SHORT- AND LONG-TERM HEALTH EFFECTS ON THE SURVIVING POPULATION OF A NUCLEAR WAR

HEARING

BEFORE THE

SUBCOMMITTEE ON
ALTH AND SCIENTIFIC RESEARCH

OF THE

COMMITTEE ON
BOR AND HUMAN RESOURCES
UNITED STATES SENATE

NINETY-SIXTH CONGRESS

SECOND SESSION

ON

TO EXAMINING SOME OF THE CONSEQUENCES THAT COULD AFFECT THE SURVIVING POPULATION OF A NUCLEAR WAR

JUNE 19, 1980

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THURSDAY, JUNE 19, 1980

U.S. SENATE,
COMMITTEE ON LABOR AND HUMAN RESOURCES,
SUBCOMMITTEE ON HEALTH AND SCIENTIFIC RESEARCH,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10:02 a.m., in room 4232, Dirksen Senate Office Building, Senator Edward M. Kennedy [chairman of the subcommittee] presiding.

Present: Senators Kennedy, Williams, and Pell.

OPENING STATEMENT OF SENATOR KENNEDY

Senator KENNEDY. We will come to order. We hold this hearing at a time when the Soviet Union and the United States may face the onset of a new nuclear arms race.

The SALT Treaty has been postponed. Powerful voices are urging that it be scrapped. We are at the edge of a new cold war that in the years ahead could flare into nuclear conflagration. We have watched as our warning systems this month sent false warnings of Soviet attack that could have started humanity's final war by mistake.

It is fashionable now to accept without criticism increases in the quantity of weapons, while rushing to retreat from efforts to improve the quality of life. We are now considering an MX missile system—a nuclear shell game in which 300 missiles, each containing as much firepower as all the bombs exploded over Germany during World War II, will be carried from silo to silo on a shuttle with a schedule as regular as the timetable for a bus route. New weapons may be necessary. But at least we ought to recognize what a mounting spiral in the arms race really means.

An entire generation of Americans have not seen even a glimpse of the nuclear reality. They were not yet born when the Hiroshima or Nagasaki bombs took 150,000 lives and wiped two great cities from the face of the Earth in a nuclear flash.

The last American nuclear test in the atmosphere was held when many of our citizens were still children. And the regular reminders of the danger have largely disappeared. We no longer experience the force or the feeling of a new mushroom cloud periodically seen on a film and on television sets. And most of us have half-forgotten the appropriate fear we once had of nuclear weapons.

So, it is easier in 1980 to think of the nuclear issue in terms of missile shell games, megatonnage, and throw weights. It is easier

perhaps to talk technologically and statistically of these things now that the mushroom cloud of a nuclear explosion is a fading shadow of our national memory.

Obviously we have to discuss weapons policy in realistic terms. We have to maintain a defense capability second to none. But we dare not lose sight of the human reality of weapons that could kill more people, sack more cities, burn more buildings, and inflict more suffering than in all the conflicts from the beginning of history until now. It may be useful to compare the size of missiles by setting up an array of models on a table in a congressional hearing room. But it is also essential to remember that if missiles those models represent are ever fired, there will be no table, no hearing room, and no Congress left to debate the aftermath.

In the face of this threat, the United States must be strong enough to deter any nuclear attack against us. Our era lives with and by a dangerous paradox. The nuclear genie can be contained only because both sides have the capacity to unstop the bottle and loose it upon the world. A quarter of a century ago, Winston Churchill told the House of Commons: "We have reached a stage where safety will be the sturdy child of terror, and survival the twin brother of annihilation."

It is a stage on which the human drama could be closed at any moment. The second imperative of nuclear policy is to control the arms race between the most powerful nations and prevent proliferation among the other nations of the Earth. This hope demands our common resolve, our tireless effort, and above all a recognition of how tenuous the human hold is on civilization and survival itself in the nuclear age.

As President Kennedy once told the United Nations:

> Today every inhabitant of this planet must contemplate the day when this planet may no longer be habitable. Every man, woman, and child lives under a nuclear sword of Damocles, hanging by the slenderest of threads, capable of being cut at any moment by accident or miscalculation or madness. The weapons of war must be abolished before they abolish us.

Today we will hear and see some of the consequences if that thread is ever cut. For a generation the human race has walked the knife's edge of nuclear war, often barely and precariously balanced, sometimes slipping and righting itself only at the last second. We need to recall that the greatest works of human enterpise and spirit can be vaporized in a single instant by the most terrible work of human invention. My hope is that this hearing will give new life to our national commitment to be equally strong in our defenses and in our determination that someday the world shall put away the nuclear sword of Damocles.

We will have as our first panel of witnesses four people who lived in Hiroshima at the time the atomic bomb was dropped on that city. And we will welcome Florence Garnett, Gene Fujita, Shigeko Sasamori, and Esuko Sasamori. And we will start off, if we could, with Gene Fujita. Maybe if I could ask you some questions, that would be agreeable with you, and we will move through and hear your story in your own words. Where were you born, Mr. Fujita?

STATEMENTS OF GENE MASANORI FUJITA, SEATTLE, WASH.; MS. FLORENCE GARNETT, MONTEREY PARK, CALIF.; MS. ESUKO BUNDY, FORT WAYNE, IND.; AND MS. SHIGEKO SASAMORI, NEWTON, MASS.

Mr. FUJITA. I was born in Centralia, Wash.

Senator KENNEDY. When did you move to Japan?

Mr. FUJITA. In 1940.

Senator KENNEDY. Where did you live in Hiroshima?

Mr. FUJITA. I lived in the—not quite the middle part of town, but it is in the metropolitan area.

Senator KENNEDY. But near the center part of the city?

Mr. FUJITA. It is approximately 5 kilometers away from the center.

Senator KENNEDY. What were you doing on the morning of the dropping of the atomic bomb?

Mr. FUJITA. During the war years, I was in high school at that time. And we were mobilized for the war effort to work in different army installations to help fight the war. Our school was assigned to a quartermaster corps which was close by our school. And we were there to bring in supplies, stack them in the warehouse, and reload them again.

Senator KENNEDY. Can you describe that morning that the bomb was dropped?

Mr. FUJITA. Well, it was hot that morning and very clear and just one B–29 came. We had a warning. Nobody gets excited with just one B–29 in those days. We see them constantly. So, we decided, well, it was hot. So, we—I am one of those typical goofoffs. And there was six of us in this platoon that we worked together. So, we decided to go down to the bomb shelter and eat half of our breakfast or lunch and—which consequently saved most of us, I would say. But when we were in the bomb shelter after I closed the door, there was kind of a sudden flash. We did not know what it was. I thought it was an electrical shortage. And then the next thing I knew, we could feel this pressurized hot air kind of squeeze your body. And at the same time, the sand from the makeshift bomb shelter was starting to drift into the area that we were sitting in. And so I told this other fellow, "Why don't you go outside and take a look?"

So, he went out and he says, "Oh, God." He closed—the door was half propped open by the compression anyway, by the explosion of the bomb. So, he closed it again. And then we stayed there for maybe 2 or 3 more minutes. Then we all got scared. So, we decided to go out. And that is when I noticed—when I went out, it was quite dusty. There was—you can hear a lot of groaning and moaning because some of the fellows that were working in the warehouse were trapped in there. There was quite a bit of debris that fell off from the buildings in there. The canned food fell on top of them. And we tried to go in there to help them, but we could not get the doors open. The building was tilting at a certain angle that the warehouse doors would not open.

Senator KENNEDY. Could you describe a little what the city looked like?

Mr. FUJITA. At the time of the explosion?

Senator KENNEDY. Just when you exited from the shelter. What did you see?

Mr. FUJITA. Well, the first impression I had, it was dark. But I suppose it is all the ashes that were thrown up in the air; the sunlight was not coming through. And as it cleared up, I could see from the top of the bomb shelter practically clear across the five rivers the other side of town. And the only thing I can remember is just skeletons of buildings standing.

Senator KENNEDY. Then you decided to try to go home, did you?

Mr. FUJITA. No. We were—we mobilized again, reorganized again to become aid people, to try to help the casualties. But it was a fruitless effort. There was no medication, nobody knew anything about burns.

Senator KENNEDY. Who were you trying to help? The victims of the blast?

Mr. FUJITA. These are the victims.

Senator KENNEDY. And where did you see them?

Mr. FUJITA. At that time there was approximately a three-lane highway that was coming through this quartermaster, and you could see, I would say, people in waves coming, and they are burned. You cannot tell which is their face or which part is their back. The skin is hanging from their hands when they are walking, practically to the ground. And they are in a—it seemed like they are in a daze. They are just following the crowd to try to get help, to try to get medicine.

Senator KENNEDY. You saw a whole sea of people walking down the highway seriously burned?

Mr. FUJITA. Yes.

Senator KENNEDY. What sort of noises were they making? Were they asking, crying for help or what?

Mr. FUJITA. Most of them were stunned. They were not making—well, there are a lot of crying. Mothers carrying their half-burned child. The mother themselves are burned, I would say, more than half of their body. Skin hanging from the child, skin hanging from their own body.

Senator KENNEDY. All in shock?

Mr. FUJITA. They were in quite a shock.

Senator KENNEDY. What could you do for them?

Mr. FUJITA. There is not much you can do for them actually at that time. You yourself are flabbergasted. You are just too excited, or you just do not know what happened. You do not know if they were burned. The explosion ripped their skin off.

Senator KENNEDY. So, after a few hours you tried to go home; is that right?

Mr. FUJITA. Yes, I did.

Senator KENNEDY. Would you describe your walk home.

Mr. FUJITA. At that time, of the explosion, we were living at my mother's uncle's house, which was quite a few miles away from Hiroshima. And in order to get there, I had to cross the river that we have in Hiroshima. There is five rivers in Hiroshima at that time. It was a delta. And because of the casualties, because of the injured people on the streets, on the bridges, there was no way in the world that you can even walk to the dead people or the casualties. The horses are dead. The trucks are turned over. So, we

decided to cross from river to river. And when you are crossing the river, you can feel these bodies floating down the river, bumping into you.

There was one scene that I still remember very well. This mother, her legs were so—she must have got hit or cut, and she had this—her two children, and they were burned about 80 percent of their body. And this little girl just kept on screaming, "Please kill me. Please kill me. I cannot stand the pain." And I really did want to go there and kill that child. I just—it comes back to me very clear. And there is thousands of people like that just all over, no matter which way you turn. That's when I thought, "Gee, if this is mankind, I came in the wrong era."

Senator KENNEDY. The next day, you and your mother went into the city to look for your father; is that right?

Mr. FUJITA. Yes, we did.

Senator KENNEDY. And what did you see?

Mr. FUJITA. Just about exactly what I saw the previous day.

Senator KENNEDY. Was there any adequate medical care available for the injured?

Mr. FUJITA. None at all, I would say.

Senator KENNEDY. Where did you get your food?

Mr. FUJITA. There was no food at all. There was no—what you can bring from home is what was your food.

Senator KENNEDY. Ms. Garnett, where were you born?

Ms. GARNETT. I was born in Los Angeles, Calif.

Senator KENNEDY. And then I understand you traveled——

Ms. GARNETT. I beg your pardon, sir?

Senator KENNEDY [continuing] To Hiroshima in 1941; is that correct?

Ms. GARNETT. That is correct. In 1941, my younger brother and myself were sent to Japan to visit my grandparents. And the war broke out on December 6. As a result, I was stranded there. One thing I would like to say is the devastating, horrifying experience that I have had, I have not been able to even talk about this until about 2 years ago.

Senator KENNEDY. We appreciate very much your willingness to share these thoughts with us. I tried to outline very briefly in my opening comment what the purposes for this hearing would be. I had an opportunity myself to visit Hiroshima a few years ago—1978, January 1978—to visit the museum there and also the medical center. And I think you understand the broader purposes for which this hearing is held, and we want to just tell you how much we appreciate your willingness to recount these nightmares because I do think that it is important for us to view the human aspects of policy decisions.

Ms. GARNETT. It is for our future children and children's children.

Senator KENNEDY. That is right. And it is in that spirit that we have asked you to share what I am sure are very, very difficult memories in very sad and tragic times. And we are very, very grateful to all of you. We thank you for it.

Do you remember the morning of the bombing itself?

Ms. GARNETT. Yes.

Senator KENNEDY. Maybe you can tell us a little bit about it.

Ms. GARNETT. I lived—we lived about 500 or 600 meters from the bomb centers where my grandparents and my brother and myself lived. That morning, as Gene says, I was a freshman or sophomore in high school and was sent out to help the war, I suppose. And I was working in a paper factory. I am told that when the bomb dropped, I was about 1.7 kilometers away from the bomb. The first thing I remember that morning is we were out in this school yard for assembly. I looked up—I heard the airplane. I saw one airplane just above my head. The next thing I knew, there was a flash. I took cover to the ground. And the next feeling I had was a tremendous pressure, like a Mack truck would be running over me. The next instance, I suppose because of the explosion, the hot air that I breathed in was so hot I thought I would die. With that hot air, with the force of it, I was thrown across the school yard. The next thing I knew was one of my schoolmates was calling to me. So, apparently I was unconscious. I got up, looked at myself, several—many, many glass cuts. And the next thing I knew was we were right in the middle of a black tarry rain. And, as I understand it, that was the radioactive rain that came down. From there I think our school teacher led us to an evacuation point, a little—maybe 1 mile away from the—where I was located. I rested there. And knowing that my grandparents and my younger brother were in the city, people tried to stop me. However, I did try to go back into the city. The intense heat itself—of course, I could not go through the city. But I started going around the outskirts of the city. And I recall very clearly people dead, just standing. And you would think they were alive with their standing. And they are just char burned. People on bicycles in upright position, frozen and dead.

Also at the time I saw another person removing the dead body and riding off on the bicycle, which I thought was inhumane. But when I think about it now, it is a matter of survival and makes sense.

Went through the burning city. I remember the intense heat. Large pine trees completely on fire. And with the velocity or the wind that the fire creates, this tree was uprooted, flew into the sky about 500 feet, and then it would drop where people are running or congregating.

I finally arrived to a prearranged destination point for my family where we were supposed to meet in case of an emergency about 11 o'clock that night.

Senator KENNEDY. That was going to be in a small town just outside of——

Ms. GARNETT. That is right.

Senator KENNEDY [continuing]. Hiroshima?

Ms. GARNETT. Yes; and I think it was about 11 o'clock at night when I got there and, you know, and was there. So, I washed the only clothing that I had, washed it or rinsed it, hung it on the clothesline, went to bed, close to 5 o'clock in the morning woke up and put on the still damp clothes and went back into the city, looking for my grandparents and my younger brother. This went on for 3 weeks. I turned every dead body or people who were burned and were unable to move. I remember taking a—the Japanese people are very fond of sour plum, especially when you are

sick or running a high temperature. And I would actually steal it from an aunt's house and take some of that.

The city itself was completely flat.

Senator KENNEDY. Did you have any radiation sickness?

Ms. GARNETT. Yes, I did.

Senator KENNEDY. What kind of symptoms did you have?

Ms. GARNETT. Nausea, vomiting, fever. I do not know. I was so hyper at the time, trying to find my family. I had—other than that, it was nausea, weight loss, hair loss.

Senator KENNEDY. You were by yourself, is that right?

Ms. GARNETT. I was by myself and as——

Senator KENNEDY. How old were you?

Ms. GARNETT. I was 13 years old.

Senator KENNEDY. This search that you were involved in went on for what, some 2 weeks?

Ms. GARNETT. Two or three weeks.

Senator KENNEDY. Two or three weeks.

Ms. GARNETT. That is correct.

Senator KENNEDY. Every day you would go out by yourself.

Ms. GARNETT. By myself. I remember looking up in the sky when the American planes would pass by. God, why did you leave me alone on this Earth? I knew nothing about my parents in the United States. So, I was actually totally alone.

Senator KENNEDY. Did you ever find any of your family members?

Ms. GARNETT. My younger brother I never found. I understand the night of the bombing, around 5 p.m., he was sitting under a telephone pole in front of the city hall, completely burned, begging for water. My grandparents—one of my friends told me to go back to where I used to live and look; "And if you find any greasy spots on the tile of the house, you would find the bodies." And I found my grandparents. I remember digging with my hands, pulling an arm. They were very decomposed. There was no way I could do anything about it. So, the next day I went back to Furchu. I borrowed my uncle's wheelbarrow, shovel, paper, burning wood. And I dug out the bodies of my grandparents. I burned them, cremated them. And the next day I went back and picked their bones.

My experience in Japan really was—another thing, as a child, they would—the Japanese Government would come over once every 2 weeks to see whether I was a spy or not. Of course the schoolmates would taunt me because I could not speak fluent Japanese. I dressed differently. It was just a sad, lonely, hungry, unhappy year.

Senator KENNEDY. Then you returned to the United States?

Ms. GARNETT. In 1947. That was the second ship that brought the Niseis back.

You had mentioned something about medical facilities and sanitation. As far as I recall, the city was in total chaos. There was no medical facilities, no medical care team. About the third day I recall the Red Cross came and distributed rice balls. That is about all.

Senator KENNEDY. Ms. Bundy, where were you born?

Ms. BUNDY. I was born in Hiroshima, Japan.

Senator KENNEDY. In where?

Ms. BUNDY. In Hiroshima.

Senator KENNEDY. And how old were you when the bomb was dropped?

Ms. BUNDY. I was 7 years old.

Senator KENNEDY. Could you describe for us where you were that morning when the bomb was dropped, you and your family, and what happened?

Ms. BUNDY. Yes, the day before the bomb was dropped, the shelter house was finished. It was a little bit farther from the main house and the store which my family owned. So, my mother encouraged my next older sister and I to move to the shelter house the night before. So, my mother and my sister and I were at the shelter house. That morning, around 7 o'clock we woke up and gathered up the wood shavings and trying to burn them and clean up around the house. That is when the bomb was dropped.

Senator KENNEDY. When the bomb was dropped, what did you do and your mother?

Ms. BUNDY. Well, I did not hear or I do not remember hearing any planes or seeing flashes or anything like that. But I must have been unconscious for a little while. And when I came to—and I was wrapped up in a smelly yellowish veil. And I heard my mother calling our names, "Esuko, Esuko." And then I was frantically calling my mother, "Mother, where are you?" And soon afterward I felt like a hot fire—fireball hit my neck, and I was very hot and all over the body. And my mother noticed we were kind of, you know, wounded. So, we decided to go to the elementary school, which was supposed to be the emergency case hospital. So, we started to walk across the field, and we noticed all the houses were flattened down and started fire. And we heard other people calling, "Help us. Help us." under the houses. And—but we must have been in a shock, and we did not feel like helping other people. We even passed the main house where my older sister was living, and we made a comment like "Oh, my sister, poor sister. She must be dead," you know.

But as we approached the school building, the intense fire kept us going farther on. It was kind of helpless. So, we turned around and then went back to the shelter house.

Senator KENNEDY. Were there other people on the streets when you were walking? Did you notice other people?

Ms. BUNDY. Yes.

Senator KENNEDY. What was their condition?

Ms. BUNDY. My shelter house was outskirt of the city. And we—as we got closer to the shelter house, we saw lines and lines of people. You know, their faces and bodies were burned and swollen; and their faces and bodies were cut and bloody. And we thought at first they were wearing ragged clothes. But we came closer to them, and they were not clothes at all. Skin, you know, hanging down from their bodies. And many of them did not have any hair, no clothes on their bodies.

Senator KENNEDY. And did you receive any medical care along the way?

Ms. BUNDY. No, none at all.

Senator KENNEDY. Or food?

Ms. BUNDY. No food. We were very thirsty. And many people were crying, begging for water. "Water, water," you know, they said. But my mother had some radishes. And she did not know what to do with a burn. So, she grated the radishes and put them on our burn.

Senator KENNEDY. You had some burns, did you not?

Ms. BUNDY. Yes, on my neck and hands and under my arm.

Senator KENNEDY. And you went out to the country some time later?

Ms. BUNDY. Right. I became unable to walk. So, one of our friends came, and he carried me on his back away, you know, for a long distance through the country.

Senator KENNEDY. And how far out to the country did you go?

Ms. BUNDY. I do not remember. Quite a way.

Senator KENNEDY. But do you remember that trip?

Ms. BUNDY. Yes. Yes. Well, along the streets, a little pass, lots of people were dead along that street.

Senator KENNEDY. A lot of people were——

Ms. BUNDY. Dead.

Senator KENNEDY. Dead along the street.

Ms. BUNDY. It looked like their eyes were wide open, and they were lying on their back and gazing at the sky, you know.

Senator KENNEDY. And you were how old at this time?

Ms. BUNDY. Seven years old.

Senator KENNEDY. Seven years old. It must have had a dramatic impact on any person, let alone on a child 7 years old.

Ms. BUNDY. Yes. It was kind of a nightmarish experience for me because physical effects, you know, were bad enough. It is very painful. It took a long time for the burn to get healed. But the psychological effects, I think I would like to mention, is I think more, you know, worse than physical aspects.

Senator KENNEDY. They remained with you for a long time, the psychological effects?

Ms. BUNDY. Yes, right. Just like Mrs. Garnett said, she could not even talk about this experience until recently. I could not mention about even Hiroshima to people or, you know, atomic bombs up to maybe 4 or 5 years ago because it gave me some tight feelings inside me.

Senator KENNEDY. I would like to ask Ms. Sasamori, if I could, please, about where you were. You lived in Hiroshima at the time; is that correct?

Ms. SASAMORI. Yes. I was born in Hiroshima City. And I was the same age as Mrs. Garnett, 13 years old, at the time.

Senator KENNEDY. Do you remember the morning when the bomb was dropped?

Ms. SASAMORI. Yes. At that particular morning, I was a student, a young student sent to city to work, helping city people. And at the time Hiroshima City had make wide road so evacuate the houses and broken houses. We as student helping cleaning up the streets. And that morning I was going to the working place with my classmates. And I heard the airplane, and I look up, and I saw that something dropped from the plane.

Senator KENNEDY. You saw the plane and what might have appeared to be the bomb as well——

Ms. SASAMORI. Yes.

Senator KENNEDY [continuing]. Being dropped?

Ms. SASAMORI. And I told my friend to look up. And the airplane dropped something. And at the same time I felt strong wind and strong light, and I felt knocking down. Then I might have an unconscious, but I do not know. I do not remember how long. But when I realize, I just run. Suddenly I was sort of in a big fire, red, grey, dark. I cannot see anything. Then a few minutes—I do not—I cannot say the time, how long it took. I was just—then pretty soon those colored going away, and I can able to see around. First, I remembered seeing surrounding me was like a different world, completely changed, sort of a hell. I cannot describe, explain to you how it looked like. The people was not like a people. People more like a monster or—I never see such a horrible looks in people. And I was so shocked, I could not understand what happened. And I knew somehow the bomb that—even I knew the bomb had dropped, but it looked so much different than the ordinary bomb that people heard. And all the city is flat. And people start walking toward the river. So, I followed them. And so many people came to the river and push each other then into the water, and many people drowned. I almost drowned myself. So, I was scared to move away from the water. And very hard to explain how——

Senator KENNEDY. That is right. You have done a very good job. You received some burns too, did you not?

Ms. SASAMORI. Yes. Because I look up to the airplane and I burned my face and the neck and burned the hand, then chest. I think one-half of my body is burned.

Senator KENNEDY. Just after the explosion, you were down next to the river; is that correct?

Ms. SASAMORI. Yes.

Senator KENNEDY. How long did you stay next to the river?

Ms. SASAMORI. Probably 5 or 10 minutes. I could not tell you the time because I was so shocked, and very difficult to describe how long or what precisely.

Senator KENNEDY. Yes. Where did your parents find you?

Ms. SASAMORI. Yes. My mother was looking for me every day. And the fourth day after the bomb dropped somebody told——

Senator KENNEDY. How many days after the bomb dropped?

Ms. SASAMORI. Fourth.

Senator KENNEDY. Fourth day after the bomb dropped. Where were you then, or where had you been from the time the bomb dropped to the fourth day?

Ms. SASAMORI. I was at the mountain, which will be about a mile and a half away the center of the bomb dropped. I was bombed less than a mile.

Senator KENNEDY. Right.

Ms. SASAMORI. But I must have walked to far away, get away from center.

Senator KENNEDY. And you stayed there, did you?

Ms. SASAMORI. Yes.

Senator KENNEDY. For 4 days?

Ms. SASAMORI. Yes. Then my parents find me. That was a miracle.

Senator KENNEDY. What were you doing then? Were you in a hospital, or were you outside, or were you sitting or what?

Ms. SASAMORI. No, no. Probably I was sitting outside. Then somebody must have bring into the building. And I do not know exactly what the building look like.

Senator KENNEDY. But you were more or less in a daze, were you, during this——

Ms. SASAMORI. No. No. I remember it took me a long time to get the place, just following people. I did not have no intention to go anywhere because so mixed up and confusing and no direction or whatever. I could not find it, my home and anything. So, I just followed the people. And I got to the place which about a mile and a half away from the center. And I sat down. I could not walk anymore. And at that time I remember about evening. It was getting dark. Then after that, I was just in a dream, just asking people to give me water, and also tell the peoples my parents' address and the names and that—ask them that—I am here, so give message. That message got to my parents.

Senator KENNEDY. What happened when your parents came?

Ms. SASAMORI. In that time, the first time a doctor gave to me injection on my chest. I never forget that painful injection. Then they bring back me to the house. Fortunately my father's house was not completely struck down. So, they can able to care for me at my house.

Senator KENNEDY. Did your father have difficulty in recognizing you when you were brought home?

Ms. SASAMORI. Well, after I healed, my mother told me when she—they was not sure that was me. All they know is some young girl in the same town and asking the help. So, my father said, "Anybody's child this town, from this town, we had better go get her." Then they came. And naturally my mother calling my name, and I answered it. And that was really like a coincidence and a miracle. Then my mother told me, first she saw me was, she could not see which side, way my face was because of burn and black and puffed up. So, first my father did is cut all my hair, then cut my face skin and peel the skin. And it was—they find it was like a cream puff, yellow stuff underneath. And so my mother put soybean oil all over face and hands, whatever the burn, that way took care of me.

Senator KENNEDY. Have you needed a good deal of medical care since that time?

Ms. SASAMORI. Well, not for the treatment to heal. I was fortunate—I survived in about a month—it took me a month and a half to be healed. But I had a plastic surgery operation which I had 10 years after the bomb, in Tokyo. Then after the operation in Tokyo, I came here, Mount Sinai Hospital, New York City. I had nine operations in plastic surgery.

Senator KENNEDY. Nine operations.

Ms. SASAMORI. In the United States. And in Tokyo I had 36 operations.

Senator KENNEDY. Thirty-six operations in all.

Let me, if I could, just ask each of the panel members a final question. Maybe I will start with you, Ms. Sasamori.

Ms. SASAMORI. Oh.

Senator KENNEDY. And that is, now that you look back on this tragedy, what kind of advice do you have? What kind of feelings can you share? What kind of observations can you make? As I mentioned at the outset of this hearing, we talk about weapon systems and the size of weapon systems and numbers of weapons. And so much of the discussion and dialog and debate of figures are on numbers and statistics. And I think all of you shared with us this morning one of the greatest nightmares that have ever been experienced by any human beings in the course of civilization. And I am just wondering, as human beings, the sense that you have about responsibilities that all of us have to try and avoid this kind of situation for future 7-year-olds or 13-year-olds, for humanity itself. What kind of comment could you make to us that you would like us to hear regarding this experience?

Ms. SASAMORI. Yes. I feel very strong about why I survived because I—many people die. And I feel I have a mission to survive, to tell the people never happen again. And if I can share my experience, to tell the people how horrible it is. And that is my mission. And then what I feel is here is a very innocent children, and we did not know anything about war and we have suffered all our life. And even death and alive. And many people still suffer in Hiroshima and many other place who have victims. And so many people forget the war and stuff. And I feel next generations, especially young children to come to this world and hell of a world is—we feel responsible to not happened again. And I fear for them to—hell of a world. So, the tragedy is human mistakes. Human makes tragedies. We can helps. But sometimes we can help the tragedy like an earthquake and tornado and driver's accident. But things like a bombing in war we can help. So, I know that I am a little person to say like this. But if I can scream and other people scream and many people start screaming at each other, I hope everybody hear this and understanding because I trust, I believe everybody have good heart and everybody wants to be care each other, and we are God's children. So, we should be like a God's children and loves and cares each other. And many people ask me, "Are you angry about Americans?" I do not. Americans—and you Americans—you did not hurt me. This is a war. So, I do not want to make American people guilty or anything. I want the American people to help us and help each other, not just helping us, help each other. You are all children and next door neighbors. And we should have to remember what the God want us, love and care. That is how I feel.

Senator KENNEDY. That is very powerful, a very lovely message.

Ms. SASAMORI. Thank you.

Senator KENNEDY. Ms. Bundy.

Ms. BUNDY. I feel we are very blessed now. You know, we have got plenty of foods, plenty of clothing, nice shelters. And we have got energies and strength. But this can change in 1 minute if a bomb like that or a bigger bomb will be dropped. And I would like to tell American people—well, the blast killed, I hear, 200,000 people to 250,000 people on the spot and later on. And it has that kind of effect, one small bomb like the one that dropped over Hiroshima. But nowadays I hear bigger bomb, hundreds of times stronger bomb both America and Russia have. So, on the grave at the Peace Park—maybe, Senator Kennedy, you have read the pre-

scription—it says, "Sleep in peace. We shall never repeat the mistake again." I think that is something we can help, with the help of God.

Senator KENNEDY. Thank you. Ms. Garnett.

Ms. GARNETT. Well, the atomic nuclear war, from my experience as a child, it was very horrifying. I can just imagine if another one was dropped, probably the whole east coast, west coast would be wiped out. My wish is that that would not happen. Not only physically, the people that were in the Hiroshima bombing were affected psychologically so much that my wish is try not to have—you know, if you can negotiate, negotiate between nations with trust, and I mean "trust" with quote. We trust them, you know. They have to trust us. That is about all.

Senator KENNEDY. Good. That is fine. Mr. Fujita.

Mr. FUJITA. It really scares the hell out of me to see a bomb even being made when you see the suffering of the common people. It is unbelievable what a bomb can do, atomic bomb, when a city with half a million people can practically be wiped out and the suffering that goes with it. There must be a better way to keep peace in this world. We have got to find a way. Thank you.

Senator KENNEDY. Those were very eloquent comments by individuals who have an insight into tragedies and disasters of atomic warfare. And it is something which, as I mentioned earlier, is certainly not realized nearly to the extent that I think should be. You hear many people talking today of winnable nuclear wars, tossing figures and statistics and theories around like it was just a chess game. And I think when you realize the magnitude of the bomb that dropped on Hiroshima was 12 kilotons or 12½ kilotons and now we are talking about thousands of megatons—we will hear more about that in the course of our hearing.

But you have described very well a very tragic situation, but one which we have to face up to. We cannot ignore it. I want to thank you all very much for your appearance here. I hope you will be able to remain with us during the course of the hearing. There is a film. And we are going to see a film now that has been supplied to us by the Arms Control Agency and filmed by Columbia University students. In the film there are words that are spoken by an actress which are the actual words of one of our witnesses today, Ms. Sasamori. So, if we could have the lights go out, we will get started.

[A film was shown from 11 to 11:15 a.m.]

Senator KENNEDY. If we could have the lights turned back on—thank you. I want to say just a very brief word. I want to thank our witnesses. And I am sure that this film brings back many different memories. I am sure it has not been an easy 12 or 15 minutes for any of them. But I want to express my very sincere appreciation to them again for their presence here today and for describing in their own words the horror of that particular occasion.

There is one fact which I think is so incredibly clear and should be incredibly clear to all Americans and all people across the world. And that is there are no winners in a nuclear exchange of an atomic war. There are no winners. There are only losers. And with a nuclear exchange, a nuclear war, a limited nuclear war, civilization as we know it will be ended. This country as we know it

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will be effectively demolished. Life as we know it will be finished. And there should be no misunderstanding of that fact. And I think it is incredibly important for the American people and for those who seek to serve them in positions of public trust to recognize that although on the one hand we have an important and fundamental responsibility to remain strong and to preserve the security, the interests of the American people—and we have that responsibility—that there is no greater responsibility for public officials than to move us away from the dangers of the nuclear arms race and the possibilities of nuclear confrontation and nuclear war. That arms race continues. And I think all of us are going to have to consider that when history looks back over this current period in which we all live at this time, that we are going to be put to the test by historians, I believe, about whether those who hold positions of responsibility have been as tireless as they could have been to move the possibility of confrontation and escalation and even perhaps mistakes as a result of the proliferation of nuclear weaponry across the landscape of nations in the world today. Have we been as tireless in reducing that possibility and have we been as constant in our determination to try and reduce that danger as we should have been? Or have we been tied up with the symbols of foreign policy and elements of foreign policy which just pale into insignificance and consequence when we consider the long-term historical responsibility that is unique to this Nation, certainly unique to the Soviet Union, unique to the other nations of the world which have the capability and the capacity for this kind of destruction. They, too, cannot escape their responsibilities. But we certainly cannot escape ours. And I want to thank all of you for your willingness to be with us today and make this presentation and share this time with our committee.

We will I guess just recess for 2 minutes while we just move the film out and change our witnesses. We want to thank you all very much again. Thank you very much.

[A recess was taken from 11:20 to 11:23 a.m.]

Senator KENNEDY. We will be back in order, if we could, please. We will now hear from Dr. Stuart Finch, chief of the Department of Medicine, the Cooper Medical Center in Camden, N.J., who will describe the short- and long-term health effects on the Japanese populations. And then we will hear from a panel of three scientists who will describe the destruction and short- and long-term health effects that would be expected in a hypothetical nuclear attack on Washington, Chicago, and San Francisco. And they will include Dr. Conrad, who is the Deputy Director of Science and Technology, Defense Nuclear Agency; Jack Geiger, professor of community medicine, City College of New York, an old friend of this committee; Howard Hiatt, dean of the School of Public Health, Harvard University. And I would especially like to thank Dr. Geiger and Dr. Hiatt for being with us today. Both have been extremely helpful to this committee over the period of years in a wide range of health policy matters.

We will have a little order now, please, because the witnesses are entitled to be heard. Would everyone take their seats, please, so we can hear from the witnesses.

Dr. Finch, I am glad to have a chance of seeing you again. We had an opportunity to meet you in Hiroshima in 1978. We visited the city and spoke at the university there about nuclear proliferation and also went up and visited the medical center there and spent some time with you and with the medical staff. And we welcome very much your presence here today. We understand you have some statements. What we would like to do, if we could, is move right into the question period, if that was agreeable with you. Respond in whichever way you would like to.

I want to welcome Senator Pell to the hearing.

Could you tell us, Dr. Finch, what the short-term causes of death were in Hiroshima and Nagasaki? Roughly how many people died in each case?

STATEMENTS OF STUART C. FINCH, M.D., CHIEF, DEPARTMENT OF MEDICINE, COOPER MEDICAL CENTER; EDWARD E. CONRAD, PH. D., DEPUTY DIRECTOR, SCIENCE AND TECHNOLOGY, DEFENSE NUCLEAR AGENCY; H. JACK GEIGER, M.D., LOGAN PROFESSOR OF COMMUNITY MEDICINE, CITY COLLEGE OF NEW YORK; AND HOWARD HIATT, M.D., DEAN, SCHOOL OF PUBLIC HEALTH, HARVARD UNIVERSITY

Dr. FINCH. I think on my second chart it illustrates the points that have been made here this morning, illustrated in the film and by the previous witnesses, that during the early acute phase of a radiation injury, the three major causes of death are thermal, the first, the flash burns which occur very quickly, almost instantaneously, and, second, the flame thermal burns which occur beneath areas of clothing which may be on fire. But these occur very, very quickly. Second, there are the mechanical or blast injuries and deaths which occur and, third, the radiation, acute radiation syndrome, which is essentially divided into two phases. The first 1 or 2 days when the acute radiation effects cause a great deal of swelling and damage to tissues and result in nausea, vomiting, loss of appetite, diarrhea, and during the next few weeks, sometimes after a short interval of well being, all of these many complications occur that were defined and described here today. They are principally due to severe damage to the bone marrow, to the intestinal tract, the rapidly turning tissues, so that individuals are extremely prone to develop infection due to a depression of the white blood count, ulceration of the intestinal tract, the bleeding which occurs in the skin and through the various orifices of the body and the epilation or hair loss, the three major radiation complications. Most of the deaths, 95 percent of the deaths that occurred during this early phase, in Hiroshima and Nagasaki, occurred within the first 20 days.

Senator KENNEDY. If the people survived beyond that 6 or 7 weeks, were they pretty much out of danger from the short-term radiation effects?

Dr. FINCH. Well, from the short-term radiation effects most individuals, after that period of time, survive. They had recovery but then were subject of course to the late radiation effects, most of which have occurred over the course of the last 30 years.

Senator KENNEDY. And would you describe those to us.

Dr. FINCH. The earliest changes that were described were the lesions in the lens of the eye, and these were in the form of cataracts or minimal cellular changes in the lens of the eye which have persisted. Certainly the most important late complication has been the occurrence of various types of cancer. And these are defined and illustrated on this chart, the first being leukemia. The overall leukemia rate in the heavily exposed people over the last 30 years has been increased around thirteenfold to fifteenfold. And the other tumors have been increased anywhere from a factor of two to five or six in the more heavily exposed populations.

The other effects are shown here as well. The children who were in their mothers' wombs were in utero and were heavily exposed, particularly during the first trimester of pregnancy. Many were born with small head size and an appreciable number of those with mental retardation. The children who were exposed, either in utero or during early life, experienced reduced growth and development.

And the other effect, which I think is very important to mention, are the chromosome aberrations of the cells of the peripheral blood. These represent damage to the cells which may be indicative of the damage to cells which has occurred and perhaps may be lingering in many cells in the body. But these are chromosomal abnormalities which may be related to the eventual occurrence of cancer.

Senator KENNEDY. We are talking in the area, for example, of leukemia about an increase rate of 13 to 15 times?

Dr. FINCH. That is about correct, over the 30-year period. The peak rates were in 1951 and 1952 when in the heavily exposed, the rates were about 40 times normal. But equated over a lifetime it is in the range of 13——

Senator KENNEDY. So, besides the obvious injuries that are experienced in terms of the blast, the continuing longterm health implications, adverse health implications in all of these areas that you have mentioned here—in leukemia, the 13 to 15 times higher rate, the thyroid, breast, lung, large bowel, myeloma—all of those have been significant percentage increases; is that correct?

Dr. FINCH. Yes, that is correct.

Senator KENNEDY. Plus the problems that we have faced with the retardation for those fetuses in utero, and that continues, and the increased frequency of chromosomal aberrations. In No. 5, what can you say about that now? Is that reflected now in the children of citizens?

Dr. FINCH. These chromosome aberrations do not reflect necessarily damage to genetic tissue.

Senator KENNEDY. The bombs available for use today are obviously far more powerful than the bombs of 1945. Is it fair to say that the long-term health effects in survivors of weapons of today would be significantly greater than those that were used in the period of 1945?

Dr. FINCH. I think that much depends on the quality of the radiation from the bombs. Gamma radiation, which is much like X-ray, is less damaging than neutron radiation. The Hiroshima bomb released more neutrons, and the effects generally have been more severe in Hiroshima than in Nagasaki. And I think one could extrapolate that to current weapons, depending on their type.

Senator KENNEDY. But you would say that the nature of the adverse health impact would be clearly greater today than it would be of the weapons that were used in that period?

Dr. FINCH. Well, it certainly would be in the sense that a great deal more radiation would be released, larger populations would be affected. The complications in individuals have been proportional to the amount of radiation received. And if individuals were adequately protected from the burn and blast effects but received radiation, we would expect a great many late radiation injuries, this type.

Senator KENNEDY. Dr. Conrad, do they have more neutron radiation? Or it depends upon the particular weapon systems? Can you tell us a little bit about that?

Dr. CONRAD. Yes, sir.

Senator KENNEDY. Just very briefly. What we are interested in is sort of the health implications here. You have heard his explanation that it depends on whether there is more neutron radiation in the weapon system or less. And is there more neutron radiation in the major weapon systems?

Dr. CONRAD. No, sir, there is proportionately less radiation.

Senator KENNEDY. Proportionately less, but total amount.

Dr. CONRAD. Totally there would be more.

Senator KENNEDY. I see. What about in terms of what you know about the Soviet Union? About the same?

Dr. CONRAD. It would be about the same.

Senator KENNEDY. So, it would be certainly more, but proportionately it has gone down; is that correct?

Dr. CONRAD. That is right.

Senator KENNEDY. Is there any way that you quantify that?

Dr. CONRAD. There is a better way to quantify it. For a weapon that is burst in the atmosphere, an air burst, it turns out that the larger the weapon, the greater the effects of blast and thermal relative to the nuclear radiation. And so if one considers very large weapons, the lethal radii for the blast and thermal effects would extend out further than that for the radiation. This is for a prompt effect. On the other hand, if the weapon is burst near the Earth's surface, there would be fallout, which of course would give delayed radiation exposure.

Dr. FINCH. I think, Senator, it should be emphasized that both Hiroshima and Nagasaki bombs were aerial bursts; so, there was relatively small ground contamination. So that the radiation which was received was almost instantaneous for the most part, whereas the type of detonation that was just described might have considerably more ground contamination than either of these bombs.

Senator KENNEDY. But we are talking—maybe just to summarize this point, if you can help us Dr. Finch—we are talking about 12½ kilotons. Now we are talking a thousand megatons in total bombs. We talked about the significance of the long-range health implications from 12½ kilotons. Is there any way that you can extrapolate in terms of the long-range health implications from the explosions of the megatonnage in language that people can try to sort of understand? We are back to statistics. But just give us some kind of idea. I think most parents understand what leukemia is all about. There is not a parent around that has not had it in their

neighborhood, children that have been affected by it. When they hear that there is a 12 to 15 times higher rate of leukemia, they think about their children. That is a very powerful message to them. They understand that, I think; most parents do. And what we are trying to do is lay this out in an understandable way for the citizens so that they will understand the human aspects of it. It is a complicated one, and what could you tell us about it?

Dr. FINCH. Well, it is not easy to quantitatively extrapolate from these data. But one can say that you would expect similar effects and probably of the same magnitude in relationship to the amount of radiation received. It would be very likely from current weapons that there would be appreciable fallout and that this, if extended over a large area, would greatly increase the number of radiation complications, which should be of the same general type that has been experienced in Hiroshima and Nagasaki.

Senator KENNEDY. Why don't we continue with the panel; Dr. Conrad?

Dr. CONRAD. Mr. Chairman, members of the committee, when a nuclear weapon is detonated in the lower atmosphere, it quickly forms a fireball that can grow to the dimensions of about 1 mile in diameter for a 1 megaton blast. To an observer at 50 miles——

Senator KENNEDY. Let us see if we can bring the mike up just a little closer. In this part of the discussion what we were trying to do is to walk through a hypothetical case history of a nuclear attack on Washington and Chicago and San Francisco. And we would hope that the witnesses would describe the area of destruction caused by a 1 megaton bomb striking each city and a second example of a 20 megaton bomb striking each city. And then we will try to get an understanding of the short- and long-range health effects of such attack and the capability of the medical care system to deal with the aftermath. And we thought with Dr. Conrad, if you could briefly explain how the bomb itself works and how it causes the widespread destruction. Then we will move ahead.

Dr. CONRAD. I mentioned the fireball that forms. To an observer at 50 miles distance from such a fireball it would indeed appear brighter than the Sun at high noon.

Consider a 1 megaton weapon fired over the city of Washington—for example, over the White House. We postulate an air burst, not a surface burst, because if a city were targeted, the attacker would want to spread the maximum damage over the greatest part of the city. For this 1 megaton detonation the inner circle on the map of Washington, at 1½ miles radius would represent an area of complete and total destruction. The next circle at 3 miles radius represents an area where only reinforced concrete buildings of the most robust type would be left standing. That corresponds to an overpressure of about 10 pounds per square inch.

[Information supplied follows:]

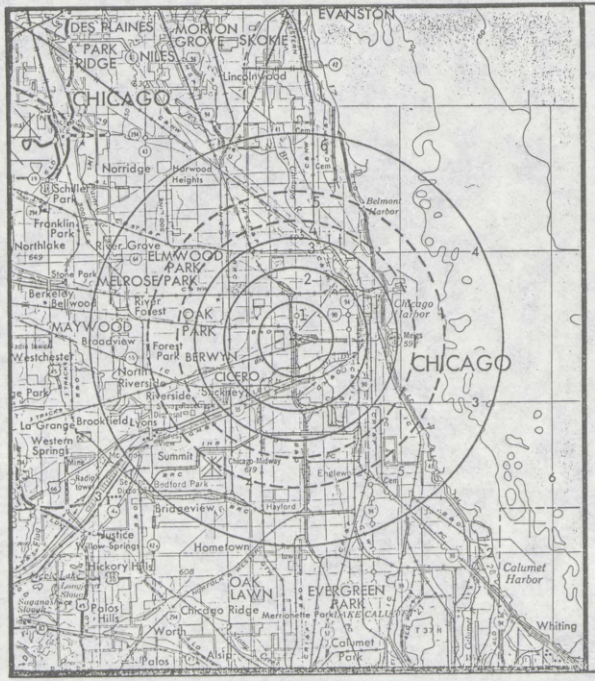
ONE MEGATON NUCLEAR WEAPON
Air Burst

Circle	Effects
6.	2 psi: Houses moderately damaged
5.	12 cal/cm^2: 3rd degree burns
4.	25 cal/cm^2: Spontaneous ignition
3.	5 psi: Houses destroyed
2.	10 psi: Masonry bldgs. destroyed
1.	20 psi: Reinforced concrete bldgs. destroyed
+	"Ground Zero"

5 0 5

STATUTE MILES

WASHINGTON, D.C.



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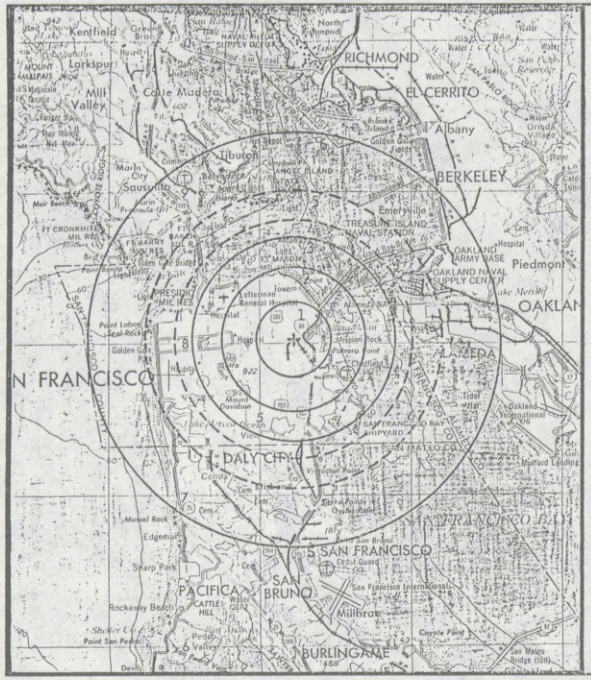
STATUTE MILES

CHICAGO

ILLINOIS



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5 0 5

STATUTE MILES

SAN FRANCISCO

CALIFORNIA

ONE MEGATON NUCLEAR WEAPONS
AIR BURST

Approximate Immediate Effects

NOTE: Each circle indicates an average range for the effects listed. Actual effects at a given range could vary considerably according to the weather, specific design of buildings, degree of exposure of individual people, and irregularities in weapon yield.

Circle #1 (Radius 1½ miles)

-- Overpressure 20 psi (pounds per square inch)
-- Winds 500 mph
-- Reinforced concrete buildings destroyed (office-type, multi-story steel framed/reinforced buildings)
-- Most people killed

Circle #2 (Radius 3 miles)

-- Overpressure 10 psi
-- Winds 300 mph
-- Stone and concrete buildings destroyed ("monument-type" wall-bearing buildings)
-- Exposed people critically burned if not killed

Circle #3 (Radius 4 miles)

-- Overpressure 5 psi
-- Winds 160 mph
-- Brick and wood frame houses destroyed
-- Exposed people seriously burned

Circle #4 (Radius 5 miles)

-- Spontaneous ignition of clothing, other combustibles
-- Likely complete burnout of area encircled

Circle #5 (Radius 6 miles)

-- Third-degree flash burns (charring) to all exposed skin

Circle #6 (Radius 8½ miles)

-- Overpressure 2 psi
-- Brick and frame houses moderately damaged (structure cracked, glass broken, inside walls knocked down, roofs partly torn off)
-- Second-degree flash burns (blisters) to exposed skin

Additional longer-lasting effects could result at various ranges from radioactive debris and dust, fallout, uncontrollable fires, and perhaps ozone depletion in the atmosphere that would let in damaging ultra-violet radiation from the sun.

Senator KENNEDY. Maybe you could tell us about what happens to people in those areas.

Dr. CONRAD. The people would be totally annihilated.

Senator KENNEDY. In which areas now? In which circle are they totally annihilated?

Dr. CONRAD. Within the first circle.

Senator KENNEDY. Within the first circle.

Dr. CONRAD. First circle. Within the second annulus there would be a heavy death rate, perhaps total annihilation.

Senator KENNEDY. Possibly total annihilation even within the second circle; is that right?

Dr. CONRAD. That is right. Now, as you move out to the third circle, the third black circle, the minimum overpressure is 5 pounds per square inch. Residential housing, normal single-family dwellings would collapse, or would be crushed. Obviously, many people would die in those structures as well.

Senator KENNEDY. This is how many times more powerful than the Hiroshima blast?

Dr. CONRAD. This is about 80 times more powerful than the Hiroshima bomb.

Senator KENNEDY. But it is the kind of weapon system that is now well within the arsenal of the Soviet Union——

Dr. CONRAD. Yes.

Senator KENNEDY [continuing]. As well as in the United States.

Dr. CONRAD. That is a weapon that is in the arsenal of the Soviet Union.

Senator KENNEDY. And the United States.

Dr. CONRAD. And the United States. Now, at a range of about 6 miles, 5 or 6 miles, there would be thermal effects, 24 calories per square centimeter. That is enough to ignite any combustible material. And at a distance of 8 miles from the center, exposed people would experience third-degree burns. The outermost circle, the black circle, corresponds to an overpressure of 2-pounds per square inch——

Senator KENNEDY. Yes, that is the beltway for local residents.

Dr. CONRAD. Yes, sir that is just about at the beltway. Here there would be moderate to light damage to housing. Walls could collapse and windows and doors would be blown out. To put this in perspective, if one were to move out to 12 miles or so from the center of the detonation—that is off the map—where there was 1 pound per square inch, a person standing by a window would suffer lethal effects from the 1 pound pressure causing the glass to shatter and impinge upon him.

Now, I can compare this with a 20 megaton weapon. We have an overlay for that. But in essence, the effect of going up to 20 megatons from 1 megaton is to move the lethal blast radii out by a factor of 2.7. So, there would be about seven times the area of damage for any one of the effects I have mentioned as there would be for the 1 megaton weapon.

If you like now, I can turn to the other cities and describe some of the effects on them. Well, before I leave, I might mention that Washington has a——

Senator KENNEDY. If this is a 20 megaton—is that correct, this is your 20 megaton?

Dr. CONRAD. Yes. The outer circle, the overlay is for 20 megatons.

Senator KENNEDY. What does that represent again? That would be the total annihilation; is that correct?

Dr. CONRAD. The total annihilation sector would move out——

Senator KENNEDY. That is correct.

Dr. CONRAD [continuing]. By a factor of 2.7 from what I showed for the 1 megaton.

Senator KENNEDY. Do you want to circle it just so we know? That is the total annihilation—that is correct—which goes to the beltway.

Dr. CONRAD. Now, for the 1 megaton case. Washington has a population of about 2½ million. It is estimated that about 1.4 million casualties would occur, about 800,000 people injured and 600,000 fatalities. That was for 1 megaton.

Now I would like to turn to the map on the far left.

Senator KENNEDY. Just before we go, what would Hiroshima look like if we had exploded the——

Dr. CONRAD. I have an overlay, if you will put that up, please. The blue circle represents the area covered by an overpressure of at least 2 pounds per square inch from the 12½ kiloton weapon that was dropped on Hiroshima. That would correspond to the circle at the beltway which represents the 2 pounds per square inch overpressure from a megaton. In other words, the relative distances are a factor of about 4, and the relative areas correspond to a factor of 16.

Senator KENNEDY. Do I understand the edge of the blue on this one then would represent the outerlimit with the 1 megaton; is that correct?

Dr. CONRAD. That is right. At the beltway.

Senator KENNEDY. That would be the beltway with the 1 megatonnage.

Dr. CONRAD. That is right, Senator.

Senator KENNEDY. And all those are squeezed down geometrically within that blue circle for the Hiroshima bomb?

Dr. CONRAD. That is right. Now I would like to turn to the map on the far left, the map of the city of Chicago. We have the same radii of effects because we are assuming the same sort of weapon. You can see that structures in the north such as Wrigley Field and in the south, the University of Chicago, would fall entirely within the damage region. Chicago has a population of 6.7 million people. The estimate is that 2½ million casualties would occur, about equally divided between fatalities and injuries. The center map represents a detonation over the center of San Francisco. And you can see that the range of damage extends up into Marin County, Sausalito, over to Berkeley, Oakland, Alameda, and down into South San Francisco. San Francisco has a population of 3.6 million people, and the estimate is there would be nine hundred and some-odd thousand casualties, 600,000 fatalities, and 300,000 injuries.

I might add, that the effects of the detonation depend on many factors——

Senator KENNEDY. Maybe just before you do that, could you do the 20 megatonnage on each of those other cities too in terms of

casualties?—because that is the predominant weapon of the Soviet Union.

Dr. CONRAD. No, sir, 20 megatons is not the predominant weapon. But of course we can put the graph on. I would estimate—we have not run the calculations for the 20 megaton for casualties. But I would——

Senator KENNEDY. Do you know the numbers of the 20 megatons that the Soviet Union has, warheads?

Dr. CONRAD. I have that information here. There are 100.

Senator KENNEDY. One hundred.

Dr. CONRAD. Yes.

Senator KENNEDY. That is a pretty good number, pretty high. Could you tell us for the 20 megatonnage—and if Dr. Shapiro would just go back up again—what the casualties would be in each one of those other cities, just so we can get that on the record? Then we will move on. Do you have those figures?

Dr. CONRAD. I do not have those figures, Senator. I could prepare them for the record. We have not done the calculations for that large a yield on the city.

Senator KENNEDY. The estimate that has been made by the Arms Control Agency is that the number of killed in the Washington area with a 20 megaton would be 2.3 million; number seriously injured, 2.5 million; and the percent of the population killed or injured, 99 percent.

In Chicago with the 20 megatonnage, 3.8 million killed; number of killed and seriously injured would be 5.3 million, which is 81 percent.

And San Francisco would be 1,500,000 killed; number killed and seriously injured 2.2 million which would be 63 percent of the total population.

Does that sound just generally, approximately right?

Dr. CONRAD. I cannot dispute those figures, and so I would accept them.

Senator KENNEDY. All right.

Dr. CONRAD. I merely wanted to add that the effects on the city are determined by many factors—the type of weapon that would be used, the height of burst, the terrain, and the actual effect on the population. Again, it is determined by the intent of an enemy, whether he would use a surface burst or an air burst. The weather would be an important factor, the time of year, the population density, and also whether it was night or day because if it happens in the daytime, the center of the city has a greater population. People have come in to work. They recede to the suburbs in the evening. It has been found that warning would make a great difference. If people have time to evacuate or to take cover, the figures could be cut in half. And of course if there were a civil defense program that was effective, the casualty rate could be cut to 25 percent of the estimates that I have given.

Those are the only formal remarks, sir, but I will be happy to answer questions.

Senator KENNEDY. Could you just briefly describe the number of warheads available both to the Soviet Union and the United States that would cause this level of destruction at this time?

Dr. CONRAD. According to an Office of Technology Assessment document, "The Effects of Nuclear War," the number of weapons possessed by the Soviet Union that are capable of this level of destruction are about 2,438 delivery systems. The total number of warheads are 8,294. Do you want to compare the number for the United States, Senator?

Senator KENNEDY. The 8,000 would be—what would be the minimum size?

Dr. CONRAD. Yes, sir, if we include the Backfire bomber, it goes up to 8,794.

Senator KENNEDY. What are the sizes in those 8,000 warheads of the megatonnage; are they at least one? Are they at least one megaton?

Dr. CONRAD. No, sir. Some are eight-tenths of a megaton, six-tenths of a megaton. There are some two-tenths of a megaton, 200 kilotons. There is a range.

Senator KENNEDY. There are some at 200 kilotons, and we were talking about 12½ kilotons for Hiroshima. That is one of the smaller ones, is that right?

Dr. CONRAD. That is right.

Senator KENNEDY. And that is still anywhere from 10 to 20 times the size of the Hiroshima.

Dr. CONRAD. Yes.

Senator KENNEDY. And then they have on the high side the estimate of at least 100 which are 20 megaton; am I correct?

Dr. CONRAD. Yes, 100.

Senator KENNEDY. Dr. Geiger and Dr. Hiatt, I would like to ask you if you would take just the next few minutes or so and describe what the short- and long-run health effects would be from the kinds of attacks described by Dr. Conrad. What kind of medical problems would be encountered? What kind of facilities would be needed to deal with them? What the state of the medical care system would be and how we could best cope with it.

Dr. GEIGER. Sir, I think the first thing that needs to be said in talking about medical effects or medical disaster plan calculations is that we are dealing with events that are absolutely unprecedented in human history. Nothing that we have heard this morning about Hiroshima or Nagasaki or seen in the film serves as a precedent for the events that we have just been hearing about or the casualty totals that we have just been hearing about. So, there is simply no prior human experience to draw on. We have never had the situation of several million people being killed in one place in periods of 11 to 30 seconds to 2 minutes.

The second thing that needs to be noted is that the casualty figures for these three cities from the Arms Control Agency are probably, if anything, significantly too low, for two reasons. One, as was mentioned, they are based on census populations. They presume that if a bomb of either megatonnage hit one of those three cities, that everybody is residing at home. In fact, the population densities at ground zero during the working day, one of the more probable times for an attack, would be substantially greater because of people commuting in to work. The kill rates, the total annihilation rates, and the injury rates would therefore be greater.

Second, and perhaps even more important for medical and disaster planning purposes, those figures do not account for the probability of firestorm or conflagration, mass fires secondary to explosions of this kind of megatonnage that can persist for 6 to 24 hours or more, create temperatures of 1,500° F. more, increase the lethal area fivefold. And what is most important about them, I think, is the experience of Hamburg and Dresden in World War II where such firestorms were created as well as at Hiroshima—in Hamburg and Dresden the only people who survived were those who fled the shelters early because otherwise, even with independent atmospheric supplies, which most of them do not have, they simply became crematoria for those who were in them. The survivors were those who risked radiation exposure and the other hazards outside in order to flee, in effect, before they cooked.

Now, the kinds of trauma that would be faced by any medical disaster planning are clear. We are talking about ruptured lungs. We are talking about ruptured internal organs. We are talking about ruptured eardrums and crushed skulls and bodies, and penetrating wounds of the skull and of chests and abdomens, every conceivable kind of trauma within the circles of damage that you have seen on the maps for 1 and 10 megatonnage. We are talking about significant amounts of blindness; a point that has not been mentioned is that a person 40 miles away making a reflex glance at the fireball would, if he looked directly at it, suffer retinal burns and be blinded. People in Milwaukee would be blinded by the Chicago fireball. People in Baltimore would be blinded by the Washington fireball. People in San Jose would be blinded by the San Francisco fireball.

Second, the thermal effects, all of those burns, second degree and third degree. We will hear more about them, I know, from Dr. Hiatt. And finally the radiation symptoms. And the most difficult problem about the radiation symptoms and the radiation sickness descriptions that you heard is that there is no way, in the early period of time, to separate those who have had lethal levels of radiation from those who have had sublethal levels of radiation and might survive, because their short-term symptoms are the same, and they will not know the exposures they have had. And any surviving physicians would simply not be able to accomplish that triage.

However, the mention of surviving physicians begins to get us to the realities of medical disaster planning. Eighteen years ago 12 of my colleagues and I calculated the effects of a 20 megaton nuclear weapons attack on Boston and calculated specifically the medical response. Our findings then, I think, are, if anything, pallid in relation to the circumstances today. We calculated that at least 25 percent of all the physicians would be killed immediately, and that is a significant underestimate because we did not allow for the fact that in all these major metropolitan areas, physicians are concentrated near the center. The same underestimate gives another 30 percent of the physicians incapacitated. It leaves a relative handful of physicians who may or may not know anything about burns, trauma, lacerations and the like, who are randomly distributed. We figured in Boston a number of years ago that perhaps 1,600 out of 6,000 physicians would be surviving and functioning at all, creat-

ing a ratio perhaps of one physician to every 1,700 injured surviving. And that does not account for or include all the rest of the population with pre-existing disease, nor for panic, nor for some of the other kinds of phenomena. If every such physician saw each patient with those complex injuries for only 15 minutes and worked for 16 hours a day, it would be from 16 to 26 days before everybody injured would be seen. And most would have died by that point in time. The blunt reality is that most of the injured survivors of any of these specified attacks would die without any medical attention, without even receiving narcotics for their pain, and that in effect the survivors will envy the dead.

Further, for physicians to do any of the kinds of things we are talking about—to treat trauma, to separate the seriously injured from the less seriously injured, to separate the lethally radiated from the less radiated—requires, of course, hospitals and complex equipment. They too are concentrated in the areas of highest lethality. And at least 60 percent of all the hospital beds in each of these metropolitan areas, perhaps a higher percentage of the tertiary care beds, would be destroyed even by a one megaton attack.

Now, to this scattering of medical resources and physicians, let us add that there would be no transportation systems, no communication systems, no electric power in most places, no X-rays, no water. Bridges and tunnels have collapsed. What is left of the buildings is lying in what is left of the streets, and both are unrecognizable. The problem of medical care becomes a metaphor for the general problem of both short- and long-term consequences of this kind of attack; that is, it becomes clear that it makes no sense to talk simply in terms of physical or biological survival. Human existence is social existence. Medical care is simply one example of a complex social enterprise that would be impossible under these circumstances.

If we moved on to the post-attack period, let me simply identify a few of the problems that would be faced then. The persisting problem of radiation sickness and the fact that the curve of death would be incrementally upward rather than, as most disasters, a curve of death that decreases over an appreciable period of time shortly after the attack.

Water: the average civilian in these cities now requires 50 to 150 gallons of water a day for all purposes. We would be fortunate in a post-attack period to have a quart of water a day. And the question of its radioactive or other contamination would be uncertain. The unavailability and the question of contamination of food and the rapid depletion of food stocks. The low resistance to infection, in addition to all these wounds, caused by radiation sickness. And the relative resistance of the insect vectors of disease to radiation. I can assure you that, relative to human beings in these three cities, the cockroaches will survive—and so will the flies and so will the mosquitoes and so will the other vectors of disease.

Let me add, finally, one other post-attack problem that has had relatively little attention but is clear from what has been said so far this morning. We calculated for Boston 18 years ago—and the figures would be the same at 20 megatons for these cities—that in the cities attacked and the surrounding areas of lethal fallout, there would be somewhere between 1 million and 2 million human

corpses. And one faces the problem, from the public health point of view—if one can call it that without straining logic—of how to dispose of two million human bodies. There is only one parallel that we could find. When U.S. Armed Forces entered Manila in 1944, they found 39,000 bodies of Japanese and Filipino soldiers. And it took them 8 weeks to dispose of that 39,000, as compared to the millions we are talking about here.

I think I would add two things in conclusion. First, that even if one hypothesized 3 or 4 days' warning time and mass evacuation of a city's population to deep blast shelters well beyond even the periphery of firestorm, and that the city as a physical entity, rather than the targeted population, were nevertheless bombed, there would be a high degree of physical and biological survival, but to what would those inhabitants return, in terms of capacity for organized human social existence? We concluded that any disaster plan, any medical response, would fail under most of these circumstances to prevent millions of deaths, millions of injuries in these three targeted cities; that to depend on such a disaster plan would be simply to take a vast and scientifically unsupportable gamble with human life. That conclusion is valid without considering the increases in magnitude from Hiroshima to now that are represented by the testimony today; that is without considering the effect of multiple strikes—that is, the possibility of these things happening at 9 in the morning and again at 2 in the afternoon and perhaps again at midnight, with multiple targeting of many cities. And it overlooks something that was true with Hiroshima and Nagasaki, which was that help was possible from outside. In a multiple megaton attack on major centers of the United States, in most of the likely scenarios there would be no "outside" to come in medically or otherwise and provide rescue.

Senator KENNEDY. Dr. Hiatt.

Dr. HIATT. Mr. Chairman, you have heard a description of the medical problems that would confront Washington, as an example, following the explosion of a 1-million ton bomb. It was suggested that 600,000 people of a population of 2½ million would be killed and 800,000 injured. These survivors would be badly burned; perhaps, on the basis of projections, as many as 25 percent badly burned, blinded, and otherwise seriously affected. Many, perhaps most, would be disoriented. Those are the short-term effects. We have heard about the problem of radiation sickness, both short term and long term. The population, therefore, is devastated. The survivors are in need of immediate medical care as well as food, shelter, clothing, and water. The communities in which they have lived have ceased to exist. The remaining food, water, and medical supplies, no matter how well stockpiled, would be dangerously inadequate.

But what of the medical response to such a disaster? In Hiroshima, 65 of the city's 150 doctors were killed in the bombing, and most of the survivors were wounded. It is estimated that some 10,000 wounded made their way to Hiroshima's 600-bed Red Cross hospital. There, only 6 doctors and 10 nurses were able to help them. John Hersey described the struggle of one of these physicians in words that were almost as eloquent as what we heard this morning:

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Dr. Sasaki realized that the casualties were pouring in from outdoors. There were so many that he began to pass up the lightly wounded. He decided that all he could hope to do was to stop people from bleeding to death. Before long, patients lay and crouched on the floors of the wards and the laboratories and all the other rooms and in the driveway and the courtyard and for blocks each way in the streets outside. Wounded people supported maimed people. Disfigured families leaned together. Many people were vomiting. The people in the suffocating crowd inside the hospital wept and cried for Dr. Sasaki to hear. And the less seriously wounded came and pulled at his sleeve and begged him to go to the aid of the worse wounded. Tugged here and there in his stocking feet, bewildered by the numbers, staggered by so much raw flesh, Dr. Sasaki lost all sense of profession and stopped working as a skillful surgeon and a sympathetic man. He became an automaton, mechanically wiping, daubing, winding—wiping, daubing, winding.

These were John Hersey's words.

What of Washington? Taking as our base the present estimate of 6,000 physicians in the metropolitan area and extrapolating from the casualties suffered by the general population, we may project that 1,500 doctors will be killed immediately and at least 1,000 seriously injured. Thus, 2,500 surviving physicians will be responsible for the care of 800,000 patients with grave wounds. In fact, as Dr. Geiger just indicated, it is likely that many, many fewer physicians will survive, for they are concentrated during working hours in an area close to the center of the blast.

Whether the postattack physician-to-patient ratio is 1 to 300 or 1 to 1,000, where will treatment take place? The bomb will reduce the number of hospital beds within the District alone, optimistically speaking, by more than 60 percent; and the amount of medical equipment and supplies are similarly inadequate.

Can the seriously injured be treated at George Washington University Hospital? It no longer exists. Georgetown University Hospital? It too has been destroyed. In ruins as well are Howard University Hospital, D.C. General, Capitol Hospital, and several others. The geographic distribution of surviving medical facilities will be another problem, some requiring physicians to enter more highly radioactive areas and thus expose themselves to greater personal danger in order to treat the injured.

With a decimated professional community, physical facilities largely in ruins, and a complete disruption of communication, the task of treating the wounded will be hopeless. Let me cite one reason for my pessimism by describing the case of a 20-year-old man who was hospitalized last week in the burn unit of Boston's Massachussetts General Hospital. As the result of an automobile accident in which the gas tank had exploded, he had suffered third degree burns over 90 percent of his body, the kind of problem at Hiroshima, that was described this morning, the kind of problem that would inevitably follow any nuclear attack. In the first 8 days of this man's hospitalization he required over 100 units of fresh frozen plasma, 40 units of fresh frozen red blood cells, and 12 units of platelets merely to compensate for losses from the burned areas. He has had five major surgical procedures, each requiring four surgeons, two anesthetists, and several nurses. He has already lost one leg since the peripheral parts of the body are more sensitive to the injuries following burn. And viability of his arms remains in question. He has been on a respirator constantly. And he has required highly specialized nursing care around the clock. Professionals and technicians in large numbers in other hospital departments have been constantly called upon. Although the Massachu-

setts General Hospital has 15 beds for the acute care of such burn victims, just to keep one such patient alive taxes the entire institution. Indeed, keeping that one patient alive to this point is a triumph of modern medicine. But it requires the extraordinary resources of one of the world's major medical centers. No amount of preparation could provide the human and physical resources required for the care of even a few such patients hospitalized simultaneously in any city of the Nation. Yet one must assume that at least tens of thousands of such casualties would result in Washington and in every other metropolitan center hit by a nuclear weapon. As Dr. Geiger has just pointed out, one cannot call on the resources from one center to another under these circumstances.

You may recall that a few years ago, following a plane crash in the Canary Islands, 50 burn victims were evacuated to the United States. Those 50 people taxed the resources of all of the major burn centers in this country. This is but one reason that it is futile, from my point of view, to suggest a meaningful medical response to the overwhelming health problems that would follow a nuclear attack. Further, only the most limited medical measures can be visualized to deal with the burden of cancer and genetic defects that would afflict survivors and future generations.

This morning's session has been stressful for all of us, I am sure. What purpose, one might wonder, to describe such almost unthinkable conditions? But these conditions are not unthinkable. Rather they are infrequently thought about. And among the results, the painful results of this silence, are the continuing proliferation of nuclear weapons and the failure to reject out of hand nuclear war as a viable option in the management of world problems.

I am grateful, Senator, to you and to your colleagues that you have undertaken to break the silence on this issue. There is of course no reason to consider the consequences of nuclear war in strictly medical terms. But if we do so, we must pay heed to the inescapable lesson of contemporary medicine. Where treatment of a given disease is ineffective or where costs are insupportable, attention must be given to prevention. Both conditions apply to the effects of nuclear war. Treatment programs would be virtually useless, and the cost would be staggering. Can any stronger arguments be marshaled for a preventive strategy?

But prevention of any epidemic requires an effective prescription. We are all for prevention of all of the illnesses that afflict man. But in the absence of an effective prescription, those wishes are not meaningful. The development of a prescription that will both prevent nuclear war and safeguard our security is a challenge that confronts all of us and particularly you, our political leaders. It is difficult for me, as a physician, to believe that any other challenge that is more urgent or more important to all Americans exists anywhere. Thank you.

[The prepared statement of Dr. Hiatt follows:]

STATEMENT BY

HOWARD H. HIATT, M.D.

BEFORE THE

SUBCOMMITTEE ON HEALTH AND SCIENTIFIC RESEARCH

OF THE

COMMITTEE ON HUMAN RESOURCES

UNITED STATES SENATE

NINETY-SIXTH CONGRESS

JUNE 19, 1980

Mr. Chairman and members of the Subcommittee on Health and Scientific Research:

I am grateful for the opportunity to appear before the Committee today, to discuss a topic of grave concern: the medical consequences of nuclear war. I am Howard H. Hiatt, Dean of the Harvard School of Public Health, an institution for which the prevention of disease is a primary goal, and also Professor of Medicine at the Harvard Medical School.

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Recent talk by public figures about winning or even surviving a nuclear war must reflect a widespread failure to appreciate a medical reality: any nuclear war would inevitably cause death, disease and suffering of epidemic proportions and effective medical interventions on any realistic scale would be impossible. This reality, in turn, leads to the same conclusion public health specialists have reached for such contemporary epidemics as those of lung cancer and heart disease: prevention is essential for effective control.

Little is said about the catastrophe of a nuclear attack, perhaps, because it is horrible to contemplate. Surely, little is said about medical intervention because so little that is hopeful can be said. And yet, our very silence permits or encourages the nuclear arms race to continue, making almost inevitable, either by design or by chance, what could be the last epidemic our civilization will know.

Much can be said, however. Two sources of information are available. The first are descriptions of the medical effects of the Hiroshima and Nagasaki bombs. The second are several recent and authoritative theoretical projections of the medical effects of bombing American --or Soviet-- cities toward which Soviet --or American-- nuclear weapons are now aimed.

The Hiroshima bomb, the explosive power of which was equivalent to 20,000 tons of TNT, is estimated to have killed 100,000 out of a total population of 245,000, 25% directly burned by the bomb, 50% from other injuries, and 20% as a result of radiation effects. It destroyed two-thirds of the 90,000 buildings within the city limits. Perhaps even more devastating than the statistics are the descriptions of individual victims. Consider this picture presented by John Hersey in his book, Hiroshima:

> "There were about 20 men...all in exactly the same nightmarish state: their faces were wholly burned, their eye sockets were hollow, the fluid from their melted eyes had run down their cheeks...their mouths were swollen, pus-covered wounds, which they could not bear to stretch enough to admit the spout of the teapot..."

A recent study, prepared by the U.S. Arms Control and Disarmament Agency, postulated a one-megaton bomb attack on Washington, D.C., and it is upon that source that these remarks are based.

The scenario which I shall present is, you must realize, conservative. While the one-million ton bomb involved in the attack is far more destructive that the Hiroshima and Nagasaki bombs, so, too, is it far less destructive than the largest contemporary weapons. And this hypothetical attack involves the detonation of only a single weapon, whereas contemporary military planning and technological capabilities make it far more likely that several weapons will be used in each attack.

Washington's trial by nuclear attack begins with the detonation of a one-megaton air burst bomb above the White House. The area of total destruction, the circle within which even the most heavily reinforced concrete structures do not survive, has a radius of 1.5 miles. That circle includes within it virtually every major monument, the heart of the city's subway system, and indeed, this very room. And within this circle, too, almost all of the population is killed.

At a distance of 3 miles from the White House, past the Arlington National Cemetery, concrete buildings are destroyed. The heat from the explosion and the spontaneous ignition of clothing cause third-degree flash burns over much of the body, killing most people in this area.

More than 4 miles from the center, brick and wood frame buildings are destroyed and fires caused by the intense heat are fanned by 160-mile per hour winds.

In a circle extending to Takoma Park, Hyattsville, and Suitland, brick and wood frame buildings sustain heavy damage. The heat exceeds 12 calories per square centimeter and all individuals with exposed skin suffer severe third-degree burns.

Nearly nine miles from the center, in McLean, Alexandria, and Bethesda, including the Walter Reed and Bethesda Naval Hospitals, brick and wood frame structures sustain moderate damage.

Miles beyond this last ring, people suffer second-degree burns on all exposed skin and additional burns from flammable clothing and environmental materials. Retinal burns resulting from looking at the fireball cause blindness. As high winds spread the fires caused by the initial blast and thermal radiation, the number of casualties grows.

If we assume a population for the metropolitan area of 2.5 million, one-quarter of the inhabitants --more than 600,000-- are killed. Even more --800,000-- are injured. Many of these survivors are badly burned, blinded, and otherwise seriously wounded. Many are disoriented. These are the short-term effects; the problem of radiation sickness, including intractable nausea, vomiting, bleeding, hair loss, severe infection, and often death, will grow in the days and weeks ahead and fallout from the bomb will spread well beyond the area of impact.

The population is devastated; many survivors are in need of immediate medical care, food, shelter, clothing and water. The communities in which they have lived have, in many cases, virtually ceased to exist as physical entities --and as social entities as well. Government is barely existent. The transportation system, including many roads, has been destroyed. Remaining food, water, and medical supplies are dangerously inadequate.

And what of the medical response to such a disaster? In Hiroshima, 65 of the city's 150 doctors were killed in the bombing and most of the survivors were wounded. Some 10,000 wounded made their way to Hiroshima's 600-bed Red Cross Hospital. There, only six doctors and 10 nurses were able to help them. John Hersey described the struggle of one of those physicians:

> "Dr. Sasaki...realized...that the casualties were pouring in from outdoors. There were so many that he began to pass up the lightly wounded; he decided that all he could hope to do was to stop people from bleeding to death. Before long patients lay and crouched on the floors of the wards and the laboratories and all the other rooms...and in the driveway and courtyard, and for blocks each way in the streets outside. Wounded people supported maimed people; disfigured families leaned together. Many people were vomiting...The people in the suffocating crowd inside the hospital wept and cried, for Dr. Sasaki to hear, 'Sensi! Doctor!' and the less seriously wounded came and pulled at his sleeve and begged him to go to the aid of the worse wounded. Tugged here and there in his stocking feet, bewildered by the numbers, staggered by so much raw flesh, Dr. Sasaki lost all sense of profession and stopped working as a skillful surgeon and a sympathetic man; he became an automaton, mechanically wiping, daubing, winding, wiping, daubing, winding."

And what of Washington? Taking as our base a figure of 6,000 physicians in the metropolitan area and extrapolating from the casualties suffered by the general population, we may project that 1,500 doctors will be killed immediately and some 2,000 will be seriously injured. Thus, 2,500 surviving physicians will be responsible for the care of 800,000 patients with grave wounds. It will take five sixteen-hour workdays for each of these patients to be visited once --for fifteen minutes.

In fact, it is likely that many fewer physicians will survive, for they are concentrated, during working hours, in an area close to the center of the blast. But whether the post-attack physician-to-patient ratio is 1:300 or 1:1000, where will treatment take place?

The bomb will reduce the number of hospital beds, within the District alone, by more than 60%, and the amount of medical equipment and supplies are similarly inadequate. Can the seriously injured be treated at George Washington University Hospital? It no longer exists. Georgetown University Hospital? It, too, has been destroyed. In ruins, as well, are Howard University Hospital, D.C. General, Capitol Hospital, and several others. The geographic distribution of surviving medical facilities will be another problem, some requiring physicians to enter more highly radioactive areas, and thus expose themselves to greater personal danger, in order to treat the injured.

With a decimated professional community, physical facilities largely in ruins, and a complete disruption of communications, the task of treating the wounded will be hopeless.

Let me cite one reason for my pessimism by describing the case of a 20 year old man who was hospitalized last week in the Burn Unit of Boston's Massachusetts General Hospital. As a result of an automobile accident in which the gas tank had exploded, he had suffered third-degree burns over 90% of his body --the kind of clinical problem that would be widespread as a result of a nuclear explosion. In the first 8 days of hospitalization, this patient needed 102 units of fresh frozen plasma, 42 units of fresh frozen red blood cells, and 12 units of platelets to compensate for losses from the burned areas. He had two 4-hour operations, each requiring 4 surgeons, 2 anesthetists, and several nurses. He was on a respirator constantly and required highly specialized nursing care around the clock. Many professionals and technicians in other hospital departments were constantly called upon.

While the Massachusetts General Hospital has 15 beds for the acute care of such burn victims, "just to keep one such patient alive taxes us," Dr. John Burke, the director of the Burn Unit, told me.

Indeed, keeping the one patient alive is a triumph of modern medicine. But it requires the extraordinary resources of one of the world's major medical centers. No amount of preparation could provide the human and physical resources required for the care of even a few such patients hospitalized simultaneously in any city of the nation. Yet one must assume that at least tens of thousands of such casualties would result in every metropolitan center hit by a nuclear weapon.

This is but one reason that it is futile to suggest a meaningful rapid medical response to the overwhelming health problems that would follow a nuclear attack. Further, only the most limited medical measures can be visualized to deal with the burden of cancer and genetic defects that would afflict survivors and future generations. With respect to temporary evacuation, radioactivity would make the blast area uninhabitable for months. Most of the area's water supply, sanitation resources and transportation and industrial capacity would be destroyed.

The preparation of these remarks was for me as stressful as their contemplation must be to you. What purpose, I wondered initially, to describe such almost unthinkable conditions. But

the conditions are not unthinkable; rather they are infrequently thought about. Among the painful results of the silence are the continuing proliferation of nuclear weapons and the failure to reject out-of-hand nuclear war as a "viable option" in the management of world problems.

I am grateful, Mr. Chairman, that you have undertaken to break the silence on this issue. There is, of course, no reason to consider the consequences of nuclear war in strictly medical terms. But if we do so, we must pay heed to the inescapable lesson of contemporary medicine: where treatment of a given disease is ineffective or where costs are insupportable, attention must be given to prevention. Both conditions apply to the effects of nuclear war --treatment programs would be virtually useless and the costs would be staggering. Can any stronger arguments be marshalled for a preventive strategy?

But prevention of any epidemic requires an effective prescription. The development of a prescription that will both prevent nuclear war and safeguard our security is a challenge that confronts all of us, and particularly our political leaders. Is there any other challenge that is more urgent or more important to all Americans and all people everywhere?

Senator PELL. Thank you very much, Dr. Hiatt and Dr. Geiger. I find your testimony very interesting and compelling. I think that this booklet put out by the Office of Technology Assessment, an organization which Senator Kennedy played a very real role in creating, does publicize the effects of nuclear war. And it is commended to the people who are following these proceedings because it digests some of the information that you have. And I noticed, Dr. Geiger, you reading some of its statistics. And Dr. Conrad has it there.

Senator Kennedy has been called to the floor on an urgent matter, and there is also a rollcall vote going on now. So, he has asked me to recess the committee, the subcommittee, until his return. But before he did so, I had a question of my own to ask. That is that in Switzerland they have a requirement that nobody can build a new building of any sort or kind in an urban area without adequate fallout shelter—a public building, parking garages are for that purpose. A private building, you cannot build a new house without having a fallout shelter in it. If the same blast occurred in Zurich, as opposed to Washington, what would be the relative savings of human lives as a result of the Swiss system?

Dr. CONRAD. Senator Pell, as I pointed out before, the hazard from huge weapons like these, from a radiation point of view, stems from the fallout capability. And it is for that reason that one would want to build some sort of shelter. Today we postulated bombs dropped directly on the city. But a more credible threat would be the bombs dropped on our counterforce, on our missiles, submarine, and air bases. And under such circumstances, one could have intensive fallout over the cities. In those circumstances it would be extremely valuable if people did have some sort of shelter, if one had the facility to survive in a basement with protection factors sufficient to reduce the radiation of the fallout by a factor of a hundred. He could make it where in other circumstances he would receive a lethal dose of radiation.

Dr. GEIGER. I think each of us are likely to give answers which will vary and reflect the complexities of interpreting hazard and response data. The greatest danger in discussing fallout shelters for cities, in my mind, is the false illusion—and an illusion of this kind on a very large scale was almost perpetrated on the American public in the early 1960's when everybody was urged to build fallout shelters, and there was almost a conspiracy of silence about blast and thermal effects which in any direct attack on cities, would kill far more millions of people than immediate radiation effects.

So, first of all, one has to be very clear that fallout shelters are by and large—especially the kind you talk about—protective only against radioactive fallout and that there may be many scenarios in which the kinds of trauma we saw this morning, blast and thermal, would be much more important.

Second, let me turn to questions of the counterforce exchange—missiles aimed at missile concentrations in silos and so on and not at target cities. In an exchange, which is a very realistic possibility that involves simply 5,000 megatons on each side, the recent calculations by physicists at Massachusetts Institute of Technology were

that there would be five million square miles of lethal fallout. That is an area the size of the United States.

Now, indeed, survivors outside the immediate blast and bomb effects could survive for some period of time during the decay of radioactivity in such shelters. The problem that is then faced is the organization of social and human existence, the probability of changes in the atmosphere, the contamination of food chains, the question very shortly of whether there would be an economy, whether there would be food, whether there would be crops, and whether there would be biological hazards that made life over a longer term unsupportable.

Dr. HIATT. I have nothing to add. I am in agreement with what I have heard, sir.

Senator PELL. Would any of you hazard a percentage? That is the figure I was really after. Zurich versus Washington: What percentage improvement in survivability would there be?

Dr. GEIGER. In an attack directly on the city?

Senator PELL. Yes.

Dr. GEIGER. I think it would be miniscule.

Senator PELL. Miniscule. Thank you. I thank you very much, indeed. I would like very much, as one member of the subcommittee, to commend the chairman for this hearing. I am chairman of the Arms Control Subcommittee, and we were thinking of having a similar hearing in July. But I think that we can probably utilize the material that this subcommittee will have produced in lieu of a hearing or certainly to make our hearing less comprehensive. I think it is a very good idea, indeed. And I am glad that this hearing has been held.

The subcommittee will now recess until the call of the chair, which should be a few minutes.

[The subcommittee stood in recess from 12:25 to 1:06 p.m.]

Senator KENNEDY. We will be back in session. I apologize to the witnesses. We had some matters on the Senate floor that needed attention. I know that Senator Pell had just inquired of our witnesses about the impact of civil defense efforts and how that would affect this kind of very grim picture which you outlined for us here today. You have given us so many different variables when the bombs went off, whether it was in daytime or nighttime and other kinds of conditions, atmospheric conditions and all of the rest of the factors. But I am just wondering if you could perhaps just review very briefly what your own impressions are of the impact of any kind of civil defense planning, what that would mean in enabling the medical community to cope with the kinds of problems after a nuclear war. How do we put that into some perspective?

Dr. GEIGER. Again, Senator, I think each of us will have slightly separate but, overall, consistent views. There is no question, I think it needs to be made clear at the outset, that in most of the scenarios we have talked about there will be survivors. There will be survivors of a nuclear war. I think that there are a variety of measures that could be taken. Each of them tends to be good only for one kind of scenario and not for another. It is like the question of fallout shelters which are ovens under some circumstances and effective protections in others. There are a variety of measures

which, under some circumstances, could increase the number of survivors—I do not know how to quantify that—by some amount.

The distinction that I think it is important to draw, and important for the public to understand, is the distinction between physical or biological survival and social survival, by which I mean really two things. I mean the possibility of organized human social existence anything remotely like the complex urban contemporary existence and lives we lead now. And I do not think survivability will in many instances include that. With the destruction of the physical infrastructure of cities, I think that would be impossible. That does not even go on to consider speculative questions that represent real but undeterminable dangers, like depletion of the ozone layer in the stratosphere by major nuclear exchange, with major consequences not only in terms of burns, skin cancers, and the like to human beings, but probably more important, to crop production and the whole question of how after a year or less or more, that order of magnitude, people will eat.

Now, the question whether one can specifically medically make an effective civil defense response seems to me, as somebody who has spent a lot of my professional career in medical care organization—although not specifically concerned with disasters—to depend almost entirely on the scenario one invents. If one invents scenarios which may or may not be realistic, which leave the possibility of an outside-of-impact areas in which there are physicians, other health workers, mobile kinds of equipment and personnel and they can safely, when radiation levels have dropped sufficiently, be brought in, there will be in afflicted areas some number of people whose recovery will be accomplished or facilitated or whose pain will be eased by that kind of medical intervention. I remain unconvinced of the efficacy of any kind of medical disaster or civil defense planning in the sense that it will have either much immediate impact or that it will be able to effect that longer term social survivability.

Senator KENNEDY. There are those that say this kind of nuclear exchange, nuclear wars are winnable and certainly survivable. I think you commented on what your view about the survivability would be for the population. I think that probably includes to some extent the issue about whether they are winnable. But there are those that say:

> Well, there would be a group that would survive and would start the rebuilding and reorganization and restructuring of our society. Look at the pasting the German cities took during World War II, and they were still able to have a remarkable industrial base and be able to function and work, and work effectively.

You do not give much weight to that argument, and I would like to hear Dr. Hiatt on it.

Dr. GEIGER. Senator, let me quote—I wanted to quote very briefly a passage that addresses that question directly from the Office of Technology report. And they say simply:

> What is clear is that from the day the survivors emerged from their fallout shelters, a kind of race for survival would begin. One side of the race would be the restoration of production—production of food, energy, clothing, of the means to repair damaged machinery, of goods that might be used for trade, even of military weapons and supplies. The other side of the race would be consumption of goods that had survived the attack and the wearing out of surviving machines. If production rose to the rate of consumption before the remaining stocks are exhausted, then viability has been achieved and economic recovery has begun. If not, then each

post-war year would see a lower level of economic activity than the year before, and the future of civilization itself in the nations attacked would be in doubt. The answer would lie in the effectiveness of post-war social and economic organization as much as in the amount of actual physical damage.

Senator KENNEDY. Dr. Hiatt.

Dr. HIATT. To answer your—or address your question, I cannot really answer it, Senator—I speak first as a physician concerned with the care of sick people. Most of the problem of the quality of life that would exist following such an episode of course would be largely nonmedical. But in terms of immediate response, I cited briefly during your absence on the floor an example described to me by a colleague who is head of the burn unit at one of the principal teaching hospitals in Boston. At the present time he is charged with the responsibility for the care of one patient, a 20-year-old boy who was in an automobile accident, 90 percent of whose body was burned when the gasoline tank of the car exploded. That boy is now, as of today, has been in the hospital 2 weeks. He has required in excess of 100 units of blood transfusions merely to stay alive. He has had five separate surgical procedures. He has lost, already lost—one of those procedures was to have a leg amputated. His arms are both in danger at the present time. All of the resources of this enormous institution and surrounding institutions—because this institution is able to borrow blood from the blood bank of the Red Cross and from other hospitals—all of the resources have been stressed in order to keep one patient alive.

We are talking about a series of episodes involving multiple American cities where not one in each city, but tens of thousands or hundreds of thousands of people would be confronted with this problem. In medical terms, it is just inconceivable to me that any kind of medical response could be mounted to the kind of suffering that we contemplate in response. And to cite precedents is, it seems to me, meaningless because one just takes the examples that you have just mentioned, Dresden and Hamburg, and multiplies them by literally the tens or the hundreds throughout the Nation and over a prolonged period of time.

The radiation effects that would follow—the effects on the cancer burden, on the genetic defects in the surviving population for those few that—for that fraction of the population that survived—again one can describe, but one can only guess about, because we have never had to contemplate it.

In the past where we have been confronted with epidemics that have been unmanageable—there was the plague in the 14th and 15th centuries where as much as 20 or 25 percent of populations were eliminated, or smallpox more recently or epidemics, contemporary epidemics, like cancer of the lung and heart disease. It is clear that our emphasis must be on prevention. To attempt to treat in piecemeal fashion problems that are just not treatable is an approach that seems to me, at a time when prevention gets as little attention as it has gotten, is an approach that seems to me not meaningful.

Senator KENNEDY. Thank you very much. I appreciate your presentation, enormously interesting and very valuable, very helpful to the committee. And I want to thank Dr. Finch very much as well for your presence. It is nice to see you again. And we will keep the record open if there are other members of the panel that have

questions, we will inquire of you. We want to thank you very much for your presence.

We have a final panel. William Chipman is Director of the Population Protection Division, Federal Emergency Management Agency; and Jacqueline Gleason, Director of the Division of Emergency Coordination, Office of the Assistant Secretary for Management and Budget, Department of Health and Human Services. They will testify on the current status of civil defense preparedness.

I want to welcome you here, Mr. Chipman. You have a map here and perhaps you would outline the high-risk areas for targets in case of nuclear attack. Would you like to describe to us how that map is drawn and how many millions of Americans live in those areas?

STATEMENTS OF WILLIAM K. CHIPMAN, DIRECTOR, POPULATION PROTECTION DIVISION, FEDERAL EMERGENCY MANAGEMENT AGENCY, AND JACQUELINE GLEASON, DIRECTOR, DIVISION OF EMERGENCY COORDINATION IN THE OFFICE OF THE ASSISTANT SECRETARY FOR MANAGEMENT AND BUDGET, DEPARTMENT OF HEALTH AND HUMAN RESOURCES, ACCOMPANIED BY PAUL KRUEGER, ASSISTANT ASSOCIATE DIRECTOR, RESOURCES PREPAREDNESS OFFICE, FEMA, AND HAROLD GRACEY, EMERGENCY COORDINATOR, PUBLIC HEALTH SERVICE

Mr. CHIPMAN. Yes, Senator. That map portrays the area which could be attacked in a very large scale nuclear attack upon this country. The large red areas you see in the High Plains—the Dakotas, Montana, and so forth—are intercontinental missile installations. There are nine of these in the country, all west of the Mississippi. The rest of the red areas include some 40 SAC bomber or tanker bases, 3 ballistic missile submarine ports—Charleston, S.C., Bremerton, Wash., and Kings Bay, Ga. And essentially the rest are 250 metropolitan areas, plus about 100 miscellaneous industrial or military areas as well. Now, in those red areas, Senator Kennedy, live approximately two-thirds of our population. They cover but a few percent of the land area, but they do include two-thirds of our population and at least that proportion of our industry.

Senator KENNEDY. I see. So, it is two-thirds of the population live in those areas; is that correct?

Mr. CHIPMAN. Yes, sir.

Senator KENNEDY. Is there a plan in effect for all of those sites at the present time?

Mr. CHIPMAN. A plan for evacuation during times of crisis?

Senator KENNEDY. Yes.

Mr. CHIPMAN. We have started, Senator, on planning—if a period of acute crisis arose—to evacuate people from these areas, to assist them to relocate elsewhere. One can see from the map—it is self-evident without making computer studies—that if most of these people are elsewhere, they will escape the blast and the heat effects of weapons and the horrible injuries and traumas that both the Japanese survivors and the physicians have been telling us about.

The planning was started about 3 years ago. We have been proceeding at a modest level but steadily. Plans have been completed for about 12 percent of the jurisdictions which will need them, and they cover on the order of 8 percent of the population.

Senator KENNEDY. Eight percent of the population.

Mr. CHIPMAN. So, a good start has been made, Senator, but there is a long way to go.

Senator KENNEDY. In 8 percent of the total national population there is a plan now for evacuation for those individuals; is that correct?

Mr. CHIPMAN. There are initial plans, yes.

Senator KENNEDY. What is your flow line in terms of covering the rest of the population?

Mr. CHIPMAN. The time?

Senator KENNEDY. Yes. How long is it going to take you to cover the two-thirds of the population that have been identified?

Mr. CHIPMAN. At the current level of effort, it would take perhaps a decade. I might say that the results of this kind of planning are instructions which can be published in time of crisis for the people—this one happens to be for Plattsburgh in northern New York and——

Senator KENNEDY. Do you have any for Massachusetts there?

Mr. CHIPMAN. I did not bring one with me, no. We may be able to provide one for the committee's file.

Senator KENNEDY. Do the short-term plans address the long-term needs for the days and weeks and months following an attack? We had in the earlier testimony a rather interesting analysis of what the health needs are for both the first 3 weeks and the post-3 week period. Do you take any consideration of that?

Mr. CHIPMAN. I might say that these plans address helping people to move away from the larger cities, to provide them temporary lodging and feeding in, shall we say, upstate New York or Vermont or the Shenandoah Valley, and to develop fallout protection during the crisis. This of course does not have a direct impact on medical problems, in terms of treatment or care. But it can have a quite significant, possibly profound, effect on the size of the problem. If most people could be evacuated during a crisis, you obviously—well, you are moving most of the medical professionals as well as the population at large to these lower risk areas.

Senator KENNEDY. How much notice do you need for that?

Mr. CHIPMAN. Sir?

Senator KENNEDY. How much notice do you need? How many minutes are you talking about?

Mr. CHIPMAN. A week would be desirable——

Senator KENNEDY. A week would be desirable.

Mr. CHIPMAN [continuing]. But we aim to have movement completed essentially in 3 days.

Senator KENNEDY. Three days.

Mr. CHIPMAN. And indeed the great bulk of it would be completed in less than that—perhaps 65 percent by the end of the first day, 85 percent by the end of the second day.

Senator KENNEDY. You need 3 days. How much can you really do, even with the plans that you have, for 80 percent of the population if we are talking about the 22 minutes, the 15 minutes

time that it takes, the 33 minutes, those 45-minute or less periods for the attacking of the major cities?

Mr. CHIPMAN. Senator Kennedy, if an attack occurs without warning—only tactical warning of minutes—all that one could do is to take cover. If we lie down on the floor of this room, we are substantially less vulnerable than if we are just sitting here. If we had a few minutes and went to the basement of this building, we would be still less vulnerable. But one cannot of course think of evacuating people from cities in a period of minutes.

On the other hand, the likelihood of having a number of days of warning is considered to be far greater than the possibility of an attack out of the blue. And one of the reasons for this is that the Soviets must—they have some blast shelters in their cities, but they must protect the bulk of their population by crisis evacuation. And that of course takes time. The intelligence community estimate that, "a week or so," would be required for them to evacuate the bulk of their urban population. And that would, of course, give us an opportunity to follow suit.

Senator KENNEDY. Of course that, I think, depends on the assumptions you have given here. We as a country now will continue to have our bombers that are flying virtually 24 hours a day because of the dangers of immediate attack. We have our submarines out and in position, prepared to respond to immediate attack. They have the roster list in the White House about who is going to evacuate over what period of time in x-minutes warning and the rest of these in fact. And your basis of assumption, as I would understand it, is that a rational set of decisions made by the Soviet Union that would give a countdown period about a nuclear launch in terms of the United States. And I suppose that there certainly are those that really wonder about how realistic that type of scenario would necessarily be because I would expect if we targeted any of their areas within the Soviet Union for a direct hit with our weapons, whatever they did, wherever they went, I doubt if there would be very much security for them either, would there?

Mr. CHIPMAN. The estimates that have been made by the intelligence community, Senator, are that if they had short warning, a matter of a few hours, then most of their leadership would survive. I am paraphrasing from a 1978 unclassified report by the Director of Central Intelligence. With a few hours of warning, the bulk of their leadership would survive and many communications and some key workers who have blast shelters near their factories. But to achieve high survival for their entire urban population, they would have to evacuate them to their rural or host areas; and that would take them upward to a week, to evacuate them and to develop fallout protection in these host areas. The difference, as I recall, was that they might experience casualties of some 100 million if they did not evacuate, as opposed to a few tens of millions if they did. One would think, therefore, that the probabilities would be much higher, that they would take that time.

Senator KENNEDY. Harold Brown on January 29 in his annual statement said, and I am quoting him:

> The Soviets will probably continue to emphasize the construction of urban blast sheltering. The actual percentage of the population that can be sheltered in cities of 25,000 people or more will increase. But the absolute number of people that will have to be evacuated will also increase because of the growth in the urban popula-

tion. During the same time, the continuing concentration of economic investment in previously existing plant sites, together with an absence of construction hardening techniques, suggest that a future attack on urban industrial targets would be about as destructive as now. Soviet leaders may continue to believe that civil defense contributes to war survival and war-fighting capabilities. But their uncertainties about its actual effectiveness will continue.

Which agency is responsible for the postattack health planning, emergency public health services in the country?

Mr. CHIPMAN. Well, as I say, while ours can rather substantially reduce the size of the problem by helping people to evacuate—more people surviving, fewer less people injured and, at the same time, many more phvsicians surviving—we are not directly responsible for health care and medical matters. That is the Department of Health and Human Services, formerly HEW. And I think Jacqueline Gleason is here today, Senator, to represent them.

[The prepared statement of Mr. Chipman follows:]

Statement by William K. Chipman
Director, Population Protection Division
Federal Emergency Management Agency

Hearings
Short- and Long-Term Health Effects on the Surviving
Population of a Nuclear War

Senate Committee on Labor and Human Resources
Subcommittee on Health and Scientific Research
Thursday, June 19, 1980

In this statement I shall outline those issues which the Federal Emergency Management Agency believes are germane to these hearings.

First, a word on FEMA's organization and responsibilities. The President, in recommending the creation of FEMA by Reorganization Plan No. 3 of 1978, established several important goals to be achieved by the new agency. These included:

(1) The consolidation of Federal authorities to anticipate, prepare for, and respond to major civil emergencies under the supervision of an official responsible to the President.

(2) The effective application of the concept that wherever possible, emergency responsibilities should be extensions of the regular missions of Federal agencies.

(3) The improved linkage of hazard mitigation programs with emergency preparedness and response functions.

(4) The increased effectiveness of a civil defense system designed to make the most effective use of all available emergency resources.

FEMA's authorities derive principally from the emergency-related programs and responsibilities of five agencies whose functions were merged into FEMA by the President's Reorganization Plan as approved by the Congress and implemented by Executive Orders 12127 of March 21, 1979, and 12148 of July 20, 1979.

Two of the predecessor agencies had responsibilities primarily in the area of national security. The Defense Civil Preparedness Agency was responsible for the civil defense program, and the Federal Preparedness Agency was responsible for a variety of programs including continuity of government and the development of plans and systems to manage resources and stabilize the economy in time of emergency, including policy guidance for stockpiling strategic materials.

Executive Order 12148 assigned to the Director of FEMA, John W. Macy, Jr., responsibilities formerly assigned to the Federal Preparedness Agency, concerning the emergency planning and preparedness functions of departments and agencies of the Federal Government. Mr. Macy is responsible to provide

guidance for, and to evaluate, the emergency planning and preparedness activities of the Federal departments and agencies.

The responsibilities of the departments and agencies are spelled out in Executive Order 11490, as amended. Thus, the Secretary of Agriculture is responsible to prepare national emergency plans and develop preparedness programs in areas including food resources, rural fire control, and rural defense education. The responsibilities of the Secretary of Health and Human Services relate to planning and preparedness in areas including health services, civilian health manpower, health resources, and welfare services.

In short, each department and agency has emergency planning and preparedness responsibilities which are extensions of its regular missions. FEMA coordinates and evaluates these activities.

Let me turn now to FEMA's programs in the area of civil defense. Policies for U.S. civil defense were enunciated in September 1978 by President Carter in Presidential Decision (PD) 41.

The PD-41 policies were based on an interagency study of issues related to U.S. civil defense, conducted between September 1977 and August 1978. The study looked not only at whether or not civil defense would make a difference in survival and recovery from nuclear war, but also at whether civil defense would play a role in a preattack crisis. Other studies examined in detail the feasibility, costs, and performance of alternative U.S. civil defense programs. The intelligence community also produced a report on the status of the Soviet civil defense program. These contributed to the analysis and conclusions of the inter-agency policy study.

The inter-agency policy study contained a range of options for a future civil defense program for the United States. These included: (1) essentially no program; (2) the program as it existed at that time; (3) a program providing for relocating (evacuating) the population of larger U.S. cities and other risk areas should time permit during a period of strategic warning resulting from an international crisis; and (4) a short warning time, in-place protection program including construction of blast shelters in our cities.

Each of the options was presented to the President with an evaluation of its potential effectiveness and associated costs. The resulting Presidential Decision (PD) 41 directed implementation of a new civil defense policy along the following lines:

- That the United States civil defense program should enhance the survivability of the American people and its leadership in the event of nuclear war, thereby improving the basis for eventual recovery;

- That the United States civil defense program should enhance deterrence and stability, and contribute to perceptions of the overall U.S./Soviet strategic balance and to crisis stability, and also reduce the possibility that the Soviets could coerce us in times of increased tension;

- That the policy not suggest any change in the U.S. policy of relying on strategic nuclear forces as the preponderant factor in maintaining deterrence; and

- That the program include planning for population relocation during times of international crisis as well as be adaptable to help deal with natural disasters and other peacetime emergencies.

Civil defense programs can make a great difference in the number of people who would survive a large-scale nuclear exchange, and in prospects for eventual postattack recovery. The means by which civil defense measures can reduce casualties are well understood and indeed are almost self-evident.

Consider, for example, the United States. A large-scale nuclear attack on both military and urban/industrial objectives could involve detonations on some or all of our metropolitan areas, as well as on some additional areas associated with miltiary or industrial installations.

It is possible, of course, that an attack might be less severe, involving only U.S. strategic nuclear offensive forces (ICBM complexes, SAC bases, and ballistic missile submarine ports). However, it is only prudent to assume -- as a basis for planning -- that some metropolitan areas might be attacked as well, for they contain much of our industry as well as a large portion of our population.

The "risk map" provided for the Subcommittee portrays such an attack. Most of the areas shown in red are our metropolitan areas. While they cover only a small percentage of the land area of the U.S., they contain about two-thirds of our population, some 140 million people.

There are two means for reducing the casualties that would be caused by nuclear attack. One is to provide shelter for the population. Inexpensive programs make use of the fallout (and limited blast) protection that is inherent in already existing structures. Expensive programs would provide high-quality blast shelter in cities, and fallout protection in non-metropolitan areas.

The second method for reducing casualties is to move people away from possible target areas over a period of several days during an acute crisis. It is evident that such "crisis relocation" (or evacuation) can substantially reduce the impact of a large-scale attack, particularly if fallout protection is developed for evacuees in "host" areas surrounding our larger cities.

A number of computer-assisted studies have confirmed the obvious. If people are protected in existing buildings in the cities, total survival in a large-scale attack such as the one shown on the map would approximate 40 percent, or some 90 million people. However, roughly one-third of the survivors would be injured or suffering radiation sickness.

If, on the other hand, the bulk of the people in our larger cities could be relocated to surrounding areas during an acute crisis, and if fallout protection were developed there, total survival could approximate 80 percent -- on the order of 180 million people. And more than six out of seven of the survivors would be uninjured, improving prospects for post-attack recovery.

The exact numbers of predicted survivors are of course affected somewhat by the level and type of attack assumed, or the level of fallout protection assumed. But all studies confirm that crisis relocation can reduce casualties by tens of millions.

Thus, it is clear that crisis relocation has good potential for great reductions in casualties. An important point to bear in mind is that effectiveness depends on far more than developing crisis relocation plans alone.

Rather, to achieve the full potential for lifesaving inherent in crisis relocation, a number of supporting capabilities are essential beyond the plans themselves. For example, the key local and State officials who would be responsible to execute the plans must understand their duties; this requires periodic exercising of plans with these officials (though not with the public at large). There must be detailed plans to develop additional fallout shelters in host areas during a crisis period. There must be protected control centers for the key officials, and protected broadcast stations to permit giving emergency information and instructions to the population. There must be a radiological defense system, so that the people can be told when it is reasonably safe to leave shelters.

The point is that the number of casualties prevented is a direct function of the civil defense capabilities that have (or have not) been developed by the time of attack. Crisis relocation plans by themselves have limited payoff -- expected total survival would be quite low, a little under half our population. To achieve survival in the range of 80 percent requires a balanced, moderate-cost civil defense system including the in-being capabilities just outlined.

Of course, there are uncertainties involved in the moderate-cost crisis relocation approach. For example, would local and State governments be effective in assisting the people to move to host areas, in providing temporary lodging and food, and in developing fallout protection for evacuees in the host areas? FEMA believes they would.

It is FEMA's judgment, based on extensive research and on experience in peacetime evacuations, that crisis relocation could be highly effective if two conditions existed: one, completion of the requisite plans, together with development of supporting systems and capabilities; and two, a week of warning time in which to move and protect the bulk of the 140 million people living near military installations and in our larger cities.

Surprise attack is considered unlikely. Rather, it is likely that we would have a week's warning time because if the Soviets are to protect the bulk of their urban population by evacuation, the Intelligence Community estimates that it would take a week or more to evacuate Soviet cities and develop fallout protection for evacuees in surrounding rural areas.

As for public cooperation, experience in both peacetime and wartime evacuation is that most people will comply with official instructions, providing that these are understandable and make sense in terms of improving chances for survival. In fact, in a threatening situation, many people will leave potential danger areas on their own, whether or not they have been advised to do so. During the Three Mile Island incident last year, for example, 40 percent of the people living within 15 miles of the plant evacuated spontaneously, with no official advice to do so. These evacuees totalled 145,000 -- out of 370,000 people within 15 miles of the plant.

The view of State and local officials is that they would rather have the relocation plan and not need it, than need the plan and not have it. The views of the public are similar. Surveys indicate that about 80 percent of the people believe we should have crisis relocation plans. Indeed, the people believe "the Government is taking care of civil defense" -- and although people give little thought to civil defense in normal times, their interest rises sharply when international tensions increase.

What are current U.S. civil defense capabilities? It would be wrong to suppose that the U.S. has no current civil defense program or capability. The investments of the past two decades have developed systems which would save some millions of lives in the event of large-scale attack.

At the same time, it would be equally wrong to suppose that the U.S. currently has well-developed civil defense capabilities. The report of the Chairman of the Joint Chiefs of Staff to Congress, "United States Military Posture for FY 1981" noted that "... the U.S. civil defense program is funded at a very low level and is relatively ineffective."

More specifically, a start has been made on development of crisis relocation plans, and work is underway in all States, but much remains to be done. About 400 plans have been approved, as against some 3,400 needed. Similarly, the systems and capabilities essential to realize the full life-saving potential of crisis relocation exist only in partial degree.

The Administration had hoped to begin implementing components of an enhanced program in FY 1980. However, the appropriation for FEMA's civil defense activities represented a net decrease (in real terms) of about 3 percent from the FY 1979 level. The FY 1981 request represents a real growth of about 12 percent over the FY 1980 level and, if supported by the Congress, would constitute a significant first step towards developing a crisis relocation capability, including both relocation plans and supporting capabilities, and would provide a practical test of its efficacy in large-scale applications.

We believe, in short, that both prudence and the PD-41 policies require a start on developing crisis relocation capabilities, and we hope that action on the President's FY 1981 request will permit that significant first setp to be taken.

As mentioned above, planning and programs relating to medical care, health services, and related areas are in the province of the Department of Health and Human Services, not FEMA. However, FEMA can make a substantial indirect, not direct, contribution to the problems of postattack medical care and of health -- in the area of prevention, not care.

This is because relocating the bulk of the population from U.S. risk areas, during an acute crisis, can add tens of millions of survivors -- and can moreover significantly reduce the number of injured. We are therefore applying our limited resources where they will produce the greatest payoff, namely, in developing capabilities to protect our population.

FEMA believes that the need for civil defense is clear. No system of civil defense can guarantee the survival of all of our people -- not even a $70 billion program to build blast shelters in our cities. No system of civil defense can assure that there would not be injuries on an unprecedented and tragic scale.

But reasonably effective civil defenses can reduce casualties by tens of millions should the worst occur. They provide the basis for eventual reconstitution and recovery -- notwithstanding that even a limited nuclear exchange would be a massive disaster for our own and other societies involved, and notwithstanding death, suffering, and misery on a scale with few if any parallels in human experience, and certainly none in the experience of the United States.

We in FEMA therefore conclude that until we can be assured that nuclear war will never occur, it is essential to develop civil defense protection for our people and our country. This is required, we believe, by the Constitution, and by the Federal Civil Defense Act of 1950, as amended ("provide a system of civil defense for the protection of life and property in the United States from attack") -- as well as by the dictates of common prudence and humanitarian concern for our people.

Everyone agrees that a nuclear war would be an unparalleled disaster. However, we believe that it is a responsibility of government to take those reasonable steps which can mitigate, even though they cannot eliminate, the deaths and suffering that would result from a nuclear disaster.

Senator KENNEDY. Is there anything you would like to add on that, Ms. Gleason?

Ms. GLEASON. We have an emergency preparedness program in Health and Human Services. Each of the components in our Department has responsibility for preparedness plans using its expertise and program resources. The principal component that would be involved in planning for health preparedness is the Public Health Service. Mr. Harold Gracey is here with me today. He is the emergency coordinator for the Public Health Service.

Senator KENNEDY. I see. Given the kind of scenario that Dr. Geiger and Dr. Hiatt described, what is your estimate of the type of medical system that would be available to deal with the health care needs in those areas which are actually targeted? What is your own assessment?

Ms. GLEASON. The only health care system would be the system that is in place on a day-to-day basis. The Department of Health and Human Services has been trying, through the Emergency Medical Services Systems Act, to upgrade the medical response capability in the Nation's cities, counties, and States.

Senator KENNEDY. Is their description of what the medical system would look like after an attack on a dozen of the major cities—does that pretty well conform to what your impressions would be?

Ms. GLEASON. I think Harold could answer that.

Mr. GRACEY. I think what they have said today is fairly accurate, yes. We plan, under FEMA's guidance, to the best of our ability, to integrate emergency preparedness and disaster response activities into our regular programs. We have done a lot of work in the last several years concerned with other types of disasters, with the expectation that although that would not solve the magnitude of the problem we might see in a nuclear war, it would go some distance. The same principles would be applied, although the number of casualties would be much greater. We do a lot of work, but what they described is accurate.

Senator KENNEDY. We have the EMS legislation here before the committee. It is about $100 million a year nationwide. I think it is probably even somewhat less than that. And it is certainly not a system that could—I do not think, as someone who is familiar with the legislation, which is primarily targeted toward the training of ambulance personnel and the development of emergency medical services for particular disasters and provides very important services certainly. But it is not of the magnitude that can reach across this country and fill in, in any meaningful way whatsoever, the kind of devastation that we have heard described here today.

Let me just ask you as well whether your perception of just not only the medical needs that—your perception of what is a result of a confrontation or of an attack—the other witnesses today sort of described the social-physical climate and atmosphere that would exist within these communities besides the medical. Would your assessment be pretty much the same as their description, Mr. Chipman?

Mr. CHIPMAN. Senator, we have done, through the last decade or so, a great deal of postattack research. People have looked at radiological problems, economic problems, psychological problems,

problems of disease control and public health in the year or so following an attack. And in all these years of research, no factor has been found which would preclude recovery. In other words, it is not a question of black and white—of perfect survival, however that may be defined, versus national extinction. It is a question of degree. And what you have done has an impact, of course, on whether there is more misery and suffering or less, and whether you are going to hope for recovery in a somewhat lesser period of years or longer. There are no certainties in this area.

Someone mentioned the Black Death, and I was impressed a few weeks ago in reading about that, during the period of the Hundred Years' War. Here was a catastrophe that killed a third of the population of England. And yet these people were able to mount an expeditionary force to France and fight the Battle of Poitiers 6 or 8 years after the epidemic. I do not know what this says about the ethics of the human race, but it shows there is a certain resilience and toughness to society.

We hope that we will never see anything like this. But if such a catastrophe should ever occur—a failure of deterrence—it is almost sure that the survivors would put back together some kind of society, some kind of economy. It would not be a question of back to the trees. Grimness, privation, suffering, yes; but not total extinction or going back to barbarism.

The important thing, it seems to me, is that what we have done by way of preparedness affects the outcome. There are many things that need more research, but there are many things that can be done.

Senator KENNEDY. I suppose that is probably open to some question. I mean, you described about whether the time that you had—whether you would be sitting here or lying down on the floor or going down to the basement. With a 20-megaton bomb, it would not make any difference whether you are going down in the basement between here and Route 495 because you would be incinerated.

Mr. CHIPMAN. No, sir. Take a 1 megaton weapon, because they are perhaps more commonly found in the inventory. It would really make quite a difference. If the thing dropped on top of this building or if it dropped between here and the National Gallery, of course that is curtains, even with a super blast shelter. But if you had a well constructed blast shelter under the building and the weapon were at the range, shall we say, of the National Gallery or further, you would survive.

Senator KENNEDY. But 20 megatons?

Mr. CHIPMAN. I was taking 1 megaton.

Senator KENNEDY. What we are talking about—they have got 100, 20 megaton weapons.

Mr. CHIPMAN. Yes. Whether they would use them on cities or save them for silos, who knows?

Senator KENNEDY. You are making a lot of assumptions on this.

Mr. CHIPMAN. It is a question of degree.

Senator KENNEDY. You need a week for notice, and then you are talking about evacuation. Your real question of course, in my mind, is, What is going to be the perception of the American people? Whether they are going to feel that they can have a civil defense program that is going to be worthy of its name, whether

they are going to feel, we have got a civil defense program so that if we get in confrontation with the Soviet Union, maybe we will have a few minutes, maybe an hour or two. But at least that shelter is going to protect me and my family. We will be able to come on up, and there will be some devastation and some ability to survive.

I think the case that has been made here today is quite to the contrary of that impression. It has been one of a recognition that the Soviet Union has the weapon systems and the delivery systems that could effectively obliterate the major urban and industrial areas in this country in a most dramatic way. There may be individuals that survive. But what they survive to is a society which is decimated in every extent, the loss of complete families, the loss of all kind of civilization that we know. And there may be individual survivors, but what is life going to be like under those circumstances? And it just defies, I think, the statements, the comments that are made by rational individuals that nuclear war and nuclear exchange are winable. I do not see how anyone could listen to the presentation today and think that they are winable in the terms which Americans use for contests, for even in the past wars in which we have been involved, no one wins, and everyone loses. And it seems to me that if this is a conclusion that can be reached—and it is certainly a conclusion that I have reached—it places an even much higher, greater emphasis and stress on the importance of the prevention. If we assume that you can survive and that things are not going to be so bad, then you can see it really is not that important that we make all the efforts in the areas of prevention. If you can see the utter destruction and decimation, then there is, I believe, a higher responsibility, higher requirement, for the efforts of those that are in positions of responsibility to fight the battle for prevention and to view the realities of today's world in which both the Soviet Union and the United States and other countries have nuclear weaponry. And it sets a criterion and a responsibility by which these nations must move urgently in the areas of avoiding both the nuclear escalation as well as nuclear confrontation. And I think what it does do, if that is a conclusion that must be reached, is that we have to ask ourselves whether in the handlings of foreign policy, whether we are giving that kind of attention and the kind of urgency that that particular nightmare really demands. And that is what I think are the parameters that we are considering.

It seems to me that we can lull the American population into a false sense of security, and that would be an enormous disservice if they were to get lulled into that sense of security, that a nuclear exchange, limited nuclear war, nuclear wars are winable; therefore, we spend just x millions of dollars or billions of dollars, and things are going to be virtually OK. They are not going to be, I believe, OK at all. And even with the longer range scenario which was spelled out here today by those that have a responsibility in this area, I do not see how any parent or any young person or retired person as well could have much sense of hope that the type of life that they would lead in the future after such an exchange would have very much meaning.

It does seem to me that we all have a responsibility to maintain the strength of this Nation and to insure that we are going to be able to protect our own vital needs of this country and do what is necessary to do that, and of our allies. That seems to me to be an essential aspect of our policy. But we also have to be tireless to try and move us away from the possibilities of nuclear confrontation and nuclear escalation and nuclear proliferation. And I think a case has been made here today in human terms and in professional terms that reminds all of us of this challenge as being certainly one of the most important, if not the most important, of statesmanship over the period of the 1980's.

I want to thank all of you very much for your appearance. I apologize for the interruptions in the time for holding you here. And we would welcome additional submissions in your testimony as well. And we will include them as part of the record.

[The following was received for the record:]

Material for the Record
Senate Committee on Labor and Human Resources
Subcommittee on Health and Scientific Research
Hearings, July 19, 1980, on Short- and Long-Term Effects
on the Surviving Population of a Nuclear War

We have summarized below the basic positions of the Federal Emergency Management Agency (FEMA) regarding the relationship of civil defense to the short- and long-term effects of a nuclear war on the surviving population. We believe that these positions are consistent to a considerable degree, though not entirely, with the views expressed by other witnesses who testified at the June 19, 1980 hearings.

(1) It is surely clear that the best conceivable civil defense for our population is for there never to be a nuclear war, and deterrence has of course been a primary U.S. objective throughout the nuclear era. As Secretary of Defense Harold Brown said in his January 29, 1980, Annual Report to the Congress, "The most fundamental objective of our strategic policy is nuclear deterrence."

(2) It is also clear, however, that while everyone hopes and trusts that deterrence will continue to be as effective as it has been to date, and that no nuclear weapon will be detonated in anger, there can be no absolute guarantee on this score. As the late President Kennedy said in May 1961,

> "This deterrent concept assumes rational calculations by rational men. And the history of this planet, and particularly the history of the 20th century, is sufficient to remind us of the possibilities of an irrational attack, a miscalculation, an accidental war, or a war of escalation in which the stakes by each side gradually increase to the point of maximum danger which cannot be either foreseen or deterred. It is on this basis that civil defense can be readily justifiable--as insurance for the civilian population in case of an enemy miscalculation. It is insurance we trust will never be needed--but insurance which we could never forgive ourselves for foregoing in the event of catastrophe."

(3) The recent report to the Congress by the Chairman of the Joint Chiefs of Staff, "United States Military Posture for FY 1981," included these observations on the possibility of crises and other risks during the 1980's:

> --The "... progressive shift in the strategic balance will continue into the latter part of the 1980's ..."
>
> --"... I anticipate that such a disparity would be reflected in a more confident Soviet leadership, increasingly inclined toward more adventurous behavior.... The Soviet invasion of Afghanistan could well be a 'leading edge' event reflecting precisely such a heightened confidence. Such a situation carries the seeds of serious miscalculation and runs the risk of precipitating a serious confrontation which neither side wants nor intends." (Emphasis added.)

--"In summary, we face a period of high risk and great uncertainty in the strategic balance throughout most of the coming decade." (Emphasis added.)

--"... (T)he world is in many ways different and more threatening than a year ago, and all the signs point to even greater risks as the days pass." (Emphasis added.)

--In view of the potentials for instability in the Mideast, "A crisis could result at any time which could curtail access to the oil that is required by the United States and its allies." (Emphasis added.)

(4) Civil defense preparations can make a difference of tens of millions in the numbers of people surviving even a large-scale nuclear war, and can moreover significantly reduce the number of survivors who are injured or suffering radiation sickness. Civil defense preparations can make a substantial contribution to alleviating both short-term and long-term effects on the surviving population, on the one hand by greatly increasing the number of physicians and other health professionals surviving and, on the other, by reducing the number of injured.

(5) FEMA therefore submits that it is essential, until such time as we can be assured that a nuclear war will not occur -- by miscalculation, escalation, or otherwise -- to develop civil defense protection for our people. Everyone agrees that a nuclear war would be an unparalleled disaster. But it need not be an unmitigated disaster. We believe -- and the American people strongly agree -- that it is a responsibility of government to take those reasonable steps which can greatly mitigate, even though they cannot eliminate, the deaths and suffering that would result from a nuclear disaster.

(6) The late President Kennedy made a remark at a July 5, 1962, news conference which we believe is still germane today. He was asked whether he expected to renew his appeal for Congressional hearings on civil defense. He replied (some three months before the onset of the Cuban missile crisis),

--"I hope the hearings are held .... I hope we will secure the money we requested....

--"These matters have some rhythm. When the skies are clear, no one is interested. Suddenly, then, when the clouds come -- after all, we have no assurance that they will not come -- then everyone wants to find out why more has not been done about it."

That civil defense preparations can substantially affect survival was illustrated by the testimony of one of the Hiroshima survivors, Mr. Fujita. He said that at the time of the detonation he was in an air raid shelter. He and his companions in the shelter were uninjured, but many of their classmates in the nearby school building were injured, and were trapped in the debris.

The point is that the level of protection available to people at the time of a nuclear detonation can have a marked effect on their chances both for survival and for avoiding injury.

Another important point is that civil defense preparations can have substantial impact on the dimensions of the postattack medical care problem. If a large-scale attack occurred with most people still in our larger cities, casualties would be very high among the population generally, and higher yet among physicians and other health professionals, who are concentrated in metropolitan areas to an even greater degree than the population at large. If, on the other hand, crisis relocation plans and related capabilities existed, and the plans had been implemented prior to a large-scale attack, there would be many more surviving health professionals. This, combined with a lesser number of injured, would alleviate the problem of medical care.

The Statistical Abstract of the United States indicates that in 1976 there were some 395,000 active physicians in the U.S. If an attack occurred without crisis relocation, it is likely that casualties among physicians would approximate 80 percent, leaving some 79,000 uninjured physicians able to provide care for the injured. If crisis relocation plans had been executed before a heavy attack, casualties among physicians would approximate 20 percent or less, resulting in at least 315,000 physicians able to work (plus some 88,000 dentists, 800,000 registered nurses, and additional members of allied health professions, many of whom could assist the physicians).

A recent detailed analysis of large-scale, mid-1980's attack suggests the following results in terms of the magnitude of the postattack medical-care problem:

	Total Survivors (Injured and Uninjured)	Injured Survivors				Uninjured Physicians	Number of Direct Effects Injured per Uninjured Physician **/
		Total Inj.	= Radiation Sickness Only	+ Direct Effects (trauma, burns)*/			
Case "A" (Crisis relocation not executed)	93M	32M	= 18M	+ 14M		79,000	175
Case "B" (Crisis relocation)	174M	22M	= 14M	+ 8M		315,000	25

*/Some direct-effects victims will also suffer radiation sickness (about 5M of the 14M direct-effects victims in Case "A", and about 2M of the 8M in Case "B").

**/Uninjured physicians are related only to trauma and burn victims because definitive treatment cannot be provided for survivors suffering radiation sickness. Care for radiation casualties includes bedrest, nursing, and other supportive care which need not be provided by a physician.

We do not wish to imply by the foregoing summary analysis that the postattack medical care problem would be anything but massive and difficult in the extreme, even with crisis relocation plans executed. The analysis is for one heavy attack, and different attacks could result in either greater or

lesser numbers of casualties, as could differing levels of urban evacuation and differing levels of shelter and related civil defense preparations.

Also, there would be great difficulties in moving many of the injured survivors to places where they could receive care. There would be acute shortages of medical supplies and facilities and of hospital beds. Large-scale attacks on U.S. cities could result, for example, in the loss of some two-thirds of our existing 1.5 million hospital beds, leaving perhaps 460,000 usable beds, with a shortfall of some 4 million. (About 45 percent of the injured would require out-patient care only, but even for Case "B", with crisis relocation plans executed, there would be some 4.4 million people requiring hospital care, that is, 55 percent times 8 million direct-effects victims.)

In short, even under relatively less-severe circumstances, with crisis relocation, the terrible conditions described by the Hiroshima survivors would confront all too many of the injured survivors of an attack on the United States. But notwithstanding suffering and tragedy on a scale without precedent in U.S. experience, reasonable civil defense preparations could reduce the scale and extent of this tragedy substantially -- by a factor of up to seven in the analysis outlined above.

Moreover, additional preparations could further ameliorate the impact of nuclear attack. For example, it would be possible -- given the requisite funding -- to resuscitate the former program for maintaining a national emergency medical stockpile. This program was commenced in the earlier 1950's but was terminated in 1973. It included maintenance of some 2,000 Packaged Disaster Hospitals with 400,000 beds, as well as programs for backup supplies and for attack-oriented planning and training involving physicians and other health professionals.

FEMA thus believes that civil defense preparations have clear and substantial value. We are guided by a philosophy expressed by President Kennedy in July 1961:

> We have another sober responsibility. To recognize the possibilities of nuclear war in the missile age, without our citizens knowing what they should do or where they should go if bombs begin to fall, would be a <u>failure of responsibility</u>.... (Emphasis added.)

Our approach in crisis relocation planning is precisely to put local and State officials, and the President, in position to advise our citizens on "where to go and what to do" should an acute crisis arise -- and no one is able to guarantee that one will not. We would prefer that these plans existed today for all the people living in potential risk areas, and we are taking steps to accelerate the development of at least initial plans by involving local and State civil preparedness staffs throughout the country.

Crisis relocation can greatly improve the odds for both individual and national survival. Analyses indicate that by the end of the first day, 60 to 70 percent of the total U.S. risk population could be evacuated; by the end of the second day, 80 to 90 percent; and by the end of the third day over 95 percent. It could take one or a few days in addition to develop fallout protection for evacuees in the host areas, with the time required being a function of the

extent to which detailed plans had been prepared to improve the inherent fallout protection of existing buildings.

We believe it is significant that in 1962, during the Cuban missile crisis, the issues of civil defense and evacuation were raised by the President. Mr. Steuart L. Pittman, who was Assistant Secretary of Defense for Civil Defense at that time, has reported,

> "(I)t is interesting that President Kennedy personally raised the civil defense question during the Cuban crisis. He was considering conventional military action against Cuba to knock out the missile sites. I understand he was the only one of the 'Committee' to raise the issue of civil defense, which tells us something. He asked whether it would be practical to evacuate Miami and other coastal cities in Florida. . . . I was called into the marathon crisis meeting and had to tell him that it would not be practical; we did not have any significant evacuation plans . . . . The President dropped the idea, but shortly after the crisis was over, his personal concern over his limited civil defense options led him to sign a memorandum directing a significant speedup in the U.S. civil defense preparations."

On hearing the tragic accounts of the survivors of Hiroshima, at the June 19 hearings, our reactions were these:

- What an immense toll of death and suffering could have been avoided, if most of the people of Hiroshima had been evacuated before August 6, 1945.

- Should a nuclear confrontation of unprecedented intensity arise in the future, we most earnestly hope that our people, and the President at the time, will have available the option for relocation from potential risk areas, and we will do our utmost to develop that option.

We would also like to address the argument, suggested at the June 19, 1980, hearings, that civil defense measures are irrelevant, regardless of the lives they would save, because there is no way to survive and recover from a nuclear attack.

Although the search certainly is not over, a great deal of research effort has been expended looking for an "Achilles heel" that would preclude recovery. Some 369 reports on postattack recovery are available in FEMA's research library. These address problems in a broad range of areas, including among others radiological phenomena and countermeasures, availability of food and water, health and medical problems, economic impacts, social and psychological impacts, late radiation and genetic effects, and ecological problems.

Suffice it to note at this point that while issues bearing on postattack recovery are extraordinarily complex, in years of research no insuperable barrier to recovery has been found. Indeed, a major conclusion of a 1969 review of postattack problems was that "... enhanced capability ... to

recover from (a nuclear attack) ... need not await new research results." Actions to enhance prospects for recovery could save millions of lives.

Thus, the case for recovery plans and preparations rests on prudence and humanitarianism -- as does the case for civil defense preparations for crisis relocation and related lifesaving operations. And as with preparations to increase survival from the blast, heat, and fallout effects of nuclear weapons, one gets what one pays for.

It is not a black-and-white, all-or-nothing issue -- "perfect recovery" (however that may be defined) versus "national extinction." Rather, the issue is whether the millions of survivors would be relatively less well off or relatively better off, whether there would be more misery and suffering or less, whether recovery might be hoped for relatively later or relatively sooner.

Surely "no one would want to live in that kind of world" -- any more then people in the 14th century "wanted" to live in a world in which perhaps one person out of three was killed by the Black Death. But the issue is not one of whether one would prefer living in a nation devastated by nuclear attack. Rather, it is whether prudence suggests the wisdom of preparedness, in a world in which nuclear weapons exist, and the possibility of their use is not zero.

Finally, it is worthy of note that the American people strongly support both arms control and civil defense. We believe these views reflect a very sound common sense, indeed, a profound wisdom: Most people hope for and support agreements that will reduce or eliminate the possibility of a massively destructive nuclear war, but most people are also convinced that we need protection should worse come to worst and a war occur despite our best hopes and our best efforts to avoid nuclear conflict.

UNITED STATES ARMS CONTROL AND DISARMAMENT AGENCY
WASHINGTON, D.C. 20451

U.S. URBAN POPULATION VULNERABILITY

AUGUST 1979

U.S. Urban Population Vulnerability

This report illustrates the level of U.S. prompt fatalities that would be caused by a nuclear attack directly aimed at the U.S. population.

The population data base used in the analysis consists of all urban areas in the U.S. with a population of 25 thousand or more persons. Currently this set of data includes 545 U.S. urban areas and 132 million people. A listing of the urban areas by population is attached (Tab A).

Three basic cases were examined:

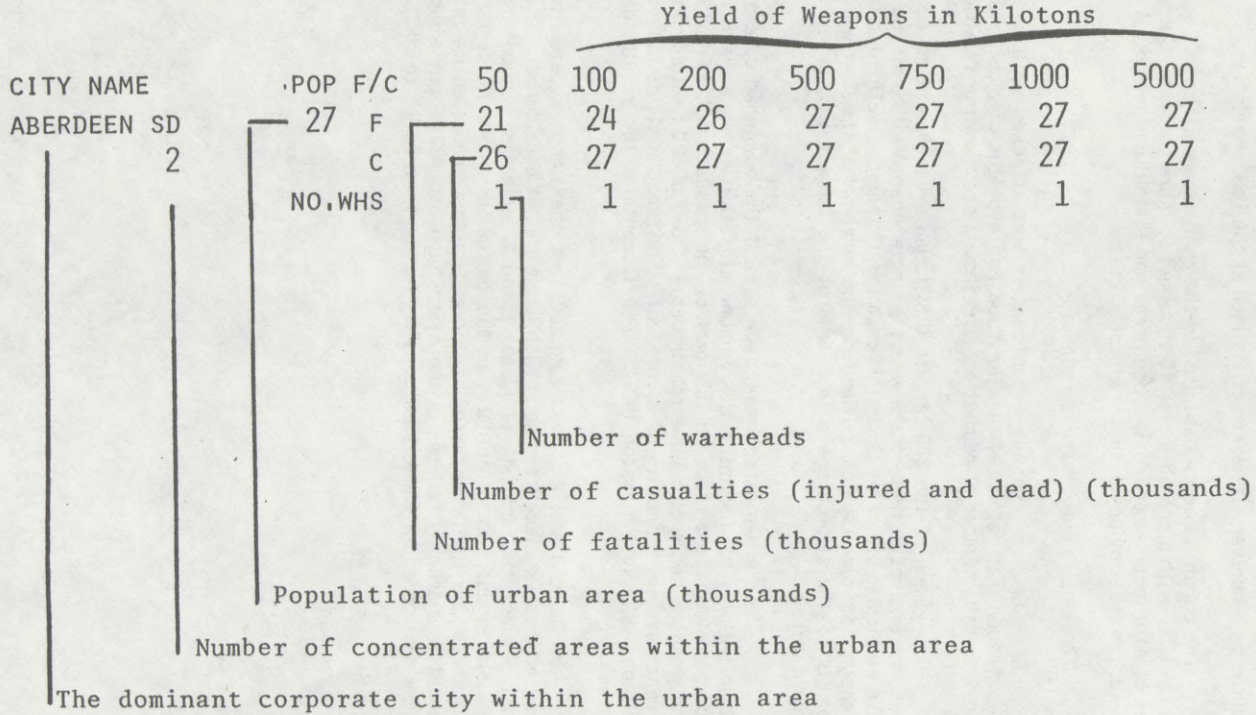
1. Each of the 545 urban centers was attacked with one weapon. The weapon was detonated at a location and a height of burst which would maximize the number of casualties. The results are shown in Tab B.

2. Each of the 200 largest U.S. urban areas was attacked with two weapons (except in those cases where a single weapon killed all the residents of a particular urban area). In this case the aimpoint selection for the second weapon maximized the casualties from the survivors of the first weapon. The results of the two-on-one attack against the largest U.S. urban areas are shown in Tab C.

3. An urban attack was made against the combined data base. The objective was to maximize the number of fatalities as a function of the number of weapons used. In this part of the simulation it was assumed that the weapons had a circular error probable (CEP) of .20 nautical miles and a weapon system reliability of 85 percent. The weapon yields ranged from 50 kilotons (KT) to 1 megaton (MT). Tab D contains the results of the full attack.

In Cases 1 and 2 it was assumed that the weapons detonated at the desired locations (accuracy and reliability were not considered). Therefore in that respect the analysis of Cases 1 and 2 indicates a maximum prompt casualty count. In an actual war the casualties might be fewer in some instances due to the accuracy factor and in some cases entire urban areas would be spared by failures in the attacking weapons. Eight weapon yields were considered for Cases 1 and 2. They ranged from 50 KT to 20 MT.

LEGEND FOR TABS B AND C



TAB A

NO.	URBAN AREA	VALUE (THOUSANDS)
1	NEW YORK NY	16323
2	LOS ANGELES CA	8664
3	CHICAGO IL	6659
4	PHILADELPHIA PA	4557
5	DETROIT MI	3858
6	SAN FRANCISCO CA	3613
7	BOSTON MA	2884
8	WASHINGTON DC	2554
9	MIAMI FL	2320
10	DALLAS TX	2087
11	CLEVELAND OH	1890
12	HOUSTON TX	1807
13	SAINT LOUIS MO	1800
14	PITTSBURGH PA	1716
15	MINNEAPOLIS MN	1577
16	BALTIMORE MD	1484
17	SAN DIEGO CA	1347
18	ATLANTA GA	1298
19	SEATTLE WA	1213
20	DENVER CO	1162
21	CINCINNATI OH	1145
22	MILWAUKEE WI	1137
23	KANSAS CITY MO	1027
24	NEW ORLEANS LA	1015
25	PHOENIX AZ	996
26	BUFFALO NY	939
27	PROVIDENCE RI	892
28	SAN ANTONIO TX	865
29	COLUMBUS OH	801
30	PORTLAND OR	782
31	INDIANAPOLIS IN	780
32	SACRAMENTO CA	745
33	LOUISVILLE KY	717
34	DAYTON OH	702
35	MEMPHIS TN	698
36	NORFOLK VA	688
37	HARTFORD CT	651
38	SAINT PETERSBUR FL	651
39	ROCHESTER NY	599
40	BIRMINGHAM AL	549
41	JACKSONVILLE FL	547
42	RIVERSIDE CA	541
43	OMAHA NE	524
44	OKLAHOMA CITY OK	499
45	HONOLULU HI	483
46	SALT LAKE CITY UT	483
47	RICHMOND VA	477
48	TOLEDO OH	470
49	AKRON OH	463
50	ALBANY NY	457
51	SPRINGFIELD MA	415
52	ORLANDO FL	407
53	NASHVILLE TN	398
54	TAMPA FL	396
55	YOUNGSTOWN OH	387
56	EL PASO TX	385
57	TUCSON AZ	379
58	SCRANTON PA	374
59	TULSA OK	369
60	ALBUQUERQUE NM	367
61	GRAND RAPIDS MI	359
62	WEST PALM BEACH FL	358
63	SYRACUSE NY	355
64	AUSTIN TX	334
65	CHARLOTTE NC	313
66	CONCORD CA	302
67	TACOMA WA	299
68	FLINT MI	295
69	LAS VEGAS NV	292
70	WICHITA KS	290
71	FRESNO CA	289
72	SOUTH BEND IN	282
73	BATON ROUGE LA	278
74	ALLENTOWN PA	276
75	MOBILE AL	276
76	DES MOINES IA	269
77	NEWPORT NEWS VA	267
78	COLORADO SPRING CO	254
79	SPOKANE WA	254
80	HARRISBURG PA	253
81	DAVENPORT IA	250
82	LITTLE ROCK AR	246
83	LANSING MI	245
84	COLUMBIA SC	245
85	CANTON OH	237
86	WORCESTER MA	231
87	FORT WAYNE IN	228
88	SHREVEPORT LA	226
89	SARASOTA FL	224
90	CHARLESTON SC	219
91	CHATTANOOGA TN	216
92	MADISON WI	209
93	KNOXVILLE TN	209
94	PEORIA IL	208
95	SAN RAFAEL CA	207
96	OXNARD CA	202
97	ROCKFORD IL	198
98	JACKSON MS	191
99	CORPUS CHRISTI TX	189
100	ANN ARBOR MI	188
101	BAKERSFIELD CA	186
102	COLUMBUS GA	186
103	GREENVILLE SC	185
104	RALEIGH NC	183
105	PENSACOLA FL	182
106	LEXINGTON KY	178
107	READING PA	178
108	FAYETTEVILLE NC	174
109	ERIE PA	174
110	LINCOLN NE	168
111	ROANOKE VA	168
112	JOLIET IL	166
113	STOCKTON CA	164
114	LUBBOCK TX	163
115	BINGHAMTON NY	163
116	AUGUSTA GA	162
117	HUNTINGTON WV	161
118	MONTGOMERY AL	158
119	GREENSBORO NC	155
120	EUGENE OR	154
121	AURORA IL	153
122	SAVANNAH GA	152
123	WINSTON-SALEM NC	152
124	SANTA BARBARA CA	151
125	SAGINAW MI	147
126	CHARLESTON WV	145
127	GREEN BAY WI	144
128	HUNTSVILLE AL	143
129	EVANSVILLE IL	138
130	WATERBURY CT	138
131	APPLETON WI	136
132	NEW BEDFORD MA	136
133	SEASIDE CA	135
134	KALAMAZOO MI	134
135	ANCHORAGE AK	132
136	SPRINGFIELD IL	131
137	UTICA NY	130
138	AMARILLO TX	129
139	CEDAR RAPIDS IA	129
140	MODESTO CA	128
141	SPRINGFIELD MO	127
142	DAYTONA BEACH FL	126
143	MACON GA	125
144	RENO NV	123
145	BILOXI MS	122
146	RACINE WI	121
147	TOPEKA KS	118
148	LAWRENCE MA	117
149	DULUTH MN	116
150	BOISE CITY ID	115

NO.	URBAN AREA	VALUE (THOUSANDS)
151	PORTLAND ME	115
152	WHEELING WV	114
153	SALEM OR	113
154	WACO TX	113
155	YORK PA	112
156	LANCASTER PA	110
157	NIAGARA FALLS NY	110
158	BEAUMONT TX	110
159	PUEBLO NM	109
160	MONROE LA	107
161	WATERLOO IA	107
162	PETERSBURG VA	104
163	CHAMPAIGN IL	104
164	DURHAM NC	103
165	PROVO UT	103
166	LAFAYETTE LA	102
167	GASTONIA NC	102
168	MUSKEGON MI	101
169	MANCHESTER NH	99
170	BOULDER CO	99
171	ALTON IL	98
172	WICHITA FALLS TX	98
173	SANTA CRUZ NM	98
174	DECATUR IL	96
175	OGDEN VT	96
176	LAKE CHARLES LA	96
177	TALLAHASSEE FL	95
178	SPRINGFIELD OH	95
179	KAILUA HI	94
180	ABILENE TX	94
181	LAWTON OK	93
182	KILLEEN TX	93
183	FARGO ND	92
184	JOHNSTOWN PA	90
185	SIOUX CITY IA	90
186	TUSCALOOSA AL	88
187	GAINESVILLE FL	88
188	EASTON PA	87
189	ALTOONA PA	87
190	MUNCIE IN	87
191	ODESSA TX	87
192	VANCOUVER WA	85
193	VALLEJO CA	85
194	SANTA ROSA CA	84
195	LAKELAND FL	84
196	KENOSHA WI	83
197	ALBANY GA	83
198	FORT SMITH AR	83
199	BILLINGS MT	82
200	NEWBURGH NY	81

NO.	URBAN AREA	VALUE (THOUSANDS)
201	JACKSON MI	80
202	LAFAYETTE IN	80
203	STEUBENVILLE OH	79
204	SIMI VALLEY CA	78
205	BLOOMINGTON IL	78
206	SPARTANBURG SC	77
207	SIOUX FALLS SD	76
208	FITCHBURG MA	76
209	KANNAPOLIS NC	76
210	LAREDO TX	76
211	PORT ARTHUR TX	75
212	LYNCHBURG VA	75
213	MCALLEN TX	75
214	GREAT FALLS MT	74
215	BATTLE CREEK MI	74
216	ATLANTIC CITY NJ	74
217	ASHEVILLE NC	74
218	ANTIOCH OH	74
219	FLORENCE AL	73
220	MANSFIELD OH	73
221	TERRE HAUTE IN	73
222	ELMIRA NY	72
223	ALEXANDRIA LA	71
224	BAY CITY MI	71
225	ELGIN IL	71
226	GALVESTON TX	70
227	OCEANSIDE CA	70
228	SALINAS CA	70
229	SAN ANGELO TX	70
230	YAKIMA WA	70
231	HIGH POINT NC	69
232	SAINT JOSEPH MO	69
233	BRYAN TX	69
234	LA CROSSE WI	68
235	NASHUA NY	68
236	WILMINGTON NC	68
237	BURLINGTON NC	67
238	FORT COLLINS CO	67
239	LEWISTON ME	66
240	PEEKSKILL NY	66
241	MONESSEN PA	66
242	PARKERSBURG WV	65
243	ROY UT	65
244	DUBUQUE IA	65
245	BREMERTON WA	65
246	TYLER TX	65
247	WILLIAMSPORT PA	64
248	FORT MYERS FL	64
249	EAU CLAIRE WI	64
250	MIDLAND TX	64

NO.	URBAN AREA	VALUE (THOUSANDS)
251	KOKOMO IN	64
252	LIMA OH	63
253	MERRITT ISLAND FL	63
254	ANDERSON IN	63
255	PINE BLUFF AR	62
256	PITTSFIELD MA	62
257	WOODBRIDGE VA	62
258	THOUSAND OAKS CA	61
259	NORMAN OK	61
260	CHARLOTTESVILLE VA	61
261	BURLINGTON VT	60
262	PASCAGOULA MS	60
263	TEXAS CITY TX	60
264	WINTER HAVEN FL	59
265	LAS CRUCES NM	59
266	SAINT CHARLES IL	59
267	ROCHESTER MN	59
268	GLENS FALLS NY	59
269	POUGHKEEPSIE NY	58
270	NEW LONDON CT	57
271	NAPA CA	57
272	KINGSPORT TN	57
273	PORT HURON MI	56
274	JOPLIN MO	56
275	PASCO WA	56
276	SAINT CLOUD NM	56
277	SHARON PA	56
278	BROWNSVILLE TX	56
279	TEXARKANA TX	56
280	GADSDEN AL	55
281	ANSONIA CT	55
282	ESCONDIDO CA	55
283	NEW CASTLE PA	55
284	OSHKOSH WI	55
285	SANTA MARIA CA	55
286	MERIDIAN MS	54
287	MERIDEN CT	54
288	OWENSBORO KY	54
289	IOWA CITY IA	54
290	YUBA CITY CA	54
291	JAMESTOWN NY	53
292	LONGVIEW TX	53
293	OLYMPIA WA	53
294	GREELEY CO	53
295	BLOOMINGTON IN	53
296	BOUNTIFUL VT	52
297	ANNAPOLIS MD	52
298	CHEYENNE WY	52
299	LAWRENCE KS	52
300	ROME GA	52

NO.	URBAN AREA	VALUE (THOUSANDS)
301	NEWARK NJ	52
302	JACKSONVILLE HE	52
303	JACKSONVILLE NC	52
304	SHEBOYGAN MI	52
305	WAUSAU WI	52
306	RAPID CITY SD	51
307	LONGVIEW WA	51
308	FORT WALTON BEA FL	51
309	COLUMBIA MO	51
310	HAGERSTOWN MD	51
311	ATHENS GA	50
312	HOMESTEAD FL	50
313	FORT PIERCE FL	50
314	DANVILLE IL	50
315	DENTON TX	50
316	DANVILLE VA	49
317	BENTON HARBOR MI	49
318	PLEASANTVILLE NY	49
319	OCALA FL	49
320	LEBANON PA	49
321	LAUREL MD	49
322	NEWPORT RI	49
323	MISSOULA MT	49
324	SANTA FE NM	48
325	PANAMA CITY FL	48
326	QUINCY IL	48
327	KANKAKEE IL	48
328	REDLANDS CA	48
329	SANFORD FL	48
330	BELOIT WI	48
331	HATTIESBURG MS	48
332	JANESVILLE WI	48
333	GRAND FORKS ND	48
334	CASPER WY	48
335	WAHIAWA HI	48
336	WARNER ROBINS GA	47
337	HOUMA LA	47
338	DOTHAN AL	47
339	HOLLAND IN	47
340	ANDERSON SC	47
341	ANNISTON AL	47
342	ENID OK	46
343	BELLINGHAM WA	46
344	MELBOURNE FL	46
345	MISSION VIEJO CA	45
346	POCATELLO ID	45
347	VICTORIA TX	45
348	SALISBURY NC	45
349	MARION OH	45
350	HICKORY NC	45

NO.	URBAN AREA	VALUE (THOUSANDS)
351	DANBURY CT	45
352	GREENVILLE MS	44
353	AMES IA	44
354	ITHACA NY	44
355	RICHMOND IN	44
356	SUMTER SC	43
357	TEMPLE TX	43
358	VISALIA CA	43
359	ROCK HILL SC	43
360	BISMARCK ND	43
361	JOHNSON CITY TN	43
362	JACKSON TN	43
363	CORVALLIS OR	43
364	CHICO CA	43
365	CHAPEL HILL NC	43
366	KINGSTON NY	42
367	CUMBERLAND MD	42
368	BRISTOL VA	42
369	GOLDSBORO NC	42
370	FAIRFIELD CA	42
371	VINELAND NJ	42
372	ROCKY MOUNT NC	42
373	MARION IN	42
374	WEST HAVERSTRAW NY	42
375	MIDDLETOWN CT	41
376	STATE COLLEGE PA	41
377	MEDFORD OR	41
378	SANDUSKY OH	41
379	ROSWELL NM	41
380	HUTCHINSON KS	41
381	HAVERHILL MA	41
382	HAYTOWN TX	41
383	FOND DU LAC WI	41
384	DECATUR AL	41
385	BUTTE MT	41
386	HOT SPRINGS AR	41
387	FLAGSTAFF AZ	40
388	LANCASTER OH	40
389	BOWLING GREEN OH	40
390	NORWICH CT	40
391	MORGANTOWN WV	40
392	VICKSBURG MS	40
393	ZANESVILLE OH	40
394	YUMA AZ	39
395	MONROE MI	39
396	TAUNTON MA	39
397	SALINA KS	39
398	VALDOSTA GA	39
399	REDDING CA	39
400	BOWIE MD	39

NO.	URBAN AREA	VALUE (THOUSANDS)
401	GREENSBURG PA	39
402	IDAHO FALLS ID	39
403	HARLINGEN TX	38
404	GRIFFIN GA	38
405	FLORENCE SC	38
406	BANGOR ME	38
407	LEAVENWORTH KS	38
408	CLARKSVILLE TN	38
409	FINDLAY OH	38
410	SAN LUIS OBISPO CA	38
411	MUSKOGEE OK	38
412	POTTSVILLE PA	38
413	MANKATO MN	38
414	ROME NY	38
415	MIDLAND MI	38
416	WEST CHESTER PA	37
417	MICHIGAN CITY IN	37
418	GALESBURG IL	37
419	CLINTON WI	37
420	CLEVELAND TN	37
421	JEFFERSON CITY MO	37
422	LIVERMORE CA	37
423	FORT KNOX KY	37
424	AUBURN NY	37
425	KLAMATH FALLS OR	36
426	GLOVERSVILLE NY	36
427	FAYETTEVILLE AR	36
428	EUREKA CA	36
429	MERCED CA	36
430	SAN CLEMENTE CA	36
431	MUNDELEIN IL	36
432	PADUCAH KY	36
433	PEKIN IL	36
434	TITUSVILLE PA	36
435	MARYVILLE TN	36
436	MINOT ND	35
437	POTTSTOWN PA	35
438	CLARKSBURG WV	35
439	BUTLER PA	35
440	GRAND JUNCTION CO	35
441	CLOVIS NM	35
442	HAZLETON PA	35
443	FAIRBANKS AL	35
444	GRAND ISLAND NE	35
445	HOPKINSVILLE KY	35
446	BIDDEFORD ME	34
447	DOVER DE	34
448	KINSTON NC	34
449	EAST LIVERPOOL OH	34
450	DEKALB IL	34

NO.	URBAN AREA	VALUE (THOUSANDS)
451	BURLINGTON IA	34
452	CARPENTERSVILLE IL	34
453	WALLA WALLA WA	34
454	STILLWATER OK	33
455	PETALUMA CA	33
456	NEW IBERIA LA	33
457	RICHLAND WA	33
458	VISTA CA	33
459	NATCHEZ MS	33
460	NEDERLAND TX	33
461	ORANGE TX	33
462	LANCASTER CA	33
463	GLASSBORO NJ	33
464	DAVIS CA	33
465	MANITOWOC WI	32
466	GREENVILLE NC	32
467	BRUNSWICK GA	32
468	HEMET CA	32
469	CAMARILLO CA	32
470	MANHATTAN KS	32
471	BARTLESVILLE OK	32
472	KEY WEST FL	32
473	ASHTABULA OH	32
474	WILSON NC	32
475	WATERTOWN NY	32
476	MURFREESBORO TN	32
477	WATERVILLE ME	31
478	WALLINGFORD CT	31
479	SELMA AL	31
480	JONESBORO LA	31
481	MIDDLETOWN NY	31
482	LODI CA	31
483	LOGAN VT	30
484	FORT DODGE IA	30
485	DALTON GA	30
486	CONCORD NH	30
487	COLUMBUS MS	30
488	DUNKIRK NY	30
489	LEWISTON ID	30
490	GAINESVILLE GA	30
491	FREDERICK MD	30
492	MASON CITY IA	30
493	ABERDEEN WA	30
494	ALLIANCE OH	30
495	STEVENS POINT WI	30
496	OTTUMWA IA	30
497	SHERMAN TX	30
498	STERLING IL	30
499	PLATTSBURGH NY	30
500	WASHINGTON PA	29

NO.	URBAN AREA	VALUE (THOUSANDS)
501	PORTSMOUTH VA	29
502	SHAWNEE OK	29
503	WINONA MN	29
504	UNIONTOWN PA	29
505	TORRINGTON CT	29
506	NEW PHILADELPHI OH	29
507	ILION NY	29
508	LOCKPORT NY	29
509	MARTINSVILLE VA	29
510	BIG SPRING TX	29
511	HOBBS NM	29
512	CAPE GIRARDEAU MO	29
513	CARBONDALE IL	29
514	KINGSVILLE TX	28
515	FAIRMONT WV	28
516	COOS BAY OR	28
517	STATESVILLE NC	28
518	PERU IL	28
519	OAK RIDGE TN	28
520	WEST MEMPHIS AR	27
521	SOUTHINGTON CT	27
522	CHILLICOTHE OH	27
523	GREENWOOD SC	27
524	MARSHALLTOWN IA	27
525	FREEPORT IL	27
526	ABERDEEN SD	27
527	NEWBURYPORT MA	26
528	AMSTERDAM NY	26
529	HANOVER PA	26
530	BLYTHEVILLE AR	26
531	LATROBE PA	26
532	GLOUCESTER MA	26
533	CARLISLE PA	26
534	MILLEDGEVILLE GA	26
535	MARLBOROUGH CT	26
536	COLUMBUS IN	26
537	XENIA OH	26
538	PONCA CITY OK	26
539	STAUNTON VA	25
540	RANTOUL IL	25
541	SEDALIA MO	25
542	EL DORADO AR	25
543	DENISON TX	25
544	NEW CASTLE IN	25
545	AUSTIN MN	25

TAB B

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
ABERDEEN SD	27	F	21	24	26	27	27	27	27	27
2		C	26	27	27	27	27	27	27	27
		NO.WHS	1	1	1	1	1	1	1	1
ABERDEEN WA	30	F	14	18	22	27	28	29	30	30
4		C	22	26	28	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1
ABILENE	94	F	39	63	72	82	87	87	93	94
4		C	71	82	87	92	93	93	94	94
		NO.WHS	1	1	1	1	1	1	1	1
AKRON	463	F	54	70	123	195	230	261	398	452
38		C	131	175	247	331	362	381	447	462
		NO.WHS	1	1	1	1	1	1	1	1
ALBANY GA	83	F	26	42	52	67	72	76	83	83
7		C	50	63	73	80	80	83	83	83
		NO.WHS	1	1	1	1	1	1	1	1
ALBANY NY	457	F	53	78	103	140	158	177	315	419
51		C	114	134	174	230	254	286	410	451
		NO.WHS	1	1	1	1	1	1	1	1
ALBUQUERQUE	367	F	49	101	145	189	214	240	337	364
22		C	140	184	231	288	307	319	359	367
		NO.WHS	1	1	1	1	1	1	1	1
ALEXANDRIA	71	F	22	39	49	60	66	67	71	71
8		C	48	58	65	70	71	71	71	71
		NO.WHS	1	1	1	1	1	1	1	1
ALLENTOWN	276	F	54	75	100	152	172	191	261	276
35		C	107	137	173	224	241	250	275	276
		NO.WHS	1	1	1	1	1	1	1	1
ALLIANCE	30	F	25	28	29	30	30	30	30	30
1		C	29	30	30	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1
ALTON	98	F	22	32	41	59	68	75	95	98
12		C	40	57	68	85	91	93	98	98
		NO.WHS	1	1	1	1	1	1	1	1
ALTOONA	87	F	35	46	57	70	74	78	86	87
11		C	58	68	73	81	83	85	87	87
		NO.WHS	1	1	1	1	1	1	1	1
AMARILLO	129	F	38	55	68	93	102	108	128	129
12		C	75	89	104	120	123	124	129	129
		NO.WHS	1	1	1	1	1	1	1	1
AMES	44	F	25	33	39	44	44	44	44	44
4		C	38	41	44	44	44	44	44	44
		NO.WHS	1	1	1	1	1	1	1	1
AMSTERDAM	26	F	20	24	26	26	26	26	26	26
4		C	26	26	26	26	26	26	26	26
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
ANCHORAGE	132	F	29	42	60	96	106	116	130	132
15		C	60	84	102	123	126	130	132	132
		NO.WHS	1	1	1	1	1	1	1	1
ANDERSON IN	63	F	31	41	48	58	61	62	63	63
6		C	50	56	59	63	63	63	63	63
		NO.WHS	1	1	1	1	1	1	1	1
ANDERSON SC	47	F	23	30	36	43	45	45	47	47
5		C	37	42	44	47	47	47	47	47
		NO.WHS	1	1	1	1	1	1	1	1
ANN ARBOR	188	F	41	61	80	102	109	118	176	188
15		C	87	103	120	140	152	159	187	188
		NO.WHS	1	1	1	1	1	1	1	1
ANNAPOLIS	52	F	30	38	45	49	51	51	52	52
4		C	45	49	51	52	52	52	52	52
		NO.WHS	1	1	1	1	1	1	1	1
ANNISTON	47	F	24	28	35	41	43	45	47	47
5		C	35	39	43	45	47	47	47	47
		NO.WHS	1	1	1	1	1	1	1	1
ANSONIA	55	F	21	27	36	46	49	49	55	55
9		C	39	44	47	53	53	55	55	55
		NO.WHS	1	1	1	1	1	1	1	1
ANTIOCH	74	F	22	27	29	47	53	57	71	74
10		C	36	40	54	64	69	70	74	74
		NO.WHS	1	1	1	1	1	1	1	1
APPLETON	136	F	46	55	63	77	85	92	125	135
11		C	65	78	86	109	116	121	133	136
		NO.WHS	1	1	1	1	1	1	1	1
ASHEVILLE	74	F	19	26	38	53	60	64	74	74
10		C	43	50	61	69	71	74	74	74
		NO.WHS	1	1	1	1	1	1	1	1
ASHTABULA	32	F	15	22	28	32	32	32	32	32
6		C	27	30	32	32	32	32	32	32
		NO.WHS	1	1	1	1	1	1	1	1
ATHENS	50	F	30	38	44	48	50	50	50	50
4		C	44	47	50	50	50	50	50	50
		NO.WHS	1	1	1	1	1	1	1	1
ATLANTA	1298	F	44	57	97	190	250	363	720	1037
104		C	115	186	275	510	614	713	1061	1224
		NO.WHS	1	1	1	1	1	1	1	1
ATLANTIC CITY	74	F	39	44	51	63	66	68	73	74
6		C	51	57	62	70	72	73	74	74
		NO.WHS	1	1	1	1	1	1	1	1
AUBURN	37	F	26	31	34	37	37	37	37	37
4		C	35	37	37	37	37	37	37	37
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
AUGUSTA	162	F	29	48	66	94	112	122	157	162
19		C	74	97	118	136	146	152	162	162
		NO.WHS	1	1	1	1	1	1	1	1
AURORA	153	F	49	70	83	102	108	112	138	151
12		C	86	98	109	122	129	131	149	153
		NO.WHS	1	1	1	1	1	1	1	1
AUSTIN MN	25	F	19	22	24	25	25	25	25	25
2		C	23	25	25	25	25	25	25	25
		NO.WHS	1	1	1	1	1	1	1	1
AUSTIN TX	334	F	41	52	129	194	221	240	315	333
11		C	95	140	227	282	294	304	331	334
		NO.WHS	1	1	1	1	1	1	1	1
BAKERSFIELD	186	F	35	61	79	124	142	154	182	186
9		C	74	108	145	167	176	178	186	186
		NO.WHS	1	1	1	1	1	1	1	1
BALTIMORE	1484	F	53	264	186	494	636	704	1151	1393
59		C	181	573	527	956	1041	1105	1381	1468
		NO.WHS	1	1	1	1	1	1	1	1
BANGOR	38	F	28	31	34	37	37	37	38	38
2		C	34	36	37	38	38	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1
BARTLESVILLE	32	F	13	15	23	29	32	32	32	32
6		C	21	28	30	32	32	32	32	32
		NO.WHS	1	1	1	1	1	1	1	1
BATON ROUGE	278	F	58	75	93	143	170	188	261	278
18		C	112	133	165	226	242	250	276	278
		NO.WHS	1	1	1	1	1	1	1	1
BATTLE CREEK	74	F	33	43	51	63	66	70	74	74
7		C	54	59	66	71	73	73	74	74
		NO.WHS	1	1	1	1	1	1	1	1
BAY CITY	71	F	30	43	56	67	69	70	71	71
8		C	57	64	68	71	71	71	71	71
		NO.WHS	1	1	1	1	1	1	1	1
BAYTOWN	41	F	26	32	36	40	41	41	41	41
4		C	36	40	40	41	41	41	41	41
		NO.WHS	1	1	1	1	1	1	1	1
BEAUMONT	110	F	20	39	57	83	91	96	110	110
7		C	54	79	92	103	105	107	110	110
		NO.WHS	1	1	1	1	1	1	1	1
BELLINGHAM	46	F	24	30	37	43	45	46	46	46
5		C	37	41	45	46	46	46	46	46
		NO.WHS	1	1	1	1	1	1	1	1
BELOIT	48	F	28	34	40	47	47	48	48	48
4		C	39	43	47	48	48	48	48	48
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
BENTON HARBOR	49	F	24	32	40	47	47	49	49	49
	7	C	40	44	47	49	49	49	49	49
		NO.WHS	1	1	1	1	1	1	1	1
BIDDEFORD	34	F	22	26	30	32	33	33	34	34
	4	C	29	31	32	34	34	34	34	34
		NO.WHS	1	1	1	1	1	1	1	1
BIG SPRING	29	F	21	24	27	29	29	29	29	29
	3	C	27	29	29	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
BILLINGS	82	F	34	51	63	73	76	78	82	82
	5	C	65	71	76	80	81	81	82	82
		NO.WHS	1	1	1	1	1	1	1	1
BILOXI	122	F	26	31	40	50	54	56	95	116
	16	C	41	47	54	66	76	79	113	122
		NO.WHS	1	1	1	1	1	1	1	1
BINGHAMTON	163	F	35	51	68	90	104	111	150	163
	19	C	72	89	106	131	141	143	163	163
		NO.WHS	1	1	1	1	1	1	1	1
BIRMINGHAM	549	F	43	65	87	154	193	224	403	503
	55	C	105	146	227	316	359	390	500	539
		NO.WHS	1	1	1	1	1	1	1	1
BISMARCK	43	F	30	36	41	43	43	43	43	43
	3	C	41	42	43	43	43	43	43	43
		NO.WHS	1	1	1	1	1	1	1	1
BLOOMINGTON IL	78	F	49	58	67	75	76	77	78	78
	3	C	68	72	75	78	78	78	78	78
		NO.WHS	1	1	1	1	1	1	1	1
BLOOMINGTON IN	53	F	34	42	49	52	53	53	53	53
	5	C	47	52	52	53	53	53	53	53
		NO.WHS	1	1	1	1	1	1	1	1
BLYTHEVILLE	26	F	18	20	22	25	25	26	26	26
	2	C	22	23	25	26	26	26	26	26
		NO.WHS	1	1	1	1	1	1	1	1
BOISE CITY	115	F	31	63	85	104	109	111	115	115
	3	C	76	98	108	113	114	115	115	115
		NO.WHS	1	1	1	1	1	1	1	1
BOSTON	2884	F	88	133	242	456	585	695	1428	2018
	242	C	346	444	727	1116	1304	1430	2132	2550
		NO.WHS	1	1	1	1	1	1	1	1
BOULDER	99	F	42	59	76	91	95	97	99	99
	4	C	81	89	94	98	98	99	99	99
		NO.WHS	1	1	1	1	1	1	1	1
BOUNTIFUL	52	F	31	39	45	50	51	52	52	52
	5	C	44	48	50	52	52	52	52	52
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
BOWIE	39	F	24	30	35	38	39	39	39	39
3		C	34	37	39	39	39	39	39	39
		NO.WHS	1	1	1	1	1	1	1	1
BOWLING GREEN	40	F	24	31	37	40	40	40	40	40
5		C	35	39	40	40	40	40	40	40
		NO.WHS	1	1	1	1	1	1	1	1
BREMERTON	65	F	25	36	44	58	61	62	65	65
9		C	47	54	61	65	65	65	65	65
		NO.WHS	1	1	1	1	1	1	1	1
BRISTOL	42	F	20	28	35	39	41	41	42	42
5		C	33	37	40	42	42	42	42	42
		NO.WHS	1	1	1	1	1	1	1	1
BROWNSVILLE	56	F	37	44	50	54	56	56	56	56
3		C	49	54	54	56	56	56	56	56
		NO.WHS	1	1	1	1	1	1	1	1
BRUNSWICK	32	F	15	18	23	29	30	31	32	32
5		C	25	28	30	32	32	32	32	32
		NO.WHS	1	1	1	1	1	1	1	1
BRYAN	69	F	23	32	39	55	59	63	69	69
7		C	36	50	59	67	67	68	69	69
		NO.WHS	1	1	1	1	1	1	1	1
BUFFALO	939	F	151	82	250	403	460	516	793	910
69		C	331	297	511	665	727	766	899	938
		NO.WHS	1	1	1	1	1	1	1	1
BURLINGTON IA	34	F	24	29	32	34	34	34	34	34
3		C	32	34	34	34	34	34	34	34
		NO.WHS	1	1	1	1	1	1	1	1
BURLINGTON NC	67	F	29	37	43	52	57	58	66	67
6		C	46	52	58	62	64	65	67	67
		NO.WHS	1	1	1	1	1	1	1	1
BURLINGTON VT	60	F	29	37	46	53	56	57	60	60
6		C	46	50	56	59	59	59	60	60
		NO.WHS	1	1	1	1	1	1	1	1
BUTLER	35	F	24	28	31	35	35	35	35	35
4		C	31	34	35	35	35	35	35	35
		NO.WHS	1	1	1	1	1	1	1	1
BUTTE	41	F	25	30	36	40	41	41	41	41
3		C	35	39	40	41	41	41	41	41
		NO.WHS	1	1	1	1	1	1	1	1
CAMARILLO	32	F	20	24	29	32	32	32	32	32
5		C	28	30	32	32	32	32	32	32
		NO.WHS	1	1	1	1	1	1	1	1
CANTON	237	F	47	67	97	135	153	168	218	234
29		C	99	130	159	190	205	212	233	237
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
CAPE GIRARDEAU	29	F	21	25	28	29	29	29	29	29
3		C	27	29	29	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
CARBONDALE	29	F	20	25	27	29	29	29	29	29
3		C	27	29	29	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
CARLISLE	26	F	21	23	26	26	26	26	26	26
3		C	26	26	26	26	26	26	26	26
		NO.WHS	1	1	1	1	1	1	1	1
CARPENTERSVILLE	34	F	23	28	31	33	34	34	34	34
3		C	30	33	34	34	34	34	34	34
		NO.WHS	1	1	1	1	1	1	1	1
CASPER	48	F	25	31	37	45	46	48	48	48
5		C	38	43	46	48	48	48	48	48
		NO.WHS	1	1	1	1	1	1	1	1
CEDAR RAPIDS	129	F	33	45	65	92	100	108	127	129
10		C	68	85	103	119	121	126	129	129
		NO.WHS	1	1	1	1	1	1	1	1
CHAMPAIGN	104	F	42	52	71	89	95	98	104	104
10		C	71	85	94	102	104	104	104	104
		NO.WHS	1	1	1	1	1	1	1	1
CHAPEL HILL	43	F	28	34	39	41	43	43	43	43
3		C	39	41	43	43	43	43	43	43
		NO.WHS	1	1	1	1	1	1	1	1
CHARLESTON SC	219	F	34	41	54	98	117	132	200	214
25		C	60	81	110	157	177	188	214	219
		NO.WHS	1	1	1	1	1	1	1	1
CHARLESTON WV	145	F	29	40	54	71	79	83	116	136
20		C	60	68	83	100	107	112	135	144
		NO.WHS	1	1	1	1	1	1	1	1
CHARLOTTE	313	F	46	61	89	156	190	210	297	313
26		C	108	141	196	255	276	284	312	313
		NO.WHS	1	1	1	1	1	1	1	1
CHARLOTTESVILLE	61	F	31	40	51	57	61	61	61	61
6		C	50	57	58	61	61	61	61	61
		NO.WHS	1	1	1	1	1	1	1	1
CHATTANOOGA	216	F	22	50	68	106	124	138	196	215
26		C	69	101	136	170	181	191	215	216
		NO.WHS	1	1	1	1	1	1	1	1
CHEYENNE	52	F	24	32	40	49	51	51	52	52
7		C	41	46	49	52	52	52	52	52
		NO.WHS	1	1	1	1	1	1	1	1
CHICAGO	6659	F	121	114	570	923	969	1165	2251	3824
290		C	587	549	1377	1931	2236	2519	3981	5366
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
CHICO	43	F	31	37	40	43	43	43	43	43
2		C	40	41	43	43	43	43	43	43
		NO.WHS	1	1	1	1	1	1	1	1
CHILLICOTHE	27	F	18	22	25	27	27	27	27	27
4		C	25	27	27	27	27	27	27	27
		NO.WHS	1	1	1	1	1	1	1	1
CINCINNATI	1145	F	37	119	182	279	345	396	763	979
88		C	163	281	392	579	676	726	986	1095
		NO.WHS	1	1	1	1	1	1	1	1
CLARKSBURG	35	F	24	28	32	35	35	35	35	35
5		C	32	33	35	35	35	35	35	35
		NO.WHS	1	1	1	1	1	1	1	1
CLARKSVILLE	38	F	12	19	23	31	32	34	38	38
6		C	23	28	32	36	37	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1
CLEVELAND OH	1890	F	75	97	148	450	520	572	985	1369
105		C	183	268	422	776	869	952	1403	1651
		NO.WHS	1	1	1	1	1	1	1	1
CLEVELAND TN	37	F	18	23	29	34	36	36	37	37
4		C	29	32	35	37	37	37	37	37
		NO.WHS	1	1	1	1	1	1	1	1
CLINTON	37	F	19	24	29	34	37	37	37	37
5		C	31	34	35	37	37	37	37	37
		NO.WHS	1	1	1	1	1	1	1	1
CLOVIS	35	F	23	27	32	35	35	35	35	35
3		C	31	33	35	35	35	35	35	35
		NO.WHS	1	1	1	1	1	1	1	1
COLORADO SPRING	254	F	26	67	98	138	159	173	233	253
17		C	82	132	166	202	213	222	251	254
		NO.WHS	1	1	1	1	1	1	1	1
COLUMBIA MO	51	F	34	41	46	50	51	51	51	51
2		C	47	49	51	51	51	51	51	51
		NO.WHS	1	1	1	1	1	1	1	1
COLUMBIA SC	245	F	27	58	85	131	156	170	232	244
23		C	58	130	165	207	219	224	244	245
		NO.WHS	1	1	1	1	1	1	1	1
COLUMBUS GA	186	F	21	46	55	106	126	138	176	185
14		C	50	99	118	156	164	168	184	186
		NO.WHS	1	1	1	1	1	1	1	1
COLUMBUS IN	26	F	17	22	24	26	26	26	26	26
4		C	24	26	26	26	26	26	26	26
		NO.WHS	1	1	1	1	1	1	1	1
COLUMBUS MS	30	F	22	25	27	30	30	30	30	30
2		C	27	29	30	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
COLUMBUS OH	801	F	53	70	121	298	360	403	657	770
		C	107	243	334	535	600	633	763	798
41		NO.WHS	1	1	1	1	1	1	1	1
CONCORD CA	302	F	31	51	78	133	157	172	261	295
		C	96	130	171	216	232	247	295	302
34		NO.WHS	1	1	1	1	1	1	1	1
CONCORD NH	30	F	17	21	26	30	30	30	30	30
		C	26	28	30	30	30	30	30	30
4		NO.WHS	1	1	1	1	1	1	1	1
COOS BAY	28	F	10	14	19	26	27	27	28	28
		C	17	22	27	28	28	28	28	28
5		NO.WHS	1	1	1	1	1	1	1	1
CORPUS CHRISTI	189	F	46	69	95	134	151	161	185	189
		C	85	125	146	173	180	182	189	189
10		NO.WHS	1	1	1	1	1	1	1	1
CORVALLIS	43	F	34	39	41	43	43	43	43	43
		C	41	42	43	43	43	43	43	43
2		NO.WHS	1	1	1	1	1	1	1	1
CUMBERLAND	42	F	22	28	33	39	40	41	42	42
		C	34	38	39	42	42	42	42	42
5		NO.WHS	1	1	1	1	1	1	1	1
DALLAS	2087	F	47	92	147	214	286	345	803	1211
		C	156	254	372	473	671	760	1246	1571
161		NO.WHS	1	1	1	1	1	1	1	1
DALTON	30	F	21	25	28	29	30	30	30	30
		C	28	29	30	30	30	30	30	30
3		NO.WHS	1	1	1	1	1	1	1	1
DANBURY	45	F	29	35	39	44	44	45	45	45
		C	40	43	44	45	45	45	45	45
4		NO.WHS	1	1	1	1	1	1	1	1
DANVILLE IL	50	F	22	32	38	46	49	49	50	50
		C	38	44	48	50	50	50	50	50
7		NO.WHS	1	1	1	1	1	1	1	1
DANVILLE VA	49	F	21	29	38	46	47	49	49	49
		C	38	44	46	49	49	49	49	49
6		NO.WHS	1	1	1	1	1	1	1	1
DAVENPORT	250	F	52	65	94	146	169	186	240	250
		C	102	123	164	208	223	230	249	250
22		NO.WHS	1	1	1	1	1	1	1	1
DAVIS	33	F	24	28	30	33	33	33	33	33
		C	31	32	33	33	33	33	33	33
3		NO.WHS	1	1	1	1	1	1	1	1
DAYTON	702	F	56	93	120	186	245	287	479	592
		C	142	184	258	369	433	461	603	660
62		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
DAYTONA BEACH	126	F	39	52	68	89	95	101	120	126
	13	C	72	82	99	112	116	118	125	126
		NO.WHS	1	1	1	1	1	1	1	1
DECATUR AL	41	F	19	26	35	40	41	41	41	41
	5	C	33	37	40	41	41	41	41	41
		NO.WHS	1	1	1	1	1	1	1	1
DECATUR IL	96	F	29	52	64	81	86	91	96	96
	8	C	61	77	86	93	96	96	96	96
		NO.WHS	1	1	1	1	1	1	1	1
DEKALB	34	F	26	30	33	34	34	34	34	34
	3	C	33	34	34	34	34	34	34	34
		NO.WHS	1	1	1	1	1	1	1	1
DENISON	25	F	18	21	24	25	25	25	25	25
	2	C	23	25	25	25	25	25	25	25
		NO.WHS	1	1	1	1	1	1	1	1
DENTON	50	F	34	40	44	49	50	50	50	50
	3	C	45	48	49	50	50	50	50	50
		NO.WHS	1	1	1	1	1	1	1	1
DENVER	1162	F	35	59	95	219	313	437	821	1061
	56	C	130	212	340	584	706	804	1055	1145
		NO.WHS	1	1	1	1	1	1	1	1
DES MOINES	269	F	47	70	94	140	167	187	255	269
	12	C	101	130	169	223	237	246	268	269
		NO.WHS	1	1	1	1	1	1	1	1
DETROIT	3858	F	43	117	161	520	624	783	1691	2730
	205	C	183	371	703	1260	1479	1737	2857	3466
		NO.WHS	1	1	1	1	1	1	1	1
DOTHAN	47	F	35	41	45	46	47	47	47	47
	1	C	44	46	47	47	47	47	47	47
		NO.WHS	1	1	1	1	1	1	1	1
DOVER	34	F	19	22	26	31	33	33	34	34
	3	C	27	29	33	34	34	34	34	34
		NO.WHS	1	1	1	1	1	1	1	1
DUBUQUE	65	F	35	46	57	63	65	65	65	65
	6	C	55	60	64	65	65	65	65	65
		NO.WHS	1	1	1	1	1	1	1	1
DULUTH	116	F	25	32	43	62	72	81	110	116
	16	C	49	61	74	93	101	104	116	116
		NO.WHS	1	1	1	1	1	1	1	1
DUNKIRK	30	F	13	21	24	29	29	30	30	30
	5	C	25	27	29	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1
DURHAM	103	F	37	54	68	85	91	96	102	103
	9	C	69	81	91	99	102	102	103	103
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
EAST LIVERPOOL	34	F	17	23	29	34	34	34	34	34
		C	28	32	34	34	34	34	34	34
	6	NO.WHS	1	1	1	1	1	1	1	1
EASTON	87	F	32	44	58	75	79	81	87	87
		C	62	69	77	85	86	87	87	87
	11	NO.WHS	1	1	1	1	1	1	1	1
EAU CLAIRE	64	F	33	44	51	60	62	63	64	64
		C	49	58	61	64	64	64	64	64
	3	NO.WHS	1	1	1	1	1	1	1	1
EL DORADO	25	F	16	20	23	25	25	25	25	25
		C	23	23	25	25	25	25	25	25
	3	NO.WHS	1	1	1	1	1	1	1	1
EL PASO	385	F	45	75	101	154	181	208	339	379
		C	99	163	210	267	298	316	374	385
	31	NO.WHS	1	1	1	1	1	1	1	1
ELGIN	71	F	42	50	59	67	70	70	71	71
		C	60	63	68	70	71	71	71	71
	5	NO.WHS	1	1	1	1	1	1	1	1
ELMIRA	72	F	28	38	48	59	61	64	71	72
		C	50	57	64	68	69	71	72	72
	9	NO.WHS	1	1	1	1	1	1	1	1
ENID	46	F	25	34	40	45	46	46	46	46
		C	40	43	45	46	46	46	46	46
	3	NO.WHS	1	1	1	1	1	1	1	1
ERIE	174	F	68	86	107	136	144	150	171	174
		C	114	130	147	162	168	170	174	174
	14	NO.WHS	1	1	1	1	1	1	1	1
ESCONDIDO	55	F	27	37	46	53	55	55	55	55
		C	45	50	55	55	55	55	55	55
	7	NO.WHS	1	1	1	1	1	1	1	1
EUGENE	154	F	31	49	66	99	112	123	152	154
		C	68	92	113	139	143	146	154	154
	12	NO.WHS	1	1	1	1	1	1	1	1
EUREKA	36	F	21	28	32	36	36	36	36	36
		C	31	35	36	36	36	36	36	36
	4	NO.WHS	1	1	1	1	1	1	1	1
EVANSVILLE	138	F	46	65	81	106	115	122	138	138
		C	89	103	117	132	133	135	138	138
	11	NO.WHS	1	1	1	1	1	1	1	1
FAIRBANKS	35	F	18	22	28	32	33	34	35	35
		C	28	32	33	35	35	35	35	35
	5	NO.WHS	1	1	1	1	1	1	1	1
FAIRFIELD	42	F	27	35	38	42	42	42	42	42
		C	38	41	42	42	42	42	42	42
	5	NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
FAIRMONT	28	F	19	22	26	28	28	28	28	28
	4	C	26	27	28	28	28	28	28	28
		NO.WHS	1	1	1	1	1	1	1	1
FARGO	92	F	38	58	73	85	88	91	92	92
	6	C	73	83	87	91	92	92	92	92
		NO.WHS	1	1	1	1	1	1	1	1
FAYETTEVILLE AR	36	F	29	33	35	36	36	36	36	36
	1	C	35	35	36	36	36	36	36	36
		NO.WHS	1	1	1	1	1	1	1	1
FAYETTEVILLE NC	174	F	26	40	49	71	85	96	159	173
	21	C	56	63	88	117	129	137	172	174
		NO.WHS	1	1	1	1	1	1	1	1
FINDLAY	38	F	23	31	36	38	38	38	38	38
	4	C	34	36	38	38	38	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1
FITCHBURG	76	F	29	36	44	63	69	71	76	76
	8	C	46	56	68	75	75	76	76	76
		NO.WHS	1	1	1	1	1	1	1	1
FLAGSTAFF	40	F	22	27	32	38	39	39	40	40
	4	C	30	35	39	40	40	40	40	40
		NO.WHS	1	1	1	1	1	1	1	1
FLINT	295	F	42	57	132	180	208	224	282	294
	18	C	119	145	215	256	267	272	293	295
		NO.WHS	1	1	1	1	1	1	1	1
FLORENCE AL	73	F	18	27	29	48	53	60	71	73
	9	C	32	44	55	65	69	70	73	73
		NO.WHS	1	1	1	1	1	1	1	1
FLORENCE SC	38	F	20	26	31	36	37	38	38	38
	3	C	31	34	37	38	38	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1
FOND DU LAC	41	F	37	39	41	41	41	41	41	41
	1	C	40	41	41	41	41	41	41	41
		NO.WHS	1	1	1	1	1	1	1	1
FORT COLLINS	67	F	39	50	59	66	67	67	67	67
	5	C	58	63	67	67	67	67	67	67
		NO.WHS	1	1	1	1	1	1	1	1
FORT DODGE	30	F	20	25	28	30	30	30	30	30
	4	C	27	30	30	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1
FORT KNOX	37	F	26	29	34	36	37	37	37	37
	3	C	33	36	37	37	37	37	37	37
		NO.WHS	1	1	1	1	1	1	1	1
FORT MYERS	64	F	25	29	39	50	53	56	64	64
	6	C	40	48	54	61	62	62	64	64
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
FORT PIERCE	50	F	37	42	47	49	50	50	50	50
		C	46	48	50	50	50	50	50	50
	2	NO.WHS	1	1	1	1	1	1	1	1
FORT SMITH	83	F	29	40	51	64	68	70	81	83
		C	53	60	69	76	78	80	83	83
	8	NO.WHS	1	1	1	1	1	1	1	1
FORT WALTON BEA	51	F	22	31	40	48	50	50	51	51
		C	39	46	49	51	51	51	51	51
	5	NO.WHS	1	1	1	1	1	1	1	1
FORT WAYNE	228	F	54	88	112	149	166	180	221	228
		C	120	148	174	203	209	215	228	228
	17	NO.WHS	1	1	1	1	1	1	1	1
FREDERICK	30	F	29	30	30	30	30	30	30	30
		C	30	30	30	30	30	30	30	30
	1	NO.WHS	1	1	1	1	1	1	1	1
FREEPORT	27	F	21	25	27	27	27	27	27	27
		C	25	27	27	27	27	27	27	27
	2	NO.WHS	1	1	1	1	1	1	1	1
FRESNO	289	F	34	60	94	177	206	227	281	289
		C	102	151	199	254	266	272	289	289
	15	NO.WHS	1	1	1	1	1	1	1	1
GADSDEN	55	F	13	22	34	43	47	51	55	55
		C	25	41	47	54	54	54	55	55
	9	NO.WHS	1	1	1	1	1	1	1	1
GAINESVILLE FL	88	F	34	47	63	78	83	85	88	88
		C	62	73	82	87	87	88	88	88
	7	NO.WHS	1	1	1	1	1	1	1	1
GAINESVILLE GA	30	F	21	25	29	30	30	30	30	30
		C	28	29	30	30	30	30	30	30
	4	NO.WHS	1	1	1	1	1	1	1	1
GALESBURG	37	F	30	34	36	37	37	37	37	37
		C	36	36	37	37	37	37	37	37
	1	NO.WHS	1	1	1	1	1	1	1	1
GALVESTON	70	F	34	46	56	64	67	68	70	70
		C	53	62	66	68	70	70	70	70
	5	NO.WHS	1	1	1	1	1	1	1	1
GASTONIA	102	F	28	32	41	55	62	68	94	101
		C	46	55	66	78	83	85	101	102
	11	NO.WHS	1	1	1	1	1	1	1	1
GLASSBORO	33	F	18	21	25	28	29	31	33	33
		C	26	27	30	31	32	32	33	33
	4	NO.WHS	1	1	1	1	1	1	1	1
GLENS FALLS	59	F	23	30	37	49	53	55	59	59
		C	39	45	53	58	59	59	59	59
	7	NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
GLOUCESTER	26	F	20	22	25	26	26	26	26	26
		C	25	26	26	26	26	26	26	26
	4	NO.WHS	1	1	1	1	1	1	1	1
GLOVERSVILLE	36	F	19	21	25	32	34	35	36	36
		C	26	28	32	35	36	36	36	36
	5	NO.WHS	1	1	1	1	1	1	1	1
GOLDSBORO	42	F	22	26	32	38	40	40	42	42
		C	32	37	40	42	42	42	42	42
	3	NO.WHS	1	1	1	1	1	1	1	1
GRAND FORKS	48	F	33	39	43	47	48	48	48	48
		C	43	45	48	48	48	48	48	48
	3	NO.WHS	1	1	1	1	1	1	1	1
GRAND ISLAND	35	F	30	33	34	35	35	35	35	35
		C	34	35	35	35	35	35	35	35
	1	NO.WHS	1	1	1	1	1	1	1	1
GRAND JUNCTION	35	F	22	27	31	35	35	35	35	35
		C	32	34	35	35	35	35	35	35
	4	NO.WHS	1	1	1	1	1	1	1	1
GRAND RAPIDS	359	F	57	63	118	178	212	236	328	354
		C	130	166	220	280	302	317	353	359
	31	NO.WHS	1	1	1	1	1	1	1	1
GREAT FALLS	74	F	31	38	49	62	66	68	74	74
		C	51	59	65	72	73	73	74	74
	7	NO.WHS	1	1	1	1	1	1	1	1
GREELEY	53	F	34	42	49	53	53	53	53	53
		C	49	51	53	53	53	53	53	53
	4	NO.WHS	1	1	1	1	1	1	1	1
GREEN BAY	144	F	50	54	81	113	123	130	143	144
		C	80	108	122	137	139	140	144	144
	6	NO.WHS	1	1	1	1	1	1	1	1
GREENSBORO	155	F	29	47	69	106	121	131	154	155
		C	77	101	122	143	149	151	155	155
	18	NO.WHS	1	1	1	1	1	1	1	1
GREENSBURG	39	F	26	32	35	39	39	39	39	39
		C	35	39	39	39	39	39	39	39
	5	NO.WHS	1	1	1	1	1	1	1	1
GREENVILLE MS	44	F	32	37	41	43	44	44	44	44
		C	41	42	44	44	44	44	44	44
	2	NO.WHS	1	1	1	1	1	1	1	1
GREENVILLE NC	32	F	25	29	32	32	32	32	32	32
		C	31	32	32	32	32	32	32	32
	3	NO.WHS	1	1	1	1	1	1	1	1
GREENVILLE SC	185	F	21	54	88	115	132	141	179	184
		C	74	111	139	161	166	173	184	185
	14	NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
GREENWOOD	27	F	17	20	24	27	27	27	27	27
3		C	24	25	27	27	27	27	27	27
		NO.WHS	1	1	1	1	1	1	1	1
GRIFFIN	38	F	27	31	34	37	37	38	38	38
2		C	34	36	37	38	38	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1
HAGERSTOWN	51	F	30	37	43	48	50	50	51	51
6		C	43	47	49	51	51	51	51	51
		NO.WHS	1	1	1	1	1	1	1	1
HANOVER	26	F	18	22	24	26	26	26	26	26
3		C	24	26	26	26	26	26	26	26
		NO.WHS	1	1	1	1	1	1	1	1
HARLINGEN	38	F	28	33	36	38	38	38	38	38
3		C	36	38	38	38	38	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1
HARRISBURG	253	F	42	55	88	132	155	167	229	249
33		C	96	130	160	201	212	222	248	253
		NO.WHS	1	1	1	1	1	1	1	1
HARTFORD	651	F	56	69	162	216	252	278	453	570
52		C	97	123	272	358	408	435	573	626
		NO.WHS	1	1	1	1	1	1	1	1
HATTIESBURG	48	F	23	31	38	44	46	47	48	48
3		C	38	42	46	48	48	48	48	48
		NO.WHS	1	1	1	1	1	1	1	1
HAVERHILL	41	F	25	31	35	40	40	41	41	41
4		C	35	38	40	41	41	41	41	41
		NO.WHS	1	1	1	1	1	1	1	1
HAZLETON	35	F	27	30	33	35	35	35	35	35
3		C	33	35	35	35	35	35	35	35
		NO.WHS	1	1	1	1	1	1	1	1
HEMET	32	F	20	24	25	30	31	31	32	32
5		C	27	29	31	32	32	32	32	32
		NO.WHS	1	1	1	1	1	1	1	1
HICKORY	45	F	21	27	33	40	42	43	45	45
5		C	32	38	42	44	45	45	45	45
		NO.WHS	1	1	1	1	1	1	1	1
HIGH POINT	69	F	32	41	50	62	66	67	69	69
7		C	52	59	65	68	69	69	69	69
		NO.WHS	1	1	1	1	1	1	1	1
HOBBS	29	F	24	27	28	29	29	29	29	29
1		C	28	29	29	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
HOLLAND	47	F	27	31	35	41	41	42	46	47
4		C	36	39	42	44	45	46	47	47
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
HOMESTEAD	50	F	20	23	26	33	38	41	50	50
5		C	27	31	35	45	48	49	50	50
		NO.WHS	1	1	1	1	1	1	1	1
HONOLULU	483	F	79	102	134	200	234	257	381	452
37		C	159	203	253	308	343	362	449	478
		NO.WHS	1	1	1	1	1	1	1	1
HOPKINSVILLE	35	F	22	29	31	35	35	35	35	35
5		C	31	35	35	35	35	35	35	35
		NO.WHS	1	1	1	1	1	1	1	1
HOT SPRINGS	41	F	23	29	34	40	41	41	41	41
6		C	36	38	40	41	41	41	41	41
		NO.WHS	1	1	1	1	1	1	1	1
HOUMA	47	F	25	31	37	44	46	46	47	47
5		C	38	42	45	47	47	47	47	47
		NO.WHS	1	1	1	1	1	1	1	1
HOUSTON	1807	F	40	49	167	288	353	448	1060	1523
73		C	160	289	404	675	867	953	1521	1726
		NO.WHS	1	1	1	1	1	1	1	1
HUNTINGTON	161	F	37	45	53	65	70	73	101	144
16		C	55	62	68	82	85	94	140	159
		NO.WHS	1	1	1	1	1	1	1	1
HUNTSVILLE	143	F	26	40	64	91	106	112	137	143
18		C	61	88	106	126	132	136	142	143
		NO.WHS	1	1	1	1	1	1	1	1
HUTCHINSON	41	F	28	34	38	41	41	41	41	41
3		C	36	38	41	41	41	41	41	41
		NO.WHS	1	1	1	1	1	1	1	1
IDAHO FALLS	39	F	26	32	36	39	39	39	39	39
4		C	36	39	39	39	39	39	39	39
		NO.WHS	1	1	1	1	1	1	1	1
ILION	29	F	13	17	21	26	28	28	29	29
5		C	20	24	27	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
INDIANAPOLIS	780	F	30	55	94	260	266	358	598	724
47		C	71	136	281	472	521	566	724	773
		NO.WHS	1	1	1	1	1	1	1	1
IOWA CITY	54	F	31	38	45	51	53	53	54	54
6		C	45	50	53	54	54	54	54	54
		NO.WHS	1	1	1	1	1	1	1	1
ITHACA	44	F	30	36	42	44	44	44	44	44
5		C	40	43	44	44	44	44	44	44
		NO.WHS	1	1	1	1	1	1	1	1
JACKSON MI	80	F	47	55	63	70	74	75	80	80
4		C	64	71	74	77	79	79	80	80
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
JACKSON MS	191	F	45	59	81	120	136	146	183	191
14		C	85	114	139	165	175	180	191	191
		NO.WHS	1	1	1	1	1	1	1	1
JACKSON TN	43	F	32	35	39	42	43	43	43	43
3		C	39	41	42	43	43	43	43	43
		NO.WHS	1	1	1	1	1	1	1	1
JACKSONVILLE BE	52	F	16	21	25	31	37	40	51	52
6		C	23	32	35	46	48	50	52	52
		NO.WHS	1	1	1	1	1	1	1	1
JACKSONVILLE FL	547	F	37	79	111	186	232	266	463	534
50		C	91	187	267	351	398	434	527	547
		NO.WHS	1	1	1	1	1	1	1	1
JACKSONVILLE NC	52	F	20	26	34	43	45	48	52	52
6		C	34	40	47	50	51	51	52	52
		NO.WHS	1	1	1	1	1	1	1	1
JAMESTOWN	53	F	33	38	42	47	49	50	53	53
4		C	43	46	49	52	52	52	53	53
		NO.WHS	1	1	1	1	1	1	1	1
JANESVILLE	48	F	29	35	41	47	48	48	48	48
4		C	41	45	47	48	48	48	48	48
		NO.WHS	1	1	1	1	1	1	1	1
JEFFERSON CITY	37	F	18	24	29	34	35	36	37	37
5		C	29	33	36	37	37	37	37	37
		NO.WHS	1	1	1	1	1	1	1	1
JOHNSON CITY	43	F	21	29	35	40	42	43	43	43
6		C	35	39	41	43	43	43	43	43
		NO.WHS	1	1	1	1	1	1	1	1
JOHNSTOWN	90	F	29	40	57	74	80	83	90	90
13		C	57	69	79	87	89	89	90	90
		NO.WHS	1	1	1	1	1	1	1	1
JOLIET	166	F	51	73	98	127	142	150	165	166
14		C	105	128	142	158	161	163	166	166
		NO.WHS	1	1	1	1	1	1	1	1
JONESBORO	31	F	21	24	27	30	30	30	31	31
2		C	26	28	30	31	31	31	31	31
		NO.WHS	1	1	1	1	1	1	1	1
JOPLIN	56	F	22	30	38	46	47	50	55	56
8		C	37	43	48	51	53	55	56	56
		NO.WHS	1	1	1	1	1	1	1	1
KAILUA	94	F	28	37	46	74	80	86	94	94
9		C	50	63	80	90	91	94	94	94
		NO.WHS	1	1	1	1	1	1	1	1
KALAMAZOO	134	F	42	56	75	103	110	117	131	134
12		C	80	100	109	125	129	130	134	134
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
KANKAKEE	48	F	24	33	40	47	48	48	48	48
8		C	41	45	47	48	48	48	48	48
		NO.WHS	1	1	1	1	1	1	1	1
KANNAPOLIS	76	F	18	26	33	41	50	55	73	76
9		C	29	41	50	61	69	71	76	76
		NO.WHS	1	1	1	1	1	1	1	1
KANSAS CITY	1027	F	59	92	121	255	307	352	688	912
73		C	138	197	321	506	592	670	908	1005
		NO.WHS	1	1	1	1	1	1	1	1
KENOSHA	83	F	61	70	77	81	83	83	83	83
2		C	76	80	81	83	83	83	83	83
		NO.WHS	1	1	1	1	1	1	1	1
KEY WEST	32	F	19	24	29	32	32	32	32	32
4		C	28	30	32	32	32	32	32	32
		NO.WHS	1	1	1	1	1	1	1	1
KILLEEN	93	F	52	64	75	86	89	91	93	93
4		C	77	85	89	91	93	93	93	93
		NO.WHS	1	1	1	1	1	1	1	1
KINGSPORT	57	F	18	24	33	47	51	53	57	57
10		C	34	43	48	55	57	57	57	57
		NO.WHS	1	1	1	1	1	1	1	1
KINGSTON	42	F	23	29	35	41	42	42	42	42
6		C	34	39	41	42	42	42	42	42
		NO.WHS	1	1	1	1	1	1	1	1
KINGSVILLE	28	F	25	27	28	28	28	28	28	28
1		C	28	28	28	28	28	28	28	28
		NO.WHS	1	1	1	1	1	1	1	1
KINSTON	34	F	28	31	33	34	34	34	34	34
1		C	33	34	34	34	34	34	34	34
		NO.WHS	1	1	1	1	1	1	1	1
KLAMATH FALLS	36	F	14	18	26	32	35	35	36	36
4		C	24	32	34	36	36	36	36	36
		NO.WHS	1	1	1	1	1	1	1	1
KNOXVILLE	209	F	28	54	77	119	140	149	198	208
23		C	78	114	147	175	188	191	208	209
		NO.WHS	1	1	1	1	1	1	1	1
KOKOMO	64	F	30	39	49	58	60	61	64	64
6		C	48	54	60	63	63	64	64	64
		NO.WHS	1	1	1	1	1	1	1	1
LA CROSSE	68	F	38	42	48	57	60	62	67	68
5		C	50	56	59	64	66	67	68	68
		NO.WHS	1	1	1	1	1	1	1	1
LAFAYETTE IN	80	F	29	40	57	72	76	78	80	80
6		C	49	70	74	79	80	80	80	80
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
LAFAYETTE LA	102	F	34	50	69	89	93	98	102	102
		C	72	84	93	101	101	102	102	102
	11	NO.WHS	1	1	1	1	1	1	1	1
LAKE CHARLES	96	F	23	43	56	73	80	86	95	96
		C	54	71	81	90	92	93	96	96
	7	NO.WHS	1	1	1	1	1	1	1	1
LAKELAND	84	F	29	42	57	73	78	81	84	84
		C	56	69	77	83	83	84	84	84
	8	NO.WHS	1	1	1	1	1	1	1	1
LANCASTER CA	33	F	27	30	32	33	33	33	33	33
		C	32	33	33	33	33	33	33	33
	1	NO.WHS	1	1	1	1	1	1	1	1
LANCASTER OH	40	F	27	33	37	40	40	40	40	40
		C	38	39	40	40	40	40	40	40
	5	NO.WHS	1	1	1	1	1	1	1	1
LANCASTER PA	110	F	58	70	81	96	102	103	110	110
		C	84	91	101	108	109	109	110	110
	9	NO.WHS	1	1	1	1	1	1	1	1
LANSING	245	F	44	59	94	143	169	184	237	245
		C	97	117	178	211	222	228	245	245
	15	NO.WHS	1	1	1	1	1	1	1	1
LAREDO	76	F	51	60	69	76	76	76	76	76
		C	67	73	76	76	76	76	76	76
	4	NO.WHS	1	1	1	1	1	1	1	1
LAS CRUCES	59	F	27	38	46	55	57	58	59	59
		C	47	53	56	59	59	59	59	59
	4	NO.WHS	1	1	1	1	1	1	1	1
LAS VEGAS	292	F	33	59	102	162	187	205	280	292
		C	94	147	202	247	262	270	291	292
	23	NO.WHS	1	1	1	1	1	1	1	1
LATROBE	26	F	14	17	20	23	24	25	26	26
		C	21	23	24	25	26	26	26	26
	5	NO.WHS	1	1	1	1	1	1	1	1
LAUREL	49	F	21	29	37	44	47	48	49	49
		C	36	43	46	49	49	49	49	49
	5	NO.WHS	1	1	1	1	1	1	1	1
LAWRENCE KS	52	F	30	39	47	51	52	52	52	52
		C	46	50	52	52	52	52	52	52
	7	NO.WHS	1	1	1	1	1	1	1	1
LAWRENCE MA	117	F	51	70	88	105	110	113	117	117
		C	89	101	110	116	116	117	117	117
	9	NO.WHS	1	1	1	1	1	1	1	1
LAWTON	93	F	32	49	61	77	82	86	93	93
		C	64	75	82	90	90	92	93	93
	7	NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
LEAVENWORTH	38	F	17	23	29	34	36	36	38	38
5		C	30	33	36	38	38	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1
LEBANON	49	F	31	38	42	47	48	48	49	49
5		C	43	45	47	49	49	49	49	49
		NO.WHS	1	1	1	1	1	1	1	1
LEWISTON ID	30	F	13	18	22	27	28	29	30	30
4		C	21	26	28	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1
LEWISTON ME	66	F	39	47	55	63	64	65	66	66
6		C	54	59	64	66	66	66	66	66
		NO.WHS	1	1	1	1	1	1	1	1
LEXINGTON	178	F	54	78	102	138	152	158	178	178
13		C	104	127	154	168	173	176	178	178
		NO.WHS	1	1	1	1	1	1	1	1
LIMA	63	F	33	43	53	60	61	63	63	63
4		C	51	58	61	63	63	63	63	63
		NO.WHS	1	1	1	1	1	1	1	1
LINCOLN	168	F	35	81	110	140	151	156	168	168
7		C	101	136	150	162	165	166	168	168
		NO.WHS	1	1	1	1	1	1	1	1
LITTLE ROCK	246	F	30	41	68	116	140	155	224	245
21		C	72	112	149	193	205	216	243	246
		NO.WHS	1	1	1	1	1	1	1	1
LIVERMORE	37	F	24	29	34	37	37	37	37	37
5		C	33	36	37	37	37	37	37	37
		NO.WHS	1	1	1	1	1	1	1	1
LOCKPORT	29	F	21	24	27	29	29	29	29	29
5		C	27	29	29	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
LODI	31	F	24	28	30	31	31	31	31	31
2		C	29	31	31	31	31	31	31	31
		NO.WHS	1	1	1	1	1	1	1	1
LOGAN	30	F	20	23	27	30	30	30	30	30
3		C	27	29	30	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1
LONGVIEW TX	53	F	22	28	35	44	47	49	53	53
5		C	36	42	47	50	52	52	53	53
		NO.WHS	1	1	1	1	1	1	1	1
LONGVIEW WA	51	F	24	33	41	48	50	51	51	51
6		C	39	46	50	51	51	51	51	51
		NO.WHS	1	1	1	1	1	1	1	1
LOS ANGELES	8664	F	90	121	155	369	671	816	2033	3828
450		C	231	375	815	1149	1793	2010	4205	6275
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
LOUISVILLE	717	F	70	89	134	229	282	323	561	679
60		C	144	200	301	443	499	542	674	712
		NO.WHS	1	1	1	1	1	1	1	1
LUBBOCK	163	F	22	73	107	131	142	146	162	163
7		C	72	123	143	153	157	161	163	163
		NO.WHS	1	1	1	1	1	1	1	1
LYNCHBURG	75	F	25	34	46	63	67	71	75	75
10		C	49	56	67	73	75	75	75	75
		NO.WHS	1	1	1	1	1	1	1	1
MACON	125	F	35	40	73	93	102	107	124	125
8		C	74	83	104	115	120	121	125	125
		NO.WHS	1	1	1	1	1	1	1	1
MADISON	209	F	39	49	73	115	133	147	200	209
19		C	85	111	137	175	187	192	209	209
		NO.WHS	1	1	1	1	1	1	1	1
MANCHESTER	99	F	42	67	79	90	95	95	99	99
4		C	75	89	95	99	99	99	99	99
		NO.WHS	1	1	1	1	1	1	1	1
MANHATTAN	32	F	22	28	32	32	32	32	32	32
4		C	31	32	32	32	32	32	32	32
		NO.WHS	1	1	1	1	1	1	1	1
MANITOWOC	32	F	20	24	27	30	32	32	32	32
3		C	27	30	32	32	32	32	32	32
		NO.WHS	1	1	1	1	1	1	1	1
MANKATO	38	F	26	33	35	38	38	38	38	38
4		C	35	38	38	38	38	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1
MANSFIELD	73	F	32	43	54	66	70	70	73	73
7		C	55	63	69	73	73	73	73	73
		NO.WHS	1	1	1	1	1	1	1	1
MARION IN	42	F	21	28	35	40	42	42	42	42
7		C	35	38	42	42	42	42	42	42
		NO.WHS	1	1	1	1	1	1	1	1
MARION OH	45	F	33	39	42	45	45	45	45	45
3		C	42	44	45	45	45	45	45	45
		NO.WHS	1	1	1	1	1	1	1	1
MARLBOROUGH	26	F	25	26	26	26	26	26	26	26
1		C	26	26	26	26	26	26	26	26
		NO.WHS	1	1	1	1	1	1	1	1
MARSHALLTOWN	27	F	21	24	26	27	27	27	27	27
3		C	25	27	27	27	27	27	27	27
		NO.WHS	1	1	1	1	1	1	1	1
MARTINSVILLE	29	F	14	17	21	24	26	26	29	29
4		C	22	23	26	28	28	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
MARYVILLE	36	F	17	22	28	33	36	36	36	36
5		C	28	33	34	36	36	36	36	36
		NO.WHS	1	1	1	1	1	1	1	1
MASON CITY	30	F	22	26	30	30	30	30	30	30
4		C	30	30	30	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1
MCALLEN	75	F	37	42	45	62	68	70	75	75
4		C	51	57	63	73	74	74	75	75
		NO.WHS	1	1	1	1	1	1	1	1
MEDFORD,	41	F	28	34	38	41	41	41	41	41
3		C	38	39	41	41	41	41	41	41
		NO.WHS	1	1	1	1	1	1	1	1
MELBOURNE	46	F	18	20	24	31	36	37	45	46
6		C	25	28	32	40	43	44	46	46
		NO.WHS	1	1	1	1	1	1	1	1
MEMPHIS	698	F	35	130	104	293	339	372	575	672
34		C	146	284	287	479	521	555	664	695
		NO.WHS	1	1	1	1	1	1	1	1
MERCED	36	F	22	29	33	36	36	36	36	36
4		C	33	35	36	36	36	36	36	36
		NO.WHS	1	1	1	1	1	1	1	1
MERIDEN	54	F	35	44	50	53	54	54	54	54
5		C	50	52	54	54	54	54	54	54
		NO.WHS	1	1	1	1	1	1	1	1
MERIDIAN	54	F	26	37	45	51	53	54	54	54
4		C	44	48	53	54	54	54	54	54
		NO.WHS	1	1	1	1	1	1	1	1
MERRITT ISLAND	63	F	16	23	33	48	54	57	63	63
9		C	36	42	51	60	62	62	63	63
		NO.WHS	1	1	1	1	1	1	1	1
MIAMI	2320	F	75	121	201	307	366	469	944	1420
111		C	225	321	444	725	762	965	1472	1878
		NO.WHS	1	1	1	1	1	1	1	1
MICHIGAN CITY	37	F	28	33	35	37	37	37	37	37
2		C	35	37	37	37	37	37	37	37
		NO.WHS	1	1	1	1	1	1	1	1
MIDDLETOWN CT	41	F	24	31	38	41	41	41	41	41
5		C	37	38	41	41	41	41	41	41
		NO.WHS	1	1	1	1	1	1	1	1
MIDDLETOWN NY	31	F	22	27	31	31	31	31	31	31
4		C	29	31	31	31	31	31	31	31
		NO.WHS	1	1	1	1	1	1	1	1
MIDLAND MI	38	F	32	35	37	38	38	38	38	38
1		C	37	38	38	38	38	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
MIDLAND TX	64	F	25	35	48	58	62	62	64	64
	4	C	42	56	61	64	64	64	64	64
		NO.WHS	1	1	1	1	1	1	1	1
MILLEDGEVILLE	26	F	17	21	24	26	26	26	26	26
	2	C	24	25	26	26	26	26	26	26
		NO.WHS	1	1	1	1	1	1	1	1
MILWAUKEE	1137	F	76	198	234	299	462	521	885	1056
	48	C	233	402	504	669	755	849	1050	1120
		NO.WHS	1	1	1	1	1	1	1	1
MINNEAPOLIS	1577	F	49	67	88	315	299	443	940	1321
	67	C	133	216	369	647	739	835	1331	1504
		NO.WHS	1	1	1	1	1	1	1	1
MINOT	35	F	23	28	32	35	35	35	35	35
	4	C	31	35	35	35	35	35	35	35
		NO.WHS	1	1	1	1	1	1	1	1
MISSION VIEJO	45	F	22	31	38	44	45	45	45	45
	6	C	38	42	45	45	45	45	45	45
		NO.WHS	1	1	1	1	1	1	1	1
MISSOULA	49	F	26	34	41	48	49	49	49	49
	5	C	41	45	48	49	49	49	49	49
		NO.WHS	1	1	1	1	1	1	1	1
MOBILE	276	F	43	56	85	133	160	179	252	271
	20	C	85	104	157	211	230	240	270	276
		NO.WHS	1	1	1	1	1	1	1	1
MODESTO	128	F	50	62	77	103	110	117	127	128
	9	C	80	96	112	121	125	126	128	128
		NO.WHS	1	1	1	1	1	1	1	1
MONESSEN	66	F	15	27	36	48	52	56	65	66
	12	C	35	46	52	61	63	63	66	66
		NO.WHS	1	1	1	1	1	1	1	1
MONROE LA	107	F	22	40	56	81	90	93	107	107
	10	C	59	76	89	100	103	106	107	107
		NO.WHS	1	1	1	1	1	1	1	1
MONROE MI	39	F	26	32	36	39	39	39	39	39
	4	C	36	39	39	39	39	39	39	39
		NO.WHS	1	1	1	1	1	1	1	1
MONTGOMERY	158	F	32	65	96	126	138	143	158	158
	8	C	84	119	135	149	154	155	158	158
		NO.WHS	1	1	1	1	1	1	1	1
MORGANTOWN	40	F	25	30	36	39	40	40	40	40
	5	C	36	39	40	40	40	40	40	40
		NO.WHS	1	1	1	1	1	1	1	1
MUNCIE	87	F	41	57	67	79	83	84	87	87
	5	C	68	76	81	87	87	87	87	87
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
MUNDELEIN	36	F	18	22	29	34	35	36	36	36
	4	C	29	32	35	36	36	36	36	36
		NO.WHS	1	1	1	1	1	1	1	1
MURFREESBORO	32	F	20	25	28	32	32	32	32	32
	4	C	29	31	32	32	32	32	32	32
		NO.WHS	1	1	1	1	1	1	1	1
MUSKEGON	101	F	32	45	60	81	88	93	101	101
	12	C	64	79	90	96	99	101	101	101
		NO.WHS	1	1	1	1	1	1	1	1
MUSKOGEE	38	F	23	30	35	37	38	38	38	38
	2	C	34	36	38	38	38	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1
NAPA	57	F	29	39	47	54	56	56	57	57
	6	C	46	52	55	57	57	57	57	57
		NO.WHS	1	1	1	1	1	1	1	1
NASHUA	68	F	45	56	63	68	68	68	68	68
	4	C	62	65	68	68	68	68	68	68
		NO.WHS	1	1	1	1	1	1	1	1
NASHVILLE	398	F	43	69	93	147	181	208	332	385
	44	C	108	146	197	265	291	315	383	397
		NO.WHS	1	1	1	1	1	1	1	1
NATCHEZ	33	F	17	22	25	30	31	32	33	33
	4	C	26	29	31	33	33	33	33	33
		NO.WHS	1	1	1	1	1	1	1	1
NEDERLAND	33	F	17	23	27	31	32	33	33	33
	5	C	28	29	31	33	33	33	33	33
		NO.WHS	1	1	1	1	1	1	1	1
NEW BEDFORD	136	F	43	63	84	116	120	128	136	136
	14	C	86	104	121	131	134	136	136	136
		NO.WHS	1	1	1	1	1	1	1	1
NEW CASTLE IN	25	F	21	23	25	25	25	25	25	25
	2	C	25	25	25	25	25	25	25	25
		NO.WHS	1	1	1	1	1	1	1	1
NEW CASTLE PA	55	F	26	35	45	52	54	55	55	55
	7	C	44	50	52	55	55	55	55	55
		NO.WHS	1	1	1	1	1	1	1	1
NEW IBERIA	33	F	22	29	31	33	33	33	33	33
	4	C	31	33	33	33	33	33	33	33
		NO.WHS	1	1	1	1	1	1	1	1
NEW LONDON	57	F	25	34	43	51	54	55	57	57
	8	C	44	50	53	56	57	57	57	57
		NO.WHS	1	1	1	1	1	1	1	1
NEW ORLEANS	1015	F	83	109	170	359	443	503	822	971
	53	C	227	327	483	673	750	795	963	1009
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
NEW PHILADELPHI	29	F	14	18	22	27	28	29	29	29
5		C	23	26	27	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
NEW YORK	16323	F	322	513	746	1208	1454	1667	4524	7698
714		C	999	1425	2044	3265	3881	4505	8750	11572
		NO.WHS	1	1	1	1	1	1	1	1
NEWARK	52	F	29	37	45	49	52	52	52	52
5		C	43	49	51	52	52	52	52	52
		NO.WHS	1	1	1	1	1	1	1	1
NEWBURGH	81	F	33	40	49	65	70	72	80	81
9		C	52	59	69	76	79	80	81	81
		NO.WHS	1	1	1	1	1	1	1	1
NEWBURYPORT	26	F	12	11	17	23	24	24	26	26
4		C	16	22	24	26	26	26	26	26
		NO.WHS	1	1	1	1	1	1	1	1
NEWPORT	49	F	30	35	43	48	48	49	49	49
4		C	43	46	48	49	49	49	49	49
		NO.WHS	1	1	1	1	1	1	1	1
NEWPORT NEWS	267	F	42	54	74	122	147	162	225	250
32		C	78	102	143	194	209	217	253	263
		NO.WHS	1	1	1	1	1	1	1	1
NIAGARA FALLS	110	F	44	53	62	82	90	95	109	110
12		C	67	76	87	102	105	106	110	110
		NO.WHS	1	1	1	1	1	1	1	1
NORFOLK	688	F	48	58	97	180	236	273	497	627
64		C	131	162	266	376	451	485	625	674
		NO.WHS	1	1	1	1	1	1	1	1
NORMAN	61	F	38	47	54	61	61	61	61	61
4		C	53	57	61	61	61	61	61	61
		NO.WHS	1	1	1	1	1	1	1	1
NORWICH	40	F	25	30	34	38	39	39	40	40
6		C	35	38	39	40	40	40	40	40
		NO.WHS	1	1	1	1	1	1	1	1
OAK RIDGE	28	F	11	17	22	26	26	28	28	28
5		C	20	24	26	28	28	28	28	28
		NO.WHS	1	1	1	1	1	1	1	1
OCALA	49	F	30	36	41	46	48	48	49	49
3		C	41	45	47	49	49	49	49	49
		NO.WHS	1	1	1	1	1	1	1	1
OCEANSIDE	70	F	27	34	42	58	63	65	70	70
7		C	49	52	62	67	69	69	70	70
		NO.WHS	1	1	1	1	1	1	1	1
ODESSA	87	F	30	54	70	81	85	86	87	87
4		C	62	79	83	87	87	87	87	87
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
OGDEN	96	F	24	55	65	82	88	89	96	96
	6	C	58	79	85	93	95	96	96	96
		NO.WHS	1	1	1	1	1	1	1	1
OKLAHOMA CITY	499	F	37	60	83	138	184	221	399	479
	46	C	88	131	190	306	354	378	472	498
		NO.WHS	1	1	1	1	1	1	1	1
OLYMPIA	53	F	20	23	34	45	48	49	53	53
	6	C	38	42	48	52	52	53	53	53
		NO.WHS	1	1	1	1	1	1	1	1
OMAHA	524	F	33	46	140	224	269	295	454	510
	34	C	90	175	291	363	406	430	508	524
		NO.WHS	1	1	1	1	1	1	1	1
ORANGE	33	F	24	28	30	33	33	33	33	33
	3	C	30	33	33	33	33	33	33	33
		NO.WHS	1	1	1	1	1	1	1	1
ORLANDO	407	F	28	42	85	143	181	208	342	396
	43	C	77	131	206	280	306	330	394	406
		NO.WHS	1	1	1	1	1	1	1	1
OSHKOSH	55	F	41	46	51	54	55	55	55	55
	2	C	51	53	55	55	55	55	55	55
		NO.WHS	1	1	1	1	1	1	1	1
OTTUMWA	30	F	15	21	26	28	30	30	30	30
	4	C	25	28	29	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1
OWENSBORO	54	F	33	41	49	54	54	54	54	54
	5	C	48	52	54	54	54	54	54	54
		NO.WHS	1	1	1	1	1	1	1	1
OXNARD	202	F	45	58	78	99	113	121	186	201
	20	C	76	92	114	141	154	165	200	202
		NO.WHS	1	1	1	1	1	1	1	1
PADUCAH	36	F	19	23	29	32	34	35	36	36
	6	C	29	31	34	35	36	36	36	36
		NO.WHS	1	1	1	1	1	1	1	1
PANAMA CITY	48	F	21	26	31	41	43	45	48	48
	7	C	35	38	43	46	47	48	48	48
		NO.WHS	1	1	1	1	1	1	1	1
PARKERSBURG	65	F	28	35	45	55	58	59	65	65
	7	C	46	52	57	62	64	64	65	65
		NO.WHS	1	1	1	1	1	1	1	1
PASCAGOULA	60	F	28	32	42	52	56	58	60	60
	4	C	40	51	55	59	60	60	60	60
		NO.WHS	1	1	1	1	1	1	1	1
PASCO	56	F	18	26	38	52	53	55	56	56
	7	C	36	47	53	56	56	56	56	56
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
PEEKSKILL	66	F	20	26	33	41	47	49	64	66
11		C	33	42	47	56	60	62	66	66
		NO.WHS	1	1	1	1	1	1	1	1
PEKIN	36	F	26	30	34	36	36	36	36	36
4		C	33	36	36	36	36	36	36	36
		NO.WHS	1	1	1	1	1	1	1	1
PENSACOLA	182	F	41	58	82	115	131	139	175	182
17		C	90	108	131	158	163	171	182	182
		NO.WHS	1	1	1	1	1	1	1	1
PEORIA	208	F	41	61	89	128	143	155	200	208
20		C	93	118	149	175	187	190	207	208
		NO.WHS	1	1	1	1	1	1	1	1
PERU	28	F	17	20	23	26	26	27	28	28
3		C	22	25	26	27	28	28	28	28
		NO.WHS	1	1	1	1	1	1	1	1
PETALUMA	33	F	24	29	31	33	33	33	33	33
2		C	31	33	33	33	33	33	33	33
		NO.WHS	1	1	1	1	1	1	1	1
PETERSBURG	104	F	28	39	49	64	71	74	98	104
14		C	53	63	74	86	90	92	103	104
		NO.WHS	1	1	1	1	1	1	1	1
PHILADELPHIA	4557	F	98	159	279	406	533	641	1899	2906
204		C	304	450	790	1381	1669	1753	3070	3786
		NO.WHS	1	1	1	1	1	1	1	1
PHOENIX	996	F	36	54	88	276	318	380	670	884
46		C	123	164	276	531	584	650	876	967
		NO.WHS	1	1	1	1	1	1	1	1
PINE BLUFF	62	F	26	37	47	57	60	60	62	62
8		C	46	53	58	62	62	62	62	62
		NO.WHS	1	1	1	1	1	1	1	1
PITTSBURGH	1716	F	76	161	212	320	385	467	981	1327
151		C	234	344	476	727	854	940	1349	1559
		NO.WHS	1	1	1	1	1	1	1	1
PITTSFIELD	62	F	38	47	52	57	59	60	62	62
6		C	53	57	59	60	61	61	62	62
		NO.WHS	1	1	1	1	1	1	1	1
PLATTSBURGH	30	F	20	24	27	30	30	30	30	30
4		C	28	29	30	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1
PLEASANTVILLE	49	F	14	18	24	32	37	38	47	49
7		C	24	30	37	44	46	47	49	49
		NO.WHS	1	1	1	1	1	1	1	1
POCATELLO	45	F	29	37	42	45	45	45	45	45
3		C	41	43	45	45	45	45	45	45
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
PONCA CITY	26	F	19	22	24	26	26	26	26	26
2		C	24	26	26	26	26	26	26	26
		NO.WHS	1	1	1	1	1	1	1	1
PORT ARTHUR	75	F	24	40	48	62	67	68	75	75
4		C	49	59	66	72	73	73	75	75
		NO.WHS	1	1	1	1	1	1	1	1
PORT HURON	56	F	26	34	41	48	50	51	55	56
4		C	42	45	50	53	55	55	56	56
		NO.WHS	1	1	1	1	1	1	1	1
PORTLAND ME	115	F	38	51	65	88	98	102	114	115
12		C	70	83	94	107	112	113	115	115
		NO.WHS	1	1	1	1	1	1	1	1
PORTLAND OR	782	F	25	142	113	264	292	388	619	744
25		C	133	307	326	477	547	594	736	777
		NO.WHS	1	1	1	1	1	1	1	1
PORTSMOUTH	29	F	18	22	25	28	28	28	29	29
5		C	26	27	28	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
POTTSTOWN	35	F	24	27	31	34	35	35	35	35
4		C	32	34	35	35	35	35	35	35
		NO.WHS	1	1	1	1	1	1	1	1
POTTSVILLE	38	F	17	21	26	33	35	37	38	38
6		C	28	30	35	37	38	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1
POUGHKEEPSIE	58	F	36	43	50	54	56	56	58	58
6		C	49	53	56	57	57	58	58	58
		NO.WHS	1	1	1	1	1	1	1	1
PROVIDENCE	892	F	52	69	167	246	290	328	532	704
69		C	93	108	316	433	488	519	719	835
		NO.WHS	1	1	1	1	1	1	1	1
PROVO	103	F	51	57	69	83	90	94	103	103
8		C	72	82	88	98	101	101	103	103
		NO.WHS	1	1	1	1	1	1	1	1
PUEBLO	109	F	36	46	65	88	97	101	109	109
8		C	67	84	98	105	108	109	109	109
		NO.WHS	1	1	1	1	1	1	1	1
QUINCY	48	F	37	43	46	48	48	48	48	48
1		C	46	47	48	48	48	48	48	48
		NO.WHS	1	1	1	1	1	1	1	1
RACINE	121	F	52	65	87	107	111	116	121	121
5		C	80	101	111	117	121	121	121	121
		NO.WHS	1	1	1	1	1	1	1	1
RALEIGH	183	F	39	60	78	110	127	137	175	183
17		C	86	109	131	156	166	171	181	183
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
RANTOUL	25	F	20	22	25	25	25	25	25	25
3		C	25	25	25	25	25	25	25	25
		NO.WHS	1	1	1	1	1	1	1	1
RAPID CITY	51	F	24	30	37	46	49	50	51	51
5		C	39	43	47	51	51	51	51	51
		NO.WHS	1	1	1	1	1	1	1	1
READING	178	F	61	83	104	133	147	151	177	178
22		C	107	127	147	164	167	174	178	178
		NO.WHS	1	1	1	1	1	1	1	1
REDDING	39	F	14	22	28	35	37	38	39	39
5		C	30	33	37	39	39	39	39	39
		NO.WHS	1	1	1	1	1	1	1	1
REDLANDS	48	F	25	33	41	47	47	48	48	48
5		C	40	44	47	48	48	48	48	48
		NO.WHS	1	1	1	1	1	1	1	1
RENO	123	F	28	51	68	95	105	111	123	123
9		C	64	91	106	116	119	121	123	123
		NO.WHS	1	1	1	1	1	1	1	1
RICHLAND	33	F	25	29	32	33	33	33	33	33
4		C	32	33	33	33	33	33	33	33
		NO.WHS	1	1	1	1	1	1	1	1
RICHMOND IN	44	F	28	35	40	44	44	44	44	44
4		C	40	42	44	44	44	44	44	44
		NO.WHS	1	1	1	1	1	1	1	1
RICHMOND VA	477	F	29	78	111	191	231	258	411	467
40		C	107	188	228	340	371	393	461	477
		NO.WHS	1	1	1	1	1	1	1	1
RIVERSIDE	541	F	29	65	92	134	159	175	306	445
49		C	49	128	161	227	259	280	435	512
		NO.WHS	1	1	1	1	1	1	1	1
ROANOKE	168	F	20	42	62	96	114	124	162	168
18		C	56	89	118	142	151	156	168	168
		NO.WHS	1	1	1	1	1	1	1	1
ROCHESTER MN	59	F	36	43	49	55	57	58	59	59
4		C	51	53	56	59	59	59	59	59
		NO.WHS	1	1	1	1	1	1	1	1
ROCHESTER NY	599	F	123	144	212	300	340	366	521	587
48		C	243	292	361	450	482	506	583	599
		NO.WHS	1	1	1	1	1	1	1	1
ROCK HILL	43	F	21	31	38	41	43	43	43	43
3		C	36	40	43	43	43	43	43	43
		NO.WHS	1	1	1	1	1	1	1	1
ROCKFORD	198	F	26	68	108	146	158	169	195	198
11		C	79	134	160	181	188	191	198	198
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
ROCKY MOUNT	42	F	25	30	35	40	41	41	42	42
	3	C	35	38	41	42	42	42	42	42
		NO.WHS	1	1	1	1	1	1	1	1
ROME GA	52	F	17	25	32	42	47	47	52	52
	8	C	35	39	44	51	51	52	52	52
		NO.WHS	1	1	1	1	1	1	1	1
ROME NY	38	F	26	31	36	38	38	38	38	38
	5	C	36	38	38	38	38	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1
ROSWELL	41	F	23	31	37	40	41	41	41	41
	3	C	36	38	41	41	41	41	41	41
		NO.WHS	1	1	1	1	1	1	1	1
ROY	65	F	14	19	26	36	34	41	60	65
	9	C	26	36	45	49	54	58	64	65
		NO.WHS	1	1	1	1	1	1	1	1
SACRAMENTO	745	F	50	80	106	182	225	269	526	677
	38	C	133	187	268	384	457	497	674	732
		NO.WHS	1	1	1	1	1	1	1	1
SAGINAW	147	F	39	56	86	120	132	136	147	147
	8	C	78	114	129	143	145	145	147	147
		NO.WHS	1	1	1	1	1	1	1	1
SAINT CHARLES	59	F	36	45	52	58	59	59	59	59
	5	C	51	56	58	59	59	59	59	59
		NO.WHS	1	1	1	1	1	1	1	1
SAINT CLOUD	56	F	30	42	49	54	56	56	56	56
	4	C	48	52	56	56	56	56	56	56
		NO.WHS	1	1	1	1	1	1	1	1
SAINT JOSEPH	69	F	32	39	47	60	63	66	69	69
	7	C	49	58	62	68	68	69	69	69
		NO.WHS	1	1	1	1	1	1	1	1
SAINT LOUIS	1800	F	57	159	205	359	463	543	1083	1492
	131	C	214	386	524	839	973	1065	1508	1712
		NO.WHS	1	1	1	1	1	1	1	1
SAINT PETERSBUR	651	F	25	63	90	227	257	278	445	592
	42	C	94	134	178	351	390	410	585	638
		NO.WHS	1	1	1	1	1	1	1	1
SALEM	113	F	33	45	64	88	97	101	113	113
	9	C	69	86	98	108	110	110	113	113
		NO.WHS	1	1	1	1	1	1	1	1
SALINA	39	F	28	32	36	39	39	39	39	39
	3	C	36	38	39	39	39	39	39	39
		NO.WHS	1	1	1	1	1	1	1	1
SALINAS	70	F	26	39	53	66	69	70	70	70
	7	C	49	61	66	70	70	70	70	70
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
SALISBURY	45	F	21	28	33	38	41	42	45	45
	6	C	34	38	41	44	44	44	45	45
		NO.WHS	1	1	1	1	1	1	1	1
SALT LAKE CITY	483	F	34	73	103	188	230	264	424	476
	28	C	120	175	241	337	369	399	471	483
		NO.WHS	1	1	1	1	1	1	1	1
SAN ANGELO	70	F	24	42	53	65	67	68	70	70
	5	C	51	61	67	70	70	70	70	70
		NO.WHS	1	1	1	1	1	1	1	1
SAN ANTONIO	865	F	41	54	106	359	421	464	709	836
	32	C	76	105	340	602	656	691	825	862
		NO.WHS	1	1	1	1	1	1	1	1
SAN CLEMENTE	36	F	19	21	22	26	29	32	36	36
	4	C	23	25	28	32	35	35	36	36
		NO.WHS	1	1	1	1	1	1	1	1
SAN DIEGO	1347	F	66	92	127	271	339	399	871	1192
	65	C	132	218	302	677	789	850	1191	1311
		NO.WHS	1	1	1	1	1	1	1	1
SAN FRANCISCO	3613	F	96	119	183	511	580	624	895	1538
	147	C	176	235	538	779	861	930	1490	2276
		NO.WHS	1	1	1	1	1	1	1	1
SAN LUIS OBISPO	38	F	29	34	36	38	38	38	38	38
	3	C	36	38	38	38	38	38	38	38
		NO.WHS	1	1	1	1	1	1	1	1
SAN RAFAEL	207	F	28	43	59	90	105	115	168	196
	27	C	65	90	115	145	154	166	197	206
		NO.WHS	1	1	1	1	1	1	1	1
SANDUSKY	41	F	27	32	36	40	41	41	41	41
	4	C	36	39	41	41	41	41	41	41
		NO.WHS	1	1	1	1	1	1	1	1
SANFORD	48	F	36	42	45	48	48	48	48	48
	2	C	46	46	48	48	48	48	48	48
		NO.WHS	1	1	1	1	1	1	1	1
SANTA BARBARA	151	F	32	54	69	86	95	103	139	150
	16	C	65	83	94	117	126	129	149	151
		NO.WHS	1	1	1	1	1	1	1	1
SANTA CRUZ	98	F	30	41	53	71	77	81	96	98
	8	C	53	61	77	87	90	93	98	98
		NO.WHS	1	1	1	1	1	1	1	1
SANTA FE	48	F	27	33	39	45	47	47	48	48
	4	C	39	44	47	48	48	48	48	48
		NO.WHS	1	1	1	1	1	1	1	1
SANTA MARIA	55	F	28	31	35	40	43	45	54	55
	5	C	35	39	42	50	53	53	55	55
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
SANTA ROSA	84	F	40	51	62	76	79	81	84	84
6		C	63	72	78	83	84	84	84	84
		NO.WHS	1	1	1	1	1	1	1	1
SARASOTA	224	F	32	44	61	86	94	102	160	208
22		C	67	84	100	125	138	141	206	222
		NO.WHS	1	1	1	1	1	1	1	1
SAVANNAH	152	F	46	76	90	111	123	129	149	152
12		C	91	112	125	139	143	145	152	152
		NO.WHS	1	1	1	1	1	1	1	1
SCRANTON	374	F	47	65	95	123	137	142	201	299
46		C	97	114	136	166	182	194	282	358
		NO.WHS	1	1	1	1	1	1	1	1
SEASIDE	135	F	31	36	47	73	86	95	129	135
13		C	53	67	86	112	120	123	134	135
		NO.WHS	1	1	1	1	1	1	1	1
SEATTLE	1213	F	36	90	124	239	293	332	622	908
88		C	154	204	321	460	547	604	931	1102
		NO.WHS	1	1	1	1	1	1	1	1
SEDALIA	25	F	19	22	24	25	25	25	25	25
2		C	23	25	25	25	25	25	25	25
		NO.WHS	1	1	1	1	1	1	1	1
SELMA	31	F	21	25	28	31	31	31	31	31
3		C	28	29	31	31	31	31	31	31
		NO.WHS	1	1	1	1	1	1	1	1
SHARON	56	F	32	41	48	54	55	56	56	56
5		C	49	53	55	56	56	56	56	56
		NO.WHS	1	1	1	1	1	1	1	1
SHAWNEE	29	F	21	25	27	29	29	29	29	29
2		C	27	29	29	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
SHEBOYGAN	52	F	35	43	48	51	52	52	52	52
2		C	48	50	52	52	52	52	52	52
		NO.WHS	1	1	1	1	1	1	1	1
SHERMAN	30	F	22	26	28	30	30	30	30	30
2		C	27	29	30	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1
SHREVEPORT	226	F	21	73	114	149	168	177	219	226
13		C	82	141	172	197	208	213	226	226
		NO.WHS	1	1	1	1	1	1	1	1
SIMI VALLEY	78	F	31	40	50	65	69	72	78	78
11		C	53	61	66	75	77	77	78	78
		NO.WHS	1	1	1	1	1	1	1	1
SIOUX CITY	90	F	33	40	54	74	81	83	90	90
8		C	58	66	80	88	88	89	90	90
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
SIOUX FALLS	76	F	29	54	63	72	75	75	76	76
5		C	59	69	74	76	76	76	76	76
		NO.WHS	1	1	1	1	1	1	1	1
SOUTH BEND	282	F	40	54	79	127	145	157	207	255
23		C	78	114	153	181	193	201	246	274
		NO.WHS	1	1	1	1	1	1	1	1
SOUTHINGTON	27	F	16	21	24	27	27	27	27	27
5		C	23	26	27	27	27	27	27	27
		NO.WHS	1	1	1	1	1	1	1	1
SPARTANBURG	77	F	24	41	55	69	72	75	77	77
5		C	55	65	72	75	77	77	77	77
		NO.WHS	1	1	1	1	1	1	1	1
SPOKANE	254	F	28	48	92	137	157	170	230	250
12		C	87	127	163	199	212	222	249	254
		NO.WHS	1	1	1	1	1	1	1	1
SPRINGFIELD IL	131	F	48	69	88	113	120	121	131	131
10		C	91	107	119	129	131	131	131	131
		NO.WHS	1	1	1	1	1	1	1	1
SPRINGFIELD MA	415	F	62	80	108	173	207	233	355	403
42		C	126	171	223	299	322	340	400	414
		NO.WHS	1	1	1	1	1	1	1	1
SPRINGFIELD MO	127	F	37	58	79	105	113	119	127	127
9		C	85	100	112	123	125	127	127	127
		NO.WHS	1	1	1	1	1	1	1	1
SPRINGFIELD OH	95	F	39	54	70	83	87	89	94	95
7		C	66	80	88	93	93	94	95	95
		NO.WHS	1	1	1	1	1	1	1	1
STATE COLLEGE	41	F	36	38	40	41	41	41	41	41
2		C	40	41	41	41	41	41	41	41
		NO.WHS	1	1	1	1	1	1	1	1
STATESVILLE	28	F	17	21	24	28	28	28	28	28
3		C	25	26	28	28	28	28	28	28
		NO.WHS	1	1	1	1	1	1	1	1
STAUNTON	25	F	18	21	23	25	25	25	25	25
4		C	23	25	25	25	25	25	25	25
		NO.WHS	1	1	1	1	1	1	1	1
STERLING	30	F	22	25	29	30	30	30	30	30
4		C	28	30	30	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1
STEUBENVILLE	79	F	23	28	34	48	56	60	77	79
11		C	39	48	56	71	73	75	79	79
		NO.WHS	1	1	1	1	1	1	1	1
STEVENS POINT	30	F	24	27	29	30	30	30	30	30
2		C	28	30	30	30	30	30	30	30
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
STILLWATER	33	F	24	29	32	33	33	33	33	33
		C	32	33	33	33	33	33	33	33
		NO.WHS	1	1	1	1	1	1	1	1
STOCKTON	164	F	44	71	88	121	134	141	163	164
	9	C	93	118	134	151	158	159	164	164
		NO.WHS	1	1	1	1	1	1	1	1
SUMTER	43	F	22	28	34	39	42	43	43	43
	4	C	33	39	42	43	43	43	43	43
		NO.WHS	1	1	1	1	1	1	1	1
SYRACUSE	355	F	53	101	142	199	227	246	327	351
	37	C	136	194	239	286	306	314	351	355
		NO.WHS	1	1	1	1	1	1	1	1
TACOMA	299	F	42	52	70	122	145	166	257	292
	33	C	83	107	132	205	221	242	290	299
		NO.WHS	1	1	1	1	1	1	1	1
TALLAHASSEE	95	F	45	58	72	86	91	93	95	95
	8	C	73	82	90	94	95	95	95	95
		NO.WHS	1	1	1	1	1	1	1	1
TAMPA	396	F	42	55	80	178	207	233	346	390
	18	C	76	131	194	294	318	331	385	395
		NO.WHS	1	1	1	1	1	1	1	1
TAUNTON	39	F	24	29	33	38	39	39	39	39
	5	C	34	37	38	39	39	39	39	39
		NO.WHS	1	1	1	1	1	1	1	1
TEMPLE	43	F	26	33	38	42	43	43	43	43
	4	C	38	41	42	43	43	43	43	43
		NO.WHS	1	1	1	1	1	1	1	1
TERRE HAUTE	73	F	43	51	61	68	71	72	73	73
	5	C	61	66	71	73	73	73	73	73
		NO.WHS	1	1	1	1	1	1	1	1
TEXARKANA	56	F	27	34	42	51	53	55	56	56
	6	C	41	47	52	55	56	56	56	56
		NO.WHS	1	1	1	1	1	1	1	1
TEXAS CITY	60	F	23	29	34	48	52	55	60	60
	5	C	34	42	52	57	58	59	60	60
		NO.WHS	1	1	1	1	1	1	1	1
THOUSAND OAKS	61	F	26	35	43	50	52	55	60	61
	9	C	43	48	53	56	59	59	61	61
		NO.WHS	1	1	1	1	1	1	1	1
TITUSVILLE	36	F	12	15	20	26	30	32	36	36
	6	C	22	26	30	34	35	36	36	36
		NO.WHS	1	1	1	1	1	1	1	1
TOLEDO	470	F	64	94	139	223	260	295	426	466
	44	C	159	222	287	361	388	409	461	470
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
TOPEKA	118	F	19	54	81	100	106	110	118	118
5		C	55	94	106	113	116	118	118	118
		NO.WHS	1	1	1	1	1	1	1	1
TORRINGTON	29	F	26	28	29	29	29	29	29	29
1		C	29	29	29	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
TUCSON	379	F	51	75	96	181	215	241	346	376
9		C	106	145	202	285	320	333	371	379
		NO.WHS	1	1	1	1	1	1	1	1
TULSA	369	F	31	69	98	174	205	228	330	363
27		C	92	170	209	277	307	315	361	369
		NO.WHS	1	1	1	1	1	1	1	1
TUSCALOOSA	88	F	34	42	54	71	78	80	88	88
10		C	59	69	74	85	86	87	88	88
		NO.WHS	1	1	1	1	1	1	1	1
TYLER	65	F	27	41	53	62	63	64	65	65
5		C	52	58	63	65	65	65	65	65
		NO.WHS	1	1	1	1	1	1	1	1
UNIONTOWN	29	F	23	26	29	29	29	29	29	29
4		C	28	29	29	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
UTICA	130	F	49	64	81	107	115	120	130	130
13		C	87	98	112	125	128	129	130	130
		NO.WHS	1	1	1	1	1	1	1	1
VALDOSTA	39	F	24	30	35	38	39	39	39	39
4		C	34	37	39	39	39	39	39	39
		NO.WHS	1	1	1	1	1	1	1	1
VALLEJO	85	F	38	50	62	74	80	82	85	85
6		C	63	71	78	83	84	85	85	85
		NO.WHS	1	1	1	1	1	1	1	1
VANCOUVER	85	F	26	39	53	69	75	79	85	85
5		C	51	61	75	82	83	84	85	85
		NO.WHS	1	1	1	1	1	1	1	1
VICKSBURG	40	F	28	34	38	40	40	40	40	40
3		C	38	40	40	40	40	40	40	40
		NO.WHS	1	1	1	1	1	1	1	1
VICTORIA	45	F	28	34	39	44	45	45	45	45
4		C	39	43	44	45	45	45	45	45
		NO.WHS	1	1	1	1	1	1	1	1
VINELAND	42	F	29	33	37	41	41	42	42	42
3		C	35	39	41	42	42	42	42	42
		NO.WHS	1	1	1	1	1	1	1	1
VISALIA	43	F	26	32	38	41	43	43	43	43
4		C	38	40	43	43	43	43	43	43
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
VISTA	33	F	21	25	29	33	33	33	33	33
5		C	29	33	33	33	33	33	33	33
		NO.WHS	1	1	1	1	1	1	1	1
WACO	113	F	26	45	64	89	95	102	113	113
10		C	65	84	94	108	110	111	113	113
		NO.WHS	1	1	1	1	1	1	1	1
WAHIAWA	48	F	22	27	35	43	45	46	48	48
6		C	36	40	44	47	48	48	48	48
		NO.WHS	1	1	1	1	1	1	1	1
WALLA WALLA	34	F	22	25	28	31	33	33	34	34
3		C	28	31	32	34	34	34	34	34
		NO.WHS	1	1	1	1	1	1	1	1
WALLINGFORD	31	F	20	25	28	30	31	31	31	31
5		C	28	30	31	31	31	31	31	31
		NO.WHS	1	1	1	1	1	1	1	1
WARNER ROBINS	47	F	24	33	39	45	46	47	47	47
5		C	39	43	46	47	47	47	47	47
		NO.WHS	1	1	1	1	1	1	1	1
WASHINGTON DC	2554	F	112	150	226	411	526	624	1441	2114
209		C	307	461	677	1080	1280	1419	2115	2447
		NO.WHS	1	1	1	1	1	1	1	1
WASHINGTON PA	29	F	23	26	29	29	29	29	29	29
3		C	29	29	29	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
WATERBURY	138	F	57	70	87	106	114	119	136	138
12		C	90	102	116	128	130	132	138	138
		NO.WHS	1	1	1	1	1	1	1	1
WATERLOO	107	F	31	42	55	74	80	86	104	107
12		C	59	69	82	93	98	103	107	107
		NO.WHS	1	1	1	1	1	1	1	1
WATERTOWN	32	F	29	31	32	32	32	32	32	32
1		C	31	32	32	32	32	32	32	32
		NO.WHS	1	1	1	1	1	1	1	1
WATERVILLE	31	F	19	22	26	29	30	30	31	31
4		C	27	28	29	31	31	31	31	31
		NO.WHS	1	1	1	1	1	1	1	1
WAUSAU	52	F	28	32	38	44	47	48	52	52
4		C	39	43	47	51	51	51	52	52
		NO.WHS	1	1	1	1	1	1	1	1
WEST CHESTER	37	F	27	32	34	37	37	37	37	37
5		C	33	36	37	37	37	37	37	37
		NO.WHS	1	1	1	1	1	1	1	1
WEST HAVERSTRAW	42	F	24	29	35	40	42	42	42	42
6		C	36	39	40	42	42	42	42	42
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
WEST MEMPHIS	27	F	18	22	25	27	27	27	27	27
	3	C	25	27	27	27	27	27	27	27
		NO.WHS	1	1	1	1	1	1	1	1
WEST PALM BEACH	358	F	34	50	59	103	123	133	244	307
	33	C	64	89	113	186	210	224	308	341
		NO.WHS	1	1	1	1	1	1	1	1
WHEELING	114	F	20	31	44	62	69	71	102	112
	18	C	48	59	70	87	92	93	112	114
		NO.WHS	1	1	1	1	1	1	1	1
WICHITA	290	F	32	50	109	185	207	219	273	289
	15	C	100	136	201	250	257	263	288	290
		NO.WHS	1	1	1	1	1	1	1	1
WICHITA FALLS	98	F	18	35	45	64	72	77	96	98
	12	C	44	62	73	86	90	94	98	98
		NO.WHS	1	1	1	1	1	1	1	1
WILLIAMSPORT	64	F	26	35	43	55	57	58	63	64
	9	C	46	51	57	62	62	63	64	64
		NO.WHS	1	1	1	1	1	1	1	1
WILMINGTON	68	F	33	43	53	64	66	67	68	68
	5	C	52	59	64	68	68	68	68	68
		NO.WHS	1	1	1	1	1	1	1	1
WILSON	32	F	27	30	31	32	32	32	32	32
	1	C	31	32	32	32	32	32	32	32
		NO.WHS	1	1	1	1	1	1	1	1
WINONA	29	F	14	19	22	27	28	29	29	29
	5	C	24	27	27	29	29	29	29	29
		NO.WHS	1	1	1	1	1	1	1	1
WINSTON-SALEM	152	F	34	48	69	100	114	124	151	152
	19	C	79	100	119	138	144	147	152	152
		NO.WHS	1	1	1	1	1	1	1	1
WINTER HAVEN	59	F	13	20	31	44	48	52	58	59
	7	C	33	41	48	55	57	57	59	59
		NO.WHS	1	1	1	1	1	1	1	1
WOODBRIDGE	62	F	30	38	47	58	60	61	62	62
	6	C	47	51	58	61	62	62	62	62
		NO.WHS	1	1	1	1	1	1	1	1
WORCESTER	231	F	62	93	117	159	174	190	225	231
	20	C	125	154	181	203	214	220	231	231
		NO.WHS	1	1	1	1	1	1	1	1
XENIA	26	F	21	23	26	26	26	26	26	26
	3	C	26	26	26	26	26	26	26	26
		NO.WHS	1	1	1	1	1	1	1	1
YAKIMA	70	F	31	46	56	66	69	69	70	70
	5	C	53	62	67	70	70	70	70	70
		NO.WHS	1	1	1	1	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
YORK	112	F	49	63	78	95	99	103	111	112
	11	C	81	90	101	107	108	109	112	112
		NO.WHS	1	1	1	1	1	1	1	1
YOUNGSTOWN	387	F	30	63	91	149	178	196	285	352
	37	C	63	151	188	239	263	270	341	380
		NO.WHS	1	1	1	1	1	1	1	1
YUBA CITY	54	F	21	26	34	45	47	51	54	54
	6	C	32	39	46	52	53	54	54	54
		NO.WHS	1	1	1	1	1	1	1	1
YUMA	39	F	17	24	31	37	38	39	39	39
	5	C	28	36	38	39	39	39	39	39
		NO.WHS	1	1	1	1	1	1	1	1
ZANESVILLE	40	F	20	27	32	38	38	39	40	40
	6	C	33	37	38	40	40	40	40	40
		NO.WHS	1	1	1	1	1	1	1	1

TAB C

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
ABILENE	94	F	60	73	80	90	91	91	93	94
	4	C	85	89	92	94	94	94	94	94
		NO.WHS	2	2	2	2	2	2	1	1
AKRON	463	F	87	123	193	269	308	325	431	460
	38	C	212	270	339	396	420	422	457	463
		NO.WHS	2	2	2	2	2	2	2	2
ALBANY GA	83	F	42	56	66	77	79	81	83	83
	7	C	67	77	80	83	82	83	83	83
		NO.WHS	2	2	2	2	2	2	1	1
ALBANY NY	457	F	101	145	194	256	281	306	408	446
	51	C	208	245	298	358	381	408	447	457
		NO.WHS	2	2	2	2	2	2	2	2
ALBUQUERQUE	367	F	82	147	212	246	296	314	361	364
	22	C	202	242	314	336	355	356	366	367
		NO.WHS	2	2	2	2	2	2	2	1
ALLENTOWN	276	F	90	126	170	214	226	223	272	276
	35	C	178	212	242	259	265	269	276	276
		NO.WHS	2	2	2	2	2	2	2	1
ALTON	98	F	41	56	73	79	81	87	95	98
	12	C	72	82	93	93	95	96	98	98
		NO.WHS	2	2	2	2	2	2	1	1
ALTOONA	87	F	46	60	75	83	86	85	86	87
	11	C	64	83	85	87	87	87	87	87
		NO.WHS	2	2	2	2	2	2	1	1
AMARILLO	129	F	54	78	92	112	120	122	128	129
	12	C	89	116	122	128	127	128	129	129
		NO.WHS	2	2	2	2	2	2	1	1
ANCHORAGE	132	F	53	73	96	115	119	126	130	132
	15	C	93	115	125	130	131	132	132	132
		NO.WHS	2	2	2	2	2	2	1	1
ANN ARBOR	188	F	78	106	138	169	176	179	186	188
	15	C	143	162	178	185	187	187	188	188
		NO.WHS	2	2	2	2	2	2	2	1
APPLETON	136	F	65	82	96	106	113	115	134	135
	11	C	93	110	114	125	129	130	136	136
		NO.WHS	2	2	2	2	2	2	2	1
ATLANTA	1298	F	76	180	170	394	484	548	906	1169
	104	C	164	421	458	779	885	934	1181	1277
		NO.WHS	2	2	2	2	2	2	2	2
AUGUSTA	162	F	47	69	89	118	132	140	161	162
	19	C	97	119	134	150	156	160	162	162
		NO.WHS	2	2	2	2	2	2	2	1
AURORA	153	F	68	87	109	135	141	146	151	151
	12	C	114	113	141	150	152	153	153	153
		NO.WHS	2	2	2	2	2	2	2	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
AUSTIN TX	334	F	69	109	193	237	272	292	330	333
		C	177	239	298	316	321	327	334	334
11		NO.WHS	2	2	2	2	2	2	2	1
BAKERSFIELD	186	F	73	114	106	152	167	175	182	186
		C	134	163	170	179	185	186	186	186
9		NO.WHS	2	2	2	2	2	2	1	1
BALTIMORE	1484	F	98	345	321	684	848	928	1321	1458
		C	392	763	902	1153	1256	1319	1459	1483
59		NO.WHS	2	2	2	2	2	2	2	2
BATON ROUGE	278	F	81	122	154	188	217	230	274	278
		C	156	202	231	263	266	271	278	278
18		NO.WHS	2	2	2	2	2	2	2	1
BEAUMONT	110	F	44	55	74	96	104	104	110	110
		C	86	95	104	109	109	110	110	110
7		NO.WHS	2	2	2	2	2	2	1	1
BILLINGS	82	F	55	64	71	79	80	81	82	82
		C	74	77	79	82	82	82	82	82
5		NO.WHS	2	2	2	2	2	2	1	1
BILOXI	122	F	39	55	74	97	105	110	111	122
		C	71	93	104	115	121	121	119	122
16		NO.WHS	2	2	2	2	2	2	2	2
BINGHAMTON	163	F	58	82	106	136	146	148	158	163
		C	111	130	146	159	160	160	163	163
19		NO.WHS	2	2	2	2	2	2	2	1
BIRMINGHAM	549	F	74	122	161	259	299	318	475	534
		C	188	244	315	428	445	461	532	548
55		NO.WHS	2	2	2	2	2	2	2	2
BOISE CITY	115	F	54	88	99	113	115	115	115	115
		C	100	111	114	115	115	115	115	115
3		NO.WHS	2	2	2	2	2	2	1	1
BOSTON	2884	F	210	273	441	738	896	1033	1783	2315
		C	603	853	1118	1496	1685	1822	2432	2713
242		NO.WHS	2	2	2	2	2	2	2	2
BOULDER	99	F	64	76	92	97	98	99	99	99
		C	90	97	99	99	99	99	99	99
4		NO.WHS	2	2	2	2	2	2	1	1
BUFFALO	939	F	201	153	358	555	587	664	872	934
		C	450	408	651	811	846	879	929	938
69		NO.WHS	2	2	2	2	2	2	2	2
CANTON	237	F	77	99	136	182	198	210	230	234
		C	137	163	199	221	230	231	237	237
29		NO.WHS	2	2	2	2	2	2	2	1
CEDAR RAPIDS	129	F	56	73	86	112	116	118	127	129
		C	95	111	117	127	128	129	129	129
10		NO.WHS	2	2	2	2	2	2	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
CHAMPAIGN	104	F	66	69	87	98	103	103	104	104
10		C	93	94	99	104	104	104	104	104
		NO.WHS	2	2	2	2	2	2	1	1
CHARLESTON SC	219	F	62	78	109	163	173	177	213	214
25		C	115	141	181	204	207	210	219	219
		NO.WHS	2	2	2	2	2	2	2	1
CHARLESTON WV	145	F	47	61	79	102	115	117	130	144
20		C	82	99	116	130	133	132	141	145
		NO.WHS	2	2	2	2	2	2	2	2
CHARLOTTE	313	F	77	103	144	209	236	255	311	313
26		C	169	211	261	292	303	306	313	313
		NO.WHS	2	2	2	2	2	2	2	1
CHATTANOOGA	216	F	40	79	97	142	165	180	208	215
26		C	111	143	162	195	203	212	216	216
		NO.WHS	2	2	2	2	2	2	2	1
CHICAGO	6659	F	241	202	751	1493	1705	2096	3783	4874
290		C	1030	1003	1756	3088	3502	3631	5267	6060
		NO.WHS	2	2	2	2	2	2	2	2
CINCINNATI	1145	F	75	192	269	432	496	571	918	1088
88		C	309	440	555	778	871	927	1089	1135
		NO.WHS	2	2	2	2	2	2	2	2
CLEVELAND OH	1890	F	139	284	259	680	837	937	1339	1613
105		C	304	645	772	1152	1284	1359	1634	1806
		NO.WHS	2	2	2	2	2	2	2	2
COLORADO SPRING	254	F	49	100	137	189	211	223	248	253
17		C	124	176	218	239	244	248	254	254
		NO.WHS	2	2	2	2	2	2	2	1
COLUMBIA SC	245	F	65	95	127	181	195	205	242	244
23		C	134	182	200	233	235	237	245	245
		NO.WHS	2	2	2	2	2	2	2	1
COLUMBUS GA	186	F	37	72	96	134	153	160	183	185
14		C	95	139	156	172	179	179	186	186
		NO.WHS	2	2	2	2	2	2	2	1
COLUMBUS OH	801	F	89	144	286	437	475	515	740	795
41		C	268	347	552	667	703	732	796	801
		NO.WHS	2	2	2	2	2	2	2	2
CONCORD CA	302	F	64	98	126	187	214	231	286	295
34		C	141	184	209	267	279	288	302	302
		NO.WHS	2	2	2	2	2	2	2	1
CORPUS CHRISTI	189	F	77	121	151	162	174	180	185	189
19		C	138	176	183	185	189	189	189	189
		NO.WHS	2	2	2	2	2	2	1	1
DALLAS	2087	F	89	186	256	412	478	572	1249	1788
161		C	257	440	567	812	1064	1079	1793	2034
		NO.WHS	2	2	2	2	2	2	2	2

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
DAVENPORT	250	F	86	110	150	197	215	224	246	250
22		C	164	193	223	239	246	245	250	250
		NO.WHS	2	2	2	2	2	2	2	1
DAYTON	702	F	86	185	233	320	344	381	573	670
62		C	196	327	389	487	526	543	676	696
		NO.WHS	2	2	2	2	2	2	2	2
DAYTONA BEACH	126	F	51	72	89	108	112	119	124	126
13		C	87	104	118	123	124	124	126	126
		NO.WHS	2	2	2	2	2	2	2	1
DECATUR IL	96	F	50	65	76	92	92	95	96	96
8		C	82	87	93	96	96	96	96	96
		NO.WHS	2	2	2	2	2	2	1	1
DENVER	1162	F	78	111	186	466	549	618	976	1137
56		C	245	397	548	865	955	976	1132	1161
		NO.WHS	2	2	2	2	2	2	2	2
DES MOINES	269	F	76	111	151	191	220	228	266	269
12		C	153	206	237	255	264	266	269	269
		NO.WHS	2	2	2	2	2	2	2	1
DETROIT	3858	F	105	194	312	817	1004	1243	2329	3212
205		C	377	787	1149	1864	2181	2320	3333	3748
		NO.WHS	2	2	2	2	2	2	2	2
DULUTH	116	F	44	54	66	94	103	99	115	116
16		C	76	87	102	111	114	113	116	116
		NO.WHS	2	2	2	2	2	2	2	1
DURHAM	103	F	57	72	79	94	97	101	102	103
9		C	88	92	98	101	103	103	103	103
		NO.WHS	2	2	2	2	2	2	1	1
EASTON	87	F	50	59	74	83	85	84	87	87
11		C	75	78	84	87	86	87	87	87
		NO.WHS	2	2	2	2	2	2	1	1
EL PASO	385	F	80	114	172	249	275	288	373	383
31		C	165	192	288	339	352	357	383	385
		NO.WHS	2	2	2	2	2	2	2	2
ERIE	174	F	91	116	135	156	162	163	171	174
14		C	139	150	160	170	172	174	174	174
		NO.WHS	2	2	2	2	2	2	1	1
EUGENE	154	F	56	82	99	127	134	141	154	154
12		C	101	125	138	150	152	153	154	154
		NO.WHS	2	2	2	2	2	2	2	1
EVANSVILLE	138	F	68	84	106	121	129	132	138	138
11		C	114	119	132	136	138	138	138	138
		NO.WHS	2	2	2	2	2	2	1	1
FARGO	92	F	58	72	86	90	88	91	92	92
6		C	85	91	91	92	92	92	92	92
		NO.WHS	2	2	2	2	1	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
FAYETTEVILLE NC	174	F	53	80	96	131	146	157	171	173
21		C	107	129	149	165	170	172	173	174
		NO.WHS	2	2	2	2	2	2	2	1
FLINT	295	F	75	134	172	225	243	257	290	294
18		C	173	232	252	284	286	289	295	295
		NO.WHS	2	2	2	2	2	2	2	1
FORT SMITH	83	F	38	53	65	73	76	76	81	83
8		C	61	70	78	80	81	82	83	83
		NO.WHS	2	2	2	2	2	2	1	1
FORT WAYNE	228	F	75	121	138	176	196	205	225	228
17		C	151	179	201	220	223	225	228	228
		NO.WHS	2	2	2	2	2	2	2	1
FRESNO	289	F	63	97	181	224	253	267	289	289
15		C	166	205	260	281	284	286	289	289
		NO.WHS	2	2	2	2	2	2	2	1
GAINESVILLE FL	88	F	54	62	77	85	87	85	88	88
7		C	77	83	86	88	88	88	88	88
		NO.WHS	2	2	2	2	2	1	1	1
GASTONIA	102	F	43	52	65	84	92	94	100	101
11		C	70	81	91	99	100	101	102	102
		NO.WHS	2	2	2	2	2	2	2	1
GRAND RAPIDS	359	F	87	131	178	236	265	285	348	356
31		C	189	237	283	318	335	345	359	359
		NO.WHS	2	2	2	2	2	2	2	2
GREEN BAY	144	F	88	85	105	132	138	142	143	144
6		C	120	127	138	143	144	143	144	144
		NO.WHS	2	2	2	2	2	2	1	1
GREENSBORO	155	F	49	72	99	129	138	147	154	155
18		C	107	120	141	153	155	155	155	155
		NO.WHS	2	2	2	2	2	2	1	1
GREENVILLE SC	185	F	38	78	111	137	153	161	184	184
14		C	112	145	162	175	175	182	185	185
		NO.WHS	2	2	2	2	2	2	2	1
HARRISBURG	253	F	69	86	117	168	191	198	244	252
33		C	130	165	194	223	233	236	251	253
		NO.WHS	2	2	2	2	2	2	2	2
HARTFORD	651	F	144	171	248	318	361	390	542	612
52		C	262	323	379	469	509	534	619	641
		NO.WHS	2	2	2	2	2	2	2	2
HONOLULU	483	F	141	183	206	298	354	384	446	476
37		C	239	282	301	403	450	459	474	482
		NO.WHS	2	2	2	2	2	2	2	2
HOUSTON	1807	F	78	148	268	526	626	782	1358	1706
73		C	279	521	745	1056	1285	1366	1713	1795
		NO.WHS	2	2	2	2	2	2	2	2

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
HUNTINGTON	161	F	61	73	88	113	123	133	149	159
16		C	92	109	122	144	148	155	160	161
		NO.WHS	2	2	2	2	2	2	2	2
HUNTSVILLE	143	F	48	67	90	113	125	130	142	143
18		C	94	113	129	138	141	142	142	143
		NO.WHS	2	2	2	2	2	2	2	1
INDIANAPOLIS	780	F	61	183	159	372	420	484	681	753
47		C	143	380	391	627	650	690	764	778
		NO.WHS	2	2	2	2	2	2	2	2
JACKSON MS	191	F	71	90	118	153	164	169	190	191
14		C	125	149	168	185	185	189	191	191
		NO.WHS	2	2	2	2	2	2	2	1
JACKSONVILLE FL	547	F	83	129	184	291	346	363	523	542
50		C	194	259	371	453	489	507	543	547
		NO.WHS	2	2	2	2	2	2	2	2
JOHNSTOWN	90	F	42	59	72	84	86	89	90	90
13		C	68	80	86	90	90	90	90	90
		NO.WHS	2	2	2	2	2	2	1	1
JOLIET	166	F	80	98	126	144	156	161	165	166
14		C	136	146	155	164	165	166	166	166
		NO.WHS	2	2	2	2	2	2	1	1
KAILUA	94	F	52	66	64	88	90	92	94	94
9		C	79	88	91	93	94	94	94	94
		NO.WHS	2	2	2	2	2	2	1	1
KALAMAZOO	134	F	63	72	95	120	125	127	131	134
12		C	103	118	119	133	133	132	134	134
		NO.WHS	2	2	2	2	2	2	1	1
KANSAS CITY	1027	F	94	217	262	412	465	495	831	991
73		C	215	423	545	721	793	821	990	1024
		NO.WHS	2	2	2	2	2	2	2	2
KENOSHA	83	F	71	78	82	81	83	83	83	83
2		C	81	82	82	83	83	83	83	83
		NO.WHS	2	2	2	1	1	1	1	1
KILLEEN	93	F	69	77	86	91	92	93	93	93
4		C	88	90	93	92	93	93	93	93
		NO.WHS	2	2	2	2	2	2	1	1
KNOXVILLE	209	F	52	76	104	147	168	175	205	208
23		C	125	154	173	195	201	204	209	209
		NO.WHS	2	2	2	2	2	2	2	1
LAFAYETTE LA	102	F	52	66	86	99	100	98	102	102
11		C	86	97	99	102	102	102	102	102
		NO.WHS	2	2	2	2	2	1	1	1
LAKE CHARLES	96	F	46	62	75	84	88	94	95	96
7		C	78	83	90	96	95	95	96	96
		NO.WHS	2	2	2	2	2	2	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
LAKELAND	84	F	48	58	70	82	82	81	84	84
8		C	68	82	82	84	84	84	84	84
		NO.WHS	2	2	2	2	2	1	1	1
LANCASTER PA	110	F	70	83	95	103	109	108	110	110
4		C	97	101	108	110	110	110	110	110
		NO.WHS	2	2	2	2	2	2	1	1
LANSING	245	F	85	116	146	185	203	215	243	245
15		C	160	185	220	236	239	238	245	245
		NO.WHS	2	2	2	2	2	2	2	1
LAS VEGAS	292	F	62	101	150	218	230	243	290	292
23		C	156	209	239	278	282	284	292	292
		NO.WHS	2	2	2	2	2	2	2	1
LAWRENCE MA	117	F	67	88	101	112	115	113	117	117
9		C	103	111	114	117	117	117	117	117
		NO.WHS	2	2	2	2	2	1	1	1
LAWTON	93	F	50	66	80	88	89	92	93	93
7		C	74	89	91	93	92	93	93	93
		NO.WHS	2	2	2	2	2	2	1	1
LEXINGTON	178	F	81	114	132	161	171	172	178	178
13		C	146	161	172	177	177	178	178	178
		NO.WHS	2	2	2	2	2	2	1	1
LINCOLN	168	F	67	108	135	158	163	165	168	168
7		C	138	153	163	167	167	168	168	168
		NO.WHS	2	2	2	2	2	2	1	1
LITTLE ROCK	246	F	55	88	116	161	187	196	240	245
21		C	115	165	197	228	234	236	245	246
		NO.WHS	2	2	2	2	2	2	2	1
LOS ANGELES	8664	F	130	243	338	856	1179	1489	3426	5736
450		C	500	840	1272	2043	2844	3297	6328	7777
		NO.WHS	2	2	2	2	2	2	2	2
LOUISVILLE	717	F	123	158	217	342	401	442	636	709
60		C	251	331	419	583	612	639	707	717
		NO.WHS	2	2	2	2	2	2	2	2
LUBBUCK	163	F	52	108	127	149	155	157	162	163
7		C	117	148	155	160	161	162	163	163
		NO.WHS	2	2	2	2	2	2	1	1
MACON	125	F	53	71	89	107	114	119	124	125
8		C	94	110	116	121	123	124	125	125
		NO.WHS	2	2	2	2	2	2	1	1
MADISON	209	F	68	84	125	159	167	175	205	209
19		C	122	168	187	198	202	203	209	209
		NO.WHS	2	2	2	2	2	2	2	1
MANCHESTER	99	F	61	79	89	95	99	95	99	99
4		C	89	95	99	99	99	99	99	99
		NO.WHS	2	2	2	2	2	1	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
MEMPHIS	698	F	79	170	184	382	437	477	647	693
34		C	275	391	456	581	613	639	695	698
		NO.WHS	2	2	2	2	2	2	2	2
MIAMI	2320	F	125	187	354	554	693	801	1530	2005
111		C	304	476	649	1176	1200	1519	2056	2236
		NO.WHS	2	2	2	2	2	2	2	2
MILWAUKEE	1137	F	149	303	377	609	712	693	1002	1113
48		C	375	609	744	913	980	986	1118	1134
		NO.WHS	2	2	2	2	2	2	2	2
MINNEAPOLIS	1577	F	71	133	206	522	613	761	1169	1469
67		C	250	445	613	975	1068	1197	1494	1567
		NO.WHS	2	2	2	2	2	2	2	2
MOBILE	276	F	85	118	142	173	207	224	266	275
20		C	157	184	207	250	261	264	274	276
		NO.WHS	2	2	2	2	2	2	2	2
MODESTO	128	F	73	89	100	120	121	126	127	128
9		C	113	120	124	127	128	127	128	128
		NO.WHS	2	2	2	2	2	2	1	1
MONROE LA	107	F	37	58	77	95	102	103	107	107
10		C	81	95	102	104	106	107	107	107
		NO.WHS	2	2	2	2	2	2	1	1
MONTGOMERY	158	F	57	87	123	146	152	155	158	158
8		C	115	139	151	158	157	158	158	158
		NO.WHS	2	2	2	2	2	2	1	1
MUNCIE	87	F	57	70	78	85	86	84	87	87
5		C	81	84	85	87	87	87	87	87
		NO.WHS	2	2	2	2	2	1	1	1
MUSKEGON	101	F	47	62	74	91	96	100	101	101
12		C	76	88	97	100	100	101	101	101
		NO.WHS	2	2	2	2	2	2	1	1
NASHVILLE	398	F	66	112	150	212	251	271	367	394
44		C	164	211	274	335	356	368	393	398
		NO.WHS	2	2	2	2	2	2	2	2
NEW BEDFORD	136	F	77	100	109	130	130	135	136	136
14		C	120	125	130	136	135	136	136	136
		NO.WHS	2	2	2	2	2	2	1	1
NEW ORLEANS	1015	F	132	275	342	505	622	684	926	1006
53		C	307	537	659	847	908	925	1001	1014
		NO.WHS	2	2	2	2	2	2	2	2
NEW YORK	16323	F	693	955	1307	2270	2670	3070	6336	9583
714		C	1746	2387	3159	5541	6328	7165	10529	13237
		NO.WHS	2	2	2	2	2	2	2	2
NEWBURGH	81	F	46	52	63	75	79	78	80	81
4		C	62	68	77	80	81	81	81	81
		NO.WHS	2	2	2	2	2	2	1	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
NEWPORT NEWS	267	F	73	97	136	177	183	200	259	267
32		C	138	168	198	224	239	251	266	267
		NO.WHS	2	2	2	2	2	2	2	2
NIAGARA FALLS	110	F	68	81	89	98	99	105	109	110
12		C	93	99	104	108	109	109	110	110
		NO.WHS	2	2	2	2	2	2	1	1
NORFOLK	688	F	88	119	182	295	350	398	599	668
64		C	204	278	405	520	580	602	671	686
		NO.WHS	2	2	2	2	2	2	2	2
ODESSA	87	F	58	70	82	86	85	86	87	87
4		C	82	86	85	87	87	87	87	87
		NO.WHS	2	2	2	2	1	1	1	1
OGDEN	96	F	51	74	83	91	95	93	96	96
6		C	89	89	93	96	96	96	96	96
		NO.WHS	2	2	2	2	2	2	1	1
OKLAHOMA CITY	499	F	61	120	162	236	288	309	456	496
46		C	162	240	314	398	432	458	494	499
		NO.WHS	2	2	2	2	2	2	2	2
OMAHA	524	F	78	88	197	300	348	369	501	522
34		C	213	282	370	453	481	494	522	524
		NO.WHS	2	2	2	2	2	2	2	2
ORLANDO	407	F	57	78	130	217	258	278	377	404
43		C	150	207	264	347	362	373	402	407
		NO.WHS	2	2	2	2	2	2	2	2
OXNARD	202	F	72	90	120	158	175	182	200	201
20		C	109	127	174	191	198	199	202	202
		NO.WHS	2	2	2	2	2	2	2	1
PENSACOLA	182	F	62	86	113	142	154	159	181	182
17		C	110	144	156	174	174	178	182	182
		NO.WHS	2	2	2	2	2	2	2	1
PEORIA	208	F	80	104	123	161	170	181	207	208
20		C	134	162	181	194	200	202	207	208
		NO.WHS	2	2	2	2	2	2	2	1
PETERSBURG	104	F	46	59	73	90	97	98	103	104
14		C	77	88	97	101	103	103	104	104
		NO.WHS	2	2	2	2	2	2	2	1
PHILADELPHIA	4557	F	226	313	688	954	1145	1456	2434	3498
204		C	524	730	1536	2100	2388	2714	3642	4172
		NO.WHS	2	2	2	2	2	2	2	2
PHOENIX	996	F	74	108	167	407	482	552	861	955
46		C	202	280	432	743	814	840	973	987
		NO.WHS	2	2	2	2	2	2	2	2
PITTSBURGH	1716	F	134	222	314	572	633	717	1185	1485
151		C	332	495	661	1005	1146	1222	1504	1665
		NO.WHS	2	2	2	2	2	2	2	2

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
PORTLAND ME	115	F	54	67	88	104	109	112	114	115
12		C	83	97	111	114	114	115	115	115
		NO.WHS	2	2	2	2	2	2	1	1
PORTLAND OR	782	F	81	183	191	391	453	516	710	776
25		C	280	382	456	645	679	707	772	781
		NO.WHS	2	2	2	2	2	2	2	2
PROVIDENCE	892	F	99	142	256	356	412	457	686	797
64		C	221	304	441	532	636	667	829	870
		NO.WHS	2	2	2	2	2	2	2	2
PROVO	103	F	70	75	91	99	99	101	103	103
8		C	94	97	102	103	103	103	103	103
		NO.WHS	2	2	2	2	2	2	1	1
PUEBLO	109	F	58	74	85	101	107	108	109	109
8		C	93	103	107	109	109	109	109	109
		NO.WHS	2	2	2	2	2	2	1	1
RACINE	121	F	80	93	108	118	119	120	121	121
5		C	111	116	121	121	121	121	121	121
		NO.WHS	2	2	2	2	2	2	1	1
RALEIGH	183	F	60	79	104	138	151	160	182	183
17		C	115	133	156	171	178	180	183	183
		NO.WHS	2	2	2	2	2	2	2	1
READING	178	F	80	109	133	156	163	165	177	178
22		C	132	151	166	173	174	177	178	178
		NO.WHS	2	2	2	2	2	2	1	1
RENO	123	F	56	82	94	111	118	121	123	123
9		C	100	112	118	123	122	123	123	123
		NO.WHS	2	2	2	2	2	2	1	1
RICHMOND VA	477	F	96	114	171	274	306	343	449	472
40		C	204	239	329	409	431	451	474	477
		NO.WHS	2	2	2	2	2	2	2	2
RIVERSIDE	541	F	57	102	154	232	274	302	456	514
49		C	117	211	284	384	427	452	527	537
		NO.WHS	2	2	2	2	2	2	2	2
ROANOKE	168	F	43	69	93	126	139	148	166	168
18		C	102	128	150	158	161	164	168	168
		NO.WHS	2	2	2	2	2	2	2	1
ROCHESTER NY	599	F	161	195	269	381	430	444	569	597
48		C	307	364	432	511	538	556	598	599
		NO.WHS	2	2	2	2	2	2	2	2
ROCKFORD	198	F	80	105	137	172	179	186	195	198
11		C	147	168	181	193	198	196	198	198
		NO.WHS	2	2	2	2	2	2	1	1
SACRAMENTO	745	F	75	122	188	367	396	452	644	727
38		C	218	307	390	595	629	660	736	743
		NO.WHS	2	2	2	2	2	2	2	2

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
SAGINAW	147	F	83	90	114	138	144	145	147	147
8		C	127	136	143	147	147	147	147	147
		NO.WHS	2	2	2	2	2	2	1	1
SAINT LOUIS	1800	F	125	266	335	542	691	792	1332	1639
131		C	360	582	775	1141	1265	1342	1678	1775
		NO.WHS	2	2	2	2	2	2	2	2
SAINT PETERSBUR	651	F	61	106	222	357	410	442	569	641
42		C	184	283	432	544	578	600	638	649
		NO.WHS	2	2	2	2	2	2	2	2
SALEM	113	F	55	65	87	103	107	109	113	113
9		C	85	99	109	113	113	113	113	113
		NO.WHS	2	2	2	2	2	2	1	1
SALT LAKE CITY	483	F	100	147	211	279	319	345	467	483
28		C	219	304	354	403	430	459	482	483
		NO.WHS	2	2	2	2	2	2	2	2
SAN ANTONIO	865	F	64	203	206	458	536	581	800	862
32		C	194	442	575	710	763	785	859	865
		NO.WHS	2	2	2	2	2	2	2	2
SAN DIEGO	1347	F	138	174	235	457	550	649	1071	1301
65		C	272	370	480	938	1019	1075	1306	1344
		NO.WHS	2	2	2	2	2	2	2	2
SAN FRANCISCO	3613	F	177	368	353	781	921	1096	1741	2726
147		C	499	755	731	1270	1385	1761	2655	3431
		NO.WHS	2	2	2	2	2	2	2	2
SAN RAFAEL	207	F	47	72	97	133	143	154	194	203
27		C	87	127	149	174	175	184	205	207
		NO.WHS	2	2	2	2	2	2	2	2
SANTA BARBARA	151	F	52	75	99	126	135	141	148	150
16		C	91	121	134	148	149	150	151	151
		NO.WHS	2	2	2	2	2	2	2	1
SANTA CRUZ	98	F	52	68	76	90	93	93	96	98
8		C	79	86	96	97	97	97	98	98
		NO.WHS	2	2	2	2	2	2	1	1
SANTA ROSA	84	F	55	66	73	82	83	81	84	84
6		C	76	81	82	84	84	84	84	84
		NO.WHS	2	2	2	2	2	1	1	1
SARASOTA	224	F	59	85	116	162	178	189	197	222
22		C	124	157	183	209	216	218	218	224
		NO.WHS	2	2	2	2	2	2	2	2
SAVANNAH	152	F	69	90	110	129	139	141	152	152
12		C	111	126	139	148	150	150	152	152
		NO.WHS	2	2	2	2	2	2	2	1
SCRANTON	374	F	90	125	179	240	269	283	354	343
46		C	184	222	268	320	334	347	370	373
		NO.WHS	2	2	2	2	2	2	2	2

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
SEASIDE	135	F	55	67	85	103	108	115	134	135
13		C	89	100	116	129	129	130	135	135
		NO.WHS	2	2	2	2	2	2	2	1
SEATTLE	1213	F	90	161	263	382	467	530	841	1051
88		C	231	372	482	691	809	868	1073	1164
		NO.WHS	2	2	2	2	2	2	2	2
SHREVEPORT	226	F	44	108	147	186	197	202	226	226
13		C	141	181	202	217	222	224	226	226
		NO.WHS	2	2	2	2	2	2	2	1
SIOUX CITY	90	F	52	64	70	85	89	88	90	90
8		C	80	85	87	90	90	90	90	90
		NO.WHS	2	2	2	2	2	2	1	1
SOUTH BEND	282	F	64	98	124	189	211	226	275	278
23		C	126	174	182	250	264	266	282	281
		NO.WHS	2	2	2	2	2	2	2	2
SPOKANE	254	F	70	99	134	184	205	214	247	254
12		C	142	175	201	238	246	248	254	254
		NO.WHS	2	2	2	2	2	2	2	2
SPRINGFIELD IL	131	F	68	89	107	127	130	126	131	131
10		C	109	123	129	131	131	131	131	131
		NO.WHS	2	2	2	2	2	2	1	1
SPRINGFIELD MA	415	F	101	131	174	254	294	311	390	413
42		C	188	257	304	353	371	380	410	415
		NO.WHS	2	2	2	2	2	2	2	2
SPRINGFIELD MO	127	F	51	82	101	120	124	127	127	127
9		C	100	120	124	126	127	127	127	127
		NO.WHS	2	2	2	2	2	2	1	1
SPRINGFIELD OH	95	F	62	69	81	90	92	93	94	95
7		C	82	89	92	95	95	95	95	95
		NO.WHS	2	2	2	2	2	2	1	1
STOCKTON	164	F	65	99	119	145	152	156	163	164
9		C	125	149	153	161	163	164	164	164
		NO.WHS	2	2	2	2	2	2	1	1
SYRACUSE	355	F	112	152	178	242	270	289	345	351
37		C	204	246	279	326	338	338	355	355
		NO.WHS	2	2	2	2	2	2	2	1
TACOMA	299	F	72	95	124	181	216	236	287	297
33		C	126	158	196	271	279	290	298	299
		NO.WHS	2	2	2	2	2	2	2	2
TALLAHASSEE	95	F	61	71	84	92	94	93	95	95
8		C	86	90	95	95	95	95	95	95
		NO.WHS	2	2	2	2	2	1	1	1
TAMPA	396	F	78	97	185	268	283	300	378	394
18		C	132	166	316	357	366	369	396	396
		NO.WHS	2	2	2	2	2	2	2	2

CITY NAME		POP	F/C	50	100	200	500	750	1000	5000	20000
TOLEDO		470	F	98	151	210	292	330	356	461	466
	44		C	211	311	363	419	434	448	467	470
			NO.WHS	2	2	2	2	2	2	2	1
TOPEKA		118	F	43	80	98	110	114	115	118	118
	5		C	88	110	116	117	118	118	118	118
			NO.WHS	2	2	2	2	2	2	1	1
TUCSON		379	F	75	117	198	281	272	296	370	378
	9		C	135	220	313	350	362	366	378	379
			NO.WHS	2	2	2	2	2	2	2	2
TULSA		369	F	55	100	152	238	255	289	357	368
	27		C	134	212	287	335	347	351	367	369
			NO.WHS	2	2	2	2	2	2	2	2
TUSCALOOSA		88	F	49	58	72	81	86	85	88	88
	10		C	75	80	84	88	88	88	88	88
			NO.WHS	2	2	2	2	2	2	1	1
UTICA		130	F	64	88	105	122	127	128	130	130
	13		C	103	121	126	129	130	130	130	130
			NO.WHS	2	2	2	2	2	2	1	1
VALLEJO		85	F	55	69	76	81	84	85	85	85
	6		C	80	84	84	85	85	85	85	85
			NO.WHS	2	2	2	2	2	2	1	1
VANCOUVER		85	F	46	62	70	79	82	84	85	85
	5		C	76	82	84	85	85	85	85	85
			NO.WHS	2	2	2	2	2	2	1	1
WACO		113	F	47	67	85	102	107	109	113	113
	10		C	90	100	106	112	113	113	113	113
			NO.WHS	2	2	2	2	2	2	1	1
WASHINGTON DC		2554	F	201	257	374	660	826	957	1845	2387
	208		C	479	682	985	1463	1700	1793	2392	2534
			NO.WHS	2	2	2	2	2	2	2	2
WATERBURY		138	F	75	89	106	121	126	130	136	138
	12		C	105	117	128	135	135	137	138	138
			NO.WHS	2	2	2	2	2	2	1	1
WATERLOO		107	F	53	67	84	100	103	98	106	107
	12		C	86	96	102	106	106	106	107	107
			NO.WHS	2	2	2	2	2	2	2	1
WEST PALM BEACH		358	F	72	92	125	190	220	234	314	340
	33		C	116	143	233	279	295	305	348	353
			NO.WHS	2	2	2	2	2	2	2	2
WHEELING		114	F	33	46	61	86	95	95	112	112
	18		C	68	81	90	108	110	112	114	114
			NO.WHS	2	2	2	2	2	2	2	1
WICHITA		290	F	58	85	167	217	239	252	286	289
	15		C	155	206	247	274	280	282	290	290
			NO.WHS	2	2	2	2	2	2	2	1

CITY NAME	POP	F/C	50	100	200	500	750	1000	5000	20000
WICHITA FALLS	98	F	32	50	63	80	89	87	96	98
		C	69	74	91	94	96	97	98	98
		NO.WHS	2	2	2	2	2	2	1	1
WINSTON-SALEM	152	F	54	72	89	121	137	142	151	152
		C	103	123	135	148	150	152	152	152
		NO.WHS	2	2	2	2	2	2	1	1
WORCESTER	231	F	86	122	143	187	196	206	229	231
		C	154	189	207	218	224	227	231	231
		NO.WHS	2	2	2	2	2	2	2	1
YORK	112	F	65	80	91	105	107	109	111	112
		C	95	101	109	111	111	112	112	112
		NO.WHS	2	2	2	2	2	2	1	1
YOUNGSTOWN	387	F	59	107	150	227	267	290	374	378
		C	150	229	278	334	360	363	385	386
		NO.WHS	2	2	2	2	2	2	2	2

TAB D

U.S. Urban Fatalities as a Function of the
Number of Attacking Weapons and Warhead Yield
(Results Expressed as Percentage of U.S. Urban Population of 132 Million)

Number of Weapons (.20 NM CEP .85 Reliability)	Warhead Yield (Kilotons) 50	100	200	500	750	1000
100	6	8	11	19	23	27
200	9	13	18	29	35	40
300	12	17	24	38	45	50
400	15	21	29	45	52	58
500	17	24	34	51	59	64
1000	28	39	52	72	79	84
1500	37	50	65	84	90	94
2000	44	59	75	92	96	98
2500	51	67	82	96	99	100
3000	57	73	87	98	100	
3500	63	78	91	100		
4000	67	83	94			

(1)

HAROLD A. KNAPP
21900 DAVIS MILL ROAD
GERMANTOWN, MARYLAND 20767
428-0044 (AREA CODE 301)

Sat 21 June 1980

Dr. Lawrence Horowitz
Subcommittee on Health and Scientific Research
Labor and Human Resources Committee
United States Senate
Washington DC 20510

Dear Dr. Horowitz:

I apologize for being so useless to you on the hearings on the short and long term effects of nuclear war, especially after all the trouble you went to to try to get something out of me. I'm even sorrier that the Institute for Defense Analyses feels so timid that they prefer that the statement I prepared not even be submitted for the record of the hearing. There is some logic to that position though: in matters of nuclear war, and anything connected with attack levels and targeting, the border line between UNCLASSIFIED and TOP SECRET is delicate and peculiar, and it's better, since I have to go out to the Strategic Air Command in two weeks for a working session on their most intimate plans and secrets, that doubts should not be raised in the JCS and OSD as to what in heavens name Harold Knapp is doing discussing nuclear war in public.

Sheep are another matter. By not sounding shrill, and with a little honest blarney and an awful lot of work, I've so far been able to keep everyone convinced that those sheep that died 27 years ago are merely one of Harold's peculiarities.

(over)

(2)

That is, of course, quite true. But what nobody quite yet understands is that on the matter of the sheep, the entire question of what was going on downwind of the Nevada Test Site unravels -- what doses where, who knew what, who didn't know what, who didn't know that they didn't know, etc. If you want to raise some mischief with the Interagency Task Force's findings -- and I confess ~~they~~ I think they deserve dynamite more than mischief -- then you and Mr. Wenger get a copy of the House Hearing record (Serial No 96-41) (which Mr. Shaffer sent his wife to pick up from the Subcommittee on Oversight and Investigations) and make sure you have read the final letter of transmittal pages 1169-1188 carefully, and also the ~~letter~~ correspondence with Dr Bustad (pages 956 - 991, esp 975-991), and the discussion and conclusions of Annex 34 (pages 1084-1090). That's a lot to inflict on anyone. But if you and Mr. Wenger are well informed on this material, you ought to be able to get the Government to give up on the sheep. On this regard I note with interest that Justice berated DOD for not commenting adversely on the provisions of S 1865 with respect to sheepherds. That's because DOD = Ed Still on this matter, and when I went to see him after he received my response to his comments (Annex 31, pages 893-940) he allowed that he thought the government should admit nothing but pay for the sheep.

After the sheep, the place to concentrate is the testimony of Mrs. Bordeli-Laird (pages 14 - 38). Get the government explain what external gamma dose could have produced a beta burn on Mrs. Laird's cow (page 16), or rather ~~if~~ inquire how could the cow have a beta burn when the gamma dose on the Interagency Task Force Map for

(3)

the Bordoli ranch indicates between 1 and 2.5 rads dose for all Nevada tests, and when beta burns develop after a dose of 50-100 rads (ref. end 8), Mrs. Bordoli's son died of leukemia, her daughter has thyroid deficiency. The correspondence in the AEC file was pathetic on this case. As Martin Bordoli got sicker he lost his appetite and would only drink milk. And the AEC kept assuring the Bordolis there could be no connection with the tests. My guess is that they were grossly off on the external gamma measurements, never measured the I-131 in the milk. And now comes the Interagency Task Force oblivious to I-131 or hot spots. There's a sort of magnificent incompetence there. No -- I should not call it that. But I can't imagine where the task force participants were 17 years ago when the Iodine battle was in full fury, and they certainly didn't demonstrate any particular awareness of the subtleties and uncertainties ~~of~~ involved in fallout evaluations.

I was intrigued to get the attached letter from Dr. Caldwell at the Center for Disease Control in Atlanta. Three months ago when I tried repeatedly to reach him by phone, he was always too busy to speak to me. So I hunted him up when he came to a radiation conference in Washington at the National Academy.

One final thought: you and Bob Wenger be very nice to Dale Eberwein (225-4441, 2323 Rayburn House Office Building, staff, Subcommittee on Oversight & Investigations) and I think it will pay big dividends for you and Senator Kennedy. She is smart and nice and pretty and Mr. Eckhardt's right hand man on this topic. Her inclination is to be suspicious that Kennedy people will steal her stuff & claim it for their own. But I'll bet if one of you went over and charmed her a little you'd find she'd work as hard as she could to help you. And as I see it the two committees can reinforce each other very well, and will need to, to finally get Senator Kennedy's bill

(4)

and Mr. McKays bill (which could probably best be absorbed by adopting the provisions in Senator Kennedy's bill) passed. There's plenty of work for everyone to do with sugar and a sledgehammer to teach the executive branch what they've always wanted to know about fallout but have been afraid they might find out.

I hadn't meant to ramble so...

Sincerely yours,

Harold Knapp

If you have no use for that gray IDA paper (P-194) on the distribution of weapon effects, I would like it back for my files. On the other hand you're free to use it, or anything in it, explicitly, if it's any good to you.

If there's a record of the hearings, and if I didn't forfeit all rights to a copy by my non performance, I'd like very much to receive one.

LOW-LEVEL RADIATION EFFECTS ON HEALTH

HEARINGS

BEFORE THE

SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS

OF THE

COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE

HOUSE OF REPRESENTATIVES

NINETY-SIXTH CONGRESS

FIRST SESSION

APRIL 23, MAY 24, AND AUGUST 1, 1979

Serial No. 96–129

Printed for the use of the
Committee on Interstate and Foreign Commerce

The final version of the Sheep paper is published in this document, pages 514 to 1188. The Subcommittee will issue its own report before the 4th of July. Call Dale Eberwein (225-4441, Room 2323 Rayburn House Office Building, Subcommittee Staff) to receive copies of each for yourself and interested Senators. The two documents should be a good take off point for your next hearings. They have been distributed widely in the Executive Branch. JHAK

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
ATLANTA, GEORGIA 30333

June 17, 1980

Harold A. Knapp
21900 Davis Mill Road
Germantown, Maryland 20767

Dear Dr. Knapp:

Thank you for forwarding a copy of your memorandum on the sheep death controversy. As we discussed in Washington on April 3, I am not at all certain that we have completely laid the issue to rest, however; it is certain that we have gathered all the information available to us at this time and that the likelihood at ever arriving at a completely certain and documented evaluation of the happening is probably impossible. However, I think the efforts of everyone involved certainly pointed out the difficulty in trying to evaluate this problem 20 years after the fact and should highlight the need to investigate openly and without prejudice any reports of this type in the future. If that is the only thing that comes from our efforts it will have been worthwhile. I enjoyed reading some of the things and probably learned more about teh cause of sheep death than I ever really wanted to know.

Thank you again for your letter and hope we can chat about more plesant topics in the future.

Sincerely yours,

Glyn G. Caldwell, M.D.

Glyn G. Caldwell, M.D.
Chief, Cancer Branch
Chronic Diseases Division
Bureau of Epidemiology

a crack is beginning to appear in the wall,...
You may wish to call Dr. Victor Zeve, Offic of the Director, National Cancer Institute, NIH, 496-9326, and get a copy of the HHS Release of 28 May 1980 entitled PANEL FINDS NO NEW EVIDENCE OF RADIATION HEALTH EFFECTS. (Panel should have been thinking rather than looking dumbly thru old files). They also have a report I have requested. Zeve is sympathetic to problem of sheep and [illegible] but I don't think he understands how to get at them. HK

BA

12 JUN 1980

Dr. Harold A. Knapp
21900 Davis Mill Road
Germantown, Maryland 20767

Dear Harold:

I received your June 6 memorandum reference the final version of the paper on the sheep deaths in Utah. I look forward to receiving the complete package from the subcommittee and to having enough undisturbed time to read it completely.

The effort you put into this task was remarkable and regardless of whether or not it is considered a scientific paper, it does represent a very thought provoking report. I enjoyed our discussions of your work and hope that some of my comments were of value to you.

Best regards.

Sincerely,

Ed Still

EDWIN T. STILL, DVM
Assistant to the Director
(Biomedical Effects)

Ed Stills remark on the Aug 1 version of the sheep paper was that it wasn't scientific. That was before I responded to his comments. I noted on the attached memo that I hoped my description of the Jan sheep paper as scientific didn't offend him. Whence his remark

HAROLD A. KNAPP
21900 DAVIS MILL ROAD
GERMANTOWN, MARYLAND 20767

428-0044 (AREA CODE 301)

6 June 1980

MEMORANDUM FOR THE PERSONS WHO REVIEWED AND/OR PROVIDED INFORMATION FOR PAPER ON SHEEP DEATHS IN UTAH AND NEVADA FOLLOWING THE 1953 NUCLEAR TESTS

On May 9, 1980, after what seemed at times like an endless effort, I turned over to the House Subcommittee on Oversight and Investigations the final version of the paper on Sheep Deaths in Utah and Nevada Following the 1953 Nuclear Tests, jointly addressed to that subcommittee, the Senate Committee on the Judiciary, and the Governor of Utah. Sometime, presumably before the end of June, 1980, the Subcommittee will publish its hearing record (including the paper) and, separately, its own report concerning all aspects of its investigation of the effects of fallout from atmospheric tests on areas downwind of the Nevada Test Site. Both of these documents will be sent to you directly by the subcommittee.

Your efforts in providing critical comment and/or data for the version of the paper you reviewed (the initial version of which was submitted to the subcommittee on August 1, 1979) are much appreciated. Hopefully, you will find the final version, in substance if not in form, improved, and more-or-less as close to a correct assessment as is possible on the basis of existing information. As finally submitted, the sheep paper--all 450 (±) pages of it--probably qualifies as one of the clumsiest scientific reports on record. It grew primarily by the addition of comments and the responses to them, as the reviews came in from individuals and government agencies. There was a two week deadline to completion which was extended, each time at the last minute, from December to May, and never time for a final rewrite. Annex 34 to Appendix E (which has two enclosures) is, in effect, a rewrite of the paper insofar as the deaths of the newborn lambs is concerned. It was completed after all comments had been received, and after I had had a chance to study the original reports of the Hanford experiments by Bustad et al in which pregnant ewes

were fed daily varying amounts of I-131. Annex 34 went directly from the typist to the Congress, and I'm afraid to read it for fear of the garbles I'll find. I've already noted from a page that dropped on the floor that Dr. Bair had become Dr. Bain, but I think I finally converged on a consistent spelling for Dr. Wolff.

The final results of the study are summarized in the final letter of transmittal to Mr. Eckhardt, Chairman of the House Subcommittee on Oversight and Investigations, found at the end of the report. But, at times, I'm inclined to think the response to point 8 of the second set of comments provided by the Secretary of Health, Education, and Welfare, written at 0230 A.M. and on page E-32-14, may be the best statement the results insofar as the cause of death of the sheep is concerned. Small but critical points, such as whether or not the original investigation had considered blue tongue as cause of the sheep deaths, or a documentation of all the considerations which go into the base case computation of the number of square meters of deposited fallout which could initially have gone into a sheep's mouth per day, are often buried away in one or more of the 38 annexes to Appendix E. I regret the inconvenience this imposes on the reader, since it makes it difficult to try to arrive at a balanced judgment concerning the whole, difficult problem without going thru a great deal of information which is often contradictory and generally incomplete. I noted with mixed emotions the October 22, 1979, comments of Dr. Potter of EPA, Nevada (which reached me in mid April 1980) that (page E-36-20) "I feel this whole problem needs a more systematic study prior to its release." What finally cheered me up about that comment was the exhilarating thought that Dr. Potter is just the person I want to do that study, and I'm exactly the right person to review it.

Thank you all again--including Dr. Potter--for all the bother you went to on the present effort.

Harold Knapp

Harold Knapp

Senator KENNEDY. The committee stands in recess.
[The subcommittee was adjourned at 1:43 p.m.]

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