COLLEGE OF ENGINEERING
Mechanical, Industrial and Nuclear Engineering

SUMMER RESEARCH OPPORTUNITIES
FOR UNDERGRADUATE WOMEN

APPLICATION DEADLINE: MARCH 1, 2005

The Department of Mechanical, Industrial and Nuclear Engineering is pleased to offer the following research project for the summer of 2005. Interested students are urged to contact the faculty member(s) directing the project that most interests them. By contacting the faculty member, you can discover more about the project, learn what your responsibilities will be and if possible, develop a timetable for the twelve-week research period.

<u>**Computational Nuclear Engineering Applications to Minor Actinide Recycling**</u>
Professor G. Ivan Maldonado
Engineering: M.I.N.E. RHODES HALL 588   (513)556-0412
FAX: (513)556-3390
E-Mail: Ivan.Maldonado@uc.edu

The US Department of Energy (DOE) Secretary Spencer Abraham announced on December 23, 2004, that a proposal submitted by Dr. G. Ivan Maldonado, UC Associate Professor in the Department of Mechanical, Industrial and Nuclear Engineering (MINE), is among the research projects at U.S. universities that will receive funding from the DOE. Under the Nuclear Energy Research Initiative (NERI) organizational infrastructure, students and professors are being engaged in the DOE's major nuclear energy research and development programs, including the Advanced Fuel Cycle Initiative, the Generation IV Nuclear Energy Systems Initiative and the Nuclear Hydrogen Initiative.

Entitled "BWR (Boiling Water Reactor) Assembly Optimization for Minor Actinide Recycling," Maldonado's $400K, 3-year proposal is one of 35 projects totaling $21M selected for funding from 160 peer-reviewed proposals from United States universities. Maldonado, whose areas of interest are Computational Reactor Physics and Nuclear Fuel Management, explains that the primary objective of this project is to apply and extend the latest advancements in light water reactor (LWR) fuel management optimization to design advanced boiling water reactor fuel assemblies for the recycling of minor actinides.

According to Maldonado, high-level nuclear waste contains certain elements heavier than uranium known as "minor actinides" such as neptunium, americium and curium, whose isotopes can have extremely long half-lives and can be largely responsible for the heat generated as radioactive nuclear waste decays. Therefore, it is believed that selective (and substantial) elimination of minor actinides extracted from spent nuclear fuel could promote significant reductions in the magnitude and duration of the toxicity and heat load of high level waste (HLW), key design parameters that define the overall capacity of a HLW repository.

Maldonado's research is not experimental in nature, it involves computational nuclear engineering simulations to design advanced BWR fuel assemblies with minor actinide loadings (presumably extracted from high level nuclear waste) in either target or blended form. The project will employ and develop optimization algorithms to maximize the transmutation rates of specific minor actinide isotopic inventories in BWR assemblies. Large-scale computational platforms such as

the 22-node Beowulf Cluster Maldonado recently assembled will prove to be invaluable to help achieve the goals of this project.

Opportunity for WISE-REWU Undergraduate Researchers

The above-described project will involve Prof. Maldonado, a post-doctoral researcher, and several graduate students in the UC Nuclear and Radiological Engineering Program for the next 3 years. Additionally, each summer, the project has explicit goals to help introduce and mentor one undergraduate researcher into areas of computational nuclear engineering that support the project. Accordingly, this opportunity is being extended to WISE-REWU applicants. Interested students are encouraged to contact Dr. Maldonado, because the details of a 12-week REWU project will depend on a student's specific background. The main skills targeted for development revolve around computational modeling of commercial nuclear reactor fuel. Stronger candidates will likely have some familiarity with programming languages (F90, C++, etc.), Unix/Linux OS, and/or a background as a user of some large-scale (canned) computer software. Students in the MNE-ACCEND combined (BS Mechanical + MS Nuclear Engineering) degree program are especially encouraged to apply.