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August 14, 1963

REPOSITORY INEL
COLLECTION SPERT
#22305 FRC#430 780073
BOX No. File: SPERT-1963
ltr. 8-14-63 Radiological data
FOLDER from SPERT-I Dest Test

Mr. Warren M. Andrews
Special Assistant to the President
Nuclear Science Center
Auburn University
Auburn, Alabama

Dear Mr. Andrews:

It was I who presented the paper "Radiological Data from the SPERT I Destructive Test" at the ANS meeting in Salt Lake City. In your letter of July 31, you stated that our calculation of the number of curies released to the atmosphere, $2.4 \times 10^5$, representing less than 1% of the calculated inventory, was too large. You asked that we either confirm or correct this number.

The original calculation was done by personnel of the U. S. Weather Bureau here at NRTS, under the direction of Dr. Norm Islitzer. This calculation was then checked by AEC-ID people. We believe this calculation to be reasonably accurate.

A word of explanation is in order here. After the results of the radiological data analyses were known, it was thought that this information would become a part of an overall destructive test report. During this time we also had a change of personnel. At any rate, due to the interest shown in the summary as published in ANS transactions we plan to publish a formal report. The following is information which is to be included in the report and will explain how we arrived at the quoted source term, and from there arrived at the percentage released. (This information was prepared by E. H. Markee, USWB, here at NRTS.)

"Diffusion Calculations"

Using the Sutton equation for obtaining the total integrated dose (USWB, 1955), plume axis dilution, X/Q, was computed for each arc downwind when high volume air sampling data were available. The air concentration data consisted of the sum of the prefilter [MSA 2133] and carbon trap measurements from the high volume samplers in $\mu c/m^3$ over an estimated 2-minute sampling interval, back-corrected for decay to a common time of 1800 MST. The SPERT destructive test was initiated at about 1227 MST. The crosswind distributions of concentration were

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plotted and analyzed so that plume centerline interpolated concentrations could be obtained. These interpolated centerline concentrations X, were then divided by their appropriate X/Q values and averaged to obtain an estimate of the virtual source strength, Q, at 1800 MST which was 1.26 x $10^4$ uc/sec for a 2-minute period. Then, with this virtual source strength estimation, values of centerline concentration versus distance downwind were computed, plotted and compared with measured values. (Figure 8)* Computations of the centerline concentrations, based on the method suggested by Pasquill (1960), for two stability classes are also shown in Figure 8. Computed (Sutton) and measured isopleths of concentration were compared (Figure 9).

Since the source strength was computed using the Sutton model and air sampling data, it is only valid to compare the slopes of lines in Figure 9 rather than the absolute values of the concentrations. In general, there is good agreement between the measured and computed concentrations.

It was found that the wind fluctuation parameter, $\sigma_\theta$, could not be used to compute concentrations, probably because the telemetered wind data were not sufficiently detailed for use with reactor excursion data. Nevertheless, the data do provide a comparative index of atmospheric turbulence levels.

ESTIMATION OF ENVIRONMENTAL RELEASE OF FISSION PRODUCTS

The computed virtual source strength at 1800 MST of 1.26 x $10^4$ uc/sec (for a two-minute period), was back-connected to the excursion time of 1227 MST by assuming a decay law of $t^{-1.21}$. This yielded a calculated release of 2.4 x $10^5$ curies into the atmosphere, which is equal to a 0.17 mw-sec release. The calculated release was based on the assumption that the mixed fission products formula (USWB, 1955) could be used for the computation of the energy release. There is some uncertainty in this since the sampling data indicated that almost all the fission product cloud consisted of noble gases [actually, because of the necessary time lag before the samples could be analyzed, the samples contained only daughters of Kr and Xe.] Therefore, calculations via an IBM 7090 curie code program of excursion decay curve for noble gases only from a reactor that had been operating for one second were made, and the results showed that the $t^{-1.21}$ decay low was a good approximation. The engineering estimates of the total release, as reported by the contractor [Phillips Petroleum Co., operating contractor, SPERT] was 33 mw-sec. Therefore, it is estimated that 0.5% of the total produced fission products escaped into the atmosphere.

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* Figures not included in this letter

The film badge Beta and Gamma dosages were used as an independent check of the assumptions used in the curie release computations. The measured deposition data strongly suggests that the film badge dosages were largely due to direct radiation from the cloud. Measured dosages interpolated to cloud centerline valves were compared with calculated (USWB, 1955) centerline dosages using the calculated release into the atmosphere of 0.17 mw-sec (Figure 10).

A background level of 20 mr was subtracted from the Gamma dosages because most of the film badges away from the path of the effluent plume showed readings of this order; however, this figure is subject to some uncertainty. The Beta dose computation is very close to the interpolated values, and the Gamma dose computations are about a factor of 2 to 3 lower than the interpolated dosages. Therefore, it can be concluded that the fractional release of fission products into the atmosphere was equal to or slightly greater than 0.5% for this particular test."

As you have no doubt concluded in reading this letter, there were many assumptions made which are subject to argument. One of the big questions is, how efficient was our sampling media in the collection of the nobles and their daughters. We have decided (quite intuitively, I admit) that we collected at least half of the active products which passed through the samplers. Still, the $2.4 \times 10^5$ curies quoted is believed to be the best number.

The other authors and I were pleased that you were interested enough in the results to write to us. If you or your staff have any suggestions concerning what we could do better next time, please let us know. A comparable destructive test, using a uranium oxide core, is planned for early this October, and we would appreciate your comments.

Sincerely,

Clyde A. Hawley, Jr., Chief
Site Survey Section
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