U.S. DEPARTMENT OF ENERGY

Rickover Fellowship Program

In Nuclear Engineering

Student Deadline for Applications for 2020-2021
January 31, 2020

Awards Announced April 2020

PREPARED FOR
U.S. DEPARTMENT OF ENERGY, NAVAL REACTORS DIVISION
BY
NAVAL NUCLEAR LABORATORY

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AN INTRODUCTION TO THE RICKOVER FELLOWSHIP PROGRAM IN NUCLEAR ENGINEERING

This program is designed to meet the needs of the Naval Reactors Division of the U.S. Department of Energy (DOE) for appropriately trained personnel for the maintenance and development of science and engineering technology as it pertains to naval nuclear propulsion. The program will assist in preparing students for roles in naval nuclear propulsion and will support the broader objective of advancing fission energy development through the research efforts of the fellows. The technical areas with greatest interest include reactor physics, nuclear materials science and engineering, radiation shielding technology, thermal hydraulics, computational fluid dynamics, and acoustic technology. The principle emphasis is on students seeking doctoral degrees in nuclear engineering, or in closely related fields.

PROGRAM BENEFITS

Fellows receive a monthly stipend in the amount of $2,900. The fellow's basic stipend is augmented by an additional $700 (prorated) dislocation allowance each month during a practicum. Stipends are mailed each month directly to the fellow or deposited directly into the fellow's bank account.

The program sponsor attempts to provide adequate funding to fellows for meeting the costs of graduate school. No other student support that requires work or any other obligation such as teaching or research assistantship can be accepted without the direct consent of the University of South Carolina Aiken (USCA), Special Programs, Charleston Office. Other awards, prizes, and similar type payments (including veteran's benefits) that do not require a service may be accepted without a reduction in the stipend. Please contact the USCA Special Programs, Charleston Office if you have a question regarding accepting the Rickover Fellowship in conjunction with any other award, prize, or similar type payment.

TUITION AND FEES

The fellow's required tuition and fees are paid by USCA directly to the participating university upon receipt of invoice. Optional, refundable, and penalty fees (such as late registration and duplication fees) are not payable by USCA. Health insurance fees will be paid only if they are certified to be required for all graduate students at the fellow's university. All tuition and fee charges must be certified to be consistent with those made to regular graduate students and necessary for enrollment into the graduate program.

In August of each year, the USCA Special Programs, Charleston Office notifies the bursar's office at each university regarding invoicing procedures for fellowship students. Students will receive a copy of this correspondence and should retain this copy for use in discussing any billing errors with their university's bursar office.

PRACTICUM

Travel expenses will be reimbursed for the fellow to travel to/from the practicum site providing that the distance is more than 50 miles one way from the fellow's university. It is the fellow's responsibility to find the least expensive mode of travel. No expenses are paid for food or lodging at the practicum site. All travel must be authorized in advance by the USCA Special Programs, Charleston Office and the sponsor and must be U.S. General Services Administration (GSA)-compliant.

CONFERENCE TRAVEL

In general, travel reimbursements are considered for seminars, conferences, and workshops associated with this program or any meeting for which the Rickover Fellowship Program requests attendance. Depending on availability of funds, full reimbursement for conference travel may be approved when the student is presenting a paper or poster. In other cases, partial or full reimbursement may be provided. Fellows should submit a Travel Request Form at least 30 days before the anticipated travel dates. All travel must be authorized in advance by the USCA Special Programs, Charleston Office and the sponsor and must be GSA-compliant.

STUDENT ASSISTANCE AWARDS

All Rickover fellows have the opportunity to apply for student assistance awards. These awards may be used for the purchase of laboratory equipment, instrumentation, software, computer hardware etc. They are restricted to one grant for a maximum of $10,000 per Rickover fellow. All student assistance awards must receive a 100% cost share from the university. Applications for student assistance must be requested through USCA, Special Programs, Charleston Office. The approval of the awards is contingent on need and relevance to the research of the Rickover fellow.

APPOINTMENT OF LABORATORY ADVISOR TO THE RICKOVER FELLOW'S COMMITTEE

It is expected that every effort will be made to appoint the Rickover fellow's advisor from the Naval Nuclear Laboratory to the Rickover fellow's Graduate Committee. The fellow's host university will arrange this appointment and the fellowship program administrators will assist to ensure that this appointment is finalized. Opportunities may be provided to faculty advisors to interact with the fellow's sponsoring laboratory. This may include short-term visits to the sponsoring laboratory.

QUALIFIED ACADEMIC AREAS

Rickover fellows must be enrolled in an academic course of study and pursue research applicable to the science and engineering programs for the Rickover Fellowship Program in Nuclear Engineering. A fellow's academic program must be structured so that it supports one of the following research areas, or a closely related area of study:

REACTOR PHYSICS

- Research on data for modeling nuclear phenomena including their improvement and assessment against worldwide experiments
- Development of advanced Monte Carlo techniques to solve the neutron transport equation for complex material arrangements in three-dimensional geometries using novel variance reduction procedures
- Improvements in methods using the diffusion approximation for calculating core neutronic behavior with burn up in the design of reactors
- Development and application of accurate and efficient deterministic methods for solution of the neutron transport equation for realistic, three-dimensional reactor core geometries.
- Investigation of procedures with improved accuracy and efficiency for evaluation of important reactor design parameters
- Development of advanced experimental techniques (e.g. measurement of sub-criticality, determination of fissile content in spent fuel)
- Development of advanced or innovative reactor design concepts

THERMAL HYDRAULICS AND COMPUTATIONAL FLUID DYNAMICS

- Measurements and modeling of the characteristics of thin liquid films in two-phase flow
- Measurements and modeling of void fraction, velocity and interfacial area in two- phase flow regimes under a wide range of conditions
- Mechanistic modeling of critical heat flux in the nucleate boiling and departure from nucleate boiling (DNB) regime
- Direct measurement and modeling of wall shear and pressure drop in two-phase flow
- Measurement and modeling of the size of liquid droplets and entrainment rates in annular two-phase flow
- Investigation of the calculational stability of various two-phase flow source terms
- Measurements and modeling of transient two-phase flow
- Development of a single-phase and/or two-phase Computational Fluid Dynamics (CFD) validation, uncertainty quantification and best-estimate plus uncertainty design methods
- Measurement of single-phase and/or two-phase flow field quantities required to validate CFD methods
- Development of new turbulence models for internal, anisotropic flows for application to CFD

MATERIALS SCIENCE

- Performance prediction of nuclear fuels
- Advanced materials for use in neutron environments
- Corrosion in nuclear environments
- Fission product attack of materials
- Instrumentation for in-core measurements
- Fundamental studies of neutron and fission fragment damage to materials
- Computational material science studies

SHIELDING

- Improved parallel efficiency in deterministic transport calculations
- Discontinuous mesh computations for large 3D problems
- Application of Monte Carlo to large scale shielding problems
- Hybrid Monte Carlo/deterministic shielding methods

ACOUSTIC TECHNOLOGY

- Noise source identification, including advanced measurement techniques and advanced signal processing for airborne, fluidborne, and structureborne applications
- Flow-induced noise and vibration, including testing and analysis
- Noise control and reduction, including active and passive noise control, advanced materials and treatments, advanced control systems and isolation device design
- Advanced computational methods, including computational aeroacoustics, fluid-structure interaction and stability, and structural acoustics
- Turbomachinery noise and vibration control including analytical methods, fundamental testing, and noise source identification

THESIS RESEARCH

Rickover fellows must perform their doctoral thesis research in one of the Qualified Academic Areas listed in the previous section, or in a related field with the approval of the USCA, Special Programs, Charleston Office. A Naval Nuclear Laboratory scientific staff member is generally assigned to the fellow's graduate committee by the fellow's university. All thesis topics must be unclassified.

FELLOWSHIP OBLIGATIONS

ENROLLMENT

During the fellowship period, fellows are expected to be registered and enrolled as full-time graduate students and must perform study and research at their university within the objectives of the fellowship program. During the summer, fellows should be at their university involved in full-time research related to the completion of their degrees, be enrolled in classes, or be on practicum assignments. Refer to the Practicum section for a description of these assignments.

TERMS OF APPOINTMENT

Each fellow must agree to the conditions contained in the letter of appointment and Terms of Appointment document including provisions for obtaining and maintaining a security clearance. A fellow must agree that at the end of the fellowship appointment period, he or she will become employed by the company operating the Naval Nuclear Laboratory at either the Bettis Atomic Power Laboratory or Knolls Atomic Power Laboratory. The required employment period will be one year for every two years of fellowship support. Knolls Atomic Power Laboratory is located near Albany, New York and Bettis Atomic Power Laboratory is located near Pittsburgh, Pennsylvania.

ANNUAL RENEWAL OF FELLOWSHIP

Each fellowship appointment is renewed annually through a renewal application process. Each renewal is based upon the fellow's maintaining excellent performance and professionalism including, but not limited to, passing examinations in pursuit of a doctoral degree required by their academic department, progressing research toward completion of a doctorate degree, and otherwise maintaining eligibility for a doctoral degree (for example, maintaining necessary grade point average and good standing with their academic department and university). Renewal forms along with supporting references and current official transcripts must be submitted to the USCA Special Programs, Charleston Office by January 31st of each year. Obtaining a DOE security clearance is required prior to renewal. Fellows must inform the USCA Special Programs, Charleston Office of their current addresses and must complete any evaluation/assessment questionnaires for Fellowship information and/or evaluation.

SECURITY CLEARANCE

At the beginning of the fellowship appointment, all Rickover fellows will be required to complete applications for an "L" clearance with the DOE. This clearance will allow the Rickover fellow to interact more freely with Naval Nuclear Laboratory engineering and scientific staff and to become a part of the Naval Reactors nuclear propulsion community. In most cases, it will take approximately six months for a Rickover fellow to receive clearance. If clearance is not granted within one year of application or if the fellow is notified that clearance processing cannot be completed, fellowship support may be discontinued prior to the end of the current appointment year. No renewal appointments will be granted to Rickover fellows who are not able to obtain a security clearance. It is expected that fellows will maintain their security clearance for the duration of their appointment.

PRACTICUM

Rickover fellows are required to participate in at least two practica for at least three months each at a Naval Nuclear Laboratory site to gain applied experience. As described above, a DOE security clearance must be obtained prior to the first practicum and maintained throughout the duration of the fellowship. The first practicum is normally held during the summer at the end of the first year of the fellowship. The practicum will be performed at the same location as the fellows agreed upon Naval Nuclear Laboratory site of employment as noted in the appointment letter. Naval Nuclear Laboratory individuals who should be contacted regarding practicum assignments are listed at the end of this booklet. Prior internships or similar appointments to DOE facilities may NOT be substituted for the practicum requirement associated with this fellowship.

In addition, a required a physical exam, including drug screening, will be conducted at the Laboratory where the practicum will be performed. Travel expenses for travel to complete the physical exam will be reimbursed.

REQUIRED APPROVALS OF RESEARCH INFORMATION

Research sponsored by the Rickover Fellowship Program in Nuclear Engineering can be published after appropriate review and approval. Each Fellow is required to keep a notebook describing accomplishments made at school and while on practicum assignment at one of the two Naval Nuclear Laboratory sites. The notebook's content will be reviewed and approved at the Laboratory. External public releases such as, but not limited to, journal publications, conference proceedings/posters, and thesis documents are coordinated through the Laboratory advisor. Each Fellow will work with their Laboratory advisor to submit information for formal review and approval no less than 25 working days prior to the required date of submission (e.g., conference submission deadline, defense date, or submission for graduation). The Laboratory advisor will assist the Fellow in obtaining required approvals.

PUBLICATION ACKNOWLEDGMENT

DOE and USCA encourage fellows to publish reports and articles in scientific and engineering journals. All publications must receive prior approval from the program administrators and must show the joint affiliation of the fellow with the university and, if appropriate, with the laboratory in which the research was conducted, and should acknowledge fellowship support. Fellowship support should be acknowledged in the following manner:

> *This research was performed under appointment to the Rickover Fellowship Program in Nuclear Engineering sponsored by Naval Reactors Division of the U.S. Department of Energy.*

APPLICATION PROCEDURES

ELIGIBILITY

Students with undergraduate degrees in the physical sciences or engineering are eligible to apply for the Rickover Fellowship Program in Nuclear Engineering. The program is open to all individuals who will be starting graduate studies or graduate students who are currently enrolled in a qualified course of study (see Qualified Academic Areas). The award is limited to 48 months maximum for doctoral candidates. Awards may be limited to less time than the maximum in some situations.

Applicants must be U.S. citizens. If any applicant is a dual citizen, the applicant is required to renounce their non-US citizenship in order to be interviewed as a finalist, and ultimately to accept the Fellowship award. Applicants must be capable of obtaining a security clearance from the DOE. If a clearance is not granted in a timely manner, the fellow will not be allowed to continue in the program. Employees of the DOE Naval Reactor Programs and their prime contractors are not eligible for the Rickover Fellowship Program in Nuclear Engineering. Title VII of the Civil Rights Act of 1964, as amended, prohibits discrimination in hiring, promotion, discharge pay, fringe benefits, job training, classification, referral, and other aspects of employment, on the basis of race, color, religion, sex or national origin.

APPLICATION DEADLINE

Application forms will be available from November through the end of January. Applications from previous years or from other fellowship programs may not be used. Completed applications will be accepted through January 31st for fellowships beginning the following September. An application consists of the following sections:

> Student application (includes background information, statement of academic and career goals, and lists of courses)
> References (3 required)
> Transcripts (official undergraduate and graduate transcripts sent directly from university registrar)
> GRE scores (scores must be sent directly from ETS using GRE code 5949, test scores dated before 2010 will not be accepted)
> Authorization for Release of Information Form

Application forms are located at the SCUREF website at www.scuref.org and applicants should submit all materials electronically through this site. If you are unable to submit the application electronically, please contact Nicole Huchet at nicoleh@usca.edu, (843) 793-1079 so alternatives can be discussed.

Transcripts should be sent directly from the university registrar by fax, mail, or email to:
USCA, Special Programs, Charleston Office
125 Building A Wappoo Creek Drive, Suite 201
Charleston, South Carolina 29412
843-647-7741 fax
nicoleh@usca.edu

Please Note: All parts of the application must be received at USCA Special Programs, Charleston Office by January 31st. GRE scores are required for a complete application. *Late and/or incomplete applications will not be considered for awards.*

EVALUATION OF APPLICATIONS

When an application is received, the staff at the USCA Special Programs, Charleston Office reviews the application to ensure that the applicant meets the basic criteria and has submitted all required application materials. If time permits, the staff will attempt to contact applicants who have submitted an incomplete application. However, it is the applicant's responsibility to check with the USCA Special Programs, Charleston Office to ensure that an application is complete.

After an application is checked and designated complete, it is submitted, along with all other complete applications, to the fellowship committee for review. The fellowship committee is composed of Naval Nuclear Laboratory personnel who are directly responsible for analysis and research in nuclear science and engineering areas applicable to the Naval Reactors program. The committee reviews each application and selects finalists, who are then invited for in-person interviews. The fellowship committee will subsequently select award recipients. Applications are reviewed on the basis of grades, GRE scores, career and goals statements, areas of research intent, references, and skill needs of the Naval Nuclear Laboratory sites.

The number of awards given each year is dependent on the available funding and the qualifications of the candidates. Some applicants who do not receive awards are selected for "Honorable Mention" status. This status recognizes their achievements and may be used in the listing of academic and career accomplishments.

USCA will notify applicants of their award status. Notification usually occurs in April of each year. Once fellowships are awarded, the USCA Special Programs, Charleston Office handles the administration of the fellowship for the Naval Reactors Program. Questions about stipends, payment of tuition and fees, practicum assignments, travel, etc. should be referred to the USCA Special Programs, Charleston Office. Shortly after acceptance of the appointment, an advisor from the Naval Nuclear Laboratory will contact the fellowship recipient. This advisor is tasked to aid the recipient in selecting a research topic, and, as previously mentioned, will be assigned to the fellow's graduate committee.

RICKOVER FELLOWSHIP PRACTICUM LABORATORIES

KNOLLS ATOMIC POWER LABORATORY	BETTIS ATOMIC POWER LABORATORY
www.knollslab.com	www.bettislab.com
KNOLLS ATOMIC POWER LABORATORY P.O. Box 1072 Schenectady, NY 12301-1072	BETTIS ATOMIC POWER LABORATORY P.O. Box 79 West Mifflin, PA 15122

RICKOVER FELLOWSHIP COMMITTEE

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