STRONTIUM - 90 LEVELS

IN THE MILK AND DIET NEAR

CONNECTICUT NUCLEAR POWER PLANTS

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For many years, both the general public and the scientific community have believed the assurances of the nuclear industry and government agencies that under normal operating conditions, the radiation doses due to releases from commercial nuclear power plants are negligibly small, and that therefore nuclear power represents much less of a threat to human health than the operation of oil or coal burning electric power stations. (1)

In particular, the nuclear industry , while admitting the atmospheric releases of iodine - 131,has repeatedly claimed that no significant amounts of strontium - 90 and cesium - 137 are released into the air from nuclear power stations, and that therefore the strontium - 90 and cesium - 137 measured in the local milk must be due to fallout from nuclear weapons tests. (2)

However , a detailed examinations of the levels of radioactive strontium and cesium in the air, the soil, the vegetation and the milk around two large nuclear power stations in Connecticut as measured by the utility's own environmental consultants over a period of many years reveals that this claim was valid only for the first few years of operation , and that in the last few years, the levels of these known cancer producing substances have reached or exceeded the levels observed in Connecticut during the height of nuclear weapons testing in the early 1960's. (3)

For instance whereas the highest yearly average following the large nuclear tests of 1961 - 1962 was 23 picocuries Sr-90 per liter of cow milk (pCi/l)[1], [(4)] the dairies within a radius of eleven miles around the Millstone Point Reactor near New London showed milk concentrations as high as 27 pCi/l in July of 1976.[(5)] At the same time, the levels measured by the U.S. Environmental Protection Agency (EPA) in Hartford some 40 miles northwest showed only 5.7 pCi/l of Sr-90 in the milk.[(6)] See Fig. 1 and Table 1)

That these high levels of Sr-90 in the local milk could not possibly be explained by fallout from nuclear weapons tests is further supported by the fact that the levels measured in the milk by the EPA for the same period decline in all directions away from Connecticut, reaching values as low as 3 pCi/l in Cincinnati, Ohio and 5 pCi/l in Portland, Maine.[(7)] A similar pattern was found for cesium - 137 in the milk, with peak values near the Millstone plant of 36 pCi/l compared with only 5 pCi/l in Hartford[(8)] (See Fig. 2 and Table 2)

That fallout from nuclear testing cannot explain the very high levels near the nuclear plants in south-eastern Connecticut is further supported by the fact that both cows milk and goat milk in the nearby farms rose sharply from their values after April and May when the plants were shut down for refueling to peak levels in July and August of 1976, with Sr-90 in goat milk reaching 32 pCi/l near the Connecticut Yankee plant, and 61 pCi/l near the Millstone Nuclear Power Station.[(9)] Yet, the fallout from the Chinese Bomb Test of September 26, 1976 was not detected in Connecticut until October 5th, and when it arrived, the levels in goat milk, as measured by the

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1. One Curie is the radioactivity of one gram of radium. One pCi is one millionth of one millionth of this amount, or 10^{-12} Ci.

utility company rose by less than 3 pCi/l.[10] (See Fig. 3 and Table 3)

The fact that the month-by-month changes in cesium - 137 in the milk measured by the E.P.A.[11] for the Providence, Rhode Island milk showed a similar but lower peak in July and August for the sampling stations near the Millstone Nuclear Plant in 1976 before the Chinese fallout arrived in October while the rest of the U.S. did not, clearly indicate that the contamination of the local milk can affect distant population centers as far as 50 or more miles away, depending on where the milk is shipped. (Fig. 4 and Table 4)

Since the concentration of strontium - 90 near the two plants was 30 to 60 times the minimum detectable level, there can be no question as to the statistical significance of these large rises in the Sr-90 concentrations around these plants. (See Tables 1 and 3).

That the source of these high levels of radioactivity in the milk is mainly due to the emissions from the Millstone Plant located some 15 miles from the Connecticut - Rhode Island border is further supported by a recent report sent by the Nuclear Regulatory Commission to Congressman C. J. Dodd of Connecticut.[12] In this report it is stated that "During 1975, the liquid and gaseous effluents from Millstone Unit No. 1 were high in radioactivity, in terms of Curie content, as compared to other nuclear power facilities", and that "this was due primarily to defects in the nuclear fuel that was being utilized at that time".

According to the N.R.C.'s report on radioactive releases from Nuclear Facilities issued in March of 1977,[13] the Millstone Plant near New London, Connecticut discharged some 2,970,000 Curies of radioactive gases into the air in 1975, the highest of any commercial nuclear plant ever reported in the United States. That same year the environmental report for the plant also showed an all-time high of 36 pCi/l of cesium - 137 produced in nearby farms, as compared with only 5 pCi/l of CS-137 for milk measured by the EPA in Hartford some 40 miles to the north.(11)

Although the N.R.C. report to Congressman Dodd indicates that the total gaseous emissions were reduced to 500,000 curies in 1976, strontium - 90 in goat milk continued to rise from 37 pCi/l in 1975 to an all time high of 61 pCi/l in the third quarter of 1976, compared to a minimum level of only 5 pCi/l measured in earlier years. Since the accuracy of these measurements is ±1 pCi/l, there can be no question as to reality of these extremely high levels of the most biologically serious of all fission products in the milk and food, a chemical substance which is known to have induced leukemia and cancer in numerous animal studies.

In order to appreciate the seriousness of these levels, it must be realized that the Federal Radiation Council in 1961 set the maximum levels of strontium - 90 for continuous consumption in the total diet at 20 pCi/day(top of Range I)# and recommended that countermeasures should be taken such as placing cows on stored, uncontaminated feed, removing the milk from the market, or removing the strontium - 90 from the milk by ion - exchange processes when levels exceed 200 pCi/day.(15) As another indication of the seriousness of these levels, it must be noted that the Environmental Protection Agency (EPA) in its newly adopted standards for drinking water which came into effect in June of 1977 requires that the levels of Sr-90 must be less than 8 pCi/l.(16) Since the carcinogenic action of a given intake of Sr-90 is the same whether it occurs in water or milk, levels that are as high as 30 to 60 pCi/l are clearly in violation of presently accepted health standards.

See Table 5. Note that since milk is only 1/3 of the daily dietary intake, the maximum allowable concentration in milk for one 1/day should be 7 pCi/l.

For an intake of 200 pCi per day, the Federal Radiation Council (15) and more recently the N.R.C.(1) has calculated a maximum dose to the bone of 1500 to 1800 mrem for individuals in the general population, namely the young infant. This dose may be compared with an annual average dose of about 80 mrem from natural background radiation in the U.S.(18)

Using the latest figures on the dose per unit strontium - 90 intake in a year published by the Nuclear Regulatory Commission in its Regulatory Guide, 1.109, March 1976,(1) it is possible to calculate the maximum dose to any individual resulting from the measured levels of strontium - 90 in the diet for individuals living near the Millstone plant.

For the measured average of 35.1 pCi/l at a goat farm two miles from the plant to the east,(19) and correcting for the background or local minimum due to world-wide fallout of 9.6 pCi/l measured at a more distant goat farm 15 miles away,(20) one obtains an excess due to the releases from the plant of 25 pCi/l for 1976. Since the total intake from all dietary sources as measured by the Connecticut Department of Health is about three times that for cows milk and 2.0 times that ingested with goat milk, one gets a daily intake of about 365 x 2.0 x 25 pCi/l or 18,250 pCi per year. From the N.R.C. Guide Table A-5,(1) one obtains a yearly dose to bone of children of 0.0172 mrem per pCi, giving a dose of 0.0172 x 18,250 or 314 mrem per year, and about half as much to bone marrow (21)

This dose is 450% of the average background radiation of 70 mrem in the area according to the EPA's latest measurements,(22) and some 40 times larger than the maximum dose to any individual of 7.9 mrem calculated by the utility in the summary of its 1976 environmental report, in which no account is taken of the Sr-90 in milk since it is claimed "to be unrelated to plant operations." (23)

These doses are some 50 times larger than bone marrow doses from a typical chest - x-ray (2-4 mrems).[24] Furthermore, these Sr-90 doses are comparable with those known to double the risk of childhood cancers and leukemia for infants following diagnostic x-rays during pregnancy as determined by the large-scale statistical studies of Dr. Alice Stewart at Oxford University[25] and Dr. Brian McMahon at Harvard,[26] which range from about 1200 mrems for exposure of the full-term infant to as low as 80 mrem for a fetus exposed in the first three months of development.[25]

Finally, these large Sr-90 doses from normal operation of nuclear reactors as determined from the detailed measurements of the utility's own monitoring organization must be compared with the recommendation of the National Academy of Sciences in its 1972 report,[27] where it is recommended that the dose from the generation of nuclear power should not exceed a small fraction of the natural radiation background of about 100 mrem/year. In fact, the Academy Report expressed the view that "societal needs can be met with far lower average exposures and lower genetic risk than permitted by the current Radiation Protection Guide."

The dose from the strontium - 90 in the local milk and diet must also be compared with the new (Appendix I) regulations of the N.R.C.,[28] which call for less than 15 mrem per year to any organ as a result of iodine and particulates such as Sr-90 and CS-137 released to the air as given on page 1.109-15 of the Regulatory Guide 1.109. (Table 6)

The average level of 35.1 pCi/l in the goat milk near the Haddam Reactor at two miles, and the level of 17.3 pCi/l Sr-90 in cows milk (five miles north-west, Station 20)[29] inidcates that although the releases from the Boiling Water Reactor (BWR) at Millstone are larger by about four times, the releases of these most biologically hazardous of all fission products is by no means negligible for commercial Pressurized Water Reactors (PWR). Comparison with the releases from the much smaller PWR at Rowe, Massachusetts, indicates that it is apparently the effort to operate the new large reactors at higher temperatures and with thinner fuel rod claddings in order to increase their thermal efficiency that has been primarily responsible for the great increase in radioactive releases to the environment.[30] (See Table 8)

These results also indicate that existing environmental statements for nuclear reactors do not reflect the true population doses observed after a few years of actual operation.[31]

For the case of the Millstone plant, the average dose alone from the Strontium - 90 in the milk and other food is some 500 times larger than the value of 0.13 mrem/yr. average dose to the population claimed in the summary of the environmental report.[32] The average bone dose to adults is found to be about 75 mrem from the ingestion of Sr-90 by adults consuming the local milk in 1976, and some five times greater for the total amount of Sr-90 accumulated in the bones of residents in the area since the plant went into operation.

The detailed calculation of the dose is summarized in Tables 9, 10, 11. Table 9 shows the annual average concentration of Sr-90 in the milk around Millstone as measured at three sampling stations located within a radius of about 10 to 15 miles starting in 1970.[1] Also shown in this table are the Sr-90 concentrations for Hartford, Connecticut, located some 35-40 miles to the north-west, and the U.S. average concentrations measured by the E.P.A. in its pasteurized milk network (PMN) for some 50 to 60 locations in the U.S.(33)

It is seen that in general, the Hartford milk concentration is very closely equal to that for the U. S. average between 1970 and 1975, so that the U.S. average, representing world-wide fallout from nuclear tests, can be used as a control for the concentrations found near Millstone.

Also shown are the excess average concentrations in the three locations near Millstone over the U.S. average, which are seen to increase from 1.8 pCi/l in 1971 to a maximum of 10.8 pCi/l in 1974. It is seen that since 1973, the excess Sr-90 near Millstone has exceeded that due to world-wide weapons testing by about two times. Thus, for the years 1973 to 1976, about two-thirds of the measured Sr-90 near Millstone must be attributed to releases from the plant, and only about one-third can be attributed to weapons fallout.

Based on these measured milk concentrations, it is now possible to obtain the average annual dose to bone as follows. First, one can obtain the total daily intake of Sr-90 from the total diet by multiplying the amount in one liter of milk consumed per day by three, according to the measurements of the Connecticut Department of Health.(34)

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1. A fourth station (No. 23A) located in a direction away from the two prevailing directions served as "control" after 1972.

This daily intake, when multiplied by 365 then gives the yearly ingestion of Sr-90 which accumulates in bone. One can then utilize the dose factors listed in the N.R.C. Regulatory Guide NUREG - 1.109 Tables A3 to A-6 to obtain the annual dose for a specific organ and a specific age group due to this annual intake of Sr-90.

This has been done in Tables 10-11 for the years following the start-up of the Millstone Reactor in October of 1970, for the case of bone in children and adults.

Inspection of these tables reveals the following important facts:

1. The yearly dose to the bone of children due to the combined amounts of Sr-90 from bomb tests and Millstone releases increased from 166 mrem in 1971 to a high of 283 mrem in 1973, compared with a normal annual background from cosmic rays and other natural sources of only 70 mrem, or some 400% of natural background radiation.
2. The cumulative dose to the bone of children living in the area since 1970 from Sr-90 in the milk and food produced near Millstone reached 1,356 mrem by 1976, compared to a dose from natural background of only 420 mrem during the same period.
3. Considering only the portion of the Sr-90 in excess of the fallout levels, the annual bone dose for children reached a peak of 204 mrem in 1974, and was still at 169 mrem in 1976. After six years of operation, the cumulative dose or "dose-commitment" from Millstone had reached 809 mrem to bone.
4. For adults, the bone dose due to all sources of Sr-90 increased from 73 mrem per year in 1971 to 125 mrem per year

in 1973, decreasing slightly to 108 mrem by 1976.

5. The dose due to the "excess" Sr-90 over that due to world-wide fallout Sr-90, increased from 15 mrem to bone in 1971 to 75 mrem in 1976. This is 577 times larger than the average dose of 0.13 mrem claimed by the utility for that year when Sr-90 is disregarded.

6. The total population exposure in man-rems may be estimated by multiplying the average bone dose by the number of people drinking the milk. Since inspection of Fig. 4 shows that the milk as far away as Providence shows a peak of radioactivity at the same time as the milk near Millstone in 1976 with a peak height of about half that of the nearby milk, one can estimate that the population of Rhode Island receives about half as much radioactivity as the people in New London County where the reactor is located.

Thus, the total population dose can be obtained by taking the population of New London County (240,000) and adding to it half the population of Rhode Island (1/2 of one million, or 500,000), and multiplying the total by the annual Sr-90 bone dose.

The result is shown for each year since 1970 in Table XI The population man-rems to bone due to Sr-90 alone are seen to have increased from 11,100 in 1971 to 55,500 in 1976, while the total cumulative man-rems for the duration of plant operation reached a total of 264,920 man-rem by 1976.

At the valuation of $1000 per man-rem assigned for purposes of cost-benefit studies by the NRC in existing regulations[35], this means that the annual health costs of operating the Millstone plant have reached a level of at least 55.5 million dollars by 1976, with a cumulative cost since start-up of 265 million dollars, ignoring the contribution of Cs-137 and I-131. These must be compared with the values one arrives at when the Sr-90 contribution is left out of consideration, namely 0.13×10^{-3} rem $\times 0.74 \times 10^{6}$ or 96 man-rems, with a cost of $96,000. The failure to consider Sr-90 doses therefore underestimates the total man-rems and health costs to society relative to fossil fuel plants by more than 500 times, considering that the actual bone-dose factors for infants, children and adolescents in the total population are significantly greater than for adults.(36)

Not only have the maximum individual and average population doses been grossly underestimated by the failure to take the airborne releases of strontium - 90 into account that enter the milk and food - chain, but also the dose to the whole body or the soft tissue organs has thereby been greatly understated.

This follows from the fact that the N.R.C. Regulatory Guide 1.109 Table A-3 to A-6 gives a whole body dose from the ingestion of Sr-90 which is about one-fourth of the dose to bone. Thus, for the adult, the whole body dose factor in Table A-3 is D.00186 mrem/pCi, compared with 0.00761 mrem/pCi for bone. (See Appendix V)

For the infant, the situation is even more serious since both the bone and whole body doses per unit Sr-90 intake are three times larger than for the adult. Thus, Table A-6 of the F.R.C. Guide gives 0.0251 mrem/pCi for infant bone, and 0.0064 mrem/pCi for soft tissue including the reproductive organs and the glands that control body growth and metabolism.

The result is that the maximum annual whole body dose due to

Sr-90 ingestion alone is one-fourth of the maximum bone dose to a one year old infant of 314 mrem/year for the case of an infant given goat milk, or 78.5 mrem/year. This may be compared to the maximum permissible whole body dose of 5 mrem/year required by the F.R.C.'s Appendix I rules reproduced in Table 6 or the 15 mrem/year to any organ from Sr-90 or other particulates.

Again, the whole body man-rems for the population drinking the milk and eating the food produced in the area are one-quarter of the bone man-rems of 55,000 or 13,750 man-rems in 1976, giving an accumulated whole body dose of 66,230 associated with a health cost of 66.2 million dollars since the Millstone Plant began operation. For a projected 30 year life of the plant, even if the strontium - 90 levels released to the environment were to drop sharply by greatly curtailing the emissions, the already accumulated bone and therefore the whole body concentrations of Sr-90 for adults would diminish only slowly so that at a minimum as a result of excretion and radioactive decay over the remaining 23 years, the annual bone and whole body man-rems would still be one-half to one-third what they were in 1976.

Likewise, the impact on local animal, fish and bird reproduction as well as disease produced by the Sr-90 already accumulated in the soil and sediment will diminish only slowly due to the 28 year half life of Sr-90, thus exacting its environmental toll for decades to come, no matter how successful the efforts might be to lower the additional amounts of Sr-90 discharged annually into the air and rivers of the area.

<u>Conclusions:</u>

1. The evidence on the gradual build-up of Sr-90 in the local cow

and goat milk around both the Haddam Neck and Millstone Point nuclear plants while elsewhere Sr-90 levels were steadily decreasing indicates that the high levels of Sr-90 in the nearby milk cannot be explained by fallout. Furthermore, the évidence for many-fold rises of Sr-90 in the milk within a matter of months following shut-down during 1973-1976 to levels not seen for the U.S. as a whole since the end of large scale nuclear testing in 1963 clearly rules out the possibility that these levels of Sr-90 can be completely explained in terms of fallout from nuclear weapons tests.

2. This conclusion is supported by the existence of a similar pattern in the milk concentrations of Cs-137 which is known to accompany Sr-90 in nearly constant proportions.

3. The evidence of growing accumulations of Sr-90 in the environment around these plants and the need to include it in dose calculations is further supported by the measured pattern of airborne Sr-90 concentrations and soil concentrations that are much larger to the north-east than to the west and north of the Millstone plant as shown in Appendix VII.

4. The detailed environmental measurements carried out by the monitoring organizations employed by the utility show that the Sr-90 concentrations in the milk and diet cannot be left out in calculating either the maximum doses to individuals or the average doses to the population measured in man-rems, as was done by the utility in its reports to the N.R.C. and by the N.R.C. in its report to Congressman C. J. Dodd in September 1977, a copy of which is enclosed as Appendix I. . The reson is that a single strontium unit (pCi) per liter of milk

every day, when the total dietary intake is considered, leads to an annual dose to the bone of a child of 18.8 mrem. This is about 20% of the annual dose from natural background radiation, and exceeds all other sources of radiation in importance. Yet the excess Sr-90 levels were as high as 10 pCi/l in the milk over periods of a year.

5. By either failing to examine the environmental reports in detail, by failing to recognize the crucial importance of strontium - 90 or by not questioning the utility's practice of leaving out the Sr-90 doses in the milk and diet in calculating the doses, the Nuclear Regulatory Commission and the Environmental Protection Agency failed in their primary duty to protect the public health and safety since the population doses and therefore the health effects were under estimated by anywhere from 500 to 2000 times.[37] The resulting health costs to the nation in man-rems per plant, instead of being in the range of 10 to 100 man-rems per year, must now be regarded as in the range of 10,000 to 100,000 man-rems, or in hundreds of millions of dollars for the 5 to 8 years of operation of the two Connecticut plants at the presently accepted health cost of 1,000 dollars per man-rem.

6. Since there is evidence that other nuclear plants have emitted comparable amounts of Sr-90 into the air as Haddam Neck and Millstone, (38) an immediate investigation by the legislatures of the states as well as by Congress is required to end the serious threat to human health that has resulted from the failure of the regulatory agencies of the Federal Government to protect the health and safety of the people living near these plants.

REFERENCES

1. "Health Effects Attributable to Coal and Nuclear Fuel Cycle Alternatives", NUREG-0332 (September 1977 Draft) and references cited therein.

2. See for example the summary of the 1976 environmental report for the Millstone Nuclear Power Station, page 1-1, (Northeast Nuclear Energy Company, Dockets 50-245 and 50-336, March 31, 1977) (Reproduced in Appendix III).

3. See environmental reports for Haddam Neck and Millstone Nuclear Reactors for 1974-1976 for cows milk and goat milk (Northeast Nuclear Energy Company)

4. The average daily levels of Sr-90 in pasteurized fluid milk for Connecticut were 8 pCi/l in 1961, 11 pCi/l in 1962, 23 pCi/l in 1963, and 20 pCi/l in 1964. (Testimony of J. G. Terrill, Jr., U.S. Department H.E.W. page 371 ff, Hearings of the Subcomm. on Research, Development, and Radiation, Joint Comm. on Atomic Energy, 89th Congress, June 29-30, 1965)

5. Reference 3, 1976, Millstone, Table 7. (Reproduced as Table 1 in the present report, and plotted in Figure 1)

6. "Environmental Radiation Data", U.S. E.P.A., Office of Radiation Programs, Monthly Reports prior to January 1975, quarterly reports since January 1975. Report number 7 for July - September 1976 milk levels of Sr-90.

7. Reference 6, Table 12. (Reproduced in Table 2(a))

8. Reference 6, Report number 7, Table 9. (Reproduced as Table 2(b) in present report)

9. Reference 3, 1976 Millstone Plant ,Table 8 (Reproduced as Table 3 in present report)

10. "Radiological Environmental Report for the Millstone Point Site", 1976 (Northeast Nuclear Energy Company) (March 31, 1977) page C-1 ff.

11. Reference 6, quarterly reports numbers 5, 6, 7, and 8 for 1976 Cs-137 in milk. (Reproduced in Figure 4 and Table 4 of the present report).

12. "Evaluation of Radioactive Effluents from Millstone Unit No. 1", Office of Nuclear Reactor Regulation. (September 1977) N.R.C. (Copy inclosed in Appendix).

13. "Radioactive Releases from Nuclear Reactors", N.R.C. Report NUREG-0218 (March 1977)

14. Reference 6, 1975, Report Number 3 for July - September 1975.

15. Federal Radiation Council Reports numbers 1 and 2, May 13, 1960 and September 1961 (U.S. Government Printing Office, Washington, D.C.)

16. U.S. E.P.A. Drinking Water Standards adopted June 24, 1977. (See E.P.A. - 902/4-77-009, Region II, 1975-76 ERAMS Summary Data Report, page 4) Note that the level of 8 pCi/l Sr-90 does not reflect any decrease in allowable levels since the F.R.C. Report Number 2 (1961), representing an infant bone dose of 7.5 mrem from water intake alone or almost 100% of the normal background radiation level, rather than a few percent as recommended by the N.H. Academy of Sciences (Reference 27).

17. "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I." Regulatory Guide 1.109, N.R.C., March 1976.

18. "Natural Radiation Exposure in the United States", D. T. Oakley, U.S. E.P.A. (ORP./SID 72-1) (June 1972) page 39 gives 84 mrem/year average for the U.S. and 65 mrem/year for coastal plain areas such as Connecticut.

19. Reference 3 1976, Table 8, Farm Number 24 (Reproduced in Table 3).

20. Reference 3, 1976, Table 8, Farm Number 25A (Reproduced in Table 3).

21. Although the 1961 F.R.C. Report Number 2 estimated that the bone marrow dose is about one-third of the bone dose (See Ref.(15) and Table (5)), the 1969 U.N. Scientific Committee Report on the Effects of Atomic Radiation, Table XIX, page 57 gives a revised estimate of 50% (64 mrem vs. 130 mrem bone dose due to Sr-90 for all Nuclear tests prior to 1968).

22. "Radiological Surveillance Study at the Haddam Neck P.W.R. Nuclear Power Station", E.P.A. - 520/3-74-007 (December 1974) Section 7.7, page 109 gives an average of 8.1 μr/hr. offsite locations, or 70 mrem per year in 1970-71. This is in sharp contrast with the claim of the utility company in Reference 2 that the normal background radiation in south-eastern Connecticut was 129 mrem per year in 1976, and indicating a significant rise in background from Cs-137 releases. (See Appendix VI)

23. Reference 2, Paragraph 3 reads as follows: "The observed results indicate that the predominant radioactivity at offsite locations are from nonplant related sources such as fallout from nuclear weapons tests and from naturally occurring nuclides." The N.R.C. report to Congressman C. J. Dodd (Ref. 12) gives an even lower average dose of 0.04 mrem in 1976 for Millstone operations.

24. "A System for Estimation of Mean Active Bone Marrow Dose" R. E. Ellis et al., U.S. Department of H.E.W. (September 1975), Table 4, page 16. (DHEW - FDA - 76 - 8015) (Reproduced as Appendix IV).

25. A. Stewart and G. W. Kneale, Lancet 1, 1185 (1970)

26. B. MacMahon, J. National Cancer, volume 28, 1173 (1962).

27. "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation", National Academy of Sciences (November 1972) Summary and Recommendations, page 1-3.

28. Reference 17, page 1.109-15 (See Table 6 of present report)

29. Reference 3, 1976 Haddam Neck environmental report, Table 8 (Reproduced as Table 7(a) in the present report)

30. "Report on Releases of Radioactivity in Effluents and Solid Waste from Nuclear Power Plants for 1972" Division of Regulatory Operations, U.S. AEC, August 1973. Table 4A gives airborne halogens and particulates for the Yankee (Rowe) Reactor in 1972 as 0.00077 Ci vs. 0.01810Ci for Connecticut Yankee (Haddam) and 1.32000 Ci for Millstone.

31. The Existing Environmental Impact Statements prepared for both Nuclear reactors and Nuclear fuel reprocessing plants under the requirements of the N.E.P.A. act have all been based on the assumption that no significant amounts of Sr-90 escape via atmospheric releases, and not on the actual environmental measurements for large reactors operating more than 3 to 4 years such as Haddam Neck or Millstone. As a result, the calculated health impacts have been seriously underestimated in all such statements.

32. See reference 2, and the N.R.C. dose estimates for Millstone (Ref. 12) which give equally low average doses when Sr-90 in the milk and diet are ignored.

33. Reference 6 for years 1970-1976.

34. Radiation data and reports; E.P.A.; A series of reports, for instance in November 1967, page 646-647 gives 33 pCi/day of Sr-90 in the total diet in June 1967 while Hartford milk was 11 pCi/l in July 1967.

35. Appendix I to 10CFR50, issued in final form April 30, 1975 (Fed. Register May 5, 1975)

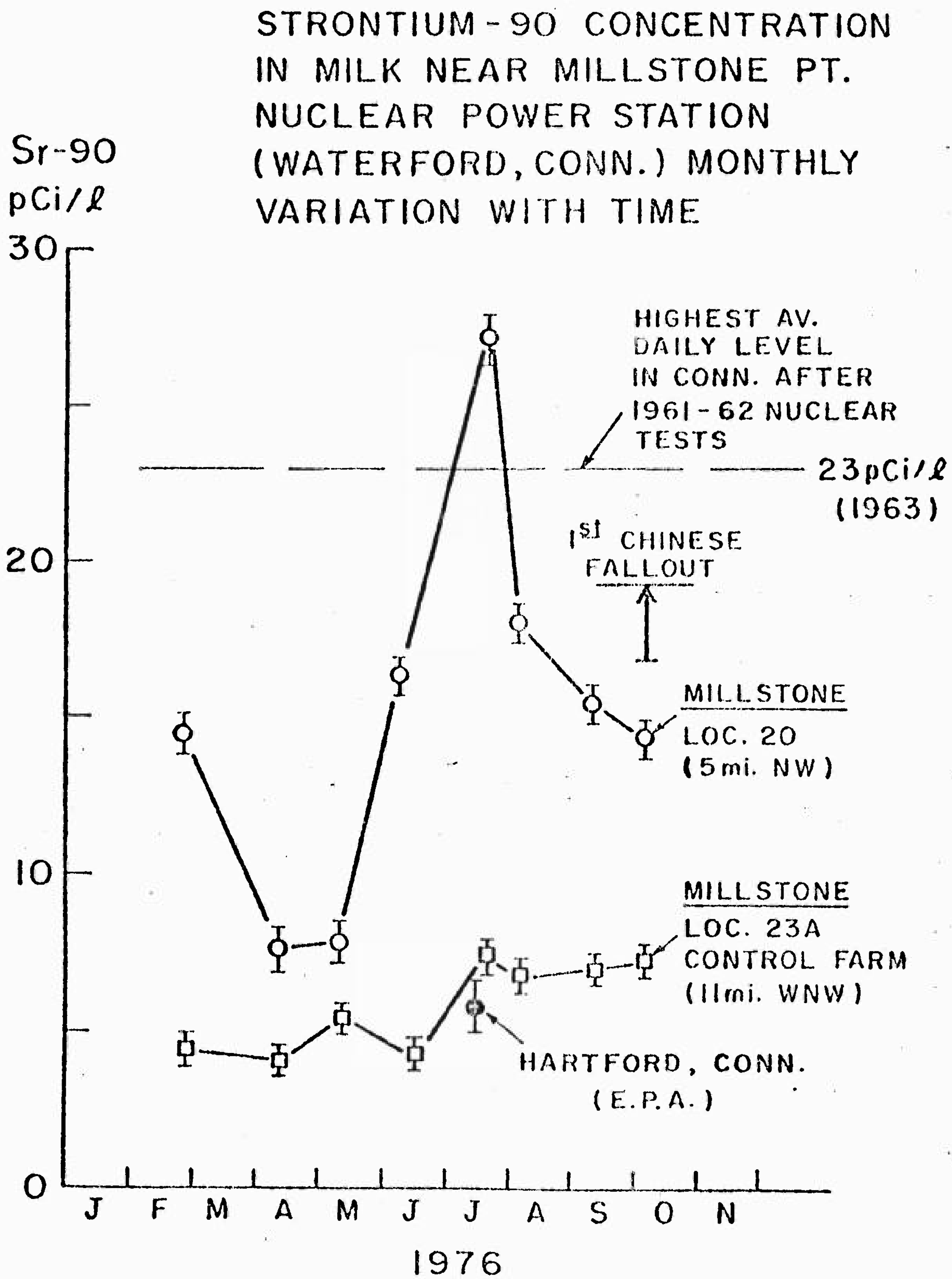
36. NUREG-1.109 (Ref. 17), Tables A-3 to A-6. (Population aver. is 1.4 X adult dose)

37. Using the 1976 Millstone environmental report average dose to population of 0.13 mrem per year (Ref. 2) and the N.R.C. report to

Congressman C. J. Dodd (Ref. 12) which gives 0.04 mrem per year, as compared with the annual adult bone-dose due to Sr-90 alone for 1976 of 75 mrem/year.

38. For the year 1974, the annual report of Environmental Radiation for New York State gives maximum Sr-90 concentrations in the milk near a series of nuclear reactors that can be compared with the U.S. average for 12 months ending July 1974 of 5 pCi/l, typical for the eastern U.S. and at sites far from operating nuclear facilities such as East Hampton, N.Y. (5±2 pCi/l).

1. Indian Point Reactor - (Westchester County , Bedford: 18±3 pCi/l maximum and 14 pCi/l average).
2. 9 - Mile Point Reactor - Oswego County Scriba: 17±2 pCi/l maximum and 12 pCi/l average).
3. Brookhaven National Laboratory (Gas Cooled Testing Reactor) Suffolk County (Site M515101) 20±4 pCi/l maximum and 11 pCi/l average).



STRONTIUM-90 CONCENTRATION IN MILK NEAR MILLSTONE PT. NUCLEAR POWER STATION (WATERFORD, CONN.) MONTHLY VARIATION WITH TIME
Sr-90 pCi/ℓ
30
20
10
0
HIGHEST AV. DAILY LEVEL IN CONN. AFTER 1961-62 NUCLEAR TESTS
23pCi/ℓ (1963)
1st CHINESE FALLOUT
MILLSTONE
LOC. 20 (5mi. NW)
MILLSTONE
LOC. 23A CONTROL FARM (11mi. WNW)
HARTFORD, CONN. (E.P.A.)
J F M A M J J A S O N
1976

FIGURE 1

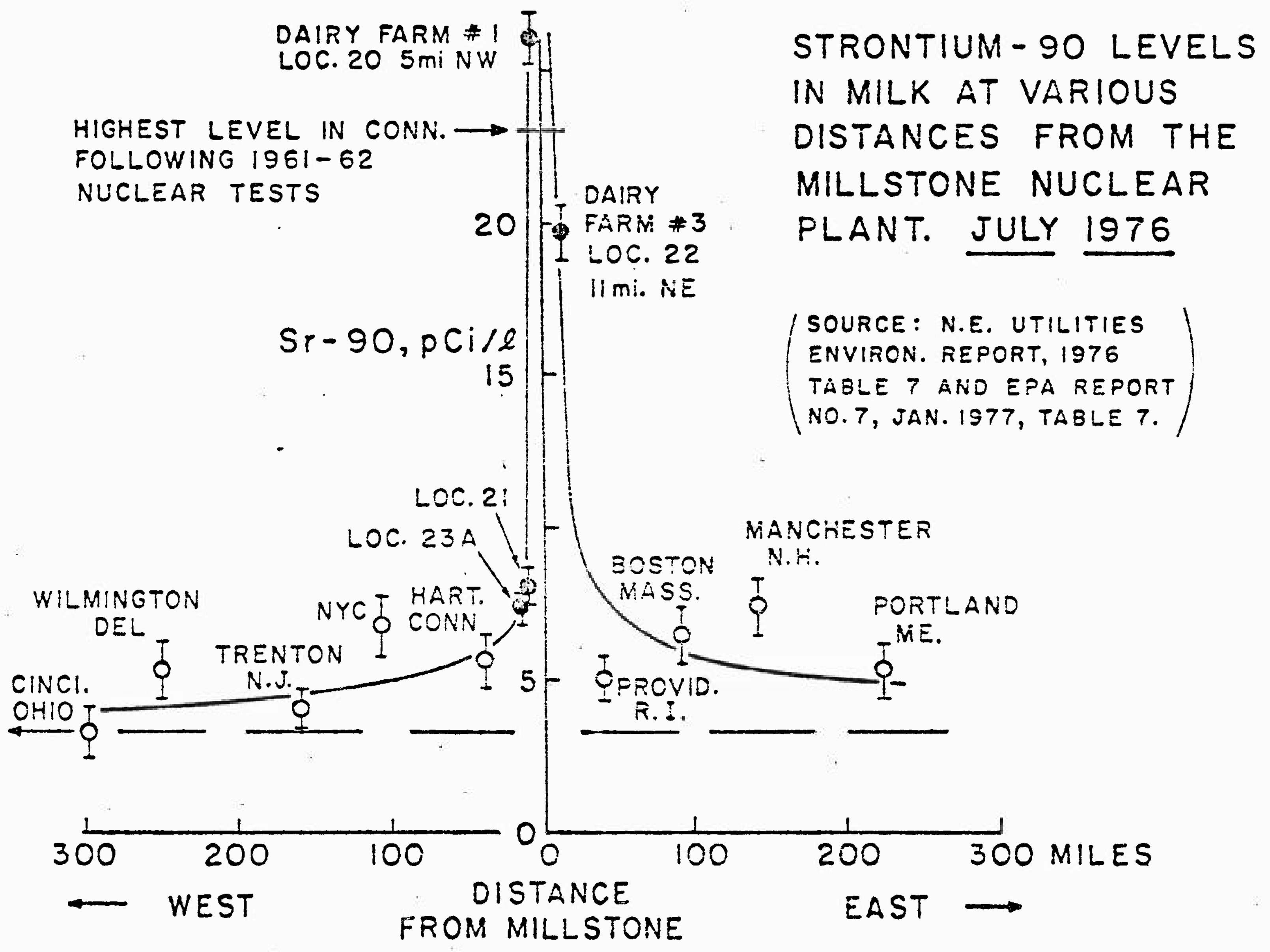

STRONTIUM-90 LEVELS IN MILK AT VARIOUS DISTANCES FROM THE MILLSTONE NUCLEAR PLANT. JULY 1976
(SOURCE: N.E. UTILITIES ENVIRON. REPORT, 1976 TABLE 7 AND EPA REPORT NO. 7, JAN. 1977, TABLE 7.)
DAIRY FARM #1 LOC. 20 5mi NW
HIGHEST LEVEL IN CONN. FOLLOWING 1961-62 NUCLEAR TESTS
DAIRY FARM #3 LOC. 22 11mi. NE
Sr-90, pCi/ℓ
20
15
5
0
LOC. 21
LOC. 23A
WILMINGTON DEL
NYC
HART. CONN
TRENTON N.J.
CINCI. OHIO
BOSTON MASS.
MANCHESTER N.H.
PORTLAND ME.
PROVID. R.I.
300
200
100
0
100
200
300 MILES
WEST
EAST
DISTANCE FROM MILLSTONE

FIGURE 2(a)

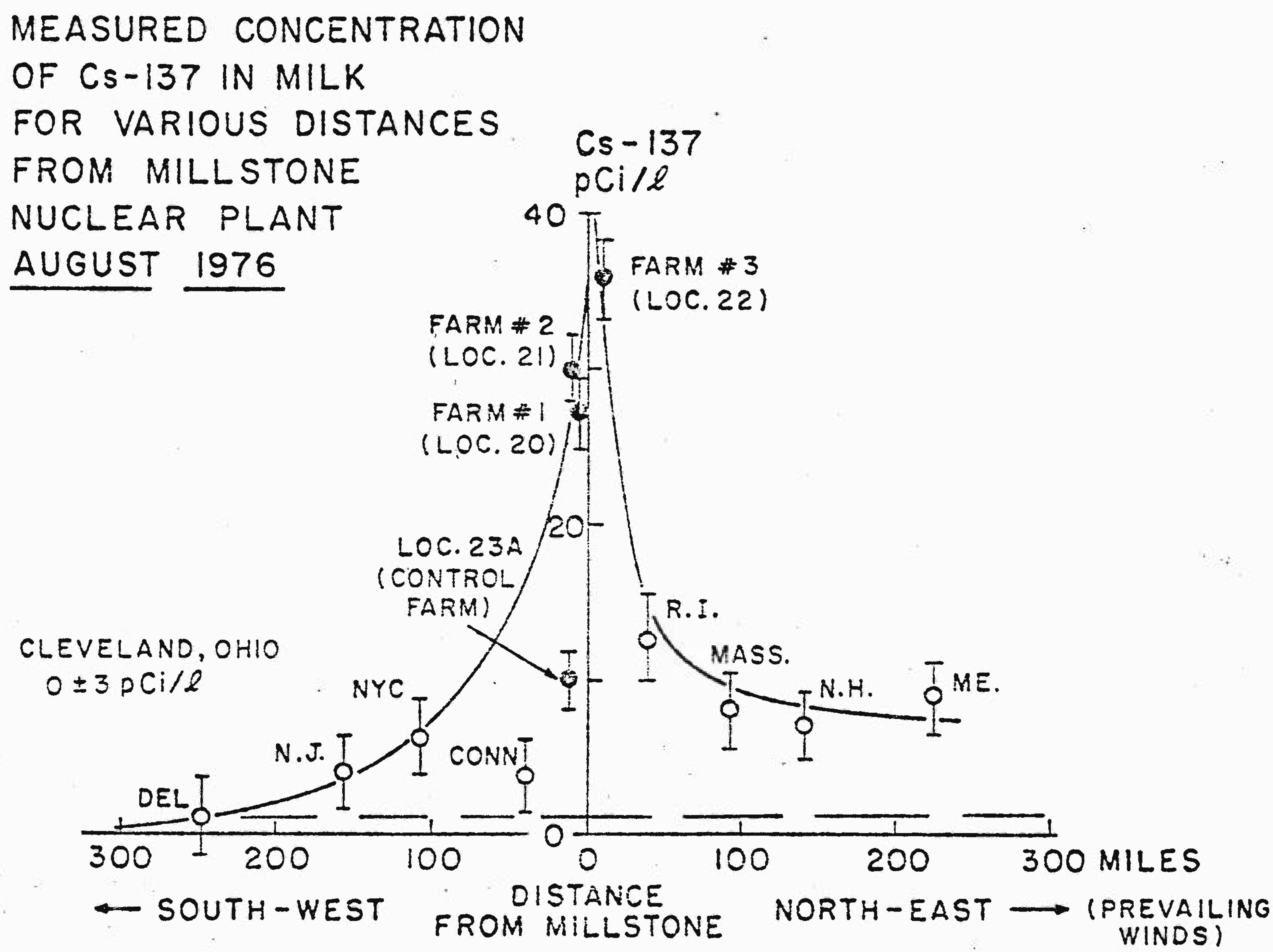
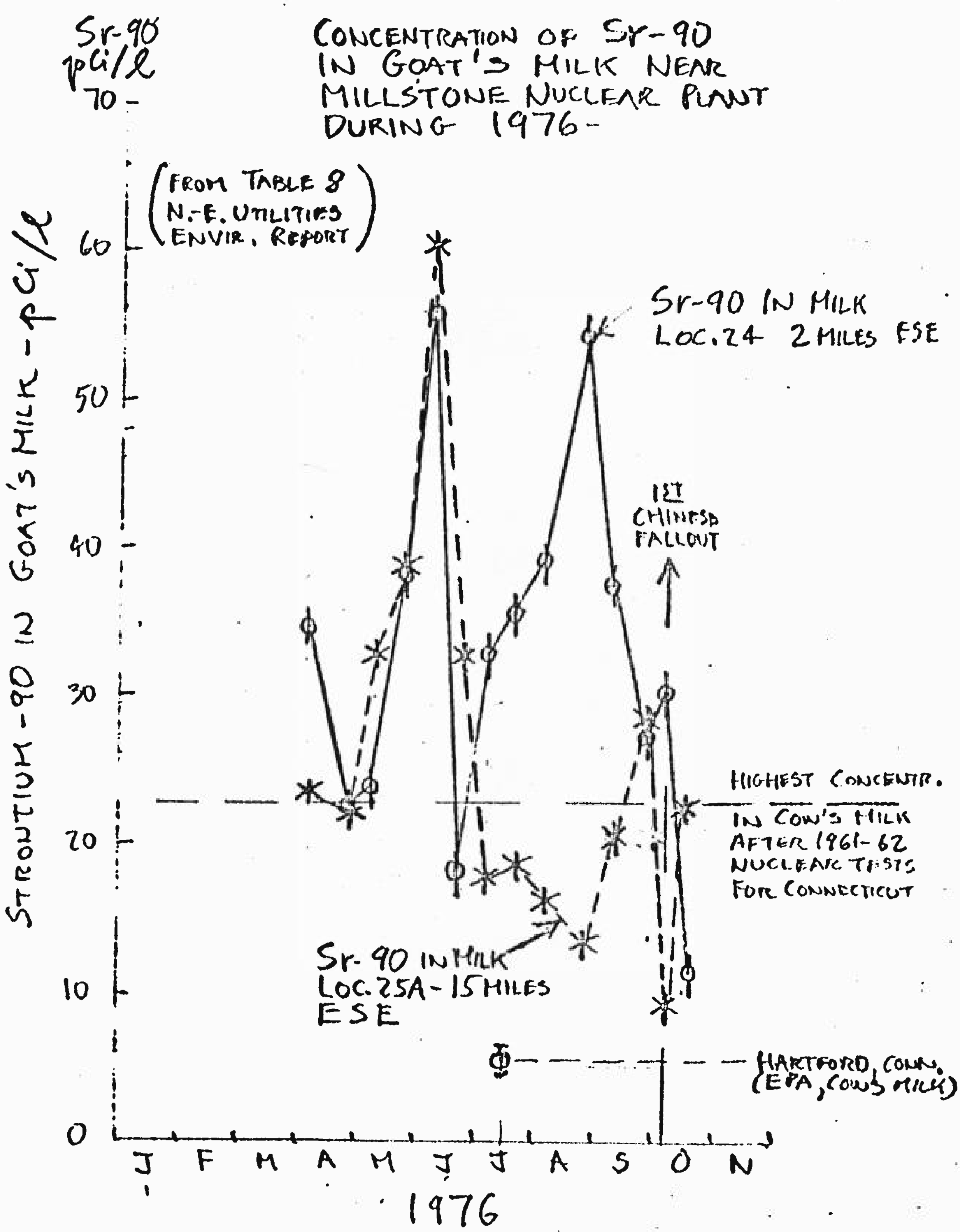

MEASURED CONCENTRATION
OF Cs-137 IN MILK
FOR VARIOUS DISTANCES
FROM MILLSTONE
NUCLEAR PLANT
AUGUST 1976
Cs-137
pCi/ℓ
40
20
0
FARM #3
(LOC. 22)
FARM #2
(LOC. 21)
FARM #1
(LOC. 20)
LOC. 23A
(CONTROL
FARM)
CLEVELAND, OHIO
0 ± 3 pCi/ℓ
DEL
N.J.
NYC
CONN
R.I.
MASS.
N.H.
ME.
300
200
100
0
100
200
300 MILES
← SOUTH-WEST
DISTANCE
FROM MILLSTONE
NORTH-EAST → (PREVAILING
WINDS)

FIGURE 2(b)



Sr-90 pCi/l
CONCENTRATION OF Sr-90 IN GOAT'S MILK NEAR MILLSTONE NUCLEAR PLANT DURING 1976
(FROM TABLE 8 N.-E. UTILITIES ENVIR. REPORT)
STRONTIUM-90 IN GOAT'S MILK - pCi/l
70
60
50
40
30
20
10
0
Sr-90 IN MILK LOC. 24 2 MILES ESE
1ST CHINESE FALLOUT
HIGHEST CONCENTR. IN COW'S MILK AFTER 1961-62 NUCLEAR TESTS FOR CONNECTICUT
Sr-90 IN MILK LOC. 25A - 15 MILES ESE
HARTFORD, CONN. (EPA, COW'S MILK)
J F M A M J J A S O N
1976

FIGURE 3

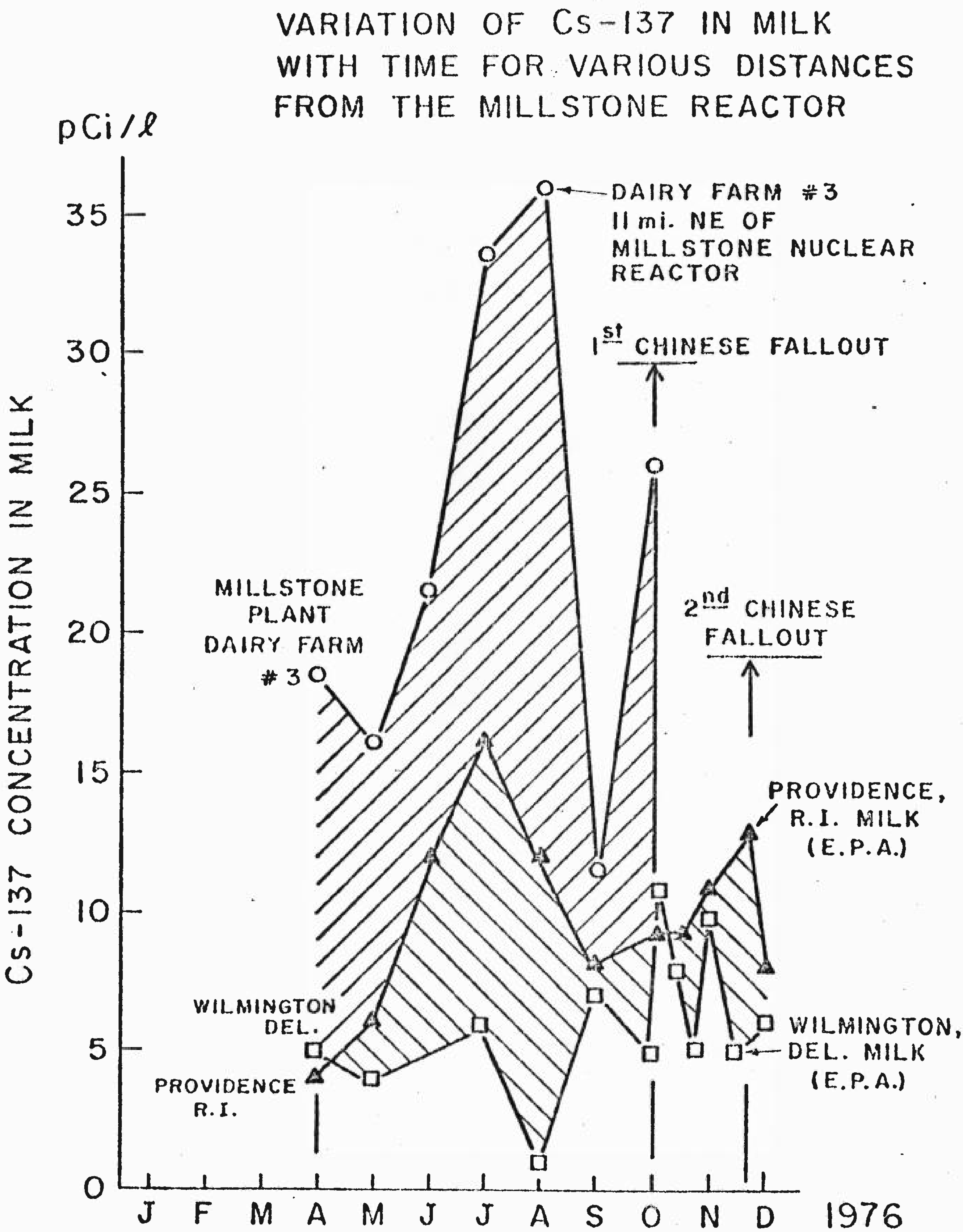

VARIATION OF Cs-137 IN MILK
WITH TIME FOR VARIOUS DISTANCES
FROM THE MILLSTONE REACTOR
pCi/ℓ
Cs-137 CONCENTRATION IN MILK
35
30
25
20
15
10
5
0
J F M A M J J A S O N D 1976
DAIRY FARM #3
11 mi. NE OF
MILLSTONE NUCLEAR
REACTOR
1st CHINESE FALLOUT
2nd CHINESE
FALLOUT
MILLSTONE
PLANT
DAIRY FARM
#3
PROVIDENCE,
R.I. MILK
(E.P.A.)
WILMINGTON
DEL.
PROVIDENCE
R.I.
WILMINGTON,
DEL. MILK
(E.P.A.)

FIGURE 4

TABLE 1

Cows milk measurements near Millstone Plant, reproduced from Environmental Statement for 1976.

TABLE 7
DAIRY MILK
(PCI/L)

LOCATION	COLLECTION DATE	SR-89	(+/-)	SR-90	(+/-)	I-131	(+/-)	CS-137	(+/-)
20	2/23/76	0.0	0.7	14.5	0.5	0.01	0.06	22.7	1.1
20	4/12/76	1.6	1.2	7.7	0.4	0.0	0.08	12.4	0.4
20	5/10/76	0.3	1.1	7.9	0.3	0.30	0.09	13.5	0.9
20	6/ 7/76	0.2	1.5	16.2	0.6	0.0	0.08	26.3	0.8
20	7/19/76	0.0	1.7	27.1	0.8	0.05	0.08	32.0	2.0
20	8/ 2/76	0.0	2.0	18.0	0.6	0.09	0.10	27.0	2.0
20	9/13/76	1.1	0.7	15.2	0.5	0.0	0.08	24.2	1.1
20	10/ 5/76	37.0	2.0	14.2	0.7	310.00	6.00	19.5	1.5
21	2/23/76	0.0	0.7	10.2	0.4	0.05	0.08	28.0	2.0
21	4/12/76	1.5	1.2	6.9	0.4	0.0	0.07	17.3	0.8
21	5/10/76	0.4	1.0	7.4	0.3	0.0	0.08	10.3	0.8
21	6/ 7/76	0.7	0.6	9.3	0.4	0.10	0.06	15.8	1.1
21	7/19/76	0.9	0.7	8.0	0.4	0.0	0.06	15.7	0.5
21	8/ 2/76	0.0	1.1	13.1	0.5	0.13	0.09	30.0	2.0
21	9/13/76	0.3	0.9	12.9	0.9	0.0	0.07	31.3	1.3
21	10/ 5/76	44.0	2.0	11.3	0.6	416.00	8.00	16.8	1.4
22	2/23/76	0.0	0.5	8.6	0.3	0.07	0.08	16.7	1.0
22	4/12/76	0.0	0.6	6.8	0.3	0.0	0.08	18.5	0.5
22	5/10/76	1.6	1.3	7.7	0.4	0.0	0.08	16.0	1.0
22	6/ 7/76	0.3	0.9	11.4	0.5	0.0	0.06	21.3	1.2
22	7/19/76	0.0	1.1	19.7	0.6	0.0	0.05	33.3	1.7
22	8/ 2/76	0.0	2.0	16.3	0.6	0.0	0.07	36.0	3.0
22	9/13/76	1.7	0.9	10.8	0.5	0.20	0.09	11.4	1.8
22	10/ 5/75	37.2	1.5	13.6	0.6	217.00	5.00	26.0	2.0
23A	2/23/76	0.0	0.4	4.5	0.3	0.05	0.08	11.8	1.1
23A	4/12/76	1.1	0.9	4.0	0.3	0.0	0.08	8.3	0.4
23A	5/10/76	0.5	0.9	5.2	0.3	0.0	0.07	13.6	1.0
23A	6/ 7/76	0.0	0.6	4.2	0.3	0.40	0.06	4.8	0.8
23A	7/19/76	0.0	0.8	7.4	0.5	0.02	0.06	5.6	0.9
23A	8/ 2/76	1.0	2.0	6.8	1.1	0.04	0.07	10.0	0.8
23A	9/13/76	0.4	0.6	7.0	0.4	0.0	0.08	13.7	1.3
23A	10/ 5/76	4.3	1.3	7.2	0.8	37.90	1.30	6.2	0.7

TABLE 2(a)

Pasteurized Milk Sr-90 concentrations in the U.S. for July 1976 reproduced from Environmental Radiation Data Report 7, U.S. E.P.A. Table 12.

Strontium-90 and Strontium-89 in Pasteurized Milk

Annual Report - July 1976

Location	^{90}Sr (pCi/l)	^{89}Sr (pCi/l)
AK:Palmer	NS	
AL:Montgomery	4.5±1.0	0±5
AR:Little Rock	6.7±1.5	0±5
AZ:Phoenix	.5± .4	1±5
CA:Los Angeles	1.4±1.1	-1±5
Sacramento	.3± .3	1±5
San Francisco	.06± .3	1±5
CO:Denver	2.8±1.6	-2±5
CT:Hartford	5.7±1.6	-2±5
CZ:Cristobal	1.9±1.0	0±5
DC:Washington	NS	
DE:Wilmington	5.2±1.7	1±5
FL:Tampa	2.8± .9	1±5
GA:Atlanta	6.9±2.0	-4±5
HI:Honolulu	1.1± .8	0±5
IA:Des Moines	3.8±1.1	0±5
ID:Idaho Falls	3.4±1.6	-1±5
IL:Chicago	4.4±1.4	0±5
IN:Indianapolis	4.1±1.0	-1±5
KS:Wichita	3.8±1.1	1±5
KY:Louisville	3.1± .8	2±5
LA:New Orleans	4.1± .9	5±5
MA:Boston	6.5±2.1	-1±5
MD:Baltimore	5.2±1.6	-2±5
ME:Portland	5.2±1.2	1±5
MI:Detroit	3.8±1.2	0±5
Grand Rapids	6.2±1.2	1±5
MN:Minneapolis	4.4±1.3	1±5
MO:Kansas City	3.8±1.4	-1±5
St. Louis	3.7±1.3	0±5
MS:Jackson	6.2±1.4	-1±5
MT:Helena	4.6±1.7	-3±5
NC:Charlotte	4.7± .9	1±5
ND:Minot	NS	
NE:Omaha	2.9±1.3	0±5
NH:Manchester	7.3±1.3	-1±5
NJ:Trenton	4.0±1.0	1±5
NM:Albuquerque	NS	

Strontium-90 and Strontium-89 in Pasteurized Milk

Annual Report - July 1976 - Continued

Location	^{90}Sr (pCi/l)	^{89}Sr (pCi/l)
NV:Las Vegas	.7± .6	0±5
NY:Buffalo	2.3± .8	2±5
New York	6.9±2.0	-1±5
Syracuse	3.1±1.1	0±5
OH:Cincinnati	3.2±1.2	1±5
Cleveland	4.5±1.4	0±5
OK:Okalahoma City	3.6± .9	0±5
OR:Portland	5.0±1.8	-2±5
PA:Philadelphia	4.7±1.0	0±5
Pittsburgh	7.2±1.9	-2±5
PR:San Juan	1.8±1.0	0±5
RI:Providence	5.0±1.3	0±5
SC:Charleston	5.6±1.4	-1±5
SD:Rapid City	4.7±1.4	-2±5
TN:Chattanooga	5.5±1.3	0±5
Knoxville	4.3±1.2	0±5
Memphis	5.1±1.3	-1±5
TX:Austin	1.1± .9	0±5
Dallas	4.7±1.4	-1±5
UT:Salt Lake City	NS	
VA:Norfolk	3.9±1.0	0±5
VT:Burlington	4.1±1.4	-1±5
WA:Seattle	2.0± .9	1±5
Spokane	3.0± .8	1±5
WI:Milwaukee	2.6±1.2	0±5
WV:Charleston	4.8±1.3	0±5
WY:Laramie	2.5±1.7	-1±5

NS - No sample.

TABLE 2(b)

Pasteurized milk Cs-137 concentrations in the U.S. for July 1976, reproduced from Environmental Radiation Data Report 7, U.S. E.P.A., Table 9.

Concentrations of Radionuclides in Pasteurized Milk

July 1976

Location	K Conc. (g/1)	Radionuclide Concentration (pCi/1 ± 2 Sigma Counting Error) ^{137}Cs	^{140}Ba	^{131}I
AK:Palmer	NS			
AL:Montgomery	1.56± .12	7± 7	-5± 9	-1± 7
AR:Little Rock	1.53± .12	3± 7	-5± 9	4± 7
AZ:Phoenix	1.51± .12	4± 7	1± 9	2± 7
CA:Los Angeles	1.51± .12	4± 7	2± 9	3± 7
Sacramento	1.56± .12	9± 7	0±10	-1± 7
San Francisco	1.57± .12	6± 7	-7± 9	2± 7
CO:Denver	1.41± .11	8± 7	0± 9	2± 7
CT:Hartford	1.42± .11	5± 7	3± 9	-1± 7
CZ:Cristobal	1.36± .11	28± 7	-1± 9	3± 7
DC:Washington	NS			
DE:Wilmington	1.43± .11	6± 7	-5± 9	0± 7
FL:Tampa	1.51± .12	32± 7	-6± 9	5± 7
GA:Atlanta	1.25± .11	10± 7	2± 9	-4± 7
HI:Honolulu	1.42± .11	13± 7	-5± 9	4± 7
IA:Des Moines	1.42± .11	10± 7	-2± 9	-1± 7
ID:Idaho Falls	1.47± .12	6± 7	-5± 9	-1± 7
IL:Chicago	1.38± .11	12± 7	-13± 9	2± 7
IN:Indianapolis	1.46± .11	9± 7	-12± 9	1± 7
KS:Wichita	1.40± .11	9± 7	-2± 9	-1± 7
KY:Louisville	1.46± .12	6± 7	0± 9	1± 7
LA:New Orleans	1.49± .12	10± 7	0± 9	0± 7
MA:Boston	1.47± .12	8± 7	-5± 9	1± 7
MD:Baltimore	1.43± .11	5± 7	-2± 9	1± 7
ME:Portland	1.44± .11	26± 7	-4± 9	0± 7
MI:Detroit	1.40± .11	7± 7	1± 9	-4± 7
Grand Rapids	1.44± .11	7± 7	-6± 9	-3± 7
MN:Minneapolis	1.42± .11	6± 7	3±10	0± 7
MO:Kansas City	1.59± .12	7± 7	-2± 9	-2± 7
St. Louis	1.47± .12	19± 7	-2± 9	-1± 7
MS:Jackson	1.36± .11	15± 7	-6± 9	-1± 7
MT:Helena	1.52± .12	12± 7	-4± 9	-1± 7
NC:Charlotte	1.41± .11	7± 7	-2± 9	2± 7
ND:Minot	NS			
NE:Omaha	1.50± .12	9± 7	-1± 9	0± 7
NH:Manchester	1.51± .12	11± 7	-10± 9	1± 7
NJ:Trenton	1.47± .12	12± 7	-4± 9	1± 7
NM:Albuquerque	NS			

Concentrations of Radionuclides in Pasteurized Milk

July 1976 (Continued)

Location	K Conc. (g/l)	Radionuclide Concentration (pCi/l ± 2 Sigma Counting Error) ^{137}Cs	^{140}Ba	^{131}I
NV:Las Vegas	1.57± .12	4± 7	-3± 9	1± 7
NY:Buffalo	1.46± .11	12± 7	-12± 9	0± 7
New York	1.51± .12	13± 7	-1± 9	-1± 7
Syracuse	1.50± .12	7± 7	-6± 9	0± 7
OH:Cincinnati	1.47± .11	9± 7	-11± 9	-1± 7
Cleveland	1.45± .11	5± 7	-3± 9	1± 7
OK:Okalahoma City	1.53± .12	7± 7	-1± 9	0± 7
OR:Portland	1.39± .11	6± 7	5± 9	1± 7
PA:Philadelphia	1.44± .11	5± 7	-9± 9	0± 7
Pittsburgh	1.46± .12	4± 7	-7± 9	-2± 7
PR:San Juan	1.47± .12	6± 7	-3± 9	1± 7
RI:Providence	1.52± .12	16± 7	-7± 9	-3± 7
SC:Charleston	1.41± .11	13± 7	2±10	-2± 7
SD:Rapid City	1.46± .11	4± 7	-3± 9	4± 7
TN:Chattanooga	1.47± .12	11± 7	-1± 9	-3± 7
Knoxville	1.43± .11	9± 7	-2± 9	1± 7
Memphis	1.54± .12	20± 7	7±10	-4± 7
TX:Austin	1.49± .12	8± 7	-3± 9	-4± 7
Dallas	1.58± .12	6± 7	-10± 9	-2± 7
UT:Salt Lake City	NS			
VA:Norfolk	1.47± .11	4± 7	-10± 9	0± 7
VT:Burlington	1.46± .12	9± 7	-3± 9	4± 7
WA:Seattle	1.57± .12	18± 7	-3± 9	0± 7
Spokane	1.44± .11	6± 7	-2± 9	-2± 7
WI:Milwaukee	1.52± .12	6± 7	-5± 9	-1± 7
WV:Charleston	1.44± .11	5± 7	-2± 9	-2± 7
WY:Laramie	1.45± .12	5± 7	-5± 9	4± 7

NS - No sample.

TABLE 3

Goat Milk data from Mill. Plant Environmental Report, 1976.

TABLE 8
GOAT MILK*
(PCI/L)

LOCATION	COLLECTION DATE	SR-89	(+/-)	SR-90	(+/-)	I-131	(+/-)	CS-137	(+/-)
24	4/12/76	1.6	1.4	34.4	0.6	0.0	0.20	51.1	0.8
24	4/26/76	0.0	1.4	22.8	1.3	0.60	0.20	64.0	2.0
24	5/10/76	0.1	1.0	24.0	0.5	0.30	0.20	44.0	2.0
24	5/25/76	0.0	1.2	38.1	0.7	1.77	0.14	80.0	2.0
24	6/ 7/76	0.0	2.0	56.0	0.8	0.44	0.15	171.0	4.0
24	6/22/76	0.0	3.0	18.3	0.9	0.03	0.10	104.0	1.0
24	7/ 6/76	0.0	2.0	33.2	1.4	0.82	0.14	70.3	1.5
24	7/19/76	0.0	1.2	35.8	0.7	2.70	0.20	67.0	2.0
24	8/ 2/76	0.0	2.0	39.3	0.9	2.30	0.20	127.0	4.0
24	8/24/76	0.0	2.0	54.2	1.0	0.53	0.15	65.9	1.5
24	9/13/76	1.2	0.2	37.7	0.3	1.40	0.11	45.4	1.4
24	9/28/76	1.0	2.0	27.8	0.7	3.40	0.20	35.0	2.0
24	10/ 5/76	7.0	2.0	30.1	0.9	484.00	11.00	64.0	2.0
24	10/19/76	8.2	1.2	11.9	0.6	860.00	20.00	53.0	2.0
25A	4/12/76	0.0	1.1	23.5	0.6	0.0	0.20	28.7	0.5
25A	4/26/76	1.1	1.5	22.6	0.5	0.0	0.20	15.4	1.1
25A	5/10/76	0.2	1.8	32.8	0.6	0.10	0.20	21.9	1.1
25A	5/27/76	0.0	1.2	39.1	0.7	0.07	0.11	21.1	0.9
25A	6/ 7/76	0.0	3.0	61.0	0.9	0.20	0.40	25.8	1.3
25A	6/22/76	1.0	5.0	32.9	1.5	0.84	0.15	28.1	1.1
25A	7/ 6/76	1.6	1.3	18.0	0.6	0.0	0.11	17.0	0.7
25A	7/19/76	0.0	1.0	18.3	0.6	0.20	0.20	15.7	1.3
25A	8/ 2/76	0.0	1.2	16.5	0.5	0.10	0.20	23.7	1.1
25A	8/24/76	1.7	1.0	13.7	0.5	0.0	0.12	29.8	1.2
25A	9/16/76[a]	3.0	2.0	20.9	0.8	0.18	0.05	28.8	1.3
25A	9/26/76	0.0	1.9	28.5	0.7	0.29	0.09	17.9	0.7
25A	10/ 5/76	0.0	1.1	9.6	0.6	1.60	0.20	6.7	0.7
25A	10/19/76	0.0	1.5	22.4	0.8	1.50	0.40	20.8	1.2

* No goat milk or pasture grass samples taken in February since none were available.

a I-131 analysis done on 9/13 sample.

Pasteurized milk data from E.P.A. Environmental Radiation Data Report 6 (Oct. 1976) Covering April-June 1976. (Data for Oct.-Dec. 1976, milk in report 8 containing the effect of Chinese Nuclear tests is too bulky to be reproduced here and is avail. from the E.P.A. Office of Radiation Programs.)

Concentrations of Radionuclides in Pasteurized Milk

April 1976

Location	K Conc. (g/l)	Radionuclide Concentration (pCi/l ± 2 Sigma Counting Error) ^{137}Cs	^{140}Ba	^{131}I
AK:Palmer	NS			
AL:Montgomery	1.55± .12	10± 7	3± 10	1± 7
AR:Little Rock	1.43± .11	10± 7	± 9	8± 7
AZ:Phoenix	1.54± .12	8± 7	5± 10	-5± 7
CA:Los Angeles	1.38± .11	1± 7	-8± 9	2± 7
Sacramento	1.47± .12	4± 7	-3± 9	0± 7
San Francisco	1.51± .12	4± 7	0± 9	3± 7
CO:Denver	1.45± .11	6± 7	-1± 9	1± 7
CT:Hartford	1.50± .12	4± 7	4± 10	-1± 7
CZ:Cristobal	1.55± .12	8± 7	2± 10	4± 7
DC:Washington	1.50± .12	6± 7	2± 10	0± 7
DE:Wilmington	1.55± .12	5± 7	0± 9	-1± 7
FL:Tampa	1.52± .12	35± 7	-6± 9	-4± 7
GA:Atlanta	1.29± .11	7± 7	-3± 9	-5± 7
HI:Honolulu	1.53± .12	6± 7	-2± 9	-4± 7
IA:Des Moines	1.62± .12	11± 7	3± 10	3± 7
ID:Idaho Falls	1.52± .12	10± 7	1± 10	2± 7
IL:Chicago	1.57± .12	11± 7	-1± 9	3± 7
IN:Indianapolis	1.48± .12	8± 7	2± 10	1± 7
KS:Wichita	1.51± .12	12± 7	2± 10	3± 7
KY:Louisville	1.43± .11	10± 7	0± 9	2± 7
LA:New Orleans	1.52± .12	9± 7	1± 9	5± 7
MA:Boston	1.57± .12	11± 7	0± 10	2± 7
MD:Baltimore	1.50± .12	7± 7	2± 10	1± 7
ME:Portland	1.61± .12	17± 7	3± 10	-1± 7
MI:Detroit	1.45± .12	9± 7	11± 10	0± 7
Grand Rapids	1.49± .12	14± 7	4± 10	-1± 7
MN:Minneapolis	1.54± .12	10± 7	0± 9	-2± 7
MO:Kansas City	1.42± .12	8± 7	0± 9	-2± 7
St. Louis	1.37± .11	10± 7	-2± 9	5± 7
MS:Jackson	1.55± .12	11± 7	-5± 9	2± 7
MT:Helena	NS			
NC:Charlotte	1.57± .12	13± 7	7± 10	0± 7
ND:Minot	1.60± .12	6± 7	0± 9	0± 7
NE:Omaha	1.34± .11	15± 7	0± 9	-1± 7
NH:Manchester	1.64± .12	17± 7	4± 10	2± 7
NJ:Trenton	1.46± .12	10± 7	3± 10	3± 7
NM:Albuquerque	NS			

Concentrations of Radionuclides in Pasteurized Milk
April 1976 - (Continued)

Location	K Conc. (g/l)	Radionuclide Concentration (pCi/l ± 2 Sigma Counting Error) ^{137}Cs	^{140}Ba	^{131}I
NV:Las Vegas	1.55± .12	6± 7	3± 10	7± 7
NY:Buffalo	1.53± .12	8± 7	1± 10	2± 7
New York	1.52± .12	25± 7	1± 10	3± 7
Syracuse	1 49± .12	12± 7	1± 9	-3± 7
OH:Cincinnati	1.49± .12	17± 7	0± 10	6± 7
Cleveland	1.49± .12	11± 7	-1± 9	0± 7
OK:Okalahoma City	1.56± .12	3± 7	1± 9	2± 7
OR:Portland	1.52± .12	18± 7	3± 10	2± 7
PA:Philadelphia	1.49± .12	13± 7	3± 10	0± 7
Pittsburgh	1.45± .12	7± 7	2± 10	2± 7
PR:San Juan	1.42± .11	8± 7	7± 10	-1± 7
RI:Providence	1.49± .12	4± 7	-9± 9	-3± 7
SC:Charleston	1.52± .12	16± 7	3± 10	1± 7
SD:Rapid City	1.53± .12	10± 7	-6± 9	1± 7
TN:Chattanooga	1.47± .12	10± 7	4± 10	-1± 7
Knoxville	1.42± .11	9± 7	5± 10	3± 7
Memphis	1.63± .12	6± 7	-3± 9	-1± 7
TX:Austin	1.48± .12	9± 7	1± 9	0± 7
Dallas	1.37± .11	4± 7	-6± 9	-3± 7
UT:Salt Lake City	1.58± .12	11± 7	1± 10	1± 7
VA:Norfolk	1.42± .11	10± 7	5± 10	-2± 7
VT:Burlington	1.43± .11	9± 7	5± 10	1± 7
WA:Seattle	1.54± .12	19± 7	2± 10	0± 7
Spokane	1.42± .11	7± 7	0± 9	-4± 7
WI:Milwaukee	1.55± .12	9± 7	0± 9	2± 7
WV:Charleston	1.44± .11	11± 7	6± 10	2± 7
WY:Laramie	1.43± .11	10± 7	0± 9	-1± 7

NS - No sample.

Table 13

Concentrations of Radionuclides in Pasteurized Milk

May 1976

Location	K Conc. (g/l)	Radionuclide Concentration (pCi/l ± 2 Sigma Counting Error) ^{137}Cs	^{140}Ba	^{131}I
AK:Palmer	NS			
AL:Montgomery	1.30± .11	4± 7	-8± 9	-5± 7
AR:Little Rock	1.42± .11	3± 7	-7± 9	-3± 7
AZ:Phoenix	1.42± .11	17± 7	-6± 9	7± 7
CA:Los Angeles	1.44± .11	5± 7	-4± 9	-5± 7
Sacramento	1.44± .11	6± 7	-7± 9	5± 7
San Francisco	1.38± .11	6± 7	-7± 9	-3± 7
CO:Denver	1.44± .11	5± 7	-8± 9	2± 7
CT:Hartford	1.50± .12	8± 7	-10± 9	-2± 7
CZ:Cristobal	1.27± .11	12± 7	-1± 9	1± 7
DC:Washington	NS			
DE:Wilmington	1.45± .11	4± 7	-7± 9	-2± 7
FL:Tampa	1.47± .12	18± 7	-6± 9	2± 7
GA:Atlanta	1.43± .11	11± 7	-7± 9	-4± 7
HI:Honolulu	1.43± .12	4± 7	-9± 9	1± 7
IA:Des Moines	1.49± .12	7± 7	-6± 9	-3± 7
ID:Idaho Falls	1.49± .12	9± 7	-13± 9	2± 7
IL:Chicago	1.38± .11	6± 7	-6± 9	-3± 7
IN:Indianapolis	1.41± .11	2± 6	-6± 9	1± 7
KS:Wichita	1.50± .12	4± 7	-10± 9	2± 7
KY:Louisville	1.51± .12	2± 6	-11± 9	1± 7
LA:New Orleans	1.49± .12	9± 7	-9± 9	-1± 7
MA:Boston	1.44± .11	7± 7	-6± 9	1± 7
MD:Baltimore	1.50± .12	0± 6	-4± 9	-3± 7
ME:Portland	1.52± .12	15± 7	-5± 9	-2± 7
MI:Detroit	1.30± .11	8± 7	-2± 9	0± 7
Grand Rapids	1.41± .11	4± 7	-8± 9	-2± 7
MN:Minneapolis	1.42± .11	4± 7	-1± 9	-2± 7
MO:Kansas City	1.57± .12	5± 7	-11± 9	1± 7
St. Louis	1.49± .12	9± 7	2±10	-2± 7
MS:Jackson	1.44± .11	10± 7	-4± 9	-4± 7
MT:Helena	NS			
NC:Charlotte	1.39± .11	5± 7	-9± 9	-1± 7
ND:Minot	1.42± .11	8± 7	-8± 9	0± 7
NE:Omaha	1.61± .12	3± 7	-4± 9	-1± 7
NH:Manchester	1.55± .12	7± 7	-6± 9	-2± 7
NJ:Trenton	1.49± .12	5± 7	-7± 9	-1± 7
NM:Albuquerque	1.39± .11	9± 7	-11± 9	-1± 7

Concentrations of Radionuclides in Pasteurized Milk

May 1976 - (Continued)

Location	K Conc. (g/l)	Radionuclide Concentration (pCi/l ± 2 Sigma Counting Error) ^{137}Cs	^{140}Ba	^{131}I
NV:Las Vegas	1.43± .11	18± 7	-5± 9	0± 7
NY:Buffalo	1.48± .12	9± 7	-4± 9	-3± 7
New York	1.48± .12	8± 7	-3± 9	-4± 7
Syracuse	1.37± .11	5± 7	-1± 9	-3± 7
OH:Cincinnati	1.48± .12	6± 7	-7± 9	2± 7
Cleveland	1.42± .11	6± 7	1± 9	-3± 7
OK:Okalahoma City	1.52± .12	6± 7	-6± 9	-4± 7
OR:Portland	1.45± .11	1± 6	-4± 9	-1± 7
PA:Philadelphia	1.52± .12	7± 7	-17± 9	3± 7
Pittsburgh	1.44± .11	3± 7	-2± 9	-6± 7
PR:San Juan	1.52± .12	9± 7	-3± 9	1± 7
RI:Providence	1.51± .12	6± 7	-1± 9	-1± 7
SC:Charleston	1.40± .11	9± 7	-8± 9	-1± 7
SD:Rapid City	1.43± .11	10± 7	-4± 9	0± 7
TN:Chattanooga	1.42± .11	9± 7	-6± 9	-2± 7
Knoxville	1.53± .12	5± 7	-5± 9	-3± 7
Memphis	1.54± .12	9± 7	-12± 9	-2± 7
TX:Austin	1.46± .11	4± 7	-7± 9	0± 7
Dallas	1.56± .12	6± 7	2±10	1± 7
UT:Salt Lake City	1.63± .12	4± 7	-10± 9	0± 7
VA:Norfolk	1.43± .11	3± 7	-6± 9	-2± 7
VT:Burlington	1.44± .11	7± 7	0± 9	-6± 7
WA:Seattle	1.36± .11	9± 7	2± 9	-7± 7
Spokane	1.49± .12	9± 7	-7± 9	-2± 7
WI:Milwaukee	1.45± .11	3± 7	-9± 9	-3± 7
WV:Charleston	1.43± .12	3± 7	-10± 9	-4± 7
WY:Laramie	1.40± .11	2± 7	4±10	0± 7

NS - No sample.

Table 14

Concentrations of Radionuclides in Pasteurized Milk

June 1976

Location	K Conc. (g/l)	Radionuclide Concentration (pCi/l ± 2 Sigma Counting Error) ^{137}Cs	^{140}Ba	^{131}I
AK:Palmer	NS			
AL:Montgomery	1.43± .11	11± 7	-3± 9	0± 7
AR:Little Rock	1.39± .11	8± 7	-2± 9	-6± 7
AZ:Phoenix	1.52± .12	4± 7	-9± 9	-1± 7
CA:Los Angeles	1.52± .12	6± 7	-5± 9	2± 7
Sacramento	1.41± .11	6± 7	-6± 9	-1± 7
San Francisco	1.50± .12	5± 7	-10± 9	0± 7
CO:Denver	1.46± .12	7± 7	1± 9	0± 7
CT:Hartford	1.53± .12	6± 7	-10± 9	2± 7
CZ:Cristobal	1.52± .12	8± 7	0± 9	-7± 7
DC:Washington	1.53± .12	6± 7	-10± 9	0± 7
DE:Wilmington	NS			
FL:Tampa	1.45± .11	20± 7	-8± 9	-1± 7
GA:Atlanta	1.41± .11	10± 7	-8± 9	-2± 7
HI:Honolulu	1.43± .11	1± 7	-6± 9	-2± 7
IA:Des Moines	1.44± .11	5± 7	-3± 9	-2± 7
ID:Idaho Falls	1.41± .11	3± 7	7±10	0± 7
IL:Chicago	1.45± .11	3± 7	-6± 9	1± 7
IN:Indianapolis	1.48± .12	8± 7	-10± 9	-3± 7
KS:Wichita	1.41± .11	9± 7	-5± 9	-2± 7
KY:Louisville	1.50± .12	9± 7	-9± 9	-1± 7
LA:New Orleans	1.46± .11	8± 7	-4± 9	-2± 7
MA:Boston	SI			
MD:Baltimore	1.47± .12	5± 7	-6± 9	-5± 7
ME:Portland	1 44± .11	9± 7	-3± 9	-5± 7
MI:Detroit	1.35± .11	7± 7	-5± 9	1± 7
Grand Rapids	1.46± .11	6± 7	-5± 9	-2± 7
MN:Minneapolis	1.57± .12	7± 7	-9± 9	-2± 7
MO:Kansas City	1.43± .11	1± 7	2± 9	1± 7
St. Louis	1.92± .73	0± 4	-1± 9	2± 8
MS:Jackson	1.43± .11	7± 7	1± 9	0± 7
MT:Helena	1.43± .11	8± 7	-1± 9	-6± 7
NC:Charlotte	1.52± .12	7± 7	-7± 9	0± 7
ND:Minot	1.48± .12	1± 7	2± 9	-4± 7
NE:Omaha	1.41± .11	2± 6	-2± 9	-1± 7
NH:Manchester	1.74± .12	3± 7	-2± 9	-2± 7
NJ:Trenton	1.38± .11	5± 7	-7± 9	3± 7
NM:Albuquerque	NS			

Concentrations of Radionuclides in Pasteurized Milk
June 1976 (Continued)

Location	K Conc. (g/l)	Radionuclide Concentration (pCi/l ± 2 Sigma Counting Error) ^{137}Cs	^{140}Ba	^{131}I
NV:Las Vegas	NS			
NY:Buffalo	1.44± .11	3± 7	-6± 9	-3± 7
New York	1.54± .12	4± 7	-11± 9	3± 7
Syracuse	1.46± .12	8± 7	-3± 9	4± 7
OH:Cincinnati	1.45± .11	8± 6	-3± 9	0± 7
Cleveland	1.48± .12	9± 7	-7± 9	1± 7
OK:Okalahoma City	1.50± .12	4± 7	-5± 9	5± 7
OR:Portland	1.39± .11	6± 7	-4± 9	0± 7
PA:Philadelphia	1.46± .11	5± 7	-4± 9	-6± 7
Pittsburgh	1.41± .11	-1± 7	-12± 9	6± 7
PR:San Juan	1.48± .12	6± 7	-5± 9	-4± 7
RI:Providence	1.46± .12	12± 7	-9± 9	-2± 7
SC:Charleston	1.40± .11	11± 7	-4± 9	0± 7
SD:Rapid City	1.43± .11	5± 7	-6± 9	-3± 7
TN:Chattanooga	1.42± .11	4± 7	-5± 9	0± 7
Knoxville	1.42± .11	7± 7	-3± 9	-1± 7
Memphis	1.44± .11	7± 7	-12± 9	0± 7
TX:Austin	1.47± .12	5± 7	-1± 9	4± 7
Dallas	1.44± .11	18± 7	-7± 9	0± 7
UT:Salt Lake City	1.47± .12	11± 7	1± 9	-1± 7
VA:Norfolk	1.51± .12	16± 7	-7± 9	-5± 7
VT:Burlington	1.31± .11	6± 7	-6± 9	2± 7
WA:Seattle	1.42± .12	12± 7	-5± 9	-5± 7
Spokane	1.46± .12	1± 6	-2± 9	-2± 7
WI:Milwaukee	1.48± .12	6± 7	-5± 9	1± 7
WV:Charleston	1.40± .11	7± 7	-8± 9	-3± 7
WY:Laramie	1.31± .11	5± 7	-3± 9	0± 7

NS - No sample.
SI - Sample inadvertantly lost in laboratory.

TABLE 5

Federal Radiation Council Radiation Protection Guides for daily total diet intakes (1961)

Table 1. Radiation Protection Guides--FRC recommendations and related information pertaining to environmental levels during normal peacetime operation

Radionuclide	Critical organ	RPG for individual in the general population (rad/a)	Guidance for suitable samples of exposed population group[a]				
			RPG (rad/a)	Corresponding continuous daily intake (pCi/day)	Range I (pCi/day)[b]	Range II (pCi/day)[b]	Range III (pCi/day)[b]
Strontium-89	Bone	[c]1.5	0.5	[d]2,000	0-200	200-2,000	2,000-20,000
	Bone marrow	[c].5	.17				
Strontium-90	Bone	[c]1.5	.5	[d]200	0-20	20-200	200-2,000
	Bone marrow	[c].5	.17				
Iodine-131	Thyroid	1.5	.5	100	0-10	10-100	100-1,000
Cesium-137[e]	Whole body	.5	.17	3,600	0-360	360-3,600	3,600-36,000

[a] Suitable samples which represent the limiting conditions for this guidance are: strontium-89, strontium-90—general population; iodine-131—children 1 year of age; cesium-137—infants.

[b] Based on an average intake of 1 liter of milk per day.

[c] A dose of 1.5 rad/a to the bone is estimated to result in a dose of 0.5 rad/a to the bone marrow.

[d] For strontium-89 and strontium-90, the Council's study indicated that there is currently no operational requirement for an intake value as high as one corresponding to the RPG. Therefore, these intake values correspond to doses to the critical organ not greater than one-third the respective RPG.

[e] The guides expressed here were not given in the FRC reports, but were calculated using appropriate FRC recommendations.

NOTE: TOTAL DIET ≃ 3 x MILK CONTENT OF 1 LITER PER DAY

TABLE 6

Maximum permissible doses under Appendix I to 10CFR50
N.R.C. Regulations from NUREG - 1.109

TABLE 1

SUMMARY OF STAFF POSITION -

METHODS OF EVALUATING COMPLIANCE WITH APPENDIX I

TYPE OF DOSE	APPENDIX I DESIGN OBJECTIVE	POINT OF DOSE EVALUATION	EQUATIONS TO BE USED
Liquid Effluents			
Dose to total body from all pathways	3 mrem/yr per unit	Location of the highest dose offsite* (see also Table A-1).	1, 2, 3, 4, & 5
Dose to any organ from all pathways	10 mrem/yr per unit	Same as above.	1, 2, 3, 4, & 5
Gaseous Effluents**			
Gamma dose in air	10 mrad/yr per unit	Location of the highest dose offsite.***	6 or 7, as appropriate
Beta dose in air	20 mrad/yr per unit	Same as above.	7
Dose to total body of an individual	5 mrem/yr per unit	Location of the highest dose offsite.*	8 or 10, as appropriate
Dose to skin of an individual	15 mrem/yr per unit	Same as above.	9 or 11, as appropriate
Radioiodines and Particulates† Released to the Atmosphere			
Dose to any organ from all pathways	15 mrem/yr per unit	Location of the highest dose offsite.††	12, 13, & 14

*Evaluated at a location that is anticipated to be occupied during plant lifetime or evaluated with respect to such potential land and water usage and food pathways as could actually exist during the term of plant operation.

**Calculated only for noble gases.

***Evaluated at a location that could be occupied during the term of plant operation.

†Doses due to carbon-14 and tritium intake from terrestrial food chains are included in this category.

††Evaluated at a location where an exposure pathway actually exists at time of licensing. However, if the applicant determines design objectives with respect to radioactive iodine on the basis of existing conditions and if potential changes in land and water usage and food pathways could result in exposures in excess of the guideline values given above, the applicant should provide reasonable assurance that a monitoring and surveillance program will be performed to determine: (1) the quantities of radioactive iodine actually released to the atmosphere and deposited relative to those estimated in the determination of design objectives; (2) whether changes in land and water usage and food pathways which would result in individual exposures greater than originally estimated have occurred; and (3) the content of radioactive iodine and foods involved in the changes, if and when they occur.

TABLE 7(a)

Measurements of radioactivity in cows milk near Haddam Neck reproduced from the Environmental Report, 1976

TABLE 7
DAIRY MILK
(PCI/L)

LOCATION	COLLECTION DATE	SR-89	(+/-)	SR-90	(+/-)	I-131	(+/-)	CS-137	(+/-)
69	2/23/76	0.0	0.7	8.8	0.4	0.0	0.09	27.3	1.1
69	4/12/76	0.0	0.8	9.8	0.7	0.02	0.09	20.1	0.8
69	5/10/76	0.0	0.8	4.7	0.3	0.0	0.08	11.2	1.0
69	6/ 7/76	0.9	1.1	4.1	0.3	0.18	0.07	9.0	1.0
69	7/19/76	0.0	0.6	6.9	0.3	0.0	0.07	13.9	1.5
69	8/ 2/76	0.0	1.4	6.4	0.3	0.0	0.07	27.6	0.8
69	9/13/76	0.3	0.9	5.2	0.3	0.09	0.08	11.6	0.8
69	10/ 5/76	3.0	1.1	4.6	0.4	143.00	2.00	4.1	0.6
70	2/23/76	0.0	0.6	6.6	0.4	0.09	0.08	7.0	0.5
70	4/12/76	0.0	0.6	6.4	0.4	0.0	0.11	6.3	0.5
70	5/10/76	1.3	0.9	6.1	0.3	0.04	0.09	6.3	1.0
70	6/ 7/76	0.5	1.0	5.5	0.3	0.13	0.07	9.2	1.0
70	7/19/76	0.8	0.5	4.0	0.2	0.09	0.07	7.4	0.7
70	8/ 2/76	0.9	0.8	5.9	0.5	0.05	0.10	6.5	0.3
70	9/13/76	1.0	2.0	7.7	0.8	0.10	0.07	6.2	0.7
70	10/ 5/76	16.4	0.9	9.1	0.4	201.60	0.70	5.4	0.8
71	2/23/76	0.2	0.4	5.5	0.3	0.0	0.06	8.6	0.9
71	4/12/76	0.0	0.7	4.8	0.3	0.0	0.09	6.7	0.5
71	5/10/76	0.3	0.9	3.8	0.2	0.07	0.08	5.4	0.6
71	6/ 7/76	1.6	1.2	6.5	0.4	0.04	0.07	15.7	0.7
71	7/19/76	1.0	0.7	8.4	0.3	0.02	0.07	36.0	2.0
71	8/ 2/76	0.0	1.0	11.2	0.7	0.0	0.10	52.0	3.0
71	9/13/76	1.4	0.8	10.5	0.6	0.03	0.09	30.9	1.1
71	10/ 5/76	0.0	0.4	4.8	0.2	248.00	7.00	16.0	1.2
72A	2/24/76	0.0	0.6	7.8	0.3	0.09	0.06	13.8	0.6
72A	4/12/76	0.0	0.6	6.6	0.3	0.0	0.08	9.5	0.5
72A	5/10/76	0.0	0.8	6.5	0.3	0.01	0.10	7.4	1.0
72A	6/ 7/76	0.2	0.9	6.8	0.3	0.06	0.05	7.9	0.6
72A	7/19/76	0.0	0.5	4.8	0.3	0.0	0.06	15.8	1.5
72A	8/ 2/76	0.0	0.4	3.1	0.2	0.0	0.07	13.3	0.9
72A	9/13/76	0.9	0.9	4.8	0.3	0.09	0.12	12.4	0.8
72A	10/ 5/76	8.0	2.0	5.8	0.5	175.00	91.40	12.6	1.4

TABLE 7(b)

Measurement of radioactivity in goat milk near Haddam Neck reproduced from the Environmental Report, 1976.

TABLE 8
GOAT MILK
(PCI/L)

LOCATION	COLLECTION DATE	SR-89	(+/-)	SR-90	(+/-)	I-131	(+/-)	CS-137	(+/-)
73A	4/12/76	0.0	0.9	18.1	0.4	0.0	0.14	20.7	0.8
73A	5/10/76	1.8	1.6	14.7	0.5	0.02	0.12	56.0	2.0
73A	6/ 7/76	0.0	1.9	18.4	0.5	0.40	0.20	37.8	1.3
73A	7/19/76	0.7	0.7	10.6	0.4	0.18	0.15	23.0	2.0
73A	8/ 2/76	0.0	1.1	11.6	0.4	0.0	0.20	52.0	3.0
73A	9/13/76	0.4	0.9	8.8	0.4	0.09	0.08	11.9	0.8
73A	10/ 5/76	8.9	1.4	10.3	0.5	196.00	2.00	28.2	1.3
74	4/12/76	0.0	1.1	19.0	2.0	0.10	0.20	17.5	0.8
74	5/10/76	0.0	1.4	18.6	0.4	0.05	0.14	37.2	1.5
74	6/ 7/76	1.4	2.5	32.6	0.9	0.09	0.15	77.0	3.0
74	7/19/76	0.0	0.8	19.1	0.6	0.0	0.20	23.9	1.1
74	8/ 2/76	1.9	0.7	23.7	0.7	0.0	0.20	37.0	2.0
74	9/13/76	0.5	0.6	5.6	0.4	0.34	0.07	19.7	1.2
74	10/ 5/76	5.9	1.4	12.8	0.5	57.00	0.60	22.7	1.1

No goat milk or pasture grass samples taken in February since none were available.

TABLE 8

Comparisons of Thermal Efficiency and
Radioactive Releases From the Yankee (Rowe),
the Haddam Neck (Connecticut Yankee) and Millstone
Point Plants (Tables Reproduced from "Report on Releases of Radioactive
Effluents", 1972, U.S.A.E.C. Directorate of Regulations, (August 1973)

	Yankee (Rowe) Mass. (PWR)	Connect. Yankee, Haddam (PWR)	Millstone Point-1, Conn. (BWR)
Lic. Power MW (Therm.)	600 MW	1825 MW	2011 MW
Elect. Power MW (el.) 1972	173 MW	568 MW	658 MW
Thermal Efficiency (1972 Data)	28.8%	31.1%	32.7%
I-131, Cs-137, Sr-90 etc. Airborne Release, Ci (1972)	0.00077 Ci	0.0181 Ci	1.32 Ci
I-131, Cs-137, Sr-90 etc. Airborne Release; Ci Per 1000 MW Electrical Power	0.0044	0.3187	4.0367
Relative Gaseous (I, Sr, Cs) Releases per 1000 MW Power	1	72	917
Year of Start-up	1960	1967	1970

Data taken from A.E.C. 1972 report (See tables reproduced in Appendix VIII)
Note the much greater releases of the biologically most hazardous materials for the more efficient, later reactors.

TABLE 9

Comparison of Sr-90 Concentrations in Milk Near the Millstone Nuclear Reactor With Concentrations in Hartford and the U.S. as a Whole - 1970 to 1976

Year	(a) Av. Daily Milk Sr-90 Concentr. Near Millstone pCi/l	(b) Av. Daily Milk Sr-90 Concentr. In July (Hartford) pCi/l	(c) Av. Daily Milk Sr-90 Concentr. for Year In U.S. pCi/l	Excess Sr-90 In Milk Near Millstone over U.S. pCi/l	%Excess Sr-90 Near Millstc pCi/l
970#	9.8	8	8	1.8	—
971	8.8	9	7	1.8	20%
972	9.6	7	6	3.6	38%
973	15.0	4	5	10.0	67%
974	14.8	Not Avail.	4	10.8	73%
975	10.7	3.1	3	7.7	72%
976	13.0	5.7	4	9.0	69%

Millstone Operation began in October 26, 1970
Conn. Yankee (Haddam Neck, 20 miles N.W., Started July 24, 1967.

a) Three locations within 10-15 miles; 1σ = ± 0.2 pCi/l
From Millstone environmental reports, annual averages

b) E.P.A. Measurements (Rad. Data and Reports) in July.
1σ = ± 1 pCi/l

c) E.P.A. Network Average (Rad. Data and Reports)
1σ = ± 0.2 pCi/l

TABLE 10

Doses to the Bone of Children Due to Sr-90 in the Milk and Total Diet Near the Millstone Nuclear Plant - 1970 to 1976

Year	Total Diet Sr-90 Intake Near Millstone pCi/day	(a) Annual Sr-90 Bone Dose For Child-All Sources mrem/yr	(b) Annual Sr-90 Bone Dose For Child Due to Millstone mrem/yr.	Cumul. Sr-90 Bone Dose For Child Due To Millstone mrem	(c) Annual Sr-90 Bone Dose For Child Due To Millstone as % of Natural
1970*	29.4	185	----	----	----
1971	26.4	166	33	33	47%
1972	28.8	181	69	102	99%
1973	45.0	283	190	292	271%
1974	44.4	279	204	495	291%
1975	32.1	202	145	640	207%
1976	39.0	245	169	809	241%

* Millstone Operations Began October 26, 1970

a) Using dose factor of 0.0172 mrem/pCi annual intake from Table A-5, NUREG 1.109 (N.R.C., March 1976), equivulant to 6.28 mrem/yr. per 1 pCi daily intake in total diet.

b) Using percent excess Sr-90 levels due to Millstone from milk measurements (Table 9).

c) Natural Radiation background 70 mrem/yr. ((E.P.A. measurements; E.P.A. report on Haddam Neck
E.P.A. - 520/3-74-007 ; Sect. 7.7 , page 109

TABLE 11

Average Doses to Adult Bone From Sr-90 in the Milk and Total Diet Near the Millstone Point Nuclear Plant, 1970-1976

Year	Annual Adult Bone Dose From Total Sr-90 Intake Near Millstone mrem/yr.	Annual Adult Bone Dose Due to Sr-90 from Mill-Stone mrem/yr.	Cumulative Adult Bone Dose Due To Sr-90 From Millstone mrem/yr.	Annual Adult Bone Tot. Pop. Dose Due to Millstone Man-Rem	Cumulative Adult Bone Total Pop. Dose Due To Millstone Man-Rem	Cumulative Health Costs of Bone Doses From Millstone Mill. Dollars
970#	—	—	—	—	—	—
971	73	15	15	11,100	11,100	11.1
972	80	30	45	22,200	33,300	33.3
973	125	84	129	62,160	95,460	95.5
974	123	90	219	66,600	162,060	162
975	89	64	283	47,360	209,420	209
976	108	75	358	55,500	264,920	264

Millstone Operation Began October 26, 1970

a) Based on dose factor of 0.00761 mrem/pCi annual intake from Table A - 3 NUREG 1.109 (NRC, March 1976)

b) Based on population of New London County plus one-half of Rhode Island (740,000)

c) Based on N.R.C. and E.P.A. Health cost of $1000 per man-rem

APPENDIX I
Report to Congr. C.J. Dodd, Sept. 1977

EVALUATION OF RADIOACTIVE EFFLUENTS FROM MILLSTONE UNIT NO. 1

OFFICE OF NUCLEAR REACTOR REGULATION

NORTHEAST NUCLEAR ENERGY COMPANY

DOCKET NO. 50-245

MILLSTONE UNIT NO. 1

1.0 Introduction

During 1975, the liquid and gaseous effluents from Millstone Unit No. 1 were high in radioactivity, in terms of Curie content, as compared to other nuclear power facilities. The dose rate due to these effluents to the local population and its significance is addressed in Section 2.0 below. Our conclusions regarding effluents from Millstone Unit No. 1 are contained in Section 3.0.

2.0 Explanation for Radioactive Effluents from Millstone Unit No. 1 and Significance to Local Population

During 1975, the comparatively high curie content of the radioactivity, in gaseous effluents from Millstone Unit No. 1, was due primarily to defects in the nuclear fuel that was being utilized at that time. The comparatively high Curie content of the liquid effluents was due mostly to the conduct of required plant maintenance. Moreover, the liquid radwaste was diluted and discharged rather than solidified as is currently the practice at Millstone Unit No. 1. The effluent release data is summarized in Table 1. Although the Curie content of the effluents from Millstone Unit No. 1 during 1975 was the highest for any nuclear power reactor in the United States, the concentration (measured as micro Curies per milliliter) of radioactive material in the effluents was controlled and represent only small fractions of the limits specified in Title 10, Code of Federal Regulations, Part 20.

During 1976, as can be seen in the attached Table 1, the radioactive effluents Curie content decreased considerably. The decrease in the Curie content of the gaseous effluents was due partly to removal of some of the defective fuel in the fall of 1975 during the third refueling of Millstone Unit No. 1. In addition, the licensee (Northeast Nuclear Energy Company) adopted a plant operating technique specifically designed to further maintain fuel integrity, thus reducing the radioactive components of gaseous effluents. The decrease in the level of liquid effluents during 1976 was due to the startup of the liquid radwaste treatment system. This system concentrates and solidifies liquid waste for removal from the site to approved disposal areas instead of discharging the diluted liquid effluent from the plant. During the fourth refueling of Millstone Unit No. 1, in the fall of 1976, more of the previous defective fuel was removed thereby causing the Curie content of the gaseous effluent to undergo a further decrease during 1977. During 1978, we expect that the new augmented gaseous radwaste treatment system will become operational and will result in a further decrease in radioactivity in gaseous effluents.

The calculated dose to the population, as a result of operation of Millstone Unit No. 1, is summarized in Table 2. During the comparatively high releases of 1975, it is significant to note that the average individual's dose in the population located within 50 miles from Millstone Unit No. 1 was only 0.2 millirem per year. As can be seen in Table 2, this exposure is very small compared to the natural background (natural radiation) level of 125 millirem per year. Moreover, the 0.2 millirem per year is small when compared to the normal variation in the background radiation level over the state of Connecticut of at least ±15 millirem per year.

3.0 Conclusion

From the information presented in Section 2.0, we conclude that the doses from the operation of Millstone Unit No. 1 to the population within 50 miles of the facility is statistically indistinguishable from the natural background radiation doses. The extremely low levels of exposure (less than 0.2% of natural background radiation dose) precludes distinguishing any health effects that could have even theoretically been produced by the operation of Millstone. Even so, the licensee has taken positive action to further decrease the liquid and gaseous radioactive effluents from Millstone Unit No. 1, so that we expect the Curie content of radioactive effluents to decrease through 1978 with a corresponding decrease in the dose to the offsite population.

TABLE 1

Release of Radioactive Material from Millstone Unit No. 1

	Airborne Releases (Ci/yr)				Liquid Releases (Ci/yr)	
	Noble Gas		Radioiodine 131			
	Release	% of Federal Release Limit	Release	% of Federal Release Limit	Release	% of Federal Release Limit
1975	3,000,000	12	10	10	199	11.
1976	500,000	2	2	2	9.3	0.5
Projected 1977	200,000	1.5	2	2	0.5	0.06
After mid 78	10,000	0.07	0.6	0.6	0.2	0.01

Radiation Dose due to Radioactive Materials Released from Millstone Unit No. 1

	Maximum Individual Dose (mrem/yr)				Population Dose within 50 miles of station (man-rem)			
	Total Body	Thyroid	Natural Background	% of Natural Background	Reactor Releases	Natural Background	Avg. Indv. Dose (mr/yr)	% of Back
1975	30	10	125 ± 15 *	27	670	370,000	0.2	0
1976	6	2	125 ± 15	5	112	370,000	0.04	C
Projected 1977	5	1.5	125 ± 15	4	93	370,000	0.03	C

*This value is the average for the State of Connecticut. The natural background for Millstone Point averages 150 mrem/yr and is higher than the average for the State due to the granitic nature of the site.

APPENDIX II
From EPA Region II ERAMS 902/4-77-009

ERAMS Data Analysis of Water Samples Under Drinking Water Standards

° Newly-established drinking water standards, effective June 24, 1977, set the following maximum levels of radioactivity in drinking water:

tritium	20,000 pCi/l
Sr-90	8 pCi/l
Sr-89	80 pCi/l
Cs-134	20,000 pCi/l
Cs-137	200 pCi/l
Ba-140	90 pCi/l
Ra-226 and 228	5 pCi/l

° After analysis of the data collected by the ERAMS network during 1975 and 1976 the following information was noted:

-- Albany drinking water levels were 2% or less of the tritium limit, 3% of the Sr-90 limit, and 4% of the Ra-226 limit.

--Bayside (NJ) surface water tritium levels were a maximum of 2% of the drinking water limit.

-- Buffalo drinking water levels were 2% or less of the tritium limit, 14% of the Sr-90 limit, and 6% or the Ra-226 limit. WEST-VALLEY

-- Ossining surface water samples never exceeded 1.5% of the maximum tritium drinking water limit.

-- Oswego surface water samples were never more than 2% of the drinking water tritium limit.

-- Oyster Creek surface water samples were never in excess of 1.5% of the tritium drinking water standard.

-- Poughkeepsie surface water samples never exceeded 2.5% of the tritium drinking water standard.

-- San Juan drinking water never exceeded 1.5% of the tritium limit, 6% of the Sr-90 limit, or 8% of the Ra-226 limit.

-- Syracuse drinking water never exceeded 4%of the tritium limit, 10% of the Sr-90 limit, or 8% of the Ra-226 limit. Average values for the location were 2% of the tritium limit, 5% of the Sr-90 limit, and 4% of the Ra-226 limit.

-- Trenton drinking water levels were 2% of the tritium limit, 20% of the Sr-90 limit, and 6% of the Ra-226 limit. Average values for the city were less than 1.5%of the tritium limit, 10% of the Sr-90 limit, and 3% of the Ra-226 limit. N.J. Oyster Creek

-- Waretown (NJ) drinking water levels were 2% of the tritium levels, 1% of the Sr-90 limit, and 38% of the Ra-226 limit.

° Average levels in New York State were 1.5% of the tritium limit, 5% of the Sr-90 limit, and 4% of the Ra-226 Limit.

APPENDIX III

1.0 SUMMARY

The radiological environmental monitoring program around the Millstone Nuclear Power Station was continued for the period January through December 1976, in compliance with the Environmental Technical Specifications, Section 3.2. This report for 1976 was prepared by the Radiation Assessment staff of the Northeast Utilities Service Company. The laboratory analyses were done by Interex Corporation of Natick, Massachusetts who also assisted in the qualitative interpretation of the laboratory data.

Sampling and radiological analyses were performed on air particulates, gamma exposure rates, soil, milk, fruit, vegetables, well water, reservoir water, bottom sediment, sea water, mussels, oysters, clams, scallops, lobster, fin fish, algae and eggs.

The observed results indicate that the predominant radioactivity at offsite locations are from nonplant related sources such as fallout from nuclear weapons tests and from naturally occurring nuclides. Plant related radioactivity above the minimum detectable levels, as set by counting statistics was observed; as gamma exposure rate at three locations within 3 miles of the station; as iodine-131 in goats milk; as manganese-54 and cobalt-60 in bottom sediment collected within 500 feet of the discharge; as cesium-137, manganese-54, cobalt-58 and cobalt-60 in rockweed collected within 500 feet of the discharge; as cesium-137 , cesium 134, cobalt-60 and manganese-54 in mussels and oysters collected within 500 feet of the discharge; as manganese-54 in scallops; and as manganese-54 and cobalt-60 in lobsters. In general the radioactivity in 1976 was less than that observed in 1975 and the levels in aquatic media in 1976 exhibited a rapidly decreasing trend through the year. This is as a result of the operation of the augmented liquid radioactive waste treatment system.

The radiation dose to the general public from the stations discharges have been evaluated by two methods; one using the measured stations discharges and conservative transport models, and the other using the measured concentrations of radioactivity in environmental media. The maximum dose (at the station boundary) that could occur to a member of the general public as a result of the stations discharges was 7.9 millirem and the average dose to an individual residing within 50 miles of the station is 0.13 millirem. These doses are 1.6 percent and 0.08 percent of the corresponding Federal and State standards for annual permissible doses to the public from man-made radiation, which are 500 millirem and 170 millirem respectively. Natural background radiation in Connecticut gives members of the public a dose of 129 millirem per year. Thus the stations effect on the public is minimal.

Table 4. Mean active bone marrow dose for several different examinations: subject No. 16 of the USPHS study

Examination	SSD	HVL (mm Al)	Calc. Skin Exposure (mR)	Mean Active Marrow Dose per film (mrad)
AP Lumbosac. Spine	64	1.8	1705	87.2
Lat. Lumbosac. Spine	50	1.9	4603	56.2
PA Chest	80	2.7	16	2.2
PA Upper GI	74	2.3	712	51.1
PA IVP	80	2.4	125	13.3
PA Chest	80	2.2	31	4.0
AP Cerv. Spine	80	2.2	189	4.9
PA Barium Enema	80	2.2	759	97.1
Lat. Hip	67	2.6	666	26.7
Lat. Skull	80	2.3	243	13.0
PA Sinuses	71	2.3	987	16.5
AP Left Shoulder	80	2.4	28	3.3
Lat. Skull	79	2.3	311	15.9
PFG Chest	79	2.1	380	41.2
Lat. Gall Bladder	60	2.5	546	24.3
PA Barium Enema	74	3.3	608	119.0
AP Urethrogram	74	2.4	55	5.1
PA Ribs	72	2.0	1049	82.5
AP Thor. Spine	72	3.0	482	84.2
AP Mandible	76	2.2	222	12.9
Lat. Chest	80	3.0	218	20.5
Lat. Cerv. Spine	80	1.0	94	2.0
PA Chest	80	2.3	33	4.1
Lat. Dental	20	2.0	1186	1.8
AP Dental	31	2.6	806	3.7

SUMMARY

The exposure measurements, model and computer program for estimation of mean active bone marrow doses formerly employed in the 1962 British Survey of x-ray doses and proposed for application to x-ray exposure information obtained in the U.S. Public Health Service's X-Ray Exposure Studies (1966 and 1973) are described and evaluated.

The method described in this paper is feasible for use to determine the mean active bone marrow doses to adults for examinations having a skin to source distance of 80 cm or less. For a greater SSD, as for example in chest x-rays, a small correction in the calculated dose can be made.

From DHEW-FDA-76-8015; Ref. 24

APPENDIX V(a)

From N.R.C. Reg. Guide 1.109 March 76'

TABLE A-3

ADULT INGESTION DOSE FACTORS
(mrem/pCi ingested)

NUCLIDE		BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
1H	3	0.0	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07	1.34E-07
4BE	10	3.18E-06	4.91E-07	7.95E-08	0.0	3.71E-07	0.0	2.68E-05
6C	14	2.84E-06	5.69E-07	5.69E-07	5.69E-07	5.69E-07	5.69E-07	5.69E-07
7N	13	8.37E-09	8.37E-09	8.37E-09	8.37E-09	8.37E-09	8.37E-09	8.37E-09
9F	18	6.25E-07	0.0	6.93E-08	0.0	0.0	0.0	1.85E-08
11NA	22	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05
11NA	24	2.26E-06	2.26E-06	2.26E-06	2.26E-06	2.26E-06	2.26E-06	2.26E-06
15P	32	1.93E-04	1.21E-05	7.47E-06	0.0	0.0	0.0	2.17E-05
20CA	41	1.87E-04	0.0	2.01E-05	0.0	0.0	0.0	1.84E-07
21SC	46	5.51E-09	1.08E-08	3.11E-09	0.0	1.00E-08	0.0	5.21E-05
24CR	51	0.0	0.0	2.66E-09	1.59E-09	5.87E-10	3.53E-09	6.69E-07
25MN	54	0.0	4.57E-06	8.73E-07	0.0	1.36E-06	0.0	1.40E-05
25MN	56	0.0	1.15E-07	2.05E-08	0.0	1.46E-07	0.0	3.67E-06
26FE	55	6.20E-06	2.79E-05	7.33E-06	0.0	0.0	3.23E-05	1.09E-05
26FE	59	4.34E-06	1.03E-05	3.92E-06	0.0	0.0	2.86E-06	3.40E-05
27CO	57	0.0	1.75E-07	2.91E-07	0.0	0.0	0.0	4.44E-06
27CO	58	0.0	7.46E-07	1.67E-06	0.0	0.0	0.0	1.51E-05
27CO	60	0.0	2.15E-06	4.72E-06	0.0	0.0	0.0	4.02E-05
28NI	59	9.77E-06	3.35E-06	1.63E-06	0.0	0.0	0.0	6.90E-07
28NI	63	1.30E-04	9.02E-06	4.36E-06	0.0	0.0	0.0	1.88E-06
28NI	65	5.29E-07	6.87E-08	3.13E-08	0.0	0.0	0.0	1.74E-06
29CU	64	0.0	8.34E-08	3.92E-08	0.0	2.10E-07	0.0	7.10E-06
30ZN	65	4.85E-06	1.54E-05	6.97E-06	0.0	1.03E-05	0.0	9.70E-06
30ZN	69M	1.70E-07	4.09E-07	3.73E-08	0.0	2.48E-07	0.0	2.49E-05
30ZN	69	1.03E-08	1.98E-08	1.37E-09	0.0	1.20E-08	0.0	2.96E-09
34SE	79	0.0	2.63E-06	4.40E-07	0.0	4.56E-06	0.0	5.38E-07
35BR	82	0.0	0.0	2.26E-06	0.0	0.0	0.0	2.59E-06
35BR	83	0.0	0.0	4.02E-08	0.0	0.0	0.0	5.79E-08
35BR	84	0.0	0.0	5.22E-08	0.0	0.0	0.0	4.09E-13
35BR	85	0.0	0.0	2.14E-09	0.0	0.0	0.0	0.0
37RB	86	0.0	2.11E-05	9.84E-06	0.0	0.0	0.0	4.16E-06
37RB	87	0.0	1.23E-05	4.28E-06	0.0	0.0	0.0	5.76E-07
37RB	88	0.0	6.06E-08	3.21E-08	0.0	0.0	0.0	8.36E-19
37RB	89	0.0	4.01E-08	2.83E-08	0.0	0.0	0.0	0.0
38SR	89	3.09E-04	0.0	8.85E-06	0.0	0.0	0.0	4.94E-05
Sr90 → 38SR	90	7.61E-03	0.0	1.86E-03	0.0	0.0	0.0	1.02E-04
38SR	91	5.82E-06	0.0	2.56E-07	0.0	0.0	0.0	2.93E-05
38SR	92	2.16E-06	0.0	9.31E-08	0.0	0.0	0.0	4.26E-05
39Y	90	9.63E-09	0.0	2.58E-10	0.0	0.0	0.0	1.02E-04
39Y	91M	9.10E-11	0.0	3.53E-12	0.0	0.0	0.0	2.67E-10
39Y	91	1.41E-07	0.0	3.78E-09	0.0	0.0	0.0	7.76E-05

Note: 0.0 means insufficient data or that the dose factor is <1.0E-20.

TABLE A-5

CHILD INGESTION DOSE FACTORS
(mrem/pCi ingested)

NUCLIDE		BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
1H	3	0.0	2.03E-07	2.03E-07	2.03E-07		2.03E-07	2.03E-07
6C	14	2.26E-06	2.26E-06	2.26E-06	2.26E-06		2.26E-06	2.26E-06
11NA	22	5.89E-05	5.89E-05	5.89E-05	5.89E-05		5.89E-05	2.57E-06
27CO	58	0.0	1.85E-06	5.58E-06	0.0		0.0	1.10E-05
27CO	60	0.0	5.17E-06	1.55E-05	0.0		0.0	2.86E-05
38SR	89	1.38E-03	0.0	3.95E-05	0.0	(USE	0.0	5.15E-05
Sr 90 → 38SR	90	1.72E-02	0.0	4.36E-03	0.0		0.0	2.29E-04
39Y	90	4.21E-08	0.0	1.13E-09	0.0	ADULT	0.0	1.20E-04
39Y	91	5.85E-07	0.0	1.56E-08	0.0		0.0	7.77E-05
40ZR	95	1.04E-07	2.42E-08	2.20E-08	0.0		0.0	2.50E-05
41NB	95	1.95E-08	8.32E-09	6.11E-09	0.0	DOSE	0.0	1.44E-05
44RU	103	6.78E-07	0.0	2.74E-07	0.0		0.0	1.78E-05
44RU	106	1.19E-05	0.0	1.48E-06	0.0		0.0	1.85E-04
50SN	123	1.31E-04	1.64E-06	3.22E-06	1.73E-06		0.0	6.50E-05
52TE	125M	1.14E-05	3.09E-06	1.52E-06	3.20E-06	FACTOR)	0.0	1.10E-05
52TE	127	4.50E-07	1.20E-07	9.65E-08	3.10E-07		0.0	1.92E-05
52TE	129M	4.95E-05	1.38E-05	7.65E-06	1.58E-05		0.0	5.96E-05
52TE	132	1.02E-05	4.50E-06	5.42E-06	6.62E-06		0.0	7.89E-05
53I	129	1.39E-05	8.54E-06	3.81E-05	2.79E-02		0.0	4.29E-07
53I	131	1.63E-05	1.67E-05	1.26E-05	5.43E-03		0.0	1.43E-06
53I	133	5.98E-06	7.38E-06	2.90E-06	1.78E-03		0.0	2.99E-06
55CS	134	2.24E-04	3.77E-04	8.02E-05	0.0		4.19E-05	2.04E-06
55CS	137	3.12E-04	3.02E-04	4.50E-05	0.0		3.54E-05	1.84E-06
56BA	140	8.26E-05	7.25E-08	4.85E-06	0.0		4.32E-08	4.21E-06
57LA	140	1.01E-08	3.52E-09	1.19E-09	0.0		0.0	1.00E-04
58CE	141	3.76E-08	1.88E-08	2.80E-09	0.0		0.0	2.36E-05
58CE	144	2.14E-06	6.70E-07	1.14E-07	0.0		0.0	1.74E-04
63EU	154	2.58E-06	2.08E-07	2.03E-07	0.0		0.0	4.74E-05
92U	232	1.77E-02	0.0	1.26E-03	0.0		0.0	6.91E-05
92U	234	3.57E-03	0.0	2.21E-04	0.0		0.0	6.32E-05
94PU	238	1.24E-03	1.52E-04	3.09E-05	0.0		0.0	7.50E-05
94PU	239	1.32E-03	1.62E-04	3.27E-05	0.0		0.0	6.85E-05
94PU	240	1.32E-03	1.63E-04	3.30E-05	0.0		0.0	6.85E-05
94PU	241	7.12E-07	8.50E-08	1.81E-08	0.0		0.0	1.32E-07
95AM	241	1.42E-03	6.24E-04	9.96E-05	0.0		0.0	7.37E-05
96CM	242	6.74E-05	5.28E-05	4.46E-06	0.0		0.0	8.03E-05
96CM	244	1.12E-03	5.40E-04	6.99E-05	0.0		0.0	7.64E-05

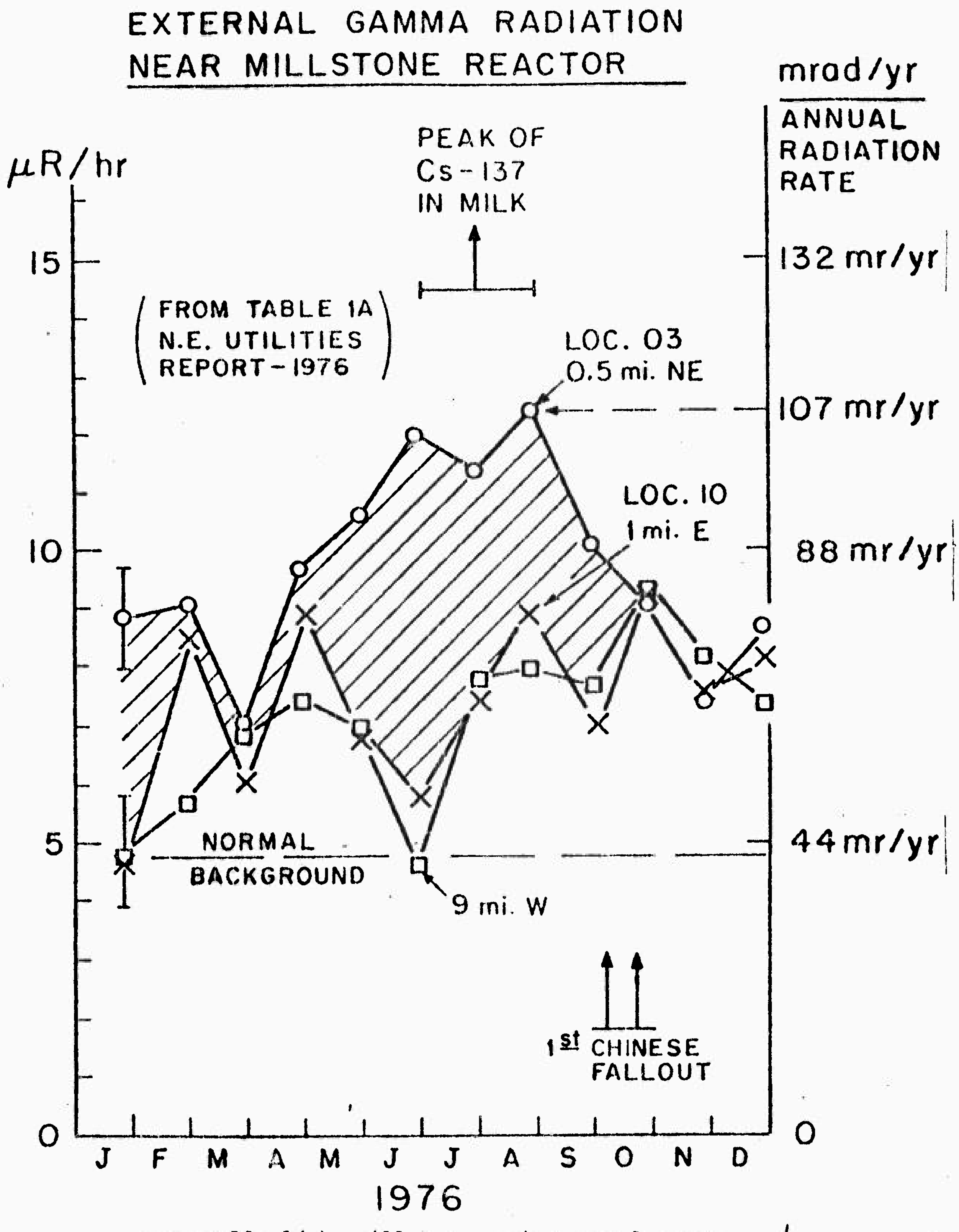
Note: 0.0 means insufficient data or that the dose factor is <1.0E-20.

TABLE A-6

INFANT INGESTION DOSE FACTORS
(mrem/pCi ingested)

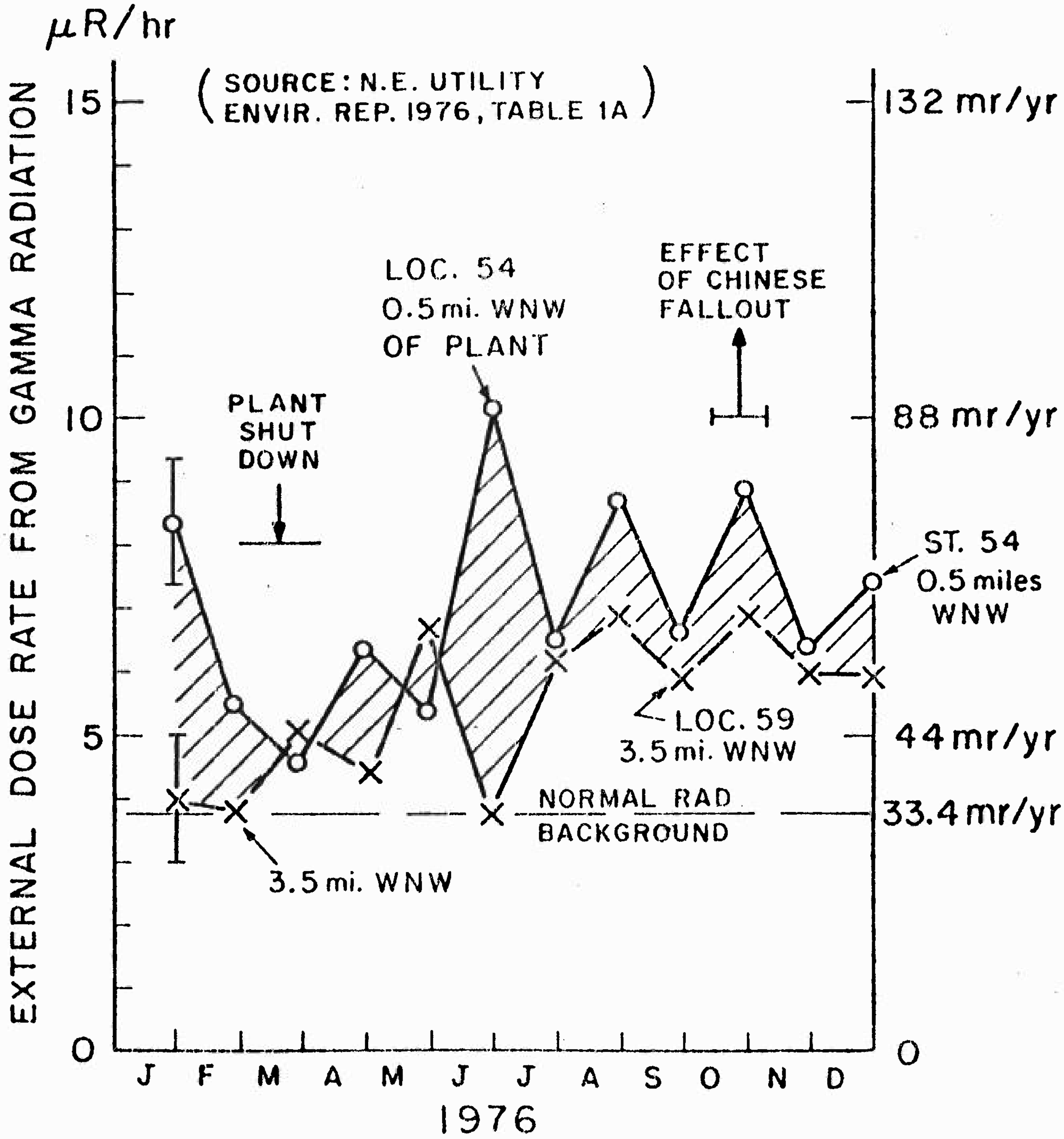
NUCLIDE		BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
1H	3	0.0	3.07E-07	3.07E-07	3.07E-07		3.07E-07	3.07E-07
6C	14	4.81E-06	4.81E-06	4.81E-06	4.81E-06		4.81E-06	4.81E-06
11NA	22	1.00E-04	1.00E-04	1.00E-04	1.00E-04		1.00E-04	2.45E-06
27CO	58	0.0	3.78E-06	9.26E-06	0.0		0.0	9.79E-06
27CO	60	0.0	1.07E-05	2.56E-05	0.0		0.0	2.64E-05
38SR	89	2.93E-03	0.0	8.42E-05	0.0	(USE	0.0	5.48E-05
Sr90 → 38SR	90	2.51E-02	0.0	6.40E-03	0.0		0.0	2.43E-04
39Y	90	8.97E-08	0.0	2.41E-09	0.0	ADULT	0.0	1.29E-04
39Y	91	1.25E-06	0.0	3.33E-08	0.0		0.0	8.27E-05
40ZR	95	2.11E-07	5.32E-08	3.78E-08	0.0		0.0	2.38E-05
41NB	95	3.89E-08	1.75E-08	1.03E-08	0.0	DOSE	0.0	1.40E-05
44RU	103	1.41E-06	0.0	4.85E-07	0.0		0.0	1.76E-05
44RU	106	2.54E-05	0.0	3.12E-06	0.0		0.0	1.97E-04
50SN	123	2.79E-04	4.33E-06	6.86E-06	4.33E-06	FACTOR)	0.0	6.91E-05
52TE	125M	2.43E-05	8.19E-06	3.24E-06	8.00E-06		0.0	1.17E-05
52TE	127	9.58E-07	3.19E-07	2.06E-07	7.75E-07		0.0	2.27E-05
52TE	129M	1.05E-04	3.61E-05	1.60E-05	3.95E-05		0.0	6.33E-05
52TE	132	2.13E-05	1.05E-05	9.76E-06	1.55E-05		0.0	8.08E-05
53I	129	2.95E-05	2.16E-05	7.76E-05	6.79E-02		0.0	4.46E-07
53I	131	3.42E-05	4.07E-05	2.38E-05	1.31E-02		0.0	1.53E-06
53I	133	1.26E-05	1.84E-05	5.58E-06	4.35E-03		0.0	3.27E-06
55CS	134	4.58E-04	5.24E-04	6.97E-05	0.0		9.42E-05	1.96E-06
55CS	137	6.53E-04	7.31E-04	4.20E-05	0.0		9.81E-05	1.89E-06
56BA	140	1.74E-04	1.75E-07	8.99E-06	0.0		1.07E-07	4.43E-06
57LA	140	2.12E-08	3.37E-09	2.16E-09	0.0		0.0	1.04E-04
58CE	141	8.00E-08	4.91E-08	5.75E-09	0.0		0.0	2.38E-05
58CE	144	4.49E-06	1.77E-06	2.42E-07	0.0		0.0	1.85E-04
63EU	154	4.30E-06	4.84E-07	3.29E-07	0.0		0.0	4.76E-05
92U	232	3.66E-02	0.0	2.68E-03	0.0		0.0	7.34E-05
92U	234	7.40E-03	0.0	4.71E-04	0.0		0.0	6.72E-05
94PU	238	1.71E-03	2.18E-04	4.25E-05	0.0		0.0	7.98E-05
94PU	239	1.78E-03	2.26E-04	4.41E-05	0.0		0.0	7.28E-05
94PU	240	1.78E-03	2.28E-04	4.45E-05	0.0		0.0	7.28E-05
94PU	241	1.06E-06	1.37E-07	2.70E-08	0.0		0.0	1.40E-07
95AM	241	1.93E-03	1.03E-03	1.38E-04	0.0		0.0	7.84E-05
96CM	242	1.43E-04	1.40E-04	9.49E-06	0.0		0.0	8.53E-05
96CM	244	1.64E-03	9.67E-04	1.04E-04	0.0		0.0	8.12E-05

Note: 0.0 means insufficient data or that the dose factor is <1.0E-20.

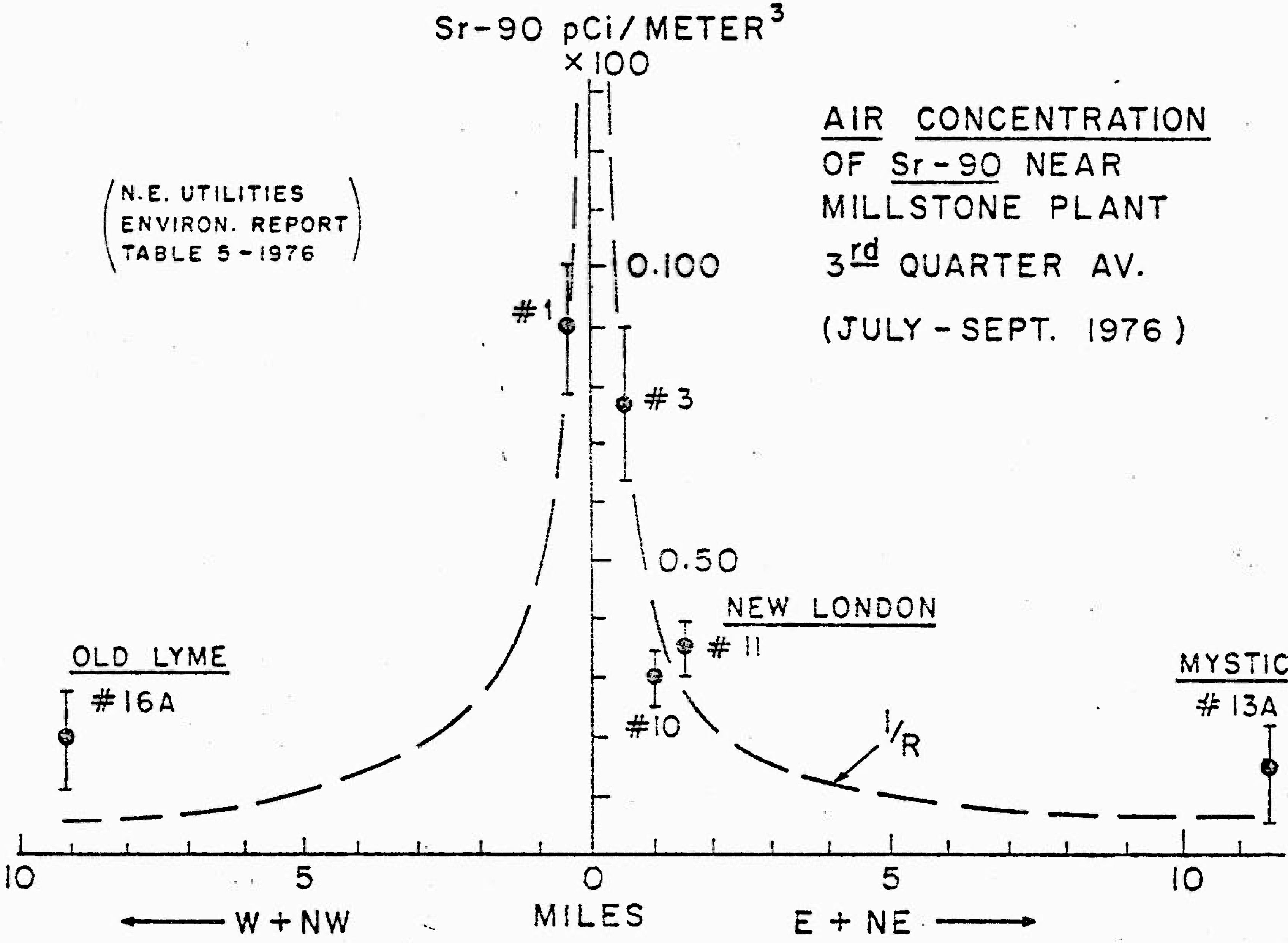


From Table 1(a), Millstone Environmental Report 1976. Note that the minimum values, which are due to the natural radiation background from radioactivity in the soil and cosmic rays are in the neighborhood of 40-50 mrem/year, not 129 mrem/yr. as stated in the utility's report (Appendix III). Furthermore, the external gamma radiation is seen to reach its peak at the same time as the measured peak of Cs-137 in milk as seen in Fig. 4 and Table 1, thus tying it to plant releases.

VARIATION OF EXTERNAL GAMMA DOSE RATE WITH TIME FOR VARIOUS DISTANCES FROM HADDAM NECK REACTOR - 1976



From Table 1A, Environmental Report for Haddam Neck Plant, 1976. Note that external gamma radiation is much lower near Haddam Neck than near Millstone, consistent with the lower levels of airborne Cs-137 levels in the local milk as shown in Tables 7(a) and 7(b). Again, the utility's own measurements of external gamma radiation show a level far below the level of 129 mrem per year stated as the natural background level for Connecticut ,and much closer to the 1970-71 EPA measurements of 70 mrem per year.



APPENDIX VII(a)

From Environmental Report for Millstone Plant, 1976.

APPENDIX VII(b)

From Environmental Report for Millstone Plant, 1976 (Units are pCi/gm)

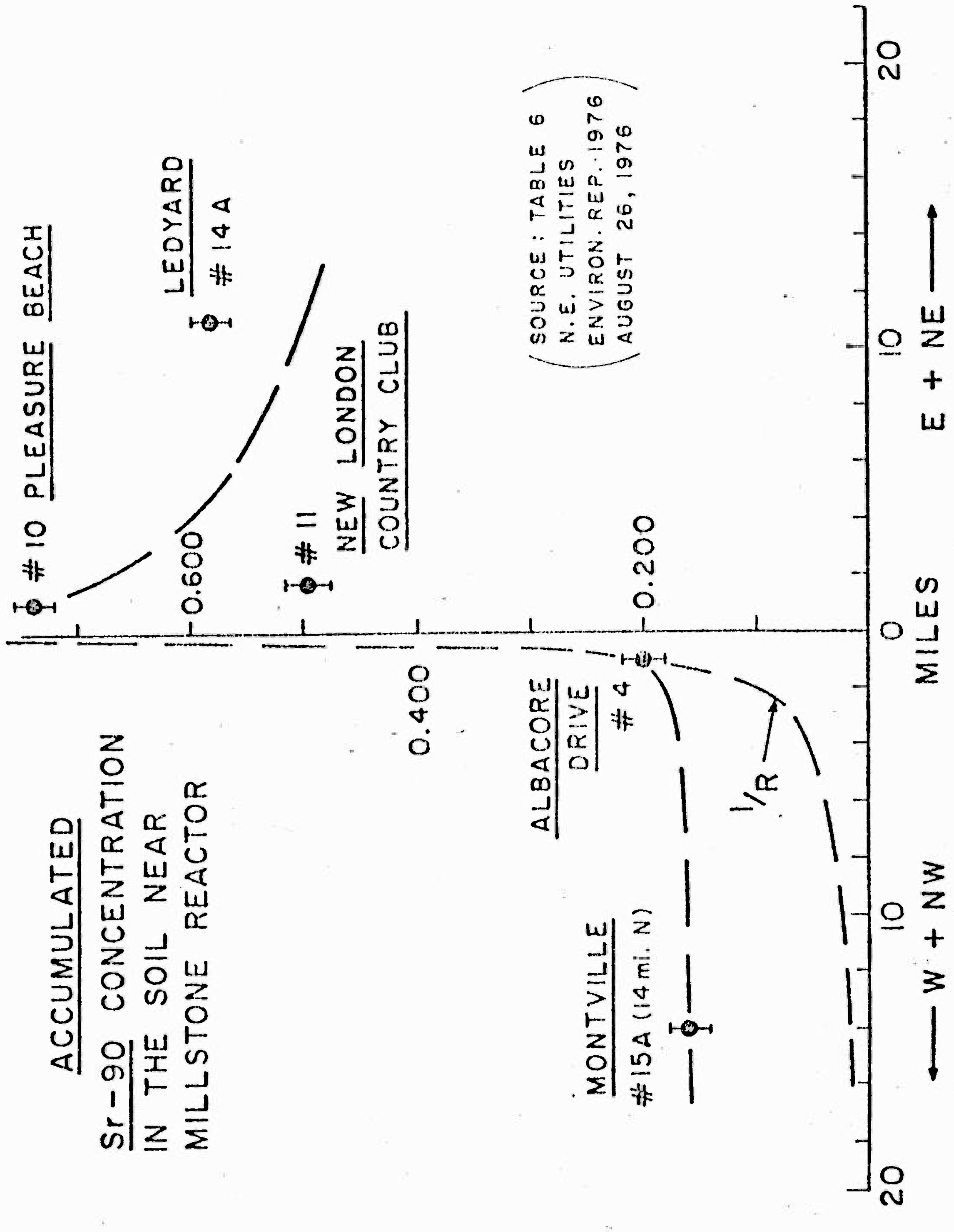


Table 4A

Tables of releases and release limits for Conn. Yankee (Haddam Neck), Mill., and Yankee (Rowe, Mass.) Reactors from A.E.C. Report on Releases of Radioactivity in Effluents " - 1972, Div. of Reg. Oper. Aug. 1973.

AIRBORNE EFFLUENT COMPARISON BY YEAR

Halogens and Particulates
(Half-life greater than 8 days)

Curies

Facility	1970	1971	1972
Boiling Water Reactors			
Oyster Creek	0.32	2.14	6.48
Nine Mile Point	<0.001	<0.06	0.969
→ Millstone 1	-	4.0	1.32
Dresden 1	3.3	<0.67	2.75
Dresden 2,3	1.6	8.68	5.89
LaCrosse	<0.06	<0.001	<0.712
Monticello	-	0.052	0.589
Big Rock Point	0.13	0.61	0.148
Humboldt Bay	0.35	0.3	1.78
* Pilgrim	-	-	0.0319
Quad Cities 1,2	-	-	0.747
* Vermont Yankee	-	-	0.171
Pressurized Water Reactors			
* Maine Yankee	-	-	3.71×10^{-6}
Palisades	-	-	9.7 x10-3
→ Yankee (Rowe)	<0.001	<0.0001	7.77×10^{-4}
Indian Point 1	0.08	0.21	0.928
R.E. Ginna	0.05	0.17	0.035
→ Connecticut Yankee (Haddam)	0.002	0.03	0.0181
H.B. Robinson	-	None detected	0.0268
San Onofre	<0.001	<0.0001	4.74×10^{-4}
Point Beach 1,2	-	<0.0001	0.0297
* Surry 1	-	-	1.75×10^{-4}
Nonwater Reactors			
Peach Bottom 1	<0.001	<0.003	None
Fermi	-	<0.001	0.001

* Operated less than 1 year

Table 21

PLANT SUMMARY 1972

Licensee:	Yankee Atomic Electric Company*
Type:	Pressurized Water Reactor
Facility:	Yankee Rowe
Docket No:	50-29
Licensed Power Level:	600 MWT ~150 MW(el)
Initial Criticality:	8/19/60
Cooling Water:	Deerfield River
Location:	20 miles N.W. Greenfield, Massachusetts

*Owned by 11 utilities.

POWER GENERATION - Megawatt hours

Gross thermal:	2.24×10^6
Net electrical:	6.44×10^5

> Effic. = 28.8%

AIRBORNE EFFLUENTS	Curies released	Percent of limit
Noble gases	1.83×10^1	2.63×10^{-2}
Halogens	2.33×10^{-4}	0.0607 1/
Particulates	5.44×10^{-4}	

1/Percent of limit includes halogens & particulates with half life >8 days.

LIQUID EFFLUENTS	Curies released	Average concentration (uCi/ml)	Percent of limit
Mixed fission and activation products	2.06×10^{-2}	1.28×10^{-10}	2.49×10^{-2}
Tritium	803.0	4.97×10^{-6}	1.66×10^{-1}

Volume of liquid waste: 1.13×10^7 liters

Volume of cooling water: 1.61×10^{11} liters

SOLID WASTE - Shipped offsite

Total curies: 2.31

Total volume: 2.22×10^2 cubic meters

Table 21A

RADIONUCLIDE SUMMARY - 1972

Facility: Yankee Rowe

LIQUID EFFLUENTS

Nuclides	Curies released	Average concentration (uCi/ml)	Percent of limit
→ Strontium-90	1.10×10^{-5}	6.83×10^{-14}	2.28×10^{-5}
Iodine-131	1.56×10^{-3}	9.69×10^{-12}	3.23×10^{-3}
Cesium-137	2.33×10^{-4}	1.45×10^{-12}	7.25×10^{-6}
Cesium-134	1.64×10^{-4}	1.02×10^{-12}	1.13×10^{-5}
Cobalt-60	3.3×10^{-4}	2.05×10^{-12}	6.88×10^{-6}
Chromium-51	4.3×10^{-5}	2.67×10^{-13}	1.34×10^{-8}
Manganese-54	5.08×10^{-4}	3.16×10^{-12}	3.16×10^{-6}
Cobalt-58	2.67×10^{-4}	1.66×10^{-12}	1.84×10^{-6}
Carbon-14	1.71×10^{-2}	1.06×10^{-10}	1.33×10^{-5}
Selenium-75	1.24×10^{-4}	7.70×10^{-13}	1.92×10^{-2}
Cesium-144	2.3×10^{-5}	1.43×10^{-13}	1.43×10^{-6}

AIRBORNE EFFLUENTS

Nuclides	Curies released	Nuclides	Curies released
NOBLE GASES		PARTICULATES	
Krypton-85	1.68	Cesium-137	2.0×10^{-6}
Xenon-133	1.12	→ Strontium-90	1.20×10^{-5}
Krypton-85m	6.0×10^{-3}	Manganese-54	8.5×10^{-5}
Xenon-135	1.94	Cobalt-60	2.23×10^{-4}
Argon-41	1.63	Cobalt-58	1.29×10^{-4}
Xenon-133m	5.4×10^{-2}	Iron-59	8.0×10^{-6}
Argon-37	1.84	Selenium-75	3.9×10^{-5}
Carbon-14	9.79×10^{-1}	Chromium-51	2.4×10^{-5}
HALOGENS			
Iodine-131	2.33×10^{-4}		

Table 24

PLANT SUMMARY 1972

Licensee: Connecticut Yankee Atomic Power Company

Type: Pressurized Water Reactor

Facility: Haddam Neck

Docket No: 50-213

Licensed Power Level: 1825 MWT

Initial Criticality: 7/24/67

Cooling Water: Connecticut River

Location: 13 miles E. Meridan, Connecticut

POWER GENERATION - Megawatt hours

Gross thermal: 1.38×10^7

Net electrical: 4.3×10^6

> EFFIC. = 31.1%

AIRBORNE EFFLUENTS	Curies released	Percent of limit	(Curies) Limit
Noble gases	6.45×10^2	2.52×10^{-1}	256,000 Ci
Halogens	1.01×10^{-2}	8.7 1/	0.12 Ci
Particulates (Sr, Cs, etc)	8.0×10^{-3}		0.09 Ci

1/Percent of limit includes halogens & particulates with half life >8 days.

LIQUID EFFLUENTS	Curies released	Average concentration (uCi/ml)	Percent of limit
Mixed fission and activation products	4.78	6.20×10^{-9}	2.33×10^{-1}
Tritium	5890.0	7.64×10^{-6}	2.55×10^{-1}

Volume of liquid waste: 3.44×10^7 liters

Volume of cooling water: 7.71×10^{11} liters

SOLID WASTE - Shipped offsite

Total curies: 4.0×10^3

Total volume: 1.07×10^2 cubic meters

Table 24A

RADIONUCLIDE SUMMARY - 1972

Facility: Connecticut Yankee

LIQUID EFFLUENTS

Nuclides	Curies released	Average concentration (uCi/ml)	Percent of limit	Permiss. Limit Curies
Iodine-131	3.01×10^{-1}	3.9×10^{-10}	1.3×10^{-1}	231
Cesium-137	7.06×10^{-1}	9.16×10^{-10}	2.29×10^{-3}	308
Cobalt-60	1.15	1.49×10^{-9}	4.96×10^{-3}	
Unidentified (Sr90 etc →)	3.75×10^{-1}	4.86×10^{-10}	1.62×10^{-2}	23.1
Iodine-133	5.75×10^{-1}	7.46×10^{-10}	7.46×10^{-2}	
Cobalt-58	9.71×10^{-1}	1.26×10^{-9}	1.4×10^{-3}	
Molybdenum-99	8.96×10^{-2}	1.16×10^{-10}	2.9×10^{-4}	
Cerium-144	2.27×10^{-1}	2.94×10^{-10}	2.94×10^{-3}	
Ruthenium-103	3.04×10^{-1}	3.94×10^{-10}	4.93×10^{-4}	

AIRBORNE EFFLUENTS

Nuclides	Curies released
NOBLE GASES	
Krypton-85	1.09×10^{2}
Xenon-133	4.94×10^{2}
Krypton-88	1.67×10^{-1}
Krypton-87	5.53×10^{-1}
Xenon-135m	1.38×10^{1}
Xenon-135	2.82×10^{1}
HALOGENS	
Iodine-131	1.0×10^{-2}
Iodine-133	6.33×10^{-5}

Nuclides	Curies released
PARTICULATES	
Rubidium-88	2.13×10^{-1}
Unidentified (Sr(s))	8.0×10^{-3}