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**UNION
CARBIDE**

INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX P, OAK RIDGE, TENNESSEE 37831

To (Name) Mr. K. W. Morgan
Company
Location ORNL

Date July 16, 1965

Originating Dept.

Answering letter date

Copy to Mr. K. W. Schlier
Mr. W. P. Acorn
Mr. W. W. Center
Health Physics File - no ✓

Subject News Release on Environmental Surveys

Attached are data for the semiannual news release, as requested by AEC-CRC, covering environmental surveys made by our plant forces at off-plant locations during the first half of calendar year 1965. In accord with agreements reached with the local AEC and ORNL health physics representatives, future reports of the alpha air activity for the Oak Ridge area will be furnished by Mr. D. M. Davis, since we are discontinuing the use of our off-site stations.


K. W. Jordan

RGJ:AFB:mh

Attachment

Environmental Health Physics
JUL 21 1965

ENVIRONMENTAL RADIOACTIVITY LEVELS
THE OAK RIDGE GASEOUS DIFFUSION PLANT
JANUARY THRU JUNE, 1965

The results of sampling of the environs of the Oak Ridge Gaseous Diffusion Plant during the first half of 1965 revealed that the amount of uranium in the surface waterways and in the air as far as five miles from the plant area is not significantly different from the normal background values established for this region.

The average air-borne alpha activity at the three 5-mile sampling stations continued to be only a small fraction of the maximum permissible concentration for the general population. Environmental air sampling data are shown in Table 1 and the continuous sampling points in Figure 1.

Continuous sampling of the surface waterways adjacent to the plant revealed no instance where the uranium concentration exceeded the maximum permissible concentration specified for water (MPC_w).^{*} The average activity of natural uranium materials in the Clinch River reflecting the effects of all of the Oak Ridge plants was less than 0.1% of the MPC_w . Sampling data are shown in Table 2 and the sampling points in Figure 2.

External gamma radiation levels as determined from measurements at three locations surrounding the ORGDP area averaged 0.03 mr/hour. This approximates the average background levels obtained throughout the United States by the U.S. Public Health Service Radiation Surveillance Network, employing similar methods and detection instruments.

^{*} AEC Manual Chapter 0524, Annex 1, Table 2, "Concentrations in Air and Water Above Natural Background."

TABLE 1

ENVIRONMENTAL SAMPLING - AIR
OAK RIDGE GASEOUS DIFFUSION PLANT
JANUARY-JUNE, 1965

Distance from Center of Plant	Type of Analysis	No. of Samples *	Units of 10^{-13} $\mu\text{c}/\text{cc}$					Average $\% \text{MPC}_a^{**}$
			Direction from Plant		All Stations	Max. Permissible Conc. (MPC_a)		
			N	NE				
5-Mile Radius	Gross Alpha	1404	<1	<1	<1	<1	20.0	4.0
			Av. 0.6	0.8	0.9	0.8		
			Max. 4	5	8	8		

* Normal Sampling Frequency: Continuous; averaged over 8 hours.

** Maximum permissible concentrations for continuous exposure of the general population.

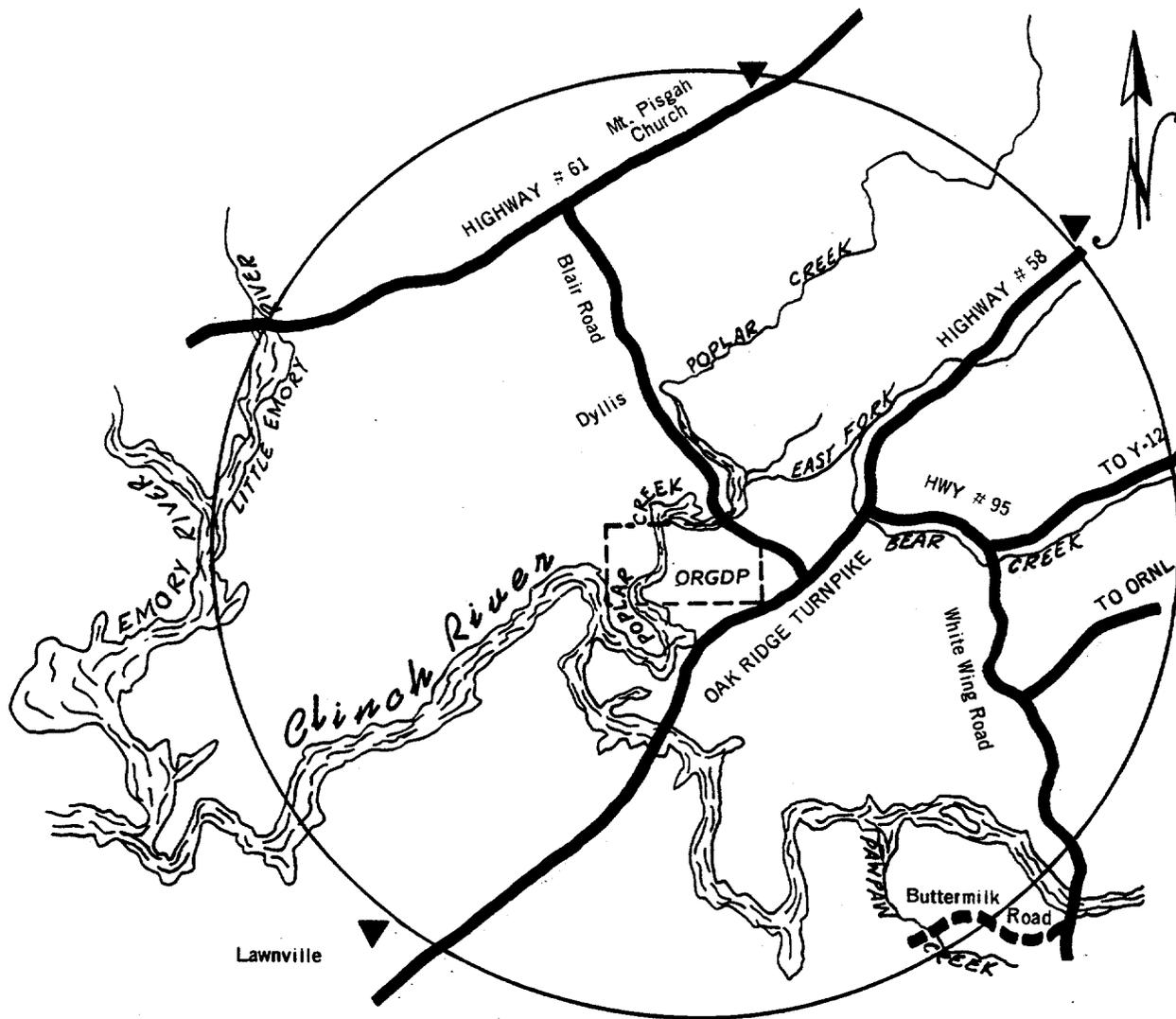
TABLE 2

ENVIRONMENTAL SAMPLING - LOCAL STREAMS
OAK RIDGE GASEOUS DIFFUSION PLANT
JANUARY-JUNE, 1965

Location of Point	Type of Analysis	No. of Samples*	Units of 10^{-8} $\mu\text{c}/\text{cc}$				Average $\% \text{MPC}_w^{**}$
			Plant Experience		Max. Permissible Conc. (MPC_w)		
			Low	High			
Upstream	Uranium Concentration	2	0.0	0.0	0.0	2000	<0.1
Downstream	Uranium Concentration	2	0.0	0.0	0.0	2000	<0.1

* Normal Sampling Frequency: Continuous; composited over one quarter.

** Maximum permissible concentrations for continuous exposure to the general population.

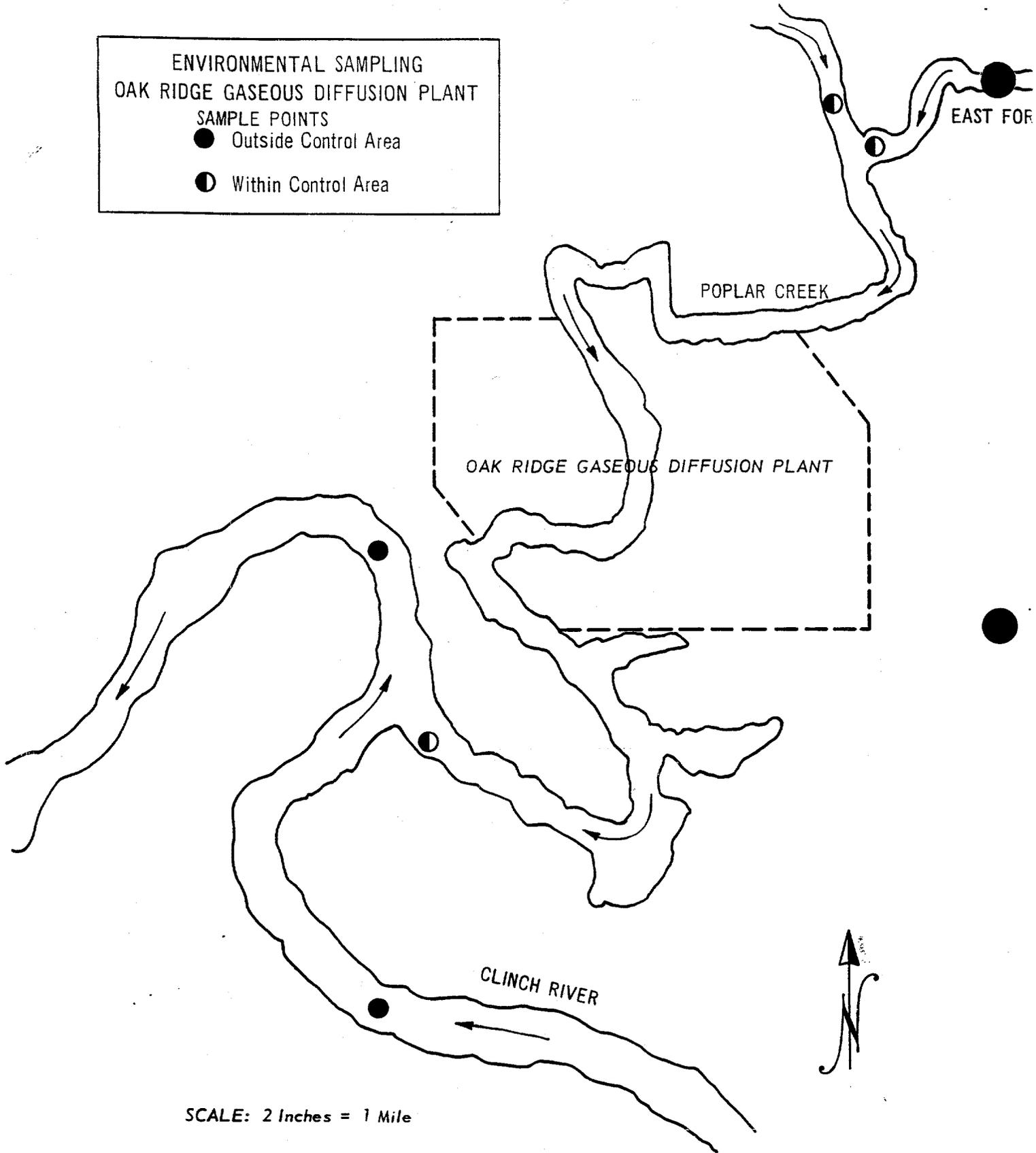


SAMPLING POINTS OF OUTSIDE ENVIRONS - ORGDP
AIR

▼ Sampling Location - Five Miles from Plant

FIGURE 1

ENVIRONMENTAL SAMPLING
OAK RIDGE GASEOUS DIFFUSION PLANT
SAMPLE POINTS
● Outside Control Area
◐ Within Control Area



SCALE: 2 Inches = 1 Mile

FIGURE 2



UNION CARBIDE CORPORATION
NUCLEAR DIVISION
P. O. BOX P, OAK RIDGE, TENNESSEE 37831

August 30, 1965

U. S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

Attention: Mr. S. R. Sapirie, Manager
Oak Ridge Operations

Gentlemen:

Dissemination to the Public of Data
on Environmental Levels of Radioactivity

As requested, we are enclosing eighty copies of the report for the first half of 1965 on Environmental Levels of Radioactivity for the Oak Ridge Area.

Very truly yours,

C. E. Larson

for

C. E. Larson
President

CEL:HGM:dg

Enclosures

cc w/encl.: A. F. Becher (2) ✓
F. R. Bruce
C. E. Center (4)
D. M. Davis (10)
W. H. Jordan
H. G. MacPherson (2)
K. Z. Morgan

ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

(Report for Period, January - June, 1965)

Compiled by the

Applied Health Physics Section

Health Physics Division

OAK RIDGE NATIONAL LABORATORY

Introduction

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are released to trenches located in the Conasauga shale formation. Low level liquid wastes are discharged, after preliminary treatment, to the surface streams.

Air that may become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by means of filters, scrubbers, and/or precipitators.

This report presents data on the environmental levels of radioactivity for the Oak Ridge Area and compares the data with established maximum permissible concentrations.

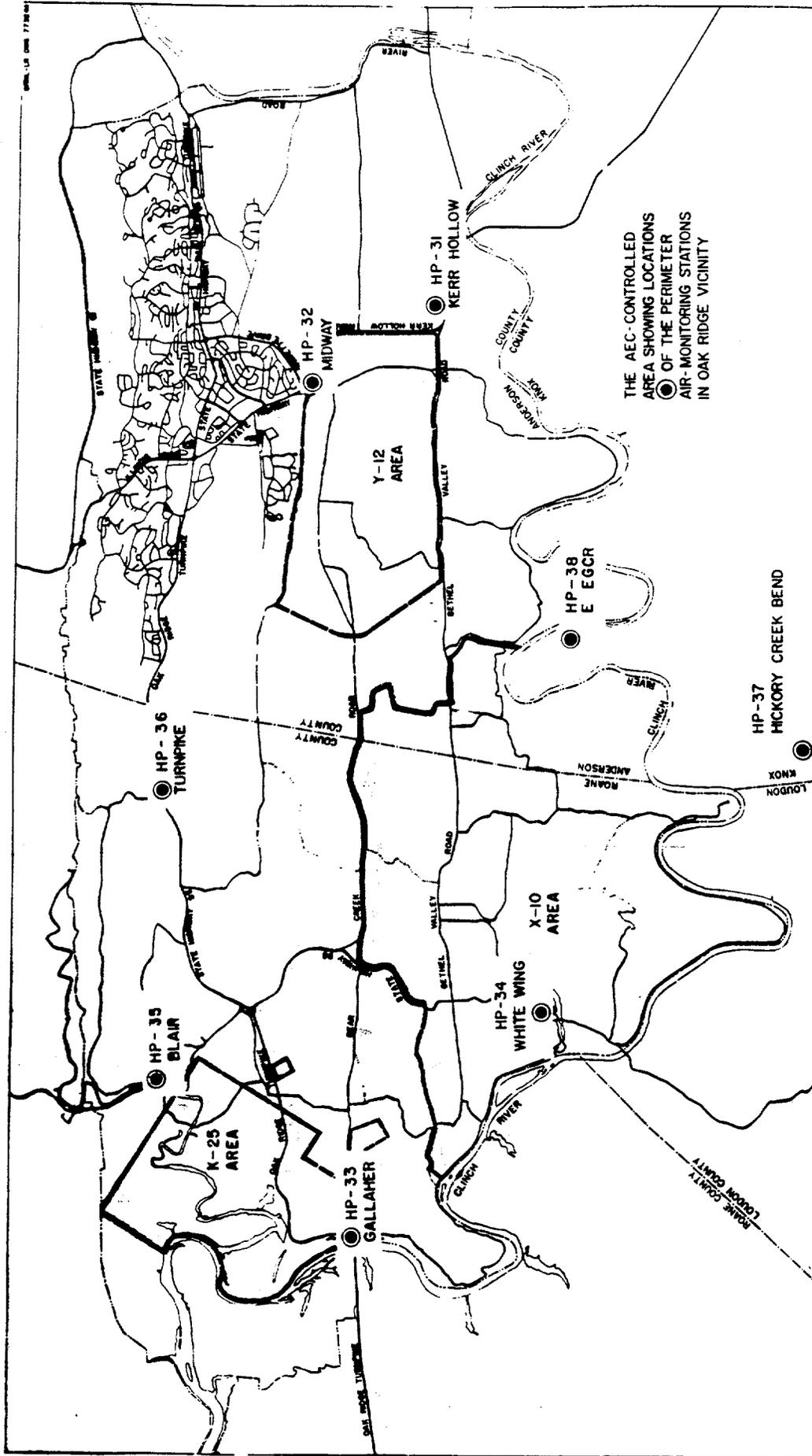
Air Monitoring

Atmospheric contamination by long-lived fission products and by fallout occurring in the general environment of East Tennessee is monitored by two systems of monitoring stations. One system consists of eight stations which encircle the plant area (Fig. 1) and provide data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of seven stations encircling the Oak Ridge Area at distances of from 12 to 75 miles (Fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Sampling for radioactive particulates is carried out by passing air continuously through a filter paper. Airborne radioactive iodine is monitored in the immediate environment of the plant areas by passing air through a cartridge containing activated charcoal. Data collected are accumulated and tabulated in average $\mu\text{c}/\text{cc}$ of air sampled.

Atmospheric contamination by alpha-emitting materials, interpreted as uranium, is determined by taking continuous air samples at three locations on a five-mile radius from the Oak Ridge Gaseous Diffusion Plant (Fig. 3).

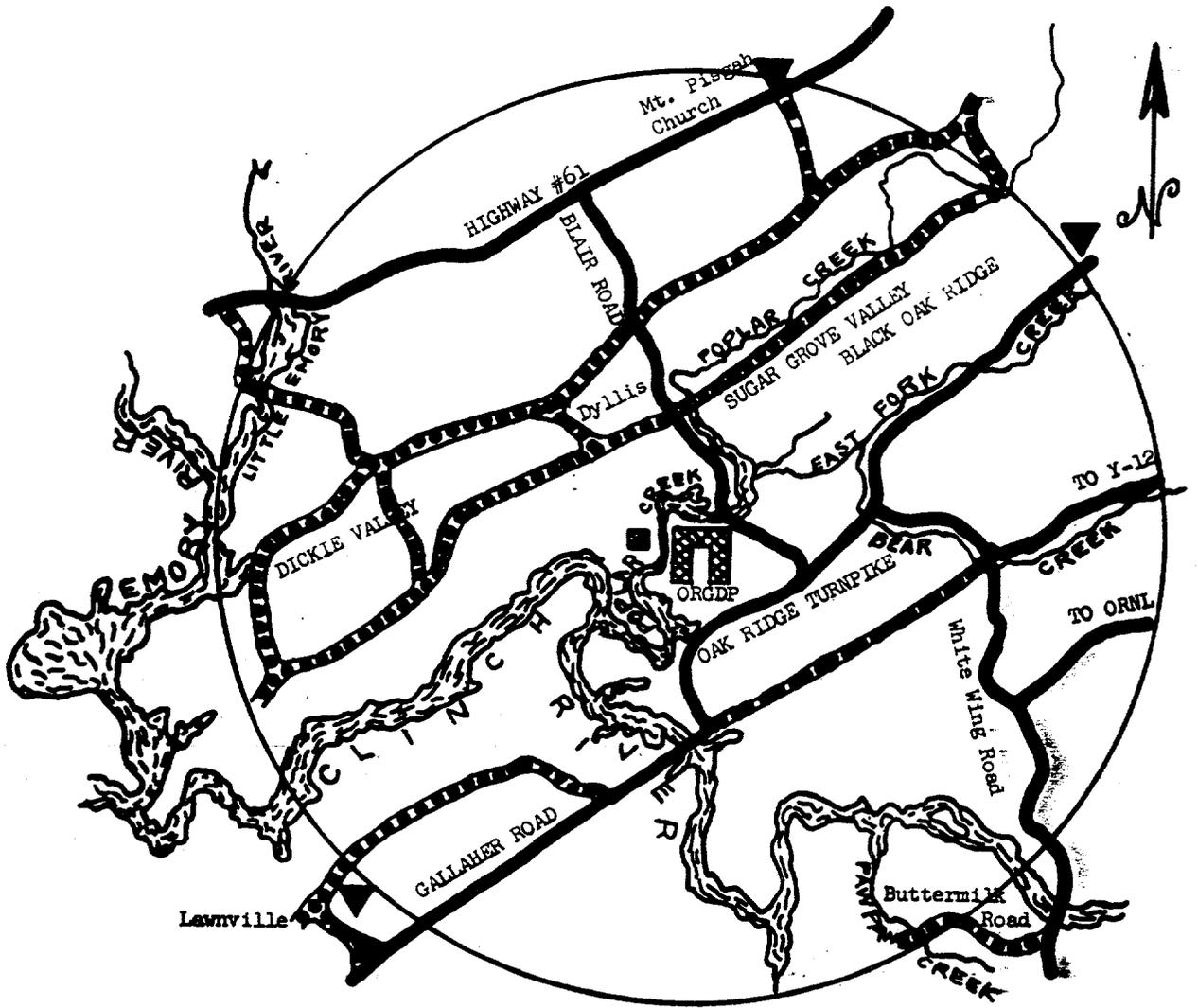
Milk Monitoring

Raw milk is monitored for ^{131}I and ^{90}Sr by the collection and analysis of samples from twelve sampling stations located within a radius of 50 miles of ORNL. Samples are collected weekly at each of eight stations



STATION SITES FOR PERIMETER AIR MONITORING SYSTEM

Figure 1



SAMPLING POINTS OF OUTSIDE ENVIRONS -- ORGDP
AIR

▼ Sampling Location - Five Miles from Plant

Figure 3

located on the fringe of the Oak Ridge Area. Four stations, located more remotely with respect to Oak Ridge Operations, are sampled at a rate of one station each week. The purpose of the milk sampling program is two-fold: first, samples collected in the immediate vicinity of the Oak Ridge Area provide data by which one may evaluate possible exposure to the neighboring population resulting from waste releases from Oak Ridge Operations; second, samples collected at the more remote stations provide background data which are essential in establishing the proper index for the evaluation of data obtained from local samples.

Water Monitoring

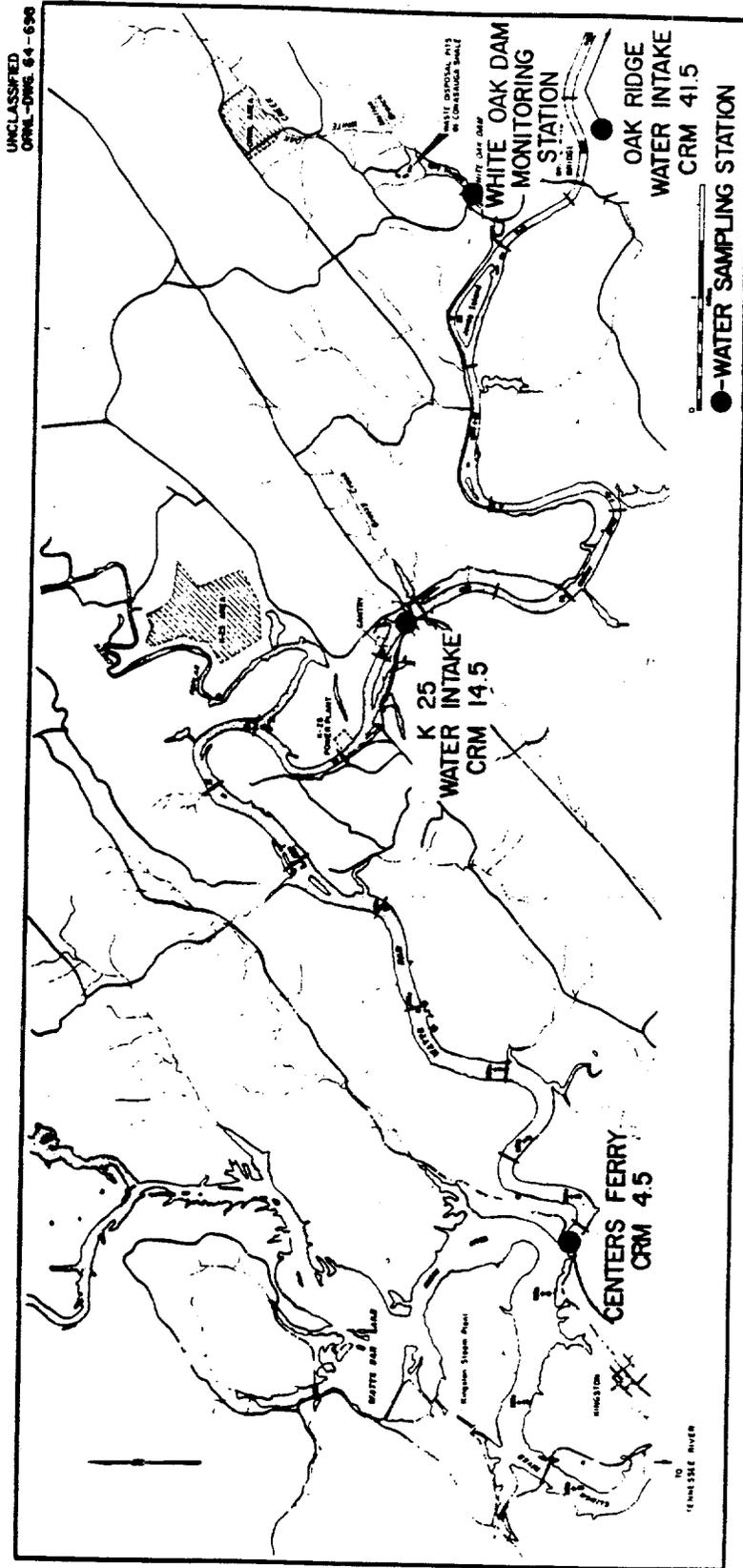
Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, into the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for populations in the neighborhood of a controlled area as specified by AEC Manual, Chapter 0524. The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 4 and 5. Samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously to obtain dilution factors for calculating the probable concentrations of wastes in the river.

Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters.

Analyses are made of the effluent for the long-lived radionuclides only, since cooling time and hold-up time in the waste effluent system is such that short-lived radionuclides are normally not present. The concentrations of those isotopes present in significant amounts are determined by analysis. A weighted average maximum permissible concentration for water, $(MPC)_w$, for the mixture of radionuclides is calculated on the basis of the isotopic distribution using the MPC values of each isotope as specified by AEC Manual, Chapter 0524.¹ The average concentrations of gross beta activity in the Clinch River are compared to the calculated $(MPC)_w$ values.

¹AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.



WATER SAMPLING LOCATIONS

Figure 4

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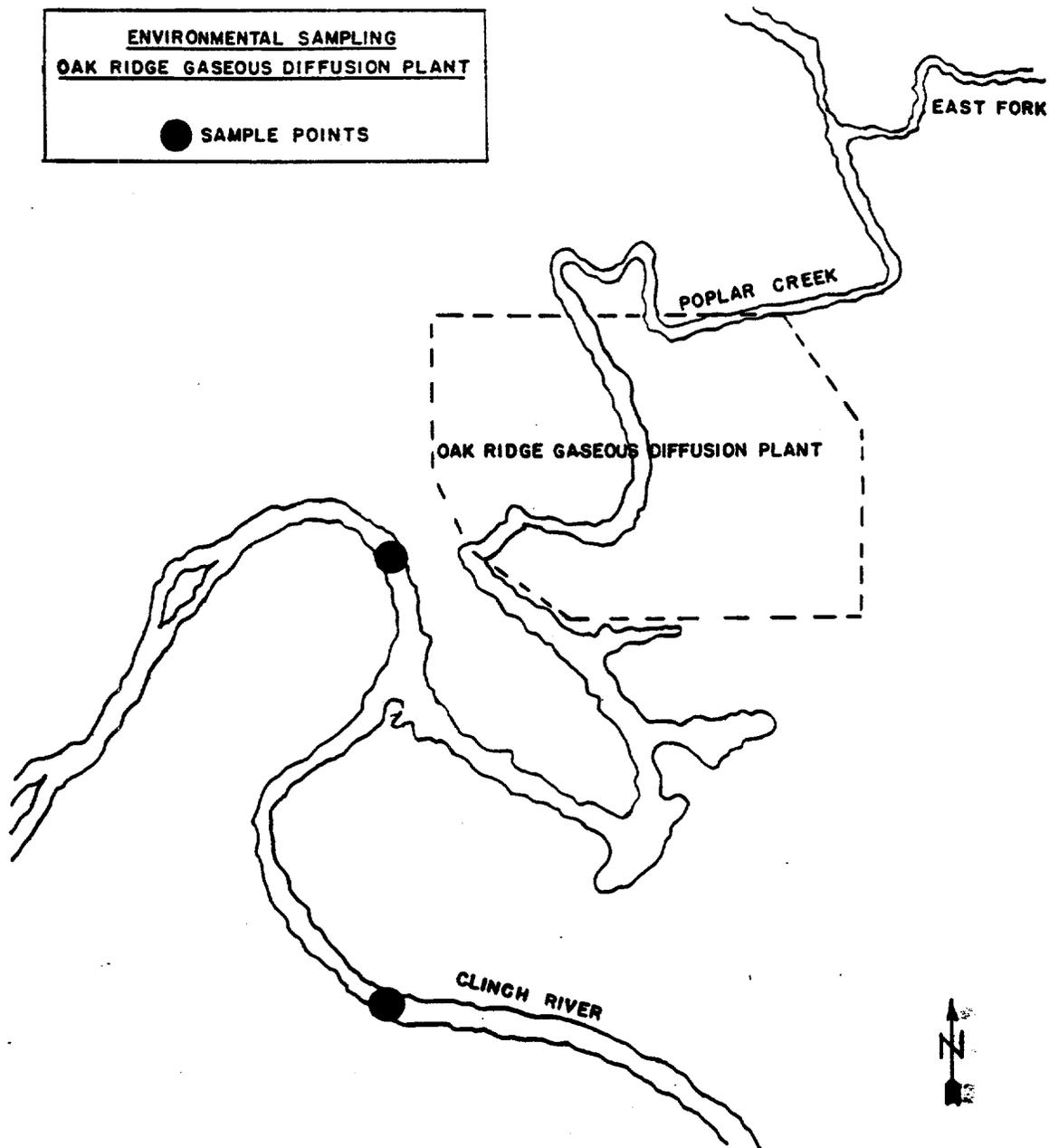


Figure 5

The concentration of uranium is compared with the specific (MPC)_w value for uranium.

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge Area. Measurements are taken with a Geiger-Müller tube at a distance of three feet above the ground, and the results are tabulated in terms of mR/hr.

Discussion of Data

Data on the environmental levels of radioactivity for the first half of 1965 in the Oak Ridge and surrounding areas are presented in Table I through Table IX.

The average air contamination level for gross beta activity, as shown by the continuous air monitoring filter data, for both the immediate and remote environs of the plants was 0.28% of the maximum permissible concentration for populations in the neighborhood of a controlled area. This value is approximately 30% lower than those for the last half of 1964 and is no higher than the average of those measured in other areas of the United States and reported by the U.S. Public Health Service Radiation Surveillance Network for the period January through April, 1965.

The average concentration of ¹³¹I in air in the immediate environs of the plants was 0.022×10^{-12} $\mu\text{c}/\text{cc}$ (Table II). This is approximately 0.022% of the maximum permissible concentration for populations in the neighborhood of a controlled area.

The average airborne alpha activity in the environs of the ORGDP, five miles from ORGDP, was 4.0% of the maximum permissible concentration for populations in the neighborhood of a controlled area.

The average concentrations of ¹³¹I in raw milk in the immediate and remote environs of the Oak Ridge Area were 8.7 pc/l and 5.4 pc/l, respectively. These values fall within the limits of FRC Range I if one assumes the average intake per individual to be 1 liter of milk per day. The maximum concentration observed in any one milk sample was 75 pc/l. This value was measured in a sample collected the week of May 30 through June 5, 1965. During this time the East Tennessee Area was experiencing an increase in fallout from weapons testing. Laboratory analyses of samples of fallout confirmed the presence of fresh fission products consistent with the timing of the announced nuclear detonation on the Chinese mainland, May 14, 1965.²

²Radiological Health Data, Vol. 6, No. 6, p. 332 (June 1965).

The average concentration of ^{90}Sr in raw milk for both the immediate and remote environs of the controlled area was 17 pc/l. This level falls within FRC Range I for transient rates of daily intake of ^{90}Sr for application to the average of suitable samples of an exposed population.

The calculated average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most of the wastes, and the measured average concentration at Mile 4.5, near Kingston, Tennessee, were 4.4×10^{-8} $\mu\text{c/ml}$ and 2.8×10^{-8} $\mu\text{c/ml}$, respectively. These values are 0.86% and 0.73% of the weighted average maximum permissible concentrations $(\text{MPC})_w$. The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 1.0×10^{-10} $\mu\text{c/ml}$ which is approximately 0.002% of the weighted average $(\text{MPC})_w$ value.

The average activity of natural uranium materials in the Clinch River, reflecting the effects of all Oak Ridge plants, was $< 0.01\%$ of the $(\text{MPC})_w$ for uranium.

The average external gamma radiation measured in the town of Oak Ridge and at the perimeter of the Oak Ridge Area was 0.012 mR/hr, which is the same as that level measured in the early period prior to Oak Ridge operations.

Conclusion

Surveillance of the radioactivity in the Oak Ridge environs indicated that the major part of the radioactivity detected continues to be the result of fallout from weapons testing. While some low level radioactivity is being released to the environment from plant operations, the resulting concentrations in both the atmosphere and surface streams of the Oak Ridge environment are well below established maximum permissible concentrations and intake guides for the neighboring population.

TABLE I
 CONTINUOUS AIR MONITORING DATA
 Long-Lived Gross Beta Activity of
 Particulates in Air

January - June, 1965

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{c}/\text{cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	4.9	0.70	2.6	0.26
HP-32	Midway Gate	26	5.4	0.98	2.9	0.29
HP-33	Gallaher Gate	26	4.5	0.47	2.3	0.23
HP-34	White Oak Dam	26	5.8	0.96	2.6	0.26
HP-35	Blair Gate	26	5.2	0.82	2.9	0.29
HP-36	Turnpike Gate	182 ^d	6.8	1.1	3.1	0.31
HP-37	Hickory Creek Bend	26	5.0	0.77	2.5	0.25
HP-38	East of EGCR	26	6.1	0.90	3.3	0.33
Average			5.5	0.84	2.8	0.28
<u>Remote Stations</u>						
HP-51	Norris Dam	26	16	0.91	3.3	0.33
HP-52	Loudoun Dam	26	4.5	0.08	2.4	0.24
HP-53	Douglas Dam	26	6.3	0.47	2.9	0.29
HP-54	Cherokee Dam	26	5.7	0.51	2.9	0.29
HP-55	Watts Bar Dam	25	5.3	0.61	2.9	0.29
HP-56	Great Falls Dam	25	5.1	0.77	2.7	0.27
HP-57	Dale Hollow Dam	26	5.6	0.78	2.8	0.28
Average			6.9	0.59	2.8	0.28

^aMaximum weekly average concentration.

^bMinimum weekly average concentration.

^c(MPC)_a is taken to be 10^{-10} $\mu\text{c}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^dSamples collected on daily schedule beginning 5/7/62. Maximum and minimum daily average concentrations were 11×10^{-13} $\mu\text{c}/\text{cc}$ and $< 0.2 \times 10^{-13}$ $\mu\text{c}/\text{cc}$, respectively.

TABLE II
 CONCENTRATION OF ^{131}I IN AIR
 AS MEASURED BY THE PERIMETER AIR MONITORING STATIONS

January - June, 1965

Number of Samples	Units of 10^{-12} $\mu\text{c}/\text{cc}$			%
	Maximum	Minimum ^a	Average	
208	0.24	< 0.010	0.022	0.022

^a Minimum detectable amount of ^{131}I is 20 d/m. At the average sampling rate used, this corresponds to approximately 0.010×10^{-12} $\mu\text{c}/\text{cc}$. In averaging, one-half of this value, 10 d/m, is used for all samples showing a total amount of ^{131}I less than 20 d/m.

^b $(\text{MPC})_a$ is taken to be 1×10^{-10} $\mu\text{c}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

TABLE III

OAK RIDGE GASEOUS DIFFUSION PLANT AIR MONITORING DATA

January - June, 1965

Distance from Center of Plant	Type of Analyses	No. of Samples*	Units of 10^{-13} $\mu\text{c}/\text{cc}$						Avg. $\%$ (MPC) _a **
			Direction from Plant			Avg.	(MPC) _a		
			North	North East	South West				
5 Mile Radius	Gross Alpha	1404	4	5	8	0.8	0.8	20.0	4.0
			< 1	< 1	< 1				
			0.6	0.8	0.9				

* Normal Sampling Frequency: Continuous, averaged over 8 hours.

** Maximum permissible concentration for continuous exposure of the general public.

TABLE IV
CONCENTRATION OF ^{131}I IN RAW MILK

January - June, 1965

Location	pc/l		
	Maximum	Minimum*	Average
Immediate Environs	75	< 10	8.7
Remote Environs	12	< 10	5.4

*Minimum detectable concentration of ^{131}I is 10 pc/l.
In averaging, one-half of this value, 5 pc/l, was
used for all samples showing a concentration less
than 10 pc/l.

TABLE V
CONCENTRATION OF ^{90}Sr IN RAW MILK

January - June, 1965

Location	pc/l		
	Maximum	Minimum*	Average
Immediate Environs	55	< 2.0	17
Remote Environs	32	< 2.0	17

*Minimum detectable concentration of ^{90}Sr in milk is 2 pc/l. In averaging, one-half of this value, 1 pc/l, was used for all samples showing a concentration less than 2 pc/l.

TABLE VI
 CALCULATED AVERAGE CONCENTRATION OF RADIOACTIVITY
 IN THE CLINCH RIVER AT MILE 20.8

January - June, 1965

Number of Samples Taken	Units of 10^{-7} $\mu\text{c}/\text{ml}$			% of $(\text{MPC})_w$
	Maximum ^a	Minimum ^b	Average	
182	1.7	0.11	0.44	0.86

^aMaximum weekly average.

^bMinimum weekly average.

TABLE VII
 AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
 IN THE CLINCH RIVER

January - June, 1965

Location	Units of 10^{-8} $\mu\text{c/ml}$							Average Beta Activity	(MPC) _w ^a	% of (MPC) _w
	⁹⁰ Sr	¹⁴⁴ Ce	¹³⁷ Cs	¹⁰⁶ Ru	⁶⁰ Co	⁹⁵ Zr - ⁹⁵ Nb				
Mi. 41.5 ^b	0.08	0.03	< 0.01	0.16	*	*	0.27	100	0.27	
Mi. 20.8 ^c	0.13	< 0.01	0.04	1.5	0.25	< 0.01	4.4	510	0.86	
Mi. 4.5	0.16	0.04	0.25	1.7	0.27	0.02	2.4	330	0.73	

^aWeighted average (MPC)_w calculated for the mixture using (MPC)_w values for specific radionuclides specified by AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^bSampling station moved from Clinch River Mile 33.2 to Mile 41.5 about January 1, 1962.

^cValues given for this location are calculated values based on levels of waste released and the dilution afforded by the river; they do not include amounts of radioactive material (e.g., fallout) that may enter the river upstream from CRM 20.8.

*None detected.

TABLE VIII
URANIUM CONCENTRATION IN THE CLINCH RIVER

January - June, 1965

Sampling Point	Type of Analyses Made	No. of Samples*	Units of 10^{-8} $\mu\text{c}/\text{ml}$				$\% (\text{MPC})_w$
			Maximum**	Minimum**	Average**	(MPC) _w	
Upstream from ORGDP	Uranium Concentration	2	< 0.1	< 0.1	< 0.1	2000	< 0.01
Downstream from ORGDP	Uranium Concentration	2	< 0.1	< 0.1	< 0.1	2000	< 0.01

*Normal Sampling Frequency: Continuous, composited over one quarter.

**No uranium was detected in Clinch River water samples during this period. Minimum detectable concentration of uranium in river water is 0.1×10^{-8} $\mu\text{c}/\text{ml}$.

TABLE IX
EXTERNAL GAMMA RADIATION LEVELS

mR/hr

January - June, 1965

Station Number	Location	Jan.	Feb.	March	Apr.	May	June	Average
1	Solway Gate	0.013	0.011	0.028	0.010	0.009	*	0.014
2	Y-12 East Portal	0.011	0.011	0.011	0.009	0.011	*	0.011
3	Newcomb Road, Oak Ridge	0.012	0.011	0.012	0.010	0.011	*	0.011
4	Gallaher Gate	0.014	0.012	0.012	0.013	0.010	*	0.012
5	White Wing Gate	0.011	0.011	0.012	0.010	0.012	*	0.011
Average		0.012	0.011	0.015	0.010	0.011	*	0.012

Note: These readings were taken with a calibrated Geiger-Müller tube at a distance of three feet above the ground.

The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

*No background readings taken this month.

**UNION
CARBIDE**

INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX P, OAK RIDGE, TENNESSEE 37831

To (Name) **Dr. K. E. Morgan**
Company
Location **ORNL**

Date **January 17, 1966**

Originating Dept.

Answering letter date

Copy to **Mr. K. W. Bahler**
Mr. C. E. Center
Mr. H. B. Schultz
Health Physics File - RC

Subject **News Release on
Environmental Surveys**

Attached are data for the semiannual news release, as requested by AEC-CRO, covering environmental surveys made by our plant forces at off-plant locations during the second half of calendar year 1965. In accord with agreements reached with the local AEC and ORNL health physics representatives, reports of the alpha air activity for the Oak Ridge area will be furnished by Mr. D. M. Davis, since we are discontinuing the use of our off-site stations.


R. G. Jordan

HJ:HBS:nh

Attachment

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THE OAK RIDGE GASEOUS DIFFUSION PLANT
JULY THRU DECEMBER, 1965

The results of sampling of the environs of the Oak Ridge Gaseous Diffusion Plant during the second half of 1965 revealed that the amount of uranium in the surface waterways and in the air as far as five miles from the plant area is not significantly different from the normal background values established for this region.

Sampling of the surface waterways adjacent to the plant revealed no instance where the uranium concentration exceeded the maximum permissible concentration specified for water (MPC_w).^{*} The average activity of natural uranium materials in the Clinch River, reflecting the effects of all of the Oak Ridge plants, was less than 0.1% of the MPC_w . Sampling data are shown in the following table:

Environmental Sampling - Local Streams							
<u>Location of Point</u>	<u>Type of Analysis</u>	<u>No. of Samples**</u>	Units of 10^{-8} $\mu\text{c}/\text{cc}$			<u>Maximum Permissible Conc. (MPC_w)</u>	<u>Av. % MPC_w***</u>
			<u>Plant Experience Low</u>	<u>Plant Experience High</u>	<u>Plant Experience Av.</u>		
Downstream	Uranium Concentration	2	0.0	0.0	0.0	2000	< 0.1

^{*} AEC Manual Chapter 0524, Annex 1, Table 2, "Concentrations in Air and Water Above Natural Background."

^{**} Normal Sampling Frequency: Continuous; composited over one quarter.

^{***} Maximum permissible concentrations for continuous exposure to the general population.

Safety and Health Physics Department
Oak Ridge Gaseous Diffusion Plant
January 17, 1966



UNION CARBIDE CORPORATION

NUCLEAR DIVISION

P. O. BOX P, OAK RIDGE, TENNESSEE 37830

March 28, 1966

U. S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

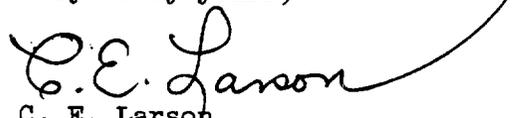
Attention: Mr. S. R. Sapirie, Manager
Oak Ridge Operations

Gentlemen:

Dissemination to the Public of Data
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Very truly yours,


C. E. Larson
President

CEL:HGM:dg

Enclosures

cc w/encl.: F. R. Bruce
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ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

(Report for Period July - December, 1965)

Compiled by the

Health Physics and Safety Section

Health Physics Division

OAK RIDGE NATIONAL LABORATORY

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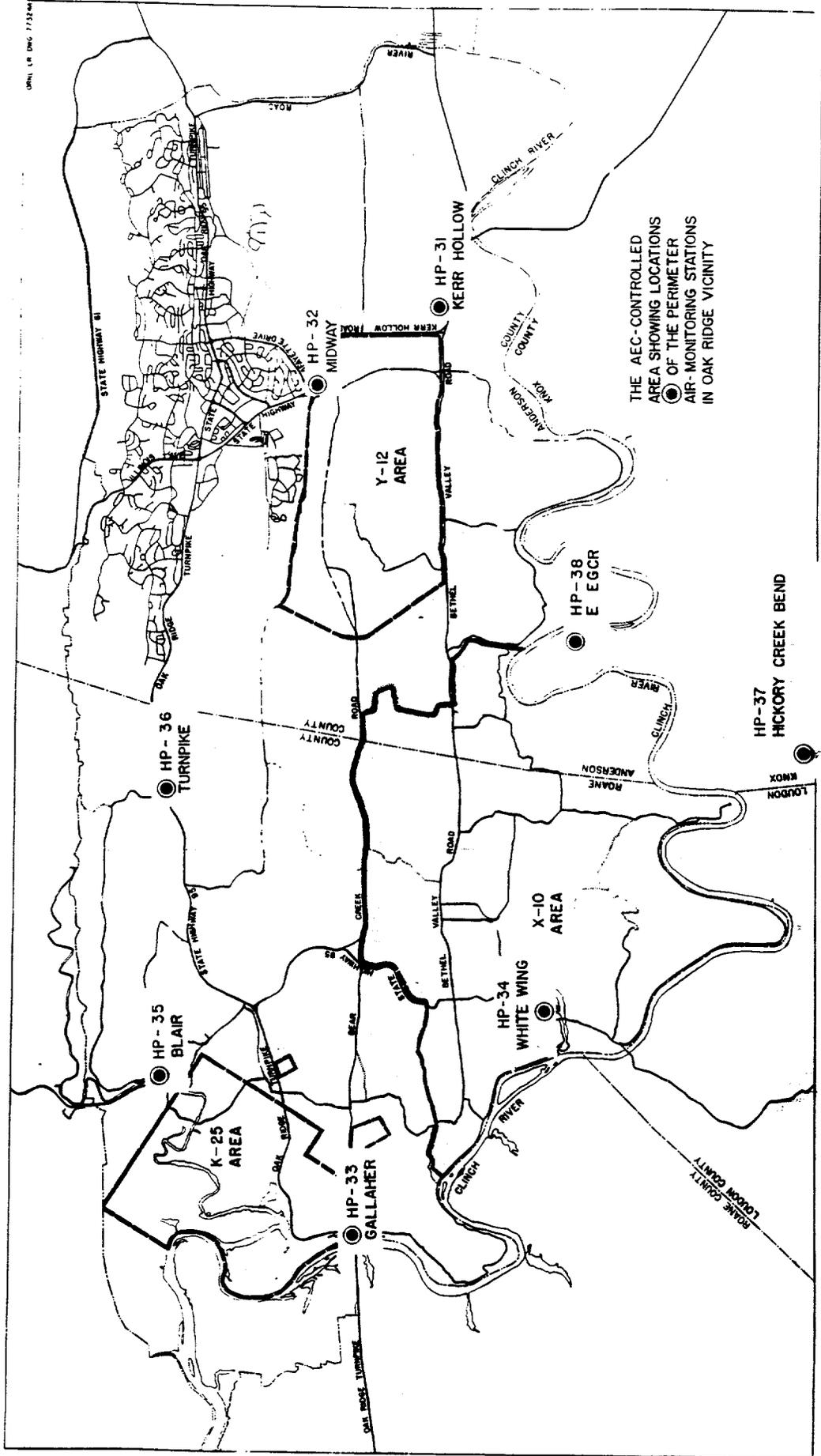
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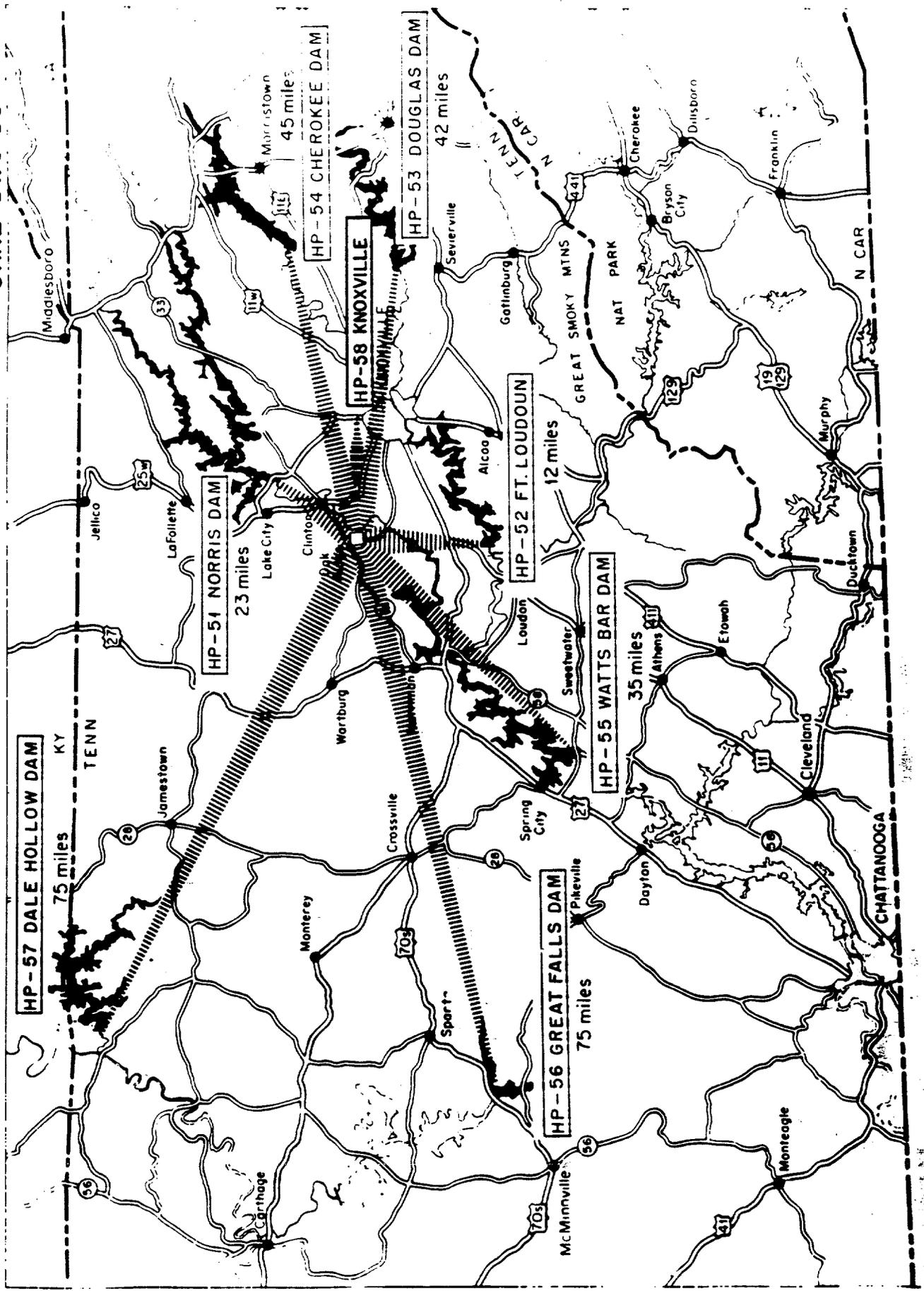
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Raw milk is monitored for ^{131}I and ^{90}Sr by the collection and analysis of samples from twelve sampling stations located within a radius of 50 miles of ORNL. Samples are collected weekly at each of eight stations located on the fringe of the Oak Ridge area. Four stations, located more remotely with respect to Oak Ridge Operations, are sampled at a rate of one station each week. The purpose of the milk sampling program is twofold: first, samples collected in the immediate vicinity of the Oak



STATION SITES FOR PERIMETER AIR MONITORING SYSTEM

Figure 1



STATION SITES FOR REMOTE AIR MONITORING SYSTEM

Figure 2

Ridge area provide data by which one may evaluate possible exposure to the neighboring population resulting from waste releases from Oak Ridge Operations; second, samples collected at the more remote stations provide background data which are essential in establishing the proper index for the evaluation of data obtained from local samples.

Water Monitoring

Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, into the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for populations in the neighborhood of a controlled area as specified by AEC Manual, Chapter 0524. The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 3 and 4. Samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously to obtain dilution factors for calculating the probable concentrations of wastes in the river.

Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters.

Analyses are made of the effluent for the long-lived radionuclides only, since cooling time and hold-up time in the waste effluent system are such that short-lived radionuclides are normally not present. The concentrations of those isotopes present in significant amounts are determined by analysis. A weighted average maximum permissible concentration for water, $(MPC)_w$, for the mixture of radionuclides is calculated on the basis of the isotopic distribution using the MPC values of each isotope as specified by AEC Manual, Chapter 0524.¹ The average concentrations of gross beta activity in the Clinch River are compared to the calculated $(MPC)_w$ values.

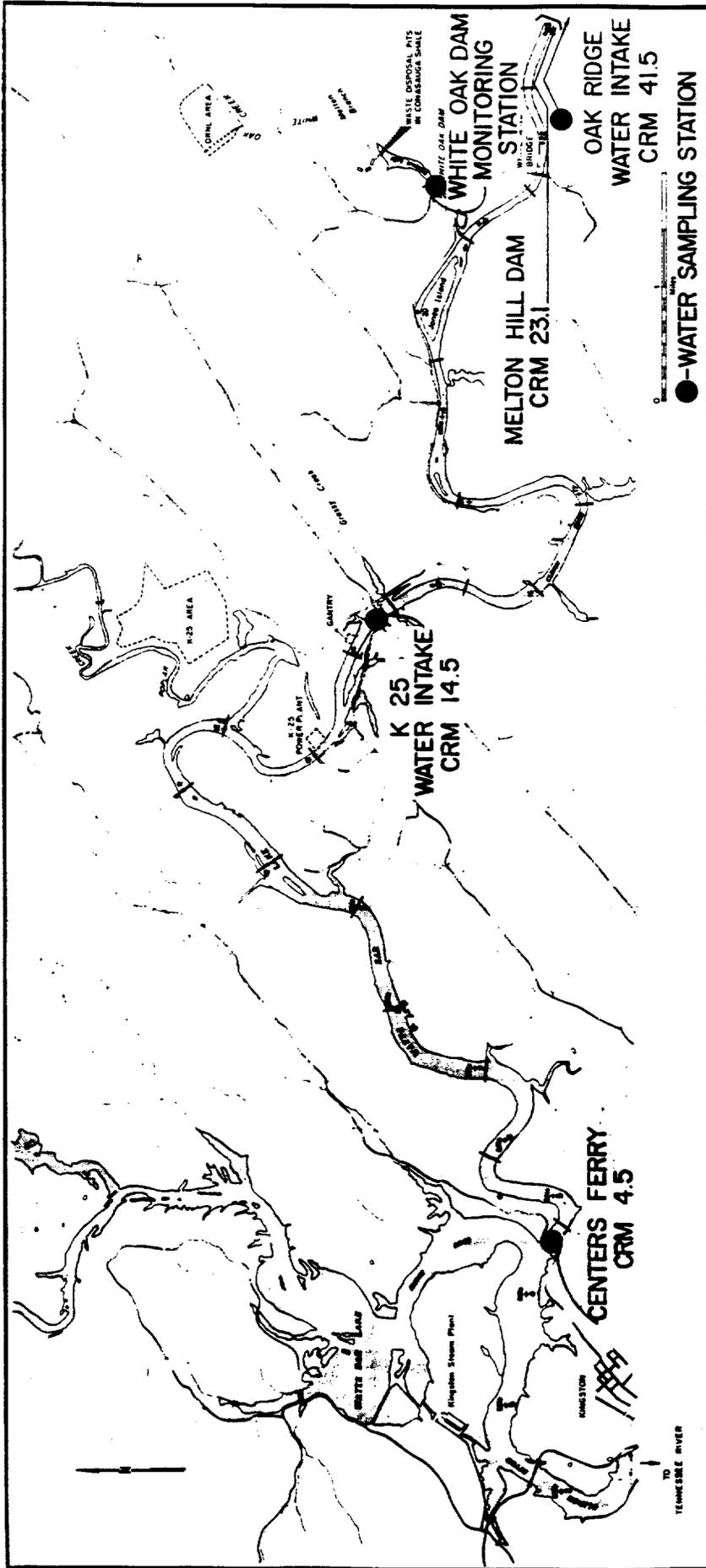
The concentration of uranium is compared with the specific $(MPC)_w$ value for uranium.

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge area. Measurements are taken with a Geiger-Müller tube at a distance of three feet above the ground, and the results are tabulated in terms of mR/hr.

¹AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

ORNL - DWG. 66-2216



WATER SAMPLING LOCATIONS

Figure 3

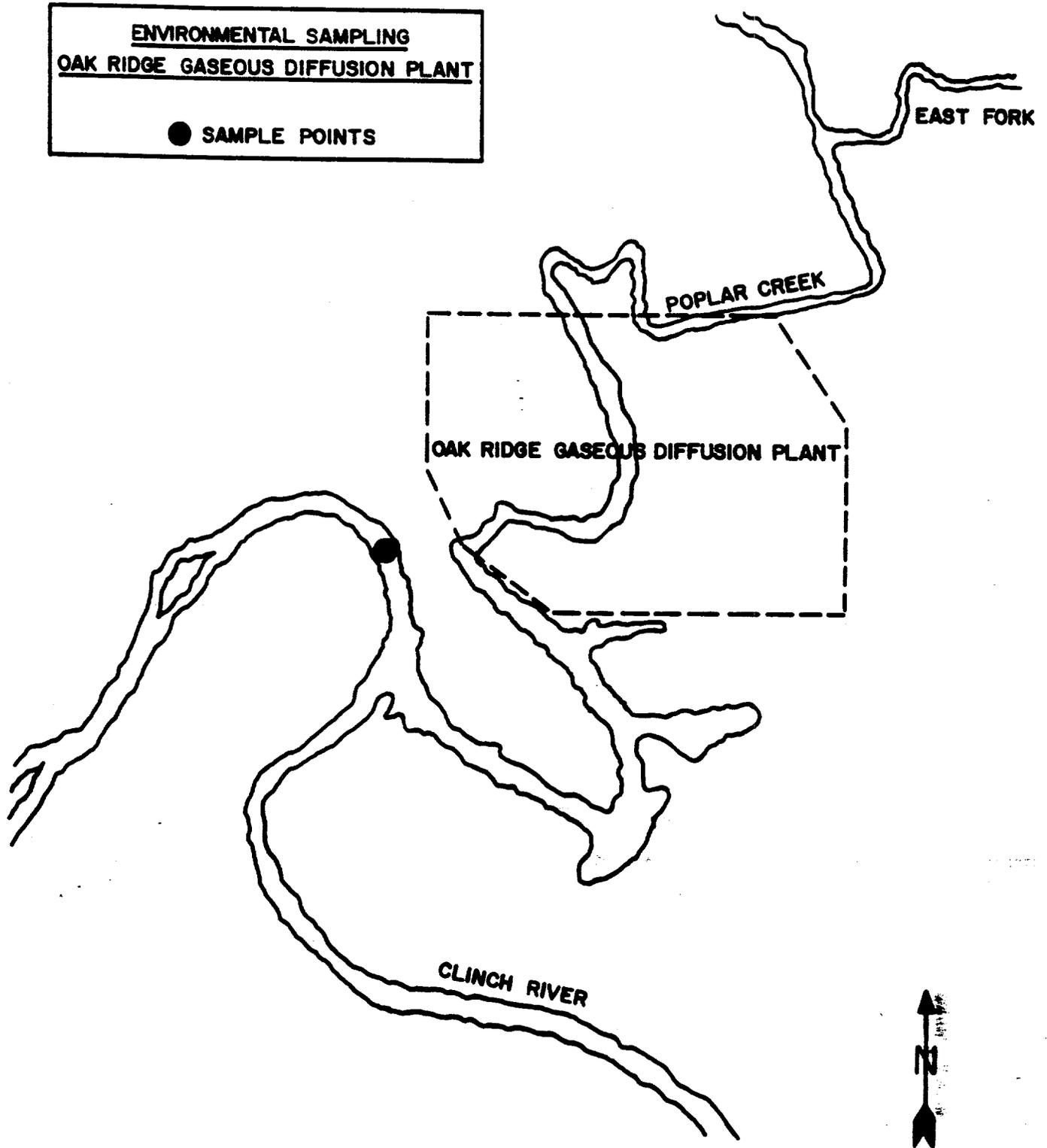


Figure 4

Discussion of Data

Data on the environmental levels of radioactivity for the second half of 1965 in the Oak Ridge and surrounding areas are presented in Table I through Table IX.

The average air contamination levels for gross beta activity, as shown by the continuous air monitoring filter data, for both the immediate and remote environs of the plants were $< 0.1\%$ of the maximum permissible concentration for populations in the neighborhood of a controlled area (Table I). These values are approximately one-third of those for the first half of 1965 and are no higher than the average of those measured in other areas of the United States and reported by the U.S. Public Health Service Radiation Surveillance Network for this period.

The average air contamination levels for gross alpha activity, as shown by the continuous air monitoring filter data, for the immediate and remote environs of the plants were 0.40% and 0.15%, respectively, of the MPC_a for natural uranium for application to populations in the neighborhood of a controlled area (Table II).

The average concentration of ^{131}I in air in the immediate environs of the plants was 0.011×10^{-12} $\mu\text{c}/\text{cc}$ (Table III). This is approximately 0.011% of the maximum permissible concentration for populations in the neighborhood of a controlled area.

The average concentrations of ^{131}I in raw milk in the immediate and remote environs of the Oak Ridge area were 6.1 pc/l and 5.9 pc/l, respectively (Table IV). These values fall within the limits of FRC Range I if one assumes the average intake per individual to be 1 liter of milk per day.

The average concentration of ^{90}Sr in raw milk for both the immediate and remote environs of the controlled area was 23 pc/l. This level falls near the lower limit of FRC Range II for transient rates of daily intake of ^{90}Sr for application to the average of suitable samples of an exposed population.

The calculated average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most of the wastes, and the measured average concentration at Mile 4.5, near Kingston, Tennessee, were 1.3×10^{-8} $\mu\text{c}/\text{ml}$ and 1.0×10^{-8} $\mu\text{c}/\text{ml}$, respectively. These values are 0.34% and 0.50% of the weighted average maximum permissible concentrations $(MPC)_w$. The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 0.4×10^{-10} $\mu\text{c}/\text{ml}$ which is approximately 0.001% of the weighted average $(MPC)_w$ value.

The average activity of natural uranium materials in the Clinch River, reflecting the effects of all Oak Ridge plants, was $< 0.01\%$ of the $(MPC)_w$ for uranium.

The average external gamma radiation measured in the town of Oak Ridge and at the perimeter of the Oak Ridge area was 0.011 mR/hr, which is approximately the same as the level measured in the early period prior to Oak Ridge Operations.

Conclusion

Surveillance of the radioactivity in the Oak Ridge environs indicated that the major part of the radioactivity detected continues to be the result of fallout from weapons testing. While some low level radioactivity is being released to the environment from plant operations, the resulting concentrations in both the atmosphere and surface streams of the Oak Ridge environment are well below established maximum permissible concentrations and intake guides for the neighboring population.

TABLE I
 CONTINUOUS AIR MONITORING DATA
 Long-Lived Gross Beta Activity of
 Particulates in Air

July - December, 1965

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{c}/\text{cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	2.0	0.07	0.80	0.08
HP-32	Midway Gate	26	2.4	0.15	0.89	0.09
HP-33	Gallaher Gate	26	1.5	0.14	0.72	0.07
HP-34	White Oak Dam	26	2.1	0.21	0.86	0.09
HP-35	Blair Gate	26	1.9	0.20	0.93	0.09
HP-36	Turnpike Gate	182 ^d	2.9	0.21	1.3	0.13
HP-37	Hickory Creek Bend	26	1.6	0.21	0.68	0.07
HP-38	East of EGCR	26	2.3	0.40	1.1	0.11
Average			2.1	0.20	0.89	0.09
<u>Remote Stations</u>						
HP-51	Norris Dam	26	2.1	0.26	0.78	0.08
HP-52	Loudoun Dam	26	1.9	0.19	0.84	0.08
HP-53	Douglas Dam	26	2.2	0.24	0.91	0.09
HP-54	Cherokee Dam	26	1.8	0.20	0.84	0.08
HP-55	Watts Bar Dam	25	1.8	0.04	0.88	0.09
HP-56	Great Falls Dam	25	1.8	0.05	0.82	0.08
HP-57	Dale Hollow Dam	26	2.6	0.26	0.75	0.08
HP-58	Knoxville	22	3.0	0.13	0.89	0.09
Average			2.2	0.17	0.84	0.08

^a Maximum weekly average concentration.

^b Minimum weekly average concentration.

^c (MPC)_a is taken to be 10^{-10} $\mu\text{c}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^d Samples collected on daily schedule beginning 5/7/62. Maximum and minimum daily average concentrations were 5.5×10^{-13} $\mu\text{c}/\text{cc}$ and $<0.01 \times 10^{-13}$ $\mu\text{c}/\text{cc}$, respectively.

TABLE II

CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Alpha Activity of
Particulates in Air

July - December, 1965

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{c}/\text{cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	0.10	0.02	0.05	0.25
HP-32	Midway Gate	26	0.17	0.01	0.08	0.40
HP-33	Gallaher Gate	26	0.14	<0.01	0.05	0.25
HP-34	White Oak Dam	26	0.14	<0.01	0.05	0.25
HP-35	Blair Gate	26	0.36	<0.01	0.10	0.50
HP-36	Turnpike Gate	182 ^d	0.29	<0.01	0.17	0.85
HP-37	Hickory Creek Bend	26	0.17	0.01	0.05	0.25
HP-38	East of EGCR	26	0.10	<0.01	0.05	0.25
Average			0.18	<0.01	0.08	0.40
<u>Remote Stations</u>						
HP-51	Norris Dam	26	0.14	0.01	0.03	0.15
HP-52	Loudoun Dam	26	0.08	0.01	0.03	0.15
HP-53	Douglas Dam	26	0.09	<0.01	0.03	0.15
HP-54	Cherokee Dam	26	0.08	0.01	0.04	0.20
HP-55	Watts Bar Dam	26	0.08	<0.01	0.03	0.15
HP-56	Great Falls Dam	26	0.04	<0.01	0.02	0.10
HP-57	Dale Hollow Dam	26	0.07	<0.01	0.03	0.15
HP-58	Knoxville	22	0.15	<0.01	0.05	0.25
Average			0.09	<0.01	0.03	0.15

^aMaximum weekly average concentration.^bMinimum weekly average concentration.^c(MPC)_a used is 20×10^{-13} $\mu\text{c}/\text{cc}$, the MPC for natural uranium as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.^dSamples collected on daily schedule beginning 5/7/62.

TABLE III
 CONCENTRATION OF ^{131}I IN AIR
 AS MEASURED BY THE PERIMETER AIR MONITORING STATIONS

July - December, 1965

Number of Samples	Units of 10^{-12} $\mu\text{c}/\text{cc}$			$\%$ (MPC) _a ^b
	Maximum	Minimum ^a	Average	
208	0.03	< 0.010	0.011	0.011

^aMinimum detectable amount of ^{131}I is 20 d/m. At the average sampling rate used, this corresponds to approximately 0.010×10^{-12} $\mu\text{c}/\text{cc}$. In averaging, one-half of this value, 10 d/m, is used for all samples showing a total amount of ^{131}I less than 20 d/m.

^b(MPC)_a is taken to be 1×10^{-10} $\mu\text{c}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

TABLE IV
CONCENTRATION OF ^{131}I IN RAW MILK

July - December, 1965

Location	pc/l		
	Maximum	Minimum*	Average
Immediate Environs	19	< 10	6.1
Remote Environs	15	< 10	5.9

*Minimum detectable concentration of ^{131}I is 10 pc/l.
In averaging, one-half of this value, 5 pc/l, was used for all samples showing a concentration less than 10 pc/l.

TABLE V
CONCENTRATION OF ^{90}Sr IN RAW MILK

July - December, 1965

Location	pc/l		
	Maximum	Minimum*	Average
Immediate Environs	50	6.3	23
Remote Environs	33	17	23

* Minimum detectable concentration of ^{90}Sr in milk is 2 pc/l. In averaging, one-half of this value, 1 pc/l, was used for all samples showing a concentration less than 2 pc/l.

TABLE VI
CALCULATED AVERAGE CONCENTRATION OF RADIOACTIVITY
IN THE CLINCH RIVER AT MILE 20.8

July - December, 1965

Number of Samples Taken	Units of 10^{-7} $\mu\text{c}/\text{ml}$			% of $(\text{MPC})_w$
	Maximum ^a	Minimum ^b	Average	
182	0.34	0.03	0.13	0.34

^aMaximum weekly average.

^bMinimum weekly average.

TABLE VII
 AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
 IN THE CLINCH RIVER

July - December, 1965

Location	Units of 10^{-8} $\mu\text{c}/\text{ml}$							Average Beta Activity	(MPC) _w ^a	% of (MPC) _w
	⁹⁰ Sr	¹⁴⁴ Ce	¹³⁷ Cs	¹⁰⁶ Ru	⁶⁰ Co	⁹⁵ Zr - ⁹⁵ Nb				
Mi. 41.5 ^b	0.05	0.02	0.05	0.32	*	*	0.45	240	0.19	
Mi. 20.8 ^c	0.05	<0.01	0.03	0.42	0.13	<0.01	1.3	380	0.34	
Mi. 4.5	0.13	0.03	0.10	0.61	0.18	<0.01	1.0	200	0.50	

^aWeighted average (MPC)_w calculated for the mixture using (MPC)_w values for specific radionuclides specified by AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^bSampling station moved from Clinch River Mile 33.2 to Mile 41.5 about January 1, 1962.

^cValues given for this location are calculated values based on levels of waste released and the dilution afforded by the river; they do not include amounts of radioactive material (e.g., fallout) that may enter the river upstream from CRM 20.8.

* None detected.

TABLE VIII
URANIUM CONCENTRATION IN THE CLINCH RIVER

July - December, 1965

Sampling Point	Type of Analyses Made	No. of Samples*	Units of 10^{-8} $\mu\text{c}/\text{ml}$			$\% (\text{MFC})_w$
			Maximum**	Minimum**	Average**	
Downstream from ORGDP	Uranium Concentration	2	< 0.1	< 0.1	< 0.1	< 0.01
						2000

* Normal Sampling Frequency: Continuous, composited over one quarter.

** No uranium was detected in Clinch River water samples during this period. Minimum detectable concentration of uranium in river water is 0.1×10^{-8} $\mu\text{c}/\text{ml}$.

TABLE IX
EXTERNAL GAMMA RADIATION LEVELS

mR/hr

July - December, 1965

Station Number	Location	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1	Solway Gate	0.012	0.012	0.008	0.008	*	0.014	0.010
2	Y-12, East Portal	0.010	0.013	0.009	0.009	*	0.010	0.010
3	Newcomb Road, Oak Ridge	0.013	0.013	0.009	0.013	*	0.012	0.012
4	Gallaher Gate	0.015	0.012	0.008	0.009	*	0.015	0.012
5	White Wing Gate	0.013	0.012	0.010	0.008	*	0.011	0.011
Average		0.012	0.012	0.009	0.009	*	0.012	0.011

Note: These readings were taken with a calibrated Geiger-Müller tube at a distance of three feet above the ground.

The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

*No background readings taken this month.

**UNION
CARBIDE**

INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX P, OAK RIDGE, TENNESSEE 37831

To (Name) **Dr. K. W. Morgan**
Company
Location **ORNL**

Date. **July 13, 1966**

Originating Dept.

Answering letter date

Copy to **Mr. K. W. Bahler**
Mr. C. E. Center
Mr. N. B. Schultz
Health Physics File - RC ✓

Subject **News Release on
Environmental Surveys**

Attached are data for the semiannual news release, as requested by AEC-CNO, covering environmental surveys made by our plant forces at off-plant locations during the first half of calendar year 1966. In accord with agreements reached with the local AEC and ORNL health physics representatives, reports of the alpha air activity for the Oak Ridge area will be furnished by Mr. D. M. Davis, since we have discontinued the use of our off-site stations.


R. G. Jordan

RGJ:HBS:sh

Attachment

ENVIRONMENTAL RADIOACTIVITY LEVELS
OAK RIDGE GASEOUS DIFFUSION PLANT
January thru June, 1966

The results of sampling of the environs of the Oak Ridge Gaseous Diffusion Plant during the first half of 1966 revealed that the amount of uranium in the surface waterways is not significantly different from the normal background values established for this region.

Sampling of the surface waterways adjacent to the plant revealed no instance where the uranium concentration exceeded the maximum permissible concentration specified for water (MPC_w).^{*} The average activity of natural uranium materials in the Clinch River, reflecting the effects of all of the Oak Ridge plants, was less than 0.1% of the MPC_w . Sampling data are shown in the following table:

Environmental Sampling - Local Streams

<u>Location of Point</u>	<u>Type of Analysis</u>	<u>No. of Samples**</u>	<u>Plant Experience</u>			<u>Maximum Permissible Conc. (MPC_w)</u>	<u>Average Per Cent MPC_w +</u>
			<u>Low</u>	<u>High</u>	<u>Av.</u>		
Downstream	Uranium Concentration	2	0.0	0.0	0.0	2000	< 0.1

* AEC Manual Chapter 0524, Annex 1, Table 2, "Concentrations in Air and Water Above Natural Background."

**Normal Sampling Frequency: Continuous; composited over one quarter.

+ Maximum permissible concentrations for continuous exposure to the general population.

Safety and Health Physics Department
July 18, 1966



UNION CARBIDE CORPORATION
NUCLEAR DIVISION

P. O. BOX P, OAK RIDGE, TENNESSEE 37830

September 8, 1966

U. S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

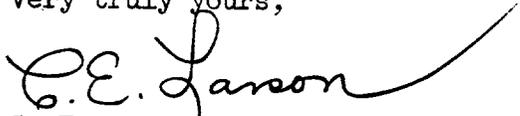
Attention: Mr. S. R. Sapirie, Manager
Oak Ridge Operations

Gentlemen:

Dissemination to the Public of Data
on Environmental Levels of Radioactivity

As requested, we are enclosing forty copies of the report for the first half of 1966 on Environmental Levels of Radioactivity for the Oak Ridge area.

Very truly yours,


C. E. Larson
President

CEL:HGM:dg

Enclosures

cc w/encl.: F. R. Bruce
C. E. Center (4)
D. M. Davis (10)
W. H. Jordan
H. G. MacPherson (2)
K. Z. Morgan
N. B. Schultz (2)

ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

(Report for Period January - June, 1966)

Compiled by the

Health Physics and Safety Section

Health Physics Division

OAK RIDGE NATIONAL LABORATORY

Introduction

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are released to trenches located in the Conasauga shale formation. Low level liquid wastes are discharged, after preliminary treatment, to the surface streams.

Air that may become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by means of filters, scrubbers, and/or precipitators.

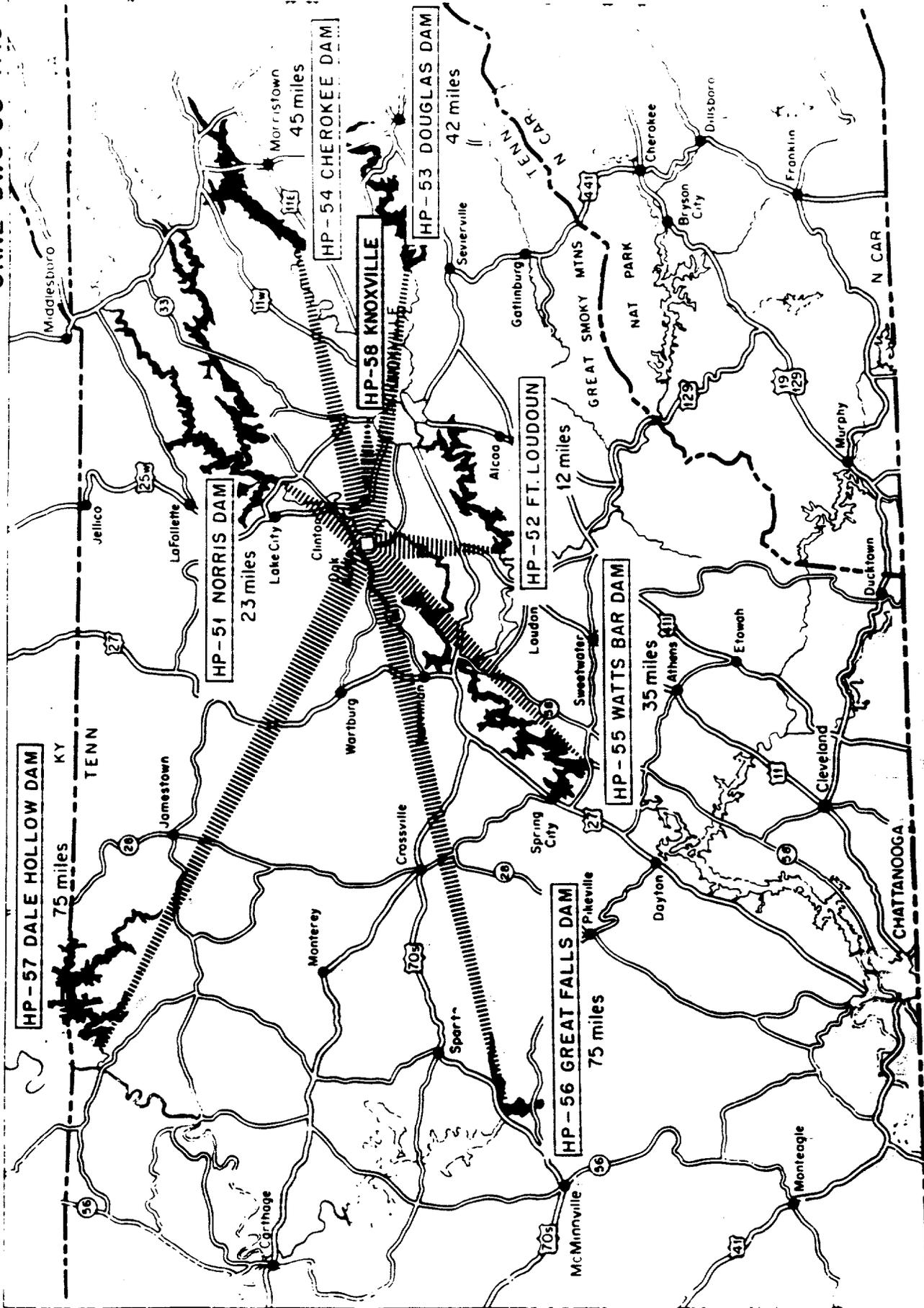
This report presents data on the environmental levels of radioactivity for the Oak Ridge area and compares the data with established maximum permissible concentrations.

Air Monitoring

Atmospheric contamination by radioactive materials occurring in the general environment of East Tennessee is monitored by two systems of monitoring stations. One system consists of eight stations which encircle the plant area (Fig. 1) and provide data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of eight stations encircling the Oak Ridge area at distances of from 12 to 75 miles (Fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Sampling for radioactive particulates is carried out by passing air continuously through a filter paper. Airborne radioactive iodine is monitored in the immediate environment of the plant areas by passing air through a cartridge containing activated charcoal. Data collected are accumulated and tabulated in average $\mu\text{c}/\text{cc}$ of air sampled.

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Raw milk is monitored for ^{131}I and ^{90}Sr by the collection and analysis of samples from twelve sampling stations located within a radius of 50 miles of ORNL. Samples are collected weekly at each of eight stations located on the fringe of the Oak Ridge area. Four stations, located more remotely with respect to Oak Ridge Operations, are sampled at a rate of one station each week. The purpose of the milk sampling program is twofold: first, samples collected in the immediate vicinity of the Oak



STATION SITES FOR REMOTE AIR MONITORING SYSTEM

Figure 2

Ridge area provide data by which one may evaluate possible exposure to the neighboring population resulting from waste releases from Oak Ridge Operations; second, samples collected at the more remote stations provide background data which are essential in establishing the proper index for the evaluation of data obtained from local samples.

Water Monitoring

Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, into the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for populations in the neighborhood of a controlled area as specified by AEC Manual, Chapter 0524. The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 3 and 4. Samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously to obtain dilution factors for calculating the probable concentrations of wastes in the river.

Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters.

Analyses are made of the effluent for the long-lived radionuclides only, since cooling time and hold-up time in the waste effluent system are such that short-lived radionuclides are normally not present. The concentrations of those isotopes present in significant amounts are determined by analysis. A weighted average maximum permissible concentration for water, $(MPC)_w$, for the mixture of radionuclides is calculated on the basis of the isotopic distribution using the MPC values of each isotope as specified by AEC Manual, Chapter 0524.¹ The average concentrations of gross beta activity in the Clinch River are compared to the calculated $(MPC)_w$ values.

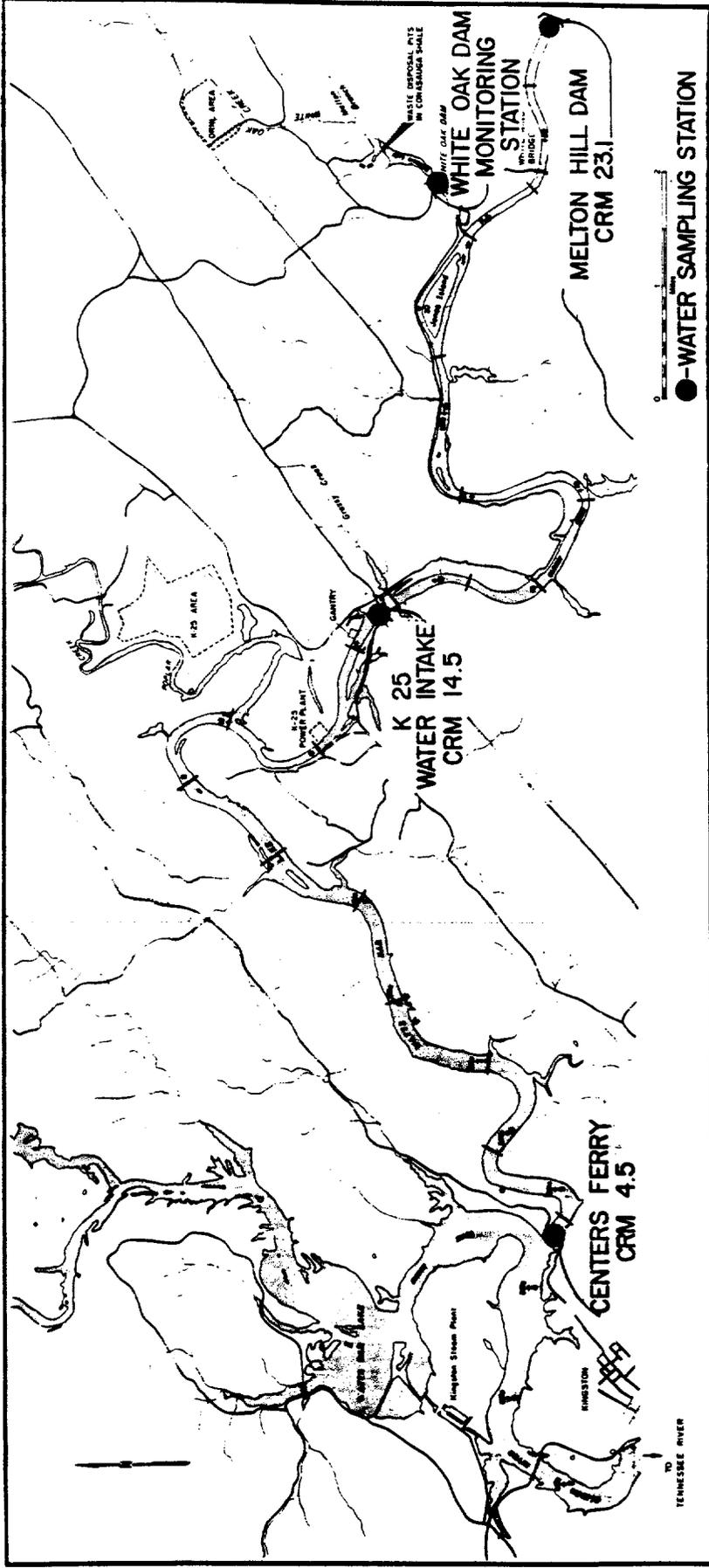
The concentration of uranium is compared with the specific $(MPC)_w$ value for uranium.

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge area. Measurements are taken with a Geiger-Müller tube at a distance of three feet above the ground, and the results are tabulated in terms of mR/hr.

¹AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

ORNL-DWG 66-2216R



WATER SAMPLING LOCATIONS

Figure 3

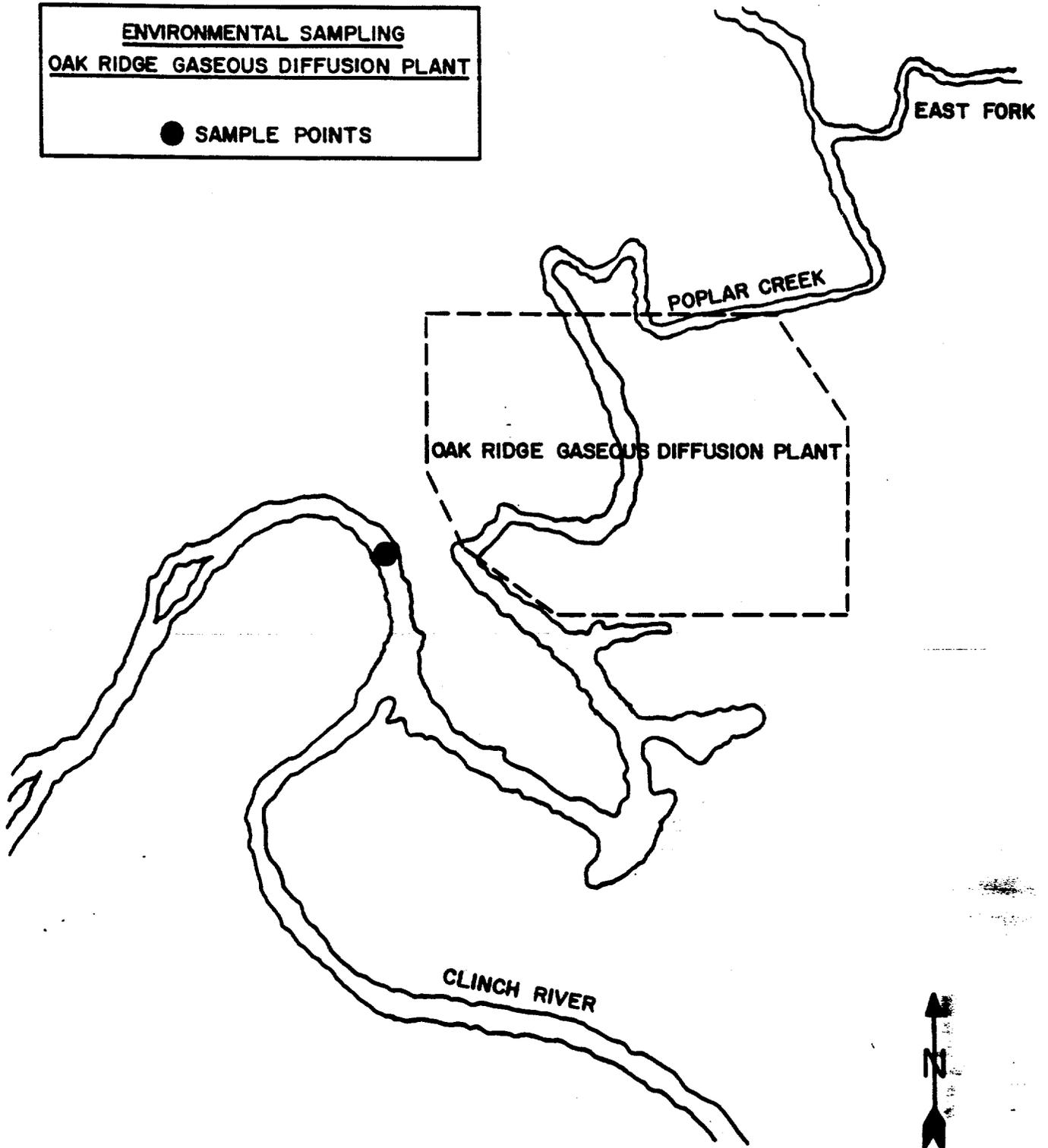


Figure 4

Discussion of Data

Data on the environmental levels of radioactivity for the first half of 1966 in the Oak Ridge and surrounding areas are presented in Table I through Table IX.

The average air contamination levels for gross beta activity, as shown by the continuous air monitoring filter data, for both the immediate and remote environs of the plants were 0.12% of the maximum permissible concentration for populations in the neighborhood of a controlled area (Table I). These levels are approximately one-third higher than those for the last half of 1965. The higher levels may be attributed to an increase in fallout from weapons testing. An increase in fallout was first observed in the Oak Ridge area on May 22, 1966. Laboratory analysis of the fallout material confirmed the presence of fresh fission products, the age of which was consistent with the timing of the announced nuclear detonation by Communist China on May 9, 1966.²

The average air contamination levels for gross alpha activity, as shown by the continuous air monitoring filter data, for the immediate and remote environs of the plants were 0.35% and 0.25%, respectively, of the MPC_a for natural uranium for application to populations in the neighborhood of a controlled area (Table II).

The average concentration of ¹³¹I in air in the immediate environs of the plants was 0.016×10^{-12} $\mu\text{c}/\text{cc}$ (Table III). This is approximately 0.016% of the maximum permissible concentration for populations in the neighborhood of a controlled area.

The average concentrations of ¹³¹I in raw milk in the immediate and remote environs of the Oak Ridge area were 10 pc/l and 6.3 pc/l, respectively (Table IV). The maximum concentration observed, 124 pc/l, occurred on May 25, 1966, approximately three days after the arrival in the Oak Ridge area of fallout containing fresh fission products. The average values fall within the limits of FRC Range I if one assumes the average intake per individual to be 1 liter of milk per day.

The average concentration of ⁹⁰Sr in raw milk for the immediate and remote environs of the controlled area were 25 pc/l and 23 pc/l respectively. These levels fall near the lower limit of FRC Range II for transient rates of daily intake of ⁹⁰Sr for application to the average of suitable samples of an exposed population.

The calculated average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most of the wastes, and the measured average concentration at Mile 4.5, near Kingston, Tennessee, were 11×10^{-8} $\mu\text{c}/\text{ml}$ and 1.7×10^{-8} $\mu\text{c}/\text{ml}$, respectively. These values are 2.8% and 1.1% of the weighted average maximum permissible concentrations (MPC)_w.

²Radiological Health Data and Reports, U. S. Department of Health, Education and Welfare, Vol. 7, No. 6, June 1966.

The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 1.2×10^{-10} $\mu\text{c/ml}$ which is approximately 0.003% of the weighted average $(\text{MPC})_w$ value.

The average activity of natural uranium materials in the Clinch River, reflecting the effects of all Oak Ridge plants, was $< 0.01\%$ of the $(\text{MPC})_w$ for uranium.

The average external gamma radiation measured in the town of Oak Ridge and at the perimeter of the Oak Ridge area was 0.012 mR/hr, which is approximately the same as the level measured in the early period prior to Oak Ridge Operations.

Conclusion

Surveillance of the radioactivity in the Oak Ridge environs indicated that the major part of the radioactivity detected continues to be the result of fallout from weapons testing. While some low level radioactivity is being released to the environment from plant operations, the resulting concentrations in both the atmosphere and surface streams of the Oak Ridge environment are well below established maximum permissible concentrations and intake guides for the neighboring population.

TABLE I
 CONTINUOUS AIR MONITORING DATA
 Long-Lived Gross Beta Activity of
 Particulates in Air

January - June, 1966

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{c}/\text{cc}$			% (MPC) ^a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	3.7	0.13	1.2	0.12
HP-32	Midway Gate	26	3.1	0.13	1.1	0.11
HP-33	Gallaher Gate	26	2.5	0.19	0.90	0.09
HP-34	White Oak Dam	26	2.7	0.06	1.0	0.10
HP-35	Blair Gate	26	3.5	0.25	1.2	0.12
HP-36	Turnpike Gate	178 ^d	4.4	0.43	1.8	0.18
HP-37	Hickory Creek Bend	26	2.4	0.35	0.82	0.08
HP-38	East of EGCR	26	4.4	0.37	1.3	0.13
Average			3.3	0.24	1.2	0.12
<u>Remote Stations</u>						
HP-51	Norris Dam	26	2.5	0.10	1.1	0.11
HP-52	Loudoun Dam	26	3.5	0.24	1.2	0.12
HP-53	Douglas Dam	26	4.2	0.26	1.2	0.12
HP-54	Cherokee Dam	26	3.6	0.22	1.1	0.11
HP-55	Watts Bar Dam	26	3.3	0.23	1.1	0.11
HP-56	Great Falls Dam	25	2.8	0.33	1.2	0.12
HP-57	Dale Hollow Dam	26	2.7	0.46	1.1	0.11
HP-58	Knoxville	25	3.3	0.27	1.2	0.12
Average			3.2	0.26	1.2	0.12

^a Maximum weekly average concentration.

^b Minimum weekly average concentration.

^c (MPC)_a is taken to be 10^{-10} $\mu\text{c}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^d Samples collected on daily schedule beginning 5/7/62. Maximum and minimum daily average concentrations were 19×10^{-13} $\mu\text{c}/\text{cc}$ and $< 0.01 \times 10^{-13}$ $\mu\text{c}/\text{cc}$ respectively.

TABLE II

CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Alpha Activity of
Particulates in AirJanuary - June, 1966

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{c}/\text{cc}$			$\%$ (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	0.21	<0.01	0.06	0.30
HP-32	Midway Gate	26	0.20	<0.01	0.06	0.30
HP-33	Gallaher Gate	26	0.09	0.02	0.05	0.25
HP-34	White Oak Dam	26	0.47	0.01	0.06	0.30
HP-35	Blair Gate	26	0.20	0.01	0.06	0.30
HP-36	Turnpike Gate	178 ^d	0.37	0.03	0.14	0.70
HP-37	Hickory Creek Bend	26	0.07	<0.01	0.04	0.20
HP-38	East of EGCR	26	0.13	<0.01	0.06	0.30
Average			0.22	0.01	0.07	0.35
<u>Remote Stations</u>						
HP-51	Norris Dam	26	0.07	<0.01	0.03	0.15
HP-52	Loudoun Dam	26	0.06	0.01	0.04	0.20
HP-53	Douglas Dam	26	0.09	0.01	0.04	0.20
HP-54	Cherokee Dam	26	0.15	0.01	0.04	0.20
HP-55	Watts Bar Dam	26	0.07	<0.01	0.03	0.15
HP-56	Great Falls Dam	25	0.42	<0.01	0.04	0.20
HP-57	Dale Hollow Dam	26	0.05	0.01	0.03	0.15
HP-58	Knoxville	25	0.09	0.01	0.04	0.20
Average			0.013	<0.01	0.04	0.20

^aMaximum weekly average concentration.^bMinimum weekly average concentration.^c(MPC)_a used is 20×10^{-13} $\mu\text{c}/\text{cc}$, the MPC for natural uranium as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.^dSamples collected on daily schedule beginning 5/7/62.

TABLE III
 CONCENTRATION OF ^{131}I IN AIR
 AS MEASURED BY THE PERIMETER AIR MONITORING STATIONS

January - June, 1966

Number of Samples	Units of 10^{-12} $\mu\text{c}/\text{cc}$			$\%$ (MPC) _a ^b
	Maximum	Minimum ^a	Average	
208	0.13	< 0.010	0.016	0.016

^aMinimum detectable amount of ^{131}I is 20 d/m. At the average sampling rate used, this corresponds to approximately 0.010×10^{-12} $\mu\text{c}/\text{cc}$. In averaging, one-half of this value, 10 d/m, is used for all samples showing a total amount of ^{131}I less than 20 d/m.

^b(MPC)_a is taken to be 1×10^{-10} $\mu\text{c}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

TABLE IV
CONCENTRATION OF ^{131}I IN RAW MILK

January - June, 1966

Location	pc/l		
	Maximum	Minimum*	Average
Immediate Environs	124	< 10	10
Remote Environs	30	< 10	6.3

*Minimum detectable concentration of ^{131}I is 10 pc/l.
In averaging, one-half of this value, 5 pc/l, was
used for all samples showing a concentration less
than 10 pc/l.

TABLE V
CONCENTRATION OF ^{90}Sr IN RAW MILK

January - June, 1966

Location	pc/l		
	Maximum	Minimum*	Average
Immediate Environs	64	7.7	25
Remote Environs	39	16	23

*Minimum detectable concentration of ^{90}Sr in milk is 2 pc/l. In averaging, one-half of this value, 1 pc/l, was used for all samples showing a concentration less than 2 pc/l.

TABLE VI
 CALCULATED AVERAGE CONCENTRATION OF RADIOACTIVITY
 IN THE CLINCH RIVER AT MILE 20.8

January - June, 1966

Number of Samples Taken	Units of 10^{-7} $\mu\text{c/ml}$			% of $(\text{MPC})_w$
	Maximum ^a	Minimum ^b	Average	
177	3.5	0.05	1.1	2.8

^aMaximum weekly average.

^bMinimum weekly average.

TABLE VII
 AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
 IN THE CLINCH RIVER

January - June, 1966

Location	Units of 10^{-8} $\mu\text{c/ml}$							Average Beta Activity	$(\text{MPC})_w^a$	% of $(\text{MPC})_w$
	^{90}Sr	^{144}Ce	^{137}Cs	^{106}Ru	^{60}Co	$^{95}\text{Zr} - ^{95}\text{Nb}$				
Mi. 23.1 ^b	0.13	0.04	0.05	0.11	*	*	0.33	73	0.45	
Mi. 20.8 ^c	0.15	<0.01	0.09	1.1	0.53	<0.01	11	380	2.8	
Mi. 4.5	0.29	0.10	0.13	0.59	0.61	<0.01	1.7	160	1.1	

^aWeighted average $(\text{MPC})_w$ calculated for the mixture using $(\text{MPC})_w$ values for specific radionuclides specified by AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^bSampling station moved from Clinch River Mile 41.5 to Melton Hill Dam, CRM 23.1 about January 1, 1966.

^cValues given for this location are calculated values based on levels of waste released and the dilution afforded by the river; they do not include amounts of radioactive material (e.g., fallout) that may enter the river upstream from CRM 20.8.

* None detected.

TABLE VIII
URANIUM CONCENTRATION IN THE CLINCH RIVER

January - June, 1966

Sampling Point	Type of Analyses Made	No. of Samples*	Units of 10^{-8} $\mu\text{c/ml}$			$\% (\text{MPC})_w$
			Maximum**	Minimum**	Average**	
Downstream from ORGDP	Uranium Concentration	2	< 0.1	< 0.1	< 0.1	2000 < 0.01

*Normal Sampling Frequency: Continuous, composited over one quarter.

**No uranium was detected in Clinch River water samples during this period. Minimum detectable concentration of uranium in river water is 0.1×10^{-8} $\mu\text{c/ml}$.

TABLE IX
EXTERNAL GAMMA RADIATION LEVELS

mR/hr

January - June, 1966

Station Number	Location	Jan.	Feb.	March	April	May	June	Average
1	Solway Gate	0.014	0.012	0.011	0.011	0.012	0.012	0.012
2	Y-12, East Portal	0.011	0.010	0.011	0.010	0.010	0.012	0.011
3	Newcomb Road, Oak Ridge	0.014	0.010	0.009	0.011	0.012	0.010	0.011
4	Galleher Gate	0.014	0.013	0.015	0.012	0.011	0.013	0.013
5	White Wing Gate	0.014	0.010	0.010	0.011	0.012	0.012	0.012
Average		0.013	0.011	0.011	0.011	0.011	0.012	0.012

Note: These readings were taken with a calibrated Geiger-Müller tube at a distance of three feet above the ground.

The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

**UNION
CARBIDE**

INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX P, OAK RIDGE, TENNESSEE 37831

To (Name) **Dr. K. Z. Morgan**
Company
Location **ORNL**

Date **January 18, 1967**

Originating Dept.

Answering letter date

Copy to **Mr. C. E. Center**
Dr. L. F. Lockett
Mr. H. B. Schultz
Health Physics File - RC

Subject **News Release on Environmental
Surveys**

Attached are data for the semiannual news release, as requested by AEC-ORO, covering environmental surveys made by our plant forces at off-plant locations during the second half of calendar year 1966. In accord with agreements reached with the local AEC and ORNL health physics representatives, reports of the alpha air activity for the Oak Ridge area will be furnished by Mr. D. M. Davis, since we have discontinued the use of our off-site stations.


R.G. Jordan

RLJ:ERS:wh

Attachment

ENVIRONMENTAL RADIOACTIVITY LEVELS
Oak Ridge Gaseous Diffusion Plant
July thru December, 1966

The results of sampling of the environs of the Oak Ridge Gaseous Diffusion Plant during the second half of 1966 revealed that the amount of uranium in the surface waterways is not significantly different from the normal background values established for this region.

Sampling of the surface waterways adjacent to the plant revealed no instance where the uranium concentration exceeded the maximum permissible concentration specified for water (MPC_w).* The average activity of natural uranium materials in the Clinch River, reflecting the effects of all of the Oak Ridge plants, was less than 0.1% of the MPC_w. Sampling data are shown in the following table:

<u>Environmental Sampling - Local Streams</u>							
<u>Location of Point</u>	<u>Type of Analysis</u>	<u>No. of Samples**</u>	<u>Units of 10⁻⁶ μCi/cc</u>			<u>Maximum Permissible Conc. (MPC_w)</u>	<u>Average Per Cent MPC_w†</u>
			<u>Plant Experience Low</u>	<u>High</u>	<u>Av.</u>		
Downstream from ORGDP	Uranium Concentration	2	0.0	0.0	0.0	2000	< 0.1

* AEC Manual Chapter 0524, Annex 1, Table 2, "Concentrations in Air and Water Above Natural Background."

**Normal Sampling Frequency: Continuous; composited over one quarter.

† Maximum permissible concentrations for continuous exposure to the general population.



UNION CARBIDE CORPORATION

NUCLEAR DIVISION

P. O. BOX Y, OAK RIDGE, TENNESSEE 37830

April 5, 1967

U. S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

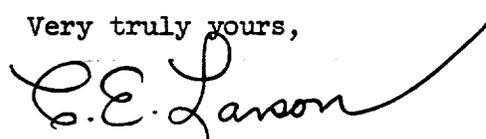
Attention: Mr. S. R. Sapiro, Manager
Oak Ridge Operations

Gentlemen:

Dissemination to the Public of Data
on Environmental Levels of Radioactivity

As requested, we are enclosing forty copies of the report for the second half of 1966 on Environmental Levels of Radioactivity for the Oak Ridge area.

Very truly yours,



C. E. Larson
President

CEL:HGM:dg

Enclosures

cc w/encl.: F. R. Bruce
C. E. Center (4)
D. M. Davis (10)
J. L. Liverman
H. G. MacPherson (2)
K. Z. Morgan
N. B. Schultz (2) ✓

ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

(Report for Period July - December, 1966)

Compiled by the

Health Physics and Safety Section

Health Physics Division

OAK RIDGE NATIONAL LABORATORY

Introduction

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are concentrated by evaporation and disposed of in deep wells. Low level liquid wastes are discharged, after preliminary treatment, to surface streams.

Air that may become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by means of scrubbers and filters.

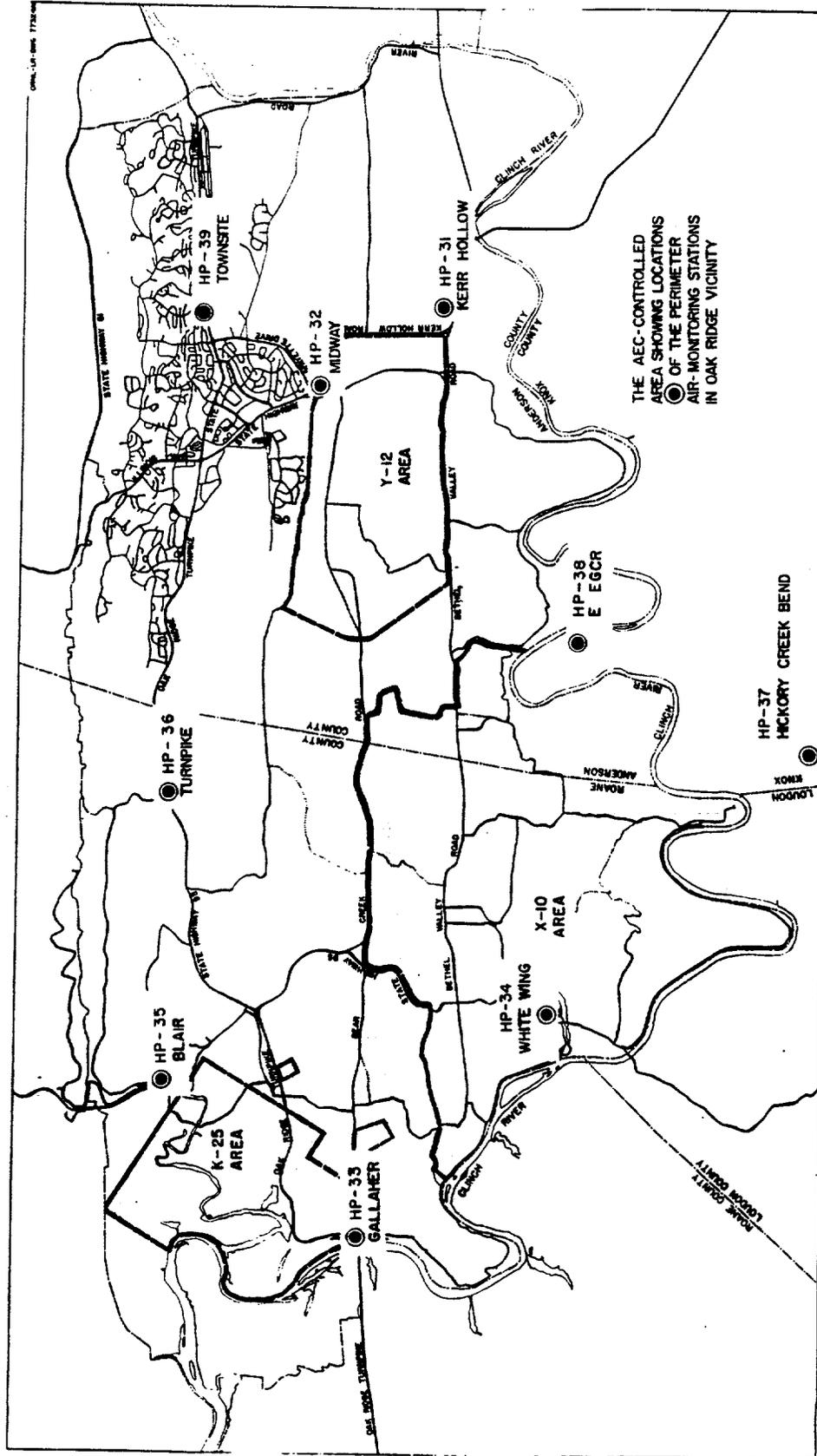
This report presents data on the environmental levels of radioactivity for the Oak Ridge area and compares the data with established maximum permissible concentrations.

Air Monitoring

Atmospheric contamination by radioactive materials occurring in the general environment of East Tennessee is monitored by two systems of monitoring stations. One system consists of nine stations which encircle the plant area (Fig. 1) and provide data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of eight stations encircling the Oak Ridge area at distances of from 12 to 75 miles (Fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Sampling for radioactive particulates is carried out by passing air continuously through a filter paper. Airborne radioactive iodine is monitored in the immediate environment of the plant areas by passing air through a cartridge containing activated charcoal. Data collected are accumulated and tabulated in average $\mu\text{c}/\text{cc}$ of air sampled.

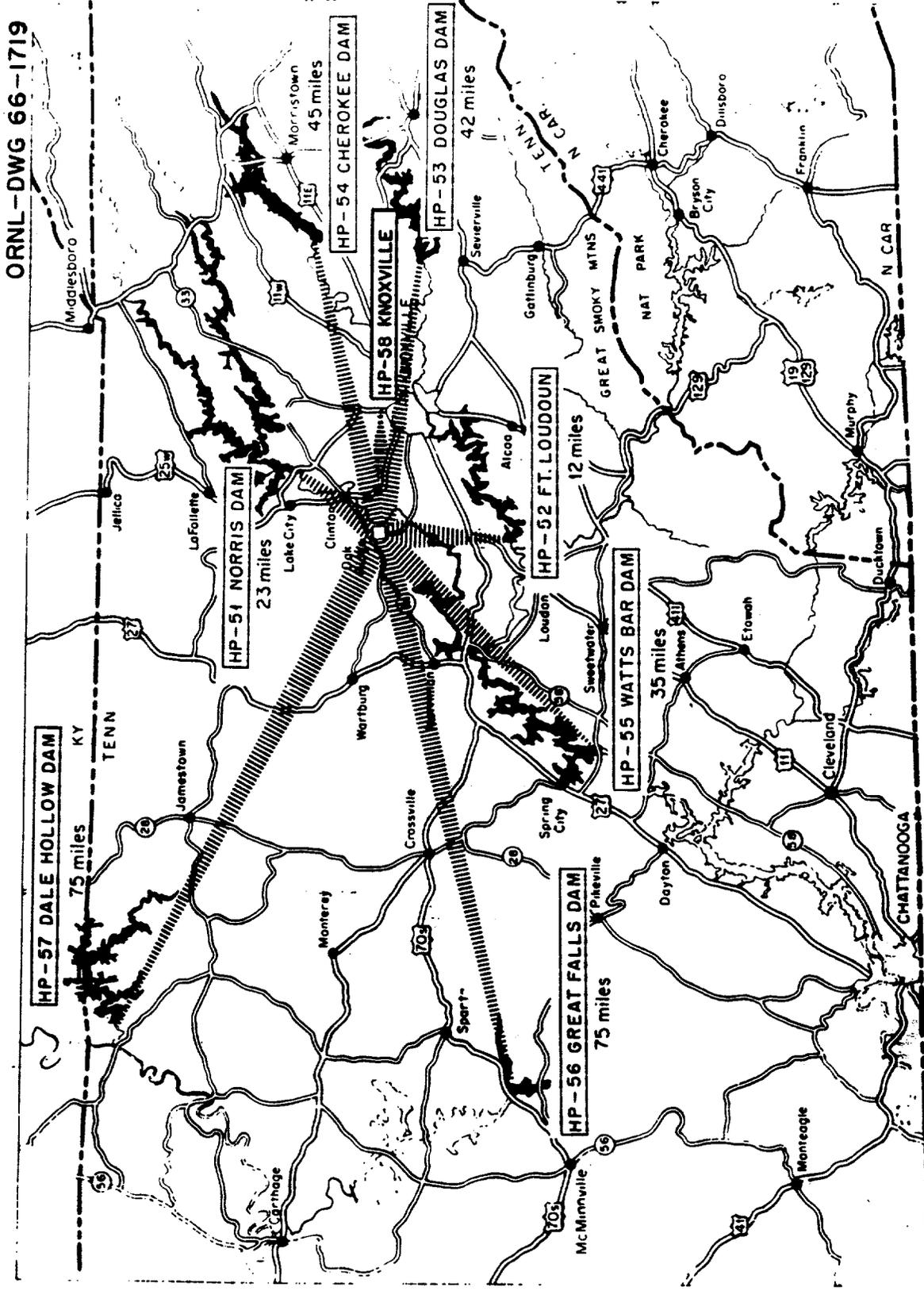
Milk Monitoring

Raw milk is monitored for ^{131}I and ^{90}Sr by the collection and analysis of samples from twelve sampling stations located within a radius of 50 miles of ORNL. Samples are collected weekly at each of eight stations located on the fringe of the Oak Ridge area. Four stations, located more remotely with respect to Oak Ridge Operations, are sampled at a rate of one station each week. The purpose of the milk sampling program is two-fold: first, samples collected in the immediate vicinity of the Oak



STATION SITES FOR PERIMETER AIR MONITORING SYSTEM

Figure 1



STATION SITES FOR REMOTE AIR MONITORING SYSTEM

Figure 2

Ridge area provide data by which one may evaluate possible exposure to the neighboring population resulting from waste releases from Oak Ridge Operations; second, samples collected at the more remote stations provide background data which are essential in establishing the proper index for the evaluation of data obtained from local samples.

Water Monitoring

Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, into the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for populations in the neighborhood of a controlled area as specified by AEC Manual, Chapter 0524. The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 3 and 4. Samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously to obtain dilution factors for calculating the probable concentrations of wastes in the river.

Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters.

Analyses are made of the effluent for the long-lived radionuclides only, since cooling time and hold-up time in the waste effluent system are such that short-lived radionuclides are normally not present. The concentrations of those isotopes present in significant amounts are determined by analysis. A weighted average maximum permissible concentration for water, $(MPC)_w$, for the mixture of radionuclides is calculated on the basis of the isotopic distribution using the MPC values of each isotope as specified by AEC Manual, Chapter 0524.¹ The average concentrations of gross beta activity in the Clinch River are compared to the calculated $(MPC)_w$ values.

The concentration of uranium is compared with the specific $(MPC)_w$ value for uranium.

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge area. Measurements are taken with a Geiger-Müller tube at a distance of three feet above the ground, and the results are tabulated in terms of mR/hr.

¹AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

ORNL-DWG. 66-1810

ENVIRONMENTAL SAMPLING
OAK RIDGE GASEOUS DIFFUSION PLANT

● **SAMPLE POINTS**

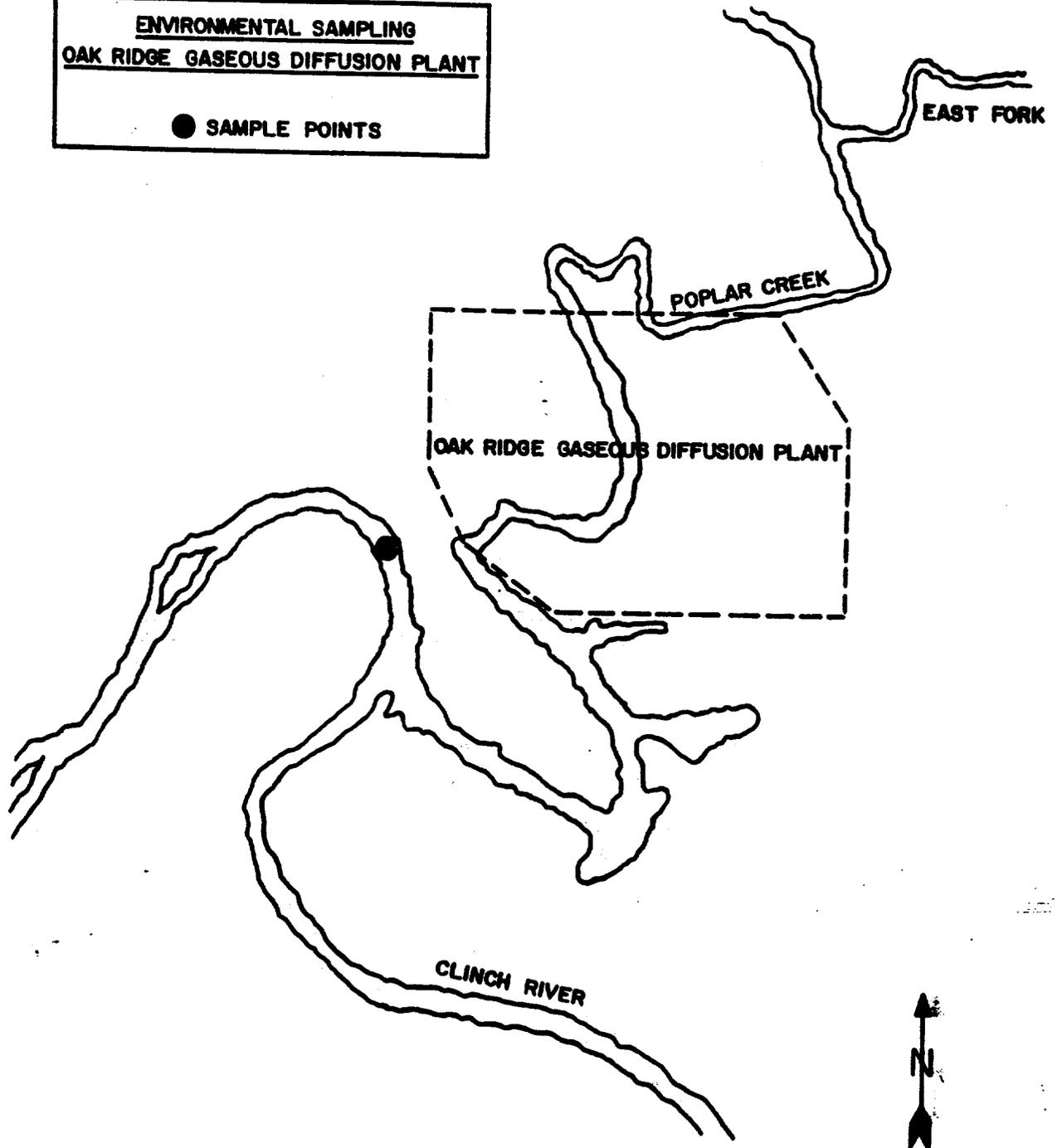


Figure 4

Discussion of Data

Data on the environmental levels of radioactivity for the last half of 1966 in the Oak Ridge and surrounding areas are presented in Table I through Table IX.

The average air contamination levels for gross beta activity, as shown by the continuous air monitoring filter data, for both the immediate and remote environs of the plants were 0.10% of the maximum permissible concentration for populations in the neighborhood of a controlled area (Table I). These levels are approximately the same as those for the first half of 1966 and are no higher than the average of those measured in other areas of the United States and reported by the U. S. Public Health Service Radiation Surveillance Network for this period. An increase in fallout occurred in the East Tennessee area during the first week of November, 1966. The arrival of the fallout material in the Oak Ridge area was consistent with the timing of the announced nuclear detonation by Communist China on October 27, 1966.²

The average air contamination levels for gross alpha activity, as shown by the continuous air monitoring filter data, for the immediate and remote environs of the plants were 0.30% and 0.15%, respectively, of the MPC_a for natural uranium for application to populations in the neighborhood of a controlled area (Table II).

The average concentration of ^{131}I in air in the immediate environs of the plants was 0.012×10^{-12} $\mu\text{c}/\text{cc}$ (Table III). This is approximately 0.012% of the maximum permissible concentration for populations in the neighborhood of a controlled area.

The average concentrations of ^{131}I in raw milk in the immediate and remote environs of the Oak Ridge area were 8.0 pc/l and 5.9 pc/l, respectively (Table IV). The maximum concentration observed, 114 pc/l, occurred on November 9, 1966, approximately four days after the arrival in the Oak Ridge area of fallout containing fresh fission products. The average values fall within the limits of FRC Range I if one assumes the average intake per individual to be 1 liter of milk per day.

The average concentration of ^{90}Sr in raw milk for the immediate and remote environs of the controlled area were 27 pc/l and 24 pc/l respectively. These levels fall near the lower limit of FRC Range II for transient rates of daily intake of ^{90}Sr for application to the average of suitable samples of an exposed population.

The calculated average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most of the wastes, and the measured average concentration at Mile 4.5, near Kingston, Tennessee, were 1.4×10^{-8} $\mu\text{c}/\text{ml}$ and 0.68×10^{-8} $\mu\text{c}/\text{ml}$, respectively. These values are 0.63% and 0.45% of the weighted average maximum permissible concentrations $(MPC)_w$.

²Radiological Health Data and Reports, U. S. Department of Health, Education and Welfare, Vol. 7, No. 11, November 1966.

The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 0.99×10^{-10} $\mu\text{c}/\text{ml}$ which is approximately 0.005% of the weighted average $(\text{MPC})_w$ value.

The average activity of natural uranium materials in the Clinch River, reflecting the effects of all Oak Ridge plants, was $< 0.01\%$ of the $(\text{MPC})_w$ for uranium.

The average external gamma radiation measured in the town of Oak Ridge and at the perimeter of the Oak Ridge area was 0.012 mR/hr, which is approximately the same as the level measured in the early period prior to Oak Ridge Operations.

Conclusion

Surveillance of the radioactivity in the Oak Ridge environs indicated that the major part of the radioactivity detected continues to be the result of fallout from weapons testing. While some low level radioactivity is being released to the environment from plant operations, the resulting concentrations in both the atmosphere and surface streams of the Oak Ridge environment are well below established maximum permissible concentrations and intake guides for the neighboring population.

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July - December, 1966

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			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	3.4	0.09	0.89	0.09
HP-32	Midway Gate	26	4.6	0.13	1.1	0.11
HP-33	Gallaher Gate	26	2.5	0.06	0.75	0.08
HP-34	White Oak Dam	26	3.5	0.11	0.77	0.08
HP-35	Blair Gate	26	4.4	0.00	0.89	0.09
HP-36	Turnpike Gate	182 ^d	5.4	0.24	1.4	0.11
HP-37	Hickory Creek Bend	26	3.8	0.11	0.83	0.08
HP-38	East of EGCR	26	4.9	0.00	0.96	0.10
HP-39	Townsite	26	6.6	0.08	1.1	0.11
Average			4.3	0.09	0.97	0.10
<u>Remote Stations</u>						
HP-51	Norris Dam	26	6.0	0.13	1.1	0.11
HP-52	Loudoun Dam	25	5.0	0.10	0.99	0.10
HP-53	Douglas Dam	26	4.9	0.00	1.0	0.10
HP-54	Cherokee Dam	26	5.5	0.20	0.93	0.09
HP-55	Watts Bar Dam	26	6.2	0.08	0.86	0.09
HP-56	Great Falls Dam	26	5.5	0.07	1.2	0.12
HP-57	Dale Hollow Dam	26	5.8	0.04	0.94	0.09
HP-58	Knoxville	24	6.0	0.13	1.1	0.11
Average			5.6	0.09	1.0	0.10

^aMaximum weekly average concentration.

^bMinimum weekly average concentration.

^c(MPC)_a is taken to be 10^{-10} $\mu\text{c}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^dSamples collected on daily schedule beginning 5/7/62. Maximum and minimum daily average concentrations were 20×10^{-13} $\mu\text{c}/\text{cc}$ and $< 0.01 \times 10^{-13}$ $\mu\text{c}/\text{cc}$, respectively.

TABLE II
 CONTINUOUS AIR MONITORING DATA
 Long-Lived Gross Alpha Activity of
 Particulates in Air

July - December, 1966

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{c}/\text{cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	0.09	<0.01	0.05	0.25
HP-32	Midway Gate	26	0.12	<0.01	0.07	0.35
HP-33	Gallaher Gate	26	0.14	<0.01	0.05	0.25
HP-34	White Oak Dam	26	0.11	<0.01	0.04	0.20
HP-35	Blair Gate	26	0.57	<0.01	0.08	0.40
HP-36	Turnpike Gate	182 ^d	0.24	<0.01	0.13	0.65
HP-37	Hickory Creek Bend	26	0.08	<0.01	0.04	0.20
HP-38	East of EGCR	26	0.12	<0.01	0.03	0.15
HP-39	Townsite	26	0.14	<0.01	0.06	0.30
Average			0.18	<0.01	0.06	0.30
<u>Remote Stations</u>						
HP-51	Norris Dam	26	0.07	0.01	0.04	0.20
HP-52	Loudoun Dam	25	0.07	<0.01	0.04	0.20
HP-53	Douglas Dam	26	0.07	0.01	0.03	0.15
HP-54	Cherokee Dam	26	0.06	<0.01	0.03	0.15
HP-55	Watts Bar Dam	26	0.06	<0.01	0.03	0.15
HP-56	Great Falls Dam	26	0.05	0.01	0.03	0.15
HP-57	Dale Hollow Dam	26	0.07	<0.01	0.03	0.15
HP-58	Knoxville	24	0.07	<0.01	0.04	0.20
Average			0.06	<0.01	0.03	0.15

^aMaximum weekly average concentration.

^bMinimum weekly average concentration.

^c(MPC)_a used is 20×10^{-13} $\mu\text{c}/\text{cc}$, the MPC for natural uranium as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^dSamples collected on daily schedule beginning 5/7/62.

TABLE III
 CONCENTRATION OF ^{131}I IN AIR
 AS MEASURED BY THE PERIMETER AIR MONITORING STATIONS

July - December, 1966

Number of Samples	Units of 10^{-12} $\mu\text{c}/\text{cc}$			$\%$ (MFC) _a ^b
	Maximum	Minimum ^a	Average	
206	0.12	< 0.010	0.012	0.012

^a Minimum detectable amount of ^{131}I is 20 d/m. At the average sampling rate used, this corresponds to approximately 0.010×10^{-12} $\mu\text{c}/\text{cc}$. In averaging, one-half of this value, 10 d/m, is used for all samples showing a total amount of ^{131}I less than 20 d/m.

^b (MFC)_a is taken to be 1×10^{-10} $\mu\text{c}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

TABLE IV
CONCENTRATION OF ^{131}I IN RAW MILK

July - December, 1966

Location	pc/l		
	Maximum	Minimum ^a	Average
Immediate Environs	114	< 10	8.0
Remote Environs	15	< 10	5.9

^a Minimum detectable concentration of ^{131}I is 10 pc/l. In averaging, one-half of this value, 5 pc/l, was used for all samples showing a concentration less than 10 pc/l.

TABLE V
CONCENTRATION OF ^{90}SR IN RAW MILK

July - December, 1966

Location	pc/l		
	Maximum	Minimum ^a	Average
Immediate Environs	53	6.8	27
Remote Environs	40	14	24

^a Minimum detectable concentration of ^{90}Sr in milk is 2 pc/l. In averaging, one-half of this value, 1 pc/l, was used for all samples showing a concentration less than 2 pc/l.

TABLE VI
 CALCULATED AVERAGE CONCENTRATION OF RADIOACTIVITY
 IN THE CLINCH RIVER AT MILE 20.8

July - December, 1966

Number of Samples Taken	Units of 10^{-7} $\mu\text{c/ml}$			% of (MFC) _w
	Maximum ^a	Minimum ^b	Average	
182	0.78	0.01	0.14	0.63

^aMaximum weekly average.

^bMinimum weekly average.

TABLE VII
 AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
 IN THE CLINCH RIVER

July - December, 1966

Location	Units of 10^{-8} $\mu\text{c/ml}$							% of (MPC) _w	
	⁹⁰ Sr	¹⁴⁴ Ce	¹³⁷ Cs	¹⁰⁶ Ru	⁶⁰ Co	⁹⁵ Zr - ⁹⁵ Nb	Average Beta Activity		(MPC) _w ^a
Mi. 23.1 ^b	0.05	0.02	*	0.01	*	*	0.08	50	0.16
Mi. 20.8 ^c	0.06	<0.01	0.02	0.43	0.05	0.01	1.4	220	0.63
Mi. 4.5	0.13	0.03	0.19	0.20	0.13	*	0.68	150	0.45

^a Weighted average (MPC)_w calculated for the mixture using (MPC)_w values for specific radionuclides specified by AEC Manual, Chapter O524, Appendix, Annex 1, Table II.

^b Sampling station moved from Clinch River Mile 41.5 to Melton Hill Dam, CRM 23.1 about January 1, 1966.

^c Values given for this location are calculated values based on levels of waste released and the dilution afforded by the river; they do not include amounts of radioactive material (e.g., fallout) that may enter the river upstream from CRM 20.8.

* None detected.

TABLE VIII
URANIUM CONCENTRATION IN THE CLINCH RIVER

July - December, 1966

Sampling Point	Type of Analyses Made	No. of Samples ^a	Units of 10^{-8} $\mu\text{c/ml}$			% (MFC) _w	
			Maximum ^b	Minimum ^b	Average ^b		
Downstream from ORGDP	Uranium Concentration	2	< 0.1	< 0.1	< 0.1	2000	< 0.01

^a Normal Sampling Frequency: Continuous, composited over one quarter.

^b No uranium was detected in Clinch River water samples during this period. Minimum detectable concentration of uranium in river water is 0.1×10^{-8} $\mu\text{c/ml}$.

TABLE IX

EXTERNAL GAMMA RADIATION LEVELS

mR/hr

July - December, 1966

Station Number	Location	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1	Solway Gate	0.012	0.012	0.011	0.012	*	*	0.012
2	Y-12, East Portal	0.011	0.012	0.011	0.010	*	*	0.011
3	Newcomb Road, Oak Ridge	0.010	0.012	0.012	0.013	*	*	0.012
4	Gallaher Gate	0.010	0.010	0.010	0.012	*	*	0.011
5	White Wing Gate	0.012	0.011	0.012	0.011	*	*	0.012
Average		0.011	0.012	0.011	0.012			0.012

Note: These readings were taken with a calibrated Geiger-Müller tube at a distance of three feet above the ground.

The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

*No measurement made.

**UNION
CARBIDE**

INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX P, OAK RIDGE, TENNESSEE 37831

To (Name) **Dr. E. L. Morgan**
Company
Location **ORNL**

Date **July 12, 1967**

Originating Dept.

Answering letter date

Copy to **Mr. R. J. Betts**
Mr. R. F. Hibbs
Mr. E. B. Schultz
Health Physics File - RC ✓

Subject **News Release on Environmental
Surveys**

Attached are data for the semiannual news release, as requested by AEC-ORO, covering environmental surveys made by our plant forces at off-plant locations during the first half of calendar year 1967.


E. G. Jordan

REJ:MS:sm

Attachment

ENVIRONMENTAL RADIOACTIVITY LEVELS
Oak Ridge Gaseous Diffusion Plant
January thru June, 1967

The results of sampling of the environs of the Oak Ridge Gaseous Diffusion Plant during the first half of 1967 revealed that the amount of uranium in the surface waterways is not significantly different from the normal background values established for this region.

Sampling of the surface waterways adjacent to the plant revealed no instance where the uranium concentration exceeded the maximum permissible concentration specified for water (MPC_w).^{*} The average activity of natural uranium materials in the Clinch River, reflecting the effects of all of the Oak Ridge plants, was less than 0.1% of the MPC_w. Sampling data are shown in the following table:

Environmental Sampling - Local Streams

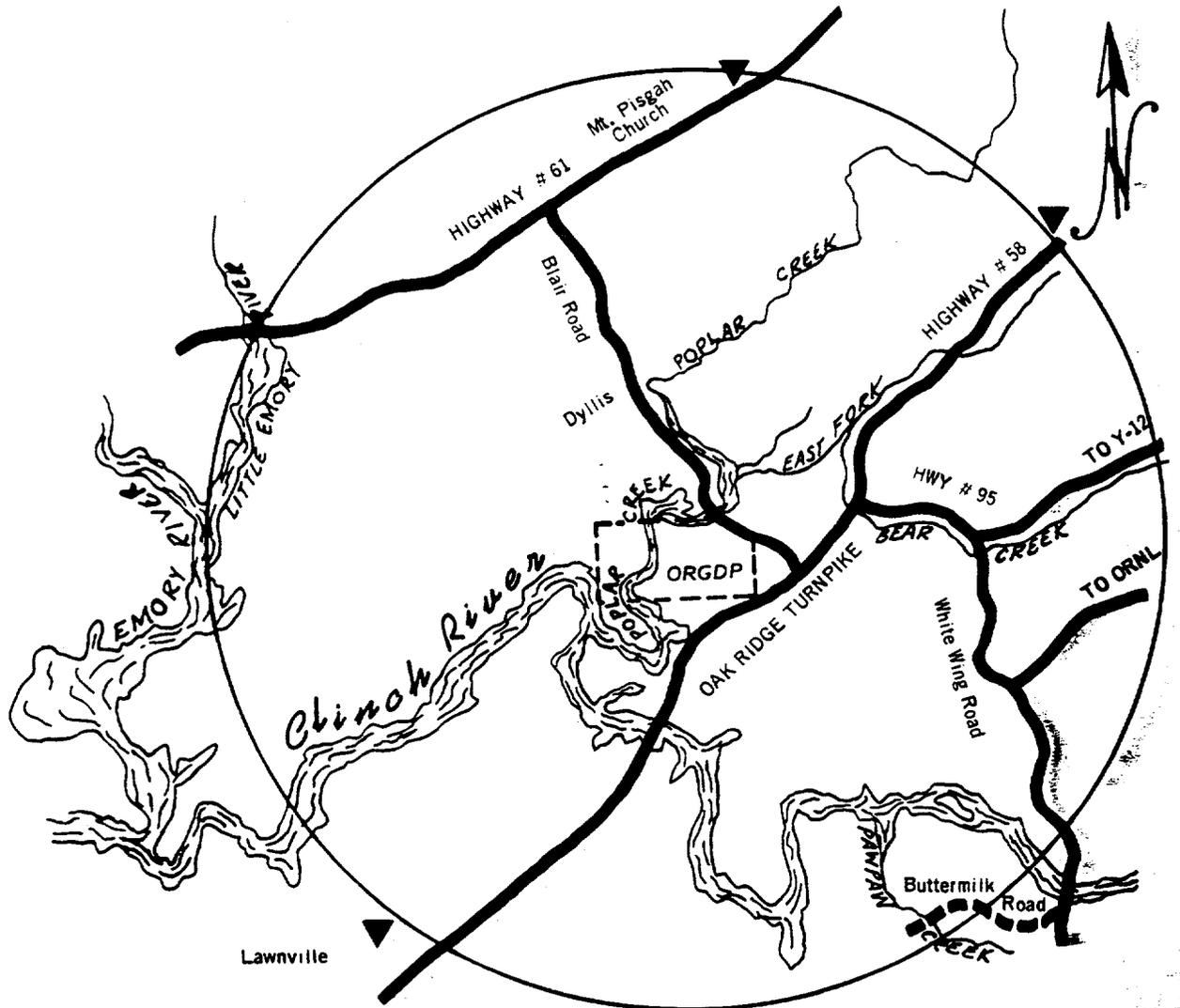
Location of Point	Type of Analysis	No. of Samples**	Plant Experience			Maximum Permissible Conc. (MPC _w)	Average Per Cent MPC _w [†]
			Low	High	Av.		
Downstream from ORGDP	Uranium Concentration	2	0.0	0.0	0.0	2000	<0.1

* AEC Manual Chapter 0524, Annex 1, Table 2, "Concentrations in Air and Water Above Natural Background".

** Normal Sampling Frequency: Continuous; composited over one quarter.

† Maximum permissible concentrations for continuous exposure to the general population.

Safety and Health Physics Department
 Oak Ridge Gaseous Diffusion Plant
 July 12, 1967

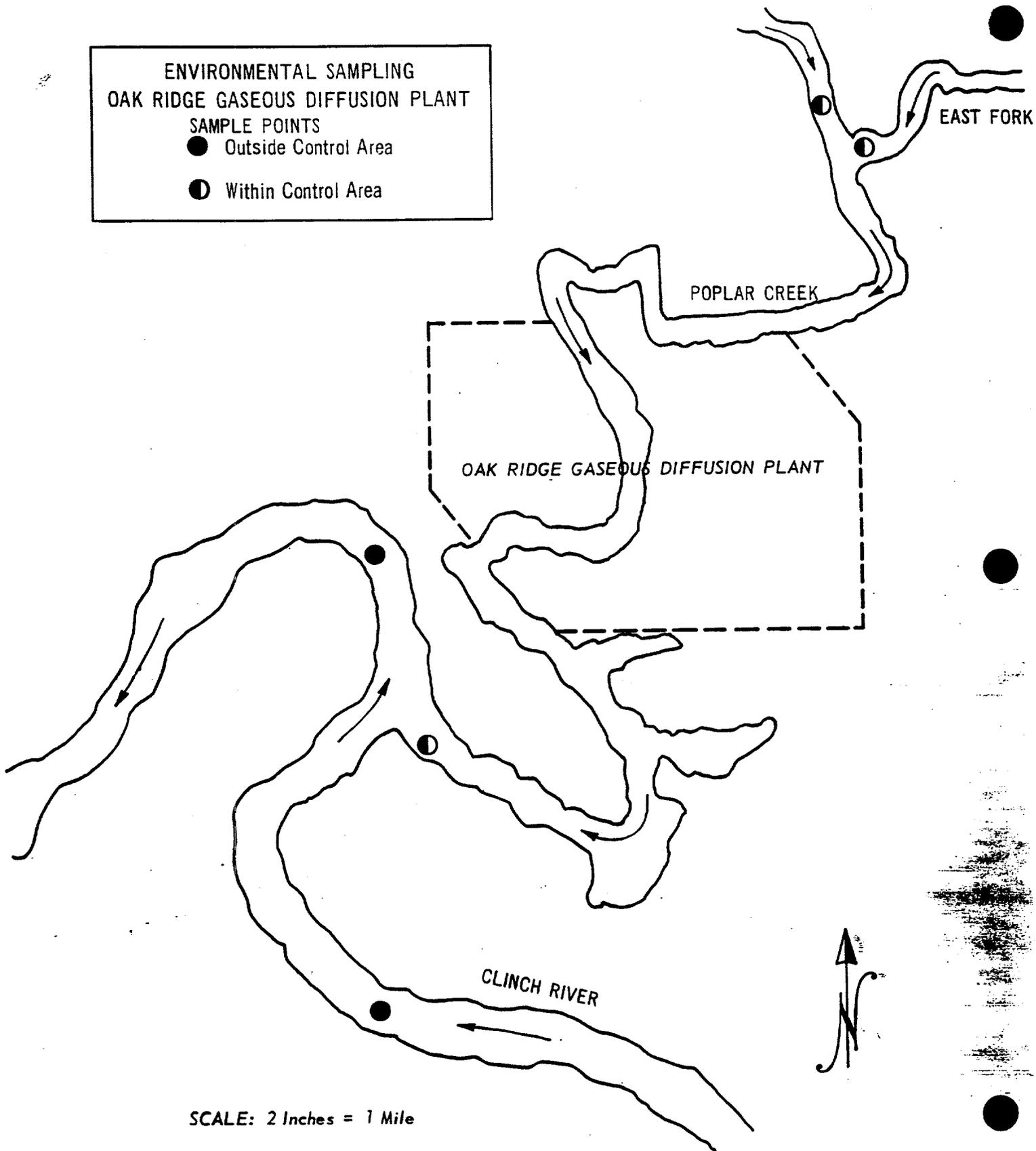


SAMPLING POINTS OF OUTSIDE ENVIRONS - ORGDP
AIR

▼ Sampling Location - Five Miles from Plant

FIGURE 1

ENVIRONMENTAL SAMPLING
OAK RIDGE GASEOUS DIFFUSION PLANT
SAMPLE POINTS
● Outside Control Area
◐ Within Control Area



SCALE: 2 Inches = 1 Mile

FIGURE 2



UNION CARBIDE CORPORATION

NUCLEAR DIVISION

P. O. BOX Y, OAK RIDGE, TENNESSEE 37830

September 27, 1967

U. S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

Attention: Mr. S. R. Sapirie, Manager
Oak Ridge Operations

Gentlemen:

Dissemination to the Public of Data
on Environmental Levels of Radioactivity

As requested, we are enclosing forty copies of the report for the first half of 1967 on Environmental Levels of Radioactivity for the Oak Ridge area.

Very truly yours,

C. E. Larson
C. E. Larson
President

CEL:HGM:dg

Enclosures

cc w/encl.: F. R. Bruce (2)
R. F. Hibbs (5)
D. M. Davis (10)
J. L. Liverman
H. G. MacPherson (2)
K. Z. Morgan
✓ N. B. Schultz (2)

ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

(Report for Period January - June, 1967)

Compiled by the

Health Physics and Safety Section

Health Physics Division

OAK RIDGE NATIONAL LABORATORY

Introduction

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are concentrated by evaporation and disposed of in deep wells. Low level liquid wastes are discharged, after preliminary treatment, to surface streams.

Air that may become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by means of scrubbers and filters.

This report presents data on the environmental levels of radioactivity for the Oak Ridge area and compares the data with established maximum permissible concentrations.

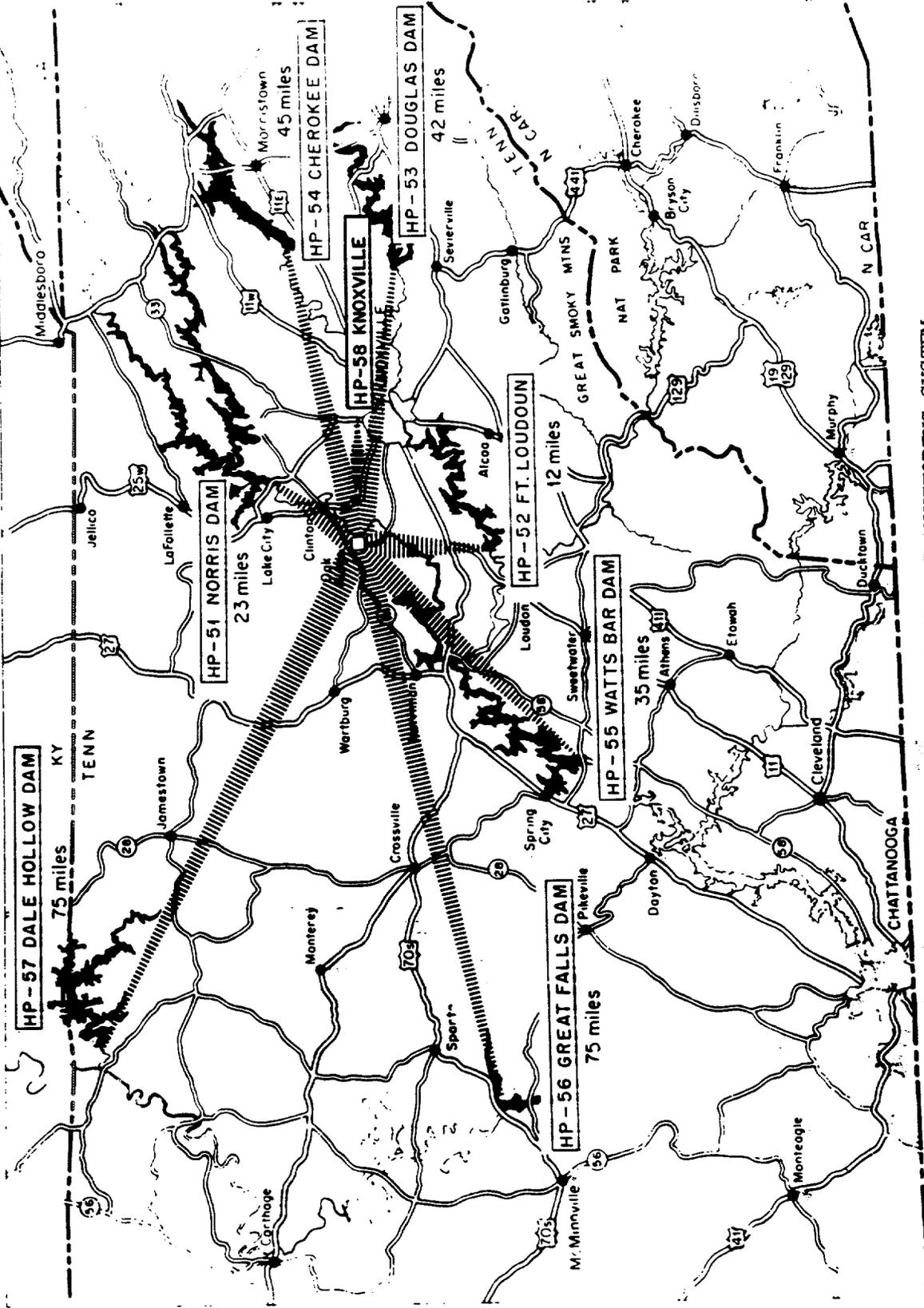
Air Monitoring

Atmospheric contamination by radioactive materials occurring in the general environment of East Tennessee is monitored by two systems of monitoring stations. One system consists of nine stations which encircle the plant area (Fig. 1) and provides data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of eight stations encircling the Oak Ridge area at distances of from 12 to 75 miles (Fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Sampling for radioactive particulates is carried out by passing air continuously through a filter paper. Airborne radioactive iodine is monitored in the immediate environment of the plant area by passing air through a cartridge containing activated charcoal. Data collected are accumulated, tabulated, and averaged in units of $\mu\text{Ci}/\text{cc}$ of air sampled.

Milk Monitoring

Raw milk is monitored for ^{131}I and ^{90}Sr by the collection and analysis of samples from twelve sampling stations located within a radius of 50 miles of ORNL. Samples are collected weekly at each of eight stations located on the fringe of the Oak Ridge area. Four stations, located more remotely with respect to Oak Ridge Operations, are sampled at a rate of one station each week. The purpose of the milk sampling program is twofold: first, samples collected in the immediate vicinity of the Oak

ORNL-DWG 66-1719



STATION SITES FOR REMOTE AIR MONITORING SYSTEM

FIG. 2

Ridge area provide data by which one may evaluate possible exposure to the neighboring population resulting from waste releases from Oak Ridge Operations; second, samples collected at the more remote stations provide background data which are essential in establishing the proper index for the evaluation of data obtained from local samples.

Water Monitoring

Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, to the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for population groups in uncontrolled areas as specified by AEC Manual, Chapter 0524. The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 3 and 4. Samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously to obtain dilution factors for calculating the probable concentrations of wastes in the river.

Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters.

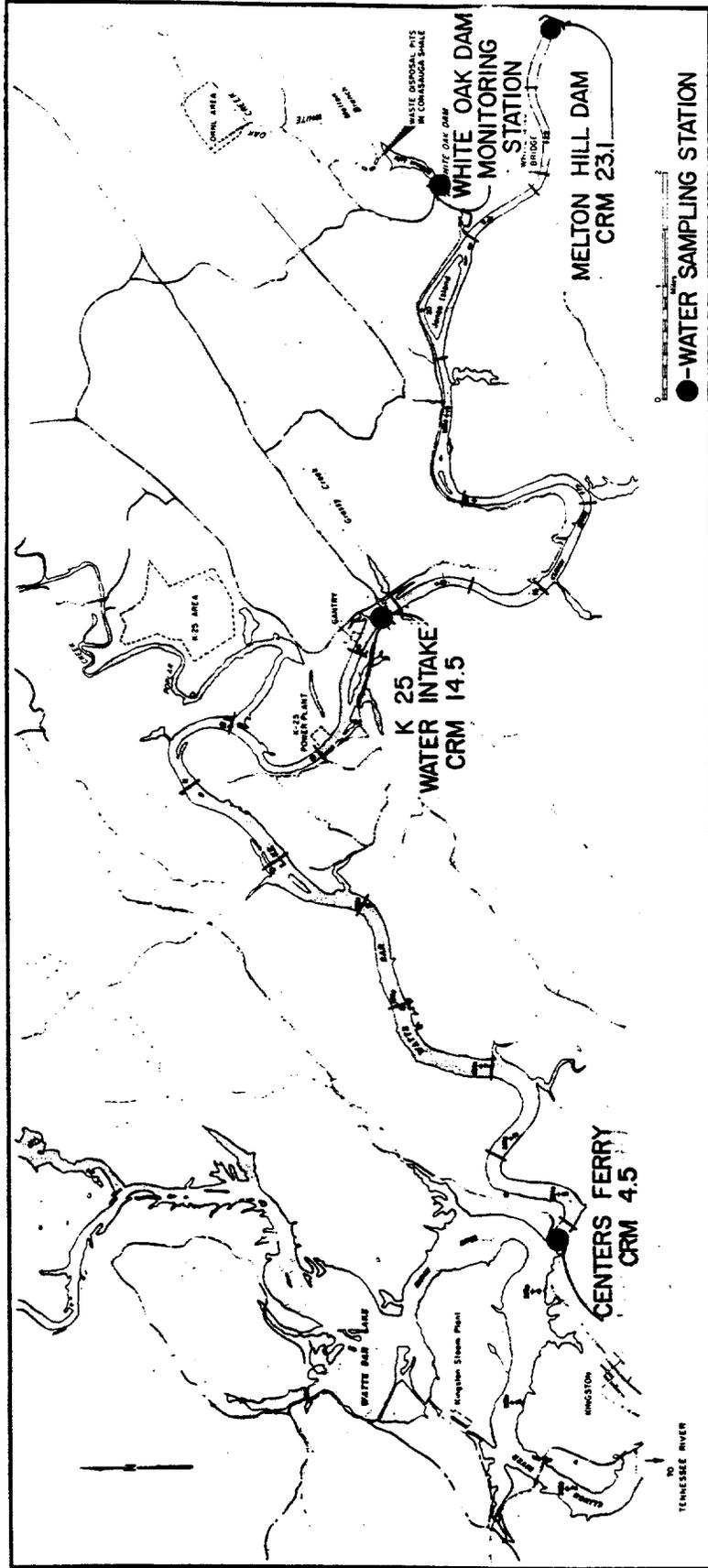
Analyses are made of the effluent for the long-lived radionuclides only, since cooling time and hold-up time in the waste effluent system are such that short-lived radionuclides are normally not present. The concentrations of those isotopes present in significant amounts are determined by analysis. A weighted average maximum permissible concentration for water, $(MPC)_w$, for the mixture of radionuclides is calculated on the basis of the isotopic distribution using the MPC values of each isotope as specified by AEC Manual, Chapter 0524.¹ The average concentrations of gross beta activity in the Clinch River are compared to the calculated $(MPC)_w$ values.

The concentration of uranium is compared with the specific $(MPC)_w$ value for uranium.

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge area. Measurements are taken with a Geiger-Müller tube at a distance of three feet above the ground, and the results are tabulated in terms of mR/hr.

¹AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.



WATER SAMPLING LOCATIONS

Figure 3

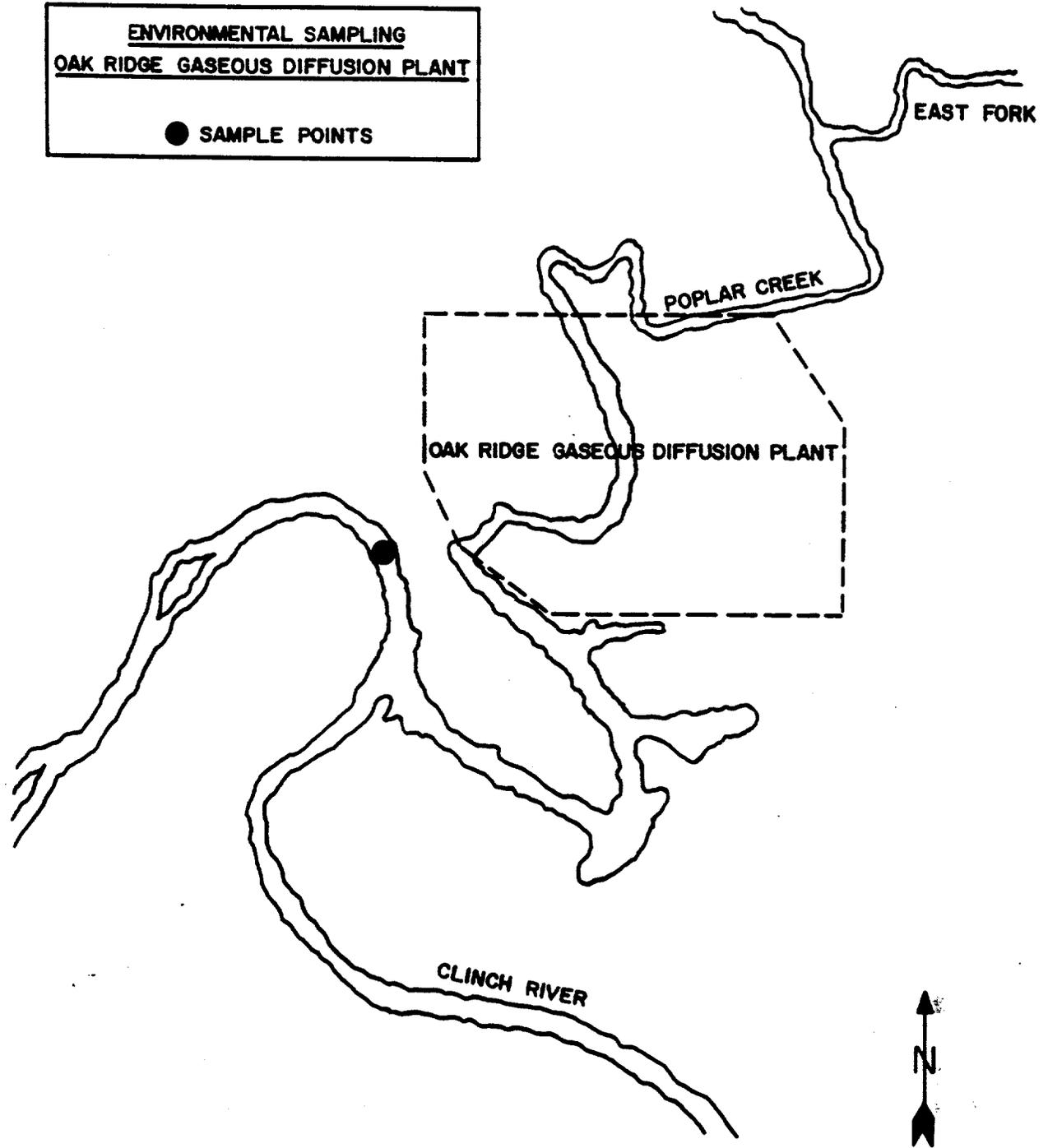


Figure 4

Discussion of Data

Data on the environmental levels of radioactivity for the first half of 1967 in the Oak Ridge and surrounding areas are presented in Table I through Table IX.

The average air contamination levels for gross beta activity, as shown by the continuous air monitoring filter data, for both the immediate and remote environs of the plants were 0.18% of the maximum permissible concentration applicable to uncontrolled areas (Table I). These levels are 1.8 times higher than those for the last half of 1966 but are no higher than the average of those measured in other areas of the United States and reported by the U. S. Public Health Service Radiation Surveillance Network for this period. An increase in fallout occurred in the East Tennessee area during the first week of January, 1967. The arrival of the fallout material in the Oak Ridge area was consistent with the timing of the announced nuclear detonation by Communist China on December 28, 1966.²

The average air contamination levels for gross alpha activity, as shown by the continuous air monitoring filter data, for the immediate and remote environs of the plants were 0.30% and 0.20%, respectively, of the (MPC)_a for natural uranium for application to uncontrolled areas (Table II).

The average concentration of ¹³¹I in air in the immediate environs of the plants was 0.018×10^{-12} $\mu\text{Ci/cc}$ (Table III). This is approximately 0.018% of the maximum permissible concentration for populations in the neighborhood of a controlled area.

The average concentrations of ¹³¹I in raw milk in the immediate and remote environs of the Oak Ridge area were 30 pCi/l and 8.2 pCi/l, respectively (Table IV). The maximum concentration observed, 930 pCi/l, occurred on January 11, 1967, approximately seven days after the arrival in the Oak Ridge area of fallout containing fresh fission products. The higher of the average values observed falls within the limits of FRC Range II if one assumes the average intake per individual to be 1 liter of milk per day.

The average concentrations of ⁹⁰Sr in raw milk for the immediate and remote environs of the controlled area were 27 pCi/l and 24 pCi/l, respectively. These levels fall near the lower limit of FRC Range II for transient rates of daily intake of ⁹⁰Sr for application to the average of suitable samples of an exposed population.

The calculated average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most of the wastes, and the measured average concentration at Mile 4.5, near Kingston, Tennessee, were 1.6×10^{-8} $\mu\text{Ci/ml}$ and 0.53×10^{-8} $\mu\text{Ci/ml}$, respectively. These values are 0.76% and 0.38% of the weighted average maximum permissible concentrations (MPC)_w.

²Radiological Health Data and Reports, U. S. Department of Health, Education and Welfare, Vol. 8, No. 1, January, 1967.

File Env. Safety (Rem-ent)

MEMO ROUTE SLIP Form AEC-93 (Rev. May 14, 1947)		See me about this. Note and return.	For concurrence. For signature.	For action. For information.
TO (Name and unit)	INITIALS	REMARKS		
F. L. Bruce, ORNL (2)		Reference is made to the letter from C. E. Larson to S. A. Sapirie dated September 27, 1967, transmitting the Oak Ridge Area Environmental Radioactivity levels for period January - June 1967.		
F. Hibbs, Y-12 (5)	DATE			
J. L. Liverman, ORNL (1)				
TO (Name and unit)	INITIALS	REMARKS		
H. G. Mac Pherson, ORNL (2)		Enclosed are copies of Page 7 which has been revised to reflect the deletion of reference to foreign weapons testing fallout. Guidance in this matter has been received from AEC Headquarters and was forwarded to UCC-ED, Attention: Dr. A. M. Weinberg, by letter from Dr. H. M. Roth, dated October 4, 1967.		
K. Z. Morgan, ORNL (1)	DATE			
H. B. Schultz, ORNDP (2) ✓				
TO (Name and unit)	INITIALS	REMARKS		
	DATE			
FROM (Name and unit)	REMARKS			
Joseph A. Lennard Director Safety Division OSH:WTT <i>WTT</i>				
PHONE NO.	DATE			
3-4113	1-10-67			

USE OTHER SIDE FOR ADDITIONAL REMARKS

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Data on the environmental levels of radioactivity for the first half of 1967 in the Oak Ridge and surrounding areas are presented in Table I through Table IX.

The average air contamination levels for gross beta activity, as shown by the continuous air monitoring filter data, for both the immediate and remote environs of the plants were 0.18% of the maximum permissible concentration applicable to uncontrolled areas (Table I). These levels are 1.8 times higher than those for the last half of 1966 but are no higher than the average of those measured in other areas of the United States and reported by the U. S. Public Health Service Radiation Surveillance Network for this period.²

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The average concentrations of ¹³¹I in raw milk in the immediate and remote environs of the Oak Ridge area were 30 pCi/l and 8.2 pCi/l, respectively (Table IV). The maximum concentration observed, 930 pCi/l, occurred on January 11, 1967, approximately seven days after the arrival in the Oak Ridge area of fallout containing fresh fission products. The higher of the average values observed falls within the limits of FRC Range II if one assumes the average intake per individual to be 1 liter of milk per day.

The average concentrations of ⁹⁰Sr in raw milk for the immediate and remote environs of the controlled area were 27 pCi/l and 24 pCi/l, respectively. These levels fall near the lower limit of FRC Range II for transient rates of daily intake of ⁹⁰Sr for application to the average of suitable samples of an exposed population.

The calculated average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most of the wastes, and the measured average concentration at Mile 4.5, near Kingston, Tennessee, were 1.6×10^{-8} $\mu\text{Ci/ml}$ and 0.53×10^{-8} $\mu\text{Ci/ml}$, respectively. These values are 0.76% and 0.38% of the weighted average maximum permissible concentrations (MPC)_w.

²Radiological Health Data and Reports, U. S. Department of Health, Education and Welfare, Vol. 8, No. 1, January, 1967.

The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 1.0×10^{-10} $\mu\text{Ci}/\text{ml}$ which is approximately 0.005% of the weighted average $(\text{MPC})_w$ value.

The average activity of natural uranium materials in the Clinch River, reflecting the effects of all Oak Ridge plants, was $< 0.01\%$ of the $(\text{MPC})_w$ for uranium.

The average external gamma radiation measured in the town of Oak Ridge and at the perimeter of the Oak Ridge area was 0.011 mR/hr, which is approximately the same as the level measured in the early period prior to Oak Ridge Operations.

Conclusion

Surveillance of the radioactivity in the Oak Ridge environs indicated that the major part of the radioactivity detected continues to be the result of fallout from weapons testing. While some low level radioactivity is being released to the environment from plant operations, the resulting concentrations in both the atmosphere and surface streams of the Oak Ridge environment are well below established maximum permissible concentrations and intake guides for the neighboring population.

TABLE I

CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Beta Activity of
Particulates in AirJanuary - June, 1967

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	15	0.19	1.6	0.16
HP-32	Midway Gate	26	22	0.38	2.5	0.25
HP-33	Gallaher Gate	26	15	< 0.01	1.4	0.14
HP-34	White Oak Dam	26	11	0.11	1.3	0.13
HP-35	Blair Gate	26	11	0.17	1.4	0.14
HP-36	Turnpike Gate	182 ^d	32	0.04	2.5	0.25
HP-37	Hickory Creek Bend	26	11	0.10	1.1	0.11
HP-38	East of EGCR	26	23	< 0.01	2.0	0.20
HP-39	Townsite	26	22	0.10	2.3	0.23
Average			18	0.12	1.8	0.18
<u>Remote Stations</u>						
HP-51	Norris Dam	26	27	0.21	2.1	0.21
HP-52	Loudoun Dam	26	18	0.06	1.6	0.16
HP-53	Douglas Dam	26	11	< 0.01	1.4	0.14
HP-54	Cherokee Dam	25	13	0.04	1.5	0.15
HP-55	Watts Bar Dam	26	22	0.14	2.2	0.22
HP-56	Great Falls Dam	26	16	< 0.01	1.5	0.15
HP-57	Dale Hollow Dam	25	17	0.07	1.7	0.17
HP-58	Knoxville	26	23	0.15	1.8	0.18
Average			18	0.08	1.8	0.18

^aMaximum weekly average concentration.^bMinimum weekly average concentration.^c(MPC)_a is taken to be 10^{-10} $\mu\text{Ci}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.^dSamples collected on daily schedule beginning 5/7/62. Maximum and minimum daily average concentrations were 87×10^{-13} $\mu\text{Ci}/\text{cc}$ and $< 0.01 \times 10^{-13}$ $\mu\text{Ci}/\text{cc}$, respectively.

TABLE II
 CONTINUOUS AIR MONITORING DATA
 Long-Lived Gross Alpha Activity of
 Particulates in Air

January - June, 1967

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{Ci/cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	0.13	0.01	0.04	0.20
HP-32	Midway Gate	26	0.13	0.03	0.07	0.35
HP-33	Gallaher Gate	26	0.09	< 0.01	0.04	0.20
HP-34	White Oak Dam	26	0.07	0.01	0.03	0.15
HP-35	Blair Gate	26	0.13	< 0.01	0.07	0.35
HP-36	Turnpike Gate	182 ^d	0.27	0.04	0.16	0.80
HP-37	Hickory Creek Bend	26	0.18	< 0.01	0.05	0.25
HP-38	East of EGCR	26	0.12	< 0.01	0.04	0.20
HP-39	Townsite	26	0.11	< 0.01	0.06	0.30
Average			0.14	0.02	0.06	0.30
<u>Remote Stations</u>						
HP-51	Norris Dam	26	0.29	< 0.01	0.04	0.20
HP-52	Loudoun Dam	26	0.07	0.01	0.04	0.20
HP-53	Douglas Dam	26	0.10	< 0.01	0.04	0.20
HP-54	Cherokee Dam	25	0.07	0.01	0.03	0.15
HP-55	Watts Bar Dam	26	0.20	< 0.01	0.04	0.20
HP-56	Great Falls Dam	26	0.10	< 0.01	0.04	0.20
HP-57	Dale Hollow Dam	25	0.09	0.01	0.04	0.20
HP-58	Knoxville	26	0.11	0.02	0.05	0.25
Average			0.13	0.01	0.04	0.20

^aMaximum weekly average concentration.

^bMinimum weekly average concentration.

^c(MPC)_a used is 20×10^{-13} $\mu\text{Ci/cc}$, the MPC for natural uranium as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^dSamples collected on daily schedule beginning 5/7/62.

TABLE III
 CONCENTRATION OF ^{131}I IN AIR
 AS MEASURED BY THE PERIMETER AIR MONITORING STATIONS

January - June, 1967

Number of Samples	Units of 10^{-12} $\mu\text{Ci}/\text{cc}$			$\%$ (MPC) _a ^b
	Maximum	Minimum ^a	Average	
234	0.12	< 0.010	0.018	0.018

^aMinimum detectable amount of ^{131}I is 20 d/m. At the average sampling rate used, this corresponds to approximately 0.010×10^{-12} $\mu\text{Ci}/\text{cc}$. In averaging, one-half of this value, 10 d/m, is used for all samples showing a total amount of ^{131}I less than 20 d/m.

^b(MPC)_a is taken to be 1×10^{-10} $\mu\text{Ci}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

TABLE IV
 CONCENTRATION OF ^{131}I IN RAW MILK

January - June, 1967

Location	pCi/l		
	Maximum	Minimum ^a	Average
Immediate Environs	930	< 10	30
Remote Environs	51	< 10	8.2

^aMinimum detectable concentration of ^{131}I is 10 pCi/l. In averaging, one-half of this value, 5 pCi/l, was used for all samples showing a concentration less than 10 pCi/l.

TABLE V
CONCENTRATION OF ^{90}Sr IN RAW MILK

January - June, 1967

Location	pCi/l		
	Maximum	Minimum ^a	Average
Immediate Environs	59	4.5	27
Remote Environs	40	5	24

^aMinimum detectable concentration of ^{90}Sr in milk is 2 pCi/l. In averaging, one-half of this value, 1 pCi/l, was used for all samples showing a concentration less than 2 pCi/l.

TABLE VI
 CALCULATED AVERAGE CONCENTRATION OF RADIOACTIVITY
 IN THE CLINCH RIVER AT MILE 20.8

January - June, 1967

Number of Samples Taken	Units of 10^{-7} $\mu\text{Ci/ml}$			% of $(\text{MPC})_w$
	Maximum ^a	Minimum ^b	Average	
182	0.80	0.02	0.16	0.76

^aMaximum weekly average.

^bMinimum weekly average.

TABLE VII
 AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
 IN THE CLINCH RIVER

January - June, 1967

Location	Units of 10^{-8} $\mu\text{Ci/ml}$							Average Beta Activity	$(\text{MPC})_w^a$	% of $(\text{MPC})_w$
	^{90}Sr	^{144}Ce	^{137}Cs	^{106}Ru	^{60}Co	$^{95}\text{Zr} - ^{95}\text{Nb}$	$(\text{MPC})_w^a$			
Mi. 23.1 ^b	0.05	0.02	<0.01	0.04	*	<0.01	0.11	70	0.16	
Mi. 20.8 ^c	0.07	<0.01	0.04	0.12	0.06	0.01	1.6	210	0.76	
Mi. 4.5	0.10	0.02	0.16	0.06	0.18	0.01	0.53	140	0.38	

^aWeighted average $(\text{MPC})_w$ calculated for the mixture using $(\text{MPC})_w$ values for specific radionuclides specified by AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^bSampling station moved from Clinch River Mile 41.5 to Melton Hill Dam, CRM 23.1 about January 1, 1966.

^cValues given for this location are calculated values based on levels of waste released and the dilution provided by the river; they do not include amounts of radioactive material (e.g., fallout) that may enter the river upstream from CRM 20.8.

* None detected.

TABLE VIII
URANIUM CONCENTRATION IN THE CLINCH RIVER

January - June, 1967

Sampling Point	Type of Analyses Made	No. of Samples ^a	Units of 10^{-6} $\mu\text{Ci}/\text{ml}$			$\%$ (MPC) _w
			Maximum ^b	Minimum ^b	Average ^b	
Downstream from ORGDP	Uranium Concentration	2	< 0.1	< 0.1	< 0.1	2000 < 0.01

^aNormal Sampling Frequency: Continuous, composited over one quarter.

^bNo uranium was detected in Clinch River water samples during this period. Minimum detectable concentration of uranium in river water is 0.1×10^{-6} $\mu\text{Ci}/\text{ml}$.

TABLE IX

EXTERNAL GAMMA RADIATION LEVELS

mR/hr

January - June, 1967

Station Number	Location	Jan.	Feb.	Mar.	Apr.	May	June	Average
1	Solway Gate	*	*	*	0.012	0.010	0.011	0.011
2	Y-12, East Portal	*	*	*	0.012	0.011	0.011	0.011
3	Newcomb Road, Oak Ridge	*	*	*	0.014	0.009	0.011	0.011
4	Gallaher Gate	*	*	*	0.011	0.010	0.008	0.010
5	White Wing Gate	*	*	*	0.012	0.011	0.012	0.012
	Average				0.012	0.010	0.011	0.011

Note: These readings were taken with a calibrated Geiger-Müller tube at a distance of three feet above the ground.

The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

*No measurement made.

**UNION
CARBIDE**

INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX P, OAK RIDGE, TENNESSEE 37831

To (Name) **Dr. K. E. Morgan**
Company
Location **ORNL**

Date **January 17, 1968**

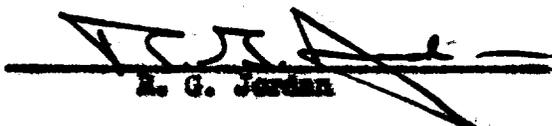
Originating Dept.

Answering letter date

Copy to **Mr. R. J. Betts**
Mr. R. F. Hibbs
Mr. N. B. Schultz
Health Physics File - RC

Subject **News Release on Environmental
Surveys**

Attached are data for the semiannual news release, as requested by
AEC-ORO, covering environmental surveys made by our plant forces at
off-plant locations during the second half of calendar year 1967.


R. G. Jordan

RES:ms

Attachment

**ENVIRONMENTAL RADIOACTIVITY LEVELS
Oak Ridge Gaseous Diffusion Plant**

July thru December, 1967

The results of sampling of the environs of the Oak Ridge Gaseous Diffusion Plant during the second half of 1967 revealed that the amount of uranium in the surface waterways is not significantly different from the normal background values established for this region.

Sampling of the surface waterways adjacent to the plant revealed no instance where the uranium concentration exceeded the maximum permissible concentration specified for water (MPC_w).^{*} The average activity of natural uranium materials in the Clinch River, reflecting the effects of all of the Oak Ridge plants, was less than 0.1% of the MPC._w. Sampling data are shown in the following table:

Environmental Sampling - Local Streams

<u>Location of Point</u>	<u>Type of Analysis</u>	<u>No. of Samples**</u>	<u>Units of 10⁻³ µg/cc</u>			<u>Maximum Permissible Conc. (MPC_w)</u>	<u>Average Per cent MPC_w[†]</u>
			<u>Plant Experience Low</u>	<u>High</u>	<u>Av.</u>		
Downstream from ORGDP	Uranium Concentration	2	0.0	0.0	0.0	2000	< 0.1

* AEC Manual Chapter 0524, Annex 1, Table 2, "Concentrations in Air and Water Above Natural Background".

** Normal Sampling Frequency: Continuous; composited over one quarter.

† Maximum permissible concentrations for continuous exposure to the general population.

Safety and Health Physics Department
Oak Ridge Gaseous Diffusion Plant

January 17, 1968



UNION CARBIDE CORPORATION
NUCLEAR DIVISION

P. O. BOX Y, OAK RIDGE, TENNESSEE 37830

March 8, 1968

U. S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

Attention: Mr. S. R. Sapirie, Manager
Oak Ridge Operations

Gentlemen:

Dissemination to the Public of Data
on Environmental Levels of Radioactivity

As requested, we are enclosing forty copies of the report for the last half of 1967 on Environmental Levels of Radioactivity for the Oak Ridge area.

Very truly yours,

C. E. Larson
President

CEL:HGM:dg

Enclosures

cc w/encl.: F. R. Bruce (2)
D. M. Davis (10)
R. F. Hibbs (5)
J. L. Liverman
H. G. MacPherson (2)
K. Z. Morgan
N. B. Schultz (2) ✓

ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

(Report for Period July - December, 1967)

Compiled by the

Health Physics and Safety Section

Health Physics Division

OAK RIDGE NATIONAL LABORATORY

Introduction

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are concentrated by evaporation and disposed of in deep wells. Low level liquid wastes are discharged, after preliminary treatment, to surface streams.

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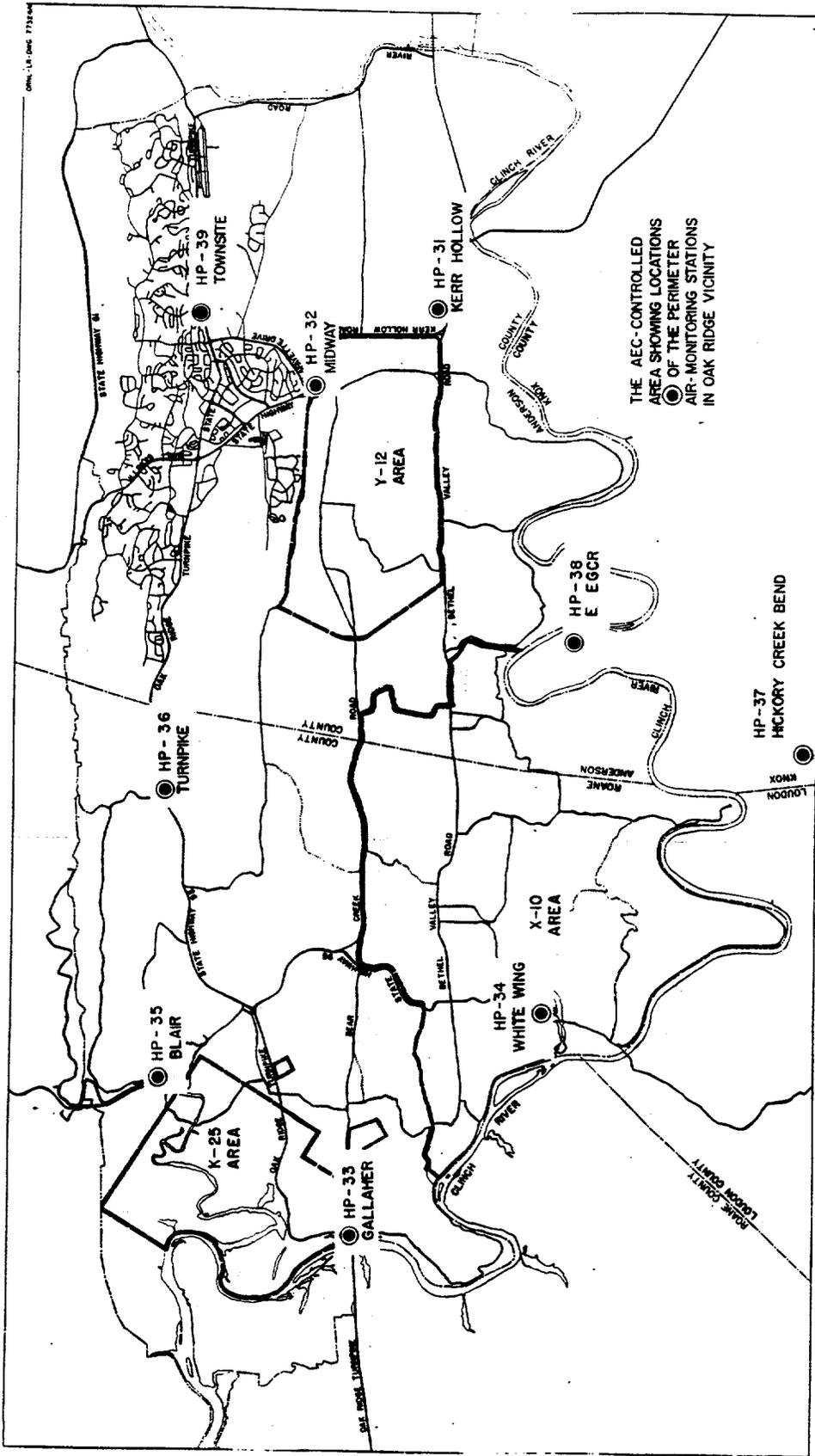
This report presents data on the environmental levels of radioactivity for the Oak Ridge area and compares the data with established maximum permissible concentrations.

Air Monitoring

Atmospheric contamination by radioactive materials occurring in the general environment of East Tennessee is monitored by two systems of monitoring stations. One system consists of nine stations which encircle the plant area (Fig. 1) and provides data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of eight stations encircling the Oak Ridge area at distances of from 12 to 75 miles (Fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Sampling for radioactive particulates is carried out by passing air continuously through a filter paper. Airborne radioactive iodine is monitored in the immediate environment of the plant area by passing air through a cartridge containing activated charcoal. Data collected are accumulated, tabulated, and averaged in units of $\mu\text{Ci/cc}$ of air sampled.

Milk Monitoring

Raw milk is monitored for ^{131}I and ^{90}Sr by the collection and analysis of samples from twelve sampling stations located within a radius of 50 miles of ORNL. Samples are collected weekly at each of eight stations located on the fringe of the Oak Ridge area. Four stations, located more remotely with respect to Oak Ridge Operations, are sampled at a rate of one station each week. The purpose of the milk sampling program is twofold: first, samples collected in the immediate vicinity of the Oak



STATION SITES FOR PERIMETER AIR MONITORING SYSTEM

Figure 1

Ridge area provide data by which one may evaluate possible exposure to the neighboring population resulting from waste releases from Oak Ridge Operations; second, samples collected at the more remote stations provide background data which are essential in establishing the proper index for the evaluation of data obtained from local samples.

Water Monitoring

Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, to the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for population groups in uncontrolled areas as specified by AEC Manual, Chapter 0524. The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 3 and 4. Samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously to obtain dilution factors for calculating the probable concentrations of wastes in the river.

Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters.

Analyses are made of the effluent for the long-lived radionuclides only, since cooling time and hold-up time in the waste effluent system are such that short-lived radionuclides are normally not present. The concentrations of those isotopes present in significant amounts are determined by analysis. A weighted average maximum permissible concentration for water, $(MPC)_w$, for the mixture of radionuclides is calculated on the basis of the isotopic distribution using the MPC values of each isotope as specified by AEC Manual, Chapter 0524.¹ The average concentrations of gross beta activity in the Clinch River are compared to the calculated $(MPC)_w$ values.

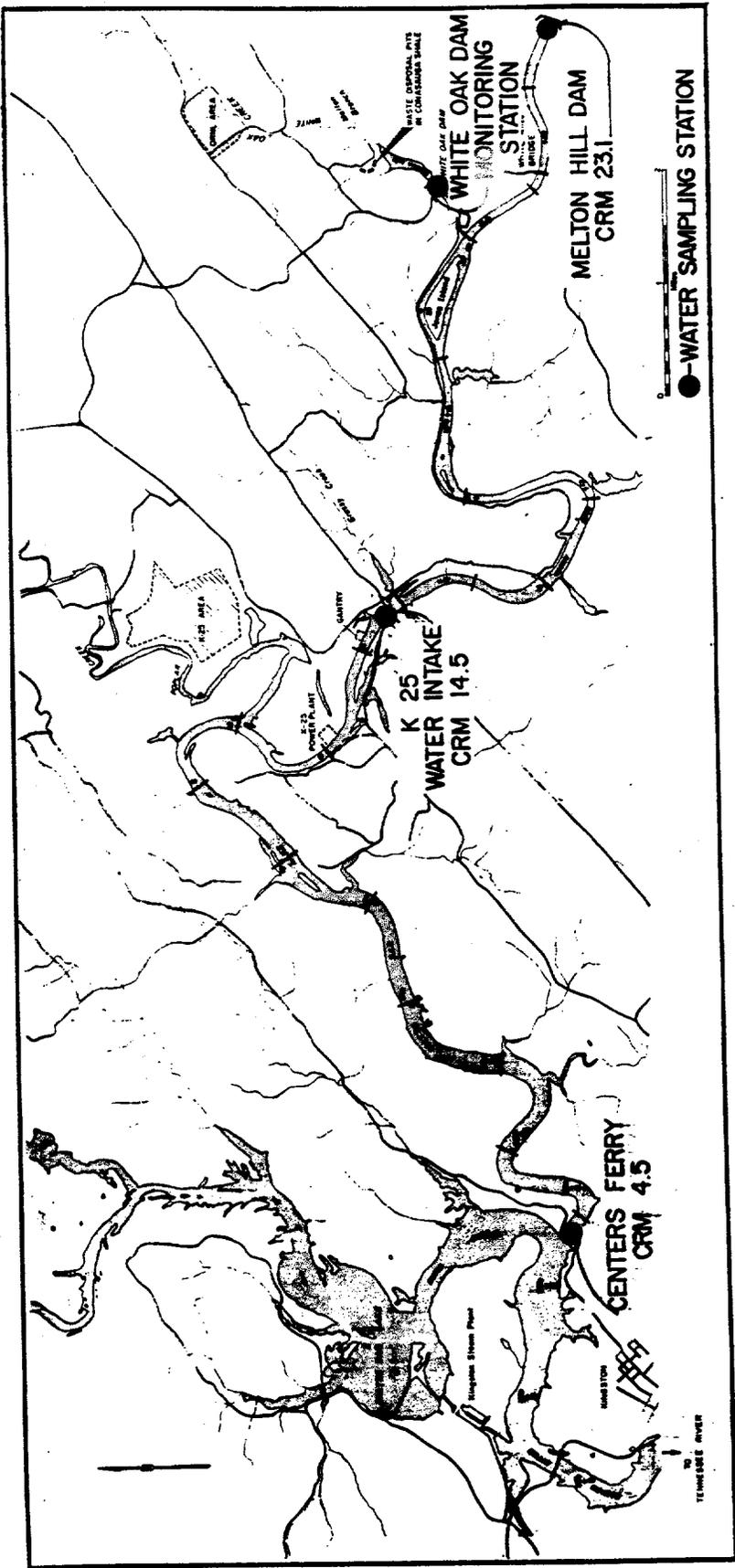
The concentration of uranium is compared with the specific $(MPC)_w$ value for uranium.

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge area. Measurements are taken with a Geiger-Müller tube at a distance of three feet above the ground, and the results are tabulated in terms of mR/hr.

¹AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

ORNL-DWG. 66-2216R



WATER SAMPLING LOCATIONS

Figure 3

ENVIRONMENTAL SAMPLING
OAK RIDGE GASEOUS DIFFUSION PLANT

● **SAMPLE POINTS**

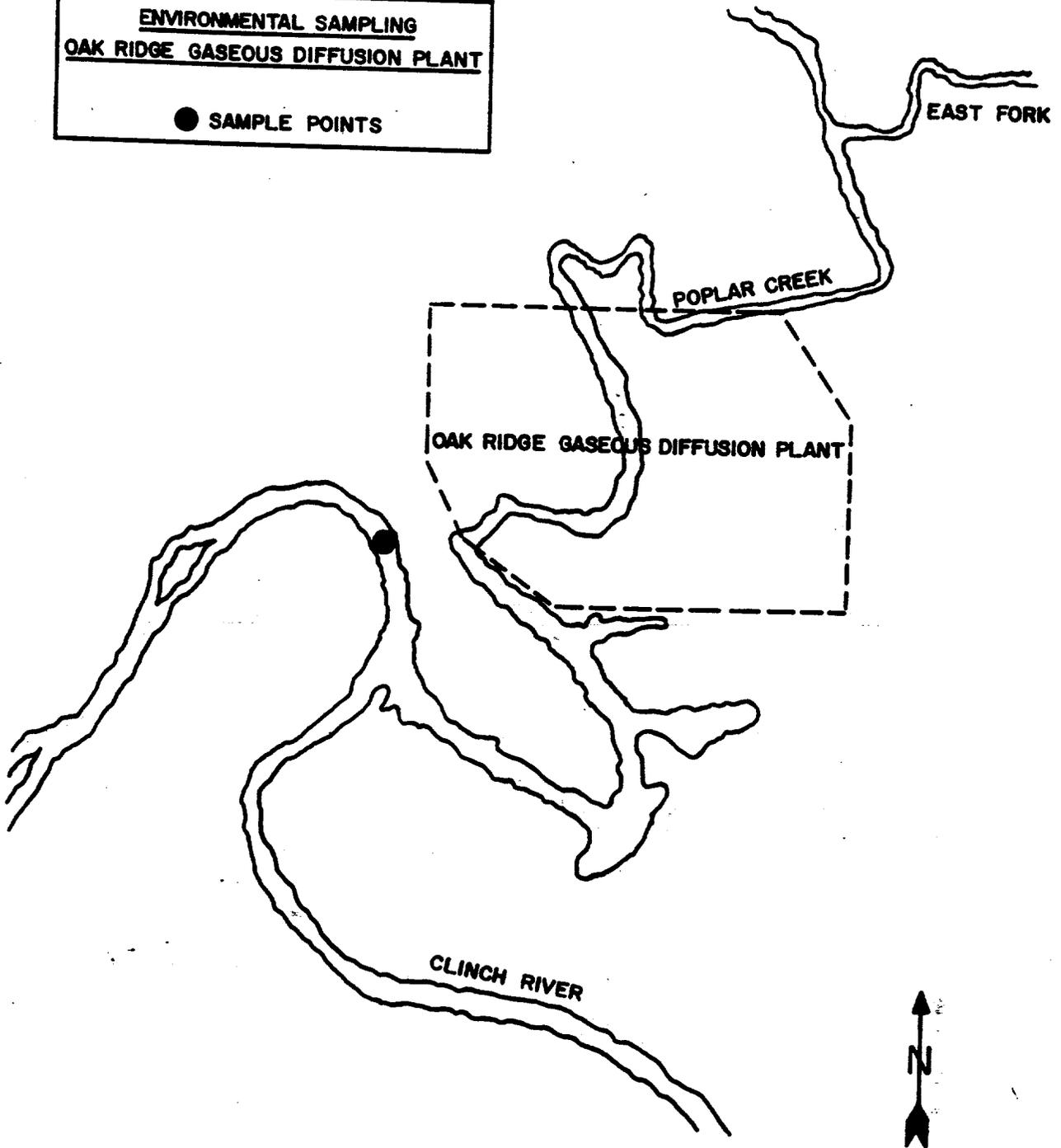


Figure 4

Discussion of Data

Data on the environmental levels of radioactivity for the second half of 1967 in the Oak Ridge and surrounding areas are presented in Table I through Table IX.

The average air contamination levels for gross beta activity, as shown by the continuous air monitoring filter data, for the immediate and remote environs of the plants were 0.05% and 0.03%, respectively, of the maximum permissible concentration applicable to uncontrolled areas (Table I).

The average air contamination levels for gross alpha activity, as shown by the continuous air monitoring filter data, for the immediate and remote environs of the plants were 0.15% and 0.10%, respectively, of the $(MPC)_a$ for natural uranium for application to uncontrolled areas (Table II).

The average concentration of ^{131}I in air in the immediate environs of the plants was 0.020×10^{-12} $\mu\text{Ci}/\text{cc}$ (Table III). This is approximately 0.02% of the maximum permissible concentration for application to uncontrolled areas.

The average concentrations of ^{131}I in raw milk in both the immediate and remote environs of the Oak Ridge area were 5 pCi/l (Table IV). This level falls within the limits of FRC Range I if one assumes the average intake per individual to be 1 liter of milk per day.

The average concentrations of ^{90}Sr in raw milk for the immediate and remote environs of the controlled area were 20 pCi/l and 25 pCi/l, respectively. These levels fall near the lower limit of FRC Range II for transient rates of daily intake of ^{90}Sr for application to the average of suitable samples of an exposed population.

The calculated average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most of the wastes, and the measured average concentration at Mile 4.5, near Kingston, Tennessee, were 0.80×10^{-8} $\mu\text{Ci}/\text{ml}$ and 0.44×10^{-8} $\mu\text{Ci}/\text{ml}$, respectively. These values are 0.67% and 0.49% of the weighted average maximum permissible concentrations $(MPC)_w$.

The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 1.1×10^{-10} $\mu\text{Ci}/\text{ml}$ which is approximately 0.01% of the weighted average $(MPC)_w$ value.

The average activity of natural uranium materials in the Clinch River, reflecting the effects of all Oak Ridge plants, was $< 0.01\%$ of the $(MPC)_w$ for uranium.

The average external gamma radiation measured in the town of Oak Ridge and at the perimeter of the Oak Ridge area was 0.011 mR/hr, which is approximately the same as the level measured in the early period prior to Oak Ridge Operations.

Conclusion

Surveillance of the radioactivity in the Oak Ridge environs indicated that the major part of the radioactivity detected continues to be the result of fallout from sources other than Oak Ridge Operations. While some low level radioactivity is being released to the environment from plant operations, the resulting concentrations in both the atmosphere and surface streams of the Oak Ridge environment are well below established maximum permissible concentrations and intake guides for the neighboring population.

TABLE I

CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Beta Activity of
Particulates in Air

July - December, 1967

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{Ci/cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	27	1.1	0.03	0.36	0.04
HP-32	Midway Gate	27	3.3	< 0.01	0.71	0.07
HP-33	Gallaher Gate	27	1.5	< 0.01	0.31	0.03
HP-34	White Oak Dam	27	3.3	< 0.01	0.39	0.04
HP-35	Blair Gate	26	0.91	< 0.01	0.33	0.03
HP-36	Turnpike Gate	188 ^d	4.9	0.04	0.72	0.07
HP-37	Hickory Creek Bend	27	0.45	< 0.01	0.23	0.02
HP-38	East of EGCR	27	6.6	< 0.01	0.58	0.06
HP-39	Townsite	27	0.89	< 0.01	0.38	0.04
Average			2.64	0.01	0.45	0.05
<u>Remote Stations</u>						
HP-51	Norris Dam	27	0.81	< 0.01	0.31	0.03
HP-52	Loudoun Dam	27	1.4	< 0.01	0.29	0.03
HP-53	Douglas Dam	27	6.6	< 0.01	0.56	0.06
HP-54	Cherokee Dam	27	1.8	< 0.01	0.28	0.03
HP-55	Watts Bar Dam	26	0.48	< 0.01	0.24	0.02
HP-56	Great Falls Dam	26	0.93	< 0.01	0.26	0.03
HP-57	Dale Hollow Dam	27	0.64	< 0.01	0.25	0.03
HP-58	Knoxville	27	0.98	< 0.01	0.35	0.04
Average			1.7	< 0.01	0.32	0.03

^aMaximum weekly average concentration.^bMinimum weekly average concentration.^c(MPC)_a is taken to be 10^{-10} $\mu\text{Ci/cc}$ as specified in AEC Manual, Chapter 0524 Appendix, Annex 1, Table II.^dSamples collected on daily schedule beginning 5/7/62. Maximum and minimum daily average concentrations were 4.7×10^{-13} $\mu\text{Ci/cc}$ and $< 0.01 \times 10^{-13}$ $\mu\text{Ci/cc}$ respectively.

TABLE II
 CONTINUOUS AIR MONITORING DATA
 Long-Lived Gross Alpha Activity of
 Particulates in Air

July - December, 1967

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	27	0.06	< 0.01	0.02	0.10
HP-32	Midway Gate	27	0.15	< 0.01	0.04	0.20
HP-33	Gallaher Gate	27	0.13	< 0.01	0.02	0.10
HP-34	White Oak Dam	27	0.05	< 0.01	0.02	0.10
HP-35	Blair Gate	26	0.08	< 0.01	0.03	0.15
HP-36	Turnpike Gate	188 ^d	0.38	0.02	0.09	0.45
HP-37	Hickory Creek Bend	27	0.05	< 0.01	0.02	0.10
HP-38	East of EGCR	27	0.09	< 0.01	0.02	0.10
HP-39	Townsite	27	0.08	< 0.01	0.03	0.15
Average			0.12	< 0.01	0.03	0.15
<u>Remote Stations</u>						
HP-51	Norris Dam	27	0.05	< 0.01	0.02	0.10
HP-52	Loudoun Dam	27	0.06	< 0.01	0.02	0.10
HP-53	Douglas Dam	27	0.05	< 0.01	0.02	0.10
HP-54	Cherokee Dam	27	0.07	< 0.01	0.01	0.05
HP-55	Watts Bar Dam	26	0.07	< 0.01	0.02	0.10
HP-56	Great Falls Dam	26	0.05	< 0.01	0.02	0.10
HP-57	Dale Hollow Dam	27	0.03	< 0.01	0.01	0.05
HP-58	Knoxville	27	0.05	< 0.01	0.03	0.15
Average			0.05	< 0.01	0.02	0.10

^aMaximum weekly average concentration.

^bMinimum weekly average concentration.

^c(MPC)_a used is 20×10^{-13} $\mu\text{Ci}/\text{cc}$, the MPC for natural uranium as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^dSamples collected on daily schedule beginning 5/7/62.

TABLE III
 CONCENTRATION OF ^{131}I IN AIR
 AS MEASURED BY THE PERIMETER AIR MONITORING STATIONS

July - December, 1967

Number of Samples	Units of 10^{-12} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^b
	Maximum	Minimum ^a	Average	
234	0.22	< 0.01	0.02	0.02

^aMinimum detectable amount of ^{131}I is 20 d/m. At the average sampling rate used, this corresponds to approximately 0.010×10^{-12} $\mu\text{Ci}/\text{cc}$. In averaging, one-half of this value, 10 d/m, is used for all samples showing a total amount of ^{131}I less than 20 d/m.

^b(MPC)_a is taken to be 1×10^{-10} $\mu\text{Ci}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

TABLE IV
CONCENTRATION OF ^{131}I IN RAW MILK

July - December, 1967

Location	pCi/l		
	Maximum	Minimum ^a	Average
Immediate Environs	13	< 10	5.0
Remote Environs	< 10	< 10	5.0

^a Minimum detectable concentration of ^{131}I is 10 pCi/l. In averaging, one-half of this value, 5 pCi/l, was used for all samples showing a concentration less than 10 pCi/l.

TABLE V
CONCENTRATION OF ^{90}Sr IN RAW MILK

July - December, 1967

Location	pCi/l		
	Maximum	Minimum ^a	Average
Immediate Environs	50	9.0	28
Remote Environs	34	14	25

^aMinimum detectable concentration of ^{90}Sr in milk is 2 pCi/l. In averaging, one-half of this value, 1 pCi/l, was used for all samples showing a concentration less than 2 pCi/l.

TABLE VI
CALCULATED AVERAGE CONCENTRATION OF RADIOACTIVITY
IN THE CLINCH RIVER AT MILE 20.8

July - December, 1967

Number of Samples Taken	Units of 10^{-7} $\mu\text{Ci/ml}$			% of (MPC) _w
	Maximum ^a	Minimum ^b	Average	
188	0.42	0.01	0.08	0.67

^aMaximum weekly average.

^bMinimum weekly average.

TABLE VII
 AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
 IN THE CLINCH RIVER

July - December, 1967

Location	Units of 10^{-8} $\mu\text{Ci/ml}$							% of $(\text{MFC})_w$	
	^{90}Sr	^{144}Ce	^{137}Cs	^{106}Ru	^{60}Co	$^{95}\text{Zr} - ^{95}\text{Nb}$	Average Beta Activity	$(\text{MFC})_w^a$	$(\text{MFC})_w$
Mi. 23.1 ^b	0.04	< 0.01	< 0.01	0.02	*	*	0.07	50	0.14
Mi. 20.8 ^c	0.06	< 0.01	0.02	0.04	0.02	< 0.01	0.80	120	0.67
Mi. 4.5	0.14	0.02	0.14	0.05	0.07	0.01	0.44	90	0.49

^aWeighted average $(\text{MFC})_w$ calculated for the mixture using $(\text{MFC})_w$ values for specific radionuclides specified by AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^bSampling station moved from Clinch River Mile 41.5 to Melton Hill Dam, CRM 23.1 about January 1, 1966.

^cValues given for this location are calculated values based on levels of waste released and the dilution provided by the river; they do not include amounts of radioactive material (e.g., fallout) that may enter the river upstream from CRM 20.8.

*None detected.

TABLE VIII
URANIUM CONCENTRATION IN THE CLINCH RIVER

July - December, 1967

Sampling Point	Type of Analyses Made	No. of Samples ^a	Units of 10 ⁻⁸ μCi/ml			% (MPC) _w
			Maximum ^b	Minimum ^b	Average ^b (MPC) _w	
Downstream from ORGDP	Uranium Concentration	2	< 0.1	< 0.1	< 0.1	< 0.01

^aNormal Sampling Frequency: Continuous, composited over one quarter.

^bNo uranium was detected in Clinch River water samples during this period. Minimum detectable concentration of uranium in river water is 0.1 x 10⁻⁸ μCi/ml.

TABLE IX
EXTERNAL GAMMA RADIATION LEVELS

mR/hr

July - December, 1967

Station Number	Location	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1	Solway Gate	0.011	0.011	0.011	*	0.009	0.011	0.011
2	Y-12, East Portal	0.010	0.014	0.009	*	0.011	0.010	0.011
3	Newcomb Road, Oak Ridge	0.011	0.011	0.014	*	0.011	0.010	0.011
4	Gallaher Gate	0.010	0.011	0.008	*	0.013	0.010	0.010
5	White Wing Gate	0.012	0.011	0.011	*	0.009	0.012	0.011
Average		0.011	0.012	0.011	*	0.011	0.011	0.011

Note: These readings were taken with a calibrated Geiger-Müller tube at a distance of three feet above the ground.

The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

*No measurement made.

**UNION
CARBIDE**

INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX P, OAK RIDGE, TENNESSEE 37830

To (Name) **Dr. K. Z. Morgan**
Division
Location **ORNL**

Date **July 16, 1968**

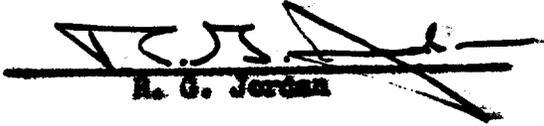
Originating Dept.

Answering letter date

Copy to **Mr. R. J. Betts**
Mr. R. F. Hibbs
Mr. H. B. Schultz
Health Physics File - RC ✓

Subject **News Release on Environmental
Surveys**

Attached are data for the semiannual news release, as requested by AEC-CRO, covering environmental surveys made by our plant forces at off-plant locations during the first half of calendar year 1968.


R. G. Jordan

MS:sh

Attachment

ENVIRONMENTAL RADIOACTIVITY LEVELS
Oak Ridge Gaseous Diffusion Plant

January thru June, 1968

The results of sampling of our environs of the Oak Ridge Gaseous Diffusion Plant during the first half of 1968 revealed that the amount of uranium in the surface waterways is not significantly different from the normal background values established for this region.

Sampling of the surface waterways adjacent to the plant revealed no instance where the uranium concentration exceeded the maximum permissible concentration specified for water (MPC_w).^{*} The average activity of natural uranium materials in the Clinch River, reflecting the effects of all of the Oak Ridge plants, was less than 0.1% of the MPC_w. Sampling data are shown in the following table:

Environmental Sampling - Local Streams

Location of Point	Type of Analysis	No. of Samples**	Units of 10 ⁻⁶ uc/cc		
			Plant Experience	Maximum Permissible Conc. (MPC _w)	Average Per cent MPC _w +
Downstream from ORGDP	Uranium Concentration	1	0.2	2000	< 0.1

* AEC Manual Chapter 0524, Annex 1, Table 2, "Concentrations in Air and Water Above Natural Background."

** Normal Sampling Frequency: Continuous; composited over one quarter.

+ Maximum permissible concentrations for continuous exposure to the general population

Safety and Health Physics Department
 Oak Ridge Gaseous Diffusion Plant

July 16, 1968



UNION CARBIDE CORPORATION
NUCLEAR DIVISION

P. O. BOX Y, OAK RIDGE, TENNESSEE 37830

September 9, 1968

U. S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

Attention: Mr. S. R. Sapirie, Manager
Oak Ridge Operations

Gentlemen:

Dissemination to the Public of Data
on Environmental Levels of Radioactivity

As requested, we are enclosing forty copies of the report for the first half of 1968 on Environmental Levels of Radioactivity for the Oak Ridge area.

Very truly yours,


C. E. Larson
President

CEL:HGM:dg

Enclosures

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ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

(Report for Period January - June, 1968)

Compiled by the
Health Physics and Safety Section

Health Physics Division

OAK RIDGE NATIONAL LABORATORY

Introduction

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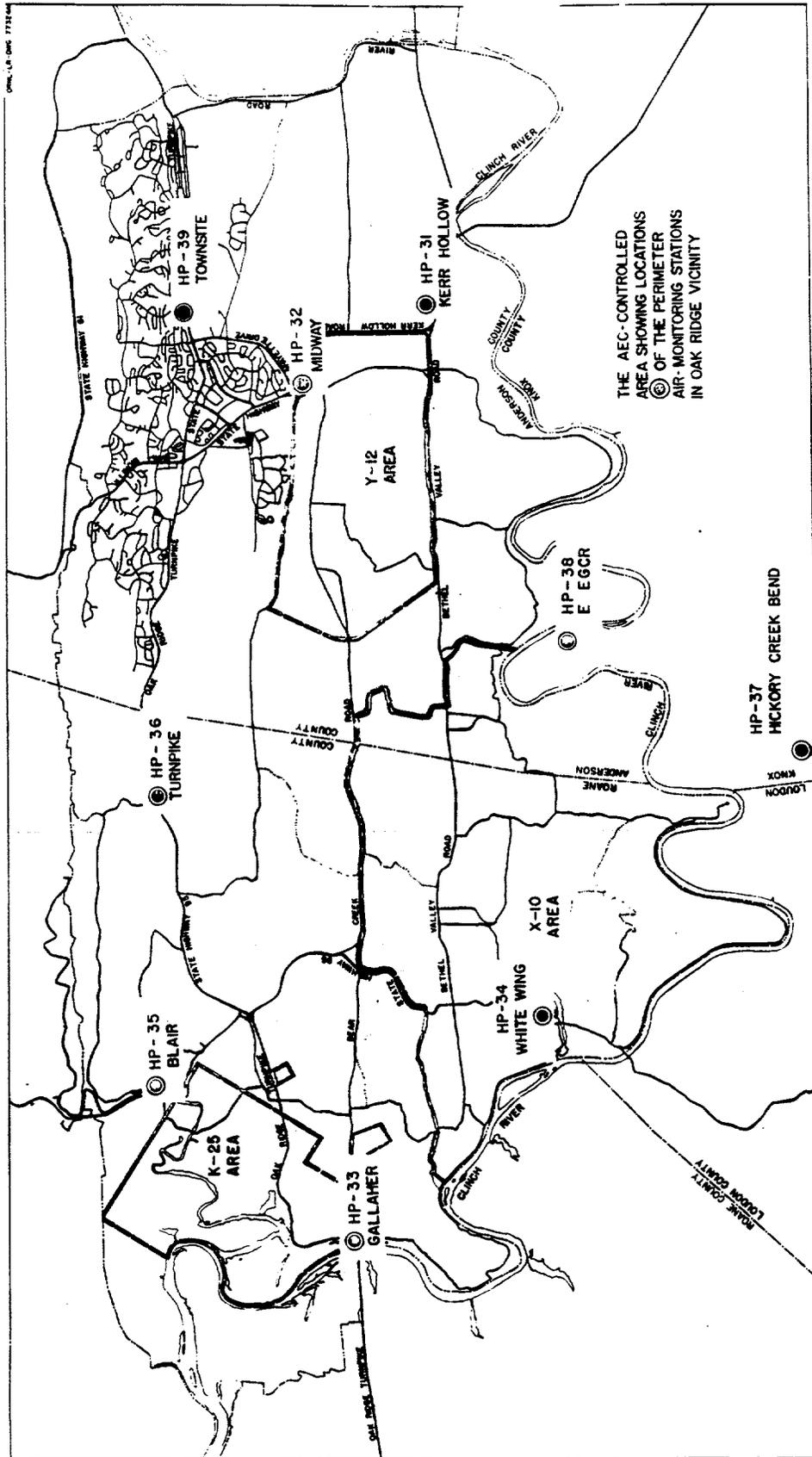
This report presents data on the environmental levels of radioactivity for the Oak Ridge area and compares the data with established maximum permissible concentrations.

Air Monitoring

Atmospheric contamination by radioactive materials occurring in the general environment of East Tennessee is monitored by two systems of monitoring stations. One system consists of nine stations which encircle the plant area (Fig. 1) and provides data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of eight stations encircling the Oak Ridge area at distances of from 12 to 75 miles (Fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Sampling for radioactive particulates is carried out by passing air continuously through a filter paper. Airborne radioactive iodine is monitored in the immediate environment of the plant area by passing air through a cartridge containing activated charcoal. Data collected are accumulated, tabulated, and averaged in units of $\mu\text{Ci}/\text{cc}$ of air sampled.

Milk Monitoring

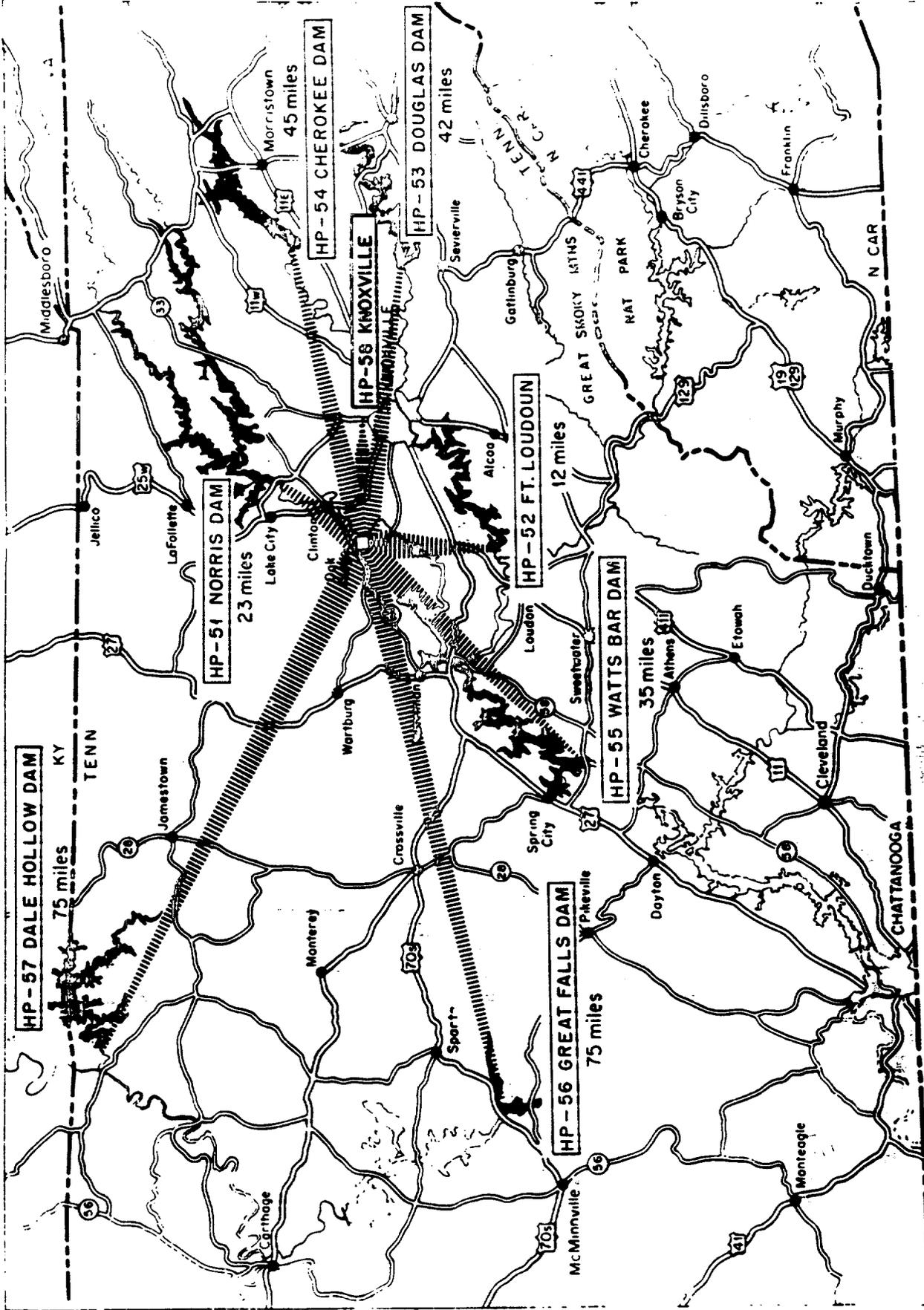
Raw milk is monitored for ^{131}I and ^{90}Sr by the collection and analysis of samples from twelve sampling stations located within a radius of 50 miles of ORNL. Samples are collected weekly at each of eight stations located on the fringe of the Oak Ridge area. Four stations, located more remotely with respect to Oak Ridge Operations, are sampled at a rate of one station each week. The purpose of the milk sampling program is two-fold: first, samples collected in the immediate vicinity of the Oak



STATION SITES FOR PERIMETER AIR MONITORING SYSTEM

Figure 1

ORNL-DWG 66-1719



STATION SITES FOR REMOTE AIR MONITORING SYSTEM

Figure 2

Ridge area provide data by which one may evaluate possible exposure to the neighboring population resulting from waste releases from Oak Ridge Operations; second, samples collected at the more remote stations provide background data which are essential in establishing the proper index for the evaluation of data obtained from local samples.

Water Monitoring

Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, to the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for population groups in uncontrolled areas as specified by AEC Manual, Chapter 0524. The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 3 and 4. Samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously to obtain dilution factors for calculating the probable concentrations of wastes in the river.

Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters.

Analyses are made of the effluent for the long-lived radionuclides only, since cooling time and hold-up time in the waste effluent system are such that short-lived radionuclides are normally not present. The concentrations of those isotopes present in significant amounts are determined by analysis. A weighted average maximum permissible concentration for water, $(MPC)_w$, for the mixture of radionuclides is calculated on the basis of the isotopic distribution using the MPC values of each isotope as specified by AEC Manual, Chapter 0524.¹ The average concentrations of gross beta activity in the Clinch River are compared to the calculated $(MPC)_w$ values.

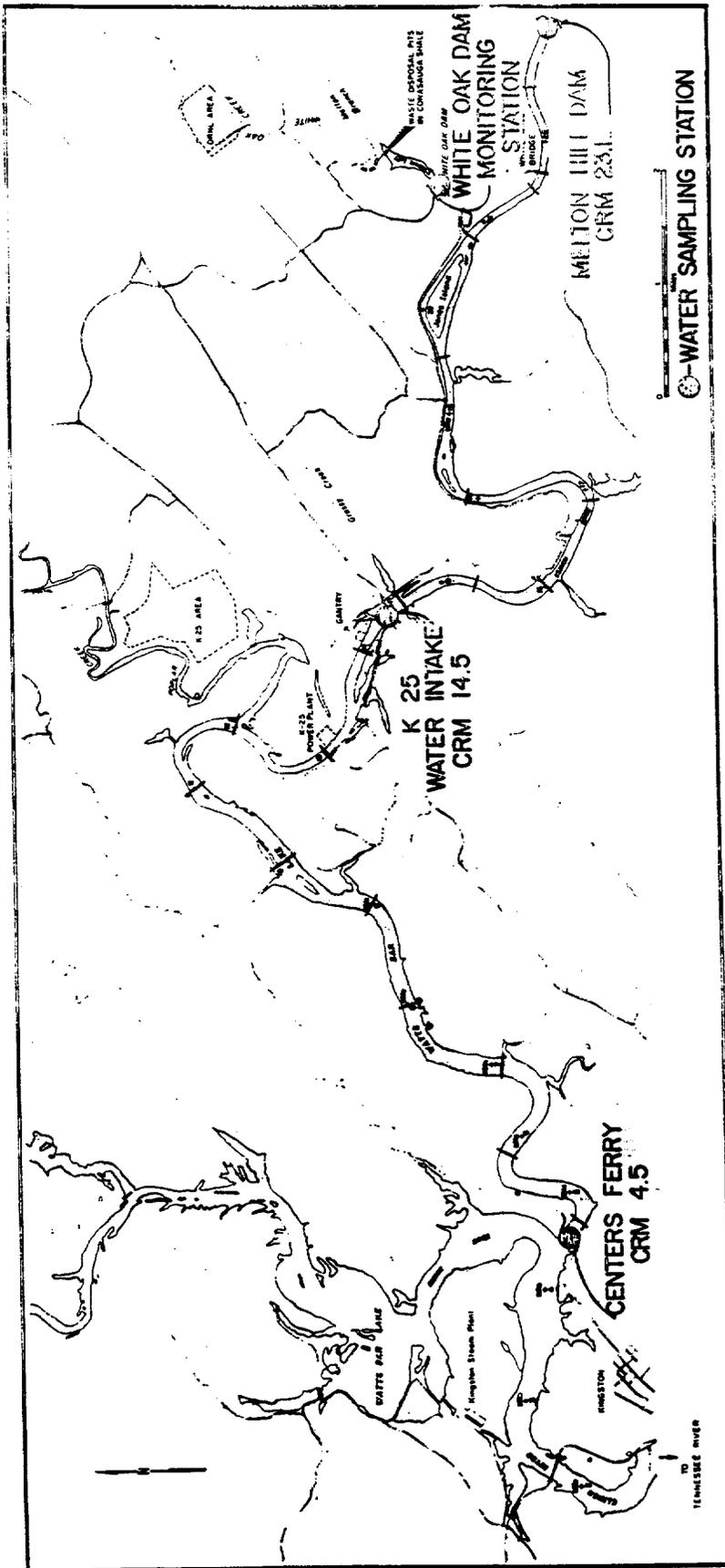
The concentration of uranium is compared with the specific $(MPC)_w$ value for uranium.

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge area. Measurements are taken with a Geiger-Müller tube at a distance of three feet above the ground, and the results are tabulated in terms of mR/hr.

¹AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

ORNL - DWG. 66-2216R



WATER SAMPLING LOCATIONS

Figure 3

ENVIRONMENTAL SAMPLING
OAK RIDGE GASEOUS DIFFUSION PLANT

● **SAMPLE POINTS**

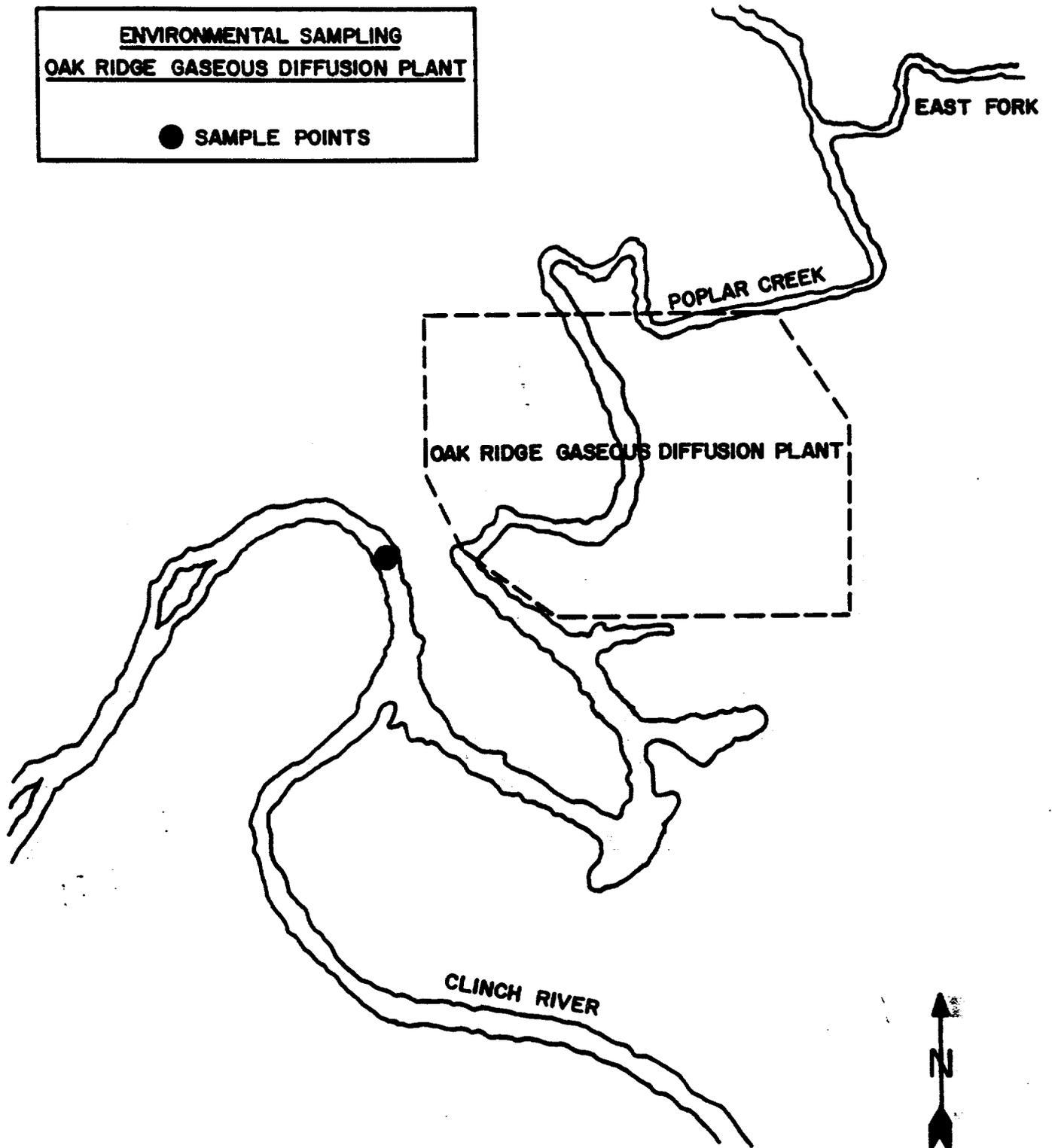


Figure 4

Discussion of Data

Data on the environmental levels of radioactivity for the first half of 1968 in the Oak Ridge and surrounding areas are presented in Table I through Table IX.

The average air contamination level for gross beta activity, as shown by the continuous air monitoring filter data, for both the immediate and remote environs of the plants was 0.22% of the maximum permissible concentration applicable to uncontrolled areas (Table I).

The average air contamination levels for gross alpha activity, as shown by the continuous air monitoring filter data, for the immediate and remote environs of the plants were 0.10% and 0.06%, respectively, of the $(MPC)_a$ for natural uranium for application to uncontrolled areas (Table II).

The average concentration of ^{131}I in air in the immediate environs of the plants was 0.01×10^{-12} $\mu\text{Ci/cc}$ (Table III). This is approximately 0.01% of the maximum permissible concentration for application to uncontrolled areas.

The average concentrations of ^{131}I in raw milk in the immediate and remote environs of the Oak Ridge area were 6.7 pCi/l and 5.0 pCi/l, respectively (Table IV). These levels fall within the limits of FRC Range I if one assumes the average intake per individual to be 1 liter of milk per day.

The average concentration of ^{90}Sr in raw milk in both the immediate and remote environs of the controlled area was ~ 21 pCi/l. This level falls near the lower limit of FRC Range II for transient rates of daily intake of ^{90}Sr for application to the average of suitable samples of an exposed population.

The calculated average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most of the wastes, and the measured average concentration at Mile 4.5, near Kingston, Tennessee, were 2.10×10^{-8} $\mu\text{Ci/ml}$ and 0.62×10^{-8} $\mu\text{Ci/ml}$, respectively. These values are 1.4% and 0.70% of the weighted average maximum permissible concentrations $(MPC)_w$.

The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 0.23×10^{-10} $\mu\text{Ci/ml}$ which is $< 0.01\%$ of the weighted average $(MPC)_w$ value.

The average concentration of natural uranium materials in the Clinch River, reflecting the effects of all Oak Ridge plants, was $< 0.01\%$ of the $(MPC)_w$ for uranium.

The average external gamma radiation measured in the town of Oak Ridge and at the perimeter of the Oak Ridge area was 0.011 mR/hr, which is approximately the same as the level measured in the early period prior to Oak Ridge Operations.

Conclusion

Surveillance of the radioactivity in the Oak Ridge environs indicated that the major part of the radioactivity detected continues to be the result of fallout from sources other than Oak Ridge Operations. While some low level radioactivity is being released to the environment from plant operations, the resulting concentrations in both the atmosphere and surface streams of the Oak Ridge environment are well below established maximum permissible concentrations and intake guides for the neighboring population.

TABLE I
 CONTINUOUS AIR MONITORING DATA
 Long-Lived Gross Beta Activity of
 Particulates in Air

January - June, 1968

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	3.4	0.37	2.1	0.21
HP-32	Midway Gate	26	5.1	0.45	2.9	0.29
HP-33	Gallaher Gate	26	3.2	0.51	1.8	0.18
HP-34	White Oak Dam	26	3.7	0.80	2.0	0.20
HP-35	Blair Gate	26	3.3	0.41	2.1	0.21
HP-36	Turnpike Gate	182 ^d	3.4	0.57	2.5	0.25
HP-37	Hickory Creek Bend	26	3.3	0.22	1.7	0.17
HP-38	East of EGCR	26	3.9	0.76	2.4	0.24
HP-39	Townsite	26	4.5	0.76	2.2	0.22
Average			3.8	0.54	2.2	0.22
<u>Remote Stations</u>						
HP-51	Norris Dam	26	3.5	0.58	2.4	0.24
HP-52	Loudoun Dam	26	3.6	0.24	2.2	0.22
HP-53	Douglas Dam	26	3.3	0.60	2.1	0.21
HP-54	Cherokee Dam	26	3.3	0.51	2.0	0.20
HP-55	Watts Bar Dam	26	2.7	0.35	1.6	0.16
HP-56	Great Falls Dam	26	4.2	0.35	2.5	0.25
HP-57	Dale Hollow Dam	26	4.0	0.67	2.2	0.22
HP-58	Knoxville	25	3.8	0.56	2.5	0.25
Average			3.6	0.48	2.2	0.22

^aMaximum weekly average concentration.

^bMinimum weekly average concentration.

^c(MPC)_a is taken to be 10^{-10} $\mu\text{Ci}/\text{cc}$ as specified in AEC Manual, Chapter 052, Appendix, Annex 1, Table II.

^dSamples collected on daily schedule beginning 5/7/62.

TABLE II
 CONTINUOUS AIR MONITORING DATA
 Long-Lived Gross Alpha Activity of
 Particulates in Air

January - June, 1968

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{Ci}/\text{cc}$			% (MPC) ^a
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	0.05	< 0.01	0.02	0.10
HP-32	Midway Gate	26	0.07	< 0.01	0.02	0.10
HP-33	Gallaher Gate	26	0.04	< 0.01	0.01	0.05
HP-34	White Oak Dam	26	0.04	< 0.01	0.01	0.05
HP-35	Blair Gate	26	0.05	< 0.01	0.02	0.10
HP-36	Turnpike Gate	182 ^d	0.04	< 0.01	0.04	0.20
HP-37	Hickory Creek Bend	26	0.04	< 0.01	0.02	0.10
HP-38	East of EGCR	26	0.08	< 0.01	0.02	0.10
HP-39	Townsite	26	0.08	< 0.01	0.02	0.10
Average			0.05	< 0.01	0.02	0.10
<u>Remote Stations</u>						
HP-51	Norris Dam	26	0.03	< 0.01	0.01	0.05
HP-52	Loudoun Dam	26	0.03	< 0.01	0.01	0.05
HP-53	Douglas Dam	26	0.05	< 0.01	0.01	0.05
HP-54	Cherokee Dam	26	0.03	< 0.01	0.01	0.05
HP-55	Watts Bar Dam	26	0.03	< 0.01	0.01	0.05
HP-56	Great Falls Dam	26	0.04	< 0.01	0.01	0.05
HP-57	Dale Hollow Dam	26	0.08	< 0.01	0.02	0.10
HP-58	Knoxville	25	0.05	< 0.01	0.02	0.10
Average			0.04	< 0.01	0.01	0.06

^aMaximum weekly average concentration.

^bMinimum weekly average concentration.

^c(MPC)_a used is 20×10^{-13} $\mu\text{Ci}/\text{cc}$, the MPC for natural uranium as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^dSamples collected on daily schedule beginning 5/7/62.

TABLE III
 CONCENTRATION OF ^{131}I IN AIR
 AS MEASURED BY THE PERIMETER AIR MONITORING STATIONS

January - June, 1968

Number of Samples	Units of 10^{-12} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^b
	Maximum	Minimum ^a	Average	
234	0.08	< 0.01	0.01	0.01

^a Minimum detectable amount of ^{131}I is 20 d/m. At the average sampling rate used, this corresponds to approximately 0.010×10^{-12} $\mu\text{Ci}/\text{cc}$. In averaging, one-half of this value, 10 d/m, is used for all samples showing a total amount of ^{131}I less than 20 d/m.

^b (MPC)_a is taken to be 1×10^{-10} $\mu\text{Ci}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

TABLE IV
 CONCENTRATION OF ^{131}I IN RAW MILK

January - June, 1968

Location	pCi/l		
	Maximum	Minimum ^a	Average
Immediate Environs	54	< 10	6.7
Remote Environs	< 10	< 10	5.0

^a Minimum detectable concentration of ^{131}I is 10 pCi/l. In averaging, one-half of this value, 5 pCi/l, was used for all samples showing a concentration less than 10 pCi/l.

TABLE V
CONCENTRATION OF ⁹⁰SR IN RAW MILK

January - June, 1968

Location	pCi/l		
	Maximum	Minimum ^a	Average
Immediate Environs	50	5.0	21
Remote Environs	34	14	20

^a Minimum detectable concentration of ⁹⁰Sr in milk is 2 pCi/l. In averaging, one-half of this value, 1 pCi/l, was used for all samples showing a concentration less than 2 pCi/l.

TABLE VI
 CALCULATED AVERAGE CONCENTRATION OF RADIOACTIVITY
 IN THE CLINCH RIVER AT MILE 20.8

January - June, 1967

Number of Samples Taken	Units of 10^{-7} $\mu\text{Ci/ml}$			% of $(\text{MPC})_w$
	Maximum ^a	Minimum ^b	Average	
182	1.0	0.01	0.21	1.4

^aMaximum weekly average.

^bMinimum weekly average.

TABLE VII
 AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
 IN THE CLINCH RIVER

January - June, 1968

Location	Units of 10^{-8} $\mu\text{Ci/ml}$							Average Beta Activity	$(\text{MFC})_w^a$	% of $(\text{MFC})_w$
	^{90}Sr	^{144}Ce	^{137}Cs	^{106}Ru	^{60}Co	$^{95}\text{Zr} - ^{95}\text{Nb}$				
Mi. 23.1 ^b	0.04	0.03	*	0.09	*	*	0.16	100	0.16	
Mi. 20.8 ^c	0.11	< 0.01	0.04	0.03	0.05	0.02	2.10	150	1.4	
Mi. 4.5	0.20	0.04	0.14	0.10	0.11	0.03	0.62	90	0.70	

^aWeighted average $(\text{MFC})_w$ calculated for the mixture using $(\text{MFC})_w$ values for specific radionuclides specified by AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^bSampling station moved from Clinch River Mile 41.5 to Melton Hill Dam, CRM 23.1, about January 1, 1966.

^cValues given for this location are calculated values based on levels of waste released and the dilution provided by the river; they do not include amounts of radioactive material (e.g., fallout) that may enter the river upstream from CRM 20.8.

* None detected.

TABLE VIII
URANIUM CONCENTRATION IN THE CLINCH RIVER

January - June, 1968

Sampling Point	Type of Analyses Made	No. of Samples ^a	Units of 10^{-8} $\mu\text{Ci/ml}$			% (MFC) _w
			Maximum	Minimum	Average	
Downstream from ORGDP	Uranium Concentration	1	0.2	0.2	0.2	0.01

^aNormal Sampling Frequency: Continuous, composited over six-month period.

TABLE IX
EXTERNAL GAMMA RADIATION LEVELS

mR/hr

January - June, 1968

Station Number	Location	Jan.	Feb.	March	April	May.	June	Average
1	Solway Gate	0.011	0.010	0.010	0.012	*	0.012	0.011
2	Y-12, East Portal	0.011	0.012	0.011	0.011	*	0.011	0.011
3	Newcomb Road, Oak Ridge	0.011	0.011	0.009	0.015	*	0.012	0.012
4	Gallaher Gate	0.014	0.012	0.011	0.011	*	0.011	0.012
5	White Wing Gate	0.009	0.011	0.009	0.013	*	0.009	0.010
Average		0.011	0.011	0.011	0.012	*	0.011	0.011

Note: These readings were taken with a calibrated Geiger-Müller tube at a distance of three feet above the ground.

The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

*No measurement made.



INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX P, OAK RIDGE, TENNESSEE 37830

To (Name) Dr. K. Z. Morgan
Division
Location

Date January 22, 1969

Originating Dept.

Answering letter date

Copy to Mr. R. J. Betts
Mr. R. F. Hibbs
Mr. N. B. Schultz
Health Physics File - RC

Subject News Release on Environmental
Surveys

Attached are data for the semiannual news release, as requested by AEC-ORO, covering environmental surveys made by our plant forces at off-plant locations during the second half of calendar year 1968.


R. G. Jordan

NBS:hmt

Attachment

ENVIRONMENTAL RADIOACTIVITY LEVELS
Oak Ridge Gaseous Diffusion Plant

July through December 1968

The results of sampling of our environs of the Oak Ridge Gaseous Diffusion Plant during the second half of 1968 revealed that the amount of uranium in the surface waterways is not significantly different from the normal background values established for this region.

Sampling of the surface waterways adjacent to the plant revealed no instance where the uranium concentration exceeded the maximum permissible concentration specified for water (MPC_w).^{*} The average activity of natural uranium materials in the Clinch River, reflecting the effects of all of the Oak Ridge plants, was less than 0.1% of the MPC_w .⁺ Sampling data are shown in the following table:

Environmental Sampling - Local Streams

Location of Point	Type of Analysis	No. of Samples**	Plant Experience	Units of 10^{-8} $\mu\text{Ci/cc}$	
				Maximum Permissible Conc. (MPC_w)	Average Percent MPC_w +
Downstream from ORGDP	Uranium Concentration	2	0.0	2000	<0.1

* AEC Manual Chapter 0524, Annex 1, Table 2, "Concentrations in Air and Water Above Natural Background."

** Normal Sampling Frequency: Continuous, composited over one quarter.

+ Maximum permissible concentrations for continuous exposure to the general population.

Safety and Health Physics Department
Oak Ridge Gaseous Diffusion Plant

January 22, 1969



UNION CARBIDE CORPORATION
NUCLEAR DIVISION
P. O. BOX Y, OAK RIDGE, TENNESSEE 37830

March 20, 1969

U. S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee

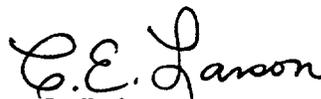
Attention: Mr. S. R. Sapirie, Manager
Oak Ridge Operations

Gentlemen:

Dissemination to the Public of Data
on Environmental Levels of Radioactivity

As requested, we are enclosing forty copies of the report for the second half of 1968 on Environmental Levels of Radioactivity for the Oak Ridge area.

Very truly yours,


C. E. Larson
President

CEL:HGM:dg

Enclosure

cc w/encl.: F. R. Bruce (2)
D. M. Davis (10)
R. F. Hibbs (5)
J. L. Liverman
H. G. MacPherson (2)
K. Z. Morgan
N. B. Schultz (2)

ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

(Report for Period July - December, 1968)

Compiled by the

Health Physics and Safety Section

Health Physics Division

OAK RIDGE NATIONAL LABORATORY

Introduction

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are concentrated by evaporation and disposed of in deep wells. Low level liquid wastes are discharged, after preliminary treatment, to surface streams.

Air that may become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by means of scrubbers and filters.

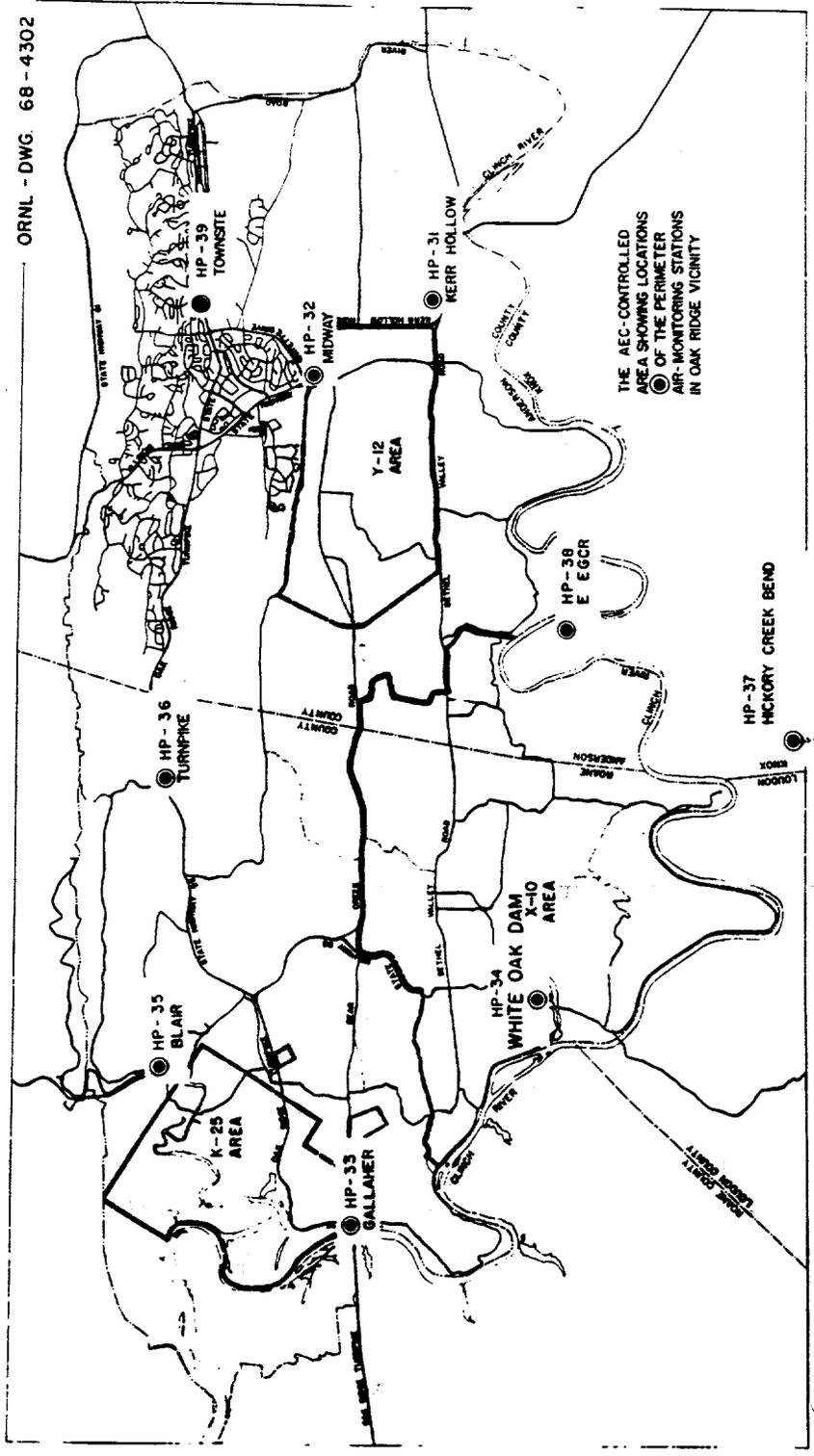
This report presents data on the environmental levels of radioactivity for the Oak Ridge area and compares the data with established maximum permissible concentrations.

Air Monitoring

Atmospheric contamination by radioactive materials occurring in the general environment of East Tennessee is monitored by two systems of monitoring stations. One system consists of nine stations which encircle the plant area (Fig. 1) and provides data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of eight stations encircling the Oak Ridge area at distances of from 12 to 75 miles (Fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Sampling for radioactive particulates is carried out by passing air continuously through a filter paper. Airborne radioactive iodine is monitored in the immediate environment of the plant area by passing air through a cartridge containing activated charcoal. Data collected are accumulated, tabulated, and averaged in units of $\mu\text{Ci}/\text{cc}$ of air sampled.

Milk Monitoring

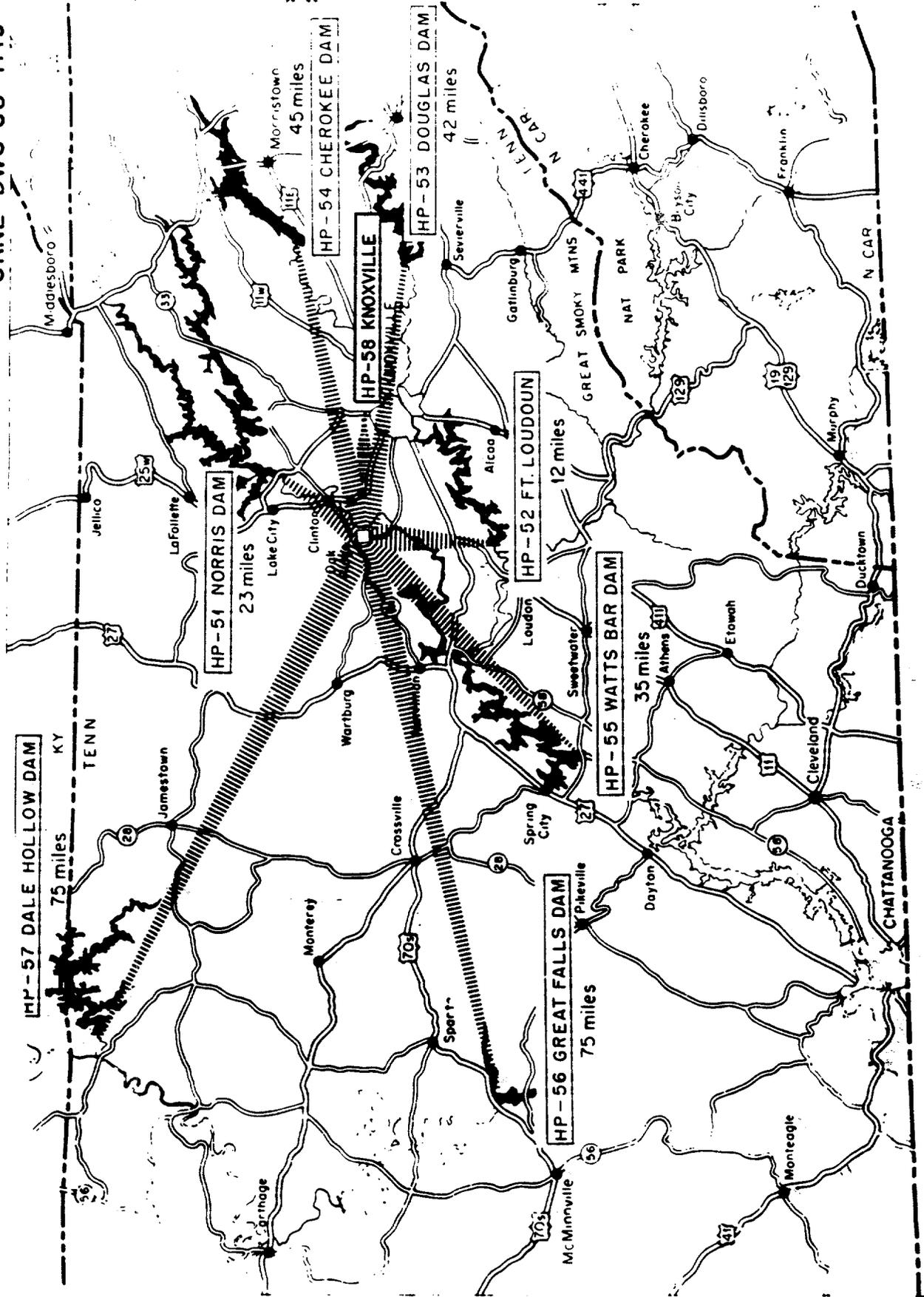
Raw milk is monitored for ^{131}I and ^{90}Sr by the collection and analysis of samples from twelve sampling stations located within a radius of 50 miles of ORNL. Samples are collected weekly at each of eight stations located on the fringe of the Oak Ridge area. Four stations, located more remotely with respect to Oak Ridge Operations, are sampled at a rate of one station each week. The purpose of the



STATION SITES FOR PERIMETER AIR MONITORING SYSTEM

Figure 1

ORNL-DWG 66-1719



STATION SITES FOR REMOTE MONITORING SYSTEM
Figure 2

milk sampling program is two-fold: first, samples collected in the immediate vicinity of the Oak Ridge area provide data by which one may evaluate possible exposure to the neighboring population resulting from waste releases from Oak Ridge Operations; second, samples collected at the more remote stations provide background data which are essential in establishing the proper index for the evaluation of data obtained from local samples.

Water Monitoring

Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, to the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for population groups in uncontrolled areas as specified by AEC Manual, Chapter 0524. The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 3 and 4. Samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously to obtain dilution factors for calculating the probable concentrations of wastes in the river.

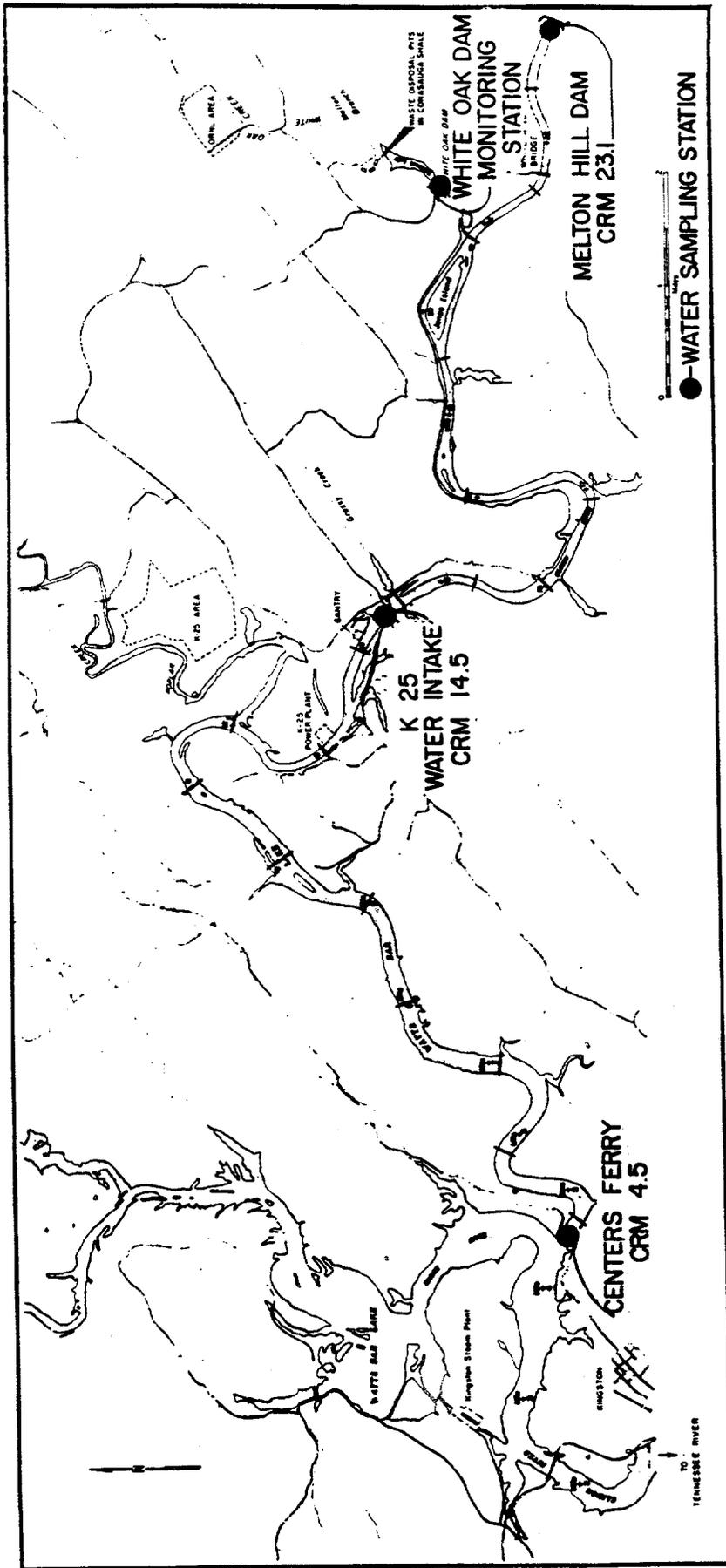
Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters.

Analyses are made of the effluent for the long-lived radionuclides only, since cooling time and hold-up time in the waste effluent system are such that short-lived radionuclides are normally not present. The concentrations of those isotopes present in significant amounts are determined by analysis. A weighted average maximum permissible concentration for water, $(MPC)_w$, for the mixture of radionuclides is calculated on the basis of the isotopic distribution using the MPC values of each isotope as specified by AEC Manual, Chapter 0524.¹ The average concentrations of gross beta activity in the Clinch River are compared to the calculated $(MPC)_w$ values.

The concentration of uranium is compared with the specific $(MPC)_w$ value for uranium.

¹AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

ORNL-DWG. 66-2216R



WATER SAMPLING LOCATIONS
Figure 3

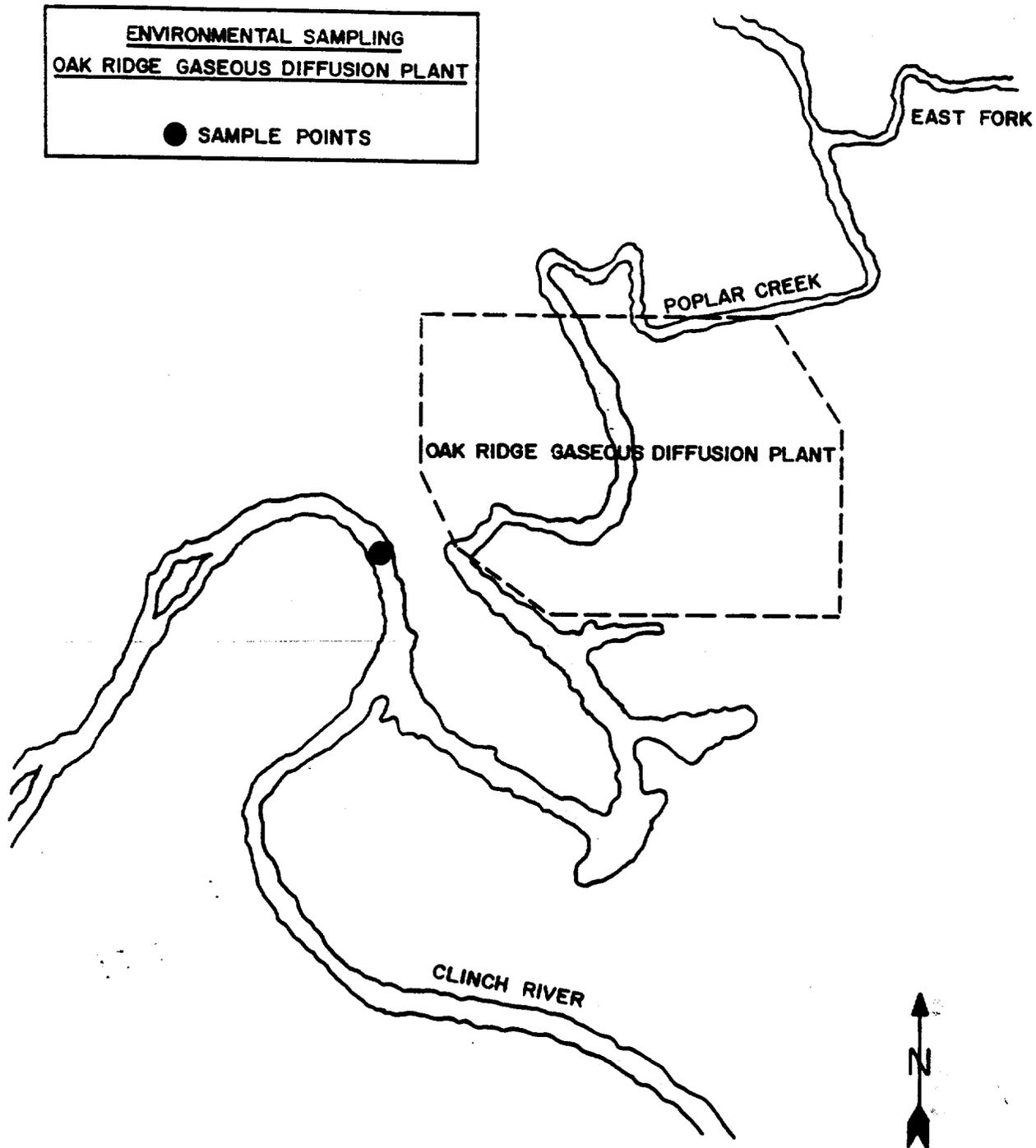


Figure 4

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge area. Measurements are taken with a Geiger-Müller tube at a distance of three feet above the ground, and the results are tabulated in terms of mR/hr.

Discussion of Data

Data on the environmental levels of radioactivity for the second half of 1968 in the Oak Ridge and surrounding areas are presented in Table I through Table IX.

The average air contamination level for gross beta activity, as shown by the continuous air monitoring filter data, for both the immediate and remote environs of the plants was 0.10% of the maximum permissible concentration applicable to uncontrolled areas (Table I).

The average air contamination levels for gross alpha activity, as shown by the continuous air monitoring filter data, for the immediate and remote environs of the plants were 0.10% and 0.05%, respectively, of the $(MPC)_a$ for natural uranium for application to uncontrolled areas (Table II).

The average concentration of ^{131}I in air in the immediate environs of the plants was 0.02×10^{-12} $\mu\text{Ci/cc}$ (Table III). This is approximately 0.02% of the maximum permissible concentration for application to uncontrolled areas.

The average concentrations of ^{131}I in raw milk in the immediate and remote environs of the Oak Ridge area were 5.1 pCi/l and 5.0 pCi/l, respectively (Table IV). These levels fall within the limits of FRC Range I if one assumes the average intake per individual to be 1 liter of milk per day.

The average concentrations of ^{90}Sr in raw milk in the immediate and remote environs of the controlled area were 19 pCi/l and 17 pCi/l, respectively. These levels fall within the limits of FRC Range I for transient rates of daily intake of ^{90}Sr for application to the average of suitable samples of an exposed population.

The calculated average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most of the wastes, and the measured average concentration at Mile 4.5, near Kingston, Tennessee, were 0.33×10^{-8} $\mu\text{Ci/ml}$ and 0.76×10^{-8} $\mu\text{Ci/ml}$, respectively. These values are 0.31% and 0.34% of the weighted average maximum permissible concentrations $(MPC)_w$. The higher than normal value reported for the average concentration of radioactivity at Mile 23.1, Melton Hill Dam, was due primarily to ^{60}Co , (Table VII). This contamination was found in the river upstream from the ORNL waste outfall and was the result of a source of contamination other than Oak Ridge Operations.

The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 0.01×10^{-10} $\mu\text{Ci/ml}$ which is $< 0.01\%$ of the weighted average $(\text{MPC})_w$ value.

The average concentration of natural uranium materials in the Clinch River, reflecting the effects of all Oak Ridge plants, was $< 0.01\%$ of the $(\text{MPC})_w$ for uranium.

The average external gamma radiation measured in the town of Oak Ridge and at the perimeter of the Oak Ridge area was 0.012 mR/hr , which is approximately the same as the level measured in the early period prior to Oak Ridge Operations.

Conclusion

Surveillance of the radioactivity in the Oak Ridge environs indicated that the radioactivity levels were not significantly different from other areas of East Tennessee. Only very low level radioactivity is being released to the environment from plant operations and the resulting concentrations in both the atmosphere and surface streams of the Oak Ridge environment are well below established maximum permissible concentrations and intake guides for the neighboring population.

TABLE I
CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Beta Activity of
Particulates in Air

July - December, 1968

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	2.5	0.32	1.1	0.11
HP-32	Midway Gate	26	2.9	<0.01	1.6	0.16
HP-33	Gallaher Gate	26	2.2	0.28	0.89	0.09
HP-34	White Oak Dam	26	2.1	0.30	0.96	0.10
HP-35	Blair Gate	26	3.3	0.24	1.1	0.11
36	Turnpike Gate	151 ^d	2.6	0.30	1.2	0.12
HP-37	Hickory Creek Bend	26	2.0	<0.01	0.73	0.07
HP-38	East of EGCR	26	2.4	0.54	1.1	0.11
HP-39	Townsite	26	1.6	<0.01	0.85	0.09
Average			2.4	0.17	1.0	0.10
<u>Remote Stations</u>						
HP-51	Norris Dam	26	2.4	0.23	0.96	0.10
HP-52	Loudoun Dam	25	2.6	0.27	1.1	0.11
HP-53	Douglas Dam	26	2.6	0.31	1.0	0.10
HP-54	Cherokee Dam	25	2.1	0.11	0.82	0.08
HP-55	Watts Bar Dam	25	2.4	0.12	0.97	0.10
HP-56	Great Falls Dam	26	2.7	0.22	1.1	0.11
HP-57	Dale Hollow Dam	26	2.5	0.24	0.93	0.09
HP-58	Knoxville	21	2.6	0.15	1.1	0.11
Average			2.5	0.21	0.99	0.10

^aMaximum weekly average concentration.

^bMinimum weekly average concentration.

^c(MPC)_a is taken to be 10^{-10} $\mu\text{Ci}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^dSamples collected five days per week beginning 9/20/68.

TABLE II
CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Alpha Activity of
Particulates in Air

July - December, 1968

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	0.04	< 0.01	0.02	0.10
HP-32	Midway Gate	26	0.05	< 0.01	0.02	0.10
HP-33	Gallaher Gate	26	0.04	< 0.01	0.02	0.10
HP-34	White Oak Dam	26	0.04	< 0.01	0.01	0.05
HP-35	Blair Gate	26	0.08	< 0.01	0.02	0.10
HP-36	Turnpike Gate	151 ^d	0.11	< 0.01	0.04	0.20
37	Hickory Creek Bend	26	0.04	< 0.01	0.02	0.10
HP-38	East of EGCR	26	0.02	< 0.01	0.01	< 0.01
HP-39	Townsite	26	0.04	< 0.01	0.02	0.10
Average			0.05	< 0.01	0.02	0.10
<u>Remote Stations</u>						
HP-51	Norris Dam	26	0.02	< 0.01	0.01	0.05
HP-52	Loudoun Dam	25	0.05	< 0.01	0.02	0.10
HP-53	Douglas Dam	26	0.04	< 0.01	0.01	0.05
HP-54	Cherokee Dam	25	0.05	< 0.01	0.01	0.05
HP-55	Watts Bar Dam	25	0.04	< 0.01	0.01	0.05
HP-56	Great Falls Dam	26	0.03	< 0.01	0.01	0.05
HP-57	Dale Hollow Dam	26	0.03	< 0.01	0.01	0.05
HP-58	Knoxville	21	0.14	< 0.01	0.03	0.15
Average			0.05	< 0.01	0.01	0.05

^a Maximum weekly average concentration.

^b Minimum weekly average concentration.

^c (MPC)_a used is 20×10^{-13} $\mu\text{Ci}/\text{cc}$, the MPC for natural uranium as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^d Samples collected five days per week beginning 9/20/68.

TABLE III
 CONCENTRATION OF ^{131}I IN AIR
 AS MEASURED BY THE PERIMETER AIR MONITORING STATIONS

July - December, 1968

Number of Samples	Units of 10^{-12} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^b
	Maximum	Minimum ^a	Average	
234	0.74	< 0.01	0.02	0.02

^a Minimum detectable amount of ^{131}I is 20 d/m. At the average sampling rate used, this corresponds to approximately 0.010×10^{-12} $\mu\text{Ci}/\text{cc}$. In averaging, one-half of this value, 10 d/m, is used for all samples showing a total amount of ^{131}I less than 20 d/m.

^b (MPC)_a is taken to be 1×10^{-10} $\mu\text{Ci}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

TABLE IV
CONCENTRATION OF ^{131}I IN RAW MILK

July - December, 1968

Location	pCi/l		
	Maximum	Minimum ^a	Average
Immediate Environs	15	< 10	5.1
Remove Environs	< 10	< 10	5.0

^aMinimum detectable concentration of ^{131}I is 10 pCi/l. In averaging, one-half of this value, 5 pCi/l, was used for all samples showing a concentration less than 10 pCi/l.

TABLE V
CONCENTRATION OF ^{90}Sr IN RAW MILK

July - December, 1968

Location	pCi/l		
	Maximum	Minimum ^a	Average
Immediate Environs	38	9.0	19
Remote Environs	23	12	17

^a Minimum detectable concentration of ^{90}Sr in milk is 2 pCi/l. In averaging, one-half of this value, 1 pCi/l, was used for all samples showing a concentration less than 2 pCi/l.

TABLE VI
CALCULATED AVERAGE CONCENTRATION OF RADIOACTIVITY
IN THE CLINCH RIVER AT MILE 20.8

July - December, 1968

Number of Samples Taken	Units of 10^{-7} $\mu\text{Ci/ml}$			% of $(\text{MPC})_w$
	Maximum ^a	Minimum ^b	Average	
181	0.18	0.008	0.033	0.31

^aMaximum weekly average.

^bMinimum weekly average.

TABLE VII
 AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
 IN THE CLINCH RIVER

July - December, 1968

Location	Units of 10^{-8} $\mu\text{Ci/ml}$							Average Beta Activity	(MPC) _w ^a	% of (MPC) _w
	⁹⁰ Sr	¹⁴⁴ Ce	¹³⁷ Cs	¹⁰⁶ Ru	⁶⁰ Co	⁹⁵ Zr - ⁹⁵ Nb				
Mi. 23.1 ^b	0.04	0.02	*	0.04	0.88	*	0.98	550	0.18	
Mi. 20.8 ^c	0.05	<0.01	0.01	0.04	<0.01	<0.01	0.33	100	0.31	
Mi. 4.5	0.09	0.03	0.14	0.05	0.44	0.01	0.76	220	0.34	

^aWeighted average (MPC)_w calculated for the mixture using (MPC)_w values for specific radionuclides specified by AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^bSampling station moved from Clinch River Mile 41.5 to Melton Hill Dam, CRM 23.1, about January 1, 1966.

^cValues given for this location are calculated values based on levels of waste released and the dilution provided by the river; they do not include amounts of radioactive material (e.g., fallout) that may enter the river upstream from CRM 20.8.

*None detected.

TABLE VIII
URANIUM CONCENTRATION IN THE CLINCH RIVER

July - December, 1968

Sampling Point	Type of Analyses Made	No. of Samples ^a	Units of 10^{-8} $\mu\text{Ci/ml}$		% (MPC) _w
			Maximum ^b	Average ^b (MPC) _w	
Downstream from ORGDP	Uranium Concentration	2	< 0.1	< 0.1	< 0.01

^aNormal Sampling Frequency: Continuous, composited over six-month period.

^bNo uranium was detected in Clinch River water samples during this period. Minimum detectable concentration of uranium in river water is 0.1×10^{-8} $\mu\text{c/ml}$.

TABLE IX
EXTERNAL GAMMA RADIATION LEVELS

mR/hr

July - December, 1968

Station Number	Location	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1	Solway Gate	0.016	0.009	0.013	0.011	*	*	0.012
2	Y-12, East Portal	0.012	0.012	0.010	0.012	*	*	0.012
3	Newcomb Road, Oak Ridge	0.012	0.012	0.012	0.011	*	*	0.012
4	Gallaher Gate	0.011	0.012	0.011	0.009	*	*	0.011
5	White Wing Gate	0.012	0.013	0.009	0.010	*	*	0.011
Average		0.012	0.012	0.011	0.011	*	*	0.012

Note: These readings were taken with a calibrated Geiger-Müller tube at a distance of three feet above the ground.

The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

*No measurement made.

**UNION
CARBIDE**

INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX P, OAK RIDGE, TENNESSEE 37830

To (Name) **Mr. S. L. Morgan**
Division
Location

Date **July 11, 1969**

Originating Dept.

Answering letter date

Copy to **Mr. A. J. Betts**
Mr. W. D. Schultz
Mr. P. R. Vanstrun
Health Physics file - DC

Subject **News Release on Environmental
Surveys**

Attached are data for the semiannual news release, as requested by AEC-GEO, covering environmental surveys made by our plant forces at off-plant locations during the first half of calendar year 1969.



R. G. Jordan

RBS:zh

Attachment

ENVIRONMENTAL RADIOACTIVITY LEVELS
 At Oak Ridge Gaseous Diffusion Plant

January through June, 1969

The results of sampling of our environs of the Oak Ridge Gaseous Diffusion Plant during the first half of 1969 revealed that the amount of uranium in the surface waterways is not significantly different from the normal background values established for this region.

Sampling of the surface waterways adjacent to the plant revealed no instance where the uranium concentration exceeded the maximum permissible concentration specified for water (MPC).* The average activity of natural uranium materials in the Clinch River, reflecting the effects of all of the Oak Ridge plants, was less than 0.1% of the MPC. Sampling data are shown in the following tables:

Environmental Sampling - Local Streams

Location of Point	Type of Analysis	No. of Samples**	Plant Experience	Units of 10^{-6} μ Ci/cc	
				Maximum Permissible Conc. (MPC)	Average Percent MPC ⁺
Downstream from DRGDP	Uranium Concentration	2	0.0	2000	< 0.1

* AEC Manual Chapter 0524, Annex 1, Table 2, "Concentrations in Air and Water Above Natural Background."

** Normal Sampling Frequency; continuous, composited over one quarter.

+ Maximum permissible concentrations for continuous exposure to the general population.

Safety, Health Physics, and
 Industrial Hygiene Departments
 Oak Ridge Gaseous Diffusion Plant

July 11, 1969



UNION CARBIDE CORPORATION

NUCLEAR DIVISION

P. O. BOX Y, OAK RIDGE, TENNESSEE 37830

September 11, 1969

U.S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee 37830

Attention: Mr. S. R. Sapirie, Manager
Oak Ridge Operations

Gentlemen:

Dissemination to the Public of Data
on Environmental Levels of Radioactivity

As requested, we are enclosing forty copies of the report for the first half of 1969 on Environmental Levels of Radioactivity for the Oak Ridge Area.

Very truly yours,

R. F. Hibbs
President

RFH:HGM:dg

Enclosure

cc w/encl.: F. R. Bruce (2)
D. M. Davis (10)
J. L. Liverman
H. G. MacPherson (2)
K. Z. Morgan
N. B. Schultz (2) ✓
P. R. Vanstrum (5)
Laboratory Records - ORNL (2)

ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

(Report for Period January - June, 1969)

Compiled by the

Health Physics and Safety Section

Health Physics Division

OAK RIDGE NATIONAL LABORATORY

Introduction

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are concentrated by evaporation and disposed of in deep wells by the hydrofracture technique. Low level liquid wastes are discharged, after preliminary treatment, to surface streams.

Air that may become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by means of scrubbers and filters.

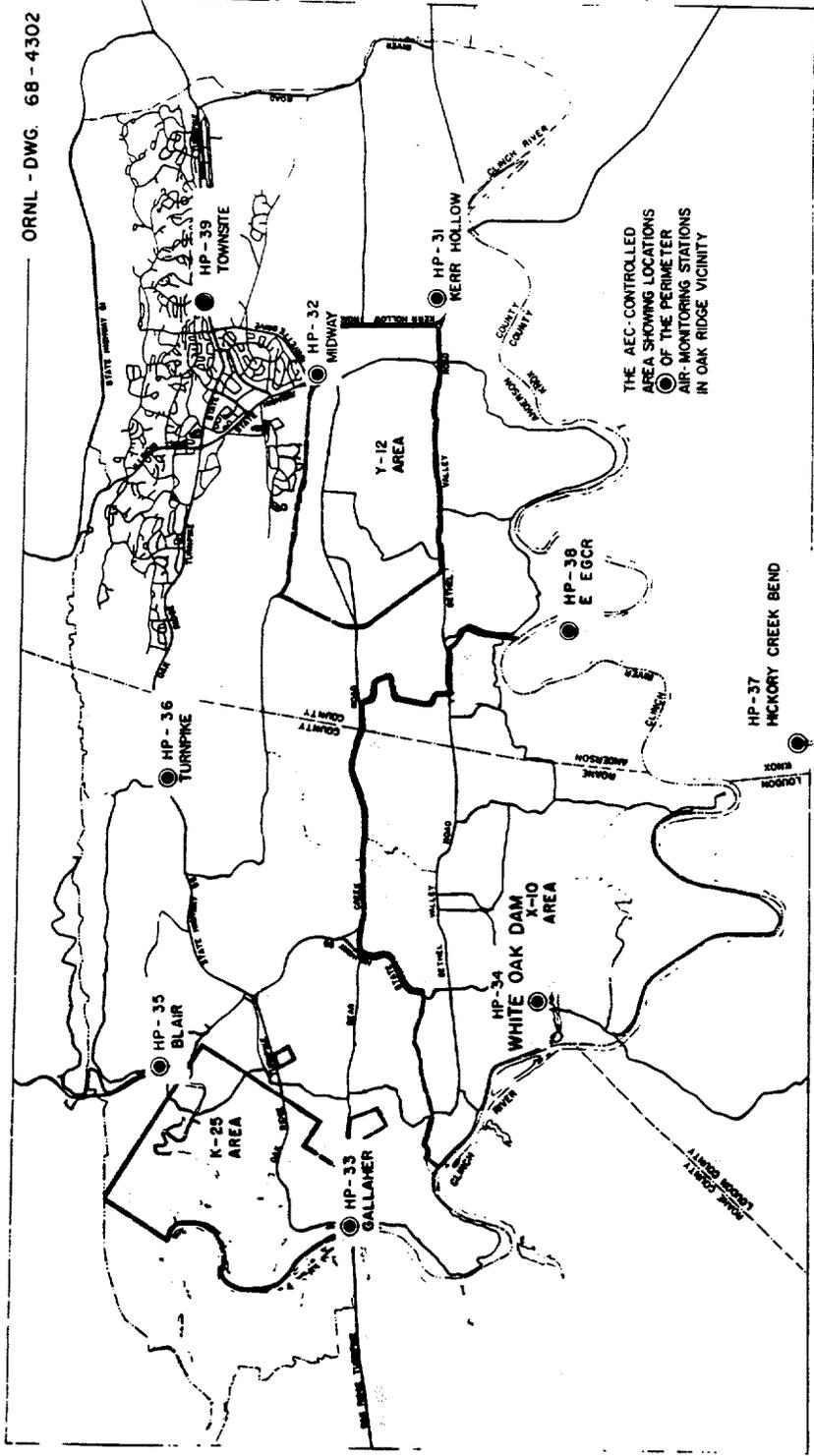
This report presents data on the environmental levels of radioactivity for the Oak Ridge area and compares the data with established maximum permissible concentrations.

Air Monitoring

Atmospheric contamination by radioactive materials occurring in the general environment of East Tennessee is monitored by two systems of monitoring stations. One system consists of nine stations which encircle the plant area (Fig. 1) and provides data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of eight stations encircling the Oak Ridge area at distances of from 12 to 75 miles (Fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Sampling for radioactive particulates is carried out by passing air continuously through a filter paper. Airborne radioactive iodine is monitored in the immediate environment of the plant area by passing air through a cartridge containing activated charcoal. Data collected are accumulated, tabulated, and averaged in units of $\mu\text{Ci}/\text{cc}$ of air sampled.

Milk Monitoring

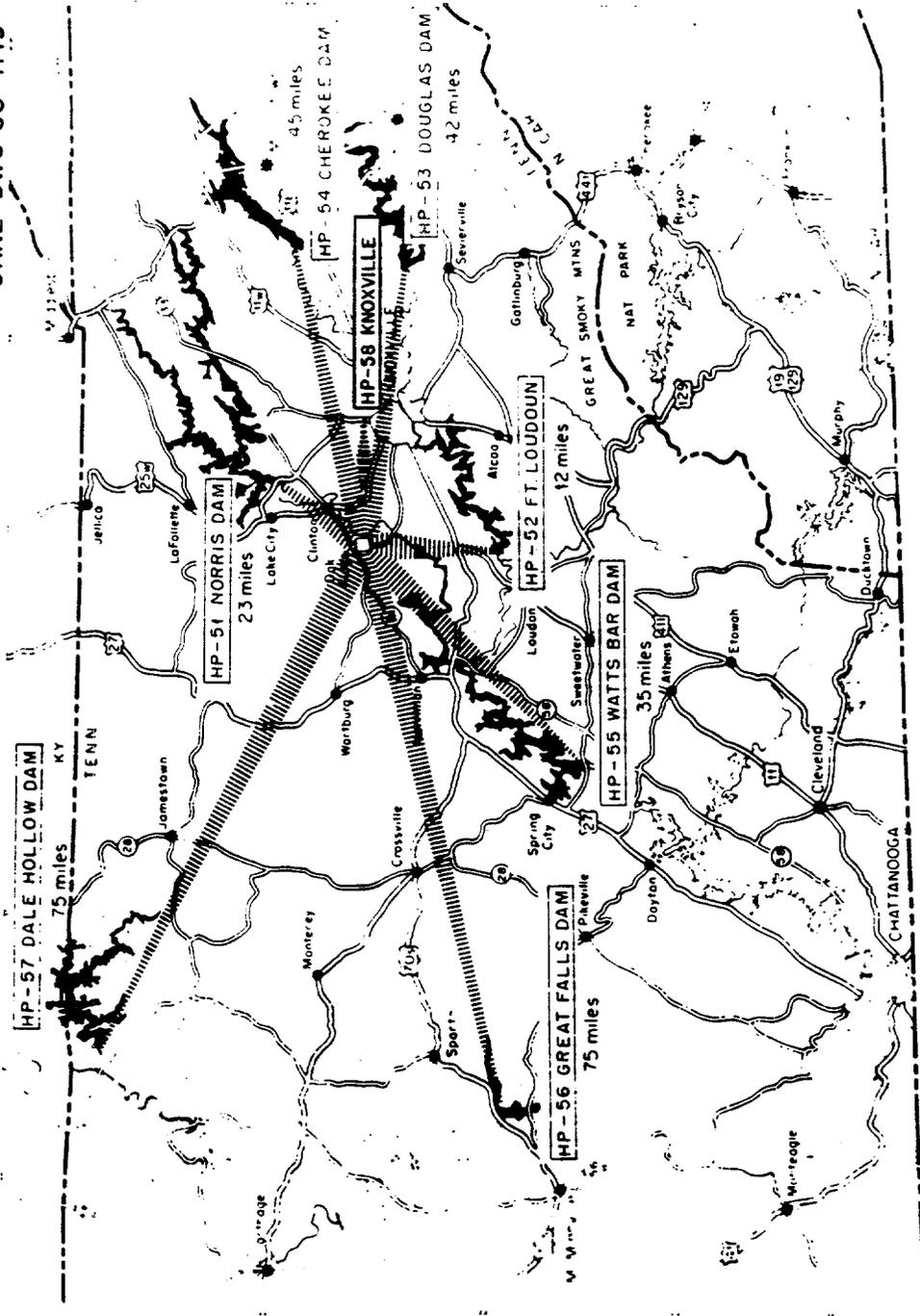
Raw milk is monitored for ^{131}I and ^{90}Sr by the collection and analysis of samples from twelve sampling stations located within a radius of 50 miles of ORNL. Samples are collected weekly at each of eight stations located on the fringe of the Oak Ridge area. Four stations, located more remotely with respect to Oak Ridge Operations, are sampled at a rate of one station each week. The purpose of the



STATION SITES FOR PERIMETER AIR MONITORING SYSTEM

Figure 1

ORNL-DWG 66-1719



STATION SITES FOR REMOTE AIR MONITORING SYSTEM

Figure 2

milk sampling program is two-fold: first, samples collected in the immediate vicinity of the Oak Ridge area provide data by which one may evaluate possible exposure to the neighboring population resulting from waste releases from Oak Ridge Operations; second, samples collected at the more remote stations provide background data which are essential in establishing the proper index for the evaluation of data obtained from local samples.

Water Monitoring

Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, to the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for population groups in uncontrolled areas as specified by AEC Manual, Chapter 0524. The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 3 and 4. Samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously to obtain dilution factors for calculating the probable concentrations of wastes in the river.

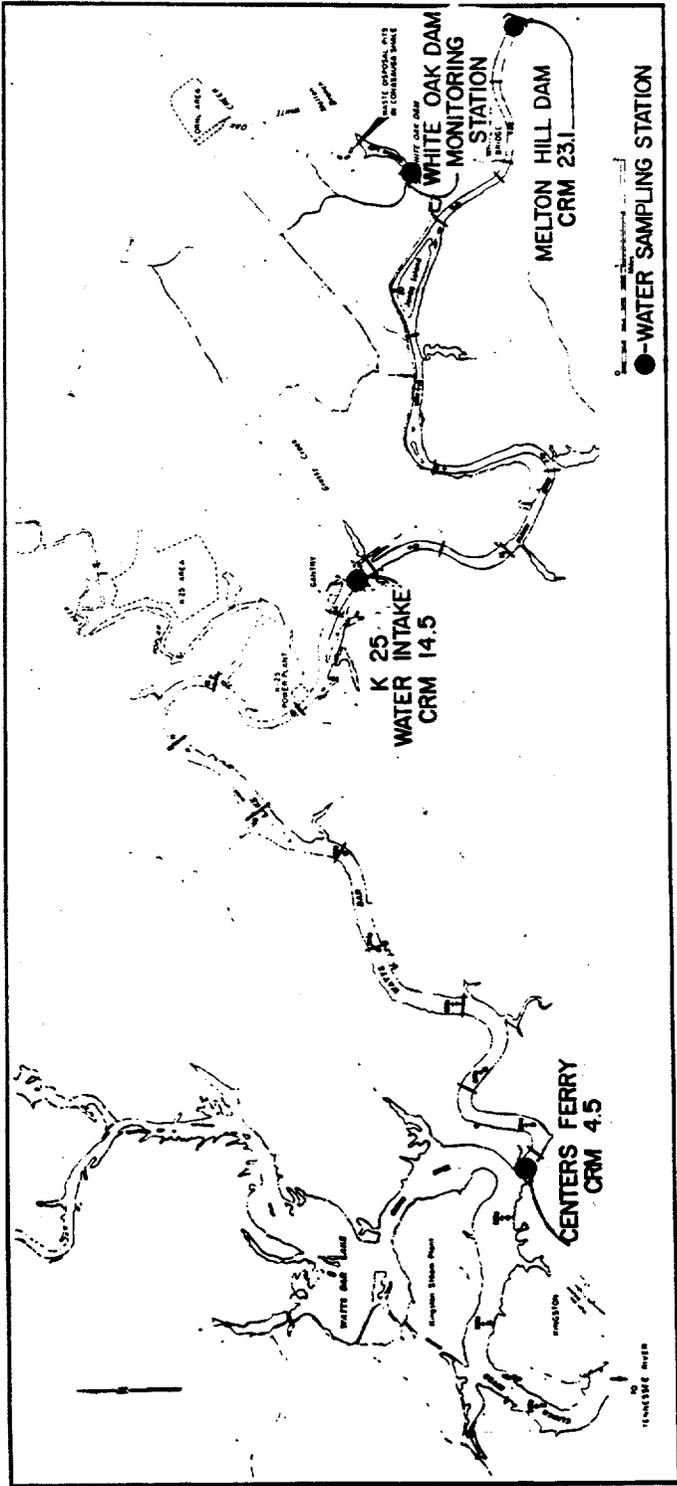
Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters.

Analyses are made of the effluent for the long-lived radionuclides only, since cooling time and hold-up time in the waste effluent system are such that short-lived radionuclides are normally not present. The concentrations of those isotopes present in significant amounts are determined by analysis. The concentration of each isotope is compared with its respective MPC value as specified by AEC Manual, Chapter 0524,¹ and the resulting fractions summed to arrive at the % $(MPC)_w$ in the Clinch River.

The concentration of uranium is compared with the specific $(MPC)_w$ value for uranium.

¹AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

ORNL-DWG. 66-2216R



WATER SAMPLING LOCATIONS

Figure 3

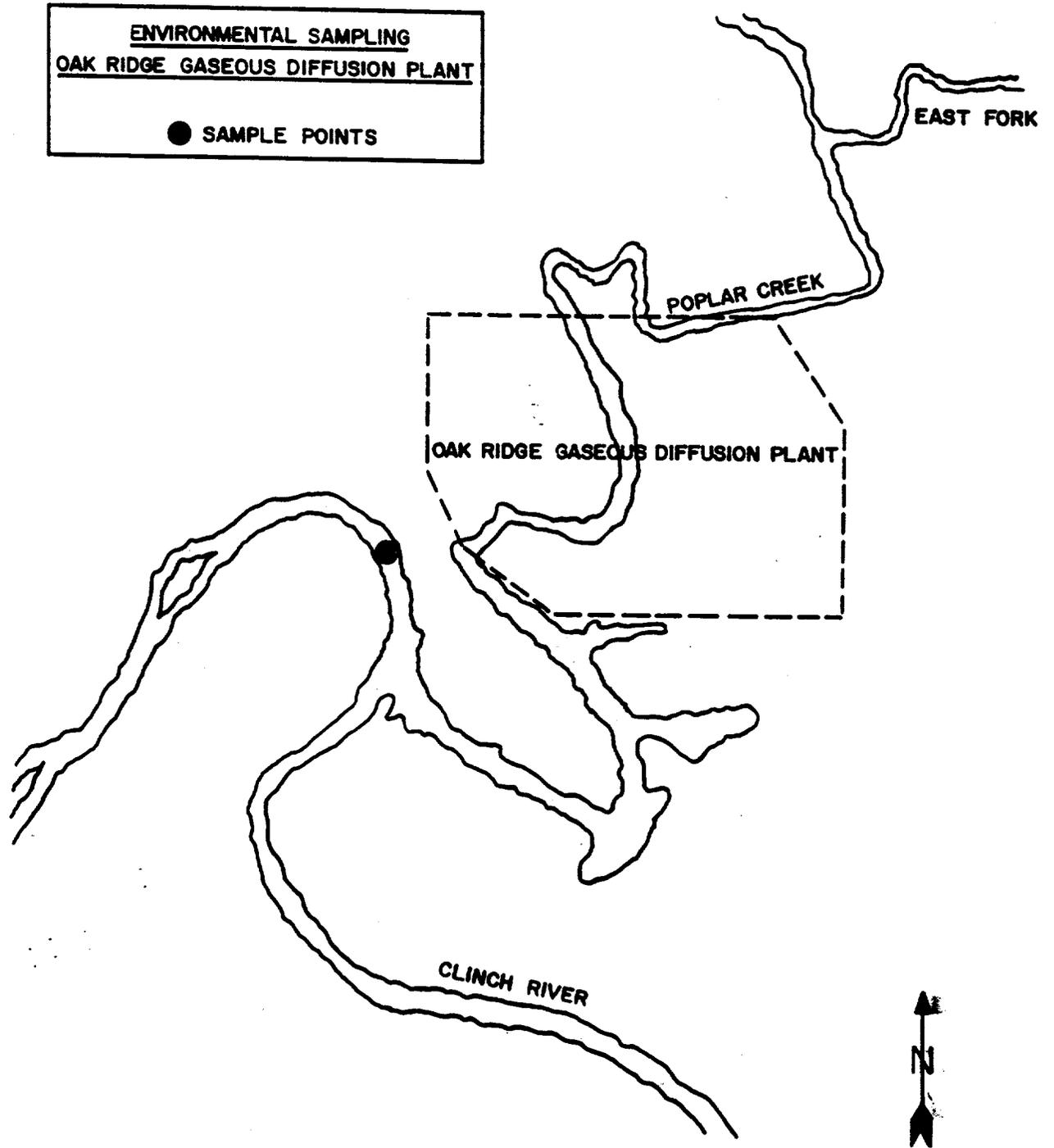


Figure 4

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge area. Measurements are taken with a Geiger-Müller tube at a distance of three feet above the ground, and the results are tabulated in terms of mR/hr.

Discussion of Data

Data on the environmental levels of radioactivity for the first half of 1969 in the Oak Ridge and surrounding areas are presented in Table I through Table IX.

The average air contamination level for gross beta activity, as shown by the continuous air monitoring filter data, for both the immediate and remote environs of the plants was 0.16% of the maximum permissible concentration applicable to uncontrolled areas (Table I).

The average air contamination levels for gross alpha activity, as shown by the continuous air monitoring filter data, for the immediate and remote environs of the plants were 0.10% and 0.05%, respectively, of the $(MPC)_a$ for natural uranium for application to uncontrolled areas (Table II).

The average concentration of ^{131}I in air in the immediate environs of the plants was 0.02×10^{-12} $\mu\text{Ci/cc}$ (Table III). This is approximately 0.02% of the maximum permissible concentration for application to uncontrolled areas.

The average concentrations of ^{131}I in raw milk in the immediate and remote environs of the Oak Ridge area were both less than 10 pCi/l (Table IV). These levels fall within the limits of FRC Range I if one assumes the average intake per individual to be 1 liter of milk per day.

The average concentrations of ^{90}Sr in raw milk in the immediate and remote environs of the controlled area were 21 pCi/l and 17 pCi/l, respectively. The average for the immediate environs, 21 pCi/l, falls near the lower limit of FRC Range II and the value for the remote environs, 17 pCi/l, falls within the limits of FRC Range I for transient rates of daily intake of ^{90}Sr for application to the average of suitable samples of an exposed population.

The calculated average concentration of radioactivity in the Clinch River at Mile 20.8, the point of entry of most of the wastes, and the measured average concentration at Mile 4.5, near Kingston, Tennessee, were 0.65×10^{-8} $\mu\text{Ci/ml}$ and 1.2×10^{-8} $\mu\text{Ci/ml}$, respectively. These values represent 0.49% and 0.52% of the $(MPC)_w$ for application to uncontrolled areas. The higher than normal concentration of ^{60}Co measured at Mile 23.1 (Table VII) above the ORNL waste outfall was the result of a source of contamination other than Oak Ridge Operations.

The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 0.11×10^{-10} $\mu\text{Ci/ml}$ which is $\sim 0.01\%$ of the $(\text{MPC})_w$ value for water containing a mixture of unknown radionuclides.²

The average concentration of natural uranium materials in the Clinch River, reflecting the effects of all Oak Ridge plants, was $< 0.01\%$ of the $(\text{MPC})_w$ for uranium.

The average external gamma radiation measured in the town of Oak Ridge and at the perimeter of the Oak Ridge area was 0.013 mR/hr, which is approximately the same as the level measured in the early period prior to Oak Ridge Operations.

Conclusion

Surveillance of the radioactivity in the Oak Ridge environs indicated that the radioactivity levels were not significantly different from other areas of East Tennessee. Only very low level radioactivity is being released to the environment from plant operations and the resulting concentrations in both the atmosphere and surface streams of the Oak Ridge environment are well below established maximum permissible concentrations and intake guides for the neighboring population.

² $(\text{MPC})_w$ is taken to be 1×10^{-7} $\mu\text{Ci/ml}$ as specified by AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

TABLE I
CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Beta Activity of
Particulates in Air

January - June, 1969

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	3.8	0.11	1.5	0.15
HP-32	Midway Gate	26	4.7	0.29	1.8	0.18
HP-33	Gallaher Gate	26	3.1	< 0.01	1.3	0.13
HP-34	White Oak Dam	26	5.9	0.19	1.6	0.16
HP-35	Blair Gate	26	4.5	0.47	1.6	0.16
HP-36	Turnpike Gate	127 ^d	4.1	0.51	1.8	0.18
HP-37	Hickory Creek Bend	26	3.6	0.17	1.4	0.14
HP-38	East of EGCR	26	4.3	0.39	1.7	0.17
HP-39	Townsite	26	4.9	0.27	1.8	0.18
Average			4.3	0.27	1.6	0.16
<u>Remote Stations</u>						
HP-51	Norris Dam	26	3.6	0.52	1.6	0.16
HP-52	Loudoun Dam	26	4.4	0.35	1.6	0.16
HP-53	Douglas Dam	26	4.5	0.41	1.6	0.16
HP-54	Cherokee Dam	25	3.5	0.24	1.4	0.14
HP-55	Watts Bar Dam	26	4.4	0.03	1.4	0.14
HP-56	Great Falls Dam	26	4.5	0.29	1.6	0.16
HP-57	Dale Hollow Dam	26	4.3	0.03	1.6	0.16
HP-58	Knoxville	25	4.4	0.42	1.8	0.18
Average			4.2	0.29	1.6	0.16

^aMaximum weekly average concentration.

^bMinimum weekly average concentration.

(MPC)_a is taken to be 10^{-10} $\mu\text{Ci}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

^dSamples collected five days per week beginning 9/20/68.

TABLE II
CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Alpha Activity of
Particulates in Air

January - June, 1969

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	26	0.05	< 0.01	0.02	0.10
HP-32	Midway Gate	26	0.07	< 0.01	0.02	0.10
HP-33	Gallaher Gate	26	0.04	< 0.01	0.01	0.05
HP-34	White Oak Dam	26	0.02	< 0.01	0.01	0.05
HP-35	Blair Gate	26	0.07	< 0.01	0.02	0.10
HP-36	Turnpike Gate	127 ^d	0.08	< 0.01	0.03	0.15
HP-37	Hickory Creek Bend	26	0.05	< 0.01	0.01	0.05
HP-38	East of EGCR	26	0.02	< 0.01	0.01	0.05
HP-39	Townsite	26	0.03	< 0.01	0.02	0.10
Average			0.05	< 0.01	0.02	0.10
<u>Remote Stations</u>						
HP-51	Norris Dam	26	0.04	< 0.01	0.01	0.05
HP-52	Loudoun Dam	26	0.04	< 0.01	0.01	0.05
HP-53	Douglas Dam	26	0.02	< 0.01	0.01	0.05
HP-54	Cherokee Dam	25	0.08	< 0.01	0.01	0.05
HP-55	Watts Bar Dam	26	0.06	< 0.01	0.01	0.05
HP-56	Great Falls Dam	26	0.02	< 0.01	0.01	0.05
HP-57	Dale Hollow Dam	26	0.02	< 0.01	0.01	0.05
HP-58	Knoxville	25	0.05	< 0.01	0.02	0.10
Average			0.04	< 0.01	0.01	0.05

^aMaximum weekly average concentration.

^bMinimum weekly average concentration.

(MPC)_a used is 20×10^{-13} $\mu\text{Ci}/\text{cc}$, the MPC for natural uranium as specified in AEC Manual, Chapter 0524 Appendix, Annex 1, Table II.

^dSamples collected five days per week beginning 9/20/68.

TABLE III
 CONCENTRATION OF ^{131}I IN AIR
 AS MEASURED BY THE PERIMETER AIR MONITORING STATIONS

January - June, 1969

Number of Samples	Units of 10^{-12} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^b
	Maximum	Minimum ^a	Average	
234	0.49	< 0.01	0.02	0.02

^a Minimum detectable amount of ^{131}I is 20 d/m. At the average sampling rate used, this corresponds to approximately 0.010×10^{-12} $\mu\text{Ci}/\text{cc}$. In averaging, one-half of this value, 10 d/m, is used for all samples showing a total amount of ^{131}I less than 20 d/m.

^b (MPC)_a is taken to be 1×10^{-10} $\mu\text{Ci}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

TABLE IV
CONCENTRATION OF ^{131}I IN RAW MILK

January - June, 1969

Location	pCi/l		
	Maximum	Minimum ^a	Average
Immediate Environs	25	< 10	< 10
Remote Environs	< 10	< 10	< 10

^aMinimum detectable concentration of ^{131}I is 10 pCi/l.

TABLE V
CONCENTRATION OF ^{90}SR IN RAW MILK

January - June, 1969

Location	pCi/l		
	Maximum	Minimum ^a	Average
Immediate Environs	47	7.0	21
Remote Environs	22	10	17

^a Minimum detectable concentration of ^{90}Sr in milk is 2 pCi/l. In averaging, one-half of this value, 1 pCi/l, was used for all samples showing a concentration less than 2 pCi/l.

TABLE VI
CALCULATED AVERAGE CONCENTRATION OF RADIOACTIVITY
IN THE CLINCH RIVER AT MILE 20.8

January - June, 1969

Number of Samples Taken	Units of 10^{-7} $\mu\text{Ci/ml}$			% of (MPC) _w
	Maximum ^a	Minimum ^b	Average	
184	0.35	0.009	0.065	0.49

^aMaximum weekly average.

^bMinimum weekly average.

TABLE VII
 AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
 IN THE CLINCH RIVER

January - June, 1969

Location	Units of 10^{-8} $\mu\text{Ci/ml}$						Average Beta Activity	% of (MPC) _w
	^{90}Sr	^{144}Ce	^{137}Cs	^{108}Ru	^{60}Co	$^{95}\text{Zr-}^{95}\text{Nb}$		
Mi. 23.1 ^a	0.04	0.05	0.08	0.12	0.62	0.05	0.96	0.16
Mi. 20.8 ^b	0.11	< 0.01	0.06	0.07	0.05	0.01	0.65	0.49
Mi. 4.5	0.14	0.04	0.26	0.13	0.63	0.03	1.2	0.52

^a Sampling station moved from Clinch River Mile 41.5 to Melton Hill Dam, CRM 23.1, about January 1, 1966.

^b Values given for this location are calculated values based on levels of waste released and the dilution provided by the river; they do not include amounts of radioactive material (e.g., fallout) that may enter the river upstream from CRM 20.8.

TABLE VIII
URANIUM CONCENTRATION IN THE CLINCH RIVER

January - June, 1969

Sampling Point	Type of Analyses Made	No of Samples ^a	Units of 10 ⁻⁸ μCi/ml			% (MPC) _w
			Maximum ^b	Minimum ^b	Average ^b (MPC) _w	
Downstream from ORGDP	Uranium Concentration	2	< 0.1	< 0.1	< 0.1	< 0.01

^aNormal Sampling Frequency: Continuous, composited over six-month period.

^bNo uranium was detected in Clinch River water samples during this period. Minimum detectable concentration of uranium in river water is 0.1 x 10⁻⁸ μCi/ml.

TABLE IX
EXTERNAL GAMMA RADIATION LEVELS

mR/hr

January - June, 1969

Station Number	Location	Jan.	Feb.	Mar.	Apr.	May	June	Average
1	Kerr Hollow Gate	0.018	0.011	0.014	0.012	0.010	*	0.013
2	Y-12, East Portal	0.011	0.010	0.014	0.012	0.020	*	0.013
3	Newcomb Road, Oak Ridge	0.013	0.011	0.016	0.011	0.015	*	0.011
4	Gallaher Gate	0.014	0.013	0.015	0.013	0.015	*	0.014
5	White Wing Gate	0.012	0.010	0.018	0.013	0.012	*	0.013
	Average	0.014	0.011	0.015	0.012	0.014	*	0.013

Note: These readings were taken with a calibrated Geiger-Müller tube at a distance of three feet above the ground.

The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

*No measurement made.

**UNION
CARBIDE**

INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX P, OAK RIDGE, TENNESSEE 37830

To (Name) **Dr. K. Z. Morgan**

Date **January 13, 1970**

Division

Originating Dept.

Location

Answering letter date

Copy to

**Mr. R. J. Betts
Mr. H. B. Schultz
Mr. P. R. Vanstrum
Health Physics File - RC ✓**

Subject **News Release on Environmental
Surveys**

Attached are data for the semiannual news release, as requested by AEC-ORO, covering environmental surveys made by our plant forces at off-plant locations during the second half of calendar year 1969.



R. C. Jordan

NBS:nh

Attachment

ENVIRONMENTAL RADIOACTIVITY LEVELS
Oak Ridge Gaseous Diffusion Plant

July through December 1969

The results of sampling of our environs of the Oak Ridge Gaseous Diffusion Plant during the second half of 1969 revealed that the amount of uranium in the surface waterways is not significantly different from the normal background values established for this region.

Sampling of the surface waterways adjacent to the plant revealed no instance where the uranium concentration exceeded the maximum permissible concentration specified for water (MPC_w).^{*} The average activity of natural uranium materials in the Clinch River, reflecting the effects of all of the Oak Ridge plants, was less than 0.1% of the MPC_w. Sampling data are shown in the following table:

Environmental Sampling - Local Streams

Location of Point	Type of Analysis	No. of Samples**	Plant Experience	Units of 10 ⁻⁸ μ Ci/cc	
				Maximum Permissible Conc. (MPC _w)	Average Percent MPC _w ⁺
Downstream from ORGDP	Uranium Concentration	2	0.0	2000	< 0.1

* AEC Manual Chapter 0524, Annex 1, Table 2, "Concentrations in Air and Water Above Natural Background."

** Normal Sampling Frequency: Continuous, composited over one quarter.

+ Maximum permissible concentrations for continuous exposure to the general population.

Safety, Health Physics, and
Industrial Hygiene Departments

January 13, 1970



UNION CARBIDE CORPORATION
NUCLEAR DIVISION
P. O. BOX Y, OAK RIDGE, TENNESSEE 37830

March 24, 1970

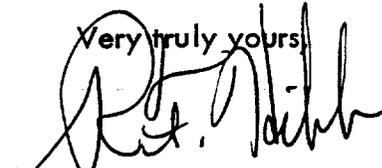
U. S. Atomic Energy Commission
Post Office Box E
Oak Ridge, Tennessee 37830

Attention: Mr. S. R. Sapirie, Manager
Oak Ridge Operations

Gentlemen:

Dissemination to the Public of Data
on Environmental Levels of Radioactivity

As requested, we are enclosing forty copies of the report for the second half of 1969 on Environmental Levels of Radioactivity for the Oak Ridge Area.

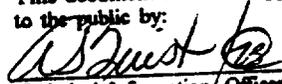
Very truly yours,

R. F. Hibbs
President

RFH:HGM:dg

Enclosures

- cc w/encl.: F. R. Bruce (2)
- D. M. Davis (10)
- J. L. Liverman
- H. G. MacPherson (2)
- K. Z. Morgan
- ~~M.~~ B. Schultz (2)
- P. R. Vanstrum (5)
- Laboratory Records - ORNL (2)

This document has been approved for release to the public by:

 4/18/95
Technical Information Officer Date
Oak Ridge K-25 Site

Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7314
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MARTIN MARIETTA ENERGY SYSTEMS, INC.
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under Contract DE-AC05-84OR21400

ChemRisk Document No. 1454

ENVIRONMENTAL LEVELS OF RADIOACTIVITY
FOR THE OAK RIDGE AREA

(Report for Period July - December, 1969)

Compiled by the

Health Physics and Safety Section

Health Physics Division

OAK RIDGE NATIONAL LABORATORY

Introduction

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are concentrated by evaporation and disposed of in deep wells by the hydrofracture technique. Low level liquid wastes are discharged, after preliminary treatment to surface streams.

Air that may become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by means of scrubbers and filters.

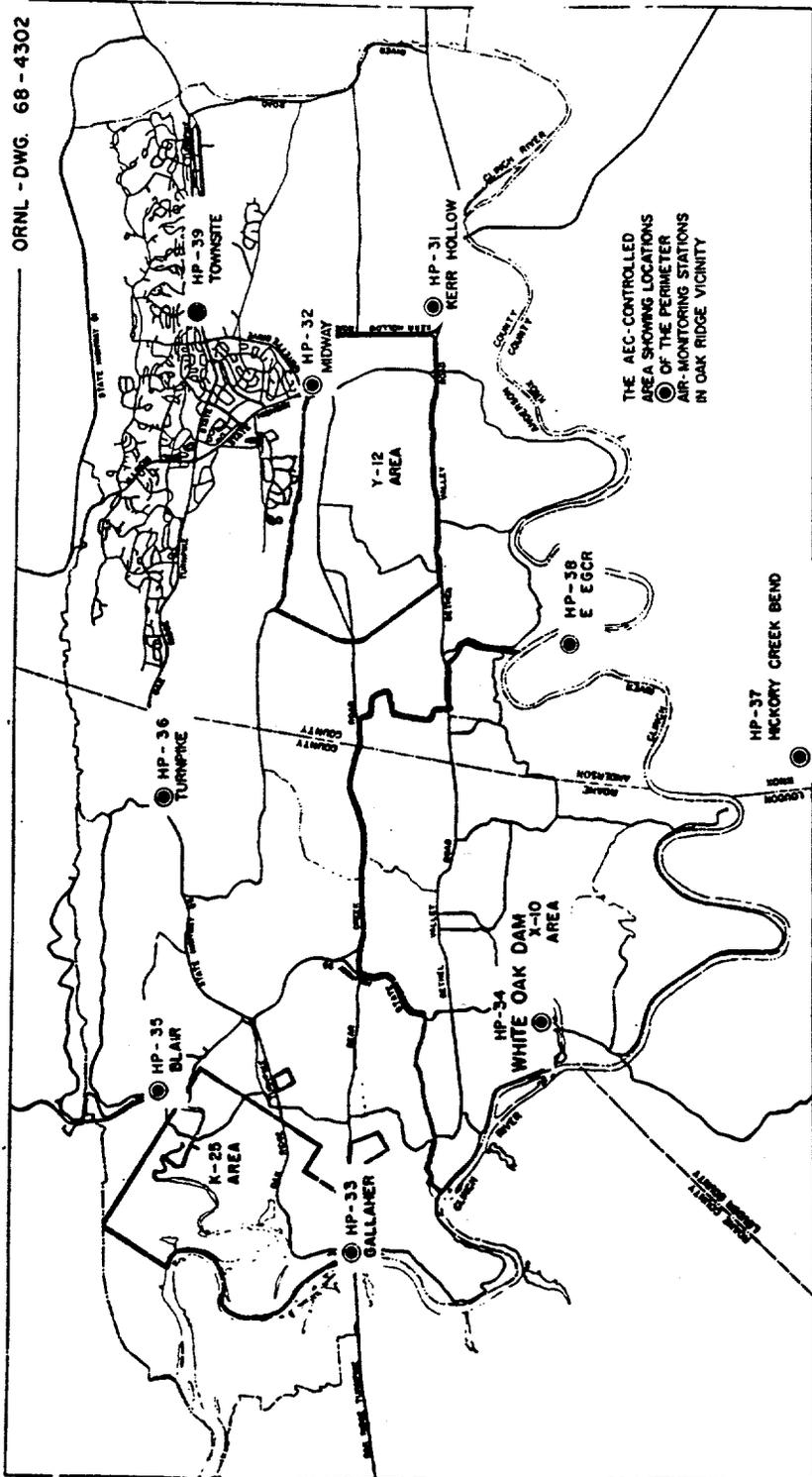
This report presents data on the environmental levels of radioactivity for the Oak Ridge area and compares the data with established maximum permissible concentrations.

Air Monitoring

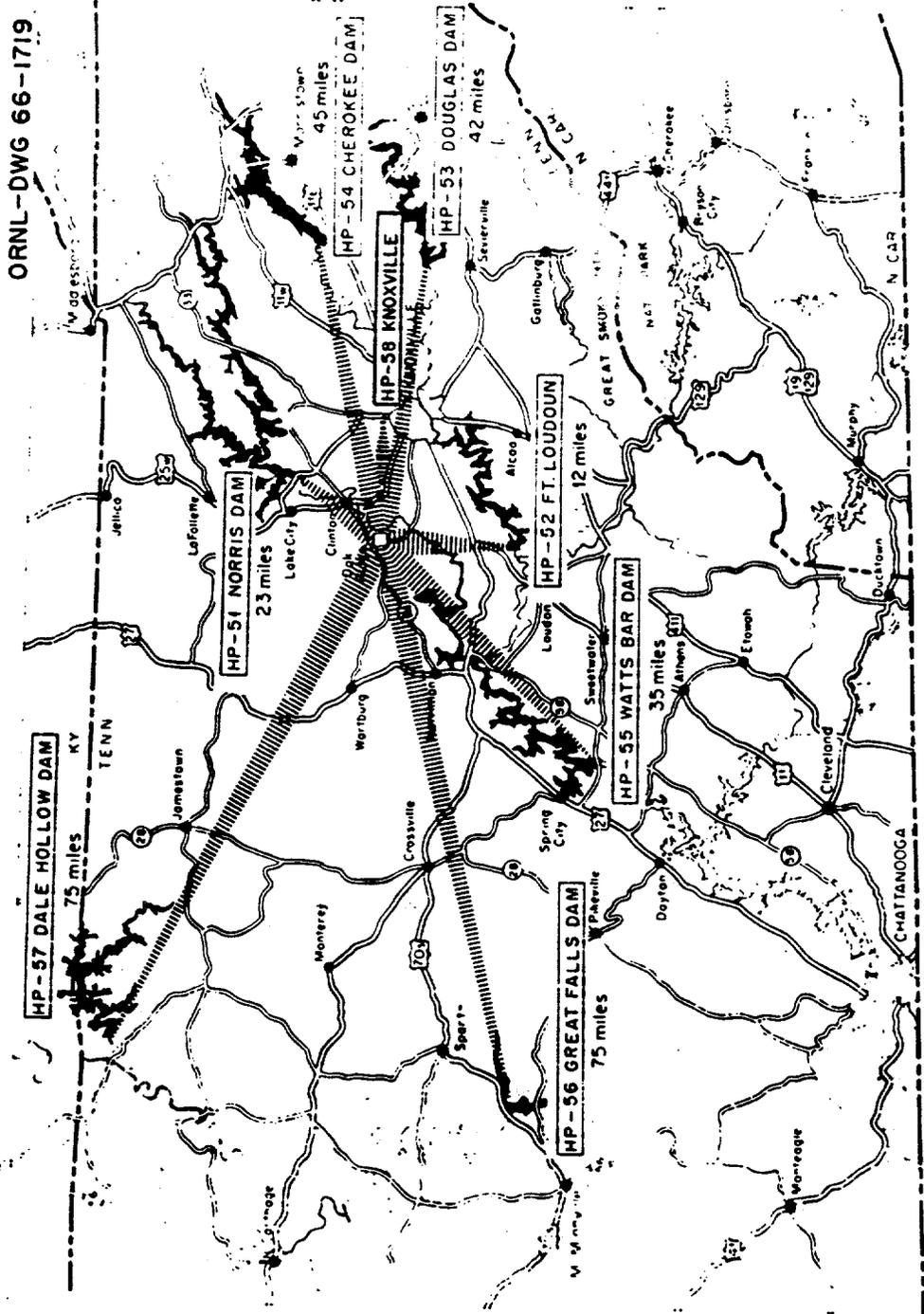
Atmospheric contamination by radioactive materials occurring in the general environment of East Tennessee is monitored by two systems of monitoring stations. One system consists of nine stations which encircle the plant area (Fig. 1) and provides data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of eight stations encircling the Oak Ridge area at distances of from 12 to 75 miles (Fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Sampling for radioactive particulates is carried out by passing air continuously through a filter paper. Airborne radioactive iodine is monitored in the immediate environment of the plant area by passing air through a cartridge containing activated charcoal. Data collected are accumulated, tabulated, and averaged in units of $\mu\text{Ci}/\text{cc}$ of air sampled.

Milk Monitoring

Raw milk is monitored for ^{131}I and ^{90}Sr by the collection and analysis of samples from twelve sampling stations located within a radius of 50 miles of ORNL. Samples are collected weekly at each of eight stations located on the fringe of the Oak Ridge area. Four stations, located more remotely with respect to Oak Ridge Operations, are sampled at a rate of one station each week. The purpose of the



STATION SITES FOR PERIMETER AIR MONITORING SYSTEM
Figure 1



ORNL-DWG 66-1719

STATION SITES FOR REMOTE AIR MONITORING SYSTEM
Figure 2

milk sampling program is two-fold: first, samples collected in the immediate vicinity of the Oak Ridge area provide data by which one may evaluate possible exposure to the neighboring population resulting from waste releases from Oak Ridge Operations; second, samples collected at the more remote stations provide background data which are essential in establishing the proper index for the evaluation of data obtained from local samples.

Water Monitoring

Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, to the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for population groups in uncontrolled areas as specified by AEC Manual, Chapter 0524. The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 3 and 4. Samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously to obtain dilution factors for calculating the probable concentrations of wastes in the river.

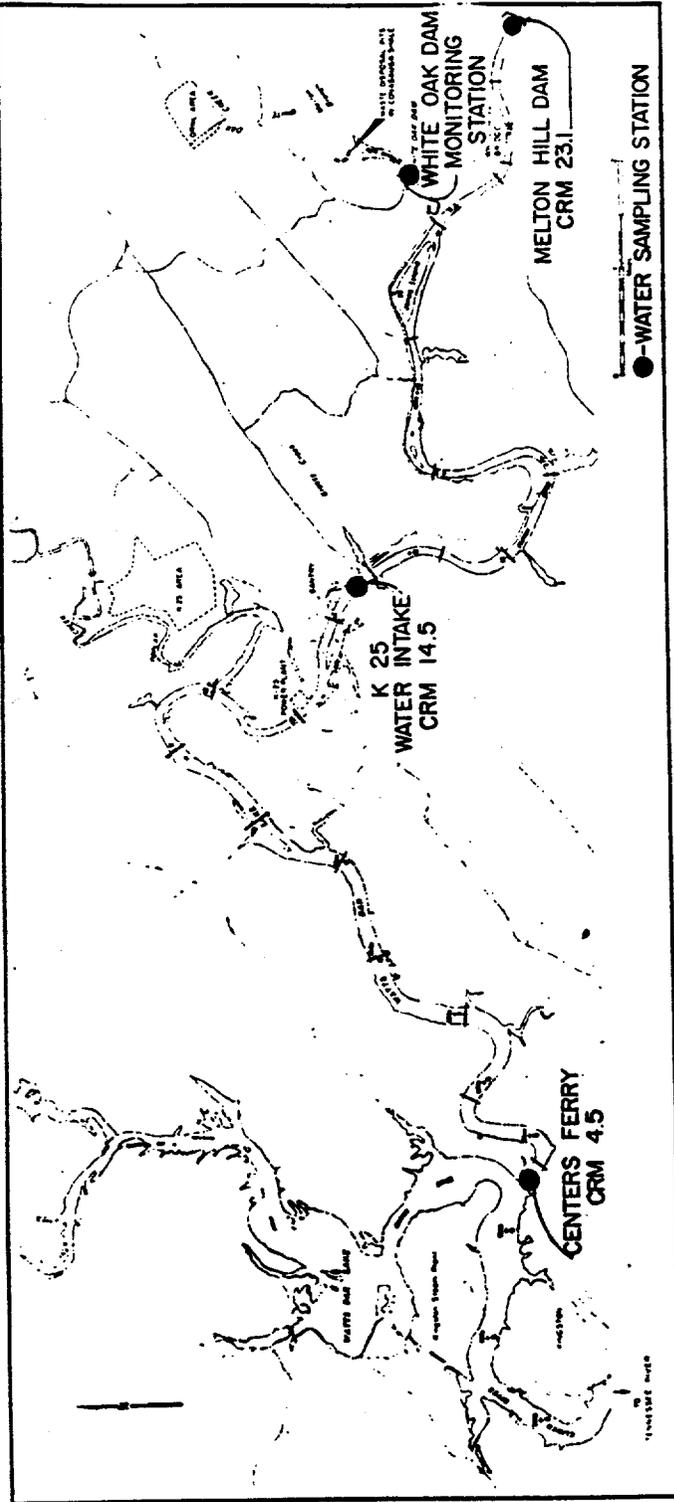
Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic alpha emitters.

The concentrations of those isotopes present in significant amounts are determined by analysis. The concentration of each isotope is compared with its respective MPC value as specified by AEC Manual, Chapter 0524,¹ and the resulting fractions summed to arrive at the % $(MPC)_w$ in the Clinch River.

The concentration of uranium is compared with the specific $(MPC)_w$ value for uranium.

¹AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

ORNL-DWG 66-2216R



WATER SAMPLING LOCATIONS
Figure 3

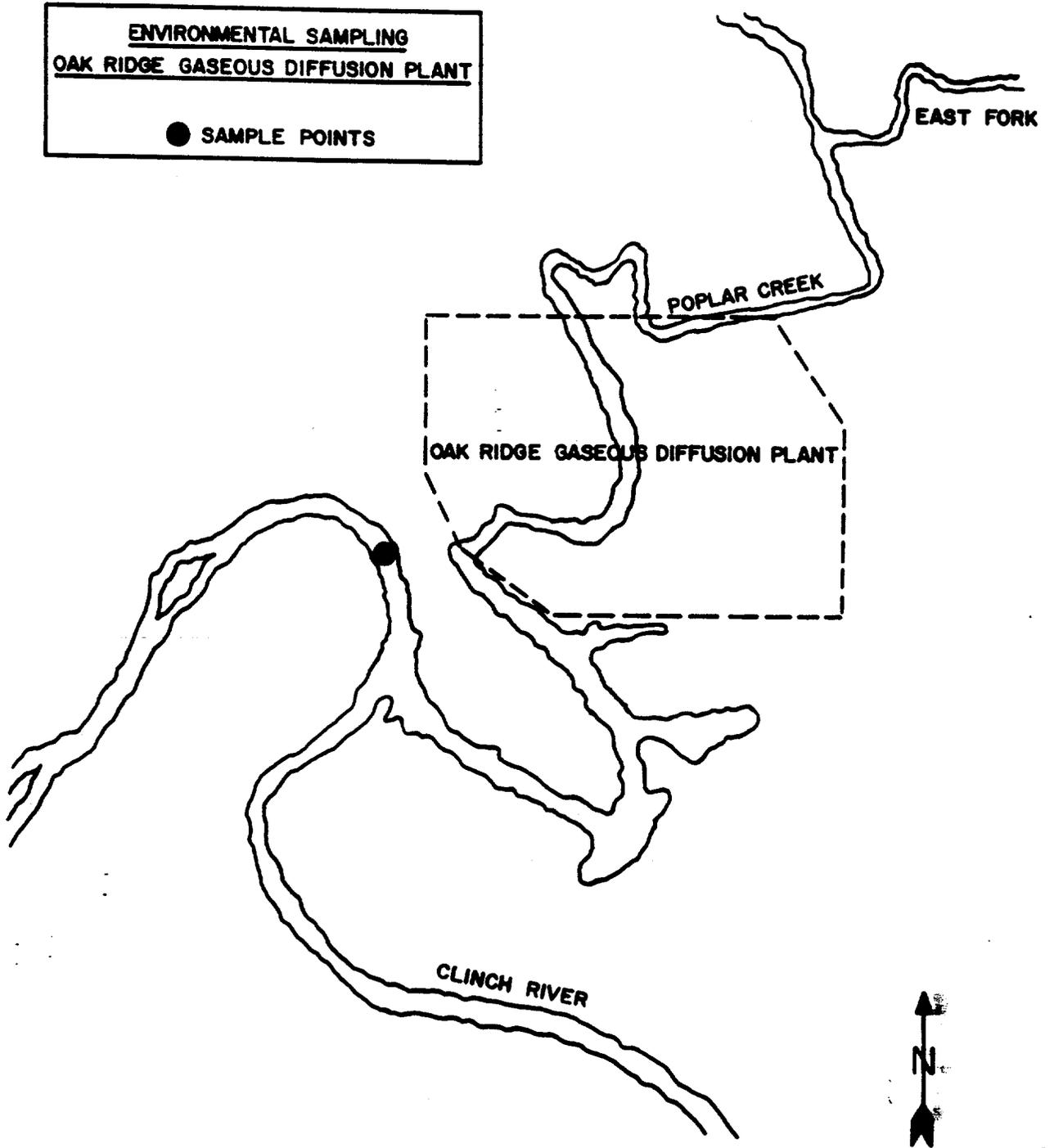


Figure 4

Gamma Measurements

External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge area. Measurements are taken with a Geiger-Müller tube at a distance of three feet above the ground, and the results are tabulated in terms of mR/hr.

Discussion of Data

Data on the environmental levels of radioactivity for the second half of 1969 in the Oak Ridge and surrounding areas are presented in Table I through Table VIII.

The average air contamination level for gross beta activity, as shown by the continuous air monitoring filter data, for both the immediate and remote environs of the plants was 0.16% of the maximum permissible concentration applicable to uncontrolled areas (Table I).

The average air contamination levels for gross alpha activity, as shown by the continuous air monitoring filter data, for the immediate and remote environs of the plants were 0.10% and 0.05%, respectively, of the $(MPC)_a$ for natural uranium for application to uncontrolled areas (Table II).

The average concentration of ^{131}I in air in the immediate environs of the plants was 0.01×10^{-12} $\mu\text{Ci}/\text{cc}$ (Table III). This is approximately 0.01% of the maximum permissible concentration for application to uncontrolled areas.

The average concentrations of ^{131}I in raw milk in the immediate and remote environs of the Oak Ridge area were both less than 10 pCi/l (Table IV). These levels fall within the limits of FRC Range I if one assumes the average intake per individual to be 1 liter of milk per day.

The average concentration of ^{90}Sr in raw milk in both the immediate and remote environs of the controlled area was 15 pCi/l (Table V). The averages fall within the limits of FRC Range I for transient rates of daily intake of ^{90}Sr for application to the average of suitable samples of an exposed population.

The percent maximum permissible concentrations of radioactivity in the Clinch River at Mile 20.8, the point of entry of most of the wastes, and at Mile 4.5, near Kingston, Tennessee, were 0.39% and 0.25%, respectively, of the $(MPC)_w$ for application to uncontrolled areas. The higher than normal concentration of ^{60}Co measured at Mile 23.1 (Table VI) above the ORNL waste outfall was the result of a source of contamination other than Oak Ridge Operations.

The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 1.4×10^{-10} $\mu\text{Ci/ml}$ which is 0.14% of the $(\text{MPC})_w$ value for water containing a mixture of unknown radionuclides.²

The average concentration of natural uranium materials in the Clinch River reflecting the effects of all Oak Ridge plants, was $< 0.1\%$ of the $(\text{MPC})_w$ for uranium (Table VII).

The average external gamma radiation measured in the town of Oak Ridge and at the perimeter of the Oak Ridge area was 0.012 mR/hr (Table VIII), which is approximately the same as the level measured in the early period prior to Oak Ridge Operations.

Conclusion

Surveillance of the radioactivity in the Oak Ridge environs indicated that the radioactivity levels were not significantly different from other areas of East Tennessee. Only very low level radioactivity is being released to the environment from plant operations and the resulting concentrations in both the atmosphere and surface streams of the Oak Ridge environment are well below established maximum permissible concentrations and intake guides for the neighboring population.

² $(\text{MPC})_w$ is taken to be 1×10^{-7} $\mu\text{Ci/ml}$ as specified by AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

TABLE I
CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Beta Activity of
Particulates in Air

July - December, 1969

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	25	4.3	0.32	1.6	0.16
HP-32	Midway Gate	26	5.3	0.25	1.9	0.19
HP-33	Gallaher Gate	26	3.5	< 0.01	1.2	0.12
HP-34	White Oak Dam	26	4.3	0.38	1.4	0.14
HP-35	Blair Gate	26	4.4	0.42	1.6	0.16
HP-36	Turnpike Gate	119 ^d	4.3	0.19	1.8	0.18
HP-37	Hickory Creek Bend	26	3.9	0.07	1.6	0.16
HP-38	East of EGCR	26	4.3	0.35	1.6	0.16
HP-39	Townsite	26	5.7	0.40	1.9	0.19
Average			4.4	0.27	1.6	0.16
<u>Remote Stations</u>						
HP-51	Norris Dam	26	4.2	0.47	1.6	0.16
HP-52	Loudoun Dam	25	5.0	0.35	1.7	0.17
HP-53	Douglas Dam	26	4.9	0.08	1.6	0.16
HP-54	Cherokee Dam	25	4.2	0.35	1.5	0.15
HP-55	Watts-Bar Dam	25	3.2	0.13	1.1	0.11
HP-56	Great Falls Dam	26	5.5	0.21	1.7	0.17
HP-57	Dale Hollow Dam	26	4.6	0.38	1.6	0.16
HP-58	Knoxville	23	4.9	0.30	1.9	0.19
Average			4.6	0.28	1.6	0.16

^aMaximum weekly average concentration.

^bMinimum weekly average concentration.

^c(MPC)_a is taken to be 10^{-10} $\mu\text{Ci}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1 Table II.

^dSamples collected five days per week beginning 9/20/68.

TABLE II
 CONTINUOUS AIR MONITORING DATA
 Long-Lived Gross Alpha Activity of
 Particulates in Air

July - December, 1969

Station Number	Location	Number of Samples Taken	Units of 10^{-13} $\mu\text{Ci}/\text{cc}$			% (MPC) ^c
			Maximum ^a	Minimum ^b	Average	
<u>Perimeter Stations</u>						
HP-31	Kerr Hollow Gate	25	0.06	< 0.01	0.02	0.10
HP-32	Midway Gate	26	0.08	< 0.01	0.02	0.10
HP-33	Gallaher Gate	26	0.05	< 0.01	0.02	0.10
HP-34	White Oak Dam	26	0.03	< 0.01	0.01	0.05
HP-35	Blair Gate	26	0.08	< 0.01	0.02	0.10
HP-36	Turnpike Gate	119 ^d	0.25	< 0.01	0.05	0.25
HP-37	Hickory Creek Bend	26	0.05	< 0.01	0.02	0.10
HP-38	East of EGCR	26	0.03	< 0.01	0.01	0.05
HP-39	Townsite	26	0.08	< 0.01	0.02	0.10
Average			0.08	< 0.01	0.02	0.10
<u>Remote Stations</u>						
HP-51	Norris Dam	26	0.03	< 0.01	0.01	0.05
HP-52	Loudoun Dam	25	0.05	< 0.01	0.02	0.10
HP-53	Douglas Dam	26	0.04	< 0.01	0.01	0.05
HP-54	Cherokee Dam	25	0.04	< 0.01	0.01	0.05
HP-55	Watts Bar Dam	25	0.03	< 0.01	0.01	0.05
HP-56	Great Falls Dam	26	0.04	< 0.01	0.01	0.05
HP-57	Dale Hollow Dam	26	0.04	< 0.01	0.01	0.05
HP-58	Knoxville	24	0.06	< 0.01	0.02	0.10
Average			0.04	< 0.01	0.01	0.05

^a Maximum weekly average concentration.

^b Minimum weekly average concentration.

^c (MPC)_a used is 20×10^{-13} $\mu\text{Ci}/\text{cc}$, the MPC for natural uranium as specified in AEC Manual, Chapter 0 Appendix, Annex 1, Table II.

TABLE III
 CONCENTRATION OF ^{131}I IN AIR
 AS MEASURED BY THE PERIMETER AIR MONITORING STATIONS

July - December, 1969

Number of Samples	Units of 10^{-12} $\mu\text{Ci}/\text{cc}$			% (MPC) _a ^b
	Maximum	Minimum ^a	Average	
233	0.15	< 0.01	0.01	0.01

^a Minimum detectable amount of ^{131}I is 20 d/m. At the average sampling rate used, this corresponds to approximately 0.010×10^{-12} $\mu\text{Ci}/\text{cc}$. In averaging, one-half of this value, 10 d/m, is used for all samples showing a total amount of ^{131}I less than 20 d/m.

^b (MPC)_a is taken to be 1×10^{-10} $\mu\text{Ci}/\text{cc}$ as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

TABLE IV
CONCENTRATION OF ^{131}I IN RAW MILK

July - December, 1969

Location	pCi/l		
	Maximum	Minimum ^a	Average
Immediate Environs	48	< 10	< 10
Remote Environs	< 10	< 10	< 10

^a Minimum detectable concentration of ^{131}I is 10 pCi/l.

TABLE V
CONCENTRATION OF ^{90}Sr IN RAW MILK

July - December, 1969

Location	pCi/l		
	Maximum	Minimum ^a	Average
Immediate Environs	32	2.0	15
Remote Environs	22	5.4	15

^a Minimum detectable concentration of ^{90}Sr in milk is 2 pCi/l. In averaging, one-half of this value, 1 pCi/l, was used for all samples showing a concentration less than 2 pCi/l.

TABLE VI
RADIOACTIVITY IN THE CLINCH RIVER

July - December, 1969

Location	Concentration of Radionuclides of Primary Concern Units of 10^{-8} $\mu\text{Ci}/\text{ml}$							% of (MPC) _w
	^{90}Sr	^{144}Ce	^{137}Cs	$^{103-106}\text{Ru}$	^{60}Co	$^{95}\text{Zr-}^{95}\text{Nb}$	^3H	
CRM 23.1 ^a	0.13	0.02	0.14	0.04	0.15	0.03	*	0.45
CRM 20.8 ^b	0.08	<0.01	0.02	0.03	0.01	<0.01	174	0.39
CRM 4.5 ^a	0.07	<0.01	0.12	0.15	0.07	0.05	*	0.25

^a Measured values.

^b Values given for this location are calculated values based on the concentrations of waste released from White Oak Dam and the dilution afforded by the Clinch River. They do not include radioactive materials (e.g., fallout) that may enter the river upstream from CRM 20.8.

* No analysis.

TABLE VII
URANIUM CONCENTRATION IN THE CLINCH RIVER

July - December, 1969

Sampling Point	Type of Analyses Made	No. of Samples ^a	Units of 10^{-8} $\mu\text{Ci/ml}$			% (MPC) _w
			Maximum ^b	Minimum ^b	Average ^b (MPC) _w	
Downstream from ORGDP	Uranium Concentration	2	< 0.1	< 0.1	< 0.1	< 0.1

^aNormal Sampling Frequency: Continuous, composited over six-month period.

^bNo uranium was detected in Clinch River water samples during this period. Minimum detectable concentration of uranium in river water is 0.1×10^{-8} $\mu\text{Ci/ml}$.

TABLE VIII
EXTERNAL GAMMA RADIATION LEVELS
mR/hr

July - December, 1969

Station Number	Location	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1	Kerr Hollow Gate	*	0.012	0.012	0.010	0.012	0.013	0.012
2	Y-12, East Portal	*	0.011	0.013	0.011	*	0.018	0.013
3	Newcomb Road, Oak Ridge	*	0.011	0.012	0.011	*	0.012	0.012
4	Gallaher Gate	*	0.011	0.010	0.014	0.019	0.014	0.014
5	White Wing Gate	*	0.011	0.011	0.010	0.011	0.011	0.011
Average			0.011	0.012	0.011	0.014	0.014	0.012

Note: These readings were taken with a calibrated Geiger-Müller tube at a distance of three feet above the ground.

The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

*No measurement made.