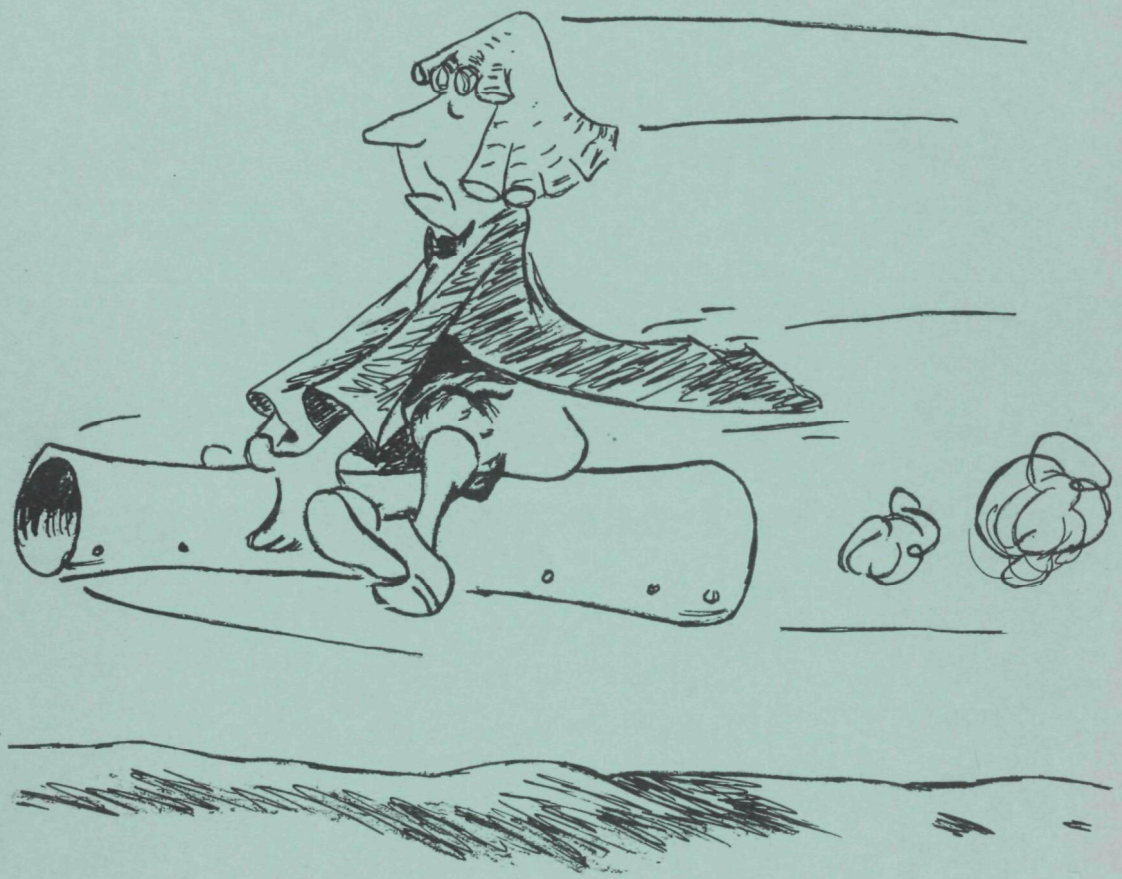
SWRHL-10r

FINAL REPORT OF OFF-SITE SURVEILLANCE FOR THE TORY II-C TESTS

by the
Southwestern Radiological Health Laboratory

for the
Atomic Energy Commission



September 1, 1964

Public Health Service

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FINAL REPORT OF OFF-SITE SURVEILLANCE FOR THE TORY II-C TESTS

by the
Off-Site Radiological Safety Program
Southwestern Radiological Health Laboratory
Las Vegas, Nevada

for
Operational Safety Division
Nevada Operations Office
Atomic Energy Commission

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O. R. Placak, Officer in Charge
SWRHL, Las Vegas, Nevada

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Department of Health, Education, and Welfare
Public Health Service

ABSTRACT

The Public Health Service provided off-site surveillance in support of the TORY II-C reactor tests conducted on May 12 and May 20, 1964. This support consisted of tracking the effluent, monitoring radiation dosage to the off-site population, and collecting environmental samples. The data collected indicate that no hazard to the off-site population was created as a result of the TORY tests.

TORY II-C TESTS

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I. INTRODUCTION

On May 12 and May 20, 1964, the TORY II-C nuclear reactor was tested at the Nevada Test Site at a location approximately 7.7 miles southwest of CP-1. The May 12 test, conducted at 1315 hours PDT, was an intermediate power test (sixty per cent of design power). The May 20 test was a full power test conducted at 1350 hours PDT. The reactor was tested in a position such that the exhaust and escaping fission products were directed toward the north. The two tests resulted in the release of fission products which were detected in off-site areas.

Under a Memorandum of Understanding between the U.S. Atomic Energy Commission (AEC) and the U.S. Public Health Service (PHS) the Off-Site Radiological Safety Organization was established in 1954 to conduct radiological surveillance of the area within a 300-mile radius surrounding the Commission's Nevada Test Site. A Commissioned Officer of the Public Health Service was designated by the AEC as Off-Site Radiological Safety Officer, and was responsible to the Test Manager for directing the surveillance activities.

Since that time, the PHS has established in Las Vegas, Nevada, its Southwestern Radiological Health Laboratory (SWRHL). The off-site surveillance of nuclear testing conducted by the Nevada Test Site Organization at the Nevada Test Site has become one of the Laboratory's regular operational programs, and the Officer in Charge of the Laboratory serves as Off-Site Radiological Safety Officer to the Operational Safety Division, AEC-Nevada Operations Office.

The Off-Site Radiological Safety Program of SWRHL conducts its present program of radiation monitoring and environmental sampling in the off-site area surrounding the restricted area enclosed by the Nevada Test Site (NTS) and the Nellis Air Force Range. The NTS and Nellis Air Force Range complex includes the NTS proper, the Nuclear Rocket Development Station (NRDS), the Tonopah Test Range (TTR), and the Nellis Air Force Range proper and for simplicity will be called the test range complex throughout the remainder of this report.

Since Public Health Service monitors must begin tracking and monitoring an effluent cloud close to its point of origin, measurements are made within the test range complex, but are used only as a guide to trajectory determination, or for purposes of checking instrumentation and methodology. They do not serve as parameters in determining dose to people or contamination of property in the off-site area, and are not a subject of this report.

II. OPERATIONAL PROCEDURES

A. EXTERNAL MEASUREMENTS

Ground Monitors

Ten ground monitors tracked the reactor effluent from both tests with portable instruments. Each monitor was equipped with the following radiation monitoring instruments: an Eberline E-500B, a Precision Model 111 Standard "Scintillator", a Beckman MX-5, and a Tracerlab AN/PDR T1B.

The Eberline E-500B has a range of 0 - 200 milliroentgens per hour (mr/hr) gamma and beta-gamma detection in four scales with an external halogen filled G M tube and a 0 - 2000 mr/hr range from an internal Anton 302 tube. The Precision Model 111 "Scintillator" is used primarily for low level detection and provides for a range of 0 - 5 mr/hr in six scales. The Beckman MX-5 instrument has a range of 0 - 20 mr/hr in three scales. It is equipped with an external Geiger tube with a slide-open beta shield. The Tracerlab AN/PDR T1B has a range of 0 to 50,000 mr/hr in five scales. This instrument employs an air ionization chamber detector. These instruments are accurate to $\pm$20%, and readings can be taken to two significant figures.

Remote Dose Rate Recorders

Eberline RM-11 dose rate recorders were placed at sixteen sta tions around the test range complex. These recorders utilize a Geiger tube detector to document radiation levels at specific locations. The instrument operates on 110V AC and has a 0.01 - 100 mr/hr range.

Gamma dose rate is recorded on a 30-hour strip chart. The instrument is accurate to ±20%. The locations of dose rate recorders are presented in Figure 1.

Aircraft Cloud Tracking

An Air Force U3-A aircraft manned by two Public Health Service monitors equipped with portable instruments identical to those of the ground monitors tracked the reactor effluent from both tests, and served to position ground monitors.

Film Badges

The PHS maintains 65 film badge stations off the test range complex and assigns badges to 166 off-site residents. The badge used is made up of Dupont type 555 film. Dose, as determined from this film, is accurate to ±50% in the 20 - 100 mr range and ±10% in the 100 to 2000 mr range.

B. ENVIRONMENTAL MEASUREMENTS

The PHS maintains routine air, milk, and water sampling stations off the test range complex and analyzes the samples on a regular basis. Only air samples were analyzed specifically for the TORY tests because of the overlapping sampling program for the KIWI test. The locations of sampling stations are shown in Figure 1.

On the test days, the PHS maintained General Metal Works high volume air samplers containing glass fiber prefilters and MSA* charcoal filters at off-site locations. These are air sampling stations that are operated under the routine surveillance program of SWRHL. All air sample prefilters collected following the TORY reactor tests were

*Mine Safety Appliance Company

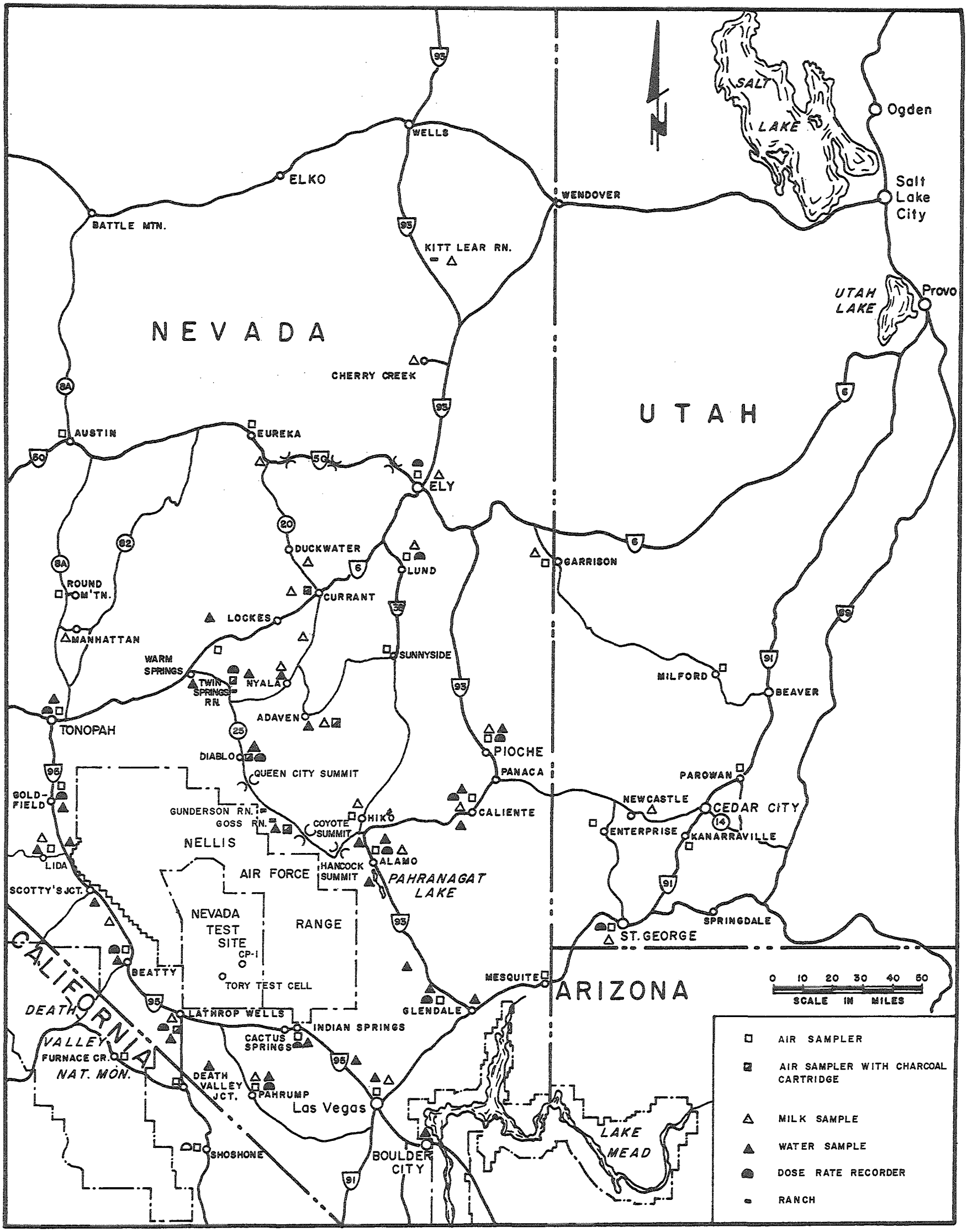

Figure 1. Environmental sampling locations.

returned to Las Vegas and counted for gross beta activity with a thin window, large area gas flow proportional probe connected to a high speed scaler. The system is designed to count the 8"x 10" glass fiber filter and has an efficiency of approximately 30% for 1.5 mev betas. The system background is 575 $\pm$20 counts per minute.

All samples were counted as soon as possible after collection, and activity levels were computed at the time of count for the purpose of screening samples and delineating the cloud pattern. These samples were then stored for five days to allow natural activity to decay. They were recounted at this time and again seven days later. Activity levels were then recomputed to end of sample collection from these two later counts. The air samples exhibiting levels of activity significantly above natural background were recounted frequently to obtain a decay curve. The curve obtained was then analyzed for best fit to the general equation $y=ax^b$. Based on an analysis of decay curves, a $T^{-1.25}$ relationship was found to exist with a mean error of $\pm$5%. This relationship was then used to correct the filters with high activity to end of collection.

All charcoal cartridges were analyzed for gamma isotopes by placing each cartridge directly on a 4"x 4" sodium iodide crystal coupled to a 400-channel gamma pulse height analyzer set to view energies from 0 to 2 mev. Assuming no break in the prefilter, the activity on the cartridge should represent the volatile or gaseous fission products such as isotopes of iodine. Overall detection efficiency for this geometry is about 18% at 0.53mev. The minimum detectable activity for I^{131}, I^{132}, I^{133}, and I^{135} is taken to be 200 picocuries total (each isotope) on the cartridge, $\pm$50% for I^{131}, I^{132} and I^{133} and $\pm$100% for I^{135}. The time of count is taken to be 10 minutes. Error estimates are such that values

less than 1 picocurie per cubic meter (pc/M^3) of air collected are generally not reported. Since it is not possible to define duration of cloud passage at all locations, the reported values given as pc/M^3 assume an average concentration over each entire sampling period.

III. RESULTS

A. THE TORY II-C INTERMEDIATE POWER RUN

Only one indication of activity off the test range complex was found on May 12. This was a ground monitor's report of 0.02 mr/hr net gamma at 1617 hours PDT, at the junction of Valley Road and State Highway 25. Readings above background at this location were detected in the time interval 1600 1645 hours PDT. A vegetation sample collected from Gunderson's Ranch at 1700 hours PDT on May 12 indicated no residual activity. Gunderson's Ranch is located seven miles west northwest of the Highway 25-Valley Road intersection.

B. THE TORY II-C FULL POWER RUN

The full power run yielded detectable radioactivity off the NTS.

Ground Monitor Data

Gamma dose rates were detected at two locations off the test range complex. A summary of the monitoring is presented in Table 1.

Table 1. Dose rates off the test range complex on May 20, 1964.

LOCATION Azimuth & Distance from CP-1	Time Interval of Readings Greater than Background (hrs. PDT)	Time of Peak Dose Rate (PDT)	Net Peak Dose Rate (mr/hr)
Goss Ranch 14°, 46 mi.	1630 - 1652	1939	0.05
Queen City Summit 5°, 52 mi. (Unpopulated)	1640 - 1700	1655	<0.05

Monitors assigned to Coyote and Hancock Summits, Adaven, and Sunnyside detected no radioactivity above background levels.

Dose Rate Recorder Data

Dose rate recorders around the test range complex did not record activity above background following the May 20 test.

Film Badge Data

Stationary and personnel film badges that were exposed off the test range complex during May indicated no exposure that could be associated with the TORY tests. All film badges collected north of the test range complex indicated no result above the threshold exposure (20 mr).

Air Sample Data

Three of the samples taken off the test range complex contained fresh fission products. I^{133} was the only isotope detected. Analyses of the prefilters and charcoal filters are presented in Table 2.

Milk Sample Data

A milk sampling program was initiated following the KIWI B4D full power test (May 13, 1964). Twenty-five of the samples in this program were taken following the May 20 TORY test. Although the presence of I^{131} was detected in several samples taken following May 20, the contribution, if any, from the TORY test was indistinguishable from the KIWI test. Comparison of air sampling results and effluent trajectories of the KIWI and the TORY tests tends to substantiate the conclusion that milk contamination was a result of the KIWI test. These data are presented in SWRHL-7r, "Final Report of Off-Site Surveillance for the KIWI B4D Experiment".

Table 2. Results of air samples collected following the TORY II-C full power test, May 20, 1964, in pc/M^3 at end of sample collection.

LOCATION*	Date-Time On Hours (PDT)	Date-Time Off Hours (PDT)	8"x 10" Prefilter Gross Beta	Gamma Pulse Height Analysis - Charcoal Cartridge I^{133}
Goss Ranch	5/20-1530	5/20-1713	1000	6.9
Adaven	5/20-1745	5/21-1000	2.3	<1
Sunnyside	5/20-1621	5/21-1020	8.8	<1

*See Figure 1.

IV. CONCLUSIONS

The TORY II-C intermediate and full power tests yielded detectable radioactivity to the off-site area. The presence of minute amounts (<1 pc/M^3) of I^{133} in the air at Adaven and Sunnyside following the May 20 test was the only indication of radioactivity north of Highway 25 from either test. No off-site personnel were subjected to levels of radioactivity approaching the AEC off-site safety guides as reference criteria*.

*Standard Operating Procedures AEC-NTO "Operational Guide - Radiation Exposure" NTSO-0524-054.

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