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The Public Whole Body Counting Program Following the Three Mile Island Accident

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ABSTRACT

In early April, 1979 the U.S. Nuclear Regulatory instituted a program to determine whether any radioactivity released as a result of the March 28, 1979 accident at the Three Mile Island Unit-2 was accumulating in members of the general public living near Unit-2. The program used a device called a whole body counter which has the capability of measuring very small quantities of radioactivity in people. There were 753 men, women and children successfully counted; nine of these people were counted a second time, leading to a total of 762 whole body counts. There was no radioactivity identified in any member of the public which could have originated from the radioactive materials released following the accident. Several people with higher than average levels of naturally occurring radioactivity were identified. The counting systems used are briefly described. Technical problems encountered, results and conclusions are discussed.

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ACKNOWLEDGEMENTS

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INTRODUCTION

1.1 Brief History of Decisions leading to the Whole Body Counting Program

During the week of April 1, 1979, following the accident at Three Mile Island - Unit 2, information concerning the releases of radioactive materials and radiation from the TMI site was being issued. The NRC staff discussed actions which could be taken to ensure that measurements and calculations being used to estimate public exposure to radioactive materials were correct. It was hoped these actions would also alleviate some of the fears of nearby residents concerning exposure to radioactive materials. Whole body counting, a process using a device (whole body counter) which can measure very small amounts of radioactivity inside people, was determined to be one positive measure that could reassure residents that any internal exposures resulting from the TMI accident were minimal or nonexistent.

On Friday afternoon, April 6, 1979, an NRC representative contacted the Helgeson Nuclear Services Company of Pleasanton, California, and arranged for whole body counting services to be provided. The Helgeson Co. provided two mobile whole body counting systems (Units 3 and 4) at the site within one day. On April 9, it was decided that Unit 3 would be used primarily for counting occupationally exposed workers at the site, while Unit 4 would be dedicated exclusively to the public whole body counting program.

Middletown was the nearest population center (about three miles from the plant). Two members of the NRC staff and a Helgeson Co. representative met with Mayor Reid of Middletown on Monday afternoon, April 9, 1979, to determine the best location for the whole body counting system. It was decided that the Middletown Borrough Hall would provide the best access to the public, the press, security, electric power, and telephone service. With the help of the Mayor's staff, the local news media, the local Red Cross office, and the Commonwealth of Pennsylvania,* the NRC staff and the Helgeson Co. had Unit 4 set up and counting local residents by 11:35 a.m., April 10, 1979.

1.2 Criteria for Selecting Candidates for Whole Body Counting

Since the major TMI-2 releases had occurred 7 to 10 days earlier, it was believed necessary to establish the program as rapidly as possible.** The only radioisotope detected in biological samples as a result of the accident was iodine-131 (I-131). I-131 has a 7.5 day effective half-life in man (i.e., the radioactivity declines by one-half every 7.5 days after initial uptake into a human body.) In addition, measured levels of radioactivity in air, cow and goat milk, and vegetation indicated uptake by humans from inhalation and

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*USNRC Region I Office, King of Prussia, PA.

**Months after the program had been completed, it was found that the iodine releases did not correlate closely with the noble gas releases. Thus, although the noble gas releases occurred primarily during the first few days, iodine releases continued for weeks. About 60% of the iodine had been released before the whole body program began, and nearly all of the balance occurred during the program. As a result, the program had a better chance to determine the radioiodine then originally believed.

ingestion (food) would be extremely small (even for people living near the plant boundary and who drank milk from their own dairy animals), making detection in people even more difficult.

Given the fact that only one whole body counting system was readily available for use in counting local residents, it was necessary to determine how large a population could reasonably be counted within a short time (e.g., within another half-life of I-131). In order to assure detectability of a significant amount of radioactivity (discussed in Section 2.2), it was decided that the minimum acceptable scanning time was on the order of 10 minutes. This also allowed time for instruction, proper placement of each person within the whole body counter, and transfer of data via telephone to the Helgeson central computer. Thus, 6 persons per hour could reasonably have been counted. Allowing four hours per day for maintenance, rest, background counts, and quality assurance checks, about 120 persons per day could have been counted. Therefore, at best (assuming no major equipment breakdown) on the order of 900 persons could conceivably have been counted within an 8-day period.

As a starting point, it was considered desirable to scan as many of the people living within the 5-mile evacuation zone* as possible. However, there were about 28,000 persons living within that zone at the time of the accident. Even if only 10% of that population converged on downtown Middletown, it would have created severe logistical problems (parking, etc.), and the time and equipment constraint made that an unacceptable option.

Recognizing that potential radiation exposures were likely to be highest for those persons living nearest TMI-2, it was decided that a three mile radius should provide an adequate sample of the highest exposed population. Further, only about 10,000 persons (i.e., about 3,000 families) lived within a 3-mile radius, and about 10% could reasonably be expected to be counted within a 7 or 8-day period of time. In order to provide the maximum service to the public, it was decided that as a screening procedure, only one member of a family (selected by the family) would be counted initially; if any radioactivity was detected in any family member, then that entire family would be counted.** It was also decided that if measurable amounts of radioactivity associated with the accident were detected within the three mile radius, then the radius could be extended to 5 miles, and the duration of the counting program extended. A few exceptions were made in cases where people exhibited signs of severe emotional stress, and in one case where the pilot of a helicopter that hovered over TMI-2 for air sampling and radiation measurements was counted.

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*Governor's advisory zone for preschool children and pregnant women.

**Unfortunately, in reviewing the data there were several cases found where whole families were counted. It is believed the numerous public health nurses doing the registrations were not always aware of the selection criteria. Furthermore, some members of the same families were counted at disparate times, so that the nurses could not readily determine whether other family members had already been counted.

2. DESCRIPTION OF THE HELGESON WHOLE BODY COUNTING SYSTEM AND HOW IT WORKS

2.1 The Basic Physics

The types of radiations emitted most commonly as the result of the radioactive decay of the nucleus of an atom are called gamma, beta, and alpha rays. Gamma rays are nonparticulate electromagnetic waves (photons) similar to ordinary light rays, but of much higher energy. It is the high energy electromagnetic wave characteristic of gamma rays which permits their detection by whole body counters. Both alpha and beta rays are charged particles which are not directly detectable by whole body counting since all such emissions released within the human body are totally absorbed there. However, the emission of alpha or beta particles is generally followed by emission of X-rays or gamma rays which can be detected escaping from internal sites within the human body. Some important exceptions to the generalization are pure beta emitting radionuclides such as tritium and carbon-14.

References 1-3 listed below provide detailed descriptions of the physical principals involved in the interaction of gamma radiation with matter which permit whole body counting by the method employed at Middletown, Pa. (gamma ray scintillation spectrometry). References 4 and 5 provide detailed information about the type of counter used in the program. These details will not be provided here since many of the readers will either not be interested in the technical details or will already be familiar with the physics and systems involved.

In simple terms, gamma rays originating from radioactivity within the human body can escape absorption within the body. Such gamma rays have energies that are characteristic of a specific radionuclides much as a fingerprint is characteristic of a specific individual. When these characteristic gamma rays are totally absorbed by a special crystal which scintillates (emits light), the amount of light emitted is directly proportional to the energy of the gamma ray. Using a suitable electronics, the light flashes are converted to proportional electronic pulses which are sorted according to the size of the pulse (pulse height) and stored in a minicomputer (memory). The result is a spectrum containing photopeaks characteristic of the gamma rays detected, which can then be compared with reference spectra of known gamma emitting

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1. Heath, R. L. Scintillation Spectrometry; Gamma-Ray Spectrum Catalogue, 2nd Ed., Vols. 1 & 2, IDO-16880, 1964.

2. Price, W. J. Nuclear Radiation Detection, 2nd Ed. McGraw-Hill, Inc., 1964.

3. Gibbs, W. D. and C. C. Lushbaugh, "Whole-Body Counter Systems," in Handbook of Radioactive Nuclides, Ed. by Y. Wang, the Chem. Rubber Co., p. 134 (1969).

4. Palmer, H. E. and Roesch, W. C. "A shadow-shield whole-body counter," Health Physics 11, p. 1213, (1965).

5. Brady, J. N. and Swanberg, F. "The Hanford mobile whole-body counter," Health Physics 11, p. 1221, (1965).

radionuclides and then identified. (See, for example, Figure 1, a spectrum of naturally occuring uranium from Reference 1, p. 7.) This general method is called gamma ray spectrometry and has been widely used the world over for more than 25 years.

2.2 The Helgeson Co. Whole Body Counter

The mobile Helgeson whole body counting system utilizes the shadow shield concept which permits quite sensitive measurements of internally deposited radioactivity. The shadow shield, made up of 2 inches of lead around the person being counted and 4 inches of lead around the detector, effectively prevents most gamma rays from sources outside the counter from reaching the scintillation detector. It is important to note that the whole body counter does not emit radiation (like an X-ray machine) while scanning; it merely collects data on radioactivity originating from the person being counted.

The Helgeson detector is a 20 cm. diameter by 10 cm. thick sodium iodide crystal (thallium activated) which is housed in a large box-like structure which passes over the body of the person being counted (i.e., it scans the person). Figures 2 and 3 illustrate the typical configuration of the transportation system and the whole body counter employed at TMI. Light pulses from the large crystal are detected by a 13 cm. diameter photomultiplier tube optically coupled to the crystal.

Once the gamma spectrum has been collected by the minicomputer, the stored data is transmitted by telephone to a central computer located at the Helgeson home office in California. Once stored in the central computer, a number of sophisticated spectrum analyses are carried out along with quality assurance (QA) checks on the raw data. Such "QA" checks are necessary to provide assurance that the electronic components were working properly during each whole body count. These and other quality assurance tests will be discussed in more detail in Section 2.3. Typical minimum detectable activities (MDA) of various radionuclides for the Helgeson system and elements are shown in Table 1. The minimum detectable activities are somewhat variable for different body dimensions (reflecting age and sex), counting times (the values shown are for time on the order of 6 to 8 minutes), and background radiation levels.

Of all the nuclides listed, only iodine-131 (I-131) and iodine-133 (I-133) were detected in the atmospheric releases from the plant, and only I-131 was detected in food pathways* (cow and goat milk collected near the plant). As shown in Table 1, the MDA for I-131 is about 2 nanocuries (nCi).** Two nanocuries in an adult thyroid would result in a lifetime dose of about 12 millirem. That is numerically equal to about 12% of the annual dose to each organ within the body from external natural radiation in Pennsylvania. However, from a risk equivalence standpoint, a 12 millirem dose to the thyroid alone is approximately equivalent to a total body dose of about one millirem or less.

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*See NUREG-0558, "Population Dose and Health Impact of the Accident at the Three Mile Island Nuclear Station," P. 74, (May, 1979.)

**A nanocurie (nCi) is one-billionth of a curie (the basic unit of measurement for radioactivity). One nCi represents that amount of radioactive material which decays at a rate of 37 nuclear disintegrations per second.

(Human studies to date indicate I-131 produces considerably fewer cancers per unit of dose than external radiation such as X-rays.[6,7])

The system employed by Radiation Management Corporation at the site is very similar to the Helgeson counter, with similar electronics and sensitivity. Since only one member of the public was counted on it, it will not be discussed further.

2.3 Quality Assurance

Quality assurance (QA) checks are necessary to ensure that the detection system was working properly during each whole body count. In addition to verifying the proper operation of the electronic components, a special device referred to as a "phantom" supplied by NRC and containing three (3) very low level radioactive sources was counted by the Helgeson whole body counting system used in Middletown. The phantom provided a method of determining whether the Helgeson system was capable of identifying specific radionuclides as well as correctly quantifying the amount of each one. The QA methods employed at Middletown are described in the following sections.

2.3.1 Checks for Proper Electronic Gain and Linearity of Energy Response

Whole body counting is a special application of pulse height analysis. Since pulse height is proportional to the energy of each gamma ray detected, any electronic factors which could cause a variation in pulse height or in the counting of such pulses for a specific gamma ray energy must be carefully controlled.

The method used by Helgeson Nuclear Services is that of R. Heath (IDO-16880).* It is both simple and reliable, and is based on the assumption that if the system response for photons of known specific energies at the high energy and low energy ends of the spectrum are correct, the system responses for intermediate energies will also be correct. To make such a check for the low energy end of the spectrum, a small americium-241 (Am-241) check source is attached to the detector. As a result, every count made (including background counts) provides a record of the system response to the 0.060 MeV X-rays coming from the Am-241 source.** These counts fall in the very low energy end of gamma spectra and thus do not interfere with detection of the typically higher energy gamma rays of interest (e.g., see Figure 1).

The gain and linearity check for the high energy end of the gamma spectrum is done by evaluating the photopeak for naturally occuring potassium-40 (1.46 MeV) which is present in everyone regardless of where they live or what they do.

Continuity of detector resolution is assured by checking the resolution*** for each count. A significant loss in resolution could indicate a serious system

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[6]Maxon, H. R. et al., "Ionizing Irradiation and the Induction of Clinically Significant Disease in the Human Thyroid Gland." Amer. J. Med. 63, p. 967 (1977).

[7]The Effects on Populations of Exposure to Low Levels of Ionizing Radiation, Nat'l Acad. of Sciences, Nat'l Research Council, Wash, DC, p. 353 (1980).

*Ref. 1, p. 7.

**MeV = million-electron-volts; it is a measure of the energy of the radiation. Similary keV = thousand-electron-volts.

***Resolution here is defined as the (spread in energy across the photopeak at half the maximum height of the photopeak, divided by the gamma energy of the peak, expressed in percent).

failure (e.g., cracked crystal, fluctuating detector voltage, etc.) and could result in an underestimate of internally deposited radioactivity. Figure 4 shows the results of an actual whole body count compared with reference spectra for potassium-40 (K-40) and radium-226, and the system background. Note the excellent fit between the reference spectra and the whole body count data.

An additional check on long-term stability (and reproducibility) comes by comparing the K-40 results for nine individuals who were counted twice as a result of higher levels than expected of naturally occurring radon-222 daughters in their initial whole body scans (see section 3.3 and Table 3, files 109 and 746, 150 and 727, 383 and 720, 429 and 725, 533 and 724, 534 and 742, 535 and 739, 625 and 740, and 736 and 744). Although body potassium levels may vary from time to time, the K-40 levels should remain fairly constant over time intervals of a few weeks. The recount data confirmed that the K-40 levels were statistically the same for both whole body scans. Therefore, it can be concluded that the long-term stability of the Helgeson Co. system was very good.

2.3.2 Use of the NRC Region II Inter-Comparison Phantom

The NRC phantom (a rough model of the human trunk) which is made up of several sheets of heavy plywood bolted together and containing specific quantities of certain radionuclides (cesium-134,137 and cobalt-57,60) was counted by each whole body counter utilized at Three Mile Island. Neither the radionuclides nor their quantities were known by the whole body counter operators. Two whole body counters were operated by Helgeson Nuclear Services (Units 3 and 4), and one by Radiation Management Corporation (RMC). In every case, Helgeson Unit 4 (the system employed in Middletown) and Unit 3 (employed at the TMI site) overestimated the actual radioactivity present. None of the units was able to detect the Cs-134 since it was about one-fourth of the MDA for the systems employed at TMI.

Table 2 shows the results of comparisons between the Helgeson and RMC units with other whole body counters around the United States.

2.4 Technical Problems Encountered

After the whole body counting program had been completed, a few problems were observed in the evaluations carried out at the Helgeson Nuclear Services Co. home office in Pleasanton, CA.

Preliminary results failed to identify any naturally occurring potassium-40 (K-40) in several individuals. Since everyone contains K-40, the raw data for each person was carefully reevaluated at the request of the NRC. As a result, enough K-40 was found to quantify the stable potassium level for each person counted except for one small child whose K-40 burden was below the minimum level of detection.

Of the 769 whole body counts made, seven sets of transmitted data were lost. These persons were notified by letter of the loss of data* However, determine

*In the event a participant did not receive either a certificate of participation or a letter explaining what happened to their data, it is possible that their certificate is among many still being held in Harrisburg after being returned by the Postal Service. Further information can be requested from the office of Ms. Margaret Reilly, Bureau of Radiation Protection, Dept. of Environmental Resources, Commonwealth of Pennsylvania, Harrisburg, PA 17120.

that it was possible to based on the gross I-131 count data recorded at the counting facility, no I-131 or Ra-B,C of any consequence was present in their bodies at the time of the count. Of the seven losses, four appear due to operator error. In those cases, it appears the operators failed to realize that the data transmission to Pleasanton had not been successful before starting the next count.

The remaining three sets of data were lost due to computer errors. In two of those cases, it appears the minicomputer had restarted the counting program (and erased the preceding data set) before it completed the "automatic" telephone transmission to Pleasanton, CA. The third set of data was lost by the receiving computer in California which failed to store the data.

Another source of concern was whether or not the radium-226 and radon daughters (Ra-B,C) detected were always inside the person being counted as opposed to being in the air surrounding the person being counted. This problem occurs particularly under conditions of low barometric pressure and stable meteorology It was not possible to resolve that question completely. More discussion on this problem follows.

3. RESULTS

No radioactivity was detected in any member of the public which could have originated from the releases following the Three Mile Island (TMI) accident on March 28, 1979. That is not to say that people did not receive any radiation exposure as a result of the accident. Almost all of the radioactivity released from the accident was in the form of noble gases, principally isotopes of xenon and krypton. These elements are not taken up by living things in significant amounts and, therefore, are not measurable by whole body counting methods even if the counting had been completed within a few hours after exposure. As a result, no noble gases were detected in members of the public a week after the major releases had occurred.

It is particularly important to note that no radioactive iodine-131 (I-131) was detected in any of the participants counted. I-131 was the only radioisotope released during the accident which was detected in food pathways to man (specifically in cows' and goats' milk collected near TMI). The sensitivity of the whole body counters used was such that if I-131 had been present (concentrated primarily in the thyroid gland) at just below the minimum detectable level, people could have received a radiation dose to the thyroid of about 12 millirem.* Estimates of maximum thyroid doses based on measurements of environmental concentrations indicate a realistic value of less than 5 millirem. The subject is discussed in more detail in NUREG-0558, "Population Dose and Health Impact of the Accident at the Three Mile Island Nuclear Station" (May 1979).

*Natural background radiation doses result from cosmic rays (about 42 mrem/yr) and terrestrial radiation (about 46 mrem/yr) from external radiation and about 20 mrem/yr from internally deposited naturally occurring radioisotopes. These radiation doses have nothing to do with nuclear power plants, weapons testing, or medical and dental x-rays.

The results reported by the operator of the whole body counting units are reported in Table 3. Listed are the file number, weight, sex, age, radioactivity, and the local wind speed and Pasquill atmospheric stability categories during the period of each whole body count. A detailed discussion of the results follows.

3.1 Potassium-40 (K-40)

Every living creature contains the element potassium. There are about 100 to 150 grams of stable potassium in adults depending on age, sex, and body weight. In general, potassium levels per unit body weight are lower in women, and decline with increasing age in both sexes. Of this total, about 0.012% is radioactive potassium-40 (1.3 billion year half-life). This amount of K-40 is equivalent to about 100 nanocuries* per person and accounts for an annual radiation dose to each person's entire body of about 20 millirem, or approximately 1,400 millirems during a lifetime of 70 to 75 years.

Evaluation of the K-40 data collected in Middletown shows good agreement with previous studies (see, for example, "Sources and Effects of Ionizing Radiation," United Nations Scientific Committee on the Effects of Atomic Radiation, 1977 Report to the General Assembly, pp. 56-57). The 371 males counted ranged in age from 1.5 years to 81 years (mean = 29.8 ± 21.2 years), while the 381 females counted ranged in age from 4 years to 76 years (mean = 31.4 ± 19.8 years).

The average K-40 concentrations were 1.44 nCi/kg for males (± 0.404 nCi/kg) and 1.18 nCi/kg for females (± 0.410 nCi/kg). Linear regression analyses of K-40 concentration vs age showed the following relationships:

Males: K-40 (nCi/kg) = 1.67 - 0.00778x(Age)
Females: K-40 (nCi/kg) = 1.49 - 0.00977x(Age)
Both Sexes (combined): K-40 (nCi/kg) = 1.5 - 0.00895x(Age)

It would appear males generally begin life with somewhat higher K-40 concentrations than females, and lose K-40 slower with advancing age than females.

Potassium is necessary for life (e.g., in heart muscle rhythm, nerve transmission, and maintaining electrolyte and water balance in living cells).** The nanocuries of K-40 shown in Table 3 may be converted to total grams of potassium by multiplying by 1.2. Typical levels should range from about 0.4 gram to 1.3 grams per pound of body weight (0.9 to 2.9 grams per kilogram).

*Natural background radiation doses result from cosmic rays (about 42 mrem/yr) and terrestrial radiation (about 46 mrem/yr) from external radiation and about 20 mrem/yr from internally deposited naturally occurring radioisotopes. These radiation doses have nothing to do with nuclear power plants, weapons testing, or medical and dental x-rays.

**Physicians are interested in the total body potassium level as an indicator of potential health problems. Potassium deficiency often results in muscular weakness, impaired breathing, and intestinal problems.

3.2 Radium - B,C (Ra-B,C)

Radium-B,C exists naturally and is not associated with the accident at TMI.* About 60% of the whole body counts showed detectable levels of radium-B (lead-214) and radium-C (bismuth-214). The average amount of these nuclides detected in this group was about 4 nanocuries plus or minus about 2 nanocuries (two standard deviations). The minimum level of detection for Ra-B,C in the whole body counter used in Middletown was about 2 nanocuries, depending somewhat on body size and length of the counting time, assuming the Ra-B,C was actually in the body of the person being counted. Since Ra-B,C are radioactive decay products of radon-222 (Rn-222), which is also naturally occurring and varies widely with both time and location, it is possible that the Ra-B,C measured during the whole body counting may have actually been in the air around the person being counted rather than in their body. There was no way to make that determination without further expensive and arduous tests. In any case, since everyone is exposed to naturally occurring radion-222 and its radioactive products to verying degrees, and the exposures are not associated with the accident, no further effort was deemed necessary.

3.3 Radium-226 (Ra-226)

Every person has some naturally occurring radium-226 deposited within their body; however, it is very difficult to detect with conventional whole body counting techniques. Therefore, the amounts of Ra-226 estimated in participants were calculated rather than measured, and are more uncertain than the Ra-B,C levels actually detected. The calculated Ra-226 levels are based on the assumption that the detected Ra-B,C came from the decay of naturally occurring Ra-226 deposited in the bodies of each participant. As already mentioned, it is possible that the Ra-B,C levels in some of the participants may actually have been outside their bodies in the air around them during the period of their whole body counts. It is also possible that the Ra-B,C detected was actually in the gastrointestinal tract in water ingested from local wells, or in the lungs as a result of inhaling these naturally occurring radon progeny from air containing higher than average levels of Rn-222 immediately before the whole body count. An indication that not all of the calculated amount of Ra-226 was internally deposited came from recounts of nine participants initially showing higher than average levels of Ra-B,C. If the Ra-B,C detected were coming from the radioactive decay of internally deposited Ra-226, the amounts of Ra-B,C would not have changed significantly in the time between counts since the long-lived Ra-226 (1,600 years) is eliminated very slowly from the body once incorporated. However, in eight of the nine recounts, the recounts were much lower than the initial counts. It is unlikely this was due to electronic or analytical errors since, as

*Although Ra-226 and Ra-B,C ultimately come from the decay of uranium-238 (U-238), Ra-B,C detected in members of the public could not have come from the damaged fuel in TMI Unit 2. That is because (a) the Ra-226 and other progeny of U-238 (e.g., thorium-230) are separated from uranium when the ore is processed at a uranium mill (most mills are in the western U.S.) and (b) it takes many thousands of years before the predecessors of Ra-B,C would reappear in reactor fuel as a result of the normal radioactive decay of U-238 in the fuel, assuming the chemical composition of the fuel was not perturbed (for example, by chemical reprocessing).

mentioned in Section 3.3.1, the K-40 results were statistically consistent between the counts and recounts. Had the K-40 results (taken from the same gamma spectra as the Ra-B,C) been statistically different, the observed differences in Ra-B,C (and therefore Ra-226) could have been due to systematic or analytical errors.

An evaluation of the meteorological data in Table 3 for participants reporting more than a few nanocuries of Ra-B,C was carried out to determine if there was any correlation between reported Ra-B,C and weather conditions. For those participants reporting more than 3 nanocuries, 19 were counted during very unstable atmospheric conditions, 66 during neutral conditions, and 90 during stable conditions. This trend indicates that perhaps most of the results for Ra-B,C that were statistically significant occurred during periods when meteorological conditions (e.g., temperature inversions) could have resulted in higher than normal radon concentrations near the ground surface. Higher concentrations would generally result in temporarily higher than normal levels of radon progeny (Ra-B,C) being deposited in the lungs of people just prior to and while being counted. In addition, variations in such concentrations would also cause small variations in the background of the whole body counter, and in the gross gamma spectra of the persons being counted.

However, for the 17 participants who had 10 or more nanocuries of Ra-B,C reported, 6 were counted during unstable atmospheric conditions, 4 during neutral conditions and 7 during stable conditions. This would indicate that for those few people who had much higher levels of Ra-B,C the weather may not have been a significant factor. This leaves open the possibility that the Ra-B,C came from their homes, water supplies, or places of work (or wherever they had been prior to being counted). The Department of Environmental Resources, Commonwealth of Pennsylvania, checked the homes of some of the participants showing the highest levels of Ra-B,C and found each home was built of brick, stone, cinderblock or some combination of the three. Since such building materials result in higher than normal exposures to Rn-222 and progeny it is possible that could also have contributed to the highest levels that were detected. In addition, each of those homes had their own well, and water samples showed detectable levels of Ra-B,C in each well. Thus, for these few participants, it is possible that much of the detected Ra-B,C could have come from their own homes and well water. As a result, it is probable that most of the Ra-226 data reported does not represent internally deposited activity.

For perspective, typical concentrations of Ra-226 in adult humans are on the order of 0.008 nanocurie per kilogram in bone, and about 0.00013 nanocurie per kilogram in soft tissue. The average content in adult males is about 0.15 nanocurie. This would produce an amount of Ra-B,C that would be about one-twentieth the level that could have been detected by the whole body counting system employed in Middletown. Radiation doses for these typical levels would be about 0.3 millirem per year in soft tissues (e.g., lung and gonads) and 0.9 millirem per year to the red bone marrow. These are small fractions of the total body dose from K-40 (about 20 millirem per year) or total natural background radiation in the U.S. (about 100 to 200 millirem per year). Because of these small potential doses and the probable overestimates of the Ra-226, the indicated presence of these naturally occurring nuclides in the body should not be of any concern to the program participants.

3.4 Cesium-137 (Cs-137):

Cesium-137 is present in all human beings as a result of world-wide fallout from nuclear weapons testing. About 30% of the participants in the whole body counting program had detectable amounts. The minimum level of detection for the counting system used at Middletown was about 2 nanocuries. The average amount detected in the 30% of participants was also about 2 nanocuries. The Cs-137 originated as fallout from atmospheric nuclear weapons tests most of which were conducted before the Three Mile Island nuclear power plants were built. In general, since the number of atmospheric tests have declined in recent years, the Cs-137 levels detected are much lower now than before the TMI units began operation.

It is possible that some of the very low levels of Cs-137 reported may be statistically zero because the statistical uncertainty does not exclude that possibility. Also, because of the problems encountered with variations in ambient levels of Rn-222 and progeny, it is probable that some of the Cs-137 reported was actually from the short-lived radon progeny. Note that in Figure 1, one of the principal gamma ray photopeaks (at 0.61 MeV) would overlap the 0.66 MeV Cs-137 photopeak. Small electronic gain shifts during the scan, for example, could have resulted in false measurements of Cs-137 in some cases. In any case, the small amounts of Cs-137 reported should not be of any concern to participants in the whole body counting program conducted at Middletown since the radiation doses are much less than 1 millirem per year (i.e., less than 1% of the natural background radiation doses).

4. CONCLUSIONS

Seven-hundred and sixty-two whole body counts were completed after the Three Mile Island Unit-2 accident of March 28, 1979. No radioactivity was detected which could have originated from Unit-2 releases. Based on the minimum detectable activity for I-131, the maximum (undetectable) dose to a typical thyroid could have been about 12 millirem. That dose would represent about a 12% increase over the natural background radiation dose received during 1979 by residents in that area of Pennsylvania.

Higher than normal levels of radium-B,C (short-lived daughters of naturally occuring radon-222) were found in several participants in the program. Most of the observed Ra-B,C activity did not appear to come from internally deposited radium-226.

Barely detectable levels of cesium-137 from long-term stratospheric fallout (weapons tests) were detected in a small fraction of the total population. The observed levels are comparable to levels elsewhere in the eastern U.S.

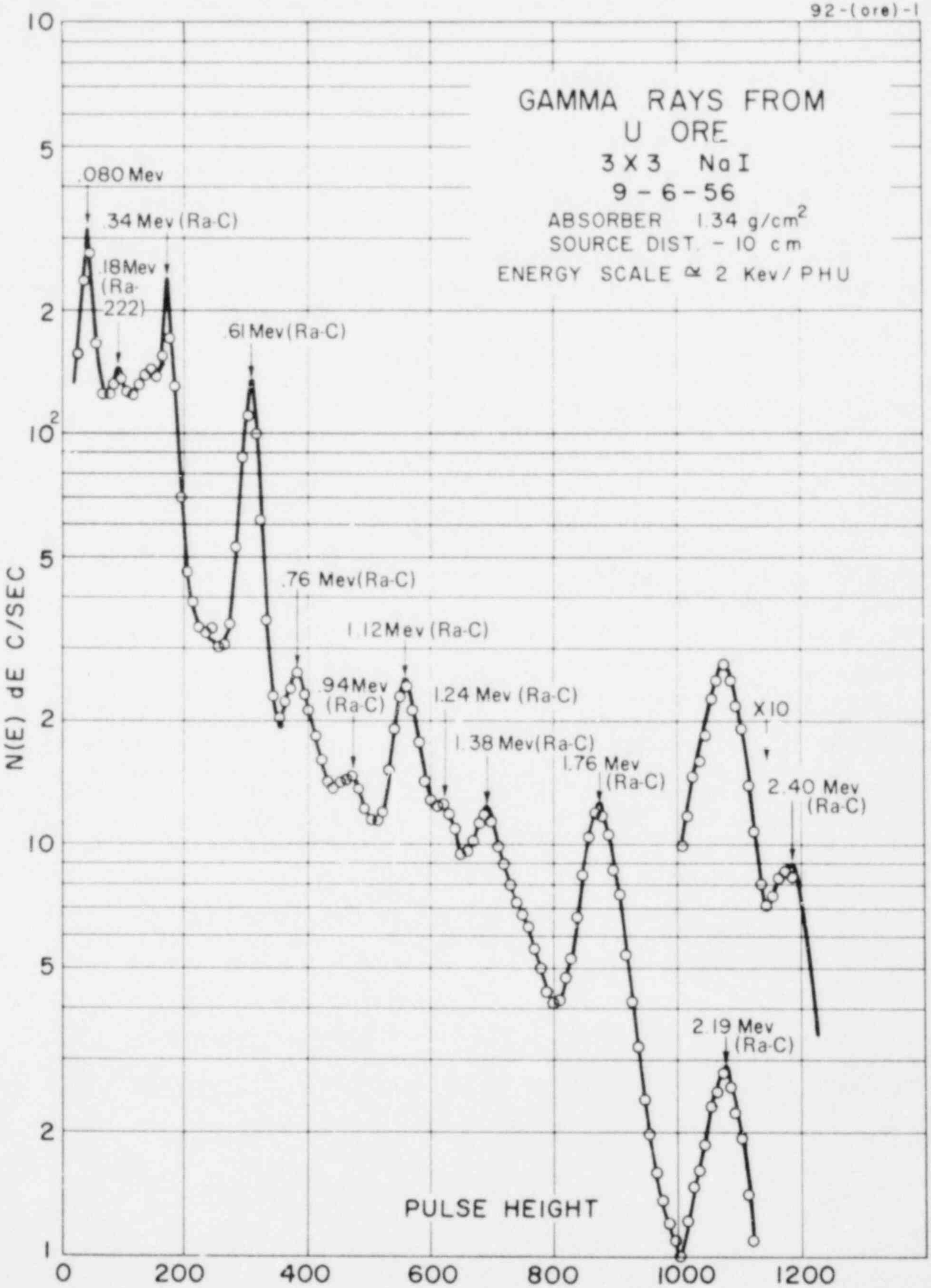
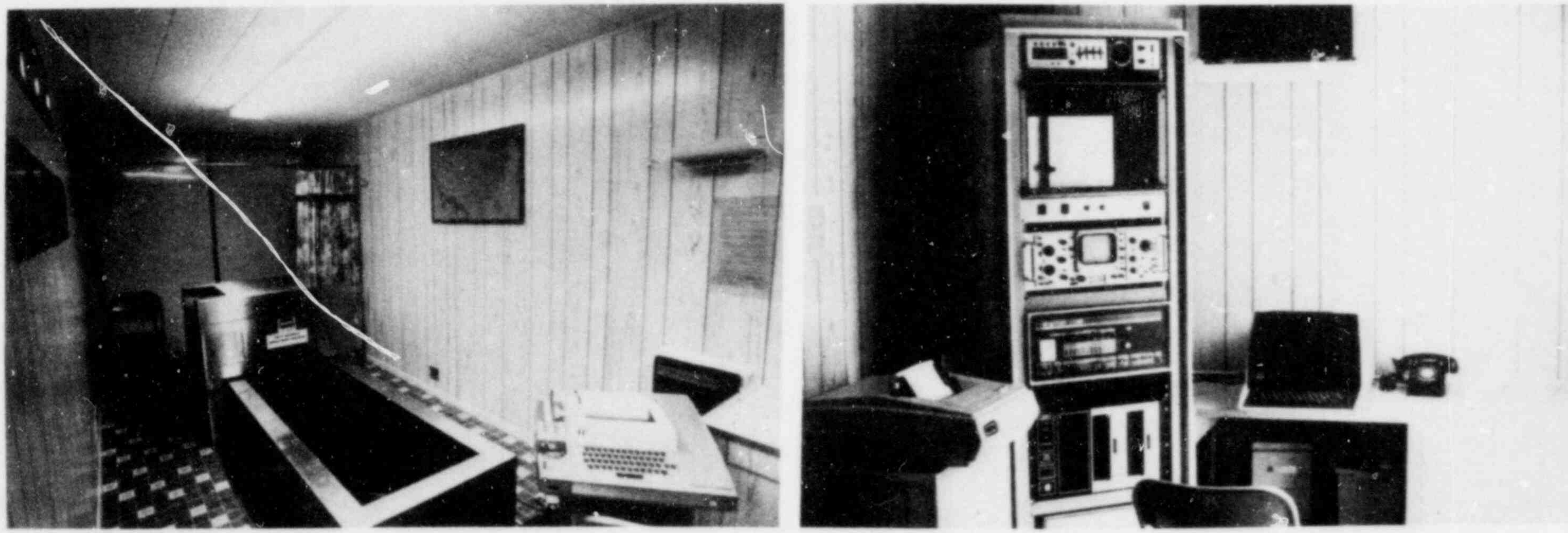


FIGURE 1. PRINCIPAL GAMMA RAYS FROM SHORT-LIVED RADON-222 PROGENY (REF. 1)

Figure 2. Helgeson Unit-4 on Location in Middletown, Pennsylvania.

Figure 3. Interior of Helgeson Unit-4 Whole Body Counting System



SHADOW SHIELD

GAMMA SPECTROMETRY EQUIPMENT

FIGURE 4. EXAMPLE OF GAMMA SPECTRUM AND RESULTS

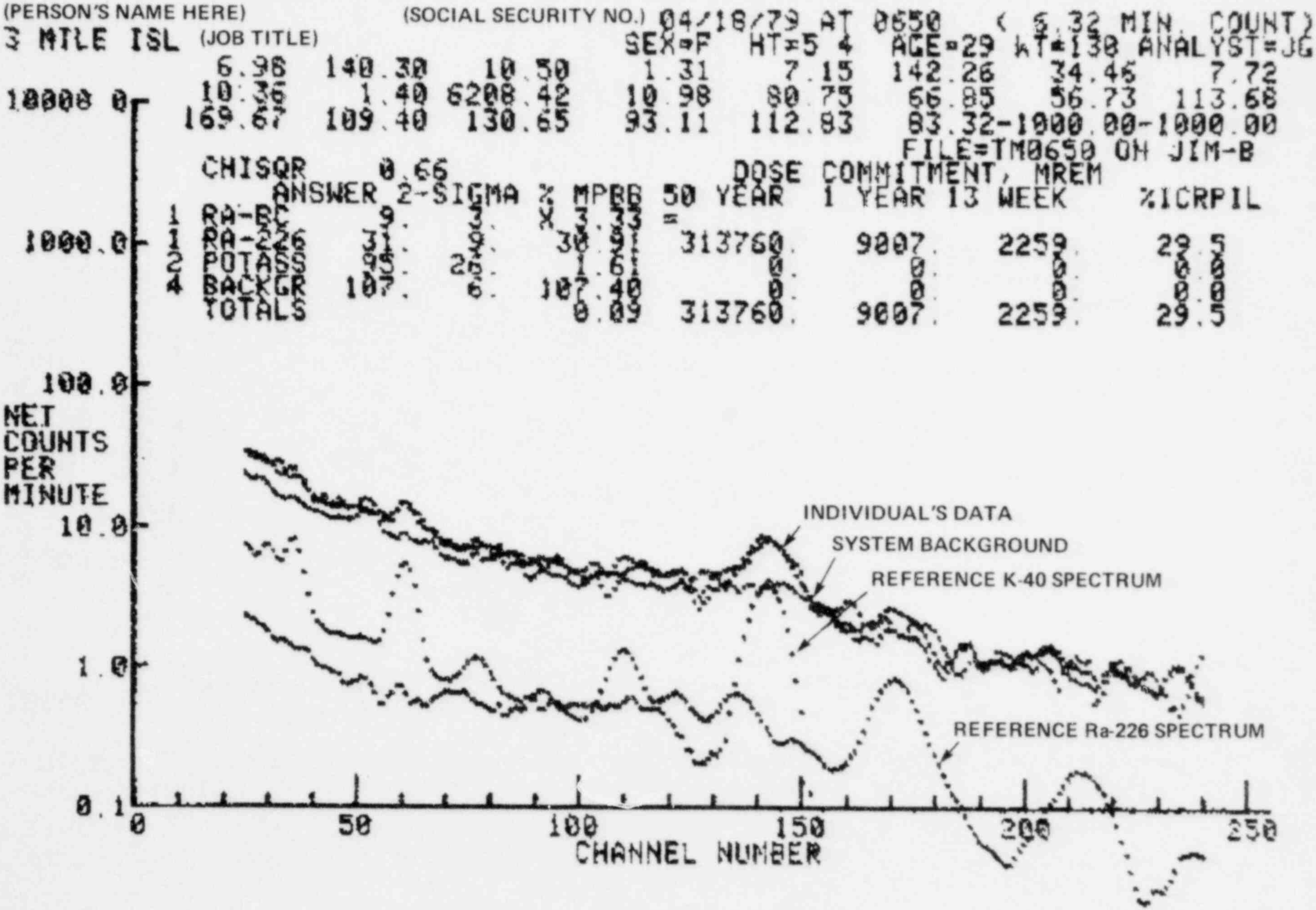
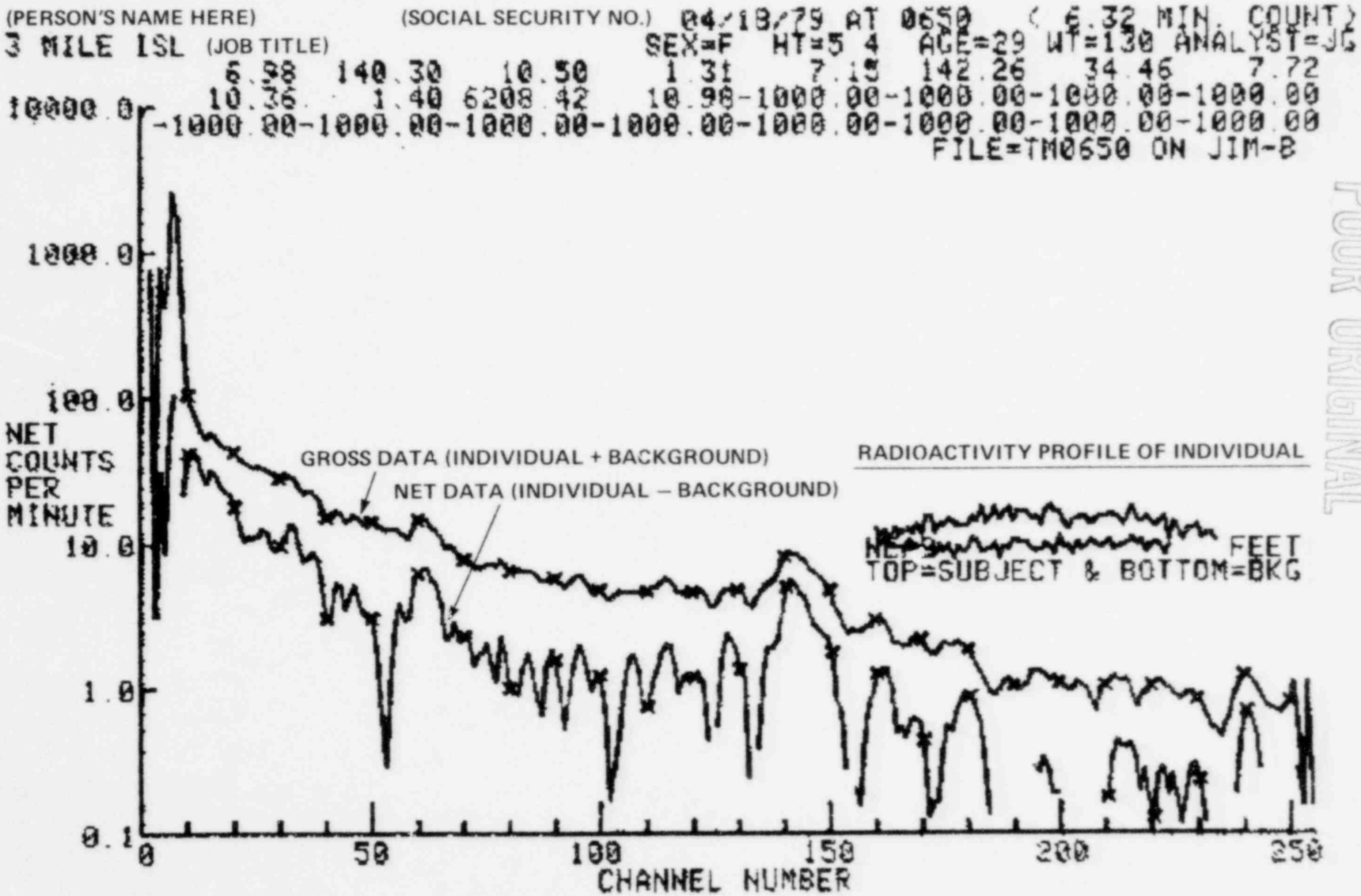


FIGURE 5.



POOR ORIGINAL

FIGURE 6. RESIDUAL COUNT DATA EXPRESSED IN COUNTS PER MINUTE

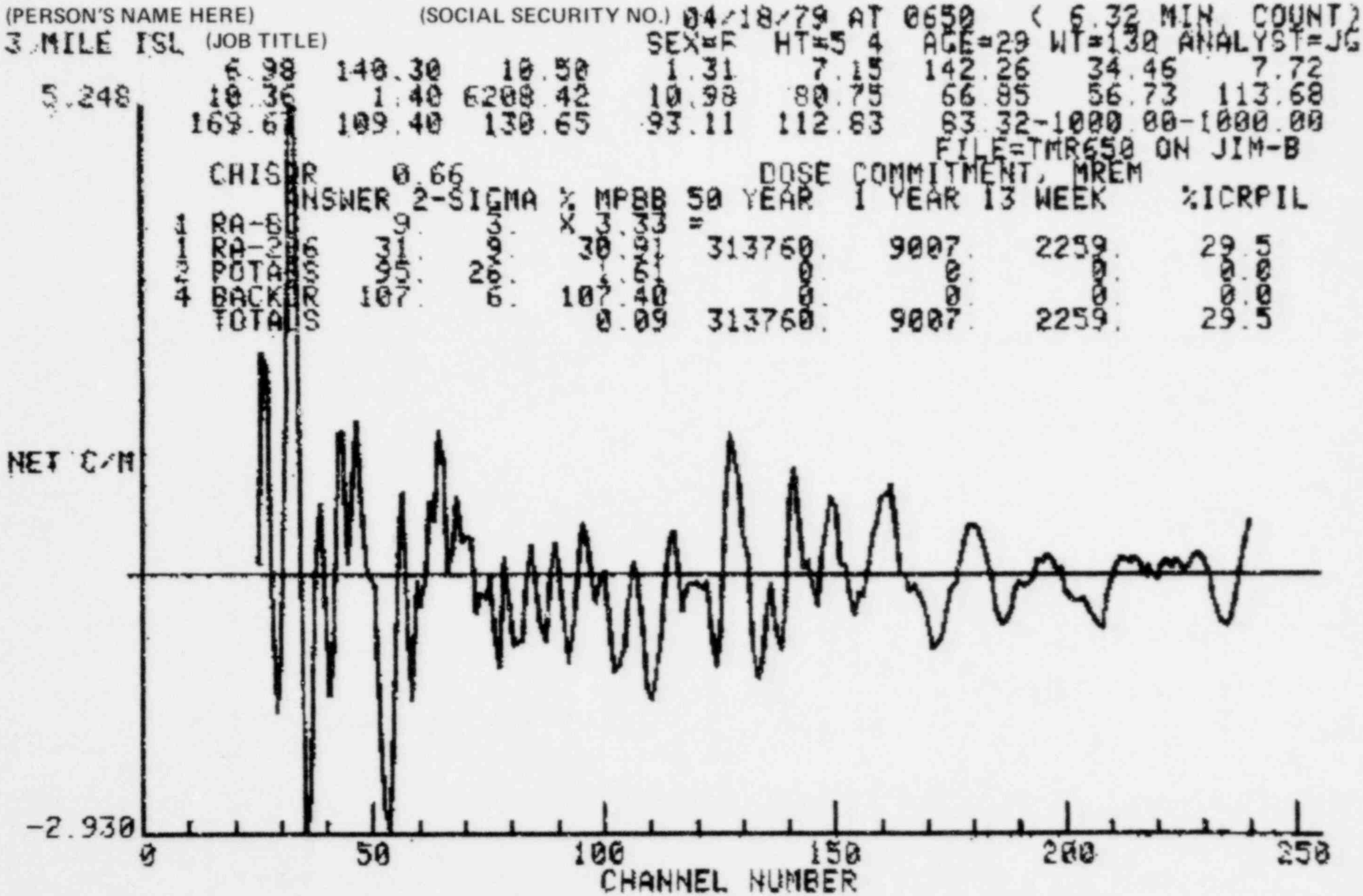


FIGURE 7. RESIDUAL COUNT DATA EXPRESSED IN STATISTICAL STANDARD DEVIATIONS

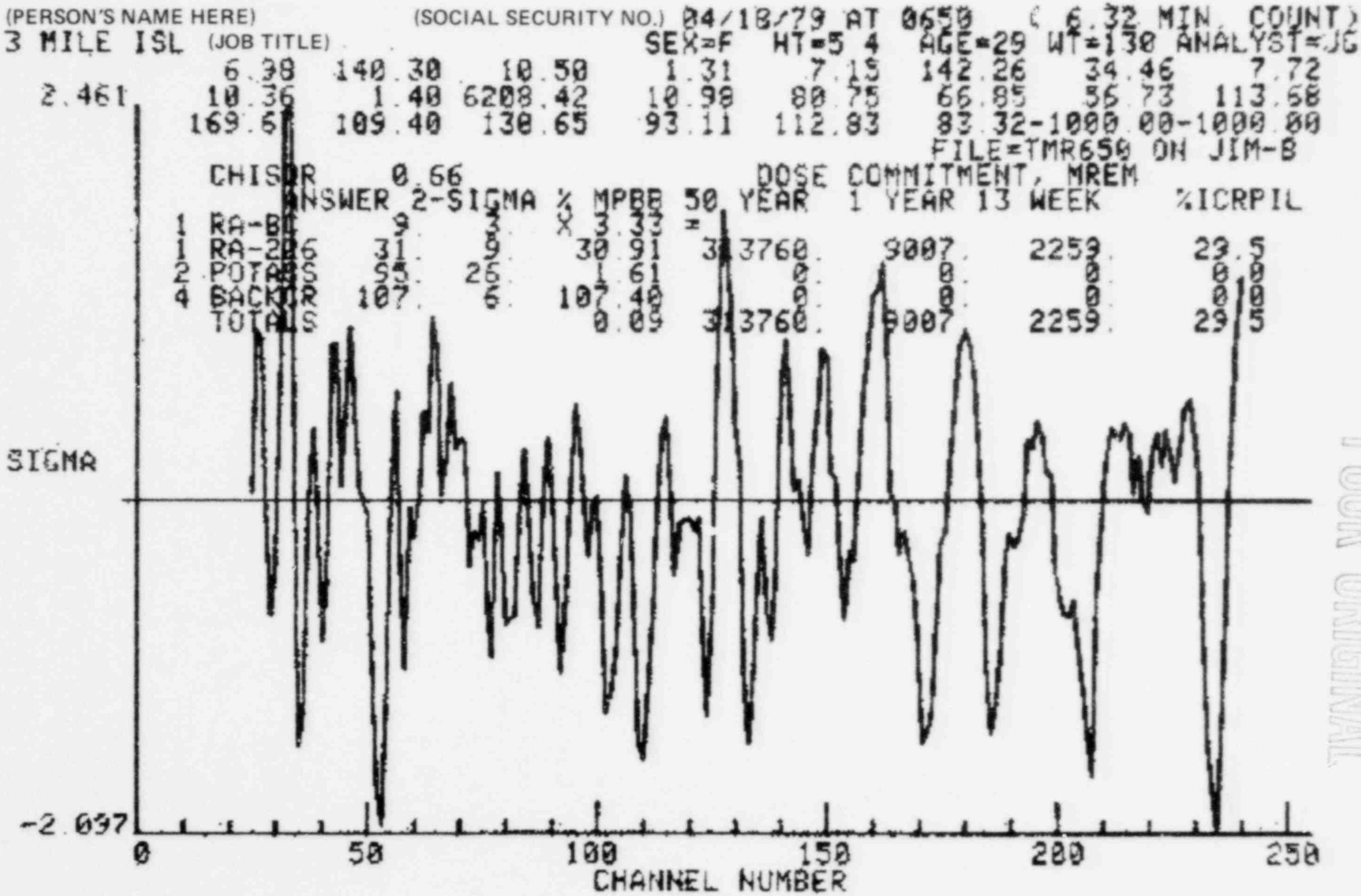


TABLE 1

TYPICAL MINIMUM DETECTABLE ACTIVITIES

RADIONUCLIDE (Mixed Fission, Activation and Corrosion Products)	MINIMUM DETECTABLE ACTIVITY* (nCi unless otherwise noted)
Sb-124	2.0
Sb-125	6.0
Ba La-140	2.0
Ce-141	18.0
Cs-134	2.0
CS-137	2.0
Cr-51	23.0
Co-58	2.0
Co-60	2.0
Au-198	2.0
I-131	2.0
I-133	3.0
Ir-192	2.0
Mn-54	2.0
Hg-203	4.0
Ru-106	10.0
Se-75	4.0
Ag-100m	2.0
Sr-85	2.0
Ta-182	2.0
Tc-99m	1.0
Sn-113	2.0
Zn-65	4.0
Zr Nb-95	2.0
OTHER RADIONUCLIDES	
U (Natural & Depleted)	10 mg
U-235	50 mg
Ra-226	10
Th (Natural)	6 mg
K	22 g (19 nCi of K-40)

*The "Minimum Detectable Activity" is defined as three times the standard deviation of the background divided by the calibration factor.

mg = milligram or one-thousandth of a gram (g)
mg = microgram or one-millionth of a gram

TABLE 2

RESULTS OF COUNTING THE NRC REGION II INTERCOMPARISON PHANTOM*

Counting Unit	Ratio of the Reported Radioactivity to Actual Activity Co-57	Co-60	Cs-134	Cs-137
Helgeson #3	2.31	1.64	***	2.27
Helgeson #4	2.26	1.57	***	2.18
RMC	***	1.27	***	1.48
A**	0.07	1.29	***	1.62
B	1.22	1.08	***	1.92
C	0.66	1.42	***	1.31
D	***	1.46	***	0.85
E	***	2.04	***	2.77
F	1.22	1.25	***	0.85
G	1.33	1.42	***	1.62
H	0.63	0.88	43	1.62
I	0.23	1.63	***	2.38
J	***	2.42	***	2.62
AA	2.97	1.36	***	1.38
BB	0.67	0.78	***	0.92
CC	1.00	1.13	***	1.38
Nominal Activity at Time of Count	~300nCi	~200nCi	~0.5nCi	~100nCi

* Double letters are Department of Energy units, single letters are units used at power reactors (primarily in the S.E.).

** Facility A reported Cr-51 (100 nCi) present although it was not present in the phantom.

*** Not detected or reported.

TABLE 3

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count 4/10/79	Wind Speed (mph)	Pasquill Atm. Stability Category*	Comments
-001	198	M	40	140±20	1±2	4±6	3±2	1135	18.0	A	
002	132	F	62	47±18				1200			
003	185	M	38	110±21	2±2	6±7	2±2	1214	13.6	A	
004	165	F	38	67±14			1±1	1224			
005	150	M	41	100±15	3±2	10±5	1±1	1238			
006	162	F	42	69±20	3±2	11±7		1250			
007	160	F	75	50±15	3±2	9±6		1300	14.0	A	
008	46	M	5	44±12	1±1	3±5	2±1	1315			
009	155	F	23	84±14	3±1	11±5	1±1	1327			
010	143	F	27	32±17	2±2	8±8		1340			
011	40	F	6	37±13	1±2	4±5		1355			
012	180	M	58	80±20	5±2	16±7		1409	16.2	C	
013	210	M	63	110±17	4±2	13±6	2±1	1426			
014	179	F	71	49±14	2±2	6±6	1±1	1439			
015	190	F	56	78±16	2±2	6±6		1457			
016	180	M	27	110±21	2±2	7±6	2±2	1510	14.8	D	
017	150	M	23	120±24				1524			
018	128	F	20	73±19	3±2	11±7		1534			
019	123	F	37	55±15			1±1	1549			
020	190	F	64	54±14			1±1	1601	15.6	D	
021	63	F	5	49±14	3±2	11±5	1±1	1613			
022	175	F	31	66±18	1±2	5±7	2±2	1624			
023	150	F	56	49±14	1±2	3±5		1636			
024	176	M	69	76±20			2±2	1648			
025	158	F	56	49±14			1±1	1700	13.5	E	
026	85	M	9	49±14	4±2	12±6		1715	13.5	E	
027	65	F	7	32±15				1728			

*Pasquill Stability Categories based on NRC Regulatory Guide 1.23 and Metropolitan Edison meteorological data
A=Extremely Unstable B=Moderately Unstable C=Slightly Unstable D=Neutral
E=Slightly Stable F=Moderately Stable G=Extremely Stable
-Indicates background count was taken between two whole body counts.

TABLE 3 (Continued)

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Ra-B,C	Ra-226	Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/10/79 Cont'd			
028	165	F	53	67±17	2±2	5±6		1739			
029	80	F	12	50±14				1751		E	
030	130	F	14	46±14	4±2	12±6	1±1	1821	11.3		
031	35	M	5	18±17				1845			
032	99	F	10	33±14	2±2	8±6		1852			
033	165	F	19	78±20	2±2	6±7		1903	8.8	E	
034	175	M	53	121±15	2±1	7±5	2±1	1915			
035	134	M	68	65±15			1±1	1929			
036	105	F	12	82±17	2±2	7±6	1±1	1946			
037	70	F	8	34±11				1955			
038	36	F	3	NR**	1±2	5±6		2008	4.9	G	***
039	120	F	32	78±15	1±2	3±5	1±1	2020			
040	132	F	29	74±16	3±2	12±6	1±1	2036			
041	34	M	6	27±13				2049			
042	105	F	12	53±13	2±1	7±5		2102	2.3	G	***
043	130	F	30	81±19	2±2	7±6		2113			
044	25	F	3	33±12	2±2	6±5	1±1	2125			
045	47	F	5	30±12	3±2	9±5		2137			
046	20	M	2	22±11	5±2	15±5		2148			
047	135	M	27	100±19	4±2	13±6	1±1	2200	1.9	G	***
048	70	M	8	43±14	3±2	10±6		2213			
049	151	F	43	65±15	3±2	10±6		2224			
050	130	F	12	62±14	3±2	9±5		2238			
051	70	M	10	54±14	3±2	9±5	1±1	2250	1.9	G	***
052	52	F	7	38±12			1±1	2302	1.5	G	***
053	130	M	13	63±17	4±2	15±7		2317			
054	150	F	39	73±18	5±2	16±7		2329			
055	230	F	45	77±16	1±2	4±5		2351			

**NR = Not reported; subsequent analysis indicated 13 ± 12 nCi, but it was very uncertain since that is below the minimum detectable level for Helgeson Unit-4.

***Meteorological conditions (e.g., temperature inversion) which typically lead to higher than normal levels of Rn-222 and its short-lived progeny (Ra-B,C) at ground level.

TABLE 3 (Continued)

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count 4/11/79	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
056	122	F	35	55±13	2±1	6±5		0002			
057	190	M	21	130±25	3±2	9±8	1±2	0013	1.2	G	***
058	165	M	21	100±17	1±2	5±5		0030			
059	158	F	57	53±14				0041			
060	135	M	34	89±18	2±2	7±6	4±2	0053			
061	168	F	52	72±14	2±2	6±5	1±1	0105	1.3	G	***
062	138	F	49	54±14	4±2	12±6	1±1	0116			
063	102	M	13	72±14	4±1	12±5		0126			
064	120	F	71	52±16				0137			
065	165	M	38	100±20			3±2	0148			
066	172	M	68	83±18	3±2	9±6		0202	2.1	G	***
067	[illegible]35	M	29	110±20	3±2	11±6	2±2	0213			
068	[illegible]	M	29	110±20	4±2	12±6	2±2	0225			
069	130	F	51	63±16	3±2	11±6	1±1	0240			
070	[illegible]	M	52	90±14	3±2	11±5	1±1	0251			
071	190	M	23	89±22	4±2	14±8		0316	2.4	G	***
072	180	M	25	87±18	3±2	9±6	2±2	0328			
073	128	[illegible]	22	120±21	[illegible]2	6±7	1±2	0635	0.8	G	***
074	201	M	46	130±21	5±2	9±8	2±2	0649			
075	56	F	11	55±16				0703	1.7	F	***
076	80	F	9	54±24			1±2	0716	1.7	F	***
077	130	M	40	110±20	6±2	21±8	3±2	0729			
078	225	M	54	110±19	2±2	5±7	2±2	0741			
079	155	M	29	130±25				0759			
080	165	M	28	140±25	3±2	11±8	2±2	0812	0.9	A	
081	85	M	10	59±17				0823			
082	160	M	65	91±21			1±2	1013			
083	137	F	59	59±17				1024			
084	175	M	57	100±24				0835			
085	155	F	55	69±19	7±2	22±8		0904	3.0	C	

TABLE 3 (Continued)

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/11/79 Cont'd			
086	168	M	55	77±20				0915			
087	200	F	69	72±20	2±3	7±8		0847			
088	160	F	49	97±20			1±2	0928			
089	172	M	42	120±22	5±2	18±8		0939			
090	252	M	47	180±28			2±2	0951			
091	32	M	3	34±15	2±2	6±7	2±2	1222	3.4	A	
092	110	F	22	83±17				1002	4.0	A	
093	143	F	56	72±22	2±3	8±9		1036			
094	155	M	23	160±22			1±2	1049			
095	200	M	70	89±19			2±2	1059			
096	175	M	52	140±25				1110	2.8	A	
097	150	F	59	82±22	2±3	7±9		1120			
098	136	F	55	73±20			2±2	1129			
099	24	M	2	33±14				1139			
100	149	F	29	78±18	4±2	15±7		1150			
101	142	F	44	58±20				1201	3.4	A	
102	197	M	65	130±23			1±2	1213			
103	285	F	58	67±25				1234			
104	140	F	28	100±23			1±2	1246			
105	195	F	63	92±17	2±2	7±7	2±1	1256			
106	200	M	58	130±20			3±2	1305	4.6	A	
107	135	F	33	62±19				1314			
108	30	F	2	17±14				1322			
109[a]	196	M	81	89±20	10±3	32±9		1331			
110	155	F	62	83±22	4±3	15±9		1340			
111	110	F	57	56±20				1349			
112	170	M	31	91±21	3±3	11±8	1±2	1400	3.7	A	
113	155	M	24	110±25	3±3	10±9	3±2	1409			
114	103	F	40	80±21				1423			

[a]Recounted on 4/21/79 - File #746

TABLE 3 (Continued)

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Ra-B,C	Ra-226	Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/11/79 Cont'd			
115	195	M	70	95±23			2±2	1433			
116	160	M	35	140±24				1441			
117	200	F	49	81±22	9±3	29±10	3±2	1450			
118	50	F	6	50±16				1459			
119	200	F	47	100±20	2±2	6±7		1500	4.4	A	
120	185	M	27	160±22			1±2	1517			
121	73	F	11	25±18			1±2	1526			
122	50	M	7	49±17				1536			
123	171	M	23	130±22				1556			
124	115	M	14	73±19				1547			
125	135	F	36	66±21	3±3	10±9		1609	5.0	D	
126	134	F	15	90±18	4±2	12±7		1619	5.0	D	
127	185	M	41	97±16	7±2	23±6		1731	4.5	D	
128	138	M	15	140±24	5±2	17±7	1±2	1740			
129	95	F	11	62±16	4±2	12±7		1749			
130	195	M	49	99±17	4±2	13±6	1±1	1759			
131	75	M	6	53±17	2±2	7±7		1811	3.1	E	
132	85	M	10	72±19	3±2	11±7		1820			
133	200	F	36	75±20	7±2	22±8	2±2	1830			
134	60	F	7	44±14	3±2	9±6		1843			
135	140	F	53	82±21	8±2	25±8		1852			
136	162	F	22	64±20	8±3	28±9		1907	4.6	F	***
137	185	M	25	170±30	6±3	18±9	2±2	1646	5.0	D	
138	145	F	12	120±20	7±2	22±7		1655			
139	111	F	19	64±20	4±2	13±8		1704	4.5	D	
140	125	F	10	63±16	6±2	19±7		1713			
141	202	M	46	130±19	5±2	17±6	1±1	1722			
142	80	F	9	59±18				1942	4.6	F	***
143	196	M	59	93±16			2±1	1952			
144	190	M	31	140±21			1±2	2001	2.3	G	***

TABLE 3 (Continued)

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Ra-B,C	Ra-226	Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments+
								4/11/79 Cont'd			
145	225	M	31	170±22	2±2	7±6	3±2	2017			
146	130	M	29	130±20	7±2	22±7	1±2	2026			
147	36	M	4	24±14	4±2	13±7		2035			
148	100	F	13	72±16	3±2	11±6		2044			
149	150	F	49	75±23				2053			
150	190[b]	M	42	140±22	19±3	62±9	2±2	2101	4.2	G	***
151	75	F	9	66±16	5±2	16±6		2111	4.2	G	***
152	200	M	63	130±20	5±2	13±6	2±2	2120			
153	135	F	22	91±20	4±2	13±7	2±2	2136			
154	128	F	21	82±21	6±2	19±8		2145			
155	181	F	31	75±19	3±2	11±7		2157			
156	117	F	20	85±21	4±2	15±8		2217	2.7	G	***
157	120	F	20	65±16	5±2	17±7		2230			
158	170	M	45	110±23	5±2	17±8		2242			
159	112	F	27	75±16	3±2	9±6	1±1	2250			
160	165	M	36	130±19	10±2	32±7	2±2	2320	2.9	G	***
								4/12/79			
161	160	M	28	74±19	2±2	5±7	2±2	0024	2.1	G	***
162	50	M	7	49±14	3±2	11±6		0037			
163	150	M	17	110±19			2±1	0046			
164	165	M	21	95±20				0056			
165	215	M	20	100±21	1±2	5±7		0107	2.3	G	***
166	177	M	21	100±19	4±2	14±6		0116			
167	170	F	52	60±14	2±2	5±6		0126			
168	170	F	34	42±13	7±2	23±6		0138			
169	----------------------FILE NOT USED----------------------										
170	170	F	49	120±25	6±3	21±9		0700	2.1	F	***
171	60	F	5	51±16	3±2	11±7		0710			
172	215	M	33	95±22	3±2	10±7		0633	3.6	G	Trace of rain ***

[b] Recounted on 4/26/79 - File #727

+Rainfall information from NOAA, National Weather Service Office, Harrisbury, PA.

TABLE 3 (Continued)

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/12/79 Cont'd			
173	125	M	17	89±20	4±2	12±6		0646			
174	142	F	60	110±20	12±3	41±9	4±2	0722	2.1	F	***
175	195	M	28	180±31	9±3	31±10		0734			
176	162	M	53	140±23	3±2	11±7		0745	2.1	F	***
177	154	F	64	72±20	2±2	5±7		0755			
178	135	F	29	46±13	7±2	23±5		0810	3.9	D	
179	125	F	19	110±20	6±2	19±7		0830			
180	75	M	8	78±18	3±2	11±7		0840			
181	160	F	58	85±21	6±2	22±8		0850			
182	165	M	22	170±26	6±2	21±8		0900	2.3	F	Light
183	178	M	32	200±28	5±2	17±8		0912			rain ***
184	120	F	55	91±19	5±2	16±7	1±2	0925			
185	230	M	19	100±25	4±2	15±8	1±2	0935			
186	220	M	38	97±22	4±2	14±7	1±2	0947			
187	210	M	21	200±32	11±3	35±10	2±2	1012	3.2	E	
188	234	M	22	150±22	7±2	22±7		1022			
189	180	M	22	120±23	3±2	9±7		1129	6.4	F	***
190	157	M	21	72±18				1000	3.2	E	Trace
191	160	M	57	62±18			2±2	1141	6.4	F	of
192	150	F	35	61±23				1149			rain ***
193	132	F	21	61±14	3±2	9±5		1158			
194	152	F	53	57±19			2±2	1206	3.0	E	Light
195	70	M	10	57±20	2±2	8±8		1215			Rain
196	103	F	29	49±17			1±2	1224			
197	205	M	50	83±21	9±3	30±9	2±2	1235			
198	115	M	10	53±15				1243			
199	178	M	67	89±17			2±2	1257			
200	145	F	56	55±19	8±3	26±9	2±2	1315	3.8	E	

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count 4/12/79	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
201	135	F	67	45±17			2±2	1334	3.8	E	Light rain
202	180	M	31	94±20	4±2	12±7		1406	6.4	E	Light rain
203	132	M	14	100±21	2±2	7±7		1417	6.4	E	Light rain
204	170	M	67	74±18				1428	6.4	E	Light rain
205	65	M	10	43±15	2±2	8±6		1441	6.4	E	Light rain
206	185	M	54	67±18	2±2	5±7		1455	6.4	E	Light rain
207	65	F	8	26±15	2±2	6±7		1521	1.6	E	Light rain
208	125	F	75	40±19	3±2	10±8		1536	1.6	E	Light rain
209	35	F	4	16±15	3±2	9±7		1547	1.6	E	Light rain
210	150	M	37	89±20	2±2	8±7		1603	3.4	E	Light rain
211	234	M	46	100±22	3±2	9±7		1615	3.4	E	Light rain
212	91	M	9	43±14	1±2	3±6		1627	3.4	E	Light rain
213	180	F	24	35±18	2±2	6±7		1639	3.4	E	Light rain
214	80	F	8	33±14	5±2	16±7		1655	3.4	E	Light rain
215	150	M	64	79±19	1±2	4±6		1708	4.5	F	***Trace of rain
216	90	M	13	26±15	3±2	9±7		1720	4.5	F	***Trace of rain
217	194	M	53	82±19				1732	4.5	F	***Trace of rain
218	140	F	33	66±14	3+2	9+5		1744	4.5	F	***Trace of rain
219	85	M	12	85±19	1±2	4±6		1756	4.5	F	***Trace of rain
220	130	F	29	100±21	3±2	12±7		1808	3.2	E	
221	75	F	10	38±15	3±2	9±6		1818	3.2	E	
222	145	M	19	92±20	3±2	8±7		1830	3.2	E	
223	115	F	27	59±17	2±2	8±6		1840	3.2	E	
224	48	F	7	28±16	7±2	22±8		1853	3.2	E	
225	45	M	5	29±14	5±2	16±6		1905	2.5	E	
226	180	F	24	73±20	3±2	9±7		1920	2.5	E	
227	135	F	45	46±19	2±2	8±7		1933	2.5	E	
228	225	M	23	88±22	6±3	21±8		1946	2.5	E	
229	60	M	8	35±19	3±2	11±8		2008	4.2	F	***
230	165	M	20	130±27				2021	4.2	F	***
231	180	M	21	120±23	3+2	11+7		2033	4.2	F	***
232	142	M	25	72±21	2±2	5±7		2042	2.3	F	***

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/12/79 (Cont'd)			
233	140	F	27	49±20	3±2	9±8		2055	4.2	F	***
234	45	M	6	14±14	2±2	8±7		2104	2.3	F	***
235	84	F	11	60±20	3+2	10+7		2116	2.3	F	***
236	148	M	19	110±24				2125	2.3	F	***
237	170	M	45	120±20	6+2	20+7		2135	2.3	F	***
238	117	F	16	62±18	2+2	7+7		2151	2.3	F	***
239	142	F	62	60±18	3+2	10+7		2200	0.6	F	***
240	120	F	21	50±15	1+2	4+6		2209	0.6	F	***
241	----------FILE NOT USED----------										
242	170	M	15	120±23	3+2	11+7		2235	0.6	F	***
243	110	F	57	39±19				2247	0.6	F	***
244	108	F	57	34±18	3+2	10+8		2256	0.6	F	***
245	110	F	31	47±15	2+2	6+6		2309	1.8	G	***
246	137	F	54	44±16				2329	1.8	G	***
247	210	M	46	130±25	3+2	11+8	2+2	2338	1.8	G	***
248	150	M	19	90±25	4+3	12+8		2349	1.8	G	***
								4/13/79			
249	135	F	26	68+20	3+2	10+7		0001	4.3	G	***
250	42	F	8	20±15				0009	4.3	G	***
251	120	F	29	69±19	3+2	9+7		0018	4.3	G	***
252	170	F	47	55±18	4+2	13+7		0026	4.3	G	***
253	185	M	37	97±23	1+2	4+8	2+2	0035	4.3	G	***
254	163	M	68	64±21	6+3	21+8		0046	4.3	G	***
255	160	M	33	120±25				0054	4.3	G	***
256	136	M	17	78±20				0107	1.6	F	***
257	82	F	10	37±16	2+2	7+7		0118	1.6	F	***
258	135	F	29	62±18	2+2	8+6		0127	1.6	F	***
259	225	M	32	130±27	4+2	15+8		0136	1.6	F	***
260	150	F	52	51±18	2+2	8±7		0146	1.6	F	***
261	200	M	49	130±26	2±2	5±8		0155	1.6	F	***
262	208	M	32	99±27				0631	16.3	E	***
263	120	F	11	78±19			1+2	0643	16.3	E	***

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/13/79(Cont'd)			
264	122	F	67	55±17				0654	16.3	E	
265	165	M	50	80±17	1±2	4±6		0704	14.8	E	
266	157	M	73	90±26			2±2	0713	14.8	E	
267	210	M	41	87±20			5±2	0734	14.8	E	
268	127	F	48	93±22	2±2	7±8	1±2	0746	14.8	E	
269	100	F	10	45±17			1±2	0754	14.8	E	
270	180	M	26	140±27				0804	12.0	D	
271	145	F	20	95±20				0813	12.0	D	
272	225	M	38	110±22	2±2	8±8	1±2	0822	12.0	D	
273	70	M	10	56±18	2±2	6±7		0841	12.0	D	
274	160	F	21	64±20	3±2	9±8		0850	12.0	D	
275	76	M	9	58±18				0722	14.8	E	
276	160	M	59	96±24	8±3	25±9		0859	13.6	D	
277	78	F	12	79±20	4±2	14±7		0907	13.6	D	
278	160	M	33	76±22	3±3	8±8	1±2	0917	13.6	D	
279	130	F	13	69±20	4±2	13±8		0926	13.6	D	
280	150	F	13	110±23	4±2	14±8	2±2	0935	13.6	D	
281	180	M	35	110±22	6±2	20±8		0946	13.6	D	
282	123	F	56	66±18	2±2	7±7	2±2	0956	13.6	D	
283	53	F	6	26±15	1±2	4±7		1007	15.1	D	
284	65	M	9	48±19	2±2	7±8		1019	15.1	D	
285	120	F	32	86±21	2±2	6±7		1028	15.1	D	
286	45	F	5	32±13				1037	15.1	D	
287	34	F	4	30±17				1048	15.1	D	
288	106	F	60	79±20	5±2	18±8		1057	15.1	D	
289	135	M	69	89±18	5±2	16±7	1±1	1110	12.1	D	
290	62	F	11	50±17	4±2	14±7		1123	12.1	D	
291	105	F	23	77±21	4±2	13±8		1133	12.1	D	
292	56	M	9	56±18	2±2	6±7		1143	12.1	D	
293	65	F	8	54±18	1±2	5±7		1152	12.1	D	
294	157	M	57	110±24			1±2	1201	16.4	D	
295	130	M	37	70±20	3±2	9±8		1211	16.4	D	
296	134	F	64	60±20	4±2	14±8	2±2	1222	16.4	D	

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count 4/13/79(Cont'd)	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
297	130	M	13	100±21	2±2	8±7		1232	16.4	D	
298	210	M	28	120±21	2±2	7±7	2±2	1241	16.4	D	
299	130	F	31	89±20	5±2	16±7		1250	16.4	D	
300	110	F	23	54±17			1±2	1258	16.4	D	
301	178	M	73	76±22	5±3	17±9		1307	13.5	D	
302	87	M	12	59±23				1336	13.5	D	
303	100	F	12	44±19				1345	13.5	D	
304	75	M	9	52±19				1354	14.5	D	
305	131	F	71	51±21				1403	14.5	D	
306	65	M	7	42±24				1416	14.5	D	
307	100	F	13	43±22				1430	14.5	D	
308	45	M	6	21±15				1439	14.5	D	
309	175	M	52	71±25				1449	14.5	D	
310	165	M	44	120±29	3±3	9±9		1500	13.2	D	
311	130	F	16	40±20	7±3	24±10	1±2	1509	13.2	D	
312	85	F	10	49±24				1518	13.2	D	
313	115	F	25	52±21				1527	13.2	D	
314	138	F	35	49±24				1539	13.2	D	
315	62	M	7	52±21				1554	13.2	D	
316	112	F	30	73±21				1603	11.4	D	Trace of rain
317	60	M	6	42±16	1±2	5±7		1612	11.4	D	Trace of rain
318	195	F	40	60±22	3±3	10±9		1624	11.4	D	Trace of rain
319	185	M	63	76±22				1634	11.4	D	Trace of rain
320	66	M	8	38±17				1643	11.4	D	Trace of rain
321	102	F	30	50±18				1652	11.4	D	Trace of rain
322	120	F	27	76±21	2±2	5±8		1700	11.9	D	Trace of rain
323	122	F	51	51±16	5±2	16±7		1706?	11.9	D	Trace of rain
324	70	F	8	39±14	1±2	4±6		1717	11.9	D	Trace of rain
325	160	M	23	95±24				1726	11.9	D	Trace of rain
326	240	F	56	61±21				1744	11.9	D	Trace of rain
327	131	F	25	46±17				1754	11.9	D	Trace of rain

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count 4/13/79(Cont'd)	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
328	135	F	35	68±20				1803	15.4	D	Trace of rain
329	120	M	65	63±20	1±2	5±8		1813	15.4	D	Trace of rain
330	60	F	8	20±20				1828	15.4	D	Trace of rain
331	139	F	35	75±23	3±3	10±9		1838	15.4	D	Trace of rain
332	115	F	28	62±22				1847	15.4	D	Trace of rain
333	100	F	16	71±26	2±3	8±10		1857	15.4	D	Trace of rain
334	56	F	7	32±16				1906	13.8	D	
335	175	M	54	80±20			2±2	1916	13.8	D	
336	30	F	6	11±14				1925	13.8	D	
337	45	M	8	42±14				1934	13.8	D	
338	158	F	54	63±18	2±2	6±7		1955	13.8	D	
339	149	M	59	83±20	4±2	15±8		2004	16.2	D	
340	120	F	26	50±21	3±3	9±9		2013	16.2	D	
341	48	M	5	32±17				2034	16.2	D	
342	160	M	25	100±23				2044	16.2	D	
343	55	M	7	32±18	2±2	6±8		2114	10.7	D	
344	135	F	17	66±18				2123	10.7	D	
345	60	M	10	49±15				2214	7.7	D	
346	110	F	38	38±16				2223	7.7	D	
347	242	M	43	140±23				2231	7.7	D	
348	247	M	47	110±24			2±2	2244?	7.7	D	
349	155	M	40	78±23				2252	7.7	D	
350	84	M	10	53±18	4±2	12±8		2301	7.7	D	
351	152	M	27	140±24	7±2	22±8		2310	7.7	D	
352	152	M	63	81±19	2±2	6±7		2319	7.7	D	
353	52	M	10	24±18				1943	13.8	D	
354	170	F	39	51±20				2022	16.2	D	
355	128	F	25	62±27	2±3	8±11		2053	16.2	D	
356	150	F	21	72±23				2104	10.7	D	
357	130	F	41	47±18				2354	7.2	D	Trace of rain

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/14/79			
358	172	M	74	86±19	1±2	3±7		0006	7.2	D	Trace of rain
								4/13/79			
359	190	F	33	83±22	2±2	6±8		2342	7.7	D	Trace of rain
360	155	F	54	29±15	4±2	14±8	2±2	2204	7.7	D	Trace of rain
								4/14/79			
361	140	M	24	89±20	3±2	9±6		0750	5.7	D	
362	95	M	9	33±15				0759	5.7	D	
363	210	M	65	110±19	2±2	8±6		0808	6.6	D	
364	140	F	51	78±16	3±2	10±6	1±1	0817	6.6	D	
365	170	M	66	83±21				0827	6.6	D	
366	67	M	10	52±15	4±2	13±6	1±1	0836	6.6	D	
367	138	F	59	37±20	2±2	8±8		0845	6.6	D	
368	127	F	38	58±16	5±2	16±6		0853	6.6	D	
369	70	M	10	71±20	2±2	8±7		0902	6.5	A	
370	160	M	16	130±27	3±2	10±8		0911	6.5	A	
371	136	F	47	62±26				0919	6.5	A	
372	165	M	65	94±21				0930	6.5	A	
373	120	F	28	43±17	3±2	9±7		0939	6.5	A	
374	134	F	14	83±22	2±2	7±8		0947	6.5	A	
375	145	F	45	82±19	2±2	7±6	2±2	0956	6.5	A	
376	185	F	41	81±22	4±2	13±8		1005	5.6	A	
377	160	M	78	95±20	4±2	13±7	1±2	1013	5.6	A	
378	148	M	49	81±21				1022	5.6	A	
379	80	M	10	59±19				1031	5.6	A	
380	175	M	42	110±23	2±2	7±7		1040	5.6	A	
381	51	M	8	52±16	2±2	7±6		1048	5.6	A	
382	65	M	8	55±16	3±2	11±6	1±2	1057	5.6	A	
383[c]	74	M	8	40±16	14±3	47±8	2±2	1105	5.9	A	
384	120	M	13	89±19				1114	5.9	A	
385	175	M	15	89±18	3±2	10±6		1122	5.9	A	

[c] Recounted on 4/26/79 - File #720

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/14/79(Cont'd)			
386	185	F	36	99±15	7±2	24±6		1131	5.9	A	
387	109	F	10	66±16	4±2	12±6	1±1	1139	5.9	A	
388	160	M	66	85±24				1148	5.9	A	
389	90	M	9	55±15			1±1	1156	5.9	A	
390	150	F	38	75±16				1205	4.0	A	
391	160	M	65	85±23	3±2	9±8		1214	4.0	A	
392	175	F	51	74±18	2±2	7±6		1222	4.0	A	
393	175	M	45	110±21	9±2	30±8	2±2	1232	4.0	A	
394	165	M	37	120±23	3±2	11±7		1241	4.0	A	
395	155	M	12	110±21	3±2	9±7		1255	4.0	A	
396	60	F	10	30±1[illegible]	2±2	5[illegible]		1315	7.2	A	
397	95	F	13	51±15	2±2	[illegible]±6		1324	7.2	A	
398	137	F	57	46±19			1±2	1333	7.2	A	
399	37	F	4	23±14			1±1	1349	7.2	A	
400	52	F	10	32±14	1±2	4±6	1±1	1358	7.2	A	
401	174	M	34	38±28				1409	16.9	D	
402	---FILE NOT USED---										
403	90	F	9	70±16	4±2	12±6		1510	17.5	D	
404	128	F	47	56±14	2±2	5±5	1±1	1519	17.5	D	
405	150	M	15	120±19			1±1	1528	17.5	D	
406	160	F	62	50±17	4±2	12±7		1537	17.5	D	
407	200	F	49	100±16	2±2	5±5	2±1	1432	16.9	D	
408	140	F	73	63±14	3±2	10±5	2±1	1441	16.9	D	
409	150	F	76	55±17	2±2	7±7		1450	16.9	D	
410	70	M	6	60±13			2±1	1459	16.9	D	
411	69	M	8	58±14			1±1	1550	17.5	D	
412	160	M	15	150±24	3±2	9±7		1602	14.7	E	
413	125	F	16	67±20			1±2	1654	14.7	E	
414	120	F	14	51±14	2±2	6±6	1±1	1703	7.6	E	
415	157	F	58	53±17	3±3	10±9	2±2	1712	7.6	E	
416	139	F	60	66±13			1±1	1738	7.6	E	

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Ra-B,C	Ra-226	Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/13/79(Cont'd)			
417	175	M	16	130±22				1749	7.6	E	
418	70	M	10	38±14	2±2	5±6		1802	2.1	E	
419	90	M	12	87±19				1810	2.1	E	
420	37	M	5	21±13				1824	2.1	E	
421	167	M	23	120±20				1839	2.1	E	
422	47	F	7	46±14	4±2	12±6	1±2	1957	2.1	E	
423	95	F	49	51±14				1909	4.8	G	***
424	140	M	53	110±30				1918	4.8	G	***
425	125	F	53	67±14	2±2	7±6	1±1	1932	4.8	G	***
426	160	M	11	76±16	1±2	3±6		1940	4.8	G	***
427	40	F	5	51±16				1950	4.8	G	***
428	170	M	23	84±20				2000	4.6	G	***
429[d]	140	F	56	60±15	24±3	78±9	2±2	2113	4.6	F	***
430	176	M	67	110±22	2±2	5±8	1±2	2010	4.6	G	***
431	155	F	56	53±18				2024	4.6	G	***
432	106	F	13	61±20				2037	4.6	G	***
433	84	F	11	55±16	3±2	11±7		2052	4.6	G	***
434	145	F	52	55±14	2±2	7±6	2±2	2101	4.6	F	***
435	190	M	57	110±23				2133	4.6	F	***
436	178	M	60	110±19				2142	4.6	F	***
437	110	M	11	78±20				2152	4.6	F	***
438	144	F	53	66±16			1±2	2205	4.1	G	***
439	130	F	55	34±14	2±2	8±7		2216	4.1	G	***
440	117	F	31	44±14				2246	4.1	G	***
441	50	F	9	39±13				2256	4.1	G	***
								4/15/79			
442	172	F	32	53±15				0624	3.3	F	***Trace of rain
443	110	F	24	72±17				0635	3.3	F	***Trace of rain
444	185	M	53	97±20	3±2	9±7	2±2	0649	3.3	F	***Trace of rain

[d] Recounted on 4/26/79 - File #725

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/15/79(Cont'd)			
445	160	F	60	49±15				0702	1.8	F	***Trace of rain
446	160	F	33	45±18				0715	1.8	F	***Trace of rain
447	150	F	34	89±20				0724	1.8	F	***Trace of rain
								4/14/79			
448	101	F	16	52±15				2230	4.1	G	***Trace of rain
								4/15/79			
449	200	M	62	82±22				0749	1.8	F	***Trace of rain
450	143	F	38	71±23				0759	1.8	F	***Trace of rain
451	140	M	76	45±16	7±2	22±7		0823	5.3	E	
452	120	F	16	61±21				0937	8.2	D	
453	140	F	32	74±20				095[illegible]	8.2	D	
454	52	F	6	20±13				1007	12.0	D	
455	176	M	38	120±25	2±2	6±8		1017	12.0	D	
456	70	F	6	26±16				1032	12.0	D	
457	85	M	11	60±17	3±2	10±7		1058	12.0	D	
458	50	M	7	36±15				1110	10.6	D	
459	69	F	11	26±14				1119	10.6	D	
460	172	M	61	82±21			1±2	1128	10.6	D	
461	50	M	7	36±18	2±2	6±8		1145	10.6	D	
462	150	F	58	67±21				1158	10.6	D	
463	155	M	18	142±22	2±2	8±7		1211	16.6	D	
464	95	M	11	95±21				1220	16.6	D	
465	50	M	8	57±17				1229	16.6	D	
466	105	F	23	49±15	2±2	5±6		1248	16.6	D	
467	170	M	57	110±25	3±3	11±8		1257	15.6	D	
468	128	F	23	64±18	2±2	8±7		1325	15.5	D	
469	120	M	14	100±20			2±2	1352	15.3	D	
470	185	M	29	110±22	2±2	6±7		1421	20.7	D	
471	70	M	10	60±15				1446	20.7	D	
472	130	F	17	97±21				1455	20.7	D	
473	211	F	57	100±20	2±2	5±7		1507	19.3	D	

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/15/79(Cont'd)			
474	32	F	5	17±11				1431	20.7	D	
475	150	M	69	74±20				1516	19.7	D	
476	152	F	76	57±17	2±2	8±7		1524	19.3	D	
477	115	M	17	100±22				1533	19.3	D	
478	220	M	27	130±22				1543	19.3	D	
479	132	F	55	86±19				1552	19.3	D	
480	50	F	7	55±14	4±2	13±6		1601	16.1	A	
481	145	M	24	130±26				1610	16.1	A	
482	120	F	56	83±23				1619	16.1	A	
483	128	F	33	55±19	2±2	8±8		1628	16.1	A	
484	132	F	24	85±18				1637	16.1	A	
485	127	M	13	93±20	5±2	17±8		1646	16.1	A	
486	152	F	54	91±20				1655	16.1	A	
487	105	F	31	54±15				1704	16.7	D	
488	62	M	8	37±16				1713	16.7	D	
489	75	F	9	50±17				1721	16.7	D	
490	175	F	45	61±16				1731	16.7	D	
491	60	M	6	27±16				1741	16.7	D	
492	81	F	8	69±20				1750	16.7	D	
493	76	F	6	43±16	4±2	12±7		1758	16.7	D	
494	210	F	67	48±17				1810	13.5	E	
495	112	F	53	76±17			1±1	1903	14.1	E	
496	135	M	57	95±17	3±2	11±6	1±1	1912	14.1	E	
497	205	M	47	120±20	2±2	5±6		1921	14.1	E	
498	60	M	7	39±14			1±1	1930	14.1	E	
499	135	F	41	53±17				1939	14.1	E	
500	65	M	7	51±14				1947	14.1	E	
501	68	M	8	37±13	4±2	13±6	1±1	1956	14.1	E	
502	190	M	26	130±20			2±2	2005	14.6	E	
503	100	M	11	57±15				2017	14.6	E	
504	50	M	6	39±14				2028	14.6	E	

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/15/79(Cont'd)			
505	160	M	23	99±20	3±2	9±7		2037	14.6	E	
506	160	F	27	80±17	9±2	29±7	1±2	2045	14.6	E	
507	153	M	11	72±17	4±2	13±7		2053	14.6	E	
508	95	F	12	62±13			1±1	2102	12.5	E	
509	160	M	20	140±20	3±2	9±6		2128	12.5	E	
510	175	M	21	140±20			2±2	2138	12.5	E	
511	78	F	10	60±16	4±2	14±6		2146	12.5	E	
512	185	M	38	130±20	5±2	18±7	1±2	2157	12.5	E	
513	38	F	5	20±12				2207	11.5	E	
514	38	M	6	25±13			1±1	2215	11.5	E	
515	155	F	32	73±16	2±2	7±6		2224	11.5	E	
516	210	M	23	130±21	3±2	10±7	1±2	2255	11.5	E	
517	175	M	22	140±22				2304	9.0	E	
518	120	F	29	83±20	4±2	13±7		2356	9.0	E	
								4/16/79			
519	128	F	22	100±19	1±2	4±6		0009	9.0	E	
520	170	M	20	130±25	2±2	7±7	1±2	0022	9.0	E	
521	64	F	9	55±15	4±2	15±6	1±1	0031	9.0	E	
522	105	M	10	60±16	3±2	10±6		0041	9.0	E	
523	150	M	62	110±26	7±3	22±9		0054	9.0	E	
524	175	M	38	78±22	2±2	8±7		0632	9.1	E	Trace of rain
525	105	F	16	43±18				0641	9.1	E	Trace of rain
526	150	F	51	73±16	4±2	12±6		0650	9.1	E	Trace of rain
527	75	F	11	76±20				0659	9.1	E	Trace of rain
528	183	F	63	47±16	9±2	30±7		0708	6.9	E	Trace of rain
529	247	M	62	95±21	6±2	20±8	2±2	0717	6.9	E	
530	160	M	23	130±20	4±2	12±6		0106	10.0	E	
531	155	M	19	130±23	4±2	12±7		0116	10.0	E	
532	70	M	7	48±14	2±2	6±6	1±1	0927	6.7	D	Trace of rain

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Ra-B,C	Ra-226	Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/15/79			
533[e]	145	M	61	90±16	21±2	71±8	2±2	0936	6.7	D	Trace of rain
534[f]	134	F	11	74±17	14±2	48±8	2±2	0945	6.7	D	Trace of rain
535[g]	185	M	41	77±22	17±3	56±11		1021	8.2	D	Trace of rain
536	155	M	35	75±19	5±2	18±7		0725	6.9	E	Trace of rain
537	98	M	10	73±20	2±2	7±7		0734	6.9	E	Trace of rain
538	125	F	31	49±19	3±2	10±7		0744	6.9	E	Trace of rain
539	149	M	53	72±19				0808	7.3	D	Trace of rain
540	106	F	24	93±18	2±2	6±6		0818	7.3	D	Trace of rain
541	160	M	25	100±19	2±2	8±6		0826	7.3	D	Trace of rain
542	40	F	4	29±12			1±1	0835	7.3	D	Trace of rain
543	150	M	75	99±19	2±2	7±6		0849	7.3	D	Trace of rain
544	206	F	50	94±18			2±2	0859	7.3	D	Trace of rain
545	65	M	9	63±16	4±2	12±6		0908	6.7	D	Trace of rain
546	198	F	54	75±14	4±2	14±6		0917	6.7	D	Trace of rain
547	140	M	16	53±15	2±2	5±6		1101	9.7	D	Trace of rain
548	126	F	21	60±16	4±2	12±6		1112	9.7	D	Trace of rain
549	145	[illegible]	21	100±23				1121	9.7	D	Trace of rain
550	156	M	64	110±20	2±2	7±6	2±2	1130	9.7	D	Trace of rain
								4/16/79			
551	48	F	7	54±15	1±2	4±6		1139	9.7	D	Trace of rain
552	100	M	14	57±20	3±2	10±8		1147	9.7	D	Trace of rain
553	114	F	31	64±15	4±2	15±6		1156	9.7	D	Trace of rain
554	60	F	7	36±14	2±2	7±6		1210	9.1	D	Trace of rain
555	93	M	15	88±18	2±2	7±6		1221	9.1	D	Trace of rain
556	120	F	24	72±18				1230	9.1	D	Trace of rain
557	135	F	65	55±20	8±3	26±9		1238	9.1	D	Trace of rain
558	85	F	58	72±20	3±2	9±7	2±2	1250	9.1	D	Trace of rain

[e]Recounted on 4/26/79 - File #724

[f]Recounted on 4/26/79 - File #742

[g]Recounted on 4/26/79 - File #739

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count 4/16/79	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
559	150	M	49	98±19			1±2	1304	10.2	E	Trace of rain
560	90	F	11	49±20	3±3	10±9		1313	10.2	E	
561	55	M	7	42±14	1±2	4±6		1323	10.2	E	
562	127	F	33	91±20	1±2	4±7		1332	10.2	E	
563	105	F	24	67±20				1343	10.2	E	
564	55	M	9	43±14				1352	10.2	E	
565	49	F	7	46±15				1401	11.5	D	
566	116	F	27	66±17	2±2	6±7	1±2	1412	11.5	D	Trace of rain
567	215	F	20	73±21				1421	11.5	D	Trace of rain
568	198	M	62	120±24	1±2	5±8		1430	11.5	D	Trace of rain
569	170	F	20	100±17	3±2	11±6	2±1	1511	12.3	D	Trace of rain
570	148	F	24	100±19	3±2	10±6		1519	12.3	D	Trace of rain
571	95	F	20	43±14			2±2	1529	12.3	D	Trace of rain
572	225	F	20	68±14			1±1	1538	12.3	D	Trace of rain
573	155	F	62	78±17	4±2	14±7	1±2	1546	12.3	D	Trace of rain
574	119	M	8	39±13				1555	12.3	D	Trace of rain
575	105	F	29	78±17			2±2	1610	11.9	D	Trace of rain
576	140	F	25	74±18				1618	11.9	D	Trace of rain
577	140	F	31	50±14	1±2	4±5		1628	11.9	D	Trace of rain
578	130	M	20	110±18	4±2	15±6	2±2	1636	11.9	D	Trace of rain
579	195	M	33	140±20	3±2	10±6		1649	11.9	D	Trace of rain
580	174	F	43	51±18	2±2	8±7		1727	11.8	D	
581	135	F	34	68±16	1±2	5±6	1±1	1737	11.8	D	
582	155	M	26	95±26				1747	11.8	D	
583	150	F	66	34±18				1758	11.8	D	
584	115	F	18	80±20	3±2	11±7		1817	15.5	E	
585	220	M	58	100±23	6±2	19±8		1825	15.5	E	
586	42	F	6	20±14				1807	15.5	E	
587	90	M	10	58±20	2±2	8±8		1834	15.5	E	
588	115	F	32	70±20	2±2	6±7		1916	9.9	E	
589	156	M	32	82±20				1843	15.5	E	

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/16/79(Cont'd)			
590	120	F	29	60±18	3±2	9±7		1851	15.5	E	
591	120	M	25	110±17				1901	9.9	E	
592	102	F	11	33±13	2±2	7±6		1928	9.9	E	
593	170	M	29	110±20	2±2	6±7		1939	9.9	E	
594	125	F	12	67±19	4±2	12±7		1947	9.9	E	
595	175	M	23	100±22	2±2	6±7		2017	11.7	E	
596	210	M	19	160±23	2±2	7±7	1±2	2031	11.7	E	
597	175	M	59	132±23				2049	11.7	E	
598	140	F	22	49±17				2101	17.3	E	Trace of rain
599	130	F	23	60±14	4±2	12±6		2110	17.3	E	Trace of rain
600	165	M	26	84±18			2±2	2119	17.3	E	Trace of rain
601	114	F	15	75±19				213[illegible]	17.3	E	Trace of rain
602	229	M	21	88±23				2140	17.3	E	Trace of rain
603	133	F	22	77±19				2153	17.3	E	Trace of rain
604	90	M	11	71±16				2205	14.3	E	Trace of rain
605	150	F	18	88±18				2119	14.3	E	Trace of rain
606	130	F	22	91±19	3±2	9±6		2237	14.[illegible]	E	Trace of rain
607	140	F	22	88±18	4±2	12±6		2250	14.3	E	Trace of rain
608	66	M	8	58±16	4±2	13±7		2300	13.5	E	
609	129	F	37	84±19	3±2	9±7		2309	13.5	E	
610	270	M	28	120±23	5±2	18±9		2319	13.5	E	
611	170	M	38	95±21	3±2	9±7		2328	13.5	E	
612	125	F	22	73±16	3±2	10±6		2338	13.5	E	
613	100	F	32	76±23	4±3	15±9		2347	13.5	E	
								4/17/79			
614	40	F	7	28±10			1±1	0819	10.5	D	
615	140	M	42	100±17				0834	10.5	D	
616	185	M	30	130±22	2±2	7±7	2±2	0844	10.5	D	
617	185	M	21	120±21			2±2	0853	10.5	D	
618	160	F	45	64±17				0906	10.6	A	
619	103	F	34	62±14			1±1	0917	10.6	A	

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/17/79(Cont'd)			
620	125	F	74	67±15	1±2	4±6	2±2	0929	10.6	A	
621	165	F	64	52±16				0938	10.6	A	
622	101	F	74	57±14			1±1	0948	10.6	A	
623	145	F	52	52±18	3±2	10±8	1±2	1000	15.6	A	
624	45	M	5	54±17	3±2	9±7		1306	14.6	E	
625[h]	115	F	26	85±19	25±3	84±10	2±2	1316	14.6	E	
626	121	F	68	53±19	4±2	12±8	1±2	1336	14.6	E	
627	180	F	60	35±17				1345	14.6	E	
628	110	F	30	40±21				1356	14.6	E	
629	130	F	29	57±16	1±2	4±6		1410	13.4	D	
630	185	M	47	140±28	6±3	19±9		1420	13.4	D	
631	60	M	9	66±18	6±2	20±7	1±2	1438	13.4	D	
632	156	M	65	80±21	5±2	16±8	2±2	1448	13.4	D	
633	48	F	7	20±16				1522	16.0	D	
634	42	M	5	32±14	2±2	6±6		1548	16.0	D	
635	240	M	29	130±28				1621	16.9	E	
636	145	F	60	76±19	4±2	15±7		1633	16.9	E	
637	170	M	48	99±20	3±2	11±7	1±2	1642	16.9	E	
638	50	M	7	37±15				1651	16.9	E	
639	50	M	3	17±16				1659	16.9	E	
640	50	M	8	26±15				1708	13.6	E	
641	156	M	43	67±17	2±2	6±6		1716	13.6	E	
642	58	F	7	34±13				1729	13.6	E	
643	40	F	6	20±12	2±2			1816	14.3	E	
644	135	F	28	45±17			1±2	1827	14.3	E	
645	110	F	27	66±16	4±2	12±6	2±1	1837	14.3	E	
646	185	F	43	85±17			1±1	1853	14.3	E	
								4/18/79			
647	205	M	39	130±26	4±3	12±8	2±2	0624	7.3	E	

[h] Recounted on 4/26/79 - File #740.

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/18/79(Cont'd)			
648	170	F	42	100±20	7±2	23±7	2±2	0633	7.3	E	
649	40	M	5	32±15				0641	7.3	E	
650	130	F	29	81±22	9±3	31±9		0650	7.3	E	
651	145	F	24	83±16	3±2	10±6		0659	7.3	E	
652	160	F	23	81±17	7±2	22±7		0708	12.0	D	
653	128	F	46	74±22	6±3	18±9		0717	12.0	D	
654	165	M	31	95±20				0725	12.0	D	
655	55	F	8	44±15	3±2	10±7		0736	12.0	D	
656	144	M	70	110±22	4±2	13±7	1±2	0745	12.0	D	
657	70	M	6	61±17			1±2	0753	12.0	D	
658	45	F	5	49±12	2±1	6±5		0802	13.8	D	
659	130	F	57	60±16	4±2	14±6		0810	13.8	D	
660	92	F	11	60±20	5±3	16±8		0818	13.8	D	
661	190	M	55	85±23	1±2	5±8		0836	13.8	D	
662	160	F	32	65±21	5±3	17±9		0847	13.8	D	
663	160	M	65	62±19	2±2	7±7		1001	16.6	D	
664	35	M	4	16±14	2±2	5±6		1019	16.6	D	
665	80	M	8	31±15				1027	16.6	D	
666	69	F	7	32±16				1036	16.6	D	
667	225	M	45	95±26	4±3	12±9		0900	15.9	D	
668	190	M	33	120±20	3±2	9±7		0910	15.9	D	
669	47	M	6	35±14	5±2	15±6		0910	15.9	D	
670	132	F	29	81±19	2±2	6±6		0919	15.9	D	
671	120	F	56	36±19	2±2	8±8		0943	15.9	D	
672	104	F	34	75±19	3±2	9±7		0952	16.6	D	
673	99	F	31	45±16	2±2	6±7		1054	14.1	A	
674	175	M	26	170±29	5±2	16±8	2±2	1104	14.1	A	
675	150	M	31	140±21	4±2	12±6	1±2	1113	14.1	A	
676	48	F	7	46±16				1131	14.1	A	
677	172	F	55	63±24				1146	14.1	A	

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/18/79(Cont'd)			
678	120	F	31	72±19				1156	14.1	A	
679	60	M	5	39±15	4±2	14±6		1205	11.8	D	
680	35	M	5	26±14	4±2	12±6		1218	11.8	D	
681	212	M	66	100±22	4±2	14±7		1234	11.8	D	
682	90	M	9	53±22				1243	11.8	D	
683	115	F	15	49±16				1252	11.8	D	
684	198	M	62	110±26	4±2	12±8		1301	16.5	D	
685	185	F	33	73±20	7±3	25±9		1317	16.5	D	
686	91	F	72	44±19	3±2	12±8		1327	16.5	D	
687	245	F	(Count not completed at request of participant)					1337	16.5	D	
688	95	F	21	46±18	2±2	7±8		1343	16.5	D	
689	104	F	30	71±18				1352	16.5	D	
690	225	M	28	160±27				1402	17.6	E	
691	145	M	17	100±22				1440	17.6	E	
692	40	F	4	13±14				1459	17.6	E	
693	70	M	10	47±17	3±2	9±6		1507	20.7	E	
694	59	M	6	[illegible]0±16	2±2	7±7		1518	20.7	E	
695	150	M	17	1[illegible]0±26	3±2	11±8		1527	20.7	E	
696	64	M	7	26±19				1536	20.7	E	
697	137	F	64	53±14	4±2	13±7	1±2	1545	20.7	E	
698	65	F	8	39±17	3±2	10±7		1554	20.7	E	
699	217	M	32	140±23	2±2	7±6	2±2	1602	18.5	F	***
700	200	M	32	99±20	6±2	18±7	2±2	1614	18.5	F	***
701	163	F	18	49±18	1±2	3±5		1624	18.5	F	***
702	130	M	79	52±16	4±2	13±6		1635	18.5	F	***
703	34	F	4	25±15			1±2	1657	18.5	F	***
704	170	M	42	110±20	3±2	11±6	2±2	1707	15.9	F	***
705	43	F	4	33±14	1±2	5±5		1716	15.9	F	***
706	155	M	21	120±22	5±2	15±7	1±2	1724	15.9	F	***
707	160	M	24	100±20	2±2	7±6		1740	15.9	F	***
708	200	M	61	130±26			3±2	1751	15.9	F	***

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/18/79(Cont'd)			
709	95	M	8	57±17			2±2	1800	16.1	E	
710	165	M	49	99±23	4±2	13±8	2±2	1809	16.1	E	
711	158	M	21	120±23			1±2	1819	16.1	E	
712	140	M	18	100±25	2±2	8±7		1828	16.1	E	
713	150	M	48	81±20	3±2	8±7	1±2	1837	16.1	E	
714	166	M	52	96±20	5±2	16±6		1846	16.1	E	
715	200	M	25	110±21	4±2	15±7		1854	16.1	E	
716	55	M	7	23±12	2±2	6±5	1±1	1902	10.8	E	
717	198	M	64	93±21	4±2	14±7	1±2	1917	10.8	E	
								4/14/79			
718	175	M	14	100±18				2124	4.6	E	
								4/26/79			
719[1]	155	M	15	150±19	2±2	7±6	1±1	0902	16.5	D	Trace of rain
720	75	M	8	64±12	5±2	16±5		0919	16.5	D	Trace of rain
721	135	F	32	93±19	4±2	15±7		0934	16.5	D	Trace of rain
722	205	M	36	130±22	2±2	7±7		0953	16.5	D	Trace of rain
723[2]	135	F	58	53±16	24±3	81±9		1011	14.9	A	Trace of rain
724[3]	145	M	61	88±17	12±2	41±8	2±2	1027	14.9	A	Trace of rain
725	140	F	56	64±20	4±2	13±8		1042	14.9	A	Trace of rain
726[4]	93	F	13	44±13	5±2	17±6	1±1	1521	8.7	E	Trace of rain
727	186	M	42	120±19	1±2	5±6	1±1	1545	8.7	E	Trace of rain
728	156	M	57	110±18	5±2	18±6	3±2	1613	9.5	D	Trace of rain
729	105	F	17	83±14	3±2	9±5		1632	9.5	D	Trace of rain
730	168	M	15	110±20				1649	9.5	D	Trace of rain
731	135	F	39	79±15	11±2	36±7	2±2	1704	9.5	D	

[1] Recount of File #383
[2] Recount of File #533
[3] Recount of File #429
[4] Recount of File #150

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Nanocuries Ra-B,C	Nanocuries Ra-226	Nanocuries Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								4/26/79(Cont'd)			
732	155	M	53	120±18	3±2	9±6		1724	9.5	D	
733	160	M	59	97±18	2±2	7±6		1742	9.5	D	
734	125	F	29	66±20				1758	9.5	D	
735	197	F	45	62±13	2±2	8±5		1140	5.2	E	Trace of rain
736[1]	155	F	69	55±23	58±5	192±17	7±4	1157	5.2	E	Trace of rain
737	32	M	3	11±10	2±2	6±5		1256	7.1	F	Trace of rain
738	26	M	1.5	18±12	1±2	3±6		1319	8.4	C	Trace of rain
739[5]	180	M	41	100±19	1±2	5±7	2±2	1212	7.1	F	Trace of rain
740[6]	115	F	26	74±18	5±2	16±7		1233	7.1	F	Trace of rain
741	175	M	28	88±20	1±2	4±7		1245	7.1	F	Trace of rain
742[7]	134	F	11	64±14	2±2	5±5		1111	5.2	E	Trace of rain
743	68	M	9	47±14				1123	5.2	E	Trace of rain
								5/17/79			
744[8]	150	F	69	70±17	7±2	24±7		0948	11.3	A	
745	171	M	74	82±17	5±2	16±7	1±1	0950	11.3	A	
								4/21/79			
746[9]	196	M	81	98±20	16±3	53±9		1134	4.0	A	
								4/20/79			
747	238	M	52	120±19	4±2	13±7	2±2	1405	5.4	A	
748	200	F	49	89±19				1440	5.4	A	Light rain
								4/9/79			
749	190	M	57	78±18	2±2	7±5		1258	4.6	D	Light rain

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[1] Recounted on File #744
[5] Recount of File #535
[6] Recount of File #625
[7] Recount of File #534
[8] Recount of File #736
[9] Recount of File #109

TABLE 3 (Continued)

RESULTS OF THE PUBLIC WHOLE BODY COUNTING PROGRAM
FOLLOWING THE THREE MILE ISLAND ACCIDENT

File No.	Wt. (lbs)	Sex	Age	Nanocuries K-40	Ra-B,C	Ra-226	Cs-137	Time of Count	Wind Speed (mph)	Pasquill Atm. Stability Category	Comments
								6/20/79			
750	54	M	7	33±16	2±2	6±7		1015	2.5	F	***
751	37	M	5	42±14				1020	2.5	F	***
752	62	F	9	29±14				1020	2.5	F	***
753	54	F	7	41±16				1032	2.5	F	***
754	40	M	5	37±14	2±2	8±6		1404	2.5	F	***
								6/22/79			
755	45	M	4	31±14				1133	2.5	F	***
756	34	M	3	37±14				1138	3.3	F	***
757	79	M	8	76±17	3±2	10±7		1602	5.8	E	
758	155	F	30	110±21	4±2	12±8		1549	6.4	E	
								6/26/79			
759	185	M	34	130±25			1±2	1250	7.1	F	***
760	28	M	3	35±14				1313	8.4	C	
761	82	M	9	79±15				1326	8.4	C	
762	70	F	7	69±14	1±2	5±5	1±1	1338	8.4	C	
763	220	F	35	40±20				1350	8.4	C	
								6/22/79			
764	122	F	27	83±17			1±1	1117	3.3	F	***
765	50	F	7	17±16				1122	3.3	F	***
								4/15/79			
RMC-1	140	F	50	87±9.5				2240			

TABLE 4. RAW COUNT DATA AND SYSTEM BACKGROUND DATA

(PERSON'S NAME HERE) (SOCIAL SECURITY NO.) 04/18/79 AT 0650 (6.32 MIN. COUNT)
3 MILE ISL (JOB TITLE) SEX=F HT=5 4 AGE=29 WT=130 ANALYST=JG
FILE= TM0650 ON JIM-B

379.	56118.	0.	96.	5653.	2304.	5005.	18782.	9569.	1066.	573.	514.	428.
355.	334.	385.	310.	304.	293.	279.	276.	236.	222.	224.	213.	209.
221.	197.	192.	182.	177.	183.	189.	182.	135.	142.	154.	138.	127.
102.	87.	103.	119.	93.	79.	111.	99.	88.	83.	94.	86.	90.
76.	79.	85.	79.	74.	65.	80.	97.	92.	96.	81.	77.	77.
56.	60.	63.	51.	46.	54.	42.	43.	46.	43.	50.	41.	51.
46.	40.	39.	44.	42.	38.	46.	38.	33.	35.	34.	42.	33.
28.	36.	34.	44.	36.	34.	25.	28.	37.	25.	21.	31.	32.
29.	28.	32.	28.	29.	30.	32.	34.	33.	36.	40.	23.	30.
27.	34.	22.	33.	33.	22.	19.	27.	31.	32.	32.	26.	32.
28.	21.	21.	32.	34.	33.	39.	36.	51.	61.	53.	54.	47.
51.	38.	36.	35.	38.	32.	21.	23.	15.	9.	22.	15.	12.
21.	18.	15.	16.	27.	15.	4.	17.	13.	10.	14.	15.	17.
10.	11.	7.	12.	19.	9.	14.	12.	13.	12.	10.	6.	9.
5.	8.	3.	6.	8.	10.	4.	8.	3.	9.	9.	8.	11.
3.	10.	5.	9.	6.	5.	6.	8.	7.	7.	1.	8.	4.
7.	11.	7.	3.	11.	6.	4.	4.	5.	7.	8.	9.	3.
10.	5.	5.	4.	5.	9.	4.	6.	4.	2.	5.	1.	5.
2.	8.	4.	10.	9.	9.	5.	4.	3.	7.	5.	1.	5.
8.	4.	5.	4.	7.	3.	1.	7.	1.	101.	132.	117.	127.
104.	132.	121.	125.	129.	123.	140.	122.	157.	159.	123.	139.	137.
153.	140.	138.	135.	137.	161.	145.	183.	142.	161.	182.	151.	170.
179.	149.	168.	170.	168.	151.	157.	139.	175.	187.	170.	169.	145.
133.	148.	154.	159.	155.	139.	150.	158.	158.	167.	159.	155.	141.
164.	186.	152.	146.	159.	149.	136.	147.	156.	112.	145.	133.	111.
131	132.	139.	114.	122.	123.	108.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

NUMBER OF COUNTS = 489. SUBJECT INTEGRAL = 56118. BKG INTEGRAL = 86301.

659.	86301.	0.	128.	9442.	3953.	7782.	31428.	16922.	1493.	507.	393.	326.
310.	294.	283.	289.	271.	247.	251.	284	292.	284.	249.	246.	251.
214.	223.	246.	210.	196.	182.	165.	166.	162.	167.	169.	134.	156.
125.	143.	125.	128.	121.	115.	118.	126.	116.	114.	125.	120.	151.
127.	135.	116.	92.	86.	99.	75.	90.	103.	73.	90.	75.	83.
79.	80.	76.	60.	64.	58.	65.	54.	59.	56.	62.	73.	55.
59.	66.	53.	69.	57.	45.	62.	52.	64.	43.	33.	51.	52.
48.	52.	42.	45.	51.	37.	47.	37.	36.	43.	46.	41.	53.
33.	30.	30.	41.	47.	43.	44.	36.	42.	41.	37.	40.	44.
34.	33.	42.	37.	44.	39.	39.	35.	22.	29.	26.	46.	31.
44.	39.	40.	43.	34.	35.	40.	46.	33.	38.	27.	51.	44.
35.	37.	45.	41.	30.	32.	38.	25.	23.	31.	22.	25.	25.
24.	13.	15.	24.	20.	10.	15.	19.	23.	9.	14.	23.	20.
22.	10.	23.	12.	18.	17.	14.	16.	7.	12.	9.	8.	10.
7.	22.	6.	18.	18.	10.	9.	9.	11.	12.	13.	9.	11.
13.	7.	10.	17.	14.	9.	13.	14.	15.	12.	13.	12.	8.
9.	8.	9.	6.	11.	4.	9.	4.	4.	15.	12.	7.	10.
9.	6.	9.	6.	8.	10.	5.	5.	8.	10.	12.	9.	14.
6.	9.	4.	8.	5.	5.	5.	13.	10.	8.	9.	4.	4.
12.	9.	11.	13.	9.	3.	5.	6.	6.	204.	180.	[illegible]	223.
193.	198.	195.	195.	199.	203.	199.	193.	187.	189.	169.	202.	181.
198.	164.	197.	180.	192.	227.	213.	179.	182.	187.	205.	168.	199.
191.	216.	213.	208.	211.	192.	182.	186.	204.	196.	175.	229.	193.
197.	178.	213.	191.	199.	218.	206.	194.	202.	216.	190.	200.	202
209.	227.	205.	219.	179.	205.	209.	205.	174.	201.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.												

TABLE 5. RESIDUAL COUNT DATA

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(PERSON'S NAME HERE) (SOCIAL SECURITY NO.) 04/18/79 AT 0650    ( 6. 32 MIN.  COUNT)
3 MILE ISL  (JOB TITLE)                   SEX=F   HT=5 4   AGE=29 WT=130 ANALYST=JG
     6. 98    140. 30      10. 50      1. 31       7. 15    142. 26     34. 46      7. 72
    10. 36       1. 40   6208. 42     10. 98      80. 75     66. 85     56. 73    113. 68
   169. 67    109. 40     130. 65     93. 11     112. 83     83. 32 -1000. 00 -1000. 00
    CHISQR      0. 66                  DOSE COMMITMENT, MREM
        ANSWER 2-SIGMA % MPBB 50 YEAR  1 YEAR 13 WEEK     %ICRPIL
  1 RA-BC      9.     3.    X 3. 33 =
  1 RA-226    31.     9.     30. 91  313760.    9007.    2259.    29. 5
  2 POTASS    95.    26.      1. 61       0.       0.       0.     0. 0
  4 BACKGR   107.     6.    107. 40       0.       0.       0.     0. 0
    TOTALS                    0. 09  313760.    9007.    2259.    29. 5
    XYZ123            FILE=TMR650 ON JIM-B
    6. 317 8884. 114   793. 422    13. 637   792. 812   433. 393   731. 263 2632. 623
 1762. 294  415. 129   106. 041    83. 332    70. 796    58. 934    53. 707    58. 824
   55. 002   49. 618    46. 702    45. 212    43. 249    39. 446    36. 464    35. 214
   34. 140    0. 135     2. 464     2. 289    -0. 127    -1. 546    -0. 798     1. 945
    5. 248    5. 247     0. 936    -2. 930    -2. 450    -0. 092     0. 812    -0. 029
   -1. 365   -0. 776     1. 602     1. 595     0. 147     0. 827     1. 726     0. 917
    0. 131   -0. 008    -0. 142    -1. 392    -2. 611    -2. 871    -1. 841     0. 181
    0. 950   -0. 623    -1. 411    -0. 063    -0. 346     0. 004     0. 837     0. 611
    1. 612    1. 256     0. 046     0. 301     0. 885     0. 377     0. 432     0. 397
   -0. 438   -0. 212    -0. 252    -0. 024    -0. 747    -1. 037     0. 187    -0. 210
   -0. 784   -0. 751    -0. 746    -0. 120     0. 320    -0. 059    -0. 592    -0. 748
   -0. 025    0. 364     0. 056    -0. 572    -0. 970    -0. 553     0. 017     0. 588
    0. 410   -0. 049    -0. 303    -0. 014     0. 018    -0. 564    -1. 077    -1. 019
   -0. 797   -0. 309     0. 129    -0. 031    -0. 648    -1. 308    -1. 412    -1. 094
   -0. 664   -0. 104     0. 416     0. 481    -0. 023    -0. 400    -0. 120    -0. 106
   -0. 102   -0. 159    -0. 101    -0. 776    -1. 033    -0. 461     0. 700     1. 587
    1. 356    1. 030     0. 427     0. 184    -0. 808    -1. 171    -0. 990    -0. 430
   -0. 100   -0. 638    -0. 833    -0. 433     0. 920     1. 187     0. 562     0. 076
    0. 138   -0. 134    -0. 333     0. 202     0. 557     0. 884     0. 770     0. 130
    0. 101   -0. 197    -0. 453    -0. 197    -0. 236     0. 117     0. 431     0. 626
    0. 883    0. 907     1. 007     0. 563     0. 026    -0. 009    -0. 184    -0. 111
   -0. 191   -0. 314    -0. 493    -0. 823    -0. 762    -0. 714    -0. 419    -0. 158
   -0. 106    0. 138     0. 392     0. 546     0. 570     0. 511     0. 367     0. 163
   -0. 059   -0. 405    -0. 558    -0. 521    -0. 412    -0. 148    -0. 087    -0. 112
   -0. 099   -0. 032     0. 170     0. 151     0. 223     0. 169     0. 077     0. 065
   -0. 177   -0. 257    -0. 283    -0. 291    -0. 268    -0. 386    -0. 477    -0. 546
   -0. 590   -0. 238    -0. 048     0. 099     0. 200     0. 170     0. 161     0. 201
    0. 149    0. 013     0. 104     0. 007    -0. 032     0. 119     0. 176     0. 083
    0. 172    0. 096     0. 043     0. 125     0. 224     0. 238     0. 167     0. 051
   -0. 206   -0. 446    -0. 521    -0. 571    -0. 467    -0. 231     0. 097     0. 405
    0. 626    1. 223     1. 111     0. 996     0. 878     0. 756     0. 744     0. 709
    0. 633    0. 743     0. 823     1. 108     0. 475     0. 158     1. 108     0. 158
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APPENDIX - DETAILS OF RESULTS

A.1 Quality Assurance

Referring to Figure 4, note the quality assurance data printed out in the third and fourth lines of the printed data. The first number, 6.98, represents the americium-241 (Am-241) photopeak before any computer adjustment of the system electronic gain. The second, 140.30, represents the potassium-40 (K-40) photopeak before computer adjustment. The third, 10.50, represents the system gain (in keV per channel) during the actual whole body count. The fourth, 1.31, is the channel location of 0.0 keV for the energy spectrum. The fifth, 7.15, represents the midpoint of Am-241 photopeak after the adjustment of the zero and electronic gain. The sixth number, 142.26, represents the adjusted midpoint of the photopeak for K-40. The seventh and eighth values, 34.46 and 7.72, represent the system resolutions for Am-241 and K-40 (expressed in percent), respectively. The first figure in the fourth line, 10.36, is the energy gain (keV per channel) after the gain and zero shift adjustments. The next value, 1.40, is the channel of 0.0 keV after the gain and zero shift adjustments. The third value in the second line, 6208.42, represents the net counts per minute (i.e., after subtraction of the system background count rate) under the Am-241 photopeak. This value also serves as a QA check since the Am-241 (458 year half-life) count-rate should remain constant over the useful life-time of the counting system. The remaining figures represent background count time (10.98 minutes) and count-rates at various energies in the background spectrum. They are in order: K-40, cobalt-60 (1.33 MeV), cobalt-60 (1.17 MeV), cesium-134 (0.800 MeV); cesium-134 (1.60 MeV); cobalt-58 (0.800 MeV); cesium-137 (0.667 MeV); zinc-65 (1.12 MeV); zirconium-niobium-95 (0.72-0.77 MeV); and manganese-54 (0.835 MeV). None of these nuclides were detected among the public, but are occasionally observed among workers at nuclear facilities.

A.2 Sample of the Data on File for Each Participant

The data on each individual participant on file at NRC are available to each individual upon request, but to no one else without that person's written permission (requirement of the Privacy Act of 1974, Public Law 93-589).

The first sample data sheet, at the top of Figure 4, represents a summary of the results of the analysis of the raw data collected during the actual whole body count. Name, social security number, date and time of count and length of time this person was counted (minutes) are listed on the first line. The second line is the work classification, and the "CHISQR" value in the third line is a measure of the statistical fit of the count data with standard gamma spectra of the radioisotopes identified in the scan. In general, a value of 2 or less indicates a good fit. Beginning with the fifth line, the first column lists the radionuclides or element (in the case of stable potassium) found during the whole body count. The second column contains the estimated radioactivity in nanocuries, or in the case of stable potassium, in grams. The third column represents the 95 percentile uncertainty estimate in the value estimated in column 2 (i.e., two standard deviations). The fourth and last columns represent fractions of maximum limits for radiation workers and are not applicable to the general public. As mentioned previously, the doses shown in the columns under "Dose Commitment" probably overestimate the actual situation for Ra-B,C since any dose to an individual would be very small unless supported by Ra-226 in the body or continued exposure to high levels of Ra-B,C in air or water. The dose commitments listed for varying periods in columns 5 - 7 assume that the Ra-B,C detected came from internally deposited Ra-226, and they include the doses from radon-222 and all its short-lived daughters (including Ra-B,C).

The last column (%ICRPIL) is the percentage of the investigation level recommended by the International Committee on Radiological Protection (ICRP) for occupational workers, and has no relevance for members of the general public. In this particular case, the individual was not recounted, but based on those who were, it is probable that the Ra-226 levels are overestimated.

Table 4 represents two sets of data. The data at the top are the raw count data on the same person shown in Figure 4. The data at the bottom are the system background count data used for this analysis. The data are presented in total counts in each channel of the multichannel pulse height analyzer used to collect and store each pulse from the detector system. In this particular system, a system gain of about 10 keV/channel over 256 channels permitted collection of gamma ray data up to about 2.5 MeV.

The first data in both sets of count data (i.e., 379 in the gross counts and 659 in the background) are the total seconds for each count. The data in the second channels (i.e., 56 118 and 86 301) represent the total number of counts in the entire spectra for gross and background counts respectively. The large number of counts in channel 7 represents the Am-241 source (see quality assurance section for details). The first 19 rows of data in each data set include the first 247 channels, and the first nine sets of data in the 20th row accounts for a total of 256 channels of data. The data which follow channel 256 in the top data set represent a series of total counts over five second time intervals during the time the detector moved over person's body (the background scan data shown are for ten second intervals). These data are the source of the scan profile discussed below in reference to Figure 5. Such data permits a quick inspection to determine if there was any highly localized source of radioactivity on the person being counted (e.g., a radium dial wristwatch that had not been removed).

Table 5 is the net count rate (counts per minute) after the system background count-rate was subtracted and after the spectrum stripping of identified radionuclides was completed. These are called the residual count-rate and provide assurance to the analyst that no gamma emitting nuclides remain unidentified. If one had been missed, there would be large deviations from zero between channels 30 through 256.*

Figure 4 (discussed earlier with regard to quality assurance) is a display of the person's count rate data (the top spectra), the system background count-rate (immediately below the top spectra), and reference spectra of the nuclides detected in the person's count (in this case, potassium-40 and radium-B,C) near the bottom of the figure.

*The first 30 channels do not yield useful spectral data since secondary cosmic rays undergoing compton scatter in the person being counted are counted primarily in the lower energy region. These added background counts are not present when the system backgrounds are taken. therefore, no meaningful background correction is possible.

Figure 5 contains two sets of data. The larger figure shows a plot of the gross count rate versus channel number for the person who was counted (upper spectrum) and the system background (lower spectrum). The small figure shows the variation in count-rate over the length of the person versus system background count-rate over the same distance.

The remaining figures (6 and 7) are graphical expressions of Table 6 (in terms of counts per minute and standard deviations for each channel beyond channel 30).

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In early April, 1979 the U.S. Nuclear Regulatory instituted a program to determine whether any radioactivity released as a result of the March 28, 1979 accident at the Three Mile Island Unit-2 was accumulating in members of the general public living near Unit-2. The program used a device called a whole body counter which has the capability of measuring very small quantities of radioactivity in people. There were 753 men, women and children successfully counted; nine of these people were counted a second time, leading to a total of 762 whole body counts. There was no radioactivity identified in any member of the public which could have originated from the radioactive materials released following the accident. Several people with higher than average levels of naturally occurring radioactivity were identified. The counting systems used are briefly described. Technical problems encountered, results and conclusions are discussed.

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