NUCLEAR REACTOR OPERATOR TRAINING FOR DISADVANTAGED AMERICANS

A Final Report

March 1, 1984 - November 30, 1992

Submitted to:

**Procurement and Contracts Division
U. S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402**

Attention:

**Mr. Brad G. Bauer
Contracting Officer**

Submitted by:

**J. P. Farrar
Reactor Administrator**

**R. U. Mulder
Research Assistant Professor and Facility Director**

**Report No. UVA/527301/MANE93/108
December 1992**

**DEPARTMENT OF MECHANICAL, AEROSPACE
AND NUCLEAR ENGINEERING**

**PREPARED FOR THE U.S. DEPARTMENT OF ENERGY
UNDER Grant NUMBER DE-FG05-84ER75116**

SCHOOL OF

ENGINEERING
& APPLIED SCIENCE

**University of Virginia
Thornton Hall
Charlottesville, VA 22903**

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

UNIVERSITY OF VIRGINIA
School of Engineering and Applied Science

The University of Virginia's School of Engineering and Applied Science has an undergraduate enrollment of approximately 1,500 students with a graduate enrollment of approximately 600. There are 160 faculty members, a majority of whom conduct research in addition to teaching.

Research is a vital part of the educational program and interests parallel academic specialties. These range from the classical engineering disciplines of Chemical, Civil, Electrical, and Mechanical and Aerospace to newer, more specialized fields of Applied Mechanics, Biomedical Engineering, Systems Engineering, Materials Science, Nuclear Engineering and Engineering Physics, Applied Mathematics and Computer Science. Within these disciplines there are well equipped laboratories for conducting highly specialized research. All departments offer the doctorate; Biomedical and Materials Science grant only graduate degrees. In addition, courses in the humanities are offered within the School.

The University of Virginia (which includes approximately 2,000 faculty and a total of full-time student enrollment of about 17,000), also offers professional degrees under the schools of Architecture, Law, Medicine, Nursing, Commerce, Business Administration, and Education. In addition, the College of Arts and Sciences houses departments of Mathematics, Physics, Chemistry and others relevant to the engineering research program. The School of Engineering and Applied Science is an integral part of this University community which provides opportunities for interdisciplinary work in pursuit of the basic goals of education, research, and public service.

A Final Report
Grant No. DE-FG05-84ER75116

March 1, 1984 - November 30, 1992

NUCLEAR REACTOR OPERATOR TRAINING FOR DISADVANTAGED AMERICANS

Submitted to:

Procurement and Contracts Division
U. S. Department of Energy
Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

Attention:

Mr. Brad G. Bauer
Contracting Officer

Submitted by:

J. P. Farrar
Research Administrator

R. U. Mulder
Research Assistant Professor and Facility Director

Department of Mechanical, Aerospace and Nuclear Engineering
SCHOOL OF ENGINEERING AND APPLIED SCIENCE
UNIVERSITY OF VIRGINIA
CHARLOTTESVILLE, VIRGINIA

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Report No. UVA/527301/MANE93/108
December 1992

Copy No. 3

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

TABLE OF CONTENTS

	<u>Page</u>
A. Introduction	1
B. Summary of Training	1
C. University of Michigan Subcontract	6
D. Summary	6

NUCLEAR REACTOR OPERATOR TRAINING FOR DISADVANTAGED AMERICANS

A. Introduction

The Nuclear Engineering and Engineering Physics Department of the University of Virginia was awarded a grant by the U.S. Department of Energy in 1984 to establish and administer a reactor operator training program for disadvantaged Americans. Stipends were provided by the U.S. DOE for five trainees with the anticipation that four other educational facilities would participate in the program. Sub-contracts were awarded to four other Universities: Massachusetts Institute of Technology, The University of Missouri at Columbia, Oregon State University, and The State University of New York at Buffalo.

The initial two year program was very successful and the grant was renewed in late 1986 for another two years. MIT declined to participate in the second program and was replaced by Ohio State University. U.Va. was notified in September, 1987 that new funding would no longer be provided for this program after December, 1987. U.Va. requested and was granted a no cost extension for the program through December, 1990, since sufficient funds remained in the initial grant to pursue the program further. DOE subsequently approved a no cost extension through November, 1992.

B. Summary of Training

1. Oregon State University

Oregon State selected Ms. Cecilia Marchetti, 19 years old, as their first trainee in this program and she reported to the facility on September 14, 1984. She progressed well through the first year of the program and took the NRC examination for reactor operator on September 24, 1985. She passed the oral examination and all sections of the written exam with the exception of one section on General Operating Characteristics. After further study she successfully passed that section of the exam and was issued a reactor operator license on March 12, 1986. During the remainder of her training she was actively involved in the daily operations of the facility and assisted in the training of a new operator. To provide her with a greater range of experience she was trained in, and performed, a number of radiation protection functions. She completed her training in September, 1986 and moved to California. OSU felt that the training program had been very successful. The management was impressed by the fact that, during the two years Ms. Marchetti was at OSU, she changed from a fresh, young high school graduate with no knowledge of the nuclear world, to become a confident, self-assured research reactor operator.

OSU began a search for a second trainee and selected Ms. Kim Gross, who began her training on January 6, 1987. Ms. Gross initially had a difficult time adjusting to the training program, since she had just recently finished high school, but as time progressed she became more self-confident and she showed a marked improvement. In addition to self-study of the various manuals associated with the facility, she participated in reactor

operations, maintenance, and surveillance activities. By August, 1987, Ms. Gross decided she wanted to pursue other interests, and dropped out of the program. OSU concluded their participation in the program at that point.

2. Massachusetts Institute of Technology

MIT began a search for a candidate for this program in early 1984 and after several months, the Boston Technical High School referred two candidates for interviews. Mr. Frank Wamsley was selected as the initial trainee and began his training in January, 1985, which consisted of self-study, tutoring, lectures, and working with the staff on a daily basis. He progressed very well in the program but experienced difficulties with algebra and nuclear physics. It was hoped that he would be qualified to take the NRC exam for reactor operator after one year of training but additional training in math and reactor physics was indicated. After additional training he took the NRC exam and did very well on all portions of both the oral and written parts of the exam. He was issued a reactor operator license on October 6, 1986. At the conclusion of his training program he was retained as a reactor operator on the staff of the MIT reactor.

MIT declined to participate further in the program.

3. Ohio State University

Ohio State was contacted about participation in this program when MIT decided to drop out and they eagerly accepted. They advertised for the position and received ten applications. After interviewing candidates they chose Ms. Elaine Groh, who reported to the facility on February 2, 1987. She attended weekly classroom sessions and worked with the staff on a daily basis. As her training progressed she became involved with reactor operations, surveillance and maintenance activities. She performed exceptionally well in the program and took the NRC exam for reactor operator after only 8 months of training. She successfully passed the exam and was issued an operator license on October 22, 1987. After receiving her license she participated in reactor operations, experimental activities, maintenance activities, procedure writing and emergency planning. She terminated her participation in the program in August, 1988 to pursue employment in the nuclear industry.

Ohio State did not participate further in the program.

4. State University of New York at Buffalo

Buffalo selected Ms. Kristen Gray as their first trainee in this program and she began her training on January 30, 1985. Her training consisted of self-study, formal lectures, and participation in the daily operation of the facility. She also took a university course in radiation protection. Ms. Gray proved to be very intelligent and a fast learner. An NRC exam was scheduled for another trainee on September 2, 1985 and the staff decided to let Ms. Gray also take the exam, although it was several months earlier than originally planned. She passed the oral exam but failed two sections of the written exam. The NRC reexamined her on the two sections which she passed and she was issued a reactor operator license on February 11, 1986. After

receiving her license she worked full time as a reactor operator with the anticipation of taking the senior operator exam in the fall of 1986, however the NRC stated that they felt she had not had enough experience as an operator to apply for a senior license. Ms. Gray left the program in early 1987 to pursue employment in the nuclear field.

Buffalo recruited and hired another trainee, Ms. Rochelle Collins, who reported to the facility on December 14, 1987. Ms. Collins had a positive attitude and demonstrated a willingness to learn, however she had great difficulty with mathematics and reactor theory. She decided to drop out of the program in June, 1988 to pursue a career in other areas.

This was the last trainee Buffalo had in the program.

5. University of Missouri at Columbia

The University of Missouri selected Mr. David Fleming as the first trainee in their program and he reported to the facility on October 11, 1984. He was given a facility orientation including health physics practices, emergency procedures and security procedures. He was then assigned to one of four operating shifts at the facility to begin his training, rotating shifts periodically so he would have direct contact with all four shifts and shift supervisors. He experienced difficulty with mathematics and reactor theory and the staff put more emphasis on those areas of his training. His overall progress through the program was satisfactory. He enrolled in an adult education course in algebra to strengthen his mathematical ability and confidence. He was given the biennial requalification exam in November 1985. The staff felt that he had not scored as well as expected at this point in the training program. Several external problems affected his progress in the program during this period. He was legally separated from his wife and children and his father was diagnosed with cancer. He missed several weeks of training because of his father's illness. These personal problems and the pressure associated with them led Mr. Fleming to request that his training program be terminated. The staff reluctantly agreed and Mr. Fleming left the program on March 11, 1986.

The staff felt that although the program was not completed, Mr. Fleming gained valuable experience. He had previously been in law enforcement and hopes to combine this with his training at Missouri to pursue a career in the nuclear security area.

Missouri did not participate further in the program.

6. University of Virginia

The University of Virginia selected as it's first trainee Mr. Courtney Cobb. He began his training on September 3, 1984 and progressed rapidly through the program. He worked with the staff on a daily basis, attended lectures, participated in a self-study program and quickly became acclimated to the operation of the facility. He received an NRC operator license for both the UVAR reactor and the CAVALIER reactor on June 17, 1985. He began the second year of his training with the intent of taking the NRC senior operator exam in the late spring of 1986. During this period he worked with the staff on a daily basis as a reactor operator and took a formal course in Radiation Detection Instrumentation. By the end of January, 1986, Mr. Cobb had

performed 72 start-ups on the UVAR reactor and accumulated 247 hours at the console. He had performed 7 start-ups on the CAVALIER with approximately 20 hours at the console. Mr. Cobb took the senior operator exam on May 13, 1986 and passed the oral exam and all sections of the written exam with the exception of the section on reactor theory, and was consequently denied a senior license. He continued to study with the intention of retaking that part of the senior operator exam before his training program ended in September, 1986, however the exam could not be scheduled until November, 1986. At the end of his training program Mr. Cobb was retained as a full time staff member at the facility. He subsequently passed the senior operator exam and was issued a senior operator license on November 19, 1986.

U.Va. advertised for another trainee for this position and received 25 applications. The facility management selected Ms. Faheemah Bilal, who reported to the facility on November 16, 1986. A training program was established that included classroom lectures, self-study, and working directly with the reactor staff on a daily basis in the operation and maintenance of both reactors. She progressed very well in her training and spent ~ one month with the Health Physicist in performing area surveys, analysis of air and water samples, liquid waste disposal and personnel monitoring. She continued to work with the staff on a daily basis in the area of reactor operations including the completion of checklists associated with the start-up and operation of the UVAR reactor and spent considerable time at the console under the direction of a senior operator. She developed a keen interest in the Health Physics program and worked closely with the Health Physicist in performing the surveys and the surveillance items required of the facility. She was given the annual reactor operator requalification exam and passed all sections although several weak areas were uncovered and the staff worked to strengthen these areas. Ms. Bilal took the NRC reactor operator exam on September 14, 1987, but unfortunately did not pass. Her training continued with the anticipation that she could retake the exam sometime in early 1988. She became more interested in the field of health physics and a full time job became available in the office of Environmental Health and Safety, which she accepted. She left the training program at the end of November, 1987.

The facility advertised for another trainee and selected Ms. Lisa Scheid, who reported to the facility on February 1, 1988. She progressed rapidly through the program. She attended lectures covering reactor theory, nuclear instrumentation, health physics and reactor operating procedures. She also attended all reactor operator requalification lectures and worked with the staff on a daily basis. She took a formal course in calculus to improve her math skills. She was given an assignment each week to study, such as Tech. Specs., SOP's, SAR, etc. and was given a quiz each week to check her progress. She began working with the staff each week in the completion of checklists and reactor startups. During the summer of 1988 she took two formal courses: Radiation Detection Laboratory and Introduction to Nuclear Engineering. She performed daily checklists with a senior operator at every available opportunity and performed reactor start-ups under the guidance of a senior operator. Ms. Scheid took the NRC exam for reactor operator on November 14, 1988 and successfully passed. She was issued a license on January 4, 1989. After obtaining a license, Ms. Scheid was assigned additional responsibilities in the day-to-day operation of the facility. She participated in the daily checkout of the reactor prior to operation and was

assigned two hours per day at the console to operate the reactor. She was given the primary responsibility for the release of liquid waste from the facility, collecting and analyzing water samples prior to release. She was also assigned various health physics duties and assisted with several experiments being performed in the reactor. Since Ms. Scheid was functioning as a regular staff member, the management felt that she should be earning a higher salary. In May, 1989, her position was upgraded from Laboratory Technician A, a position that paid a salary closely matching the DOE grant, to Nuclear Reactor Operator, a position that paid ~ \$7000 a year more. The difference in salary was paid by local funds from the facility. Ms. Scheid's training program terminated in December, 1989 and she was retained as a full time staff member. She is still on the staff and earned a NRC senior operator license in July, 1992.

Since funds still remained in the program the facility began a search for another trainee. It was late fall before a suitable candidate could be found. The facility selected Ms. Eleanor Yoon, who reported to the facility on November 1, 1990. She was given a facility orientation and issued documents pertaining to the operation of the facility. She attended a series of lectures on reactor theory, nuclear instrumentation, Technical Specifications, normal and emergency operating procedures, and the safety analysis report for the UVAR reactor. She worked with the staff on a daily basis, assisting in the checkout of the reactor and performing startups of the reactor under the guidance of a senior operator. She attended operator requalification lectures and was given the annual requalification exam, which she passed. In order to learn the various systems in more detail, Ms. Yoon requested that she be allowed to build a model of the reactor. She completed the model, which included the reactor pool, reactor structure, experimental facilities, primary and secondary systems including the heat exchanger, pumps, cooling tower and demineralizer system, in early July, 1991. Ms. Yoon applied for and was granted admission to the U.Va. medical school to begin in the fall of 1991. She dropped out of the program on July 19, 1991.

Since the program was to terminate at the end of November, 1992, the facility recruited two trainees for a period of one year. Messrs. W.E. Brown and W.N. Wilson reported to the facility in December, 1991. After joining the staff they were given a facility, security and Health Physics orientation and issued documents pertaining to the operation of the 2 MW reactor, such as, Standard Operating Procedures, Safety Analysis Report, Technical Specifications and Emergency Procedures. They attended lectures given by the staff on a frequent basis covering the areas of reactor theory, health physics, nuclear instrumentation and the various systems associated with the reactor. They worked with the staff on a daily basis assisting with reactor startup checklists, startup and operation of the reactor and other activities associated with operation of the facility. They attended Operator Requalification lectures and were given quizzes on a regular basis to gauge their progress. Both trainees progressed very well in the program, however, Mr. Brown dropped out of the program in June, 1992, to pursue employment at the U.Va. Medical Center. Mr. Wilson took the NRC examination for Reactor Operator in July, 1992, and passed the operating exam with no problems. He failed the written exam and will retake that part of the exam in the near future.

The training program was terminated at the end of November, 1992 since funds were depleted. Mr. Wilson will be retained on the staff with his

salary being paid from funds generated by the facility.

C. University of Michigan Sub-Contract

In December, 1990, the University of Michigan requested and was granted a \$10,000 sub-contract from the DOE grant funds to begin a minority training program at that facility. During the summer of 1991, eight high school students were selected to spend eight weeks (20 hours per week) at the Michigan facility. They attended lectures, performed lab experiments utilizing the reactor, and were assigned projects to complete during the summer. In the fall ten high school students were selected to spend Saturday mornings (4 hours) for five consecutive weeks at the reactor facility to perform lab experiments utilizing the reactor. Out of this group, students were selected to spend two days per week (4 hours per day) at the reactor facility for a period of two years. They will attend lectures on math, reactor theory, Health Physics, reactor systems, procedures, and Technical Specifications. They will be given problem solving assignments associated with the reactor. Eight students were selected for a summer intern program and spent 20 hours per week at the facility. This program will continue with funding provided from other sources.

D. Summary

Since its inception in 1984 thirteen individuals have participated in this training program resulting in the NRC licensing of eight individuals, seven with an operator's license and one with a senior operator's license. Ms. Lisa Scheid, who was formerly in this program and now part of our staff, recently received a Senior Operator License from the Nuclear Regulatory Commission. None of these individuals had any previous experience in the nuclear field. This program has given these disadvantaged and minority representatives an opportunity to learn about and ingress into the nuclear field. This was a chance that they otherwise would certainly not have had. Although several individuals did not complete their training, we feel the overall program has been successful. The University of Virginia, along with the other Universities participating in this program, wishes to thank the Department of Energy for their financial support of this program.

DISTRIBUTION LIST

1 - 3* Procurement and Contracts Division
 U. S. Department of Energy
 Idaho Operations Office
 785 DOE Place
 Idaho Falls, Idaho 83402

 Attention: Mr. Brad G. Bauer

4 - 5 Mr. Tom Williams
 U. S. Department of Energy
 Idaho Operations Office
 785 DOE Place
 Idaho Falls, Idaho 83402

 ** SEAS Postaward Administration

6 - 7 R. U. Mulder

 8 J. P. Farrar

 9 P. E. Allaire

10 - 11 E. H. Pancake, Clark Hall

 12 SEAS Preaward Administration Files

*Original, unbound copy and 2 bound copies

**Cover letter only

JO#4799:ph

END

DATE
FILMED

5/04/93