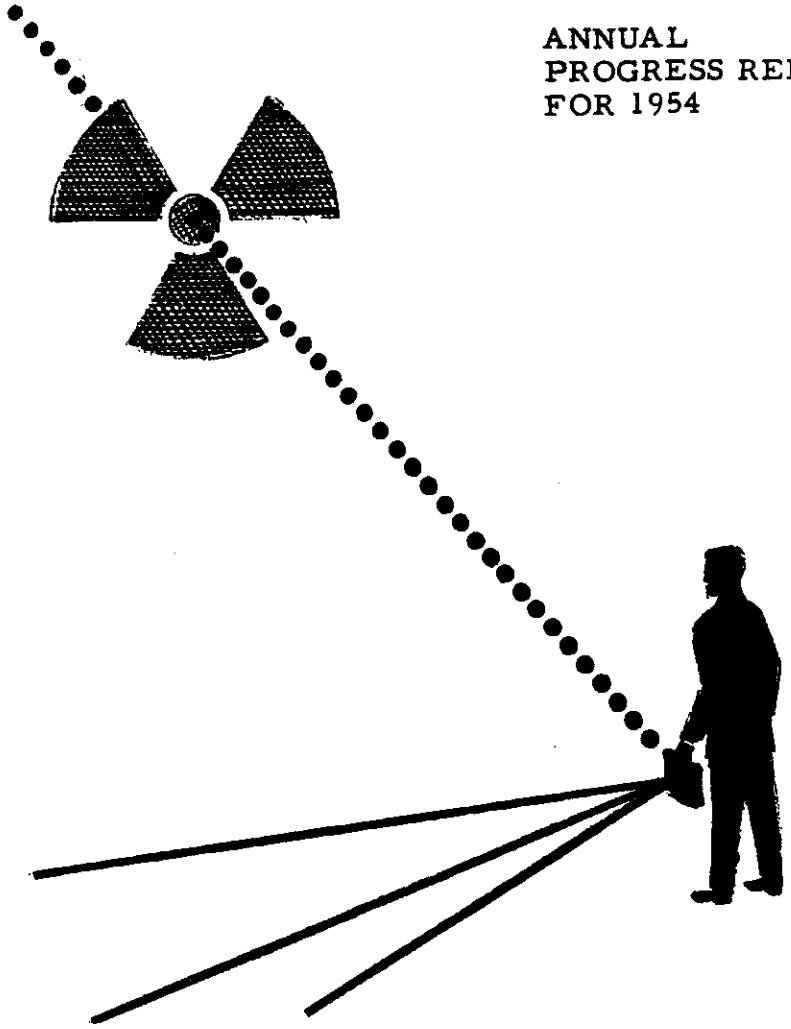
RADIOLOGICAL SAFETY AT USNRDL

ANNUAL PROGRESS REPORT FOR 1954



RADIOLOGICAL SAFETY AT USNRDL – 1954

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Annual Progress Report
For Period 1 January to 31 December 1954

Health Physics Division

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U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY
San Francisco 24, California

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INTRODUCTION

In this report of progress of the Laboratory's Health Physics Division for the calendar year 1954, the accomplishments are presented under the Division's two major organizational headings, the Radiological Safety Branch and the Radiological Development Branch.

Health Physics Division support in the Laboratory and in field operations was provided by the Radiological Safety Branch. Planning and preparation for Field Operations 11 and 12, as well as active field participation in FO-11, were executed by this Branch. Test samples from the site were monitored and evaluated at the Laboratory.

The special work permit was used extensively as a method of control for maintenance work under radiological conditions.

Surveys were made of Bldg. 816 during operations of the Van de Graaff generator; radiation areas of the building were delineated, as necessary, to meet radiological safety requirements.

Special studies were made of an X-ray unit and radiation sources in Rm. 140 of Bldg. 351B; recommendations for improved operating procedures were made for the prevention of overexposure to personnel.

Authorization was obtained from the Atomic Energy Commission for the chemical use of Fe^{59} in human blood donors at the Laboratory in the treatment of burn patients at the U. S. Naval Hospital, Oakland.

Two minor spills and seven minor radiological accidents occurred during the year. In each case decontamination was successfully carried out and no injury to personnel was incurred.

Four exposures in excess of maximum personnel exposure were received in 1954. In each case the causes were investigated, corrective measures were taken, and appropriate compensatory restriction from further exposure was enforced.

In the dosimetry program, over 16,000 films were processed. A change was made from the use of Eastman Type K film to the use of DuPont 191 film.

The Health Physics Division provided liaison assistance in the sea disposal of 17 barge loads of waste matter.

The Radiological Development Branch gave technical advice or executed plans in solving radiological safety problems presented to the Laboratory by eight military and civilian agencies. Comments and suggested modifications to NavMed P-1325 (Rev.) were submitted to the Bureau of Medicine and Surgery. A training program for field operation radiological safety monitors was established with the assistance of the Naval Training Schools Command at Treasure Island; the writing of the program textbook, "Radiation and Contamination Control," was completed.

RADIOLOGICAL SAFETY BRANCH

Laboratory Consultation and Monitoring

The routine monitoring schedules for all Laboratory spaces were evaluated and modified to insure adequate monitoring coverage with the personnel available for the job during the first half of 1954. However, starting in July, the routine monitoring program was discontinued because of lack of manpower for this particular assignment.

Chemical Technology Division. During the first six months of 1954 a total of 1,222 routine surveys were made in the Chem-Tech Division spaces as an aid to radiation and contamination control. A total of 403 wipe surveys were made of laboratory benches, floors, and hoods. In all cases where the measurements exceeded 200 c/m beta-gamma removable activity, decontamination was carried out.

Increased use was made of the special work permit for controlled maintenance work involving radioactive material. Sixty-five permits for work involving maintenance, decontamination, and waste removal in Chem-Tech spaces were issued during the year. Each permit required the evaluation of an operation involving radiological hazards. Use of the work permit has proven very successful in giving maintenance section personnel confidence in working in radiation fields or on contaminated equipment and in assuring adherence to safe working procedures.

General health physics measures for the Chem-Tech Division were studied by the senior investigator. He reviewed requests for isotopes and made recommendations concerning experimental setup and monitoring requirements.

A variety of special monitoring services was performed. These included spot checks of air-borne and surface contamination; radiological surveys of areas and spaces, laboratory apparatus, field operational equipment, clothing, and waste materials.

Discussions were held with various members of the Chem-Tech Division concerning the radiological safety procedures involved in processing the samples returned from Field Operation 11. Special monitoring services were supplied during the unpacking of returned samples.

Specific examples of liaison between Health Physics and Chem-Tech Divisions are noted:

(1) An irradiated sample from the Materials Test Reactor at Arco, Idaho, was used in contamination-decontamination studies. Special shielding requirements were met and special monitoring was continued through the course of the experiment. Two requests for additional irradiations at the MTR of NRDL-supplied source and special material (SS) were sent to the MTR Policy Board in Washington, D. C., for approval.

(2) Thirteen 1-gal carboys of liquid samples were processed by Chem-Tech personnel to concentrate the associated radioactive materials. A study of this process was made to formulate recommendations, from a radiological safety point of view, for future operations of this type involving samples of higher activity levels.

(3) Operational failure of the liquid level warning system in Bldg. 364 waste tanks enabled the tanks to fill and back up into the drains. Recommendations to eliminate such malfunctions were forwarded to the Engineering Division and the system was modified accordingly.

(4) The hood filters in Bldg. 351A were changed under conditions controlled by radiological safety standards as per the special work permit.

Nucleonics Division. A total of 132 routine surveys were made in the Nucleonics Division spaces during the first six months of the year. The nature of the Division's operations obviated the need for an air sampling program. A total of 124 wipe surveys were made of laboratory benches, floors, and hoods. Decontamination operations were carried out in all cases where significant removable contamination (200 c/m) was found. Ten special work permits for maintenance work were issued.

Building 816 spaces and environs were completely monitored during various operating conditions of the Van de Graaff accelerator during the year. Radiation levels existing in these areas under the various operating conditions are a matter of record in the offices of the Health Physics Division and the Accelerator Branch. On the basis of monitoring survey results, a security fence was constructed at the foot of the stairway leading to the roof of Bldg. 816. Precautions have been established to prevent personnel from entering, by accident, zones of radiation in excess of 7.5 mrem/hr.

Special monitoring surveys were made in Rm. 140, Bldg. 351B. The Westinghouse X-ray tube had been remounted in a new lead-lined enclosure with a pneumatic portal. A survey made during the 3rd Quarter disclosed excessive radiation exposures to personnel gathered around the tube housing during operation of the machine. Upon accomplishment of recommended changes in operating conditions, the exposure to operating personnel was reduced to acceptable levels.

Health Physics Division personnel performed a calibration of the UDM-1 set No. 40 (Co^{60} source) in Rm. 140, Bldg. 351B, and found it to be 18 per cent lower in radiation levels delivered than was predicted on the basis of the original calibration.

The Nuclear Radiation Branch set up a calibration range in Bldg. C-500 at San Bruno for fast neutron studies. The experimental setup was inspected and found satisfactory for the use of a 2-curie Sb-Be source as well as Ra, Co^{60}, and Ra-Be sources. Adequate signs and barricades were posted. Special film badges were set up around the working area in the building for measuring the integrated dosage in various locations.

Biological and Medical Sciences Division. A total of 490 routine surveys were made in the Bio-Med spaces during the first six months of 1954. No routine air samples were taken in the Bio-Med Division because of the nature of the experimental operations. During the first two quarters a total of 624 wipe surveys were made and decontamination operations were carried out in all cases where removable contamination in excess of 200 c/m was detected. Twenty-five special work permits for maintenance, decontamination, and waste removal work in Bio-Med spaces were issued and accomplished.

Discussions were held with various members of the Bio-Med Division on (1) radiological safety procedures involved in processing samples returned from FO-11; (2) inspection and operation of the aerosol generator in Bldg. 506; (3) methods of contamination control in laboratory spaces.

Decontamination operations conducted on behalf of the Bio-Med Division included:

(1) The continuing function of decontamination of rat cages for the Internal Toxicity Branch.
(2) Decontamination of a portion of the hood and a number of lead shielding bricks in Rm. 36, Bldg. 506. The lead bricks were used to construct an isotope storage cave for the joint use of Health Physics and Bio-Med Divisions.
(3) Decontamination of Rm. 24, Bldg. 506, on two occasions. The room, which was used for animal storage, became contaminated with Sr^{89} through improper handling procedures. Recommendations as to safe handling procedures were made to cognizant Bio-Med personnel. Drawings of a proposed new facility to replace Bldg.517 were reviewed. Consideration was given to the use of a large Co^{60} source, approximately 15 curies, and to the use of a neutron source.

Authorization was obtained from the Atomic Energy Commission for the chemical use of Fe^{59} in human blood donors at the Laboratory in the treatment of burn patients at the U. S. Naval Hospital, Oakland.

A 10,000 rep/hr P^{32} source was received for animal beta burn studies. During the course of the experiment the evaluation and monitoring surveys indicated no radiation hazard to personnel.

Special Operations

In conjunction with Field Operation 11, a duty watch was established to handle the radiological safety aspects of samples returned to the Laboratory from the test site. The maximum radiation levels measured on the samples received was 50 mr/hr. The maximum removable contamination was 19,000 c/m on equipment and material returned to the Laboratory. Personnel contamination was kept to a minimum by issuing protective clothing to all personnel involved in the duty watch. A final monitoring of duty watch trucks was made after the last pickup and no significant contamination was detected.

Radiological Accidents

Chemical Technology Division. Two minor spills of radioactive waste occurred during the first half of the year. In May liquid waste from the collection tank in the rear of Bldg. 364 backed up and contaminated the sink in the building. Contamination was confined to the sink, and the required decontamination operations were easily performed. The second spill took place in June when a 5-gal liquid waste can had an acid solution put into it. Heat produced by chemical action between acid and water in the can weakened the plastic liner. The liquid waste seeped through the liner and the can, spreading over the floor of Rm. 17, Bldg. 351A. Wipe samples indicated approximately 5,000 c/m beta-gamma removable activitiy which was reduced to less than 200 c/m removable activity following decontamination.

One radiological accident involving mixed fission products occurred during the 3rd Quarter. This accident took place in Rm. 36, Bldg. 351A, on 23 September 1954. The investigator received minor injury and contamination. He was successfully decontaminated and a 24-hour urine sample indicated that there was no detectable internal contamination. Decontamination of the work area was successfully completed.

Two radiation overexposures involving Chem-Tech Division personnel occurred in the 3rd Quarter of the year. An investigator received 0.50 rep beta exposure over the MPE while working aboard YAG's 39 and 40 from 27 June to 25 July. He was restricted from further radiation exposure for nine working days to compensate for his overexposure.

During the same period another investigator received 1.10 rep beta exposure above the MPE while working on an isotope separation of a pile irradiated sample of uranium. He was restricted from further exposure to radiation for 18 working days to compensate for his over-exposure.

Three minor radiological accidents involving fission product activity occurred during the 4th Quarter. Each accident released contamination in work areas, all of which were successfully contaminated. No personnel contamination resulted from these spills.

Biological and Medical Sciences Division. One radiological accident occurred during the first half of 1954. In May 1954 in Rm. 22, Bldg. 506, a large Erlenmeyer flask containing two liters of active solution was broken and the entire contents spilled upon the bench and floor area. The solution, which consisted of approximately 1/2 lb of animal bones contaminated with fission products and dissolved in sulfuric acid, contained an unknown amount of radioactivity. The Bio-Med investigator involved in the accident had removed most of the liquid from the floor prior to the arrival of the Health Physics representative. Wipe tests of the floor indicated that the removable contamination was less than 100 c/m and bits of undissolved bone read up to 1200 c/m. A complete monitoring survey of the spill area after cleaning showed no detectable activity above normal background. A survey of the investigator's clothing showed no contamination.

Nucleonics Division. Two radiological accidents occurred during the 1st and 2nd Quarters. On 8 March 1954 an investigator received an overexposure of 1.56 rep as a result of the malfunctioning of pneumatic equipment used to control the raising and lowering of a 5-curie Co^{60} source. The investigator was restricted from further exposure to radiation for a period of 26 working days. Within the period of 25 April to 23 May 1954, a second investigator received an overexposure of 0.21 rep while working with X-ray equipment and beta sources. The man was restricted from further exposure to radiation for five working days.

Dosimetry

Film was processed for NRDL and outside activities during 1954 as follows:

NRDL	Film Processed
Laboratory personnel	7,397
Laboratory visitors	3,005
Calibrations	718
Environmental monitoring	251
Special film	1,346
Total	12,717

Outside Activities	Film Processed
SFNS	2,503
YAG's	1,082
USMC, 100 Harrison St., S.F.	33
NAS, Moffett Field	135
Navy Dispensary, Fell St., S.F.	35
Port Chicago, Calif.	50
Monitors School, TI	82
Total	3,920

GRAND TOTAL 16,637

In addition to the above, 40 neutron films were obtained from and processed by University of California Radiation Laboratory. These films were issued to Nucleonics Division personnel working with neutron sources. Of the film results obtained from UCRL, only two indicated radiation exposures in excess of MPE.

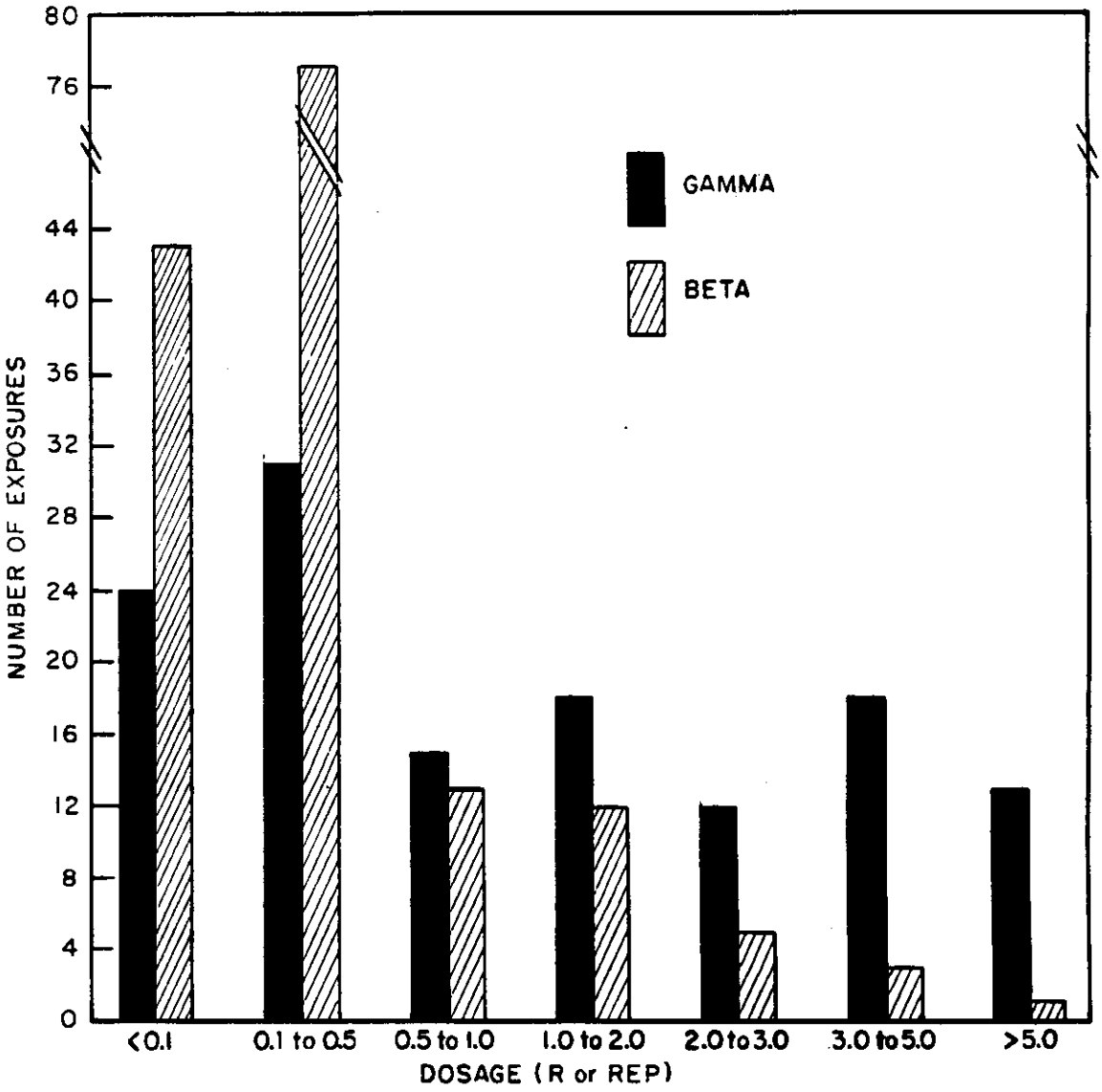
Film badge results for Laboratory personnel for both field operational and Laboratory work indicated that 131 persons received detectable gamma exposures and 154 persons received detectable beta exposures during the year. Beta and gamma exposure were received by 90 persons. The maximum total gamma exposure for the year was 7.44 r with an average of 1.72 r among those receiving any gamma exposure. Among those receiving beta exposures, the maximum exposure accumulated yearly was 5.56 rep with an average of 0.49 rep. The Laboratory-wide average exposure for the year was 0.41 r plus 0.14 rep.

At the beginning of the 3rd Quarter the Laboratory made a change from Eastman Type K film to DuPont 191 film. The DuPont film is more stable in its response to radiation and covers broader dosage range than the Eastman Type K.

During the 3rd Quarter approximately 300 films were exposed in the beam of the Bio-Med X-ray machine as the first step in an evaluation to determine the efficiency of the NRDL badge as compared with the Los Alamos type badge in the differentiation between various energies of radiation.

Radiological Safety Services for Laboratory Operations

Accountability. During the year 146 orders involving 16 curies of activity were processed. Two hundred and eleven shipments involving



Distribution of the Yearly Dosage Totals

21 curies of activity were received from outside suppliers. The following table summarizes radioisotope ordering and receiving data:

Division	Processed	Received
Chemical Technology	22 orders - 663 mc	30 shipments - 49[illegible] mc
Biological and Medical Sciences	58 orders - 556 mc	104 shipments - 625 mc
Nucleonics	27 orders - 5,024 mc	26 shipments - 9,603 mc
Health Physics	5 orders - 10,001 mc	3 shipments - 10,001 mc

In addition, the following cyclotron and pile irradiation samples were processed and received. An indeterminate quantity of activity was produced in these irradiations.

Division	Orders Processed	Shipments Received
Chemical Technology	19	34
Biological and Medical Sciences	9	12
Nucleonics	4	2

Thirty-five separate quantities of isotopes totaling 1600 mc of activity are being held in storage in Bldg. 529 until needed by Laboratory experimenters. One hundred and sixteen separate quantities of isotopes totaling 2,060 mc of activity are located in Laboratory spaces.

Thirty-six aliquots totaling 180 mc and 5 grams of uranium were taken from radioisotope and SS material stocks in Bldg. 529 storage and delivered to Laboratory experimenters.

The following table summarizes the radioactive materials in the form of sources that are currently available in the Laboratory:

Type	Number	Total Quantity
Co^{60}	11	46 curies (200 mc to 11 curies)
Ra	14	681 mg (0.1 mc to 459 mg)
Cs^{137}	1	10 curies
P^{32}	1	10,000 rep/hr
Ra-Be	4	114 mg Ra
Sb-Be	1	2.6 curies
H^3-Zr	3	5.15 curies H^3

An itemized inventory of radioisotopes available in Bldg. 529 is being prepared for assembly in catalogue form and will be distributed to all interested Laboratory personnel.

Radioactive Waste Disposal

The Radiological Safety Branch in 1954 coordinated the removal and disposal of radioactive wastes from this Laboratory as well as sea disposal of wastes from the University of California Radiation Laboratory, California Research and Development Company, McClellan Air Force Base, Naval Air Station , Alameda, Mare Island Naval Shipyard, Stanford Research Institute, and Naval Supply Annex, Stockton.

Seventeen barge waste disposal trips to sea were made to accomplish sea disposal of radioactive wastes from the Laboratory and the seven other installations named above. The trip details are summarized as follows:

Date	Source	Quantity
1/15/54	UCRL	119 drums - 2 blocks (100 cu ft)
2/10	UCRL	7 blocks (450 cu ft)
2/25	UCRL	64 drums - 3 blocks (200 cu ft)
2/27	UCRL	29 drums - 3 blocks (300 cu ft)
3/23	NRDL	70 drums - 4 blocks (400 cu ft)
3/28	NASA	3 blocks - (80 cu ft)
	UCRL	171 drums
	MINS	1 metal box (150 lbs)
	CR & D	32 drums
4/15	NRDL	40 drums - 1 block (100 cu ft)
	UCRL	31 drums - 1 block (200 cu ft)
	NASA	4 blocks (100 cu ft)
	SRI	2 drums
	SFNS	5 gas bottles
	CR & D	64 drums
6/28	McAFB	165 drums
7/2	UCRL	180 drums - 3 blocks (200 cu ft)
8/9	NASA	3 blocks (80 cu ft)
	NRDL	180 drums - 1 block (100 cu ft)
9/10	NASA	3 blocks (80 cu ft)
	UCRL	190 drums - 1 block (60 cu ft)

Date	Source	Quantity
9/15	NASA	2 blocks (60 cu ft)
	UCRL	128 drums
10/1	NRDL	136 drums
	MINS	4 drums
	SFNS	1 hold bulk sand
10/25	UCRL	56 drums
11/17	UCRL	14 drums - 1 block (60 cu ft)
	NRDL	1 block (100 cu ft)
	CR & D	115 drums - 2 blocks (120 cu ft)
12/9	McAFB	147 drums
	NRDL	28 drums
	SFNS	40 drums
12/16	UCRL	107 drums - 4 steel tanks
		15 cables and misc. items
		5 diesel engines
	NSAS	65 drums

A summary of Laboratory waste disposal costs follows:

Engineering Division labor (125 man days)	$ 5,000
Materials	400
Shipyard crane service	900
Health Physics Division labor	1,600
TOTAL	$ 7,300

A total of 454 drums, 312 liquid and 142 solid, and 10 blocks of NRDL waste were removed during the year. The average cost per drum was approximately $11.00 and per concrete block approximately $200.00. The 1953 cost was approximately $27.00 per drum.

Among the mishaps which occurred in relation to loading, transporting, and dumping of waste disposal was the opening of Hold No. 5 during loading for the 25 February trip to sea and the subsequent dumping of 29 drums of UCRL waste into the water of Berth 2, SFNS. All drums were recovered by divers and reloaded for a later trip.

On the sea trip of 27 February, 14 drums of UCRL waste were discharged before arrival at the dumping site because of malfunctioning of the door-holding mechanism of one of the barge holds.

A holdup of three UCRL end-loaded drums occurred on the 28 March trip. The drums were returned to reloading and sent out on a later trip.

During the 15 April trip five drums of undetermined origin floated after discharge and were sunk by rifle fire.

Eight drums of liquid from McAFB were found to be leaking while being loaded for the 28 June trip. The drums were returned to their source and no serious contamination spread resulted.

On the 9 August trip two drums floated at the dump site and were sunk by rifle fire. Again, on the 1 October trip, three floating drums had to be sunk by rifle fire.

A complete series of photographs and titles on the Laboratory's method of handling, drumming, and disposing of liquid and solid radioactive waste was prepared and sent to Johns Hopkins University for use at a forthcoming symposium on the subject of radioactive waste disposal planned by the University.

Decontamination Laundry and Protective Equipment Issue

The functions of the decontamination laundry and of protective equipment issue were continued through the year. Contaminated liquid waste from the laundry was drummed for sea disposal. However, during the 4th Quarter the drumming of the first wash water for sea disposal was discontinued due to the fact that the contamination levels were found to be below that for sewer disposal.

SFNS personnel, with the assistance of NRDL personnel, operated the laundry to decontaminate all protective clothing worn in the decontamination of YAG's 39 and 40.

An inventory of lead bricks in the Laboratory indicated a total of 1,994 lbs in use throughout the Laboratory.

The responsibility for maintenance of clothing issue stocks was transferred from the Health Physics Division to Engineering during the 4th Quarter. Health Physics recommended the type and quantity of radiological protective equipment to be carried in stock. Responsibility for authorizing the issue of clothing for non-radiological work was assigned to the division head of personnel utilizing the clothing.

Environmental Survey

The environs monitoring program throughout the year included air sampling, water sampling, and radiation intensity measurements of various Laboratory spaces and boundary areas.

During the first two quarters an extensive monitoring survey was made of Laboratory locations where large radiation sources were in use. Among the locations so monitored were the boundaries of Rm. 140, Bldg. 351B, including the room walk, the working spaces overhead, the fence outside Bldg. 351B, and the boundaries of the target room of the Van de Graaff building.

Integrated radiation dosage was measured with film. No excessive radiation levels in the immediate surrounding of any of the radiation sources monitored were noted as a result of these surveys.

The effective half-life of air-borne activity collected was measured daily during the 3rd Quarter. The half-life of natural occurring activity does not exceed 11 hours. By noting the change in slope of the half-life curve, it is possible to detect the presence of minute quantities of contamination other than the natural activity. Several such instances were noted during the quarter.

The monitoring station, consisting of a low-flow continuous air sampler located in the small tower near Bldg. 313, indicated that air-borne contamination concentrations throughout the year were not significant.

Radiological Safety Instrumentation

The Division continued to coordinate NRDL radiac calibration and repairs with the Radiac Section, Shop 67, SFNS, through the 1st and 2nd Quarters. At the close of the 2nd Quarter, however, this function was transferred to the Engineering Division.

The trend is toward an increased use of 110-volt operated counting rate meters for self-monitoring by Laboratory experimenters. Use of this type of instrument reduced the use of portable radiacs, thus minimizing maintenance and upkeep costs.

A neutron detection instrument was calibrated in mrem/hr for the use of personnel in Bldg. 816. Thermal neutron pocket chambers were also made available for neutron dosage measurements.

Work progressed on a portable tritium monitoring instrument for use with the Van de Graaff accelerator in conjunction with irradiation of tritium-zirconium targets.

Field experience with Navy Allowance List equipment as well as commercial equipment for personnel monitoring prompted the development of a single scale unit for this purpose. Development of a prototype of such an instrument was begun.

RADIOLOGICAL DEVELOPMENT BRANCH

Radiological Monitoring for Outside Agencies

Stanford Research Institute. At the request of Stanford Research Institute a radiological assessment was made of two laboratory spaces and associated equipment used in Fe^{59} and radium metallurgical experimentation. Recommendations for decontamination were successfully carried out. Approximately 75 lbs of radioactive waste material was removed to NRDL for disposal.

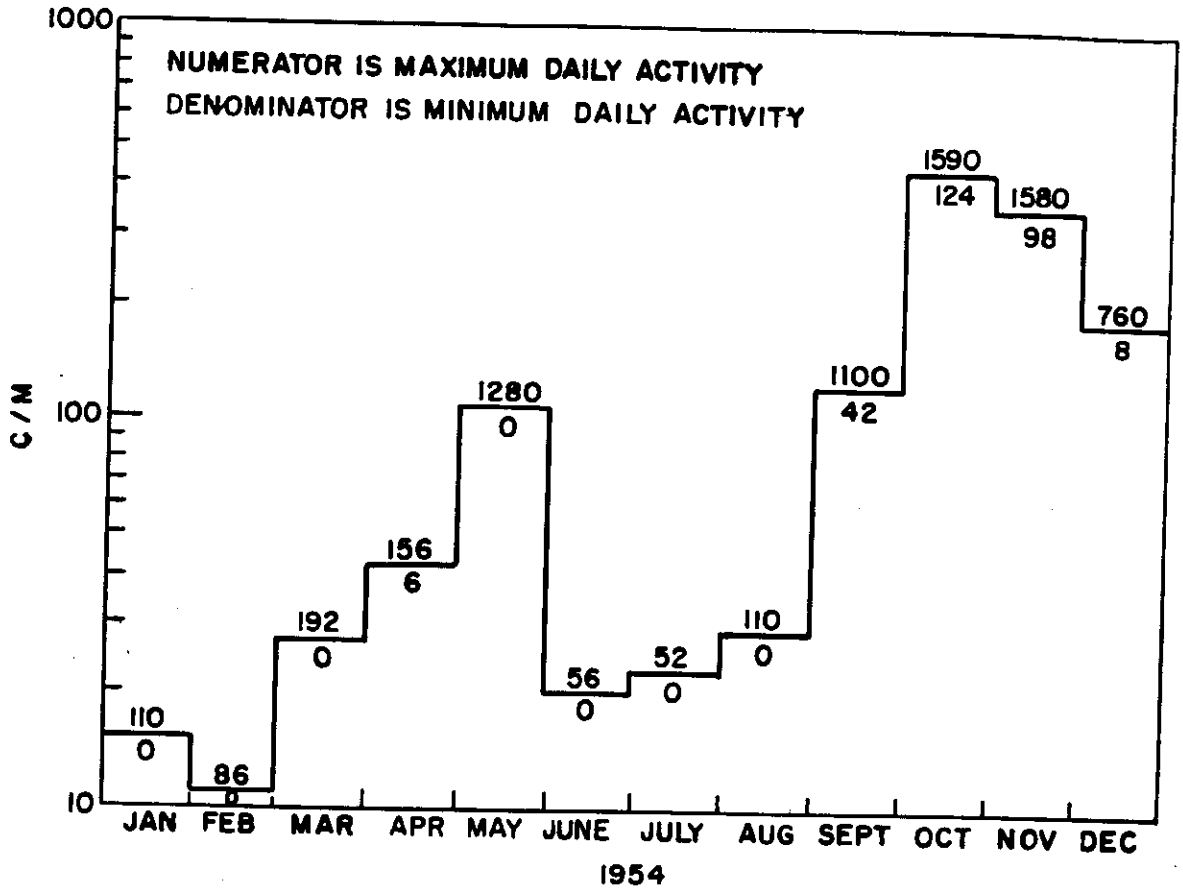
Carnegie Institute of Technology. A shaped charge project involving a distribution study of shaped charge cones through tracer techniques was undertaken by the Chem-Tech Division of NRDL. The Laboratory prepared shaped charge cones with bands of electroplated Fe^{59}. Other cones were bombarded with deuterons to form a band of Co^{57} with activities varying from 3 μc to 500 μc per cone. Carnegie Institute of Technology provided the explosive and the firing range at Pittsburgh, Pa. Targets were returned to NRDL for analysis.

The Health Physics Division provided assistance in the preparation of the radioactive cones and, during the firing tests at C.I.T., performed the Rad Safe functions of establishing radiological safety procedures, and monitoring laboratory spaces, equipment, and radioactive aerosol concentration.

Following the initial firing tests, a study of the long term operation at C.I.T. was made by representatives of the Chem-Tech and Health Physics Divisions. Recommendations regarding the health physics aspects of this study were forwarded to C.I.T.

Daily Environmental Aerosol Analysis

Twenty-four hour air samples were taken daily and their half-lives and activity concentration were determined, documented, and investigated. Activity data of those aerosol samples having a half-life significantly longer than that of the natural thorium content were reported to the cognizant authority. No aerosol concentrations above the maximum permissible concentrations (MPC) were detected although activity above the normal background was measured. A figure presents a summary of the data collected during 1954.



Monthly Average Long-Lived Beta-Gamma Activity ($T_{1/2} > 10.6$ hr) of 24 hr Environ Aerosol Samples for 1954

Radiological Safety Evaluation and Consultation

Safety Orders for General Industry. The Division of Industrial Safety of the State of California requested evaluation and comment on the proposed revision of General Industry Safety Orders. Comments and suggestions for modification of the Safety Orders were incorporated in a letter to the Chief of the Division of Industrial Safety.

Safe Handling Procedures. The Naval Supply Center, Oakland, was given advice on the storage and handling of strontium 90, the safe handling procedures involved in the disposal of radioactive dials and instruments, and radiological safety aspects of handling radioactive waste material.

San Francisco Naval Shipyard (SFNS) Problems. SFNS requested and received evaluation and consultation on (1) contamination aboard the Dentuda, a submarine which participated in Operation CROSSROADS; (2) air sampling techniques in the YAG decontamination program; (3) analysis of drinking water samples from the fresh water system of the YAG 39; (4) usage of protective clothing to evaluate cost factors involved in decontamination; (5) proposed SFNS Medical Department instruction concerning industrial radiological safety problems; (6) proposed SFNS-BuShips article entitled "Shipboard Rules and Practices for Use of Co^{60} in Inspecting Castings and Welds."

Instrument Calibration. Instrument calibration and the evaluation of back-scattering from radioactive sources were services performed for Mare Island Naval Shipyard.

Radiological Decontamination Training Kit. At the request of the Navy Special Devices Center, Port Washington, N. Y., a preliminary study and evaluation of a Radiological Decontamination Training Kit was prepared as the joint undertaking of the Chemical Technology and Health Physics Divisions, with the chemical phase handled by Chem-Tech and the evaluation of radiological safety aspects the responsibility of Health Physics.

Co^{60} Source Re-encapsulated. Several Co^{60} sources were re-encapsulated for the Twelfth Naval District. The source containers had become contaminated when water entered them and Co^{60} metal flaked onto the container walls. Following the Division's design of a new Co^{60} source capsule, the sources were re-encapsulated and placed into the decontaminated containers.

Protective Clothing. No active work on protective clothing evaluation has been performed. Only minimum liaison has been accomplished to maintain the continuity of the program with the Bureau of Supplies and Accounts.

Field Operations

FO-11. A report on the Laboratory radiological safety operations in Field Operation 11 was prepared as the combined endeavor of persons most familiar with the particular phases of the field operation. This project was undertaken in the 3rd Quarter of the year with completion of the final draft planned for the 1st Quarter of 1955.

FO-12. The Health Physics Division was assigned radiological safety support for TG-7.3, Project 0.17 of FO-12. The mission of 0.17 was (1) radiological protection of personnel and equipment, (2) broad radiological training of TG-7.3 personnel where required, (3) detailed radiological training of 0.17 personnel, and (4) evaluation of the effectiveness of radiological safety training and radiac equipment.

Personnel requirements of Project 0.17 were far in excess of the capabilities of the Health Physics Division to provide,so military and civilian support were requested from the Bureau of Ships and the AEC. The planning for operational and equipment requirements was assigned to NRDL Health Physics Division with the support of three health physicists each from Oak Ridge National Laboratory and UCRL. These six health physicists were assigned as senior members of the 0.17 organization. In addition to the use of standard allowance radiacs, development and field testing of the following radiacs was scheduled: (1) beta sensitive cutie-pie, (2) logarithmic GM contamination radiac, (3) continuous recording cyclic air sampler, and (4) film badge capable of recording beta dose in addition to the gamma dose.

The planning of the training program for the 0.17 personnel was undertaken with the assistance of the Naval School Training Command at Treasure Island. A four-week training program was established, the first two weeks being the regular "atomic defense" training course of the Atomic Biological and Chemical Warfare School at T. I., and the second two weeks, a course prepared by NRDL for emphasizing the field operation phase of radiological safety. The first rough draft of the Radiation and Contamination Control Manual, to be used as a text to bridge the gap between theory and application, was completed in December by NRDL Health Physics Division personnel.

Principles of Radiological Safety

NavMed P-1325. Comments and suggested modifications of the proposed revision of "Radiological Safety Regulations," NavMed P-1325 (Revised), were evaluated and prepared. Up-to-date procedures on radiological safety operations, including data on air-borne and removable contamination and monitoring techniques, were assembled.

Radiological Safety Design Criteria for Area and Facilities

Building 816. The initial operation of the 2 Mev Van de Graaff generator in Bldg. 816 required a radiological hazard evaluation of areas in and around Bldg. 816 to check the shielding design and operational procedures. Studies were made of the gamma and fast and slow neutron radiation intensity level for electron, proton, and deuteron beams at maximum current for various targets. The shielding was found adequate for current operating procedures. The roof was the only area where the radiation intensity was above the maximum permissible dose-rate. A security fence was constructed to bar access to the roof of Bldg. 816 as recommended by the Health Physics Division. A tritium safe was also recommended and later installed in the generator room of Bldg. 816.

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