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ABSTRACT

RHTG # 40857
BOX #

The project covered by this report was instituted by
AFOAT-1 as an endeavor to (1) compare a group of laboratory in-
struments as airborne detectors of radioactivity and (2) simultan-
eously obtain data relative to the diffusion rate of radioactive
contamination emitted into the atmosphere from off-gas stacks of
production runs. Research was conducted in the Oak Ridge, Tennessee
and Hanford, Washington areas. Detection was accomplished at a
maximum distance of seventeen miles from the plant. Very little
information of a conclusive nature was gained concerning the dif-
fusion. Further research with the nuclear instruments, using a
stronger source, is recommended. To obtain conclusive information
concerning the meteorological aspects of the project, a larger
observational program will be needed..

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ORNL-341

SOURCES OF RADIOACTIVITY FOR PROJECT PURPOSES

OAK RIDGE

During project operations at Oak Ridge, two sources of radioactivity in gaseous form and one of particulate matter were available.

Most readily available as a source, was the pile which was shut down only for a few hours occasionally. This pile is air-cooled by two Buffalo Forge special fans with an air-flow of about 90,000 cu ft per min. After blowing through the pile, this air is jetted into the atmosphere through a 200 ft. stack. Contamination carried into the atmosphere in this manner is mostly Argon⁴¹ with a strength of 500 curies per day. The cooling air is processed through a cyclone separator to remove any large particulate matter that it may have picked up on its passage through the pile, and then through a filter house containing 1" PG-50 filter media and CWS #6 filter paper.

Another source of radioactive contamination in the Oak Ridge vicinity is the dissolving step of the Chemical Separation process. Here, irradiated slugs from the pile are dissolved in a HNO₃ solution. Activity produced reaches a maximum about one

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p. 43-14

~~SECRET~~

ORNL-341

hour after the dissolving begins, decreases to one-third during the second hour, and diminishes to zero at the end of approximately eight hours.

150 lbs. of slugs aged for 5 days after extraction from the pile, are dissolved in each operation. The following radioactive gases are released in the indicated quantity for each operation:

- Xenon¹³³ 2500 curies
- Iodine¹³¹ 1300 curies
- Krypton⁸⁵ Less than one curie

An effort is made to remove the Iodine¹³¹ with scrubbers and filters before the off-gases are released to the stack. The efficiency of this filtering is not known, but the activity from iodine leaving the stack is much less than the 1300 curies originally released.

+ plating on surfaces

An additional source of radioactive particles at Oak Ridge is in Evaporation stage of the Chemical Separation. This process has an incorporated filter system but some particulate matter escapes in an undetermined manner.

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p. 43-15

HANFORD

Only one type of source was available at Hanford Works. This was the Chemical Separation process, taking place in two separate plants at very frequent intervals. Dissolving sometimes occurs simultaneously in both plants as was the case on one of the days of project operation. Even though the number of slugs being dissolved is much greater than at Oak Ridge, they have been aged for a longer period and hence give the lower output of Xenon and Iodine as shown by the following chart:

For one Dissolving process, duration six to eight hours these gases were emitted:

Xenon ¹³³	0.3 curies
Iodine ¹³¹	10 to 20 curies
Krypton ⁸⁵	90 curies

Here again an effort is made to remove the Iodine from the off-gases with a sand trap filter.

The Hanford piles offer no source for detection purposes with methods used on this project. They are water-cooled and the water is returned to the Columbia River where it is diluted to a strength of about 2% of its contamination acquired in passing through the pile.

As a comparison between the two plants, the following summary is offered:

	Oak Ridge	Hanford
Pile out-put	500 curies/day Mostly Argon ⁴¹	None
Dissolver out-put for	5 day slugs	100 day slugs
Xenon ¹³³	2500 curies/per operation	0.3 curies per operation
Iodine ¹³¹	1300 curies/ per operation	10 to 20 curies/ per operation
Krypton ⁸⁵	less than 1 curie per operation	90 curies per operation

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ORNL-341

PART II

METEOROLOGICAL INFLUENCE
ON
AIRBORNE RADIOACTIVE CONTAMINATION

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ORNL-341

I. Introduction:

On 17 November 1948 flight operations were begun in the Oak Ridge area in order to make comparison tests of airborne detection instruments. These flights were without precedent, and there was no previous knowledge on which to estimate the success with which airborne instruments might respond to the radioactive gases released during routine manufacturing operations at an atomic plant. Nevertheless, in planning for these first flights it was recognized that some meteorological assistance would be required for successful completion of the project. For this reason, Lt. Robert Kane, a meteorologist, was assigned as co-pilot aboard the project aircraft. Also, the U.S. Weather Bureau representative with the AEC Administration at Oak Ridge, Mr. Joshua Holland, was informed of the meteorological nature of the project and by means of an informal arrangement was asked to assist the project personnel whenever possible. As the object of the first flights was simply to fly into the radioactive gases emitted from stacks at X-10 in order that the responses of the instruments might be noted, it was thought that the meteorological requirements of the project were adequately taken care of. Later, as the project progressed, the meteorological program was considerably amplified so that the relationship between meteorological

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1108361

p. 4388

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ORNL-341

conditions and the concentration of radioactive materials might be studied. The growth of the meteorological phase of the project is discussed below.

During these first flights only the cooling air from the pile, essentially all argon, was available as a source of radioactivity. Because of the short half-life of the radioactive argon (110 minutes) it was not expected that it would be detectable beyond a few miles. To actuate the instruments, flights were made within sight of and directly over the stacks. The instrument records obtained on the four flights prior to 2 December 1948 merely showed efforts to adjust different components of the instruments and were of no permanent value. Actually, the first three flights were conducted just outside of the Oak Ridge prohibited area because permission had not yet been granted for the aircraft to fly over this controlled zone.

On 2 December, members of Headquarters USAF (AFOAT-1) visited the project and were passengers aboard the project airplane during a demonstration flight over the X-10 area. This flight showed that the instruments being tested were responding successfully and that further work with the instruments was justified. After the flight, an informal

1108362

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p-43-89

~~SECRET~~

ORNL-341

conference was held at which it was decided that a more extensive use should be made of meteorological techniques in flight planning and that the data collected during the instrument tests be used for furthering the study of the diffusion processes in the atmosphere. This decision was in part influenced by consultation with Weather Bureau representative at Oak Ridge. For this greater meteorological effort, AFOAT-1 authorized project No. W/58/N/WB on 22 December. The responsibility for this project was assigned to the U.S. Weather Bureau, and Paul Humphrey of the Special Scientific Services Division of the U.S. Weather Bureau was designated as a second meteorologist to the project. Mr. Humphrey was to report to Oak Ridge prior to 1 January 1949, the date when a dissolving operation was tentatively scheduled. In order to begin planning for this operation, he reported on 28 December; however, the dissolving was postponed until 11 January 1949.

Meteorological work associated with this project may be divided for the purpose of discussion into three different phases. The first phase consisted of work done at Oak Ridge with respect to the flights from 17 November through 31 December 1948 when initial adjustments were being made on the instruments.

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1108363

p.43.90

ORNL Graphite 120 ft
200 ft stack 11/1968

500 Ci/day Ar⁴ 110 m³

Chemical Separators

5.2 hr X 132 2500 Ci

8.0 hr X 131 1300 Ci

4.9 hr X 85 < 1 Ci

most in 1st 2 hrs

2 hrs

8.0 hr

I-filtered < 1300 Ci -
the sand

13.8

11.0 hr
10-20 Ci I¹³¹
0.3 X¹³²
90 K⁸⁵

Harford Filter = covered
later to

ORNL 200 ft 1961
200 m³

1961

Kap/30
14 miles down
17 miles wide
no description of
radiation detector

Hanford
Activity was
less than other days

Beaufort

4000 Ci 7×10^{13}
7900 Ci 1.37×10^{13}
X 2 or 3

~~4000~~
4000 X

$X = 1 \times 10^{-3}$
 $I = 1 \times 10^{-10} \quad 4 \times 10^{-9}$