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UNITED STATES ATOMIC ENERGY COMMISSION

ANNUAL REPORT - 1958

HEALTH AND SAFETY DIVISION

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IDAHO OPERATION OFFICE

IDAHO FALLS, IDAHO

ATOMIC ENERGY COMMISSION · UNITED STATES OF AMERICA

NATIONAL REACTOR TESTING STATION

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ANNUAL REPORT

of the

HEALTH AND SAFETY DIVISION

1958

IDAHO OPERATIONS OFFICE

Edited by

John R. Horan

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Chapter 1

INTRODUCTION

By John R. Horan, Director

The Health and Safety Division of Idaho Operations Office is responsible for the protection of property and the health and safety of people, plants, and animals at the National Reactor Testing Station and its environs. Assurance must be given to employees, visitors and the residents of adjacent areas, that no current or future health hazards will result from routine or experimental activities at the NRTS.

The interests of the Health and Safety Division encompass all phases of occupational safety. The program includes the development and enforcement of traffic and industrial safety policies; the maintenance of a professional fire department and the training of plant fire brigades; administration of an ecology program to determine the influence of various readioactive materials on soil, as well as plant and animal life; maintenance and development of radiation instrumentation to provide a sixth sense to detect radiation hazards, maintenance of a complete program to provide chemical or radiochemical analysis for any substance which is a potential health hazard, as requested by IDO or NRTS contractors; furnishes a comprehensive personnel metering program for radiation monitoring of all NRTS personnel; provides a complete radiation monitoring program, including a fixed air monitoring network and various subsurface water investigations, as well as inspection of radioactive shipments; administers an active medical program to provide "human maintenance", as well as the treatment for injuries and diseases sustained by AEC and contractor personnel; is responsible for the safe disposal of radioactive material, as well as the organization and training of a radiological assistance team for on-site as well as off-site incidents. The Division also coordinates cooperative research programs with other Government agencies such as the Weather Bureau, the Geological Survey and the Public Health Service.

The following are noteworthy achievements which contributed during 1958 to fulfilling our responsibilities as a service organization to develop new skills and improved techniques and facilities:

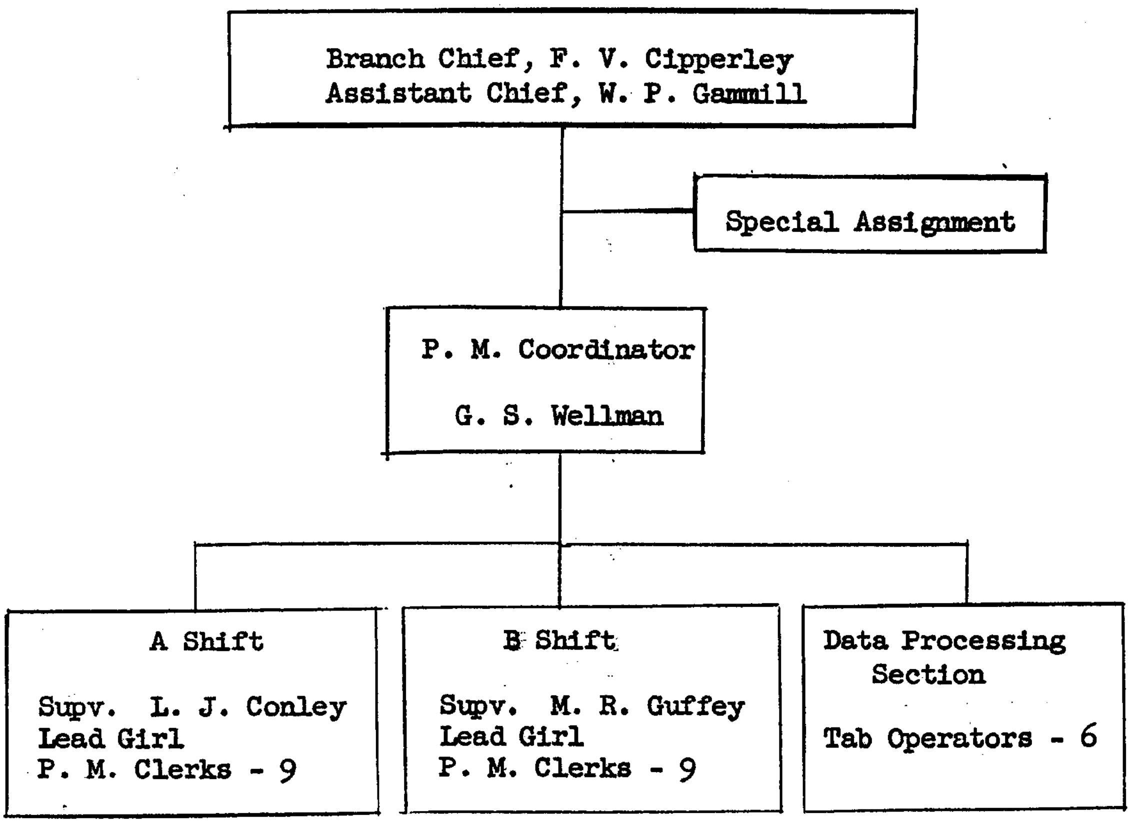
1. The acquisition of a 256-channel analyzer has revolutionized the quantity and quality of our field monitoring programs.
2. The initiation of a 13-week field training program for the Radiological Physics Fellowship Program provided the opportunity to indoctrinate four graduate students from Vanderbilt University in the unique Health Physics experiences at the NRTS.
3. The development of the carbon cartridge for iodine and the new beryllium procedure were major analytical advances in the field of hazard evaluation.
4. Aerial monitoring by light aircraft with scintillation equipment proved a practical method for rapid survey of large ground areas and for cloud evaluation.

5. The construction and operation of a new fire station added significantly to our fire protection program.

The intent of this sketch review is not one of completeness, but rather to provide an insight to the many facets of our continuing program to maintain the excellent reputation which the AEC and its contractors have established in the field of occupational health and safety.

TABLE OF ORGANIZATION

PERSONNEL METERING BRANCH



Chapter 2

PERSONNEL METERING

Foster V. Cipperley, Branch Chief

2.1 General

The Personnel Metering Branch is a service organization, and its services are available to all contractors and personnel at the National Reactor Testing Station. The primary function of the branch is to provide and interpret radiation detection devices worn by personnel who might encounter radiation from external sources, and to maintain adequate and accurate personal exposure records.

At the NRTS we are primarily concerned with external hazards from beta, gamma and neutron radiation and have an assortment of devices for their detection and measurement. The results found from the various devices are reported to the appropriate contractor at regularly scheduled intervals. All original records such as exposure reports, logs, etc., are retained indefinitely. In this respect we have a dual responsibility. First, the responsibility of protecting the worker, and second, the responsibility of protecting the AEC and its contractors from groundless or fraudulent claims.

2.2 Summary of Major Programs

A number of improvements occurred in the Personnel Metering Branch during 1958. These changes were brought about due to the rapid growth of the NRTS, the increased interest in recorded occupational exposure, the awareness of a need for improved techniques in external exposure determination and more efficient methods of exposure record tabulation. These changes are discussed in some detail below:

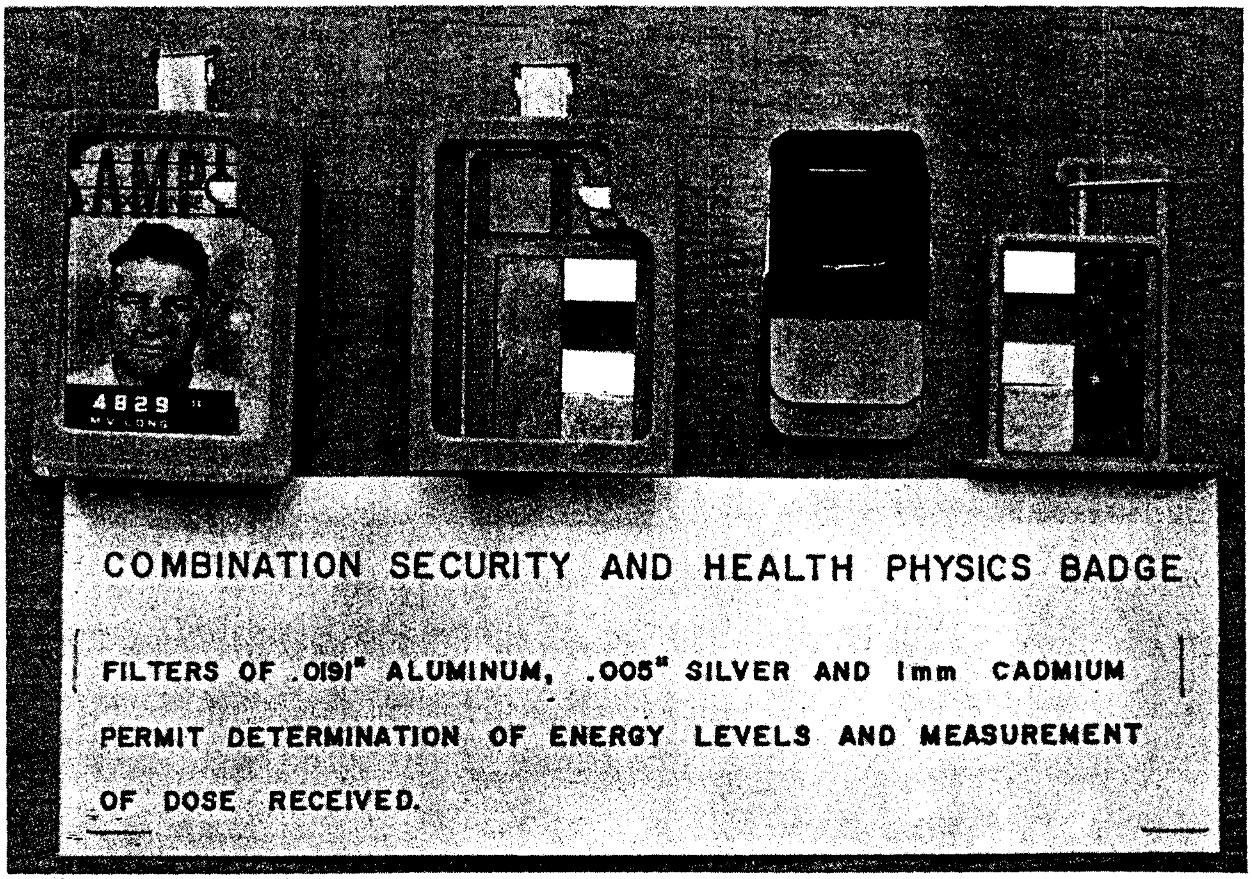


Fig. 2.1 Combination Badge

2.2.1 New Combination Security-Film Badge

The use of the original ORNL type metal film badge was discontinued, and a new plastic combination security-film badge, a modification of the Hanford Type, was placed into service. This change was completed by mid 1958 with the exception of one project area, and will be completed in that area by March 1, 1959. The new film badge contains three filters - Cadmium, Aluminum, and Silver. The Aluminum and Silver filters aid greatly in determining exposures due to beta or low energy gamma radiation.

2.2.2 Automatic Film Reader

In November, 1958, the Branch began routine use of an automatic film reader which was designed and built by the IDO Instrument and Development Branch. Several of the Personnel Metering clerks have been trained to operate the machine. A detailed description of the machine is contained in the Instrument and Development Branch report.

2.2.3 Automation of Record Keeping

In March, 1958, an IBM system of record keeping was installed to replace the manual Kardex system. This changeover has resulted in increased accuracy and efficiency of operation. Master files are maintained showing name, age, sex, craft, employer, etc., for all employees by badge number, area and alphabetically to furnish a complete cross reference file. Exposure detail cards are prepared automatically when the film is read by the automatic film reader. At regular intervals the detail cards are combined with their

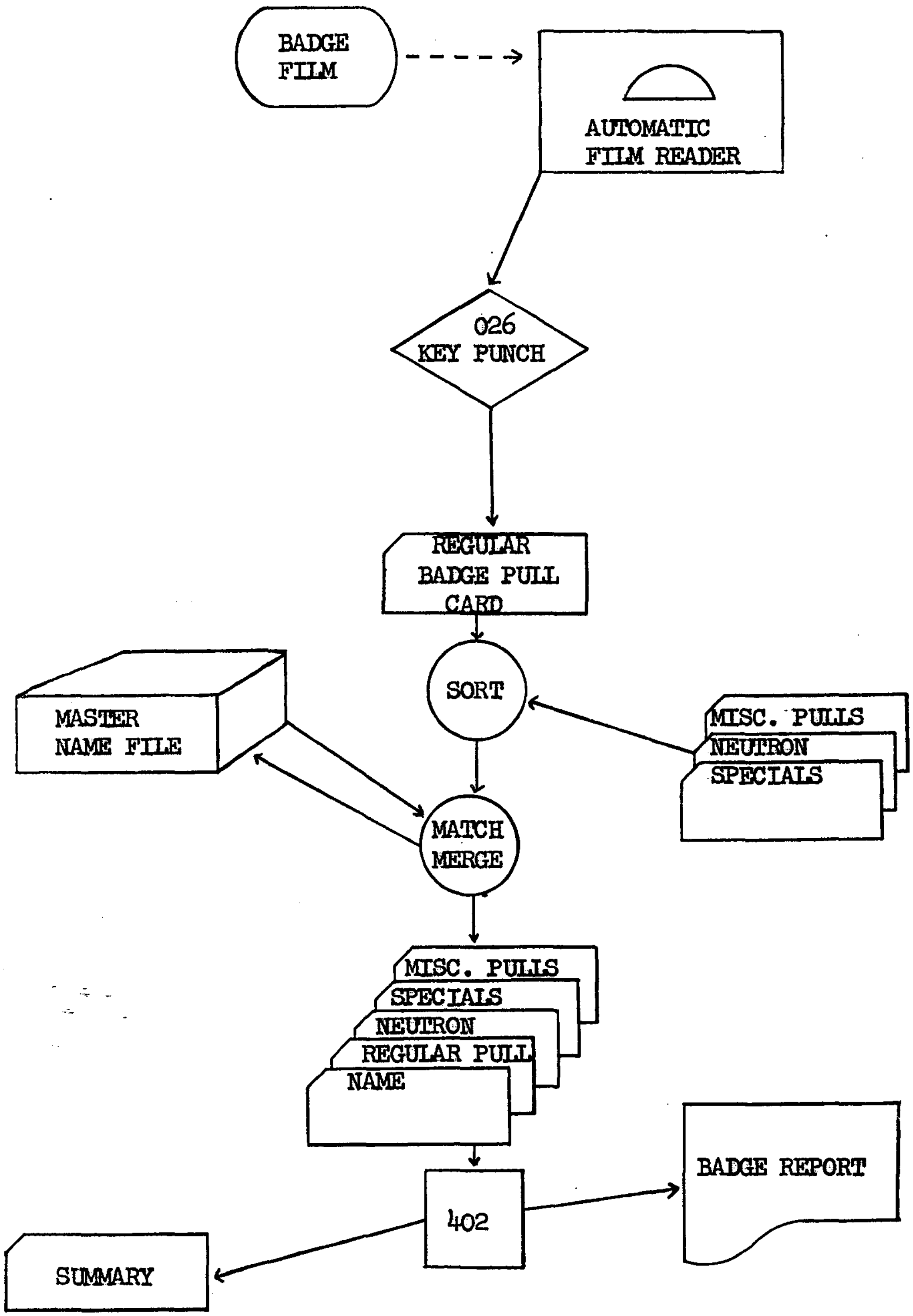


Fig. 2.2 Tabulation Flow Chart of Film Badge Data

corresponding master cards and an exposure report is printed listing the exposure for each individual for the period concerned. While this report is being produced, an automatic summary punch prepares a card showing the total exposure for each person during that period. Each month these summary cards are combined with the master cards and a summary report is prepared. At this time, another summary card is automatically punched to be used for quarterly and annual summary reports. All summary reports list the individual's total accumulated exposure for the current period as well as the accumulated total for the year. Eventually they will show totals for his term of employment at the NRTS, and lifetime occupational exposure as far as we know it.

The Data Processing Section is presently equipped with three 026 key punches, one 526 summary punch, one 077 collater, one 082 sorter and one 402 alphabetical accounting machine. Figure 2.2 is the Tabulation Flow Chart of data from the time of film badge development until the final badge report is printed.

<u>2.2.4 Discontinued Use of Pocket Ionization Chambers</u>

The use of the Victoreen Model 352 pocket ionization chamber was discontinued and direct reading dosimeters were issued to all personnel who are routinely subject to exposure to ionizing radiation. Although the initial expense of this change was relatively high, we now have an improved and more economical program. Contractors and their personnel utilize the constant monitoring feature of the dosimeter to better control their estimated exposures and the Branch is relieved of the necessity of processing some 800 pencils daily. The dosimeter results are used by the Contractor only, thus eliminating dual exposure recordings (dosimeter and film badge), on the individual's personnel exposure record.

2.2.5 Rescheduling of Film Badge Servicing Dates

All routine film badge servicing on weekends was discontinued during the latter part of 1958. Servicing is now equally distributed over the week days. This change resulted in the processing of approximately 1000 badge film each day, Monday through Friday, rather than 6000 on Saturday and Sunday, and a smoother distribution of work load. The Branch was also able to operate on two scheduled shifts rather than three as a result of the above changes with only two Personnel Metering clerks on duty over the weekend to handle any special servicing which might be required.

2.2.6 Extension of Time Between Film Badge Servicing Dates

The routine badge servicing for all AEC Contractors at the NRTS who operate under the jurisdiction of the Idaho Operations Office has been rescheduled to cover longer periods of time. Our experience has shown that approximately 95% of all weekly badge films have indicated an exposure of less than 30 mrems. This means we are working with film threshold level doses where the statistical error is greatest. By using the film to cover two and four week periods, the integrated dose would be larger and the accuracy of the dosimetry greatly improved. The new schedules were begun in December and were in effect in all areas by the end of the year.

2.3 Special Activities

2.3.1 Personnel Neutron Threshold Detectors

Preliminary work was performed on the design and testing of a personal neutron threshold detector. In the event of a criticality accident, this detector would be used to determine the total neutron exposure and provide a rough picture of the neutron energy spectrum. It would also be used to screen out the affected individuals following an incident. The detector will be an integral part of our newly adopted film badge, and will contain Gold foil, Sulfur, and Indium foil.

2.3.2 Film Emulsion Studies

A series of experiments were performed on the effects of temperature and humidity on the sensitivity of film emulsions. This work was performed by Mr. Clarence Cooper, an AEC Fellow in Radiological Physics from Vanderbilt University, as his thesis research work. The thesis will be published around July 1, 1959.

2.3.3 On the Job Training

Mr. A. D. Ailsworth of the Newport News Ship Building Company, Newport News, Virginia, spent approximately two months with the Branch learning the basic techniques of film dosimetry.

Mr. Spradlin, Mr. Gill, and Dr. Cracavanner also of Newport News, received instruction in personnel metering during the year.

Messrs. Lee Reed, Lyle Slagle, Gene Holley and Clarence Cooper, four AEC Fellows in Radiological Physics from Vanderbilt University, received on the job training in conjunction with the

NRTS Applied Health Physics Training Program. Dr. Hastings, Dr. Seaton, and Dr. McCarthy of the Navy, as well as one Navy technician, received instruction in personnel metering techniques, as did Mr. Lewis of Combustion Engineering, and three Westinghouse technicians.

2.3.4 Non-Routine Processing

The Branch processed various non-routine items used by Site Survey Branch and Contractors in fall-out studies, gamma flux measurements, etc. Table 2.1 lists these items by type.

TABLE 2.1 NON-ROUTINE ITEMS PROCESSED IN 1958

5 x 7 FILM	14x17 FILM	DOSIMETER FILM	NEUTRON FILM	RING FILM	WRIST BADGES
292	555	6,631	32,618	2,277	144

2.3.5 Preliminary Experiments on Thermal Neutron Dosimetry

Preliminary experiments were performed in the use of Cd filters and beta-gamma film for thermal neutron detection and measurement. Although incomplete, indications were interesting enough to warrant further study.

2.3.6 Activity Distribution Measurements Made for G. E.

Several tests were run during the year for the General Electric Company, ANP, to determine the distribution of activity within various fuel elements. High level dosimeter film was utilized for this purpose.

2.4 Routine Activities

Routine processing of personnel metering badges is shown in Table 2.2 while table 2.3 shows the results on regularly badged personnel engaged on contracts administered by the IDO.

TABLE 2.2 FILM BADGES SERVICED AT THE NRTS DURING 1958

MONTH	REGULAR	VISITOR	TOTAL	APPROXIMATE NUMBER OF PERSONS COVERED
JANUARY	15,378	1,932	17,310	5,745
FEBRUARY	14,487	2,670	17,157	5,857
MARCH	17,330	2,803	20,133	5,969
APRIL	16,620	1,832	18,452	6,294
MAY	16,839	1,973	18,812	6,219
JUNE	17,002	2,707	19,709	7,277
JULY	14,164	2,809	16,973	7,080
AUGUST	16,389	3,575	19,964	7,734
SEPTEMBER	15,220	2,667	17,887	6,464
OCTOBER	15,584	3,020	18,604	6,486
NOVEMBER	17,279	2,835	20,114	7,214
DECEMBER	12,295	2,697	14,992	6,865
TOTAL	188,587	31,520	220,107	AVERAGE

TABLE 2.3 RADIATION EXPOSURES RECEIVED AT THE NRTS BY IDO PERSONNEL (AEC & CONTRACTOR)

1958

Dose, rem	Area A	Area B	Area C	Area D	Area E	Total	%
0 - 1	961	357	1,567	97	19	3,001	84.73
1 - 2	239	2	19	11	6	277	7.82
2 - 3	142	0	1	4	9	156	4.40
3 - 4	47	0	0	2	5	54	1.52
4 - 5	23	0	1	0	1	25	0.71
5 - 6	11	0	0	0	0	11	0.31
6 - 7	8	1	0	0	0	9	0.25
7 - 8	4	0	0	0	0	4	0.11
8 - 9	4	0	0	0	0	4	0.11
9 - 10	1	0	0	0	0	1	0.03
Above 10	0	0	0	0	0	0	0.00
Total	1,440	360	1,588	114	40	3,542	100.00

and does not include visitors or personnel employed on contracts administered by other operations offices.

Approximately 15,000 visitors were badged during 1958 with 98% receiving less than 30 mrem, or statistical zeroes, and none approaching recommended maximum permissible values.

2.5 Future Programs

2.5.1 Personnel Neutron Threshold Detectors

All testing of the Neutron Threshold Detectors will be completed and the detectors will be in service around June 1, 1959.

2.5.2 Area Threshold Detectors

We are obtaining approximately 65 Area Threshold Detectors designed by ORNL. These neutron detectors consist of Au and Au plus Cd for determining the thermal flux, Pu^{239} shielded with B^{10} for determining the total fast flux, Np^{237} for determining the flux above 0.75 MeV, U^{238} for determining the flux above 1.5 MeV, and S^{32} for determining the flux above 2.5 MeV. The detectors will be located in processing and reactor areas at the NRTS where a criticality accident might occur.

2.5.3 Gamma Energy Determination Study

We plan to investigate further, with the aid of the U. S. Bureau of Standards, the ratios of the film densities produced behind the three shields and open window of our new film badge by exposure to low energy gamma radiation. This will be done by exposing groups of badges to a known amount of X-radiation, with varying effective energies between 10 kev and 250 kev. After the films are processed and density readings obtained for all four fields of each film, the results will be analyzed and a method derived for the determination of gamma energies.

2.5.4 Crystal Dosimeters for Area Monitoring

Studies are planned to determine the feasibility of using gamma sensitive silver activated phosphate glass dosimeters for area monitoring purposes. If practical, these dosimeters will be distributed throughout each area at the NRTS to be used for disaster monitoring.

2.5.5 Standardization of Dosimetry Film Type

Since 1955 we have been using DuPont type 552 and 558 film packets. Obvious advantages will result if we standardize on one type of film. Studies are now underway to determine which film type will be adopted for exclusive use.

2.5.6 Data Processing Equipment Improvements

A 101 Electronic Statistical Machine will be installed in our Data Processing section in March to facilitate the preparation of various statistical reports. Also the 402 Accounting Machine will be converted to a net balance type and will have additional type bars and counters installed to enable machine correction of exposure records where necessary, eliminating a great deal of mannual effort.

Table 2.4 shows the increase in work load of the Branch since its inception in August 1951, based on the number of regular operating and construction employees provided film badge service as of January 1 of each year.

TABLE 2.4 REGULAR EMPLOYEES PROVIDED WITH BADGE SERVICE

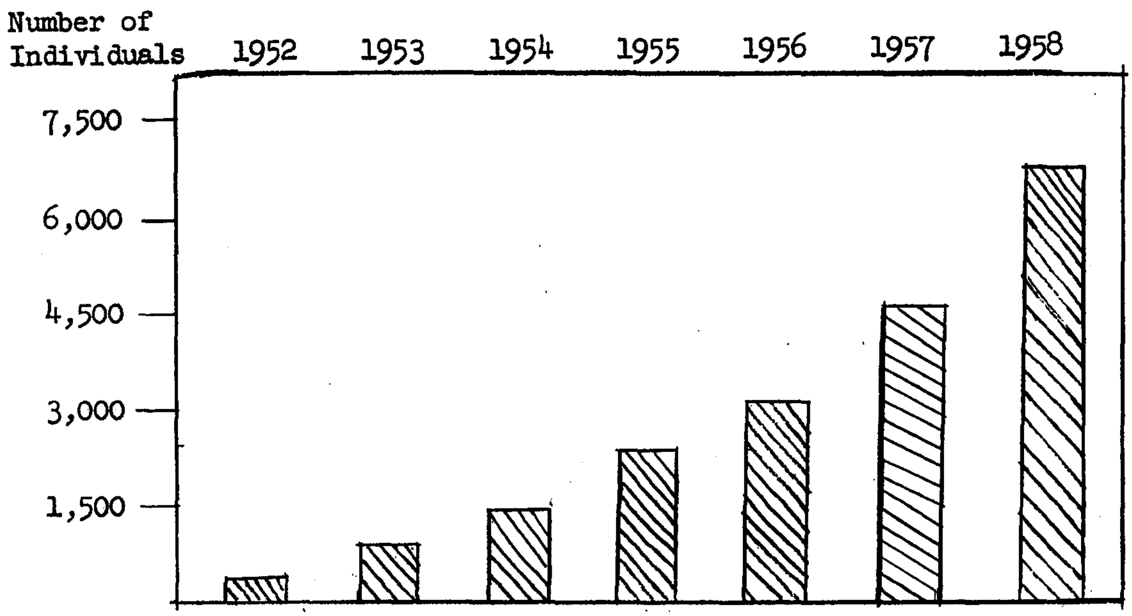
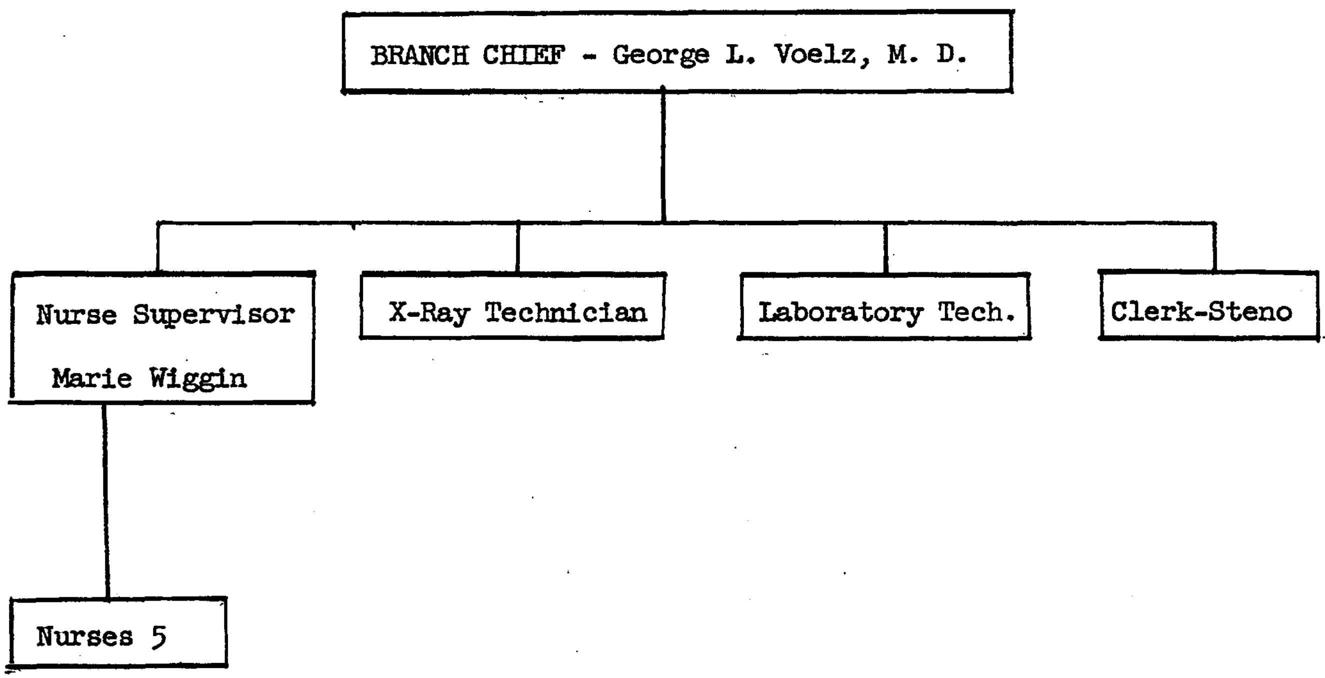


TABLE OF ORGANIZATION

MEDICAL SERVICES BRANCH



CHAPTER 3

MEDICAL SERVICES

George L. Voelz, M. D., Branch Chief

3.1 GENERAL

The Medical Services Branch conducts a comprehensive preventive industrial medical program for AEC and contractor personnel at the National Reactor Testing Station. Contractors utilizing this service include Phillips Petroleum Company, Argonne National Laboratory and Atomics International. First aid and emergency medical care is provided for construction contractor personnel working at the National Reactor Testing Station. Laboratory and X-ray examinations are provided for Westinghouse Electric Corporation and General Electric employees, as requested by their medical services.

3.1.1 Facilities

The main dispensary is located in the Central Facilities area. Equipment is provided to perform physical examinations, including Ortho-rater eye testing, audiograms and electrocardiograms. Medical supplies are maintained to provide medical and first-aid care including diathermy treatments and minor surgical procedures. A laboratory is equipped to conduct most clinical laboratory examinations. Diagnostic X-ray and dark room facilities are provided. A small room in the basement is specially designed and equipped to decontaminate personnel contaminated with radioactive material. Two ambulances are available for emergency transportation at all times. These are operated by the AEC Fire Department under the supervision of the Medical Services physician.

In addition to the Central Facilities dispensary, Phillips Petroleum maintains dispensaries staffed by a registered nurse at the MTR and the CPP areas during the day shift. These dispensaries are visited for one hour on each of the night shifts by the AEC nurses. Westinghouse Electric Corporation (NRF) and General Electric Company (ANP) maintain separate dispensaries at their respective facilities under supervision of part-time physicians.

3.1.2 Personnel

The Medical Services Branch is staffed with ten AEC employees. The branch chief is a full-time industrial physician, registered to practice medicine in the state of Idaho and trained in the field of occupational medicine. Four shift nurses provide professional attendance at the dispensary at all times, including holidays and weekends. One nurse spends approximately half-time visiting construction areas to provide close liaison with the first-aid attendants on construction and to perform medical retreats at the construction sites. The remainder of her time is spent as an additional day shift nurse at the dispensary. The head nurse works only week days at the dispensary. One clinical laboratory technician and one X-ray technician operate their respective departments and are trained to relieve each other during annual or sick leave. One secretary maintains the medical records, types all physical examinations and correspondence, records statistical data and completes branch reports. No personnel was added to the staff in 1958.

3.2 SUMMARY OF MAJOR PROGRAMS

3.2.1 Physical Examinations

Physical examinations are the most important single function of a medical service which is oriented to provide a preventive medical program. Pre-employment examinations are performed prior to hiring personnel in order to properly place an individual on a job compatible with any disability or health problem which may be found. Periodic and termination examinations determine any change in the employee's health status which may have resulted from his occupation or may necessitate a change in his work placement. These examinations also provide early diagnosis of unknown conditions which may be treated to prevent further progression or be cured before lost time or diability occurs. Indirectly, the periodic examinations evaluate plant conditions and direct attention to problem areas which may require industrial hygiene, health physics or safety consultation.

In 1958 the number of physical examinations performed increased 38% over the 1957 figure.

Since a physical examination includes laboratory and X-ray procedures, as well as clerical, nurse and physician services, this growth represents an increased work load on all branch personnel. The number of examinations, laboratory and X-ray procedures performed during the past five years are graphically illustrated in Fig. 3.1.

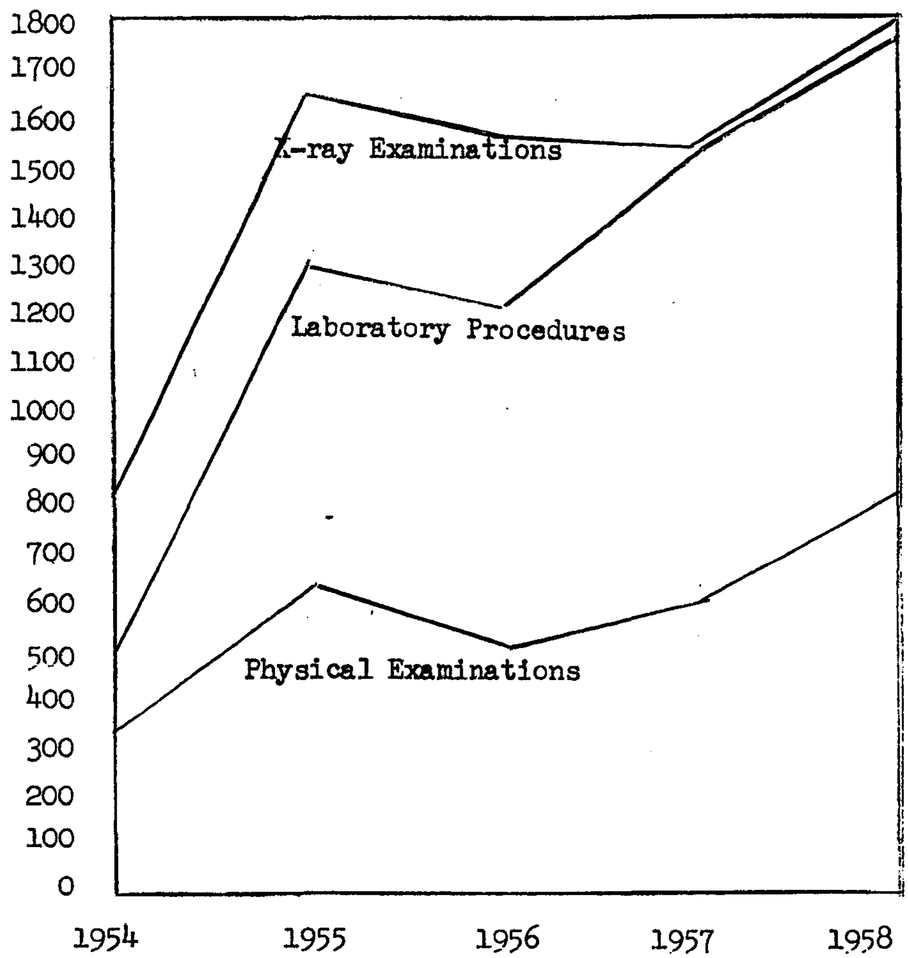


Fig. 3.1 Examinations performed by Medical Services Branch

In addition to the routine laboratory test, 113 electrocardiograms were performed and approximately 40 timed vital capacity tests.

Physical examinations were performed for the following companies during 1958.

PHYSICAL EXAMINATIONS

	Pre-Employment	Periodic	Termination	Total	%
AEC	24	119	-	143	16.8
Argonne National Lab.	33	2	8	43	5.0
Phillips Petroleum Co.	85	422	130	637	74.9
Atomics International	-	27	1	28	3.3
	142	570	139	851	100.0

In 1958 a statistical tabulation of the results of physical examinations was recorded. Only 31% of persons examined were found to be completely normal.

MOST COMMON DIAGNOSES ON 851 EXAMINATIONS

	Number	%
Normal	262	31
Overweight	137	16
Vision Correction Required	132	16
Hay Fever	45	5
Hearing Loss, over 10% in one ear	31	4
Uncorrected Vision Loss (one or both eyes	30	4

Gastritis (recurrent) or Peptic Ulcer	25	3
Eye Muscle Imbalance (phorias)	23	3
History of Drug Allergy	20	2
Hemorrhoids	20	2
Hearing Loss, over 10% in both ears	16	2
Asthma (history)	14	2
Dermatitis (eczema or contact types)	12	1
Back Strains (recurrent)	10	1

Seventy seven (77) new significant conditions were discovered on these 851 examinations. Fifty one (51) or 66% of these conditions were without symptoms. One hundred fifty three (153) laboratory and X-ray findings were outside normal limits on the physical examinations. Many of these returned to normal on subsequent determinations.

Late in 1957 arrangements were made for an ophthalmologist to come out to the Central dispensary to perform special slit lamp eye examinations for Phillips Petroleum employees working in potential neutron exposure areas. Previously these examinations were done by sending the employees to the doctor's office in town or doing them in the evening. The new procedure enabled the examinations to be done with a significant decrease in time off the job. This has proved to be a very satisfactory arrangement. During 1958 a total of 68 slit lamp examinations were performed.

3.2.2 Laboratory

During 1958 the clinical laboratory developed the capability to perform a number of diagnostic tests beyond the routine blood counts and urinalyses. Tests performed by the laboratory now include blood sugar analysis, serum cholesterol, serum bilirubin, thymol turbidity, phenosulfonphthalein excretion test, bromosulphalein excretion test and sedimentation rates. A microhematocrit method was adopted during 1958 in order to save technician time required by the standard hematocrit technique previously used.

3.2.3 Dispensary Visits

During 1958 a total of 7493 patients visited the CFA dispensary. Of this total the following visits (by company) were seen for treatment or examination.

Company	Total Treated	%
Atomic Energy Commission	893	18.7
Argonne National Laboratory	146	3.1
Atomics International	66	1.4
Phillips Petroleum Company	2819	58.9
Construction contractors and others	857	17.9
	4781	100.0

Of these visits, 1376 or 29% were for occupational injuries or consultations; 3405 or 71% were nonoccupational treatments or consultations.

The first-aid stations at the construction areas, visited periodically by an AEC nurse, reported a total of 468 treatments.

The IDO contractor-operated dispensaries cooperating with the AEC Central dispensary had the following patients during 1958.

	Occupational	%	Nonoccupational	%	Total
CPP Dispensary (Phillips)	386	17	1870	83	2256
MTR-ETR Dispensary (Phillips)	1195	19	5080	81	6275
Fluor Dispensary (Fluor)	511	42	713	58	1224

The grand total of all patients who passed through the AEC and IDO contractor dispensaries and first-aid stations during 1958 was 22,065 persons. Of these, 15,004 received treatment or consultation and the remainder were to collect laboratory samples and vaccinations.

3.2.4 Talks

The following talks were given by the branch chief during 1958, besides those given at the NRTS itself for visiting groups or training courses:

Meeting	Paper
Idaho Falls Business & Professional Women's Society	Medicine In Industry
Idaho State Anesthetists Association	Radiation and Reaction
Nuclear Science Seminar (Navy Reserve)	Radiation and Health Problems

3.3 FUTURE PROGRAMS

3.3.1. Our physical examination program must continue to grow to meet increasing demands, partially due to increased numbers of personnel. At present it has not been possible to cover the personnel as adequately as is desired. For example, Phillips Petroleum has approximately 1000 persons in operations areas (MTR, CPP, and SPERT) where annual examinations are desirable. In 1958 we performed only 422 periodic examinations on Phillips employees. The forthcoming employment of 200 or more persons by Argonne National Laboratory will place an additional load on our physical examination schedules, equivalent to 25% of our 1958 examinations.

Efforts will be made to increase this program within the limits of the present staff.

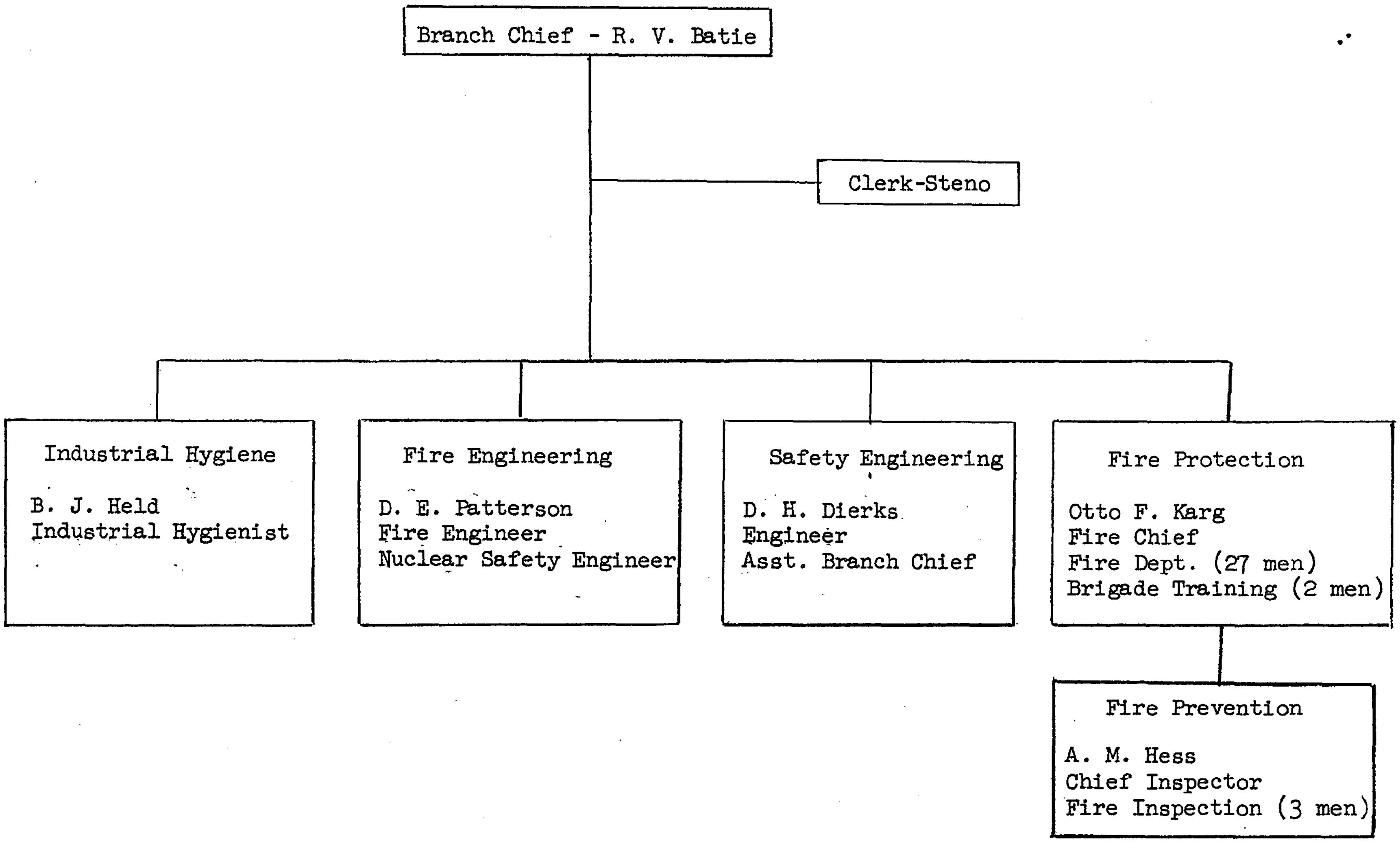
3.3.2. During 1959 it is hoped that arrangements may be made to provide a year's in-plant training program for one of the AEC Industrial Medical Trainees. The work at the NRTS should provide a year of valuable practical experience in the field of industrial medicine.

3.3.3 An endeavor which would make our medical program a source of more useful information both from a practical work-day standpoint as well as for research, is the use of some type of coding system for our medical records. The present record system does not permit extracting data except on an individual basis. In the future we hope to devise a system which will permit better utilization of the medical data collected on personnel at the NRTS. This program will be developed in conjunction with the Data Processing Section of the Personnel Metering Branch.

3.3.4. The primary function of the Medical Services Branch is the operation of an industrial medical department. No research activity has been promoted in the past. It is hoped that in the future secondary research efforts may be promoted on data gathered on the periodic physical examination program. An initial effort is being made to correlate results of plant radiation exposure history and findings on the slit lamp eye examinations.

TABLE OF ORGANIZATION

SAFETY AND FIRE PROTECTION BRANCH



CHAPTER 4

SAFETY AND FIRE PROTECTION

R. V. Batie, Branch Chief

4.1 GENERAL

The Safety and Fire Protection Branch is fundamentally responsible for the development of the Idaho Operations Office Safety and Fire Protection Program, and for furnishing the necessary guidance and coordination to the IDO Staff and the operational and construction contractors. The IDO Standard Health and Safety Requirements, as a part of the IDO Manual, furnishes basic program and operational guides, and is a specific requirement in all Idaho Operations Office contracts. The Branch is the authority for interpretation of the Requirements and/or Reference Codes, in matters of Safety and Fire Protection and as such, a considerable portion of time is devoted to problems presented by the field. The Branch maintains the professional Fire Department at the National Reactor Testing Station, and provides fire prevention inspection of all facilities.

The National Reactor Testing Station involves activities and facilities of three AEC Operations Offices other than IDO. Since IDO has the only AEC Safety and Fire Protection staff located at the site, the Branch serves as a field liaison group to the Manager and the other respective operations office representatives. An informal liaison agreement exists providing for surveys, inspections, reporting, vehicle licensing and other service functions necessary for an effective program.

4.2 SUMMARY OF MAJOR PROGRAM

Results of a safety program are generally reflected in the experience records. Since the program encompasses overall IDO activities, the charts that follow will also reflect the overall picture. Due credit is given to the operational and construction contractors involved, since the figures in reality express their cooperation, enthusiasm and follow through with the IDO program.

4.2.1 Disabling Injury Experience

IDO's overall accident frequency (operations, construction and AEC) has shown a favorable downward trend over the years (Figure 4.1). During the past three years IDO's overall accident frequency has been lower than the average of all AEC activities. Compared to the Chemical Industry (Bureau of Labor Statistics) which has the greatest similarity to NRTS activities, IDO is now experiencing less than one disabling injury to the Chemical Industrie's four.

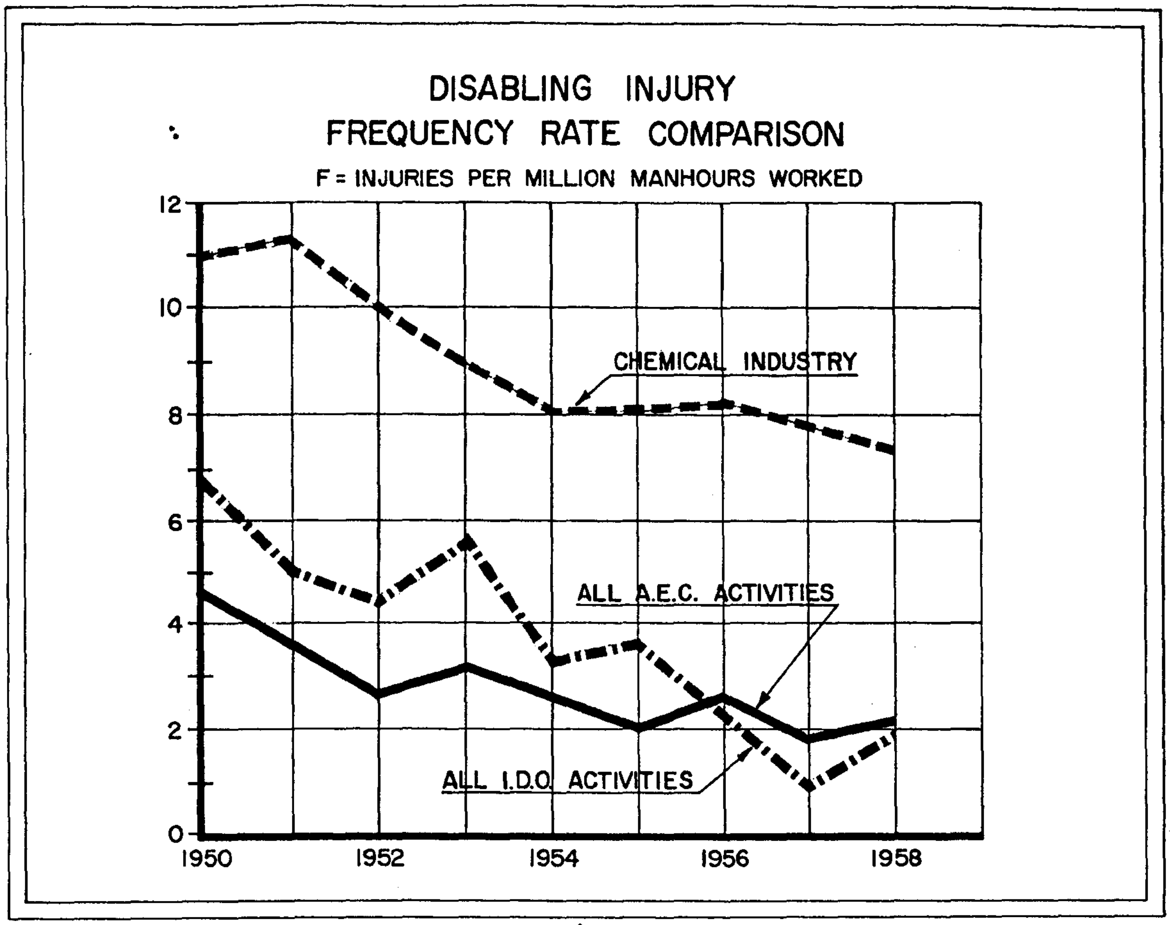


Figure 4.1

4.2.2 Severity Rate

The severity of accidents from overall IDO experience compares favorably with overall AEC operations, and $2\frac{1}{2}$ times better than the Chemical Industry (Figure 4.2). The average days lost per million manhours worked for the past nine years are the following:

All IDO Activities	399
All AEC Activities	533
Chemical Industry	1004

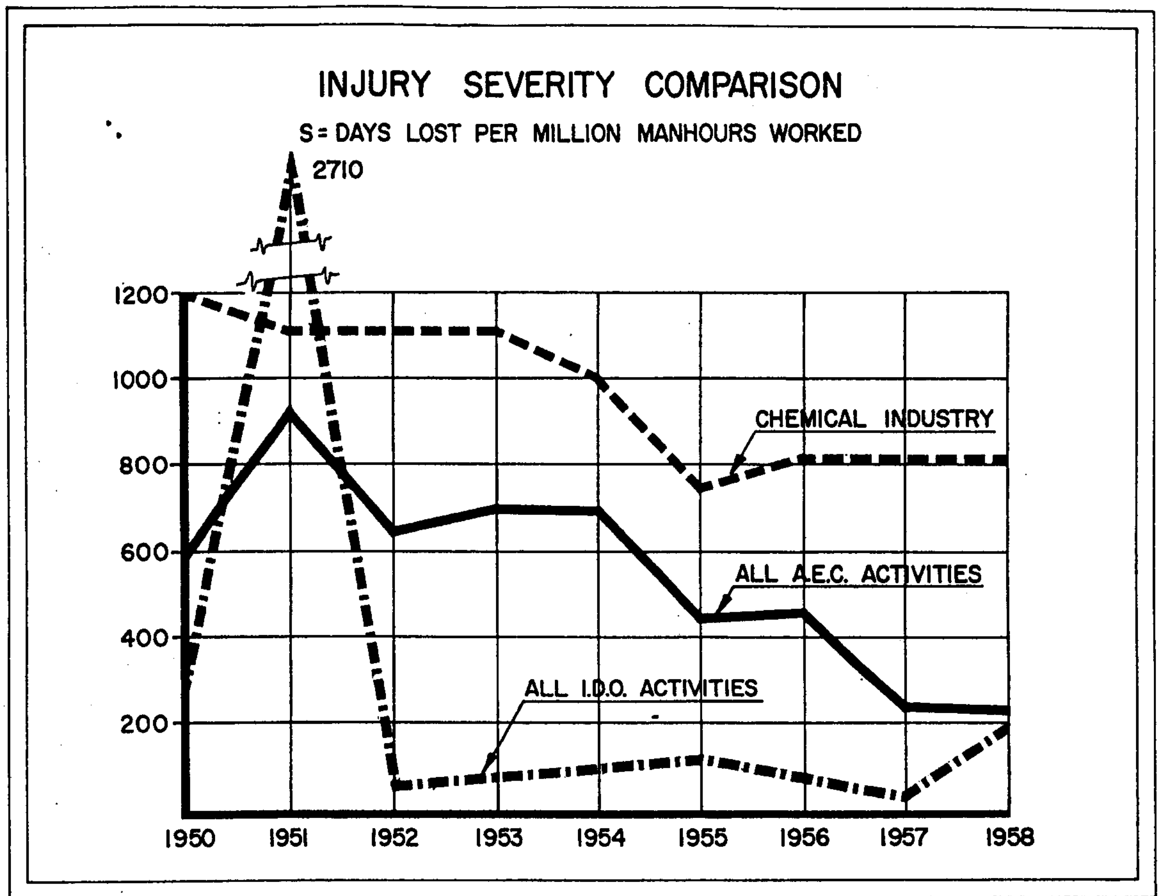


Figure 4.2

The high severity rate in 1951 reflects the drastic effect that two fatalities, during construction activities, had on the severity comparison graph.

4.2.3 Motor Vehicle Accidents

IDO motor vehicle accident experience compares favorably with the average of all AEC Activities, primarily because of the outstanding performance of the Phillips Petroleum Company operated bus service. (Figure 4.3). The majority of vehicle accidents resulted from backing into objects; however; the forward motion accidents resulted in greater total damages.

The mileage driven is increasing at a rate of approximately a million miles per year because the bus operation is expanding to serve the growing number of operational facilities at the NRTS.

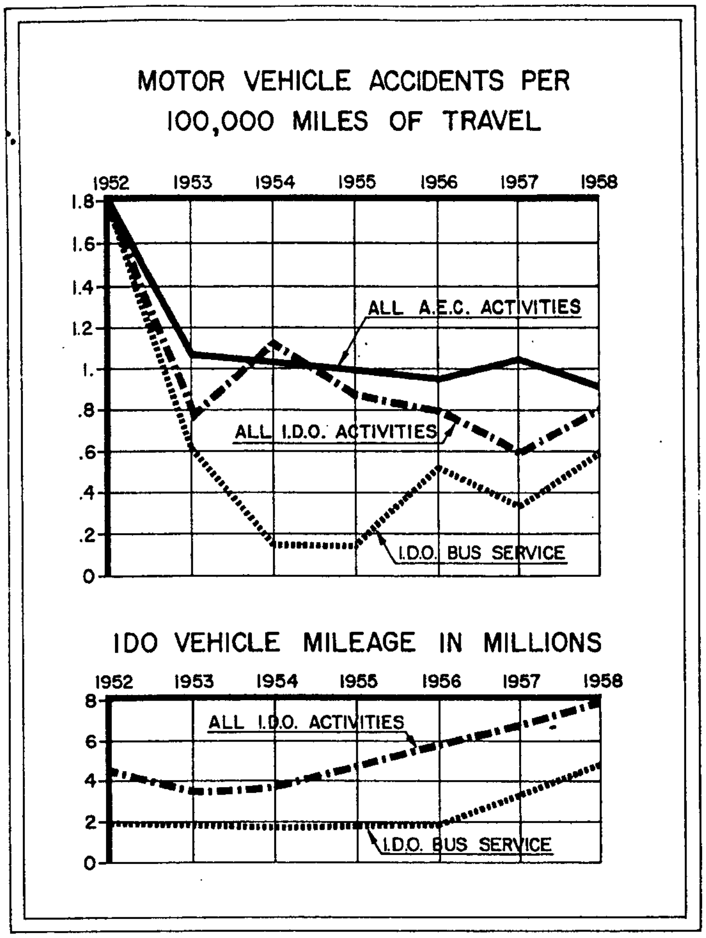


Figure 4.3

4.2.4 Fire Loss Experience

In examining the Fire Loss Data (Table 4.1) it is seen that the IDO loss exceeded the AEC average in two of the past three years, although the total loss is less than the average AEC loss for the three years. the NRTS loss during the same period was only a fraction of what might have been suffered if fire had occurred at the National rate or the "improved risk" rate. To exceed the "improved risk" loss rate it would have to be necessary to have an additional fire loss of $170,000 during this period. Such a loss is very possible as a result of one serious incident, and it is this type of loss which our fire protection efforts are primarily aimed at preventing.

	NRTS Fire Loss Comparison			
	NRTS Valuation	Actual NRTS Fire Loss	AEC Comp. Loss	Improved Risk Comp. Loss
1958	259,620,000	2050	not available	71,000
1957	204,900,000	22685	15200	56,000
1956	150,000,000	217	44900	41,000
1955	118,000,000	5366	2120	32,200

Table 4.1

4.2.5 Property Damage

IDO property damage loss from all causes except fire amount to 1.42 cents per $100 valuation.

IDO Property Valuation	151,320,000
Loss	21,508

Sixty-nine percent of this loss was due to one operational incident which involved considerable decontamination.

4.2.6 Design Criteria

Considerable time has been spent in formulating a Safety and Fire Protection Section of the IDO Engineering Standards Design Criteria, which is to be used as a guide by Architect - Engineer Groups in the design of future NRTS facilities. Pending formal issuance of this criteria as IDO report # 12008, the Safety and Fire Protection Branch reviewed approximately fifty (50) sets of engineering drawings and specifications on new project facilities, and approximately sixty (60) project modification proposals. Such reviews included evaluation of the risk resulting from the type of construction, contemplated occupancy, adjoining facilities, accessibility and other contingencies.

4.2.7 Surveys

Annual Safety Surveys of operational areas evaluated the effectiveness of the operating contractors' Safety Program, and the degree of compliance with AEC policies and standards.

Annual Fire Surveys of major operations facilities were based on "improved risk" criteria for AEC Fire Protection. In previous years the surveys were made by outside fire engineers. This year the Branch fire engineer made the surveys, and thoroughly investigated fire water systems. The Fire Protection Improvement Program, incorporated in the survey, was endorsed by Management, funds made available for the most important projects, and design is underway.

4.2.8 Reviews and Inspections

The Fire Department and Fire Prevention Unit furnishes protection and fire inspection to the overall site. To implement this service, Station No. 2 was built and put in service centrally located to the high value areas of NRF, CPP and MTR-ETR. The station has a four-man company, with 24 hour coverage, one engine and an ambulance.

4.3 SPECIAL ACTIVITIES

The Branch initiated monthly meetingswith Union Business Agents to encourage and promote safety education within the Unions. The Business Agents have gained a better understanding of the AEC-IDO Standards Health and Safety Requirements, and have been able to discuss and obtain assistance on numerous field problems.

The standardization of NRTS evacuation and emergency alarms was strengthened. New installations and the modification of some existing systems are being installed in accordance with the IDO Standard. During 1958 the Branch was assigned responsibility for Nuclear Safety. A survey of "Nuclear Criticality Hazards at IDO" was completed and appropriate reports submitted to the Director, Division of Production, Washington, D. C. The Branch has also initiated the making of criticality reviews on all shipment of SS material wherein IDO has responsibility.

The physical protection of radiological shipments required by both ICC and IDO has necessitated coordinating engineering design work on casks of various descriptions, long haul trucks, and rail car facilities, to assure the safest possible transportation of these potentially hazardous or high value materials. Approximately three hundred (300) shipments on and off site, were physically checked prior to release.

A special addendum to Appendix K of the Health and Safety Requirements was issued to control and guide contractor usage of ammonium nitrate as a blasting agent on the NRTS. The Branch issued thirty-two (32) blasting permits to powdermen, after each man had demonstrated aptitude and knowledge of powder storage, handling, and use techniques.

Branch personnel were instrumental in the organizing of the Eastern Idaho Safety Engineers as a professional society dedicated to community service. All Safety Engineers at the NRTS are actively participating. Action has been obtained on several worthwhile projects.

Area fire maps are being developed on the entire NRTS. Maps reflect occupancy, construction, built-in fire protection, and specific fire hazards of each building.

The Branch has added an Industrial Hygienist to its staff to provide consulting service on problems of industrial hygiene. Ventilation, noise, lighting, chemical contaminates, and toxicity problems can now receive specialized reviews, sampling and analysis.

4.4 ROUTINE ACTIVITIES

Safety and fire reviews are basically spot checks of contractors' activities for compliance with acceptable standards. The Fire Prevention Unit made a total of 1764 fire prevention inspections covering both operational and construction activities (Figure 4.4).

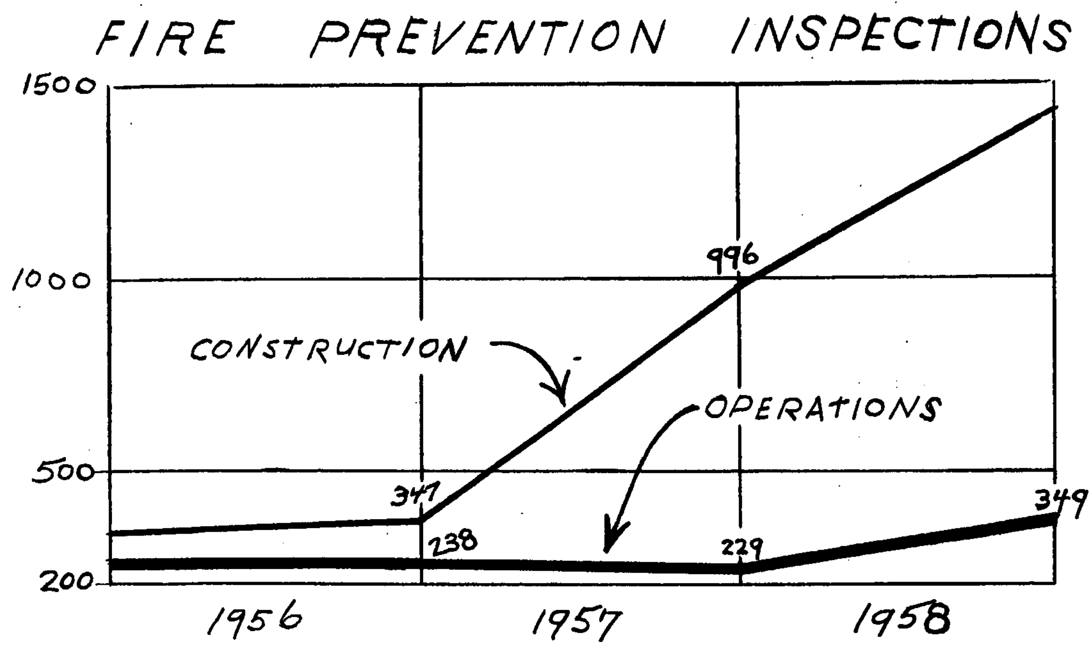


Figure 4.4

Monthly tests were conducted of all fixed fire protection devices and fire alarm systems in all areas except at ANP which has its own program.

Ambulance service, as a part of Fire Department operation, was furnished as necessary to industrial cases, personal illnesses and highway accidents. The ambulance responded to forty-one (41) emergency calls, and transported one hundred and thirty-six (136) persons to further medical addention.

Fire Department personnel received an average of 125 hours of classwork instruction and 70 hours of outside drillwork with apparatus and equipment. Fire Department officers served as instructors. The officers received training in the use of radiation detection instruments, office duties and responsibilities. All Fire Department personnel qualified for the Advanced American Red Cross First Aid Certificate during the year. The Training Officer conducted 194 hours of group instruction, which was given to Fire Brigades of the various operating contractors.

Equipment and personnel were on stand-by status for approximately sixty (60) hours to provide protection for hazardous operations, and to perform decontamination washdown.

New materials and chemicals are continually being introduced into the various operations without full knowledge as to their fire or health hazard. Testing and research are sometimes necessary to determine properties and use restrictions. Quarterly reports to the Division of Biology and Medicine on new potentially toxic materials used or generated at the NRTS have included:

Cesium Carbonate

Neptunium-237

Yttrium

Zirconium Hydride

Site traffic controls are established by the Branch, through review of traffic studies and coordination as necessary with State and County Codes and engineering groups. These controls include road widths, intersection layouts, all signs, pavement markings, special routings, restrictions, and parking patterns.

Quarterly seminars of the NRTS Safety Committee have been continued and are programmed to present technical papers, coordinate mutual projects such as Clean-up and Fire Prevention Weeks, and exchange of information which would be of value to the individual operations' programs.

Monthly meetings with the Resident Engineers and their Architect-Engineering inspection personnel on construction jobs, has provided familiarization with the IDO Health and Safety Requirements, thereby equipping them to recognize and correct field hazards.

Safety and fire protection orientation meetings are conducted with supervision of construction contractors before the start of the job. This clarifies contractual responsibilities in regards to safety and fire prevention, and results in a more effective program and understanding of regulations.

All IDO accident experience reports are reviewed and summarized. Special investigation and reports are made dependent upon: Severity of the accident, Management request, Third-party involvement, possible liability, or possible recovery of damages.

4.5 FUTURE PROGRAMS

The development of new project areas in the east section of the NRTS necessitates expansion of the Fire Department. A new fire station is under construction at the EBR-II area, located 21 miles from the nearest existing station. This station will be staffed by a 10 man company to provide a 4 man crew on a 24-hour service.

The more important items on the 1958 Fire Protection Improvememt Program will be completed during the year 1959. This will bring IDO closer to full compliance with the AEC "improved risk" criteria.

Due to the increased number of high, windowless, unventilated buildings, and large redwood cooling towers, the need has developed for an aerial ladder truck. A new 750 gpm Quintuple Combination 75' aerial ladder truck is on order for delivery in 1959.

IDO Manual Revisions are contemplated on:

Chapter 0502 - Injury, Fire and Property Damage Records, Reports and Investigations

Chapter 5201 - Basic Transportation Policy. Section -09, Radioactive Materials, Explosives and Other Dangerous Articles

Chapter 0553 - Operators of Federal Motor Vehicles

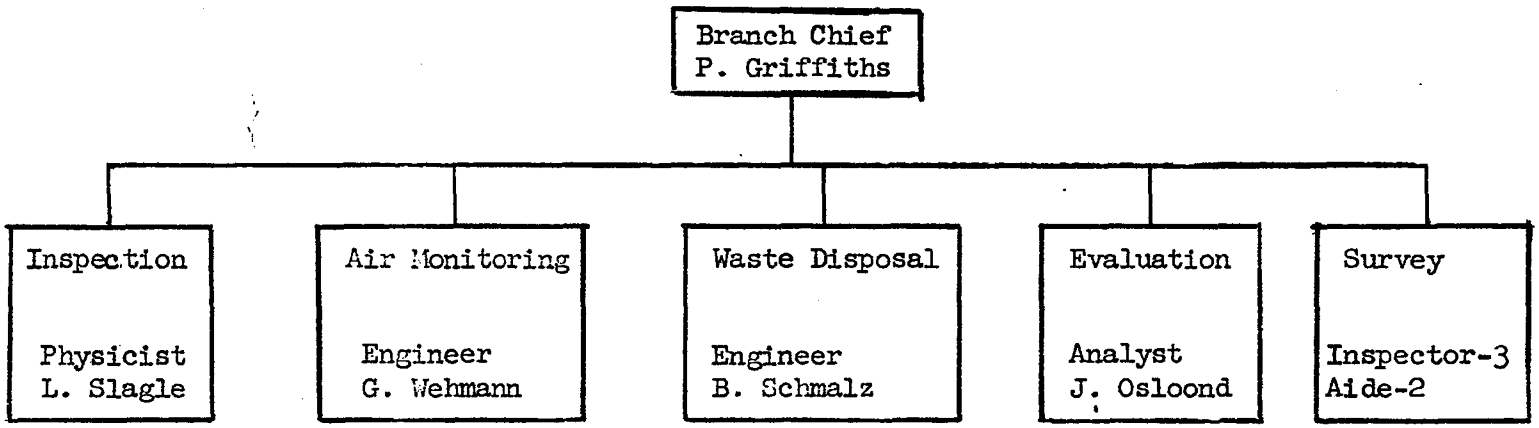
Publication of technical papers on "Redwood Cooling Towers", "Fire Properties of Sheet Polyethylene", and other subjects are contemplated. To improve the effectiveness of plant fire brigades there is proposed a standard 24-hour basic training course to be completed by all present brigade members during 1959.

4.6 Papers and Publications

Subject	Speaker	Date	Place	Group	Attendance
Fire Hazards of Atomic Reactors	Fire Chief Otto Karg	March 1958	Idaho Falls	AEC Emergency Monitoring Team Captains	60
Fire Hazards of Atomic Industry	Training Officer Capt. E. G. Dingman	August 1958	NRTS	Police and fire personnel from 3 neighboring states	25
Shipping of Radioactive Material	R. V. Batie	May 1958	Washington D. C.	AEC Safety Conference	300
Shipping of Radioactive Material	R. V. Batie	June 1958	Chicago	Private Industry Power Reactor Group	20

ORGANIZATION CHART

SITE SURVEY BRANCH



CHAPTER 5

SITE SURVEY

Percy Griffiths, Branch Chief

5.1 GENERAL

The Site Survey Branch is responsible for the detection, and evaluation of radioactivity, in any form, outside areas assigned to contractors at the NRTS. The purpose is to minimize the hazard to employees and community populaces in surrounding areas. The Branch is the liaison organization between AEC contractors and other organizations and agencies working with radioactive materials to a degree where exposure could occur to personnel or environmental effects could result. Specific functions of the Branch are classified as follows:

5.1.1 Environmental Monitoring

A continuous radiation monitoring system and a telemetering network are operated by the Branch for the purpose of observing radioactivity released to the environment and to establish background data. Monitoring personnel are made available to contractors upon request for assisting in specific tests and problems. Advice and assistance relative to problems involving radiation and its control are provided.

5.1.2 Shipments

Shipments of radiological materials in and out of specific contractor jurisdiction are controlled by the Branch. This involves interpretation and formulation of regulations and procedures, providing technical advice, and assistance in design and preparation of containers and packages, and finally inspection of radioactive shipments.

5.1.3 <u>Waste Management</u>

Waste Management involves:

1. Establishment of criteria, regulations and procedures for disposal.
2. Management and supervision of a burial ground for radioactive solid waste.
3. Inspection of radioactive disposal operations.
4. Control and monitoring of low level liquid waste in the ground water.
5. Control of planned airborne releases where radioactive materials are involved.
6. Calculations of potential exposures prior to planned experiments.
7. Determination of actual exposures following releases of radioactive materials.

5.1.4 <u>Design Review</u>

The Branch reviews, comments and approves design of proposed construction, and experiments at the NRTS wherein radioactivity is involved.

5.1.5 Radiological Assistance Plan

Radiological Assistance Plan responsibility involves leadership in a cooperative program embodying contractor and AEC personnel for mutual assistance to local authorities in the event of accidents involving radioactive materials in the five-state area of Idaho, Montana, Wyoming, Utah and Colorado.

5.2 SUMMARY OF MAJOR PROGRAMS

Two vacancies on the staff were filled during the year by the transfer or hiring of two engineers. A Junior Physicist was also added to the staff late in the year.

One engineer with meteorological training and experience was assigned primary responsibility for control and monitoring of radioactivity in the atmosphere. The other engineer with training in engineering and earth sciences was assigned responsibility for waste disposal to the environment in liquid and solid form, and research studies in this field. The addition of these people made possible more detailed supervision of the Branch programs.

The Fission Products Field Release Test #1 was conducted under the regulatory control of the Branch.

Progress was made in the underground water studies as a result of the drilling of two monitoring wells and a "Tracer" study. A Radiological Assistance Plan for implementation of the National Plan was developed.

5.3 SPECIAL ACTIVITIES

5.3.1 Fission Products Field Release Test No. 1

The Branch participated in the Fission Products Field Release Test which was sponsored by the Air Research and Development Command, U. S. Air Force. The program was managed by the U. S. Air Force Specail Weapons Center with the Convair Division of General Dynamics Corporation assigned operational responsibility. The work was conducted on Test Grid No. 3 at the NRTS. (Fig. 5.1)

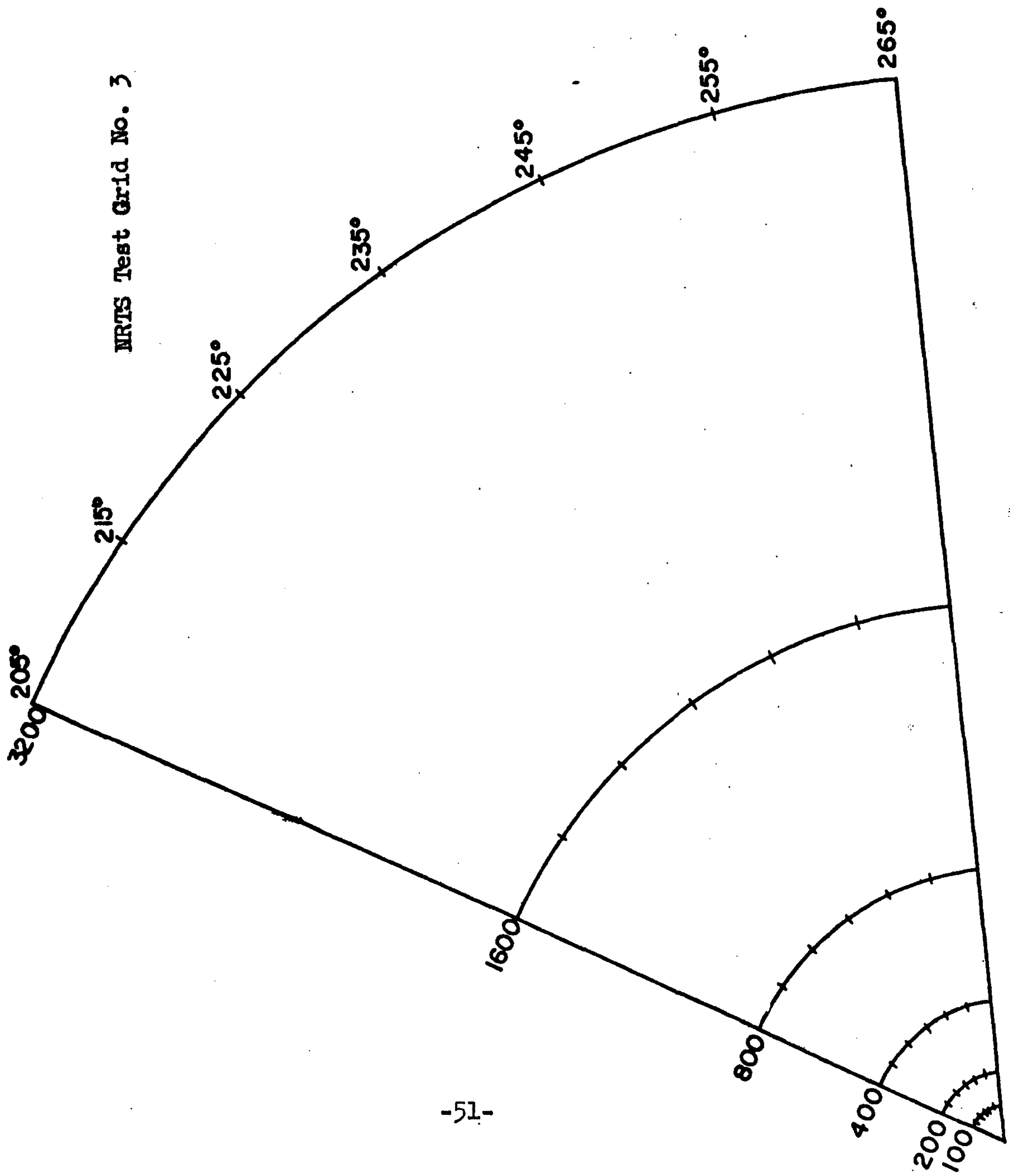


Fig. 5.1

This grid consisted of sampling arcs with radii of 100, 200, 400, 800, 1600 and 3200 meters. The purpose of the test was to obtain information on the dispersion and deposition of radioactive isotopes under controlled conditions where fuel elements were destroyed by heat. Nine releases were accomplished during the test, the first on July 25, and the last on September 26, 1958. Aged elements were used for five releases and fresh elements for the remaining four. The Branch was responsible for the following:

1. Administrative liaison with cooperating agencies and organizations.
2. Supervisory control of each release.
3. Inspection to insure compliance with regulations governing the handling of radioactive materials.
4. Ground deposition studies using water and sand trays.
5. Monitoring beyond the grid boundaries to insure no hazard was presented to other operations of off-site populaces.

The details of IDO participation together with results are the subject of a separate report, IDO-12006.

5.3.2 Incident Monitoring

5.3.2.1 Particulate Release - ICPP

During the latter part of July and throughout the month of August an increase in particulate fallout was noted in the vicinity of the Chemical Processing Plant (ICPP) in an area principally to the north and east. This evidence was obtained on fallout plates by autoradiographing. Particles obtained from soil samples collected northwest of the ICPP were also physically isolated and photographed.

The particles were composed mainly of Cerium 144, Zirconium 95, and Niobium 95. Analysis of one particle indicated 10^{-2} microcurie of Zirconium 95. All particles isolated were in the size range of 5.0 microns or greater. Maximum dose from a single particle was calculated for Ce 144, Zr 95 and Nb 95, based on pessismistic assumptions. The calculated maximum dose was as follows: 25 mrads from inhalation and 17 mrads from ingestion using Ce 144 as the most hazardous isotope.

A joint investigation was initiated with the operating contractor to determine the source and cause, and as a result it was discovered that a vent on the solvent process building near ICPP stack was discharging liquid radioactive material on the metal roof where it solidified. Subsequent spectrum analysis indicated that this was not the major source of the problem. At the end of the year the cause of this problem had not been determined.

5.3.2.2 ICPP - FECF Filter Break

On October 30, 1958 a rupture of exhaust filters at the ICPP Fuel Element Cutting Facility resulted in the release of particulate activity to the south of ICPP. Surveys indicated an area of approximately 200 acres contaminated with approximately 100 curies of aged fission products. Particulate material was collected at distances up to one mile downwind from the FECF.

5.3.2.3 ANP - Atmospheric Release

On November 18, 1958 an accidental release of radioactive materials occurred at the IET area of the ANP during low power experiments. Fallout consisting of green fission products occured over an area of approximately 1500 acres to the south of IET. It is estimated that the ground concentration four hours after release was approximately 2 uc per square foot at a point 2.5 miles from the stack. The external infinity dose due to residual contamination was approximately 5 mr. This calculation was based upon a GM (window closed), 3-foot-in-air reading of 0.15 mr/hr. This was measured 2.5 miles downwind from the IET stack approximately four hours after the incident had occurred and assumed all of the activity due to Iodine 133. It is also to be noted that this is the dose due to the fallout and does not take into account the exposure during cloud passage. No measurable exposure to personnel or the public occurred as a result of this incident.

5.4 ROUTINE ACTIVITIES

5.4.1 Environmental Monitoring

5.4.1.1 ANP Operations

During the first half of the year the Branch was occupied in monitoring a series of tests at the Aircraft Nuclear Propulsion Area. Mobile and fixed equipment was utilized. The maximum activity detected by any of the various techniques was less than 50% of the pre-established limits. The maximum infinity exposure levels at the NRTS boundary were estimated as 9 mr/hr (gamma radiation) for the whole body and 10 mrem for the thyroid. The maximum levels as determined by analysis of high volume air samples were calculated to be 24×10^{-3} uc/m^3. Autoradiographs of fallout plates presented a pattern approximating wind direction for the period.

5.4.1.2 ICPP Operations

Thirteen Rala process runs were made at the ICPP, all of which were monitored by the Branch at points beyond the operational area. The run on January 6 was the first processing which was conducted under meterological controls which permitted operation when favorable diffusion conditions existed without regard to wind direction. Maximum estimated exposure was estimated at 0.1 mr to the body, and 0.5 mrem assuming I-131 to the thyroid.

The highest release of activity occurred on May 28 when an estimated 49.5 curies of I-131 was discharged to the atmosphere.

The calculated maximum infinity dose assuming I-131 at one mile from the point of release was 130 mrads.

No significant exposures were received by personnel as the result of Rala discharges to the atmosphere.

5.4.1.3 ANL Operations

The Borax IV facility was operated with fuel plate ruptures at intervals between March 11 and 27. Monitoring activities indicated Cesium 138 as the predominant isotope release. Maximum radiation levels detected during the operation were 12.0 mr/hr at a distance of 500 feet from the reactor. No exposure to personnel occurred beyond the project area.

5.4.1.4 Continuous Monitoring

Air samples for Iodine analysis were collected from 8 stations on the NRTS. Thirty-four locations provided fallout information through the medium of conventional fallout methods. Film badges were located at 33 stations as a means of monitoring external radiation. These activities indicated that no hazardous environmental effects occurred as a result of NRTS operations.

5.4.1.5 Weapons Tests

A monitoring program was conducted in connection with weapons tests in the Pacific and at the Nevada Site in cooperation with the Division of Biology and Medicine. Samples were collected at a station in Idaho Falls and at Central Facilities area of the NRTS. Samples were collected and evaluated on a daily basis starting on April 8 and continuing through December. Air samples were collected and evaluated according to the recommended USPHS method in use on a nationwide basis. Fallout results were obtained by visual inspection of autoradiographs of sticky paper collectors which had been placed in the field over a 24-hour period of this program. The results are summarized in Table 5.1.

Table 5.1 Fallout Monitoring Program

	Filter Readings (uuc/m^3)						Particles (No)		
	Idaho Falls			CFA - NRTS			Idaho Falls		
Month	Ave.	High	Low	Ave.	High	Low	Ave.	High	Low
April	7	16	3	17	60	4	1	5	0
May	10	17	5	19	37	10	3	25	0
June	10	14	4	11	25	5	3	9	1
July	9	12	5	15	30	7	5	25	1
August	9	15	6	13	23	7	6	26	1
September	8	11	4	10	14	6	4	19	1
October	82	1090	6	315	4760	8	-	*	2
November	16	51	7	27	51	7	12	100	1
December	10	16	6	26	83	9	-	-	-

*Saturated (particles too numerous to identify individually) on 10/15, 10/16, 10/25, 10/26, 10/27 and 10/28.

The correlation between the fallout accumulation on the filter and fallout plates is obvious.

Gamma radiation was measured during the period by surveying an area of approximately ten square feet at a height of three feet above the ground. In no instances were readings in excess of previously determined background levels, indicating no reported exposure to the populace.

5.4.2 Shipments

Approximately 1007 shipments were made from the NRTS. Inspection of the shipments was conducted on a non-routing basis. All outgoing shipments were inspected for compliance with regulations. Six incoming shipments were found to be in violation of regulations or had been damaged while in transit.

5.4.3 Waste Management

During the year, a supplement to the ID Manual Chapter 0500-7 was developed and published for the purpose of establishing policy and procedure and delegating responsibility for the discharge of waste at the NRTS.

5.4.3.1 Liquid Waste

During 1958, approximately 650,000,000 gallons of water containing an estimated 3,600 curies of radioactive isotopes were discharged to the environment. Approximately seventy-five percent of the radioactive material was of less than ten-day half-life.

A cooperative program continued with the U. S. Geological Survey for the purpose of determining the flow patterns and the rate of movement and dilution of discharge waste. Under this program two monitoring wells were completed near the Chemical Processing Plant (ICPP) during April and June, bringing the total to fifteen. Seven hundred and ninety-one water samples were collected from these wells during the year as part of our monitoring program.

A tracer study using fluorescein dye and a "slug" amount (10 tons) of common salt was initiated during October for the purpose of determining the rate of movement of the underground water. The dye was detected in four wells at distances up to 900 feet. A maximum rate of movement of approximately 100 feet per day was indicated. The salt was not detected in the monitoring wells, probably due to the fact that the amount which was introduced was insignificant in comparison to the amount which has been discharged routinely from the water softening process over the past years.

On December 9, 1958, an unidentified source at the CPP began discharging liquid waste at levels which averaged ten times the maximum permissible concentration for Strontium 90, in addition to other fission products. Traces of this material began to appear in the monitoring wells at a distance of 700 to 800 feet on December 15 which substantiated the flow rate as determined by the dye tracer.

Four hundred fifty-four water samples were collected from production wells on the NRTS and 225 from wells and springs located across the Snake River Plain south and west of the NRTS. Analysis did not reveal radioactive or chemical contamination as a result of operations of the NRTS.

5.4.3.2 Solid Waste

Approximately 9000 cubic yards of solid waste, containing approximately 10,000 curies of activity was disposed of in the NRTS burial ground.

The size of the burial ground was increased to 80 acres by the enclosure of an additional sixty-five acres. The operational cost of the burial ground was approximately $10,000, sixty-one percent of which was labor cost, thirty-seven percent equipment cost and two percent miscellaneous materials and services.

5.4.3.3 Atmospheric Waste Discharge

It is estimated that approximately 145,000 curies of gaseous and particulate material was released to the atmosphere during 1958 as a result of routine operations at the NRTS. Over seventy-five percent of the isotopes had a half-life of less than two hours.

5.4.4 Design Review

Approximately sixty sets of design drawings and specifications and project proposals were reviewed by the Branch and comments applied in regard to radiation protection requirements.

5.4.5 Emergency Monitoring

During the year, a plan was developed for handling nuclear emergencies under the National Radiological Assistance Plan, and eight planning and training meetings were conducted. Three of the sessions were field exercises. The plan of action was published in draft form. Response was made to two incidents, one in the vicinity of Grand Junction, Colorado, and the other near Roberts, Idaho. The Colorado incident occurred on June 20, 1958 when a truck carrying a shielded capsule of radium and beryllium used for well logging left the highway and slid into the Colorado River. The source was recovered intact without radioactive consequence. The Roberts, Idaho incident occurred on November 12, 1958, when an AEC truck skidded off the highway. Investigation revealed that radioactive material was not involved as previously reported.

5.5 FUTURE PROGRAMS

Tentative plans as applicable to the different phases of the work are as follows:

5.5.1 Environmental Monitoring

This phase of the work has become somewhat routine, which is cause for concern and reason for evaluation. It is possible that some techniques and procedures have outlived their usefulness and need to be improved, changed, or discontinued. It is the intent of the Branch to continue to improve methods, obtain better equipment, and discontinue procedures which fail to justify themselves.

5.5.2 Shipments

It is the goal of the Branch to prepare and issue a revision to the IDO Administrative Manual which will set forth responsibilities and procedures for the handling of radioactive shipments in a clear and concise manner. It is hoped that by so doing confusion and administrative procedures may be reduced. Regulations, standards, and procedures need to be unified throughout the industry, and it is the goal of the Branch to develop a greater degree of coordination with other sites in this respect.

5.5.3 Waste Management

Improvement and progress was made during 1958 in the management of the radioactive waste by the development of standards and regulations. Implementation and improvement in this work remain to be accomplished.

As the activities at the NRTS increase, the need for specific information in regard to underground hydrology and the movement of radioactive isotopes through the earth mantle also increases. Plans for 1959 include ten wells and further studies in the vicinity of the ICPP and, if possible, the initiation of a program in connection with the seepage pond at the MTR.

A considerable portion of the man-hours available to the Branch have been utilized in the routine management of solid waste. It is the intent to reduce this workload, if at all possible, by more efficient methods. While the cost of solid waste disposal at the NRTS compares very favorably with other installations,we believe that it is still excessive and studies are planned in an effort to make a further reduction.

5.5.4 Design Review

It is expected that this work will continue in direct proportion to the planning and design of new installations. This work supplements the inspection activities, and no changes are anticipated or recommended.

5.5.5 Emergency Assistance

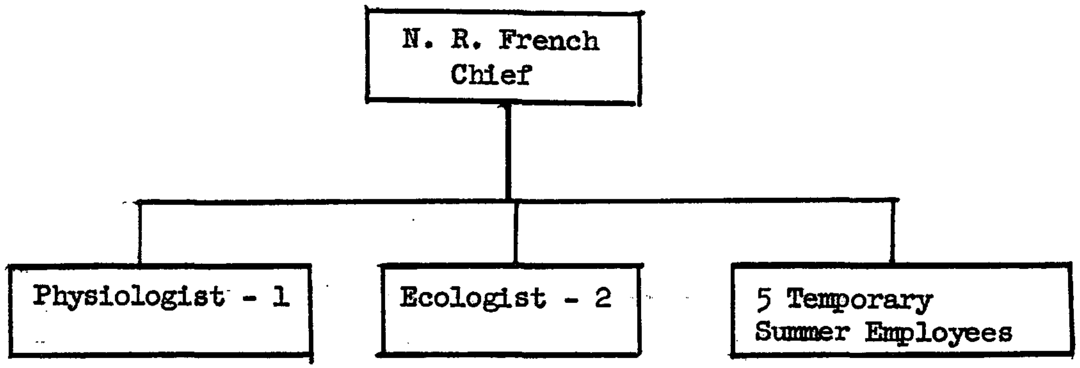
With the development of a plan and organization, it is felt that the main effort will be a matter of developing and maintaining efficiency through a training program. Of particular concern in this regard is the development of a capability for contingencies involving weapons.

5.5.6 In-Service Training.

Progress in the field of nucleonics is always ahead of the individual or group of individuals; therefore, the problem of keeping abreast through training will always be with us. It is the goal of the Branch to conduct and sponsor as much training as will be possible without interfering with responsibilities of the assigned workload.

TABLE OF ORGANIZATION

ECOLOGY BRANCH



CHAPTER 6

ECOLOGY

N. R. French, Branch Chief

6.1 GENERAL PROGRAM AND PURPOSES

The Ecology Branch program consists of two types of work: (1) environmental monitoring, (2) special studies.

The main purposes of the environmental monitoring program are: (1) to determine the presence, distribution, and concentration of radionuclides in the flora, fauna, and soils of the National Reactor Testing Station and adjacent areas, (2) to relate whenever possible the radioactive contamination to the responsible operation, and (3) to develop methods of estimating environmental contamination from scheduled operations and the meteorological regimes.

The purposes of the special studies are: (1) to determine the effects of radionuclides on plants, animals, and soil organisms and their subsequent ecological relationships, (2) to develop better methods of assessing the radioactive contamination present in the natural environs, (3) to develop methods of predicting the deposition, concentration and cycling of radionuclides through ecological environments and food chains.

Both the environmental monitoring and research programs were carried on in the laboratory and the field throughout the year. The environmental monitoring program was carried out mainly in conjunction with scheduled and nonscheduled releases from reactors, processing plants, and field tests. The research program utilized wherever and whenever possible the soils, plants, and animals in contaminated areas.

The magnitude and scope of the program are indicated by the data in Table 6.1 which contains the number of field samples collected and analyzed.

Table 6.1 Field Samples Collected and Analyzed in Support of NRTS Operations

Operation	Jack Rabbits	Dutch Rabbits	Vegetation	Soil	Milk	Cattle	Total
IET - I-2	229		210		229		668
IET-Boot	33		163		144		340
IET-incident	11		9				20
CPP-Rala	267		308		387		962
CPP-FECF	10		48	54			112
FPFRT	22	72	425	52	67		638
I^{131} Studies	55	62					117
Borax	7		20				27
Controls	77		26			40	143
TOTAL	711	134	1209	106	827	40	3027

6.2 SUMMARY OF MAJOR PROGRAMS

6.2.1 General Methods

6.2.1.1 Vegetation: Most of the vegetation samples were sagebrush leaves which are available throughout the year. Samples of grass and alfalfa were collected in conjunction with the monitoring of milk.

6.2.1.2 Animals: Jack rabbits were collected for all operations; small mammals were collected for the Fission Product Field Release Test (FPFRT-I). Organs and tissues of antelope, coyote, deer, and badger were collected offsite and onsite for other purposes than operational monitoring. These were either taken during the hunting season or were accidental road kills. Thyroids were obtained from nearly all the animals collected and analyzed for I-131. Muscle samples were analyzed for Cs-137. In some cases, kidney, heart, stomach contents, scalp, lung, and tracheae were analyzed for gross gamma activity. Bone samples were taken from a small per cent of the animals for Sr-90 analysis.

6.2.1.3 Soil: Surface and subsurface soil samples were collected on IDO Grid No. 3 for the FPFRT-I test and on the FECF grid. The samples were analyzed for gross gamma activity and gamma spectra were run on selected samples.

6.2.1.4 Milk: Creameries supplied samples of milk from individual farms. Some samples were obtained directly from farms. The detection level of I-131 when counting a 50 ml sample was 1 uuc/ml. In addition the Branch purchased two goats to be used as mobile iodine milk monitors.

6.2.1.5 Analyses: Gross gamma counts of all vegetation, animal, soil and milk samples were made in a well-type scintillation counter. Gamma spectra of some samples were made with a 256 channel analyzer.

6.2.1.6 Location: The presence of sagebrush and jack rabbits throughout onsite and offiste areas permitted great flexibility in arranging sampling arrays for various types of releases. For the Boot, FPFRT-I, and Fuel Element Cutting Facility (FECF) releases, fixed grids were used to obtain systematically located downwind sampling locations. In the above three operations samples were also collected at off-grid locations.

6.2.1.7 Time of Sampling: For determining the fallout or the deposition pattern of a single release or specific operation, background sagebrush leaves and jack rabbit thyroids were collected immediately before the release. Sagebrush samples were usually collected immediately after the release. Jack rabbit thyroids were usually collected 8-12 days after a release when the I-131 level was in equilibrium. Jack rabbit thyroids were collected periodically for the operations whose fallout was present throughout most of the year (Rala) or for an extended period of time (IET).

6.2.2 Operations

6.2.2.1 Initial Engine Test (IET) Insert II

The gross gamma activities of the offsite control sagebrush samples (Table 6.2) declined continuously during this test. The activities of the sage samples collected during and after a daily Insert II release are presented in Table 6.3. These samples were collected in areas having high air activity. The activity levels of sagebrush samples during the first 2 months of the Insert II tests was higher than the offsite control levels. Between February 22 and March 6 there was a significant increase in the activity of sage samples collected in areas of high air concentration. This increase was correlated with a subsequent increase in I-131 activity in jack rabbit thyroids collected in the same area.

During Insert II, the I-131 activity levels in the thyroids of offsite "control" rabbits from Taber (Table 6.4) declined steadily. The correlated rise and fall of I-131 activity in Insert II jack rabbit thyroids with Insert II operation is shown by the data presented in Table 6.5. An overall deposition pattern of the I-131 activity in jack rabbit thyroids for the entire operation is plotted in Figure 6.1. The curves and time periods show that as the operation proceeded, the deposition area for each level of activity increased.

Table 6.2 Gross Gamma Activity of Offsite (Taber) Sagebrush Samples for Insert-II Operation

Date	c/m/g	Date	c/m/g
10/17/57	360	2/11/58	59
			60
10/27/57	188		52
11/ 8/57	226	2/28/58	37
			38
1/ 2/58	104		45
	99		
	87	3/13/58	139
			86
1/16/58	71		39
	59		149
	67		169
1/29/58	81	3/20/58	50
	78		60
	73		67

Table 6.3 Gross Gamma Activity of Insert-II Sagebrush Samples.

COUNTED 24 HOURS AFTER

Date	Total No. of Samples Collected	Location of Highest From STACK. Direction	Distance (mi.)	Range in c/m/g Highest	Lowest
12/11/57	6	NE	2.0	184	100
23	4	NE	1.5	168	143
26	9	ENE	5.0	220	99
30	13			175	72
1/ 4/58	16			139	67
5	13	SW	1.8	122	62
7	13	SW	1.5	132	57
10	8	N	6.0	160	102
12	13	WSW	1.1	113	75
13	8	NE	6.0	159	73
14	9	N	6.0	135	74
19	28	NE	5.0	165	55
21	38	N	2.5	161	65
22	13	N	2.5	303	47
23	13	WSW	7.0	125	39
25	13	N	6.0	163	80
26	8	SW	2.0	94	57
1/29-30/58	9	N	6.0	147	62
2/ 8/58	16	SW	1.4	184	41
9	19	NW	2.5	104	50
13	7	NNE	5.5	114	59
15	6	SW	1.8	91	66
16	6			89	53
19	6	SSW	1.7	106	56
20	8	SW	1.7	98	56
22	22	WSW	1.1	266	55
23	12	S	2.0	189	71
24	30	N	6.5	419	94
25	10	ENE	4.5	940	213
3/ 2/58	6	S	1.5	295	140
3	2	ESE	2.0	705	135
4	2			154	120
5	6	NNE	5.0	485	126
6	1			538	

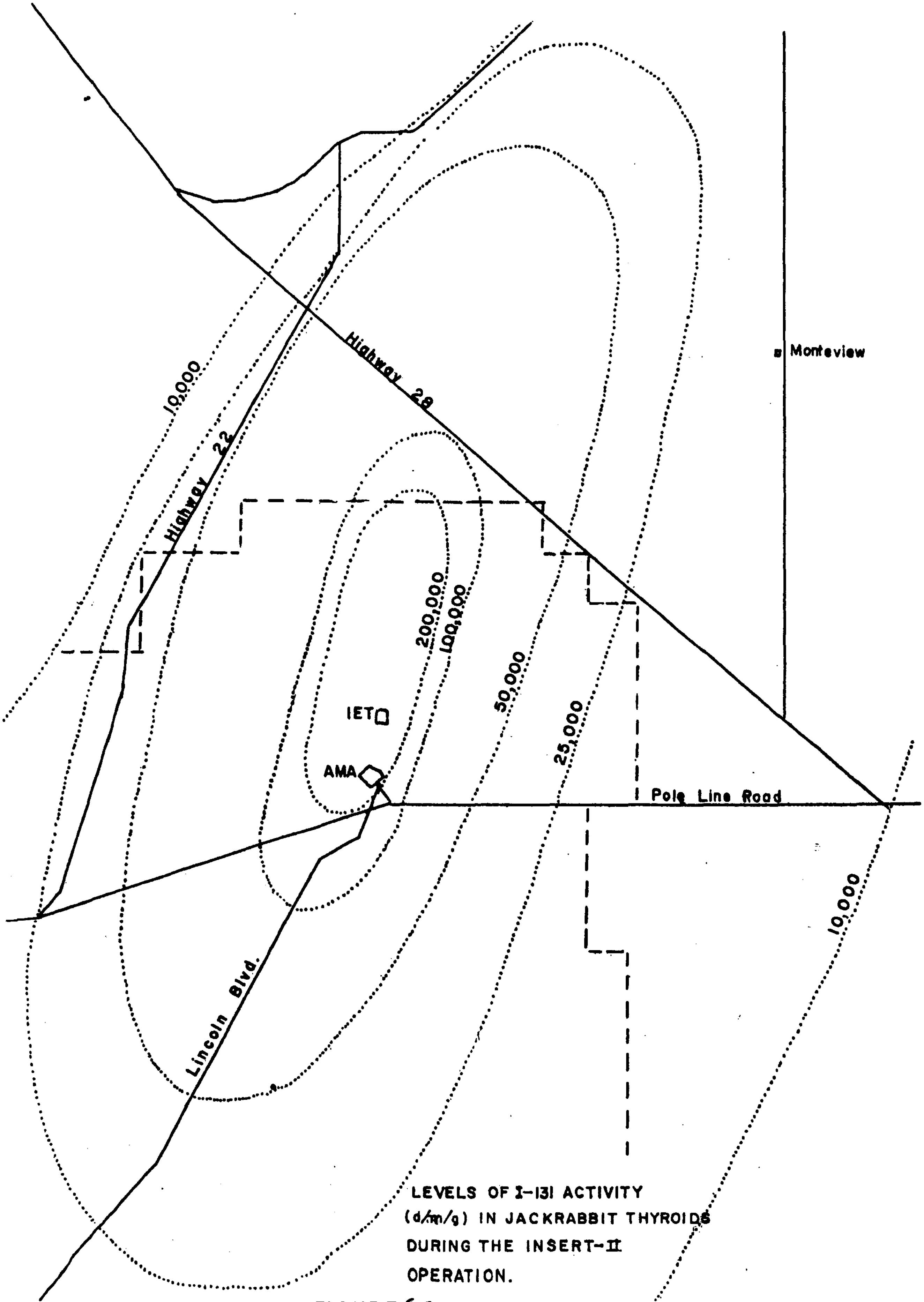
Table 6.4 I-131 Activity Levels in Jack Rabbit Thyroids Collected at Offsite Control Locations, During 1958

Date	Number	Location	Mean	Highest
11/20/57	3	Taber	1,489	2,222
1/ 2/58	3	"	1,398	2,587
1/16/58	3	"	1,708	2,331
1/29/58	3	"	1,828	2,789
2/11/58	3	"	889	1,337
2/21/58	4	"	533	764
2/28/58	3	"	431	597
3/ 5/58	3	"	349	549
3/13/58	3	"	2,967	3,419
3/20/58	3	"	2,956	3,596
3/21/58	3	"	10,840	11,568
4/ 9/58	3	"	16,469	34,317
4/23/58	3	Arco	4,201	10,239
5/ 2/58	3	Blackfoot	433	1,054
5/ 9/58	3	Taber	699	1,646
6/ 5/58	3	"	4,766	7,310
6/20/58	3	"	2,929	5,077
6/27/58	3	"	2,822	4,883
8/ 6/58	3	"	3,461	4,590
8/21/58	3	"	3,302	5,382
9/ 4/58	3	"	1,039	1,486
10/ 1/58	3	"	204	336
10/20/58	3	"	10,134	13,003
10/28/58	3	"	12,231	16,252
12/ 3/58	3	"	1,788	2,195
12/31/58	1	"		200

Table 6.5 I-131 Activity in the Thyroids of Jack Rabbits Collected in the IET Deposition Area.

Collection Date	Number of Animals	Activity in d/m/g of Thyroid of Animals Collected on Indicated Dates		
		Average	Lowest	Highest
11/26/57	12	3,333	735	8,520
12/11/57 12/23/57	8	1,210	325	2,452
1/4/58	6	1,238	625	2,523
1/15/58	3	908	282	1,386
1/22/58	11	1,613	203	2,780
1/27/58	14	3,096	252	12,714
1/30/58	8	14,995	2,672	35,231
2/3/58	17	5,063	492	18,731
2/6/58	14	5,295	1,078	15,028
2/10/58	8	5,180	693	9,162
2/17/58	11	17,087	7,463	29,745
2/24/58	9	39,772	3,287	105,910
2/26/58	15	16,211	3,063	49,644
3/6/58	11	83,959	20,714	242,960
3/17/58	13	88,839	20,450	293,700
3/21/58	15	49,084	11,330	136,816
3/24/58	26	18,764	3,192	81,998
4/10/58	12	23,789	6,779	91,751
4/22/58	5	5,468	1,199	10,868
4/23/58	11	8,473	1,973	18,251

TOTAL..229



LEVELS OF I-131 ACTIVITY (d/m/g) IN JACKRABBIT THYROIDS DURING THE INSERT-II OPERATION.

FIGURE 6.1

Samples were obtained from 31 farms in the IET fallout area between December 27, 1957 and March 31, 1958. Of the 229 samples, only 2 had detectable I-131 activity. These were well below the maximum permissible level for I-131 in water, a value which we use as a guide for milk, or 3 X 10^{-5} uc/ml.

6.2.2.2 IET Boot Test

Pre-release and post-release samples of sagebrush, jack rabbit thyroids, and milk were collected onsite on IDO Grid No. 4 and offsite along Highway 28, and in the Monteview area. Green and dry grass and alfalfa samples were also collected. Samples of milk were obtained from two goats which were pastured in the fallout area before and after the release.

The activity deposited on sagebrush from the Boot release was below the detectable limits of the sampling method employed.

Green grass and alfalfa samples were collected because of the low surface contamination on new growth, their availability in the agricultural areas, and the possibility of establishing a relationship between the depositions on sagebrush and on pasture vegetation. The activity varied from 4 to 90 counts per minute per gram. The activity of alfalfa samples in the deposition area, 3.5 to 5.5 miles west of Monteview was slightly higher than the activity of samples adjacent to this area.

The highest jack rabbit thyroid activity was over 18,000 d/m/g. Thyroid activity decreased with distance from the source.

I-131 activity was not detected in any of the 86 samples of cows' milk collected in an arc from Terreton, Monteview, Reno Ranch to Howe. At a location approximately eight miles from the source, I-131 activity was detected in the May 4th and 5th milk of one goat. The other animal refused to eat at the time.

6.2.2.3 November 18 Incident at ANP: The analysis of the gamma spectra of the sagebrush samples collected 1 mile SW of IET gave the following activity in d/m/g. I-133 - 8.1×10^4, I-131 - 1.5×10^4. The activity in a jack rabbit thyroid from the same location was 2.2×10^5 d/m/g. Assuming a ratio of 1:4 for I-131:I-133, the dose to a rabbit thyroid was about 5 rads. No activity was detected in milk samples collected November 24 from 2 farms in the Howe area, 15 miles WSW of IET.

6.2.2.4 ICPP Rala Releases: The dates of the Rala releases (acid drops) are listed in Table 6.6. I-131 is released from the CPP stack at other times than the period of the "acid drop". In the Rala monitoring program jack rabbit thyroid I-131 activity and sagebrush gross gamma activity were used to obtain estimates of the activity deposited in an area during a specific release and the overall deposition area for the Rala releases.

Table 6.6 I-131 Activity Levels in the Thyroids of Jack Rabbits Collected for the Monitoring of the Rala Operations

Mean I-131 Activity (x 10^3 d/m/g) in the Thyroids of Jack Rabbits Collected on Indicated Date and in Indicated Downwind Direction and Distance from CPP.

Dates		NE				SW			
Release	Collection date	1.0 Miles	2.0 Miles	4.0 Miles	8.0 Miles	1.0 Miles	2.0 Miles	4.0 Miles	8.0 Miles
11/27/57	1/3/57			5					
1/6/58	1/17/58							48	
	1/29/58							27	
	2/11/58	35	37	17		56	7	10	
2/12/58	2/19/58	167	140	29	14				
	2/21/58					39	47	21	18
	3/4/58	107	66	29	18	114	208		
	3/10/58							53	
3/13/58	3/26/58	334	248	69		709	246	93	92
	4/1/58					474		51	
	4/16/58	154	13	50					
4/16/58	4/30/58	245	18			83	16	12	
4/30/58	5/28/58	279	189	17		113	25	32	
5/28 & 6/12	6/6/58	534	81	148					
	8/4/58	8	6	1		10	4	5	
8/6 & 8/13	8/22/58	41				12			
9/18/58	9/30/58	22	6	4		3	4	2	
	10/7/58					12	11	4	
	10/8/58		20			68	22	6	
10/12/58	10/21/58	34	21	11		36	25	12	
10/22 & 23	10/23/58			15				20	
	10/27/58			26				122	
	10/29/58			35				115	
	10/31/58			31				101	

Table 6.6 gives the dates of Rala releases and the I-131 activity levels in jack rabbit thyroids before and after each release. Rabbits collected on the same date as the release were collected before the release, except on October 23 when thyroids were obtained 6 and 12 hours after the two releases of October 22 and 23. The data in Table 6.6 show the buildup and decline of I-131 levels in relation to the dates of the Rala releases. In general, the highest activity was obtained one to three miles from the stack. Thyroids collected NW and SE of CPP also displayed the same I-131 activity level gradients with distances from source. In the NW and SE sectors at similar distances the activity levels were not as high as in the NE and SW sectors.

The March 13 release was sampled in all 4 sectors and gave isodose lines following an elliptical pattern. On March 13, because of high levels 8 miles SW of CPP, thyroids were collected 16, 20, and 25 miles SW of CPP. The mean activity at 16 and 20 miles were respectively 1.4×10^5 and 9.3×10^4 d/m/g. The 25 mile sampling line extended from 180 through 220 degrees. The mean activity for 13 thyroids was 5.1×10^3.

During the May 28 release, aircraft monitoring detected gamma activity in the vicinity of Mud Lake, 25 miles NE of CPP. On June 9, thyroids were obtained from jack rabbits collected along a 20 mile sampling line from ANP to a point 9 miles east of Mud Lake. The highest I-131 activity was observed in thyroids from Circular Butte (9150 d/m/g) and Mud Lake (10,900 d/m/g). The I-131 activity decreased westward from Circular Butte and eastward from Mud Lake.

Offsite "control" rabbits were collected at Taber (20 miles SSE of CPP) 24 times during the year, once at Arco (20 miles W of CPP) and once at Blackfoot (35 miles SE of CPP). I-131 levels at the three offsite locations were utilized as controls for onsite operations. However, the data in Tables 6.6 and 6.4 indicate that the rise and fall of the I-131 activity in Taber thyroids coincided with the rise and fall of the I-131 activity in onsite thyroids. The increased I-131 activity in October is attributed to weapons test fallout. From the comparatively low levels of activity in Taber thyroids during the year, it may be concluded that very little of the onsite I-131 activity in thyroids, except during October, resulted from offsite sources.

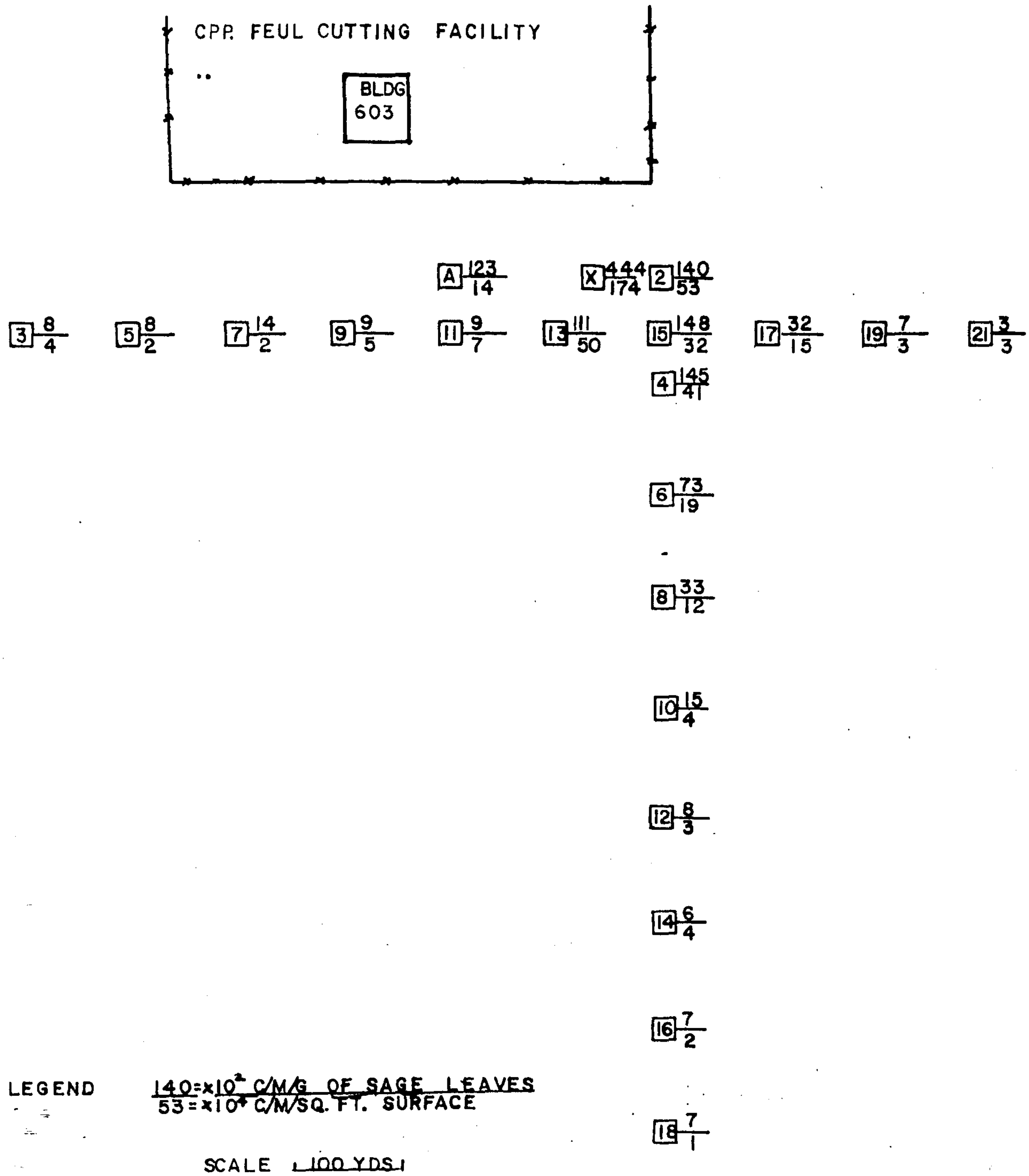
Sagebrush samples were collected along downwind sampling lines before and after a number of Rala releases. The increased activity of post-release samples over pre-release samples was taken as a measure of the activity deposited by the particular release. In a few releases thus monitored, the gross gamma activity deposited was observed at locations and distances in agreement with meteorological conditions during the release.

The gross gamma activity of green grass samples from pastures in the Mud Lake area (Rala - May 28) exceeded slightly the background levels.

I-131 activity was detected in 14 of 32 milk samples collected from farms in the Mud Lake area (Rala - May 28). None of the activity levels exceeded the MPC for milk (3300 d/m/50 ml). This figure is based upon the MPC for water. I-131 activity was not detected in any of the other offsite Rala monitoring milk samples.

6.2.2.5 Fuel Element Cutting Facility Incident

During the evening of October 29-30, fission products were released to the atmosphere from the Fuel Element Cutting Facility. During the release the wind direction was mainly from the NW. A permanent sampling grid consisting of 2 sampling lines E-W and N-S was laid out south of the CPP fence (Figure 6.2). The gross gamma activities of the sage and soil samples collected at 21 of the 50 stations are shown in Figure 6.2 and indicate that the major fallout was within a 1/4 mile of Building 603. Gamma spectra of sagebrush samples indicated that about 90% of the activity was due to Ce-144, 5% to Zr-Nb-95, 5% to Cs-137. Gamma spectra of jack rabbit muscle, stomach and colon contents showed the presence of Cs-134 and Ru-103, in addition to the above. Thyroid I-131 and muscle Cs-137 in jack rabbits collected in the FECF fallout area are



GROSS GAMMA ACTIVITIES OF SAGE AND SOIL SAMPLES COLLECTED ON THE F.C.F. GRID, DECEMBER, 1958.

FIGURE 6.2

presented in Table 6.7. The high I-131 activity on November 3 is attributable to the Rala release on October 23. The decline of Cs-137 activity with time suggests that Cs-137 activity on the vegetation was being removed by rain, snow or wind. Gamma spectra of rabbit furs were similar to the spectra of GI tracts, suggesting that the fur may be an important source of ingested nuclides.

No gamma activity was detected in the leachates from treating undisturbed soil cores (1-3/4" diameter x 2-1/2" long) with 50 ml of H_2O or 0.1 NHCl. About 5-10% of the activity on sagebrush was soluble in distilled water and 40% was soluble in 0.1 NHCl.

Further Ecological studies of animals and plants on the FECF grid are planned.

6.2.2.6 Fission Product Field Release Test (FPFRT-I)

Samples of the natural vegetation were collected at stations along the 100, 200, 400 meter arcs before and after 7 of the 9 releases and the activity levels were graphically plotted.

During release No. 7, 46 flats of wheat and rye seedlings were exposed on the 200 and 400 meter arcs. Significant differences between the deposition on sage, wheat, and rye were not obtained.

Table 6.7 Thyroid I-131 and Muscle Cs-137 Activities in Jack rabbits From the Fuel Element Cutting Facility Grid

Date	d/m/g/	
	I-131 (thyroid)	Cs-137 (muscle)
11/3/58	122,789 ± 1,632	
	126,283 ± 1,483	
12/18/58	7,772 ± 495	747 ± 7
	21,799 ± 561	473 ± 7
12/30/58	4,695 ± 277	193 ± 3
1/14/59	972 ± 222	47 ± 2
	2,038 ± 263	45 ± 7
1/23/59	2,261 ± 337	37 ± 3
	1,787 ± 248	25 ± 2

The heads and ears of Dutch Rabbits in restraining cages were exposed to releases 1, 2, and 3. During each release two animals were kept in the collection vehicle for controls. Gamma spectra of scalp, ears, lungs and trachea indicated that Cs-137 was the major contributor to both external and internal contamination. No consistent relationship could be found between the external and internal contamination of the same animal.

Three species of small mammals were trapped on October 2 at stations on the 200 and 400 meter arcs. Thyroid I-131, muscle Cs-137, and GI tract gross gamma activities are presented in Table 6.8. Organ activity levels appeared to be roughly proportional to the size of each species. The locations of the animals with detectable levels of activity in one or more organs were in agreement with the deposition patterns of the FPFRT-I releases. For future studies of the effect of the residual contamination on the IDO Grid No. 3 on small mammal populations, a permanent trapping grid was staked-out in an area bounded by the 200 and 400 meter arcs and the 30 and 60 degree stations.

The I-131 activity in the thyroids and the Cs-137 activity in the muscle was determined in animals collected on IDO Grid No. 3 from August 1 to December 3. The highest thyroid I-131 activity ever observed in NRTS jack rabbits was observed in two

Table 6.8 Radionuclide Activity in the Organs of Three Species of Small Mammals Collected on IDO Grid No.3 on October 2, 1958

Dipodomys (Kangaroo Rat)

Location Arc-Sta	I-131 d/m/g Thyroid	Cs-137 d/m/g Muscle	Gross Gamma c/m/g G. I. Tract
200-5	2,500	120	190
200-13	13,450	220	470
200-17	3,150	100	80
200-27	3,960	0	140
200-33	1,550	0	0
200-53	270	0	0
200-55	180	0	0
200-59	620	0	0

Eutamias (Chipmunk)

Location Arc-Sta	I-131 d/m/g Thyroid	Cs-137 d/m/g Muscle	Gross Gamma c/m/g G. I. Tract
200-43	2,480	0	230
400-7	3,460	120	320
400-25	120	0	0
400-41	620	0	0
400-53	0	0	0

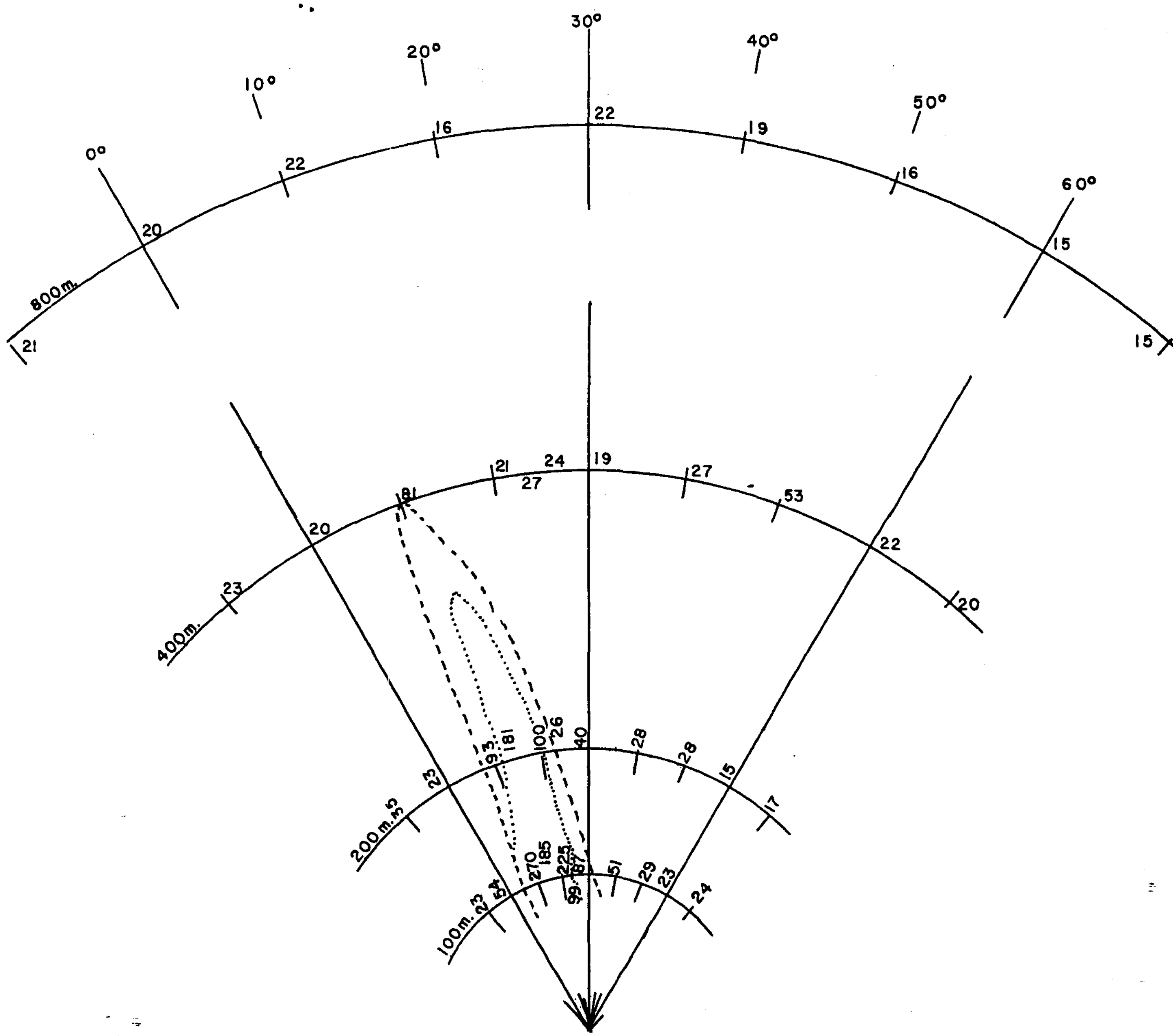
Peromyscus (Deer Mouse)

Location Arc-Sta.	I-131 d/m/g Thyroid	Cs-137 d/m/g Muscle	Gross Gamma c/m/g G. I. Tract
200-1	230	0	260
200-25	140	0	0
200-29	170	0	0
200-39	0	0	0
400-9	150	80	120
400-13	330	0	220
400-17	0	0	0
400-21	1,160	0	0
400-23	90	0	0
400-37	0	0	0
400-55	0	0	0
400-57	0	0	0

animals collected on September 10. Their mean I-131 activity was 7.7×10^6 d/m/g. Cs-137 activity was detected only in jack rabbits collected within 400 meters of the release point. Animals with high thyroid I-131 activity also had detectable muscle I-131 activity. The two types of muscle activity were measured and distinguished with the RCL 256 channel analyzer.

The residual soil contamination on IDO Grid No. 3 from FPFRT releases was assessed from samples collected on October 15, 17, and 27. The gross gamma activities per square foot of surface soil at stations on the first 4 arcs are shown in Figure 6.3. The gamma spectra of a selected group of soil samples are presented in Table 6.9.

Milk samples were obtained from farms in the downwind path of releases. As predicted, no detectable activity was observed in any of the samples.



RESIDUAL SOIL CONTAMINATION

IDO GRID No. 3, OCTOBER, 1958, FROM FPFRT-I.

(Gross gamma activities in 10^3 c/m/sq.ft. of surface soil)

FIGURE 6.3

Table 6.9 Gamma Activities of Five Nuclides in Soil Samples from IDO Grid #3, Collected October 15 and 17, Analyzed October 27 and 30.

Location	Gamma Activity per ft^2 ($x\ 10^5$ d/m) of indicated Nuclide and Sample				
Arc-Sta.	Ce	I-131	Ru-103	Cs-137	Mn-54
100-1		0.62	1.00	8.37	
100-10			8.00	8.24	20.90
100-30		1.81	2.70	6.60	2.03
100-60			0.08	2.59	
200-350°				2.5	
200-10		4.13	47.54		89.08
200-30	6.95		0.92	2.41	1.01
200-40	4.30	0.04	0.03	1.41	1.03
400-10		1.94	6.43		10.94

6.3 SPECIAL PROJECTS

6.3.1 Improved Techniques for Environmental Monitoring

6.3.1.1 Methods of Small Mammal Population Analysis:

Four different grid arrangements for live trapping small mammals were compared for purposes of estimating the small mammal population. The objective was to determine the best method to be used in long term population studies of small mammals in contaminated areas. Four grid arrangements were established incorporating different grid size, trap density, trap numbers, and trapping time. The capture-mark-recapture method was used. The resulting population estimates were compared statistically and data were plotted graphically with respect to total numbers and number retrapped by method, species, and time. The results indicate that a grid of 225 traps spaced ten meters apart and activated for three successive nights gives a fairly good population estimate.

6.3.1.2 Methods of Plant Community Analysis:

In an area of approximately five acres with uniform vegetation cover a comparison was made between three methods of analyzing the plant community. The three methods were: (1) a square guadrat 5 meters on a side, (2) a rectangular quadrat 1 meter by 25 meters, and (3) two 50 foot line transects with 20 subplots 0.3 by 1 meter. Ten square quadrats, ten rectangular quadrats, and thirty line transects were established at random in the five acre area. Density, frequency and coverage of the plant species were determined in each sample. The results obtained by the three methods were compared by the analysis of variance method. The methods were found to give comparable results with the exception of the data on frequency. The methods were paired and compared by means of the "t" test, which indicated the line transect method was different from the other two. An examination of the data provided the explanation that in the use of smaller plots, the resulting frequency figures were shifted to a different region of the scale, giving different numbers that were being compared, though these numbers were perfectly valid when compared to figures gathered by the same method. The general conclusion is that the three methods provide equally valid results in the community where they were applied. The line transect and sub-plot method, being the easiest and most rapid method, is therefore chosen as the standard procedure.

6.3.1.3 Methods of Sampling Sagebrush

The objective of this study was to determine the factors affecting the variability of the gross gamma activity of sagebrush samples collected at the same location or station. The following factors were studied: (1) leaf: stem ratio (2) moisture content (3) floral development (4) upwind or downwind side of plant. Sagebrush samples for the above comparisons were collected during August on the IDO Grid No. 3 and had been exposed to FPFRT-I releases. The amount of activity deposited on sagebrush appeared to be a function of the exposed surface area. The exposed surface area is not always proportional to fresh or dry weight. Because of their lower surface: weight ratio than leaves per unit weight, stems contained less activity per unit weight than leaves. Samples from the upwind side of plants contained about 25 per cent more activity than samples from the downwind side of plants. The variation in activity between samples did not decrease when the activity was calculated on a dry weight basis. Evidence was obtained that leafy sagebrush twigs with flowers and flower buds had less activity per unit weight than twigs having only leaves.

6.3.1.4 Jack Rabbit Biology

Home range or feeding area of a jack rabbit: This study was initiated in 1956 to determine the feeding area of a jack rabbit and therefore the area affecting the I-131 activity level in its thyroid. To date, 547 have been tagged, 55 were recaptured, and 126 were shot. With one exception, all tagged animals were retaken within 1/2 mile of the point of original capture. The exceptional rabbit tagged in 1958 near NRF was retrapped by a farmer at Taber, 35 miles from the point of the original capture. In 1958, 156 jack rabbits were tagged.

6.3.2 Long Range Ecological Studies

6.3.2.1 Plant Ecology:

Approximately twenty new permanent vegetation study plots were added to the 150 previously established plots. Coverage, density and frequency data were gathered by line intercept and quadrat methods. The new plots were located near the following installations: EBR II, TREAT, SPERT III, and SL-1 (ALPR).

6.3.2.2 Soil:

Soil monoliths (samples of the complete soil profile) were collected in eight different soil types. From each of the locations samples of each horizon were collected for physical and chemical analysis. Volume weight determinations were made on 84 samples.

6.3.2.3 Radionuclides in Native Vegetation:

A total of 71 vegetation samples from different species of plants and various locations were submitted for analysis on the RCL 256 channel analyzer. Quantitative estimates of the major contributors to gamma activity will be compared, as far as possible, with background vegetation data collected in 1950. These results will remain on file for future comparison.

6.3.3 Jack Rabbit Metabolism Studies

Investigations of iodine metabolism in jack rabbits were conducted for approximately one month beginning mid-August. The objectives were to repeat previous experiments for verification of results and to determine seasonal variation in thyroid function. The experiments were designed to show: (1) how much of the ingested iodine reaches the thyroid, (2) the effective half life of iodine in the tyroid, (3) the shape of a curve representing the changes in activity in jack rabbit thyroids resulting from deposition of radioactive iodine on the food supply.

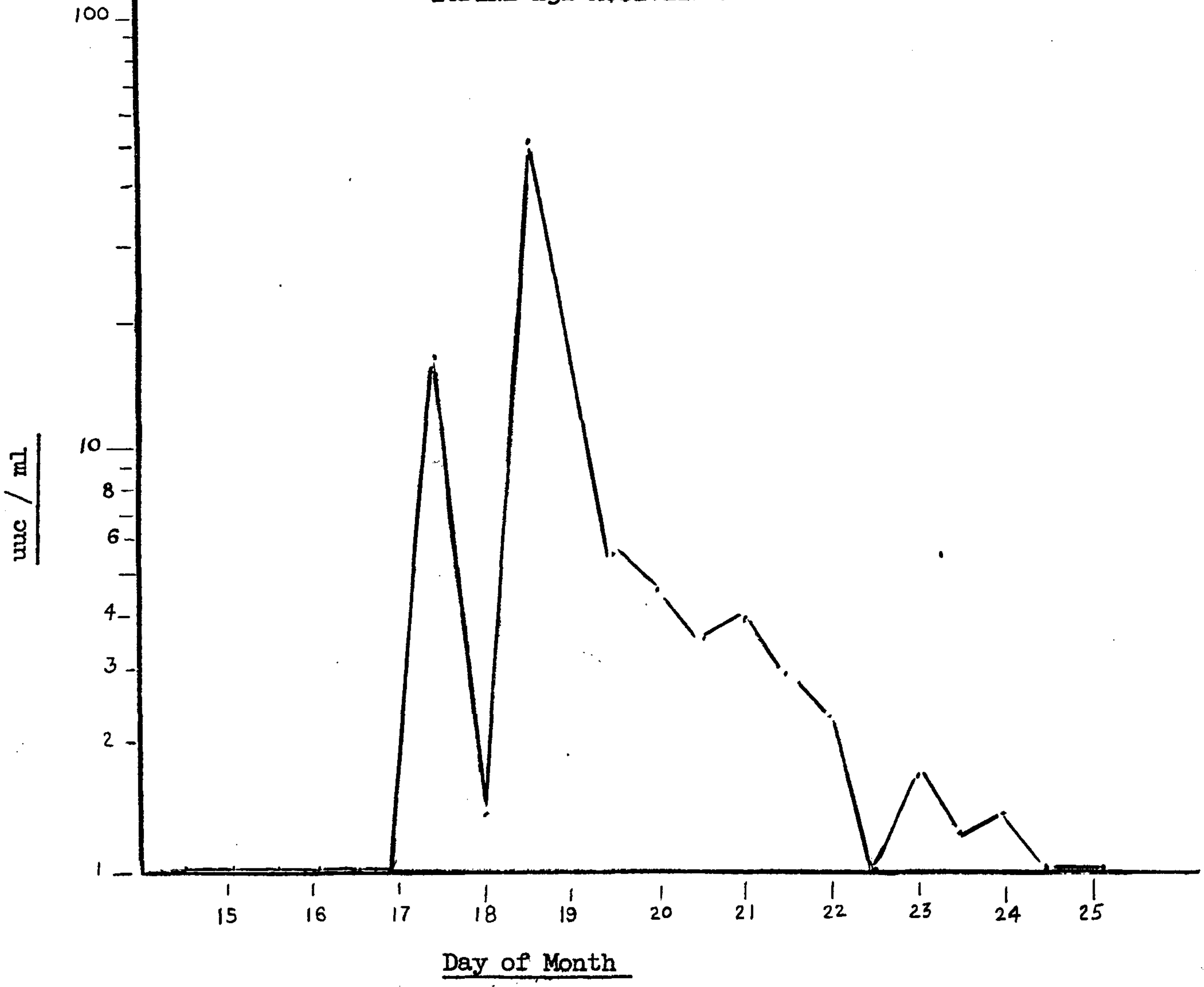
Fifty-seven Dutch rabbits were provided with feed that had been contaminated with radioactive iodine. Two were sacrificed daily to determine activity in the thyroids. Five Dutch rabbits were provided with a singal oral dose of radioactive iodine and each was counted daily in the in vivo counter. One hundred forty-one jack rabbits were trapped in the field, fed a known dose of radioiodine, marked and released. Fifty-five of these were recaptured and their thyroids examined for radioiodine content.

The results indicate that there is a decided seasonal difference of thyroid activity in rabbits. In summer the jack rabbit thyroid receives 15% of the ingested iodine, in winter almost 30% goes to the gland. The effective half life of I-131 in the thyroid is approximately 2.5 days in summer and probably less than 2 days in winter. There were similar differences, though slight, for Dutch rabbits kept at warmer or cooler temperatures. The results also enabled the comparison of buildup and decay of thyroid activity from contaminated feed with the theoretical derived curve of this situation, a comparison that was very favorable.

6.3.4 Special Studies

1. The relationship between the I-131 activities of pasture grass and goat's milk: Two goats having no detectable I-131 activity in their milk were pastured for 6 hours per day for 2 consecutive days, April 17 and 18, in an area 1 mile NE of CPP in which the I-131 activity of the green grass was 1×10^{-4} uc/g. The mean I-131 activity in the milk of the two goats at the end of the second day of pasturing was 4.0×10^{-5} uc/ml. The increase and decline of the I-131 activity in the milk of one goat is shown in Figure 6.4. The detection limit of the analysis was 1.5×10^{-6} uc/ml. This result suggests that low levels of I-131 on pasture grass could be readily detected in goat's milk and that goats might be used to monitor pasture areas for I-131.

FIGURE 6.4
APRIL 1958
IODINE-131 ACTIVITY IN GOAT MILK



6.4 Routine Operations

6.4.1 Noxious Weed Control

During 1958 a total of 2425 acres was plowed and reseeded to Crested Wheatgrass according to Bureau of Land Management specifications. This brings to 3420 acres the amount of NRTS land that has been treated in this manner in an effort to check the spread of Halogeton. The work was conducted in the south and southeast portions of the site, where scattered small infestations of the weed occur.

Further attempts to check the spread of the weed by spraying were conducted by four men from the labor pool, under Ecology Branch direction, who sprayed isolated patches of Halogeton with 2, 4-D over a six week period during the spring and early summer, the time most favorable for killing the weed with this herbicide.

In the fall of the year a test was made of a new herbicide which may be effective against Halogeton. The active ingredient is trichlorobenzoic acid. Thirteen plots of Halogeton were selected for the test and five as controls. The test plots were sprayed at the rate of approximately 4 lbs/acre. A total of approximately 25 acres was treated. All plots were photographed from a marked position.

6.4.2 Predatory Animal Control

Personnel of Predator and Rodent Control Agency, U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, established trap lines on the site for coyote control. Eleven coyotes and eight bobcats were collected. They continued the use of winter poison bait stations, as in previous years.

6.5 FUTURE PROGRAMS

6.5.1 Extension of iodine uptake studies:

We believe the empirical expression for iodine uptake derived for jack rabbits can be applied to other native animals and to other isotopes in these organisms, once the appropriate factors for fractional uptake of the ingested dose and effective half-life are determined. It is proposed to test these hypotheses on small native mammals, starting with the kangaroo rat.

6.5.2 Source of internal contamination in animals:

A strong similarity has been noted between gamma scans of fur and GI tract of animals collected in contaminated areas. This suggests licking of the fur as a source of ingested isotopes. Food versus fur will be evaluated as to their contribution to internal emitters in jack rabbits.

6.5.3 Small mammal populations

Studies of seasonal and annual fluctuations of the native small mammal population in contaminated and uncontaminated areas will be initiated. This will be accomplished by the trap-mark-recapture method. If possible, this will be accompanied by observation of the growth of confined populations of native animals in the laboratory under conditions of contamination and no contamination.

6.5.4 Ecotones

New vegetation plots in the field will be established with particular emphasis on ecotones, the zones of transition between two distinct vegetation types. Because some plants characteristic of both adjacent vegetation types occur in the ecotone, and exist there under conditions that are less than optimum for the species, it is possible that effects of radioactive contamination may first be expressed where these organisms are already living under conditions of stress.

6.5.5 Effect of Radionuclides on Plants

Different species and different biotypes of plants may have different responses to various nuclides. Knowledge of their absorption, retention, and elimination is important for an understanding of the hazard to animals. The interactions between radionuclides and plants will be studied in the plant growth room and in the field. Nuclides will be applied indirectly through the soil and directly by dipping, spraying, and injection. Additional information will be obtained in contaminated areas. The behavior of nuclides in plants and the plant responses will provide information on where to base control measures for the protection of man and animals.

6.5.6 Cytogenetic effects of radionuclides in plants

High levels of external radiation induce mutations and chromosomal rearrangement in plants. Small amounts of radionuclides in the nucleus and cytoplasm of plant cells give equally high doses to the contents of the cells. These induced cytogenetic changes result in the production of new genotypes which may be more or less adapted to the environment and ecological niches than existing types. Changes in plant populations may occur. Information is needed on how internal nuclides affect the inheritance mechanism of plants. This information will be obtained by furnishing radionuclides to plants and observing cytogenetic changes directly in the chromosomes and indirectly from the appearance of mutations and the genetics of plant populations.

6.6 Talks and Publications

Papers

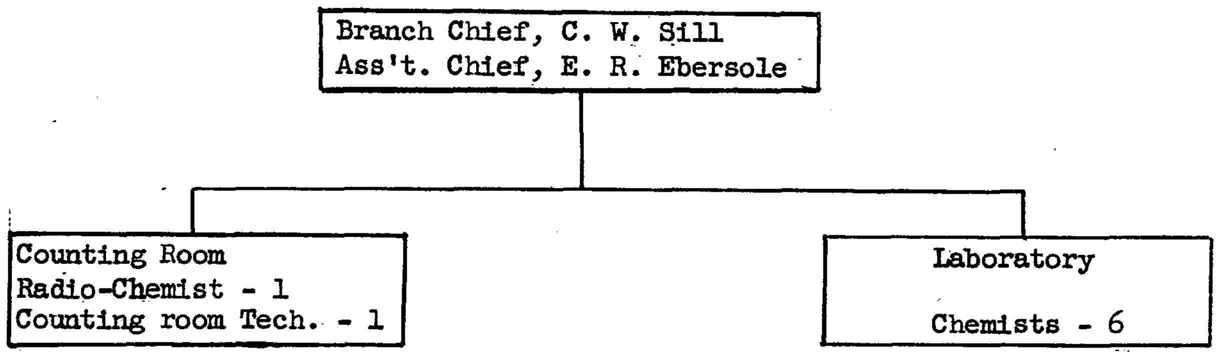
N. R. French and Van Middlesworth, L. "Biological Monitoring of Recent Air Borne Fission Products." Proceedings, Second United

Nations International Conference on Peaceful Uses of Atomic Energy, Paper No. 2497.

N. R. French, "Iodine Uptake in Jack Rabbits." An application of Radiation Ecology presented at the annual meeting of American Association for the Advancement of Science, Washington, D. C., December, 1958.

TABLE OF ORGANIZATION

ANALYSIS BRANCH



CHAPTER 7

ANALYSIS

C. W. Sill, Branch Chief

7.1 GENERAL

The Analysis Branch maintains and operates a general purpose analytical laboratory from which all AEC and contractor personnel at the NRTS may obtain analyses for any chemical or radioactive material that may be required. Generally, the analyses are concerned with materials that relate to the general health and welfare of personnel working at the NRTS and those living in the neighboring vicinity. The principal effort is directed toward detection of toxic materials in urine, air, water, soil, vegetation or other materials taken internally by humans, either directly or indirectly. Analytical problems not related to personnel protection or environmental contamination are accepted as the workload of the Branch permits.

The Branch provides urinalyses of all personnel on the NRTS routinely at intervals determined by the Chief Health Physicist of the requesting establishment. To determine if radioisotopes of any kind have been taken into the body, the samples are analyzed for gross beta activity and for gross gamma to detect iodine. If activity is found, the isotope or isotopes are identified and an estimation of the body burden and of the dose to the critical organ is made. Analyses for specific isotopes such as Pu-239, Sr-90, I-131, etc., in body excretia, water, and air samples are available at the request of the contractor.

Samples of potable water from every reactor area on the NRTS and from 33 wells off-site in an arc down gradient from the NRTS are monitored for gross alpha and gross beta activity. Milk supplies in the area bordering the site are continuously monitored for iodine accumulation. Low-level effluent waters from the reactor areas are analyzed for long-lived fission products, specifically for Sr-90, before being released to the environment. Many analyses are also performed for the Ecology program including I-131 and Sr-90 determinations on rabbits, soil and vegetation in addition to general work involving gamma spectrometry.

Because chemically toxic materials can be as hazardous as the radioactive ones, the Branch makes analyses for materials related to good industrial hygiene practices such as beryllium, lead, mercury, arsenic, fluorine, etc., or any other that may be required.

Professional consultation or assistance in the development or evaluation of analytical procedures, sampling methods, or on any problems related to chemistry and radiochemistry are available. The Analysis Branch makes every effort to keep abreast of modern developments in the field of analytical chemistry so that problems can be solved quickly and accurately as they arise. In addition to a small, but highly skilled, staff of professional chemists, the Branch employs the very latest procedures and techniques available. Chemical reagents and written procedures described in the current literature are kept on hand ready for instant use.

7.2 SUMMARY OF MAJOR PROGRAMS

A 256-channel gamma spectrometer was obtained during the year and considerable experience has been gained in its use. The instrument is used in conjunction with a 3" X 3" sodium iodide (Tl) crystal in a large shield constructed of low-background armorplate steel designed and built in cooperation with the Instruments Branch. (Fig. 7.1) The multi-channel analyzer is also used with a Frisch grid chamber to obtain energy spectra of alpha-emitting isotopes.

Considerable progress has been made in improvement of existing analytical procedures and in the development of new ones. For example, a fluorometric procedure has been devised for the determination of submicrogram quantities of beryllium that uses the same reagent, morin, that has been used for many years by others. However, the present modifications result in greatly enhanced sensitivity, precision and, particularly, reliability in comparison to existing procedures. The method has a detection

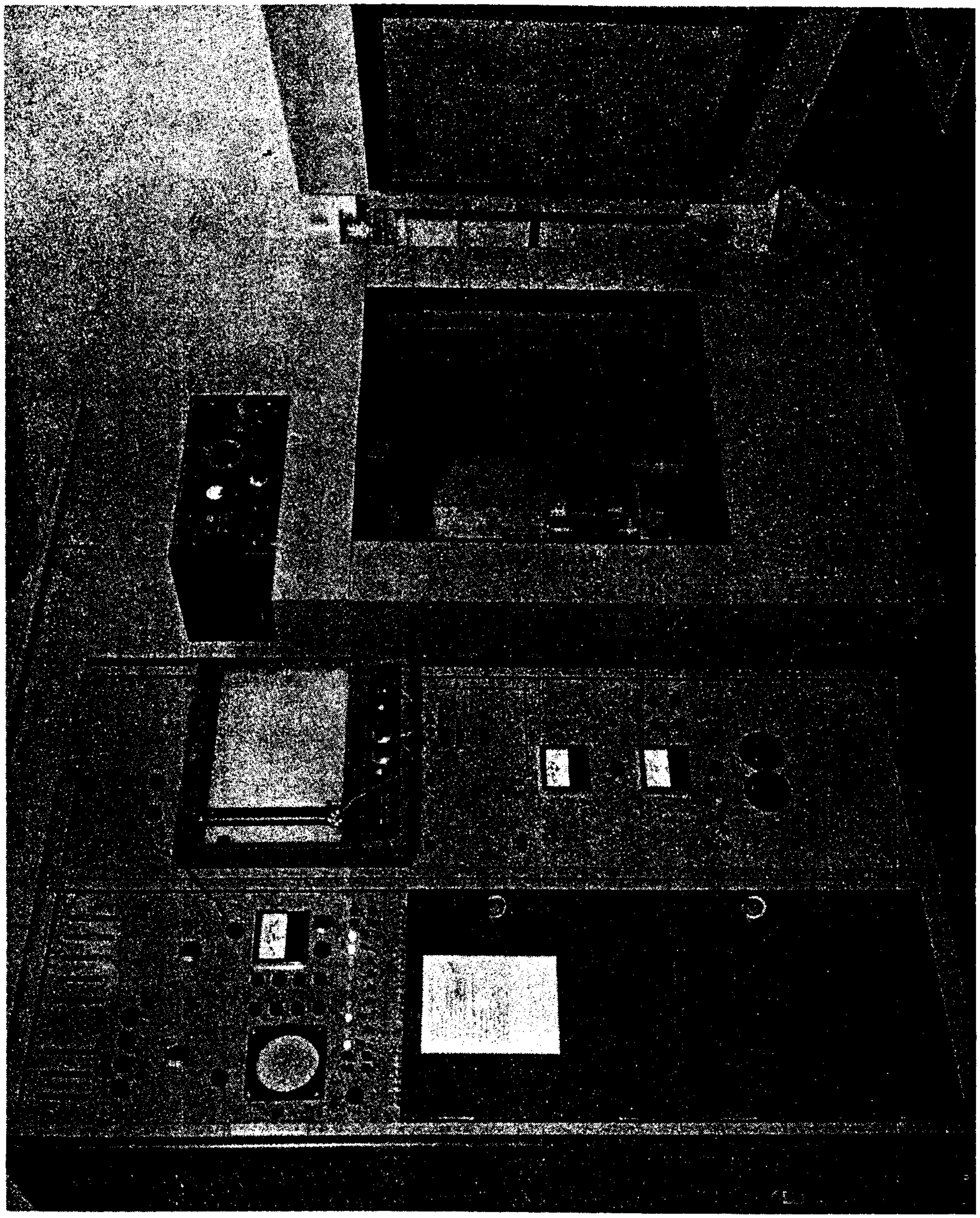


Fig. 7.1

limit of 4×10^{-10} gram of beryllium and will detect 5×10^{-7} gram with a precision of 0.4 percent, both figures at the 95 percent confidence level.

Two types of devices for the collection and detection of gaseous radioiodine have been developed and put into routine field use. The field cartridge (Fig. 7.2) is a simple plastic tube filled with activated carbon and open at both ends. After collecting a sample by drawing air through the tube, the cartridge is counted in a standard 5/8" well counter. The other device is more elaborate and is used for continuous monitoring of gaseous iodine in the field where significant concentrations of people are present in sensitive locations. The airstream is drawn through a plastic vial filled with activated carbon that is placed inside a well-shielded well counter. The output from the counter is fed to a counting-rate meter and finally to a strip-chart recorder. The monitor gives an instantaneous indication of the presence of radioactive iodine gas, and gives a permanent record of the build-up of activity as a function of time.

A statistical summary of analyses completed during the year is given in section 7.4.

7.3 SPECIAL ACTIVITIES

A major part of the total workload of the Branch involves

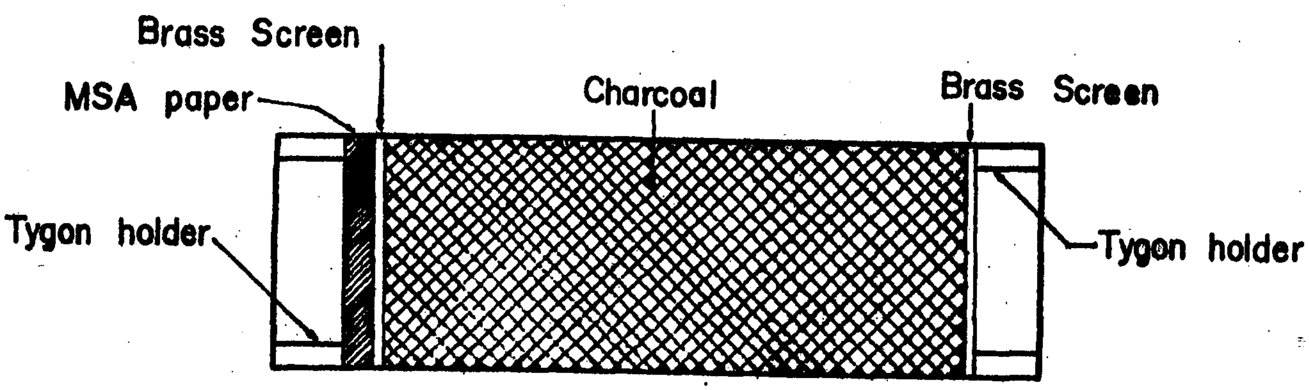


Figure 7.2 FIELD CARTRIDGE

evaluation and solution of highly specialized problems of such nature that few samples can be analyzed per unit time and highly trained and experienced chemists are required. A prime example of this type of special analysis is the identification and determination of over 20 different isotopic species in a sample of terphenyl that had become degraded and polymerized through use as the primary coolant in the Organic Moderated Reactor Experiment. The primary problem was to devise ways of decomposing the tarry material to get the sample into an aqueous system so that chemical separations could be performed. Direct decomposition with nitric and perchloric acids under carefully controlled conditions is possible. Direct extraction with 2 N sulfuric acid could also be used with certain advantages.

During field experimentation such as the Fission Product Field Release Tests, the Branch is called upon to make various kinds of analyses in support of the tests and to assist in development of instrumentation and procedures.

Lectures are given periodically to visitors and trainees on various aspects of the contribution of the Branch to the Health and Safety program. Lectures on methods of internal dose calculations, or methods of chemical analysis, are presented to various contractor groups, or to other branches of the Health and Safety Division as may be required.

7.4 ROUTINE ACTIVITIES

Following is a statistical summary of the analyses completed during the year on the main routine programs of a recurring nature. In addition to the 22,053 analyses listed in Table 7.1, over 500 gamma spectra have been obtained in the six-month period since the 256-channel gamma spectrometer was acquired. Many other varied types of problems not susceptible to statistical presentation have been completed.

TABLE 7.1

STATISTICAL SUMMARY OF ANALYSES

URINE

Gross Beta	8,443
Gross Gamma	2,378
Uranium	84
Mercury	10
Lead	10
Strontium-90	3
Uranium-233	2
Cobalt-60	6
Plutonium	2
Beryllium	2
Total	10,940

WATER

Fluorescein	354
Sodium	1,487
Gross Alpha	1,117
Gross Beta	1,312
Gross Gamma	401
Chloride	121
Strontium-90	80
Cesium-134-137	5
Total	4,877

GROSS GAMMA COUNTING

Carbon Cartridges	1,658
Filters and Fallout Plates	277
Milk	837
Vegetation	1,420
Soil	181
Animal Parts:	
Thyroids	866
Other	343
Total	5,582

MISCELLANEOUS

Beryllium on air dusts	164
Lead on air dusts	2
Lead in blood	4
Mercury in blood	1
Strontium-90 in soil	2
Strontium-90 in bone	471
Plutonium in smear	1
Barium-140	9
Total	654

7.5 FUTURE PROGRAMS

Since a large part of the workload of the branch is in the nature of services to contractors at the NRTS and to other branches within the Division of Health and Safety, the variety and scope of future activities will be determined largely by the nature and extent of reactor operations and field testing programs in the coming year. It is expected that the routine urinalysis service to contractors will continue to increase as will analytical services in support of the Ecology and Site Survey programs because of increased numbers and complexity of operating reactors "on stream".

Although the fluorometric procedure for determination of sub-microgram quantities of beryllium developed during the current year has proved to be highly sensitive, precise and reliable, experience gained during its development has indicated several ways in which it can be improved even further. The improvements relate mainly to simplification and greatly increased selectivity for beryllium. These potentialities will be explored before the problem is finally closed. A similar technique can be applied to the fluorometric determination of thorium to yield greater sensitivity, precision and reliability than any chemical procedure available currently. Preliminary experiments indicate that this procedure will be highly successful and a full investigation will be initiated shortly. Similar procedures for zirconium, scandium, yttrium and lanthanum will be developed.

The total body human counter is expected to be ready for use about mid-1959. Several uses of this instrument are anticipated for the future such as total body counting and body scanning of personnel employed at the NRTS; determination of human exposure to neutrons by induced activities; determination of low-level radioactive contaminants in foodstuffs, etc.

Because of the complex nature of operations at the NRTS and the need for a large amount of field survey and monitoring work, the ability to make both qualitative and quantitative determinations of radioactivity at the site of operations in the field is becoming more acute. The feasibility of a mobile counting room, including portable gamma-ray spectrometers of the transistorized type, will be considered.

Large numbers of gross gamma measurements are currently being made, both for screening samples for activity and for making actual determinations of gamma-emitting isotopes. Because of the attendant requirements for personal attention, automatic sample changing and recording equipment is being developed capable of handling 100 ml volumes of sample in 3" X 3" thallium-activated sodium iodide well crystals. A 5" X 5" sodium iodide (thallium) crystal is also being procured to handle 500 ml samples, as well as small animals, to further increase the speed, sensitivity and capability of the analytical programs.

Liquid scintillation equipment with automatic sample changing and readout will be procured to develop a capability for the determination of tritium and other soft beta-emitting nuclides. The same equipment will be used to investigate the feasibility of determining other radionuclides more simply than is possible with present techniques.

Work has been initiated toward improving the detection limit on the determination of Sr-90 in a wide variety of samples. The approach is toward cosmic ray umbrellas in conjunction with anti-coincidence circuits using newly developed tubes and more sophisticated circuitry. Also, the physical space requirements for such equipment might be improved by using other shield configurations than have been used in the past.

Ways and means will be considered for using existing IBM key sorting equipment for automatic recording of all routine radiochemical analyses, particularly the urinalysis, water and gamma-counting programs.

7.6 TALKS AND PUBLICATIONS

"Iodine Monitoring at the National Reactor Testing Station" was presented by C. W. Sill at a meeting of the Health Physics Society held in Berkeley, California, in June 1958.

"Fluorometric Determination of Submicrogram Quantities of Beryllium" was presented by C. W. Sill both at the Beryllium Symposium held at Massachusetts Institute of Technology in November 1958, and at the Bioassay and Analytical Chemistry Meeting held at the University of Rochester in December 1958.

TABLE OF ORGANIZATION

INSTRUMENT AND DEVELOPMENT BRANCH

Branch Chief, M. Wilhelmsen

Electronics Engineers - 6
Calibration Engineer - 1
Technicians - 2

CHAPTER 8

INSTRUMENT DEVELOPMENT

M. Wilhelmsen, Branch Chief

8.1 GENERAL

The functions of the Instrument and Development Branch are twofold:

1. Performing original research and development in the field of radiation instrumentation to further the knowledge of radiation detection in order to protect NRTS personnel more adequately which includes:

   a. Development of electronic instrumentation and special devices for the detection and analysis of radiation materials and hazards.

   b. Improvement and modification of presently available equipment for special application to radiation detection.

2. Insuring that an adequate supply of portable and special types of radiation detection instruments are procured, maintained, calibrated and are readily available for use by Health Physics personnel of IDO, its contractors and other NRTS contractors.

The Branch is essentially a service organization in that maintenance and development work is performed for all other branches in the Health and Safety Division and most of the NRTS contractors.

Many of the branches in the Division are extremely dependent upon the service of the Instrument and Development Branch and the quality and quantity of their work is a function of the instrumentation supplied them.

8.2 SUMMARY OF MAJOR PROGRAMS

Development work has been performed for many of the branches and associated organizations during the past year and is outlined below:

8.2.1 Personnel Metering Branch

Development work, during the year, was for the most part centralized around the "Automatic Film Reader System", (Fig. 8.1) for the Personnel Metering Branch. During this time, many parts of the system were designed and fabricated, some pieces of equipment were purchased, many units were modified in some respect and all components were made operational within the system.

A considerable time was spent testing and in eliminating the "bugs" from the completed units. Toward the end of the year, the system became operational. Preliminary studies indicate that the automatic film reader is the most accurate component of the film dosimetry program. This, however, provides a challenge and points out the necessity of improving other phases of the program (film developing processes, for example) and in

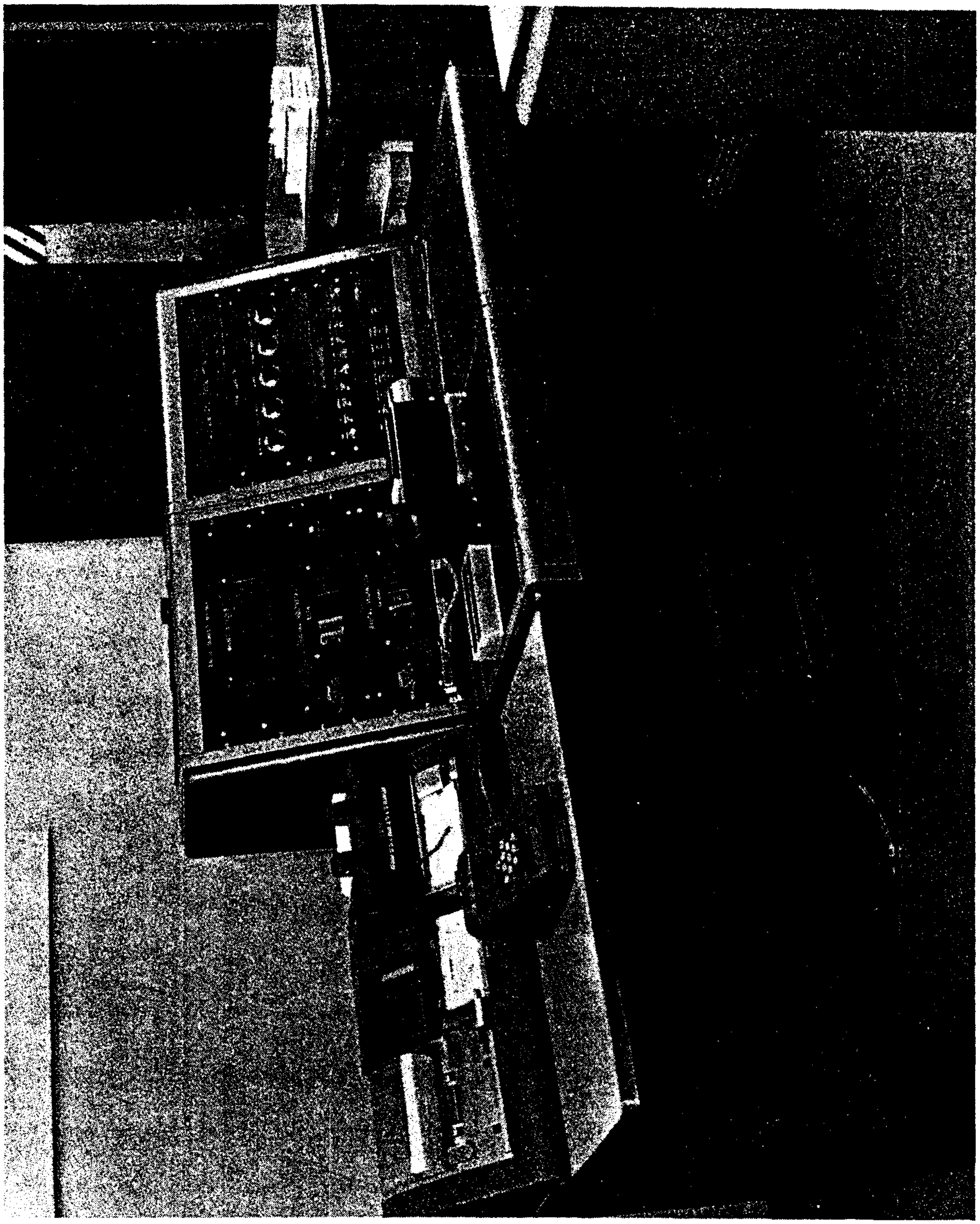


Fig. 8.1

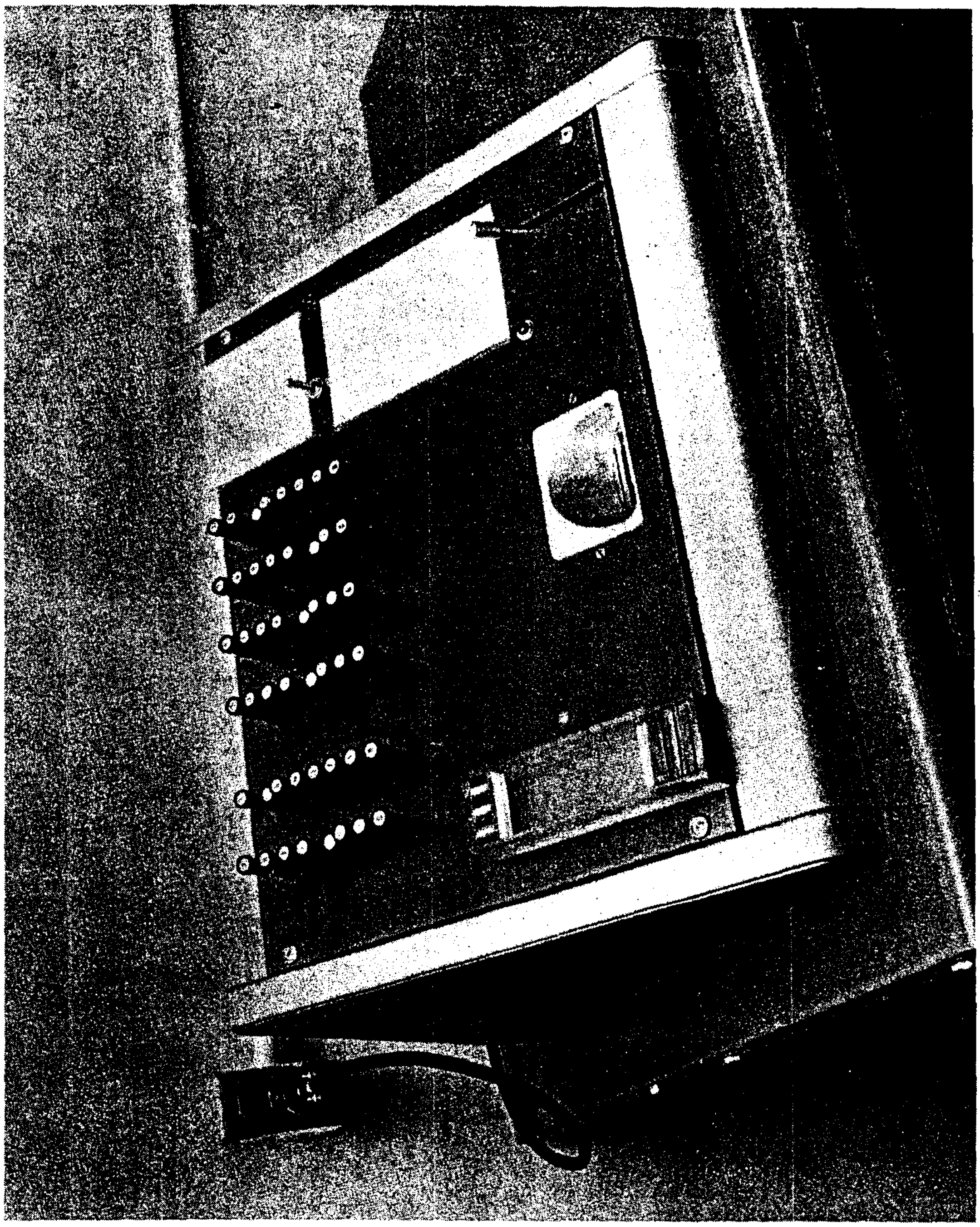


Fig. 8.2

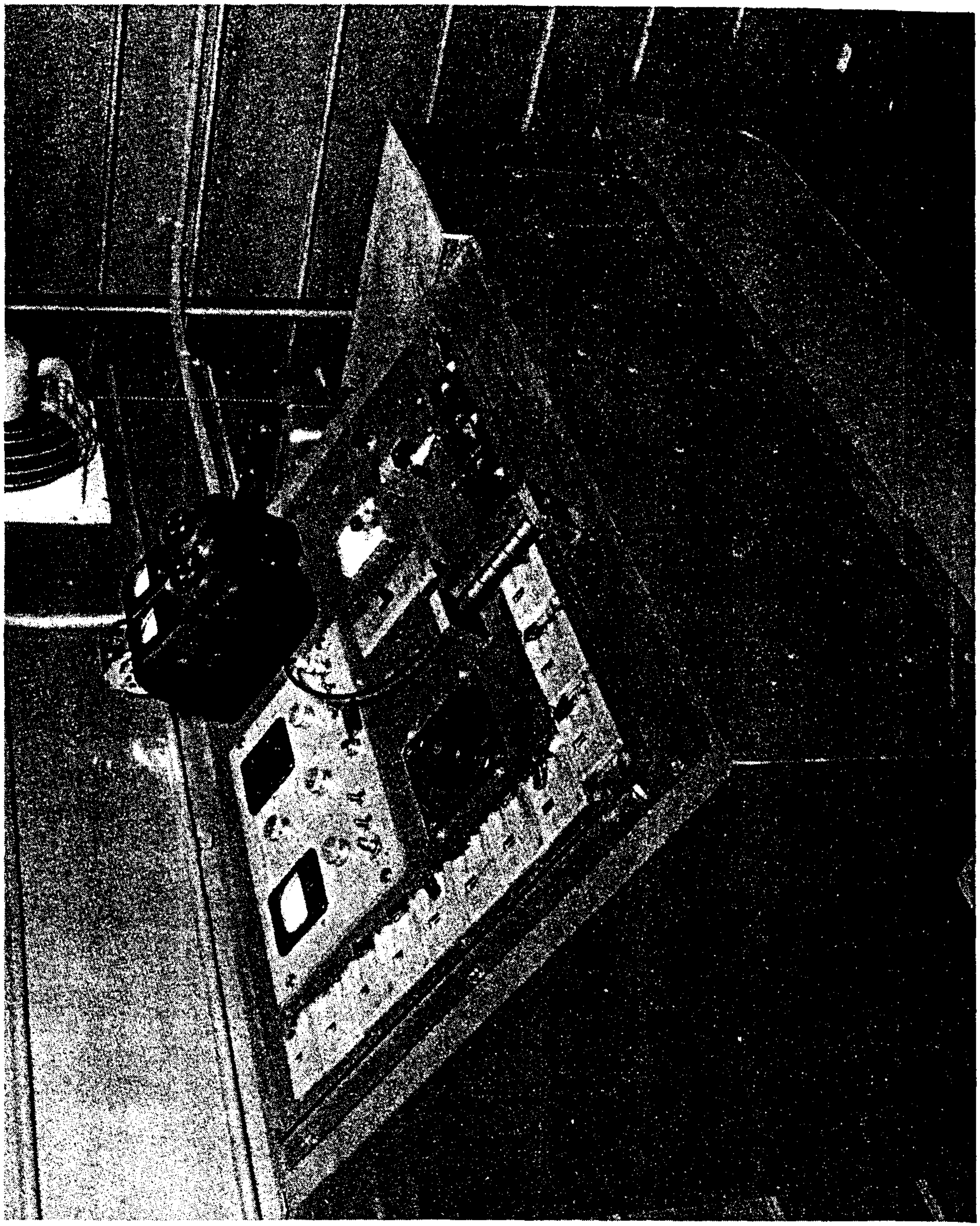


Fig. 8.3

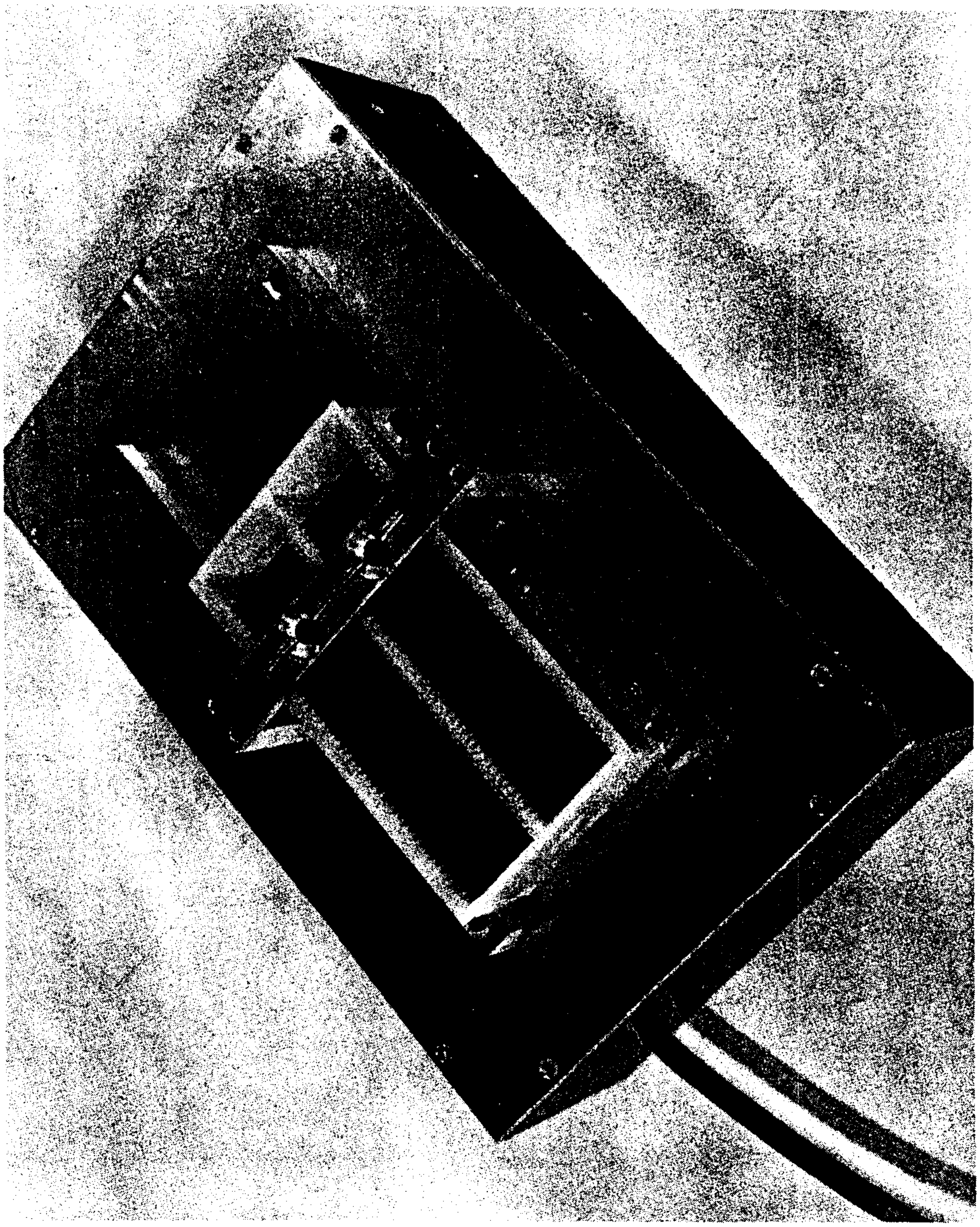


Fig. 8.4

making more stringent specifications for the film vendors.

The "Automatic Film Reader" (Fig. 8.1) identifies an individual's dosimetry film by means of a number assigned to him. This identification number and dosage data are automatically read from the film, reduced to digital form by computer circuits and presented as permanent records on an IBM card.

To facilitate automatic reading, the identification is placed on the film badge in binary form. This is accomplished by punching a lead insert with an arrangement of holes corresponding to an individual's assigned number. A special punch was designed and fabricated for this purpose. (Fig. 8.2) The punched insert is cemented permanently to the badge. An X-ray beam, collimated through this insert produces a binary coded latent image on the film. An automatic X-ray unit was designed and built to perform this function (Fig. 8.3).

The film is removed from the badge and placed in a special tray for chemical processing and drying. These trays were designed by members of the Branch and were produced commercially. (Fig. 8.4)

After the film is dry, identification data appears as a series of black, opaque spots and transparent areas on the film. Dosage information is obtained from two areas on the film. The density of each film area is determined by the quantity and type of radiation penetrating the particular filter provided.

A tray of film is placed on the film changer table and transported into the reader. Each film is automatically lifted from the tray to the reading position and then returned to the tray. In the film reader a light source illuminates the entire film. A series of photo diodes respond to light transmission through the identification coded area and a relay matrix reduces these signals to a numerical number ready for printout by the IBM punch.

Dosage data which are proportional to the density of the film in respective areas, are obtained by two multiplier photo tubes and associated electronic circuitry. A beta and gamma dosage reading is taken and stored in digital form, the beta dosage reading being corrected against the gamma component. All of the stored information is fed into an IBM card punch in serial form and punched into a data card. The reading process is completely automatic and is keyed to the cycle of the IBM card punch. The read out rate is approximately 15 films per minute. Several fail-safe circuits are incorporated to prevent erroneous information from being recorded.

8.2.2 Analysis Branch

8.2.2.1 Low Background Shield

To provide adequate shielding for low background work, with satisfactory geometry conditions, an iron shield was designed and constructed for the detector head associated with a new multi-channel analyzer. A design utilizing low activity armour plate iron, providing for 10" thick walls, lined with cadmium and copper, with inside dimensions of 30 x 30 x 30 inches was used so that back scatter would be kept to a minium and provide sufficient volume for the insertion of the diversified types of samples expected to be analyzed.

8.2.2.2 Total Body Counter

Design specifications were made and a contract let for the fabrication of a scanning mechanism and crystal shield to be used within our Total Body Counter. When used with a small, columnated crystal assembly, this mechanism will allow for the automatically controlled movement of the detector head over an accurately prescribed path, at the same time providing drive voltages for an X-Y recorder which will follow the identical path prescribed by the detector head. The counting rate from the detector will actuate a point plotting mechanism on the X-Y recorder thus providing a histogram showing activity within the human body. A large, shielded 4" by 8" crystal will be used for counting total body activity and for isotope analysis when coupled to the multichannel analyzer.

8.2.3 Site Survey

To assist in the location and study of microscopic radioactive particles, a microscope was modified and fitted with a pancake thin window GM tube, shielded except for a very small pin hole, looking at the sample slide. With the aid of this detector attached to an aural type annunciating instrument, the location and visual identification of these small radioactive particles on a filter paper or in an earth sample was made quite easy.

8.2.4 Ecology

8.2.4.1 A rabbit "thyroid counter" was designed and fabricated using a 1" diameter crystal assembly to facilitate the study of Iodine in the rabbit thyroid (Fig. 8.5). With this device, the rabbit need not be sacrificed and repeated counts may be taken on the live animal to observe uptake and decay.

8.2.5 Weather Bureau

8.2.5.1 Diffusion Nozzle

To facilitate diffusion studies being conducted by the USWB a "diffusion nozzle" was designed and fabricated. This nozzle mixes air and a liquid dye, breathing the dye into minute particles and ejecting it into the air from a high tower.

8.2.5.2 Precipitation Indicator

The weather bureau at the NRTS is not manned on a 24-hour basis, and it was desirous to have a device which would indicate the exact time that precipitation began and ended. A precipitation

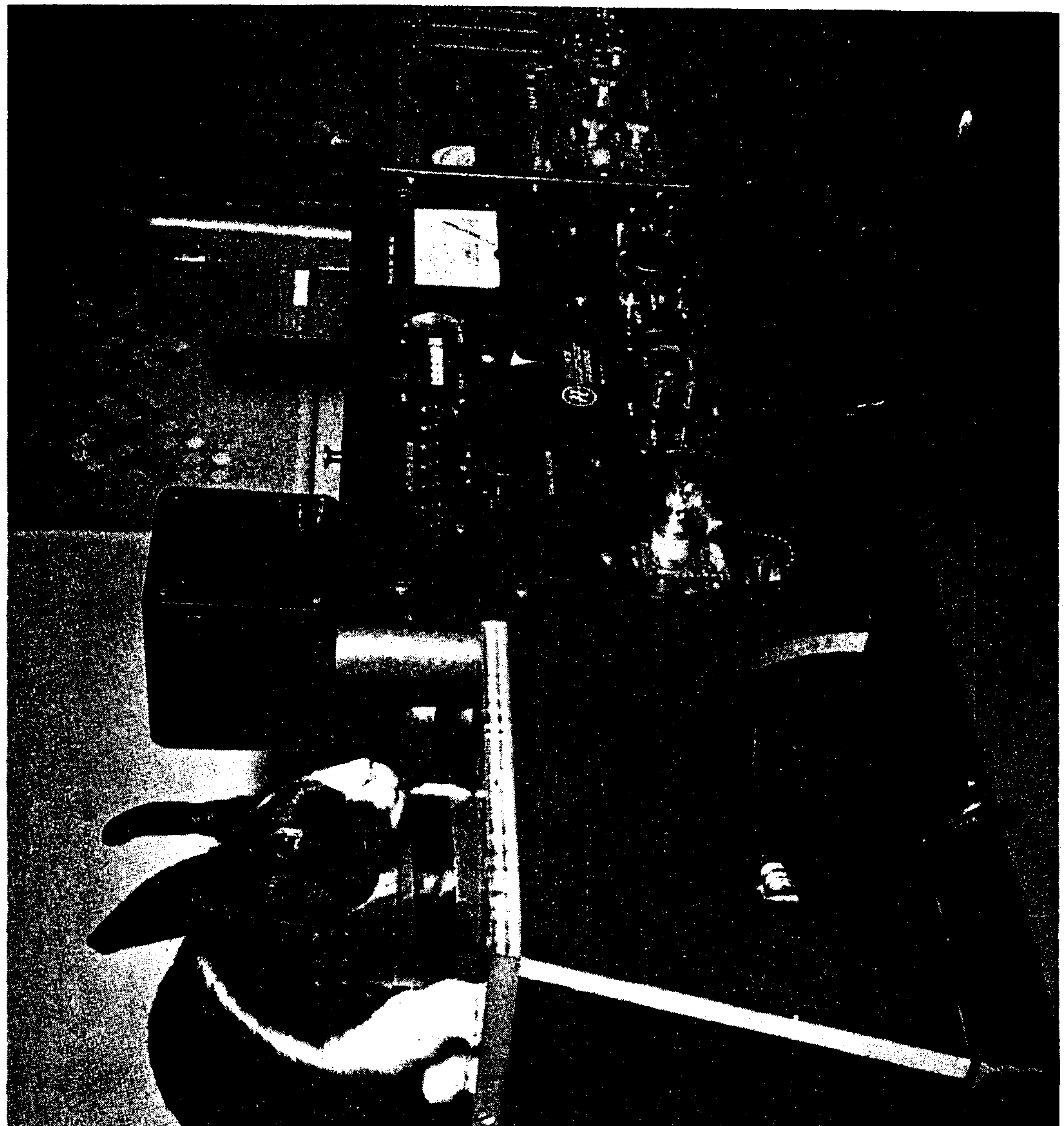


Fig. 8.5

indicator, sensitive to a single drop of water was constructed and wired to a strip chart recorder to give this desired information.

8.3 ROUTINE ACTIVITIES

The maintenance work of the Branch is of two different types, maintenance of fixed instrumentation for the Division and maintenance of the portable radiation detection instruments used by both the Division and NRTS contractor personnel.

8.3.1 Fixed Instrumentation

Major equipment items of a fixed nature which are maintained by the Branch and which are normally not credited to portable instrumentation maintenance are listed below.

ITEM	NUMBER
Automatic Film Reader System	1
Automatic Sample Changer System	3
Badge Contamination Checkers	3
Badge Insert Punch	1
Cary Spectrophotometer	1
Densitometers	2
Flame Spectrophotometer	2
4 Pi Counting System	1
Frisch Grid Chamber	1
Low Background Counter System	1
Manual Beta Counting System	3
Microscopic Partial Detector	1
Photometer	1
Proportional Alpha Counters	6
Rabbit Counter System	1
Road Scanners	4
Single Channel Analyzer System	2
256 Channel Analyzer System	1
Well type Scintillation Counters	8
X-Ray Machines	3

8.3.2 Telemetering System

The telemetering system maintained and operated by the Branch consists of: (1) 11 monitoring stations which telemeter to the central control station an indication of whether the radiation level at the station is above or below a preset level: (2) Two weather stations telemetering to the central station wind direction, velocity and temperature: (3) 23 radio controlled sample stations which can be turned on or off at the central station for controlled air sampling. This system is set up to determine the radiation levels at various locations in the area surrounding the NRTS (Fig. 8.7)

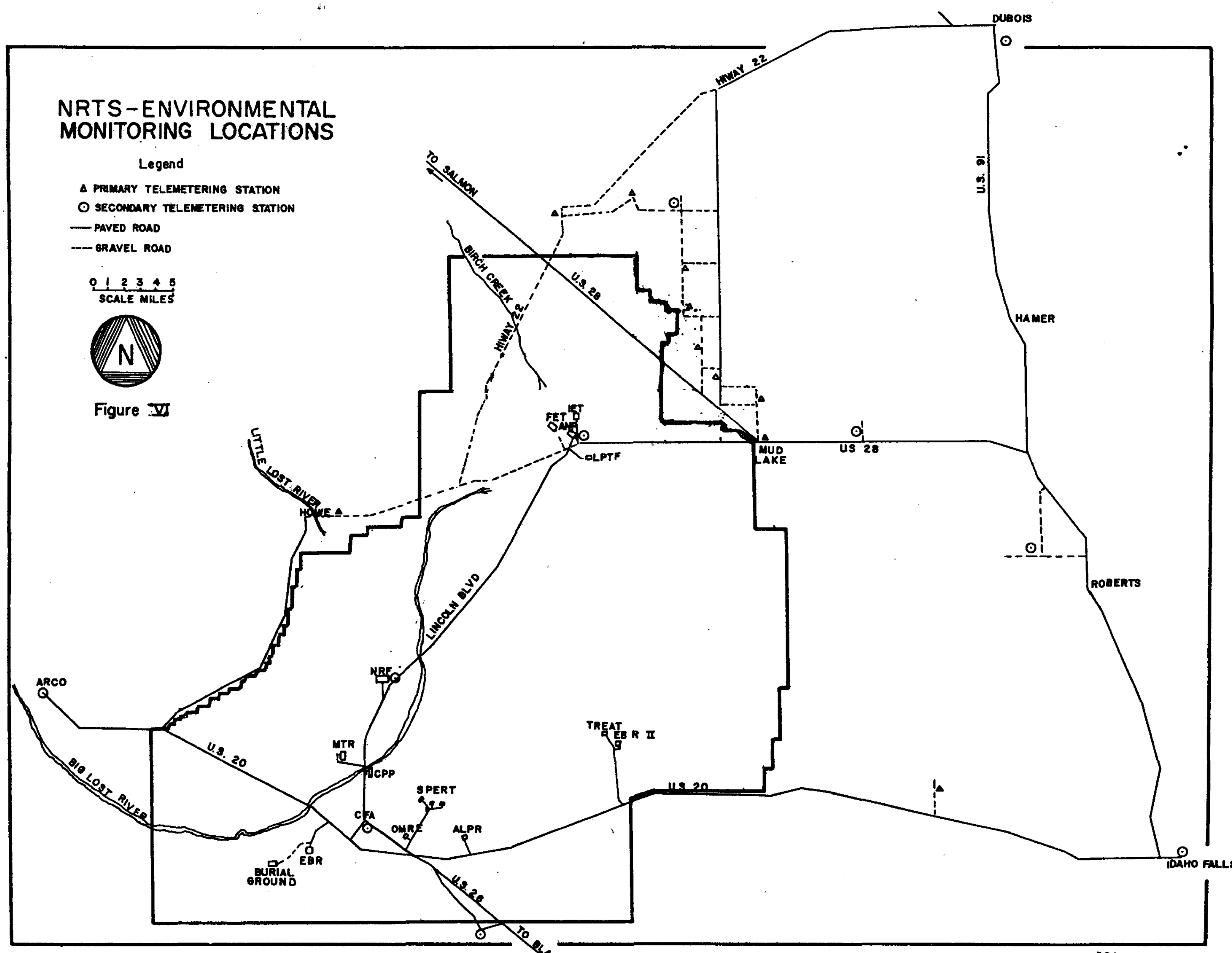

NRTS-ENVIRONMENTAL MONITORING LOCATIONS
Legend
PRIMARY TELEMETERING STATION
SECONDARY TELEMETERING STATION
PAVED ROAD
GRAVEL ROAD
0 1 2 3 4 5
SCALE MILES
N
Figure VI
DUBOIS
HIWAY 22
TO SALMON
U.S. 91
BIRCH CREEK
U.S. 28
HIWAY 22
HAMER
IET
FET
ANP
LPTF
MUD LAKE
US 28
LITTLE LOST RIVER
HOWE
ROBERTS
LINCOLN BLVD
NRF
ARCO
TREAT
EBR II
MTR
U.S. 20
ICPP
U.S. 20
BIG LOST RIVER
SPERT
CFA
OMRE
ALPR
EBR
BURIAL GROUND
U.S. 26
TO BLACKFOOT
IDAHO FALLS
DRA
1-8-59

Fig. 8.7

Appreciable modification has been done to this system as well as routine maintenance. Line voltage regulators were installed at each station to improve the stability of the counting rate meters. A power supply was designed and installed in each transmitter to operate the transmitter turn on relay, since battery operation proved unsatisfactory. Low voltage and time delay relays were installed to protect the equipment against low voltage and power failures.

8.3.3 Portable Instruments

Maintenance of portable instruments consists of the repair and calibration of the instruments to insure their accuracy and performance.

8.3.3.1

The following instruments were in service:

G. M. Counters	181
Junos	144
Cutie Pies	133
Moto-Air Samplers	94
Radectors	80
Hi. Vol. Air Samplers	50
Scalers	37
E. A. Recorders	34
Count Rate Meters	29
Samsons	25
Rudolphs	21
B. F.3s	18
Portable Alpha Counters	12
Lab. Monitors	5
TOTAL	875

8.3.3.1

B. The following organizations received portable instrument service from the Instrument and Development Branch:

1. Atomics International
2. Argonne National Laboratories
3. General Electric Company
4. Phillips Petroleum Company
5. Westinghouse Electric Corporation
6. U. S. Public Health Service
7. U. S. Weather Bureau
8. Idaho Operations Office

    (a) Health and Safety Division

        (1) Analysis Branch
        (2) Ecology Branch
        (3) Personnel Metering Branch
        (4) Site Survey Branch

    (b) Inspection Division

    (c) Security Division

8.3.3.2

C. The following number of instruments were repaired and calibrated:

Cutie Pies	1,260
Junos	1,080
G.M.'s	660
Radectors	348
Rudolphs	216
B.F.$_3$'s	144
Samsons	84
Hi. Vol. Air Samplers	84
Portable Scintillators	60
Count Rate Meters	48
Scalers	20
Electroscopes	15
Port. Alpha Counters	15
E. A. Recorders	15
Lab Monitors	15
TOTAL	4,144

8.3.4 Calibration

All portable instruments are calibrated with Radium or Cobalt sources standardized by the National Bureau of Standards with the exceptions of Neutron and Alpha detecting instruments. Neutron instruments are calibrated with Polonium-Beryllium sources standardized at the time of their manufacture. Alpha detecting instruments are calibrated with standardized Plutonium sources. Victoreen R meters standardized by the National Bureau of Standards are used for checking the sources and as a secondary standard for calibration of various sources for contractor personnel.

Dosimeter film is exposed to radium sources for gamma and Uranium metal for Beta to provide the Personnel Metering Branch with standards for comparison with field film to determine the amount of dose received.

Following is a list of sources used by the calibration engineer in this work:

1. Radium Sources

Quantity	Size
2	500 mg
1	100 mg
2	25 mg
2	10 mg
5	1 mg
4	.1 mg

2. Uranium Metal

3 Rectangular Bars - 51 cm by 8 cm by 1/2 cm

3. Cobalt 60

5 curie source

4. Polonium Beryllium

Approximately 30 curies

5. Plutonium

12 small sources of various emission rates

8.5 FUTURE PROGRAMS

8.5.1 Automatic Film Reader

New components and techniques have opened the possibility of eliminating the stepping switches and relays in the control and digital voltmeter sections of the film reader. Information on switching transistors, beam switching tubes, mercury relays, and other data handling components now available indicate that considerably more reliability can be built into the reader. The possibility of reading four film areas under various absorbers to compensate for the energy of the incident radiation and give more accurate data may be investigated.

8.5.2 Telemetering System

Further expansion of the telemetering system is planned, both in number of stations and in the quality and quantity of the information obtained. The proposed system will have 19 monitoring and reporting radiation stations, 2 weather stations, and 24 radio-controlled air sampling stations.

The telemetering portion of this system will be procured from commerical channels. The radiation detection equipment will be designed and installed by the branch with the various components being procured from commerical channels.

8.5.3 Total Body Counter

The scanning mechanism and sodium iodide crystal assembly will be completed and tested. Operational checks will be made and background studies started.

8.5.4 Automation of Counting Room Data Handling

A preliminary study and perhaps some development work will be done on the problem of simplifying the analysis and recording of the vast amount of data accumulated in the counting room.

8.5.5 Equipment for Monitoring by Aircraft

Instrumentation will be designed and constructed for use in low-flying aircraft for the purpose of ground and cloud monitoring.

TABLE OF ORGANIZATION

U. S. WEATHER BUREAU

- Meteorologist in Charge, N. F. Islitzer
  Assistant Meteorologist, N. E. Bowne
  - Secretary
  - Meteorologists - 4
    Meteorological Aides - 6

CHAPTER 9

WEATHER BUREAU OFFICE

Norman F. Islitzer, Meteorologist in Charge

9.1 GENERAL

9.1.1 Observational Network and Facilities

The Weather Bureau, under the auspices of the U. S. Atomic Energy Commission, started its observational program at the National Reactor Testing Station (NRTS) in late November 1949. It maintains a network of weather stations over the NRTS and its environs to study the local climate. Marked contrasts in weather across the site have prevented blind extrapolation from measurements at one or two points as always being indicative throughout the entire region.

In addition to a network of surface stations, wind and temperatures at higher levels are recorded to compute trajectories and diffusion of any radioactive material released from the stacks at the NRTS. The Weather Bureau maintains a 250-foot tower at Central Facilities with winds and temperatures continuously recorded at several levels. The General Electric Company operates a 200-foot tower at ANP with winds and temperatures at several levels recorded and telemetered to the Central Facilities location. Captive blimp ascents to over 1000 feet above the ground have provided temperatures above tower heights. Winds to 5000 feet are measured by single and double theodolite tracking of 30-gram balloons. Figures 9-1 and 9-2 show the measurements taken at the north and south ends of the NRTS.

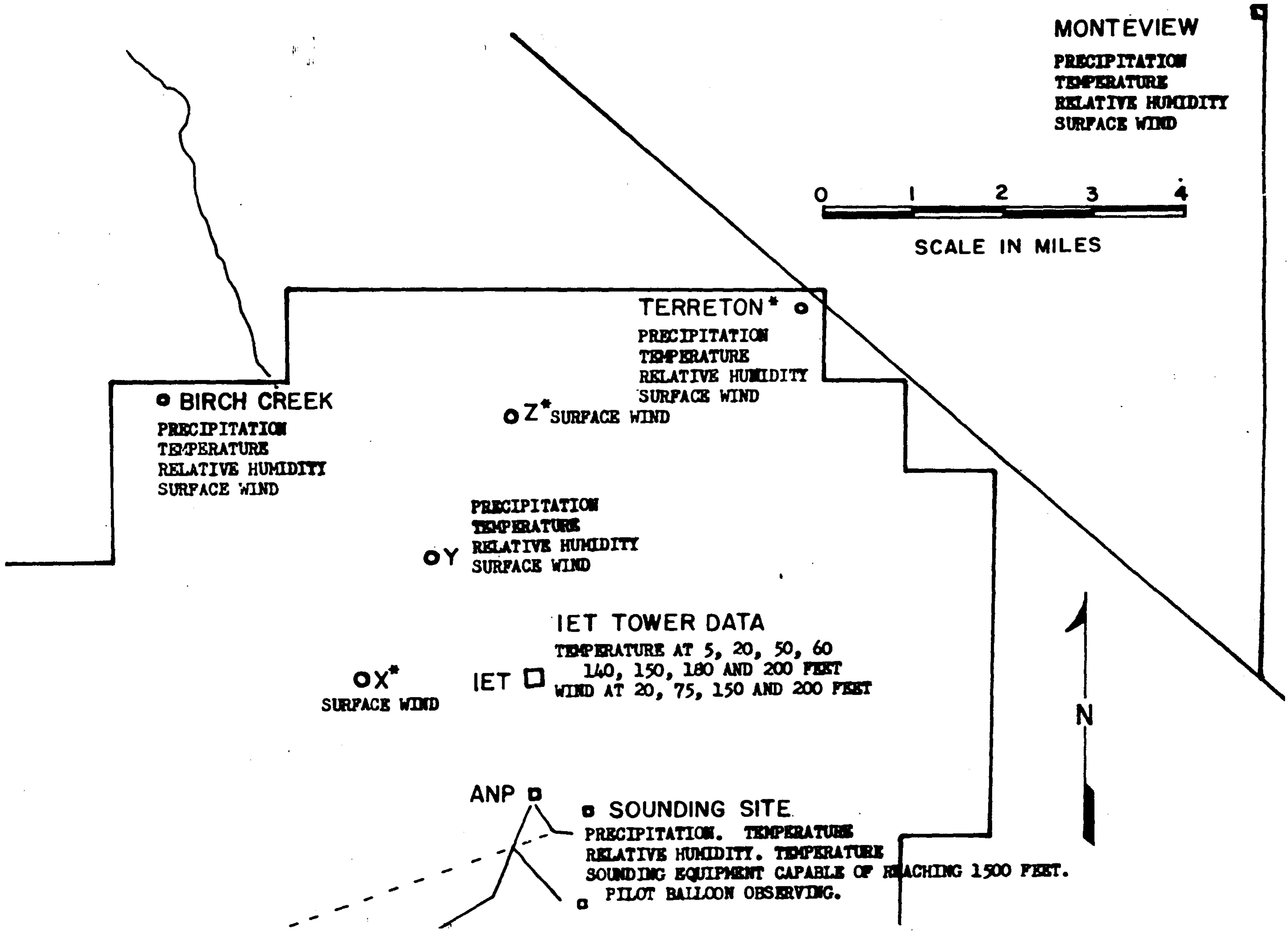
9.2 FUNCTION

At the Weather Bureau Office at Central Facilities, weather teletype circuits A and C provide the surface and higher level observations for forecast purposes from the western region of the United States. The normal observations of a regular weather station are made twice daily and transmitted to the forecast center at Salt Lake City. Synoptic charts of the weather are plotted at levels and times deemed necessary to make the required forecasts for reactor operation and construction purposes.

An active research program in atmospheric diffusion and objective forecasting, particularly of winds, has been conducted. Radioactive materials released from the stacks during some of the reactor operations have been used as a tracer for diffusion studies. A program using non-radioactive tracer releases from a 150-foot tower has been initiated. Development of micrometeorological equipment for the measurement of turbulence properties of the lower atmosphere has been carried out in conjunction with these diffusion studies. The forecasting studies have resulted in objective schemes for prediction of the duration of up-valley (southwest) winds and maximum speeds. The method is fairly successful for wind forecasts in the southern region of the NRTS. Forecasts for the northern part of the site have not been as successful in the wintertime.

The Weather Bureau is frequently consulted with respect to problems of reactor and stack location and reactor hazards. Numerous weather studies and diffusion calculations have been supplied to the AEC and its contractors for these purposes.

The six meteorologists on the staff have sufficient formal training in micro-meteorology and weather forecasting to conduct various phases of the research program, to advise the AEC and its contractors on various matters of reactor operation that are dependent upon weather, and to provide the required operational forecasts and positioning of monitoring teams during reactor tests. The six sub-professional employees have sufficient training to assist the meteorologists in the completion of their research projects. They also are well versed in meteorological observations, preparing climatic summaries, and general field work.



N.B. DURING PERIODS OF SPECIAL OPERATIONS TWO MOBILE UNITS WITH WIND SOUNDING EQUIPMENT AND A STATIONARY TELEMETERING WIND STATION NEAR TERRETON ARE ACTIVATED.

* DISCONTINUED.

FIG. 9.1 INSTRUMENTATION AT THE NORTH END

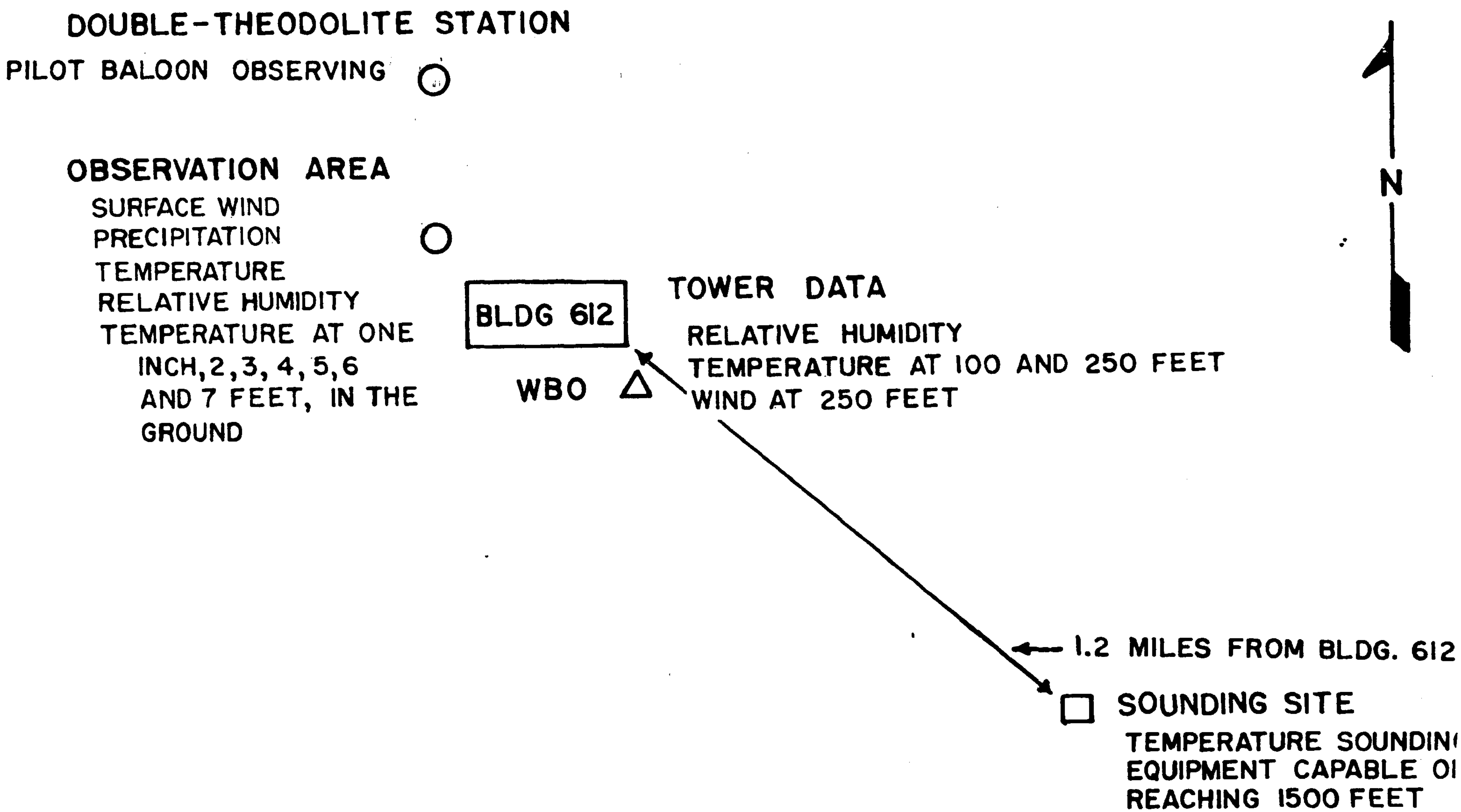


FIG. 9-2 INSTRUMENTATION AT WBO

9.2 SUMMARY OF MAJOR PROGRAMS

9.2.1 Operational

The Weather Bureau has provided operational forecasts to the AEC and the various contractors to assist in the conduct of their experiments. In addition to forecasts of certain meteorological elements such as wind speed and direction, temperatures and precipitation, diffusion forecasts are also made. The diffusion of any radioactive material discharged from a reactor stack is known to be correlated to the wind and the vertical temperature stability. Forecasts of vertical temperature stability through the day are given as required. Values of Sutton's diffusion coefficients and stability parameter "n" are then included in the forecast. This will permit calculations of anticipated air concentration or radioactive dose for releases of radioactive material. Of particular interest to field monitoring teams are areas of maximum surface concentration from stack releases. These can be estimated fairly well for some weather conditions. Forecasts of distances to maximum surface concentration allow the monitoring teams to plan the disposition of their equipment.

9.2.1.1 ANP Operations

The major contractor activities requiring forecasts for the last 12-month period were the ANP operations at the IET, the Rala operations at the Chemical Processing Plant, and the

Fission Products Field Release Tests conducted by Convair for the Air Force.

The ANP operations were not permitted to proceed by the contractor if the computed dose from their maximum credible accident, a one-tube burnout, exceeded a prescribed value at any offsite populated area. The downwind trajectory as indicated by the measured wind direction determined the nearest inhabited area. An additional restriction, not imposed by IDO, limited contractors' high power operations if the winds blew from a sector between 324° - 45°, (NW through NE). This was to prevent any discharge from the IET stack from going over the administration area of ANP. Since a high percent of the winds are from these directions, tests were sometimes delayed or postponed. The forecasts had to be quite specific as to expected wind direction and vertical temperature stability.

The region around ANP at the north end of the NRTS, because of its proximity to the mountains to the west and north and several large valleys, such as the Birch Creek Valley, is a region of extremely complex wind patterns. In addition, during the winter months when the tests were conducted calms prevailed a large percent of the time. Marked wind shifts would occur within several miles of the IET stack. A network of stations at the northern region of the NRTS was necessary to compute accurate trajectories and to avoid being misled by transient and marginal weather conditions measured at a single location.

Due to the nature of the tests, the weather conditions as meassured by the network were carefully scrutinized. Considerable experience was gained in forecasting weather trends at the north end and properly evaluating transient conditions.

9.2.1.2 Rala Operations

The Rala operation of the Chemical Processing Plant has two phases separated by a time interval of several hours. The operation requires some 10-12 hours for completion. The Ralas were conducted at first only if the forecast indicated that the winds would blow for a continuous 10-hour period from a narrow 45° sector, southwest to west. This was to insure that releases of radioactive material would not be over any adjacent facilities. Because of the diurnal behavior of the winds, this presented a complicated forecast problem. Usually a passing pressure trough or frontal system had to be experienced to insure the desired winds through the duration of the test. This resulted in delays with consequent loss of product to the contractor.

After a number of Rala operations were conducted, an examination of the data collected in the field by the monitoring teams showed that the operation could be conducted safely under favorable diffusion conditions regardless of wind direction. A more relaxed type of meteorological control was applied which reduced delays to a minimum. The more serious diffusion types for close-in areas such as "looping" and "fumigating" were avoided to prevent contamination of the Chemical Processing Plant itself. The successful application of the less restrictive type of meteorological control to the Rala indicates the value of close cooperation between the meteorologist, the operating contractor and the health physics teams in the field. Field and stack data measured in sufficient detail and carefully analyzed may prove their value many times over in conducting future tests safely.

9.2.1.3 Fission Products Field Release Tests

The Fission Products Field Release Tests conducted by Convair involved releases of radioactive material from melted fuel elements over a grid 60° wide and 3200 meters long, whose center line was oriented along a 235° wind direction. The orientation of the sampling grid was based on the frequency of southwest winds on summer afternoons. Meteorological specifications for the tests required a wind direction nearly coinciding with the center line and with ranges of wind speed and temperature lapse or inversions that were quite restrictive. The stringent conditions of the tests permitted the forecasts to state only that a reasonable chance for all conditions to be realized simultaneously did exist. With favorable forecasts, participants resorted to standby procedures and suspended operations if the forecasts were definitely unfavorable. This procedure enabled nine releases to be obtained in the sixteen days for which favorable conditions were expected between July 25 and September 26, 1958. If stringent meteorological conditions for the tests are required, the experimenter must be prepared for frequent standby periods.

The releases occurred over short periods, on the order of less than a minute. Although the conditions specified had to persist for less than 30 minutes to clear the grid, later wind shifts had to be foreseen and avoided to prevent the radioactive material from being blown back and contaminating the samples and analyzing equipment. This condition was most troublesome for the mild inversion shots that were conducted shortly after sunset. This period marks the onset of the nocturnal down-valley winds. Thus, rapid wind shifts can be expected at this time. This is the only period that southwest winds can be expected for inversion conditions with any degree of frequency.

The effect of convective activity, particularly thunderstorm cloud buildup in the area, upon confining wind directions to a small sector became quite noticeable. These effects are most apparent during late afternoon in the summer, when most of the other weather requirements were realized. Forecasting their effect was difficult and caused several standby periods during which tests could not be carried out. Future design of experiments of this type would do well to consider the effect of late afternoon summertime heating.

9.2.2 Research

The research efforts of the Weather Bureau have been directed along two main lines. One is the study of diffusion of material from elevated sources such as stacks and its correlation with micro-meteorological variables. The second is an improvement of forecast methods, particularly for winds.

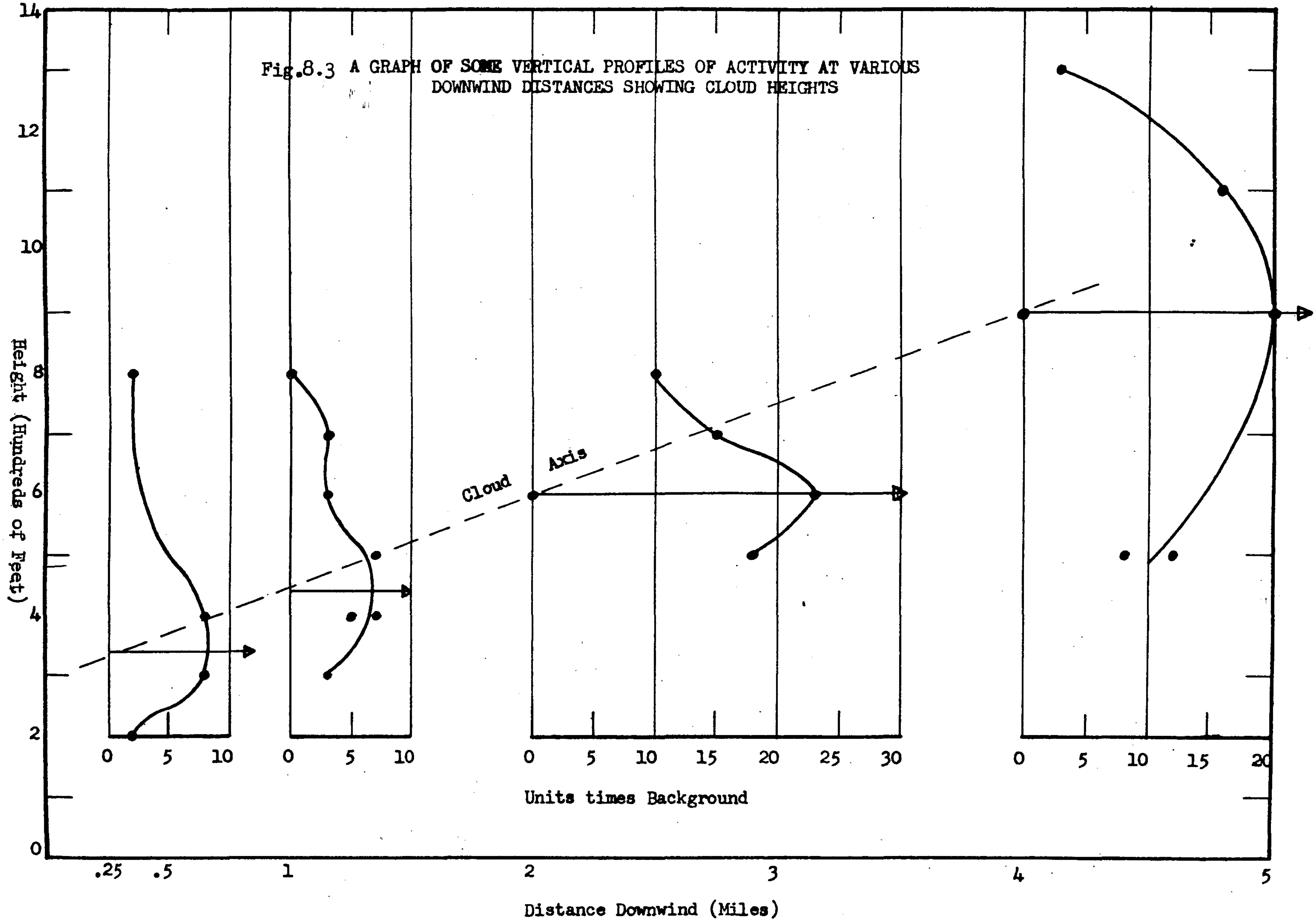
9.2.2.1 Diffusion Studies

The past work on diffusion has been concentrated upon the use of radioactive tracer material released from 150- or 250-foot stacks. Much of the information has been obtained by the Site Survey and Ecology Branches of the Health and Safety Division, Idaho Operations Office. Of particular interest have been the vegetation and rabbit samples and data obtained from aerial monitoring. The rabbit and vegetation samples from several Rala runs have provided some data to check prediction equations for distances to maximum surface concentrations from a 250-foot stack. The data are rather sparse, but do indicate that one mile and about four miles are the distances to maximum surface deposition for a weak lapse and a weak inversion respectively.

For strong inversions, material has been carried for 20 miles in detectable amounts as shown by these studies. Insufficient data points prevented locating a specific area of maximum deposition for the strong inversion case.

The aerial monitoring data gave some estimates of effective stack height and vertical cloud width from the ANP operations. Effluent temperatures reached 500° F and resulted in considerable cloud rise above that predicted by the Bryant-Davidson equation. The results of one series of flights are shown in Figure 8.3. It can be seen that activity above background was detected 1300 feet above the ground at 4 miles downwind. The axis of the cloud rose from about 300 feet at 1/4 mile downwind to 900 feet at 4 miles downwind. The release was from the 150-foot IET stack under near adiabatic temperature lapse rates. Computations from the Bryant-Davidson method showed that the cloud axis should have remained below 300 feet, thereby greatly underestimating the cloud rise. The increase of activity with distance in Figure 8.3 results from the increase of stack release rates with power and temperature increases of the reactor. About two hours elapsed between the measurements at the 1/4 and 4 mile distances by the aircraft during which time the reactor increased power. The weather conditions were quite steady through this period so no appreciable effect on the shape of the curves would be likely.

Fig.8.3 A GRAPH OF SOME VERTICAL PROFILES OF ACTIVITY AT VARIOUS DOWNWIND DISTANCES SHOWING CLOUD HEIGHTS



In order to obtain some estimates of Sutton's diffusion coefficient Cy, the gamma dose-rate at the surface from several Rala operations was measured. Two methods were used to make these measurements. The sky scanner, an instrument devised by the Instruments Branch, Health and Safety Division, IDO, seemed to lend itself particularly to this application. This device consists of a sodium iodide crystal mounted at the bottom of a lead barrel, thereby restricting radiation striking the crystal from a narrow cone rather than from the entire hemisphere. When the barrel is pointed in the vertical, the gamma dose measured comes from only a narrow vertical segment of the cloud. A line of such sky scanners placed across the trajectory of the cloud enables a computation of the lateral variance of the diffusing gamma emitters. By assuming appropriate values for the stability parameter "n", a computation of Cy is permitted. These measurements were made for temperature lapse conditions at one mile downwind from the 250-foot Chemical Processing Plant stack.

Additional information on cloud widths can be obtained from fallout plates. A line of fallout plates were installed with the sky scanners one mile downwind and a second line about three miles downwind of fallout plates only. These plates were analyzed in a deep well gamma counter for gamma activity. The results of two Rala runs showed a mean Cy of 0.341 for moderate lapse and wind conditions assuming an "n" of 0.25. The entire details of the studies described above will be presented in a future IDO report.

9.2.3 Forecasting

Winds are perhaps the most important single parameter that the forecaster is required to predict to conduct the safe removal of stack releases. The location of the NRTS in the Snake River Valley introduces topographical effects from the nearby mountain ranges upon the winds to complicate the forecast problem. The winds experience a strong diurnal behavior with SW (up-valley) winds prevailing during the daytime hours and NE (down-valley) winds prevailing at night. In addition, frequent instances of opposing wind directions are observed between different parts of the site.

Forecasts from surface pressure gradients alone do not provide satisfactory results. An objective technique based upon momentum transfer from the gradient winds at the 10,000-foot level to the surface and also employing surface pressure gradients was developed. This scheme forecasts the duration of and the maximum hourly average speed of the prevailing SW winds at Central Facilities. Verification studies have shown that the scheme can be applied successfully for wind forecasts in this area. Attempts to employ this method for the ANP region have been less successful, particularly in the wintertime.

The model for the forecast scheme was limited to using data which probably do not describe sufficiently the forces that are effective in the ANP region. Vertical temperature stability was not incorporated due to the absence of temperature information throughout the height of the inversion layer. Most of the temperature soundings by tethered blimp do not go above 1000 feet, which is frequently below the inversion top. This is unfortunate since the vertical temperature stratification undoubtedly plays an important role in the winds at NRTS. Future studies will consider vertical stability, particularly if temperature information to higher levels is obtained.

9.3 SPECIAL ACTIVITIES

9.3.1 Diffusion Studies With Non-Radioactive Tracers

Studies to improve the understanding of short-range diffusion from elevated sources have been initiated. Particular emphasis will be placed upon studying the light wind-strong temperature lapse condition commonly referred to as "looping." Under such conditions, vertical air currents affect the diffusing plume to such an extent that existing diffusion equations may be quite inaccurate. The looping case can be a health problem for an area near the stack since downdrafts permit high concentrations to be brought to the surface quite quickly.

A fluorescent tracer, uranine dye, is mixed with water to a 20% solution and released from the top of a 150-foot tower at a rate of about 60 grams/minute. The release time is usually 30 minutes. The dye solution is forced up a hose by a compressor supplying 100 cfm of air and 100 psig of pressure. A specially designed nozzle introduces the air to the dye solution at the proper point to insure a small particle size distribution. The water quickly evaporates, leaving an aerosol of uranine dye particles. The results of Robinson (1), et al, indicate that a fine particle size of 2-10 microns with a median size of 5 microns can be expected.

The tracer is collected on a MSA 1106-B filter from air drawn through by a high volume sampler. The flow rate with this glass fibre type filter attached is 15 cubic feet per minute. A grid with six arcs covering a 60° sector out to 3200 meters from the release point has been established. There are 100 sampling stations available for any one test.

The exposed filters are washed in distilled water, after which a phosphate buffering solution is added. The fluorescence of the washing is measured by a Photovolt Model 540 Fluorescence Meter in much the same manner as described by Robinson, et al. A quantity of 10^{-8} grams of uranine dye is readily detected by this instrument.

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(1) Robinson, Elmer, J. A. McLeod, and C. E. Lapple: A Meteorological Tracer Using Uranine Dye. (Unpublished) Stanford Research Institute, Menlo Park, California

The micro-meteorological network for these tests include temperature measurements at three levels of the 150-foot tower and Beckman and Whitley wind instruments at the 20- and 150-foot levels. Two bivanes have been constructed to give the vertical wind direction fluctuations at the 20- and 150-foot levels. Additional wind information is recorded on the grid itself. From these measurements, the correlation between various micro-meteorological variables and atmospheric diffusion is examined.

The preliminary work and testing were completed by December 1, 1958, but a month of unfavorable weather prevented any tests over the grid for the rest of the year. Several releases under steady wind and slight lapse conditions will be made in order to obtain a good feel for the experiment. Under such conditions, the best agreement between measured and computed diffusion can be expected. Tests during looping conditions will be conducted as soon as they occur. This weather type is not too common in the wintertime due to the lack of solar heating of the surface.

9.4 ROUTINE

The Weather Bureau provides a daily weather forecast service for the AEC and its contractors for construction purposes and routine reactor operations. Normally only a day shift is maintained, but extra shifts are supplied as needed. A morning forecast is issued for the following 24-hour period and a subsequent 24-hour forecast is issued again late in the afternoon.

All the pertinent data from the network of weather stations throughout the NRTS and its environs are processed and summarized in various reports. Particular emphasis is placed upon the stations at Central Facilities and ANP. Monthly and annual local climatological data summaries are prepared for these two stations and distributed to interested groups. Numerous interpretations of meteorological information and special studies are provided for the Idaho Operations Office and its contractors.

The Weather Bureau frequently provides recommendations to the contractors with respect to such problems as location of reactors and reactor stacks. This often involves special studies of the appropriate weather data in a form readily understandable to the reactor hazard analysis. Hazard reports that discuss the consequence of any planned or accidental release of radioactive material to the atmosphere are reviewed. In the past year, hazard reports concerning the Flight Engine Test, Gas Cooled Power Reactor, Fission Product Field Release Tests, TREAT, and IET were evaluated.

9.5 FUTURE PROGRAMS

9.5.1 Diffusion Studies with Radioactive Tracers

Radiation data collected by mobile crews and from the fixed network of sampling stations of the Health and Safety Division, IDO, will be analyzed for diffision studies whenever the data appears suitable. This will probably involve data collected by the Site Survey and Ecology Branches of the Health and Safety Division, IDO, and the U. S. Public Health Service.

It is anticipated that two aspects of the diffusion problem will continue to be studied from the collected data. The first is the variation in distances out to maximum surface deposition from elevated sources for different temperature lapse rates. The rabbit and vegetation samples collected by the Ecology Branch represent time integrals of air concentration or deposition rates that have given above background readings for 30 miles. Therefore, information on the diffusion of radioactive material for great distances can be obtained. Absolute values of air concentration can be estimated, but the chief use of the information requires only relative values.

The second principal effort will be further studies of cloud rise and vertical cloud spread from gamma measurements by aircraft. Considerable uncertainty as to the accuracy of the existing equations for computation of the rise of hot plumes above the stack indicates the great need for this type of information. For the successful application of field data towards studying the various diffusion models, fairly good estimates of the effective stack height are important. Only sparse information of the vertical profiles of air concentration or radioactivity, particularly at above-tower heights and at great distances, has been reported in the literature. Therefore, even semi-quantitative estimates of vertical cloud spread will be useful to fill in the gaps in the current knowledge of diffusion. Flights through the cloud and also downwind along the sides of the cloud are planned.

General Electric is establishing a network of wind and temperature stations mounted on weather towers with the information telemetered back to a central location at the northern end of the site. This will supplant the present Weather Bureau stations in the ANP area. However, we understand meteorological information from this network will be available to the U. S. Weather Bureau for correlation with diffusion measurements.

9.5.2 Diffusion Studies with Non-Radioactive Tracers

Diffusion studies using uranine dye as a tracer will continue with the present grid and equipment. Emphasis will be placed on studies of the looping diffusion case as soon as this weather type becomes more common. As much useful data will be accumulated as weather conditions permit before the equipment, on loan from the Air Force, must be returned. This should be sometime in May. In addition to studying diffusion, test data on the use of uranine dye as a tracer will have been accumulated and procedures of sampling and analysis will have been explored. With this background knowledge, plans for further studies involving releases from elevated points during inversion conditions can be formulated. Studies out to greater distances, 10 - 30 miles, would be a primary objective.

It is hoped that the objectives of the proposed experiments can be so clearly defined and the details so clearly presented that funds will be made available for these studies in the future. Low volume type samplers with millipore filters are planned. These filters have less inherent fluorescent background difficulties than the glass fibre type. Amounts of uranine dye as small as 10^{-9} grams have been analyzed by Robinson*, et al. Additional major items besides the samplers that would have to be supplied are several weather towers, a number of Beckman and Whitley anemometers, recorders for several bivanes and temperature elements, and possibly a more elaborate method of dispensing larger amounts of tracers.

9.5.3 Wind and Upper Temperature Studies

In order to improve the understanding of the complicated relationship between winds and vertical temperature stability at the NRTS, particularly for the north end of the site, two new tools have been obtained and will soon be tried.

One is an APS-3 radar set for tracking constant level targets. This may also become a useful operational tool for following stack releases of radioactive material as well as giving more detail on upper level winds.

*ibid

The second device is a slight modification of the Weather Bureau radiosonde. The original element is repacked in a styrofoam cover with only the temperature element retained. The transmitted data will be displayed on an oscilloscope after detection by a radio receiver. Flights to 5,000 feet are planned with 100-gram balloons. If the flights are successful, more information on inversion depth and intensity should be gathered than can be gleaned from captive balloon ascents.

9.5.4 Wind Tracer Studies

The abrupt changes in wind direction that are frequently encountered about the NRTS often make accurate determination of trajectories somewhat doubtful. The most noteworthy phenomenon of this type is the occurrence of southwest winds over the southern part of the NRTS and the eastern part of the upper Snake River Valley, simultaneously with northeast winds in the ANP region and at Dubois. This wind pattern can exist for 10-12 hours in the winter and for shorter, but quite frequent periods in the summer. It appears that a topographically induced eddy may be occurring that could cause a recirculation of radioactive material released in the southwest flow.

It is difficult to substantiate this hypothesis from wind observations alone, so fluorescent tracer studies are planned. Either uranine dye in solution or a fluorescent pigment will be released at the ground or from a crop-dusting type aircraft at heights of 500 - 2,000 feet in the prevailing southwest winds when the opposing wind phenomenon is observed. The pertinent stations in the Health and Safety monitoring network between Reno Ranch and Monteview will be activated when the cloud is expected to pass. Millipore filters on low-volume samplers will be the principal collecting medium. Background samples also will be taken.

9.5.5 Digitization of the Weather Network at Central Facilities

Studies for placing the weather information now recorded on strip chart recorders into a digital form will continue. The system will integrate various inputs and read them out as required and also store the information on tape. Sampling speed, integration periods, and readout frequency will vary with the various variables and with the use of the data, either operational or climatological. The present analog system will still be operative for checks and special studies. A special feature of the system is the computation of the variances of the horizontal and the vertical wind direction fluctuations.

9.6 TALKS AND PUBLICATIONS

The following talks were presented by personnel of this office:

1. "The Role of the Weather Bureau in Problems of Radioactive Waste Disposal at the NRTS;" June 1958. Norman F. Islitzer, presented to the NRTS Environmental Advisory Committee.

2. "Meteorological Problems in the Operation of Reactors;" July 1958. Norman F. Islitzer, presented to the Fifth Annual Nuclear Sciences Seminar, sponsored by the Office of Naval Research.

3. An Objective Wind-Forecasting Technique for the NRTS; August 1958. Harry R. Mansfield. Paper presented at the American Meteorological Society Meeting at Denver, Colorado.

4. "Meteorology and Reactors;" November 1958. Norman F. Islitzer, presented to the local American Society of Chemical Engineers.

The following publications were issued by this office in the past year:

1. The Climatology of the National Reactor Testing Station; June 1958, IDO-12003. G. A. De Marrais.

2. The Engineering Climatology of the National Reactor Testing Station; November 1958, IDO-12004. G. A. De Marrais.

TABLE OF ORGANIZATION

U. S. PUBLIC HEALTH SERVICE

R. D. Coleman
Senior Public Health Service Officer

Chief Monitoring Evaluation Project
J. J. Sabo

Electrical Engineer	- 1
Chemical Engineer	- 1
Health Physicist	- 1

CHAPTER 10

U. S. PUBLIC HEALTH SERVICE

R. D. Coleman, Senior Public Health Service Officer

10.1 GENERAL

The U. S. Public Health Service first assigned an officer to the National Reactor Testing Station, attached to the Division of Health and Safety, in July 1956. During the two years of his assignment, he made valuable contributions in the fields of diffusion predictions and environmental monitoring.

The mutual needs of the Service and the Idaho Operations Office for the evaluation of monitoring techniques were recognized. In April, 1958, an agreement was reached which created the Monitoring Evaluation Project at the National Reactor Testing Station. This project was to be staffed by Public Health Service technical personnel and supported by the Idaho Operations Office, Division of Health and Safety, and was given the mission of:

A. The evaluation of existing sampling and monitoring equipment and methods.

B. The development and field testing of new equipment and methods of environmental monitoring.

C. The correlation of diffusion predictions with field samples.

10.2 SUMMARY OF MAJOR PROGRAMS

10.2.1 A two-week conference on Nuclear Plant Site Problems was conducted in February. This conference had in attendance about 25 people from State and Federal health agencies.

10.2.2 The original liaison officer, Mr. D. J. Nelson, was hospitalized in June, and the position was filled by assignment of Mr. R. D. Coleman as Senior Public Health Service Officer, NRTS, in July.

After an orientation period, Mr. Coleman was assigned special survey and evaluation duties by the Director of Health and Safety. These activities, plus consultation on disaster planning, preparation for aerial surveys, and special PHS administrative assignments, constituted the activities of the Senior PHS Officer for period covered by this report.

10.2.3 The staffing of the Monitoring Evaluation Project began with assignment of J. J. Sabo as Project Chief in July 1958. He immediately began to obtain equipment and to develop the program. Mr. R. Frank Grossman (Chemical Engineer) and James E. Martin (Health Physicist) were added to the staff in October. During the period of organization and preparation, facilities were obtained for routine alpha, beta, gamma counting, spectral analysis, and field sampling with an off-the-road vehicle. Arrangements were also concluded for receipt of the general and specific information needed to properly plan the activities.

Examination of the composition of mixed fission products at various times after formation indicated that the iodine group showed the most promise as an indicator of fresh fission products.

Laboratory scale tests indicated that silver nitrate treated filters were as effective for iodine collection as activated charcoal.

Several scintillation detectors showed promise for development of cloud locating and tracking equipment.

10.3 SPECIAL ACTIVITIES

Project personnel conducted field activities for evaluation of sampling techniques and vertification of meteorological predictions in conjunction with five Rala runs. However, the anticipated releases did not materialize when expected and conclusions cannot be made from the data available. Arrangements had been made to supplement air sample results with measurements of deposition on vegetation by the Ecology Branch.

10.4 FUTURE PLANS

10.4.1 The Senior Public Health Service Officer anticipates special emphasis being placed on the following items within the next year:

A. Waste calcination. The design of the liquid waste and off-gas systems will be closely followed.

B. Aerial monitoring. There is a need for development of a standard procedure for the use of aircraft in cloud tracking, cloud measurement, and determination of fallout patterns.

C. The present telemetering system will be evaluated to provide information for an improved system.

D. The overall water sampling program on and off the NRTS will be evaluated in light of data available.

E. The sponsoring of a second conference on Nuclear Plant Site problems.

10.4.2 The future efforts of the Monitoring Evaluation Project will be devoted to continuation of the following activities:

A. Resolution of fission product composition to aid in the development of evaluation techniques.

B. Evaluation of silver-treated paper in continuous tape samplers.

C. The development of cloud locating and tracking instruments with the establishment of distance concentration relationships.

D. Correlation between meteorological predictions and field observations.

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