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A summary of exposures to the Off-Site Population as a result of nuclear tests conducted at the Nuclear Rocket Development Station during 1965.

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SUMMARY

A summary of whole body and thyroid exposures resulting from five nuclear reactor experiments conducted at NRDS during 1965 is presented. The exposures are compared with protection standards and it is shown that the exposures are small compared to the standards.

During 1965 five releases of radioactivity from NRDS were detected in the off-site area. The releases resulted from the Kiwi TNT experiment, Experimental Plans 4, 5, and 6 of the NRX-A3, and Experimental Plan 4 of Phoebus 1-A. A summary of exposures from the tests is presented in the following tables; additional information may be found in the surveillance reports^{1, 2, 3} on each test. For convenience a summary of data pertinent to the surveillance is presented in Table 1.

Table 1 Reactor Test Data

TEST	DATE TIME	Nominal operating power megawatts
KIWI TNT	1/12/65 1058 PST	Transient
NRX-A3, EP4	4/23/65 1254-1258 PST	1100
NRX-A3, EP5	5/20/65 1032-1046 PDT	1100
NRX-A3, EP6	5/28/65 1030-1100 PDT	<500
PHOEBUS 1-A, EP4	6/25/65 1315-1326 PDT	1100

Whole Body Exposure

Monitors equipped with survey instruments obtained dose rates due to cloud passage. From a plot of dose rate vs time one may estimate the dose due to cloud passage. In addition, an estimate of the infinite external dose has been made by assuming a dose rate decay from a residual dose rate following cloud passage. A summary of the peak exposures at populated locations is presented in Table 2. The infinite doses following EP4 and EP5 are given as zero; any actual deviation from this is very small.

Table 2. Summary of whole body exposures resulting from 1965 NRDS testing.

Event	Location of peak dose (See Figure 1)	External whole body gamma exposure in milliroentgens		
		Due to cloud passage	Due to Fallout	Total Exposure
KIWI TNT	Death Valley Jct.	.23	.44	.67
	Hwy 95, 1.5 mi W of Lathrop Wells (unpopulated)	5.7	8.5	14
NRX-A3, EP4	Pahrump	<.03	0	<.03
NRX-A3, EP5	Goss Ranch	<.03	0	<.03
NRX-A3, EP6	No measurable dose rates off the test range complex.			
PHOEBUS 1-A	Diablo	.04	1.2	1.2

Thyroid dose due to inhalation

Concentrations of iodine in air were detected following each experiment. A summary of the peak concentrations of iodine, as detected by charcoal cartridges, is presented in Table 3. From data collated by P. Griffiths⁴, one may predict the potential thyroid dose at a downwind location.

Table 3. Summary of inhalation thyroid exposures resulting from 1965 NRDS experiments.

EVENT	Location of peak concentrations (See Figure 1)	Thyroid dose conversion factors				Thyroid dose due to inhalation of ^{131}I and ^{133}I in mrad
		^{131}I		^{133}I		
		$3.42 \times 10^{-7} \text{ mrad}^4$		$9.21 \times 10^{-8} \text{ mrad}^4$		
		pCi-sec/m ³		pCi-sec/m ³		
		pCi-sec/m ³	Millirad to thyroid	pCi-sec/m ³	Millirad to thyroid	
KIWI TNT	Death Valley Jct	ND	0	2.4×10^5	<.1	<.1
	Hwy 95, 1.5 mi W of Lathrop Wells (unpopulated)	8.6×10^5	.29	1.7×10^6	.16	3.3*
NRX-A3, EP4	Pahrump	1.1×10^5	<.1	3.4×10^5	<.1	<.1
NRX-A3, EP5	Hiko	3.0×10^4	<.1	5.4×10^4	<.1	<.1
	Coyote Summit (unpopulated)	4.0×10^5	.14	6.0×10^5	<.1	<.2
NRX-A3, EP6	Lathrop Wells	3.6×10^4	<.1	4.2×10^4	<.1	<.1
PHOEBUS 1-A	Diablo	6.0×10^4	<.1	2.0×10^5	<.1	<.1
	Queen City Summit (unpopulated)	5.5×10^5	.19	1.6×10^6	.15	.34

*Determined by in vivo thyroid counting.

Thyroid dose due to milk ingestion

Following three of the experiments conducted at NRDS there were detectable quantities of ^{131}I in milk collected in the test site environs. As mentioned in the NRX-A3 and Phoebus 1-A reports^{2,3} sources other than NRDS reactors could have been responsible for a portion of the activity. If one scales from data prepared by the Federal Radiation Council⁵, it is possible to estimate the potential dose to an infant's thyroid from the milk ingestion. However, scaling by this method assumes that the contamination was a result

of a single event, and it is necessary to consider this possible source of error in judging the dose estimate.

A summary of the milk sampling results is presented in Table 4. Analyses of samples collected in Nevada and Southern California following Kiwi TNT did not indicate the presence of ^{131}I . This probably reflects the fact that at the time of the test most of the animals were on stored feed. In addition, samples collected following NRX-A3, EP4 did not contain radioiodine.

Table 4. Summary of milk ingestion thyroid exposures resulting from 1965 NRDS experiments.

Event	Locations where ^{131}I was detected in milk(see Fig. 1)	Milk radio-assay data, peak ^{131}I (pCi/l)	Millirad to thyroid(12 mrad/100 pCi ^{131}I /1 peak) ⁵
NRX-A3, EP5	Hiko	90	11
NRX-A3, EP6	Springdale	70	8
Phoebus 1-A	Alamo	50	6
	Hiko	60	7
	Blue Eagle	180	22
	Currant	20	2

CONCLUSIONS

The levels of radioactivity encountered off the test range complex as a result of 1965 NRDS tests were small fractions of the AEC Radiation Protection Guides⁶. The dose to any one location was limited by the infrequency of testing and the varied directions of the five experiment "hot lines"(See Figure 1).

By assuming that one roentgen exposure produces one millirad or one millirem absorbed dose, a comparison of the 1965 results with the protection standards has been made in Table 6.

Table 6. Comparison of protection standards with 1965 NRDS effluent effects.

Type of Exposure	AEC Radiation Protection Standards for individuals and population groups in controlled areas.		Maximum potential exposure encountered in the off-site area (millirem)
	Based on Exposure to individual (millirem/year)	Based on average exposure to a suitable population sample (millirem/year)	
Whole body, gonads, or bone marrow	500	170	14 (unpopulated) 1.2 (Diablo)
Thyroid or bone	1500	500	22 (Blue Eagle Ranch) 18 (Hiko)

A comparison of Tables 3 and 4 indicates that the contribution to the thyroid exposure from inhalation was negligible. Table 6 shows the potential exposure, due to milk ingestion, from Schofield Dairy at Hiko and from the Blue Eagle Ranch. The milk from Hiko, representing 150 cows, is potentially capable of delivering a larger integrated dose to a population, although the Blue Eagle Ranch milk, from one cow, had the higher concentration of ^{131}I .

The results indicate that the power integral of future routine tests can safely be increased, provided that other factors remain equal and that recurrent exposures to a given populated area are avoided.

References

1. "Final Report of Off-Site Surveillance for the Kiwi TNT Experiment", SWRHL-17r, August 1965.
2. "Final Report of Off-Site Surveillance for the NRX-A3 Experiment", SWRHL-18r, October 1965.
3. "Final Report of Off-Site Surveillance for the Phoebus 1-A Experiment", SWRHL-19r, to be published in 1966.
4. "Radiological Prediction and Monitoring of Tests at the Nuclear Rocket Development Station", P. Griffiths and P. Erickson, SNPO-N, November 1965.
5. "Background Material for the Development of Radiation Protection Standards", Report No. 5, July 1964.
6. "Standards for Radiation Protection", AEC Manual, Chapter 0524, August 1963.

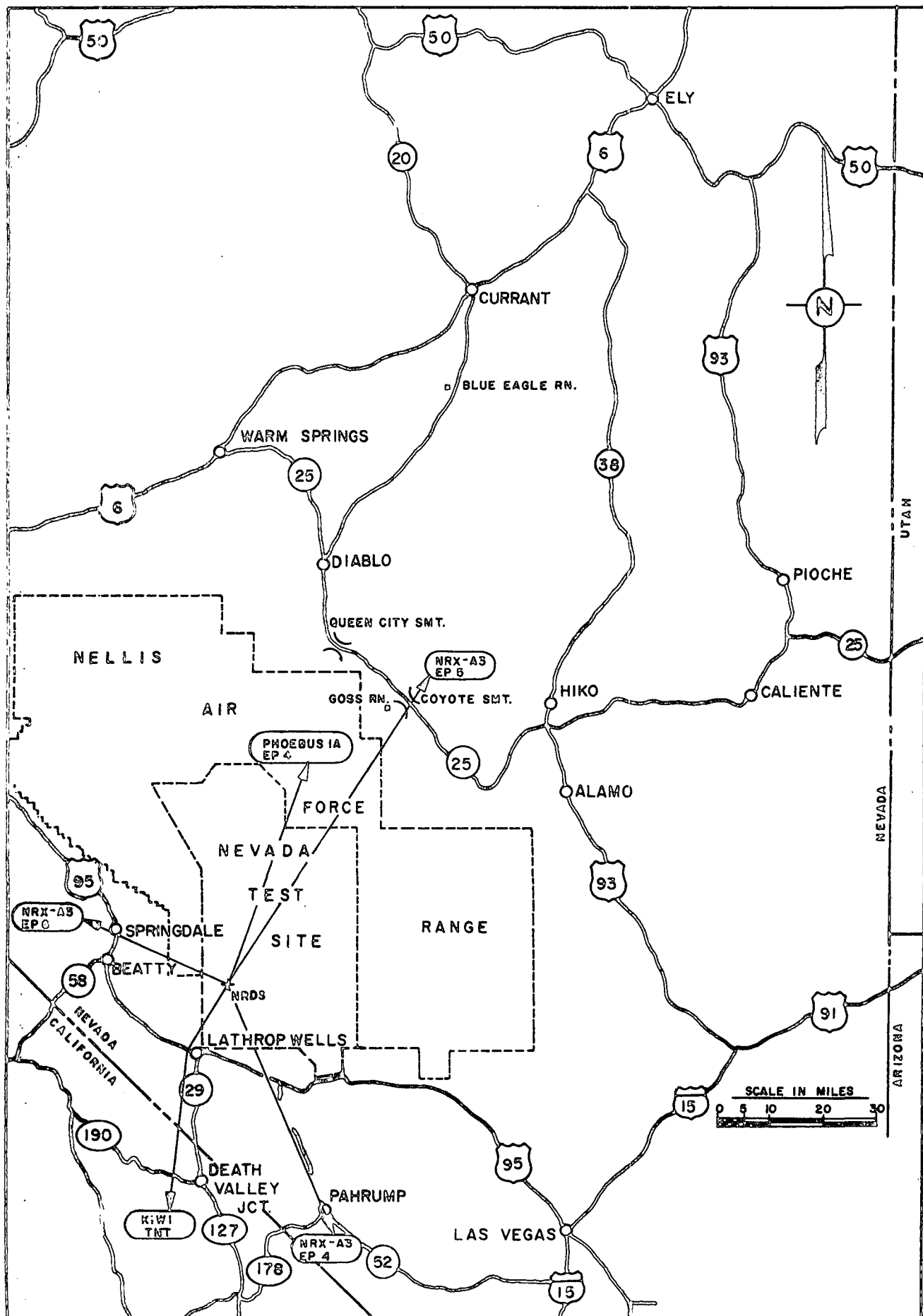


Figure 1. Sampling locations and "hot lines" of 1965 NRDS experiments.