PROTECTIVE ACTION TAKEN AT SCHOFIELD'S DAIRY HIKO, NEVADA FOLLOWING AN ACCIDENTAL RELEASE OF RADIOACTIVITY FROM THE NEVADA TEST SITE

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ENVIRONMENTAL PROTECTION AGENCY

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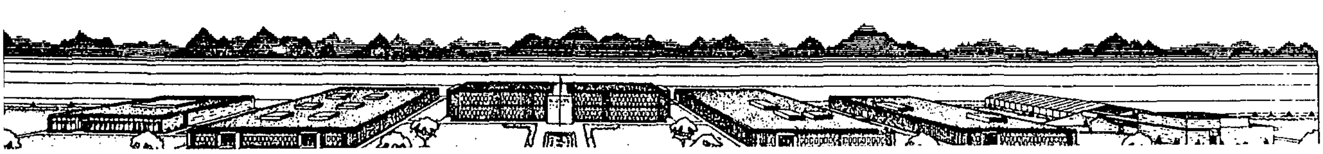

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*Formerly Southwestern Radiological Health Laboratory, part of the U. S. Department of Health, Education, and Welfare, Public Health Service, Environmental Health Service, Environmental Control Administration, Bureau of Radiological Health.

INTRODUCTION

Protective Action Guide is a term often cited in health physics with consideration to public exposure, but applied protective actions have been few. Any protective action is unique with respect to the many possible influences. This report defines a protective measure applied to decrease radioiodines in a dairy's milk production and the factors judged in choosing the mode of action. This action by the Western Environmental Research Laboratory (WERL) in concurrence with the Atomic Energy Commission was taken at levels below the Federal Radiation Council guides and, although intended primarily as a feasibility study, was a prudent measure for minimizing the potential thyroid dose.

On April 25, 1966, an underground nuclear test conducted at the Nevada Test Site released radioactivity to the atmosphere. Weather conditions were such that the effluent traveled from the Nevada Test Site in a northeasterly direction. Levels of radioactivity detected by portable instrumentation in the immediate off-site area on the day of the test were low. The maximum exposure rate in the off-site area was 8 mR/h, 42 miles from surface ground zero in an unpopulated area. The highest exposure rate in a populated area was 1.5 mR/h at Hiko, Nevada, 63 miles from surface ground zero in Pahranagat Valley.

Milk samples were collected in the Pahranagat Valley where family milk cows and dairy operations were present. In addition to milk samples, other environmental samples were collected simultaneously: natural vegetation, field forage, green chop, dry hay, grain, water, air and soil. Environmental samples were collected once daily with the exception of milk which was collected twice daily after the morning and evening milkings. All samples were immediately taken to the WERL in Las Vegas, Nevada, for laboratory analysis.

All samples were analyzed on systems using a 4- by 4-inch NaI(Tl) crystal coupled to a 400-channel pulse height analyzer. Results are reported in pCi/l for milk or pCi/kg for vegetation.

Of the milk samples collected in the Pahranagat Valley, those from Schofield's Dairy at Hiko showed the highest concentrations of ^{131}I. The location with the second highest concentration was about three-fourths of that observed from Schofield's Dairy; however, this sample was from a family cow, the entire production of which was utilized for sampling purposes. This report is concerned only with circumstances involving Schofield's Dairy.

RADIOLOGICAL SITUATION

Table I lists the initial radioiodine levels through the maximum observed following contamination at Schofield's Dairy. These samples were composites from cows of the main dairy herd.

Table I. Radioiodine Levels in Milk From Schofield's Dairy

Date and Time of Collection		pCi/l			
		^{131}I	^{132}I	^{133}I	^{135}I
4-25	PM	320	----	1,000	800
4-26	AM	1,900	490	6,100	4,300
4-26	PM	3,300	3,100	20,000	11,000
4-27	AM	4,400	1,100	15,000	2,500
4-27	PM	4,800	1,900	12,000	1,000

Field forage samples for the same location gave the following values (Table 2). The dairy herd was not eating this vegetation but it should serve as a reference parameter in more areas than green chop (freshly cut growing alfalfa and wheat).

Table 2. Radioiodine Levels in Field Forage From Schofield's Dairy

Date of Collection	pCi/kg			
	^{131}I	^{132}TeI	^{133}I	^{135}I
4-25	120,000	320,000	310,000	220,000
4-25	460,000	580,000	580,000	390,000
4-26	140,000	150,000	300,000	48,000
4-26	85,000	85,000	160,000	27,000

Schofield's Dairy was feeding green chop and grain exclusively to its one hundred and thirty-eight producing cows. The dairy was producing approximately 650 gallons of milk per day which was transported to a Las Vegas processing plant at two-day intervals.

Various means of determining whether radiation levels violate established guides have been proposed. However, the most important consideration in any situation of this sort is that radiation exposure should always be kept at a minimum level.

Initial concentrations of radioiodine in milk from Schofield's Dairy were low. Past experience indicated that the maximum concentrations in milk would be reached at about five days after contamination. The levels of ^{131}I on field forage pointed toward relatively high ^{131}I concentrations in the milk. Data from past radioactive releases have shown that ^{131}I in milk will reach a maximum concentration of 0.015 to 0.15 times the ^{131}I concentrations on vegetation. This indicated that the peak concentration of ^{131}I in the milk would fall in the range of 6,900 to 69,000 pCi/l.

Ralph A. James, University of California, states a radiation field produced by unfractionated fission products of 0.032 mR/h at H+24 hours is the field corresponding to the FRC upper limit for range II of ^{131}I.*

An actual gamma exposure rate of 0.1 mR/h was measured at Hiko 24 hours after the detonation. Based on this measurement and James' relationship, a concentration of 8700 pCi/l of ^{131}I in milk was estimated.** Referring to the FRC Report #5, page 11, "Deposition of ^{131}I can vary greatly within a relatively small geographical area. As a result, there can be large differences between ^{131}I concentrations in milk produced on farms only a few miles apart." Then the text goes on to state, "It is not possible to predict reliably the maximum concentrations of of ^{131}I in milk from deposition data." The prior statements are referenced not to discredit the projected dose but to point out the uncertainty

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*"Calculation of Radioactive Iodine Concentrations in Milk and Human Thyroid as a Result of Nuclear Explosions" Ralph A. James, University of California, Lawrence Radiation Laboratory, Livermore, California, February 14, 1964, Report #UCRL-7716.

**From this measurement, greater than three times FRC Range II, that is, more than 8700 pCi/l of ^{131}I in milk was projected.

involved in projecting milk contamination from ground deposition data.

The Federal Radiation Council Report #5 states that from a single event a total intake of 600 nanocuries of ^{131}I would result in a dose of about 10 rads to a two-gram thyroid. It is estimated that a peak concentration in milk of 60 to 70 nanocuries of ^{131}I per liter could result in such thyroid doses. The FRC does not include approximately 20 to 25% of the infinite thyroid dose which is obtained prior to the peak ^{131}I concentration. It is deduced then that a maximum concentration of 60 to 70 nanocuries actually gives 12.5 to 13.3 Rad. Chapter 0524, Standards of Radiation Protection, U.S. Atomic Energy Commission, gives 1.5 rem/year as a standard for thyroid dose to individuals of the population in an uncontrolled area. It follows that 1.5 rem results from 6,800 to 8,400 pCi/l.

CONSIDERATIONS

These guides are based on FRC recommendations for exposure of the general public for normal peacetime operations. Since Hiko is near the Nevada Test Site, there was no assurance that another exposure would not result within a year. Also, experience was needed in the application of preventive action and its effects on the dairy herd, the contaminant levels, and the public. The recommendation was made to the AEC to take protective action. The course of action was chosen after considering the following:

A. The milk was being picked up from the producer dairy and shipped to Las Vegas, Nevada (at two-day intervals). The milk was being processed and delivered to the consumers within thirty-six hours after receipt by the pasteurization plant. Dilution at the pasteurization plant could not have been greater than a factor of seven after proportioning the milk in the plant's bulk tanks. The milk was not normally proportioned in the tanks and to do so would have created inconvenience and expense to the processor.

B. Disposing of the thirteen hundred gallons of milk would have caused the processor to operate below his consumer commitments since no other Grade A supply was available for milk replacement. Therefore, disposal of the milk was not a desirable protective action for this case.

C. Storage facilities for this large volume were non-existent thereby eliminating the possibility of decreasing the hazard through radioactive decay.

D. Diversion of the contaminated milk to milk products seemed a likely procedure which would have allowed a large reduction of the activity due to holding time. This possibility was discarded, however, because the producer would receive lower prices for milk which must be diverted. Furthermore, there were no milk product processing facilities in the nearby area.

E. The remaining possibility was replacing the dairy's feed supply. This action was chosen as the most feasible protective action to be taken, and it is one of the actions recommended by the FRC for reduction of human exposure from ^{131}I. Intake of the contaminant would be cut to a minimum and contact with any persons other than the producer would be unnecessary. The only reduction in milk production would come from changing the cow's feed. Reimbursement for this decrease would be small. Replacement hay was available. This course would also yield useful information as to the effects of the protective action on the level of ^{131}I in milk.

PROTECTIVE ACTION

The following questions were then posed to the dairy operator:

A. Would he cooperate in feeding dry hay if the hay was supplied without cost?

B. What type and what amount of feed would be necessary?

C. How much, if any, hay was on hand at that time?

D. What time interval was necessary for the herd to be switched to dry feed?

E. What hay suppliers could he recommend?

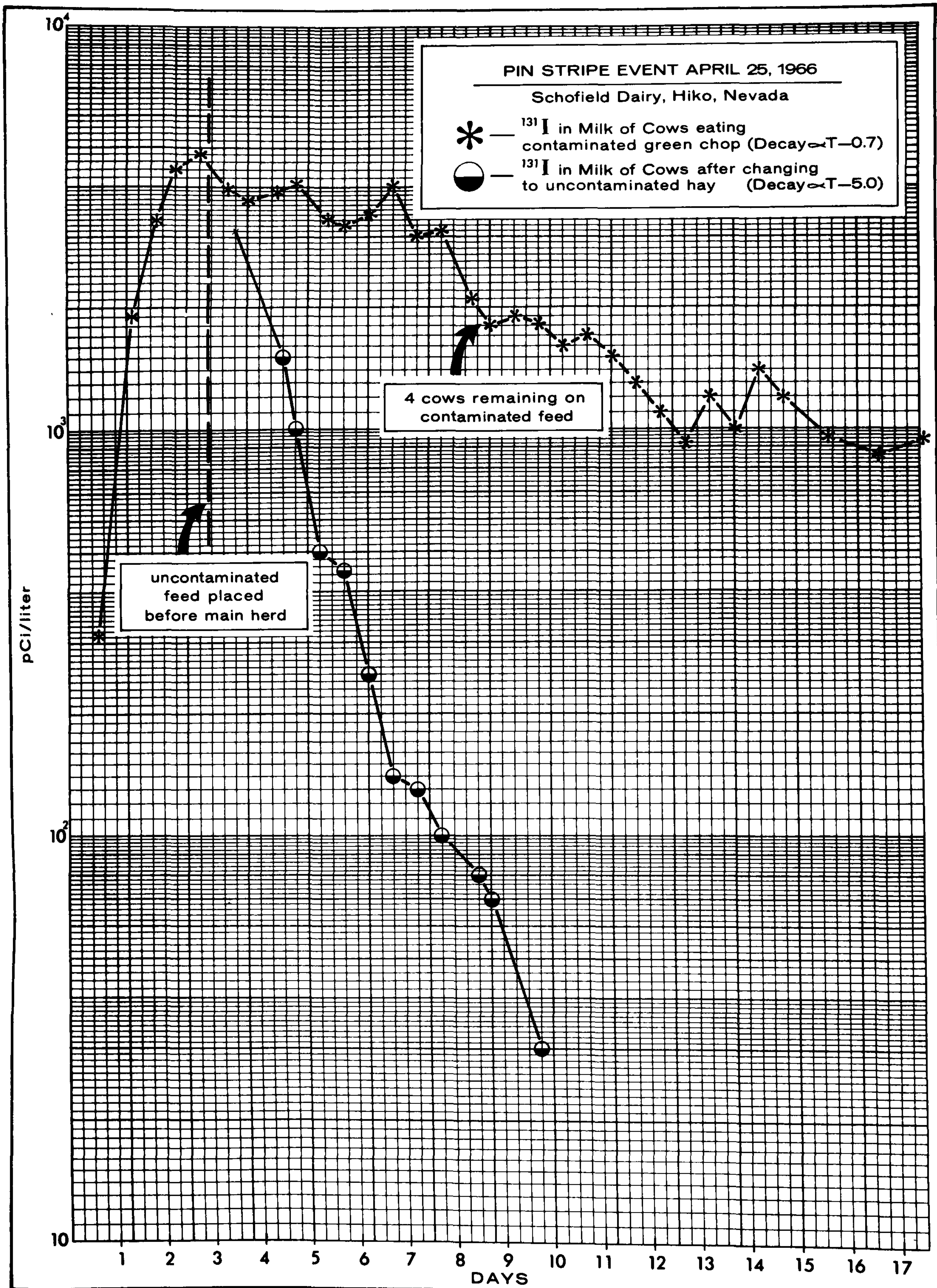
The manager of Schofield's Dairy was most cooperative and immediately agreed to switch to dry hay and grain as soon as it was available. The nearest supplier with suitable uncontaminated hay was contacted and delivery was made on April 27. Dry feeding was initiated on the evening of April 27.

A small decrease of ^{131}I in the milk was seen on April 28 and this decrease was quite marked by April 29. Time was required for the clean feed to purge the radioiodine already in the animals, but the following results show that ^{131}I levels dropped by a factor of four within two days after the feed change.

Table 3. Radioiodine Levels in Milk Following Change to Dry Feed

Date and Time of Collection		pCi/l ^{131}I	^{132}I	^{133}I	^{135}I
4-28	AM	4,000	-----	6,700	-----
4-28	PM	3,700	-----	4,700	-----
4-29	AM	1,500	-----	1,400	-----
4-29	PM	1,000	-----	730	-----

Four cows were fed the regular diet of green chop and grain as a control to assess the effect of the protective action. The ^{131}I levels in their milk decreased only about 10% per day. The milk from these cows was not used for human consumption. The following graph depicts the trends seen in both groups. It is estimated that this action reduced the ^{131}I thyroid dose by 71%. Schofield's Dairy continued to feed dry hay for 16 days, time for 2-3 effective half-lives of ^{131}I to pass and acceptable levels of ^{131}I to be reached. The cows were then returned to their normal diet.


PIN STRIPE EVENT APRIL 25, 1966
Schofield Dairy, Hiko, Nevada
131I in Milk of Cows eating contaminated green chop (Decay∝T–0.7)
131I in Milk of Cows after changing to uncontaminated hay (Decay∝T–5.0)
4 cows remaining on contaminated feed
uncontaminated feed placed before main herd
pCi/liter
10⁴
10³
10²
10
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
DAYS

CONCLUSION

The initial considerations of peak ^{131}I concentrations in vegetation at Schofield's Dairy pointed to maximum levels in milk about ten times higher than those reached. Using the James' model relationship, the estimated milk levels were within about a factor of two of the measured peak level.

Two features become paramount in handling any situation where protective action may be needed. The first is to sample all possible sources which may delineate and quantitate the contamination. The second, a quick assessment of the total radiological situation is necessary before employing protective action.

This paper has assessed a specific case which may or may not be a precedent for planning similar protective actions. Any incident would have to be judged on the set of circumstances controlling its situation. The parameters set forth here are those used to judge this situation and to determine the course of action taken. Under different circumstances, other equally important issues may need to be considered by the group responsible for taking the necessary precautions.

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