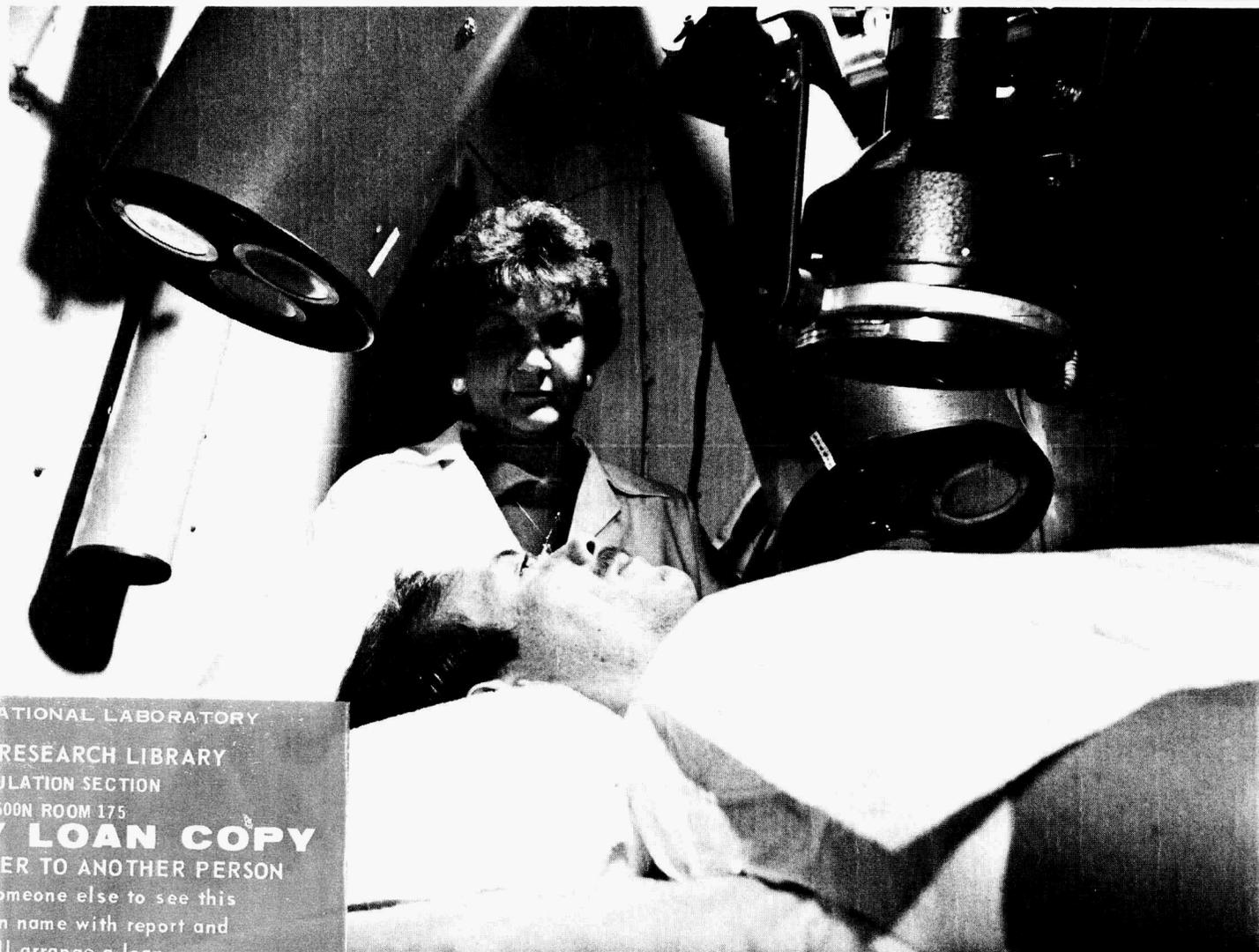




3 4456 0268916 0

.ORNL/M-454

The ORNL Whole Body Counter



OAK RIDGE NATIONAL LABORATORY

CENTRAL RESEARCH LIBRARY

CIRCULATION SECTION

4500N ROOM 175

LIBRARY LOAN COPY

DO NOT TRANSFER TO ANOTHER PERSON

If you wish someone else to see this
report, send in name with report and
the library will arrange a loan.

UCN-7969 13 9-771

at Oak Ridge
National Laboratory

**The Radiation Dosimetry Group
Radiation Monitoring Department
Environmental Compliance and
Health Protection Division
Oak Ridge National Laboratory**

Prepared by the
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831
operated by
Martin Marietta Energy Systems, Inc.
for the
U.S. DEPARTMENT OF ENERGY
under Contract No. DE-ACO5-84OR21400



What is a Whole Body Counter?

A Whole Body Counter is an instrument which is used to detect radioactive materials within your body. This radioactivity is not easily measured by other monitoring devices.

The radiation dosimeter on your security badge measures the radiation dose from material outside your body. We call this your external radiation dose. The Whole Body Counter is a tool to help us measure your internal radiation exposure.

The Oak Ridge National Laboratory (ORNL) Whole Body Counter is one of few such facilities in the world. Our recent improvements with state-of-the-art detectors make it possible to measure very low levels of radioactivity.

What is radioactivity?

Radioactivity is energy given off by unstable materials. We call this energy "radiation" and we call the materials "radionuclides." You cannot detect radiation yourself. You can't smell, see, hear, taste, or feel it.

We use the Whole Body Counter to detect the energy given off by radioactive material in your body, a process we simply call "counting". The Whole Body Counter is operated by trained Health Physicists.



What is Health Physics?

Health Physics is the science of radiation protection. Health Physicists are concerned with keeping all radiation exposures as low as possible.

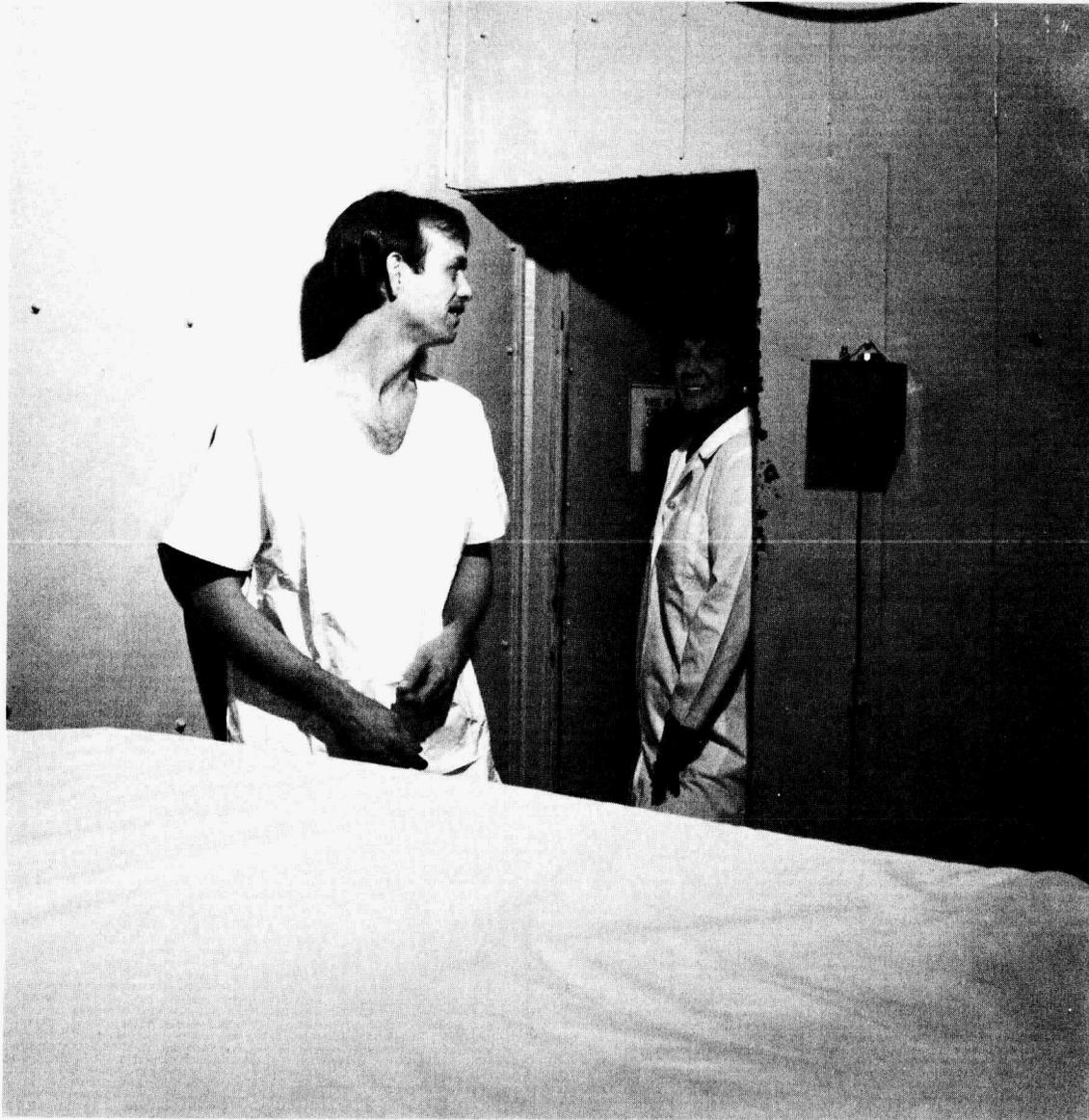
Why we count

People who work with radioactive materials should have periodic counts in a Whole Body Counter. This is done to insure that your exposure to radioactive materials is as low as possible.

How often you receive a Whole Body Count depends on your job and the materials you work with. Some people are counted about every three months. Others may be counted every year. Your area Health Physicist monitors your work environment and schedules your routine Whole Body Counts accordingly. You may also receive a Whole Body Count if you are in an incident involving the potential release of radioactive materials.

The Whole Body Counter is one tool used to help assure your health and safety on the job. Other methods, such as analyzing a sample of your urine for radioactive material,





may also be used. Depending on your job and the radionuclides involved, one or both of these methods may be used to help determine your internal radiation exposure.

Common radionuclides used at ORNL include radioactive iodine, cesium, plutonium, curium, uranium, and strontium. Some of these radionuclides are used in medicine, in research programs, and in helping to meet our country's energy needs.

Measuring Radiation

We measure the radiation inside your body by counting the number of gamma rays coming from inside your body. Gamma rays are bundles of energy similar to those that make up sunlight. Unlike sunlight, however, you can't detect these gamma rays unless you have an instrument like a Whole Body Counter.

The number of gamma rays is related to the amount of radioactivity. The more gamma rays, the more radioactivity. By counting the gamma rays, we can find out how much radioactive material is inside your body. This counting process is why we call the measurement a Whole Body "Count".

Shielding and Equipment

In order to detect small levels of radiation coming from inside your body, we must have special shielding in order to keep out the natural radiation found in the environment. This shielding is provided by a special room called a "vault", in which the radiation detection equipment is located.

The walls, floors, and ceiling of the vault are constructed of pre-World War II battleship armor. This was used because metals made since that time have small amounts of radioactivity in them due to the manufacturing process. This would interfere with our measurements. The vault's walls are about fifteen inches thick.

The Whole Body Counter has both an inner and an outer door on the entrance. The doors are very heavy and should be handled only by the Technician; do not try to open them yourself. You will enter a small airlock area and the outer door will be closed before you open the inner door and enter the Whole Body Counter vault.

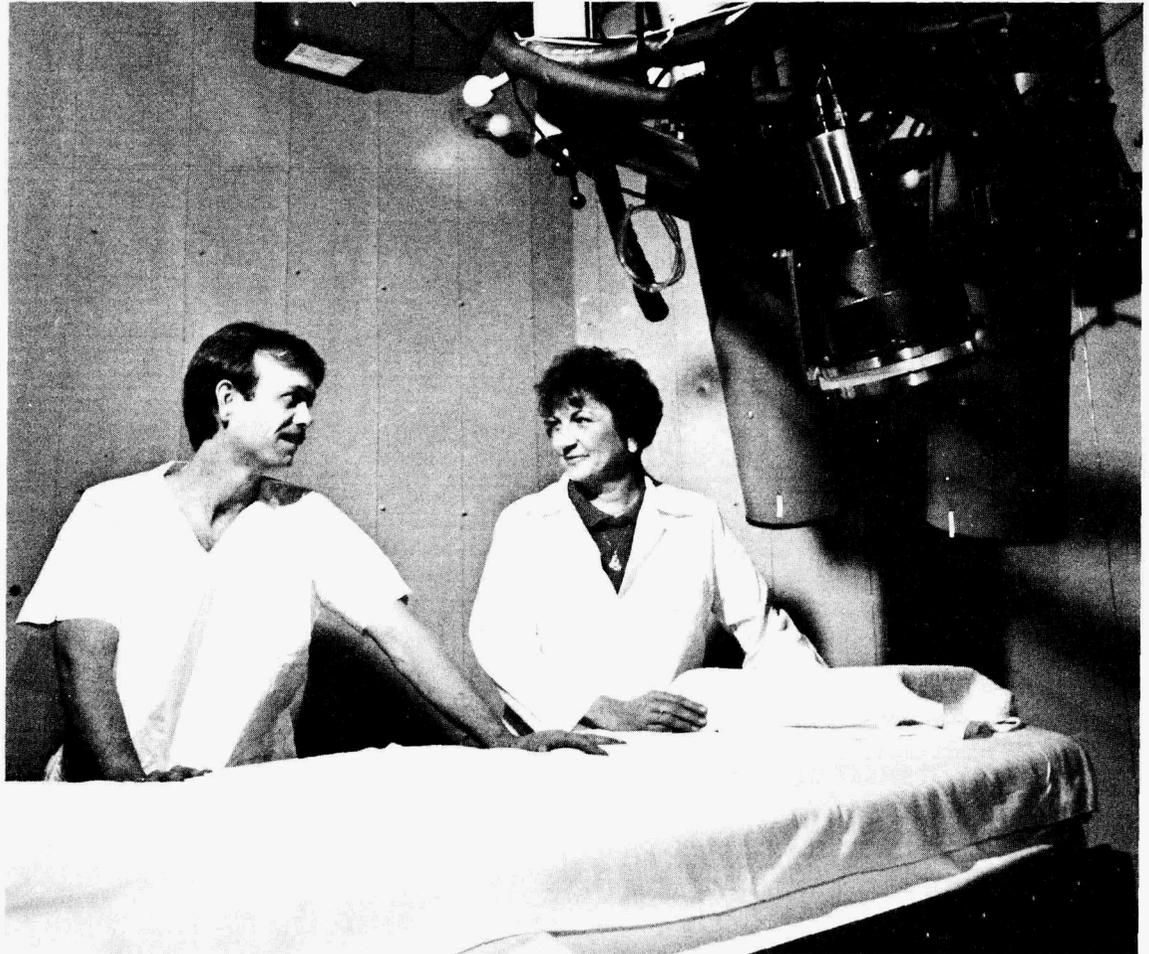
Inside the vault is a bed, which you will lie on during your Whole Body Count. Around the bed are detectors of several different shapes and sizes.

The detectors are positioned around your body during your Whole Body Count. Several

different detectors may be used depending on what radioactive material we are looking for.

These detectors detect gamma rays. They are connected to the analysis equipment in

the Whole Body Counter Control Room by several cables. When a detector "sees" a gamma ray, it sends a signal in the form of an electrical pulse through the cable to the



analysis equipment. You will not be able to detect these pulses, since these cables are not connected to you in any way.

A high-energy gamma ray will cause a larger pulse than a low-energy gamma ray. The analysis equipment sorts the pulses by size. The number of pulses of each size are counted and recorded by the computer.

The computer analyzes the pulses from all the detectors at the same time. The results are displayed on a screen similar to a television screen. This provides a picture of your Whole Body Count. This picture is called a "spectrum".

What does all this mean?

The whole subject of Whole Body Counting is very complicated, but there are several simple ideas that will help you to understand the results of your Whole Body Count.

What we are looking for are peaks in your spectrum. The height of the peak represents the number of gamma rays. The position of the peak is related to the identity of the radionuclide which gave off the gamma rays. Background radiation (described below) causes random energy pulses to also be recorded.



Many radionuclides will give off several gamma rays of different energies and thus will show several peaks, sometimes of different heights. By looking at the position and height of these peaks, the Whole Body Counter Specialist can identify the radionuclides in your body and estimate the amount of them present.

This information is then compared to the radiation protection limits, which are set for each individual radionuclide. Some limits are higher than others. For example, the limit for radioactive cesium is much, much higher than the limit for curium. This is because radioactive curium is more hazardous than cesium.

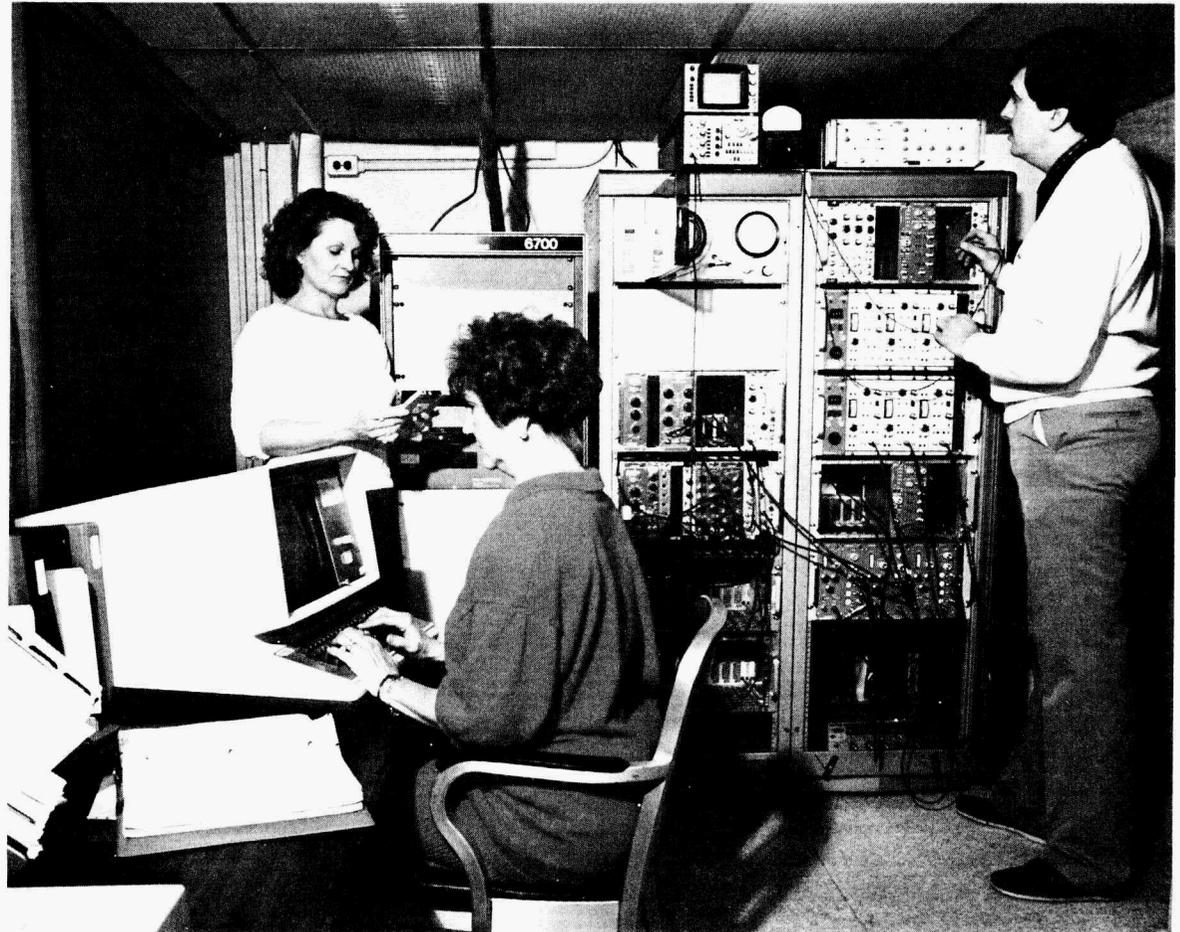
Most people do not show any unusual results in their Whole Body Count. We call this a “normal human spectrum”. Approximately 95% of all routine Whole Body Counts are normal.

Background Radiation

Natural radioactivity, called “background radiation”, comes from sources such as radium in soil and in building materials, as well as from cosmic rays from outer space. This background radiation is also detected by

our Whole Body Counter. In order to tell how much radioactivity is present above natural background levels, we subtract this background level from your count.

A “background count” is obtained by placing a “phantom” in the vault instead of your body. The phantom is made of a material which simulates a human body without any



radioactive materials in it. This allows us to measure the natural radiation background in the Whole Body Counter vault. This background count is subtracted from your count. The difference tells us how much radioactivity was present above the background level.

You have naturally-occurring radioactive materials present in your body. Some naturally-occurring radioactivity is found in everyone. The gamma rays from these materials will also be detected by a Whole Body Counter. For example, about 0.01% of all potassium in the world, *including that in your body*, is naturally radioactive.

This radioactive potassium shows up in everyone's Whole Body Count and is normal. Therefore, everyone's Whole Body Count will show at least one peak in the spectrum.

What's going to happen to me?

Upon arrival at the Whole Body Counter you will be provided with a paper suit, socks, and towels. You will then be asked to shower and shampoo your hair before dressing in these clothes.

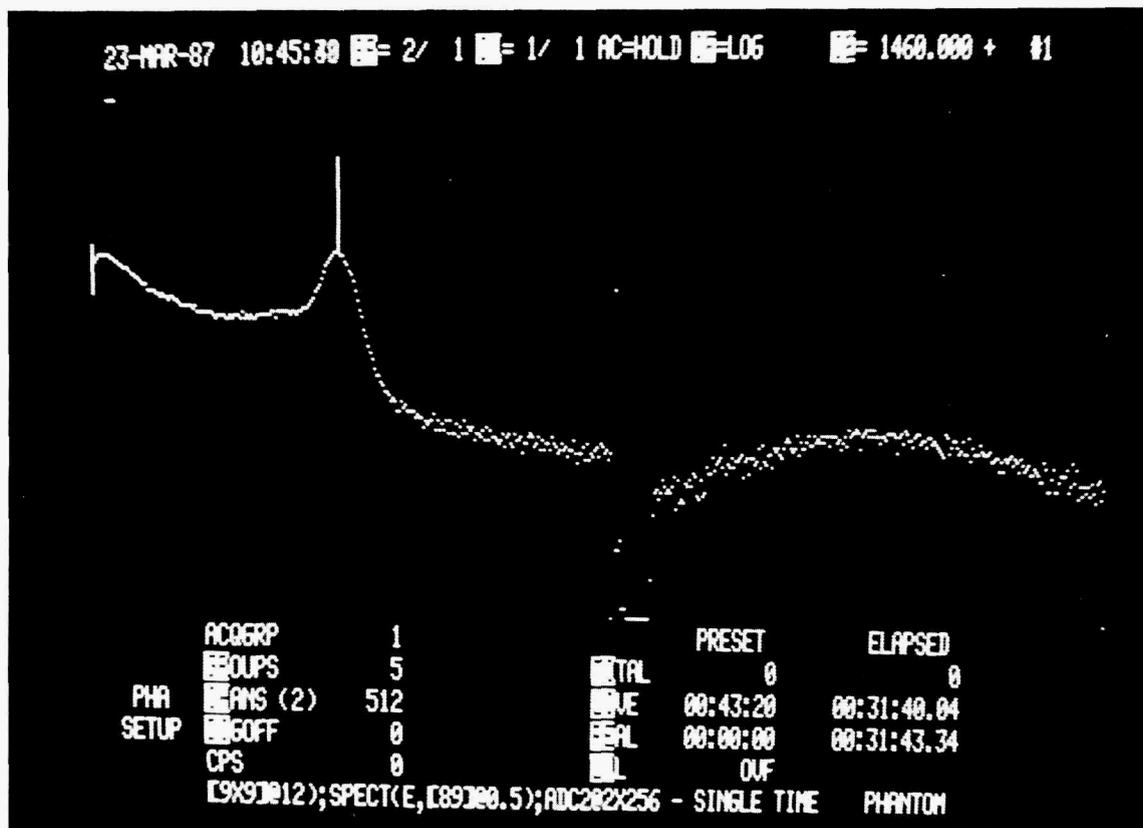
These steps are taken so that the count will detect radioactive material only within

your body and not on your skin or clothing. Please remove any jewelry, except wedding rings, that you may have on. This includes your eyeglasses. These items could also interfere with your Whole Body Count.

Place your clothes and personal belongings in a empty locker and take the key with you. Exit from the rear of the shower area into

the annex and let the Technician know you are ready. The Technician will then measure your height and weight.

You will be escorted into the vault by the Technician and asked to lie down on the bed. You are positioned over the detectors which are underneath the bed. Other detectors are then positioned over your lungs.



Some of these detectors are kept very cold to provide the best possible results, so you may feel a small draft of cold air from them. Please tell the Technician if you are uncomfortably cold and you will be provided with extra sheets to help keep you warm.

There is a radio inside the vault for you to listen to during your Whole Body Count. The Technician will ask you for the radio station that you prefer. If you like, we will turn the radio off so that you can enjoy the peace and quiet inside the Whole Body Counter.

The Technician will leave the vault and close the door, leaving you alone inside. An intercom inside the vault allows you to talk to the Technician outside. It is set to listen to you all the time you are inside. You do not have to push any buttons to be heard; simply speak slowly in a clear voice. The Technician will answer you in just a few moments. You will not normally hear the Technician unless they push the "talk" button on the intercom outside.

Information about you, such as your name, height, and weight, are entered into the computer. Your Whole Body Count will normally last for about 45 minutes.

The Technician will remove the detectors from around your body after the count is complete. After leaving the vault, you can then go back to your locker, dress, and return to the Control Room to discuss your results.



Results

When your Whole Body Count is complete, the preliminary results will be explained to you by the Whole Body Counter Technician. The results are then further

analyzed by a Whole Body Counter Specialist. A summary of the results will be sent to your area Health Physicist, and a copy stored for future reference.

Questions You May Have About Your Whole Body Count

Will I have to lie perfectly still during the count?

No, not perfectly still, but as still as possible. This is because the detectors above your body are easily damaged and very expensive.

Will I feel anything during the count?

No, your Whole Body Count will not produce any feeling or sensation.

What if I want out before my time is up?

You can get out any time you want by simply talking to the Technician over the intercom. The intercom will be on the whole time you are inside the Whole Body Counter vault.

Will I be locked inside the vault?

No. The vault doors can be opened from inside, but we prefer that you do not open these yourself. The doors are very heavy and are best opened and closed by the Technician. Also, the detectors that are above your body are very expensive and easily damaged, so we request that you simply talk to the Technician over the intercom if you want to leave. The Technician listens to the intercom all the time you are inside the vault.

Will I feel cramped in the vault?

No, the inside of the vault is about the same size as a small office.

Is there an air supply in the vault?

Yes. Clean air is continuously pumped into the Whole Body Counter vault. Additional safety features have been designed to assure your comfort and safety during your Whole Body Count.

What if I am claustrophobic?

Please let the Technician know if you are uncomfortable in enclosed spaces and special arrangements will be made for you.

What is "ultrasound"?

Depending on the radionuclides you work with, you may receive an "ultrasound" chest-wall thickness measurement. The equipment used is similar to that used for fetal monitoring of pregnant women. It bounces very high frequency sound waves inside your chest and provides a picture of your chest cavity. It gives information on the thickness of tissue over your lungs. A chest-wall thickness measurement is not required for most people. A very good estimate can be made from your height and weight.

If you have other questions, please feel free to contact the Radiation Monitoring Department at 574-6654.