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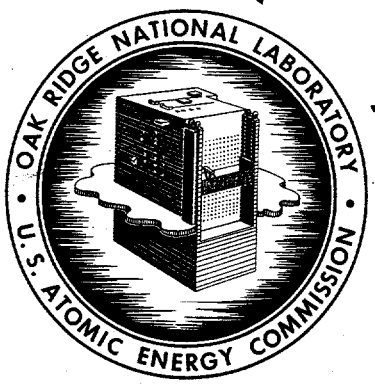
REACTOR OPERATIONS

RADIOACTIVE WASTES OPERATIONS

AND HOT CELLS OPERATIONS

QUARTERLY REPORT

APRIL - JUNE, 1961



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

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REACTOR OPERATIONS

RADIOACTIVE WASTES OPERATIONS

AND HOT CELLS OPERATIONS

QUARTERLY REPORT

April - June, 1961

By

J. A. Cox

Prepared from reports by:

F. T. Binford
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E. M. King
E. J. Witkowski

Date Issued

SEP 18 1961

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

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REACTOR OPERATIONS
RADIOACTIVE WASTES OPERATIONS
AND HOT CELLS OPERATIONS
QUARTERLY REPORT

Summary

The ORR operating time increased to 81.2% for the quarter in spite of shim-rod drive troubles which required that several drives be changed. Harder components have been installed in all of the ball-latch mechanisms, and these appear to be giving better service than the original components.

A boiling detection device is being designed for the ORR to give added safety in the event of a local blockage in the fuel.

Monitoring in the White Oak Creek permitted a fairly good inventory to be made of the various sources of Sr, the most troublesome isotope in the waste. As usual the Ru inventory did not balance, and it appears that considerable amounts of Ru are held up in the creek bed.

Gaseous waste monitoring equipment of new design is being compared with the present equipment.

The Hot Cells in Buildings 3025, 3026D, and the ORR have been in operation full time, limited only by the personnel available. The dejacketing of fuel elements in 3026D Hot Cells is being continued, and sample examination is being continued in all six cells of Building 3025. Two shifts are being worked whenever possible.

1. OAK RIDGE RESEARCH REACTOR

1.1. Operations

W. R. Casto

Operations

The ORR was operated during this period at a power level of 30 Mw. Total operating time for the quarter was 177.27 hours. The operating data are given in Table 1.1.

Table 1.1. ORR Operations
Period April 1, through June 30, 1961

	This Quarter	Last Quarter	Year to Date
Total energy, Mwd	2197.5	2136.7	4334.2
Average power, Mw/operating hr	29.8	29.7	29.8
Time operating, %	81.2	80.0	80.6
Reactor water radioactivity, c/m/ml (av)	30,236	38,622	34,406
Pool water radioactivity, c/m/ml (av)	1368	900	1135
Reactor water resistivity, ohm-cm (av)	524,000	501,000	513,000
Pool water resistivity, ohm-cm (av)	704,000	669,000	687,000
Research samples	7	9	16
Radioisotope samples	103	109	212

The core configuration at the end of the quarter is indicated in Figure 1.1.

Cycles of operation during this period are shown in Table 1.2.

Table 1.2. ORR Cycles of Operation

Cycle No.	Date Begun	Date Ended	Accumulated Energy (Mwd)
33	March 17, 1961	May 7, 1961	1,382.6*
34	May 19, 1961	In progress	1,223.6

*Accumulated energy for cycle 33 during this quarter was 973.9 Mwd.

Figures 1.2 and 1.3 indicate the positions of the shim rods during cycles 33 and 34.

4. LABORATORY FACILITIES

E. J. Witkowski

4.1. Radioactive Waste Disposal

Inventory of Total Activity Discharged

A summary of the total liquid and gaseous activity emanating from the Laboratory and discharged to the environment during the last quarter is given in Table 4.1. Routine samples were taken from the Settling Basin-Waste Treatment Plant discharge, the seepage streams in the Waste Pit area, White Oak Creek, Melton Branch, and the four principal process stacks. The locations of the various sampling points are shown in Figure 4.1. Supplementary data were also obtained from the Health Physics Division, and these are included. The discharges from Burial Ground No. 4 and miscellaneous Laboratory drainage were arrived at by difference between the radioactivity in White Oak Creek, just north of its confluence with Melton Branch, and that known to be discharged from the Settling Basin–Waste Treatment Plant.

Table 4.1. Summary of Total Liquid and Gaseous Activity Discharged

Source	Monitoring Station Number	Total Activity (curies)
Liquid Waste		
Process waste to White Oak Creek	1	5
Burial ground No. 4 and miscellaneous Laboratory drainage to White Oak Creek	2	2
7500 waste to Melton Branch	3	4
East waste pit seepage to White Oak Creek	4	1,104
West waste pit seepage to White Oak Creek	5	218
Total liquid waste discharged to the environment		1,333
White Oak Dam to Clinch River	6	602

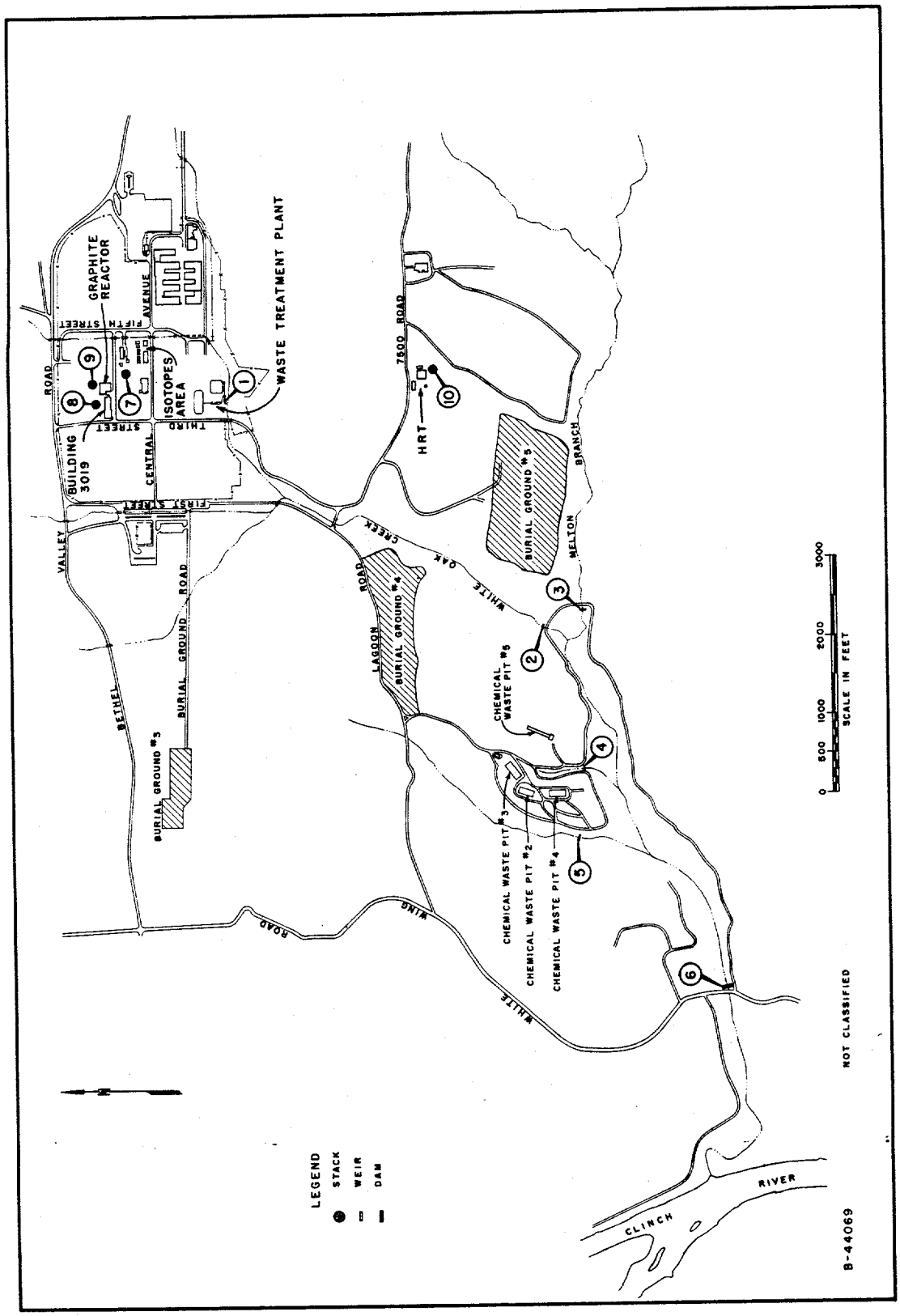

Fig. 4.1. Location Plan for Laboratory Waste Monitoring Stations

Table 4.1. Continued

	Monitoring Station Number	Total Activity (curies)
	Gaseous Waste	
3039 stack	7	5.41
3020 stack	8	0.02
3018 stack	9	0.45
7500 stack	10	0.02
Total gaseous waste discharged to the environment		5.90

Process Waste Treatment and Discharge to White Oak Creek

The Waste Treatment Plant processed all low-level waste generated by the Laboratory during the quarter and discharged 4.6 curies of activity to White Oak Creek. This is less than half that released during the first quarter which was, at the time, the lowest recorded discharge for any three-month period. Data for the process-waste system operation are given in Table 4.2; volumes are shown in Figure 4.2. Two abnormal releases occurred during the quarter, one of which resulted from a line plug at the North Tank Farm and the other from a cell flushing operation in the Isotopes area. Neither incident affected the inventory of the over-all system and steps were taken to prevent a similar recurrence.

Table 4.2. Process Waste Treatment and Discharge to White Oak Creek

Volume Waste Treated this Quarter: 26.6×10^6 gal*

Total Volume Waste Discharged to White Oak Creek this Quarter: 32.5×10^6 gal

Nuclides	Plant Influent (curies)	Plant Effluent* (curies)	Removed (percent)	Discharge to White Oak Creek (curies)
Sr^{89}	0.6	0.1	76	0.2
Sr^{90}	6.6	1.6	76	2.0
$Ru^{103, 106}$	0.5	0.2	72	0.1
Co^{60}	0.1	0.1	22	0.1
Cs^{137}	1.0	0.1	91	0.1
TRE	15.0	1.5	90	2.1
Total	23.8	3.5	85	4.6

*The values are apparently low, possibly by 10-15%, due to erratic instrument operation.

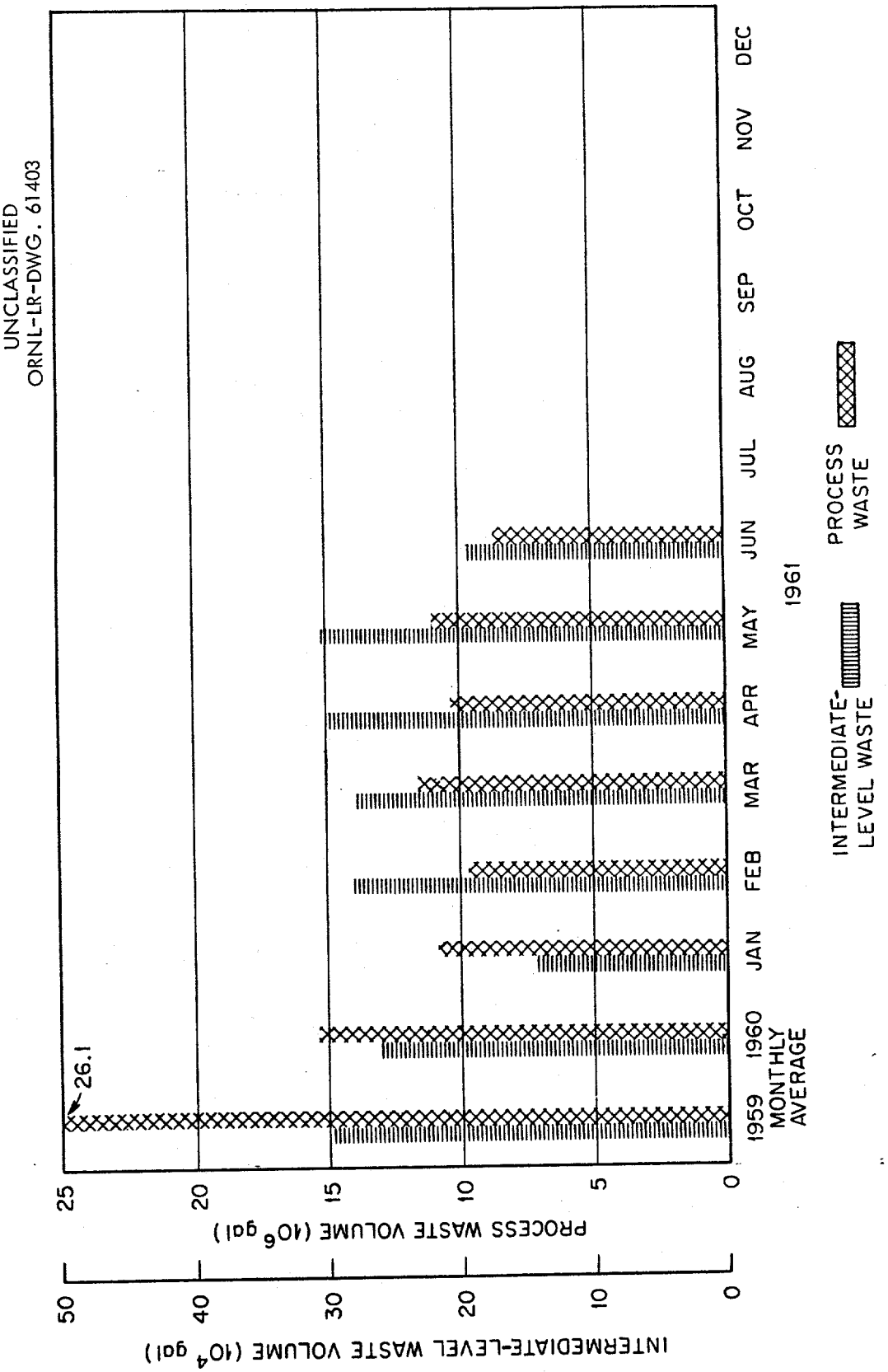

Fig. 4.2 Liquid Waste Volumes

The alterations to the process (low-level) waste system, which include the addition of monitoring equipment and telemetering of data to the Monitoring Control Center, have been completed by the contractor; and Laboratory maintenance forces have begun installation of the instruments.

The Monitoring Control Center, Building 3104, was started in early May and is approximately 50% complete. The Laboratory should obtain occupancy and begin the installation of instrumentation by the end of August.

Initial excavations have been completed for the dam at the emergency catch basin, and the reservoir area has been cleared. Construction of the dam is scheduled for July.

Intermediate-Level Waste

The waste pits and trench No. 5 operated at full capacity for the entire quarter. Heavy rainfall and continued high-volume releases from Building 3019 resulted in a maximum inventory of the system (see Figure 4.2 and Table 4.3).

Table 4.3. Activity Transferred to Pits and Trench (curies)

Nuclide	Trench No. 5				Pits 2, 3, and 4			
	This Quarter	Year to Date	Total 1960	Total to Date	This Quarter	Year to Date	Total 1960	Total to Date
Sr^{89}	42	54			45			
Sr^{90}	504	766			508			
Ru^{106}	74	474			67			
Cs^{137}	1,090	1,390			1,207			
TRE	248	642			165			
Total	1,958	3,326	3,536	6,862	1,992	3,490	21,494	471,985

Major contibutors of intermediate-level waste during the quarter were as follows:

Fission Products Pilot Plant	126,000 gal
ORR and related operations	77,000 gal
Radioisotopes processing area	86,000 gal
Building 4507	40,000 gal
Building 3019	283,000 gal
Building 3026 Segmenting Cells	49,000 gal

Two leaks developed in the west bank of pit No. 4. An intercepting trench was excavated at the junction of these leaks and liquid accumulations are pumped back to the pit.

The excavation and filling of the new waste trench No. 6 has been completed; and the installation of an access road, power line, and connecting pipeline by August 1 will complete the project. The new 2-in. waste line is currently being held in standby pending the installation of valve stations for future facilities. In the meantime, the old waste line is being used.

Creek Monitoring

The installation of monitoring stations in the White Oak Creek and Melton Branch has been completed, and the equipment is now in continuous operation. A record of the flow rate at each station and the total integrated discharge is computed monthly. Proportional samples are collected daily, accumulated, and analyzed monthly for Sr, Cs, Ru, Co, and rare earths. The Health Physics Division continues to operate the monitoring facilities at White Oak Dam, and their data are included in Table 4.1 for comparative purposes.

Figure 4.3 shows the total activity and the Sr activity discharged to White Oak Creek for each month of 1961. It also shows, for comparison, the average monthly discharge experienced during the last three quarters of 1960. The contribution of the main branches of the White Oak Creek drainage system to the Sr^{90}, Cs^{137}, and Ru^{106} discharged into the Clinch River is shown in Table 4.4. The total activity discharged to the creek during the last quarter (1,333 curies) was about 25% less than the amount released during the first quarter of 1961 (1,803 curies); and, as usual, most of this was ruthenium from the waste pits.

Only about 50% of the gross activity accounted for in the creeks and streams was discharged at White Oak Dam. Holdup in the lake bed may partially explain this discrepancy.

The strontium release (4.2 curies) was 66% less than that accounted for in the first quarter (12.3 curies) but shows good agreement with the data reported for the dam discharge. It may be noted, however, that although the strontium release for June of this year was lower than for any recent month the total activity discharge has increased during the past two months.

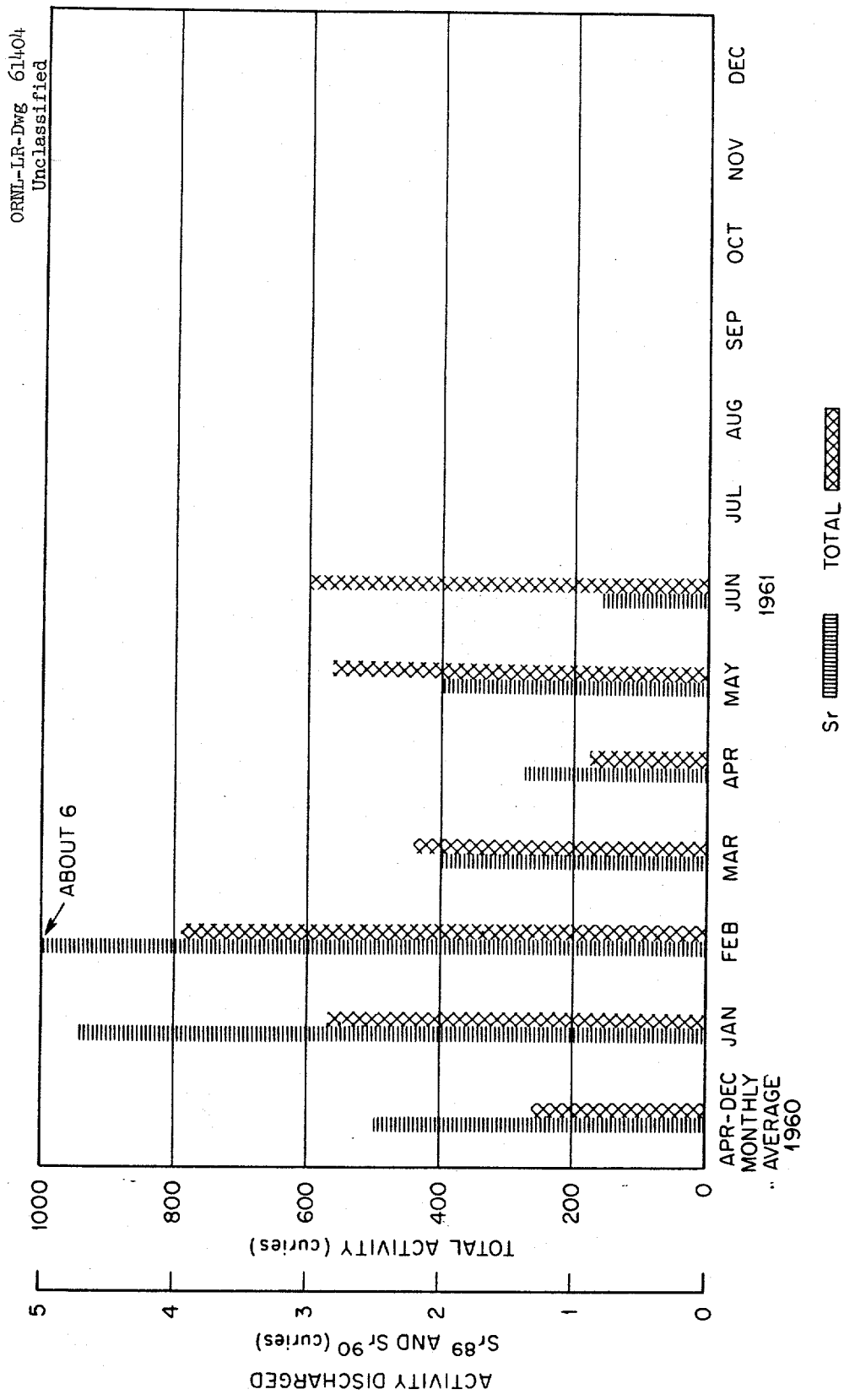

Fig. 4.3 Liquid Activity Discharge to White Oak Creek

Table 4.4. Contribution of Main Branches in White Oak Creek Drainage System to Sr^{90}, Cs^{137}, and Ru^{106} Discharged into Clinch River

Month	1 Waste Treatment Plant	2 White Oak Creek[a] Below Burial Ground No. 4	3 Melton Branch	4 East Seep Stream Waste-Pit Area	5 West Seep Stream Waste-Pit Area	6 White Oak Dam[b]
			Sr^{90} (curies)			
April	0.6	1.1	0.3	0.0003	0.0004	1.6
May	0.7	0.6	1.2	0.0007	0.0007	1.3
June	0.7	0.3	0.03	0.0002	0.0005	1.3
			Cs^{137} (curies)			
April	0.02	NA[c]	0.04	0.0002	0.001	3.5
May	0.06	0.02	0.007	0.0005	0.0019	0.4
June	0.06	0.3	0.04	0.0002	0.0001	0.9
			Ru^{106}			
April	0.04	NA	1.6	128.0	37.0	192.2
May	0.04	0.07	0.06	447.0	111.0	186.0
June	0.05	0.3	0.03	525.0	69.0	169.1

[a] This sample is obtained to determine whether a significant amount of activity is being leached from the No. 4 Burial Ground. Otherwise, it should contain the same activity as the Waste Treatment Plant sample. (Column 2 – Column 1 = contribution from Burial Ground No. 4.)

[b] Column 6 should equal the sum of Columns 2, 3, 4, and 5 less the quantity deposited in the bed of White Oak Lake.

[c] NA means Not Available.

Gaseous Waste Monitoring

Figure 4.4 shows the total monthly discharges of long-lived gamma activity from the principal Laboratory process stacks 3039, 3020, 3018, and 7500. The total activity discharged during the past quarter (5.90 curies) was 37% less than that emitted during the first quarter of 1961 (9.35 curies). Argon-41 from the 3018 stack (Graphite Reactor) is not considered because of its short half life.

Ninety percent of the total discharge came from the 3039 stack, and, 50% of this was generated in the Isotopes area during periods of iodine processing. Principal activities detected were I^{131} and I^{133} with traces of Ru^{103}. Curtailment of operations in the Pilot Plant, Building 3019, and in the Homogeneous Reactor area (7500) was undoubtedly responsible for the reduction in activity originating in those areas.

Membrane filters are now being used in place of paper filters in all duct and stack samplers. Membrane has a filter efficiency of greater than 99% for 0.05 micron particles; and, due to its retention of the particles on the surface of the filter, alpha counting can be done with greater efficiency. This characteristic also makes the membrane filter ideally suited for microscopic examination should this be desired.

Anemometers were installed in each of the four principal cell ventilation ducts, and a measure of the discharge through these ducts is now being recorded. A pitot tube has likewise been installed in the discharge from the off-gas facility; and the measured flow, while not being recorded, is locally indicated. The approximate value of these flows, at present, is as follows:

Location	Flow Rate, cfm
4500 area	46,800
3500 area	12,000
Buildings 3025 and 3026	58,000
Isotopes area	18,000
Off-gas	2,500
Stack Total	137,300

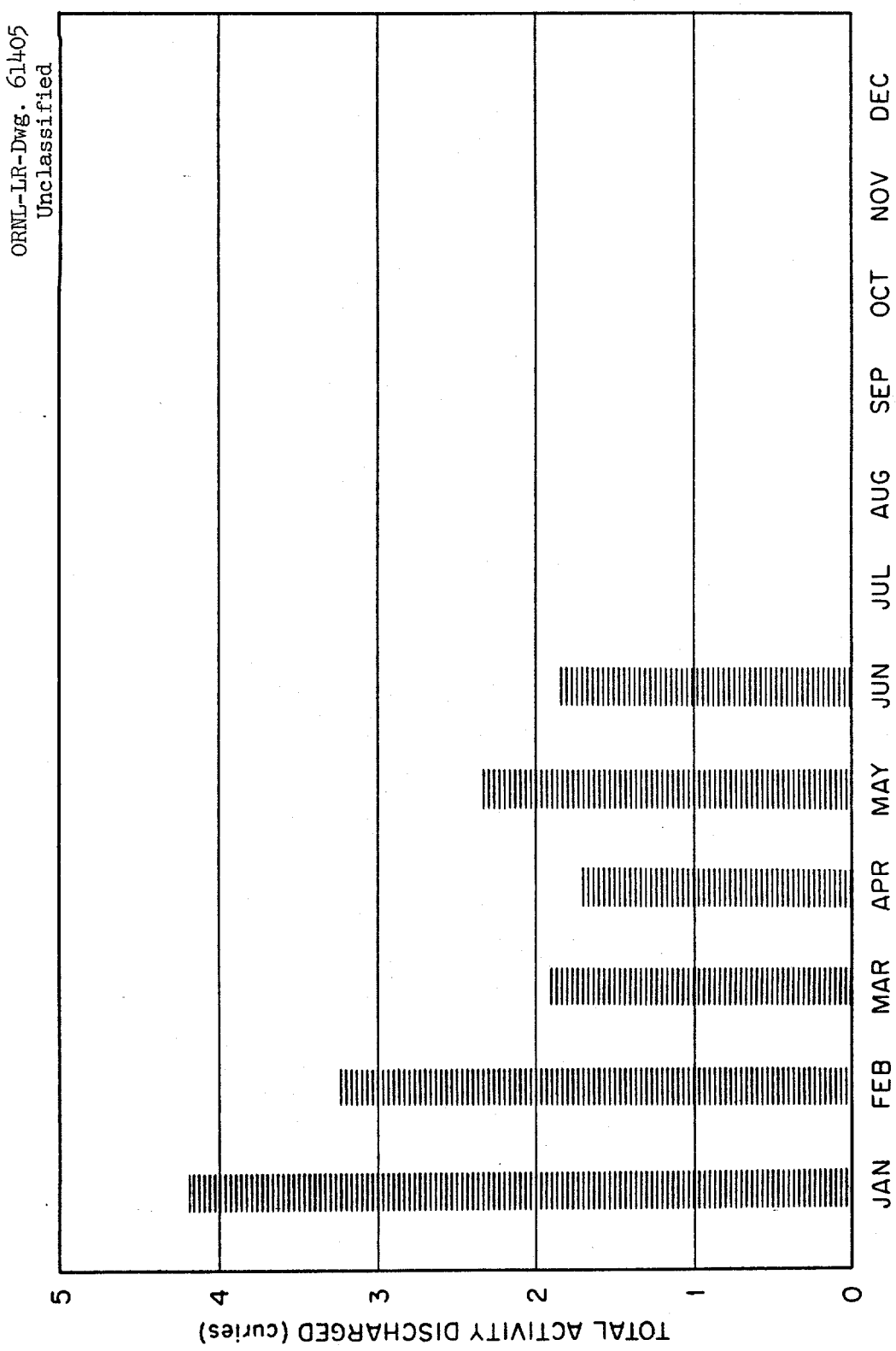

Fig. 4.4. Gaseous Activity Discharge to Environment

Off-Gas Scrubber and Filters

The new off-gas facility, with modifications, went into operation in the middle of April; and only minor difficulties have been encountered since that date. After 73 days of operation one bank of filters was changed after it became plugged by an ammonium nitrate precipitate resulting from a release of ammonia at the Fission Products Development Laboratory. Subsequent modifications to the scrubber systems in that area eliminated further difficulties.

Tests to evaluate the efficiency of the facility continue, and conclusion of this study at an early date is expected. Conventional sampling devices used on other ducts and on the stack do not perform satisfactorily at the low negative pressure of the off-gas system because of in-leakage of air. Sampling equipment is being modified to give representative samples.

Design of New Gaseous Waste Monitoring Equipment

The ORNL Stack Monitor Committee, which was set up to evaluate the Tracerlab stack monitoring proposal, has begun studies on a sample withdrawal system for the 3039 stack. Three one-inch stainless steel probes have been fabricated and inserted in the stack at the 50-ft level. Attached to each probe and located on the platform at the 50-ft level is a step-moving tape monitor equipped with a beta-gamma detector tube. Readout from these tubes is recorded on a multipoint recorder located at ground level. The purpose of the experiment is to determine if the activity sampled by any one probe is significantly different, or varies, from the activity sampled by the other probes. The three probe systems are identical except for the location of the withdrawal tips within the stack. An attempt is being made to keep the sample withdrawal rate through the probes equal to the stack discharge velocity; i.e., isokinetic. After the equipment has been installed and made to operate satisfactorily (mechanically and electronically), a series of injection tests is planned. Known quantities of activity will be injected into the stack system and the response of the monitors observed. Of equal importance will be the day-to-day monitoring of routine stack releases afforded by the system. When operating reliably, the installation will become a valuable adjunct to the over-all gaseous waste monitoring complex and will be an experimental tool.

To provide permanent continuous monitoring of the major streams which

merge at the 3039 stack, five additional tape monitors have been ordered and will be installed in each of four main cell-ventilation ducts and in the discharge from the off-gas facility. These instruments will monitor beta-gamma activity, and their readout will be recorded in the Monitoring Control Center now under construction.