GRADUATE PROGRAM HANDBOOK

Department of Mechanical and Nuclear Engineering

The Pennsylvania State University

Nuclear Engineering Graduate Student Handbook

Academic Year 2017-2018

PennState College of Engineering | MECHANICAL AND NUCLEAR ENGINEERING

2017-2018 GRADUATE STUDENT HANDBOOK

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Introduction

Welcome to the Nuclear Engineering Program at Penn State. We hope your experience with us will be a very valuable and rewarding one, and will contribute to your personal and professional development. Nuclear Engineering is a challenging and rewarding major, and in your graduate research and course work you will likely have to combine knowledge from many different disciplines to achieve your goals. The faculty members are well prepared to assist you, and you will have the advantage of the experimental and computational facilities in the program, especially the Radiation Science and Engineering Center and the Breazeale Nuclear Reactor. Finally, as a high-quality research university, Penn State has many resources outside the program and the department that can serve to your benefit. We encourage you to seek out these opportunities to take full advantage of your time at Penn State.

Most of you will be faced with new situations involving changes in housing, lifestyle, community, faculty, student body and academic policies. In some cases, it will represent a complete change in culture and language. We will try to help you to get through this time of transition. The staff has experience in helping with many academic issues such as registration, locating a desk, computer policies and financial aid. Also, the continuing graduate students are a very useful source of information about the community and the University. We have prepared this handbook to help deal with some of these issues. It includes detailed information about policies, and about the Radiation Science and Engineering Center. It also contains a brief discussion of our faculty and their interests. We urge you to review this document carefully and keep it available for reference.

Nuclear Engineering may be taken as a major field of study for the Master of Science (thesis or paper), the Master of Engineering, or the Doctor of Philosophy degree. New students should go to the Nuclear Engineering Graduate Staff Assistant, in 127 Reber Building, for the assignment of an academic advisor. Your advisor will assist you in the development of your program of study. Each student's program of study will be tailored with regard to their particular interest. Initially, your academic advisor may or may not be your research advisor depending on your research area of interest. Generally your research advisor takes over as the academic advisor when your research activity is determined. It is now a requirement that you complete a plan of study with your academic advisor during your first month of enrollment, covering your whole course of study. This program of study will be kept on file and can be changed with the approval of your advisor. To assure that you can meet with your advisor and discuss your academic program, please make an appointment prior to the desired meeting time.

Students enroll in classes with LionPATH, http://launch.lionpath.psu.edu/node/2 is the student information system. Any questions concerning registration procedures, dates and schedules can be directed to the Graduate Staff Assistant. Your registration should always be in consultation with your advisor. For issues dealing with office keys, contact the Business Office in 132 Reber Building. An office area and desk can be assigned for your use if you wish and if one is available. See the Graduate Staff Assistant in 127 Reber Building during the third week of the semester for their location.

Completion of a graduate degree program inevitably involves far more work near the end of the program than is anticipated. As a consequence, many students are unduly rushed just prior to their graduation to complete their scholarly paper, thesis, or M. Eng. paper. A student may have to delay graduation if there is not sufficient time for review and defense of the thesis, paper, or M. Eng. paper. Your advisor and the Program Chair must receive a copy of your paper or thesis at least one week (two weeks is better) before it is due in the Graduate School (Kern Building).

We would like to call your attention to the bulletin boards that are maintained in Reber Building and in the main hallway at the Reactor. Please scan the bulletin boards occasionally for announcements of importance to you, such as seminars, course offerings, and social events. You are assigned a mailbox

located in 127 Reber which will serve as your contact point for mail, notices and other information periodically distributed. This is one of our main communication routes to you; check it when you pass through. Our other main way to contact you is via e-mail. You are assigned an e-mail address when you join Penn State. Please check it often.

All graduate students in the Nuclear Engineering Program are required to participate in the seminar program, NucE 590 Colloquium, which includes seminars by graduate students, faculty and outside speakers. These seminars form an important part of your program and will provide you with instruction not only by your fellow students and our faculty, but also by prominent people in the nuclear engineering field.

A word about our local chapter of the American Nuclear Society (ANS) is appropriate here. Our student chapter is a focal point of professional and social activity for students and faculty in Nuclear Engineering. The ANS organizes seminars, conducts field trips under Nuclear Engineering Program auspices, conducts public information programs, and provides services to the Program and undergraduate and graduate students. I strongly recommend that you consider joining the chapter and actively support it. For more information, visit: http://php.scripts.psu.edu/clubs/up/ans/index.php or contact Dr. Marek Flaska mxf5309@psu.edu . Likewise, I draw your attention to the Graduate Student Association (GSA), http://gpsa.psu.edu/ and recommend your consideration and participation in its activities.

If you have any questions or problems, please see your academic advisor. In addition, the MNE Graduate Program Office will be glad to assist you on any matter. Please make an appointment with my assistant, in 138 Reber Building. I would also be glad to meet with you to discuss any issues. Again, welcome to Penn State.

Dr. Arthur Motta

Professor and Chair of Nuclear Engineering

Academic Procedures for Graduate Students

GRADING SYSTEM

Grades shall be assigned to individual students on the basis of the instructor's judgment of the student's scholastic achievement using the grading system below.

Undergraduate and Graduate Grading System

Quality of Performance		Grade	Grade Point Equivalent
Excellent	Exceptional Achievement	A	4.00
		A-	3.67
Good	Extensive Achievement	B+	3.33
		B	3.00
		B-	2.67
		C+	2.33
Satisfactory	Acceptable Achievement	C	2.00
	(Does not count for Graduate Study)	D	1.00
Failure	Inadequate Achievement	F	0.00
	(To secure credit, course must be repeated.)		

A minimum grade-point average of 3.00 for work done at the University is required for graduation.

UNSATISFACTORY SCHOLARSHIP

A graduate student who fails to maintain satisfactory scholarship or to make acceptable progress in a degree program may be dropped from the University. One or more failing grades or a cumulative grade-point average below 3.00 for any semester or session or combination of semesters and/or sessions may be considered as evidence of failure to maintain satisfactory scholarship. Action may be initiated by the department or committee in charge of the graduate major or by the chair of the student's committee.

DEADLINES

It is the responsibility of the student working with his/ her advisor and committee to ensure that all deadlines established by the Graduate School are met. (http://www.gradschool.psu.edu/calendars/important-dates/). Extensions should not be expected, and are granted by the Graduate School only under exceptional circumstances**.**

MINORS

Many MNE students take graduate – level minors in other programs, or in special areas. It is the student's responsibility to make sure, that all requirements are met. **Ph.D. students must inform the Graduate School of their intent to take a graduate – level minor before taking their comprehensive exam.** Minors must be requested in conjunction with the establishment of PhD committees or prior to the semester of graduation for Master's students. The Graduate School will decline late requests, as the intent is that a minor should be an integral part of the student's graduate program, not an afterthought.

COURSE LOAD

Full-time students and students receiving fellowships should register for 9-12 credits per semester. All students (US and international) receiving assistantships should register for the following:

Appointment	Fall/Spring	Summer
1/4-time assistantship	9-14 credits/semester	5-7 credits
1/2-time assistantship	9-12 credits	4-6 credits
3/4-time assistantship	6-8 credits	3-5 credits

MS students are not required to register for course work or research once the course requirements have been met, although international students may need to register for courses in order to maintain their visa status. The Graduate School requires that all students receive a cumulative grade point average of 3.0 or better to graduate. After passing the comprehensive exam, all Ph.D. students must maintain "continuous registration," which requires them to register for NUCE 601 (Ph.D. Thesis Preparation) for the Fall and Spring semesters. If Ph.D. students plan to take their oral or comprehensive exams during the Summer Session, they must be registered. Also, Ph.D. students must spend at least two semesters over some 12-month period during the interval between admission to candidacy and completion of the Ph.D. program as a registered full-time student. For full details, see the Graduate Degree Programs Bulletin website at http://bulletins.psu.edu/bulletins/whitebook/index.cfm .

DROPPING/ADDING/AUDITING COURSES

DROPPING and ADDING COURSES

If you are considering adding or dropping a course, there are many factors you will want to consider:

- Is there still time to drop or add a course?
- Will dropping a course affect my progress towards my degree?
- Will a change in my course schedule have financial implications?
- If an international student, will a change in my course schedule have an impact on my visa status?

Remember, international graduate students must be registered full-time or for at least 9 credits in order to maintain their visa status during fall and spring semesters.

Penn State University maintains three periods relating to course drops: the pre-semester period, the add-drop period, and the late drop period.

1. The **pre-semester period** begins on the first day of scheduling and ends the day before the semester starts. While exceptional circumstances may necessitate the need to process schedule changes after classes begin, students are encouraged to finalize all schedule changes prior to the first day of the semester.

2. The **regular drop/add period** begins the day that your courses start, and is when dropping a course can be made without receiving a drop/add fee. Dropping a course during this time means that:
   - Length of drop period is ten days during fall/spring for full-semester courses and is a calculated proportional length for all other courses (see Registrar's Academic Calendar http://registrar.psu.edu/academic_calendar/calendar_index.cfm
   - No signature(s) required.
   - **No fee**

3. A student can drop a course with certain restrictions and requirements. They are: **late drop period** starts the day after the regular drop period and before the late drop deadline,

- No signature(s) required
- A fee for each transaction
- Courses are recorded on the student record

Changing your overall number of credits after your course begins can have financial implications. Before making any registration changes consult with your academic adviser.

- When you are a full-time student and drop below full-time status, your overall number of credits changes. This can impact the tuition, fees, student aid, and refunds applied to your bursar account. Additionally, during the late drop period, the University assesses processing fee for any course dropped or added. The tuition adjustment is determined by the effective date of the drop and is made according to Penn State's Tuition Adjustment Schedule. Visit the Tuition Adjustment Policy at: http://www.bursar.psu.edu/adjustments.cfm . If you are a full-time graduate student (i.e., 9 or more credits) who drops a course but still remains at full-time status, you will not incur the same impacts on your bursar account, as the tuition rate is flat once full-time enrollment is reached.
- You will also want to investigate whether you are meeting the "Satisfactory Academic Progress" standards for federal financial aid programs when considering a course drop. Details about satisfactory academic progress is available at the http://studentaid.psu.edu/ website.
- During the pre-semester period, you can add and drop courses as many times as needed to create a suitable schedule without the same financial implications. Please be mindful to check your tuition bill for updates if you make changes to your schedule (especially adding credits) after you have already paid your tuition bill.

AUDITING COURSES

Courses taken formally as audit are not included in the maximum number of credits required for assistantships or for satisfying visa requirements for international students. **The request to audit a course must be done within the regular drop add period**. The adding of an audited course after the regular drop/add period is not permitted. Courses cannot be changed to an audit after the semester has begun. Requests to take a course for audit must be made to the program that offers the course.

TRANSFER OF CREDITS

Transfer of Credit from an External Institution

- A maximum of ten (10) credits of high-quality graduate work done at a regionally accredited institution or recognized degree-granting institution may be applied toward the requirements for a master's degree. However, credits earned to complete a previous master's degree, whether at Penn State or elsewhere, may not be applied to a second master's or doctoral degree at Penn State. Credit transfers are not allowed for the Ph.D. degree.
- Approval to apply any transferred credits toward a degree program must be granted by the program head or graduate officer, and the Graduate School.
- Transfer credits must meet the following criteria:

    - o Must have been earned at a regionally accredited institution or a recognized degree-granting institution;
    - o Must be of "A" or "B" grade value ("B-" grades are not acceptable; pass-fail grades are not transferable unless substantiated by the former institution as having at least "B" quality);
    - o Must appear on an official graduate transcript;
    - o Must be earned within the five years prior to the date of registration to a degree program at Penn State.

Forms for transfer of credit may be found at http://gradschool.psu.edu/current-students/

Transfer of Nondegree Graduate Credits

Approval to apply nondegree graduate credits toward a degree program must be granted by the program head or graduate officer, and the Graduate School. A maximum of 15 credits earned at PSU as a nondegree student may be applied to a degree program.

- The credits must have been earned within five years preceding entry into the degree program. Requests to transfer graduate work taken more than five years prior to admission into a graduate degree program must be accompanied by a letter justifying the validity of the course work.
- Only 400, 500 and 800-level graduate courses may be transferred.
- Any courses taken by a graduate student in non-degree status that are not transferred into the degree program (as requested by the student and approved by the graduate program) will be coded as "credits not applied toward the degree" (NDC) and, therefore, will not count in the total credits earned towards the degree and the degree grade-point average. (Revised by Graduate Council, December 2010; implemented, Fall 2011.)
- Only A, B, and C grades will be transferred. D and F grades will be marked "NDC."

Forms for transfer of credit may be obtained from the graduate program.

Courses

Graduate courses carry numbers from 500 to 599 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level will not count. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

Both Masters programs (M.Sc. and M.Eng.) require that a student take NucE450 (Radiation Detection and Measurement) and NucE403 (Advanced Reactor Design). Students with a BSc. in Nuclear Engineering may be excused from these courses. In addition a total of 24 course credits are required for the M.Sc. degree, 12 of which must be at the 500-level and 12 of which must be in Nuclear Engineering. A total of 27 course credits are required for the M.Eng. with the same restrictions regarding 500-level and Nuclear Engineering courses.

A **Nuclear Security Option** is available for the M.Sc. and M.Eng. students who take a required suite of five courses (NucE441, NucE442, NucE542, NucE543, NucE544) and fulfill all other requirements of the degree.

NUC E 590, (colloquium) for Nuclear Engineering students.

This course includes seminars by graduate students, faculty and outside speakers. These seminars form an important part of the program and provide instruction not only by students and faculty but also by prominent people in the nuclear engineering field.

- All Nuclear Engineering students registered at a full time level are required to schedule colloquium, during the Fall and Spring Semesters.
- Credits earned from this course do not count towards the 30 credits required for graduation with an MS of MENG degree.

• Student who are registered at a level less than full time, (9 credits) or during the summer semester are not required to enroll in NUC E 590.
• PhD students who successfully complete the comprehensive exam are then excused from the NUCE 590 registration requirement.

Requests for exceptions to the registration requirements listed above can be made to the Chair of the Nuclear Engineering Program and are evaluated on a case by case basis.

NUCE 596, 600 (610), 601 (611)

Graduate students registering for these courses must first consult with their advisor (or the instructor if different from advisor) to insure that they are registering for the appropriate course. Failure to select the correct course may require the student to pay "retroactive drop/add fees" and perhaps additional course-credit fees. The MNE Graduate Programs staff can also assist graduate students in registering for the appropriate course.

NUCE 596 - INDIVIDUAL STUDIES "Paper Research" - Creative projects, including non-thesis research, that are supervised on an individual basis and which fall outside the scope of formal courses. NUCE 596 cannot be used for M.S. or Ph.D. thesis research. A minimum of 3 credits of NUCE 596, supervised by the student's advisor is required when submitting a research paper. Achievement of a quality letter grade is required.

NUCE 600 (610 Off Campus) - THESIS RESEARCH - This course should be used to register for M.S. and Ph.D. thesis research. A minimum of 6 credits of NUCE 600, supervised by the student's advisor is required when submitting a thesis. There is no limit on the total number of credits of 600 a student can take. However, there is a maximum number of credits which a student can receive a quality letter grade (A, B, etc.). A student must receive a non-letter grade (R, etc.) for any additional credits of 596/600. The R grade is assigned for satisfactory completion of research (http://bulletins.psu.edu/graduate/academicprocedures/procedures6).

LIMITS ON RESEARCH CREDITS (NUCE 600)

Students registering for 600 or 610 should be aware that Graduate Council has established limits on the total number of research credits that can be assigned letter grades in a student's program (i.e., other than R). Students are not permitted to have more graded credits of research than stated by the policy: http://bulletins.psu.edu/graduate/academicprocedures/procedures5

Maximum number of graded credits of NUCE 600

MS only – 6 credits
PhD only – 12 credits
PhD with an "MS along the way" (MS paper or Option C) – 12 credits
PhD with an "MS along the way" (MS thesis) – 18 credits

NUCE 601 (611 Part time) - Ph.D. THESIS PREPARATION – Only Ph.D. students who have passed the comprehensive examination are permitted to enroll in 601. Ph.D. students are eligible for 601 in the semester following their comprehensive exam and have met the two semester residency requirement. Ph.D. students can register for one additional course either for credit or audit (up to 3 credits) when they are registered for ME 601/611. Students who are eligible must contact the MNE Graduate staff to enroll in NUCE 601. Note that NUCE 601 cannot be used to meet the residency requirement.

It is vital that graduate students consult with their advisor prior to each semester's registration to ensure that they are registering for the appropriate courses.

General Administrative Policies

Assistantship Responsibilities

A graduate student on a 1/2-time assistantship is expected to work a minimum of 20 hours per week. These work requirements can include thesis research activities.

All international students who have been offered teaching assistantships and graderships which involve interaction with undergraduate students are required to have passed the American English Oral Communicative Proficiency Test (AEOCPT), as a result of a State law and Penn State Faculty Senate Legislation. This test is administered before the semester begins by the Department of Applied Linguistics (http://aplng.la.psu.edu/programs/about-the-aeocpt). All international graduate students offered teaching assistantships must take and pass this test. Students who are selected for teaching assistantships will be registered for the AEOCPT test directly by the department.

SCORE	REQUIRED COURSE	PROGNOSIS
250-300	**None**	**Student may assume teaching duties with no restrictions.**
200-249	**Enroll in ESL 118G before assuming teaching duties.**	**Students enrolled in ESL 118G must pass the qualifying exit examination, called the Interactive Performance Test (IPT), before they can assume teaching duties with no restrictions.**
150-199	**Enroll in ESL 117G**	**Will require at least two semesters before student is recommended to teach.**
<150	**Enroll in ESL 115G**	**Will require at least three semesters before student is recommended to teach.**

Expenses for Thesis Preparation and Manuscripts

Expenses for thesis preparation, such as typing, word processing, drafting, paper, photocopying, etc., are considered personal expenses and should be paid by the student and not the Program Expenses related to the preparation of required reports or publications based on theses or technical projects are considered legitimate Program expenses. Also, students are encouraged to participate with faculty in the preparation of grant proposals to obtain the necessary support for research activities. Secretarial services will be made available for preparation of reports required for grant research projects.

Office and Key Assignments

MEETING SPACE - Every effort will be made to provide graduate students with a meeting space so they can carry out their responsibilities as teaching assistants. Students on research assistantships will also be provided with a meeting space.

KEYS - Keys are individually numbered and assigned to each person. If a change of assignment results in you no longer needing a key, return the key to the key custodian who assigned it to you (usually in the

MNE Business Office in 132 Reber Building); do not pass it on to another individual. Access to Reber Building is gained by the use of the PSU student ID card.

Purchasing

All purchases of materials, supplies, equipment, or tickets for travel related to Nuclear Engineering Program research and teaching activities, must receive prior approval of the student's advisor.

Use of University Vehicles

University vehicles are for **OFFICIAL USE ONLY**. Operators of University vehicles must abide by all state highway laws. Special courtesy to other drivers should be exercised at all times, since one is representing the Nuclear Engineering Program, the University and the Commonwealth when driving a University vehicle. No passengers are allowed to ride in any of these vehicles unless the passengers are authorized to participate in official business.

A valid Pennsylvania driver's license is required to operate University vehicles, except that operation of vehicles heavier than 30,000 pounds gross requires a Class 2 license. A Class 3 license is required to drive a vehicle towing a trailer more than 10,000 pounds. Caution: Only persons employed by the University are covered by insurance while operating a University owned vehicle. A graduate student on an assistantship meets the employment criterion. Students operating University vehicles should check with their advisor concerning current procedures for signing out vehicles, purchase of fuel, etc.

Health Insurance

Penn State requires medical insurance for all international students, and for all dependents of international students.

Graduate assistants will be placed on the Penn State student insurance plan underwritten by Aetna Student Health. The University will pay 80 percent of the student's premium and the remainder of the premium will be deducted from graduate assistants' paychecks every month from September to May.

Students required to have health insurance may choose coverage other than Aetna Student Health; however, in order to be granted a waiver, alternate plans must meet certain criteria (the guidelines and waiver application are available through the Student Insurance Office, 302 Student Health Center. An application for a waiver must be received by early September each year. Otherwise, enrollment in Aetna Student Health is automatic for graduate assistants. Newly arriving international students without assistantships who do not purchase Aetna Student Health or apply for a waiver by early September will be withdrawn from school.

Additional information can be obtained from their website at:
http://studentaffairs.psu.edu/health/services/insurance/

Reporting Resources

The University does not condone wrongful conduct by any member of the Penn State community, no matter what position he or she may hold.
Thus all members of the University community are urged to speak up if they see or suspect illegal, unethical, or unsafe conduct. If you do so, be assured that the University will protect you from retaliation. See AD67 (https://guru.psu.edu/policies/AD67.html) or contact the Office of Ethics & Compliance for more information (http://www.universityethics.psu.edu/).

The following resources are available for faculty, staff, students, and others:
TO MAKE A REPORT
Crime or emergency situation

- Contact University Police 814-863-1111

- In an emergency, dial **911**

Child abuse, including child sexual abuse

- Contact the Pennsylvania Child Welfare Services "ChildLine" at **800-932-0313** or https://www.compass.state.pa.us/cwis
- If the child is in immediate danger, dial **911** first
- You must also email AD72@psu.edu communicating that a report has been made. For more information on AD72, see https://guru.psu.edu/policies/AD72.html

Behavioral threat

- Contact the Behavioral Threat Management Team at **855-863-BTMT (2868), 814-863-BTMT (2868)**, reportBTMT@psu.edu or http://btmt.psu.edu/

Bias or discrimination

- Contact the Affirmative Action Office at **814-863-0471**
- Visit the Report Bias website: http://equity.psu.edu/reportbias
- Students at University Park should call the Lion Support Help Line at 814-863-2020 to report acts of intolerance
- Students at other campuses may contact their campus Student Affairs office to report acts of intolerance

Sexual harassment and other forms of sexual misconduct

- Contact the Affirmative Action Office at **814-863-0471** or another appropriate office listed here: http://www.psu.edu/dept/aaoffice/sexharass.htm
- Visit the Office of Sexual Misconduct Prevention & Response website at http://titleix.psu.edu to file an online report.
- To file a complaint outside of the University, contact:
  - The Office for Civil Rights (Philadelphia Office) at **215-656-8541** or email OCR.Philadelphia@ed.gov
  - The Equal Employment Opportunity Commission (Philadelphia District Office) at **800-669-4000**
  - The Pennsylvania Human Relations Commission (Harrisburg Regional Office) at **717-787-9780**

Research-related

- Contact the Office for Research Protections at **814-865-1775** or ORProtections@psu.edu

Suspected ethical or policy violations

(including fraud, theft, conflict of interest, retaliation, athletics compliance)

- Use Penn State Ethics and Compliance Hotline at **800-560-1637** or https://psuethicsandcompliance.tnwreports.com/. Both are anonymous and available 24/7

TO ASSIST VICTIMS

Sexual violence, sexual abuse or sexual harassment

- The Penn State Sexual Assault and Relationship Violence Hotline is available 24/7 at **800-560-1637 (TTY 866-714-7177)**
- The Office of Sexual Misconduct Prevention & Response website at http://titleix.psu.edu includes a list of sexual assault resources for each campus location
- The University-wide designated sexual harassment resource person for students, regardless of sex or gender, is the Director of the Center for Women Students at **814-863-2027** or http://studentaffairs.psu.edu/womenscenter/
- The University-wide designated sexual harassment and sexual misconduct resource person for employees is the Vice Provost for Affirmative Action at **814-864-0471**
- For University Park, the Centre County Women's Resource Center Hotline is available 24/7 at **814-234-5050** or **877-234-5050**

All others

- Contact the Center for Counseling and Psychological Services (CAPS) at **814-863-0395** or http://studentaffairs.psu.edu/counseling/
- Contact the Employee Assistance Program at **866-799-2728** or http://ohr.psu.edu/health-matters/employee-assistance-program/

RESOURCES

All employees should be aware of Penn State's Conflict of Interest policy. Please see the following for more information:

- http://news.psu.edu/story/143476/2013/01/04/employees-reminded-disclose-conflicts-interest
- Policy HR91 – Conflict of Interest: https://guru.psu.edu/policies/OHR/hr91.html
- Policy RA20 – Disclosure and Management of Significant Financial Interests: https://guru.psu.edu/policies/RA20.html
- Policy AD86 – Acceptance of Gifts and Entertainment: https://guru.psu.edu/policies/AD86.html

If it is not clear where to turn for assistance, any of these offices will guide the individual to someone who can help:

- Office of Human Resources Employee Relations Division at **814-865-1412** or http://ohr.psu.edu/employee-relations/
- Office of University Ethics and Compliance at **814-867-5088** or http://www.universityethics.psu.edu/
- Office of Affirmative Action and Title IX Coordinator at **814-863-0471** or http://www.psu.edu/dept/aaoffice/
- Office of Student Conduct at **814-863-0342** or http://studentaffairs.psu.edu/conduct
- Office of Internal Audit at **814-865-9596** or http://www.internalaudit.psu.edu/
- Clery Act Compliance Manager at **814-863-7459** or http://www.police.psu.edu/clery/
- Your campus, college, or unit's Human Resources representative. Contact information is available http://ohr.psu.edu/hr-representatives

Other Resources for Graduate Students

Counseling and Psychological Services (CAPS) can help students resolve personal concerns that may interfere with their academic progress, social development, and satisfaction at Penn State. Some of the more common concerns include difficulty with friends, roommates, or family members; depression and anxiety; sexual identity; lack of motivation or difficulty relaxing, concentrating or studying; eating disorders; sexual assault and sexual abuse recovery; and uncertainties about personal values and beliefs. http://studentaffairs.psu.edu/counseling/

Obligations and Responsibilities of Graduate Students

A large number of graduate students are appointed as graduate assistants. They are assigned tasks in teaching, research, or other activities which are educationally significant.

The privileges and benefits as well as the obligations and responsibilities of graduate assistants are:

As a Graduate Student

Privileges and Benefits

1. Eligible for financial assistance (grant-in-aid, tuition waivers and stipend).
2. Eligible for services at the Student Health Center.

3. Eligible for participation in Accident and Sickness Insurance Plan of the Graduate Student Association.
4. Eligible to use Penn State Career Services (http://studentaffairs.psu.edu/career/).
5. Participation in the program of the Graduate Student Association.
6. Eligible to join undergraduate student organizations, except those whose constitutions limit membership to undergraduates.

Obligations and Responsibilities

1. Maintain scholarship satisfactory to department.
2. Make progress in degree program acceptable to department, which includes eighteen weeks of service each semester as a graduate assistant.
3. Assume full responsibility for knowing the regulations and pertinent procedures of the Graduate School.
4. Forego other employment while a graduate assistant as required by the Graduate School.
5. Meet standards of conduct outlined by the Division of Student Affairs – Office of Student Conduct – Code of Conduct for Penn State students. Please go to the following website for details: http://studentaffairs.psu.edu/conduct/codeofconduct/.
6. Register for the appropriate number of courses/credits per semester.
7. Meet standards of the department for behavior in the performance of assigned duties.
8. Exercise the privileges and obligations of academic freedom.

Master of Engineering Degree Program

The Master of Engineering (M.Eng.) degree is a professional master's degree. A minimum of 30 credits at the 400, 500, or 800 level is required. Twelve of those credits must be in Nuclear Engineering with at least 18 credits at the 500 level. There are 6 credits required in the following core courses: NUCE 450 Radiation Detection and Measurement and NUCE 403 Advanced Reactor Design. The two required courses may be waived for students with a B.Sc. in Nuclear Engineering; however, the minimum of 30 credits will still be required. Students must petition the head of the graduate program to review their undergraduate transcripts to assess their eligibility for a waiver. The remaining elective credits may be chosen from a list of approved electives maintained by the program office. The program culminates with a scholarly paper completed while the student is enrolled in NUCE 596 (3 cr.). The scholarly paper must be approved by the adviser, a faculty reader, and the program chair.

Admission Requirements

Completion of an undergraduate degree in Nuclear Engineering or in another related engineering or science discipline is required for admission to the M.Eng. degree program in Nuclear Engineering. Students should have at least a 3.00 (4.00 base) junior-senior average to be considered for admission.

Provisional Admission

Provisional admission (non-degree status) is a temporary classification in which an applicant may remain for a period of no longer than 2 semesters following admission or the time it takes to accrue 15 credits. If the deficiencies that caused the provisional admission are not corrected by this time, the student may be dropped from the program.

Examinations for Admission

Test of English as a Foreign Language (TOEFL). To qualify for admission, an international student must achieve a minimum TOEFL score of 550 on the paper-based test, or a minimum score of 80 on the internet-based test with a minimum of a 19 in the speaking section. This requirement is waived if the student's native tongue is English or if the student received baccalaureate or master's degrees from an institution in which the language of instruction was English.

Graduate Record Examination (GRE). All students must submit scores on the general aptitude tests of the GRE prior to admission consideration.

Program Requirements (MENG)

Each of the following requirements must be met in order for a student to be approved for graduation:

1) A minimum of 30 graduate credits must be earned. Only grades of A, B, and C are accepted for graduate credit.

2) A minimum grade point average (GPA) of 3.00 is required, not counting grades obtained in NucE 596 Individual Studies.

3) At least twelve (12) 400- or 500-level course credits must be taken as NucE courses. A minimum of six credits must be NucE 500-level courses.

4) At least eighteen (18) of the 30 required credits must be in 500-level courses. This includes NucE 596 as well as any 500-level NucE courses taken to satisfy requirement #3 above. A letter grade must be assigned in NUCE 596. NUCE 600 cannot be used as a substitute to meet this requirement.

5) Specific course requirements

For students with a BS in Nuclear Engineering, (some of) these requirements may have already been satisfied. Please consult with your advisor for verification.

NUCE 301 (Fall only) *Fundamentals of Reactor Physics* **and NUCE 302 (Spring only)** *Introduction to Reactor Design*. Students can take NucE 497 *Fundamentals of Nuclear Engineering*, a three-credit reactor theory course, which is considered an acceptable substitute for NucE 301 and 302.

NUCE 403 *Advanced Reactor Design.* Students who have not had reactor theory must take this course.

NUCE 450 *Radiation Detection and Measurement*. NucE 497 *Radiation Detection Lab* offered biannually in a short course format is considered an acceptable substitute for NucE 450.

6) Candidate writes a paper on a topic mutually agreed upon by the advisor suitable for publication in a professional journal or presentation at a national or international conference. Students must take three (3) credits of NUCE 596 - Individual Studies in Nuclear Engineering representing formal recognition of the student's effort spent on writing a paper on an engineering subject. A quality letter grade in NUCE 596 is required. ME 600 does not count towards the requirements for the paper option.

Submission of the final paper must include approval of student's advisor, a faculty reader who is a current member of the Nuclear Engineering Graduate Faculty, and the Program Chair.

Selection of a Faculty Reviewer (Paper Reader)

Master's paper reviewers are chosen by the student in conjunction with their advisor. The reader must be a member of the Nuclear Engineering Graduate Faculty and be appointed in a timely manner to ensure they have adequate time to review the work. If a reader is unable to be determined one can be assigned by the Program Chair upon request.

7) The remaining credits must be courses at the 400- and/or 500-level as selected by the student with approval by the student's advisor as having significance and value for the degree program.

Maintaining Satisfactory Scholarship

A minimum grade point average of 3.00 is required in order to be granted a graduate degree in Nuclear Engineering. In addition, at the end of the initial semester, a student with less than a 3.00 average will be notified by their faculty advisor of future grade point average requirements.

If in a review of the student's grade point average, the minimum requirements are not met, a letter (signed by the advisor) to the student from the Graduate Faculty of the Nuclear Engineering will state:

a) The requirement(s) which the student has failed to satisfy.
b) The requirement(s) which the student must meet by the end of the next semester.
c) If the next semester requirement(s) set forth in item b. is not met, the faculty will review the student's academic performance at a meeting convened prior to the end of the first two weeks of the subsequent semester. In the absence of extenuating circumstances, the student will be dropped as a regular graduate student immediately following the meeting.

If a student is dropped as a regular graduate student in Nuclear Engineering, continuing nuclear engineering study as a provisional student is possible. The student must be re-admitted into the Graduate School as a nondegree student. Such admission is subject to the recommendation of the Program Chair of Nuclear Engineering, who will act according to the recommendations of the Graduate Faculty developed in (c) above. During nondegree student status, no research credit (NucE 596 may be earned).

The student may petition the Graduate Faculty of Nuclear Engineering for admission as a regular graduate student when their cumulative graduate course grade point average is elevated to 3.00 or greater. A maximum of 15 graduate-level credits earned while a nondegree student will be counted in satisfying the graduate degree requirements in Nuclear Engineering.

Summary of Master of Engineering Degree Requirements

It is the student's responsibility to ensure that all requirements have been met.

Requirement	Person Responsible	Suggested Completion Date
Assign a faculty member to serve as faculty advisor	Student	Early in first semester or prior to choosing a paper topic
Establish a program of study	Student, with advisor approval	
Activate your Intent to Graduate on Lionpath	Student	Prior to the Graduate School's deadline date*
Submit draft copy of engineering paper to faculty advisor	Student	Early in last semester

Select a NUCE Faculty Reader and submit a draft of the Master's Paper for their review.	Student in conjunction with the Faculty Advisor	Prior to or early in the semester of graduation
Submit final copy of engineering paper to Program Chair	Student	Prior to the Graduate School's deadline date*
Return keys and any books, software, supplies, etc. to Nuclear Engineering	Student	Prior to departure
Provide one copy of scholarly paper to advisor	Student	Prior to graduation

*Every semester the Graduate School produces a calendar of deadline dates regarding graduation and thesis approval. This calendar is posted at: http://www.gradschool.psu.edu/calendars/important-dates/

Master of Science Degree Program

The Master of Science (M.S.) degree program is designed for students to gain advanced knowledge for research, analysis, and design in nuclear engineering. A minimum of 30 credits at the 400, 500, 600, or 800 level is required, with least 18 credits at the 500 and 600 level combined. Twelve credits must be in Nuclear Engineering. There are 6 credits required in the following core courses: NUCE 450 Radiation Detection and Measurement and NUCE 403 Advanced Reactor Design. The two required courses may be waived for students with a B.Sc. in Nuclear Engineering; however, the minimum of 30 credits will still be required. Students must petition the head of the graduate program to review their undergraduate transcripts to assess their eligibility for a waiver. The remaining elective credits may be chosen from a list of approved electives maintained by the program office. Students are required to write a thesis, and at least 6 credits in thesis research (600 or 610) must be taken in conjunction with completing the thesis. The thesis must be approved by the advisers and readers, the head of the graduate program, and the Graduate School.

Admission Requirements

Completion of an undergraduate degree in Nuclear Engineering or in another related engineering or science discipline is required for admission to the M.S. degree program in Nuclear Engineering. Students should have at least a 3.00 (4.00 base) junior-senior average to be considered for admission.

Provisional Admission

Provisional admission is a temporary classification in which an applicant may remain for a period of no longer than 2 semesters following admission or the time it takes to accrue 15 credits, whichever comes first. If the deficiencies that caused the provisional admission are not corrected by this time, the student may be dropped from the program.

Examinations for Admission

Test of English as a Foreign Language (TOEFL). To qualify for admission, an international student must achieve a minimum TOEFL score of 550 on the paper-based test, and a minimum score of 80 on the internet-based test with a minimum of a 19 in the speaking section. This requirement is waived if the student's native tongue is English or if the student received a baccalaureate degree from an institution in which the language of instruction was English.

Graduate Record Examination (GRE). All students must submit scores on the general aptitude tests of the GRE prior to admission consideration.

Program Requirements (MS)

Each of the following requirements must be met in order for the student to be approved for graduation:

1) All Nuclear Engineering students registered at a full time level are required to schedule colloquium (NUCE 590), during the Fall and Spring Semesters.

2) A minimum of 30 graduate credits must be earned. Only grades of A, B, and C are accepted for graduate credit.

3) A minimum grade point average of 3.00 is required, not counting grades obtained in NucE 600, Thesis Research.

4) At least twelve (12) 400- or 500-level course credits must be taken as NucE courses. A minimum of six credits must be NucE 500-level courses.

5) At least eighteen (18) of the 30 required credits must be in 500-level courses. This includes 6 credits of NucE 600 Thesis Research, as well as any 500-level NucE courses taken to satisfy requirement #3 above. NucE 596 cannot be used as a substitute to meet this requirement.

6) Specific course requirements For students with a BS in Nuclear Engineering, (some of) these requirements may have already been satisfied. Please consult with your advisor for verification.

NUCE 301 (Fall only) *Fundamentals of Reactor Physics* **and NUCE 302 (Spring only)** *Introduction to Reactor Design*. Students can take NucE 497 *Fundamentals of Nuclear Engineering*, a three-credit reactor theory course, which is considered an acceptable substitute for NucE 301 and 302.

NUCE 403 *Advanced Reactor Design.* Students who have not had reactor theory must take this course.

NUCE 450 *Radiation Detection and Measurement.* NucE 497 *Radiation Detection Lab* offered biannually in a short course format is considered an acceptable substitute for NucE 450.

7) There are two options for the M.S. degree. Requirements for the Thesis Option and the Non-Thesis Option follow:

- **a)** Thesis Option - six (6) credits of thesis research, NucE 600, and the submittal of a thesis that meets the Graduate School requirements. The thesis requires approval of three individuals. The student's advisor, Faculty Reader – who is a current member of the NUCE Graduate Faculty. and the Program Chair.
- **b)** Non-Thesis Option - an additional six (6) credits, for a total of 18 credits, of 500-level courses and the submittal of a scholarly paper that must be approved by a faculty supervisor and the Program Chair.

8) The remaining credits must be courses at the 400- and 500-level as selected by the student with approval by the student's advisor as having significance and value for the degree program.

Maintaining Satisfactory Scholarship

A minimum grade point average of 3.00 is required in order to be granted a graduate degree in Nuclear Engineering. In addition, at the end of the initial semester, a student with less than a 3.00 average will be notified by their faculty advisor of future grade point average requirements. These requirements will be developed by the graduate faculty early in the next semester. The Program will review each graduate student's grade point average at the end of each semester.

If in a review of the student's grade point average, the minimum requirements are not met, a letter (signed by the advisor) to the student from the Graduate Faculty of Nuclear Engineering will state:

a) The requirement(s) which the student has failed to satisfy.

b) The requirement(s) which the student must meet by the end of the next semester.

c) If the next semester requirement(s) in b. is not met, the faculty will review the student's academic performance at a meeting convened prior to the end of the first two weeks of the subsequent semester. In the absence of extenuating circumstances, the student will be dropped as a regular graduate student immediately following the meeting.

If a student is dropped as a regular graduate student in Nuclear Engineering, continuing nuclear engineering study as a provisional student is possible. The student must be readmitted into the Graduate School as a nondegree student. Such admission is subject to the recommendation of the Program Chair of Nuclear Engineering, who will act according to the recommendations of the Graduate Faculty developed in (c) above. During nondegree student status, no research credit (NucE 600, 611) may be earned.

The student may petition the Graduate Faculty of Nuclear Engineering for admission as a regular graduate student when their cumulative graduate course grade point average is elevated to 3.00 or greater. A maximum of 15 graduate-level credits earned while a nondegree student will be counted in satisfying the graduate degree requirements in Nuclear Engineering.

Summary of Master of Science Degree With Thesis Requirements

It is the student's responsibility to ensure that all requirements have been met in a timely manner. Please read carefully the section of this manual titled *Academic Policies*.

Requirement	Person Responsible	Suggested Completion Date
Assign a faculty member to serve as faculty advisor	Student	Early in first semester
Establish a program of study	Student, with advisor approval	Within first month of enrollment in NucE grad program
Activate your Intent to Graduate on E-Lion	Student	Prior to the Graduate School's deadline date*
Submit draft copy of thesis to faculty advisor	Student	Early in last semester
Submit a complete draft of the thesis to the Thesis Office for format review.	Student	Prior to the Graduate School's deadline date*
Submit final, corrected, signed copy of thesis to the Thesis Office	Student	Prior to the Graduate School's deadline date*
Return keys and any books, software, supplies, etc. to Nuclear Engineering	Student	Prior to departure
Provide one hardcover bound copy of thesis to advisor	Student	Prior to graduation

*Every semester the Graduate School produces a calendar of deadline dates regarding graduation and thesis approval. This calendar is posted on the Web at: http://www.gradschool.psu.edu/current-students/etd/thesisdissertationperformance-calendar/.

Master of Science Degree Without Thesis Requirements

This option must be approved by the Chair of the Nuclear Engineering Program. See the Mechanical and Nuclear Engineering Graduate programs office for details.

Doctor of Philosophy Degree Program

The Ph.D. program emphasizes scholarly research and helps students prepare for research and related careers in industry, government, and academe. Students are admitted to candidacy after passing written and oral examinations. The Ph.D. program is quite flexible, with minimal formal requirements. The Ph.D. degree is awarded upon completion of a program of advanced study that includes a minimum period of residence, a satisfactory thesis, and the passing of comprehensive and final oral examinations as determined by the student's doctoral committee.

Continuous registration is required of all Ph.D. students until the thesis is approved.

Admission Requirements

The Program requirement for acceptance to graduate study toward a Ph.D. degree in Nuclear Engineering is a B.S. degree from an engineering or science program. The students considered for admission to the doctoral program in Nuclear Engineering are those whose background leads the faculty to believe they will succeed. Students are formally considered doctoral candidates after they have passed the candidacy exam.

Examinations for Admission

Test of English as a Foreign Language (TOEFL). To qualify for admission, an international student must achieve a minimum TOEFL score of 550 on the paper-based test, and a minimum score of 80 on the internet-based test with a minimum of a 19 in the speaking section. This requirement is waived if the student's native language is English or if the student received baccalaureate or master's degrees from an institution in which the language of instruction was English.

Graduate Record Examination (GRE). All students must submit scores on the general aptitude tests of the GRE prior to admission consideration.

Program Requirements

A doctoral program in Nuclear Engineering, as in all other disciplines at The Pennsylvania State University, consists of a collection of courses, seminars, and research that meets the minimum requirements of the Graduate School and is approved by the Doctoral Committee for each individual candidate. No specified number of courses completed or credits earned are required by the Nuclear Engineering Program. Typically, 45-55 credits of 400-500 level courses (including your M.S. program) plus NucE 600 credits are needed. The numbers above (45-55 credits) are not construed as requirements; they are given merely to indicate to the Ph.D. candidate the typical number of graduate course credits

taken by students before attaining their Ph.D. Your program is to be worked out in consultation with your major advisor and doctoral committee. About half of the course credits should be in Nuclear Engineering courses and the other half in other disciplines, such as math, physics, or another engineering field. Registration in NUCE 590 Colloquium is required until completion of the Comprehensive exam.

A student entering the Ph.D. program without an M.S. in NucE must meet the course requirements for an M.S. in NucE. Courses are: NucE 301, NucE 302, NucE 450, NucE 403 and six credits from NucE 500-level courses, but is to exclude NucE 596 courses.

Maintaining Satisfactory Scholarship

A minimum grade point average of 3.00 is required in order to be granted a graduate degree in Nuclear Engineering. In addition, at the end of the initial semester, a student with less than a 3.00 average will be notified by their faculty advisor of future grade point average requirements. These requirements will be developed by the graduate faculty early in the next semester. Nuclear Engineering will review each graduate student's grade point average at the end of each semester.

If in a review of the student's grade point average, the minimum requirements are not met, a letter (signed by the advisor) to the student from the Graduate Faculty of Nuclear Engineering will state:

a) The requirement(s) which the student has failed to satisfy.

b) The requirement(s) which the student must meet by the end of the next semester.

c) If the next semester requirement(s) in b. is not met, the faculty will review the student's academic performance at a meeting convened prior to the end of the first two weeks of the subsequent semester. In the absence of extenuating circumstances, the student will be dropped as a regular graduate student immediately following the meeting.

If a student is dropped as a regular graduate student in the Nuclear Engineering Program, continuing nuclear engineering study as a provisional student is possible. The student must be readmitted into the Graduate School as a nondegree student. Such admission is subject to the recommendation of the Program Chair of Nuclear Engineering, who will act according to the recommendations of the Graduate Faculty detailed in (c) above. During nondegree student status, no research credit (NucE 600, 611) may be earned.

The student may petition the Graduate Faculty of Nuclear Engineering for admission as a regular graduate student when their cumulative graduate course grade point average is elevated to 3.00 or greater. A maximum of 15 graduate-level credits earned while a nondegree student can be counted towards satisfying the graduate degree requirements in Nuclear Engineering.

Nuclear Engineering Candidacy Exam

Objective: The objective of the Candidacy Exam is to perform an in-depth assessment of the student's ability to perform doctoral level scientific research.
Format and Frequency: The Candidacy exam will be held two times per year – one in the January/February time frame and the other in September/October time frame. The Chair of NucE PhD Candidacy Committee will chair both sessions. Both sessions are the same in format and logistics and all graduate students can take the exam. The Candidacy exam consists of two parts: a *written exam* and an *oral exam*. The judgement of whether a student passes is the responsibility of the committee who will take into account the student's performance in *both* the written and the oral parts. Each student has two chances to pass the Candidacy Exam.
Written Exam: The written portion of the exam will be divided into 3 major areas and 3 additional areas (additional areas might be added in the future following changes/additions to Nuclear Engineering undergraduate curriculum – 300- and 400-level courses):

a. Major areas:
    i. Nuclear Science (Nuclear physics and Radiation detection)
    ii. Reactor physics and analysis
    iii. Thermal-hydraulics
b. Additional areas
    i. Nuclear materials and fuel performance
    ii. Reactor design, dynamics, and systems
    iii. Nuclear security

Students take four questions in the written exam, chosen either as three from the major areas and one from the additional areas (3+1) or two from the major areas and two from the additional areas (2+2). Advisors may specify one area (either Major or Additional) that the individual student is required to take. The student should consult with the advisor prior to signing up. The choice of the four areas is specified by the student upon signing up to take the exam and cannot be changed afterwards. The faculty responsible for the area will prepare questions at a level of difficulty commensurate with a distinguished, top-ranked doctoral program in nuclear engineering. The written exam will be closed book (faculty will provide any required additional information to solve the questions).
Assessment of the student's performance in the written exam will take into account both the overall grade in the four questions and the individual grade in each section. Students are expected to demonstrate mastery of the material in all areas. If the student's performance is judged satisfactory, the student will be allowed to take the Oral Exam. If not, they are considered to fail the exam. According to the discretion of the committee, students may be judged to fail the whole written test or for some particular area(s). If a student fails the written portion of the exam in part or in whole, the committee will determine which areas the student has to re-take on the second attempt at the written portion of the exam.
Oral Exam: The committee will consist of at least three faculty members. The students whose performance is considered satisfactory in the written exam will be assigned a paper by their advisor for the oral exam. Students are to write a critical review of the assigned paper and make a technical presentation of its main points and any concerns or deficiencies. After the presentation the student will be asked questions of a free-ranging nature designed to explore the familiarity of the student with the fundamentals of the nuclear engineering discipline based on the areas of the written exam. The oral exams are scheduled in advance starting in the third week after the written exam.
Although the advisor may be present and may ask questions during the oral exam, the advisor does not have a vote in the decision.
Overall Evaluation: The overall evaluation of the student's performance in the Candidacy Exam will take into account both the oral and the written parts. The committee may decide that the student has to re-take only the oral exam or both the written and oral exams. The decision made by the committee is final. If the student fails the Candidacy Exam twice, the student will not be admitted to Ph.D. Candidacy in nuclear engineering.
English Competency: The paper write-up and oral presentation during the Candidacy Exam also serve for the committee to judge the student's competency in written and oral communication in English. The committee's evaluation will be communicated to the student and the Graduate School at the end of the exam.
Implementation Date: This new updated policy for NucE Candidacy Exam is effective starting in the 2015/16 academic year.

Residency Requirement

There is no required minimum number of credits or semesters of study to meet residency requirements. However, during some 12-month period between admission to candidacy and completion of the Ph.D. degree, the candidate must spend at least two semesters back-to-back (Fall/Spring or Spring/Fall)

(including the semester in which the candidacy examination was taken) as a registered, full-time student engaged in academic work at University Park. Note: NUCE 601 cannot be used to meet the Graduate Schools Residency requirement.

Language and Communications Requirements

The Graduate School requires a high level of competence in the use of the English language. You will be given an English Proficiency Exam during your candidacy exam. Based upon the assessment, coursework in Speech Communication and English will be identified to improve English competency and enable the student to meet the requirement. Competency must be formally attested before the doctoral comprehensive examination will be scheduled.

In addition to the Assessment program in coursework at the time of candidacy, each student must submit a three to five-page technical paper prior to the oral exam on the subject identified for the oral presentation. The language complexity should be similar to that of a thesis. The student must certify that the paper is their original work without review or assistance by others. The Candidacy Committee and the student's advisor will certify whether adequate proficiency in the English language has been demonstrated based on the paper and the oral exam. A student may pass the candidacy exam but not be certified in English proficiency. In this case, the complete exam need not be taken again; but simply to demonstrate English proficiency by taking a Speech Communication or English course. If the student has not demonstrated proficiency in English, the student will be admitted to candidacy and but a doctoral committee will not be appointed. Upon improvement of English skills, the student must write another paper, make a verbal presentation and respond to questions by the Candidacy Committee and advisor in the same manner.

The Doctoral Committee

The doctoral committee has the responsibility of giving the Comprehensive Examination and/or approving the doctoral thesis, both written thesis and the oral defense. The formation of the doctoral committee is governed by requirements of the Graduate School, which follow:

1) appointed soon after the student is admitted to the candidacy,

2) must include at least of four active members of the Graduate Faculty,

3) normally includes at least three faculty members from the Nuclear Engineering Program,

4) at least one regular member of the committee must be from outside Nuclear Engineering,

5) the chair, or at least one co-chair, of the committee must be a faculty member from Nuclear Engineering. If the student is working with a faculty member outside of the Nuclear Engineering Program, that individual can be co-chair of the committee, and

6) the student's faculty advisor must notify the Graduate Staff Assistant to appoint a committee. There is a required form that must be completed.

The committee is not limited to four faculty members, and frequently includes additional members who can contribute technical advice regarding the research are included. External members, e.g., scientists at national laboratories, who are not at the University can be included as special members of a committee.

The doctoral committee is formed by the candidate with consultation between the candidate and main research advisor. It is advisable for the committee chair and the candidate to then schedule a committee meeting to review past and future course work in relation to the proposed area of research.

Comprehensive Examination

When a Ph.D. candidate has completed a substantial amount of the necessary course work, including the language and communication requirement, they will be required to take a comprehensive examination. The type of examination is determined by the doctoral committee but usually consists of a literature

review and thesis proposal. Additional questions can cover the major and related areas of study. Requirements are as follows:

1) the student must satisfy the English Competence Requirement before taking the comprehensive.

2) must have a minimum grade point average of 3.00;

3) may not have deferred or missing grades;

4) must be registered full- or part-time for the semester in which the comprehensive is taken, including summers. Being registered for one credit of NucE 600 is sufficient;

5) the examination should be taken at least 3 months before the final oral examination;

6) must give at least two-weeks' notice to the Graduate School for scheduling, and;

7) must see the Graduate Staff Assistant to schedule the exam. There is a required form that must be completed.

The comprehensive examination consists of written and oral parts. The written part includes preparation of a Comprehensive Paper which details the research plan to be conducted, methods and proposed approach. The paper should have the following list of contents: abstract, introduction, literature review, dissertation research proposal, summary of the research performed to date, detailed research plan to complete research with time-table, and conclusions with summary of the envisioned original contributions. The paper should be given to the committee at **least two weeks** before the exam. The oral part consists of the presentation of Comprehensive Paper and answers to questions of the PhD committee. These questions can relate both to the research and general topics of nuclear engineering. It is given and evaluated by the entire doctoral committee. A favorable vote of at least two-thirds of the members of the committee is required for passing. In case of failure, it is the responsibility of the doctoral committee to determine whether the candidate may take another examination.

If a period of eight years has elapsed between the passing of the comprehensive examination and the completion of the program, the student is required to pass a second comprehensive examination before the final oral examination can be scheduled.

Continuous Registration

After a Ph.D. candidate has passed the comprehensive examination and met the two semester full-time residence requirement, the student must register continuously for each fall and spring semester (beginning with the first semester after both of these requirements have been met) until the Final Oral Exam is passed and the Ph.D. thesis is accepted and approved by the doctoral committee. Post-comprehensive Ph.D. students can maintain registration by registering in the usual way, or by registering for noncredit 601 or 611, depending upon whether they are devoting full-time or part-time to thesis preparation. Students may take 601 plus up to 3 additional credits of course work for audit by paying only the dissertation fee. Students wishing to take up to 3 additional credits of course work for credit, with 601 may do so by paying the dissertation fee and an additional flat fee. Students who want to combine course work with thesis preparation must register for 600 or 611 (not for 601, which is full-time thesis preparation). Note that the least expensive way for a student to work full-time on research and thesis preparation is to register for 601. This clearly is the procedure of choice for international students who need to maintain status as full-time students for visa purposes.

Final Oral Examination

Upon recommendation of the doctoral committee, a doctoral candidate who has satisfied all other requirements for the degree will be scheduled by the Dean of the Graduate School to take a final oral examination. It is the responsibility of the doctoral candidate to provide a copy of the thesis to each

member of the doctoral committee at least two week before the date of the scheduled examination. Other requirements are as follows:

1) The final oral examination may not be scheduled until at least three months have elapsed after the comprehensive exam was passed;

2) two-weeks' notice must be given to the Graduate School for scheduling;

3) must see the Graduate Staff Assistant to schedule this exam. There is a required form that must be completed;

4) the deadline for holding the exam is ten weeks before commencement. This date is listed in a calendar produced by the Thesis Office. A copy of this calendar can be obtained from the following web site http://forms.gradsch.psu.edu/thesis/Calendar.pdf

5) the student must be registered full- or part-time during the semester in which the final oral exam is taken.

The final examination is an oral examination administered and evaluated by the entire doctoral committee. It consists of an oral presentation of the thesis by the candidate and a period of questions and responses. The examination is related largely to the thesis, but it may cover the candidate's whole field of study without regard to courses that have been taken either at this University or elsewhere. The defense of the thesis should be well-prepared including any appropriate visual aids. The portion of the exam in which the thesis is presented is open to the public.

A favorable vote of at least two-thirds of the committee is required for passing. If a candidate fails, the committee will determine whether another examination may be taken at a later date.

Summary of Ph.D. Degree Requirements

It is the student's responsibility to ensure that all requirements have been met in a timely manner. Please read carefully the section of this manual titled *Academic Policies*.

Requirement	Person Responsible	Suggested Completion Date
Assign a faculty member to serve as faculty advisor	Student	Early in first semester
Complete doctoral candidacy examination	Ph.D. Candidacy Examination Committee to conduct the examination.	To be scheduled after a minimum of 18 course credits beyond the baccalaureate degree, but no later than two enrolled semesters after earning 24 course credits beyond the baccalaureate degree.
Prepare thesis research area. (Thesis advisor and chairman)	Student	Beginning of first semester after completing candidacy examination.
Recommend faculty members to serve on doctoral committee	Thesis Chairman. Student to see Graduate Staff Assistant to complete appointment paperwork.	Beginning of first semester after completing candidacy examination.
Complete written and oral comprehensive examinations	Student to schedule exams through Graduate Staff Assistant	Upon substantial completion of course work.
Activate your Intent to Graduate on E-Lion.	Student	Prior to the Graduate School's deadline date*

Submit draft copy of thesis to faculty advisor.	Student	Early in last semester
Distribute draft copies of thesis to each committee member and Program Chair.	Student	After the thesis has been approved by faculty advisor.
Submit a complete draft of the thesis to the Thesis Office for a format review	Student	Prior to the Graduate School's deadline date*
Complete final oral examination	Student notifies the Graduate Staff Assistant to complete the necessary paperwork.	As soon as faculty advisor approves thesis for oral examination. Early enough for final draft of thesis to be submitted before deadline date.
Submit final, corrected, thesis to Graduate School by eTD	Student	Prior to the Graduate School's deadline date*
Provide one hardbound copy of thesis to faculty advisor.	Student	Prior to departure
Completion of paper for submission to a refereed periodical	Student	Prior to departure
Return keys and any books, software, supplies, etc. to Nuclear Engineering.	Student	Prior to departure
*Every semester the Graduate School produces a calendar of graduation deadlines and is posted on at http://www.gradschool.psu.edu/current-students/etd/thesisdissertationperformance-calendar/.		

Scholarship and Research Integrity (SARI)

Based on guidance provided by the Council of Graduate Schools in a report entitled "Graduate Education for the Responsible Conduct of Research (RCR)," the Scholarship and Research Integrity (SARI) program is an opportunity to engage graduate students broadly in a dialog surrounding issues pertinent to research ethics. The SARI program has two parts.

PART 1. SARI

- SARI RCR (Responsible Conduct of Research) portion of SARI – complete during first year
- CITI – complete during first semester

PART 2. CITI On-line training

All graduate students in MNE are required to complete the on-line CITI training program for **engineering** within their first semester. Completion of the CITI program will result in a certificate of completion. Failure to comply will preclude certification for graduation by the Department.

1. Go to http://citi.psu.edu/
2. Select "Log in to CITI" under University Park
3. Enter your PSU credentials. (If this does not work, go to https://www.citiprogram.org/ instead, and create a username and password to access the CITI online training.)
4. Select the course called "Responsible Conduct of Research (RCR) – Basic"

5. Remember to email the certificate to grad@mne.psu.edu after completing the course.

Facilities

The Radiation Science & Engineering Center (RSEC)

The RSEC is one of the most complete and modern university reactor facilities in the country. The laboratory complex contains a TRIGA Mark III reactor, the Cobalt-60 Radiation Facility, two hot cells, a radio-chemistry laboratory, a radio-nuclear applications laboratory, a natural uranium graphite subcritical reactor, a neutron radiography laboratory, a microprocessor and microcomputer laboratory, an electronics shop, a machine shop, an extensive array of radiation sources and counting equipment, and student classrooms.

TRIGA Reactor

The TRIGA reactor system at the RSEC is a most versatile and useful reactor operating at a power level of 1 MW with a maximum thermal neutron flux of 2.7×10^{13} neutrons/cm^2-sec and can be pulsed to a peak power of 2000 MW with a maximum integrated output of 6×10^{16} neutrons/cm^2. The reactor core, suspended from a movable bridge, can be positioned in the "swimming pool" to provide the most effective experimental setup. Special equipment directly associated with the reactor includes a D_2O thermal column, pneumatic "rabbit" tubes, several beam ports, and a traversing experimental ridge. The reactor normally operates one shift per day, five days a week.

Neutron Radiography Laboratory

Otherwise known as the RSEC Beam Hole Laboratory, this facility passes a well-collimated beam of neutrons from the reactor, thermalized by a D_2O thermal column, into the Center for use in nondestructive testing and evaluation. The major work now being done is utilizing a real time neutron image intensifier for real time radiography. This includes simulation of boron mixing in nuclear power plants using gadolinium and florinert. The beam is also being used for static neutron radiography and neutron attenuation studies. Equipment is available to digitize the real time radiography images for image processing.

Cobalt-60

In 1966, the University placed into operation a 3,200 square foot laboratory extension to its reactor facility. This two-level, gamma-ray laboratory houses about 5,000 curies of cobalt-60 in a 15,000-gallon pool of water. The radioactive cobalt-60, in the form of cobalt metal slugs contained in 150 stainless steel tubes, can be arranged in various configurations to meet the needs of the experimenter. Exposure rates up to 5 x 105 roentgens per hour are available and irradiation conditions such as controlled temperature, and instrumentation for experiments are possible. This facility is in around-the-clock use for a variety of radiation effects studies conducted by faculty members and students throughout the University.

Nuclear Materials Laboratory

Located at the RSEC, this laboratory includes a positron annihilation lifetime spectrometer which is being used to monitor damage to pressure vessel steels. Facilities for sample preparation for electron microscopy are available, including electropolishing and arc melting. The laboratory also includes a Charpy impact tester and full hot cell facilities.

Hot Cells

To aid materials research and provide safe handling of many highly radioactive sources, the University has constructed two well-equipped hot cells at the RSEC. Each of these cells is capable of handling the equivalent of 100 curies of cobalt-60. Special shielding arrangements make possible experiments at an even higher level. Direct viewing of experiments through lead glass windows, remote manipulators, air cleaning equipment, utilities, and special control of waste materials all add to the capabilities of these hot cells.

Subcritical Reactor

A graphite, natural uranium subcritical reactor is used for student instruction. Five different lattice spacings can be set up with this subcritical reactor, allowing studies of heterogeneous arrays. Its unique construction permits all of the usual experiments associated with graphite reactor physics. Replacement of the fuel with graphite stringers provides a 6 x 6 x 9 foot graphite region for neutron slowing down and diffusion studies.

Radionuclear Applications Laboratory

Located at the RSEC, this laboratory is equipped with the latest in radiation detection equipment, including pulse height analyzers, GPGe, and Nal(Ti) radiation detectors. Personnel of this laboratory conduct research and offer other services to the University research community in the areas of neutron activation analysis, gamma-ray spectroscopy, tracer techniques, radiography, isotope gaging, and other applications of radiation and radioisotope technology.

Intelligent Distributed Control Research Laboratory (IDCRL)

The Penn State IDCRL was established in 1989. The original funding supplied the initial Bailey Control System. Equipment added later includes seven UNIX workstations, simulation and controls software, additional Bailey controller equipment and a modern state-of-the-art UNIX network compatible microprocessor-based control system. The equipment is used for advanced intelligent control research for fossil and nuclear power plants. This research includes validation using distributed real-time simulation of plant-wide power plant systems including boiler, feedwater turbine and generator subsystems and validation using the Penn State TRIGA research reactor. This laboratory is jointly used by faculty and students from the Mechanical and Nuclear Engineering Department and the Electrical Engineering Department that are conducting applied controls research involving implementation in a Bailey microprocessor-based distributed control system. The main part of the equipment is housed in 104 Electrical Engineering East Building. A portion of the equipment is also maintained at the Penn State Breazeale Reactor for those students conducting tests of advanced concepts on the reactor.

Low Pressure Integral Test Facility (LPITF)

The Penn State Nuclear Engineering Low Pressure Integral Test Facility (LPITF) is a unique, multipurpose, thermal hydraulic test loop. This test facility is made of two separate components with two separate objectives. These two components are the test loop and the boiling regime pipe. The test loop is designed to be an integral effects test facility, while the boiling regime pipe is a separate effects facility.

The study of natural circulation in a reactor system is a primary facility objective. This includes system behavior during startup, normal operation, and during accident scenarios. To this end, the test loop is a scaled version of the General Electric Simplified Boiling Water Reactor (SBWR). In addition to the modeling of the reactor core, chimney, and down comer, the test loop also models the emergency core cooling systems (ECCS) allowing for an integral effects study. Another design purpose is the study of boiling. The test loop instrumentation can be coupled with a computer and related software to allow for digital signal acquisition and control of various valves, heaters, and pumps.

The Advanced Multiphase Flow Laboratory (AMFL)

The facility is equipped with an air- water two-phase flow loop capable of investigating various geometric effects in comprehensive two-phase flow regimes, spanning from bubbly flow to annular flow. It is equipped with state-of-the-art two-phase flow instrumentation including a high-speed digital movie camera, ideal for flow visualization study, which is being employed in both undergraduate and graduate reactor thermal-hydraulics courses.

PC Studio

In addition to the many student computer laboratories available throughout the University, there is a lab, located in 119 & 120 Reber specifically the Mechanical & Nuclear Engineering students. Access to the laboratory is by your Penn State ID.

Course Descriptions

Updated Course Schedule can be found on LionPATH or at http://launch.lionpath.psu.edu/

Undergraduate 4xx Courses

403 ADVANCED REACTOR DESIGN (3:3:0) Physical principles and computational methods for reactor analysis and design. Multigroup diffusion theory; determination of fast and thermal group constants; cell calculations for heterogeneous core lattices. Prerequisite: NUC E 302.

405 (CHEM 405) NUCLEAR AND RADIOCHEMISTRY (3:3:0) Theory of radioactive decay processes, nuclear properties and structure, nuclear reactions, interactions of radiation with matter, biological effects of radiation. Prerequisites: PHYS 237 or CHEM 452 or NUC E 301.

409 (MATSE 409) NUCLEAR MATERIALS (3:3:0) Nuclear reactor materials: relationship between changes in material properties and microstructural evolution of nuclear cladding and fuel under irradiation. Prerequisite: PHYS 203 or 204

420 RADIOLOGICAL SAFETY (3:3:0) Ionizing radiation, biological effects, radiation measurement, dose computational techniques, local and federal regulations, exposure control. Prerequisites: MATH 251, PHYS 237 or 265, or NUC E 301.

428 RADIOACTIVE WASTE CONTROL (3:3:0) Nature, sources, and control of radioactive wastes; theory and practice of disposal processes. Prerequisites: NUC E 301 or instructor permission.

430 DESIGN PRINCIPLES OF REACTOR SYSTEMS (3:3:0) Nuclear power cycles; heat removal problems; kinetic behavior of nuclear systems; material and structural design problems. Prerequisites: M E 412; NUC E 301 or 401.

431W NUCLEAR REACTOR CORE DESIGN SYNTHESIS (4:4:0) Technical and economic optimization of nuclear systems. Prerequisites: ENGL 202C; NUC E 403 and 430.

450 RADIATION DETECTION AND MEASUREMENT (3:2:3) Theory and laboratory applications of radiation detectors, including proton, neutron, charged particle detectors. NIM devices, and pulse-height analysis. Prerequisite: NUC E 301 or NUC E 405.

451 EXPERIMENTS IN REACTOR PHYSICS (3:1:4) Acquisition and processing nuclear and atomic data; application to nucleonic phenomena of importance in nuclear engineering. Prerequisites: NUC E 450, E E 305.

460 NUCLEAR SYSTEMS RISK ASSESSMENT (3:3:0) Probability concepts and distributions, failure data, reliability and availability of simple systems, fault and event tree analysis, risk concepts, nuclear power risks, WASH-1400. Prerequisite: NUC E 309 or STAT 401.

470 POWER PLANT SIMULATION (3:2:2) Basic knowledge necessary for intelligent simulation and interpretation of simulations of transients in nuclear power plants. Prerequisite(s): ME 33, MATH 251, NUC E 302

490 (AERSP 490, E E 490) INTRODUCTION TO PLASMAS (3:3:0) Plasma oscillations; collisional phenomena; transport properties; orbit theory; typical electric discharge phenomena. Prerequisite: E E 361 or PHYS 467.

497A FUNDAMENTALS OF NUCLEAR ENGINEERING (3:3:0) An intensive course providing introduction to NucE to undergraduate co-op students, non-NucE graduate, and returning students.

Graduate 5xx Courses

501 REACTOR ENGINEERING (3) Thermal hydraulic fundamentals including thermal hydraulic characteristics of power reactors, thermal design principles, reactor heat generators, thermal analysis of fuel elements and size and two-phase heat transfer in heated channels. Prerequisites: NUC E 302; NUC E 430

502 REACTOR CORE THERMAL-HYDRAULICS (3) In-depth analysis of the thermal hydraulic design in LWRs. Topics include: LWR design criteria, fuel rod design, subchannel analysis, uncertainties analysis, and system design. Prerequisite: NUC E 501

505 REACTOR INSTRUMENTATION AND CONTROL (3) Reactor control principles; classical control methods; operational control problems; control simulation using modern mainframe and microcomputer software packages; reactor instrumentation. Prerequisite: NUC E 302 or NUC E 401

511 NUCLEAR REACTOR KINETICS AND DYNAMICS (3) Analytical kinetics and dynamics modeling for reactivity-induced transients, applications including reactor accident kinetics methods for simple and complex geometries, experimental methods.

512 NUCLEAR FUEL MANAGEMENT (3) Develop advanced techniques for reloading nuclear reactors using sophisticated neutronic codes. Emphasis on calculational techniques in reactor optimization and design, and economic value through the fuel cycle. Prerequisite: NUC E 302.

521 NEUTRON TRANSPORT THEORY (3) Derivation of Boltzmann equation for neutron transport; techniques of approximate and exact solution for the monoenergetic and spectrum regenerating cases. Prerequisite: NUC E 403 or PHYS 406

523 ENVIRONMENTAL DEGRADATION OF MATERIALS IN NUCLEAR POWER PLANTS (3) covers the electrochemistry and materials aspect of the in-reactor degradation processes that affect materials performance. Uniform and localized cladding corrosion, stresscorrosion cracking irradiation creep and growth.

525 MONTE CARLO METHODS (3) Fundamentals of the probability theory and statistics, analog and non-analog Monte Carlo methods and their applications, random processes, and numbers. Prerequisite: CMPSC 201, MATH 141, NUC E 309 or STAT 401.

530 PARALLEL/VECTOR ALGORITHMS FOR SCIENTIFIC APPLICATIONS (3) Development/analysis of parallel/vector algorithms (finite-differencing of PDEs and Monte Carlo methods) for engineering/scientific applications for shared and distributed memory architectures. Prerequisites: AERSP 424 or CSE 457.

597D NUCLEAR REACTOR SAFETY (3) Covers the licensing process and analysis used for nuclear reactor safety. Topics include: federal regulations, accident classification and analysis, review of historical accidents, risk assessment, and advanced reactor design. Prerequisite: NUC E 501.

597E POWER PLANT DYNAMICS AND CONTROL (3) Mathematical foundation for modeling and analysis of dynamic behavior for electrical generating power plant components and systems; includes steam generation, feedwater, and turbine generator systems. Automatic control with single loop PID feedback and some conditioned feedforward signals.

Faculty Research Interests

J. S. Brenizer, Jr.	Professor Emeritus of Nuclear Engineering,; Ph.D., Penn State University. Radiation detection, neutron radiography, neutron activation analysis, nuclear test ban treaty monitoring, aerogel materials. (863-6384 or 865-6351), 229 Reber Bldg. or Nuclear Reactor, brenizer@engr.psu.edu .
N. Brown	Assistant Professor of Nuclear Engineering, Ph.D., Purdue University, Nuclear reactor core design and analysis, nuclear reactor safety, advanced nuclear fuel and cladding materials, advanced reactor concepts, sustainable nuclear fuel cycles, and thermal hydraulics-neutronics coupling, 229 Reber Bldg. (814-865-4863), nrb26@psu.edu
G. L. Catchen	Professor emeritus of Nuclear Engineering; Ph.D., Columbia. Characterization of electronic, optical, magnetic materials, radiation detection/measurement, nonlinear regression/optimization, radiation dosimetry. (865-2011), 226 Reber Bldg., g9c@psu.edu .
F. B. Cheung	George L. Guillet Professor of Mechanical and Nuclear Engineering; Ph.D., Notre Dame. Two-phase flow and heat transfer, Reactor thermal hydraulics and safety, DBA and BDBA analyses and experimentation. (863-4261), 304 Reber Bldg., fxc4@psu.edu.
M. Flaska	Assistant Professor of Nuclear Engineering; Ph.D., Delft University of Technology. Radiation detection, characterization, and imaging for nuclear nonproliferation, safeguards, and forensics, fundamental nuclear physics, radiation-data processing, and development of radiation-detection electronics, fast-neutron activation analysis (867-4754), 227 Reber Bldg., mflaska@psu.edu

S. Kim	Associate Professor of Mechanical and Nuclear Engineering, Ph.D., Purdue University, Thermal-hydraulics and reactor safety, Multi-phase flow phenomena, Interfacial area transport, Geometric effects in two-phase flow transport, Development of two-phase flow instrumentation. (867-1783), 230 Reber Bldg., skim@psu.edu
S. H. Levine	Professor emeritus of nuclear engineering – Fuel management, reactor operations, neutron spectrum and beta dosimetry measurements and calculations, reactor design, and fast reactor physics. (863-1653) 323 Reber Bldg. shl@psu.edu
A. Lintereur	Assistant Professor of Nuclear Engineering; Ph.D., University of Florida. Radiation detection, detector development, homeland security, international safeguards, MCNP simulations. atl21@psu.edu
A. T. Motta	Professor and Program Chair of Nuclear Engineering and Professor of Materials Science and Engineering; PhD., U. California at Berkeley. Corrosion of zirconium alloys, radiation damage and phase transformations under irradiation, mechanical behavior, transmission electron microscopy, synchrotron radiation. (865-0036) 138 Reber Bldg. atm2@psu.edu .
A. Ray	Distinguished Professor of Mechanical Engineering, Nuclear Engineering, and Mathematics, and Graduate Faculty of Electrical Engineering, Ph.D., Northeastern University. Nuclear Instrumentation and Control. (865-6377), 329 Reber Bldg.,axr2@psu.edu
M. Tonks	Assistant Professor of Nuclear Engineering and Assistant Professor of Mechanical Engineering, Ph.D., University of Illinois at Urbana-Champaign: mesoscale computational approaches in predicting important phenomena related to nuclear fuel performance. mrt5296@psu.edu
K. Ünlü	Professor of Nuclear Engineering and Director of the Radiation Science and Engineering Center; Ph.D., U. Michigan. Development and Applications of Nuclear Analytical Techniques: Neutron Depth Profiling, Cold Neutron Prompt Gamma Activation Analysis, Neutron Imaging, Neutron Activation Analysis, Nuclear Security, Nuclear Forensics and Noproliferation. (865-6351), 102 Breazeale Nuclear Reactor, and 231 Reber, kxu2@psu.edu.
W. Walters	Assistant Professor of Nuclear Engineering; Ph.D., Virginia Tech. Computational methods for radiation transport, especially hybrid methods; applications to reactor physics, spent fuel criticality, safeguards. (867-4329), 228 Reber Bldg., wjw24@psu.edu
J. Watson	Senior Research Associate and Associate Professor of Nuclear Engineering, Ph.D., The Pennsylvania State University. Multiphysics Modeling and Simulation; Reactor kinetics and dynamics; power plant simulation; numerical methods; thermal hydraulics; two-phase flow and heat transfer; reactor safety analysis. (863-6754) 231 Reber Bldg. jkw104@psu.edu

R. Zboray	Associate Professor of Nuclear Engineering, Ph.D., Delft University of Technology. Radiation-based imaging methods using gammas, X-rays and neutrons, experimental nuclear thermal-hydraulics, single- and multi-phase flow measurement technology. rzz65@psu.edu