NC STATE UNIVERSITY

College of Engineering
Department of Nuclear Engineering

Campus Box 7909
Burlington Engineering Labs
2500 Stinson Drive
Raleigh, NC 27695-7909

NE 591-618 Special Topics in Nuclear Engineering
Nuclear Design Fundamentals II
Capstone Project

Spring 2026, 3 Credit Hours

Time: Periodic Team Meetings per Faculty Instruction
Place: GVH Wilmington Site

Instructor
Instructor: Dr. John F. Zino, Associate Teaching Professor of Nuclear Engineering
Location: Remote, Wilmington, NC
Office hours: By Appointment
Email: jfzino@ncsu.edu
Alternate Email: john.zino@gevernova.us
Phone number: (910) 398-2832

I. Course Description

This course will be a 3-credit hour project-based engineering course. Students will apply the engineering and design principles learned from previous courses and apply them to real-world technical problems that solve business critical needs for GE Vernova Hitachi (GVH) and Global Nuclear Fuels (GNF).

Students will be grouped into teams of roughly 4-5. Each team will be assigned a high priority, high visibility project sponsored by an Executive Sponsor from GVH. The project will be connected directly with an Assignment Leader and Chief Engineer from GVH. Each team will report to the Assignment Leader for their project. One individual from the team will be designated as the Team Leader for the project and assigned to the Assignment Leader's team for the duration of the project. The Team Leader will have majority responsibility and accountability for the management of tasks for the project. As such, their allotted time on the task is determined by the Assignment Leader. Other team members will support at least 5 hrs./week, for the duration of the project. There will be a weekly check-in with the team and the Capstone Project Manager to facilitate communication and provide support as necessary. The project/task scope should be manageable within these time constraints.

Each participant will be evaluated on the project by the Executive Sponsor, the Assignment Leader, the Edison program staff, and their teammates. The evaluation will provide input foe the course grade. Assignments will be given in early January. Deliverables for the course will include a mid-semester presentation submitted and presented in March as well as a final report submitted and presented to the Executive Sponsor, Chief, Assignment Leader, and Edison program staff following completion of the project in late-June. The reports and project will serve as an evaluative basis for the participants' final class grade.

II. Course Objectives

- Enhance understanding of the design process.
- Integrate information learned from the GVH Edison Program and other university graduate-level courses in engineering including design ethics and design process.

- Develop analytical skills supportive of the design process such as iterative techniques, investigation of alternatives, optimization techniques, economic considerations and cost-benefit analyses.
- Provide design team experiences.
- Develop oral and written technical communication skills when interfacing with project sponsors, customers, business executive leadership and members of the Chief Engineers office.

III. Course Prerequisites

- This course is only available to GVH Nuclear employees in the Edison Engineering Development program. Instructor approval required to register.

IV. Outline of Projects

Project #1 – RPV Head Tensioning Mock-Up for Training Center

Quantifiable Outcomes: The desired outcome from this effort is design completion of a BWRX-300 RPV head tensioning mock-up that allows for proper training of vessel technicians to perform this task in the field. This training is to be performed at actual tensioning pressures using authentic hardware. Design completion is defined as all the necessary documents required to proceed with procurement of equipment (i.e., drawings/specifications).

Detailed Description: This design shall replicate the RPV tensioning environment, including the lower cavity, where the tensioning activities take place. Design will require a lightweight, full-size mock-up RPV head, RPV head strong-back for lifting, tensioners, RPV flange mock-up (including studs/nuts, washers), all access equipment and head holding pedestals. Other miscellaneous items will also be required. Additionally, support of placement of this mock-up assembly in the new training center will be needed, including inputs towards sizing of the overhead crane.

Project #2 – Natrium Fuel Fabrication Process Engineering

Quantifiable Outcomes: GNFA has been selected by Terrapower to provide metallic fuel for the Natrium reactor. The bundle assembly process for this fuel exists in a conceptual state and must be proved out in real life. The result of this work will be to advance the Manufacturing Readiness Level (MRL) of the bundle assembly process to a tangible state and help prepare shipping test bundles to meet Fall 2026 milestones.

Detailed Description: The Manufacturing Readiness Level (MRL) for the Natrium fuel bundle assembly process must be advanced to meet short-term project milestone such as preparing shipping test assemblies for Fall 2026. Further, the long-term viability of process assumptions must be proved to ensure the operability of the fuel fabrication facility. Edison's will prove out the key steps in the bundle assembly process from fuel pin receipt to bundle assembly inspection. Processes needing validation include inlet nozzle subassembly preparation, pin rail layer loading, bundle movement, duct installation, inlet nozzle shear and retention ring installation, and final inspection. Current bundle assembly processes are estimated to be at an MRL of 4, while the final inspection is estimated to be at an MRL of 2. MRL advancement during this term would drive to progress MRL by two levels for each respective

process. Taking the bundle assembly process to an MRL of 6 and the final inspection process to an MRL of 4. Key competencies that will be exercised and developed include hands-on mechanical/process design, prototyping, 3-D printing, ergonomics design, equipment procurement, ensuring safety, quality and continuous improvement,

V. Assignments and Grading Policy

- Grading will be based on the instructor's evaluation of the technical work and the individual contributions of each team member, participation, overall performance in the design work and the overall joint group achievement.

- Feedback from the project assignment leader, the business executive sponsor and members of the Engineering leadership organization.

Grading rubric for overall project:

Deliverable	Weight
Team Evaluations	10%
Mid-Point Presentation	20%
Final Presentation	20%
Final Design Report	50%

The highest assigned grade for this course will be an "A". The course instructor reserves the right to modify grade criteria and will inform participants of such modifications.

VI. Recommended Texts

Course Textbook:

None.

Reference Text:

None.