STEPHEN WALSH

INSIDE EPA RESEARCH

A look at current air-pollution research activities gives an indication of future regulatory concerns

Frank Princiotta
U.S. Environmental Protection Agency

Since its creation in December 1970, the U.S. Environmental Protection Agency (EPA) has had as its primary goal the mitigation of pollution effects on human health and the environment. Within EPA, the Office of Research and Development has the primary mission of providing high-quality, timely scientific and technical information in the service of Agency goals.

Within this Office are laboratories devoted to various aspects of pollution media (air, water, solid waste). These laboratories represent a resource to help assess environmental problems, and to develop technical solutions. The Air & Energy Engineering Research Laboratory, the subject of this article, has a variety of ongoing programs, many of which are already geared up with participation from private industry.

These programs represent an opportunity for the private sector to gain assistance from, and to participate in, EPA research activities. Knowing where the information and new technology is being generated, and gaining access to it, has been a challenge — but with this guidance, that challenge can be reduced.

Setting the agenda

In 1990, EPA Administrator William Reilly requested his Science Advisory Board (SAB) to seek the best opportunities to reduce environmental risks. He was interested in updating an earlier report [*1*] that prioritized environmental and health risks associated with anthropogenic (human-caused) pollution. The Table summarizes the results of the SAB study. The clear conclusion is that air pollution problems dominate the risk categories, including risks to human health. (SAB limited its ranking to only high human-health risks, since it felt that there is insufficient information to assess other problems.)

In response to the legislative and technical demands placed on it, EPA has organized an extensive network of laboratories across the country. The Figure shows a simplified organizational chart of the Air and Energy Engineering Laboratory (AEERL), which is one of 12 laboratories within the Office of Research and Development (ORD). AEERL is headquartered in Research Triangle Park, N.C. The lab's roots actually precede the creation of EPA (in 1970).

AEERL has a staff of about 100 federal employees supplemented by about 50 onsite contractors. The current (fiscal year 1992) budget is $34 million. The Laboratory has been involved in a number of successful projects, including lime and limestone fluegas desulfurization, low-NO_x burners and chlorofluorocarbons recycling. As significant as past challenges have been in AEERL's research program, they pale in comparison to future ones. It is clear that the private sector, the Dept. of Energy, the Dept. of Defense and AEERL must work cooperatively and productively on an international basis to provide the technology needed to sustain and improve living standards during a period of increased population growth and increased dependence on technology.

The following summarizes ongoing EPA research in key *industrial* air-pollution areas. There are also programs on indoor air pollution, radon mitigation and emissions estimation.

Air toxics control

The air toxics program consists of four components:

1. The development of innovative approaches for the control of organic

Environmental Risk	Relative Risk Level	Human Health Risk
Statospheric Ozone Depletion	HIGH	Ambient Air Pollution
Global Climate Change		Ozone, carbon monoxide, sulfur dioxide
Habitat Alteration and Destruction		Air Toxics: Lead, arsenic, carcinogenic hydrocarbons
Species Extinction and Overall Loss of Biological Diversity		Indoor Pollution
		Radon
		Combustion products
		Toxic agents in consumer products
		Worker Exposure to Chemicals in Industry and Agriculture
		Pollutants in Drinking Water
Acid Deposition	MEDIUM	
Airborne Toxics		
Herbicides and Pesticides		
Surface Water Pollution: Toxics, Nutrients		
Biochemical Oxygen Demand and Turbidity		
Oil Spills	LOW	
Groundwater Pollution		
Radionuclides		
Acid Runoff to Surface Waters		
Thermal Pollution		

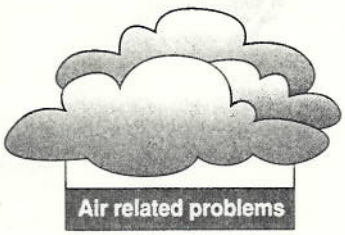

TABLE. Air pollution problems rank high on an assessement of enviromental risks, according to an advisory panel of scientists

emissions from point and area sources

2. The development and evaluation of an innovative VOC-destruction process based on corona discharge, which has the potential for economically controlling small-source emissions

3. Cooperative research with academia to develop, enhance and evaluate engineering approaches for the control of organic emissions

4. The development of a woodstove design that can greatly exceed current emissions standards

Ozone precursor (VOC) control

The ozone-related research program focuses on volatile organic compound (VOC) control. This includes the development of innovative approaches for controlling VOC emissions from point and area sources, especially materials-coating operations. Working with other research specialists, AEERL is also seeking to quantify the impacts of VOC emissions and tropospheric ozone.

The program also includes an organics-control technology-transfer mechanism known as the the Control Technology Center (CTC). CTC, operating in conjunction with the air regulatory office, responds to requests received from regional, state and local environmental authorities for assistance with engineering issues related to the control of organic and other pollutants. To contact CTC, write to CTC, Air and Energy Engineering Laboratory, Research Triangle Park, NC 27711, or call (919) 541 0800.

Ozone protection program

The Montreal Protocol of 1987, the amended Protocol of 1990 and the Clean Air Act Amendments of 1990 have specified schedules for the phase-out of various chlorinated organic compounds, especially chlorofluorocarbons, methyl chloroform and methyl chloride. The AEERL program addresses alternative refrigerant chemistry; recovery, recycling and disposal (RRD); refrigeration; fire protection; and technology transfer.

RRD is important for enabling the use of current capital equipment for as long as possible while production of ODCs is being phased out. The other applications involve research on replacement chemicals, new technologies, or both. The Laboratory is actively involved in technology transfer, since developing countries are an essential part of the global solution to this problem.

Global change program

EPA-ORD has expanded its global climate-change program as a result of increased national and international concern over greenhouse warming and related issues. A major component of this effort is AEERL's research on:

- methane control
- tropospheric ozone
- gaseous emissions
- biomass utilization
- technology evaluation and transfer

Sulfur oxide and acid rain

AEERL has had a long tradition of innovative and productive research in sulfur oxide control. In recent years, the emphasis has been technology that is more economical, and that can be retrofitted on existing coal-fired boilers. Two candidates under development are limestone injection multistage burners (Limb) and advanced silicate (Advacate) technology.

Limb is a retrofit technology developed by AEERL. This approach uses low-nitrogen oxide burners and upper-furnace sorbent injection with a high-surface-area hydrate sorbent. The hydrate acts to adsorb SO_2. The Laboratory has successfully piloted and demonstrated this low-capital-cost technology on a wall-fired coal boiler in Ohio Edison's Edgewater plant, a 100-MWe facility. The technology successfully achieved its goals of removing up to 70% SO_2 and controlling up to 50% NO_x. Current fullscale testing involves a tangentially fired boiler. EPA expects that Limb technology will be used in certain smaller, older boilers for which this technology is cost-effective relative to wet limestone scrubbers.

Recently, AEERL did pilot testing of what could be a breakthrough technology, called Advacate. Engineers from AEERL, the University of Texas and Acurex Corp. (Mountain View, Calif.) have co-invented the Advacate process, which is based on the ability of lime and flyash to form non-crystalline calcium silicate under controlled conditions. The silicate sorbent is injected as a damp powder and is typically 4–5 times as reactive as lime toward SO_2. The ability to carry an equal weight of water and be handled as a dry powder allows the Advacate sorbent to be integrated into a process 50% lower in both

capital and operating costs than a conventional wet limestone unit.

AEERL is working with its licensee, ABB Environmental (Knoxville, Tenn.) and the Tennessee Valley Authority to test this technology at a large pilot plant and ultimately to demonstrate it on a fullscale boiler.

Combustion research

Many air pollutants result from the combustion of fuels or wastes, and thus the program at AEERL covers a broad range of stationary sources, including boilers, industrial process equipment, incinerators and engines. A significant recent activity in this area has been the development of what is referred to as "reburning" technology for NO_x control.

Reburning involves the addition of a clean fuel, such as natural gas, in a downstream portion of a coal boiler with the aim of chemically reducing any NO_x formed in the hotter, upstream combustion stages. The concept is currently being demonstrated on a 108-MWe boiler. Early tests to date have suggested that a 50–70% reduction is achievable with reasonable additions of natural gas. Further field tests are planned.

The combustion program has also investigated the control of toxic emissions from municipal and hazardous waste incineration. In-house research for municipal incinerators has centered on dioxin formation and destruction, and on mercury capture. A new in-house pilotscale combustor capable of burning municipal waste, biomass or coal has been designed for installation in the first half of this year. Also, a RCRA research, development and demonstration permit for hazardous waste incineration is now in force.

Get involved

AEERL has a history of productive collaboration with the private sector — a goal that was enhanced by passage of the Federal Transfer Act of 1986, which facilitates the transfer of technologies from government laboratories to the private sector. The law promotes enhanced interaction between federal laboratories and universities, foundations, and industry through so-called Cooperative Research and Development Agreements (CRDAs). The Advacate/ABB Environmental project, signed in 1990, is the first EPA CRDA.

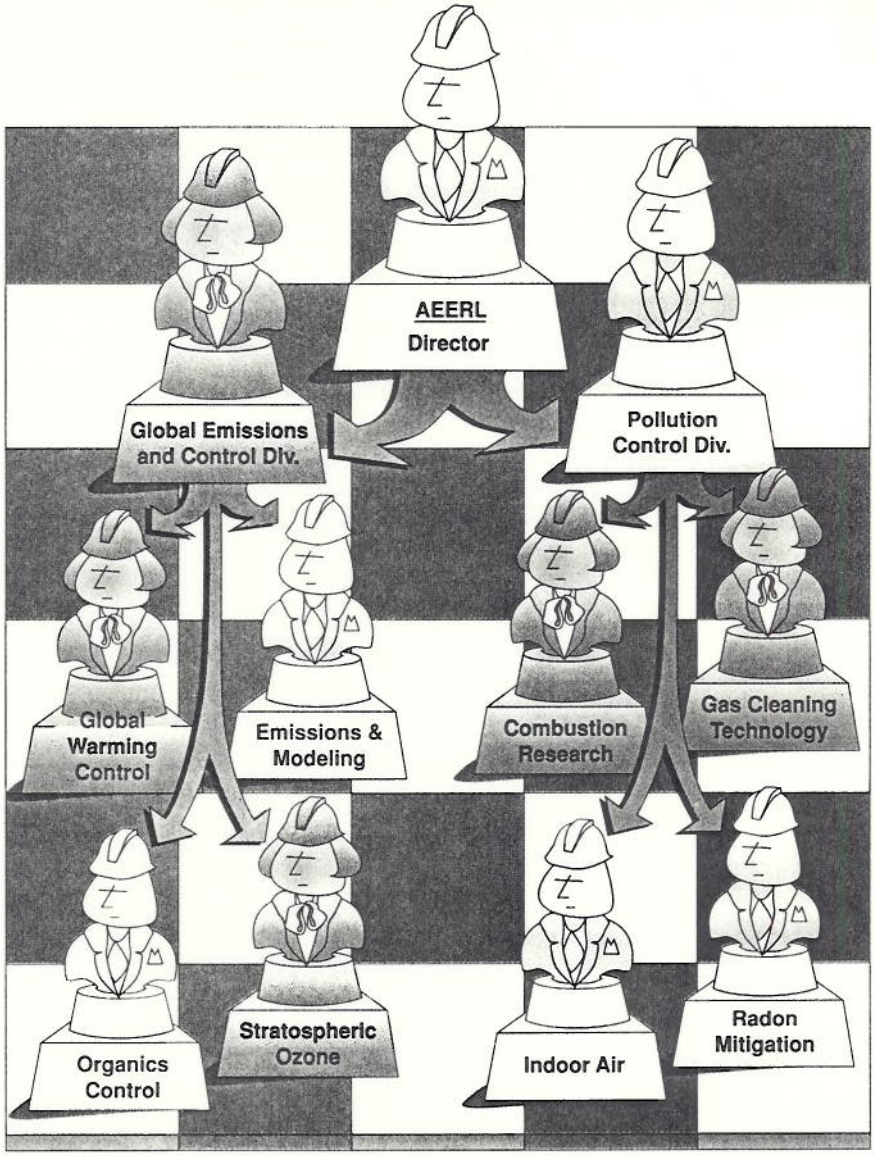

FIGURE. The organization of AEERL is divided into two "branches," one for global emissions, the other for pollution control

Along with most other governmental entities, AEERL, through the ORD Center for Environmental Research Information (Cincinnati), makes all of its published documents available to the general public through the U.S. Government Printing Office (GPO) and the National Technical Information Service (NTIS). GPO's Depository Library Program ensures the distribution of federal documents to more than 50 regional depository libraries and nearly 1,350 selective depository libraries. Write to: U.S. Government Printing Office, Depository Administration Branch, Stop: SLLA, Washington, DC 20401 (tel: 202 275-1071).

At NTIS, a pay-as-you-go affiliate of the U.S. Dept. of Commerce, government documents can be provided on a quick-turnaround basis. For further details of this program, contact: U.S. Dept. of Commerce, National Technical Information Service, Springfield, VA 22161 (tel: 703 487-4650). ■

Edited by Nicholas Basta

Reference

1. USEPA, *Reducing Risk: Setting Priorities and Strategies for Environmental Protection*, SAB-EC-90-021, September 1990.

The author

Frank T. Princiotta is the Director of the Air and Engineering Research Laboratory. He has served as a division director of the Office of Research and Development's Office of Environmental Engineering and Technology Demonstration. Prior to going to EPA headquarters in 1975, he was chief of AEERL's Engineering Test Section. He has been awarded several EPA commendations, including the EPA Gold Medal and two Presidential Executive awards. He has also worked at Hittman Associates, as a senior project engineer, and the U.S. Atomic Energy Commission's New York Operations. He has a B.S.Ch.E. from City College of New York, and a certificate from the Oak Ridge School of Reactor Technology.