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Center for Energy  
Research and Training

C E R T

FINAL REPORT

October 1993

Infrastructure Support

Under

USDOE/MEIAP

Submitted by

Arup K. Mallik, Ph.D., P.E.  
Principal Investigator  
Department of Industrial Engineering

and

Peter Rojeski, Jr., Ph.D., P.E.  
Co-Principal Investigator  
Department of Architectural Engineering

North Carolina Agricultural & Technical  
State University

1602 East Market Street  
Greensboro, N.C. 27411

CERT Address:

401 McNair Hall  
Greensboro, North Carolina 27411

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## EXECUTIVE SUMMARY

The North Carolina A&T State University **Center for Energy Research and Training (CERT)** intends to continue working toward its mission and strategic implementation plans for the 1992-93 academic year. This year the University has made exciting progress toward CERT's mission and CERT has played a significant role in concert with the University's overall goals and objectives in enhancing energy related research and training activities.

As one of the several institutions of higher education, North Carolina Agricultural and Technical State University at Greensboro has received support from the office of Minority Education Institution Assistance Program (MEIAP) of the US Department of Energy primarily to provide infrastructure support to promote and enhance interdisciplinary energy-related research. In this effort, the university has been authorized to prepare a plan to create a center for Energy research and Training (CERT), which was initiated on September 30, 1987.

This project was financed from the office of MEIAP/USDOE for a three-year period beginning in September 1987 at a federal funding level totaling \$648,653 ending September 1992. North Carolina A&T State University contributed \$244,405 as indirect costs. This year, CERT received an extension of 10.5 months, with no additional funding.

Efforts are being made to continue its mission and maintain a high level energy research environment throughout the campus and throughout the community. The University's continued vital leadership role in the community would be significantly enhanced by this support, and energy education will be an important part of North Carolina A & T's educational and research programs.

CERT participants are currently reviewing programs at other universities and gathering materials to determine the feasibility of an undergraduate and/or graduate program specifically dealing with the issues of energy utilization, the environment and global economic competitiveness including economic potentials of biofuels as alternate energy source in North Carolina.

INFRASTRUCTURE SUPPORT TO CREATE A CENTER FOR ENERGY RESEARCH AND  
TRAINING AT NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE  
UNIVERSITY UNDER USDOE/MEIAP

North Carolina A & T State University  
Greensboro, North Carolina 27411  
919-334-7780

## I. INTRODUCTION

As one of the several institutions of higher education, North Carolina Agricultural and Technical State University at Greensboro has received support from the office of Minority Education Institution Assistance Program (MEIAP) of the US Department of Energy primarily to provide infrastructure support to promote and enhance interdisciplinary energy-related research. In this effort, the university was authorized to prepare a plan to create a center for Energy research and Training (CERT), which was initiated on September 30, 1987. The goals and objectives for CERT are as specified below:

1. To encourage research by the faculty in many academic disciplines and to enhance their success in finding and obtaining funds for interdisciplinary and multi-school research.
2. To enhance students' energy education with increased opportunities for:
  - a) theoretical and practical contact with energy issues and technologies
  - b) new courses and improved course content
  - c) internships and graduate funding
  - d) ability and desire to pursue careers in energy field.
3. To establish training and service programs for off-campus constituents in energy issues, use, and management.
4. To develop cooperative relationships with industry, businesses, universities, and other private and professional organizations and with the State Energy Office.

5. To cooperate ~~( )~~ —————> in establishing communications and collaborative research projects with various national research laboratories and other federal agencies.

6. To develop a permanent university infrastructure for energy research, training, and community service.

## II. ACTIVITIES SUMMARY- September 30, 1992 to September 29, 1993

### Energy Project At Washington Elementary School

Students in the Architectural Engineering Department were involved in a demonstration Project at Washington Elementary School. The purpose is to establish the performance and cost effectiveness of micro-processor controlled, variable speed heat pumps for retrofit applications. Also being studied is the performance and cost effectiveness of automatic dimming and occupancy sensors for lighting systems.

### Training/Internship Program

The U.S. Department of Energy has sponsored a Training/Internship program for A&T engineering students who have interest in national energy policy, especially building energy conservation programs. Program participants worked in summer of 1993 at the Department of Energy in Washington, D.C. ALL participants have taken two engineering courses on Energy Conservation and Environment-Global Perspective and a third course on Worldwide Energy Economics. Ten students are selected based on their academic records.

### Building Environmental Laboratory

Dr. Rojeski initiated a new project to build an environmental laboratory chamber to experimentally evaluate the thermal characteristics of innovative wall design and construction techniques, reflecting and heat absorbing glass, window shading techniques, infiltration and moisture migration. Improving energy efficiency is part of the objectives.

Search for funding from several agencies are continuing.

### Continuing Education

Dr. Peter Rojeski involved with ASHRAE Continuing Education Committee and reviewed proposals to develop several courses dealing basic heating and air conditioning principles. Eventually, a total of eight courses will be developed, and these will be offered on a nationwide basis for individuals interested in gaining additional

knowledge of heating and air conditioning systems, their design and operation.

Dr. Rojeski is active with A&T Energy Conservation Committee to discuss strategies for improving the energy efficiency of campus operations. Enhancing "Energy Awareness" in campus is one of the activities which has been promoted by CERT.

### Interdisciplinary Energy Program

Dr. Rojeski and other CERT participants are currently reviewing programs at other universities and gathering materials in an effort to determine the feasibility of an undergraduate and/or graduate program specifically dealing with the issues of energy utilization, the environment and global economic competitiveness. The first effort in a proposal submitted to the department of Energy by the Architectural Engineering Department for the creation of an intern program in energy/Environment/Economy as related to building energy conservation.

The second proposal was submitted through the "SUCCEED" consortium of engineering colleges. This project will investigate the feasibility of developing interdisciplinary curricula at both the undergraduate and graduate levels dealing with global industrial competitiveness.

### Joint Energy Conference

CERT actively participated in a joint Energy Conference with Utilities and Energy, environment & Plant Engineering Divisions of the Institute of Industrial Engineers. The title of the conference will be "Competitive Strategies with Integrated Resource Planning". Drs. Mallik, Rojeski and Singh of North Carolina A & T and Curtis Phillips of N.C. Energy Division are among the list of speakers. The conference was held in Charlotte, North Carolina on March 7-9, 1993.

### U.S. EPA Green Lights

CERT has taken initiative to get involved in EPA Green Lights Program and implement at A&T campus. Dr. H.M. Singh is in-charge of the program.

### New Energy Course

Energy and Maintenance Management is a new graduate course offered by the Architectural Engineering Department. The course addresses the major energy-using systems in buildings, viz. boilers, chillers, and HVAC systems. Maintenance and operative maintenance programs were presented. The students also worked with the PMC computerized maintenance management software system.

### CERT in the News

The Energy, Environment, and Plant Engineering (EEPE) Division of the Institute of Industrial Engineers (IIE) awarded Dr. Arup K. Mallik a **Special Citation Award for Outstanding Contribution in energy field**. Dr. Mallik attended the International IIE Conference in Chicago in May to receive this award.

Dr. Arup K. Mallik presented two seminars at the Indian Institute of Technology (IIT) at Kharagpur in June. The seminar topics were "Energy Strategies in 1990s and Beyond" and "Cost Effectiveness Model for Energy Production under Inflationary Environment."

### ENERGY SYMPOSIUM

CERT organized a symposium entitled "Economic Progress Through Energy Innovation" on March 24, 1992. Mr. Frank M. Stewart, Deputy Assistant Secretary, Office of Technical and Financial Assistant of Conservation and Renewable Energy, USDOE, was the keynote speaker. Other speakers were Robert E. Koger, President of North Carolina Alternate Energy Corporation, Carson D. Culbreth, Director of North Carolina Energy Division in the Department of Economic and Community Development, and Walter E. Jonston, President of the Association of Energy Engineers.

This symposium was attended by 135 people from ASHRAE, A&T faculty and students. ASHRAE co-sponsored this program.

### Research on Manufactured Homes

CERT has initiated an area of research concerning the status of manufactured homes. Contacts have been made with North Carolina Energy Division, North Carolina Alternative Energy Corporation, and the Department of Energy for potential funding. Drs. Sarin, Benjamin, and Mallik have prepared a proposal and submitted for funding to North Carolina Alternative Energy Corporation. Dr. Turner of Home Economics Department has also submitted a proposal on the same subject to NCAEC. None of the proposals have been funded.

### Energy Analysis and Diagnostic Center (EADC)

CERT has expressed interest in re-initiating an EADC at A&T. A proposal was prepared and submitted to the University City Science Center in Philadelphia. The request was denied.

### Alternate Energy Corporation

Dr. Harold L. Martin, Dean of the School of Engineering, and Drs. Arup Mallik, Peter Rojas, Carolyn Turner, and Harmohindar Singh were invited to North Carolina Alternate Energy Corporation (AEC) to share some of many energy-related activities that A & T faculty are involved. The objective was to develop ways of establishing a greater partnership with the AEC. Consequently, Drs. Mallik, Rojas, and Singh were invited to join in three different program committees. Dr. Turner is an existing member of another program.

### A & T Energy Conservation Committee

A committee has been formed to make recommendations regarding existing programs and implementation of energy policies and procedures to the Chancellor and Central Administration Staff. The recommendations will form the basis for a University Energy policy. Dr. Peter Rojas is involved in this committee representing CERT.

### Construction Engineering Research Labs (CERL)

Drs. H. M. Singh and Arup Mallik visited the Construction Engineering Research Labs (USA CERL) in Champaign, Illinois, in April, 1992, to explore the possibilities of joint research in energy-related field. Consequently, Dr. Singh got involved in two areas of research on (1) Indoor Air Quality and (2) Demand Controlled Ventilation Rates. Both projects involve students from Architectural Engineering Department. Currently, Dr. Singh is actively involved in research with CERL.

### IIE Student Conference

CERT has co-sponsored the Southern Eastern Regional Conference hosted by the A & T Student Chapter of the Institute of Industrial Engineers held on February 5-7, 1993, in Greensboro, North Carolina. In this conference a workshop was planned entitled "Global Competitiveness" where three papers on energy related topics were presented. Approximately 250 students and faculty attended this conference.

### Symposium

CERT has sponsored a symposium entitled "Energy & Environment: A Vehicle of Achieving Engineering Excellence" on February 23, 1993, in Greensboro, North Carolina. A brochure listing the complete program is included in appendix.

### Indoor Air Quality

The International Facility Management Association/ Piedmont Triad Chapter invited Dr. H.M. Singh of Architectural Engineering Department to speak on "Ventilation & Air Quality" in Winston-Salem, North Carolina, on November 12, 1992.

### Energy and The Environment-Undergraduate Education

A grant to develop an undergraduate educational program in Energy and the Environment for engineering students was funded by the U.S. Department of Energy, Office of Conservation and Renewable Energy. The Program includes the development of three special courses: (1) Energy and the Environment, (2) Energy Conservation in Buildings, and (3) Energy in a Global Economy. The program also includes a summer intern feature where 10 students will work in the DOE office in Washington, D.C. for ten weeks.

The first course, under this program, has been developed and offered in the Spring 1993 semester.

### EMMY Award

Dr. H.M. Singh of Architectural Engineering Department was awarded EMMY Award 1991/1992 from North Piedmont Chapter of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers for his outstanding contribution in energy field.

### Cooperative Educational Program

The U.S. Department of Energy approved a cooperative educational program for students at North Carolina A&T State University. fifteen students applied for the program and the DOE interviewers selected eleven. Of the eleven chosen students, seven accepted the positions and reported to work at the Department of Energy, Washington, D.C. on June 7, 1993. this summer program will last for ten weeks. The various activities in which the students will participate.

### Excellence in Building Science

Dr. Rojeski has initiated a new plan to revitalize existing graduate program in Architectural Engineering program. The focus of this proposed program includes new courses on integrated building design, energy management, life cycle costing, and facility management.

### IIE 1993 Fellow Award

Dr. Mallik has been selected to receive 1993 IIE Fellow Award of the Institute of Industrial Engineers.

### IIE International Conference

Drs. Rojeski and Mallik are invited to speak at the International IIE Conference at Los Angeles in May 1993. Dr. Rojeski will on "Energy, The Environment and Economic Competitiveness" and Dr. Mallik will speak on "Economic Considerations Concerning Environmental Systems".

## Biofuels

CERT is in the process of organizing a research team to investigate the potentials of biofuels as an alternative energy source in North Carolina. Dr. Mallik visited ORNL in July to discuss how CERT can initiate a biofuels Research program at A&T. Contact has been made with North Carolina Energy Division for cosponsoring activities in this area. A pre-proposal has been submitted for their review.

## Symposium II

CERT cosponsored a symposium entitled "Indoor Air Quality & Energy Issues" on June 8, 1993, at Wake Forest University campus in Winston Salem, North Carolina. The State Energy division was cosponsoring the program and Dr. H. M. Singh of Architectural Engineering department was in-charge of the program. Approximately 75 professionals were attending. A brochure is included in the appendix.

CERT cosponsored a one-day workshop with North Carolina Energy Division entitled "Energy Management Systems: Making Them Work". This workshop is scheduled in Charlotte, NC, on September 23, 1993, and in Raleigh, NC, on June 21, 1994. Dr. H.M. Singh is in-charge of this program. A brochure is included in the appendix.

## A New Engineering Course

Dr. Arup Mallik is in the process of developing a new course on Life Cycle Cost Analysis of Energy Conservation Opportunities which will replace the current Engineering Economy course in the future. The course focuses case studies based on actual industrial energy audits with three objectives - teaching life cycle cost analysis, teaching industrial energy conservation, and teaching how to use a spread sheet software package for cost analysis.

## Energy-Related Research Funding Since 1984

Since the initiation of CERT, energy-related research funding in the campus has been increased significantly. The chart below shows the data collected since 1984.

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## PROPOSAL (TOTAL DOLLAR AMOUNT)

YEAR	SUBMITTED	FUNDED
1984	\$346,173	\$257,713
1985	160,360	197,090
1986	578,651	282,335
1987	1,353,724	251,692
1988	1,197,841	389,571
1989	2,071,396	931,353
1990	2,568,353	715,409
1991	3,175,929	1,118,300
1992	1,989,023	1,249,628

CERT Sponsored Seminars

In 1990, CERT sponsored a series of seminars. Outside and inside speakers discussed current energy-related topics. The interested faculty and students participated in the discussion. The list below shows the speakers and topics.

<u>TOPICS and SPEAKERS</u>	<u>DATE</u>
Energy Strategies for the 1990's And Beyond - Dr. A. K. Mallik	Jan 24, 1992
Simulation of Manufacturing Systems - Mr. Ken Davis, Manager, Decision Engineering	Jan 31, 1992
Automatic Generation of Softwares For Control of Manufacturing Systems - Dr. Sanjoy Joshi, Professor, Penn State	Feb 07, 1992
CFC's and Their Replacement for Stratospheric Ozone Protection- Dr. H. M. Singh, Professor, N.C. A & T	Feb 14, 1992
Preventive Maintenance Software- Demonstration	Feb 21, 1992
Maximize Return on Investment - Dr. Arup K. Mallik	Feb 28, 1992
Computerized Energy Management Systems - W. Curtis Phillips N. C. Energy Division	Mar 20, 1992
Energy Conservation Technology for Manufactured Homes - Fred Singleton, USDOE, Atlanta	Mar 27, 1992
Expert Systems: Software Application - Paul L. Adams, Systems Analyst	Apr 10, 1992

CERT Sponsored Energy-Related Workshops

1. Energy Conservation in Furniture Industry
2. EADC End Users' Conference
3. Indoor Air Quality in Furniture Manufacturing
4. Energy Efficient Wood Dust Collection
5. Economic Impact of Waste Heat Recovery
6. Strategic Planning for Energy Management and Plant Engineering
7. Clean Air Act and Energy issues
8. Second Annual Symposium on IAQ and Energy Issues
9. Increase Profitability Through Energy Cost Reduction
10. Impact of Energy Efficiency on IAQ
11. Condensing Heat Exchanger: A Success Story
12. Healthy Indoor Air and Energy Issues
13. Energy Cost Reduction Using Air Washer Control Strategies
14. Indoor Air Quality and Energy Issues
15. Energy Management Systems : Making Them Work
16. Air Washer Control Strategies
17. Advanced Preventive Maintenance
18. Economic Progress Through Energy Innovation

Dr. H. M. Singh, professor of Architectural Engineering, is the coordinator of all these workshops. CERT has plans to conduct twelve one-day seminars for the coming year, 1992-1993. A list of these seminars is attached in the appendix.

CERT Sponsored Energy-Related Courses

Illuminating Engineering  
HVAC Controls, Operation, and maintenance  
Advanced Energy Conservation Systems  
Energy Management Planning  
Design of Energy Conservation Systems  
ERWM Academic Partnership Program  
Hazardous Waste Management

APPENDIX

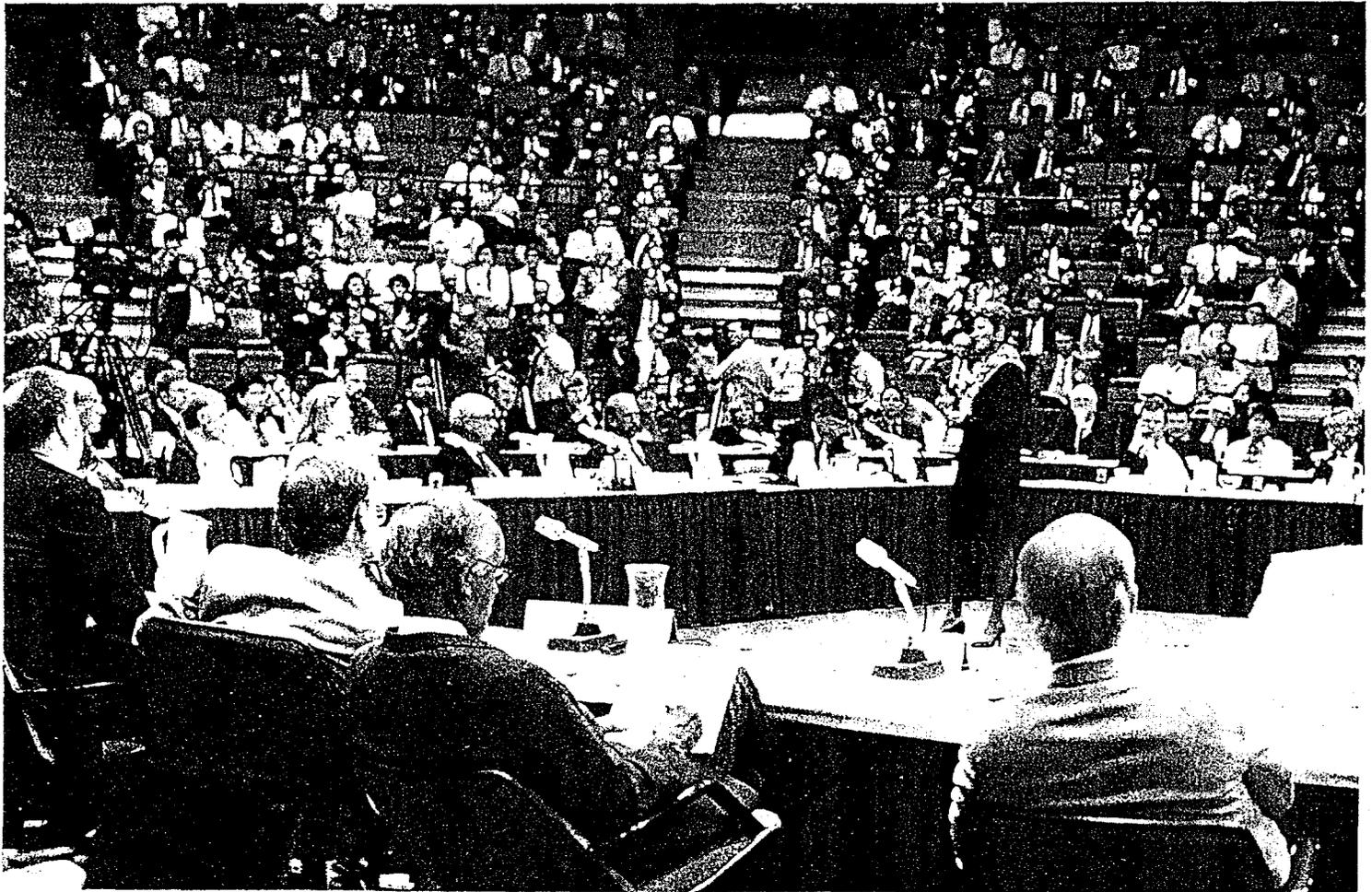
# DOE This Month



OCTOBER 1993

U.S. Department of Energy, Washington, D.C.

Vol. 16, No. 10



## The Hanford Summit

Streamlining the cleanup, a shared vision..... 3

DOE 'readiness' order follows Chinese test ..... 3

Energy International  
DOE delegations to Moscow, IAEA .. 9

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Energy Awareness Month  
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Relighting, fuel friendly vehicles  
Energy Management winners..... 7

Presstime Briefs  
Vehicles, reactors..... 13

## AT PRESSTIME



(DOE Photo by Watkins)

### 'All Season' Summer Students

Eight student engineers from North Carolina Agricultural and Technical State University, who recently completed 10 weeks of summer training at DOE Headquarters, are now combining final (fifth) year academic courses with orientation visits to DOE facilities. The cooperative education program, sponsored by the Office of Energy Efficiency and Renewable Energy (EE), brought the eight to Headquarters last June and assigned them to projects in energy efficiency and renewable energy technologies. During their current final year, they remain under DOE scholarship.

Orientation trips include visits to the National Renewable Energy Laboratory at Golden, Colo.; the Denver Support Office; the Western Area Power Administration; the Golden Field Office; the World Energy Engineering Congress; in January the meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers in New Orleans; and in February the Oak Ridge National Laboratory. Upon graduation with a bachelor's degree next spring, they will work for 12 months at Department Headquarters or a field or laboratory site. As part of the program, they will enroll in a graduate engineering program. Students who successfully complete the program are eligible to be hired by the Department as regular employees on a noncompetitive basis.

Shown above at the presentation of their final summer project reports to EE monitors are: (l-r) Ed McDonald, Justin Burroughs, Frances Keel, Scottie Miller, Dennis Clough, Leah Boggs, Brian Lawson, and Kermit Smith.

### Model Car Solar Race May Go National

DOE's Boston Support Office, sponsor of last summer's model solar car race involving some 5,000 seventh and eighth graders, is leading a move to expand the event nationally.

The New England event was designed to challenge students to use math and science skills together with creativity and innovation to construct a car from a kit containing only solar cells and a motor.

Representatives from DOE Headquarters, the Boston Support Office, the National Renewable Energy Laboratory, and Argonne National Laboratory met recently to consider races

in other regions and adding a more comprehensive curriculum package and more advanced kits.

Cosponsors for the 1993 Junior Solar Sprint were the American Society of Mechanical Engineers which coordinated the event and provided technical assistance to science teachers; and Mobil Solar Energy Corp. which made and donated the solar cells.

Heritage Industries of Peabody, Mass., a vocational training division of the North Shore Association of Retarded Citizens, was awarded DOE funds to assemble the solar car kits.

### Rocky Flats Transition

In the transition of the Rocky Flats Plant to a new environmental cleanup mission, the Office of Environmental Restoration and Waste Management (EM) will replace the Office of Defense Programs as the "landlord" of the Plant. EM will manage all Rocky Flats facilities, with the exception of four non-nuclear manufacturing buildings and their support facilities, and the metal-working Oxnard facility.

### Hybrid Vehicle Contract

Under a cost-shared \$138 million DOE contract, a team headed by General Motors will develop a "hybrid" vehicle that combines electric propulsion with conventional heat engine systems. The move follows a White House initiative to join Government expertise with the Big Three auto makers for a new generation of clean, efficient vehicles.

### Fusion Reactor Design

Ebasco Services Inc. of New York City will lead the U.S. industrial design effort in support of both the International Thermonuclear Experimental Reactor (ITER) and the U.S. fusion program system studies. Ebasco and 10 subcontractors will perform engineering design and analysis for the 6-year Engineering Design Activities phase of the ITER project that is jointly funded by the U.S., the European Community, Japan, and the Russian Federation. Following design activities, the four parties will decide whether to build the ITER facility. Lawrence Livermore National Laboratory will be the primary DOE coordinating lab.

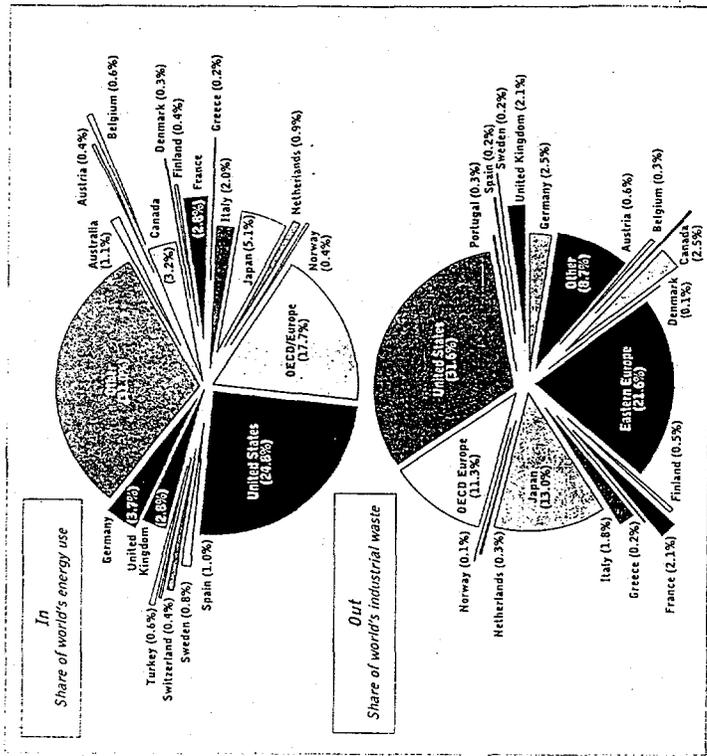
### Revised Cleanup Pact

DOE, the State of Washington, and the Environmental Protection Agency have agreed on updated plans for the Hanford Site cleanup including more emphasis on transforming tank waste into a solid, more stable form. The new actions also call for addressing urgent safety risks and protecting the Columbia River.

ENERGY, THE ENVIRONMENT & THE ECONOMY

A COOPERATIVE EDUCATION PROGRAM

NORTH CAROLINA A&T STATE UNIVERSITY  
U.S. DEPARTMENT OF ENERGY



Frank Stewart (DOE), Peter Rojeski (A&T), Patricia Rose (DOE), Anita Johnson (DOE), and the 1993 DOE/NC A&T STATE UNIVERSITY co-op students.

## STUDENT REQUIREMENTS

In order to participate in the program, the students must be citizens of the United States and must be enrolled in engineering and must demonstrate an interest in energy issues. Students must maintain a minimum grade point average of 2.60. In order to participate in the 12 month employment opportunity following graduation, students must be enrolled in the Graduate School at North Carolina A&T State University.

Graduate students are eligible to participate in this program but they must continue their enrollment until their one year of employment has been completed.

Students who withdraw from the program before completing the one year of employment must repay the government the \$1,500 per semester scholarship.

## THE UNIVERSITY

North Carolina A&T State University is a Historically Black University located in Greensboro, North Carolina. Total enrollment is 7,500 students. The School of Engineering consists of the following departments: Agricultural Engineering, Architectural Engineering, Civil Engineering, Chemical Engineering, Mechanical Engineering, Industrial Engineering, Electrical Engineering and Computer Science. Master of Science degrees are offered in Architectural, Industrial, Mechanical, and Electrical Engineering. PhD programs in Mechanical and Electrical Engineering are scheduled to begin in 1994.

For further information, contact Dr. Peter Rojeski, Jr., P.E., Program Manager, at (919)334-7575.

## PRIVATE SECTOR PARTICIPATION

Private industries and utility companies can participate in this program and students can be assigned to the companies for a period of up to thirteen weeks. This assignment counts toward satisfying the one-year employment requirement and will usually occur at the beginning of that period. The companies must reimburse the government for the students' salaries and fringe benefits. Travel and living expenses are paid directly to the students by the company sponsors. After the students complete their one year of DOE employment, they may decide to seek employment with their sponsoring company.

North Carolina A&T State University is committed to equality of educational opportunity and does not discriminate against applicants based on race, color, national origin, religion, sex, or handicap. Moreover, North Carolina A&T State University is open to people of all races and actively seeks to promote racial integration by recruiting and enrolling a larger number of white students.

## ENERGY, THE ENVIRONMENT & THE ECONOMY

### STUDENT BENEFITS

#### SUMMER EMPLOYMENT

For ten weeks during the summer prior to their Senior year, students have the opportunity to work at the Department of Energy on a real-world problem. They also learn about the Department, its goals and management. They also participate in field trips and seminars.

Students receive a salary ranging from \$8.34 per hour to \$15.00 per hour, depending on prior education and work experience. They also receive a housing allowance and the other benefits normally received by Federal employees, including health and life insurance, vacation and sick leave, etc.

#### ACADEMIC SCHOLARSHIPS

A scholarship of \$1,500 per semester for the final two semesters at the University will be received.

#### ANNUAL EMPLOYMENT

Once the three courses developed for the program and all other graduation requirements are completed, a one-year work assignment with the Department of Energy is negotiated. The government-specified salary and all benefits afforded a government employee, will be received.

#### PERMANENT EMPLOYMENT

After the one year of employment, the participants can apply, on a non-competitive basis, for a permanent position with the Department of Energy.

### GOAL

The goal is to develop a cadre of engineering graduates who have, in addition to strong analytical capabilities, an in-depth knowledge of energy issues, a sensitivity toward environmental preservation, and an understanding of the economic factors which affect national energy programs and policies. Areas of research interest include, but are not limited to, the following.

ENERGY EFFICIENT BUILDING DESIGN  
WIND, SOLAR, & PHOTOVOLTAIC ENERGY  
ELECTRICAL POWER DISTRIBUTION  
ENERGY FROM MUNICIPAL WASTE  
ALTERNATIVE FUELS

### ACADEMIC COMPONENT

In addition to departmental curricular requirements, students must complete the following three courses which have been developed specifically for this program.

ENERGY & THE ENVIRONMENT: A GLOBAL PERSPECTIVE  
ENERGY CONSERVATION IN BUILDINGS  
ENERGY ECONOMICS

The courses are Senior/Graduate level and are taught by faculty in the School of Engineering and the School of Business and Economics.

### TRAINING COMPONENT

The first phase of the on-the-job training component consists of a ten week summer work assignment at the Department of Energy in Washington, D.C. This work experience occurs one year prior to graduation (normally between the Junior and Senior years).

The second training phase consists of a twelve month work assignment within the Department of Energy in Washington or at one of the national laboratories, or regional offices.

## STUDENT PROJECTS

The following are descriptions of some of the projects which the students pursued during their 10 week summer assignments.



Kermit Smith &  
Brian Lawson

Geothermal Heat Pumps: Research the state-of-the-art of geothermal heat pumps, their positive and negative points, their costs and operating efficiencies. Also, investigate the feasibility of integrating thermal storage with the geothermal heat pump concept. Assess the commercialization potential of the alternative concepts.



Justin Burroughs

New Building Energy Efficiency: Analyze the proposed designs for new buildings at the National Renewable Energy Lab in order to document the energy efficiency of these designs. A preliminary analysis was conducted using ASEAM-2.1 and a more detailed analysis using the PC-version of DOE-2D and DOE PLUS.



Ed McDonald &  
Dennis Clough

District Heating and Cooling: Gather operating data and conduct field audits as required for the energy efficiency analysis of the district heating and cooling plants which serve most of the government buildings in the District. Develop recommendations regarding cost effective ways to upgrade existing systems and equipment.



Leah Boggs

Appliance Efficiency Standards: Investigate mandated efficiency standards for refrigerator/freezers. Determine the degree of compliance and the monitoring requirements needed to encourage compliance by all manufacturers. Investigate the technical, economic, and policy implications associated with improving the operating efficiency of refrigerator/freezers, including rebate strategies for purchasing higher efficiency models.



Frances Keel

Energy Efficiency in Manufacturing: Analyze energy use in glass manufacturing and the food and beverage industry. Develop state-of-the-art process flow diagrams for each manufacturing process and evaluate the economic and technical feasibility of technologies that are presently being researched or which are in the demonstration phase.



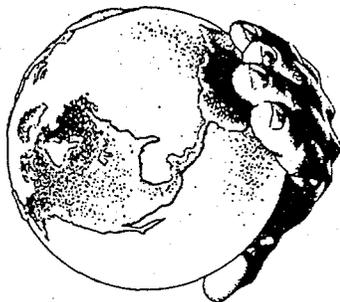
Jerome Miller

Geographic Information System (GIS): Develop an energy-related database for entry into a GIS system. The database included such information as wind, coal, and solar resources, utility locations, distribution systems, population centers, etc. This graphical representation will be used for long-term forecasting of energy demand and supply requirements.

# SYMPOSIUM

MARCH 24, 1992  
EMBASSY SUITES HOTEL  
204 CENTERPORT DRIVE  
GREENSBORO, N.C.

*"Think globally...Act locally,"*



**SPONSORED BY:**

Center for Energy Research and Training (CERT)  
North Carolina A&T State University  
Greensboro, N.C. 27411

**PROGRAM**

- 6:00 p.m. .... Registration
- 6:15 p.m. - 6:35 p.m. .... Mr. Robert Koger, President  
NC Alternative Energy Corporation
- 6:35 p.m. - 6:55 p.m. .... Mr. Doug Culbreth  
Director  
NC Energy Division
- 6:55 p.m. - 7:15 p.m. .... Mr. Walter Johnston  
President  
Association of Energy Engineers
- 7:15 p.m. - 7:45 p.m. .... Social
- 7:45 p.m. - 8:45 p.m. .... Dinner

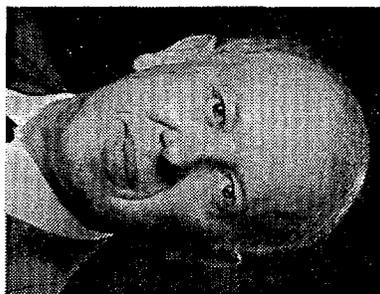
**Speaker**  
**Mr. Frank Stewart, Deputy Assistant  
 Secretary for Technical and Financial Assistance**  
 US Department of Energy



**Frank M. Stewart**

Mr. Stewart is the Deputy Assistant Secretary, Office of Technical and Financial Assistance, Office of Conservation and Renewable Energy, U.S. Department of Energy. He directs grant programs and provides technical assistance for States and localities, including the Institutional Conservation Program, Weatherization Assistance Program, State Energy conservation Program, Energy Extension Service, Investigations and Innovation Program, and the Technical Conservation and Renewable Energy. In 1987, Mr. Stewart was the recipient of the annual Appreciation Award from the National Association of State Energy Officials, and in 1988, he was named the Energy Executive of the year. Mr. Stewart received his undergraduate and graduate education from Wesleyan University, Harvard University and American University.

**Robert E. Koger, P.E.**



Dr. Koger has been President and Executive Director of the North Carolina Alternative Energy Corporation since 1988. He received B.S. in Electrical Engineering from the University of Tennessee and Ph.D. in Industrial Engineering from North Carolina State University at Raleigh. Dr. Koger served eleven years as Commissioner of North Carolina Utilities Commission including seven years as Chairman of the Commission. He served over 20 years in various utilities as Engineer and Director. Dr. Koger is Licensed Professional Engineer and has served on many boards and committees. He has published numerous technical articles in professional journals and presented speeches to professional groups.

**Carson D. (Doug) Culbreth**



Mr. Culbreth has been director of the North Carolina Energy Division in the Department of Economic and Community Development since 1980. He was educated at Wake Forest University and Campbell College. Mr. Culbreth also serves as Executive Director of the North Carolina Energy Policy Council, Governor's representative to the Energy and Environment Committee of the National Governor's Association, and many other advisory committees. Mr. Culbreth was chosen "Energy Executive of the Year" in 1988 and has recently been appointed to the Legislative Research Committee on Ways to Promote the Conservation of Energy and Use of Renewable Energy Sources.

**Walter E. Johnston, P.E.**



Mr. Johnston is International President of the Association of Energy Engineers. He is presently the Manager of Energy/Presentive Maintenance Program at North Carolina State University Industrial Extension Service. Mr. Johnston was chosen "1989 International Energy Engineer of the Year", "1987 North Carolina Energy Engineer of the Year", and "1990 Southeast Regional Energy Educator". He has over 27 years of experience as a Facility/Plant Engineer. Mr. Johnston is Licensed Professional Engineer and serves as Energy Manager for two national conglomerates. He has travelled as Energy Management Consultant throughout the USA, Canada, Japan, Chile, Australia, England, Italy, Egypt, Austria, and Germany.

**REGISTRATION FORM**

Please register me for the symposium "Economic Progress Through Energy Innovation" scheduled for March 24, 1992, at the Embassy Suites Hotel, 204 Centerport Drive, Greensboro, N.C.

Name: \_\_\_\_\_ Company: \_\_\_\_\_

Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

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Please make all checks payable to NC A&T State University Foundation and mail to : Dr. H. Singh, 437 McNair Hall, School of Engineering North Carolina A&T State University, Greensboro, NC 27411. For further information call (919) 334-7575.

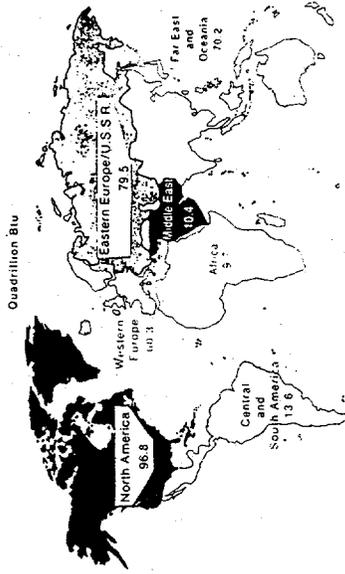
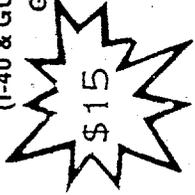
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**SYMPOSIUM**

**ENERGY & ENVIRONMENT:  
A VEHICLE OF ACHIEVING  
ENGINEERING EXCELLENCE**

FEBRUARY 23, 1993  
HOWARD JOHNSON  
(I-40 & GUILFORD COLLEGE ROAD)  
GREENSBORO, NC



LED BY THE UNITED STATES, NORTH AMERICA CONSUMED MORE ENERGY THAN ANY OTHER REGION (SOURCE 1989 U.S. DOE) DATA BOOK



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Greensboro, N. C. 27411

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Refrigerating, and Air Conditioning  
Engineers (ASHRAE)

Center for Energy Research and Training (CERT)  
437 McNair Hall  
N.C. A&T State University  
Greensboro, N.C. 24711

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Please note any changes to the address label and return to CERT.  
\_\_\_\_\_

**Dr. H. Singh**  
437 McNair Hall  
School of Engineering  
N. C. A&T State University  
Greensboro, N.C. 24711

**PROGRAM**

**STUDENT WORKSHOP  
2:30 p.m. - 4:30 p.m.**

2:30 p.m. - 3:10 p.m. Organizational Structure and Operation of ASHRAE

Jim Fields  
President, North Piedmont Chapter of ASHRAE

3:10 p.m. - 3:30 p.m. Students Perspective "What Can ASHRAE Do For Us?"

Melissa Calhoun  
President, Student branch of ASHRAE

3:30 p.m. - 4:00 p.m. Student Research Project #1

Graduate Student

4:00 p.m. - 4:30 p.m. Student Research Project #2

Graduate Student

**SYMPOSIUM  
4:30 p.m. - 6:30 p.m.**

4:30 p.m. - 5:10 p.m. "Salient Features of Energy Policy Act 1992"

Joe Roop  
Technology Planning and Analysis Center  
Battelle Pacific Northwest Laboratories

5:10 p.m. - 5:30 p.m. "Energy Policy Act 1992 and Electrical Utilities"

Ron Gibson  
Vice-President/Customer Planning  
Duke Power Company

5:30 p.m. - 6:30 p.m. "Energy Policy Act 1992 and Gas Utilities"

Don Harrow  
Vice-President Government Relations  
Piedmont Natural Gas Company

7:00 p.m. - 7:15 p.m. SOCIAL

Business Meeting  
Jim Fields  
President, North Piedmont Chapter of ASHRAE

7:15 p.m. - 7:45 p.m. DINNER

Mr. Frank Stewart  
Deputy Assistant Secretary for Technical and Financial Assistance  
U. S. Department of Energy

8:15 p.m. - 8:45 p.m. Remarks

Richard A. Charles  
International President, ASHRAE

8:45 p.m. - 9:00 p.m. Closing Remarks

Peter Rojeski, Jr.  
Chairman  
Architectural Engineering Department

**Dr. Joseph Roop**

Dr. Joseph Roop is a Staff Economist at Battelle, Pacific Northwest Laboratories, in the Technology Planning and Analysis Center. He has a B.S. in Economics from Central Missouri State University and a Ph.D. in Economics from Washington State University. He has recently returned from a 22-month assignment with the International Energy Agency, an agency of the Organization for Economic Co-operation and Development, located in Paris. Dr. Roop has returned to activities that focus on industry and international economics, with an emphasis on energy demand and the implications of energy use for carbon emissions. He is the author of about 50 publications in the areas of energy, energy policy, macroeconomics, and economic modeling.

**Ron Gibson**

Ron Gibson is Vice President of the customer planning department for Duke Power Co. in Charlotte, N.C. The Columbia, S.C. native graduated from Davidson College with a B.A. in economics. He also holds a doctor of law degree from the University of North Carolina School of Law. Mr. Gibson develops products and services for the changing energy needs of Duke Power's customers and examines how Duke Power can assist in the way customers use energy. Before joining Duke Power, he was in private law practice from 1979 to 1983. Mr. Gibson joined Duke Power in 1984 as senior attorney and was named Vice President of Customer Planning in 1992. He has served as a North Carolina State Bar Counselor since 1984.

**Donald F. Harrow**

Donald F. Harrow is Vice President-Governmental Relations for Piedmont Natural Gas Company headquarters in Charlotte. A native of Natick, Massachusetts, Mr. Harrow received his B.A. in biology from Wesleyan University in 1977. He also earned an MBA from the University of North Florida in 1983. He is responsible for coordinating the company's relations with city, state and federal officials as well as offering increased company assistance to local Chamber of Commerce and economic development leaders. Mr. Harrow is a member of the American Gas Association's State and Local Affairs Committee, Southern Gas Association's Governmental Affairs Committee and the Natural Gas Vehicle Coalition's State Legislative and Regulatory Committee.

**Frank M. Stewart**

Mr. Stewart is the Deputy Assistant Secretary, Office of Technical and Financial Assistant, Office of Conservation and Renewable Energy, U.S. Department of energy. He directs grant programs and provides technical assistance for States and localities, including the Institutional Conservation Program, Weatherization Assistance Program, State Energy Conservation Program, Energy Extension Service, Inventions and Innovation Program, and the Technical Conservation and Renewable Energy Program. In 1987, Mr. Stewart was the recipient of the annual Appreciation Award from the National Association of State Energy Officials, and in 1988 he was named the Energy Executive of the year. Mr. Stewart received his undergraduate and graduate education from Wesleyan University, Harvard University and American University.

**Richard A. Charles**

Richard A. Charles is the International President of American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. Mr. Charles, president of Charles & Braun, Consulting Engineers, in San Francisco, California joined ASHRAE in 1959. During his more than 30 years of engineering work, Mr. Charles has been responsible for or supervised the design of nearly 2,000 projects, dealing with every type of structure requiring environmental control. His interest in energy management predated the dramatic increases in energy costs of the 1970s. Instead he focused on the efficient operation of HVAC equipment. He was chairman of the ASHRAE Committee which helped organize CLIMA 2000 in Sarajevo, Yugoslavia in 1989. Mr. Charles is an ASHRAE Fellow, and he has received the Society's Distinguished Service Award. He is a registered Professional Engineer.

**REGISTRATION FORM**

Please register me for the symposium "Energy and Environment: A Vehicle of Achieving Engineering Excellence" scheduled on February 23, 1993, at the Howard Johnson (I-40 & Guilford College Road), Greensboro, N.C. Registration Fee: \$15.00.

Name: \_\_\_\_\_ Company: \_\_\_\_\_  
 Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_  
 Telephone: \_\_\_\_\_ Amount Enclosed: \$ \_\_\_\_\_

Please make all checks payable to ASHRAE STUDENT BRANCH and mail to : Dr. H. Singh, 437 McNair Hall, School of Engineering North Carolina A&T State University, Greensboro, NC 27411. For further information call (919) 334-7575.

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## **CENTER FOR ENERGY RESEARCH AND TRAINING**

*“Promoting Interdisciplinary Education in Technological Subjects  
of Vital National and Global Concern”*

- \* **ENERGY & RESOURCE CONSERVATION**
- \* **ENVIRONMENTAL PROTECTION**
- \* **INDUSTRIAL COMPETITIVENESS**
- \* **SUSTAINABLE ECONOMIC GROWTH**

### **The Center for Energy Research and Training**

- \* Is an association of faculty interested in global concerns at a technical and policy level.
- \* Sponsors seminars for students and faculty.
- \* Sponsors technical workshops for industry.
- \* Supports undergraduate and graduate course development.
- \* Supports interdisciplinary technical and policy research.
- \* Publishes a quarterly newsletter.
- \* Promotes energy awareness in public schools.

**SEPTEMBER 10, 1992 (12:00 noon — 2:00 p.m.)**

## **AN INTERDISCIPLINARY APPROACH TO GLOBAL ISSUES:**

Solutions to industrial redevelopment problems in the United States, such as declining productivity, high consumer liability claims, and environmental regulation, are interdisciplinary and involve science, engineering, technology, business, law, and public health. Similarly, solutions to global concerns such as global warming, the destruction of the ozone layer, the impact of the industrialization of underdeveloped countries, and the destruction of critical rain forests involve many disciplines working together.

CERT seeks to continue to be the vehicle at NC A&T State University which promotes interdisciplinary cooperation among faculty and students from different departments and different schools. While developing new technologies will continue as an important University-wide research objective, the major emphasis of CERT is the optimal utilization of existing technologies based on economic, regulatory and policy incentives.

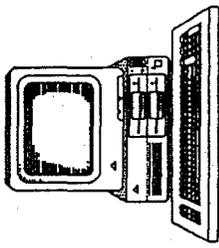
## **LONG RANGE PLAN:**

The objective of the Center for Energy Research and Training is to promote interdisciplinary education in technological subjects of vital national and global concern. To achieve this objective, the following tasks have been identified.

1. Identify those faculty and administrators who have an interest in interdisciplinary solutions to complex technological problems.
2. Petition UNC General Administration to make CERT a permanent center.
3. Identify sources of interdisciplinary research support within private companies and government agencies.
4. Develop an interdisciplinary Masters program in which graduates from Arts and Science, Business and Economics, Engineering, and Technology can participate.
5. Petition to UNC General Administration to reallocate industrial extension program funds in favor of NC A&T State University.
6. Develop secondary school and undergraduate college courses which introduce students to global issues from an interdisciplinary perspective.

LOWER MAINTENANCE COSTS  
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**ADVANCED PREVENTIVE  
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- \* Predictive Maintenance Techniques
- \* Preventive Maintenance Techniques
- \* Computerized Maintenance Management
- \* Design for Maintainability

Radisson Hotel — High Point, NC  
 February 12 & 13, 1992

Sponsored By:



Center for Energy Research and Training (CERT)  
 North Carolina A&T State University



N.C. Energy Division  
 Department of Economic and  
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Future workshops to be conducted by the state  
 Energy Division include:

- Basics of Energy Efficiency for:
  - HVAC
  - Boilers
  - Chillers
  - Steam Traps
  - Air Compressors
  - Preventive Maintenance
  - Motors
  - Lighting
- Advanced HVAC Energy Conservation
- Energy Conservation in the Chemical and  
 Pharmaceutical Industry
- Certified Energy Managers Review

Contact Curt Phillips at 919-733-2230  
 for more information.

Future workshops sponsored by the A & T Center  
 for Energy Research and Training include:

- Kiln Energy Control
- Air Washer Control Systems
- Indoor Air Quality

Contact Dr. Harmohindar Singh at 919-334-7575  
 for more information.

Professional Engineers of North Carolina  
 4000 Wake Forest Road, Suite 108  
 Raleigh, North Carolina 27609-6859

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- Plant Manager
- Plant Engineer
- Maintenance Superintendent
- Manufacturing Superintendent

TO:

# ADVANCED PREVENTIVE MAINTENANCE WORKSHOP

## Program Schedule

Wednesday, February 12, 1992

Location: Radisson Hotel

- |  |  |
|--|--|
| 2:00-2:50<br>Seminar A<br>Vibration Analysis | 2:00-2:50<br>Seminar B<br>PC Hardware Update     |
| 3:00-3:50<br>Oil Analysis                    | 3:00-3:50<br>Digital Data Acquisition            |
| 4:00-4:50<br>Infrared Imaging                | 4:00-4:50<br>Energy Management<br>Systems Update |

Thursday, February 13, 1992

Location: Exhibition Center

- |  |  |
|--|--|
| 9:00-12:00<br>Computerized Maintenance Management<br>Systems Users Survey Results, Implementation<br>Effort & Vendor Support | 12:00-1:30<br>Lunch in Exhibit Area  |
| 1:30-2:15<br>Design for Maintainability  | 5-3:15<br>The Role of CMMS in a Comprehensive Facilities<br>Management Program |
| 3:30<br>Tour of Exhibits   |  |

## Exhibition Center

Showplace in the Park  
130 W. Commerce Avenue

Vendors of computer hardware and software, commercial building products, scientific equipment, and facilities maintenance equipment are expected to participate.

## ABOUT THE WORKSHOP

The workshop is being held in conjunction with the Professional Engineers of North Carolina Winter Annual Meeting and is open to the general public. The program should be of special interest to the following persons:

- Design Engineers and Architects
- Facilities Engineers and Planners
- Maintenance Technicians
- Physical Plant Directors

The cost of the workshop is \$45, and includes the Wednesday and Thursday programs, lunch on Thursday and admittance to the Exhibition Area. Persons wishing to participate in the other activities associated with the PENC Winter Annual Meeting may register and pay the additional fee at the workshop. Additional information regarding the PENC Annual Meeting can be obtained by calling 919-872-0683.

## WORKSHOP SPEAKERS

- Mr. Dennis Karczynski  
Staff Engineer, General Motors Corporation  
Detroit, Michigan
- Mr. Don Bahnfleth  
President, ZBA Engineers, Cincinnati, Ohio
- Mr. Rick Henry  
Duke Engineering Services, Charlotte, NC
- Mr. Gary Thompkins  
Physical Plant Department  
University of North Carolina, Chapel Hill, NC
- Dr. Peter Rojeski, Jr.  
Architectural Engineering Department  
A & T State University, Greensboro, NC
- Mr. Curt Phillips  
North Carolina Energy Division, Raleigh, NC

## CORPORATE PARTICIPANTS

- Schenck Trebel, Inc., Deer Park, NY
- Thermal Techniques, Charlotte, NC
- Diagnostic Technologies, Charlotte, NC
- National Instruments, Inc., Marietta, GA
- IBM, Greensboro, NC

## REGISTRATION FORM

Please register me for the **Advanced Preventive Maintenance Workshop** scheduled for February 12 & 13, 1992, at the Radisson Hotel, 135 South Main Street, High Point, NC. For hotel reservations call (919) 889-8888.

Name: \_\_\_\_\_ Company: \_\_\_\_\_

Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Telephone: \_\_\_\_\_ Amount Enclosed: \$ \_\_\_\_\_

Please make checks payable to the **Professional Engineers of North Carolina**, 4000 Wake Forest Road, Raleigh, NC 27609-6859, 919-872-0683. The workshop is sponsored by the Energy Division, N.C. Department of Economic and Community Development, the North Carolina A & T State University Center for Energy Research and Training, and the Professional Engineers of North Carolina. Any opinions, findings, conclusions and recommendations expressed at the conference, are those of the speaker(s) and do not necessarily reflect the views of the sponsors.

The Third Annual  
Symposium

**INDOOR AIR QUALITY  
&  
ENERGY ISSUES**

June 5, 1992

Babcock Auditorium  
The Bowman Gray School of Medicine  
Winston-Salem, NC

**WHO SHOULD ATTEND:**

Microbiologists & Health Professionals working in designing, operating and maintaining health facilities.

Hygienists

Consulting Engineers responsible for the selection and application of System Design.

Owners who want to be sure of making the right decisions about new equipment purchases.

Architects who must advise clients on the wisest choices for the future.

Contractors who will be affected by changes in installation and service requirements.

Others who have vested interest in the future of the HVAC & Utility Industry.

**HOW TO REGISTER:**

Complete and return the registration form in this brochure to Dr. H. Singh, 437 McNair Hall, North Carolina A&T State University, Greensboro, N.C. 27411, Attention: **IAQ Symposium.**

**REGISTRATION FEES:**

The \$75.00 per person fee includes the cost of the symposium and refreshments.

**DATE AND LOCATION:**

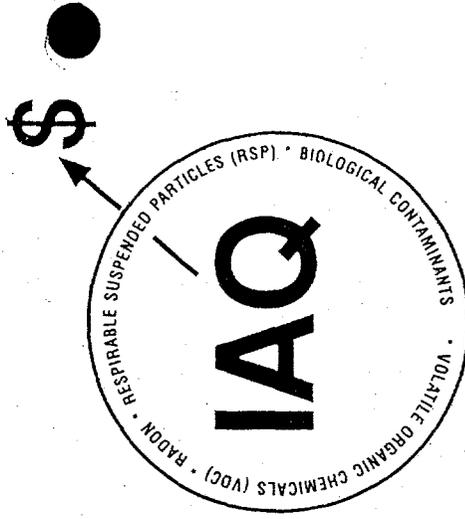
June 5, 1992, 8:30 to 5:00 p.m. Babcock Auditorium, The Bowman Gray School of Medicine, Winston Salem, N.C.

**FUTURE SEMINARS:**

1. Advanced Preventive Maintenance.
2. Energy Monitoring Control Systems (EMCS).
3. Specialized Ventilation System Controls.
4. Kiln Energy Controls.

For further information contact Dr. H. Singh (919) 334-7575 at Center for Energy Research and Training at NC A&T State University, Greensboro, NC 27411. Attention: **IAQ Symposium.**

Dr. H. Singh  
437 McNair Hall  
School of Engineering  
N. C. A&T State University  
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Winston-Salem, NC

Piedmont Council of  
Engineering & Technical Societies (PCETS)

North Piedmont Chapter of American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)

**PROGRAM**

8:30 - 8:55 a.m. .... Registration

8:55 - 9:00 a.m. .... Welcome

9:00 - 9:20 a.m. .... **Indoor Air Problems in Buildings**  
H. Singh  
North Carolina A&T State University

9:20 - 10:10 a.m. .... **Sick building Syndrome and Multiple Chemical Sensitivity Syndrome**  
Dr. William Meggs  
Division of Clinical Toxicology  
East Carolina University

10:10 - 11:05 a.m. .... **Ventilation & Smoke Activity in Office Buildings**  
Kenneth B. Parrish P.E.  
Senior Engineer  
R.J.R. Tobacco Company

11:05 - 11:15 a.m. .... COFFEE BREAK

11:15 - 12:10 p.m. .... **Building Design Procedures for Satisfying ASHRAE 62**  
James E. Woods  
Professor  
VPI and State University

12:10 - 1:20 p.m. .... LUNCH

1:20 - 2:15 p.m. .... **Building O & M Procedures to comply ASHRAE STANDARDS**  
James E. Woods  
Professor  
VPI and State University

2:15 - 3:10 p.m. .... **Preventive Procedures for Mitigating Indoor Air Problems**  
Shirley J. Hansen  
President  
Hansen Associates

3:10 - 3:20 p.m. .... COFFEE BREAK

3:20 - 4:15 p.m. .... **Liability Issues Related to Indoor Air Quality**  
Dr. Geraldine Edens  
Attorney  
Cadwalader, Wickersham & Taft

4:15 - 5:00 p.m. .... **PANEL DISCUSSION**  
Moderator  
Dr. Anthony R. Shoaf  
Chemical/Biohazard Safety Officer  
Health Protection Section  
The Bowman Gray School of Medicine  
Wake Forest University

5:00 p.m. .... CLOSING REMARKS

**Harmohindar Singh, Ph.D., P.E., C.E.M.**

HARMOHINDAR SINGH, is a Professor of Architectural Engineering at NC A&T State University. Dr. Singh is a member of ASHRAE, and other technical and professional societies. He is a certified energy analyst in the state of North Carolina. He has over twenty five years of teaching and research in the thermal sciences and has presented numerous papers in the field of Energy Conservation, Heating Ventilating and Air Conditioning and Indoor Air Quality.

**William Meggs, M.D.**

WILLIAM MEGGS, M.D., is Assistant Professor in the division of Clinical Toxicology of the Department of Emergency Medicine at East Carolina University. Dr. Meggs is co-author of *Biologic Markers of Immunotoxicity* with the subcommittee on immunotoxicology of the National academy of sciences, published this spring. He has researched and written on problems of sensitivity to environmental chemicals, and recently received a N.C. Lung Association grant to continue this work.

**Kenneth B. Parrish, P.E.**

KENNETH B. PARRISH, is a senior design engineer at the R.J.R. Reynolds Tobacco Company. He got his license to practice as a Professional Engineer in the state of North Carolina in 1988. He is a graduate from the NC State University with BS, in Mechanical Engineering. He has conducted investigations in many buildings regarding Smoking Activity, Outdoor Air Needs, etc.

**James E. Woods, Ph.D., P.E.**

JAMES E. WOODS, is the William E. Jemerson Professor of Building Construction, College of Architecture and Urban Studies, Virginia Polytechnic Institute and State University. Previously he was Senior Staff Scientist and Senior Engineering Manager at Honeywell. Dr. Woods, who is a member of ASHRAE and the building Research Board of the National Research Council, has taught, researched, and practiced environmental control in buildings for more than 25 years. He has published more than 100 technical papers and 3 books on this subject.

**Shirley J. Hansen, Ph.D.**

SHIRLEY J. HANSEN, is the president of Hansen Associates, a company which provides consultations & training in Energy Management and Indoor Air Quality fields to the governmental and private companies. Prior to founding Hansen Associates in 1986 Shirley was the director of The Schools and Hospitals Conservation Division of the U.S. Department of Energy. She has written 15 manuals on Performance Contracting and Energy Management. In 1990 she authored the book, *Managing the Indoor Air Quality and its presently writing a book on Performance Contracting for Energy and Environmental Systems.*

**Geraldine E. Edens, Ph.D.**

GERALDINE E. EDENS, is an associate in Cadwalader, Wickersham & Taft's Environmental Law Group. Before joining Cadwalader, Ms. Edens was an Associate Professor at the University of Miami where she taught research methods and statistical analysis and has published and presented papers on the topic. She graduated from the University of Miami, School of Law, magna cum laude and order of the coif and has a Ph.D. in Higher Education from the University of Florida. She has an extensive background in the health and biological sciences.

**Antony R. Shoaf, Ph.D.**

ANTONY R. SHOAF, is the Chemical/Biohazard Safety Officer of the Health Protection Section, Bowman Gray School of Medicine. Dr. Shoaf has won fellowships awarded by NRC, Southern Regional Res. Ctr. and USDA. Previously he held positions of asst. professor, Dept. of Interdis. Toxicology, Univ. Arkansas Medical School, Little Rock and Director, La. State Drug Testing Laboratory and Consulting Toxicologist, Weyerhaeuser Company.

**REGISTRATION FORM**

Please register me for the Symposium on "INDOOR AIR QUALITY AND ENERGY ISSUES" to be held June 5, 1992, in Babcock Auditorium, The Bowman Gray School of Medicine, Winston-Salem, NC.

Name: \_\_\_\_\_ Company: \_\_\_\_\_

Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_

Telephone: \_\_\_\_\_ Amount Enclosed: \$ \_\_\_\_\_

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