University of Arkansas Center and Institute Proposal
Center for **P**ower **O**ptimization and **E**lectro-**T**hermal **S**ystems (POETS)
Proposed by H. Alan Mantooth, Distinguished Professor
Department of Electrical Engineering

CENTER VISION

POETS is an Engineering Research Center won by the University of Illinois at Urbana Champaign, The University of Arkansas at Fayetteville, Stanford University and Howard University. POETS is the first Engineering Research Center ever awarded in the state of Arkansas. These four universities include a multi-disciplinary team that will create new paradigms for power flow in complex systems. POETS long term goal is to increase the power density of current mobile electrified systems by 10-100 times over current state of the art systems. While ambitious, this would have a profound impact on a mobile electrified infrastructure of the U.S. and beyond. On-highway vehicles could save between 100-300 million liters of fuel per year and could nearly double the range of all-electric vehicles. Off-highway vehicles could save on the order of 100 billion liters of fuel since their electrification is starting from a less mature point than current on-highway vehicles. Similarly, aircraft could see 10-30 billion liters of fuel saved as well as up to 10 million tons of CO2 saved from going into the high altitude atmosphere. These economic and environmental impacts are just the beginning of the art of the possible with the achievement of the POETS vision. This center is a multi-disciplinary center involving several fields of study including Mechanical Engineering, Electrical Engineering and Physics. The center functions under the assumption that a single discipline could not achieve the goals set by this team and must integrate multiple disciplines and domains to achieve such success.

Name of the College, School, Department, or Unit in which the Center will be housed.

The POETS Center will be housed in the College of Engineering within the Department of Electrical Engineering.

Name and title of the person(s) proposing creation of the Center.

H. Alan Mantooth, Distinguished Professor of Electrical Engineering

The Center type (research, service, or instructional) that is requested.

The main focus of the POETS center is basic research activities. However, a good portion of the center's charge is to involve and graduate as many POETS students at all levels in order to populate a workforce armed with the special skills from their experience with the POETS Center. The center represents both research and education goals required by The National Science Foundation befitting a center the size and magnitude of an Engineering Research Center.

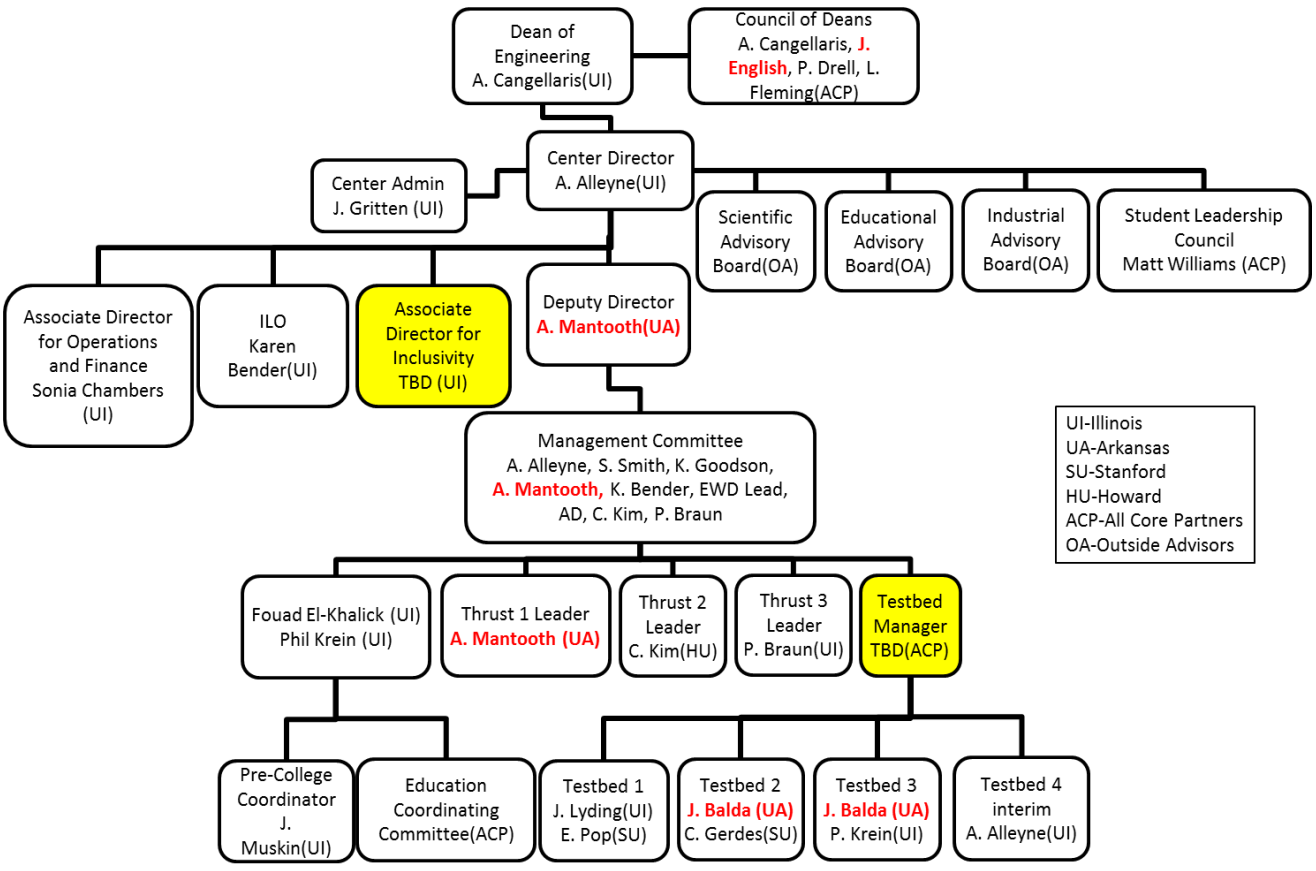
The unique value of the program to the University, and the distinction to any similar programs in Arkansas.

POETS is the first Engineering Research Center (ERC) ever awarded in the state of Arkansas. Such an award represents the National Science Foundation's most prestigious award. To be chosen out of approximately 200 proposals and become one of only three teams awarded is an accomplishment to which many aspire, but seldom achieve. The value of such an award to the University of Arkansas at Fayetteville is immeasurable in terms of the opportunity for the positive visibility for the University, College of Engineering and the specific program areas participating in the work to be accomplished. Simply put; there are no other programs similar in Arkansas. The NSF Arkansas EPSCoR program is an important program, but its purpose is to prepare for an award such as an ERC. This team's extensive participation in the EPSCoR program is one activity that prepared them to compete successfully for such a distinction.

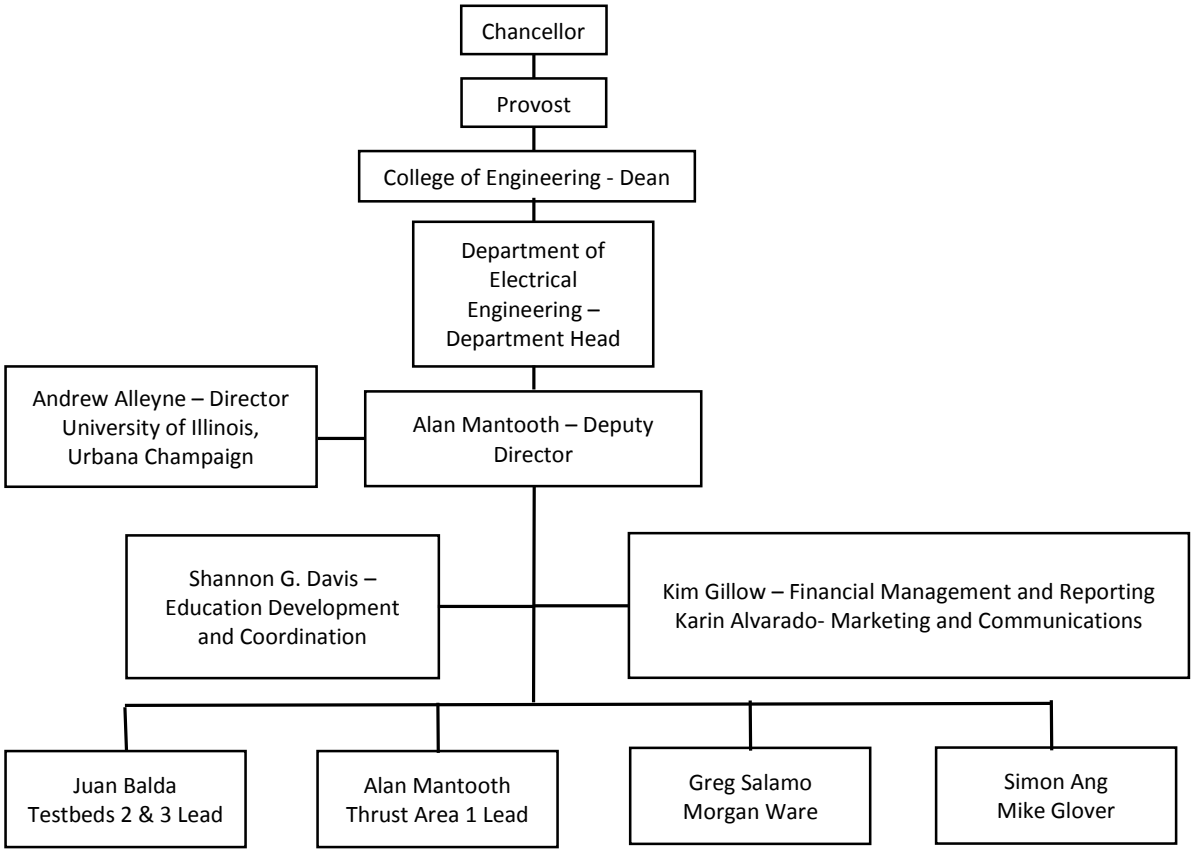
Information on the Director position and the organizational structure

Alan Mantooth, Distinguished Professor in the Electrical Engineering Department is the Deputy Director of POETS and proposing center designation. Alan Mantooth received the B.S. (*summa cum laude*) and M. S. degrees in electrical engineering from the University of Arkansas in 1985 and 1986, respectively, and a Ph.D. degree from the Georgia Institute of Technology in 1990. He joined Analogy in 1990 where he focused on semiconductor device modeling and research and development of HDL-based modeling tools and techniques. In 1998, he joined the faculty of the Department of Electrical Engineering at the University of Arkansas, Fayetteville. He currently holds the rank of Distinguished Professor and his research interests focus on power electronics in grid and transportation systems and include: analog and mixed-signal IC design & CAD, semiconductor device modeling, power electronic circuit design, and power electronic packaging. He has published over 250 refereed articles in these fields. Dr. Mantooth led the establishment of the National Center for Reliable Electric Power Transmission (NCREPT) at the UA in 2005. He serves as its Executive Director as well as two of its constitutive centers of excellence: the NSF I/UCRC (Industry/University Cooperative Research Center) on GRid-connected Advanced Power Electronic Systems (GRAPES) and the Cybersecurity Center on Secure, Evolvable Energy Delivery Systems (SEEDS) funded by DoE. Dr. Mantooth holds the 21st Century Research Leadership Chair in Engineering. Dr. Mantooth is a Fellow of IEEE, a member of Tau Beta Pi and Eta Kappa Nu, and registered professional engineer in Arkansas. As Deputy Director, Mantooth will work daily with the ERC Director, Andrew Alleyne at the University of Illinois. Mantooth is required by NSF to spend 50% of his time devoted to POETS, indicating the level of commitment and work to be provided by the University of Arkansas in this effort.

The organizational structure of the whole center is illustrated below:



University of Arkansas internal center organization is illustrated below:



Identification of faculty (or qualifications of type of faculty), other personnel, and academic units that will be involved with the Center.

While the center involves an interdisciplinary team of faculty from University of Illinois, University of Arkansas at Fayetteville, Howard University, and Stanford University, The University of Arkansas at Fayetteville is contributing a significant amount of faculty and staff effort to the POETS Center because the amount of work expected. The UA POETS Center will be led by Alan Mantooth, Distinguished Professor of Electrical Engineering. Department Head and Professor, Juan C. Balda with the Electrical Engineering Department will lead all Center activities for Testbeds 2 and 3. Additionally, the Center includes Distinguished Professor Gregory Salamo from the Department of Physics; Professor Simon Ang, Professor Morgan Ware, and Research Assistant Professor Michael Glover from the Electrical Engineering Department. Mr. Chris Farnell the NCREPT Test Facility Engineer will participate in the development and implementation of testbed activities for the POETS center. Dr. Shannon G. Davis will serve as the UA lead in developing and coordinating education activities for POETS. In addition, four new faculty will be hired during the first five years of the center. The first is currently being recruited, and the other three will be hired in the next few years.

Student involvement, if any

Graduate students, both Masters and PhDs along with undergraduate students from the Physics, Electrical and Mechanical Engineering fields will be working on the research projects associated with POETS. POETS will develop a new kind of engineer, trained in new ways due to their involvement in this unique research. Students are already involved in approximately 15 research projects and they share those projects with each other to receive feedback from faculty and peers on a regular basis. The POETS Center will also run a Research Experiences for Undergraduates (REU) program and some of those

students will join UA during each summer as well as a Research Experiences for Teachers (RET) program for 2 teachers each summer to join UA faculty and students in the laboratory. This will contribute to their own journey of learning to be passed on to their students in the public school setting.

Annual budget for the Unit or the estimated expenditures per year.
Estimated fiscal resources and potential sources of funding (e.g., state, private, endowment, grant, contract, or other).

POETS has an annual budget as follows: $650,000 for year 1, $700,000 for year 2, $750,000 for year 3, $800,000 for years 4 and 5. This funding is a combined total of federal funds from the National Science Foundation and match from the University of Arkansas at Fayetteville.

Space and equipment needs of the Center and a description of how they will be met.
While each university will contribute space to the Center for research purposes, the UA Center will be housed at the University of Arkansas' Cato Springs Research Center. Existing facilities located at the Engineering Research Center, the High Density Electronics Center and the Institute for Nanoscience and Engineering, will be major elements needed to complete the work for the POETS Center. In addition to faculty labs, center work will be performed in the National Center for Reliable Electric Power Transmission (NCREPT).

Description of administrative control and lines of authority for the Center. Description of administrative control and lines of authority for the Center.
The Center will follow the campus policy and procedures of the University of Arkansas. The center reports to the Head of the Department of Electrical Engineering, who then reports to the Dean of the College of Engineering. The Dean reports to the Provost and the Provost reports to the Chancellor of the University.

Description of the advisory board including its size, the method of its selection, and length of terms
The UA POETS Center will not have its own Advisory Board, but will be under the Industrial Advisory Board for the four-university center. The Industrial Advisory Board (IAB) is currently recruiting industrial members which are relevant to the research activities. It is yet undefined how many companies will reside on the IAB. There is no upward limit on the number of companies that can join the center. The IAB will be led by a Chair and a Vice-Chair. Each year the IAB will elect a Vice-Chair, who will serve in that position for one year. In the following year, the Vice-Chair will become the Chair and a new Vice-Chair will be elected. The IAB will be responsible for selecting projects for funding (based on projects proposed by faculty), reviewing progress of ongoing projects, and providing direction to researchers on future projects.

The metrics to be used to evaluate the Center's feasibility at its five-year review.

The metrics reviewed at the five-year mark used to evaluate center success are:

1. Center has been renewed by NSF
2. Technical milestones according published roadmap have been met
3. Cross-institutional collaborations on educational initiatives have been instituted
4. Entrepreneurship training for students has been developed
5. REU/RET programs in place and running each summer
6. Publications
7. ~15 Industry members in the center