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XENON AND IODINE CONCENTRATIONS IN THE ENVIRONS OF THE T AND B PLANT

The sampling equipment in the Stack Monitor Building has given results of dubious value until recently. It is believed that the series of measurements made in early November offers a reliable estimate of the stack emission of active gases, subject only to the uncertainties of representative sampling in the stack; a brief review of the xenon and iodine problems may be useful at this time.

In the period 10/25/45 to 11/16/45, seven satisfactory runs of iodine emission, and four of xenon emission, were made. The I^{131} content of the dissolved metal was estimated at 4530 curies from the fission yield data. The measured emission was 3245 curies. This value would be consistent with the expected retention of some iodine in the dissolver solution.

The cooling time of the metal ranged from 40 to 51 days. The measurements of iodine concentration were converted to equivalent values at 46 days cooling, with the following results:

Radio-iodine in the Stack Gases with 46 Days Cooling

Date	Approximate Charge Tons	Concentration of I^{131} Average [curie/cc] x 10^{10}	Concentration of I^{131} Maximum [curie/cc] x 10^{10}
10/25/45	2	2.8	4.7
11/6/45	2	3.2	6.2
11/7/45	3	3.0	7.4
11/8/45	1	2.4	4.5
11/13/45	1	3.2	6.1
11/14/45	2	3.5	6.2
11/15/45	2	4.1	8.2

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The weighted means of the average and maximum concentrations were respectively 3.2×10^{-10} curie/cc and 6.4×10^{-10} curie/cc. The average concentration was effective over periods up to 15 hours for the larger charges. Therefore, the possible hazard extended over the entire work period. This may be taken as 9 hours, including transit time in the vicinity of the T and B Plants. For an 8 hour exposure per day, the tolerable concentration is 2.6×10^{-13} curie/cc. For a 9 hour day, one could reasonably use $\frac{8}{9} \times 2.6 \times 10^{-13} = 2.3 \times 10^{-13}$ curie/cc.

The required minimum dilution of stack gases at ground level would then be:

$$\frac{3.2 \times 10^{-10}}{2.3 \times 10^{-13}} = \sim \underline{1400}$$

The equivalent dilution factors at other cooling times would be:

Cooling Time	Safe Dilution
35 days	3600
40 days	2300
50 days	1000
60 days	400

It has to be noted that dilution factors less than these would not necessarily be unsafe. In the final analysis, the radiation hazard depends on the accumulation of radio-iodine in the thyroid, and this can be checked by routine examinations.* Nevertheless, the operation has to be conducted with the reservation that the gaseous effluent disposal is not automatically safe for the current lower limit of 500:1 dilution unless the cooling time approximates 60 days. In the summer period, there has already been a demonstration of the practical safety of the present procedure. Winter conditions in combination with current cooling periods require further study. It has been tacitly assumed that atmospheric concentrations of iodine in the residence areas will be very low. This may not be the case during a prolonged period of atmospheric stagnation such as was observed by the Meteorological Group in the winter of 1943-44.

Two other circumstances suggest the desirability of maintaining the cooling time as long as is consistent with other determinants. Whenever radio-iodine comes in contact with vegetation or with ground objects some is deposited, and may later be smeared off and ingested. Rainwater has been found to become highly active, with concentrations up to 3 times the tolerable value. Restriction of metal dissolving to periods of very favorable meteorological conditions would hold both these factors down in the vicinity of the plants. However, this might not reduce, and could obviously increase, the hazard in more remote areas such as Walla Walla. It is of interest that the ground contamination in that city is as high as in the 300 Area. Again it should be emphasized that there is no hazard in these areas at this time, and that generally adequate observations are being made to follow the pattern of such contamination. Increase of cooling time would appear to be the simplest expedient for reducing these and related effects to negligible proportions.

* General philosophy of the H. I. approach to the iodine problem has been given in the report of S.T.Cantril and J.F.Healy to File - "Iodine Metabolism With Reference to I131," 10-22-43 Document 7-2604

The most spectacular hazard arising from the emission of radio-iodine occurs when a downdraft near the stack brings the material to ground at low dilution. It can now be shown that this would never produce an inhalation hazard. The mean of maximum concentration in the stack gas is 6.4×10^{-10} curie/cc, and a ground dilution less than 50:1 is inconceivable. Hence, the maximum ground concentration is 1.3×10^{-11} curie/cc. Such a concentration would not be maintained for more than a few minutes. For a single day exposure, a concentration of 2.8×10^{-10} curie/cc can be tolerated for 8 hours. In the present case, the downdraft exposure is added to a continuum of low daily doses, but there is evidently ample safety margin against iodine inhalation due to a sudden occurrence of adverse atmospheric conditions. Deposition of iodine on hands, face, clothing and equipment has to be separately considered. The ease with which the material washes off should help to eliminate hazard from this source.

The average xenon concentration at 46 days was 2×10^{-10} curie/cc. This would be equivalent to 8.2×10^{-10} curie/cc at 35 days. With a very pessimistic dilution factor of 100, this gives 8.2×10^{-12} curie/cc at the ground. The tolerable concentration is taken as 2×10^{-11} curie/cc, and consequently the xenon hazard can be dismissed. The possibilities of absorption in rainwater and in oils and fats has to be considered, but fails to put the xenon in the practical hazard category. The xenon hazard at the time of downdraft would be negligible.

The existence of longer lived materials, either gaseous or solid, in the stack gases has not been overlooked. The isolation of such radio-elements is proceeding slowly. The activity from these materials introduces no hazard at this time, and changes in cooling time would not influence the future outlook.

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