



Mechanical Engineering
School of Engineering & Applied Sciences

Conference Website

<https://tricity.wsu.edu/futureme-conference/>



FutureME 2025 Conference

Washington State University Tri-Cities
2710 Crimson Way, Richland, WA 99354
Consolidated Information Center (CIC 120)

Friday April 25th, 2025

10:00 AM – 12:00 PM

Conference Organizer

Dr. Messiha Saad

Conference Chair

Dr. Changki Mo

Conference Officers

Drs. Joseph Iannelli, Joshua Heyne, Yuxin Zhang, Che-Hao Yang

Distinguished Guest

ME Industry Advisory Board (IAB) Members

Lance Stephens

Richland Site Manager, VP North America Fuel Manufacturing, Framatome

Chad Hendrix

Director, North & Advanced Design and Manufacturing Division, ENERCON

Karthik Subramanian

Chief Operating Officer, Hanford Tank Waste Operations & Closure (H2C)



Distinguished Speaker

“H2C Capstone Sponsorship and the Hanford Mission”

Presented by

Doug Reid, PhD, PE

Engineer, Chief Technology Office
Hanford Tank Waste Operations & Closure (H2C)



Guest Speakers

“ASME and Your Future”

Presented by

Janice Parker

ASME - Student Section Operations

Acknowledgments

ASME Columbia Basin Section

ANS-EWS

WSU Tri-Cities Student Section



Sponsors: ASME Columbia Basin Section, ANS-EWS, and WSU Tri-Cities Student Section

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Washington State University Tri-Cities Consolidated Information Center (CIC 120)

Friday April 25th, 2025

Time (PDT)	Topic
9:00 – 10:00 AM	Poster Presentation – SEAS Design Expo
10:00-10:20 AM	Evaluation of 3D Printed Compact Heat Exchanger Damian Firkins, Nathaniel Linn, Matthew Sutton, Colton Weitz
10:20– 10:40 AM	Field Implementation and Testing of Grout Delivery Sensors Mario Abraham, Christina Lansing, Wyatt McNary, Jackson Morgan
10:40 – 11:00 AM	Solidification Mixing System (SMS) Redesign Jesus Barron Barajas, Daniel Labeau, Luis Moreno, Randy Tran
11:00 – 11:20 AM	Redesign of the Shielded Sampler Transportation Gear Box Matt Barrows, Jacob Getchell, Berlin Rasmussen, Makenzie Edinger, Quinn Norton
11:20 – 11:40 AM	Design of a Cost Effective Vectored ROV for Water Sampling Dylan Chase DuBois-Killooy, Sarah Ellis, Kris Hahn, Joe Hawkins, John Lindquist
11:40 – 12:00 PM	3D- Printing Monolithic Multi-Material Tactile Sensors End-of-arm-tooling for Apple Picking Robot Eric Loeffler
12:00 – 12:10 PM	Distinguished Speaker “H2C Capstone Sponsorship and the Hanford Mission” Doug Reid, PhD, PE Hanford Tank Waste Operations & Closure (H2C)
12:10 – 12:20 PM	Guest Speakers ASME and Your Future Janice Parker ASME - Student Section Operations
12:20-12:25 PM	Closing Remarks Dr. Changki Mo
12:25 – 1:00 PM	Lunch

Evaluation of 3D Printed Compact Heat Exchanger

Damian Firkins, Nathaniel Linn, Matthew Sutton, Colton Weitz

Faculty Advisor: Dr. Yuxin Zhang

Sponsor: Framatome-IB, Andrew Porter

The objective of this project is to explore the potential of Compact Heat Exchangers (CHEs) in reducing the physical footprint of nuclear reactors and their secondary power systems. As environmental concerns surrounding traditional energy systems continue to grow, the demand for smaller, modular reactor designs becomes increasingly critical. Building upon foundational research by Kays and London, Manglik and Bergles, as well as the 2023–2024 Senior Capstone project at Washington State University, this study aims to develop theoretical correlations between size, material properties, and fluid flow characteristics in CHEs. Using dimensional analysis of the governing fluid flow equations, the project derives these correlations while intentionally excluding heat transfer considerations. The methodology has been carefully documented to ensure replicability by the project sponsor, particularly for the validated offset strip fin configurations established by the previous capstone team. Three custom CHE models were designed using SolidWorks 2024 and fabricated with a Formlabs Form 3+ resin printer. These include a 4× single-length model, a 4× double-length model, and a 6× single-length model. Experimental testing was conducted using the sediment channel in the Hydrology Lab at Washington State University Tri-Cities, supported by a digital manometer and custom 3D-printed platforms designed to minimize boundary layer effects in the channel flow. The experimental data collected and analyzed will inform future project development for Framatome and contribute valuable insights to the ongoing research and development of custom Compact Heat Exchangers.

Field Implementation and Testing of Grout Delivery Sensors

Mario Abraham, Christina Lansing, Wyatt McNary, Jackson Morgan

Faculty Advisors: Dr. Messiha Saad

Sponsor: Hanford Tank Waste Operations & Closure (H2C)

Sponsor Contact: Dr. Doug Reid & Dr. Michelle Hendrickson

The purpose of this project is to design and test a sensor system that can be readily deployed during Hanford Site Single-Shelled Tank (SST) Closure activities, to verify grout is appropriately placed within the SSTs and ensure regulatory requirements are met. This project occurred in three phases: Design, Lab Testing, and Field Testing. In Design, the system was broken down into subsystems: a Doppler flow meter, resistive temperature detectors (RTDs), a photoelectric sensor, and a camera. The Doppler flow meter measures the volumetric flow rate of the grout during pouring. The RTDs record the temperature of the grout during solidification and curing. The photoelectric sensor provides grout displacement measurements within the tank, and the camera gives a live visual of the process. Within these subsystems, several designs were developed and considered for equipment interface with the mock tank. Ultimately, final designs were selected by considering the design complexity and compatibility with the risers located on the tank lid. A custom testing platform was designed to mimic the riser conditions of the mock tank for the Lab Testing Phase. The sensors and interface designs were tested at the AtkinsRéalis US Nuclear Technology Center (ATC) with this testing platform and grout simulant. The tested designs and equipment will be used at the Cold Test Facility (CTF) to monitor and collect data during Field Testing, in which grout developed by Civil Engineering (CE) Capstone students will be poured into and cured inside of a 1000-gallon mock tank.

Solidification Mixing System (SMS) Redesign

Jesus Barron Barajas, Daniel Labeau, Luis Moreno, Randy Tran

Faculty Advisor: Dr. Che-Hao Yang

Sponsor: Atkins-Réalisis; Mark VanderZanden

The safe handling and long-term storage of nuclear waste has always been a priority for regulatory committees in limiting potential risks to the environment and human health. AtkinsRéalisis has developed a Solidification Mixing System (SMS) as a solution to safely operate on and dispose of nuclear waste in a remote manner. While the system is proven to work, its assembly process is both complicated and time consuming. This project aims to streamline the installation and improve the operational processes by generating multiple design iterations. Through a systematic design process, including static and lifting simulations on Solidworks and ANSYS, we developed modifications that simplify the SMS structure while maintaining its original functionality and safety features. Alongside this, we have addressed operational aspects through several design iterations. These include the specification of different robotic arms, the selection of an electromechanical lift table, the design of full floor catch pans, and the redesign of a lower profile shield door, as well as a sliding door. The resulting design for the SMS includes three sub-assemblies: an upper cask handling area, a lower cask handling area, and a primary/secondary confinement area. Operational improvements allow the SMS to operate with less human interaction, increased reliability, and have a lower overall profile. To ensure proper integration of these assemblies, the next recommended step in developing this design is to prototype as well as assess the manufacturability and assembly of the SMS.

Redesign of the Shielded Sampler Transportation Gear Box

Matt Barrows, Jacob Getchell, Berlin Rasmussen,

Makenzie Edinger, Quinn Norton

Faculty Advisor: Dr. Joseph Iannelli

Sponsor: Atkins-Réalisis, Nicholas Doyle

In this project, the goal is to redesign a gearbox used to lift a bucket containing radioactive liquids from the Hanford waste tanks. The current system uses two thin steel tapes that raise and lower the bucket simultaneously via two gears with a one-to-one ratio. This system functions well during lowering. However, when raising the bucket, the valve tape gear must rotate an additional $\frac{3}{4}$ inch to close the bucket, resulting in unequal tape winding rates. This discrepancy causes slack in the valve tape, leading to the bucket reopening. After reviewing multiple designs, we constructed a prototype to better understand the system and test a potential solution. This solution involves a lever and roller mechanism to deflect the tape. Two key constraints were considered when designing this solution: the weight of the system and the limited space within the gearbox. To accommodate the mechanism, we expanded the gearbox while keeping the total weight under the 40-pound limit. Initial prototype testing showed that while the mechanism

functioned as intended, the system failed when the gap between the tapes disappeared during bucket retrieval. Further adjustments to the tape hub diameter confirmed that shifting tension from one tape to another consistently caused the tapes to wind unevenly, ultimately leading to failure. Separate tape-wrapping tests supported this finding. It was concluded that there are two further solutions that should be investigated. The first is a single-tape design that would likely provide the most effective solution to this problem. However, implementing such a design would require an almost complete redesign of both the gearbox and the sample bucket, which is beyond the scope of this project. The second is to modify the existing sample bucket to equalize the tensions on the two tapes throughout the movement.

Design of a Vectored Remote Operated Vehicle for Water Sampling

Joe Hawkins, John Lindquist, Sarah Ellis, Dylan Dubois-Killooy, Kris Hahn

Faculty Advisor: Dr. Changki Mo

Sponsor: Pacific Northwest National Laboratory (PNNL)

Sponsor Contact: Dr. Daniel Deng & Aljon Salalila

The United States is well known for its vast terrain, large mountain peaks, and beautiful bodies of water. The U.S. government monitors the water quality of these bodies of water, or more specifically, lakes and rivers to ensure that pollutants and any other outside factors do not cause problems for the local fish and wildlife. There are a wide variety of markers that are monitored to ensure good water quality such as dissolved oxygen, pH levels, and nutrient densities. To collect data on these markers, physical samples need to be collected. Water sampling is the act of taking a specific quantity of water away from the main body of water for further analysis. This sampling is usually conducted by dropping a device into the body of water and retrieving it. Typically, the device is some variation of a bucket lowered into a body of water, where it is then closed/capped, and finally raised out of the water. Water sampling can be best summarized using the term: "If it ain't broke don't fix it". The art of water sampling has not changed very much or progressed outside of niche circumstances. As such we are readily able to create a state-of-the-art water sampler. One simply needs to design a better bucket, or an alternative way of getting said bucket to its desired sample location. A conceivable way of doing this is by designing a Remote Operated Vehicle (ROV) that can move the water sampler to any location within a body of water for remote sample retrieval. This is where our trusty team comes in. Tasked by Pacific Northwest National Laboratory (PNNL) and our school Washington State University Tri-Cities (WSU-TC), we have set out on a year-long journey to design a cost effective vectored ROV with water sampling capabilities for our senior design project. Join us as we discuss our project's design, its capabilities and our other findings.

3D- Printing Monolithic Multi-Material Tactile Sensors End-of-arm-tooling for Apple Picking Robot

Eric Loeffler

Faculty Advisor: Dr. Changki Mo

The integration of 3D printing in robotics has revolutionized the design and functionality of end-of-arm tooling, particularly in agricultural applications. Building upon the foundational prior work of 3D printed underactuated tendon driven and soft robotic hands, this research explores the development of monolithic multi-material tactile sensors for robotic apple picking systems. The primary objective is to enhance the robot's ability to handle delicate fruits with precision and care, minimizing damage during harvesting, and an affordable cost. Monolithic designs, achieved through advanced 3D printing techniques, allow for seamless integration of multiple materials with distinct properties into a single structure. This approach eliminates the need for assembly, reducing potential points of failure and improving durability. The tactile sensors are proposed to mimic the sensitivity and adaptability of human touch, enabling the robot to detect variations in fruit texture, size, and firmness. By incorporating soft, flexible materials alongside rigid components, the sensors achieve a balance between compliance and structural integrity. The research also addresses challenges such as optimizing material compatibility, ensuring sensor accuracy, and maintaining cost-effectiveness. This research looks to perform experimental validation involving field tests in orchards, where the robotic system's performance can be evaluated under varying environmental conditions. Successful results will exhibit significant improvements in harvesting cost and efficiency without sacrificing fruit quality. This study not only advances the field of soft robotics but also contributes to sustainable agricultural practices by reducing labor dependency and post-harvest losses.

H2C Capstone Sponsorship and the Hanford Mission

Dr. Doug Reid

Hanford Tank Waste Operations & Closure (H2C)

Dr. Doug Reid, from the Chief Technology Office (CTO) at Hanford Tank Waste Operations & Closure (H2C), has long been a sponsor of mechanical engineering senior design capstone projects. These initiatives are part of a collaboration between H2C and Washington State University (WSU), aimed at addressing technical challenges within the Hanford tank farms. Dr. Reid's vast experience at Hanford, combined with his enthusiasm for academia, offers students a distinctive chance to participate in real-world learning experiences. The capstone projects tackle a variety of technical issues, enabling students to gain hands-on experience and apply their knowledge to solve intricate problems. Through this collaboration, H2C seeks to foster the growth of future engineers and scientists while also addressing technical challenges at the Hanford site. By providing students with real-world contexts, these capstone projects not only benefit the students but also advance the overall mission at Hanford. In summary, Dr. Reid's sponsorship of these capstone projects underscores H2C's dedication to supporting education and nurturing the development of future professionals in engineering and science.