STATEMENT OF DR. GEORGE D. THURSTON, Sc. D.

TO THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

OF THE

UNITED STATES SENATE

RE: THE HUMAN HEALTH EFFECTS OF

AIR POLLUTION FROM UTILITY POWER PLANTS

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I am George D. Thurston, a tenured Associate Professor of Environmental Medicine at the New York University (NYU) School of Medicine. My scientific research involves investigations of the human health effects of air pollution.

I am also the Director of the National Institute of Environmental Health Sciences' (NIEHS) Community Outreach and Education Program at NYU. A goal of this program is to provide an impartial scientific resource on environmental health issues to decision-makers, and that is my purpose in testifying to you here today.

Despite progress over the last decade, Americans are still suffering from the adverse health effects of air pollution. And now, with calls for more electrical energy from fossil-fuel combustion sources, such as coal-fired power plants, we may face a greater health burden on our children, older adults, and even healthy Americans

The adverse health consequences of breathing air pollution caused by emissions from utility power plants are severe and well documented in the published medical and scientific literature. Over the past few decades, medical researchers examining air pollution and public health, including myself, have shown that air pollution is associated with a host of serious adverse human health effects, including: asthma attacks, heart attacks, hospital admissions, adverse birth outcomes, and premature death. Ozone (O_3) and Particulate Matter (PM) are among the key air pollutants resulting from power plant emissions that have been found to adversely affect human health.

One of the air pollutants most carefully studied in the 1990's is particulate matter. Fine particles, such as those that result from power plants emissions, can bypass the defensive mechanisms of the lung, and become lodged deep in the lung where they can cause a variety of health problems. Indeed, the latest evidence indicates that short-term exposures can not only cause respiratory damage, but also cardiac effects, including heart attacks. Moreover, long-term exposure to fine particles increases the risk of death, and has been estimated to take years from the life expectancy of people living in the most polluted cities, relative to those living in cleaner cities (Brunekreef, 1997).

Ozone is another pollutant that can result from power plant emissions that adversely affects human health. Ozone is a highly irritating gas that is formed in our atmosphere in the presence of sunlight from other "precursor" air pollutants, including the nitrogen oxides that are emitted by fossil fuel combustion pollution sources such as power plants.

The state of the science on particulate matter and health was thoroughly reviewed in the recently released Draft 2001 U.S. EPA Criteria Document for Particulate Matter—of which I am a contributing author. Since the $PM_{2.5}$ standard was set, the many dozens of new published studies, taken together, collectively confirm the relationship between $PM_{2.5}$ pollution and severe adverse human health effects. In addition, the new research has eliminated many of the concerns that were raised in the past regarding the causality of the PM-health effects relationship, and has provided plausible biological mechanisms for the serious impacts associated with PM exposure.

PM air pollution is composed of two major components: primary particles, or "soot" and “ash”, emitted directly into the atmosphere by pollution sources, and; "secondary particles" formed in the atmosphere from gaseous pollutants such as sulfur dioxide (SO_2), nitrogen oxides (NO_X), and hydrocarbons.

Sulfur dioxide emissions from coal plants contribute the most to secondary particle formation. Sulfur dioxide is chemically converted in the atmosphere after it is released from a smokestack to become a “sulfate” particle. Sulfates include sulfuric acid particles that, when breathed, reach deep into the human lung.

In the East and Midwest U.S., sulfates make up the largest proportion of the particles in our air—in many regions well over half of the fine particles. Moreover, power plants currently emit two thirds of the sulfur dioxide in the U.S. Older, pre-1980 coal-fired power plants contribute about half of all electricity generation in the US, but produce nearly all the sulfur dioxide (SO_2) and nitrogen oxide (NO_x) emissions from the entire national power industry. Therefore, to reduce particulate matter in the Eastern U.S., major reductions in pollution emissions from older fossil-fuel power plants are needed.

The hazards of particulate matter have become particularly clear in the past decade’s research. Two of the largest landmark studies on particulate matter and death, the Harvard Six Cities Study, published in 1993, followed by the American Cancer Society Study in 1995, demonstrated greater risk of premature death from particulate matter in more polluted cities, as compared to cities with cleaner air (Dockery et al, 1993; Pope et al, 1995). Fine particles, especially sulfates, were most strongly associated with excess mortality in polluted cities. The American Cancer Society study examined half a million people in over 150 metropolitan areas throughout the United States and found a 17 percent greater risk of mortality between the city with the least sulfate and particulate matter and the city with the highest levels of this particulate pollution. The results of

these studies were challenged by industry, resulting in an independent reanalysis by the Health Effects Institute (HEI)—funded by industry and EPA. HEI confirmed the associations found by the original investigators.

Recent epidemiologic and toxicologic evidence also suggests that the particles resulting from fossil-fuel utility power plant air emissions, and especially those from coal-fired power plants, are among the most toxic in our air. Many studies in the published literature have indicated that sulfate particles, which are predominantly formed from coal-fired power plant SO_2 emissions, are more strongly associated with human mortality than other components of PM. Also, my own published analysis of U.S. mortality and PM by source category found that coal combustion-related particles were more strongly associated with variations in annual mortality rates across U.S. cities than were other components of PM (Ozkaynak and Thurston, 1987). More recently, an analysis by Laden and co-authors (2000) at Harvard University of PM sources and daily pollution confirms that coal combustion particles, along with automobile pollution, were among the PM components that most affected daily variations in mortality. In addition, toxicological studies have indicated that particles resulting from fossil-fuel combustion that contain metals are very toxic to cells in the lung. Thus, both the toxicologic and epidemiologic evidence available indicate that pollution from fossil-fuel power plants are of great human health concern.

The conclusion that power plant particle pollution is one of the more toxic types of particles that we breathe is supported by the facts that combustion particles have different sizes, physio-chemical characteristics, and deposit in different parts of the lung than other more “natural” particles, such as wind-blown soil. Therefore, these particles can defeat the body’s natural defenses, and may have a far greater adverse effect on health. In particular, these power plant particles are enriched in toxic metals, such as arsenic and cadmium, as well as in transition metals, such as iron and vanadium, that can cause damaging oxidative stress in lung cells (e.g., Costa et al, 1997; Dreher et al, 1997, and; Lay et al, 1999). This may also be especially true in the case of power plant particles because of the co-presence of acidic sulfates, such as sulfuric acid, that can make these transition metals even more bio-available and potent to damage the lung (e.g., Chen et al. 1990, Gavett et al., 1997). Moreover, power plant PM is composed of very small particles that bypass the natural defenses of the lung, and therefore can penetrate deep into the lung where they are not easily cleared, and can therefore reside there for long times, potentially causing significant damage to the lung and to the human body.

Thus, power plant air pollution is cause for special concern, and this indicates an urgency to the need for reductions in the amounts of this pollution emitted into our air.

Recent policy analyses have quantified some of the potential health benefits of cleaning-up SO_2 and NO_x emissions from presently uncontrolled "grandfathered" power plants. For example, Levy and Spengler in the April, 2001 issue of Risks in Perspective recently estimated that reducing SO_2 and NO_x emissions at only nine of these "grandfathered" plants would annually avoid some 300 deaths, 2000 respiratory and cardiac hospital admissions, 10,000 asthma attacks, and 400,000 person-days of respiratory symptoms. Using a similar approach, a study by Abt Associates (2000) recently found that if all such uncontrolled power plants across the U.S. applied SO_2 and NO_x emissions controls, some 18,000 premature deaths per year might be prevented. It is notable that the Levy and Spengler article shows that most of the effects are estimated to occur within 100 miles of the plants studied, indicating that a national SO_2 cap and trade policy would likely fail to protect the health of all Americans, as it would not reduce the risks in "hotspots" near the plants.

Thus, the evidence is clear, and has been confirmed independently: Fine particle air pollution, and especially those particles emitted by fossil-fuel combustion, are adversely affecting the lives and health of Americans. The importance of these particulate matter-health effects relationships is made clear by the fact that virtually every American is directly impacted by this pollution.

Finally, I would like to emphasize the importance of controlling Carbon Dioxide (CO_2) from such power plants, along with the precursor gases for PM and O_3. We now know that CO_2 concentrations in the atmosphere can adversely affect our climate, and utility power plants are a major source of that CO_2. In addition, coal as an energy source emits far more CO_2 than other sources providing the same energy. Therefore, if we are to continue to use coal as a major source of electrical energy production, while at the same time addressing our growing CO_2 emission problem, technology for the removal and sequestering of CO_2 will also need to be developed and applied to these coal-fired power plants.

In conclusion, it is important for committee members to realize that the downside to not acting to control power plant pollution at this time is the fact that these pollutants' adverse effects will continue to occur unabated. This would result in the public unnecessarily continuing to bear the ongoing diminished quality of life and the health care costs we presently pay because of the adverse health effects of this air pollution from fossil-fuel power plants.

Technologies have existed for decades that can remove high percentages of the pollution from power plant smokestacks, so there is no reason to delay action. Considering the magnitude of the health and climate risks posed by this pollution, the Congress should take action now to provide relief to Americans from the burden of the air pollution presently resulting from fossil-fuel power plant emissions.

Thank you for the opportunity to testify on this important issue

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