DOE/OR/21479--T1

AUG 0 8 1989

PROGRESS REPORT ON THE

DEPARTMENT OF ENERGY'S

PILOT INTERNSHIP PROGRAM ON RADIOACTIVE WASTE

AT

VANDERBILT UNIVERSITY

DOE/OR/21479--T1

DE89 016438

(September 1, 1987 to August 31, 1988)

I. INTRODUCTION

The fourth year of the program began with the selection of the new interns. Mailings were sent to prospective graduate students and rising juniors at Vanderbilt University with grade point averages of 3.0 or better (out of 4.0) advertising the availability of internships in radioactive waste disposal.

The new interns selected were:

NAME	STATUS	GRADE POINT AVERAGE
Eric J. Dawson	First year graduate student in Environmental Engineering B.S., Colorado State University	3.83/4.00
Tina Marie Hannye	Junior in Civil and Environmental Engineering	3.93/4.00
Robert Todd Harris	Junior in Chemical Engineering	3.89/4.00
Eric Samuel Lookofsky	Junior in Chemical Engineering	3.29/4.00
John Mathis Rudolph	Junior in Civil and Environmental Engineering and Mathematics	3.65/4.00
Dean Vlachos	First year graduate student in Environmental Engineering B.S., Colorado State University	3.90/4.00

All of the interns selected in the fourth year chose to return to Vanderbilt after their field assignment.

II. COURSE OF STUDIES

As outlined in the proposal for the Pilot Internship Program, each student continued his normal curriculum in his respective engineering discipline, with the additional requirements of Physics 133, Introduction to Modern Physics, or Physics 153, Principles of Modern Physics (in the future, students will be encouraged to take Physics 153); Physics 238, Atomic and Nuclear Physics (Laboratory Course); and CEE 269, Radiological Aspects of Environmental Engineering. Copies of the syllabi are attached as Appendix A. Students in their second year have been encouraged to take EWRE 355, Hazardous Waste Engineering, to prepare them to deal more effectively with mixed hazardous chemical and radioactive waste problems.

The equipment purchased for use as part of the internship (liquid scintillation counter, ion chromatograph, UV-vis spectrophotometer) has been set up and tested. A new laboratory course, CEE 273 - Environmental Engineering Laboratory, will be taught for the first time in the Spring 1989 semester. The interns taking this course will be introduced to this equipment and instructed on its use in environmental monitoring. The monitoring techniques will be useful for groundwater modelling, waste stream evaluation and laboratory testing of waste treatment technologies. In addition, the interns have been exposed to the unique capabilities of this equipment for research into the partitioning of carbon in environmental processes, i.e., a complete (solid-liquid-gas phase) mass balance on carbon, separation and quantification of hydrophillic organic compounds in water, such as organic acids, and fingerprinting of wastes (UV-vis scanning). The experience with this equipment through hands-on laboratory work, research seminars, and classroom teaching will provide invaluable training for the interns.

Tim Tope, an earlier intern, has already used the ion chromatograph in a research project. Now that the equipment is operational, it is expected to be more widely used by the interns.

The two IBM AT Personal Computers (PC) purchased for the internship program continue to prove invaluable. They are used extensively in both course work and research work.

III. INTERN ASSIGNMENTS

Applications were solicited from the firms initially suggested by DOE and from other major firms doing decontamination and decommissioning work. Those solicited were: Bechtel National, Inc., Westinghouse Electric Corporation, General Electric Corporation, NUS Corporation, IT Corporation, Westinghouse Hanford Operations, UNC Geotech Technical Measurements Laboratory, and DuPont Savannah River Laboratory. Those interested provided us with proposed work assignments for the interns. These are shown in Appendix B.

Early in the spring semester, most of the companies sent representatives to Vanderbilt University to present seminars on the work they were doing and to interview the interns for possible assignments at their work places. Prior to the visits, a curriculum vita for each student was sent to each company (shown in Appendix C). During the visits, it was stressed with the company representatives that the internship must be a learning experience in D & D.

The students were counseled on the advantages and disadvantages of the various opportunities, but were encouraged to make independent choices, consistent with some distribution among companies and projects. Each student was reminded that he was required to do a senior paper or master's thesis on a topic within the decontamination and decommissioning field. A letter reminding them of the obligation to do this was sent to each intern. Each student then made his choice:

Ernest Roberts Alley, Jr. - E.I. DuPont de Nemours, Savannah River Laboratory, Aiken, South Carolina - Though Rob was admitted in the third year of the program, as discussed in last year's progress report, he chose to do his field study this year. Rob continued some of the work begun by Tim Tope on the off-gas cleanup from the plutonium waste incinerator. He was in charge of the design, construction, and startup of the two loop design modifications to the mobile off gas system (SMOG). In the development of an incineration facility for the plant, the SMOG was expanded from a one loop water system to a two loop system for particulate salt removal as part of the design modifications. Tests on salt buildup and water transport between the two loops were begun.

Eric Dawson - General Electric Company, Shippingport Decommissioning Project, Beaver Valley, Pennsylvania - Eric extended the work done by Connor Haugh in designing a plan for site soil sampling to be sure it meets the site release criteria. In addition, he worked with the release team doing many parts of the release procedures, such as performing surveys, taking samples, documenting results, assisting in engineering analyses, and in preparation of data packages.

Tina Hannye - Bechtel National, Inc., Oak Ridge, Tennessee - Tina prepared a reference document concerning solidification and stabilization processes, including physical, chemical and biological, and incineration. The document shows what types of waste are best suited for this treatment, what type of pretreatment is most helpful and what the costs are.

R. Todd Harris - UNC Geotech Technical Measurements Center, Grand Junction, Colorado - Todd utilized existing equipment and expertise to determine the half life of ^{218}Po and the precision of that measurement. Though previous measurements existed, there were discrepancies in the values. With the increased interest in radon exposure, a more accurate value was needed. Todd and his supervisor, Dowell Martz, have submitted this work to the Health Physics Journal for possible publication.

Eric Lookofsky - Martin Marietta Energy Systems, Inc., Paducah Gaseous Diffusion Plant, Paducah, Kentucky - Eric worked at preparing a computer mode to achieve better understanding of trap chemistry and performance to improve operating conditions to maintain UF_6 emissions at low levels. The study tested the increased efficiency of trapping using Al_2O_3 following NaF complexation.

John Rudolph - Westinghouse Hanford Company, Richland, Washington - The purpose of the study was to prepare a collection and treatment plan of the contaminated groundwater at the Hanford site, utilizing newer technology. Technologies which were to be investigated were filtration, precipitation, reverse osmosis, ion exchange and biodestruction.

Dean Vlachos - Bechtel National, Inc., Oak Ridge, Tennessee - Dean carried out laboratory experiments to determine if a relationship exists between radionuclide activity and size distribution of contaminated soils from selected FUSRAP sites. If such a relationship exists, then it may be possible to reduce the costs of FUSRAP site cleanup by separating the fines with their higher concentration of radionuclides from the lower concentrations in the larger sizes and then treating the fines to a greater degree than the larger sizes.

IV. STATUS OF THE SECOND-YEAR PROGRAM INTERNS

The six remaining second-year students returned for the second year of the internship (grade reports for all interns for the second year are included in Appendix D).

Ernest Roberts Alley, Jr. - Rob continued his studies and will graduate in May 1989.

David Cristol - David graduated in mechanical and materials engineering and went to work for Boeing Aerospace in Huntsville, Alabama.

Connor Haugh - Connor finshed his master's paper on "A Risk Analysis of the Effectiveness of Synthetic Liners in Reducing the Risk from Hazardous Waste Landfills." He will receive his degree in environmental engineering in December 1988. He went to work for the U.S. Geological Survey on hazardous waste sites.

Bruce Patrick Herndon - Bruce graduated summa cum laude with a joint degree in computer science and mathematics and went on to graduate work in expert systems at Stanford University.

Elizabeth Ann Shurte - Elizabeth graduated in chemical engineering and went into the Army to fulfill her ROTC obligations. She presented the paper she prepared with her summer internship supervisor, Nevyn Rankin, entitled "Evaluation of the Effectiveness of Commercially-Available Decontamination Chemicals on Stainless Steel and Inconel 625" at Waste Management '88.

Jamie Wright - Jamie chose, at the end of the first semester, to return to Bechtel National, Inc., to continue her work on the cleanup of FUSRAP sites. She has enrolled at the University of Tennessee-Knoxville in Nuclear Engineering 597, Special Topics in Radiation Protection, taught by James Turner, and Public Health 511, Occupational Health. Upon successful completion of these courses, she will graduate with a master's degree.

Tim Tope - Tim, a former intern, has continued his graduate studies in environmental engineering at Vanderbilt University. During this past year, he won the Carl Mason Prize for Research in the Treatment, Destruction or Disposal of Industrial, Hazardous or Nuclear Waste for "A Method for Rating the Integrity of Flexible Membrane Liners for Hazardous Waste Disposal Sites." In addition, he presented "Minimum Technical Criteria and Public Involvement in Siting Hazardous Waste Facilities," in conjunction with Frank L. Parker and John A. Roth, at the DOE Model Meeting in Oak Ridge, Tennessee on October 5, 1988, and will present "Use of U.S. EPA's EXAMS Model to Predict the Fate of Contaminants into the Rhine and Monongahela Rivers," with Daniel S. Travis and Frank L. Parker, at Superfund '88 - Hazardous Materials Control Research Institute on November 30, 1988.

V. TECHNICAL ADVISORY COMMITTEE

The third meeting of the Technical Advisory Committee was held in conjunction with the fall colloquium on October 1, 1987. At the colloquium, the

interns presented the results of their summer work and also described their impression of the program. In addition, their local sponsors described their experience with the interns over the summer and discussed their programs and likely opportunities for the following summer. The new interns attended the colloquium and the luncheon with the local sponsors and the members of the Technical Advisory Committee (frequently the same person). The members of the Technical Advisory Committee are listed in Appendix E. At the close of session, the Technical Advisory Committee expressed again its enthusiasm for the program.

None of the expenses of the colloquium or the Technical Advisory Board was paid from DOE funds.

VI. INTERNSHIP PROGRAM RENEWAL

The Department of Energy has renewed the internship program for another three years. We are grateful for the continued expression of confidence in this program.

VII. RECRUITMENT OF NEW STUDENTS

To make the existence of the program better known, the Director presented a paper, "A University Program in Hazardous Chemical and Radioactive Waste Management," at the Oak Ridge Model Conference at Oak Ridge, Tennessee, on October 13, 1987. He presented an invited paper, "Risk Assessment Applied to Indoor Radon," in a panel discussion on radon at the American Nuclear Society Meeting in Los Angeles on November 16, 1987. He also presented an invited paper, "What We Can Learn About Low-Level Radioactive Waste Management from Other Countries," at the American Chemical Society meeting on September 3, 1987 in New Orleans. All of these appearances resulted in favorable publicity for the program and increased applications for the fifth year of the internship program.

The choice of interns this year was difficult, since the number and quality of applicants was so high. Those awarded internships are:

NAME	STATUS	GRADE POINT AVERAGE
Reid Adams	Junior in Civil and Environmental Engineering	3.36/4.00
Lawrence Lacy Baldy	Junior in Civil and Environmental Engineering	3.22/4.00
Ronald James Falco	First year graduate student in Civil and Environmental Engineering, B.S., Chemical Engineering, University of California-Berkeley	3.24/4.00
Brennan Smith	Junior in Civil and Environmental Engineering and Economics	3.31/4.00
Mark Valenzuela	Junior in Civil and Environmental Engineering	3.94/4.00

Two other candidates were admitted but withdrew at the beginning of the semester when it was found that their premedical course requirements precluded their taking the necessary courses for the internship.

VIII.QUALITY ASSURANCE

In addition to the Technical Advisory Committee overview of the entire program, a system of checks has been installed to assure the quality of the program. Within two weeks after the student begins his summer assignment, he and his supervisor prepare a description of the proposed summer project. After receipt of the proposal, the Program Director reviews it to be sure that the topic and scope of the work are compatible with the objectives of the program. Shortly thereafter, the Program Director visits the site to discuss with the intern and his supervisor the work program and any difficulties there may be in implementing it. At the end of the summer internship, the intern and his supervisor prepare, if appropriate, a proposal for further work on the summer project. During the course of the summer program, the intern is encouraged to seek advice from the appropriate faculty members at Vanderbilt University. If work is continued at Vanderbilt, then the appropriate faculty member is encouraged to continue to work with the student.

APPENDIX A

SYLLABI

ADVANCED LABORATORY: NUCLEAR PHYSICS

PHYSICS 238

Fall 1987 W 1:10 - 5:00 PM
Professor Ramaya

1. Determination of the characteristics of GM Counter and gas flow proportional counter.

2. Investigation of the absorption coefficients for α, -β, -γ radiation.

3. Determination of the energies of γ-radiation with NaI counter. -Investigation of the shapes of the γ-spectrum with different size NaI detectors and Multichannel analyzer.

4. Measurement of half life of the isomeric state in ^{137}Ba.

5. Investigation of the γ-ray spectra with Ge(Li) detector and a Multichannel analyzer.

6. Determination of the energies and intensities of the γ-radiation emitted by ^{152}Eu source.

7. Setting up a coincidence spectrometer with two NaI detectors and plastic detectors.

8. Measurement of the speed of γ-rays using the set up in No. 7.

9. Construction of decay scheme by performing coincidence experiments.

10. Angular distribution of the γ-rays emitted by ^{60}Co to assign spins to the Nuclear levels.

Elements of Modern Physics
Physics 161 - Spring 1988

Charles E. Roos
322-2857 (O) 292-1415 (H)
Office Hours: M W F at 11:10 to 12:00
SC 6929

Text: Physics of the Atom
by Wehr, Richards, and Adair

Section I The Atomic View and Relativity

Jan. 9:	Introduction	
12 and 14	Chapter 1.	Problems: 1.5, 1.9, 1.15, 1.39
16 and 19	Chapter 2.	Problems: 2.13, 2.26, 2.31, 2.38, 2.43
21, 23, 26	Chapter 3.	Problems: 3.3, 3.9, 3.17, 3.30, 3.37, 3.41
28, 30, 2	Chapter 5.	Problems: 5.11, 5.20, 5.29, 5.31, 5.37, 5.45

Feb. 4 FIRST HOUR EXAMINATION (Chapters 1, 2, 3 and 5)

Section II Quantum Phenomena

6, 9, 11	Chapter 4.	Problems: 4.3, 4.19, 4.23, 4.24, 4.42, 4.45
13, 16, 18	Chapter 6	Problems: 6.7, 6.12, 6.19, 6.27, 6.32, 6.37
20 and 23	Chapter 7.	Problems: 7.1, 7.3, 7.7, 7.18, 7.25

Feb. 25 SECOND HOUR EXAMINATION (Chapters 4, 6, and 7)

Secton III Quantum Mechanics

27 and 9	Chapter 8	Problems: 8.5, 8.8, 8.17, 8.21
	March 1 to March 8	SPRING BREAK
11, 13, 16	Chapter 9	Problems: 9.1, 9.7, 9.9, 9.12, 9.13, 9.15
18, 20, 23	Chapter 10	Problems: 10.3, 10.6, 10.19, 10.25, 10.40

Mar. 25 THIRD HOUR EXAMINATION (Chapters 8, 9, and 10)

Section IV Nuclear and Particle Physics

27, 30, 1	Chapter 11	Problems: 11.1, 11.9, 11.12, 11.23, 11.44, 11.49
3, 6, 8	Chapter 12	Problems: 12.2, 12.8, 12.15, 12.25, 12.29, 12.31
10 and 13	Chapter 13	Problems: 13.1, 13.3, 13.9, 13.12, 13.15

April 15 FOURTH HOUR EXAMINATION (Chapters 11, 12, and 13)

Section V Modern Physics (1987)

17, 20, 22 Current research topics in physics will be discussed.

VANDERBILT UNIVERSITY
SCHOOL OF ENGINEERING
DEPARTMENT OF CIVIL AND
ENVIRONMENTAL ENGINEERING

CEE 269 - RADIOLOGICAL ASPECTS OF
ENVIRONMENTAL ENGINEERING
SPRING 1988
INSTRUCTOR: F. L. PARKER

TEXTS: 1. Introduction to Nuclear Engineering, John R. Lamarsh, 1983
2. Radiological Assessment, NCRP Report No. 76, 1984

DATE	TOPIC	READING ASSIGNMENTS JRL	NCRP	PROBLEMS
1-15	Atomic & Nuclear Physics	1-43		2.3,2.7,2.11
1-18	Atomic & Nuclear Physics			2.12,2.16,2.28
1-20	Atomic & Nuclear Physics			2.29,2.31,2.37,2.42
1-22	Interaction with Neutrons	44-64		3.1,3.2,3.4
1-25	Interaction with Neutrons	64-78		3.18,3.24,3.28,3.29
1-27	Interaction of α & β with Matter	78-101		3.39,3.41,3.47,3.49
1-29	Interaction of α & β with Matter			3.56,3.64
2-1	Interaction of γ with Matter			
2-3	Interaction of γ with Matter			
2-5	Nuclear Reactors	102-188		4.9,4.11,4.13,4.30
2-8	Biological Effects of Radiation	397-434		9.3,9.5,9.9
2-10	Legal Aspects of Radiation	434-471		9.11,9.13,9.15
2-12	EXAM			
2-15	Dose Computations			9.17,9.21,9.22,9.27, 9.29
2-17	Dose Computations			
2-19	Dose Computations			
2-22	Dose Computations			
2-24	Gamma Ray Shielding	472-498		10.1,10.2,10.4
2-26	Gamma Ray Shielding			10.11,10.15,10.34
2-29	Reactors - Licensing, Siting, and Accidents	532-549, 584-615		
3-2	Source Terms			
3-4	Dispersion of Effluents-Atmospheric	549-583	198-218, 233-239	11.3,11.5,11.7
	SPRING BREAK			
3-14	Dispersion of Effluents-Atmospheric		1-93	
3-16	Dose from Atmospheric Releases			11.13,11.19,11.21
3-18	Dose from Atmospheric Releases			
3-21	Dispersion of Liquid Effluents-Surface	615-632		11.23,11.25,11.27
3-23	Dose from Liquid Effluents-Surface		96-156	
3-25	EXAM			
3-28	Dose from Liquid Effluents-Surface			
3-30	Dispersion from Effluents-Ground Water		157-197	
4-1	Dose from Effluents - Ground Water			
4-4	Dose from Effluents - Ground Water			
4-6	Special Case Radionuclides			

4-8	Model Uncertainties	219-232
4-11	Model Development	
4-13	Accidental Releases	
4-15	Environmental Effects of Mining & Milling	
4-18	Environmental Effects of Fuel Reprocessing	
4-20	Environmental Effects of Low Level Waste Disposal	
4-22	Environmental Effects of High Level Waste Disposal	
4-25	Geological Formations	
4-27	EXAM	

Please pay Mrs. Lahde, in Room 106, $5.00 for class handouts.

APPENDIX B

WORK ASSIGNMENTS

VANDERBILT DOE/INTERNSHIP PROGRAM - SUMMER, 1988

POTENTIAL ASSIGNMENTS - SAVANNAH RIVER LABORATORY

Potential assignments in the field of decontamination and waste handling exist in three general areas - process development, mechanical development, and expert system development. Assignments completed or still in progress include:

- o an Artificial Intelligence system for a prototype incineration process,
- o a fluid mechanics study of decontamination,
- o an engineering feasibility study for a pyrolysis Pu recovery incinerator, and
- o startup and testing of a mobile hydrosonic scrubber off-gas system,
- o a real-time, on-line melter artificial intelligence system,
- o a decontamination chemical effectiveness test program, and a
- o remote robotic manipulator force sensing and collision avoidance system.

As in the past, the Intern will spend the first week defining the scope of his/her assignment in consultation with Vanderbilt and DuPont. And, Interns will not be doing actual radioactive work themselves, but will rely on trained operators and technicians if any radioactive test work is needed as part of their assignment.

A. Process Development Assignments

1. Decontamination - A pilot-scale decontamination test facility is being built to demonstrate various decontamination techniques, including "Freon" blasting, slurry blasting, steam blasting, and chemical dissolution. The Intern will

- o start up the pilot facility
- o design and implement test programs
- o evaluate (in a "Consumer Reports" type of test program) various decontamination and sealing techniques, materials, and equipment
- o analyze and report test results

2. Hazardous Waste Incineration - The mobile hydrosonic scrubber system is now coupled to a prototype solids incinerator. The off-gas system will be operated to develop fundamental information on system performance and liquid purge requirements. The Intern will

- o define and implement specific tests
- o complete energy and material balances for the system
- o upgrade an existing artificial intelligence computer program

3. Fundamental Incineration Studies - A computer model has been developed to model the kinetics and mass transfer of char-combustion of cellulose and has been validated using lab and pilot-scale data. This work needs to be extended to other potential feedstocks. The Intern will

- o extend the computer model to include other materials
- o design and supervise lab and pilot experiments to validate the model
- o analyze data and report the results

B. Mechanical Development Assignments

1. Remote Decontamination and Material Handling - Robots are being modified to be

coupled with equipment so that decontamination operations can be executed remotely. Also, equipment is being developed to allow remote handling of waste materials. The Intern will

- o design, modify, debug, and demonstrate coupling decontamination equipment to the robot(s)
- o assist in procuring robotic and decontamination equipment
- o train operations personnel to use the equipment
- o document test results and technical support of actual decontamination jobs

2. Ashcrete Immobilization - A unit has been built to remotely and automatically stabilize incinerator ash by adding water, concrete, and sand and tumbling the mixture through various addition cycles. The unit is controlled by a programmable controller. First generation tests are complete, and mechanical modifications are needed to improve unit reliability so that it can moved to the Plant. The intern will:

- o complete and implement design modifications and verify programmable controller software
- o design and execute tests to debug and demonstrate modifications
- o document test results

3. Telerobot Development - A large electro-mechanical manipulator has been built and coupled with a robotic control system. The unit is currently operational. Future development items include adding force sensing capability at various points on the manipulator and implementing a software collision avoidance system. The Intern will

- o design and specify equipment needed for force sensing and collision avoidance
- o install, debug, and demonstrate operation of the equipment
- o document test results

C. Expert System Development Assignments

SRL is involved in applying and integrating artificial intelligence/expert system technology to the control of the Defense Waste Processing Facility (DWPF), which will convert high level liquid waste to glass. The Feed Analysis Decision System (FADS) is an example of one such application. This system will be used to aid Plant personnel with the operation of the facility, including feed additions and corrective actions during process upsets.

Work is currently being done on a Symbolics computer to rapidly develop a "proof-of-concept: prototype of FADS using the advanced graphics and symbolic processing capabilities particular to the LISP machine. One essential feature of FADS will be the ability to access and analyze process data to aid operators in controlling the DWPF processes. The most accessible and complete source of operational data is a data collection system running on a DEC VAX 7550 mainframe computer. Through a proprietary software system called Infotrol, one can directly acquire any DWPF process information, including laboratory analysis results, analog and digital process data, and the operational status of equipment. The intern will assist engineers with the FADS data acquisition system, including

- o assimilation of data necessary for DWPF control
- o determination of the best source from which to retrieve the necessary data
- o development of a program to allow FADS to access the DWPF process information.

December 1987

RESEARCH CONCEPT
DOE/NE Student Intern Program with Vanderbilt University
UNC Geotech/Technical Measurements Center
Grand Junction, Colorado

Research Title: Measure Environmental Radon Exposures by In-Vivo Counting

Research Advisor: Dr. Dowell E. Martz and G. Harold Langner, Jr.

Background: A recent paper by Stebbings, et. al., (1) presented data from in-vivo radon-daughter measurements on subjects exposed to environmental levels of radon in Pennsylvania residences. These data are the first reported for individuals exposed at these low levels. The potential for mass screenings (2) in conjunction with indoor concentration measurements may be practical for epidemiological studies.

We have submitted a proposal to the DOE Office of Health and Environmental Research to develop instrumentation that will increase the sensitivity of in-vivo counting systems for detecting internally deposited radon progeny. We believe that an increase in count rate over the Stebbings system of up to two orders of magnitude can be realized.

Research: The first phase of the work consists of the design, fabrication, and testing of an in-vivo radon-daughter counting system. It is anticipated that significant effort will be required to optimize the signal-to-noise ratio and improve the geometry.

The second phase will involve field measurements of 100 individuals living in Grand Junction, Colorado, structures that have been monitored by the Technical Measurements Center for the past four years.

---

1. "Correlation of Radon Daughter Contamination of Pennsylvania Residents", J. H. Stebbings, J. J. Dignam and R. E. Toohey, Division of Biological and Medical Research, Argonne National Laboratory, Paper presented at the 32nd Annual Meeting of the Health Physics Society, Salt Lake City, Utah, July 5 - 9, 1987.

2. R.E. Toohey, Quoted in Science News, Volume 132, No. 7, 105, August 15, 1987.

November 1987

RESEARCH CONCEPT
DOE/NE Student Intern Program with Vanderbilt University
UNC Geotech/Technical Measurements Center
Grand Junction, Colorado

Research Title: Half-Life Determination of RaA (^{218}Po)

Research Advisor: Dr. Dowell E. Martz

Background: The Thomas-modified-Tsivoglou method (1) is the method most frequently employed to determine radon progeny (RaA, RaB, and RaC) from total-alpha counting of air samples. Some researchers in the indoor-air quality field have found improved results in radon progeny determination by using a value of 3.11 minutes for the half-life of RaA instead of the accepted value of 3.05 minutes (2) in the equations given by Thomas (1). The only and recent remeasurement (3) of the RaA half-life supports the higher value.

The source of the RaA in the only remeasurement (3) included small amounts of thoron which could have influenced the result. We are proposing the use of a very pure Rn-222 source which would eliminate this potential error.

Research: The work consists of measuring the half-life of RaA (^{218}Po) and determining the precision of the half-life determination. It is expected that the results will be significant and therefore preparation and submittal of a brief report to a scientific journal (Physical Review, Nuclear Physics, Health Physics, etc.) is expected.

---

1. Jess W. Thomas, Health Physics, 23, 783 (1972).

2. M. Curie, et al, Re. Mod. Phys., 3, 427 (1931).

3. James R. VanHise, et al, Phys. Rev. C, 25, No. 5, 2802 (1982).

GENERAL ELECTRIC

Attachment to
S-88-033

SHIPPINGPORT STATION DECOMMISSIONING PROJECT

ENGINEER IN TRAINING (EIT) - SITE RELEASE SUPPORT

Shippingport Atomic Power Station will be the first power reactor site returned to nature. Release criteria have been developed, and from them limiting conditions. The job at Shippingport in the summer of 1988 will be to help demonstrate that the site meets those limits and to document that fact. The position will entail work with the release team doing many parts of the release procedures, i.e., performing surveys, taking samples, documenting results, assisting in engineering analyses and participating in data package development.

The assignment will allow the EIT to become familiar with the implementation of the first program for the unrestricted release of a major nuclear power reactor site.

ENGINEER IN TRAINING (EIT) - ENGINEERING SUPPORT

One of the more significant aspects of the project is the one-piece removal and shipment of the 1000 ton Reactor Pressure Vessel/Neutron Shield Tank (RPV/NST) package by barge to Hanford, Washington. Work in the summer of 1988 will consist of preparing a Barge Shipment Environmental Assessment Report and a RPV/NST Package Recovery Plan in the event of the barge capsizing or sinking during shipment.

The EIT will report to the Manager, Engineering Support, and will be involved in the preparation of the impact study and recovery plan. The EIT will work with the Principal Engineer, RPV Transport, and the Principal Engineer, Decommissioning Technology.

VANDERBILT UNIVERSITY SUMMER INTERNSHIP PROGRAM

BECHTEL NATIONAL, INC. FUSRAP PROJECT

The Formerly Utilized Sites Remedial Action Program (FUSRAP) is a Department of Energy (DOE) initiative to clean up or otherwise control sites where low-level radioactive contamination, at levels above current guidelines, remains from the early years of the nation's atomic energy programs.

Bechtel was selected by DOE in 1981 to serve as Project Manager Contractor (PMC) for the program. Through its Oak Ridge Office, Bechtel provides DOE with the engineering, construction management, procurement, radiological, cost and scheduling, site operations, and public relations support needed to manage the program.

Several FUSRAP project assignments will be available to Vanderbilt University summer interns. The assignments are structured to provide exposure to and experience with a wide range of the remedial action and disposal processes. Students will be based in the Oak Ridge Office. The following briefly describe the assignments.

Conduct a study to determine the applicability of experimental treatment technologies for remediating radioactive soils. The purpose of this study will be to evaluate soil treatment technologies capable of removing radioactive contamination from contaminated soils. The intern will be responsible for reviewing relevant literature and on-going research in this area. The intern will also be responsible for structuring and conducting an analysis of the cost-effectiveness of these techniques.

Assist in the completion of preliminary environmental assessments for Superfund and non-Superfund hazardous waste sites. Includes evaluation of site histories, contaminant migration pathways (air, groundwater, and surface water), identification of environmental receptors, and preliminary assessment of the potential risks posed by site releases. Position also will involve documentation activities.

Investigate and review solidification and stabilization technologies for radioactive and nonradioactive waste materials. This position would involve obtaining current information via telephone correspondence and literature review, and subsequent summation of available technologies in a report.

Review and evaluate the methodology used by BNI contractors to determine the performance of analytical equipment used at FUSRAP waste sites. This work will include comparing current methods with those developed by the Environmental Protection Agency. As an output, the intern will provide BNI with recommendations for improving the current approaches to evaluate equipment performance. This project will entail some statistical analysis.

VANDERBILT UNIVERSITY SUMMER INTERNSHIP PROGRAM

BECHTEL NATIONAL, INC. ORNL-RIFS PROJECT

The Oak Ridge National Laboratory, Remedial Investigation/Feasibility Study (ORNL-RI/FS) is a Martin Marietta Energy Systems Program to provide an RI/FS for several areas of ORNL that are contaminated with radiological materials and hazardous chemicals. At least 13 areas, each containing one or more contaminated Solid Waste Management Units (SWMUs), will be included in the RI/FS.

A Remedial Investigation Plan will be developed and implemented for each of the 13 areas. Analytical results of the remedial investigation will be documented and incorporated into an assessment of remedial action alternatives for each area that addresses each SWMU individually or collectively. The Alternatives Assessments (AAs) for all areas will be incorporated into a single Feasibility Study, providing a comprehensive assessment of the need, extent, priority, timing, cost and environmental implication of future remedial actions. The RI/FS process will be meshed with NEPA so that the requirements of both are met and so that the final product serves as a functional equivalent of an EIS as well as documentation of the results of the RI/FS.

Two ORNL-RI/FS project assignments will be available to Vanderbilt University summer interns. Each assignment is structured to provide exposure to and experience with the full scope of a remedial action process. Each student will be based in the Oak Ridge Office. The following briefly describes each assignment:

Plugging and Abandonment Demonstration Study

The study involves the plugging and abandonment of a "Cold Rock Cover" well at the hydrofracture facility (designated as well number N200RC) to demonstrate a series of alternative techniques to plug

the subject well and consequently develop an abandoned well that prohibits the migration of groundwater and any contaminants that may be entrained in that groundwater. The end product of this demonstration study will be a hole that is filled from its total depth to ground surface with cement grout. The information will be used to demonstrate how contaminated wells at hydrofracture can be plugged and safety abandoned.

The hydrofracture process was a unique waste disposal method that resulted in disposal of over 19 million L of waste grout mix containing more than 1.4×10^6 Ci of radioactivity at ORNL over a 25-year period (1959-1984). The technology consisted of mixing liquid radioactive wastes with cement and other additives to form a slurry. The slurry was then pumped down a cased and slotted well under pressure into a low permeability shale (Pumpkin Valley Shale) at depths of about 240 to 300m. Under pumping pressures of 2000 psi and higher, bedding plane fractures were formed. The slurry spread along these fractures for as much as hundreds of meters, forming thin grout sheets (less than a few cm thick).

The student will report to the manager responsible for the site and will be involved in all aspects of the work including performing the field work, assisting with analysis of results, and writing final reports. The student will be required to pass a rigorous physical examination and be capable of certification on a respirator.

Remedial Investigation Plans

The student will be involved in all aspects of Remedial Investigation (RI) Plan generation including review of existing analytical data, analysis of data gaps, generation of sampling plans, quality assurance assessments, and cost estimates. RI Plans are the basic planning documents that will be used to conduct field investigations. These documents are crucial to the control of field investigations that may be conducted over a two-year period.

CONCEPTUAL DISPOSAL FACILITY DESIGN

The FUSRAP is planning to site 3 low level radioactive waste disposal facilities in the next several years. A major element of this process is development of a conceptual design to allow communication of the design features to federal and state agencies and the general public. This effort will include the evaluation of the performance of the design to meet or exceed the performance criteria.

The student will report to the project engineer responsible for the design effort. He will participate with a team of other professionals in development of the design concepts. The activities are expected to focus on computer modeling of design features to evaluate them for expected loading and possible instrumentation methods to determine correlation to or validation of computer model results. The student should have a strong background in soils, hydrology, and computer applications.

MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 1410
PADUCAH, KENTUCKY 42001

March 22, 1988

Dr. Frank Parker
P. O. Box 1596
Station B
Vanderbilt University
Nashville, Tennessee 37235

Dear Dr. Parker:

Eric Lookofsky was employed in the Production Engineering group of the Operations Division at the Paducah Gaseous Diffusion plant during the summer of 1987. Eric worked on a variety of projects related to plant operations and was very effective in accomplishing his work. It is planned that he again work in the Production Engineering group during the summer of 1988. Every effort would be made to provide him assignments relative to his current engineering studies. His assignments would include refinement of a computer program used to model chemical traps for uranium hexafluoride, testing of instrumentation used to monitor purge gases for extremely low quantities of uranium hexafluoride and radiation monitoring techniques of uranium contaminated media. If you have any questions please call R. A. Green at (502) 444-6311 ext 426.

Sincerely,

J. H. Thomas, Department Head
Operations Planning & Plant Protection

JHT:RAG:mdw

cc: W. J. Ellington
R. A. Green
File

HANFORD

Task Description Summer Environmental Project Intern (Chemical/Environmental Engineering)

Objective: Review Hanford groundwater contamination and prepare a collection and treatment plan of new technology being developed or demonstrated at Hanford.

Discussion: Several technologies are being evaluated for treatment of groundwater at Hanford to remove contaminants. These technologies include filtration, precipitation, reverse osmosis, ion exchange, and biodestruction. A study needs to be done of how to practically deploy (utilize) these technologies at the Hanford Site to treat the contaminated water. Given the successful demonstration of these technologies to remove specific contaminants, where should these systems be located, how should contaminated water be supplied to them, what should be done with the treated water, and what will be done with the contaminants that are removed.

This work will give the individual an opportunity to see laboratory demonstrated water treatment technology and to figure out practical application of that technology to real contamination problems at Hanford.