

Tritium Activity in Garden Produce from Pembroke in 2007 and Dose to the Public

Overview

SRB Technologies (SRBT) has been producing tritium light sources in Pembroke since 1991. As a result of CNSC compliance enforcement actions, SRBT temporarily ceased tritium processing in 2007. This resulted in a large reduction in atmospheric releases relative to past operations and provided a unique opportunity to study the response of the local environment to significantly lowered tritium releases. This study provides results of CNSC-funded research at the University of Ottawa on tritium activity in garden vegetables and fruits, and a few matching soils collected in late summer 2007. Dose estimates for people consuming local produce are also provided for interpretation.

Objectives

The study aimed to document how the local environment recovers when a long-term source of tritium is removed. Similar produce data were collected by CNSC staff in 2005, providing a suitable point of comparison for this investigation.

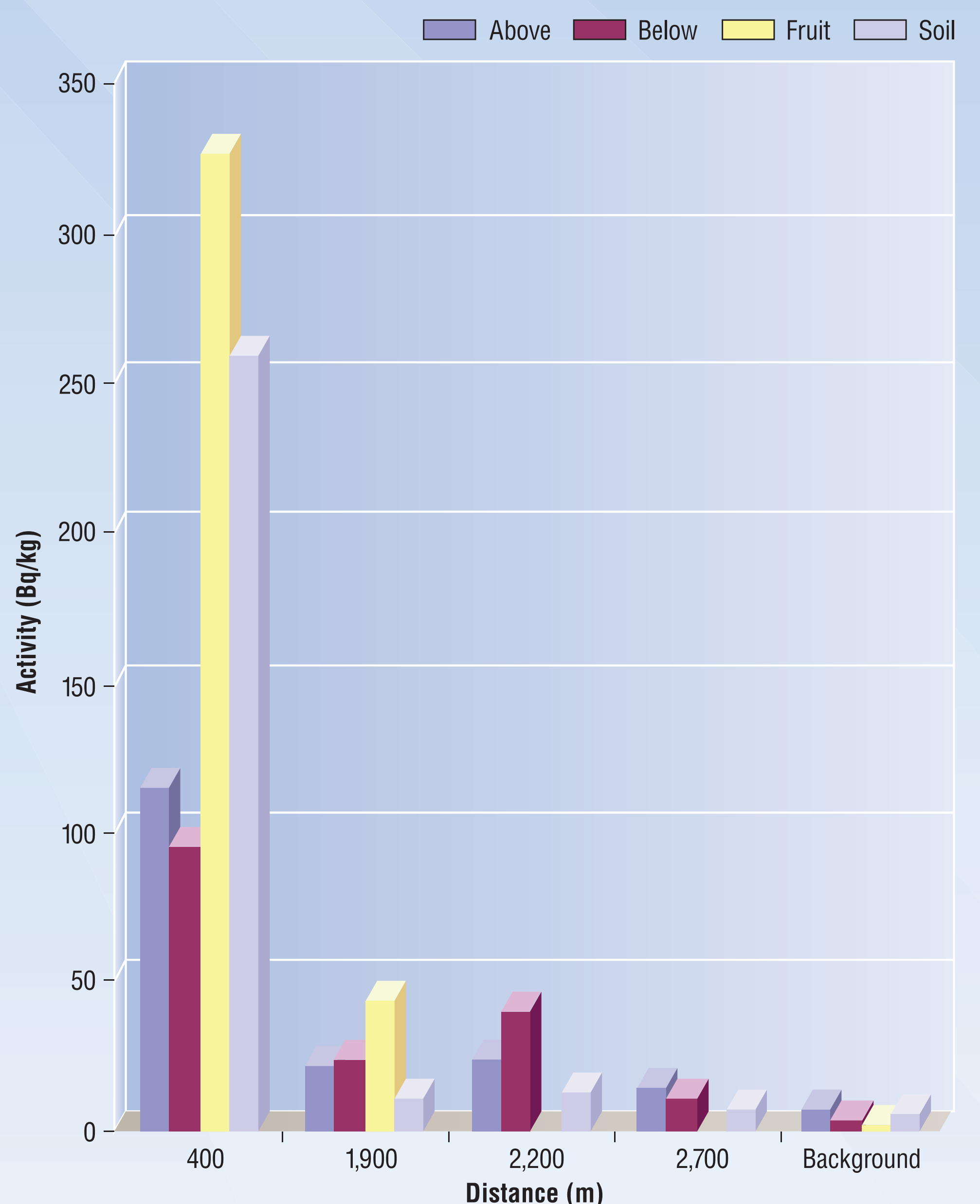
Main Findings

Garden produce and soils

- Tritium activity in the water (HTO) in produce grown close to SRBT in 2007 was about 20 times natural tritium background. Overall, activity levels were about 100 times lower than during normal operations in 2005.
- Total tritium activity in produce and soils declined considerably with increasing distance from SRBT's stacks and approached natural tritium background levels at about 3 km (Figure 1).
- First-time measurements of organically bound tritium (OBT) in produce and surface soils from Pembroke in 2007 did not reveal significant accumulation of tritium from past releases, but did reveal some high ratios of OBT relative to HTO.
- HTO results from the CNSC and the University of Ottawa generally agreed with compliance monitoring data reported by SRBT.
- On the whole, tritium activity in produce and soils agreed with expectations based on reported releases from SRBT and models of tritium behaviour in the environment.

Figure 1. Total tritium activity in produce

Total tritium activity (Bq/kg fresh weight) was extracted from apples and above- and below-ground garden produce such as tomatoes, cucumbers, potatoes and carrots. Matching garden soils were also collected at several distances from an atmospheric source of tritium in 2007 at Pembroke and at a background location (Russell, Ontario). All data are from matching samples collected on August 14, 2007 by CNSC staff and analyzed by the University of Ottawa.





Tritium Activity in Garden Produce from Pembroke in 2007 and Dose to the Public *(continued)*

Public Dose

- Based on measurements of HTO and OBT in garden produce, public dose from the consumption of local produce was less than 0.004 mSv per year, a small fraction of the 1 mSv public dose limit. Data are graphed for locations from 400 m to 2,700 m from SRBT, where most produce samples were collected (Figure 2).
- This dose can be compared to the annual dose from tritium in produce of 0.0002 mSv calculated from the background tritium samples.
- Doses to adults and infants, including nursing infants, were calculated taking into account all types of tritium and the models recommended by the International Commission on Radiological Protection (ICRP). New, improved models (R-OBT, for adults only) were also used for comparison (Table 1).
- A single apple (not included in the above calculations) collected in a field near a home 2,200 m from SRBT had a very high concentration of OBT relative to HTO. If all fruit in the diet was consumed at this concentration for a year, the annual dose would still be low at about 0.005 mSv (adults) and 0.007 mSv (infants).

Conclusions

- CNSC-funded research found expected levels of tritium in local garden produce grown in Pembroke in 2005 and 2007.
- There was no evidence for significant accumulation of tritium in surface soils in 2007 after 16 years of tritium releases from the SRBT facility.
- First-time measurements of OBT from fruits in Pembroke and from several items at background locations revealed much greater diversity in OBT/HTO ratios than expected.
- The dose resulting from the consumption of tritium in fruits and vegetables grown in Pembroke declines considerably with increasing distance of gardens from the SRBT facility. The highest annual dose in 2007 was about 0.004 mSv. This is well below the public dose limit of 1 mSv per year and several orders of magnitude below doses known to cause health effects.

Figure 2. Adult ingestion doses by food type

Adult ingestion doses by food type were measured for above- and below-ground vegetables and fruits at several distances from an atmospheric source of tritium at SRBT in 2007 at Pembroke versus a background location (Russell, Ontario). Tritium data are from home garden samples at each distance collected on the same day in August 2007 and analyzed at the University of Ottawa.

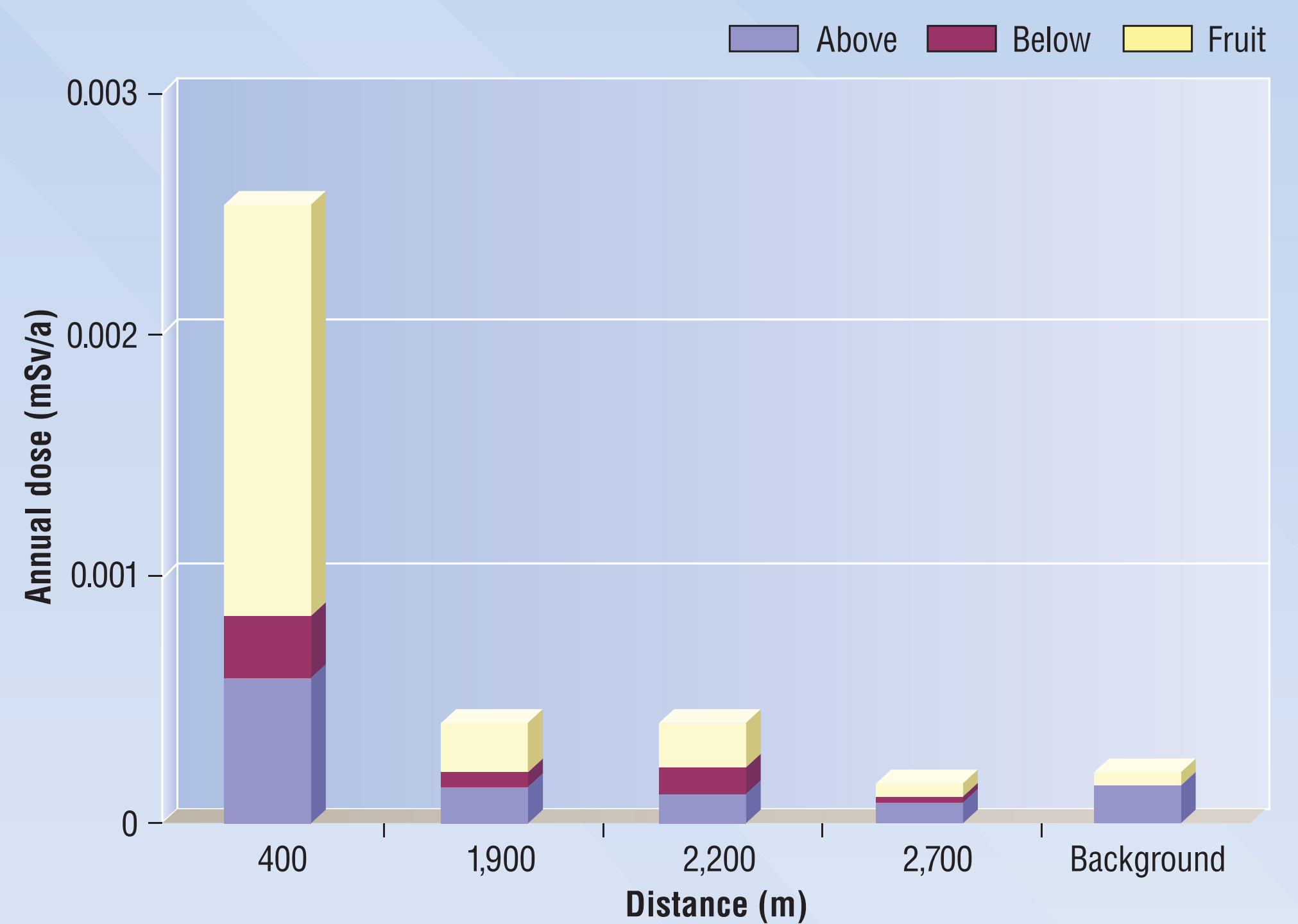


Table 1. Ingestion dose (µSv) calculated using various models

Ingestion dose (µSv) calculated using the ICRP model compared with the improved R-OBT model for adults versus ingestion dose in two kinds of infants calculated by the ICRP model. There are 1,000 µSv in 1 mSv.

Distance (m)	Adult (ICRP)	Adult (R-OBT)	Infant (ICRP)	Nursing Infant (ICRP)
400	2.54	3.45	3.08	2.75
1,900	0.41	0.55	0.44	0.44
2,200	0.41	0.54	0.44	0.45
2,700	0.16	0.19	0.16	0.19