Chapter 6 Appendix 1

EXPOSURE OF NISHIYAMA RESIDENTS IN NAGASAKI TO RADIOACTIVE FALLOUT

INVESTIGATION OF BEHAVIOR IMMEDIATELY AFTER THE A-BOMB

Shunzo Okajima
Nagasaki University

The purpose of this report is to estimate the maximum radioactive fallout from the Nagasaki A-bomb to which Nishiyama residents in Nagasaki were exposed.

Environmental radiation in the Nishiyama area after the A-bomb was measured from September to November 1945, by US and Japanese scientists. The exposure rate at the time of measurement was determined and the cumulative exposure estimated. These data had some discrepancies in value but, according to the data in this chapter, the cumulative exposure in the Nishiyama area is estimated to be 20 to 40 R.

To be realistic, individual Nishiyama residents did not spend all of their time outdoors where the exposure rate was high. They must have slept indoors at night and some of them must have gone out of the Nishiyama area from time to time. Therefore, the levels of individual exposure of Nishiyama residents must be lower than the above-mentioned cumulative exposure. Prior to the measurement of exposure of Nishiyama residents in 1969, using the whole-body counter, an investigation was conducted on the individual behavior of Nishiyama residents after the A-bomb. Using the data available from the investigation, it is proposed to review the behavior of Nishiyama residents immediately after the A-bomb, determine the time of stay in the high-dose region and estimate the maximum exposure.

Methods and Results

In the survey of the effects of radioactive fallout in the Nishiyama area, Nagasaki in 1969, the following methods were used in the selection of the subjects exposed from internal radioactivity from among Nishiyama residents using the whole-body counter. That is, of the 324 individuals who had lived in 4-chome, Nishiyama or Kiba, Nagasaki on 1 October 1950, and were alive in 1969 in the area where the exposure rate from fallout had been high (0.5 mR/h and over) when measured on 3 to 7 October 1945, 162 who were thought to have

received relatively high radiation exposure were interviewed.

A narrative history of events at the time of the bomb (ATB) was obtained from Nishiyama residents, and specific information was requested in terms of half-days spent in the area from 9 August to 31 December 1945. An interview form was used to record the information.

On the basis of the results of the surveys, the 162 interviewed were ranked in the order of the amount of radioactive fallout received and a total of 80 subjects was selected with 50 of the most heavily exposed identified in the first survey and 30 more in the second survay.

The interview forms of the 80 subjects were reviewed in this study.

The level of exposure depends on the time spent outdoors in the region of high exposure rate. Though the Nishiyama area is located approximately 3000 m east from the hypocenter with a 366 m mountain lying in between, a strong blast destroyed houses in that area ATB. Most of the Nishiyama residents repaired their houses temporarily and slept indoors that night, but 24 of the 80 subjects spent the night in the air-raid shelters nearby because their houses were damaged beyond repair. These 24 residents are thought to have been exposed to radiation outdoors most of the time except during sleeping hours. Accordingly, it appears that these people were the most heavily exposed.

External gamma-ray radiation dose from radioactive fallout is attenuated at the rate of time raised to the -1.2 power until 4000 hours after the explosion. Given the estimated maximum value of the cumulative exposure in the Nishiyama areas as being 40 R, the exposure rate will be approximately 8 R/h one hour after the explosion. The record shows that in the Nishiyama area, which is located appoximately 3000 m east from the hypocenter, a west wind was blowing at about 3 m per second ATB. Also it was witnessed that black rain started to fall over the area about 20 minutes after the explosion. It is likely that radioactive fallout occurred in the Nishiyama area around that time.

Let us calculate the outdoor exposure from noon after in the Nishiyama area with 11:00 AM set as the time the A-bomb dropped in Nagasaki. Assuming that the residents, whose houses were destroyed on that day, stayed outdoors until 10:00 PM, the exposure would have been 14.8 R, which means that they received 37% of the total cumulative exposure on that day alone. If they were not exposed to radiation while sleeping in the air-raid shelters and spent the following day working outdoors most of the time, the exposure on that day would have been 1.8 R and the total exposure for the two days 17.6 R, which is 44% of the total cumulative exposure.

The data on the behavior of Nishiyama residents after the third day after the A-bomb is not necessarily accurate, but assuming that they spent half a day outdoors, the cumulative outdoor exposure after the third day after the A-bomb would have been 18.8 R and the exposure of the residents 9.4 R. Accordingly, the total exposure would have been 27 R including the additon of the 17.6 R from the first two days. It is approximately 68% of the given total cumulative outdoor exposure of 40 R.

The total cumulative outdoor gamma-ray radiation exposure in the high-dose region of radioactive fallout in the Nishiyama area in Nagasaki is estimated to be 20 to 40 R. The exposure of Nishiyama residents is a maximum of 27 R taking into account the time of outdoor stay, which is about two-thirds of the total outdoor cumulative exposure. However, it is an estimated value based on a calculation one hour after the explosion of the A-bomb. If exposure to radiation started 30 minutes after the explosion, 6.4 R must be added.