JAN 14 1980

Ms. Barbara J. Heivly
15 Redwood Building
Middletown, Pennsylvania 17057

Dear Ms. Heivly:

In accordance with your request of November 19, 1979, the detailed results of your whole body count are enclosed. In the event of any further inquiries, please refer to file number 0650.

As stated in your Certificate of Participation, no radioactivity was detected which could have originated from the releases following the Three Mile Island (TMI) accident of March, 1979. That is not to say you 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 any significant amount and, hence, are not measureable 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 last major releases occurred. The average radiation dose to the population in Middletown from the noble gases was about one-tenth of the annual dose from natural background radiation in that part of Pennsylvania,* and much less than that at more distant locations; such as Harrisburg. However, the reference to radioactive iodine-131 (I-131) on your certificate is very important. Iodine-131 was the only radioisotope released during the accident which was detected in biological samples (specifically in cows' and goats' milk collected near TMI). The minimum detectable I-131 level (concentrated primarily in the thyroid gland) would, as noted on your certificate, result in a thyroid dose of about 15 millirem. That is about the same radiation dose your entire body (including your thyroid) receives from natural environmental radiation every eight weeks. Estimates of actual thyroid doses based on measurements of environmental concentrations indicate a realistic value of less than 1 millirem. This 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). A copy is enclosed for your information.

*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.

To assist you in interpreting the results of your whole body count, you should know the following facts about the elements and radionuclides that were measured:

1. Potassium:

Every living creature contains the element potassium. In humans, there are about 100 to 150 grams of stable potassium in each person, depending on age, sex, and body weight. Of this total, about 0.012% is radioactive Potassium-40 (K-40). This amount of K-40 is equivalent to about 100 nanocuries* per person. As noted in your Certificate of Participation, that small amount of naturally occurring K-40 accounts for an annual radiation dose to your entire body of about 20 millirem or a dose of approximately 1,400 millirems during a lifetime of 70 - 75 years. The potassium results stated on the accompanying data sheets are for grams of potassium, not nanocuries of K-40.

2. Radium - B,C:

About 60% of the participants in the program had detectable levels of the naturally occurring radioactive nuclides Radium-B (Lead-214) and Radium-C (Bismuth-214). The average amount of these nuclides detected in this group was about 4 nanocuries, and the standard deviation was about plus or minus 2 nanocuries. Your whole body count indicated that your body contained 9 nanocuries with a standard deviation of about 3 nanocuries. 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 the 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 is no way to make that determination without further expensive and arduous tests. However, the NRC can assure you that the lifetime risk of cancer mortality as a result of the naturally occurring Ra-B,C detected in the program participants is very small relative to the current risks from other causes (e.g., cigarette smoke and other environmental pollutants, food additives, and certain drugs) even if the radionuclides detected were within the person's body. In any event, this radioactivity exists naturally and is totally unrelated to the accident at TMI.

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*A nanocurie is one-billionth of a curie (standard unit for measurement of radioactivity), or 37 nuclear disintegrations per second.

3. Radium-226:

Every person has some naturally occurring Radium-226 (Ra-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 Ra-226 levels calculated are based on the assumption that the Ra-B,C detected 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 normal levels of Rn-222 immediately before the whole body count. A further indication that not all of the calculated amount of Ra-226 was not internally deposited is the fact that several participants showing higher than average levels of Ra-B,C were given second whole body counts which indicated significantly lower although still above average levels than the initial counts. If the Ra-B,C detected were coming from the radioactive decay of internally deposited Ra-226, the amount of Ra-B,C would not have changed significantly in the time between counts. As a result, it is probable that most of the Ra-226 data reported are not associated with internally deposited activity.

For perspective, typical concentrations of Ra-226 in human beings are on the order of 0.008 nanocuries per kilogram in bone, and about 0.00013 nanocuries per kilogram in soft tissue. The average content in adult males is about 0.15 nanocuries. This would produce an amount of Ra-B,C that would be about one-tenth 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 NRC feels the presence of these naturally occurring nuclides in the body should not be of any concern to the program participants.

It should be stressed that 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

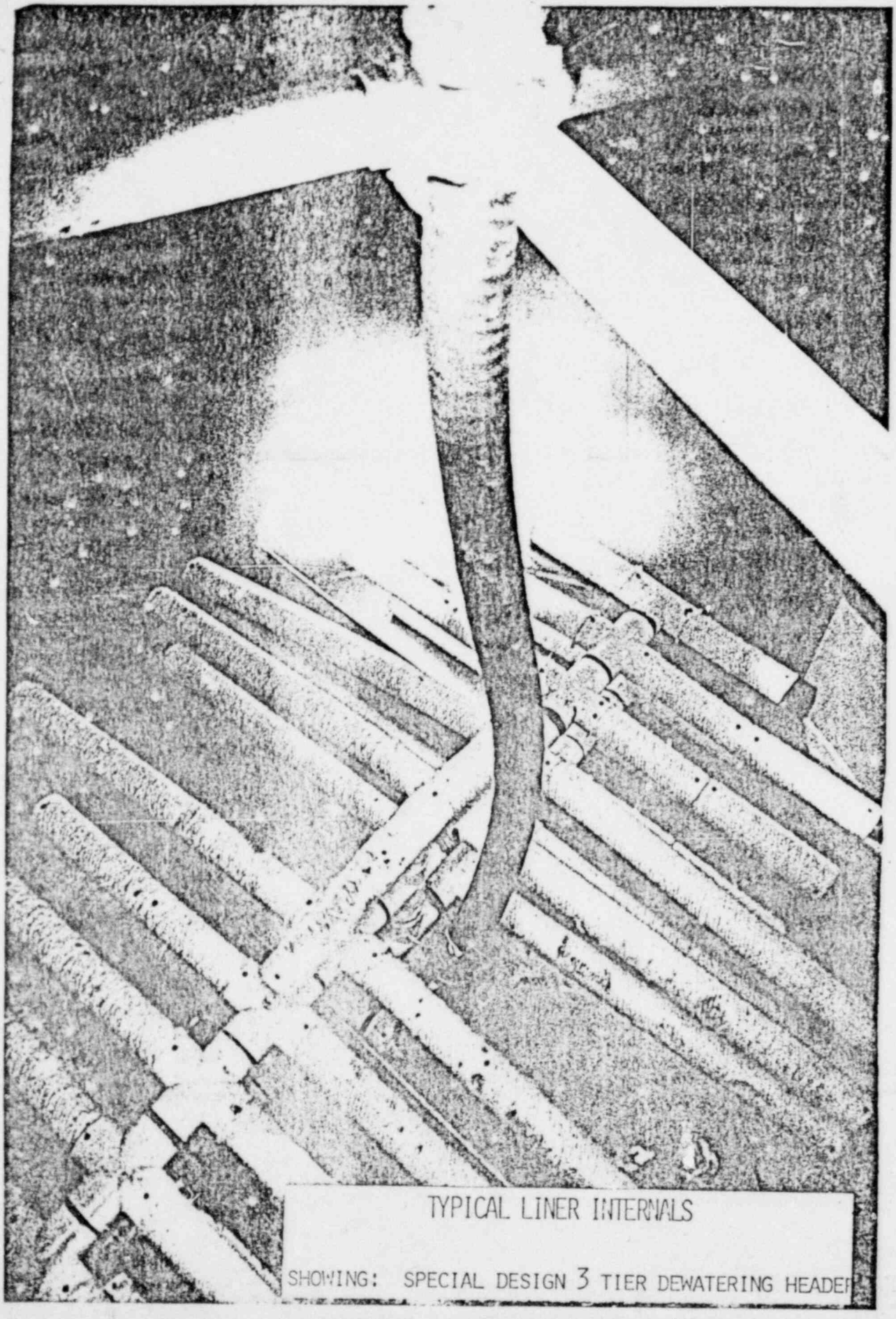
thousands of years before the predessessors of Ra-B,C would reappear in reactor fuel as a result of the normal radioactive decay of U-238 in the fuel, assuming the fuel were not perturbed (for example, by chemical reprocessing).

4. Cesium-137:

Cs-137 is present in all human beings, however, only about 30% of the participants in the whole body counting program had detectable amounts of Cesium-137 (Cs-137). The minimum level of detection for the counting system used at Middletown was about 1 or 2 nanocuries, The average amount detected in the 30% participants was about 2 nanocuries. The Cs-137 originated as fallout from atmospheric nuclear weapons tests that 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. The small amounts of Cs-137 detected 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 natural background radiation doses).

Attached to this letter is a summary of all the actual data from your whole body count that the NRC has on file. Your name, social security number, date and time of count and length of time you were counted (minutes) are listed on the first line. The second line is your work classification, and the CHISQR value in the third line is a measure of the statistical fit of your count data with standard gamma spectra of the radioisotopes identified in your 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 your 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 assumes 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).

Also attached are three additional pages of detailed technical information which lead to the results described in the first summary page. The three pages contain the following information in the same order.



TYPICAL LINER INTERNALS

SHOWING: SPECIAL DESIGN 3 TIER DEWATERING HEADER

DEWATERING PROGRAM RESULTS

TYPICAL 6' x 6' RESIN LINER

TOTAL CONTAINER VOLUME	145 FT^3
RESIN VOLUME	116 FT^3
FREE STANDING WATER PRIOR TO DEWATERING (518 GAL.)	69 FT^3
FREE STANDING WATER AFTER DEWATERING AND OVER-THE-ROAD TRANSPORTATION (1.6 GAL.)	0.2 FT^3
FREE STANDING WATER PERCENT OF TOTAL LINER VOLUME	0.15%

TMI SHIPPING OVERVIEW

FULL COMPLIANCE WITH NRC AND DOT REQUIREMENTS ASSURED.

11 APPROVALS REQUIRED FOR DISPATCH

- TMI VOUCHES FOR:
  - CONTENTS
  - RADIATION LEVELS
  - PACKAGING
  - LABELING
  - VEHICLE CONDITION

- NRC INSPECTS FOR COMPLIANCE

- DOT INSPECTS FOR COMPLIANCE

MET ED CERTIFIES COMPLIANCE WITH WASHINGTON STATE EO 79-09

SUMMARY

- PROPER SHIPPING PACKAGE

- PROPER TRANSPORTATION VEHICLE

- SATISFY ALL SHIPPING AND BURIAL GROUND REQUIREMENTS