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Ltr: 5-18-65 from J.R. Horan
FOLDER to R.S. Decker

Ralph S. Decker
Chief, Safety Branch, SNPO

John R. Horan, Director
Health and Safety Division

DRAFT
WPGammill:d
RVBatie
JRHoran
HSHP
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CONTROLLED ENVIRONMENTAL RADIOIODINE TEST

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We wish to thank you for the comments and suggestions contained in your memorandum of February 9, 1965, subject - suggested modifications of CERT. The difficulty which you encountered is a very real one and one which has still not been completely overcome. Your suggestion to graze the cow(s) within the same narrow strip throughout the experiment is being considered for future experiments. The grazing procedures used during the first test was chosen to facilitate average grass consumption measurements.

As you surmised, no attempt was made to simulate the pasture contamination and subsequent ingestion dose which might be expected to result from a reactor accident. It was our intent to design an experiment which would enable us to evaluate the parameters of prime importance in determining ingestion thyroid dose. This was to be done under field conditions without exorbitant expenditures of effort and money and would involve the atmospheric release of minimum quantities of radioiodine. Evaluation of our experimental design was the primary objective of our first test.

As a result of the first test, it was concluded that the experimental design was reasonably good, though several inadequacies were noted, and that it was feasible to proceed with plans to establish an irrigated pasture, typical of those used in this locality, which could be used in series of CERT experiments. Our interest in establishing an irrigated pasture stemmed

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from the fact that Crested Wheatgrass is not a typical pasture grass. Also, cows will only eat this grass in the spring, before it becomes course and tough. We became more concerned about the use of this grass when we observed a half-life of iodine 131 on the grass of about 3.5 days; much shorter than the five day half-life reported by most observers.

Our Experimental Dairy Farm was constructed during fiscal year 1964 and the first test on the irrigated pasture was conducted in September, 1964. The location of iodine generator line was influenced by the terrain on the 1963 test. The generators were moved an additional 50 meters upwind for the second test. Again, only the downwind half of the pasture was used for grazing. As a result, the initial concentration on the final grazing strip was only twice that of the first strip. Though this had a significant influence on the results, it was not considered drastic. Also, the length of the grazing strips was governed by that part of the pasture which exhibited relatively uniform lateral distribution of the radioiodine.

The computation which was attached to your memorandum has been reviewed. We found it to be a very straightforward and reasonable treatment. Although it was quite different from the approach we used, the final result compares very well with ours. A comparison of your ingestion dose value of $3.34 \times 10^5$ rads/curie-sec/$m^3$ with the generally accepted iodine 131 inhalation dose value of 329 343 rads/curie-sec/$m^3$ yields an ingestion to inhalation dose ratio of about 1000 for a child. Our value for this, based on the 3.5 day effective half-life, was 850.

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I am attaching a description of our method of treatment and would appreciate your review and comments. Also, I will be sending you a copy of our CERT Progress Report which is to be published within the next few weeks. Our program for the next fiscal year is directed toward investigating the behavior of methyl iodide and the effect of atmospheric stability on deposition velocity.

Enclosure:

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In using the ingestion to inhalation dose ratio, it should be remembered that children generally constitute the critical segment of the exposed population because of their smaller thyroid. For a given intake, the dose to the thyroid of a one year old child (thyroid weight of two-grams) is about ten times that of an adult. Therefore, it appears that a reasonable ratio of a child's ingestion dose to an adult's inhalation dose would be about 1,250. The reason for comparing this with the adult inhalation dose is that no standard breathing rate for a child has been established. It is normally assumed. however, that a child's lower air intake off-sets the larger dose one would expect because of the smaller thyroid.

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FIGURE 1

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Ingestion to Inhalation Dose Ratios

The use of an ingestion to inhalation dose ratio in the evaluation of potential or planned atmospheric releases of radioiodine is a practice which is gaining in acceptance. The use of this ratio eliminates the need for a separate ingestion dose calculation in the preparation of Reactor Safety Analysis Reports. The treatment of this subject in the CERT-I report considered only the milk ingested during the first 14 days of the test and made no correction for the short effective half-life of iodine on the grass. It was generally agreed that this treatment resulted in a value which would be too low under normal conditions with an effective iodine half-life of five days on the grass. Since the CERT-I report was published, a more realistic evaluation of this ratio has been completed. Basically, this was done in the following manner. The daily concentrations of radioiodines observed in the milk were multiplied by a factor which corrected for the non-uniformity of the pasture contamination level in the downwind direction. These correction factors were obtained by normalizing the pasture contamination level to the contamination level of the first grazing strip. Semi-log plots of the corrected and observed concentrations are presented in Figure 1. The effective half-life of the iodine in milk on the corrective curve is approximately three days. This provides substantiative evidence for the 3.5 day half-life observed on grass since they should be about equal. The corrective curve was then extrapolated back one day to account for the one day to account for the one day delay in getting

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the cows on the contaminated pasture. It was then calculated that a person drinking on eliter of milk per day from a single contaminating event such as this would ingest a total of about 0.6 μCi of iodine 131. Based upon an uptake fraction of 0.19, this would result in 625 mrad for an adult with a 20g thyroid. The inhalation dose calculated for an adult who might have been located near the mid-point of arc D was 7.3 mrad. The ingestion to inhalation dose ratio for this contaminating event would be about 85. Still, this was not considered a reasonable ratio due to the fact that a majority of the investigators have reported values for the effective half-life on grass about five days.

To arrive at a more reasonable value for this ratio, a five day half-life on grass was assumed. It was further assumed that the difference in half-life would have a minor effect on the peak iodine concentration in the milk. A plot of this postulated situation is also presented in Figure 1. This treatment yielded the following results:

| | |
|---|---|
| Total iodine ingested | 0.85 μCi |
| Ingestion dose | 890 mrad |
| Ingestion to Inhalation dose ratio | 120 |

The CERT II data were treated in similar manner and are presented in Figure 2. The major difference between these two treatments was that the corrected daily milk concentrations fitted a 5 1/4 day effective half-life reasonably well, so that it was necessary to postulate a more reasonable situation. This treatment yielded the following results, again based upon the assumption previously described.

| | |
|---|---|
| Total iodine ingested | 0.635 μCi |
| Ingestion dose | 660 mrad |
| Ingestion to Inhalation dose ratio | 130 |

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