OAK RIDGE NATIONAL LABORATORY
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87

RADIATION SAFETY AND CONTROL AT THE OAK RIDGE NATIONAL LABORATORY: 1960-1962

F. R. Bruce

ORNL-TM-507

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Date Issued

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ABSTRACT

Activities of the radiation safety program at Oak Ridge National Laboratory for the period 1960-1962 are described. A reduction in the frequency of radiation accidents has been observed and a training program for technical and nontechnical personnel has been formulated. Sixteen facilities were improved to ensure safe operation at a cost of approximately $2,388,589. A comprehensive Radiation Warning and Communication System is being installed in three phases over a period of three years ending in FY 1964.

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1.0 INTRODUCTION AND SUMMARY

Early in 1960 an intensified effort was initiated at ORNL to prevent radiation accidents and to develop a vigorous radiation safety program. A Radiation Safety and Control Department was established consisting of a Director and four staff members. The general areas of responsibility for the elements of the program are shown in Chart 1. A Laboratory radiation safety policy was defined, which required that all operations be performed in such a way that personnel exposures, property losses from contamination, and environmental contamination be minimized.

These requirements have been satisfied in the last three years by assigning responsibilities for radiation safety, establishing regulations and procedures for safe operation, initiating an intensive training program, upgrading Laboratory facilities, and establishing safety criteria for the design of new facilities.

A decrease in the frequency of radiation accidents is now apparent. The last reportable radiation incident occurred October 23, 1961, and the number of unusual occurrences reported for 1962 was 59, compared to 87 in 1960.

With the development of containment criteria and design standards it became necessary to improve many facilities to ensure safe operation. Within a period of two and a half years, sixteen facilities were improved at a cost of approximately $2,388,589. An additional $147,934 of equipment funds was expended for containment control and process waste monitoring instruments. Each facility, upon completion of the required modifications, was carefully examined and tested to ascertain that the containment criteria were fulfilled.

To improve the understanding of radiation safety problems throughout the Laboratory, a training program for technical and nontechnical personnel was initiated and has since become a permanent part of the RS&C program. To date, radiation safety training has been given to about 2000 people, including 1700 technical personnel, 100 craft foremen, 150 technicians and chemical operators, and 40 apprentices. Many other employees have received training through the media of safety meetings, lectures by members of Applied Health Physics, and individual intra-divisional programs.

Radiation safety publications have been an important part of the program. In September, 1960, a Radiation Safety and Control Training Manual was published and since then approximately 1600 copies have been issued.

A Radiation Safety and Control Pocket Manual was published in June of 1961 and approximately 1000 copies were distributed. This manual was extremely well received and extra-Laboratory demand required its being reprinted by the USAEC Division of Technical Information for sale to the public.

Following the SL-1 Reactor accident, increased emphasis was placed on reactor safety and an engineer was added to the RS&C staff to coordinate radiation safety activities relating to Reactors and Critical Experiments.

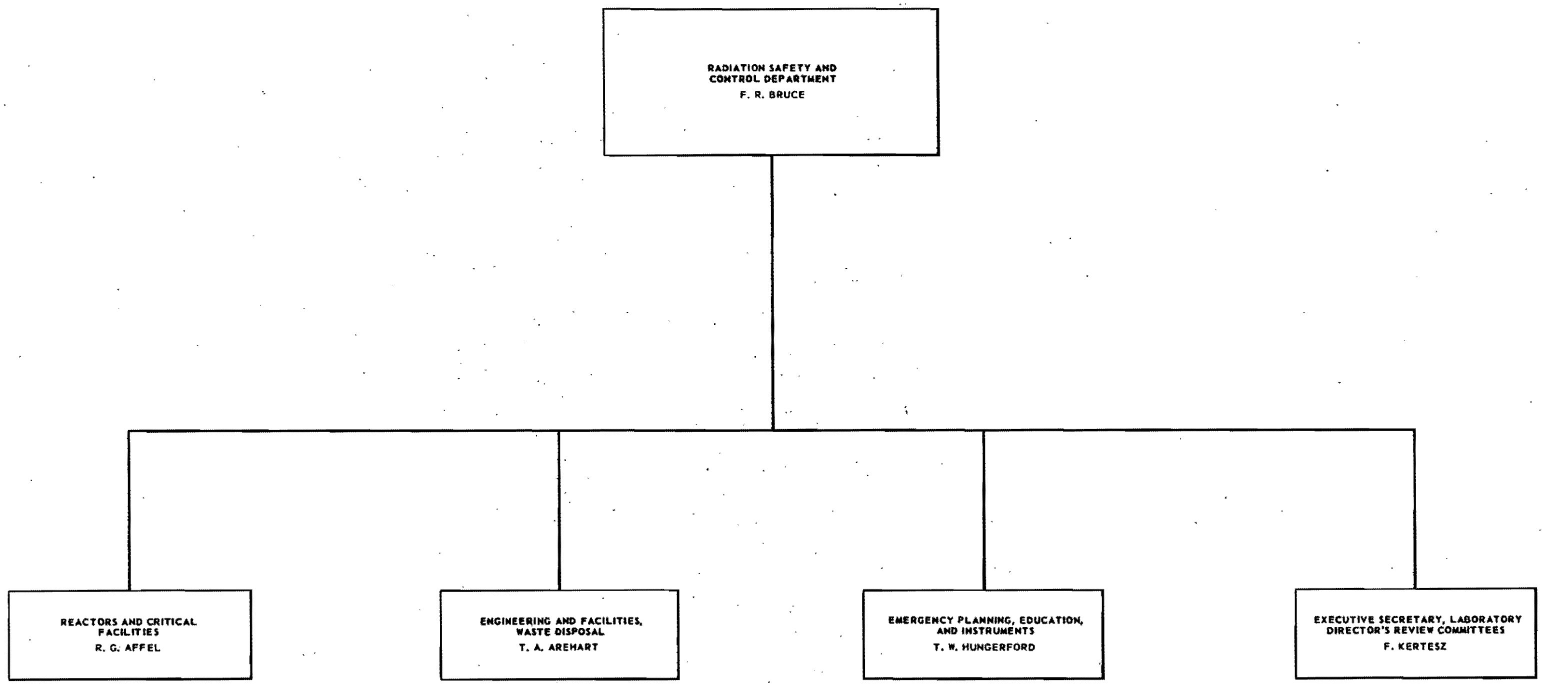

Chart 1.

ORGANIZATION CHART
OAK RIDGE NATIONAL LABORATORY
OPERATED BY
UNION CARBIDE NUCLEAR COMPANY
DIVISION OF UNION CARBIDE CORPORATION
POST OFFICE BOX X · OAK RIDGE, TENNESSEE

F.R.B.		1-1-63	[signature]

Radioactivity measurements in the Clinch River indicate a downward trend for the past three years: 25% of the maximum permissible concentration in 1959 versus 7% in 1962.

2.0 CONTAINMENT

Following three serious accidents in the processing and handling of radioactive materials in the latter part of 1959, a radiation safety directive was issued establishing criteria* for the containment of radioactive operations. The criteria specified that each facility handling more than one gram of plutonium, or isotope of equivalent hazard; or more than 1000 curies of beta-gamma activity, should be capable of containing the materials on suffering the maximum credible accident.

Initially, the adequacy of all facilities handling radioactive and source materials was investigated and it was determined that modification of most of the facilities was required. With few exceptions these facilities were shut down or operating restrictions were imposed pending the completion of the containment modifications. In order that operations could be resumed as soon as possible, the containment program was given a high priority.

The program proceeded with close cooperation between RS&C and most of the Laboratory divisions, and its elements were:

1. Development of design criteria for achieving the desired degree of safety.

2. Establishment of a design review committee for determining the adequacy of changes under the containment program.

3. Planning for the funding and manpower required for the engineering design and construction.

4. Preparation of formal hazards reports for those facilities handling quantities of materials requiring containment.

Table I shows the facilities included in the Containment Program which entailed the expenditure of $2,388,589 of General Plant Project funds and $147,934 of expense funds.

Several projects were not included in the original Containment Program because hazards evaluations indicated that the need for renovations was less urgent. They are:

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*"General Criteria for Containment of Radioactive Operations," December 11, 1959, by J. A. Swartout.

Table I

CONTAINMENT PROGRAM

General Plant Project Funds

Facility	Modifications	Completion Date	Cost
1. FPDL - Building 3517	a. Building containment	8/60	$ 158,564
	b. Off-gas scrubbers and filters	8/60	82,083
	c. Modifications to ventilation filter system	8/60	28,103
	d. Closed loop process water piping	8/60	10,542
	e. Sr-90 manipulator cell	8/61	82,389
2. Physical Examination Hot Cells - Building 3026-D	a. Modification to ventilation system	3/61	49,544
	b. Containment and maintenance cubicle	2/61	62,950
3. Building 3019 Complex	a. HRLAL ventilation filter system	11/61	91,270
	b. VPP scrubber and filter system	5/61	86,384
	c. VPP containment	6/61	53,557
4. Radioisotope Production Laboratory (A), Building 3028	a. Building containment	4/62	152,982
	b. Off-gas scrubber	9/60	13,643
5. High Radiation Level Chemical Development Laboratory - Building 4507	a. Building containment	7/61	195,745
6. Special Isotopes Separations - Building 9204-3	a. Building and facility containment	8/62	493,143
7. Source and Special Materials Vault - Building 3027	a. Building containment	7/61	20,302
8. Radioisotope Production Laboratory (B), Building 3029	a. Building containment	5/62	114,855
9. Interim Containment - Physical Examination Hot Cells - Building 3025	a. Facility containment	1/61	38,044
Completion Containment - Physical Examination Hot Cells - Building 3025		10/62	38,412

Table I - continued

Facility	Modifications	Completion Date	Cost
10. Isolation (Alpha) Laboratory - Building 3508	a. Facility containment	4/62	$ 37,848
11. Central Monitoring Station - Building 3105	a. New construction	8/61	15,088
12. Ventilation Filter System for Buildings 4501, 4505, 4507	a. New construction	4/61	182,454
13. Ventilation Filter System for Upper Isotope Area	a. New construction	11/61	118,267
14. Oak Ridge Research Reactor - Building 3042	a. Off-gas system for in-pile experiments	11/61	60,951
15. Graphite Reactor Canal - Building 3001	a. Canal water demineralizer	4/62	37,264
16. Liquid Waste System - Low and Intermediate	a. Pipe lines installed b. 3,000,000-gallon emergency storage basin	9/61	164,205
		TOTAL	$2,388,589
Equipment Funds (GPE)			
Containment Control Instruments - Building 3508	a. Radiation monitors	3/60	16,000
ORNL Process Waste Control	a. Facility monitoring and sampling stations	9/61	131,934
		TOTAL	$ 147,934

1. High Level Radiochemical Laboratory - Building 4501
    a. Containment modifications
2. Oak Ridge Research Reactor - Building 3042
    a. Additional building ventilation and filtration
3. Special Materials Machine Shop - Building 3044
    a. Additional building ventilation and filtration
4. Special Isotopes Separation - Building 9204-3
    a. Uranium Laboratory improvements
5. Fission Product Development Laboratory - Building 3517
    a. Process cooling water recirculating system
6. Low Intensity Test Reactor - Building 3005
    a. Facility containment
    b. Facility off-gas and filter system.

Item 6 is in Engineering design; item 5 has been completed and the rest are well along toward completion.

3.0 RADIATION ACCIDENTS

3.1 Classification

In order to better evaluate the long term effectiveness of the RS&C program, a system has been devised whereby radiation accidents are classified into three categories:

1. Reportable radiation incidents
2. Radiation events
3. Unusual occurrences.

A reportable incident involves the exposure of personnel to an integrated dose equal to or greater than 3.0 rem whole body, 10 rem skin, 25 rem extremities, internal body deposition which exceeds Radiation Protection Guides, or a financial loss equal to or greater than $5000. These incidents must be reported promptly to the USAEC. The parameters for a radiation event lie approximately between the above values and one-tenth of them. Radiation events are classified and reported by Applied Health Physics. An unusual occurrence is one or more of the following: (1) a violation of Health Physics regulations, (2) a radiation or contamination accident of a magnitude sufficient to temporarily suspend an operation, (3) an event which might have resulted in significant personnel exposure or facility contamination under less fortunate circumstances, (4) an event which could have resulted in public relations significance. All unusual occurrences are written up by Applied Health Physics and distributed to those concerned.

3.2 Frequency of Radiation Accidents

A decrease in the frequency of radiation accidents over the past three years is apparent (Fig. 1). The improved accident record is attributed to the increased awareness which has been promulgated by the over-all program of all Laboratory personnel for the importance of radiation safety.

4.0 FACILITY REVIEW

It is the policy of the Laboratory that each facility, operation and experiment where ionizing radiation and/or a fissionable material is handled, be designed to include necessary safeguards which are determined by the radiation hazard anticipated in the event of the maximum credible accident, as well as the potential hazard which is attendant to normal operation.

To implement this policy all operations entailing a significant potential hazard are carefully reviewed. All requests for approvals are submitted to Radiation Safety and Control where they are reviewed by a staff member and the Executive Secretary of the Laboratory Director's Review Committees. If the potential hazard of the operation in question is slight it is disposed of by the RS&C staff. If, on the other hand, the potential hazard is great, or if effective review requires talents not existing in RS&C, the appropriate Laboratory Director's Review Committee is asked to consider the case.

Normally the RS&C staff and representatives of Applied Health Physics handle requests pertaining to (1) preliminary design criteria for new radiochemical facilities or changes to existing facilities, (2) radiochemical operations or experiments involving less than 1 gram of plutonium or equivalent hazard, and (3) relatively minor changes in radiochemical operations and experiments previously approved by committee action.

Committee action is required on: (1) the plans for radiochemical operations and facilities having considerable potential hazard, (2) criticality problems, (3) all reactor operations annually, and for significant modifications, and (4) reactor experiments referred to the Committee by the Operations Division.

4.1 Radiation Safety Criteria

A need has long existed for written radiation safety criteria for more difficult operations at the Laboratory. To develop these criteria three study groups participating with Radiation Safety and Control have evaluated:

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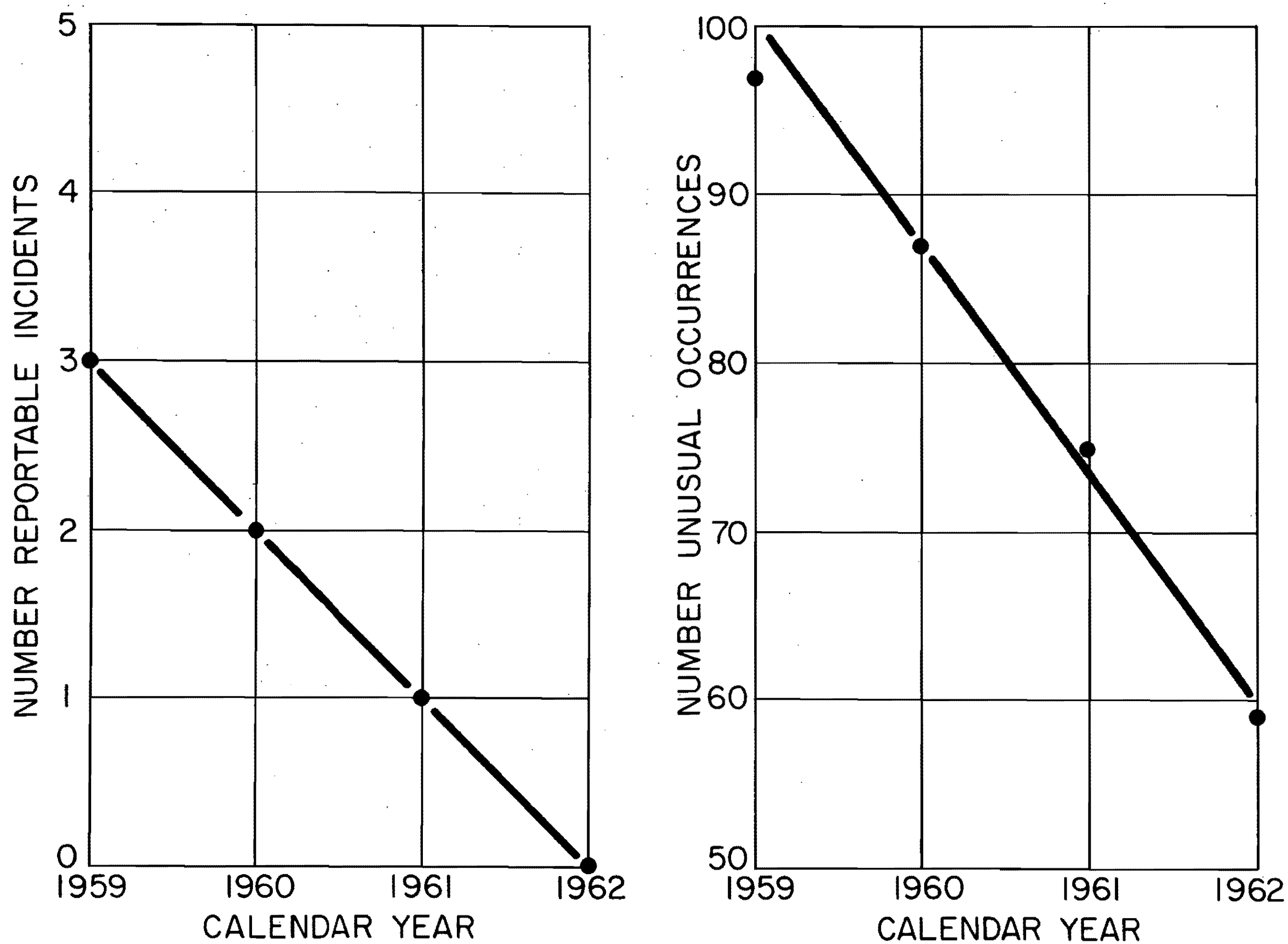

Fig. 1. Frequency of Radiation Accidents at ORNL.

(1) personnel monitoring, (2) design criteria for laboratories handling radioisotopes, and (3) safe practices for installation and operation of x ray machines. A final report with a number of recommendations has been issued on item (1). Preliminary drafts have been circulated to interested personnel covering items (2) and (3) and final reports are scheduled to be published in early 1963.

4.2 Standardization of Operating Practices

A sound radiation safety program frequently requires interpretation of specific questions which arise. Three such matters were studied and recommendations made to all Laboratory Divisions:

1. A memorandum from the Director of Radiation Safety and Control dated November 20, 1962. Requirements are defined establishing the in situ test frequency and particle collection efficiency for high efficiency filter systems.

2. A similar memorandum dated December 4, 1962, describes the procedures to be used in the disposal of flammable solvents.

3. The Radiation Safety and Control Quarterly Report - July, August, September, 1962, ORNL-CF-62-11-19, discusses practices and regulations concerned with eating, drinking and smoking in radiation or contamination control zones.

4.3 Threshold Detector Modifications

The Threshold Detector Units (TDU's) which are located for dosimetry purposes in facilities having a potential for a criticality accident, contain hazardous quantities of plutonium and neptunium. The problem of containing these materials for eight hours in the event of a 2000°F fire involving compressor lubricating oil at the ORGDP was presented. It was solved by enclosing the TDU's in a welded stainless steel container as shown in Fig. 2.

A review of the fire problems at ORNL indicated that protection against a standard one-hour fire (1700°F) would be satisfactory. It was found that the TDU's would satisfactorily meet these conditions by re-encapsulation of the soft soldered, copper sheathed neptunium and plutonium wafers with heli-arc welded stainless steel sheaths.

The SL-1 Reactor accident demonstrated the importance of being able to recover these units remotely in the event of a serious accident. A plan for remote recovery of the TDU's in the event of a neutron excursion has been developed for each facility. Applied Health Physics has compiled and keeps current a list showing the location of all TDU's and pertinent information on their remote recovery.

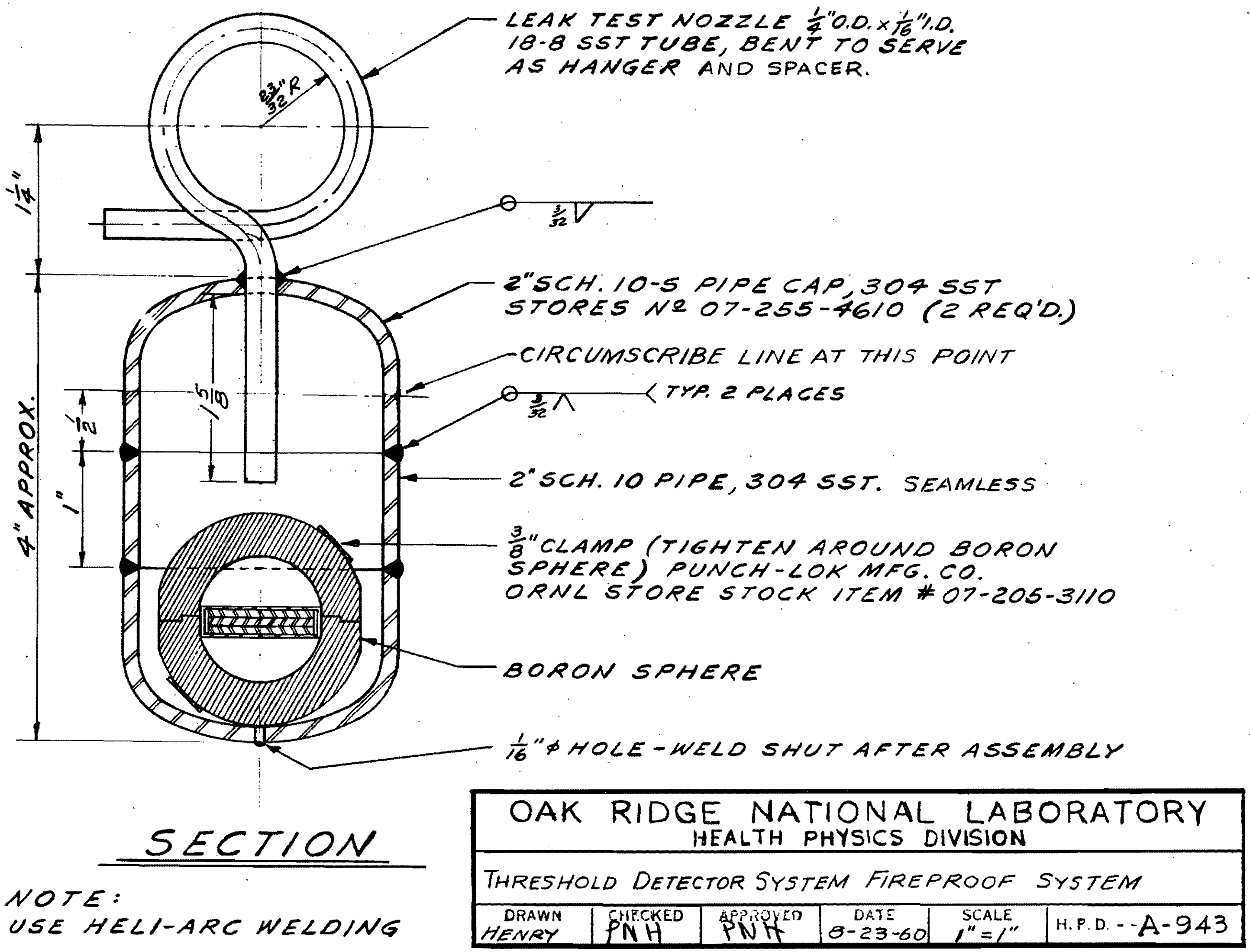
LEAK TEST NOZZLE 1/4" O.D. x 1/16" I.D.
18-8 SST TUBE, BENT TO SERVE
AS HANGER AND SPACER.
23/32" R
1 1/4"
3/32
2" SCH. 10-S PIPE CAP, 304 SST
STORES Nº 07-255-4610 (2 REQ'D.)
CIRCUMSCRIBE LINE AT THIS POINT
TYP. 2 PLACES
3/32
1 5/8
1/2
1"
4" APPROX.
2" SCH. 10 PIPE, 304 SST. SEAMLESS
3/8" CLAMP (TIGHTEN AROUND BORON
SPHERE) PUNCH-LOK MFG. CO.
ORNL STORE STOCK ITEM # 07-205-3110
BORON SPHERE
1/16" ϕ HOLE - WELD SHUT AFTER ASSEMBLY
SECTION
NOTE:
USE HELI-ARC WELDING
OAK RIDGE NATIONAL LABORATORY
HEALTH PHYSICS DIVISION
THRESHOLD DETECTOR SYSTEM FIREPROOF SYSTEM
DRAWN HENRY
CHECKED PNH
APPROVED PNH
DATE 8-23-60
SCALE 1" = 1"
H.P.D. - - A-943

Fig. 2.

5.0 REACTORS AND CRITICAL EXPERIMENTS

On January 3, 1961, the SL-1 Reactor at Idaho Falls suffered a prompt critical accident resulting in three fatalities and destruction of the reactor. Following this accident the USAEC instigated a re-evaluation of all nuclear reactors under its jurisdiction and established a program for their annual review. To cope with the work load resulting from this additional surveillance of ORNL reactors, an addition was made to the RS&C staff.

Radiation Safety and Control participated in the following matters related to the safety of ORNL reactors or critical experiments, and ORNL-AEC relations.

1. Assistance was given in the final draft editing of the hazards reports for the HPRR (ORNL-3248) and the Critical Experiments Laboratory (TM-349).

2. Guidelines for containment of the LITR and upgrading of the ORR scrubber system were established. The scrubber renovation was followed to completion.

3. A Radiation Safety and Control staff member attended the meetings of the RORC, RERC, and Criticality Committee.

4. A criticality audit of the Metals and Ceramics Division was performed in November, 1962, by RS&C with the assistance of the Criticality Committee and the Division.

5. A member of Radiation Safety and Control was appointed to the AEC Committee performing the second annual review of the Laboratory's reactors.

6. Discussions and meetings with AEC and Laboratory staff members were held on the following reactor oriented subjects: AECM Chapter 8401, Technical Specifications, Facility Descriptions, Operating Safety Limits and Subcritical Facilities. Correspondence for approval and transmission to AEC-ORO was prepared on the above subjects.

6.0 WASTE SYSTEMS

The role of RS&C in waste disposal has been primarily that of establishing criteria for safe disposal, and coordination of the groups involved in their generation, disposal and monitoring.

6.1 Radioactive Liquid Wastes

The goal for radioactive liquid waste disposal at Oak Ridge National Laboratory is to provide capability - especially in new facilities - for assuring that liquid wastes do not exceed, at the point where they leave the controlled area, 0.1 MPC_w ($10^{-7}\mu c/cc$).

To implement this objective the following changes in the waste system are either under way or completed:

1. Improvements to the central waste disposal system in Bethel Valley are under way and consist of water-cooled stainless steel tankage for concentrated high level waste storage and an evaporator for concentration of intermediate level waste prior to storage in existing concrete tanks.

2. A waste collection and handling system for the various facilities in Melton Valley and a pipe line for transfer of low and intermediate level wastes to the Bethel Valley disposal system are under construction.

3. Installation of process waste monitoring systems to determine the volume and activity level of the process waste water discharged from the various radiochemical and research facilities is essentially complete.

4. Capability of telemetering instrument readings to the Bethel Valley central monitoring station to permit centralized control by the Operations Division is essentially in hand.

6.2 Radioactive Gaseous Wastes

The Operations Division has completed the gaseous waste monitoring system for the 3039 stack. All major cell ventilation ducts, the discharge line from the central off-gas facility and stack (50-ft level) are now equipped with flow measuring devices and monitors.

Data from the stack instruments provide an inventory of the amount and type of activity being discharged from the stack and the duct monitors indicate which facilities are responsible for the activity.

Plans are now under way to provide monitors for the 3020 (3019 Pilot Plant) stack and the 3018 (Graphite Reactor) stack.

6.3 Effects of Melton Hill Dam Operations on Waste Discharge from White Oak Creek

The Melton Hill power system, when placed in operation, will be used only during peak electrical use hours and will radically change the flow of water in the Clinch River below the dam. It has been calculated that the water levels in the Clinch River and in White Oak Creek embayment will increase by 3.5 feet in the summer and by 7.7 feet in the winter above present normal levels at times of maximum power production.

As a consequence of the extreme variation in flow, it is conceivable that discharge of radioactive wastes from White Oak Creek may create a problem in the Clinch River. However, until a demonstrated problem arises, no change will be made to the present waste disposal system, other than probably raising the level of White Oak Lake to balance the back pressure created on White Oak Lake Dam when the water level rises in the embayment.

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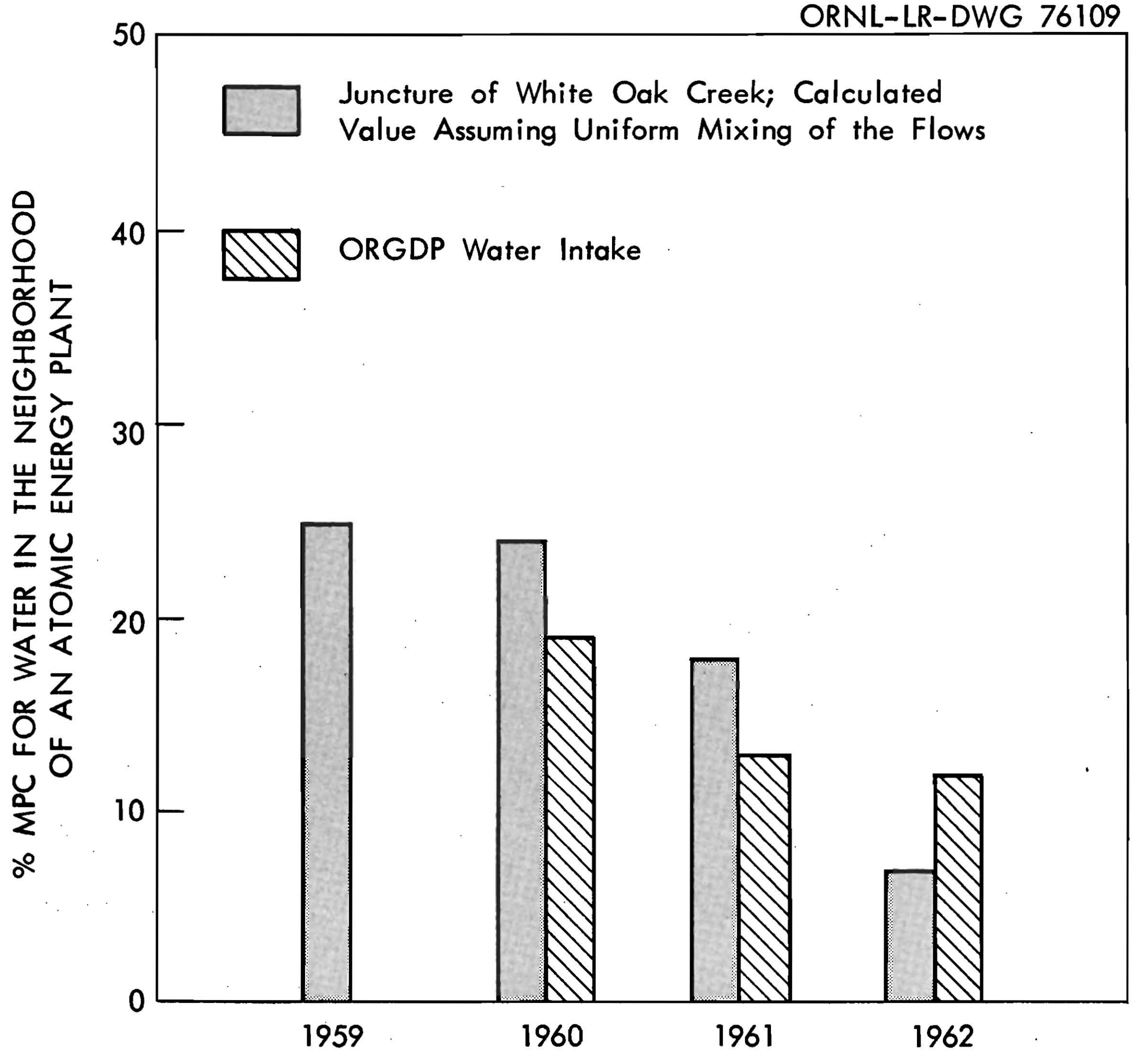

Fig. 3. Radioactivity Measurements in the Clinch River.

In the meantime, RS&C has requested the Operations Division to be responsible for developing a plan which could be implemented immediately in the event that a health or public relations problem results through operation of Melton Hill Dam.

6.4 Radioactivity Measurements in the Clinch River

Continuous sampling and monitoring stations for gross radioactivity are maintained at the White Oak Dam and the ORGDP water intake. Samples are taken periodically for determination of the specific radioisotopes present and a weighted average is used to calculate the % MPC. Fig. 3 shows the annual average for 1959 through 1962 and a slight decrease is apparent.

7.0 LIAISON WITH AEC

Close cooperation is maintained with the USAEC on radiation safety matters of mutual interest. Radiation Safety and Control staff members serve on the ORO Reactor Review Committee and the Emergency Planning Subcommittee of the EGCR Steering Committee. Approximately ten man-days/year are spent with members of the Biology Branch when they conduct their annual Health and Safety Inspection. RS&C staff members have served on joint AEC-Contractor Accident Investigation Teams.

8.0 RADIATION SAFETY EDUCATION

8.1 Training

In order to improve the understanding of radiation safety throughout the Laboratory, a training course was formulated in 1960 and is now a permanent part of the RS&C program. The course was begun in September, 1960, when a twelve-hour pilot series was given to the Radiation Control Officers. At the same time, a Radiation Safety and Control Training Manual was prepared and published.

During the last quarter of 1960, the radiation safety program was presented to approximately 132 supervisors through the Staff Conference Program.

In February, 1961, a lecture series consisting of about twelve hours of instruction and based on the Training Manual was presented to approximately 1100 technical employees. About 1200 copies of the Training Manual were distributed.

On June 22 and 23, 1961, an abridged course consisting of three hours' instruction was presented to 70 technical people assigned to the summer program.

On June 1, 1961, a Radiation Safety and Control Pocket Manual was published outlining the basic principles of radiation safety, types and sources of radiation, units, permissible exposures, exposure controls, safe practices, emergency procedures, etc. The manual was extremely popular and so many requests for copies were received from outside the Laboratory that it has been reprinted by the USAEC Division of Technical Information and is now available for sale through the Office of Technical Services as TID-7027.

On March 13, 1962, a second series of lectures consisting of twelve hours was offered to technical personnel who did not attend the 1961 series. Approximately 300 persons attended.

Two one-hour lectures - "Radiation Accidents" and "Direct Handling of Radioactive Materials" - were prepared and presented by RS&C staff members to approximately 65 of the technicians and operators of the Chemical Technology Division during the first quarter of 1962. These topics were also the subject of a Chemical Technology Division seminar, attended in the main by professional people.

In the second quarter of 1962, an eight-hour course was given to the Apprentice Group under the Laboratory's formal training program by RS&C staff members. This training will be offered on a continuing basis to the Apprentice Group.

In June of 1962 a second series of three hours' instruction was presented to approximately 75 technical people assigned to the summer program.

A short course of two one-hour lectures covering the fundamentals of radiation controls was developed and presented to approximately 80 foremen of the Engineering and Mechanical Division by RS&C staff members during the third quarter of 1962.

8.2 Radiation Control Officers

In June of 1960, at the request of the Laboratory Director, Radiation Control Officers were appointed for each division handling radioactivity to represent the Division Director in matters of radiation safety. Their role as a communication link for Radiation Safety and Control has proved invaluable to the radiation safety program.

The Director of Radiation Safety and Control meets monthly with the Radiation Control Officers at present. Matters of general interest regarding the status of radiation safety are discussed and, beginning in September, 1961, formal minutes of the meetings have been prepared and distributed. During the period June, 1960, to January, 1963, approximately thirty meetings were held.

8.3 Advisory Bulletins

In order to improve radiation safety performance, by benefitting from past experience, a Radiation Safety and Control Advisory Bulletin was initiated in late 1960. These bulletins serve as a medium for describing selected unusual occurrences, particularly those bearing a lesson of widespread interest. These bulletins are carefully written so as not to incriminate or place blame, yet it is apparent that they act as a deterent to repetitive accidents and are valuable in maintaining interest in the RS&C program. To date, sixteen Advisory Bulletins have been issued.

9.0 LABORATORY DIRECTOR'S REVIEW COMMITTEES

9.1 Summary of Activities

The Director's Review Committees were organized to advise the Laboratory Director on the safety of Laboratory facilities and practices. The committees have been found valuable because individuals with varied backgrounds supplement each other and are able to provide guidance to the experimentalists.

In March, 1959, an Executive Secretary serving all committees and reporting to the Director of Radiation Safety and Control was appointed. This provided improved liaison between the committees and other staff functions having responsibility for safety.

Members of the committees are appointed by the Laboratory Director, usually for a term of three years. Care is taken to include specialists from pertinent fields on each of the committees.

The committees hold 60 to 80 meetings per year (Table II). During the period 1960-1962 approximately 250 safety recommendations were made by the committees. Sessions may be held for such purposes as periodic review of the facilities within the scope of the committee; review prior to start-up of a facility; or review of hazards evaluation reports prior to submission to AEC. Review and subsequent approval on the part of a committee in no way diminishes line supervision's responsibility for safety. The committee provides an additional and independent review, but its members have no power to issue direct instructions. The advice and recommendations of the committees are subject to confirmation by the Director of Radiation Safety and Control, whose office is responsible for assuring compliance.

Table II

	1960	1961	1962
Reactor Experiment Review Committee	17	18	12
Waste Effluents Committee	17	12	9
Hot Cells and Sources Committee	27	14	7
Radiochemical Plants Committee	11	7	11
Reactor Operations Review Committee	7	7	8
Criticality Committee	4	10	8
Personnel Protection Committee		5	
	83	73	55

Total meetings for 1960:	83
Total meetings for 1961:	73
Total meetings for 1962:	55
Total meetings for 1960-62:	211

The following six standing committees have been operating since January, 1960.

9.2 The Criticality Committee

This Committee is charged with the review of criticality problems arising from the handling, storage and transportation of fissionable materials. The Committee receives from the Laboratory Accountability Section the number of balance areas having an inventory of more than 500 g of U-235, 350 g of U-233 or Pu-239, or any combination of these three materials in excess of 350 g. Critical amounts of fissionable materials within a reactor core are not reviewed by the Committee since they are within the jurisdiction of the Reactor Operations Review Committee; however, the fabrication and storage of fuel elements and their transportation are an important part of this Committee's duties. Committee members also act as advisors on various criticality problems.

9.3 The Hot Cells and Sources Committee

This Committee is responsible for checking radioactive operations performed in hot cells and in glove boxes. It also reviews radiation sources, x-ray machines and particle accelerators.

The Committee examines both the structural details of the facility and the experiments to be performed in them. Typical of the Committee's recommendations is one that radiation producing machines be surveyed to determine the hazard to which the personnel of neighboring work areas might be exposed. This recommendation was implemented by the Applied Health Physics Department and resulted in the discovery of several areas where a high radiation level existed.

In one instance the Committee anticipated a hazard involving the opening of an irradiated capsule containing sodium. It was recommended that the operation be delayed to allow for decay of the radioactivity, and that a fire extinguisher be placed in the cell. When the capsule was opened the sodium did ignite as feared but the fire was rapidly put out with the fire extinguisher and no activity escaped from the cell.

9.4 The Radiochemical Plants Committee

This Committee has jurisdiction over the large-scale radioactive operations including the pilot plants, operated primarily by the Chemical Technology and Isotopes Divisions. The Committee reviews complex plants which handle large amounts of highly radioactive material, presenting difficult problems of containment, maintenance and waste disposal. Subjects for review include the qualifications of operating personnel, their training in radiation safety, accident experience, and adequacy of the facility. The availability of detailed operating instructions and compliance with them are examined.

9.5 The Reactor Experiment Review Committee

Nonroutine experiments referred to this Committee by the Operations Division are reviewed before installation in the Oak Ridge Graphite Reactor, Low Intensity Test Reactor, and the Oak Ridge Research Reactor. In view of the potential danger to the reactors and to the Laboratory at large, all the features of the experiment, in particular, interference with the reactor operations, are carefully scrutinized. Prior to presentation to the Committee the experiments are checked by the Operations Division which also provides technical assistance to the experimenters.

The experiments range from relatively small irradiation tests to major loop facilities whose complexity rivals that of the reactor, and which entail the expenditure of millions of dollars.

The experiments performed at the Pool Critical Facility, the Bulk Shielding Reactor, the Tower Shielding Reactor, and the Critical Experiments Facility, are reviewed by a special committee of the Neutron Physics Division.

9.6 The Reactor Operations Review Committee

This Committee keeps under surveillance the Graphite Reactor (OGR), the Oak Ridge Research Reactor (ORR), the Low Intensity Test Reactor (LITR), the Bulk Shielding Reactor (BSR), the Pool Critical Assembly (PCA), the Tower Shielding Reactor (TSR), the Health Physics Research Reactor (HPRR), and the Critical Experiments Facility. Subcommittees spend considerable time observing the operational practices of the reactor under consideration. At the time of the annual review the practices and operational experience during the past year are closely examined and all unexplained "scrams," unexpected behavior of the reactor and near misses, are reviewed. Special reviews are held whenever major physical or operational changes are contemplated in a reactor. The operator is requested to submit written material for these reviews.

The hazards reports prepared for new reactors are also reviewed by this Committee prior to submission to the AEC.

9.7 The Waste Effluents Committee

This Committee acts as an auditor of the radioactive waste disposal activities of the Laboratory. The Operations Division submits reports on the current and proposed waste disposal practices, and the pertinent research work is reported by the Health Physics Division. Other divisions involved in proposed changes to the system such as the Chemical Technology and the Engineering and Mechanical Divisions keep the Committee informed.

9.8 Personnel Protection Committee

In addition to the above-listed standing committees with their continuing duties, an ad hoc committee, the Personnel Protection Committee, functioned during 1960. This Committee was formed to investigate Laboratory practices affecting the health and safety of the individual employee. The activities of the Health Division, Applied Health Physics Department, the Safety and Fire Departments of the Laboratory Protection Division, and the Radiation Safety and Control Department were examined, as well as those functions of the Personnel and the Personnel Development and Systems Departments, which entail the safety indoctrination of new employees. After a number of sessions during the year, the Committee made recommendations to management.

9.9 Conclusions

The work load arising from the committee assignments may place a heavy burden on individual members who continue carrying out their regular scientific or administrative duties. It is estimated that committee members, in toto, spent an average of about four thousand hours per year in actual meetings during this period, not including time spent in preparation for the meetings.

The committee system has been found effective in uncovering otherwise unsuspected hazards because it brings to bear the experience of a group of people trained in a diversity of technical fields. Not having been involved previously in the design and not being burdened by budgetary problems, the committee members are able to avail themselves of a fresh viewpoint.

The committee system has contributed substantially to the safe operation of the Laboratory and served well its assigned purpose of acting as the "eyes and ears of the Director."

10.0 PROCUREMENT OF RADIATION DETECTION INSTRUMENTS

In the third quarter of 1960 it was felt desirable to formulate a procedure for procurement and assignment of radiation detection instruments used for personnel protection. The goal was to provide uniformity, adequacy, and economy in the use of these devices. A Fixed Instruments Advisory Group and a Portable Instruments Advisory Group were appointed to review requirements of the various Divisions and make recommendations relative to type, application, and quantity of instruments. Standard Practice Procedure No. 30, "Requesting, Issuing, and Installing Radiation Detection Instruments," was issued in February, 1961, defining the method for instrument procurement.

In June, 1962, the procedure for procurement of the more commonly used instruments was simplified. These instruments will be stores stocked and a revised Standard Practice Procedure, No. 30-A, "Procurement of Radiation Detection Instruments for Personnel Protection," has been issued.

11.0 EMERGENCY PLANNING

11.1 Radiation Warning and Communication System

Early in 1961 Radiation Safety and Control appointed a study group to define the requirements for a Radiation Warning System at ORNL, as recommended in the Radiation Emergencies Steering Committee Summary Report, KB-751. The Steering Committee was organized following the June 16, 1958, criticality accident at the Y-12 Plant, for the purpose of making a comprehensive review of all the aspects of the prevention and handling of criticality and radiation accidents.

The problem at ORNL differs from the ORGDP, Y-12 and Paducah Plants because, as well as criticality accidents, there exists a possibility of accidents in which large quantities of highly radioactive material could be released with resultant air-borne contamination requiring evacuation of the entire site.

The basic principles of an adequate alarm system as defined by the Committee include: (1) It should sound, immediately and automatically, a local alarm in case of significant abnormal radiation. (2) It should indicate the location of the radiation incident. (3) It should show the radiation levels throughout the installation. (4) It should be reliable, give few or no false alarms, and sound a distinctive, audible signal.

The ORNL Radiation Warning and Communication System consists of the following elements: (1) a Facility Radiation and Contamination Alarm System and Area, Air and Fallout Monitoring System, (2) a Liquid and Gaseous Waste Monitoring Display, and (3) an Improved Radio Communication System. The entire system is being installed in three phases over a three-year period, ending in FY 1964. The total cost is estimated to be $493,000.

The Facility Alarm System gives notice of high gamma radiation fields, neutron bursts, and gaseous or particulate air-borne releases of radioactivity. A central panel board with emergency power will be installed at each facility where needed and will annunciate instrument failure and provide a radiation level reading for each instrument in the system. The panel consists of plug-in, solid-state memory matrix units and on receipt of coincident high level alarms, a nitrogen cylinder-powered whistle will be sounded automatically. Flashing magenta lights located on the outside of the facility will be actuated and an alarm transmitted to the Emergency Control Center.

The Area Air and Fallout Monitoring System consists of twelve new local air monitoring stations in addition to the ten presently installed within or adjacent to the Laboratory area. These units measure the rise of beta-gamma activity deposited on a piece of filter paper through which a continuous air stream is drawn. A fallout detection system will be added to existing and new local air monitoring stations. It will be capable of continuously measuring alpha and beta-gamma activity of the heavier particles. Data from each monitoring station are transmitted to Applied Health Physics and the Emergency Control Center.

The Liquid and Gaseous Waste Monitoring Display will consist of a slave panel connected to the Central Waste Monitoring Station. Indications of high levels of activity will be telemetered to the slave located at the Emergency Control Center.

The Improved Radio Communication Network will consist of replacement of the present Laboratory Protection net operating on 34.34 mc with two new radio nets operating in the 164 mc range.

Net No. 1, the Laboratory Protection Net, will operate in a simplex mode on dual frequency. F-1 is the normal operating frequency and F-2 is the AEC common emergency frequency of 164.225 mc, which is shared by the AEC, ORGDP, Y-12 and other emergency units located in the Oak Ridge area.

Net No. 2, the Radiation Safety Net, operates in a duplex mode utilizing a repeater station. This system operates on a single channel F-1 but has the capability of future dual channel operation if desired.

The present 34.34 single channel simplex net will be assigned to the Engineering and Mechanical Division as Net No. 3 for evaluation of the value of radio communication in their operation.

Under emergency conditions, if required, F-1 of Net No. 1, F-1 of Net No. 2, and F-1 of Net No. 3 may be patched to provide a single network. At this time all radio traffic will be restricted to radio equipment actually engaged in the emergency and will be cleared through Emergency Control. Under normal conditions, transmission of emergency announcements such as general alerts, fire alarms, accidents and radiation releases will be preceded with a tone signal and transmitted simultaneously over the three networks.

11.2 Air Attack Plan

In the middle of 1961 it was recognized that mass evacuation of people over predetermined evacuation routes to remote assembly points as a protective measure against nuclear attack was unsound. Following a large scale attack protection from radioactive fallout is a necessity for survival and would be required for a period of one to two weeks.

Two members of the Engineering and Mechanical Division have been certified as shelter analysts and a survey indicates approximately 11,000 spaces are available at the Laboratory which, with minor modifications, would offer a protection factor of 100 or more from fallout. An adequate fuel supply for 14 days' continuous operation ot the 150 kw diesel emergency generator located in the basement of Building 4500 has been provided. The AEC has authorized the use of this and additional space at Y-12 and ORGDP by the general population in the event of an emergency. The shelter spaces have been certified and marked by the Corps of Engineers and are currently eligible to receive shelter supplies from the Office of Civilian Defense. Shipment of the supplies is expected in the near future. Responsibility for shelter management in the event of an emergency will be assumed by the City of Oak Ridge.

12.0 RADIATION INCIDENT ADVISORY GROUP

To advise and assist the Director of Radiation Safety and Control in planning the safe re-entry of the Laboratory or a facility in the event of a serious accident, and to minimize the time and cost of restoring a facility to beneficial use, a Radiation Incident Advisory Group was appointed. This group consists of five senior staff members and its value was clearly demonstrated following the release of air-borne beta-gamma activity in a facility in April, 1960.

F. R. Bruce

F. R. Bruce, Director
Radiation Safety and Control

FRB:bb

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