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words by JENNIFER WALTON • *photography by* DAVID STUBBS

EAGER TO ENERGIZE

IF YOU DRIVE FROM JACKSON, WYOMING, TO SUN VALLEY, IDAHO, ON HIGHWAY 20, YOU TRAVERSE EASTERN IDAHO'S HIGH DESERT. KNOWN FOR ITS VAST VIEWS AND MIGRATING WILDLIFE, THE AREA OFFERS MINIMAL SIGNAGE MARKING TWO COMPLEXES FOR IDAHO NATIONAL LABORATORY, A NEAR-MYTHIC THINK TANK IN THE ENERGY BUSINESS. PART OF THAT MYTHOLOGY COMES FROM ITS ORIGINAL MONIKER AND THE WORK THAT HAS BEEN DONE HERE SINCE IT WAS FOUNDED IN 1949. INL WAS ORIGINALLY CALLED THE NATIONAL REACTOR TESTING STATION, AND IN 1951 ENGINEERS AND SCIENTISTS THERE FOUND A WAY TO GENERATE ELECTRICITY FROM A NUCLEAR REACTOR. SINCE THEN, THE LABORATORY HAS ATTRACTED SOME OF THE BEST MINDS IN SCIENCE TO ADVANCE OUR UNDERSTANDING OF ENERGY IN MANY FORMS–AND YES, THAT INCLUDES NUCLEAR.

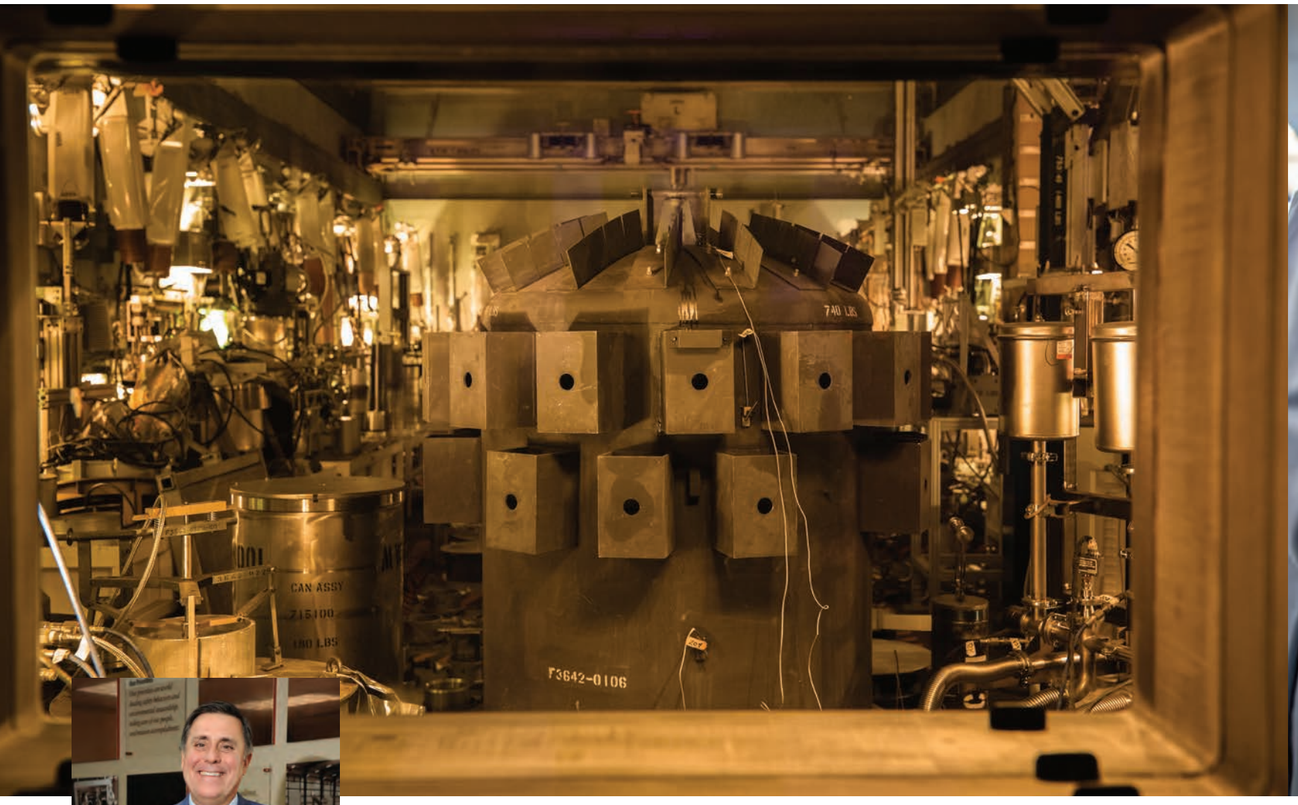
Sixty-eight years later, Idaho National Laboratory operates with a 21st-century agenda that includes energy security, environmental sustainability, and national security. A part of the U.S. Department of Energy, INL employs nearly 4,000 people and collaborates with industry and technology leaders and academia to generate cutting-edge options for our nation's future energy needs. But still, the very existence of this place in the high desert of Idaho makes many people nervous because of their work with nuclear.

Much of what happens at INL is classified and highly guarded. The people who have gravitated to this swath of high desert have come to be a part of the leading research into energy sustainability. We talked to eight people whose lives are focused on a world in which safe, clean, reliable energy is available to everyone, no matter their location, vocation, or education. What gets them out of bed in the morning? **Their shared belief in a carbon-free environment.**

"WE ARE CREATING THE ENERGY SYSTEM OF 2050. WE'RE IMAGINING AND LOOKING AT WHAT'S DECADES OUT, EVEN 2100. WHAT WE ARE DOING WILL AFFECT US FOR THE NEXT 100 YEARS, AND IT HAS TO START WITH RESEARCH. PEOPLE DRIVE BY AND DON'T REALIZE THAT THEY ARE DRIVING BY THE PLACE THAT THE WORLD LOOKS TO FOR THAT RESEARCH."

—Dr. Mark Peters, Director, Idaho National Laboratory

THIS SPREAD: The silver dome pictured here once contained the metal-fueled, sodium cooled, fast spectrum Experimental Breeder Reactor-II, which is now decommissioned. This groundbreaking reactor enabled many new advancements in nuclear technology and provided electricity for the Materials and Fuels Complex (and 30-50% of INL's electrical needs) from 1964-1994.



TOP: The shielded hot cells within INL's Hot Fuel Examination Facility enable researchers to safely examine nuclear fuels and materials after irradiation in a reactor, gathering data to support development of advanced nuclear fuels, as well as improved fuels for the current power fleet. The argon-atmosphere hot cell houses sophisticated measurement equipment, instruments, and furnaces that can be used to simulate various operating scenarios for fuel testing.

DR. MARK PETERS

DIRECTOR, IDAHO NATIONAL LABORATORY

In grade school, his grandfather gave him a book about rocks entitled, *Marvels of the Earth*. While he was in high school, Mount St. Helen's erupted. "That was it for me. Right away, I declared geology," says Idaho National Laboratory's Director, Dr. Mark Peters. An Illinois native whose biography confirms his expertise in nuclear fuel cycle technologies, nonproliferation, and waste management, Peters has the enviable position of being surrounded by the best and brightest in the sectors of applied science, research, engineering, and technology. On the flip side, he is tasked with managing the lab's $900 million annual budget and is relied upon by Congress to speak on nuclear's intricacies and its broad strokes, regionally, nationally, and internationally.

For him, the lab unequivocally reflects the future in nuclear research. But he says, the lab also has implications for our everyday lives and our interactions with our most useful tools—our computers, lights, cars, phones, etc. Cyber, energy, and water security, bioenergy, safe chemical production, automotive battery technology, wireless technology, plus a plethora of innovations that protect and secure critical infrastructure and identify American ingenuity like space exploration, small modular reactors, and recovering critical materials are all on his team's to-do list.

Peters says, "The challenge we have as a lab is making sure we are in a place where we can support innovation and partner with innovators in the private sector. The U.S. is still the most entrepreneurial nation in the world, so we need to enable that and lead as well." Peters and his team at INL recognize that the time to solve our energy problems is now. Peters says, "We are committed to that effort and every day our team asks, 'How, not when, can we create a clean energy future using all our resources, including wind, solar, and biofuels?'" But Peters is also confident that a new generation of passionate and purpose-driven people will include nuclear in what he and others at INL see as the most important conversation of the 21st century.

WHY ALGAE? ALGAE ARE KNOWN AS ONE OF THE PRIME SOURCES OF BIO-FUELS. BECAUSE THEY NEED CO2 TO GROW, THEY SIMULTANEOUSLY REDUCE CARBON EMISSIONS AND PRODUCE AN ENERGY SOURCE. IN ADDITION, ALGAE CAN GROW 20-30 TIMES FASTER THAN A FOOD CROP, CONTAIN UP TO 30 TIMES MORE FUEL THAN EQUIVALENT AMOUNTS OF OTHER BIO-FUEL SOURCES SUCH AS SOYBEAN, CANOLA, AND PALM OIL, AND CAN BE GROWN ALMOST ANYWHERE.

LYNN WENDT

ENVIRONMENTAL MICROBIOLOGIST

According to Lynn Wendt, algae is the future. But more on that later.

As a five-year-old, Wendt liked plants. "I've always had a green thumb," which led to her love of science. "As I got older, I realized I liked biochemistry—but more than anything I liked understanding how things worked." After earning her degree in biochemistry from the University of Minnesota, her memories of summers spent in McCall called her back to Idaho.

For over a decade, Wendt has been working toward energy from renewables (plants). Blending algae with grass clippings, she stores different types of biomass and by controlling the environment in her lab's large-scale reactor, Wendt can simulate outdoor storage for the collection of gas samples. Her goal is to record the microbial respiration (off-gassing) and fermentation and stabilize the biomass. "We are looking to see if we can store algae in anaerobic [without oxygen] conditions."

Why algae? Algae are known as one of prime sources of biofuels. Because they need CO2 to grow, they simultaneously reduce carbon emissions and produce an energy source. In addition, algae can grow 20-30 times faster than a food crop, contain up to 30 times more fuel than equivalent amounts of other bio-fuel sources such as soybean, canola, and palm oil, and can be grown almost anywhere.

Aside from the algae storage and bio-energy possibilities, Wendt is working with universities on water clean-up as well. Last year, 150-square-mile Utah Lake made the news when it closed due to choking on an enormous chartreuse algae bloom. Hundreds of people became ill. Fishing, swimming, and all outdoor activities were halted. And, Wendt states, this wasn't the only place blooms occurred. Both Island Park Reservoir and Henry's Lake Reservoir in Idaho, and Wade Lake near West Yellowstone in Montana, all prime recreation spots, experienced similar blooms. "It makes sense to me to take a natural resource that isn't needed, in this case the algae, and make something out of it, like energy. Simultaneously protecting the environment and the water."

TOP: Lynn Wendt works with algae to develop alternate energy sources.

CHANDRAKANTH (CHANDU) BOLISETTI, PH.D.

RESEARCH ENGINEER, SEISMIC STUDIES

"I used to have attention issues, so I couldn't remember anything. I also couldn't read properly. I only did well in things involving logic, programming, and math." Thankfully, Chandu Bolisetti excelled in those areas. Born into a traditional middle-class family in India meant one studied engineering or medicine. So engineering it was.

Arriving at INL as a post-doctoral associate, Bolisetti gravitated towards predicting seismic loads. Nuclear plants are large structures, which require massive amounts of concrete and capital costs. "Predicting seismic loads is extremely difficult," says Bolisetti. "So the design and construction of plants tend to be quite conservative. When there are a lot of uncertainties, there are in turn many redundancies. At one point, it is not any safer. The way to solve this is to come up with a better prediction of what kind of seismic load you expect, so that when you get a better prediction, you can reduce those conservatisms." The important thing to know, he assures us, is that the type of soil (from stiff sand to hard rock) influences the motion of the structure and the motion of the structure influences the response of the soil and the outcome. Yes, that's why you need multiple graduate degrees to work in this field.

One of Bolisetti's projects is seismic isolation. "We put a whole building on huge, cylindrical isolators, hundreds of them. The most common are made from rubber and lead. We measure all the energy dissipated in the rubber and lead and estimate what kind of benefits we can see when we use this technology in nuclear structures."

This specific technology has been applied in commercial structures around the world, however, it has not been utilized in the nuclear industry because of scale, implementation, and regulation. "I want the energy industry to thrive and there are problems it cannot solve. Often it lacks the intellectual resources and academia doesn't have the financial resources. That's the power of national labs. For me, we are taking science and making it into reality. We're taking it out of the papers and we are giving it to the industry."

Bolisetti exudes a compelling combination of curiosity and kindness. He is passionate about helping others, especially those whose lives are severely impacted by climate change. "The biggest problems in the world are water and energy. If you solve those problems, you can open up opportunities for education and reduce poverty. There are solutions. I wouldn't spend so much time if it weren't personal!" Bolisetti says he often thinks of getting another Ph.D. He's contemplating the social sciences. That and his first snowboarding lesson.

JOHN JACKSON, PH.D.

NATIONAL SCIENTIFIC USER FACILITY (NSUF)

He was a farm kid who was driving a tractor by the third grade. His parents, who met at a party in Martha's Vineyard when his dad was a math teacher in New York City, were a progressive couple, living off-the-grid in north central Washington before most people knew the term "off-the-grid." With no electricity, telephone, or refrigeration, John Jackson found other ways to occupy his time.

Self-sufficient and a 'fixer' by necessity, he has always been fascinated by how things work. Life on a dairy farm with goats, sheep, and cows provided a steady stream of family chores and a close connection to the earth, an experience, he says, that has made him "an environmentalist at heart."

Jackson says that he never had a life plan, and that's why he was surprised to find himself in Houston at ExxonMobil Upstream Research Co. after receiving his Ph.D. "I don't think I'm very practical... I just think that as you go through life, you'll find your place." And for over a decade, Jackson's place has been with INL as the lead for the National Scientific User Facility (NSUF)—a collaborative space at INL where researchers from all over can study nuclear energy in a state-of-the-art facility offering "unparalleled research opportunities for nuclear energy researchers" at no cost through "an open competitive review process."

Jackson is unwavering in his belief in nuclear. "I see nuclear as the only path to a carbon-free world," says Jackson. He has spent significant time thinking about the legacy of nuclear, the fear surrounding it, and the procedures that need to be in place to make it safe and sustainable. "We need to overcome our fear about nuclear."

Jackson also runs another program called Gateway for Accelerated Innovation in Nuclear (GAIN) where the mission is to advance nuclear power as a "resource capable of meeting the nation's energy, environmental, and national security needs by resolving technical, cost, safety, proliferation resistance, and security barriers through research, development, and demonstration." It's a towering task list.

Jackson's forte for program management and his ease in conversing with academics, tech specialists, and government officials serve him well. His minimalist office and single-serving coffee maker signifies a man who spends more time on the go than getting comfy in his office chair. Because, after all, when he's done making nuclear energy safe for the world, he's got another big job as Dad.

TOP: A dummy fuel assembly shows the typical arrangement of fuel rods in the core of a full-sized commercial power reactor, with space to allow cooling water to flow between the rods. Uranium oxide fuel pellets are stacked inside the fuel rods, and the rods are bundled together into assemblies like this one and combined with many other bundles to form the core of the reactor.

GABRIEL ILEVBARE, PH.D.

MATERIAL SCIENCES & ENGINEERING MANAGER

"As far back as I can remember I wanted to know how things worked. I didn't know it was science or engineering, I just needed to know." Gabriel Ilevbare was raised on the campus of the University of Nigeria. His father, now a retired professor of the Classics who writes and speaks fluently in Latin and Greek, was his inspiration and mentor. When he was eight years old, Ilevbare visited the U.S. for the first time with his father, who was on sabbatical at UC Berkeley. "That singular time in my life made a lasting impression. It is the main reason why I found my way back to the U.S. I saw a different world that I wanted to be a part of. It's what propelled me to become a U.S. citizen."

Ilevbare received his first degree in industrial chemistry from the University of Ibadan before his required one year of national service when he was assigned to Union Allied Engineering. From there he departed Africa for England to study materials science and metallurgy at the University of Cambridge. And then he hopped the pond to the University of Virginia, where as a fellow he worked on a project for the U.S. Air Force on aircraft aging. Recently, Ilevbare became the manager for the materials science and engineering department at INL. "I'm expected to bring all my life's experiences and every effort to bear to help achieve our goals."

Ilevbare is working to bring additive manufacturing (AKA 3D printing), notably with high-temperature materials, for use on nuclear power components, which will allow advanced reactors to operate at a higher level of efficiency. That work could also have an impact in aerospace and military advancements. "Take aircraft engine design, the future is going to be phenomenal. And the progress has been every bit as notable. From paper to plywood to aluminum to titanium, now aircraft are made of composites—that is a materials evolution!" In addition to engines, Ilevbare says to consider the amount of stuff we depend on that is battery-operated—phones and computers for instance. At their cores, the battery is a material science question and one that Ilevbare believes will be a defining aspect of our future.

From Nigeria to Cambridge to somewhere outside of Idaho Falls. It's only natural to ask what brought him to INL. "When you have people this talented...look at my wall, 20 nationalities, names from all over the world! Idaho Falls was the first place I shoveled snow in my life! I came here because of the team that I plugged into, their dedication, their expertise, the technological innovation, and the hope they embody for the future. It is a wonderful feeling to create something that makes a difference to the nation. There are not many places in the world like this."

ABOVE (right): The tools of Ilevbare's trade still include WD-40, packing tape, tin foil, and of course, a boom box.

AUDREY GARRETT

MATERIAL BALANCE AREA CUSTODIAN & CRITICALITY SAFETY OFFICER

"Our hot cell areas are shaped like a lollipop. The main cell is filled with purified argon and is 30' across, 30' tall, and 70' long," says Audrey Garrett, a highly skilled nuclear facility and process operator at the Hot Fuel Examination Facility (HFEF) at INL. "The high-density concrete is four feet thick. Our windows are four feet thick and oil-filled with cerium-stabilized glass."

Growing up in Rexburg, Idaho, Audrey Garrett wanted to be an aircraft mechanic. She tried college for a bit, but instead joined the Navy, where she tested well in science and physics. When a billet for nuclear opened up, she took it. After serving at the Naval Weapon Station in Charleston, South Carolina, and on the USS Stennis in Bremerton, Washington, Garrett found her way back to Idaho with a position at INL.

The HFEF is set up to safely allow researchers to study radioactive materials. "Half of my job is to make sure everyone is following rules imposed by the Department of Energy and our internal administration. The other half is to safeguard our security... to know where all this material is at one time. I keep track of what comes in and out of our facility and at the end of the month I reconcile with our national database."

Casks now arrive by a truck. The container resembles a dumbbell and it's shielded and weighs 20 to 30 tons. When it arrives, a crane pulls the cask off, lowers it through the hatches in the floor where it is placed on a cart and starts its life in the hot cell. On a three-foot circular cover, it is mated to the argon cell. Plugs are lifted out. The cargo is raised and the plugs are replaced. The cask is disconnected and then an operator looks at fuel. This procedure is done remotely. Yes, it sounds terrifying to those of us living within breathing distance of the INL that there is an entire facility dedicated to studying the remote handling of irradiated materials and to understanding the way materials respond to irradiation. But...

Born and bred into the culture at INL is safety. Like Garrett—a single mother of two—thousands of employees, their families, and friends depend on the rigorous precautions and programs derived from experience, commitment, and methodology. "Those are my Bibles," she says, pointing to two gigantic three-ring notebooks on criticality hazards. Garrett points out the CAM (Constant Air Monitor), which tests the atmosphere for contamination (particulates in the air) throughout the entire building, while RAM (Radiation Area Monitor), a gray box mounted on the wall, tests for radiation particles. Garrett says that the HFEF is vital for the research into handling irradiated materials and the development of safer and more efficient fuel designs. And like many who work at INL and live the quest for sustainable and carbon-free energy, Garrett believes that the work they do here plays a significant role in achieving energy security.

EAGER TO ENERGIZE

A DAUGHTER, WIFE, AND MOTHER, BRAGG-SITTON IS ON THE CUSP OF AN ENERGY REVOLUTION. A HIGH SCHOOL STUDENT ONCE POSED A QUESTION TO BRAGG-SITTON, "HOW CAN I CONVINCE MY DAD TO LET ME GO INTO THIS FIELD?" SHE UNDERSTANDS THAT ANYTHING HAVING TO DO WITH NUCLEAR ENERGY OFTEN SCARES PEOPLE. BUT, HER OWN FATHER'S VOICE ECHOES IN HER MIND AND HAS INSPIRED HER THROUGHOUT HER CAREER. "HE ALWAYS SAID, 'DO IT DIFFERENTLY.'"

SHANNON BRAGG-SITTON, PH.D.

SENIOR NUCLEAR ENGINEER

Shannon Bragg-Sitton has nuclear energy in her blood. When her father retired from the military, the family moved to Albuquerque, where her father worked at Los Alamos National Lab and her mother at the University of New Mexico. At 15 years old, Bragg-Sitton began working alongside 16 Russians who were testing non-nuclear units at the Air Force Phillips Laboratory. That was her first job. "I've never flipped burgers," she jokes. After college, this underachiever worked at NASA.

In 2010, she left a faculty position at Texas A&M to come to Idaho National Laboratory where she is now the Deputy National Technical Director of the Department of Energy's Advanced Fuels Campaign and Nuclear Fuels and Materials Division. Yes, that's a mouthful. She is also the lead for the Nuclear-Renewable Hybrid Energy Systems. What does that mean for us? "I am rethinking energy systems. That means developing, designing, and deploying energy systems that provide energy security, reliability, affordability, and they must be clean." But how will that happen? Bragg-Sitton states, "The question is how do we produce electricity better? When we look at our carbon footprint, part of that comes from industry and transportation; I want to impact those too. People automatically think about electric vehicles. It's thinking about transportation in a completely redesigned way. It's about fuel cell vehicles that burn hydrogen, and hydrogen being produced by new techniques that use clean energy instead of taking natural gas and reforming it, which is emitting it."

Her work revolves around questions; she has to push to perfect an imperfect energy system and that takes innovative thinking. "If you're telling me we can't burn fossil fuel anymore, you're cutting jobs, right? No. Instead of sending coal 'as is' to be burned in coal-fired power plants, what else can we do with that carbon resource? Can we engineer that resource? Can we reform it into other products? Can we use clean energy for the heat input and take that carbon resource to make plastics, to make an end product that is consumable, that's a commodity that we use every day?" On her computer is a PowerPoint presentation on drying the coal. Stats in a box show reductions in transportation and emissions, as well as a whopping 70% reduction in mercury emissions.

Because all of that is not a tall enough order, Bragg-Sitton is also rethinking our approach to nuclear waste. "How can we use that radiation? How can we implement new industrial practices or chemical processes using every aspect of energy, whether it's from the direct fission energy that we already capture for electricity, the waste heat from power conversion cycles, or the radiation that comes from those nuclear fuel pins? How can we do it differently?"

PAUL LIND

SENIOR PROCESS ENGINEER, HOT FUEL EXAMINATION FACILITY

He likes to run. And he still holds the U.S. age record for the fastest 50 miles for 17-years-old and under. At 18, he was the youngest runner to complete the Western States 100-Mile Endurance Run. A few years back he was the top Idaho finisher in the Leadville Trail 100-Mile Race, and in 2015 Lind finished the Western States 100 in under 24 hours.

Lind also cares deeply about his work and his family. At work, his job is to examine radiated fuel, the materials, the cladding, and study how it performed, how it can perform better, how it performed in a simulated accident, and then feed that information back to the industry and universities. Part of the foundation of this facility is that information is powerful and can help us create better, safer systems. But it takes a special group of people to work in HFEF. "Not everybody gets to work here. You have to be extremely talented and patient."

Lind explains that they are set up to play a vital role in homeland security as well. "If there were an incident, let's say a dirty bomb, special teams will come here and we will analyze it and determine where it came from. Not just fuels, but materials as well."

Lind rises each morning at 4:00am to make his one-way, 125-mile drive from Challis, Idaho, to INL, where he has worked for 27 years. After an eight-hour day, he crushes it back home (he's been known to buy a 'beater' car every three years) to make track and field practice at Challis High School, where he is the head coach. With 17 athletes on NCAA scholarships and four state championships, this guy's middle name is "discipline." When asked why make the drive, why not live closer to work, he says, "I get to live on the Salmon River and climb the Lost River Range after morning coffee on the weekends. I can hunt out my backyard with my son. And, I can run."

ABOVE (left): Inside the hot cell.