building (Hot Semi-Works) during decontamination efforts in preparation for general maintenance work. Personnel dose rates were of the order of 300 mr/hr at 15 feet from contaminated equipment.

A potentially serious skin contamination case was discovered at the lobby hand counter at the 234-5 Building. A Separations Technology Laboratory Assistant failed to detect skin contamination during the normal work location surveys. When the plutonium contamination appeared to increase in quantity during skin decontamination efforts, the employee was transported to the Kadlec Hospital for further decontamination. The contamination level at this point was 250,000 d/m. An Industrial Physician removed a minute piece of plutonium metal which was lodged in the epidermis. Subsequent decontamination was completed the following day.

A routine survey in the 222-U Building uncovered a balance which had an electrostatic device which contained a radioactive source, probably polonium, measuring 500 mrads/hr at surface including 20 mr/hr at two inches uncorrected for source size. A similar loss of control occurred when a specific gravity indicator containing a cesium-137 source was delivered to Minor Construction without proper control. Increasing attention will be required to assure awareness of all such commercial devices which are becoming more prevalent.

RADIOLOGICAL FIELD DEVELOPMENT

Exposure Evaluation and Records

Delivery by the vendor of the first batch of 500 new plastic film badges is expected for August 3, 1956. Field tests of this badge will be started August 6. A cursory study was made to determine the feasibility of providing a centralized "drive-in" type of badge service issuing a universal badge to some 2,000 employees as they pass through the 300 barricade. This service could be provided by September 1, 1956; however, implementation of such a service will be dependent on resolving several security matters by General Electric Security management.

Preliminary data was developed on the type of information which may be needed for personnel exposure analysis in the coming several years. This will permit an orderly programming of the exposure records system for IBM analysis. Adaptation of the exposure records system to the IBM computer is proceeding satisfactorily with a goal of all external records being adapted to IBM processing by January 1, 1957.

Radiological Protective Apparel

Investigations into a number of types of protective clothing and equipment continued. These included:

1. Ordering a test lot of Scottoramic filter masks which appear to have several improvements over present Army assault masks.

2. Laundry testing of the Tingley one-piece unlined rubber boot, which displayed good wearing quality.

3. Laundry testing of rubber-coated nylon fabric which is being considered for rubber suit fabrication.

4. Communication with the Kimberly-Clark Corporation, manufacturer of paper fabrics, and the Williamson-Dickie Company, a clothing manufacturer, on the development of disposable garments.

Arrangements were made for on-plant tailor assistance for design of protective clothing. This will permit simple fabrication of cheese-cloth prototype styles which may then be sent to manufacturers for fabrication with plastic or disposable paper fabrics.

Radiation Monitoring

One running time meter was calibrated and successfully installed in a portable GM meter. Field testing is in progress with early results favorable. This idea has as its potential benefits: Determination of the use time of portable instruments, scheduling of instrument calibration by use time, and replacement of batteries according to use rather than elapsed time. Testing is still in progress.

Methods were considered to effectively increase the response of the scintillation poppies. The use of a grooved or roughened scintillation surface may prove an effective method for increasing the concentration per projected area while maintaining a constant density thickness of phosphor. Use of a lens system to focus emitted light from the phosphor on the photomultiplier tube was not productive. A marked advantage was noted in the spraying of phosphors on plates in "Duco" and acetone solution in that they are fixed tightly to the plate, whereas phosphor which is dusted on plates is easily removed by touching.

The design on the improved bioassay container was completed. Check prints were sent to vendors, through Market Research, for comments on design and rough cost estimates. Preliminary replies indicated the design was adequate, permitting molding in quantities. Several suggestions were received from vendors which would permit economies in production of the new bioassay sample container.

EXPOSURE RECORDS

Tabulation of total gamma dose to employees during the first six months of 1956 compared to the same period in 1955 and 1954 indicated the following:

	Number of Employees	
	>1r	>2r
First Half of 1956	266	0
First Half of 1955	113	4
First Half of 1954	104	8

CALIBRATIONS

The drilling phase of the Calibration Wells project was completed. Well casings were installed and preparations were made for pouring the lead shielding around the well casings.

A complete inventory of all portable instruments was made by Property Accounting personnel. Three poppy chargers, representing 0.2% of the number of items inventoried and 0.2% of the total inventory value, could not be located.

Thirty-seven new scintillation portable poppies were delivered to the instrument pool and placed into field use.

EXPOSURE INVESTIGATION AND ANALYSIS

No new cases of plutonium or fission product deposition were confirmed during the month. The total number of known cases of plutonium deposition remains at 165 (erroneously reported as 166 last month). Eight employees known to have been involved in the June 233-S incident show indications of detectable plutonium deposition. Except for the three employees principally involved, the deposition in these five employees appears to be less than 5% of the MPL. Treatment with Ca EDTA is continuing for two of the above three employees. Eleven persons who previously had not shown uranium deposition this year or in 1955 evidenced some deposition of uranium in samples processed in July. All cases were less than 25% of the MPL.

Radiation Incidents

	June	July	1956 To Date	Same Period Last Year
Informal	25	18	209	235
Class I	2	7	62	87
Class II	1	3	11	8

Class II

No. 109-R - Journeyman (Reactor - Radiation Monitoring) received an exposure in excess of permissible limits, and several other Radiation Monitors received exposure in excess of that planned, while monitoring at the 105-D Reactor Building, 100-D Area on July 4, 1956. The dose sustained was 355 mr over a seven day period, 255 mr received on the incident day.

No. 110-C - Instrument Trainee (Reactor - Maintenance) sustained an exposure in excess of permissible limits to a portion of his right palm while performing routine Radiation Zone work at the 105-D Reactor, 100-D Area on July 11, 1956. The dose is estimated to have been between 1.3 and 17 rads, with the most probable dose in the order of 4 rads.

No. 111-C - Process Operator (Separations - Metal Removal) exposed both hands in excess of the permissible limits when he handled, without monitoring, a highly contaminated electrode wire, at the 241-TXR Tank Farm, 200 West Area on July 19, 1956. Calculated hand dose, 6 to 10 rads.

Class I

No. 609-R - Engineer (Project - 300 Area and General Areas Field Construction) entered a Radiation Zone without his film badge at the 107-C Basin, 100-B Area on July 2, 1956.

No. 610-C - Uncontrolled spread of process solution to the ground at the 241-UR Tank Farm, 200-West Area on July 6, 1956.

No. 611-R - Fieldman (Project - Construction Inspection) entered a Radiation Zone without his personnel meters at the 224-U Building, 200-West Area on July 10, 1956.

No. 612-R - Electrician (Minor Construction - Industrial Electric Co.) entered a Radiation Zone without his personnel meters at the 224-U Building, 200-West Area on July 10, 1956.

No. 613-R - Uncontrolled handling and storage of a commercial instrument containing a radioactive source prior to being received by Minor Construction forces at the 224-U Building, 200-West Area on July 12, 1956.

No. 614-R - Four employees (Reactor - Operation, Radiation Monitoring) potentially overexposed while working in the discharge area of the 105-H Reactor, 100-H Area on July 17, 1956.

No. 615-C - Laboratory Assistant (Separations Technology - 234-5 Development) found to have a sliver of metallic plutonium on her finger after performing routine work at the 234-5 Building, 200-West Area on July 18, 1956.

Claims for Reimbursement for Contaminated Personal Effects

During the month 10 claims for 64 separate articles were received. Reimbursement was recommended for all of the articles, as all but one were an outgrowth of the contamination spread at 233-S which occurred last month. The total value was $301.75. The total for the year to date is 38 claims for 124 articles with reimbursement recommended for all of the articles at a cost of $640.90.

Instrument Standards

The Juno rebuilding program was completed. All the units are now modified to the CP circuit utilizing the 5886 electrometer tube. Barring obsolescence, these units should have a useful life of five more years.

Appropriation requests for 30 scintillation portable poppies, 97 GM meters, 13 Samson Alpha Meters and 22 CP-TP meters were prepared and submitted for approval.

RADIOGRAPHIC TESTING

Requests for radiographic testing have shown a steady increase since the middle of June, 1956. A new record of 369 exposures was made excluding 28 other supplementary tests. The major portion of the work was on the CC-558 Project and involved the radiographic examination of production welds on 1 1/4" wall thickness x 36" diameter high pressure pipe. The acceleration of the zirconium process tube program in the Technical sections gave rise to a large number of radiographic examinations for the groups working with zirconium.

A new market for radiographic examination was found in the HAPO program of irradiations made in the Materials Testing Reactor at Arco. A number of pieces were examined for weld integrity. Other samples were examined to check internal assemblies before irradiation.

Miscellaneous smaller jobs were of equal interest and included: A gamma-graph of a repaired flywheel for new pumps on Project CC-558; microradiographs of polyethylene used in bellows for Separations work; radiographs of high tension connectors for Electrical Utilities; and magnetic particle examination of concrete mixer truck wheel spindles.

A. R. Keene
A. R. Keene
RADIOLOGICAL RECORDS AND STANDARDS SECTION

ARK:jc

APPENDIX

RADIATION MONITORING

	July	1956 To Date
Special Work Permits	2,324	16,274
Routine and Special Surveys	2,036	17,792
Air Filter Samples	2,957	19,559
Skin Contamination Cases	12	70

EXPOSURE RECORDS

Gamma Pencils

	Pencils Processed	Paired Readings 100-280 mr	Paired Readings Over 280 mr	Lost Readings
July	299,398	21	21	18
1956 to Date	2,105,824	127	125	103

Beta-Gamma Film Badges

	Badges Processed	Readings 100-300 mrads	Readings 300-500 mrads	Readings Over 500 mrads	Lost Readings	Average Dose Per Film Packet mrad(ow)	Average Dose Per Film Packet mr(s)
July	59,904	694	6	1	43	2.43	2.68
1956 To Date	375,567	6,779	209	112	327	4.45	3.82

Slow Neutron Pencils

	Pencils Processed	Paired Readings 4-12 mrem	Paired Readings Over 12 mrem	Lost Readings
July	2,236	48	8	4
1956 To Date	14,398	257	49	20

Fast Neutron Film Badges

	Badges Processed	Readings Above 50 mrem	Lost Readings
July	745	2	2
1956 To Date	6,045	11	18

Bioassay

	July	1956 To Date
Plutonium: Samples Assayed	940	8,830
Results Above Detection Limit*	37	198
* Detection limit was 0.05 d/m		
Fission Product: Samples Assayed	1,141	10,172
Results Above 5.0 c/m/sample	2	23

Uranium Analyses

Sample Description	Following Exposure µg/liter Maximum	Average	Number Samples	Following Period of No Exposure µg/liter Maximum	Average	Number Samples
Metal Preparation	15.2	3.1	95	15.7	2.6	86
Technical	9.9	3.2	14	7.9	2.5	17
UO_3 Plant	23.6	7.0	45	36.2	7.2	31
Special Incidents	16.0	2.2	38	----	---	--
Total 326						

Thyroid Checks

No thyroid checks were reported.

Hand Checks

There were 61,590 alpha and 56,413 beta hand checks reported from all plant locations. None were reported high.

CALIBRATIONS

	Number of Units Calibrated July	1956 To Date
Portable Instrument Calibration		
CP Meter	952	6,852
Juno	379	2,846
GM	1,318	9,489
Other	159	1,118
Total	2,808	20,305
Personnel Meters		
Badge Film	2,209	14,142
Pencils	11,293	69,857
Other	182	1,241
Total	13,684	85,240
Miscellaneous Special Services	291	3,632
	July	1956 To Date
Total Number of Calibrations	18,522	122,825

RADIOGRAPHIC TESTING

Customer (Section)	No. of Exposures	Feet of Weld Examined	No. of Pieces Examined
Radiographic			
Pile Technology	138	75	18
Separations Technology	2		2
Project	120	140	18
Electrical Utilities	14		2
Metal Preparation	2		3
Purchasing and Stores	15	15	1
Separations	73	185	36
Radiological Engineering	1		1
Radiological Records and Standards	4		2
Total	369	415	83
Ultrasonic			
Project	16		16
Magnetic Particle			
Project	12		6

MONTHLY REPORT - BIOPHYSICS SECTION - JULY 1956

REGIONAL MONITORING UNIT

The general findings are summarized in the following:

Sample Type and Location	Activity Type	Average Activity Density μc/ml	Trend* Factor
Drinking Water and Related Materials			
Benton City Water Co. Well	alpha	1.2×10^{-8}	--
Richland, N. Richland, Benton City Wells	alpha	$(<0.5 \text{ to } 1.2) \times 10^{-8}$	--
100 Areas	beta	$(0.09 \text{ to } 1.5) \times 10^{-6}$	--
200 Areas	beta	$(1.5 \text{ to } 2.1) \times 10^{-7}$	+2
Pasco, Kennewick, McNary Dam	beta	$(<0.5 \text{ to } 7.6) \times 10^{-7}$	--
Backwash Solids - Pasco Filter Plant	beta	7.1×10^{-3}	--
Backwash Liquids - Pasco Filter Plant	beta	8.7×10^{-7}	--
Anthracite, Sand Filter - Pasco Filter Plant	beta	4.6×10^{-5}	--
Other Waters and Related Materials			
300 Area Wells #1 and #3	alpha	$(0.09 \text{ to } 2.5) \times 10^{-7}$	+2
300 Area Well #4	alpha	1.8×10^{-7}	--
Well #4 measured as Uranium	U	1.5×10^{-7}	--
107 and 108 Wells	beta	$(<0.0005 \text{ to } 6.3) \times 10^{-4}$	+2
200 East Wells	beta	0.7×10^{-3} to 4.7×10^{-1}	--
200 West Wells	beta	3.0×10^{-6} to 1.9×10^{-2}	--
Wells Near 200 Areas	beta	$(<0.5 \text{ to } 1.6) \times 10^{-7}$	--
Outlying Wells	beta	$(<0.5 \text{ to } 1.2) \times 10^{-7}$	--
Columbia River - Hanford Ferry	beta	6.3×10^{-6}	--
Columbia River - Below Reactors	beta	6.0×10^{-6}	-2
Columbia River - Paterson to McNary	beta	2.1×10^{-7}	--
Columbia River - Shore Mud	beta	$(1.1 \text{ to } 5.4) \times 10^{-5}$ μc/gm	--
Raw Water - Operating Areas	beta	$(<0.05 \text{ to } 3.7) \times 10^{-6}$	--
Reactor Effluent Retention Basins to River	beta	6,000 to 29,000 μc/sec/reactor	--
		$(1.8 \text{ to } 7.1) \times 10^{-3}$	--
Reactor Effluent Retention Basins to River	alpha	<0.04 μc/sec/reactor	--
		$<5 \times 10^{-9}$	--

* The trend factor shows the n-fold increase (+) or decrease (-) from last month, where values of n less than 2 will not be noted.

Sample Type and Location	Activity Type	Average Activity Density μc/ml	Trend* Factor
Other Waters and Related Materials (contd)			
I-131 in Farm Wastes to River		11.1 μc/day	--
	I-131	1.9×10^{-7}	--
I-131 in Columbia River - Hanford	I-131	1.4×10^{-8}	--
300 Area Pond Inlet	alpha	2.3×10^{-6}	--
Atmospheric Pollution			
Gross Alpha Emitters	alpha	$(<0.4 \text{ to } 0.8) \times 10^{-14}$	-4
Gross Dose Rate - Separations Areas	beta-gamma	1.2 to 7.1 mrad/day	--
Gross Dose Rate - Residential Areas	beta-gamma	1.8 to 9.4 mrad/day	--
Active Particles - Separations Areas	beta	$(2.1 \text{ to } 7.0) \times 10^{-13}$	--
I-131 Separations Areas	I-131	$(0.1 \text{ to } 1.9) \times 10^{-12}$	--
I-131 Separations Stacks	I-131	0.3 curie/day	-9
Ruthenium - Separations Stacks	Ru-103,106	<0.01 curie/day	--
Active Particles - Wash., Idaho, Ore., Mont.	--	0.04 to 0.21 ptle/m^3	+4
Active Particles - Project	--	0.02 to 0.11 ptle/m^3	--
Vegetation			
Environs of Separations Areas	Iodine	$(0.3 \text{ to } 7.3) \times 10^{-5}$ μc/gm	+5
Residential Areas	Iodine	$(<0.03 \text{ to } 5.7) \times 10^{-5}$ μc/gm	+5
Eastern Washington and Oregon	Iodine	$(<0.03 \text{ to } 1.5) \times 10^{-4}$ μc/gm	+4
Non-Volatile Beta Emitters Wash. and Ore.	beta	$(<0.1 \text{ to } 9.3) \times 10^{-4}$ μc/gm	+3
Alpha Emitters - Separations Areas	alpha	$(<0.5 \text{ to } 0.9) \times 10^{-7}$ μc/gm	-3

* The trend factor shows the n-fold increase (+) or decrease (-) from last month, where values of n less than 2 will not be noted.

The average daily emission of I^{131} from separations plants was 0.3 curie with a maximum emission of 1.6 curies from the Purex Plant on July 1. The total contribution of I^{131} to the environs from the separations plants was approximately one-tenth that experienced during June. Extensive deposition of bomb debris on vegetation occurred between July 9 and 10 and again between July 15 and 17 with smaller amounts detected throughout most of the month. The deposition covered most of the Pacific Northwest with the exception of the Seattle area which received only very minor amounts. Maximum iodine measurements were 2.0×10^{-4} and 8.4×10^{-5} uc/gm on July 10 and July 17, respectively, and the maximum non-volatile beta measurement was 2.1×10^{-3} uc/gm on July 10. Decay measurements of the July 10 deposition showed a half-life of 4 days which would indicate that the nuclear detonation occurred between July 4 and 7.

The well drilling and well monitoring functions were transferred from Earth Sciences to Regional Monitoring on July 1.

A total of 2200 feet was drilled during the month in the well drilling program. Eight wells were completed and are ready for sampling. These are the 241-S-21, 241-S-13, 241-S-22, 241-B-20, 241-B-21, 241-BC-7, 216-A-9-1, and 55-50-4 wells.

RADIO-ANALYSIS LABORATORY UNIT

The responsibility for the nitrate analysis of all test well samples was assumed by the laboratory. A colorimetric procedure was adopted to replace the more time consuming polarographic method for nitrate concentrations greater than 25 ppm.

Investigation of changing characteristics of the gamma scintillation spectrometer when used as a counter revealed that the age of the 404 A tubes in the pulse height analyzer becomes critical when using a 5 volt slit width. The differential scan using aged 404 A tubes and a 5 volt slit width resembled an integral scan, while the same tubes using a one-half volt slit width produced satisfactory differential scans.

The gross beta activity in 100 KE reactor effluent increased by a factor of approximately 1.4 with the majority of the increase due to Mn^{56}. An increase in the power level occurred during the same period.

Continued increases in Mn^{56} concentrations in the reactor effluent water from 100 B, 100 C, and 100 DR occurred during the month. The Mn^{56} concentration in water from 100 H and F reactors remained relatively constant while 100 D water showed a decrease similar to that of previous years. The As^{76} and P^{32} concentrations in the reactor effluent waters decreased and appeared to be following the expected seasonal trend.

The gross beta activity in the 100 F reactor effluent water decreased to approximately three-fourths that of the previous month. Previously noted differences in the fission product activity density in the water from the two sides of the reactor disappeared. The higher fission product concentration of the water from the foreside of the reactor appeared to be due to incipient ruptures.

METEOROLOGY UNIT

Three field experiments were conducted and reduction of data and diagnostic analyses were completed for each. During the first, fluorescent pigment and smoke were emitted continuously from the 185-foot and 200-foot levels on the Tower during a period of strong winds and a near-neutral temperature lapse rate. Aerial photographs of the visible plume were taken at one-minute intervals from 7000 feet above the surface and ground-level concentrations and dosages were measured out to one-half mile from the source and over an arc of 160° centered opposite the mean wind direction. The ground-level concentration of the pigment was found to be quite invariant with time as opposed to the large fluctuations observed in lighter winds and super-adiabatic lapse rates. Extensive analyses of this significant experiment were begun.

The second and third experiments were designed to measure the vertical and horizontal distribution of concentration of materials emitted into stable atmospheres. Due to technical difficulties the first of these runs produced no useable data but did serve as excellent experience for the second experiment. During the second run the horizontal distribution was measured from aerial photographs and the vertical distribution was successfully measured using impactor-type samples held aloft in a vertical array by a large tethered blimp. Quantitative measurements of the relative concentrations of the fluorescent pigment emitted continuously from the Tower during this experiment gave the data necessary for the specification of the time-mean distribution in the vertical dimension. It appeared, subject to further statistical tests, that the vertical distribution of concentration for this experiment and at a distance of 1000 feet from the source could be adequately described by a normal error law with a standard deviation between 10 and 20 feet.

The recently completed double-theodolite observation system for measuring winds aloft very precisely was tested and found to be completely adequate for our experimental purposes.

Surface and upper-air wind data, temperature lapse rates, precipitation, and trajectory data were summarized and submitted for inclusion in a reactor safeguard report.

The wind station network continued to operate at a satisfactory level of performance and data from this network were reduced on a routine basis. Excessive work loads on the IBM 702 computer and the relatively low priority assigned to wind summaries prevented the processing of these wind data.

Temperatures during July averaged 78.9°F which was 2.6° above normal. After the 7th of July there were only two days in which the maximum failed to reach 90° and during 8 consecutive days (July 17 - 25) there was a maximum of 100° or above.

There was no measurable precipitation although thunderstorms occurred on 4 days.

Type of Forecast	Number Made	% Reliability
24 hour general	62	85.0
8 hour production	93	83.3
Special	84	79.8

METHODS UNIT

A gamma-gamma coincidence counting technique was developed for determining Cs^{134} in the presence of Cs^{137}. Although Cs^{134} is not a fission product it is present in wastes disposed to the ground. If further investigation should prove that the Cs^{134}:Cs^{137} ratio is constant in the waste streams, subsequent ratio determinations on underground water samples would provide a measure of the age of the sample and a rate of movement of cesium in the underground water.

The addition of soluble chemicals to the cooling water of one of the reactor tubes was continued in a study to determine the source of the radioisotopes observed in reactor effluent water. In this test 3.68 ppm sodium, 2.51 ppm sulfur (as sulfate) and 1.29×10^{-2} ppm copper were added and Na^{24}, P^{32}, S^{35} and Cu^{64} activities were determined. The hold-up times of the materials were calculated assuming a constant rate of addition, constant known flux, and using the thermal neutron cross section. The value for sodium was 4.59 sec. The copper hold-up time was 8.55 minutes. A cross check of the S^{35} and P^{32} results indicated that sulfur cannot be a major source of P^{32} in this test. The increase of 16 d/m/ml of P^{32} observed in the test may have been due to phosphorus impurities in the chemicals added.

The low background beta counting system neared completion; it consists of four hemispherical, end window, proportional chambers in an anticoincidence shield of cosmic ray tubes and a 6" iron shield. The background rate for each unshielded proportional tube is 35 counts per minute. Shielding with 6 inches of iron in all directions reduced the rate to 16 counts per minute. Additional use of five 2" by 30" cosmic ray tubes arched over the proportional counters and operated in anticoincidence reduced the background to 1.9 to 2.1 counts per minute. Further lowering of the background may be realized when the counting tubes are completely ringed by the anticoincidence tubes. Precision counting of samples with activities as low as 2 counts per minute is now possible. The four counting tubes operate independently and the system can thus handle four samples at a time.

Final drawings, schematic diagrams, and specifications were completed for the end window proportional beta counting equipment for beta emitters for the counting room modification.

An improved water sampling system was installed at the Pasco Water Plant inlet. This system provides a continuous sample which is not dependent upon the water plant operation. The previous sampler obtained samples from the water plant line in which water was pumped only 16 hours per day. The new sampler obtains weekly samples of cations on an ion exchange resin and a 40 liter sample of the river water for studies on the radioisotope content.

Eight standardized sources of Co^{60}, Ru^{106}, I^{131}, Cs^{137}, UO_3, and Pu^{239} were prepared for various organizations.

INDUSTRIAL HYGIENE UNIT

A study was commenced to evaluate workers' exposures to UO_3 dust during the changing of air cleaning filter bags at Metal Recovery. Dust concentrations ranged from 7.4×10^{-8} to 3.5×10^{-6} uc/cc; median particle size was 0.5 u. The final data will also be used to appraise the respiratory protection and evaluate the adequacy of air cleaning equipment.

The NO_2 monitor was operated for 168 hours at a distance of 1600 yards from the Purex stack for further evaluation of its performance with respect to the timing of ground contact by stack gases. Thirty-five contacts were demonstrated. Of these, 20 persisted 1-5 min., 13 for 5-15 min. and 2 for 45-75 min.

Aluminum dust exposures arising from buffing of canned slugs was studied. Although the concentration of airborne dust ranged from 139 to 280 mg/m^3 of air, no health hazard was evident.

A re-study was conducted of noise resulting from the operation of export pumps in the 182B Bldg. following the installation of acoustic absorbing material on the walls. A noise reduction was demonstrated but the HAPO criteria were still exceeded in the 1200-2400 cps frequency band.

Design criteria were completed for a particle elutriator in which bulk dust samples can be separated by their terminal settling velocity in air into eight fractions by size. Particles will be collected on a transparent tape for microscopy or autoradiography.

EARTH SCIENCES UNIT

Twelve firms engaged in geophysical mapping work were contacted relative to the possible use of various geophysical techniques at Hanford to delineate basalt surface, ground water surface, and other features. It appears that seismic reflection and refraction techniques would provide the most hope of success and that gravity, magnetic and electrical resistivity surveys would provide little and less-useable data.

An investigation into the feasibility of substituting rotary drilling for the far slower churn drilling indicated that considerable savings in time and cost might be obtained.

The ground water mound east of 200-East has built up to an elevation of 404.5 feet, an increase of 7.5 feet since January 1, at well 46-43 due to Purex operation. Elsewhere in the vicinity, well readings continued to exhibit irregular rises and falls indicating the need of more frequent measurements to detect short time changes.

Drilling at a pump-test site south of Gable Mountain neared completion. This well will have well screen rather than perforations to permit readier entry of ground water into the well. Improved data so obtained will allow better calculation of aquifer transmissibility, coefficient of storage, and ground water velocity; these will be applied to evaluation of the effect of the proposed Gable Mountain Lake on the water table in that vicinity.

The presence of 1.6×10^{-3} to 3.2×10^{-4} moles/liter of Al (III) in synthetic TBP waste inhibited Sr^{90} adsorption on soil but had little effect on Cs^{137} adsorption.

The failure of Na_2S to break the Co^{60} complex in TBP scavenged waste further supports the earlier assumption that cobalt is present therein as a cyanide complex ion.

The equilibrium exchange of yttrium for calcium was determined as a function of pH for two concentrations of Y ion. The replacement of Ca by Y was most effective in alkaline medium. In waste solution going to ground higher pH should favor removal of yttrium isotopes.

The use of Separan 2610 in concentrations of 1 ppm maintained or increased the percolation rate of tap water through soil columns for 300 hours as contrasted to the usual progressive decrease in the rate of flow with time.

PHYSICS UNIT

A small lead cave was built around a thin, small sodium iodide scintillation counter to give a small version of the equipment planned for the Body Monitor. Plutonium in hand punctures was measured with the device; 0.0015-0.002 microcurie was detectable.

The magnetic resonance detector built to measure the field of the positive ion accelerator analyzing magnet was put into use. The device was calibrated by measurement of the Li(p,n) and T(p,n) threshold energies and appears capable of measuring beam energies to an accuracy of 0.03%. Opening the accelerator for maintenance changed the calibration only 0.1%, an amount which is negligible except for certain very precise experiments. Certain results for the moderated dosimeter which had been assumed to be a case of poor statistics were shown to be due to a fine structure in the response as a function of neutron energy.

A small bundle of germanium ingots was exposed to D(d,n) neutrons for KAPL. Angular distribution data were obtained for the T(p,n) reaction to permit exposure of another bundle to this source.

INSTRUMENT DEVELOPMENT UNIT

All channels of an experimental sensitive Alpha Air Monitor were fabricated and tested with good results on background radiation. This instrument is being developed to detect low level alpha air contamination with a detection limit of ten to one-hundred times the maximum permissible concentration of plutonium in air.

Changes in the probe configurations for the experimental twelve-fold Hand and Shoe Counter resulted in improved reliability and sensitivity and simplified maintenance procedure. The alpha channels indicate with high reliability hand and shoe contamination levels corresponding to fifty microcuries of uranium nitrate solution uniformly distributed over the detecting surfaces.

Tentative specifications were completed for an instrument for the approximate location and measurement of gamma and x-ray emitting radioisotopes in dogs. The proposed instrument would employ a six-inch thick steel shield enclosing eighty cubic feet. It would automatically scan the animal and present the integrated isotope quantity as well as a graph of the differential quantity as a function of position. The switching circuits for the Automatic Scintillation Scanning Device were fabricated and tested with good results. The instrument will be used for determining the feasibility of mapping in detail the distribution of a radioactive material in a given small volume of an animal.

Acceptance tests were completed on 41 new portable battery scintillation poppies and evaluation tests were completed on a commercial remote area monitoring system. Evaluation tests were continued on a portable battery transistorized poppy and were started on a commercial exposure-rate meter.

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BIOPHYSICS SECTION

DWP:hsf

BIOLOGY SECTION MONTHLY REPORT - JULY 1956

AQUATIC BIOLOGY UNIT

Highlights of the Columbia River Survey

Activity densities of small fish in the vicinity of Hanford increased about fivefold from the levels observed in June, because of increased river temperatures and reduced river flow. The value for plankton increased about threefold which correlates with reduced river flow. With the possible exception of Ringold, there was no significant increase in the contamination level of whitefish, however. The buildup in activity density for river organisms immediately below the 100-H effluent overflow flume continued through the early part of the month. Small fish in this area had an average level of 2×10^{-2} μc/g and some individuals contained 5×10^{-2} μc/g. These high levels are expected to decline as the river flow returns to normal.

Selected values of interest were:

Organism	Location	Sample Type	Activity Density (μc/g) June	Activity Density (μc/g) July
Minnows	Hanford	Average	4×10^{-4}	2×10^{-3}
		Maximum	2×10^{-3}	6×10^{-3}
Whitefish flesh	Hanford vicinity	Average	4×10^{-5}	3×10^{-5}
		Maximum	9×10^{-5}	1×10^{-4}
	Priest Rapids	Average	5×10^{-6}	5×10^{-6}
		Maximum	1×10^{-5}	1×10^{-5}
	Ringold	Average	2×10^{-5}	2×10^{-5}
		Maximum	3×10^{-5}	4×10^{-5}
Plankton	Hanford	Average	3×10^{-3}	8×10^{-3}

Effluent Monitoring

Routine monitoring of reactor area effluent was carried out during July with juvenile whitefish. This is the first time that this species has been used for such studies. Mortality to date has been nominal in all concentrations and at this early date there is no indication that this species is more sensitive than the salmon.

The test which was set up to determine whether young salmon were more sensitive to Cr(VI) at high than at low temperatures was terminated early in the month. Final results were essentially the same as reported in June. There appears to be no simple correlation between temperature and sensitivity to Cr(VI). Young salmon held in 0.09 ppm Cr(VI) at 10° C had a better survival and growth rate than fish held in 5° C water in the absence of Cr(VI).

A test was initiated to determine whether Separan (a polymer scheduled for use in the water treatment process) will be toxic to Columbia River fish.

BIOLOGICAL ANALYSES UNIT

Biological Monitoring

Waterfowl concentrations of P^{32} remained essentially unchanged from June. Average values were:

Specimen	Concentration of P^{32} (μc/g) Soft Tissue	Bone
Geese (young)	9×10^{-5}	1×10^{-3}
Gulls	2×10^{-4}	1×10^{-4}
Merganser adults	1×10^{-4}	8×10^{-5}
Merganser young	4×10^{-4}	4×10^{-3}
Puddle ducks	1×10^{-4}	4×10^{-4}
Shorebirds	6×10^{-4}	1×10^{-3}
Swallows	2×10^{-4}	1×10^{-3}
Terns	3×10^{-4}	4×10^{-4}

Rodent thyroid concentrations of I^{131} increased by a factor of 20 in specimens collected east of the 200-East Area. Other collecting sites showed smaller increased in I^{131} and feces activity densities of fission products. Values, in units of μc/g, were as follows:

Location	Thyroid I^{131} Maximum	Thyroid I^{131} Average	Mixed F.P. in Feces Average
One mile S.E. of Redox	0.003	0.002	1×10^{-5}
Prosser Barricade	0.008	0.007	1×10^{-4}
Meteorology Tower	0.003	0.002	1×10^{-5}
Four miles S.W. of Redox	0.001	0.001	2×10^{-5}
East of 200 East Area	0.07	0.04	3×10^{-5}
West of 200 West Area	0.002	0.001	2×10^{-5}
100-B Area	0.001	0.001	2×10^{-5}
Sampled Bi-monthly			
R4S M14	0.01	0.009	2×10^{-4}
3 miles south of White Bluffs	0.003	0.002	4×10^{-5}
Wahluke Slope, Northeast	0.002	0.001	3×10^{-5}
Wahluke Slope, East	0.004	0.003	8×10^{-5}

Services

A new procedure for determining P^{32} concentration, developed by the Methods Unit of Biophysics, was tested and found to promise improvement in assays for P^{32}.

EXPERIMENTAL ANIMAL FARM UNIT

Toxicology of I^{131}

Forty-four out of forty-nine lambs in the experimental group were weaned. As in former years there appears to be no effect on weaning weight due to feeding the dams 0.15, 0.5, 1.5, or 5 μc of I^{131} per day.

Whole Body X-Irradiation

In order to determine the dose of x-irradiation that will cause a significant leucopenia in lambs, the following short-term phase of the whole body irradiation study was initiated:

Number of Animals and Exposure Level

Group	Number of Animals	Treatment
I	6	Control
II	6	15 r
III	6	30 r

Only the lambs exposed to 30 r whole body x-ray showed a signficant decrease in lymphocytes.

METABOLISM UNIT

Plutonium Absorption and Metabolism

The percutaneous absorption of plutonium administered to the rat as a TBP-CCl_4 process solution was not significantly different from that previously reported.

Fission Product Absorption and Metabolism

The gastrointestinal absorption of ruthenium in rats two days old was found to be six times greater than in adult animals. In 26-day-old animals, it was three times greater. Distribution of the absorbed ruthenium showed significant differences in the young animals as compared to adult animals. Kidney deposition in the two-day-old rats was only doubled whereas muscle and bone deposition increased tenfold. The most marked difference in deposition between the two-day-old rat and adult rat was noted in the brain with over 100-fold increased deposition in the young animals. This is, no doubt, due to incomplete development of the blood-brain barrier in these very young animals. Despite this marked increase in brain deposition, the brain still showed the lowest ruthenium concentration present in the tissues analyzed.

The experiment measuring the long-term retention of cesium in the rat following a single intraperitoneal administration was terminated at 300 days. Animals sacrificed at this time contained insufficient cesium for reliable counting. The last reliable samples from this experiment are, therefore, those obtained at 200 days' post-administration.

Gastrointestinal Radiation Injury

An as yet incompleted analysis of the histopathologic results of irradiation of the exteriorized gut of rats indicates that epithelial damage occurred as early as one day after doses ranging from 900 to 1900 r. Damage ranged from decreased mitosis after 900 r to extensive necrosis after 1900 r. At the higher dose levels maximum damage was seen six days after exposure with regeneration of the intestinal epithelium evident by the ninth day but still incomplete by the twelfth day. The greatest damage was apparent in the ileum. These results coupled with hematological data previously reported indicated a need for additional data at longer time intervals following exposure.

Additional animals were administered Pu^{239} intragastrically and some preliminary results were obtained on the effect of such administration on the blood. The interpretation of all results from these plutonium feeding experiments is clouded by the suspected presence of substantial beta-emitting impurities in the plutonium.

An experiment was initiated to study incorporation of intravenously injected Fe^{59} in the red blood cells following intestinal irradiation. Results will serve as a test of the relative damage to the hematopoietic system following various types of irradiation.

Electrophoretic studies were made of the plasma protein patterns following intestinal and total body x-irradiation. Preliminary results indicate a marked effect on albumin content with total body irradiation being considerably more effective than intestinal irradiation. Changes in other blood protein fractions were also observed. None of these observations are as yet sufficient to permit quantitative interpretation.

PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS UNIT

Metabolism and Toxicity of Radioactive Particles

Six month lung examination of mice intratracheally injected with 0.1% Pluronics, a non-ionic suspending agent used to stabilize our particle suspensions, showed this material apparently elicits a physiological response closer to that occurring in untreated animals than the Tween-80 formally used. It appears that the Pluronics is inert in the lung, while Tween-80 is anti-tumorigenic.

At the 25th week, after the intratracheal injection of $Ru^{106}O_2$ particles, the amount remaining in the mice, from the second week on, follows the function $Q = Q_0 e^{-\lambda\beta t}$ with a biological decay constant of 0.0115 $days^{-1}$.

Arrangements are practically complete for the test of the prototype acute aerosol exposure equipment using Fe^{59}. The mice will be exposed to an initial concentration of approximately 0.075 $\mu c/cc$ of air using particles mainly in the 2 - 3 μ size range.

An aerosol generator has been altered to increase the concentration of dry aerosol produced per volume of air by changing the drying air inlet location.

PLANT NUTRITION AND MICROBIOLOGY

Plant Nutrition

Neubauer tests with Cs^{137} indicate that the addition of carrier to the soil increases the concentration factor of Cs^{137} from 0.4 with no carrier added to 6.2 with 1000 mg Cs^{133}/g of soil. The amount of increase is almost as great as previously observed with iodine although previous tests using nutrient solution had indicated that the effect of carrier was much greater with iodine than with cesium. With both elements yield is depressed with from 100 to 1000 µg of carrier/g of soil and the concentration factor is depressed following the appearance of this toxicity.

RBE by Microbiological Methods

Gelatin, agar, and yeast cells were tested for their ability to bind and hold Po^{210} in suspension so it could serve as a uniformly distributed radiation source to irradiate growing yeast cells. In no case was more than 80% of the Po^{210} held.

Genetic Effects of Metabolized Isotopes

Yeast cultures grown on a uniform concentration of S^{35} and three different concentrations of S^{32} were held in lyophilized form and are being tested for the frequency and kind of biochemical mutations. No difference in frequency was observed in the cultures as a result of the preliminary tests.

Testing of the kinds of mutations produced in yeast by x-rays is almost completed. These will serve as reference material in evaluating the kinds of mutations induced by S^{35}.

Plutonium Toxicity

Yeast cells exposed to 1.6 µg Pu/ml and then to glucose and either KH_2PO_4 or triethylamine-succinate-tartrate (T-S-T) buffer utilized the same amount of glucose as did controls containing no Pu. Approximately 90% of the Pu attached to the yeast cells initially was removed by the T-S-T buffer. The KH_2PO_4 did not affect the amount of Pu on the cells.

The addition of 0.8 mg EDTA/ml to growth medium containing 16.7 µg Pu^{239}/ml resulted in much greater growth depression than when the Pu was added without EDTA, indicating that the EDTA may have been carrying the plutonium through the cell membrane into the yeast cell.

BIOLOGY SECTION

W. Bumbergius