

AN ASSESSMENT OF THE NEED FOR NUCLEAR  
RELATED TECHNICIANS IN SELECTED  
EMPLOYING ORGANIZATIONS

By

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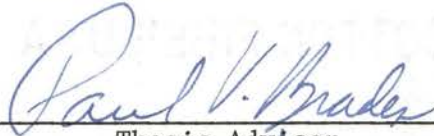
1970

Submitted to the Faculty of the Graduate College  
of the Oklahoma State University  
in partial fulfillment of the requirements  
for the Degree of  
MASTER OF SCIENCE  
May, 1971

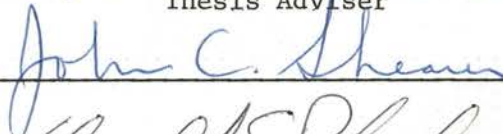
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Thesis Approved:



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## ACKNOWLEDGEMENTS

This study was completed only through the cooperation, guidance and assistance of many persons. The writer wishes to express his thanks to those who made this project a reality. The author wishes to thank Dr. Paul V. Braden, Major Advisor, for his interest, guidance and assistance throughout this entire study. The author thanks Mr. Krishan Paul who spent many hours of his time in advisement and general encouragement during the development and completion of the study.

Acknowledgement must also go to Mr. Robert Gifford and the Southern Interstate Nuclear Board for their general support of a larger project of which this study is related. The author is grateful to Dr. John C. Shearer and the Manpower Research Center which made this graduate research opportunity possible.

I would also like to thank Mr. John Haley for his help in the computer analysis and to Miss Judy Lacy for her typing of this manuscript.

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## CHAPTER I

### THE PROBLEM

#### Introduction

Technological advances and the emergence of new occupations within the last decade has increased the need for knowing and being able to predict the manpower needs within our society. The manpower requirements, at the technician level, as reported by a study entitled, Technician Manpower 66-80<sup>1</sup>, indicated that one million new workers will be required between the years 1966 and 1980.

Manpower planning, whether it be on a state, regional or national basis is in a developmental stage. Yet, this type of planning is a critical component in the development of human resources which in turn is critical to our nations economic development.

This research project is concerned with estimating the supply and demand of nuclear technicians. More specifically, the study is concerned with the identification and measurement of the need for nuclear technician manpower in seventeen southern states and Puerto Rico which are encompassed by the Southern Interstate Nuclear Board (hereafter referred to as SINB).

### Purpose of the Study

The three key terms that shed light on the purpose of this research project are "identification", "measurement", and "estimation". The overall purpose of the study is to identify with due regard to some serious methodological constraints, the need for nuclear technicians; measure the present demand and estimate the future demand for nuclear technicians by comparing the supply and the demand for nuclear technicians.

The specific purpose of this study can best be identified by attempting to answer the following research questions:

1. How many nuclear technicians are presently employed and what will be the demand for nuclear technicians during the 1970's?
2. How many nuclear technicians are now being trained?
3. What are the manpower requirements for nuclear technicians when both supply and demand factors are considered?

### Need for the Study

The nuclear industry is in a unique developmental stage. It is a new industry with future potential. This potential, however, is dependent on a vast amount of manpower planning. The satisfaction of future manpower needs is one of the critical concerns in the development of this industry.

This research project will deal with two of the major sectors of manpower planning i.e., supply and demand. If the present manpower level of the nuclear industry can be identified including any manpower demand along with future manpower requirements, then the manpower

supplies can be evaluated in terms of meeting these present and future manpower needs.

Identification of manpower needs is one of the first steps in manpower planning. The review of literature (see Chapter II) shows that within the nuclear industry, there has been little research on sub-professional manpower needs. This lack of total manpower planning in a systematic way supplies the basic need for this study.

### Definition of Terms

The term Manpower Supply shall be used to mean the total number of projected skilled persons available during the time period under consideration, categorized according to specific skill, or "skill cluster."<sup>1</sup>

Manpower Demand will denote the total number of skilled persons measured or estimated to be needed during the time period under consideration, according to job titles and descriptions.

The Southern Interstate Nuclear Board (SINB) is a board established by the Southern Governor's Conference in 1961 to aid in the development of the Nuclear Industry in Puerto Rico and seventeen southern states: Maryland, Delaware, Virginia, West Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, Missouri, Oklahoma, and Texas.

A technician will be defined as a person who directly or indirectly support scientists and engineers in designing, developing, producing, and maintaining machines and materials. In general, these technician jobs are technical in nature but more limited in scope than those of the engineer or scientist, and have a practical rather than a

theoretical orientation.<sup>2</sup> Furthermore, the term is used in this study to denote those in the nuclear industry who perform nuclear related technical tasks regardless of educational background.

#### FOOTNOTES

<sup>1</sup>Paul V. Braden, James L. Harris, and Krishan K. Paul, Occupational Training Information System, June 30, 1970, p. 21.

<sup>2</sup>Maurice W. Roney and Paul V. Braden, Occupational Education Beyond The High School In Oklahoma, September, 1967, p. 21.

## CHAPTER II

### REVIEW OF LITERATURE

#### Introduction

Historically, research in nuclear science began in the nineteenth century but the major emphasis placed on this field is a recent development. The need for adequately trained manpower is gaining major emphasis as the nuclear field continues its rapid growth. This study is part of an effort to assess the demand for nuclear related manpower within the Southern Interstate Nuclear Board (SINB) region and to determine how these needs might most effectively be met.

Specifically, the purpose of this study is to ascertain the need for nuclear technicians; measure the present demand and estimate the future demand for nuclear technicians by comparing the supply and the demand for nuclear technicians. There is hardly any research completed which addresses itself to both supply and demand of the nuclear industry. The U. S. Atomic Energy Commission in cooperation with the Bureau of Labor Statistics reported that between 1963 and 1968 the number of technicians in the nuclear field, excluding Radiologic Technicians, increased from 22,347 to 25,446 an increase of 14 percent over a five year period.<sup>1</sup>

The studies so far completed, though admirable for gauging national trends, can serve only as a starting point for manpower planning on a state or regional level.

This chapter will be divided into the following sections to help fulfill the purpose of this study:

1. Manpower Implications
2. Technician and Technical Training
3. Manpower Forecasts
4. Summary

### Manpower Implications

The impact of nuclear energy has been felt in three major areas: power generation, health, and research and development. The power generation area requires thousands of highly trained workmen to construct, fuel, operate, and maintain nuclear power plants. The U. S. Atomic Energy Commission in a publication entitled Utility Staffing for Nuclear Power, estimated that technician level manpower requirements of a nuclear power plant are 47 highly trained technicians at different levels.<sup>2</sup>

SINB has reported there are 31 power plants scheduled to be completed in the period 1970-77. According to SINB:

Within the SINB region it is estimated that there will be 50 to 60 nuclear power reactors by 1980 with a generating capacity of 52,000 Mwe and that 193,000 Mwe of nuclear power will be required by 1990. This leaves an additional requirement of over 166,000 Mwe for which sites must be selected.<sup>3</sup>

Perhaps the biggest and most noticeable effects of nuclear energy is in the Health field. The number of X-ray technicians have been estimated at between 30,000 and 75,000.<sup>4</sup> Dr. Howard L. McMartin, when speaking in a conference of X-ray Technician Manpower, reports that on the average the hospitals employ eight X-ray technicians per thousand

beds, 29 percent of the private offices employ X-ray technicians, and 66 percent of the clinics employ such technicians.<sup>5</sup>

Industrial research and development of nuclear energy has grown through the development of nuclear energy in the area of national defense. Of the 25,400 technicians employed in 1968 in the nuclear field, 11,100 or 43 percent were involved in research.<sup>1</sup>

### Technician and Technical Training

Technician, a term used by many for a variety of different type individuals, has defied a clear and precise definition. Drs. Maurice Roney and Paul Braden have defined "technician" as:

...A person who directly or indirectly supports scientist and engineers in designing, developing, producing, and maintaining machines and materials. In general, these technician jobs are technical in nature but more limited in scope than those of the engineer or scientist, and have a practical rather than a theoretical orientation.<sup>6</sup>

Drs. Maurice Roney and Donald Phillips contend there are three generations of technicians. According to them first and second generation technicians are somewhere between the skilled workmen and the engineers and scientists. The third generation of technicians, however, differ from their first and second generation brethren "in the mathematics and science base required ... and in the shift from procedural and manipulative skills to cognitive and analytical skills." The authors continue to explain:

The third generation of education will cut across established fields of technology. This generation will provide new combinations of technical skills and knowledge built around a core of the sciences. Applications of the sciences will be drawn from modern industrial activities, and the "specialized" content of the instructional program will be systems oriented, rather than field oriented.<sup>7</sup>

It is in the context of Drs. Roney and Braden that the term "Nuclear Technician" will be used in this study, with the addition of that regardless of educational background, if the individual performs nuclear related technical task he will be included in this study.

### Manpower Forecasts

No meaningful manpower planning is possible without an accurate assessment of the jobs (demand) for which training is required (supply). Kaufman and Brown state that:

...A forecast can seldom be more than a very sophisticated and knowledgeable guess about the future, and so should be treated only as an approximate guidelines. Finally, manpower projections and analysis are concerned only with the economic effects of education; the social and other effects should also be considered.<sup>8</sup>

No model has yet been developed to serve the needs of both industrial manpower and education planners. Some recent efforts have been developed in several states to systematically gather data on manpower supply and demand and affect manpower planning by their matching.

A systems model, developed in Oklahoma entitled, Occupational Training Information System (OTIS), is especially worthy of notice because of its systematic approach to manpower planning. This model is aimed at analysis of supply data collected through institutions of training like vocational schools, junior colleges and private schools. The area skill survey method was combined with the sample-survey techniques to arrive at demand figures. Braden, harris, and Paul, while defining the design of the system stated that:

The issue of resource allocation to geographic areas and vocational-technical program categories is central to the design of OTIS. Before the decision as to which program to support is made, inter-program comparisons

must be made of relative costs and returns. This comparison will help determine how a given amount of money can be most effectively allocated among programs to achieve an established set of objectives. Of course, this type of inter-program comparison requires prior assumption about their effectiveness. The broadest level of evaluation should ask how the returns on investment in vocational education compares with alternative uses of tax dollars.

The system has implications for expansion to other states, regions and even over the nation.<sup>9</sup>

### Summary

United States Atomic Energy Commission reports and other surveys show that there is an accelerating demand for nuclear power and the peaceful uses of nuclear energy. Continued supply of manpower will be essential to achieve the fullest potential of this energy source. This has many complex manpower planning implications for the nation. For example, in the SINB region alone, the power generation will more than double within the next decade requiring hundreds of highly trained technicians.

Because of complexity of the training requirements, there is slightly more lead time required to provide trained technicians for the nuclear industry. It is, therefore, imperative that an accurate estimate of future demand and supply be made so as to initiate training programs sufficiently in time. Furthermore, it is necessary to have continuous and systematic approach to manpower planning since every year new dynamics enter into consideration.

## FOOTNOTES

<sup>1</sup>United States Atomic Energy Commission, Occupational Employment Trends in the Atomic Energy Field 1963-1968, Government Printing Office (Washington, 1969), pp. 1-3, 9.

<sup>2</sup>United States Atomic Energy Commission, Utility Staffing For Nuclear Power, Publication 1130, Government Printing Office (Washington, 1969), pp. 6-7.

<sup>3</sup>Southern Interstate Nuclear Board, Alliance for Technological Advancement, Report to Southern Governor's Conference (Biloxi, Mississippi, September 22, 1970), p. 7.

<sup>4</sup>United States Department of Labor, Technology and Manpower in Health Service 1965-75, Government Printing Press (Washington, May, 1967), p. 21.

<sup>5</sup>United States Department of Health, Education, and Welfare, Training Branch, National Conference of X-Ray Technician Training (Rocheville, Maryland, September, 1966), pp. 14-21.

<sup>6</sup>Maurice W. Roney and Paul V. Braden, Occupational Education Beyond the High School in Oklahoma, ~~Oklahoma State University~~ (Stillwater, Oklahoma, 1967), p. 21.

<sup>7</sup>Maurice W. Roney and Donald S. Phillips, Electromechanical Technology, American Association of Junior Colleges (Washington, D.C., 1970), pp. 9-10.

<sup>8</sup>Jacob J. Kaufman and Anne F. Brown, "Manpower Supply and Demand", Review of Educational Research, Vol. XXXXIII, No. 4, October, 1958, p. 342.

<sup>9</sup>Paul V. Braden, James L. Harris, and Krishan K. Paul, Occupational Training Information System: Final Report, Oklahoma State University (Stillwater, June, 1970), pp. 11-48.

## CHAPTER III

### METHODOLOGY

#### Introduction

This study is a descriptive study which has as its major purpose the identification of the need for nuclear technicians; measure the present demand and estimate the future demand for nuclear technicians by comparing the supply and the demand for nuclear technicians.

The preceding review of literature (see Chapter II) pointed out that there has been a very limited amount of research in the field of manpower planning for the nuclear industry. The limited manpower projections were generally for the total industry and not for any one particular section of the country. This study is intended to narrow the manpower projections to an area encompassed by the Southern Interstate Nuclear Board (SINB). It is hoped that this study, while reporting the total presently employed nuclear related technician manpower, will also have basic manpower supply and demand estimates for the coming years, which can be updated on a yearly basis so that a much clearer picture of the actual demand and supply trends may be established.

#### The Population

This study was divided into two populations; the demand population and the supply population. This chapter will be divided into two sections for discussion purposes, demand and supply.

### Demand Sector

There were 1,588 firms identified as licensees for using nuclear material in the Southern Interstate Nuclear Board (SINB) region. These 1,588 organizations constituted the population for the demand sector of this project. An introductory letter was sent to these organizations asking them to identify the "key-man" within their organizations who would be most familiar with nuclear technician manpower requirements and who could be contacted about the project. The "key-man" letter had a response of 378 or 23.8 percent of the population initially identified as having an AEC License. This "key-man" response facilitated demand data collection activities.

Six hundred and forty-nine questionnaires were returned and of these, 385 were usable returns, as of January 1, 1971, the cut off date for responses. The usable returns were those in which the organization had indicated that they have some need for nuclear technicians. There were 333 "key-men" who returned their questionnaires. This represented 88 percent of the key-men who had been identified by the initial letters returned before the questionnaire was mailed. Table I shows the actual number of returns from the demand population.

The overall response rate to the demand questionnaire was 40.8 percent. It was necessary, therefore, to conduct a bias check on non-respondents. Of the 58.2 percent non-respondents, a 10 percent bias sample was drawn in order to check on any hidden biases. The bias check indicated that only 34 percent of those non-responding organizations did employ technicians in the nuclear area, and of this 34 percent, 48 percent employed less than five. The remaining 66 percent were divided with 57.2 percent of the organizations not employing technicians

TABLE I  
RESPONSE RATES FOR DEMAND  
QUESTIONNAIRES

Demand Sector	Number	Percent
Total Number Mailed	1588	100
Number Mailed to Key-Men	378	23.8
Total Number Returned	649	40.8
Number Indicating a Demand	385	24.2
Number Indicating No Demand	264	16.6
Number of Returns from Key-Men	333	20.9

in the nuclear area and 8.8 percent of the organizations unable to be contacted. The bias check did help strengthen demand data analysis in that the 40.8 percent returns seem to represent the major portion of the population that might have a demand for nuclear related technician manpower.

In summary, the bias check did indicate some additional demand for nuclear technician manpower. However, since the majority of the non-respondents indicated no demand, the calculations reported in this study should be viewed as conservative in regard to the true demand.

#### Supply Sector

Suppliers of technicians, exclusive of in-house training in employing organizations, were composed of 656 institutions which made up the population for the supply sector of this study. The response rate for the supply questionnaire was 59.2 percent. Of these, 18.9 percent were returned from area vocational schools, 16.1 percent were returned from

junior colleges, 9.3 percent were returned from hospitals, 9.1 percent were returned from technical institutes, and the remaining 5.8 percent were returned from private schools, universities, four-year colleges, and other programs. Table II shows the actual number of returns from the supply population. A 10 percent bias check of the non-respondents was also made on the supply sector to check for any hidden bias. The bias check indicated that only 2.7 percent of the non-responding institutions had a nuclear related technician training program. The remaining 97.3 percent was divided with 88.9 percent of the institutions having no nuclear related training programs and 8.3 percent that were unable to be contacted. This bias check strengthened the analysis of data in Chapter IV, in that the usable returns represent the major training institutions in the population.

TABLE II  
RESPONSE RATES FOR SUPPLY  
QUESTIONNAIRES

Demand Sector	Number	Percent
Total Number Mailed	656	100
Total Number Returned	389	59.2
Number Having Training Programs	99	15
Number Not Having Training Programs	290	44.2

#### The Instruments and Data Collection

The demand questionnaire was developed to obtain data relating to the present number of nuclear technicians employed and for estimates of future manpower during specific time frames. The demand instrument,

(see Appendix A), was broken down into clusters of job descriptions and in turn these divisions were further divided into segments of the nuclear industry, for example, production, test and measurements, and health. It was hypothesized that by job clustering a person in the health field could turn to the cluster associated with health and fill in only this portion of the instrument without spending unnecessary time going through the entire instrument.

The demand instrument was pretested to selected individuals within the Nuclear Industry throughout the SINB region. Their suggestions were combined into an instrument which the steering committee then reviewed and made additional comments. The final instrument was a combination of many inputs and it is hoped that an instrument that would be easily understood, easily answerable, while supplying the necessary data would be the results of the combined efforts of many.

The final demand instrument was mailed with a personal letter to the "key-men" identified by the initial letter and an introductory form letter to the additional establishments holding licenses which did not reply to the previous correspondence. (See Appendix B for the introductory letters.)

On the supply side, a similar format as that of the demand instrument was followed in developing the instrument. (See Appendix C) The supply questionnaire was divided into clusters of similar program titles and the time frame used in obtaining future estimates of graduates were the same as the time frames used for obtaining future estimates of demand on the demand questionnaire.

In the development of both the demand and supply questionnaires, some credit must be given to Mr. Krishan Paul, who was working on a

doctoral dissertation relating to the complex issue of interfacing supply and demand in the nuclear industry. His dissertation work, by necessity, exceeded the scope of this investigation.

#### Data Analysis

Analysis of the data was facilitated thru the Oklahoma State University Computer Center. Since the study was basically descriptive the method of analysis used to provide the necessary understanding was determined to be a frequency and percentage analysis. The analysis was made on the basis of usable returns of the questionnaire. The treatment of the data in this manner permitted a comparison based on present and future demand and supply data.

## CHAPTER IV

### RESULTS OF THE STUDY

#### Introduction

The overall purpose of this study is to identify the need for nuclear technicians; measure the present demand and estimate the future demand for nuclear technicians by comparing the supply and the demand for nuclear technicians.

This chapter will be devoted to the analysis of selected data in an attempt to answer the questions of this study. They are:

1. How many nuclear technicians are presently employed and what will be the demand for nuclear technicians during the 1970's?
2. How many nuclear technicians are now being trained?
3. What are the manpower requirements for nuclear technicians when both supply and demand factors are considered?

The chapter will be divided into sections structured by the above questions.

#### How Many Nuclear Technicians Are Presently Employed And What Will Be The Demand For Nuclear Technicians During The 1970's

In order to answer the question, Tables III-VII were developed which show the overall demand by clusters of job descriptions.

As shown in Table III, there is an increase of 174, 111, and 161 percent for the time periods of 1971 to 1972-73, 1972-73 to 1974-75,

TABLE III  
REACTOR OPERATION AND PRODUCTION TECHNICIANS

Job Code	Job Title	Technicians Presently Employed	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
1.01	Test or Research Reactor Operator	68	27	35	34	51
1.02	Production, Test or Research Reactor Operator-- Government Owned	118	9	12	12	20
1.03	Accelerator Operator	27	24	32	36	36
1.04	Radioisotope-Production Operator	46	47	62	14	22
1.05	Nuclear Power Plant Operator	132	69	129	163	272
1.06	Nuclear Material Processor, Senior	349	14	25	29	59
1.07	Hot-Cell Technician	75	5	10	14	27
1.08	Nuclear Facility Equipment Operator	93	64	109	128	196
1.09	Nuclear Facility Maintenance Technician	229	88	180	245	392

TABLE III (Continued)

Job Code	Job Title	Technicians Presently Employed	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
OTHER						
1.10	Radio Pharmaceutical Production Technician	1	2	2	3	3
1.11	Radiological Instrument Maintenance and Calibration Technician	4	0	1	0	0
1.12	Process Radiation Facility Operators (Non AEC Licensed)	12	4	20	10	30
1.13	Process Radiation Facility Operators (Non AEC Licensed)	<u>2</u>	<u>2</u>	<u>1</u>	<u>0</u>	<u>2</u>
	TOTALS	1156	355	618	688	1110

and 1974-75 to 1976-80, respectively. The largest percentage increase, excluding the jobs listed as others, is in the Nuclear Facility Equipment Operator job where the lowest percentage increase is in the Nuclear Material Processor, Senior job.

Table IV indicates there is an increase of 134, 101, and 135 percent for the time periods of 1971 to 1972-73, 1972-73 to 1974-75, 1974-75 to 1976-80, respectively. The largest percentage increase, excluding the jobs listed as others, is in the Non-Destructive Testing Technician job where the lowest percentage increase is in the Nuclear Facility Chemistry job.

Table V indicates there is an increase of 119, 104, and 111 percent for the time periods of 1971 to 1972-73, 1972-73 to 1974-75, and 1974-75 to 1976-80, respectively. The largest percentage increase, excluding the jobs listed as others, is in the Well Logging Technician job where the lowest percentage increase is in the Instrumentation and Control Technician job.

As shown in Table VI there is an increase of 126, 112, and 121 percent for the time periods of 1971 to 1972-73, 1972-73 to 1974-75, and 1974-75 to 1976-80, respectively. The largest percentage increase, excluding the jobs listed as others, is in the Chest Radiographer job where the lowest percentage increase is in the Radiopharmacist job.

Table VII indicates there is an increase of 132, 102, and 125 percent for the time periods of 1971 to 1972-73, 1972-73 to 1974-75, 1974-75 to 1976-80, respectively. The largest percentage increase, excluding the jobs listed as others, is in the Soils Evaluation Technician job where the lowest percentage increase is in the Welding Technician job.

TABLE IV  
TEST AND MEASUREMENT TECHNICIANS

Job Code	Job Title	Technicians Presently Employed	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
2.01	Radiation Control Technician	287	125	175	175	227
2.02	Nuclear Facility Chemistry (Radiochemistry) Technician	247	47	74	89	121
2.03	Non-Destructive Testing Technician	532	254	321	309	424
OTHER						
2.04	Radioisotope Testing Technician	3	3	3	4	4
2.05	Radiation Control Technician	1	1	1	1	1
2.06	Non-Destructive Testing Technician	1	1	1	1	1
2.07	WPC Lab Technician	2	2	3	3	0
2.08	Technician	4	1	1	0	0
2.09	Industrial Radiographer	4	3	5	6	8

TABLE IV (Continued)

Job Code	Job Title	Technicians Presently Employed	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
2.10	Mobile X-Ray Technician	50	5	10	15	30
2.11	Combined Job Code 2.01 and 2.02	<u>4</u>	<u>2</u>	<u>0</u>	<u>0</u>	<u>0</u>
	TOTALS	1135	445	595	603	816

TABLE V  
INSTRUMENTATION TECHNICIANS

Job Code	Job Title	Technicians Presently Employed	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
3.01	Instrumentation and Control Technician	325	120	179	201	291
3.02	X-Ray Calibration Technician	41	31	42	49	43
3.03	Well Logging Technician	488	476	528	528	528
OTHER						
3.04	Mobile X-Ray Equipment	<u>1</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>2</u>
	TOTALS	855	628	750	778	864

TABLE VI  
HEALTH TECHNICIANS

Job Code	Job Title	Technicians Presently Employed	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
4.01	Radiologic Technologist	971	693	850	935	1136
4.02	Radiologic Technologist, Chief	137	111	122	141	151
4.03	Nuclear Medical Technologist	280	213	284	321	431
4.04	Chest Radiographer	19	19	26	26	28
4.05	Urology X-Ray Technician	27	17	23	32	25
4.06	Orthopedic Radiologic Technician	54	39	44	51	47
4.07	Special Procedures Technician	100	81	117	130	169
4.08	Radiation Therapy Technician	119	87	109	127	131
4.09	Internal Dosimetry Technician	15	5	14	14	14
4.10	Radiobiology Technician	56	22	27	32	56
4.11	Radiopharmacist	71	8	24	29	33

TABLE VI (Continued)

Job Code	Job Title	Technicians Presently Employed	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
OTHER						
4.12	Research Tech. Radiobiologic Problem	3	1	1	1	1
4.13	Radiographers	1	1	1	1	1
4.14	T3 Tests for Thyroid Function	2	2	2	2	2
4.15	Radioflo Non-Destructive Testing	0	1	1	1	1
4.16	X-Ray Technologists	4	4	4	4	5
4.17	Organic Radio-Chemical Synthesis Research Technician	2	0	1	0	0
4.18	Radiopharmacist Assistant	0	1	0	1	0
4.19	Chief Technologist Education	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
TOTALS		1862	1305	1650	1847	2230

TABLE VII  
RELATED TECHNICIANS

Job Code	Job Title	Technicians Presently Employed	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
5.01	Soils Evaluation Technician	415	415	524	633	724
5.02	Draftsman	463	207	194	233	290
5.03	Computer Programmer	161	58	113	127	167
5.04	Mechanical and Structural Technician	593	264	362	475	642
5.05	Welding Technician	272	86	109	130	159
5.06	Electronic and Instrument Technician	541	247	384	186	244
5.07	Quality Control and/or Quality Assurance Specialist	309	128	167	113	149
OTHER						
5.08	Engineering Technician	2	2	1	1	2
5.09	Electron Capture Gas Chromatography	3	1	2	3	3
5.10	Physical Science Technician	4	4	5	5	5

TABLE VII (Continued)

Job Code	Job Title	Technicians Presently Employed	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
5.11	Industrial Radiography	12	12	14	16	20
5.12	Medical Research Technician	3	4	6	6	6
5.13	Radiation Chemistry Technician	0	0	6	0	0
5.14	Fabricators	20	5	10	10	0
5.15	Radiochemical Technician	1	1	1	1	1
5.16	Production Technician	11	3	2	2	3
5.17	Engineering Technician	6	0	2	2	4
5.18	Assistant Manager Nuclear Research & Testing	<u>1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
	TOTALS	2817	1437	1900	1943	2420

Table VIII indicates the total present employment to be 7,825 workers in Nuclear Related Manpower and the demand estimate for the 1970's at 22,982 workers.

TABLE VIII  
PERCENTAGE INCREASE IN FUTURE EMPLOYMENT  
OF NUCLEAR RELATED MANPOWER

	Present Employment	Demand Estimates for 1970's*	Percent Increase Over Present Employment
Reactor Operation and Production Technicians	1156	2771	240
Test and Measure- ment Technicians	1135	2459	217
Instrumentation Technicians	855	3020	353
Health Technicians	1862	7032	378
Related Technicians	<u>2817</u>	<u>7700</u>	<u>273</u>
TOTAL	7825	22982	

\*Includes estimates for new jobs and replacements.

Table VIII shows that the Health Field is the field which has the greatest potential for growth with 378 percent increase over the present employment to meet the demands for the 1970's.

#### How Many Nuclear Technicians Are Being Trained

In order to answer the question, "How many nuclear technicians are now being trained?", Table IX was developed which shows the overall supply, exclusive of in-house or on-the-job training programs, by program titles.

TABLE IX  
SUPPLY  
DESCRIPTION OF ENROLLMENT AND ESTIMATED GRADUATES  
BY PROGRAM TITLES

	Present Enrollment	Estimated Number Of Graduates For The Period 1970-75
Radiologic Technology	1435	3145
Radiation Therapy	16	40
Nuclear Medical Technology	56	349
Radiological Health Technology	69	175
Radiologic Technology (X-ray)	61	266
Installation, Operation and Maintenance of Reactors	15	129
Radiography	24	234
Electronic Technology (Nuclear Option)	20	40
Electromechanical Technology	0	18
Instrumentation Technology (Nuclear Option)	0	27
Nuclear Technology	90	346
Four-Year Technical Program (Radiation)	31	50
Physicians Assistant (Radiology)	6	24
Radiological Monitoring	20	20
Non-Destructive Testing	<u>7</u>	<u>355</u>
TOTALS	1850	5218

Table IX indicates there to be an increase of 282 percent in the number of graduates between 1970 and 1975 to the total present enrollment. The adjusted data gives the estimated number of graduates for the time period of 1971-75 as 4,565 graduates.

In-house or on-the-job training programs have a total estimated number of graduates for the time period of 1971-75 at 8,484 graduates.

What Are The Manpower Requirements For Nuclear Technicians When Both Supply And Demand Factors Are Considered

In order to answer the above question, Table X was developed which shows the overall demand and the overall supply estimates for the same time periods.

TABLE X  
TOTAL ESTIMATES FOR SUPPLY AND DEMAND  
FOR 1971-1975

	Estimate
Demand	15,542
Supply	13,049
Deficit	2,493

Table X indicates that for the total number of workers now estimated for the demand sector and the total number of workers estimated by the training institutions there to be a difference in demand and supply of 2,847 workers short of the projected demand.

The demand estimate was arrived at by summing the totals of the estimated manpower requirements for the calendar years 1971 through 1975 from Table IV through Table VII. The supply estimate indicates the total of in-house and formal training program graduates for the period 1971-1975. Both the above summations have been made with known limitations.

## CHAPTER V

### SUMMARY AND CONCLUSIONS

#### Summary

The purpose of this study was to identify the need for nuclear technicians; measure the present demand and estimate the future demand for nuclear technicians by comparing the supply and demand for nuclear technicians.

A total of 1,588 employing organizations were surveyed on the demand side, with a questionnaire return rate of 40.8 percent. The supply sector which was composed of 656 institutions which had a return rate of 45 percent. On the basis of usable returns, which was 24.2 percent on the demand side and 15 percent on the supply side, the following observations to the research questions have been made. The remainder of this chapter consists of the research questions and related observations, conclusions drawn from the observations and recommendations.

Research Question 1: How many nuclear technicians are presently employed and what will be the demand for nuclear technicians during the 1970's?

Observations: The total present employment is 7,825 workers in nuclear related jobs and the demand estimate for the 1970's is 22,982 workers. A further breakdown of demand, by clusters of job descriptions, indicates that the jobs with the most demand are Nuclear

Facility Equipment Operator, Non-Destructive Testing Technician, Well Logging Technician, Chest Radiographer, and Soils Evaluation Technician within the following job clusters, respectively, Reactor Operation and Production Technicians, Test and Measurement Technicians, Instrumentation Technicians, Health Technicians, and Related Technicians.

Research Question 2: How many nuclear technicians are now being trained?

Observations: There are two main sources of trained nuclear related manpower i.e., formal school programs and on-the-job or in-house training programs. The formal training programs have a present enrollment of 1,850 students with 4,565 students estimated to graduate between 1971 and 1975. In-house or on-the-job training programs have an estimated number of graduates for 1971 to 1975 of 8,484.

Research Question 3: What are the manpower requirements for nuclear technicians when both supply and demand factors are considered?

Observations: When comparing total supply and demand figures for the time period 1971-1975, Table X shows there is a difference in supply and demand of 2,493 workers. The supply sector is short of the estimated demand for the indicated time period.

### Conclusions

Findings of this study indicated that in the nuclear field, in the SINB region, there will be an increased need for nuclear technicians in the 1970's. This study also indicates that the present nuclear related manpower supply sources will not be able to meet the demand if they continue at their present estimated level of activity.

### Recommendations for Further Study

The in-house or on-the-job figures should be examined with some degree of caution. These figures may not reflect a program which actually trains nuclear technicians but may be a program which is designed to update the level of the present workers. Information on these programs needs to be further analyzed so that a precise breakdown of the programs can be ascertained and utilized in referring to the total supply sector of the nuclear industry.

Further efforts should be made to keep the data in this study updated. The employers might be revisited again on a yearly basis to revise and update the data of this study.

An in-depth interfacing of supply and demand would be very useful to the overall systems approach to the manpower planning for the nuclear industry.

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- United States Department of Labor. Technology and Manpower in Health Service 1965-75. Washington: Government Printing Office, 1967.

APPENDIX A

DEMAND INSTRUMENT

1. NAME OF THE ESTABLISHMENT \_\_\_\_\_

(If the establishment is a part of another organization, specify the name of the organization but report only the establishment named above. A separate questionnaire should be completed for each of your establishments within the SINB region. Please make extra copies where necessary.)

2. MAILING ADDRESS OF ESTABLISHMENT \_\_\_\_\_  
Number and Street

Number and Street

City or Town	State	County	Zip Code
--------------	-------	--------	----------

3. Representative Completing This Form

### Representative Completing This Form

Representative's Title

Representative's Address

Representative's Phone and Extension

4. TOTAL NUMBER OF EMPLOYEES IN THIS ESTABLISHMENT

Please rank the segment(s) of the nuclear field in which this establishment participates using product or service "mix" activity as a guideline. Please rank them (1) for the most and (2), (3), (4), etc. for the next highest level of activity.

_____ Uranium Milling	_____ Radiation Preservation of Foods
_____ Production of Feed Materials	_____ Radioactive Waste Disposal
_____ Production of Special Materials for Use in Reactors	_____ Activation Analysis
_____ Fuel Element Fabrication and Recovery Activities	_____ Nuclear Instrument Manufacturing
_____ Reactor and Reactor Component Design and Manufacturing	_____ Processing and Packaging Radioisotopes
_____ Design and Engineering of Nuclear Facilities	_____ Particle Accelerate Manufacturing
_____ Power Reactor Operation and Maintenance	_____ Research Laboratories
_____ Uranium Mining	_____ Industrial Radiography
_____ Radiation Processing	_____ Nuclear Medicine
_____ Irradiation Manufacturing or Services	_____ Other Health Related
_____ Non-Destructive Testing (NDT)	_____ Nuclear Training for Employment Outside your Organization
_____ Transportation of Radioactive Materials	_____ Higher Education
	_____ Other _____ (Please Specify)

## GENERAL INSTRUCTIONS

■ Please enter your best estimates of the number of workers you will need for the "job titles and descriptions" and "years" listed on the following pages. When estimating manpower requirements only consider "new jobs" and "replacements" (deaths, retirements, and normal turnover) and enter the composite figure in the appropriate column.

■ When estimating your manpower needs, please enter your total anticipated requirements even though you may plan to satisfy a portion and/or all of this through training programs within your own organization.

■ When estimating manpower requirements for more than one calendar year, please enter only the cumulative total requirements for new jobs and replacements. For example, if you estimate your need for a specific job title to be 3 in 1972 and 4 in 1973, enter only the total of 7 in the column headed 1972-73.

■ If you cannot relate the work performed in your establishment to the descriptions contained herein, list your own job title and a description of the work performed on the blank spaces provided for that purpose. If you need more space than provided please use an extra blank sheet.

ASSUMPTIONS--These manpower estimates should be based on the assumptions (1) that the economic growth rates over the past decade of your establishment and/or organization and the state and national economy will continue their trend unless you anticipate changes, (2) that private and government support of nuclear and nuclear related activities will continue at the same fraction of the GNP, and (3) that required manpower will be available.

Job Code	Job Titles and Descriptions for Reactor Operation and Production Technicians	How many technician level workers are presently employed?	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
1.01	<u>TEST OR RESEARCH REACTOR OPERATOR</u> --Performs hands-on operation of these facilities and requires AEC Senior Reactor Operator or Reactor Operator License.					
1.02	<u>PRODUCTION, TEST OR RESEARCH REACTOR OPERATOR-GOVERNMENT OWNED</u> --Performs hands-on operation of these facilities and requires certification by the operating agency.					
1.03	<u>ACCELERATOR OPERATOR</u> --Sets up or assists in setting up, coordinates, and monitors the operation of particle accelerates under the supervision of a research scientist.					
1.04	<u>RADIOISOTOPE-PRODUCTION OPERATOR</u> --Prepares radioisotopes and other radioactive materials for use in biological, biochemical, physiological, and industrial research.					
1.05	<u>NUCLEAR POWER PLANT OPERATOR</u> --Performs hands-on operation of the nuclear power plant requiring AEC Senior Reactor Operator or Reactor Operator License.					
1.06	<u>NUCLEAR MATERIAL PROCESSOR, SENIOR</u> --Is responsible for the maintenance and operation of radioactive processing facilities; receiving, transferring, and shipping of nuclear material, and the issuance of reactor fuels for research assemblies.					
1.07	<u>HOT-CELL TECHNICIAN</u> --Operates remote-controlled equipment in cell to perform chemical and metalurgical tests involving radioactive materials.					
1.08	<u>NUCLEAR FACILITY EQUIPMENT OPERATOR</u> --Operates nuclear facility auxiliary equipment and does not require AEC operator license.					

Job Code	Job Titles and Descriptions for Reactor Operation and Production Technicians	How many technician level workers are presently employed?	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
1.09	NUCLEAR FACILITY MAINTENANCE TECHNICIAN--Performs electrical and mechanical equipment maintenance on nuclear facility.					
Other-- Please Describe						
Other-- Please Describe						
Job Code	Job Titles and Descriptions for Test and Measurement Technicians	How many technician level workers are presently employed?	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
2.01	RADIATION CONTROL TECHNICIAN--Monitors personnel, plant facilities, work environment, and plant vicinity to detect and control radioactivity and/or radiation exposure. Performs operation, analysis and calibration of radiation monitoring equipment.					
2.02	NUCLEAR FACILITY CHEMISTRY (RADIOCHEMISTRY) TECHNICIAN--Performs all plant related laboratory chemistry analyses including radiochemistry.					
2.03	NON-DESTRUCTIVE TESTING TECHNICIAN--Performs NDT testing on nuclear facility equipment (includes radiography, ultrasonics, dye penefram, magnetic particle and visual techniques.					
Other-- Please Describe						
Other-- Please Describe						

Job Code	Job Titles and Descriptions for Instrumentation Technicians	How many technician level workers are presently employed?	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
3.01	INSTRUMENTATION AND CONTROL TECHNICIAN--Handles facility instrumentation and control system calibration and maintenance. (Includes computer maintenance)					
3.02	X-RAY CALIBRATION TECHNICIAN--Test X-ray calibration, equipment reliability and safety; evaluates field and filter performance.					
3.03	WELL LOGGING TECHNICIAN--Conducts radioactive logging in the underground study of oil fields; maintains source instruments; evaluates data.					
Other-- Please Describe						
Other-- Please Describe						
Job Code	Job Titles and Descriptions for Health Technicians	How many technician level workers are presently employed?	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
4.01	RADIOLOGIC TECHNOLOGIST--Applies roentgen and/or gamma rays to patients for diagnostic and therapeutic purposes.					
4.02	RADIOLOGIC TECHNOLOGIST, CHIEF--Coordinates activities of and supervises radiologic technologists engaged in taking and developing X-ray photographs.					
4.03	NUCLEAR MEDICAL TECHNOLOGIST--Prepares, administers and measures radioactive isotopes in therapeutic, diagnostic, and tracer applications, utilizing variety of radioactive equipment.					
4.04	CHEST RADIOGRAPHER--Conducts mass chest X-ray surveys to determine the incidence of pulmonary diseases.					

Job Code	Job Titles and Descriptions for Health Technicians	How many technician level workers are presently employed?	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
4.05	<u>UROLOGY X-RAY TECHNICIAN</u> --Assists a urologist by performing radiographic examinations of the urogenital tract to rule out disease in that system.					
4.06	<u>ORTHOPEDIC RADIOLOGIC TECHNICIAN</u> --Works with an orthopedic surgeon in performing radiographic studies of the skeletal system.					
4.07	<u>SPECIAL PROCEDURES TECHNICIAN</u> --Performs radiographic studies of the blood vessels and the nervous system, which requires special skills.					
4.08	<u>RADIATION THERAPY TECHNICIAN</u> --Positions patients and applies X-ray or gamma radiation to predetermined anatomical areas with known malignant disease.					
4.09	<u>INTERNAL DOSIMETRY TECHNICIAN</u> --Conducts whole body counting, bioassay, and wound contamination analysis.					
4.10	<u>RADIOBIOLOGY TECHNICIAN</u> --Conducts tests for external and internal radiation effects in plants and animals.					
4.11	<u>RADIOPHARMACIST</u> --Purchases of pre-prepared radiopharmaceuticals and formulates all locally prepared radiopharmaceutical compounds.					
Other-- Please Describe						
Other-- Please Describe						
Other-- Please Describe						

Job Code	Job Titles and Descriptions for Related Technicians	How many technician level workers are presently employed?	Estimated Manpower Requirements for the Calendar Years:			
			1971	1972-73	1974-75	1976-80
5.01	<u>SOILS EVALUATION TECHNICIAN</u> --Assesses soil density, radioactivity, and moisture content.					
5.02	<u>DRAFTSMAN</u> --Performs routine tasks in preparing detail engineering drawings, from work outlined by others.					
5.03	<u>COMPUTER PROGRAMMER</u> --Converts scientific, engineering, and other technical problem formulations to a format processed by computer.					
5.04	<u>MECHANICAL AND STRUCTURAL TECHNICIAN</u> --Assists in the design and fabrication of nuclear facility mechanical and structural equipment.					
5.05	<u>WELDING TECHNICIAN</u> --Performs specialized welding operations on nuclear components--requires code certification.					
5.06	<u>ELECTRONIC AND INSTRUMENT TECHNICIAN</u> --Does various operations connected with fabricating, assembling, modifying, maintaining, and installing nuclear electronic equipment.					
5.07	<u>QUALITY CONTROL AND/OR QUALITY ASSURANCE SPECIALIST</u> --Does product evaluation, testing, and monitoring to insure strict adherence to product specifications.					
Other-- Please Describe						
Other-- Please Describe						

### TRAINING PROGRAMS

1. Do you have an in-house or on-the-job training program? YES ☐ NO ☐  
(check one)

2. If yes, please supply the following information.

Job Title(s) for Which You Have Training Programs	Length of Training Program in Hours	Number of Graduates (if any) in the Years:			
		1971	1972-73	1974-75	1976-80

All other things being equal, would you hire graduates from public and private training institutions if they were available for the job titles listed above? YES ☐ NO ☐  
(check one)

If no, please explain: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## APPENDIX B

### INTRODUCTORY LETTERS

Telephone (404) 876-4385



SOUTHERN INTERSTATE NUCLEAR BOARD

Suite 664 • 800 Peachtree St NE • Atlanta, Ga. 30308

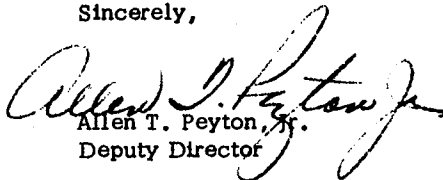
You were designated by your organization recently as the "key person" most familiar with present and future manpower and training requirements for personnel in the nuclear field whose duties are generally at the technician level. Accordingly, would you please fill out the attached questionnaire and return it in the enclosed postage paid envelope? This demand data will be compared with supply information from a related study of training institutions.

The form is designed to determine technician manpower needs for each establishment or division of your organization (if more than one) within the SINB Region. This includes Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia and the Commonwealth of Puerto Rico.

A steering committee of persons whose names appear on the attached list has carefully reviewed the questionnaire, and believes that the information obtained will be vital to your interests; particularly by assisting training institutions in their efforts to provide trained persons to meet your manpower requirements. You will receive a summary of the final report which should be available in July, 1971. So that we can meet this date, we would appreciate your returning the questionnaire by December 21, 1970.

Please be assured that the information you furnish will be held in strict confidence and only this Board and selected school officials will share it. If you have any questions or would like additional information, please feel free to phone or write.

Sincerely,



Allen T. Peyton Jr.  
Deputy Director

ATPjr:cb

Enclosures

SERVING THE STATES OF THE SOUTHERN GOVERNORS' CONFERENCE

Telephone (404) 876-4385

**SOUTHERN INTERSTATE NUCLEAR BOARD**

Suite 664 • 800 Peachtree St NE • Atlanta, Ga. 30308

The rapid growth of the nuclear industry foretells increased job opportunities for trained technicians, below the baccalaureate level, in such areas as power generation, fuels production and medicine, to name only a few. Accordingly, the Southern Interstate Nuclear Board is undertaking a project for a systematic approach to nuclear technician manpower planning throughout the SINB Region. This includes Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia and the Commonwealth of Puerto Rico.

Demand information is presently being gathered and it will be matched to supply information from training institutions. Accordingly, we would appreciate it if you would fill out the attached Nuclear Related Manpower Supply Questionnaire and return it in the enclosed postage paid envelope by December 21, 1970. Published results of this project will make it possible for training institutions to become more involved in relevant programs for nuclear related occupations during the coming years.

Dr. Paul Braden and associates from Oklahoma State University, who recently completed Oklahoma's Occupational Training Information System (OTIS), is assisting SINB in this study. Additionally, a select steering committee of persons whose names appear on the attached list is providing guidance and advice during all phases of the project.

If you have any questions or would like additional information, please feel free to phone or write.

Sincerely,

Allen T. Peyton, Jr.  
Deputy Director

ATPjr:cb

Enclosures

SERVING THE STATES OF THE SOUTHERN GOVERNORS' CONFERENCE

APPENDIX C

SUPPLY INSTRUMENT

## NUCLEAR MANPOWER INFORMATION SYSTEM

1.

---

Name of the representative completing the questionnaire

---

Representative's title

---

Representative's phone number and extension

2.

---

Name of the institution and/or organization

---

Number and Street

---

City or Town

State

Zip Code

3. Is this institution or organization (check one):

☐ University☐ Technical Institute☐ Four Year College☐ Junior and/or Community College☐ Area Vocational School☐ Private Vocational School☐ Hospital☐ Training School operated by an industry for purposes other than training their own labor supply☐ Other \_\_\_\_\_  
(Please Specify)

## GENERAL INSTRUCTIONS

■ Please enter your best estimate of the number of nuclear related manpower program graduates for the "program descriptions" and "years" listed on the following pages. Space is provided for you to list any additional program descriptions.

■ Provide information on nuclear related training program graduates which generally have the following characteristics:

1. The program is usually offered beyond the "secondary" but less than the "baccalaureate level".
2. The content is derived from technical skills and knowledge requirements of technical occupations.
3. Mathematics and the physical or biological sciences are integral parts of the program; technical study is mathematics and science-based at all levels of the program.
4. The technical specialization is within an occupational field; but is not confined to, or limited by, the requirements of any single occupation or industry. The emphasis in instruction is placed on technical skills and knowledge that have broad applications.
5. Instruction is laboratory-oriented and makes use of many applications of the technical principles being studied. Emphasis is placed on analytical, rational thought processes in addition to the development of specific procedural techniques or skills.

ASSUMPTIONS---These estimates should be based on the assumptions (1) that the economic growth rates over the past decade of your training operations and/or organization and the state and national economies will continue their trend unless you anticipate changes, and (2) that private and government support of nuclear and nuclear related activities will continue at the same fraction of the Gross National Product.

Program Code	Titles and Descriptions	Duration of Program (In Months)	Present Enrollment (If Any)	Estimated Number of Graduates for the Calendar Years:			
				1970	1971	1972-73	1974-75
07.0501 (As Modified)	<u>RADIOLOGIC TECHNOLOGY</u> --A combination of subject matter and experiences designed to prepare a person for the safe use of X-ray and/or other radiation equipment in clinical settings under the supervision of a radiologist or other physician.						
07.0502	<u>RADIATION THERAPY</u> --A combination of subject matter and experiences designed to prepare a person to use radiation producing devices to administer therapeutic treatments as prescribed by a radiologist.						
07.0503	<u>NUCLEAR MEDICAL TECHNOLOGY</u> --A combination of subject matter and experiences designed to enable a person to prepare, administer, and measure radioactive isotopes in therapeutic, diagnostic, and tracer studies, utilizing a variety of radioisotope equipment.						
07.0902 (As Modified)	<u>RADIOLOGICAL HEALTH TECHNICIAN</u> --A combination of subject matter and experiences 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.						
16.0115 (As Modified)	<u>NUCLEAR TECHNOLOGY</u> --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.						

Program Code	Titles and Descriptions	Duration of Program (In Months)	Present Enrollment (If Any)	Estimated Number of Graduates for the Calendar Years:			
				1970	1971	1972-73	1974-75
16.0304	<u>RADIOLOGIC TECHNOLOGY (X-RAY)</u> --A combination of subject matter and experiences designed to enable a person to prepare, administer, and measure radioactive isotopes in therapeutic, diagnostic studies, utilizing a variety of radioisotope equipment.						
17.2001	<u>INSTALLATION, OPERATION, AND MAINTENANCE OF REACTORS</u> --Organized learning experiences concerned with atomic reactor plants, their use, and related factors.						
17.2002	<u>RADIOGRAPHY</u> --Organized learning experiences concerned with the installation, safe operation, interpretation, and maintenance of industrial X-ray equipment:						
17.2003	<u>INDUSTRIAL USES OF RADIOISOTOPES</u> --Organized learning experiences concerned with the industrial use of radioisotopes in production and control operations.						
Program Titles and Descriptions not Previously listed:							
Other-- Please Specify Both the Title and Description							
Other-- Please Specify Both the Title and Description							

NOTE: The program titles and descriptions listed below do not refer to nuclear programs as such, but rather to program areas that combine training in the nuclear field with training in a different area of specialization.

Program Code	Titles and Descriptions of Training Programs with a Nuclear Option	Duration of Program (In Months)	Present Enrollment (If Any)	Estimated Number of Graduates for the Calendar Years:			
				1970	1971	1972-73	1974-75
16.0108 (As Modified)	ELECTRONIC TECHNOLOGY (NUCLEAR OPTION)--A combination of subject matter and experiences designed to prepare a person in fabricating, assembling, modifying and installing electronic equipment with some additional training in the nuclear field.						
16.0109 (As Modified)	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, and testing of electromechanical devices and systems within the nuclear field.						
16.0105 (As Modified)	CHEMICAL TECHNOLOGY (NUCLEAR OPTION)--The subject matter emphasizes qualitative, quantitative and analytical analysis in general and organic chemistry. This program prepares the graduate to install, and operate pilot plants for chemical processes, and may be directly involved with the preparation of isotopes and other radioactive materials.						
16.0112 (As Modified)	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 the instrumentation within the nuclear field.						

NOTE: Use the spaces below for program titles and descriptions with a nuclear option which were not listed previously.

Program Code	Titles and Descriptions Training programs with some emphasis in the Nuclear Field--Not Previously Listed	Duration of Program (In Months)	Present Enrollment (If Any)	Estimated Number of Graduates for the Calendar Years:			
				1970	1971	1972-73	1974-75
Other-- Please Specify Both the Title and Descrip- tion							
Other-- Please Specify Both the Title and Descrip- tion							
Other-- Please Specify Both the Title and Descrip- tion							
Other-- Please Specify Both the Title and Descrip- tion							

VITA<sup>2</sup>

Neal A. Willison

Candidate for the Degree of  
Master of Science

Thesis: AN ASSESSMENT OF THE NEED FOR NUCLEAR RELATED TECHNICIANS IN  
SELECTED EMPLOYING ORGANIZATIONS

Major Field: Technical Education

Biographical:

Personal Data: Born in Stillwater, Oklahoma, June 30, 1948, the  
son of James D. and Elsie Willison.

Education: Attended and graduated from high school at Ponca City,  
Oklahoma, in 1966; received an Associate of Science degree  
from Oklahoma State University, with a major in Electronic  
Technology in May, 1969, and a Bachelor of Science degree  
from Oklahoma State University, with a major in Technical  
Education in May, 1970; completed requirements for the Master  
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