Overview of DOE Radiation Exposure Information Reporting System (REIRS)

**J. J. Fix, PNL Principal Investigator
G. J. Briscoe, EG&G Principal Investigator
J. M. Selby, PNL Project Manager
E. J. Vallario, DOE Project Manager**

May 1981

**Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830**

**Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute**

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

The views, opinions and conclusions contained in this report are those of the contractor and do not necessarily represent those of the United States Government or the United States Department of Energy.

PACIFIC NORTHWEST LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
Under Contract DE-AC06-76RLO 1830

Printed in the United States of America
Available from
National Technical Information Service
United States Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151

Price: Printed Copy \$_____*; Microfiche \$3.00

*Pages	NTIS
	Selling Price
001-025	\$4.00
026-050	\$4.50
051-075	\$5.25
076-100	\$6.00
101-125	\$6.50
126-150	\$7.25
151-175	\$8.00
176-200	\$9.00
201-225	\$9.25
226-250	\$9.50
251-275	\$10.75
276-300	\$11.00

3 3679 00055 2234

OVERVIEW OF DOE RADIATION EXPOSURE
INFORMATION REPORTING SYSTEM (REIRS)

J. J. Fix, PNL Principal Investigator
G. J. Briscoe, EG&G Principal Investigator(a)
J. M. Selby, PNL Project Manager
E. J. Vallario, DOE Project Manager(b)

May 1981

Prepared for
the U.S. Department of Energy
under Contract DE-AC06-76RL-1830

Pacific Northwest Laboratory
Richland, Washington 99352

-
- (a) EG&G Idaho, Inc., System Safety Development
Center, Idaho Falls, Idaho 83415.
(b) Operational and Environmental Safety Division,
Department of Energy, Washington, DC 20555.

FOREWORD

The Operational and Environmental Safety Division (OES) of the Department of Energy (DOE) initiated a study during FY-80 to review the status the DOE Radiation Records Repository. The repository provides an overview of DOE and DOE contractor employee occupational irradiation exposure, an assessment of transient worker exposure between DOE contractors, and information for the DOE annual report of occupational radiation exposure received by DOE and DOE contractor employees. These functions have been served by the repository since its establishment during 1968.

The purpose of the study is to determine the adequacy of the present system, identify any necessary short-term improvements and propose feasible alternatives for an improved system. The study will include topical reports as follows:

- Current Personnel Dosimetry Practices at DOE Facilities
- Overview of DOE Radiation Exposure Information Reporting System (REIRS)
- Alternatives to Provide Upgraded Occupational Exposure Record System.

This study constitutes the second report and was a joint effort between Battelle Northwest and EG&G, Idaho Falls. EG&G has been responsible for the repository since the fall of 1978.

E. J. Vallario
Assistant Chief/Manager
Health Physics Programs
Division of Operational &
Environmental Safety
U.S. Department of Energy

SUMMARY

The Radiation Exposure Information Reporting System (REIRS) was initiated in 1968 (1). By the end of 1979 the REIRS data repository contained approximately 226,600 records consisting of:^(a)

- Individual dose records for 225,000 terminated employees (99.3% of the total data base),
- Records for 399 internal deposition doses where the internal deposition exceeded 50% of the annual standard (0.2% of the total data base),
- Twelve hundred entries of whole body dose summaries and distributions by DOE office, Contractor, and/or facility (0.5% of the total data base).

REIRS output data is currently used to produce the annual report of Occupational Exposure for DOE Operations (2). This report provides an assessment of several dose parameters at DOE facilities such as the average individual dose, number of employees in selected dose ranges, cumulative man-rem dose, etc. REIRS also provides DOE headquarters with a quarterly microfiche copy of the terminations file, alphabetically and by social security number, which aids in response to inquiries regarding dose histories of terminated employees.

Several factors currently limit the usefulness of REIRS:

- Some useful data is not currently entered into the repository: The current cumulative dose of an active employee is not entered into the system (the cumulative dose is entered only when an employee terminates). There is no provision to extract dose information based on employee age distribution or to distinguish between an employee's neutron dose and the dose from other types of radiation.

(a) One record refers to the input from one form submitted to the repository (either a 190, 191, or 192).

- The time lag between an employee's termination and when REIRS data is made available limits the system's usefulness in providing exposure history of an employee moving from one DOE Contractor to another.
- The data base contains inaccuracies due to incomplete submittals on certain individuals, some duplications of data, and some errors. These known deficiencies affect the credibility of the present system.
- Contractors vary in the way they interpret Manual Chapter 0525, resulting in inconsistent input data as provided on Forms 190, 191, and 192.
- As discussed herein and in Topical Report No. 1⁽³⁾ nonuniform methods used for measuring and assessing external radiation dose and internal deposition at the various field offices and contractors make the reported doses inconsistent regardless of consistency in reporting.

The present REIRS system does currently provide several services unavailable elsewhere. It provides:

- Historical overview of occupational exposure at DOE facilities,
- A record of transient worker dose among DOE and DOE contractors,
- Summary data for the DOE Annual Report.

CONTENTS

FOREWORD	iii
SUMMARY	v
FIGURES	ix
TABLES	ix
INTRODUCTION	1
RADIATION EXPOSURE RECORD SYSTEM	2
REPOSITORY INPUT	2
Form 190 – Annual Summary of Whole Body Exposures to Ionizing Radiation	2
Form 191 – Summary of Exposures Resulting in Internal Body Depositions of Radioactive Materials for CY-19__	4
Form 192 – Termination Occupational Exposure Report	4
REPOSITORY COMPUTER OUTPUT	5
Annual Summary File	5
Internal Body Depositions	7
Terminations	7
DATA ANALYSIS	7
Form 190 Data	7
Form 191 Data	10
Form 192 Data	11
OBSERVATIONS	12
DOE Repository	12
NRC Repository	13

CONCLUSION	.	.	.	.	.	.	.	.	.	.	.	.	15
ACKNOWLEDGMENT	.	.	.	.	.	.	.	.	.	.	.	.	17
REFERENCES	.	.	.	.	.	.	.	.	.	.	.	.	18
APPENDIX A - DOE FORMS 190, 191 AND 192	.	.	.	.	.	.	.	.	.	.	.	.	A.1
APPENDIX B - FORM 190 DATA FILE	.	.	.	.	.	.	.	.	.	.	.	.	B.1

FIGURES

1	Radiation Exposure Information Reporting System	.	.	.	.	6
2	Personnel Monitored by Field Office.	.	.	.	.	8

TABLES

1	Present REIRS Subsystems	.	.	.	.	.	.	.	.	3
2	Form 191 Records by DOE Operation	.	.	.	.	.	.	.	.	4
3	Percentage of Personnel Monitored with Less-Than Measurable Doses	.	.	.	.	.	.	.	.	9
4	Percentage of Personnel Monitored by Facility Type	.	.	.	.	.	.	.	.	10

OVERVIEW OF DOE RADIATION EXPOSURE INFORMATION REPORTING SYSTEM (REIRS)

INTRODUCTION

The Radiation Exposure Information Reporting System (REIRS) was initiated in 1968. All Atomic Energy Commission (AEC) and AEC-contractor offices monitoring personnel radiation exposure were directed to report exposure records on terminating employees and visitors, individual internal body depositions, and employer summary exposure information. While contractors were not required to report the exposure to previously terminated personnel, AEC government offices were required to include exposures for employees terminating prior to 1968. Radiation exposure records were initially submitted to Workmen's Compensation Group for manual processing and filing. During January 1975, the AEC was split into the Energy Research and Development Administration (ERDA) and the Nuclear Regulatory Commission (NRC). In 1975, a contract was made with Union Carbide Corporation at Oak Ridge to computerize the reporting and processing of both the ERDA and NRC radiation exposure reporting systems. On October 1, 1977, the Department of Energy (DOE) was formed, replacing ERDA. Processing and programming continued at Oak Ridge until October 1978, when the management and further development of the DOE radiation exposure reporting system was assigned to the System Safety Development Center, EG&G Idaho, Inc.; the NRC system remained at Oak Ridge.

An analysis of the current repository input forms and the historical data base is presented in this report. Operating practices in personnel dosimetry, including input to the repository, vary among DOE contractors. Contractors at certain DOE sites have varied through time further complicating the consistency of the data base. Completeness and apparent consistency of the data base are considered in this report.

RADIATION EXPOSURE RECORD SYSTEM

REPOSITORY INPUT

DOE operators are required to submit information to the repository according to the criteria contained in Manual Chapter 0525 (4). The following three input forms are required and are included in Appendix A:

Form 190 - Annual Summary of Whole Body Exposure to Ionizing Radiation

Form 191 - Summary of Exposures Resulting in Internal Body Depositions of Radioactive Materials for CY-19__

Form 192 - Termination Occupation Exposure Report.

Three basic subsystems derived from these forms are described in Table 1. The terminations subsystem contains the majority of file data with approximately 99.3% of the total records; internal body deposition and annual summary information subsystems contain 0.2% and 0.5%, respectively.

Form 190: Annual Summary of Whole Body Exposure to Ionizing Radiation

Statistical whole-body exposure data for 18 dose intervals are provided by each DOE contractor and DOE office every year using unique employer identification numbers. Information is also subdivided into one of eleven facility types. Over the years, there have been numerous companies at each of the DOE operations. The facility types, company identification codes, and company names included in the Form 190 File are listed in Appendix B.

There have been several instances when a company has assumed the contract from a previous company. Top management was changed but the majority of the workers remained. Practices with regard to occupational exposure records have varied with this type of transfer. In some cases, all employees were treated as terminations from the previous company. In other cases, the subsequent company simply continued the dose records without terminations being submitted by either company. At the end of 1979, this file contained approximately 1200 entries of whole body dose summaries and distributions. (Each facility and year for a given contractor or office is counted as an entry.)

TABLE 1. Present REIRS Subsystems

	<u>Terminations Report</u>	<u>Internal Body Depositions</u>	<u>Annual Summary Information</u>
Input Form	Termination Occupational Exposure Report (DOE Form EV-192)	Summary of Exposures Resulting in Internal Body Deposition of Radioactive Material (DOE Form EV 191)	Annual Summary of Whole Body Exposures to Ionizing Radiation (DOE Form EV-190)
Frequency	30 days after Termination	Annually	Annually
Groups Reported	Terminated Employees and Visitors	Individuals with greater than 50% of the Annual Dose commitment	All individuals monitored summarized by facility
Content	Individual Exposures External and Internal	Internal Depositions	External Exposures
ω Information Recorded	Employer Name of Individual Social Security Number Date of Birth Employment Dates Exposure Periods Exposure Amounts Area or Organ Exposed Method of Measuring Exposure Nuclides Detected	Employer Name of Individual Social Security Number Date of Birth Date of Exposure Exposure Amounts Organs Affected Method of calculating dose Nuclides Detected	Employer Type of Facility Number of Individuals in each dose range Name of Facility
Output Reports	Individual Terminations (SS#) Individual Terminations (Name) Summary of Terminations Transient Workers Length of Employment	Internal Body Depositions	Distribution of Annual Whole Body exposures Average Whole Body Exposures Annual Summary Reports Annual Man-Rem Summary
Number of Records (1968 - 1979)	225000	399	1200

Form 191: Summary of Exposures Resulting in Internal Body Depositions

Dose commitments from internal depositions exceeding 50% of the pertinent annual dose equivalent standards in MC 0524 during a calendar year and previously unreported are to be reported on Form 191. Any dose received by the organ from external radiation should be added to the internal dose.^(a) The form provides space to identify the nuclides involved and one of 14 different organs (see form in Appendix A).

As of December 1979, there have been 399 internal depositions records entered in the repository. Each record represents a specific yearly dose measurement for a particular body organ. The breakdown by DOE office is shown in Table 2.

TABLE 2. Form 191 Records by DOE Operation

	<u>Records</u>	<u>Individuals</u>
Albuquerque	83	72
Chicago Operation	76	76
Grand Junction Operations	0	0
Idaho Operations	0	0
Nevada Operations	0	0
Oak Ridge Operations	131	70
Pittsburgh Naval Reactors	0	0
Richland Operations	1	1
San Francisco Operations	105	4
Schenectady Naval Operations	0	0
Savannah River Operations	<u>3</u>	<u>2</u>
Total	399	225

Form 192: Termination Occupation Exposure Report

A termination form is submitted for each monitored visitor and each monitored employee who terminates for any reason from DOE or a DOE contractor. Information on the form includes the employee's hire and termination dates, birth date, social security number, his employer's code,

(a) Depending upon the interpretation of MC 0525, the external dose might be included in the reported dose or merely used to determine whether the 50% guideline had been exceeded.

both internal and external doses, and their exposure periods. Much of this information, such as the number of transient workers and their respective dose, is not available elsewhere.

At the end of 1979, the terminations file contained approximately 225,000 records.

REPOSITORY COMPUTER OUTPUT

Presently there are ten separate output formats to retrieve information from the:

- Annual Summary File,
- Internal Body Depositions File, and
- Terminations File.

Figure 1 illustrates these files and the available output reports. A description of each report follows according to file accessed.

Annual Summary Information

- a. "Distribution of Annual Whole-Body Exposures."^(a) The number of individuals recorded in each of several exposure ranges, separated by facility type is given. Tables are provided for each DOE Operation Office and for all DOE Operations. Calculations are printed for the total man-rem at each facility type.
- b. "Average Whole-Body Exposures." The number of individuals (visitors and employees) recorded in each of several exposure ranges for each contractor is given.
- c. "Annual Summary Report (DOE)." The number of individuals in each dose range by contractor, by facility type, and by calendar year is given.
- d. "Annual Man-Rem Summary." The number of individuals reported in each range is given. (This data is compared for five years and is shown by facility type within contractor grouping.)

(a) Report refers to report identification used in Figure 1.

FIGURE 1. Radiation Exposure Information Reporting System (REIRS)

Internal Body Depositions

"DOE Internal Body Deposition." The complete file data for each individual on record are listed.

Terminations

- a. "Individual Terminations"--by social security (SS) number. Complete file data for each individual in SS-number sequence are listed; dates of exposure are not shown.
- b. "Individual Terminations"--by name. Complete file data for each individual in name sequence are listed; dates of exposures are not shown.
- c. "Summary of Terminations"--by employer, by year. Complete file data for each individual by employer, by year of termination, and by SS number are listed.
- d. "Transient Workers." The total number of employees terminating with two or more employers in any one quarter, by year, is shown.
- e. "Length of Employment for Individuals Terminating Each Year." The number of terminations each year, by length of employment is listed.

DATA ANALYSIS

Form 190 Data

An analysis of the data reported on form 190 by the DOE field offices for 1978 (2) indicates significant differences between DOE contractors regarding the percentage of personnel for which a positive dose was measured. Figure 2 summarizes this information showing a range from 5% of reported doses being less-than measurable for Richland Operations Office to nearly all reported doses (97%) being less-than measurable for the Nevada Operations Office. The reason for this wide range is likely attributable to the types of projects underway within the different field offices and/or personnel dosimetry policies for the different DOE contractors. For example, Richland Operations Office utilizes two types of dosimeters at Hanford; one for radiation workers

FIGURE 2. Percentage of Monitored Personnel with Less-Than Measurable Doses by Field Office

(reported to repository) and another for everyone else (not reported to repository). This policy likely accounts for their reporting a very small percentage of people (5%) as receiving less-than measurable doses. Other facilities may utilize area monitors to assess personnel exposures for part of their staff which are not reported to the repository.

Approximately three-fourths (77%) of the personnel dose information reported according to facility type is reported in the non-specific categories of other (8%), visitors (50%), or general research (19%) as shown in Table 3. By reference to Table 5 included in the 1978 report (2), it can be seen that these three categories contribute about 51% of the total man-rem dose for all DOE operations.

Of particular interest is the individual (Table 4 of 1978 report) and cumulative exposure received by visitors. Individual doses greater than 1.0 rem

TABLE 3. Percentage of Personnel Monitored by Facility Type^(a)

<u>Facility Type</u>	<u>Total Monitored</u>	<u>Percentage^(b)</u>
Reactor	6,613	3
Fuel Fabrication	1,096	0.5
Fuel Processing	3,003	1
Uranium Enrichment	12,035	6
Weapon Fabrication & Testing	18,296	9
Irradiation Facilities	--	
General Research	38,624	19
Accelerator	3,200	2
Other	17,347	8
Visitors	102,994	50
DOE offices	1,806	1
Total	205,014	

(a) Data taken from Table 5 included in the 1978 Annual Report (2).

(b) Percentages may not total 100% because of rounding individual entries.

were reported in the 1978 report (2). Also, visitor man-rem dose is greater than any other category with the exception of reactor, general research, and other. An inspection of the data for individual facilities indicates that the relatively high individual doses are received at facilities providing irradiation facilities, such as Brookhaven, Fermi, LASL, ORNL, and Argonne. This information is included in Table 4. Also shown in Table 4 is the fact that Albuquerque Operations contributed the majority of the total visitors man-rem dose for 1978. Their contribution is approximately 82% of the total, however, 97% of their calculated total man-rem dose is in the "less-than 0.1 rem" category. This likely indicates a difference regarding contractors between their assigned lower dose threshold for a positive dose measurement. Most Operation Offices report more people in the "less-than measurable dose" category than in the "less-than 0.100 rem" category.

Table 4 shows several individuals, classified as visitors, who received between 0.5 and 3.0 rem during 1978. Likely these people were not visitors per se, but radiation workers from other facilities present on an interim basis. For example, personnel from the San Francisco Office who visit the

TABLE 4. Distribution of Annual Whole Body Exposures for Visitors During 1978(a)

Operations Office	Dose Equivalent Ranges (rem)										Total	Man	Rem
	< Monitored	< Measured	0.10	0.25	0.50	0.75	1.00	1-2	2-3	3-4	4-5		
Albuquerque	25,532	5,546	19,863	89	19	12	2	1					1,027
Chicago	10,680	9,517	951	147	46	7	7	4	1				110
Grand Junction	4	4											1
Idaho	36,163	36,148	15										1
Nevada	11,961	11,617	285	49	9								27
Oak Ridge	1,118	805	280	19	9								24
Pittsburgh	452	235	214	3									11
Richland	870	287	547	29	5			1	1				38
San Francisco	12,468	12,238	220	9	1								13
Schenectady	252	177	75										4
Savannah River	3,494	3,460	32	2									2
TOTAL	102,994	80,034	22,482	347	89	25	9	6	2				1,258

(a) Data taken from Table 4 included in the 1978 Annual Report (2).

Fermi Laboratory within the Chicago Operations Office would be classed as visitors by the Chicago Operations Office and whatever dose is received while at Fermi would be reported as a visitor dose. Also, the dose received would be included in their employer dose records and reported again as a personnel dose within a different category (e.g., general research, reactors, etc.). As such, any dose received by a DOE contractor employee visiting another DOE facility would be reported to the repository twice.

Form 191 Data

The instructions of Manual Chapter 0525 (4) leave uncertainty in the criteria requiring Form 191. The instructions currently state that Form 191 must be filed whenever:

"Any uptake of radioactive material occurring during the reporting year that independently, or when added to a current burden, is estimated to result in a dose commitment to the critical organ in excess of 50% of the pertinent annual dose equivalent standards set forth in Appendix 0524 (5)."

The time period of the dose commitment is not stated (i.e., 30 yr, 50 yr, infinity, etc.) and apparently there are differences between DOE contractors regarding input to the repository. Apparently, some contractors report internal depositions every year following a deposition when the routine analysis shows a deposition greater than their defined level for reporting to the repository. Other contractors report a deposition only once.

Examples of these differences are included in Table 2 (page 5). For the San Francisco Operations Office, annual records have been filed for both the bone and lung for one person since 1952 and another since 1960. At the end of 1979, a total of 96 records have been filed for these two persons. The Chicago Operations Office has filed one record for each of 76 individuals (76 total reports). Apparently the reports from Oak Ridge Operations have been based, in some cases, on the results of routine in vivo counts. If the observed deposition is greater than a set level, then a Form 191 is filed. It is not always certain if the deposition has been reported previously.

Since the deposition quantity is not reported (only dose), it is not possible to inspect the current record to see if contractors are using similar methodologies. Also, the form (or computer record) does not have the analysis date to allow inspection of the contractor policy with regards to defining the exposure date (i.e., apparently some contractors use the analysis date as the exposure date). For the computer record, the year of data entry is not available and must be determined by referring back to Form-191. This procedure is obviously cumbersome although all of the information is apparently available either at the repository, DOE headquarters, or at the responsible DOE Field Office.

Form 192 Data

This form is used for reporting the cumulative dose received by terminating employees or by visitors. For visitors, the process is apparently straight forward. For terminating employees, reporting the cumulative external exposure received according to area of exposure (i.e., whole body, extremities, skin, etc.) should not be any problem. For internal exposure, it is not clear if the cumulative deposition is required according to date(s) of exposure or residual deposition upon termination.

OBSERVATIONS

DOE Repository

The terminations data file (Form 192) constitutes the vast majority of the repository data base and is the most costly and time consuming component of the system. Historically there has not been a procedure of reporting back to the DOE field offices data received and entered into REIRS unless the submitted data were in error. Preferably, a copy of all data received and entered into the system should be returned back to the field office for validation.

The editing code used with the present REIRS is not sufficiently sophisticated to detect all of the kinds of errors entering the system. Also, the code is cumbersome making it difficult to correct those kinds of errors it does detect.

Assuming the availability of a good editing code to identify the majority of incoming errors and to correct the existing data base, a significant amount of time and effort would still be required to correct the historical data base. However, there does not appear to be any other choice if the repository is to be continued.

Generally, the site specific personnel dosimetry programs provide professional dosimetry support and extensive records which are not available from the repository. A determination of the types of data preferably handled through the repository will be proposed in the final Topical Report regarding identification of feasible alternatives available to upgrade the current system.

Several other observations of the attributes and drawbacks of the present records repository follow:

Attributes

The repository occupies the unique position of examining exposures of transient workers between DOE contractors.

The repository allows inspection of the cumulative lifetime occupational dose for retiring DOE employees.

The repository provides a data base for the DOE annual report of occupational exposure.

Drawbacks

The presence of errors and omissions in the historical data base has led to a general distrust of the repository.

The process of submitting termination forms, entering information, and retrieving information for use by DOE is slow.

The DOE repository does not solicit the pertinent exposure history information for new employees from other government agencies (NRC, EPA, FDA, etc.), military, universities, or private companies.

The data definition in the present repository, especially for lower dose categories for external dosimetry and for internal depositions, is inconsistent between DOE contractors.

The edit programs are inadequate to reduce all errors and duplications in the data base to an acceptable level.

As a result of these drawbacks, the repository is of limited usefulness. However, there is no obvious alternative which will provide a reliable DOE-wide repository without active contractor involvement.

NRC Repository^(a)

Similar observations can be made of the historic NRC repository.^(b) However, during recent years they have embarked on an improvement program intended to provide a greater degree of accuracy in the data base. Significant aspects of their efforts include:

-
- (a) NRC licensees whose operations consist of power reactors, radiography, fuel processing, or byproduct license according to the definitions included in Section 4-7 of the Code of Federal Regulations Part 20 are required to submit similar reports. The NRC also publishes an annual report of the information received. The NRC has expanded their reporting requirements to include estimates of the number of personnel and man-rem by work and job function.⁽⁶⁾
 - (b) Interpretation of conversation with B. G. Brooks, NRC, during February, 1980.

- The apparent inconsistency between contractors with regards to reporting employees who receive doses either "less-than measurable" or "less-than 0.100 rem." The latter category is used in the man-rem calculation and in several cases is the major contributor.
- Some facilities apparently monitor employees expected to receive little or no radiation separately from radiation workers and do not report these doses to the repository.

Form-191 (Internal Deposition)

Four types of problems were observed as follows:

- Inconsistencies between contractors in reporting a single deposition. MC 0525 requires a submittal only during the year of uptake.
- The failure to state the time period of the dose commitment following uptake (i.e., 30 yr, 50 yr, infinite, etc.) in MC 0525.
- The unavailability of the data submittal date on the computer record.
- The uncertainty of whether or not the reported doses include any consideration of external exposures potentially received.

Form-192 (Terminations)

Four types of problems were observed as follows:

- The uncertainty of the internal depositions reported as being either cumulative to date or residual upon termination.
- The unavailability of the form reporting date on the computer record.
- Use of visitor classification for radiation workers from other DOE facilities who are on assignment.
- Inappropriate use of title "Method Dose" in specific instruction #18 of Form-192 instead of "Analytical Technique."

For all three forms the date of the form preparation as part of the computer record would be helpful.

CONCLUSION

Major observations identified in this study relating to the current status of REIRS include:

- the inconsistency in data submitted by different contractors attributable to different contractor policies
- the presence of inaccuracies in the data base due to incomplete submittals, duplication of data, and some errors
- the time lag between an employee's termination and the availability of the data in REIRS
- the lack of useful data, such the cumulative dose of active employees or sex distribution of annual doses, entered into REIRS
- the current unavailability of any other method to overview exposures at DOE facilities and provide information for the annual report
- a record of transient worker exposure at DOE facilities.

It is essential that inaccuracies in the data base be corrected if REIRS is to function as originally designed. Several observed difficulties relative to the specific reporting form or associated data file are summarized below.

Form-190 (Annual Dose Summaries)

Three types of problems were identified involving contractor inconsistencies or possible misinterpretation of the data base as follows

- Classification of visiting radiation workers as "visitors" as opposed to "relocated radiation workers" or "interim radiation workers." In the case of DOE contractor employees visiting other DOE facilities, their dose received while visiting is reported twice; once as a visitor by facility A and again as an employee at facility B.
- The apparent inconsistency between contractors with regards to reporting employees who receive doses either "less-than measurable" or "less-than 0.100 rem." The latter category is used in the man-rem calculation and in several cases is the major contributor.

- Some facilities apparently monitor employees expected to receive little or no radiation separately from radiation workers and do not report these doses to the repository.

Form-191 (Internal Deposition)

Four types of problems were observed as follows:

- Inconsistencies between contractors in reporting a single deposition. MC 0525 requires a submittal only during the year of uptake.
- The failure to state the time period of the dose commitment following uptake (i.e., 30 yr, 50 yr, infinite, etc.) in MC 0525.
- The unavailability of the data submittal date on the computer record.
- The uncertainty of whether or not the reported doses include any consideration of external exposures potentially received.

Form-192 (Terminations)

Four types of problems were observed as follows:

- The uncertainty of the internal depositions reported as being either cumulative to date or residual upon termination.
- The unavailability of the form reporting date on the computer record.
- Use of visitor classification for radiation workers from other DOE facilities who are on assignment.
- Inappropriate use of title "Method Dose" in specific instruction #18 of Form-192 instead of "Analytical Technique."

For all three forms the date of the form preparation as part of the computer record would be helpful.

ACKNOWLEDGMENT

Special acknowledgement is extended to W. H. Millet, System Safety Development Center, EG&G Idaho for use of his study⁽¹⁾ of the Radiation Exposure Information Reporting System (REIRS) and for his review of and comment on this topical report. Marianna Cross, PNL, typed the final report.

REFERENCES

1. W. H. Millet. 1979. "Appraisal of the Radiation Exposure information Reporting System (REIRS)," EG&G, Idaho Falls, Idaho.
2. U.S. Department of Energy. 1979. Eleventh Annual Report of Radiation Exposures for DOE and DOE Contractor Employees - 1978. Division of Operational and Environmental Safety, Washington, D.C.
3. J. J. Fix, "Current Personnel Dosimetry Practice at DOE Facilities," PNL-3538, November 1980, Pacific Northwest Laboratory, Battelle-Northwest, Richland, Washington.
4. U.S. Department of Energy. "Occupational Radiation Exposure Information," Manual Chapter 0525, Washington, D.C.
5. U.S. Department of Energy. "Occupational Radiation Exposure Limits," Manual Chapter 0524, Washington D.C.
6. B. G. Brooks. 1979. "Occupational Radiation Exposure at Commercial Nuclear Power Reactors 1978," NUREG-0594, U.S. Nuclear Regulatory Commission, Washington, D.C.

APPENDIX A

DOE FORMS 190, 191 and 192

U.S. ATOMIC ENERGY COMMISSION ANNUAL SUMMARY OF WHOLE BODY EXPOSURES TO IONIZING RADIATION

PUNCH COLS.
1-16 IN ALL
THREE CARDS
(A, B, AND C)

1. EMPLOYER (L.J.)	
TYPE	CONTRACTOR CODE
1 2	3 4 5 6 7 8 9 10 11 12 13 14 15 16

ORGANIZATION	PREPARED BY
ADDRESS	DATE AREA CODE PHONE

A.1

CARD	2. YR.		3. TOTAL	4. NUMBER OF INDIVIDUALS WITH DOSE IN EACH RANGE - RLM																(R. J.)																																																							
	CY		NUMBER	NONE	0.100	.100 - .249	.250 - .499	.500 - .749	.750 - .999	1.000 - 1.999	2.000 - 2.999	3.000 - 3.999	4.000 - 4.999	5.000 - 5.999																																																													
	A																																																																										
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92

4. (CONTINUED)														(R.J.)	5. ACTUAL VALUES OF EXPOSURES 12.000																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
6.000 - 6.999				7.000 - 7.999				8.000 - 8.999				9.000 - 9.999				10.000 - 10.999				11.000 - 11.999				12.000				VALUE 1				VALUE 2				VALUE 3				VALUE 4																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															

6. OTHER FACILITY TYPE (L.J.)
17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48

- FACILITY TYPES
- 02 REACTOR
 - 04 FUEL FABRICATION
 - 06 FUEL PROCESSING
 - 08 URANIUM ENRICH.
 - 10 WEAPONS FAB. & TEST
 - 12 IRRADIATION FACIL.
 - 14 GENERAL RESEARCH
 - 16 ACCELERATOR
 - 40 OTHER*
 - 88 VISITORS
 - 99 AEC OFFICES

INSTRUCTIONS FOR COMPLETING FORM AEC-190

Annual Summary of Whole Body Exposures to Ionizing Radiation

GENERAL INSTRUCTIONS

- A. Pursuant to AECM 0525-01, an annual report summarizing whole body exposures recorded during the previous calendar year for AEC and AEC contractor employees in the course of AEC activities and for visitors to AEC or AEC operations shall be prepared each year.
- B. Please print all information. The letter 'O' should be printed 'Ø' to differentiate it from the number zero. Similarly, the letter 'Z' should be printed 'Z̄' to differentiate it from the number '2'. Several of the data items require data to be right justified (R. J.), written from the right hand side of the field, while others require data to be left justified (L. J.), written from the left hand side of the field.
- C. Only one character per indicated space is allowed. Do not use more than the allotted spaces on the form.
- D. PREPARED BY, DATE, ORGANIZATION, AND ADDRESS - This information is for reference, should future verification be required from the individual who originally encoded the summary information. If cards or tapes are submitted, this portion of Form AEC-190 should be completed and submitted with them.
- E. A separate Form AEC-190 must be completed for each facility type where monitored personnel are employed. For example, if a contractor operates several facilities and also monitors visitors, a separate Form AEC-190 should be prepared for each facility and for the total number of visitors.

SPECIFIC INSTRUCTIONS

1. **EMPLOYER:** This section must always be completed and consistent for all cards (A through C). It is composed of codes in three parts as follows:
- i. Type - A one-character alpha code to indicate the type

of organization. 'C' = AEC contractor. 'G' = AEC office.

- ii. **Contractor Code** - A unique identifier assigned to each contractor and AEC office reporting to the Radiation Exposure Information Reporting System. The code should be left justified in the field with hyphens included and spaces trailing.
- iii. **Facility Code** - A two-character numeric code identifying the facility type for which the summary is being reported. If the facility type does not correspond to one of those listed on the front of Form AEC-190, indicate code '40' here and specify the facility type in item number 6 of card C.
2. **YR:** Indicate the calendar year for which the summary is being submitted.
3. **TOTAL:** The total number of individuals in all of the dose ranges. (The number should be right justified with leading blanks.)
4. **NUMBER OF INDIVIDUALS WITH DOSES IN EACH RANGE (REM):** A series of 18, 5-digit fields which represent the number of individuals who received doses during the calendar year for the 18 ranges specified. (The numbers must be right justified with leading blanks.)
5. **ACTUAL VALUES:** All exposures over 12.000 rems must be reported individually by actual value. (The value is right justified in the field with leading spaces. Omit the decimal point, e.g., code 13.426 as 13426. Three decimal places are assumed for these values.)
6. **'OTHER' FACILITY TYPE:** If the facility type for which a contractor wishes to submit a report is not listed on the front of Form AEC-190, indicate code '40' in item 1-iii and enter the name of the new facility type here, left justified, abbreviating when necessary.

[illegible]

INSTRUCTIONS FOR COMPLETING FORM AEC-191

Annual Summary of Exposures Resulting in Internal Body Depositions of Radioactive Materials

GENERAL INSTRUCTIONS

- A. Pursuant to AECM 0525, an annual report summarizing internal exposures recorded during the previous calendar year for AEC and AEC contractor employees in the course of AEC activities and for visitors to AEC or AEC operations shall be prepared each year.
- B. Please print all information. The letter 'O' should be printed 'Ø' to differentiate it from the number zero. Similarly, the letter 'Z' should be printed 'Z' to differentiate it from the number '2'. Several of the data items require data to be right justified (R.J.), written from the right hand side of the field, while others require data to be left justified (L.J.), written from the left hand side of the field.
- C. Only one character per indicated space is allowed. Do not use more than the allotted spaces on the form.
- D. PREPARED BY, DATE, ORGANIZATION, AND ADDRESS - This information is for reference, should future verification be required from the individuals who originally encoded the summary information. If cards or tapes are submitted, this portion of Form AEC-191 should be completed and submitted with them.

SPECIFIC INSTRUCTIONS

1. **EMPLOYER** (required item on all cards): This section must always be completed and consistent for all cards.
 - a. Contractor Code - A unique identifier assigned to each contractor and AEC office reporting to the Radiation Exposure Information Reporting System. The code should be left justified in the field with hyphens included and spaces trailing.
 - b. Type - A one-character alpha code to indicate the type of organization:
 'C' = AEC contractor 'G' = AEC office
2. **SOCIAL SECURITY NUMBER**: Enter social security number(s)

of individual(s) being reported.

3. **EXPOSURE DATE**: Enter beginning date of exposure.
4. **BIRTH**: Enter birthdate of individual(s) being reported.
5. **NAME**: Enter the first initial of the individual in column 36, the middle initial in column 37, and the last name starting in column 38.
6. **NUCLIDES**: Enter the deposited nuclide(s), left justified. Use the proper isotope notation as listed in the Table, Annex A of AEC Appendix 0524-Standards for Radiation Protection, omitting hyphens and spacing. If the dose resulted from a mixture of nuclides, list the major contributors consecutively (i.e., Cesium 137 and Cobalt 60 would be coded CS137CØ60).
7. **ORGAN CODE 1**: Enter 2-digit code to indicate each organ for which a dose is specified. Select from the codes listed:

Lung	28	Liver	56
Bone	11	Testes	78
Digestive System	50	Prostrate	77
Whole Body	00	Thyroid	96
Kidney	71	Ovary	87
Spleen	07	Muscle	13
Pancreas	59	Adrenal Gland	93
8. **ORGAN CODE 2**: Second organ code (if required).
9. **ORGAN CODE 3**: Third organ code (if required).
10. **DOSE EQUIVALENT**: Enter the dose commitment (rems) received by the specified organ(s) during the calendar year; seven digits including three decimal positions. (Right justify numbers omit the decimal point, e.g., code 45.252 as 45252.)
11. **METH. DOSE**: Enter method of determining dose. Select 2-digit code from following list:

B - Bioassay
IV - In-vivo count

GPO 882-643

REPORTING ORGANIZATION	PREPARED BY		
ADDRESS	DATE	AREA CODE	PHONE

**KEYPUNCH
COLS. 1-9 & 66-79
IN ALL CARDS**

1. SOCIAL SECURITY NO.									
1									9

6. CONTRACTOR CODE							7.
							TYPE
66							78 79

2. HIRE						3. NAME																												BIRTH						5. TERM.										
M	M	D	D	Y	Y	FIRST												L	LAST															M	M	D	D	Y	Y	M	M	D	D	Y	Y					
10				15		22											36	37	38															53	54							59	60							65

8. BEGIN						9. END						10.		11. EXTERNAL EXPOSURE						12.		13.	
M	M	D	D	Y	Y	M	M	D	D	Y	Y	AREA	EXP.							TYPE	PREC	TYPE	EXP
10				15	16						21	22	23	39					45		64	65	

14. BEGIN						15. END						16. ORGAN. CODE	17. INTERNAL EXPOSURE							18. METH. DOSE	19. ORGAN. CODE	20 UNIT	21. NUCLIDE(S) (L.J.)										22 TYPEPREC	23 TYPEEXP	CARD													
M	M	D	D	Y	Y	M	M	D	D	Y	Y																																					
10						15	16					21	22	23	31																39	40	41	42	43	44	45								60	64	65	80

A.5

INSTRUCTIONS FOR COMPLETING DOE FORM EV-192

Termination Occupational Exposure Report

GENERAL INSTRUCTIONS

- A. Pursuant to IMD 5001, a Termination Exposure Report summarizing whole body exposures recorded during the period of employment by DOE and DOE contractor shall be prepared upon termination.
- B. Please print all information. The letter 'O' should be printed 'Ø' to differentiate it from the number zero. Similarly, the letter 'Z' should be printed 'Z̄' to differentiate it from the number '2.' Several of the data items require data to be right justified (R.J.), written from the right hand side of the field, while others require data to be left justified (L.J.), written from the left hand side of the field. All months and days should be represented by two-digit numbers (e.g., September 3, 1941, should be written, 09-03-41).
- C. Only one character per indicated space is allowed. Do not use more than the allotted spaces on the form.
- D. **PREPARED BY, DATE, ORGANIZATION, AND ADDRESS**—This information is for reference, should future verification be required from the individual who originally encoded the summary information. If cards or tapes are submitted, this portion of DOE Form EV-192 should be completed and submitted with them.

For each individual reported, there must be identification data ('1' in column 80) and either external exposure data ('2' in column 80) or internal exposure data ('3' in column 80). The '2' or '3' cards, as many as necessary, should be grouped and follow the '1' card when transmitted to assure that all exposure data for an individual is reported.

SPECIFIC INSTRUCTIONS

1. **SOCIAL SECURITY NUMBER:** Enter social security number of individual being reported. Use the word "none" for individuals without a social security number and "unknown" for those who refuse to reveal it.
2. **HIRE:** Enter date the individual was hired.
3. **NAME:** Enter the first name of the individual starting in column 22, the middle initial in column 37, and the last name starting in column 38. If there is no middle initial, leave that box blank.
4. **BIRTH:** Enter birthdate of individual.
5. **TERMINATION:** Enter the date the individual was terminated. For visitors, the end exposure date will be the same as the termination date.
6. **CONTRACTOR CODE:** A unique identifier assigned to each contractor and DOE office reporting to the Radiation Exposure System. The code should be left justified in the field with hyphens included and spaces trailing. This section and item 7, Type, must always be completed and consistent for all cards (1 through 3).
7. **TYPE:** Enter alphabetic character to indicate type of organization:
 'C' = DOE Contractor
 'G' = DOE Office
8. **BEGIN:** Enter beginning monitoring date of exposure for external exposure reports.
9. **END:** Enter ending monitoring date of exposure for external exposure reports.

10. **AREA EXP:** Enter 2-character code to indicate the area of exposure:

'WB' = Whole Body	'EX' = Extremity
'SK' = Skin	'EY' = Eye
'HN' = Hands	'HD' = Head
'FA' = Forearms	'GN' = Gonads

11. **EXTERNAL EXPOSURE:** Indicate the total dose in REMS that was recorded for the specified part of body during the indicated period of exposure: use seven digits, three decimal positions. If the total dose was recorded as being minimal (i.e., less than measurable by the monitoring system employed), place an 'M.' Right justify data and omit the decimal point, e.g., code 1.252 as 1252.
12. **TYPREC:** Always equal 'T' for terminated employees.
Always equal 'V' for report of visitor exposure.
13. **TYPEXP:** Always equal 'E' for external.
14. **BEGIN:** Enter beginning date of exposure for internal exposure reports.
15. **END:** Enter ending date of exposure for internal exposure reports.
16. **ORGAN CODE:** Enter 2-digit code to indicate organ affected:

Internal Organ Codes

Lung	28	Liver	56
Bone	11	Testes	78
Digestive System	50	Prostate	77
Whole Body	00	Thyroid	96
Kidney	71	Ovary	87
Spleen	07	Muscle	13
Pancreas	59	Adrenal Gland	93

17. **INTERNAL EXPOSURE:** Enter estimate of internal disposition; seven digits, three decimal positions (right justify numbers omit the decimal point, e.g., code 45.252 as 45252). If the total dose was recorded as being minimal (i.e., less than measurable by the monitoring system employed), place an 'M.'
18. **METH. DOSE:** Method of determining dose:
 B - Bioassay
 IV - In-vivo count
19. **ORGAN CODE:** Second organ code (see number 16, if required).
20. **UNITS:** Unit of measure codes:

Microcuries	'C'	% of Lung Burden	'G'
Micrograms	'D'	% of Thyroid Burden	'H'
% of Body Burden	'E'	% of Kidney Burden	'L'
21. **NUCLIDE:** Enter the deposited nuclide(s), left justified. Use the proper Isotope notation as listed in the Table, Annex A of ERDA Appendix 0524—Standards for Radiation Protection, omitting hyphens and spacing. If the dose resulted from a mixture of nuclides, list the major contributors consecutively (i.e., Cesium 137 and Cobalt 60 would be coded CS137CØ60).
22. **TYPREC:** Always equal 'T' for terminated employees.
Always equal 'V' for report to visitor exposure.
23. **TYPEXP:** Always equal 'I' for internal.

APPENDIX B

FORM 190 DATA FILE

APPENDIX B

FORM 190 DATA FILE

Facility Type

'02'	Reactor
'04'	Fuel Fabrication
'06'	Fuel Processing
'08'	Uranium Enrichment
'10'	Weapons Fabrication and Testing
'12'	Irradiation Facilities
'14'	Accelerator
'40'	Other (space to specify)
'88'	Visitors
'99'	DOE Offices

* C 01-00-0209-00
Albuquerque Miscellaneous Contractors

C 01-00-0210-01
Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Gove Drive
Pasadena, CA 91103

C 01-00-0211-01
Teledyne Isotopes
Energy Systems Division
110 W. Timonium Road
Timonium, MD 21093

* C 01-00-0212-01
Ross Aviation, Inc.
P. O. Box 9124
Albuquerque, NM 87119

C 01-00-0213-01
Martin Marietta Aerospace
Denver Division
P. O. Box 179
Denver, CO 80201

C 01-00-0218-01
Lincoln Laboratory
Hanson Air Force Base
Lexington, MA

C 01-00-0219-01
AF-Sponsored Snap Launch
Les 8 & 9
Cape Kennedy, FL

C 01-00-0220-01
NASA MJS Voyager Launch
Cape Kennedy, FL

* Active employer identification codes.

* C 01-01-0001-01
Mason & Hanger-Silas Mason
Co., Inc.
P.O. Box 647
Amarillo, TX 79177

C 01-02-0001-02
Mason & Hanger-Silas Mason
Co., Inc.
P.O. Box 561
Burlington, IA 52601

* C 01-03-0002-01
Monsanto Research Corporation
Mound Laboratory
P.O. Box 32
Miamisburg, OH 45342

* C 01-04-0003-01
The Bendix Corporation
P. O. Box 1159
Kansas City, MO 64141

* C 01-05-0004-01
University of California
Los Alamos Scientific Laboratory
P.O. Box 1663
Los Alamos, NM 87544

* C 01-05-0005-01
The ZIA Company
901 Trinity Drive
Los Alamos, NM 87544

* C 01-06-0006-01
General Electric Company
Neutron Devices Department
P.O. Box 11508
St. Petersburg, FL 33233

* C 01-07-0007-01
Rockwell International
Energy Systems Group
P.O. Box 464
Golden, CO 80401

C 01-08-0006-02
General Electric Company
Space Division
P.O. Box 8661
Philadelphia, PA 19101

* C 01-08-0008-01
Sandia Laboratories
P.O. Box 5800
Albuquerque, NM 87115

* C 01-08-0008-02
Sandia Laboratories Livermore
Livermore, CA 94550

* C 01-08-0009-01
Inhalation Toxicology Research
Institute
Lovelace Foundation for Medical
Education and Research
Bldg. 9200, Area Y Kirtland
Albuquerque, NM 87115

* C 03-00-0011-01
Ames Laboratory
Iowa State University
P.O. Box 1129, Isu Station
Ames, IA 50010

* C 03-00-0012-02
Argonne National Laboratory
9700 South Cass Avenue
Argonne, IL 60439

C 03-00-0013-00
Chicago Miscellaneous Contractors

* C 03-00-0035-01
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, MA 02139

* C 03-00-0037-01
Princeton University
P.O. Box 451
Princeton, NJ 08540

* Active employer identification codes.

* C 03-01-0135-01
Fermi National Accelerator Laboratory
P.O. Box 500
Batavia, IL 60510

* C 03-02-0010-01
Brookhaven National Laboratory
Associated Universities, Inc.
Upton, NY 11973

* C 04-00-0001-00
Bendix Field Engineering Corp.
P.O. Box 1569
Grand Junction, CO 81501

C 05-00-0065-01
ARDE Technical Specialists, Inc.
16200 Ventura Blvd. Suite 301
Encino, CA 91316

C 05-00-0066-01
CDI Corporation
15300 Ventura Boulevard
Sherman Oaks, CA 91403

C 05-00-0067-01
Energy Incorporated
P.O. Box 736
Idaho Falls, ID 83401

C 05-00-0068-01
Mountain States Insulation & Supply
774 South 5th West
Salt Lake City, UT 84110

* C 05-00-0069-01
Ormond Construction Company
P.O. Box 2071
Idaho Falls, ID 83401

* C 05-00-0070-01
Arrington Construction Co., Inc.
P.O. Box 581
Idaho Falls, ID 83401

* C 05-00-0071-01
Lehigh Design Co., Inc.
P.O. Box 883
Idaho Falls, ID 83401

C 05-00-0072-01
Pacific Pumps Division of Dresser
Industries, Inc.
5715 Bickett Street
Huntington Park, CA 90255

C 05-00-0073-01
Ralph M. Parsons Co.
100 W. Walnut Street
Pasadena, CA 91124

* C 05-00-0074-01
Biggers Construction Co., Inc.
P.O. Box 2413
Idaho Falls, ID 83401

* C 05-00-0075-01
C-L Electric Company
P.O. Box 1070
Pocatello, ID 83201

C 05-00-0076-01
Stone & Webster Engineering Corp.
225 Franklin Street
Boston, MA 02110

C 04-00-0077-01
Schott Optical Glass, Inc.
York Avenue
Duryea, PA 18642

* C 05-00-0078-00
Idaho Miscellaneous Contractors

* C 05-00-0082-01
Bingham Mechanical & Metal Products,
Inc.
Idaho Falls, ID 83401

* C 05-00-0134-01
Morrison-Knudsen
P.O. Box 7808
Boise, ID 83707

* Active employer identification codes.

C 05-00-0138-01
Norman Engineering Co.
5899 Venice Boulevard
Los Angeles, CA 90019

* C 05-00-0156-01
Waters Asbestos & Supply Co.
P.O. Box 1117
Idaho Falls, ID 83401

C 05-00-0169-01
Aerojet Nuclear Company
550 Second Street
Idaho Falls, ID 83401

* C 05-00-0169-01
Allied Chemical Corporation
550 Second Street
Idaho Falls, ID 83401

* C 05-00-0181-01
Consultants & Designers, Inc.
505 E. Middle Field Road
Mountain View, CA 94040

* C 05-00-0182-01
EG&G, Idaho, Inc.
P.O. Box 1625
Idaho Falls, ID 83401

* C 05-00-0183-01
Jones - Boecon
P.O., Box 1608
Idaho Falls, ID 83401

C 05-00-0184-01
Exxon Nuclear Co. - Idaho
550 Second Street
Idaho Falls, ID 83401

* C 06-00-0027-01
Defense Nuclear Agency
Kirtland Air Force Base
Albuquerque, NM

* C 06-00-0028-01
EG&G, Inc.
P.O. Box 1912
Las Vegas, NV 89101

* C 06-00-0029-01
Holmes & Narver, Inc.
400 East Orangethorpe Avenue
Anaheim, CA 92801

* C 06-00-0093-01
Reynolds Electrical & Engineering
Co., Inc.
P.O. Box 14400
Las Vegas, NV 89114

* C 06-00-0113-01
Fenix & Scisson, Inc.
P.O. Box 15408
Las Vegas, NV 89114

* C 06-00-0116-01
Environmental Protection Agency
(NERC)
P.O. Box 15027
Las Vegas, NV 89114

* C 06-00-0118-01
Mackenhut Services, Inc.
3280 Ponce de Leon Blvd.
Coral Gables, FL 33134

C 06-00-0127-01
TVD Company
510 South Highland
Las Vegas, NV 89106

C 06-00-0130-01
University of Hawaii (MPML)
Hawaii Institute of Marine Biology
P.O. Box 1346
Coconut Island, HI 96744

C 06-00-0131-01
Halliburton Services
A Division of Halliburton Company
P.O. Box 1431
Duncan, OH 73533

* Active employer identification codes.

* C 06-00-0150-01
Sperry-Sun Well Surveying Company
P.O. Box 36363
Houston, TX 77036

* C 06-00-0157-00
Nevada Miscellaneous Contactors

* C 06-00-0159-01
Air Resources Laboratory
National Oceanic & Atmospheric
Administration
U.S. Department of Commerce
Boulder, CO 80302

* C 06-00-0214-01
Birdwell Division of Seismograph
Services Corp.
6200 East 41st Street
Tulsa, OK 74102

* C 06-00-0215-01
CER Geonuclear
P.O. Box 15090
Las Vegas, NV 89114

* C 06-00-0216-01
U.S. Department of Interior
Geological Survey
Reston, VI 22092

* C 06-00-0217-01
Westinghouse Electric Corp.
Astronuclear Laboratory
P.O. Box 10864
Pittsburgh, PA 15236

* C 06-00-0218-01
Eberline Instrument Co.
P.O. Box 2108
Santa Fe, NM 87501

C 08-00-0042-01
Union Carbide Corporation
Nuclear Division ORGPD
P.O. Box P
Oak Ridge, TN 37830

* C 08-00-0042-02
Union Carbide Corporation
Nuclear Division, Y-12
P.O. Box Y
Oak Ridge, TN 37830

* C 08-00-0042-03
Union Carbide Corporation
Oak Ridge National Laboratory
P.O. Box X
Oak Ridge, TN 37830

* C 08-00-0042-04
Union Carbide Corporation
P.O. Box 1410
Paducah, KY 42001

* C 08-00-0043-01
RMI Company
Extrusion Plant
P.O. Box 579
Ashtabula, OH 44004

* C 08-00-0044-01
Comparative Animal Research
Laboratory
1299 Bethel Valley Road
Oak Ridge, TN 37830

* C 08-00-0045-01
Rust Engineering Company
P.O. Box 587
Oak Ridge, TN 37830

* C 08-00-0048-01
Woven Structures, Inc.
1600 West 125th St.
Gardena, CA 90249

* C 08-00-0128-01
Oak Ridge Associated Universities
P.O. Box 117
Oak Ridge, TN 37830

* C 08-01-0047-01
National Lead Company of Ohio
P.O. Box 39158
Cincinnati, OH 45239

* Active employer identification codes.

* C 08-04-0049-01
Goodyear Atomic Corporation
P.O. Box 628
Piketon, OH 45661

C 08-05-0046-02
Puerto Rico Nuclear Center
Caparra Heights Station
San Juan, PR 00935

C 08-00-0050-02
Westinghouse Electric Corporation
Bettis Atomic Power Laboratory
P.O. Box 79
West Hifflin, PA 15122

* C 09-00-0052-01
Westinghouse Plant Apparatus Div.
Pittsburgh Naval Reactor Rep., PAD
P.O. Box 1347
Pittsburgh, PA 15320

* C 09-01-0050-01
Westinghouse Electric Corporation
Naval Reactors Facility
P.O. Box 2068
Idaho Falls, ID 83401

* C 09-02-0051-01
Duquesne Light Company
Shippingport Atomic Power Station
P.O. Box 57
Shippingport, PA 15077

* C 10-00-0013-02
Battelle Memorial Institute
Pacific Northwest Laboratory
P.O. Box 999
Richland, WA 99352

C 10-00-0052-01
Atlantic Richfield Hanford Company
P.O. Box 250 Federal Bldg.
Richland, WA 99352

C 10-00-0054-01
Computer Sciences Corporation
825 Jadwin Avenue
Richland, WA 99352

* C 10-00-0055-01
United Nuclear Industries, Inc.
P.O. Box 490
Richland, WA 99352

* C 10-00-0056-01
BCS Richland Inc.
P.O. Box 300
Richland, WA 99352

* C 10-00-0057-01
Hanford Environmental Health
Foundation
P.O. Box 100
Richland, WA 99352

* C 10-00-0058-01
J. A. Jones Construction Company
801 First Street
Richland, WA 99352

* C 10-00-0142-01
Hanford Engineering Development
Laboratory
P.O. Box 1970
Richland, WA 99352

* C 10-00-0205-01
Automation Industries, Inc.
P.O. Box 296
Richland, WA 99352

* C 10-00-0220-01
Rockwell Hanford Operations
P.O. Box 800
Richland, WA 99352

* C 11-00-0004-02
University of California
Lawrence Berkeley Laboratory
Berkeley, CA 94720

* Active employer identification codes.

* C 11-00-0004-03
University of California
Lawrence Livermore Laboratory
P. O. Box 808
Livermore, CA 94550

* C 11-00-0004-04
University of California
Radiobiology Laboratory
Davis, CA 95616

* C 11-00-0004-05
University of California
Los Angeles Laboratory of Nuclear
Medicine and Ra
900 Veteran Avenue
Los Angeles, CA 90024

* C 11-00-0004-06
University of California Medical
Center
Laboratory of Radiology
Paranassus & Third Avenue
San Francisco, CA 94122

* C 11-00-0004-07
University of California
Lawrence Livermore Laboratory
Nevada Test Site
Mercury, NV 89023

* C 11-00-0060-01
Rockwell International
Energy Systems Group
P.O. Box 309
Canoga Park, CA 91304

* C 11-00-0062-01
Stanford Linear Accelerator Center
P.O. Box 4349
Stanford, CA 93404

* C 13-00-0006-06
General Electric Company (KAPL)
P.O. Box 1072
Schenectady, NY 12301

* C 13-00-0007-01
General Electric Machinery
Apparatus Operation
Schenectady Naval Reactors Rep., MAD
P.O. Box 1021
Schenectady, NY 12301

* C 14-00-0063-01
E. I. duPont de Nemours & Company
Savannah River Plant (Operations)
Aiken, SC 29801

* C 14-00-0063-02
E. I. duPont de Nemours & Company
Savannah River Plant (Construction)
Aiken, SC 29801

* C 14-00-0064-01
Savannah River Ecology Laboratory
Savannah River Plant
Drawer E
Aiken, SC 29801

C 14-00-0065-01
Southern Bell Telephone and
Telegraph Co.
Aiken, SC 29801

C 14-00-0066-01
U.S. Forest Service
Savannah River Plant
Aiken, SC 29801

* G 00-00-0000-00
U.S. Department of Energy
Headquarters
Washington, DC 20545

* G 01-00-0000-00
U.S. DOE
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, NM 87115

* G 01-01-0000-00
U.S. DOE
Amarillo Area Office
P.O. Box 1086
Amarillo, TX 79105

* Active employer identification codes.

* G 01-02-0000-00
U.S. DOE
Burlington Area Office
P.O. Box 561
Burlington, IA 52601

* G 01-03-0000-00
U.S. DOE
Dayton Area Office
P.O. Box 66
Miamisburg, OH 45342

* G 01-04-0000-00
U.S. DOE
Kansas City Area Office
P.O. Box 202
Kansas City, MO 64141

* G 01-05-0000-00
U.S. DOE
Los Alamos Area Office
Los Alamos, NM 87544

* G 01-06-0000-00
U.S. DOE
Pinellas Area Office
P.O. Box 11500
St. Petersburg, FL 33733

* G 01-07-0000-00
U.S. DOE
Rocky Flats Area Office
P.O. Box 928
Golden, CO 80401

* G 01-08-0000-00
U.S. DOE
Sandia Area Office
P.O. Box 5400
Albuquerque, NM 87115

* G 03-00-0000-00
U.S. DOE
Chicago Operations Office
9800 South Cass Avenue
Argonne, IL 60439

* G 03-01-0000-00
U.S. DOE
Batavia Area Office
P.O. Box 2000
Batavia, IL 60510

* G 03-02-0000-00
U.S. DOE
Brookhaven Area Office
Upton, NY 11973

* G 03-03-0000-00
New Brunswick Lab
P.O. Box 150
New Brunswick, NJ 08903

* G 03-04-0000-00
U.S. DOE
Environmental Measurements
Laboratory
376 Hudson Street
New York, NY 10014

* G 04-00-0000-00
U.S. DOE
Grand Junction Office
P.O. Box 2567
Grand Junction, CO 81501

* G 05-00-0000-00
U.S. DOE
Idaho Operations Office
550 2nd Street
Idaho Falls, ID 83401

* G 06-00-0000-00
U.S. DOE
Nevada Operations Office
P.O. Box 14100
Las Vegas, NV 89114

* G 08-00-0000-00
U.S. DOE
Oak Ridge Operations Office
P.O. Box E
Oak Ridge, TN 37830

* Active employer identification codes

G 08-01-0000-00
U.S. DOE
Cincinnati Area Office
P.O. Box 39180
Cincinnati, OH 45239

* G 08-02-0000-00
U.S. DOE
Paducah Area Office
P.O. Box 1150
Paducah, KY 42001

G 08-03-0000-00
U.S. DOE
Portsmouth Area Office
Piketon, OH 45661

G 08-04-0000-00
U.S. DOE
Puerto Rico Area Office
P.O. Box 88
Hato Rev., PR 00919

* G 09-00-0000-00
U.S. DOE
Pittsburgh Naval Reactors office
P.O. Box 109
West Mifflin, PA 15122

* G 09-01-0000-00
U.S. DOE
Idaho Branch Office
P.O. Box 2469
Idaho Falls, ID 83407

G 09-02-0000-00
U.S. DOE
Shippingport Branch Office
P.O. Box 11
Shippingport, PA 15077

* G 10-00-0000-00
U.S. DOE
Richland Operations Office
P.O. Box 550
Richland, WA 99352

* G 11-00-0000-00
U.S. DOE
San Francisco Operations Office
1333 Broadway, Wells Fargo B1
Oakland, CA 94616

* G 13-00-0000-00
U.S. DOE
Schenectady Naval Reactors Office
P.O. Box 1069
Schenectady, NY 12301

* G 13-01-0000-00
U.S. DOE
West Milton Field Office
P.O. Box 1069
Schenectady, NY 12301

G 13-02-0000-00
U.S. DOE
Windsor Field Office
P.O. Box 393
Windsor, CT 06095

* G 14-00-0000-00
U.S. DOE
Savannah River Operations Office
P.O. Box A
Aiken, SC 29801

* G 15-00-0000-00
U.S. DOE
Morgantown Energy Technology Center
P.O. Box 880
Morgantown, WV 26505

G 16-00-0000-00
U.S. DOE
Pittsburgh Energy Technology Center
4800 Forbes Avenue
Pittsburgh, PA 15213

G 17-00-0000-00
U.S. DOE
Grand Forks Energy Technology Center
Box 8213, University Sta...
Grand Forks, ND 58202

* Active employer identification codes.

DISTRIBUTION

No. of
Copies

No. of
Copies

OFFSITE

A. A. Churm
DOE Patent Division
9800 South Cass Avenue
Argonne, IL 60439

G. P. Dix
Director, Operational and
Environmental Safety Division
U.S. Department of Energy
Washington, D.C. 20545

H. C. Field
Chief, Policy, Measurements
and Institutional Standards
Operational and Environmental
Safety Division
U.S. Department of Energy
Washington, D.C. 20545

N. R. Glover
Leader, Performance Measure-
ments Group
Policy, Measurements and
Institutional Standards Branch
Operational and Environmental
Safety Division
U.S. Department of Energy
Washington, D.C. 20545

E. N. Patigalia
Performance Measurements Group
Policy, Measurements and
Institutional Standards Branch
Operational and Environmental
Safety Division
U.S. Department of Energy
Washington, D.C. 20545

D. E. Patterson
Deputy Director
Operational and Environmental
Safety Division
U.S. Department of Energy
Washington, D.C. 20545

D. M. Ross
Chief, Health Protection
Branch
Operational and Environmental
Safety Division
U.S. Department of Energy
Washington, D.C. 20545

5 E. J. Vallario
Assistant Chief/Manager
Health Physics Program
Operational and Environmental
Safety Division
U.S. Department of Energy
Washington, D.C. 20545

C. A. Wood
Performance Measurements Group
Policy, Measurements and
Institutional Standards Branch
Operational and Environmental
Safety Division
U.S. Department of Energy
Washington, D.C. 20545

27 DOE Technical Information Center

5 G. J. Brisco
System Safety Development Center
EG&G Idaho, Inc.
P.O. Box 1625
Idaho Falls, ID 83415

No. of
Copies

W. H. Millet
System Safety Development Center
EG&G Idaho, Inc.
P.O. Box 1625
Idaho Falls, ID 83415

B. C. Brooks
Licensee Operations Evaluations
Branch
Division of Technical Support
Office of Management and
Program Analysis
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

No. of
Copies

ONSITE

5 DOE Richland Operations Office

M. F. Mills
H. E. Ransom
J. L. Rhoades
M. W. Tiernan
G. R. Yesberger

24 Pacific Northwest Laboratory

L. G. Faust
J. J. Fix (10)
W. A. Glass
G. R. Hoenes
H. W. Hunt
J. J. Jech
J. M. Selby
V. L. Witherspoon
Technical Information (5)
Publishing Coordination (2)