29
2-1-82
#25 NTIS
T-1176

ORAU-194

MASTER

Prepared by
Oak Ridge Associated
Universities

Prepared for
Office of Nuclear
Power Systems

Assistant Secretary for
Nuclear Energy

U.S. Department
of Energy

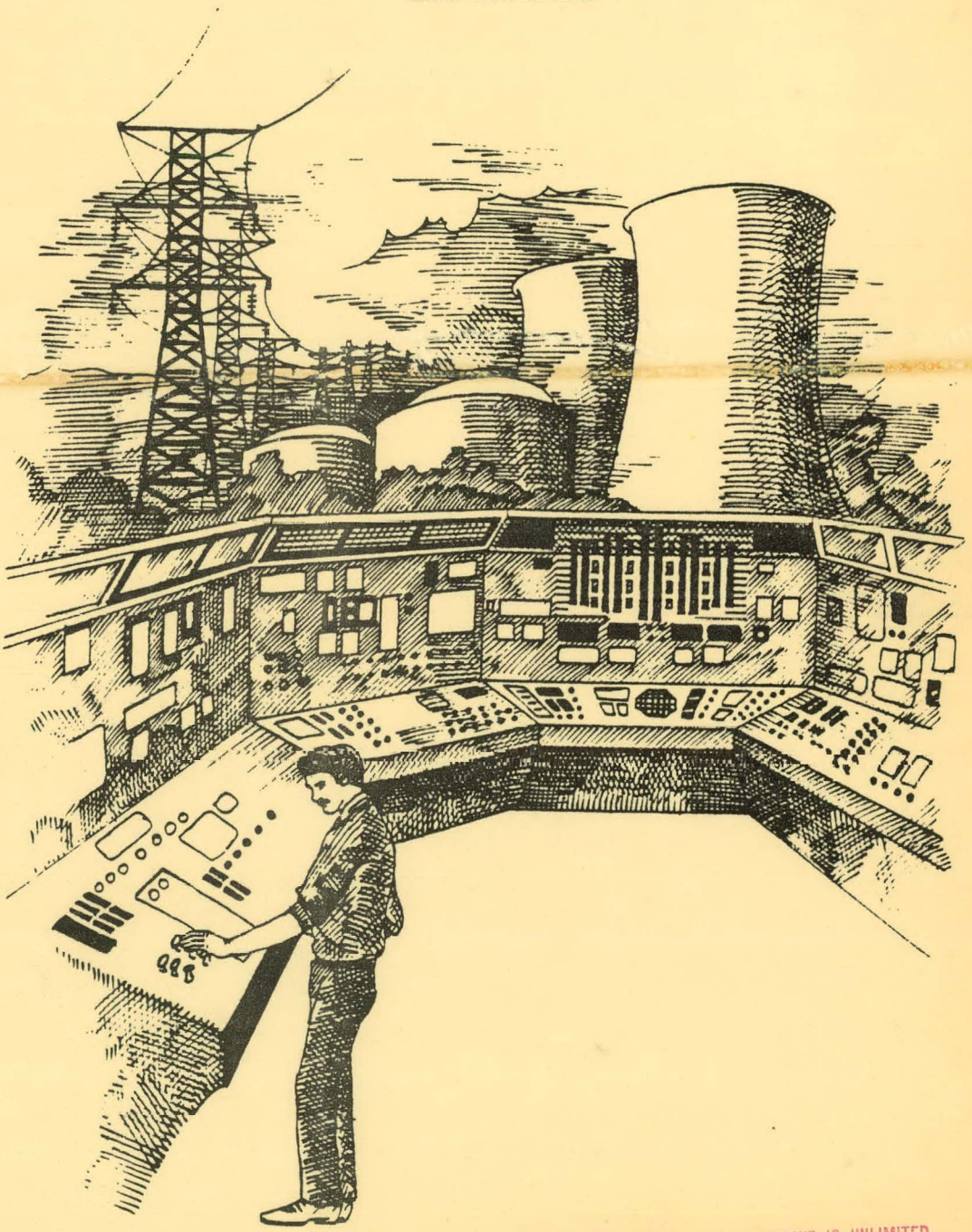
and

The Institute of
Nuclear Power
Operations

NUCLEAR-RELATED TRAINING AND EDUCATION OFFERED BY ACADEMIC INSTITUTIONS

(Less-than-Baccalaureate degree)

Lee Howard



DISCLAIMER

Oak Ridge Associated Universities is a private, not-for-profit association of more than 50 colleges and universities. It seeks to help the U.S. Department of Energy, other private and governmental organizations, and its member institutions solve societal probblems relating to energy, health, and the environment. Established in 1946, Oak Ridge Associated Universities was one of the first university-based, science-related corporate management groups. Today it conducts diverse, cooperative programs of research, training, education, and information and is noted for its contributions to the development of science and human resources.

The mission of the **Manpower Education, Research, and Training Division**, formed in 1977, is to enhance the knowledge and abilities of the professional and skilled work force involved in national energy, environmental, and health-related activities. The division is organized into five program areas that examine human resource issues, evaluate manpower requirements and training needs, assist in establishing manpower training programs, and provide opportunities for professional education and industrial craft training. The division's programs include the Assessment and Field Support Program, the Labor and Policy Studies Program, Professional Training Programs, the Training and Technology Program, and University Programs.

Available from the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161. Please direct all price inquiries to NTIS.

NUCLEAR-RELATED TRAINING AND EDUCATION OFFERED BY ACADEMIC INSTITUTIONS

(Less-than-Baccalaureate degree)

ORAU--194

DE82 010026

Prepared by

Labor and Policy Studies Program
Manpower Education, Research, and Training Division
Oak Ridge Associated Universities
Oak Ridge, Tennessee

Project Staff

Author: Lee Howard
Project Manager: Larry M. Blair
Support Staff: Don Levison

Prepared for

Office of Nuclear Power Systems
Assistant Secretary for Nuclear Energy
U.S. Department of Energy

and

The Institute of Nuclear Power Operations

January 1982

This report is based on work performed by Oak Ridge Associated Universities for the Assistant Secretary for Nuclear Energy, U.S. Department of Energy, under contract number DE-AC05-76OR00033.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DESCRIPTION OF SURVEY

INTRODUCTION

Current projections indicate that in addition to the 10,100 technician positions and 6,100 existing operator positions in the nuclear power industry, another 9,100 technicians and 9,700 operators will be required over the next decade.[1] With 56 nuclear plants currently in operation and an additional 35 plants under construction, it is essential that trained technical personnel be available for employment in the nuclear utilities. Much of the technician training required can be provided through nuclear-related associate degree and certificate programs offered by academic institutions.

Because of the growing demand for technicians in the nuclear utility industry, this report has been prepared to identify the nuclear-related, less-than-baccalaureate, technical educational programs provided by academic institutions and to ascertain both the current number of students and the maximum number that could be trained, given present staff and facilities. The data serve as a gauge for the proportion of technician training required by the nuclear industry that can be provided by academic institutions.

SURVEY UNIVERSE

This study presents the results of a survey of academic institutions offering nuclear-related training and education at the less-than-baccalaureate degree level. The survey universe was compiled from publications listing nuclear-related academic programs. The scope of the survey includes only those programs which have a nuclear power industry application and excludes all programs which are affiliated with nuclear medicine. The survey instrument was distributed by the Institute of Nuclear Power Operations (INPO) to 262 academic institutions. Since the initial mailing in May 1981, ten of the institutions have closed and eight other listings have been identified as duplications, thus reducing the universe to 244 institutions.

---

[1]Ruth C. Johnson, 1981, "Occupational Employment in Nuclear Power Utilities" (A Working Paper), prepared by Labor and Policy Studies Program, Oak Ridge Associated Universities, Oak Ridge, Tennessee.

Fifty-five percent of the survey population (134 institutions) responded to the questionnaire, of which 45 percent (109) were out of the survey scope and 10 percent (25) indicated they offer less-than-baccalaureate degree, nuclear-related programs. A review of the college catalogs for the 110 institutions that did not respond to the survey yields the following results: 31 offer programs in nuclear medicine; 31 offer 4-year, baccalaureate degree programs in nuclear fields; 21 offer less-than-baccalaureate degree programs in energy-related, but nonnuclear, fields; and 25 are 2-year schools which do not offer any nuclear-related programs. With 108 of the non-responding institutions identified through the college catalog review as out of the scope of the survey, the status of only two listings in the survey universe remains unknown. Thus the 25 institutions analyzed here constitute the entire population of the institutions known to offer nuclear-related programs at the less-than-baccalaureate degree level. See Table 1.

SURVEY INSTRUMENT

The survey instrument requested the institutions to provide the following data on their nuclear-related training and education programs: (1) duration of program; (2) whether the program reflected initial instruction or a skills maintenance/update orientation; (3) recognition awarded; (4) enrollment as of January 1, 1981; (5) enrollment capacity; and (6) number of program completers for 1979, 1980, and estimate for 1981. (A copy of the survey instrument is attached as Appendix A.) It should be noted that each 9 to 12 month period of program duration is assumed to represent 30 semester hours except in those areas where the actual number of program semester hours is indicated by the survey respondents.

DEFINITION OF TERMS

Nuclear-Related Training and Education. A curriculum program leading to an associate degree, or a series of courses leading to a diploma, certificate, or other recognition, that includes a core of nuclear knowledge allowing graduates/completers to function in the nuclear power field.

Initial Instruction. Instruction provided to persons who have no significant prior training or education in their current field of study.

TABLE 1. SURVEY UNIVERSE AND RESPONSE, INPO SURVEY OF NUCLEAR-RELATED TRAINING AND EDUCATION (Less-than-Baccalaureate Degree), 1981

		262	- Original universe
		- 8	- Duplications
		254	
		- 10	- Schools defunct
100%		244	- Adjusted universe
55%		-134	- Returned questionnaires
	45%		109 reporting no nuclear-related programs
	10%		25 reporting nuclear-related education programs
45%		110	- Non-respondents
	44%	-108	- Identified through college catalog review as out of the survey scope
			31 - programs in nuclear medicine
			31 - Nuclear-related programs leading to a baccalaureate degree
			21 - Non-nuclear, energy-related less-than-baccalaureate degree programs
			25 - Two-year colleges that do not offer nuclear-related programs
	1%	2	- Status unknown

Skills Update/Maintenance. Instruction provided to persons employed in nuclear power who have prior training or education in their current field of study and who are seeking to update/refresh their skills.

DESCRIPTION OF NUCLEAR-RELATED PROGRAM TOTALS

Thirty-five less-than-baccalaureate degree nuclear-related programs were identified by the 25 academic institutions which are within the survey scope. The programs cited are offered in the areas of Nuclear Technology; Health Physics (Radiation Protection); Nuclear Technology and Health Physics; Non-Destructive Testing; Engineering Physics; Chemical Technology (Nuclear Option); Nuclear Quality Assurance Technology; Instrumentation Technology; and Installation, Operation, and Maintenance of Reactors. Six of the 35 programs represent less-than-baccalaureate degree, nuclear-related courses rather than degree or certificate programs. For the purposes of this report, however, these courses are defined as programs and are identified by the letter "c" in Tables 1, 10, 14, and 19. The 25 institutions are identified and summary descriptions of the individual programs are given in Appendix B.

A total of 854 students were enrolled in the 35 nuclear-related programs as of January 1, 1981 (Table 2). Although Nuclear Technology is the field with the most programs cited, the Health Physics (Radiation Protection) programs have the most students enrolled. Furthermore, while a greater number of program completers are cited in Nuclear Technology than in Health Physics (Radiation Protection), a large proportion of the Nuclear Technology graduates complete a 3-month program, whereas a large proportion of the Health Physics graduates complete 2-year programs. Clearly, more graduates can be realized on a yearly basis from a 3-month program than from a program requiring 2 years to complete.

Overall, the total nuclear-related programs cite 305 graduates in 1979, 360 graduates in 1980, and an estimated 436 graduates in 1981. These figures represent an increase of 18 percent in the number of graduates between 1979 and 1980 and an increase of 21 percent between 1980 and estimated 1981, suggesting a possible trend toward increasing numbers of graduates from less-than-baccalaureate degree nuclear-related programs.

Over half of the programs within the survey scope lead to an associate of science degree (Table 3) and require 18 to 24 months to complete. Twenty-three percent of the nuclear-related programs award a certificate at the completion of

TABLE 2. FIELD OF STUDY BY NUMBER OF COMPLETERS; INPO SURVEY OF NUCLEAR-RELATED TRAINING AND EDUCATION (Less-than-Baccalaureate Degree), 1981

Field of Study	Number of Programs	Enrollment 01/01/81	Number of Completers		
			1979	1980	Estimated 1981
Nuclear technology	15	257	147	170	257
Health physics (radiation protection)	8	400	121	158	142
Nuclear technology and health physics	1	15	0	0	4
Non-destructive testing	3	53	3	0	0
Radiation physics	1	2	0	0	1
Engineering physics	1	60	20	20	20
Chemical technology (nuclear option)	1	0	0	0	0
Nuclear quality assurance technology	1	43	8	9	12
Instrumentation technology	2	24	6	3	0
Installation, operation, and maintenance of reactors	2	-	-	-	-
Total, all fields of study	35	854	305	360	436

TABLE 3. FIELDS OF STUDY BY TYPE OF PROGRAM RECOGNITION AWARDED; INPO SURVEY OF NUCLEAR-RELATED TRAINING AND EDUCATION (Less-than-Baccalaureate Degree), 1981

Field of Study	Number of Programs that Award Associate of Science Degrees	Number of Programs that Award Certificates	Number of Programs that Do Not Award Formal Recognition	Total, All Programs
Nuclear technology	8	4	3	15
Health physics (radiation protection)	5	2	1	8
Nuclear technology and health physics	1	0	0	1
Non-destructive testing	1	0	2	3
Radiation physics	1	0	0	1
Engineering physics	1	0	0	1
Chemical technology (nuclear option)	1	0	0	1
Nuclear quality assurance technology	1	0	0	1
Instrumentation technology	0	0	2	2
Installation, operation, and maintenance of reactors	0	2	0	2
Total, all fields of study	19	8	8	35

training, and 23 percent do not cite any type of formal recognition for program completion. This latter category is comprised mainly of programs and courses of 3 or 4 months duration.

From the 23 programs for which the current maximum enrollment capacity is listed, 1400 students can be trained, given present faculty and facilities (Table 4). These same 23 programs with 575 persons enrolled in 1981 represent 41 percent of the nuclear-related programs enrollment capacity. The programs in Nuclear Technology show the most capacity for accommodating growth, with only 36 percent of the enrollment capacity currently used, while the Health Physics (Radiation Protection) programs indicate less capacity for growth, with 64 percent of their maximum enrollment met by the present number of enrollees.

As can be seen in Table 5, most of the programs are offered as initial instruction in the nuclear field (see Definitions of Terms, page 2). Only 14 percent of the programs represent training to update or maintain skills of persons employed in the nuclear area. This figure, however, is supplemented by the 11 percent of the programs that offer a training orientation of both initial instruction and skills update/maintenance.

Sixty percent of the nuclear-related programs are west of the Mississippi River (Figure 1). Although more programs are in the West, the programs with the most enrollees and graduates are in the Southeast (Table 6). The majority of the programs cited in the Southwest are primarily in Texas. Although there are four programs in the Southwest, the number of enrollees is comparable to the Central region which has only two programs. The Mountain region is the only area in the United States which has no less-than-baccalaureate degree, nuclear-related programs within the survey scope.

DESCRIPTION OF INDIVIDUAL NUCLEAR-RELATED FIELDS OF STUDY

NUCLEAR TECHNOLOGY

Of the 35 nuclear-related academic programs identified by the survey participants, 43 percent (15) are in the field of Nuclear Technology (Table 7). Seventy-three percent of the Nuclear Technology programs are offered as initial instruction in the field, and 53 percent of the programs result in an associate of science degree after approximately 2 years of study (Figures 2 and 3).

TABLE 4. FIELDS OF STUDY BY PERCENT OF MAXIMUM ENROLLMENT CAPACITY USED; INPO SURVEY OF NUCLEAR-RELATED TRAINING AND EDUCATION (Less-than-Baccalaureate Degree), 1981

Field of Study	Number of Programs*	Enrollment 01/01/81	Current Maximum Enrollment Capacity	Percent of Maximum Enrollment Capacity Used 01/01/81
Nuclear technology	12	141	390	36
Health physics (radiation protection)	5	316	490	64
Nuclear technology and health physics	1	15	200	7
Non-destructive testing	1	0	70	-
Engineering physics	1	60	90	67
Chemical technology (nuclear option)	1	0	70	-
Nuclear quality assurance technology	1	43	80	54
Instrumentation technology	1	0	10	-
Totals, all fields of study	23	575	1400	41

*Excludes 12 programs which did not indicate current maximum enrollment capacity.

TABLE 5. FIELDS OF STUDY BY PERCENT OF PROGRAMS OFFERED IN EACH TRAINING AND EDUCATION ORIENTATION; INPO SURVEY OF NUCLEAR-RELATED TRAINING AND EDUCATION (Less-than-Baccalaureate Degree), 1981

Field of Study	Percent of Programs Offered as Initial Instruction	Percent of Programs Offered as Skills/Update Maintenance	Percent of Programs Offered as Both Initial Instruction & Skills Update/ Maintenance
Nuclear technology	73	20	6
Health physics (radiation protection)	62	12	25
Nuclear technology and health physics	100	-	-
Non-destructive testing	66	-	33
Radiation physics	100	-	-
Engineering physics	100	-	-
Chemical technology (nuclear option)	100	-	-
Nuclear quality assurance technology	100	-	-
Instrumentation technology	100	-	-
Installation, operation, and maintenance of reactors	50	50	-
Total, all fields of study	74	14	11

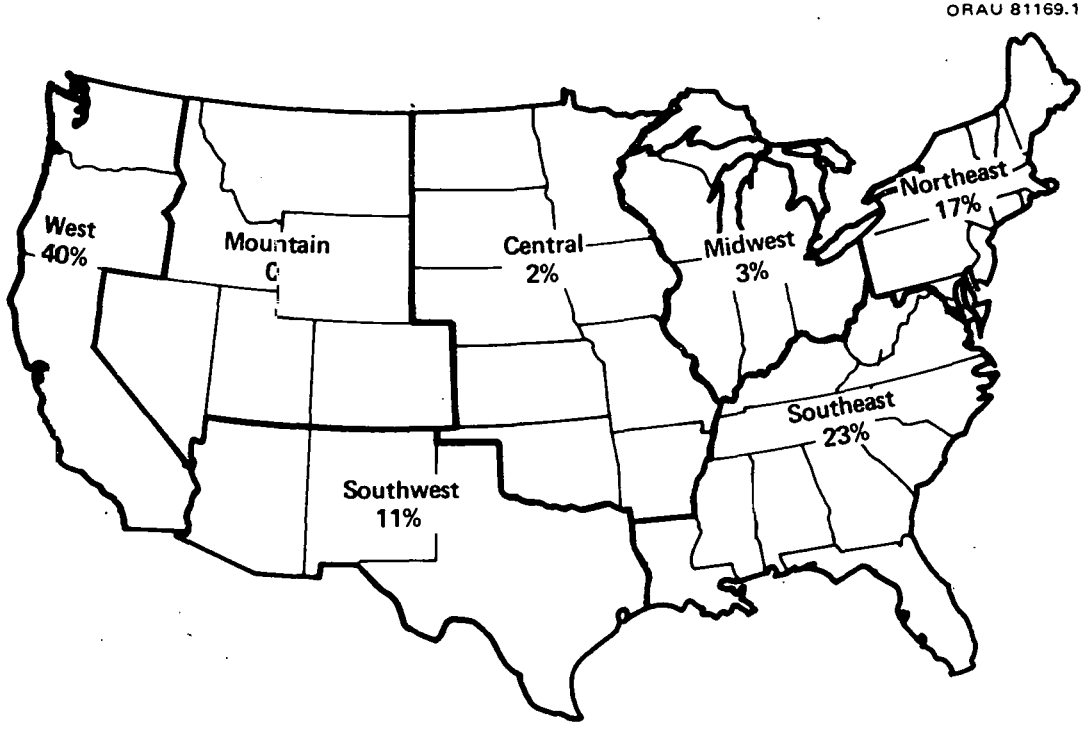


Figure 1. Regional Distribution of Nuclear-Related Training and Education Programs; INPO Survey of Training and Education (Less-than-Baccalaureate Degree), 1981.

TABLE 6. REGIONAL DISTRIBUTION OF PROGRAM ENROLLMENT AND NUMBER OF COMPLETERS; TOTAL NUCLEAR-RELATED PROGRAMS; INPO SURVEY OF NUCLEAR-RELATED TRAINING AND EDUCATION (Less-than-Baccalaureate Degree), 1981

Region	Number of Programs	Enrollment 01/01/81	Number of Completers		
			1979	1980	Estimated 1981
Northeast	6	92	27	29	29
Southeast	8	391	190	242	316
Midwest	1	---NEW PROGRAM---			
Central	2	55	-	-	-
Southwest	4	52	16	23	19
West	14	264	72	66	72
Total, all regions	35	854	305	360	436

TABLE 7. NUCLEAR-RELATED TRAINING AND EDUCATION OFFERED BY ACADEMIC INSTITUTIONS (Less-than-Baccalaureate Degree): Nuclear Technology, INPO Survey, 1981

Field of Study: NUCLEAR TECHNOLOGY										
Institution	Duration of Training and Education		Training and Education Orientation		Recognition Awarded (degree, diploma, certificate, etc.)	Enrollment as of 01/01/81	Current Maximum Enrollment Capacity	Number of Completers for Calendar Year		
	Sem. Hrs.	Months	Initial Instruction	Skills Update/ Maintenance				1979	1980	Estimated 1981
California State Univ. Northridge Northridge, CA	15	4	X		Certificate	12	18	10	10	12
	15	4		X	Certificate	3	18	-	-	3
Columbia Basin College Pasco, WA	60	24	X		Associate of Science Degree	26	40	12	11	10
Denmark Technical College Denmark, SC	87	24	X		Associate of Science Degree	17	24	3	2	3
Farmington-Darlington Technical College Florence, SC*	60	24	X		Associate of Science Degree	1	25	7	4	1
Kansas State University Manhattan, KS	64	18		X	None	20	25	0	0	0
Memphis State University Memphis, TN	10	3		X	Certificate	100	-	75	100	200
Mississippi Gulf Coast-Junior College Gautier, MS	60	18	X		Associate of Science Degree	0	0	3	5	0
Orange Coast College Costa Mesa, CA[c]	3	4	X		None	16	-	-	-	-
Pennsylvania State Univ. Altoona Campus Altoona, PA	60	24	X		Associate of Science Degree	6	24	1	4	6
Pennsylvania State Univ. University Park, PA	60	24	X		Associate of Science Degree	21	48	14	12	6

*Program no longer offered as of June 1, 1981.

[c]Indicates course rather than program offering.

TABLE 7. (continued)

Field of Study: NUCLEAR TECHNOLOGY										
Institution	Duration of Training and Education		Training and Education Orientation		Recognition Awarded (degree, diploma, certificate, etc.)	Enrollment as of 01/01/81	Current Maximum Enrollment Capacity	Number of Completers for Calendar Year		
	Sem. Hrs.	Months	Initial Instruction	Skills Update/ Maintenance				1979	1980	Estimated 1981
Pennsylvania State Univ. Hazelton Campus Hazelton, PA	60	21	X		Associate of Science Degree	5	60	4	4	0
Reed College Portland, OR	15	6	X		None	14	20	6	8	6
Shoreline Community College Seattle, WA	30	9	X		Certificate	6	18	8	4	6
Texas State Technical Institute Waco, TX	60	18	X	X	Associate of Science Degree	10	70	4	6	4

*Program no longer offered as of 1 June, 1981.

[c]Indicates course rather than program offering.

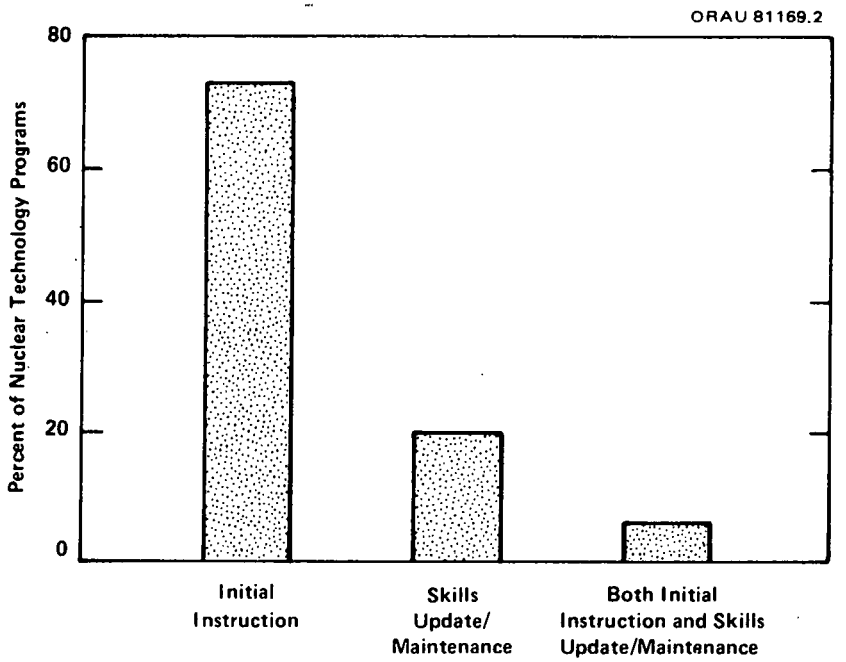


Figure 2. Type of Training Orientation: Nuclear Technology Programs; INPO Survey of Nuclear-Related Training and Education (Less-than-Baccalaureate Degree), 1981.

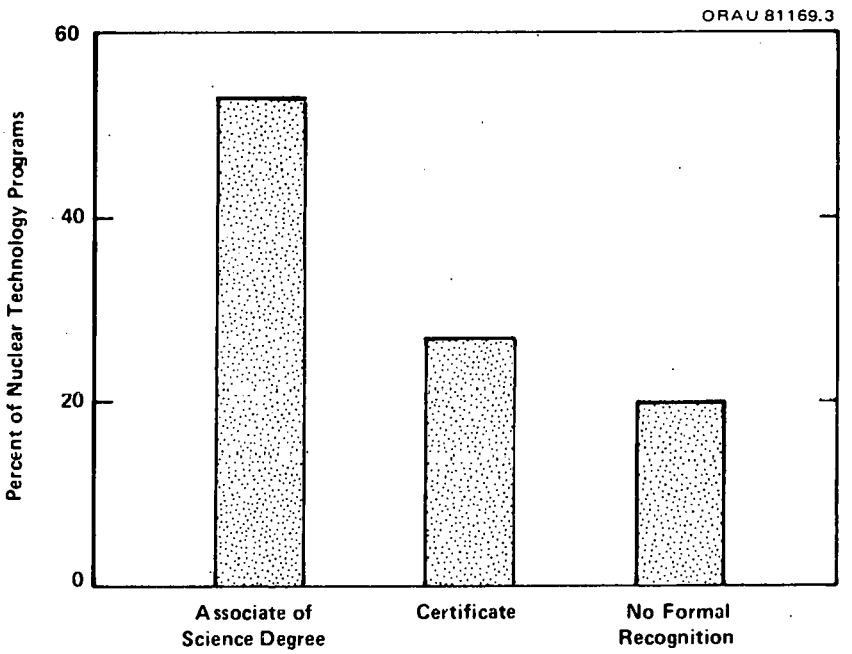


Figure 3. Type of Recognition Awarded: Nuclear Technology Programs; INPO Survey of Nuclear-Related Training and Education (Less-than-Baccalaureate Degree), 1981.

The Nuclear Technology programs show a marked increase in enrollment for 1980 and 1981. In 1979, there were 147 graduates. In 1980, the number of graduates increased by 16 percent to 170, and in 1981 it is estimated that 257 persons will graduate, an increase of 51 percent (Table 8). As noted earlier, the number of Nuclear Technology program graduates includes a large proportion of students completing a 3-month program that is offered more than once during the year.

Twelve of the 15 programs in Nuclear Technology indicate current maximum enrollment capacity (Table 9). Enrollment on January 1, 1981, averaged 36 percent of capacity. Although the single program cited in the Central region reflects a high percentage of capacity (80 percent) in use this year, the programs in other regions reflect more than sufficient capacity to expand enrollment.

The greatest number of Nuclear Technology programs is in the Western United States; however, the Nuclear Technology programs with the greatest numbers of enrollees and graduates are in the Southeast.

HEALTH PHYSICS (RADIATION PROTECTION)

Although more individual programs are cited in Nuclear Technology than any other nuclear-related area, the field of Health Physics (Radiation Protection) has the greatest number of enrollees (400), as shown in Table 10. Sixty-two percent of the eight Health Physics (Radiation Protection) programs are of an 18- to 24-month duration and lead to an associate of science degree (Figure 4). Only 12 percent are offered as a skills update/maintenance orientation, while 62 percent are offered as initial instruction in the field, and another 25 percent are offered as both initial instruction and skills update/maintenance (Figure 5).

In 1979, 121 students completed the Health Physics (Radiation Protection) programs (Table 11). Although the number of graduates increased by 31 percent between 1979 and 1980, the 1981 estimated number of program completers indicates a 10 percent decrease from 1980. Half of the Health Physics (Radiation Protection) programs and the majority of the program completers are in the institutions in the Southeastern United States. The four Health Physics (Radiation Protection) programs outside the Southeast represent only 15 percent of the 1979 graduates, 17 percent of the 1980 graduates, and 21 percent of the estimated 1981 graduates.

TABLE 8. REGIONAL DISTRIBUTION OF PROGRAMS AND NUMBER OF COMPLETERS; NUCLEAR TECHNOLOGY, INPO SURVEY OF NUCLEAR-RELATED TRAINING AND EDUCATION, (Less-than-Baccalaurete Degree), 1981

	Nuclear Technology			
Region	Number of Programs	1979	1980	Estimated 1981
Northeast	3	19	20	12
Southeast	4	88	111	204
Central	1		---NEW PROGRAM---	
Southwest	1	4	6	4
West	6	36	33	37
Total, all regions	15	147	170	257

TABLE 9. PERCENT OF CURRENT MAXIMUM ENROLLMENT CAPACITY USED BY REGION: NUCLEAR TECHNOLOGY PROGRAMS, INPO SURVEY OF NUCLEAR-RELATED TRAINING AND EDUCATION, (Less-than-Baccalaureate Degree), 1981

	Nuclear Technology			
Regions	Number of Programs*	Enrollment 01/01/81	Current Maximum Enrollment Capacity	Percent of Maximum Enrollment Capacity 01/01/81
Northeast	3	32	132	24
Southeast	2	18	49	37
Central	1	20	25	80
Southwest	1	10	70	14
West	5	61	114	53
Total, all regions	12	141	390	36

*Excludes enrollment for three programs that did not indicate current maximum enrollment capacity (116 enrollees).

TABLE 10. NUCLEAR-RELATED TRAINING AND EDUCATION OFFERED BY ACADEMIC INSTITUTIONS (Less-than-Baccalaureate Degree): Health Physics (Radiation Protection), INPO Survey, 1981

Field of Study: HEALTH PHYSICS (Radiation Protection)										
Institution	Duration of Training and Education		Training and Education Orientation		Recognition Awarded (degree, diploma, certificate, etc.)	Enrollment as of 01/01/81	Current Maximum Enrollment Capacity	Number of Completers for Calendar Year		
	Sem. Hrs.	Months	Initial Instruction	Skills Update/ Maintenance				1979	1980	Estimated 1981
Aiken Technical College Aiken, SC	60	18	X		Associate of Science Degree	45	100	6	6	6
Central Florida Community College Ocala, FL	75	30	X		Associate of Science Degree	163	200	36	42	50
Chabot College Livermore, CA	19	24	X		Certificate	25	70	10	10	15
Chattanooga State Technical Community College Chattanooga, TN	60	24	X		Associate of Science Degree	41	50	12	17	8
Lakeshore Technical Institute Cleveland, WI	62	18	X		Associate of Science Degree	---NEW PROGRAM---		0	0	0
Memphis State University Memphis, TN	3	1		X	Certificate	24	-	48	66	48
Orange Coast College Costa Mesa, CA[c]	3	4	X	X	None	60	-	-	-	-
Texas State Technical Institute Waco, TX	60	18	X	X	Associate of Science Degree	42	70	9	17	15

[c]Indicates course rather than program offering.

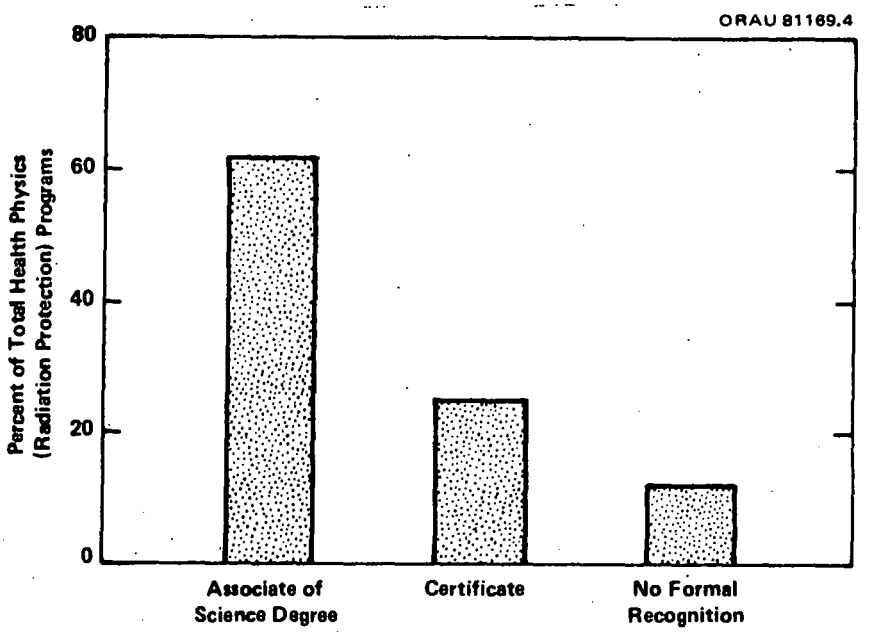


Figure 4. Type of Recognition Awarded: Health Physics (Radiation Protection) Programs; INPO Survey of Nuclear-Related Training and Education (Less-than-Baccalaureate Degree), 1981.

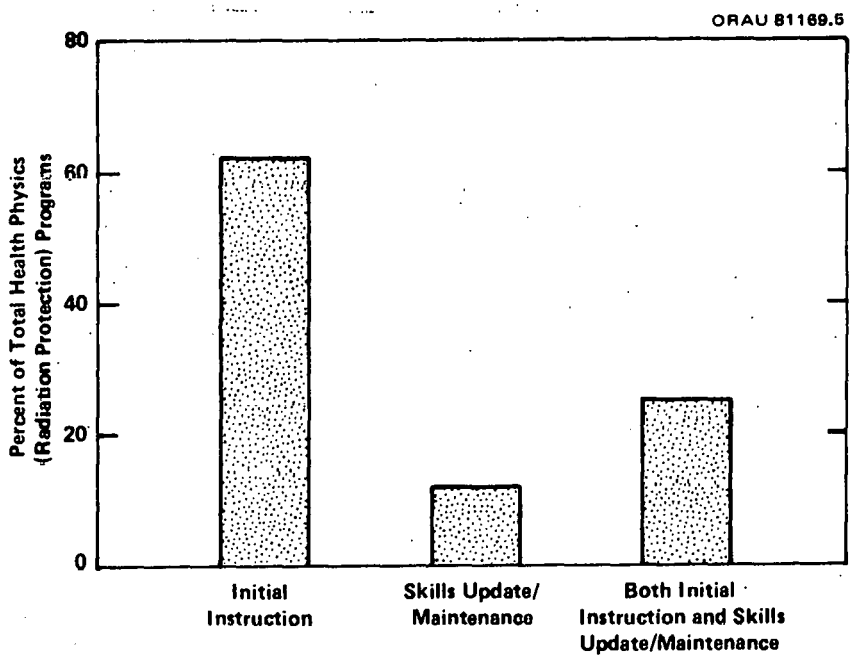


Figure 5. Type of Training Orientation: Health Physics (Radiation Protection) Programs; INPO Survey of Nuclear-Related Training and Education (Less-than-Baccalaureate Degree), 1981.

TABLE 11. REGIONAL DISTRIBUTION OF PROGRAMS AND NUMBERS OF COMPLETERS: HEALTH PHYSICS (RADIATION PROTECTION), INPO SURVEY OF NUCLEAR-RELATED TRAINING AND EDUCATION (Less-than-Baccalaureate Degree), 1981

	Health Physics (Radiation Protection)			
		Number of Completers		
Region	Number of Programs	1979	1980	Estimated 1981
Southeast	4	102	131	112
Midwest	1	---NEW PROGRAM---		
Southwest	1	9	17	15
West	2	10	10	15
Total, all regions	8	121	158	142

The current maximum enrollment capacity is cited for five of the eight Health Physics (Radiation Protection) programs (Table 12). The programs in the Southeast, the region where the majority of the activity in this field is located, have the least potential for enrollment growth, with 71 percent of their capacity currently used. The one program in the Southwest indicates a somewhat greater growth potential, given present faculty and facilities, with 60 percent of its maximum enrollment capacity used currently, and the one program in the West indicates the greatest growth potential, with only 36 percent of its capacity in use this year.

NUCLEAR TECHNOLOGY AND HEALTH PHYSICS

One relatively new program cited offers training in both Nuclear Technology and Health Physics, and the first four students are expected to complete the program in 1981 (Table 13). Fifteen students were enrolled in the Nuclear Technology and Health Physics program as of January 1, 1981, which represents only 7 percent of the maximum enrollment capacity, given present faculty and facilities. The program is offered as initial instruction in the field and leads to an associate of science degree after 24 months of training.

NON-DESTRUCTIVE TESTING

The three institutions that cite training in Non-Destructive Testing are located west of the Mississippi River (Table 14). One institution offers an associate of science degree program requiring 18 months of training and has an orientation of both initial instruction and skills update/maintenance. Although this program has an enrollment capacity of 70 students, no one is currently enrolled, and there have been no graduates since 1979. The other two institutions offer courses in Non-Destructive Testing that do not lead to a degree or certificate acknowledging training in the field. These courses are offered as initial instruction, and 53 enrollees were cited as of January 1, 1981.

RADIATION PHYSICS

A program in Radiation Physics is cited by one institution as an option offered through its Physics Department. This program expects its first graduate

TABLE 12. PERCENT OF MAXIMUM ENROLLMENT CAPACITY USED: HEALTH PHYSICS (RADIATION PROTECTION), INPO SURVEY OF NUCLEAR-RELATED TRAINING AND EDUCATION, 1981

	Health Physics (Radiation Protection)			
Regions	Number of Programs*	Enrollment 01/01/81	Current Maximum Enrollment Capacity	Percent of Maximum Enrollment Capacity 01/01/81
Southeast	3	249	350	71
Southwest	1	42	70	60
West	1	25	70	36
Total, all regions	5	316	490	64

*Excludes three programs that did not indicate current maximum enrollment capacity (84 enrollees).

TABLE 13. NUCLEAR-RELATED TRAINING AND EDUCATION OFFERED BY ACADEMIC INSTITUTIONS (Less-than-Baccalaureate Degree): Nuclear Technology and Health Physics, INPO Survey, 1981

Field of Study: NUCLEAR TECHNOLOGY AND HEALTH PHYSICS										
Institution	Duration of Training and Education		Training and Education Orientation		Recognition Awarded (degree, diploma, certificate, etc.)	Enrollment as of 01/01/81	Current Maximum Enrollment Capacity	Number of Completers for Calendar Year		
	Sem. Hrs.	Months	Initial Instruction	Skills Update/ Maintenance				1979	1980	Estimated 1981
Queensborough Community CUNY College Bayside, NY	67-69	24	X		Associate of Science Degree	15	200	0	0	4

TABLE 14. NUCLEAR-RELATED TRAINING AND EDUCATION OFFERED BY ACADEMIC INSTITUTIONS (Less-than-Baccalaureate Degree): Non-Destructive Testing, INPO SURVEY, 1981

Field of Study: NON-DESTRUCTIVE TESTING										
Institution	Duration of Training and Education		Training and Education Orientation		Recognition Awarded (degree, diploma, certificate, etc.)	Enrollment as of 01/01/81	Current Maximum Enrollment Capacity	Number of Completers for Calendar Year		
	Sem. Hrs.	Months	Initial Instruction	Skills Update/ Maintenance				1979	1980	Estimated 1981
Orange Coast College Costa Mesa CA[c]	3	2	X		None	18	-	-	-	-
Oklahoma State University Stillwater, OK	3	4	X		None	35	-	-	-	-
Texas State Technical Institute Waco, TX	60	18	X	X	Associate of Science Degree	0	70	3	0	0

[c]Indicates course rather than program offering.

in 1981 and has a January 1, 1981, enrollment of two students (Table 15). The Radiation Physics option, offered as initial training in the field, leads to an associate of science degree after 24 months of instruction.

ENGINEERING PHYSICS

An Engineering Physics program, one third of which is nuclear-related, is cited by one survey participant. The program duration is 21 months, resulting in an associate of science degree (Table 16).

The enrollment for the Engineering Physics program was 60 persons as of January 1, 1981, which represents two-thirds of the enrollment capacity. Twenty program graduates are reported for both 1979 and 1980, and 20 are estimated to graduate in 1981.

CHEMICAL TECHNOLOGY (NUCLEAR OPTION)

An associate of science degree program in Chemical Technology (Nuclear Option) is cited by one institution in the survey. This program has an enrollment capacity of 70 persons but currently has no students enrolled. There are no graduates indicated for 1979, 1980, or 1981 (Table 17).

NUCLEAR QUALITY ASSURANCE TECHNOLOGY

One survey participant cites a program in Nuclear Quality Assurance Technology. This program, offered as initial instruction in the nuclear QA field, indicates an 18-month duration in order to meet the requirements of an associate of science degree (Table 18).

The Nuclear Quality Assurance Technology program with an enrollment of 43 persons has an enrollment capacity that could accommodate almost twice that number. Eight graduates are cited for 1979, nine in 1980, and 12 are projected for 1981.

INSTRUMENTATION TECHNOLOGY

Two academic institutions cite training in the field of Instrumentation Technology (Table 19). Since the two responses in this field are courses rather

TABLE 15. NUCLEAR-RELATED TRAINING AND EDUCATION OFFERED BY ACADEMIC INSTITUTIONS (Less-than-Baccalaureate Degree): Radiation Physics, INPO Survey, 1981

Field of Study: RADIATION PHYSICS										
	Duration of Training and Education		Training and Education Orientation		Recognition Awarded	Enrollment as of	Current Maximum	Number of Completers for Calendar Year		
Institution	Sem. Hrs.	Months	Initial Instruction	Skills Update/ Maintenance	(degree, diploma, certificate, etc.)	01/01/81	Enrollment Capacity	1979	1980	Estimated 1981
Queensborough Community College-CUNY Bayside, NY	60	24	X		Associate of Science Degree	2	No Actual Limit	0	0	1

TABLE 16. NUCLEAR-RELATED TRAINING AND EDUCATION OFFERED BY ACADEMIC INSTITUTIONS (Less-than-Baccalaureate Degree): Engineering Physics, INPO SURVEY, 1981

Field of Study: ENGINEERING PHYSICS										
Institution	Duration of Training and Education		Training and Education Orientation		Recognition Awarded (degree, diploma, certificate, etc.)	Enrollment as of 01/01/81	Current Maximum Enrollment Capacity	Number of Completers for Calendar Year		
	Sem. Hrs.	Months	Initial Instruction	Skills Update/ Maintenance				1979	1980	Estimated 1981
Los Angeles Valley College Van Nuys, CA	60	21	X		Associate of Science Degree	60	90	20	20	20

TABLE 17. NUCLEAR-RELATED TRAINING AND EDUCATION OFFERED BY ACADEMIC INSTITUTIONS (Less-than-Baccalaureate Degree): Chemical Technology (Nuclear Option), INPO SURVEY, 1981.

Field of Study: Chemical Technology (Nuclear Option)										
Institution	Duration of Training and Education		Training and Education Orientation		Recognition Awarded (degree, diploma, certificate, etc.)	Enrollment as of 01/01/81	Current Maximum Enrollment Capacity	Number of Completers for Calendar Year		
	Sem. Hrs.	Months	Initial Instruction	Skills Update/ Maintenance				1979	1980	Estimated 1981
Texas State Technical Institute Waco, TX	60	18	X		Associate of Science Degree	0	70	0	0	0

TABLE 18. NUCLEAR-RELATED TRAINING AND EDUCATION OFFERED BY ACADEMIC INSTITUTIONS (Less-than-Baccalaureate Degree): Nuclear Quality Assurance Technology, INPO SURVEY, 1981

Field of Study: NUCLEAR QUALITY ASSURANCE TECHNOLOGY										
Institution	Duration of Training and Education		Training and Education Orientation		Recognition Awarded (degree, diploma, certificate, etc.)	Enrollment as of 01/01/81	Current Maximum Enrollment Capacity	Number of Completers for Calendar Year		
	Sem. Hrs.	Months	Initial Instruction	Skills Update/ Maintenance				1979	1980	Estimated 1981
Community College of Beaver County Monaca, PA	60	18	X		Associate of Science Degree	43	80	8	9	12

TABLE 19. NUCLEAR-RELATED TRAINING AND EDUCATION OFFERED BY ACADEMIC INSTITUTIONS (Less-than-Baccalaureate Degree): Instrumentation Technology, INPO SURVEY, 1981

Field of Study: INSTRUMENTATION TECHNOLOGY										
Institution	Duration of Training and Education		Training and Education Orientation		Recognition Awarded (degree, diploma, certificate, etc.)	Enrollment as of 01/01/81	Current Maximum Enrollment Capacity	Number of Completers for Calendar Year		
	Sem. Hrs.	Months	Initial Instruction	Skills Update/ Maintenance				1979	1980	Estimated 1981
Loma Linda University Riverside, CA[c]	3	2	X		None	0	10	6	3	0
Orange Coast College Costa Mesa, CA[c]	3	2	X		None	24	-	-	-	-

[c]Indicates course rather than program offering.

than programs, no formal recognition of completion of training is given. Both courses are offered as initial instruction in the field.

One of the Instrumentation Technology courses cites an enrollment of 24 students as of January 1, 1981; however, no graduates are listed for 1979, 1980, or 1981. The other course cites no enrollment for January 1, 1981, although a maximum of 10 students could be accommodated, given present faculty and facilities. This latter course indicates that six students completed training in 1979 and three in 1980. No graduates are expected in 1981.

INSTALLATION, OPERATION, AND MAINTENANCE OF REACTORS

Two programs are cited by one institution in the field of Installation, Operation, and Maintenance of Reactors. One program, offered as a skills update/maintenance orientation, requires 4 months to complete (Table 20). The other program is offered as initial instruction in the field and requires 8 months to complete. Both programs offer a certificate as recognition of completion of coursework; however, no graduates are listed for either program in 1979, 1980, or 1981. Furthermore, although each cites a maximum enrollment capacity of 18 students, no enrollment is indicated in either program as of January 1, 1981.

SUMMARY

The purpose of this report is to provide a description of less-than-baccalaureate degree, nuclear-related training and education provided by academic institutions in the United States. In addition to identifying those institutions which provide nuclear-related programs, this report includes information regarding program field of study, training orientation, recognition offered graduates, current enrollment and enrollment capacity, and number of program completers for 1979, and 1980, and those estimated for 1981.

The data gathered for this report indicate the greatest proportion of the less-than-baccalaureate degree, nuclear-related training is provided in the fields of Nuclear Technology and Health Physics (Radiation Protection). Although the majority of the programs are in the western United States, the majority of enrollees and graduates are in programs in the Southeast. Over half of the nuclear-related programs lead to an associate of science degree

TABLE 20. NUCLEAR-RELATED TRAINING AND EDUCATION OFFERED BY ACADEMIC INSTITUTIONS (Less-than-Baccalaureate Degree): Installation, Operation, and Maintenance of Reactors, INPO SURVEY, 1981

Field of Study: INSTALLATION, OPERATION, AND MAINTENANCE OF REACTORS										
Institution	Duration of Training and Education		Training and Education Orientation		Recognition Awarded (degree, diploma, certificate, etc.)	Enrollment as of 01/01/81	Current Maximum Enrollment Capacity	Number of Completers for Calendar Year		
	Sem. Hrs.	Months	Initial Instruction	Skills Update/ Maintenance				1979	1980	Estimated 1981
California State University-Northridge Northridge, CA	15	4 mos.		X	Certificate	-	18	-	-	-
	30	9 mos.	X		Certificate	-	18	-	-	-

after 18 to 24 months of study, and three-fourths of the programs are offered as initial instruction in the field. Overall, the programs indicate ample potential for growth, given present faculty and facilities, with Nuclear Technology programs citing the most capacity and Health Physics (Radiation Protection) programs citing the least capacity for growth.

This information is useful for giving an overall view of the academic programs available for training technicians for employment in the nuclear power industry. Given the extensive growth projected for this occupational sector, the institutions that provide less-than-baccalaureate degree, nuclear-related programs have an important role to play in meeting the technician training needs of the nuclear power industry over the next decade.

APPENDIX A

1981 Survey of Nuclear-Related Training and Education: Academic Institutions (Less than Baccalaureate Degree)

INPO
Institute of
Nuclear Power
Operations
1820 Water Place
Atlanta, Georgia 30339

A SURVEY OF NUCLEAR-RELATED TRAINING AND EDUCATION

Name of Institution _____ Street Address _____

City and State _____ Zip Code _____

Name and title of the person at your institution responsible for this survey who can be contacted by INPO if questions arise concerning your submission:

Name and Title _____ Telephone _____

If you have questions concerning this survey, please place a collect call to Lee Howard or Don Levison at (615) 576-3314.

PLEASE RESPOND BY MAY 29, 1981

GENERAL INSTRUCTIONS

This survey requests information on enrollment levels and capacities in nuclear-related training and education *below the baccalaureate level* at your institution. For purposes of this survey, nuclear-related training and education include a core of nuclear knowledge that allows graduates/completers to function in the nuclear power field. Examples of nuclear-related fields of study are listed in Part II and include, in addition to nuclear technology, other technical disciplines that offer a nuclear concentration.

For purposes of this survey, training and education may consist of a curriculum program leading to an associate degree, or a series of courses leading to a diploma, certificate, or other recognition. Training and education may be oriented towards new entrants receiving initial instruction in a nuclear-related field, or towards trained personnel seeking to update/refresh their skills.

PLEASE ENCLOSE WITH YOUR COMPLETED SURVEY:

- A catalog of course offerings and other descriptive literature for the training and education reported in this survey.
- A 200-word summary description of nuclear-related training and education at your institution (see Part III) to be included in the final survey report.

If your institution offers no nuclear-related training or education, check the following box and return the survey to avoid further correspondence. (Please review the fields of study listed in Part II before responding.) ☐

PART I. TYPE OF INSTITUTION (Check one.)

- ☐ University
- ☐ Four-Year College
- ☐ Community College
- ☐ Private Vocational School
- ☐ Technical Institute
- ☐ Junior College
- ☐ Area Vocational School
- ☐ Other (please specify)

PART II. ENROLLMENT AND CAPACITY INFORMATION

Please provide the requested information for nuclear-related training and education at your institution. To avoid double counting, do not report a person in more than one field of study. Maximum capacity should be based on *current* staffing, space, and funding levels.

Definition of Terms for the Training and Education Orientation Question Below:

Initial Instruction. Instruction provided to persons who have no significant prior training or education in their current field of study.

Skills Update/Maintenance. Instruction provided to persons employed in nuclear power who have prior training or education in their current field of study and who are seeking to update/refresh their skills.

Field of Study	Duration of Training and Education (in months)	Training and Education Orientation (see definitions above; check one)		Recognition Awarded (degree, diploma, certificate, etc.)	Enrollment as of Jan. 1, 1981	Current Maximum Enrollment Capacity	Number of Completers for Calendar Year		
		Initial Instruction	Skills Update/ Maintenance				1979	1980	Estimated 1981
NUCLEAR TECHNOLOGY. The subject matter emphasizes atomic and nuclear physics, nuclear reactor physics, nuclear reactor operations, health physics, shielding, radioisotopes, chemistry, electronics, nuclear instrumentation, and nuclear reactor safety.									
HEALTH PHYSICS (RADIATION PROTECTION). A combination of subject matter and experience designed to prepare a person to conduct radiological measurements and evaluations of exposure to X-ray, gamma, and alpha emitters and to recommend measures to insure maximum protection (does not include medical applications of radiation such as nuclear medical technology or radiation therapy).									

INSTALLATION, OPERATION, AND MAINTENANCE OF REACTORS. Organized learning experiences concerned with nuclear reactor plants, their use, and related factors.									
NONDESTRUCTIVE TESTING. Training radiography, ultrasonics, liquid/dye penetrant, magnetic particle, and other techniques of NDT, including uses of spectrograph, spectrometer, densitometer, X-ray, sound-testing equipment, eddy-current testing.									
ELECTRONIC TECHNOLOGY (NUCLEAR OPTION). A combination of subject matter and experiences designed to prepare a person to fabricate, assemble, modify, install, and maintain electronic equipment, with some additional training in the nuclear field.									
ELECTROMECHANICAL TECHNOLOGY (NUCLEAR OPTION). Specialized classroom and laboratory learning experiences in both the mechanical and electrical fields. Instruction is planned to provide preparation for responsibilities concerned with the design, development, testing calibration, and maintenance of electromechanical devices and systems within the nuclear field.									
CHEMICAL TECHNOLOGY (NUCLEAR OPTION). The subject matter emphasizes qualitative and quantitative analysis in general and organic chemistry. This program prepares the graduate to complete chemical and radiochemical analyses in process chemistry for nuclear power plants, including involvement with radioactive materials and measurements.									
INSTRUMENTATION TECHNOLOGY (NUCLEAR OPTION). This program is planned to prepare the graduate to design, develop prototypes, test and evaluate control systems or automated systems, and prepare written reports in support of professional personnel. This program is concerned with instrumentation within the nuclear field.									
OTHER (Please specify both field and description.)									

PART III. DESCRIPTION OF TRAINING AND EDUCATION

Please provide in the designated area below a summary description of nuclear-related training and education at your institution to be included *as submitted* in the final survey report. The description should not exceed 200 words. Typical information should include training and education objectives, content areas, prerequisites, and special features such as cooperative work study programs.

SUMMARY DESCRIPTION:

Name and title of person to whom users of the final survey report should address inquiries concerning nuclear-related training and education at your institution:

Name and Title _____ Telephone _____

Address _____

APPENDIX B

Summary Descriptions of Nuclear-Related Training and Education Programs Provided by Survey Participants

Aiken Technical College
P.O. Drawer 696
Aiken, SC 29801

Contact: Dr. Tek Chand
(803) 593-9231

Health Physics (Radiation Protection)

The Health Physics and Radio-chemistry training began at Aiken Technical College in 1972. The program prepares the students for Health Physics and Radio-chemistry jobs in the nuclear industry. It gives some background knowledge on instrumentation and reactor operation. After some initial enrollment difficulties, the program is now growing at a rapid pace. The laboratory facilities are excellent, including several G.M. counting stations, all of the most commonly used H.P. survey meters, NaI and Gellie detectors, Canberra MCA connected to a H.P. computer for gamma spectroscopy, and nine curie Pu-Be source for neutrons. The institution is blessed with a very active advisory committee from industry. The program provides an excellent opportunity for training and increases the earning potential tremendously.

California State University
18111 Nordhoff St.
Northridge, California 91330

Contact: Donald E. Bianchi, Dean, School of Science
(213) 885-2004

Nuclear Technology; Installation, Maintenance, and Operation of Reactors

Nonmatriculated students may sign up for courses in engineering, physics, chemistry, and biology through concurrent enrollment in extension program. There are 4 courses including labs in nuclear engineering, 4 with labs in nuclear physics, 1 with lab in both chemistry and biology.

Central Florida Community College
P.O. Box 1388
Ocala, Florida 32678-1388

Contact: Frank Holland, Associate Professor, Nuclear Technology
(904) 237-2111, ext. 375 or 376

Nuclear Technology

Chabot College-Valley Campus
3033 Collier Canyon Road
Livermore, California 94550

Contact: Donald R. Milanese, Director of Instruction
(415) 455-5300

Health Physics (Radiation Protection)

The certificate in Radiation Technology offers the student an understanding of the field of nuclear energy with special emphasis on radiation protection. Radiation protection includes evaluation of potential hazards to workers in radiation areas, observing radiation work in progress to anticipate potential problems, and collecting and analyzing air and water samples to determine the effectiveness of radiation control programs.

Course work includes methods of radiation detection, regulations pertaining to safety and health, effects of radiation, principles of atomic energy and radioactivity, fission, fusion, nuclear materials, radioactive decay, measurements of radiation, genetic and somatic effects of irradiation on biological systems, hazards associated with ionizing radiations, field survey guides, decontamination and waste disposal, and other areas of study associated with radiation detection and instrumentation. The certificate also includes mathematics and English courses related to this field of study.

The program is offered in the evening and may be completed on a part-time basis normally over a period of more than one year.

CERTIFICATE OF ACHIEVEMENT - TOTAL UNITS REQUIRED 32	Units
Radiation Technology 50 (Introduction to Nuclear Energy)	3
Radiation Technology 60A-60B (Fundamentals of Radiation)	6
Radiation Technology 61 (Biological Effects of Radiation)	3
Radiation Technology 62A-62B (Radiation, Hazard Evaluation, & Control)	4
Radiation Technology 63A-63B (Radiation Instrumentation)	5
Mathematics 60A-60B (Technical Mathematics) or equivalent	8
English (Composition)	3
	32

Chattanooga State Technical Community College
Chattanooga, Tennessee 37406

Contact: D.R. Stone, Department Head
(615) 622-6262

Health Physics (Radiation Protection)

The two-year A.S. degree program is designed to train health physics technicians. Courses included are: basic properties of radiation including their interaction with matter, the rules and regulations governing radiation exposure, and specific radiation protection procedures. Laboratory experiments performed give students a wide experience in the proper uses of radiation detection equipment.

Columbia Basin College
Pasco, Washington 99301

Contact: Larry DeWitt, Instructor, Nuclear Technology
(509) 547-0511

Nuclear Technology

This 2-year vocational program in Nuclear Technology was developed by the Hanford DOE contractors to provide a supply of academically prepared, nuclear trained personel to fill a variety of nuclear-related positions. Included in these positions are:

a. Reactor operator trainee
b. Chemical Lab technician
c. Radiation monitor
d. Associate engineer
e. Radioisotope counting room technician

Community College of Beaver County
College Drive
Monaca, Pennsylvania 15061

Contact: Mr. Scott F. Ensworth, Director of Admissions
(412) 775-8561

Nuclear Quality Assurance Technology

Nuclear Quality Assurance Technology leading to an Associate in Applied Science Degree was instituted by Community College of Beaver County in 1974 and the first class graduated in 1976. Graduates have been employed by architectural/engineering firms, nuclear equipment suppliers, nuclear construction contractors, and utility companies operating nuclear power plants.

This cross-technologies NQA program is designed specifically to prepare qualified junior engineers to aid and assist professional engineers in the QA/QC functions of materials, construction and operations of nuclear power systems.

Throughout the two-year program, heavy emphasis is placed on 10 CFR and F.S.A.R.'s as related to subject matter. In addition students must complete a unique course in metrology using ANSI Y 14.5, "DIMENSIONING & TOLERANCING." They also qualify at Level I in four (4) nondestructive testing areas in the "Welding Specs & Codes" course. The ability to calculate reliabilities is the end product of the "Elements of QA/QC" course.

Students for the past four summers have taken the optional "On-Site QA Internship" at commercial nuclear power plants in cooperation with the A/E's and utility companies in Pennsylvania and Ohio. This direct experience has been very beneficial for students in completing their second year and has improved their employment oppportunities.

Denmark Technical College
P.O. Box 327
Denmark, SC 29042

Contact: LeRoy R. Brown, Director of Research
(803) 793-3301, ext. 47

Nuclear Technology

PROGRAM: The Nuclear Engineering Technology program is designed to provide students with a background in nuclear chemistry and engineering fundamentals. The graduate will be qualified to work in nuclear industries, chemical industries, and radiological laboratories. An increasing number of Denmark Technical College graduates enter the field of nuclear energy plants as health physicists. South Carolina has more nuclear facilities than both of the neighboring states (Georgia and North Carolina) and the demand for trained nuclear personnel will no doubt increase within the next few years.

CURRICULUM: To graduate from this Associate of Engineering Technology Degree Program, the student must complete 115 Quarter Hours of Credit (QHC); 60 QHC in General Education Courses, 45 QHC in Major Courses.

Florence-Darlington Technical College
P.O. Drawer F-8000
Florence, SC 29501

Contact: Dr. Darrel W. Staat, Dean of Instruction
(803) 662-8151

Nuclear Technology

The graduates of the Nuclear Technology program will be trained primarily to assume duties as reactor operators for Nuclear generating facilities. Students will receive training through lecture and laboratory experiences in areas of nuclear safety, controls, and facility operations. Cooperative phases of the program will provide students with on-site practical experience with nuclear generating equipment. Although trained primarily as reactor operators, graduates may also find employment in fields such as health safety and waste disposal technicians.

Kansas State University
Nuclear Engineering Department
Ward Hall
Manhattan, Kansas

Contact: Dr. N. Dean Eckhoff, Professor and Head
(913) 532-5624

Nuclear Technology

Kansas State University (KSU) and Emporia State University (ESU), through Continuing Education Divisions, are beginning an approximately 18-month technology educational program for KG&E Wolf Creek Generating Station Operators. Currently there is no formal degree awarded; however, the possibility of awarding an Associate Degree is being studied. ESU is responsible for 17 semester hours of math and 19 semester hours of fundamental college level sciences (chemistry, physics, and applied statics). KSU is responsible for 12 semester hours of basic engineering courses and 16 semester hours of nuclear engineering technology courses. A total of 64 semester hours will provide a sound nuclear engineering technology associate degree background.

Lakeshore Technical Institute
1290 North Avenue
Cleveland, Wisconsin 53015

Contact: Robert Naber
(414) 693-8211

Health Physics (Radiation Protection)

Course No.	Course Title	Cr.	Hrs./ Wk.	Total Hours
First Semester				
801-151	Communication Skills I	3	3	54
804-112	Algebra Computations	3	3	54
804-114	Calculator Computations	2	2	36
804-116	Basic Trigonometry	2	2	36
806-108	Chemistry, General	4	6	108
		14	16	288
Second Semester				
624-114	Introduction to Nuclear Systems	3	5	90
824-118	Introduction to Radiation Biology	3	4	72
624-122	Radiation Physics	3	4	72
801-160	Technical Writing	3	3	54
804-118	Advanced Algebra	2	2	36
809-153	American Institutions	3	3	54
		17	21	378
Third Semester				
624-130	Radiation Protection	2	2	36
624-132	Radiological Emergencies	3	4	72
624-136	Radiation Monitoring Techniques	3	5	90
624-140	Radionuclide Chemistry	3	5	90
809-110	Economics	3	3	54
		14	19	342
Fourth Semester				
624-134	Radiation Shielding	2	2	36
624-138	Radioactive Materials Management and Disposal	4	6	108
624-142	Advanced Radionuclide Analysis	3	4	72
809-151	Psychological Human Relations	3	3	54
605-xxx	Mini- & Micro-Computer Systems	3	4	72
	Elective	2		
		17	19	342

Loma Linda University
College of Arts and Sciences
Riverside, California 92515

Contact: Ivan F. Rouse, Associate Professor of Physics
(714) 785-2137

Instrumentation Technology

The Department of Physics at Loma Linda University offers a one-quarter, 4-unit course in Nuclear Instrumentation and Measurement. Its overall objective is to provide students majoring in chemistry or physics with practical experience in handling nuclear instrumentation and interpreting measurement results. Theory is developed as needed throughout the course. Students design and conduct an experiement of their own as part of the course requirements.

Additional course work is offered in Radiological Technology by the University through the School of Allied Health Professions. The emphasis is medical applications of radiation.

PHYS 474 - Nuclear Instrumentation and Measurements (4): Basic nuclear theory, interaction of radiation with matter, physics of detectors, experimental techniques involving: instrumentation, radiological safety, spectrometry, coincidence measurements, activation analysis. Two lectures and two three-hour laboratories per week. Prerequisite: three quarters of general physics.

Los Angeles Valley College
5800 Fulton Avenue
Van Nuys, California 91401

Contact: Myron A. Mann, Chairman, Physics Dept.
(213) 781-1200, ext. 281

Engineering Physics

Los Angeles Valley College offers a standard first two years program for physics or engineering majors. This includes three semesters of laboratory physics, all of which have a calculus prerequisite. The third course in this sequence contains material on atomic and nuclear structure, radioactivity, and particle physics.

Memphis State University
Center for Nuclear Studies
Memphis, Tennessee 38152

Contact: Dr. D.W. Jones, Director
(901) 454-2687

Nuclear Technology, Health Physics (Radiation Protection)

The following programs and courses are provided both at nuclear plant sites and on the MSU campus for students seeking employment in the nuclear power field and present employees of nuclear power plants seeking to upgrade their capabilities:

Nuclear Reactor Fundamentals	Radiation Technician Fundamentals	Shift Technical Advisors Program
Mathematics	Mathematics	Calculus
Physics Mechanics	Radiation Principles	Materials Science
Heat and Thermodynamics	Radiation Detection	Corrosion Chemistry
Fluids	Radiation Management	Materials Failure
Electricity	Biological Effects	Thermodynamics
Nuclear Physics		Fluid Dynamics
Reactor Physics		Heat Transfer
Reactor Chemistry		Reactor Physics
Reactor Instrumentation		Computer Technology
Radiation Protection		Electrical Power Generation
		Human Behavior
		Projects in Accident Assessment

Mississippi Gulf Coast Junior College
P.O. Box 100
Gautier, Mississippi 39553

Contact: Herb Robbins, Assistant Director of Vocational Instruction
(601) 497-4313, ext. 217

Oklahoma State University
CR 208
Stillwater, Oklahoma 74078

Contact: Howard M. Johnson, Associate Professor
(405) 624-5716

Nuclear Technology, Nondestructive Testing

Orange Coast College
2701 Fairview Road
Costa Mesa, California 92626

Contact: Nell M. Woodward, Associate Dean,
Director, Institutional Research
(714) 556-5542

Nuclear Technology, Health Physics (Radiation Protection), Nondestructive Testing, Instrumentation Technology

Nuclear Technology

Energy 111 - Energy Sources: Approximately 3 hours per semester are devoted to discussion of nuclear energy as a sourse of energy in this course. Offered Fall & Spring semesters.

Health Physics

Radiologic Technology 110 - Radiologic Physics & Protection: Covers the fundamentals of radiation & radiologic physics; the effects of radiation; principles of protection as applied to radiography; health physics instrumentation with a study of radiation control regulations. Offered Fall & Spring semesters.

Nondestructive Testing

Welding Technology 210 - Testing & Inspection: Approximately nine weeks devoted to nondestructive testing. This includes magnetic particle, ultrasonic, penetrant dyes, eddy current, x-ray, and visual tests. The students have hands on experience with all but the x-ray. Offered Fall only.

Instrumentation Technology

Energy 107 - Steam Plant: This course is designed to assist steam plant operators to be able to pass the test for a license to operate such. This is a one semester course offered Fall semester only. One week (3 hours) is devoted to the discussion of nuclear powered steam plants.

Pennsylvania State University
Altoona Campus
Altoona, Pennsylvania 16603

Contact: Ronald A. Petak, Administrative Assistant
(814) 946-4321

Nuclear Technology

This major is designed to provide technically trained personnel to support the rapidly developing nuclear industry between the levels of high school graduate and professional engineer. The wide scope of training prepares the nuclear technologist for careers in radiation safety, reactor operations, radioisotope handling, nuclear and control instrumentation, fuel fabrication, and health physics.

Pennsylvania State University
Hazleton Campus-Highacres
Hazelton, PA 18201

Contact: Dr. William J. David, Campus Director
(717) 454-8731

Nuclear Technology

Pennsylvania State University
231 Sackett Building
University Park, PA 16802

Contact: Warren F. Witzig, Professor & Dept. Head
(814) 865-4911

Nuclear Technology

FIRST TERM	Credits
E.G.1, Engineering Drawing	2
*Engl. 4, Basic Writing Skills; or Engl. 10, Composition and Rhetoric I	3
Engr. 2, Engineering Orient.	1
Math. 801, Technical Math.	3
Phys. 150, Tech. Physics	3
	12

SECOND TERM	
Cmp. Sc. 1, Basic Computer Programming	1
D.C. Circuits	3
E.E. 809, D.C., Circuits Lab.	2
Math. 802, Tech. Mathematics	3
Phys. 151, Tech. Physics	3
	12

THIRD TERM	
Chem. 11, Intro. Chemistry	3
E.E. 814, Electrical Circuits	4
Engl. 10, Composition & Rhetoric I; or Engl. 20, Composition & Rhetoric II	3
Math. 803, Tech. Calculus	3
	13

FOURTH TERM	Credits
Nuc. E., 800, Nuclear & Atomic Science	2
Nuc. E., 802, Principles of Measurement	3
Social science selection	3
Sp. Com. 200, Effective Speech	3
	11

FIFTH TERM	
Engl. 820, Report Writing	3
M.E. 807, Heat Transfer	3
Nuc. E. 801, Radiological Safe.	2
Nuc. E., 802, Elements of Nuclear Technology	2
Humanities selection	3
	13

SIXTH TERM	
Nuc. E. 803, Elements of Nuclear Power Generation	3
Nuc. E 804, Intro. to Reactor Technology	3
Nuc. E. 812, Nuclear Tech. Laboratory	3
Nuc. E. 814, Reactor Tech. Laboratory	3
	12

TOTAL CREDITS: 73

Queensborough Community College
Physics Dept., Room S3-42
Bayside, New York 11364

Contact: Dr. Don Engelberg, Professor of Physics
(212) 631-6234

Nuclear Technology and Health Physics, Radiation Physics

Queensborough offers a 2-year AAS degree in Nuclear Technology and Health Physics including theoretical training at the technician level or higher and practical experience with the entire spectrum of instruments currently used in industry. The program is designed for maximum flexibility, preparing students for the nuclear power industry, nuclear medical instrumentation, or the general non-power nuclear and radiation industries. Four specifically nuclear courses follow a two-semester technical physics sequence. After a basic course in atomic and nuclear physics presented algebraically and graphically, students study reactors, health physics, and dosimetry principles and techniques in separate courses. They also train in mathematics and electronics, in addition to the general requirements of the college. Students can also opt for a Radiation Physics concentration under an AS degree. Graduates can enter Bachelor of Technology or BS (Engineering) programs.

Students use a 400 KeV Van De Graaf accelerator, a neutron source, a DEC PDP 11/34A computer, and wide selection of NIM instrumentation. Standard survey meters of all sorts are available. Students also operate a TLD reader. Training includes operation of a high-purity germanium detector and multichannel analyzer.

Students can enter from high school or at any time after.

A council drawn from power and non-power industry, hospitals, and government advises concerning equipment and curriculum.

Reed College
Portland, Oregon 97202

Contact: Michael A. Kay, Director
Reed Reactor Facility
(503) 771-1112, ext. 284

Nuclear Technology

A Reactor Operator Seminar is offered to all interested persons (students, faculty, staff, community) leading to an NRC license for the Reed Reactor Facility's 250 KW TR16A Mark 1 Research Reactor. It starts in September one evening a week and includes the 2-week, 8 hour per day annual reactor maintenance in January. NRC exams are held during spring recess. Completion of the program means the operator will help with reactor operations for educational classes and routine reactor maintenance. The reactor is used in analytical chemistry and radiochemistry courses and experiments.

Shoreline Community College
16101 Greenwood Avenue North
Seattle, Washington 98133

Contact: Dr. Dave Rosenquist, Science Division Chairman
(206) 546-4568

Nuclear Technology

Shoreline Community College, in cooperation with the Department of Nuclear Engineering at the University of Washington and the U.S. Department of Energy (DOE) is offering a series of three courses in nuclear technology. The one-year Nuclear Technology Program is an orientation to the nuclear industry to complement the training in Chemical Technology, Electronics Engineering Technology, and Mechanical Engineering Technology. Our intent is not to train a student as a nuclear technician, but to acquaint students who are involved in other technical degree programs with the scope of the nuclear industry and the basic regulations and physical principles involved. Graduates will enter the industry in technical fields directly related to their major area of study.

The first course consists of three one-hour lectures per week which will focus on the basic principles underlying the release, control, and utilization of all forms of energy from nuclear energy.

The second course consists of two one-hour lectures per week plus a two-hour laboratory period in the Nuclear Reactor Laboratory at the University of Washington. The lectures will focus on properties of nuclear radiations, nuclear instruments and measurements, radiation shielding, and biological effects of radiation. The laboratory demonstrations will be coordinated with the lecture material.

The third course consists of two one-hour lectures per week and one two-hour laboratory period at the University of Washington. The lecture material focuses on the operating characteristics of nuclear power reactors, licensing, and safety aspects. The lecture demonstrations using the University of Washington nuclear reactor, together with the lecture material in the three courses, prepares the student for the examinations given by the Nuclear Regulatory Commission.

Texas State Technical Institute-Waco
Waco, Texas 76705

Contact: J. Carl Kee, Program, Chairman, Nuclear Technology
(817) 799-3611, ext. 510

Nuclear Technology, Health Physics (Radiation Protection), Chemical Technology

The nuclear technology program at TSTI-Waco prepares students for entry into the nuclear industry as technicians in health physics, radiation chemistry, quality assurance/quality control, and environmental control. Students who choose so may take elective courses to become reactor operator trainees. The courses are

Texas State Technical Institute-Waco (continued)

fully accredited and graduates receive an associate of applied science degree. Courses are approximately 50% lecture and 50% lab and are supplemented by activities at the 1 MW(t) TRIGA reactor at Texas A&M University. Special short courses, tailored for particular customers in industry, are available, as well as contract training on existing curricula.