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Toward a U.S. National Radiation Dose Registry ... and More

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BACKGROUND

ALTHOUGH IT has been recognised for years that a nationwide radiation worker registry in the United States would be of significant scientific, as well as administrative benefit, to date there is no existing centralised registry. There are several reasons why a registry does not exist in the United States. In contrast to Canada, for example, the U.S. Government has never been the sole supplier or processor of radiation dosimeters. Government-owned or operated facilities, including the military, independently developed and processed dosimeters during the early years of weapons development and energy research. Commercial suppliers of dosimetry services were formed to serve the private sector of the nuclear industry. In addition, regulations pertaining to radiation record keeping and reporting practices were never standardised or uniformly applied throughout the nuclear industry. Although the occupational exposures of individuals employed in various segments of the U.S. nuclear industry are governed by similar limits and standards, requirements for the reporting of demographic and exposure data to a central facility are not in place. In the late 1960s, the Atomic Energy Commission proposed legislation to require all of its licensees and contractors report exposures of all workers to the Commission. This failed and resulted in the rather piecemeal requirements for the collection of exposure data currently promulgated by the Nuclear Regulatory Commission (NRC), the Department of Energy (DOE), and the Department of Defense.

Another reason for the lack of centralised registry in the United States is the split between the NRC and DOE in responsibilities for regulation, management, and promotion of nuclear energy, weapons, and other facilities. The NRC regulates the use of radioactive materials by the private sector. It directly licenses all commercial nuclear power reactors and the fabricators of fuel for these reactors, but shares its regulatory authority with about half of the States (so-called Agreement States) in the regulation of all other uses of radioactive materials. It does not regulate or license users of produced radiation or most naturally occurring radioactive materials. Regulations are applicable to workers in all segments of the nuclear industry, including nuclear power plants, fuel processing, fabrication and storage facilities, nuclear medicine, industrial radiography and well-logging, radioactive waste disposal facilities, and universities, hospitals and other research institutions.

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NRC MONITORING

Currently, the NRC and its Agreement States, require their licensees to assess and record the occupational doses of individuals exposed to radiation. The licensees keep detailed records in various formats and media of these assessments. Limited individual and summary dose information for workers are required to be reported to a central repository at the following types of NRC-licensed activities:

commercial nuclear power reactors;
fuel processors, fabricators, and reprocessors;
industrial radiographers (using radioactive material);
high-level waste geological repositories;
independent spent fuel (commercial reactor) storage facilities;
low-level radioactive waste disposal installations; and
processors and manufacturers of large quantities of certain radioactive materials.

Monitoring is required for any individual present at a licensee's facility whose dose is likely to exceed 10% of applicable limits.

CURRENT NRC REPORTS

An annual statistical report of the distribution of the external, whole-body doses received by individuals monitored by each of the 500 NRC licensees covered by the reporting requirement is submitted to the NRC's Radiation Exposure Information Reporting System (REIRS). No individual doses are included in the report; each licensee simply indicates into which one of 18 ranges a worker's total annual dose fell. Compilation of the annual statistical reports provides a fair indication of the distribution of annual doses received by workers at the various types of facilities and allows the estimation of their collective, average and maximum doses each year. Some of the limitations of

the statistical reports may be overcome by use of the 'termination' reports, which are submitted to REIRS each time an individual ceases to be monitored for exposure to radiation by one of the covered licensees. The following information is extracted from each of the approximately 115,000 termination reports that are submitted each year:

licensee name, facility type;
individual name, social security number, birth date, sex;
beginning and ending dates of monitoring;
external (whole-body) dose equivalent;
shallow dose (skin);
extremity dose; and
indication of internal exposure (results may be provided in any suitable units from dose in rems to concentrations of radionuclides in urine).

Since a personal identifier is retained, these data allow worker doses to be tracked as they move from one covered licensee to another and facilitate the compilation of career doses. Contractor reactor workers are particularly mobile, often working at five or six nuclear power plants per year. The combination of these data with similar data for current workers at a particular power plant would allow the determination of career doses for all those workers. However, complete career or lifetime doses are not easily compiled for workers who do not spend their entire careers at facilities covered by the reporting requirements. An annual report summarising the exposure data reported to REIRS has been published each year since 1969.

NRC'S FUTURE REIRS

Effective 1 January 1994, an annual 'Occupational Exposure Record' will be required to be submitted to NRC's REIRS for each individual monitored by the seven types of licensees previously described. Submission to REIRS of the annual statistical dose distribution reports and the individual termination reports will no longer be required. The report will have a specified format (NRC Form 5), which may be submitted on electronic media, and will contain the following data elements for each individual:

licensee name, number, type;
name, social security number, sex, birth date;
beginning and ending dates of monitoring;
total effective dose equivalent, including the external and internal components — (deep dose and committed organ and effective dose equivalents);
shallow dose (skin of whole body);
eye dose equivalent;
extremity dose equivalent; and
nuclides, class, mode and estimate of intake (Uci) resulting in the internal doses.

These data will allow the compilation of improved statistics and trend analyses of annual doses for certain types of workers and allow the eventual development of career doses. In order to expedite this process, the covered licensees will be requested (on a one-time basis) to voluntarily submit the cumulative doses incurred by current workers before 1994.

DOE MONITORING

The DOE regulates the occupational exposures of all DOE and contractor workers exposed to radiation and radioactive materials at facilities involved in the production and processing of fuel for Government reactors, weapons fabrication and testing, operation of reactors and accelerators, general and special energy research, and waste processing and management. Currently, DOE requires its contractors to measure and maintain the occupational doses of workers exposed to radiation. Individuals working at, or visiting, DOE facilities are required to be monitored for exposure to radiation when the potential exists for their doses to exceed 10% of applicable limits. For about the last 10 years, between 80,000 and 90,000 of the approximately 160,000 DOE and contractor employees have been monitored each year. An additional 50,000 individuals who are classified as visitors are also monitored annually. Approximately 600,000 workers have been monitored at DOE/AEC facilities since operations began in the late 1940s.

CURRENT DOE REPORTS

An annual radiation dose summary is submitted to the DOE's System Safety Development Centre (SSDC) for each monitored worker or visitor with a positive exposure. The report contains the following data elements for each individual:

name, social security number, sex, date of birth, occupation;
organisation and facility;
beginning and ending dates of monitoring;
total effective dose equivalent (whole body), including the external and internal components;
shallow dose (skin); and
extremity dose.

An additional report is submitted for any individuals who incurred an uptake of radioactive material during the year that resulted in an organ dose commitment in excess of 50% of the annual standards. After 60 days, the individual identification data contained in these reports are included in the Monitored Personnel Locator File so that individual identities are no longer associated with exposure data. These data allow the calculation of the collective dose incurred by DOE workers, analyses of the annual doses by age, sex, facility type, occupation, etc., and an examination of trends in such doses over time. However, the disassociation of personal identifiers from the exposure data limits the usefulness of the system because career (or lifetime) doses cannot be developed or analysed; the accumulation of dose with time cannot be determined for individuals; the trends of higher-dose workers over time or by age, occupation, etc. cannot be examined; and workers cannot be tracked as they move from site to site, agency to agency, or in and out of the nuclear industry. An annual report summarising the reported exposure information has been published for each year since 1969.

FUTURE DOE SYSTEMS

The objectives of DOE's occupational dose repository (sometimes also called REIRS) are being re-evaluated with the intention of possibly retaining personal identifiers to increase the usefulness of the data as currently reported. Efforts to collect improved dose data will be co-ordinated with the needs of DOE's new health surveillance programme to maximise their application. Consideration will

be given to making the system compatible with that of the NRC with the use of similar formats and system specifications. Consideration will be given to the evaluation or reassessment of each worker's historical doses in light of more recent developments in radiological protection philosophy and methodologies. This could lead to the development of a registry containing identification and dose information for each current and previous DOE worker.

With particular reference to epidemiological studies is the DOE CEDR [1]. Although not technically a dose registry, CEDR may some day function as the U.S. radiation worker dose (and health outcome) registry. CEDR is a primary component of DOE's current efforts to enhance its epidemiological programme. Its primary mission is to ensure that data resulting from DOE epidemiological activities are systematically collected, organised, documented, and made readily accessible to a broad spectrum of independent researchers without violating privacy rights of the subjects of the studies. The CEDR data will be a valuable resource for the education and training of graduate students in various fields, such as biostatistics, and will encourage the development of new methodologies in the treatment of epidemiological data. The most extensive occupational epidemiological activities in which DOE, and its predecessor agencies, have been involved are those in the Worker Health and Mortality Study. This study was begun in the 1960s with an examination of the Hanford cohort, and in the late 1970s was expanded to other DOE facilities. All of the data resulting from these efforts are to reside in CEDR and will be made available, in a de-identified manner, to interested researchers. Currently, the analysis files for 21 datasets resulting from the last 30 years of the Health and Mortality Study, which contain record-level data pertaining to approximately 120,000 workers at ten DOE sites, are available. The de-identified view of the data is identical to that compiled by the original researcher except that names and social security numbers have been replaced by a CEDR identifier number, the birth and death dates are shown only as years, the day of the month is not shown in hire and termination dates, and indicators of race are limited to one of three. These efforts, along with the requirement that CEDR users agree to treat the data as confidential CEDR and will not attempt to determine the identity of individuals, ensure that individual privacy is protected without compromising the usefulness of the data.

The types of data found in these datasets include demographic, socio-economic, employment and work history, exposure information, and vital status or coded cause of death. However, because the studies were conducted by different investigators, for workers at various sites, and include data from records generated years ago, there is little standardisation in their structure or variables. Consequently, CEDR treats each one as a separate database with its own documentation, called metadata. Because of the uniqueness and complexity of each of these datasets, extensive documentation is required to maximise their usefulness to other investigators. The information system currently supporting the CEDR data is a prototype that utilises commercial relational database management software on a UNIX system at Lawrence Berkeley Laboratory in California. After completion of the required confidentiality forms, CEDR data are available at no cost to the researcher. The CEDR project personnel at Berkeley will assist researchers in formulating their requests and in establishing the type of interaction they desire. Researchers may simply order copies of various datasets from their catalogue, or they may explore the possibility of electronic access.

The usefulness of CEDR for epidemiological studies will be enhanced as more and different types of datasets are made available in the future. These include data on NRC workers obtained annually, as described above, and linked with mortality or other health outcome data.

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1. U.S. Department of Energy. Access. Comprehensive Epidemiologic Data Resource: Program Goals. *DOE Publication DOE/EH-0339*, Washington DC, 1993.