INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*EnergySolutions (ES)*	**Date Submitted**	*11/6/2024*
Project Title	*Hemispherical Bottom Head (HBH) Bottom Mounted Tooling Holder and Delivery* ***(ENERGY SOLUTIONS_REMOTE)***	**Planned Starting Semester**	*Spring 2025*

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing on the table below. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

Discipline	Number	Discipline	Number
Mechanical	3-4	Electrical	1
Computer	1	Systems	

Company and Project Overview:

EnergySolutions is an international nuclear services company headquartered in Salt Lake City Utah, with operations throughout the United States, Canada, and Japan. EnergySolutions is an industry leader in the safe recycling, processing, and disposal of nuclear material. Our customers include the United States Government, all United States Power Plants, along with various medical and research facilities. EnergySolution's Decommissioning &Decontamination business is headquartered in Charlotte, NC, and offers a full range of services for the decommissioning and remediation of nuclear sites and facilities, management of spent nuclear fuel, the transportation of nuclear material, and environmental cleanup of nuclear legacy sites. On-going D&D projects include San Onofre 2&3 in California; Ft. Calhoun in Nebraska; Kewaunee in Wisconsin and Three Mile Island 2 (TMI2) in Pennsylvania.

This project will be focused on solving a challenge the TMI2 project is facing.

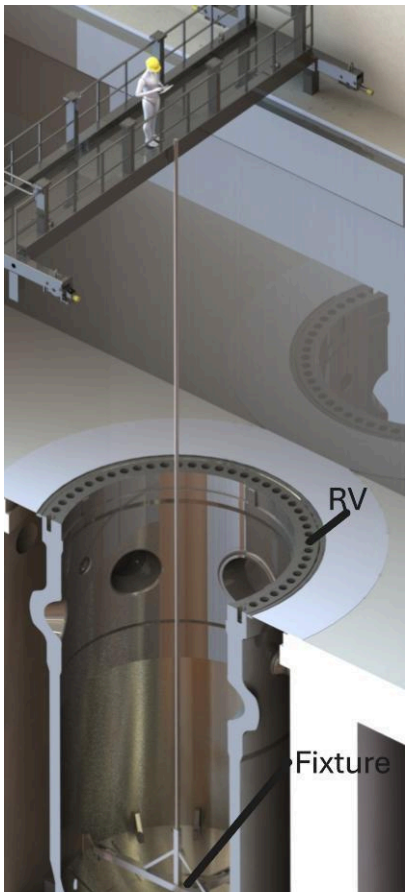
In March of 1979, TMI2 experienced an accident initiated by an interruption of secondary

feedwater flow. This led to a core heat-up that resulted in damage to the fuel and a permanent shutdown of the facility. As a result of the accident, the heat which caused the fuel to melt into a molten state traveled to the lower region of the reactor vessel or what is commonly called the hemispherical bottom head (HBH). The molten fuel damaged several locations of the bottom-mounted instrument (BMI) tubes/nozzles and embedded/fused itself into the stainless-steel cladding on the inside of the HBH. (see diagram below) This led to a state called fuel-bearing material (FBM). The accident also caused small quantities of damaged core material (DCM) and fission products to be transported through the reactor coolant system and the reactor building.

Approximately 99 percent (%) of the damaged fuel was successfully removed in the post-accident defueling effort. Additionally, large quantities of radioactive fission products released into various systems and structures were removed as part of the waste processing activities during the TMI2 Cleanup Program which spanned over a decade.

Following decontamination activities, only the reactor building and a few areas in the auxiliary and fuel handling buildings continued to have general radiation levels higher than those of an undamaged reactor facility nearing the end of its operating life. These high radiation levels will require the use of remote and robotic tooling to remove plant components, decontaminate them, and downsize them for efficient packaging and disposal.

Project Requirements:



The focus of this project is the remote delivery of a fixture capable of setting up on the HBH. The fixture will be lowered into the Reactor Vessel (RV) by an existing crane. The fixture should have the capability to accept the delivery, set up, and operation of the FBM removal tool and the BMI removal tool. These tools are separate items and design, and provision of the tools are not part of the scope of the project. All work operations and delivery of the fixture and tools start at the bridge/platform allowing an overhead view of the RV. The depth of work from the base of the platform to the bottom of the HBH is approximately 60’ to 75’ (feet) depending on the bridge floor working height. The student designed fixture and tooling setup will provide a stable and repeatable configuration to provide control and stability over the forces and vibration from the operation of the FBM and BMI removal tools (tools supplied by others). The RV will be filled with water to provide shielding during the FBM removal activities, so this fixture equipment will need to work underwater. After FBM removal, the RV will be drained for BMI removal, so this device also needs to work dry. The setup and operation of the fixture

system should be controlled from a common control console.

The scope of this project will be to:

1. Design a delivery system and tooling fixture that can be set up remotely on the HBH as a base or docking station to support the delivery and operation of the FBM and BMI removal tools. The design features should provide a stable and repeatable setup. The fixture must lock into place during tool operation.
2. Design an X,Y,Z range of motion to manually, adjust, index, and position the fixture (and attached tooling provided by others) to the location of interest for FBM and BMI removal.
3. Design a common control console to facilitate the operation of the fixture.

Expected Deliverables/Results:

- Specification for the systems – including site power and utility requirements
- Prototype of a scale model of the systems
- Drawings of the systems in subassemblies and final general assembly
- Bill of Material (BOM) for all components within the system, including recommended spare parts
- Calculations associated with the design
- Operating procedures for the systems delivery, setup, and basic operation

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

List here any specific skills, requirements, specific courses, or knowledge needed or suggested (If none please state none):

- This project is expected to require coordination of Mechanical and Electrical disciplines. Students should have good machine design skills.
- Interest in nuclear power.