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RADIOACTIVE WASTE DISPOSAL AND DECONTAMINATION

ANNUAL REPORT FOR 1957

OAK RIDGE NATIONAL LABORATORY
operated by
UNION CARBIDE CORPORATION
for the
U.S. ATOMIC ENERGY COMMISSION

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OPERATIONS DIVISION

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E. J. Witkowski

DATE ISSUED

APR 18 1958

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INTRODUCTION

The main waste disposal facilities at ORNL, which are under the jurisdiction of the Operations Division, serve the laboratories and operating buildings located in the Bethel Valley Area. This report covers the operation of these facilities, which include the hot-chemical and the metal waste systems, the process waste system (frequently called the "semihot-waste system"), and the radioactive gas disposal system, which utilizes the 250-ft stack located in the Radioisotope Area. Also included is a report on equipment decontamination and off-shift services performed for the research divisions. The report does not cover the disposal of cooling water from the LITR, gases from the Hot Pilot Plant and the ORNL Graphite Reactor buildings, or solid wastes at the burial ground.

WASTE DISPOSAL OPERATING COSTS

The total 1957 operating cost, charged to research programs through monthly cost allocations, was $177,600, with $116,600, or 66%, representing basic costs (labor and material). A breakdown of the total cost is shown in Fig. 1. A comparison of basic costs for the last three years is made in Table 1. Overhead, utilities, and other charges not controlled by operating methods have not been included, because the method of calculating them has been changed during the last three years.

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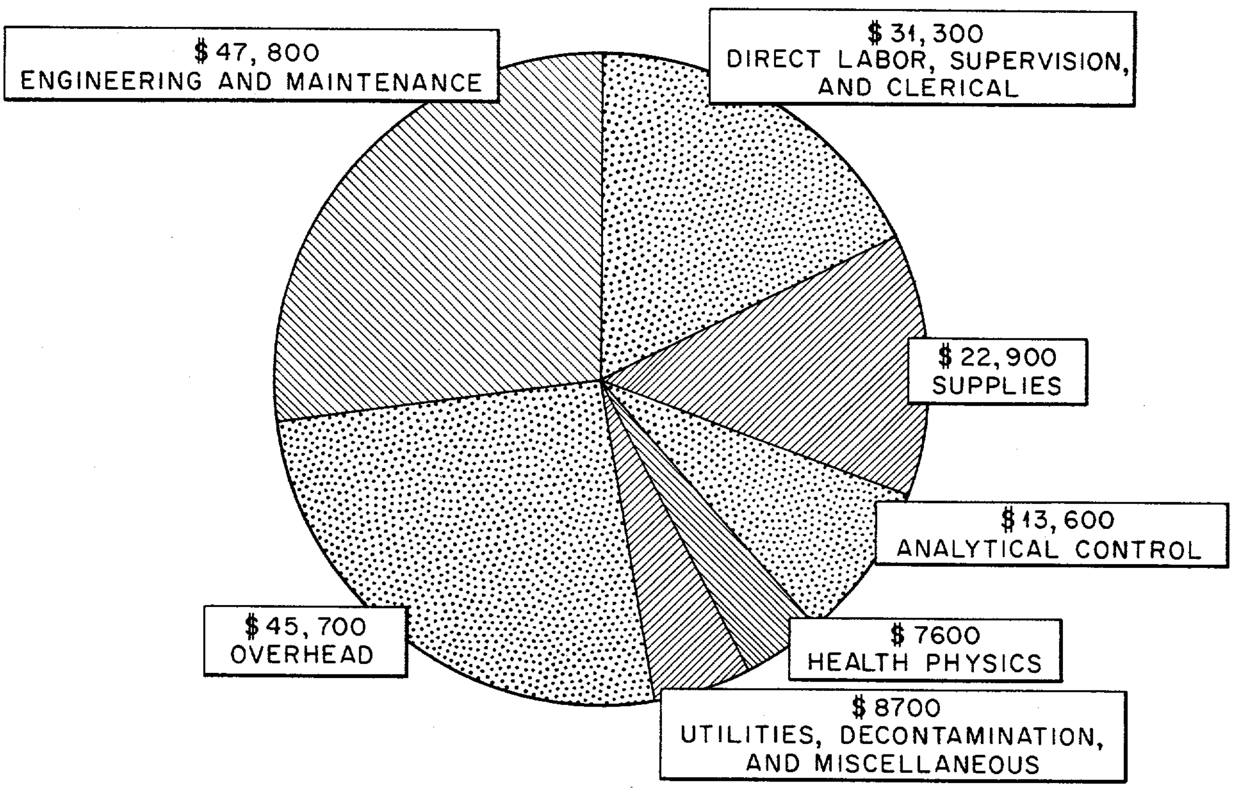

Fig. 1. Waste Disposal Costs for 1957.

Table 1. Waste Disposal Basic Costs for 1955–1957

	1957	1956	1955
Direct labor, supervision, and clerical work	$31,300	$30,300	$27,200
Engineering and maintenance	47,800	27,000	53,000
Analytical control	13,600	11,100	15,400
Supplies	22,900	8,500	– 800*
Miscellaneous	1,000	700	3,800
Total	$116,600	$77,600	$98,600

*Stores credit for return of material.

The $31,300 charge for direct labor, supervision, and clerical work represents a cost of $3.57 per operating hour – an increase of 3% over 1956 costs. This increase was a result of wage increases. The increase of $20,800 in engineering and maintenance cost was required for the startup of the Process Waste Treatment Plant, with a large portion of the increase being spent on excavation of the equalization basin. The $2500 increase in analytical costs was a result of an increase in the number of control analyses required for operation of the Process Waste Treatment Plant.

Charges for caustic, used for neutralization of wastes, accounted for $12,000 of the $14,400 increase in supply charges. The waste disposal operations were not charged for this material in previous years because a large portion of the waste was neutralized by the excess caustic in Rala wastes, with the balance being supplied, without charge, by the Chemical Technology Division, the main waste contributor. The caustic for neutralizing all wastes, other than those from the Hot Pilot Plant and the Metal Recovery Building, is now charged to the waste disposal operation. The balance of the supply cost increase, $2400, was spent for chemicals for operating the Process Waste Treatment Plant.

PROCESS WASTE SYSTEM

Activity and Volume Released to White Oak Creek

A total of 189 curies of activity was discharged into White Oak Creek in 1957, representing the lowest discharge since 1951 and a decrease of 31% under that of the previous year. The decrease was due to a reduction in the frequency of accidental releases, constant policing of the process waste streams, and operation of the Process Waste Treatment Plant during the latter part of the year. Surveillance of the streams brought to the attention of the users leaks that had developed in processing equipment.

The two major contributors to the system were the Hot Pilot Plant and the Metal Recovery Building, which were responsible for a minimum of 25% of the total activity released to the Creek. The high activity from the Metal Recovery Building was eliminated during the latter part of the year by scheduling the purging of the canal so that the waste water could be processed through the Process Waste Treatment Plant. It is planned to reduce future releases by the Hot Pilot Plant by installing constant monitoring equipment nearer the source rather than depending on delayed monitoring results from the waste disposal operation.

The volume of waste was increased from 260,710,000 gal in 1956 to 272,910,000 gal in 1957 and was due entirely to an increase in large-scale chemical processing. Its effect on the capacity of the system was negligible. Other waste disposal data for the last five years are given in Table 2.

A survey, completed in July, revealed that approximately 15% of the water handled by the system during the summer was coming from equipment, mainly air conditioners, that should not have been connected to the system. A program is now in progress to correct this condition before next summer.

PROCESS WASTE TREATMENT PLANT

Construction of the Process Waste Treatment Plant, begun in August 1956, was completed, and operation was started on August 8, 1957 (see Fig. 2). The operation has been essentially trouble-free; not one shutdown has been necessary for extensive repairs or replacement of equipment.

The lime soda ash process has been used almost exclusively thus far in order for the optimum feed rates to be established by laboratory analyses and for research personnel to develop data that may be of use to other atomic installations. The analytical results listed in Table 3 give some indication of the effectiveness of the operation

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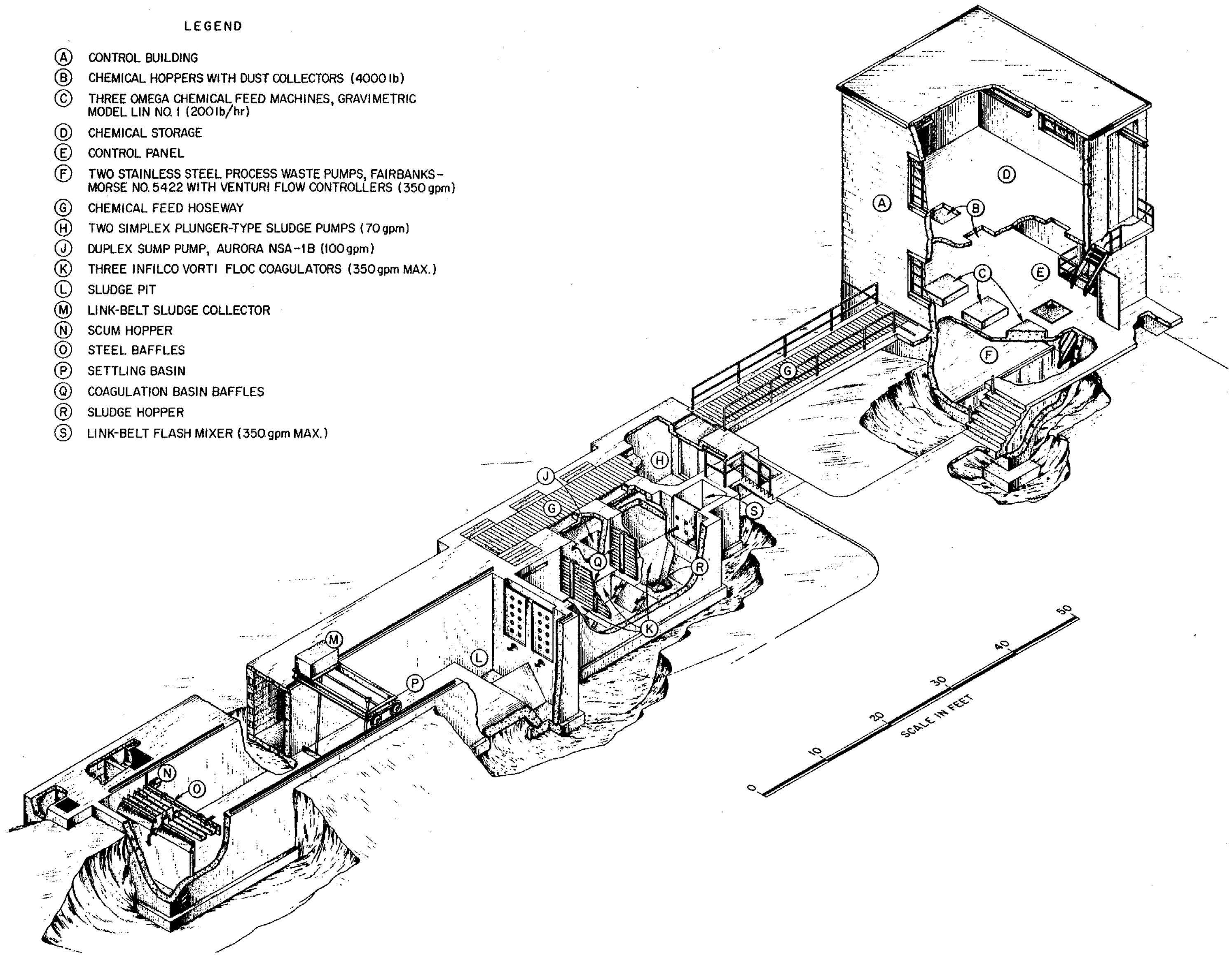

Fig. 2. Process Waste Treatment Plant.

Table 2. Liquid-Waste-Disposal Data for 1953 Through 1957

	1953	1954	1955	1956	1957
Activity discharged to White Oak Creek, beta curies	429	254	267	273	189
Volume discharged to White Oak Creek, gal	239,360,000	164,290,000	210,600,000	260,710,000	272,910,000
Activity discharged to waste pits, curies	7716	7224	21,391	34,989	41,918
Volume discharged to waste pits, gal	227,000*	997,000*	1,682,000	2,694,000	2,903,000

*The waste evaporator operation was discontinued in June 1954. The operation of that equipment accounts for the relatively low volumes handled in 1953 and 1954.

Table 3. Process Waste Treatment Plant Data

	Process Waste*		Per Cent of Activity Removed
	Influent (curies)	Effluent (curies)	
Sr^{90}	12.37	2.27	82
Sr^{89}	1.14	0.19	83
Ru^{106}	2.95	1.66	44
Cs^{137}	9.98	7.55	24
Co^{60}	0.84	0.37	56
TRE	11.50	1.86	84

*Total volume processed: 33,623,000 gal.

thus far, although they are not an actual measure of the total activity processed or removed. The analyses are made on monthly composite samples without consideration being given to the decay that takes place while the sample is being collected. Also, because of cost and other practical considerations, analyses are made on only a few isotopes even though some of the many isotopes, such as Pa^{233} accidentally released in November, may be removed up to 100% by the process.

Only the wastes released between 8:00 AM and 8:00 PM on Monday through Friday have been processed through the plant thus far. Although this schedule of operation gives the Laboratory protection during a period when discharges of activity are most likely to take place, it does not give the maximum protection that the plant is capable of providing. Complete service is expected early in 1958, when the automatic equipment now being installed will divert waste above a predetermined level of activity to the plant and below that level into White Oak Creek without processing. Without the automatic diversion equipment, the plant can handle only about one half the total Laboratory waste. A simplified flowsheet of the entire liquid waste disposal operation, including changes made as a result of the addition of the plant, is shown in Fig. 3.

The treatment of process wastes with materials other than lime and soda ash is also expected to increase the efficiency of the plant and to further reduce the amount of activity released to the Creek. One of the materials that has been tested on a limited scale and shows promise of good results is Conasauga shale. A small quantity prepared at the Laboratory and used as feed material (30 ppm) with lime and soda ash for one week increased the removal of Cs^{137} from an average of 25% to 56%. An effort is now being made to locate a commercial source of this material in order to test it on a larger scale over a longer period of time.

HOT CHEMICAL WASTE SYSTEM

Waste Volume and Activity

The disposal of all hot wastes to waste pits 2, 3, and 4 continued throughout the year. By the end of 1957 the total of all wastes discharged into the pits was 8,546,000 gal containing 114,191 curies (at time of transfer). There was no indication of a significant loss of pit seepage

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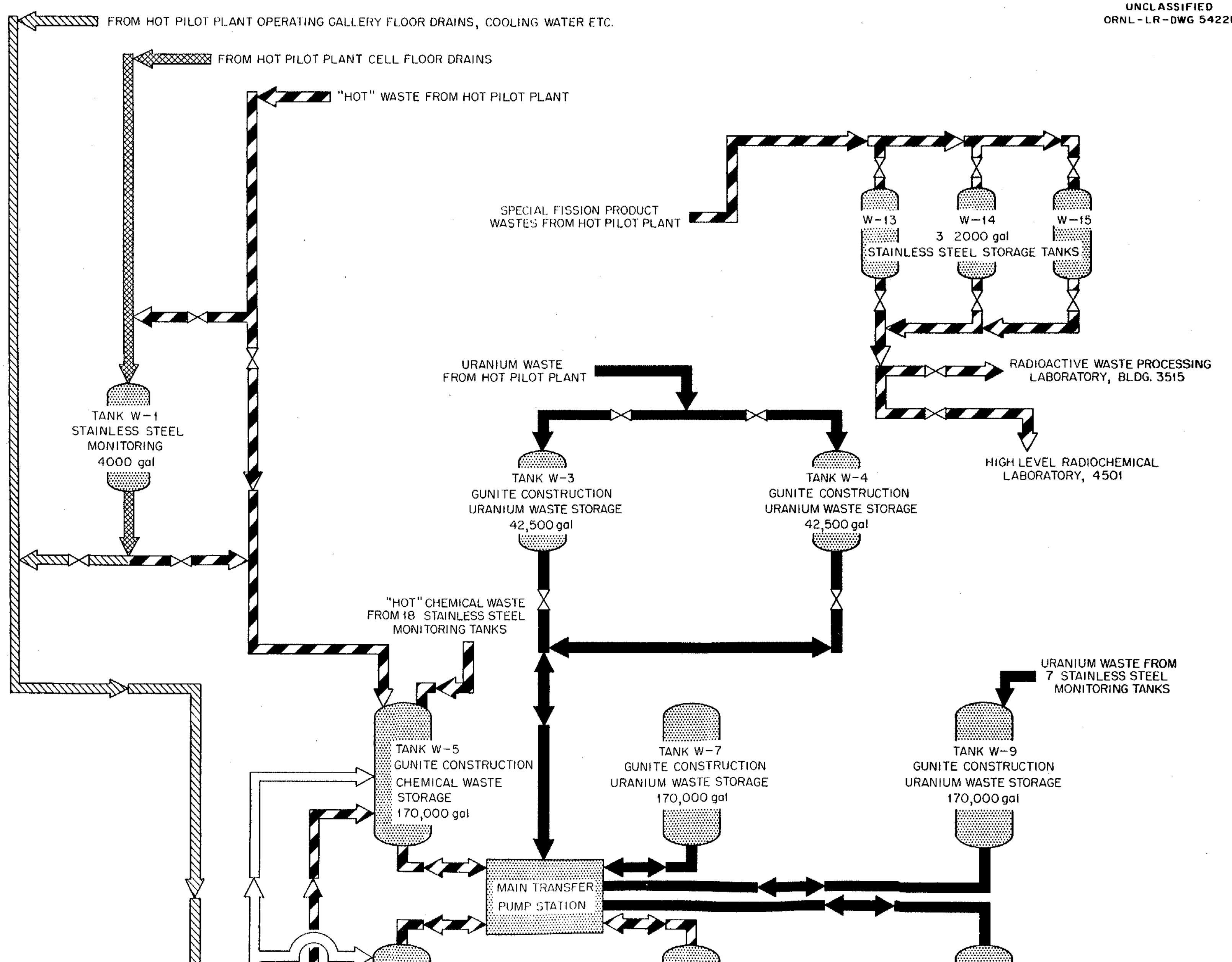
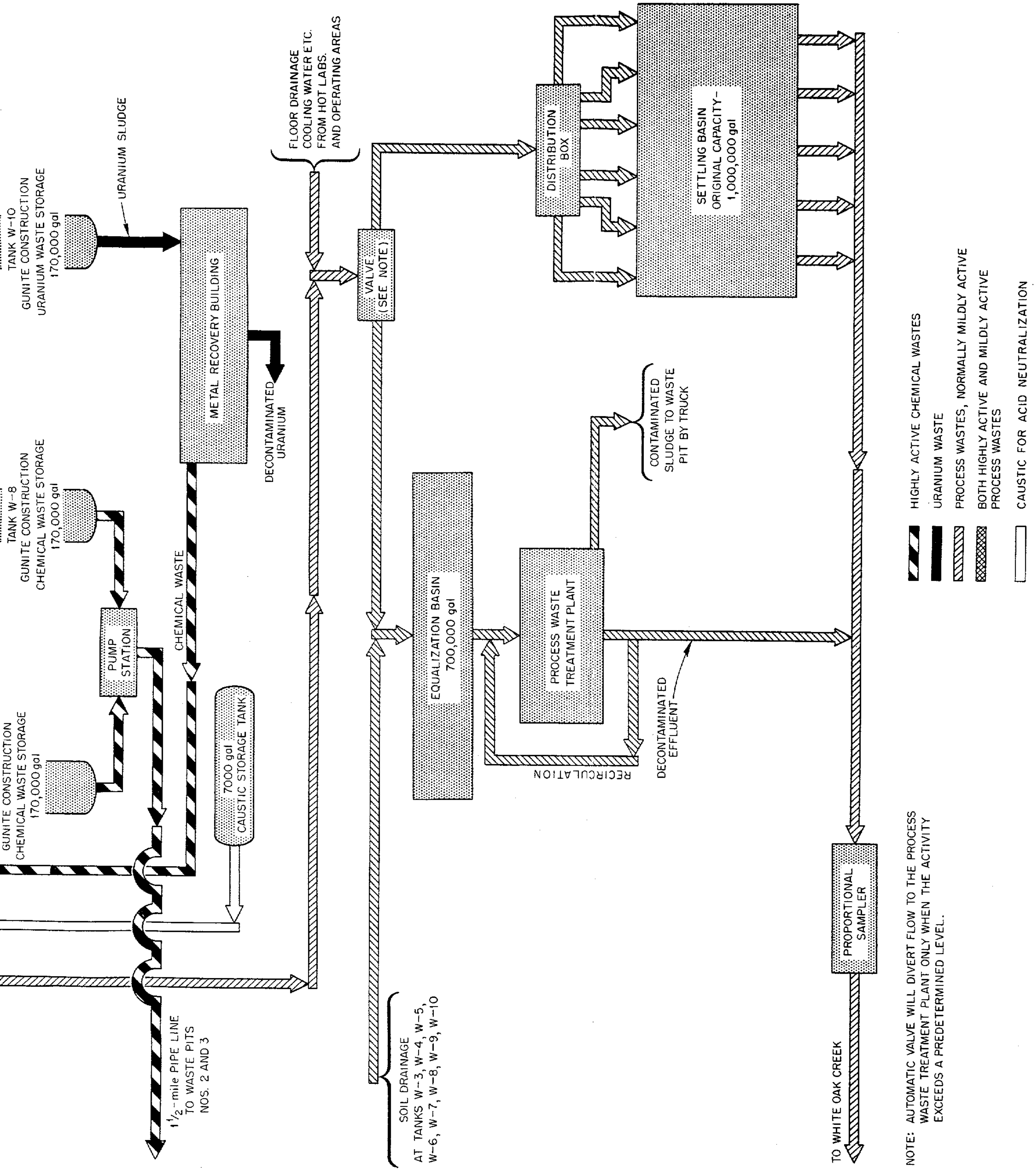


Fig. 3. Simplified Liq



Waste Disposal System Flowsheet.

capacity or breakthrough of activity into White Oak Creek. A total of 41,918 curies was discharged to the waste pits in 1957, an increase of 20% over that in 1956. The increase was due mainly to high radiation levels in processing at the Hot Pilot Plant.

The volume of waste in 1957 was 2,903,000 gal, an increase of 8% over that in 1956. There were two reasons for the increase: a higher discharge from the Hot Pilot Plant and the diversion of some wastes into the system that in previous years were handled by the process waste system. The diversion into the hot waste system, of wastes of lower activity level and of those that had to be analyzed to determine whether they could be handled by the process waste system, helped to reduce the activity discharged to the Creek and eliminated costly analyses. A comparison of volumes as well as activity handled by the system in the last five years is given in Table 2.

Corrosion of Tanks – Waste Neutralization

The neutralization of acid wastes, as they are collected in the stainless steel monitoring tanks, by maintaining an excess of caustic in these tanks at all times, was begun in January. The procedure, which was put into effect after one tank, serving the 4500 Area, was damaged beyond use by HCl corrosion, consists in putting caustic into the tanks after they are emptied and frequently checking the pH while the tanks are being filled. The caustic is hauled to the tanks in a small tank truck.

Continuous agitation of wastes in W-5, the 170,000-gal concrete main storage tank, was also started in January after it became evident that there was a stratification of acid layers because of incomplete mixing. The agitation was made possible by installing a larger tank farm main transfer pump (3000 gph) and installing a second line between the pump and the tank. The waste is now continuously recirculated by pumping from a 3-ft level on one side of the tank and discharging on the opposite side on the surface where the waste is received. The recirculation is stopped only for short periods when transfers between tanks are necessary.

To further eliminate operating difficulties that might arise if tank W-5 were damaged beyond use, a new diversion box is being designed that will allow tank W-7 (an empty 170,000-gal-capacity uranium tank) to be used as an alternate for tank W-5. Since all the waste must be routed to W-5 at present and the drainage outside the tank is to the Process Waste Treatment Plant, where decontamination would be inadequate in case of a major break, the Laboratory could be faced with a prolonged shutdown of many operations until the lines going into W-5 were rerouted to another tank. The installation of the diversion box in the near future will eliminate this risk.

Uranium Storage Tanks

All the uranium waste scheduled for recovery in the Metal Recovery Building has either already been processed or has been transferred to tank W-10, from which it can be transferred directly to the processing equipment. The total free space in the uranium tanks is now 450,000 gal.

RADIOACTIVE GAS DISPOSAL OPERATION

Expansion of Facilities

The expansion of the cell ventilation and off-gas facilities at the 3039 Stack Area, begun in December 1956, was completed with only minor adjustments and alterations remaining to be made at the end of the year. The expansion included the following:

1. A new electrically driven fan was installed to increase the capacity available to the 4500 Area from 30,000 cfm to 60,000 cfm. For emergency purposes, the duct was also connected to the 60,000-cfm steam-driven standby fan previously used only for the Isotope Area and Building 3026.

2. The 30,000-cfm electrically driven fan and its steam-driven standby fan of equal capacity, which previously served the 4500 Area, were connected to the Fission Product Pilot Plant and the Metal Recovery Buildings. The capacity of the electric fan was increased from 30,000 cfm to 35,000 cfm by increasing the size of its motor.

3. A new 2000-cfm stainless steel off-gas blower was installed to double the normal over-all capacity in anticipation of an increase in demand caused by the Laboratory's expanded operations such as the ORR, the Fission Product Pilot Plant, and the Metal Recovery Building. The blower is connected to the 4500 Area and the ORR, with the old steam-driven 2000-cfm blower to be used as a standby for both the old and the new electrically driven blowers. An equipment flowsheet incorporating the changes made in 1957 is shown in Fig. 4.

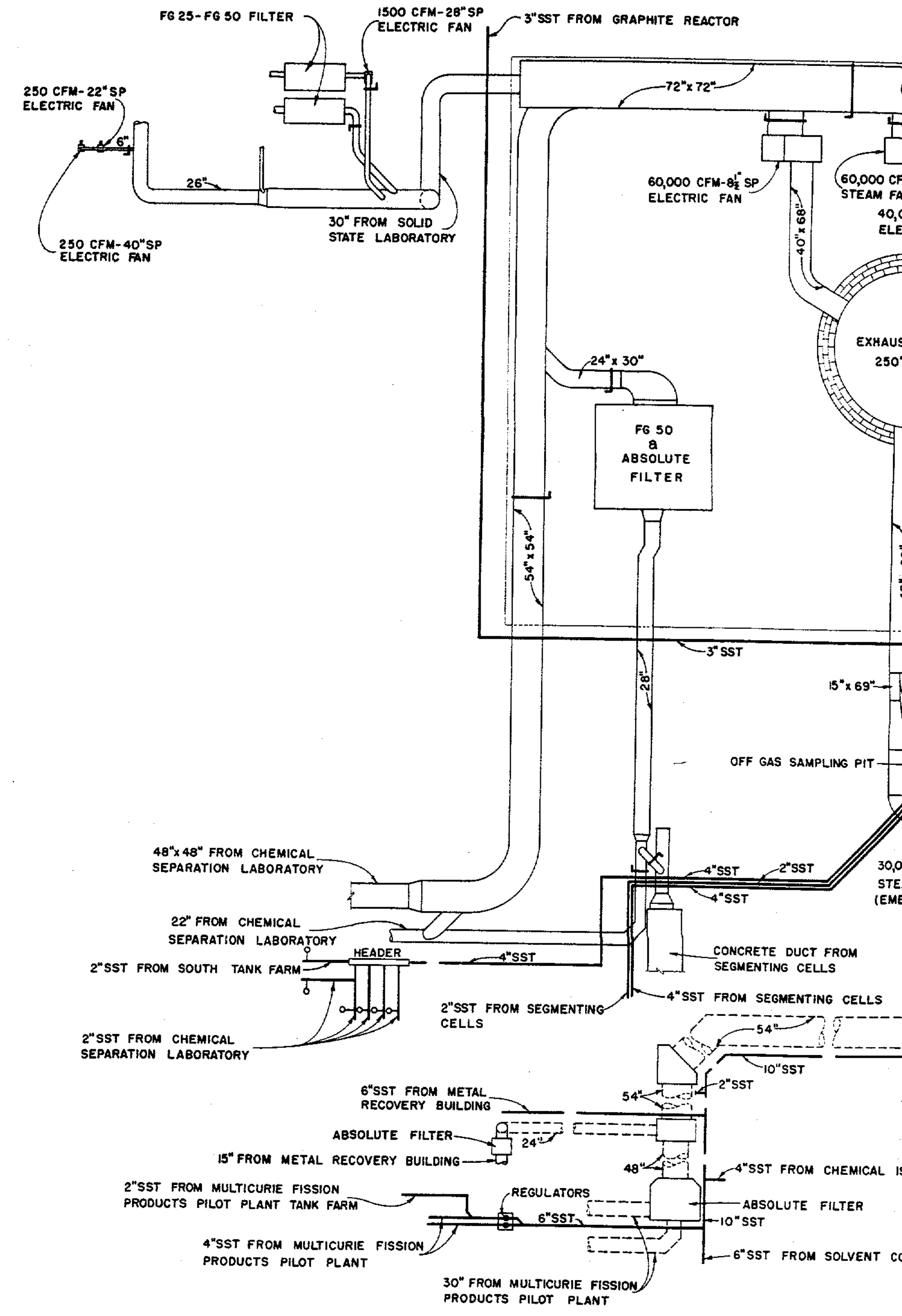
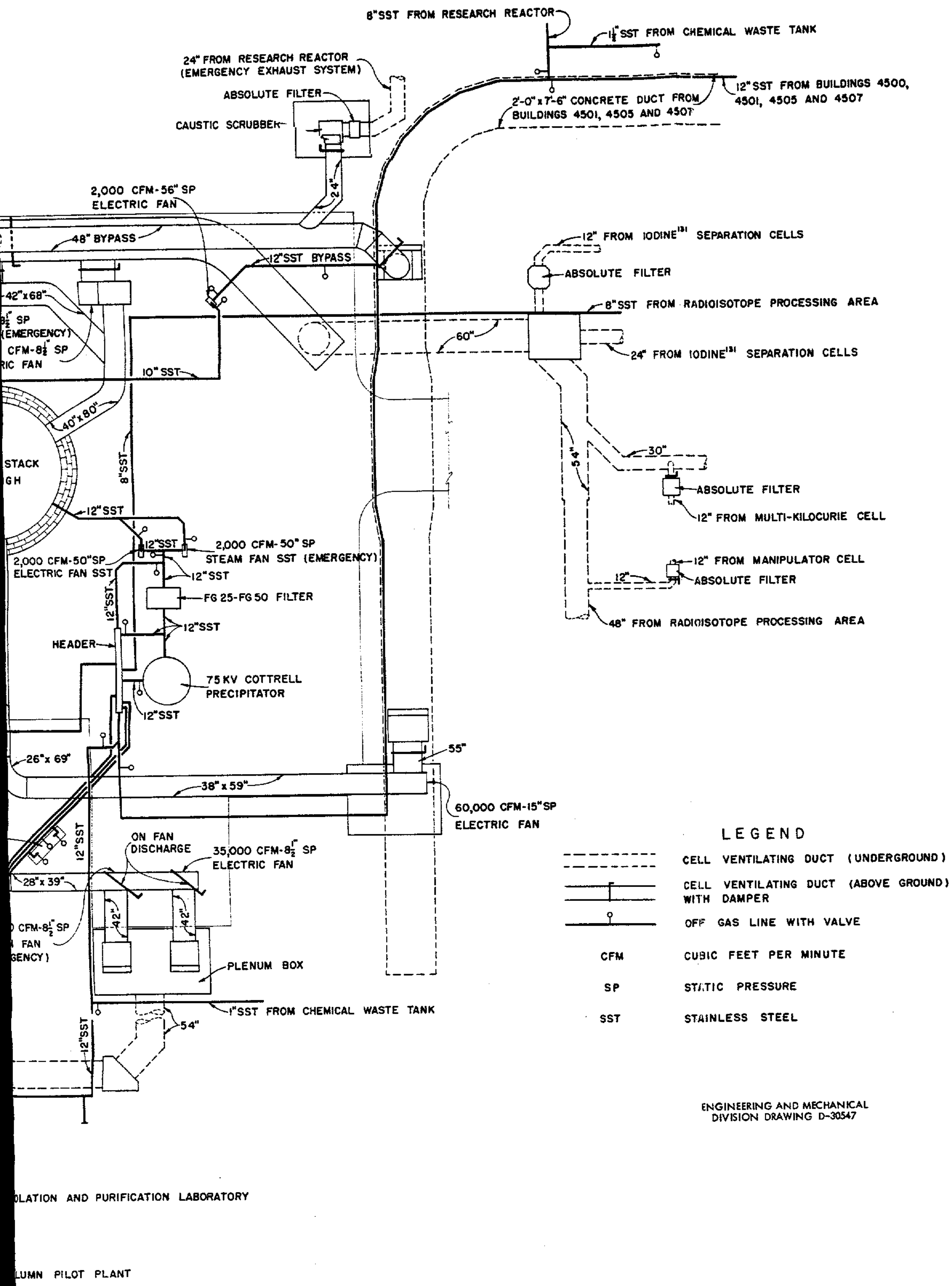


Fig. 4. Area 3039 Ce



Ventilation and Off-Gas Facilities.

Operation of the new equipment was satisfactory except for erratic operation of the automatic damper control on the 60,000-cfm fan and cracks that developed in the outlet duct, which were caused by vibration on the fan outlet. To eliminate these difficulties, additional bracing has been installed on the duct and the controls are being relocated.

Continuity of Service

All interruptions of cell ventilation service were either scheduled at a time when they would not interfere with operations or were of such duration as to create no perceptible hazard. There were no interruptions in off-gas service this year.

Maintenance

Minor cracks and leaks found at the stack breeching during the stack inspection made in August 1956 were repaired in the summer of 1957. All other maintenance requirements were of a routine nature.

Planned Expansion

Preliminary engineering design is in progress for increasing the present off-gas capacity by 4000 cfm to meet an anticipated increase in demand as a result of expanding Laboratory programs and to provide capacity for the Hot Pilot Plant. The present Hot Pilot Plant off-gas facilities at the 2020 Stack Area have been proved to be inadequate from the standpoint of safety and are obsolete and expensive to maintain. The new equipment as planned will include a caustic scrubber, drying equipment, filter, and an electrically driven blower with a duplicate standby steam-driven blower. This expansion will consolidate all the off-gas equipment at one area, thereby making more efficient distribution of service and more economical maintenance possible.

After the Hot Pilot Plant off-gas system is tied into the 3039 Stack Area off-gas blowers, the 3020 stack will be used exclusively for cell ventilation for the Hot Pilot Plant. This cell ventilation service is now provided by means of a 31,000-cfm electric fan and a 31,000-cfm steam-driven fan as an emergency standby. Plans are now in the engineering stage to provide filters for this system to eliminate the high discharge experienced from the 3020 stack in the past.

OFF-SHIFT SERVICES FOR RESEARCH DIVISIONS

More than three man-years (6129 hr) of miscellaneous work was performed for the research divisions on the 12-8, 4-12, and weekend shifts, an increase of approximately 20% over the year 1956. The steady increase in the demand for this service during the last several years has made it impossible for the tank farm operator, working alone, to keep up with the waste disposal tasks and this service. Arrangements are being made to add one operator to the crew so that there will be two men per shift for handling the weekend work. With the additional operator it will also be possible to operate the Process Waste Treatment Plant on a continuous basis rather than five days per week as in the past, thus improving the operation of the waste disposal system and decreasing the amount of activity that would be discharged to White Oak Creek.

EQUIPMENT DECONTAMINATION

The total cost of equipment decontamination was $54,000 (see Fig. 5), representing an increase of $10,283 or 24% over the previous year. Health physics costs accounted for 43% of the increase; direct labor and supervision, 17%; engineering and maintenance, 10%; supplies and clothing, 13%; and overhead, 17%.

It became more apparent during 1957 that the present facilities are inadequate from the standpoint of safety. This inadequacy was emphasized by the lack of ventilation equipment that should have been available for working with highly alpha-contaminated equipment never encountered in previous years. To prevent possible interference with work in the Isotope Area that could result from airborne contamination, it was necessary to schedule some of the work on weekends. To protect the operators doing the decontamination work, it was necessary to take unusual precautions which made the work extremely difficult as well as expensive.

A new building that will provide the necessary equipment is budgeted for 1960. Conceptional design drawings for cost estimating purposes are now being prepared.

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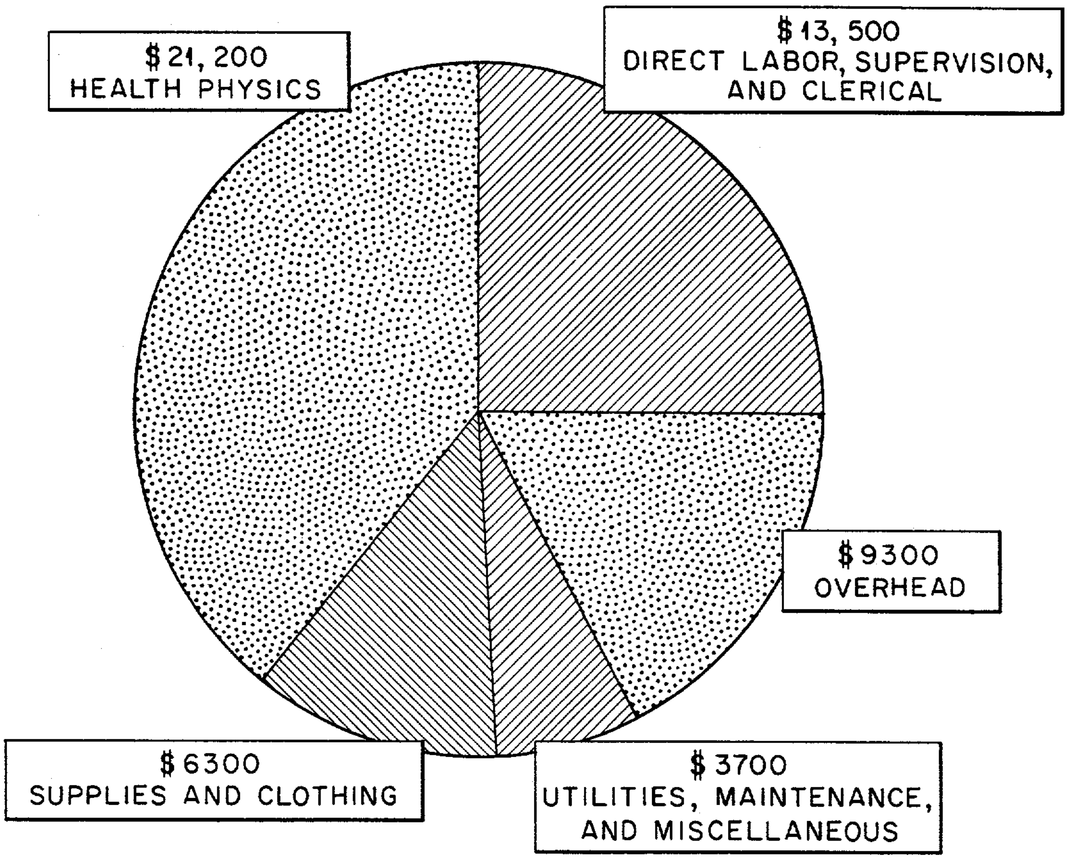

Fig. 5. Equipment Decontamination Costs for 1957.

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