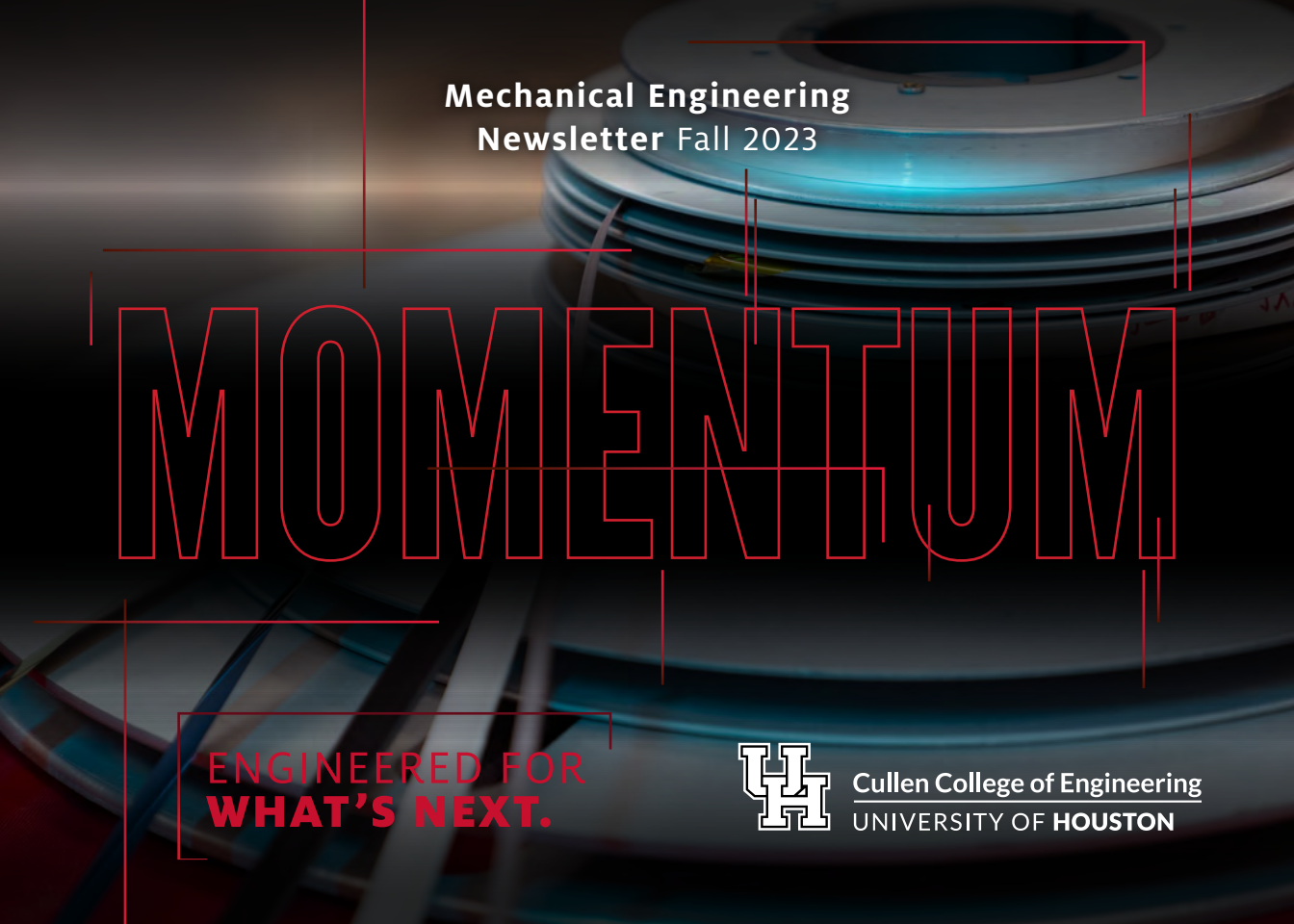

Mechanical Engineering
Newsletter Fall 2023
MOMENTUM
ENGINEERED FOR
WHAT'S NEXT.
Cullen College of Engineering
UNIVERSITY OF HOUSTON

Letter from the Chair

Dear Colleagues,

Greetings! I hope you are well. I am delighted to share some of the highlights and accomplishments of the UH Mechanical Engineering department's esteemed faculty and industrious students. There are many exciting developments in progress in our department, and I invite you to come visit us in person when you can. When we collaborate, we have the potential to make great strides in innovation.

Warm Regards,

Karolos Grigoriadis, Ph.D.
Interim Department Chair of Mechanical Engineering
Director of Aerospace Engineering
Cullen College of Engineering
University of Houston

UH ME **BY THE NUMBERS**

FACULTY *(FALL 2022)*

4 NATIONAL ACADEMY OF ENGINEERING MEMBERS

2 NATIONAL ACADEMY OF INVENTORS FELLOWS

1 NATIONAL ACADEMY OF INVENTORS SENIOR MEMBER

ENROLLMENT *(FALL 2023)*

1060 UNDERGRADUATE STUDENTS

268 GRADUATE STUDENTS

LEARN MORE ABOUT ME PROGRAMS:
www.me.uh.edu

DEGREES AWARDED *(FY 2022)*

184 B.S. **53** M.S. **31** PH.D.

NEW

FACULTY

KELLY HUANG

Kelly Huang will join the department as an assistant professor in Jan. 2024. Huang earned her doctorate from Princeton University in 2021. For the past two years, she has been employed as a postdoctoral researcher at Notre Dame.

NEW

FACULTY

MYOUNGKYU LEE

MyoungKyu Lee joined the department as an assistant professor in Fall 2023. Lee earned his doctorate from the University of Texas in 2015. He was previously an assistant professor at the University of Alabama, and a postdoctoral researcher at Sandia National Laboratories and the University of Texas.

NEWLY FUNDED RESEARCH

Pictured: Venkat Selvamanickam

MECHANICAL ENGINEERING

$2 MILLION IN DEPARTMENT OF ENERGY FUNDING FOR SUPERCONDUCTING TAPE PROJECTS

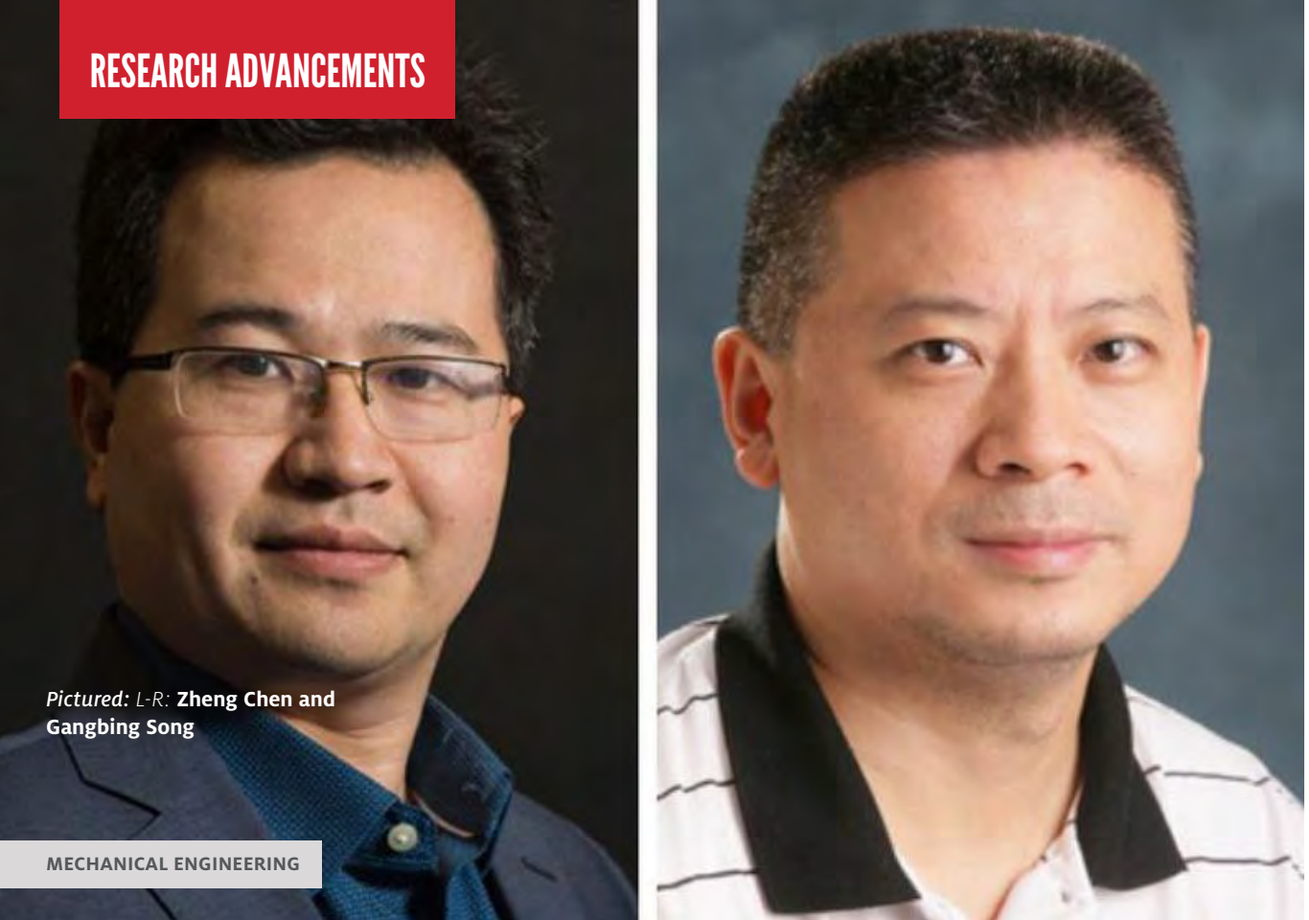
UH's Selva Research Group received $2 million for a three-year project, titled "Low-Cost, High-Rate Fabrication of High-Performance, Uniform, Long REBCO Conductors. he funding, through the DOE's Advanced Research Projects Agency-Energy's (ARPA-E) Novel Superconducting Technologies for Conductors Exploratory Topic, will help boost different types of superconductive technologies.

"Their work focuses on scaling up the manufacture of the team's high-temperature superconductor tape to implement the technology for clean energy applications. The project will scale up the advanced metal organic chemical vapor deposition (MOCVD) process developed by the team and address key metrics such as speed and cost of production, and uniformity of tape performance.

Venkat Selvamanickam, M.D. Anderson Chair Professor of Mechanical Engineering and director of the Advanced Manufacturing Institute, is recognized globally for his research to develop better manufacturing technologies for thin film superconductor tape. His team was the first to manufacture the thin film superconductor tape, which was used in 2008 to power 25,000 households in Albany, N.Y., and now is used by more than 200 institutions worldwide.

The Selva Group has demonstrated its HTS tape's electric current-carrying-performance is three times better than the tapes available on the market. His research group works with many partners to use its HTS tape to make small-scale prototypes of magnets, coils and cables to incorporate in several applications. Now, the team is focusing its attention to make the manufacturing process for its tape more efficient and consistent.

"Even though our superconducting tape is three times better than today's industry products, for us to be able to take it to full-scale commercialization, we need to produce it faster and at a lower cost while maintaining its high quality," Selvamanickam said. "This funding is to address this challenge and it's an important step forward towards commercialization of our technology."



Pictured: L-R: **Zheng Chen and Gangbing Song**

$960K GRANT AWARD TO DEVELOP AUTONOMOUS ROBOT FOR SUBSEA OIL AND GAS

SUBSEA OIL PIPELINE INSPECTION

The SmartTouch technology now in development at UH consists of Remote Operated Vehicles (ROVs) equipped with multiple stress wave-based smart touch sensors, video cameras and scanning sonars that can swim along a subsea pipeline to inspect flange bolts – bolted connections have accelerated the rate of pipeline accidents that result in leakage, according to the Bureau of Safety and Environmental Enforcement (BSEE).

The BSEE is funding the project with a $960,493 grant to UH researchers **Zheng Chen,** Bill D. Cook Assistant Professor of Mechanical Engineering and **Gangbing Song**, John and Rebecca Moores Professor of Mechanical Engineering, who are working in collaboration with Oceaneering International and Chevron.

"By automating the inspection process with this state-of-the art robotic technology, we can dramatically reduce the cost and risk of these important subsea inspections which will lead to safer operations of offshore oil and gas pipelines as less intervention from human divers will be needed," said Chen, noting that a prototype of the ROV has been tested in his lab and in Galveston Bay. The experiments demonstrated the feasibility of the proposed approach for inspecting the looseness of subsea bolted connections. Preliminary studies were funded by UH's Subsea Systems Institute.

The UH researchers are collaborating with Oceaneering International, an industrial leader in ROV development, non-destructive testing and inspections, engineering and project management, and surveying and mapping services. Additionally, Chevron, a major oil and gas operator, will evaluate the technology's future commercialization.

ME'S ZHAO WINS THE 2023 VISKANTA YOUNG SCIENTIST AWARD

Bo Zhao, assistant professor in the Mechanical Engineering Department, was the recipient of the 2023 Elsevier/JQSRT Raymond Viskanta Young Scientist Award, one of the highest honors for faculty early in their careers in the field of radiative transfer. "I feel deeply honored to receive this esteemed award," Zhao said. "It serves as an encouragement for me to persist in making significant contributions to the heat transfer community."

With this accolade, Zhao joins a select roster of emerging scientists who have previously received the award. Several of these individuals have since become global leaders in the field of radiative transfer. The award is named for Raymond Viskanta, the W. F. M. Goss Professor of Engineering at Purdue University, in recognition of his profound contributions to the field of radiative transfer since the 1950s. Viskanta was legendary in the field, with more than 500 journal publications and 200 keynote papers and invited lectures.

Before joining the faculty of the Cullen College of Engineering in the Fall of 2021, Zhao was a postdoctoral research associate at Stanford University. He earned his Ph.D. from Georgia Institute of Technology in 2016.

Currently, he serves as the director of the Thermal PhotoinX (TPX) Lab at UH, where his research group focuses on the theoretical and experimental aspects of thermal photonic transport processes. Their work aims to advance thermal management, energy conversion, and information processing. Zhao's most recent research proposal, "Thermal Emission Beyond the Conventional Kirchhoff's Law," was awarded by the National Science Foundation in June for $351,337.

Pictured: *Professor Haleh Ardebili and Navid Khiabani, a UH graduate research assistant, discussing bendable batteries.*

BREAKTHROUGH PROTOTYPE OF STRETCHABLE

FABRIC-BASED BATTERY

The idea for this cutting-edge evolution of the lithium-ion battery came from the mind of **Haleh Ardebili**, Bill D. Cook Professor of Mechanical Engineering at UH. “As a big science fiction fan, I could envision a ‘science-fiction-esque future’ where our clothes are smart, interactive and powered,” she said. “It seemed a natural next step to create and integrate stretchable batteries with stretchable devices and clothing. Imagine folding or bending or stretching your laptop or phone in your pocket. Or using interactive sensors embedded in our clothes that monitor our health.”

The weaved silver fabric was ideal for this since it mechanically deforms or stretches and still provides electrical conduction pathways necessary for the battery electrode to function well. The battery electrode must allow movement of both electrons and ions,” said Ardebili, who is the corresponding author of a paper detailing this research in the Extreme Mechanics Letters. The first author of the paper is Bahar Moradi Ghadi, a former doctoral student who based her dissertation on this research.

By transforming rigid lithium-ion battery electrodes into wearable, fabric-based, flexible, and stretchable electrodes, this technology opens up exciting possibilities by offering stable performance and safer properties for wearable devices and implantable biosensors..

Pictured: Dr. Zhao Kan, assistant professor of mechanical engineering, and his doctoral student, Shadi Jafari Chaleshtarneh.

XU EARNS NSF GRANT FOR

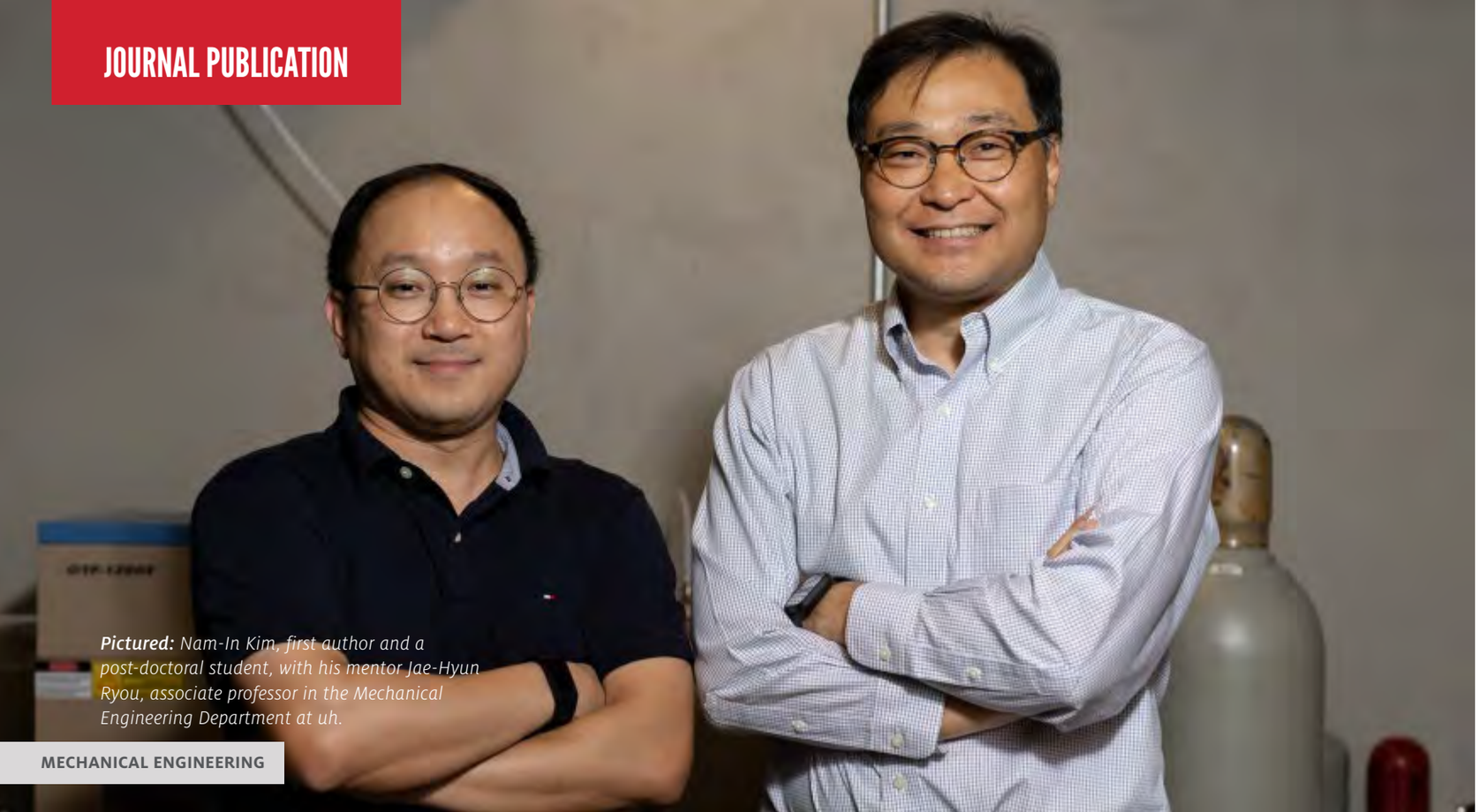
HEAT TRANSFER RESEARCH

A University of Houston faculty member in the Mechanical Engineering Department at the Cullen College of Engineering received a six-figure grant from the National Science Foundation for collaborative research into oscillating flow and heat transfer in porous media.

Ben Xu, an Assistant Professor and Presidential Frontier Faculty Fellow, received the award in March for his proposal, "Collaborative Research: Multiscale study of oscillating flow and multiphase heat transfer in porous media." As the leading PI in this collaborative campaign, the $171,734 grant will cover research at UH through August 2025.

According to the grant's abstract, several state-of-the-art energy technologies central to energy generation and storage require complicated flow and heat transfer through porous media, yet these flow and heat transfer mechanisms are not well understood when combining with multiphase and oscillating process. The proposed research attempts to experimentally study oscillating and multiphase flows in porous media, and then develop a numerical approach that can be used to gain further insight into the fundamental behavior, thereby improving energy efficiency, and lowering both economic costs and environmental impacts.

JOURNAL PUBLICATION



Pictured: *Nam-In Kim, first author and a post-doctoral student, with his mentor Jae-Hyun Ryou, associate professor in the Mechanical Engineering Department at uh.*

MECHANICAL ENGINEERING

RESEARCHERS DEVELOP SENSORS THAT OPERATE **AT**

HIGH TEMPERATURES, IN EXTREME ENVIRONMENTS

Now a team of University of Houston researchers has developed a new sensor that was proven to work in temperatures as high as 900 degrees Celsius or 1,650 degrees Fahrenheit, which is the temperature mafic volcanic lava, the hottest type of lava on Earth, erupts.

"Highly sensitive, reliable and durable sensors that can tolerate such extreme environments are necessary for the efficiency, maintenance and integrity of these applications," said **Jae-Hyun Ryou**, associate professor of mechanical engineering at UH and corresponding author of a study published in the journal *Advanced Functional Materials*.

The article, which was featured on the cover of the journal, is titled "Piezoelectric Sensors Operating at Very High Temperatures and in Extreme Environments Made of Flexible Ultrawide-Bandgap Single-Crystalline AlN Thin Films."

"Our plan is to use the sensor in several harsh scenarios. For example, in nuclear plants for neutron exposure and hydrogen storage to test under high pressure," Ryou said. "AlN sensors can operate in neutron-exposed atmospheres and at very high-pressure ranges thanks to its stable material properties." The researchers look forward to their sensor being commercially viable at some point in the future.

ME STUDENT COMPLETES **MICKEY LELAND FELLOWSHIP**

Mechanical Engineering senior **Chris Slaton's** work with superalloys over the summer as a Mickey Leland Energy Program fellow with the U.S. Department of Energy (DOE) and Office of Fossil Energy and Carbon Management (FECM) was one piece of a larger puzzle that seeks to bring us one step closer to reducing our net carbon emissions to zero by the year 2050.

"I really want to get into the energy sector, so I thought this was a perfect opportunity to jump in and do some research with the DOE for the FECM," Slaton said. In August, the program concluded with a forum that allowed participants to present their research work and project findings.

Slaton hopes that his knowledge and experience will help him find further research opportunities with a material science lab at the University of Houston.

Pictured: *Chris Slanton*

Pictured: *Cullen College of Engineering alumni Terrance "Terri" Ivers (BSME '80).*

ME ALUM IVERS LEADING INNOVATION INTO DEEPWATER DRILLING

While there is a push for renewable energy sources, the world's growing energy consumption means that generation from fossil fuels will still be required for decades. However, even if that's the case, Cullen College of Engineering alumni **Terrance "Terri" Ivers** (BSME '80) still sees an opportunity for that process to be done in a way that is more environmentally conscious and responsibly manages our critical energy resources.

"I think all engineers are curious, and they should be, and we should set goals to improve what has been done previously," Ivers said. "What we saw was a great opportunity to enhance ultra-deepwater appraisal and production in the Gulf of Mexico in particular, but also globally. And yet, we saw the industry going down a path that was heavily reliant on unproven subsea production systems for the deepest and riskiest oil plays in the high temperature, high pressure (HPHT) formations beneath the Gulf of Mexico."

Ivers is the founding chairman of Frontier Deepwater Appraisal Solutions, LLC. The company is in the startup phase with a small but highly experienced core team. Ivers himself has extensive experience in the energy and construction industries. He is the former executive president of the North American unit of Germany's Bilfinger, an international construction and maintenance company with more than $4 billion in yearly revenue.

Ivers noted that, because many ultra-deepwater subsea drilling and completion methods are reliant on complex systems that are extremely expensive to deploy and maintain, production efforts have suffered financially on the most challenging HPHT oil fields.

Wellbays can provide direct surface access to wells and accompanying equipment on drilling/production platforms for safer, more efficient operations. Ivers saw the opportunity for patents and new technology to enable this highly desirable direct access to wells and completion/control systems in ultra-deep waters with a straightforward innovation to the way the wellheads are supported in the wellbay.

The University of Houston
Cullen College of Engineering

The University of Houston Cullen College of Engineering addresses key challenges in energy, healthcare, infrastructure, and the environment by conducting cutting-edge research and graduating hundreds of world-class engineers each year. With research expenditures topping $40 million and increasing each year, we continue to follow our tradition of excellence in spearheading research that has a real, direct impact in the Houston region and beyond.

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