***Benefits*** The primary benefit of the fallout forecasting is its triggering of a network to alert officials in radiation-sensitive industries. Once the news of a nuclear event is released, NOAA notifies the National Association of Photographic Manufacturers (NAPM), EPA (usually a joint announcement with DOE), FAA, NRC, the Food and Drug Administration (FDA), and FEMA.

Each organization responds according to the needs of its users. Generally, the actions taken are preventive in nature. The kinds of problems prevented and the actions taken as a result of the alert network and subsequent forecasts are user-specific.

1. The photographic industry is concerned about potential damage to sensitive materials during manufacture. The most sensitive are scientific plates and X-ray film. NOAA alerts NAPM, which in turn notifies 16 member-plant officials (DuPont, Kodak, 3M, and Polaroid, for example). If radiation levels rise sufficiently, filtered air and water may be recirculated to avoid contamination from external sources. Only in the early 1950's (from United States tests) has fallout been severe enough to damage materials and cause a production shutdown.
2. The EPA (a) disseminates to Federal agencies and the general public predictions from NOAA on pathways of contaminated air-mass movements over the United States and areas of possible rainout of radioactive materials and (b) activates the standby portions of the Environmental Radiation Ambient Monitoring System (ERAMS). EPA also recommends necessary radiation surveillance or protective actions to appropriate state agencies.
3. The FAA uses data from NOAA, the Air Force, and DOE to develop air traffic advisories for appropriate air traffic control centers, airman's information centers, and airlines regarding airspace that should be avoided because of potential or actual radioactive contamination. These advisories depend most heavily on Air Force and ARAC information.
4. NRC is concerned about the possibility that fallout may trigger on- or off-site monitors at nuclear facilities. Local severe weather following a nuclear test can cause monitors to show significant increases in radiation levels that can be confused with a radiation leak from a reactor. NRC alerts all reactor facilities and has thereby avoided costly power plant shutdowns that might last from hours to weeks at a potential cost of $500,000/day.
5. FDA receives information from NOAA regarding the probable location of fallout contamination and consults with EPA concerning radiation surveillance and protective actions. FDA then provides guidance to state and local Governments regarding appropriate responses for evaluating and preventing hazardous radioactive contamination of foods and animal feeds, as well as guidance on the control and use of such products should they become contaminated.

## Detection and Measurement of Human Health Effects

No area of science can develop very far without special tools, methods, and instruments. During the early stages of a science, observation with available instruments is usually sufficient. At some point, it becomes necessary to measure events that have not been measured before. A new technology often provides the means of developing new, more efficient or more cost-effective instruments that find applications outside the original thrust of the research.

The instruments developed in OHER programs have found specialized applications in hospitals and clinical laboratories, research laboratories, Government, and industry. They have brought true automation, as opposed to mechanization, to the areas of cell counting and blood-chemistry analyses. The methods and procedures of short-term bioassays, fast tests for screening materials for potential cancer-causing agents, have revolutionized the field of testing new chemicals for potential hazards.

Instruments originally designed to measure radiation doses to biological systems are now found in operating power reactors and metal recovery plants, as well as in the delicate interior of electron microscopes. The concepts of personal badges and on-the-spot dosimeters are providing new ways to further increase employee safety in chemical processing facilities. The United States has a way to track and measure the path of dangerous substances released to the atmosphere should an accident or mishap occur.

In the 1960's the emphasis of environmental research shifted to the support of a civilian nuclear industry, and research efforts were directed toward perceived problems of nuclear power plants. Although all types of power plants release heat to the rivers used to supply their cooling water, the effect of the increased heat releases from the larger nuclear power plants needed to be understood. Plans to construct ocean-cooled, off-shore reactors focused research on the Continental Shelf and near-shore areas and provided valuable information for non-nuclear energy development, such as ocean thermal energy conversion (OTEC), and information necessary to evaluate ocean waste disposal. Research in the cycling of transuranic elements (man-made elements heavier than uranium, primarily plutonium) in the environment turned to the concern about their potential uptake by crops such as wheat, corn, soybean, and root crops.

Efforts to understand the impact of radioactive materials inadvertently introduced into the ecosystem by nuclear bomb tests led to a clearer understanding of how ecosystems operate. The controlled use of radioisotopes to further this understanding has