ORAU-225

Prepared by
Oak Ridge Associated Universities

Prepared for
Office of Industrial Relations
U.S. Department of Energy

MANPOWER TRENDS AND TRAINING REQUIREMENTS FOR RADIATION PROTECTION PERSONNEL IN THE DOE CONTRACTOR SYSTEM

Jan Trice

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Printed in the United States of America
Available from
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
NTIS price codes
Printed copy: A06
Microfiche copy: A01

ORAU--225

DE84 010692

Distribution Category UC-41

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February 1984

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Oak Ridge, Tennessee 37831-0117

Prepared for
Office of Industrial Relations
Office of Nuclear Safety
U.S. Department of Energy

Published by
Office of Scientific and Technical Information
United States Department of Energy

This report is an account of work performed under contract number DE-AC05-76OR00033 between the U.S. Department of Energy and Oak Ridge Associated Universities.

MANPOWER TRENDS AND TRAINING REQUIREMENTS FOR RADIATION PROTECTION PERSONNEL IN THE DOE CONTRACTOR SYSTEM

Abstract

This document reports results of a survey undertaken jointly by the Office of Nuclear Safety and the Office of Industrial Relations, U.S. Department of Energy, with assistance from Oak Ridge Associated Universities. The purpose of the survey was twofold: (1) to determine the current status and recent trends in technician-level radiation safety manpower among DOE contractors, and (2) to document the scope of radiation safety training activities for radiation protection technicians and other workers within the DOE contractor system. Data reported here were obtained both by use of a formal written questionnaire completed by staff at 34 government-owned, contractor-operated (GOCO) nuclear facilities and through supplemental documentation obtained from contractors of training procedures and requirements. The first half of this report describes trends in radiation protection manpower and reports workforce characteristics of health physics technicians. The second half of the report describes program requirements and procedures in those facilities that conduct formal in-house training programs for their radiation protection workforces.

FOREWORD

The radiation protection technician (RPT) plays a key role in the safety programs at DOE/DOE-contractor facilities. His functional responsibility covers a broad range of activities directly keyed to the protection of the worker, the public, and the environment. These responsibilities are discharged under the direction of a professional health physicist and generally include:

1. the implementation of radiation control procedures and standards,
2. the performance of radiation surveys to assure effective control of radiation exposures,
3. the maintenance of a radiation dosimetry program and bioassay program (as appropriate),
4. the testing and operation of radiation protection instrumentation,
5. the testing and operation of radiation safety equipment,
6. the sampling of air, water, and soil (as appropriate), and
7. the maintenance of survey and exposure records.

The importance of the radiation protection technician in the safe conduct of operations is recognized and it is critical that sufficient numbers of radiation protection technicians are available and receive adequate training to fulfill their responsibilities. This importance is reflected in a recent finding which shows a direct correlation between the reduction in staff and training of radiation protection technicians and increase in worker exposure and contamination spills.

With staff reduction at DOE facilities, information is needed on the number of radiation protection technicians at DOE facilities, scope of program, educational background, training, and functional responsibilities at each site. With this need in mind, a project was undertaken jointly by the Office of Nuclear Safety and the Office of Industrial Relations to (1) determine the current status and recent trends in health physics technicians manpower supply and demand among DOE contractors, and (2) to document the scope of health physics technicians training activities within the DOE-contractor system. This report details the result of that study.

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INTRODUCTION

DESIGN AND SCOPE

This document reports results of a survey undertaken jointly by the Office of Nuclear Safety and the Office of Industrial Relations, U.S. Department of Energy, with assistance from Oak Ridge Associated Universities. The purpose of the survey was twofold: (1) to determine the current status and recent trends in technician-level radiation safety manpower among DOE contractors, and (2) to document the scope of radiation safety training activities for radiation protection technicians and other workers within the DOE contractor system. The workforce under examination here does not include employees of the Department of Energy. During fiscal year 1983, the Office of Nuclear Safety requested and received information from 34 government-owned, contractor-operated (GOCO) nuclear facilities. (See Appendix A for a list of facilities included in this survey.) Data reported here were obtained both by use of a formal written questionnaire completed by staff at each of the 34 facilities and through supplemental written documentation obtained from contractors of training procedures and requirements. The survey questionnaire, which includes a list of supplemental documents requested from contractors, is reprinted in Appendix B.

While the primary focus of this study is health physics technicians, some information also has been compiled on other contractor personnel whose job responsibilities include or are directly related to radiation safety functions. Survey respondents were provided with the following generic job category definitions to assist them in determining which personnel at their facilities should be reported in the survey. These definitions have been developed only for purposes of this survey and in no way represent Department of Energy standards or policy.

> HEALTH PHYSICS TECHNICIAN (HPT). Individual whose primary function is radiation protection activities. Under the direction of a professional health physicist, performs any or all of the following tasks: assures compliance with radiation control procedures; conducts ambient radiation surveys to assure effective control of radiation exposure for workers, the public, and the environment; assures effective control of radioactive waste disposal and shipment and receipt of radioactive materials; assures proper distribution, maintenance, testing, and operation of radiation safety equipment and supplies; recommends and assists in

the implementation of procedures to minimize exposures and contamination during operations; performs various analyses for safety purposes of nuclear materials, waste materials, and water; assumes other functions as appropriate in the area of radiation safety.

ASSIGNED OPERATOR (AO). Individual who performs health physics technician activities as assigned portion of his/her job responsibilities. This aspect of responsiblities corresponds to health physics technician func-tion above. (Not all facilities will have personnel in this category.)

SUPPORT SERVICES TECHNICIAN (SST). Individual whose function is to support health physics technicians in one specific aspect of radiation safety (e.g., counting technician, bioassay technician, calibration lab technician).

RADIATION WORKER (RW). Individual for whom potential exists to receive a dose or (annual) dose commitment in any calendar quarter in excess of 10% of the quarterly standards specified in DOE Order 5480.1, Chapter XI.

Responses to earlier surveys suggested that formal job titles for personnel performing radiation protection activities may vary widely across contractor facilities, even in cases where actual job functions are quite similar. The definition of health physics technician cited above is intended to be broadly inclusive of all technician-level personnel whose primary function is radiation protection. An "assigned operator" job category was included in the survey to accommodate those facilities, primarily large production facilities, which assign significant portions of radiation safety functions to personnel whose job responsibilities also include major activities other than radiation protection.

It is apparent from the numbers of employees reported as radiation workers that all survey respondents did not interpret that job category definition in the same way. Some respondents categorized as radiation workers all employees who are badged for monitoring purposes; other respondents were much more restrictive in their interpretations of the definition. Radiation workers as a proportion of the total workforce in individual facilities range from 0% to 100% (see Appendix C).

Table 1 reports the number of facilities which employ radiation protection personnel included in the first three job categories defined above. Thirty-one of the 34 facilities included in this analysis employed a total of 959 health hysics technicians in FY 1983. Eleven facilities employed 881 assigned operaors, and 23 facilities employed a total of 344 support service technicians.

TABLE 1

NUMBER OF FACILITIES EMPLOYING RADIATION PROTECTION PERSONNEL AND TOTAL FY 1983 NUMBER OF EMPLOYEES BY JOB CATEGORY

Job Category	Number of Facilities N = 34	Number of FY 1983 Employees
Health physics technicians	31	959
Assigned operators	11	881
Support service technicians	23	344

MANPOWER ANALYSIS

The first half of this report describes trends in radiation protection manpower and reports workforce characteristics of health physics technicians. Numbers of workers employed in fiscal years 1980, 1981, 1982, and 1983 in all four job categories defined above were obtained from each of the 34 facilities surveyed. Manpower figures were further divided according to functional categories, including reactors, fuel cycle, weapons, waste processing and management, and accelerators. (See Appendix B, Part IA.) Each facility also provided information on ages, work experience, educational backgrounds, sources of recruitment, and turnover for those employees who fit the survey definition of health physics technician. Finally, the questionnaire elicited each facility's specific job titles, entry-level requirements, and formal classroom and laboratory hours required in training for health physics technicians. Respondents also provided copies of health physics technicians' job descriptions.

TRAINING REQUIREMENTS

The second half of the report describes program requirements and procedures in those facilities that conduct formal in-house training programs for their radiation protection workforces. For the purposes of this survey, formal training was defined as that which is conducted according to a predetermined curriculum, a definition intended to exclude unstructured on-the-job experience from this analysis. Each facility that conducts formal in-house training supplied information on curriculum, methods of instruction, training materials, facilities and equipment, instructors, testing procedures, and provisions for updating formal training. Respondents also were asked to provide some supplemental documentation such as course descriptions and course outlines. Limited information was obtained about general training for support service technicians and radiation workers; this section focuses primarily on health physics technicians and assigned operators.

MANPOWER TRENDS IN THE RADIATION PROTECTION WORKFORCE

MANPOWER TRENDS BY RADIATION PROTECTION JOB CATEGORIES

Figures 1 and 2 graph contractor workforce levels from FY 1980 to FY 1983 for the total workforce, radiation workers, health physics technicians, and assigned operators. The size of the total workforce remained fairly stable during this time, increasing by only 2%. (Appendix C reports data from which these percentages are computed.) Figure 2 indicates that both the health physics technician and the assigned operator workforces increased during the period examined here. Health physics technicians increased 13% overall. The overall increase for assigned operators was 21%.

These aggregated figures, of course, obscure the substantial differences among individual facilities, both in workforce size and in rates of change in workforce size. The 34 facilities included in this analysis range in size of total workforce from 145 to 8600, and in reported number of radiation workers from none to 7600. Health physics technician workforces range in size from 1 to 147, and assigned operator workforces are as small as 1 and as large as 432. (See Appendix C for a breakdown of workforces by individual facilities.)

RADIATION PROTECTION MANPOWER TRENDS BY FACILITY FUNCTIONS

Categorizing radiation protection personnel into specific facility functions gives a clearer picture both of the current manpower situation and of what changes have occurred in the contractor workforce since FY 1980. Figures 3 and 4 depict FY 1983 health physics technician and assigned operator workforces in nine functional categories as a proportion of the total health physics technician and assigned operator workforces. (Appendix G lists the number of health physics technicians, assigned operators, support service technicians, and radiation workers by facility function in each individual facility. Note that multipurpose facilities may employ radiation protection personnel in several functional categories.)

The largest proportion of health physics technicians in FY 1983 (24.2%) was employed in weapons fabrication and testing. General research and development accounted for 18.2% of the workforce; and the functional categories of waste processing and management, reactors, and fuel reprocessing account for

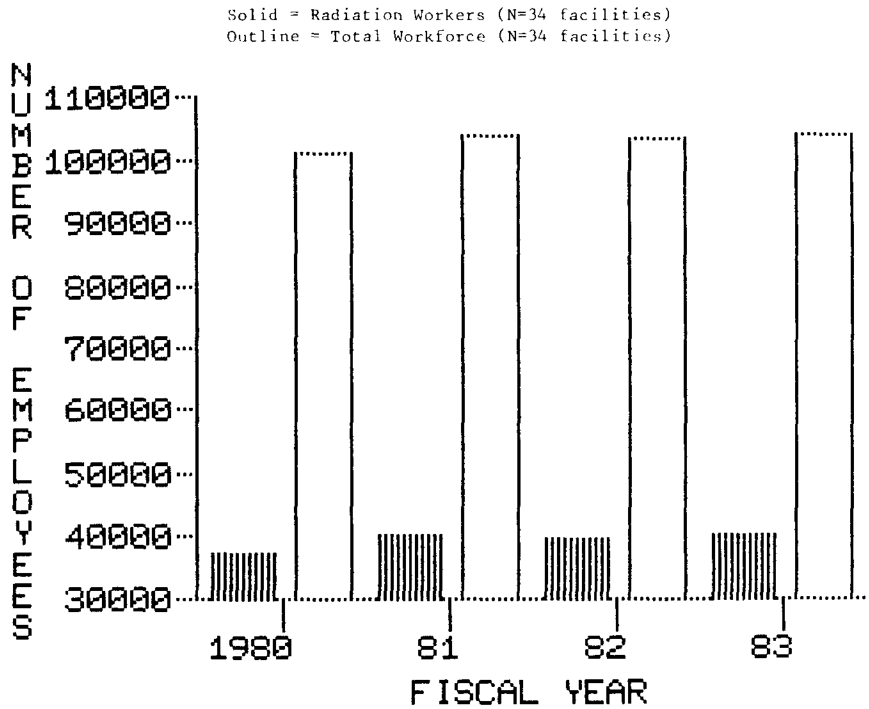

Figure 1. Total Workforce and Radiation Workers, FY 1980-1983

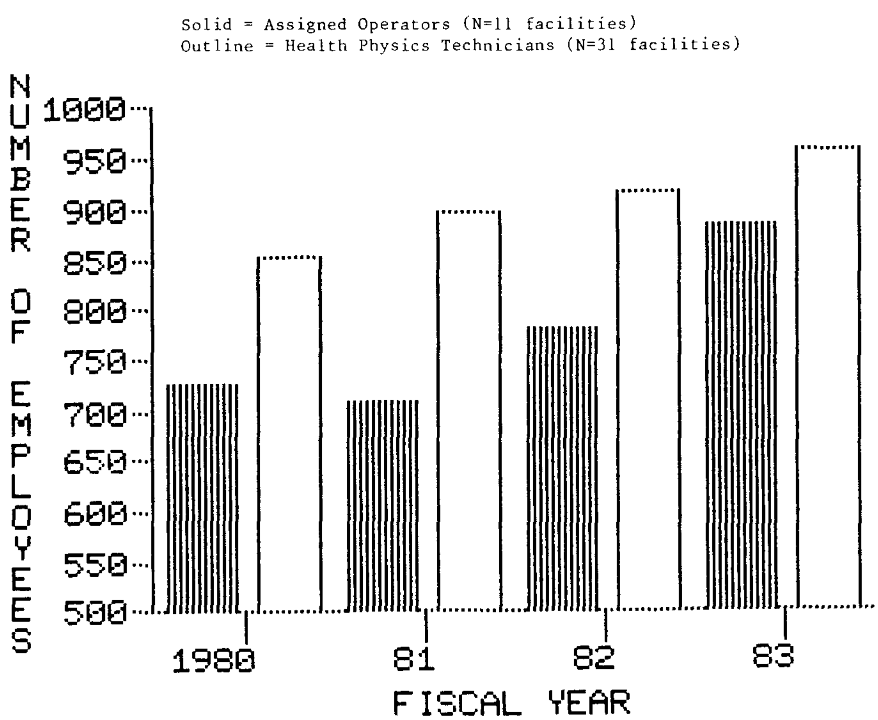

Figure 2. Health Physics Technicians and Assigned Operators, FY 1980-1983

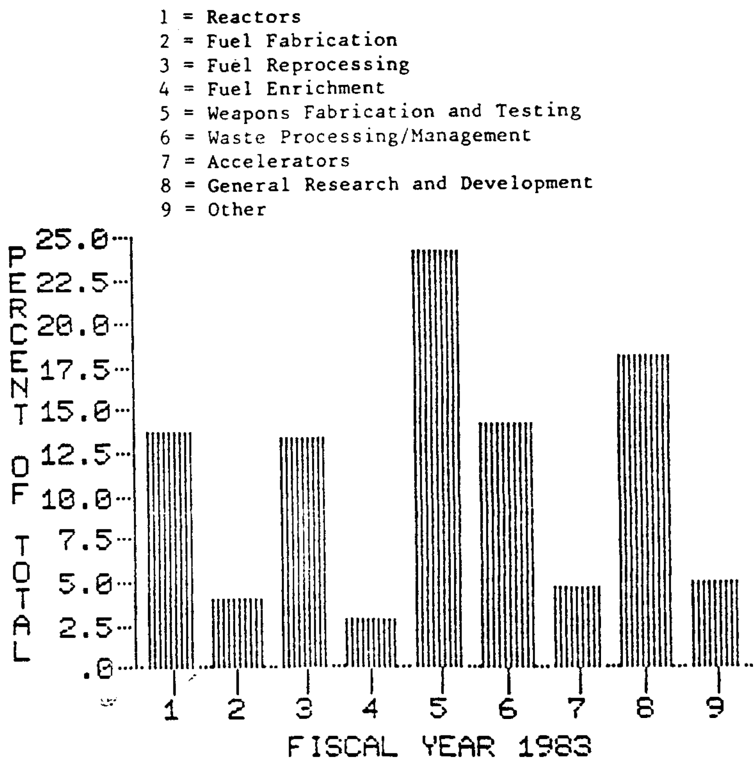

Figure 3. Percentages of the Total Health Physics Technician Workforce Employed in Specific Facility Functions, FY 1983

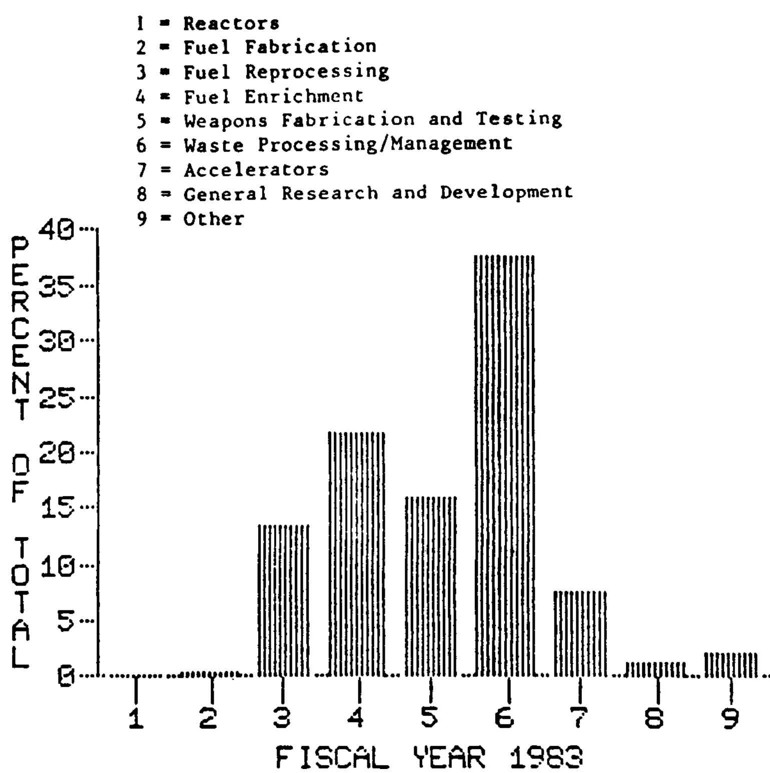

Figure 4. Percentages of the Total Assigned Operators Workforce Employed in Specific Facility Functions, FY 1983

approximately equal proportions of 14.2%, 13.7%, and 13.3%, respectively. As Table 2 indicates, these proportions have not changed substantially since FY 1980. Some increases occurred in weapons fabrication and testing and in waste processing and management, but the relative proportions of health physics employment in functional categories remained stable.

By far the largest proportion of assigned operators in the DOE contractor system in FY 1983 was employed in waste processing and management; this category accounts for almost 40% of the assigned operator workforce. Almost 22% of assigned operators were employed in fuel enrichment, with weapons fabrication and testing and fuel reprocessing accounting for the next largest proportions of the workforce. As Table 2 indicates, waste processing and management remained the largest employer of assigned operators throughout the FY 1980-1983 period. Substantial changes occurred, however, in proportions of the assigned operator workforce employed in the fuel cycle; the proportion of assigned operators employed in enrichment activities declined by 6%, while the proportion employed in reprocessing has increased by 11%.

Table 2 reveals some interesting contrasts in workforce composition among functional categories. (See Appendix D for raw data from which these percentages are computed.) Reactor facilities do not employ assigned operators. Radiation protection personnel in waste processing and management facilities are much more likely than their counterparts in other facilities to be performing their radiation safety duties as one portion of their responsibilities rather than as their primary job function; approximately 7 out of every 10 radiation protection workers in this functional category are assigned operators. Health physics technicians and assigned operators made up about equal portions of the radiation protection workforce in fuel cycle activities in FY 1980, but by FY 1983, assigned operators had increased to 62% of the radiation safety workforce. In weapons testing, fabrication and research, the ratio of health physics technicians to assigned operators is approximately 6 to 4.

Table 3 compares ratios of health physics technicians and assigned operators to radiation workers in specific facility functional categories. Given the obvious diversity of respondents' determinations of which personnel should be categorized as radiation workers (see Appendix C), ratios generated from aggregated figures in this job category should be interpreted with caution.

TABLE 2

HEALTH PHYSICS TECHNICIANS AND ASSIGNED OPERATOR WORKFORCES BY FACILITY FUNCTION, FY 1980-1983 (AS PERCENTAGES OF TOTAL HPT AND AO WORKFORCES)

Facility Function[a]	Health Physics Technicians FY 80 N=852	FY 81 N=986	FY 82 N=918	FY 83 N=959	Assigned Operators FY 80 N=726	FY 81 N=710	FY 82 N=780	FY 83 N=881
Reactors (11)	13.7	14.4	13.6	13.7	0	0	0	0
Fuel fabrication (6)	5.2	5.1	4.4	4.0	.1	.4	.5	.5
Fuel reprocessing (5)	14.7	14.2	15.7	13.3	2.5	4.4	11.5	13.4
Fuel enrichment (4)	2.9	3.7	3.5	2.8	28.1	28.3	24.6	21.7
Weapons fabrication and testing (10)	21.5	21.1	22.9	24.2	16.7	17.8	17.4	16.0
Waste processing/ management (13)	11.0	11.3	11.7	14.2	38.7	35.4	33.7	37.8
Accelerators (8)	5.4	5.5	5.2	4.7	9.0	9.2	8.3	7.4
General research and development (10)	19.5	19.1	17.6	18.2	1.5	1.6	1.4	1.3
Other (14)	6.1	5.7	5.3	5.0	3.4	3.1	2.4	2.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a]Numbers in parentheses indicate number of facilities that employ personnel in each functional category.

Ratios of health physics technicians and assigned operators to radiation workers in individual facilities vary from 1:5 to 1:400. (Appendix H lists ratios for each individual facility.)

Ratios of health physics technicians to radiation workers varied in FY 1983 from 1:15 in waste processing and management to 1:57 in accelerator facilities. Assigned operator ratios varied even more widely, from 1:5 in fuel enrichment and 1:6 in waste processing and management to 1:182 in fuel fabrication.

TABLE 3

RATIOS OF HEALTH PHYSICS TECHNICIANS AND ASSIGNED OPERATORS TO RADIATION WORKERS BY FACILITY FUNCTION, FY 1980-1983

Facility Function[a]	Health Physics Technicians				Assigned Operators			
	FY 80	FY 81	FY 82	FY 83	FY 80	FY 81	FY 82	FY 83
Reactors (11)	1:24	1:25	1:25	1:24	--	--	--	--
Fuel fabrication (6)	1:24	1:23	1:20	1:19	1:1073	1:361	1:205	1:182
Fuel reprocessing (5)	1:14	1:19	1:19	1:21	1:94	1:76	1:30	1:23
Fuel enrichment (4)	1:75	1:61	1:37	1:38	1:9	1:10	1:6	1:5
Weapons fabrication and testing (10)	1:37	1:39	1:38	1:40	1:55	1:58	1:59	1:66
Waste processing/ management (13)	1:18	1:17	1:17	1:15	1:6	1:7	1:7	1:6
Accelerators (8)	1:56	1:53	1:54	1:57	1:40	1:40	1:40	1:40
General R&D (10)	1:62	1:61	1:61	1:52	1:936	1:941	1:889	1:816
Other (14)	1:63	1:181	1:198	1:201	1:339	1:420	1:510	1:537

[a]Numbers in parentheses indicate number of facilities that employ personnel in each functional category.

Growth in radiation protection manpower has not occurred evenly throughout the DOE contractor system, but has been concentrated in those facilities whose functions are primarily waste processing and management, fuel reprocessing, and weapons fabrication and testing. Seventy-two percent of the FY 1983 health physics technicians were employed in weapons fabrication and testing, the fuel cycle, reactors, and waste processing and management. Weapons fabrication and testing and waste processing and management workforces are increasing as proportions of the total workforce, while the proportion employed in the fuel cycle workforce is decreasing. Ninety percent of assigned operators work in waste processing and management, the fuel cycle, or weapons fabrication and testing, with the functional areas of waste processing and management and fuel reprocessing experiencing the highest rates of growth.

HEALTH PHYSICS TECHNICIAN WORKFORCE CHARACTERISTICS

Survey respondents were asked to report the number of health physics technicians employed at each facility according to categories of age, educational background, source of recruitment, and work experience as health physics technicians. Respondents also reported reasons for and numbers of turnovers in the health physics technician workforce in fiscal years 1980, 1981, and 1982, and supplied facility-specific job titles, entry-level requirements, and the numbers of hours of formal classroom and laboratory training required for personnel who fit the survey definition of health physics technician (see Appendix B, Part IIA). The following discussion develops a profile of the current (FY 1983) health physics technician workforce, comparing personnel in the facilities that require formal training with those facilities that do not, reports patterns of recruitment and turnover, and describes entry-level requirements for GOCO health physics technicians.

DEMOGRAPHIC PROFILE

Table 4 reports the proportions of the total FY 1983 health physics technician workforce that fall into various age, work experience, and educational background categories and contrasts workforces in facilities which do and facilities which do not require employees to complete formal in-house training programs. (Formal training is defined for purposes of this survey s that which is conducted according to a pre-determinted curriculum. Note that 90% of the health physics technician workforce is required to complete formal training.) Health physics technicians in facilities not requiring formal training are somewhat older as a group than those in facilities with formal training programs. Employees in facilities not requiring formal training also tend as a group to be more experienced as health physics technicians than their counterparts in facilities which do require formal training, although large proportions of both groups have many years of experience as health physics technicians. As a group, health physics technicians in facilities without formal training programs have attained higher levels of formal education than health physics technicians in facilities with such programs. Sixty-nine percent have completed at least associate degree programs, compared to only 26% of health physics technicians in facilities with formal training. Half of the

TABLE 4

AGE, WORK EXPERIENCE, AND EDUCATIONAL BACKGROUND
PROFILE OF HEALTH PHYSICS TECHNICIANS WORKFORCE
(AS PERCENTAGES OF TOTAL HPT WORKFORCE)

Background Characteristics	Employed at Facilities Requiring Formal Training N=864	Employed at Facilities Not Requiring No Formal Training N=95	Total
Age			
<21	0.9	-	0.8
21-25	12.7	7.5	12.2
26-35	36.4	30.1	35.8
36-45	18.9	10.5	18.1
46-55	18.1	30.1	19.2
56-65	12.8	19.4	13.4
>65	0.2	2.2	0.4
Years experience as HPT			
<1 year	13.4	9.0	12.9
1-2 years	19.5	11.2	18.7
3-5 years	19.5	12.4	18.9
6-10 years	12.9	12.4	12.9
>10 years	34.6	54.0	36.5
Education			
<High school	0.6	1.1	0.7
High school	73.5	30.3	69.4
Associate degree	15.0	19.1	15.4
Bachelor's degree	10.7	38.2	13.3
Graduate study	0.2	11.2	0.4

health physics technicians in the eight facilities which do not require formal training have completed four-year degree programs, and 11% have gone on to enroll in graduate programs.

A large majority of the workers in these facilities who have only high school diplomas have been employed as health physics technicians for more than

10 years; generally, as Table 5 indicates, the fewer years experience workers have in these facilities, the more likely they are to have at least associate degrees. That pattern does not occur in facilities which do require formal in-house training. In these facilities the proportion of health physics technicians who hold associate or higher degrees has remained relatively stable, and has actually decreased slightly among more recently hired health physics technicians.

TABLE 5

EDUCATIONAL BACKGROUND BY YEARS EXPERIENCE
AS HEALTH PHYSICS TECHNICIANS
(AS PERCENTAGES OF TOTAL HPT WORKFORCE)

	Years Experience as HPT				
Education	<1	1-2	3-5	6-10	>10
<High school					
Total	0.8	0	0.6	0.8	0.9
Formal training[a]	0.9	0	0.6	0.9	0.7
No formal training	0	0	0	0	2.1
High school diploma or equivalent					
Total	70.8	68.2	65.1	64.7	73.3
Formal training	74.1	71.2	69.3	69.4	78.6
No formal training	25.0	20.0	9.1	18.2	41.7
Associate degree					
Total	15.0	13.3	19.4	21.0	12.5
Formal training	15.2	12.9	17.8	19.4	78.6
No formal training	12.5	20.0	45.5	36.4	10.4
Bachelor's degree					
Total	11.7	17.3	13.7	11.8	12.2
Formal training	8.0	16.0	12.3	10.2	8.0
No formal training	62.5	40.0	36.4	27.3	37.5
Graduate study					
Total	1.7	1.1	1.1	1.7	1.2
Formal training	1.8	0	0	0	0
No formal training	0	20.0	18.2	18.2	10.4

[a]Formal in-house training is that which is conducted according to a predetermined curriculum.

RECRUITMENT AND TURNOVER

Table 6, which compares sources of health physics technician recruitment in facilities with and without formal in-house training programs, again indicates differences between the two groups of facilities. Facilities that do not require formal training are more likely to recruit directly from four-year educational institutions or graduate programs, while facilities that have formal training are more likely to recruit from vocational-technical training programs. Facilities without formal training are somewhat less likely to recruit from other DOE facilities and somewhat more likely to recruit from non-DOE nuclear facilities. In both groups of facilities, as Table 7 indicates, recruiting health physics technicians from other DOE facilities is less common with recently hired employees and is most common with those employees who have worked more than 10 years as health physics technicians.

The largest proportions of both health physics technician workforce groups, however, are reported as having been recruited into the workforce through in-house promotion or transfer, which obscures the original sources from which these employees were recruited. Among facilities with formal training programs, the two employing the largest numbers of health physics technicians account for well over half of the workers in this category.

Table 8 reports reasons for and numbers of turnovers in the health physics technician workforce during fiscal years 1980, 1981, and 1982. These figures are totals for the entire health physics technician workforce; because the number of turnovers is so small in facilities without formal training programs (a total of 30 in the three-year period), no meaningful comparisons can be made between these facilities and those which do require formal training. The number of turnovers as a proportion of the total health physics technician remained fairly stable over the time period examined here; the rate of turnover was 13% in FY 1980, 14% in FY 1981, and 13% in FY 1982.

The largest proportion of turnovers in each fiscal year resulted from health physics technicians who voluntarily left the workforce for other employment. The second most frequent reason for turnovers in each fiscal year was in-house promotion or transfer to some other job category.

TABLE 6

SOURCE OF RECRUITMENT PROFILE OF HEALTH PHYSICS TECHNICIAN WORKFORCE
(AS PERCENTAGES OF TOTAL HPT WORKFORCE)

Source of Recruitment	Formal Training[a]	No Formal Training	Total
Directly from four-year educational institution or graduate program	3.0	18.3	4.1
Directly from vocational/ technical training programs	13.2	4.3	12.8
From other DOE facilities	9.0	6.5	9.1
From non-DOE nuclear-related facilities	5.2	9.7	6.2
Through in-house promotion or transfer	42.4	37.6	43.3
From the nuclear-related military service	5.1	0	5.1
Through local job service, local advertisement, etc.	3.9	7.5	2.4
Other	18.2	16.1	17.1

[a]Formal in-house training is that which is conducted according to a pre determined curriculum.

Approximately 20 to 25% of the health physics technicians recorded as turnovers in each fiscal year did not seek other employment, but left the workforce entirely. A very small proportion of the workforce was fired for cause during this three-year period, and only 10 health physics technicians were terminated due to reductions in force.

JOB TITLES

The 34 facilities in this study use approximately 30 different job titles for workers whose job responsibilities are included in the survey definition of

TABLE 7

SOURCES OF RECRUITMENT BY YEARS EXPERIENCE AS HEALTH PHYSICS TECHNICIAN (AS PERCENTAGES OF TOTAL HPT WORKFORCE)

Source of Recruitments	Years Experience as HPT				
	<1	1-2	3-5	6-10	>10
Directly from 4-year ed. inst. or grad. progr.					
Total	6.9	4.1	0.6	4.1	8.0
Formal training	5.7	3.8	0	3.6	4.0
No formal training	25.0	11.1	8.3	10.0	23.1
Directly from voc/tech training programs					
Total	17.7	11.8	26.0	12.4	3.6
Formal training	18.9	22.9	30.0	13.5	3.5
No formal training	0	11.1	0	0	3.8
From other DOE facilities					
Total	3.8	4.1	7.5	6.6	18.4
Formal training	4.9	3.8	8.1	7.2	20.7
No formal training	0	11.1	0	0	9.6
From non-DOE nuclear-related facilities					
Total	3.9	5.3	5.8	9.9	7.2
Formal training	4.1	5.6	4.4	9.0	6.1
No formal training	0	0	25.0	20.0	11.5
Through in-house promotion or transfer					
Total	42.3	58.0	42.8	41.3	42.8
Formal training	42.6	59.4	42.2	38.7	46.0
No formal training	37.5	33.3	50.0	70.0	30.8
From the nuclear related military service					
Total	3.9	4.7	0.6	7.4	7.6
Formal training	4.1	5.0	0.6	8.1	9.6
No formal training	0	0	0	0	0
Through local job service, local advertisement, etc.					
Total	7.7	1.8	2.3	7.4	2.4
Formal training	8.2	1.9	2.5	8.1	3.0
No formal training	0	0	0	0	0
Other					
Total	20.8	11.8	16.8	18.2	12.4
Formal training	19.7	10.6	16.8	19.8	10.1
No formal training	37.5	33.3	16.7	0	21.2

TABLE 8

TURNOVER IN HEALTH PHYSICS TECHNICIAN WORKFORCE FY 1980-1982
(AS PERCENTAGES OF TOTAL TURNOVERS)

	Health Physics Technician Turnovers		
Reasons for Turnover	FY 1980 N=113	FY 1981 N=125	FY 1982 N=117
Promoted or transferred in-house	22	32	26
Left voluntarily for other employment	54	37	38
Left the workforce (e.g., retirement, continuing education, military duty, poor health)	18	23	24
Fired for cause	6	5	8
Terminated due to reduction in force	0	3	5

health physics technician, with over 100 "levels" or "grades" within those job categories. (See Appendixes K and L for listings of job titles and entry level requirements at individual facilities.) Three general categories of job titles, however, are most frequently employed. In part because many of the facilities in this analysis are units of larger corporate organizational structures, generic job titles frequently are employed that apply to a broad range of technician-level activities. In some cases, the job descriptions that survey respondents supplied as supplemental documentation are equally generic; in other cases, job descriptions specific to the radiation safety program unit have been developed. These generic job titles such as "technician," "laboratory assistant," "support technician," "research technician," and "engineering and science technician" account for approximately one-third of all job titles assigned to the GOCO health physics technician workforce.

The label "health physics technician" or some variation of it accounts for slightly less than a third of all job titles reported in this survey. Six facilities use the title either exclusively or in conjunction with other job titles, and other facilities use related titles such as "health protection technologist," "health and safety technician," "health physics surveyor," or simply "health technician." A third general category of job titles includes those which make some reference to radiation safety or radiation protection. Job titles include "radiation protection technologist," "radiation monitor" or "radiation safety monitor," and "radiation control technician." In all cases in which a facility uses both "technician" and "technologist," the term "technologist" denotes a more advanced job classification than the term "technician."

Within individual facilities the number of specific job titles may range from one to nine. In most cases, however, a facility will employ one or two major job titles (e.g., health physics technician or radiation safety monitor) and attach qualifying nouns or adjectives such as "trainee, "specialist," "junior," "senior," "chief," or "principal" to denote different levels or grades within the job classification. Advancement within job classifications generally reflects assumption of additional responsibilities, most of which require not only mastering a greater range of technical skills and operating more independently in routine situations, but also performing some administrative and supervisory functions as well. Trainees or entry-level technicians typically perform routine measuring and monitoring activities under close supervision by more experienced personnel. Mid-level technicians assume additional responsibilities for compiling and analyzing radiation safety data, monitoring materials handling by facility personnel, and maintaining records of routine and nonroutine events. Senior technicians not only supervise the activities of radiation safety personnel at lower grade levels, but also serve as instructors and conduct training sessions for radiation safety personnel and other radiation workers, and participate in planning and review of operational and development projects to ensure that radiation protection standards are observed. These technicians frequently act as radiation safety liaisons with other program units and with other organizations and serve as members of emergency response teams.

In some facilities, radiation safety personnel are expected, or are required as a condition of continued employment, to progress from lower to higher levels of job classifications. Time frames which specify the minimum and/or maximum lengths of time employees may remain at a given level are written into job descriptions, and detailed procedures are included as to what steps are required (e.g., oral, written, and/or performance examinations) for promotion to a higher level of the job classification. Failure to complete requirements within the time limit specified by the employer results either in transfer of the employee out of the radiation safety unit or in termination.

The generic job description of health physics technician developed for this survey encompasses almost all of the functions performed by GOCO radiation safety personnel as indicated in their job descriptions, particularly in large facilities where the radiation protection function involves a sizable number of employees. One notable variation from the survey definition, however, is that job descriptions in these facilities make specific and repeated references to the recordkeeping aspects of health physics technician job responsibilities. The only other consistent variation from the survey job description occurs most frequently in smaller facilities that employ fewer numbers of radiation safety workers. In these facilities, those workers who are responsible for radiation safety often are assigned primary responsibility for most other types of industrial safety, too: general industrial hygiene, fire protection, explosives handling, monitoring and control of nonradioactive toxic chemicals, emergency planning (for nonradiological emergencies), and general first aid.

ENTRY-LEVEL REQUIREMENTS

Table 9 summarizes entry-level requirements with regard to educational background, work experience, and training for health physics technicians in the 31 facilities which employ these personnel (see Appendix B, Section II.A.3). The data reported here are for the entry-level job classification and grade at each facility. In most facilities, both formal educational requirements and work experience requirements increase as employees progress from least senior to most senior health physics technician job classifications. In many cases, additional in-house training is required as well (see Appendixes K and L).

TABLE 9

ENTRY-LEVEL REQUIREMENTS
FOR HEALTH PHYSICS TECHNICIAN WORKFORCE

Entry-Level Requirements	Facilities Requiring No Formal Training	Facilities Requiring Formal Training		
	No.	No.	Range of Classroom Hrs. Req.	Range of Lab Demonstration Hrs. Req.
None	1	2	SS[a]-96	0
Satisfactory score on entry test	0	1	140	140
High school diploma or equivalent	0	5	0-1000	0-1000
High school diploma with science, math	2	5	55[a]-72	4-960
High school & voc/tech or equivalent experience	1	6	15-138	0-100
Some college	0	2	80-100[b]	0-40[b]
Two years college or equivalent experience	4	1	60	40
Bachelor's degree or equivalent experience	0	1	SS[a]	
TOTAL	8	23		8

[a]Self-study
[b]Includes one facility where HPTs complete a two-week university short course

In general, those facilities without formal in-house training programs for health physics technicians tend to require more formal education as a condition of employment in radiation safety than those facilities that formally train new workers after employment. Two of the eight facilities without formal training programs require new radiation safety employees to have completed at least an associate degree; three others require applicants to have completed specialized training in radiation protection. In fact, in facilities without formal training the percentage of personnel who hold degrees is even higher than these figures might suggest (69%). The one facility without formal training which has no entry-level requirements employs only one health physics technician and reports that all training is conducted on the job.

The majority of facilities that provide formal training for their health physics technicians after employment do not require any formal education beyond high school as a condition of employment. Three facilities do not even require high school diplomas: two have no entry-level requirements, and the third uses an in-house laboratory technician aptitude test to evaluate job applicants. Four facilities, on the other hand, require applicants to have completed at least some college coursework before employment: two require some college but less than an associate degree (one facility sends its health physics technicians to a two-week university short course rather than conducting formal in-house training). One requires two years of college or the equivalent in work experience, and one requires a bachelor of science degree as a condition of employment as a health physics technician (see Appendix J).

The length of formal training programs conducted at these 23 facilities varies from a few hours concentrated in one or two week periods to several hundred hours stretched out over periods of a year of longer. Some facilities have designed their training programs so that all classroom training is completed before new employees are actually assigned work responsibilities; other facilities intersperse classroom and laboratory training with on-the-job work experience for technician trainees under close supervision by more experienced personnel. There is some tendency for facilities with lower entry-level requirements for health physics technicians to provide more hours of formal classroom and/or laboratory training, but this is not always the case. In some facilities, it is not possible to specify the number of hours devoted to classroom or laboratory training. Training consists of completion by individual employees of workbooks, checklists, and oral, written, and/or practicum examinations over written and/or audiovisual materials designed as self-study courses, and the number of hours required varies for each employee. Generally in those facilities that use self-study training methods, employees are required to complete course materials and pass exams within a specified period of time.

FORMAL TRAINING FOR HEALTH PHYSICS TECHNICIANS AND ASSIGNED OPERATORS

As part of this effort to document the scope of formal radiation safety training in the DOE contractor system, survey respondents at facilities with formal training for health physics technicians (23) and those which train assigned operators (8) were asked to supply course descriptions and course outlines used in classroom and/or laboratory settings. The extent to which training programs have been documented internally varies considerably among these facilities. Some respondents supplied two- or three-page listings of topics included in training sessions, without describing procedures or schedules. Others provided detailed outlines and descriptions, both of course contents and of procedures for conducting the programs. Structured questions in the survey itself allow some general comparisons across facilities with respect to curricula, resource materials, testing procedures, and other elements of formal training programs. The discussion that follows focuses upon survey questions, for which responses are available from each facility, but draws upon the supplemental documentation supplied where appropriate.

Table 10 summarizes formal training requirements for technician-level radiation protection personnel in DOE contractor facilities. (See Appendix I for a list of requirements at individual facilities.) Of the 31 facilities that employ health physics technicians, 23 require completion of a formal training program. One facility does not conduct formal training in-house, but sends its health physics technicians through a two-week university short course. Thirteen facilities require that formal training be completed before job assignment. Six facilities grant exemptions from their formal training programs, but of the 331 health physics technicians currently employed in these facilities, only 16 have not participated in formal training. Waivers are granted case by case; reasons for individual exemptions include previous health physics work experience, completion of some other formal training program or of an associate degree program in nuclear technology, or passing exams and boards required for completion of the training program.

Of the 11 facilities that employ assigned operators, eight require employees in this job category to complete a formal in-house training program.

TABLE 10

FORMAL TRAINING REQUIREMENTS FOR HEALTH PHYSICS TECHNICIAN AND ASSIGNED OPERATOR WORKFORCES

Training Requirements	Number of Facilities			
	Health Physics Technician		Assigned Operator	
	Yes	No	Yes	No
Completion of a formal in-house training program is required.	23	8	8	3
Completion of a formal in-house training program is required before job assignment.	13	10	3	5
Exemptions from formal training may be granted selected personnel.	6	17	0	8

Three facilities require that training be completed before job assignment. No facility reported granting an exemption from formal training to an assigned operator.

The absence of a formal training program for radiation protection personnel is not characteristic of a particular type of DOE facility. Of the eight facilities included in this survey that do not require formal training, all eight employ health physics technicians; three also employ assigned operators. The eight facilities range in size of total workforce from as small as 424 to as large as 6900. Five are research and development facilities, and three are production facilities; their specific functions include the full range of nuclear-related activities conducted in the system.

PROGRAM METHODS

Table 11 presents the frequency of use in the DOE contractor system and effectiveness rankings for various methods of presenting training materials. Each respondent was asked to indicate which methods of presentation are used in

TABLE 11

USE AND EFFECTIVENESS RANKINGS OF FORMAL METHODS EMPLOYED TO TRAIN GOCO HEALTH PHYSICS TECHNICIANS AND ASSIGNED OPERATOR WORKFORCES

	Health Physics Technicians N=23		Assigned Operators N=8	
Methods of Presentation	Number of Facilities Using Method	Effectiveness Ranking[a]	Number of Facilities Using Method	Effectiveness Ranking*
Practical performance demonstration	22	1.18	7	1
Classroom presentation by instructor/ lecturer	20	2	7	2
Classroom presentation by audiovisual mechanisms without instructor/lecturer	12	2.75	6	2.66
Self-study	5	2.33	0	0
Computer-based instruction	2	3	0	0

[a]Effectiveness ranking = $\frac{\text{sum of rankings by individual facilities}}{\text{no. of facilities ranking the method}}$

each facility training program, and then to rank those methods used in order of their effectiveness. Twenty-two of the 23 facilities which conduct formal health physics technicians training include some form of demonstration or practical performance procedures in their training programs. The second most frequently used method is classroom presentation by an instructor or lecturer, (20 facilities). Twelve of the 23 facilities also rely at least in part on classroom audiovisual presentations without having lecturers or instructors present. Five structure at least part of their formal training programs as self-study courses, and two facilities have implemented computer-based instruction. Because one facility may employ several different methods of presentation in the course of a training program, multiple responses inflate the numbers in Table 11 to a total greater than the number of facilities included here.

The effectiveness rankings reported in Table 11 are computed by summing the total scores assigned to a particular method by all facilities which ranked it and then dividing that sum by the number of facilities which ranked the method. Respondents were asked to assign a score of "1" to the method of presentation they found most effective and to rank (2, 3, etc.) all other methods used in order of effectiveness. (Appendixes M and N report use and effectiveness rankings by individual facilities for health physics technician and assigned operator training programs.) The practical performance/demonstration method of presentation received an overall effectiveness ranking of 1.18; almost every facility using the method ranked it as the most effective. Most of the 23 facilities also present training materials in classroom settings with instructors or lecturers.

Formal programs designed to train assigned operators do not differ substantially from those for health physics technicians in the methods of presentation used, nor in the effectiveness rankings assigned to those methods. Of the eight facilities with formal assigned operator training, seven use the practical performance/demonstration methods. Seven also conduct classroom training with instructors or lecturers, and six present materials using audiovisual equipment without instructors. The effectiveness rankings for each method are similar to those for health physics technician training.

PROGRAM CONTENT

Table 12 summarizes the technical elements included in formal training programs for health physics technicians and assigned operators in the GOCO system. Respondents were presented a list of technical elements that might be included in such training and asked to check only those elements included in their facilities' programs. (Appendixes O and P report technical elements included in health physics technician and assigned operator training programs at individual facilities.) Of the 34 technical elements listed in Table 12, only plant radiation safety policies and procedures, basic units and

TABLE 12

TECHNICAL ELEMENTS INCLUDED IN FORMAL TRAINING PROGRAMS FOR HEALTH PHYSICS TECHNICIAN AND ASSIGNED OPERATOR WORKFORCES

	Number of Facilities	
Technical Elements	Health Physics Technician N=23	Assigned Operator N=8
Basic math	18	2
Basic nuclear physics	22	6
Radiation protection standards, guides, and limits	20	6
National/international organizations (e.g., ICRP, NCRP)	8	0
Biological effects of radiation	22	6
Basic units and terminology	23	7
Fundamentals of bioassay	16	2
Fundamentals of detection	22	6
Respirator use, test, and maintenance	23	5
Protective clothing	22	6
Personnel contamination assessment	20	4
Air sampling technology	20	4
Surface contamination assessment	21	5
Dose/stay-time calculation	16	4
Radioactive source control	20	5
Shielding	18	3
Decontamination methodology	21	4
Personnel dosimetry	19	4
Alpha monitoring	21	7
Beta, gamma monitoring	22	6
Neutron monitoring	17	2
Instrumentation (e.g., testing, maintenance, and calibration of portable survey equipment)	17	2
Standardization and application of lab counting equipment	15	2
Plant radiation safety policies and procedures	23	8
On-site emergency preparedness	20	6
Off-site emergency preparedness	10	1
Criticality safety	17	3
ALARA	19	4
Recordkeeping	20	3
Waste management	14	2
Posting and labeling	21	5

terminology, and respirator use, test, and maintenance are included in the curricula of programs at all 23 facilities with formal health physics technician training. A large proportion of the facilities, however, teach most of the technical elements listed. The only two technical elements not taught by a majority of the facilities are off-site emergency preparedness and national/international organizations. The pattern of inclusion and exclusion of particular technical elements in formal training programs for assigned operators differs somewhat from that in programs for health physics technicians; 17 of the 34 technical elements are not included in at least five of the eight formal training programs. Only plant radiation safety policies and procedures are taught by all eight facilities.

RESOURCE MATERIALS

Facilities which require formal training of their health physics technicians and assigned operators employ a variety of textbooks and other publications as resource materials (Table 13). Appendixes Q and R report printed materials used by individual facilities in their formal training programs, but some generalizations about resources for formal training can be made. A majority of facilities use in-house manuals, either specific training manuals or plant radiation safety manuals adapted for training purposes. In some cases, these manuals are the primary, if not the sole, text material for formal training courses. In other cases, these types of materials are used more heavily in on-the-job training, while more generic materials are employed in the structured classroom and laboratory portions of facility training.

No textbook or handbook appears to have been universally adopted by radiation protection trainers in the contractor system, but several publications are widely used, both as actual textbooks for trainees and as reference or source books for instructors. Seven of the 23 facilities that conduct formal health physics technician training rely exclusively on one of four frequently used publications or on these materials in conjunction with in-house manuals (see Appendix Q). More frequently, facilities use several texts, selecting those sections within texts which are most appropriate to their specific substantive training needs. Only two respondents reported that no texts are used in their health physics technician training programs. A one facility no specific text was named; trainers rely heavily on standard operating procedures, supplemented by commercially produced videotapes. Three of the eight facilities with formal training for assigned operators reported that no textbook materials are used in their training programs, and one relies exclusively on the in-house radiation safety manual.

TABLE 13

USE OF TEXTBOOKS OR OTHER RESOURCE MATERIALS IN FORMAL TRAINING PROGRAMS FOR HEALTH PHYSICS TECHNICIANS AND ASSIGNED OPERATORS

Number of Textbooks or Other Resource Materials	Number of Facilities	
	Health Physics Technicians N=23[a]	Assigned Operators N=8
None	2	3
One	2	1
More than one	18	4

[a]Includes one facility which sends HPTs to off-site training

Table 14 summarizes the availability of physical training resources for health physics technician and assigned operator training programs. For each of the items of equipment listed, survey respondents were asked to indicate which were reserved exclusively for training purposes and which were available for training but also were used for nontraining purposes. As the figures in Table 14 indicate, equipment tends to be available for training rather than reserved exclusively for training in both health physics technician and assigned operator programs. A large majority of facilities which conduct health physics technician training use respirators, protective clothing, radiation survey instruments, fume hoods, and air sampling or monitoring equipment, with respirators and survey instruments most likely to be available exclusively for training use. Most facilities have training rooms available, but only seven set aside space to be used solely for training purposes. All assigned operator

TABLE 14

EQUIPMENT USED IN FORMAL TRAINING PROGRAMS
FOR HEALTH PHYSICS TECHNICIAN
AND ASSIGNED OPERATOR WORKFORCES

Types of Equipment	Number of Facilities: Reserved Exclusively for Training HPT N=23	Reserved Exclusively for Training AO N=8	Available for Training HPT N=23	Available for Training AO N=8
Training room	7	3	23	8
Glove box	2	1	17	4
Respirator	5	1	23	7
Protective clothing	3	0	23	7
Radiation survey instruments	6	1	23	8
Hood	0	0	20	6
Air sampling, monitoring equipment	3	-	23	6
Mockups of specialized facilities or equipment	3	2	12	5

training programs use radiation survey instruments in their formal programs, and most also use respirators, protective clothing, and air sampling or monitoring equipment. Training for assigned operators, like that for health physics technicians, generally includes the use of fume hoods, but none of the facilities which conduct formal training reserve a hood exclusively for use by training staff and trainees. Mockups of special facilities or equipment are not frequently employed in either health physics technician or assigned operator training. Appendixes S and T indicate the availability of training equipment at each individual facility.

INSTRUCTORS

Table 15 reports the total number of full-time and part-time instructors who staff formal health physics technician and assigned operator training programs in contractor facilities. Of the 23 facilities with formal health physics technician training, eight employ full-time instructors. One facility does not employ any instructor; this facility employs only one health physics technician, and has required that technician to pass a written examination over material covered in a radiation protection self-study course. Only one facility employs full-time instructors to train assigned operators; this facility employs 11 instructors for its assigned operator workforce of 432.

TABLE 15

STAFFING FOR FORMAL HEALTH PHYSICS TECHNICIAN AND ASSIGNED OPERATOR TRAINING PROGRAMS

	Health Physics Technicians			Assigned Operators		
Type of Instructors	No. of Facilities N=23	No. of HPTs	No. of Instructors FT/PT	No. of Facilities N=8	No. of AOs	No. of Instructors
Full-time only	1	62	5	1	432	11
Part-time only	14	288	67	7	434	30
Both	7	516	9/35	0	0	0
None	1	1	-	0	0	0

The much more common practice for staffing formal training programs for radiation safety personnel is to employ part-time rather than full-time instructors. Twenty-one facilities employ part-time health physics technician instructors; the number of instructors in an individual facility ranges from one to 15. (See Appendix U for the number of instructors by individual facility.) Seven of the eight facilities which conduct formal training for assigned operators employ a total of 30 part-time instructors (the eighth employs full-time instructors). The number of instructors in individual facilities varies considerably as does the ratio of instructors to assigned operators.

Survey respondents were asked to report qualifications required of instructors at each facility which conducts formal training. A few facilities require instructors to be certified health physicists. Several require that instructors have at least a bachelor's degree, but the most commonly reported requirements is simply that an instructor have extensive work experience in the field of health physics.

Contractor facilities make limited use of outside consultants to conduct their in-house training programs. Consultants may develop course materials or perform other tasks but they rarely conduct the actual training sessions. Only three facilities reported using outside consultants as instructors for formal radiation safety training. Some facilities, however, have sent employees to receive radiation safety training at off-site locations.

TESTING PROCEDURES

Table 16 reports testing procedures used by contractor facilities to verify the effectiveness of formal training programs for health physics technicians and assigned operators. (Appendixes V and W list testing procedures at individual facilities.) Although a few facilities rely exclusively upon one procedure, most employ a combination of different procedures to test their radiation safety trainees. Two facilities which conduct formal training do not also have formal testing procedures to verify the effectiveness of that training.

Nineteen of the 23 facilities that conduct formal training for health physics technicians require trainees to pass a written examination at the conclusion of the training program (periodic tests also may be administered during the course of the program); 18 of these facilities conduct practical performance examinations to test the effectiveness of formal training. Fourteen health physics technician training programs include oral examination requirements, although only one facility relies exclusively on an oral test of training effectiveness. Four of the eight facilities that train assigned operators require written examinations, and five of these facilities use practical performance tests. Four assigned operator programs include oral tests.

TABLE 16

TESTING PROCEDURES IN FORMAL HEALTH PHYSICS TECHNICIAN AND ASSIGNED OPERATOR TRAINING PROGRAMS

	Number of Facilities	
Testing Procedure	Health Physics Technicians N=23	Assigned Operators N=8
Oral	14	4
Written	19	4
Practical performance test	18	5
No formal testing procedure	2	3

Table 17 summarizes procedures that facilities employ to maintain records of test results for health physics technician and assigned operator trainees. At those facilities which conduct formal tests, the most common practice is to retain records indefinitely either as part of individual employees' files or in a collective training file. In all but one facility, test records are retained for at least three to five years. Appendixes V and W report recordkeeping procedures at individual facilities.

Table 18 summarizes procedures in facilities which conduct formal training for health physics technicians and assigned operators for advising trainees as to what constitutes satisfactory performance on training examinations, and reports the number of facilities which make job assignment for radiation safety personnel dependent upon satisfactory performance on the tests. Three facilities reported no procedures for informing trainees prior to examinations what would constitute satisfactory performance. Twenty facilities which conduct formal tests as part of their health physics technician training programs

TABLE 17

PROCEDURES FOR MAINTAINING RECORDS OF TEST RESULTS
IN FACILITIES WITH FORMAL TRAINING FOR
HEALTH PHYSICS TECHNICIANS AND ASSIGNED OPERATORS

	Number of Facilities	
Procedures	Health Physics Technicians N=21	Assigned Operators N=5
Length of time records are retained:		
1 - 2 years	1	0
3 - 5 years	7	1
> 7 years	12	3
Not available	1	1
Availability of test results:		
In individual's personnel file	7	1
In individual's training file	13	3
In collective training files	12	3
Not available	1	1

TABLE 18

ADVISEMENT AND JOB ASSIGNMENT PROCEDURES
IN FACILITIES WITH FORMAL TRAINING PROGRAMS
FOR HEALTH PHYSICS TECHNICIANS AND ASSIGNED OPERATORS

	Number of Facilities	
Procedures	Health Physics Technicians N=21	Assigned Operators N=5
Advisement of trainees prior to test as to what constitutes satisfactory performance	20	3
Orally	20	3
In writing	12	2
Not advised	1	2
Job assignment dependent upon satisfactory completion of test	17	4

inform trainees orally what will be required to earn a passing score on tests; 12 of those facilities also inform trainees in writing. One facility informs its assigned operator trainees orally what is required in test performance, and two facilities provide written as well as oral instructions.

Seventeen facilities with formal training for health physics technicians make job assignment dependent upon satisfactory completion of oral, written, and/or practical performance tests; only four facilities did not indicate that satisfactory test performance is a requirement for job assignment in the radiation safety workforce. Of the five facilities which conduct formal tests as part of their assigned operator training, only one does not make job assignment dependent upon satisfactory test performance. Appendixes X and Y list procedures of advisement and job assignment at individual facilities.

Table 19 reports procedures implemented by facilities when trainees fail the formal test after health physics technician or assigned operator training. Only one facility reassigns its health physics technician trainees to some other position without first retesting them. Five facilities have no uniform procedures for dealing with health physics technician trainees who fail, but deal with each case individually. Similar provisions are made for assigned operator trainees at two facilities.

TABLE 19

PROCEDURES FOR TRAINEES WHO FAIL FORMAL TESTS IN CONTRACTOR HEALTH PHYSICS TECHNICIAN AND ASSIGNED OPERATOR TRAINING PROGRAMS

	Number of Facilities	
Procedure	Health Physics Technicians N=21	Assigned Operators N=5
Retrain and retest	15	3
Retest only	0	0
Reassign or terminate	1	0
No uniform procedure	5	2

All other facilities reported that health physics technician and assigned operator personnel are retrained and retested if they fail tests initially. In supplemental documentation, some respondents specify in great detail the conditions under which retraining and retesting can occur, and the time frame within which trainees must successfully complete training requirements. In other cases, no mention is made of what specific procedures might be followed. When trainees are allowed to repeat all or portions of the training program, most facilities limit the number of times any individual employee may be retested. The number of retests allowed ranges from one to four. Employees who cannot successfully be retested are either assigned to some other job classification or terminated. Appendixes X and Y report procedures and number of retests allowed at individual facilities.

UPDATING JOB SKILLS

Table 20 summarizes procedures implemented by GOCO facilities to update job skills of their health physics technician and assigned operator workforces. (See Appendixes Z and AA for descriptions of programs at individual facilities.) Five facilities did not report any update programs. One facility has no program currently but reported that an informal program is being developed.

TABLE 20

PROGRAMS TO UPDATE JOB SKILLS OF HEALTH PHYSICS TECHNICIANS AND ASSIGNED OPERATORS IN CONTRACTOR FACILITIES

	Formal Programs		Informal Programs	
Program Characteristics	HPT	AO	HPT	AO
Number of facilities with programs	14	5	9	4
Program lengths (range in hours)	1-546	1-110	<1-400	1-60
Number of times conducted per year	<1-15	1	1-260	1-6
Number of facilities in which participation is mandatory for all HPTs or AOs	10	5	9	4

Among the 18 remaining facilities which offer formal training for health physics technicians, 9 require formal update training, 4 conduct informal update programs, and 5 facilities require participation in both formal and informal programs. These programs range in length from a one-hour program conducted once a month to what one facility reports as a 546-hour "ongoing" program. Formal programs tend to be one of two types: brief programs conducted on a monthly or near monthly basis, or more extensive programs conducted only once or twice a year. Ten of the 14 facilities which conduct formal update training require that all health physics technicians participate in the training. Participation is mandatory for approximately 75% of the technicians at one facility, and another facility has mandatory update training only for supervisors. Participation is mandatory in all other formal update programs.

Seven of the eight facilities which conduct formal training for assigned operators also conduct some type of program to update or upgrade skills of their assigned operator workforces; only one, which employs one assigned operator did not report any update program. Five facilities conduct formal update programs, two of them in conjunction with informal programs. One facility relies upon a one-hour informal update conducted once a year, and requires a one-hour update course every other month. Formal programs range in length from a one-hour program once a year to one facility's 110-hour "ongoing" update.

NATIONAL REGISTRY OF RADIATION PROTECTION TECHNOLOGISTS

The National Registry of Radiation Protection Technologists (NRRPT) administers standardized formal examinations through which health physics technicians and other radiation safety personnel can achieve national certification in their field. Table 21 summarizes the extent to which DOE contractor facilities are involved in supporting national certification efforts for their radiation safety personnel. (See Appendix BB for a listing of activities supported at individual facilities.) Seventy-three health physics technicians and six assigned operators currently employed at 16 facilities have passed NRRPT exams and are registered radiation protection technologists. One facility employs 22 registered technologists; another employs 13. Thirty-four other contractor employees have taken the exam and either have failed or are still awaiting test results from NRRPT.

Fifteen facilities report no involvement at all with NRRPT in terms of financial support for employees wishing to achieve certification, although six of these facilities do have registered radiation protection technologists on their radiation safety staffs. Six facilities pay application and/or examination fees for their employees, and six fund travel to the exam location. The more common forms of support for NRRPT, however, are allowing paid work time for exam preparation and for the exam itself, and funding specialized training specific to NRRPT exam preparation. Twelve facilities allow paid work time for the exam itself, and 11 allow work time for preparation. Eleven facilities fund specialized NRRPT training. In some cases, this training is conducted in-house; in others, employees are provided funds to attend special training at other facilities.

TABLE 21

CONTRACTOR ORGANIZATIONAL INVOLVEMENT WITH NRRPT

Organizational Involvement	Health Physics Technicians	Assigned Operators
Number of employees certified by NRRPT	73	6
Number of employees who have taken NRRPT exam	107	6
Number of facilities which support NRRPT registration through:		
Funding application/exam fees	6	
Funding travel to exam location	6	1
Allowing paid work time for exam	12	1
Allowing paid work time for exam preparation	11	1
Funding specialized training specific to NRRPT exam preparation	11	

TRAINING FOR SUPPORT SERVICE TECHNICIANS AND RADIATION WORKERS

While the primary focus of this analysis has been health physics technicians and assigned operators, limited information also was obtained from each facility on training procedures for support service technicians (see job category definition on page 2 and for radiation workers. Table 22 summarizes the characteristics of these programs. Appendixes CC and DD provide a listing of program characteristics by individual facilities.

Of the 23 facilities which employ support service technicians, 22 conduct informal training programs for these radiation safety employees. Nine facilities require formal training in conjunction with their informal programs; 13 require only informal training, and 1 facility conducts only formal training for support service technicians. Twelve facilities conduct training specific to the support service task in conjunction with general radiation safety training, while 10 facilities restrict training only to the specific support task.

Instructors for support service technician training programs generally are drawn from one of two sources: the technical training staffs of contractor facilities and line supervisors. Line supervisors are involved in training at 21 of the 23 facilities that train support service technicians. The two facilities that do not use line supervisors rely exclusively on technical training staff. Six facilities depend entirely upon instruction by line supervisors. Nontechnical staff are involved in support service technician training at 6 facilities, but always in conjunction with line supervisors, technical trainers, or both. Only 2 facilities employ outside consultants to conduct training for their support service technicians. Only 7 of the 23 facilities reported the duration of their support service technician training. The duration of training in those facilities which specified program length ranges from 2 hours to approximately 100 hours.

Seven facilities did not report any training for radiation workers. Of the 26 facilities which did report characteristics of training programs for radiation workers, 13 conduct both formal and informal programs. Eight conduct formal training only, and 5 rely exclusively upon informal training procedures. As is the case with support service technicians, radiation worker training in contractor facilities is conducted most frequently by technical training staff in conjunction with line supervisors. Unlike support service training,

TABLE 22

CHARACTERISTICS OF TRAINING IN CONTRACTOR FACILITIES
FOR SUPPORT SERVICE TECHNICIANS AND RADIATION WORKERS

Program Characteristics	Number of Facilities: Support Service Technicians N=23	Number of Facilities: Radiation Workers N=34
Type of program		
Formal	10	21
Informal (OJT)	22	17
No training program reported		7
Nature of training		
Specific to support service task	10	
Specific to support service task in conjunction with general radiation safety training	12	
Training instructors		
In-house		
Technical training staff (e.g., health physics)	15	22
Nontechnical training staff (e.g., personnel)	6	8
Line supervisors	21	15
Other	3	4
Outside consultants	2	2
Duration of programs (range, in hours)	1-100	1-20

however, radiation workers are not trained exclusively by line supervisors in any of the 26 facilities which conduct general radiation safety training. In 6 of the 7 facilities using nontechnical trainers in their training programs for radiation workers, these instructors work with both technical trainers and line supervisors. Two facilities employ outside consultants to conduct all or part of their radiation worker training. Training programs range in length from 1 to 20 hours. Only 2 facilities reported program durations of more than 10 hours; programs generally average about 4 hours.

SURVEY COMMENTS

The final section of the questionnaire employed in this analysis departed from the structured, forced-choice format of earlier sections and solicited comments from survey respondents based on their experiences in radiation protection training and their observations of procedures and methods in other programs. These general, open-ended questions (see Appendix B, Questions 23 and 24) were designed to elicit the perceptions of GOCO personnel about past, current, and future trends in radiation safety training and about what constitutes a good radiation safety training program.

No doubt in part as a response to this questionnaire which heavily emphasizes formal over informal training, many respondents took these questions as an opportunity to defend the legitimacy and the necessity of hands-on, field, or on-the-job training as an essential element of good radiation safety training programs. Of the 31 respondents who offered general comments, 23 specifically cited OJT as integral to overall radiation protection training. These respondents generally do not question the need for formal, structured elements in training programs, but argue that, in the absence of practical experiences to supplement information presented in a classroom setting, formal training is not effective.

In descriptions of their own programs, in listings the essential elements of good programs, and in general discussions of trends in training, a fairly clear picture emerges of what these survey respondents consider to be an "ideal" radiation safety training program. While not all respondents subscribe to this view, it clearly is the dominant one among survey participants. The ideal training program for these respondents combines both formal and informal training procedures. Formal training is most effective as a means of presenting generic radiation protection concepts and of introducing trainees to methods and procedures of comprehensive radiation safety programs. Because such theoretical concepts are applicable across the broad range of radiation protection situations encountered by trainees, the structured uniformity imposed by formal classroom training is appropriate to the materials to be presented, and formal testing is an appropriate technique for determining whether or not trainees have sufficiently mastered the training material.

Respondents indicated, however, that formal training should be augmented by extensive hands-on field experience in work situations. Ideally such experience should be gained under close supervision on a one-to-one basis by more experienced radiation safety personnel. Survey respondents repeatedly emphasized that such training should be directed at specific performance objectives; unless training is directly related to the tasks which workers will be expected to perform, knowledge is unlikely to be retained for more than a short period of time.

The great advantage of formal training noted by respondents in this survey is that it tends to standardize not only the technical elements of training programs, but also documentation procedures and, consequently, measures of training effectiveness. Respondents feel that formal training generally leads to formal testing, which many respondents feel may raise standards applied to evaluate trainees' performances. An additional desirable consequence of formal training indicated by respondents is that it tends to raise the level of "professionalism" among radiation safety workers, by developing in them a more comprehensive understanding of the radiation protection field.

Respondents, however, expressed concern that recent trends toward more structured, formalized training may be focusing on the "academic" aspects of radiation protection at the expense of directly applicable job skills. A fairly wide range of generic instructional tools and materials is now available to radiation safety personnel from commercial vendors and other sources. Respondents feel that these materials, by their very nature, cannot be tailored to the specific job situations encountered by personnel at individual facil-ities. Several survey respondents commented that such material, while much of it is of high quality, cannot make up all of a facility's training program.

APPENDIXES

APPENDIX A

FACILITIES INCLUDED IN THIS SURVEY

Argonne National Laboratory East
Argonne National Laboratory West
Bendix Field Engineering Corporation
Brookhaven National Laboratory
EG&G Energy Measurements Group
Fermi National Accelerator Laboratory
Garrett Airesearch
General Electric Company Pinellas Plant
Goodyear Atomic Piketon Plant
Hanford Engineering Development Laboratory
Idaho Chemical Processing Plant
Idaho National Engineering Laboratory
Inhalation Toxicology Research Institute
International Energy Systems Group
Lawrence Berkeley Laboratory
Lawrence Livermore National Laboratory
Los Alamos National Laboratory
Mound Facility
NLO Feed Materials Production Center
Oak Ridge Associated Universities
Oak Ridge Gaseous Diffusion Plant
Oak Ridge National Laboratory
Oak Ridge Y-12 Plant
Pacific Northwest Laboratory
Paducah Gaseous Diffusion Plant
Pantex Plant
Reynold Electrical and Engineering Company
Rockwell Hanford Waste Management Site
Rockwell International
Rocky Flats Plant
Sandia National Laboratory
Savannah River Plant
Stanford Linear Accelerator Center
UNC Nuclear Industries
West Valley Demonstration Project

APPENDIX B

HEALTH PHYSICS TECHNICIAN SURVEY FORM

Return to: Jan Trice
MERT Division, AFSP
Oak Ridge Associated Universities
P.O. Box 117
Oak Ridge, Tennessee 37830

Please Respond by March 30, 1983.

Person completing this questionnaire:

Name: ______________________________

Title: ______________________________

Telephone Number: ______________________________

Name of Facility: ______________________________

Name of Contractor: ______________________________

The purpose of this survey is: (1) to determine the current status and recent trends in radiation safety manpower supply and demand among DOE contractors, and (2) to document the scope of radiation safety training for those responsible for radiation protection activities within the DOE contractor system.

Data collected through the use of this questionnaire will be compiled in report form for DOE. Information will be codified, and no contractor or facility will be identified by name in the final DOE report.

This survey focuses on health physics technicians, but some information also is required on assigned operators, support service technicians, and other radiation workers. The following definitions of each of these job categories are provided to assist you in identifying personnel in your organization who should be included in this survey:

HEALTH PHYSICS TECHNICIAN. Individual whose primary function is radiation protection activities. Under the direction of a professional health physicist, performs any or all of the following tasks: assures compliance with radiation control procedures; conducts ambient radiation surveys to assure effective control of radiation exposure for workers, the public, and the environment; assures effective control of radioactive waste disposal and shipment and receipt of radioactive materials; assures proper distribution, maintenance, testing, and operation of radiation safety equipment and supplies; recommends and assists in the implementation of procedures to minimize exposures and contamination during operations; performs various analyses for safety purposes of nuclear materials, waste materials, and water; assumes other functions as appropriate in the area of radiation safety.

ASSIGNED OPERATOR. Individual who performs health physics technician activities as assigned portion of his/her job responsibilities. This aspect of responsibilities corresponds to health physics technician functions above. (Not all facilities will have personnel in this category.)

SUPPORT SERVICES TECHNICIAN. Individual whose function is to support health physics technicians in one specific aspect of radiation safety (e.g., counting technician, bioassay technician, calibration lab technician).

RADIATION WORKER. Individual for whom potential exists to receive a dose or dose commitment in any calendar quarter in excess of 10 percent of the quarterly standards specified in DOE Order 5480.1, Chapter XI.

Please note that five attachments should be returned with this questionnaire: (1) job descriptions for health physics technicians; (2) course descriptions and course outlines for health physics technician training programs; (3) course descriptions and course outlines for assigned operator training programs; (4) course descriptions and course outlines for support service technician training programs; and (5) course descriptions and course outlines for radiation workers.

If you have any questions or require any assistance in completing this questionnaire, please call Jan Trice at FTS 626-3310 (615/576-3310).

PART I. MANPOWER

A. Please complete the chart below by recording the number of health physics technicians, assigned operators, support service technicians, and radiation workers employed in each of the activities listed for fiscal years 1980, 1981, 1982, and 1983.

	Number Employed															
	FY 1980				FY 1981				FY 1982				FY 1983			
Function	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers
Reactor																
Fuel Fabrication																
Fuel Reprocessing																
Fuel Enrichment																
Weapons Fabrication																
Weapons Testing/ Research																
Waste Processing/ Management																
Radiochem. Materials Development																
X-Ray																
Accelerator																
Office or Administrative																
Other (specify):																
Other:																
Other:																
Total																

B. Total workforce (including **all** employees; not limited to job categories above):

FY 1980	FY 1981	FY 1982	FY 1983
______	______	______	______

PART II. HEALTH PHYSICS TECHNICIANS (HPTs) AND ASSIGNED OPERATORS (AOs)

A. Health Physics Technician Workforce Characteristics

1. Please complete the chart below for **health physics technicians only**. Record the number of HPTs who fall within each subcategory (e.g., age, education).

	Number of Health Physics Technicians																				
	Age							Education					Source of Recruitment								
Years of Experience as Health Physics Technician	<21 years old	21-25 years old	26-35 years old	36-45 years old	46-55 years old	56-65 years old	>65 years old	Less than High School Diploma or Equivalent	High School Diploma or Equivalent	Associate Degree	Bachelor's Degree	Graduate Study	Directly from 4-year Educational Institutions	Directly from Vocational/Technical Training Programs	From Other DOE Facilities	From Non-DOE Nuclear-Related Facilities	Through In-House Promotion from Some Other Job Classification	From the Nuclear-Related Military Service	Other (specify):	Other:	Other:
<1 Year																					
1-2 Years																					
3-5 Years																					
6-10 Years																					
>10 Years																					

2. Please record the number of **health physics technicians** lost through turnover for the following reasons during fiscal years 1980, 1981, and 1982.

	Number of HPT Turnovers		
Reasons for Turnover	**FY 1980**	**FY 1981**	**FY 1982**
Promoted In-House			
Left Voluntarily for Other Employment			
Left the Workforce (e.g., retirement, continuing education, military duty, poor health)			
Fired for Cause			
Terminated due to Reduction in Force			
Other (specify):			
Other:			
Other:			
Total			

3. Please list job titles/levels of all personnel in the chart below who fit the definition of **health physics technician** at the beginning of this survey. Note that there may be several such titles/levels in your organization and all should be listed. Xerox additional copies if necessary.

Job Title/Level*	Number of Employees				Entry-Level Requirements	Formal Training Requirements**	
	FY 1980	FY 1981	FY 1982	FY 1983		Class Time in Total Hours	Lab Demonstration Time in Total Hours

*Attach written job descriptions.
Include only **formal training required to reach this job level, not on-the-job experience. Formal training is conducted according to a previously established curriculum.

B. Health Physics Technician (HPT) and Assigned Operator (AO) Training

In this survey, **formal training** is training conducted according to a previously established curriculum.

4. Check appropriate spaces in the chart below.

	HPT		AO	
	Yes	No	Yes	No
Completion of a formal in-house training program is required.				
Completion of a formal in-house training program is required before job assignment.				
Exemptions from formal training may be granted selected personnel.				

5. Approximately how many current employees have been exempted from formal in-house training?

HPTs ____________ AOs ____________

6. Under what specific circumstances are personnel exempted?

____

____

____

7. What provisions are made before job assignment to ensure quality of performance?

____

____

____

8. Indicate by a check in the first two columns of the chart below all methods of presentation used by your organization for HPT or AO training. In columns 3 and 4 use numbers to rank methods of presentation used by your organization in order of effectiveness (1 = most effective).

Methods of Presentation	**Methods Used for Training**		**Methods Found Most Effective**	
	HPT	AO	HPT	AO
Classroom Presentation by Instructor/Lecturer				
Classroom Presentation by Audiovisual Mechanisms without Instructor/Lecturer				
Computer-Based Instruction				
Practical Performance Test				
Other (specify):				
Other:				
Other:				

9. In the chart below is a general list of technical elements that might be included in an HPT or an AO training program. All of these elements may not be appropriate for each facility. Please check only those elements which are included in the formal training program for HPTs or AOs in your organization. **Attach course descriptions and course outlines.**

Technical Elements	**HPT**	**AO**
Basic Math		
Basic Nuclear Physics		
Radiation Protection Standards, Guides, and Limits		
National/International Organizations (e.g., ICRP, NCRP)		
Biological Effects of Radiation		
Basic Units and Terminology		
Fundamentals of Bioassay		
Fundamentals of Detection		
Respirator Use, Test, and Maintenance		
Protective Clothing		
Personnel Contamination Assessment		
Air Sampling Technology		
Surface Contamination Assessment		
Dose/Stay-Time Calculation		
Radioactive Source Control		
Shielding		
Decontamination Methodology		
Personnel Dosimetry		
Alpha Monitoring		
Beta, Gamma Monitoring		
Neutron Monitoring		
Instrumentation (e.g., testing, maintenance and calibration of portable survey equipment)		
Standardization and Application of Lab Counting Equipment		
Plant Radiation Safety Policies and Procedures		
On-Site Emergency Preparedness		
Off-Site Emergency Preparedness		
Criticality Safety		
ALARA		
Recordkeeping		
Waste Management		
Posting and Labeling		
Other (specify):		
Other:		
Other:		

10. What textboods or similar publications do you use in your formal HPT and AO training programs?

HPT: ______________________________

____

____

____

AO: ______________________________

____

____

____

11. Indicate in the chart below those facilities and equipment in your organization reserved exclusively for HPT and/or AO training programs, and those not reserved exclusively but available for training purposes.

	Reserved Exclusively for Training		Available for Training	
	HPT	AO	HPT	AO
Training Room				
Glove Box				
Respirator				
Protective Clothing				
Radiation Survey Instruments				
Hood				
Air Sampling/ Monitoring Equipment				
Mockups of Specialized Facilities or Equipment (specify):				

12. Use the chart below to describe staffing for formal HPT and AO training in your organization.

Source of Instructors	Number of Full-Time Instructors		Number of Part-Time Instructors		Qualifications Required of Instructors (e.g., Education, Experience)	
	HPT	AO	HPT	AO	HPT	AO
In-House Instructors						
Outside Consultants						

Names of firm or individual consultants: ______________________________

____

____

13. Indicate by a check which of the following testing procedures are used to verify the effectiveness of formal HPT and/or AO training.

Testing Procedure	HPT	AO
Oral		
Written	minimum passing score: ______	minimum passing score: ______
Practical Performance Test		
Other (specify):		
Other:		
No Formal Testing Procedure		

14. Written records of test results are:

	HPTs	AOs
Available in individual's personnel file	______	______
Available in individual's training file	______	______
Available in collective training files	______	______
Not available	______	______

15. Records of test results are maintained for a period of:

	HPTs	AOs
Less than 6 Months	____	____
6 Months–1 Year	____	____
1-2 Years	____	____
2-5 Years	____	____
6-7 Years	____	____
More than 7 Years	____	____

16. Is job assignment dependent upon satisfactory completion of the test?

Job Classification	**Yes**	**No**
HPTs		
AOs		

17. Are trainees advised prior to taking the test what constitutes satisfactory performance on the test?

	HPTs	AOs
Orally		
In Writing		
Not Advised		

18. Indicate by a check where applicable procedures followed for employees who fail the formal test.

	HPTs	**AOs**
Retrain and Retest	(number of retests allowed:)	(number of retests allowed:)
Retest Only	(number of retests allowed:)	(number of retests allowed:)
Reassign		
Other (specify):		
Other:		
Other:		
No Uniform Procedure		

19. Use the chart below to describe programs in your organization to retrain or update job skills of HPTs and AOs.

Type of Program	**Length (in hours)**		**Number of Times Conducted Per Year**		**Mandatory Participation for All HPTs and AOs**		**Reasons for Exemption**
	HPT	**AO**	**HPT**	**AO**	**HPT**	**AO**	
Formal							
Informal							

____ Not applicable: no program

20. Indicate the radiation safety training budget in your organization for the following fiscal years (estimate or approximate).

FY 1980	FY 1981	FY 1982	FY 1983
____	____	____	____

21. Indicate in the chart below your organization's involvement with the National Registry of Radiation Protection Technologists (NRRPT).

	HPT		AO	
Number of Employees Certified by NRRPT				
Number of Employees Who Have Taken NRRPT Exam				
Organizational Support for NRRPT Registration	Yes	No	Yes	No
Funding application/exam fees				
Funding travel to exam location				
Allowing paid work time for exam				
Allowing paid work time for exam preparation				
Funding specialized training specific to NRRPT exam preparation				

PART III. RADIATION SAFETY TRAINING FOR SUPPORT SERVICES TECHNICIANS AND RADIATION SAFETY WORKERS

22. Please check the appropriate spaces in the chart below to describe training in your organization for support service technicians and radiation workers (refer to Page 1 for definition of job classifications). **Attach course descriptions and course outlines.**

Program Characteristics	Support Service Technicians	Radiation Workers
Type of Program		
Formal		
Informal (OJT)		
No training program		
Nature of Training		
Specific to support service task		X
Specific to support service task in conjunction with general radiation safety training		X
Training Instructors		
In-house		
Technical training staff (e.g., health physics)		
Nontechnical training staff (e.g., personnel)		
Line supervisors		
Other (specify):		
Other:		
Other:		
Outside consultants		
Duration of Program (in hours)		

PART IV. GENERAL COMMENTS

This questionnaire focused on documenting the scope of radiation safety training activities within the DOE contractor system. In addition to the specific information requested, DOE welcomes any comments or suggestions you may have regarding necessary and appropriate training to ensure effective performance of the radiation safety function in DOE facilities.

23. Generally, what is your experience with radiation safety training efforts? Is training appropriate to the tasks assigned health physics technicians and other radiation safety personnel? How do HPTs perform in formal versus informal training programs? What do you see as the essential elements of a good radiation safety training program?

24. From your perspective, what are the current trends in radiation safety training? Please comment on methods, quality, and frequency of training.

Please attach and return with questionnaire:

1. **Job descriptions for health physics technicians**
2. **Course descriptions and course outlines for health physics technician training programs**
3. **Course descriptions and course outlines for assigned operator training programs**
4. **Course descriptions and course outlines for support service technician training programs**
5. **Course descriptions and course outlines for radiation worker training.**

APPENDIX C

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE BY JOB CATEGORY AND INDIVIDUAL FACILITY, FY 1980-1983

Facility	FY 1980					FY 1981					FY 1982					FY 1983				
	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Total Workforce	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Total Workforce	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Total Workforce	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Total Workforce
17	29		4	1806	4898	29		4	1715	4919	23		2	1550	4287	20		1	1520	4012
25	29			420	712	29			390	661	27			388	658	26			395	669
5		3	3	146	526		1.5	3	105	392		.5	3	83	346		.5	3	92	321
20	18		10	2431	3631	18		10	2447	3372	18		10	2326	3237	18		10	2166	3289
29	3			22	1740	4			23	1830	4			32	2040	4			32	2160
24	12		5	440	1900	12		5	451	1932	12		5	436	1916	10		5	432	1953
16	2				500	2				500	1				500	1				500
9	1		2	370	1500	1		2	380	1600	1		2	390	1800	1	1	2	400	1875
13	15	114	26	995	3117	23	116	30	1255	3253	23	112	29	599	3245	18	111	28	500	3057
30	38			1239	3586	40			1110	3208	33			948	264	29			836	2229
4	33		3	762	874	34		3	855	953	34		6	926	1018	31		6	750	1083

APPENDIX C (Continued)

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE BY JOB CATEGORY AND INDIVIDUAL FACILITY, FY 1980-1983

	FY 1980					FY 1981					FY 1982					FY 1983				
Facility	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Total Workforce	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Total Workforce	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Total Workforce	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Total Workforce
23	40		2	1128	4024	45		2	1366	4217	38		2	1392	3730	41		2	1309	3617
34	2			13	230	2			15	240	2			11	220	1			9	200
27	15		12	1850	2817	15		11	1922	2905	12		11	1769	2592	12		10	1512	2552
32		38	8.5	7100	7109		38	9.5	7400	7400		37	10.5	7600	7662		37	10.5	7600	7608
19	76		11	4555	6950	85		15	4750	7296	95		16	4725	7079	95		15	4740	7007
12	22		10	140	1811	23		11	142	1912	21		11	150	2060	32		12	170	2042
6		1		563	563		3		618	618		4		262	777		4		265	786
33	11		1	102	432	9		2	126	389	11		2	184	409	12		3	102	424
2	7		4	420	5979	7		4	415	5153	7		4	348	4363	7		3	274	4352
21	44		19	846	5882	43		1	823	5611	40		16	780	5138	39		15	740	5134
8	12			268	5950	12			314	6380	10			357	6750	13			367	6900

APPENDIX C (Continued)

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE BY JOB CATEGORY AND INDIVIDUAL FACILITY, FY 1980-1983

Facility	FY 1980					FY 1981					FY 1982					FY 1983				
	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Total Workforce	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Total Workforce	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Total Workforce	Health Physics Technicians	Assigned Operators	Support Service Technicians	Radiation Workers	Total Workforce
28	28			997	2551	25			950	2680	21			895	2627	21			840	2545
14	1	90	6	456	1936	1	85	6	330	1621	1	80	35	247	1410	1	80	6	248	1380
7	2	115		800	2223	2	120		900	2306	3	130		950	2517	3	134		950	2582
1	59		23	75	3223	61		24	75	4009	66		25	75	4453	62		26	75	4612
11	84	294	24	1400	3700	94	277	35	1450	3800	107	348	66	1600	4100	112	432	97	2096	4350
18	9	8		300	2150	6	6		300	2126	5	5		300	1915	5	3		300	1500
15	94		32	2566	3418	98		32	2886	3848	115		34	3377	4502	137		35	4500	5181
26	7	1	3	1250	7661	6	1	3	1395	7923	6	1	3	1380	7941	6	1	3	1450	7990
10	120		43	2682	7019	119		50	3686	7820	135		49	3834	8273	147		50	4012	8600
31	5	62		200	1400	5	62		200	1400	4	62		200	1400	4	62		200	1400
3	31			659	1086	41			986	1325	38			1357	1546	39			859	1568
22	4			20	50	4			20	50	5			30	50	12	14		130	145

APPENDIX D

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE BY JOB CATEGORY AND FACILITY FUNCTION, FY 1980-1983

	Number Employed															
	FY80				FY81				FY82				FY83			
Function	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW
Reactors	117	0	4	2817	129	0	4	3258	124	0	4	3079	131	0	3	3061
Fuel fabrication	44	1	0	1073	46	3	0	1082	40	4	0	818	38	4	0	729
Fuel reprocessing	125	18	7	1692	127	31	15	2350	144	90	36	2740	128	118	47	2703
Fuel enrichment	25	204	36	1871	33	201	40	2000	32	192	68	1194	27	191	37	1022
Weapons fabrication	108	115	34	4004	112	120	34	4480	128	130	36	5074	153	135	37	6217
Weapons testing/ research	75	6	35	2696	77	6	36	2859	82	6	38	2923	79	6	39	3073
Waste processing/ management	94	281	11	1653	101	251	13	1689	110	263	14	1818	136	333	14	2019
Radiochemical materials development	78	5	17	3674	83	5	19	3697	82	5	19	3369	85	5	18	3194
Accelerators	46	65	14	2589	49	65	13	2609	48	65	13	2578	45	65	13	2574
General R&D	88	6	33	6627	88	6	32	6651	79	6	31	6414	89	6	31	5787
Other[a]	52	25	63	8465	51	22	73	9241	49	19	84	9684	48	18	105	9657
Total in category	852	726	254	37161	986	710	279	39916	918	780	343	39691	959	881	344	40036
Total workforce	101,148				103,649				103,205				103,623			

[a]Includes personnel reported on original survey forms as "x-ray" and "office or administrative."
HPT = Health Physics Technicians AO = Assigned Operators
RW = Radiation Workers TW = Total Workforce

APPENDIX E

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE BY JOB CATEGORY AND FACILITY FUNCTION IN FACILITIES WITH FORMAL TRAINING PROGRAMS, FY 1980-1983

Function	Number Employed															
	FY80				FY81				FY82				FY83			
	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW
Reactors	110	o	2	2545	122	0	2	3000	117	0	2	2815	124	0	2	2793
Fuel fabrication	44	1	o	1073	46	3	0	1082	40	4	0	818	38	4	0	729
Fuel reprocessing	125	18	7	1692	127	31	15	2350	144	90	36	2740	128	118	47	2703
Fuel enrichment	24	114	30	1415	32	116	34	1670	31	112	33	947	26	111	31	774
Weapon fabrication	96	115	32	3366	100	120	32	3786	118	130	34	4327	140	134	35	5450
Weapons testing/ research	72	6	35	2674	73	6	36	2836	78	6	38	2891	75	6	39	3041
Waste processing/ management	90	281	11	1569	97	251	12	1603	105	263	13	1729	128	333	13	1930
Radiochemical materials development	66	5	17	3434	72	5	19	3457	72	5	19	3144	75	5	18	2994
Accelerators	34	3	12	1565	37	3	11	1499	37	3	11	1567	35	3	11	1459
General R&D	63	6	8	4830	63	6	10	4935	56	6	10	4757	65	6	11	4413
Other[a]	34	25	62	8303	35	22	71	9055	31	19	82	9440	19	18	102	9495
Total in category	758	574	216	32466	804	563	242	35273	829	638	278	35175	863	738	309	35781
Total workforce	78,677				81,446				81,021				81,061			

[a]Includes personnel reported on original survey forms as "x-ray" and "office or administrative."
HPT = Health Physics Technicians AO = Assigned Operators
RW = Radiation Workers TW = Total Workforce

APPENDIX F

TECHNICIAN LEVEL RADIATION PROTECTION WORKFORCE BY JOB CATEGORY AND FACILITY FUNCTION IN FACILITIES WITHOUT FORMAL TRAINING PROGRAMS, FY 1980-1983

	Number Employed															
	FY80				FY81				FY82				FY83			
Function	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW
Reactor	7	0	2	272	7	0	2	258	7	0	2	264	7	0	1	268
Fuel fabrication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fuel reprocessing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fuel enrichment	1	90	6	456	1	85	6	330	1	80	35	247	1	80	6	248
Weapons fabrication	12	o	2	638	12	0	2	694	10	0	2	747	13	1	2	767
Weapons testing/ research	3	0	0	22	4	0	0	23	4	0	0	32	4	0	0	32
Waste processing/ management	5	0	1	84	5	0	1	86	5	0	1	89	5	0	1	89
Radiochemical materials development	12	0	0	240	11	0	0	240	11	0	0	225	11	0	0	200
Accelerators	12	62	2	1024	12	62	2	1110	11	62	2	1011	10	62	2	1115
General R&D	25	0	25	1797	25	0	23	1716	23	0	22	1657	24	0	21	1374
Other[a]	18	0	1	162	16	0	2	186	18	0	2	244	20	0	3	162
Total in category	95	152	39	4695	93	147	3	4643	90	142	66	4516	95	143	36	4255
Total workforce	22,471				22,203				22,184				22,562			

[a]Includes personnel reported on original survey forms as "x-ray" and "office or administrative."
HPT = Health Physics Technicians AO = Assigned Operators
RW = Radiation Workers TW = Total Workforce

APPENDIX G

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE BY JOB CATEGORY AND FACILITY FUNCTION, BY INDIVIDUAL FACILITY FY 1980-1983

Function/ Facility	FY80				FY81				FY82				FY83			
	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW
Reactors																
Facility 17	2		.6	97	2		.6	67	2		.3	63	1		0	42
Facility 25	29			420	29			420	27			388	26			395
Facility 20[a]	3		2	197	3		2	183	3		2	189	3		1	193
Facility 30				500				500				400				350
Facility 23	24			569	26			616	23			549	23			569
Facility 19	2		<1	20	2		<1	20	2		<1	15	2		<1	15
Facility 21[a]	4			75	4			75	3.5			75	3.5	.5		37.5
Facility 18	1			37.5	.7			37.5	.5			37.5	.5			37.5
Facility 26	4		1.5	60	4		1.5	55	4		1.5	60	4		1.5	55
Facility 10	22			735	22			1125	26			1099	34			1165
Facility 3	26			106	36			159	32			203	33			164
Total in category	117	0	4	2817	129	0	4	3258	123	0	4	3079	130	0	3	3061

[a]Facility does not require formal in-house training for HPTs or AOs.
HPT = Health Physics Technicians AO = Assigned Operators
RW = Radiation Workers TW = Total Workforce

APPENDIX G (Continued)

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE BY JOB CATEGORY AND FACILITY FUNCTION, BY INDIVIDUAL FACILITY FY 1980-1983

Function/ Facility	FY80				FY81				FY82				FY83			
	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW
Fuel <u>Fabrication</u>																
Facility 30	38			150	40			110	33			100	29			100
Facility 19	1		<1	10	1		<1	10	1		<1	15	1		<1	20
Facility 6		1		563		3		618		4	262	777	4	265	786	
Facility 18	1			37.5	.7			37.5	.5			37.5	.5			37.5
Facility 10	3			282	3			277	3			355	5			269
Facility 3	1			29	1			29	2			48	2			37
Total	44	1	0	1073	46	3	0	1082	40	4	0	818	38	4	0	729
Fuel <u>Reprocessing</u>																
Facility 4	28		3	714	29		3	807	33		6	876	25		6	698
Facility 11	15	18	4	74	16	31	12	118	18	90	30	276	22	118	41	327
Facility 10	74			842	74			1381	84			1491	79			1660
Facility 3	4			42	4			42	4			67	4			18
Facility 22	4			20	4			20	5			30				
Total	125	18	7	1692	127	31	15	2368	144	90	36	2740	130	118	47	2703

APPENDIX G (Continued)

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE
BY JOB CATEGORY AND FACILITY FUNCTION, BY INDIVIDUAL FACILITY
FY 1980-1983

Function/ Facility	FY80				FY81				FY82				FY83			
	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW
Fuel Enrichment																
Facility 16	2				2				1				1			
Facility 13	15	114	26	995	23	116	30	1255	23	112	29	599	18	111	28	500
Facility 2	7		4	420	7		4	415	7		4	348	7		3	274
Facility 14[a]	1	90	6	456	1	85	6	330	1	80	35	247	1	80	6	248
Total	25	204	36	1871	33	201	40	2000	32	192	68	1194	27	191	37	1022
Weapons Fabrication																
Facility 9[a]	1		2	370	1		2	380	1		2	390	1	1	2	400
Facility 8[a]	11			268	11			314	9			357	11.5			367
Facility 7	115		800	2	120		900	3	130		950	3	134		950	
Facility 15	94		32	2566	98		32	2886	115		34	3377	137		35	4500
Total	108	115	34	4004	112	120	34	4480	128	130	36	5074	153	135	37	6217

[a]Facility does not require formal in-house training for HPTs or AOs.

APPENDIX G (Continued)

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE
BY JOB CATEGORY AND FACILITY FUNCTION, BY INDIVIDUAL FACILITY
FY 1980-1983

Function/ Facility	FY80				FY81				FY82				FY83			
	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW
Weapons Testing Research																
Facility 29	3			22	4			23	4			32	4			32
Facility 32		5	6	850		5	6	860		4.75	7	875		4.75	7	900
Facility 19	10		1	500	10		1	500	11		1	550	12		1	600
Facility 12	3		3.3	59	3		3.3	61	3		3.1	71	3		3.3	71
Facility 1	56		23	75	58		24	75	62		25	75	58		26	75
Facility 26	3	1	1.5	1190	2	1	1.5	1340	2	1	1.5	1320	2	1	1.5	1395
Total	75	6	35	2696	77	6	36	2859	82	6	38	2923	79	6	39	3073
Waste Processing Management																
Facility 20[a]	.5		.5	14	.5		.5	14	.5		.5	14	.5		.5	14
Facility 4	5			48	5			41	1			50	6			52
Facility 23	3			17	3			18	3			14	3			20

[a]Facility does not require formal in-house training for HPTs or AOs.

APPENDIX G (Continued)

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE BY JOB CATEGORY AND FACILITY FUNCTION, BY INDIVIDUAL FACILITY FY 1980-1983

Function/ Facility	FY80				FY81				FY82				FY83			
	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW
Facility 27	3			396	3			411	3			482	3			412
Facility 32		5	.5	8		5	.5	10		4.75	.7	13		4.75	.7	18
Facility 19	4		<1	60	4		<1	60	5		<1	70	5		<1	75
Facility 12	2.7		.2	22	2.7		.2	22	2.7		.2	22	3.7		.2	22
Facility 21[a]	4			70	4			72	4			75	4			75
Facility 1	3				3				3				3			
Facility 11	59	276	10	690	66	246	11	646	77	258	12	694	79	314	12	810
Facility 18	1			37.5	.7			37.5	.5			37.5	.5			37.5
Facility 10	9			290	9			350	10			346	16			353
Facility 22													12	14		130
Total	94	281	11	1653	101	251	13	1689	110	263	14	1818	136	333	14	2019

[a]Facility does not require formal in-house training for HPTs or AOs.

APPENDIX G (Continued)

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE BY JOB CATEGORY AND FACILITY FUNCTION, BY INDIVIDUAL FACILITY FY 1980-1983

Function/ Facility	FY80				FY81				FY82				FY83			
	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW
Radiochemical Materials Development																
Facility 30				589				500				448				386
Facility 23	12				15				11				14			
Facility 27	9		8	1190	9		8		1236	6	8	965	6		7	825
Facility 32		5	.5	385		5	.5	380		4.75	.7	380		4.75	.7	380
Facility 19	32		8	700	36		10	750	42		10	750	41		10	800
Facility 21[a]	12			240	11			240	10.5			225	10			200
Facility 18	1			37.5	.7			37.5	.5			37.5	.5			37.5
Facility 10	12			532	11			553	12			563	13			565
Total	78	5	17	3674	83	.5	19	3697	82	5	19	3369	85	5	18	3194

[a]Facility does not require formal in-house training for HPTs or AOs.

APPENDIX G (Continued)

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE
BY JOB CATEGORY AND FACILITY FUNCTION, BY INDIVIDUAL FACILITY
FY 1980-1983

Function/ Facility	FY80				FY81				FY82				FY83			
	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW
Accelerators																
Facility 17	6		.6	486	6		.6	370	6		.2	399	5			322
Facility 20[a]	6		2	798	6		2	884	6		2	781	5		2	885
Facility 24	12		5	440	12		5	451	12		5	436	10		5	432
Facility 27	2		4	264	2		3	275	2		3	322	2		3	275
Facility 32		3	.5	25		3	.5	28		3	.7	35		3	.7	30
Facility 19	14		2	350	17		2	375	17		2	375	18		2	400
Facility 21[a]	1.25			26	1.25			26	1.25			30	1.25			30
Facility 31[a]	5	62		200	5	62		200	4	62		200	4	62		200
Total	46	65	14	2589	49	65	13	2609	48	65	13	2578	45	65	13	2574

[a]Facility does not require formal in-house training for HPTs or AOs.

APPENDIX G (Continued)

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE
BY JOB CATEGORY AND FACILITY FUNCTION, BY INDIVIDUAL FACILITY
FY 1980-1983

Function/ Facility	FY80				FY81				FY82				FY83			
	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW
General Research & Development																
Facility 17	11		1.2	807	11		1.2	787	8		.4	730	9		0	553
Facility 20[a]	8.5		5.5	1422	8.5		5.5	1366	8.5		5.5	1342	9.5		5.5	1074
Facility 34	2			13	2			15	2			11	1			9
Facility 32		6		700		6		750		6		800		6		800
Facility 19	5		1	220	7		1	2340	9		2	2230	8		2	2100
Facility 12	16.6		6.5	55	17.6		7.5	55	15.6		7.5	53	25.6		8.5	73
Facility 21[a]	16.5		19	375	16.5		17	350	14.5		16	315	14		15	300
Facility 28	28			997	25			950	21			895	21			840
Facility 18	1			37.5	.7			37.5	.5			37.5	.5			37.5
Total	88	6	33	6627	88	6	32	6651	79	6	31	6414	89	6	31	5787

[a]Facility does not require formal in-house training for HPTs or AOs.

APPENDIX G (Continued)

TECHNICIAN-LEVEL RADIATION PROTECTION WORKFORCE
BY JOB CATEGORY AND FACILITY FUNCTION, BY INDIVIDUAL FACILITY
FY 1980-1983

Function/ Facility	FY80				FY81				FY82				FY83			
	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW	HPT	AO	SST	RW
Other																
Facility 17	10		1.6	416	10		1.6	491	7		1.2	358	5		1	603
Facility 5		3	3	146		1.5	3	105		.5	3	83		.5	3	92
Facility 23	1		2	542	1		2	732	1		2	829	1		2	720
Facility 32		14	1	5183		14	1	5399		13.75	1.4	5595		14.75	1.4	5575
Facility 19	8		1	695	8		1	695	8		1	720	8		1	730
Facility 33[a]	11		1	102	9		2	126	11		2	184	12		3	102
Facility 21[a]	6.25			60	6.25			60	6.25			60	6.25			60
Facility 8[a]	1				1				1				1.5			
Facility 28				66				78				73				62
Facility 11	10		10	636	12		12	686	12		24	630	11		44	959
Facility 18	4	8		113	2.8	6		113	2	5		113	2	3		113
Facility 10			43				50				49				50	
Facility 3				506				756				1039				641
Total	52	25	63	8465	51	22	73	9241	49	19	84	9684	48	18	105	9657

[a]Facility does not require formal in-house training for HPTs or AOs.

APPENDIX H

RATIOS OF HEALTH PHYSICS TECHNICIANS AND ASSIGNED OPERATORS TO RADIATION WORKERS AND TOTAL WORKFORCE, BY FACILITY, FY 1983

Facility	Number of HPTs	HPT:RW	HPT:TW	Number of AOs	AO:RW	AO:TW
Facility 17	20	1: 76	1: 201			
Facility 25	26	1: 15	1: 26			
Facility 5				1	1: 92	1: 642
Facility 20	18	1:118	1: 183			
Facility 29	4	1: 8	1: 540			
Facility 24	10	1: 43	1: 195			
Facility 16	1	1: 1	1: 500			
Facility 9	1	1:400	1:1875	1	1: 400	1:1875
Facility 13	18	1: 28	1: 170	111	1: 5	1: 28
Facility 30	29	1: 29	1: 77			
Facility 4	31	1: 24	1: 35			
Facility 23	41	1: 32	1: 88			
Facility 34	1	1: 9	1: 200			
Facility 27	12	1:126	1: 213			
Facility 32				37	1: 205	1: 206
Facility 19	95	1: 50	1: 74			
Facility 12	32	1: 5	1: 64			
Facility 6				4	1: 66	1: 197
Facility 33	12	1: 9	1: 35			
Facility 2	7	1: 39	1: 622			
Facility 21	39	1: 19	1: 132			
Facility 8	13	1: 28	1: 531			
Facility 28	21	1: 39	1: 121			
Facility 14	1	1:248	1:1380	80	1: 3	1: 17
Facility 7	3	1:317	1: 861	134	1: 7	1: 19
Facility 1	62	1: 1	1: 74			
Facility 11	112	1: 19	1: 3	432	1: 5	1: 10
Facility 18	5	1: 60	1: 300	3	1: 100	1: 500
Facility 15	137	1: 33	1: 38			
Facility 26	6	1:242	1:1332	1	1:1450	1:7990
Facility 10	147	1: 27	1: 59			
Facility 31	4	1: 50	1: 350	62	1: 2	1: 23
Facility 3	39	1: 26	1: 40			
Facility 22	12	1: 11	1: 12	14	1: 9	1: 10

[a]Facility does not require formal in-house training for health physics technicians or assigned operators.

HPT = Health Physics Technicians — RW = Radiation Workers

AO = Assigned Operators — TW = Total Workforce

APPENDIX I

FORMAL TRAINING REQUIREMENTS FOR HEALTH PHYSICS TECHNICIANS AND ASSIGNED OPERATORS, BY FACILITY

Facility	Health Physics Technicians: Formal In-House Training is Required	Health Physics Technicians: Formal Training Is Required Prior to Job Assignment	Health Physics Technicians: Exemptions From Formal Training May Be Granted	Assigned Operators: Formal In-House Training Is Required	Assigned Operators: Formal Training is Required Prior to Job Assignment	Assigned Operators: Exemptions From Formal Training May Be Granted
Facility 17	X		X	NA[a]	NA	NA
Facility 25	X	X		NA	NA	NA
Facility 5	NA	NA	NA	X		
Facility 20				NA	NA	NA
Facility 29				NA	NA	NA
Facility 24	X			NA	NA	NA
Facility 16	X			NA	NA	NA
Facility 9						
Facility 13	X	X		X		
Facility 30	X	X		NA	NA	NA
Facility 4	X	X	X	NA	NA	NA
Facility 23	X	X	X	NA	NA	NA
Facility 34	X			NA	NA	NA
Facility 27	X			NA	NA	NA
Facility 32	NA	NA	NA	X		
Facility 19	X		X	NA	NA	NA
Facility 12	X			NA	NA	NA
Facility 6	NA	NA	NA	X		
Facility 33				NA	NA	NA
Facility 2	X	X	X	NA	NA	NA
Facility 21				NA	NA	NA
Facility 8				NA	NA	NA
Facility 28	X	X		NA	NA	NA
Facility 14						
Facility 7	X[b]			X[b]		
Facility 1	X	X		NA	NA	NA
Facility 11	X			X	X	
Facility 18	X	X		X	X	
Facility 15	X	X		NA	NA	NA
Facility 26	X	X		X		
Facility 10	X	X		NA	NA	NA
Facility 31						
Facility 3	X			NA	NA	NA
Facility 22	X	X		NA	NA	NA

[a]NA = not applicable; facility does not have personnel in job category.

[b]Formal training for HPTs is through two-week university radiation protection short course; formal training for AOs is in-house.

APPENDIX J

TRAINING REQUIREMENTS FOR ENTRY-LEVEL HEALTH PHYSICS TECHNICIANS BY FACILITY

Entry-Level Requirements	Class Time in Total Hours	Lab/Demonstration Time in Total Hours
None		
Facility 4	96	0
Facility 19	0	0
Facility 28	1000	1000
Facility 9[a]		
Satisfactory score on entrance exam		
Facility 10	140	140
High school diploma of equivalent		
Facility 24	0	0
Facility 23	40	6
Facility 11	40	60
Facility 3	480	OJT
High school diploma with some math or science		
Facility 2	36	4
Facility 12	40	OJT
Facility 5	72	40
Facility 8	1[b]	OJT
Facility 22	3 month self-study	960
Facility 8[a]		
Facility 21[a]		
High school and voc/tech or equivalent experience		
Facility 25	60	40
Facility 13	40	0
Facility 30	138	40
Facility 27	15	100
Facility 1	0	0
Facility 26	24	0
Facility 29[a]		
Facility 33[a]		
Facility 31[a]		
Some college		
Facility 16	100	40
Facility 7[c]		
Two years college or equivalent experience		
Facility 17	60	40
Facility 20[a]		
Facility 14[a]		
Bachelor's degree or equivalent experience		
Facility 34	self-study	

[a]Facility does not require formal training.
[b]Facility 18 reported that additional training is required as needed.
[c]HPTs at Facility 7 complete a 2-week university short course.

APPENDIX K

JOB TITLES, ENTRY-LEVEL REQUIREMENTS, AND TRAINING HOURS REQUIRED OF HEALTH PHYSICS TECHNICIANS IN FACILITIES WITH FORMAL TRAINING PROGRAMS, BY FACILITY

Facility/Job Title	Entry-Level Requirements	Class Time in Hours	Lab/Demonstration Time in Hours
Facility 17			
Health Physics Technician II	2 years college or equivalent experience	60	40
Health Physics Technician III	2 years college or equivalent experience	60	40
Health Physics Technician Senior	2 years of college + 3 years health physics experience, or 5 years HP experience	60	40
Facility 25			
Technician II	High school + vocational/technical school, or 2 years of college	60	40
Technician III	2 years of college or equivalent + 1-2 years experience	0	0
Technician, Senior	2 years of college or equivalent + 3-4 years experience, or 5 years experience		
Technician, Chief	10 years experience		
Facility 24			
Lab Assistant	High school diploma		
Technician I	High school diploma + 2 years experience	100	0
Technician II	Associate of science degree + 2 years experience, or equivalent		
Senior Technician	Associate of science degree + 5 years experience, or equivalent		
Facility 16			
Health Technician	High school, some college; math, science background	100	40

APPENDIX K (Continued)

JOB TITLES, ENTRY-LEVEL REQUIREMENTS, AND TRAINING HOURS REQUIRED OF HEALTH PHYSICS TECHNICIANS IN FACILITIES WITH FORMAL TRAINING PROGRAMS, BY FACILITY

Facility/Job Title	Entry-Level Requirements	Class Time in Hours	Lab/Demonstration Time in Hours
Facility 13			
Environmental Surveyor I	2 years vocational/technical school, or equivalent relevant experience	40	0
Environmental Surveyor II	Above, + several years experience as Environmental Surveyor II		
Environmental Surveyor III	Above, + several years experience as Environmental Surveyor II		
Facility 30			
Junior Radiation Protection Technologist	>.06 months experience + formal training	138	40
Radiation Protection Technologist	>1.5 years experience + formal training	140	200
Senior Radiation Protection Technologist	>3 years experience + formal training	150	200
Facility 4			
Trainee D	none	96	0
Trainee C	2 years as Trainee D	60	0
Trainee B	6 months as Trainee C	60	0
Trainee A	6 months as Trainee B	60	0
Senior Technician C	6 months as Trainee A + qualification	25	0
Senior Technician B	1 year as Senior Technician C	25	0
Senior Technician A	1 years as Senior Technician B	25	0
Specialist B	1 years as Senior Technician A + certification	25	0
Specialist A	1 years as Specialist B	0	0
Facility 23			
Associate Support Technician I	High school diploma or equivalent	40	6
Associate Support Technician II	High school diploma + 1 year experience	50	8
Support Technician	High school diploma + 2 years experience	60	10
Senior Support Technician	High school + 3 years experience	70	10
Master Support Technician	High school + 7 years experience	80	12

JOB TITLES, ENTRY-LEVEL REQUIREMENTS, AND TRAINING HOURS REQUIRED OF HEALTH PHYSICS TECHNICIANS IN FACILITIES WITH FORMAL TRAINING PROGRAMS, BY FACILITY

Facility/Job Title	Entry-Level Requirements	Class Time in Hours	Lab/Demonstration Time in Hours
Facility 34			
Senior Research Technologist	Bachelor of science, or relevant experience	self-study	
Facility 27			
Health Safety Technologist Level 1	2 years of technical college or equivalent + LBL training course	15	100
Health Safety Technologist Level 2	2 years experience + LBL certification	24	50
Health Safety Technologist Level 3	3 additional years experience + proven field ability	24	0
Health Safety Technologist Level 4	Qualified to instruct + proven ability to work independently	0	0
Facility 19			
Health Protection Technician TEC I	None	0	0
Health Protection Technician TEC II	Associate degree or 2 years experience	12	0
Health Protection Technician TEC III	5 years experience		
Health Protection Technician TEC IV	>10 years experience		
Facility 12			
Health Physics Surveyor D Level 5	1 year of college or high school science or math	40	OJT
Health Physics Surveyor C Level 6	1 year of college or high school science or math	40	OJT
Health Physics Surveyor B Level 7	1 year of college + 1 year experience, or high school + 1 year experience	40	OJT
Health Physics Surveyor A Level 8	1 year of college + 4 years experience, or high school + 4 years experience	40	OJT
Health Physics Technician I Level 9	3-4 years as Health Physics Surveyor A	40	OJT
Health Physics Technician II Level 10	3-4 years as Health Physics Technician I	40	OJT
Facility 2			
Health Physics Technician	High school, with math & science	36	4
Senior Health Physics Technician	High school, with math & science		
Health Physics Technologist	Some chemistry, physics, math, or life sciences		

APPENDIX K (Continued)

JOB TITLES, ENTRY-LEVEL REQUIREMENTS, AND TRAINING HOURS REQUIRED
OF HEALTH PHYSICS TECHNICIANS IN FACILITIES WITH FORMAL TRAINING PROGRAMS, BY FACILITY

Facility/Job Title	Entry-Level Requirements	Class Time in Hours	Lab/Demonstration Time in Hours
Facility 28			
Radiation Protection Technologist Trainee	none	1000	1000
Radiation Protection Technologist	High school diploma	40/yr	8/yr
Facility 7			
Chemical Technician	12 hours college credit in science + 6 hours college credit in math	*	*
Facility 1			
Radiation Instrument Technologist	High school diploma or equivalent + residence electronics school + 1 year experience		
Radiation Safety Monitor	2 years experience or equivalent, or 2 years of college with basic sciences + successful completion of monitors employment aptitude test	80	
Laboratory Technician	2 years experience or equivalent, or 2 years of college in basic science which involved laboratory work		
Facility 11			
Radiological Protection Trainee	High school diploma or equivalent	40	60
Junior Radiation Protection Technologist	High school diploma or equivalent or military or vocational/technical training + 6 months experience	170	90
Radiation Protection Technologist	Same as above + 1-2 years experience	160	175
Senior Radiation Protection Technologist	Same as above + 4 years experience	176	75

* HPTs at Facility 7 complete a 2-week university short course.

APPENDIX K (Continued)

JOB TITLES, ENTRY-LEVEL REQUIREMENTS, AND TRAINING HOURS REQUIRED
OF HEALTH PHYSICS TECHNICIANS IN FACILITIES WITH FORMAL TRAINING PROGRAMS, BY FACILITY

Facility/Job Title	Entry-Level Requirements	Class Time in Hours	Lab/Demonstration Time in Hours
Facility 18			
Health Physics Assistant	High school diploma + facility with numbers and instrumentation	1+ as needed	OJT
Health Physics Associate	2 years of college or equivalent experience	1+ as needed	OJT
Health Safety Representative	Same as above + 2 years experience	1+ as needed	OJT
Health Safety Assistant	Bachelor of science degree or equivalent experience + 2 years experience	1+ as needed	OJT
Facility 15			
Radiation Monitor	High school diploma, with math and physical science	72	40
Facility 26			
Engineering Science Assistant (Entry)	Vocational/technical degree, or equivalent in academic education and experience	24	
Engineering & Science Assistant (Level I)	Same as above		
Engineering & Science Assistant (Level II)	Same as above + extensive experience		
Facility 10			
Health Protection Technician	Satisfactory score on lab tech entry test	140	140
Facility 3			
Radiation & Chemical Technician	High school diploma or equivalent	480	OJT
Facility 22			
Radiological Control Technician B	High school diploma with biology, chemistry, physics and math + 12-18 months experience or equivalent	self-study (3 mo.)	960
Radiological Control Technician A	Rad. Control Tech. B + 2 years experience	self-study (3 mo.)	960
Senior Radiological Control Technician	Rad. Control Tech. A + 3 years experience	self-study (30 wks.)	
Radiological Control Specialist	Pass NRRPT exam		

APPENDIX L

JOB TITLES AND ENTRY-LEVEL REQUIREMENTS FOR HEALTH PHYSICS TECHNICIANS IN FACILITIES WITHOUT FORMAL TRAINING PROGRAMS, BY FACILITY

Facility/Job Title	Entry-Level Requirements
Facility 20	
Senior Technician	Associate of science degree or equivalent
Principal Technician	2 years as Senior Technician
Technical Specialist	2 years as Principal Technician
Technical Associate II	Bachelor of science or equivalent
Technical Associate I	Technical (Associate II + experience)
Senior Technical Associate	Technical (Associate I + experience)
Facility 29	
Technologist III	Previous training and experience in health physics or related technical field (e.g., electronics with radiation detection application; x-ray technician)
Technologist	Technologist III + Company experience with increasing responsibility
Facility 9	
Support Aide - Environmental Health	None
Facility 33	
Health Physics Technician (Safety)	High school diploma with math science; special training in radiation-related experience
Health Physics Technician	Associate of science degree in nuclear technology; bachelor's degree in science or high school diploma + training + experience in health physics
Health Physics Technician (Rad. Chem.)	Bachelor of science degree or an equivalent combination of education + experience
Health Physics Technician (Training)	Bachelor of science degree in radiation protection or related field

APPENDIX L (Continued)

JOB TITLES AND ENTRY-LEVEL REQUIREMENTS FOR HEALTH PHYSICS TECHNICIANS IN FACILITIES WITHOUT FORMAL TRAINING PROGRAMS, BY FACILITY

Facility/Job Title	Entry-Level Requirements
Facility 21	
Radiological Safety Technician	High school diploma with math, general science
Senior Radiation Survey Technician	Associate degree or equivalent + basic applied Health Physics training courses
Radiation Survey Technician	Same as above, + be registered as a radiation protection technologist
Health Physicist I	Bachelor of science degree + basic understanding of radiaiton & its detection
Health Physicist II	Same as above, + knowledge of health physics fundamentals
Radiation Protection Specialist	All above, + master of science degree or certification in health physics preferred
Facility 8	
Health Physics Trainee	Knowledge of elementary principles of physics, chemistry, math, or one life science
Health Physics Technician	Same as above, + fundamentals of radiation detection & measurement, sampling techniques
Senior Health Physics Technician	Same as above, + ability to recognize problems, plan investigative action, define correction measures
Health Physics Technologist	Same as above + good verbal & oral communication skills
Facility 14	
Health Physics Technician	2 years college with courses in physical science, or equivalent
Facility 31	
Science & Engineering Technician	Knowledge of radiation detection & measurements, survey techniques
Senior Science and Engineering Technician	Same as above, + use of analytical equipment, statistical analysis; radiation protection standards

APPENDIX M

USE AND EFFECTIVENESS RANKINGS OF TRAINING METHODS EMPLOYED IN FACILITIES WITH FORMAL TRAINING PROGRAMS FOR HEALTH PHYSICS TECHNICIANS

	Methods of Presentation[a]				
Facility	Practical Performance/ Demonstration	Classroom Presentation by Instructor/ Lecturer	Classroom Presentation by Audiovisual Mechanisms without Instructor/Lecturer	Computer-Based Instructor	Self-Study
Facility 17	X	X			
Facility 25	X				
Facility 24	1	2			
Facility 16	1	2	3		
Facility 13	1	2	3		
Facility 30	1	1			2
Facility 4	2	1	3		
Facility 23	2	1	4		3
Facility 34					X
Facility 27	1	2	3		
Facility 19	1	X	1		
Facility 12	1	2			
Facility 2	X	X	2		2
Facility 28	X	X			
Facility 7	X	X			
Facility 1	1	2	3		
Facility 11	1	2			
Facility 18	1	2	3		
Facility 15	2	1			
Facility 26	1	3	2		
Facility 10	1	3	2		
Facility 3	1	2	4	3	
Facility 22	X				X

[a]Number indicates ranking assigned by facility respondent (1 = most effective). "X" indicate that facility uses method, but did not assign rank.

APPENDIX N

USE AND EFFECTIVENESS RANKING OF TRAINING METHODS EMPLOYED IN FACILITIES WITH FORMAL TRAINING PROGRAMS FOR ASSIGNED OPERATORS

Facility	Methods of Presentation[a]		
	Practical Performance Demonstration[b]	Classroom Presentation by Instructor/ Lecturer	Classroom Presentation by Audiovisual Mechanisms without Instructor/Lecturer
Facility 5	X	X	X
Facility 13	1	2	3
Facility 32	1	2	3
Facility 6	1	2	
Facility 7		1	2
Facility 11	1	2	3
Facility 18	1	2	3
Facility 26	1	3	2

[a]Number indicates ranking assigned by facility respondent (1 = most effective).

[b]Several facilities report on-the-job or field training as part of their assigned operator training programs.

"X" indicated that facility uses method, but respondent did not assign ranking.

APPENDIX O

TECHNICAL ELEMENTS IN TRAINING COURSES IN FACILITIES WITH FORMAL TRAINING PROGRAMS FOR HEALTH PHYSICS TECHNICAN, BY FACILITY

Technical Elements	Facility 17	Facility 25	Facility 24	Facility 16	Facility 13	Facility 30	Facility 4[a]	Facility 23	Facility 34	Facility 27	Facility 19	Facility 12	Facility 2	Facility 28	Facility 7	Facility 1	Facility 11	Facility 18	Facility 15[b]	Facility 26[c]	Facility 10[d]	Facility 3	Facility 22
Basic math	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X				X	X	X
Basic nuclear physics	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Radiation protection standards, guides, and limits	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X
National/international organizations (e.g., ICRP, NCRP)	X			X				X	X					X			X				X		X
Biological effects of radiation	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Basic units and terminology	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fundamentals of bioassay	X	X	X		X	X	X	X	X	X		X		X		X	X				X	X	X
Fundamentals of detection	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Respirator use, test, and maintenance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Protective clothing	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Personnel contamination assessment	X	X	X		X	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X
Air sampling technology	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X		X	X	X	X	X
Surface contamination assessment	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X
Dose/stay-time calculation	X	X	X			X	X	X	X	X		X		X		X	X			X	X	X	X
Radioactive source control	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X			X	X	X	X	X
Shielding	X	X	X			X	X	X	X	X		X	X	X		X	X		X	X	X	X	X
Decontamination methodology	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X
Personnel dosimetry	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X			X	X	X	X
Alpha monitoring	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X
Beta, gamma monitoring	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	X	X	X
Neutron monitoring	X	X	X		X	X		X	X	X		X		X	X		X		X	X	X	X	X
Instrumentation (e.g., testing, maintenance, and calibration of portable survey equipment)	X	X	X	X	X	X	X	X	X			X	X		X				X	X	X	X	X
Standardization and application of lab counting equipment	X	X	X			X	X	X	X			X		X	X		X			X	X	X	X
Plant radiation safety policies and procedures	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
On-site emergency preparedness	X	X	X	X	X	X	X	X	X	X		X	X	X			X	X	X	X	X	X	X
Off-site emergency preparedness	X				X	X		X	X	X		X									X	X	X
Criticality safety	X				X	X	X	X	X		X	X	X	X			X	X	X	X	X	X	X
ALARA	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X			X	X	X
Recordkeeping	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X		X	X	X
Waste management	X	X	X			X	X	X	X			X		X	X	X					X	X	X
Posting and labeling	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X

[a]HPT training includes industrial safety and plant operation.

[b]HPT training includes supplied breathing air operations and tritium monitoring.

[c]HPT training includes reactor technical specifications.

[d]HPT training includes industrial hygiene.

APPENDIX P

TECHNICAL ELEMENTS INCLUDED IN TRAINING COURSES IN FACILITIES WITH FORMAL TRAINING PROGRAMS FOR ASSIGNED OPERATORS, BY FACILITY

Technical Elements	Facilities							
	Facility 5[a]	Facility 13	Facility 32	Facility 6[b]	Facility 7	Facility 11	Facility 18	Facility 26[c]
Basic math				X		X		
Basic nuclear physics	X	X		X		X	X	X
Radiation protection standards, guides, and limits	X		X	X		X	X	X
National/international organizations (e.g., ICRP, NCRP)								
Biological effects of radiation	X	X	X			X	X	X
Basic units and terminology	X	X	X	X		X	X	X
Fundamentals of bioassay				X		X		
Fundamentals of detection	X	X	X	X		X		X
Respirator use, test, & maintenance		X	X	X		X		X
Protective clothing	X	X	X	X		X		X
Personnel contamination assessment	X		X			X		X
Air sampling technology		X	X	X				X
Surface contamination assessment		X	X	X		X		X
Dose/stay-time calculation			X	X		X		X
Radioactive source control			X	X		X	X	X
Shielding			X			X		X
Decontamination methodology			X			X		X
Personnel dosimetry	X		X			X		X
Alpha monitoring	X	X	X	X	X	X		X
Beta, gamma monitoring	X	X	X	X		X		X
Neutron monitoring	X							X
Instrumentation (e.g., testing, maintenance, and calibration of portable survey equipment)				X				X
Standardization and application of lab counting equipment						X		X
Plant radiation safety policies and procedures	X	X	X	X		X	X	X
On-site emergency preparedness		X	X	X		X	X	X
Off-site emergency preparedness			X					
Criticality safety			X			X		X
ALARA			X	X		X		
Recordkeeping			X	X		X		
Waste management			X			X		
Posting and labeling	X	X				X	X	X

[a]Assigned operator training also includes DT regulations.

[b]Assigned operator training also includes environmental monitoring and industrial hygiene.

[c]Assigned operator training also includes reactor technical specifications.

APPENDIX Q

TEXTBOOKS AND OTHER PUBLICATIONS UTILIZED BY FACILITIES IN FORMAL TRAINING PROGRAMS FOR HEALTH PHYSICS TECHNICIANS

Facility	Text Material
Facility 17	in-house manual; Radiation Safety Technician Training Course ANL-7291
Facility 25	in-house manual; Radiation Safety Technician Training Course ANL-7291
Facility 24	H. J. Moe, Radiation Safety Technician Training Course; H. Cember, Introduction to Health Physics; in-house radiation guides
Facility 16	Radiation Protection Technology, D. Gollnick; Radiation Monitoring, J. E. Wade and G. E. Cunningham; Radiological Health Handbook; Accident Prevention Manual, National Safety Council
Facility 13	in-house procedures; applicable information from Rockwell International Radiation Protection Technology Program
Facility 30	Health Physics Principles, General Physics Corporation
Facility 4	in-house manual; Introduction to Radiation Protection, Martin and Harbison; references by Moe, Shapiro, Cember; various videotape lectures
Facility 23	in-house manual; Radiological Health Handbook; NBS handbook
Facility 34	Rockwell International course; Radiation Safety Technician Training Course, Moe, Lasuk ANL-7291 rev. 1; Nuclear Energy, Schwank and Shammon; Experimental Radiological Health Physics, Gollnick; Radiation Protection Technology: A Study Guide, Gollnick

APPENDIX Q (Continued)

TEXTBOOKS AND OTHER PUBLICATIONS UTILIZED BY FACILITIES IN FORMAL TRAINING PROGRAMS FOR HEALTH PHYSICS TECHNCIANS

Facility	Text Material
Facility 27	primarily in-house manual prepared by the Safety Department; Source Book on Atomic Energy Glasstone; NCRP reports
Facility 19	videotapes from Atomic Industrial Forum, Lawrence Livermore, Radiation Management Corporation, Rockwell International Rocky Flats Plant; in-house workbooks for tapes prepared by health physics staff; for optional Level 3, self-study training workbooks by the Center for Occupational and Development Research
Facility 12	Radiation Monitoring and Living with Radiation, both available from U.S. Government Printing Office
Facility 2	EDM-123 Radiation Monitoring, Wade and Cunningham: Radiation Safety Technician Training Course, ANL-7791 Moe, Lasuk, Schumacher, and Hunt; Radiological Health Handbook, U.S. HEW; Radiation Monitor Training Program, Fundamentals of Nuclear Physics, Rockwell International
Facility 28	Radiation Safety Technician Training Course, Moe et. al., ANL-7291; Radiation Protection, General Physics Corporation; various in-house manuals
Facility 7	training is off-site
Facility 1	Radiological Health Handbook; in-house text

APPENDIX Q (Continued)

TEXTBOOKS AND OTHER PUBLICATIONS UTILIZED BY FACILITIES IN FORMAL TRAINING PROGRAMS FOR HEALTH PHYSICS TECHNCIANS

Facility	Text Material
Facility 11	Radiation Safety Technician Training Course, Moe et. al., ANL-7291; Radiological Health Handbook, U. S. HEW; DOE Order 5480.1A, Chapters 3, 11; in-house manuals; A Training Manual for Nuclear Medicine Technologists, U. S. HEW; Mathematics, Volume I, Bureau of Naval Personnel; Radiation Monitoring, J. E. Wade and G. E. Cunningham
Facility 18	none
Facility 15	Radiation Monitoring, a J. E. Wade and G. E. Cunningham, General Electric Company, August 1967
Facility 26	none
Facility 10	no specific text; rely heavily on in-house SOPs; also videotapes by reputable personnel in field
Facility 3	Moe handbook; CRC handbooks on radiation protection; Radiation Protection, Shapiro; Radiological Health Handbook 10CFR 20, 10CFR50, etc.; various TLD texts; International Commission on radiological units and measures; NBS Handbook 72
Facility 22	ANL 7291 - Moe and Lasuk Radiation Safety Technician Training Course; in-house guides and materials

APPENDIX R

TEXTBOOKS AND OTHER PUBLICATIONS UTILIZED BY FACILITIES IN FORMAL TRAINING PROGRAMS FOR ASSIGNED OPERATORS

Facility	Text Material
Facility 5	in-house radiation safety manual
Facility 13	in-house procedures; applicable information from Rockwell International Radiation Protection Technology Program
Facility 32	Radiological Health Handbook, Bureau of Radiological Health; Radiation Safety Technician Training Course Moe et al.; Los Alamos Handbook of Radiation Monitoring
Facility 6	Radiation Monitoring, Wade and Cunningham; Fundamentals of Industrial Hygiene, Olishifski; Environmental, and Physical Sciences, Wang, Willis, and Loveland
Facility 7	none
Facility 11	General Radio Chemical Operator Training Manual; in-house training manual; Final Safety Analysis Report; Operational Safety Analysis Report; in-house manuals
Facility 18	none
Facility 26	none

APPENDIX S

EQUIPMENT RESERVED EXCLUSIVELY OR AVAILABLE FOR TRAINING IN FACILITIES WITH FORMAL TRAINING FOR HEALTH PHYSICS TECHNICIANS, BY FACILITY

Facility	Training Equipment															
	Training Room		Glove Box		Respirator		Protective Clothing		Radiation Survey Instruments		Hood		Air Sampling/ Monitoring Equipment		Mockups of Specialized Facilities or Equipment	
	R	A	R	A	R	A	R	A	R	A	R	A	R	A	R	A
Facility 17		X		X		X		X		X		X		X		X
Facility 25		X				X		X		X		X		X		X
Facility 24	X					X		X		X		X		X		
Facility 16		X		X		X		X	X	X		X	X	X		
Facility 13		X		X		X		X	X	X		X		X		X
Facility 30		X		X		X		X		X		X		X		
Facility 4		X		X		X		X		X				X		
Facility 23	X			X	X		X		X			X	X			X
Facility 34		X				X		X		X		X		X		
Facility 27		X	X			X		X		X		X		X	X	
Facility 19		X		X		X		X		X		X		X		
Facility 12		X		X		X		X		X		X		X		
Facility 2		X				X		X		X				X		
Facility 28		X		X		X		X		X		X		X		
Facility 7		X		X		X		X		X		X		X	X	
Facility 1	X	X			X	X		X	X	X			X	X	X	X
Facility 11		X		X		X		X		X		X		X		
Facility 18	X			X	X			X		X		X		X		X
Facility 15	X		X			X		X	X	X		X		X		
Facility 26		X		X	X			X		X		X		X		X
Facility 10	X	X		X	X	X	X	X	X	X		X		X		X
Facility 3	X					X	X			X		X		X		X
Facility 22		X		X		X		X		X		X		X		X

R = Reserved exclusively for training.

A = Available for training.

APPENDIX T

EQUIPMENT RESERVED EXCLUSIVELY OR AVAILABLE FOR TRAINING IN FACILITIES WITH FORMAL TRAINING PROGRAMS FOR ASSIGNED OPERATORS, BY FACILITY

	Training Equipment															
	Training Room		Glove Box		Respirator		Protective Clothing		Radiation Survey Instruments		Hood		Air Sampling/ Monitoring Equipment		Mockups of Specialized Facilities or Equipment	
Facililty	R	A	R	A	R	A	R	A	R	A	R	A	R	A	R	A
Facility 5		X				X		X		X				X		X
Facility 13	X	X		X		X		X	X	X		X				
Facility 32		X	X			X		X		X		X		X		
Facility 6		X				X		X		X		X		X		
Facility 7	X					X		X		X		X		X	X	
Facility 11		X		X		X		X		X		X		X		X
Facility 18	X									X					X	
Facility 26		X		X	X			X		X		X		X		X

R = Reserved exclusively for training.

A = Available for training.

APPENDIX U

NUMBER OF FULL-TIME AND PART-TIME HEALTH PHYSICS TECHNICIANS AND ASSIGNED OPERATOR TRAINING INSTRUCTORS, BY FACILITY, FY 1983

Facility	No. of HPTs	No. of Full-Time HPT Instructors	No. of Part-Time HPT Instructors	No. of AOs	No. of Full-Time AO Instructors	No. of Part-Time AO Instructors
Facility 17	20		2			
Facility 25	26		7			
Facility 5				1		3
Facility 20[a]	18					
Facility 29[a]	4					
Facility 24	10		8			
Facility 16	1		1			
Facility 9[a]	1			1		
Facility 13	18		3	111		4
Facility 30	29	1	2			
Facility 4	31	1	1			
Facility 23	41		7			
Facility 34	1					
Facility 27	12		10			
Facility 32				37		13
Facility 19	95		2			
Facility 12	32		12			
Facility 6				4		4
Facility 33[a]	12					
Facility 2	7		3			
Facility 21[a]	39					
Facility 8[a]	13					
Facility 28	21	1	8			
Facility 14[a]	1			80		
Facility 7[b]	3		1	134		1
Facility 1	62	5				
Facility 11	112	2	2	432	11	
Facility 18	5		5	3		3
Facility 15	137	2	6			
Facility 26	6		4	1		2
Facility 10	147	1	15			
Facility 31[a]	4			62		
Facility 3	39	1	1			
Facility 22[c]	12		2	14[c]		

[a]Facility does not require formal in-house training for health physics technicians or assigned operators.

[b]Health physics technicians complete a two-week radiation protection university short course.

[c]Originally reported having no assigned operators. The survey response was amended in a telephone call to include 14 assigned operators in FY 1983. No information was provided, however, on training requirements or procedures for these personnel.

APPENDIX V

TESTING METHODS AND RECORDKEEPING PROCEDURES IN GOCO FACILITIES WITH FORMAL TRAINING PROGRAMS FOR HEALTH PHYSICS TECHNICIANS, BY FACILITY

Facility	Testing Method				Test Results Maintained in:			Number of Yrs Test Results Retained		
	Oral	Written[a]	Practical Performance	No Test	Individual Personnel Files	Individual Training Files	Collective Training Files	1-2	3-5	>7
Facility 17	X	70	X							
Facility 25	X	62.5	X		X	X				X
Facility 24	X				X					X
Facility 16	X	80	X				X		X	
Facility 13				X						
Facility 30		70	X			X	X			X
Facility 4	80	80	X			X	X			X
Facility 23	X[b]	70[b]	X				X			X
Facility 34		88[c]				X				X
Facility 27	70	X				X			X	
Facility 19			X			X	X			X
Facility 12		70					X		X	
Facility 2		75	X				X		X	
Facility 28		70	X		X		X			X
Facility 7				X						
Facility 1				X						
Facility 11	X	70	X			X	X		X	
Facility 18	X	70	X			X	X			X
Facility 15		70	X		X	X				X
Facility 26	X	80	X		X	X				X
Facility 10	X	80	X		X	X			X	
Facility 3	X	75	X			X	X		X	
Facility 22	X	80	X			X		X		

[a]Number indicates minimum passing score on written exam.

[b]Also requires a walk-through plant oral exam.

[c]Requires HPTs to pass the NRRPT exam.

APPENDIX W

TESTING METHODS AND RECORDKEEPING PROCEDURES IN FACILITIES WITH FORMAL TRAINING PROGRAMS FOR ASSIGNED OPERATORS, BY FACILITY

Facility	Testing Method				Test Results Maintained in:			Number of Yrs Test Results Retained		
	Oral	Written[a]	Practical Performance	No Test	Individual Personnel Files	Individual Training Files	Collective Training Files	1-2	3-5	>7
Facility 5			X							
Facility 13				X						
Facility 32	X	X	X				X			X
Facility 6				X						
Facility 7				X						
Facility 11	X	X	X			X	X		X	
Facility 18	X	X	X			X	X			X
Facility 26	X	X	X		X	X				X

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[a]Number indicates minimum passing score on written exam.

APPENDIX X

JOB ASSIGNMENT, TESTING ADVISEMENT, AND PROCEDURES FOR EMPLOYEES WHO FAIL FORMAL TESTING IN FACILIITES WITH FORMAL TRAINING PROGRAMS FOR HEALTH PHYSICS TECHNICIANS, BY FACILITY

Facility	Job Assignment Depends upon Test Results		Method of Prior Advisement as to Performance Standards			Procedures for Employees Who Fail Formal Tests[a]			No Formal Test
	Yes	No	Oral	Written	No Advisement	Retrain & Retest[b]	Retest Only[b]	No Uniform Procedure	
Facility 17	X		X			X			
Facility 25	X		X	X		X			
Facility 24	X								
Facility 16		X	X			3			
Facility 13									X
Facility 30	X		X	X		2			
Facility 4	X		X	X		1			
Facility 23	X		X	X		2			
Facility 34		X	X					X	
Facility 27	X		X	X		X			
Facility 19		X	X			X			
Facility 12	X		X	X				X	
Facility 28	X		X			4			
Facility 7									X
Facility 1[c]	X		X	X					
Facility 11	X		X	X		1	1		
Facility 18	X		X	X				X	
Facility 15	X		X	X		1			
Facility 26	X		X			3			
Facility 10	X		X	X		1			
Facility 3		X	X			2	2		
Facility 22	X		X	X		3			

[a]Most facilities reassign or terminate employees if retesting is unsuccessful.

[b]Number indicates number of retests allowed; X indicates number of retests not specified.

[c]Reassigns employees who fail formal test, without retraining or retesting.

APPENDIX Y

JOB ASSIGNMENT, TESTING ADVISEMENT, AND PROCEDURE FOR EMPLOYEES WHO FAIL FORMAL TEST IN FACILITIES WITH FORMAL TRAINING PROGRAMS FOR ASSIGNED OPERATORS, BY FACILITY

Facility	Job Assignment Depends upon Test Results		Method of Prior Advisement to Trainees			Procedure for Employees Who Fail Formal Test[a]			No Formal Test
	Yes	No	Oral	Written	No Advisement	Retrain & Retest[a]	Retest Only	No Uniform Procedure	
Facility 5	X				X			X	
Facility 13									X
Facility 32	X				X	1			
Facility 6									X
Facility 7									X
Facility 11	X		X	X		1	X		
Facility 18	X		X	X				X	
Facility 26		X	X			3			

[a]All facilities reassign or terminate employees if retraining and/or retesting is unsuccessful.

[b]Number indicates the number of retests allowed.

APPENDIX Z

UPDATING JOB SKILLS IN FACILIITES WITH FORMAL TRAINING PROGRAMS
FOR HEALTH PHYSICS TECHNICIANS

Facility	Formal Training: Length (in hrs.)	Formal Training: Number of Times Conducted per Year	Formal Training: Mandatory Participation	Informal Training: Length (in hrs.)	Informal Training: Number of Times Conducted per Year	Informal Training: Mandatory Participation	No Program
Facility 17	1	12	yes				
Facility 25	6	4	yes				
Facility 24				*			
Facility 16	40	1	yes	40	1	yes	
Facility 13	3-4	12	yes				
Facility 30	80	10-15	yes				
Facility 4	2	12	for 75%	2	12	yes	
Facility 23	8	2	yes	as needed	continuous	yes	
Facility 34							X
Facility 27				2	12	yes	
Facility 19							X
Facility 12							X
Facility 2				10	3	yes	
Facility 28	4	9	yes				
Facility 7	40	.5	yes				
Facility 1	20	1					
Facility 11	546	ongoing	yes	400	ongoing	yes	
Facility 18	varies	varies					
Facility 15							X
Facility 26				40	1	yes	
Facility 10	12	8	yes	.25	260	yes	
Facility 3	32	4	supervisors only				
Facility 22				40	1	yes	

*Informal program now being developed.

APPENDIX AA

UPDATING JOB SKILLS IN FACILITIES WITH FORMAL TRAINING PROGRAMS FOR ASSIGNED OPERATORS

Facility	Formal Program Length (in hrs.)	Formal Program Number of Times Conducted per Year	Formal Program Mandatory Participation	Informal Program Length (in hrs.)	Informal Program Number of Times Conducted Per Year	Informal Program Mandatory Participations
Facility 5				1	1	Yes
Facility 13	2	1	Yes			
Facility 32	16-24	1	Yes	2-50	1	Yes
Facility 6				1	6	Yes
Facility 7	2		Yes			
Facility 11	110	ongoing	Yes	60	ongoing	Yes
Facility 18	1	1	Yes			
Facility 26						

APPENDIX BB

ORGANIZATIONAL SUPPORT FOR THE NATIONAL REGISTRY OF RADIATION PROTECTION TECHNOLOGISTS, BY INDIVIDUAL FACILITY

	Number of Employees		Organizational Suport for NRRPT Certification					
Facility	Number of Employees Certified by NRRPT	Number of Employees Who Have Taken NRRPT Exam	Organizational Support for NRRPT Registration / Funding Application/ Exam Fees	Funding Travel to Exam Location	Allowing Paid Work Time for Exam	Allowing Paid Work Time for Exam Preparation	Funding Specialized Training Specific to NRRPT Exam Preparation	No Involvement
Facility 17	2	5				X	X	
Facility 25	6	7						
Facility 5								X
Facility 20	4	5						
Facility 29	1	1						
Facility 24			X	X	X	X	X	
Facility 16			X	X	X		X	
Facility 9								X
Facility 13					X	X	X	
Facility 30	4	6						
Facility 4	2	4				X	X	
Facility 23	3	5		X	X	X		
Facility 34	1	2					X	
Facility 27					X	X	X	
Facility 32	6	6				X		
Facility 19	1	1						
Facility 12								X
Facility 6								X
Facility 33								X
Facility 2					X			
Facility 21	5	6						
Facility 8								X
Facility 28	4	5						
Facility 14								X
Facility 7					X		X	
Facility 1	22	40				X	X	
Facility 11	13	8						
Facility 18			X	X	X	X	X	
Facility 15								X
Facility 26				X	X			
Facility 10								X
Facility 31		2	X		X			
Facility 3	2[a]	7[a]	X		X	X	X	
Facility 22	3	3	X	X	X	X		

[a]Results from last exam not yet available.

APPENDIX CC

CHARACTERISTICS OF TRAINING PROGRAMS FOR SUPPORT SERVICE TECHNICIANS, BY FACILITY

	Program Characteristics									
	Type of Program		Nature of Training		Training Instructors					
Facility	Formal	Informal (OJT)	Specific to Support Service Task	Specific to Support Service Task in Conjunction with General Radiation Safety Training	In-House Technical Training Staff (e.g., health physics)	Nontechnical Training Staff (e.g., personnel)	Line Supervisors	Other	Outside Consultants	Duration of Program (in hours)
Facility 17		X	X				X			50
Facility 5		X		X	X	X	X	X		8-40 initially
Facility 20		X	X							1-4 annually
Facility 24	X	X		X			X			NA
Facility 9		X	X		X		X			30
Facility 13	X			X	X		X			
Facility 4	X	X	X	X	X		X			varies
Facility 23		X	X		X					2
Facility 27		X		X			X			
Facility 32	X	X		X	X		X			15
Facility 19		X	X		X		X			100
Facility 12		X			X		X			
Facility 33		X				X	X	X		
Facility 2		X		X						
Facility 21		X		X			X			
Facility 28	X	X	X		X					
Facility 14		X		X	X	X	X		X	
Facility 1		X	X		X		X	X		continuing
Facility 11	X	X	X	X			X			
Facility 15	X	X		X			X			varies
Facility 26	X	X	X		X	X	X			varies
Facility 10	X	X		X	X	X	X		X	as required
Facility 22	X	X		X	X	X	X			
					X		X			120

APPENDIX DD

CHARACTERISTICS OF TRAINING PROGRAMS FOR RADIATION WORKERS, BY FACILITY

	Program Characteristics							
	Type of Program		Instructors					
Facility	Formal	Informal (OJT)	In-House Technical Training Staff (e.g., health physics)	Nontechnical Training Staff (e.g., personnel)	Line Supervisors	Others	Outside Consultants	Duration of Program (in hours)
Facility 17	X			X				1
Facility 25	X			X				4
Facility 5	X	X		X		X	X	
Facility 20		X		X	X	X		2
Facility 29	X	X					X	4-8
Facility 24	X	X		X		X		2
Facility 16								
Facility 9		X		X		X		
Facility 13	X							4.5
Facility 30	X	X		X	X	X		20
Facility 4	X	X		X	X	X		8
Facility 23	X			X				4
Facility 34	X			X				3
Facility 27								
Facility 32								
Facility 19	X	X		X				1-4
Facility 12	X	X		X	X	X	X	4
Facility 6	X	X		X	X	X		7
Facility 33								
Facility 2		X		X		X		
Facility 21								
Facility 8								
Facility 28	X	X		X				1.5
Facility 14		X		X		X	X	3 continuing
Facility 7	X			X				4
Facility 1								1
Facility 11	X	X		X	X			6.5
Facility 18	X	X	X		X	X		varies
Facility 15								
Facility 26	X	X	X	X	X		X	as req'd.
Facility 10	X	X		X	X			
Facility 31								
Facility 3	X		X		X			12
Facility 22	X		X		X			8