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Department of Energy
Washington, D.C. 20545

NOV 29 1978

Dr. Karl Z. Morgan
School of Nuclear Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Dear Dr. Morgan:

I am pleased to advise you that the Office of Health and Environmental Research (formerly the Division of Biomedical and Environmental Research) has approved renewal of your research project, "Development and Application of Some Fast Neutron Dosimetry Techniques Utilizing Plastic Track Detectors for Radiotherapy and Health Physics," for an additional year.

A Procurement Request has been sent to the Oak Ridge Operations Office for renewal of this project for one year from December 1, 1978 through November 30, 1979 with a recommended level of support in the amount of $36,050.

You will be contacted by someone from the Oak Ridge Operations Office in the near future regarding negotiation of the renewal contract. Responsibility for the technical aspects of the program lies with the Office of Health and Environmental Research in Washington.

We wish you every success in your work.

Sincerely,

Robert L. Butenhoff
Physical & Technological Programs
Office of Health and
Environmental Research
Office of Environment

bcc: OR

REPOSITORY Oak Ridge Operations Records Holding Area
COLLECTION Documents 1944-1994
BOX No. H-78-17 Bldg. 2714-H
Cont. No. DE-AS05-76EV04818
FOLDER GA Inst. of Tech.

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SCh JL OF NUCLEAR ENGINE..ING

Atlanta, Georgia 30332 (404) 894-3720

August 30, 1978

Mr. Robert L. Butenhoff
Physical and Technological Programs
Division of Biomedical and
Environmental Research
Department of Energy
Washington, D.C. 20545

Dear Bob:

Please find enclosed our final annual report for our contract EY-76-S-05-4814 and our proposal to continue and renew this contract for another year. We have sent copies of these reports also to the Oak Ridge Operations Office of DOE, Oak Ridge, Tennessee. You will note that the present contract continues on to November 30, 1978 but we were instructed to submit these two items before the end of August. Also enclosed is a complete set of reprints and we will send you reprints of some of our other publications as soon as they are received from the publishers.

Gary Stillwagon completes his requirements for the Ph.D. degree the first of October and will be leaving about then for a job in the Veterans Administration Hospital in Memphis. He did an unusually good job on this project and as a consequence had a number of good job offers. I am sure we will hear much more of him in the field of health physics in the years ahead and you and we can be proud of the part we played in his development. I believe Gary's discovery of the two size particles in the foils and their production is a patentable discovery and Gary will continue working with us (as a consultant) in further development of this and in securing DOE's patent rights.

Su will continue on until January 1979. The results of his research also are very encouraging and I am sure you will be pleased with what he is doing.

In order to continue this research program without any lag, I am starting two new graduate students, Dorothy Rea and Michael Edward Sanders, on this research in a few days, and I certainly hope the present funding can continue, for without it this program would come to a screeching halt. You will note that we are proposing the new contract be at the same level as this year except a small increase to cover the increase in overhead which has gone into effect.

GEORGIA INSTITUTE OF TECHNOLOGY

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The most exciting development in the present contract was the discovery of two distinct sizes of tracks. We are laying claim to this discovery by a Letter-to-the-Editor of Health Physics and believe DOE will wish to issue a patent on this discovery. We believe this opens up a whole new area of microdosimetry and provides a direct means for LET correction of dose and correlation with local radiation damage to tissue. It suggests important applications in industry as well as in microdosimetry.

Again we thank you for the tremendous assistance you have been to this program at Georgia Tech and in the progress and development of our students in the field of Health Physics.

Best personal regards.

Sincerely,

Karl

Karl Z. Morgan
Neely Professor

KZM:rs

Enclosure

cc ORNL

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PROPOSAL FOR RENEWAL OF CONTRACT EY-76-S-05-4814 AND TO CONTINUE DEVELOPMENT AND APPLICATION OF SOME FAST NEUTRON DOSIMETRY TECHNIQUES UTILIZING PLASTIC TRACK DETECTORS FOR RADIOTHERAPY AND HEALTH PHYSICS

Submitted to the

Department of Energy

by the

School of Nuclear Engineering
Georgia Institute of Technology
Atlanta, Georgia 30332

Karl Z. Morgan
Co-Principal Investigator

Shian-Jang Su
Co-Principal Investigator

and two new graduate students, Michael Edward Sanders and Dorothy Rea

Lynn E. Weaver
Director, School of Nuclear Engineering

Dwight L. Allen, Deputy Director
Office of Contract Administration

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PROPOSAL FOR RENEWAL OF CONTRACT EY-76-S-05-4814 AND TO CONTINUE DEVELOPMENT AND APPLICATION OF SOME FAST NEUTRON DOSIMETY TECHNIQUES UTILIZING PLASTIC TRACK DETECTORS FOR RADIOTHERAPY AND HEALTH PHYSICS

by

Karl Z. Morgan and Shian-Jang Su

Abstract

Research in the area of electrochemical etching has been attracting increasing interest for many health physics uses and radiotherapeutic applications. A few of the studies of interest which we propose to continue and carry out in the coming year include completion of ^{239}Pu bone dosimetry, extensions of our bone dosimetry technique, epithermal neutron dosimetry and a more detailed examination of the two distinct track sizes from alpha irradiations which were discovered during the present investigations and and are being announced in scientific journals at the present time. This discovery of two distinct alpha track sizes is particularly exciting because it provides the possibility of developing a system of dosimetry that corrects for LET. Investigation of these problems is expected to make a major contribution to the fields of alpha particle and neutron dosimetry.

1039681

TABLE OF CONTENTS

	Page
Abstract.	iii
Introduction.	1
Completion of ^{239}Pu Bone Dosimetry in Human and Dog Bones	
Thermal and Epithermal Neutron Dosimetry	
Extensions of our Dosimetry Techniques	
Two Sizes of Alpha Particle Tracks	
Proposed Budget	5
Duration of the Proposed Research	6
Project Personnel	6
Support Facilities at Georgia Tech.	15

1039682

Introduction

The complete results to date of our research in the field of electrochemical etching of polycarbonate foils for the purpose of dosimetry have been accumulated and appear in (ORO-4914-5) and our progress reports dated August 1977 and August 1978. These reports show the intensive research done by the investigators in the field as well as some recommendations for the solution of new problems for the advancement of this rapidly developing and interesting type of dosimetry to many dosimetry applications. Some of the recommended studies are already under investigation and preliminary results have been presented at several scientific meetings including the American Physical Society, Auburn, Alabama, 1975; Health Physics Society, Denver, Colorado, 1976 and San Francisco, 1976; International Radiation Protection Association, Amsterdam, The Netherlands, 1975; the American Industrial Hygiene Association, Atlanta, Georgia, 1976; the Health Physics Society, Atlanta, Georgia, 1977; the American Nuclear Society, Raleigh, North Carolina, 1977 and Gainesville, Florida, 1978; and the Health Physics Society, Minneapolis, Minnesota, 1978. (Copies of these reports have been sent to the Washington office of DOE, but an additional complete set of reprints is appended to this project renewal proposal.

Many of the problems we have listed under this contract are being investigated actively at present, including completion of the ^{239}Pu bone dosimetry study and the thermal and epithermal neutron studies. These projects will be completed in the new contract year and the other interesting problems mentioned here will be examined more intensively and in greater detail.

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Proposed New Research

The following proposals for continued research into the field of electrochemical etching of polycarbonate foils are but a few of the promising avenues of research and application of this technique. This new development offers the promise of information hitherto unachievable in the field of health physics by prevailing dosimetry methods such as the use of thick photographic emulsions with proton track counting (a technique which one of us [KZM] first introduced to health physics in 1944). Descriptions of the major problems of current interest to us are as follows:

Completion of ^{239}Pu Bone Dosimetry in Human and Dog Bones

We have now completed calibration procedures for the electrochemical etching system using polycarbonate foils for alpha particles. Through the generosity of Dr. W. S. S. Jee at the University of Utah one of us (Stillwagon) was priviledged to work 10 days at the Radiobiology Laboratory at the University of Utah and returned with approximately 150 bone samples from beagle dogs prepared for our applications. Present status of this work involves taking of data from the exposed foils and this portion of the study including submission of results for publication should be completed within a few months.

Thermal and Epithermal Neutron Dosimetry

Our electrochemical etching system has previously been used as a fast neutron dosimetry system. Now we are extending this system to thermal neutron dosimetry by placing thin tablets of ^{6}Li over a portion of the foils to interact with thermal neutrons in the (n,α) reaction ($\sigma_c \approx 953b$). A tablet of ^{7}Li is placed on top of the ^{6}Li to obtain even compression

1039684

against the foil. The alpha particles emitted then create tracks in the polycarbonate foils, the number being proportional to the initial fluence of thermal neutrons. This study also is nearing completion.

Extension of this contract involves also modifications of present techniques in order that this method of dosimetry include measurement of dose from epithermal neutrons as well as from fast and thermal neutrons. The epithermal region is an extremely difficult one in which to evaluate absorbed dose to tissue and such dosimetry has been largely neglected. We feel this study is important and could make a significant contribution to the field of neutron personnel dosimetry by providing a system that will measure neutron dose over an energy range of 0.025 eV to 50 MeV.

Extensions of Our Bone Dosimetry Techniques

We would like to investigate other uses for the general technique we have developed for bone dosimetry. We propose to vary exposure time of the foils to our bone samples, use samples of different plutonium content and use small cubes of trabecular bone tissue rather than large infinitely thick planes to obtain the microdose distribution in three dimensions. Additionally we can examine the adaptability of the general technique to the dosimetry of other tissues, e.g., lung, pulmonary lymph nodes, liver and gonads--to which the dose from plutonium is of current interest and controversy.

Two Sizes of Alpha Particle Tracks

As reported in our August 1977 and 1978 Progress Reports, we have observed two categories of tracks on our foils after exposure to alpha emitters and employment of our electrochemical etching techniques. It has been proposed the larger tracks are due to carbon and oxygen recoils.

1039685

This could be verified by irradiation of foils by accellerator produced alpha particles of various energies then by carbon nuclei produced in an accellerator. The frequency histograms of the track diameters could then be compared. If the energies, of the accelerator produced helium and carbon nuclei were chosen carefully, the ratio of small to large tracks should vary in accordance with the theory we have developed. Other possibilities are the use of polarized alpha particles, selected to maximize the interaction cross-section with carbon and oxygen muclei to attempt to increase the numbers of large tracks, thereby proving their origin.

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Proposed Budget

Contract No. EY-76-S-05-4814

Cost Estimate for Period
December 1, 1978 to November 30, 1979

A.	Direct Salaries and Wages:		$17,900
	Principal Investigators:		
	Karl Z. Morgan (Principal Investigator)	$9,000	
	Shian J. Su*	1,050	
	Michael Edward Sanders*	3,150	
	Dorothy Rea*	4,200	
	Secretarial Time	500	
	Retirement Benefits (9.83 of applicable Salaries and Wages		934
	Total Direct Salaries, Wages & Retirement Benefits		18,834
B.	Equipment		1,408
C.	Materials Publication Costs		494
D.	Travel		1,000
E.	Indirect Costs		
	At a predetermined fixed rate of 76% of Salaries and Wages as established by the Naval Material Command upon advisory audit by the Defense Contract Audit Agency		14,314
	TOTAL PROJECT COST		$35,050**

Total actual project cost for the current period (through 11/30/78)	$33,500
Total actual and estimated cost chareable to DOE for the new period	$36,050

*Graduate Students

**$33,500 + $2,550 to cover increase in overhead from $11,764 to $14,314

Duration of the Proposed Research

The proposed research is intended to be completed within a period of 12 months which will last from December 1, 1978 to November 30, 1979.

Project Personnel

Karl Ziegler Morgan was born in Enochsville, North Carolina on [redacted] He received the [redacted] and [redacted] degrees from the [redacted] respectively, and the [redacted] From 1934 to 1943 he was chairman of the Physics Department of Lenoir Rhyne College, and during this period did research in cooperation with Duke University in the field of cosmic ray showers, the meson lifetime, etc., in Linville Caverns, on Mt. Mitchell, Beech Mountain, Mt. Evans, etc.

He joined the Metallurgical Laboratory staff at the University of Chicago in the spring of 1943. Here he was one of a group of six persons who developed and established the new science and profession of health physics. During the fall of 1943, he transferred to Oak Ridge National Laboratory where, until the latter part of 1972, he was Director of the Health Physics Division which was engaged in research, engineering, and applied problems. Upon leaving Oak Ridge National Laboratory, he joined the faculty of the Georgia Institute of Technology as Neely Professor in the School of Nuclear Engineering.

In 1956, he was the first president of the Health Physics Society, and from 1966 to 1970 was the first president of the International Radiation Protection Association which has about 10,000 members in some 65 countries. He now is President Emeritus of IRPA, an Emeritus member of

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the Main Commission of ICRP, and a member of NCRP. For 20 years he was chairman of the committees of ICRP and NCRP dealing with maximum permissible internal dose of radioisotopes. He has published over 300 papers dealing with subjects of cosmic rays, radiation protection, istrumentation, internal dose, and general health physics. He is past editor of the journal HEALTH PHYSICS.

In 1962, K. Z. Morgan and W. Binks (England) were awarded the first gold medals for meritorious work in the field of radiation protection by the Royal Academy of Science of Sweden.

Dr. Morgan received the Distinguished Alumni Award and the honorary Doctor of Science Degree from Lenoir Rhyne College, honorary membership in Sigma Pi Sigma from Berea College, and the First Distinguished Service Award of the Western Chapter of the Health Physics Society. He is a member of the Health Physics Society, the International Radiation Protection Association, the American Public Health Association, the American Association for the Advancement of Science, the American Industrial Hygiene Association, the Research Society of America, the Radiation Research Society, the Society of Nuclear Medicine, the American Association of Physicists in Medicine, the American Association of Physics Teachers, an Associate Fellow of the American College of Radiology, a Fellow of the American Physical Society and of the American Nuclear Society, and an Affiliate of the Royal Society of Medicine.

1039689

Major Reports and Publications

Over 300 papers and publications have been written. Those of major importance over the past few years are as follows:

"Common Sources of Human Exposure to Ionizing Radiation in the United States," American Engineer, July 1968

"Ionizing Radiation: Benefits Versus Risks," Annual Meeting of the Health Physics Society, June 16-20, 1968, Denver, Colorado; and published in Health Physics, Vol. 17, No. 4

"Assumptions Made by the Internal Dose Committee of the International Commission on Radiological Protection," Sixth Annual Meeting of the Gesellschaft fur Nuclearmedizin, Wiesbaden, Germany, September 26-28, 1968; Published in Proceedings, 1969

"Redirecting Health Physics Studies to Areas of Greatest Interest," First European Congress of the International Radiation Protection Association, Menton, France, October 9-11, 1968; Published in Proceedings, 1968

"Development of Health Physics as a Profession," Proceedings of First International Congress of Radiation Protection, Rome, Italy, Vol. 1, 3, Pergamon Press, 1968

"The Need for Standardization Procedures in the Application of Ionizing Radiation to Medical and Dental Patients," Seminar sponsored by the National Center for Radiological Health, Rockville, Maryland, November 15, 1968, Seminar Paper 003

"The Proper Working Level of Radon and Its Daughter Products in the Uranium Mines of the United States," Hearing on Radiation Standards for Mines, Washington, D.C., November 20, 1968; Congressional Record, 1968

"Supplemental Statement on the Proper Working Level of Radon and Its Daughter Products in the Uranium Mines of the USA," Supplement to Testimony presented on November 20, 1968, Washington, D. C.; Congressional Record, 1968

"Future Opportunities in Health Physics," Health Physics Society Midyear Topical Symposium, Los Angeles, California, January 29-31, 1969

"Risks from Diagnostic X-Rays," Yale Scientific, Vol. XLII No. 5, February 1969; Reprinted from Yale Scientific in the Journal of the American Radiography Technologists, Vol. XIV, No. 4, Winter 1969

"Radiation Standards for Reactor Siting," Testimony presented before the Joint Committee on Atomic Energy at its Hearings on Environmental Effects of Producing Electrical Power, Phase 2, January 1970; Congressional Record

"Energy Pollution of the Environment," Midyear Symposium of the Health Physics Society, Louisville, Kentucky, January 28, 1970; Proceedings published in USPHS-BRH Series, BRH/DEP-70-26 Oct. 1970

"A Time of Challenge to the Health Physicist," Presidential Address presented before the Second International Congress on Radiation Protection, May 8, 1970, Brighton, England; Health Physics, Vol. 20, May 1971, pp. 491-498

1039690

"My Opinion--You Can Drastically Cut X-Ray Exposure Below Today's Levels," Consultant, March/April 1970

"History of the Health Physics Society," published as part of the RSNA Symposium on the Critical History of American Radiology (Nov. 1970)

"Standard Man-Standard Patient," Medical Radioisotopes: Radiation Dose and Effects, AEC Series 20, p. 87, June 1970

"History of the International Radiation Protection Association," published in Proceedings of the RSNA Symposium on the Critical History of American Radiology, November 1970

"Criteria for the Control of Radioactive Effluents," IAEA Symposium on Environmental Aspects of Nuclear Power Stations, UN Building, New York, August 1970, Proceedings published, this paper is IAEA-SM-146/10; synopsis published also in Environmental Studies, 1971

"Maximum Permissible Levels of Exposure to Ionizing Radiation," International Summer School on Radiation Protection, Boris Kidric Institute of Nuclear Sciences, Cavtat, Yugoslavia, September 20-30, 1970; Proceedings published in 1971 under title of "Radiation Dosimetry"

"President's Report to the General Assembly of IRPA," Brighton, England, May 1970, Health Physics, Vol. 20, No. 5, 1971

"History of Radiation Protection," Symposium Commemorating the 75th Anniversary of the Discovery of X-Rays, Milwaukee, November 13-14, 1970; Materials Evaluation, Vol. XXIX, No. 3, March 1971

"Why the 1968 Act for Radiation Control for Health and Safety Is Required," Radiology, Vol. 99, No. 3, pages 569-588, June 1971

"Excessive Medical Diagnostic Exposure," Third Annual National Conf. on Radiation Control, Scottsdale, Arizona, May 3, 1971; Published in Proceedings

"Health Physics and the Environment," International Symposium on Rapid Methods for Measurement of Radioactivity in the Environment, Neuherberg, Federal Republic of Germany, IAEA-STI/PUB/289, Vienna, 1971

"Adequacy of Present Radiation Standards," presented at the Environmental and Ecological Forum, Silver Spring, Maryland, January 20, 1971; Proceedings of Forum published in 1972, USAEC-TID-25857

"Proper Use of Information on Organ and Body Burdens of Radioactive Material," presented at the IAEA/WHO Symposium on the Assessment of Radioactive Organ and Body Burdens, Stockholm, Sweden, November 22-26, 1971, IAEA/SM/150-50; Proceedings of Symposium published by IAEA

"Health Physics Measures to Implement New USAEC Regulations Relating to Radiation Exposure of the General Public," Budapest, May 1971; Proceedings published by Akademiai Kiado, Budapest, Hungary

"The Need to Reduce Medical Exposure in the United States," outline of testimony presented before the Health and Welfare Subcommittee of the Senate Committee on Labor and Public Welfare on Senate Bill S.3327, May 15, 1972, Washington, D. C.; published in Congressional Record, 1972

"Comparison of Radiation Exposure of the Population from Medical Diagnosis and the Nuclear Energy Industry," Transactions ANS, 15:1, 64 (June 1972)

"Environmental Impact of Natural and Man-Made Ionizing and Non-Ionizing Radiations," Second International Summer School on Radiation Protection, Herceg Novi, Yugoslavia, Aug. 1973; Proceedings, 1973

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"The Need for Radiation Protection," Radiologic Technology, 44, 6, p. 385 (1973)

"Exposure in the United States," and "Mogliche Folgen einer Ubermassigen Medizinischen Strahlenbelastung in der Vereinigten Staaten von Amerika," Rontgen-Blatter, 27, 127 (March 1974)

"Reducing Medical Exposure to Ionizing Radiation," American Industrial Hygiene Journal (May 1975).

Two chapters in text, Environmental Problems in Medicine titled "Exposure to Non-Ionizing Radiation" and "Ionizing Radiation Exposure," W. D. McKee, Editor; Chas. C. Thomas Publisher, 1974

"Types of Environmental Health Physics Data That Should Be Collected and Evaluated in a Nuclear Power Program" in Environmental Impact Statements for Nuclear Power Plants, 1975, Pergamon Press

Chapters by K. Z. Morgan in test, Environmental Impact of Nuclear Power Plants, by R. A. Karam and K. Z. Morgan, GEORGIA INSTITUTE OF TECHNOLOGY SERIES IN NUCLEAR ENGINEERING, Pergamon Press 1975

"The Bases for Standards and Regulations" in Environmental Impact Statements for Nuclear Power Plants, 1975 Pergamon Press

Chapters by K.Z. Morgan in text, Environmental Impact of Nuclear Power Plants, by R. A. Karam and K. Z. Morgan, GEORGIA INSTITUTE OF TECHNOLOGY SERIES IN NUCLEAR ENGINEERING, Pergamon Press 1975

"Release of Radioactive Materials from Reactors" and "Ways of Reducing Radiation Exposure in a Future Nuclear Power Economy," in Nuclear Power Safety, GEORGIA INSTITUTE OF TECHNOLOGY SERIES IN NUCLEAR ENERGY, Pergamon Press

"Transportation of Radioactive Material by Passenger Aircraft," Report to Joint Committee of Congress on Atomic Energy, Report No. 1 - Sept. 17, 1974, U. S. Government Printing Office

"Health Physics -- Past, Present and Future," presented at First Asian Regional Congress of the International Radiation Protection Assn. in Bombay, India, Dec. 1974; published in Proceedings

"Suggested Reduction of Permissible Exposure to Plutonium and Other Transuranium Elements," J. Am. Ind. Hygiene 36 (8), 567 (Aug. 1975)

"Effects of Radiation on Man -- Now and in the Future," in Energy and the Environment -- Cost-Benefit Analysis; Pergamon Press, 1976,

Chapters by K. Z. Morgan in text, Energy and the Environment, Cost Benefit Analysis, by R. A. Karam and K. Z. Morgan, GEORGIA INSTITUTE OF TECHNOLOGY SERIES IN NUCLEAR ENGINEERING, Pergamon Press 1976

"Programs Needed for Education and Training of Health Physicists," Proc. Am. Phys. Soc. Meeting, December 1974

"Recent Developments in Fast Neutron Personnel Dosimetry Using Track Etch Methods," presented at Congress of the International Radiation Protection Assn., Holland, May 1975; published in Proceedings

"Medical Radiation Protection," presented at Health Physics Society Meeting, Buffalo, New York, July 15, 1975

"Ways of Reducing Exposure in a Future Nuclear Power Economy," presented at American Public Health Association Annual Meeting, Chicago, Illinois, November 18, 1975

"A Course on Non-Ionizing Radiation Protection for State and Local Health Officers," Proceedings of Health Physics Society, Denver, Colorado, February, 1976

1039692

"The Particle Problem," Third International Summer School on Radiation Protection, Herceg Novi, Yugoslavia, published in Boris Kidric Institute Series, August-September 1976

"The Linear vs. The Threshold Hypothesis," Third International Summer School on Radiation Protection, Herceg Novi, Yugoslavia, published in Boris Kidric Institute Series, August-September, 1976

"Current Problems and Concepts of the Health Physicist," Third International Summer School on Radiation Protection, Herceg Novi, Yugoslavia, published in Boris Kidric Institute Series, August-September 1976

"Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors," testimony presented at public hearings on MOX fuel, Washington, D.C., Nov. 1976

"Keeping Dose Commitments ALAP," Proc. ANS National Topical Meeting, 71, Tucson, Arizona, October 6-8, 1975

"Radiation-Induced Health Effects," Science 195, 157, 344 (January 28, 1977)

"The Dilemma of Present Nuclear Power Programs," Proc. of Hearings Before the Energy Resources Conservation and Development Comm., Sacramento, Cal., February 1, 1977

"Comments on Operation of the Kerr-McGee Cimarron Facility and the Karen Silkwood Case," before the Congressional Small Business Comm., April 26, 1976

"Data Interpretation," Proceedings of Workshop on the Utilization and Interpretation of Environmental Radiation Data, Orlando, Fla., March 1-3, 1976

"Rolf M. Sievert: The Pioneer in the Field of Radiation Protection," Health Phys. 31, 263-264 Sept. 1976

"Health Hazards from Diagnostic and Therapeutic X-Ray," Proceedings of Conference on Diagnostic Imaging, Chicago, Ill., Sept. 27, 1976

"Yes is the Answer to Question of R. H. Thomas and D. D. Busick, 'Is It Really Necessary to Reduce Patient Exposure?'" J. Am. Ind. Hygiene 37, 665-667, Nov. 1976

"The Linear Hypothesis of Radiation Damage Appears to Be Non-Conservative in Many Cases," Proceedings of Fourth International Congress of the International Radiation Protection Association, Paris, France, April 25-29, 1977.

"The Need to Reduce Medical Diagnostic Exposure," J. Am. Ind. Hygiene 38, 6, June 1977.

"Possible Consequences of Excessive Medical Exposure in the United States," Given before the Fachverband fur Strahlenschutz at the Bern, Switzerland meeting, March 21, 1973 and published in the Fachverband Proceedings, 1973.

"Biological Effects of Ionizing Radiation," published in Proceedings of Short Course, September 9, 1974.

"Appropriateness of Regulations for Air Shipment of Radioactive Materials," Miami Beach, Florida, September 23, 1974, International Conference on Shipping of Radioactive Material; and published in Proceedings, 1975.

"Recent Developments in Fast Neutron Personnel Dosimetry Using Track Etch Methods," Proc. 3rd European Congress IRPA, Paper 14, Amsterdam, The Netherlands, May 1975, with Mehdi Sohrabi.

1039693

"Development and Application of Some Fast Neutron Dosimetry Techniques Utilizing Plastic Track Detectors for Radiotherapy and Health Physics," USERDA Contract No. AT-(40-1)-4814, 1975, with Mehdi Sohrabi.

1039694

Biographical Sketch

SU, SHIAN-JANG--[redacted]

Education

[redacted]

Employment History

Atomic Energy Council, Republic of China, Research Assistant	1968
Army of Republic of China, 2nd Lieutenant	1970-1971
Institute of Nuclear Energy Research, Researcher	1971-1975
Karshrue Nuclear Center, West Germany, Practical Training	1972
Georgia Institute of Technology, Graduate Assistant	1976-Present

Experience Summary

While working at the Institute of Nuclear Energy Research, Republic of China, Mr. Su was responsible for radiation dosimetry in the health physics section. He attended many programs such as construction of whole body counters, hot cell shielding design, personnel monitoring and instrument calibration for a 50 MW heavy water reactor and radioisotope applications. In July 1972, under the sponsorship of the Atomic Energy Council, Mr. Su went to West Germany and attended practical training at the WAK fuel reprocessing plant. Since 1975 he has been pursuing a Ph.D. degree in Nuclear Engineering with a specialty in Health Physics. He is a member of the China Nuclear Society and the Health Physics Society.

Reports, Publications and Papers

1. B.S. Thesis, "Fast Neutron Flux Measurement of 1MW Tsing Hua Open Pool Reactor," National Tsing Hua University, 1968.
2. M.S. Thesis, "Study on Taiwan Natural Background," National Tsing Hua University, 1970.
3. Su, Shian-Jang, "A Preliminary Calculation of Argon-41 Gamma Dose From TRR," Nuclear Science Journal, 11, 58 (1974).
4. Su, Shian-Jang, "Final Report for Whole Body Counter," INER, Taiwan (1975).
5. Su, Shian-Jang, "Neutron Dosimetry Using Electrochemical Etching," Paper presented in 1977 American Nuclear Society Eastern Region Student Conference, Raleigh, N. C., 1977.
6. Literature review of the proposed research, "Neutron Dosimetry Using Electrochemical Etching," in partial fulfillment of the Ph.D. degree, Georgia Institute of Technology, 1977.
7. Su, Shian-Jang, "Neutron dosimetry using Electrochemical Etching," Paper P/21 presented in 22nd Annual Meeting of the Health Physics Society, Atlanta, Georgia, 1977.
8. Su, Shian-Jang, "Detection of Hot Fallout on Taiwan in the Period 1971-1975," Health Physics, 33, 241 (1977).

1039695

New Graduate Students Assigned to Project

Dorothy Rea graduated with the [redacted] degree from [redacted] with a major in [redacted] and is enrolled in the graduate program of the [redacted]

Michael Edmond Sanders took a number of courses at [redacted] and completed his [redacted] program at [redacted] with a major in [redacted]. He will enter the graduate program of the [redacted]

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GEORGIA TECH FACILITIES

The facilities most closely related to teaching and research in the nuclear engineering programs at Georgia Tech are located in the Frank H. Neely Nuclear Research Center and the Cherry L Emerson Building.

Nuclear Research Center

The Frank H. Neely Nuclear Research Center, valued at $10 million dollars, was completed in 1964. The Georgia Tech Research Reactor (GTRR) which serves as the key component to the Center is a heterogeneous, heavy-water moderated and cooled reactor, fueled with enriched uranium. It is similar in design to the Argonne Research Reactor, CP-5, which has demonstrated excellent research capability and dependable service. The GTRR has been designed to develop a sustained power output of five megawatts with a corresponding thermal neutron flux of about 10^{14}n/cm^2-sec. The reactor has a variety of experimental facilities (such as beam tubes, through-tubes, pneumatic tubes, fast flux facility, biomedical facility, thermal column, and gamma facility) to provide a wide range of experiments. The GTRR currently operates at a power of five megawatts two or three shifts per day.

The reactor and associated systems are housed in a steel containment building eighty feet in diameter and sixty-five feet in height. The adjoining 24,000 square foot, two-story, air-conditioned laboratory and office building contains laboratories for radiochemistry, health physics, materials preparation, nuclear spectroscopy, low-level counting, radiobiology, electronics, as well as a machine shop and a large animal quarter.

1039697

Equipment at the Frank H. Neely Nuclear Research Center includes:

5 megawatt, heavy-water research reactor

Neutron diffractometers (3)

Time-of-flight neutron spectrometer

Experimental setup for pile oscillator measurements

100,000 curie Co^{60} facility

50,000 curie capacity hot cell with master-slave manipulators

20' x 6' x 18' deep storage pool joined to hot cell by transfer chute

Neutron generator--200 keV TMC Activation Model 211, (d,n) reactor with tritium producing 2×10^{14} MeV neutrons/sec

Gamma facility--spent fuel element storage in pool provides gamma rates to 10^6 R/hr depending on sample geometry

Intermediate level radiochemistry laboratory (18' x 26') with radioisotope hoods, shielded glove boxes

Facilities for treatment, storage, and handling of solid and liquid radioactive wastes, including retention tanks of 8000 gallon capacity

Model 33 teletype terminal providing remote computer access on and off campus

Data acquisition system

The data acquisition system consists of three data processors (PDP-8, PDP-8/I, and PDP-12), with appropriate peripheral devices for use in sophisticated experiments requiring on-line analysis and control, as well as data collection. One of the processors is located within the reactor containment building and is intended for use by experimenters with a minimum of setup time. A rather sophisticated interface for accepting both digital and analog signals is operational. There is a communications link to the other processors, located in the laboratory portion of the Center, which acts as

1039698

a data collection center for several experiments and a secondary processor. Cell processors function (with lower priority) as a data reduction and preprocessing facility, and as such are generally available for use 24 hours per day.

Emerson Building

The School of Nuclear Engineering also occupies about 24,000 square feet in the Cherry L. Emerson Building. This space contains ample classrooms, student laboratories and offices as well as a periodical library, staff machine shop, electronics shop, seminar room, computation laboratory and a large, two-story high bay with 10 ton crane. The latter space houses the nuclear engineering laboratory. The counting rooms and other laboratories have been well equipped with conventional radiation detection instruments (including several multichannel analyzers) in sufficient numbers to accommodate laboratory sections of 12-15 graduate students.

Specialized equipment available in the Emerson Building to nuclear engineering students includes:

An AGN-201 training reactor

A natural uranium-light water subcritical assembly

Korad K-15 pulsed ruby laser

Three EAI model TR-20 analog computers

A 12,000 curie Cs-137 gamma source

One MeV Van de Graaff positive particle accelerator with beam analysis system

50 and 250 KVP x-ray machines

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Several gas chromatographs

Eleven radioisotope fume hoods and three glove boxes

Vacuum deposition system

The training reactor is located in the nuclear engineering laboratory. It is used in laboratory exercises and for special student problems and theses. The GTRR continues to be available for all pedagogical experiments and research which require its higher flux.

Rich Electronic Computer Center

The Georgia Tech Rich Electronic Computer Center was established in 1955 and its facilities are an integral part of the academic and research programs at Georgia Tech. The Office of Computing Services operates two large-scale digital computers, a Control Data Corporation CYBER 74 system and a Control Data Corporation 6400 system. Both systems operate under the NOS 1.0 operating system, thus providing back-up capabilities.

The CDC CYBER 74 has the following configuration: Two central processors (one 6400 and one 6600), fourteen peripheral processors, 131,072 words of core memory (60 bit words), 944 million characters of disk storage, eight magnetic tape drives, two card readers (1200 cpm), three line printers (1200 lpm), one card punch (250 cpm), 64 ports for time-sharing users, and an operator console. A CALCOMP Model 763 Digital Incremental Plotter provides high quality.

The following software packages are available: COMPASS, ALGOL, COBOL, FORTRAN (four different compliers are available), APL, RPG, MIMIC, MIX, plus many others.

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A Radiation, Inc. Analog-to-Digital conversion system is available in an off-line mode. It multiplexes up to 16 channels of analog magnetic tape input in a sequence determined by a programmable scanner, digitizes the samples at a rate up to 50,000 amples per second and to an accuracy of 11 bits plus sign, and produces a digital magnetic tape output.

Small Computer Applications Laboratory

The Small Computer Applications Laboratory was established to provide expertise for the development of complete hardware-software systems, particularly those systems associated with nuclear instrumentation and data reduction.

The laboratory has both general-purpose and specialized facilities for the application of small computer systems to a wide variety of research, development, instrumentation, and educational areas. It is equipped with four general purpose computers (a PDP-12, PDP-8/I, GT 42, and PDP-8) with various peripheral equipment specifically suited to small computer applications and system development. The 8K PDP-12 with its high speed disk storage, line-tape storage, and a graphics facility plays an important role in software systems development and data storage. In addition, the PDP-12 is equipped with multiple analog-to-digital converters, relays, a programmable KW-12A clock, and an I/O access panel to provide convenient development, fabrication, testing, and simulation of the interfacing of special equipment to the computer.

Library

The Price Gilbert Memorial Library is a centralized scientific, technical, and management collection of 730,000 volumes, plus 690,000

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microtext and other bibliographic units. Outstanding collections in the fields of science and engineering have been developed to support graduate study and research. It is housed in adjoining structures totaling 240,000 square feet of space. It can house over one million volumes and can seat two thousand users. The library's United States Patent specification collection is the only one in the Southeastern area. In 1962, the library was designated one of twelve Federal Scientific Report Centers and its collection of reports from the Atomic Energy Commission, the Department of Defense, the National Aeronautics and Space Administration, the Clearinghouse for Scientific and Technical Information now totals over 500,000 titles. Extensive files of standards issued by American associations and societies and a complete file of U.S. Military Standards and Specifications and of British Standards are maintained. The library is also a depository for United States government publications issued by the Government Printing Office, and for maps issued by the Army Map Service. Available on microfilm are more than 6,000 company catalogs providing information on industrial components.

Other Facilities

Georgia Tech has many other facilities closely allied with the nuclear engineering program including, for example, various facilities operated by Divisions of the Engineering Experiment Station. Among these are specialized laboratories utilizing x-ray equipment, optical and electron microscopes, emission and absorption spectroscopes, analog computers, microwave systems, cryostats and many other research devices. In addition, close cooperation exists between the School of Nuclear Engineering and other Schools of the Engineering College and the School of Physics.

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