HEALTH PHYSICS SOCIETY

HUMAN CAPITAL CRISIS TASK FORCE REPORT

July, 2004

Health Physics Society Human Capital Crisis Task Force

Kevin L. Nelson, Ph.D., CHP
Chair

EXECUTIVE SUMMARY

A projected shortfall in sufficiently educated radiation safety professionals has placed a burden on industries using radiation to support our nation's, energy, security and health needs. This national shortage is primarily due to a lack of funding of academic research and educational health physics programs. Another concern is the anticipated large number of radiation safety personnel reaching retirement age in the near future.

The major energy-related customers of an educated radiation safety professional workforce include the commercial nuclear power industry, DOE energy contactors, including the national laboratories, and the nuclear fuel cycle. ***For all employment sectors combined, a conservative total of approximately 6700 radiation protection professionals were identified in this survey. This value does not include, for example, part time or all consulting radiation protection professionals.***

The HPS Task Force study identified approximately 2940 permanent radiation protection staff and 800-850 temporary radiation protection staff employed within the commercial nuclear power sector.

Our study found that certain federal agencies with radiation safety responsibilities face a huge challenge with the number of radiation protection staff reaching retirement age in the near future. Of the federal agencies responding to the HPS FOIA request, 488 full time radiation safety professionals are employed. Federal agencies not responding to our survey but certainly involved with radiation protection activities include the Department of Homeland Security (including FEMA). Also not included in these employment numbers are radiation protection professionals associated with the armed forces due to the sensitive nature of their work.

The total number of FTE's devoted to radiation safety and regulatory control in state radiation control programs was 803 (1047 if recent CRCPD data was used for states not responding to the survey). CRCPD guidance suggests a desired ratio of FTE's involved with inspection and licensing to range from 1 FTE:33 licenses to 1 FTE:50 licenses. Our results indicate a range of 1:29 to 1:87 with six out of eighteen states, 33%, exceeding an arbitrary ratio of 1:65.

It was difficult to estimate the number of individuals involved in radiation protection in the health care setting due to varying and overlapping job responsibilities. However, based on AHA statistics, it is conservatively estimated that a minimum of 580 individuals whose primary responsibility is radiation protection are employed at large teaching hospitals with diagnostic radiology, nuclear medicine and radiation oncology services.

Strong, healthy academic programs are necessary in order to continue to fill the pipeline of radiation protection professionals working in the energy, regulatory/security and health sectors of our nation. ***The number of students graduating with either a bachelor's, master's or Ph.D. degree in health physics declined 55% from 270 students in 1995 to 122 in 2002.*** In addition, ***the number of health physics programs graduating at least 5 students annually decreased from 20 programs in 1995 to 7 programs in 2002. Even if it is assumed that an equal percentage of individuals will retire each year over a forty year working lifetime, the number of existing health physics program graduates, i.e., 122 per year, does not meet or exceed the demand based on a retirement rate of 167 per year.***

Recommendations from the HPS Task Force include:

- Continue to work with DOE and other federal agencies in exploring opportunities to secure funding for health physics academic programs
- The Health Physics Society should continue to explore private sources of funding for health physics academic programs
- Continue to strongly encourage ABET accreditation for 4 year and advanced degree health physics programs. Standardization of a core curriculum is essential for providing a consistent, good quality educational program. Centers of excellence should be formed to address specific programmatic needs.
- Promote standardization or accreditation of technician level training through the NRRPT or similar organizations. Although training programs are already available through commercial organizations, private companies, and are often provided in-house by the employer, establishment of core curriculum would provide consistent background for more advanced training.
- The Health Physics Society should commit to develop methods to encourage students to become interested in health physics programs.

TABLE OF CONTENTS

I. FORWARD

The shortage of technically qualified and trained individuals in science and technical fields is well documented.

The National Science Foundation indicated (NSF, 2001) that the number of U.S. citizens enrolling in science and technology (S&E) graduate degree programs declined more than 15% from 1993 through 1999, with the greatest decline in mathematics (25%), engineering (23%) and physical sciences (15%). Competition from programs such as physical therapy, speech and language pathology and public health attracted some of the top high school graduates due to shorter formal training requirements. In addition, undergraduate science and technology students were attracted to non-S&E programs, such as graduate business school, where the number of MBA's awarded annually have risen by nearly one-third between 1992 and 2000. Support for research and teaching has historically come from the federal government, but recently this support has dwindled.

In an article by Zumeta and Raveling (2002-03), science and technology careers were considered less attractive because:

- Training and apprentice times in science fields are very long
- Compensation for graduate students and postdoctoral appointees is very modest
- Autonomous research positions are difficult to obtain. Life science PhD's holding faculty positions 9 to 10 years post-degree fell from 61% in 1973 to 39% in 1995.

The number of high school graduates considering an engineering major decreased from 8.6% in 1992 to 5.5% in 2002. In addition, the number of potential engineering majors that participated in college preparatory programs decreased from 83.4% in 1991 to 70.6% in 2002 (Noeth, et al, 2003).

In a recent Government Accounting Office (GAO) report (GAO, 2001), it was reported that human capital issues were felt in all federal agencies. It was anticipated that 35% of the fiscal year 1998 federal workforce will be eligible for regular retirement by 2006. Cutbacks in agency budgets in the 1990's adversely affected training and professional development programs. Citing a specific example of the U.S. Nuclear Regulatory Commission (NRC), GAO reported that NRC's ability to achieve its mission was being threatened by a decline in university enrollments in nuclear sciences. The report concluded that human capital problems will require the sustained commitment of executive and legislative leaders.

In a draft report from the National Science Board (NSB) Committee on Education and Human Resources Task Force on National Workforce Policies for Science and Engineering, several startling statistics were mentioned (NSB, 2003):

- 50% of federal science and engineering workers are expected to retire over the next 10 years
- Flat or declining interest in S&E college programs is projected to continue
- Projected rapid growth in S&E occupations over the next decade.
- Global competition for S&E talent is intensifying
- In 1999, 1/3 of all S&E PhD holders working in industry were born abroad

The Task Force recommended the Federal government reassess its role in the preparation of the nation's science and engineering workforce and suggested substantial new funding to students and institutions was needed in order to improve success in science and engineering programs by U.S. undergraduates from all demographic groups

Within nuclear sciences and engineering programs, the current and future needs of qualified students and workforce has been described in documents published by the Nuclear Engineering Department Heads Organization (NEDHO) and in information provided by trade organizations. In a report published in 2000, NEDHO mentioned enrollment in nuclear engineering programs had been declining since 1992 (72% decline in undergraduate programs, 42% reduction in MS degree graduates). Recently, demand for nuclear scientists has outstripped supply. One of the recommendations in this report suggested the federal government recognize and accept its role in sustaining nuclear related programs, such as health physics. These concerns were summarized in a position statement published by the American Nuclear Society in 2002 (ANS, 2002). In a recent letter to the Health Physics Society (HPS), the Department of Energy Assistant Secretary stated, "We share your view that an anticipated shortfall in the nation's supply of radiation safety professionals could have a deleterious effect on the safety of our nations' workers, the public and the quality of health care," (Cook, 2002).

A human capital crisis can occur whenever one of the 4 R's indicated below is not addressed:

- Recruitment
- Resources
- Retention
- Retirement

Without successfully Recruiting high school and undergraduates into health physics and other S&E programs, the supply of properly trained individuals able to fill vacated positions will decrease. Without Resources to help support the academic programs or fellowships, the number of individuals entering the field will decrease. Without competitive salaries compared to alternative programs and a challenging and interesting work environment, it will be difficult to Retain educated people. When large numbers of individuals currently in the field Retire, who will replace them?

It was with this looming crisis in mind that the Health Physics Society endeavored to evaluate the current and future status of radiation protection professionals in the workplace.

References

ANS, *Human Capital in Nuclear Science and Technology*, Position statement 29, American Nuclear Society, LaGrange Park, Il, November 2002.

Cook, Beverly, Personal communication, Letter from DOE Asst Secretary Cook to HPS President Frazier, 25 November, 2002.

GAO, *Meeting the Governmentwide High-Risk Challenge*, Testimony presented before the U.S. Senate Subcommittee on Oversight of Government Management, Restructuring and the District of Columbia Committee on Governmental Affairs, GAO-01-357T, U.S. General Accounting Office, 1 February, 2001.

NSB, *Report of the National Science Board Committee on Education and Human Resources Task Force on National Workforce Policies for Science and Engineering, Draft Report*, National Science Board, 22 May, 2003.

NSF, Division of Science Resources Studies, *Graduate students and postdoctorates in science and engineering: fall 1999*, NSF 01-315, National Science Foundation, Arlington, VA. 2001.

Noeth, R.J., Cruce, T and Harmston, M.T., *Maintaining a Strong Engineering Workforce*, ACT Policy Report, 2003.

NEDHO*, Manpower Supply and Demand in the Nuclear Industry*, Nuclear Engineering Department Heads Organization, 2000.

Zumeta, W. and Raveling J.S., Attracting the Best and Brightest, *Issues in Science and Technology*, pp 36-40, Winter 2002-03.

II. INTRODUCTION

Many within the profession of health physics are concerned that there is, or soon will be, a shortage of educated, trained, and experienced radiation safety personnel. This concern led the Health Physics Society to issue a Position Statement titled "Human Capital Crisis in Radiation Safety", in August 2001. Testimony provided to the United States House of Representatives Energy Subcommittee on June 10, 2003 indicated that the demand for health physicists in the nuclear energy employment sector will exceed supply by 210% over the next 10 years. At the conclusion of the 47th Annual Meeting of the HPS in Tampa, Florida on June 20, 2002, then HPS President, John Frazier asked Director Kevin Nelson to coordinate an assessment of human capital issues facing the health physics profession and to serve as Chair of the Health Physics Society Human Capital Crisis Task Force. This report is a summary of the work of the Task Force.

In a review of HPS membership statistics, declines in plenary and student membership have occurred over he last five years (see Fig. II.1 and II.2 respectively). These declines were seen over most employment sectors (see Figure II.3). It is felt that these declines are reflective of advanced members of the society reaching retirement age without a subsequent infusion of newly educated staff to replace them.

Fig. II.1

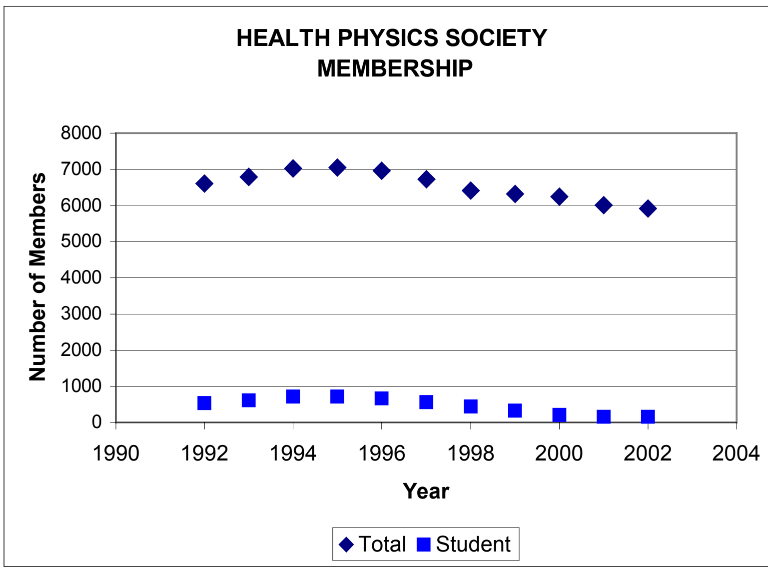


Fig. II.2

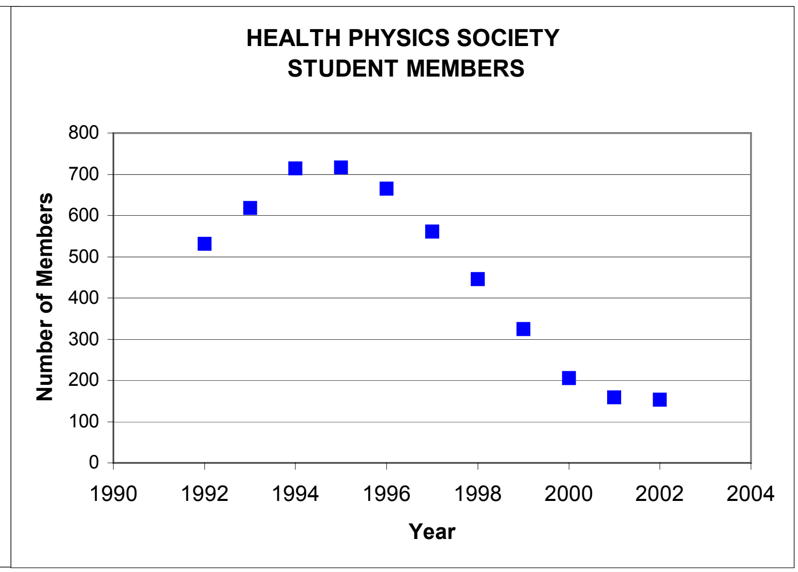
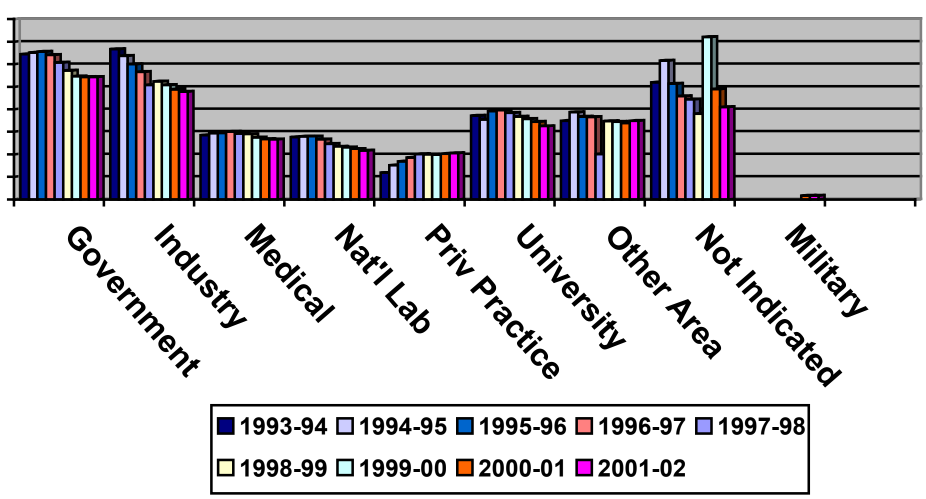


Fig. II.3
Health Physics Society Employment Sectors



The focus of this document will be the human capital crisis facing the health physics employment community. The field of health physics encompasses many disciplines. Health physicists, and other radiation safety specialists, find employment in many critical employment sectors necessary for the well being of this nation. These sectors include

- Energy
- Regulatory and Security, and
- Health

In the body of this document, current health physics employment statistics are presented for each of the employment sectors listed above

A. Goals

The primary goals of the assessment were:

- verify the current health physics manpower status,
- project future needs for radiation safety personnel, and
- identify ways to meet current and future manpower needs.

B. Preliminary Issues

The preliminary list of issues that have been identified are:

1. The increasing need for radiation protection professionals is not met due to decreasing funding support for health physics education and training programs.

2. Many radiation protection professionals are approaching retirement age.

3. Academic educational programs in health physics are unique, yet there are multiple education/training paths leading to employment in the health physics profession.

4. An increasing number of unqualified or marginally qualified persons are working in health physics positions.

5. The ability of future radiation safety personnel to implement U.S. policies in energy, health, and security is questionable.

A determination of the validity of these issues and the identification/evaluation of other human capital issues was part of the assessment.

C. Assessment Team

The HPS Human Capital Crisis Task Force was composed of individuals knowledgeable in one or more of these manpower issues and affiliated with well-respected agencies/organizations involved with the practice of radiation safety. Volunteer representatives from academia, state and federal regulatory agencies, and health care facilities were selected as team members. Representatives from commercial nuclear power operations, Department of Energy facilities, and other related organizations were also sought.

To address these major issues facing radiation protection professionals and the Health Physics Society, the following individuals were asked to participate in this very important and timely review.

- Kevin Nelson, Ph.D, Mayo Clinic Jacksonville, Chair, HPS Manpower Assessment Writing Group

- Ralph Andersen, Nuclear Energy Institute, Member, HPS Power Reactor Section
- Richard Brey, PhD., Idaho State University, Chair, HPS Academic Education Committee
- Cynthia Jones, Ph.D., NRC, HPS Board of Directors
- Thomas Laiche, Sandia, Energy Facilities Contractors Group
- Richard Morin, Ph.D., Mayo Clinic Jacksonville, Past-President AAPM
- Pearce O'Kelley, South Carolina Bureau of Radiological Health, Chair-Elect Organization of Agreement States
- HPS President, President-Elect, Secretariat - Ex-officio members

Task Force members were encouraged to use publicly-available, reliable, non-biased references whenever possible.

D. Tasks

The specific tasks to be accomplished were identified as:

I. Assess the current health physics manpower status within the U.S.:

A. Identify employers of health physicists and other radiation safety personnel
B. Determine the specific radiation safety/radiation protection duties of those personnel
C. Quantify the fraction of work time spent by these personnel on radiation safety-related activities
D. Determine the demographics of the radiation safety personnel for federal and state organizations

II. Project future needs for radiation safety personnel:

A. Identify and assemble reports of previous studies of HP and radiation safety manpower needs
B. Assemble future health physics manpower projections from members of the HPS
C. Survey employers of health physicists and other radiation safety personnel for their projections of future manpower needs
D. Identify contemporaneous studies of manpower needs that may include radiation safety personnel

III. Identify specific ways to meet current and future human capital needs:

A. Identify current and potential future sources of funding for undergraduate and graduate students in academic education programs in health physics
B. Investigate the current status of State and Federal funding for formal training courses in health physics and radiation safety for regulatory personnel
C. Assemble information relevant to programs (in place or proposed) for structured on-the-job training in health physics and radiation safety
D. Evaluate current programs for recruitment of individuals into the field of health physics and radiation safety
E. Develop a preliminary strategy for securing future funding for health physics education and training and for recruiting individuals into the field of health physics and radiation safety

References

HPS, *Human Capital Crisis in Radiation Safety*, Position statement, Health Physics Society, McLean, VA., August 2001.
United States House of Representatives, Testimony provided to U.S. House of Representatives Energy Subcommittee on 10 June, 2003.

III. HEALTH PHYSICS CUSTOMER SURVEY RESULTS

A. ENERGY

1. OPERATIONAL NUCLEAR POWER PLANT

Key Human Capital Crisis Questions
The following key questions were asked to help determine the current and future status of radiation protection professionals within the nuclear power industry:

Define types of jobs requiring radiation safety education/training
Assess current number of individuals filling these positions in the United States and project future needs
What licensing requirements for radiation safety personnel are in place for individuals performing radiation safety-related activities at a nuclear facility?

Scope of Radiation-Safety Related Activities
Health physics staffing at a nuclear power plant includes a designated Radiation Protection Manager (RPM), health physicists, health physics technicians, and supervisors. Typical duties and responsibilities for plant health physics staff are outlined in USNRC Regulatory Guides 8.8 and 8.10 and include:

1. Participating in design reviews for facilities and equipment that can potentially affect potential radiation exposures;
2. Identifying locations, operations, and conditions that have the potential for causing significant exposures to radiation;
3. Initiating and implementing an exposure control program;
4. Developing plans, procedures, and methods for keeping radiation exposures of workers and members of the public as low as reasonably achievable (ALARA);
5. Reviewing, commenting on, and recommending changes to job procedures to maintain exposures ALARA;
6. Participating in the development and conduct of training programs related to work in radiation areas or involving radioactive materials;
7. Conducting radiation surveillance and dose monitoring programs;
8. Collecting, analyzing, and evaluating data attained from radiation surveillance and dose monitoring programs;
9. Providing around-the-clock radiation protection coverage;
10. Conducting monitoring and control programs for radioactive materials, radioactive waste shipments, and radiological effluents, including radiation surveillance and monitoring of the surrounding environs;
Providing radiological protection support for the emergency response program and filling positions within the emergency response organization.

Response to Human Capital Questions
Responses to question posed by Nuclear Energy Institute (NEI) of all nuclear power generating stations in the United States. Results of the survey are as follows:

# of permanent radiation protection staff: 2940
% of radiation protection staff > 55 years of age: 10.4% (est)
% of radiation protection staff < 35 years of age: 7.3% (est)
% of positions desiring, at a minimum, a 4 year degree in health physics or a related field: 12% (est)
% of staff with a 4 year degree (minimum): 16% (est)

# of temporary contract radiation protection staff: 800-850
Supervisory/engineering staff: 36-38
Senior HP technician: 655-696
Entry level HP technician staff: 109-116

Specialized Educational or Training Requirements

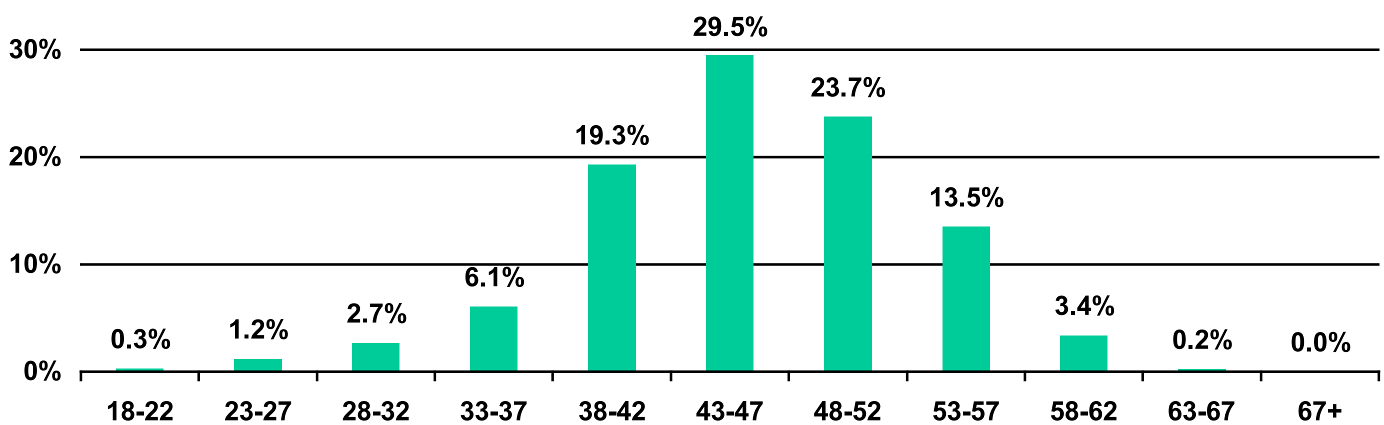
Training and education requirements for nuclear power plant radiological protection staff are contained in USNRC Regulatory Guide 1.8, "Qualification and Training of Personnel for Nuclear Power Plants," and ANSI/ANS-3.1-1993, "Selection, Qualification and Training of Personnel for Nuclear Power Plants." The radiation protection manager (RPM) should have bachelor's degree in science, health physics, or engineering and a minimum of 4 years of related experience, including at least 1 year supervisory or management experience and 3 years of nuclear power plant experience at a level requiring policy planning and decision-making related to the programmatic aspects of the radiation protection program as a whole. Senior health physics technical and support staff typically should have a bachelor's degree in science, health physics, or engineering and a minimum of 4 years of related experience, including 3 years of nuclear power plant experience. First line supervisors and senior radiation protection technicians should have a high school diploma at least 3 years of related experience, including 2 years of nuclear power plant experience carrying out varied activities in the radiological protection area.

Human Capital Conclusions

From a staffing standpoint, a previous survey (NEI, 2002) of the nuclear industry has indicated the demand for health physicists in the nuclear power industry will far exceed available supply, even exceeding the demand for nuclear engineers. The current age distribution of permanent radiation protection staff working at commercial nuclear power plants as supplied by NEI, is summarized in Figure III.1.

Fig. III.1

Age Distribution of Radiation Protection Professionals at Commercial Nuclear Utilities



Based on annual survey results from NEI (NEI, 2004), approximately 3 times as many permanent radiation protection professionals are employed as compared to temporary radiation protection positions. Approximately 12% of this work force has a 4-year degree in health physics or a related field. The number of people entering the field, i.e., < 35 years of age, is approximately equal to the number of people reaching retirement age, i.e., > 55 years of age. In the very near term, finding an adequate number of technical level radiation protection professionals appears most critical. Based on this information, the need for both professional and technical level radiation protection professionals in order to help maintain this country's energy balance and operate the plants safely, is extremely critical.

References

ANSI, *Selection, Qualification, and Training of Personnel for Nuclear Power Plants,* American National Standards Institute, ANSI/ANS-3.1-1993, 1993.

NEI, Integrated Plan for Nuclear Industry Staffing Pipeline 2002-2011, Nuclear Energy Institute, Washington, D.C., June 2002.

NEI, NEI Annual Survey 2003; Nuclear Energy Institute, Washington, D.C., 2004.

Useful Documents

NEDHO, *Nuclear Engineering in Transition: A vision of the 21st Century*, Nuclear Engineering Department Heads Organization, December 1998.

NEDHO, *Manpower Supply and Demand in the Nuclear Industry*, Nuclear Engineering Department Heads Organization, 1999.

III. HEALTH PHYSICS CUSTOMER SURVEY RESULTS

A. ENERGY

2. DOE CONTRACTORS AND NATIONAL LABORATORIES

Key Human Capital Crisis Questions
The following key questions were asked of DOE contactors to help determine their current and future needs of radiation protection professionals:

What are your present needs for professional health physicists?
Does your site have specific, written qualifications for health physicists?
Does your site have certification requirements for any positions?
How many professional vacancies do you presently have?

To help answer these key questions a member of Energy Facility Contractors Group (EFCOG) was chosen to assist the Task Force. Survey results (EFCOG, 2003) include the following DOE contractor sites:

Sandia – NM, CA
Livermore – CA
Brookhaven – NY
Savannah River – SC
Rocky Flats – CO
Los Alamos – NM
Fluor Hanford – WA
Oak Ridge – TN
INEEL – Idaho
Pantex – TX
Hanford – WA
NTS

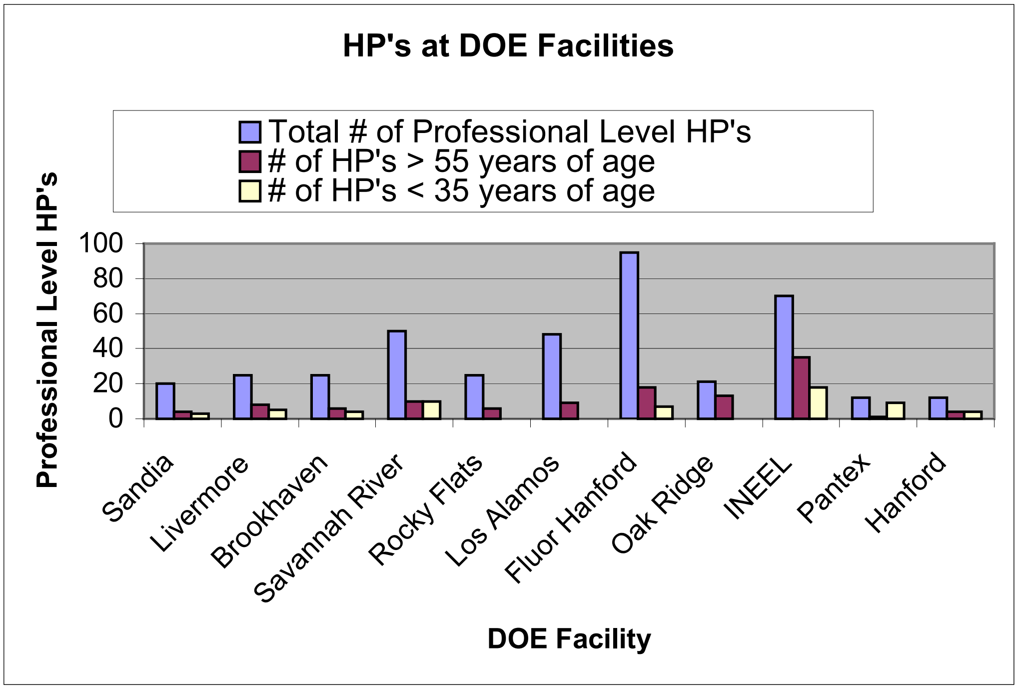
Scope of Radiation-Safety Related Activities
Health physicists working for DOE contractors and at National Laboratories are typically responsible for characterizing radiological hazards, establishing radiological monitoring protocols, providing work planning guidance, providing radiation protection support to radiological waste sorting and disposal operations, reviewing internal and external dosimetry data, performing internal dose assessments, reviewing quality assurance/control data, helping line organizations implement the Radiation Protection Program in accordance with internal procedures and external regulations, procedure and process development and generating lessons learned. Health physicists also provide design reviews, shielding analyses, incident review and analysis, and technical assistance with project planning.

Response to Human Capital Questions
Of the facilities listed above, 11 facilities (92%) responded to the survey request. A total of 403 full time professional-level HP's are employed at these facilities (see Fig. III.2). Of this total, 114 or 28% of the total are > 55 years of age and 60 or 15% of the total are < 35 years of age. 28 openings currently exist.

All reporting DOE facilities with the exception of Oak Ridge and INEEL, require professional staff to have a 4 year degree in health physics or an associated field.

EFCOG is a volunteer organization founded in 1991, directed by senior level executives from DOE contractors and supported and funded by DOE. One of EFCOG's missions is to promote operational excellence and effective and efficient use of resources through an active exchange of best practices programs with its facility members.

Fig. III.2



Specialized Educational or Training Requirements
DOE requires that individuals filling the positions of radiological control manager, radiological control senior, technical and support staff (includes classification of health physicist) and radiological assessor have a baccalaureate degree in health physics or related discipline (DOE, 1997). Four years of related work experience is also required for these positions although certification by the American Board of Health Physics can be used in lieu of educational and work experience requirements. This requirement would also hold true for DOE contractors.

The radiological control technician positions require a high school diploma and three years of related experience. Certification by the National Registry of Radiation Protection Technologists (NRRPT) can be used in lieu of educational and work experience requirements.

Radiological control instructor positions require a high school diploma and two years related experience.

Additional in-house training by DOE is required for all positions.

Human Capital Conclusions
Health physics contactors working at DOE facilities tend to work in situations where an incorrect decision could affect a large number of people. Work areas are usually security-sensitive and may involve classified projects. Because of the importance of this work, most radiation protection professionals working for DOE are required to have a four-year degree in health physics or a closely related filed. In addition, certification by the American Board of Health Physics is highly desired. Currently, nearly twice as many of the most knowledgeable people are reaching retirement age as compared to those entering the field. It has been reported by the Assistant Secretary of DOE, that due to nuclear facility closings, the number of advanced degreed health physicists require in the short term should not dramatically increase, however, the current need for radiation technicians is strong (Cook, 2002).

References

Code of Federal Regulations, 10CFR 835, DOE Training Requirements, 2003.

Cook, Beverly, Personal communication, Letter from DOE Asst Secretary Cook to HPS President Frazier, 25 November, 2002.

Department of Energy, *Knowledge, Skills and Abilities for Key Radiation Protection Positions at DOE Facilities*, DOE Standard DOE-STD-1107-97, January 1997.

EFCOG, EFCOG survey results, Thomas Laiche, 2003.

III. HEALTH PHYSICS CUSTOMER SURVEY RESULTS

A. ENERGY

3. NUCLEAR FUEL CYCLE

Includes mining, milling, fuel fabrication, architect-engineering firms and used fuel management

Key Human Capital Crisis Questions

Define types of jobs requiring a radiation safety education
Assess current number of individuals filling these positions in the United States and project future needs
What licensing requirements for radiation safety personnel are in place for individuals performing radiation safety-related activities at a nuclear facility?
Projections for future

Scope of Radiation-Safety Related Activities
Yet to be determined

Response to Human Capital Questions
# of radiation protection staff – Yet to be determined
# of radiation protection staff > 55 years of age - Yet to be determined
# of radiation protection staff < 35 years of age - Yet to be determined
Type and number of positions desiring, at a minimum, a 4 year degree in health physics or a related field. - Yet to be determined

Specialized Educational or Training Requirements
Yet to be determined

Human Capital Conclusions
Yet to be determined

References

Useful Documents

III. HEALTH PHYSICS CUSTOMER SURVEY RESULTS

B. REGULATORY/SECURITY

1a. FEDERAL AGENCIES – Nuclear Regulatory Commission (NRC)

Key Human Capital Crisis Questions
The following key questions were asked to help determine the current and future status of radiation protection professionals within the Nuclear Regulatory Commission (NRC):

1. The current number of radiation protection professionals at your organization
2. The number of FTE's that NRC has for these type of positions
3. The number of open radiation protection positions
4. For each radiation protection position, please provide a copy of the position
5. A description indicating the salary and grade of each position.
6. A determination whether NRC hires contractors for particular positions.

The agency was also asked whether an internal study has been performed to estimate future manpower needs within the agency.

Scope of Radiation-Safety Related Activities
The U.S. Nuclear Regulatory Commission is an independent agency established by the Energy Reorganization Act of 1974 to regulate civilian use of nuclear materials. The NRC's mission is to regulate the nation's civilian use of byproduct, source, and special nuclear materials to ensure adequate protection of public health and safety, to promote the common defense and security, and to protect the environment.

The NRC's regulatory mission covers three main areas:

- Reactors – Commercial reactors for generating electric power and non-power reactors used for research, testing and training
- Materials – Uses of nuclear materials in medical, industrial and academic settings and facilities that produce nuclear fuel
- Waste – Transportation, storage and disposal of nuclear materials and waste and decommissioning of nuclear facilities from service

Primary responsibilities include:

- Develop licensing and inspection policies and programs for all three main mission areas
- Develop, evaluate and coordinate emergency preparedness plans for nuclear reactors
- Review and evaluate technical information involving licensed and non-licensed contaminated sites undergoing decommissioning
- Review and evaluate sealed source integrity and design criteria submitted by applicants
- Review and evaluate applications for facilities for spent fuel storage, waste treatment and storage, uranium enrichment and spent fuel reprocessing
- Review and evaluate applications for facilities for long term storage of low-level radioactive wastes and uranium recovery
- Determine the adequacy and compatibility of State radiation control programs for the regulation of byproduct, source and certain special nuclear materials

The NRC is currently responsible for 103 operating reactors and 36 non-power reactors. Of the 36 non-power reactors, 9 are being decommissioned and 7 have possession-only licenses

As of September 2002, the NRC is responsible for 4905 licenses in 114 different categories. The top four categories include 1047 portable measuring gauge licensees, 675 medical facilities where written directives are required, 456 private medical practice licensees where written directives are not required and 440 fixed measuring system licensees.

Response to Human Capital Questions
Based on the response to our FOIA request, the number of radiation protection professionals working at the NRC was determined to be 189 (NRC personal communication, 2003). Approximately 200 FTE positions exist. Eight openings currently are unfilled.

The salary range for radiation protection professionals is based on the 2003 Federal Pay Scale and will vary with location. The maximum salary for a health physicist, Class GS-1306, working in the Washington D.C. area, would be $142,500. This information can be found on the U.S. Office of Personnel Management website (http://www.opm.gov/oca/payrates/).

A summary of the response to human capital crisis questions posed to the NRC and other federal agencies can be found in Table III.A.

A 2001 GAO report (GAO, 2001), estimated that in fiscal year 2001, approximately 16% of the NRC staff would be eligible to retire. This percentage was projected to increase to 33% by the end of fiscal year 2005. As a result, in October 2000 GAO suggested that the NRC identify core competencies, as well as the skills and expertise necessary to fulfill NRC's mission. NRC has established a tuition assistance program, relocation bonuses and other inducements to encourage qualified individuals to accept and continue their employment with the agency.

To assess long term needs in fulfilling its mission, NRC employed a skills assessment tool completed by NRC supervisory staff. In the 2002 *Most Critical Skills and Available Resources Report for Nuclear Materials*, health physics knowledge or skills were found to be in greatest demand (NRC, 2002). Over the next two to five years, 9% of staff considered themselves as having expert knowledge and/or skills in health physics as determined by a self-assessment guide, 21% have extensive knowledge, 24% applied knowledge, 29% general knowledge or skills and finally, 18% have limited knowledge or skills in health physics.

Specialized Educational or Training Requirements
The NRC has issued a directive outlining formal qualifications for individuals working in NRC and state radiation control programs conducting radioactive material program reviews (NRC, 1999). All individuals in this category must have, at a minimum, a Bachelor's degree or equivalent training or experience in a physical, life science, engineering or other appropriate field. In addition, 2 years of work experience with a radioactive materials program is required. Core training, as well as biannual refresher training by the NRC, is required.

Internal training requirements for a broad range of NRC positions, such as materials license reviewer, materials health physics inspector, fuel cycle license reviewer and high-level was repository license technical reviewer, are specified in NRC Inspection Manual Chapter 1246 (NRC, 2001).

Human Capital Conclusions
In order to support its mission, NRC will continue to require properly trained individuals to help protect the security of this nation's radioactive material, nuclear reactors and radioactive waste. As reported in a recent GAO report, NRC faces a huge challenge with the number of radiation protection staff reaching retirement age in the near future. Although creative retention programs have been implemented and core competencies identified, failure to find an adequate number of personnel could had catastrophic consequences on the security of radiation sources and reactor safety in this country.

References
General Accounting Office*, Major Management Challenges and Program Risks: Nuclear Regulatory Commission*, GAO-01-259, Washington, D.C., January, 2001.
NRC, Management Directive 5.10, *Formal Qualifications for Integrated Materials Performance Evaluation Program (IMPEP) Team Members*, United States Nuclear Regulatory Commission, Washington, D.C., 5 January, 1999.
NRC, Inspection Manual Chapter 1246, *Formal Qualification Programs in the Nuclear Material Safety and Safeguards Program Area*, United States Nuclear Regulatory Commission, Washington, D.C., 5 January, 2001.

NRC, *Most Critical Skills and Available Resources Report*: Category Nuclear Materials and Nuclear Waste, United States Nuclear Regulatory Commission, Washington, D.C., 2002.
NRC response to September 5, 2003 FOIA request sent by Ken Kase, 2003.

III. HEALTH PHYSICS CUSTOMER SURVEY RESULTS

B. REGULATORY/SECURITY

1b. FEDERAL AGENCIES (excluding NRC and Homeland Security)

Key Human Capital Crisis Questions
The following key questions were asked to help determine the current and future status of radiation protection professionals within federal agencies most likely to use radiation protection personnel:

1 The current number of radiation protection professionals at your organization
2. The number of FTE's that your agency has for these type of positions;
3. The number of open radiation protection positions
4. For each radiation protection position, please provide a copy of the position
5. A description indicating the salary and grade of each position.
6. An indication whether or not your agency hires contractors for this service.

The agencies were also asked whether a future needs study for this particular area of expertise had been performed.

Scope of Radiation-Safety Related Activities
The following agencies were asked to respond to our FOIA request for information pertaining to the number of radiation protection professionals:

Nuclear Regulatory Agency (response in previous section)
Department of Energy
Department of Health & Human Services
Environmental Protection Agency
Tennessee Valley Authority
Defense Nuclear Facility Safety Board
Department of Commerce
Department of Defense
Department of Labor
Food and Drug Administration
National Institutes of Health
Public Health Service
Department of Transportation
Department of Veterans Affairs
National Aeronautics and Space Administration
Department of Homeland Security (response in following section)
Customs & Border Protection (response in following section)
Federal Emergency Management System (response in following section)
United States Coast Guard (response in following section)

A brief summary of the radiation-related activities performed by each federal agency most likely to be involved with radiation or radioactive material is provided below. Much of this information was obtained directly from job descriptions for personnel in each of these positions.

Department of Energy: Department of Energy health physicists work either in Washington D.C. or one of the fourteen regional operations or field offices. Activities that at one time were conducted at DOE sites include nuclear materials production operations and processing of plutonium and uranium. Job functions will vary with job classification and location but include managing DOE health and safety programs at DOE sites, developing or revising DOE orders as necessary and working closely with contractors to ensure consistency with state and federal regulations and programs. At locations were remediation or site closure is involved, health physicists work though technical, regulatory and administrative barriers preventing site closure schedule acceleration. DOE health physicists serve as liaisons with NRC, OSHA, and other federal and state agencies. They also evaluate and provide expert regulatory advice and consultation to DOE line programs on safety and health issues related to new activities involving other regulators

Department of Health & Human Services: The Food and Drug Administration (FDA), National Institutes of Health (NIH) and the Centers for Disease Control and Prevention (CDC) are most likely to employ radiation protection personnel within the Department although NIH uses extensive contract support. Health physicists employed by NIH are responsible for the safety of research staff as well as the licensing of radioactive material. Within the FDA, the Centers for Devices and Radiological Health (CDRH) is responsible for implementing regulations regarding the manufacture of electronic devices that emit ionizing and non-ionizing radiation. These devices range from the advanced medical imaging equipment to consumer products such as TV receivers and microwave ovens. CDRH is also responsible for implementing the Mammography Quality Standards Act of 1992 (MQSA). This Act is intended to ensure that equipment used in breast screening operates correctly and that personnel are properly trained. With the acute awareness of terrorism within this county, CDC is one of the lead agencies providing information to clinicians and other individuals on the effects and treatment of biologic, chemical and nuclear terrorism devices.

EPA: The Environmental Protection Agency's Office of Radiation and Indoor Air (ORIA) requires radiation protection professionals, most being described as health physicists. ORIA is responsible for implementing EPA's Radon Action Program and formulating and recommending policies, criteria, and standards to protect the general public and the environment from ionizing radiation. ORIA is also responsible for developing emergency planning criteria for, and coordinating, EPA's response to accidents and emergencies involving radiation. This office also develops guidance and/or regulations for cleanup of sites contaminated with radioactive material and provides technical support to the Office of Solid Waste and Emergency Response and other Federal agencies. Health physicists working for the EPA also provide professional input in developing documents such as the Federal Guidance series. In addition, several radiobiologists are employed at EPA. The primary responsibility of the radiobiologist is to evaluate the potential genetic and somatic effects of exposure to sources of ionizing radiation from environmental, medical, occupational and natural radiation sources.

Tennessee Valley Authority: The Tennessee Valley Authority (TVA) requires radiation protection professionals to plan, develop, coordinate and direct radiation safety activities at the three TVA nuclear power plants. Health physicists at TVA must ensure the dosimetry program is effective and meets or exceeds accreditation standards. It should be noted that all TVA health physics positions require the incumbent to have obtained, at a minimum, a bachelors of science degree in health physics or related physical science field. Certification by the American Board of Health Physics or National Registry of Radiation Protection Technologists or an M.S. degree in health physics is desired. Technicians employed by TVA must have an associate degree in health physics or related physical science field.

Defense Nuclear Facilities Safety Board: The Defense Nuclear Facilities Safety Board is an independent federal agency established by Congress in 1988. The Board's mandate, under the Atomic Energy Act, is to provide safety oversight at the fourteen nuclear weapons complexes operated by the Department of Energy. The Board is required to ensure that all of these activities are carried out by DOE in a manner that provides adequate protection for the public, workers, and the environment.

Department of Commerce: Activities requiring radiation protection personnel at the Department of Commerce primarily occur at the National Institute of Standards and Technology (NIST) although some work occasionally is performed by the National Oceanic & Atmospheric Administration. NIST operates a materials research reactor and associated Cold Neutron Research Facility, several accelerators, x-ray standards comparison laboratories, beta, gamma and neutron instrument and source calibration facilities as well as a primary isotope standards distribution program. Health physicists and technical staff are required to operate these radiation-specific programs.

Department of Labor: The Mine Safety and Health Administration (MSHA) reside within the Department of Labor. One of the MSHA program areas include the Metal and Nonmetal Mine Safety and Health program. This program is responsible for enforcing the Mine Act at all metal and nonmetal mining operations in the United States. This includes conducting inspections and investigations at the mine sites to insure their compliance with health and safety standards required by the Mine Act

Response to Human Capital Questions

The federal agencies that responded to the FOIA request (DOE personal communication, 2003; DHHS personal communication, 2003; EPA personal communication, 2003; TVA personal communication, 2003; DNFSB personal communication, 2003; DOC personal communication, 2003; DOL personal communication, 2003) included:

Nuclear Regulatory Commission (response in previous section)
Department of Energy
Department of Health & Human Services
EPA
Tennessee Valley Authority
Defense Nuclear Facilities Safety Board
Department of Commerce
Department of Labor
Customs & Border Protection (response in following section)
United States Coast Guard (response in following section)

Some federal agencies that failed to provide a response, reasoned the request was greater than what could be reasonably accommodated without a charge for page duplication or research time.

Federal agencies use health physicists to perform the majority of radiation protection work. The number of radiation protection professionals for each federal agency providing a response is as follows:

Department of Energy - 68
Department of Health & Human Services - 60 health physicists
Department of Health & Human Services - 216 with some radiation protection background
EPA - 14
Tennessee Valley Authority – 132 (including 78 listed as technicians)
Defense Nuclear Facilities Safety Board –0
Department of Commerce (NIST) – 12
Department of Labor (MSHA) - 0

All positions were considered full time. Of those agencies responding, seven openings currently exist (four occurring at NIST). Most agencies hire radiation protection professionals with the exception of DOE and NIH which use extensive contract support. No federal agency indicated that a future needs study had been conducted.

The Department of Health & Human Services also employs 216 diagnostic radiologic technologists with some radiation protection background obtained through qualified training programs.

The salary range is based on the 2003 Federal Pay Scale and will vary with location. The maximum salary for a health physicist, Class GS-1306, working in the Washington D.C. area would be $124,783. This information can be found on the U.S. Office of Personnel Management website (http://www.opm.gov/oca/payrates/).

A summary of the human capital crisis responses received by all federal agencies can be found in Table III.A.

Specialized Educational or Training Requirements

DOE requires that individuals employed in the positions of radiological control manager, radiological control senior, technical and support staff (includes classification of health physicist) and radiological assessor have a baccalaureate degree in health physics or related discipline (DOE, 1997). Four years of related work experience is also required for these positions although certification by the American Board of Health Physics can be used in lieu of educational and work experience requirements. This requirement is similar for DOE contractors.

The radiological control technician positions require a high school diploma and three year of related experience. Certification by the National Registry of Radiation Protection Technologists (NRRPT) can be used in lieu of educational and work experience requirements.

Radiological control instructor positions require a high school diploma and two years related experience.

Additional in-house training, provided by DOE, is required for all positions.

NIST health physicists are required to have a degree in a natural science and at least 30 hours in health physics or closely related disciplines. Certification by the American Board of Health Physics plus appropriate experience is an acceptable alterative.

Department of Health & Human Resources health physics positions, GS-7 or greater, require a at least one year of graduate level education devoted to health physics and related subjects. Specialized experience can be used in lieu of this educational requirement.

Human Capital Conclusions

The job specifications for radiation safety professionals working at federal agencies are diverse. Although it is difficult to form an absolute conclusion based on limited FOIA response, it appears as though the need for radiation safety professionals will continue, although DOE and at least one other agency have used outsourcing. Even with outsourcing, the need for qualified individuals will continue. Educational and work experience requirements differ, depending on the agency and work involved, but DOE has established job-specific educational and training requirements. Many jobs within DOE, or its contractors, require a 4-year degree in health physics or a related field.

References

Defense Nuclear Facilities Safety Board response to September 5, 2003 FOIA request sent by Ken Kase, 2003.

Department of Commerce response to September 5, 2003 FOIA request sent by Ken Kase, 2003.

Department of Energy, *Knowledge, Skills and Abilities for Key Radiation Protection Positions at DOE Facilities*, DOE Standard DOE-STD-1107-97, Washington, D.C., January 1997.

Department of Energy response to September 5, 2003 FOIA request sent by Ken Kase, 2003.

Department of Health & Human Resources response to September 5 and December 8, 2003 FOIA requests sent by Ken Kase, 2003.

Department of Labor response to September 5, 2003 FOIA request sent by Ken Kase, 2003.

Environmental Protection Agency response to September 5, 2003 FOIA request sent by Ken Kase, 2003.

Tennessee Valley Authority response to September 5, 2003 FOIA request sent by Ken Kase, 2003.

III. HEALTH PHYSICS CUSTOMER SURVEY RESULTS

B. REGULATORY/SECURITY

1c. FEDERAL AGENCIES INVOLVED WITH HOMELAND SECURITY

This section includes information regarding Department of Homeland Security, Coast Guard, Customs and FEMA

Key Human Capital Crisis Questions
The following key questions were asked to help determine the current and future needs of radiation protection professionals within federal agencies:

1. The current number of radiation protection professionals at your organization
2. The number of FTE's that your agency has for these type of positions;
3. The number of open radiation protection positions
4. For each radiation protection position, please provide a copy of the position
5. A description indicating the salary and grade of each position.
6. An indication whether or not your agency hires contractors for this service.

The agencies were also asked whether a future needs study for this particular area of expertise had been performed.

Scope of Radiation-Safety Related Activities
The following agencies were asked to respond to our FOIA request for information pertaining to the number of radiation protection professionals:

Department of Homeland Security
Customs & Border Protection (CBP)
Federal Emergency Management System
United States Coast Guard

A brief summary of the radiation-related activities performed by each federal agency is provided below. Much of this information was obtained directly from job descriptions for personnel in each of these positions.

Department of Homeland Security (DHS): The National Strategy for Homeland Security and the Homeland Security Act of 2002 served to establish the Department of Homeland Security. One of the primary reasons for the establishment of the Department of Homeland Security was to provide a unifying core for the many agencies and organizations tasked with securing the United States. DHS currently employs approximately 180,000 individuals. DHS's mission statement includes the statement, "We will prevent and deter terrorist attacks and protect against and respond to threats and hazards to the nation." Implicit in this definition is the possibility of a terrorist attack involving nuclear material.

Customs & Border Protection (CBP): CBP health physics administer the radiation safety program at U.S. Customs offices. Major responsibilities include maintaining appropriate NRC licenses for byproduct material as well as providing training regarding the safe use of radioactive materials and x-ray generating equipment. They are also responsible for the oversight of the personnel monitoring program and conducting radiological surveys at Customs ports of entry and research locations.

Federal Emergency Management Agency (FEMA): FEMA became part of the new Department of Homeland Security in March 2003 and is responding to, planning for, recovering from and mitigating against disasters. Included in the term 'disaster', is FEMA's response to nuclear reactor accidents such as Three Mile Island or participating in required drills conducted at over 70 commercial nuclear power plant sites in the United States.

United States Coast Guard: The Coast Guard's mission includes maritime safety, mobility and security, national defense and protection of natural resources. It also has command responsibilities for the U.S. Maritime Defense Zone. The Coast Guard provides security in the harbors, ports and along coastlines through numerous port security, harbor defense, and coastal warfare operations and exercises. Since 9/11, commercial, tanker, passenger, and merchant vessels have all been subject to increased security measures enforced by the Coast Guard. One of the concerns relates to the possible terrorist use of nuclear materials on a vessel.

Response to Human Capital Questions
The federal agencies that responded to the FOIA request (CBP personal communication, 2003; U.S. Coast Guard personal communication, 2003) included:

Customs & Border Protection
United States Coast Guard

Some federal agencies that failed to provide a response, reasoned the request was greater than what could be reasonably accommodated without a charge for page duplication or research time.

Federal agencies use health physicists to perform the majority of radiation protection work. The number of radiation protection professionals for each federal agency providing a response is as follows:

Customs & Border Protection – 2
United States Coast Guard - 0

All positions were considered full time. CBP reported contracting radiation safety services with the U.S. Public Health Service, Federal Occupational Health branch. Contractors are also hired to conduct training and radiation equipment maintenance and repair. No reporting federal agency indicated that a future needs study had been conducted. The United States Coast Guard currently employs 15 environmental health and 10 industrial hygiene officers to provide health and safety support in the event of a natural or man-made disaster. These individuals do not hold the title of health physicist but have had some training on the health effects of ionizing and non-ionizing radiation. Survey instrument calibration had been outsourced to the FDA but the Coast Guard is now looking for an outside provider. The Coast Guard's personnel monitoring program is maintained by the Navy.

The salary range is based on the 2003 Federal Pay Scale and will vary with location. The maximum salary for a health physicist, Class GS-1306, working in the Washington D.C. area would be $124,783. This information can be found on the U.S. Office of Personnel Management website (http://www.opm.gov/oca/payrates/).

A summary of the human capital crisis responses received by all federal agencies can be found in Table III.A.

Specialized Educational or Training Requirements
No specialized educational or training requirements were identified in the FOIA responses received.

Human Capital Conclusions
Considering the scope of activities involved with the Department of Homeland Security, it is somewhat surprising that additional health physicists are not employed, especially to address the threat of nuclear terrorism, among the 180,000 current employees. FEMA's involvement with nuclear power reactor drills and accidents would also suggest radiation protection personnel employment opportunities.

References
Customs & Border Protection response to September 5, 2003 FOIA request sent by Ken Kase
United States Coast Guard response to September 5, 2003 FOIA request sent by Ken Kase

Table III.A
Summary of Federal Agency Response to FOIA Request

Agency	# of Radiation Protection Professionals	# of Open Positions	Comments
Coast Guard	0	0	
Customs & Border Protection	2	0	
Defense Nuclear Facilities Safety Board	0	0	Contractors not hired
Department of Commerce (NIST)	12	4	
Department of Energy	68	Unknown	Extensive contract support
Department of Health & Human Services (FDA, NIH, CDC)	60	2	Extensive contract support
Department of Labor (MSHA)	0	0	
Environmental Protection Agency – Office of Radiation and Indoor Air (ORIA)	14	0	
Nuclear Regulatory Commission	200	8	NSIR uses contractors to develop computer modeling software. Office of Nuclear Reactor Regulation uses contractors for some of its radiation protection work
Tennessee Valley Authority	54 – Professional 78 - Technical	1 0	Occasionally will use contractors for short term assignments

III. HEALTH PHYSICS CUSTOMER SURVEY RESULTS

B. REGULATORY/SECURITY

2. STATE PROGRAMS

Key Human Capital Crisis Questions
The following key questions were asked to help determine the current and future status of radiation protection professionals working in state radiation control programs:

1 Determine the total number of radiation protection program staff for licensing, inspection, waste, x-ray machine and other programs
2 Determine the number of vacancies
3 Determine the number of RPP staff < 35 years of age
4 Determine the number of RPP staff > 55 years of age
5 Number of RPP positions where a 4 yr radiation safety degree is *desired*
6 Number of staff with a 4 yr radiation safety degree (or greater)
7 For each licensing group, determine groups most likely to require enhanced educational or training requirements for the RSO
8 For each licensing group determine whether the RSO performs radiation safety-related duties *greater than 50%* of the time
9 Determine total # of civil penalties issued since January 1, 2000 for each license type
10 Determine the number of medical, dental and veterinary x-ray tubes as well as linear accelerators and other devices within each state program

The Task Force was interested in determining if large numbers of unfilled vacancies, due to the human capital crisis, were occurring (Question 2). If the number of radiation protection professionals reaching retirement age (Question 4) exceeded those entering the profession (Question 3), and concern regarding the transfer of knowledge. We were interested in the educational background of radiation protection staff within each state (Questions 5 and 6) and possible unique educational requirements for individual licensees (Question 7). In theory, if improperly trained or educated individuals were responsible for the use of radioactive material, the number of infractions or civil penalties would increase (Question 9)

For consistency, NRC license code numbers were used in evaluating licensee types.

Scope of Radiation-Safety Related Activities
All state radiation safety professionals are responsible for the safety of electronic devices that emit ionizing radiation such as medical and dental x-ray equipment, accelerators and veterinary x-ray units. In addition, agreement state staff are responsible for the activities normally conducted by the NRC within state borders. That is, they are responsible for the licensing, inspection and registration of radioactive materials and sources. They are not responsible, however, for inspecting nuclear reactors.

Response to Human Capital Questions
A draft of the state questionnaire was sent to President Frazier and President-elect Kase for review on 4/25/03. After comments were received and integrated, a final version was sent to Peace O'Kelley for distribution to all state programs (see Appendix 1 for letter). A reminder was sent out to the state program directors on 7/7/03. The states that responded to this questionnaire are identified below. 29 of 52 entities or 56% responded to the survey.

Agreement State (as of 7/03)	Participated	Non-Agreement State (as of 7/03)	Participated
Alabama	No	Alaska	Yes
Arizona	No	Connecticut	No

Arkansas	Yes
California	Yes
Colorado	No
Florida	Yes
Georgia	Yes
Illinois	Yes
Iowa	No
Kansas	Yes
Kentucky	No
Louisiana	No
Maine	No
Maryland	No
Massachusetts	Yes
Mississippi	No
Nebraska	Yes
Nevada	No
New Hampshire	No
New Mexico	Yes
New York (state & city)	Yes
North Carolina	Yes
North Dakota	No
Ohio	Yes
Oklahoma	No
Oregon	No
Pennsylvania	No
Rhode Island	Yes
South Carolina	Yes
Tennessee	Yes
Texas	Yes
Utah	Yes
Washington	Yes
Delaware	Yes
District of Columbia	No
Hawaii	No
Idaho	Yes
Indiana	Yes
Michigan	No
Minnesota	Yes
Missouri	Yes
Montana	No
New Jersey	Yes
Puerto Rico	No
South Dakota	No
Vermont	Yes
Virginia	Yes
West Virginia	Yes
Wisconsin	Yes
Wyoming	No

Although the total number of radiation protection staff working in a state regulatory environment cannot be ascertained with absolute certainty due to <100% response rate to the HPS survey, states with the largest radiation protection professional impact, i.e., California, Florida, Illinois, New York and Texas, did provide responses.

All states provided employment statistics. Of the states responding, 90% provided statistics on the number of x-ray tubes and other ionizing emitting devices. Of the agreement states that responded, 94% provided statistics on the number and type of licensees. Non-agreement state licensee statistics are kept by the NRC and can be viewed in the NRC section.

Total number of FTE's devoted to radiation safety and regulatory control was 803.3 for the entities responding to the survey. For states not responding, the 2003 CRCPD directory was used to estimate an additional 241 individuals involved with state radiological health programs, although the number of FTE's was not defined in the CRCPD document (CRCPD, 2003). A small number of positions listed in the CRCPD directory were identified as vacant, i.e., 1.5%. In the survey responses, the greatest percentage of FTE's were devoted to licensing and inspection of radioactive material (32%; 260.6 out of 803.3). The next largest percentage of FTE's were involved with x-ray machine inspections and certifications (28%; 222.6 out of 803.3 FTE's). For agreement states, the total number of FTE's involved in either licensing or inspection was 241. The CRCPD publication, *Criteria For An Adequate Radiation Control Program*, suggests the following professional and technical staffing guidance for the effective control and safety of radioactive material and devices emitting ionizing radiation:

Table III.B
Suggested Radiation Control Program Staffing Guidelines

Program	Suggested FTE's
Radioactive Materials	1.0 to 1.5 FTE per 50 uncomplicated licenses
Ionizing Emitting Product	Dental: 1.0 FTE per 500 tube inspections/yr
	MSQA: 1.0 FTE per 100 tube inspections/yr
	Other: 1.0 FTE per 300 tube inspections/yr
Non-ionizing Emitting Product	1.0 FTE
Emergency Response	0.5 FTE per year per million population
Env Monitoring and Surveillance	Ambient monitoring: 1.5 to 3.0 FTE's
	1 nuclear facility: 2.5 to 5.0 FTE's
	2 to 5 nuclear facilities: additional 1.5 FTE's per facility
	> 5 nuclear facilities: additional 1.0 FTE per facility
Low Level Waste	State without proposed or active site: 0.25 to 0.5 FTE per million population
	State with proposed or active site: 6.0 to 8.0 FTE's for site characterization and pre-licensing activities
	State with closed site: 0.5 to 1.5 FTE's per site depending upon stability of site
Radon	0.5 FTE plus 0.5 FTE per 100 contractors over 100

For radioactive material programs in agreement states responding to our survey, the desired ratio of FTE's involved with inspection and licensing is suggested to range from 1 FTE:33 licenses to 1 FTE:50 licenses. Our results indicate a range of 1:29 to 1:87 with six out of eighteen states, 33%, exceeding an arbitrary ratio of 1:65. It should be noted, no attempt was made to try to determine the number of 'uncomplicated' licenses in each state. In theory, states with a larger number of more complicated licenses, such as broad scope, would require additional FTE's beyond the guidance suggested.

In agreement states participating in this survey, a total of 13,234 radioactive material licenses were identified. The most common type was identified as 'Measuring Systems Portable Gauges" in 12 of 18 agreements states reporting. Although the security of all radioactive material is important, the control over portable radioactive devices is especially critical when possible terrorism events are discussed. Clearly an adequate number of properly trained individuals is required to perform the licensing and inspection aspects of radioactive material programs

All states are required to register and inspect electronic devices emitting ionizing radiation. These devices include medical and dental x-ray equipment as well as linear accelerators used to treat cancer patients. NCRP Report No. 100 estimated that the number of medical x-rays taken in 1980 was 180,000,000 and the number of dental x-rays 101,000,000. The effective dose equivalent as a result of these exams has been estimated to be 0.4 mSv. This compares to an annual effective dose equivalent of 3.0 mSv for a member of the general public in the United States or Canada (NCRP, 1988). Clearly, the effective control of ionizing radiation emitted from electronic devices will reduce unnecessary radiation burden to members of the public. For the states that responded in our survey, 96,805 medical tubes as well as 210,640 dental tubes, an approximate 1:2 ratio, were identified. The number of veterinary tubes was established at 12,677. The number of accelerators identified was 2636.

Specialized Educational or Training Requirements
CRCPD guidelines (CRCPD, 1999) suggest that a 4-year degree in health physics or equivalent field be obtained for those individuals involved in agreement state licensing and inspection programs. In the HPS Task Force survey, although 93% of the total licensing and inspection FTE positions were desired to have a 4-year radiation safety degree, only 55% of FTE's in these positions actually had a 4-year degree in radiation safety.

Human Capital Conclusions

Clearly the control of radioactive material is of primary concern especially since the events of 9/11. Having properly trained and educated individuals responsible for these programs is in the best interest of our country. The total number of FTE's devoted to radiation safety and regulatory control was 803.3 for the entities responding to the survey. Licensing and inspection activities required the greatest number of FTE's followed by x-ray machine inspection and certification programs. Some agreement state licensing and inspection programs have less FTE's than suggested by CRCPD guidance.

References

Conference of Radiation Control Program Directors*, Criteria For An Adequate Radiation Control Program*, CRCPD Publication 99-2, Frankfort, Kentucky, April 1999.

Conference of Radiation Control Program Directors*, Directory of Personnel Responsible for Radiological Health Programs*, CRCPD Publication 03-1, Frankfort, Kentucky, January 2003.

National Council on Radiation Protection and Measurements, *Exposure of the Population in the United States and Canada from Natural Background Radiation*, NCRP Report 94, Washington, D.C., 1988.

Useful Documents:

U.S. Nuclear Regulatory Commission, *Reviewing Common Performance Indicator #3 Technical Staffing and Training*, OSP Procedure SA-103, Washington, D.C., 6 January, 2000.

U.S. Nuclear Regulatory Commission, *Training Criteria for Agreement State Personnel*, OSP Procedure SA-100, Washington, D.C., 11 July, 2000,

U.S. Nuclear Regulatory Commission, *Training Criteria for Agreement State Personnel,* STP Procedure SA-600, Washington, D.C., 22 January, 2001.

III. HEALTH PHYSICS CUSTOMER SURVEY RESULTS

C. HEALTH

1. MEDICAL HEALTH PHYSICS

Key Human Capital Crisis Questions
The following key questions were asked to help determine the current and future status of radiation protection professionals employed within the medical field:

1. Work with professional societies to determine the number of potential individuals requiring radiation safety training, i.e., ACR, AAPM, AART, NMTCB, ASTRO, RSNA
2. What radiation safety-related educational backgrounds are required for individuals working with radiation at medical facilities, i.e., RSO, medical physicist, radiation physicist, technologist?
3. What licensing requirements (federal or state) are in place for individuals performing radiation safety-related activities at a hospital?

Scope of Radiation-Safety Related Activities
Activities performed by radiation protection staff at medical facilities include: prepare and process licensing and amendment requests; implement dosimetry program and review records, conduct waste management activities, conduct survey compliance and radiation monitoring, perform and/or review shielding calculations for diagnostic x-ray, nuclear medicine, PET and radiation oncology facilities; perform internal dosimetry calculations, conduct radiation risk assessment for certain exposure situations, assist in facility planning and design activities; communicate radiation risk and procedures to patients.

Response to Human Capital Questions
Because of an overlap in responsibilities, quantitative data on the number of radiation protection professionals working the majority of time in radiation safety, is either unavailable or unreliable. It has been estimated that 4% of medical physicists are performing medical health physics activities (Morin, 2003). Medical physics program directors contacted felt that the number of medical health physics jobs exceeded the number of available graduates.

A review of 2003 statistics from the American Hospital Association (AHA, 2003) revealed the following:

- 2692 hospitals have diagnostic radioisotope facilities
- 1191 hospitals have radiation therapy facilities
- 1092 hospitals have both diagnostic and radiation therapy facilities
- 580 of the 1092 hospitals are considered teaching hospitals
- 448 facilities use PET
- 307 hospitals have diagnostic radioisotope, radiation therapy and PET facilities
- 210 of the 307 are classified as major teaching hospitals

In addition, the Health Physics Society Medical Health Physics Section has 474 members in 2003.

The American Board of Medical Physics lists 699 diplomates; 40 listed as medical health physicists in 2002.

Specialized Educational or Training Requirements
NRC and agreement state regulations require Radiation Safety Officers (RSO's) working at healthcare facilities have at least 200 hours of didactic training in radiation physics, instrumentation, radiation protection, mathematics pertaining to the use and measurement of radioactivity, radiation biology and radiopharmaceutical chemical. In addition, some agreement states require that RSO's working for large medical broad scope licensees also have advanced education or be certified by the American Board of Health Physics.

The American Academy of Health Physics has published guidelines for Healthcare Facility Radiation Safety Officer (AAHP, 2003). For large healthcare organization, i.e., having radiation oncology, diagnostic and interventional radiobiology and nuclear medicine departments, the Academy recommends certification by the American Board of Health Physics and two years of work experience of a graduate degree in health physics or related field and 4 years of work experience. For intermediate healthcare organizations, i.e., having diagnostic radiology, nuclear medicine and clinical laboratories using tracer amounts of radionuclides, a bachelors degree in health physics or closely related field and two years of work experience was suggested or certification in a technologists program and two years of work experience.. For small healthcare organizations, i.e., having diagnostic radiology and/or laboratory using only radioimmunoassay kits, the Academy recommends the RSO to have completed a residency program in radiology or registration in radiology and one year of work experience.

The American Association of Physicists in Medicine recommends that students seeking a graduate degree in medical physics have health physics as part of their core curriculum. (AAPM, 2002).

Human Capital Conclusions

Radiation protection professionals within the health care setting play an important role in protecting patients and members of the general public from excessive radiation. Some states have enacted laws requiring certification of physicists because of actions of improperly trained individuals which have caused harm. It is difficult to estimate the number of individuals involved in radiation protection in the health care setting due to varying and overlapping job responsibilities, however, based on AHA statistics, it is estimated that 580 individuals whose primary responsibility is radiation protection, are employed at large teaching hospitals with diagnostic radiology, nuclear medicine and radiation oncology services. This is a reasonable assumption since large teaching hospitals with multiple services utilizing ionizing radiation often hire health physicist due to the complexity of radioactive material licensing and frequency of patient interaction.

References

American Academy of Health Physics, *Qualifications for Healthcare Facility Radiation Safety Officer*, AAHP Standard of Qualification and Practice Report SQ/P-002, American Academy of Health Physics, McLean, VA, 2003.

American Association of Physicists in Medicine, *Academic Program Recommendations for Graduate Degrees in Medical Physics*, AAPM Report No. 79, Medical Physics Publishing, Madison, Wisconsin, 2002.

American Hospital Association, *AHA Hospital Statistics 2003*, Available at: http//www.ahastatistics.org. Accessed 29 July 2003.

Morin, Richard. Personal communication, 2003

Useful Documents

American Association of Physicists in Medicine, *Essentials and Guidelines For Training Based Medical Physics Residency Training Programs,* AAPM Report No. 36, American Institute of Physics, July 1990.

American Association of Physicists in Medicine, *Academic Program For Masters of Science Degree in Medical Physics, American Association of Physicists in Medicine*, AAPM Report No. 44, American Institute of Physics, October 1993.

III. HEALTH PHYSICS CUSTOMER SURVEY RESULTS

E. PRIVATE CONSULTANTS

Private consultants are utilized in all employment sectors identified in this document. As companies or facilities downsize, the role of properly trained and educated consultants becomes more critical. Determining the number of radiation protection professionals performing consulting activities is difficult for a number of reasons. Many consult only a part time basis. Some work for companies providing consulting services in a number of different areas. For the purposes of this survey, statistics gathered by the Health Physics Society were reviewed (HPS, 2003). Although the Society membership is smaller than the actual number of individuals performing radiation safety activities, it's assumed membership activities mimic those performed across all employment sectors. In 2003, the Health Physics Society determined 399 out of 5560 respondents were involved in private consulting activities or approximately 7% of the membership. Of the 399 Health Physics Society members primarily performing consulting activities, 139 or 35% are classified as Certified Health Physicists. It is anticipated that the number of private consultants will increase, at least in the near future, due to continued downsizing by companies and federal agencies.

References

Health Physic Society, *Membership handbook; an official publication for the 2003-2004 term of the Health Physics Society*, Health Physics Society, McLean, VA, 2003.

IV. ACADEMIC PROGRAM OVERVIEW

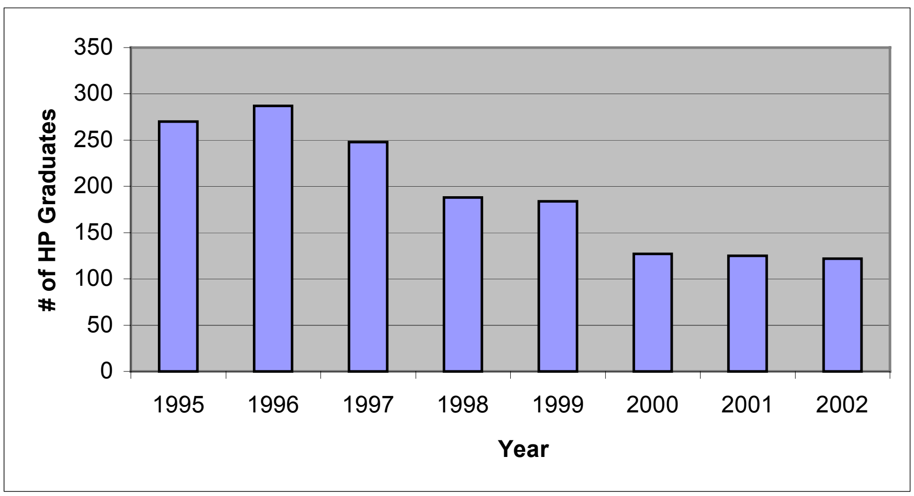
Associate, 4 Yr Undergraduate, and Graduate Health Physics Programs

Current Status of Health Physics Academic Programs

To better define the current status of health physics academic programs, a survey was conducted by the Health Physics Program Directors Organization (HPPDO). Statistics were gathered on the number of students graduating with health physics degrees since 1995, number of faculty as well as amount of outside funding. Graduation rates for associate programs were not ascertained due to a paucity of programs. Undergraduate and graduate degree information was obtained from the Health Physics Education Reference Book (2003) and the Oak Ridge Institute for Science & Education (ORISE) Human Resource Data Base (2003). Radiation protection professionals have diverse educational backgrounds. Many have degrees in related disciplines such as biology, chemistry or engineering but most have at least a bachelors degree in health physics.

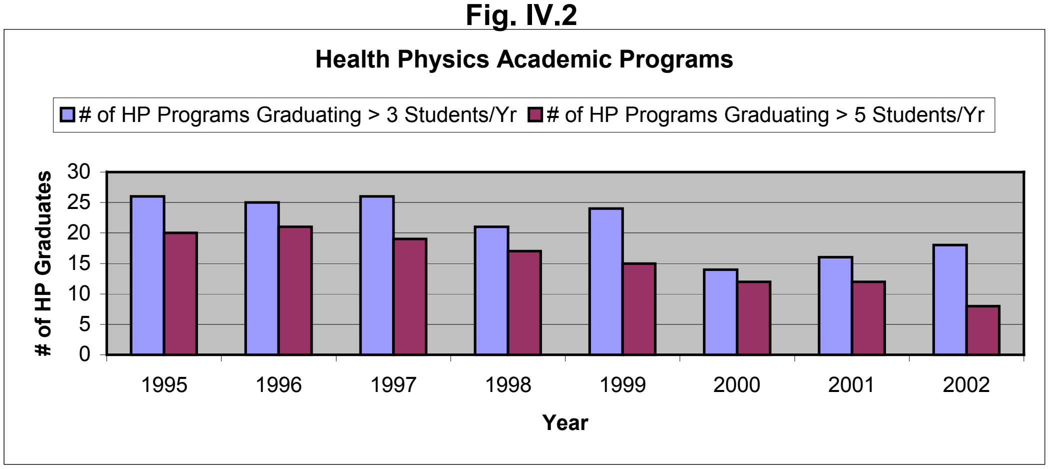
The number of students graduating from health physics programs in the United States with either a bachelor's, master's or Ph.D degree in health physics declined 55% from 270 in 1995 to 122 in 2002 (see Fig. IV.1). These statistics do not include students graduating from associated programs such as medical physics or nuclear engineering.

Fig. IV.1
Total Number of Health Physics Program Graduates



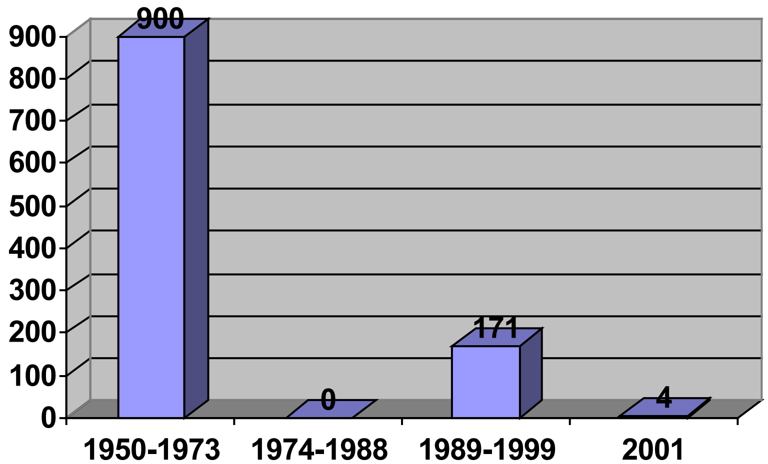
The number of academic health physics programs graduating at least 5 students annually decreased from 20 programs in 1995 to 7 programs in 2002 (see Fig. IV.2). A similar decline was noted if the number of students graduating annually was adjusted to 3 although some slight upward movement was noted beginning in 2000.

Fig. IV.2



Funding information for HP–related fellowships, obtained from the ORISE Allied Health Physics Graduate Fellowship Completion Report, indicate approximately 900 AEC-sponsored fellowships were granted during the period of 1950 to 1973 when this country's peaceful use of radiation was rapidly expanding. DOE funded 171 fellowships from 1989 to 1999 as part of the DOE Applied Health Physics Fellowship Program, to help fill the void in it's energy sector. During this same time frame the Nuclear Engineering Health Physics (NEHP) Fellowship program existed but recipients were typically from nuclear engineering departments. However, as can be seen in Fig. IV.3, only a few federally-sponsored HP fellowship programs exist today. Funding of health physics academic programs is described in greater detail in the following section.

Fig. IV.3
Awarded Health Physics Fellowships



Programs intended to train radiation scientists with expertise in radiation biology, oncology and epidemiology typically employed at biotechnology and pharmaceutical companies, national laboratories, government agencies and cancer treatment centers have also seen a decrease in the number of students and erosion of program support (Coleman, C.N., et al, 2003).

Funding Support For Health Physics Academic Programs

Support of fellowship programs is an important avenue in assuring a continuous pipeline of radiation protection professionals entering the work force. It has been estimated that the federal government supported half of all research assistantships, approximately two-thirds of all traineeships and one-quarter of all fellowships. Non-federally funded sources typically support teaching assistantships. For individuals wishing to enter a graduate program of study in health physics, HPS and DOE fellowships have historically been the predominate method for obtaining assistance. DOE fellowships also provided a stable source of support for the institutions and faculty administering health physics programs. Currently, only four federally-sponsored grants and a variable number of HPS fellowships (typically 3-5) are awarded annually to help students and faculty. It has been estimated by the Health Physics Academic Program deans that it costs approximately $30,000 per year to educate a graduate student in health physics (includes tuition, fees and stipend). Further, education and research grants are needed to support basic and applied research in health physics, as well as to assist in the recruitment and retention of junior faculty at institutions with health physics programs. It is estimated that the *minimum* amount needed to support a junior research faculty position is $120,000 per year. This information was presented as part of written testimony supplied by HPS to the U.S. House of Representatives Subcommittee on Energy and Water Development in a letter dated March 20, 2003 (Frazier, 2003). Outside funding for the most viable health physics programs ranged from $50K to $2.5M per year largely dependent on the number of students and faculty members.

HPS Fellowships

Between 1985 and 2003, 103 HPS fellowships have been awarded (French, 2003) with a total of 102 recipients (1 recipient received two separate awards). Monies for the HPS fellowships were obtained from Society general funds. Information was obtained on 75 of the 102 recipients (74%). Of the vast majority of those receiving fellowships and responding to this survey, i.e., 96 % (72 out of 75) currently work in the field of radiation protection or a related field. Approximately 15% (11 out of 75) have become professors in a health physics or related academic program.

DOE Fellowships

The Applied Health Physics Graduate Fellowship (AHP) program authorized under the U.S. Department of Energy (DOE) began in fiscal year 1989. The objectives, as referenced in an Oak Ridge Institute for Science and Education (ORISE) report on this program (ORISE, 2000), included:

- Encourage talented undergraduate science, engineering and mathematics students to pursue graduate study at the master's level in operational health physics.
- Assist DOE in efforts to maintain an adequate supply of approximately trained and highly qualified operational health physicists who could carry out the DOE nuclear energy agenda.
- Enhance the academic community's commitment to maintain M.S. degree programs in health physics
- Strengthen ties between the academic community and DOE facilities in health physics education, research and training.
- Encourage graduating fellows to accept employment with DOE or DOE contractors and work in areas supportive of the mission of the Office of Environment, Safety and Health.

The AHP program operated through 1999. During this period 449 applications were received from which 171 fellow appointments were made. 150 of the 171 fellows performed a practicum at a DOE facility. This practicum not only provided students with a wide range of educational and training opportunities, it saved DOE facilities a considerable amount of money in permanent hires. ORISE attempted to track the employment history of the DOE fellows. According to their report, approximately one quarter of all fellows did not respond to repeated attempts in obtaining this information. Of those responding, 41% accepted employment with a DOE facility or DOE contractor. 12% continued with their education by pursuing a Ph.D. program and 6% accepted employment within federal or state agencies. Overall, the report states "the AHP program was successful in that it attracted quality applicants, from which Fellows were appointed, including women and minorities, who did significant, mission-related research both on campus and at their practicum facility."

Non-Federally Funded Student Opportunities

Although the vast majority of financial resources have historically come from federal sources to fund health physics academic programs, private funding has also been obtained. This is only natural since many of the customers of qualified radiation protection professionals are from private industry or individuals. Current sources include the Health Physics Society, Robert S. Laudauer, Sr., Dick Burk and Burton Moyer fellowships.

Accreditation

Two bachelors level and two masters level health physics programs are currently accredited through the Accredited Applied Science Programs of the Accreditation Board for Engineering and Technology, ABET. Accreditation aids in the establishment of a core curriculum taught in a consistent manner demanded by customers of health physics services.

ABET, Inc., an accreditor of college and university programs in applied science, computing, engineering, and technology, is a federation of 31 professional and technical societies representing these fields. ABET currently accredits some 2,500 programs at over 550 colleges and universities nationwide. ABET's four accreditation commissions perform the accreditation function and determine accreditation actions. The Engineering Accreditation Commission is responsible for engineering programs, the Technology Accreditation Commission is responsible for engineering technology programs, the Computing Accreditation Commission is responsible for computer science programs, and the Applied Science Accreditation Commission for applied science programs. All commission members who chair the on-site visit teams are qualified evaluators and are thoroughly knowledgeable of accreditation procedures, policies, and criteria. Programs are identified as accredited by the Engineering Accreditation Commission of ABET (EAC/ABET), Technology Accreditation Commission of ABET (TAC/ABET), Computing Accreditation Commission (CAC/ABET), or Applied Science Commission of ABET (ASAC/ABET).

Recommendations
Strong, healthy academic programs are necessary in order to continue to fill the pipeline of radiation protection professionals working in the energy, regulatory/security and health sectors of our nation. Recommendations from the HPS Task Force include:

- Continue to work with DOE and other federal agencies in exploring opportunities to secure funding for health physics academic programs

- The Health Physics Society will continue to explore private sources of funding for health physics academic programs

- Continue to encourage ABET accreditation for 4 year and advanced degree health physics programs. Standardization of a core curriculum is important for providing a consistent, good quality educational program. Centers of excellence can be formed to address specific programmatic needs

- Investigate standardization or accreditation of technician level training through the NRRPT or similar organization. Although training programs are already available through commercial organizations, private companies, and are often provided in house by the employer, establishment of core curriculum would provide consistent background for more advanced training.

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Brey, R; *United States Health Physics Academic Program Capacity*, Health Physics Program Directors Organization, July 2002
Oak Ridge Institute for Science & Education, *ORISE Health Physics Enrollments and Degrees Brief*, Oak Ridge, Tennessee, April 2002.

V. CONCLUSIONS AND RECOMMENDATIONS

Health Physics Society President John Frazier's decision in 2001 to create a task form to review human capital crisis issues for radiation protection professionals came at a critical time for the profession and the country. At a time when the demand for radiation protection professionals is strong and new initiatives such as response to nuclear terrorism are at the fore front, the number of professionals reaching retirement age is increasing and the number of academic health physics programs to support the pipeline of radiation protection professionals has dramatically decreased, even within the last ten years. Added to these concerns is the competition for students entering science and engineering (S&E) fields in this country. The National Science Foundation has indicated that the number of U.S. citizens enrolling in S&E graduate degree programs declined more than 15% from 1993 to 2000, with the greatest decline in mathematics (25%), engineering (23%) and physical sciences (15%). Undergraduate science and technology students were attracted to non-S&E programs, such as graduate business school, where the number of MBA's awarded annually have risen by nearly one-third between 1992 and 2000. The radiation protection profession is not alone in it's efforts to understand and attempt to resolve human capital crisis issues. In a recent Government Accounting Office report, it was reported that human capital issues are felt in all federal agencies. It was anticipated that 35% of the fiscal year 1998 federal workforce will be eligible for regular retirement by 2006. Cutbacks in agency budgets in the 1990's adversely affected training and professional development programs. Citing a specific example of the U.S. Nuclear Regulatory Commission, GAO reported that NRC's ability to achieve its mission was being threatened by a decline in university enrollments in nuclear sciences. The report concluded that human capital problems will require the sustained commitment of executive and legislative leaders.

In an attempt to address human capital crisis concerns, the status of radiation protection professionals working within the energy, security/regulatory and medical sectors was ascertained.

Approximately 6700 individuals involved in radiation safety activities, 63% in energy, were identified in this survey. These numbers should be viewed with some caution as they are thought to be conservative. It is believed that a large number of individuals perform radiation safety activities on a part time basis. Also, many radiation protection professionals provide consulting services not completely identified in this survey. Certain federal agencies such as the armed forces and certain sections within the Department of Homeland Security, employ radiation protection professionals but did not respond to our requests for information due to security reasons. The greatest near-term demand, as determined by this survey, resides within the energy sector. Other than the Nuclear Regulatory Commission, no other group or agency had conducted a future needs assessment to identify potential professional resource issues. Even if it is assumed that an equal percentage of individuals retire over a forty year working lifetime, the number of existing health physics program graduates, i.e., 122 per year (2002 data), does not meet or exceed the demand based on a retirement rate of 167 per year.

Within the **nuclear power industry**, surveys have indicated the demand for health physicists will far exceed available supply, even exceeding the demand for nuclear engineers. Based on annual survey results from NEI, approximately 3 times as many permanent radiation protection professionals are employed as compared to temporary radiation protection positions. Approximately 12% of this work force has a 4-year degree in health physics or a related field. The number of people entering the field, i.e., younger than 35 years of age, is approximately equal to the number of people reaching retirement age, i.e., greater than 55 years of age. In the very near term, finding an adequate number of technical level radiation protection professionals appears most critical.

For health physics **contactors working at DOE facilities**, nearly twice as many of the most knowledgeable people are reaching retirement age as compared to those entering the field. Because of the importance of this work, most radiation protection professionals working for DOE are required to have a four-year degree in health physics or a closely related filed. In addition, certification by the American Board of Health Physics is highly desired. Currently, It has been reported by the Assistant Secretary of DOE, that due to nuclear facility closings, the number of advanced degreed health physicists require in the short term should not dramatically increase, however, the current need for radiation technicians is strong.

The **NRC** faces a huge challenge with the number of radiation protection staff reaching retirement age in the near future as identified in a GAO report. The NRC has conducted a future needs assessment and have implemented creative retention programs and identified core competencies. However, failure to find an adequate number of personnel could have catastrophic consequences on the security of radiation sources and reactor safety in this country.

The response from **other federal agencies** for information regarding radiation protection professionals was not complete. Although it is difficult to form an absolute conclusion based on limited FOIA response, it appears as though the need for radiation safety professionals within agencies will continue, although DOE and at least one other agency have used outsourcing. Educational and work experience requirements differ, depending on the agency and work involved, but DOE has established job-specific educational and training requirements. Many jobs within DOE, or its contractors, require a 4-year degree in health physics or a related field. Agencies not responding to our FOIA request but most certainly involved in radiation protection activities or addressing nuclear terrorism concerns include FEMA, and the Department of Homeland Security. In addition, members of the armed forces involved in radiation safety duties were not included in our results due to security reasons. Future surveys should attempt to obtain information on these important employment sectors.

Clearly the control of radioactive material is of primary concern especially since the events of 9/11. Having properly trained and educated individuals responsible for the **state regulatory programs** is in the best interest of our country. The total number of FTE's devoted to radiation safety and regulatory control was 803 for the entities responding to the survey. Licensing and inspection activities required the greatest number of FTE's followed by x-ray machine inspection and certification programs. Some agreement state licensing and inspection programs have less FTE's than suggested by CRCPD guidance.

Radiation protection professionals working within the **health care** setting play an important role in protecting patients, staff, and members of the general public from excessive radiation. Some states have enacted laws requiring certification of physicists because the actions of improperly trained individuals have caused harm. It is difficult to estimate the number of individuals involved in radiation protection in the health care setting due to varying and overlapping job responsibilities, however, based on AHA statistics, it is estimated that approximately 580 individuals whose primary responsibility is radiation protection, are employed at large teaching hospitals with diagnostic radiology, nuclear medicine and radiation oncology services. This is a reasonable assumption since large teaching hospitals with multiple services utilizing ionizing radiation often hire health physicist due to the complexity of radioactive material licensing and frequency of patient interaction.

Private consultants are utilized in all employment sectors identified in this document. As companies or facilities downsize, the role of properly trained and educated consultants becomes more critical. For the purposes of this survey, statistics gathered by the Health Physics Society were reviewed (HPS, 2003). In 2003, the Health Physics Society determined 399 out of 5560 respondents were involved in private consulting activities or approximately 7% of the membership. Of the 399 Health Physics Society members primarily performing consulting activities, 139 or 35% are classified as Certified Health Physicists. It is anticipated that the number of private consultants will increase, at least in the near future, due to continued downsizing by companies and federal agencies.

Future opportunities to gain a more complete picture of radiation protection professionals in all employment sectors and address issues raised by stakeholders include:

- Continue to attempt to obtain radiation safety professional employment information from those not responding to the HPS FOIA request. These agencies include certain sections within the Department of Homeland Security and FEMA. In addition, an estimate of the number of radiation protection professionals within the armed forces should be obtained

- Obtain employment information from the nuclear fuel cycle. Although it is felt that this employment sector is not as significant as others based only on number of radiation protection professionals employed, this area may increase in the future depending on the needs of the country and benchmarking efforts should continue.

- Obtain employment information for radiation protection professionals employed by private industry and not currently accounted for in this survey. Examples of industries employing radiation protection professionals in this category include radiopharmaceutical suppliers and radiation instrument manufacturers.

- Attempt to estimate the number of individuals that perform radiation safety duties only part time.

- Determine the number of individuals performing consulting activities. Health Physics Society membership statistics for 2002 indicated approximately 8% of members involved in private consulting

- Review the effects of outsourcing.

- Determine type of jobs obtained by DOE HP Fellowships

Strong, healthy academic programs are necessary in order to continue to provide meaningful succession of radiation protection professionals working in the energy, regulatory/security and health sectors of our nation.

Recommendations from the HPS Task Force include:

- **Continue to work with DOE and other federal agencies in exploring opportunities to secure funding for health physics academic programs**

- **The Health Physics Society should continue to explore private sources of funding for health physics academic programs**

- **Continue to strongly encourage ABET accreditation for 4 year and advanced degree health physics programs. Standardization of a core curriculum is essential for providing a consistent, good quality educational program. Centers of excellence should be formed to address specific programmatic needs**

- **Promote standardization or accreditation of technician level training through the NRRPT or similar organizations. Although training programs are already available through commercial organizations, private companies, and are often provided in house by the employer, establishment of core curriculum would provide consistent background for more advanced training.**

- **The Health Physics Society should commit to develop methods to encourage students to become interested in health physics programs.**

This report by the HPS Task Force is but a first attempt to try to determine the number of radiation protection professionals working within various employment sectors, their relative age and other key demographic information. Future studies will better clarify the needs of customers utilizing radiation protection professionals.

APPENDICES

Organization of Agreement States

Appendix 1

Pearce O'Kelley, Chair
Stan Fitch, Chair-Elect
William Sinclair, Past Chair
Gary Robertson, Treasurer
Kenneth Weaver, Secretary

May 29, 2003

State Radiation Control Program Directors,

In order to continue to provide trained and educated radiation safety professionals to serve the energy, medical, and regulatory needs of this country, the Health Physics Society has embarked on a study to evaluate the following:

- types of jobs requiring radiation safety training and expertise in the regulatory, energy, security and medical environment
- number of radiation safety professionals, both 4-year degreed and technically-trained, filling these positions
- number of radiation safety professionals nearing retirement age

The Health Physics Society is asking for your assistance in obtaining information on the scope of your regulatory programs. To aid in this assessment, a spreadsheet is attached. *Sheet A* is intended to derive information on the types of programs, educational background and age of staff involved administering these programs in each state. This sheet is intended to be completed by all state program directors. *Sheet B* is intended to obtain additional information on non-radioactive material programs administered in each state and should be completed by all state program directors. *Sheet C* is intended to be completed only by Agreement State directors. Its intent is to identify the types and numbers of licensees, any specialized training or educational requirements of the licensee RSO and number of civil penalties levied for each license type since January 1, 2000.

To assist the Health Physics Society in their efforts, I am asking the radiation control directors to complete the following spreadsheet and return it to Kevin Nelson either electronically at nelson.kevin2@mayo.edu, by fax or mail to the address listed below. Please do not hesitate to contact me if you have any questions. If at all possible, the Health Physics Society would like to have this information by July 11, 2003. Information gathered in this effort will be used for trend analysis only.

Kevin Nelson, Ph.D., CHP
Health Physics Society Board of Directors
Director, Environmental Health & Occupational Safety
Mayo Clinic Jacksonville
4500 San Pablo Rd.
Jacksonville, FL. 32224

904/953-8978 (pager)
904/953-1010 (FAX)

I know your time is valuable and that you can be overwhelmed with additional survey requests. I would appreciate your willingness to complete this one. This survey could result in additional training opportunities for your staff, licensees, and registrants. Thank you for your cooperation in this very important project.

Sincerely,

T. Pearce O'Kelley, Chair
Organization of Agreement States

HEALTH PHYSICS SOCIETY

"Specialists in Radiation Safety"

KENNETH R. KASE, President
Stanford Linear Accelerator Center
2575 Sandhill Road
Menlo Park, CA 94025
Telephone: (650) 926-2045
FAX: (650) 926-3569
E-Mail: krk@slac.stanford.edu
http:/ / www.hps.org

5 September 2003

Brenda Dolan
Department of Commerce
FOIA/PA Officer
Room 6020
14th Street and Constitution Avenue, N.W.
Washington, D.C. 20230

Re: Freedom of Information Act Request with **Request for Expedited Consideration**

Dear Ms. Dolan:

Pursuant to the Federal Freedom of Information Act, 5 U.S.C., s. 522, the Health Physics Society, an educational and scientific non-profit society for promoting the practice of radiation safety, requests a profile of the number of radiation protection professionals that your agency employs, either directly or through contracts, which would include the terms health physicist, radiation safety technician, or the term "radiation or radiological" within the position title that are employed at your agency.

More specifically, we request:

1 The current number of radiation protection professionals at your organization
2 The number of FTE's that your agency has for these type of positions;
3. The number of open radiation protection positions
4. For each radiation protection position, please provide a copy of the position
5. A description indicating the salary and grade of each position.
6. An indication whether or not your agency hires contractors for this service.

In general, we are also interested in whether or not your agency has performed a future needs study for this particular area of expertise.

Information obtained in this survey will be used to inform key individuals in Federal agencies and Congress regarding the current and future needs for qualified radiation protection professionals to meet this country's energy, medical and security needs. We request an expedited review due to Congressional discussions affecting appropriations for health physics educational programs

Answers to the above-listed questions can be sent to me at krk@SLAC.Stanford.EDU or the address above. Questions regarding the human capital crisis assessment project undertaken by the Health Physics Society can be directed to Kevin Nelson at nelson.kevin2@mayo.edu or 904/953-8978.

Thank you, in advance, for your assistance in this matter.

Sincerely,

Kenneth R. Kase
President, Health Physics Society