Statement by

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16. Abstract (Limit: 200 words) This statement concerned NIOSH programs relating to occupational exposure to radiation. In the study of industrial carcinogens, attention was given to the problem of radiation induced carcinogenesis. Much epidemiological data gathered points to exposure to radon daughters as hazards to uranium miners and milling operators. Problems arising from the operation of radiation generating equipment were also addressed such as personnel working with baggage x-ray inspection units at airports. Nonionizing radiation hazards included visible, ultraviolet, radiofrequency and microwave radiation, infrared and ultrasonic radiation. Ultraviolet radiation can cause sunburn, eye damage, depigmentation, precancerous tumors, basal and squamous cell cancers, and malignant melanomas. Infrared radiation has been implicated in the development of cataracts. Laser radiation was linked with burns and fire hazards. The only hazard associated with visible radiation thus far has been eyestrain due to the lack of sufficient light while performing a given task. Optical radiation exposures occurred among workers using cathode ray tubes, such as computer screens, in their jobs. Workers were exposed to many sources of microwave and radiofrequency radiation from radio and radar transmitters, industrial drying equipment, heat sealing and curing equipment, and certain medical research devices. Training and support services offered to those exposed to radiation sources were briefly considered.

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Mr. Chairman and Members of the Subcommittee:

I am Dr. Elliott S. Harris, Director of the NIOSH Division of Biomedical and Behavioral Science. Accompanying me today are Dr. Wordie H. Parr, Chief of the Physical Agents Effects Branch, Mr. William E. Murray, Chief of the Radiation Section, and Dr. Zory R. Glaser, Director of our Special Hazards Evaluation Program in the Division of Criteria Documentation and Standards Development. We are pleased to have been invited to discuss the NIOSH programs relating to occupational exposure to radiation. We have discussed the four specific questions raised in Senator Magnuson's letter of May 26 in a separate letter to the Chairman.

The National Institute for Occupational Safety and Health (NIOSH) was established by the Occupational Safety and Health Act of 1970 (P.L. 91-596). Prior to 1970, the predecessor organization of NIOSH operated under the general research authorities of the Public Health Service Act. Between 1968 and 1971 a small portion of our resources were devoted to the radiation effort. Following passage of the Act, NIOSH was given specific responsibility to develop recommended standards for exposure to a broad range of occupational hazards, including radiation. A Radiation Section was established in 1972 in the Physical Agents Effects Branch of NIOSH.

We do not have authority under the Radiation Control for Health and Safety Act of 1968 (P.L. 90-602), which concerns the public health aspects of radiation emissions from electronic products. However, under the Occupational Safety and Health Act, NIOSH has several vital functions related to occupational safety and health. These include the conduct of research programs, the performance of hazard evaluations, field studies, morbidity and mortality studies, the development of recommended standards, the dissemination of information to employers and employees, the provision

of technical assistance, and the conduct of training and education programs. Many of these are concerned specifically with ionizing and non-ionizing radiations.

The development of criteria documents as a basis for standards for the occupational exposure to chemical and physical hazards is a continuing activity of NIOSH. These criteria documents are prepared for the purpose of recommending an occupational health or safety standard to the Occupational Safety and Health Administration (OSHA) within the Department of Labor (DOL), which is responsible for setting and enforcing standards to protect workers. It is the goal of the Institute to identify the health effects produced by a substance or process and to recommend methods to evaluate and control the hazard. Before the documents are transmitted they undergo extensive internal review and external review by management and trade associations, organized labor, academia, State and Federal agencies, and professional societies. More than 65 criteria documents recommending standards for occupational exposure have been transmitted to OSHA, including documents on hot environments and ultraviolet radiation. Documents involving consideration of worker radiation exposure planned for completion during fiscal years 77-81 include radiofrequency (RF) and microwave radiation, infrared radiation, and ultrasonic radiation. In addition, a criteria document will be developed for welding and brazing processes, which have radiation exposure aspects.

IONIZING RADIATION

One of NIOSH's major efforts mandated by Congress is the study of industrial carcinogens. Since it is well established that ionizing radiation induces cancer in man, NIOSH has initiated a study to survey the current knowledge of radiation-induced carcinogenesis. The information

will assist us in estimating the potential carcinogenicity of the various forms of radiation and help to update the National Academy of Sciences 1972 summary report entitled, "The Biological Effects of Ionizing Radiation" (BEIR Report).

For the past decade, NIOSH and its predecessor organizations have been gathering, analyzing, and publishing epidemiologic data on the hazards to workers from radon daughter products present in the uranium mining and milling operations. It was this work which first identified the lung cancer problems among uranium miners. Efforts were initiated to control exposure, and a cohort of exposed workers is being followed as part of our surveillance activities. This research on uranium miners was also instrumental in developing field methods for measuring radon daughters, procedures for engineering controls, and medical monitoring procedures for the diagnosis of lung cancer.

NIOSH has provided technical assistance, upon request, in addressing problems from radiation-generating equipment. For example, because of employee concern for the possibility of excessive ionizing radiation exposure, the Federal Aviation Administration (FAA) and the Air Transport Association (ATA) requested NIOSH to evaluate the potential radiation hazards to airport personnel working with baggage X-ray inspection units. NIOSH performed this service, and concluded that the employee doses were well below the OSHA exposure standard, and that the radiation hazard was minimal.

NON-IONIZING RADIATION

A large part of NIOSH present and future radiation effort is the non-ionizing area. Our efforts include programs on visible, infrared,

ultraviolet, laser, radiofrequency/microwave radiation, and ultrasonic radiation.

Ultraviolet Radiation (UV)

NIOSH transmitted a criteria document on UV to the Department of Labor in 1972. In addition to a recommended occupational exposure standard, the document addressed environmental data, bio-effects, quantitative measurements, and protection and control measures.

The UV portion of the spectrum is responsible for sunburn, and can produce eye damage. Prolonged exposure to UV radiation results in hyperpigmentation and the possibility of skin cancers. Another less common effect of ultraviolet radiation on normal skin causes the victim to develop freckling, depigmentation, precancerous tumors, basal and squamous cell cancers, and malignant melanomas. Welding arcs, and certain sun tanning lamps, and industrial lamps and dryers can emit large amounts of UV radiation and have the potential of producing these effects in workers.

The following areas were identified in the UV criteria document as requiring further research effort: the lack of a portable survey instrument for evaluating UV hazards according to the recommended standard, and the need for research on the ocular effects over the wavelength range of 315-400 nanometers(nm).

Portable UV monitors have been developed and are presently undergoing testing and evaluation. The National Bureau of Standards (NBS) cooperated in developing a UV transfer standard, and in establishing at NIOSH a UV calibration facility. Research is also underway to determine UV thresholds for ocular effects in the 300-400 nm range.

Infrared Radiation (IR)

Although the near-IR portion of the spectrum has been implicated in the development of cataracts, threshhold levels have not been established as a function of wavelength. NIOSH will soon initiate animal studies to assess eye damage resulting from exposure to near-IR radiation. These data will be used to assist in the development of an occupational exposure standard.

Lasers

In fiscal year 68 we surveyed over 2,100 lasers in 200 occupational establishments in three states, Massachusetts, New Jersey, and California. The protocol included a review of the company safety program, and a "walk-through" survey of the laser operating area. The safety and engineering control procedures were found to be marginal or inadequate for 40 percent of the lasers in use.

In fiscal year 75 NIOSH was requested by OSHA to prepare a compendium of lasers which would categorize lasers into one of five hazard classes specified in a recent draft of the OSHA proposed standard for exposure to lasers. The report was compiled with the assistance of the U.S. Army Environmental Hygiene Agency and was published in 1976. The compendum contains technical data on 2,500 laser devices manufactured after 1963.

Visible Radiation

With the inception of the Federal energy conservation program, questions were raised about the health and safety implications associated with reduced illumination levels in the workplace. At the direction of the Secretary of HEW, NIOSH sponsored a symposium on the subject and invited experts in the field of illumination from the U.S. and Europe to present their views. Based on the information available, NIOSH concluded that the

only effect on health from reduced illumination levels in the workplace would be an increased occurrence of eyestrain and that there was no evidence for any long-term permanent ocular damage. With regard to safety, it was concluded that the standard used by the General Services Administration (GSA) would not pose an additional hazard to worker health and safety. The proceedings of the symposium were published as a technical report.

Optical Radiation

Additional projects have been pursued which involve an integrated approach to evaluating optical radiation hazards. This includes the UV, visible, and IR spectrum. We are performing a study in conjunction with the American Welding Society to examine hazards of the welding process. Optical radiation measurements have been made by NIOSH and the U.S. Army Environmental Hygiene Agency on the most common welding processes, under a variety of conditions. We are also determining whether transparent welding curtains surrounding the welder protects his co-workers from harmful levels of optical radiation. At the request of the Newspaper Guild, we have performed surveys to measure the radiation emissions from the cathode ray tube (CRT) of video display terminals (VDT) used in a newspaper composition room where 2 young employees developed bilateral cataracts. The levels of optical and RF radiation measured were several orders of magnitude below existing occupational exposure guidelines and it has not been possible to establish that the cataracts are related to radiation emissions from these terminals.

NIOSH has developed a calibration and testing facility to assist in evaluating optical radiation hazards. This facility contains several standard sources and detectors for the calibration of laboratory and field

instruments. We have also initiated a quality assurance program to perform long-term studies on the stability, accuracy, and reproducibility of the instruments.

Radiofrequency (RF) and Microwave Radiation

Workers are potentially exposed to RF and microwave radiation from a large number of sources and devices, including a large number of radio and radar transmitters, industrial drying, heat sealing and curing equipment, and certain medical research devices. Consequently, NIOSH is planning a criteria document for occupational exposure to radiofrequency (RF) and microwave radiation. NIOSH is currently updating an extensive bibliography of world literature of the bio-effects of RF and microwave radiation.

Recent observations raise the question of the possibility of cancer induction by TACAN radar, which is extensively used for tactical air navigation. NIOSH was requested to investigate the work hazards associated with TACAN operator and TACAN repair procedures at Department of Defense facilities after two TACAN repairmen had been diagnosed as having carcinoma of the pancreas. At none of the three survey sites did the present levels of microwave or X-radiation exceed the currently accepted permissable exposure levels. NIOSH is also considering performing a retrospective epidemiologic study to determine whether TACAN system repairmen exhibit an increased incidence of cancer of the pancreas, as well as carcinomas of other body sites.

NIOSH became aware of several problem areas in the radiofrequency radiation band (specifically 10-300 MHz) in 1972. The first problem to be recognized was that employers often were unaware that they were using RF radiation in their facilities. This may have stemmed from the fact that the industrial uses of RF generators were not widely publicized, and little

information was available on their uses. For these and other reasons, estimates of workers exposed to RF and microwave radiation vary from as few as 50,000 to as many as 21 million. The second problem identified was that there were no survey instruments available with which "near-zone" measurements could be made in the field. Third, little information was available on the biological effects at the radio frequencies used in industry.

The National Bureau of Standards (NBS) laboratory in Boulder, Colorado, has developed, under interagency agreement with NIOSH, RF-detection equipment capable of measuring the energy in the "near-zone" of the electromagentic field, as is the case of the worker exposure situations we have studied. A unique RF exposure and calibration facility capable of simulating near-field exposure conditions was also developed for NIOSH by NBS. This facility has been used to evaluate commercial monitoring instrumentation which manufacturers claim to be usable from 10 to 40 MHz. Accurate measurement equipment and instrumentation, and standard survey techniques are essential for the monitoring and enforcement of RF and microwave exposure levels.

In our field studies 75 percent of the workers using RF sealing and heating equipment were found to be exposed to RF radiation levels higher than the present occupational exposure guideline. A majority of these workers were women, of child bearing age. Because recent literature indicates that exposure of pregnant animals to RF radiation may harm the fetus, we are beginning animal studies designed to determine threshhold levels for teratogenic effects from RF exposure.

Radiation Training and Support Services

Various NIOSH Divisions provide support and training functions in the radiation field. NIOSH has been responsible for the calibration of instrumentation used by the OSHA Compliance Officers in inspections of the workplace. The Maintenance and Calibration Laboratory has established calibration procedures and techniques for ionizing radiation and microwave survey instruments. These instruments are routinely calibrated on a twelve month cycle. A radio frequency (RF) radiation (10-300 MHz) calibration facility is in the final stages of development and will be completed by the end of 1977.

NIOSH presents short-term training courses in occupational safety and health as part of its responsibilities for manpower development. The courses provide the health professional with an overview of industrial hygiene and safety as well as specialized training to broaden the background of the practicing professional. Two of the speciality courses address the safety and health problems associated with ionizing and non-ionizing radiations. Course materials are available to any Federal or State agency and other interested groups. The general availability of these courses serves as a multiplying factor in enhancing NIOSH's role in training and manpower development.

Mr. Chairman, this concludes our overview of NIOSH's involvement in the occupational aspects of radiation health effects and worker protection. If you have any questions, my colleagues and I will be glad to try to answer them.